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Karyotypes of Two Types of a Chinese Cyprinid Fish, *Tanichthys albonubes*

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Abstract Chromosomes of two types of a Chinese cyprinid fish, *Tanichthys albonubes* LIN, were observed. The karyotype of specimens corresponding to White Cloud Mountain population comprises 12 pairs of metacentric, 7 pairs of submetacentric, and 6 pairs of acrocentric chromosomes, while the karyotype of specimens corresponding to Hong Kong population comprises 11 pairs of metacentric, 11 pairs of submetacentric, and 3 pairs of acrocentric chromosomes. Any difference between male and female karyotypes could not be found in each type. Systematic significance of difference between karyotypes of two types was discussed.

Recently karyotypes of Chinese cyprinid fishes have been intensely studied (TUN, 1984; ZAN *et al.*, 1984, 1985).

There are known two types of a Chinese cyprinid fish, *Tanichthys albonubes* LIN. One type corresponds to White Cloud Mountain population and is characterized by white bands on the edges of both the dorsal and anal fins. The other type corresponds to Hong Kong population and differs from White Cloud Mountain type by absence of white bands on both the dorsal and anal fins (WEITZMAN & CHAN, 1966). However, systematic interrelationships between these two types have been ambiguous because comparative anatomy and zoogeographical study of this species are poor. Thus we observed chromosomes of *Tanichthys albonubes* in the family Cyprinidae to clarify interrelationships between two types cytogenetically.

Materials and Method

Fourteen male and twelve female specimens of White Cloud Mountain type and six male and five female specimens of Hong Kong type were used for experiments. These specimens were offsprings of fishes, which had been imported from China to Japan, and had been kept at the aquaria in Laboratory of Aquatic Biology, Department of Fisheries, Tohoku University. As we distinguished its closely related fish, *Hemigrammocypris lini* WEITZMAN et CHAN, from Hong Kong type of *Tanichthys*

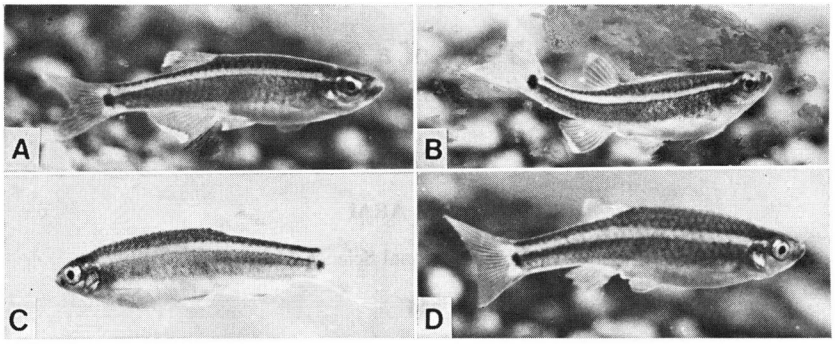

Fig. 1. Two types of *Tanichthys albonubes*. A and B: White Cloud Mountain type (A, male, 31.5 mm TL; B, female, 30.0 mm TL). C and D: Hong Kong type (C, male, 32.5 mm TL; D, female, 34.0 mm TL).

White spots in the dorsal and the anal fins of a female of White Cloud Mountain type (B) are not those of fins, but bubbles on the glass of an aquarium.

Table 1. Characters of specimens corresponding to two types of *Tanichthys albonubes*.

White Cloud Mountain type							Hong Kong type						
Cat. No.	Sex[1]	TL (mm)	SL (mm)	Dorsal	Anal	VN[2]	Cat. No.	Sex[1]	TL (mm)	SL (mm)	Dorsal	Anal	VN[2]
A·16·5	M	33.0	26.6	ii, 6	iii, 8	35	A·21·1	M	33.0	26.4	ii, 5	iii, 8	33
A·17·4	M	35.2	28.0	ii, 6	iii, 7	34	A·26·1	M	33.2	25.8	ii, 6	iii, 8	33
A·18.3	M	30.6	24.4	ii, 6	iii, 8	33	A·26·2	M	33.0	25.1	ii, 4	iii, 8	33
A·28.1	M	32.6	26.1	ii, 6	iii, 8	33	A·26.3	M	33.4	25.4	ii, 6	iii, 9	33
A·28·2	M	32.0	24.7	ii, 6	iii, 8	34	A·27·2	M	33.0	25.1	ii, 6	iii, 8	32
A·28·3	M	35.7	27.9	ii, 6	iii, 8	34	A·27·3	M	32.2	25.2	ii, 6	iii, 8	29
A·28·4	M	35.2	27.7	ii, 6	iii, 8	34							
A·28·5	M	33.9	26.3	ii, 6	iii, 9	34							
A·29.1	M	32.3	25.2	ii, 6	iii, 8	34							
A·29·2	M	29.4	23.1	ii, 6	iii, 8	34							
A·29·3	M	30.0	24.2	ii, 6	iii, 8	35							
A·29·4	M	33.3	26.4	ii, 6	iii, 8	34							
A·30·1	M	34.3	27.2	ii, 6	iii, 8	34							
A·30·4	M	32.3	25.5	ii, 6	iii, 8	34							
A·16·1	F	35.5	29.3	ii, 6	iii, 8	35	A·22·1	F	32.4	25.0	ii, 6	iii, 8	33
A·16·3	F	33.0	26.5	ii, 6	iii, 7	35	A·24·1	F	34.1	27.1	ii, 6	iii, 8	33
A·16·4	F	35.3	27.5	ii, 6	iii, 8	35	A·24·2	F	33.0	26.4	ii, 6	iii, 9	33
A·31·1	F	35.0	26.9	ii, 6	iii, 8	34	A·25·2	F	35.0	27.7	ii, 6	iii, 9	33
A·31·2	F	28.0	21.6	5[3]	iii, 8	33	A·25·4	F	35.8	27.9	ii, 6	iii, 9	33
A·31·3	F	35.0	26.7	ii, 6	iii, 8	33							
A·31·4	F	36.9	29.3	ii, 6	iii, 8	34							
A·31·5	F	32.6	29.5	ii, 6	ii, 7	34							
A·32·1	F	37.0	28.4	ii, 6	iii, 7	33							
A·32·2	F	34.0	27.9	ii, 6	iii, 8	34							
A·32·3	F	36.2	28.5	ii, 6	iii, 8	35							
A·32·4	F	32.8	25.9	ii, 6	iii, 8	33							

1) M: male, F: female; 2) VN, number of vertebrae; 3) abnormal

albonubes, specimens of *H. lini* were not mixed in our material fish.

Some morphological characters of material specimens are shown in Table 1.

All the specimens used for the experiments are deposited in the fish collection of the Department of Zoology, National Science Museum, Tokyo.

Method of chromosome preparation is similar to that of ARAI (1973), excepting following procedure, i.e., the gill fixed with methyl alcohol and acetic acid (2: 1, v/v) was beaten gently to mount cells of the gill on a slide-glass.

Classification of chromosomes is adopted from LEVAN *et al.* (1964). Metacentrics and submetacentrics are described as two-arm chromosomes, and subtelocentrics and acrocentrics as one-arm chromosomes. The definition of the new arm number is referred to ARAI & NAGAIWA (1976).

Table 2. Frequency distributions of diploid chromosome counts in specimens corresponding to two types of *Tanichthys albonubes*.

White Cloud Mountain type									Hong Kong type								
Cat. No.	Sex[1]	2n							Cat. No.	Sex[1]	2n						
		45	46	47	48	49	50	51			45	46	47	48	49	50	51
A·16·5	M						1		A·21·1	M		1		4	2	5	1
A·17·4	M						1		A·26·1	M						3	
A·18·3	M		1						A·26·2	M					1		
A·28·1	M		1		1		3	1	A·26·3	M		1				3	
A·28·2	M						6	1	A·27·2	M		1			1	1	
A·28·3	M			2		3	6	1	A·27·3	M				1		3	
A·28·4	M						7										
A·28·5	M			1		1	5										
A·29·1	M						3	1									
A·29·2	M				2		1										
A·29·3	M					4	4										
A·29·4	M					2	2										
A·30·1	M	1					3	1									
A·30·4	M						3										
A·16·1	F					1			A·22·1	F		3		1	2	6	
A·16·3	F					1			A·24·1	F						2	1
A·16·4	F			1	1	2	2		A·24·2	F						4	
A·31·1	F						1		A·25·2	F	1			1		5	
A·31·2	F				1		1		A·25·4					1		3	1
A·31·3	F				1		5										
A·31·4	F						1										
A·31·5	F					1	2	1									
A·32·1	F		1	1	1	2	4										
A·32·2	F						3										
A·32·3	F		2			2	10										
A·32·4	F		1			1	6	1									
Total		1	6	5	7	20	80	7			1	6		8	6	35	3

1) M: male, F: female.

Results

As the karyotype of White Cloud Mountain type differs from that of Hong Kong type, each karyotype is described separately.

White Cloud Mountain Type

(Figs. 1 A, B and 2)

As shown in Table 2, the diploid chromosome number of this type is 50. The karyotype comprises 12 pairs of metacentric, 7 pairs of submetacentric, and 6 pairs of acrocentric chromosomes. All chromosomes show a gradiation in size which makes it impossible to arrange them in size groups. The arm number is 88. The new arm number is 50. We could not find any difference between male and female karyotypes.

Hong Kong Type

(Figs. 1 C, D and 3)

The diploid chromosome number is 50 (Table 2). The karyotype of Hong Kong type comprises 11 pairs of metacentric, 11 pairs of submetacentric, and 3 pairs of acrocentric chromosomes. The arm number is 94. The new arm number is 50. Any difference between male and female karyotypes could not be found.

The karyotype of Hong Kong type agrees with that of White Cloud Mountain type in the diploid chromosome number, but differs from that of White Cloud Mountain type in the arm number.

Discussion

Although intraspecific variations of karyotypes have been reported in various groups of fishes, e.g., *Salmo gairdneri* in the Salmonidae (THORGAARD, 1983), *Pseudobagrus aurantiacus* in the Bagridae (UENO, 1974), *Ilyodon furcidens* in the Goodeidae (TURNER *et al.*, 1985), 3 species of *Dascyllus* in the Pomacentridae (OJIMA & KASHIWAGI, 1981), and *Gobius paganellus* in the Gobiidae (THODE *et al.*, 1985), the diploid chromosome number and the arm number, generally, have been considered to be very conservative at species level in most fishes.

As regards intraspecific variations of karyotypes, following explanations can be thought, i.e., (1) by misidentification, specimens used for experiments consist of more than one species, (2) classification of the species should be revised, and (3) real intraspecific variation.

It is unknown which of explanations described above can be applied to chromosome polymorphism found in *Tanichthys albonubes*. However, two populations are distributed far apart from each other and can be distinguished by color pattern (WEITZMAN & CHAN, 1966). On the other hand, it was observed that fishes belonging

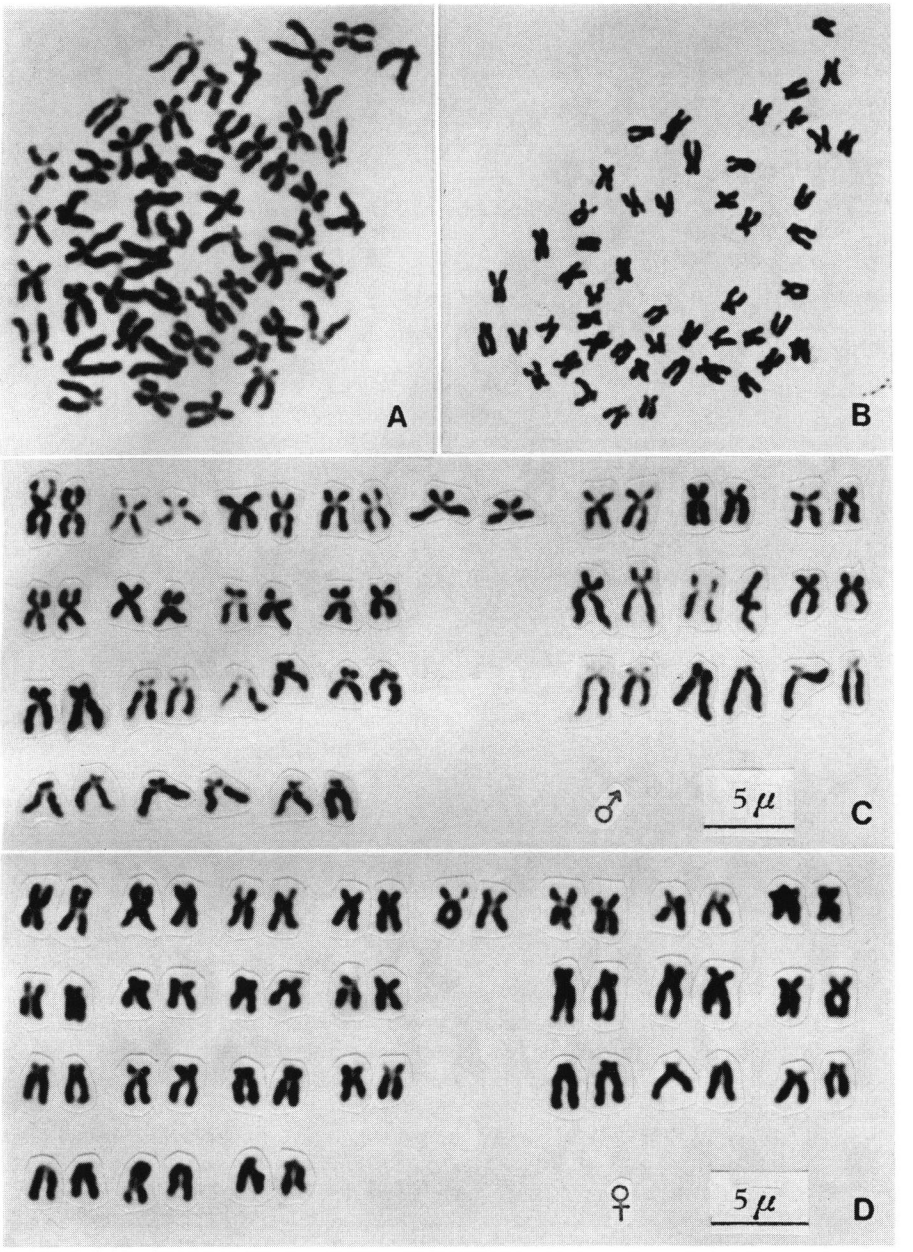

Fig. 2. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of White Cloud Mountain type of *Tanichthys albonubes*. —— A, male (Cat. No. A·30·4), 2n=50, ×2,550; B, female (Cat. No. A·31·3), 2n=50, ×1,700; C, male, from Fig. A, NF=88, ×2,430; D, female, from Fig. B, NF=88, ×2,600.

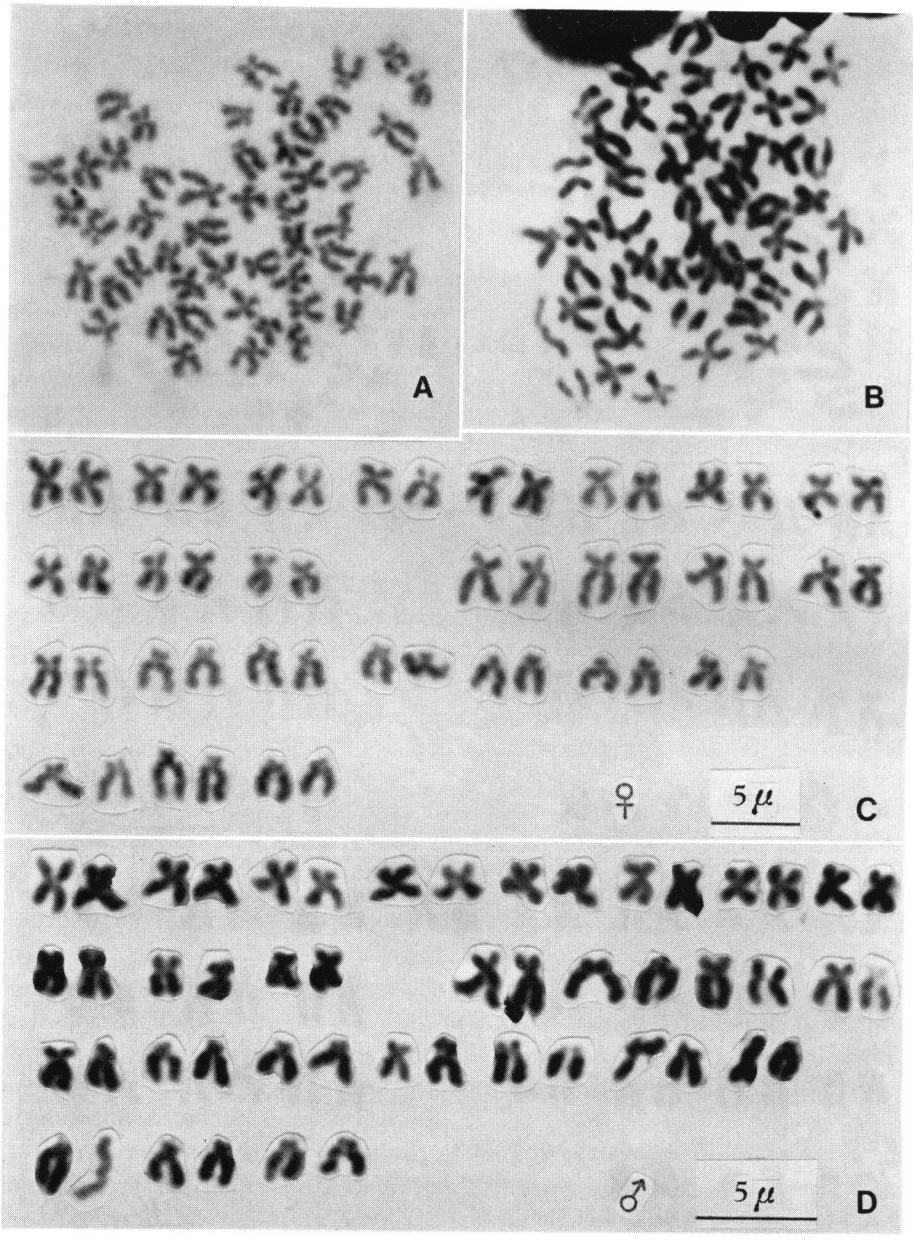

Fig. 3. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of Hong Kong type of *Tanichthys albonubes*. —— A, female (Cat. No. A·24·2), 2n=50, ×2,030; B, male (Cat. No. A·26·3), 2n=50, ×2,900; C, female, from Fig. A, NF =94, ×2,390; D, male, from Fig. B, NF=94, ×3,280.

to two types crossed each other in an aquarium and their hybrids were full-grown (YATES, 1940). These facts seem to show that *Tanichthys albonubes* should be separated into two subspecies, *T. albonubes albonubes* LIN which corresponds to White Cloud Mountain type (LIN, 1932) and *T. albonubes* subsp. which corresponds to Hong Kong type (WEITZMAN & CHAN, 1966).

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