A Study on Water Quality in Relation to Length-Weight Relationship and Relative Condition Factor of Two Fresh Water Fishes- Labeo rohita and Oreochromis niloticus in Krishna Raja Sagara Reservoir

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Abstract

Fish being the cheapest source of protein, the population explosion and economic pressure demands increase in fish yield. Since biotic and abiotic factors have influence on growth and well-being of fish, there is a need to continuously monitor the fish culture water bodies for physico-chemical water quality parameters and presence of pollutants. This work shows the allometric growth (cube rule) and well-being of two fresh water fishes *Labeo rohita* and *Oreochromis niloticus* and whether or not the deviation if any from cube rule is accompanied by altered water quality required for fish culture.

This study reveals that majority of the physico-chemical water quality parameters namely temperature, pH, turbidity, conductivity, DO, BOD, TSS and phosphate were within the optimal range for fish culture, whereas nitrate levels were higher than the desired levels. These results indicate near normal growth and well-being in *L. rohita* as well as in *O. niloticus* in the prevailing environmental conditions in the KRS reservoir.

Keywords: Labeo rohita 1, Oreochromis niloticus 2, allometric growth 3

Introduction

A large number of ponds, lakes and reservoirs are used for culture of mainly Indian major carps and few other species of fishes. As fish being rich source of proteins and vitamins, demands also increases. While culturing fishes, biotic and abiotic factors needs to be monitored for well growth of fishes. Some of the factors when present beyond tolerable range to fish might be stressful to fish and adversely affect their growth and reproduction (Iwama *et. al.*, 2000). Hence there is a need to look into methods of Pisciculture on one hand and assessment of water quality of culture area on the other to provide optimum conditions for fish growth and there by enhance fish yield.

L. rohita is a species of fish of the carp family, found in rivers in South Asia. It is an omnivore. It is a non-oily and white fish in Nepal and India. It is diurnal and generally solitary. It reaches sexual maturity between two and five years. In nature, it spawns in the marginal areas of flooded rivers. It is an important aquaculture freshwater species in South Asia. When cultured, it does not breed in lake ecosystems, so induced spawning becomes necessary. *Labeo rohita* is the most important among 3 Indian major carps. It has very high food value and commercial importance; it is highly liked for its taste flavor.

Oreochromis niloticus commonly called as tilapia, even this is also much preferred as food fish for its taste. *O. niloticus* is the fresh water fish which show vigorous growth in all type of water bodies and in almost all type of prevailing environmental conditions, it is not much affected by varying water quality parameters, hence we are considering this fish for comparing its growth with that of one of the major carp *L. rohita* in our study.

One of the most important parameters of physiology is "growth". Growth means a change in length or weight or both with increasing age. Increasing in size is due to conversion of the food matter into the building matter of the body by the process of nutrition. Different fishes grow with different rates depending upon their genetic makeup, and food resources available and the environmental conditions in which they live and grow.

The allometric growth in fishes is explained by cube rule, which states that "the weight is three times the length of fish". This relationship is known as length-weight relationship in fish and was put forth by Le'Cren (1951) supersized a logarithmic form of this equation for practical purposes. Hence, fish growth can be assessed by determining L-W relationship, i. e.

$$\mathbf{W=aL^b}$$

Where, a=constant, b=exponent (growth coefficient),

L=length, W=weight of the fish.

A deviation from the cube rule either due to the fluctuations in reservoir or physiological conditions of fish (Sinha, 1973; Dasgupta, 1988 and Kaur, 2000) is reported. In the L-W equation, 'b' (growth coefficient) value >3 indicates isometric growth, whereas the value of 'b' <3 indicates a subnormal growth (Tesch, 1968). The subnormal growth may be due to prevailing condition in the water body, as suggested by Iwama *et. al.* (2000).

Number of studies have reported a positive allometric growth (i. e., b=3 or > 3) as well as subnormal growth (i. e., b < 3) in Indian water bodies as well as outside. A few studies are cited here. A positive allometric growth. (b> 3) was found *in Catla catla*, *Labeo rohita* and *cirrhina mrigala* in different rivers of India (Jhingran, 1952) and fish breeding centers and reservoirs (Mohan and Shankaran, 1988); *Ompok bimaculatus* in Bhavani sagar reservoir in Tamil Nadu (Siwakami, 1987); *Hypopthamichthys molithorix in* ponds of Guwahati (Pathak and Singh, 2001); *chocolate mahascer, Neolissocheilus hexagonolepis* in shally lake, (Laskar *et.al.*, 2005); *Acipenser fulvescens* in St. Clair River system, Michigan (Craia, *et. al.*, 2005); *Rhinomugil corsula* in Inland water bodies of Bangladesh (Mortuza *et. al.*, 2006).

On the other hand, some studies have reported a negative allometric as shown by b<3, in *Tilapia nilotica* in lake mariut, Egypt (Botros, 1970*); C. mrigala* at fish breeding center and reservoir of Malampuzha, (Mohan and Shankar, 1988); and in the pond of Jabalpur (Solanki *et. al.*, 2004); *Puntius Sarana sarana, L.boggut*, *Garna gotyla* and *Notopterus notopterus* in Bhosga reservoir (Patil and Kulkarni, 1997); *L. rohita*, *C. catla* and *Stenopharyngodon iddlla* in ponds of Guwahati, (Patgiri, 2001); *C. catla*, *L.rohita* and *N. notopterus* in the ponds of Satna (Pathak and Singh., 2001); *Lepidocehalicthys guntia* in lake of Morang (Dhakal *et. al.*, 2003); *C. catla* and *L. rohita* in yennehole lake in Mysore (Sachidanandhamurthy, 2006).

Though deviation from cube rule is reported in many studies, the possible factors for suboptimal growth have not been investigated in all studies, unless a study on water quality along with fish growth parameters is conducted it is not possible to establish whether prevailing conditions or optimal or not for fish growth. Hence, there is a need to conduct studies on fish growth and water quality in fish culture bodies, which will be useful in undertaking appropriate measures for proper utilization of the natural resources. Though there are number of independent studies on water quality, fish growth parameters, attempts were not made to conduct a combined study to assess the water quality and fish growth except for a comparative study of two lakes in Mysuru city (Sachidanandhamurthy, 2006); and a study of two major carps in the kukkarahalli tank in Mysuru city (Mahadevaswamy, 2008). Hence the present investigation was carried out on two species of fishes *L. rohita* and *O. niloticus* in the KRS reservoir.

Materials and methods

Collection of water sample

Water samples for the study of physico-chemical water quality parameters were collected from different sites of Krishna Raja Sagara dam. These sites represent different regions of the reservoir. Water samples were collected between 7-8 am early in the morning from different sampling sites in 5-liter polythene jerry cans by the help of fishermen while the process of catching the fishes from the reservoir. The water samples were collected fortnightly for 4 times. Subsurface water samples were collected by immersing cans in the water.

Temperature (water and air) was recorded at the time of water collection. For the determination of dissolved oxygen (DO) content, water sample was fixed in field and was brought to the laboratory for further analysis. Other parameters viz., pH, conductivity, turbidity, total suspended solids, phosphates and nitrates were determined in the laboratory separately for different samples collected.

Collection of Fish Samples

Fish samples were collected fortnightly for 4 times from February to April 2015 for a period of two months along with the water samples. Gillnets were used by the fishermen to collect the fish. During every collection 60 specimens 0f *L. rohita* and *O. niloticus* were picked randomly from the lot collected by fishermen.

Weight and length of each specimen were recorded in the field in fresh condition. The length was measured using measuring tape to the nearest of centimeter. Each fish was weighed using a digital weighing balance.

Estimation of different physico-chemical water quality parameters:

Color: Color of the water was judged by visual observation

Odor: Odor of the water was detected by smell emitting near the water body and smell emitted by collected water samples.

Temperature: Temperature of subsurface water and air temperature was recorded using mercury thermometer at a sampling site

P^H: pH was determined with the aid of digital pH meter equipped with a calomel electrode.

Turbidity: Turbidity was recorded using Nephlometer

Conductivity: The conductivity was determined by using conductivity meter

TSS (Total suspended solids): Evaporation method

Total suspended solids mg/L= $(W_1 - W_2) \times 1000$ / Sample volume (ml)
Where, $W_{1=}$weight of dried glass fiber filter and residue,
$W_{2=}$weight of glass fiber disk before filtering

Dissolved Oxygen (DO): Winkler's method:

Biochemical Oxygen Demand (BOD):
The water samples were artificially aerated, each sample was filled in 2 BOD bottles, and 1 bottle was kept in BOD incubator for 5 days at 20°C. The DO content in another bottle was determined immediately in the laboratory by Winkler's method and it was initial DO. The DO content of the incubated sample was determined using same procedure, after 5 days of incubation, and that was final DO. BOD was calculated using the formula,

BOD, mg/L = $(D_o - D_5)$ X Dilution factor
Where, Do = initial DO.
D_5 = DO after 5 days of incubation

Nitrate: Brucine sulphate method
Phosphate: Stannous chloride method

Assessment of fish growth and wellbeing
Length – weight relationship (L-W relationship):
The length and weight of the fish were recorded in field itself with the help of measuring tape and hanging spring scale balance respectively. Length and weight of 60 individuals of L. rohita and O.niloticus were recorded 4 times with fortnight intervals. The length-weight relationship was computed for each species fortnightly. L-W relationship was determined using allometric growth equation proposed by Huxley (1924), which is shown below;

W= a Lb
Where, W = weight of fish,
L = length of fish
a = constant,
b = exponent or growth co-efficient (constant).

The values of 'a' and 'b' were calculated empirically from observed length and weight.

$a = \overline{y} - b\,\overline{x}$
$b = \Sigma x y - n\,\overline{x}\,\overline{y} / \Sigma x2 - n (\overline{x}) 2$
Where, n= total number of length groups,
$\overline{x}$ = mean of x (length), $\overline{y}$ = mean of y (weight).

Le' Cren (1951) suggested a logarithmic form of this equation which is used for practical purpose, Log W = Log a + b Log L
Where, W = weight of the fish,
L = length of the fish,
a = constant,
b = exponent or growth co-efficient (constant).

Assessment of well-being of fish (computation of relative condition factor, Kn):
Another parameter, Relative condition factor (Kn) is used to assess well-being of a fish in the given env-

ironmental condition. Kn for each fish species is calculated by employing the following formula,
Kn = Wo / Wc
Where, Kn = relative condition factor, Wo = observed weight,
Wc = calculated weight.
Wc = is determined by using L-W relationship equation,
Log W = Log a + b Log L
Where, W = weight to be computed (i. e. Wc),
L = observed length,
a and b are the constants.
O. niloticus were divided into 13 length groups and L. rohita were divided into 4 length groups and Kn values of each length group was determined out of four fish collections.

Results and Discussion

Estimation of different Physico-chemical water quality parameters:

Table 1: Physico-chemical water quality parameters of KRS reservoir during the study period:

Parameters	I Collection (26-2-15)	II Collection (12-3-15)	III Collection (26-3-15)	IV Collection (10-4-15)	Mean±SE
Colour	Blue	Blue	Blue	Blue	-
Odour	Odourless	Odourless	Odourless	Odourless	-
Temperature Water	20ºc	20ºc	22ºc	23ºc	21.25±10.62
Air	23ºc	22ºc	24ºc	27ºc	24±12
pH	8	8.4	8.7	9	8.52±4.26
Conductivity	6.59 m/S	7.70 m/S	8.40 m/S	14.60m/S	9.32±4.66
Turbidity	10 NTU	10 NTU	12 NTU	30NTU	15.5±7.75
DO	5.632Mg/L	5.732 Mg/L	6.734 Mg/L	6.924 Mg/L	6.25±3.12
BOD	0.68 Mg/L	1.74 Mg/L	1.92 Mg/L	2.01 Mg/L	1.58±0.79
Phosphate	0.06 Mg/L	0.08 Mg/L	0.04 Mg/L	0.07 Mg/L	0.06±0.03
Nitrate	0.53 Mg/L	0.71 Mg/L	0.62 Mg/L	0.6 Mg/L	0.61±0.30
TSS	10mg/l	20 mg/l	10 mg/l	30 mg/l	17.5±8.75

Estimation of different Physico-chemical water quality parameters:

a). Color: The water was blue in color.

b). Odor: The water samples were odorless.

c). Temperature: The air temperature ranged from 22˚C to 27˚C with average of 24˚C, whereas water temperature ranged from 20˚C to 23˚C with the average of 21.25˚C during study period (Table 1). Average water temperature was highest (23˚C) in month of April. Water as well as air temperature showed significant variation in different months.

d). PH: The pH of water ranged from 8.0 to 9.0 with average of 8.53 during the study period (Table 1) the average pH did not significantly vary in different fortnight intervals during the study period.

e). Conductivity: The conductivity of water ranged from 6.59 to 14.60 milli/Simens with average of 9.32 m/S during the study period (Table 1). The conductivity was highest in April, conductivity showed significant variation among different fortnight intervals during the study period.

f). Turbidity: The turbidity ranged from 10 to 30 NTU with average of 15.5 NTU during the study period (Table1). The turbidity was highest in April; turbidity showed significant variations among different fortnight intervals during the study period.

g). Dissolved oxygen (DO): The DO content of water varied from 5.632mg/L to 6.924mg/L with the average of 6.25 mg/L during the study period (Table 1). There was a significant variation in DO content of water with highest level in April.

h). Biological oxygen demand (BOD): The BOD of water ranged from 0.68mg/L to 2.01mg/L with the average of 1.58mg/L (Table 1). The BOD varied among different samples, highest being recorded in the last sample i. e. of April.

i). Phosphate: The phosphate concentration in water varied from 0.04mg/L to 0.08mg/L with average of 0.06mg/L during the study period (Table 1). The phosphate concentration did not show significant variation in different samples. The highest phosphate concentration was recorded in 2^{nd} and 4^{th} samples collected in March and April respectively.

j). Nitrate: The nitrate concentration in water varied from 0.53mg/L to 0.6mg/L with the average of 0.61mg/L during study period (Table 1). The nitrate concentration did not show significant variation in different samples. Nitrate concentration was highest in II sample collected in March. Nitrate concentration was higher than the permissible range (0.1mg/L).

k). Total suspended solids: TSS showed variation from 10mg/L to 30mg/L with the average of 17.5 mg/L during the study period (Table 1) with highest level in April. There was no significant variation in concentration of TSS among different samples.

Fish study: L-W relationship and relative condition factor:

a) *Labeo rohita:*

L-W relationship of *L.rohita* during different collections of the study period is as shown in (Table 2). The scattered diagrams showing regression line fitted for logarithmic length and weight for each month are shown in fig 1, 2, 3 & 4 and the value of 'b' in L-W equation varied from 2.94 to 2.99 with average of 2.96 during study period. The majority of the dots in the scatter diagrams were close to the regression line in all the samples collected during the study period (Fig. 1, 2, 3 & 4). The relative condition factor (Kn) in majority of length groups in different months of the study period were >1(Table 4).

b) *Oreochromis niloticus:*

Length-weight relationship of *O.niloticus* during different collections of the study period is as shown in (Table 3). The scattered diagrams show regression line fitted for logarithmic length and weight for each month are shown in fig 1, 2, 3 & 4 and the value of 'b' in L-W equation varied from 2.9 to 3.0 during study period. The majority of the dots in the scatter diagrams were close to the regression line in all the samples collected during the study period (Fig. 1, 2, 3 & 4). The relative condition factor (Kn) in majority of length groups in different months of the study period were >1(Table 5).

Table-*2:* Length-Weight relationship of *labeo rohita* in Krishna Raja Sagara reservoir during study period:

Collections	No. Of Fish	Calculated 'b' (Growth co-efficient)	Calculated 'a'	$W=aL^b$	Relative condition factor (Kn)
Collection I (26-2-15)	60	2.9995	1.057	$1.057L^{2.9995}$	1.1174
Collection II (12-3-15)	60	2.9533	1.0715	$1.0715L^{2.9533}$	1.1188
Collection III (26-3-15)	60	2.9495	1.0879	$1.0879L^{2.9495}$	1.2010
Collection IV (10-4-15)	60	2.9488	1.0798	$1.0798L^{2.9488}$	1.1995
Mean±SE		2.96±1.3	1.07±0.35		1.15±0.57

Table-3 *Length*-Weight relationship *of O. niloticus* in Krishna Raja Sagara reservoir during the study period.

Collections	No. Of Fish	Calculated 'b' (Growth co-efficient)	Calculated 'a'	$W=aL^b$	Relative condition factor (Kn)
Collection I (26-2-15)	60	2.9	4.9641	$4.9641L^{2.9}$	1.1555
Collection II (12-3-15)	60	3	5.8411	$5.8411L^3$	1.259
Collection III (26-3-15)	60	3	7.0021	$7.0021L^3$	1.3485
Collection IV (12-4-15)	60	3	7.4837	$7.4837L^3$	1.3863
Mean±SE		2.97±1.48	6.32±3.16		1.28±0.64

Table 4: Relative condition factor of *Labeo rohita* belonging to different *length* groups in KRS

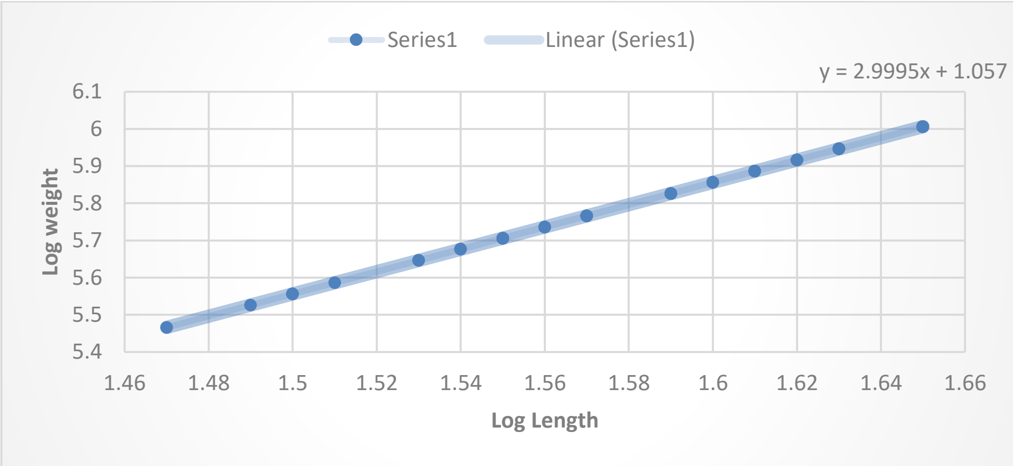
Size groups	Collection I (26-2-15)		Collection II (12-3-15)		Collection III (26-3-15)		Collection IV (10-4-15)	
	No of fishes	Kn	No of fishes	Kn	No of fishes	Kn	No. of fishes	Kn
30-33	6	1.15	5	1.158	3	1.1566	3	1.1566
34-37	15	1.10	14	1.18	16	1.1806	18	1.1791

38-41	20	1.01	18	1.1980	16	1.1987	16	1.2025
42-45	19	1.47	23	1.1698	25	1.219	23	1.2191
mean±SE		1.18±0.59		1.17±0.58		1.18±0.59		1.18±0.59

Table 6: Relative condition factor of *O. niloticus* belonging to different *length* groups in KRS reservoir.

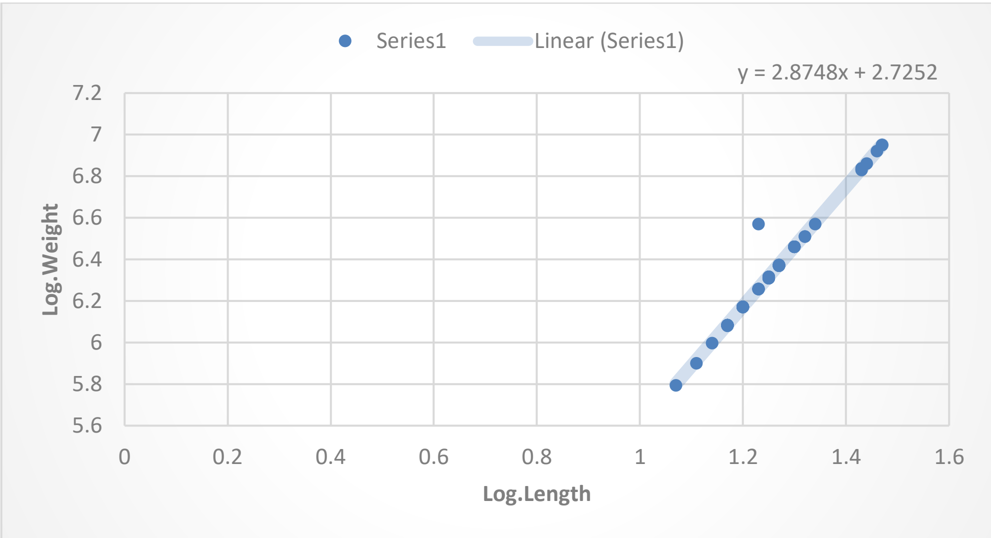
Size groups	Collection I (26-2-15)		Collection II (12-3-15)		Collection III (26-3-15)		Collection IV (10-4-15)	
	No of fish	Kn	No of fish	Kn	No of fish	Kn	No. of fish	Kn
12-14	2	1.9488	1	1.99	-	-	-	-
14-16	12	1.5131	1	1.09	-	-	-	-
16-18	14	1.0711	3	1.135	2	1.1766	3	1.1866
18-20	14	1.1146	16	1.18	4	1.2166	2	1.2166
20-22	8	1.1616	14	1.23	9	1.2566	6	1.2666
22-24	-	-	6	1.28	3	1.3066	7	1.3066
24-26	-	-	5	1.3	9	1.33166	8	1.8416
26-28	2	1.279	10	1.34	8	1.3666	6	1.3866
28-30	2	1.2966	4	1.37	8	1.36966	5	1.4066
30-32	2	1.3166	-	-	6	1.42666	8	1.4366
32-34	-	-	-	-	-	-	-	-
34-36	-	-	-	-	7	1.48166	10	1.4916
36-38	-	-	-	-	3	1.49666	5	1.5066
mean±SE		1.33±0.47		1.32±0.44		1.34±0.42		1.40±0.44

Log W = Log a + b Log L



Labeo rohita

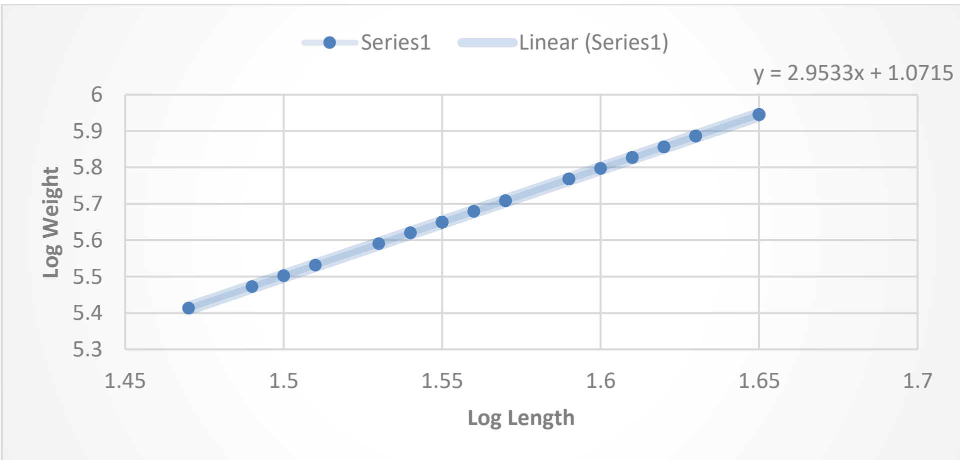
Log W = Log a + b Log L



O. niloticus

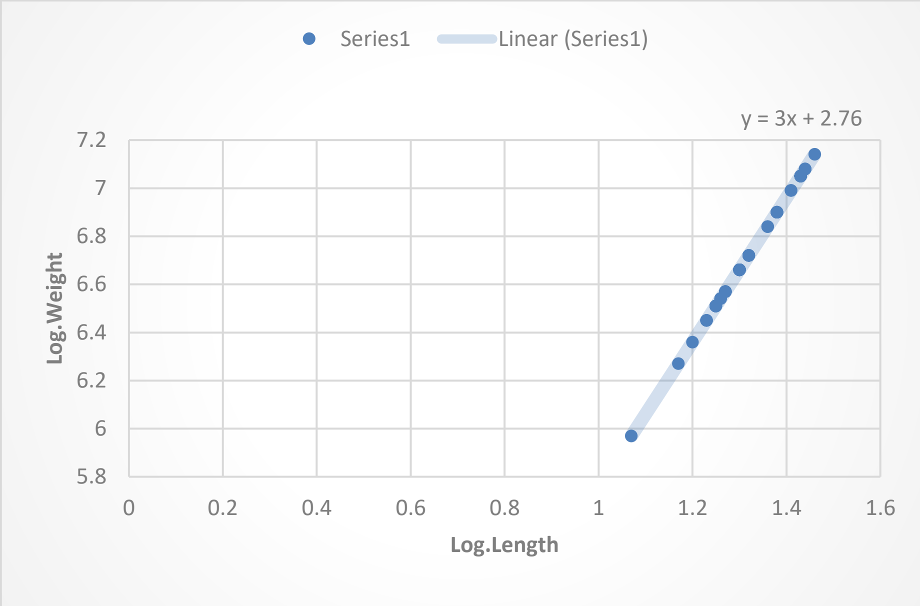
Fig.1: Scatter diagram showing logarithmic L-W relationship of *L.rohita* and *O. niloticus* of I sample collection.

Log W = Log a + b Log L



Labeo rohita

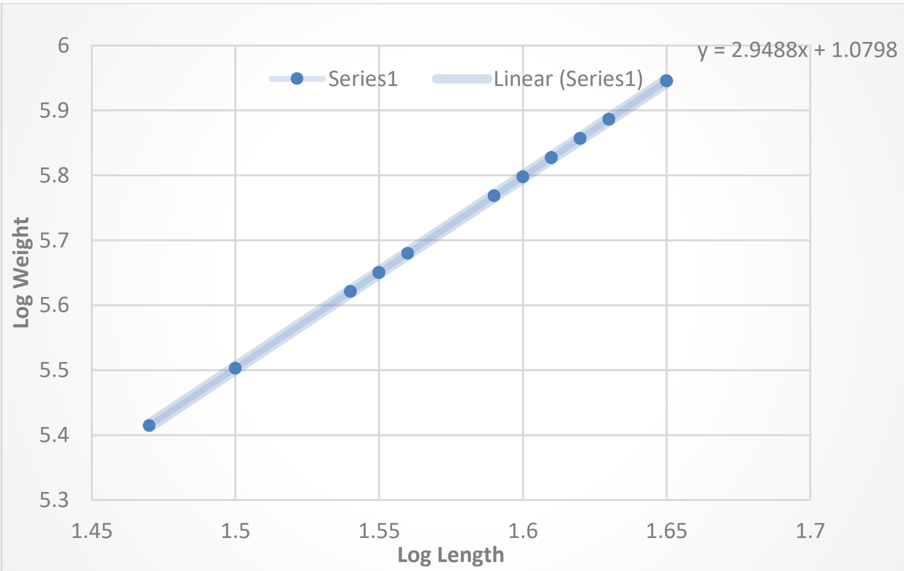
Log W = Log a + b Log L



O. niloticus

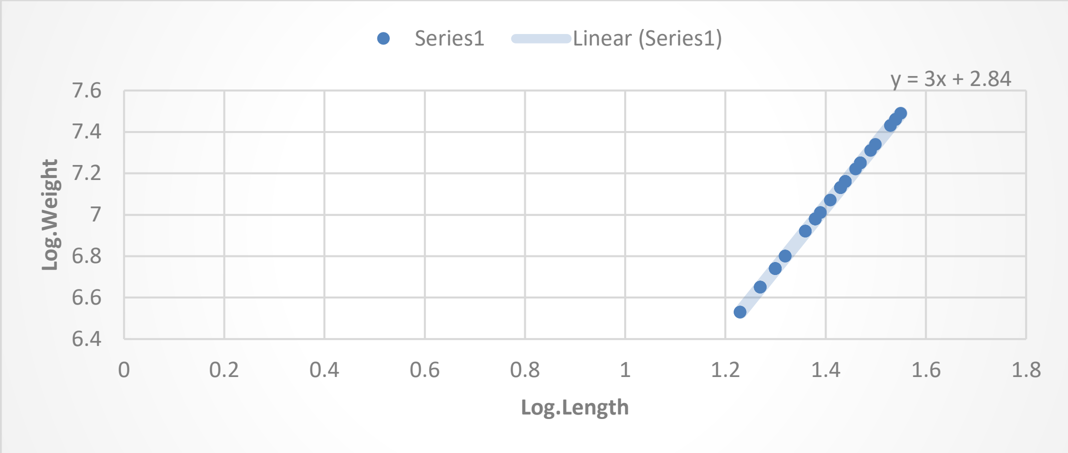
Fig .2: Scatter diagram showing logarithmic L-W relationship of *L.rohita* and of *O. niloticus* of II sample collection.

Log W = Log a + b Log L



Labeo rohita

Log W = Log a + b Log L



O. niloticus

Fig .3: Scatter diagram showing logarithmic L-W relationship of *L.rohita* and *O. niloticus* of III sample collection.

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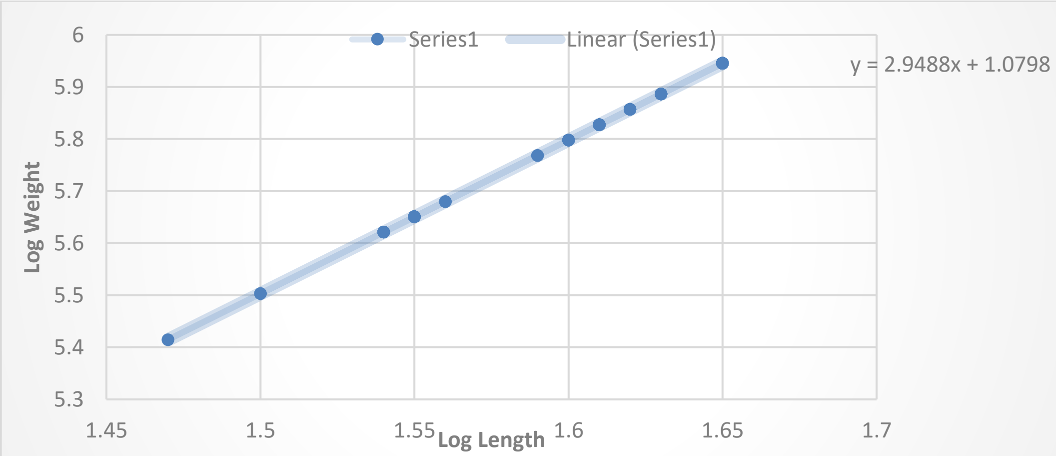
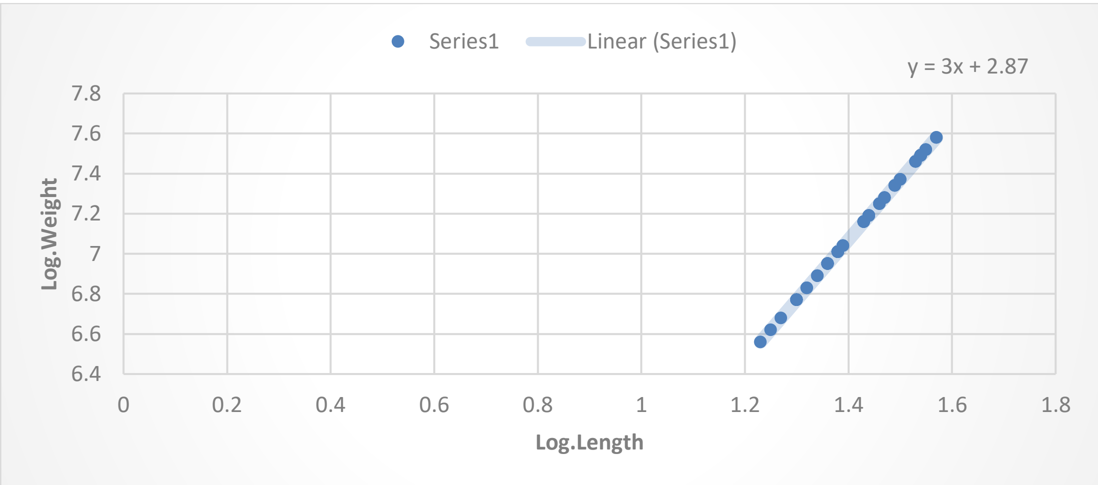


Labeo rohita

Log W = Log a + b Log L



O. niloticus

Fig .4: Scatter diagram showing logarithmic L-W relationship of *L.rohita* and *O. niloticus* of IV sample collection

In the present study fourth night variation in different physico-chemical parameters, which are known to influence well-being of fish growth have been studied, to find out whether differences in these parameters in KRS Reservoir is accompanied by difference in growth co- efficient and relative condition factor of a major carp *L.rohita and O. niloticus*.

In the present study **water temperature** of KRS ranged from 20°C to 23°C during the study period. Since a range of 27-32°C in tropical waters (IFAS: Institute of food and agricultural sciences, University of Florida, Circular-1051, Jinghra, 1968) is congenial for optimal growth of fish, KRS reservoir under study showed temperature closer to the lower limits of the optimum range. Similarly, the **DO** content of KRS reservoir during study period was conducive for fish growth as it was well above the minimum required amount (i.e., 5-6mg/lit., Alabaster &Lloyd, 1980). Since higher levels of total suspended solids clog the fish gills, their concentration less than 25mg/lit is preferred (Maitland, 1990). In our study **TSS** level was well within the range in the KRS reservoir. However, other physico-chemical parameters showed significant differences. For instance, low turbidity (20-30 NTU) is desirable for fish culture (Zweig, 1989) as high-level **turbidity** affects the photosynthetic process and there by the potential yield of the fish is reduced (Sukumaran & Das 2005). The turbidity was conducive for the fish growth.

Similarly, higher **alkalinity (pH** >9) in water bodies is unsuitable for good fish production (Boyd 1979). The water pH in KRS reservoir was at the range of 8 to 9 was equal to optimal range Schroeder, 1980) for fish culture.

BOD indicates the presence of organic load in a water body and waters having BOD more than 35 to 45 mg/lit are not good for fish culture (Pande & Sharma 1999). In the present study BOD level in KRS reservoir was below the preferred range in all the fortnight intervals and is good for fish growth.

Phosphate is a nutrient which causes rich phytoplankton crop (Moss, 1993). An optimum level 0.1 to 0.2 mg/lit phosphate (Sreenivasan, 1965) is needed for growth of fish. In our study, the **phosphate** concentration was several folds lesser than optimal level (0.1 to 0.2 mg/lit, Sreenivasan, 1965) needed to support phytoplankton growth.

Nitrate could be hazardous to fish if it exceeds the permissible range (Train &Russell 1979) which is 0.015 mg/lit for salmonids (Iwama *et.al.* 2000) and generally 0.1mg/lit considered tolerable range in tropics (Hart & Reynolds, 2002). In the present study **nitrate** concentrations in KRS reservoir exceeded the tolerance limit. Minimum level of nitrate required for the reservoir to be productive is 0.1mg/lit (Srinivasan 1965, Hart & Reynolds, 2002). In the present study nitrate content although exceeded the optimal level in KRS reservoir, the concentration of nitrate was far higher in KRS reservoir. The excessive level of nutrients was reflected in the presence of algal bloom during most part of the study period.

High levels of pH, total alkalinity, turbidity, BOD, phosphate and nitrite were reported in number of studies in different lakes in India and outside, to cite a few, Hutchinson 1957, Verma 1967, Banergia 1967, Saxena & Adoni 1973, Ayyappan & Gupta 1981, Yousuf *et al.* 1986, Kaur *et al.* 2000, Ragavendra & Hosmani 2002. However, these studies did not focus on the fact that whether these conditions interfered with growth and well-being of fish in these water bodies.

Higher or lower levels of these physico-chemical factors directly or indirectly interfere with fish physiology and affect their growth. For instance, high turbidity (Zweig, 1989) reduces photosynthetic zone resulting in night time decline of DO and higher pH (Boyd, 1979) influences the blood pH and causes alkalosis; damages skin, gills and eyes; and increases mucus production. Similarly, oxygen consumption of fish is affected by high, nitrate (Tilak *et al*. 2005) as nitrate in addition interferes with oxygen transport from gills to blood (Smart, 1978, Lewis & Morris, 1986., Datta *et al.* 2005) and damages gills stress (Barthelmes & Bramick 2003).

The isometric growth of fish under optimum conditions follows length-weight relationship, wherein weight is cube of length. (Cube rule, Le Cren, 1951). In the length weight relationship equation ($W=aL^b$), b is the growth co-efficient and its value is 3 (Allen, 1938) under optimal conditions. Hile (1936) and Martin (1949) opined that value of b usually lies between 2.5 and 4. Hence, in the study of length weight relationship, value of b because less than 2.5 can be considered as subnormal growth of fish in that given lake. Further the relative condition factor (Kn) is an expression used to assess the condition of fish, and Kn value 1 or more than 1 is considered as well being of fish.

Although several earlier studies on fish growth revealed sub optimal growth of fish, they did not provide evidence of any causative factor. In the present study, the sub optimal growth of *L. rohita* in KRS reservoir was accompanied by high nitrate and low phosphate levels which were altering the normal range for fish culture.

The present study reveals that although a few parameters were beyond optimal level (nitrate) overall water quality was supporting the fish growth. The growth of all the fishes of 4 collections reveals that growth coefficient (b) was close to 3 or it was 3 accompanied by Kn value more than 1 in all the fortnight intervals. These observations clearly indicate better growth and health (well-being) of *L. rohita* and *O. niloticus* in the KRS reservoir.

Conclusion

The study was conducted to estimate the physico-chemical parameters of water and length weight relationship and relative condition factor of the fish, *L. rohita* and *O.niloticus* in KRS reservoir. Four collections of water samples and fish samples were made, at fort nightly intervals during 2 months' study period.

L. rohita showed a little deviation from cube rule, as growth co-efficient, 'b' was <3 ('b'=2.92±1.32) and relative condition factor, Kn was >1 (1.32±0.66) during the study period, whereas *O. niloticus* also showed a very little deviation from cube rule, as 'b' was <3 ('b'=2.97±1.48), Kn was >1 (1.28±0.64). There was a significant correlation between length and weight as revealed by fitting regression line. Majority of the physico-chemical water quality parameters namely temperature, pH, turbidity, conductivity, DO, BOD, TSS and phosphate were within the optimal range for fish culture, whereas nitrate levels were higher than the desired levels. These results indicate near normal growth and well-being in *L. rohita* as well as in *O. niloticus* in the prevailing environmental conditions in the KRS reservoir. It is suggested that appropriate measures to reduce nitrate content might improve fish growth reaching optimal level, i.e., growth co-efficient >3.

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