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Fecundity Variations Of Indian Major Carps Catla catla, Labeo rohita And Cirrhinus mrigala In Different Waters- A Research Analysis

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Abstract

Research on the fecundity variations of Catla Catla , Labeo Rohita and Cirrhinus Mrigala in different waters is crucial for understanding their reproductive biology and optimizing aqua culture practices. The paper focussed on the growth variations of eggs in different waters like canal water, Bore well Water and mixed water. Fecundity is defined as the capacity of an individual fish to produce ripe eggs in one spawning season. The appropriateness of any fish species for successful culture and seed production depends upon proper growth reproduction and it also needs strong management. The present study was conducted to investigate the fecundity (Egg laying capacity) of an Indian Major Carp, Female brood fishes were identified and collected from Government Fisheries department. Fishes were dissected out and fecundity was estimated by using standard technique and formula. The absolute fecundity was also determined of the selected fishes. Present study was conducted in three different waters like canal water, bore water and mixed water to analyze the status of and importance of three major carps Cirrihinus Mrigala, Labeo Rohita and Catla Catla.

Key words: Fecundity, Catla Catla, Labeo Rohita, Cirrhinus Mrigala, Indian major carps, Different waters

Introduction

Indian major carps (IMCs) are of great importance in freshwater aquaculture across the Indian subcontinent. Indian major carps are a cornerstone of India's aquaculture industry, supporting millions of livelihoods and contributing significantly to the country's food security.

Fecundity is defined as the capacity of an individual fish to produce ripe eggs in one spawning season. This must be known to assess the reproductive and commercial potential of a fish stock (Das et al., 1989). For efficient fish culture and effective management it is important to know the fecundity of fish (Mian and Dewan, 1984). Studies on fecundity and its relationship with various body parameters viz. total body weight, total length, ovary length and ovary weight are very useful and important in increasing the fish production, stock management and assessment in any water body (Das et al., 1989)

Fecundity is usually defined as the number of ripening eggs found in the female just prior to spawning. This contrasts with fertility which is the number of eggs shed. The fecundity of fishes as that of other animals is an adaptation which assures the survival of the species under the conditions in which originated and exists.

Large fecundity evolves under conditions of heavy mortality, particularly when this is due to predators, changes in individual fecundity are regulated by changes in the food supply. Faster growing individuals usually have a higher fecundity than slower growing ones of the same size (Bagenal,.T.B., 1978).
The species responds to changes in the environment by changes in its fecundity.
The number of eggs laid by various groups of fishes varies considerably ie from a few large eggs as in several sharks to three thousand millions of eggs in the ocean sunfish (Mola mola). On the whole, the fecundity of fishes is much higher than the terrestrial vertebrates.(Uma sharma and Grover 1982). The most fecund fishes are those which have floating as well as pelagic eggs. With respect to specific gravity, two egg types exists among ostiecthys, they are the buoyant of planktonic eggs, which is very common in marine fish families; and The non buoyant type, which is common in fresh water fishes, Fishes having protective devices for the eggs are usually provided with a low fecundity. The fecundity in marine fishes usually somewhat higher than those of fresh water or migratory fishes, The number of eggs contained in an ovary of a fish is termed as the individual, absolute or total fecundity, The fecundity differences can be observed in fishes of the same length if kept under different conditions. The substantial differences are observed in the fecundity between closely related species and even in the subspecies.

The increase in fecundity of fishes may arise from several factors.

- It may be due to the reduction of the passive feeding period which may be due to the decrease in the reserve of yolk in the egg. Therefore availability of food is also an important factor affecting reproduction.
- Increase in the density of yolk may cause increase in fecundity.
- Increase in volume of gonads also increases fecundity.
- Individual fecundity is also increased when the eggs present in the ovary ripen together at any time (Uma Sharma and Grover S.P 1982).
- Several environmental factors also effects on fecundity are believed to act through the food supply. For example ‘Hodder (1965) suggested that the fecundity differences of Grand banks haddock were associated with water temperature. The temperature itself does not directly affect fecundity. All the lake morphology factors were negatively correlated with fecundity. Food resources and growth were positively correlated with fecundity. Food resources and growth were positively correlated and population density was negatively correlated with the index of individual fecundity.

According to Jhingran V.G, (1983) Indian major carps are known for their high degree of fecundity. The eggs of Indian major carps like Catla, Rohu, Mrigal, are not floating type in nature. Round shaped, but they differs in diameter and yolk colour.

- In Catla egg size is 5.3 to 6.5mm and yolk is light red colored.
- In Rohu egg size is 5.0 mm and having red coloured yolk.
- In the case of Mrigal Egg size is 5.5mm and brownish coloured yolk present.

It is often thought that since fish weight is connected with the condition of fish, fecundity is more likely to be more closely correlated with weight than with length. More over, where the correlations have been analysed adequately very little advantage has been found in considering weight rather than length. This is shown by Bagenal (1957 a) and by Baxter and Hall (1960).
Perhaps more uncritical papers have been written about egg size and quality than any other aspect of fish fecundity. To start with, if the size of eggs are to be compared, they must be measured at the same developmental stage and this is impossible while they are in the ovary since they are developing fast.
They are, therefore best measured after fertilization, by which time is impossible to determine the fecundity by the usual methods. This difficulty is less with salmonids, or fish such as the herring or carp which lay adhesive eggs; and it is with these that the best work has been done. The first print to make is that in general large fish tend to lay larger eggs than do small fish. (Pope et al 1961) and Galkina (1970) found this with salmon. Therefore an attempt is made on this investigation to study the rate of fecundity of Indian major carps in different types of waters with varying nutrients.
It can be said that greater fecundity the more acute will be the intraspecific competition. It will lead to the extermination of the old forms and new species will emerge. An increase in the fecundity may leads to its own extermination this notion is not correct.
In fact an increase in the fecundity of an individual with in the population represented an adaptive response of the population to environmental changes. Outram et. al (1974) observed an egg density of 1000 eggs per square inch with the egg stock together in many layers.

EXPERIMENTAL FISHES

Phylum ----------Chordata
Sub.phylum---------- Vertebrata
Super Class ---------- Gnathostomata
Class----------Actionopterygii
Order ----------Cypriniformes
Series ------- ---------- Pisces
Division ----------Cyprini
Sub order -- Cyprinoidei
Family -- Cyprinidae
Subfamily - - Cyprininae;
Genus --- Catla/Labeo/Cirrhinus
Species -- Catla/Rohita/Mrigala.

CATLA

LABEO ROHITA

CIRRHINUS MRIGALA

Catla catla (Hamilton)

It is commonly called Catla in Assam, Bengal, Bihar and Uttarpradesh,Bhakur in Orissa, Thaila in the Punjab; Bocha in Andhra, Thoppameen in Madras and Karakatla in Malabar. Though it's natural distribution extends only to the Godavari river in Andhrapradesh, It is now common in the Krishna and the Cauvery rivers also. It is the fastest growing carp in India.

A characteristically deep body with conspicuous head, large upturned mouth, non-fringed lips devoid of barbels, and a broad dorsal fin with 14 to 16 branched rays distinguish the adult fish and advanced fingerlings. The body is ordinarily dull, silver white, but tends to be rather darkish in weedy waters. The fry, from half to one inch in size, are distinguished by the relatively large head with reddish gills; broad dorsal fin with a greyish margin and the rather pale body Colour owing to a scarcity of pigment spots.

Catla is a surface feeder and its upturned mouth and the large gill rakers are adapted to feeding on the numerous organisms floating in water. Submerged aquatic weeds are not of any value as food for Catla, and in ponds with an overgrowth of submerged weeds it's growth is generally unsatisfactory.

Young ones, from the time they begin feeding until they reach a length of about 15 to 20 millimetres, feed almost exclusively on water fleas and other animal Cules in the water. After that stage they are probably capable of making use also of the microscopic plants floating in the water, though at all stages. water fleas and other animal Cules in the water Constitute an important item of food.

Catla reported to grow very quick. even up to three to four inches per month. This phenomenal growth may often be due to extreme and perhaps uneconomical, under stocking in virgin waters. In normally stocked waters, a growth of 15 to 18 inches in the first year can ordinarily be expected. Catla grows to over four feet in length.

It under stood, Catla grows to over 20 inches in length in the first year, however, attain sexual maturity at that age. Fish in the second year are Ordinarily sexually ripe. Specimens 22 months old measuring 18 inches in total length and weighting about 3 pounds have been observed in ponds with the ovaries almost ripe in June. They are, therefore, ready to breed in the third season after hatching.

Catla breeds in rivers during the rainy months of June to August. It does not breed in ordinary ponds, though in certain ponds in Bengal and Bihar, known &s bundh type tanks closely akin to the minor irrigation tanks of South India, is Known to breed during the South-West monsoon after sudden heavy rains. Early fry are available in large numbers during June-July in Assam, Bengal,and Bihar and during July-August in Orissa, the Panjab and Andhra pradesh and are Collected in millions and stocked in nursery ponds.

Labeo rohita (Hamilton)

Labeo rohita is a member of the Indian major carp species and originally an inhabitant of the Ganga river network in India. It is among the top ten aquaculture species of the world.

Rohu (*Labeo rohita*) is the most important among the three Indian major carp species used in carp polyculture systems. This graceful Indo-Gangetic riverside species is the natural inhabitant of the riverine system of northern and central India, Bangladesh and Myanmar. In India, it has been transplanted into almost all riverine systems including the freshwaters of Andaman, where its population has successfully established. The species has also been introduced in many other countries, including Sri Lanka, the former USSR, Japan, China, the Philippines, Malaysia, Nepal and some countries of Africa. The traditional culture of this carp goes back hundreds of years in the small ponds of the eastern Indian states. Information on its culture is available only from the early part of the 20th century. The compatibility of rohu with other carps like Catla (*Catla catla*) and mrigal (*Cirrhinus mrigala*) made it an ideal candidate for carp polyculture systems. While riverine collection of seed was solely meeting the requirement for culture of the species until the first half of the 20th century, the success in induced breeding in 1957 and the assured seed supply thereafter was the major factor for the development of its culture in freshwater ponds and tanks. Its high growth potential, coupled with high consumer preference, have established rohu as the most important freshwater species cultured in India, Bangladesh and other adjacent countries in the region. Considering its importance in the culture system, emphasis has also been given to its genetic improvement through selective breeding in India.
Labeo Rohita is very quick-growing carp, with almost the same natural distribution as Catla and considered a tastier fish than any other Indian carp.

Cirrhinus mrigala (Hamilton)
Another important major carp is Cirrhinus mrigala, This is also a best fish for cultural purposes. It is the common carp in the major river systems as far South as the Godavari. Locally called Mori in the Punjab, Naini in Uttar Pradesh and Bihar; Mrigal in Bengal and Assam, Mirikali in Orissa and Rerrameen in Andhra, It is easily distinguished by the relatively linear body, small head with rather blunt snout, terminal mouth with thin non-fringed lips, bright silvery body and reedish fins. The dorsal fin has 12 to 13 branched rays. The young ones,3/4 to one inch long, are distinguished by their rather blunt snout, thin lips, and a rather small, somewhat diamond, shaped dark spot at the base of the tail, besides the faint greenish tinge on the dorsal aspect of the body. In slightly larger specimens, the scales at the sides of the body have their edges pigmented dark. The fins also become reddish. Mrigal appears to be a bottom feeder, though the young ones, as soon as they commence feeding, have the same feeding habits as those of Catla and Rohu. The fingerlings and adults take in relatively larger quantities of decaying organic and vegetable debris, phytoplankton organisms and sand and mud than in the case of Rohu. The proportion of animal matter in the diet Is generally poor.
The thin terminal lips are adopted to picking up things from the mud and from the invariable presence of appreciable quantities of sand and mud in the gut, it is presumed that algae in the fresh or decaying condition are also picked up from the bottom, Mrigal grows slower than Catla or Rohu. In a pond stocked at the rate of about 6,000 fingerlings per acre, an average size of eight inches may be attained within eight months. if the stocking is thinner, quicker growth may be expected. The species attains a length of over three feet. Mrigal becomes sexually mature only when about two years old. Fingerlings, however much grown in the first year, do not attain maturity, but second year fish (third season from hatching) become sexually ripe, even if stunted in growth. Mrigal breeds in rivers during the rainy months of June to August.

Different types of fresh waters selected:
The study involves a comparative account on the productivity of major carps in different types of freshwaters like
1. Canal water
2. Bore Water
3. Bore water mixed with black cotton soil

Physico- chemical Analysis of Three Different Fresh Waters

S.NO	Name of the Factor	Canal Water	Bore Water	Bore water mixed with Black cotton Soil
1	Temperature	27 ^{0} C	27 ^{0} C	27 ^{0} C
2	Colour	Brown	Clear	Black
3	Turbidity	Medium	No turbidity	High
4	Light (Penetration)	Medium	High	Low
5	Planktons	High	Low	High
6	~~pH~~	7.2-7.4	8.5-9.0	7.5-8.0
7	Oxygen	0.8526 ml/lit	0.2842 ml/lt	0.2842 ml/lt

8	Carbon dioxide	0.880 ml/lit	0.890 ml/lit	0.880 ml/lit
9	Salinity	0.6382%	1.045%	1.045%
10	Conductance	$0.324x10^{3}$ Ohm^{-1} Cm^{-1}	$0.66x10^{-3}$ Ohm^{-1} Cm^{-1}	$0.672x10^{-3}$ Ohm^{-1} Cm^{-1}
11	Calcium	0.2004 mg/lit	0.5611 mg/lit	0.6413 mg/lit
12	Magnesium	0.0972 mg/lit	0.1459 mg/lit	0.2918 mg/lit
13	Nitrogen	1.60 mg/lit	1.25 mg/lit	3.65 mg/lit
14	Phosphorus	0.40 mg/lit	0.32 mg/lit	0.96 mg/lit
15	Organic matter	1040 mg/lit	900 mg/lit	1780 mg/lit

Methods & Materials

Fecundity, which represents the number of eggs released from a breeder is calculated in the following way. Before conduction of breeding experiment the female Weight is noted with the help of single pan balance in all the 3 major carps like Catla, Rohu, and Mrigal separately. After release the eggs the weight is noted again, the difference in the weight indicates the mass of eggs released. Three different waters used for this study is Canal water, Bore well water and mixed water. This is converted into rate and % fecundity.

Rate of Fecundity= W1-W2

Where W1= weight of the female before releasing eggs.

Where W2 = weight of the female after releasing eggs.

From the mass of eggs released, the number of eggs counted by transferring in to a 10ml measuring cylinder without water accounts eggs. The rate of fecundity is calculated by dividing the number of egg released with weight of the fish.

The % fecundity is calculated by using the following formula

% Fecundity =Number of Eggs released/ Weight of Fish X 100

Table-1: Rate of Fecundity (No. Of Eggs produced/1 kg of Fish) in Indian major Carps in three different waters each value is the mean of six individual counting's

S.NO	Indian Major Corp	Canal Water	Bore Water	Mixed Water
1	**Catla**			
	Mean	62450	55630	66345
	SD $^{+}$-	30.2	25.1	33.0
	t-test	------	P< 0.001	P< 0.001
2	**Rohu**			
	Mean	69450	64900	81150
	SD $^{+}$-	34	31	29
	t-test	--------	P< 0.001	P< 0.001
3	**Mrigal**			
	Mean	65150	60280	71145
	SD $^{+}$-	32	28	27
	t-test	---------	P< 0.001	P< 0.001

Table-2: Percentage of Egg production in Indian major Carps in three different waters Each value is mean of six individual counting's

S.NO	Indian major Carp	Canal Water	Bore Water	Mixed water
1	Catla	62.4	55.6	66.3
2	Rohu	69.4	64.0	81.1
3	Mrigal	65.1	60.2	71.1

The Differences are found to be highly significant (P< 0.001)

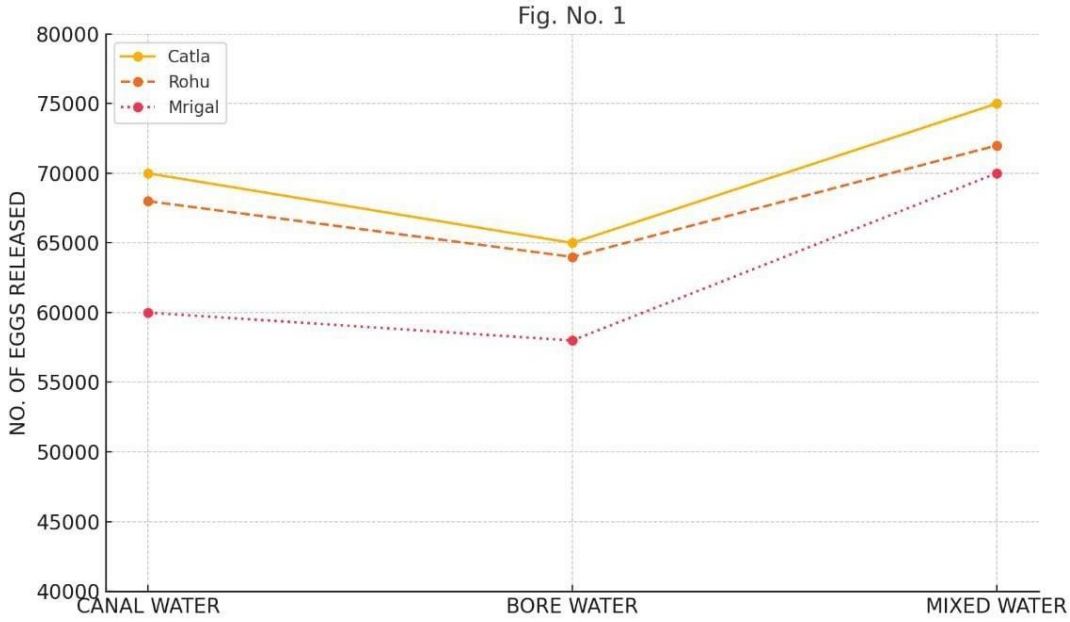

Figure: 1 Rate of fecundity (No of eggs released/1Kg of fish) in Indian major carps, Catla catla, Labeo rohita & Cirrhinus mrigala in different waters like canal water Bore water & mixed water (Bore water mixed with black cotton soil). Each point is mean of 6 individual countings.

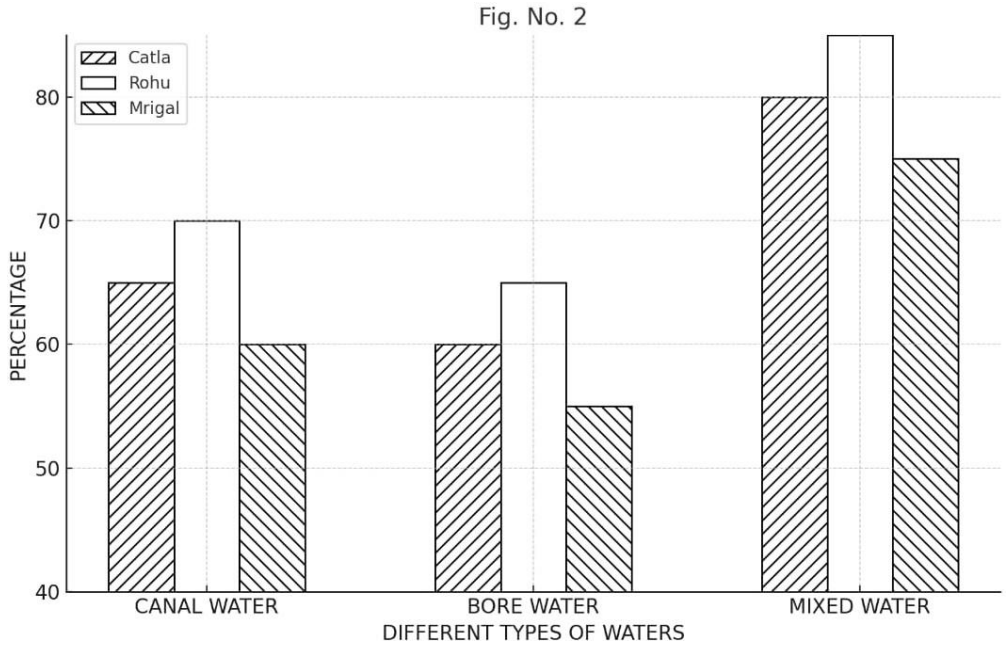

Figure: 2 Figure 2 showing percentage of egg production in three Indian major carps in different waters. Each value is a mean of 6 individual countings.

Results and Discussion:

Fecundity which represents the number of ripening eggs found in the female. This directly gives an indication the rate of fertility in any organism including fishes. The results of the present investigation on the rate of fecundity shows that the Rohu exhibited the highest rate of fecundity the least by Catla with an intermediate rate in Mrigal (Table No.1, Fig.No:1). Therefore the percentage of fecundity in different types of waters is found to be from 64.9% to 81.1% for Rohu, 60.2% to 71.1% for Mrigal and 55.6% to 66.3% for Catla (Table No.2,Fig.No.2). On the other hand amongst the three different types of waters in all the species of major carps

the rate of fecundity is found to be maximum in Bore water mixed with black cotton soil followed by Canal and Bore well waters.

These differences among the three varieties of carps which are found to be significant ($P<0.001$) may be attributed to the nature of the growth and food habits of major carps, in that Rohu is very quick growing carp followed by Mrigal and Catla as also suggested by Alikunhi (1957). Further Rohu is a column feeder Capable of engulfing variety of food available in the greater portion of the Water. With its rather anterior fringle-lipped mouth is well adapted to browsing on shallow pond bottoms also now and then, The second highest rate of fecundity is noticed in Mrigal, in which case considerable quantities of bottom sand or Mud, vegetable debris or decaying leaves of aquatic plants, planktonic algae etc.

Constitute the stomach contents. Whereas water fleas and other animalcules are only found among the food items consumed by the surface feeder Catla. Added to this, water temperature at different levels surface, column and bottom might have influence the rate of fecundity. Thus the surface feeder Catla might have experienced a high temperature, Mrigal being the bottom feeder a low temperature, when Compare to the column feeder Rohu which must have been enjoy an ideal and favourable water temperature in the middle of the pond. In this context it is apt and appropriate to state the interesting observations made by Hodder (1965) where several environmental factors also effects on fecundity are believed to act through the food supply. More specifically the fecundity differences of "Grand banks haddock" were associated with water temperature.

The rate of fecundity also varied depending upon the type of water used in this investigation as media for breeding the findings indicate that the mixed water that is Bore water mixed with black cotton soil recorded the highest rate of fecundity followed by canal and Bore water in all the species of major carps like Catla, Rohu, and Mrigal. This might be due to high degree of nutrients and alkalinity in mixed water and lowest level of same in the underground bore water.
This observations are supported by the facts that the water on acid soil is generally less productive than that on alkaline soils as suggested by Alkunhi(1960). Further the mixed water that is Bore water mixed with black cotton soil with a high degree of turbidity with more suspended particles might have adsorb considerable amount of nutrient elements like phosphates, Potassium and nitrogen to enhance the nutritional status to produce more Planktons the micro food for fishes. The findings also coincide with the chemical nature of different types of water.

This plank tonic blooms are known to Produce more oxygen in the water to increase the overall metabolic activities including the breeding and the fecundity of fishes. The reproductive capacity of fish is also influenced by pH of water. In the present investigation pH of mixed water of 7.5-8.0 recorded the highest rate of fecundity rate in all three major carps and the fecundity relatively decrease at pH of 7.2-7.4 canal water and PH of 8.5-9.0 of Bore water. This decrease in fecundity is more in the Bore water which is somewhat more alkaline than the canal water. This is justifiable in the light of work done by Swingle (1967a) where the waters having a pH range of 6.5-9.0 as recorded before day-break are more Suitable for fish culture in Ponds and those having pH values of more than 9.5 as unsuitable, in the later Coo is not available. Fish dies at about PH 11.
Thus waters reaching towards more acidic nature and waters with high alkalinity are found to be not suitable for breeding of major carps. But a pH with the range 7.5 to 8.0 is found to be optimum pH with maximum breeding capacity in all the species of major carps Catla, Rohu, and Mrigal. Most probably acid waters seduce the appetite of the fish their growth and tolerance to toxic substances as reported by Swingle (1967a),

Conclusion

Thus the three Indian major carps, catla *(Catla catla),* rohu *(Labeo rohita)* and mirgal (Cirrhinus mrigala *)* are the main components incomposite fish farming in India Although some exotic major carps are also found and are well adopted to Indian water. Hence the carps appear to be of considerable importance to freshwater aquaculture in India. In conclusion, the Indian major carps play a pivotal role in India's aquaculture industry and have significant economic, nutritional , and cultural importance. The paper concluded that mixed water i.e, Bore water mixed with black cotton soil is more suitable for fish culture especially for the culture of Indian Major Carps Catla catla,Labeo rohita and Cirrhinus mrigala and this study on Fecundity variations in Indian Major carps in different types of waters is more useful for Fisheries and Fish farmers.

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