Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 92, Number 1, January 1983, pp. 1–10.

Condition factor of *Amblypharyngodon chakaiensis* Babu and Nair in the Chakai boat channel (Trivandrum-Kerala-India)

N BABU* and N BALAKRISHNAN NAIR
Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum 695 007, India
*Department of Zoology, University College, Trivandrum 695 034, India

MS received 25 August 1982

Abstract. Condition factor (K) and relative condition factor (K_n) of *Amblypharyngodon chakaiensis* Babu and Nair males and females respectively have been studied in relation to the various months of the year and length groups. No significant correlation exists between the proportion of the males in the population and value of condition factor (K). On the basis of K and K_n and the various length groups in respect of males and females are arranged into three classes and their incidence in the pre-spawning, spawning and post-spawning seasons were represented. In females K_n showed significant positive correlation with gonadosomatic index. The size at first maturity observed by direct observation of the gonads in females and males agrees with the inflexions on the curve depicting K and K_n with respect to length groups. The influence of feeding intensity on K does not seem to be quite apparent in *A. chakaiensis*. The steady fall in K in the males seems to be related to the decrease in the percentage occurrence of males of these length group in the sample.

Keywords. Condition factor; *Amblypharyngodon chakaiensis*; Chakai boat channel.

1. Introduction

The weight of the fish is said to vary with the cube of its length. Any deviation from this relationship has been reasoned as physiological changes in fish and is termed the 'condition factor' or 'ponderal index' (Hile 1936; Thompson 1943) which is calculated from the formula $K = 100W/L^3$ where K represents the condition factor, W the weight and L the length of the fish. By determining K it is possible to define the seasonal variation in the condition of the fish in relation to age and sex of the fish, and differences between the condition of the same species in different waters which might also serve as an index of the productivity of the water mass. The above formula is based on a comparison with ideal fish where the cubic relationship holds good.

Further modifications of the above relationships have been proposed. The K value will be affected if the fish does not obey the cube law in its length-weight relationship. Factors such as age, maturity, racial diferences, food supply, degree of parasitization, environment and selection in sampling size may affect K indirectly through the exponent value. Instead, by using an empirical, $W = aL^n$ the length-weight relationship is calculated, and the factors affecting K could be eliminated (Le Cren 1951). The condition factor so calculated is called the relative condition factor (Kn) and is given by the formula $K_n = W/aL^n$. This may otherwise be denoted as $K_n = W/W$ where W represents the observed weight and W the calculated weight of fish obtained by logarthmic formula. The difference, therefore, between K and K_n is that the latter measures the deviation of an individual fish from the average weight for length, while the former measures the deviation from a hypothetical ideal fish.

The present study deals with K in males and K_n in females in relation to season and length groups from samples collected from November 1978 to October 1979 from the Chakai boat channel, Trivandrum district, Kerala.

2. Material and methods

The K value for males and K_n value for females were calculated. Data on the length and weight of 158 males and 456 females ranging from 4.9 to 8.9 cm and from 5.4 to 9.38 cm respectively were calculated. The regular monthly samples were utilized for this purpose. Regression equations of length and weight were calculated separately for 158 males and 456 females. The equations were found to be

$$\log W = 2.9081 \log L - 1.6732 \tag{1}$$

$$\log W = 2.6861 \log L - 1.4220 \tag{2}$$

for males and females respectively (Babu 1981).

The K and K_n values were obtained for each male and female respectively and the arithmetic mean was calculated for each month and each length group taking the respective averages of the above values. The grand mean of K and K_n for monthly samples and various length groups for male and female *A. chakaiensis* respectively was also calculated for comparison.

3. Results

Values of K and K_n in respect of males and females of *A. chakaiensis* into various months and length groups are presented in tables 1 and 2 respectively.

3.1 *The males*

In November, December, January, May, September and October the K values remained below the grand mean. November, December, January and September registered very low K values, while in May and October the K values remained relatively near the grand mean. In all other months, the K values were higher and remained above the grand mean except in July when it remained at the grand mean. Though the proportion of males was low in the months with very low K values, no significant correlation could be drawn between the proportion of males and values of K since the proportion of males showed irregular fluctuations in the months with high K values (figure 1).

The K values of *A. chakaiensis* in respect of length groups reveal certain interesting features. The whole population throughout the period of observation was divided into ten length groups and designated as group I to X in order of length starting the lowest point from I. It will be seen that the values of K increase steadily from I to III and remain almost stable from III to VI (figure 2) and thereafter

Table 1. Means of condition factor, (K) and relative condition factor (K_n) of males and females of *A. chakaiensis* from November 1978 to October 1979.

Month	Mean K (male)	Mean K_n (female)
November 1978	0.11	0.95
December	0.08	0.97
January 1979	0.11	1.04
February	0.24	1.06
March	0.18	1.07
April	0.18	1.06
May	0.15	1.04
June	0.20	0.95
July	0.16	0.94
August	0.25	1.10
September	0.12	0.92
October	0.15	0.94
Grand mean	0.16	1.003

Table 2. Condition factor (K) and relative condition factor (K_n) of *A. chakaiensis* with respect to length groups.

Male		Female	
Length group (cm) standard length	K	Length group (cm) standard length	K_n
4.9-5.3	1.65	5.4-5.79	1.04
5.3-5.7	1.76	5.79-6.18	0.96
5.7-6.1	1.84	6.18-6.57	0.96
6.1-6.5	1.88	6.57-6.96	1.00
6.5-6.9	1.79	6.96-7.35	1.01
6.9-7.3	1.78	7.35-7.74	1.02
7.3-7.7	1.68	7.74-8.13	1.01
7.7-8.1	1.45	8.13-8.52	0.98
8.1-8.5	00*	8.52-8.91	1.04
8.5-8.9	1.15	8.91-9.30	1.03

*Samples were not available

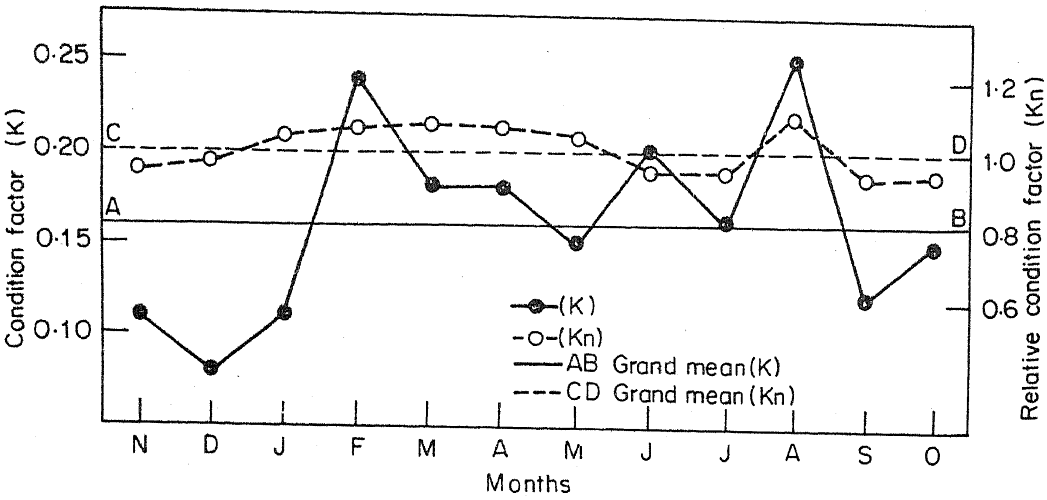

Figure 1. Condition factor and relative condition factor of *A. chakaiensis* in respect of months in the Chakai boat channel during 1978-79.

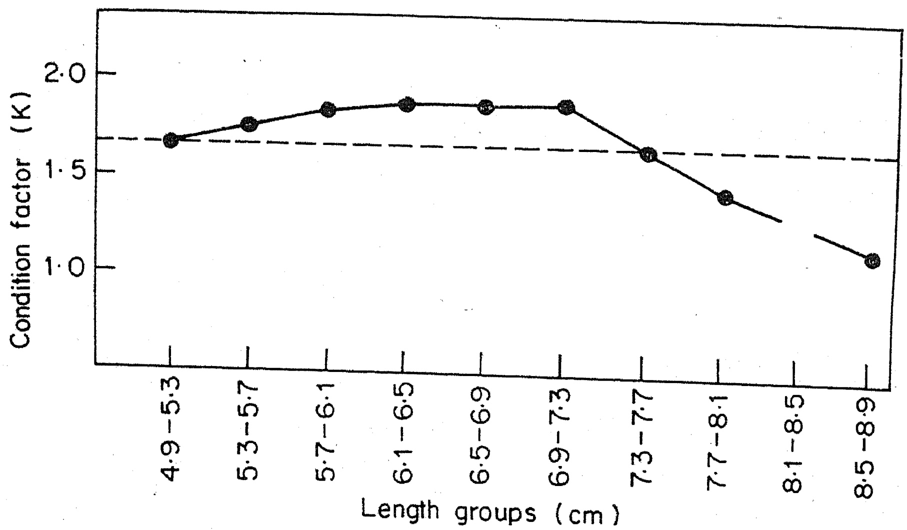

Figure 2. Condition factor of the male *A. chakaiensis* in relation to different length groups.

decrease sharply below the grand mean.

On the basis of the *K* values the ten groups were arranged into three classes and their incidence in the pre-spawning, spawning and post-spawning periods was determined (table 3). Class 1 comprised of length groups I to III, Class 2 of IV to VI and Class 3 of VII to X. Class 1 consisting of maturing and just matured individuals (since the size at first maturity of males was determined at 5.6 to 6.1 cm standard length) forms 43.41% for the whole period and 14.2% during the spawning period. More individuals of class 1 are seen in the pre-spawning period (59.25%) than post-spawning period (34.26%). Class 2 individuals form the largest percentage for the whole period (54.43) and spawning period (80.95%). Class 3 individuals are conspicuous by their absence in the pre-spawning period (those spawned in the previous breeding season probably do not survive up to the pre-spawning period) and scarce during the spawning and post-spawning periods.

Table 3. Percentage of male and female *A.chakiensis* based on length groups and condition during the pre-spawning, spawning and post-spawning periods (from November 1978 to October 1979).

	Male			Female		
	I	II	III	I	II	III
Length Group (cm)	4.9-6.1	6.1-7.3	7.3-8.9	5.40-6.96	6.96-8.13	8.13-9.39
Range of condition factor (K)	1.63-1.84 (Mean 1.75)	1.79-1.88 (Mean 1.82)	1.15-1.65 (Mean 1.42)			
Range of relative condition factor (K_n)				0.96-1.04 (Mean 0.99)	1.01-1.02 (Mean 1.013)	0.96-1.04 (Mean 1.016)
% in the pre-spawning period	59.25	40.75	00	16.35	72.33	11.32
% in the spawning period	14.29	80.95	4.76	11.25	78.10	10.65
% in the post-spawning period	34.26	58.89	6.85	84.82	57.79	7.39
% for the whole period	42.41	54.42	3.16	18.99	70.95	10.06

Pre-spawning period—February to May
Spawning period—June to September
Post-spawning period—October to January

3.2 *The females*

In the females the K_n values are below the grand mean in November, December, June, July, September and October and in other months above the grand mean (figure 1). The maximum K_n values was registered in August which coincides with the highest gonadosomatic index values (GSI). There is a positive correlation between K_n value and GSI (figure 3). The relationship between relative condition factor (Y) and gonadosomatic index (X) can be expressed as

$$Y = 0.0221X + 0.7773$$

and the correlation co-efficient (r) = 0.6402 which is significant at 5% level of significance.

The low K_n values during June and July can be attributed to low frequency spawnings in these months and that of September and October on account of the peak spawning in September. Low K_n values of November and December represent the post-spawning condition from which the female recovers gradually from January onwards.

The K_n values of the female in respect of the various length-groups exhibit certain interesting peculiarities. The population is arranged into ten length groups and these are designated as group I to X in order of length with the smallest form in group I. These groups are delineated under three classes. Class 1 consists of the first four length groups *viz.* 5.4 to 6.96 cm in standard length, class 2 consists of length

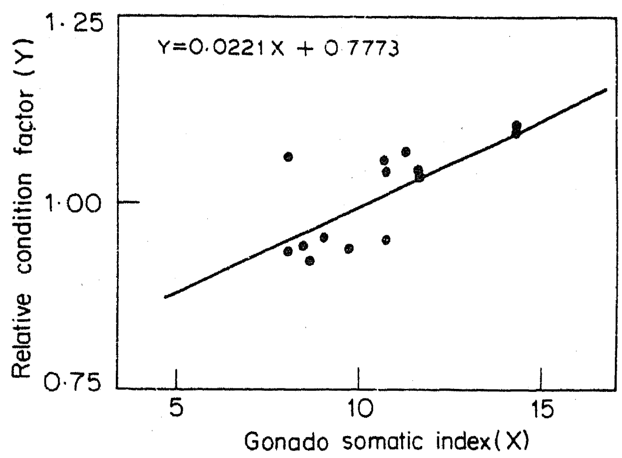

Figure 3. Gonadosomatic index-relative condition factor relationship in female *A. chakaiensis*.

group V to VII (6.96 to 8.13 cm) and class 3 consists of VIII to X length groups (8.13 to 9.3 cm). The percentage occurrence for the whole period and for the pre-spawning, spawning and post-spawning periods was determined. Individuals of class 1 consist of maturing and recently matured ones (minimum length at first maturity determined by direct observation of the gonads was found to be between 6.5 and 6.9 cm in standard length) and they formed 18.99% for the whole period and 11.25% for the spawning period and these increase considerably in the post-spawning season to 34.82%. Class 2 formed 70.95% for the whole period and 78.10% for the spawning period. It is seen that class 2 occurs in its maximum frequency in the spawning period when the breeders are ready for spawning. A reduction in their percentage is observed in the post-spawning period. In class 3 the percentage occurrence of individuals is meagre when compared to the other two classes and formed 10.06% for the whole period and 10.65% for the spawning period. This class is consistent of low percentage occurrence in the pre-spawning, spawning and post-spawning periods indicating that the class is very lean owing to the effects of predation and ageing. The relative fecundity of this class is maximum when the relative fecundity and percentage occurrence during the spawning period are taken into consideration. Class 2 forms the dominant breeding group having the highest reproductive potential (table 4).

4. Discussion

Hart (1946) observed a point of inflexion on a curve showing the dimunition of K with increase in length which indicated the length at which sexual maturity is attained. This feature has often been applied successfully in many fishes (Menon 1950; Pillay 1954; Sarojini 1957; Qayyum and Qasim 1964a, b, c; Kagwade 1969). But Bhatt (1968, 1970) observed that in the fish studied by him K did not give any indication of the size at first maturity. In male *A. chakaiensis* a gradual slope from the immature to the just matured length group is discernible from 4.9 to 6.1 cm (figure 2). In females the inflexion is conspicuous between 5.79 and 6.57 cm of standard length (figure 4). This is almost in agreement with the minimum size at first

Table 4. Relation of length group, relative condition factor (K_n) and relative fecundity of *A. chakaiensis* during November 1978 to October 1979.

Length group standard length (cm)	Range in K_n	Average relative fecundity (Number of mature eggs/g body weight)	Percentage occurrence of the length group in the whole period	Percentage occurrence of the length group in the breeding season	Reproductive potential as expressed as the product of columns 3 and 5
(1)	(2)	(3)	(4)	(5)	(6)
5.40-6.96	0.96-1.04 (Mean 0.99)	719	18.99	11.25	8088
6.96-8.13	1.01-1.02 (Mean 1.013)	957	70.95	78.10	74741
8.13-9.30	0.98-1.04 (Mean 1.016)	972	10.06	10.65	10352

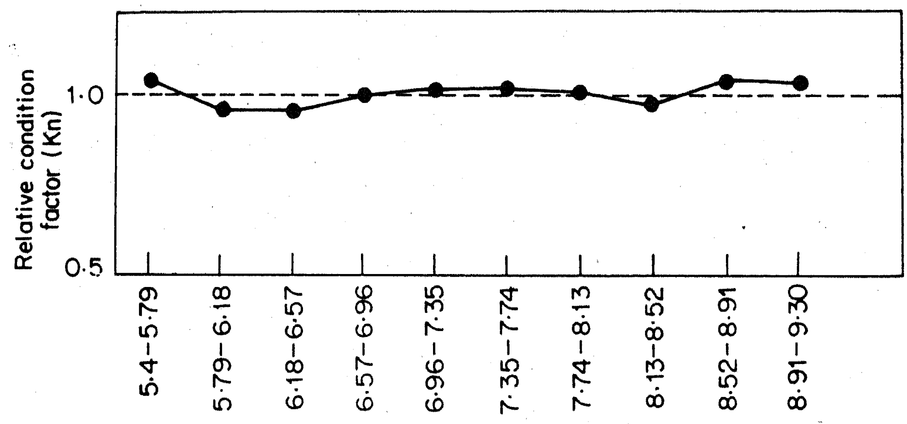

Figure 4. Relative condition factor of the female *A. chakiensis* in relation to different length groups.

maturity determined by the direct observation of gonads of the samples where it was seen that males and females attain maturity when they are 7.5 to 7.9 cm and 8.5 to 8.9 cm respectively in total length. When the standard length is reckoned for this purpose it will be 5.7 to 6.2 cm and 6.3 to 6.7 cm for males and females respectively. Thus the condition factor in *A. chakaiensis* readily indicates the size at first maturity as observed by Hart (1946). The incompleteness of the inflexion in the male is due to the non-availability of younger ones in the sample for length-weight studies. The presence of a less conspicuous inflexion in the K_n curve of the females of 8.13 to 8.52 cm length group (figure 4) needs further studies to arrive at definite conclusions.

Several factors have been pointed out by earlier investigators as influencing the condition of fish. Fluctuations in the gonad weight is the main factor which seems to regulate the condition factor (Le Cren 1951; Morrow 1951; Qayyum and Qasim 1964a, b, c). The other factor which seems to govern the rise and fall of K is the feeding rate of fish (Qasim 1957; Bal and Jones 1960; Bhatt 1968). Bhatt (1970) observed in *Heteropneustes fossilis* and *Mystus seenghala* that the increase and decrease of K value gave no indication of the spawning season of these fish. He observed that the feeding rhythm was closely related to K than the cycle of gonad weight. He also observed that the feeding intensity overshadowed the effect of increase and decrease of gonad weight on the condition factor. The present observation of *A. chakaiensis* revealed that there is a conspicuous positive correlation between K_n values and gonadosomatic index (figure 3) and gonad volume in females (figure 5). In males also the relationship is distinct and thus is in agreement with the findings of Le Cren (1951); Morrow (1951); Qayyum and Qasim (1964a, b, c).

The influence of feeding intensity on the condition factor does not seem to be quite apparent in *A. chakaiensis,* yet a negative correlation is observed though not statistically significant (figure 6). Plant materials mostly algae and detritus dominate the food materials of *A. chakaiensis* and as such the weight of these items does not seem to be very conspicuous like the food items in carnivores such as *Heteropneustes fossilis* and *Mystus seenghala* (Bhatt 1968, 1970) where the feeding intensity has considerable effect on K values.

Nikolsky (1963) observed that sometimes a sharp reduction in the condition coefficient is seen associated with mass mortality. Qayyum and Qasim (1964a, b, c) observed fall in K values in larger fish of both sexes and this is possibly because of increasing metabolic strain on account of spawning in older age groups. Perhaps with increase in age, senility sets in and complete recovery which contributes towards reserve building and increase in weight gradually declines. Presumably this is the reason for their being poorer in condition than the younger breeders. The present study of *A. chakaiensis* reveals certain interesting features in the light of the above findings.

The steady fall in K and the sharp decrease in the percentage occurrence of males from 7.3 to 8.9 cm in standard length in samples (figure 2) indicate that the individuals in these length groups are being removed from the population by way of mortality. But in female *A. chakaiensis* the values of K_n do not show any sharp fall in the

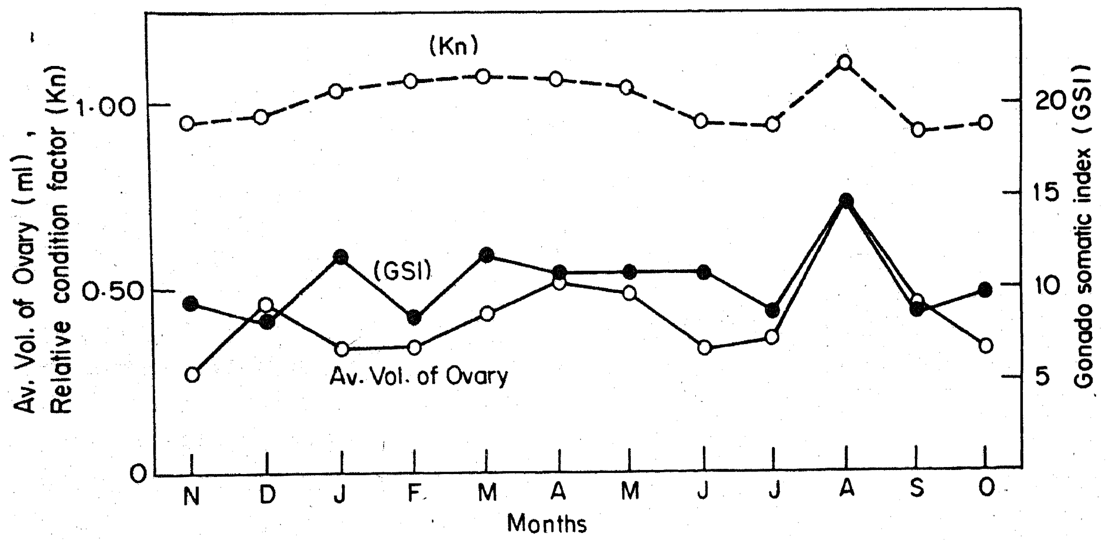

Figure 5. Relative condition factor, gonadosomatic index and average volume of the ovary in *A. chakaiensis.*

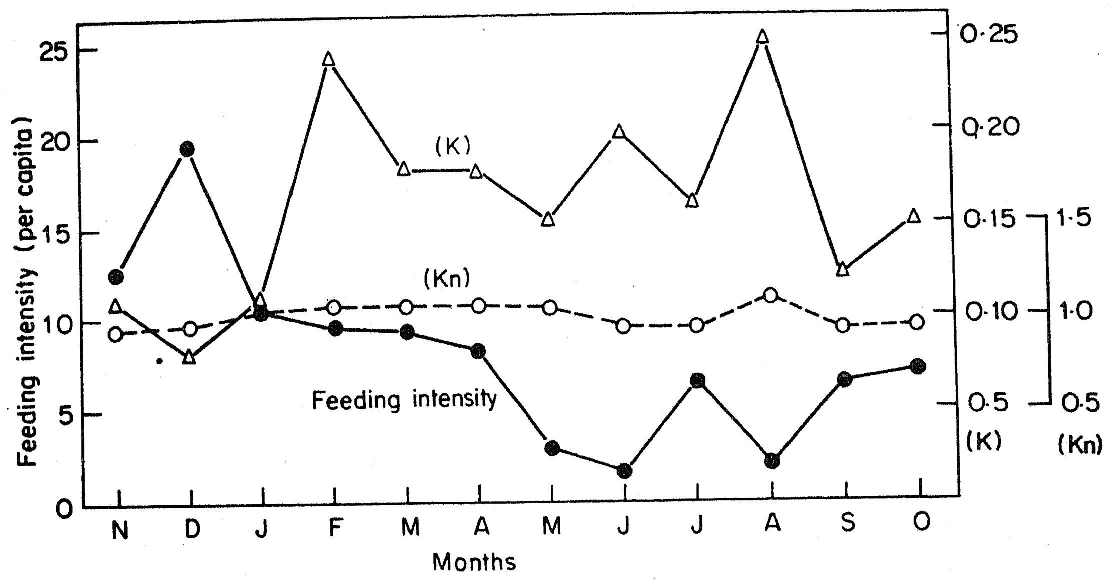

Figure 6. Relationship of condition factor and relative condition factor to per capital feeding intensity (combined) of *A. chakaiensis*.

higher length groups (figure 4) and the low percentage occurrence of these length groups *viz.* 8.13 to 9.3 cm in samples may probably be due to predation and fishing.

The apparent absence of specimens of male *A. chakaiensis* beyond 8.5 cm forces us to the irresistible conclusion that individuals beyond this size do not survive at all. It would also appear that in males, individuals beyond 7.3 to 7.7 cm in standard length represent the ageing class and they are gradually being removed from the population by mortality. The sharp fall in the *K* values suggest the advent of old age and consequent mortality as observed by Nikolsky (1963) and Qayyum and Qasim (1964a, b, c) and these are in agreement with the above findings.

Acknowledgements

One of the authors (NB) is thankful to the Head of the department of Aquatic Biology and Fisheries, University of Kerala for the laboratory facilities provided and to the Government of Kerala for deputing him for research under FIP.

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