ISSN: 2347-5129
IJFAS 2014; 1(5): 08-11

www.fisheriesjournal.com
Received: 04-03-2014
Accepted: 15-04-2014

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Live Handling and Domestication of Selected Indigenous Ornamental Fishes of India

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ABSTRACT
Ornamental fish breeding and rearing is a fastest emerging branch of aquaculture as is ornamental fish trade. Though, indigenous ornamental fishes contribute less to the total ornamental fish trade, possibilities for the development of indigenous ornamental fish trade is very high. Potential ornamental fishes of the Western Ghats are studied for its occurrence in different water bodies and its potential value in international ornamental fish trade is assessed. Experiments on postharvest handling and domestication of twenty species of selected indigenous ornamental fishes were conducted to assess its suitability for aquarium keeping. Seven fishes showed survival above 80% during the domestication, showing its high suitability for aquarium trade, however, three species showed survival below 20% which are associated to be not suitable for aquarium trade. *Sahyadria denisonii* (41.87%), *Pristolepis marginata* (41.9%) and *Mastacembelus armatus* (26.88%) showed, lower percentage survival during domestication. The present study brings out the significance of assessing the suitability of indigenous fishes for fish trade before their clandestine and unsustainable exploitation from biodiversity hotspots of India.

Keywords: Freshwater ornamental fishes, Western Ghats, Aquarium trade, Kerala.

1. Introduction
Ornamental fish culture is getting more popular now-a-days and is one of the fastest emerging branches of aquaculture due to its tremendous prospects and economic opportunities. About 120 countries contribute to the global ornamental fish trade and more than 1,800 species of fishes are traded, of which over 1200 are of freshwater origin. Most of the ornamental species globally traded are warm water tropical fishes except some eurythermal carps. Advancement in breeding and aquarium technology has added a new dimension in the ornamental fish trade with more species and varieties being introduced to the aquarium trade. The global freshwater ornamental fish industry is heavily dependent on cultured fishes and fishes from wild contribute only in meager proportions. In total contrast to this, the marine fish species constitute only 15% of the global market by value, however, nearly 98% of these fishes are wild caught and very few from captive-breeding [1].

Contribution of India to the world ornamental fish trade is only at a tune of US$ 1.7 million, which is rather sparse considering the vast US$8 billion global market that has been growing at an average annual rate of 9%. Considering India's richness of fish biodiversity, geographic location and access through air connectivity to the international markets, it wouldn't be an understatement that India has not tapped these resources effectively, which could have propelled exports and would have taken the country to a prominent position in the global ornamental fish trade. The Indian ornamental fish industry is focused mainly on exotic species, due to its high demand in local markets. The promotional schemes of the central and state governments provide ample impetus to the development of ornamental fishes; however, lack of awareness of quality standards of exotic ornamental fishes has often acted as stumble stone limiting exports to international markets.

The Western Ghats is considered as one among the 34 'biodiversity hotspots' of the world with a plethora of diverse fish species having remarkable endemism [2] and one of the eight "hottest hotspots" of biological diversity in the world. The river drainage and associated water bodies of the Western Ghats holds rich freshwater fish diversity with about 290 species belonging to 106 genera, 33 families and 11orders [3].

The Western Ghats also portrays rich endemic fish fauna of 189 species, belonging to 69 genera, 23 families and 7 orders [3]. About 110 species of fishes reported from the Western Ghats have ornamental value [4]. However, these resources have not been managed properly either for its conservation or for sustainable exploitation. Unlawful exploitation of fishes like *Sahyadria denisonii* from southern-Western Ghats, due to its high market demand, and subsequent reduction in its population are an example of exploitation of unmanaged resources [5].

Availability of viable technologies, which ensures low production cost and better returns within a short period and growing domestic and global demand are the major attractions of aquaculture. Climatic conditions of Kerala are extremely favourable for the development of ornamental fisheries. Local self-governments and national promotional authorities have been providing financial support for this segment due to its high potential in employment generation in rural sector and as a product for overseas market. The recent infrastructural initiatives of the Government of Kerala, like, Aqua technology park- Kerala Aqua Ventures International Ltd (KAVIL) with public-private participation envisages to provide a platform for better facilitation of trade of ornamental fishes. More than 200 ornamental fish trade units are functioning in the state under the financial assistance of MPEDA, FIRMA, Matsyafed etc. and most of them are focussed on the breeding and rearing of exotic ornamental fishes. Only a handful of exporters is progressing with the collections from the wild, acclimatisation and export of indigenous ornamental fishes, while none are concentrating on commercial breeding and rearing of these fishes.

Present article provides an overview of the indigenous ornamental fishes of Kerala, aspects of domestication and its suitability in the aquarium trade.

2. Materials and Methods

The data on occurrence of indigenous ornamental fishes inhabiting rivers of Kerala part of Western Ghats, India were gathered from the literature and during the surveys and sampling carried out as part of various research projects. For the assessment of its suitability for the aquarium trade, the fishes were collected from the wild and estimated the survivability in different stages of domestication. Fishes for the experiment were selected based on their demand in the aquarium trade. The survival of fishes, while holding for 3 h at the collection site in happa, during 12 h transportation in oxygen filled polythene bags, in the course of 48 h acclimatization at the laboratory and while keeping in 4×2×2 glass aquarium for two weeks, was assessed.

Table 1: The results of domestication of selected indigenous ornamental fishes of Kerala showing the survivability after collection, transportation and up to 2 week keeping in aquarium.

S. No	Species	Specimen Collected	Percentage Survival				
			3hrs acclimati-sation at field	12 hrs transport-tation under O_2 packing	laboratory acclima-tisation (48 hrs)	Aquarium I week	Aquarium II week
1	*Etroplus maculatus*	128	93.75	88.60	87.01	87.01	87.01
2	*Horabagrus brachysoma*	24	100.00	87.86	82.86	82.86	82.86
3	*Dawkinsia filamentosa*	45	92.22	84.81	80.37	73.89	73.89
4	*Pseudosphromenus cupanus*	49	100.00	96.43	96.43	96.43	96.43
5	*Devario malabaricus*	90	95.08	89.56	86.92	86.92	86.92
6	*Osteobrama bakeri*	60	38.36	13.06	10.69	7.44	6.44
7	*Sahyadria denisonii*	52	89.22	55.69	48.71	41.87	41.87
8	*Haludaria fasciata*	120	97.96	92.30	90.73	89.47	77.84
9	*Pethia ticto*	75	92.42	89.88	86.13	86.13	78.07
10	*Puntius vittatus*	80	96.39	93.96	88.65	86.31	76.94
11	*Hypselobarbus jerdoni*	11	85.71	39.29	39.29	14.29	7.14
12	*Rasbora daniconius*	75	94.35	89.81	86.20	79.54	76.76
13	*Aplocheilus panchax*	68	96.43	95.15	93.29	89.63	89.63
14	*Pristolepis marginata*	32	76.85	53.47	47.92	41.90	41.90
15	*Mastacembelus armatus*	21	68.13	42.50	36.25	26.88	26.88
16	*Barilius bakeri*	78	86.77	78.18	74.95	71.67	70.39
17	*Barilius gatensis*	132	92.41	87.98	86.19	84.76	84.76
18	*Garra mullya*	98	90.07	86.11	84.17	84.17	84.17
19	*Xenentodon cancila*	36	45.63	24.38	15.00	15.00	15.00
20	*Nemacheilus triangularis*	19	87.50	83.33	76.19	76.19	72.02

3. Results and Discussion

Of the total of about 250 freshwater fishes so far reported from Kerala, 103 species were found to have ornamental value [4]. The fishes were assigned as potential ornamental fish status based on their colouration, size and compatibility in aquariums. However, the suitability of most of the fish as an aquarium fish is not yet assessed. Barbs, members of the family Cyprinidae, were found to be the most abundant group which is usually seen in midstreams. Members of the family Balitoridae, the loaches, which are abundant in upstream, formed the second largest group of potential ornamental fishes. Most of these fish are common and their distribution and abundance showed variation between rivers and different stretches of the same river. *Pristolepis marginata, Nandus*

nandus and *Parambassis thomasi* were commonly seen in the middle stretches of the rivers. *Glossogobius giuris, Tetraodon travancoricus* and *Aplocheilus panchax* were mostly distributed in the lower stretches of the rivers. The endemic and endangered species such as *Lepidopygopsis typus, Travancoria elongata, Garra surrendranathanii, Nemacheilus menonii* were found highly to some of the specific microhabitats of the Periyar river.

The experiments on the domestication of native ornamental fishes were done on 20 species of aquarium relevance and the results are provided in the Table 1. Seven fishes showed a survival above 80% during the domestication, showing its high suitability for aquarium trade, however, three species, *Osteobrama bakeri, Hypselobarbus jerdoni* and *Xenentodon cancila* showed survival below 20% which are not suitable for aquarium trade. *Sahyadria denisonii* (41.87%), *Pristolepis marginata* (41.9%) and *Mastacembelus armatus* (26.88%) showed a lower percentage survival during domestication. *Sahyadria denisonii* one of the most sought and most exported native ornamental fish of Kerala showed low percentage survival, pointing towards the damage caused by the export to the natural stock of the species. Most of the fishes selected for the study showed good potential for the domestication with higher survival in aquarium and captive condition. All of the species, except those showed very low survival started feeding in the first week of captive rearing and subsequent weaning to the dry feed was comparatively simple. This aspect again points towards the possibility of easy brood-stock development for captive breeding of these fishes.

Catch per unit effort (CPUE) has been worked out for many of the ornamental fishes like *Sahyadria denisonii* (chalakudy River, 0.036 kg/hr; Bharathapuzha 0.062 kg/hr; Pamba 0.02 kg/hr), *Horabagrus brachysoma*, (achankovil river, 0.04 kg/Hr; chalakudy river 0.05kg/Hr.), *Pethia conchonius* (kabini river, 0.01 Kg/hr) from major river system of Kerala [6]. However, the distribution of these, heavily exploited and highly priced fishes are restricted to a few river systems only. Higher CPUE were recorded for some of the potential ornamental species such as *Devario malabaricus* in muvattupuzha and Bharathapuzha rivers (0.49 to 0.10 kg/hr.) and *Barilius gatensis* in Pamba and Chinnar rivers (0.13 to 0.42 kg/hr.). Similarly, the catch/hr values were recorded in *Dawkinsia filamentosa, Barilius bakeri*, *Garra mullya*, *Parambassis thomasi* etc. in diverse river systems and were compared to the species already exported from the country [6]. It would thus appear that the indiscriminate exploitation of the wild stock has contributed to the stock depletion of some of the prime ornamental fishes of the rivers of Kerala [7]. In this particular situation, the potential for domestication is an important criterion for collecting the fishes for ornamental purpose from wild populations. A fish with high CPUE and low domestication potential will never support the ornamental fish trade considerably, but the natural population the same will disastrously deplete.

The freshwater ornamental fish trade of the country is contributed by exotic species to the tune of 85%. The major problem facing the ornamental fish industry is the quality of the exotic fishes. This problem can well be overcome by selective breeding and mass production of the indigenous fishes since the genetic stock of wild caught fishes are pure and without any cross breeding. Though many species have tremendous potential for the introduction in the international markets, the potential is not properly tapped till date. More than a dozen species such as *Sahyadria denisonii* (Denison's barb), *Dawkinsia arulius* (Aruli barb), *Pethia conchonius* (Rosy barb), *Dawkinsia filamentosa* (Tiger barb), *Pethia ticto* (Ticto barb), *Puntius vittatus* (Koolie barb), *Haludaria fasciata* (Melon barb), *Parambassis thomasi* (Glass fish), *Horabagrus brachysoma* and *Horabagrus nigricollaris* (Yellow cat fishes) are already included in the national and international trade of freshwater ornamental fishes. More than a dozen locations, especially of the rivers, Chalakudy, Periyar, Bharathapuzha and Kabini were heavily exploited for the higher priced items like Denison's barb and Rosy barb.

Laboratory or mass production technology of breeding and rearing of a few commercially important indigenous ornamental fishes have been developed [8], however, a commercial level production technology have not so far been perfected. This stands as the major bottle-neck for augmentation of the ornamental fish trade in India. The National Bureau of Fish Genetic Resources (NBFGR) and Regional Agricultural research station, Kerala Agricultural University have developed captive breeding protocols for food fishes like *Horabagrus brachysoma, Labeo dussumieri, Hypselobarbus curmuca* and *Etroplus suratensis* [9]. Captive breeding technology for thirteen species of indigenous ornamental fishes of Western Ghats [6]. If the indigenous fish resources are open for the exporters, the fishing pressure on the natural stock will be increased, which will lead to disastrous depletion of the natural stock of these fishes. Therefore perfection of the present captive breeding technology of indigenous ornamental fishes to suit to the mass production is the need of the hour as far as the trade and export of these fishes are concerned.

Though, most of the river systems, especially upstream, are pristine many downstream regions have shown incidences of industrial and sewage pollution. Agricultural, industrial, domestic sewage, and pesticide pollution are causing deleterious effects on aquatic life, especially fish life in many rivers of Kerala. Most industries in Kerala, especially those, situated in the lower stretches, discharge wastes to rivers without proper treatment. Intensive harvesting of the fish resources for food and the aquarium pet trade is the second biggest threat to fishes of the Western Ghats. In Kerala, several food fish species have shown population declines of varying levels due to unmanaged exploitation. These include *Horabagrus brachysoma, Tor khudree, Hypselobarbus curmuca, H. dubius, H. kolus, H. micropogon* etc. [3]. Recent studies have demonstrated that *T. khudree* is subjected to unsustainable levels of harvest, and that the commercial fishery for this species in a few reservoirs of Kerala are in imminent danger of collapsing [10].

The ornamental fish resources of the rivers of Kerala were subjected to indiscriminate exploitation especially for export purposes with least consideration to population size and stock. Many of the ornamental fishes of Kerala which were once abundant are vulnerable or endangered category now. Anthropogenic interventions together with the invasion of exotic species have resulted in stock depletion and the endangerment of native fauna [4, 11]. The ornamental fishes are also facing threats from unethical fishing practices like, poisoning, dynamiting, electrocution etc. The destruction of natural spawning and breeding grounds of many of the fishes resulted in the decline of the fish population size.

If the promotional activities, for the augmentation of indigenous ornamental fish trade from Kerala, are intensified,

following management measures are suggested to conserve the native freshwater ornamental fishes of Kerala from endangerment.

1. A database on the abundance and distribution of ornamental species should be developed by undertaking extensive micro geographical surveys. The area of higher availability and the micro geographical information about the areas of these fishes should be properly monitored and the area need be conserved as non-fishing zones or sanctuaries.
2. Information on breeding behaviour and spawning grounds of indigenous ornamental fishes should be identified and utilized for *ex situ* or *in situ* conservation of the species.
3. Extensive research should be initiated for the captive breeding and brood-stock development of the potential ornamental fishes. Commercial scale export of the species should only be started only after standardizing these techniques.
4. Captive breeding techniques should be developed centrally in a state wide manner involving research and development establishments of Kerala and the same should be extended to the small and large-scale aquarists for the enhancement of ornamental fish exports.
5. Aqua ranching of the indigenous fishes should be promoted with the young ones developed by the captive breeding for augmenting the natural population.
6. Anthropogenic intervention harming the population of native fishes may be identified and checked through stringent regulations and policies.
7. The introduction of exotic species of fishes to the open freshwater resources should be completely banned and measures should be taken to remove or reduce the exotic fish population in natural freshwater resources of Kerala.

The present study reveals the potential of indigenous fishes of Kerala as ornamental fishes for international trade. Though the export of indigenous fish attained momentum, the lack of adequate public awareness and unmanaged and unethical fish collection leads to stock depletion of many fishes which ultimately hindered the export of these fishes. Standardisation of breeding and seed production protocols of many of the species is underway. Most of the potential indigenous ornamental fish have specific habitats or restricted distribution which limits continuous exploitation. A conservation strategy or management measure is totally lacking to control, fishery of these fishes from the natural waters. Anthropogenic intervention has led to the destruction of natural spawning and breeding grounds which further dwindle the natural stock of native fishes. Further, the exotic fishes introduced to the waters of Kerala exert very high pressure to the indigenous fishes by competing for food and space. With vast potential in terms of indigenous ornamental fish resources and bioclimatic and academic resources for the development of commercial production technologies, Kerala can contribute immensely in the export of indigenous ornamental fishes. Concerted attempts need be initiated, for the development of resource maps, expansion of breeding and rearing protocol and formulation of viable conservation strategy and management tactics for the spread out of sustainable indigenous ornamental fish trade in Kerala.

4. Acknowledgement: SS gratefully acknowledge the financial support of Kerala State Council for Science, Technology and Environment, Govt. of Kerala through SARD Scheme.

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