Ornamental fish culture and trade: current status and prospects

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Ornamental fishes are often called as 'living jewels' due to their colour, shape, behaviour and origin. They are peaceful, generally tiny, available in attractive colours and capable of living in confined spaces. In China aquarium fish keeping has been a hobby from ancient times. When domestic electricity became available at turn of the century hobbyists began to keep in aquaria species other than gold fish which required heating and certain other special conditions. By about 1930 it became possible to keep saltwater fish in captivity although high costs and supply distances restricted their acquisition. Because of high mortality and expenses, marine aquaria were not found commonly in private homes before the middle 1960's. Recently, several useful publications have appeared, facilitating a budding fish hobbyist to organise and maintain his/her marine aquarium tank on scientific lines (Ranta, 1996a,b,c; Straton, 1995 Wilkens, 1995; Lamberton, 1996; Mills 1987).

Global trade in ornamental fishes

During the last four decades, there has been considerable growth and diversification in the international trade in ornamental fishes which is valued at about US $ 5 billion. The major players in this market include USA, Europe, Japan, Australia, Singapore, Indonesia, Philippines and Sri Lanka. In recent years much interest has been shown by the home hobbyists and public aquaria to keep marine ornamentals. Thereby the proportion of marine fish in the total global trade has jumped from less than 15% to about 40%.

The market for ornamental fishes consists of 99% home-hobbyists and 1% public aquaria and research institutes. The market is mostly located in areas with high density population, industrial areas and cool climate (Bassleer, 1994). The industrial chain which determines the price is explained as, fisherman/breeder → exporter → airline → importer/wholesaler → retailer → hobbyist.

The importer/wholesaler plays a very important role as the link between producer and consumer. Only perfect, good and healthy fish have good market value. The extra cost of quality control in a fish house (at both export and import level) with good seawater management and trained staff thus adds to the value of the fish. According to statistics, 50% of the suppliers are located in Asian countries. Singapore, Thailand, Hong Kong, Japan and Malaysia are the major suppliers of freshwater fish, while Indonesia, Philippines and Sri Lanka are the major suppliers of wild-caught marine fish. Philippines is known for the direct export of marine exotic varieties. Singapore exports relatively few salt water fish, originating from its own resources but depends mainly on re-export of Indonesia-caught fish and invertebrates, while Sri Lanka exports her own reef fishes and fishes coming from Maldives. Those fishes originating from the Maldives are either usually available in lesser numbers in Sri Lankan waters or are only seasonal. The largest import markets for tropical fish are USA, EEC and Japan. Approximately 14 percent of British homes and 8 percent of USA homes keep ornamental fish. According to Andrews (1992) 150 million ornamental fish are sold on a world-wide basis each year. Current opinions suggest that about 90% of the freshwater ornamentals traded are captive-bred, while 99% of the marine ornamentals exported are wild-caught.

Indian Scenario

India, despite its vast expanse of sea coast and flow of perennial rivers and consequent abundant resources of freshwater and marine ornamentals, is still way behind other developing countries in the matter of development of this trade. In fact, the natural resources of India are more varied as compared to those of Sri Lanka, Africa, Singapore, Indonesia and Malaysia. Several freshwater varieties of Indian fishes are well known in the international market. The lagoons and coral reefs of Lakshadweep and Minicoy islands, Andaman & Nicobar islands, Okha-Pintan-Gulf of Kutch complex, coast of Kerala around Cape Comorin, Gulf of Mannar and Palk Bay abound with highly attractive and varied species of ornamental fishes. We could certainly make a good deal of money and enjoy a considerable share in the world trade by supplying marine ornamental fishes and live rocks originating from the vast resources which are the basic material essential in keeping the aquarium environment healthy. Live rocks afford organisms living in it a much longer life span. Poor knowledge on the part of our people about aquariculture and live fish trade could be the principal reason for our backwardness in this field.

India's contribution to global aquarium trade is worth a mere 10 crore rupees (Srivastava, 1994) while we have a great potential to increase the level of exports to about US$ 30 million (about Rs. 110 crores) every year (Ninawe, 1997). There are atleast 150 varieties for commercial exploitation, including clown fishes, damsels, marine angels, moorish idol, surgeon fishes, tangs, butterfly fishes, etc. Table 1 furnishes names of important marine ornamental fishes reported from Andaman & Nicobar islands, Lakshadweep, gulf of Mannar and Palk Bay. Calcutta, Mumbai and Chennai are major breeding centres for freshwater ornamentals. There are about 150 full time and 1500 part time ornamental fish breeders in the country, ☞

Table1. Commercially important marine ornamental fishes from Indian waters

Sl. No.	Family	Common Name	Scientific Name
1.	Acanthuridae	Grey surgeon	*Acanthurus caeruleus*
		Powder-blue surgeon	*A. leucosternon*
		Clown surgeon	*A. lineatus*
		Convict Tang	*A. criostegus*
		Unicorn tang	*Naso brevirostris*
		Smooth head unicorn fish	*N. lituratus*
		Brown tank	*Zebrosoma scopas*
		Yellow-tail sailfin Tang	*Z. veliferum*
2.	Balistidae	Undulate Triggerfish	*Balistapus undulatus*
		Blue-finned Triggerfish	*Balistoides viridescens*
		Picasso Triggerfish	*Rhinecanthus aculeatus*
		Sargassum triggerfish	*Xanthichthys ringens*
		Belted Triggerfish	*R. rectangulus*
3.	Callyodontidae	Striped Parrotfish	*Callyodon taeniurus*
4.	Chaetodontidae	Threadfin Butterflyfish	*Chaetodon auriga*
		Pearlscale Butterflyfish	*C. chrysurus*
		Citron Butterflyfish	*C. citrinellus*
		White-colar Butterflyfish	*C.collare*
		Saddle Butterflyfish	*C. ephippium*
		Double-daddle Butterrflyfish	*C. falcula*
		Klein's butterflyfish	*C. kleini*
		Lined Butterflyfish	*C. lineolatus*
		Raccoon Butterflyfish	*C. lunula*
		Black-backed Butterflyfish	*C. melanotus*
		Meyer's Butterflyfish	*C. meyeri*
		Ornate Butterflyfish	*C. ornatissimus*
		Dotted Butterflyfish	*C. pelewensis*
		False Vagabond Butterflyfish	*C. picturs*
		Two Spot Butterflyfish	*C.plebeius*
		Raffles Butterflyfish	*C. rafflessi*
		One spot Butterflyfish	*C. speculum*
		Three-striped Butterflyfish	*C. trifasciatus*
		One spot Butterflyfish	*C. unimaculatus*
		Vagabond Butterflyfish	*C. vagabundus*
		Goldheaded Butterfly fish	*C. xanthocephalus*
		Pennant Coralfish	*Henichus acuminatus*
		Poor Man's Moorish Idol	*H. chrysostomus*
		Humphead Bannerfish	*H. varius*
6.	Pomacanthidae	Coral Beauty	*Centropyge bispinosus*
		Pigmy Angelfish	*C. multispinis*
		Blue King Angelfish	*Pomacanthus annularis*
		Emperor Angelfish	*P. imperator*
		Semicircle Angelfish	*P. semicirculatus*
6.	Holocentridae	Squirrelfish	*Holocentrum rubrum*
		Bigeye Squirrelfish	*Myripristis murdjan*
7.	Labridae	Lyretail Wrasse	*Thalassoma lunare*
		Bird Wrasse	*Gomphosus coeruleus*
		Longface Wrasse	*G. varius*
		Yellow Cleaner Wrasse	*Labroides bicolor*

(contd.in next page.)

but they cannot even meet the demand (Srivastava, 1994). Of the 20 or so aquarium fish exporters in the country only half of them are active (Elamparithy, 1996).

Why aquarium fishes?

Aquarium fish can fetch about 100 times more price than the food fish and marine ornamentals are about ten times costlier than their freshwater counterparts (Bassleer, 1994; Gomes, 1996). Approximate export value (only indicative price) in US $ per piece: damsels: 0.50-1.00; Wrasses: 0.85-2.00; tangs: 3.25-3.75; moorish idol: 3.25-3.50; powder blue surgeon: 11.00-12.50; butterfly fishes: 1.65-4.25; cardinal fishes: 0.60 - 0.70.

The economics and profitability of an ornamental fish-exporting unit works out to be highly lucrative provided the activity is taken up on scientific lines with appropriate marketing strategies. The activity is possible not only on large scale but also on small scale. It provides good opportunity even to small entrepreneurs to enter into the field. Institutional funding for R & D activities is, however, essential. Commercial banks can formulate schemes for extending financial assistance to prospective entrepreneurs for short-term training programmes on production of ornamental fishes. Two of the major areas which require immediate attention are, (a) in-house breeding of selected species of marine ornamental fishes which are in great demand to release the pressure on wild-capture and (b) scheme of educating/training a good number of fisherfolk in the more skilled and specialised techniques of collecting handling, storing and transport of ornamentals which could revolutionise the fishing industry to some extent, provide enhanced cash income and thus better living standards for those involved.

Conservation of natural resource

It is imperative to adopt a rational exploitation strategy of coral reef fishes. The growing worldwide interest in marine aquarium keeping is causing detrimental effects on the environment. Intensive and selective catching techniques, such as cyanide poisoning and dynamite fishing pose major threats to the delicately balanced reef ecosystem and this is of particular concern in marine ornamental fish trade. These unscrupulous practices result also in

		Common Cleaner Wrasse	*L. dimidiatus*
		Twinspot Wrasse	*Coris angulata*
		Clown Wrasse	*C. formosa*
		False Clown Wrasse	*C. gaimardi*
8.	Pomacentridae	White-tailed Damselfish	*Dascyllus aruanus*
		Reticulated Damselfish	*D. reticulatus*
		Threespot Damselfish	*D. trimaculatus*
		Black Velvet Damselfish	*Pomacentrus nigricans*
		Blue-green Damselfish	*Chromis caerulea*
		Bicolour Damselfish	*C. dimidiatus*
		Indian Orange Anemonefish	*Amphiprion akallopisos*
		Yellow-tailed Anemonefish	*A. clarkii*
		Red Clowsn	*A. frenatus*
		Maldivan Anemonefish	*A.nigripes*
		False Skunk-striped Anemonefish	*A. perideraion*
		Two-banded Anemone fish	*A. bicinctatus*
		Biocellatus Damselfish	*Abudefduf biocellatus*
		Damselfishes	*A. sexafasciatus*
			A.lacrymatus
			A. dickii
			A. xanthozona
			A. glaucus
			A.septemfasciatus
9.	Pelcorhynchidae	Yellow-Lines Sweetlips	*Plectorhynchus albovittatus*
		Strianght-Banded Sweetlips	*P. gaterinoides*
		Oriental Sweetlips	*P. orinetalis*
		Painted Sweetlips	*P.pictus*
10.	Canthigasteridae	Amboina Toby	*Cnathigaster albovittatus*
		Bennett's Toby	*C. bennetti*
		Sharp-nosed Puffer	*C. margeritatus*
		Saddled Toby	*C. valentini*
		Porcupine fish	*Diodon hystrix*
11.	Ostraciidae	Spotted Cube	*Ostracion cubicus*
		Spotted Boxfish	*O. meleagris*
		Cowfish	*Lactoria cornuta*
12.	Platicidae	Orbiculate Batfish	*Platax orbicularis*
		Long-finned batfish	*P.teira*
13.	Apogonidae	Cardinal fishes	*Apogon spp.*
14.	Scorpaenidae	Scorpionfish	*Pterois volitans*
		Spotfin Lionfish	*P. antennata*
		Whitefin Lionfish	*P. radiata*
15.	Serranidae	Blue and yellow Reef-cod	*Epinephelus flavocaeruleus*
		Malabar Reef-cod	*E. malabaricus*
		Golden-striped Grouper	*Grammistes sexlineatus*
		Saddleback Grouper	*Plectropomus maculatus*
16.	Lutjanidae	Blue-striped snapper	*Lutjanus kasmira*
		Red Emperor	*L. sebae*
		Black and white snapper	*Macalor niger*
17.	Triacanthidae	Black-finned Triple-spine	*Triacanthus biaculeatus*
		Short-nosed Tripodfish	*T. brevirostris*
18.	Muraenidae	Snowflake Moray Eel	*Echindan nebulosa*
		Zebra Moray Eel	*Echidna Zebra*
		Moray eel	*Muraena tessalata*
19.	Zanclidae	Moorish idol	*Zanclus conutus*

natural stock depletion. The high mortality rates suffered by captured fish is also a wanton waste of animal life. Additionally, the overdependence on natural populations coupled with the increasing demands for restrictions on capture jeopardise the future of the aquarium industry. Developing and utilising aquacultural techniques, such as broodstock management and captive-breeding to supply fish to the trade can ease the pressure on wild-capture and thus reduce overexploitation of the reef fish. This should receive the highest priority to stop supply of `sick' fish to the market abroad, to save the wild stocks from depletion, to save the fragile coral environment from destruction, to avoid conflicts over fishing rights and to provide continuous and increased opportunities particularly in rural sector. Two principal ways in which the ornamental trade might adversely affect populations of fish in the wild is through the introduction of non-native organisms and through the direct depletion of wild stocks (Andrews, 1990). Murthy (1996) has underlined the need for considering protection of environment, adoption of non-destructive capture methods, monitoring the exploitation, breeding and culture as well as establishment of sanctuaries for formulating policy of exploitation and export of marine ornamental fishes.

Marine aquaria

The concept of seawater public aquaria should receive greater attention in our country. These aquaria stimulate interest and develop knowledge about marine aquatic environments. Conservation is reflected in a subtle blend of science and art, reminding visitors that our quality of life depends on a fragile balance which must be nurtured by all of us. The benefits from establishment of public seawater aquaria could be summarised as (a) they offer an educational window to a diversified aquaculture world from which some of us make a living, (b) facilitate families to observe a simulated natural habitat of a variety of species without donning a wet suit, (c) create awareness on the importance of ecology and (d) provide first hand experience with state of art of technology in aquaculture. Technologies on handling, packaging and transportation of live marine ornamentals, marine aquarium setting and maintenance, captive propagation and seed production have to be

perfected and the fruits of research have to be transferred to the fisherfolk. Central Marine Fisheries Research Institute has established a public aquarium at the Vizhinjam Research Centre which harbours several species of freshwater, brackishwater and marine ornamental fishes and invertebrates.

Captive propagation and culture

Technology of captive propagation of freshwater ornamental fishes is perfected (Chye, 1991; Fernando and Phang, 1994). In contrast only a handful of marine species could be successfully bred in captivity. There are a number of reasons for this. One of the main obstacles to the establishment of a marine ornamental fish farming industry is the complex nature of the reproduction and rearing of the larvae of these fish in captivity. Due to the efforts of a small number of private entrepreneurs, a few species of marine ornamental fishes could be commercially raised but governmental support has been insignificant. Most of the species currently farmed are from the family Pomacentridae and Gobiidae which are considered to be "easier" to propagate. Gome (1996) has considered some important issues in the propagation of marine ornamentals, such as broodstock development, larval management, larval tank characteristics, environmental conditions, water management, larval nutrition and disease control. Shariff and Subasinghe (1992) have described aquarium fish health management. The Tropical Marine Centre (TMC) in UK is one of the major commercial producers of hatchery reared clown fishes. The TMC is Europe's premier importer and wholesaler of a wide range of marine ornamentals including molluscs, live rocks and crustacea. There are also a few isolated reports on the success of spawning of marine ornamental fish in aquaria, such as *Amphiprion clarkii* and *A.percula* (Alava and Gomes, 1989), *Dascyllus albisella* and *D. aruanus* (Danilowicz and Brown, 1992) and *Amphiprion percula* (Malpass, 1996).

R & D efforts

Marine Products Export Development Authority (MPEDA) funded a project on 'Mass production of aquarium fishes" including new strains through induced breeding and least cost growth promoting agents, carried out by Madras Christian College for 3 years. They have claimed significant achievements in breeding, disease control measures etc. MPEDA in association with the Centre for the Promotion of Imports from Developing countries (CBI), Netherlands, took up a project for promotion of exports of ornamental fishes from India. As a part of this, a survey was conducted in 1985 and 1986 by an expert in ornamental fish culture and trade, W.A. Tomey. He indicated considerable scope for initiating and developing export of marine ornamental fish from India. A training mission for ornamental fish export to Netherlands was organised (Anon. 1986). In 1990, a Workshop was conducted at Guwahati on collection, acclimatisation, packing and transportation of ornamental fish for export. This was to educate the local people and the officials of the Department of Fisheries on the subject. More recently, a Workshop was organised on 16th May, 1997 at Savera Hotel, Chennai to assess prospects and problems of Ornamental fish export. W.A. Tomey presented a paper on 'Ornamental Fish Marketing'. MPEDA has worked out the economics and profitability of ornamental exporting units. Central Marine Fisheries Research Institute is also formulating projects for propagation and culture of marine ornamental fishes with a view to promoting trade and tourism.

DNA fingerprinting in ornamental fishes

Unambiguous identification of the colour variants is essential in efficient monitoring and genetic management of stocks, and in stock/strain/variety improvement programmes. Conventional methods of strain/variety identification and selective breeding programmes are either inadequate or cumbersome. Ornamental fish breeders have tw0 major objectives. First is the improvement of fish stocks to enhance their viability, reproductive fitness and adaptability to environmental changes and stress. The second is the continual introduction or development of novel and exotic fish variants to captivate and sustain the interests of fish hobbyists.

Demand for fancy varieties has resulted in stringent selection for desirable colours and other economic traits over generations, leading to high inbreeding depression in guppy, *Poecilia reticulata* (Fernando and Phang, 1994; Foo *et al.*, 1995). This has prompted V.P.E. Phang and her colleagues from the National University of Singapore to carry out RAPD fingerprinting in guppy, gold fish, discus, tiger barbs and marine clown fish. Average similarity index values for the guppy and gold fish were in the range typically exhibited by populations that were small and isolated or were highly inbred. DNA markers of gold fish were examined (Yu *et al.*, 1994; Chen and Leibenguth, 1995). RAPD fingerprinting was applied to examine the species and subspecies of tilapia (Bardakci and Skibinski, 1994; Naish *et al.*, 1995; Dinesh et al., 1996) Degani *et al.* (1997) have examined the DNA fingerprint bands in three strains of angel fish, *Pterophyllum scalare*. No work has been cited on DNA fingerprinting of aquarium fishes from India. Major potential applications of DNA fingerprinting in ornamental fish culture will be in the efficient monitoring and genetic improvement of stocks, and in the stock improvement programmes.

Conclusion

Ornamental fish has emerged as a resource with considerable economic potential. India is endowed with rich resources of freshwater and marine ornamental fishes. India can certainly become a major contributor in international trade of ornamental fishes. Apart from improving foreign exchange reserves, this trade can generate more job opportunities and self-employment in rural areas. It is the onerous duty of those engaged in aquarium trade and industry to abstain from overfishing as well as the use of destructive methods of wild capture for managing the sustainable yield of these beautiful creatures.

References

ALAVA, V.R. and GOMES, L.A.O. 1989. Breeding marine aquarium animals: The Anemonefish. *Naga, The ICLARM Quarterly*. pp. 12-13.

ANDREWS, C. 1992. The ornamental fish trade and fish conservation: *Infofish Int.*, 2: 25-29.

ANON. 1986. Report on the training mission on ornamental fish export to the Netherlands, *Marine Products Export Development Authority*, Cochin, India, 24 pp.

BARDAKCI, F and D.O.F. SKIBINSKI 1994.

Application of RAPD technique in tilapia fish: species and sub-species identification. *Heredity*, 73: 117-123.

BASSLEER, G., 1994. The international trade in aquarium ornamental fish. *Infofish Int.*, No. 5 : 15-17.

CHEN, H and F. LEIBENGUTH 1995. Studies on multilocus fingerprints, RAPD markers and mitochondrial DNA of a gynogenetic fish (*Carassius auratus gibelio*). *Biochemical Genetics*, 33 (9/10): 297-306.

CHYE, W.C. 1991. Ornamental fish breeding. *Infofish Int.*, 5: 54-59.

DANILOWICZ, B.S. and C.L. BROWN. 1992. Rearing methods for two damselfish species: *Dascyllus albisella* (Gill) and *D. aruanus* (L.) *Aquaculture*, 106: 141-149.

DEGANI, G., J. PITCOVSKI, T. DOBSKI and Y. PLOTSKY. 1997. DNA fingerprint bands applied to analysis of variations in angelfish (*Pterophyllum scalare*) (Cichlidae) strains. *J. Aqua. Trop.*, 12 (1): 43-51.

DINESH, K.R., T.M. LIM, W.K. CHAN and V.P.E. PHANG 1996. Genetic variation inferred from RAPD fingerprinting in three species of tilapia. *Aquaculture international*, 4, 19-30.

ELAMPARITHY, B., 1996. Culture of ornamental fishes and their export potential. Proceedings of the Seminar on fisheries - multibillion dollar industry. *Aquaculture Foundation of India & The Fisheries Technology Forum*. pp. 101-104.

FERNANDO, AA. and PHANG, V.P.E. 1994. *Freshwater ornamental fish aquaculture in Singapore*, Singapore Polytechnic, Singapore, pp. 39-50.

FOO, C.L., K.R. DINESH, T.M. LIM, W.K. CHAN and V.P.E. PHANG 1995. Inheritance of RAPD markers in the guppy fish, *Poecilia reticulata*. *Zool. Sci.*, 12: 535-541.

FRANKEL, J.S., 1992. Inheritance of trunk coloration in the three-spot gourami *Trichogaster trichopterus Pallas*. *J. Fish Biol.*, 41 (4) : 663-665.

LAMBERTON, K. 1996. Some perfect marine echinoderms. *Tropical Fish Hobbyist*, December. pp. 60-69.

MALPAS, D. 1996. Raising *Amphiprion percula*. *Tropical Fish Hobbyist*, August. pp. 56-61.

MILLS, D., 1987. *The Practical encyclopedia of the Marine Aquarium*. Salamander Books Ltd., London. New York. 209 pp.

MURTY, V. SRIRAMACHANDRA 1996. Marine ornamental fishes of India. Proceedings of the Seminar on Fisheries - a multibillion dollar industry. *Aquaculture Foundation of India & The Fisheries Technology Forum* : pp. 23-34.

NAISH, K.A., M. WARREN, F. BARDAKCI, D.O.F. SKIBINSKI, G.R. CARVALHO and G.C. MAIR 1995. Multilocus DNA fingerprinting and RAPD reveal similar genetic relationship between strains of *Oreochromis niloticus* (Pisces: Cichlidae). *Mol. Ecol.*, 4: 271-274.

NINAWE, A.S. 1997. Ornamental fish culture - a new prospects in India. *Fish Farmer*. pp. 32-34.

RANTA, J.A., 1996 a. Starting a marine tank Part - 1. *Tropical Fish Hobbyist*, September, pp. 28-37.

RANTA, J.A., 1996b. Starting a marine tank Part-2. *Tropical Fish Hobbyist*, October, pp. 60-71.

RANTA, J.A., 1996c. Starting a marine tank Part-3. *Tropical Fish Hobbyist*, November. pp.40-50.

SRIVASTAVA, L.S., 1994. Ornamental fish - New export opportunities *Yojana*, Nov. 15:22.

SHARIFF, M and R. SUBASINGHE 1992. Aquarium fish health: do we really care? *Infofish Int.*, 6:43-47.

STRATTON, R.F., 1995. Some suggestions for the marine community tank. *Tropical Fish Hobbyist*, December. pp. 62-72.

TOMEY, W.A. 1985. Survey in the Union territory of Lakshadweep, the Bombay and Madras area: Promotion and export trade of Indian ornamental fishes from marine as well as freshwater origin and ornamental water plants. *Report to CBI, the Netherlands and Marine Products Export Development Authority*, Cochin.

TOMEY, W.A. 1986. Promotion of export trade of Indian ornamental fishes from marine as well as freshwater origin and aquatic plants for the aquarium industry: the pilot project conclusions and recommendations. Report on the project results to CBI/MPEDA.

WILKENS, P., 1995. Filter-feeders in the marine aquarium. *Tropical Fish Hobbyist*, may. pp.46-62.

YU, J.K., Y. WEI, Z. YULIAN, S. YU and Y. SHAOYI 1994. Sperm mediated gene transfer and method of detection of integrated gene by PCR. *Acta. Zool. sin/Dongwu Xuebao*, 40 (1):96-99.