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Age, growth and diet of Reba carp *Cirrhinus reba* (Hamilton 1822) in Lower Anicut reservoir, Tamil Nadu, India

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Abstract

The Reba carp *Cirrhinus reba* (Hamilton) has a best food category fish in India and its adjacent countries. The natural resources of this species are on the way out due to over exploitation and habitat changes. Here, is an important consideration that should be taken into account to the develop conservation strategies of the species. Besides, the present investigation was designed the health condition, age and growth and assessment of feeding behaviour. Following this, the species health status was assessed by Fulton's condition factor and reported their irrelevant growth related to the size. *C. reba* attained the highest growth rate in females than males were strong-minded by von Bertallanffy Growth Factor parameters and Electronic Length Frequency Analysis. However, analysis of stomach contents was revealed that this species were observed an omnivore, particularly plankton feeder. So far, the objective of this study was to provide necessary inputs on the biological parameters of this species for artificial propagation programs and conserved natural populations in our riverine ecosystem.

Keywords *Cirrhinus reba*; Fishery information; LWR; Health condition; Age and growth; Food feeding behaviour

Introduction

In current years, there has been an ever-increasing interest for culture aspects, the Reba carp *Cirrhinus reba* [1] as a both commercial and angling species in India and its adjacent Asian countries. Although there is much anecdotal evidence of the moribund stocks and there has been no obvious and complete meticulous investigation on complete biology and population dynamics. Resembling, *C. reba* is one of the most popular food fish and it's widely distributed in India, Bangladesh, Pakistan, Nepal, Burma and Thailand [2,3]. Moreover, this species of *C. reba* is a most important leading fish resource (year around) of Lower Anicut show the relative catch composition of virtually in tonnes past years. Currently, the Cirrhinus is an important genus comprised of eleven species in widely distributed, containing several cultivable and economically value species. Two of them, the mrigala carp *Cirrhinus mrigala* [1] and reba carp *Cirrhinus reba* [1] were available in the Lower Anicut, Tamil Nadu. In order to, one of the most important indigenous minor carp *C. reba* is locally known as 'arainjan podi or kendai' (Lower Anicut region) in Tamil and Reba Carp in English. Besides, 15-20 varieties of minor and medium carps that has a high potential for freshwater aquaculture, which is yet to be exploited in India. Yet, the wild population of this species on the way out due to heavily harvested the Anicut ecosystem. Until, no qualitative and quantitative unique stock structures are available. However, the catches of this species have turned down in recent years due to increase it range of fishing mortality. For that reason, a feasible management seems to be very necessary for this and other Cirrhinus species in this sampling area. In view of the fact that, commercial aquaculture productions of this species are most possible one by way of the wild populations could be controlled [4]. Hitherto, the biological research information is most vital one to meet out the diminishing state of the fishes. Besides, being important noted studies on fisheries based biology can expressed either in diet or reproduction survey have largely favoured to collection of information on the wild captured fishes [5]. Nonetheless, knowledge about the Reba carp populations in India is still scarce and fragmentary [6]. In this background, knowledge of individual length-weight relationship (LWR) in such population has been extensively used the estimation of weight from length due to technical difficulties and amount of time required to record weight in the field. The conversion of growth-in-length equations to growth-in-weight for use in stock assessment models, the evaluation of bio-mass from length observations and also assess the condition factors of fish [7]. Length-weight relationships for fish are originally used to provide information on condition of fish in order to determine whether somatic growth is isometric or allometric [8]. As a result, the estimates of age and growth are very essential for estimating the natural mortality, longevity and yield per recruit [9]. More to the point, the age determination will provide a key element for management and constitute on the basis to realize the growth and stock structure of this resource [10]. Thus, the reliable methods of ageing are an absolute requirement for rational management. Herein, deficient of accurate age information of Reba carp has been a major stumbling block to fisheries research. No more authors are reporting on age of *C. reba*. Nothing is known about age of this species in Indian waters as none of these publications dealt with this. In the way of, dietary habits of fishes have a great significance in an aquaculture practices and manifold importance in fisheries biology. Similar to, food is the main source of energy, plays an important role to influential the population level, development and condition of fishes. Herein, composition of foods in habitat varied throughout year and it tends to have a maximum importance of seasonal elasticity [11]. Besides, the diet and growth of this species varied widely among ecosystem and unique growth variations have been linked to both biotic and abiotic factors. Unfortunately, be short critical information has often complicated the production of appropriate fisheries management policies on the other hand, the factor such as lack of accurate age and growth records has hampered the management efforts.

Besides, explain the variations in the level of populations as well as to make efforts to increase the amount of harvest and recruitment stocks are of great value in fishery management and also very essential part of aquaculture practices. Because of their low down reproductive rate and direct relationship between stock structures of populations are very extremely susceptible [12]. Therefore, the populations could be depleted under high fishing mortality on mature fish or by any substantial fishing mortality on immature age individuals. These results are implied that the population is going to vulnerable intense fishing activities in this region. However, the deficient in earlier period of research and uncertainty nature response of the resource and fishing pressures a high risk for sustainable exploitation. At present, improvement and managing plan of this species very complicated to several countries because a lack of sufficient biological data. Finally, the main objective of this study was providing the first and complete biological information of *C. reba* in Cauvery (Kollidam) waters. Moreover, the present work is my doctoral contribution to clarify the knowledge about biological uniqueness about this species.

Materials and Methods

Study site

Biological data was collected from a branch of Cauvery, specifically Kollidam (Coleroon) river, Lower Anicut was selected for the present study (Figure 1) which is located 11° 08' 03" N latitude and 79° 27' 05" E longitude. Kollidam river flows from west to east forming located in northern boundary of this block flanking at Tamil Nadu. The present fishery occupies a prominent one in this river at Lower Anicut.

Sample collection

Totally 395 (225 males and 170 females) individuals of *C. reba* were collected. Specimens were kept chilled in ice box immediately after capture and brought to the laboratory for further examinations. Total length (TL) were obtained using a measuring board and recorded to nearest mm. Whole wet weight (TW) was measured using an electronic balance (DIGI' Arts maximum=500 g to d=0.05 g) and recorded to g. Specimens were identified morphologically using scientific literature relevant to the group with original descriptions [13]. Further, species identification using tissue samples (i.e., caudal fin) were collected and stored in sterile eppendorf tubes containing absolute ethanol, sealed with parafilm kept at room temperature for DNA study analysis. After that, sex was determined by gross examinations of the stomachs. At the same time juveniles, males and females were differentiated and data were recorded after dissecting out the gonad. Specimens were preserved in 5% formalin for future examinations. Damaged specimens were rejected.

Length-weight relationship (LWR)

Length-to-weight relationship was calculated the least square method [14]. TW=aTLb (or) log W=log a + b log L. Where, TW=Total Weight (g), TL=Total Length (mm) and a-constant (intercept) and b-allometric coefficient (slope of linear regressions). Following, the differences between TL and TW relationship were estimated and fitted between sexes [15,16]. The degree of relation between variables was compute and as an indicate regression co-efficient determination (r^2) were used for excellence of linear regression [17]. Values of the exponent b provide information on fish growth. When b=3, the increase in weight is isometric. When the value of b is other than 3, the weight increase is allometric (positive allometric if b>3, negative allometric if b<3) [18,19]. The student t-test using and assessed significant analysis against length and weight the statistic: ts=(b—3) Sb^{-1} where Sb is the standard error of the slope [20]. In addition, growth type was evaluated based on information provided by value of b. Growth factor has typically been analyzed through 'Condition factor or K-factor or Ponderal index (K)' were calculated. Following this to investigate the condition factor (K) was employed [21] K=W/aLb × 100; where, K=Fulton's condition factor, W=weight of fish (g), a - constant, b - regression co-efficient and L=lengths in mm^3. Analysis of covariance (ANCOVA) was employed to evaluate the significant difference in length and weight relationships between sexes at 0.005% level [22]. All analyses were performed using Statistica (Ver. 10.0 StatSoft Inc.).

Age and Growth

Electronic length frequency analysis (fisat-elefan): Analysis the length-frequency module was built into FiSAT-ELEFAN computer program [23]. Using the ELEFAN, it was possible to achieve the best fit for growth curve to length-frequency data sets. Following the growth of *C. reba* was described by von Bertalanffy Growth Function vBGF [24]. The vBGF is defined by the following logistic equation of length at age as LT=L∞ $[l\text{-}e^{-k(t-t_0)}]$. Where, LT is the expected total length (mm) at age, t-time (years), L∞=mean asymptotic length (mm) predicted by equation; k=growth co-efficient ($year^{-1}$); t=age of the *C. reba* and t_0=the hypothetical age at which fish would have length is zero. Generally, the computing software was used to calculate the growth equation parameters. Monthly length-frequency distributions of *C. reba* were analyzed using Fisheries Stock Assessment Tool (FiSAT) [25]. Estimate the maximum length (L_{max}) was obtained and extreme values were implemented by FiSAT. Parameters of vBGF as mentioned the L∞=asymptotic length and K=growth co-efficient were estimated through ELEFAN [26]. Identified the growth curve (K-scan values) fits based on LFD data using the value of Rn as a decisive factor.

Diet analysis: Foods of fresh specimens were removed, weighed and preserved in 5% formalin to prevent digestion of food materials. Food items were sorted and identified taxonomically at species level [27] and American Public Health Association [28]. Firstly, to examine the Gastro-Somatic Index (GaSI) for both sexes were calculated as follows: GaSI=GW/TW × 102. Subsequently, to analyze the foods and used some following indices. Herein, the percentage frequency of occurrence (%F=Number of stomachs containing food/Total number of full stomachs × 100), percentage numerical abundance (%N=Number of food /Total number of food × 100) [29,30] and also the weight (%W) is defined as the weight of individual food relative to total weight of all foods. Finally, the index of relative importance (IRI): IRI=%F × (%N + %W) were following the mentioned author [31].

Intensity of feeding: Feeding periodicity (months) was determined by analyzing the intensity of feeding and vacuity index ratio. The stomach fullness index (SFI) was adopted to measure the degree of feeding intensity and it was calculated are as follows: SFI=[(weight of the stomach - body weight)] × 100 [32]. Following this, the vacuity index ratio (VIR)=(Number of empty stomachs/Total number of stomachs × 100). Though, the stomachs were visually classified as empty (vacuity), trace, ¼ fullness, ½ fullness, ¾ fullness and fullness (depending upon degree of fullness with amount of food). Individual stomachs were measured as full, ¾ full were considered as active feeders, ½ full as moderate feeders and ¼ full and trace stomachs as poor feeders [33].

Results

Estimates of the length-weight equations were calculated separately based on sexes. The exponent 'b' (slope) values for all sexes ranged from 1.889 to 2.317 respectively in Table 1. The 'b' values were lesser than 3.0 (b<3) growth is generally exhibited as negative allometric (A^-) for all the sexes as shown by the exponents values of 'b' indicating that increase in length is not proportionate to increase in weight. In this, the present work was calculated the values of 'b' for length and weight were lower than 3. Correlation co-efficient 'r' for ranging from 0.873^{**}-0.897^{**} which is highly significant at P<0.01 level while, the 'r^2' values were estimated from 0.835-0.875 at significant (r<1) nature. Likewise, the values of a- Intercept, b- Slope, SEb- Standard Error of b, r- Correlation co-efficient, r^2- Regression Co-efficient, t- 't' test, P- Probability and GP-Growth Pattern were also abbreviated. To examine the t values are also accordance significantly for both sexes in Table 1. As well, analysis of covariance (ANCOVA) was employed to determine the significant differences in length-weight relationship (Table 2). Furthermore, the ANCOVA showed that the values of slopes (b) for sex based to exhibit a significant differences were find out between length and weight (computed F417.4 and P<0.005).

Sexes	LWR	Logarithmic transformation	a	b	SEb	r	r^2	t	P	GP
Males	W=0.0049*L10.889	Log W=-2.391+1.889*Log L	0.0041	1.889	0.049	0.889**	0.875	7.0434	<0.01	A-ve
Females	W=0.0019*L20.317	Log W=-2.997+2.317*Log L	0.0012	2.317	0.042	0.897**	0.863	6.1315	<0.01	A-ve
Pooled sex	W=0.0543*L20.165	Log W=-1.685+2.165*Log L	0.0518	2.165	0.059	0.873**.	0.835	13.406	<0.01	A-ve

Table 1: Estimated parameters of LWR, correlation, regression co-efficient, t-test and growth pattern for between sexes of *C. reba*.

Sources of variation	Df	Sum of squares	Mean squares	F	P
Deviation from individual regression	393	7.73438	0.010137	417.039	P<0.005
Difference between regressions	2	8.45489	4.227445		
Deviation from total regression	395	16.18927	-		

Table 2: Regression analysis of LWR for between sexes of *C. reba*.

Month-wise mean Fulton's condition factors (K) for all sexes of *C. reba* were represented in Figure 2. The value (K) of males was ranged from 0.98 ± 0.04- 1.44 ± 0.29 and females varied from 0.82 ± 0.03- 1.25 ± 0.27 whereas, estimated value for pooled sexes from 0.91 ± 0.05-1.38 ± 0.19. Subsequently, the condition factor values were observed in low down during July while, the values of K were high during January in all sexes. In addition, the variations of K showed in diverse months, it was noticed the mean K was higher when the species was enter into maturing and maturation phase (January to March), even as the spawning period for the duration of June-July with the value was lower in nature. Females had relatively higher mean K value than males and pooled sexes also respectively. In both sexes were observed low mean K value was obtained during April was gradually decreased and finally attained low down during July. However, the present investigation shows this species attains sexual maturity and breeding season during April-August with peak in July for both sexes. In view of that, evaluation of growth parameters based on size at age showed that the *C. reba* has a maximum life span about 6+ and 7+ years in both sexes. Males are attained the size in 81.0 mm and females were 87.0 mm during the first year of age (Figures 3). The size at age data was fitting by vBGF growth equation. The von Bertalanffy size-at-age (L∞) of females was higher than males and also estimated growth rate (K) were generally correlated to sexes. The vBGF's fitting size-at-age and growth equation was described by following equation for sex based. The $Lt=237.3[1-e^{-1.00\ (t + 0.445)}]$ for males and $Lt=253.1[1-e^{-1.00\ (t+0.392)}]$ for females. The size frequency distribution of *C. reba* was using the vBGF parameters with FiSAT-ELEFAN-I programme. The size frequency histograms with clear growth curves for sex based were represented and the values of t0 was referred as t0=0.445 in males t_0=0.392 in females respectively in Figure 4. Observed and estimated growth parameters of asymptotic length (L∞), growth co-efficient (Z/K), growth co-efficient ($year^{-1}$) K (yr^{-1}) and response surfaces (Rn score) for both sexes separately.

ELEFAN	Sex	L∞ (mm)	Z/K	K (yr^{-1})	Rn/score
a) Automatic scan	M	237.3	-	1	0.101
	F	253.1	-	1	0.16
b) K – scan	M	237.3	-	0.37	0.237
	F	253.1	-	0.42	0.248

Table 3: Size range and age were recorded by ELEFAN for both sexes of *C. reba*.

Estimates of response surfaces (Rn) values was obtained in males (0.237 mm) and (0.248 mm) females by ELEFAN-I. Generally, the Rn values were ranged between 0 and 1 with the L∞ and K values were obtained by ELEFAN-FiSAT-II package. The total length range in

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males (237.3 mm) and females (253.1 mm) and also K-scan 1.00yr^{-1} in both sexes respectively, whereas the K-scan routines provide the values 237.3 mm and 0.370 yr^{-1} in males and 253.1 mm and 0.420 yr^{-1} in females respectively in Table 3.

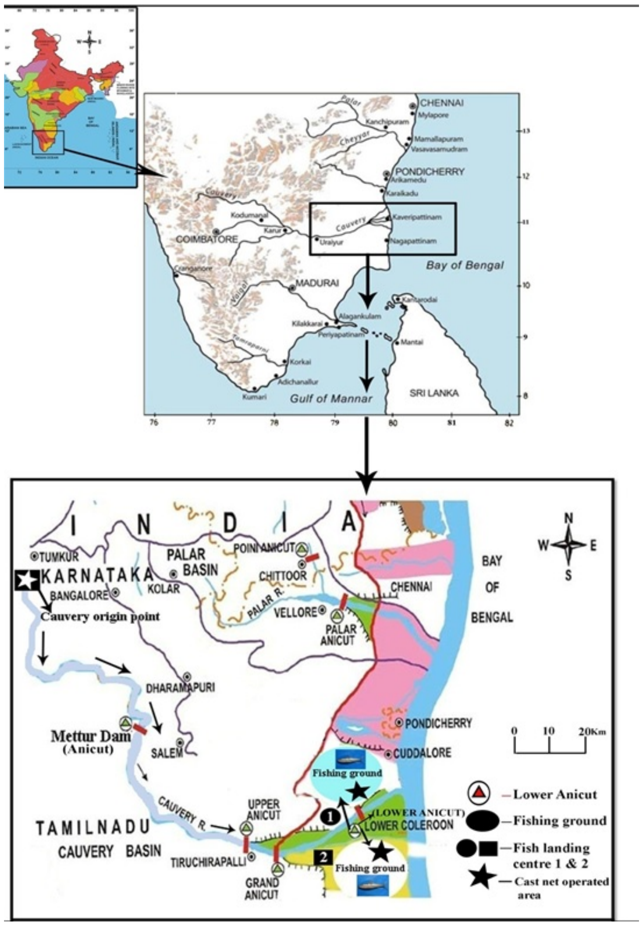

Figure 1: Map showing the geographical location of sampling area in Lower Anicut, Tamil Nadu.

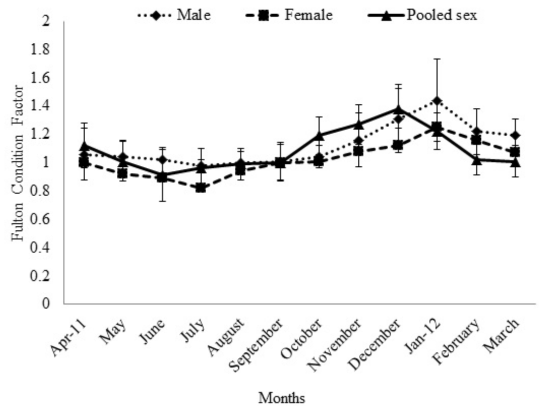

Figure 2: Monthly variations of mean condition factor of *C. reba.*

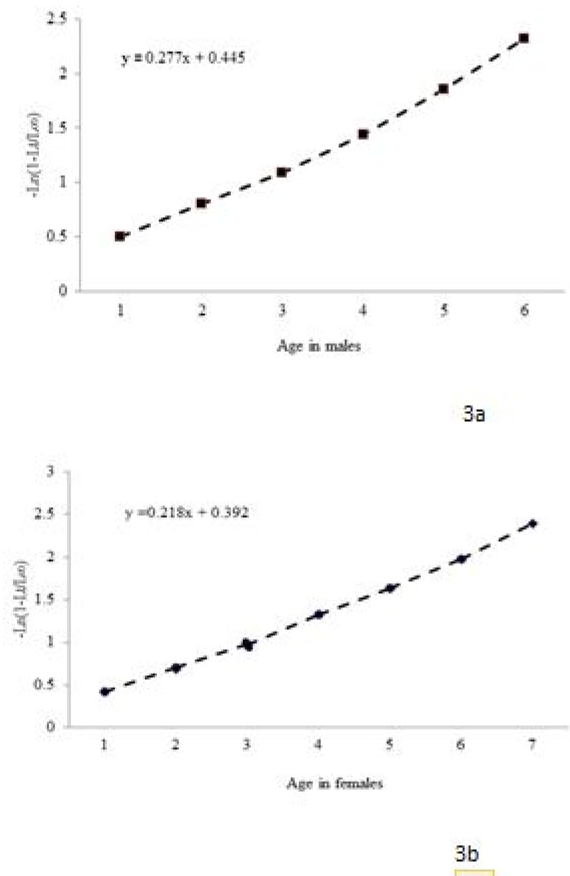

Figure 3: (a) Estimation of age and growth curve of male *C. reba.* (b) Estimation of age and growth curve of female *C. reba.*

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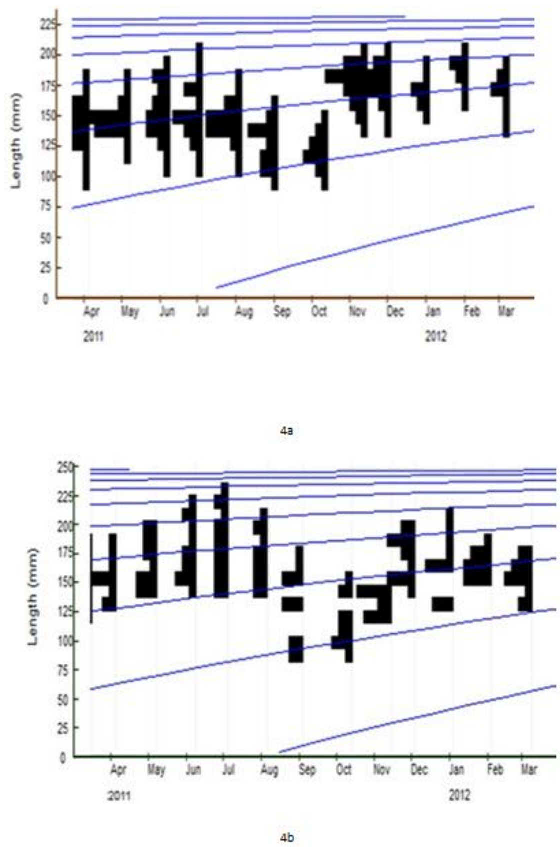

Figure 4: (a) ELEFAN analysis of age and growth plot male *C. reba.* (b) ELEFAN analysis of age and growth plot female *C. reba.*

Different types of percentage composition of stomachs of *C. reba* were represented in Table 4. Generally, food items was examined stomachs were grouped into eight categories. The main groups of foods were found in blue green algae, diatoms, green algae, non-motile green algae, plant materials, detritus, zooplanktons and others (unidentified). The frequency of occurrence (FO%) values of foods totally 494. Foods were dominated such as blue green algae were present in 154 (38.4%), diatoms 113 (27.3%), non-motile green algae 63 (13.6%), green algae 86 (11.8%), plant materials 29 (3.8%), detritus 21 (2.9%), zooplankton 19 (1.2%) and others 7 (0.9%). Following this, the total values of numerical (N) food items were represented such as blue green algae 732 (36.8%), diatoms 621 (25.7%), green algae 436 (13.9%), non-motile green algae 498 (12.9%), plant materials 179 (2.9%), detritus 142 (1.8%), zooplanktons 116 (1.2%) and others 43 (0.6%) respectively. Besides, the weight (W) categories of foods totally 364.1 g and also preferences of foods like blue green algae 118.7 g (39.7%), diatoms 74.6 g (25.4%), green algae 44.2 g (14.4%), non-motile green algae 65.5 g (13.2%), plant materials 23.3 g (2.4%), detritus 18.4 g (1.7%), zooplanktons 12.1 g (1.2%) and others 7.3 g (0.7%). Subsequently, the Index of Relative Importance (IRI) values of foods were represented like blue green algae 2691.6 (58.1%), diatoms 1249.3 (26.9%), non-motile green algae 382.2 (8.2%), green algae 277.3 (5.9%), plant materials 18.6 (2.4%), detritus 8.1 (1.2%), zooplanktons 4.6 (0.8%) and others 1.1 (0.2%). Analysis of stomach contents of *C. reba* was carried out in the present study. All the food items were grouped into eight categories. The considerable quantity of blue green algae and diatoms were the most dominant food in both the sexes. Subsequently, the various foods like plant materials, detritus (sand, mud, decay plants and animals) rotifers, cladocerans and copepods.

Food items	FO	FO%	N	N%	W(g)	W% (g)	IRI	IRI%	P
Blue green algae	154	38.4	732	36.8	118.7	39.7	2691.6	58.1	***
Oscillatoria subbrevis									
Anabaena fertilissima									
Nostoc carneum									
Microcystis elegans									
Sprirulina major									
Diatoms	113	27.3	621	25.7	74.6	25.4	1249.3	26.9	**
Cyclotella antique									
Fragillaria crotonensis									
Diatoma vulgare									
Navicula gracilis									
Synedra ulna									
Green algae	86	11.8	436	13.9	44.2	14.4	277.3	5.9	*

Chlamydomonas globosa									
Tetraspora lubrica									
Euglena acus									
Chlorella vulgaris									
Paediastrum tetras									
Non-motile green algae	63	13.6	498	12.9	65.5	13.2	382.2	8.2	N.S.
Synechococcus sp.,									
Dinococcus sp.,									
Anacystis sp., Volvox sp,									
Plant materials	29	3.8	179	2.9	23.3	2.4	18.6	2.4	*
Detritus	21	2.9	142	1.8	18.4	1.7	8.1	1.2	N.S.
Zooplanktons	19	1.2	116	1.2	12.1	1.2	4.6	0.8	***
Brachionus calciflorus									
Daphnia carinata									
Kertalla cochlearies									
Cyclops vicinus									
Others (unidentified)	7	0.9	43	0.6	7.3	0.7	1.1	0.2	N.S.
Total	494	99.9	2767	95.8	364.1	98.6	4632.8	100	-

Table 4: Stomach content analysis of *C. reba.*

On the analysis of food and feeding habits of *C. reba* the modifications of inferior with slightly protrusible mouth presence of extremely long and highly coiled alimentary canal. It may provide strongly suggest that the stomach were longer surface of the gut especially for the uptake more food. From the above observations, it can be concluded that the *C. reba* is an omnivore, particularly plankton feeding are also observed bentho-pelagic food habits. The planktons were the predominant food but resort to feed on plant foods, animal food and detritus as an evident from this observation. Following this, Gastro Somatic Index (GaSI) was illustrated as an agreement between monthly variations in gastro somatic index and stomach fullness. Generally month-wise average GaSI varied between sexes excluding, females (13.9 ± 2.91) individuals are higher than males (10.7 ± 2.23) (Figure 5). So far, the present observation shows that this species were fed large amount of food during September-December (post spawning period) whereas, the small amount of food were covered during January-March (pre spawning period). Herein, the percentage composition of feeding condition is given in Figure 6. Month-wise percentage composition of active feeding (considered as full and 3/4 full) individuals showed values are high during October-March and gradually decrease in July. Following this, the moderate feeding (1/2 and 1/4) showed that high during May-July whereas low during November-January. Percentage composition of empty stomachs showed a wide range of fluctuations were covered from December to April was observed in both sexes. Gastro somatic index (GaSI) and feeding intensity was revealed that high during winter (pre-spawning period) and low during summer (spawning period).

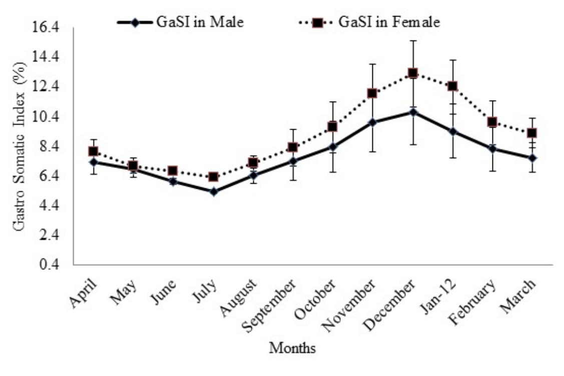

Figure 5: Monthly variations of Gastro Somatic Index (GaSI) of *C. reba.*

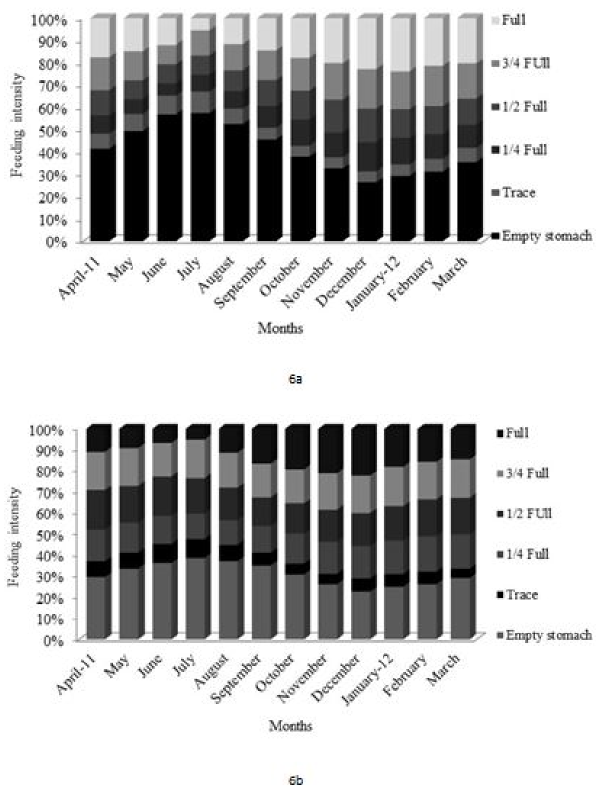

Figure 6: (a) Monthly variations of feeding intensity of male *C. reba*. (b) Monthly variations of feeding intensity of female *C. reba*.

Discussion

Like, exponent of the arithmetic form and slope of the regression line in the logarithmic form 'b' is the most important parameter in LWR [16]. Values for 'b' less than 3.0 (b<3) shows that the fish becomes lighter (allometric -ve) or greater than 3.0 (b>3) indicates that the fish become heavier (allometric +ve) for a particular length as it increases in size [33]. Besides, the overall value of parameter b, which was varied between 2 and 4 but mostly, remained within the expected range of 2.5 and 3.5. Values of 'a' and 'b' (intercept and slope) differ not only in various species but also same within species depending on sex, maturity stage, feeding intensity, area/season effects, distinctions of the observed LWR ranges of the specimens caught and which duration of sample collection can be added [34]. As a result, the earlier LWR study with negative allometric growth for some freshwater cyprinids (b=2.885) in Chela sp., (b=2.665) and (b=2.864) in Puntius schwanenfeldii which are accordance with the present findings. Considering the 'b', for large specimens have a body shape that becomes more elongated otherwise the small specimens were in better nutritional condition at the time of sampling. Sometimes, the extreme values (b) are possibly caused by unique evolutionary reason to modify adult body shape [16,35]. At present, the allometric model seems to be most appropriate describing for LWR in fishes and applied to vast majority of relationships between morphological characters and total lengths [36]. However, there is no previous information on the condition factor of *C. reba* except [37] in Manchar Lake, Pakistan which are in accordance with the present work.

However, estimates of their growth parameters to indicate males were attained a higher asymptotic size and growing slowly than females. One of the author's [38] was reported that the asymptotic lengths (L∞) the growth co-efficient (K yr^{-1}) were low against the present study. Following this, [39] the observed L∞ and K for freshwater cyprinids like, *Labeo calbasu* in Bangladesh water, Ghaghra river was relatively higher. Thus, the present estimates of asymptotic length and growth coefficient value accordance with above authors were justified. Herein, the growth rate is quite low due to longer life span while in high the life span is short were also acceptable. Following, the age and growth depends upon the quality and quantity of food ingested; inadequate nutrition retard growth and delayed developmental transitions [40]. Elucidation of age information from interpretation of FiSAT-ELEFAN analysis was found to be most efficient one and informative [41]. Accurate determination of age in fishes is very essential for fisheries research as it provides an effective tool for assessing their growth and production of fish populations, which in turn are important tool for fish stock assessment and sustainable exploitation of fisheries. In accordance with [42,43] the report L∞ and K values in strongly agreement with some cyprinids species like, *Cirrhinus mrigala* (L∞=850.0 mm and K=0.43 $year^{-1}$), *Catla catla* (L∞=700.0 mm and K=0.73 $year^{-1}$) *Labeo rohita* (L∞=510.0 mm and K=0.80 $year^{-1}$) and *Labeo calbasu* (L∞=525.0 mm and K=0.76 $year^{-1}$) respectively. Therefore, the estimated K- scan values for the present study (0.370 male and 0.420 female) as correlate to earlier studies of the same groups. As a result, the present study considered the specific analysis of three parameters (L∞, K, and t_0) was carried out to determine the age and growth parameters between sexes. So far, the age and growth of *C. reba* have not been done. This information provided here the base line and most important data for *C. reba* in Lower Anicut reservoir, Tamil Nadu. These parameters will be of immense use for formulating conservation strategies of *C. reba* both riverine and inland fisheries. On the other hand, the age variations were noticed the present findings like, various authors could be related to geographical variations and prevailing hydrographical conditions. As well these differences were principally focusing in age distribution of the fish populations could also be due to net selectivity, fishing activity and pressure, feeding habits and ecological characteristics of rivers [44,45]. This above information is in accordance with the similar groups of cyprinids species [13,46,47].

Following, the biology of food and feeds of fishes in earlier stages differ from young to adult and sometimes foods were different between sexes. Generally fishes are herbivorous, carnivorous and omnivorous in their food habits. Most of them are highly adaptable in their feeding habits and utilize the readily available food [48]. Most of the Cypriniform fishes have scales besides teeth on the inferior pharyngeal bones which may be modified in relation to the feeding habits [49]. The structure of mouth and associates with them are characteristically modified in different groups of fishes in relation to either their diet or methods of feeding. The well developed and strongly built stomach with long intestine and their gut contents suggest that the species may be omnivorous feeder [13]. Besides, the above information is in agreement with the similar findings in other cyprinids species like *Labeo dussumieri* this species is extremely long, highly coiled with broad surface area for absorption of the phytoplankton and decayed plant matter reported [50]. The species of *C. reba* is a bentho-pelagic as well as bottom feeding nature with the shape of the mouth being inferior suitable to feed benthic and pelagic food materials were have reported [1,13,47,51]. Gut content analysis of *C. reba* suggest that the plankton foods are the most preferred food items in both the sexes. However four categories of food items such as blue green algae, diatoms, green algae and non-motile green algae were predominant foods whereas plant matter, detritus, zooplankton and others constituted the secondary food items in both sexes during the study period.

The present findings were in agreement with same species in Sindh, Pakistan waters were reported [47]. The composition of food items in the entire diet of male and female individuals were found to be slightly varied. It is reported that generally during spawning season, feeding rate would be relatively low and it increases gradually after spawning the species feed voraciously to recover from fast [52]. The similar finding has also been reported [52,53]. The author's [54] was reported that the variations in intensity of feeding and dietary composition between sexes may perhaps be due to the larger sizes attained by females, thus enabling them to utilize relatively larger and nutritionally profitable food items than males. Subsequently, the composition of food items in the entire diet of male and female individuals was found to be slightly varied. This may be explained that is not shortage of food in the river but this main consequence was related to the breeding period of the fish in which fish feed very little or avoid feeding because of the voluminous ripe gonads during spawning, the species had fully occupied abdominal cavity with the empty stomach. The synchronization of the poor feeding activity with peak during spawning season was reported [55,46]. At the end of spawning period the fish starts recovering the loss of weight through gradually increasing by feeding activity. This denotes that, there is a relationship between feeding and breeding activity. In the same way, the present result found that the stomach content was low during spawning season the explained their finding as fish need more energy input in spawning season to meet out the requirements of reproduction [56,57]. Following, the presence of occasional empty stomach were covered may be due to regurgitation or digestion of food items in this stomach as the fish struggled for escape from the net catching activity [58]. Likewise, some other reasons the empty stomachs are regurgitation, periodicities of feeding, availability of food and its digestibility, physiological reasons and illness of health reported [59]. Here in, the present work should compare with different species in cyprinid groups in various waters whereas, no one authors could not attempt the complete aspects of biology in this region.

Conclusion

These studies provide is important baseline information on the biology and fishery of *C. reba*. The results of this study would be an effective tool for fishery biologists, fish culturist, entrepreneurs and conservationists to initiate on time management strategies and regulations of the sustainable upkeep for the remaining stocks of this species. In addition, information on complete and accurate biological characteristics of *C. reba* are evidently lacking from literature and data bases including FishBase, IUCN and ICZN etc. As a result, of this study will provide vital information for future studies within the reservoir and surrounding ecosystems.

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