RESEARCH ARTICLE

RELATIVE CONDITION FACTOR AND FULTON'S CONDITION FACTOR OF THE FRESH WATER CYPRINID *AMBLYPHARYNGODON MOLA* (HAM-BUCH) FROM ASSAM

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ARTICLE INFO	ABSTRACT
	The Fulton's condition factor (K) and relative condition factor (Kn) of the cyprinid *Amblypharyngodon mola* collected from the culture ponds of Jorhat district, Assam was studied during July 2010 to June 2012. The study was carried out in relation to various length groups and different months of the year. The regression coefficient 'b' computed from the length-weight data of 260 females and 310 males was 2.846 for male and 3.286 for female. The values of 'K' fluctuated between a minimum of 0.824 and maximum of 1.039 for males, while for females, the values were between 0.879 to 1.184. On the other hand, the 'Kn' values showed variation between 1.315 to 1.943 in male and 1.642 to 3.473 in females. The high average 'Kn' values and 'K' values recorded for all the months indicated good condition of the fish.

INTRODUCTION

Amblypharyngodon mola (Ham-Buch), belonging to the family Cyprinidae and order Cypriniformes, is a small indigenous fish species (SIS) of high commercial importance. The fish is particularly important because of its high content of vitamin-A than any other edible fish (Ahmed, 1981). *A.mola* contains as high as >2680 retinol activity equivalents per 100gm of raw and edible portions (Roos, 2001). Considered as a delicacy by the common man of the region, the fish is relished not only in cooked or fried form but also in the form of smoked, dried and pickle form. It has good demand as an ornamental fish in the international market also. *A.mola* is a self recruiting species and its culture in ponds, both as mono-culture and poly-culture with Indian major carps and exotic carps as well as culture in rice fields has been encouraged among the fish farmers of India to overcome the nutritional deficiency.

The Fulton's condition factor 'K' or ponderal index is a key for evaluation of adaptability and well being of the fish in relation to its biotic and abiotic environments (Suryavanshi and Wagh, 2001. Singh, 2003). It is also a useful index for monitoring feeding intensity, age and growth rates in fish (Oni *et al.*, 1983). But, certain factors like age, sex, maturity, food, degree of parasitisation, environment, and selection in sampling size etc might affect the value of 'K' (Babu and Nair, 1983).

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Hence, relative condition factor 'K$_n$', was also considered along with Fulton's condition factor in the present study, so as to ascertain the proper culture conditions for *A.mola.*

MATERIALS AND METHODS

The samples for study were collected at monthly intervals during July 2010 to June 2012 from the ponds of Assam Agricultural University, situated in Jorhat district at 26°48´; 296″N Longitude and 94°11´961″ E Latitude. The length-weight relationship was calculated for 260 females and 310 males with the help of the formula of Le Cren (1951). The condition factor 'K' and the relative condition factor 'Kn' was calculated for both the sexes separately month wise as well as in different size groups.

Condition factor (K) was calculated by the formula

$$K = \frac{W \times 100}{L^3}$$

Where, W= weight of fish in grams**,** L= Standard Length of the fish in centimeters**.**
Relative condition factor (Kn) was calculated by the formula

$$Kn = W / \underline{W}$$

Where, W and $\underline{W}$ are the observed and calculated weights respectively in grams.

RESULTS

The total length of the males ranged from a minimum of 40.7mm to a maximum of 76.7mm and their weights ranged from a minimum of 0.544 grams to a maximum of 4.364 grams. The total length of females on the other hand, ranged from a minimum of 54.3 mm to a maximum of 94.2 mm while their weights ranged from a minimum of 1.362 grams to a maximum of 9.8604 grams. The regression equation computed from data for males and females is presented as:

Males   Log W= -4.759 + 2.846 Log L (r = 0.945,SE=0.0392, df=309)

Females   Log W= -5.536 + 3.286 Log L (r = 0.953, SE=0.0496, df=259)

Condition factor

Males

In the months of January, April, October, November and December, the 'K' values remained below the grand mean (Table 2). 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.

Table 1. K and K_n values of male and female *A.mola* in different length groups

Size groups	Condition factor (K)		Relative condition (K_n)	
	Male	Female	Male	Female
41-45	0.958	--	0.86	--
46-50	0.993	--	0.981	--
51-55	0.969	0.919	1.5	1.065
56-60	0.925	0.988	1.672	1.577
61-65	0.929	0.934	1.397	2.457
66-70	0.914	0.934	1.489	2.652
71-75	0.907	0.954	1.013	1.623
76-80	0.974	0.982	1.106	1.847
81-85	--	0.964	--	2.079
86-90	--	1.155	--	1.202
91-95	--	1.17	--	1.352

The condition factor with regard to different months for male recorded a minimum of 0.824 during November and April whereas the maximum 'K' was noticed during the month of June (1.039). The variation of condition factor (K) for male in different months is shown graphically in Fig.1.
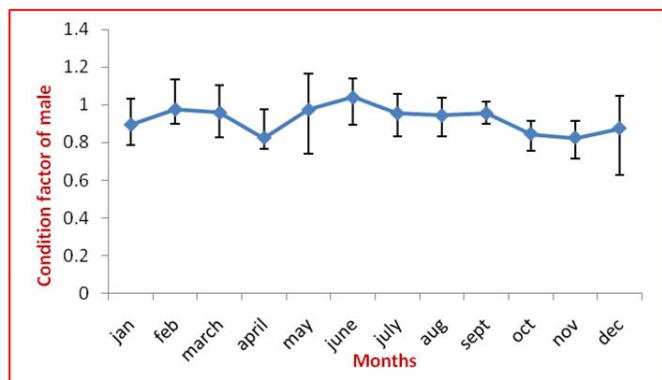

Fig.1. Variation of condition factor (K) for male in different months

The whole population throughout the period of observation was divided into 8 length groups, starting from 41-45 mm to 76-80 mm. Highest fluctuation in 'K' values ranging from 0.709-1.211 was recorded in the length group 66-70 mm while the lowest fluctuation (0.967-0.981) was recorded in the length group 76-80 mm. The length group 46-50 mm recorded the highest 'K' value (0.993), while the length group 71-75 mm recorded minimum 'K' value (0.907). The graphical representation of variation of condition factor (K) for male at different length groups is shown in Fig.2.
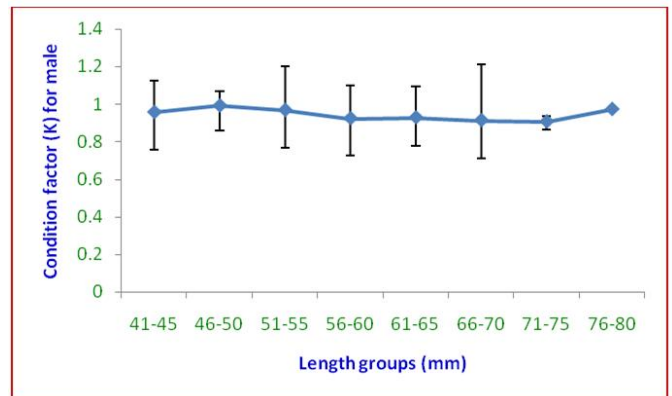

Fig.2. Variation of condition factor (K) for male at different length groups

Females

The females showed better condition than the males in various months. In the months of January, March, September, October, November and December, the 'K' values remained below the grand mean (Table 2).

Table 2. K and K_n values of male and female *A.mola* in different months

Months	Condition factor (K)		Relative condition (K_n)	
	Male	Female	Male	Female
Jan	0.894	0.88	1.454	1.767
Feb	0.976	0.979	1.626	2.081
March	0.958	0.953	1.538	1.825
April	0.824	1.002	1.323	1.798
May	0.974	1.079	1.472	2.438
June	1.039	1.184	1.943	3.473
July	0.955	0.983	1.378	2.102
Aug	0.943	0.99	1.52	1.92
Sept	0.955	0.964	1.8	2.044
Oct	0.846	0.903	1.315	1.758
Nov	0.824	0.894	1.574	1.642
Dec	0.875	0.879	1.763	1.825
Grand mean	0.922	0.974	1.558	2.056

Highest fluctuation in 'K' value was recorded in the months of April (0.686- 1.234) and May (0.692-1.216) while lowest 'K' value was recorded in the month of February (0.933-1.03). However, the highest 'K' value recorded for females was in the month of June (1.184), while the minimum was recorded in the month of December (0.879). (Fig.3)

The female population of *A.mola* was grouped into 9 length groups starting from 51-55 mm to 91-95 mm. No prominent variation in the 'K' values was recorded in different size groups. The condition factor 'K' of females with regard to length groups showed highest value (1.17) in the length group

91-95 mm, while minimum value (0.919) in the length group 51-55 mm. Highest fluctuation in 'K' value was recorded in the length group 61-65 mm while lowest fluctuation was recorded in the length group 51-55 mm (Fig.4).
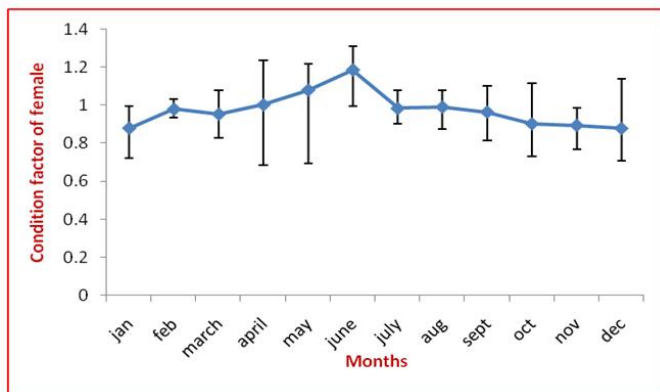

Fig.3. Variation of condition factor (K) for female in different months
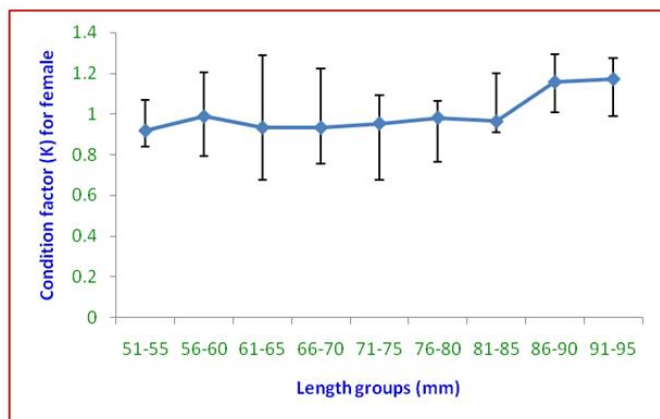

Fig.4. Variation of condition factor (K) for female at different length groups

Relative condition factor

Males

In males the relative condition factor (Kn) was below the grand mean in the months of January, March, April, May, July, August and October (Table 2). During the months of March and August, the 'Kn' values remained relatively near the grand mean. The highest 'Kn' value (1.943) was recorded in the month of June while the lowest value (1.315) was recorded in the month of November. Almost regular fluctuation level of 'Kn' values of males was recorded in every month. Highest fluctuation (1.035-2.99) was recorded in the month of June, while the lowest fluctuation (1.164-1.78) was recorded in the month of May. However, three peaks in 'Kn' values could be recorded in the months of February, June and September, which can be correlated with the peak breeding season of *A.mola*. The variation of Relative condition factor (Kn) for male in different months is represented graphically in Fig.5.
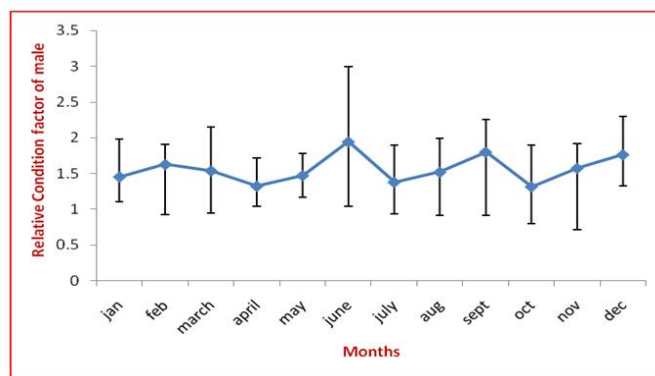

Fig.5. Variation of Relative condition factor (Kn) for male in different months

The relative condition factor of males with respect to length groups showed much variation with an almost similar trend of fluctuation. The highest 'Kn' value (1.672) was recorded in the length group 56-60 mm, while the lowest value (0.86) was recorded in the month of 41-45 mm. There was a gradual increase in the values of relative condition factor (Kn) starting from 46-50 mm size group onwards with a slight decline in the size group 61-65 mm and again an increase in 66-70 mm size group then again a decrease in 71-75 mm size group. (Fig. 7).

Females

In the females, the 'Kn' values were below the grand mean in majority of the months viz. January, March, April, August, September, October, November and December. The 'Kn' values were close to the grand mean in the months of February, July and September. Highest value of 'Kn' was recorded in the month of June (3.473) and the lowest in the month of November (1.642). Highest fluctuation the 'Kn' values was recorded in the months of April (1.1-2.86), May (1.28-3.35), June (1.99-4.018) and December (0.814-2.84). While, lowest fluctuation (1.948-2.27) was recorded in the month of July. The variation of Relative condition factor (Kn) for female in different months is represented in the Fig.6.
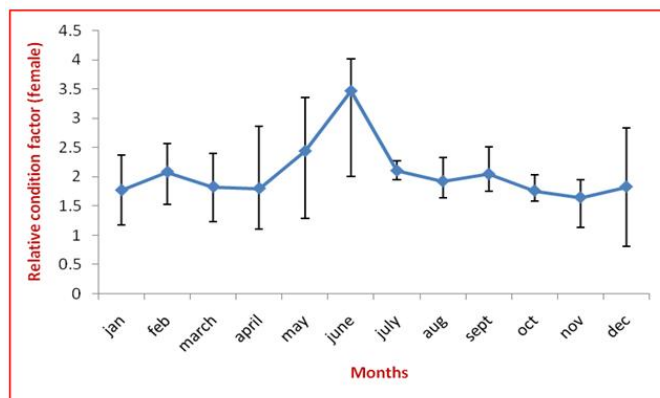

Fig.6. Variation of Relative condition factor (Kn) for female in different months

In the female population of *A.mola*, unlike the values of condition factor (K), the values of relative condition factor

(Kn) showed significant variation. The female population was grouped into 9 size groups. The 'Kn' values showed a marked increase from 51-55 mm size group till 66-70 mm size group, with an abrupt fall in 71-75 mm size group and again a steady rise till 81-85 mm size group and again fall in 86-90 mm size group. The highest value of 'Kn' (2.652) was recorded in the size group of 66-70 mm, while the lowest value (1.065) was recorded in 51-55 mm size group. The trend of fluctuation recorded in the different size groups for female was almost similar and the variation of Relative condition factor (Kn) at different length groups is represented in Fig.8.
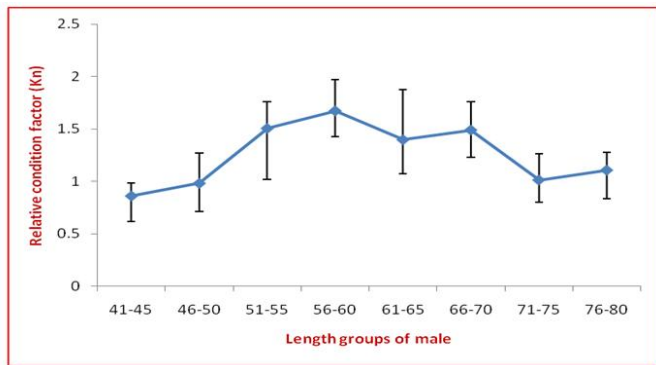

Fig.7. Variation of Relative condition factor (Kn) for male in different length groups
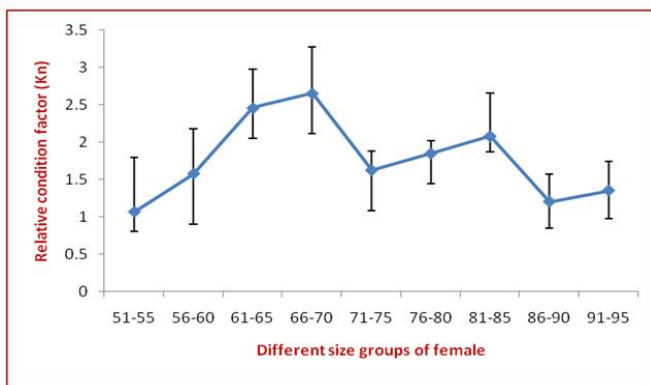

Fig.8. Variation of Relative condition factor (Kn) for female at different length

DISCUSSION

Generally, weight of fish will be proportional to the cube of their length, based on its dimensional equality (Harish Kumar *et al.,* 2006). For a fish, which maintains its shape throughout its life, the value of regression coefficient will be 3 (Verghese, 1961; Talwar, 1962). Other than 3, the value indicates allometric growth. The present study indicated that the fish did not follow the cube law strictly. The values of regression coefficient computed were 3.286 (female) and 2.846 (male).

Several factors influencing the condition of fish have been pointed out by earlier investigators. Fluctuation 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 factors which seems to govern the rise

and fall of 'K' is the feeding rate of fish (Qasim, 1957; Bal and Jones, 1960; Bhatt, 1968). In the present observation on the seasonal variation in 'K' and 'Kn' values of *A.mola* revealed that there is a conspicuous positive correlation between 'K' and 'Kn' values and gonadosomatic index and spawning season of females. The study on reproductive biology revealed that *A.mola* breeds thrice in a year in the months of March, June and September in the agro climatic conditions of Assam (Borah. C. B. *et al.,* 2010). Higher values of 'K' and 'Kn' recorded in females during March, June and September clearly showed the impact of gonad weight on the condition of the fish. In case of males also, this correlation of 'K' and 'Kn' values with spawning season 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.mola*. Plant materials mostly algae dominate the food materials of *A.mola* (Piska *et al.,* 1991) and as such the weight of these items do not seem to be very evident like the food items in carnivorous fishes like *Heteropneustes fossilis* and *Mystus seenghala* (Bhatt, 1968, 1970) where the feeding intensity has considerable effect on 'K' values. However, slight rise in the 'K' and 'Kn' values during the post spawning period i.e. November and December may be attributed to the increased feeding activity of the fish. Similar findings were also reported by Piska *et al.* (1990) in *A. mola* from Himayath sagar, Hyderabad.

Nikolsky, (1963) observed that sometimes a sharp reduction in the condition co-efficient is seen associated with mass mortality. Qayyum and Qasim (1964a, b, c) observed fall in 'K' values in larger fish of both sexes which he attributed to the increasing metabolic strain due to spawning. On the contrary, in the present study of *A.mola*, the variation of condition factor and relative condition factor with regard to different size groups did not show any fall in condition of the fish with increase in size. Rather there was abrupt increase and decrease of 'K' and 'Kn' values among various size groups. Such variation in condition of fish in different size groups may be due to the influence of a number of factors such as the onset of maturity, availability of food and physico-chemical properties of water etc.

The values of 'K' did not exhibit any specific pattern, indicative of the maturation cycle at different lengths in *A.mola,* The bigger fishes had comparatively higher values than the smaller ones. In the present study, the average 'K' value recorded for all the months were nearly or above '1' indicating good condition of the fish.

Conclusion

From the above findings it can be concluded that *A. mola* follows an isometric pattern of growth. The 'K'and 'Kn' values of male and female *A.mola* in different months shows variation which is correlated with the spawning cycle as well as feeding cycle. Higher values of 'K' and 'Kn' in peak breeding months shows the impact of gonad weight on the condition of the fish, while slight rise in condition during post spawning period may be attributed to the increased feeding

activity. The present study provides preliminary information on the condition factor and relative condition factor of nutrient dense fish, *A.mola* which will be beneficial for its proper management, culture and higher production.

REFERENCES

Ahmed K, 1981. Nutritional blindness in Bangladesh. *In Touch: VHSS News letter*, 45:1-2

Babu, N. and Nair, B. N. 1983. Condition factor of *Amblypharyngodon chakaiensis* (Babu and Nair) in the Chakai boat channel (Trivandrum-Kerela-India). *Proc. Indian Acad. Sci. (Anim. Sci.),* Vol. 92, Number 1, January 1983,pp.1-10.

Bal, J.W. and Jones, J.W. 1960. On the growth of the brown trout of Llyn Tegid; *Proc. Zool. Soc*. Lond. 134: 1-41

Bhatt, V. S. 1968. Studies on the biology of some freshwater fishes. Part III *Heteropneustes fossilis* (Bloch); *Indian J. Fish*, 15: 99-115

Bhatt, V. S. 1970. Studies on the biology of some freshwater fishes. Part IV *Mystus seenghala* (Sykes*); J. Bombay Nat. Hist. Soc.,* 67: 194-211

Borah, C. B., Gogoi R., Kakati, B., 2010. Breeding of *Amblypharyngodon mola* (Ham.) in small homestead ponds. *In J. Inland Fish. Soc. India*, 42 (2), pp-42-47.

Harish Kumar, K., B.R. Kiran, R. Purushotham, E.T. Puttaiah & S. Manjappa 2006. Length-weight relationship of cyprinid fish *Rasbora daniconius* (Hamilton-Buchanan) from Saravathi reservoir, Karnataka. *Zoos' Print Journal,* 21(1): 2140-2141.

Le Cren, E.D. 1951. Length-weight relationship and seasonal cycle in gonadal weight and condition in the perch (*Perca fluviatalis*). *J.Anim. Ecol*., 20: 201-219.

Morrow, Jr J.E. 1951. Studies on the marine resources of South New England VIII. The biology of the long horn sailpin *Myxocephalus Ostodecimapinosis* (Mitchell) with a discussion of the Southern New England 'trash' fishery: *Bull. Bingh. Ocean. Coll.,* 13: 1-41

Nikolsky, G.V. 1963. Adaptations of fishes to a biotic environment factors. The ecology of fishes. Academic Press, London and New York, pp-147-187

Oni, S.K., Olayemi, J.Y. and Adegboye, J.D. 1983. Comparative physiology of three ecologically distinct fresh water fishes, *Alestes nurse* Ruppell, *Synodontis schall* Bloch and *S. schneider* and *Tilapia zilli* Gervais. *J. Fish Biol*., 22: 105-109.

Piska, R.S, Ramaswamy, B. and Devi, I. P., 1991. Food and feeding habits of freshwater cyprinid *Amblypharyngodon mola* (Ham). *Indian J. Fish.,* 38: 126-128.

Piska, R.S, Waghray, S. and Danial Raj, 1990. Studies on ponderal index of freshwater cyprinid, *Amblypharyngodon mola* (Ham.) from Himayath Sagar Hyderabad. *Journal of Aquatic Biology,* 2: 35-38.

Qasim, S. Z., 1957. Biology of *Blennius pholis* L. (Teleostei); *Proc. Zool. Soc. London*, 128: pp-161-208

Qayyum, A. and Qasim, S. Z., 1964 a. Studies on the biology of some fresh water fishes. Part I *Ophicephalus punctatus* (Bloch): *J. Bombay Nat. Hist. Soc.,* 61: 74-89

Qayyum, A. and Qasim, S. Z., 1964 b. Studies on the biology of some fresh water fishes. Part II *Barbus stigma* (Cuv. & Val.): *J. Bombay Nat. Hist. Soc.,* 61: 330-347

Qayyum, A. and Qasim, S. Z., 1964 c. Studies on the biology of some fresh water fishes. Part III *Callichrous himaculatus* (Bloch): *J. Bombay Nat. Hist. Soc.,* 61: 627-650

Roos, N. 2001. Fish consumption and aquaculture in rural Bangladesh: nutritional contribution and production potential of culturing small indigenous fish species in pond polyculture with commonly cultured carps. Doctoral thesis. *Research Dept of Human Nutrition, RVAU, Denmark.*

Singh, O.S. 2003. Length-weight relationship and relative condition factor of *Ostcobrama belangeri* (Val.) in Manipur. *J. Inland Fish. Soc India.* 35(1):n8-12.

Suryavanshi, S.N. and Wagh, S.B. 2001. Ponderal index of *Puntius kolus* (Sykes), *J. Inland Fish. Soc India,* 33(1); 90-92

Talwar, P. K. 1962. A contribution to the biology of the halfbeak, *Hyporhamphus georgji* (Cuv. and Val.) (Hemirhamphidae). *Indian J. Fish*., 9(1): 168-196.

Verghese, T. J. 1961. Observations on the biology of *Raconda russelliana* (Gray). *Indian J. Fish.,* 8(1) : 96-106.

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