

Comparative growth and survival of hatchery produced and wild fingerlings of Deccan mahseer, *Tor khudree* (Sykes)

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ABSTRACT

The present study reveals the results of a growth trial conducted using the hatchery produced and wild caught fingerlings of the Deccan mahseer, *Tor khudree* (Cyprinidae). The fingerlings were fed with a diet containing 41.21% protein and 15.17% fat at the rate of 5% of the body weight, once daily for 120 days. On termination of the experiment, the hatchery produced fingerlings were found to reach an average weight of 96 g, while the wild caught fingerlings registered 49.16 g. The corresponding lengths obtained were 17.85 and 14.26 cm respectively. The growth increment was higher (0.74 g day⁻¹) in hatchery produced fingerlings than that of the wild caught fingerlings (0.38 g day⁻¹). The average survival rate was 98 and 95% for the hatchery produced and wild fingerlings, respectively. The results of the proximate composition of the fish muscle showed no significant difference between the two groups of fish.

Keywords: Fingerlings, Growth, Mahseer, Survival, *Tor khudree*

Introduction

India is blessed with some of the world's best game fishes like mahseers. These game fishes once attracted the attention of best anglers and naturalists from several parts of the world. Fish of the genus *Tor*, commonly referred to as masheers, are important to most nations in the Asian region for biodiversity reasons and are also sought after as high valued food and game fish (Ng, 2004). The mahseers also possess almost all the major qualities to occupy an important place in commercial fisheries too. Even though, mahseers are considered coldwater fishes, having a temperature tolerance range of 6-35 °C, some species such as *Tor khudree* (the Deccan mahseer) can thrive and grow well in coastal regions at temperatures ranging between 25 and 32 °C (Bazaz and Keshavanath, 1993; Basavaraja *et al.*, 2002). Earlier studies have shown that this species could be successfully grown at 28-32 °C (Gogoi and Keshavanath, 1990; Bazaz and Keshavanath, 1993; Basavaraja *et al.*, 2002).

In India, among half a dozen species of mahseers belonging to the genus *Tor*, *T. khudree* is the most important species available in the streams and rivers of peninsular India and is known to attain 120-150 cm length and 40-50 kg weight (Shanmukha, 1996). The National Commission on Agriculture (1976) stated that construction of weirs and dams, and other anthropogenic activities led to the depletion of the natural stocks of most species of

mahseers in India. In view of this, methods for mahseer fry production in captivity have been developed (Kulkarni, 1988; Nandeeshia *et al.*, 1993; Ingram *et al.*, 2005; Keshavanath *et al.*, 2006; Kangku and Basavaraja, 2010). Following standardization of fry production technology for mahseer, efforts are now being made to develop grow-out techniques. One major constraint is their relatively slow growth rate (Sehgal, 1999). Bista *et al.* (2002) observed low water temperatures to be the reason for the slow growth of fingerlings of *T. putitora* wherein they recorded weights of 19-23 g in 210 days and 44 g in 6 months. In India, pond-reared mahseer attained 175 g in 12 months (Ogale, 2002), while in Malaysia, cage reared *T. tambroides* was found to reach mean weights of 142-179 g (maximum 270 g) in 60 weeks (Ingram *et al.*, 2006).

In view of the growing interest in the commercial culture of mahseers in the Asian region, studies on nutritional aspects of *T. khudree* and other mahseer species have been carried out by many workers (Bazaz and Keshavanath, 1993; Shrestha, 1997; Islam, 2002). Bazaz and Keshavanath (1993) reported weight gains of 19.37-25.65 g when *T. khudree* was fed with four different feeds containing 37.12 - 39.8% protein. Raina *et al.* (1999) cultured *T. putitora* in manured ponds for one year with artificial feed and obtained a survival rate of 55%. Islam and Tanaka (2004) concluded that *T. putitora* is a highly promising indigenous species for commercial aquaculture

and the fish performs well if proper dietary conditions are met. Kohli *et al.* (2006) reported survival rates of 89.7, 88.9 and 46.3%, at 100, 50 and 25 fry m⁻³, respectively in cages fixed in open waters. However, no information is available on growth and survival of wild caught mahseer fingerlings in captivity. Hence, the present study was conducted to evaluate comparative growth and survival of pond raised and wild caught *T. khudree* fingerlings in manured and formulated diet fed ponds.

Materials and methods

Fish sampling

The present study was carried out at the Fish Farm of College of Fisheries, Mangalore, India. The *T. khudree* fry produced at Harangi Fish Farm, Government of Karnataka and the wild fry collected from the Harangi River (a tributary of river Cauvery), were used for the study. The wild fry were collected from the crevices of stones using a plankton net. After a brief period of acclimatization (2-3 days) at Harangi, they were transported to Mangalore, following standard protocols. At Mangalore, the fry were initially reared in FRP tanks for two weeks and then transferred to a prepared nursery pond where they were fed with a formulated diet until fingerling stage. The hatchery produced fry were also transported from the Harangi Fish Farm to Mangalore and reared to fingerling size in nursery pond as described for the wild collected fry.

Pond preparation

The growth trial was conducted in 25 m³ concrete tanks (5 x 5 x 1 m), which were initially dried till the soil cracked and later filled with water from a perennial well. The ponds were manured with poultry manure at 2-3 kg per 25 m² to ensure plankton production. As soon as sufficient plankton was observed in the ponds, three tanks were stocked each with 20 nos. of hatchery produced fingerlings (stocking density: 8000 per ha) and another three tanks were stocked each with 20 nos. of wild fingerlings. The initial length and weight of hatchery produced fingerlings and wild fingerlings were recorded.

Feed preparation

The fingerlings were fed with a formulated pelleted feed and the proportion of ingredients in the feed was: fish meal (55%), groundnut oilcake (15%), pig faecal matter

(10%) and egg yolk (20%). The pelleted feed was prepared by mixing fishmeal, groundnut oilcake and pig faecal matter. The pellets were then powdered using a mixer; the powdered feed was then mixed with egg yolk (20%) at the ratio of 80:20. The fingerlings were fed at 5% of their body weight once daily for a period of 120 days.

Sampling

The water quality parameters such as temperature, dissolved oxygen, carbon dioxide, alkalinity, pH and ammonia were recorded from the culture tanks at fortnightly intervals. Every 30 days, the fish were sampled (with a drag net) to record their growth rate and the feed quantity was readjusted. A minimum of 50% of the stocked fish were weighed and measured. After a rearing period of 120 days, all the surviving fish were collected and their weights and lengths recorded.

Growth parameters

The growth parameters such as specific growth rate (SGR), food conversion ratio (FCR), protein efficiency ration (PER), survival, net production and proximate composition of fish muscle were recorded at the end of the culture period, using standard methods.

Statistical analysis

The weight of fish recorded was analyzed statistically using one-way analysis of variance. For comparison of different treatment means, Duncan's multiple range test was used.

Results

Proximate composition of diet

Data on the proximate composition of the diet used in the present study is presented in Table 1. The dry matter and moisture contents of the diet were 87.29 and 12.71%, respectively. The protein and fat contents were 41.21 and 15.17% respectively. The gross energy content of the diet was 17.11 kJ g⁻¹.

Length and weight

It is evident that the length of the hatchery produced fingerlings was higher than that of wild fingerlings throughout the 120-day culture period with final average lengths of 17.85 and 14.26 cm, respectively (Fig. 1). It is obvious that, higher weight of *T. khudree* was observed in

Table 1. Proximate composition of diet (on dry weight basis) used for feeding trials in *T. khudree*

Dry matter (%)	Moisture (%)	Crude protein (%)	Crude fat (%)	Crude fibre (%)	Ash (%)	Nitrogen free extract (%)	Gross energy (kJ g ⁻¹)
87.29	12.71	41.21	15.17	5.86	8.42	16.63	17.11
(1.04)	(1.04)	(0.34)	(0.17)	(0.06)	(0.10)		

Numbers in parentheses indicate standard deviation (n=3)

hatchery reared fingerlings than that of the wild counterparts throughout the study (Fig. 2). The final average weight recorded after 120 days of culture period was significantly higher (96 g) in the former than in the latter (49.16 g) group. Both length and weight showed similar increasing trends, but the cultured fingerlings showed a higher growth increment from the 60th day and the same trend was maintained till the end of the experiment. The increment in weight was found to be 0.74 and 0.38 g day⁻¹ in hatchery and wild fingerlings, respectively.

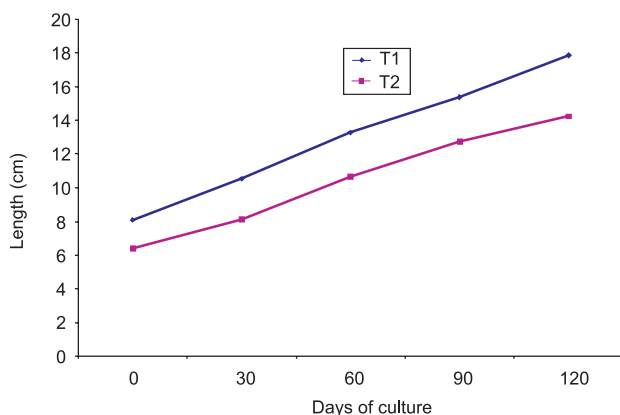


Fig. 1. Average length (cm) attained by *T. khudree* during the culture period

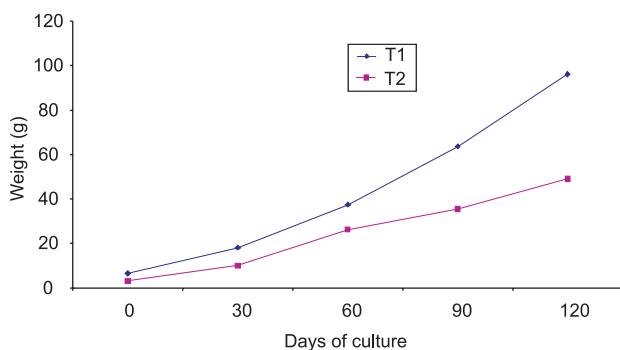


Fig. 2. Average weight (g) attained by *T. khudree* during the culture period

Growth parameters

The average SGR of *T. khudree* was found to be 2.25 and 2.32% for the hatchery and wild fingerlings (Table 2). The corresponding FCR values were 1.49 and 1.48 respectively. The PER worked out to be 2.54 for the former and 2.73 for the latter groups.

Survival and net fish production

The survival of fish at the end of the culture period (120 days) was high and it ranged between 90 and 100% in different replications, with the average survival working out to be 98.3 and 95% in cultured and wild fingerlings (Table 3). The net weight gain and net fish production were almost double in the hatchery reared fish as compared to the wild fish (Table 3). The total weight gain between the two groups was significantly different ($p < 0.05$). Duncan's multiple range test revealed that there was a significant difference in the mean weight gain between two groups of fish ($p < 0.05$).

Proximate composition of fish muscle

Moisture, crude protein, crude fat, ash, carbohydrate (as nitrogen free extract) and energy contents did not show much variation between the two groups of fingerlings (Table 4).

Discussion

The results of the present study indicate that the growth increment in the hatchery produced fingerlings was much higher than that of the wild fingerlings. However, the survival was not significantly different between the two groups of fish. To date, this appears to be the first report on comparative growth and survival of wild and cultured mahseers. Murthy and Keshavanath (1986) made a systematic study on the optimum protein requirement of *T. khudree*, employing casein-based pelleted diet containing 35-50% protein. Fish fed at 5% of the body weight recorded the best growth (0.29 g day⁻¹) at 40% diet after 135 days

Table 2. SGR, FCR and PER values recorded in *T. khudree* on termination of the experiment.

Group	Tank number	SGR	FCR	PER
Hatchery produced fingerlings	1	2.27	1.49	2.56
	2	2.25	1.40	2.60
	3	2.24	1.60	2.46
	Mean	2.25	1.49	2.54
		(0.01)	(0.10)	(0.07)
Wild fingerlings	1	2.29	1.63	2.91
	2	2.41	1.34	2.79
	3	2.26	1.48	2.49
	Mean	2.32	1.48	2.73
		(0.08)	(0.14)	(0.21)

Numbers in parentheses indicate standard deviation

Table 3. Survival, weight gain and net production of *T. khudree* recorded at the end of the culture period

Group	Tank number	No. of fish recovered	Survival (%)	Weight gain (g)	Net production (g 25 m ⁻² 120 days ⁻¹)
Hatchery produced fingerlings	1	20	100	91.42	1829
	2	20	100	89.32	1786.4
	3	19	95	88.12	1667.9
	Mean	-	98.33 (2.88)	89.62 (1.67)	1761.1 (83.47)
Wild fingerlings	1	19	95	44.49	842.3
	2	20	100	51.49	1029.8
	3	18	90	42.49	758.8
	Mean	-	95 (5.00)	46.15 (4.72)	876.96 (138.78)

Numbers in parentheses indicate standard deviation

rearing, indicating 40% protein to be optimum for *T. khudree*. The crude protein content of the diet used in the present study was 41.21% and the fat content was 15%. Bazaz and Keshavanath (1993) observed that a 16% fat diet had no adverse effect on the muscle composition of *T. khudree*. There was no significant difference in survival between the two groups of fish. Basavaraja *et al.* (2006) reported that *T. khudree* fingerlings attained a size of 39.15 g, with a survival rate of 87.4%, after one year culture period in concrete tanks, without a soil base. In the present study, growth increment was 0.74 and 0.38 g day⁻¹, indicating faster growth of hatchery produced fingerlings. The increment in length was 0.81 and 0.65 mm day⁻¹. The difference in growth rate between the two groups may be attributed to the nature of habitat (pond and river) and their genetic structure; the wild stock was part of the Cauvery strain and the hatchery stock was the descendents of *T. khudree* stock from TPCL, Lonavla, Maharashtra. However, further study is needed in this regard.

Table 4. Proximate composition of the muscle of *T. khudree* (on dry weight basis) on termination of the experiment

Parameter	Hatchery produced fingerlings	Wild fingerlings
Moisture (%)	75.54 (0.71)	74.73 (0.20)
Crude protein (%)	15.86 (0.12)	16.16 (0.67)
Crude fat (%)	5.24 (0.14)	5.41 (0.03)
Ash (%)	1.09 (0.05)	1.07 (0.02)
NFE (%)	2.27	2.63
Gross energy (kJ g ⁻¹)	5.67	5.86

Numbers in parentheses indicate standard deviation

Food conversion ratio is a measure of nutrient utilization of feed and depends upon factors such as water temperature, size of the animal, stocking rate, quality of feed and availability of natural food (Felt, 1990). Srikant and Keshavanath. (1986) recorded FCR values of 2.66 and

3.16 for diets with 60% silkworm pupa plus fish meal and 50% de-oiled silkworm pupa alone respectively, in *T. khudree*. In the present study, there was no difference in FCR between the two treatments. Protein efficiency ratio is the measure of utilization of dietary protein by fish. PER values provide better indication of nutritional status of fish with respect to dietary protein than food conversion ratio (Jauncey, 1982). In the present study, the PER values were found to be 1.68 for the cultured and 1.79 for the wild fingerlings. Raina *et al.* (1999) grew *T. putitora* in manured ponds for one year with artificial feed and obtained a survival rate of 55%. Kohli *et al.* (2006) reported the results of culture of *T. khudree* from fry to advanced fry, advanced fry to yearling and yearling to table size in cages wherein the survival rates were 89.7, 88.9 and 46.3%, respectively. Langer *et al.* (2001) reported survival rates of 72.2, 71.2 and 68.9%, when stocked at densities of 100 nos m⁻³ (1800 per cage), 25 nos m⁻³ (450 per cage) and 25 nos m⁻³ (450 per cage), respectively.

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