Fishery Science is one of the important subjects in the curriculum of both under and post graduate students of all Indian Universities. The teacher, scientists and students are also actively engaged in research in fishery science. For this purpose the proper methodology is necessary. Being a fishery science teacher we felt the information required particularly the methodology to study the fish biology and basic concept in a consolidated.

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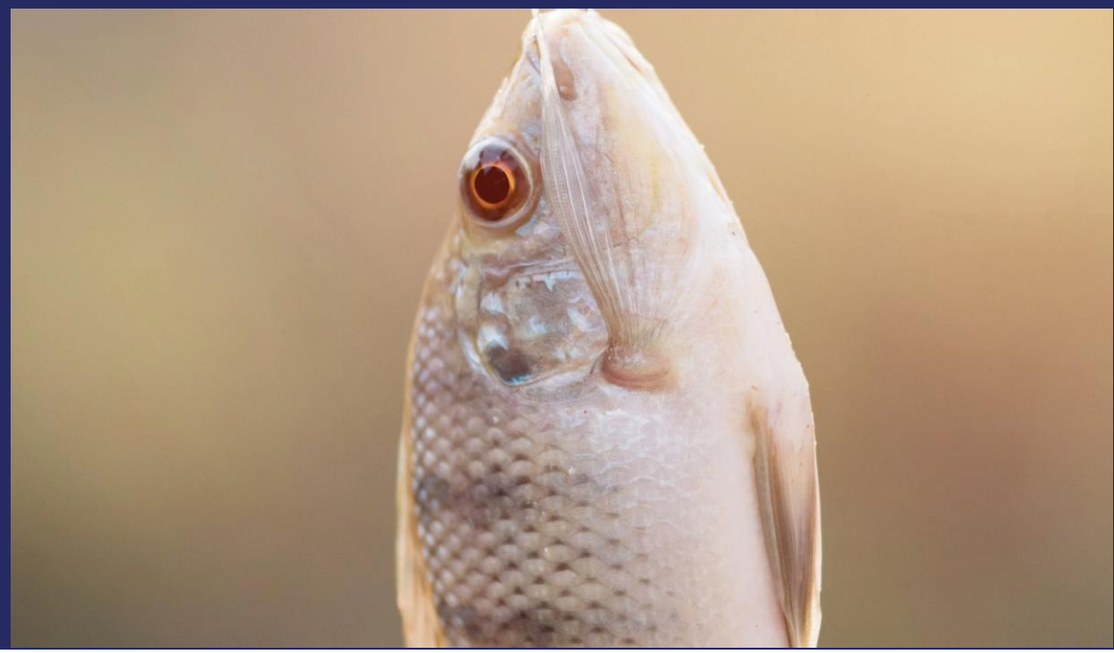
Basic Concept Of Fishery Science



Kiran Shillewar
Dipti V Totawar

A Text Book Of Fishery Science

Fishery Science

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A Text Book of
“FISHERY SCIENCE”
(Third Edition)

A Text Book of
"FISHERY SCIENCE"
(Third Edition)

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Preface

Fishery Science is one of the important subjects in the curriculum of both under and post graduate students of all Indian Universities. The teachers, scientists and students are also actively engaged in research in fishery science. For this purpose the proper methodology is necessary. Being a fishery science teacher we felt the basic concept required particularly the methodology to study the fish biology in a consolidated manner. An effort has been made towards bringing out a manual to fulfill the requirement of students and researchers concerned with Fishery Science.

The present manual is prepared for students and teachers as well as researches.

The authors are very much thankful to Dr. D.U. Gawai (Principal, Science College, Nanded), Dr S.L. Jadhav (Librarian, Science College, Nanded).

Criticism and suggestions are always welcome for further improvement of this book.

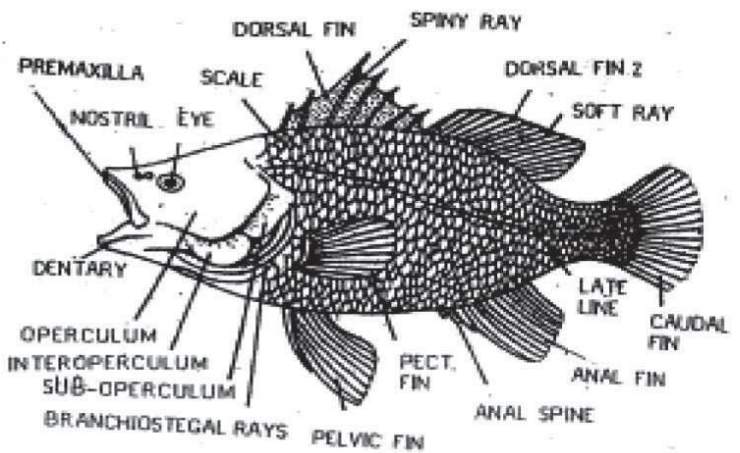
- *Author*
Dr. Kiran Shillewar
Dr. Dipti V. Totawar

CONTANTS

Chapter 1 INTRODUCTION OF FISHERY SCIENCE

Fish :

Fish is cold blooded vertebrate aquatic animal, respiration by mean's of gills, locomotion by fins, spindle of boat shape called fish. Species differing widely from each other in shape, size, habits and habitats. Some of them are very small, not more than an inch in length, while a few attain a length upto 18.50 meters. They live in all the seas, rivers, lakes, canals, dams and in almost every place where there is water. Fishes usually have a stream-lined body but some are elongated snake-like and a few are dorsoventrally compressed. They have paired and unpaired fins supported by soft or spiny rays.



Fish

barbels which are an excellent organs of touch. They constitute economically a very important group of animals. Besides being used as food, fish liver is an important source of oil containing vitamins A and D. Body oil from fish is extensively used in soap industry and tanning. Fishes also yield fish meal, fish manure.

GENERAL CHARACTERS OF FISHES:

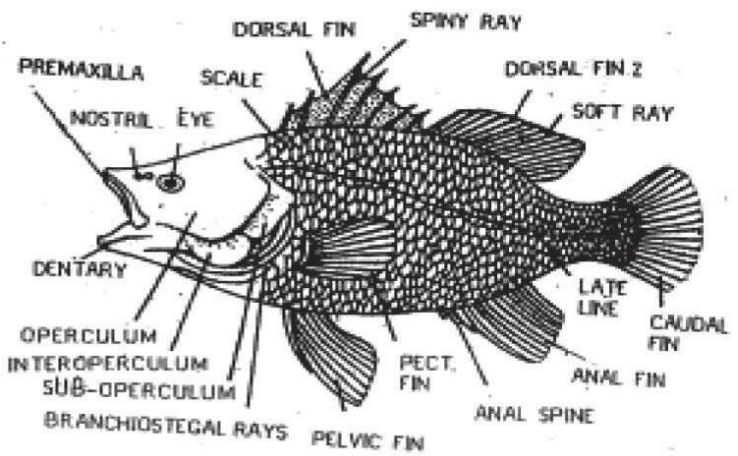
1. All fishes are aquatic animals, They live is marine water, fresh water or brakish water.
2. They are cold blooded animals.
3. Respiratory organs are gills, but accessory respiratory organs may be present.
4. Skin is covered with scales (exoskeleton scales)
5. Generally body is streamlined but some are elongated, snake like (eel) or dorsoventrally flattened.
6. Presence of paired and unpaired fins supported fin rays.
7. Pectoral and pelvic are paired but dorsal cau dal and anal fins are unpaired.
8. Presence of barbels in some telcostomitactile organ
9. Gills open outside by gills slits covered by operculum.
10. Gill slite are generally 5 to 7.
11. Air bladder generally present except elasmobranchi.
12. Lateral line is present.
13. Heart is two chambered.
14. Gonads shows true gonoducts.

***

Chapter 2 EXTERNAL CHARACTERS OF SCALY & SCALESS FISH

External Characters of Scaly Fish:

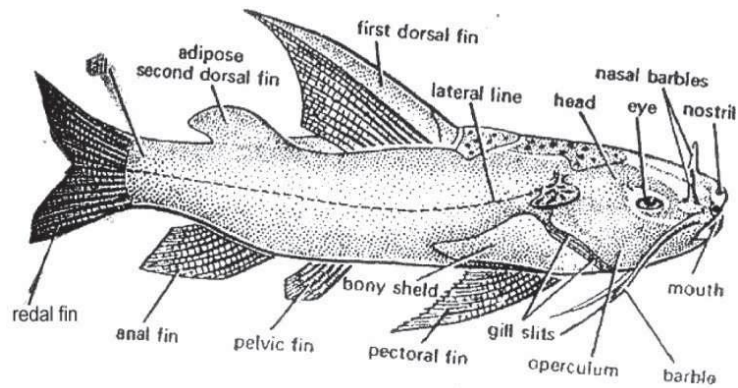
1) The Fish is a cold blooded, vertebrate, aquatic animal, breaths by means of gills, body is spindle or boat shaped.
2) The fish is covered with scales. The body of fish is slippery in nature.
3) Fish has two dorsal fins & ventral fins & fish has also two pectoral fins.
4) Fish has a caudal fin in tail region. It is used for changing directions.
5) To ventral side near the Anus, Anal fin is present.
6) On lateral side, from head region up to the caudal region base a doted line is present is known as lateral line.
7) Ex.: - Catla, Rahu, Mrigal



Scaly Fish

External Characters of Scale less Fish :

1) Fish is a cold blooded, aquatic, vertebrate animal, breaths by means of gills, body is spindle or boat shaped.
2) The fish is a scale less fish. The body of fish is covered with the skin.
3) The fish has two dorsal fins.
4) In tail region caudal fin is situated.
5) To ventral side near the Anus, Anal fin is situated.
6) Fish is having pairs of barbels, barbels is a long & it reaches upto caudal base.
7) In mouth of fish teeth are present. Hence, it is a carnivorous fish in nature.
8) Ex. : Wallago attu, Notopterus notopterus



Scaleless fish (Rita rita)

***

i) Total Length :

It is the measurement of body length from tip of snout to the longest part of caudal fin.

ii) Standard length :

Length from snout to the origin of caudal fin.

iii) Forked Length :

Length from snout to the point of bifurcation of caudal fin.

iv) Head Length :

Length from snout to the posterior most part of the operculum.

v) Snout Length :

Length from snout to the anterior most margin of the eye orbit.

vi) Eyediameter :

Maximum length of eye orbit from one margin to the other

vii) Inter orbital Length :

Distance between two dorsal most orbits of the eye.

viii) Pre dorsal Length :

Length from snout to the origin of dorsal fin first & second.

ix) Pre Pectoral Length:

Length from snout to the origin of pectoral fin.

x) Pre Pelvic Length:

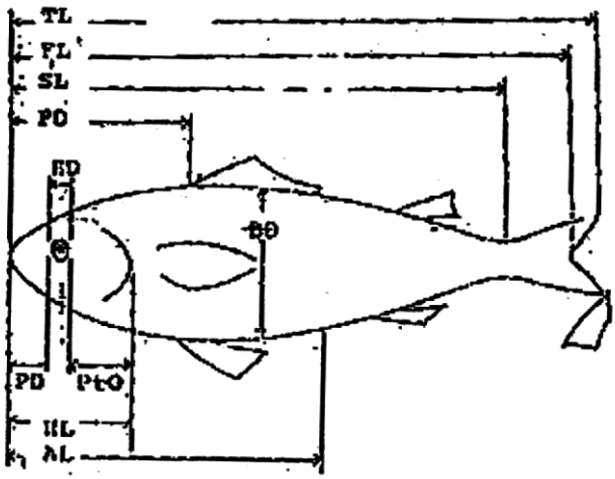
Length from snout to the origin of pelvic fin.

xi) Pre anal Length:

Length from snout to the origin of anal fin.

xii) Height of dorsal fin :

Height of dorsal fin from base of origin of dorsal fin to end of the longest finery.



Morphometric measurements of a fish

[TL:total length, FL: fork length, SL: standard length, BD : body depth,ED : Eye diameter , PD : pre-dorsal]

***

Chapter 4 BIOLOGY OF INDIAN MAJOR CARP & BIOLOGY OF EXOTIC CARP

INDIAN MAJAR CARP : (IMC)

The carps whose origin is India or indigenous carps which are commercially important fishes of India are called Indian major carps. eg: Catla, Rahu, Mrigal

A) Herbivorous fishes

i) Rohu ii) Silver carp iii) Grass carp

B) Carnivorous fishes

i) Wallaga attu ii) Rita rita iii) Channa sp.

C) Omnivorous Fishes

i) Cirrhinus mrigala, cyprinus carpio, Tor tor

Functions of fins :

Pectoral fin	= For swiming
Caudal fin	= Change the direction
Pelvic fin	= Balance and support to dorsal fin
Darsal fin	= Balance the body
Anal fin	= Support to dorsal fin and protection of Anus.

BIOLOGY OF CATLA:

The scientific name of Catla is catla - catla. It has fastest growth rate among the majar carps.

Characters:

1) It is fresh water fish.
2) Mouth is large and upturned with prominnant lips
3) Body is elongated, broad, barbels are absent.
4) Head is large having rounded eyes.
5) Colour blakish gray above & silvery on sides.
6) Coudal fin is bilobed.

Food and feeding habits :

It is surface feeder. Spawn to fry stage feeds on phytoplankton. From fingerlings to adults feed on crustaceans, insects. It is a zooplankton animal (60% zoop-lankton & 40% phyto plankton)

Spawning Season :

Spawning of catla in river from July -September once a year.

Maturity:

Age and size at maturity in fishes is different to climatic & ecological conditions.

Catla attains maturity within 2 year.

Growth:

It is one of the fast growing major carp of India, attains 6 ft. in lehgth & weight more than 60 kg.\ In good nursery ponds hatchling of catla stocked at rate of 10-12.5 lakh / ha. grow to length of 20-25mm in 15 days.

According to Hora and Pillay (1962) catla grows to 38-45cm (900 gm) at end of 1st year, 4-5 kg by the IInd year & 6-7 kg by end of 3rd year.

Fecundity:

In 5 kg of femal, a total no. of 4,00,000 ova were found. According to Jhingran (1963) fecundity of Catla ranges from 2,30,831 to 42,02,250 depending on the length & weight of ovary of fish.

Distribution:

It is fresh water fish, It is also found in pakisthan/ Burma/Bangladesh It has been transplanted in cylon & Israel.

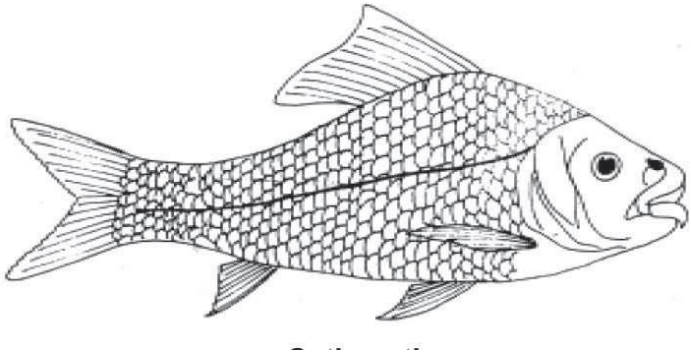
Economic Importance :

It is important food fish, It is largely employed for pond culture through out the country.

It play a important role in composite fish culture.

CLASSIFICATION :

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Cypriniformes
Family	-	Cypriniidae
Genus	-	Catla
Species	-	catla



Catla catla

BIOLOGY OF ROHU:

The scientific name of Rohu is Labeo-rohita. Rohu also grow very fast but is relatively little slower than catla.

Characters :

1) Body is elongated with rounded abdomen
2) Calour is brownish gray to black above.
3) Scales are large & arrange redish in colour in the center.
4) Head is prominant, lips thick
5) Mouth is sub-terminal
6) Caudal fin forked & barbels are absent.

Food & feeding :

It is colum feeder animal feeds on vegetable de-bris, microscopic plants, decayed and mud.

Spawning seasons :

Spawning of Rohu, June to Augest In river Ganga, it breeds from April to August (David 1959)

Maturity :

Rohu, attains maturity at 2nd years.

Males mature early than females.

Growth :

In good Nursery ponds hatchling of rohu when stocked at the rate of 10-12.5 Lakhs/hac, grow to a length of 25-30 mm in 15 days.

Accroding to Hora (1962) rohu gorws to a length of 35-45 cm (900gm) in one year.

2-3 kg in the 2nd year and 4-5kg end of 3 rd year After 4 year the growth is very slow.

Fecundity:

The absolute fecundity of several specimen of rohu, ranging from 51-75 cm & weight 1.5 -7.6 kg was found to vary from 4,25,600 to 27,94,000 eggs.

Distribution:

It is fresh water fish

It is also found in pakisthan, Bangladesh, Burma

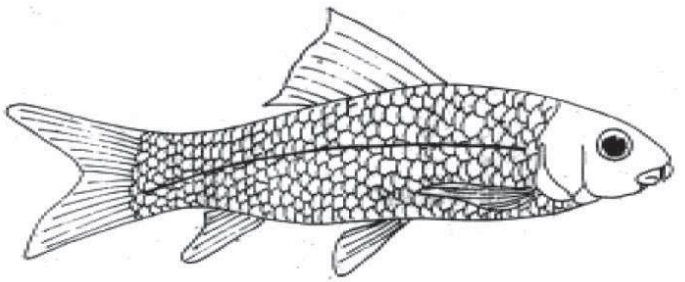
It has been transplanted in many Countries.

Economic Importance :

Quick growing carp. It is largely used for culture in ponds all over the country. It is valuable food fish.

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Cypriniformes
Family	-	Cypriniidae
Genus	-	Labeo
Species	-	rohita



Labeo rohita

BIOLOGY OF MRIGAL :

The scientific name of Mrigal is Cirrhinus mrigala. It grows fast and is next to Rohu.

Characters :

1) Body elogated with small head.
2) Mouth is terminal.
3) Colour of the body is silvery dark gray.
4) Pectroal, Anal, fins are black in colour.
5) Caudal fin is sharply forked.

Food & Feeding habits:

It is battom feeder. It is omnivores animal It feeds copepods, decayed plants, algae, animal mat-ter, mud, phytoplankton etc.

Spawning seasons:

Spawning season of mrigal start from June to early Aug.

Maturity :

Both male and female attain maturity when they are two year old.

Growth :

Fry when stokced at 10 to 12.5 lakh /hac grow to a length of 25-30 mm in 15 days. Fingerlings are reported to grow a length of 55 -65 cm. and weight of 1-2.2 kg in one year. According to Hora & pilay (1962) mrigal grows 1.8 kg, 2.6 kg, 4 kg by end of 1st, IInd & IIIrd year.

Fecundity :

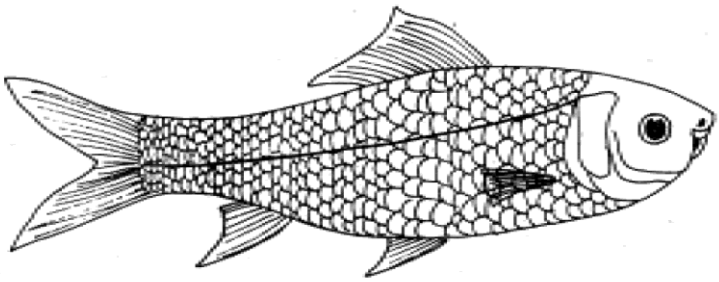
Weight of femal mrigal 1.47 kg a total no. of eggs 2,16,800 were found.

Distribution:

Originally found in North Indian river, It is also found in pakisthan, Bangladesh, Burma.

Economic Importance :

It is important carp caltured widely through out India It is valuble food fish.



Cirrhinus mrigala

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Cypriniformes
Family	-	Cypriniidae
Genus	-	Cirrhinus
Species	-	mrigala

BIOLOGY OF EXOTIC CARPS :

Exotic Carp = Exotic carp are those fishes whose native in foreign, which is introduce in India for commerciall purpose called exotic carp.

Ex.: Grass carp, Silver carp, Common carp.

The scientific name of Grass carp ctenopharyrigodon idella.

BIOLOGY OF GRASS CARP:

Characters:

Body elongated and moderately compressed. Head broad with short-round snout, upper jaw slightly longer than lower jaw, no barbels, short dorsal fin rays. Dorsal origin slightly in advance or opposite to that of ventral and scales are of moderate size. In color it is dark grey above and silvery on belly.

Food and feeding habits:

Early fry to fingerlings feed mainly on zoop-lankton. From fingerlings to adult stage it feeds on macrovegetation, Hydrilla, ceratophylum, Lemna, Wolffia and soft parts of the plants.

Growth:

It has a fast growth rate, fry stokced at 10-12-5 lakh/hac attain a length of 22-27 mm in 15 days. When stocked along

with silver carp they grow to 12 cm in 3 months and attain a length of 73-86 cm (4-7 kg) when 3 years old.

Maturity:

In temperate regions it matures from 2nd to 3rd year, when weight of fish is 2 kg. about cold countries it gets matured during 5 - 7 years age when its weight is 2.5 kg.

Fecundity:

In specimen weight 4 - 7 kg, Alikunhi et al (1963) found a total number of 3,0800 to 6,18,000 eggs.

Spawning:

Breeds only in lotic environment, during south west monsoon from June to Sept. and once in a year.

Distribution:

It is native of south, central and north China and middle and lower sections of river Amur in USSR.It has been transplanted and cultured in large number of countries in world; including India. In many countries like Japan and Taiwan it has well established.

Economic Importance :

It is widely cultured every where in world for biological weed control. It is an essential component of polyculture.

BIOLOGY OF SILVER CARP:

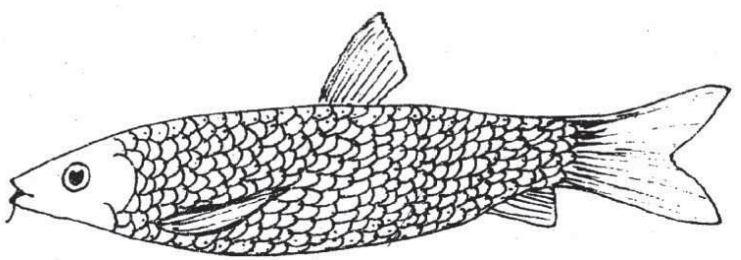
The scientific name of silver carp is Hypopthal michthya molitix.

Characters:

Body ablong, slightly compressed, head pointed, snout bluntly rounded, lower jaw slightly protrusing, small eyes, very small scales, origin of dorsat fin behind the ventral, midway between tip of snout and base of caudal fin.

CLASSIFICATION :

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Cypriniformes
Family	-	Cypriniidae
Genus	-	Ctenopharyngodon
Species	-	idella



Ctenopharyngodon idella

Food and feeding habit :

On larval stages, it feeds on nanoplankton shifting to zooplankton. from early fry to late fry stages it feeds on zooplankton as main food with phytoplank-ton as occasional food but later phytoplanklton becomes the major food.

Growth:

Hatchlings when stocked at 10-12.5 lakh/hac grow to a size of 25-30 mm in 15 days. In China species grows to 150,900,1800 and 4200 gm at the end of first, second, third and fourth years respectively, in reserviors it grows to 900 gm, 2000 gm,4500 gm to 5000 gms during the I, II and III year- Rao and Trivedi (1972).

Maturity :

In temperate countries, it matures in 2-3 years of its life, when weight of fish is 2 kg about or higher, but in very cold countries during it matures 5-6 years,when weight is 2.5 kg.

Fecundity:

According to Alikunhi (1963) the total fecundity of silver carp ranging in weight from 3-8.5 kg.was found to vary from 1,45,000 to 20,44.000 giving an average of 171 eggs/gm body weight.

Spawning :

Spawns once a year by hypophysation from June to August.

Distribution:

Native of fresh waters of China and Russia transplanted and Cultured in large number of countries of temperate and sub-tropical regions of world, including India.

Economic Importance:

Fastest growing carp of India highly useful in composite fish culture. Useful for stocking reserviors and tanks rich in phytoplankton.

BIOLOGY OF COMMON CARP :

The scientific name of Common carp is Cyprinus carpio, the fish has 3 varieties:

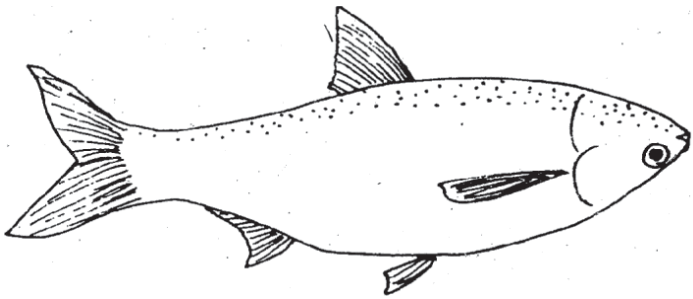
1) Cyprinus carpio var communis (scale carp)
2) Cyprinus carpio var specularies (mirror carp)
3) Cyprinus carpio var nudus (leather carp)

Characters:

First ray of dorsal fin and anal fin modified into spine and both are internally serrated, two pairs of bar-bels scales are loosely placed, shining and small in size, mouth protrusible.

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Cypriniformes
Family	-	Cypriniidae
Genus	-	Hypophthalmichtys
Species	-	molitrix



Hypophthalmichtys molitrix

Food and feeding habits:

Larval stages feeds on nanoplankton fry feeds on zooplankton. From fingerlings to adult stage it feeds on benthic fanna, tubefix and other insect lavae, decayed vegetable matter, detritus of phyto and zooplankton. Adults are bottom feeder omnivores and readily take artifical food. They collect food by taking bottom mud into the mouth, taking in digestible particulate food and throwing out mud; making water turbid.

Growth :

According to Alikunhi (1966) fry stocked at 1.6 million per ha grow to a length of 26 mm in 20 days, with 50% sarvival. In various ponds in India, the fingerling grow to a weight of 1 kg in one year, with artificial feeding and at a stocking rate of 2500/hac.

Maturity :

The species become sexually mature at different times depending on the climatic conditions. In U.S.S.R. it attains maturity between 4-5 years. In temperate zones of Europe males ripe at 4 years and females at 5 years. In China and Japan, it matures at 2-3 yr. In India at cuttack, Chinese strain species mature at 6-8 months age, males maturing earlier (Alikunhi 1967).

Fecundity:

The absolute fecundity of this species is reported to vary from 39,400 to 16,59,000 eggs. It is difficult to compare the fecundity of common carp from different regions , as it breeds 4 or 5 times a year in troprical countries and only once a year in temperate countries.

Spawing :

In temperate countries, in spring once a year, while in tropical waters it spawns throughout the year.

Distrbution:

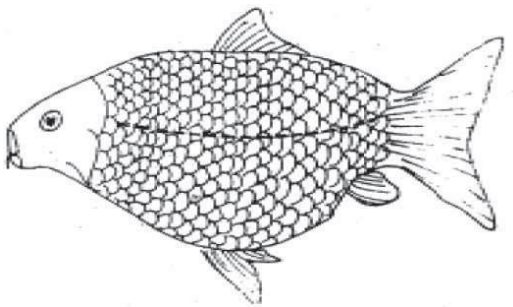
The fish is distributed in fresh waters rivers and ponds of China, Russia transplanted and cultured pracetically in all parts of the world, in temperate and troprical parts including India.

Economic Importance:

Largest cultivable and domesticated fish all over the world.

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Cypriniformes
Family	-	Cypriniidae
Genus	-	Cyprinus
Species	-	carpio



Cyprinus carpio

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Chapter 5 STUDY OF PREDATORY FISHES

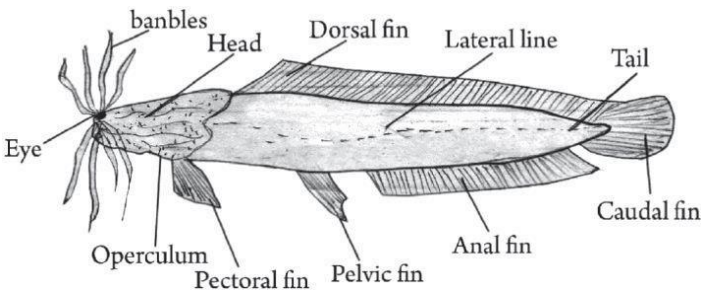
Defination :

Predator fishes are carnivorous in nature & predate on spawn , fry , fingerlings of Indian major carp.

CLARIUS BATRACHUS:

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Silluriformes
Family	-	Clariidae
Genus	-	Clarius
Species	-	batrachus



Clarius batrachus

IDENTIFICATION:

1) It is commonly called as ‘Mangri'in Hindi.

2) Body is elongated, with laterally compressed head.
3) Scale less and measuring upto 45 cm in length.
4) It is predatory in nature.
5) The general colour of the body is uniform brown or greyish black.
6) Sensory barbels are four pairs.
7) Dorsal fin is long and without spines, extending from the neck to the caudal fin.
8) Anal fin also long. No adipose fin.
9) Caudal fin more or less rounded, pectoral fins are provided with spines.
10) Acessory respiratory organs are branceed tree like especially designed to take in oxygen from air.
11) The Air-bladder is connected with internal ear by weberian ossicle.
12) It is highly nourishing and estimated as food.

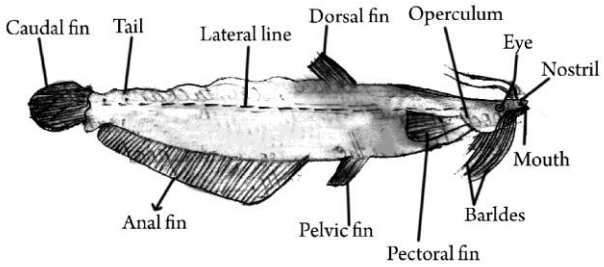
Distribution :

Clarius is distributed in India, Burna, Sri Lanka

HETEROPNEUSTS FOSSILIS:

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Silluriformes
Family	-	Hetropneustidae
Genus	-	Heteropneusts
Species	-	fossils



Heteropneusts fossils

IDENTIFICATION :

1) It is commonly called as ‘Singhi'in Hindi.
2) Its body is elongated and laterally compressed measuring about 30 cm in length.
3) Skin without scales.
4) It is predatory in nature.
5) Head flattened, eyes with free circular margins.

6) Barbles long and four pair.
7) Dorsal fin is short without spine, ventral fin situated at the level of the dorsal fin.
8) Pectoral fins are strong with poison spine.
9) Anal fin is enlongated, reaches upto the caudal fin seperated from it by a notch.
10) Air-bladder absent.
11) Accessory breathing organs are present.

Distribution :

Heteropneustes is found in fresh water of India and Burma.

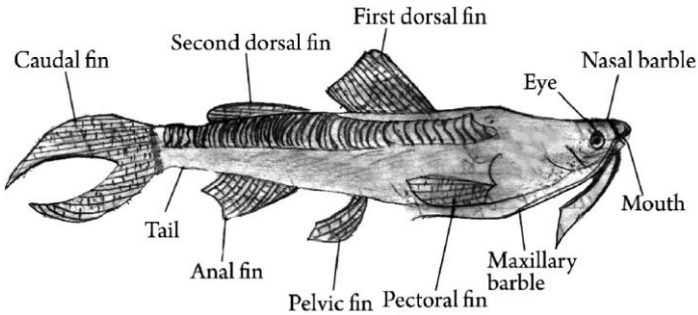
MYSTUS SEENGHALA

IDENTIFICATION:

1) Body is brownish on the dorsal surface and silvery on sides.
2) Eyes are small.
3) Barbles are well developed by which they make a good vision and found their way.
4) It attains a length of about 46 cm.
5) This fish is predatory, feeds on small carps, other fishes and prawns and also feed on some insects, larvae, crustaceans, aquatic weeds.
6) This fish provides a good nutritive value.

CLASSIFICATION:

Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Silluriformes
Family	-	Bagridae
Genus	-	Mystus
Species	-	seenghala



Mystus seenghala

It breeds in the rivers and pools and the breeding season is April to July.

Distribution :

This fish is found in riverine system like Ganga and Jamuna and also inhabitants in small reservior.

WALLAGO ATTU:

CLASSIFICATION

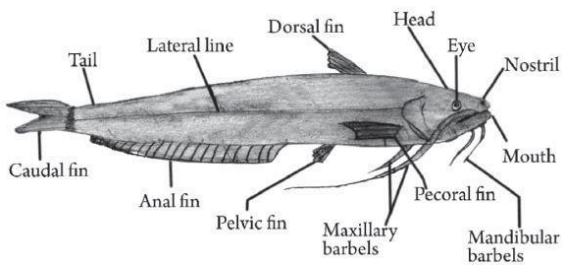
Phylum	-	Chordata
Group	-	Pisces
Class	-	Osteichthys
Order	-	Silluriformes
Family	-	Silluridae
Genus	-	Wallago
Species	-	attu

IDENTIFICATION:

1) Commonly known as Freshwater Shark.
2) This is one of the largest fresh water catfish.
3) It attains a maximum length about 183 cm. but is usually 61 to 91 cms long.
4) It is predatory in nature.
5) They are provided with large mouth and sharp teeth helpful for predatory action.
6) Breeding takes place in rainy season.
7) This fish is used as food.

Distribution :

Found in fresh water in India, Pakistan, Burma,and Indonesia.



Wallago attu

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Chapter 6 INDUCED BREEDING

INDUCED BREEDING: (HYPOPHYSATION)

Fish induced by giving extract stimules gontrops for breeding in stagnant water.

History :

The technique was Ist used in Brazil in 1930. Then Russia, Europe America. Dr. Choudhari 1955 used there became In Maharashtra 1959 the tecnique is used in Nagpur.

Tecnique of Hypophysation:

P.G. present below the brain. The P.G. preserved in obsolute alcohal as aceton. Freshely killed fish & remove P.G. in month of May-July P.G.crush in homogenise with distal water, then centrifu it for 2-3 min after that supernatent come at upper surface, Take supernatent in injection. 0.2 ml/kg of body weight. The injection gave caundal pendacle or above laleral line.

Selection & Breeding:

Healthy and good brooders are selected for the successful spawning. The brooders gives as artifical food like oil cake & rice bran for healthy purpose.

A fully ripe male oozes milt at slight pressure on the abdomen, (rough on dorsal surface) full ripe femal rounded belly & reddish vent oozes egg.

The ratio of breeding is 1:2 one femal & 2 male Ist femal giues 2-3 mg/kg. body wt. After in-terval, of 6 hurs the femal gives 2nd higher dose 5-5mg/kg. male giue low dore 2-3 mg/kg. body wat.

Male & female are intruduce in Happa, fixed in a pond with the help of Bomboo poles.

A breeding happa is a rectungler box shaped container made of mosquito net cloth . The brooders starts swimming actively, try to Jump out, chasing each other, pushing with snout. The spawning usually occurs within 3-6 hurs after IInd injection.

The fertilized eggs are removed to hatching hapas for hatching.

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Chapter 7 HYBRIDIZATION

Hybridization :

In India the hybridization of carps was Ist time expermented in 1958. The Indian hybrids are catla catla x Labeo rohita, labeo rohita x Catla Catla were better than parent species.

Grawth rate is fast, maturity is early 1 $^{1}/_{2}$ year In India choudhari produced 5 interspecifis.

Hybrid of genus Labeo. They are hyb.

1) L.rohita x L. calbasu u Rohita - calbasu
2) L.Calbasu x L. Rohita u Calbasu - Rohita
3) L. Bata x L. rohita u Bata - rohita
4) L.Bata x L.Calbasu u Bata. Calbasu
5) L.Calbasu x L. Gonius u calbasu -Gonius

In crossing hybrid 94% fertlization observed growth rate also superiar the parent.

Large no of hybrid between member of family cypriniidae choudhari (1959)

1) Catla Catla x Labeo rohita ---> Catla rohita.
2) Catla Catla x L . Calbasu ---> Catla calbasu
3) Catla Catla x cirrnus mrigal ---> Catla mrigal
4) Labeo. rohita x C. mrigala ---> Rohita mrigal

5) C. Mrigala x L. rohita ---> Mrigala rohu

6) C. Mrigal x L.Calbasu ---> Mrigala calbasu

7) C.Reba x C.rohita ---> Reba rahita

8) L.Rohita x Catla Catla u Rohu catla

In crossing hybrid Rohu mrigal x mrigal Rahu 90% fertilisation of egg obtained.

Then 1971 hybridisation betweem Indian major carp x Exotic c carp

1) C.idella x L.rohita ---> Idella . rohu

2) Molitrix x L.rohita ---> Maltrix rohu

3) H.Molitrix x C.Catla ---> molitrix catla

4) C.idella x C.Catla ---> Idella . catla

5) L.rohita x C.idella ---> Rohu . idella

6) C.Catla x C.idella ---> catla idella

Ramaswami (1958) produced hybrids crossing H.fossiles with femal Clarius batrachus & male clarius batrachus with femal H.fossiles.

INFLUENCE OF ENVIROMENTAL FACTORS ON BREEDING OF FISH.

Enviromental factors such as light, temp, on breeding of fish

Photo-period :- (Light)

Hairington (1956) Suggests that long photoperiod gives the early maturation sharadhari (1966) observed that shat phatopriod give late maturation. In India artifical phato-period gives early maturation.

Tempature :

Temp is on of the most important factor maturation of gonads in fishes. Successful spawning take place when tep 25-32°C In summer pitatory active & winter late maturity.

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Chapter 8 CRAFTS & GEARS

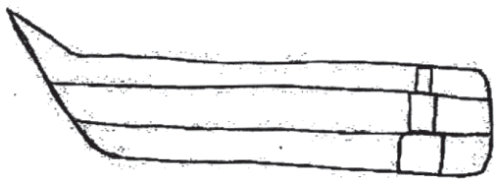
Fishing Craft :

Various kinds of fishing crafts are used in India and are generally of the primitive type, designed according to local conditions. River crafts one light and flat, as compared to the larger ones used in the sea.

1) Coracle : A simple craft, like a circular basket with a wide mouth about 4 m. in dia. The frame of the basket is made of bamboo and is made water tight by a covering a leather. It is mostly used for fishing in rivers and reservios.

CORACLE

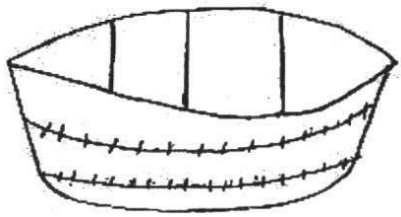
2) Catamaran : It is made by tying together several wooden logs.The size of catamaran varies depending upon the number of logs used. Which may be 4-7 m.



CATAMARAN

3) **Dugout canoe** : It is made by scoopingout material from a single wooden log. They are 6-10 m long. The bigger dugout canoes are provided with planks on the sides.

4) **Masula boat:** It is open wooden boat made of planks a wood without ribs of farmes.



MASULA BOAT

Fishing gears :

several types of hooks, traps and nets are used to catch fish from waters. It is difficult to enumerate all fishing methods used in India and there is no uniformity in the names given to various fishing gears. Some of the common methods a fishing and fishing gears are described below:

1) **Fishing without gear** : It is the simplest method of catching fish, in this method fishes are cought by hands in shallow water, In some hill areas or near dams, water flows, and fishes that come out in the shallow channels are picked up by hands.

2) **Wounding Gear** : Large sized fishes are cought by hunting them, using weapons like spear, harpoon, lance and rifles.

3) **Stapefying Method:** Fishes are paralysed by underwater explosions or by poisons, but this method is not very useful as if kills all the fish from ponds, fishes are also paralysed by passing a weak electricurrent through the water.

4) **Line fishing** : This method is used from a long time. The principle of line fishing is to offer a real or artificial bair to catch fish; which is then unable to release the bail and is lifted from the water. Previously a thorn was used as a hook but now metallic hooks of various shape and sizes are used.

5) **Fish Trap** : Various types of traps are used to catch the fish which allowed to get in but are prevented from escaping. A basket trap, a vide mouthed earther pot or vessel and cover pot/ baket trap are commonly used to each fish.

Dip net / Lift net:

Dip nets are of serval shapes and sizes are lowered into the water in hope that fish would swim over them and are lifted out of water. They are triangular or square in shape and are fitted round a frame, some bait is often put on the net or suspended over it to attract fishes. Smaller nets are operated by hands while larger are dipped and lifted from water by means of a long pole, which is operated like lever, The types of lift nets are

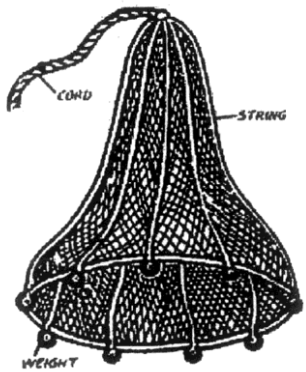
1) Helajal
2) Kharra Jal
3) Bhesal Jal
4) Khoursla Jal
5) Chinese dip net.

Cast net (Ghagaria Jal)

It is an example of falling gear. It is a circular net having the shape of a large umbreela. A storng cord is attached to the apex of the umbrella and a number of lead or iron weight are fixed all along the margin.

The fisherman throws the net fully spread over the water, keeping the longrope in his left hand. This has to be done very skillfully so that net falls on the surface of water fully expanded. The net sinks to the bottom and the circum ference closes due to the weight attached to it. All kinds of small sized fish are entangled in the net, which is then pulled out by means of the cord.

The cast net is extensively used in ponds and rivers and all along the sea coast, but cannot be used in places full of needs or with rocky bottom,

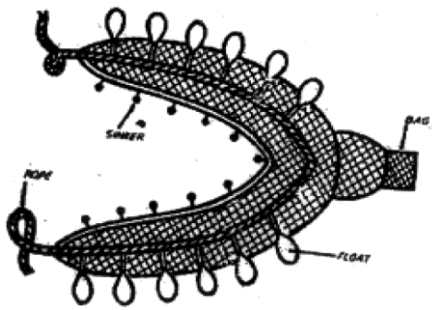


CAST NET (GHAGARIA JAL)

Drag net :

It is a wall like net. The upper margin of the net is supported by a headrope and is provided with floats, Along loawer margin is the foot rope, to which are tied a number weights or stone sinkens to keep the net in position.

One end of the net remains on the bank of the river or sea shore, while a boat carries the rest of the net to spread it out in the water in a semicirular way, ringing the other extermity of the net to another point on the river bank. The two ends of the net are then slowly draged by two parties of fishmen.



DRAG NET

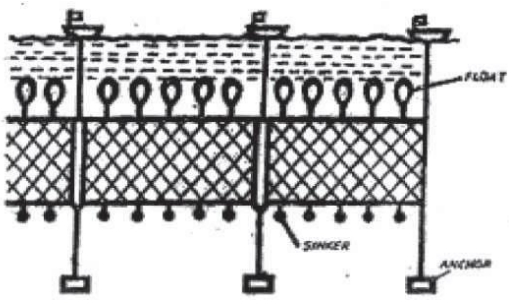
Gillnet and drift net: Gill nets are wall-like nets with floats attached to the headrope and sinkers are fixed to the foot rope. The net is set in transverse direction of the migrating fish, so that when the fish tries to swim through a net wall, the meshes form a noose round its head and the fish is caught. As the fish tries to escape,it gets stuckup behind the opercle, hence these nets are called gill nets.

Three types of gill nets are used in fisheries.

1) Set nets (stationary nets)

2) floating gill nets.

3) Drift nets.



GILLNET AND DRIFT NET

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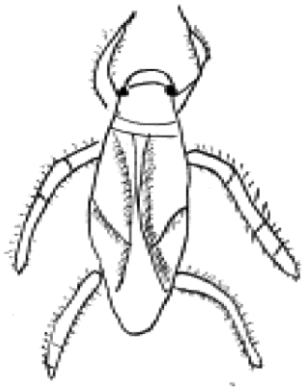
Belostoma:

Belostoma is commonly called as ‘ Giant water bug, which is found in lakes & ponds. Body is dorso-ventrally flattened and covered with minute hairs. Head is broad, less movable, bears a pair of compound eyes and a pair of antenna. Mouth parts are of ficrcing & sucking type. Thorox is broad somewhat triangular.

Three pairs & legs are present. Abdomen is 11 segmented but only 7 segments are visible externally. It is carnivorus feeds on insects, snails, fish fry & tadpoles.

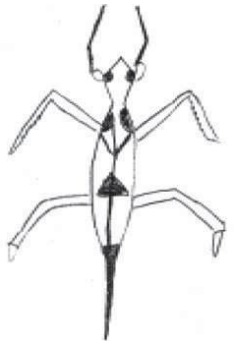


Belostoma

Ranatra:

Ranatra commonly called as water stick insect. It has long body & lone legs, first pair of leg is meant for capturing

the pary. It has a pari breathing tube at hindes and of body. Mouth parts are sucking type. Body is dark green in colour, measuring upto 5 cms.

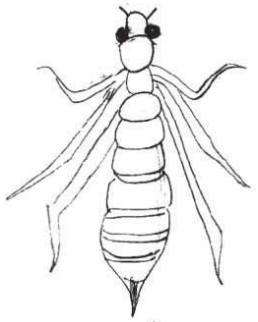


Ranatra

Dragon fly Nymph:

Dragon fly Nymph is commonly found in all types of water bodies. Abdomen consists of 10 segments. Three pairs of legs with developing wings are present.

Nymphs feed on all aquatic orgonisms.



Dragon fly nymph

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Chapter 10 AQUATIC WEEDS & THEIR CONTROL

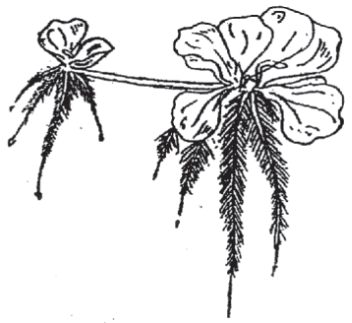
Aquatic weeds: Aquatic weeds are unwanted, undeserible aquatic plants which reproduce & grows in water, which is more harmful than benifical to fishes.

Aquatic weeds are the undersirable plants that grow in water and are more harmful than beneficial for fish culture. Excessive growth of aquatic vegetation prevents effective utilisation of water and reduces productivity. Depending on their habits and habitats, weeds have been classified into the following groups:

(i) Floating plants :

These weeds have their leaves freely floating on the surface of water, and roots hanging underneath. They are profusely found in wind protected ponds and are harmful as they shade the pond,

e.g., Eichhorina, Pistia, Lemma, Azolla, Wolffia etc.



Pistia

(ii) Emergent Weeds :

These are ‘surface' plants which are rooted in the bottom of the pond, but their leaves float on the water surface or rise above the water level. They prefer shallow parts and shores of the pond.

e.g., Nymphea (Lotus), Nelumbium, Nymphoides.

Nymphea

(iii) Submerged weeds :

Ceratophyllum

These plants grow under the water surface and may or may not be rooted, The rooted submerged weeds are *Hydrilla, Najas, Vallisneria, Potamogeton, etc. Rootless plants are Ceratophyllum, Utricularia etc.*

(iv) Marginal weeds :

These plants grow along the shore line of the ponds e.g. Typha, Cypenus, Colocasia, Ipomoea, Sagittaria etc.

(v) Mates or scums formed by filamentous algae and chlamydomonas e.g., Spirogyra, pithophara etc.

(vi) Algae that are scattered in the water body e.g., Microcystis, Oscilatoria, Anabaena etc.

Typha

Accoriding to Hickling (1962) aquatic weeds are of two types:

i) hard plants and (ii) soft plants

A properly consturcted and fertilized supports aquatic vegetation that is necessary for its maintenance. But the

excessive growth of the plants is harmful and it becomes necessary to control the weeds.

Disadvantages of weeds :

Aquatic weeds are harmful as they consume nutrients of the pond and obstruct netting operations. They check free movement of the fish and cause oxygen depletion and accumulation of carbon-dioxide. Gases like hydrogen sulphide and methane are formed which are harmful to the fish. Algal blooms choke the gills and spoil the water on rotting.

Advantages of aquatic weeds :

Aquatic plants, when in limited quantity are useful and necessary for the ecology of the pond. They form natural food of many species of fish, and fertilize the pond when decayed. They provide shade and shelter to many fish and oxygenate the water. They reduce turbidity and provide spawning beds for fishes.

Weed Control :

The aquatic weeds can be kept in check by three methods:

(i) Mechanical

(ii) Chemical

(iii) Biological

WEED CONTROL BY MANUL AND MECHANICAL METHODS:

Mechanical removal of weeds by employing human labour or by machines is the most satisfactory method. In India, where labour is cheap, manual labour is often employed. Periodical removal of aquatic plants by hand picking, uprooting or cutting, keeps them in check.

The rooted submerged weeds are removed by dragging log weeders fitted with spikes and barbed wire, or by cutting them with long handled forks and sickles. During the recent year, power lifts or diesel operated machines have been used for eradicating dense rooted vegetation.

Chemical Control:

Several chemical weedicides are now available for the control of aquatic weeds, but they have to be used carefully to prevent adverse effect on the fishes in water. The chemical is to be selected and used in such a way that:

(i) it should be cheap and easily available.

(ii) non-toxic to fish and man.

(iii) should not pollute the water, and

(iv) should not involve the use of special and costly equipment.

(i) Floating weeds :

It can be successfully controlled by the chemical 2,4 dichlorophenoxy acetic acid (2,4-D). This chemical is applied at

the rate of 4.5 - 6.5 kg/ha, and has little harmful effects on fish. It kills the plants by deadening the leaves and may also be absorbed by the roots destroying them. Pistia and Lemna can also be treated with 2,4-D. Another weedicide is Taficide -80 (2,4-D sodium salt 80%) and when used at the rate of 4-6 kg/ha, in an aqueous solution of 1-1.5% concentration in combination with 0.25% solution of 'surf', is reported to kill the water hyacinth completely (Ramchandram and Prabhu, 1968). Simazine (ethyl amino-S-triazme) is also an effective weedicide.

3.5 kg of chloroxone in 500-1000 litre of water can be sprayed on an acre of water. This chemical kills the plants in 2-3 weeks but is harmless to fish and the operator. It has to be used on clear sunny days, as rain washes off the chemical from the leaves. Pistia and Lemna can also be killed in 10 days by using 1 % solution of sodium arsenite (15 kg/ha), but this is posionous and precautionary measures must be taken. Pistia is also reported to be killed by using ammonia at a concentration of 40 ppm N.

(ii) Marginal weeds : Plants like Typha, Colocasia, Sagittaria and grasses grow along the pond margin and harbour predatory insects. Although the most effective method is to cut them by manual labour, they can be controlled by chemical weedicides. Young Cyperus and Colocasia are totally killed

with 1-1.5 % aqueous solution of Taficide-80 along with detergent 'surf' Colocasia and Ipomoea can also be killed with a solution of 2,4-D sodioum salt (3-4%) with 0.25% surf.

(iii) Emergent weeds:

Water lilies and lotus are the common rooted plants with leaves emerging on the surface. Pulling them out with manual labour or surface treatment with chemicals is of little use in eradicating them. Use of Taficide-80 is reported to be effecitve in controlling Nelumbo. Lily plants get uprooted by treatment with 2,4-D sodioum salt at 1.5% concentration, along with 0.25-1 % detergent 'surf'. At the Central Inland fisheries. Research Institute (CIFRI), marginal weeds like Nymphoides and Nymphea have been eradicated to some extent by spreading copper sulphate with mud on the bottom soil in 4-5 intermittent doses, totalling 175kg/ha.

(iv) Submerged weeds :

Submerged plants like Hydrilla, Vallisheria, Potamageton, Najas and Ceratophyllum are most trouble some, and their removal by manul labour is tedious and costly. The submerged weeds are killed if the water is made trubid for a long time. Copper sulphate in combination with ammonium salt is also found to be effective. Sodium arsenite at 5-6 ppm is also found to be effective in killing submerged weeds.

Other weedicides like 2,4-D and Simazine when sprayed on water, are only partly effective in killing fully submerged plants. The inoganic fertilizers like superphosphates and urea have a toxic effect on these plants. Expennents at CIFRI have shown that superphosphates at 500 ppm completely killed submerged weeds. Hydirilla was completely killed with urea at 250-300 ppm. But urea is harmful to the fish, as ammonia is released. Anhydrous ammonia is also effective in killing the sub-merged weeds, but it is harmful to the fish.

(v) Algal Blooms and Filamentous Algae:

The filamentous algae rarely become a nuisance, but sometimes spirogyra and pythophora form extensive mats, Sodium arsenite is effective in killing them especially in warm weather. Algal blooms consisting of Microcystis, Anabaena and Oscillatoria are sometimes harmful by choking the gills of fish, by causing oxygen depletion or by rotting. They can be eradicated by treatment with coper sulphate. Simazine at a small dose of 0.5 - 1.0 ppm is also effective in controlling Microcystis.

BIOLOGICAL CONTROL :

Several types of weeds can be kept under control with the help of a few species of herbivorous fishes such as the Ctenopharyngodon idella (grass carp), Cyprinus carpio

(Common carp), Tilapia mossambic (Tilapia) and Osphronemus goramy (gourami). The grass carp, C.idella is an important herbivorous species and effectively keeps certain weeds in check. It has been found that advanced fry and fingerlings consume Wolffia. Advanced fingerlings, juveniles and adults feed on Lemna, Azolla and salvinia. Submerged weeds like Hydrilla, Najas and Ceratophyllum is consumed by the grass carp. The fish is also reported to feed on Vallisneria and Potomogeton. In China, the grass crap is reported to consume 40-70 % of its own weight of grass per day and 100 fish per ha can totally eradicate weeds.

The common carp, Cyprinus carpio is also useful in eradicating weeds. While digging and burrowing in search of food, the fish destroys aquatic weeds by uprooting them. Filamentous algae and Pithophora can be kept in check with the help of a few carps in the pond. Tilapia and Gourami are also found to be of great help in keeping the submerged weeds under control. Besides fishes, other animals like ducks and geese can also be employed for weed control. Submerged aquatic weeds can be destroyed to a limited extent by shading the Pond using surface cover of plants.

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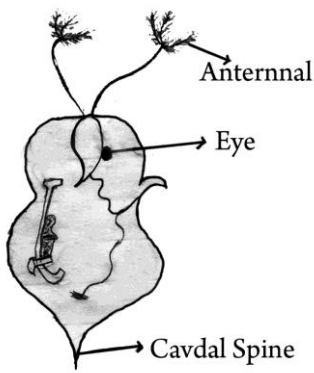
Chapter 11 STUDY OF PLANKTONS

Plankton : Microscopic, Unicellular, plants & animal present in water called plankton. Their are two type of planktons (1) Phyto Plankton (Ex. Spirogyra) (2) Zoo Planktons (Ex. Cyclops, Daphnia)

DAPHNIA :

Classification

Phy	-	Arthopoda
Class	-	Crustacea
Order	-	Diplostraca
Genus	-	Daphnia



Daphnia

1) It is Commonly called as water flea.
2) It size up to 2 mm when well grown.

3) Food of big fry, fingerlings & adult fishes.

4) Sometime if injures fish spawn & young fry with its long sharp positerior spine.

5) Body laterally comprassed.

6) Head bears single blackish small eye.

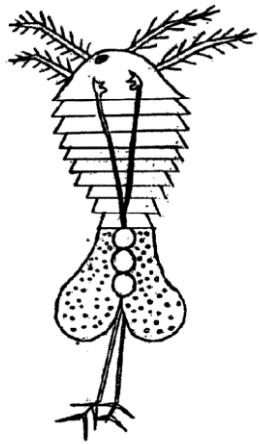
7) A sharp characteristic coudal spine present.

8) Five pair of thoracic appendages.

CYCLOPS:

Classification

Phy	-	Arthopoda
Class	-	Crustacea
Sub-class	-	Copepoda
Geneus	-	Cyclops



Cyclops

1) It is found in fresh water ponds .

2) Its size up to 5 mm.

3) Lays eggs during faverable season which develop into adult within 22 -26 days.

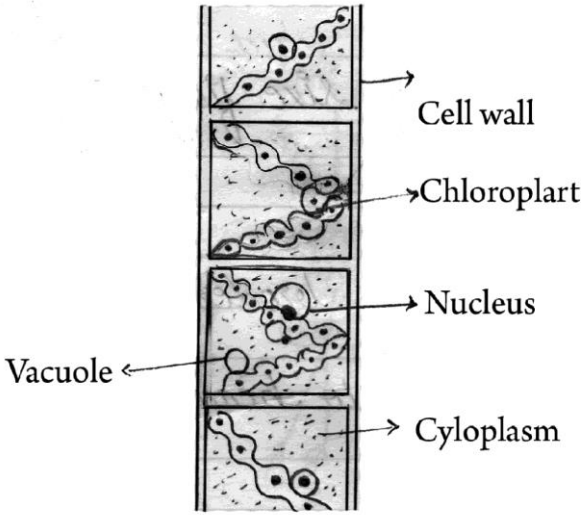
4) Good food for big size fingerling.

5) Body elongated.

6) Anterior part much broder.

7) Body is divisible into head, thorax, abdomen.

SPIROGYRA :



Spirogyra

1) Common fresh water unbranched green alga

2) It is microscopic.

3) Mostely found in ponds, ditches and running water.

4) Chloroplast ribbon shaped

5) Good food for herbivoures fishes.

6) Cells are star shaped.

7) Each cells two layered.

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Chapter 12 BREEDING OF AQURIUM FISHES

Method of Reproduction:

Aquarium fishes reproduce by sexual method of reproduction.

Characteristic feature of sexual reproduction is formation and fusion of gametes to form zygote.

With reference to reproduction aquarium fishes are grouped as:

1) Bubble nest builder fishes.
2) Oviparous fishes
3) Ovo -viviparous fishes
4) Viviparous fishes

1) Bubble nest builder fishes :

The fishes which construct the nest of air bubbles at water surface by blowing the air through mouth.The air bubbles are coated with the sticky secretion of buccal cavity (i.e. saliva) due to which bubble donot burst and accumulate on the water surface inthe form of nest.

e.g. i) Beta splendens (Siamese fighting fish) ii) Colisa lalia (Dwarf gourami) iii) Trichogaster leen (Pearl gourami)
iv) Macropodus opercularies (Paradise fish)

2) Oviparous Fishes :

Fishes which lay the eggs in surrounding medium are called oviparous fishes.

In oviparous fishes fertilization is external i.e. In the water. Fish eggs are of two types adhesive and non adhesive type.

3) Ovo-viviparous fishes :

Fishes produce eggs which hatched without the formation of a placenta inside the mother's body. In ovo-viviparous fishes fertilization is internal.

4) Viviparous Fishes :

Fishes which give birth to young ones are called viviparous fishes.

In viviparous fishes fertilization is internal and embryo nourished from mother's body by forming placenta.

LIST OF AQUARIUM FISHES WITH BREEDING HABIT :

1) Helostoma temminki (kissing gourami) - Oviparous
2) Puntius concheinus (Rosy barbs) - Oviparous
3) Puntius filamentous (Indian Tiger barb) - Oviparous
4) Brachidanio ratio (Zebra fish) - Oviparous
5) Pterophyllum scalare (Angel fish) - Oviparous
6) Pterophyllum eminki (Angel fish) - Oviparous
7) Caracious aurates (Gold fish) - Oviparous
8) Betta splendens(Siamese fighting fish) - Air bubble nest builder fish, Oviparous
9) Colisa fasciata (Gaint Gourami) - --"--

10) Colisa lalia (gourami) - Air bubble nest builder fish, Oviparous

11) Xiphophours helleri (Sword tail) - Live bearer

12) Poecilia reticulata (Guppy) - Live bearer

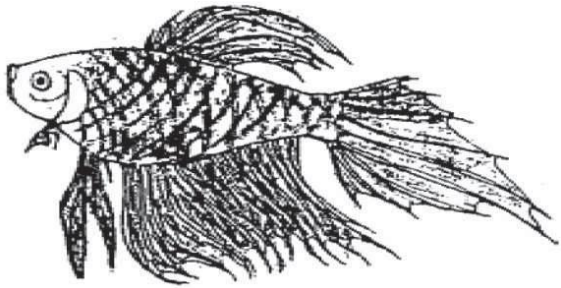
13) Xiphophorus maculatus (Platy) - Live bearer

14) Gambusia affinis (Mosquito fish) - Live bearer

BREEDING AND REARING OF AQUARIUM FISHES :

1) Beta splendens (Siamese fighting fish) :-

The Siamese fighting fish is most famous aquarium fish grows to the length of 6 cm.



It is egg laying bubble nest builder fish from south east Asia (Thialand, Siam, Singapore)

The body is cylindrical with very flowing fin in male.

Females are less colourful with less elongated fins.

The original wild specimens have many sheds and coloures such as green, blue, red and yellow are existed in man made varieties.

Male construct the nest and take parental care. Males have pugnacious nature and battle between them is the subject of a bet in their native country.

Males are extraordinarily aggressive while females are more adjective.

Sexual Dimorphism :-

Male :-

* Males have more intense colours.
* Fins are longer and pointed
* Anal and dorsal fins are too long and expanded.
* Males are small in size.

Female :-

* Female are less colourful.
* Fins are usually shorter than males.
* Body of the female is larger and heavy.
* The abdomen is bulging on lateral sides.

Breeding :-

* Betta splendens is not very difficult fish to breed.
* For the breeding, aquarium of 10 gallon capac ity should be used.
* Water level in aquarium should be reduced by 6 inch.
* Manitain the water temperature close to 80°F.
* Introduce the breeding pair into the aquarium tank, fist male.
* Place the female into a jar that float in to the water of

aqurium so male can see the female.

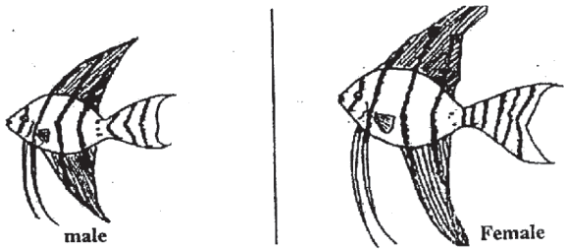
* Generally male observe the female and immediately begins to built a bubble nest.
* Nest is the group of bubbles which coats with saliva.
* The nest is about 2 to 3 inches in diameter and float at the water surface.
* During construction of bubble nest female chased away by the male from nest.
* Instead of chasing away male tries to bring the female into the position under the nest.
* Here male curve its body around the body of the female in such a manner that their anal openings come close together.
* Eggs are not adhesive and they sink to the bottom of aquarium tank.
* Male pick up the eggs in his mouth and spit them into the bubble nest.
* This spawning act is repeated until the female ovaries get empty completely, female lays near about 200 eggs.
* After spawning, female should be removed the aquarium.
* Eggs hatch within 24 to 30 hours under the temperature of 80°F .
* The newly hatched young ones use the yolk from yolk sac up to 2 to 3 days.
* Then they are fed with infusouria, pieces of worms,

boiled eggs.

* Male guards the spawn for a week or two.
* After this male should be removed from the tank before he feed on them.
* Betta will attain its full size in 6 months.
* At the age of one year they get sexually matured and ready for breeding.

2) Pterophyllum scalare (Angel fish) :-

* Angel fish is more popular aquarium fish.
* It is slow moving, egg laying aquarium fish.
* Body discshaped, laterally compressed measuring 11 cm in length.
* The dorsal and anal fins are high and have equal length.
* Caudal fin is triangular and ventral fin have elongated bony rays.
* Natural colour of the fish is silver with four vertical dark black bars.
* The varieties like all black, half black, marbled blushing and gold are developed.
* It requires deep tank with tall plants for breeding.



Sexual dimorphism :-

Male :-

* Male has comparatively shorter body with intense colours.
* Fins are large, well expanded and pointed at the tip.
* At the maturity the opercular region becomes rough.
* The first strip is straight and passing through eye.

Female:-

* Female has comparatively large body.
* Body coloures are less intense.
* Fins are well expanded but small sized.
* At maturity the opercular region becomes very smooth.
* The first strip is sightly curved. (And passes through eyes)

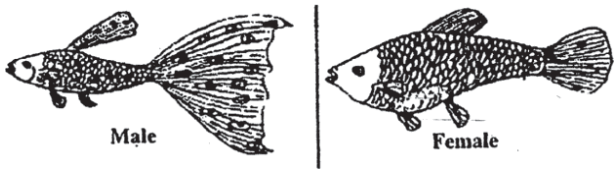
Breeding :-

* It breed at the age of 2 years or 3 yrs.
* Large sized aquarium tank of 20 gallon capacity should be used.
* the aquarium tank should contain tall plants like sagittaria, vallisneria etc.
* As they decides on which slate the eggs are to be deposited, they go over and cleaned off.
* The ovipositor of the female becomes appearent and used to place string of eggs.
* Male swim close behind the female spraying sperms over eggs through shorter and more pointed ovipositor.

* When the spawning is finished the pair will go over to their work.
* Fishes can identify the unfertilized eggs and pricking them out.
* Young hatchout 24-36 hours under the temp of 26° to 30°c
* When a week old, the young fish will swim helped by parent.
* The young fish can be fed on powdered food (dried shrimps and fishes and rotifers)

3. Poecilia reticulata (Guppy) :-

* Guppy is most famous live bearer fish.
* It is easily available, inexpensive and easy to keep and breed.
* Due to its voracious character for mosquito larvae. (it has been utilized as a means of controlling mosquitoes.)
* It has upturned mouth and large eyes.
* Male are 3 cm in length with bright colour seldom.
* Females yellowish grey and having the size of 6 cm in length.



Sexual dimorphism :

Male :-

* The males are much smaller than female.

* They are more colourful than females.
* Presence of copulation, organ Gonopodium.
  (anal fin of the male form sex orgo-gonopodium)

Females :

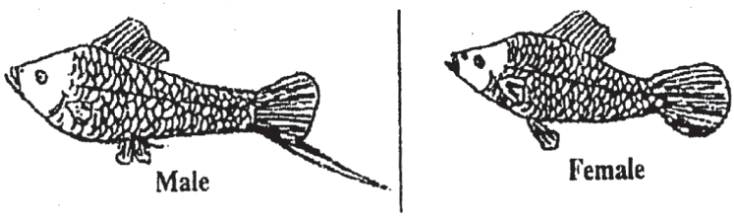
* Females are large bodied than male.
* They are less colourful than males.
* Few coloured spots in the tail.

Breeding Mechanism:

* Guppies breed when two to three months old.
* Select matured male and matured unfertilized female and keep them in separate tank.
* Medium sized aquarium tank should be used for breeding of guppy.
* The water temperature should maintain 68° to 80° F
* Guppy is very easy to breed and courtship in Guppies is an intersting affair in which male performing major role.
* The male approach the female from behind and he chase her for some time.
* Then he turns away from her but at the same time making s-shaped motions to hold her attention further.
* She follows him and keeps on spawning until they are parallel to each other.
* At the same time male use Gonopodium to introduce sperms into the genital opening of female.
* Male should be removed from the tank after mating.

* The gestation period is lasts for 4 to 6 weeks.
* A female can give birth to brood at 20-100 young ones or even more.
* Female should remove from the breeding tank after finishing the birth otherwise it will eat the young ones.
* As the young borns, they swim actively and start feeding immediately.
* The young fishes can be feed with newly hatched shrimps and microworms together with a mixture of powdered dried food.
* Guppys grow rapidly and becomes sexually matured in 2 months but reach full growth in 6 months.

Xiphophorus helleri :- (Sword tail)



* Sword tail is small fish with bulky body from Mexico Guatemala.
* Wild variety having the colour olive green back, greenish yellow sides and yellow at belly.
* Male grows up to 8 cm and female 12 cm in length.
* The lower rays of the coudal fin in the male are drawn into a sword.

Sexual dimorphism :-

Male :-

* Male is shorter in length than the female.
* Male possess different intense colours male has sword like tail presence of gonopodium.

Female :-

* Female has longer body than male.
* It has intense colours.
* No sword like tail.

Breeding mechanism:

* Sword tail is a live bearer.
* It requires maximum area for active swimming
* The temperature of water should be maintained at the range of 20 to 25°c.
* When a matured pair of male and female is introduced into the well maintained breeding tank containing few water plants swim actively.
* He swims very actively around the female to hold her attention towards him.
* The receptive female follow the male and move along side of the male.
* Later on he take the position in such a way that his gonopodium comes in contact with the genital opening of female.

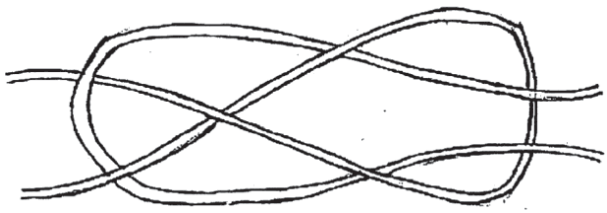
* Male hold the female in proper position with the help of sword like tail and inject spermatic fluid into the genital opening of her by gonopodium.
* The successful copulation lasts for about 5 to 7 seconds.
* After 4 to 6 weeks femal give birth young ones.
* Depending upon size and age female can give birth to 20 to 240 young ones.
* The young can take food immediately, hence fed with powdered shrimps and plant food.
* They attend sexual maturity at the age of 6 to 8 months and are ready to breed after 10 months.

Chapter 13 STUDY ON DIFFERENT TYPES OF KNOTS

Different Types of Knots :

i) Reef knot;

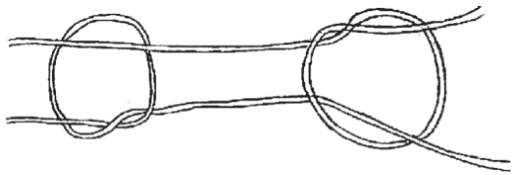
It is general utility knot which can be easily made & joined together. It is used for joining two lines or line ends where great strain is not expected.



REEF KNOT

ii) Fisherman Knot:

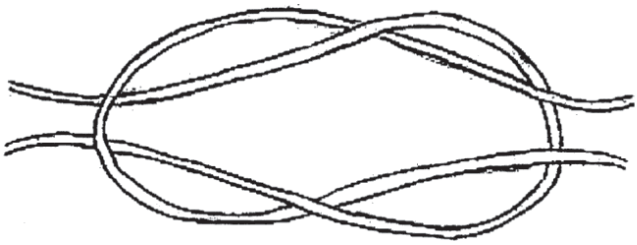
It is also known as water knot or leader knot. It is made by tying two overhand knot. It is mainly used for tides the ends of ropes.



FISHERMAN KNOT

iii) Single sheet bend knot :

It is an excellent for joining last two lines where heavy loads are expected & is used in joining fwo lines of dissimilar diameters & in fibricating a net.



SINGLE SHEET BEND KNOT

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Chapter 14 METHODS OF FISH CULTIVATION

Main purpose of fish culture is to produce good quality fish in large quantity as food of man.

The method adopted for fish culture in a particular area is depend upon the available water source and climatic conditions.

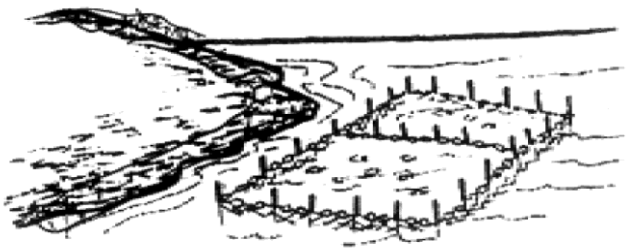
Hence fishes are being cultured differently in different parts of the world. The most commonly used methods are 1) Pen culture 2) Cag culture 3) Recirculatory water system.

Pen Culture:-

- This method of fish culture is commonly practiced is Scotland and Israel.
- Now a days it is adopted in some of the Asian countries.
- Fishes are cultured in pens inside lakes or offshore areas in flowing water.
- Pens are enclosures, constructed of bamboo or wooden poles and nylon nets.
- Poles are fixed in the bottom of shallow water area and nets strung from pole to pole to form enclosure.
- The nets are anchored at the bottom so stocked fishes can't escape.
- The netting used for the pens must be of nylon so it does not rot.
- The size of pens varies, usually 20 m. in length 10 m.

in breadth and 5 m. in depth.

- If the water is not fertile then supplimentary feeding is to be given to the stocked fishes.
- In fertile waters fishes grow with faster rate & there is no need to supply the food.
- Pens require no fertilization and very little maintenance
- However pens are expensive to built.
- The expenditure required to built a pen is equal to the cost of one pond of the same size.
- Life of fish pen is 3 to 5 yrs in water.



Offshore pen

Advantages :-

- Fish cultivation is possible in flowing water.
- No fertilizer or manure is required.
- No. extra feeding is required.
- Fishes are protected from their enemies.
- It requires little maintenance.
- Fishe grow better with fast rate

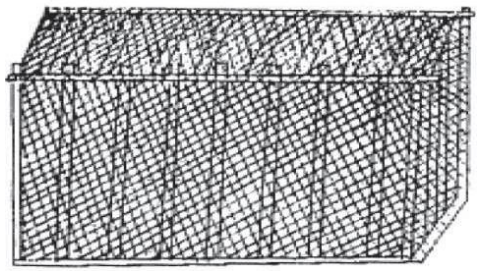
Disadvantages :-

- Pens are expensive to built.

- Life of fish pens is less than pond.
- In infertile water expenditure required for supplimentary feeding.
- It reduce the natural productivity

2) **Cage Culture:-**

- In many parts of the world, the only water available is flowing water or large water bodies of water where it is not possible to divert the water into a pond.
- In these waters, it is possible to grow fish in small cages.
- This method is also adopted for cultivation of carps in small water area.
- Cages can be rectangular boxex, bamboo cylinders that can be floated in water current so that the water passess through.



Rectangular cage

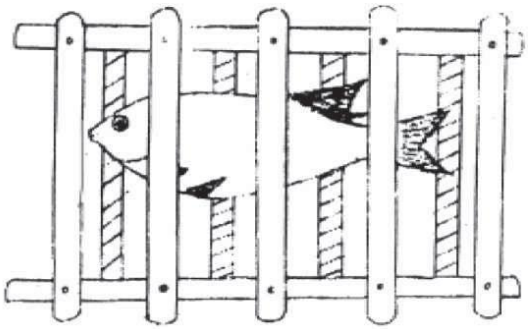
- In addition to bamboo, cages can be made up of such materials as wirescreen, nylon net of mesh size of 10mm.
- Cages of various size are made up of bomboo or woody

material and invested by nylon net on all sides.

- Cage site should be protected from heavy strong wind to avoid any damage to cages and mortality to fish due to imbalance.
- In Japan and Russia floating cages are used for culture of carp inside the lakes.
- In Thiland cages are used for fish cultivation from many years.
- In Jawa and Combodia this method is practiced traditionally for cultivation of Tilapia and Clarias batrachus respectively.
- In India cage culture is adopted in Tripura and West Bengal.
- Fast flowing water is best for cage culture.
- If the water is not flowing very fast the problem like oxygen lack and competition for food can occur.
- Due to contineous flow of water the waste material produced inside the cage can easily washed out and at the same time oxygen level is maintained.
- Cultivation of fishes by this method requires small budget.
- If fish cultivation practiced on small scale cages should be of 2x1x1 m in size.
- Where as in s commercial culture cages should be of 5x4x2 m.
- Cages are useful to produce hybrid i.e. new strain, by

introducing selected pairs of male & female fishes.

- Stocked fishes are protected from predators.



Advantages : -

- Fish cultivation is possible in samll water area as well as in flowing water.
- It requires small budget.
- In flowing water natural atmosphere is maintained.
- Stocked fishes are protected from their predators.
- Hybridization of fishes can be done.

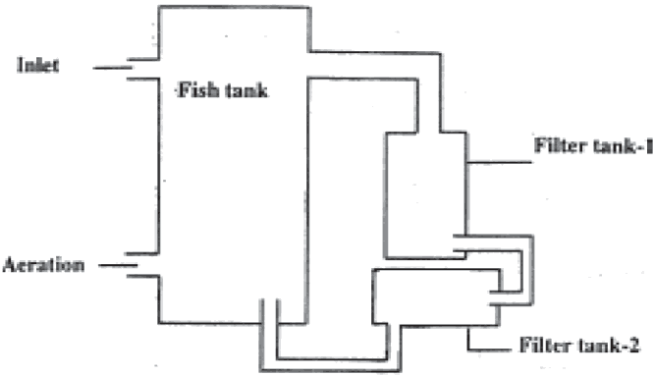
Disadvantages : -

- Heavy expenditure required for the supply of food.
- Strong wind, flood damage the cages by imblancing them.
- Heavy mortality of fishes occurs due to damage and imbalancing of cages.
- It requires contineous watch and skillful handling.

3) Recirculating water system :-

- This method is adopted for rearing of fishes in minimum water and in small area.

- In this method same water can be used for long time by circulation and recirculation.



RECIRCULATING WATER SYSTEM

- First of all I. Motocava in Japan successfully developed recirculating water system in 1951.
- Requirements of this method are one fish tank two filtration tanks, connecting pipes, water supply and areation facility.
- Ateation facility is essential to maintain O_2 level because same water is used for longer time.
- For the removal of waste, collected at the bottom of fish tank, water, is transferred to the filtration tank through connecting pipe and then into the fish tank.
- Thus same water is used for long time up to its total utility and then replaced by new fresh water.
- For the contineous supply of clean water two filtration tanks are used.
- The filtrations tanks are used alternately.

- The tanks are washed using compressed air passing through pipe.
- Fish yield obtained by this method is always higher then any other method offish cultivation.

Merits :-

- In this method fishes are cultivated in small space.
- Fishes are reared in small quantity of water.
- Quality of water can be maintained hence same water can be used for long time.
- It minimise the expenditure against human labour.
- Fishes are protected from fish predators.
- As aquatic environment is maintained hence very less mortality of stocked fishes occur.

Demerits :-

- It requires heavy expenditure for the supply of artificial food.
- Contineous areation is required.
- This method can not be adopted in rural area with illiterate people.
- Filtration facility is required.

Earth fill raceway:-

- In earth fill raceway purely earthen ponds are used.
- These ponds are long, narrow and constructed in earth.
- Size of ponds is 30.5 m in length, 1.5 m in depth, 9 in. wide at the surface and 1.3 m at the bottom.

- Such, type of 4-8 ponds are constructed.
- In this type of ponds supplimentary food is not required.
- These ponds have self purification capacity.
- But maintenance is required to control the vegetation which grow along the bank of ponds.
- Pond corners get break due to water content.
- Therefore year to year repairing of ponds is required.
- Though ponds have self purification capacity, bottom remain unclean and toxic .gases liberate.
- Trout fishes are cultivated in such ponds.

Advantages :-

1) It has self purification capacity.
2) As natural food grow in the pond hence it requires no supply of artificial food.
3) It requires no areation.
4) Regular cleaning is not required.

Disadvantages:-

1) It requires maximum maintenance to prevent growth of plants.
2) Year to year repairing of ponds is required.
3) Plants grow along the bank area of ponds provide harm to stocked fishes.
4) Bottom remain unclean and toxic gases may liberate, which affect fish growth.

2) Concrete raceway :-

- In this type cemented (concrete) tanks are used for fish cultivation,
- Size of concrete tanks is 30.5m length, 1.1 m depth, 6m. breadth at top and 3m at the bottom.
- Near about 6-10 ponds arc constructed in scries.
- In concrete raceway areation is required.
- It can be done by using water pump.
- Flow of water should be 84 lit/sec, for 6 ponds series and 40 lit/sec. for 10 ponds series.
- Road should be prepaed between ponds which facilitate feeding of fishes.
- Key ways are provided in concrete walls between ponds.
- Key ways consists of waste collecting boards called check boards.
- The waste material is collected in the check board and is not driven to another pond due to water flow.
- The waste material is then be collected and removed from the check board.
- In concrete raceway following fishes are grown in Asian as well as European countries.

i) Onchorhyncus nerka (Pacific salmon).
ii) Salvenlius fortanalis (Brook trout)
iii) Salmo clarkii (Cut throat salmon)
iv) Salmo trutta (Brown trout)

v) SaImo salar (Atlantic Salmon)

vi) Hucho hucho (Danube salmon)

Advantages :-

- Year to year repairing is not required. Maximum maintenance is not required.
- As plants not grow along the bank of ponds so fishes not get any harm.
- Such ponds are easy to control the diseases and disinfect.

Disadvantages :-

- Fishes should be supplied with artificial food as natural food is completely absent.
- Erequent cleaning of pond is necessary.
- Areation is required to maintain dissolved oxygen content of water.
- It does not have self purification capacity.

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Chapter 15 AQUARIUM FABRICATION

Definition of Aquarium :

An aquarium may be called as a public institution exhibiting a large collection of living fishes & other aquatic animals.

Fabrication of Aquarium:

Fabrication of the tank involves selection of suitable sized tank, preperation of its frame, fixing of glasses, cleaning & checking leakage etc.

The popular size of the aquarium is 60x30x40 cm (24'x12'x18'Inches) Which 1 wide aluminium.

The frame is rusually made up on iron of aluminium angle. Aliminium angles are suitabile for the samaler tank & iron angles for the large tanks. The width of the angle depends upon the size of the aquarium. e.g. 95 lit aquarium needs 51.8 inches wide angle, 190 lit aquarium needs 3/4 inches wide angle. 285 lit needs 1 inch. wide angel. he thickness of glass depends upon the tank. Tank up to 190 lit needs 4.8 mm thickness glass. 250 lit needs 6 mm thickness glass.

While making the frame for the aquarium (60x30x40 cm), cut 4 pieces with the help of hack saw, rivette the width to the up right angle betn width & upright of the frame.

Prepace the holes 1/4 inch away from the end. Use rivet of size 1/8 diameter.

After prepare the frame, fixe the glass in the frame using aquarium cement. (bitumen) The order of fitting glass into the frame is 1st the bottom, then the front, back & finally the sides.

After applying a layer of cement over the angles inside keep the bottom glass over it & press it. Then the fix the front glass by fallowing the same procedure. In this way fix all the glasses in the aquarium.

After fixing the glasses keep the tank as it is for a day then check it for the leakage. If the tank is having slightly leakage, the leakage will stop by itself after a few days. If more is the leakage then remove the cement & again add a new cement to remove the leakage.

Setting of Aquarium :

Wash new aquarium with the help of common salt & water. It will kill germ. Do not wash aquarium with detergent or soap.

Keep the aquarium on a leveled table or a stand away from the window or direct sunlight. Keep layer of sand of some 5-8 cm deep, sand should have small particles. Do not use the marbal chips, it have the sharpness which will injure the fish.

Wash the sand till it becomes the clean. While keeping the sand in the aquarium, give slope to it so that it is deeper at the reacer end & shallow at the front.

Now fill the aquarium with water, while filling the aquarium do not distrub the sand. To avoid distrubing the sand, put soccer or pot on the sand & pour the water on this, the pot will be filled up & the water will the gently overfolw in the aquarium. Fill the aquarium just below the top frame.

Do the rockwork & decoration. do the plantation, such as shorter plant at the front & tall at the back.

The front of the aquarium should be kept free of plant so that the fishes can be seen. The rootless plants such as cabomba, cerato phylum etc. Should be bronched together & a strip of lead twisted around them a little away from the bottom end.

After planting, the aquarium should be left without disturbing for a week before introducing fishes, to allow the plant roots to grow.

Maintainance of Aquarium :

Success of maintenance of Aquarium fishes depend upon clean-ness of the fish keeper. The aquarium fishes must never be handled with dry hand or cloth, this may damage the slimy coating on their body which may lead to deaseases & may becomes a cause of death. While handeling with the hand net, do not put the hand in the tank, unless it is essential. Fish never must be disturbed the unnessessary. While netting out the fishes from tank, bring them in the corner.

Maintain level of water in the tank by adding the water, from outside. The water must have the same temperature as that

already in the tank. Pond water or river water never be used for maintaining level in the tank because such water contains pacasites which are harmful to fishes. Always used decholrinated water.

Check the temperature of water everyday, & maintain it. Feed fishes at the same time, daily. Remove the uneaten food from the tank. Some times, the tank water takes on a delicate green shade, this is due to the developement of alage. The excess developement of algae create the problem. Algae may spread over the glass & grow in the way as plants. When their is a excess algae the tank looks dirty. The two main types of algea i) green & ii) brown developes in the tank. green algea developes n the excess light where as brown algea develops in the poor light, for that maintain the sufficient light in the tank.

Much of the beauty of the tank is due to the plants. Maintain the plants properly. Remove the sand from time to time & clean it.

Keep light shade or lead over the tank it will protect the aquarium from dust, domastic animals like cat. It prevents jumping out of fishes, it prevents from fingers in the tank.

Importance of Water :

Water is life of fishes. Fill the tank with water without disturbing the sand & the rock.Do not change the water everyday. Add some water in the tank to maintain the level Do

not more the tank after filling it with water from one place to another.

Undigested food & metorbolic waste accumulates in the water, slows down fish growth & reduces their resistance power.

Accumulation of waste leads to bacteran infection to the fishes. Lack of oxygen in the tank is indicated by swimming of fishes at the water surface. It requaires change of water or increse of Do_2 contain by aireation. The amount of disolved O_2 depends upon water temprature, cold water holds more O_2 than the warm. Use alawyas decblorinated water to fill the tank. The acidity or alkanity of water depends upon the H_2 ion conc. i.e. PH of water.

PH of pure water is 7 i.e. water is neutral. Tropical fishes needs 6.5 - 6.8 PH. of water where as live bearer need 7 to 8 PH. To make water acidic add sodium acid phosphate & to make alkaline use sodium bi-cacbonate. Water may be temprory or permanent hard, hardness of water can be remove by adding distilled water.

Role of Light :

Light is essential in the aquarium. During day time plant absorbs CO_2 & release O_2 . It increases disolved oxygen containt of water. Where as fish take O_2 & release CO_2 . At night, plant & fishes releases a certain amount of CO_2. The

growth of plant in the aquarium is fully dapend upon the light. If light is sufficient, growth is fast, plant grows long & leaves are of full apearance.

Role of Aquacium plants

Azolla :

These are floating plants leaves of minute & green in colour. Spread in masses over the surface. Under bright light it turns red. If is from America.

Cabomba :

Leaves are branched, propogated by cutting. It have finely leaves fan like a, set in pairs on the stem. Colour is deep green. The plant is both ornamental & good oxygenator. The plant is of America & grows in cold as well as tropical tank. Plant needs strong light.

Amazon Sword plant :

This is pecfect centre piece for a large tank with 35 cm long leaves of brigth green colour arising on the stock. It grows fastly, but not in strong light & in alkaline water.

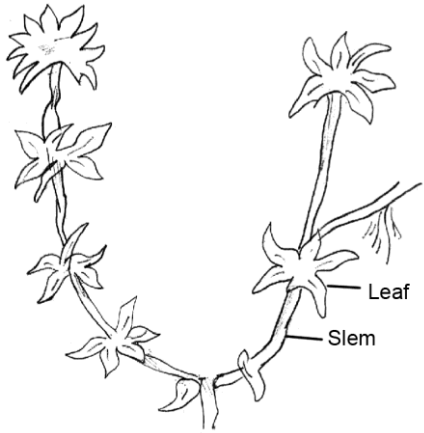
Vallisneria:

A rooted plant with grass like leaves. The best of all aquarium plants. Leaves are green in colour & the leaves gives of much oxygen, plant is from united state & southern Europe.

Eelodea Canadensis:

A north American plant propogated by cutting & grow rapidely in good light. It is an excellent oxygenater.

Hydrilla :



It has green & long leaves up to 26 mm & red central midrib.

Imporatance of Aquarium Plants :

1) They help to maintain the oxygen containt of the water.
2) They provide shed & safe hiding place for every young fishes.
3) They help in keeping aquarium balance by disposing of harmful gases.

Selection of plant :

1) Select half grown, healthy, looking with abundant leaves.

2) Handle the plant delicately & it should have roots stem & leaves.
3) Do not allow the plants to dry befor plantation.
4) Wash the plant under running water.
5) Remove the broken or discolourd leaves before plantation.

Food and Feeding for aquarium fishes :

Infosuria :

It is smallest unicellular which is found in the pond water where decaying vegetative matter is present. It can be cultured with the help of dry gras, banana skin. Any one of them can be kept in the container with sufficient water the container should be covered with Muslin cloth. It is observed that water then turbid within 2-3 days. & then again becomes clear on the other day this clear water is full of infosuria.

Micro-worm culture :

A live food taken by fish of all size is known as micro worm. These are white, minute worm & are cultivated by the fish keeper

The microworm culture can be prepaid on the paste of wheat flour. The wheat flour is mixed with water & it is kept in the bottle or petry dish. Then a drop of miro-worm culture brought from some aquarist is added to it. The container is covered within 3-4 days, microworm starts coming on the side of container.

This can be removed easily and feed to the fishes.

Tubifex worms:

These are small reddish worm, avaible in the morning or in the evening hour in the water with organic material. After collection they washed carefully & given as a food to the fishes.

Mosquito larvae:

These are also found in stagnent water, pond etc. & can be collected with hand nets They are feed to the fishes after washing properly.

Earth Worm:

Earth worm after chopping in the suitaible size are given to the fishes as a food. Earth - worm after collection are washed with water, food which is present in the intestine is removed & then chopped

Cyclops:

Cyclops are given as a food to IMC Cyclops can be cut-livated in cement cisterns with the help of cow dung or cotton seed oil cake.

Daphina :

It is found in stagnant water they can be collected with hand net. Daphina can be given to the hatchlings and adult fishes also. Daphina can be cultivated in cement eistern with the help of cow dung or cotton seed oil cake.

Dry food:

This is mostly a mixture of ground wheat & fish male or dry prawns.

Feeding :

Feeding the fishes once in the morning & again in the evening. Feed the fishes at a regular hours for a day. & at a perticular place in the aquarium. If live food is not available & dry food is to be given then feed the fishes atleast once a week on fresh or live food.

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Chapter 16 FRESH WATER FISHERIES OF INDIA

Resources available for capture fishery

- Inland fishery resources of India are one of the richest in the world.
- The principal rivers in India Including their main tributaries have a total length of about 27,355 km.
- Canals and irrigation channes have a length of 1.12,654km.
- In addition, open estuaries,brackish water lakes,back water of Kerla etc.have an area of 0.76 million ha.
- These are main capture fishery resources of India.
- For culture fishery, the available resources are 6.00 million ha.
- These resources include i) Reservoires (2 million ha.) ii) Ponds and tanka (1.40 million ha.) iii)Swamps and derelict water area (0.6 million ha.) iv) Brackish water area suitable for fish culture (2.00 million ha.)
- Several dams are under construction and many are in planning stage, hence are of reservoirs is bound to increase in future

Riverine fisheries of India

Riverine fisheries resources of India composed of five major system.

1) Ganga river system

2) Brahmaputra river system

3) Sindhu (Indus) river system

4) East coast river system

5) West coast river system

1) Ganga River System :-

- Ganga river system has total length of about 8047 km and regarded as one of the largest river system in the world.
- Ganga is a perennial river, originated from Gangotri in Himalya.
- It runs about 220 km in slopes of Himalaya .
- It covers the states Utter Pradesh,Bihar and West Bengal and Ultimately join the Bay of Bengal.
- The river Yamuna is one of the major components of the system
- It is about 1000 km long and meets to Ganga at allahabad.
- It covers the border parts of state of Punjab and Haryana & flows through teritorry of Delhi.
- The tributaries of Ganga are Ramganga,Gomti, Ghagra, Gandak, Kosi from north.
- The yamuna meets to Ganga at allahabad before that it has three main tributaries namely Chambal, Betwa and Ken.
- Ganga river system has catchment area of abour 9.71 Lakh sq.km
- At variour centres the types of fishes landed are Cirrhina mrigala,Catla catla,Labeo rohita,Labeo calbasu,Mystus seenghala,Hilsa ilisha,Wallago attu.

Cirrhina Mrigala :-

- Cirrhina mrigala was found to be the most dominant species in the upper regions of Ganga from Kanpur down to allahabad and in the yamuna.
- Its average annual landing was found to be 36.01 tones each at Agra and Allahabad and 16,56 tones at Kanpur

Catla catla :-

- The catla fishing was low through out the Ganga system.
- Even at Allahabad and Kanpur centres its avarage annual landing were 16.86 tones and 4.98 tones respectively.
- But at all other centres avarage annual landing ranged between 1.63 tones to 4.99 tones.

Lebeo rohita :-

- The Rohu fishery of the Ganga river system was more like that of Mrigala.
- It is more important in Lower strtches of Ganga and less improtant in the middle.
- Average annual landing of Rohu recorded to be 14.80 tones at Agra 16.67 Tones at Allahabad and 6.15 tones at Kanpur

Labeo calbuu :-

- The calbasu fishing in Ganga is almost negligible except for some limited landing in the upper and mid region.
- The average annual landing of L-calbasu 7.38 tones and 9.57 tones at Agra and Allahabad respectivly.

Mystus seenghala and Mystus aor :-

- The Maximun avarage annual landing of Mystus obtained was 34.28 tones at Allahabad at Agra 22.86 Tones and at Kanpur 9.98 tones.

Wallago attu :-

- This species is present maximum in upper stretches river Yamuna and Ganga.
- At Agra and at Kanpur it was obtained about 24.01 and 7.99 tones respectively.
- The Wallago fishery at Allahabad as of relatively less important.
- Avarage annual landing of 12.5 tones have been recorded.

Hilsa ilisha :-

- The Hilsa fishery was almost entirely concentrated in the middle portan of ganga and to lower stretches a little.
- In uppper stretches of Ganga and Yamuna few catches recorded during 1958 -59 to 1952 to 1959.
- The annual landing was 20-16 tones.

Fingerlings (Carp Juveniles)

- The juveniles fishery was more dominant in the Ganga river system during the year 1952 to 1959.
- All the three Indian carps Catla,Rohu and Mrigala weighing 12.7 Tones have been captured in 208 km. streatch of Ganga.

- Specieswise catch consists of 159783 specimens of Mrigala, 110595 specimens of catala and 35134 of Rohu.

The avarage fish landing from the Ganga river system during teh period of 1955-56 to 1965-66 at various centres is given below.

No.	Name of Centre	Fish catch in tons
1	Agara	119.49
2	Allahabad	243.25
3	Kanpur	59.02
4	Varanasi	74.02
5.	Ballia	69.64
6.	Patna	91.85
7.	Bhagalpur	81.93

2) Brahmaputra River system :-

- The river Brahamaputra has total length of 2900 km.
- It is the another big river of India.
- It is originated from Mansarower lake.
- The Bramhaputra traverse for its first 1600km through Tibet where it is known as Tsangpo.
- There after it flows through Arunachal Prades for about 160 km.
- Various type of fishing gears are used for operation they are, Dragnet, Gillnet, Bagnet, Trawlnet, Cast net etc.

- Its enters again in the vally of Assam for about 640km and lastly about 460km through Bangla Desh and join wigh Ganga at Goalando.
- After joining Ganga the united river flow under the name Padma reaching the Bay of Bengal.
- In the river Brahmaputra 126 species of fishes are present
- Out of these only 41 species are commercially important.
- In Brahmaputra Catfishes are predominant (Mystus and Wallago) of about 23.26% of avarage catch of 243.27 tones.
- It is followed by major carps i.e. Catla,Rohu and Mrigala of about 17.35% avarage catch of 243.27 tones.
- Minor carps and Hila fishes are of about 14.37% and 12.25% respectively of the avarage catch of 243.27 tones.
- Prawn fishery is very low throughout the Brahamputra river which is nearly 4.35% of avarage catch of 243.27 tones.
- Miscellaneous species about 26.91% of avarage catch of 247.27 tones

3) The Sindhu (Indus) River Sustem :-

The smallest river system in India.It consist of two main tributaries.

i) i) Sutlaj and ii) Beas

- This river system is rather rich in fresh water fish fauna in comparison with the Brahmaputra.

- However only a small portion of the system which compris ing the river beas and Sutlaj and their tributaries is now within the India.
- It covers the states of Himachal Pradesh, Haryana and Panjab.
- There is no commercial fishery for major carps in Himachal Pradesh.
- But from the same region maximum yield source of fish seed is collected from this system in Panjab.
- Fry and Fingerlings is the only source of fish seed is collected from this system in Panjab
- The Rainbow trout and brown trout are reported from upper stretches .
- Small size major carps and catfishes are available in lower stretches.

River Jhelum :-

- Only small part of river Jhelum of the Sindu (indus) river system flows through the states of Jammu and Kashmir.
- The Fisheries which the river composed of commercial species of fishes are L.dero, L.dyochellius. Cyprinus carpio,from the major catches.

4) East coast River system :-

East coast river system consists of three major rivers namely i) Godavari ii) Krishna iii) Cauvery.

i) River Gadavari :-

- The river Godavari originates in Deolali Hills near Nasik.
- It flows through M.S.,A.P. and draining into Bay of Bengal.
- It has total length of about 1440km with catchmet are of about 315980 sq.km.
- The main tributaries of the Godavari river are Manjira, Painganga and Indrayani.
- Its minor tributaries are Purna,Maner,Sabari etc.
- Number of Dams have been constructed on Godavari and its tributaries.
- They are Jaykwadi Dam, Vishnupuri Dam

Fisheries of Gadavari :-

- Apreliminary survey of river Godavari and river krishna was carried out to evalute their fishery in 1958.
- During survey Rajmundry was selected as head quarter of the Krishna Godavari unit of CIFRI and established in 1959.
- In survey following group are reported which support the fishery of river Godavari.
  i) Carps - L.fimbriatus, L.Calbasu,C.Mrigala,C.catla.
  ii) Cat fishes - M.Seenghala,M.aor,W.attu.
  iii) Hilsa ilisha - P.pangasius, Bagerius bagerius.
  iv) Prawans Macrobrachium malconsomil.
  v) Miscellaneous group.
- The maximum annual fish landing observed of about 330.1 tones in 1963,321.8 tones in 1964, 245.6 tones in 1965

231.1 tones in 1966,261.8 tones in 1967,233.5 tones in 1968 and 218.0 tones 1969.

River Krishna:-

- Krishna river system has a length of nearly 1120 km.It is originated in western Ghats to south (Maharashtra) Puna.
- It has catchment area of about 233229 sq.km.
- The main tributaries of Krishna river are river Bhima and river Tungbhadra.
- Bhima is almost dry river during summer month.
- While Tungbhadra is peremmial with greater volume of water flow.
- Many reservoirs are formed by high dams on Krishna river.

Fisheries of Krishna :-

- In the water of krishna river major carps,minor carps, cat fishes, Hilsa and Prawns are available
- About 91 kg to 136 kg of fish are being captured daily from the water of krishna by each individual fisherman.

iii) River Cauvery :-

- The river cauvery originated from the Brahmagiri hills on Westren Ghats, at elevation of 1440 m.s.l.
- It is longest perennial river south of the Krishna.
- It flows south eastern direction and emptying into the Bay of Bengal in Tanjauar district of Tamilnadu.
- The largest dam constructed on this river is Mettur.

- From Cauvery 80 species of fishes have been reported in 1954.
- Among the carps, the species froming specil feature of the river cauvery are Barbus dubius,Labeo Kontius, Labeo ariza, Cirrhinus cirrhosa.
- The important cat fishes are Mystus aor, M.seenghala, P.pangasius,W.attu.
- Channa marulius (murrel) is also found .
- The major carps - Catla catla, Labeo rohita, cirrhina mrigala and exotic carp Cyprinus carpio have been transplanted in the cauvery river system.

West Coast River System :-

The west coast river system consists of two main rivers known as i) Narmada ii) Tapi

River Narmada :-

- River Narmada originates in the Amarkantak hills at an elevation of 1057 m.above m.s.1. in Bilaspur district of Madhya Pradesh
- The total length of river Narmada is about 1,280 km.
- It has catchment area of 94,235 sq.km. and mainly depend upon seasonal
- The river Narmada has 18 tributaries.
- Out of these 16 tributaries are in Madhya Pradesh and only 2 in Gujrat

- The river during 1958-59 to 1965-66, 41.5 tones of fishes have been captured.
- Commercial catches of river Narmada consists of 10 species of Carps, 85 species of Catfishes 25 species of Murrel and 2 species of Eel.

ii) River Tapti :-

- River Tapti originates in Chindawara of the Satpura range State of M.P. at hight of 670 - 1000 above m.s.1
- It flows to west through the states of Madhya Pradesh, Maharashtra, and Gujrat before joining the Arbian Sea at Duman near Surat in Gujrat.
- It has catchmen area of 48000 sq.km.
- Fishing season in river Tapti is from Sept - Oct. up to monsoon.
- Fishing is done by cast nets, gillnets and long lines.
- The important fishes of this river system are Tor,tor,Labeo, fimbriatus ,Mystus seeghala,M.aor,Wallago attu, L.calbasu L.Bata
- Total fish catch obtained during winter from Tapti was 2,605 kg. during 1959-60

Ecology of Lake

Ecology of some of the important Lakes.

Major Lakes in India

1) Kodai Kanal Lake
2) Yercaud Lake

3) Ooty Lake

4) Ligtak Lake

1. Kodia Kanal Lake

Kodai Kanal lake is situated in the Palni hills. This Lake was constructed in about 1860 in a basin adjacent to Kodai Kanal town. The water expanse of the lake is 26 hectare with a maximum depth of 10 m and an average depth of 2 m

Temperature	17.2^0C
pH	never exceeds 6.8
DO	5.5 to 9.8 ppm

The Lake sediment show high organic matter, high nitrogen content and low calcium content. Fish Production is about 5.3 kg. per hectare

2. Yercaud Lake :-

The Yercaud Lake in shevaror hills is an horse lake. It has an effective area of 8 hectares and average depth of 2 m

Temperature	21 to 25^0C
pH	7.3 to 9.2

The lake soil contains silica , calcium and phosphorus. The annual fish yield of the lake is about 31.6kg per hectare.

3. Ooty Lake :-

Ooty Lake is located in the Nilgiris. The Lake has an area of 39 hectares and the maximum depth of 10 m and average depth of 3m. The water temperature of the lake is similar to that of Kodai Kanal Lake. The bottom zone of lake has high

aluminum and low calcium content.Fish yield is recorded to be 75kg per hectare per year.

4. Logtat Lake :-

Logtat Lake is situated in Manipur and has water spread area of about 4480 to 27300 hectares. The depth varies from 1,5 to 4.5 m. The lake soil is clayey in texture and characterized by high N^2 content, high organic carbon and pH is recorded as 4.4 to 5.4 .

DEVELOPMENT OF RESERVOIR FISHERIES IN INDIA

1) PRE-IMPOUNDMENT SURVEY OF RIVER BASIN

A complete survey of fish and fisheries,fishing village , fisherman population,fishing craft and tackle is necessary before impoundment of the reservoir.In the most of the cases it is not done properly.In some of the reserviors like Tungbhadra, Bhavanisagar,Hirakund &Gandhisagar Pre-impoundment survey is conducted.

2) CLEARANCE OF SUBMERGED OBSTRACTION :

Before undertaking construction submerged obstraction should be removed as to faciliate easy fishing.The presence of aquatic vegetation not only hampers fishing but also suppresses growth of benthic fauna as it occupies the productive Zone.For the removal of aquatic vegetation use of mechanical winches

are recommended,Central institute of fisheries technology has developed a machine for eradication of aquatic weeds.

3) STOCKING OF RESERVOIRS:-

Maximum yield from the reservoir is depend upon the stocking of fish seed in reservoirs.Before stocking fish predators like Reptiles,Birds and Mammals should be eradicated. Hydrological condition of the reservairs is also an important aspect which has to taken into account,while stocking the reservoir.Stocking of the fishes varies from reservoirs to reservoir for ex.U.P.fingerlings of 38 mm to 76 mm are stocked.Fingerlingsare stocked in Nagarjuna sagar aslo.

4) SURVEY OF FISH BREEDING GROUNDS :

Mostly fish breeds either in the reservoir or in river.fishes migrate into river Mahanadi.IMC are breed in river or reservoir.

Therefore it is necessary to carry out survey of breeding ground in the reservoir.

CONSERVATION AND MANAGEMENT :

For conservation,rules and regulations framed by Indian fisheries act are used in various State.

i) limit on mesh size of net,the minimum range of mesh size is 30mm.

ii) Size of fish to be caught,the minimum size of fish is 229 mm to 305 mm.

iii) Closed season,In large reservoir fishing is closed from June to September so that it will not disturb the breeding and

migration of fish.

6) TRANSPORATION AND MARKETING:

For transportation boats are used while transportation fishes are packed with ice in bamboo basket.

Marketing is in the hand of middleman. Reservoires in India are used for fish culture. Fish production in reservoirs varies from water to water depending upon its fisheries development.

To take better production from reservoirs, proper management and development is essential.

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Chapter 17 MANAGEMENT OF FISH FARM

Hatchey :

An artificial chamber, hatching where the eggs are incubated for hatching and production of young onces, specially on commercial scale is called hatchecy.

1) Hatching Pits

- Hatching pits are small, shallow ponds of 8x4x2 m or as per requirement.
- Hatching pits are constructed near to the river where natural breeding of carps occurs.
- Continious but slow flow of water is desirable in the hatching pits far aeration of eggs.
- Water should be clean & non-polluted.
- The inlet & outlet must be provided with fine mesh screen to avoid the entry of Predator.

2) Hatching happa (in pond) (Fixed)

- Hatching happa is a rectangular box like cloth container without covering to the top & used for hatching of fish eggs.
- Hatching happa is the set of two rectangular happa, namely Inner happa and outer happa.
- The inner happa is smaller & fixed inside the outer hatching happa.
- The cloth hatching happa has no cover on top side.
- The outer happa is made up of musline cloth & inner happa of rounded meshed mosquito Net cloth.
- The standard size of outer hatching happa is 2x1x1m.
- While the size of inner hatching happa is

1.75x0.75x0.50 m.

- The outer happa is provided with ropes at it's 4 upper and 4 bottom corners.
- The inner bottom corer of outer happa also provided with ropes to tie the inner happa.
- The hatching happa is fixed in shallow ponds by using 4 bamboo poles.
- The upper edge of outer happa should be kept 25-30 cm above the water level, to prevent the entry of predator into the happa.

3) Floating hatching happa

- It is also used in floating water where it is tied to heavy objects with long ropes.
- Outer and inner happas are open at the top.
- The outer happa is made up of musline cloth and inner happa of round mesh mosquito net cloth.
- Size of rectangular frame used to fit the happa is 2.1x 1.1 m with 4 perpendicular arms of 1.2 m in length at its 4 corners.
- Arms are provided with holes for tying the cord of happa.
- The inner happa is fitted inside the happa in the same way.
- The bottom wall of inner happa must be kept in a stretched condition.

Operation:

- At the time of removing eggs from the breeding chember, fertilized eggs are placed in the inner happa at the rate of 50,000-75,000 eggs / happa.
- Eggs should be spread in entire inner happa.

- After about 10-25 hours of spawing and depending on the existing, water temperature, the embrya hatch out into a young fish called hatchling.
- Hatching gradually passes out to the outer happa through the mesh of inner happa.
- As soon as the hatching process is completed, the inner happa is removed delicately along with the egg shells.
- The hatchling are still to remain in the outer happa for a period of about 3-4 days.
- At this stage young fish is called Spawn, which starts feeding on the micro-organism present in the water.
- Therefore, the outer happa along with spawn is removed and transferred the spawn to a fine musline cloth slightly deeped in water.
- Then the spawn is stocked in well prepared nursery pond or selle by packing in polythin bag with oxygen.

4) Glass Jar Hatchery :

The hatchery unit consist of

1) Water supply

2) Breeding chamber.

3) Incubation and hatchery chamber.

4) Spawnary

1. Water supply

- Water supply is from pound . It is collected in a over head tank of 5500 lit. Capacity.
- Tank is kept on tower at about 4m height. The tank is connected to the hatchery system.

2. Breeding chamber

- Cement sisterns of size 1.8m x 0.9 m are used as a breeding tank.

- Breeding happa is fixed inside the cement sisterns.
- Injected fishes are released in therefore breeding happ.
- Breeding tanks are proved with an over head showers for spraying of fresh water and to maintain temp.

3. Incubation and hatchery chamber

- Glass jar of capacity 6.35 lit. each are arranged in rows.
- Jars are cylindrical with cone shaped at the bottom.
- Jars are fixed in the vertical position.
- They are connected with the water system. Water flow is mentioned to circulate the eggs.
- The spawns are collected with flow of water.
- Stacking capacity in the jar is 50,000 eggs. of major carps.

4. Spawnary:

- It is cement sisterns of size 1.8 x 0.9 m.
- Nylon happa of size 1.65 x 0.8 x 1.0 m is fixed inside the cement tank.
- A over head shower is present.

Operation :-

- After releasing the eggs. (50,000 eggs / jar) in the jar, Water is circulated in the jar from bottom to top. It provides fresh oxygen water.
- After complete hatching, flow is slightly increased to called hatchling into spawnary.
- Bad eggs, egg's shells, dead hatchlings, are left behind in the jar.

Cement Sisterns :

Cement sisterns are used in M.P. The size of the sisterns is 2.4m x 1.6 m x 0.45m. They are constructed just below the dam

on dry bundh, they receive water from dam it self and are provided with outlet and inlet.

Preparation and management of Nursery Pond

Nursery Pond :

For the preparation of nursery ponds following steps must be follow.

1. Methods of controlling aquatic weeds.
2. Irradiation of unwanted (predator) fishes.
3. Liming of nursery pond.
4. Manuring fertilization.
5. Irradiation of predatory aquatic insects.
6. Stocking of carps spawn in nursery.
7. Supplimentory feeding.
8. Harvesting.

1. Methods of controlling aquatic Weeds :-

In this method, three types are included and are as follow.

Manual & mechanical method :-

The periodic removal of imergent and marginal weed by hand picking up roating them out keeps them in control.

The floating weeds can be controlled by repeated drang netting by nylon net's

Rooted submerged weeds are removed by cutting them with long handle forests.

Periodical drening and drying of ponds is also effective to control the weeds.

Control of weeds by mechanical method is done only on limited state.

During recent year diesel operation machine like weed harvester and weed cutlers are used for irradiation of weeds.

2. Chemical Method

In this method, herbicides are used to control the weeds.

The chemical should be selected and used carefully to prevent the adverse effect on fishes and water.

3. Biological control method :

In this method, Herbovarous species like grass carp and Tilapia are used control weeds effectively.

This fishes are also known as bioagent.

In this, grass carp is very effective to controlling weeds because. grass carp can consume weeds upto 70% of its body weights per day.

Tilapia consume filaments algee and sub-merged weeds.

Also silver carps is specially feeder of phytoplankton.

4. Irradiation of unwanted fishes:

i. Predator fishes:-

Predator fishes which commonly occurs in nursery, rearing ponds they are wallago, channa, Notopterous, claurias etc.

Predators are accidentally occurred in ponds i.e. weeds fishes are unsuitable in carps pond as they are enemy of cultivable varieties.

Chemical control of predator fishes :-

For complete removal of predators and weeds fishes poison should be selected.

1. It should be kill the target fish at fairly low dose.
2. It should be cheap and easily available.
3. It should not pollute the water.
4. It should be neutralise within few days.

When de watering and drying is not possible, possions are used for removal of such fishes.

The poission used in nursary pond are as folows.

1. Plant Derivateves :-

It contain 4 to 6% cephones

It enters the blood strem of fishes through gills and buccul cavity (tissue)

It causes destructeen RBC's which results in death of fish.

For the complete removal of undedrsirable fishes it should be applied at the rate of 200 ppm to 250 ppm.

For better result it should be applied at least before the 15 days before the stocking of ponds with carp seeds.

At first fishes show no effect but later on they become inactive loose their balance.

2. Derris Root Powder

Derris root powder containing about 1-5% rotenone is effective in killing fishes.

It should be applied at the rate of 4-10 gm / c^3 m of water (4-10ppm)

It should be applied at least 3-4 week before, the stocking of pond with carps spaws.

3. Liming of Nursery ponds

Liming should be done when pH of pond water is very low. Soil is too muddy and organic matter is in large quantity.

It correct the pH of pond water and soils.

It is also act as antiparasitie substance as kills bacteria and other fish parasites.

Quick lime (Cao) is generally used for liming of pond.

Dose of lime for application is depend upon pH of soil as well as nature of soil.

Generally 200-250 kg / hector lime is sufficient.

Quick liming is spread over the pond bottom during liming and mixed with soil at least 15 days before the stocking of developing carps.

Advantages of liming :

It increases total hardness and total alkalanity.

Increases the availability of carbon for photosynthiesis.

Treatment of dam pond mud with Cao destroys the parasites and other unwanted organisms when applied at the rate of 200-250 kg /hec.

Watering:

After liming, ponds are filled with water.

During watering care should be taken that no undesired fish, ex. insects or other organism enter into the pond with water.

So water should be passed thorough muscline cloth.

A water level of 3-4' is maintain in pond.

4. Manuring and Fertilization :

Manuring increases production.

The fertilization is an imp for fish cultivateen as it is in agriculture.

Nursery ponds should be fertilized after liming.

Monuring in nursery pond 10,000-15,000 kg/hec.

Ponds are treated with cowding organice manure or inorganic copper fertilizer.

The mannure used in nursery pond are cow dung, buffelow dung, poultry manure, etc and In organic fertilizer like N.P.K.

In India, fish farming, caw dung is prefare than inoraganic fertilizer, because it leads to production of large number of zoo-plankton.

In organie fertilizer like Nitrogen fertilizer, phosphat fertilizer and potassium fertilizer can be used.

The rate of application for Nitrogen fertilizer is 50 kg/ hec, for phosphate fertilizer 30 kg / her, for potassium fertilizer 30 kg / hec.

5. Irradication of predator aquatic insect.

The predater aquatic insect commonly occur at nursery pond, they are Ranetra, Napha, dragon fly, lymph.

Many insects may fly from pond to pond and causes harms to stocked fishes.

Hence, it is essential to control the predator aguatic insect to graw the spawn well and in satisfactory number.

They are irradiated by repeated drang netting by using inest net but result are not satisfactory.

Therefore, certain insecticides are used in ponds for effective control of such insects.

Evmulssion of mustered oil or coconut oil and washing soap in the ration 56:18 kg / hec. should be applied at least 12-24 hours before stocking of spawns into the ponds.

Teepol - B - 300 coloured yellowish can be also used.

560 ml of Teepol B-300 with 56 kg of mustered oil effectively kill the insect.

For effective control fishery dept. of M.H. state recomded use of oil emulssion, prepaired by using diesel oil, hydroxide and water at the rale of 1040.75 ml for every 200 m^2 of water surface.

6. Stocking of carp spawn in Nursery pond

Stocking rate of spawn in nursary ponds is varries from 12-20 lacks spawns / hec. depending upon quantity of zoo-planktan in the ponds.

With the provision of artificial food 10-12 lack spawns are will manured nurseries will gives satisfactory results.

But-Now-a day , stocking rate of spwan increased upton to millioan / hec. rearing reduced 15-11 days.

The Rahu spwan stocked at average rate 10.21 millions / hec.

7. Supplimentory food

Carp spawn start feeding on zooplankton soon after being stocked.

At this stage the food requirement of spwan is very high.

During 1st two days spawn does not take artificial food. and depends completely on natural food.

After this period the spawn accepts artificial food along with nature food.

The commonly used artificial food far carp spawn, after 3-4 days stocking are rice bran wheat bran , oil cack etc.

Daily dose of artificial food should be related to the body wt of spawn stocked.

According to Alikunhi, stocked spawns should be feed with artificial food as follows.

Dose of artificial food for 1-5 days should be dabaule to the body with of stocked spwan.

For 6 to 10 days the dose of food should be 3 times more than body wt. of stocked spawn.

For 11 to 15 Days, it should be provided 4 times to the body wt. of stocked spawn.

According to Horra and Pilly, stocked spawn should be feed with amount of artificial food equal to the body wt. of stocked spawn for 1 to 5 days.

For 6 to 10 days, spwan are feed with amount of artificial food double to the body wt. of stocked spawn.

For last 5 days dose of artificial food should be thrice to the body wt. of stocked spawn.

Feeding scheduled for 15 days in Nursery pond.

	Ali kunti	Horra and Pillay
1 st to 5 th days	Double	Equal
6th to 10 th days	Triple	Double
11 to 15 days	4 time	Triple

To body wt. of stocked spawn.

Feeding :-

Food should be spread on water surface.

Feeding spots do not change daily.

Feeding should be done in morning.

8. Harvesting

Carp spawn stocked in well prepared nurseries and feed with artificial food grows 15 to 25 mm. in size within 12-15 days are called try.

At this stage, fry is most suitable for harvesting.

As it is more appropriate size for packing and further transport to the fish pond for culture.

A drag net prepared to a fin mesh used for netting usually called fry net.

The fry net carefully operated from side of the nursary pond by dragging it slowly or the bottom towards to other side of nursery by two persons.

The collection is than scooped up with small hand net and transferred to the water in a bucket.

Transporation of Fish seed

Carp spawn fry or fingerlings are sold as a fish seed but mostly carp fry.

Carp fry are transported to the market where they are sell to owners of water bodies for further growth to attained marketable size.

Transportation by two different method.

1) Open system
2) Closed system.

1) Open system.

Composing open carries with or without artificial aerations i.e. Hundi Method.

Hundi Method :

Hundi is the earthen vessel of variable size.

Open container used for the transportation of fish seed.

The density of fish seed carried in hundi is various according to the time to be spend in journey.

However, many fry are to be transported, the water in hundies should be constantly prevent oxygen.

Plastic Bags :

If the fish seed is to be transported at long distance, plastic bags are used for better production.

Rectangular bags of 30x45 cm size are used for transportation of fish seed.

Half of bag is filled with water and fish seed is placed into the bag.

Rearing Pond :

Management of Rearing Pond

For the preparation and management.

1. Irradiation of aquatic weeds.
2. Irradiation of predators and weed fishes.
3. Liming.
4. Manuaring and fertilization.
5. Irradiation of predator aquatic insects.
6. Stocking of carp fry in rearing pond.
7. Supplementary feeding.
8. Harvesting.

1. Irradiation of aquatic weeds:

In this method, three types are included and are as follows.

a. Manual and mechanical method :

The periodic removal of imergent and marginal weed by hand picking, up rooting them out keeps them in control.

The floating weeds can be controlled by repeated drag netting by nylon nets.

Rooted submerged weeds are removed by cutting them with long handle forests.

Periodical drening and drying of ponds is also effective to control the weeds.

Controll of weeds by mechanical method is done only on limined scale.

During recent year diesel operation machine like weed harvested and weed cultuers are used Irradiation of weeds.

b. Chemical method :

In this method , harbicides are used to control the weeds.

The chemicals should be selected carefully to prevent the adverse effect on fishes and water.

c. Biological methods:

In this method, Herbivorous species like grass carp, silver carp and Tilapia are used to control weeds effectively.

These fishes are also known as bio-agent.

In this, grass carp is very effective to controlling weeds because grass carp can consume weeds upto 70 % of its body wt. per day.

Tilapia consume filamentous algee and sub-marged weeds.

Also, silver carp is spe. feeder of phytoplankton.

2. Irradiacation of unwanted fishes:

i. Predator fishes :

Predator fishes which communally occurs in nursery and racing are wallago, channa, Notopterous, clarius etc.

Predators are accidently occurs in ponds i.e. weed fishes are unsuitable in carp ponds as they are enemy of cultivable vacties.

Chemical control of predator fishes :

For complete removal of predators and weed fishes poison should be selected.

1. It should be kill predator target fishes at fairly law dose.
2. It should be cheap and easily available.
3. It should not pollute the water.
4. It should be neutralized in few days.
5. When dewatering and drying is not possible then poisons are used to remove such a fishes.

The Poisson used in rearing ponds are

Plant derivateves :

1. Mahuva oil cake:

It contain 4 to 6 % saponine

It enters the blood streams of fishes through gills and buccual cavity.

It cause damage to RBC's which results in death of fishes.

For the complete removal of undesirable fishes it should be applied at the rate of 200 ppm to 250 ppm.

For better result it should be applied at least before the 15 days before the stocking of ponds with carp seeds.

At first fishes show no effect but later on they become inactive, loose their balance.

2. Derries Root powder :

Derries root powder containing about 15% rotenone is effective in killing fishes.

It should be applied at the rate of 4-10 gm/c3m of water (4-10 ppm)

Should be applied at least 3-4 weeks before the stocking of pond with carp fries.

3. Liming of rearing pond:

Liming shold be done when pH of water is very law, soil is too muddy and oraganic matter is large quantity.

It corrects the pH of pond water and soil.

It is also acts as antiparasitic sub. as it kills bacteria and other fish parasite.

Quick lime (Coa) is generally used for liming of pond.

Dose of application of lime is depends upon the pH of soil as well as nature of soil.

Generally 100-225 kg/hec. lime is sufficient.

Quick lime is spred over the pond bottom liming and mixed with soil at least 15 days before the stocking of developing carps.

4. Manuring and fertilization:

The rearing ponds are fertilized with caw dung at the rate 15,000 to 20,000 kg/hec. 10 days before stocking of fry into it.

They act treated with ammo. Sulphate, S.S. Phosphate, and ammo. nitrale (11:5:5) at 690 kg/hec.

Stocking of fry :

Releasing of fry into pond is called stocking of fry.

Stocking combination :

To obtain the higher survival of carp fry they should be stocked in suitable combination.

Polycuture is adopted raither :

Than monocuture for higher prond of fish from rearing pond.

Polyculture means culture of 2 or many species of fishes together in pond and also called as composite cultures.

Polyculture can have fishes of any size or age as long as balanced relationship is mentioned.

The carp should be stocked in rearing pond at the rate of 62,500 to 1,25,000 fry/hec. in following combination.

Catla		**Rahu**		**Mrigala**		**Cyprinus**
3	**:**	**4**	**:**	**1**	**:**	**2**

At the same rate of stocking following combination should be used.

Silver carp		**Grass Carp**		**Common Carp**
4	**:**	**3**	**:**	**3**

Irradiation of predator aquatic insects :

The predators aquatic insects commonly occur in rearing pond are Nepha, ranatra, dragon fly, Nymph.

Many insects may fly from pond to pond and causes to stocked fishes.

Hence, it is essential to control the predators aquatic insects to grow the fry well and in satisfactory number.

They are Irradicated by repeated drag netting by using insect net. but results are not satisfactory.

Certain insecticides are used in ponds for effective control of such insects :

Emulssion of mustered oil or coconut oil and washing soap in the ratio of 56:18 kg/hec. should be applied at least 12-24 hours before stocking of fry into the pond.

Teepol B-300 a number colored (yellowish) can be also used.

560 ml of Teepol B-300 with 56 kg of mustered oil effectively kills the insects.

For effective controll, fishery dept. of M.H. state recomnded used of oil emulssion, prepaired by using disesel oil, hydroxide and water at the crate of 1040.75 ml for every 200 m2 of water surface.

Stocking of carp fry in reacing pond :

Put the fry into a basket containing water.

Carry the basket to the rearing pond where the fry will be placed.

Check the temp of water in the basket, it should be the same as the water temp. of pond.

Add water from rearing pond to the basket slowly until the temp. of the water in the basket is the same as the temp of water in the pond.

Dip the basket slowly into the pond and let the fry swim out into the pond them self.

Supplementary food:

Fishes are to be feed with mustard oil cake and rice brain in 1:1 ratio by body weight at 1400 kg/ha.

Ist month - equal to the total weight of fry stocked / day

IInd month - Twice the initial weight of fry.

IIIrd month - stocked / day

8. Harvesting :

In the rearing pond fry attain the length 75-150 mm in rearing of 3-5 months.

At this stage developing fishes are called fingerlings.

Fingerlings are netted out by special net and are transferred them into the stocking pond for further growth.

Stocking pond :

4. Manuring and fertilization:

Fertilization :

It is necessary to manure the stocking pond. before introducing the fingerlings into it.

It use of manure into the pond leads the quick and abundent, appearance of plankton.

Stocking pond should be fertilized with organic and inorganic fertilizer.

For max. product of natural fish food organism in stocking pond, it is necessary to manure them in suitable installments with organic manure, the cow dung at the rate of 20,000 to 25,000 kg/hec.

The inorganic fertilizer it mixture of ammo. suiphate, S.S.P. and calcium nitrate in 11:5:1 ratio at 1000 to 1500 kg/hec.

5. Stocking of fingerling in stocking pond:

Species combination their ratio and rate of stocking, because every pond can support a fish biomass up to the certain weight limit called carrying capacity.

The fingerlings of major carp catla, Rahu, mrigal at the rate of 5,000 to 8,000 per 1.5 hec. to 2 hec. in the ratio of 3:6:1 can be stocked.

Alikunhi recommended to stock fingerlings of major carp catla, rahu and mrigal at the rate of 3,400 per 0.8 to 1.2 lac hec in the ratio 3:3:4

6. Supplementary feeding :

To obtain max fish, fishes must be provided with supplementary food in addition to the natural food.

Carrying capacity of the pond also depend upon the type and quality of food provided.

It should be provided at different station in the pond at definite intervals.

7. Harvesting :

Carps may grow up to 1000 gm by wt. at the end of 1st year, can be harvested.

Harvesting should be done with suitable nets by employing manual labour.

Harvesting of typical species can be done by using proper mesh sized net.

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