

Karyotype and DNA Content in the Cyprinid *Catlocarpio siamensis*

Atsushi Suzuki and Yasuhiko Taki

(Received July 13, 1987)

Catlocarpio siamensis Boulenger is a gigantic cyprinid of the subfamily Barbinae occurring in the Menam Chao Phrya River in Thailand and the Mekong River systems in Laos, Cambodia and Vietnam. Due to its morphological resemblance to the Indian and Burmese *Catla catla* (Hamilton-Buchanan), this species has often been assigned to the genus *Catla* or even identified as *Catla catla* (or its synonym, *Catla buehneri*).

Karyologically, *Catla catla* is known to be a diploid species with a diploid chromosome number of 50 (Manna and Khuda-Bukhsh, 1977), but the chromosomes of *Catlocarpio siamensis* have not been studied. In the present study, we found that *Catlocarpio siamensis* has a diploid chromosome number of 98 and most probably there is a diploid-tetraploid relationship between the two species.

Material and methods

Two specimens of *Catlocarpio siamensis*, 74.0 and 110.0 mm SL, were obtained from an aquarium fish dealer in Tokyo. Karyotype analysis was made from these two specimens, and DNA content measurement from the larger specimen. To determine the DNA content of this species relative to DNA levels in the Cyprinidae, 1 specimen of *Puntius orphoides* ($2n=50$), 80.5 mm SL, and 1 specimen of *Cyprinus carpio* ($2n=100$), 170.0 mm SL, both secured from aquarium fish dealers in Tokyo, were used for DNA analysis.

Chromosome preparation and DNA measurement were made in accordance with the methods employed in Suzuki and Taki (1986). Classification of chromosomes followed that of Levan et al. (1964). Meta-, submeta- and subtelocentrics were counted as biarm chromosomes, and acrocentrics as monoarm.

Results

Of 20 metaphase plates obtained from two specimens of *Catlocarpio siamensis*, 16 plates had 98 chromosomes, three with 97 and one with 95

chromosomes. Based on these counts, the diploid chromosome number of *C. siamensis* was determined as 98. The chromosome complement was made up of 18 metacentric, 54 submeta-subtelocentric and 26 acrocentric chromosomes (Figs. 1, 2). The arm number was 170.

The DNA content in the species was about 2.3 times as much as that in *Puntius orphoides*, and nearly equal to that in *Cyprinus carpio* (Table 1).

Discussion

The oldest record of *Catlocarpio siamensis* was made by Tirant (1885), who reported the fish from Cambodia and Cochin China (southern Vietnam) under the name *Catla buehneri* (Cuvier et Valenciennes). Chevey (1934) synonymized it with *Catla catla*. Boulenger (1898) described this Southeast Asian form as a new species, erecting the genus *Catlocarpio* for the species. However, some workers after Boulenger (1898) still identified it as *Catla catla* (e.g., Hora, 1923), and it was not until 1931 that the fish came to be recorded under the name *Catlocarpio siamensis* (Smith, 1931; Fowler, 1937; Chevey and Le Poulain, 1940; spelled *Catlacarpio* in the latter two papers).

The confusion of *Catlocarpio siamensis* with *Catla catla* is due to the close similarity of the two species in overall morphology, particularly in having the disproportionately large head, though there are distinct differences between them in the number of dorsal fin-rays and arrangement of pharyngeal teeth (Smith, 1931, 1945). The two species are isolated geographically; *Catlocarpio siamensis* occurs in the Menam Chao Phrya and Mekong drainages, while *Catla catla* is distributed from India to Burma. It is most likely that the two species have derived from a common ancestor, and geographic isolation had to do with their differentiation.

The diploid karyotype of the Indo-Burmese *Catla catla* consists of 50 chromosomes including 8 metacentric, 16 submetacentric, 14 subtelocentric, 8 acrocentric and 4 terminal elements (Manna and Khuda-Bukhsh, 1977). Whereas its Southeast Asian counterpart, *Catlocarpio siamensis*, has a diploid number of 98 and an arm number of 170. The DNA contents in *C. siamensis*, *Puntius orphoides* and *Cyprinus carpio* are nearly proportionate to their chromosome numbers (Table 1).

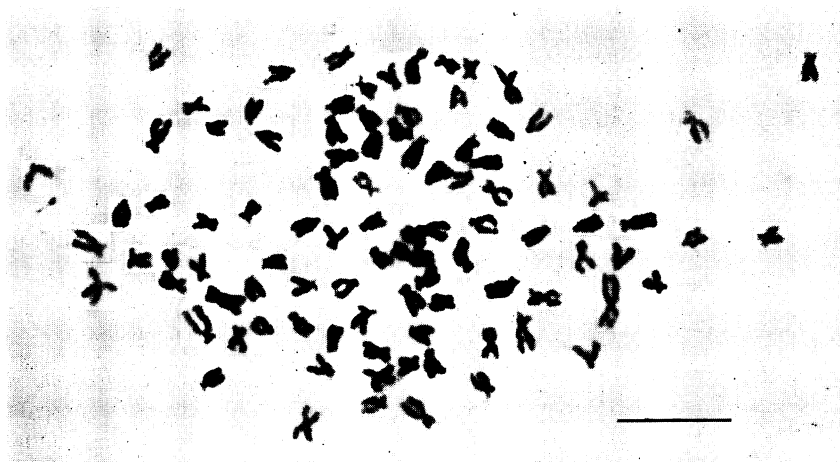


Fig. 1. Metaphase chromosomes from a kidney cell of *Catlocarpio siamensis*. Scale bar: 10 μ m.

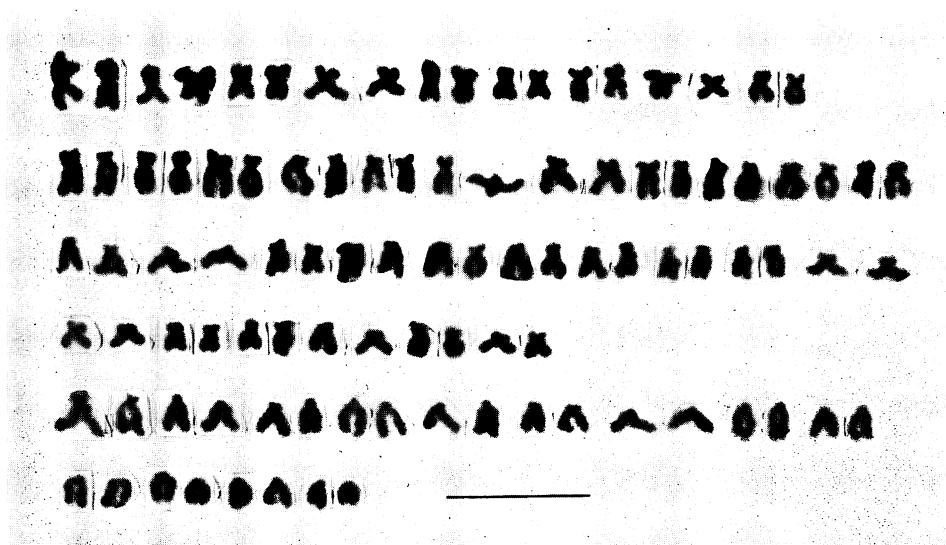


Fig. 2. Karyotype of *Catlocarpio siamensis*. Top row, metacentrics; second to fourth rows, submetacentric; fifth to sixth rows, acrocentrics. Scale bar: 10 μ m.

Table 1. DNA contents in *Catlocarpio siamensis* ($2n=98$), *Cyprinus carpio* ($2n=100$) and *Puntius orphoides* ($2n=50$).

Species	No. of cells measured	DNA content	
		Arbitrary unit (mean \pm SE)	Relative value
<i>Catlocarpio siamensis</i>	30	0.0556 \pm 0.0039	2.279
<i>Cyprinus carpio</i>	20	0.0536 \pm 0.0052	2.197
<i>Puntius orphoides</i>	20	0.0244 \pm 0.0038	1.000

Although the DNA content in *Catla catla* is unknown, a diploid-tetraploid relationship between *Catla catla* and *Catlocarpio siamensis* is strongly suggested by the chromosome number in the latter being about double of that in the former and the DNA content in *Catlocarpio siamensis* relative to other cyprinids (Table 1), coupled with the morphological similarity of the two species. It is most likely that *Catlocarpio siamensis* arose from a *Catla*-like ancestral population which underwent chromosomal polyploidization as it became isolated geographically. The discordance in chromosome number and arm number between the two species seen, when these counts for *Catla catla* are doubled, should be the results of chromosomal rearrangements following tetraploidization.

Acknowledgments

We are grateful to Dr. Norio Kondo, Research Institute of Evolutionary Biology, for his support to our chromosome study, and to Messrs. Tousei Urushido and Arata Kawamoto of the same Institute, for technical assistance. We are indebted to Dr. Ryoichi Arai, National Science Museum, Tokyo, for providing literature. This is contribution No. 88, the Research Institute of Evolutionary Biology.

Literature cited

- Boulenger, G. A. 1898. Description of a new genus of cyprinoid fishes from Siam. *Ann. Mag. Nat. Hist.*, (7) 1: 450-451.
- Chevey, P. 1934. Revision synonymique de l'oeuvre ichthyologique de G. Tirant. *Inst. Océanogr. Indochine*, 7^e note, 291 pp.
- Chevey, P. and F. Le Poluain. 1940. La pêche dans les eaux douces du Cambodge. *Trav. Inst. Océanogr. Indochine*, 5^e mem., 193 pp., 48 pls.
- Fowler, H. W. 1937. Zoological results of the third de Schauensee Siamese expedition. Part 8. Fishes obtained in 1936. *Proc. Acad. Nat. Sci. Philad.*, 89: 125-264.
- Hora, S. L. 1923. On a collection of fishes from Siam. *J. Nat. Hist. Soc. Siam*, 5(2): 134-184, pls. 10-12.
- Levan, A., K. Fredga and A. A. Sandberg. 1964. Nomenclature for centromeric position of chromosomes. *Hereditas*, 52: 120-220.
- Manna, G. K. and A. R. Khuda-Bukhsh. 1977. Karyomorphology of cyprinid fishes and cytological evaluation of the family. *Nucleus*, 20(1/2): 119-127.
- Smith, H. M. 1931. Notes on Siamese fishes. *J. Siam Soc., Nat. Hist. Suppl.*, 8: 177-190.
- Smith, H. M. 1945. The fresh-water fishes of Siam, or Thailand. *U.S. Natn. Mus., Bull.* 188, xi+622 pp., 9 pls.
- Suzuki, A. and Y. Taki. 1986. Chromosomes and DNA values of two cyprinid fishes of the subfamily Barbinae. *Japan. J. Ichthyol.*, 32(4): 459-462.
- Tirant, G. 1885 (reprinted, 1929). Note sur les poissons de la basse-Cochinchine et du Cambodge. *In Oeuvre ichthyologique de G. Tirant. Service Océanographique des Pêches de l'Indochine*, 6^e note, pp. 43-175.
- (AS: Research Institute of Evolutionary Biology, 2-4-28, Kamiyoga, Setagaya-ku, Tokyo 158, Japan; YT: Tokyo University of Fisheries, Konan, Minato-ku, Tokyo 108, Japan)

コイ科 *Catlocarpio siamensis* の核型と DNA 量

鈴木淳志・多紀保彦

Catlocarpio siamensis はタイ、ラオス、カンボジア、ベトナム南部に分布する大型のコイ科・バルブス亜科魚類である。本種はインドからビルマにかけて分布する *Catla catla* と形態的に酷似しており、背鰭条数、咽頭歯数などで明瞭に区別されるものの、過去には両種を混同した報告が少なくなかった。本研究で *Catlocarpio siamensis* の染色体と DNA 量を調査した結果、本種の染色体数は $2n=98$ 、腕数 (arm number) は 170、DNA 量を他のコイ科魚類と比較すると四倍性のコイ *Cyprinus carpio* ($2n=100$) とほとんど等しく、2 倍性の *Puntius orphoides* ($2n=50$) の約 2.28 倍であることが判明した。*Catla catla* の DNA 量は未調査であるが、染色体数は $2n=50$ と報告されており、*Catlocarpio siamensis* の染色体数、DNA 量と、両種の形態的類似性を考え合わせると、この 2 種は倍数関係にあるものと判断される。*Catlocarpio siamensis* は *Catla catla* 型の祖先型から染色体の倍数化によって出現し、地理的に隔離された条件下で分化したものと思われる。両種の染色体数、腕数は完全な倍数関係にはないが、これは倍数化後の染色体再構成によるものであろう。

(鈴木: 158 東京都世田谷区上用賀 2-4-28 進化生物学研究所; 多紀: 108 東京都港区港南 4-5-7 東京水産大学)