RECENT ADVANCES IN OUR KNOWLEDGE OF THE BIOLOGY AND CONSERVATION OF MAHSEERS

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ABSTRACT

Mahseers, at one time considered to be of single species, are now represented by six valid species distributed all over India. Unfortunately, their catches have considerably dwindled due to illegal methods of fishing and habitat deterioration. Studies on their food habits, ecology of spawning grounds, eggs, larval development and especially methods of artificial propagation have fairly advanced in recent years. Transport of eggs of *Tor khudree* by air in moist cotton has been possible for easy distribution. Breeding of *T. khudree* not only by hypophysation, but even without it in small ponds by manipulation of flow of water, exercise and feed has also been practicable. Fry and fingerlings of *T. khudree* is being distributed to many of the states in the country as a measure of rehabilitation and conservation of the species.

Mahseers, the world renowned game fish of India need no introduction to fishery scientists. But till recent years those who followed the classification given by Day (1878) considered the mahseer as a single species, *Barbus (Tor)* (Ham.). However, Hora (1939-1947) supported Hamilton (1822), Sykes (1830) and McCleland (1839), and accepted the existence of six different species of mahseers in India. Hora, nevertheless, retained Cuvier's genus *Barbus* and adopted Gray's genus *Tor* as subgenus. Listing the various species under *Barbus (Tor)*. Later on Munro (1955) following Deraniyagala (1930) preferred to replace the composite genus *Barbus* and adopted Gray's genus *Tor* as subgenus. Thus we have now six valid species of mahseers under genus *Tor*, which are being mentioned here for ready reference.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
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<tbody>
<tr>
<td><em>Tor putitora</em> (Ham)</td>
<td>Golden mahseer</td>
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<tr>
<td><em>T. tor</em> (Ham.)</td>
<td>Turia or Tor mahseer</td>
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<tr>
<td><em>T. mosal</em> (Ham.)</td>
<td>Copper mahseer</td>
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<tr>
<td><em>T. progeneius</em> (McCld.)</td>
<td>Jungha mahseer &quot;Jungha&quot;</td>
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<tr>
<td><em>T. khudree</em> (Sykes)</td>
<td>Deccan mahseer</td>
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<tr>
<td><em>T. mussullah</em> (Sykes)</td>
<td>Humpback mahseer</td>
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</table>
In addition to these true mahseers, there is one more large scaled fish which anglers refer to as chocolate mahseer, the bokar of Assam or the katli mahseer of the north western hill region, which is scientifically not a mahseer and is identified as *Accrossocheilus hexagonolepis* (McClld.). Beside these, *T. mosal mahanadicus* (David) has, so far, been accepted as valid subspecies, but the validity of *T. Khudree malabaricus*, *T. neilli*, *T. Khudree longispines* is in doubt. It must be admitted that the interspecific classification mahaseers has been extremely confusing, although Sen and Jayaram (1982) and Raj Tilak et al. (1982) have tried to simplify it. Such confusing situation prevails largely because of the very close range of variations in meristic and morphometric characters in some species. Intraspecific colouration also varies from place to place, season to season as well as according to the quality of food available and also the nuptial or gonadal condition. Good deal of work can be undertaken on these aspects provided adult specimens from different localities and in varying seasons and biological conditions are available for examination.

Earlier information about these fishes was largely recorded by the British Officers who took to angling as their pastime. In fact we owe a debt to these old time anglers like Thomas (1897), Sneé Dhu (1923), and MacDonald (1948) who recorded their observations on the spawning biology, feeding habits and other characteristics of these fishes from different parts of the subcontinent of India.

As these fishes take bait quite avidly, an impression gained ground among fishery workers that the fish must be very carnivorous and undesirable as a cultivable variety, growth also being comparatively slow. Consequently not much research was undertaken on this group of fishes except by Hamid Khan (1939), and Ahmed (1948) on *Accrossocheilus hexagonolapis* and the extensive taxonomic account by Hora (loc.cit). Pioneering biological investigations on *T. tor* in the Narmada river by Karmachandani et al. (1967), Desai (1970) and *T. Khudree* in peninsular India and Lonavala lakes (Maharashtra) by Kulkarni (1971) have been the beginnings of mahseer studies in recent years. The National Commission on Agriculture (1976) played significant role in recommending ecological and biological investigations on this piscine group, as a result of which, considerable investigations commenced under the guidance of Dr. S.M. Das and others in Northern India. Chaturvedi dealt with the spawning biology of *T. tor* in Rajasthan, including fecundity, length-weight relationship, gonado-somatic index, etc., whereas, Nautial and Lal (1985) directed attention on the fecundity of *T. Putilora*.
Present status of our knowledge: As a result of the aforesaid recent investigations, several new facts about mahseer biology came to light. One of the most important aspects of it was that *Tor tor* the most common mahseer was not found to be very carnivorous and much less piscivorous. Karamchandani et al. (1967) and Desai (1970) showed that *T. tor* was largely a herbivorous form and the food items of both the juvenile and the adult have been as under:

<table>
<thead>
<tr>
<th>Items</th>
<th>Juvenile</th>
<th>Adult</th>
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<tr>
<td>Macrovegetation</td>
<td>4.7%</td>
<td>48.5%</td>
</tr>
<tr>
<td>Filamentous algae</td>
<td>2.8%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Insect matter</td>
<td>53.8%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Mollusca</td>
<td>21.9%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Sand &amp; mud</td>
<td>16.8%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Unidentifiable debris</td>
<td>16.8%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Fish remains</td>
<td>16.8%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Plum fruit</td>
<td>16.8%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>16.8%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Thus fish forms only a very minor percentage of the normal diet of mahseer in its natural riverine habitat. This was further confirmed by the study of its (mahseer) food habits in the Govindgarh reservoir (M.P.) by another author, Pisolker et al. (1981). Das and Pathani (1978) found *T. putitora* also, omnivorous and largely herbivorous, small fish forming only a minor part of its menu. Recently Sharma (1987) has also reconfirmed this. Similarly, *T. khudree* though it takes small fish in certain months (Kulkarni, 1980), it is predominantly dependent on material of vegetative origin, insect larvae and molluscs. Consequently, the impression that it is extremely carnivorous has been dispelled by recent observations. Protein requirements and amino acid preferences of *T. khudree* have also been studied in detail by Murthy and Keshavnath (1986). The aforesaid studies by different authors have thus elevated the role of mahseers as a useful member in the reservoir fisheries of India in different ways.

Breeding habits: Considerable knowledge has been gained and practical experience achieved in recent years in the field of spawning and breeding habits, methods of artificial propagation and the behavioural pattern of the hatchlings. Hamid Khan (loc.cit) tried to study the spawning season by examining the ovaries of gravid females, but thereafter, no studies were undertaken on the spawning and breeding habits of the mahseer till these aspects received specific attention of the TATA Electric Company's fish farm at Lonawala (Kulkarni, 1971) where later on large scale methods of artificial propagation and hatchery practices were also studied and detailed (Kulkarni and Ogale, 1978). Natural spawning grounds in the reservoirs were indenti-
fied and their peculiarities elucidated. These habitats usually comprise the marginal lake areas where the streams draining the adjoining hilly region cascade into the main lake. The ripe fish in the lake, attracted by the sound and the incoming oxygenated running water, which also gives an indication to them of possible upstream migration, congregate in this area. If the streams are negotiable the prospective brood fish migrate into the wilderness (streams) of the surrounding environment and cannot be captured for stripping and artificial propagation. The configuration of the marginal areas of the lakes has thus to be of appropriate nature to enable capture of spawners. In addition to good oxygenated water, optimal water temperature varying from 20 to 21° C proves to be effective for final maturation, leading to proper response to stripping and the ultimate release of eggs (ova). Spawners in such ripe condition only are useful for artificial fecundation, proper hatching and further propagation as indicated in Fig. 1, vide Kulkarni and Ogale (1978). It has now been known that the eggs are heavy and demersal unlike those of catla, rohu, etc., about 2.8 - 3.0 mm in diameter and have a hatching period as long as 60 to 80
Hatchlings pass through a semiquiescent stage of six days and in the early free swimming stage they have a queer habit of congregating in dark crevices and corners, with their heads tucked away from light, as if negatively phototropic. This behaviour exposes them to heavy depredation by their predators. Further, the demersal nature of the eggs and the prolonged semiquiescent stage of six days add to the possibilities of increased mortality. As regards spawning season, several periods have been attributed to different species and in different areas. However, there seems to be an unanimity on the peak period of the spawning season, viz., July and August, almost in all the species reported so far.

Fig. 2 Demonstration of mashree stripping operations at the training course at the fish farm at Lonavla.
Hypophysation: It would be seen from the description of the spawning grounds that for success in the artificial propagation of the above type, the aforementioned specialised environmental condition of hills and streams would be necessary. But since such conditions may not be forthcoming at places, simple and controllable methods were considered necessary. With this end in view, efforts were made to raise fry and fingerlings of *T. khudree* and *T. tor* in small ponds and breed them successfully by hypophysation (Kulkarni, 1986); stripping of the injected fish was, however, found necessary in these early efforts. This dispelled another impression that the mahseer being a large fish in its adult stage may not mature in small ponds and that too, on artificial feed. Moreover, the above two species could be cross-bred successfully and in subsequent efforts the F1 generation was grown and also bred successfully, dispensing with hypophysation, (Ogale and Kulkarni, 1987). This improvement in technology is considered significant in our efforts to multiply this fish in ordinary fish farms.

In the above effort of breeding the fish without pituitary hormone addition of fish meal to the usual mixture of rice-polish and groundnut cake (1:1) was resorted to. In addition to this, a feed additive, "trinitro" (3 Nitro - 4 hydroxy phenylarsonic acid) was added to the feed and a small jet of water kept running into the pond. In this trial also, stripping of the selected adults became necessary. In the case of *T. putitora* hypophysation has been attempted by Pathani and Das (1979) as well as Tripathi (1978) on a small scale. In Nepal, too, artificial propagation of *T. putitora* has been carried out by Shrestha (1986).

Thus step by step it is being proved that mahseers can be bred in ponds and their fingerlings can be used for restocking natural streams and reservoirs.

Air-transport of eggs: Another step forward in the technology to facilitate distribution of mahseer seed to distant places was taken when efforts were successfully made to transport mahseer eggs by aircraft in moist cotton from Bombay to Bangalore. In this method, fertilised eggs are allowed to harden and develop for about 24 hours, then placed on moist cotton in two layers in perforated plastic boxes and the latter packed in suitable containers. As the minimum hatching period is 60 hours, sufficient time is available for transport over long
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Distances. Success of such method will enable transportation of fertilised eggs by air services to any place in the country or even abroad. On reaching the destination the eggs can be hatched in the normal manner and the resultant fry and fingerlings released into desired sheets of water (Kulkarni, 1979).

Conservation: Several authors and anglers have been lamenting bitterly the decline of mahseer fisheries throughout the country, except perhaps the Narmada river near Hoshangabad and Tapi river near Barhanpur in the early sixties (vide Karamchandani et al., 1967). But even in this vanishing haven of mahseers, considerable reduction in catches has been reported of late. Causes of this depletion are well known and are oft repeated. Measures to counteract this declining trend especially in this unseen aquatic resource are, therefore, urgent and we cannot wait till we reach a point of no return.

Closer studies of different biological aspects and behavioural patterns of mahseers in recent years have contributed to an understanding of the shortcomings in their life cycle and also, as to the methods of conservation which can be effectively practised (Kulkarni, 1986). A few of the main recommendations in this case are: raising large number of fry and fingerlings in fish farms for restocking the depleted waters, prevention of illegal fishing, and improvement of the habitat. The first conservational step has already commenced at Lonavla fish farm by producing more than 500,000 fertilised eggs every year for the past 13 years and by supplying fry and fingerlings to almost all the states in the country for assisting them to restock their waters. Similarly, several technical persons deputed by the states are also being trained in the techniques developed there. A consignment of fry of khudree mahseer has already reached Lao, PDR in South East Asia, crossing the Indian frontiers and demonstrating successful long distance transportation.

Although the behaviour of this fish with reference to the use of fish passes has not yet been studied sufficiently, methods of conservation were discussed and recommendations made at a special workshop on this subject held at Lonavla (Maharashtra) in 1986, attended by senior fishery biologists of the country (vide Pb. fish Bull. Vol. X No. 3, 1986). Another seminar held at the C.I.C.F.R.I. (Barrackpore, 1985) on the development of reservoir fisheries also discussed similar problems. Recommendations made on both these occasions would be useful in conserving and propagating this world famous game fish in the interest
not only of the anglers but also fishermen, fishery resources as well as consumers at large.

ACKNOWLEDGEMENT

I shall be failing in my duty if I do not acknowledge my deep sense of gratitude to the Tata Electric Companies for their whole hearted support for establishing a fullfledged fish farm at Lonavla for studying the breeding habits of mahseer and for artificial propagation and conservation of the fish. Their continued support and assiduous efforts by Shri S.N. Ogale enabled abundant seed multiplication and demonstration of the technology to other Scientists within the country and even those from abroad, the farm, thus assuming a status of a demonstration centre of national importance.

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