

$$W = 0.000012 L^{3.41} \text{ (n=517, } r^2= 0.92)$$

Since there was no significant difference between the regression equations of immature and mature fishes, the data were pooled and a common equation was calculated which is $W = 0.000014 L^{3.38}$ (n = 800, $r^2 = 0.98$)

However, the difference between the regression equations of indeterminate and pooled male and female fishes was significant. So a separate equation for the indeterminate was derived as $W = 0.000044 L^{2.67}$ (n = 155, $r^2= 0.82$). The size of indeterminate ranged from 91 to 165 mm and weight varied between 7 and 52 g.

Condition factor (Kn): The values of the condition factor per length class (Fig. 1) varied between 0.9 and 1.18. The highest value was at 145 mm. The monthly Kn values (Fig.2) showed the lowest in May and the highest in March from the pooled samples from both ring net and trawl net.

Sex ratio: Sex ratio was found out separately for both immature and mature male and female. For this 1378

fishes from ring net and 1981 fishes from trawl net were observed. In the immature fishes, the ratio was found significant in September 2002 and in September, October and December 2003 and in 2004 the deviation was not significant. In the overall total, the ratio was found significant. In mature fishes, the ratio was significant in March 2002, March, June, August and December in 2003 and January, April to June and November in 2004.

Size at first maturity: Size at maturity of male was 172.7 mm with confidence limit of 171.13 and 174.27 mm and for females 173.4 mm with confidence limit of 172.1 and 174.7 mm (Tables 1, 2, 3).

Discussion

The length weight relationship shows that the typical cubic law is not followed indicating allometric growth. According to Lizama *et al.* (2002) the highest values of condition factor, as a general rule, occur in the lowest lengths or rather in the juvenile classes. Vazzoler (1996) opined that the lowest K values during the more devel-

Table 1. Maturity stage distribution and computation of mean size at first maturity of male mackerel

Length group (mm)	Mid-length (mm)	Log mid-length (x1)	No.of fish sampled (n1)	No.of immature fish	Fully mature Fish(r1)	Proportion mature(p1)	$x=x1+1-x1$	$q1=1-p$	$p1q1/n1-1$
125	127.5	2.10551	2	2					
130	132.5	2.122216	5	5					
135	137.5	2.138303	6	6					
140	142.5	2.153815	6	6					
145	147.5	2.168792	7	7					
150	152.5	2.18327	10	10			0.01	0	0
155	157.5	2.197281	4	4	0	0.000	0.01	1	0
160	162.5	2.210853	13	5	8	0.615	0.01	0.385	0.02
165	167.5	2.224015	20	3	17	0.850	0.01	0.15	0.007
170	172.5	2.236789	44	5	39	0.886	0.01	0.114	0.002
175	177.5	2.249198	71	9	62	0.873	0.01	0.127	0.002
180	182.5	2.261263	98	12	86	0.878	0.01	0.122	0.001
185	187.5	2.273001	101	9	92	0.911	0.01	0.089	0.001
190	192.5	2.284431	70	10	60	0.857	0.01	0.143	0.002
195	197.5	2.295567	69	13	56	0.812	0.01	0.188	0.002
200	202.5	2.306425	46	4	42	0.957	0.01	0.043	0.001
205	207.5	2.317018	31	3	28	0.903	0.01	0.097	0.003
210	212.5	2.327359	43	1	42	0.977	0.01	0.023	0.001
215	217.5	2.337459	37	0	37	1.000		0	
Total						10.5195			0.042
m	2.337459	$+0.01/2-(0.01*10.519)=2.237269$							
Antilog	2.237269	= 172.7mm							
Confidence limit		Antilog (2.2337459+/-1.96Sqrt0.01^2*0.042=174.3 & 171.1mm							

Table 2. Maturity stage distribution and computation of mean size at first maturity of female mackerel

Length group (mm)	Mid-length (mm)	Log mid-length (x1)	No. of fish sampled (n1)	No. of immature fish	Fully mature Fish(r1)	Proportion mature (p1)	$x=x1+1-x1$	$q1=1-p$	$p1q1/n1-1$
125	127.5	2.10551	2	2					
130	132.5	2.122216	6	6					
135	137.5	2.138303	1	1					
140	142.5	2.153815	17	17					
145	147.5	2.168792	17	17					
150	152.5	2.18327	8	8			0.000	0.01	0
155	157.5	2.197281	21	20	1	0.048	0.01	0.952	0.0023
160	162.5	2.210853	25	18	7	0.280	0.01	0.72	0.0084
165	167.5	2.224015	36	10	26	0.722	0.01	0.278	0.0057
170	172.5	2.236789	43	7	36	0.837	0.01	0.163	0.0032
175	177.5	2.249198	49	3	46	0.939	0.01	0.061	0.0012
180	182.5	2.261263	65	13	52	0.800	0.01	0.2	0.0025
185	187.5	2.273001	72	4	68	0.944	0.01	0.056	0.0007
190	192.5	2.284431	96	15	81	0.844	0.01	0.156	0.0014
195	197.5	2.295567	92	2	90	0.989	0.01	0.011	0.0001
200	202.5	2.306425	69	1	68	0.986	0.01	0.014	0.0002
205	207.5	2.317018	58	1	57	0.983	0.01	0.017	0.0003
210	212.5	2.327359	40	1	39	0.975	0.01	0.025	0.0006
215	217.5	2.337459	43	0	43	1.000			
Total						10.346			0.0266

$m = 2.337459 + 0.01/2 - (0.01 * 10.346) \approx 2.238999$

Antilog $2.23899 = 173.4\text{mm}$

Confidence limit Antilog $(2.238999 \pm 1.96\text{sqrt}0.01^2 * 0.0266) = 174.7 \text{ \& } 172.1\text{mm}$

oped gonadal stages might mean resource transfer to the gonads during the reproductive period. In the present observation, the highest value was found at 145 mm. In other size groups, the values were almost similar. The mature fishes obtained in the present study belonged

either to the partially spent or fully spent stages and the lower values found in the higher size groups might be due to energy transfer to the gonad. The deviation of sex ratio from the general 1:1 was observed in one or two months in a year. But here this was observed in different months

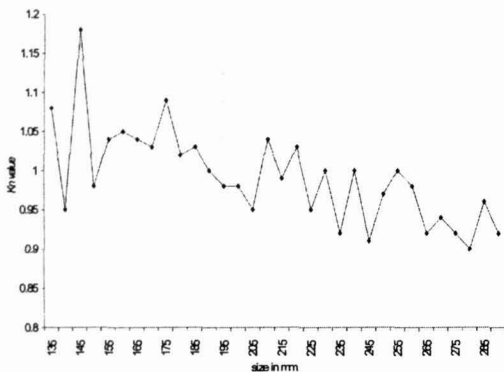


Fig.1. Condition factor per length group

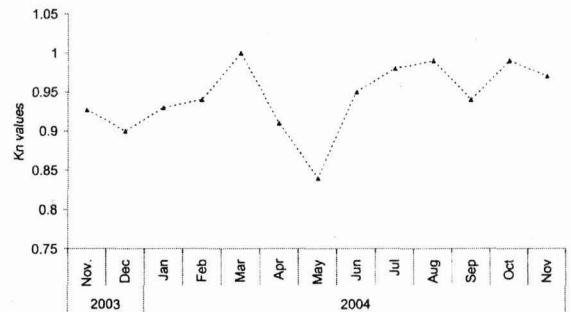


Fig.2. Monthly Kn values

Table 3. Size at maturity reported by earlier workers

Author	Size at maturity
Devanesan and John, 1940	19.9 cm
Pradhan, 1956	22.4 cm
Radhakrishnan, 1962	21-22 cm
Rao <i>et al.</i> , 1962	20 cm
Rao, 1967	21.7cm
Udupa, 1986	20.62 cm with con.limit 20.1 & 21.2 cm
Gopakumar <i>et al.</i> , 1999	223 mm
Prathibha Rohit & Alli C.Gupta, 2004	180 mm
Present study	172.7mm with con.limit 171.1 & 174.3 mm for male 173.4 mm with con.limit 172.1 & 174.7 mm for female

in different years indicating no clear pattern. So it was not clear whether it was due to sampling or due to any behavioral peculiarity.

The present observation of size at first maturity between 171 and 175 mm agrees with that given by Prathibha and Alli (2004). Moreover in Calicut, the smallest mature fish observed was at 150 mm. Such occurrence of mature fish of smaller sizes were not uncommon here as during the present study. It was seen in July 2001, March, May, July and November in 2002, January to April and July and December in 2003 and January, March, April and June in 2004.

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