ON THE FISHERY AND BIOLOGY OF THE LARGE TONGUE-SOLE, *CYNOGLOSSUS DUBIUS* DAY, AT CALICUT, KERALA

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ABSTRACT

Observations made on the fishery and biology of *Cynoglossus dubius* Day at Calicut during 1967-1972 showed that 1969 was the best year, and 1972 the worst for this fishery. The length range varied from below 5 cm to 40-40.9 cm (total length); the exceptionally smallest and largest records were, however, 2.2 cm and 41.4 cm respectively. Scales showed growth rings. The first ring was seen in fish of about 18 cm total length. Up to ten or even more rings seem to occur in the largest fish. The spawning season is roughly the same as, or a little later than that of the Malabar sole, *C. macrostomus* (Norman).

INTRODUCTION

While the common flatfish fishery on the west coast of India is that of the Malabar sole, *Cynoglossus macrostomus* (Norman), a few other species of *Cynoglossus* also occur occasionally along with it, though they are not significant from the quantitative point of view (Bhimachar and Venkataraman 1952). But, after the introduction of mechanised trawling, the large tongue-sole (*C. dubius* Day, which grows to more than three times the normal adult size of the Malabar sole) appeared in fairly considerable quantities in the landings at Vellayil, Calicut. The results of the study made on the fishery and biology of this species from 1967 to 1972 are presented in this paper. A detailed description of *C. dubius* from this coast, with a photograph, was published by Krishnan Kutty (1972).

THE FISHERY

As stated above and as pointed out by Seshappa (1969), *C. dubius* came into some prominence in the fishery only after the introduction of mechanised fishing (trawling) in this region. Trawling is done in slightly deeper waters —roughly between 18 and 36 m — than that of the canoes operating the *Paithuvala* (boat-seine) which was hitherto the main and often the only gear employed for sole-fishing in this place. Even the trawler catches of *C. dubius* are by no means very large, and the fishery was a complete failure in 1972. Table 1 shows the estimated monthly and annual catches of *C. dubius* at Calicut during the years 1967-1972.

Leaving out 1972 as an exceptional year (Table 1), the best catches of the sole were obtained, as a rule, during the months of January-February, even though the fishery spread over the period of November to April; May to October was almost completely without any landings. The annual average catch was estimated as 9,827 kg, but it would be 11,767 kg if the year 1972 was left out

TABLE 1. *Estimated landings of* C. dubius *(in kg) at Velleyil Calicut,* 1967—1972.

Months	1967	1968	1969	1970	1971	1972
January	1937	3772	2744	3737	1542	0
February	874	1939	8029	2372	4976	0
March	0	1070	7045	2040	770	0
April	48	370	951	1247	69	0
May	0	5	0	35	37	0
June	12	0	8	0	0	0
July	9	0	0	0	0	9
August	0	0	0	0	32	30
September	0	0	0	0	0	0
October	75	0	40	26	0	0
November	752	4289	9	280	1651	0
December	570	1664	1922	1885	0	91
Totals	4277	13109	20748	11622	9077	130
Yearly increase or decrease	—	+206.5%	+58.3%	—44.0%	—21.4%	—98.6%

as an abnormal year. An interesting feature of the fishery during the period was, that the annual landing was steadily increasing from 1967 until 1969, but slowly declined thereafter. Table 1 shows the increase or decrease as the case may be, of the total catches of each year expressed as a percentage of the total catch of the previous year.

Table 2 shows the effort (expressed in terms of number of fishing units) and the monthly catch rate (CPUE, or catch per unit of effort) for the period. Since mechanised boats were the mainstay of the effort (*Paithuvala* was the only other gear which accounted for this fish but in negligible quantities, except in January and February 1969 when 1,662 kg and 1,166 kg respectively, were contributed) this unit was treated as the standard gear of *C. dubius* and the CPUE was calculated based on this. The catch per unit followed almost the same trend as the total catch, the highest being 5.06 kg (in February 1969 when the monthly total was also the highest for the entire period, namely, 8,029 kg). Compared to this, 1970 recorded a poor yield evidently due to the decline in the availability; despite a very notable increase in the effort the decrease of total

catch during the year was 44% of the 1969 total catch. In 1971, however, the catch rate remained almost the same as that of the previous year, but the total catch suffered considerably owing presumably to the decrease in the number of units operated. In 1972, the annual catch rate fell steeply to 0.04 kg per unit. The number of units operated was also least during this year (2122). The

TABLE 2. *The monthly CPUE (catch per unit in kg) of* C. dubius *at Calicut, during* 1967—1972. *(Figures in brackets indicate numbers of units operated)*

Months	YEARS					
	1967	1968	1969	1970	1971	1972
January	1.63	2.54	2.56	1.88	1.40	0
	(1190)	(1486)	(439)	(1989)	(1099)	(253)
February	0.72	1.11	5.06	1.06	2.50	0
	(1219)	(1754)	(1355)	(2230)	(1987)	(80)
March	0	0.87	2.79	0.97	0.35	0
	(1191)	(1230)	(2517)	(2108)	(2174)	(3)
April	0.05	0.83	1.77	1.05	0.15	0
	(921)	(405)	(530)	(1186)	(459)	(1)
May	0	0.18	0	0.33	0.40	—
	(56)	(59)	(78)	(106)	(93)	(0)
June to September	—	—	—	—	—	—
	(0)	(0)	(0)	(0)	(0)	(0)
October	0.35	—	0.36	0.20	—	0
	(215)	(0)	(110)	(132)	(0)	(80)
November	1.17	4.12	0.07	0.53	1.65	0
	(641)	(1042)	(129)	(533)	(998)	(423)
December	0.27	1.18	1.56	2.61	0	0.07
	(2109)	(1410)	(1234)	(722)	(104)	(1282)
Annual	0.56	1.77	2.80	1.29	1.31	0.04
	(7542)	(7386)	(6392)	(9006)	(6914)	(2122)

absence of the fish in the grounds during this year was clearly evidenced by the fact that no catch of any magnitude was obtained even in January-February, (the usual peak months of the fishery) when a considerable number of units were operated. It is therefore concluded that the fishery was a failure in 1972, not merely because there was a reduced fishing effort, but also because the available stock was practically exhausted in the area fished.

SIZE DISTRIBUTION

A problem of great difficulty in the length-frequency studies on *C. dubius* was, that only occasional specimens were available for examination most of the time, though fairly good samples would be available on occasions of good land-

ings. Representative samples were thus possible only during a limited part of the year. The conclusions regarding the biology of the fish reached in this paper are therefore subject to this unavoidable limitation; but as the material has been drawn on a random basis from time to time, the general trends may be considered as largely reflecting the conditions as they exist in nature.

TABLE 3. *Monthly size-distribution of* C. dubius *at Calicut.*
(*Months with totals of less than* 30 *are omitted*)

Size-groups.	Jan.68	Jan.69	Feb.69	Dec.69	Jan.70	Feb.70	Apr.70	Nov.70	Dec.70	Jan.71
Below 5	0	0	0	4	0	0	0	0	3	0
5— 5.9	0	0	0	0	0	1	0	0	8	1
6— 6.9	0	0	0	0	0	0	0	0	11	2
7— 7.9	0	0	0	0	1	0	0	0	6	2
8— 8.9	0	0	0	0	1	0	0	0	4	4
9— 9.9	1	0	0	3	1	0	1	0	7	0
10—10.9	0	0	0	2	0	0	0	0	6	0
11—11.9	0	0	0	1	3	0	0	0	2	1
12—12.9	0	0	0	0	3	0	0	0	5	0
13—13.9	0	0	0	1	3	1	0	0	5	1
14—14.9	0	2	0	8	2	1	0	0	1	9
15—15.9	0	1	0	0	3	4	1	0	0	5
16—16.9	3	3	0	1	10	8	1	0	3	4
17—17.9	3	6	2	0	13	14	1	0	1	11
18—18.9	4	7	8	0	21	15	0	0	0	13
19—19.9	2	13	9	0	21	14	0	0	0	8
20—20.9	2	9	18	0	14	13	5	0	0	6
21—21.9	6	9	8	0	10	9	3	0	0	0
22—22.9	4	8	5	0	7	7	4	1	0	0
23—23.9	3	1	4	0	3	3	5	0	0	0
24—24.9	2	2	0	0	4	2	5	0	0	0
25—25.9	1	1	1	0	1	0	6	2	0	0
26—26.9	2	0	0	2	0	2	1	1	0	0
27—27.9	0	0	1	3	0	0	0	4	0	0
28—28.9	0	0	0	9	2	0	1	5	0	0
29—29.9	0	0	0	6	1	0	0	4	1	0
30—30.9	0	0	0	4	2	0	0	6	0	0
31—31.9	0	0	0	2	1	0	0	3	3	0
32—32.9	0	0	0	2	1	0	0	1	2	0
33—33.9	0	0	0	3	3	0	0	0	1	0
34—34.9	0	0	0	0	0	0	0	1	0	0
35—35.9	1	0	0	0	2	0	0	0	1	0
36—36.9	0	0	0	0	0	0	0	0	0	0
37—37.9	0	0	0	0	0	0	1	1	0	0
38—38.9	0	0	0	0	0	0	0	0	0	0
39—39.9	0	0	0	0	0	0	0	0	0	0
40—40.9	0	0	0	0	0	0	0	1	0	0
Totals	34	62	56	43	139	95	36	31	70	67

A total of 840 fish were measured from January 1968 to December 1971 (Table 4). Of these, the monthly totals were above 30 only in one month in 1968, three months in 1969, five months in 1970 and one month in 1971. The size-distribution for the months when the sample-sizes exceeded 30 speci-

TABLE 4. *Size-distribution in the annual totals of the samples of* C. dubius *Examined at Calicut during* 1968-1971.

Size-groups (cm)	1968	1969	1970	1971	Totals
Below 5	5	4	3	0	12
5— 5.9	3	1	9	1	14
6— 6.9	8	0	11	2	21
7— 7.9	3	1	7	2	13
8— 8.9	4	0	5	4	13
9— 9.9	4	3	9	0	16
10—10.9	6	2	6	0	14
11—11.9	2	1	5	1	9
12—12.9	1	0	8	0	9
13—13.9	1	2	9	1	13
14—14.9	4	5	12	9	30
15—15.9	3	1	8	5	17
16—16.9	3	6	22	4	35
17—17.9	3	12	29	11	55
18—18.9	5	16	36	14	71
19—19.9	7	24	35	13	79
20—20.9	8	31	32	11	82
21—21.9	9	20	24	11	64
22—22.9	7	13	20	10	50
23—23.9	8	6	11	12	37
24—24.9	4	2	11	5	22
25—25.9	2	8	9	6	25
26—26.9	4	3	4	1	12
27—27.9	0	5	4	1	10
28—28.9	0	10	10	0	20
29—29.9	0	7	7	2	16
30—30.9	0	9	8	2	19
31—31.9	0	4	8	4	16
32—32.9	0	6	5	0	11
33—33.9	0	4	5	1	10
34—34.9	0	0	2	2	4
35—35.9	1	3	5	3	12
36—36.9	0	0	1	2	3
37—37.9	0	0	2	1	3
38—38.9	0	0	0	2	2
39—39.9	0	0	0	0	0
40—40.9	0	0	1	0	1
Totals	105	209	383	143	840

mens in the monthly totals, is shown in Table 3 and the pooled annual size-distribution is shown in Table 4. Because of the relatively large size to which the fish grows and the wide range represented in the size-distribution, the frequency figures appear scattered through the entire or most of the range and the numbers represented in each size-interval are frequently not impressive as dominant modal groups. But inspite of these drawbacks, there are some clearly evident trends to be noted. The main points to be considered are: (1). The largest size that has been recorded during the four years is 40.9 cm (however, a single specimen of 41.4 cm length was recorded in 1973); the smallest specimen measured 2.2 cm; the range of total length between 5-5.9 cm and 38-38.9 cm may be said to be the normal range for the species in the landings. (2). Very small juvenile recruits occur mostly during a month or two at the beginning and a month or two at the end of the calendar year. (3). During 1969, the main modal length moved upward by a single centimetre group, from 19-19.9 cm to 20-20.9 cm between January and February; the main mode in January and February of 1970, however, remained in the same position. (4). Among the adults, the large sizes noticed showed a tendency to be relatively more frequent during the last few months of the calendar year than during the first few months, there being no catches at all of the fish in the intervening period which include the southwest monsoon. (5). The size-distribution in the annual totals gives a multimodal picture, the young fish having a mode at 14-14.9 cm in all the years in addition to one or two modes in the still smaller sizes, which include the fresh juvenile recruits also; there is another mode at 21-21.9 cm in 1968 and at 20-20.9 cm in 1969. The corresponding position for this in both 1970 and 1971 was at 18-18.9 cm; the next higher mode is seen at 26-26.9 cm in 1968 and at 25-25.9 cm in 1969; a mode at 23-23.9 cm in 1971 perhaps corresponds to this, while no corresponding mode is seen in 1970. There is a mode at 28-28.9 cm in both 1969 and 1970 but not in the earlier two years. At least two distinct modes seem to occur in the still higher size-range, though not always well-marked numerically; one of these which occupies the same position in 1969, 1970 and 1971 is in the 35-35.9 cm group.

Sex-ratio, Maturity and Spawning

The numbers of males and females in the samples examined for sex and maturity are shown in Table 5. As in the case of length frequency, in the figures of the sex-ratios also, the monthly totals should not be considered significant, except where they were 30 or more for both sexes together. Although the disparity between the two sexes is not much in some months, as for example, in January 1969 and February 1970, the disparity is considerable in some other months, as for example, in December 1969 and November 1970. For the entire period, the sex-ratio of male to female was 347:304. An interesting observation from the Table is that the males are consistently higher in numbers in all the years. While the magnitude of this difference is not very great, the regularity of

its occurrence may be of significance. Moreover, in the largest size-groups encountered in this study, only females and no males have occurred, eventhough the rate of such occurrence is very small.

TABLE 5. *Monthly sex-ratios in* C. dubius *during* 1968—1971.

Months	1968		1969		1970		1971	
	Males	Females	Males	Females	Males	Females	Males	Females
January	14	18	27	30	47	56	22	26
February	16	5	32	26	33	35	1	3
March	5	2	6	5	1	2	16	4
April	0	1	3	5	20	14	12	10
May	1	0	0	0	0	0	7	4
June & July			No samples					
August	0	0	4	11	0	0	4	0
September			No samples					
October	0	0	3	1	6	3	0	0
November	0	0	2	4	23	9	8	8
December	1	4	21	9	12	9	0	0
Totals	37	30	98	91	142	128	70	55

A total of 326 females were examined for maturity studies during 1968-72. The key for maturity stages described for *C. macrostomus* (= *C. semifasciatus*, Seshappa and Bhimachar 1955) was used in the present case also without any difficulty. The frequency of occurrence of the different stages of maturity, monthly and annual, is shown in Tables 6 and 7. During all the five years, a very large percentage of specimens were in stage I of maturity; stages VI and VII occurred only in three individuals in 1970, stages above III were completely absent during 1968, and one specimen in stage VII+ occurred in January 1973.

Considering the period as a whole, the length range at stage I of maturity was 10.1-27.9 cm in total length, stage II was 23.6-30.8 cm, and stage III, 25.3-35.5 cm. Fish of stages IV and above mostly ranged from 28.7 cm to 40.9 cm. A single 41.4 cm specimen recorded in January 1973 was, as stated above, in stage VII+, and a 26.5 cm specimen was already in stage IV in the same month. There is thus an overlapping in the sizes of successive maturity stages. Taking stages IV-V as an indication of first maturity, the minimum size at which this stage is attained was found to be 28.7 cm. Stage V itself occurred in specimens ranging from 29.5 cm to 36.8 cm during the period. A stage VI specimen measured 32.0 cm and two specimens in stage VII measured 30.4 cm and 32.9 cm in November and January respectively in 1970.

In the absence of direct data on spawning, the probable spawning period can only be inferred from the data on seasonal maturity trends (Tables 6 and 7) and from the trends of occurrence of very small juveniles in the catches (Table 8). Individuals of stages IV and/or V were found during August, October, November and December in 1969, during January, April and October-December in 1970, and during November in 1971 and 1972, showing that these stages are relatively more numerous during the November-January period although a few in stage IV occurred also in August and October in 1969 and in April and October in 1970. A single individual in stage VI and another one in stage VII were noticed in November 1970. In January 1973 an individual of *C. dubius* measuring 41.4 cm was found to be in stage VII+.

TABLE 6. *Distribution of the different stages of maturity in monthly totals of females of* C. dubius. (*Figures in brackets indicate sizes in cm.*)

Months		Total females	Stages of maturity						
			I	II	III	IV	V	VI	VII
Jan.	1968	18	17 (16.1—26.0)	0	1 (35.9)	0	0	0	0
Feb.	1968	5	5 (19.0—24.1)	0	0	0	0	0	0
Mar.	1968	2	1 (24.3)	1 (26.8)	0	0	0	0	0
Apr.	1968	1	1 (15.6)	0	0	0	0	0	0
Dec.	1968	4	4 (11.8—14.7)	0	0	0	0	0	0
Jan.	1969	30	30 (14.8—25.1)	0	0	0	0	0	0
Feb.	1969	26	26 (17.7—27.9)	0	0	0	0	0	0
Mar.	1969	5	4 (25.4—27.0)	1 (30.8)	0	0	0	0	0
Apr.	1969	5	2 (20.0—21.3)	1 (28.0)	2 (32.4—35.5)	0	0	0	0
Aug.	1969	11	8 (14.3—20.8)	0	2 (25.3)	1 (32.6)	0	0	0
Oct.	1969	1	0	0	0	1 (33.7)	0	0	0
Nov.	1969	4	0	0	0	1 (32.7)	3 (29.5—32.5)	0	0
Dec.	1969	9	2 (10.1—16.5)	0	0 (31.7—33.1)	3	4 (29.7—32.8)	0	0
Jan.	1970	56	48 (11.3—23.3)	1 (24.7)	0	6 (29.1—32.8)	0	0	1 (32.9)
Feb.	1970	35	34 (15.5—26.5)	1 (26.6)	0	0	0	0	0

TABLE 6. *(Continued)*

Months	Total females	Stages of Maturity						
		I	II	III	IV	V	VI	VII
Mar. 1970	2	2 (21.8—22.4)	0	0	0	0	0	0
Apr. 1970	14	9 (14.8—26.3)	4 (23.6—25.8)	0	1 (28.7)	0	0	0
May 1970	3	0	0	0	3 (33.2—35.8)	0	0	0
Nov. 1970	9	0	0	0	6 (30.1—40.9)	1 (36.8)	1 (32.0)	1 (30.4)
Dec. 1970	13	9 (11.1—17.0)	0	0	0	4 (31.9—35.1)	0	0
Jan. 1971	26	26 (11.4—20.3)	0	0	0	0	0	0
Feb. 1971	3	3 (21.5—23.4)	0	0	0	0	0	0
Mar. 1971	4	3 (24.7—25.7)	1 (25.8)	0	0	0	0	0
Apr. 1971	10	9 (21.1—25.3)	1 (27.6)	0	0	0	0	0
May 1971	4	4 (21.9—25.4)	0	0	0	0	0	0
Nov. 1972	1	0	0	0	1 (27.7)	0	0	0
Dec. 1972	17	14 (19.5—24.2)	3 (22.5—24.8)	0	0	0	0	0
Jan. 1973	24	7 (16.2—24.2)	13 (24.2—29.6)	1 (28.9)	2 (26.5—40.3)	0	0 (41.4, st. VII+)	1

TABLE 7. *Numbers of different maturity stages in the annual totals of females of* C. dubius *at Calicut*, 1968—1972.

Years	Numbers of females	Stages of maturity						
		I	II	III	IV	V	VI	VII
1968	30	28	1	1	0	0	0	0
1969	91	72	2	4	6	7	0	0
1970	132	102	6	0	16	5	1	2
1971	55	45	2	0	7	1	0	0
1972	18	14	3	0	1	0	0	0
Totals	326	261	14	5	30	13	1	2

The juveniles of *C. dubius* are generally encountered along with those of the Malabar sole in the departmental *Paithuvala* collections and as these are not noticed in the commercial landings, the data presented here (Table 8) are purely based on these. It is seen that the largest numbers of juveniles were found in December (1968-1970) though in 1968 they are high in March also. Considering this with the occurrence of advanced gonad stages during the months of November-January (ignoring the occurrence of these stages in May 1969 and June 1972 as stray), it would appear that the spawning season in this species is a little later than or roughly the same as that of the Malabar sole, *C. macrostomus* in which it is established that the spawning starts in October-November and small juveniles enter the catches in early December or even late November (Seshappa and Bhimachar 1955). As the juveniles of *C. dubius* are less numerous during January-February, when the large sizes occur relatively more frequently, it may be concluded that the very small juveniles remain mostly in the relatively deeper waters outside the fishing area where the data for the present study were collected.

TABLE 8. *Occurrence of small juveniles of* C. dubius *in Paithuvala collections.*

Month & Year	Numbers	Size-range (cm)	Remarks
January 1968	1	9.9	Indeterminate
February 1968	1	9.4	Indeterminate
March 1968	13	2.2 to 7.1 (including 5 nos. below 5 cm)	Indeterminates
December 1968	14	5.9 to 10.0	Indeterminates
March 1969	1	7.6	Indeterminate
May 1969	1	5.3	Indeterminate
December 1969	7	(a) 4.0 to 4.3 (4 nos) (b) 9.4 to 9.8 (3 nos.)	(a) Indeterminates (b) Males
January 1970	3	7.0 to 9.6	Indeterminates
February 1970	1	5.1	Indeterminate
April 1970	1	9.9	Indeterminate
December 1970	40	5 to 10 cm (including 3 below 5 cm, 6 below 6 cm and 11 below 7 cm)	All Indeterminates
January 1971	9	5.9 to 8.3	Indeterminates
January 1972	1	8.9	Indeterminate
June 1972	3	4.6 to 6.5	Indeterminates

OBSERVATIONS ON SCALES

Examination of scales in *C. dubius* revealed the presence of growth-checks comparable to those seen in *C. macrostomus* (Seshappa and Bhimachar 1951, 1954 and 1955), though they were sometimes fainter as in the case of *C. macrolepidotus* observed by Krishnan Kutty (1967), who found 6^+ and 7^+

growth rings in individuals of 26 to 33 cm length in that species. In *C. dubius* some rings are however, better marked than others, though all the rings can easily be read once the eye gets used to them.

Out of 435 individuals examined from January 1968 to March 1973, 40 were below 17 cm in total length and all except two of these were without any rings in the scales; one in the 16-16.9 cm group had one ring and another in

TABLE 9. *Numbers of growth-rings in the scales of different size-groups of* C. dubius (*Pooled data, Jan.* 1968—*Mar.* 1973)

Size groups (cm)	Numbers of rings (Please see note below)									
	0	0+	1&1+	2&2+	3&3+	4&4+	5&5+	6	above 6	Totals
Below 17	38	1	1	0	0	0	0	0	0	40
17—17.9	6	5	4	0	0	0	0	0	0	15
18—18.9	1	3	14	0	0	0	0	0	0	18
19—19.9	1	7	23	0	0	0	0	0	0	31
20—20.9	0	6	37	2	0	0	0	0	0	45
21—21.9	0	7	25	11	0	0	0	0	0	43
22—22.9	1*	0	15	15	1	0	0	0	0	32
23—23.9	0	0	9	21	2	0	0	0	0	32
24—24.9	0	0	2	21	4	0	0	0	0	27
25—25.9	0	0	0	7	15	1	0	0	0	23
26—26.9	0	0	1	5	8	3	0	0	0	17
27—27.9	0	0	0	2	4	12	0	0	0	18
28—28.9	0	0	0	1	3	12	0	0	0	16
29—29.9	0	0	0	0	0	11	3	0	0	14
30—30.9	0	0	0	0	2	7	7	0	0	16
31—31.9	0	0	0	0	1	4	9	1	0	15
32—32.9	0	0	0	0	2	2	5	0	0	9
33—33.9	0	0	0	0	0	6	1	3	0	10
34—34.9	0	0	0	0	0	0	1	2	1	4
35—35.9	0	0	0	0	1*	1	2	4	2	10
36—36.9	0	0	0	0	0	0	1	1	1	3
37—37.9	0	0	0	0	0	1*	0	0	2	3
38—38.9	0	0	0	0	0	0	0	0	2	2
39—39.9	0	0	0	0	0	0	0	0	0 (8 rings)	0
40—40.9	0	0	0	0	0	0	0	0	1 (8 rings)	1
41—41.9	0	0	0	0	0	0	0	0	1 (10 rings)	1
Totals	47	29	131	85	43	60	29	11	10	435
Mean length (cm)	—	19.64	20.72	23.74	26.55	29.53	31.84	34.50	—	—

* left out as possible doubtful cases in calculating mean lengths.

(Note: The *plus sign* after the number of rings indicates the possibility of one more ring though not clearly noticed)

this group was suspected to have a ring, though this was not clear. In the 17-17.9 cm group, 6 out of 15 individuals were without any rings, four had one clear ring each, and the remaining five had faintly marked rings in the scales. In the higher size-groups, there were no instances of complete absence of growth rings except in one specimen each at 18-18.9 cm, 19-19.9 cm and 22-22.9 cm (the last being obviously an abnormality). The length range and estimated average length of the fish with different ring-counts are shown in Table 9.

Krishnan Kutty (1967) opined that the growth rings in *C. macrolepidotus* are perhaps formed during the southwest monsoon, in the same way as in the Malabar sole. It is probable that the growth rings in the scales of *C. dubius* are also formed in the same way and in the same season, due to the physiological factors prevailing in the fish under the influence of the environmental conditions of the southwest monsoon. The sequence of the formation of the rings at the margin of the scales could not be followed in this case owing to the fact that samples were not available regularly and continuously. It is interesting to record here that similar growth rings as observed in this case and in the Malabar sole have also been noticed by the author in most of the other species of *Cynoglossus* in this area, such as *C. puncticeps, C. bilineatus* and *C. lida.*

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