

Karyotypic diversity between rainbow trout (*oncorhynchus mykiss*, walbaum) and snow trout (*schizothorax richardsonii*, gray)

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Abstract

The Cytogenetic studies were carried out in two important coldwater fishes, Rainbow trout (*Oncorhynchus mykiss*) and Snow trout (*Schizothorax richardsonii*), by Giemsa staining. The diploid chromosome number ($2n$) in Rainbow trout (*Oncorhynchus mykiss*) the modal diploid number was found to be $2n = 60$. The karyotype formula obtained consist of 38 metacentric (M), 6 submetacentric (Sm) and 16 telocentric chromosomes ($24M + 20 Sm + 16 T$). The fundamental arm number was derived to be 208 ($FN = 208$) and in Snow trout (*Schizothorax richardsonii*), the modal diploid number was found to be $2n = 96$. The karyotype formula obtained consist of 18 metacentric (M), 16 submetacentric (Sm) and 12 subtelo-centric and 50 telocentric chromosomes ($18 M + 28 Sm + 50 T$). The fundamental arm number was derived to be 284 ($FN = 284$). This is the attempt to compare the wild snow trout obtained from Himalayan stream and farm raised Rainbow trout in these species using conventional staining.

KEY WORDS

Rainbow trout, Snow trout, karyotype

INTRODUCTION

The rich fish diversity of India is reflected in its large number of documented 2163 fish species of which 157 from the coldwater environment (Ayappan, 2006). Cytogenetic studies in recent years gained a considerable importance concerning species characterization, evolution and systematic (Gold et al., 1990; Barat et al., 2002). The cytogenetic studies in fishes are limited to just about 10% of the total fishes known taxonomically all over the world (Barat et al., 1996). Fish chromosome data have great importance concerning evolution, systematics, aquaculture and mutagenesis (Al-Sabti, 1991).

The lack of data on karyotypes of fishes in Uttarakhand (a hill state of India) provoked us to examine chromosomal study of farm raised Rainbow trout (*Oncorhynchus mykiss*) and wild Snow trout (*Schizothorax richardsonii*).

The efforts to develop farming practices for rainbow trout started especially in Jammu and Kashmir and Himachal Pradesh. Presently there are about 23 trout hatcheries in different states of the country with 1.5 to 2.0 million annual seed production capacity. The species can withstand vast ranges of temperature variation ($0-27\text{ }^{\circ}\text{C}$), but spawning and growth occurs in a narrower range ($9-14\text{ }^{\circ}\text{C}$). The optimum water temperature for rainbow trout culture is below $21\text{ }^{\circ}\text{C}$. But at Experimental Fish Farm, Champawat (DCFR) it was observed that Rainbow trout attended maturity even in less than two years during February, 2011 due to climatic changes.

Snow trout, an indigenous cold water riverine and short migratory fish is locally known as asla. No technology has been developed yet for commercial culture. It is a good sport and food fish.

MATERIALS AND METHODS

Snow trout (*Schizothorax richardsonii*) ($n=57$) were collected from Gaudi River in Champawat. Rainbow trout (*Oncorhynchus mykiss*) ($n = 25$) were taken from the Experimental Fish Farm, Champawat (DCFR). All the specimens were immature and the sex could not be identified. Fishes were administered intramuscularly with 0.05% colchicine (1.0 ml / 100 gm body weight) to stop the nuclear division and maintained alive for 1.30 hours in a plastic tub. The specimens were then sacrificed and the head kidney was processed for chromosome preparations using hypotonic treatment of 0.56% Potassium chloride. The fixation was done by methanol – acetic acid (3:1) and slides prepared by flame-drying technique. The chromosome slides were stained with 4% Giemsa in phosphate buffer pH 6.8). The chromosome slides were mounted with synthetic neutral mountant DPX and

cleaned with xylene. The slides then observed under microscope for good metaphase spreads. For karyotyping, chromosomes were grouped into metacentric (m), submetacentric (sm), subtelocentric (st) and telocentric (t) as per the classification proposed by Levan et al. (1964).

RESULTS AND DISCUSSION

The stained slides of metaphase chromosomes were photographed and analyzed. Counts of a total 150 metaphase spreads from 10 different specimens of Rainbow trout (*Onchorynchus mykiss*) and Snow trout (*Schizothorax richardsonii*) showed the following results.

In case of Rainbow trout (*Onchorynchus mykiss*), the modal diploid number was found to be $2n = 60$ Figure 1. The karyogram (i.e. karyotype formula) obtained by arranging the chromosomes in order to decreasing size and centromere position consisted of 38 metacentric (M), 6 submetacentric (Sm) and 16 telocentric chromosomes ($24M + 20 Sm + 16 T$). The fundamental arm number was derived to be 208 (FN = 208) Figure 2.

In case of Snow trout (*Schizothorax richardsonii*), the modal diploid number was found to be $2n = 96$ Figure 3.

The karyogram (i.e. karyotype formula) obtained by arranging the chromosomes in order to decreasing size and centromere position consisted of 18 metacentric (M), 16 submetacentric (Sm) and 12 Subtelocentric and 50 telocentric chromosomes ($18 M + 28 Sm + 50 T$). The fundamental arm number was derived to be 284 (FN = 284), Figure 4.

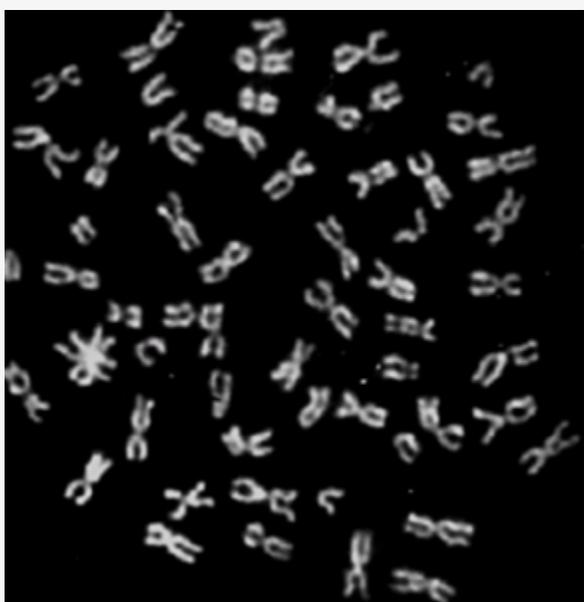


Fig. 1: Metaphase spread of Rainbow trout (*Oncorhynchus mykiss*), $2n = 60$



Fig. 2: Karyotype of Rainbow trout (*Oncorhynchus mykiss*)



Fig. 3: Metaphase spread of Snow trout (*Schizothorax richardsonii*), $2n = 96$



Fig. 4: Karyotype of Snow trout (*Schizothorax richardsonii*)

DISCUSSION

The chromosomal studies revealed that the diploid chromosome number in Rainbow trout (*Oncorhynchus mykiss*) and Snow trout (*Schizothorax richardsonii*) was to be $2n = 60$ and $2n = 96$; karyotype formula $24 M + 20 Sm + 16 T$ and respectively. Ohno et. al. (1965) also reported $2n = 60$ diploid chromosome number in case of Rainbow trout. Thorgaard (1976) reported 6 triploid individuals in a full-sib family of 11 adult rainbow trout (*Oncorhynchus mykiss*) from a domesticated hatchery stock. Among the 11 fish in family 267, showed that five were diploid with 59 or 60 chromosomes, and six were triploid with 89 or 90 chromosomes. The karyotype formula reported was $22 M + 22 Sm + 1 St + 7 T$. Ohno et. al. (1965) also reported the same diploid chromosome number in Rainbow trout.

Gold (1975) has been also reported modal haploid number $2n = 58$ in golden trout (*Salmo aquaboniatata*), karyotype formula was $22 M + 1 Sm + 1 St + 5 T$ and fundamental arm number (FN) = 104. The difference between the diploids with 59 and 60 chromosomes appeared to be associated with a Robertsonian rearrangement. These differences in chromosome number among fish with the same number of chromosome arms have also been observed in other rainbow trout populations (Ohno et al. 1965; Thorgaard, 1976).

Although most cells from the kidney and ovary had hypo-triploid chromosome numbers, determination of chromosome arm numbers, where possible, revealed that the variation probably resulted from chromosome loss during the preparation procedure and not from the intraindividual Robertsonian variation that has been reported in some salmonid fish (Ohno et al. 1965; Davisson et. al. 1973).

After seeing the observations on chromosomes it can be concluded that the chromosomes number of Snow trout (*Schizothorax richardsonii*) (collected from hill streams of Uttarakhand, India) was found to be $2n = 96$ while in Cyprinids the modal diploid chromosome number $2n = 50$ generally. The diploid chromosome number reported in Rainbow trout (*Oncorhynchus mykiss*) was $2n = 60$. It is to be mentioned that heavy rainfall and land sliding happened severally, before the observation in this year.

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