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Fecundity of seahorse, *Hippocampus Kelloggi*, (Jordan and Snyder, 1902) in Cuddalore coast, Southeast coast of India

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Abstract

Background/Objectives: Commercial demands for seahorses, mainly for medical purposes, are increasing by 20 % per year. Seahorses are found worldwide in shallow coastal tropical and temperate seas. The reproductive behaviour of seahorses, found the females to deposit pear-shaped eggs in the male brood pouch where fertilization takes place. The dwarf seahorse, *H. zosterae* to form monogamous pair every morning until copulation takes place.
Methods/Statistical Analysis: The collection was made from Cuddalore coast on monthly basis over the period of one year (October 2000 to September 2001). The samples after collection were preserved in 5% formalin and later dissected along latero-ventral side near the abdominal region and the gonads were removed carefully. Ovaries were preserved in modified Gilson's fluid and ova diameter measurements were made from ovaries. For fecundity estimation, only stage V ovary was taken into consideration. Fecundity was estimated by the gravimetric method of various maturity stages.
Findings: The fecundity of the seahorse was calculated in the animals having stage V (mature) ovary only. The number of eggs varied from 850 to 18,950 in the size range 156 - 296 mm (SL). The average fecundity of *H. kelloggi* observed in the present study was 6638.2 eggs.
Application/Improvements: It is particularly used as ingredients in traditional medicine, particularly in Southeast Asia where Traditional Chinese Medicine. The decline of these species is great concern in the light of global exploitation of seahorses. The fecundity aspect must be established to know the production and survival of the seahorse species and with effective conservation measures can be applied to target organisms. Hence, the present study has been carried out the fecundity of seahorse *H. kelloggi*.
Keywords: Seahorses,

1. Introduction

Marine ornamental fishes are the most fascinating and diversified group of vertebrates having marvelous morphology, physiology and behavior. They also serve as a good source of nutrition to mankind, and also help to control many diseases viz. asthma, heart disease, cancer, diabetes and high blood pressure. Besides, anthropogenic, industrial, domestic and other disturbances to the habitat caused severe damage to seahorse population. These threats led to the inclusion of most of the Indo-Pacific seahorse species in the IUCN Red Data Book of Threatened Animals. Commercial demands for seahorses, mainly for medical purposes, are increasing by 20 % per year and the price per kilogram of dried seahorse varies from US$ 400.00 to 1 300.00. Survival, Seahorses have low fecundity with limited mobility, structured mating patterns and site fidelity, making them vulnerable to heavy fishing pressure. In syngnathid fishes the fecundity ranged from 100 to 200 eggs [1]. They also stated that the variation in fecundity among the species might be due to the size variation. The aim of this paper was to count and calculate fecundity of seahorse, *Hippocampus kelloggi*.

2. Study area

The Cuddalore coast (Lat.11* 43'N, Long. 79* 46' E) receives the rivers of Uppanar and Gadilam River. It is situated in the Bay of Bengal. This coast consider as an important fishing harbor in Tamil Nadu coast.

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Figure 1. Study area map

3. Materials and methods

The collection was made from Cuddalore coast on monthly basis over the period of one year during October 2000 to September 2001 (Figure 1). Collection were not done during April (30 days) – May (15 day) 2001 as the Tamil Nadu Government imposed the fishing holydays during this month's conserve the marine resources and many marine organisms were reported to spawn during these months. The samples after collection were preserved in 5% formalin and later dissected along latero-ventral side near the abdominal region and the gonads were removed carefully. International Council for Exploration of the Sea (ICES) scale of gonadal maturity [2] was adopted in the present study with suitable modifications as suggested [3].

1. Gonado-somatic index (GSI)

The spawning season of the seahorse was delineated from the percentage occurrence of various maturity stages of gonads during different months of the year and from the monthly average GSI.

The GSI was calculated as described [4] use the following formulae:

$$GSI = \frac{\text{Gonad weight (g)}}{\text{Total body weight}} \times 100$$

$$BPSI = \frac{\text{Brood pouch weight (g)}}{\text{Total body weight}} \times 100$$

2. Condition factor (Kn)

The condition factor (Kn) was calculated using the following formula:

$$K = \frac{W \times 10^5}{L^3}$$

Where, k = condition factor,

W = weight of the fish, and

L = length of the fish.

It is based on the ideal form of a fish where in the length–weight formula, $W = aL^b$, 'b' is equal to 3. When $b \neq 3$, as seen frequently the value of k computed by this formula changes with length [5]. Relative condition factor (Kn) was computed based on the following empirical length–weight relationship that is calculated by the following formula, however, can eliminate the effect of length on k:

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$$Kn = \frac{w}{\overline{w}}$$

Where, Kn = relative condition factor;

w = observed weight; and

$\overline{w}$ = calculated weight.

The 'K' measures the deviation of an individual from the hypothetical ideal fish while the "Kn" measures the derivation of an individual from the average weight of the length.

The monthly mean values of the relative condition factor for females were derived. The percentage occurrence of different maturity stages of gonads during different months of study was calculated to determine the spawning season and it was confirmed by gonado-somatic index and relative condition factor values as worked out n fishes [5].

3. Fecundity (f)

For fecundity estimation, only stage V ovary was taken into consideration. Fecundity was estimated by the gravimetric method [6] using the following formula:

$$F = \frac{nG}{g}$$

Where, F = fecundity

n = number of eggs in sub sample

G = weight of both ovaries and

g = weight of eggs (g) in sub sample.

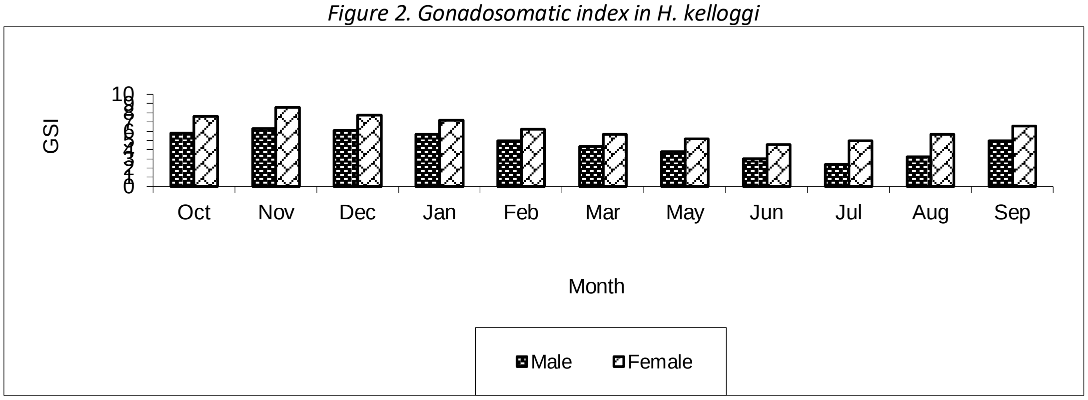
Fecundity model was fitted after a logarithmic transformation of the variables.

4. Results

1. Gonad somatic index (GSI)

The GSI was calculated for both males and females separately and the monthly mean values are plotted (Figure 2). The development of gonads and the general growth of the fishes were closely associated [7-8]. Gonad increased geometrically during spawning period and stopped at the ripe condition. GSI also increased until the gonads attained ripe condition and declined sharply after spawning.

Figure 2. Gonadosomatic index in H. kelloggi



2. Fecundity

The relationships between fecundity and total length, body weight and ovary weight were calculated and are presented in figures. The fecundity of the seahorse was calculated in the animals having stage V (mature) ovary only. The number of eggs varied from 850 to 18,950 in the size range 156 - 296 mm (SL). The average fecundity of *H. kelloggi* observed in the present study was 6638.2 eggs.

3. Relationship between fecundity and standard length

Fecundity is usually related to length of the fishes. Hence, it has been expressed by the following formula:

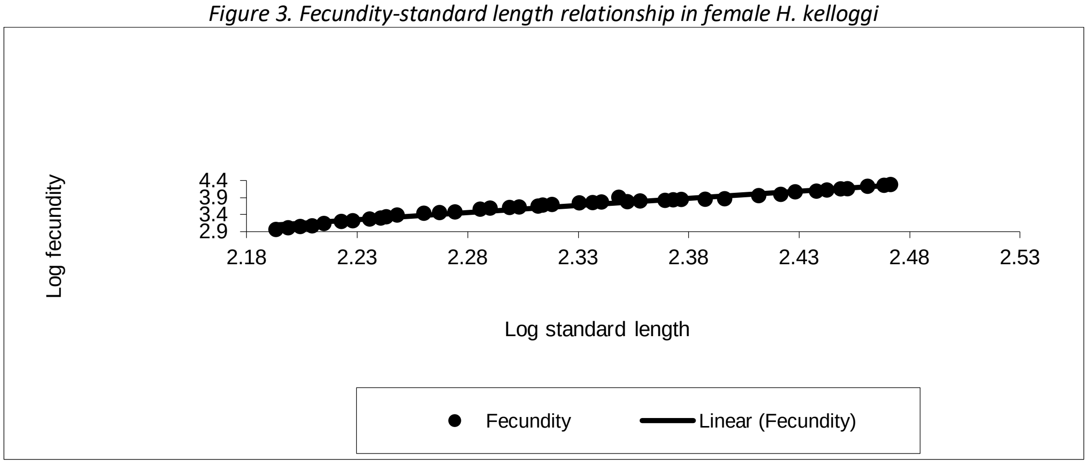
Log F = a + b Log L

Where, F = fecundity, L = total length, ‘a’ and ‘b’ are two constants estimated by the method of least squares. The fecundity and standard length of *H. kelloggi* were correlated (Figure 3) and the equation can be written as:

Log F = 1.4224 + 0.2473 Log L.

The correlation coefficient (‘r’) value between fecundity and standard length was found to be highly significant (r = 0.9897; P < 0.001). Thus in the present study the number of ova increased with the increase in length of the seahorse.

Figure 3. Fecundity-standard length relationship in female H. kelloggi



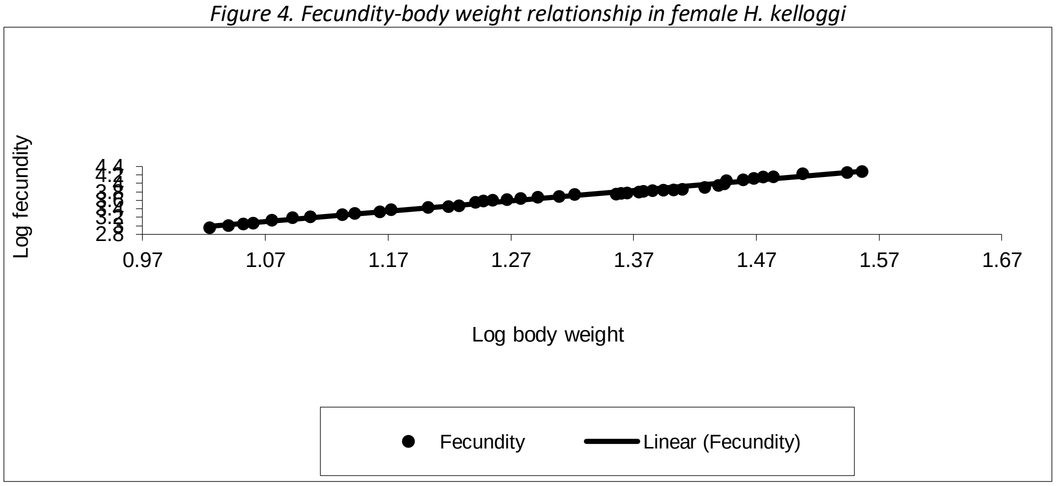
4. Relationship between fecundity and body weight

The fecundity showed linear relationship with body weight also (Figure 4). The regression equation of fecundity against body weight (W) can be written logarithmically as:

Log F = - 0.0200 + 0.4103 Log W.

The correlation coefficient (‘r’) value between fecundity and body weight was found to be highly significant (r = 0.9918; P < 0.001) indicating high degree of correlation between them.

Figure 4. Fecundity-body weight relationship in female H. kelloggi



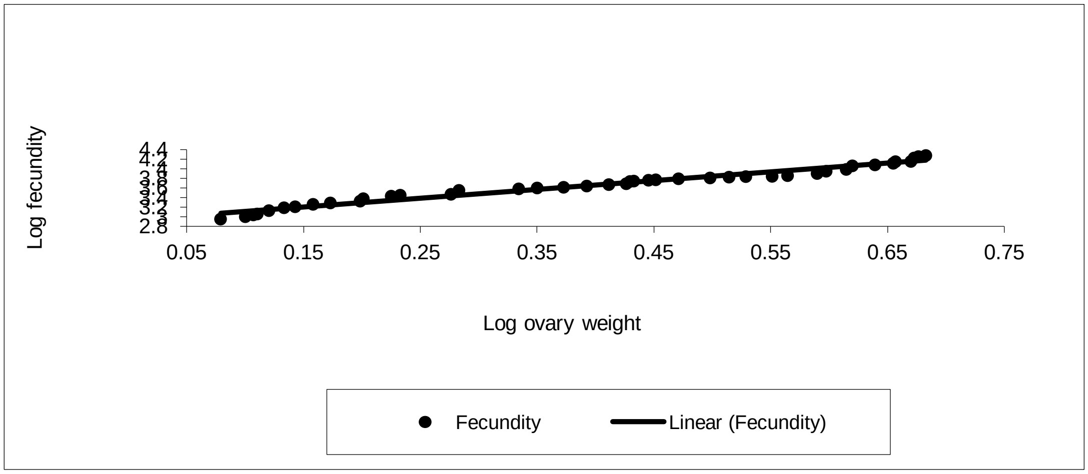
5. Relationship between fecundity and ovary weight

The relationship between fecundity and ovary weight (g) of *H. kelloggi* is shown in Figure 5. The logarithmic form of relationship between fecundity (F) and ovary weight (OW) can be expressed as:

Log F = -1.4417 + 0.5152 Log OW

The 'r' value obtained between fecundity and ovary weight was also found to be significant (r = 0.9785; P<0.001) explaining a high degree of correlation between these parameters. It could be inferred that the increase in the fecundity is a fractional increase with increase in the length and weight of a fish.

Figure 5. Fecundity-ovary weight relationship in female H. kelloggi



5. Discussion

The results of ova diameter study revealed that *H. kelloggi* is a multiple spawner with indeterminate absolute fecundity. Hence, the potential annual fecundity fixed prior to the onset of spawning, and un-yolked oocytes continue to mature and to be spawned during the reproductive season. This assumption is based on the presence of maturing ovaries with postovulatory follicles (spent stage), which indicates that after spawning, a new clutch of eggs develops within 20 days and is released (*H. trimaculatus*) as reported [9]. The entire clutch of eggs was transferred to a single male of *H. zosterae* [10].

In the present study the GSI values of *H. kelloggi* were higher during October - February. These indicated the occurrence of mature ovaries, testes and brood size (young ones). The sudden fall in GSI values during June is due to the completion of spawning and gestation. The low values of GSI observed in July and September may be due to the cessation of breeding.

Fluctuations in the Kn (condition factor) values might be either related to breeding cycle [5]. The change in 'Kn' value with increasing standard length depends on the size at first maturity, which is also supported [11].

In the present study, the values of 'Kn' showed significant fluctuations in both male and female seahorses, which may be due to smaller sample size or different stages of maturity or spawning on the part of female or difference in weight of food content in the gut.

Fecundity is defined as the number of the eggs found in the ovaries prior to spawning [12]. It is necessary for the successful management of a fishery [13]. Fecundity is the most common measure of reproductive potential in fishes because it is relatively an easy measurement to understand the number of eggs in the ovaries of a female fish. Further, knowledge of fecundity is important from practical point of view and should be considered in the development of mathematical models for purposes of stock assessment. In general, fecundity increases with the size of the female as $F = aL^b$, where F = fecundity, L = fish length, and 'a' and 'b' = constants derived from the data [6]. It is usually related to length-weight relationship of fishes.

In the present study, the fecundity of *H. kelloggi* ranged from 850 to 18750 eggs. Mean of 6968 eggs were in the size range 156 – 296 mm. The fecundity of the seahorses, *H. kuda* and *H. erectus* from 2451 to 27936 and 90 to 1313eggs were recorded [14, 11]. In syngnathid fishes the fecundity ranged from 100 to 200 eggs [1]. The fecundity varied among the species which might be due to the size variation and other factors.

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6. Conclusion

Seahorses have very low fecundity than the other fishes, which is also lead to vulnerable to heavy fishing pressure. The present study, the descriptions of fecundity was made in seahorse, *H. kelloggi.* The estimation of fecundity of seahorse is very much essential for conservation purpose. Hence, the present study has been given clear picture of seahorse, *H. kelloggi* in cuddalore coast. It will be helpful to clarify their conservation status.

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