Aquaculture and Fisheries
(22ZOOME21)

INTRODUCTION TO CAPTURE FISHERIES

Content

Introduction

Capture fisheries

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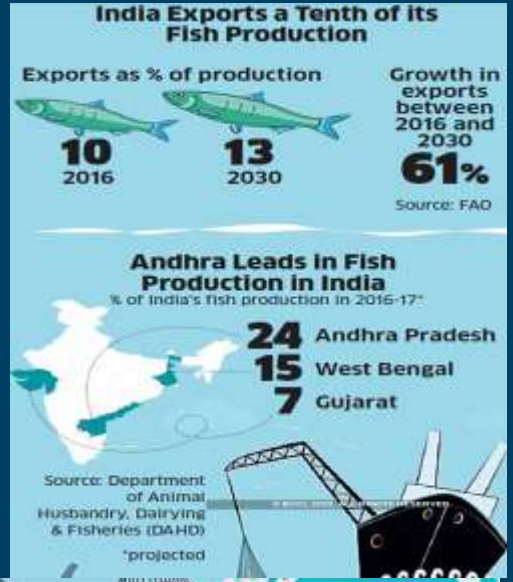
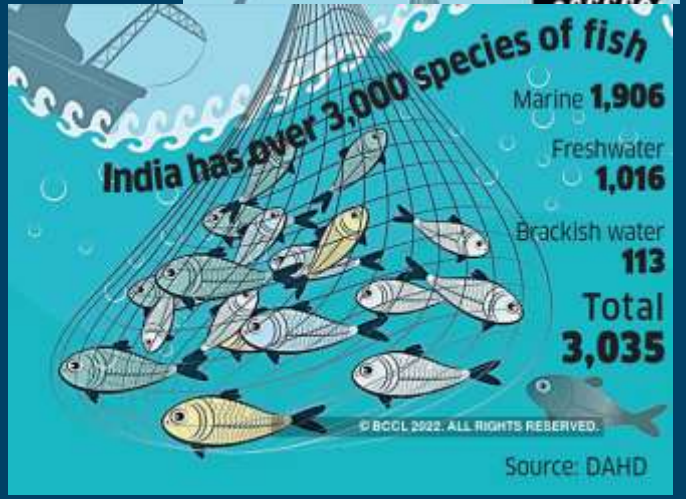
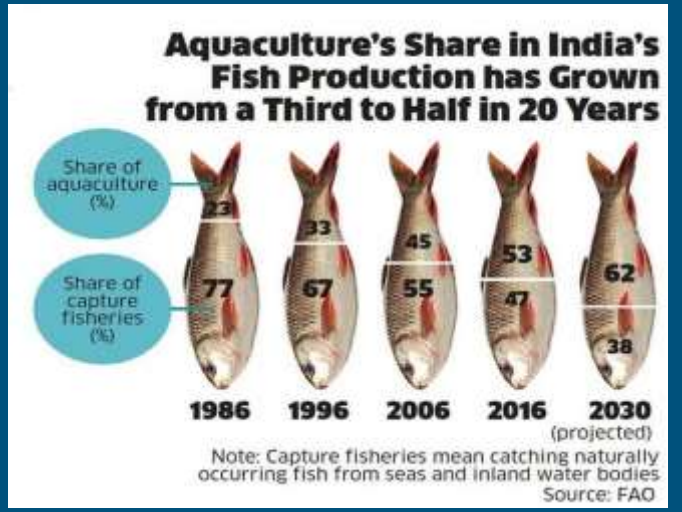


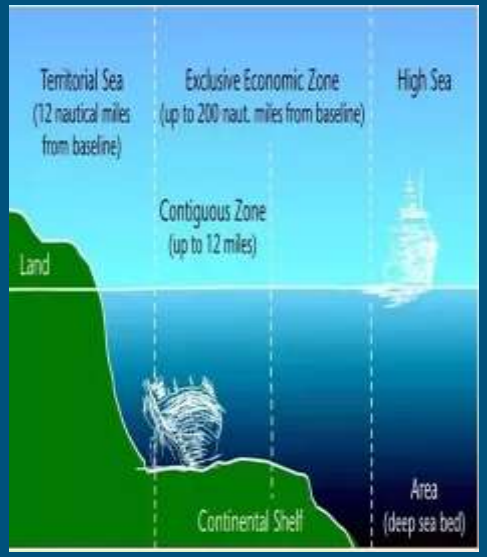


Inland Fisheries in India

- ★ India is the III largest fish producing and II largest aquaculture nation in the world after China.
- ★ The Blue Revolution in India - Fisheries and Aquaculture sector.
- ★ A sunrise sector - a significant role in the Indian economy in near future.
- ★ Indian fisheries has witnessed - in inland fisheries, a shift from capture to culture-based fisheries has paved the way for sustained blue economy.



UNCLOS - UN convention on the Law Of Sea → EEZ (right to explore and exploit resources) - 16th Nov, 1982



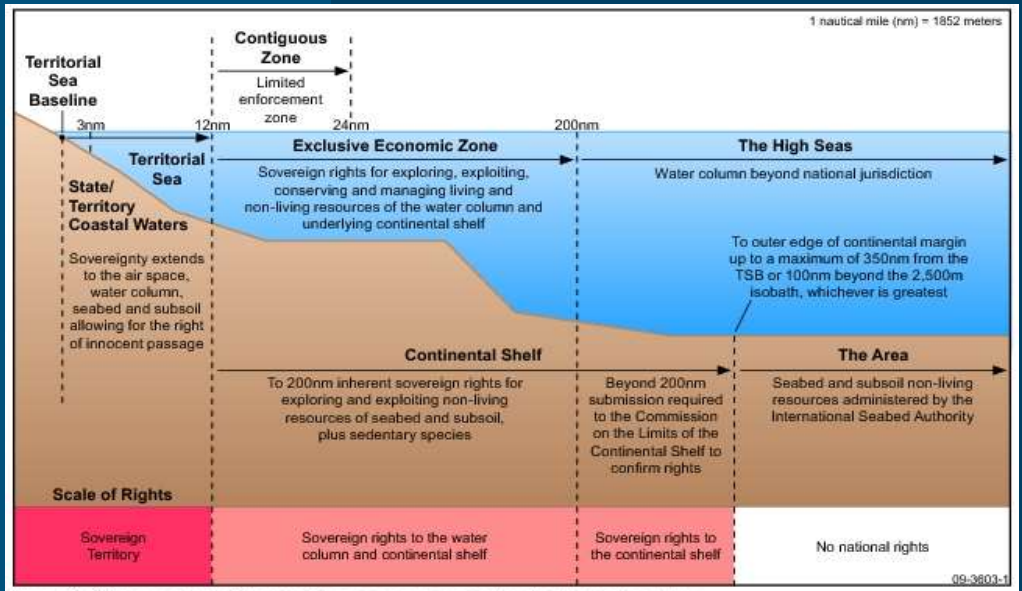
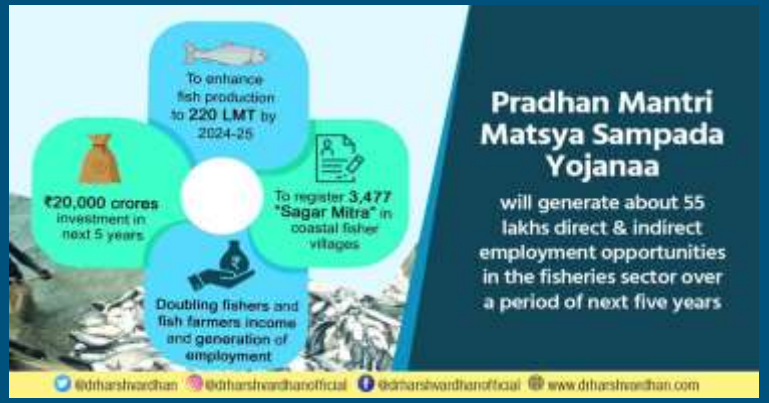
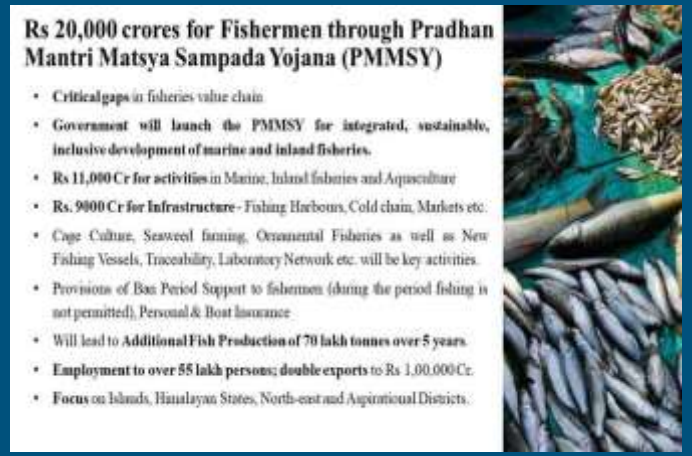


Figure 1: Offshore extent of the maritime zones recognized under international law

- ★ The unutilized and underutilized vast and varied resources offer great opportunities for enhanced production along with livelihood development and ushering economic prosperity.
    - 1,91,024 km of rivers and canals,
    - 1.2 million Ha of floodplain lakes,
    - 2.36 million Ha of ponds and tanks,
    - 3.54 million Ha of reservoirs
    - 1.24 million Ha of brackish water resources

- ★ PMMSY marks the highest ever investment in the fisheries sector, to be implemented over a period of five years from FY 2020-21 to FY 2024-25 in all States/Union Territories.
- ★ To drive the sustainable and responsible development of the Fisheries sector while ensuring socio-economic development of the fishers, fish farmers and fish workers.
- ★ PMMSY was thus launched by the Hon'ble Prime Minister on 10th September 2020.





Department of Fisheries - committed towards holistic development of fisheries and aquaculture resources by developing, managing, conserving and getting its resources responsibly utilized for

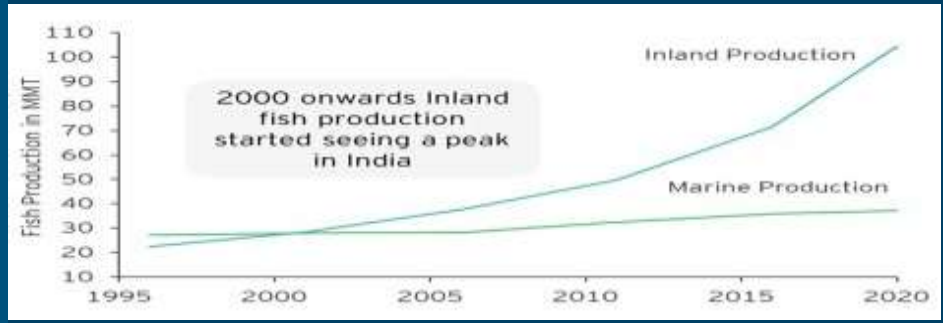
- ➔ improving livelihoods,
- ➔ generating employment,
- ➔ food and nutrition security,
- ➔ economic prosperity and wellbeing (appropriate strategies),
- ➔ stakeholders' participation,
- ➔ public, private and community partnership,
- ➔ market support, and
- ➔ strengthening research,
- ➔ extension, convergence and their linkages.

Till 2000, **marine fish production** dominated India's total fish production.

However due to practice of science-based fisheries, **Inland fisheries in India has seen a turnaround and presently contributes ~70 % of total fish production.**

Therefore, through the holistic approach adopted under PMMSY,

inland fisheries offers immense opportunity and potential to enhance production through optimal utilisation of fisheries, technology infusion and capacity building.



India is the second largest fish producer in the world with a total production of 13.7 million metric tonnes in 2018-19 of which 65 % was from inland sector.

Almost 50 per cent of inland fish production is from culture fisheries, which constitutes 6.5 per cent of global fish production.

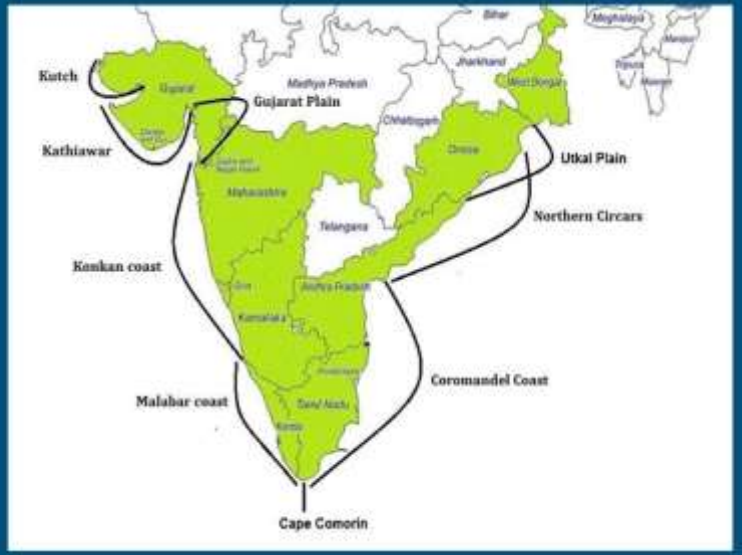
9 Maritime states –

Gujarat,
Maharashtra,
Goa,
Karnataka,
Kerala,
Tamil Nadu,
Andhra Pradesh,
Odisha,
West Bengal

&

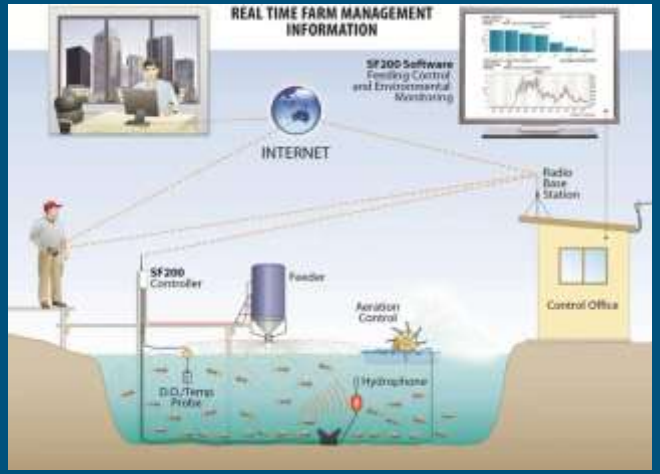
2 UTs --

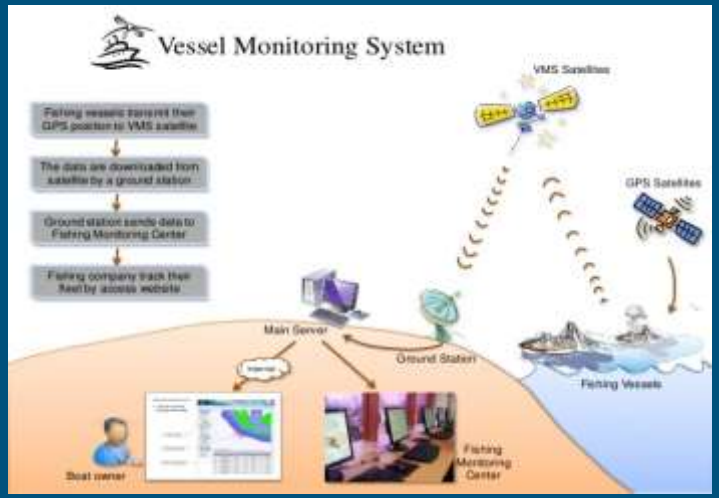
Daman and Diu
and
Puducherry



The 2018-19 Economic Survey highlighted: "Foreseeing the vast resource potential and possibilities in the fisheries sector, a separate Department Fisheries was created in February 2019. The Government has merged all t schemes of fisheries Sector into an umbrella scheme of 'Blue Revolution: Integrated Development and Management of Fisheries' focusing on increasing fish production and productivity from aquaculture and fisheries resources, both inland and marine."

It further added: "Towards realization of these objectives the creation of the Fisheries and Aquaculture Infrastructure Development Fund (FIDF) was approved with a total fund size of Rs 7522.48 crore."


REAL TIME FARM MANAGEMENT INFORMATION
SF200 Software
Feeding Control and Environmental Monitoring
INTERNET
Radio Base Station
SF200 Controller
Feeder
Aeration Control
Control Office
D.O./Temp. Probe
Hydrophone


Vessel Monitoring System
VMS Satellites
Fishing vessels transmit their GPS position to VMS satellite
The data are downloaded from satellite by a ground station
Ground station sends data to Fishing Monitoring Center
Fishing company track their fleet by access website
GPS Satellites
Main Server
Ground Station
Fishing Vessels
Boat owner
Fishing Monitoring Center


Government of India
Fishery Survey of India
Hindi Version
Home
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Mandate
Organization Structure
Survey & Research
Vessel Survey Operations
Database
Publications
Fisheries Value
Institutional Linkages
Right To Information (RTI)
Contact Us
VIGOTSAV
EVENTS / ACTIVITIES:
Marine Mammal Project - Vacancies
Project on Marine Mammal Stock Assessment studies
Preamble of India
Operational Guidelines of PMMSY
Pradhan Mantri Matsya Sampada Yojana (PMMSY) 2020
Office Working Hours - Headquarters & Base Offices
Vessel Survey Operations August 2021
Base Offices Working Hours Change - Order
Uniform fishing ban in Indian EEZ during 2022 - Order
Sabka Saath
Sabka Vikas
Sabka Vishwas
Sabka Prayas
Posting of

Inland fisheries resources

Includes rivers, floodplains, estuaries, mangroves, reservoirs and ponds.

Classified :

freshwater aquaculture → pond culture of carp;
brackishwater aquaculture → mostly shrimp culture; and

Capture fisheries in rivers, estuaries, lakes, reservoirs, etc.

Profile of major river systems of India

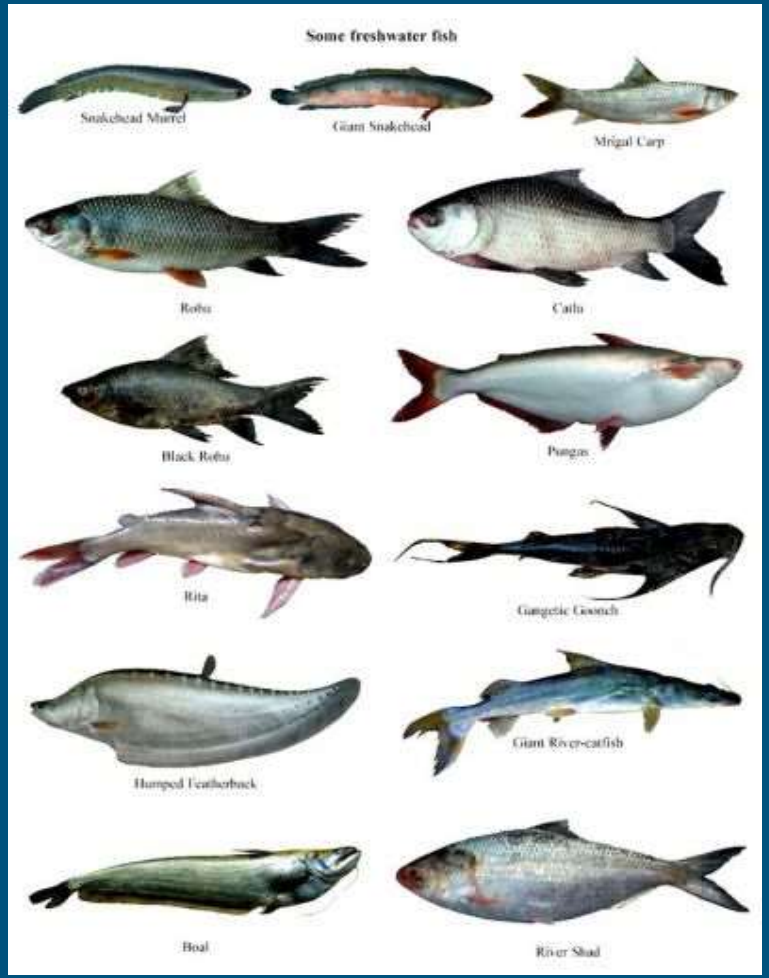
River System	Name of main rivers	Approximate length (km)	States
Extra Peninsular Rivers			
Himalayan Ganges	Ganga	2,525	Uttarakhand, Uttar Pradesh, Jharkhand Bihar, West Bengal
	Ramganga	569	Uttar Pradesh
	Gomti	940	Uttar Pradesh
	Ghagra	1080	Uttar Pradesh, Bihar
	Gandak	300	Bihar
	Kosi	492	Bihar
	Subernarekha	395	Bihar, Odisha, West Bengal
	Yamuna	1376	Uttarakhand, Haryana, Delhi, Uttar Pradesh
	Chambal	1080	Madhya Pradesh, Uttar Pradesh, Rajasthan
	Tons	264	Uttarakhand
	Sone	784	Uttar Pradesh
	Ken	360	Madhya Pradesh, Uttar Pradesh
Brahmaputra	Brahmaputra	4000	Arunachal Pradesh, Assam
	Dibang, Siang, Lohit, Manas, Buri Dihang, Dhansiri, Koppili		Nagaland, Sikkim Manipur
Indus	Jhelum	400	Jammu and Kashmir
	Chenab	330	Jammu and Kashmir, Himachal Pradesh
	Beas	460	Himachal Pradesh, Punjab
	Sutlej	1450	Himachal Pradesh, Punjab
	Ravi	725	Jammu and Kashmir, Himachal Pradesh, Punjab

Peninsular Rivers			
East Coast	Mahanadi	851	Odisha, Madhya Pradesh
	Brahmani	799	Odisha, Bihar
	Godavari	1465	Maharashtra, Andhra Pradesh
	Krishna	1401	Andhra Pradesh, Karnataka, Maharashtra
	Cauvery	800	Karnataka, Tamil Nadu
	Pennar	597	Karnataka, Andhra Pradesh
	Bhima	861	Karnataka
West Coast	Narmada	1322	Maharashtra, Gujarat, Madhya Pradesh
	Tapti	720	Gujarat, Maharashtra
	Mahi	583	Gujarat
	Sabarmati	371	Gujarat, Rajasthan

Fisheries of Floodplain wetlands (beels) and lakes

Potential fisheries resources are in the states of Assam, West Bengal and Bihar, which offer scope for both culture and capture fisheries.

Play vital role for recruitment of fish stocks of the riverine system and provide nursery grounds for commercially important finfishes and shellfishes.



https://en.banglapedia.org/index.php/Fish

https://www.itmedicalteam.pl/articles/enumeration-of-fish-from-dulakhojiya-beel-wetland-of-lakhimpur-district-assam-india-105242.html

The bells are estimated to possess potential production levels of 1,000-1,500 kg/ha/year, while the present levels remain at only 100-150 kg/ha.

Rich nutrient load and availability of fish food organisms make these water-bodies ideal for culture-based fisheries leading to higher growth of stocked fish species than those of reservoirs.

Further, the marginal areas of the bells can be utilized for construction of ponds or pens of suitable sizes for raising the required fingerlings.

States	Area ('000 ha)
West Bengal	42.5
Bihar	40.0
Assam	100.0
Uttar Pradesh	152.0
Other NE states	192.0
Total	**526.5**

Pen Culture

- Effective Utilization of Wetlands

The wetlands in India support subsistence and livelihood to thousands of people. Culture of fish and prawn in the enclosures or pens of manageable size and area, erected in the marginal areas of wetlands is an effective method for additional fish production and income for fishers.

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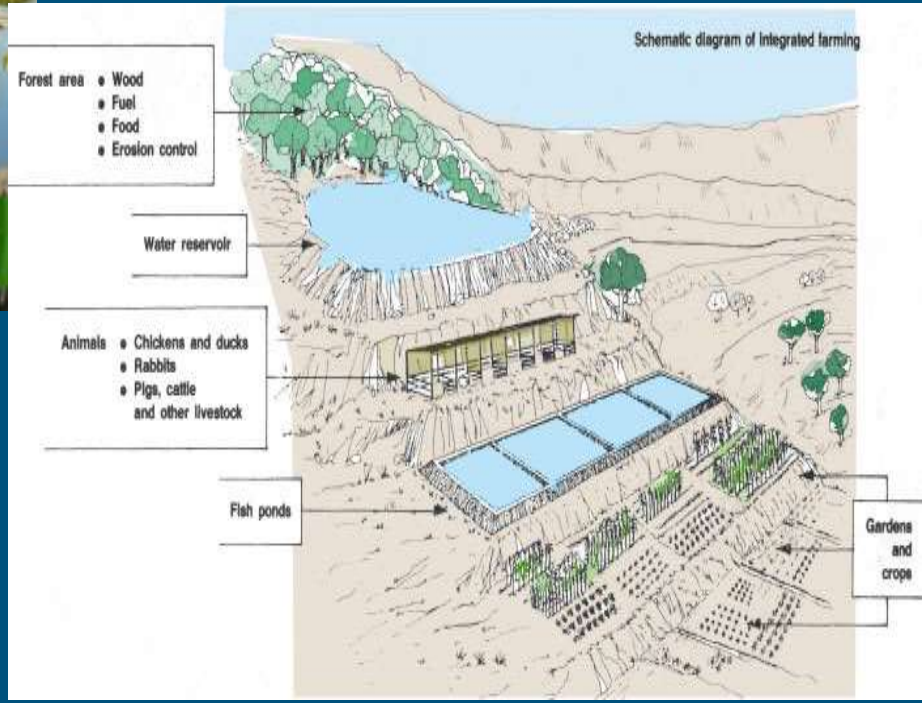


Reservoir fisheries

Open water that contribute to the bulk of inland fisheries production even at their minimum level of exploitation and also hold the key for increased fish production in coming years.

(i.e., natural or artificial lake, pond, or impoundment created using a dam or lock to store water)

Indian reservoirs are diversified and located under different geo-climatic situations.

Classified as

large (>5,000 ha) → (56 nos.) - 1.14 mha

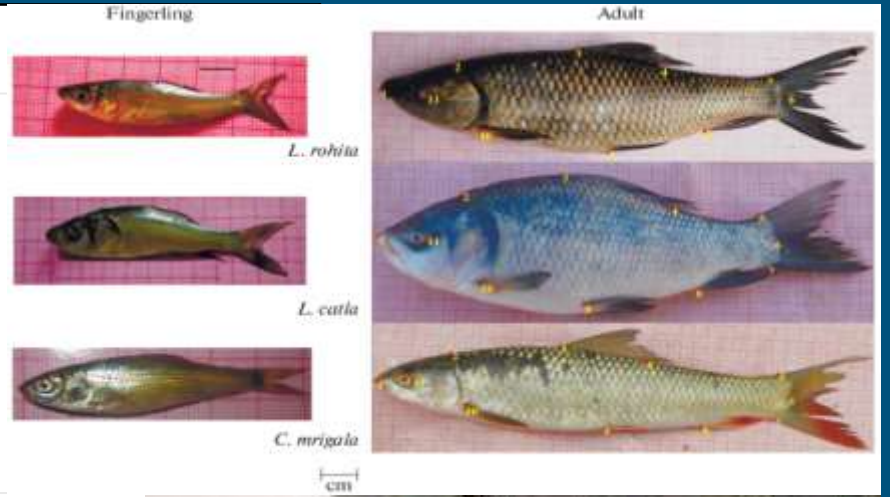
medium 10005000 ha) → (180 nos.) 0.527 mha

small (<1,000 ha) → (19,134 nos.) 1.485 mha

Ref: https://www.fao.org/3/v5930e/v5930e01.htm__RESERVOIR FISHERIES RESOURCES OF INDIA

Common fish species of reservoirs in India

Groups	Species Name
Indian major carps	• *Labeo rohita,* • *L. calbasu,* • *L. fimbriatus,* • *Cirrhinus mrigala,* • *Catla catla*
Mahseers	• *Tor tor ,* • *T.putitora,* • *T.khudree,* • *Neolissochilus hexagonolepis*



Minor carps including snow trout and peninsular carps

- *Cirrhinus cirrhosa,*
- *C. reba ,*
- *Labeo kontius,*
- *L. bata,*
- *Puntius sarana,*
- *P. dubius,*
- *P. carnaticus,*
- *P. kolus,*
- *P. dobsoni,*
- *P. chagunia,*
- *Schizothorax richardsonii,*
- *Thynnichthys sandkhol,*
- *Osteobrama vigorsii,*
- *Hypselobarbus kurali,*
- *H. periyarensis,*
- *Crossocheilus periyarensis*

Aquaculture and Fisheries (22ZOOME21)

Indian Institutes and Authorities:

ICAR - CIFA

Indian Institutes and Authorities:

- ICAR - CIFE - Central Institute of Fisheries Education, Mumbai - India's first fisheries university

- CIFA - Central Institute of Freshwater Aquaculture

- CMFRI - Central Marine Fisheries Research Institute

- ICAR-CIBA - Central Institute of Brackishwater aquaculture

- NFDB - National Fisheries Development Board

- MPEDA - Marine Products Export Development Authority

- CAA – Coastal Aquaculture Authority

ICAR - CIFA

भा.कृ.अनु.प - केन्द्रीय मीठाजल जीवपालन अनुसंधान संस्थान
ICAR - Central Institute of Freshwater Aquaculture
आईएसओ ९००१: २०१५ प्रमाणित संस्थान
ISO : 9001:2015 Certified Institute

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News & Update

scientific aquaculture NEW

Corrigendum Walk-In-Interview - YP-II (Advt. No 02/2023-24) NEW

ICAR-CIFA organized Training programme on "Freshwater Aquaculture" for SC farmers of Dhenkanal and Kandhmal NEW

27.04.2023: ICAR-CIFA organised farmer-scientist interface at Raitala, Dhenkanal NEW

Recent Activity | CIFA Technologies / Products | Quick Links

ICAR-CIFA - Drone View

Haul of Pabda

Haul of Freshwater Prawn


G20
भारत 2023 INDIA
वसुधैव कुटुम्बकम्
ONE EARTH • ONE FAMILY • ONE FUTURE


Sprawling Farm Campus of ICAR-CIFA

Haul of Mixed Carps

Haul of Jayanti Rohu – The improved Rohu

★ Successful production of new generations of genetically improved breeds viz.,

- ➔ 13th generation of Jayanti rohu,
- ➔ 3rd generation of improved catla and
- ➔ 14th generation of CIFA-GI Scampi

★ Captive breeding and seed rearing protocols

- Red-bellied pacu *Piaractus brachypomus*,
- Spiny eel *Macrognathus pancalus* and
- Indigenous ornamental fishes - *Danio dangila*, *Haludaria fasciata* and *Dawkinsia assimilis*.

★ Fry rearing of Indian major carps

★ Fingerling rearing of *Anabas testudineus*, *Hypselobarbus pulchellus*, *Labeo fimbriatus* and *Heteropneustes fossilis* could be successfully demonstrated in biofloc system signifying the potential of system in seed rearing of freshwater fishes.

13th generation of Jayanti rohu

Jayanti Rohu™ was developed through selective breeding of rohu, Labeo rohita from different founder populations of North Indian Rivers. Improved Jayanti Rohu™ is the first genetically improved fish in India. It has shown improvement in the gain of 17% per generation for growth trait.

(ICAR - CIFA)

GENETICALLY IMPROVED JAYANTI ROHU: A BOON TO FRESHWATER AQUACULTURE IN INDIA

A. RASAL, M. PATNAIK, K. MURMU, P. NANDANPAWAR, J.K. SUNDARAY AND K.D. MAHAPATRA

A large section of the Indian population is dependent on animal source of protein like meat, fish and eggs, among which fish is consumed by one-quarter of the population, numbering around 300 million (Harik 2016). It is estimated that about 16 million t of fish will be required to feed the growing population by 2025, nearly double the present production. This is a big task with the current challenges of resource competition, water scarcity, climate change, growing disease outbreaks and several other environmental and social issues.

Freshwater aquaculture contributes significantly to India's economy and the food security and livelihoods of the masses. Fish production in India has increased from 3.8 million t in 1990-91 to 10.8 million t in 2015-2016 with a contribution of 7.2 million t from the inland sector and 3.6 million t from the marine sector (DAHD 2016-17). In India, carps are the mainstay of freshwater aquaculture. The Indian major carps — catla Catla catla, rohu Labeo rohita and mrigal Cirrhinus cirrhosus — contribute 70 to 75 percent of total freshwater fish production, followed by silver carp, grass carp, common carp and catfishes forming a second important group, contributing 25 to 30 percent (Chaudhari and Alikunhi 1957). Currently, most commercial fish farmers in Andhra Pradesh, West Bengal and Odisha states practice carp polyculture with 90 percent rohu and 10 percent catla.

The attractive appearance of Jayanti rohu

Jayanti rohu broodstock

Selecting Jayanti rohu broodstock

ROHU WAS SELECTED AS THE CANDIDATE SPECIES FOR SELECTIVE BREEDING DUE TO ITS HIGH CONSUMER PREFERENCE, RELATIVELY GOOD GROWTH PERFORMANCE IN MULTISPECIES CARP CULTURE SYSTEM AND LOW SUSCEPTIBILITY TO DISEASES. THE SALIENT FEATURES OF JAYANTI ROHU ARE SUBSTANTIAL ADDITIVE GENETIC VARIANCE AND NEGLIGIBLE HETEROSIS FOR GROWTH. AN AVERAGE GENETIC GAIN OF 18 PERCENT PER GENERATION HAS BEEN OBTAINED AFTER EIGHT GENERATIONS OF SELECTION.

The aquaculture sector should be more profitable and produce more fish per unit area in a sustainable and environmentally friendly manner. Marine and brackishwater aquaculture sectors have limitations with problems of large-scale adoption to increase fish production. This imposes the responsibility of bridging the future gap between additional fish demand and supply on freshwater aquaculture. Only about 40 percent of the available area of 2.36 million ha of ponds and tanks has been put to use and an immense scope for expansion of area exists under freshwater aquaculture (Ayyappan et al. 2011). Therefore, it is necessary to increase the present national average annual productivity from about 3 t/ha to at least 5 t/ha to meet the increasing demand for fish in the country.

Species and system diversification are important approaches for enhancing fish production through aquaculture. The technologies of induced carp breeding and polyculture in static ponds and tanks virtually revolutionized the freshwater aquaculture sector. Genetic improvement can further enhance fish production through exploitation of additive genetic variance for economically important traits such as growth and disease resistance. In this context, use of genetically improved Jayanti rohu developed by ICAR-CIFA can play a major role towards sustainable aquaculture production.

(CONTINUED ON PAGE 24)

3rd generation of improved Catla

NATIONAL AWARENESS PROGRAM ON

'CIFA-GI SCAMPI': THE GENETICALLY IMPROVED AND FAST-GROWING STRAIN OF SCAMPI FOR HIGHER PRODUCTION AND INCOME'

MAY 07, 2021

VIRTUAL EVENT LIVE VIRTUAL EVENT

The giant freshwater prawn widely known as 'Scampi' is one of the most important cultivable prawn species due to its high price, large size, faster growth, good taste and high export demand. It can be cultured either in freshwater or slightly brackish water (<7 ppt) and both alone or with compatible fishes like carps. India used to be a major scampi producing country in late nineties to early 2000s. However, since 2006 scampi production in India started declining. Reduction in economic returns from scampi farming was the major reason for the decline in production. Increase in the cost of farming (increase in cost of feed, labour and energy) and static nature of farm gate price lead to reduction in profit from farming and forced farmers to shift to other fish species. The other concerns were lack of availability of quality seeds and emergence of nodavirus infection in early phase of life. Considering the immense potential of scampi farming in increasing aquaculture production as well as income of farmers, it is essential to work towards reviving the culture of scampi.

Availability of a fast growing strain of scampi could help to increase production and productivity, and bring the farmers back to scampi farming. ICAR-CIFA has developed a genetically improved and fast growing strain of scampi through selective breeding.The new strain is registered as '***CIFA-GI Scampi***' in 2020. The grow-out performance of the latest generations of selectively bred scampi was evaluated in farmers' ponds in Odisha, which revealed its superior performance. The average daily growth of improved breed recorded in the farmer's field was 0.26 g/day which is significantly higher than that of farmer's stock (0.17 g/day). Dissemination of the '***CIFA-GI Scampi***' to the scampi farmers through multiplier hatcheries is one way to revive the scampi farming. The aim of the present National Awareness program is to create awareness about the '***CIFA-GI Scampi***' and partner with the potential state fisheries departments and other stakeholders in disseminating the improved strain.

Jointly Organized by :

ICAR-Central Institute of Freshwater Aquaculture &
Dept. of Fisheries, MoFAHD, GoI & NFDB

Farming of scampi and tiger shrimp together: A case study from West Bengal, India

Subrato Ghosh and Himadri Chandra*

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**Vill. and P.O. Amarshi, Dist. Purba Medinipur, West Bengal, India*

Scampi produced at Mrityunjoy's farm.

In tiger shrimp *Penaeus monodon* farming, farm ponds connected to estuaries, brackishwater rivers and creeks are considered ideal since pond water salinity of 12-20ppt is a favourable parameter and basic requirement. The giant freshwater prawn *Macrobrachium rosenbergii*, which has become an important cultured species in freshwater aquaculture systems, requires pond water conditions similar to the Indian major carps. Recently it has been experienced that remarkably both *M. rosenbergii* and *P. monodon* could be cultured simultaneously in the same environment, i.e., freshwater ponds. Sri Chandra has worked extensively as technical supervisor to commercial shrimp and scampi producers in brackishwater and freshwater farms respectively in Purba Medinipur District in West Bengal.

Sri Mrityunjoy Bal, S/o Sri Bishnupada Bal, residing at Vill. Gorbhera under Dighanagar Mouza, P.O. Gurgram, Block Bhagabanpur-1 under PS Bhagabanpur, Dist. Purba Medinipur, West Bengal, is a moderately resource-rich professional prawn farmer, who has been involved in nursery rearing and grow-out monoculture of M. rosenbergii since 2004. He owns three scientifically-managed, perennial and rain-fed grow-out ponds of approximately 0.1 ha, 0.2 ha and 0.36 ha in area, having 1.2-1.8 metres depth. Since March-April 2013, he has been practicing farming of both these species together in his first two freshwater ponds. During March-April, he procures seeds of *M. rosenbergii* (5-8mm; paddy grain size, counted by spoon) and *P. monodon* (PL-15; 14-15mm size) from professional riverine prawn/shrimp seed fishers; seeds of such size of these two species are available in the Rupnarayan River (captured at Kolaghat, distance of 65km from Gorbhera village) and the Keleghai River (at Sabang) in this district during March to July. Mainly scampi seeds are available in the Keleghai River. Seeds are transported at his pond site either in aluminium hundi or empty dalda oil plastic containers of 15 litre capacity, with pores on lid, each containing 5,000-5,500 pieces. Each seed of *M. rosenbergii* and *P. monodon* costs Rs. 2.00-2.50 and 40-50 paisa respectively. Scampi seeds available during July-August are not much preferred for farming.

Multiplier Hatcheries for 'CIFA-GI Scampi'

Background information:

'CIFA-GI Scampi' is a genetically improved and fast growing strain of giant freshwater prawn *Macrobrachium rosenbergii* developed by ICAR-CIFA through systematic selective breeding. Giant freshwater prawn also widely known as 'scampi' is an indigenous freshwater prawn species of India inhabiting rivers, canals, estuaries and coastal waters. It is one of the most important cultivable species in freshwater systems due to its high price, large size, faster growth, good taste and high export demand. It can be cultured either in freshwater or slightly brackish water (<7 ppt) and both in monoculture or polyculture system. India used to a major producer of this species till 2005, however since then smaller harvest size and low survival in grow out ponds has caused poor returns to farmers leading to a reduction in production. In order to revive the farming of scampi ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA) in collaboration with the WorldFish (an international research organization headquartered in Malaysia) has started a systematic selective breeding programme for improving the growth rate of *M. rosenbergii* in 2007. The base population with wide genetic base for the selective breeding was formed using populations of scampi from three geographically distant locations in India (Gujarat, Kerala and Odisha). Selection for harvest body weight was carried out since then and the cumulative response after 10 generations of selection has been 60%. The new developed strain was registered as 'CIFA-GI Scampi' in 2020. Dissemination of the 'CIFA GI Scampi' to the scampi farmers through multiplication hatcheries is one way to revive the scampi farming.

The present advertisement is therefore given to select the interested scampi hatchery operators in India to become the 'Multiplier Hatcheries for 'CIFA-GI Scampi'. The Criteria for selection of multiplier hatcheries and application for is given in the annexures. Interested scampi hatchery operators may apply in the prescribed application form with supporting documents for consideration.

The last date for application is 31 July 2021.

Red-bellied pacu, ***Piaractus brachypomus***

Aquaculture
Volume 547, 30 January 2022, 737483

Farming practices and farmers' perspective of a non-native fish red-bellied Pacu, *Piaractus brachypomus* (Cuvier, 1818) in India

B. Seshagiri [a 1], Aditya Kumar [b 1], P.K. Pradhan [b], Neeraj Sood [b], Uday Kumar [b], C. Satyavati [a], Y. Sravanti [a], Krishna Prasoon [c], Arnab Ghosh [d], G. Kantharajan [b], V.S. Basheer [c], P.P. Chakrabarti [d], P.C. Das [e], Kuldeep K. Lal [b], J.K. Jena [f]

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https://doi.org/10.1016/j.aquaculture.2021.737483

Highlights

- Red-bellied Pacu, *Piaractus brachypomus* has been introduced into Indian aquaculture through ornamental fish trade.
- The present study provides evidence about farming practices and farmers' perspective about Pacu culture in India.
- There has been increase in area of culture, production and demand over the years.
- Selling price of pacu is comparatively higher than Indian Major Carps and striped catfish.
- Most of the farmers (87%) are satisfied with pacu culture due to its shorter culture period and faster growth rate.


Spiny eel, *Macrognathus pancalus*

Indigenous ornamental fishes

Work to do !!

- ★ Commercially important fishes of India (Fresh water, Marine, Reef associated, etc)
- ★ Important days related to Fisheries
- ★ Logos

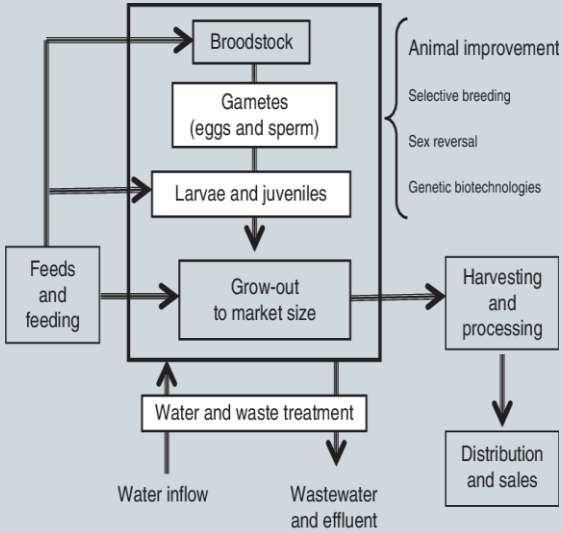
Aquaculture and Fisheries
(22ZOOME21)
Culture and Breeding - Aquaculture Biotechnology

Hormonal and genetic approaches to fisheries

- Fish genetic resources (germ plasm)
- Application to fisheries management
  - Capture fishery management
  - Fish culture management
  - Taxonomy

- Cryopreservation of gametes (Gene banking)
  - Cryopreservation of sperms
  - Fertilization of cryopreserved sperms

- Monosex culture
- Sex reversal
- Sterile fish
- Hybridization
  - Triploid hybrid (Polyploid)
  - Hybrid vigour (favourable heterosis)
- Transgenic fish and its application
- Triploids - broiler fish
- Inbreeding, Cross-breeding, Selective breeding
  - Gold fish
  - Inbred lines
  - Super fish (Super-males and super-females)
  - Sex determination and Sexuality
  - Gynogenesis



Sex-reversal in adult fish

2

Posted by Megan Wilson, on 27 July 2013

Dranow DB, Tucker RP and Draper BW. Germ cells are required to maintain a stable sexual phenotype in adult zebrafish. Developmental Biology 376: 43-50.

Adult sex-reversal – the change of primary sex (gonadal sex) and secondary sex characteristics and to another sex during adulthood, occurs in many fish species and is triggered by social or environmental conditions. This is an extreme example of phenotypic plasticity – the ability of animal to change its form due to a cue from the environment. Sex reversal requires considerable changes to both the reproductive system (testis or ovary) and changes to secondary sex characteristics (such as pigment, body shape).

One example of sex-reversal occurring in nature is observed in some species of goby fish. These fish get around as a group of females (harem) with a single dominant male. With the loss of the male from group, one of the adult female fish (usually the largest) undergoes sex reversal to become the male of the group .

https://www.researchgate.net/figure/Overview-of-the-production-cycle-of-farmed-fish-with-an-indication-of-the-areas-in_fig1_230460389

Germplasm resources (Sustainable utilization of biodiversity)

BIODIVERSITY TREATY 1993

- Global fish population - biodiversity of Indian fishes (693 nos. / 81000 fauna).
- More no. of extant fish species (Systematics and evolution - difficulty in relating - lack of knowledge). Commercial sp - 400 only.

- Naturally available - hybrids (Magur), inter, intra-specific, maternal half sibs (Female -Sea bass), steriles, sex-reversed individuals, endangered and recently extincts.

Magur

Sterile group (triploids) / broiler fish continued to grow through the period, in which the normal diploids mature and ceases to grow.

- Suppression of meiotic metaphase II
- Eggs (pressure shock shortly after fertilization)
- Prevents the normal expulsion of one set of maternal chromosomes.
- Fusion of the chromosomes from the sperm the developing embryo contains three sets of chromosomes
- Triploids are only for somatic growth (15 % faster) than spending energy on reproductive growth

- Survey - Production 23 species (Adv: Administered steroids - metabolize and digest in human)
- 15 species are temperate and 8 are distributed both in temperate and tropical water
    - Induction of triploid in *Oreochromis mossambicus*
    - Triploid sterile hybrid, common carp x rohu, common carp x mrigal showed faster growth rate than the maternal parental i.e. common carp.

- Sterile males of *Betta splendens*, an aquarium fish in highly decorative and fancy in colour as compared to its female partner.

Genetic approach + hormonal approach → Faster and economic growth, food conversion efficiency.

- Monosex production
- Sterile fish production
- Sex-reversed fish production

In XY mechanism,

Female → Homogametic (XX); Male → Heterogametic (XY)

In XO mechanism,

Female → (XX); Male → (XO)

In ZW mechanism,

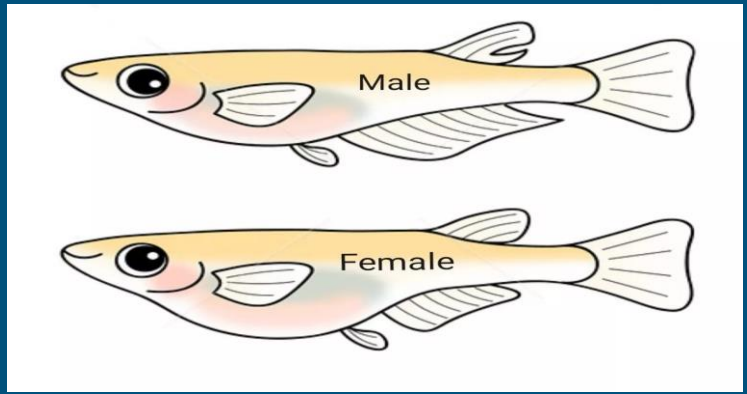
Female → (ZZ); Male → (ZW)

Eg: *Xiphophorus maculatus* - Sex chromosomes (XYW) - XX, WX and WY combinations.

Mono Sex Culture

Mono-sex culture is based on the culture of fish by producing all males or all females depending upon the sex which have better food conversion ratio and growth rate.

Genetic determination of sex - Sex chromosomes (X, Y, Z, or W).
Male determining gene M is present on any of the three X, Y and W.



Sex chr.	Female	Male
XY	XX	XY
XO	XX	XO
ZW	ZZ	ZW
WXY (*Xiphophorus maculatus*)	WY, WX, XX	XY, YY

Female → Male → Female = SEX REVERSAL → Progeny (Single sex) → MONOSEX CULTURE

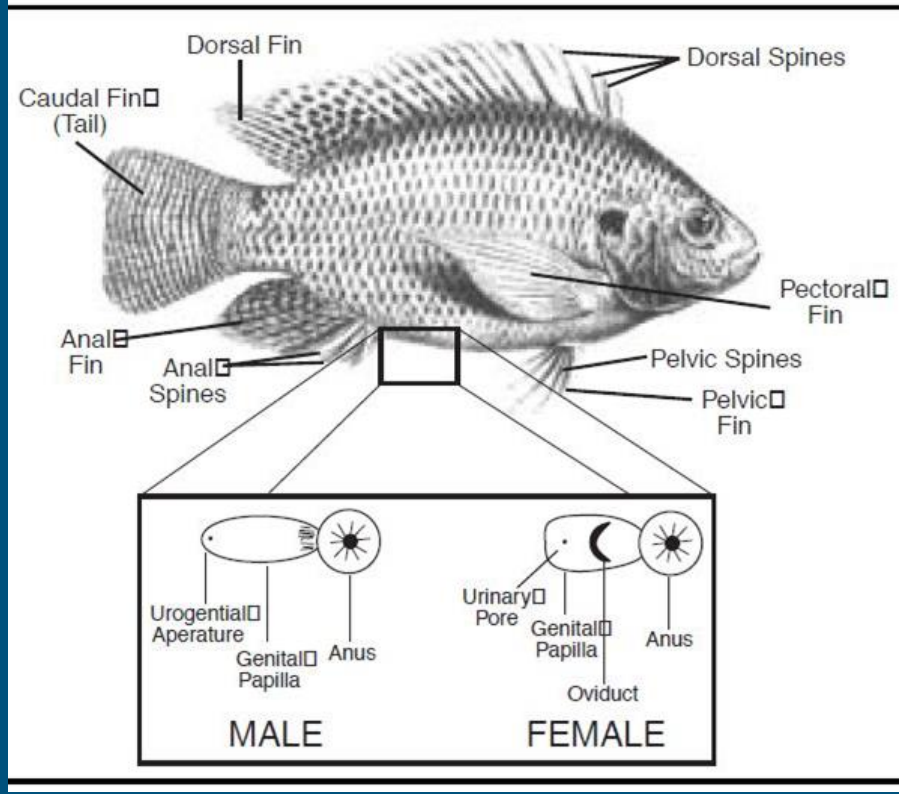
Advantages in aquaculture:

- Superior traits/Better food conversion efficiency/growth/higher market value.
- High fecundity, risk of overcrowding leading to stunted growth.

MONOSEX STOCKING - Mechanically (Tilapia) - laborious and time consuming.

For all male or female productions the flowing procedures are maintained:

- The sex of fish is identified before maturity and male and females are separated.
- The process is laborious.
- Desired quantity of male or females are not produced by that process.

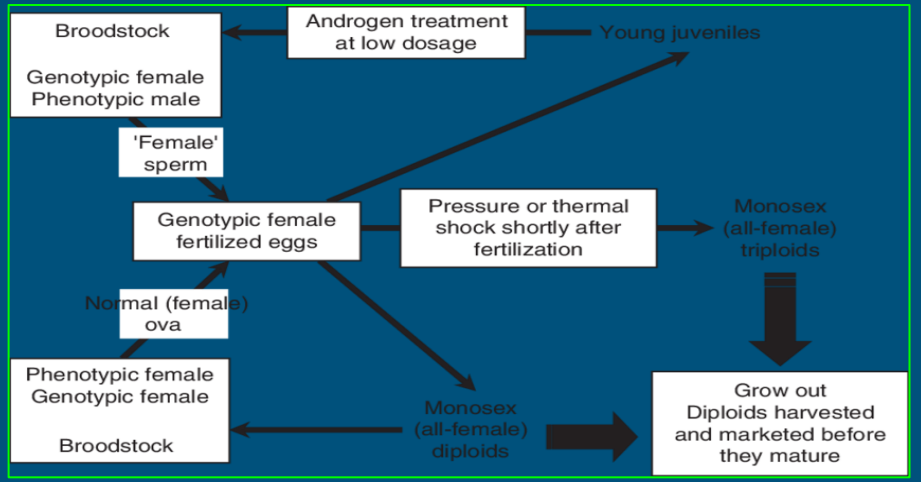


Experimental hybridization in Tilapia can produce monosex stock.

- Experimental hybridization - Tilapia (Oreochromis) (Interspecific and intraspecific mating) yielding all male stocks.

♂ T, macrohir × ♀ T. nilotica
♂ T. hornorum × ♀ T. mossambica
♂ T. mossambica × ♀ T. nilotica
♂ T. mossambica (African) × ♀ T. mossambica (Malaysian)



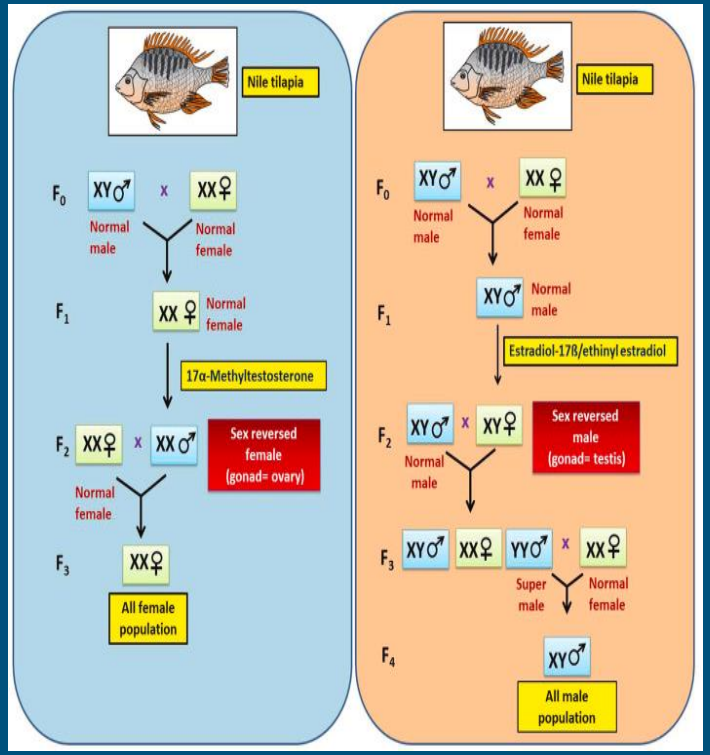
Treatment with sex hormones:

- Easiest way.
- Male sex hormone methyl testosterone is administered through feeding (15 - 60 mg / kg of food) in early developmental stages of female fish (30 - 50 days of life).
- The genotype female (XX) then transferred to phenotype male (XX).
- If such sex reversed male are crossed with normal female, the progeny will be 100% female.

Sex reversed male (XX) ×
Normal female (XX)
↓
Female (XX) F1

- The hormone treated sex reversed male are generally not fit for human consumption.

But F1 progeny is normal female and suitable for human consumption.



KeAi
CHINESE ROOTS GLOBAL IMPACT

Aquaculture and Fisheries
Volume 7, Issue 5, September 2022, Pages 525-539

Review article

Sexual plasticity in bony fishes: Analyzing morphological to molecular changes of sex reversal

Swathi Tenugu, Balasubramanian Senthilkumaran

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https://doi.org/10.1016/j.aaf.2022.02.007

Fig. 2: Transgenic Nile tilapia (top and bottom) produce very significant increases in growth rates compared to their nontransgenic siblings. Photo by A. Rahman.

Ref: https://www.globalseafood.org/advocate/tilapia-genetics-applications-and-uptake/

Inbreeding:

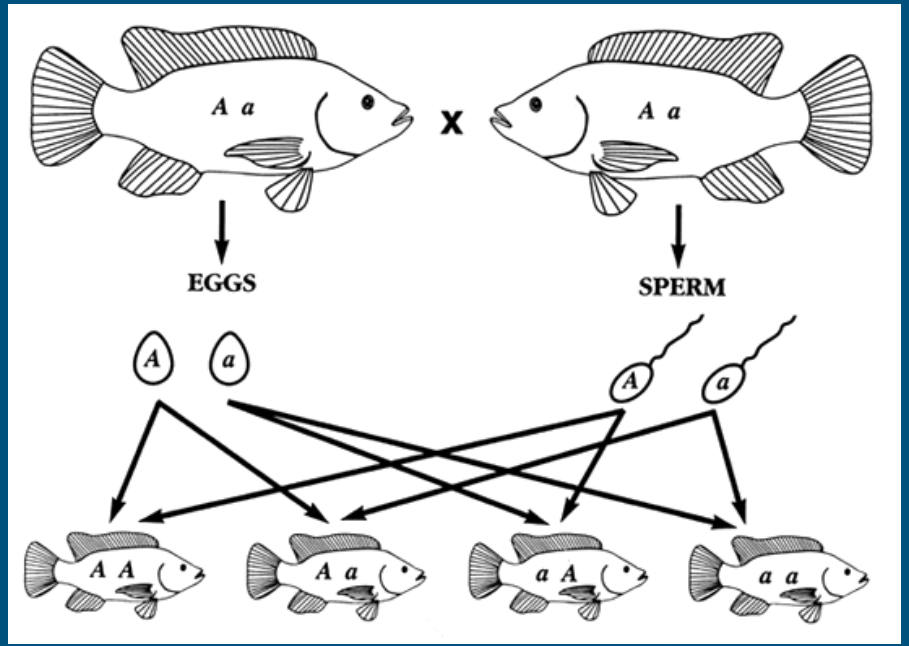
Mating of fish derived through generations from same brood pair occurs, if farming care is not proper.

Inbreeding coefficient: (0 to 100 %)
0 % → unrelated parents

100 % → parents for many generations
Back are related by descent.

It causes
"Inbreeding depression / homozygosis"
Reduction in

- Growth rate
- Yield
- Fertility



- Solution to inbreeding depression → "Cross breeding" (heterozygosis).
- Mating → different breeds, varieties, strains, or genotypes of farm fish.
- Artificial selection of mating parents by the breeder → "Selective breeding".

Table 1. Some hybrids made by crosses with red common carps in China

Hybrid	Parental combination
Feng common carp	Xingguo red common carp(♀); Scatter mirror carp(♂)
He-Yuang common carp	Purse red common carp(♀); Yuangjiang river carp(♂)
Yue common carp	Purse red common carp(♀); Xiangjiang river carp(♂)
Tri-hybridization carp	He-Yuang common carp(♀); Scatter mirror carp(♂)
Lotus common carp	Scatter mirror carp(♀); Xingguo red common carp(♂)
Allogynogenetic crucian carp	Fangzheng crucian carp(♀); Xingguo red common carp(♂)
Cold resistance strain of Purse red common carp	Helongjiang river carp(♀); Purse red common carp(♂)
Jian common carp	Purse red common carp(♀); Yuangjiang river carp(♂)

The listed hybrids have been certified as good varieties for aquaculture by the National Certification Committee on Wild and Bred Aquatic Varieties of China

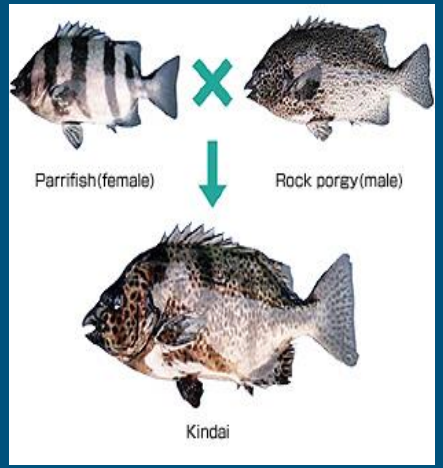


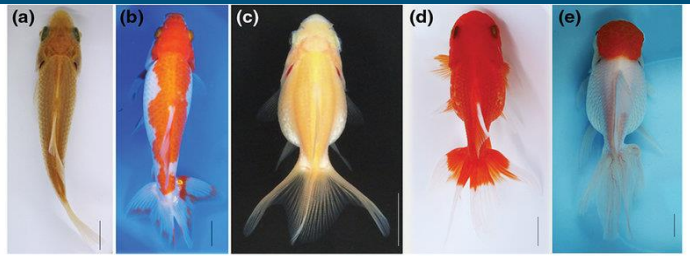
Fig. 4. Oujiang color common carp.

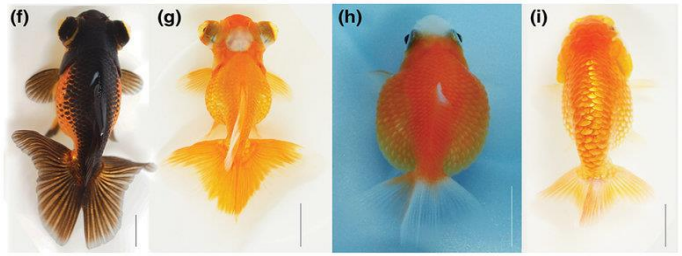
Fig. 1. Xingguo red common carp.

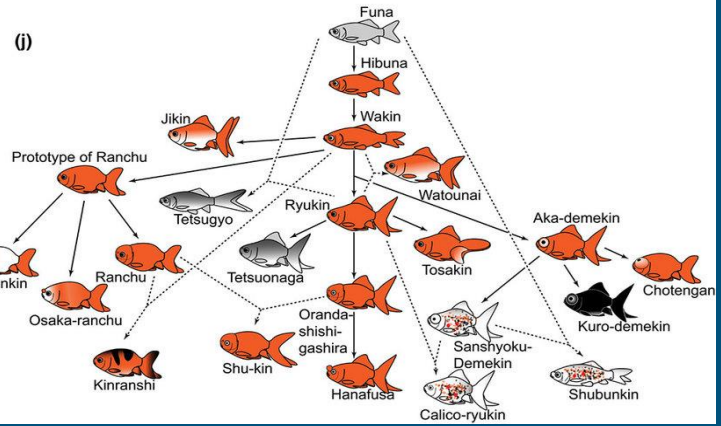
Fig. 2. Purse red common carp.

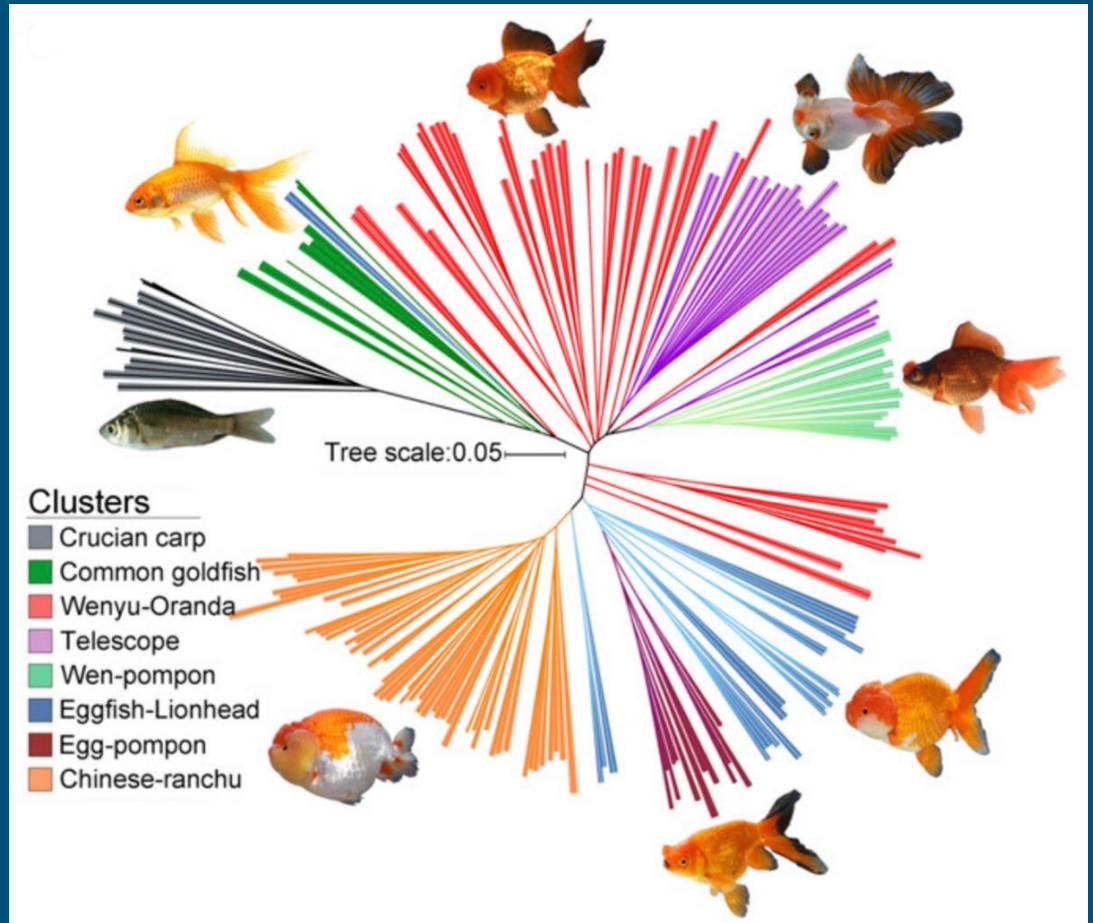
Naga, The ICLARM Quarterly (Vol. 24, Nos. 3 & 4) July-December 2001

Fig. 3. Glass red common carp.

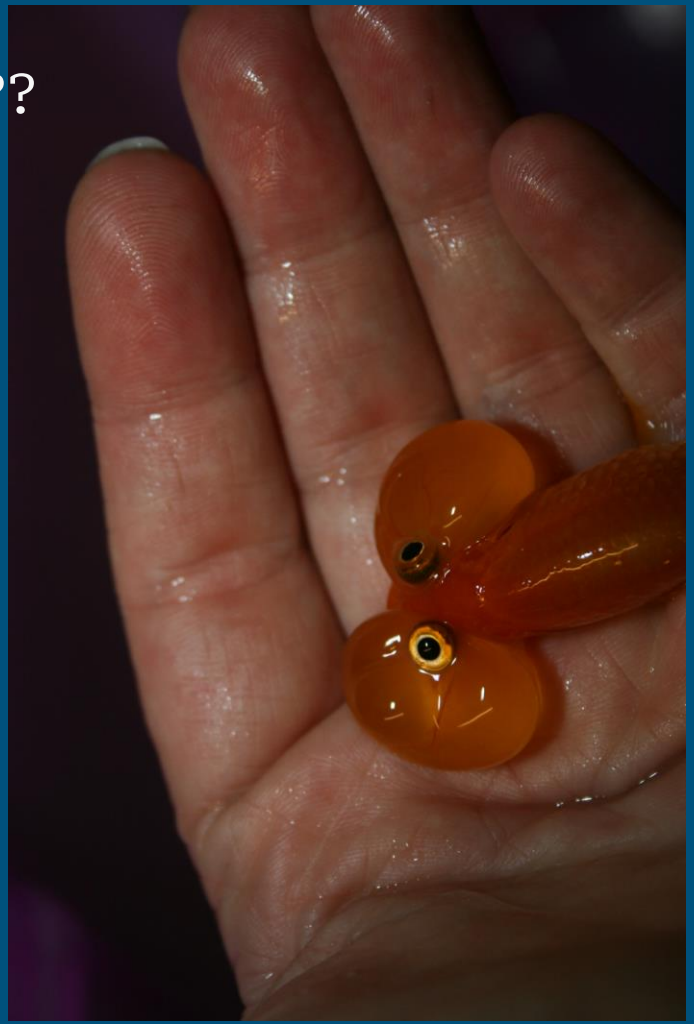

(a)
(b)
(c)
(d)
(e)


(f)
(g)
(h)
(i)

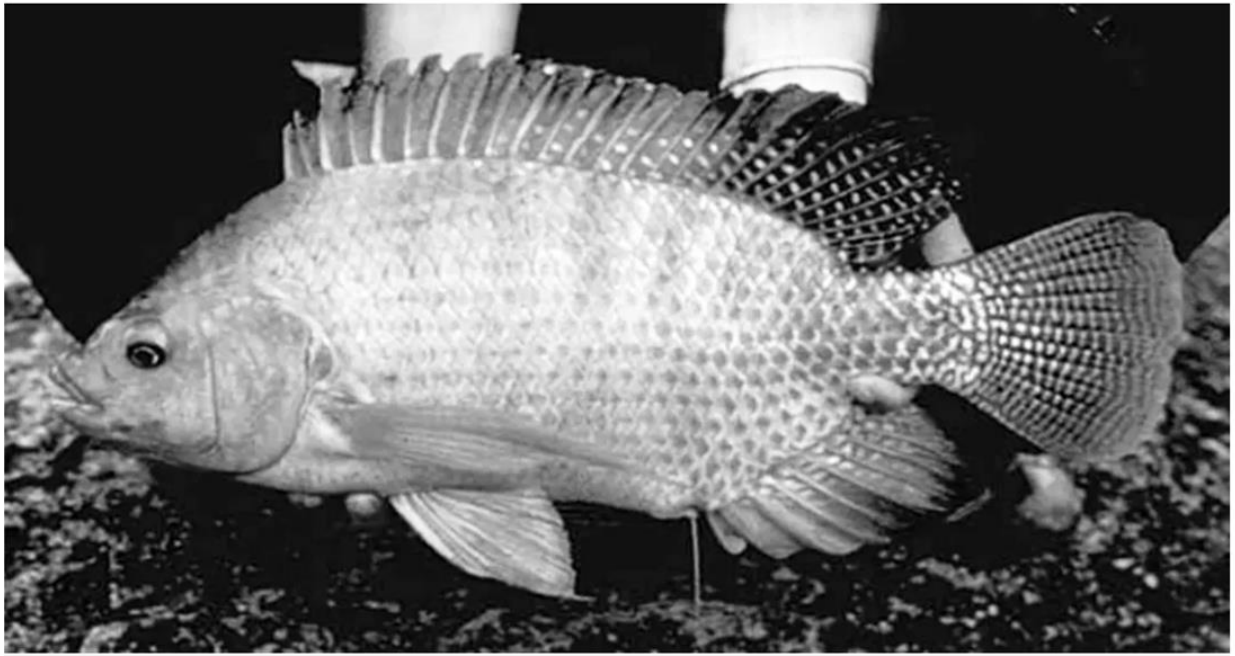

(j)
Funa
Hibuna
Wakin
Jikin
Prototype of Ranchu
Watounai
Tetsugyo
Ryukin
Aka-demekin
Nankin
Ranchu
Tetsuonaga
Tosakin
Chotengan
Osaka-ranchu
Oranda-shishi-gashira
Kuro-demekin
Sanshyoku-Demekin
Kinranshi
Shu-kin
Hanafusa
Shubunkin
Calico-ryukin


Tree scale:0.05
Clusters
Crucian carp
Common goldfish
Wenyu-Oranda
Telescope
Wen-pompon
Eggfish-Lionhead
Egg-pompon
Chinese-ranchu

A fancy goldfish ???



YY males grew best in water of low salinity

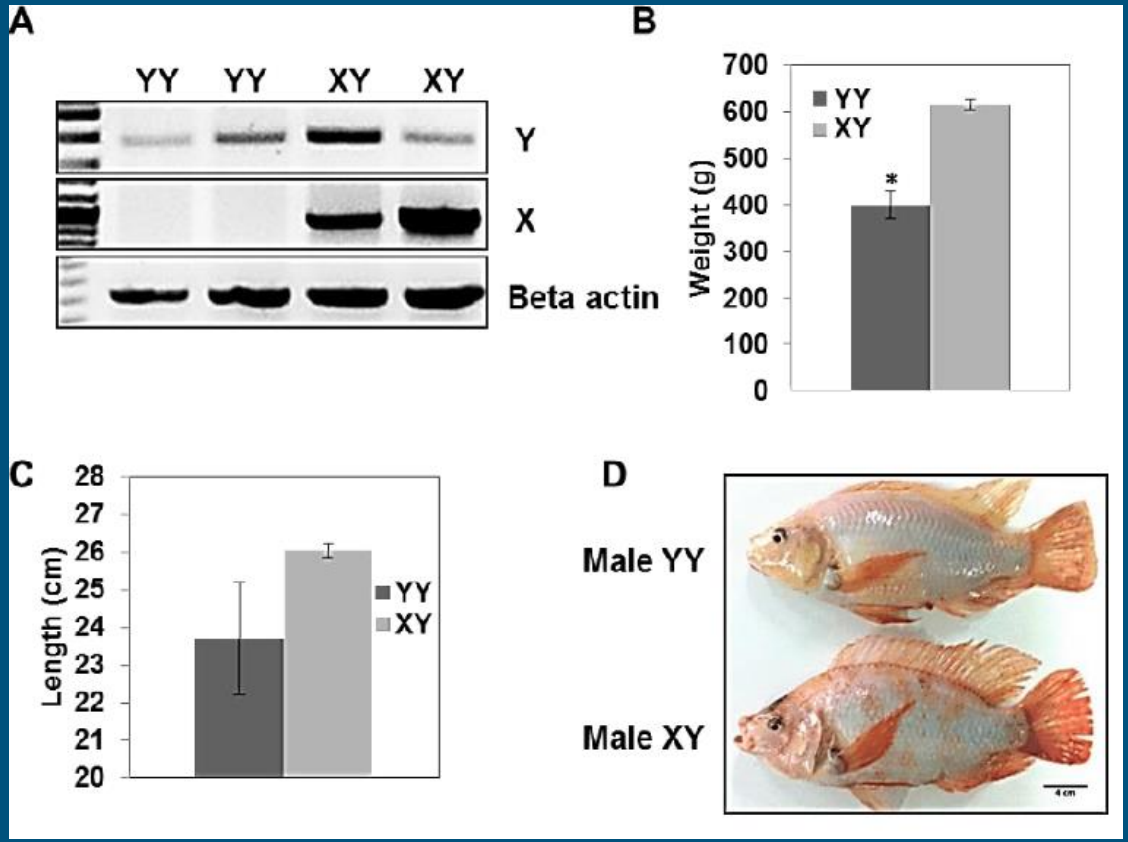


Super male (YY) Nile tilapia.

A great dilemma facing culturists of Nile tilapia (*Oreochromis niloticus)* has been the unwanted offspring that result from stocking mixed-sex seed in grow-out ponds and other culture units. The high reproductive success of the tilapia becomes evident as the ponds fill with young, but insufficient natural food does not support acceptable growth in the originally stocked fish. At harvest, the stunted fish are of low market value.

Published in 2017

YY super males have better spermatic quality than XY males in red tilapia Oreochromis niloticus



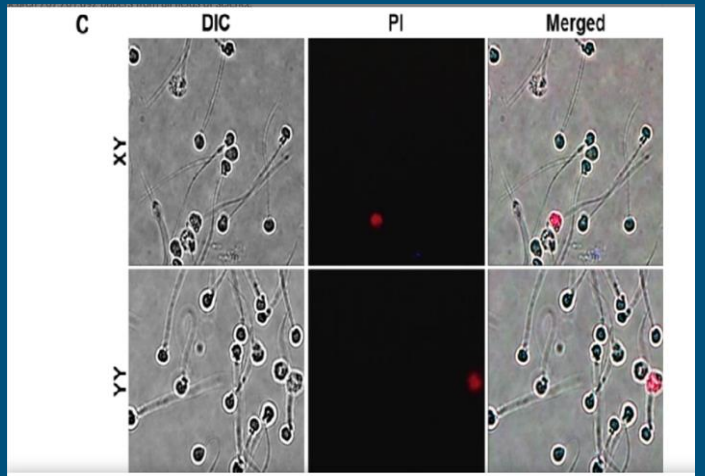


Figure 2. Spermatic quality of YY and XY males of Oreochromis niloticus red tilapia. A. Spermatic volume, mean ± SD (n = 20), $p < 0.05$ t test. B. Spermatic concentration, mean ± SD (n = 20), $p > 0.05$. C. Sperm viability... Expand

Published in 2017

YY super males have better spermatic quality than XY males in red tilapia Oreochromis niloticus

Aquaculture and Fisheries
(22ZOOME21)

Diseases and Ailments in Aquatic Species

About....

- ➔ Common diseases:
  - Bacterial diseases
  - Viral diseases
  - Protozoan diseases
  - Fungal diseases
  - Worm diseases and ectoparasites
- ➔ Control of fish diseases in farm ponds
  - Hygiene
  - Prophylaxis
  - Prevention of nutritional disease
  - Curative measures - individual fish treatment
  - Curative measures - fish stocks treatment
- ➔ Treatment/s
  - by immersion for external therapy
  - By drugs via food for internal therapy

Diseases and Ailments

- In fish farms certain conditions in fish causes serious conditions.
- It is unimportant in natural waters.

Causes / factors:

1. Density of fish - crowded population of same age group.

1. Wintering period - hibernation (weeks to months) - condition of susceptibility to parasites.

   Eg: Mass infestation occurs in a very large scale (Cyprinids).

1. Poor management - nursery ponds - bad planning and faulty practices.

1. Susceptibility in Tropical waters > temperate waters.

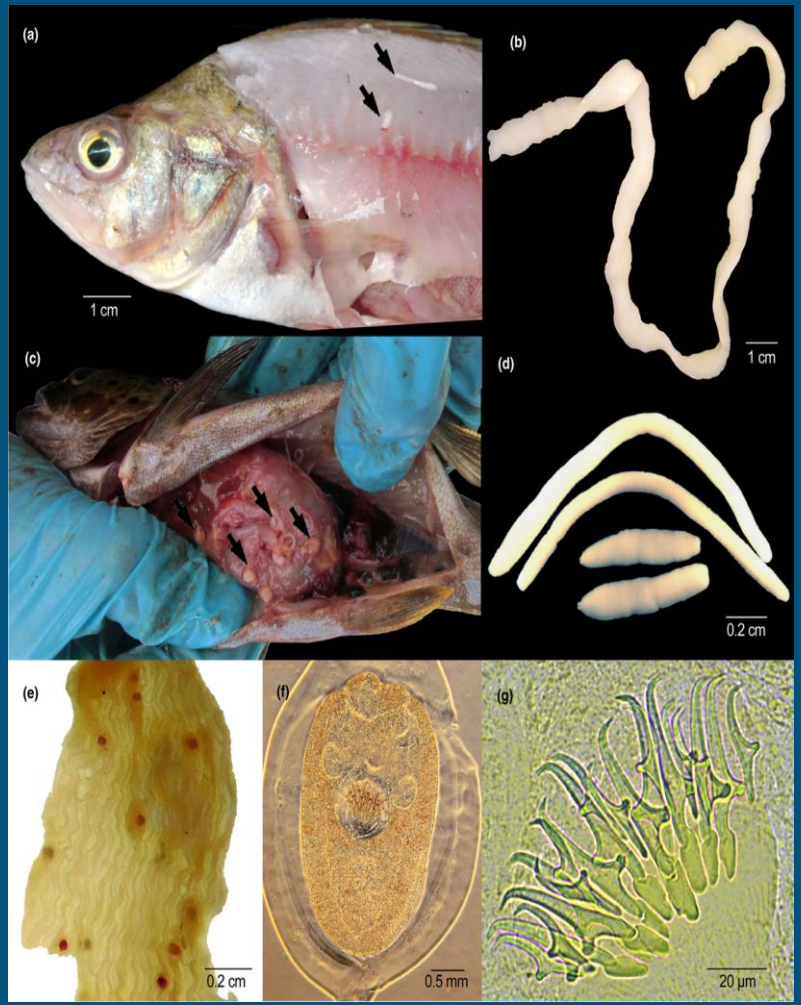
5. Oxygen depletion

6. Temperature fluctuation (abruptly)

7. pH alterations (extreme)

8. Introduction of new fishes into pond

9. Accidental introduction of Molluscs and plants (host for parasites)

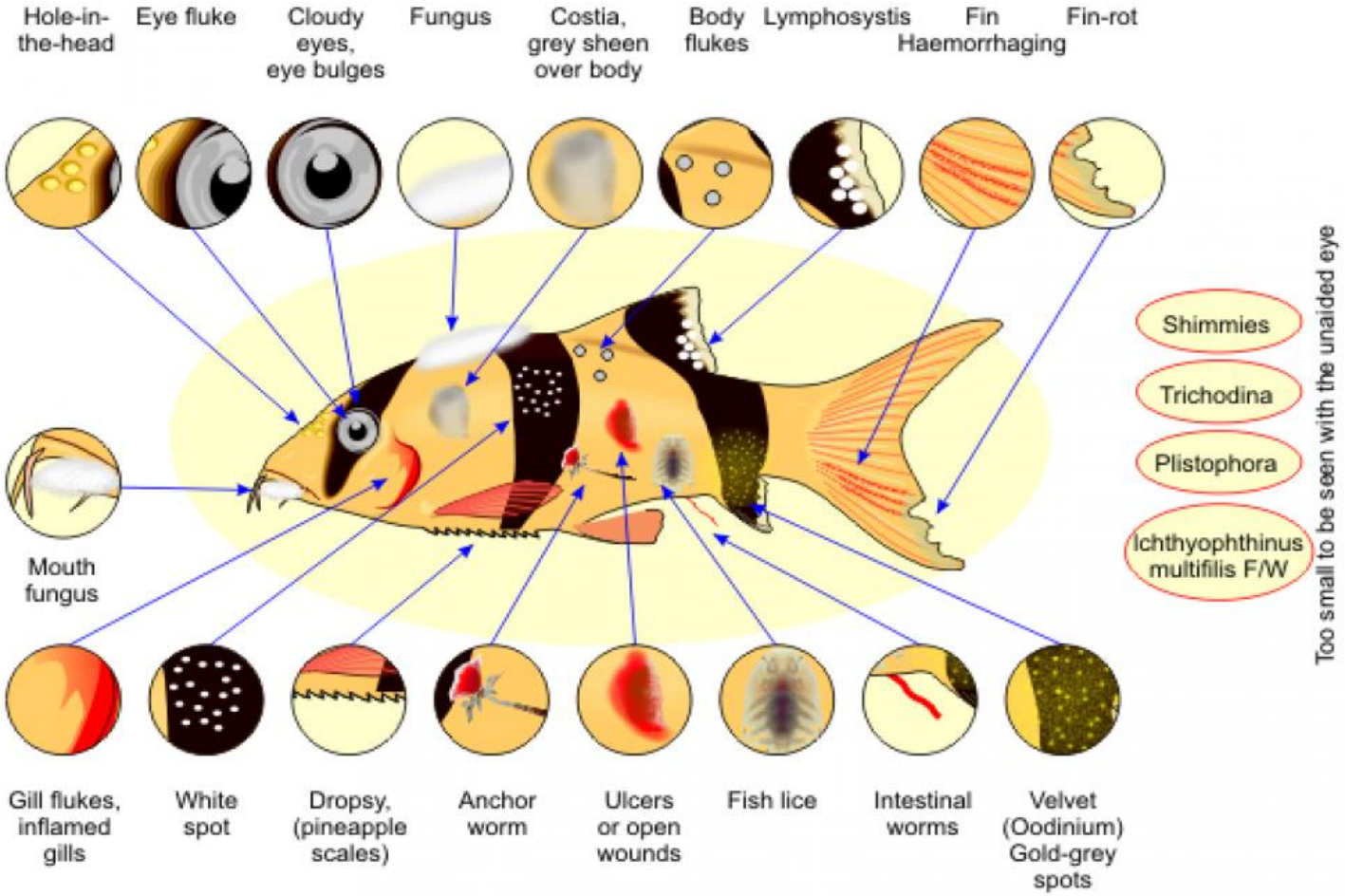


Sickness → Nutritional, environmental and parasitic in origin

- It develops a no. of ailments and diseases.

Common external symptoms:

1. Fish becomes restless
2. Balance loss
3. Lie on its side and may float or rest in bottom
4. Lack of vigour - tail and fins
5. Persisting discolouration
6. Pale gills
7. Body - slimy, grey excretions on skin



https://in.pinterest.com/pin/853924779318997622/

- Bacterial diseases
  1. Abdominal dropsy (Carps)
  2. Furunculosis (Salmons and trouts)
- Viral diseases
  1. Viral haemorrhagic septicaemia (VHS) - Rainbow trouts
  2. Infectious pancreatic necrosis (IPN)
  3. Spring viraemia of carp (SVC) / Dropsy of carps

- Protozoan diseases
  1. Costiasis
  2. Ichthyophthiriasis
  3. Ulceration / boil disease
  4. Sleeping sickness / trypanosomiasis
- Fungal diseases
  1. Dermatomycosis
  2. Gill rot of carps
  3. Saprolegniasis

- Worm diseases
  1. Flatworms (Trematodes)
  2. Tapeworms (Cestodes)
  3. Roundworms (Nematodes)
  4. Acanthocephalans

- Common ectoparasites (others)
  1. Fish lice
  2. Fish leech

- Bacterial diseases

1. Haemorrhagic septicemia - Reovirus, *Pseudomonas fluorescens*, *Aeromonas liquefaciens*.
2. Abdominal dropsy (Carps) - *Pseudomonas punctata, Aeromonas liquefaciens, Aeromonas hydrophilla*
3. Tropical ulcerative disease - *Aeromonas hydrophilla* (+ other combinations)
4. Vibriosis - *Vibrio anguillarum, Vibrio parahaemolyticus*
5. Gill rot - Myxococcus sp.
6. Enteritis - Aeromonas sp.
7. Gill hyperplasia syndrome - *Myxobacterial complex*
8. Edwardsiellosis - *Edwardsiella tarda*
9. Saddle back disease (COLUMNARIS) - *Flexibacter columnaris*
10. Erythroderm - *Pseudomonas fluorescens*
11. Furunculosis (Salmons and trouts) - Aeromonas sp.

- Fungal diseases
    1. Gill moult (rot) disease - Ichthyosporidium sp., *Branchiomyces sanguinis, Branchiomyces demigrans*
    2. Watermould disease - Saprolegniasis - Aphanomyces, Saprolegnia & Achlya

- Viral diseases
    1. IPNV - Infectious Pancreatic Necrosis Virus
    2. VHS - Viral Haemorrhagic Septicemia
    3. IHN - Infectious Haematopoetic Necrosis
    4. Carp pox

- Invasive diseases - Parasites
    1. Sanguinicola (Blood fluke) - Sanguinicola sp.
    2. Myxosporidiasis & Microsporidiasis - Myxobolus sp., Microsporidiae and Myxosporidia sp.
    3. Ichthyophthriasis (white spot disease) - *Ichthyophthrius multifilis*
    4. Trichodinasis & Trichodineliasis, Tripartiella & Glossatella - Trichodina sp., Trichodinella sp.
    5. Sinergasilosis - Sinergasilus (female), Ergasilus sp.
    6. Ergasilus - Ergasilids sp.
    7. Ligula (Tape worm) - *Ligula intestinalis*
    8. Eimeria cyprini - *Eimeria cyprini*, *Eimeria subepithelialis*
    9. Posthodiplostomus & Diplostomum (Digenetic trematodes) - Trematode sp.
    10. Argulosis - Argulus sp.
    11. Ichthyobodonecator - Ichthyobodo sp.
    12. Bothriocephalus - Bothriocepahalus sp.
    13. Learneasis (anchor worm) - Learnaea sp.
    14. Dactylogyrosis (Gill fluke) & Gyrodactylosis - Dactylogyrus & Gyrodactylus sp.
    15. Albinodermasis - —
    16. Cryptobiosis - *Cryptobiosis branchialis*