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BREEDING BIOLOGY OF INDIGENOUS ORNAMENTAL FISH *PSEUDOSPHROMENUS DAYI* (KOHLER, 1908)

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Abstract: Ornamental fishes are fascinating for their brilliant and attractive colouration, pattern, tiny size and their ability to adapt in confined aquarium tanks. The objectives of the present study comprises a detailed investigation on the reproductive biology of *Psuedosphromenus dayi*. Samples were regularly collected once in a fortnight from the Vellayani lake, near Trivandrum for a period of twelve months from February 2012 to January 2013. Every month about fifty fishes ranging from 1.7 centimetre to 4.5 centimetre in total length were collected. They were then measured to the nearest centimetre (cm) for their total length and standard length using a scale in cm and then weighed to the nearest gram (g) for their weight using an electronic balance. Inorder to examine the spawning season and spawning frequency of the species the Gonado-Somatic index (GSI) for different months were determined. The fecundity was determined by the gravimetric method. Regression analysis was performed with the length-weight data to check the linearity of the relationship. Simple regression analysis was done to find out the length-gonad weight relationship in female fish. The results of the study shows that the two sexes did not occur in the same proportion during different seasons of the year. Four maturity stages of ovaries were identified and were classified based on I.C.E.S. scale. *P. dayi* has atleast two spawning seasons. One spawning period is in February-March.This must be a short breeding season. Another spawning period from July to early October with a peak in August. This is the long breeding season. The values of GSI were high during February and March indicating a short breeding season. GSI value increased gradually from July onwards reaching a peak in August and slightly declined during October. This indicates a long breeding season which started in July and continued till early October which exhibits a peak value in August. The fecundity increased with increase in length and weight of fish.

Key words: *Pseudosphromenus dayi,* breeding biology, spawnig frequency

INTRODUCTION

The ornamental fish sector is a widespread and global component of international trade, fisheries, aquaculture and development. Reproductive performance and quality of eggs play a major role in developing ornamental fish culture and trade (Maya Devi, 1997). An understanding of the reproductive biology of a species is a central aspect of providing sound scientific advice for fisheries management. Life history parameters such as maturity at size or age, sex ratio, fecundity and spawning time and duration, vary between populations of a species. Descriptions of reproductive strategies and the assessment of fecundity are fundamental topics in the study of the biology and population dynamics of fish species and also for evaluation of the reproductive potential of individual fish species.

Life-history characteristics can be considered as adaptive because the fitness of an individual organism depends strongly on such traits as fecundity, age at first maturity and longevity. Knowledge on reproductive biology of fish is essential for evaluating the commercial potentialities of its stock, life history, culture practice and management of its fishery . Reproductive potential of a population is one of the basic exigencies to designate the individuals

of that population in respect to their gonad conditions (Jhingran and Verma, 1973).

In order to achieve success in fish culture, it is important to assess the breeding cycle associated with fecundity of cultivable fishes. Estimates of fecundity, sexual maturity and method of spawning are essential in fishery science and important in the dynamics of the population. Knowledge on length at maturity and spawning season detects when and at which length the fish should be protected and therefore it is important in fish stocks assessment. Knowledge on the fecundity of a fish is important for determining the spawning potential and its success. Determination of breeding season is an essential part of biological investigations of fishes. Fecundity information of a species is essential for estimating seed production capacity and spawning population of the species concerned. The success of any fish species is ultimately determined by the ability of its members to reproduce successfully in a fluctuating environment and thereby to maintain the viable population.

The objectives of the present study comprise a detailed investigation on the reproductive biology of *Psuedosphromenus dayi*.*P. dayi* is a member of the family Osphronemidae.Their breeding behaviour is very fascinating. Like many labyrinth fishes, *P. dayi* is a bubble nest builder, with the male creating a small raft of mucous-coated bubbles in which to place the eggs.

MATERIALS AND METHODS

Samples were regularly collected once in a fortnight from the Vellayani lake, near Trivandrum for a period of eleven months from February 2012 to January 2013. Every month about fifty fishes ranging from 1.7 centimetre to 4.5 centimetre in total length were collected.The specimens were preserved in 4% formalin and then brought to the laboratory for further analyses.The specimens were wrapped in blotting paper to remove excess moisture from their bodies. They were then measured to the nearest centimetre (cm) for their total length (from the tip of the snout to the tip of the caudal fin) and standard length(from tip of snout to the end of the vertebral column) using a scale in cm and then weighed to the nearest gram (g) for their weight using an electronic balance.Each specimen was dissected and the gonad examined. Colour and appearance of the ovary was recorded, weighed to the nearest gram.

For the present study gonads were classified in to different stages of maturity based on I.C.E.S. scale (Wood, 1930) as reproduced by Qayyam and Qasim (1964 a, b).The characters used for the classification of the ovary were appearance, colour, size, relative space occupied in the body cavity, size of the ova and their yolk content and microscopic observations such as ova diameter measurements.Inorder to examine the spawning season and spawning frequency of the species the Gonado-Somatic Index (GSI) or the maturity coefficient, for different months were determined. The fecundity was determined by the gravimetric method. For this ,ripe ovaries of ten females were selected after noting the length and weight of the specimens. The ovaries were carefully removed from the fish and preserved in 5% formalin, when the ovaries were sufficiently hardened, the excess of moisture was removed and the ovaries were weighed in an electronic balance to the nearest milligrams. Subsequently the yolk laiden ova were separated and counted. Regression analysis of the total length and total weight was carried out. The relationship of fecundity with standard length of fish is estimated by regression analysis.Regression analysis was also performed with the length-weight data to check the linearity of the relationship. Simple regression analysis was done to find out the length-gonad weight and fecundity- fish length relationship.

RESULTS AND DISCUSSION

Overall 550 fishes were sexed during the course of this investigation, 352 males and 198 females. The two sexes did not occur in the same proportion during different seasons of the year. The overall sex-ratio (M: F) was 1:0.56. ,i.e. the number of males was relatively higher than the females during the period of investigation.For

the present study, it was convenient to have the ovaries classified in to four stages of maturity based on I.C.E.S. scale (Wood, 1930) as reproduced by Qayyam and Qasim (1964 a, b).Four stages of ovary development could be recognised during the course of the present study.

Stage 1: Immature ovary

Ovaries of this stage appear as small and thin transparent structures. The oocyte is not distinguishable, and do not show any sign of yolk formation. The ovaries are transparent and occupy less than a third of the body cavity.The ovary is pale yellow in colour.

Stage 2: Mature ovary

The ovaries are slightly larger and thicker occupying about one-third of the body cavity. The oocytes can be seen under microscope. The maturing oocytes are spherical and partly opaque owing to the commencement of yolk deposition.The developing ovary loses the transparency and transforms into a white colour.

Stage 3: Ripening ovary

The ovaries are enlarged, broadened and occupy more than half of the body cavity.The ovaries are fully packed with densely yolk laiden eggs which can be easily distinguished without the aid of microscope. The ovarian wall is highly distended and semi-transparent.

Stage 4: Ripe ovary

The ripe stage is characterised by immensely enlarged ovary filling almost the entire body cavity, masking the internal organs. The ovarian wall is very thin and easily rupturable. The eggs are opaque, prominent, fully ripe and ready for expulsion.

The percentage occurrence of fishes with ovaries in different stages of maturity during different months was determined to delineate the spawning season and is shown in Table 1.The ovaries show regular seasonal changes in the stages of maturity. It is seen that immature virgins (Stage 1) occur throughout the months. The second stage (Mature) is present during all the months. Their percentage remains high from August to October.The ripening stage (Stage 3) appears in February, continues to increase and becomes dominant in May and June. However after June there is a sudden fall in stage 3 with a complete absence in August, September and October. Ripe ovaries first appear in February and their number increases attaining a maximum in June and then declines to a minimum in July. The ripe females appear for the second time after July. From August onwards the females show a preponderance of ripe ovaries with a maximum in September. The high incidence of ripe ovaries last for a period of one month and after it declines. One spawning period must be between February and March. This must be a short breeding season. Another spawning period must be between late July to early October with a peak in August. This must be the Peak Breeding season.

The GSI of *P.dayi* was estimated monthly for females for a period of eleven months from February 2012 to December 2012. It is evident from Table 2 that values of GSI were high during February and March indicating a short breeding season. There is abrupt decline of GSI thereafter till June. GSI value increased gradually from July onwards reaching a peak in August and slightly declined during October. This indicates a long breeding season which started in July and continued till early October which exhibits a peak value in August.Fecundity was determined for 10 ripe females ranging in size between 2.2cm to 2.6cm. The range of fecundity was found to be 118 to 251 with a mean of 186.89.The fecundity increased with increase in length and weight of fish.The scatter diagrams for males and females are obtained by plotting the logarithm of length against the logarithm of weight of each individual fish.It is shown in Fig.1. and Fig.2.

The Length Weight relationship in males is

$$\text{Log } W = 1.75 \text{ log } L - 1.293$$

The Length Weight relationship in females is

$$\text{Log } W = 1.851 \text{ log } L - 1.247$$

The length weight relationship in males and females follows the hypothetical cubic law. The

scatter diagram shown in Fig.3. indicating the length - gonad weight relationship in females is obtained by plotting standard length against gonad weight.

The Length - Gonad Weight relationship in Females is

$$\text{Log } W = 0.175 \log L - 0.029$$

The scatter diagram shown in Fig.4 for females are obtained by plotting standard length against fecundity.

The relationship between fecundity (F) and fish length (L) in *P. dayi* can be expressed as

$$F = 27.50 \log L + 115.5$$

The sex composition of the samples of *P.dayi* collected during the period of investigation appeared to be rather unequal. There is a general preponderance of males over females. Qasim (1966) noticed such a disparity in the sex ratio in *Ophiocephalus punctatus*, *Barbus stigma* and *Calichrous bimaculatus*. He attributed this disparity of sexes in the population to the sexual difference in growth rate. Prabhu (1956) and Karekar and Bal (1960) classified the spawning activity of fishes in to four categories based on the observations made by De Jong (1939).

Category ' A'-one spawning of short duration, ovary containing mature ova distinctly separated from immature ova.

Category 'B'-one spawning of longer duration, range of size of mature ova being nearly half the range of total size of entire intra-ovarian eggs.

Category 'C'-spawning twice a year, ovary containing two batches of ova

Category' D'- intermittant spawning, different batches of eggs not sharply distinguishable.

Qasim and Qayyum (1961) classified the fishes in to three categories

Category 1 - having short breeding season with a single batchof maturing eggs

Category 2 - having a longer breeding season with more than one batch of maturing eggs.

Category 3 - having non-seasonal breeding without a well marked batches of eggs

The present investigation undertaken to study the breeding biology of *P. dayi* by an examination of the gonado-somatic index has shown that this species spawns more than once in a year, one in February-March and a second time from July to October. The occurrence of Stage- 4 individuals in large numbers during the months of July-October coupled with high values of G.S.I. in the same months show that peak maturity is attained during these months. Thus *P. dayi* belongs to category "C" of Prabhu (1956) or category 2 of Qasim and Qayyum (1961).

From a perusal of the previous literature, it has been observed by fishery biologists that the

Table 1. The maturity stages of ovary of *P. dayi* during the period of study.

Month	Immature	Mature	Ripening	Ripe
Feb	80.95	9.52	4.76	4.76
Mar	82.6	13.04	_	4.37
Apr	68	20	4	8
May	37.03	37.03	14.81	11.11
Jun	12.5	50	25	12.5
Jul	50	30	10	10
Aug	25	65	_	10
Sep	16.66	66.66	_	16.66
Oct	18.75	75	_	6.25
Nov	44.44	44.44	11.11	_
Dec	30.76	53.84	_	15.38

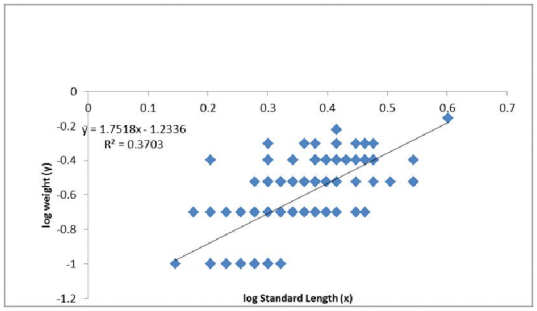

Fig. 1. Length-Weight relationship in males of *P. dayi*

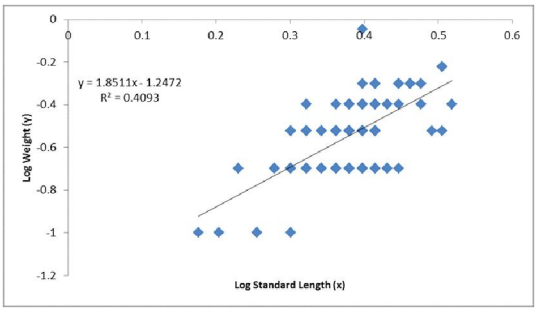

Fig. 2. Length-Weight relationship in females of *P. dayi*

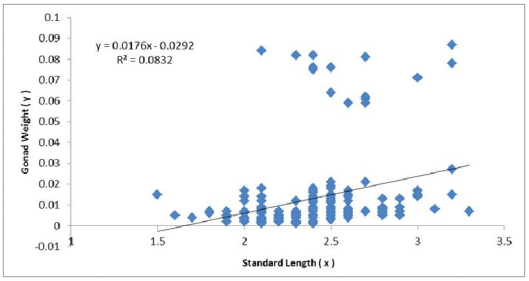

Fig. 3. Standard length-Gonad Weight relationship in females of *P.dayi*

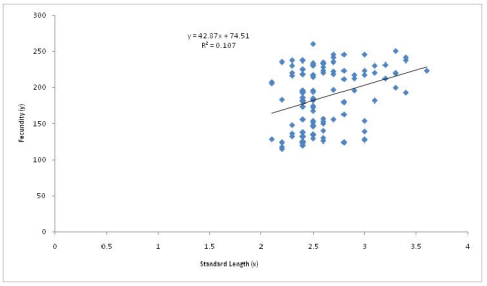

Fig. 4. Standard length-Fecundity relationship in females of *P.dayi*

Table 2. Gonado - Somatic Index of *P.dayi* during the period of study.

MONTH	G.S.I.
FEB	5.21
MAR	4.34
APR	3.47
MAY	4.26
JUN	4.82
JUL	5.18
AUG	7.17
SEP	6.23
OCT	4.69
NOV	2.66
DEC	4.82

fecundity of a fish varies with size and that the relation between fecundity and length of fish varies in different fishes. Most of them (Kisselevitch, 1923; Clark, 1934) held the view that fecundity of a fish increase in proportion to the square of its length. Still higher rates of increase in fecundity in relation to length have been reported in Irish herring (Hickling, 1940) and in two small sized freshwater fish species, *Calichrous bimaculatus* and *Mystus vittatus* (Qasim and Qayyum, 1963). Simpson (1951) pointed out that fecundity of *Pleuronectes platessa* is related to the cube of length using the formula, F=KL3, where F, number of ova, K, a constant and L3, cube of the length.In the case of *P.dayi* an increase in fecundity at a lesser or higher rate in relation to the length is noticed. Hence it can be concluded that fecundity of *P. dayi* is dependent on the length of the fish and weight of the ovary.

Previous workers have attributed several reasons for the changes in the fecundity of fish. According to Bagenal (1965), the variation of the fecundity of the long rough dabs in the Clyde sea area influence changes in the abundance of the common food items which are available. However in the case of the plaice,Bagenal(1966) found that the fecundity was dependent on the density and inturn regulates the population of fish. Winters (1971) reported that fecundity of the Grand Bank Copelin (*Malletus villosus*) is related more to age than to length. This has been attributed to the inhibition of growth as a result of spawning and to the presence of repeated spawners in the older fish. Since the present study was limited to a period of eleven months, changing abundance of food as an influencing factor in the fecundity could not be clearly established.The present study was confined only to establish the relationship between fecundity and length of fish, length and ovary weight. No definite reason can be ascertained regarding the fluctuations in the fecundity of this fish. The fecundity increases with increase in length and weight of fish.

The findings of the study show that the two sexes did not occur in the same proportion during different seasons of the year, the males are higher than the females.Four maturity stages of ovaries were identified and were classified based on I.C.E.S. scale (Wood, 1930) as reproduced by Qayyam and Qasim.*P. dayi* has atleast two spawning seasons. One spawning period is during February-March.This must be a short breeding season. Another spawning season from July to early October with a peak in August. This is the long breeding season. The values of GSI were high during February and March indicating a short breeding season. GSI value increased gradually from July onwards reaching a peak in August and slightly declined during October. This indicates a long breeding season which started in July and continued till early October which exhibits a peak value in August.The fecundity increased with increase in length and weight of fish.

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