BIOMETRICS OF MULLET IN LAKE MANZALA

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SUMMARY

A thorough morphometric study is carried out on fry, juveniles and adults of *M. cephalus*, *L. ramada* and *L. saliens* living at Lake Manzala. Linear regressions of total length on various body length criteria are given for both the fry and juveniles (fish smaller than 80 mm) and the juveniles and adult fishes (longer than 80 mm). Most of the characters show slight or no differences between observed and the calculated values. However, the calculated values of peduncle length and to a less extent interorbital width, and the considered lengths of the first dorsal, ventral and anal fins are found to vary from the observed value for both the small and large fishes of the three species in the lake.

Some of the regression lines show no change from the fry to the adult stages and the lines for the adult appear to be a mere continuation of the lines of the small fishes. Such a condition is reflected by fork length and preventral length of the three mullet species.

The regression lines of some characters of one species are found to coincide with those of the corresponding ones of another species. The lines of the prefirst dorsal length of the small fish, and those of the fork, standard, preanal and presecond lengths and the length of the pectoral fin of the larger fish, of the three species are found to coincide.

INTRODUCTION

Mullets are widely distributed in many parts of the world especially the tropics and subtropics. They are considered as important foodfishes in the countries that lie in these zones. Their farming is practised in many countries (Thomson, 1963, 1966).

Five species of grey mullets are found in the coastal waters of the Mediterranean off the shores of Egypt namely *Mugil cephalus* *Liza ramada, Liza saliens, Liza aurata* and *Chelon labrosus.* Their fishing grounds are the coast of the Mediterranean Sea and the coastal Delta lakes : Manzala, Borollos, Edku and Mariut. During 1962—1968 Lake Manzala mullet fishery constituted 60—80% of the annual country yield of mullets.

The present contribution attempts to show morphometric differences between the three mullet species living at Lake Manzala which are *Mugil cephalus, Liza ramada,* and *Liza saliens,* and between them and the same species at another locality. Moreover, the rate of increase of body part with total length is followed during two different stages of life. Examination of many specimens can indicate the best characters to distinguish between the species over a wide size range. Regression analysis of the original data as a tool in the interprelation of relative growth is used in addition to the use, in one case, of the body dimensions expressed as percent of total length.

The morphological characters were selected through precedent and experience. The precedent was established by several workers who attempted thorough morphometric studies on mullets (Kesteven, 1942, 1950 ; Thomson, 1954; Anderson, 1957, 1958; Ezzat, 1965; Bishara, 1967), and other fish (Hile, 1948; Ricker & Merriman, 1945 ; Scattergood, 1952 etc.). Most of the recent workers on mullet did not explain how they selected the various length criteria, but undoubtedly they were guided by previous workers in this field.

MATERIAL AND METHODS

The following morphometric measurements were recorded for each species :

1. Total length (T.L.), from tip of snout to the end of the caudal fin.
2. Fork length (L.C.F.), from tip of snout to the end of the medium ray of the caudal fork.
3. Standard length (S.L.), from tip of snout to the origin of the caudal fin.
4. Predorsal I distance (D_1.) from tip of snout to insertion of the first dorsal fin.
5. Predorsal II distance (D_2.) from tip of snout to insertion of the second dorsal fin.

6. Preventral distance (V.), from tip of snout to insertion of the ventral fin.
7. Preanal distance (A.), from tip of snout to insertion of anal fin.
8. Head length (H.), from tip of snout to the operculum edge.
9. Preorbital distance (Sn.), from tip of snout to the anterior margin of the eye.
10. Interorbital width (I.O.), the distance measured by the divider across the head between the uppermost rim of the eye.
11. Eye diameter (E.), distance between the anterior and posterior margins of the eye.
12. Body depth (B.D.), the greatest vertical part of the body under the first dorsal fin.
13. Peduncle depth (Pd. D.), the narrowest part posterior to the position of the anal and anterior to the caudal fin.
14. Peduncle length (Pd. L.), the line joining the posterior point of the origin of the anal fin to the origin of the caudal fin.
15. Length of pectoral fin (Pct. L.), from its base to its end.
16. Length of ventral fin (V.L.), from its base to its end.
17. Height of the first spine of the first dorsal fin (D_1. H.).
18. Height of the anal (A.H.), the longest ray from its base to its end.

All measurements were taken on the left side of freshly caught fish. These morphometric measurements are based on the examination of 103, 95 and 141 fry of total length ranging from 14-80 mm. of *M. cephalus, L. ramada* and *L. saliens,* and of 248, 245 and 216 longer fish up to 550, 400 and 300 mm of the same species, respectively.

Measurements of body proportions of fish less than 100 mm long were recorded to the nearest 0.1 mm using a binocular microscope provided with a moving stage. Measurements of body proportions for fish longer than 100 mm were taken to the nearest millimetre. These measurements are the actual distance between two points and not the distance parallel to the midline of the body and between perpendiculars. However, an additional number of mullet ranging in length from 35 to 100 mm were measured using the divider. It was noticed that there were no differences in lengths when compared with those measured under the binocular microscope. The number of *M. cephalus, L. ramada* and *L. saliens* whose measurements were taken using the former and the latter methods is 12, 64 & 45 and 138, 56 & 99, respectively.

RESULTS

Linear regressions were employed in relating the total length T.L. (independent variable, X), to the various body and fin lengths (dependent variables, Y). The regression equation is $Y = a + bX$. Two regression lines were calculated for each measurement, one for fish with length less than 80 mm and one for longer specimens up to 550 mm in *M. cephalus,* 400 mm in *L. ramada* and 300 in *L. saliens.* As an example for comparative purpose, a regression equation for all length ranges of *L. saliens* is also given for each measurement.

The calculated constants, "a" & "b" are given in Table 1, and all results are represented in Figs. 1-3, from which the following points are worth mentioning.

Differences of calculated body parts from their observed averages

In *M. cephalus* and *L. ramada* considerable variation is observed in Pd. L. while I.O., D_1.H., V.L. and A.H. show moderate variations. In addition, observed averages of A. & V. of *M. cephalus,* Sn. & Pct. L. of large (more than 80 mm) *M. cephalus* and Sn. of *L. ramada* differ from their regression lines. In *L. saliens* only moderate variations are found in V.L., A.H., Sn. & E. of all fish length range, and in D_1. of large fish ($>$ 80 mm).

All other length criteria show very slight or no difference between the observed and calculated values.

Comparison of regression lines

When following the regression lines of both the small (< 80 mm) and larger fish, it is found that, L.C.F., S.L. & V. of the three species, in addition to B.D. of *M. cephalus,* Pd. D. & E. of *L. ramada* and D_1., D_2., A., B.D. & Pct. L. of *L. saliens,* show a uniform rate of increase with total length throughout the size range. On the other hand the two regression lines of I.O. in the three species, show the greatest change in rate of increase with T.L., gradually followed by Pd.L., D_1.H., A.H. & V.L. of *M. cephalus,* Pd. L., A.H. & V. L. of *L. ramada* and E., Sn. & V.L. of *L. saliens.* A slight change is observed in H., Pct. L. & Pd.D. of *M. cephalus,* H., B.D., D_2., A., D_1. & Pct. L. of *L. ramada* and Pd. D. of *L. saliens.* The degree of inflection in the rate of increase of the other measurements with T.L., varies with body part and species.

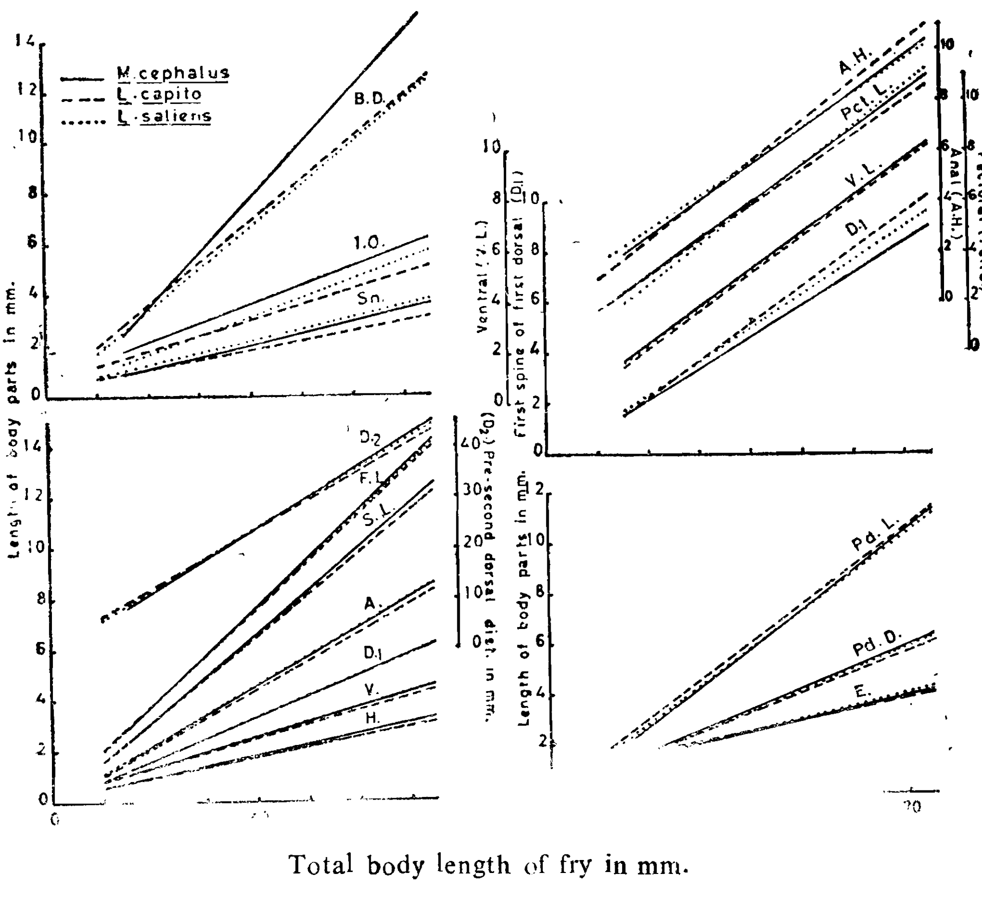
The general equation for all length ranges of *L. saliens* was found *to give better results for S.L., D_2. & A. than those given by the two* regression equations for the small and large fish, while no difference was found in case of L.C.F., D_1., V., B.D., and Pct. L. In case of I.O., E., Sn., H., V.L., D_1. H., A.H., Pd.D. & Pd.L. the results given by the equations for small and large fish separately were less deviated from the observed values than the given by the general equation.

Biometric differences between the mullet species

In order to recognize biometric differences between the three species, comparison of the corresponding regression lines for the small and large fish ($\lesseqgtr$ 80 mm long) for each measurement is represented in Figs. 4 & 5.

No difference, in small fish, is found in D_1. of the three species, in A.H., A. & V. of *M. cephalus* and *L. saliens,* and in L. C. F. & S. L. of *L. ramada* and *L. saliens.* In large fish, the regression lines for L.C.F., S. L., A., D_2 & Pct. L. of the three species, coincide, as well as those for Sn. of *M. cephalus* and *L. saliens* and for B.D., V.L. & I.O. of *M. cephalus* and *L. ramada.* In small fish, slight difference is shown by V.L., H.E., Pd. L. & Pd. D. of the three species, by L.C.F. & S.L. of *M. cephalus,* and by A. & V. of *L. ramada.* However, there is a marked difference in Pct. L. & B.D. of the three species and in A.H. of *L. ramada.* The maximum difference is observed in I.O., Sn. & D_1. H.

of the three species. Fish larger than 80 mm show a slight difference in E., A.H., D_1. & Pd. D. of the three species, and in B.D. of *M. cephalus* and *L. ramada,* while a slightly higher difference is observed in V., Pd.L. & D_1.H. of the three species. Marked difference exists in V.L. & I.O. of *L. saliens*, and the highest difference is found in H. of the three species, in Sn. of *L. ramada* and in B.D. of *L. saliens.*



Total body length of fry in mm.

Fig. 4. Comparative representation of regression lines of the morphometric characters on total length of the fry of the three mullet species

The biometric differences between the three species described above are based on the regression lines, i.e., on "b" and "a".

TABLE 1. The constants "b" and "a" of the regression equations of body parts on total length of the mullet species in Lake Manzala

Species	Langth (mm)	b	a	b	a	b	a	b	a	b	a	b	a
		L.C.F.		S.L.		D_1		D_2		V.		A.	
Mugil cephalus	18—79	0.9473	0.3736	0.8466	—0.8591	0.4196	—0.0673	0.6076	—0.5464	0.2964	0.9209	0.5829	—0.4318
	80—550	0.8902	5.7120	0.8338	0.0262	0.3904	—0.8310	0.5948	—2.1381	0.2762	1.8929	0.5772	—3.6429
L. ramada . . .	14—79	0.9226	1.0257	0.8161	—0.1157	0.4118	0.2293	0.5687	0.7743	0.2809	1.0979	0.5583	—0.2607
	80—400	0.8890	4.5067	0.8444	—1.8737	0.4185	—2.1113	0.6073	—4.9273	0.2963	—0.2260	0.5848	—4.1117
	14—79	0.9337	0.6666	0.8137	0.0554	0.4075	0.3267	0.5930	0.0642	0.2968	0.8783	0.5774	—0.2100
L. salines . . .	80—300	0.8810	5.5182	0.8293	0.2677	0.3930	0.8064	0.5861	0.7136	0.2879	0.5055	0.6583	0.8105
	14—300	0.8934	2.8700	0.8323	—0.3580	0.3925	0.9580	0.5876	0.4320	0.2846	1.2120	0.7513	0.1700
		H.		Sn.		E.		I.O.		B.D.		PD. D.	
Mugil cephalus .	18—79	0.2151	0.4100	0.0469	0.1146	0.0461	0.6809	0.0743	0.6209	0.2167	—0.8891	0.0848	0.336
	80—550	0.1821	1.6191	0.0363	—0.0959	0.0350	1.9881	0.0940	—4.1099	0.1749	0.6857	0.0695	1.6643
L. ramada . . .	14—79	0.1939	1.0100	0.0355	0.4150	0,0417	0.9264	0.0598	0.6014	0.1051	0.2700	0.0783	0.2257
	80—400	0.2114	—1.1280	0.0468	—0.8680	0.0332	1.7053	0.0950	—3.8890	0.1750	—0.8917	0.0766	0.4120
	14—79	0.1943	0.9665	0.0452	0.3808	0.0494	0.5825	0.0744	0.1300	0.1647	0,0583	0.0856	0.0200
L. salines . . .	80—300	0.1556	3.9936	0.0339	0.7373	0.0327	2.2482	0.0625	—0.3200	0.1532	0.6441	0.0776	0.7959
	14—300	0.1624	2.5650	0.0340	0.7300	0.0373	1.2800	0.0586	0.5220	0.1538	0.4810	0.0799	0.3010
		Pd. L.		Pct. L.		V.L.		D_1.H.		A.H.			
Mugil cephalus .	18—79	0.1547	—0.2918	0.1440	0.1991	0.1446	—0.5282	0.1250	—0.3182	0.1421	—0.2791		
	80—550	0.1738	1.2453	0.1326	1.1191	0.1114	2.7048	0.0944	3.0834	0.1125	2.7572		
L. ramada . . .	14—79	0.1506	0.0650	0.1372	0.3293	0.1465	—0.7486	0.1448	0.6179	0.1551	—0.6679		
	80—400	0.1889	—0.5173	0.1331	0.5640	0.1108	2.8550	0.1011	3.8700	0.1047	4.3413		
	14—79	0.1475	0.0242	0.1548	—0.3942	0.1436	—0.5067	0.1323	—0.2400	0.1355	0.0642		
L. saliens . . .	80—300	0.1852	—1.8068	0.1575	—0.5246	0.0915	3,9686	0.0974	2.2596	0.1131	1.1235		
	14—300	0.1827	—1.3740	0.1575	—0.5160	0.1029	1.5650	0.1027	1.1650	0.1142	0.9310		

TABLE 2.—Ratio of various body length criteria to total length of the mullet fry in Lake Manzala

Species	Length (mm)	L.C.F.	S.L.	Sn.	E.	I.O.	H.	V.	A.	D_1.	D_2.	Pd.L.	Pd.D.	B.D.	D_1.H.	Pct.L.	V.L.	A.H.
Liza ramada	10	—	0.805	0.0504	0.0935	0.0719	0.237	0.324	0.496	0.424	0.590	0.165	0.0935	0.158	0.101	0.209	0.115	0.101
	15	0.967	0.805	0.0450	0.1384	0.0883	0.236	0.326	0.533	0.416	0.581	0.163	0.0923	0.165	0.109	0.137	0.124	0.093
	20	0.964	0.811	0.0519	0.0833	0.0734	0.232	0.327	0.548	0.426	0.591	0.154	0.0806	0.166	0.111	0.142	0.124	0.102
	25	0.961	0.811	0.0494	0.0727	0.0885	0.234	0.320	0.554	0.408	0.584	0.155	0.0831	0.182	0.120	0.143	0.065	0.137
	30	0.957	0.813	0.0498	0.0718	0.0817	0.225	0.310	0.551	0.422	0.590	0.155	0.0872	0.187	0.126	0.146	0.092	0.142
	35	0.955	0.813	0.0452	0.0744	0.0795	0.224	0.306	0.554	0.418	0.618	0.155	.0811	0.175	0.138	0.147	0.141	0.143
	40	0.966	0.822	0.0499	0.0624	0.0767	0.223	0.318	0.564	0.418	0.592	0.151	0.0883	0.181	0.133	0.139	0.138	0.147
	45	0.950	0.815	0.0519	0.0579	0.0823	0.222	0.318	0.561	0.423	0.596	0.151	0.0886	0.185	0.125	0.141	0.140	0.147
	50	0.912	0.804	0.0517	0.0640	0.0769	0.228	0.313	0.559	0.428	0.604	0.133	0.0782	0.158	0.130	0.149	0.141	0.151
	55	0.946	0.818	0.0495	0.0609	0.0747	0.221	0.318	0.560	0.420	0.600	0.149	0.863	0.169	0.133	0.150	0.139	0.148
	60	0.944	0.811	0.0447	0.0577	0.0720	0.215	0.313	0.558	0.407	0.594	0.150	0.0900	0.175	0.142	0.148	0.139	0.147
	65	0.932	0.818	0.0344	0.0564	0.0597	0.202	0.280	0.540	0.480	0.548	0.151	0.0757	0.165	0.134	0.135	0.132	0.141
	70	0.945	0.822	0.0356	0.0480	0.0658	0.192	0.274	0.548	0.418	0.575	0.171	0.0754	0.171	0.137	0.137	0.127	0.144
	75	0.932	0.806	0.0398	0.0550	0.0641	0.209	0.300	C.557	0.414	0.575	0.143	0.0838	0.164	0.135	0.146	0.137	0.139
	Grand Average	0.949	0.812	0.0464	0.0712	0.0754	0.221	0.310	0.549	0.418	0.588	0.153	0.0846	0.171	0.127	0.148	0.125	0.134
	15	0.968	0.815	0.0693	0.0815	0.0852	0.243	0.348	0.561	0.421	0.581	0.140	0.1010	0.142	0.108	0.151	0.101	0.129
	20	0.962	0.811	0.0544	0.0767	0.0896	0.233	0.328	0.553	0.416	0.582	0.150	0.0821	0.159	0.101	0.154	0.123	0.129
	25	0.967	0.828	0.0582	0.0753	0.0951	0.240	0.328	0.574	0.425	0.595	0.151	0.0817	0.189	0.109	0.152	0.129	0.132
	30	0.962	0.822	0.0486	0.0688	0.0920	0.232	0.326	0.568	0.417	0.597	0.147	0.0826	0.204	0.116	0.147	0.131	0.132

Mugil cephalus	35	0.951	0.821	0.0489	0.0647	0.0916	0.230	0.329	0.581	0.421	0.598	0.142	0.0836	0.198	0.120	0.149	0.131	0.132
	40	0.954	0.824	0.0450	0.0582	0.0960	0.220	0.316	0.576	0.412	0.598	0.142	0.0857	0.205	0.129	0.148	0.135	0.137
	45	0.957	0.825	0.0428	0.0599	0.0994	0.221	0.318	0.575	0.414	0.599	0.153	0.0857	0.204	0.117	0.147	0.135	0.134
	50	0.956	0.818	0.0428	0.0580	0.0932	0.213	0.309	0.566	0.418	0.599	0.143	0.0852	0.200	0.119	0.150	0.134	0.139
	55	0.954	0.818	0.0445	0.0575	0.0952	0.215	0.320	0.575	0.416	0.603	0.143	0.0890	0.203	0.119	0.156	0.135	0.138
	60	0.947	0.827	0.0461	0.0577	0.0886	0.215	0.310	0.566	0.410	0.595	0.151	0.0836	0.196	0.114	0.146	0.136	0.140
	70	0.957	0.855	0.0600	0.0572	0.0643	0.236	0.307	0.586	0.429	0.600	0.157	0.0857	0.200	0.121	0.157	0.136	0.136
	Grand Average	0.958	0.824	0.0510	0.0650	0.0900	0.227	0.322	0.571	0.418	0.595	0.147	0.0845	0.191	0.120	0.151	0.130	0.134
Liza saliens	10	0.976	0.802	0.0614	0.0887	0.0717	0.259	0.352	0.549	0.433	0.597	0.133	0.0785	0.160	0.098	0.133	0.109	0.143
	15	0.968	0.813	0.0531	0.0852	0.0782	0.239	0.335	0.554	0.420	0.595	0.144	0.0811	0.159	0.110	0.144	0.117	0.141
	20	0.968	0.814	0.0587	0.0780	0.0821	0.240	0.338	0.583	0.434	0.605	0.136	0.0913	0.166	0.115	0.136	0.115	0.132
	25	0.962	0.814	0.0594	0.0698	0.0779	0.230	0.333	0.578	0.416	0.594	0.149	0.0890	0.171	0.125	0.144	0.119	0.127
	30	0.958	0.828	0.0659	0.0656	0.0717	0.234	0.330	0.581	0.421	0.593	0.155	0.0842	0.170	0.131	0.132	0.124	0.132
	35	0.948	0.820	0.0548	0.0682	0.0749	0.223	0.320	0.564	0.418	0.592	0.150	0.0827	0.163	0.133	0.147	0.129	0.139
	40	0.956	0.819	0.0554	0.0620	0.0756	0.220	0.325	0.575	0.419	0.598	0.147	0.0858	0.169	0.130	0.142	0.136	0.137
	45	0.951	0.809	0.0518	0.0604	0.0842	0.133	0.317	0.572	0.408	0.594	0.150	0.0838	0.170	0.131	0.150	0.137	0.141
	50	0.945	0.810	0.0488	0.0601	0.0919	0.211	0.310	0.571	0.410	0.589	0.145	0.0836	0.170	0.129	0.144	0.135	0.140
	55	0.946	0.816	0.0504	0.0583	0.0773	0.213	0.309	0.573	0.409	0.593	0.154	0.0812	0.166	0.133	0.144	0.139	0.140
	60	0.943	0.821	0.0542	0.0538	0.0785	0.197	0.309	0.566	0.411	0.596	0.149	0.0814	0.153	0.123	0.146	0.136	0.148
	70	0.938	0.811	0.0512	0.0586	0.0674	0.213	0.310	0.580	0.418	0.596	0.141	0.0863	0.163	0.125	0.155	0.132	0.126
	Grand Average	0.955	0.815	0.0554	0.0678	0.0776	0.224	0.324	0.570	0.418	0.595	0.146	0.0841	0.166	0.124	0.143	0.127	0.137

N.B. : For abbreviations, see pages 4 and 5.

According to previous investigators the body dimensions were expressed in percent of standard or total length. The small fish less than 80 mm long of the three species when treated in this way, showed that their biometric differences follow the values of the grand averages of the ratio of body part to T.L. much more than the value of "b" (Table 2).

DISCUSSION

In the present study, the plots of the studied body parts against total length of the three mullet species in Lake Manzala, to which appropriate regression have been fitted, indicate that linear relationship between variables is adequate (Figs. 1-3). The analysis shows measurement variations in some length criteria. However, a close agreement is found between the observed and calculated values of fork length (L.C.F.), standard length (S.L.), prefirst dorsal distance (D_1.), presecond dorsal distance (D_2.), head length (H.), body depth (B. D.), peduncle depth (Pd. D.), and length of pectoral fin (Pct. L.) of both the small and large fish of the three species.

The prefirst dorsal distance is slightly less than half the standard length, i.e., the first dorsal fin is situated nearly at the mid-point between the snout tip and the base of the caudal fin, and the anal fin is slightly in advance of the second dorsal. These results agree with those given by Thomson (1966) and can be deduced from the factor "b" (Table 1)whose values for the prefirst dorsal distance are less than half the corresponding ones for the standard length; and those for the preanal distance are less than for the presecond dorsal distance (D_2.).

It is well known that a species can exhibit morphologically different populations. These morphometric differences can arise as a result of changes in the local environment during the phenocritical period of development or they may be genetic differences resulting from natural selection during long periods of geographical isolation (Hubbs, 1926; Hart, 1952; McHugh, 1954; Howard, 1954; De Sylva *et alii*, 1956, etc.). However, the general froms of various relationships for mullet species at Lake Manzala are in close agreement with those previously given for the same species either in Egypt (Bishara, 1967) or other localities in the world (Kesteven, 1942; Ezzat, 1965). This is reflected by the approximate values of "b" representing the slope of regression of different body parts on total lengths of the three mullet species (Table 3). These findings confirm the conclusions of De Sylva *et alii* (1956) who showed that mullet, sometimes, belonging to distinct geographical localities, have the same regression coefficients. However, a remarkable heterogenity is noticed. Bishara (1967) has shown that the calcualted values for some body parts obtained from Ezzat (1965) equations are not correct probably due to some error when computing these equations. Such errors lead to abnormal values of "b" like that of Ezzat's prefirst dorsal distance (D_1.) of *M. cephalus* and the preventral distance of *M. capito* (Table 3) ; the Y intercept "a" may be abnormal like that of the prefirst and presecond dorsal distances of *M. capito* which equals to -22.36 and -29.87, respectively. Nevertheless, Ezzat's (1965) observed values of most measurements (Tables 14 and 24) in addition to those of Bishara (1967) are comparable with those of the present corresponding findings. Ezzat's (1965, Table 48) standard, preventral and preanal distances of *L. saliens* are exceptionally high and contrary to what is expected the preanal distance is always larger than the presecond dorsal distance. The value of "b" of the body depth by Kesteven (1942) is different since it was determined as maximum width by trial.

Inspection of the graphs of the calculated regression lines (Figs. 1—3) suggests that the location of point of inflection varies with the body part and that some parts have little or no inflection. Where there is no inflection, the calculated regression lines for individuals longer than 80 mm has the same slope "b" and is merely an extension of that for smaller fish. This is shown by the standard length (S.L.) and the prefirst dorsal distance (D_1.) of the three species as given in table 1.

Thus, from the above account the regression coefficient is found useful in comparison between the relative position of the different body parts, and in comparison of one character either of different species in one locality or of one species in different localities.

TABLE 3. The constant "b" of the regression equations of body parts on total length of the mullet species at different regions

Species	Authority	Locality	Length range(mm)	L.C.F.	S.L.	D_1.	D_2.	V.	A.	H.	Sn.	E.	B.D.
Mugil cephalus	Kesteven (1942)	Australia	30—580	0.866	0.784	0.396*	—	0.290*	0.551	0.1720	—	—	0.255
	Ezzat (1965)	France	250—400* 100—450	0.9396	0.8477	0.1850	0.6128	0.2760	0.5592	0.1855	—	—	—
	Bishara (1967)	Egypt	80—204	—	0.8431	0.3769	0.5886	0.2944	0.5901	0.2002	0.0643	0.0283	0.1844
	esent Work	Egypt	80—550	0.8902	0.8338	0.3904	0.5943	0.2762	0.5772	0.1821	0.0363	0.0350	0.1749
	Bishara (1967)	Egypt	18—80	—	0.8453	0.4420	0.6300	0.3500	0.6060	0.2431	0.0774	0.0368	0.2044
	Present Work	Egypt	18—79	—	0.8466	0.4196	0.6076	0.2964	0.5829	0.2151	0.0469	0.0461	0.2167
Liza capito (*ramada*)	Ezzat (1965)	France	—	—	0.8095	0.4714	0.6861	0.6022	0.6062	0.2429	—	—	—
	Bishara (1967)	Egypt	80—171	—	0.8301	0.4163	0.5993	0.3213	0.5730	0.2410	0.0670	0.0260	0.1523
	Present Woqk	Egypt	80—400	—	0.8444	0.4185	0.6073	0.2963	0.5848	0.2114	0.0468	0.0332	0.1750
	Bishara (1967)	Egypt	18—80	—	0.8361	0.4309	0.6077	0.3149	0.5764	0.1192	0.0571	0.0258	0.1529
	Present Work	Egypt	14—79	—	0.8161	0.4118	0.5687	0.2809	0.5583	0.1939	0.0355	0.0417	0.1651
Liza saliens	Ezzat (1965)	France	120—320	—	0.8406	0.4239	0.6173	0.3431	0.5470	0.2200	—	—	—
	Present Work	Egypt	80—300	—	0.8293	0.3930	0.5861	0.2879	0.5683	0.1556	—	—	—

Marr (1955) gave examples to demonstrate that presenting the data on body proportions in the form of ratios or regression of ratios, as opposed to the regression analysis of original variates are inefficient and may often lead to erroneous interpretation. Furthermore, Kesteven (1950) preferred to express the different body dimensions by covariance and regression equations which he proved their validity in marine species as herring and mullets. The latter author objected to the use of numerical ratio between the dimensions of two body parts, i.e. indices, as tools for identification of races or species in marine species. However, the present data suggest that grand averages of the ratio of body parts to total length of the mullet small fishes are close to the values of "b" in the corresponding regression equation except for eye diameter (E.), interorbttal width (I.O.), preventral distance (V.) and the length of ventral fin (V.L.) (Tables. 1 & 2). It has been shown that the difference of regression lines of a body part on total length of the small fish of the three species follows the values of the grand averages of the indices more than values of "b", especially when the difference exists from the very beginning of early life. Kesteven (1942) found that indices for immature *M. cephalus,* particularly the head (H.) and trunk length indices, differ somewhat from the indices of older fish.

The present results show that indices calculated for *M. cephalus* from Lake Manzala are nearly the same as those given by Thomson (1954) for the same species from Australia and adjacent seas (Table 4). The values in table (4) are identical except for body depth (B. D.), interorbital width (I. O.) and height of the first spine of the first dorsal fin (D_1. H.). The difference of these latter parts may mostly be due to non-identical measured parts, e.g., the last item (D_1. H.) is given by Thomson (1954) as the longest height of the first dorsal fin while it represents the height of the first spine of this fin, in the present study.

TABLE 4. **Ratio of proportional measurements of *M. cephalus* in Australia and Egypt**

Divisor / Dividened	L.C.F.	S.L.	A.	B.D.	H.	D_1.	D_2.	Authority
Total length	—	—	—	—	4.33—5.74	2.55—2.65	—	KESTEVEN (1942)
	1.06—1.13	1.22—1.33	1.76—1.89	4.32—5.51	4.24—5.54	2.27—2.79	1.48—1.75	THOMSON (1954)
	1.06—1.11	1.17—1.28	1.72—1.83	5.26—6.22	4.81—5.49	2.54—2.73	1.68—1.78	Present work
Fork length	—	1.04—1.19	1.61—1.72	4.00—5.18	3.91—5.01	2.05—2.59	1.37—1.60	THOMSON (1954)
	—	1.08—1.18	1.56—1.70	4.64—5.84	4.54—5.08	2.27—2.45	1.52—1.64	Present work

	Sn.	E.	I.O.	D_1.H.	A.H.	Authority
Head length	3.93—5.84	3.45—4.31	1.78—2.27	1.73—2.26	1.54—2.00	THOMSON (1954)
	4.84—6.03	3.64—4.95	1.99—3.16	1.59—1.94	1.44—1.62	Present work

	Pd.D.	D_1.H.	Authority
Body depth	2.18—2.80	1.03—1.28	THOMSON (1954)
	2.03—2.53	1.32—1.85	Present work

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