

FISHES OF THE HIGH ALTITUDE* OF THE HIMALAYAS AND CENTRAL ASIA

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ABSTRACT

From south-west China (Yunnan) in the east to Seistan in the west one finds a uniform fish fauna, which consists of the Schizothoracine carp-trouts, *Nemachilus*, and allied loaches and of Glyptosternoid cat-fishes. Though in general allied to the Indian fauna, it appears to have diverged from the Indian fauna during the Pleistocene glaciation. The high altitude fishes are adapted to live in torrential waters through a torpedo-shaped or greatly depressed body form and the reduction of scales, when present. Some forms have become secondarily adapted to lakes conditions of life at high altitudes.

Though this characteristic fish fauna is mainly confined to the high altitudes of Central Asia, where it is now represented by a large number of species and genera, it has colonized certain depressions in the region, such as the Kashmir Valley and Seistan. As some of the Indian rivers have trans-Himalayan sources, certain Schizothoracine fishes have also come down to the southern slopes of the Himalayas. An outcrop of the Central Asiatic fishes is also found in Travancore and thus presents a very interesting zoogeographical problem.

The authors deal with the origin, evolution, adaptation and distribution of the high altitude fish fauna of Central Asia with reference to its palaeontology, morphology, ecology and zoogeography. Attention is drawn to large populations of certain species at high altitudes permitting their exploitation as a source of protein food for the indigenous populations.

INTRODUCTION

Fishes of the high altitudes of the Himalayas and Central Asia can be readily recognized from the fishes of the plains and of the low altitudes on the southern face of the Himalayas (Hora, 1937), as they have several features of build in common though they belong to three different families, viz. Cyprinidae, Cobitidae and Sisoridae. The most striking common feature is the absence of scales or their great reduction (Annandale and Hora, 1920). Cyprinidae is a widely distributed family with a large number of genera and species inhabiting diverse types of habitats. Those characteristic of the high altitude are grouped under the sub-family Schizothoracinae and are allied to the Barbel-group of fishes of the lower altitudes and the plains. The Cobitidae is also a widely distributed family, being found in Europe, Asia and Africa, but at present is represented by a large number of genera and species in the Oriental Region. Its representatives at high altitude are akin to the loaches of the genus *Noemachilus* van Hasselt so common in the hill streams of south-east Asia, but they are bulkier and of a heavier build. The Sisoridae are mainly Oriental fishes though certain forms extend to the west as far as the valleys of the Tigris and the Euphrates. One form is painted on the Nal pottery of the third millennium B.C. (Hora, 1954), showing thereby that the gap in its westward distribution is of a comparatively recent date. They are mostly hill-stream fishes with special adaptations for living in torrential waters.

SOME SALIENT FEATURES OF THE FISH FAUNA

Of the above three types of fishes, from a distributional point of view the Cobitidae are the most ancient, the members of the family being the most widely

* High altitude here means heights above the snow limit about 10,000 ft. in the Western Himalayas and about 12,500 ft. in the Eastern Himalayas.

distributed extending from the Oriental Region as far westward as Africa. These loaches normally live among pebble and shingle at the bottom of clear rocky streams but some drift into lakes among the hills and become secondarily modified for life in deeper waters (Hora, *op. cit.*). Aquatic insect life and other food organisms must be plentiful in streams at high altitudes as this is reflected by the comparatively giant size of the loaches of the high altitudes. Some *Diplophysa* Herzenstein as they are called, through the acquisition of a new air-bladder, have become physiologically adapted for living in high altitude lakes of Central Asia. Some have developed an adipose fin (Annandale and Hora, *op. cit.*) for storage of food to survive through adverse conditions and have been termed *Adiposia*. For that reason these high altitude loaches have been classified into several genera and a large number of species but the systematic position of most of them is very problematic as they all look alike and their diagnostic features are not well defined. They show that either the evolutionary processes had not had much time to play upon them or the conditions of their lives have remained more or less static till their uplift to the high altitudes.

In chronological order, the next group is the Sisoridae. The fossil remains of one of its members, *Bagarius bagarius* Hamilton, are known from the Siwalik beds of the Pliocene period. The high altitude genus *Glyptosternum* McClelland is a very specialized form found at high altitudes from Afghanistan to Eastern Tibet. Here again, among the Glyptosternoid fishes of the family Sisoridae (Hora and Silas, 1952), species of *Glyptosternum* are comparatively giants. Hora and Silas have expressed the view that the Glyptosternoid group of fishes evolved from other Sisorid fishes within the last one million years.

Though the Cyprinidae are as old as the Eocene, the Schizothoracinae made their appearance during the second Inter-glacial Period. Hora (1937a) described their fossils from the Karewa Beds of Kashmir. One of the interesting features is their distribution because one of the forms is now isolated in Peninsular India (Sundara Raj, 1941). The date of isolation of this form is the first or second Glacial Period (Silas, 1952).

PROBABLE AGE OF THE FISH FAUNA AND ADAPTATION

It will thus be evident that the fish fauna of the high altitudes is of the Pleistocene age and in its evolution it had to contend with torrential conditions produced by the melting of the snows during the Inter-glacial Periods (Hora, 1954a). Whereas the Cobitidae and the Schizothoracinae assumed torpedo-shaped body accompanied by reduction of scales to withstand great rush of water, *Glyptosternum* sought refuge in a depressed body and in producing very efficient organs of adhesion to rocks. The fatty nature of all the high altitude forms is perhaps an adaptation against severe cold. Though all the forms characteristic of the high altitudes are not found in torrential waters, they bear the impress of that environment all the same. In fact, *Glyptosternum* is the only form restricted to torrential environment now, while both the Cobitidae and the Schizothoracinae have drifted into lakes of lower altitudes, such as those of the Kashmir Valley and Seistan and become adapted to placid waters secondarily.

EVOLUTION OF HIGH ALTITUDES AND ITS FISH FAUNA

If the fauna of the high altitudes is so recent as the Pleistocene, it has to be conceded that high altitudes, as understood here, are themselves of a very recent age. It is known that a great Himalayan earth movement occurred at the beginning of the Pleistocene when the Pir Panjal Range was uplifted. There were later upheavals also, but towards the end of the Pleistocene period there was a strong earth movement which lifted Pir Panjal to the present height.

Towards the east such uplifts and upheavals occurred somewhat later as a gap in the Eastern Himalayas continued up to the Holocene Glacial Period (Menon, 1954) which permitted monsoon to cross the Himalayas and render parts of Central Asia a fertile land.

CONCLUSIONS

Generally speaking then, the fish fauna of the high altitudes is derived from the fauna of the Oriental Region but with the evolution of the high altitudes in three or four phases during the Pleistocene, it became gradually completely isolated from the parent forms. This was probably the first step in its evolution, but this trend soon became masked by the adaptations that resulted from repeated glaciations in the later two-thirds of the Pleistocene. The physiological adaptations to meet the rigours of the first phase of glaciation by the storage of fat in the tissues must have preceded any structural modifications. The first Inter-glacial Period, which produced unprecedented torrential environment for them, probably induced in them structural modifications of form and organs of adhesion. These conditions of the glacial and inter-glacial phases repeated four or five times during the last 600,000 years must have had a selective rôle in the production of the present-day high altitude fish fauna and the elimination of many other commoner forms of the Oriental Region which must have got uplifted during the later Himalayan orogenic movements. The few forms that survived the test, barbels, loaches and one form of catfish, had vast pastures at their disposal so they increased in size and multiplied in numbers. It is characteristic of all unfavourable environments that the variety of types of animals inhabiting them are few but populations of each species are great. For this reason, it should be possible to develop fisheries of the lakes and streams of high altitudes as the conditions are analogous to those of the north temperate and Arctic regions where the richest fisheries of the world lie at present.

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