IX. PONDERAL INDEX OR CONDITION FACTOR

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INTRODUCTION

Ponderal index or condition factor is used for obtaining information on seasonal variation of the condition of fish in relation to its environment. The condition of fish is subjected to a great deal of variations depending upon the various factors, nutritional and biological cycles of the species (Chatterji, 1976).

The condition factor of fish is estimated in two ways. The first method is based on the cube law in which the condition factor (K) is calculated by the equation $k = w/cl^3$, where w and l are the weight and length of the fish, respectively, and "c" is constant. If the specific gravity of fish is unit and value of `c' is `1' then $k = w/l^3$. The value of k is generally multiplied by 100 to obtain the value of `k' into a round figure as $k = w/l^3 \times 100$ (Hile 1936).

In the later, cases, however, the relative condition factor (kn) is calculated by the formula $kn = w/al^n$, where al^n shows the calculated weight (from the regression equation) and w is the observed weight. This equation may also be written as observed weight/calculated weight (w/wo) (Le Cren, 1951). The value of `kn' fluctuates around one and any departure from 1 represent the deviation from the regression of weight/length as proportional part of the standard 1.0. This deviation represents all variations in weight not associated with length, for example genetic variations; variations associated with food supply, sexual condition and parasitism (Blackburn, 1960). These variations cannot be evaluated with the help of condition factor (k) unless `n' is actually 3, which is rarely the case.

To obtain the maximum information regarding the growth of fish, the breeding and feeding cycle of A. commersoni, relative condition factor was calculated for the male and female, separately monthwise and length groupwise.

MATERIAL AND METHODS

A total of 1199 specimen, comprising 484 male (only one specimen of male was found in length group 41-45 mm (Hence `kn' value was not calculated) 527 females and rest 187 juveniles, collected from the fish landing centres during the year December 1987 - March 1989 were used for the study. The specimens had a length range of 18 - 135 m.m. and weight range of 0.05 - 33.5 gms.

The regression of weight and length was determined by grouping the fish into 13 groups of 5 mm interval each and by fitting the regression of logarith value of the average weight of the fish on the logarith of the average length of fish belonging to the same group. Length weight relationship was then computed based on the formula $w = cl^n$ where w - weight of fish in gm, l - length of the fish in mm, c and n are constants. kn was estimated from the formula (w/wo) where w = the observed weight & wo = calculated weight of fish (Le cren 1951). From the individual values, the mean ``kn' was calculated separately for males and females for each 5 mm class sequence and for different months of the year. As no significant difference was noticed between male and females, the common equation derived was used for deriving the kn factor. The length-weight relationship derived were used to get the mean relative condition factor (kn) for each month and varying size range separately for male and female.

RESULTS

The value of kn obtained is a quantitative measure of relative heaviness and in this sense is directly comparable between the fish of any length. The fluctuation in mean kn value with respect to size is depicted in Fig. 39 and Table 43. The increase in mean `kn' values under 46-50 m.m size range indicates the gonadal development in fish. The fish _A. commersoni_ was found to mature in the size range of 61-65 mm in male and 66-70 mm in females.

In both sexes, kn value remained high, in size group 46-50 mm and then gradually declined to 61-65 m.m in male and 66-70 mm in female size group. The value of `kn' indicates that most of male and female were probably in spawning stage. The study of gonads also indicated that the size at first maturity was 65 mm for male and 67.5 mm for females. In the size groups between 76-135 m.m in female and 65-125 m.m. in male, `k' value showed major fluctuation which may be attributed to the spawning activity of the species.

The variation in the mean `kn' values between males and females with regards to months in Fig. 40 and Table 44, reveals that fluctuation in `k' value for both the sexes were different thus indicating that the metabolic strain for both the sexes was different. Beginning from January, the `kn' value was higher in female and low in male but `kn' value increased (1.0105) in February in female and decreased (0.9997) in male. The minimum condition exhibited by both the sexes during April (male - 0.9815 and female - 0.9920) may be due to spawning activity or due to feeding activity.

The low value of `kn' during May, June, November and December indicates the presence of 0 - group or spent fishes or may be due to poor feeding activity.

The high condition factor exhibited by both the sexes during July - October in female and July - August in male may be due to maturity and matured condition of gonads but high value of `kn' in October in female indicates high intensity of feeding in female.

In the beginning of the year 1989, progression of curve shows similar trend as observed in the previous year.

DISCUSSION

The condition in fishes can be affected by the onset of maturity as reported by many workers (Le Cren 1951; Weatherly 1979). According to Hart (1946) the point of inflexion is a good indication of length at which the sexual maturity is attained. In the present study, a sharp inflexion (Fig. 39) is noticed in the case of males at length range of 61-65 mm (total length) and female at a length range of 66-70 mm (total length). This is in correspondence with the earlier observation that size at first maturity in male was 65 mm and female 67.5 mm. (vide infra).

Pillay (1954); Sarojini (1957); Narasimhan (1970); Parulekar and Bal (1971); Das (1978); Gowda, Shanbhogue and Udupa (1987) have mentioned that point of inflexion on the curve showing a decrease in value of `kn' with increasing length is a good indication of the length at which sexual maturity is attained. Gradual increase in `k' value from length group 76-85 and onward was due to recovery of weight after spawning in female. Similarly in male from 61-65 length group a gradual increase in `kn' value was observed. Sudden rise in condition factor in male and female at 116-125 mm and 126-135 mm respectively may possibly be due to intensive feeding or stage of gonadal development for next spawning or slight increase in `kn' values of larger fish measuring 135 mm in female and 122 mm in male was perhaps due to obesity of the fish.

Though for fishes which maintain the same shape and chemical composition, growth is isometric though it is not so in fishes which changes their shape as growth advances. It has been emphasised by Le Cren (1951) in his studies on Windermere perch population that, in many cases, the cube law fails to apply in a population as a whole because it includes a range of size classes. In the present case, the regression coefficient `n' is 3, which means that the growth of fish was isometric.

Hart, as quoted by Jhingran (1973), reported that the ponderal index might indicate a broad outline of seasonal cycle. This index has been shown to be correlated with gonadal cycle, rate of feeding etc. A close scrutiny of kn factor in <u>A. commersoni</u> in relation to different seasons shows that the condition of the species was much affected during spawning period. The fall in value during month of April to June corresponds with the main breeding season as has been shown by Das (1978) and Sivakami (1982). During the period of July to October and January - February. `Kn' value (Fig.40, Table 44) remained higher in female which may be attributed to the high percentage of maturing and mature fishes. Similarly, in males during January - March and July - August (Fig. 40, Table 44) ponderal index remains high which indicates the high percentage of mature and maturing males.

Kn value was low in April in both the sexes which indicates the preponderance of either spent fishes or 0-group fish. In November and December, the value was low which reflects, either the increased prevalence of 0-group fishes or on low intensity of feeding. The `Kn' values here cannot be attributed to feeding intensity because of the inverse relationship with gastro-somatic index during May, June and November, December in both the sexes. Nair et al. (1983) reported that `kn' cycle of the female closely follows the seasonal pattern of GSI, the periods of heavy breeding activity showing comparatively high `kn' value and vice-versa in A. commersoni.

Monthly variation in the gastro-somatic index and gonado-somatic index in the species are presented in Fig. 38. In A. commersoni, the fluctuation in the condition factor was more influenced by the spawning cycle than by feeding activity. The ponderal index as related to maturity

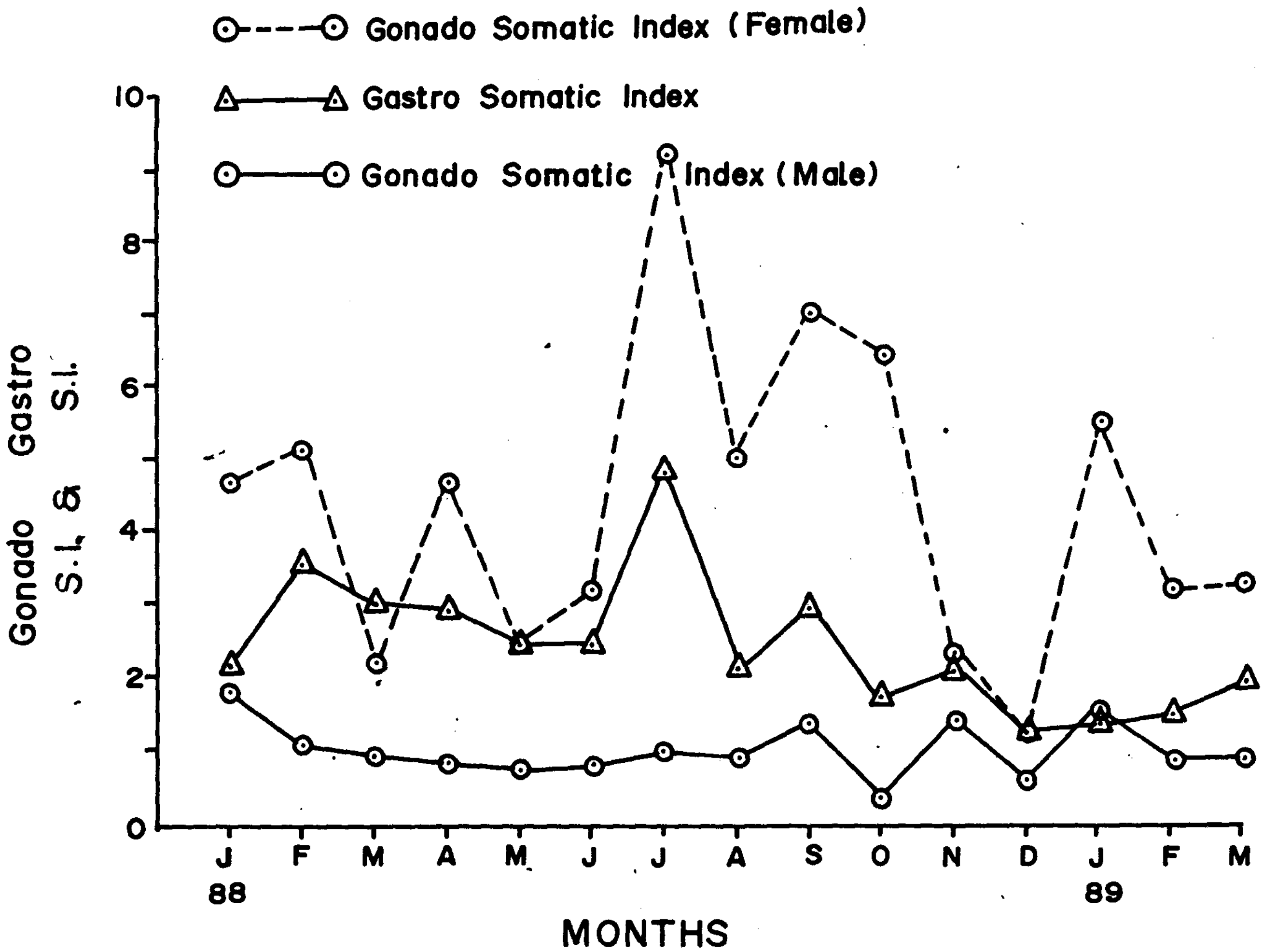

Fig. 38 Monthwise variation in Gonado-Somatic Index and Gastro-Somatic Index in A. commersoni.

cycle is elaborately discussed by Parulekar (1964), Parameswaran et al. (1970), Das (1978) and Sivakami (1987). Nair et al. (1983) reported the change in `kn' with the growth of sexes i.e. the immature and first maturity stages show poor `kn' while the adult active breeders show better `kn' and is clearly reflected in the seasonal changes in `kn' with breeding cycle. Here the rise and fall in GSI is closely followed by the `kn' factor in A. commersoni. Similar observations are recorded in the present study, also.Matured fish appearing conspicuously during the month of July support the rise in mean `kn' value.

Active feeding was observed during July, September, October and empty stomachs found to increase in May, June, November and December indicating poor feeding activity during the pre-monsoon and post-monsoon months.

EL - Maghraby et al. (1973) reported that the spawning period affected the weight and consequently condition factor in Mugil. capito. They also observed low `Kn' values in spent fish and high values during spring and summer in mature fishes. Nair et.al (1983) in A. commersoni reported that `kn' value in the immature male show a `kn' value `1' while immature and first maturity stage of females and first maturity stage of males show a `kn' value below `1'. The actively breeding groups, of male and female, show comparatively very high `kn' values while highest groups of male and female show comparatively low `kn' value. Raman et al., (1975) in A. gymnocephalus made similar observations, where the male and females in advanced stages of maturity showed very high `kn'. Present study also show similar results in A. commersoni wherein immature males and females show `kn' value `1' while immature first maturity stage male and female show `kn' value below `1'. The actively breeding male had comparatively high `kn' value.

Thus it may be concluded that `Kn' value was influenced more by maturation cycle than feeding intensity in A. commersoni.

TABLE - 43

Fluctuation of average `K' value at different length groups of A. commersoni

S.No.	Length group of 5 mm. each	Male No.	Male K value	Female No.	Female K value
1.	46-50	2	1. 0063	4	1. 0011
2.	51-55	13	1. 0020	9	1. 0286
3.	56-60	67	0. 9943	35	0. 9964
4.	61-65	59	0. 9833	64	0. 9907
5.	66-70	58	0. 9899	54	0. 9892
6.	71-75	54	0. 9948	39	0. 9893
7.	76-80	64	1. 0017	16	0. 9994
8.	81-85	53	1. 0027	14	1. 0151
9.	86-90	46	1. 0010	18	1. 0118
10.	91-95	27	1. 0089	41	1. 0083
11.	96-100	26	1. 0063	53	1. 0113
12.	101-105	1	0. 9966	69	1. 0141
13.	106-110	2	1. 0103	44	1. 0100
14.	111-115	4	0. 9983	40	1. 0147
15.	116-120	5	1. 0084	15	1. 0105
16.	121-125	3	1.0157	8	1. 0086
17.	126-130	-	-	3	1. 0197
18.	131-135	-	-	1	1. 0300

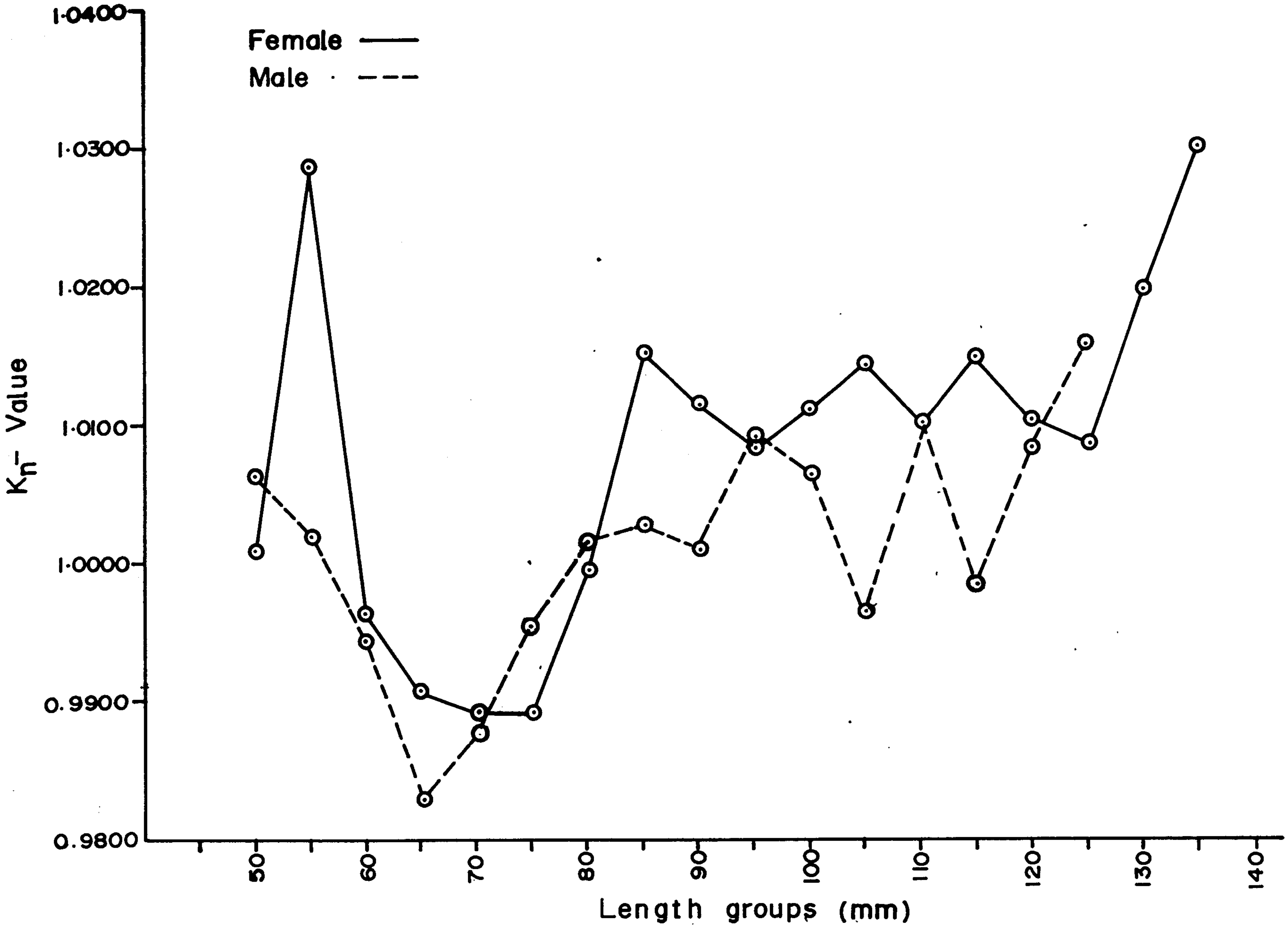

Fig. 39 Length groupwise fluctuation in 'K_n' of male and female A. commersoni.

TABLE - 44

Monthly fluctuation in `K' value of A. commersoni

S.No.	Months	Male		Female	
		No.	K value	No.	K value
	1987				
1.	December	28	0. 9885	13	0. 9933
	1988				
2.	January	39	1. 0044	32	1. 0062
3.	February	25	0. 9997	50	1. 0105
4.	March	46	1. 0020	28	0. 9950
5.	April	37	0. 9815	36	0. 9920
6.	May	43	0. 9876	15	0. 9953
7.	June	45	0. 9962	24	1. 0017
8.	July	26	1. 0055	42	1. 0141
9.	August	36	1. 0096	53	1. 0052
10.	September	6	0. 9870	62	1. 0094
11.	October	23	0. 9931	26	1. 0184
12.	November	24	0. 9991	21	0. 9953
13.	December	35	0. 9999	18	1. 0015
	1989				
14.	January	27	0. 9997	27	1. 0109
15.	February	25	0. 9983	46	1. 0005
16.	March	19	0. 9940	34	0. 9957

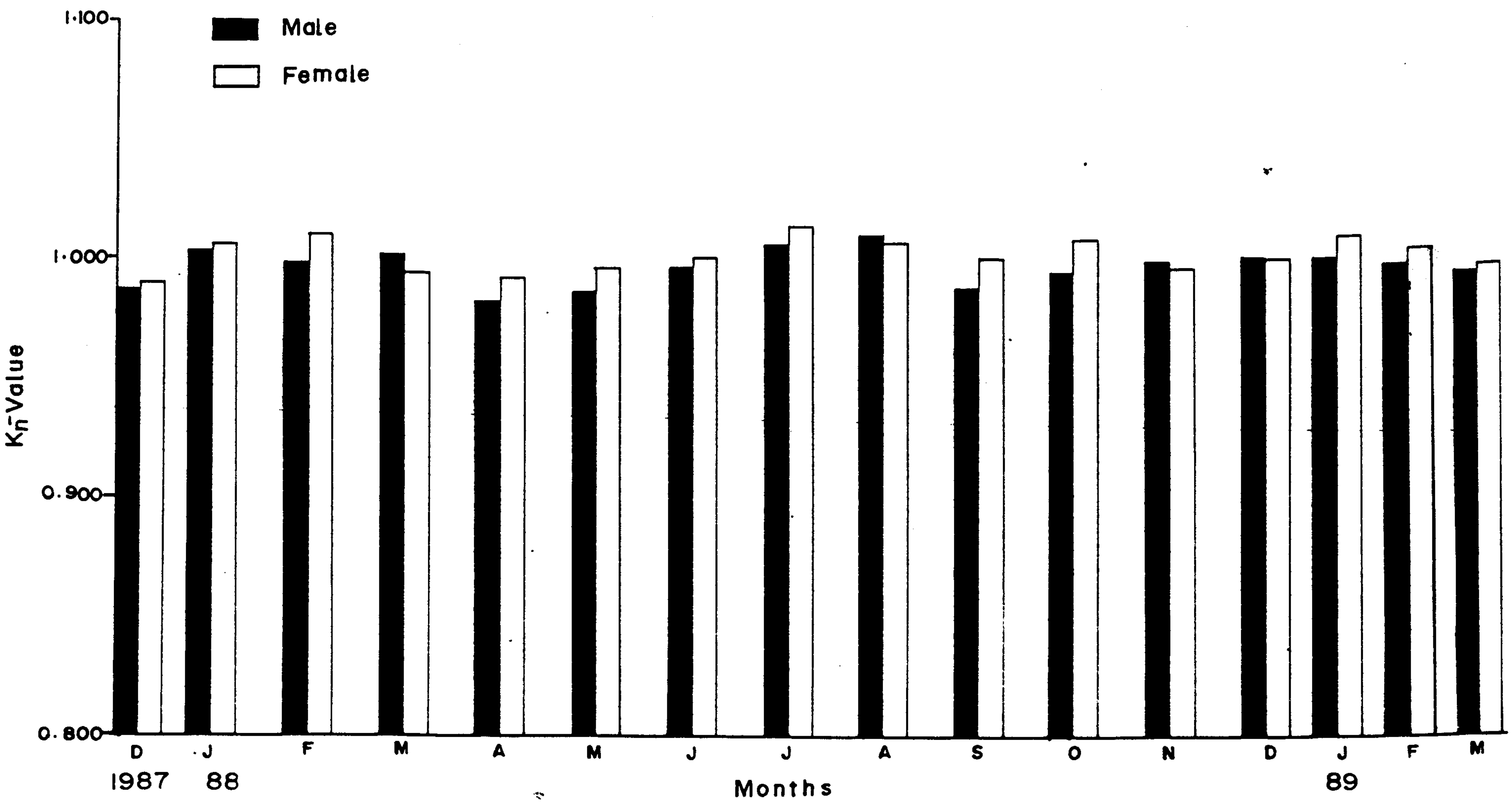

Fig. 40 Monthly fluctuation in 'Kn' value of male and female A. commersoni.