Vol III Issue VIII May 2014 ISSN No : 2249-894X

Monthly Multidisciplinary Research Journal

Review Of Research Journal

Welcome to Review Of Research

RNI MAHMUL/2011/38595 **ISSN No.2249-894X**

Review Of Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

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Review Of Research
Vol. 3 | Issue. 8 | May. 2014
Impact Factor : 2.1002 (UIF)
ISSN:-2249-894X
Available online at www.ror.isrj.net

ORIGINAL ARTICLE

BIOMETRIC & FECUNDITY STUDIES OF HARPODON NEHEREUS (HAM-BUCH) FROM COASTAL WATERS OF MUMBAI

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Abstract:

A curvilinear relationship with the length that becomes linear on logarithmic transformation was observed during present investigation in Harpodon nehereus (Ham-Buch). The coefficient of correlation r=0.899 for males & r=0.951 for females signify high degree of association between the two variables. The high value of positive correlation between length & weight for both the sexes revealed that applicability of equation derived is high. Exponential value for both male & female fish is less than 3 indicate that the growth is isometric. The relative condition factor is a measure indicating the condition of fish during different seasons & stages of growth. The study indicated inter-seasonal variation by change of weight in relation to length of the test fish. The values of Kn clearly demarcates two spawning seasons during one year, first from March to July & the second from September to November that is confirmed by the study of ova diameter measurements of egg of various stages of maturity reveal that fish spawns twice in a breeding season, which is evidenced by the presence of double mature stock of ova in the ripe stage in the ovary twice In a year. The relationship between fecundity & body weight was observed to be linear in the present investigation. Exponential values of fecundity-fish length & fecundity-fish weight showed that fecundity was related more to length than to weight of the fish.

KEYWORDS:

Harpodon nehereus, Length-Weight relationship, Relative condition factor, Fecundity.

INTRODUCTION

Several aspects of fishery biology such as length-weight relationship, maturation, spawning & fecundity are of considerable significance in assessment & management of the fishery potential. The biometric studies provide various practical applications in fishery biology. In tropical & sub-tropical waters the growth fluctuation is more frequent in fishes due to variations in seasons, multiple spawning & food composition (Das et al., 1997). The length-weight relationship parameters are very much useful in fishery science to determine the catch per unit effort, in determining the yield equations, selectivity of gear & imposing fishery regulations for prevention of over exploitation of the fishery resources. The relative condition factor helps to assess the well being of the fish & is based on the hypothesis that the heavier fish of a given length are in better condition as proposed by Bagenal (1967). These parameters along with other aspects of fishery science such as feeding & breeding biology of fish, habit & habitat study will provide a better insight into the sustainable management of these protein rich marine aquatic resources. The knowledge on the length-weight relationship of fish has vital importance in fishery science as it not only helps in establishing the mathematical relationship between the two variables but also in converting one variable into another, for calculating condition factor to know the well being of the fish & to measure variation from the expected weight or length of individual or relevant group of individuals (Le Crens, 1951; Chonder, 1972). Relationship can also be used in setting of the yield equations for estimating the number of fish landed & comparing the population in space & time (Beverton & Holt 1957). The relationship studies give important information in fishery assessment for predicting weight from length required yield assessment (Garcia et al., 1998). Length–length relationships (LLRs) are important in fisheries management for comparative growth studies (Moutopoulos and Stergiou, 2002). The Condition factor will help determine present and future population success by its influence on growth, reproduction and survival (Hossain et al., 2006).

Measurement of diameter of eggs in the ovary, may give evidence of the duration of spawning in the fish (Hickling & Rutenberg 1936). Studies on the fecundity of fishes are useful for increasing the yield of the consumable fish species (Sivakumar et. al 2003). Gonads undergo seasonal cyclical changes in weight, particularly in female fish. Such seasonal changes are indicative in the gonad weight in relation to body weight expressed as the Gonosomatic Index (GSI) (Dadzie et. al. 2000; Ahirrao 2002). GSI is one parameter in the study of fishery biology that gives an idea regarding the reproductive status of the fish & also helps in ascertaining breeding period of the fish.

Harpodon nehereus (Ham-Buch) popularly known as 'Bombay duck' & locally called 'bombil' in Maharashtra is one of the important inshore shallow water estuarine fish of the west coast of India. The fish is carnivorous and even cannibalistic in feeding habit. Bombay duck is the only species of the Family Scopelidae (Francis Day, 1865) / Harpodontidae (FAO) forming a major fishery along the west coast from Gujarat to Maharashtra in India. On an average it forms about 10% of the total marine fish landings & of these nearly 98% comes from the above two states. Bombay duck is a very soft fish & due to its highly perishable body composition, a large part of the catch particularly during the peak fishing season is sun dried on bamboo scaffolding & a small portion is sold fresh in the local markets. This fish has a great demand among the local populace of the coastal districts. Bombay duck is generally caught by the 'dol nets' (fixed bag net) that is operated in the estuarine & shallow coastal waters. It is placed against the tidal flow with fixed bamboo poles & each haul of at least six hours duration. At the end of the high & low tides, the bag is taken up from the water & the catch emptied.

MATERIALS & METHODS

Fresh Bombay duck were procured from the fish landing centre at Versova (Andheri) on a regular basis for a period of ten months from July 2006 to April 2007. Every month about 10-15 fishes in size range of 200mm to 275mm were brought to the laboratory under sterile condition. The length-weight relationship was studied as per methods given by Biswas (1992) & Jaiswar et al. (2004). Total of 121 fishes were analyzed for the study of length-weight relationship and Fecundity of *Harpodon nehereus* (Ham-Buch). Total length was measured using the meter scale to the nearest millimeter & weight was measured by electronic balance of 0.01g accuracy. The total length & weight relationship was determined by equation $W = aL^b$ given by Le Cren (1951), where 'a' is the intercept & 'b' is the slope of the regression line (exponent). The equation was transformed into the logarithmic form, Log W = Log a + b Log L. The values of 'a' & 'b' were determined empirically. Relative condition factor (K_n) fish for different months was determined by using the formula, K_n=W / W'x100 (where W=Observed mean weight & W'=Calculated body weight). To determine the stages of ova maturity & spawning duration the ovaries were dissected out of fish blotted dry & weighed. The length of ovaries was also determined & than preserved in 10% formalin to permit hardening of ova to facilitate subsequent studies. The diameter of each ovum was measured following the method described by Hickling & Rutenberg (1936). For each sample 300 eggs were counted. For fecundity estimation, gravimetric method of Polder & Zijistra (1959) was employed. Gonadosomatic Index (GSI) was calculated using the formula, GSI = Weight of gonad (g) / Weight of fish (g) x 100 (Parameswarn *et al*., 1974).

RESULTS & DISCUSSION

The length-weight relationship for the individuals ranging in size from 199 mm to 274 mm was estimated during the period of ten months from July'06 to April'07. It is observed from the results that weight of *Harpodon nehereus* (Ham-Buch) bears a curvilinear relationship with the length that becomes linear on logarithmic transformation (Fig. No. 1 & 2). The length & weight measurements of the fish are related to each other with very high coefficient of correlation (r=0.899 for males & r=0.951 for females). The maximum weight was found to be in the month of January'07 (W=115 g) corresponding with maximum length (L=274 mm). The high value of positive correlation between length & weight in the case of *Harpodon nehereus* (Ham-Buch) for both the sexes revealed that applicability of equation derived was high. The mathematical expression of length & weight relationship generally follows the 'Cube's law' which was proposed by Spenser (1971). According to this law, weight of fish equals to the product of cube of its length. The divergence from Cube's law may be due to certain environmental factors distressing the physiology of the fish. In the relationships between different types of variables (linear and ponderal), LWRs reflects an isometric growth when b=3, i.e., relative growth of both variables is identical (Quinn II and Deriso, 1999). When b<3 it can be said to have a negative allometric growth and is a defined hypoallometry Slope value less than 3 indicates that the fish becomes more slender as they increase in length; instead when b>3 it showed a positive allometric growth and is a defined hyperallometry (Shingleton, 2010). The regression equation for both the sexes of *Harpodon nehereus* (Ham-Buch) are given below,

Males: Log W = - 87.7 + 0.63 Log L

Females: Log W = - 90.6 + 0.67 Log L

In the present study, the 'b' value for *Harpodon nehereus* (Ham-Buch) ranged between '0.63' (males) to '0.67' (females). The equation $W = a + b L^3$ was found to be the best fit to the length-weight data of Bombay duck. The study revealed exponential value for both male & female *Harpodon nehereu*s (Ham-Buch) less than 3 indicates that the fish becomes slender as they grow, which is a morphologically evident fact. According to Das et al. (1997) in tropical & sub-tropical waters, the growth fluctuation is more frequent in fishes due to variation in season, multiple spawning & food composition. Rajsegar (2005) reported significant correlation between length & weight of *Nemipterus japonicus* from Karaikkal coastal waters of Tamil Nadu. Devendra & Preeti (2003) reported values higher than 3 for *Cyprinus carpio* (4.445) & *Cirrhinus mrigala* (3.160) that indicated increase in weight was more than the cube of its length. Mohanraj (2008) assessed the length-weight relationship of *Upeneus sundaicus* & *Upeneus tragula* from Gulf of Mannar & reported high significance in body weight & total length of both the sexes.

The relative condition factor also known as Fulton's relative condition factor (K_n) is the ratio between observed weight of fish & calculated mean weight of fish. A conspicuous decline in the K_n value (K_n=0.936) was observed in the month of August'06 in the length group of 199 mm, which was the smallest length recorded during the entire study period. A marked elevation in the K_n value (K_n=1.595) was observed in the month of December'06 in the length group of 228 mm (Fig. No. 3). The study indicated inter-seasonal variation by change of weight in relation to length of the test fish. The increase in K_n value is indicative of increased deposition of fat as a result of adaptability & high feeding activity of the individuals coinciding with the breeding season. The decreased Kn value on the other hand is an indication of poor condition of the fish as reported by Solanki et al. (2005) in Catla catla. The values of Kn clearly demarcates two spawning seasons during a year, first from March to July & the other from September to November. The high values of Kn during the breeding season could be correlated with the maturity of the gonadal tissues.

Fecundity is usually exponentially related to body length, body weight, ovary weight & ovary length of the fish.

Fecundity in relation to weight of fish:

The relationship between fecundity (F) & body weight (W) can be written as,

Log F = - 5.097 + 1.77 Log W

The regression line fitted to the two variables show a linear form. The coefficient of correlation value is 0.89.

Fecundity in relation to length of fish:

The relationship between fecundity (F) & body length (L) can be written as,

Log F = - 7.01 + 2.98 Log L

The above variables are statistically correlated; the value of coefficient of correlation value is 0.67 & the relationship is observed to be linear.

Fecundity in relation to weight of ovary:

The regression equation for relationship between fecundity (F) & ovary weight (OW) can be written as,

Log F = - 0.89 + 1.37 Log OW

The regression line fitted to these two variables show a linear relationship. The coefficient of correlation value is 0.952.

Fecundity in relation to length of ovary:

The relationship between fecundity (F) & ovary length (OL) can be written as,

Log F = - 0.62 + 1.52 Log OL

The regression line shows a linear relationship with respect to the above mentioned variables. The coefficient of correlation value is 0.87.

In the present study, exponential value of fecundity-ovary weight relationship was found to be lower (b=1.37) than that of fecundity & ovary weight (b=1.52), fecundity & body weight (b=1.77) & fecundity & body length (b=2.98) of the fish indicating that the rate of egg production in relation to body weight & ovary weight is less compared to the body length of fish. It can therefore be inferred that there could be a close relationship between fecundity & body length of *Harpodon nehereus* (Ham-Buch) than those of body weight, ovary weight & ovary length. Observations on the ovaries & ova under microscopic examinations reveal the fact that the maturity stages of ova in Bombay duck could be categorized into immature, mature & ripe. Ova diameter measurements of various stages of maturity reveal that fish spawns twice in a breeding season, which is evidenced by the presence of double mature stock of ova in the ripe stage in the ovary. Fecundity is observed to vary as cube of its length as reported by Sivakumar et al. (2003). In *Harpodon nehereus* (Ham-Buch) fecundity increases at a rate than that of increase of body length in relation to the body weight as indicated by Joshi & Khanna (1980) in *Labeo gonius*. Nevertheless, variability in fecundity even in fishes of same length was noted by Le Crens (1951) & Thomas (1969). The relationship between fecundity & body weight was observed to be linear in the present investigation; similar findings were also reported by Qasim & Qayyum (1963) in *Channa punctatus*. Exponential values of fecundity-fish length & fecundity-fish weight showed that fecundity was related more to length than to weight of fish as reported by Joshi & Khanna (1980) in *Labeo gonius*. Exponential values of fecundity-fish weight & fecundity-ovary weight showed that fecundity was more closely related to fish weight than to ovary weight. This could be explained by Bagenal's (1967) contention that either larger ovaries produce larger & fewer eggs or the connective tissue increases disproportionately by the fact that in many fishes, somatic weight change significantly towards the spawning period (Wooton, 1973) resulting in an alteration of fish between fecundity & fish weight as the season progresses.

According to gonad maturity stages and GSI variations, reproduction activity of *Harpodon nehereus* (Ham-Buch) continued round the year and intensively spawning occurred twice in a year. The Gonadosomatic Index (GSI) depicts the reproductive status & breeding periodicity of the fish. The rise in GSI of female fish from January'07 to March'07 & again from September'06 to November'06 indicates that the fish are in advanced stage of maturity. The fall in GSI from June'06 to August'06 & from December'06 to January'07 indicates depletion of gonadal products as a result of intense spawning activity. The GSI reaches its peak during the spawning period. From the present study on GSI of *Harpodon nehereus* (Ham-Buch) it is evident that weight of ovaries followed regular cyclic changes that is correlated with the process of oogenesis. Observations of GSI are in concurrence with the results reported by Jayaprakash & Nair (1981) in *Etroplus suratensis* & *Ramakrishniah* (1992) in *Mystus aor.*

ACKNOWLEDGEMENT

Investigator is grateful to the Principal & Management of S.V.K.M's Mithibai College for constant encouragement & also for providing laboratory facilities. Thanks are also due to University of Mumbai for funding this project.

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Fig. No. 1 Relationship Between Total Length & Body Weight of H. nehereus

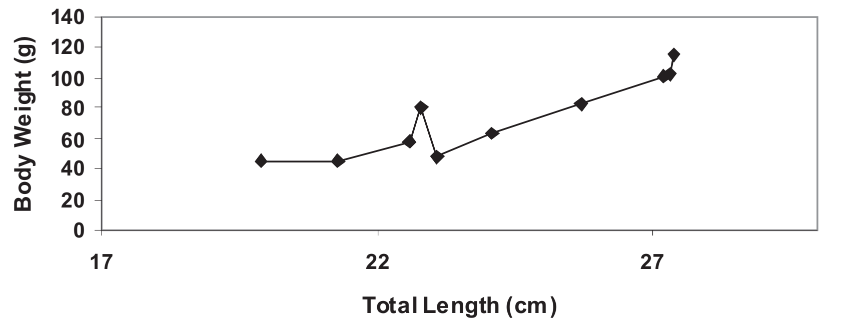

Fig. No. 2 Log Length & Log Weight Relationship of H. nehereus

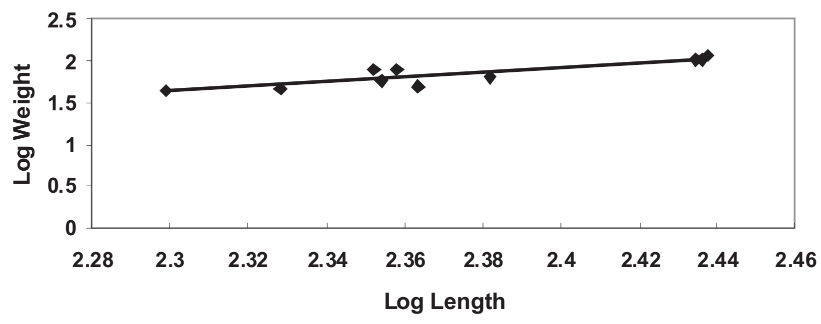

Fig. No.3 Monthly Relative Condition Factor (Kn) of H. nehereus

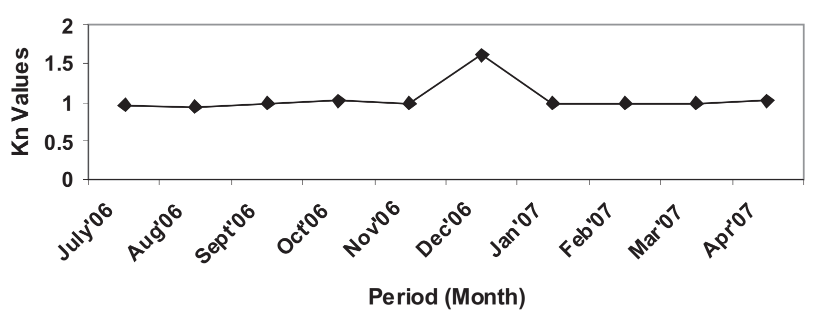

Table 1 Month wise Length-Weight Relationship of *Harpodan nehereus* (Ham-Buch)

Month	No. of Fish	Average Total Length X (mm)	Average Total Weight Y (g)	Log L (X)	Log W (Y)	Log L^2 (X^2)	Log W^2 (Y^2)	XY	Calculated Weight	Condition Factor (K_n)
July 2006	12	241	63	2.382	1.7993	5.6739	3.3274	4.2859	65.01	0.969
August 2006	12	199	45	2.2989	1.6532	5.2849	2.733	3.7984	48.05	0.936
September 2006	12	273	103	2.4362	2.0128	5.9350	4.0513	4.9035	102.94	1.00
October 2006	12	257	83	2.3521	1.8926	5.7965	3.9015	4.547	82.51	1.005
November 2006	10	213	46	2.3284	1.6628	5.4214	2.7649	3.8716	46.112	0.997
December 2006	15	228	81	2.3579	1.9085	5.5596	3.6423	4.50	80.78	1.595
January 2007	12	274	115	2.4378	2.0607	5.9428	4.2464	5.0235	115.01	0.999
February 2007	12	272	101	2.4346	2.0043	5.9272	4.0172	4.8796	102.5	0.985
March 2007	12	226	58	2.3541	1.7634	5.5417	3.0195	4.1512	59.3	0.978
April 2007	12	231	48	2.3636	1.6812	5.5866	2.8264	3.9736	47.66	1.007
	N=121	Σ = 2414 Mean = 241.4	Σ= 743 Mean = 74.3	Σ= 23.745 Mean =2.374	Σ= 18.438 Mean =1.843	Σ= 56.669 Mean =5.666	Σ= 34.5299 Mean =3.4529	Σ= 43.934 Mean =4.393		

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