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BIOLOGICAL ASPECTS OF GOLD SPOTTED GRENADIER ANCHOVY, *COILIA DUSSUMIERI* (CUV. & VAL., 1848)

Hitesh U. Shingadia

SVKM's Mithibai College of Arts, Chauhan Institute of Science and Amrutben Jivanlal College and Economics, Vile Parle - West Mumbai 400 056

ABSTRACT The present paper deals with some biological aspects of *Coilia dussumieri* (Valenciennes, 1848) from the offshore waters along Mumbai Coast (Maharashtra). Four stages of maturity viz. immature, maturing, mature & ripe ova were recognized during the maturation studies of fish. Ova diameter study revealed that fish spawns once in the spawning season which, is evident from appearance of single peak in the mature stock of ova separated from a small peak of immature stock of ova. The comparison of exponential values of fecundity-fish length (L), fecundity-fish weight (W), fecundity-fish ovary weight (OW) & fecundity-fish ovary length (OL) showed that the production of ova to be more depended on weight of gonad than length & weight of fish and fecundity of fish was more closely related to the weight of fish ovary than the length & weight of the fish. These findings are in concurrence with other researchers regarding observations of linear relationship between fecundity and weight of fish.

KEYWORDS : Coilia dussumieri, Spawning, fecundity, Gonadosomatic Index

INTRODUCTION:

The gold spotted grenadier anchovy, *Coilia dussumieri* (Valenciennes, 1848) is a species of ray-finned fish (Actinopterigii) belonging to Family Engraulidae showing widespread distribution from India, Java, Sumatra to Southeast Asia. The body of fish tapering towards caudal end with colour light brown on back and flanks. Silvery belly with 2-3 rows of golden or pearly spots in rows below the scales and along the isthmus, edge of lower jaw, on cheeks and also on the gill cover, hence the name. The total length of fish ranges between 15.5 to 20 cm (Rahman, 2005; Huda et al., 2003). It is a coastal and estuarine amphidromous fish forming a minor fishery along the coast of Peninsular India from Mumbai in the West to Kolkata in the East. Along the North Western Coast of India, stock is concentrated between 19^0N & 21^0N latitudes & 71^0E & 73^0E longitudes (Fernandez & Devraj, 1988). Fish is carnivorous and feeds on fish larvae, mysids, copepods, prawns, polychaete larvae, Sagitta, etc. Among the local populace of coastal Maharashtra, the fish is regionally known as 'mandeli'. It is sold in small clusters in local fish market as low priced fish commodity. During bulk catches after fresh consumption fairly large amount whole of fish is preserved by salting and sun drying.

Several aspects of fishery biology viz. length-weight relationship, food & feeding, age & growth determination, maturation, spawning, fecundity etc. are of significance in the stock assessment & management of fishery prospects for the sustainable exploitation of the fishery resource. The length-weight relationship & relative condition factor were computed for the Anchovy *Coilia dussumieri* (Cuv. & Val.) and the 'b' value showed significant correlation between length & weight of fish and also the values obtained for mean weight by sex show that females were significantly ($P<0.05$) larger than males (Shingadia, 2014). The measurement of ova diameter in the ovaries well advance towards spawning, may give evidence of the duration of spawning in a fish (Hickling & Rutenberg, 1936). The gonads undergo regular cyclical changes in weight, which are indicative of spawning season of fish. One of the methods of studying the spawning periodicity is to follow the seasonal changes in gonad weight in relation to the body weight expressed as Gonadosomatic Index (GSI) (Dadzie et al., 2000). 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. 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 knowledge of fecundity estimation may also be used to assess the abundance & reproduction potential of the spawning stock.

MATERIALS & METHOD:

The random sample of fish *Coilia dussumieri* (Valenciennes, 1848) were obtained from Versova fish landing centre from January 2009 to November 2009. A total of 154 specimens were analyzed for the study of spawning periodicity & fecundity of the fish. The length-weight relationship was studied as per methods given by Biswas (1992) & in Practical Manuel of Fish Biology (Jaiswar et al., 2004). Total length was measured using fish measuring board to the nearest millimeter & weight was measured using electronic balance of 0.1g accuracy. To determine the stage of maturity & spawning duration the ovaries were dissected out of fish blotted dry & weighed. The length of ovaries was also determined & was 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. The relationship between length-weight fecundity of fish was calculated by formula $F=aL^n$ (Le Cren, 1951) or $\text{Log } F = \text{Log } a + n \text{ Log } L$, where 'F' is Fecundity, 'L' is length of fish, 'a' is constant and 'n' is exponent. In order to calculate the values of 'a' and 'n', the arithmetic values of length/weight and fecundity data were converted to Log length/weight and Log fecundity. Gonadosomatic Index (GSI) was calculated using the formula, GSI=Weight of gonad/Weight of fish x 100 (Parameswarn et al., 1974)

RESULTS & DISCUSSION:

Maturation studies of Fish:

The minimum length of fish at first maturity is around 11.5 to 12.0 mm. Based on the observation of ovaries four stages of maturity were recognized in the ovary of *Coilia dussumieri* (Valenciennes, 1848) viz. immature, maturing, mature & ripe ova. In immature stage, ovaries were small in size with spindle shape & appeared faintly pink in colour. Ova were transparent & nuclei were seen under microscopic observation. In maturing stage, ovaries appeared reddish in colour with increased size. Ova were translucent & nuclei were not clearly visible under microscopic observation. Ovaries in mature stage were bright red in colour, more vascularized & larger in size. Ova appeared opaque under microscopic observation. The ripe stage was characterized with ovaries larger in size occupying entire body cavity of the fish. Ova appeared completely opaque with thin rim of cytoplasm. According to Fernandez and Devraj (1989) also four major gonad maturation stages with eight minor maturity stages could be identified on *C. dussumieri* (Valenciennes, 1848) that agrees with the present findings. In tropical & subtropical waters the growth fluctuation is more frequent in fishes due to variation in seasons, multiple spawning & food composition (Das et al., 1997).

Spawning of Fish:

Coilia dussumieri (Valenciennes, 1848) spawns in batches throughout the year releasing mature eggs during each spawning act with a periodicity of six months. Minimum number of ova was observed in immature stage within the ovary in ova diameter of 0.095-0.17 mm & 0.61-0.69 mm (Fig.1). Ova in maturing stage was observed in diameter of 0.18-0.26 mm & 0.35-0.43 mm. Fairly good number of ova in mature stage was observed in diameter of 0.44-0.52 mm. Maximum number of ova in spent stage were recorded in the diameter of 0.53-0.6 mm. The maximum diameter of ova recorded was 0.7-0.78 mm. The percentage frequency of ova recorded for the different stages of maturity reveals that ova develop up to the maximum diameter of 0.7-0.78 mm. However present observation to some extent differs from the findings of Fernandez and Devraj (1989), who reported ripe ova to measure from 0.82 to 0.90 mm in diameter *C. dussumieri*

(Valenciennes, 1848). Further it can be inferred that fish spawns once in the spawning season which, is evident from appearance of single peak in the mature stock of ova separated from a small peak of immature stock of ova. The study by Hitesh Shingadia (2014) indicated inter-seasonal variation by change of weight in relation to length of fish and reported higher relative condition factor in males (K_n=0.521) to be an indicative of increased deposition of fat as a result of adaptability & high feeding activity in male over female fish. Whereas lower K_n value in female (K_n=0.306) indicating spawning periodicity of the fish. In terms of seasonality, K followed the reproductive cycle of fish, decreasing during the spawning season and increasing after it and well matched with their reproductive cycle (Froese and Pauly, 2010). Sivashanthini & Abeyrami (2003) suggested that during peak spawning season breeding stock should be protected by imposing strict rules & regulations in order to maintain sustainable exploitation of the fishes.

Fecundity of Fish:

Fecundity is exponentially related to variables like length, body weight, ovary weight & ovary length (Table 1). The relationships between fecundity and length of fish, fecundity and body weight of fish and fecundity and gonad weight were found to be linear indicating that the fecundity generally increased with an increasing length, weight and ovary weight. Variation in the fecundity of the fish in the same length class was found in this study that indicates that the fecundity of a fish does not exclusively depend on its length rather a considerable closer relationship of fecundity with gonad weight was observed. The fecundity varies from species to species, as well as within the same species, due to different factors such as age, size, body and gonad weight and the ecological condition of the water body. The variation in fecundity is very common in fish and has been reported by many researchers in past. The fecundity of *C. dussumieri* was found to vary from 1200 to 4200 (Gadgil, 1967) and 1000 to 5000 (Fernandez and Devaraj, 1996) in Bombay waters of India.

Relationship between fecundity & length of fish can be represented by the equation, Log F = 3.21 + 0.227 Log L (Fig. 2). These two variables showed linear relationship with correlation coefficient value to be 0.592.

Relationship between fecundity & weight of fish can be represented by the equation, Log F = 0.722 + 0.733 Log W (Fig. 3). These two variables showed linear relationship with correlation coefficient value to be 0.653.

Relationship between fecundity & ovary weight of fish can be represented by the equation, Log F = -0.48 + 1.031 Log OW (Fig. 4). These two variables showed linear relationship with correlation coefficient value to be 0.924.

Relationship between fecundity & ovary length of fish can be represented by the equation, Log F = 1.798 + 0.352 Log OL (Fig. 5). These two variables showed linear relationship with correlation of coefficient value to be 0.759.

It is a known fact that the number of ova produced by a fish increases with increase in the size of fish. In the present investigation the exponential value of fecundity-weight of fish (0.733) & fecundity-length of fish (0.227) was observed to be lower than that of fecundity-ovary weight (1.031) of fish indicate that production of eggs to be more depended on weight of gonad than length & weight of fish. These findings are in concurrence to observations of linear relationship between fecundity and weight of fish (r = 0.7621) made by Fernandez and Devraj (1989) with male to female fish ratio in a population to be 1:0.75. Verghese (1988) reported parabolic curve in case of length-fecundity relationship but the weight-fecundity relationship in *C. dussumieri* (Valenciennes, 1848) collected from Hooghly estuary was quite flat indicating that it was not very different from linear relationship as observed in present study. Khan et al., (2002) in brackish water catfish *Plotosus canius* (Ham.-Buch.). Strongest correlation was found in fecundity & ovary weight (r = 1.031). Fecundity of *C. dussumieri* (Valenciennes, 1848) ranges from 1,000 to 5,000 eggs per female fish at size ranging from 15.7 to 19.0 cm in total length respectively (Fernandez and Devraj, 1989). Fecundity was observed to vary as cube of its length as reported by Simpson (1951). A direct proportional increase of fecundity with the increase in ovary weight as observed in the present study was also reported by Bhatnagar (1964) in *Labeo bata.*

Gonadosomatic Index (GSI):

The growth of fish is very rapid in terms of length before attaining sexual maturity, subsequently, energy is rapidly diverted for the growth and maturation of gonadal tissues instead of somatic tissues. The GSI is a good indicator of the gonadal development and maturity of the fish which increases with sexual maturity and declines after spawning (Soyinka, 2014). The average value of the GSI showed an apparent variation throughout the period of study. Lower GSI value represents the pre-spawning period that sharply increases to reach the peak indicating the spawning period. After the spawning period the GSI values gradually decreased. The weight of ovary is influenced by the number of ova present in it. The Gonadosomatic Index in the present study ranges from 1.17-15.36. GSI increases with progressive development & maturation of gonads. The maximum value of GSI coincides with the maximum weight of the ovary of the fish and vice versa. Lower values of GSI indicates pre-spawning season of *Coilia dussumieri* (Valenciennes, 1848). Gradual rise in the GSI values indicate prolonged spawning period that goes on till the complete of maturation phase of the ovary. Similar results were obtained in *Etroplus suratensis* by Jayaprakash & Nair (1981). The sharp decline in the GSI may be due to resorption of the remnants of ova in the spent ovaries. It is evident from the weight of ovary & GSI that *C. dussumieri* (Valenciennes, 1848) undergoes regular cyclical changes correlated with the Oogenesis. According to Talwar and Jhingran (1991) *C. dussumieri* (Valenciennes, 1848) enters estuaries to breed. Though the value of condition factor is highly dependent on the external factors around the fish, higher K values show that plenty of food is available to support both the somatic and gonadal development of fish resulting in better condition of this species as reported by Dhanya et al. (2004).

CONCLUSIONS:

The range of fecundity and the average number of eggs indicates that the fish is moderately fecund. The relationships between fecundity and length of fish, body weight of fish and gonad weight were found to be linear indicating that the fecundity generally increased with an increasing length, weight of fish and ovary length and weight. The information about reproductive cycle and spawning periodicity obtained in the present investigation might add up to the available life history data for the fish and also assist in taking appropriate measures to manage the fishery in view of the mismanagement and overexploitation thus diminishing fishery resource.

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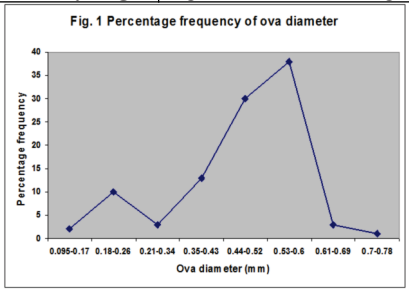
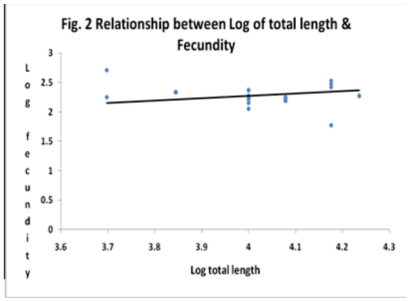
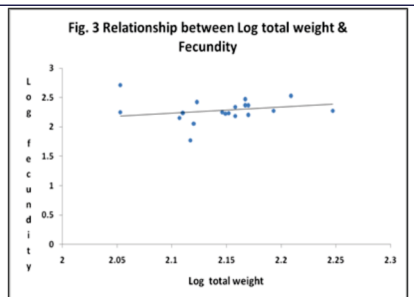
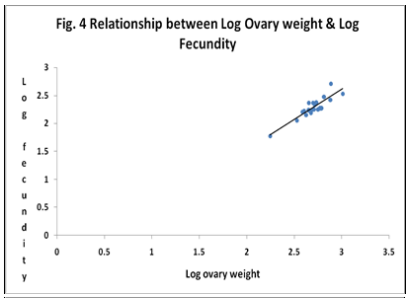
Table 1: Relationship between fecundity & different variables of *Coilia dussumieri* (Valenciennes, 1848) from Mumbai Coast

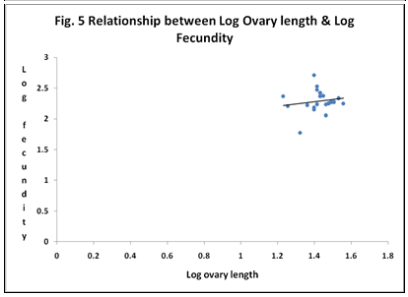
Variables	Linear regression equation	'r'
Fecundity & length	Log F = 3.21 + 0.227 Log L	0.592
Fecundity & weight	Log F = 0.722 + 0.733 Log W	0.653
Fecundity & ovary weight	Log F = -0.48 + 1.031 Log OW	0.924
Fecundity & ovary length	Log F = 1.798 + 0.352 Log OL	0.759











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