BIOLOGY AND FISHERY OF 'CHOO PARAI'— *SELAROIDES LEPTOLEPIS* (CUVIER AND VALENCIENNES)

Part III. Population Studies*

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INTRODUCTION

THIS paper is the third in series of publications on the studies of *Selaroides leptolepis*. The details regarding the material have been given in an earlier paper (Tandon, 1960).

In order to have a rational basis for the management and exploitation of the fishery resources and as an important step in understanding the biology of the species, we must have a good knowledge of the identity of the stocks supporting the fishery. When a species is commercially exploited, it becomes important to know whether the catch comes from a single stock or from several stocks which may or may not remain as discrete entities. The term stock in this investigation is used to denote a group of individuals which inhabit a particular area in a given time showing certain distinct meristic or morphometric characters. If the species exploited belongs to one stock, the fishing intensity at any one place is likely to have its effect in due course at other centres too and hence it is imperative to know about the nature and composition of the commercially exploited stocks.

METHODS

It is a well-known fact that ratios between various body parts may differ at different stages of life-history in fishes and this has been demonstrated by Godsil (1948), Schaefer (1948), Schaefer and Walford (1950) and Marr (1955). If, however, the regression of one character over another is found to be linear within a certain range of the independent variable, then comparison of such regressions within the range facilitates testing the homogeneity of various

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samples. Godsil (*op. cit.*), Schaefer (*op. cit.*), De Sylva *et al.* (1956), Pillay (1957), Sarojini (1957), Berdegue (1958), Prasad (1958 *b*), etc., followed the method of regressions for the analysis of different characters to separate the populations, races or stocks as labelled by them. In the present investigation it was found that the regression of each character was linear over the range of independent variable. Thus the comparison of different samples has been based on the comparison of regressions.

The fork length was taken as an independent character and other lengths as dependent ones. For the meristic counts last dorsal and anal rays were counted as one each. All the measurements and counts were made by the author himself. The measurements were recorded in millimeter. The significance of the difference of regression of each morphometric character and the significance in the difference in the mean values of meristic character were considered at 5% probability level. In the columns 5% F. the values of the nearest or the next number, as described in the F. Tables, are given.

Relation between Fork Length and Total Length

Most workers take total length as an independent variable. In this paper, however, the fork length has been used as an independent variable. As will be seen from the following account there is a high correlation between the two and a linear relation exists between them. An attempt was, therefore, made to ascertain this relation. For this purpose 150 specimens ranging from 47–152 mm. in length were measured. The total length was taken from the tip of the lower jaw to the longest ray in the caudal fin when the two lobes were brought together. The regression equation was found out to be $Y=0.0349+0.8677\ X$. From the same data the correlation coefficient '*r*' was also calculated and found to be 0·9993 indicating a high correlation between the two lengths. 'Y' and 'X' denote fork and total lengths respectively. That the relationship is linear can be shown by testing for linearity (Table I).

Table I, thus, indicates that almost the entire variation is accounted for by linear regression, *b* is highly significant.

Characters Selected

A large array of morphometric characters may be measured from an individual fish. In order to expedite the collection and analysis of data, however, it is desirable to limit collection to the best few of the many possible characters. Selection of the 'best' characters is, however, rather

TABLE I

Test of linearity of the regression of fork length on total length

Source of variation	Degrees of freedom	Sum of squares	Mean square	F.
Variation due to regression	1	805·824	805·824	
Residual ..	148	1·026	0·006932	116247
TOTAL ..	149	806·850		

difficult as there is no definite yardstick upon which judgement can be based *apriori*. It has been suggested by some workers that the characters should be selected (1) with a view to choosing those that would be likely to show possible differences, (2) because of facility of measurements under field conditions and (3) because of their use by previous workers.

The three criteria enumerated above suggested the selection of the following characters (Fig. 1):

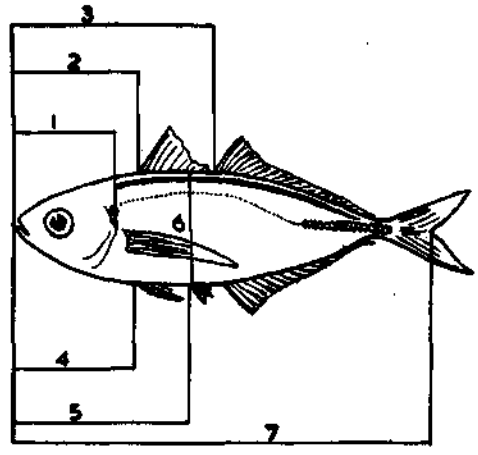

FIG. 1. Diagram of *Selaroides leptolepis* indicating the morphometric measurements. 1. Head length. 2. Snout to first dorsal. 3. Snout to second dorsal. 4. Snout to ventral. 5. Snout to anal. 6. Maximum depth of body. 7. Fork length.

(*a*) *Morphometric Characters*

(i) Head length,

(ii) Snout to first dorsal,

(iii) Snout to second dorsal,
(iv) Snout to ventral,
(v) Snout to anal,
(vi) Maximum depth of body.

b) Meristic Characters

(i) Number of rays of second dorsal,
(ii) Number of rays of anal,
(iii) Number of vertebrae.

Sexual Dimorphism

In many fish the regression of one character on another may differ for the two sexes. In such cases, comparison of samples have to be made on the basis of sex. On the other hand if there is no significant difference between regressions of one character or another in the two sexes, the comparison of samples can be made directly without reference to sex. Hence, to see if there were differences in the regressions of various characters in the two sexes, a sample of 50 fish was selected. These fish were then separated according to sex, and measurements and counts for individual fish were recorded.

Comparison of regressions of various characters studied showed that except for snout to first dorsal which was significant at 5% probability level, none of the other regressions were significant. Therefore, in the subsequent analyses samples were treated without reference to sexes.

Results

(a) Morphometric Characters

To test the homogeneity or otherwise of the stocks at a particular centre from year to year, and from different centres within a year samples were collected during 1957, 1958 and 1959 from Rameswaram, Thangachimadam, Rameswaram Road and Pudumadam. However, samples were not available at Rameswaram Road during 1957. In 1958 fish were also procured from Madras and Vizhingam.

Comparisons were first made between samples collected during different years from the same place and similarly between samples from different centres within a year. In the event of significant differences between samples, comparisons were made between all possible pairs of samples to find out if the samples could be grouped conveniently. The relevant results are presented in Tables II–X.

TABLE II

Comparison of different body lengths of Selaroides leptolepis *between years* (1957, 1958 *and* 1959) *at Rameswaram*

Character	Deviation from total regression		Deviation from individual regressions within years			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length	135	46·4205	133	39·2026	0·2947	2	7·2179	3·6089	12·2460	3·06
Snout to first dorsal	135	70·2613	133	68·1329	0·5122	2	2·1284	1·0642	2·0777	3·06
Snout to second dorsal	135	1208·3633	133	1204·2966	9·0548	2	4·0667	2·0333	4·4532	19·49
Snout to ventral	135	58·6375	133	57·5026	0·4323	2	1·1349	0·5674	1·3125	3·06
Snout to anal	135	111·8570	133	98·7870	0·7427	2	13·0700	6·5350	8·7989	3·06
Maximum depth of body	135	92·8805	133	81·7254	0·6144	2	11·1551	5·5775	9·0779	3·06
Head length:										
1957 and 1958	96	25·4305	95	25·3589	0·2669	1	0·0716	0·0716	3·7276	253
1957 and 1959	92	36·5144	91	29·8315	0·3278	1	6·6829	6·6829	20·3871	3·94
1958 and 1959	81	29·4204	80	23·2148	0·2901	1	6·2056	6·2056	21·3912	3·96
Snout to anal:										
1957 and 1958	96	81·6297	95	69·8118	0·7348	1	11·8179	11·8179	16·0831	3·94
1957 and 1959	92	74·9962	91	74·9479	0·8236	1	0·0483	0·0483	17·0517	253
1958 and 1959	81	66·9656	80	52·8143	0·6601	1	14·1513	14·1513	21·4381	3·96
Maximum depth of body:										
1957 and 1958	96	69·1392	95	65·5405	0·6793	1	4·5987	4·5987	6·7697	3·94
1957 and 1959	92	51·5467	91	49·0004	0·5384	1	2·5463	2·5463	4·7293	3·94
1958 and 1959	81	59·2670	80	49·9099	0·6238	1	9·3571	9·3571	15·0001	3·96

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE III

Comparison of different body lengths of Selaroides leptolepis *between years* (1957, 1958 *and* 1959) *at Thangachimadam*

Character	Deviation from total regression		Deviation from individual regressions within years			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length	152	72·3412	150	69·9843	0·4665	2	2·3569	1·1784	2·5260	3·06
Snout to first dorsal	152	118·5561	150	113·3457	0·7556	2	5·2104	2·6052	3·4478	3·06
Snout to second dorsal	152	140·0965	150	138·2285	0·9215	2	1·8680	0·9340	1·0135	3·06
Snout to ventral	152	88·0574	150	87·4301	0·5828	2	0·6273	0·3136	1·8584	19·49
Snout to anal	152	190·0312	150	187·1314	1·2475	2	2·8998	1·4499	1·1622	3·06
Maximum depth of body	152	151·7904	150	140·8316	0·9388	2	10·9588	5·4784	5·8365	3·06
Snout to first dorsal:										
1957 and 1958	113	105·9944	112	101·1230	0·9028	1	4·8714	4·8714	5·3958	3·92
1957 and 1959	103	95·9229	102	84·3949	0·8274	1	11·5280	11·5280	13·9328	3·92
1958 and 1959	87	42·5725	86	41·1735	0·4787	1	1·3990	1·3990	2·9224	3·94
Maximum depth of body:										
1957 and 1958	113	116·8846	112	111·8093	0·9982	1	5·0753	5·0753	5·0844	3·92
1957 and 1959	103	110·5877	102	99·7019	0·9774	1	10·8858	10·8858	11·1375	3·92
1958 and 1959	87	73·0027	86	70·1520	0·8157	1	2·8507	2·8507	3·4947	3·94

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE IV

Comparison of different body lengths of Selaroides leptolepis *between years* (1958 *and* 1959) *at Rameswaram Road*

Character	Deviation from total regression		Deviation from individual regressions within years			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length ..	97	75·7784	96	72·4579	0·7547	1	3·3205	3·3205	4·3997	3·94
Snout to first dorsal	97	81·6975	96	80·5001	0·8385	1	1·1974	1·1974	1·4280	3·94
Snout to second dorsal	97	98·9595	96	98·7668	1·0288	1	0·1927	0·1927	5·3388	253
Snout to ventral	97	57·6467	96	57·1751	0·5955	1	0·4716	0·4716	1·2627	253
Snout to anal ..	97	160·9037	96	160·7118	1·6740	1	0·1919	0·1919	8·7232	253
Maximum depth of body	97	91·7082	96	91·5819	0·9539	1	0·1263	0·1263	7·5526	253

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE V

Comparison of different body lengths of Selaroides leptolepis *between years* (1957, 1958 *and* 1959) *at* **Pudumadam**

Character	Deviation from total regression		Deviation from individual regressions within years			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length ..	139	74·9407	137	73·3821	0·5356	2	1·5586	0·7793	1·4550	3·06
Snout to first dorsal	139	124·7949	137	124·7235	0·9103	2	0·0714	0·0357	25·4985	19·49
Snout to second dorsal	139	212·7598	137	212·1323	1·5484	2	0·6275	0·3137	4·9359	19·49
Snout to ventral	139	84·9866	137	83·5527	0·6098	2	1·4339	0·7169	1·1756	3·06
Snout to anal ..	139	181·2911	137	176·5169	1·2884	2	4·7742	2·3871	1·8527	3·06
Maximum depth of body	139	340·6158	137	312·1031	2·2781	2	28·5127	14·2563	6·2579	3·06
Snout to first dorsal:										
1957 and 1958	90	66·0833	89	66·0831	0·7425	1	0·0002	0·0002	3712·5	253
1957 and 1959	88	92·0491	87	91·9890	1·0573	1	0·0601	0·0601	17·5923	253
1958 and 1959	99	91·4252	98	91·3749	0·9323	1	0·0503	0·0503	18·5347	253
Maximum depth of body:										
1957 and 1958	90	274·7034	89	252·4855	2·8369	1	22·2179	22·2179	7·8317	3·94
1957 and 1959	88	248·0523	87	224·1499	2·5764	1	23·9024	23·9024	9·2774	3·94
1958 and 1959	99	148·3999	98	147·5708	1·5058	1	0·8291	0·8291	1·8161	253

D.F. = Degrees of Freedom S.S. = Sum of Squares.

TABLE VI

Comparison of different body lengths of Selaroides leptolepis *by covariance analysis from Rameswaram, Thangachimadam and Pudumadam during* 1957

Character	Deviation from total regression		Deviation from individual regressions within places			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length	158	81·8344	156	74·3045	0·4763	2	7·5299	3·7649	7·9044	3·04
Snout to first dorsal	158	152·1329	156	142·8845	0·9159	2	9·2484	4·6242	5·0488	3·04
Snout to second dorsal	158	1304·7920	156	1300·2112	8·3346	2	4·5808	2·2904	3·6389	19·49
Snout to ventral	158	107·2277	156	105·2182	0·6744	2	2·0095	1·0047	1·4897	3·04
Snout to anal	158	152·5318	156	151·3287	0·9700	2	1·2031	0·6015	1·6126	19·49
Maximum depth of body	158	280·9593	156	267·0274	1·7117	2	13·9319	6·9659	4·0695	3·04
Head length:										
Rameswaram and Thangachi-madam	118	60·9566	117	54·0979	0·4623	1	6·8587	6·8587	14·8360	3·92
Rameswaram and Pudu-madam	93	39·0890	92	36·1944	0·3934	1	2·8946	2·8946	7·3579	3·94
Thangachi-madam and Pudumadam	104	59·9083	103	58·3167	0·5661	1	1·5916	1·5916	2·8115	3·92

Snout to first dorsal:										
Rameswaram and Thangachi-madam	118	117·9325	117	109·5359	0·9362	1	8·3966	8·3966	8·9688	3·92
Rameswaram and Pudu-madam	93	71·1344	92	70·7123	0·7686	1	0·4221	0·4221	1·8208	253
Thangachi-madam and Pudumadam	104	112·5226	103	105·5208	1·0244	1	7·0018	7·0018	6·8350	3·92
Maximum depth of body:										
Rameswaram and Thangachi-madam	118	111·3834	117	102·4951	0·8760	1	8·8883	8·8883	10·1464	3·92
Rameswaram and Pudu-madam	93	206·3537	92	196·3478	2·1342	1	10·0059	10·0059	4·6883	3·94
Thangachi-madam and Pudumadam	104	235·4652	103	235·2119	2·2836	1	0·2533	0·2533	9·0153	25[illegible]

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE VII

Comparison of different body lengths of Selaroides leptolepis *by covariance analysis from Rameswaram, Thangachimadam, Rameswaram Road, Pudumadam, Madras and Vizhingam during* 1958

Character	Deviation from total regression		Deviation from individual regressions within places			Difference			Observed F.	5% F.
	D.F.	S S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length ..	256	116·5907	251	108·8721	0·4337	5	7·6586	1·5317	3·5317	2·23
Snout to first dorsal ..	256	180·9694	251	170·7747	0·6803	5	10·1947	2·0389	2·9970	2·23
Snout to second dorsal ..	256	223·4730	251	218·3329	0·8698	5	5·1401	1·0280	1·1819	2·23
Snout to ventral ..	256	145·0954	251	131·3098	0·5231	5	13·7856	2·7571	5·2706	2·23
Snout to anal ..	256	349·9361	251	318·6501	1·2695	5	31·2860	6·2572	4·9288	2·23
Maximum depth of body ..	256	298·4082	251	270·3871	1·0772	5	28·0211	5·6042	5·2025	2·23
Head length										
Rameswaram and Thangachimadam	91	31·9575	90	28·1002	0·3122	1	3·8573	3·8573	12·3552	3·94
Rameswaram and Rameswaram Road	91	44·7546	90	44·7527	0·4972	1	0·0019	0·0019	261·6842	253
Rameswaram and Pudumadam	93	29·8370	92	29·6199	0·3219	1	0·2171	0·2171	1·4827	253
Rameswaram and Madras	91	31·9341	90	30·9160	0·3435	1	1·0181	1·0181	2·9639	3·94
Rameswaram and Vizhingam	58	13·5943	57	12·9677	0·2275	1	0·6266	0·6266	2·7542	4·00
Thangachimadam and Rameswaram Road	97	55·8828	96	54·1107	0·5633	1	1·7721	1·7721	3·1442	3·94
Thangachimadam and Pudumadam	99	40·3987	98	38·9779	0·3977	1	1·4208	1·4208	3·5725	3·94
Thangachimadam and Madras	97	44·3460	96	40·2740	0·4195	1	4·0720	4·0720	9·7067	3·94
Thangachimadam and Vizhingam	64	24·1016	63	22·3257	0·3543	1	1·7759	1·7759	5·0124	3·99
Rameswaram Road and Pudumadam	99	55·7418	98	55·6304	0·5676	1	0·1114	0·1114	5·0951	253
Rameswaram Road and Madras	97	57·7805	96	56·9265	0·5929	1	0·8540	0·8540	1·4403	3·94

Rameswaram Road and Vizhingam	64	39·5851	63	38·9782	0·6187	1	0·6069	0·6069	1·0194	253
Pudumadam and Madras	99	43·3584	98	41·7937	0·4264	1	1·5647	1·5647	3·6695	3·94
Pudumadam and Vizhingam	66	24·7278	65	23·8454	0·3668	1	0·8824	0·8824	2·4056	3·99
Madras and Vizhingam	64	25·1921	63	25·1415	0·3990	1	0·0506	0·0506	7·8853	253
Snout to first dorsal										
Rameswaram and Thangachimadam	91	45·7118	90	42·9253	0·4769	1	2·7865	2·7865	5·8429	3·94
Rameswaram and Rameswaram Road	91	72·8158	90	67·0571	0·7450	1	5·7587	5·7587	7·7297	3·94
Rameswaram and Pudumadam	93	47·1880	92	46·7090	0·5077	1	0·4790	0·4790	1·0599	253
Rameswaram and Madras	91	42·8754	90	42·6448	0·4738	1	0·2306	0·2306	2·0546	253
Rameswaram and Vizhingam	58	29·5739	57	27·3365	0·4795	1	2·2374	2·2374	4·6661	4·00
Thangachimadam and Rameswaram Road	97	83·4816	96	82·0334	0·8545	1	1·4482	1·4482	1·6947	3·94
Thangachimadam and Pudumadam	99	62·3171	98	61·6853	0·6290	1	0·6318	0·6318	1·0044	3·94
Thangachimadam and Madras	97	57·7849	96	57·6211	0·6002	1	0·1638	0·1638	3·6642	253
Thangachimadam and Vizhingam	64	46·2097	63	42·3128	0·6716	1	3·8969	3·8969	5·8024	3·99
Rameswaram Road and Pudumadam	99	88·7057	98	85·8171	0·8756	1	2·8886	2·8886	3·2989	3·94
Rameswaram Road and Madras	97	83·0411	90	81·7529	0·8515	1	1·2882	1·2882	1·5128	3·94
Rameswaram Road and Vizhingam	64	71·9829	63	66·4446	1·0546	1	5·5383	5·5383	5·2515	3·99
Pudumadam and Madras	99	63·3432	98	61·4048	0·6265	1	1·9384	1·9384	3·0940	3·94
Pudumadam and Vizhingam	66	48·9754	65	46·0965	0·7091	1	2·8789	2·8789	4·0599	3·99
Madras and Vizhingam	64	44·5708	63	42·0323	0·6671	1	2·5385	2·5385	3·8052	3·99
Snout to ventral										
Rameswaram and Thangachimadam	91	40·8180	90	40·5131	0·4501	1	0·3049	0·3049	1·4762	253
Rameswaram and Rameswaram Road	91	47·2292	90	46·2238	0·5135	1	1·0054	1·0054	1·9579	3·94

TABLE VII (*Contd.*)

Character	Deviation from total regression		Deviation from individual regressions within places			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S S.	Variance	D.F.	S.S.	Variance		
Rameswaram and Pudumadam	93	44·8764	92	37·4462	0·4070	1	7·4302	7·4302	18·2560	3·94
Rameswaram and Madras	91	41·6942	90	34·4079	0·3823	1	7·2863	7·2863	19·0591	3·94
Rameswaram and Vizhingam	58	23·8420	57	22·8968	0·4016	1	0·9452	0·9452	2·3535	4·00
Thangachimadam and Rameswaram Road	97	62·0363	96	61·6479	0·6421	1	0·3884	0·3884	1·6531	253
Thangachimadam and Pudumadam	99	58·0666	98	52·8703	0·5394	1	5·1963	5·1963	9·6334	3·94
Thangachimadam and Madras	97	55·7235	96	49·8320	0·5190	1	5·8915	5·8915	11·3516	3·94
Thangachimadam and Vizhingam	64	38·9957	63	38·3209	0·6082	1	0·6748	0·6748	1·1095	3·99
Rameswaram Road and Pudumadam	99	59·8551	98	58·5810	0·5977	1	1·2741	1·2741	2·1320	3·94
Rameswaram Road and Madras	97	58·5813	96	55·5427	0·5786	1	3·0386	3·0386	5·2516	3·94
Rameswaram Road and Vizhingham	64	44·3394	63	44·0316	0·6989	1	0·3078	0·3078	2·2706	253
Pudumadam and Madras	99	47·8172	98	46·7651	0·4771	1	1·0521	1·0521	2·2051	3·94
Pudumadam and Vizhingam	66	35·2627	65	35·2540	0·5423	1	0·0087	0·0087	62·3333	253
Madras and Vizhingam	64	32·4076	63	32·2157	0·5113	1	0·1919	0·1919	2·6644	253
Snout to anal										
Rameswaram and Thangachimadam	91	98·3308	90	84·2506	0·9361	1	14·0802	14·0802	15·0413	3·94
Rameswaram and Rameswaram Road	91	122·8219	90	122·8176	1·3646	1	0·0043	0·0043	317·3488	253
Rameswaram and Pudumadam	93	73·2976	92	60·2142	0·6545	1	13·0834	13·0834	19·9899	3·94
Rameswaram and Madras	91	106·2048	90	90·5638	1·0062	1	15·6410	15·6410	15·5446	3·94

Rameswaram and Vizhingam	58	56·1650	57	56·1603	0·9852	1	0·0047	0·0047	209·6170	253
Thangachimadam and Rameswaram Road	97	165·9525	96	159·3900	1·6603	1	6·5625	6·5625	3·9525	3·94
Thangachimadam and Pudumadam	99	96·9633	98	96·7866	0·9876	1	0·1767	0·1767	5·6081	253
Thangachimadam and Madras	97	131·3388	96	127·1362	1·3243	1	4·2026	4·2026	3·1734	3·94
Thangchimadam and Vizhingam	64	93·6600	63	92·7327	1·4719	1	0·9273	0·9273	1·5872	253
Rameswaram Road and Pudumadam	99	142·4753	98	135·3536	1·3811	1	7·1217	7·1217	5·1565	3·94
Rameswaram Road and Madras	97	177·7212	96	165·7032	1·7260	1	12·0180	12·0180	6·9629	3·94
Rameswaram Road and Vizhingam	64	140·2788	63	131·2997	2·0841	1	8·9791	8·9791	4·3083	3·99
Pudumadam and Madras	99	106·0528	98	103·0998	1·0520	1	2·9530	2·9530	2·8070	3·94
Pudumadam and Vizhingam	66	69·8667	65	68·6963	1·0568	1	1·1704	1·1704	1·1074	3·99
Madras and Vizhingam	64	102·5460	63	99·0459	1·5721	1	3·5001	3·5001	2·2263	3·99
Maximum depth of body										
Rameswaram and Thangachimadam	91	74·9682	90	73·8547	0·8206	1	1·1135	1·1135	1·3569	3·94
Rameswaram and Rameswaram Raad	91	95·5666	90	86·4494	0·9605	1	9·1172	9·1172	9·4921	3·94
Rameswaram and Pudumadam	93	131·5934	92	120·6782	1·3117	1	10·9152	10·9152	8·3214	3·94
Rameswaram and Madras	91	91·2213	90	77·4664	0·8607	1	13·7549	13·7549	15·9810	3·94
Rameswaram and Vizhingam	58	47·1836	57	42·8384	0·7515	1	4·3452	4·3452	5·7820	4·00
Thangachimadam and Rameswaram Road	97	100·1546	96	94·8541	0·9880	1	5·3005	5·3005	5·3648	3·94
Thangachimadam and Pudumadam	99	134·9877	98	129·0829	1·3171	1	5·9048	5·9048	4·4831	3·94
Thangachimadam and Madras	97	96·0037	96	85·8711	0·8944	1	10·1326	10·1326	11·3289	3·94
Thangachimadam and Vizhingam	64	54·4710	63	51·2431	0·8133	1	3·2279	3·2279	3·9688	3·99
Rameswaram Road and Pudumadam	99	141·7690	98	141·6776	1·4456	1	0·0914	0·0914	15·8161	253
Rameswaram Road and Madras	97	100·2266	96	98·4658	1·0256	1	1·7608	1·7608	1·7168	3·94
Rameswaram Road and Vizhingam	64	64·5750	63	63·8378	1·0132	1	0·7372	0·7372	1·3743	253
Pudumadam and Madras	99	135·4568	98	132·6946	1·3540	1	2·7622	2·7622	2·0400	3·94
Pudumadam and Vizhingam	66	99·0820	65	98·0666	1·5087	1	1·0154	1·0154	1·4858	253
Madras and Vizhingam	64	54·8608	63	54·8548	0·8707	1	0·0060	0·0060	145·1166	253

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE VIII

Comparison of different body lengths of Selaroides leptolepis *by covariance analysis from Rameswaram, Thangachimadam, Rameswaram Road and Pudumadam during* 1959

Character	Deviation from total regression		Deviation from individual regressions within places			Difference			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Variance	D.F.	S.S.	Variance		
Head length ..	175	104·8647	172	96·9918	0·5639	3	7·8729	2·6243	4·6538	2·65
Snout to first dorsal ..	175	120·8517	172	115·0753	0·6690	3	5·7764	1·9254	2·8780	2·65
Snout to second dorsal ..	175	203·4145	172	198·4934	1·1540	3	4·9211	1·6403	1·4214	2·65
Snout to ventral ..	175	83·0721	172	81·3482	0·4729	3	1·7239	0·5746	1·2150	2·65
Snout to anal ..	175	253·6994	172	252·2142	1·4663	3	1·4852	0·4950	2·9622	8·54
Maximum depth of body	175	146·8134	172	143·6823	0·8353	3	3·1311	1·0437	1·2494	2·65
Head length										
Rameswaram and Thangachimadam	77	27·2053	76	26·9888	0·3551	1	0·2165	0·2165	1·6401	253
Rameswaram and Rameswaram Road	87	50·9239	86	50·9200	0·5920	1	0·0039	0·0039	151·7948	253
Rameswaram and Pudumadam	87	51·4756	86	46·7704	0·5314	1	4·7052	4·7052	8·8543	3·94
Thangachimadam and Rameswaram Road	87	50·3351	86	50·2214	0·5839	1	0·1137	0·1137	5·1354	253
Thangachimadam and Pudumadam	87	51·4022	86	46·0718	0·5357	1	5·3304	5·3304	9·9503	3·94
Rameswaram Road and Pudumadam	97	73·4554	96	70·0030	0·7291	1	3·4524	3·4524	4·7351	3·94
Snout to first dorsal										
Rameswaram and Thangachimadam	77	29·2822	76	29·0174	0·3818	1	0·2648	0·2648	1·4418	253
Rameswaram and Rameswaram Road	87	46·6711	86	44·2122	0·5140	1	2·4589	0·4589	4·7838	3·94
Rameswararam and Pudumadam	87	75·7595	86	75·4351	0·8771	1	0·3344	0·3344	2·6229	253
Thangachimadam and Rameswaram Road	87	41·5527	86	39·6402	0·4609	1	1·9125	1·9125	4·1494	3·94
Thangachimadam and Pudumadam	87	72·9416	86	70·8631	0·8239	1	2·0785	2·0785	2·5227	3·94
Rameswaram Road and Pudumadam	97	91·3454	96	86·0579	0·8964	1	5·2875	5·2875	5·8985	3·94

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE IX

Significance and non-significance of morphometric characters of Selaroides leptolepis *between years from Rameswaram, Thangachimadam, Rameswaram Road and Pudumadam*

Locality	Head length	Snout to first dorsal	Snout to second dorsal	Snout to ventral	Snout to anal	Maximum depth of body
Rameswaram						
1957 *v.* 1958 ..	NS	NS	NS	NS	S	S
1957 *v.* 1959 ..	S	NS	NS	NS	NS	S
1958 *v.* 1959 ..	S	NS	NS	NS	S	S
Thangachimadam						
1957 *v.* 1958 ..	NS	S	NS	NS	NS	S
1957 *v.* 1959 ..	NS	S	NS	NS	NS	S
1958 *v.* 1959 ..	NS	NS	NS	NS	NS	NS
Rameswaram Road						
1958 *v.* 1959 ..	S	NS	NS	NS	NS	NS
Pudumadam						
1957 *v.* 1958 ..	NS	S	NS	NS	NS	S
1957 *v.* 1959 ..	NS	NS	NS	NS	NS	S
1958 *v.* 1959 ..	NS	NS	NS	NS	NS	NS

NS = Non-significant. S = Significant.

The results of the regression analyses of various morphometric characters of *Selaroides leptolepis* may be summarised as follows:

(i) *Head length.*—The comparison of the samples collected during the years 1957 and 1959, and 1958 and 1959 showed significant differences at Rameswaram. Similarly the samples of 1958 and 1959 were significantly different at Rameswaram Road.

The regressions of head length showed significant differences in the samples collected during 1957 between Rameswaram and Thangachimadam, and Rameswaram and Pudumadam. During 1958, they were significantly

TABLE X

Significance and non-significance of morphometric characters of Selaroides leptolepis *between places during* 1957, 1958 *and* 1959

Locality	Head length			Snout to first dorsal			Snout to second dorsal			Snout to ventral			Snout to anal			Maximum depth of body		
	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959
Rameswaram *v.* Thangachimadam	S	S	NS	S	S	NS	NS	NS	NS	NS	NS	NS	NS	S	NS	S	NS	NS
Rameswaram *v.* Rameswaram Road	..	S	NS	..	S	S	..	NS	NS	..	NS	NS	..	S	NS	..	S	NS
Rameswaram *v.* Pudumadam	S	NS	S	NS	NS	NS	NS	NS	NS	NS	S	NS	NS	S	NS	S	S	NS
Rameswaram *v.* Madras	..	NS	..	..	NS	..	..	NS	..	..	S	..	..	S	..	..	S	..
Rameswaram *v.* Vizhingam	..	NS	..	..	S	..	..	NS	..	..	NS	..	..	NS	..	..	S	..
Thangachimadam *v.* Rameswaram Road	..	NS	NS	..	NS	S	..	NS	NS	..	NS	NS	..	S	NS	..	S	NS
Thangachimadam *v.* Pudumadam	NS	NS	S	S	NS	NS	NS	NS	NS	NS	S	NS	NS	NS	NS	NS	S	NS
Thangachimadam *v.* Madras	..	S	..	..	NS	..	..	NS	..	..	S	..	..	NS	..	..	S	..
Thangachimadam *v.* Vizhingam	..	S	..	..	S	..	..	NS	..	..	NS	..	..	NS	..	..	NS	..
Rameswaram Road *v.* Pudumadam	..	NS	S	..	NS	S	..	NS	NS	..	NS	NS	..	S	NS	..	NS	NS
Rameswaram Road *v.* Madras	..	NS	..	..	NS	..	..	NS	..	..	S	..	..	S	..	..	NS	..
Rameswaram Road *v.* Vizhingam	..	NS	..	..	S	..	..	NS	..	..	NS	..	..	S	..	..	NS	..
Pudumadam *v.* Madras	..	NS	..	..	NS	..	..	NS	..	..	NS	..	..	NS	..	..	NS	..
Pudumadam *v.* Vizhingam	..	NS	..	..	S	..	..	NS	..	..	NS	..	..	NS	..	..	NS	..
Madras *v.* Vizhingam	..	NS	..	..	NS	..	..	NS	..	..	NS	..	..	NS	..	..	NS	..

NS = Non-Significant. S = Significant.

different between Rameswaram and Thangachimadam, Rameswaram and Rameswaram Road, Thangachimadam and Madras, and Thangachimadam and Vizhingam. In 1959 significant differences were observed in the samples between Rameswaram and Pudumadam, Thangachimadam and Pudumadam, and Rameswaram Road and Pudumadam.

(ii) *Snout to first dorsal.*—The samples collected from Thangachimadam during 1957 when compared with 1958 and 1959 revealed significant differences. Similarly the samples of Pudumadam in 1957 and 1958 were also significantly different.

The comparison of regressions revealed that samples were significantly different between Rameswaram and Thangachimadam, and Thangachimadam and Pudumadam in 1957. In 1958, significant differences were observed between the samples of Rameswaram and Thangachimadam, Rameswaram and Rameswaram Road, Rameswaram and Vizhingam, Thangachimadam and Vizhingam, Rameswaram Road and Vizhingam, and Pudumadam and Vizhingam. The differences persisted during 1959 between Rameswaram and Rameswaram Road, Thangachimadam and Rameswaram Road, and Rameswaram Road and Pudumadam.

(iii) *Snout to second dorsal.*—In regard to this character the comparison of the regressions from year to year and from different centres within a year showed that samples might have been drawn from a homogeneous population.

(iv) *Snout to ventral.*—The regressions of the samples when compared from different years revealed that they did not differ significantly.

The comparison of the regressions showed that samples from different centres might have been drawn from a homogeneous population in 1957 and 1959, whereas significant differences were observed during 1958 between the samples of Rameswaram and Pudumadam, Rameswaram and Madras, Thangachimadam and Pudumadam, Thangachimadam and Madras, and Rameswaram Road and Madras.

(v) *Snout to anal.*—The samples showed significant differences between 1957 and 1958, and 1958 and 1959 at Rameswaram.

Regressions of the samples within 1957 and 1959 from different places when compared revealed that the differences were non-significant in regard to this character. In 1958 samples were significantly different between Rameswaram and Thangachimadam, Rameswaram and Rameswaram Road, Rameswaram and Pudumadam, Rameswaram and Madras, Thangachimadam

and Rameswaram Road, Rameswaram Road and Madras, Rameswaram Road and Pudumadam, and Rameswaram Road and Vizhingam.

(vi) *Maximum depth of body.*—The samples were significantly different between all the years at Rameswaram. Significant differences were also observed in the samples of Thangachimadam and Pudumadam between 1957 and 1958, and 1957 and 1959.

The analysis of this character showed that the regressions were significantly different between the samples of Rameswaram and Thangachimadam, and Rameswaram and Pudumadam in 1957, between Rameswaram and Rameswaram Road, Rameswaram and Pudumadam, Rameswaram and Madras, Rameswaram and Vizhingam, Thangachimadam and Rameswaram Road, Thangachimadam and Pudumadam, and Thangachimadam and Madras in 1958, while they did not show any significant difference within the samples of 1959.

(b) Meristic Characters

In order to test whether the samples were drawn from a homogeneous population from year to year, and from different centres within a year the meristic characters were analysed by the method of Analysis of Variance. The samples were first compared together and in the event of their showing significant differences, they were compared in pairs. The details of the analyses are given in Tables XI–XV and the final results are presented in Tables XVI and XVII.

The following interesting points can be brought out in connection with the meristic characters of *Selaroides leptolepis :*

(i) *Dorsal fin rays.*—Samples collected from year to year and from different centres within a year did not show significant differences in their mean values.

(ii) *Anal fin rays.*—The mean values of the samples collected from Rameswaram Road showed significant differences between 1958 and 1959.

The analysis of the mean values of this character did not reveal significant differences between the samples of 1957 and 1959; the differences were observed in 1958 between the samples of Rameswaram and Rameswaram Road, Rameswaram and Madras, Rameswaram Road and Pudumadam, and Rameswaram Road and Madras.

(iii) *Vertebral counts.*—The number of vertebrae being 24 (10 + 14) in all the fish examined, irrespective of the time and place of collection, this character was not analysed.

TABLE XI

Frequency distribution of dorsal and anal fin ray counts of Selaroides leptolepis *during* 1957 *from Rameswaram, Thangachimadam and Pudumadam*

Locality	N	Number of fish having dorsal fin ray counts of				Number of fish having anal fin ray counts of			
		23	24	25	26	19	20	21	22
Rameswaram ..	40	7	20	13	..	..	27	8	5
Thangachimadam ..	40	6	17	14	3	2	10	26	2
Pudumadam ..	38	4	17	16	1	1	17	16	4

TABLE XII

Frequency distribution of dorsal and anal fin ray counts of Selaroides leptolepis *during* 1958 *from Rameswaram, Thangachimadam, Rameswaram Road, Pudumadam, Madras and Vizhingam*

Locality	N	Number of fish having dorsal fin ray counts of				Number of fish having anal fin ray counts of					
		23	24	25	26	18	19	20	21	22	23
Rameswaram ..	44	2	30	11	1	..	..	20	21	3	..
Thangachimadam ..	40	2	16	20	2	..	..	12	20	8	..
Rameswaram Road ..	50	1	22	20	7	..	..	7	27	16	..
Pudumadam ..	80	2	44	27	7	1	..	23	47	9	..
Madras ..	50	..	22	26	2	..	..	15	26	8	1
Vizhingam ..	17	..	10	6	1	..	..	6	6	4	1

TABLE XIII

Frequency distribution of dorsal and anal fin ray counts of Selaroides leptolepis *during* 1959 *from Rameswaram, Thangachimadam, Rameswaram Road and Pudumadam*

Locality	N	Number of fish having dorsal fin ray counts of							Number of fish having anal fin ray counts of					
		21	22	23	24	25	26	27	18	19	20	21	22	23
Rameswaram ..	40	..	..	1	26	12	1	..	..	..	13	25	2	..
Thangachimadam ..	90	..	..	8	50	30	2	..	..	2	24	52	12	..
Rameswaram Road	96	..	..	2	46	43	5	..	1	1	24	58	12	..
Pudumadam ..	73	1	..	6	29	31	5	1	..	3	17	36	15	2

TABLE XIV

Analysis of variance for dorsal and anal fin rays of Selaroides leptolepis *within years* (1957, 1958 *and* 1959) *from* (*i*) *Rameswaram,* (*ii*) *Thangachimadam,* (*iii*) *Rameswaram Road and* (*iv*) *Pudumadam*

	Total		Within years			Between years			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Mean square	D.F.	S.S.	Mean square		
(i) Rameswaram										
Dorsal fin rays	123	46·7420	121	46·1250	0·3811	2	0·6170	0·3085	1·2353	19·49
Anal fin rays	123	49·8388	121	48·3069	0·3992	2	1·5319	0·7659	1·9185	3·07
(ii) Thangachi-madam										
Dorsal fin rays	169	85·3883	167	83·4889	0·4999	2	1·8994	0·9497	1·8997	3·04
Anal fin rays	169	77·9765	167	77·1556	0·4620	2	0·8209	0·4104	1·1257	19·49
(iii) Rameswaram Road										
Dorsal fin rays	145	65·6712	144	65·1262	0·4523	1	0·5450	0·5450	1·2050	3·91
Anal fin rays	145	71·5617	144	67·3696	0·4678	1	4·1921	4·1921	8·9613	3·91
(iv) Pudumadam										
Dorsal fin rays	190	120·4555	188	120·0489	0·6385	2	0·4066	0·2033	3·1406	19·49
Anal fin rays	190	111·2147	188	108·2474	0·5757	2	2·9673	1·4836	2·5770	3·04

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE XV

Analysis of variance for dorsal and anal fin rays of Selaroides leptolepis *from (i) Rameswaram, Thangachimadam and Pudumadam during* 1957; *(ii) Rameswaram, Thangachimadam, Rameswaram Road, Pudumadam, Madras and Vizhingam during* 1958 *and (iii) Rameswaram, Thangachimadam, Rameswaram Road and Pudumadam during* 1959

	Total		Within places			Between places			Observed F.	5% F.
	D.F.	S.S.	D.F.	S.S.	Mean square	D.F.	S.S.	Mean square		
(i) For 1957										
Dorsal fin rays ..	117	66·2034	115	65·0422	0·5655	2	1·1612	0·5806	1·0267	3·07
Anal fin rays ..	317	56·6526	115	55·3790	0·4815	2	1·2736	0·6368	1·3225	3·07
(ii) For 1958										
Dorsal fin rays ..	280	124·2278	275	119·5928	0·4349	5	4·6350	0·9270	2·1315	2·23
Anal fin rays ..	280	143·8862	275	135·2994	0·4919	5	8·5868	1·7173	3·4911	2·23
Rameswaram and Thangachimadam	83	37·7500	82	36·0319	0·4394	1	1·7181	1·7181	3·9101	3·94
Rameswaram and Rameswaram Road	93	45·3192	92	37·8119	0·4109	1	7·5073	7·5073	8·2703	3·94
Rameswaram and Pudumadam	123	54·6775	122	53·8194	0·4411	1	0·8581	0·8581	11·9453	3·92
Rameswaram and Madras	93	44·8511	92	42·9319	0·4666	1	1·9192	1·9192	4·1131	3·94
Rameswaram and Vizhingam	60	32·2623	59	30·4319	0·5157	1	1·8304	1·8304	3·5493	4·00
Thangachimadam and Rameswaram Road	89	42·7223	88	40·9800	0·4656	1	1·7423	1·7423	3·7420	3·94
Thangachimadam and Pudumadam	119	57·3250	118	56·9875	0·4829	1	0·3375	0·3375	1·4808	254
Thangachimadam and Vizhingam	56	33·7193	55	33·6000	0·6109	1	0·1193	0·1193	5·1207	253
Rameswaram Road and Pudumadam	129	63·5077	128	58·7675	0·4591	1	4·7402	4·7402	0·3249	3·91
Rameswaram Road and Madras	99	49·8400	98	47·8800	0·4885	1	1·9600	1·9600	14·0122	3·94
Rameswaram Road and Vizhingam	66	45·7911	65	45·3800	0·6981	1	0·4111	0·4111	1·6981	253
Pudumadam and Madras	129	64·2770	128	63·8875	0·4991	1	0·3895	0·3895	1·2813	254
Pudumadam and Vizhingam	96	52·0207	95	51·3875	0·5409	1	0·6332	0·6332	1·1706	3·94
Madras and Vizhingam	66	40·6269	65	40·5000	0·6230	1	0·1269	0·1269	4·9093	253
(iii) For 1959										
Dorsal fin rays ..	298	150·7425	295	147·3894	0·4996	3	3·3531	1·1177	2·2371	2·62
Anal fin rays ..	298	152·2944	295	150·9011	0·5115	3	1·3933	0·4644	1·1014	8·54

D.F. = Degrees of Freedom. S.S. = Sum of Squares.

TABLE XVI

Significance and non-significance of meristic characters of Selaroides leptolepis *between years from Rameswaram, Thangachimadam, Rameswaram Road and Pudumadam*

Locality		Dorsal fin rays	Anal fin rays
Rameswaram			
1957 v. 1958	..	NS	NS
1957 *v.* 1959	..	NS	NS
1958 *v.* 1959	..	NS	NS
Thangachimadam			
1957 *v.* 1958	..	NS	NS
1957 *v.* 1959	..	NS	NS
1958 *v.* 1959	..	NS	NS
Rameswaram Road			
1958 *v.* 1959	..	NS	S
Pudumadam			
1957 *v.* 1958	..	NS	NS
1957 *v.* 1959	..	NS	NS
1958 *v.* 1959	..	NS	NS

NS = Non-significant. S = Significant.

From the analyses of the regressions between places within a year and between years within a place, it is seen that the regressions of snout to second dorsal and that of snout to ventral do not differ significantly from sample to sample. Hence, it appears that the utility of these two characters in raciation is of little value. Similarly the Analysis of Variance shows no significant difference between samples with regard to the meristic character 'dorsal fin rays', indicating that this character is also not of much value in racial studies of *Selaroides leptolepis.*

DISCUSSION

That populations resemble each other more if the distribution is closer to one another and as we go farther apart the differences become greater have been obsernd by De Sylva *et al.* (1956), Berdegue (1958), Prasad

TABLE XVII

Significance and non-significance of meristic characters of Selaroides leptolepis *between places during* 1957, 1958 *and* 1959

Locality	Dorsal fin rays			Anal fin rays		
	1957	1958	1959	1957	1958	1959
Rameswaram v. Thangachimadam	NS	NS	NS	NS	NS	NS
Rameswaram *v.* Rameswaram Road	..	NS	NS	..	S	NS
Rameswaram *v.* Pudumadam	NS	NS	NS	NS	NS	NS
Rameswaram *v.* Madras	..	NS	..	..	S	..
Rameswaram *v.* Vizhingam	..	NS	..	..	NS	..
Thangachimadam *v.* Rameswaram Road	..	NS	NS	..	NS	NS
Thangachimadam *v.* Pudumadam	NS	NS	NS	NS	NS	NS
Thangachimadam *v.* Madras	..	NS	..	..	NS	..
Thangachimadam *v.* Vizhingam	..	NS	..	..	NS	..
Rameswaram Road *v.* Pudumadam	..	NS	NS	..	S	NS
Rameswaram Road *v.* Madras	..	NS	..	..	S	..
Rameswaram Road *v.* Vizhingam	..	NS	..	..	NS	..
Pudumadam *v.* Madras	..	NS	..	..	NS	..
Pudumadam *v.* Vizhingam	..	NS	..	..	NS	..
Madras *v.* Vizhingam	..	NS	..	..	NS	..

NS = Non-significant. S = Significant.

(1958 *b*) and may other workers. In the present study it was noticed that some of the characters were non-significant among the samples obtained from places situated far apart while others were significant. The converse, *i.e.*, populations from closely situated places exhibited characters which were at times significantly different and at other times not, was also true.

The regression analyses of various morphometric characters and the Analyses of Variance of meristic characters showed (i) that the samples

collected during different years at the same place show significant difference and (ii) samples obtained from different centres within the same year also differ significantly. Paired comparisons of samples did not lead to any meaningful grouping of samples, indicating consistent and independent spatial or temporal groups. The only conclusions that can be drawn from the above analyses are that there exist significant statistical differences among morphometric and meristic characters of the samples drawn from different centres within the same year and among samples drawn from different years at the same place. The rather anomalous situation arising from the analyses, *viz.*, that the regressions of some characters being significantly different between two years and not being so for another two years and similarly the regressions of some characters being significantly different between two neighbouring places but not being so between distant places, make it rather difficult to interpret these statistical differences as racial differences. Statistical differences may be due to varying ecological or other factors at different places and time that affect differently the various characters studied.

The spawning period of the fish is protracted and ecological conditions undergo considerable change during this period, and we may expect varying influence of these on some of the characters (at the time of first spawning, January–March, the temperature and salinity in the neighbourhood of Mandapam vary from 23·5–30° C. and 24·76–33·08‰ respectively, and at the time of second spawning, July/August to October, they range from 25·5–30·5° C. and 33·04–37·45‰ respectively, Prasad, 1958 *a*).

Summary

The relationship between fork length and total length was found to be $Y = 0{\cdot}0349 + 0{\cdot}8677\,X$, and correlation coefficient '*r*' to be 0·9993.

The test of linearity of the regression of fork length on total length showed that the hypothesis of linear relation was very good.

The statistical analyses of the morphometric and meristic characters on data collected during 1957–59 from different centres probably do not indicate the existence of distinct populations. The biological significance of these differences has been discussed.

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REFERENCES

Berdegue, J. A. 1958 .. Biometric comparison of the anchoveta, *Cetengraulis mysticetus* (Günther), from ten localities of the Eastern Tropical Pacific Ocean. *Inter-Amer. Trop. Tuna Comm. Bull.*, **3**, 1–53.

De Sylva, D. P., Stearns, H. B. and Tabb, D. C. 1956 Populations of the black mullet (*Mugil cephalus* L.) in Florida. *Florida State Bd. Cons. Tech. Ser.* (19), 1–45.

Godsil, H. C. 1948 .. A preliminary population study of the yellowfin tuna and the albacore. *Calif. Fish Game Fish. Bull.* (70), 1–90.

Marr, J. C. 1955 .. The use of morphometric data in systematic racial and relative growth studies in fishes. *Copeia* (1), 23–31.

Pillay, T. V. R. 1957 .. A morphometric study of the populations of Hilsa, *Hilsa ilisha* (Ham.) of the river Hooghly and of the Chilka Lake. *Indian J. Fish.*, **4**, 344–86.

Prasad, R. R. 1958 *a* .. Plankton calendars of the inshore waters at Mandapam, with a note on the productivity of the area. *Ibid.*, **5**, 170–88.

———. 1958 *b* .. Racial analysis of *Clavelandia ios* (Jordan and Gilbert) in California waters. *Amer. Midl. Nat.*, **59**, 465–76.

Sarojini, K. K. 1957 .. Biology and fishery of the grey mullets of Bengal. I. Biology of *Mugil parsia* Hamilton with notes on its fishery in Bengal. *Indian J. Fish.*, **4**, 160–207.

* Schaefer, M. B. 1948 .. Morphometric characteristics and relative growth of yellowfin tuna (*Neothunnus macropterus*) from Central America. *Pacific Science*, **2**, 114–20.

——— and Walford, L. A. 1950 Biometric comparison between yellowfin tunas (*Neothunnus*) of Angola and of the Pacific Coast of Central America. *Fish. Bull., U.S.*, **51**, 425–43.

Tandon, K. K. 1960 .. Biology and fishery of 'Choo parai' *Selaroides leptolepis* (Cuvier and Valenciennes). Part I. Food and feeding habits. *Indian J. Fish.*, **7**, 82–100.

* Not consulted in original.