HAND BOOK OF AQUAFARMING

# ORNAMENTAL FISHES

Compiled by

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# PREFACE

To meet the increasing protein requirements of the fast growing world population, it is recognised that the development of aquaculture can play a major role. Aquaculture has emerged as an important economic activity in many countries. In India too, we have seen the boom in aquaculture in recent years as a sunrise industry. Considerable awareness has been created about the unexplored potential of Indian aquaculture through publicity campaigns in the media and expositions. MPEDA had organised INDAQUA fairs to acquaint potential entrepreneurs of the vast developments that have taken place in this sector.

During the first INDAQUA organised by MPEDA in 1993, 15 handbooks on aquafarming were brought out high lighting the culture aspects of almost all important aquatic species. These publications were well received and appreciated by all concerned. Due to persistent demand for copies of these publications from various quarters, we have pleasure in bringing out their reprints.

Cochin
February 1996

(K.B. PILLAI)
Chairman

# FORWARD

The international trade on ornamental fishes is growing rapidly in different parts of the world. USA, Europe and Japan hold big markets and India's contribution in export is negligible. The Marine Products Export Development Authority (MPEDA) has done extensive survey to promote the export of freshwater and marine ornamental fishes in India. If these potentials are properly tapped, India can emerge as one of the leading exporters of ornamental fishes in the world. Therefore, the Organising Committee of "INDAQUA" - the first Aquaculture Show in India decided to bring out this handbook for the benefit of entrepreneurs in ornamental fish culture. The hard work put up by Shri V.K. Dey, MPEDA in compiling all useful information deserves special appreciation. The Ministry of Food Processing Industries - Fisheries Division Government of India was very kind enough to come forward to meet the entire printing cost of this book. The coordination done by Dr. G. Santhana Krishnan in bringing out this publication is appreciated. It is my earnest desire that this book will be of great help to investors in ornamental fish culture.

(M. SAKTHIVEL)
CHAIRMAN
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# ORNAMENTAL FISHES

## Introduction

Ornamental fishes can be defined on the basis of their attractive colouration, peaceful nature, tiny sizes, its suitability for keeping in captivity and adaptability for living in confined spaces. The colourful fishes are fancy for the people all over the world and fish keeping as a hobby has developed with world wide interest next to photography. The world Ornamental fish industry has been growing steadily over the years and more and more entrepreneurs are becoming interested in the trade. Rapid development of the technology of the century is really a boon to this trade, coupled with air transport system which revolutionised this industry. Consequently more and more hatcheries, farms and traders have increased remarkably over past one decade. The current value of world trade for ornamental fish has been estimated to be about US $ 4.5 billion and the demand is growing up steadily. On regional basis, the export of tropical ornamental fish is to the extent of 69% by value which originate from Eastern Asia and Singapore accounts for the major share of 35% by value followed by Hong Kong, Malaysia, Thailand, Philippines, Taiwan and Indonesia in that order.

## World Market

Over US $ 500 million worth of Ornamental Fish are imported into USA every year which is the largest market, followed by Europe and Japan. It has been estimated that 8% of the estimated 86 million houses in USA keep fish in their homes, 14% of the estimated 21 million houses in Britain adopted fish keeping as the hobby, 4% of Belgian and Italian houses, 5% of German houses keep fish. Dutch is very popular for keeping fish in aquaria and approximately 20% of Dutch houses keep fish. Fish keeping is also popular in Japan, China, Australia, South Africa and other countries. About 85% of the market for ornamental fishes is of freshwater origin and the rest is of marine ornamental fishes, which is a high value item and invertebrates and brackish water fishes. The growing popularity of fish keeping is reflected in the ubiquitous aquaria that feature as an integral part of modern interior decoration. The aquarium

fishes are thus rapidly gaining importance, not only because of their aesthetic value, but also due to their immense commercial value in the export trade the world over. The demand for good quality tropical fishes far exceeds the supply. This points to the fact that aquarium fishes are of immense commercial importance.

**Domestic Market**

The present trend of domestic market for ornamental fish is promising one. The demand for good quality tropical fish far exceeds the supply. Due to ideal climatic condition, Calcutta, Bombay, and Madras have emerged as the major breeding centres of the country. There are atleast 150 full time and over 1500 part-time ornamental fish breeders in the country and their production level does not cope up with the domestic demand. For example, Madras City has about 100 amateurs and about 30 full time breeders and wholesalers. These breeders concentrate only a dozen varieties. The retail and wholesale turn over of ornamental fish in Madras City alone is around Rs. 1.5 crore annually and the country's overall trade would be around Rs. 10 crores. The trend at present is that if the production of needed varieties is improved, there is every chance for the turn over to double in the next five years.

Demand for tropical ornamental fish in developed countries is being met increasingly through imports, and the trend is likely to continue due to high cost of labour. Taking into consideration that 90% of Europe's demand is covered with ornamental fish originating from developing countries, and imports into USA for 80% then it would be clear that the export of aquarium fish found some important outlet in the Australian world. Japan and Middle East countries are the growing market.

**Types of Fish**

85% of the volume of world trade in ornamental fish is originating from freshwater and the rest is Marine fishes and invertebrates and fishes of brackishwater origin. The trade in freshwater ornamental fish tends to grow more rapidly with special emphasis on cold water varieties such as Gold fish and coloured Carps (Koi-Carp). In Europe,.the trade in cold water varieties is concentrated mainly in the months of the end of February to the end of April just before the spring temperature allow to bring the fishes into outdoor garden ponds. Importers all over the world are eager to find supplies of rare and new species of ornamental fish to keep up with the demand of the most sophisticated hobbyists and Scientists

as well. Hobbyists account for nearly 95% of the world market and in the industrialised countries like Europe and USA with relatively colder climates and less sun shine, the demand for Ornamental fish is far better than is sunny climates where people usually lives more outdoors.

**Supplying Countries**

Countries supplying the world market with ornamental freshwater fish by far out number those providing the wholesale importers with marine fish. About 80% freshwater ornamental fish in the market comes from South East Asia with Singapore and Hong Kong as its principal suppliers. A major part of these fishes are bred in captivity, as for example Neon Tetras for which Hong Kong is famous and many other species of South American fishes comes from the breeding centres in Singapore. Japan is the largest supplier of cold water ornamental fish both for aquaria and pond such as Gold fish varieties and the famous Japanese Koi Carps. In Gold fish breeding and export, Japan closely followed by Israel, Italy and lately also USA. The imports of ornamental fish in the USA comes proportionally on a fifty-fifty basis for Asian and South American fish. Tropical freshwater ornamental species from South America are supplied by Brazil, Colombia, Peru, Venenzuela, Surinam, the Guyanas which are usually wild caught. A large number of African freshwater ornamental fish are still unknown to the trade and regularly new species of ornamental fishes finds their way into the market especially from Tanzania.

The wild caught freshwater species from South East Asia are mainly supplied by Indonesia, Malaysia, Thailand, Hong Kong as few species of Sri Lanka and India which has a growing interest in exporting native fishes as well as fishes bred in captivity. Certain species of Indian Ornamental fishes even fetch a high demand in the world market and get an excellent price because they are in short supply and not easy to breed with good quality and in quantity as well.

# Part I

## INDIAN ORNAMENTAL ICHYTYO FAUNA

### 1. Freshwater and brackishwater fishes

Several freshwater varieties of Indian fishes are well known in the international aquarium fish hobby and have been kept in Europe and America over six decades. Many more species have good potential for export, as they occur in good numbers over here. The points that are to be considered for suitability of a fish for introduction as pet are :

(a) Attractive colouration

(b) Peaceful nature

(c) Readiness to accept varieties of food

(d) Adaptability to living in confinement

Indian Water are the gold mine for ornamental fish traders with more than 100 varieties of indigenous species and same or more of exotic species. In fact, the natural resources of India are greater compared to those of Sri Lanka, Africa, Singapore, Malaysia and Indonesia. A few freshwater varieties of fish are already known in international trade having been exported from India for well over six decades. Several species of the genus Puntius, more popularly known as Barbus in the hobby, such as *P.chola, P.conchonius, P.gelius P.phutunio, P.terio, P.ticto* and *P.vittatus,* while those are predominantly plain silvery in colour and cannot hold their own against the colourful and flashy varieties like neon

tetra or jewel Cichlids, their advantage lies in their incessant activity and peaceful behaviour. Other freshwater Indian fishes which are renowned in the international trade are the Cat fish, (*Mystis tengara*) the dwarf and giant gouramis, (*Colisa lalia*) and (*Colisa fasciata*) and *Danio malabaricus*, better known as Malabar Danio. Some of the Indian freshwater fishes though known in the hobby are available only to connoisseurs as they are not exported in large volume. These are striped and Y. loaches (*Botia striata* and *B.lohachata*) orange and green chromides (*Etroplus maculatus* and *E.suratensis*) and Indian Killi fishes (*Aplocheilus panchax, A. blochii and A. lineatus*). Indian entrepreneurs have introduced some of the fishes which were not known to the international aquarium fish hobby. Melon or amber barb (*P. melanampyx*) honey gourami (*colisa chuna*) *Danio* (*Laubuca dadiburjori, Botia dario, B. geto, B. dayi, B.almorhae*, Dwarf Cat fishes of the genus *Gagata*, and *Nangra* and some of the Barbs like *P.sahyadrensis or P. denisoni* etc. are few of the examples.

A list of freshwater and Brackishwater Ornamental fishes having demand in the international ornamental fish industry which are being exported at present are detailed below :

**Barbs**

A common Indian fish, fancied for their attractive colouration. India can be called the land of Barbs as many of the popular aquarium barbs come from here. They have large, silvery mirror like scales which flash in the light. They are peaceful and good community fish.

(a) *Puntius arulius* : Commonly known as 'Aruli' barb, larger among Indian barb, olive green coloured on the back which blends to silvery on the belly, with three irregular black blotches merging or body. Dorsal, caudal and anal fins pinkish with a black bar across the summit of the first, while the caudal fin is stained at its edges. These are found in North East and South East Kerala (Wynaad and Nilgiri ranges as far as South Kottayam) also in the Cauvery basin at Srirangapatnam.

(b) *Puntius chola* : Not striking in colouration, the monotony of the silver body being relieved by a dark spot on the caudal peduncle and a rosy spot on the gill cover. The male has orange tingled pelvic and anal fins. These are cosmopolitan in distribution from Malabar and Wynaad (Kerala) through Madras, Orissa, Punjab, Bengal, Uttar Pradesh, Madhya Pradesh, Assam and other North eastern States.

(c) *Puntius conchonicus* : Commonly known as Rosy barb. Very striking in colouration with black spot on the caudal peduncle and a rosy spot on the gill cover. The male has orange tinged pelvic and anal fins. Found from lower Bengal to Assam, Bihar and Punjab Deccan.

(d) *Puntius dennisoni* : Silver coloured with a black band above which runs a horizontal scarlet stripe passing from the snout to the centre of the base of the caudal fin. Caudal fin with an oblique black band crossing the posterior portion of each lobe. This is one of the largest Barb.

(e) *Puntius filamentosus* : This is one of the larger Indian Barb commonly known as Indian Tiger barb. The name was derived by the presence of four black ventral stripes on a pink body found in juvenile. But in aquarium condition three stripes disappear and the last is converted into a horizontal oval spot on the caudal peduncle. The adult male has filamentous fins on the dorsal fin just as in arulius. Reported from Karnataka down to the west and along the base of Nilgiris.

(f) *Puntius gelius* : Better known as Golden dwarf barb, which has an interrupted band of black spots which however give the fish an over all beauty. These are reddish brown with a black band over the tail, a little before the base of the caudal fin, and another less distinct, close to the base of the tail, with a silvery band along the side. The black spot passes across the base of the interior half of the dorsal fin extending one third of the distance up the rays. These fishes are found in the Mahanadhi system, in Orissa, Brahmaputra river in North eastern India and in West Bengal.

(g) *Puntius melanampyx* : Known as melon barb. These colourful fish having brownish red body with three ventral black bands, the first from the whole of the base of the dorsal fin to just beneath the lateral line, the second commences four scale beyond the posterior extremity of the base of the dorsal fin and descends to one scale below the lateral line, while the last one is just before the base of the caudal fin. These fishes are found to occur in Northern and central Kerala and Cauvery basin in Tamil Nadu with a coloured variety is also reported from Kodaikanal.

(h) *Puntius narayani* : These are with silvery body with a golden yellow colour with two dark ventral bands, one descending to the pectoral fin, the second across the free portion of the tail, found in the river system of Karnataka and Sangli.

(i) *Puntius phutunio* : Commonly known as pygmy barb or Dwarf barb. This is one of the smallest Indian barb coloured reddish brown to silvery body with a black base passing from the back to opposite the middle of the pectoral fin, a second from the back to the posterior end of the base of the caudal fin. Two other lighter bands passes downwards, one from the anterior, the other from the posterior extremity of the dorsal fin. A dark band down the centre of the dorsal fin, another at the base of the caudal fin. Reported from the rivers of Orissa and Bengal.

(j) *Puntius terio* : Known as one-spot barb, which is yet another interesting Indian barb having silvery to greenish across the back, each scale having numbers of fine black spots. A large black blotch in the middle of the side over the posterior extremity of the anal fin. Sometimes extended in the median line as far as the tail. A black blotch in the young under the posterior extremity of the dorsal fin, passing downwards to the middle of the fish which becomes indistinct in adult. Fins are yellowish with margins stained in black, the dorsal fin having a median band. Found in the river systems of West Bengal.

(k) *Puntius ticto* : Better known as, Tie-tac-toe, barb, has a black stripe behind gill cover, silvery sometimes stained with red, a black spot on caudal, a similar one at the commencement of the lateral line. Fins black and sometimes orange. The dorsal fin in the male has a thick red border. Reported throughout India.

**Varieties of Barbs recorded in India :**

1. Puntius amphibius - Peninsular India upto Orissa and Rajasthan.
2. P. arenatus - Tamil Nadu.
3. P. arulius - Southern India (Kerala & Tamil Nadu).
4. P. arulius tampraparniei - Tampraparny river in Tamil Nadu, S. India.
5. P. bovanicus - Tamil Nadu (Cauvery river system).
6. P. carnaticus - Tamil Nadu, Cauvery, Krishna river system and North east Kerala.
7. P. chilinoides - Ganga river system.
8. P. chola - Through out India.
9. P. chrysopterus - Eastern India.
10. P. clavattus clavattus - North eastern India.
11. P. conchonius - Ganga, Brahmaputhra and Mahanadi river system, North eastern India and also in Cauvery river system in South India.

12. P. curmica - Rivers of Western ghats - South India.
13. P. denisoni - South eastern Kerala.
14. P. dorsalis - Cauvery & Krishna river system also recorded from Rajasthan.
15. P. dubius - Foot hills of Nilgiri hills, S. India.
16. P. dukai - Northern Bengal.
17. P. filamentosus - Cauvery river system & Goa.
18. P. fraseri - Dharna river - North India.
19. P. gelius - Eastern & North eastern India.
20. P. guganio - Ganga & Brahmaputhra river system.
21. P. hexastichus - Himalayan foot hill rivers from Kashmir to Sikkim & Assam.
22. P. jerdoni - Rivers of South India.
23. P. kolus - Rivers of South India & Madhya Pradesh.
24. P. lithopidos - Karnataka.
25. P. malabaricus - Western ghats & Travancore hills in Kerala.
26. P. melanampyx - Western ghats & Travancore hills in Kerala & Goa.
27. P. melanostigma - Cauvery & Bhavani river system in Tamil Nadu and Wynaad.
28. P. micropogon - Western ghats from Canara to Nilgiri Hills.
29. P. muzaffarpurensis - Bihar.
30. P. narayani - Tamil Nadu & Karnataka.
31. P. neilli - Thungabhadra & Krishna river systems of Andhra Pradesh.
32. P. parrah - South India.
33. P. phutunio - North eastern India.
34. P. pulchellus - Karnataka.
35. P. puntio - West Bengal.
36. P. rossipinnis - South India (Pondicherry)
37. P. sahyadriensis - Maharashtra.
38. P. sarana - Throughout India except Southern India.
39. P. subnasutus - South of Krishna river.
40. P. shalynius - North eastern India.
41. P. terio - North eastern river system.
42. P. thomassi - Karnataka.
43. P. ticto punctatus - Kerala & Coromandal coasts.
44. P. ticto - Through out India.

45. P. vittatus - Southern India and also Rajasthan.

46. P. wynaadensis - North eastern Kerala.

**Loaches**

These fishes have a sharp curved spine below the eye, which can reflect a nasty cut, when is erected while the fish is alarmed. No varieties of loaches are known to have bred in captivity hence is very dear to the hobby market.

1. *Botia almorhae* : Known as stripped or Tiger loach, reticulated body with grey on a yellow background, fins are yellow. Dorsal, pectoral and anal fins with four transverse black bands, the pectoral fins and each caudal lobe with five. Sometimes reticulated vertical bands are present. Reported from Kashmir, Almorha (Maharashtra) and Khasi Hills (Karnataka) and Uttar Pradesh.

2. *Botia dario* : Commonly known as Necktie loach. Oblique bands numbering seven or eight descend from the back to the abdomen are two or three or even more which cross the lobes of caudal fin. This fish is reported from the North eastern Indian rivers and Uttar Pradesh.

3. *Botia histrionica* : Dorsal fin inserted slightly behind intersection of pelvic and not at equal distance from tip of snout and caudal fin base - found in Uttar Pradesh, Manipur and Assam.

4. *Botia hymenophysa* : Three pairs of barbels present - Four nostrils united at their base and two maxillary - Recorded in Manipur.

5. *Botia lohachata* : Better known as Y loach because of the 'Y' shaped stripes or Pakistani loach in the international trade. There is a series of Y shape markings on an earthy brown body. The arms of the Y form each side meet on the top of the body so that top view shows about four 'O' shaped markings. In very old fish the regular Y-mark became obsolete, and the fish then shows haphazard rod like markings. It grows to a larger size than B. striata. It is reported from the rivers of North Eastern India, Punjab, Himalayas, Valleys of Ganges and Indus river system.

6. *Noemacheilus evezardi* : Commonly known as Poor Man's Botia. There are so many species of *Noemacheilus* scattered all over the country. They do not grow as large as Botia. They are of sober, earthy brown colour with vertical stripes, blotches or spots. The body is more slender than in Botia but not as tubular as in Coolie loaches. Like Botia, they

are bottom dwellers and make good scavengers.

**Noemacheilus species recorded in Indian river systems are :**

1. Noemacheilus altipendunculatus - North Canara, Kati river drainage.
2. N. anguilla - Maharashtra.
3. N. beavani - Garo hills (Meghalaya), Darjeeling (North Bengal) and Uttar Pradesh.
4. N. bimachari - Cauvery river system and Karnataka.
5. N. botia aureus - Ganga, Yamuna and Brahmaputhra river system.
6. N. botia botia - North eastern river system.
7. N. carletoni - Punjab.
8. N. corica - North eastern river system and Punjab.
9. N. denisonii - North eastern Kerala.
10. N. devdevi - Northern West Bengal.
11. N. guttatus - Assam.
12. N. horai - Punjab
13. N. kangjupkhulensis - Manipur valley & Naga hills.
14. N. kangrae - Punjab.
15. N. manipurensis - Rivers of Manipur valley & Naga Hills.
16. N.marmoratus - Rivers of Kashmir valley.
17. N. monilis - Bhavani river, Mettupalayam and Nilgiri hills.
18. N. monoceros - Assam.
19. N. montanus - Kangra & similar hills.
20. N. multifasciatus - North eastern river system.
21. N. pavonaceus - Assam.
22. N. poonaensis - River system of Poona (Maharashtra) & North Canara.
23. N. prashadi - Manipur (Thonagpal tank).
24. N. pulchellus - Bhavani & Cauvery river system.
25. N. rajasthanicus - Pratap Sagar, Kallara lakes, Takhat sagar (Rajasthan).
26. N. rendahli - Uttar Pradesh and Maharashtra.
27. N. rupicola - Rivers of Kashmir valley, Western Himalayas and Nagaland.
28. N. rupelli - Krishna river system & Poona.
29. N. savona - Northern Bengal.
30. N. scaturigina - North eastern river systems.
31. N. semiarmatus - Nilgiri Hills (Karnataka).

32. N. shebbeari - North Bengal.
33. N. shimogensis - Karnataka (Thunga river).
34. N. sikmaiensis - River systems of Manipur adjoining Burma.
35. N. spilopterus - Assam.
37. N. striatus - North eastern Kerala.
38. N. subfusca - Naga Hills & Khasi Hills, Meghalaya.
39. N. triangularis - Travancore hills, Kerala.
40. N. zonalternans - Manipur.
41. N. zonatus - Yamuna and Ganga river system.

**Cat Fishes**

They are equipped with sensitive whisker like barbels around the mouth. These are scale-less fishes and often growing to a large size. India is rich in many families of cat fishes, having potential aquarium fish in the overseas market.

About 20 varieties of Indian Cat fishes are reported to be good for keeping in aquarium. Cat fishes are with naked skin bony scutes or plates and never with true scales. Mouth is not protractile. One to four pairs of barbels are present. Most of the varieties are recorded from North eastern river system. Different varieties of Cat fishes recorded in Indian waters are:

*Ailia coila* : They are with short body rounded abdomen and short head. Small eyes, external, nearly or quite behind angle of mouth visible from below ventral surface. Anal fin long, caudal fin forked with simple and complete lateral line. Found in the larger rivers of northern India upto Krishna river system in South.

*Ailia punctata* : Short bodies with rounded abdomen and short head arched vertical profile. Body colour pale or dull white with a black blotch on caudal base and along upper third of body. Recorded from the river systems of Ganga, Yamuna and Indus.

*Batasio batasio* : Short, high and compressed body with rounded abdomen. Four pairs of barbels one each of maxillary, nasal and two of mandibular. Caudal fin forked. Lateral line complete. Longitudinal bands on either side of lateral line and a black spot on shoulder. Recorded from Assam, North Bengal and Kerala.

*B. tengara* : Body with oblique saddle shaped bands and a black spot on

nape. Distribution : North Bengal.

*Conta conta* : Commonly known as sucker Cat fishes. Generally small to medium sized fishes with oval shaped and compressed head and anterior part of body depressed. An adhesive apparatus on thorax hence name sucker fish. Found in Brahmaputhra river system.

*Gagata cenia* : Better known as Yellow Cat fish. Yellowish Bronze yellow body with silver coloured abdomen, three dark bands over the head, four more over the back, descending as low as the lateral line. Caudal fin with a semilunar black band, or a black blotch on each lobe, a dark mark across the dorsal fin. Commonly found in Bengal, Orissa, Yamuna, Ganges and Indus river systems.

*Somileptes gongota* : They are with an undulating band along the side of the body, giving off ventral bands towards the back or else oblique blotches with light edges descending from the back or placed irregularly on the body. Dorsal and caudal fins with transverse rows of blackish dots. They are found in North eastern river systems.

*Nangra punctata* : Coppery glossed body with gold colour on the sides, a black blotch on the occipit and three or four along the back descending halfway down the sides. A black band on the dorsal fin, and some black markings on the caudal fin, common in West Bengal.

*Nangra viridescens* : Glossy greenish brown on the back with two very light green bands, passing one from the base of each dorsal fin to the middle of the depth of the body. A dark band on the dorsal fin and spots on either lobe of the caudal fin. They are found in the Brahmaputhra tributaries and Yamuna river system.

*Nangra itchkeea* : Commonly known as Clown Cat fish. Yellowfish bronze body with silvery on the sides and abdomen, dark blotches along the back descending to half way down the sides. Black blotch on either lobe of the caudal fin and another on dorsal fin. Found in the rivers of Deccan plateau.

*Mystus tengara* : Commonly known as Cat fish. They are brilliant yellow in colour with a black shoulder spot and five black longitudinal line. Common in Northern and North Eastern river system.

*Mystus vittatus* : Short and compressed body with 3 or 4 longitudinal colour bands above and below lateral line. A dark shoulder spot and no spot at the base of caudal fin. Cosmopolitan in distribution.

*Mystus cavasius* : Short and compressed bodied fish with rounded snout. Four pairs of barbels on each of maxilliary, nasal and two of mandibular generally longer than head. A dark spot at the base of dorsal fin. Also cosmopolitan in distribution.

**Half Beaks**

*Hemiramphus Xanthopterus* : They are red half beaks with a brilliant lateral band two thirds as wide as a scale in its widest part. The tip of the beak is coral red and hence the name red half beak. Found in Kerala. Other one variety found near Bombay is with black beak and silvery lateral band. Hence the name H. leucopterus.

**Mud Perches**

*Badis badis* : They are with variable colour from rose pink to earthy brown to bluish violet to grayish green, but always showing a ventral chain link pattern. Body moderately elongated, compressed with rounded abdomen, mouth, slightly upturned. Lateral line present which is interrupted. The one with lateral line absent is *Badis dario* which is stone coloured with three or four broad bands. These are found in North Eastern riven system.

*Nandus nandus* : Greenish brown body with brassy reflections vertically marbled with three broad patches. A fourth crosses the free position of the tail occasionally with a black blotch. Compressed and oblong body with rounded abdomen. Terminal mouth, very protractile, its cleft very wide. These fishes are commonly found in North Eastern India.

**Paradise Fish**

*Macropodus cupanus* : Commonly known as Indian paradise fish. This do not have the flashy colouration as that of Chinese paradise fish, being earthy brown with two parallel dark horizontal stripes. The males with red pelvic fins and red tipped anal fins. It is also known as spike tailed paradise fish. This is found in Kerala.

*Macropodus cupanus dayi* : This one is rosy coloured, with two horizontal dark bands, one from above the orbit to the upper part of the caudal fin, the other from the angle of the mouth through the eye to the lower part of the same fin with spotted head and cheeks. Found in Kerala, Tamil Nadu and Karnataka States.

**Noble Fish**

*Ctenops nobilis* : Known as noble fish because of its peaceful nature and calm behaviour having golden brown marbled colour and a laterally compressed body with a longer and protrusible snout. It is a foam ball nest breeder, found in the riverine systems of North Eastern India.

**Gourami :**

These are calm fishes with attractive colouration varying from dull greenish to scarlet light blue with dark bands. Three common species are recorded.

a) *Colisa chuna* : Dwarf Gourami : With dull greenish body lighter along the abdomen, a dark sometimes black band along the side to the lower half of the tail. A dark band in the upper third of the dorsal fin and another along the base of that fin, and fin banded similar to dorsal, a dark band along the base of the soft portion. Caudal fin sometimes with a black spot at its base, its last third rather dark with two or three transverse bands. These are found in West Bengal and all North Eastern rivers.

b) *Colisa lalia* : Dwarf Gourami : These are smallest of gouramis having similar colour pattern of C. labiosa. This is the prettiest of all Colisa varieties having metallic blue and green stripes. This fish is extremely shy in nature. This is found in North Eastern river systems.

c) *Colisa fasciata* : Giant Gourami : These are dirty white in colour at bottom with greenish above, a green spot on either gill cover with orange greenish above, a green spot on either gill cover with orange bands descend obliquely downwards and backwards from back to abdomen, ventral fins edged with red and variegated with black green and white. Dorsal and caudal fins spotted with orange. These are cosmopolitan in distribution. Coromandel Coast as far South upto River Krishna in Andhra Pradesh, Ganges system in North and North Eastern States.

**Murrels**

*Ophiocephalus punctatus* : These are snake heads or commonly known as murrels. Greenish black colour on the back which becomes yellow on the sides and abdomen with a dark stripe along the side of the head. Several bands from the back pass downwards to the middle of the body with spotted fins. These fishes are recorded throughout the country.

**Puffer Fishes**

*Tetradon cutcutia* : Greenish yellow above, white on abdomen. A light band from eye to eye. A large black ocellus surrounded by light edge on side. The whole back marked with dark greenish reticulations enclosing carmine. A red spot on throat. Found in the riverine systems of W. Bengal, Orissa and Assam.

**Pipe Fishes**

*Syngnathus kalyanensis* : These are known as Pipe fishes with tubular body single dorsal fin without spines and pelvic fins absent. Tail not prehensile. Lateral line absent. Air bladder without pneumatic duct. Males with an egg pouch on tail. These fishes are found in Kalyan (Maharashtra). Other two species of *Syngnathus* found in India are *S. argyrostictus* (Tamil Nadu & Goa) and *S. spicifer* (Throughout).

**Glass Fishes**

This is a popular ornamental fish possessing transparent appearance with skeleton and some internal organs clearly visible. Indian glass fishes looks like a piece of crystal, floating and reflecting colours, in water with greenish to yellowish colour but shining like a gold or iridescent bluish green in reflected light. This little gem treasured much by any aquarist caught in large numbers from the lakes and pools of the country especially northern and north eastern parts. Four species are recorded in India. They are :

1. *Chanda baculis* : Shoulder spot absent; A golden spot on occipit found in the riverine systems of Orissa, W. Bengal, Uttar Pradesh, Bihar upto Punjab.
2. *C. nama* : Indistinct laterline, a dark blotch on dorsal fins upper edge generally present. Common in West Bengal.
3. *C. ranga* : A dark shoulder spot present. Common in Assam and other North Eastern river.
4. *C. thomassi* : Interopercle is not serrated. Found in Kerala.

**Knife fishes**

These are popularly known as feather back or knife fishes for their remarkable movements and knife like appearance. The fishes are soft without spiny rays which give them the appearance of a veil scantillating

in wind. Two species are recorded in India viz. *Notopterus notopterus* and *N. chitala* which are of cosmopolitan in distribution especially in Northern parts.

**Spiny eels**

*Macrognathus aculeatus* : Have an elongated brownish eel like body with dark patches, very long snout and small eyes with head protruding out. These are found throughout the country.

*Mastacembelus pancalus* : Commonly known as Spiny eels. Eel like elongated body with greenish line along the back, yellowish-white spots over the sides. Posterior portion of body often usually striped. Soft dorsal, pectoral, caudal and anal fins yellow in colour with numerous spots. Found in North Eastern rivers upto South but not South of Andhra Pradesh.

*M. armatus* : Coloured rich brown but lighter on abdomen. A blackish band through the eye is continued in and undulating course along upper half side of body. A row of black spots occurs along the base of soft dorsal fin, short black bands over the back under the region of the dorsal fin spines pectoral fin usually spotted, dorsal and anal fins usually banded or spotted. Commonly found in the river system of North Eastern State. Yet another species *M. guentheri* is also recorded in Kerala and Assam.

**Flying barb**

*Esomus danricus* : Commonly known as flying barb. Body with a broad black lateral band, long maxilliary barbels extending upto the anal fin. The peculiarity of this fish is its long pectoral fins and its propensity to jump out of water. While breeding the male strikes the sides of the female and she in turn bulls him. The eggs are only partially adhesive. Distributed throughout the country. Another species with plain sides without bands are also recorded in Tamil Nadu and Karnataka.

*Rasboras* : *Rasbora daniconius* - A black stripe runs across the silvery body, and is edged with a golden stripe parallel to it. It grows to 10 cms and is handy and active. This is a common fish in all riverine systems.

**Zebra fishes**

*Danios* : *Danio devario* : Body greenish above, silvery white below. The anterior part of the body is reticulated in its centre by steel blue lines, divided from one another by narrow vertical yellow bands. Three blue

lines divided by yellow ones, are continued backwards to the caudal fin, where the lower to amalgamate and passing upwards become lost on the superior half of the fin. Found in Northern and North Eastern river systems.

*Danio malabaricus* : Back steel blue, some irregular vertical yellow lines on the fore part of the body and three or four blue bands along the sides, the central so as to form a broad bluish band along the middle of the caudal fin. Commonly found in West Coast of India especially Northern Kerala.

*Danio aequipinnatus* : Body yellowish white. A wide bluish band extends along the body from the eye to the centre of the back of the caudal fins in its course are sometimes round silvery spots. Below it is another narrow band which occasionally joins the central one anteriorly. There are two other lighter bands above the central one. The intermediate ground colour is yellow. Fins yellowish. Dorsal and anal fins each with a broad bluish band along their outer half. Himalayas at Darjeeling and whole of Assam, Naza and Garo hills, and Deccan are the place of distribution.

*Danio dangila* : Back alive, abdomen silvery, sides with several narrow blue lines which in the anterior half or two thirds of the body form a beautiful network. A dark spot behind the gill covers anal fin with two or three blue stripes. Found in Bengal, Bihar, Himalayas at Darjeeling.

Other species of Danios which are of importance to India are :

a) D. fraseri - Rivers of Deoali area in Maharashtra.
b) D. naganensis - Naga hills in Manipur.
c) D. neilgherriensis - Nilgiri hills in Tamil Nadu.

*Brachydanio rerio* : Four metallic blue lines along the sides separated by 3 narrow silvery ones and forming three bands on the caudal fin, dorsal fin with a blue edging. Anal fin with three longitudinal blue bands. Lateral line short, not extending beyond pectoral fin. Bengal and as low the coromandel coast upto Machilipatnam in Andhra Pradesh.

**Chilwas**

*Chela dadyburjori* : Silvery with black lateral band along the body on which, strung like beads are found to frre black spots. Goa, Cochin (Kerala) and Nagercoil (Tamil Nadu).

*Chela laubuca* : Body long compressed, Abdomen keeled from below pelvic origin to arms, lateral line curved downwards. Found in Andhra Pradesh, Orissa, West Bengal, Madhya Pradesh and Assam river systems.

**Killi fishes**

*Aplocheilus lineatus* : Greenish with a gloss of purple on the cheek and along the abdominal surface. A golden green spot in the centre of each scale eight to ten vertical black bands pass down the sides to the abdomen. Coorg and Wynaad down the Malabar Coast. Commonly known as Killi fishes.

*Aplocheilus panchax* : Upper surface greenish becoming dull white on the sides and beneath. Fins yellow, lower third of dorsal fin covered with a large black spot, dorsal, caudal and anal fins margined with black. Orissa through lower Bengal, Andaman and Nicobar islands. These fishes are also known as Killi fishes or Green panchax. Another species recorded in India is *A. nibrostigma* with one or two rows of red spot along base of anal fin.

**Hill trouts**

*Barilius barna* : Adult dull green. Nine to eleven vertical dark bands on body, dorsal and caudal fins edged with black. The young have the back grey, the sides silvery with gold, seven to nine narrow deep blue vertical bands. Fins yellow, dorsal and caudal stained with black. Found in Assam, Ganges and its branches and upto Bengal and Orissa.

*Barilius shacra* : Black olive, rest of the body pinkish silvery, about twelve incomplete bars from the back downward towards the lateral line, a dark bar along the upper third of the dorsal fin. From Haridwar down the valley of the ganges, Assam.

*Barilius bendelisis* : Silvery spot purple back of a slaty grey, descending bars downwards the lateral line. In adults these bars become indistinct, but each scale with a black spot at its base and two on each scale forming the lateral lines. Fins whitish tinged with orange. A grey margin to the dorsal and caudal fins. Assam and Himalayas through India as far as the Western Ghats but not from Malabar and Canara Coast.

Other species of interest in Ornamental fish trade are :

a) B. bakeri : High ranges of Kerala.

| | | | |
|---|---|---|---|
| b) | B. barila | : | Northern Indian rivers and Mahanadhi in Orissa. |
| c) | B. bola | : | Northern India upto Orissa. |
| d) | B. canarensis | : | Western ghats of Kerala & Karnataka. |
| e) | B. dogarsinghi | : | Manipur. |
| f) | B. evezardi | : | Poona. |
| g) | B. gatensis | : | Western ghats, Kerala. |
| h) | B. radiolatus | : | Madhya Pradesh. |
| i) | B. tileo | : | North Eastern river system. |
| j) | B. vagra | : | North Eastern riven system. |

*Rohtee cotio* : Body silvery, darkest along the back and sometimes with a silvery lateral band. Throughout India except the Malabar Coast and South of the Krishna.

**Calbasu**

*Labeo calbasu* : Body blackish. In clear streams many of the scales have a scarlet centre. Found in rivers of Punjab, Kutch, Deccan, Southern India and Malabar from Krishna through Orissa and W. Bengal.

*Scats* : *Scatophagus argus* : These are originally brackishwater water fishes with short and compressed body, abdomen rounded, head short and compressed with conical snout of moderate length. Scales small with curved lateral line, lemon yellow coloured body with brownish black spot. Common in Southern India.

Although Indian climate is almost similar to that of the other countries in Eastern Asia and several varieties of Indian freshwater ornamental fishes are well known in the international market, India cannot make any significant progress in commercial breeding of ornamental fish on a large scale. However, our riverine resources are plentiful and give enormous opportunity to any trader. What we need is a person with fair knowledge of their locations, ability to organise fishermen to exploit and a little bit spirit it of adventure to explore these wild fishes in inaccessible places where absence of transport or even civilisation. We have the advantage of a mild climate, suitable soft water, abundant natural food and reasonably cheap labour. Thus both wild collection and bred varieties as well could be exported from the country.

## 2. MARINE FISHES

The seas around Laccadives and Minicoy on the Western side and Andaman & Nicobar Islands on the Eastern side teem with innumerable varieties of colourful Marine Ornamental Fishes. The coloured varieties are abundantly available in coral reefs and lagoons. A survey conducted during 1985 and 1986 indicate that the Indian water abound in fascinating and colourful ornamental fishes. The lagoons and coral reefs around Laccadives & Minicoy Islands and Andaman & Nicobar Islands are the abode of an extremely rich, colourful and varied Marine Ornamental Fish fauna.

Marine ornamental fishes are always fascinating for their spectral colour patterns and appearance. Some of the commercially important marine ornamental fishes are:

a) Clown fishes (*Amphiprion* spp.) are the most popular among the marine ornamental fishes. They are colourful, hardy, peaceful and popular for their symbiotic relationship with sea anemones. They live in the coral reefs, often several hundreds at a time, and occasionally in pairs also. The species available in Indian waters are *Amphiprion akallopisos, A. bicinctus, A. chrysogaster, A. clerkii, A. frenatus, A. melanopus, A. nigripes, A. perideraion.*

b) Marine Angels (*Holacanthus* spp.) live largely in pairs or small groups in the coral reefs and rocks. The outstanding feature of these fishes is their indescribable beauty and wide range of colour patterns. Probably the most beautiful of all the angels is the rock beauty, coloured jet black in the front part and yellow in the rear with its bright yellow fin studded with red spots. The available species in Indian waters are *Holacanthus annularis, H. imperator, H. semicirculatus, H. nigricans.*

c) One of the most important of the coral reef fishes is the moorish idol (*Zunclus* spp.). There are three species of moorish idol, the largest measuring upto 8 inch but 4 inch long fish are common. The body is strong and compressed on the sides and when looked at from the side it looks nearly circular. The high positioned dorsal fin and the triangular anal fin provide a diamond-shaped outline. The most striking feature is the colour pattern, the body being white and pale yellow with broad bands of brownish black colour running from top to bottom. In Laccadives waters, *Zanclus cornutus* and *Heniochus acuminatus, H. chrysostomus, H. varius* are available.

d) Puffers or Puffer fishes are mostly known by their other names such as balloon fishes, swell fishes, globe fishes and blow fishes. All these names express their outstanding feature of being able to blow themselves upto twice or more their normal size. The five species of puffers recorded in the waters around Laccadives belong to the genera *Canthigaster*.

e) Yet another notable as well as ugliest fish in the world is the Scorpion fish. The most showy Scorpion fish is called the turkey fish, lion fish, zebra fish, dragon fish or butterfly cod. The body has striped, zebra like markings. All the fins are divided into ribbon like strips with the massive head in irregular shape with eyes set high up and the mouth wide and sloping down at corners. They are brightly coloured with maroon grey stripes, rose - blue-white stripes and brown - yellow stripes. The body is decorated with warts, flaps and frills which with the added mottled colour makes it difficult to identify them along seaweeds. *Pterois antennata, P. radiata,* and *P. volitans* are the three species available in our waters.

f) Squirrel fishes classified under the genus *Holocentrus* are usually bright red and have large eyes giving them a faint resemblance to red squirrels and hence the name. The red body is usually ornamented with silvery spots or stripes on the flanks running from behind the gills to the base of the tail fin. They are available in Laccadives waters.

g) The Surgeon fishes are very strongly coloured but cause difficulties to those trying to name them as they change their colour frequently. They are called Surgeon fishes as they carry lancets that can cut one's flesh like a surgeon's scalpel. The body is deep and flattened from one side to the other and almost oval in outline except for the tail fin. The lancets are small and two extremely sharp bony keels, one on either side near the base of the tail fin are present. Their colours, while varied, have subdued appearance of pastel shades. *Acanthurus coaruleus, A. leucosternon, A. lineatus, A. tennenti, A. triostigus* are species available in India.

h) The File fishes and Trigger fishes have peculiar dorsal spine which has an ingenious locking device. The head occupies about a third of the body length, the mouth is small and the eyes are fairly large. Though they look like artificially coloured, trigger fishes are often boldly marked with garish, sometimes most grotesque, colour patterns. They show an interesting swimming behaviour. The colour varies from grey brown to green brown with a violet tinge on the back and blue bands with yellow or black spots on the dorsal and anal fins. Laccadive waters

have *Rhinecanthus* sp., *Odonus niger, Oxymonocanthus longirostris* (file fish), *Pseudobalistes fusech, Xanthiuchthys ringens.*

i) The trunk fishes or box fishes have fanciful colours and are suitable for salt water aquaria. Their bodies are enclosed in bony boxes made up of 6 sided bony plates fitting to snug into one another, leaving only the tail unarmoured and hence the name. In Laccadives area, two species viz. *Ostracion cubicus* and *O. meleagris* are found.

J) The common Cardinal fishes (*Apogon* spp.) are usually red in colour and live in and around the coral reefs. One of them, *Siphamia versicolor* lives in association with a dark red sea urchin, moving in between the sea urchin and cleaning their shells. If the urchin has different colour, the fish will also change its colour suitably to match with that of its new host.

There are other fishes having bright colouration. They include butterfly fishes belonging to the group *Chaetodontidae*. These are less hardy, but very beautiful. They are relatively small fish, highly bilaterally compressed, hence they swim like a standing disc. Some species have brilliant colours, and they are very peaceful, but often have rather specialised food habits. The problem is worse with some close relatives of *Chaetodon*, especially those with long tiny snout eg. *Chelmon rostratus, Forciper longirostris* and *F. flavissimus.* There are about 20 species of varying colours from yellow to greenish brown varieties of butterfly fishes are reported in Indian waters.

One group which has recently gained great popularity is that of the wrasses. The best known of these is the beautiful blue banded cleaner wrasses, *Labroides dimidiatus.* The cleaner wrasses is in such great demand that its numbers have decreased in some of the more collecting areas around the world. In India there are two species of cleaner fishes reported which are yet to be exploited. Besides fish, cleaner shrimp, some of the sea-anemones and marine tube worms make interesting aquarium habitat. No marine aquarium seems complete without sea anemones. In fact they are a must, if one wants to keep clowns. Two genera of sea anemones are favoured by the clowns, (*Amphiprion* spp) and often imported are *Radianthus* and *Stoichactis* which are available in our waters. Other groups of fishes which have recently become popular are Sea horses (*Hippocampus* spp.) and Mandarin fish (*Synciropus* spp.). They are difficult to feed and hence usually do not live long in captivity.

Different types of Tangs, Damsels, Sweet lips and Snappers with glowing colours are the other beautiful ornamental fishes available in our waters which will be having great demand in the international market. A complete list of fishes available in the seas around Laccadives islands as well as Andaman & Nicobar islands is annexed.

**Market trend for marine ornamental fishes**

Major suppliers of marine fishes are Philippines, Singapore, Indonesia, Sri Lanka, the Caribbean, Kenya, Mauritius and some Red Sea countries. India is yet to make a beginning in this line. Philippines are known for the direct export of marine exotic varieties. Singapore exports relatively few salt water fish, originating from its own resources and depends mainly on re-export of Indonesian caught fish and invertebrates, while Sri Lanka exports her own reef fishes and fishes coming from Maldives. Those fishes originating from the Maldives are usually less available in Sri Lankan waters or only seasonal. Since Indian fauna is rich and similar to that of Sri Lanka and Maldives, we could certainly make a good deal 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, which affords organisms living in it a much longer life span.

Prices of marine ornamental fish have been remarkably stable during the last ten years. A moderate increase in the prices of the cheaper species has been registered plus as tendency for a small decrease in the more expensive ones. The more expensive species usually receive better care than the cheaper ones. Consequently, they have a better chance of survival. The majority of clownfish has supply and demand constraint, which keep its price stable. In contrast, there is increasing demand for tangs and surgeonfish. Furthermore, they are less abundant than clownfish and more difficult to catch, thus fetch higher prices. Nonetheless the most expensive of them all is the clown trigger fish, *Ballistoides niger* which are often exported at US$ 50 to 60 each, while other triggerfish fetch usually much less at US $ 4 to 6.

However, prices show very little variation in the case of different exporters in an exporting country. A major stabilising factor is the keen competition between the exporting companies. Occasionally, some big exporters give official discounts which will attracts customers and also serves to increase interest in the marine section of the trade. Good

trade practises are dependable deliveries and quality species.

The paradise islands like Laccadives and Andaman the jewels in the Bay of Bengal, are virgin ground for marine ornamental fishes that could be easily exploited for export. However, the coral reefs need to be protected from robbing them of their hard calcareous base by indiscriminate exploitation which would cause disastrous and deleterious ecological effects on the surrounding biota.

**Annexure I**

| Scientific Name | Common Name | Potential *** | Transport nature **** |
|---|---|---|---|
| Abudefduf sp. | Damselfishes | A | Ha |
| Acanthurus coeruleus | Grey Surgeon | F | St |
| Acanthurus leucosternon | Powder-blue Surgeon | A | St |
| Acanthurus lineatus | Clown Surgeon | F | St |
| Acanthurus tennenti | | F | Fı |
| Acanthurus triostegus | Convict Tang | R | De |
| Amphiprion akallopisos | Indian Orange Anemone fish | F | Ha |
| Amphiprion bicinctus | | F | Ha |
| Amphiprion chrysogaster | | S | Ha |
| Amphiprion clarkii | Yellow-tailed Anemone fish | F | Ha |
| Amphiprion frenatus | Red Clown | F | Ha |
| Amphiprion melanopus | | F | Ha |
| Amphiprion nigripes | Maldivan Anemone fish | F | Ha |
| Amphiprion perideraion | False Skunk-striped Anemone fish | F | Ha |
| Antennarius leprosus | Yellow Rocking Weedfish | F | Ha |
| Anthias squamipinnis | Lyretail Coralfish | F | Fr |
| Apogon spp. | Cardinal Fishes | A | Ha |
| Apogonichthys ocellatus | | F | Ha |
| Aspidontis tractus | False Cleanerfish | F | Ha |
| Balistapus rectangulus | | F | St |
| Balistapus undulatus | Undulate Triggerfish | F | St |
| Balistoides viridescens | Blue-finned Triggerfish | F | St |
| Butis butis | Sleeper Goby | F | Ha |
| Cantherinus pardalis | Leopard Filefish | F | Ha |
| Canthigaster albovittatus | | F | Ha |
| Canthigaster amboinensis | Amboina Toby | F | Ha |
| Canthigaster bennetti | Bennett's Toby | S | Ha |
| Canthigaster margeritatus | Sharp-nosed Puffer | F | Ha |

| Scientific Name | Common Name | Potential *** | Transport nature **** |
|---|---|---|---|
| Canthigaster valentini | Saddled Toby | F | Ha |
| Centropyge bispinosus | Dusky Angelfish | S | St |
| Centropyge multispinis | Pigmy Angelfish | S | St |
| Chaetodon auriga | Threadfin Butterflyfish | F | St |
| Chaetodon chrysurus | Pearlscale Butterflyfish | F | St |
| Chaetodon citrinellus | Citron Butterfish | F | St |
| Chaetodon collare | White-colar Butterflyfish | F | De |
| Chaetodon ephippium | Saddle Butterflyfish | F | De |
| Chaetodon falcula | Double-daddle Butterflyfish | F | De |
| Chaetodon kleini | Klein's Butterflyfish | F | De |
| Chaetodon lineolatus | Lined Butterflyfish | R | De |
| Chaetodon lunula | Raccoon Butterflyfish | R | De |
| Chaetodon melanotus | Black-backed Butterflyfish | S | De |
| Chaetodon meyeri | Meyer's Butterflyfish | Sc | De |
| Chaetodon ornatissimus | Ornate Butterflyfish | Sc | Fr |
| Chaetodon pelewensis | Dotted Butterflyfish | R | Fr |
| Chaetodon picturs | False Vagebond Butterflyfish | R | Fr |
| Chaetodon plebeius | Two Spot Butterflyfish | F | St |
| Chaetodon rafflesii | Raffles Butterflyfish | Sc | De |
| Chaetodon speculum | One Spot Butterflyfish | F | De |
| Chaetodon trifasciatus | Three-striped Butterflyfish | F | De |
| Chaetodon unimaculatus | One Spot Butterflyfish | F | De |
| Chaetodon vagabundus | Vagabond Butterflyfish | F | We |
| Chaetodon xanthocephalus | Goldheaded Butterflyfish | R | De |
| Chromis caerulea | Blue-green Damselfish | A | Ha |
| Chromis dimidiatus | Bicolor Damselfish | A | Ha |
| Coris angulata | Twinspot Wrasse | F | St |
| Coris formosa | Clown Wrasse | F | St |
| Coris gaimardi | False Clown Wrasse | F | St |
| Ctenochaetus strigosus | Kole | S | St |
| Dascyllus aruanus | White-tailed Damselfish | A | Ha |
| Dascyllus reticulatus | Reticulated Damselfish | A | Ha |
| Dascyllus trimaculatus | Three-Spot Damselfish | A | Ha |
| Dendrochirus brachypterus | Scorpionfish | F | Ha |
| Dendrochirus zebra | Scorpionfish | F | Ha |
| Diodon hystrix | Porcupinefish | F | Ha |
| Echindan nebulosa | Snowflake Moray Eel | | |
| Echidna zebra | Zebra Moray Eel | | |
| Eleotridus strigata | Goldenhead sleeper Goby | | |
| Epinephelus flavocaeruleus | Blue and Yellow Reef-Cod | F | Ha |
| Epinephelus malabaricus | Malabar Reef-Cod | F | Ha |

## ORNAMENTAL FISHES

| Scientific Name | Common Name | Potential *** | Transport nature **** |
|---|---|---|---|
| Forcipiger flavissimus | Long-Nose Butterflyfish | S | St |
| Glyphidodontops hemicyaneus | Azure Demsel | F | Ha |
| Gobiodon citrinus | Lemon Goby | F | Ha |
| Gomphosus coeruleus | Bird Wrasse | F | Ha |
| Gomphosus varius | Longfase Wrasse | A | Ha |
| Grammistes sexlineatus | Golden-Striped Grouper | F | St |
| Halichoeres app. | Wrasses | A | Ha |
| Hemibalistes chrysopterus | White-Rim Triggerfish | F | Ha |
| Hemipteronotus taeniourus | Masked Wrasse | F | St |
| Hemitaurichthys zoster | Pyramid Butterflyfish | F | Fr |
| Heniochus acuminatus | Pennant Coralfish | F | St |
| Heniochus chrysostomus | Poor Man's Moorish Idol | F | St |
| Heniochus varius | Humphead Banner Fish | F | St |
| Histrio histrio | Sargassum Fish | | |
| Holocentrus spp. | Squirrelfishes | F | De |
| Labroides bicolor | Yellow Cleaner Wrasse | F | Ha |
| Labroides dimidiatus | Common Cleaner Wrasse | F | Ha |
| Lactoria cornuta | Long-Horned Cowfish | F | Ha |
| Lutjanus kasmira | Blue-Striped Snapper | A | St |
| Lutjanus sebae | Red Emperor | A | St |
| Macalor niger | Black and White Snapper | J | St |
| Macropharyngodon meleagris | Leopard Wrasse | A | St |
| Meiacanthus spp. | | A | St |
| Muraena tessalata | Moray Eel | | |
| Myripristis spp. | Soldierfishes | | |
| Naso brevirostris | Shor-Nosed Unicorn Tang | A | Ha |
| Naso literatus | Smooth-Head Unicorn Tang | A | Ha |
| Nomateleotris splendida | | F | St |
| Odonus niger | Black Triggerfish | F | Ha |
| Ostracion cubicus | Spotted Cube | S | St |
| Ostracion meleagris | Spotted Boxfish | S | St |
| Oxymonocanthus longirostris | Long-Nosed Filefish | F | Fr |
| Parachaetodon ocellatus | | F | St |
| Platax orbicularis | Orbiculate Bat Fish | F | Ha |
| Platax teira | Long-Finned Bat Fish | F | Ha |
| Plectorhynchus albovittatus | Yellow-Lines Sweetlips | F | Ha |
| Plectorhynchus gaterinoides | Straight-Banded Sweetlips | F | Ha |

| Scientific Name | Common Name | Potential *** | Transport nature **** |
|---|---|---|---|
| Plectorhynchus orientalis | Oriental Sweetlips | F | St |
| Plectorhyncus pictus | Painted Sweetlips | F | St |
| Plectropomus maculatus | Saddleback Grouper | F | St |
| Plotosus anguillaris | Saltwater Cat Fish | A | St |
| Pomacanthus annularis | Blue King Angelfish | R | Ha |
| Pomacanthus imperator | Emperor Angelfish | R | Ha |
| Pomacanthus semicirculatus | Semicircle Angelfish | R | Ha |
| Pomacenturs nigricans | Black Velvet Damselfish | A | St |
| Pseudobalistes fuscus | Blue-Lined Triggerfish | A | Ha |
| Pterois antennata | Spotfin Lion Fish | F | Ha |
| Pterois radiata | Whitefin Lion Fish | F | Ha |
| Pterois volitans | Scorpion Fish | F | Ha |
| Rhinecanthus aculeatus | Picasso Triggerfish | F | Ha |
| Rhinopias spp. | Popeyed Sea Goblins | R | Ha |
| Scarus sordidus | Green Parrotfish | A | Ha |
| Scorpaenopsis cirrhosa | False Stonefish | F | Ha |
| Siganus vermiculatus | Vewrmiculated Rabbitfish | F | Ha |
| Syngnathus spp. | Pipefishes | F | De |
| Taeniotus triacanthus | Sailfin Leaffilsh | | |
| Tetrosomus gibbosus | Humpbacked Boxfish | F | St |
| Thalassoma lunare | Lyretail Wrasse | A | St |
| Therapon jarbua | Target Perch | F | Ha |
| Triacanthus biaculeatus | Black-Finned Triple-Spine | F | Ha |
| Triacanthus brevirostris | Short-Nosed Tripod Fish | F | Ha |
| Tripterygion fasciatum | | F | Ha |
| Xanthichthys ringens | Sargassum Triggerfish | | |
| Zanclus cornutus | Moorish Idol | A | St |
| Zebrasoma scopas | Brown Tang | A | St |
| Zebrasoma veliferum | Yellow-Tail Sailfin Tang | S | De |
| Zebrasoma xanthurum | | | |
| Stenopus hispidus | Red-Banded Cleanershrimp | A | St |

*** *Under potential* **** *Under transport nature*
*A = abundant; F = frequent; R = rare; Sc = scarce; I = infrequent; Ha = hardy; St = sturdy/strong; De = delicate; Fr = fragile; We = weak.*

# Part II

## MASS PRODUCTION OF ORNAMENTAL FISHES

### 1. Freshwater fishes

Mass production of ornamental fishes is one of the recognised industries in many of the South Asian countries, which has not assumed any significance in India except one or two large scale production centres in Madras, Southern India. India is the only country which has many indigenous colourful fishes to the ornamental fish industry after South American and African countries. Taking into consideration of the huge demand for export of ornamental fish, it is possible to undertake mass production of ornamental fish, on farm scale basis; as production on small scale will not be profitable. This will also build up a proper international and internal marketing set up as well which will make it economically viable and earn foreign exchange.

The present demand for ornamental fish having good quality fishes within the country is very much promising. Due to ideal climatic conditions, three of the four metros in the country have emerged as the major breeding centres. There are atleast 200 full time and over 1500 part time ornamental fish breeders in the country and their production level is not at all enough to cater to the demand. In the country, mass production of fresh water food fishes has been achieved its height and our position in the world is second, China being the largest producer of fresh water food fishes. Due to blue revolution in the country, we have reached a stage called 'aquaplosion'. A similar achievement is yet to be made in ornamental fishes. In the country, we have only two large

ornamental fish farm which could cater to only about 15% of the national demand. Except for common exotic species like gold fishes (*Carassius auratus*) angles (*Pterophylum scalare*) different varieties of tetras (*Tetragonopterus*), cichilids (*Apistogramma* spp.) and various live bearers, by and large several beautiful varieties of fishes are still collected from the wild for domestic supply and export as well. Organised export trade in ornamental fish depends primarily on assured and adequate supply as and when there is demand. There can hardly be assured supply if we depend on collection from natural sources. Besides, such natural sources could be far away from export centres, necessitating organised interim storage, handling and transportation facilities which will add up to the cost of the fish to the buyer, while natural sources may be exploited primarily to meet the internal demand and for developing export markets, regular export trade in selected high priced species should depend largely on organised production centres.

**Production of fishes could be conveniently grouped as**

i) Extensive

ii) Semi intensive and

iii) Intensive method

Extensive method is nothing but trapping or storing/stocking of cultivable organisms in the culture sites where there is no control over the predators and where there is no supplementary feed. Hence quality and quantity of seeds is is not assured. In the case of semi intensive method, the culture ponds are selectively stocked with fast growing species which are fed with artificial feeds and where predators and parasites are controlled; where as intensive method is very expensive involving high density culture with continuous exchange of water and intensive feeding with control over predators and parasites.

Since ornamental fishes are very delicate, semi intensive or intensive culture methods have to be adopted. However, Ornamental fishes are being raised at present mostly in indoor set ups, either in cement, glass or earthern tanks. Detailed knowledge on their biology, habitat, feeding and breeding habits, characteristic of eggs and larvae etc. are essential to organise large scale breeding and mass production of ornamental fish while a lot of such information are available in published literature, the precise technical know how on breeding a particular species of fish and successfully rearing its young ones is generally lack-

ing particularly for large scale operation. Successful large scale rearing of young ones of ornamental fishes depends on specific knowledge on the types of food required by the post larvae, fry and juveniles and in making dependable arrangements for producing adequate quantities at each stage. This involves technology for intensive production of live feed organisms such as selected protozoans, rotifers and hatching Artemia cysts, the using its nauplii for feeding larvae. In order to avoid mortality of fishes collected from natural resources or produced at the production centres, technology of handling and transportation has to be perfected with reference to each species. The experience gained in closed system transportation of carp fingerlings by air, rail and road would be the best example in this regard.

We have the technology of induced breeding of Indian major carps and Chinese carps by hypophysation. This technology has been adopted successfully for the commercial breeding of selected species of ornamental fishes. Large scale rearing of ornamental fishes has also been successfully done in the country through 'dirt system' which is being practised in USA (Florida) and South East Asian countries. The following aspects in mass production ornamental fishes through 'dirt system' need careful consideration before being adopted for implementation.

**Water**

Water being the environment which is the pre-requisite for the maintenance, breeding and culture of tropical fishes. It is therefore, necessary that without the source of water the project cannot just start. Several sources of fresh water such as rain, river, artesian, well, canal and reservoirs are available. Also these sources may or may not be perennial, hence a perennial source has to be chosen. The quantity removed should be enough to compensate for losses through seepage and evaporationand same quantity of water must be replaced by an adequate flow to maintain the level. The flow of water from these resources to the site of the project can be gravitational or by lifting with water pumps powered by electricity or diesel. Other physico-chemical factors such as pH, hardness, temperature and dissolved oxygen are of concern for culture and maintenance of tropical fishes.

**pH**

Depending upon the source, the pH of water shall have variation from acidic to alkaline. pH varies according to a number of chemical and

biological factors. The best water for major varieties of fish for cultivation is that which is neutral or slightly alkaline with pH between 7.00 to 8.00, whereas the fishes belonging to *Characin* group respond better in slightly acidic conditions. pH variation is minimum in the alkaline waters. Marshy and peaty water with negligible alkalinity have an acid pH. The same is true for water from a soil poor in calcium. On the other hand, excessive increase in the pH can occur, not only through the flow of effluents with high alkalinity but also through a natural processes following assimilation by plants of all the carbondioxide reserves in a water with low alkalinity. The top limit of pH for carps is 10.8. Among the possible ways of controlling pH in a pond water with low alkalinity, liming will permit the pH to be increased and ensure sufficient pH stability. The pH should be controlled regularly in acid water arising from marshes, in alkaline regions sheltered from important fluctuations of pH a very regular control is not indispensable. The pH must, however, be controlled again when the water or bottom of a pond has been treated with quick lime, otherwise the pH can then exceed the value which fish can tolerate.

**Total Hardness**

Hardness in principle is the total soluble calcium and magnesium salts present in the water expressed as its $CaCo_3$ equivalent. The total hardness also includes the sulphates and chlorides of calcium and magnesium. Total hardness is used to classify waters as hard or soft but the amount of hardness taken as a criterion for classification varies with different workers. According to Swingle (1986) total hardness of 50 ppm $CaCo_3$ equivalent is taken to be the dividing line between hard and soft waters. Pond waters having a hardness of 15 ppm or above are satisfactory for growth of fish and do not require addition of lime, whereas waters having hardness less than 12 ppm require liming for higher production of fish. Waters less than 5 ppm of $CaCo_3$ equivalent cause slow growth, distress and eventual death of fish. Free $Co_2$ at a concentration of more than 15 ppm is detrimental to pond fishes. The air breathing fishes can however, survive 100 ppm of $Co_2$. Lime treatment for waters having total hardness and alkalinity below 20 ppm and found a close relationship between the base saturation of bottom muds and total hardness of water.

**Temperature**

Proper temperature of water is the most important factor for breeding, rearing and transport of tropical fishes, for most of the vari-

eties, 21°C to 39°C being the low and high limits, respectively. 28°C being the most suitable temperature, most of the varieties breed in this temperature. However, in the winter it is necessary to increase the water temperature in the areas where the temperature falls below 21°C. Thermostatically controlled heating can be utilized in such areas in indoor tanks. In the areas where the water temperature goes beyond 30°C, it is recommended to move the fish to shady areas and the farms should have adequate shade and plantation to keep down the temperature.

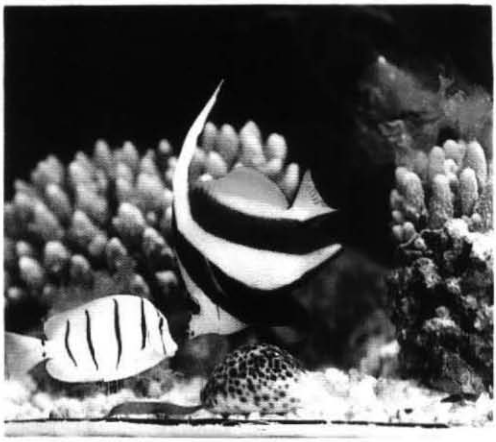
**Oxygenation**

Dissolved oxygen in the water plays a crucial role in the fish culture. If the required level is not maintained the fishes are subjected to stress becoming vulnerable to diseases and parasite outbreak. Its solubility varies with temperature and also upon the rate at which it is brought into contact with water. Oxygen dissolves in water by direct diffusion at the air water interface. It is also available from the plants, being given out after photosynthesis. It can be increased in the water by various artificial means such as constant aeration, circulation of water, surface agitation, also in transporting bags by way of pure oxygen. The surface agitation drives free carbon di oxide from solution by bringing greater portion of the respired water to the air water interface in a given period of time. A constant turnover rate of 1 gsfm (Gallons per square foot per minute) in systems larger than 200 gl keeps the oxygen level at saturation at all temperatures and eliminates oxygen depletion as a factor when other conditions in a culture systems becomes questionable. Temperature is the most critical factor affecting respiration as the breathing rate increases, with rising temperature there is an increase in metabolic rate creating higher oxygen demand on the tissues and contrary to this, the temperature and solubility of oxygen are inversely related. As the temperature increases, the oxygen holding capacity of water decreases. When the oxygen depletion is detected, the simplest method of increasing dissolved oxygen is to add well aerated new water or spraying water over the surface of pond water. Compressed air, compressed oxygen, air blowers and air compressors can be utilised to aerate oxygen deficient ponds.

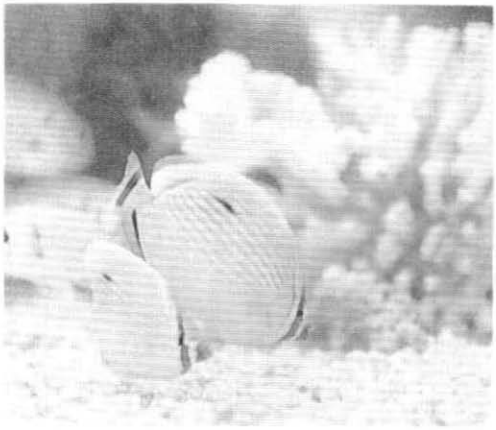
**Filteration**

Filteration is the most important and necessary aspect of intensive farming systems and is inevitable in the closed system culturing as it removes the accumulated toxic metabolites on a continuous basis which

Heniochus acuminatus (Moorish Idol)

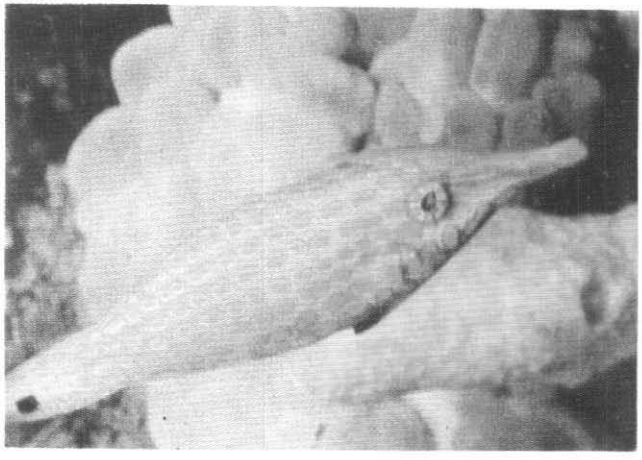


Chaetodon trifasciatus (Rainbow Butterfly)

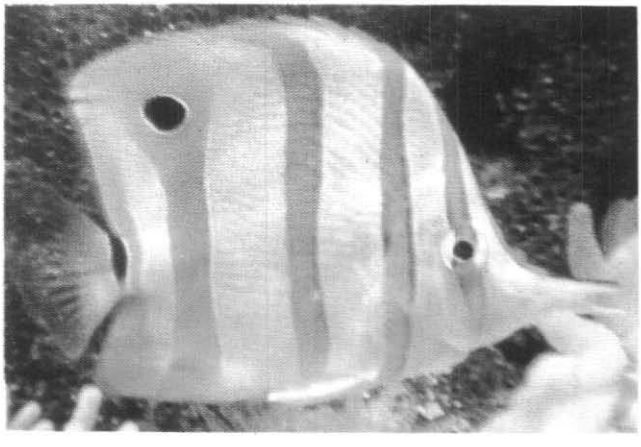


Amphiprion clarki (Clown Fish)

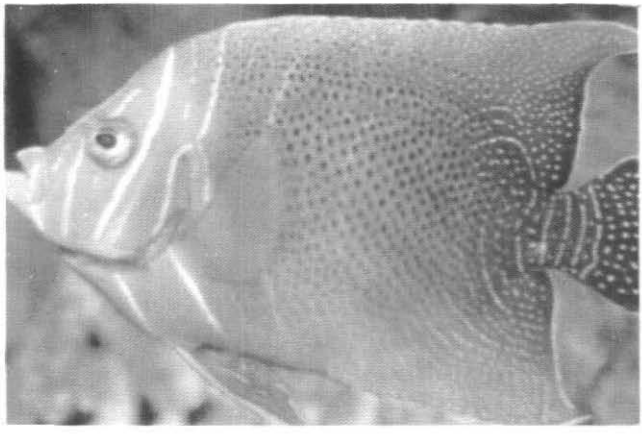
Oxymonacanthus longirostrics (File Fishes)



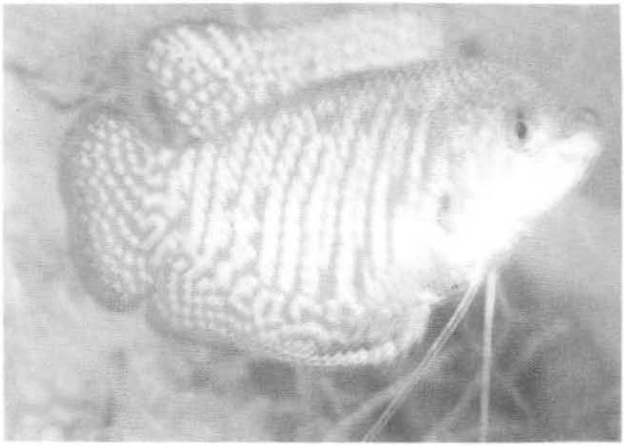
Chelmon rostratus (Copperband Butterfly)



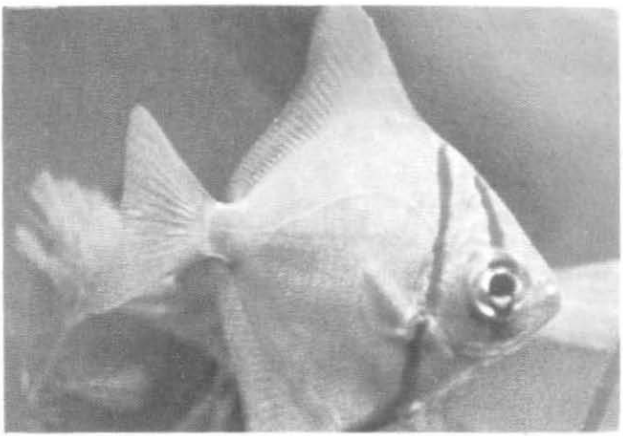
Pomacanthus semicirculatus (Koran Angel Fish)



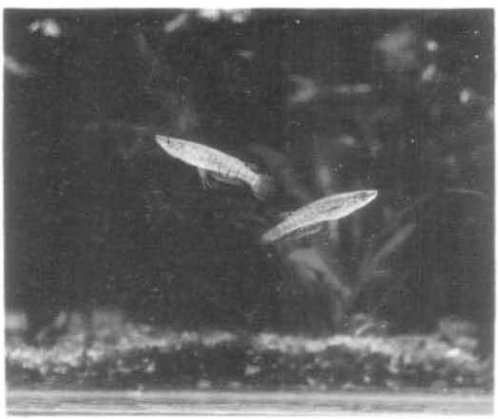
Colisa lalia (Dwarf Gourami)



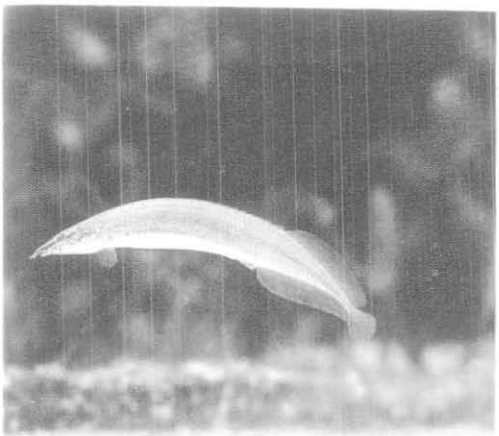
Monodactylus argentus (Finger Fish)



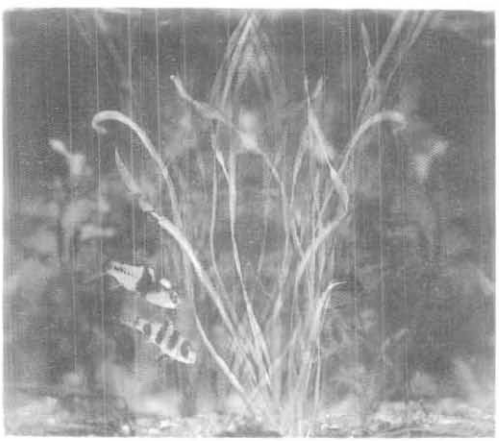
Aplocheilus panehax (Killi Fish)



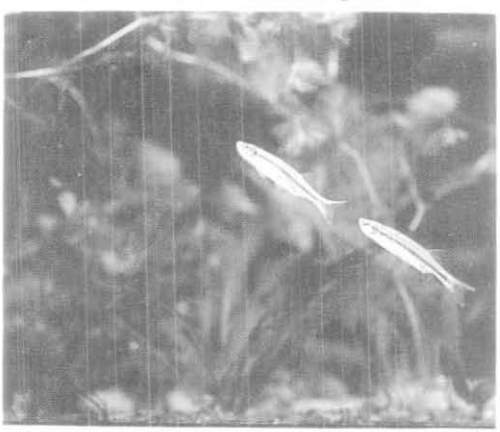
Mastacembelus armatus (Spiny Eel)



Barbus nigrofasciatus (Barbs)



Esomus danricus (Flying Barb)



are primary limiting factors in the ornamental fish culture. The successful results depend on sustaining and reproducing stable water conditions. In the closed system approach of culturing aquatic animals, the water is recycled and used again. In semi closed and open systems, water is continuously discarded and replenished from a natural source. The closed systems can be operated in areas of water shortage and heavily polluted areas without depending on the local water supply and offer better environmental control. Two types of filteration are used in the closed system culturing or biological or mechanical filteration.

**Biological filteration**

Mineralisation of organic nitrogenous compounds, nitrification and denitrification by bacteria suspended in water and attached to the gravel in a filter bed is biological filteration. Most of the nitrification in filter bed occurs on the upper gravel layers. Hence filteration may be designed with the surface area of the bed in mind rather than the volume of water. Size of the gravel is important as the small gravel has more for bacterial attachment compared to large sized gravel. Circulation through the bed is impaired when the gravel is of very fine size. As detritus accumulates and surface of the bed is clogged, vertical channels form and water follows these paths of least resistance. The result is erratic oxygenation and anoxic areas where the growth of aerobic bacteria is inhibited. For this reason sand or very fine gravel is undesirable, especially in deep beds. Gravel measuring 2-5 mm size is the best for most systems. The shape of gravel should be angular as it has more surface than round types. Since filter bed is a permanent installation, the gravel should not be taken out of the filter systems and washed. The washing removes most of the detritus matter which support a large population of nitrifying bacteria.

The turnover rate or the rate at which water moves through a system should not fall below 1 gsfm in systems of 200 gallons or more. This rate keeps oxygen level near saturation at all times under normal culturing conditions. An air lift is the most trouble free means of moving water through a biological filter system. An air lift is essentially a vertical length of pipe where 70% submergence is necessary for maximum efficiency.

**Mechanical filteration**

Physical separation and concentration of suspended particulate matter from circulating water. The gravel size of 2-5 mm recommended for

biological filteration system works well as a mechanical filteration system also. The water may be filtered by allowing it to percolate through the filter medium by gravity or by forcing it through the filter bed under pressure. Both technique needs pumping to deliver water into the filter and to back flush when the medium becomes clogged. Very fine particles may pass through sand filters and later flocculate and settle out in culture tanks. It can lead to turbid water or undesirable sediment accumulations in tanks or raceways.

**Feed and feeding**

Fish food may be live, dried, freeze dried or frozen and it plays a most vital role in any production of fish items. The live fish food such as tubifex is collected from natural resources such as sewage channels etc. Fresh water plankton consists mainly of Cladocerans such as Daphnia and Moina, copepods and rotifers which are available round the year in the waste water ponds in and around the city and suburban areas. The method utilised for the culture of plankton in the nursery are well suited for this purpose, hence Daphnia, Moina and Rotifer can be cultured in the cement cisterns of size 1m x 3m x 1m, plastic pools above one meter diameter and nursery ponds of size measuring 10 m x 5 m x 1 m. The suitable manuring agents suggested are cowdung, oil cake, superphosphate and yeast etc. Constant blooms can however be maintained with repeated doses.

Marine food organism, *Artemia* or brine shrimp can also be cultured in plastic pools with constant aeration and adults ones are harvested and used as food for breeding fishes. Successful operation of any mass production centres for ornamental fish depends upon the production of live feed organisms continuously to cater the centre. At present it is possible to maintain a continuous culture in the field conditions also.

**Artificial feeds**

Artificial feeds in the form of flakes are acceptable to ornamental fishes and can be prepared with 40 to 50% protein level by using animal protein, algae, minerals and vitamins. It must always be noted that nutritional deficiencies exist in processed foods.

**Breeding and rearing**

There are two types of breedings in the Ornamental fishes viz., egg layers and live bearers. Among the egg layers the method of breed-

ing differs from family to family, such as in the families *Cyprinidae, Anabantidae, Characidae,* segregation of males and females prior to breeding helps for increased fecundity and higher fertilization. Among the cyprinids such as gold fish, koi, etc. artificial breeding techniques such as hypophysation and hand stripping method can be applied for desirable results along with selective breeding by culling the stock having undesirable characters.

While the eggs of gold fish are adhesive, those of Characin are demersal. It is, therefore, necessary to remove the breeding pairs after breeding. Among the anabantids such as *Betta* sp., Gourami sp., forming the most important group of aquarium fishes, has a tendency to prepare a bubble nest and deposit the eggs in the nest at the surface of water. This group also takes the care of the eggs upto yolk absorption stage of hatchlings whereas in the egg laying family like *Cichlidae,* the males and females select their mate and need privacy for breeding. The pair lays the eggs on the cleaned substratum and guards till fry stage. This unique parental care ensures full protection to the babies from the predators till the fry stage. While raising the fry of the egg layers special care is necessary as infection can kill the tiny hatchlings. To reduce the rate of infection, good quality filtered and oxygenated water is necessary. Once the hatchlings become free swimming after the yolk sac absorption, selective food oragnisms of appropriate size such as culture of infusoria containing mainly paramecia, freshly hatched brine shrimp nauplii are most ideal. The fry of cyprinid varieties can be fed directly on the small sized zooplankton or microworms, detritus and faecal matter etc. Next stage of rearing fry is after its growth for a week. It needs larger space, hence it must be moved to larger aquaria, cistern, plastic pool or nursery pond where it is grown to 3-4 centimetre size and is ready for sale. The varieties suitable for the mass rearing at indoor scale are small *Characins, Puntius* sp., *Cichlids, Anabantids* etc. Also the varieties like white cloud minnows, Zebra danio, leopard danio etc. can be bred on a community basis on mass scale.

The live bearer group of aquarium fishes belongs to family Poecilidae which covers the most popular varieties like Guppies, Swordtails, Mollies, Platies etc. There have distinct differentiating characters between males and females. The males are brighter in colour and have a characteristic gonopodium. In most of these species a single copulation provides enough sperms to fertilize not only one batch of eggs but several batches. The female gives birth at approximately four

it is possible to maintain continuous cultures in the field conditions at present.

**2. Marine fishes - Some tips**

Breeding of marine oramental fish has not been tried in India so far. The following method has been adapted from the method perfected by Dr. Torben Jul in Denmark. (Courtesy- Seascope vol.9, 1992).

Successful breeding of Marine Ornamental Fish is a rare phenomenon compared to Freshwater Fish. Only a few species of marine ornamental fishes have been raised on commercial scale all over the world. Anemone fishes of the species, *Amphiprion* spp. has been bred successfuliy in captivity. As more and more hobbyists seem to have realised the great advantages of getting tank raised marine ornamental fish, the market for bred varieties of Anemone fish has increased considerably.

The breeding station should have several functionally different systems. The synthetic sea salt is to be used for making sea water with a temperature of 27°C and salinity of 34ppt; pH is of 8.20 and nitrate is less than 0.1ppm. These conditions should be maintained with very few variation as fas as possible. The water has to be heated if need be, in a central reservoir where it is pumped through sand filters & through the UV sterilizer and finally to the aquarium which holds about 125-130 litres of water which is equipped with an air driven under gravel filter, an anemone, decorative live rocks and a pair of brood stock. Fluorescent day light tubes are to be kept over the tanks to give a 12 hour day.

The nursery system contains 1 cubic metre of water in 4 tanks using filtered water from the spawning system. Three sides of the tanks are to be covered with dark PVC sheets to make food particles more clear to the fish. Overhead fluorescent lights are set for a 24 hour day to allow the larvae to feed continuously. Food is kept in the tanks by means of a series of filter which has a mesh size of 69 microns to 500 microns. The grow out system differs from nursery system. Here, tanks should be aerated heavily, feeding should be done periodically. The system has a total volume of 5cu.m or 1300 gallons and is seperated. Nursery system composed of both aquariums and self cleaning circular tanks. Short PVC tubes and nets are provided to give shade and shelter to the young ones. In order to produce fish on a commercial scale, a steady and interrupted supply of live feed such as Algae, rotifers and brine shrimp are to be produced continuously. *Chlorella* algae which is cultured easily at high

densities ad its nutritional value is acceptable to An emone fish. *Rhodomonas* and *Isochrysis* is used for getting healthy and colourful An emone fishes; which are characterised by a superior amino and fatty acid composition. The algae are normally grown in photo reactors; having a volume of 600 litres, which have a daily output of 400 litres of algae.

The first food of small Anemone fish larvae are rotifer, *Brachionus,* which is cultured at 20-22°C at a salinity of 25ppt. These are cultured in large circular PVC tanks having conical bottoms and a volume of 800 litres. Another live feed is Brine shrimp, *Artemia.* Decapsulation of artemia cyst is necessary in the operaion as accidental consumption of artemia cysts is possible by fish larvae which would be lethal.

Anemone fishes start breeding at an age of 8 to 12 months normally. The incubation period varies from species to species among individual pairs; and water temperature plays an important factor here. At 26-28°C, *Amphiprion* hatch in 10-8 nights as *Amphiprion* egg would hatch within an hour after sunset and this behaviour seems to be desirable. Harvesting of larvae is done by keeping a bucket with a screen over it and allow the tank to overflow where all the larvae is concentrated. Newly hatched larvae are being transferred to a nursery aquarium very carefully as the larvae are sensitive to physical, osmotic and chemical stress. The newly hatched larvae start to feed immediately. So frequent feeding with rotifers and algae is necessary. As long as rotifers are the main food source, the algae concentration is kept high to the point where the water is green.

Initial growth of the larvae is fast and within 5 to 7 days, the larvae would be as large as 5 to 6mm size so that they could feed on *Artemia* anuplii and *Artemia* is the main food for the next 2 to 3 weeks.

Towards the end of this period, dry food is introduced and the fishes are gradually accustomed for this diet and at this stage where they are consuming dry food, the growth rate accelerates and within $3^1/_2$ to 4 months, the fish would reach marketable size of 2.5 to 3 cms.

Food is one of the important aspects in breeding marine ornamental fish and the greatest demand for food exists when the fish are juveniles. In order to get good colouration, the fish food must be rich in natural marine pigments; the best source of which are said to be frozen krill and copepods. In home aquaria with abundant algal growths, anemone fishes obtain the necessary red and yellow pigments by grazing on small crustaceans on the walls and rocks.

## Part III

# DISEASES

The development and success of any enterprise that deals with live animals including Ornamental fishes depend on the progress acquired in breeding, various aspects of management, health care and marketing strategies. The development of the industry is based mainly on knowledge acquired through trial and error rather than through systematic approach.

Disease control is a vital aspect in mass production of Ornamental fishes. Very often we come across diseases which are unknown. Outbreaks of diseases can seldom be attributed to a single causative factor. Fish diseases are caused both by action of infectious agents and due to unsatisfactory environmental factors including water quality, inadequate diet and stress.

The potential for development of the Ornamental fish industry is vast and this will be better realised if a more scientific approach could be adopted. A significant aspect that has been neglected in the past is diseases. The occurrence of a major disease problem can cause a severe setback to the ornamental fish industry. Disease can result in high mortalities, poor growth or cause deformities. Losses of 50% to 100% of consignments have been commonly reported.

For a rapidly developing industry such as the ornamental fish industry one has to adopt a modern integrated approach in order to

ensure its greater success. Therefore a professional approach based on scientific criteria should be applied and this is more critical for a specialised field like fish disease. With the establishment of hatcheries for breeding ornamental fishes especially on a commercial basis, the possibility of frequent disease outbreak becomes a threat. Diseases may also be transmitted and spread through the movement of these fishes from place to place within the country or internationally.

**Causes of disease**

Causes of disease can be broadly classified as follows: biological, nutritional, genetic and stress related.

**Biological Factors.**

Biological factors are important in causing of diseases in ornamental fishes. Biological factors can be categorised as follows: parasites, bacteria, viruses and fungi. These organisms are also referred to as infectious agents.

**External Parasites (Ectoparasites)**

Among the biological factors, the external parasites are the most common cause of diseases in ornamental fishes. Many of these parasites multiply in the tanks without involving an intermediate host, such as snails or cyclopoids, thus making it easier for the parasite to complete its life cycle. The external parasites infect the skin, fins and the gills. The following are the common ectoparasites recorded:

*Dactylogyrus, Gyrodactylus, Chilodonella, Ichthyophthirius, Tetrahymena, Piscinoodinium, Trichodina, Ichthyobodo, Uronema, Lernaea* and *Argulus. Brooklynella* is a counterpart of *Chilodonella* in marine fish as *Cryptocaryon* to *Ichthyophthirius.*

Since the external parasites are found on the body surface and the gills, symptoms of their presence are easily detected. With a few exceptions, most of the ectoparasitic diseases cause similar clinical signs.

a) In the initial stages of infection the fish will show flashing movements, indicating irritation due to the presence of the parasites on its body. The flashing is more obvious in cases where the parasites penetrate the host tissues, as in *Ichthyophthirius multifiliis* and *Larnaea* infection. In addition to flashing, the fish may also rub its body against the gravel

or sides of the tank, indicating signs of irritation.

b) Pin point haemorrhages can be seen on the body surface if the parasites have penetrated the host tissue.

c) Following infection, there will be excessive mucus production on the body. This is easily noted by a bluish or whitish coat on the body surface.

d) If the gills are infected, the efficiency for gas exchange (oxygen and carbon dioxide) is lowered. Under this condition, the operculae movement will be rapid and the fish will be gulping air from the water surface to overcome the shortage of oxygen. Similar to the skin condition, the excessive mucus and in some cases haemorrhages can be seen on the gills.

e) In severe infection the mucus starts to slough off, the fish becomes lethargic and sits at the bottom of the tank. Fins are held close to the body surface, indicating pain on movement. Fin rot and systemic infection and ulceration may occur if medication is not provided.

f) In addition to the above signs, infection by *Ichthyophthirius multifiliis* will cause the appearance of white spots over the body surface and infection by *Piscinoodinium* will reveal dusty brown or yellow velvet coating on the skin.

External parasites are normally introduced into the tanks via infected fish, contaminated water, feed such as blood worms collected from contaminated waters and aquatic plants. The main source of infection, though often unsuspected, is through the introduction of new fish purchased from dealers or collected from the wild. These fish may look healthy but they may be carriers of potential pathogens. It is not uncommon to have these parasites existing on the fish in the tank. They will cause disease when the host is weakened by other factors such as stress.

Infection with external parasites can cause severe losses within short periods due to the rapid multiplication of the parasites through a lifecycle without involving any intermediate host. The tropical climate also plays an important role in the rapid multiplication of the parasites. Parasites that penetrate the tissue cause damage to the gills and skin epithelium. In severe cases it will lead to secondary infection with bacteria and ulceration. It is very common to see "mixed" infection with

several species of external parasites during an outbreak of disease.

Less harmless protozoans, such as *Apiosoma, Scyphidia, Epistylis* and *Zoothamnium* are also common causes of disease in an aquarium. Mortalities of fish as result of infection is due to large numbers of protozoans which foul the gill surface, causing respiratory distress. On the body surface their presence can cause skin irritation, which may lead to dermal ulcers.

A mixture of formalin and malachite green (25ppm and 0.1ppm respectively) has also been proven to give good results. Care should be taken during the use of malachite green as it is carcinogenic. Treatment for *lernaeaeosis, argulosis* and white spot has to be repeated, because the medication will only kill the larval stages of the parasite which are present in the water. Treatment for *lernaeaeosis* and *argulosis* is carried out weekly for four weeks, while treatment for white spot is repeated three times on alternate days.

**Internal Parasites (Endoparasites)**

The presence of internal parasites in ornamental fishes will vary with the source of the consignment. Many internal parasites have complex life cycles which involve one or more intermediate hosts. Intermediate hosts of parasites, such as snails, cyclopoids and tubifex worms can become an important sources of infection to fish. Transmission of these parasites within a fish population without involving the intermediate host is not possible.

**a0 Hexamita**

Hexamita, a protozoan flagellate, occurs in the digestive tract of fish. The fish lose their appetite and appear emaciated with a large head 'Pinhead'. The fish become weak and restless and sometimes swim on their sides or with a "corkscrew" motion. Once systemic, the parasite can penetrate the subcutis and emerge, causing tubular eruptions.

**b) Myxosporidians**

*Myxosporidian* spores can be found to infect various organs, depending upon the parasite species. A majority of pathogenic *myxosporidians* l) alize in the musculature, gills or the cutaneous tissue. White or yellow opaque spheres (cysts) which contain numerous spores can be found in the affected tissue. There is no treatment for fish infected with *myxosporidians.*

**c)Microsporidians**

The microsporidian commonly infecting aquarium fishes is *Pleistophora.* It causes severe damage to the muscle tissue. It is commonly recorded in tetra thus also known as "neon tetra disease", but it has also been recorded from several other fishes as well. Cysts are produced in the muscles. Discoloration, spinal curvature, loss of balance, emaciation, fin degeneration, and bizarre swimming behaviour are some of the common clinical signs seen in infected fishes. There is no cure for microsporidan infection.

**d)Camallanus**

The nematode, *Camallanus* commonly occurs in livebearers. The guppies, mollies, platies and swordtails are common hosts. This red coloured worm is 8-20 mm long. Infected fish show signs of poor growth and emaciation, and the parasite can often be seen sticking out of the anal opening.

**e) Capillaria**

*Capillaria* is a common nematode found in discus and many other cichlids. Signs of infection are emaciation, stringy white faeces and poor feeding. The medication is di-N-butyl tin oxide at 1.0 ppm in tank water for a period of three days.

**f) Clinostomum**

Larvae of digeneans are common in the muscles of the host. *Clinostomum* is common species found in giant and kissing gouramy. In the kissing gouramy, the larvae can be seen encysted in the muscle tissue.

**Bacterial infection**

Bacterial infection is commonly seen in association with poor water quality, as a secondary infection in parasitic diseases or after rough handling. The most common bacteria isolated are *Pseudomonas* and *Aeromonas* in freshwater fishes and *Vibrio* spp. in marine fishes. The general symptoms in bacterial infection are as follows:

a) Fish will be darker in colour

b) Fish will not respond to feeding

c) Dermal haemorrhagic lesions occur along the lateral and ventral surfaces of the body which may develop into ulcers

d) Accumulation of fluid in the abdominal cavity (ascitis)

e) Internally, the spleen, liver and kidneys may be enlarged haemorrhagic or liquified, depending on the state of infection..

Fish infected with *Aeromonas* and *Pseudomonas* could be injected with tetracycline at 25mg/kg body weight or given 0.5mg/kg of food for 7 days or bath at 50ppm overnight.

**Mycobacteriosis**

Fish tuberculosis is another common disease in aquarium fishes. *Mycobacterium marinum,* as causative agent, has been frequently reported from several species of fishes. *Mycobacteriosis* is a chronic disease and fish infected show the following signs: lethargy, inability to maintain balance, anorexia, emaciation, rapid opercular movements, ascitis, spinal cord deformities, exophthalmia, skin discolourations, scale defects and scale loss, skin ulceration and fin destruction. Fish treated with kanamycin sulphate at 100 ppm for 5 days has recovered.

**Viral Infection**

*Lymphocystis* is the best viral disease which occasionally appears in the marine aquarium. The virus causes wart or pearl-like growths mainly on the fins and skin. No treatment is effective. It is recommended that the wart be removed by minor surgery and the site be swabbed with iodine or acriflavine.

**Fungal Infection**

Fungal infection is usually associated with parasitic or bacterial infection. Fungal infection is also commonly found when the mucus is removed after rough handling or netting. One of the most common fungi is *Saprolegnia.* A cotton-like tuft can be seen on the host which is normally on the dorsal or the ventral side of the body. Infertile eggs are usually infected with fungus which spreads out to fertile eggs. Malachite green can be used for treatment at 0.1 to 0.15 ppm.

**Nutritional disorders**

Nutritional deficiencies can occur if the fish is not fed the right kind of food; hence, the fish is deprived of certain essential nutritional requirements. On the other hand excessive feeding of vitamins and minerals can also cause different forms of disease conditions. It must be noted that in most cases the symptoms of nutritional deficiencies cannot be differentiated from one another, i.e. either from lack of vita-

mins, minerals or proteins, as the sign seen are often similar. Feeding schedule is also important. Highly active marine fish needs two feedings a day whereas freshwater fish can be fed once a day.

**Genetic abnormalities**

There are several genetic abnormalities but the most obvious one are in the form of deformities that can be recognised easily. The common deformities are lordosis or crocked back, eyes missing from the time of birth, short or missing fins or deformed jaws. However, such deformities can also be caused by biological agents or nutritional deficiencies and thus the diagnosis has to referred to a specialist. Genetic abnormalities are usually seen in less than 10% of the offsprings. Nothing can be done to repair the abnormality due to genetic factor. Prevention of inbreeding, which can cause recessive abnormal trait genes to dominate, should be avoided. Fish that are physically abnormal should never be used for breeding. Fancy fishes, such as lion head and pop-eyed gold fish are examples of genetic abnormalities which are produced by genetic manipulation i.e. by inbreeding.

**Stress**

Stress could be considered a major cause of fish disease that results in severe mortalities. Stress can be equated to a silent killer in fish, just as hypertension in man. Thus an understanding of stress and its causes in fish is important.

Fish in the aquatic environment can be subjected to different physical and chemical changes at various degrees. Fish have a limited tolerance to changes in the environment. The level of tolerance that can cause stress varies in different species of fishes. The changes in environmental factors could be gradual or sudden, depending on the cause. If the changes go beyond the limits of tolerance, they disturb the normal body function of the host. Fish that cannot tolerate change in the environment succumb to either disease causing agents that are normally present in the water or die shortly if the stress is too severe.

Stress in fish is caused by various factors; handling, changes in temperature, overcrowding, poor water quality, poor nutrition, excessive lighting and noise are some of the major factors. Thus as far as possible all these factors have to be taken into account while designing the aquarium system for daily management practices.

The stress of capture and adaptation to captivity initiates a complex physiological response in fish which appears to cause dysfunction

in organ systems which may result in death. Delayed mortalities following capture have been attributed to loss of osmotic homeostasis or secondary bacterial or viral infection.

Use of anaesthetic agents will reduce stress during transport and handling during treatment, collection or weighing. Sedation lowers the activity of fishes, thus reducing nitrogenous waste production, oxygen consumption and carbon dioxide production.

**Miscellaneous diseases**

**a) Dropsy**

Dropsy is the swelling of the abdominal region due to accumulation of body fluids. Bristling of the scales, i.e. the scales stand out, occurs concurrently with dropsy. The appearance of dropsy in aquaria has been related to overcrowding during shipment and poor condition in the aquaria. The bacteria *Aeromonas* and *Pseudomonas* have always been isolated from fishes with dropsy.

**b)Fin Rot**

A very common condition associated with poor water quality, overcrowding, temperature variations and infection with external parasites. The bacteria *Pseudomonas* and *Aeromonas* are usually associated with fin rot.

**c) Floating Fish**

Fish that lose control of their buoyancy, float upside down or on their sides. This condition results from disturbance of the swim bladder. Sudden temperature changes ( usually a quick drop), bacterial infection and hereditary factors have been identified as possible causes. Excess dried food, either flakes or pellets, can cause constipation and thus interfere with the normal function of the swim bladder. Air bubbles seen in the faeces is a sign of excessive feeding. The problem can be overcome by soaking the pellet or flakes in water prior to feeding. In mild cases, withhold the food for a few days and provide salt bath treatment. If it is a bacterial infection, use antibiotics.

Successful treatment and control of infection will depend on the correct diagnosis. It is thus essential that a correct diagnosis is made before treatment, causing loss of valuable fish. Many diseases show similar symptoms, thus clinical signs alone may not suffice for a conclusive diagnosis.

**Prophylaxis and treatment**

Ozone treatment can improve sea water quality. Ozone, an unstable form of oxygen (O3), is generated in the ozonizer from air passed through an electrical discharge. Ozone will both disinfect and sterilize sea water, oxidize organic material and toxic nitrite. Ozone treatment has also been proven to be an effective bactericide and virucide when tested on selected freshwater pathogens. An ozonizer is often used in conjunction with a protein skimmer. Since ozone is harmful to all living organisms, it must be used with caution.

Use of ultraviolet light for control of *Ichthyophthirius multifiliis* revealed 1.3% mortalities as compared to the control which had 82.8% mortalities. Quarantine measures must be made a routine practice, so that new animals to be introduced into the system do not spread disease. Similarly care should also be taken for plants and corals.

Many of the parasites with direct life cycles, that cause problems during breeding are introduced with the breeders. The breeders should be treated to eliminate the problem before they are brought together for spawning. A general policy is to treat all breeding fishes irrespective of the possibility of diseases.

*Myxosporidian* infections, which cannot be treated, are known to be transmitted by feeding infected tubifex worms. Ensure that the tubifex worms are from a source that is free from myxosporidian infection.

Compared to the pond situation, where the water body is large and complicated by other factors such as high organic load and the complexity of water and soil chemistry, treatment of fish in aquarium tanks is much easier and simpler. Treatment by immersion can be provided either by a dip or a bath. For dip treatment, a high dosage is used and the period of contact of drug with fish is short i.e. a few minutes. While for bath the duration of contact is longer and may last for a few days or till the effect of the drug disappears. Dip is suitable for new arrivals which are still in good health.

It is important to ensure that the medication used does not have impurities. Old stock of formaldehyde changes to paraformaldehyde, which is milky white and toxic. Locally prepared bottled medication sold in ready to use solutions, when kept too long on the shelf may no longer be effective. Some of the locally bottled medication has been

reported to be ineffective when used at five times the recommended dosage.

Treatment should always be considered as the last step in solving the problem. Instead, control measures to avoid the introduction of potential pathogens should be strictly enforced. Any form of medication introduced into the fish tank is going to cause additional stress to the sick fish. Therefore it is very important to avoid repeated treatments. In many instances it is the environmental factors, such as poor water quality or changes in temperature, that are the prime factors that cause disease outbreak. Thus, in any form of treatment, the stress factors should be first checked and only then treatment is carried out. Higher mortalities can be expected if treatment is provided without elimination of stress.

**Quality control and quarantine regulations**

Specific steps have to be taken to ensure the quality of fish produced, for specific size of each species, norms should be prescribed on length, weight, colour, condition etc. and before shipment. Each shipment should be subject to voluntary, anti parasite/anti infection treatment. The production centres should adopt periodic inspection to ensure production of proper quality fish for export and domestic market as well.

## Part IV

## SETTING UP OF AN ORNAMENTAL FISH EXPORTING UNIT

An export set up for the ornamental fish can be divided mainly into:

1. Collection and rearing
2. Breeding
3. Re-conditioning of export stock
4. Packing and air transport for export

The infrastructure requirements at each of these four sections are given below:

1. **Collection**: The first and more vital part in the export trade of Ornamental fishes is the collection of fishes from natural rivers, lagoons, ponds and lakes. Collection is the very vital point which has to be stressed because unless the collections of these fishes are done in a systematic manner giving priority to handling the fishes right from the point of catching. Even the best handling of the fish and treatments given after the bad collection will not prove successful. The following points have to be kept in mind while organising wild collection which will go a long way in stabilising the trade.

a) The net used for collection should be as soft as possible with small meshes. Fishing nets used generally for the food fishes should never be used as ornamental fishes are small and will either slip in the large mesh sized fishing nets or their gills will get entangled and eventually die when pulled from the net.

b) Since ornamental fishes are to be exported in live condition, the collector should make adequate arrangements on the banks of rivers or lakes or lagoons to store and pack them in plastic bags inflated with oxygen. In the cases of marine fishes, the fishes, could be kept in floating reservoirs wherein they will be so comfortable as they are in marine environment. Equipments needed for collection and immediate packing are:-

i) Hand nets & seine nets
ii) Floating reservoirs
iii) Plastic pools
iv) Aerators (field type)
v) Plastic trays & buckets of different sizes
vi) Oxygen cylinder with flow metre and regulator
vii) Double plastic bags (not less than 300 gauge
viii) Rubber bands
ix) Corrugated master cartons or thermocole boxes

c) Handling of fishes while collection should be done as gentle as possible with maximum precaution in order not to injure the fishes in any manner.

d) The collected fishes should be stocked in plastic trays, sorted and should be kept in floating reservoirs or packed immediately with the same water from the river or lake or lagoon.

e) The number of fishes packed should either be optimum for journey to the collector's re-conditioning station from place of collection. It is always advisable to lower the numbers of fishes packed per bag in order to avoid overcrowding and bruising. This might cost a bit more in plastic bags, oxygen and energy but will have much beneficial effect during re-conditioning or acclimatising.

f) Collectors should be given adequate training on fishing technique. The fishes collected should be assorted separately according to compactability and they have to be quarantined and transported to the re-conditioning station either in open containers or in oxygenated bags as the case may be.

**2. Breeding**

Tropical ornamental fishes as the name itself indicate can be bred successfully only if a tropical climate is provided with a low cost hatchery.

It would be cheaper to set up fish farms and hatcheries at places where there is no extremes in climate. Thus choosing of breeding centres is of utmost importance. Since land is needed for growing fishes it is better to set up hatcheries in suburban areas so that cost of the land may be reduced but at the same time having easy transporting facilities from the breeding centres to city for final conditioning before export. Breeding centres can have earthern grow out ponds, cemented cisterns/ tanks and glass aquaria where breeding operations are being undertaken.

**3. Stocking and re-conditioning**

Re-conditioning or acclimatization of fishes in general may be defined as the process to habituate them, when they are transferred from their original environment to new water, especially in the first 12 hours. When the fishes are transferred from their original environment to new water, they are subjected to stress due to difference in the quality of water, which ultimately results in mortality. Therefore, it is very essential to reduce the mortality by slowly acclimatizing them to the new environment by manipulating the quality of water almost very close to its original environment. This could be achieved by determining the hardness, pH, temperature and dissolved oxygen of the original environment from where the fishes are collected and accordingly maintain the same levels in the new water into which they are released.

The stocking and re-conditioning/ acclimatising of wild caught ornamental fishes is another vital aspect in the export business. The following points has to be practised strictly by the collector to avoid stress on the fishes meant for export. Shock and stress are the main creator of all problems in wild caught fishes during acclimatising periods.

a) The collected fishes are graded for sizes and varieties and each size and variety or species has to be placed in different tanks.

b) The collected fishes when brought to the collectors re-conditioning tanks should be left in tanks with clear water with pieces of broken pots and tiles as camouflage.

c) A water sample analysis in respect of hardness,, pH, temperature and dissolved oxygen has to be made before collection and it is better to convert the reconditioning tanks water quality as close to water from the collected area.

d) While grading the fishes, the dying ones, half dead ones in critical condition should be placed in separate hospital tank. Bruised and

injured fishes had to be placed in another separate hospital tanks. This isolation of badly injured and partly injured fishes will not only save the other fishes from bacterial infection but also provide a fair chance to reduce general mortality rates.

e) The general acclimatising tanks should contain ink blue solution of methylene blue with common salt (one handful of salt for every 5 gallons) along with Epsom salt (one tea spoon for every 5 gallons) along with Epsom salt (one tea spoon for every 5 gallons of water) to be added to bring out the slime on the fish. In hospital tanks along with the above, tetracycline capsules at the rate of 250 mg per 5 gallons of water should be added to avoid bacterial infections due to bruises.

f) After 48 hours, this treatment should be repeated with a lesser dosage and at this time fishes should be fed lightly.

g) After the initial preventive quarantine for 4 days the fishes should be kept in tanks which is well aerated and filled with clear water. If a mild running water system like dripping tap can be arranged, it will be much beneficial.

h) The collector should have a careful watch on the acclimatised fishes as at any time fishes will show signs of diseases and those fishes should be spotted and taken out to the hospital tanks immediately and treated or the whole tank has to be treated.

i) All dead fishes should be removed on the first sight and inspection of tank should be done every 4 hours.

jj) A minimum conditioning of two weeks is needed for all wild caught fishes and they should be shipped only when the mortality had come down to one percent.

**4. Packing**

Efficient packaging of ornamental fishes plays a key role in the success of the export trade. The present packaging system used is a closed one involving sealed polyethylene bags, a small volume of water and a volume of pure oxygen in the ratio 1:3. Stress caused by crowding and accumulation of ammonia and carbon dioxide might be the main cause of mortality.

Trading live animals, particularly fish, is confronted with special packaging being a crucial factor, sustaining the safety and survival of the fish in transit. The well being of fish in transit depends as much on the

packaging methods and materials used as on the travel time involved and the handling of the consignment by the agent if any, the customs and the airline. The strength and quality of plastic bags, single or double use of plastic bags, the type of insulation lining if corrugated cardboard boxes are used, the quality of all foam boxes, the quantity and quality of the water in the bags, the number and types of fish placed in a single bag, the amount of oxygen in each bag and last but not least the preparation of the fish before shipment are all factors that affect the safety and survival of the fish during transport and transit. Except for shipments from few exporters from south east Asian countries, importers in the industrialised countries used to consider packaging standards for tropical fish to be inadequate, mainly caused by the lack of styrofoam and strong double corrugated cardboard boxes in many developing countries. In the meantime, this situation has almost been rectified and mortality rate, estimated at over 25 percent of all fish exported, has become less than 2 per cent for cultured fish and less than 8 per cent in wild caught fishes. If there are no price hikes in future freight charges, mortality will still be less.

The advent of jet cargo services has brought new markets for ornamental fishes within selling distance while packing methods have been developed which ensure protection of product. As ornamental fishes are being transported by air, the airlines play a very vital role in the export trade. A suppliers selection of fish depends as much on the infrastructure and domestic transport possibilities as his selection of export markets, both are largely dictated by the availability of connecting flights.

Air freight charges represent about 40% of the landed cost of the ornamental fish. The air carriers route is of crucial importance for the safe and live arrival of fish consignments. Healthy, well fed fish, starved for atleast 24 hours before packing in order to avoid spoilage of the transport water with excrements and well packed can often withstand a 48 hours journey even sometimes 56 hours.

Sometimes however, shipments are left out in the cold for a few hours (in Europe eg.) as may occur when consignments have to be transferred from one aircraft to another. Far worse is that if they are left the heat off the glaring sun on the fish mortality increase substantially but overheating is far more lethal than the cold. Some major airlines immediately after the arrival, transfer the consignments to their own so called animal hotel with heated warehouses in the airport premises, during change over periods. Since all airports are not equipped with such advanced and modern facilities, however traders try to select an airline whose

route will not require a change of air craft. Airlines, however responsible rarely pay compensation to clients for losses in transit, although they claim to do it, as it is almost impossible for the exporters and importers as well, to prove that the partial or total loss was due to the negligence of the airlines.

**Future Packaging**

The newer boxes, are moulded thick styrofoam boxes which has a weight about half of the old style double corrugated cardboard boxes which were not water proof. The size of the new boxes fits exactly into the 88 x 125 inch LD 10 pallet (325 x 220cm) without any loss of space. This represents a big revenue for the carriers who presently face a five to ten percent space loss on the old style boxes and other commodities. The members of the ornamental fish international organisation (OFI) recommend the use of pallets wherever possible for the obvious reason that palletising reduces handling, resulting in less damage to the boxes and their contents. The new box is well able to resist exposure to heat and cold during normal ramp transit time. During winter conditions the boxes would be lined with newspaper to increase the insulating ability. Other new items for transport of fishes, called heat and ice packs will follow and should be added for extreme winter and summer conditions. Labelling in bright colours with clear instructions should make airline staff aware of fishes perishable nature.

**Preparation of an export consignment**

The preparation of ornamental fishes for export from the exporters stocking centre has to be done systematically to ensure that the fishes reach the importers destination alive and healthy. The arrival condition of the fishes is the crucial and deciding factor in getting repeated export orders. The method detailed below has to be followed generally so that the fishes arrive in their best condition in the importers premises.

*Facilities required*

1. Glass tanks and cement tanks for holding exportable stock.
2. Aeration and filteration equipments
3. Hand nets made of soft netting
4. Medical oxygen cylinder with pressure gauge and regulator equipped with oxygen jet nozzle gun
5. Card board cartons (5 ply corrugated master cartons) lined with thermocol sheets or thermocol boxes.

6. Strapping machine with cellophane tapes
7. Marking pen with water proof ink
8. Plastic bags (300 to 350 gauge)
9. Rubber bands and outer indication labels

Following preparations are recommended when an export order is received assuming that he has all or most of the varieties of fishes at hand:

1. The varieties of fishes ordered has to be caught from the stocking tanks at least 72 hrs. before shipment and to be placed in acclimatization tanks in variety wise.
2. The reconditioning or acclimatization tanks should have clear and well filtered and aerated water to which methylene blue (5% solution one drop to gallon), common salt ( 1 handful per every 5 gallons of water) Epsom salt (1 teaspoon for every 5 gallons of water) Epsom salt (1 teaspoon for every 5 gallons of water) and tetracycline (250 mg to every 10 gallons) are to be added before the fishes are placed.
3. It is advisable to keep the fishes which are sensitive to medicine in clear water with filteration and aeration.
4. The fishes to be exported need not be fed before 48 hrs. before shipment. This has to be done to avoid fouling of water in the plastic bags during transit. It is better to feed the fishes heavily prior to the stopping of feeding 48 hours before shipment.
5. It has been proved beyond doubt that fishes which are stocked and well fed are able to withstand regress packing and air journeys than ill fed fishes. So proper conditioning of fishes in stock tanks is of utmost importance to provide the fishes the needed strength to withstand bad handling in airports and harsh journeys.
6. Temperature is one of the main causative agent for the diseases. So the acclimatization tanks should be kept at a constant temperature and ideal for the fishes kept in it.
7. Overcrowded fishes in the reconditioning tanks should avoided as this may lead to severe stress on the fishes. The same holds good during packing also as stress is slow killer, mortality rate on arrival and in the importers tanks may be high.
8. Fishes already counted and kept in preparation tanks should not be disturbed as far as possible. Handling and netting should be avoided

and maximum rest has to be provided for the fish to be packed as to withstand the journey in confined plastic bag.

9. In some of the South East Asian countries chilled water is being used to reduce metabolic activity of fishes. This is done by keeping the finally packed fishes in an air-conditioned room with a constant temperature of 70 degree F.

10. Tranquilizer like Quinaldine or paraldehyde can be used in mild concentration, before packing to reduce the activity of the fishes in the plastic bags. Lower metabolic activity leads to lower consumption of oxygen and lower excrete secretion and hence a better arrival condition of the fishes. These are the normal procedures being practised by the exporters all over the world. It is always better for every individuals exporters to work out better methods by trail and error or rather by his own experience.

**Economics and profitability of an ornamental fish exporting unit**

The estimated production and profitability of an ornamental fish exporting unit has been prepared based on the following assumptions :

a) Capacity of the unit : 6.76 lakhs fishes per year (13000 fishes per week)

b) Product mix : i) Wild caught fishes (fresh water & Marine)
: ii) bred varieties
: iii) Invertebrates

c) Mortality : 10% (Loss of fishes during transit is an important factor in this trade. Losses are generally borne by the exporter and the importer on shared basis and internationally accepted loss is 10%

d) Shipment is expected only once in a week

e) The unit will work throughout the year as it is dealt with live animals

f) The export price have been worked out on the basis of current market, however it may vary based on species and size of the fishes

g) The price for wild caught fishes and bred varieties has been worked out based on the prevailing market price which may also vary during season.

h) Repairs and maintenance have been assumed as 2% on the cost of machineries and 1% on the cost for building.

i) Insurance has been worked out at 1% of priced assets

j) Depreciation has been calculated as 10% on building, 15% on machinery, 30% on vehicles and 10% on miscellaneous assets.

k) Requirement of packing material was calculated on the basis of weekly shipment requirements of 13,000 fishes. Packing material required are master cartons, Polyethylene sheets, styrofoam sheets, oxygen, poly bags, rubber bans, packing paper, cellophane tapes etc.

l) Rs. 50000 has been provided for sales promotion

m) Total investment is borrowed from banks at an interest rate of 18% for capital cost and 24% for operational cost with a repayment schedule of 7 years.

n) Contingency has been provided at 5% on all above except on raw material and consumables.

o) The annual sale turnover is expected to be Rs. 25.00 lakhs.

**Development Cost**

| *a)* | *Breeding Centre* | | *Rs. inlakhs* |
|---|---|---|---|
| | Civil work - Shed and Tanks | : | 4.50 |
| | Earth work - Construction of ponds | : | 2.00 |
| | Water inlet structure | : | 0.50 |
| | Water outlet structure | : | 0.50 |
| | Pumps, sluices, generator compressor & Electrical installation | : | 1.50 |
| | Cement tanks/Breeding glass tanks | : | 1.00 |
| | laboratory/Farm equipment/Breeding kits | : | 1.50 |
| | *Total* | : | *11.50* |
| *b)* | *Collection & Rearing Centre* | | |
| | Plastic pools | : | 0.30 |
| | Aerators | : | 0.05 |
| | oxygen cylinder with gauge & valve | : | 0.30 |
| | Plastic tubing/nets/containers | : | 0.10 |
| | *Total* | : | *0.75* |

| | | | |
|---|---|---|---|
| c) | *Reconditioning Centre* | | |
| | Civil work | : | 1.00 |
| | Air pumps / Blowers / Compressor | : | 0.50 |
| | Air stores / Plastic tubs / air dividers connectors / regulators / plastic containers / hoses etc. | | 0.15 |
| | Thermometer / DO meter / pH meter and other laboratory equipments | : | 0.20 |
| | Glass Aquaria / Cement Aquaria | : | 1.50 |
| | *Total* | | *3.35* |
| d) | *Packing and transport centre* | | |
| | Civil work shed | : | 0.50 |
| | Oxygen cylinder with gauge valve | : | 0.30 |
| | Tube well with motor & pump and other accessories | : | 0.30 |
| | *Total* | : | *1.10* |
| | **Total (a + b+c+d)** | : | **16.70** |

**Operational cost for one year**

| | | | |
|---|---|---|---|
| a) | Fishes- wild caught (fresh water) | : | 3.50 |
| | Wild caught (Marine & Invertebrates) | : | 3.50 |
| | Bred varieties (Fresh water | : | 2.30 |
| b) | Feed - 2 ton @Rs. 20/- per kg | : | 0.40 |
| c) | Chemicals | : | 0.25 |
| d) | Fuel & electricity | : | 0.20 |
| e) | Annual maintenance | : | 0.07 |
| f) | Staff salary | : | 0.80 |
| g) | Office expenses | : | 0.25 |
| h) | Sales promotion | : | 0.50 |
| i) | packing material | : | 1.50 |
| j) | Filters / PVC pipes | : | 0.25 |
| k) | Insurance | : | 0.16 |
| | Total | : | 13.68 |

| III | Product mix and sales turn over | | |
|---|---|---|---|
| | a) Wild caught (fresh water & marine) | : | 18.50 |
| | b) Bred varieties | : | 6.50 |
| | Total | : | 25.00 |

**IV. Economics and repayment**

| | | | |
|---|---|---|---|
| a. | Total investment | : | Cost of development + operation cost for 1 year<br>(Rs. 16.70 + 13.68) = Rs. 30.38 lakhs |
| b. | Gross profit before interest and repayment | : | Gross year income - (Operation cost of one year + depreciation @ 10% on the developmental cost)<br>Rs. 25.00 lakhs - (Rs. 13.68 + 1 67)<br>= Rs. 9.65 lakhs |

**Conclusion**

Indian sub-continent found to hold rich resources of fresh water and Marine Ornamental Fishes. It is rather unfortunate that these valuable fishes are at present used as food fishes for the local population fetching Rs. 8/- to Rs. 10/- per kg. (for 100-200 nos.) However, when the same is exported one fish could fetch 20 times more than what is being realised. If this trade is organised properly, India could play a vital role and contribute considerable share in the international trade. In addition to the generation of foreign exchange by way of export, this would create job opportunities and self employment to the rural population.

ANNEXURE -1 (a)

**List of fresh water ornamental fishes & plants available in India for export with its indicative price offered by the importer.**

| | Species | Common name | Available area | Indicative pirce/ piece (in US $) |
|---|---|---|---|---|
| 1. | Barbus arulis | Barb | Kerala&Tamil Nadu | 0.20-0.40 |
| 2. | B. chola | Barb | Kerala, Tamil Nadu Punjab, Orissa, U.P., M.P.,Bengal & Assam | 0.20-0.35 |
| 3. | B. conchonius | Barb | Assam, Bengal, Bihar and Punjab | 0.80-0.90 |
| 4. | B. denisonii | Barb | Kerala | 0.70-0.80 |
| 5. | B. filamentosis | Barb | Kerala (coastal region) | 0.40-0.50 |
| 6. | B. gelius | Barb | Orissa, Bengal & Assam | 0.80-0.90 |
| 7. | B. melanampyx | Barb | Kerala, Karnataka & Goa | 0.80-0.90 |
| 8. | B. narayani | Barb | Karnataka & Kerala | 0.60-0.80 |
| 9. | B. phutunio | Barb | Orissa & Bengal | 0.40-0.60 |
| 10. | B. terio | Barb | Orissa, Bengal & Punjab | 1.20-2.00 |
| 11. | B.ticto | Barb | Throughout India | 0.80-1.00 |
| 12. | Botia striata | Loach | W. Bengal | 0.20-0.25 |
| 13. | Botia almorhae | Loach | Kashmir | |
| 14. | Botia lohachata | Striped Loach | W. Bengal | 0.25-0.35 |
| 15. | B. dario | Loach | Punjab & Assam | 1.20-1.50 |
| 16. | Chanda ranga | Indian glassfish | W. Bengal | 0.05-0.10 |
| 17. | Gagata cenia | | Bengal, Orissa | 0.20-0.30 |
| 18. | Gagata itchkeea | | Rivers of Deccan | 0.70-0.80 |
| 19. | Macropodus cupanus | Paradise fish | Kerala & Tamil Nadu | 0.35-0.50 |
| 20. | Ctenops nobilis | Noble fish | Assam & Bengal | 0.70-0.80 |
| 21. | Colisa chuna | | Assam & Bengal | 0.80-0.90 |
| 22. | C. fasciata | | Bengal & Madras | 0.70-0.90 |
| 23. | Rasbora daniconius | Karnataka | 0.40-0.60 | |
| 24. | Danio devaro/malabaricus | | Orissa, Bengal, Punjab Assam & Kerala | 0.25-0.40 |
| 25. | Aplocheitus panchax | Panchax | Orissa, Bengal & Kerala | 0.80-1.00 |

There are about 50 other varieties of fresh water fishes which are either collected from the wild or bred in captivity, available in India for export.

ANNEXURE - 1 (b)

**List of some of the marine ornamental fishes and invertebraes available in Laccadive Islands, Andaman & Nicobar Islands**

| | Species | Common name | Indicative pirce/ piece (in US $) |
|---|---|---|---|
| 1. | Dasyllus aruanus | White tailed Damselfish | 0.50-0.60 |
| 2. | D. reticulatus | Reticulated Damsel fish | 0.55-0.67 |
| 3. | D. trimaculatus | Three spot Damsel fish | 0.55-0.67 |
| 4. | Gomphosus varius | Long face wrasse | 2.00-2.50 |
| 5. | Halichoeres spp. | Wrasses | 0.85-1.00 |
| 6. | Lutjanus kashmira | Blue stripped snapper | 0.50-0.60 |
| 7. | Lutjanus sebee | Red Emperor | 0.60-0.80 |
| 8. | Macropharyagodon meleagris | Leopard wrasse | 0.85-1.00 |
| 9. | Meiacanthus spp. | -do- | 0.55-1.10 |
| 10. | Naso brevirostris | Short nosed unicorn Tang | 3.25-3.50 |
| 11. | Naso lituratus | Smooth Head Unicorn Tang | 3.75 |
| 12. | Plotosus anguillaris | Salt water cat fish | 0.35-0.40 |
| 13. | Pomacentrus nigricans | Black velvet Damsel fish | 0.55-0.60 |
| 14. | Scarus sordidus | Green Parrot fish | 0.95-1.10 |
| 15. | Thalassoma gibbosus | Humpbacked Box fish | 2.25-2.40 |
| 16. | T. lunarae | Lyretail Wrasse | 1.90-2.00 |
| 17. | Zanclus cornutus | Moorish idol | 3.25-3.50 |
| 18. | Zebrasoma scopas | Brown Tang | 2.25-2.40 |
| 19. | Abudefduf spp. | Damsel fish | 0.80-1.00 |
| 20. | Acanthurus leuco sternon | Powder-blue surgeon | 11.00-12.50 |
| 21. | Apogon spp. | Cardinal fishes | 0.60-0.70 |
| 22. | Chromis caerulea | Blue green damsel fish | 0.55 |
| 23. | C. dimidatus | Bicolor Damsel fish | 0.55 |
| 24. | Chaetadon spp. | Butterfly fish (22 species) | 1.65-4.25 |
| | | (Vary according to species) | |

*These are only an indicative list. There are still more than 100 species of fishes available in Indian waters*

ANNEXURE 2

**List of major importers of ornamental fish**

**The Netherlands**

Th. Ruinemans Aquarium B V
I jsselveld 9/P.O. Box 44-3417 ZG
Montfoort
Phone : (31) 03484-2004
Telex : 70309
Ruimp Nl/Fax : 3484-4299

M. Ruysbroek
Noordvliet
159 - 3142 CL, Maassluis
Phone : (31) 01899-15955
Telex : 24703 RSBRK NL

Jarathana
Platinastraat 56
8211 AR Lelystad
Phone (31) 03200-42484
Telex: 76396

Fa. Gommers
Ducheine, Willem
Alexanderstraat
15-6691 EE Gendt.
Phone: (31) 088-124600

Gevo Bv
De Spaarpot 24
5667 KX Geldrop
Phone: (31) 040-855505

I.P.D. Holding
P.O. Box: 50075 - 1305
AB Almere-Haven
Phone: (31) 03240-11943

Landman's Groothandel
Hoge Rijndijk 195
2382 AJ Zoeterwoude
Phone: (31) 071-892256

Langhour's Groothandel
Hoge Rijndijk 195
2394 AC Hazerswoude RD
Phone: (31) 01714-2984

Aqua Tropica
Rosandeweg 6
6905 DR Zevenaar
Tropical Imex,
Postbus 323
3300 AH Dordrecht

Hilhorst
Steenhofstraat 34
3764 BL Soest
Greba
Ressensestraat 42
6684 DB Ressen

Interfish
Aslsdijk 287
3079 RG Rotterdam

H. Baul
Indonesien Korallfischcenter
(Inter Fish)
Linkensweg 44
5341 CC Oss (N. Br.)
Phone: (31) 4120-23010
Telex: 37520 FISH NL

H. Gommers
Ducheine
Willem Alexanderstraat 15
6691 EE Gendt
Phone: (31) 088-124600

Koraalvis Center BV
(J. Nieuwendijk)
Industrieweg 17
4131 NK Vianen
P O BOx 177
4130 ED Vianen
Phone: (31) 03473/1687
Telex: 70705 KORAAL NL

Trading Services International
GmbH voor Belelux (TSI)
TSI dorpstraat 22
6441 CG Brunssum
Phonw: (31) 045-250015

D.E.P. International
Joh.de Wittstraat 1.
- 4902 VG Oosterhout (N-Br)
Phone: (31) 01620 - 22433
Telex: 54585 i text NL
Fax: 0162 - 16791

**Goldfishes**
Smulders BV
Dolmanstraat 5
6235 At Ulestraten

De Boon BV
Rivierdijk 27 a
3372 BE Hardinxveld
G'dam
Phone: (31) 010-463655
Telex: 27197 BOON NL

**Aquatic Plants**
Aqua Flora Vinkeveen BV
Herenweg 123-125
3645 DJ
Vinkeveen
Phone: (31) 02972-1861

H. Stoffels
Peters-Maalbekerweg 14
5961 NT Belfeld
Phone: (31) 04705-1253

Aquarium Sport BV (H. Koenzen)
Klapwijkseweg 12
2642 RO Pijnacker
Phone: (31) 01891-13668
Telex: 21442 ASPNL

**United kingdom**

Aqua Imports
25, Beaconsfield Road
Walthamstow
London E17
Tel: 01-521-6166

J. and K. Aquatics
The Old Stable
Wellingdon Garden Centre
Wellington, Somerset, TA 21 8 RA
Tel: 082347 7077

Gunthberg Thompson Company Ltd.
24, Castlereagh Street
Marble Arch
London W1H 5 YR
Tel: 01-724 4349
Tlx: 295441

Fanday Aquaria
Branheath Lane, New End
Redditch, B96 6 NQ
Tel: 052-789-2975

R.J. Whitewell
11, Lexton Road
West Bergholt
Colchester, Essex, CO6 3BU
Tel: 0206-240223

Pet & Water World Ltd
221, Meols Cop Road
Southport, PR9 6JY
Tel: 0704 677460

The Golding Ltd
Barton Stacey
Winchester,Hampshire, So21 3QL
Tel: 0962-760792
Telex: 477608 petgod

The Coral Bazar
Queens Close
Walton-on-the -Hill
Tadworth, Surrey, KT 20 7SU
Tel: 073 781 2475

Fish World Northampton
126, Wellingborough Road
Northampton
Tel: 0604-3721
Tlx: 312247

Tachbrook Tropicals Ltd
244, Vauxhall Bridge Road,
London SW1
Tel: 01-834 5179

Keith Barraclough Aquarist Ltd
Hayfield Mills
Haycliff Lane
Bradford,
West Yorkshire BD6 9ET
Tel: 0274-576241
Tlx: 517722

Lotus Water Garden Products Ltd
260/300 Berkhamated Road
Chesham,
Buckinghamshire,
HP5 3EZ
Tel: 0494-774451
Tlx: 837569

J.M.C Aquatics
59, Stubbley Lane
Dronfield
Sheffield S18 6PG
Tel: 0246-415275
Tlx: 54146

Faithful's Fisheries Ltd.
19, Waldo Road
London, NW10
Tel: 01-960 1091
Tlx: 9419505

Mainly Tropicals
1, Norman Road
Turnbridge Wells,
Kent
Tel: 0892-36263

**Germany**

Aquarium Niderrhein
G. Plessn, Herdt 9
4050 Moncheglandhach-
Rheindahlen.
Te. : (02161) 580766

Johann Christ
Steinfurther Allee 41
200 Hamburg
Tel : (040) 7122169

Hagenbeck's Tierpark
Uwe Richter
Borsteler Chaussee 284a
2000 Hamburg 61
Tel ; 4054000147

Fritz Muller
Aquarium, Dieslstrasse 7
30001 Isernhagen
Tel : 511773069

West Aquarium GmbH
Scharzfelderstr. 109
3422 Bad Lauterbach
Tel : (05524) 4091

Aquarium Muster Pahlsmeier
GmbH, Galgheide 8
4404 Telgte
Tel : (02504) 3031.

H. Espe
Zierfishgrosshandlung
Bevenserstr, 2800 Bremen
Tel : (0421) 451791.

Tropical Sonnen Studio
Heinz Heincke
Max-Brauer-Allee 148
2 Hamburg 50
Tel : 404976.

Willinbald Muller
Zoogrosshandlung
Munsterstrasse 21
4401 Rinkerode
Tel : 25388195.

**Finland**

ADVAARIO PIEKKALA
P O Box 192, SF-00141 HELSINKI
Tel : 90-605 687
Tlx : 123525 jari sf

KAPTEENIN LINTUKAUPPA OY
Uudenmaankatu 27
SF-00120 HELSINKI
Tel : 90-648 276

PORIN AKVAARIOTARVIKE
Isolinnankatu 24
Herttuantori
SF-28100 PORI
Tel : 939-142 19

ELAINSOPPI
Sommarnas
SF-04130 NIKKILA
Tel : 90-232 565

TURUN AKVAARIO OY
Kaarningonkatu 18
SF-20720 TURKU
Tel : 921-366 195
Tlx : 62510 tjish sf

**United States of America**

1. Amszon Tropical Hatcheries
   P O Box 553, Fort Lauderdale
   Fla 33302

2. Angels Hatchery
   9800 S.W. 68th Street, Miami
   Fla 33175

3. EKK-Will Tropical Fish Farm Inc.
   P O Box 307, Symmes Rd
   Gibsonton, Fla 33534

4. Exotica Aquaria Inc.
   3065 S.W. 37th Avenue, Miami
   Fla 33054

5. Fine fish Farms Inc.
   3475 N.W. 187th Street, Miami
   Fla 33054

6. Florida Aquatics
   Tropical Fish Division
   2705 West Kirby St., Tamba
   Fla 33614

7. Florida Tropicals
   315 Sunny Road, Lakeland
   Fla 33801.

8. F.T.F.
   P O Box 1321,
   Bradenton (nr Tampa)
   Fla 33505

9. Global Fish Import
   3550 N.W. 189th Street, Miami
   Fla 33055

10. Peterson Pet supply Co.
    7391 N.W. 78th Street
    Miami Springs
    Fla 33166

11. Ocean Aquatics Inc.
    8789 S.W. 132 Street, Miami
    Fla 33176

12. Paramount Aquarium Inc.
    Route 4, Box 57 (Hawley Rd)
    Fort Pierce
    Fla 33450

13. Popsa
    P O Box 560801, Kendall
    Fla 33156

14. Premium Fish Hatchery
    P O Box 728
    7213 Nundy Avenue, Gibsonton
    Fla 33534

15. The proaqua of Miami
    4039 N.W. 22nd Avenue, Miami
    Fl;a 33142

16. Robers Fish Farm Inc.
    P O Box 65-38G, Miami
    Fla 33165

17. Ray;s Pet Department Store
    8515 S.W. 136th Street, Miami
    Fla 33156

18. South Miami Tropical Fish
    Hatchery Inc.
    7100 S.W. 97th Avenue, Miami
    Fla 33173

19. Sunlan Aquatic Nurseries
P O Box 44-006
8301 N.W. 8th Street, Miami
Fla 33144

20. Surfside Aquatics Inc.
P O Box 518
Gibsonton (near Tampa)
Fla 33534

21. Al West Aquatics
Box 544, Lake Helen
Fla 32744

22. Aquatics Inc
7004 W. Cullon Avenue
Norridge (near Chicago)
Ill. 60634

23. Cramer's Aquarium
5302 85th Avenue W.
Milan
Ill. 61264

24. Midwest Aquarium Inc.
639 North Thomas Drive
Bensenville (near Chicago)
Ill. 60106

25. Noah's Ark Pet Center
2430 East Oakton Street
Elk Grove Village (near Chicag)
Ill. 60007

26. All-City Tropical
Importers Inc.
135-30 Rockaway Blvd S.
Ozone Park
N.Y. 11420

27. Aquarium Products
133-18 Liberty Avenue
Richmond Hill
N.Y. 11419

28. Emark Tropical Imports of New
York
2302 Voorhies Avenue
Brooklyn
N Y 11235

29. T A Aquatics
1795 Jerome Avenue, Bronx
N. Y. 10453

30. S. Greespan's Tropical Fish Inc.
144-165 Northern Blvd
Flushing
N Y 11357

31. Henry's Tropical Fish Hatchery
109-08 101st Avenue
Roshmond Hill
N Y 11419

32. Marine Tropical Importers
9803 Fourth Avenue, Brookyln
N Y 11209

33. Regal Tropical Fish
1612 Madison Street,
Ridgewood
N Y 11227

34. A-1 Fisheries Inc.
118 Center Street
El Segundo
Cal. 90245

35. Long Beach Fisheries Inc.
2035 E. 14th Street
Long Beach
Cal. 90804

36. Marine Fish Enterprises
130-1/2 W. Gardena Blvd
Gardena
Cal. 90248

37. Marinelife Inc.
940 West Olive, Inglewood
Cal. 90301

38. Pratt's Tropical fish
155 W. 35th Street, Suite C
National City
Cal. 92050

39. Pet Dealers Supply Co.
Aquatics Division
3300 Lenois Blvd,
Vernon
Cal. 90058

40. Pet Dealers supply Co.
Aquatic Division
3300 Lenois Blvd,
Vernon
Cal. 90058

41. Taiwan Tropical Fish Co.
Box 1144
1357 Greenbrier Drive
San Carlos
Cal. 94070