

# Tropical indigenous ornamental fishes of the Western Ghats of India and the present status of the development of their captive breeding technology

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## Abstract

India has a rich diversity of fresh water fishes in the Western Ghats and North Eastern Hills. The Western Ghats is the richest region in India with endemic freshwater fishes. It is one of 34 biodiversity hotspot areas on the global map. It extends from the tip of Kanyakumari to the River Tapti of South India for a stretch of 1600 km. Studies carried out under the National Agricultural Technology Project entitled “Germplasm inventory, evaluation and gene banking of fresh water fishes”, a database of indigenous ornamental fishes of the Western Ghats (WG) was prepared based on their desirable qualities. Of the 300 species of fishes inhabiting the different river systems of the Western Ghats, 155 are considered as potential ornamental fishes. Of this, 120 species are endemic to the Western Ghats. Under the project, 90 species of fishes were collected from the different river systems of the WG and they were studied for desirable qualities such as nature of acclimatization in aquariums, compatibility with other species of fishes, food and feeding habits in captive conditions, level of occurrence in the water column and their behaviour in aquariums. Based on the results, 85 of them are recommended as ornamental fishes. Most of them belong to the categories of barbs, loaches, danios, killifishes, hill trout and catopras.

In spite of the abundance of this rich resource, only a few of them have received the attention of ornamental fish traders and hobbyists in the global market. This is due to the lack of awareness of these resources and the lack of a steady supply according to the demand. The few species exported from India are collected from the river systems in the wild and sent directly and, as a result, many of the endemic species have now become endangered. In this context, development of captive breeding technology has great relevance. So far no serious attempt has been made to develop captive breeding technology for these rich resources of India. Under the above-mentioned project, captive breeding technology was developed successfully for 10 prioritized species of ornamentals, which is the first of its kind in India. They are *Puntius filamentosus*, *Puntius pookodensis*, *Puntius melanostigma*, *Puntius melanampyx*, *Garra mullya*, *Danio malabaricus*, *Chela fasciata*, *Nemacheilus triangularis*, *Nemacheilus semiarmatus* and *Pristolepis marginata*. The sexual dimorphism, life history stages and water quality parameters and reproductive strategies are also described in the paper. The technology can be utilized well for their commercial production in captivity.

**Keywords:** Ornamentals, Western Ghats, Indigenous fishes, Captive breeding

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## **Introduction**

India has a rich diversity of fresh water fishes in the Western Ghats and North Eastern Hills. The Western Ghats is the richest region in India with endemic freshwater fishes. It is one of 34 biodiversity hotspot areas on the global map. It extends from the tip of Kanyakumari to the River Tapti of South India for a stretch of 1600 km. Of the approximately 630 species considered as belonging to the freshwaters of India, nearly 300 teleosts are reported from the Western Ghats (WG) and of these, nearly 68% are endemic to the region (Gopalakrishnan and Ponniah, 2000).

Even though there is a series of publications on the inventory of freshwater fish fauna of Peninsular India (Day, 1865,1878; Pillay, 1929; Hora and Law, 1941; Hora, 1942; Silas, 1952a, b, 1953; Talwar and Jhingran, 1991; Kowtal, 1994; Chakraborty, 1996; Gopi, 1996; Shaji *et al.*, 1996; Arun, 1997; Jayaram, 1999, Arunachalam, 2000), a consolidated list of freshwater fishes of the Western Ghats, with emphasis on the endemic species, became available only in the year 2000, (Gopalakrishnan and Ponniah, 2000) in their publication "Endemic Fish Diversity of the Western Ghats". This book also contained a State-wise list of freshwater fishes prepared by various authors. Gopi (2000) listed out 165 species from Kerala. Rema Devi and Indra (2000) enlisted the species diversity of Tamil Nadu as 144. The same for Maharashtra was prepared by Acharaya and Iftekhar (2000) and for Karnataka by Chandrashekhariah *et al.* (2000). Some authors have highlighted potential ornamental species from selected streams and rivers from different states (Rengit Daniels and Ouseph, 2000, Mercy *et al.*, 2000, Shaji and Easa, 2000, Bhat, 2003 & 2004 and their export potential (Sane, 2000). In all the publications mentioned above, the list of ornamental fishes was prepared based only on bright colouration and appearance. Further information on the desirable qualities of ornamental fishes, however, is essential to popularize them in the global market and to avoid the collection of non-desirable fishes from the wild. In this paper the results of captive studies on the desirable qualities of the indigenous ornamental fish such as nature of acclimatization, hardiness, compatibility, food and feeding habits, and their behaviour in an aquarium are reported.

In spite of the abundance of this rich resource, only a few of them have received attention and popularity among ornamental fish traders and hobbyists in the global market. This is due to the lack of awareness of these resources and the lack of steady supply according to the demand. The few species exported from India are collected from the river systems in the wild and sent directly. As a result, many of the endemic species have now become endangered. In this context development of captive breeding technology

has great relevance. So far no serious attempt has been made to develop captive breeding technology for these rich resources of India. Under the above-mentioned project, captive breeding technology was developed successfully for 10 prioritized species of ornamentals, which is the first of its kind in India.

Under the National Agricultural Technology Project entitled “Germplasm inventory, evaluation and gene banking of fresh water fishes” carried out at the College of Fisheries, Kerala Agricultural University, 90 species of fishes were collected from the different river systems of the WG and they were observed for the desirable qualities such as nature of acclimatization in aquariums, compatibility with other species of fishes, food and feeding habits in captive conditions, level of occurrence in the water column and their behaviour in aquariums. Based on the results, 86 of them are recommended as ornamental fishes. Most of them belong to the categories of barbs, loaches, danios, killifishes, hill trout and catopras.

### **Materials and Methods**

Fishes for the present study were collected from different river systems of Kerala. They were brought to the hatchery of the College of Fisheries, Kerala Agricultural University in oxygen-filled polythene bags. They were gradually acclimatized to captivity by gradual exchange of water and fed with mosquito larva, earthworms and boiled chicken egg yolk. Artificial pellet feed were also provided occasionally. The fishes were observed for their nature of acclimatization, food and feeding under captivity, compatibility with other species of fishes, and behaviour in aquariums. The results are given in table I.

Table -I. Desirable qualities of fishes collected from the different river systems of the Western Ghats of Kerala for ornamental purposes

Sl. No.	Name of Fish	Nature of acclimatization	Source of collection	Food & Feeding	Behaviour in captivity	Aquarium requirements
1	<i>Anguilla bicolor</i> McClelland	This can be easily acclimatized to captive conditions	Bharathappuzha river	Carnivorous, but readily accepts any food in captivity. Even accepts food from our hand.	It is a compatible and hardy fish. Always remains hidden at the bottom of the tank. Lives in harmony with other fish. It can be easily tamed.	It always remains buried in the sand or gets into the filter tubes. Hiding places are essential for settling in the tank. Smell of food makes it come out of hiding places.
2	<i>Amphypharyngo don mola</i> (Hamilton-Buchanan)	This can be easily acclimatized to captive conditions	Muvattupuzha river, Vembanad lake	It is an omnivorous fish, readily accepts artificial feed also	It is a compatible fish that moves in groups and remains in the water column.	Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water.
3	<i>Barilius bakeri</i> Day	Highly oxygenated water is needed to thrive	Chalakkudy river	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae. Feed from the surface of water column	It is a very compatible and lovely fish. Remains towards the surface of water column and moves very fast.	It is a very hardy fish. Always moves very fast in the tanks. Hence rectangular tanks will be comfortable for them.
4	<i>Barilius bendelisis</i> (Hamilton-Buchanan)	Need highly oxygenated and soft water	Bharathappuzha River	It is an omnivorous fish, readily accepts anything its mouth	It is a fast moving fish as in the case of <i>Barilius bakeri</i> . It is	Less demanding fish, but prefers clear and aerated water.

				can hold, not at all fussy about food. Prefers insect larvae.		also a very compatible and peaceful fish. Needs plenty of food.
5	<i>Barilius canarensis</i> (Jerdon)	Need highly oxygenated and soft water for successful acclimatization	Chalakkudy river, Periyar river	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food.	It is a fast moving fish, always moves to and fro in the large tanks and requires large quantities of food. It is a very compatible and peaceful fish.	Less demanding fish, but prefers clear and aerated water.
6	<i>Brachydanio rerio</i> (Hamilton-Buchanan)	Easy to acclimatize	Bhavani river	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Feeds from the surface.	It is a popular aquarium fish that moves in groups and remains in the upper part of the water column.	Hardy and thrives well in clear aerated water. This danio is one of the most popular aquarium fishes being extremely active and graceful. It is strikingly beautifully coloured, easy to feed, and resistant to disease.
7	<i>Chela dadiburjori</i> (Menon)	Clear and well oxygenated water is required during acclimatization	Muvattupuzha river	It is an omnivorous fish, readily accepts anything its mouth can hold. Prefers insect larvae.	It is a popular aquarium fish that moves in groups and remains in the upper part of the water column. This is one of the smaller fishes of the Western Ghats.	Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water. Less demanding fish, but prefers clear and aerated water.

8	<i>Chela fasciata</i> Silas	Not so easy, needs highly oxygenated and soft water	Bharathappuzha river	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae.	It is a popular aquarium fish that moves fast along the mid water column. It never takes food from bottom.	Less demanding fish, but prefers clear and aerated water.
9	<i>Chela laubca</i> (Hamilton-Buchanan)	Easy to acclimatize	Wayanad	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae.	Its small size, iridescent blue-green body colour and hardiness is the main reason why it has found a place in the list of desirable tropical aquarium fishes.	Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water. This is very beautiful shoaling fish prefers the upper water-layers.
10	<i>Danio acquipinnatus</i> (McClelland)	Very easy to acclimatize, very little water exchange is needed	Kallada river, Achankovil river	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers live food	It is a popular aquarium fish that moves in groups and remains in the water column.	Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water. It is easily acclimatizable.
11	<i>Danio malabaricus</i> (Jerdon)	Very easy to acclimatize, very little water exchange is needed	Muvattupuzha river, Periyar river	It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food.	It is a popular aquarium fish that moves in groups and remains in the water column. It is compatible and very active in aquariums.	Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water. It is easily acclimatizable.

- 12 *Esonus danricus* (Hamilton-Buchanan) Needs careful steps to acclimatize with new environment ; Noolpuzha It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae moving and jumping ability. It is best to keep the tank covered for these fish. It is a peaceful fish suitable for community aquarium. It is a popular aquarium fish that moves in groups and remains in the water column. This fish is noted for its fast moving and jumping ability. It is best to keep the tank covered for these fish. It is a peaceful fish suitable for community aquarium. Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water. It is acclimatizable, but a sensitive fish.
- 13 *Garra gotyla stenorrhynchus* (Jerdon) Very sensitive fish, takes long time to get adapted to captive conditions Bharathappuzha river It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Fee from the bottom. aquariums. Mostly remains towards the bottom of the tank. It is compatible and well suited for community aquariums. Less demanding fish, but prefers clear and aerated water. It can thrive well even in non-aerated water.
- 14 *Garra mullya* (Sykes) Easy to acclimatize Muvattupuzha river, Kallada river It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. It is an algae eater. Its fantastically large ventral suctorial lips are well adapted to scrounging around for algae. It is a bottom feeder. But it is quite interesting to see it feeding from the glass surface, algae from the leaves without damaging them. Can be used as an algae cleaner in aquariums. Needs well-aerated water. It can be easily acclimatized to captivity. Thrives well in tanks having algal growth.

- 15 *Gonoproktopterus curmuca* (Hamilton-Buchanan) Sensitive fish, needs frequent water exchange during the initial period of acclimatization. Bharathappuzha river It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. It is not so far exposed to the aquarium business as an ornamental fish. Since it grows to a large size, it is considered as a food fish. But young ones are very attractive and compatible in aquarium conditions. Juveniles are more beautiful than adult and hence can be used in aquariums. It is not a hardy fish. It needs well-aerated clean water. Needs large sized tanks as it is fast moving. It has a tendency to jump out of the tank even for a slight disturbance and hence tank to be covered.
- 16 *Gonoproktopterus dubius* (Day) Sensitive fish, needs frequent water exchanges. Wayanad It is omnivorous. Feeds on anything in captivity. It is not so far exposed to the aquarium business as an ornamental fish. Since it grows to a large size, it is considered as a food fish. But young ones are very attractive and compatible in aquarium conditions. Less demanding fish, but prefers clear and aerated water. It is easily acclimatisable. Tendency to jump out and hence the tank should be covered.
- 17 *Lepidophygopsis typus* (Raj) Very sensitive fish from high altitude, needs very careful Periyar It is an omnivorous fish, but does not accept artificial food; it may die of It is compatible and peaceful but not comfortable in aquarium conditions. Difficult to acclimatize. Does not thrive in captive conditions for long periods.



	procedures to acclimatize.	starvation if live food is not provided.
18	<b><i>Horadandia atukorali brittani</i></b> (Deraniyagala)	<p>Easy to acclimatize</p> <p>It is the smallest of the barbs available from Kerala.</p> <p>It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae. Since its mouth is small, small sized pellets should be given as food. Prefers live food.</p> <p>It is a very compatible, peaceful and active fish. Being very small, a large number of them can be kept in a tank. It is not a popular aquarium fish. This is one of the smallest freshwater fishes of the Western Ghats. It has great potential as an ornamental fish.</p> <p>Not very easy to acclimatize. It can thrive in saline water also. Hence fishes collected from the saline water need gradual exchange of water for acclimatization to fresh water.</p>
19	<b><i>Parluciosoma daniconius</i></b> (Hamilton-Buchanan)	<p>Easy to acclimatize</p> <p>Bharathappuzha river, Muvattupuzha river</p> <p>It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae.</p> <p>It is a popular aquarium fish that moves in groups and remains in the water column. It is a very compatible and active fish.</p> <p>Less demanding fish, but prefers clear and aerated water. It can thrive well even in non aerated water. It is easily acclimatizable.</p>
20	<b><i>Puntius amphibius</i></b> (Valenciennes)	<p>Easy to acclimatize</p> <p>Bharathappuzha river</p> <p>Active feeder, prefers insect larvae, readily accepts any food including pellet feed. Feed from the bottom also.</p> <p>Highly compatible, hardy, peaceful and very active in the aquarium tanks, suitable for community aquariums</p> <p>Prefers well aerated water. Hardy and less demanding.</p>

- 21 ***Puntius arulius*** (Jerdon) Sensitive fish difficult to acclimatize Wayanad
- Active feeder, prefers insect larvae, readily accepts any food including pellet feed. Requires plant feed also. It is a lovely fish. Active, usually dwells at the upper part of the tank. Little aggressive also. Two mature males in a tank are not compatible to each other. Otherwise good for community aquariums. Needs larger tanks and well-aerated clear water. Not very easily acclimatizable. Cannot tolerate wide range in pH, temperature or oxygen.
- 22 ***Puntius bimaculatus*** (Bleeker) Easy to acclimatize Wayanad
- Active feeder, prefers insect larvae, readily accepts any food including pellet feed. A peaceful and active fish. Compatible with other fishes. Needs well aerated clear water
- 23 ***Puntius carnaticus*** (Hamilton-Buchanan) Easy to acclimatize Bhavani river, Bharathappuzha river
- Active feeder, prefers insect larvae, readily accepts any food including pellet feed. Needs plant food for survival and better growth. Very compatible and peaceful. It dwells in the middle of water column. Hardy also. Feed on all plants in the aquarium. Need well-aerated water, since grows to a large size, large tanks are required. Growth rate high and can be used as a food fish also.
- 24 ***Puntius conchonius*** (Hamilton-Buchanan) Easy to acclimatize Wayanad
- Active feeder, prefers insect larvae, readily accepts any food including pellet feed. Compatible and peaceful. Very active swimmer. Dwells at the Middle of the tank. The fish is docile and can generally be kept with other small fishes. Needs clear and well-aerated water

- 25 *Puntius denisonii* (Day) Very sensitive fish, high quality water. Large sized fishes are difficult to acclimatize. Bharathappuzha river, Chalakkudy river. It is basically herbivorous fish, but accepts live insects, worms, mosquito larva etc. Also accepts pellet feed. Not an active feeder. In single species aquariums, it is very active. Peaceful and compatible, very shy. It is a very sensitive fish, difficult to acclimatize in captive condition. Needs clear and well-aerated water. Make sure that it gets food in a community tank.
- 26 *Puntius fasciatus* (Jerdon) Easy to acclimatize Kallada river, Chalakkudy river. It feeds on both natural and artificial food. Not at all fussy about food. It is a very compatible fish. It is apeaceful fish food for community aquariums. Almost similar to the tiger barbs in appearance. aerated water/ It can thrive well even in non aerated water.
- 27 *Puntius filamentosus* (Valenciennes) Easy to acclimatize Chalakkudy river Muvattupuzha river. Feed on any food given in the tank. They are basically herbivorous accept artificial feed also. The surface is watched constantly and they feed from the upper column of water hence floating feed is preferable. Usually do not feed from the bottom. It is compatible species very active and moves along all the parts of the water column. Young ones are very beautiful with the vertical bands on their body. The tip of tail with black and red colour adds more to its beauty. Since it grows to a fairly big plant food. Feed on any food given in the tank. The surface is watched constantly and they feed from the upper column of water hence floating feed is preferable. Usually do not feed from the bottom. They require plant food.

	They require plant food.		size, this is also considered as a food fish. This can be recommended as a very good garden fish also.
28	<i>Puntius jerdoni</i> (Day)	Not easy to acclimatize, needs highly oxygenated water	Hardy and peaceful fish. Very compatible with other fishes. Moves along all parts of the aquarium tanks.
29	<i>Puntius melanostigma</i> (Day)	Wayanad	It is a shy fish always wants to hide behind the plants or leaves. Care should be taken to see that this fish gets food in a community tank. It takes food from the bottom also.
30	<i>Puntius ophicephalus</i> (Raj)	Periyar river	Needs well-aerated water.
		Not easy to acclimatize	This fish is basically a vegetarian, accepts artificial feed also. Prefers live food.
		Highly sensitive, high altitude fish	It is compatible and active fish. But very sensitive and does not live long if not properly cared.

- 31 *Puntius sarana subnasutus* (Valenciennes) Easy to acclimatize Periyar river, Chalakkudy river It feeds on both natural and artificial food. Not at all fussy about the type of food. juveniles are very beautiful as ornamental fish. It is a very compatible and peaceful fish, good for community aquariums. The juveniles are very beautiful as ornamental fish. It is a very hardy species. But prefers clear and aerated water. It can thrive well even in non aerated water.
- 32 *Puntius ticto* (Hamilton-Buchanan) Easy to acclimatize Chalakkudy river It is an omnivorous fish. Readily accepts any food. But requires live feed for maturation. It is well behaved in community tanks. Always very active and agile. Can withstand a wide range in pH and less demanding in aquarium conditions. It is priced for its iridescence and the red edging on its dorsal fin, which takes a deep ruby hue during mating time. A popular barb in the aquaria. Even though not brightly coloured, it is a fair sized fish and easily acclimatizable, very hardy also.
- 33 *Puntius vittatus* (Day) Easy to acclimatize Most of the rivers and streams of Kerala It is an omnivorous fish, readily accepts anything its mouth can hold, not at all fussy about food. Prefers insect larvae. It is very fast moving fish. Always moving along the mid water column of the tank. It is a compatible fish but not hardy. Less demanding fish, but prefers clear and aerated water. It can thrive well even in non- aerated water. It is easily acclimatizable.
- 34 *Salmostoma boopis* (Day) Highly sensitive fish, difficult to acclimatize Pampa river It is an omnivorous fish, readily accepts moving fish. Always moving fish. Always moving fish. Always moving fish. Prefers clear and aerated water. It cannot thrive in

		anything its mouth can hold, not at all fussy about food. Prefers insect larvae.	moving along the mid water column of the tank. It is a compatible fish but not hardy.	non- aerated water. It is not easily acclimatizable.
35	<i>Bhavana australis</i> (Jerdon)	Highly oxygenated water is needed	Bharathappuzha river	Difficult to maintain in aquarium conditions. Studies made by the authors show that they do not thrive well in aquariums for more than one month.
36	<i>Nemacheilus keralensis</i> (Rita & Nalbant)	Highly sensitive to temperature and pressure changes, difficult to acclimatized	Idukky	They become comfortable only when provided with convenient hiding places.
37	<i>Nemacheilus monilis</i> (Hora)	Not easy to acclimatize	Noolpuzha river	They become comfortable only when provided with convenient hiding places.

artificial feed. They are compatible and peaceful, and it is quite interesting to note that they come out of the hiding places when food is given.

bottom, hence care should be taken to note that the feed reaches bottom in a community tank.

They always dwell at the bottom of the tank. Never come to the top layers of water column. They are compatible and peaceful, and it is quite interesting to note that they come out of the hiding places when food is given.

Food is no problem for them. They enjoy mosquito larvae, boiled egg yolk and artificial feed. They feed from the bottom, hence care should be taken to note that the feed reaches bottom in a community tank.

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Wayanad

Not easy to acclimatize

*Nemacheilus nilgiriensis* (Menon)

38

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Wayanad

Not easy to acclimatize

*Nemacheilus semiarmatus* (Day)

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40	<i>Nemacheilus striatus</i> (Day)	Not easy to acclimatize	Wayanad	Prefers live food	Active but remains towards the bottom of tank	Hiding places are required for the comfortable stay in the tank.
41	<i>Nemacheilus triangularis</i> (Day)	Needs good quality water	Kallada river, Kallar river	Food is no problem for them. They enjoy mosquito larvae, boiled egg yolk and artificial feed. They feed from the bottom, hence care should be taken to note that the feed reaches bottom in a community tank.	They always dwell at the bottom of the tank. Never come to the top layers of water column. They are compatible and peaceful, and it is quite interesting to note that they come out of the hiding places when food is given.	They become comfortable only when provided with convenient hiding places.
42	<i>Lepidocephalus thermalis</i> (Valenciennes)	Easy to acclimatize	Bharathappuzha river, Kallar river	Food is no problem for them. They enjoy mosquito larvae, boiled egg yolk and artificial feed. They feed from the bottom, hence care should be taken to note that the feed reaches bottom in a community tank.	They always dwell at the bottom of the tank. Never come to the top layers of water column. They are compatible and peaceful, and it is quite interesting to note that they come out of the hiding places when food is given. If the bottom is sand they burrow into it.	They become comfortable only when provided with convenient hiding places. But requires well aerated water.



43	<i>Travancoria elongate</i>	Highly sensitive fish	Bhrathappuzha river	Browses algae from the	Does not thrive in captivity for longer periods. Needs algal food	Requires algal food. It can browse algae from the surface of glass tanks or from leaves/stones.
44	<i>Batasio travancoria</i> (Hora & Law)	Needs long time to be acclimatized	Bhrathappuzha river	It is carnivorous and hence not advisable to keep with small sized fishes	Usually remains towards the bottom of tank and shy in nature. Prefer to hide among leaves or stones in the tank.	Needs well aerated water.
45	<i>Horabagrus brachysoma</i> (Gunther)	Easy to acclimatize	Muvattupuzha river	It is omnivorous, feeds on both live and artificial feed	It is nocturnal in habit. During daytime they prefer to remain hidden under stones and drift wood. They are comfortable only when hiding places are provided	It can thrive even in non-aerated water. Being omnivorous, it is not safe to keep them along with small fishes.
46	<i>Horabagrus nigr collaris</i> (Pethiyagoda & Kottelat)	Not easy to acclimatize	Chalakkudy river	It is omnivorous, feeds on both live and artificial feed	It is nocturnal in habit. During daytime they prefer to remain hidden under stones and drift wood. They are comfortable only when hiding places are provided	It can thrive even in non-aerated water. Being omnivorous, it is not safe to keep them along with small fishes.

47	<i>Mystus armatus</i> (Day)	Easy to acclimatize	Muvattupuzha river	It is omnivorous. It becomes carnivorous if sufficient food is not given in the tank. Hence not ideal for community aquariums.	Being slightly carnivorous, not good for community aquariums. They are nocturnal in habit. During daytime they always remain hidden among stones.	They can thrive even in non-aerated water. They always prefer top hide among pebbles or stones. Hence hiding places are essential.
48	<i>Mystus cavassius</i> (Hamilton-Buchanan)	Easy to acclimatize	Chalakkudy river	They are omnivorous, feed on smaller fishes also.	Compatible with large sized fishes. During daytime they always prefer to be hidden among stones or plants. Not ideal for community tanks.	Hardy and nocturnal. They can thrive even in non-aerated water also. Requires hiding places in the tank.
49	<i>Mystus gulio</i> (Hamilton-Buchanan)	Easy to acclimatize	Periyar river, Vembanad lake	Omnivorous, feed on anything available.	Needs hiding objects for comfortable stay. They are gregarious and tend to be hidden in dark corners or places in the tank	The are gregarious and nocturnal. During daytime they always remain hidden under stones.
50	<i>Mystus occulatus</i> (Valenciennes)	Easy to acclimatize	Bharathappuzha river	Omnivorous, not advisable to keep with smaller fishes.	Avoids light and tend to remain hidden below stones or among crevices. Not advisable for community aquariums.	Nocturnal and requires hiding places for comfortable stay.

51	<i>Aplocheilus lineatus</i> (Valenciennes)	Easy to acclimatize	Muvattupuzha river	Surface feeder, accepts artificial feed from surface and column.	Peaceful and moves along the surface of water column, but exhibits cannibalism, swallowing juveniles of the same species hence should be kept with fishes of the same size.	Survives well in clean aerated tanks. Exhibits jumping nature, hence to be kept in covered tanks.
52	<i>Parambassis thomassi</i> (Day)	Easy to acclimatize	Bharathappuzha river	Omnivorous, but prefers live feed, rarely accepts pelleted feed.	Highly carnivorous and aggressive, an excellent species for single species tanks.	Once acclimatized, it will survive. But not easy to acclimatize. Survives well in clean aerated tanks.
53	<i>Scatophagus argus</i> (Linnaeus)	Needs long time to be acclimatized	Vembanad lake	Omnivorous, but accepts pelleted feed also.	Hardy and compatible, ideal species for aquariums	It is euryhaline and can withstand salinity up to 25 ppt. It can be gradually acclimatized to fresh water conditions.
54	<i>Nandus nandus</i> (Hamilton-Buchanan)	Easy to acclimatize	Bharathappuzha river	Carnivorous, accepts only fresh or frozen meat, not pelleted feed. Attacks smaller fishes.	Hides in between leaves of aquatic vegetation, feeding the fish are a problem, as it does not accept artificial feed. Being piscivorous, not suitable for a community aquarium, with small fishes.	Survives in clean aerated water with aquatic plants in the tank. It is quite interesting to note them remaining among the plants, mimicking the leaves of plants.

55	<i>Pristolepis fasciata</i> (Bleeker)	Not easy to acclimatize	Achankovil river	Omnivorous, accepts pellet feed also.	It is a peaceful and hardy fish, suitable for community aquariums. Very attractive and compatible with other varieties, but little aggressive when sexually mature.	Requires gravel bottom, survives well in aerated clean water.
56	<i>Pristolepis marginata</i> (Jerdon)	Easy to acclimatize	Muvattupuzha river, Bharathappuzha river	Omnivorous, but accepts pelleted feed also.	It is a slow moving fish, standing most of the time in still position, moving its pectorals. It readily accepts any food under captive conditions and is compatible with other inmates in the aquarium except for its breeding time.	Requires gravel bottom, survives well in aerated clean water.
57	<i>Eetroplus maculatus</i> (Bloch)	Easy to acclimatize	Vembanad lake, Muvattupuzha river, Periyar river	Omnivorous, readily accepts pelleted feed. It also consumes aquatic vegetation.	Hardy fish, peaceful and compatible with other species. It can tolerate lower salinity also.	Survives in clear water. It can survive in non-aerated aquariums also.

58	<i>Etroplus suratensis</i> (Bloch)	Not easy to acclimatize	Vembanad lake	Omnivorous. But prefers vegetable food.	Peaceful and compatible fish, well suited for community aquariums.	Survives in clean aerated water with aquatic plants in the tank.
59	<i>Awaous guttum</i> (Hamilton-Buchanan)	Easy to acclimatize	Periyar river	It is carnivorous, but accepts artificial feed also	Compatible, peaceful, and hardy but has a tendency to feed on smaller fishes in the tanks.	This fish thrives well in aquariums for long periods. Needs well-aerated water, always hides below the stones or pebbles.
60	<i>Glossogobius giuris</i> (Hamilton-Buchanan)	Easy to acclimatize	Bharathappuzha river, Periyar river	It is carnivorous. Feed on small fishes. In captivity accepts pelleted feed.	Always dwells towards the bottom of the tank. Remains buried in the tank. Not compatible with small sized fishes. Being carnivorous, it should be kept with large sized fishes.	This fish thrives well in aquariums for long period. Needs well-aerated water, always hides below the stones or pebbles.
61	<i>Sicyopterus griseus</i> (Day)	Not easy to acclimatize. Needs highly aerated water to thrive in.	Chalakkudy river	Omnivorous, does not accept artificial feed.	It always remain hidden behind big stones or buried in the mud. Feeding the fish is problematic as it doesn't readily accept artificial feed.	Survives in clean aerated water with aquatic plants in the tank.

62	<i>Anabas testudineus</i> (Bloch)	Easy to acclimatize	Muvattupuzha river	Omnivorous, accept artificial feed.	Not good with smaller fishes. Has air breathing capacity.	This fish thrives well in aquariums for long period. Always hides below the stones or pebbles.
63	<i>Macropodus cupanus dayi</i> (Valenciennes)	Easy to acclimatize	Vembanad lake	Omnivorous, accept artificial feed.	It is a bubble nest builders. It is a fairly good larvicidal fish.	Thrives well in captive conditions. Hardy and peaceful fish needs clear water. They can survive in less oxygenated water also, since being air breathing. It hides among aquatic vegetation, moves in the upper halves of the water column.
64	<i>Channa marulius</i> (Hamilton-Buchanan)	Easy to acclimatize	Bharathappuzha river	Carnivorous	Being carnivorous, not good for community aquariums. It usually dwells at the bottom of the tank. Ideal for garden ponds.	Only juveniles are suitable for aquarium. Not suitable for community aquariums.
65	<i>Channa punctatus</i> (Bloch)	Easy to acclimatize	Periyar river	Carnivorous	Being carnivorous, not good for community aquariums. It usually dwells at the bottom of the tank. Ideal for garden ponds.	Only juveniles are suitable for aquarium. Not suitable for community aquariums.

66	<i>Channa striatus</i> (Bloch)	Easy to acclimatize	Muvattupuzha river	Carnivorous	Being carnivorous, not at good for community aquariums. It usually dwells at the bottom of the tank. Ideal for garden ponds	Only juveniles are suitable for aquarium. Not suitable for community aquariums.
67	<i>Notopterus notopterus</i> (Pallas)	Easy to acclimatize	Kabani river	Carnivorous fish	Very attractive in single species tanks	Thrives well in captive conditions. Hardy and peaceful fish. Needs clear water.
68	<i>Dayella malabarica</i>	Very hard to acclimatize to captive conditions	Bharathappuzha river	Omnivorous fish	Not known	Could not be observed as it died soon after it was caught
69	<i>Osteobrama bakeri</i> (Day)	Not easy to acclimatize	Achankovil river	Omnivorous	An ideal fish for aquariums. It is attractive both in community and single species tanks.	Highly oxygenated good quality water
70	<i>Glyptothorax madraspatanum</i> (Day)	Not easy to acclimatize	Achankovil river	Algae eater. Rarely takes artificial food	Characterized by its nature to be attached to substances with its ventral suckers	Compatible and peaceful fish, needs clear and highly oxygenated water
71	<i>Glyptothorax lonah</i> (Sykes)	Not easy to acclimatize	Noolpuzha	It is very fussy about food. It always gets attached to the glass surface	Needs well-aerated clear water. Thrives well in glass tanks with biological filter	Does not remain for long periods. Prefer to be hidden among the pebbles or behind the stones.

72	<i>Neolissocheilus wynaadensis</i> (Day)	Not easy to acclimatize	Kabani river	Omnivorous	and browse from the surface. Rarely takes artificial food.	Compatible and peaceful. Usually remain in the column of water	Needs well-aerated water
73	<i>Osteochilus (Osteochilichthys) nashii</i> (Day)	Easy to acclimatize	Noolpuzha	It is omnivorous in habit but prefers live food. Readily accepts any food in captive conditions.		Compatible and peaceful fish. Usually dwells towards the bottom part of the water column	Needs well-aerated water. It is hardy and easily acclimatizable. Active swimmer in aquariums
74	<i>Nemacheilus denisoni dayi</i> BI (Hora)	Not easy to acclimatize	Kabani	Omnivorous in feeding habit. It prefers live food; but readily accepts artificial feed also.		Peaceful and compatible. Always dwells at the bottom of the tank. Hiding among pebbles, drift wood or under big stones.	Needs well-aerated water. They are comfortable in the tank only when some hiding places are provided.
75	<i>Tetraodon travancoricus</i> (Hora & Nair)	Easy to acclimatize	Muvattupuzha river, Periyar river	Feed only on live food. They hardly take artificial feed. Prefers mosquito larvae and zooplankton.		Compatible and peaceful. But they are notorious for nipping the fins of other fishes. They always remain towards the upper half of the water	Very easy to acclimatize to captive conditions. They require clean well-aerated water. Not good for community aquariums. They feed on mollusks. It is quite interesting to watch them sucking flesh



column. They are from the shell of Lymnea & slow moving and Planorbis. excellent candidates for mono-species aquariums.

76	<i>Pisodnophis boro</i> (Ham-Buch)	Easy to acclimatize	Bharathappuzha river, Vembanad lake	Carnivorous	Very attractive with its snake-like body	It needs proper hiding places in tanks for comfortable settlement.
77	<i>Garra maclellandi</i> (Jerdon)	Very difficult to acclimatize	Upstreams of Bharathappuzha river	Herbivorous	It browses algae from the substances available in the tank.	Needs highly oxygenated water
78	<i>Garra surendranathanii</i>	Very hard to acclimatize	Pampa river	Herbivorous	It browses algae from the substances available in the tank.	Needs highly oxygenated water
79	<i>Mesonemacheilus guentheri</i> (Day)	Not easy to acclimatize	Bharathappuzha river	Omnivorous. But prefers live food like insect larvae	They always dwell at the bottom of the tank. Never come to the top layers of water column. They are compatible and peaceful.	They become comfortable only when provided with convenient hiding places.
80	<i>Ompok bimaculatus</i> (Bloch)	Easy to acclimatize	Muvattupuzha river	Carnivorous, Piscivorous	This fish exhibits hiding habits.	Needs proper hiding places in tanks.

81	<i>Heteropneustes fossilis</i> (Bloch)	Easy to acclimatize as they possess accessory respiratory organs	Muvattupuzha river, Pampa river	Carnivorous	This fish exhibits hiding habits. Not good for community tanks	Needs proper hiding places in tanks
82	<i>Xenentadon cancila</i> (Humboldt)	Not easy to acclimatize	Bharathappuzha river, Muvattupuzha river	Piscivorous. Does not accept artificial food	Very attractive fish in a single species aquarium	No smaller fish should be co-habituated with this fish.
83	<i>Mastacembelus armatus</i> (Lacepede)	Easy to acclimatize	Periyar river, Bharathappuzha river, Muvattupuzha river	Carnivorous fish. It prefers small fishes and other aquatic animals	The fish get easily tamed and will respond to the viewers	It needs proper hiding places. It jumps out if the tank is not properly covered, especially large sized fishes.
84	<i>Macrornathus aral</i> (Bloch & Schneider)	Easy to acclimatize	Chalakkudy river	Carnivorous fish	Sluggish and nocturnal	It needs proper hiding places.

The data given in this table form part of the project work entitled "Germplasm inventory, evaluation and gene banking of fresh water fishes" funded by NATP, ICAR, India.

**Table II.** Sexual dimorphism, fecundity and size at first maturity of some fresh water ornamental fishes in the Western Ghats of India.

Name of fish	Sexual dimorphism		Fecundity (eggs/g body weight)	Length at first maturity (mm)	
	Male	Female		Male	Female
<i>Chela fasicata</i>	Males become more colourful and fins become darker during breeding season	Females develop bulged belly	25-35	40	35
<i>Danio malabaricus</i>	Males develop intensive colouration during breeding	Females develop bulged belly	20-30	50	40
<i>Puntius melanampyx</i>	Male becomes brick-red or maroon as they are matured and ready to spawn. They also develop nuptial tubercles at the anterior tip of the snout. This colour is intensified during the actual spawning time.	Females do not have such colour. They have a bulged belly.	30-40	50	40
<i>Puntius filamentosus</i>	Males have first few rays of the dorsal fin elongated when mature. The snout is covered with a patch of	Females do not develop such colour pattern and elongation of fin rays but have a bulged	40-45	80	70

	large tubercles on either side, in front of the eyes. They also become brightly coloured	belly when fully mature.			
<i>Puntius melanostigma</i>	Males develop a scarlet band along its lateral side extending from behind the opercle to the caudal region. The colour is more intensified during spawning period.	Females do not have such colour band, but develops bulged belly.	25-35	50	40
<i>Puntius pookodensis</i>	Males develop a red band along its lateral side that extends all along the body	Females do have such red band. They have a bulged belly.	30-35	40	35
<i>Garra mullya</i>	No clear cut sexual dimorphism could be observed Male oozes out milt on gentle press on the belly.	Females can be identified by the bulged belly when mature.	50-55	80	70
<i>Nemacheilus semiarmatus</i>	Male develops pink colour when mature and it is intensified	Females develop bulged belly when they are mature.	40-45	50	40

	during courtship behaviour				
<i>Nemacheilus triangularis</i>	Colour of male is more intensified when they are fully mature.	Females develop bulged belly when they are mature	100-125	60	50
<i>Pristolepis marginata</i>	Exhibits no sexual dimorphism except during the time of breeding. Male has an enlarged anal papilla But sexes can be identified by their behaviour in captivity. Mature male exhibits territorial behaviour.	Female develops a potbelly.	40-45	50	40

The data given in this table form part of the project work entitled "Germplasm inventory, evaluation and gene banking of fresh water fishes" funded by NATP, ICAR, India.

### **Reproductive strategies**

A great variation was observed in the manner of spawning and subsequent care of the young among these fishes. They range from mere egg scatterers to egg guarders and nest builders (Balon 1975). According to the breeding characteristics *Puntius filamentosus*, *Puntius pookodensis*, *Chela fasciata*, and *Danio malabaricus* are included under the ethological classification of non guarders, ecological group of open substratum spawners and morphological type of phytophils whereas, *Nemacheilus triangularis*, *Nemacheilus semiarmatus*, *Garra mullya* and *Puntius melanampyx* are included under the same ethological and ecological group but under the morphological type of pelagophils and *Puntius melanostigma* under the morphological type of lithophils. *Pristolepis marginata* is included under the Ethological classification of guarders, ecological group of nest builders and morphological type of lithophils.

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