Game Fishes of India

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ABSTRACT-

Garhwal Himalaya lies between the latitudes 29° 26′ to 31° 28′N and longitude 77° 49′ to 80° 06′E. The mountain streams or rivers consist of a series of tributaries, which join one another and form the principal riverine system. The fluvial ecosystem of Garhwal region embodies the snow fed rivers and streams notably Alaknanda, Bhagirathi, Yamuna, Bhilangana, Ganga, Asi Ganga, Mandakini, Nandakini, Pindar etc.; large number of springfed tributaries and thousands of rivulets, which finally pour into major rivers at various sites. The Alaknanda and Bhagirathi are the two parental streams, which join at Devprayag to form the river Ganga. Besides, Garhwal hills are also beautifully dotted with a number of natural ice-cold lakes and small ponds. The nature has gifted and varies and colorful aquatic flora and fauna in all these water bodies.

Key Words: *Fluvial, Snow fed rivers, streams, nature.*

Introduction-

The existing hydroelectric projects including those under construction and proposed shall be coming up in Garhwal region in near future a total of twenty projects, thirteen are ones in the Ganga and remaining seven on the Yamuna stream. In case of the former, quite a number of projects are under construction including the controversial Tehri and Vishnuprayag projects on the Bhagirathi and Alaknanda main stream respectively. Although these proposed and commissioned projects, seven on the Bhagirathi and four on the Alaknanda shall certainly influence the pristine quality of the Ganga including the fish fauna, it will be projects in the different zones of the Ganga and

its main tributaries that shall be crucial for the survival of the Garhwal Himalayan mahseer (Nautiyal and Singh, 1989).

Tor tor and *Tor putitora* species of mahseer commonly found in the Garhwal region of Uttarakhand, and provide the main fishery in the Ganga river at Garhwal region. The foot hill stretch of the forms the natural habitat of mature mahseer fishery stocks for a major part of the year and feed actively (Nautiyal and Lal, 1984). But the populations of spot fish mahseer species have been continues to be decimated by the large scale destruction of their natural habitat and are categorized as threatened fishes in India (NCA, 1976). Mahseer fish population dynamics is devoted to the proposition that the resources exploited in early life ultimately limit overall population abundance. This hypothesis is often embodied in a stock-recruit relation that links egg production to juvenile abundance via a short period of high density-dependent mortality early in the life cycle (Ricker 1954, Cushing 1981). Each fish species is best adapted to only a subset of all the conditions within a stream.

The status of sympatric population of mahseer fishes are reflected in their population size and age structure. Among the various factors, the population size is regulated by competition, an adequate supply of food, the space and other resources necessary for existence and reproduction of mahseer species. Studies, such as present one is important as they help in understanding how the closely related fish species co-exist in same environment of more interest is how the population of sympatric mahseer species maintain themselves in Ganga river. The nature of river may also influence the population structure and it is quite possible that streams with different gradients and discharges may influence the population in a different manner.

The population size is structured by natality and mortality rates, which eventually is the sum total of abiotic stress and biotic interactions. The shape of the mortality curves varies greatly with years and species. In many cases, most of the deaths occur in the spawn or free embryo stage while in others they occur in larval or fry stages. Some species show a considerable and variable number of deaths among the adults. Each species is adapted to a certain range of death rates. The mortality that a population can withstand is inversely related to the exposure to predator and parasites, also, the fecundity tends to be higher and more labile when natural mortality is high. Abiotic conditions usually can produce large number of death only when their changes lie outside the limits to which the species is adapted, as most frequently occurs at the biological limits to the range of the species.

The spawning population of a species with a long life cycle consists of many age groups. A population consisting of few age groups is adapted to rapid changes in numbers. Such a species usually exists on a variable food base and with a relatively high exposure to predators. The numbers fall rapidly under poor conditions. On the other hand, such a species is also adapted to more stale spawning conditions than a population with a many age groups, for a poor year-class at once affects the total numbers in the population when the life cycle is short and so fluctuations in year class strength have a pronounced effect on the breeding population. The population structure may vary greatly, which is not accidental but an adaptive response. The adaptation provides a rapid increase in numbers when the food supply improves, the population density influencing the fecundity during breeding seasons.

The sex ratio in the spawning population and in the various age and size groups varies with the species, reflecting the relationship of that species to its environment. The sex structure is also adaptive to the food supply, which thereby influences the reproductive rate and the variability of the offspring (Makeeva and Nikolskii 1965). The sex structure is very important to the reproduction of a population, and consequently there are mechanism for adjusting this structure to any changes, and specially changes in food supply. The last is itself dependent on the population density, so that the sex ratio naturally reflects the density. There is thus little doubt that fish have a variety of mechanisms for the adjustment of the sex ratio, but many instances of altered ratios cannot be explained in terms of enhanced mortality or differences in maturation (Nikolskii 1980).

OBJECTIVES OF THE STUDY

The Himalayan mahseer species (*Tor putitora & Tor-tor*) are commonly inhabitant of Ganga river in Uttarakhand region. The aims and objectives of the proposed study are as follows:

A. To study the fish diversity in riparian zone of Ganga river.

B. To study the population racial structure, population size, mortality, survival rate and age structure.

C. To assess the reproductive biology including food utilization.

D. To undertake the measures for conservation and management of mahseer fishery in Ganga river.

RESEARCH METHODOLOGY-

Survey method is used by the research scholar according to need and requirement of the topic.

The unabated downward trend in commercial as well as sport fishing catches of mahseer can be curtailed by a continuous rehabilitation programme on a mass scale and conservation by enforcing the prevailing legislation strictly. The rehabilitation programme would require intensive production of stocking materials (fry and fingerlings) for planting in the perennial water e.g. streams, lakes, rivers. Since conservation and rehabilitation of threatened fishes, Himalayan mahseer is a sport game fish play a vital role in subsistence fishery resources for Uttarakhand as well as of national importance. The production of stocking material through artificial propagation of mahseer species and ranching in their natural habitats is the only solution to save mahseer germplasm from extinction.

To make studies on the population dynamics of mahseer fishes, *Tor tor* & *Tor putitora* in Ganga river at Garhwal region. The methods adopted in investigating for various biological aspects are based on standards evolved in different research laboratories both in India and abroad. Whenever necessary, the methodology was modified to suit the field conditions. The scientific observations on the biology of mahseer in Ganga river were carried out by dividing the Ganga river stretch into three sampling zones namely, upper stretch of Ganga river at Devprayag, Down stretch of Ganga river from Devprayag to Byasi Ghat and Riverine stretch of Ganga river from Biyasi Ghat to Shivpuri (Rishikesh).

METEOROLOGICAL PARAMETERS

The meteorological data, i.e. maximum and minimum air and water temperature, relative humidity and rainfall have been collected from the State Irrigation Meteorological Research Laboratory, State Forest Department and Central Water Commission at Devparag and Rishikesh. The meteorological parameters observed with the help of digital instruments during the field visits on sampling periods.

FISH DIVERSITY AND CATCH COMPOSITION

The mahseer fishes, *Tor tor* and *Tor putitora* were collected seasonally during March 2024 to February 2025 from different sampling zones of Ganga river. The fish catch samples were obtained from local fish market, fisherman and anglers. The use of cast net was found very common to land the mahseer (small size), while gill nets in addition to hooks were by rod lines used to land the larger size of mahseer. The fishes were taken to laboratory in fresh condition for further investigation and analysis. The catch composition and per unit effort was estimated applying following method.

$$\text{Catch per unit effort (CPUE)} = \frac{\text{Total weight of fish catch}}{\text{Number of ersons} \times \text{hrs. of fishing}}$$

The fish samples were preserved in 5% formalin solutions and identified according to Day (1878, 1879), Gunther *et al.,* (1959), Menon (1962), Badola and Pant (1973), Jayaram (1987) and Sehgal (1992).

PHYSICO-CHEMICAL AND BIOLOGICAL FACTORS

The physico-chemical and biological characteristics of the riverine water on spawning grounds were determined according to Welch (1948), Edmondson (1959), Needham and Needham (1966) and APHA (1995). The abiotic and biotic parameters have an idea of the optimum conditions required for successful spawning in natural conditions. Some physico-chemical parameters viz., water temperature, turbidity, dissolved oxygen, pH, conductivity; TDS, Free C02 and Alkalinity were analyzed. The details of measurements of different physico-chemical parameters as follows:

(A) **Water temperature:** Water temperature was recorded with the help of (±1°C) centigrade thermometer.

(B) **pH:** pH is the negative $\log_{10}$ of the Hydrogen ion concentration in a solution. The pH value is expressed as the negative ion of [H+] concentration. pH of water sample was analyzed by pH meter (portable) made by Hanna instruments.

RESULTS & FINDINGS-

1) Geographically, Garhwal region has almost central position in the long Himalayan sweep, it is the most important part of lesser Himalaya, which lies between the latitudes 29° 26' to 31o 28' N and longitude 77° 49' to 80° 06' E. It has an area of about 30090 sq km, spreading 220 km in east-west and 235km in north-south.

2) The main stream of river Ganga originated from the result of confluences of rivers Bhagirathi and Alaknanda at Devparyag. Now river Ganga flowed rapidly in a zig zag motion along the distance as 167 km. in foot hills of lower Garhwal region and emerges into Indo-Gangatic plains at Haridwar. Three sampling zones as upper, middle and lower stretches were selected for the research findings in Ganga river.

3) The impact of meteorological observations were showed clear seasonal variations in different parameters i.e., atmospheric and water temperature, relative humidity and rainfall. The climate of the surrounding riverine zone of the study area has observed as colder than plains and can be categorized as subtropical in nature. The total average rainfall (300-475mrn) in month of July-August enhanced the spawning and breeding activities in mahseer fishes in Ganga river.

4) The Ganga river has a very diversified fish biodiversity as 35 fish species belongs to 21 genera, 7 sub family and 9 families. The Cyprinidae family occurs in a

dominating phase. In middle and lower riverine stretches, the 12 species were recorded rare status due to most exploitative fishing efforts and others natural & anthropogenic factors for declining the endemic fish populations in Ganga river.

5) The fish catch composition showed that the mahseer fishes have contributed about 72.28% of the total catch in lower stretch in winter season and about 41.07% mahseer catch have decline in upper stretch during the same period. The size groups 461 - 500 mm of the mahseer as a dominant size of the catch have also contributed 47.61% in middle stretch but the same size groups have again shown 5.32% declining pattern in upper stretch of Ganga river.

6) The Ganga river water remained alkaline throughout the year, pH ranged 7.2- 8.5, DO recorded maximum in winter, favored the fish growth and food resources in the Ganga river. The turbidity and TDS showed higher values in rainy seasons due to discharge of heavy sedimentation from the catchment basin and affected the production of planktonic biomass and productivity of Ganga river.

7) Biotic components of river Ganga were the phytoplankton were recorded in winter season, zooplankton recorded in March and May and contributed the existence of food materials in river water for denoted the food and feeding habits of mahseer fishes.

8) The biometric analysis of the mahseer species have showed that the body parameters, standard length and head length were highly correlated but snout length and length of the rostral barbel were least correlated with total length of the fish *Tor tor* and *Tor putitora* in both upper and middle stretch of Ganga river.

9) In the *Tor putitora,* the total length 40.125±8.002 and head length 9.55±1.709 were recorded and high regression coefficient were calculated for SL (0.8828) and least (0.0069) for average H found in the upper stretch. Average head length (7.72) and average snout length (4.21) of 34.00 cm average size group of the fishes, high degree of correlation of SL (0.9972) followed by HL (0.9929) and least correlation of SnL (0.6110) with TL were calculated in middle stretch.

10) In *Tor tor,* the total length 30.5±3.628 and head length 7.22±0.458 were recorded and high regression coefficients were calculated for SL (0.8276) and least (0.0004) for LRB found in the upper stretch. Average head length (6.56) and average snout length (3.08) of 33.9 cm average size group of the fishes. High degree of correlation of SL (0.9906) followed by HL (0.9515) and least correlation of SnL (0.7095) with TL were calculated in middle stretch.

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