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دراسات مورفومتريه ومرستيكيه على سمكتي لابيو هورى ولا بيو فورسكلياى في منطقة أسيوط

عبد الحميد خليل ، عزت يواقيم ، أسامه محمود

يتضمن هذا البحث دراسات على بعض النسب المورفومتريه والصفات المرستيكيه لسمكتي لابيو هورى ولابيو فورسكلياى وهما سمكتان شائعتان في منطقة أسيوط ، ويمكن تلخيص أهم نتائج هذا البحث على النحو التالي :

١ ـ حسبت بعض النسب المورفومتريه للسمكتين موضع البحث ومدى تغير هذه النسب بتغير الطول الكلي لكل سمكة .

٢ ـ بدراسة معنويه الفروق بين معاملات الانحدار وكذلك معنوية الاجزاء المقطوعة من محور الصادات بواسطة خط الانحدار لبعض القياسات المورفومترية أمكن تحديد الصفات الموفومترية التي يمكن الاعتماد عليها في الأغراض التقسيمية ، وكذلك في التفريق بين السمكتين موضع البحث .

٣ ـ وجد أن جميع الصفات المرستيكيه التي درست باستثناء عدد الاشعة الزعنفية في الزعنفه الحوضيه ذات قيمه تصنيفيه عاليه ويمكن الاعتماد عليها في التفريق بين السمكتين موضع البحث .

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BIOMETRIC AND MERISTIC STUDIES ON TWO NILE CYPRINOID FISHES LABEO HORIE AND LABEO FORSKALII FROM ASSIUT

(With 26 Tables and 22 Figures)

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SUMMARY

The ranges and means of certain morphometric indices of L. horie and L. forskalii and the significance of variation of such indices according to the total length were studied. Discrimination between the two species was possible by making use of the significance of differences between the regression coefficients of some of their morphometric characters and the significance of Y-intercepts of such characters. But for the pelvic fin ray count, all meristic counts considered for L. horie were highly significantly different from those of L. forskalii. In both species examined, a straight line relationship was found between the number of gill rakers on the first right gill arch and total length of the fish.

INTRODUCTION

Labeo species were reported by NAWAR and YOAKIM (1965) to be very common in Assiut area. They belong to family Cyprinidae which was considered by NELSON (1976) to be the most abundant family in most areas within its distribution. According to him, such family contains more species than any other family of fishes. Taxonomic studies on cyprinoid fishes, other than Labeo species, were the focus of research of many ichthyologists. To mention a few, the following authors could be referred to: LACHNER and JENKINS (1971), BANISTER (1973), BALESTRA and MURATORI (1974), TILAK and SINHA (1975), CASTELL (1976) and TOKI and URUSHIDO (1978). However, few studies were carried out on the taxonomy of the genus Labeo (BOULENGER, 1907; DU PLESSIS, 1963 and RAHMAN, 1974).

The objective of this paper is to study some of the morphometrics and meristics of Labeo horie and Labeo forskalii from Assiut. It is hoped that the results of the present investigation may give a contribution to a better view of the taxonomic status of Labeo species of the Nile.

MATERIALS and METHODS

The present investigation is based on the examination of random samples of L. horie and L. forskalii which were collected from the commercial catch from Assiut fish markets during the period October 1977 - June 1979. Table 1 shows the number and total length range of the fishes examined for each of the morphometric and meristic characters considered in the present investigation.

For each fish, 19 morphometric measurements were made on the left side up to the nearest millimeter. Those morphometric measurements included the total length (T.L), fork length (F.L),

standard length (S.L), pre-dorsal length (Pr. D), post-dorsal length (Pt.D), pre-ventral length (Pr.V), pre-anal length (Pr.A), post-anal length (Pt.A), head length (H.L), snout length (Sn.L), eye diameter (E.D), post-orbital length (Pt.O), caudal peduncle length (C.P.L), inter-nasal width (In.W), inter-orbital width (Io.W), mouth width (M.W), head depth (H.D), body depth (B.D) and caudal peduncle depth (C.P.D). Except for M.W, the definition of those morphometric measurements and the calculation of the corresponding morphometric indices were carried out according to KHALIL et al. (in press). The mouth width was considered as the distance between the angles of the closed mouth. The M.W index was calculated by relating the mouth width to the head length. The regression equations of S.L, Pr.D, Pr V, Pr.A, H.L, E.D, B.D, C.P.L and C.P.D versus T.L; also those of Sn.L, In.W, Io.W and H.D versus H.L were calculated.

The meristic studies included counts of vertebrae, gill rakers on the first right gill arch, fin rays and scales. Fin ray counts included the number of branched and unbranched soft rays in each of the dorsal, anal, pectoral and plivic fins. Scale counts comprised the number of scales along, above and below the lateral line and those around the caudal peduncle. All meristic counts were carried out according to DU PLESSIS (1963).

The data of the morphometrics and meristics were subjected to the Student's T-test and analyses of variance and covariance according to SIMPSON et al. (1960).

RESULTS

Morphometric Studies:

The ranges and means of certain morphometric indices of the fishes under investigation and the significance of variation of such indices according to the total length are presented in Table 2. This table indicates that all the morphometric indices considered for L. horie, except those of the F.L and H.D, varied significantly according to the total length. In case of L. forskalii, only the Pr.D, B.D, Sn.L and M.W indcices revealed significant variation according to the total length; the remainder of the morphometric indices considered varied insignificantly in that connection. The mode of variation of the morphometric indices of the fishes under investigation according to the total length is represented graphically in Figs. 1 - 18.

Analyses of variance and covariance revealed that the Pr.A and Pt.A indices of L. horie were insignificantly different from those of L. forskalii ($P > 0.05$). The C.P.L index of L. horie differed significantly from that of L. forskalii ($0.05 > P > 0.01$). The remainder indices considered for L. horie were highly significantly different from those of L. forskalii ($P < 0.01$).

In both fishes of the present investigation, the regressions of S.L., Pr.D, Pr.V, Pr.A, H.L, E.D, B.D, C.P.L and C.P.D versus T.L; also those of Sn.L, In.W, Io.W, and H.D versus H.L were found to be linear. The respective regression equations were calculated and presented in Tables 3 & 4. Figures 19 - 22 show the close fitness of the mean observed values on the straight lines, indicating that the regression equations expressing straight lines are correct and they best fit the morphometric characters in question. In both fishes under investigation, the regression coefficients of all the aforementioned morphometric characters were significantly different from zero value (Tables 3 & 4).

Application of Student's T-test showed that the regression coefficients of the Pr.V, Pr.A, H.L, E.D, B.D, C.P.L, C.P.D and Sn.L of L. horie were highly significantly different from those of L. forskalii ($P < 0.01$). The regression coefficients of the remainder morphometric characters considered for L. horie were insignificantly different from those of L. forskalii.

Tables 3 & 4 show the significance of the Y-intercepts of regression lines of the morphometric measurements considered for the fishes under investigation. In L. horie, the Y-intercepts of regression lines of S.L, Pr.D, Pr.V, Pr.A, H.L, E.D, C.P.L and C.P.D versus T.L and those of Io.W and H.D versus H.L were significantly different from zero; those of B.D versus T.L and Sn.L and In.W versus H.L were insignificantly so.In case of L. forskalii, the Y-intercepts of regression lines of Pr.D, Pr.A, E.D, B.D, C.P.L and C.P.D against T.L and of In.W against H.L were significantly different from zero; those of S.L, Pr.V and H.L against T.L and Sn.L, Io.W and H.D against H.L were insignificantly so. It is to be noticed that morphometric characters having significant Y-intercepts would change according to the total length of the fish and hence they are not reliable for taxonomic purposes. Morphometric characters having insignificant Y-intercepts would not change according to the total length of the fish and consequently they are reliable for taxonomic purposes.

Meristic Studies:

The distribution of counts of the total vertebrae, abdominal and caudal vertebrae, gill rakers on the first right gill arch, lateral line scales, scales above and below the lateral line, scales around the caudal peduncle and soft rays of the dorsal, anal, pectoral and pelvic fins of L. horie and L. forskalii are summarized in Tables 5 - 26.

Application of the analyses of variance and covariance revealed that but for the pelvic fin ray count, all the meristics considered in the present investigation for L. horie were highly significantly different ($P < 0.01$) from those of L. forskalii. In both species under investigation, there was an insignificant relationship between the number of gill rakers on the first right gill arch and the total length of the fish (for L. horie D.F = 103, F = 0.753, $P > 0.05$; for L. forskalii D.F = 48, F = 0.340, $P > 0.05$). This result denoted the presence of a straight line relationship between the number of gill rakers and total length of the fish i.e. the number of gill rakers increased steadily with increase of the fish length.

DISCUSSION

In the present investigation, it was possible to discriminate between L. horie and L. forskalii in terms of the Pt.D, E.D, Sn.L, Pt.O, M.W, In.W and Io.w index ranges and all the morphometric index means except those of the Pr.A. and Pt.A Using the ranges and means of some morphometric indices, BERRA and WEATHERLEY (1972) differentiated between Maccullochella macquariensis and Maccullochella peeli. Also PAGE and BRAASCH (1976) were able to differentiate between Etheostoma obeyense and Etheostoma simithi on the same basis.

Discrimination between L. horie and L. forskalii was possible by making use of the significance of differences between the regression coefficients of some of their morphometerics. Also, the significnace of Y-intercepts of some morphometric characters was helpful in this conncention. LACHNER and JENKINS (1971), on the basis of regression coefficients and Y-intercepts of some morphometric measurements, were able to differentiate between certain species of Necomis biguttatus group. WASSEF (1973) calculated the regression coefficients of some morphometric measurements of Diplodus sargus, Diplodus vulgaris and Oblada melanura in Alexandria without making comparisons between such coefficients. EZZAT et al. (1979) employedof regression coefficients for the biometric comparison between Solea vulgaris of Alexandria and that of Lake Quarun.

In the present investigation, but for the pelvic fin ray count, all meristic counts considered for L. horie were highly significantly different from those of L. forskalii. GODSIL and RYERS

(1944) employed gill raker counts for the spicific identification of the Pacific tunas. Making use of scale counts, DU PLESSIS (1963) differentiated between Labeo rosae and L. ruddi. AKIHITO and MEGURO (1977) used the mean values of the total, abdominal and caudal vertebral counts for the discrimination between five species of the genus Callogobius. MARKLE (1977) employed the mean values of the dorsal and anal fin ray counts for the differentiation between Rouleina attrita and Rouleina maderensis.

REFERENCES

Akihito, P. and Meguro, K. (1977): Jpn. J. Ichthyol., 24 (2): 113 - 127.
Balestra, V. and Muratori, R.A. (1974): Boll. Mus. Ist. Biol. Univ. Genova, 42: 33 - 50.
Banister, K.E. (1973): Bull. Br. Mus. nat. Hist. (Zool.) 26 (1): 1 - 148.
Berra, T.M. and Weatherley, A.H. (1972): Copeia, 1: 53 - 64.
Boulenger, G.A. (1907): The Fishes of the Nile. London, Hugh Rees Ltd.
Castell, R.W. (1976): Paleobiols., 22: 1 - 12.
Du Plessis, S.S. (1963): Ann. Transvaal Mus., 24 (4): 327 - 337.
Ezzat, A.A.; Hashem, M.T. and El-Gharabawey, M.M. (1979): J. Fish. Biol., 14 (1): 39 - 46.
Godsil, H.C. and Byers, R.D. (1944): California Div. Fish and Game, Fish Bull, 60: 1 - 131.
Khalil, A.; Yoakim, E.G. and Mekkawy, I.A. (in press).
Lachner, E.A. and Jenkins, R.E. (1971): Smithsonian Contributions to Zoology, 91: 1 - 28.
Markle, D.F. (1977): Fishery Bulletin, 76 (1): 79 - 87.
Nawar, G. and Yoakim, E.G. (1965): Bulletin of Science and Technology, Assiut, 8: 169 - 178.
Nelson, J.S. (1976): Fishes of the World. New York, Wiley.
Page, M.L. and Braasch, M.E. (1976): Occasional papers of the Museum of Natural History. the University of Kansas Lawrence, Kansas, 60: 1 - 18.
Rahman, A.K.A. (1974): Bangaladesh J. Sci. Ind Res., 9: 198 - 206.
Simpson, G.G.; Roe, A. and Lewontin, R.C. (1960): Quantitative Zoology. New York, Harcourt. Brance and World Inc.
Tilak, R. and Sinha, N.K. (1975): Ann. Zool. (Warszawa), 32: 289 - 297.
Toki, Y.A.K. and Urushido, T. (1978): Jpn. J. Ichthyol., 25 (1): 1 - 8.
Wassef, E.A.A. (1973): M. Sc. Thesis, Alexandria University.

EXPLANATION OF FIGURES

Figs. 1 - 18. Variation of morphometric indices of L. horie and L. forskalii according to the total length.

Fig. 19: Regressions of some morphometric measurements versus total length of L. forskalii.

Fig. 20: Regressions of some morphometric measurements versus total length of L. horie.

Fig. 21: Regressions of some morphometric measurements versus head length of L. horie.

Fig. 22: Regressions of some morphometric measurements versus head length of L. forskalii.

Table 1 Number and size of fishes examined for morphometric measurements and meristic characters of *L. horie* *L. forskalii*

Items of study	*L. horie*			*L. forskalii*		
	No. of fishes	T.L. range in mm		No. of fishes	T.L. range in mm	
Morphometrics	421	180	440	90	260	540
Vertebrae	340	185	405	71	260	530
Gill rakers	104	240	370	49	265	395
Lateral line scales	442	180	440	92	260	540
Scales above lateral line	423			91		
Scales below lateral line	432			91		
Scales around caudal peduncle	368			91		
Dorsal fin rays	455			92		
Anal fin rays	457			92		
Pectoral fin rays	442			92		
Pelvic fin rays	448			92		

Table 2 The ranges and means of different morphometric indices of *L. horie* and *L. forskalii* and the significance of variation of such indices according to the total length.

Species	*L. horie*				*L. forskalii*			
Morphometric index	Index range		Index mean	P	Index range		Inex mean	P
T.L/F.L	1.11	1.14	1.13 ± 0.044		1.10	1.14	1.11 ± 0.014	
T.L/S.L	1.20	1.24	1.22 ± 0.024	++	1.15	1.22	1.17 ± 0.026	
S.L/Pr.D	2.34	2.71	2.55 ± 0.093	++	2.54	2.67	2.63 ± 0.066	++
S.L/Pt.D	1.54	1.73	1.66 ± 0.068	++	1.74	1.84	1.81 ± 0.062	
S.L/Pr.V	2.00	2.36	2.20 ± 0.115	++	2.08	2.15	2.13 ± 0.043	
S.L/Pr.A	1.29	1.44	1.38 ± 0.066	++	1.36	1.42	1.40 ± 0.032	
S.L/Pt.A	1.20	1.31	1.26 ± 0.040	++	1.25	1.28	1.27 ± 0.037	
S.L/C.P.L.	5.04	6.28	5.40 ± 0.345	++	5.45	5.96	5.74 ± 0.292	
S.L/H.L.	5.07	5.73	5.44 ± 0.233	++	4.89	5.45	5.22 ± 0.200	
S.L/B.D.	4.10	4.55	4.32 ± 0.235	++	3.69	4.30	3.99 ± 0.299	+
H.L/E.D.	3.82	4.77	4.14 ± 0.341	++	5.69	6.85	6.12 ± 0.565	
H.L/Sn.L.	2.45	2.64	2.52 ± 0.164	+	1.87	1.93	1.90 ± 0.073	++
H.L/Pt.O.	2.59	2.87	2.69 ± 0.163	++	3.24	3.56	3.38 ± 0.206	
H.L/M.W.	3.25	3.57	3.39 ± 0.240	++	2.51	2.76	2.66 ± 0.219	+
H.L/In.W.	3.06	3.41	2.23 ± 0.193	++	3.76	4.26	4.02 ± 0.320	
H.L/Io.W.	1.75	1.89	1.84 ± 0.107	+	2.06	2.28	2.13 ± 0.113	
H.L/H.D.	1.44	1.59	1.52 ± 0.108	.	1.46	1.71	1.56 ± 0.107	
C.P.L/C.P.D.	1.26	1.58	1.50 ± 0.129	++	1.57	1.66	1.61 ± 0.122	

(P > 0.05) insignificantly different from zero.

+ (0.05 > P > 0.01) significantly different from zero.

++(P < 0.01) significantly different from zero.

Table 3: Regression equations of the morphometric characters of L. horie and the significance of their regression coefficients and Y-intercepts.

Morphometric characters	Regression equation			Significance of regression coefficient	Significance of Y-intercept
S.L	S.L = -11.1213 + 0.8583	T.L		++	++
Pr.D	Pr.D = 9.9687 + 0.2886	T.L		++	++
Pr V	Pr.V = 9.4798 + 0.3429	T.L		++	++
Pr.A	Pr.A = 9.0216 + 0.5642	T.L		++	++
H.L	H.L = 3.9179 + 0.1376	T.L		++	++
E.D	E.D = 2.4554 + 0.0283	T.L		++	++
B.D	B.D = -1.6623 + 0.1965	T.L		++	.
C.P.L	C.P.L = -10.8297 + 0.1913	T.L		++	++
C.P.D	C.P.D = -3.8015 + 0.1165	T.L		++	++
Sn.L	Sn.L = -0.3485 + 0.4091	H.L		++	.
In.W	In.W = 0.4020 + 0.3010	H.L		++	.
Io.W	Io.W = 2.1375 + 0.4918	H.L		++	++
H.D	H.D = 4 1182 + 0.5727	H.L		++	++

Table 4: Regression equations of the morphometric characters of L. forskalii and the significance of their regression coefficients and Y-intercepts.

Morphometric characters	Regression equation			Significance of regression coefficient	Significance of Y-intercept
S.L	S.L = -1.5561 + 0.8562	T.L		++	.
Pr.D	Pr.D = 8.0078 + 0.2973	T.L		++	++
Pr.V	Pr.V = 3.7122 + 0.4119	T.L		++	-
Pr.A	Pr.A = -11.0999 + 0.6384	T.L		++	+
H.L	H.L = 2.4736 + 0.1554	T.L		++	-
E.D	E.D = 3.2397 + 0.0173	T.L		++	++
B.D	B.D = -31.6425 + 0.3065	T.L		++	++
C.P.L	C.P.L = 6.4546 + 0.1302	T.L		++	++
C.P.D	C.P.D = -2.5419 + 0.1001	T.L		++	+
Sn.L	Sn.L = -0.5833 + 0.5278	H.L		++	-
In.W	In.W = -4.3611 + 0.3278	H.L		++	+
Io.W	In.W = -0.5833 + 0.4833	H.L		++	.
H.D	H.D = 0.6389 + 0.6389	H.L		++	.

. (P > 0.05) insignificantly different from zero.
+ (0.05 > P > 0.01) significantly different from zero.
++ (P < 0.01) significantly different from zero.

Table 5: Percentage distribution of the total vertebral counts of L. horie.

No. of vertebrae	39	40	41	Total
No. of fish	38	280	22	340
%	11.18	82.35	6.47	
$\bar{X} \pm$ S.D.	39.95 ± 0.418			

Table 6: Percentage distribution of the abdominal and caudal vertebral counts of L. horie.

	Abdominal				Caudal			
No. of vertebrae	18	19	20	21	15	16	17	18
No. of fish	4	220	114	2	6	120	213	1
%	1.18	65.29	33.53	0.59	1.76	35.29	62.65	0.29
$\bar{X} \pm$ S.D.	19.34 ± 0.509				16.61±0.528			

Table 7: Percentage distribution of the total vertebral counts of L. forskalii.

No. of vertebrae	38	39	40	Total
No. of fish	12	58	1	71
%	16.90	81.69	1.41	
$\bar{X} \pm$ S.D.	38.85 ± 0.402			

Table 8: Percentage distribution of the abdominal and caudal vertebral counts of L. forskalii.

	Abdominal			Caudal		
No. of vertebrae	17	18	19	16	17	18
No. of fish	16	53	2	8	50	13
%	22.54	74.65	2.82	11.27	70.42	18.31
$\bar{X} \pm$ S.D.	17.80 ± 0.467			17.07±0.543		

Table 9: Percentage distribution of gill raker counts on the first right gill arch of L. horie.

No.of gill rakers	No.of fish	%
59	1	0.96
60	2	1.92
61	5	4.81
62	4	3.85
63	9	8.65
64	5	4.81
65	7	6.73
66	9	8.65
67	6	5.77
68	20	19.23
69	11	10.58
70	4	3.85
71	3	2.88
72	4	3.85
73	1	0.96
74	2	1.92
75	1	0.96
76	5	4.81
77	2	1.92
78	2	1.92
79	1	0.96
Total	104	
$\bar{X} \pm$ S.D.	67.64 ± 4.474	

Table 10: Percentage distribution of gill raker counts on the first right gill reach of L. forskalii.

No.of gill rakers	No.of fish	%
45	3	6.12
46	3	6.12
47	4	8.16
48	3	6.12
49	5	10.20
50	2	4.08
51	3	6.12
52	3	6.12
53	1	2.04
54	5	10.20
55	3	6.12
56	5	10.20
57	6	12.24
58	1	2.04
59	2	4.08
Total	49	
$\bar{X}$ + S.D.	51.94±4.260	

Table 11: Percentage distribution of scale counts along the lateral line of L. horie.

No. of lateral line scales	40	41	42	43	44	Total
No. of fish	14	104	212	103	9	442
%	3.17	23.53	47.96	23.30	2.04	
$\bar{X} \pm$ S.D.	41.98±0.823					

Table 12: Percentage distribution of scale counts along the lateral line of L. forskalii.

No. of lateral line scales	39	40	41	42	43	Total
No. of fish	2	30	58	1	1	92
%	2.17	32.61	44.57	1.09	1.09	
$\bar{X} \pm$ S.D.	41.98±0.823					

Table 13: Percentage distribution of scale counts above the lateral line of L. horie.

No. of scales above lateral line	6.5	7.5	Total
No. of fish	7	416	423
%	1.65	98.35	
$\bar{X} \pm$ S.D.	7.48 ± 0.128		

Table 14: Percentage distribution of scale counts above the lateral line of L. forskalii.

No. of scales above lateral line	5.5	6.5	7.5	Total
No. of fish	2	88	1	91
%	2.20	96.70	1.10	
$\bar{X} \pm$ S.D.	6.49 ± 0.182			

Table 15: Percentage distribution of scale counts below the lateral line of L. horie.

No. of scales below lateral line	5.5	6.5	Total
No. of fish	346	86	432
%	80.09	19.91	
$\bar{X} \pm$ S.D.	5.70 ± 0.400		

Table 16: Percentage distribution of scale counts below the lateral line of L. forskalii.

No. of scales below lateral line	4.5	5.5	Total
No. of fish	11	80	91
%	12.09	87.91	
$\bar{X} \pm$ S.D.	5.38 ± 0.328		

Table 17: Percentage distribution of scale counts around the caudal peduncle of L. horie.

No. of caudal peduncle scales	16	17	18	19	20	Total
No. of fish	118	49	198	2	1	368
%	32.07	13.32	53.80	0.54	0.27	
$\bar{X} \pm$ S.D.	17.24±0.923					

Table 18: Percentage distribution of sclae counts around the caudal peduncle of L. forskalii.

No. of caudal peduncle scales	16	17	18	Total
No. of fish	85	4	2	91
%	93.41	4.40	2.20	
$\bar{X} \pm$ S.D.	16.09 ± 0.354			

Table 19: Percentage distribution of dorsal fin ray counts of *L. horie*.

No. of unbranched and branched rays	III+12	III+13	III+14	Total
No. of fish	58	329	68	455
%	12.75	72.31	14.95	
$\bar{X} \pm$ S.D.	16.02 $\pm$ 0.527			

Table 20: Percentage distribution of dorsal fin ray counts of *L. forskalii*.

No. of unbranched and branched rays	III+9	III+10	III+11	Total
No. of fish	5	83	4	92
%	5.43	90.22	4.35	
$\bar{X} \pm$ S.D.	12.99 $\pm$ 0.314			

Table 21: Percentage distribution of anal fin ray counts of *L. horie*.

No. of unbranched and branched rays	III+5	III+6	Total
No. of fish	380	77	457
%	83.15	16.85	
$\bar{X} \pm$ S.D.	8.17$\pm$0.375		

Table 22: Percentage distribution of anal fin ray counts of *L. forskalii*.

No. of unbranched and branched rays	III+5	Total
No. of fish	92	92
%	100	
$\bar{X}$	8	

Table 23: Percentage distribution of pectoral fin ray counts of L. horie.

No. of unbranched and branched rays	I+12	I+13	I+14	I+15	I+16	Total
No. of fish	10	37	126	196	73	442
%	2.26	8.37	28.51	44.34	16.52	
$\bar{X} \pm$ S.D.	15.64 ± 0.930					

Table 24: Percentage distribution of pectoral fin ray counts of L. forskalii.

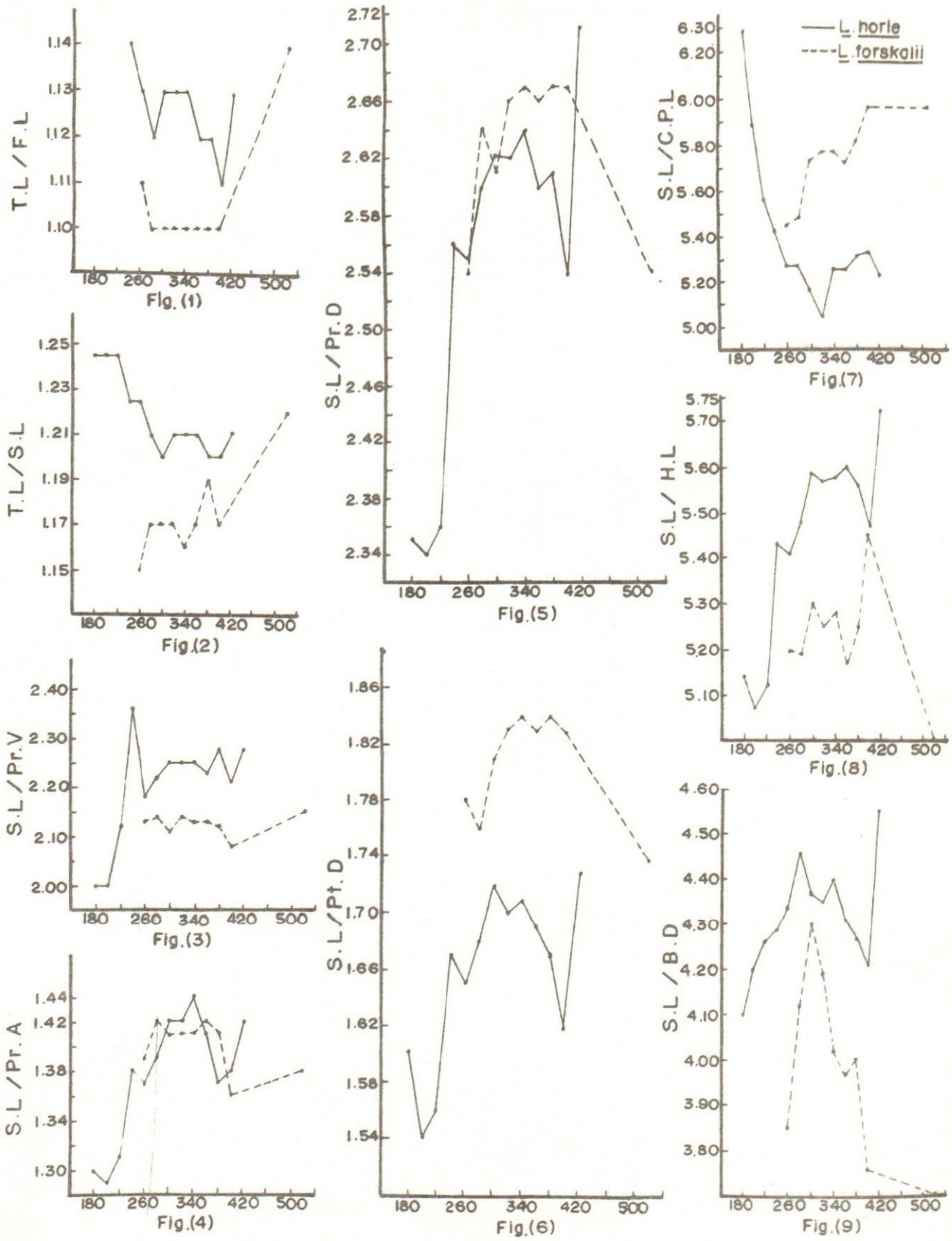
No. of unbranched and branched rays	I+14	I+15	I+16	I+17	Total
No. of fish	8	23	47	14	92
%	8.70	25	51.09	15.22	
$\bar{X} \pm$ S.D.	16.73 ± 0.827				

Table 25: Percentage distribution of pelvic fin ray counts of L. horie.

No. of unbranched and branched rays	I+7	I+8	I+9	Total
No. of fish	9	429	10	448
%	2.01	95.76	2.23	
$\bar{X} \pm$ S.D.	9 ± 0.206			

Table 26: Percentage distribution of pelvic fin ray counts of L. forskalii.

No. of unbranched and branched rays	I+8	Total
No. of fish	92	92
%	100	
$\bar{X}$	9	


T.L / F.L
1.14
1.13
1.12
1.11
1.10
180 260 340 420 500
Fig. (1)
T.L / S.L
1.25
1.23
1.21
1.19
1.17
1.15
180 260 340 420 500
Fig.(2)
S.L / Pr.V
2.40
2.30
2.20
2.10
2.00
180 260 340 420 500
Fig.(3)
S.L / Pr.A
1.44
1.42
1.38
1.34
1.30
180 260 340 420 500
Fig.(4)
S.L / Pr.D
2.72
2.70
2.66
2.62
2.58
2.54
2.50
2.46
2.42
2.38
2.34
180 260 340 420 500
Fig.(5)
S.L / Pt.D
1.86
1.82
1.78
1.74
1.70
1.66
1.62
1.58
1.54
180 260 340 420 500
Fig.(6)
L. horie
L. forskalii
S.L / C.P.L
6.30
6.20
6.00
5.80
5.60
5.40
5.20
5.00
180 260 340 420 500
Fig.(7)
S.L / H.L
5.75
5.70
5.60
5.50
5.40
5.30
5.20
5.10
180 260 340 420 500
Fig.(8)
S.L / B.D
4.60
4.50
4.40
4.30
4.20
4.10
4.00
3.90
3.80
180 260 340 420 500
Fig.(9)
Total length in mm

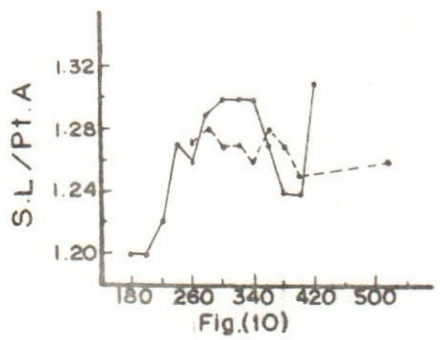


Fig.(10)

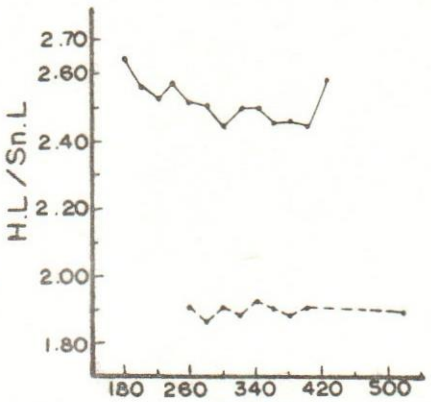


Fig.(13)

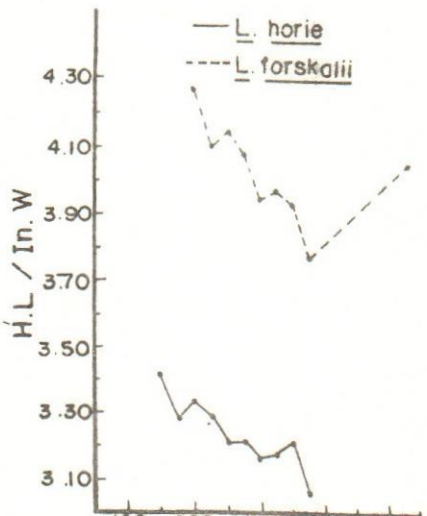


Fig.(16)

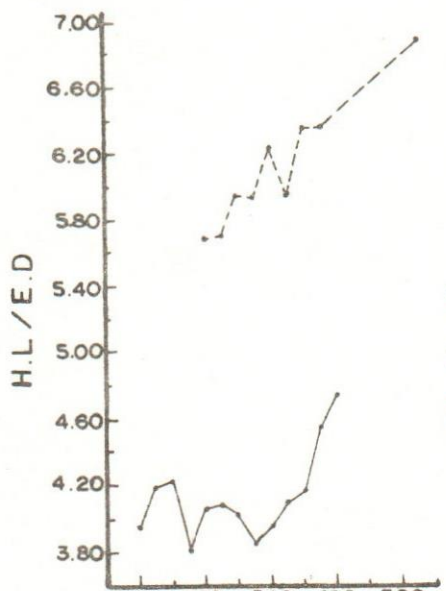


Fig.(11)

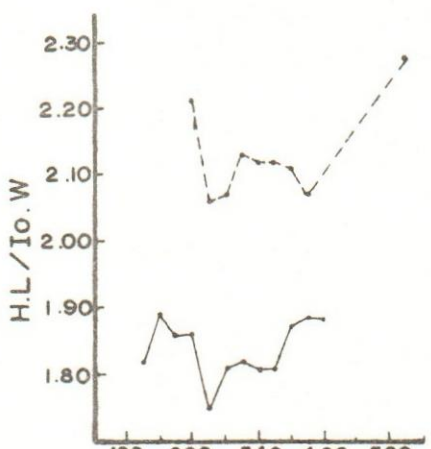


Fig.(14)

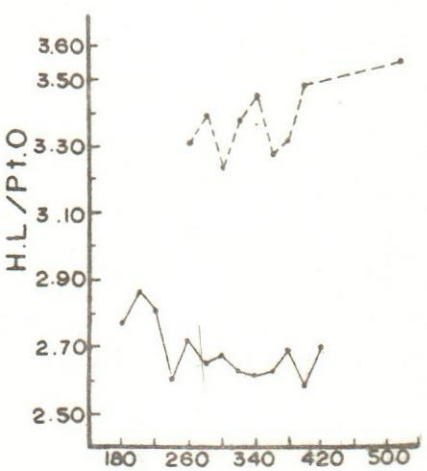


Fig.(17)

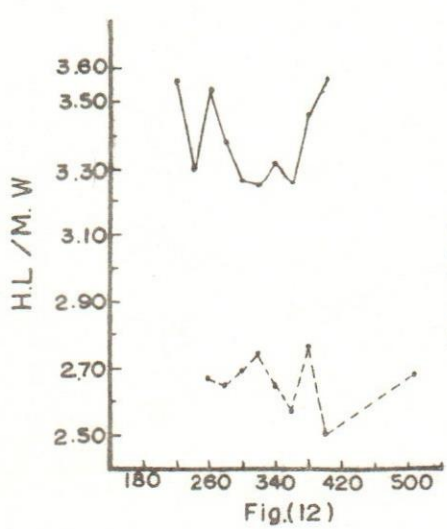


Fig.(12)

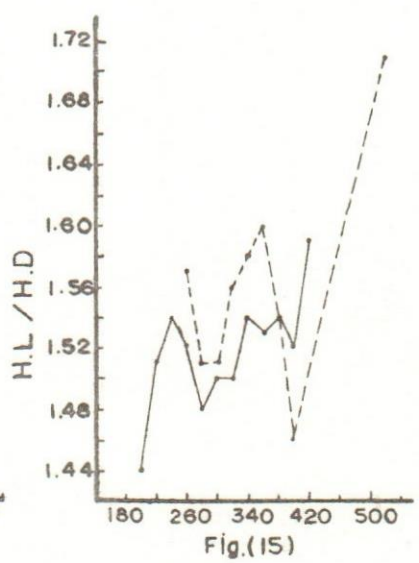


Fig.(15)

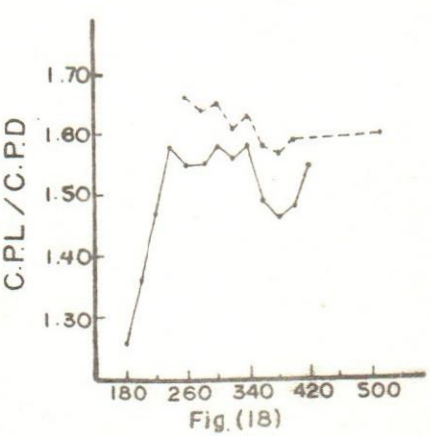


Fig.(18)

Total length in mm

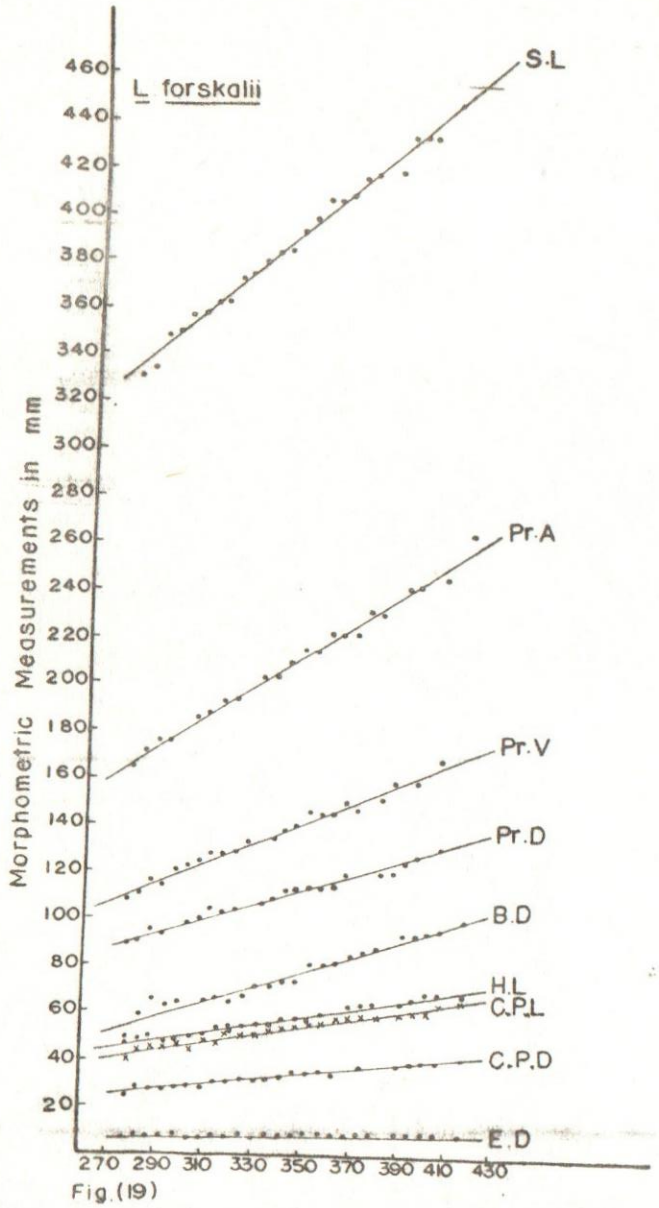


Fig.(19)

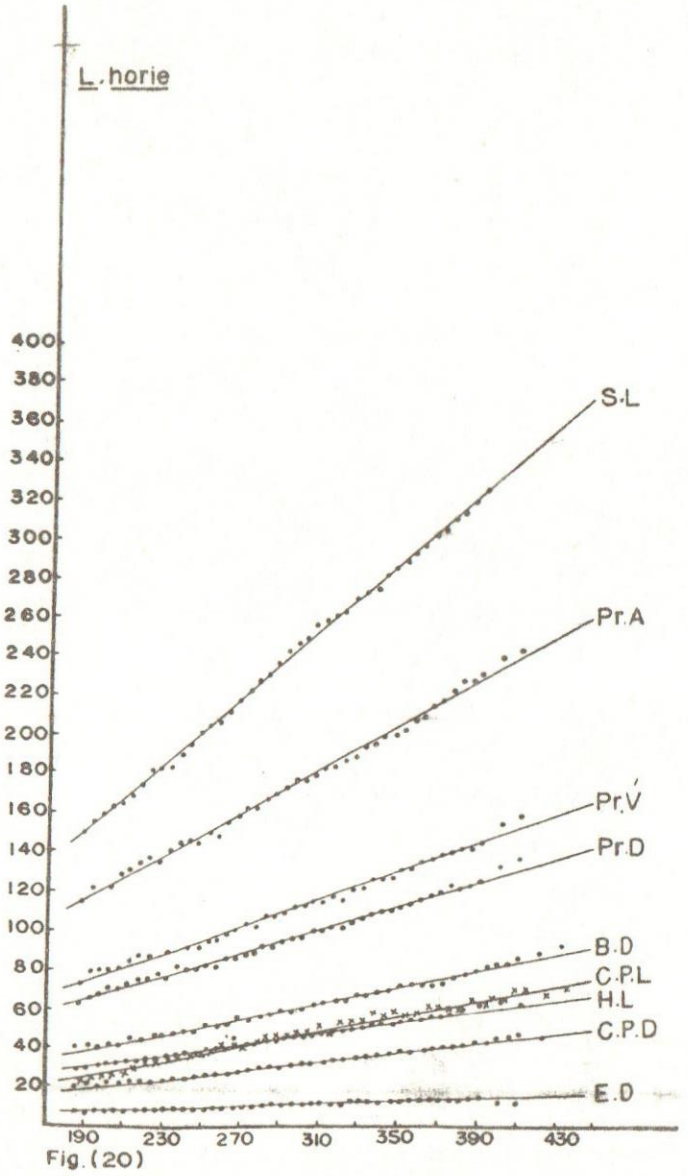


Fig.(20)

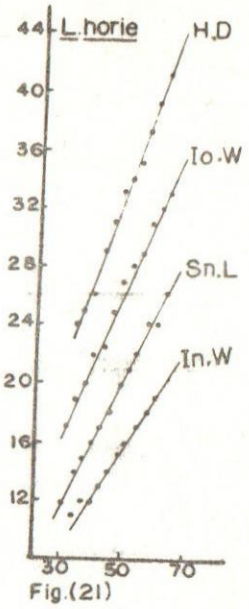


Fig.(21)

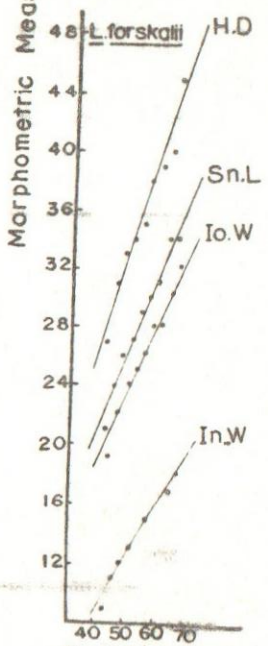


Fig.(22)

Total length in mm

Head length in mm