

**LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR
OF *Mystus gulio* AND *Odontamblyopus rubicundus* FROM THE
SOUTH WESTERN REGION OF BANGLADESH**



DALIA AFSANA



**Fisheries and Marine Resource Technology Discipline
Khulna University
Khulna**

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SOUTH WESTERN REGION OF BANGLADESH**

A Thesis

By

Dalia Afsana

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Khulna University
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Approved as to style and content

By



.....
Professor Dr. Khandaker Anisul Huq

Head

Fisheries and Marine Resource Technology Discipline

Khulna University

Khulna

Declaration

Length-Weight Relationship and Condition Factor of *Mystus gulio* and *Odontamblyopus rubicundus* from the South Western Region of Bangladesh

The results presented in the thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.



(Signature of the Candidate)

Dalia Afsana

Examination Roll No: MS 080612

Session: 2007-2008



(Signature of the Supervisor)

Dr. Md. Golam Sarower

Associate Professor

Fisheries and Marine Resource Technology Discipline

Khulna University

Khulna

December, 2009



Dedication

*This thesis is dedicated to my beloved parents who sacrificed for me,
inspired and blessed me in every way*

Acknowledgement

All praises are to the Supreme Creator and ruler of the universe, Allah whose mercy keeps author alive and gave her the strength and energy to carry out this thesis.

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Finally, the author likes to express her heart felt thanks to all her friends, especially Raza, Zerín and Linda for their sincere help to complete this thesis fruitfully.

The author

December, 2009

Abstract

Length-weight relationship, condition factor and relative condition factor of *Mystus gulio* and *Odontamblyopus rubicundus* were studied for a period of six months from October 2008 to March 2009. The results of the present study show that the length-weight of *M. gulio* was linearly related and the equation obtained for total length-body weight and standard length-body weight was $BW = -68.46 + 7.24*TL$ ($r = 0.93$) and $BW = -65.72 + 9.02*SL$ ($r = 0.94$), respectively. The correlation coefficient indicate that the relationship between length and weight of the fish was highly significant. In case of *O. rubicundus* the equation obtained for total length-body weight and standard length-body weight was $BW = -4.63 + 0.71*TL$ ($r = 0.94$) and $BW = -4.37 + 0.86*SL$ ($r = 0.94$), respectively. The mean value of the condition factor of *M. gulio* observed was 10.15 ± 0.96 . The lowest value of condition factor was observed as 7.69 in the length class of 12-14 cm and the highest value was observed as 13.3 in the length class of 10-12 cm. The values of condition factor of *O. rubicundus* varied between 1.61 to 3.4 with a mean value of 2.29 ± 0.31 . The highest value of the condition factor was observed in the length class of 9-10 cm and the lowest value was observed in the length class of 14-15 cm. The relative condition factor of *M. gulio* varied from 0.75 to 1.31. The highest and the lowest value was recorded in the length class of 10-12cm and 14-16 cm, respectively. The mean value was observed as 0.99 ± 0.09 . The mean relative condition factor of *O. rubicundus* was observed as 1.0 ± 0.12 . The lowest value of the relative condition factor was recorded as 0.66 in the length class of 6-7 cm and the highest value was observed as 1.45 in the length class of 9-10 cm.

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CHAPTER 1
INTRODUCTION

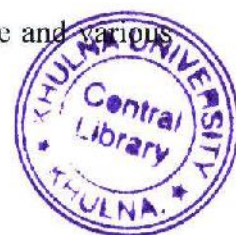
Chapter 1

Introduction

Fisheries has an important role in the agro-based economy of Bangladesh. The fisheries sector contributes 3.74% of the gross domestic product (GDP), 21% of agricultural resources and 4.04% of foreign exchange earning of Bangladesh (DoF, 2009). Bangladesh is fortunate enough for having an extensive and huge water resources scattered all over the country in the form of small ponds, beels, lakes, canals, small and large rivers, and estuaries covering an area of about 3.34 million ha (Mazid, 2002). The inland aquatic habitats of Bangladesh are rich in faunal biodiversity containing at least 265 species of finfish, 63 species of prawn, several species of turtle, tortoises, fresh water mussels and other living aquatic organisms (Rahman, 2005). The biological diversity has been endorsed to the world's one of the largest wetlands and some large waterbodies flowing over the luscious greenery of Bangladesh from the Himalayan Mountains into the Bay of Bengal. The inland water resources of the country enfold an area of 45,75,709 ha of which 88% comprise open waters and 12% closed water bodies (DoF, 2009).

Among the catfishes found in Bangladesh *Mystus gulio* is a commercially important brackishwater food fish locally known as “*nuna tengra*”. A large number of this fish is caught every year from the coastal areas of Bangladesh. It is one of the most commonly appearing fish in the off shore trawl catches. It is a medium sized catfish attaining a length of 40 cm with an elongated and compressed body. The species bears four pairs of barbels. Maxillary barbels on upper lip are very long and extend till end of pelvic fins. These barbels are black. Dorsal fin fairly high with a strong spine and the spine is serrated on its inner edge and the caudal fin is deeply forked. All fins are tipped black, especially

contrasting in younger and smaller individuals. Adipose fin small, well developed and rounded, inserted considerably behind rayed dorsal fin. The catfish is often observed to rest at the bottom between rocks and debris. Young ones tend to form school. Like most catfishes, the species is very active at night (Talwar and Jhingran, 1991). It is primarily a brackishwater fish that enters and lives in freshwater. In freshwater, it occurs mainly in larger water bodies (rivers and streams) with mud or clay substrates, and rarely found in smaller streams (Fishbase, 2008). It has failed to attract the attention of the fishery biologist and only brief aspects of its biology are available. Little attention has been paid to this fish in this country in the past. Due to the increasing fishing pressure and various ecological changes the abundance of this fish is declining day by day.



Odontamblyopus rubicundus is found in estuaries and rivers of the coastal areas of Bangladesh. Every year a large number of this fish is caught from the Sundarban Reserve Forest. The harvested fish are mainly dried and used as an ingredient in feed meal industries for manufacturing poultry and fish feed. It has an eel like elongated compressed body with a sub-cylindrical head and very small eyes. The colour of this species is greenish red above and red to whitish below. The dorsal and anal fins are separated from the caudal fin by a deep notch (Rahman, 2005). Mouth of this species is oblique; teeth biserial on upper jaw with 4 canines on each side, triserial on lower jaw with 4 or 5 canines on each side and a pair of symphyseal canines. The scales are minute and rudimentary. This fish attains a length of 25 cm (Talwar and Jhingran, 1991).

Length-weight relationship and condition factor of fish is very important for the fish culture and management and also to ascertain the environmental suitability of specific fish to a specific region with a greater biological interest (Karim *et al.*, 1988). Application of

length-weight relationship include: estimation of mean weight of fish of a given body length, determination of body condition factors and interpretations of relative wellbeing and conversion of length-growth models to corresponding weight growth models. Though this type of studies dealing with freshwater species is well documented, but studies with brackishwater fishes are rather rare. Only a few estimates of species specific length-weight relationship parameters of fish living in the Bay of Bengal are available.

Another application of the length-weight relationship is comparative growth studies (Moutopoulos and Stergiou, 2002). In fisheries studies, fish length can often be measured more rapidly and easily than mass. The knowledge of the length-weight relationship makes it easier to determine the mass where only the length is known (Kara and Bayhan, 2008). It is also very important for proper exploitation and management of the population of species. Relationship between total length and body weight are also very much essential for stabilizing the taxonomic characters of the species (Pervin and Mortuza, 2008).

Relationship between body length and weight are of great importance in fishery biology (Sparre *et al.*, 1989; Gulland, 1983). This relationship is helpful for estimating the weight of a fish of a given length and can be used in studies of gonad development, rate of feeding, maturity and condition (Le Cren, 1951). Size frequency distribution of any fish gives us the idea of the status of the population structure of that fish in the nature (Amin *et al.*, 2005).

Length-weight relationship is also of great importance in fishery assessments (Garcia *et al.*, 1998; Haimovici and Velasco, 2000). Length and weight measurements in conjunction with age data can give information on the stock composition, age at maturity, life span,

mortality, growth and production (Beyer, 1987; Bolger and Connolly, 1989; King, 1996 and Diaz *et al.*, 2000).

The changes in weight in relation to length are generally not on the basis of specific gravity but due to changes in the form of volume because the density in the organism and that of the surrounding water. Such changes are analyzed by the condition factor or “Pondered index” (Le Cren, 1951). The condition factor tells the condition of the fish, its degree of mortality, relative robustness, plumpness or fatness in numerical terms. This factor is also an additional function of age and growth studies, indicating whether the environment is good or bad for the species. Thus condition factor can also be used as indicator of the effects of environmental improvement including stocking (Cooper and Benson, 1951; Doha and Dewan, 1967). Condition factor also serves as a useful index of the nutritional and biological cycle viz. gonadal development, spawning, etc. of the species. Relative condition factor is also a useful index for estimating the physical well being as well as nutritional and biological cycle. Length-weight relationships data for brackishwater fish resources of Bangladesh are limited and the present study is aimed at compensating for this.

In the present study, the size frequency distribution, length-weight relationship, condition factor and relative condition factor of *M. gulio* and *O. rubicundus* were estimated to know the status of this two species in the Khulna region, which could be helpful for the management of the fishery.

Objectives:

The objectives of this study were

To determine the length-weight relationship of *M. gulio* and *O. rubicundus*.

To determine the condition factor and relative condition factor of *M. gulio* and *O. rubicundus*.

CHAPTER 2
REVIEW OF LITERATURE

Chapter 2

Review of Literature

This chapter is designed for a brief review of the length-weight relationship, condition factor and relative condition factor of different fish species of Bangladesh and other works which are closely related to the present study.

Islam *et al.* (1987) reported the length-weight relationship of *Hilsa ilisha* from Chittagong, Khepupara and Chandpur. The exponential form of the relationship was $W=0.0305L^{2.73}$ ($r^2=0.85$); Male: $W=0.0177L^{2.76}$ ($r^2=0.97$) and Female: $W=0.0269L^{2.89}$ ($r^2=0.98$); Male: $W=0.028L^{2.74}$ ($r^2=0.98$) and Female: $W=0.021L^{2.87}$ ($r^2=0.98$) for Chittagong, Khepupara and Chandpur respectively.

Haroon (1999) studied the length-weight relationship of *Catla catla* of Sylhet basin. The length-weight relationship was established as $W=0.012TL^{3.04}$. The logarithmic form of the length-weight relationship was $\log W=-1.92+3.04\log TL$ ($r=0.99$).

Rahman *et al.* (2000) studied the length-weight relation of *Tenualosa ilisha* of Bangladesh water. The estimated length-weight relationship for the combined sex was $W=0.01351TL^{2.974}$.

Amin (2001) reported the length-weight relationship and relative condition factor of *Harpodon nehereus* from the neritic water of Bangladesh. The logarithmic form of the length-weight relationship was $\log W=-2.5967+3.051\log TL$ ($r=0.997$). The mean value of the relative condition factor was 1.003 ± 0.081 .

Rahman *et al.* (2004) studied the length-weight relationship, condition factor and harvesting records of Silver Pomfret (*Pampus argenteus*) from the southwestern region of Bangladesh. The relationship between standard length and body weight was $\log W = -1.1004 + 2.7931 \log L$. The co-efficient of correlation (r) was 0.989. The mean value of the condition factor (K) was 44.27.

Amin *et al.* (2005) reported the size frequency distribution, sex ratio and length-weight relationship of Hilsa (*Tenualosa ilisha*) from Bangladesh water. The logarithmic form of the length-weight relationship of *T. ilisha* was $\log W = -2.516 + 3.381 \log TL$. The exponential form of equation obtained for the length-weight relationship was $W = 0.00305 TL^{3.381}$. The value of co-efficient of correlation (r) estimated for the species was 0.93 ($p < 0.01$), which indicated that the relationship between length and weight of the fish was highly significant.

Hossain *et al.* (2006a) reported the length-weight (LWR) and length-length (LLR) relationships of eight important small indigenous fish species (SIS) from the Mathabhanga River, southwestern Bangladesh, namely *Amblypharyngodon mola* (Hamilton, 1822), *Channa punctata* (Bloch, 1793), *Hyporhamphus quoi* (Valenciennes, 1847), *Macrognathus aculeatus* (Bloch, 1786), *M. pancalus* (Hamilton, 1822), *Nandus nandus* (Hamilton, 1822), *Puntius sophore* (Hamilton, 1822), and *Setipinna phasa* (Hamilton, 1822).

Hossain *et al.* (2006b) studied the annual condition as well the length-weight (LWR) and length-length relationships (LLR) of the Asian striped catfish, *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae). The allometric coefficient b of the LWR was close to the isometric value ($b = 3.058$), although it suggested negative allometric growth for males

($b = 2.959$) whilst positive allometric growth for females ($b = 3.134$). The results further indicated that the LLRs were highly correlated ($r^2 > 0.989$, $p < 0.001$). The monthly gonadosomatic index showed that the reproductive period of *M. vittatus* began in April, and ended in August when the highest values of the Fulton's condition factor (K) indicated their recovery.

Mortuza and Rahman (2006) reported the length-weight relationship, condition factor and sex-ratio of freshwater fish, *Rhinomugil corsula* from Rajshahi. The length-weight relationship was $\log W = -4.914 \pm 2.941 \log L$ ($r = 0.936$), $\log W = -5.052 \pm 3.008 \log L$ ($r = 0.934$) and $\log W = -4.997 \pm 2.984 \log L$ ($r = 0.937$) for male, female and combined sexes respectively. The mean value of the condition factor for observed weight was 0.9155 ± 0.0626 , 0.9320 ± 0.1060 and 0.9373 ± 0.0803 and for calculated weight was 0.9038 ± 0.0175 , 0.9245 ± 2.3399 and 0.9462 ± 0.0625 for male, female and combined sexes respectively.

Ahmed *et al.* (2007) reported the relationship between body weight and standard length of male and female *Gudusia chapra*. The exponential form of the relationship of male and female *G. chapra* was $W = 0.00003SL^{2.97}$ and $W = 0.00004SL^{2.82}$ respectively.

Nabi *et al.* (2007) reported the length-weight relationship of *Polynemus paradiseus* from estuarine set bag net fishery of Bangladesh. The exponential form of the length-weight relationship was $W = 0.0087L^{2.7398}$ signifying isometric growth for this species.

Pervin and Mortuza (2008) reported the length-weight relationship and condition factor of fresh water fish *Labeo boga*. The relationship between length and weight of male, female and combined sexes of *L. boga* was $\log W = -73.60 \pm 1.001 \log L$ ($r = 0.877$), $\log W = -$

195.31±1.576logL (r=0.846) and logW=-144.98±1.313logL (r=0.853) respectively. The mean value of the condition factor of male, female and unsexed specimens was 2.1194±1.9586, 1.1601±0.2537 and 1.3241±1.1712 respectively. The mean relative condition factor was 1.050±0.5005, .5555±0.3156 and 0.8865±0.5647 for males, females and combined sexes respectively.

CHAPTER 3
MATERIALS AND METHODS

Chapter 3

Materials and Methods

3.1 Sample Collection

Fortnightly samples of *M. gulio* and *O. rubicundus* were collected during October 2008 to March 2009 from the local markets of Khulna District. A total of 483 specimens of *M. gulio* and 390 specimens of *O. rubicundus* were collected during the study period. On each sampling day 25 to 50 fish were randomly sampled.

3.2 Measurement of Total Length, Standard Length and Body Weight

Total length (TL) of each individual fish was measured from the most anterior part of the snout to the posterior most tip of the caudal fin on a meter scale. Standard length (SL) was also measured from the most anterior part of the snout to the base of the caudal fin on the same scale. Body weight (BW) was taken by an electrical balance of 0.1 g accuracy. The length and weight were recorded in cm and g respectively. Total length and standard length were measured to the nearest 0.1 cm. Before taking the weight excess water from the fish body was wiped off by a piece of dry cloth.

3.3 Length-Weight Relationship

The length-weight relationship was calculated by using LeCren's (1951) formula as follows:

$$W = aL^b$$

Where,

W = weight in g

L = length in cm

a = intercept and

b = exponent

The exponential form of relationship in the formula can be expressed in the logarithmic form:

$$\log W = \log a + b \log L$$

The values of a and b in the equation were calculated for the total length-weight (TL-BW) and standard length-weight (SL-BW) in the logarithmic form of the formula.

The values of a and b in the equation were calculated by using the following mathematical relationship given by Rounsefell and Everhart (1953); Lagler (1956); Doha and Dewan (1967).

$$\log a = \frac{\sum \log W \times \sum (\log L)^2 - \sum \log L \times \sum (\log L \times \log W)}{N \times \sum (\log L)^2 - (\sum \log L)^2}$$

$$b = \frac{\sum \log W - N \times \log a}{\sum \log L}$$

Where, N = sample size

$$r = \frac{\sum xy - \frac{\sum x \times \sum y}{N}}{\sqrt{\left[\left\{ \sum x^2 - \frac{(\sum x)^2}{N} \right\} \left\{ \sum y^2 - \frac{(\sum y)^2}{N} \right\} \right]}}$$

The regression co-efficient b (slope of regression line of weight to length) was calculated using LeCren's (1951) formula.

3.4 Condition Factor (K)

The condition factor was calculated by using the following formula:

$$K = \frac{W \times 10^3}{L^3} \text{ (King, 1997)}$$

Where,

W = weight of the fish in g

L = length of fish in cm

K = condition factor and

10^3 = the factor bringing the ponderal index or condition factor near unity.



3.5 Relative Condition Factor (K_n)

In the present study, the relative condition factor (K_n) was also determined. Because Le Cren (1951) recommended that the relative condition factor (K_n) as preferable to K, as in

former, the effect of length and other correlated factors are eliminated. The relative condition factor (K_n) was estimated by using the following formula:

$$K_n = \frac{\text{Observed weight}}{\text{Caculated weight}}$$

3.6 Data Analysis

All the data collected during the experiment were recorded and saved in computer. Mean values and standard deviations were calculated using Microsoft Office Excel. For statistical analysis SPSS-12 software were used. Graphs were formulated using SPSS-12 and Microsoft Office Excel software.

CHAPTER 4
RESULTS

Chapter 4

Results

4.1 Size Frequency Distribution

4.1.1 Total length classes of *M. gulio*

For size frequency distribution a total of 483 specimens of *M. gulio* were pooled length wise at 1 cm class interval. The total length of *M. gulio* varied from 6.2 (body weight 2.1 g) to 25.5 cm (body weight 164.4 g). The maximum number of *M. gulio* was observed in the length class of 13-14 cm (18.63%, n=90) and the minimum number was observed in the length class of 25 to 26 cm (0.2%, n=1). The mean total length was observed as 13.4 ± 3.012 cm. Size frequency distribution of *M. gulio* according to total length is presented in Fig. 1.

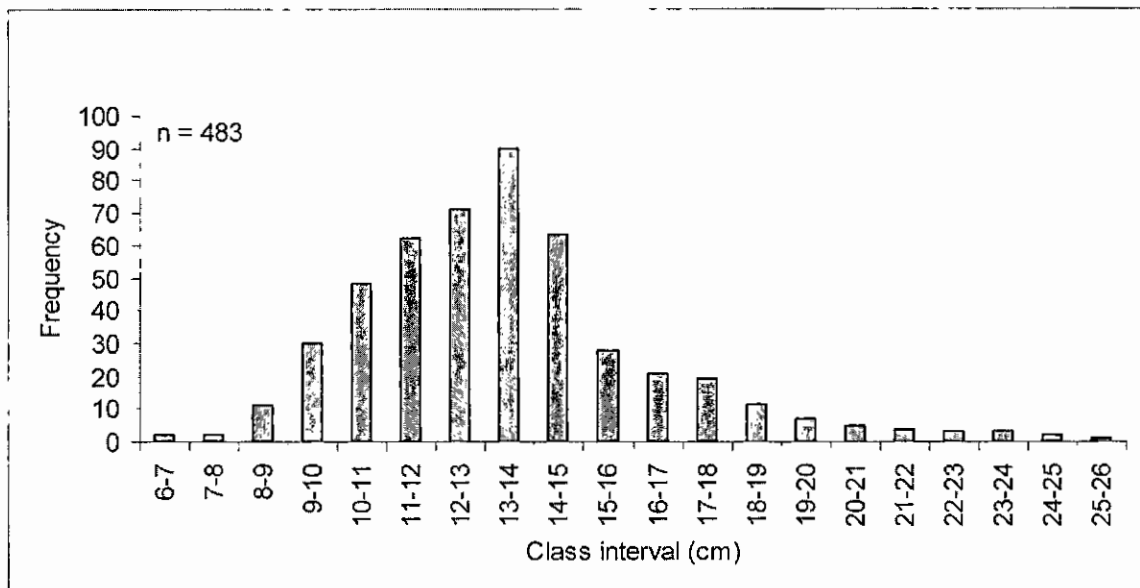


Fig. 1. Total length frequency distribution of *M. gulio*.

4.1.2 Total length classes of *O. rubicundus*

A total of 390 specimens of *O. rubicundus* were pooled length wise at 1 cm class interval for the size frequency distribution. The minimum total length of *O. rubicundus* was observed as 6.1 cm (body weight 0.4 g) and the maximum total length was observed as 15.8 cm (body weight 6.8 g). The maximum number of *O. rubicundus* was observed in the length class of 10-11 cm (27.94%, n=109) and the minimum number was observed in the length class of 15-16 cm (0.76%, n=3). The mean total length was observed as 10.73 ± 1.579 cm. The size frequency distribution of *O. rubicundus* according to total length is presented in Fig. 2.

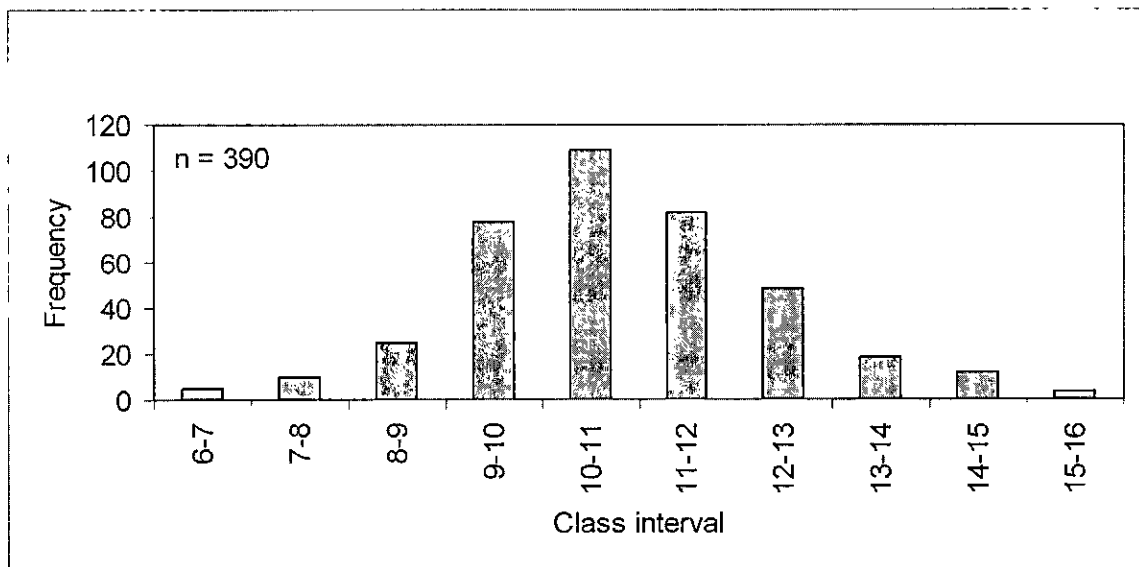


Fig. 2. Total length frequency distribution of *O. rubicundus*.

4.2 Body Weight

4.2.1 Body weight of *M. gulio*

The minimum body weight of *M. gulio* was observed as 2.1 g with a total length of 6.2 cm and standard length of 4.7 cm. The maximum body weight was observed in a fish of 164.4

g with total length of 25.5 cm and standard length of 20.2 cm. The mean body weight was observed as 28.5 ± 23.34 g.

4.2.2 Body weight of *O. rubicundus*

The body weight of *O. rubicundus* varied from 0.4 g (total length 6.1 cm and standard length 4.7 cm) to 7.6 g (total length 15.3 cm and standard length 11.2 cm). The mean body weight was observed as 2.96 ± 1.183 g.

4.3 Length Weight Relationship

4.3.1 Length weight relationship of *M. gulio*

The length-weight relationship gave the following equations for total length and standard length:

$$BW = -68.46 + 7.24 * TL \quad (r = 0.93)$$

$$\log BW = -2.04 + 3.04 * \log TL \quad (r = 0.99)$$

$$BW = -65.72 + 9.02 * SL \quad (r = 0.94)$$

$$\log BW = -1.63 + 2.96 * \log SL \quad (r = 0.99)$$

The regression line of body weight on total length and standard length are presented in Fig. 3 and 4 while the same in logarithmic form in Fig. 5 and 6, respectively. Linear relationship was obtained in each of the cases. The exponent 'b' value was close to 3 which indicated isometric growth pattern. The correlation coefficient values of total length-body weight, standard length-body weight, log total length-log body weight and log standard length-log body weight were 0.93, 0.94, 0.99 and 0.99 respectively. So, the

length and body weight of *M. gulio* were highly correlated. The values of intercept, slope and correlation coefficient of the length weight equations are summarized in Table 1.

Table 1. Intercept, slope and correlation coefficient (r) of the length weight equation of *M. gulio*.

Relationship	Intercept	Slope	r (correlation coefficient)
Body weight-total length	-68.46	7.24	0.93
Body weight-standard length	-65.72	9.02	0.94
Log body weight-log total length	-2.04	3.04	0.99
Log body weight-log standard length	-1.63	2.96	0.99

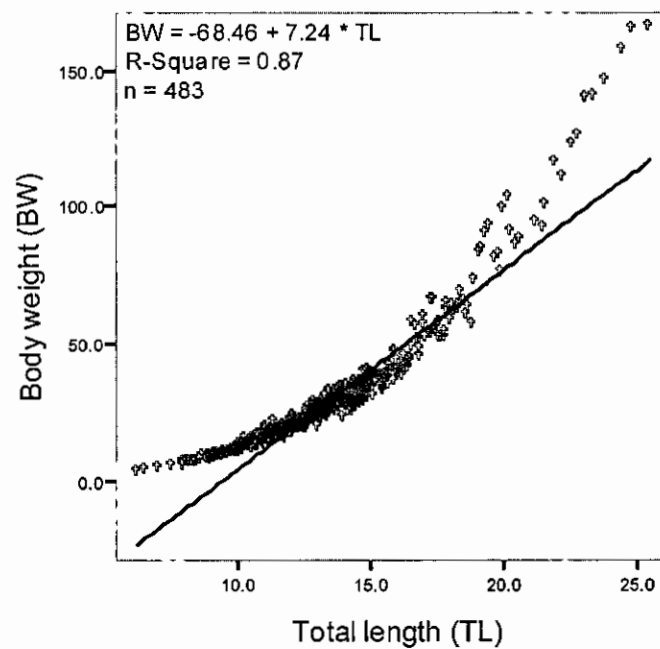


Fig. 3. Relationship between total length (TL) in cm and body weight (BW) in g of *M. gulio*.

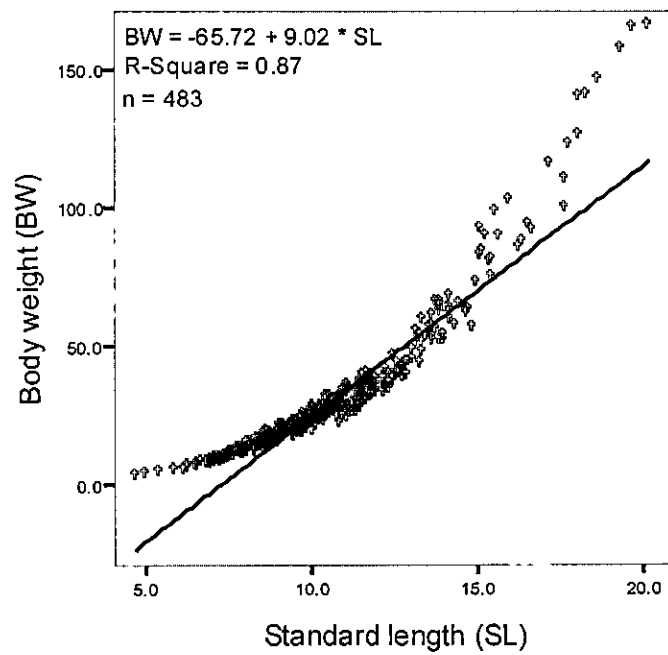


Fig. 4. Relationship between standard length (TL) in cm and body weight (BW) in g of *M. gulio*.

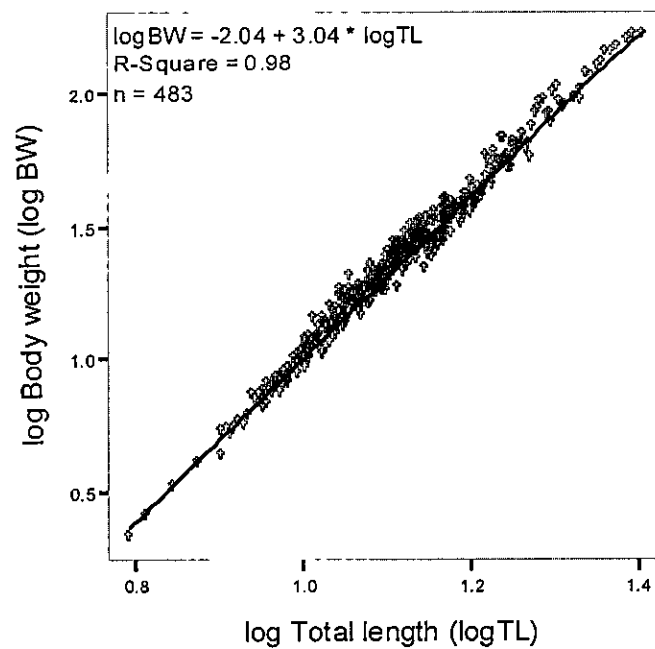


Fig. 5. Relationship between log total length (logTL) in cm and log body weight (logBW) in g of *M. gulio*.

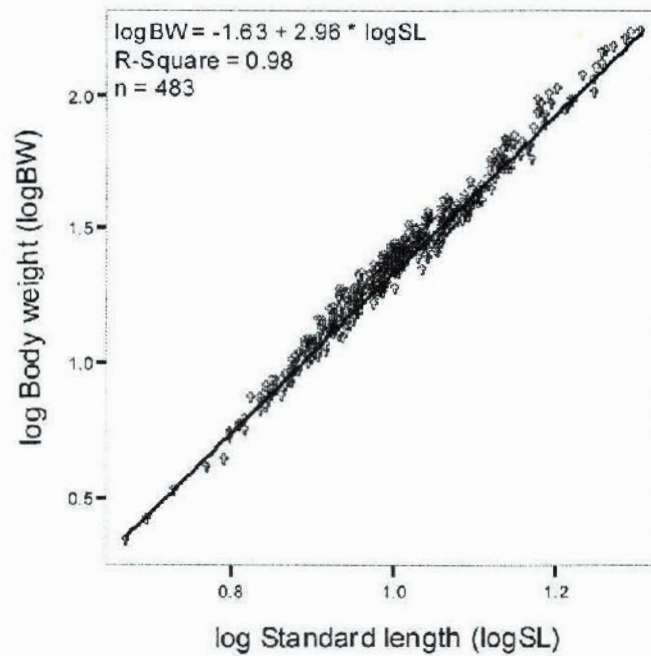


Fig. 6. Relationship between log standard length (logSL) in cm and log body weight (logBW) in g of *M. gulio*.

4.3.2 Length weight relationship of *O. rubicundus*

The relationship between body weight and total length and body weight and standard length as well as their logarithmic form gave the following equations:

$$BW = -4.63 + 0.71 * TL \quad (r = 0.94)$$

$$\log BW = -2.36 + 2.73 * \log TL \quad (r = 0.96)$$

$$BW = -4.37 + 0.86 * SL \quad (r = 0.94)$$

$$\log BW = -1.99 + 2.63 \log SL \quad (r = 0.96)$$



The regression line of body weight on total length and standard length are depicted in Figs. 7 and 8. When the body weight and length were converted to logarithmic form a linear relationship was obtained between log body weight and log total length (Fig. 9) and log body weight and log standard length (Fig. 10). The exponent 'b' values obtained from

the present study was lower than 3. The values of correlation coefficient of the length-weight equation were 0.94, 0.94, 0.96 and 0.96 in total length-body weight, standard length-body weight, log total length-log body weight and log standard length-log body weight respectively. The values of correlation coefficient were close to 1.0 which indicated the length-weight relationship of *O. rubicundus* was highly correlated. The values of intercept, slope and correlation coefficient of the length weight equation of *O. rubicundus* are presented in Table 2.

Table 2. Intercept, slope and correlation coefficient (r) of the length weight equation of *O. rubicundus*.

Relationship	Intercept	Slope	r (correlation coefficient)
Body weight-total length	-4.63	0.71	0.94
Body weight-standard length	-4.37	0.86	0.94
Log body weight-log total length	-2.36	2.73	0.96
Log body weight-log standard length	-1.99	2.63	0.96

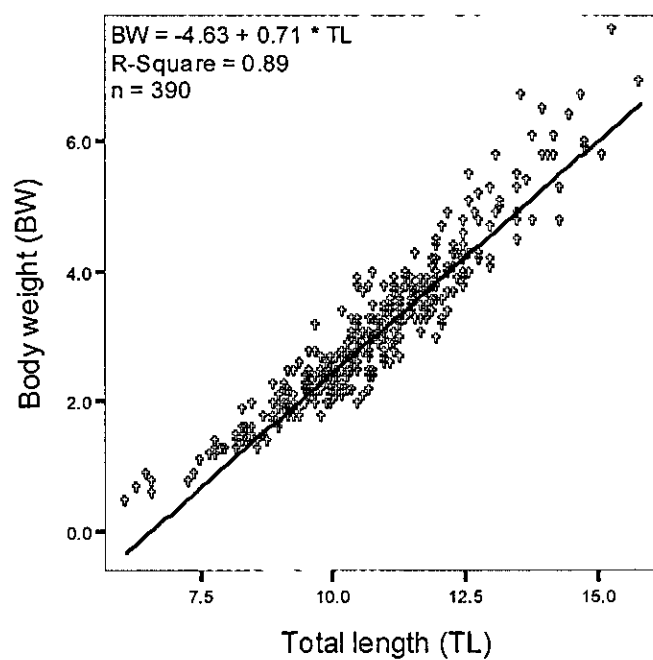


Fig. 7. Relationship between total length (TL) in cm and body weight (BW) in g of *O. rubicundus*.

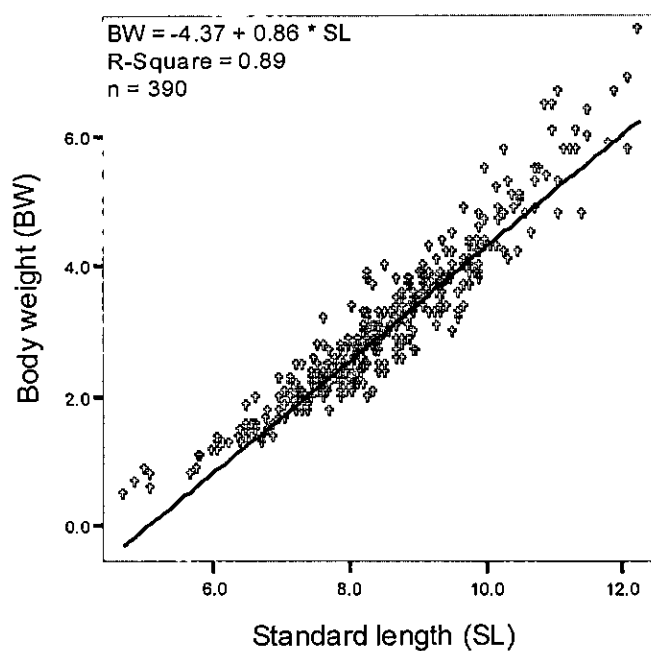


Fig. 8. Relationship between standard length (SL) in cm and body weight (BW) in g of *O. rubicundus*.

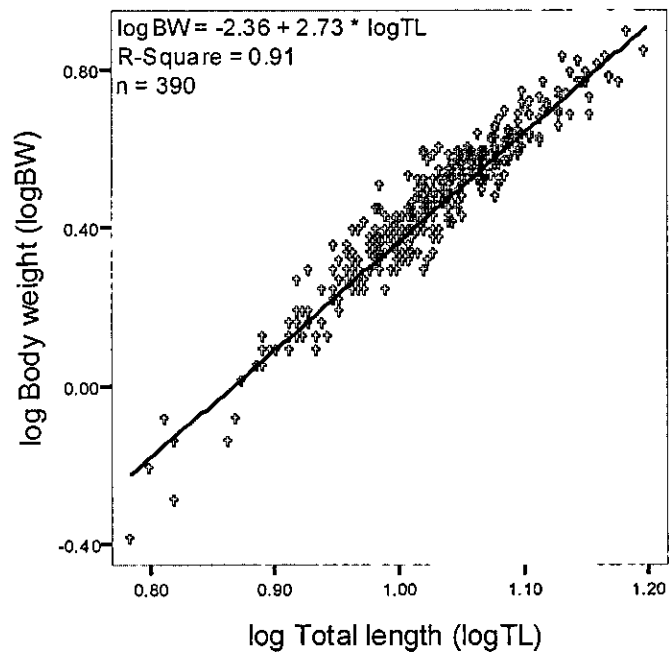


Fig. 9. Relationship between log total length (logTL) in cm and log body weight (logBW) in g of *O. rubicundus*.

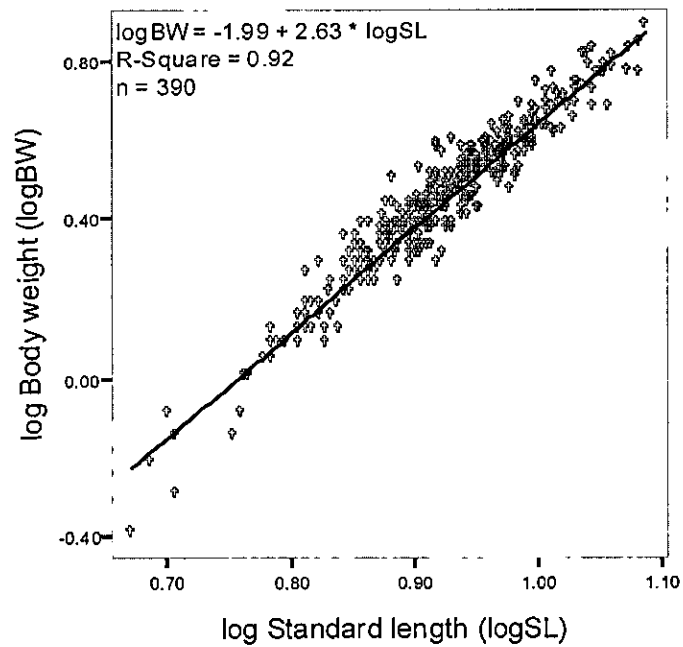


Fig. 10. Relationship between log standard length (logSL) in cm and log body weight (logBW) in g of *O. rubicundus*.

4.4 Condition Factor

4.4.1 Condition factor of *M. gulio*

The mean value of the condition factor of *M. gulio* as obtained in the present study was 10.15 ± 0.96 . The lowest value of condition factor was observed as 7.69 in the length class of 12-14 cm and the highest value was observed as 13.3 in the length class of 10-12 cm. The mean values of the condition factor according to different length classes are summarized in Table 3. The values of the condition factor increased gradually with the increase in length but a sharp fall in the values were observed in the length class of 14-16 cm. The mean values of the condition factor in different length classes of *M. gulio* is presented in Fig. 11. The highest mean value was observed in the length class of 22-24 cm (10.64 ± 0.42) and the lowest value was observed in the length class of 6-8 cm (9.14 ± 0.64).

Table 3. Condition factor of *M. gulosus* according to different length classes.

Class size (cm)	Minimum K	Maximum K	Mean $\pm$ SD
6-8	8.2	10.16	9.14 $\pm$ 0.64
8-10	8.63	10.78	9.63 $\pm$ 0.53
10-12	8.46	13.3	10.27 $\pm$ 0.95
12-14	7.69	12.52	10.42 $\pm$ 0.91
14-16	7.93	11.72	9.74 $\pm$.99
16-18	8.66	12.5	10.08 $\pm$ 1.01
18-20	8.32	12.25	10.47 $\pm$ 1.12
20-22	9.09	12.27	10.22 $\pm$ 0.99
22-24	9.97	11.24	10.64 $\pm$ 0.42
24-26	9.91	10.74	10.41 $\pm$ 0.44
Total	7.69	13.3	10.15 $\pm$ 0.96

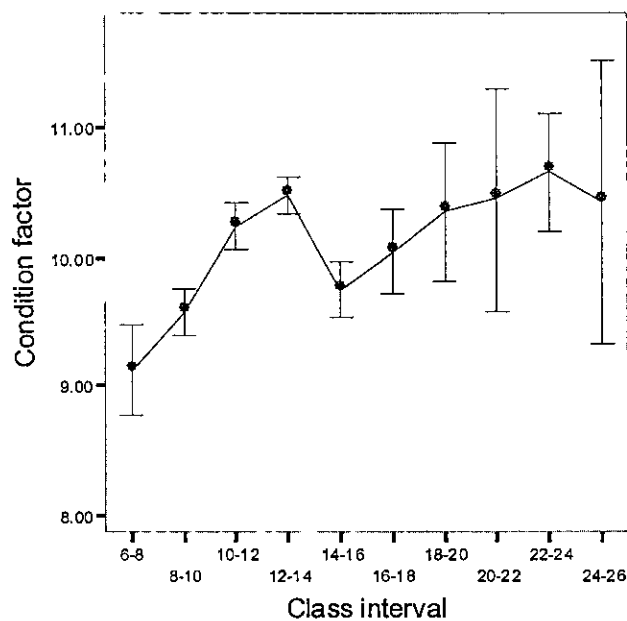


Fig. 11. Mean condition factor of *M. gulosus* according to different length classes.

4.4.2 Condition factor of *O. rubicundus*

The values of condition factor of *O. rubicundus* varied between 1.61 to 3.4 with a mean value of 2.29 ± 0.31 . The highest value of the condition factor was observed in the length class of 9-10 cm and the lowest value was observed in the length class of 14-15 cm. The mean values of the condition factor according to different length classes are summarized in Table 4. The highest and lowest mean values were observed in the length class of 9-10 cm and 15-16 cm respectively. Fig. 12 represents the mean condition factor in different length classes of *O. rubicundus*. The values of the condition factor decreased with the increase in length of the fish (Fig. 12).

Table 4. Condition factor of *O. rubicundus* according to different length classes.

Class size (cm)	Minimum K	Maximum K	Mean $\pm$ SD
6-7	1.74	2.91	2.24 $\pm$ 0.49
7-8	1.8	2.74	2.33 $\pm$ 0.26
8-9	1.89	3.15	2.41 $\pm$ 0.33
9-10	1.81	3.4	2.42 $\pm$ 0.29
10-11	1.64	3.28	2.34 $\pm$ 0.34
11-12	1.8	2.78	2.25 $\pm$ 0.23
12-13	1.68	2.7	2.15 $\pm$ 0.23
13-14	1.79	2.62	2.11 $\pm$ 0.24
14-15	1.61	2.33	2.0 $\pm$ 0.22
15-16	1.66	2.12	1.83 $\pm$ 0.25
Total	1.61	3.4	2.29 $\pm$ 0.31

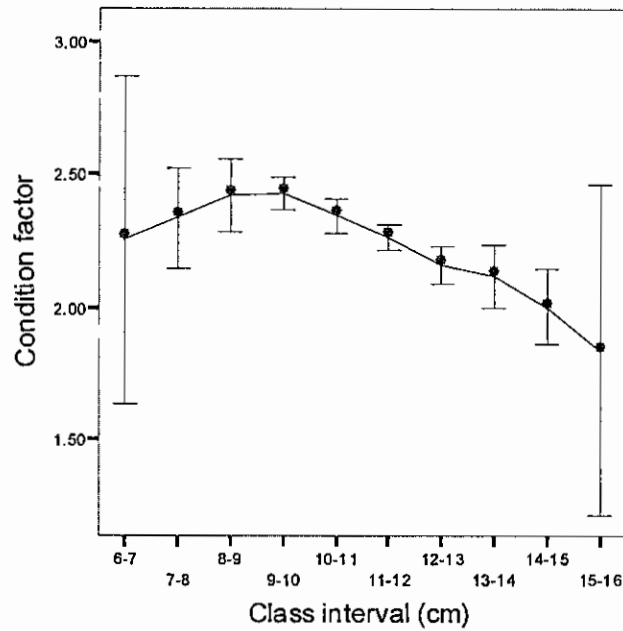


Fig. 12. Mean condition factor of *O. rubicundus* according to different length classes.

4.5 Relative Condition Factor

4.5.1 Relative condition factor of *M. gulio*

During the study period, the relative condition factor of *M. gulio* varied from 0.75 to 1.31. The highest and lowest value was recorded in the length class of 10-12cm and 14-16 cm respectively. The mean value was observed as 0.99 ± 0.09 . The values of the relative condition factor according to different length classes are summarized in Table 5. The highest mean value was observed in the length class of 12-14 and 22-24 cm and the lowest value was observed in the length class of 6-8 cm. The mean values of the relative condition factor according to different length classes are depicted in Fig. 13. The values of the relative condition factor gradually increased with the increase in length except in the length class of 14-16 cm where a sharp fall was observed.

Table 5. Relative condition factor of *M. gulosus* according to different length classes.

Class size (cm)	Minimum K_n	Maximum K_n	Mean $\pm$ SD
6-8	0.89	0.94	0.91 $\pm$ 0.02
8-10	0.82	1.08	0.95 $\pm$ 0.05
10-12	0.83	1.31	1.01 $\pm$ 0.09
12-14	0.8	1.23	1.02 $\pm$ 0.08
14-16	0.75	1.15	0.95 $\pm$ 0.09
16-18	0.84	1.21	0.97 $\pm$ 0.09
18-20	0.81	1.19	1.0 $\pm$ 0.10
20-22	0.87	1.18	1.0 $\pm$ 0.11
22-24	0.96	1.08	1.02 $\pm$ 0.04
24-26	0.95	1.03	0.99 $\pm$ 0.04
Total	0.75	1.31	0.99 $\pm$ 0.09

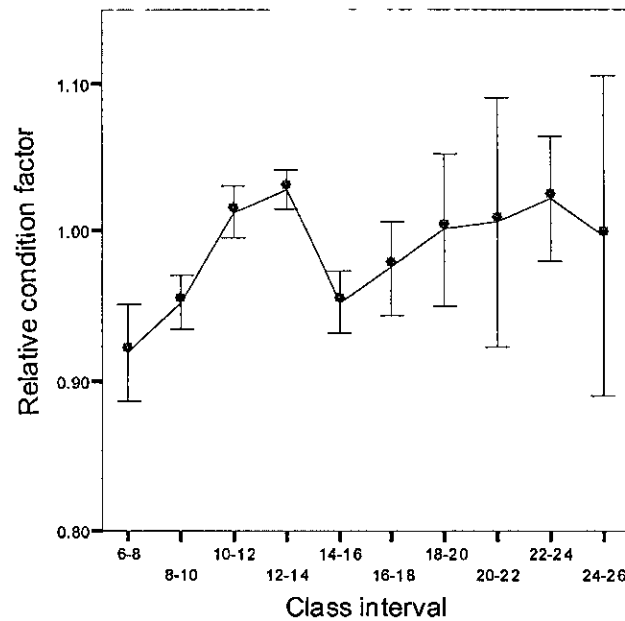


Fig. 13. Mean relative condition factor of *M. gulosus* according to different length classes.

4.5.2 Relative condition factor of *O. rubicundus*

The mean relative condition factor of *O. rubicundus* was observed as 1.0 ± 0.12 . The lowest value of the relative condition factor was recorded in the length class of 6-7 cm (0.66) and the highest value was observed in the length class of 9-10 cm (1.45). The values of the relative condition factor of *O. rubicundus* are summarized in Table 6. The values of the relative condition factor increased with the increase of total length in the middle length classes then slightly decreased with the increase in total length. Fig. 14 represents the mean relative condition factor according to different length classes.

Table 6. Relative condition factor of *O. rubicundus* according to different length classes.

Class size (cm)	Minimum K_n	Maximum K_n	Mean $\pm$ SD
6-7	0.66	1.11	0.85 ± 0.19
7-8	0.71	1.1	0.93 ± 0.11
8-9	0.78	1.3	0.99 ± 0.14
9-10	0.78	1.45	1.03 ± 0.12
10-11	0.72	1.44	1.02 ± 0.15
11-12	0.81	1.23	1.01 ± 0.09
12-13	0.76	1.25	0.98 ± 0.11
13-14	0.84	1.24	0.99 ± 0.11
14-15	0.77	1.11	0.95 ± 0.1
15-16	0.81	1.04	0.89 ± 0.12
Total	0.66	1.45	1.0 ± 0.12

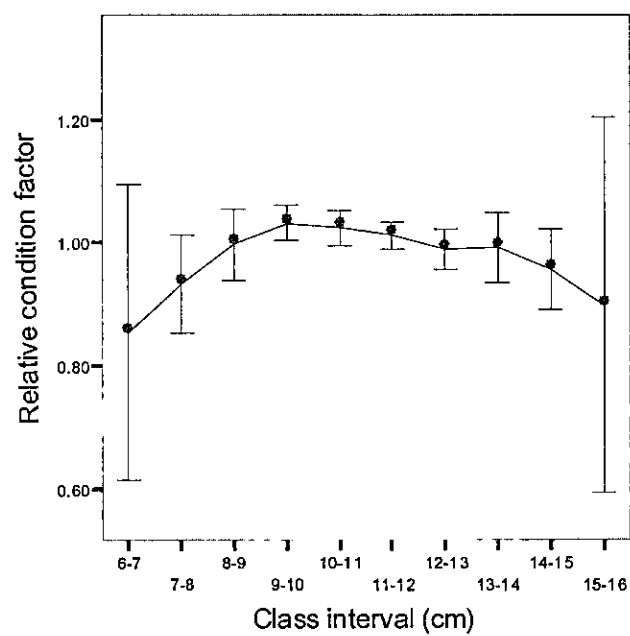


Fig. 14. Mean relative condition factor of *O. rubicundus* according to different length classes.

CHAPTER 5
DISCUSSION

Chapter 5

Discussion

The length-weight relationship of *M. gulio* and *O. rubicundus* were established by using the formula $W=aL^b$. Obtaining of the significant relationship between the total length and body weight of both *M. gulio* and *O. rubicundus* in the present study agree well with the results reported for *Tenualosa ilisha* by Haldar and Amin (2005), for *Pampus argenteus* by Rahman *et al.*, (2004) and *Catla catla* by Zafar *et al.*, (2003).

When the values of standard length were plotted against the corresponding weight of the fishes, the regression lines showed a curvilinear relationship. Their logarithmic transformation made the relationship linear. The relationship also indicates that the weight of fish is directly related with the length. The value of the correlation coefficient ($r=0.94$) also indicate that the standard length and body weight of both *M. gulio* and *O. rubicundus* to be highly correlated.

Similar findings were also reported by Mortuza and Rahman (2006), Ahmed *et al.* (2007), Nabi *et al.* (2007) and Pervin and Mortuza (2008) for *Rhinomugil corsula*, *Gudusia chapra*, *Polynemus paradiseus* and *Labeo boga*, respectively.

The relationship between standard length and body weight was also significant and curvilinear while plotting of the logarithmic transformed data made the relationship linear in both the species which indicate that standard length was also closely related with the weight of both *M. gulio* and *O. rubicundus*.

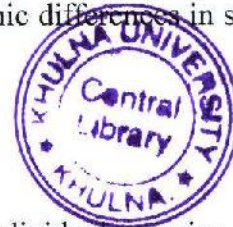
Obtaining of the exponent 'b' value nearer to 3 indicate isometric growth pattern in both the species surveyed in the present study. In fish, the weight is considered to be function of length (Weatherley and Gill, 1987). If the fish retains the same shape and its specific gravity remains unchanged during lifetime, it is growing isometrically and the value of exponent 'b' would be exactly 3.0. A value significantly larger or smaller than 3.0 indicates allometric growth (Wootton, 1990). A value less than 3.0 shows that the fish becomes lighter (negative allometric) or greater than 3.0 indicates that the fish becomes heavier (positive allometric) for a particular length as it increases in size (Wootton, 1998).

Hile (1936) observed that the value of the regression co-efficient 'b' usually lies between 2.5 and 4.0 and for perch like fishes it is often 3.0. From the logarithmic transformation of the general formula $W=aL^b$ it was clear that *M. gulio* increases as the cube of the length. The value of 'b' was 3.04 in case of total length and 2.96 in case of standard length which is very close 3.0 (the value of an ideal fish).

According to Fishbase information the value of a and b of this genus was observed as 0.0562 and 2.666 respectively which indicate allometric growth of the *Mystus* genus. But the value of b as obtained in the present study in case of *M. gulio* indicate isometric growth of this species. This might be due to distribution of the species in different geographical location, food content in the stomach, spawning season, etc. So, further study can be conducted on the length-weight relationship of *M. gulio* to know about the growth pattern of this species.

In case of *O. rubicundus*, the value of 'b' was observed as 2.73 and 2.63 for total length and standard length, respectively. The value of 'b' as obtained in the present study is lower

than 3 in both the cases which indicate that the growth pattern of *O. rubicundus* was negative allometric. The specific gravity of the fish is known to undergo changes but Le Cren (1951) indicated that the density of the fish might be maintained in the surrounding water by means of swim bladder. The changes in weight, therefore, is due to changes in form and not in specific gravity. Most fishes do not confirm the cube law because they change their shape with growth (Ali *et al.*, 2000). The 'b' value may be higher or lower than 3.0. The value of 'b' may also vary with feeding, state of maturity, sex and further more between different populations of a species indicating taxonomic differences in small populations (Zafar *et al.* 2003).



The condition factor is not constant and found to vary in an individual, species or a population having relationship between seasonal changes in the environment and with the changes of physiological conditions of the fishes (Doha and Dewan, 1967). A curve was drawn by plotting the observed values of K against class size of 2 cm interval showed certain variation in different length. In general, the condition factors tended to increase with the increase in length of the fishes. Similar fluctuating trends of the condition factor were also reported in case of other fishes by Doha and Dewan (1967), Mirza (1985), Quddus *et al.* (1987) and Hossain *et al* (1987). Such fluctuation of the condition factor might be due to the seasonal variation, feeding intensity, size of fishes, sample size and ovarian development of the fishes. The condition factor may also vary when average weight of the fish is not increasing in direct proportion to the cube of its length (Wooton, 1990).

The condition factor of *O. rubicundus* as observed in the present study ranged from 1.61 to 3.4 with a mean value of 2.29 ± 0.31 and was found to decrease slowly with the increase of

total length. The highest values of the condition factor were observed in the smaller length classes. Similar fluctuating trends of the condition factor were also reported in case of other fishes by Doha and Dewan (1967), Mirza (1985), Quddus *et al.* (1987) and Hossain *et al.* (1987).

In the present study the values of K_n were not stable to certain length classes of both *M. gulio* and *O. rubicundus*, higher in the middle total length classes and lower in the higher and lower total length classes. The variation may be due to the different stages of sexual maturity or spawning or may be due to the food content of the stomach. The present findings agree with those of Rao (1967) who suggested that generally in fishes a drop in the K_n followed by a rise is associated with the attainment of maturity and the lowest value is due to the on set of spawning and increased metabolic stress. Variation of the K_n values due to the above causes were also reported by Doha and Dewan (1967), Shafi and Mustafa (1976), Das (1977) and Kader (1984) on different species of fishes.

CHAPTER 6
CONCLUSION

Chapter 6

Conclusion

In the present investigation an attempt was made to assess the length-weight relationship, condition factor and relative condition factor of *M. gulio* and *O. rubicundus*. Both these species are widely available in the southwestern part of Bangladesh. They are of economic importance and are harvested from the wild throughout the year. Although the species are captured from the wild stocks regularly but there have been not many records on their length-weight relationship, condition factor and relative condition factor. Therefore, the findings of the present study will be immensely helpful towards formulating the future strategies for the conservation and rehabilitation of these species to a greater extent. The major limitation of the present study was small sample size and data collection for only six months. Therefore, further year round study with bigger sample size is needed.

CHAPTER 7
REFERENCES

References

- Ahmed, Z.F., Smith, C., Ahamed, F. and Hossain, M.Y. 2007. Growth and reproduction of Indian river shad, *Gudusia chapra* (Clupeidae). *Folia Zool.*, 56(4): 429-439.
- Ali, M., Salam, A. and Iqbal, F. 2000. Weight-length and condition factor relationship of wild *Channa punctata* from Multan. *Punjab University Journal of Zoology*, 15: 183-189.
- Amin, S.M.N. 2001. Studies on age and growth, VPA analysis and relative condition factor of *Harpadon nehereus* (Ham-Buch) from the neritic water of Bangladesh. *Online Journal of Biological Sciences*, 1(4): 192-194.
- Amin, S.M.N., Arshad, A., Haldar, G.C., Shohaimi, S. and Ara, R. 2005. Estimation of Size Frequency Distribution, Sex Ratio and Length-Weight Relationship of Hilsa (*Tenualosa ilisha*) in the Bangladesh Water. *Research Journal of Agriculture and Biological Sciences*, 1(1): 61-66.
- Beyer, J.E. 1987. On length-weight relationship. Part 1. Corresponding the mean weight of a given length class. *Fishbyte*, 5(1): 11-13.
- Bolger, T. and Connolly, P.L. 1989. The selection of suitable indices for the measurement and analysis of fish condition. *J. Fish. Biol.*, 34: 171-182.

- Cooper, E. L. and Benson, N.G. 1951. The coefficients of condition of brook, brown and rainbow trout in the Pigeon River, Ostego Country, Michigan. *The Progressive Fish Culturist*, 13(4): 181-192.
- Das, S.S. 1977. Maturity, spawning and fecundity of cat fish, *Tachysurus tenuispinis* (Day). *Indian Journal of Fisheries*, 27(1 & 2): 220-235.
- Diaz, L.S., Roa, A., Garcia, C.B., Acero, A. and Navas, G. 2000. Length-weight relationships of demersal fishes from the upper continental slope of Colombia. *Naga, The ICLARM Quarterly*, 23(3): 23-25.
- DoF (Department of Fisheries). 2009. Jatio Matsha Sapthaho 2009 (In Bengali), Department of Fisheries, Dhaka, 13-105 pp.
- Doha, S. and Dewan, S. 1967. Studies on the biology of tilapia (*Oreochromis mossambicus* Peters). III. Length-weight relationship and condition factor. *Pakistan Journal of Biological Sciences*, 19: 14-23.
- Fishbase. 2008. *Mystus gulio* [Online] Available: <http://www.fishbase.org/Summary/speciesSummary.php?ID=5139&genusname=Mystus&speciesname=gulio>.
- Garcia, C.B., Buarte, J.O., Sandoval, N., Von Schiller, D., Mello and Najavas, P. 1998. Length-weight relationships of demersal fishes from the Gulf of Salamanca, Colombia. *Fishbyte*, 21: 30-32.

Gulland, J.A., 1983. Fish stock assessment: a manual of basic methods. FAO/Wiley Series on Food and Agriculture, Rome.

Haimovici, M. and Velasco, G. 2000. Length-weight relationship of marine fishes from southern Brazil. *Naga, The ICLARM Quarterly*, 23(1): 14-16.

Haldar, G.C. and Amin, S.M.N. 2005. Population Dynamics of Male and Female Hilsa, *Tenualosa ilisha* of Bangladesh. *Pakistan Journal of Biological Sciences*, 8(2): 307-313.

Haroön, A.K.Y. 1999. Some population dynamics aspects of *Catla catla* (Hamilton) in the Sylhet Basin, Bangladesh. *Pakistan Journal of Biological Sciences*, 2(4): 1188-1192.

Hile, R. 1936. Age and growth of the Cisco *Leucichthys artedi* (Le Sueur) in the lakes of the northeastern highlands, Wisconsin. *Bulletin, U. S. Bureau of Fisheries*, 48: 209-317.

Hossain, M.M., Mian, M.I. and Dewan, S. 1987. Length-weight relationship and condition factor of *Macrobrachium rosenbergii* (Deman) of Tetulia River. *Bangladesh Journal of Fisheries Research*, 10(1): 89-95.

Hossain, M.Y., Ahmed, Z.F., Leunda, P.M., Roksanul Islam, A.K.M., Jasmine, S., Oscoz, J., Miranda, R. and Ohtomi, J. 2006a. Length-weight and length-length

- relationships of some small indigenous fish species from the Mathabhanga River, southwestern Bangladesh. *Journal of Applied Ichthyology*, 22(4): 301-303.
- Hossain, M.Y., Ahmed, Z.F., Leunda, P.M., Jasmine, S., Osoz, J., Miranda, R. and Ohtomi, J. 2006b. Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, southwestern Bangladesh. *Journal of Applied Ichthyology*, 22(4): 304-307.
- Islam, M.S., Huq, Q.M., Hossain, M., Azad, S.A. and Das, N.N. 1987. Maturity and Spawning of Hilsa Shad, *Hilsa ilisha* of Bangladesh. BOBP/REP/36: 81-95.
- Kader, M.A. 1984. *Studies on Gobiodes rubicandus Hamilton-Buchanan from the Karnafully Estuary*. Ph.D. Thesis, University of Chittagong, 117 pp.
- Kara, A. and Bayhan, B. 2008. Length-weight and length-length relationships of the bogue *Boops boops* (Linnaeus, 1758) in Izmir Bay (Aegean Sea of Turkey). *Belg. J. Zool.*, 138(2): 154-157.
- Karim, K.A.T.A., Dewan, S. and Hussain, M.G. 1988. Length-weight relationship and Condition Factor of *Puntius gonionotus* (Bleeker). *Bangladesh Journal of Aquaculture*, 10(2): 49-54.
- King, M. 1997. *Fisheries Biology, Assessment and Management*. 3rd edition. Fishing News Books, Blackwell Science Ltd., London, p. 111.

- King, R.P. 1996. Length-weight relationship of Nigerian Coastal water fishes. *Fishbyte*, 19(4): 53-58.
- Lagler, K.F. 1956. *Freshwater fishery biology*. 2nd edition. W.C. Brown Co., Dubuque, Iowa, pp. 106-421.
- Le Cren, C.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fleviatis*). *J. Anim. Ecol.*, 20: 201-219.
- Mazid, M.A. 2002. Development of Fisheries in Bangladesh. Plans and Strategies for Income Generation and Poverty Alleviation, 310 pp.
- Mirza, J.A. 1985. A note on the length-weight relationship and condition factor of silver carp (*Hypophthalmichthys molitrix*). *Bangladesh Journal of Fisheries Research*, 8(1-3): 61-63.
- Mortuza, M.G. and Rahman, T. 2006. Length-weight relationship, condition factor and sex-ratio of freshwater fish, *Rhinomugil corsula* (Hamilton) (Mugiliformes: Mugilidae) from Rajshahi, Bangladesh. *J. Bio-sci.*, 14: 139-141.
- Moutopoulos, D.K. and Stergiou, K.I. 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). *Journal of Applied Ichthyology*, 18: 202-203.

- Nabi, M.R.U., Hoque, M.A., Rahman, R.A. Mustafa, S. and Kader, M.A. 2007. Population Dynamics of *Polynemus paradiseus* from Estuarine Set Bag Net Fishery of Bangladesh. *Chiang Mai J. Sci.*, 34(3): 355-365.
- Pervin, M.R. and Mortuza, M.G. 2008. Notes on Length-Weight Relationship and Condition Factor of Fresh Water Fish, *Labeo boga* (Hamilton) (Cypriniformes: Cyprinidae). *Univ. J. Zool. Rajshahi Univ.*, 27: 97-98.
- Quddus, M.A., Ali, M.A. and Dewan, S. 1987. Population estimation and length-weight relationship of *Labeo rohita*. *Bangladesh Journal of Fisheries Research*, 10(1): 5-12.
- Rahman, A.K.A. 2005. Freshwater Fishes of Bangladesh, 2nd ed., Zool. Soc. Bangladesh, Dhaka, Bangladesh, 394 pp.
- Rahman, M.A., Amin, S.M.N., Haldar, G.C. and Mazid, M.A. 2000. Population dynamics of *Tenualosa ilisha* of Bangladesh water. *Pakistan Journal of Biological Sciences*, 3(4): 564-567.
- Rahman, M.S., Rahman, M.A. Rahman, M.R. and Kamal, D. 2004. Length-weight Relationship, Condition Factor and Harvesting Records of Silver Pomfret (*Pampus argenteus*) in the Southwestern Region of Bangladesh. *Pakistan Journal of Biological Sciences*, 7(4): 452-456.

Rao, R.M. 1967. Studies on the biology of *Macrobrachium rosenbergii* (De Man) of the Hoogly estuary with notes on its fishery. *Proc. Nat. Inst. Sci. India*, 33(5): 252-279.

Rounsefell, G.A. and Everhart, W.H. 1953. Observations on the maturity and spawning of *Psettodes erumei* (Schneider). *Indian Journal of Fisheries*, 9: 580-589.

Shafi, M. and Mustafa, G. 1976. Observation on some aspects of biology of the climbing Perch, *Anabus testudineus* (Bloch). *Bangladesh Journal of Zoology*, 4: 21-28.

Sparre, P., Ursin, E. and Venema, S.C. 1989. Introduction to tropical fish stock assessment. Part I. Manual. FAO Fisheries Technical Paper. No. 306. I. Rome, FAO.

Talwar, P.K. and Jhingran, A.G. 1991. *Inland Fishes of India and Adjacent Countries*. Vol 2. TYK Prokason, Dhaka, 561 pp.

Weatherley, A.H. and Gill, H.S. 1987. *The biology of fish growth*. Academic Press, London, 443 pp.

Wootton, R.J. 1998. *Ecology of teleost fishes*. 2nd edition. Dordrecht, Kulwer, 386 pp.

Wootton, R.J. 1990. *Ecology of teleost fishes*. Chapman and Hall, London, 404 pp.

Zafar, M., Mussaddeq, Y., Akhter, S. and Sultan, A. 2003. Weight-length and Condition Factor Relationship of Thaila, *Catla catla* from Rawal Dam Islamabad, Pakistan. *Pakistan Journal of Biological Sciences*, 6(17): 1532-1534.

APPENDICES

Appendix 1. Total length, standard length and body weight of *M. gulio*

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
1	6.2	4.7	2.1	0.79	0.67	0.32
2	6.5	5.0	2.5	0.81	0.70	0.40
3	7.0	5.4	3.2	0.85	0.73	0.51
4	7.5	5.9	3.9	0.88	0.77	0.59
5	8.0	6.2	4.2	0.90	0.79	0.62
6	8.0	6.3	5.2	0.90	0.80	0.72
7	8.1	6.3	5.3	0.91	0.80	0.72
8	8.2	6.3	5.0	0.91	0.80	0.70
9	8.3	6.6	5.4	0.92	0.82	0.73
10	8.4	6.5	5.6	0.92	0.81	0.75
11	8.5	6.5	5.5	0.93	0.81	0.74
12	8.6	6.6	5.9	0.93	0.82	0.77
13	8.7	6.7	7.1	0.94	0.83	0.85
14	8.8	6.9	6.8	0.94	0.84	0.83
15	8.9	6.9	7.1	0.95	0.84	0.85
16	9.0	7.0	6.8	0.95	0.85	0.83
17	9.0	7.0	7.4	0.95	0.85	0.87
18	9.0	6.9	6.3	0.95	0.84	0.80
19	9.1	7.0	6.5	0.96	0.85	0.81
20	9.1	7.0	7.8	0.96	0.85	0.89
21	9.1	7.1	7.3	0.96	0.85	0.86
22	9.2	7.2	7.8	0.96	0.86	0.89
23	9.2	7.2	7.6	0.96	0.86	0.88
24	9.2	7.1	7.2	0.96	0.85	0.86
25	9.3	7.1	8.2	0.97	0.85	0.91
26	9.3	7.2	7.6	0.97	0.86	0.88
27	9.3	7.2	7.8	0.97	0.86	0.89
28	9.4	7.2	8.2	0.97	0.86	0.91
29	9.4	7.3	7.2	0.97	0.86	0.86
30	9.4	7.5	8.1	0.97	0.88	0.91
31	9.5	7.3	8.2	0.98	0.86	0.91
32	9.5	7.4	8.7	0.98	0.87	0.94
33	9.5	7.2	7.9	0.98	0.86	0.90
34	9.6	7.4	7.9	0.98	0.87	0.90
35	9.6	7.4	8.0	0.98	0.87	0.90

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
36	9.6	7.5	9.0	0.98	0.88	0.95
37	9.7	7.4	8.6	0.99	0.87	0.93
38	9.7	7.5	8.5	0.99	0.88	0.93
39	9.7	7.5	8.5	0.99	0.88	0.93
40	9.8	7.5	9.1	0.99	0.88	0.96
41	9.8	7.5	9.7	0.99	0.88	0.99
42	9.8	7.6	9.0	0.99	0.88	0.95
43	9.9	7.5	8.5	1.00	0.88	0.93
44	9.9	7.6	9.5	1.00	0.88	0.98
45	9.9	7.6	10.1	1.00	0.88	1.00
46	10.0	7.9	9.5	1.00	0.90	0.98
47	10.0	7.9	10.1	1.00	0.90	1.00
48	10.0	7.7	10.3	1.00	0.89	1.01
49	10.0	7.7	10.2	1.00	0.89	1.01
50	10.1	7.8	11.5	1.00	0.89	1.06
51	10.1	7.8	10.5	1.00	0.89	1.02
52	10.1	7.9	11.3	1.00	0.90	1.05
53	10.1	7.8	10.9	1.00	0.89	1.04
54	10.1	7.7	8.9	1.00	0.89	0.95
55	10.2	7.9	11.6	1.01	0.90	1.06
56	10.2	8.0	10.1	1.01	0.90	1.00
57	10.2	8.0	10.6	1.01	0.90	1.03
58	10.2	7.9	10.1	1.01	0.90	1.00
59	10.2	8.0	9.8	1.01	0.90	0.99
60	10.2	7.8	11.0	1.01	0.89	1.04
61	10.3	8.0	11.2	1.01	0.90	1.05
62	10.3	8.2	13.7	1.01	0.91	1.14
63	10.3	7.8	11.4	1.01	0.89	1.06
64	10.4	8.1	11.2	1.02	0.91	1.05
65	10.4	8.0	11.7	1.02	0.90	1.07
66	10.4	8.1	11.7	1.02	0.91	1.07
67	10.4	8.0	10.9	1.02	0.90	1.04
68	10.5	8.1	11.8	1.02	0.91	1.07
69	10.5	8.2	12.7	1.02	0.91	1.10
70	10.5	7.9	11.7	1.02	0.90	1.07

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
71	10.6	8.2	13.0	1.03	0.91	1.11
72	10.6	8.1	10.3	1.03	0.91	1.01
73	10.6	8.1	13.7	1.03	0.91	1.14
74	10.6	8.1	10.1	1.03	0.91	1.00
75	10.7	8.1	11.8	1.03	0.91	1.07
76	10.7	8.3	10.6	1.03	0.92	1.03
77	10.7	8.4	12.4	1.03	0.92	1.09
78	10.7	8.3	12.5	1.03	0.92	1.10
79	10.7	8.3	12.0	1.03	0.92	1.08
80	10.7	8.5	13.1	1.03	0.93	1.12
81	10.8	8.5	12.2	1.03	0.93	1.09
82	10.8	8.6	12.0	1.03	0.93	1.08
83	10.8	8.3	11.1	1.03	0.92	1.05
84	10.8	8.6	12.1	1.03	0.93	1.08
85	10.8	8.5	15.2	1.03	0.93	1.18
86	10.8	8.3	12.0	1.03	0.92	1.08
87	10.9	8.8	14.7	1.04	0.94	1.17
88	10.9	8.4	13.2	1.04	0.92	1.12
89	10.9	8.6	13.1	1.04	0.93	1.12
90	10.9	8.4	12.9	1.04	0.92	1.11
91	10.9	8.5	13.1	1.04	0.93	1.12
92	10.9	8.5	13.2	1.04	0.93	1.12
93	10.9	8.4	12.7	1.04	0.92	1.10
94	11.0	8.6	13.8	1.04	0.93	1.14
95	11.0	8.5	13.6	1.04	0.93	1.13
96	11.0	8.5	12.2	1.04	0.93	1.09
97	11.0	8.4	15.0	1.04	0.92	1.18
98	11.0	8.5	13.3	1.04	0.93	1.12
99	11.0	8.7	11.9	1.04	0.94	1.08
100	11.1	8.6	14.7	1.05	0.93	1.17
101	11.1	8.6	16.4	1.05	0.93	1.21
102	11.1	8.6	17.6	1.05	0.93	1.25
103	11.1	8.6	14.2	1.05	0.93	1.15
104	11.1	8.5	14.4	1.05	0.93	1.16
105	11.1	8.6	16.8	1.05	0.93	1.23

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
106	11.2	9.0	16.2	1.05	0.95	1.21
107	11.2	8.5	12.9	1.05	0.93	1.11
108	11.2	8.6	14.9	1.05	0.93	1.14
109	11.2	8.6	13.8	1.05	0.93	1.13
110	11.2	8.5	13.7	1.05	0.93	1.14
111	11.2	8.7	13.9	1.05	0.94	1.14
112	11.2	8.8	12.6	1.05	0.94	1.10
113	11.3	8.9	13.0	1.05	0.95	1.11
114	11.3	8.8	13.2	1.05	0.94	1.12
115	11.3	8.8	14.9	1.05	0.94	1.17
116	11.3	8.9	16.3	1.05	0.95	1.21
117	11.3	8.9	15.6	1.05	0.95	1.19
118	11.3	8.6	13.1	1.05	0.93	1.12
119	11.3	8.8	17.2	1.05	0.94	1.24
120	11.3	8.8	13.9	1.05	0.94	1.14
121	11.4	9.0	16.2	1.06	0.95	1.21
122	11.4	9.0	14.1	1.06	0.95	1.15
123	11.4	9.0	14.2	1.06	0.95	1.15
124	11.4	9.0	15.9	1.06	0.95	1.20
125	11.4	8.7	17.7	1.06	0.94	1.25
126	11.4	9.1	19.7	1.06	0.96	1.29
127	11.5	9.1	15.4	1.06	0.96	1.19
128	11.5	8.9	17.2	1.06	0.95	1.24
129	11.5	8.8	16.5	1.06	0.94	1.22
130	11.5	9.1	15.2	1.06	0.96	1.18
131	11.5	9.0	15.9	1.06	0.95	1.20
132	11.5	9.0	15.8	1.06	0.95	1.20
133	11.6	8.7	15.6	1.06	0.94	1.19
134	11.6	8.8	16.0	1.06	0.94	1.20
135	11.6	9.0	17.3	1.06	0.95	1.24
136	11.6	9.0	15.9	1.06	0.95	1.20
137	11.6	9.1	17.1	1.06	0.96	1.23
138	11.7	9.1	14.4	1.07	0.96	1.16
139	11.7	9.2	18.2	1.07	0.96	1.26
140	11.7	9.0	14.4	1.07	0.95	1.16



SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
141	11.7	9.0	17.2	1.07	0.95	1.24
142	11.7	9.6	18.1	1.07	0.98	1.26
143	11.7	8.9	14.8	1.07	0.95	1.17
144	11.8	9.1	16.3	1.07	0.96	1.21
145	11.8	9.1	15.6	1.07	0.96	1.19
146	11.8	9.1	16.2	1.07	0.96	1.21
147	11.8	9.1	16.6	1.07	0.96	1.22
148	11.8	9.1	17.8	1.07	0.96	1.25
149	11.8	9.0	13.9	1.07	0.95	1.14
150	11.8	9.1	16.7	1.07	0.96	1.22
151	11.9	9.0	17.8	1.08	0.95	1.25
152	11.9	9.1	16.3	1.08	0.96	1.21
153	11.9	9.2	15.6	1.08	0.96	1.19
154	11.9	9.1	16.2	1.08	0.96	1.21
155	11.9	9.2	18.0	1.08	0.96	1.26
156	12.0	9.1	15.4	1.08	0.96	1.19
157	12.0	9.4	20.1	1.08	0.97	1.30
158	12.0	9.2	18.6	1.08	0.96	1.27
159	12.0	9.3	18.0	1.08	0.97	1.26
160	12.0	9.4	18.9	1.08	0.97	1.28
161	12.0	9.2	20.3	1.08	0.96	1.31
162	12.0	9.4	18.6	1.08	0.97	1.27
163	12.1	9.5	17.2	1.08	0.98	1.24
164	12.1	9.5	15.6	1.08	0.98	1.19
165	12.1	9.4	19.1	1.08	0.97	1.28
166	12.1	9.5	19.1	1.08	0.98	1.28
167	12.1	9.6	18.3	1.08	0.98	1.26
168	12.1	9.1	16.9	1.08	0.96	1.23
169	12.1	9.5	21.8	1.08	0.98	1.34
170	12.1	9.6	21.5	1.08	0.98	1.33
171	12.2	9.4	19.1	1.09	0.97	1.28
172	12.2	9.6	17.7	1.09	0.98	1.25
173	12.2	9.2	17.0	1.09	0.96	1.23
174	12.2	9.5	18.2	1.09	0.98	1.26
175	12.2	9.4	17.9	1.09	0.97	1.25

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
176	12.3	9.7	17.6	1.09	0.99	1.25
177	12.3	9.7	19.8	1.09	0.99	1.30
178	12.3	9.5	20.4	1.09	0.98	1.31
179	12.3	9.1	20.1	1.09	0.96	1.30
180	12.3	9.8	18.8	1.09	0.99	1.27
181	12.3	9.6	17.1	1.09	0.98	1.23
182	12.3	9.6	18.5	1.09	0.98	1.27
183	12.4	9.7	20.1	1.09	0.99	1.30
184	12.4	9.7	18.3	1.09	0.99	1.26
185	12.4	9.6	20.6	1.09	0.98	1.31
186	12.4	9.5	20.8	1.09	0.98	1.32
187	12.4	9.5	17.8	1.09	0.98	1.25
188	12.4	9.8	18.8	1.09	0.99	1.27
189	12.4	9.7	19.9	1.09	0.99	1.30
190	12.4	9.8	19.0	1.09	0.99	1.28
191	12.5	9.6	17.6	1.10	0.98	1.25
192	12.5	9.8	18.2	1.10	0.99	1.26
193	12.5	9.6	20.7	1.10	0.98	1.32
194	12.5	9.6	21.6	1.10	0.98	1.33
195	12.5	9.7	17.8	1.10	0.99	1.25
196	12.5	9.7	17.2	1.10	0.99	1.24
197	12.5	9.9	21.5	1.10	1.00	1.33
198	12.6	9.8	18.7	1.10	0.99	1.27
199	12.6	9.8	17.2	1.10	0.99	1.24
200	12.6	9.8	22.3	1.10	0.99	1.35
201	12.6	9.7	22.2	1.10	0.99	1.35
202	12.6	9.7	20.9	1.10	0.99	1.32
203	12.6	10.1	20.6	1.10	1.00	1.31
204	12.6	9.9	19.6	1.10	1.00	1.29
205	12.6	9.7	23.2	1.10	0.99	1.37
206	12.7	9.9	19.8	1.10	1.00	1.30
207	12.7	9.6	19.7	1.10	0.98	1.29
208	12.7	9.8	21.6	1.10	0.99	1.33
209	12.7	9.7	20.4	1.10	0.99	1.31
210	12.7	9.8	20.4	1.10	0.99	1.31

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
211	12.7	10.1	24.6	1.10	1.00	1.39
212	12.7	9.9	18.7	1.10	1.00	1.27
213	12.8	10.0	23.7	1.11	1.00	1.37
214	12.8	9.8	20.8	1.11	0.99	1.32
215	12.8	9.8	24.2	1.11	0.99	1.38
216	12.8	9.8	23.1	1.11	0.99	1.36
217	12.8	9.9	22.3	1.11	1.00	1.35
218	12.8	10.0	22.6	1.11	1.00	1.35
219	12.8	10.0	21.2	1.11	1.00	1.33
220	12.9	10.0	25.3	1.11	1.00	1.40
221	12.9	9.9	23.3	1.11	1.00	1.37
222	12.9	10.0	24.7	1.11	1.00	1.39
223	12.9	9.9	23.5	1.11	1.00	1.37
224	12.9	9.9	21.0	1.11	1.00	1.32
225	12.9	10.1	20.5	1.11	1.00	1.31
226	12.9	10.1	26.7	1.11	1.00	1.43
227	13.0	10.1	25.6	1.11	1.00	1.41
228	13.0	10.1	26.4	1.11	1.00	1.42
229	13.0	10.1	17.9	1.11	1.00	1.25
230	13.0	10.0	21.4	1.11	1.00	1.33
231	13.0	10.1	22.0	1.11	1.00	1.34
232	13.0	10.1	23.0	1.11	1.00	1.36
233	13.0	10.1	21.6	1.11	1.00	1.33
234	13.0	10.0	25.5	1.11	1.00	1.41
235	13.0	10.2	25.7	1.11	1.01	1.41
236	13.0	10.0	23.5	1.11	1.00	1.37
237	13.0	10.0	22.4	1.11	1.00	1.35
238	13.0	10.5	23.3	1.11	1.02	1.37
239	13.0	10.2	22.3	1.11	1.01	1.35
240	13.0	10.0	22.9	1.11	1.00	1.36
241	13.0	10.0	24.3	1.11	1.00	1.39
242	13.0	10.3	26.0	1.11	1.01	1.41
243	13.0	10.2	25.0	1.11	1.01	1.40
244	13.0	10.1	24.3	1.11	1.00	1.39
245	13.1	10.3	22.2	1.12	1.01	1.35

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
246	13.1	10.1	23.5	1.12	1.00	1.37
247	13.1	10.1	22.3	1.12	1.00	1.35
248	13.1	10.0	23.6	1.12	1.00	1.37
249	13.1	10.1	21.5	1.12	1.00	1.33
250	13.1	10.1	26.5	1.12	1.00	1.42
251	13.1	10.2	23.6	1.12	1.01	1.37
252	13.1	10.0	22.5	1.12	1.00	1.35
253	13.1	10.5	25.0	1.12	1.02	1.40
254	13.2	10.2	20.4	1.12	1.01	1.31
255	13.2	10.1	21.1	1.12	1.00	1.32
256	13.2	10.2	21.0	1.12	1.01	1.32
257	13.2	10.1	24.4	1.12	1.00	1.39
258	13.2	10.2	22.6	1.12	1.01	1.35
259	13.2	10.1	25.1	1.12	1.00	1.40
260	13.2	10.3	26.8	1.12	1.01	1.43
261	13.2	10.3	25.3	1.12	1.01	1.40
262	13.2	10.4	24.4	1.12	1.02	1.39
263	13.3	10.4	24.8	1.12	1.02	1.39
264	13.3	10.2	22.2	1.12	1.01	1.35
265	13.3	10.2	24.1	1.12	1.01	1.38
266	13.3	10.6	25.7	1.12	1.03	1.41
267	13.3	10.5	26.7	1.12	1.02	1.43
268	13.3	10.5	29.0	1.12	1.02	1.46
269	13.3	10.5	26.6	1.12	1.02	1.43
270	13.4	10.3	23.8	1.13	1.01	1.38
271	13.4	10.2	24.4	1.13	1.01	1.39
272	13.4	10.4	25.4	1.13	1.02	1.40
273	13.4	10.2	24.6	1.13	1.01	1.39
274	13.4	10.5	25.8	1.13	1.02	1.41
275	13.4	10.4	21.6	1.13	1.02	1.34
276	13.5	10.4	25.5	1.13	1.02	1.41
277	13.5	10.3	22.4	1.13	1.01	1.35
278	13.5	10.5	30.8	1.13	1.02	1.49
279	13.5	10.4	27.0	1.13	1.02	1.43
280	13.5	10.5	26.5	1.13	1.02	1.42

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
281	13.5	10.3	24.8	1.13	1.01	1.39
282	13.5	10.4	22.6	1.13	1.02	1.35
283	13.5	10.5	26.4	1.13	1.02	1.42
284	13.5	10.6	30.6	1.13	1.03	1.49
285	13.5	10.4	25.4	1.13	1.02	1.41
286	13.6	10.5	24.3	1.13	1.02	1.39
287	13.6	10.5	24.4	1.13	1.02	1.39
288	13.6	10.4	27.3	1.13	1.02	1.44
289	13.6	10.6	26.9	1.13	1.03	1.43
290	13.6	10.3	25.4	1.13	1.01	1.40
291	13.6	10.4	25.8	1.13	1.02	1.41
292	13.6	10.9	28.3	1.13	1.04	1.45
293	13.6	10.6	28.0	1.13	1.03	1.45
294	13.7	10.6	24.3	1.14	1.03	1.39
295	13.7	10.8	23.1	1.14	1.03	1.36
296	13.7	10.6	28.0	1.14	1.03	1.45
297	13.7	10.8	29.5	1.14	1.03	1.47
298	13.7	10.5	30.7	1.14	1.02	1.49
299	13.7	10.6	27.8	1.14	1.03	1.44
300	13.7	10.8	28.4	1.14	1.03	1.45
301	13.7	10.9	29.0	1.14	1.04	1.46
302	13.8	10.9	26.0	1.14	1.04	1.41
303	13.8	10.7	24.9	1.14	1.03	1.40
304	13.8	10.6	27.7	1.14	1.03	1.44
305	13.8	10.8	29.4	1.14	1.03	1.47
306	13.8	10.8	28.0	1.14	1.03	1.45
307	13.8	10.7	26.4	1.14	1.03	1.42
308	13.8	10.8	28.4	1.14	1.03	1.45
309	13.8	11.1	32.0	1.14	1.05	1.51
310	13.9	10.7	27.3	1.14	1.03	1.44
311	13.9	11.0	32.3	1.14	1.04	1.51
312	13.9	10.8	28.5	1.14	1.03	1.45
313	13.9	10.7	30.0	1.14	1.03	1.48
314	13.9	10.7	28.1	1.14	1.03	1.45
315	13.9	10.8	26.2	1.14	1.03	1.42

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
316	13.9	10.9	26.3	1.14	1.04	1.42
317	14.0	10.9	26.1	1.15	1.04	1.42
318	14.0	10.9	30.3	1.15	1.04	1.48
319	14.0	10.9	21.1	1.15	1.04	1.32
320	14.0	10.9	26.5	1.15	1.04	1.42
321	14.0	11.0	27.9	1.15	1.04	1.45
322	14.1	10.9	25.2	1.15	1.04	1.40
323	14.1	11.0	32.8	1.15	1.04	1.52
324	14.1	11.1	32.3	1.15	1.05	1.51
325	14.1	11.0	28.7	1.15	1.04	1.46
326	14.1	11.0	30.7	1.15	1.04	1.49
327	14.1	11.0	27.1	1.15	1.04	1.43
328	14.2	11.0	28.0	1.15	1.04	1.45
329	14.2	11.0	23.6	1.15	1.04	1.37
330	14.2	11.1	27.3	1.15	1.05	1.44
331	14.2	11.0	27.0	1.15	1.04	1.43
332	14.3	11.1	32.0	1.16	1.05	1.51
333	14.3	10.8	27.3	1.16	1.03	1.44
334	14.3	11.1	33.3	1.16	1.05	1.52
335	14.3	11.0	26.2	1.16	1.04	1.42
336	14.3	11.1	23.2	1.16	1.05	1.37
337	14.3	11.1	25.0	1.16	1.05	1.40
338	14.4	10.9	26.6	1.16	1.04	1.42
339	14.4	11.1	32.0	1.16	1.05	1.51
340	14.4	11.5	32.8	1.16	1.06	1.52
341	14.4	11.1	34.5	1.16	1.05	1.54
342	14.4	11.3	26.5	1.16	1.05	1.42
343	14.5	11.3	25.0	1.16	1.05	1.40
344	14.5	11.5	27.0	1.16	1.06	1.43
345	14.5	11.2	26.4	1.16	1.05	1.42
346	14.5	11.4	24.6	1.16	1.06	1.39
347	14.5	11.4	28.4	1.16	1.06	1.45
348	14.6	11.3	27.6	1.16	1.05	1.44
349	14.6	11.2	33.1	1.16	1.05	1.52
350	14.6	11.5	26.4	1.16	1.06	1.42

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
351	14.6	11.4	28.9	1.16	1.06	1.46
352	14.6	11.6	30.3	1.16	1.06	1.48
353	14.6	11.5	34.4	1.16	1.06	1.54
354	14.7	11.5	28.9	1.17	1.06	1.46
355	14.7	11.6	30.6	1.17	1.06	1.49
356	14.7	11.6	28.5	1.17	1.06	1.45
357	14.7	11.6	32.2	1.17	1.06	1.51
358	14.7	11.5	27.2	1.17	1.06	1.43
359	14.8	11.6	35.5	1.17	1.06	1.55
360	14.8	11.5	33.5	1.17	1.06	1.53
361	14.8	11.8	35.1	1.17	1.07	1.55
362	14.8	11.8	38.0	1.17	1.07	1.58
363	14.8	11.4	26.6	1.17	1.06	1.42
364	14.8	11.6	33.1	1.17	1.06	1.52
365	14.9	11.5	31.6	1.17	1.06	1.50
366	14.9	12.0	35.0	1.17	1.08	1.54
367	14.9	11.6	31.5	1.17	1.06	1.50
368	14.9	11.9	35.7	1.17	1.08	1.55
369	14.9	11.7	38.6	1.17	1.07	1.59
370	14.9	12.2	35.0	1.17	1.09	1.54
371	14.9	11.5	35.6	1.17	1.06	1.55
372	14.9	11.3	28.5	1.17	1.05	1.45
373	14.9	11.4	32.1	1.17	1.06	1.51
374	14.9	11.8	32.9	1.17	1.07	1.52
375	14.9	11.5	35.7	1.17	1.06	1.55
376	14.9	11.6	38.3	1.17	1.06	1.58
377	14.9	11.8	30.4	1.17	1.07	1.48
378	14.9	11.6	32.4	1.17	1.06	1.51
379	14.9	11.7	30.0	1.17	1.07	1.48
380	15.0	11.7	36.2	1.18	1.07	1.56
381	15.0	12.0	32.7	1.18	1.08	1.51
382	15.0	11.8	34.6	1.18	1.07	1.54
383	15.1	11.8	37.6	1.18	1.07	1.58
384	15.1	11.8	32.6	1.18	1.07	1.51
385	15.1	11.7	29.1	1.18	1.07	1.46

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
386	15.2	12.0	37.0	1.18	1.08	1.57
387	15.2	12.3	33.6	1.18	1.09	1.53
388	15.3	12.2	36.6	1.18	1.09	1.56
389	15.4	12.2	32.2	1.19	1.09	1.51
390	15.4	12.0	36.9	1.19	1.08	1.57
391	15.5	11.9	33.7	1.19	1.08	1.53
392	15.5	11.9	31.2	1.19	1.08	1.49
393	15.5	11.9	33.7	1.19	1.08	1.53
394	15.5	12.0	31.6	1.19	1.08	1.50
395	15.6	12.4	35.1	1.19	1.09	1.55
396	15.6	12.3	34.5	1.19	1.09	1.54
397	15.6	12.2	36.4	1.19	1.09	1.56
398	15.7	12.3	38.1	1.20	1.09	1.58
399	15.7	12.3	40.4	1.20	1.09	1.61
400	15.7	12.4	33.3	1.20	1.09	1.52
401	15.7	12.5	35.8	1.20	1.10	1.55
402	15.8	12.4	38.1	1.20	1.09	1.58
403	15.8	12.7	39.9	1.20	1.10	1.60
404	15.9	12.3	34.5	1.20	1.09	1.54
405	15.9	12.5	44.9	1.20	1.10	1.65
406	15.9	12.3	34.2	1.20	1.09	1.53
407	15.9	12.5	45.3	1.20	1.10	1.66
408	16.0	12.6	42.2	1.20	1.10	1.63
409	16.0	12.5	38.0	1.20	1.10	1.58
410	16.0	12.5	37.4	1.20	1.10	1.57
411	16.0	12.7	38.7	1.20	1.10	1.59
412	16.1	12.8	37.5	1.21	1.11	1.57
413	16.1	12.9	38.4	1.21	1.11	1.58
414	16.2	12.5	36.8	1.21	1.10	1.57
415	16.3	12.8	40.5	1.21	1.11	1.61
416	16.3	12.8	39.7	1.21	1.11	1.60
417	16.3	12.9	43.2	1.21	1.11	1.64
418	16.4	12.7	39.4	1.21	1.10	1.60
419	16.4	12.8	41.2	1.21	1.11	1.61
420	16.5	13.0	43.1	1.22	1.11	1.63

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
421	16.5	13.3	42.0	1.22	1.12	1.62
422	16.6	13.1	46.8	1.22	1.12	1.67
423	16.6	13.7	55.9	1.22	1.14	1.75
424	16.7	13.2	54.4	1.22	1.12	1.74
425	16.8	13.2	50.1	1.23	1.12	1.70
426	16.9	13.4	49.9	1.23	1.13	1.70
427	16.9	13.4	46.2	1.23	1.13	1.66
428	16.9	13.1	43.8	1.23	1.12	1.64
429	17.0	13.4	58.1	1.23	1.13	1.76
430	17.0	13.6	55.2	1.23	1.13	1.74
431	17.1	13.9	50.7	1.23	1.14	1.71
432	17.2	13.5	52.0	1.24	1.13	1.72
433	17.2	13.3	52.9	1.24	1.12	1.72
434	17.3	13.9	64.7	1.24	1.14	1.81
435	17.3	13.7	52.0	1.24	1.14	1.72
436	17.4	13.8	64.4	1.24	1.14	1.81
437	17.4	13.6	53.1	1.24	1.13	1.73
438	17.5	13.8	54.8	1.24	1.14	1.74
439	17.6	13.7	50.5	1.25	1.14	1.70
440	17.6	13.7	56.2	1.25	1.14	1.75
441	17.7	14.0	50.5	1.25	1.15	1.70
442	17.7	13.9	50.8	1.25	1.14	1.71
443	17.8	14.0	50.6	1.25	1.15	1.70
444	17.8	14.0	52.9	1.25	1.15	1.72
445	17.9	13.9	61.1	1.25	1.14	1.79
446	17.9	13.9	62.9	1.25	1.14	1.80
447	17.9	13.7	59.9	1.25	1.14	1.78
448	18.0	14.4	56.5	1.26	1.16	1.75
449	18.1	14.2	62.1	1.26	1.15	1.79
450	18.2	14.7	60.0	1.26	1.17	1.78
451	18.3	14.7	61.0	1.26	1.17	1.79
452	18.3	14.1	62.1	1.26	1.15	1.79
453	18.4	14.2	66.8	1.26	1.15	1.82
454	18.5	14.5	63.9	1.27	1.16	1.81
455	18.6	14.2	58.5	1.27	1.15	1.77

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
456	18.7	14.8	61.6	1.27	1.17	1.79
457	18.8	14.9	55.3	1.27	1.17	1.74
458	18.9	15.0	71.5	1.28	1.18	1.85
459	19.1	15.1	80.9	1.28	1.18	1.91
460	19.2	15.2	82.4	1.28	1.18	1.92
461	19.3	15.3	88.1	1.29	1.18	1.94
462	19.5	15.1	90.8	1.29	1.18	1.96
463	19.7	15.4	79.0	1.29	1.19	1.90
464	19.8	15.5	80.1	1.30	1.19	1.90
465	19.9	15.5	73.8	1.30	1.19	1.87
466	20.0	15.6	96.8	1.30	1.19	1.99
467	20.2	16.0	101.1	1.31	1.20	2.00
468	20.3	15.7	88.4	1.31	1.20	1.95
469	20.5	16.3	84.1	1.31	1.21	1.92
470	20.6	16.4	86.1	1.31	1.21	1.94
471	21.2	16.6	92.0	1.33	1.22	1.96
472	21.5	16.7	90.3	1.33	1.22	1.96
473	21.6	17.7	98.5	1.33	1.25	1.99
474	21.9	17.2	114.2	1.34	1.24	2.06
475	22.2	17.7	109.1	1.35	1.25	2.04
476	22.6	17.8	121.3	1.35	1.25	2.08
477	22.8	18.1	124.6	1.36	1.26	2.10
478	23.1	18.1	138.6	1.36	1.26	2.14
479	23.4	18.3	139.4	1.37	1.26	2.14
480	23.8	18.7	145.2	1.38	1.27	2.16
481	24.5	19.4	155.9	1.39	1.29	2.19
482	24.8	19.7	163.8	1.39	1.29	2.21
483	25.5	20.2	164.4	1.41	1.31	2.22



Appendix 2. Total length, standard length and body weight of *O. rubicundus*

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
1	6.1	4.7	0.4	0.79	0.67	-0.4
2	6.3	4.9	0.6	0.8	0.69	-0.22
3	6.5	5	0.8	0.81	0.7	-0.1
4	6.6	5.1	0.7	0.82	0.71	-0.15
5	6.6	5.1	0.5	0.82	0.71	-0.3
6	7.3	5.7	0.7	0.86	0.75	-0.15
7	7.4	5.8	0.8	0.87	0.76	-0.1
8	7.5	5.8	1	0.88	0.76	0
9	7.5	5.8	1	0.88	0.77	0
10	7.7	6	1.1	0.89	0.78	0.04
11	7.7	6	1.1	0.89	0.78	0.04
12	7.8	6.1	1.2	0.89	0.78	0.08
13	7.8	6.1	1.3	0.89	0.78	0.11
14	7.8	6.1	1.1	0.89	0.78	0.04
15	7.9	6.2	1.2	0.9	0.79	0.08
16	8	6.3	1.2	0.9	0.8	0.08
17	8.2	6.4	1.3	0.91	0.81	0.11
18	8.2	6.4	1.4	0.91	0.81	0.15
19	8.2	6.4	1.2	0.91	0.81	0.08
20	8.3	6.5	1.8	0.92	0.81	0.26
21	8.3	6.5	1.3	0.92	0.81	0.11
22	8.3	6.5	1.5	0.92	0.81	0.18
23	8.3	6.5	1.4	0.92	0.81	0.15
24	8.4	6.6	1.5	0.92	0.82	0.18
25	8.4	6.6	1.3	0.92	0.82	0.11
26	8.5	6.7	1.5	0.93	0.82	0.18
27	8.5	6.7	1.5	0.93	0.82	0.18
28	8.5	6.7	1.4	0.93	0.82	0.15
29	8.5	6.7	1.9	0.93	0.82	0.28
30	8.6	6.7	1.3	0.93	0.83	0.11
31	8.6	6.7	1.2	0.93	0.83	0.08
32	8.7	6.8	1.7	0.94	0.83	0.23
33	8.7	6.8	1.4	0.94	0.83	0.15
34	8.8	6.9	1.3	0.94	0.84	0.11
35	8.9	6.8	1.6	0.95	0.83	0.2

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
36	8.9	7	1.9	0.95	0.84	0.28
37	8.9	7	1.7	0.95	0.84	0.23
38	8.9	7	1.6	0.95	0.84	0.2
39	8.9	7	2.2	0.95	0.84	0.34
40	8.9	7	1.6	0.95	0.84	0.2
41	9	6.9	1.5	0.95	0.84	0.18
42	9	7.1	1.8	0.95	0.85	0.26
43	9	7.1	2	0.95	0.85	0.3
44	9	7.1	1.6	0.95	0.85	0.2
45	9	7.1	1.6	0.95	0.85	0.2
46	9.1	7.2	2.1	0.96	0.85	0.32
47	9.1	7.2	1.8	0.96	0.85	0.26
48	9.1	7.2	1.8	0.96	0.85	0.26
49	9.1	7.2	2.2	0.96	0.85	0.34
50	9.1	7.2	1.9	0.96	0.85	0.28
51	9.2	7.2	2.4	0.96	0.86	0.38
52	9.2	7.2	1.8	0.96	0.86	0.26
53	9.2	7.2	2.1	0.96	0.86	0.32
54	9.2	7.2	2.1	0.96	0.86	0.32
55	9.2	7.2	1.8	0.96	0.86	0.26
56	9.2	7.2	1.9	0.96	0.86	0.28
57	9.2	7.2	2	0.96	0.86	0.3
58	9.2	7.2	1.7	0.96	0.86	0.23
59	9.3	7.3	1.9	0.97	0.86	0.28
60	9.3	7.3	1.8	0.97	0.86	0.26
61	9.3	7.3	1.8	0.97	0.86	0.26
62	9.3	7.3	1.9	0.97	0.86	0.28
63	9.3	7.3	1.7	0.97	0.86	0.23
64	9.3	7.3	1.8	0.97	0.86	0.26
65	9.3	7.3	1.7	0.97	0.86	0.23
66	9.3	7.3	2	0.97	0.86	0.3
67	9.3	7.3	1.9	0.97	0.86	0.28
68	9.3	7.3	2.4	0.97	0.86	0.38
69	9.4	7.5	2.5	0.97	0.88	0.4
70	9.4	7.4	1.8	0.97	0.87	0.26

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
71	9.4	7.4	1.8	0.97	0.87	0.26
72	9.4	7.4	1.7	0.97	0.87	0.23
73	9.4	7.4	1.7	0.97	0.87	0.23
74	9.5	7.6	2.2	0.98	0.88	0.34
75	9.5	7.5	1.9	0.98	0.87	0.28
76	9.5	7.5	2.3	0.98	0.87	0.36
77	9.5	7.5	1.9	0.98	0.87	0.28
78	9.5	7.5	2.2	0.98	0.87	0.34
79	9.5	7.5	2.1	0.98	0.87	0.32
80	9.6	7.6	2.2	0.98	0.88	0.34
81	9.6	7.6	2	0.98	0.88	0.3
82	9.6	7.6	2.1	0.98	0.88	0.32
83	9.6	7.6	2.7	0.98	0.88	0.43
84	9.6	7.6	2	0.98	0.88	0.3
85	9.6	7.6	2.1	0.98	0.88	0.32
86	9.6	7.6	2.2	0.98	0.88	0.34
87	9.6	7.6	2.3	0.98	0.88	0.36
88	9.6	7.6	2.4	0.98	0.88	0.38
89	9.6	7.6	2.1	0.98	0.88	0.32
90	9.6	7.6	2.3	0.98	0.88	0.36
91	9.7	7.7	2	0.99	0.89	0.3
92	9.7	8.2	2.3	0.99	0.91	0.36
93	9.7	7.3	2	0.99	0.86	0.3
94	9.7	7.6	1.9	0.99	0.88	0.28
95	9.7	7.6	1.9	0.99	0.88	0.28
96	9.7	7.6	3.1	0.99	0.88	0.49
97	9.7	7.6	2.3	0.99	0.88	0.36
98	9.7	7.6	2.2	0.99	0.88	0.34
99	9.7	7.6	2.2	0.99	0.88	0.34
100	9.7	7.6	2.7	0.99	0.88	0.43
101	9.7	7.6	2.1	0.99	0.88	0.32
102	9.7	7.6	2	0.99	0.88	0.3
103	9.7	7.6	2	0.99	0.88	0.3
104	9.7	7.6	2	0.99	0.88	0.3
105	9.7	7.6	2.1	0.99	0.88	0.32

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
106	9.8	7.7	1.7	0.99	0.89	0.23
107	9.8	7.7	2.4	0.99	0.89	0.38
108	9.8	7.7	2.6	0.99	0.89	0.41
109	9.8	7.7	2.1	0.99	0.89	0.32
110	9.8	7.7	2.3	0.99	0.89	0.36
111	9.8	7.7	2.6	0.99	0.89	0.41
112	9.9	7.5	2.5	1	0.88	0.4
113	9.9	7.4	1.9	1	0.87	0.28
114	9.9	7.8	2.4	1	0.89	0.38
115	9.9	7.8	2.3	1	0.89	0.36
116	9.9	7.8	2.5	1	0.89	0.4
117	9.9	7.8	2.3	1	0.89	0.36
118	9.9	7.8	2.2	1	0.89	0.34
119	10	7.7	2.4	1	0.89	0.38
120	10	7.9	2	1	0.9	0.3
121	10	7.9	2.3	1	0.9	0.36
122	10	7.9	2.2	1	0.9	0.34
123	10	7.9	2	1	0.9	0.3
124	10	7.9	2.6	1	0.9	0.41
125	10	7.9	1.9	1	0.9	0.28
126	10	7.9	2.3	1	0.9	0.36
127	10	7.9	2.2	1	0.9	0.34
128	10	7.9	2.1	1	0.9	0.32
129	10	7.9	1.9	1	0.9	0.28
130	10	7.9	2.6	1	0.9	0.41
131	10	7.9	2.5	1	0.9	0.4
132	10.1	8	2.6	1	0.9	0.41
133	10.1	8	2.1	1	0.9	0.32
134	10.1	8	2	1	0.9	0.3
135	10.1	8	2.3	1	0.9	0.36
136	10.1	8	2.3	1	0.9	0.36
137	10.1	8	2.6	1	0.9	0.41
138	10.1	8	2.4	1	0.9	0.38
139	10.1	8	2.3	1	0.9	0.36
140	10.2	8	2.7	1.01	0.9	0.43

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
141	10.2	8.1	3.3	1.01	0.91	0.52
142	10.2	8.1	2.2	1.01	0.91	0.34
143	10.2	8.1	2.6	1.01	0.91	0.41
144	10.2	8.1	2.1	1.01	0.91	0.32
145	10.2	8.1	2.4	1.01	0.91	0.38
146	10.2	8.1	2	1.01	0.91	0.3
147	10.2	8.1	2.4	1.01	0.91	0.38
148	10.2	8.1	2.2	1.01	0.91	0.34
149	10.3	7.9	2.7	1.01	0.9	0.43
150	10.3	8.5	2.8	1.01	0.93	0.45
151	10.3	8.1	2.6	1.01	0.91	0.41
152	10.3	8.1	2.3	1.01	0.91	0.36
153	10.3	8.1	2.6	1.01	0.91	0.41
154	10.3	8.1	2.4	1.01	0.91	0.38
155	10.3	8.1	2.7	1.01	0.91	0.43
156	10.3	8.1	2.6	1.01	0.91	0.41
157	10.3	8.1	2.1	1.01	0.91	0.32
158	10.3	8.1	2.8	1.01	0.91	0.45
159	10.3	8.1	2.3	1.01	0.91	0.36
160	10.4	8.2	2.5	1.02	0.91	0.4
161	10.4	7.9	2.6	1.02	0.9	0.41
162	10.4	8.2	2.1	1.02	0.91	0.32
163	10.4	8.2	2.6	1.02	0.91	0.41
164	10.4	8.2	2.5	1.02	0.91	0.4
165	10.4	8.2	2.4	1.02	0.91	0.38
166	10.4	8.2	3.2	1.02	0.91	0.51
167	10.4	8.2	2.5	1.02	0.91	0.4
168	10.4	8.2	3	1.02	0.91	0.48
169	10.4	8.2	2.9	1.02	0.91	0.46
170	10.5	8.4	2.8	1.02	0.92	0.45
171	10.5	8.3	2.9	1.02	0.92	0.46
172	10.5	8.1	2.5	1.02	0.91	0.4
173	10.5	8.3	3.2	1.02	0.92	0.51
174	10.5	8.3	3.2	1.02	0.92	0.51
175	10.5	8.3	2.4	1.02	0.92	0.38

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
176	10.5	8.3	3.8	1.02	0.92	0.58
177	10.5	8.3	3.8	1.02	0.92	0.58
178	10.5	8.3	3.1	1.02	0.92	0.49
179	10.5	8.3	2.9	1.02	0.92	0.46
180	10.5	8.3	3.7	1.02	0.92	0.57
181	10.5	8.3	3.7	1.02	0.92	0.57
182	10.5	8.3	2.7	1.02	0.92	0.43
183	10.5	8.3	2.4	1.02	0.92	0.38
184	10.5	8.3	2.8	1.02	0.92	0.45
185	10.5	8.3	3.2	1.02	0.92	0.51
186	10.5	8.3	1.9	1.02	0.92	0.28
187	10.5	8.3	3.1	1.02	0.92	0.49
188	10.6	8.4	2	1.03	0.92	0.3
189	10.6	8.4	3	1.03	0.92	0.48
190	10.6	8.4	2.7	1.03	0.92	0.43
191	10.6	8.4	2.8	1.03	0.92	0.45
192	10.6	8.4	3.6	1.03	0.92	0.56
193	10.7	8.7	2.8	1.03	0.94	0.45
194	10.7	8.4	2.6	1.03	0.92	0.41
195	10.7	8.1	2.1	1.03	0.91	0.32
196	10.7	8.7	3.7	1.03	0.94	0.57
197	10.7	8.4	2.7	1.03	0.92	0.43
198	10.7	8	2.8	1.03	0.9	0.45
199	10.7	8.5	2.6	1.03	0.93	0.41
200	10.7	8.5	3.2	1.03	0.93	0.51
201	10.7	8.5	2.9	1.03	0.93	0.46
202	10.7	8.5	3	1.03	0.93	0.48
203	10.7	8.5	2.4	1.03	0.93	0.38
204	10.7	8.5	2.6	1.03	0.93	0.41
205	10.7	8.5	3.2	1.03	0.93	0.51
206	10.7	8.5	3	1.03	0.93	0.48
207	10.7	8.5	2.4	1.03	0.93	0.38
208	10.7	8.5	2.3	1.03	0.93	0.36
209	10.7	8.5	3	1.03	0.93	0.48
210	10.7	8.5	2.9	1.03	0.93	0.46

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
211	10.7	8.5	2.8	1.03	0.93	0.45
212	10.8	8.8	3.4	1.03	0.94	0.53
213	10.8	8.6	2.9	1.03	0.93	0.46
214	10.8	8.6	2.4	1.03	0.93	0.38
215	10.8	8.6	2.4	1.03	0.93	0.38
216	10.8	8.6	2.3	1.03	0.93	0.36
217	10.8	8.6	2.9	1.03	0.93	0.46
218	10.8	8.6	3.9	1.03	0.93	0.59
219	10.8	8.6	2.9	1.03	0.93	0.46
220	10.8	8.6	2.4	1.03	0.93	0.38
221	10.8	8.6	3.2	1.03	0.93	0.51
222	10.9	8.5	2.8	1.04	0.93	0.45
223	10.9	8.4	3	1.04	0.92	0.48
224	10.9	8.9	3.1	1.04	0.95	0.49
225	10.9	8.6	3	1.04	0.94	0.48
226	10.9	8.6	3	1.04	0.94	0.48
227	10.9	8.6	3.2	1.04	0.94	0.51
228	11	8.6	2.9	1.04	0.93	0.46
229	11	8.9	3.3	1.04	0.95	0.52
230	11	8.8	2.7	1.04	0.94	0.43
231	11	8.7	3	1.04	0.94	0.48
232	11	8.5	3.1	1.04	0.93	0.49
233	11	9	2.6	1.04	0.95	0.41
234	11	8.7	3.1	1.04	0.94	0.49
235	11	8.7	3.4	1.04	0.94	0.53
236	11	8.7	3	1.04	0.94	0.48
237	11	8.7	3.4	1.04	0.94	0.53
238	11	8.7	3	1.04	0.94	0.48
239	11	8.7	3.3	1.04	0.94	0.52
240	11	8.7	2.5	1.04	0.94	0.4
241	11	8.7	3.4	1.04	0.94	0.53
242	11	8.7	3.3	1.04	0.94	0.52
243	11	8.7	3.7	1.04	0.94	0.57
244	11	8.7	2.6	1.04	0.94	0.41
245	11.1	8.8	3.5	1.05	0.94	0.54

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
246	11.1	9	3.3	1.05	0.95	0.52
247	11.1	8.8	3.3	1.05	0.94	0.52
248	11.1	8.8	2.5	1.05	0.94	0.4
249	11.1	8.8	3.4	1.05	0.94	0.53
250	11.1	8.8	2.8	1.05	0.94	0.45
251	11.1	8.8	3.2	1.05	0.94	0.51
252	11.1	8.8	2.8	1.05	0.94	0.45
253	11.1	8.8	3.4	1.05	0.94	0.53
254	11.2	9.2	3.8	1.05	0.96	0.58
255	11.2	8.8	2.7	1.05	0.94	0.43
256	11.2	8.9	2.8	1.05	0.95	0.45
257	11.2	8.9	2.8	1.05	0.95	0.45
258	11.2	8.9	3	1.05	0.95	0.48
259	11.2	8.9	3.7	1.05	0.95	0.57
260	11.2	8.9	3.6	1.05	0.95	0.56
261	11.3	8.9	3.6	1.05	0.95	0.56
262	11.3	8.8	3.1	1.05	0.94	0.49
263	11.3	9	3.5	1.05	0.95	0.54
264	11.3	9	2.9	1.05	0.95	0.46
265	11.3	9	3.3	1.05	0.95	0.52
266	11.3	9	3.2	1.05	0.95	0.51
267	11.3	9	3.4	1.05	0.95	0.53
268	11.3	9	2.6	1.05	0.95	0.41
269	11.4	8.8	3.2	1.06	0.94	0.51
270	11.4	8.9	3.7	1.06	0.95	0.57
271	11.4	9.1	3.9	1.06	0.96	0.59
272	11.4	9	3.8	1.06	0.96	0.58
273	11.5	9.1	3.4	1.06	0.96	0.53
274	11.5	9.1	3.4	1.06	0.96	0.53
275	11.5	9.1	3.4	1.06	0.96	0.53
276	11.5	9.1	3.6	1.06	0.96	0.56
277	11.5	9.1	3.3	1.06	0.96	0.52
278	11.5	9.1	3.3	1.06	0.96	0.52
279	11.5	9.1	3.7	1.06	0.96	0.57
280	11.5	9.1	3.5	1.06	0.96	0.54

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
281	11.5	9.1	3.4	1.06	0.96	0.53
282	11.5	9.1	3.3	1.06	0.96	0.52
283	11.5	9.1	3.8	1.06	0.96	0.58
284	11.6	9.2	3.5	1.06	0.96	0.54
285	11.6	9.2	3.2	1.06	0.96	0.51
286	11.6	9.2	3.6	1.06	0.96	0.56
287	11.6	9.2	3.2	1.06	0.96	0.51
288	11.6	9.2	4.2	1.06	0.96	0.62
289	11.7	9	3.4	1.07	0.95	0.53
290	11.7	9.3	3	1.07	0.97	0.48
291	11.7	9.8	3.8	1.07	0.99	0.58
292	11.7	9.4	3.6	1.07	0.97	0.56
293	11.7	9.3	3.2	1.07	0.97	0.51
294	11.7	9.3	3.6	1.07	0.97	0.56
295	11.7	9.3	3.7	1.07	0.97	0.57
296	11.8	9.5	3.7	1.07	0.98	0.57
297	11.8	9.3	3.6	1.07	0.97	0.56
298	11.8	9.4	3.6	1.07	0.97	0.56
299	11.8	9.4	3.8	1.07	0.97	0.58
300	11.8	9.4	3.8	1.07	0.97	0.58
301	11.8	9.4	3.2	1.07	0.97	0.51
302	11.8	9.4	3.4	1.07	0.97	0.53
303	11.8	9.4	3.3	1.07	0.97	0.52
304	11.9	9.3	3.5	1.08	0.97	0.54
305	11.9	9.3	4	1.08	0.97	0.6
306	11.9	9.5	3.3	1.08	0.98	0.52
307	11.9	9.5	3.7	1.08	0.98	0.57
308	11.9	9.5	3.3	1.08	0.98	0.52
309	11.9	9.5	4.1	1.08	0.98	0.61
310	12	9.4	4.3	1.08	0.97	0.63
311	12	9.4	3.7	1.08	0.97	0.57
312	12	9.2	3.5	1.08	0.96	0.54
313	12	9.7	3.9	1.08	0.99	0.59
314	12	9.4	3.5	1.08	0.97	0.54
315	12	9.5	2.9	1.08	0.98	0.46

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
316	12	9.5	4.4	1.08	0.98	0.64
317	12	9.5	3.8	1.08	0.98	0.58
318	12	9.5	4.1	1.08	0.98	0.61
319	12	9.5	3.9	1.08	0.98	0.59
320	12.1	10	4.6	1.08	1	0.66
321	12.1	9.4	3.5	1.08	0.97	0.54
322	12.1	9.6	3.1	1.08	0.98	0.49
323	12.1	9.6	3.5	1.08	0.98	0.54
324	12.1	9.6	3.2	1.08	0.98	0.51
325	12.2	9.7	3.6	1.09	0.99	0.56
326	12.2	9.7	3.9	1.09	0.99	0.59
327	12.2	9.7	3.3	1.09	0.99	0.52
328	12.2	9.7	4	1.09	0.99	0.6
329	12.2	9.7	4.8	1.09	0.99	0.68
330	12.3	10	4.2	1.09	1	0.62
331	12.3	9.8	3.6	1.09	0.99	0.56
332	12.3	9.8	4.3	1.09	0.99	0.63
333	12.3	9.8	4	1.09	0.99	0.6
334	12.4	9.8	4.2	1.09	0.99	0.62
335	12.4	9.9	3.8	1.09	0.99	0.58
336	12.4	9.9	3.8	1.09	0.99	0.58
337	12.5	10	4.3	1.1	1	0.63
338	12.5	9.9	4.3	1.1	1	0.63
339	12.5	9.9	4.1	1.1	1	0.61
340	12.5	9.9	3.7	1.1	1	0.57
341	12.5	9.9	4.7	1.1	1	0.67
342	12.5	9.9	4.1	1.1	1	0.61
343	12.5	9.9	4.7	1.1	1	0.67
344	12.5	9.9	4.1	1.1	1	0.61
345	12.5	9.9	3.9	1.1	1	0.59
346	12.5	9.9	3.8	1.1	1	0.58
347	12.5	9.9	4.5	1.1	1	0.65
348	12.5	9.9	3.8	1.1	1	0.58
349	12.6	10.4	5	1.1	1.02	0.7
350	12.6	9.8	3.9	1.1	0.99	0.59

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
351	12.6	10.1	4.2	1.1	1	0.62
352	12.6	10	5.4	1.1	1	0.73
353	12.7	10.2	4.8	1.1	1.01	0.68
354	12.8	10.3	4.1	1.11	1.01	0.61
355	12.8	10.3	4.7	1.11	1.01	0.67
356	12.8	10.2	5.1	1.11	1.01	0.71
357	12.8	10.2	4.2	1.11	1.01	0.62
358	13	10.5	4.1	1.11	1.02	0.61
359	13	10.2	4.6	1.11	1.01	0.66
360	13	10.4	5.2	1.11	1.01	0.72
361	13	10.4	4	1.11	1.01	0.6
362	13.1	10.3	5.7	1.12	1.01	0.76
363	13.1	10.4	4.8	1.12	1.02	0.68
364	13.2	10.5	5	1.12	1.02	0.7
365	13.2	10.5	4.9	1.12	1.02	0.69
366	13.5	10.6	4.7	1.13	1.03	0.67
367	13.5	10.8	5.4	1.13	1.03	0.73
368	13.5	10.7	4.4	1.13	1.03	0.64
369	13.5	10.8	5.2	1.13	1.03	0.72
370	13.5	10.8	4.8	1.13	1.03	0.68
371	13.5	10.8	5.4	1.13	1.03	0.73
372	13.6	11.1	6.6	1.13	1.05	0.82
373	13.7	10.9	5.3	1.14	1.04	0.72
374	13.8	11.1	4.7	1.14	1.05	0.67
375	13.8	11	6	1.14	1.04	0.78
376	14	10.9	6.4	1.15	1.04	0.81
377	14	11	6.4	1.15	1.04	0.81
378	14	11.2	5.7	1.15	1.05	0.76
379	14.1	11.3	5.7	1.15	1.05	0.76
380	14.2	11.3	6	1.15	1.05	0.78
381	14.2	11.3	5.7	1.15	1.05	0.76
382	14.3	11.1	5.2	1.16	1.05	0.72
383	14.3	11.4	4.7	1.16	1.06	0.67
384	14.5	11.5	6.3	1.16	1.06	0.8
385	14.7	11.9	6.6	1.17	1.08	0.82

SN	Total length	Standard length	Body weight	log Total length	log standard length	log Body weight
386	14.8	11.5	5.9	1.17	1.06	0.77
387	14.8	11.8	5.8	1.17	1.07	0.76
388	15.1	12.1	5.7	1.18	1.08	0.76
389	15.3	12.2	7.6	1.18	1.09	0.88
390	15.8	12.1	6.8	1.2	1.08	0.83