Karyotype Studies in Two Cyprinids

R. P. Nayyar

Department of Zoology, University of Delhi,
Delhi-6, India

Received December 11, 1961

Introduction

In his monograph on chromosome numbers in animals, Makino (1956) has listed 130 of the more than 13,000 fish species known today. Recently, Nogusa (1960) gave a cytotaxonomic review of 64 fishes, most of which have been included in Makino's list. The majority of the cytologically known species is from waters of Japan. Karyological studies of Indian fishes have been published by Sriramulu (1958) and Sharma, Parshad and Nayyar (1960). The present report embodies the karyotype studies of two cyprinids, *Labeo dero* (Ham.) and *Labeo gonius* (Ham.) of the family Cyprinidae.

A great variation in chromosome number and morphology in different species of Cyprinoidae has been recorded by previous workers (Makino 1939, 1941, Nogusa 1960, Sharma *et al* 1960). Many of the chromosomes are small rods; but V-shaped chromosomes, varying from two to eight in number, have also been observed in different karyotypes. Diploid number varies to a great extent, ranging from 44 in *Rhodius ocellatus* (Nogusa 1960) to 104 in *Cyprinus carpio* (Makino 1939). The fishes under investigation represent a new karyotype, with 54 rod shaped chromosomes in the diploid set, not known so far among the cyprinids.

Material and methods

The fishes were collected during the period from April to August 1960 from the river Yamuna about 2 miles upstream of Okhla Weir, Delhi. In the adult, the testes are thin ribbon shaped bodies, one on either side of the swimbladder, extending to the anteriormost part of the abdomen. Immediately after removal, the testes were cut into small pieces in hypotonic solution and kept therein for 10 to 15 minutes. Squashes of pretreated material were made after fixation in acetic alcohol or stained directly in acetocarmine. Material fixed in Allen's modification of Bouin's and Zenker's fixatives was sectioned and stained by Heidenhain's iron haematoxylin or crystal violet stain.

Observations and discussion

Examination of the spermatogonial metaphase plates of *Labeo gonius* and *L. dero* showed 54 chromosomes each, constituting the diploid number.

The chromosomes are small acrocentric rods of uniform thickness with very slight variation in length. The chromosomes of *L. dero* showed a slightly greater variation in length. No regular pattern in the distribution of chromosomes was

Figs. 1-6. All figures were drawn with the aid of *camera lucida*. Figs. 1, 4, 5 and 6 are from acetocarmine squashes, while Figs. 2 and 3 are drawn from haematoxylin stained sections. 1 and 4, spermatogonial metaphase of *Labeo gonius* and *Labeo dero* respectively with 54 rod-shaped chromosomes. 2-3, metaphase I and metaphase II of *Labeo gonius*, each having 27 rounded bodies. 5-6, Metaphase I and metaphase II of *Labeo dero*.

karyotype with 54 rods and no V's.

Analysis of the karyotypes of the fishes studied so far reveals that in general the chromosomes are small rods, and V-shaped chromosomes occur only in a few forms. According to Nogusa (1960), the V-shaped chromosomes in the piscine karyotypes have resulted from the centric fusion between the rods. This view is supported by his observations on *Acheilognathus rhombea* in which three different karyotypes, 4V-type (4V's+40r's), 2V-type (2V's+44r's) and no V-type (48r's) have been reported from the same individual (Nogusa 1955). Makino (1941) recorded a similar condition in two allied fishes of family Cobitidae, *Misgurnus anguillicaudatus* and *Barbatula oreas*. The former has 52 rod-shaped chromosomes in its karyotype while in the latter, 44 rods and 4V's constitute the diploid set of 48 chromosomes. Such a relationship has also been reported in other vertebrates, Makino (1932, 1935) in Urodeles, Matthey (1938) and Makino and Momma (1949) in Lizards, Udagawa (1954) in Aves and Makino (1943) in Mammals.

An explanation for the karyotype of *Labeo* species is possible along the same lines. It evidently represents a primitive condition in the evolution of chromosome number and form in Teleosts. Nogusa's recent work (1960) has shown that in four Cyprinids, namely, *Acheilognathus lanceolata*, *Pseudorasbora parva*, *Puntungia herzi* and *Zacco temmincki*, the karyotype consists

seen in the spermatogonial metaphase plates. Chromosomes of primary and secondary spermatocytes become more or less rounded in shape and lie closely packed at metaphase. Mitosis and meiosis in general resemble those described by the author in *Esomus danricus* and *Danio (Brachydanio) rerio* (Sharma, Parshad and Nayyar 1960).

Based on the chromosome number and morphology, in the family Cyprinidae, Nogusa (1960) recognizes 13 different karyotypes. The species described here represent a new

of 46 rods and 4V's the total diploid number being 50. It seems possible that the karyotype of *Labeo* has, by centric fusions, given rise to the condition described by Nogusa.

Summary

Karyotype of both *Labeo gonius* and *Labeo dero* is characterised by the presence of 54 rod shaped chromosomes. The primary and secondary spermatocytes have 27 rounded chromosomes of approximately the same size. In a number of cyprinids a varying number of V-shaped chromosomes have been reported, in addition to rods. Considering each V-shaped chromosome equivalent to two rods in which centric fusion has taken place, it is suggested that originally the cyprinids had 54 rods, a karyotype very much like the one described here in *Labeo* species.

Acknowledgments

The author is grateful to Dr. C.M.S. Dass for guidance and to Professor B. R. Seshachar for critically going through the manuscript and providing research facilities.

Literature cited

- Makino, S. 1932. Chromosome number in some Salamanders from Northern Japan. Jour. Fac. Sci. Hokkaido Imp. Univ. Ser. VI Zool. 2: 97-108.
- 1935. The chromosomes of *Cryptobranchus alleghiensis*. Jour. Morph. 58: 573-583.
- 1939. The chromosomes of the carp, *Cyprinus carpio*, including those of some related species of Cyprinidae for comparison. Cytologia 9: 430-440.
- 1941. The chromosomal relation between the two allied species of the loach (Cobitidae, Pisces). Cytologia 12: 79-82.
- 1943. Studies on the murine chromosomes. III. A comparative study of chromosomes in five species of *Rattus*. Jour. Fac. Sci. Hokkaido Imp. Univ. Ser. VI Zool. 9: 19-57.
- and Momma, E. 1949. An idiogram study of the chromosomes in some species of reptiles. Cytologia 15: 96-108.
- 1956. A review of the chromosome number in animals. Hokuryukan Publishing Co., Ltd. Tokyo, Japan.
- Matthey, R. 1938. La loi de Robertson et la formule chromosomiale chez deux Lacertiens, *Lacerta ocellata* DAUD., *Psammodromus hispanicus* FITZ. Cytologia 10: 32-39.
- Nogusa, S. 1955. Chromosome studies in pisces. V. Variation of the chromosome number in *Acheilognathus rhombea* due to multiple chromosome formation. Annot. Zool. Japon. 28: 249-255.
- 1960. A comparative study of the chromosomes in fishes with particular considerations on the taxonomy and evolution. Memoirs of the Hyogo University of Agriculture 3: (1). (Biological series No. 3).
- Sharma, G. P., Parshad, R., and Nayyar, R. P. 1960. Chromosome number and meiosis in three species of fishes. Res. Bull. Panjab Univ. 11: 99-103.
- Sriramulu, V. 1958. A note on the chromosomes of *Oryzias melastigma*. Current Science 28: 117-118.
- Udagawa, T. 1954. Karyogram studies in birds. III. The chromosomes of five forms of birds. Annot. Zool. Japon. 27: 91-96.