median process and their greatest width in the middle reaching from one and half to two and half of the premaxillary band .

There is no published information regarding the type differences in the shape of vomerine teeth of this species i.e., category having vomerine teeth without a posterior median process, which was designated as type A or with posterior median process as type B (Fig. 1) . Teugels (1982, 1984) have given a new systematic revision of the African catfish species of the genus ***Clarias***, he reported that ***C. lazera*** is a strain of ***C. gariepinus***, who introduced the synonymy, of African catfish species. As a result of the synonymy, the name ***Clarias gariepinus*** for African catfish is at present generally accepted .

The purpose of the present study is to determine the differences between type A and type B of the African catfish using biometric characters and egg size to find the best characters can be used to distinguish type A fish from type B . Also this paper presents the results of the investigation on some biological aspect of these two types in Lake Edku.

MATERIALS AND METHODS

Specimens were collected during the period 1994-1995 from the commercial catches landing at El-Maadiya and Edku fish centers in Lake Edku (Fig. 2). A total of 229 specimens of type A and 163 specimens of type B ranging between 170-450 mm in total length were examined in the study of biometric variation, length-weight relationship & condition factor, egg size, size composition and type ratios of these two types in Lake Edku The examined biometric characters were 20 morphometric measurements and 5 meristic counts. All the measurements were taken to the nearest mm The morphometric measurements (standard length, head length, predorsal length, preventral length, preanal length, dorsal base length and anal base length were related to total length . While snout length, eye diameter, interorbital width, postorbital length, upper jaw length, lower jaw length, head width, head depth passing through eyes, maximum head depth, caudal peduncle length, prepectoral length, pectoral fin length and ventral fin length were related to head length (Fig. 3) . Counts were made for 5 meristic body characters (vertebral count, dorsal fin rays, anal fin rays, pectoral fin rays and ventral fin rays . Morphometric and meristic characters were analyzed separately as suggested by Ihseen ***et al.*** (1981), Reist

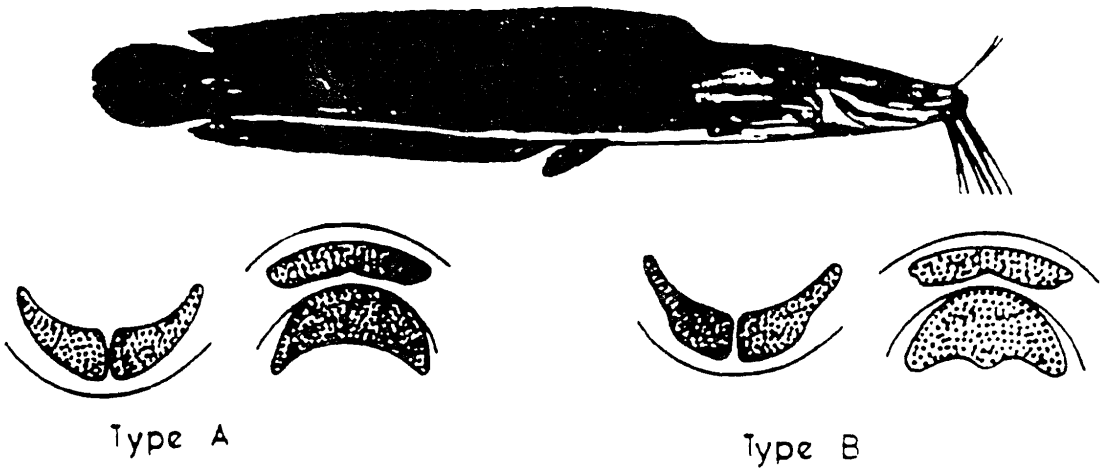

Fig. (1): African catfish *Clarias gariepinus*:
*** type A without a posterior median process.**
*** type B with a posterior median process.**

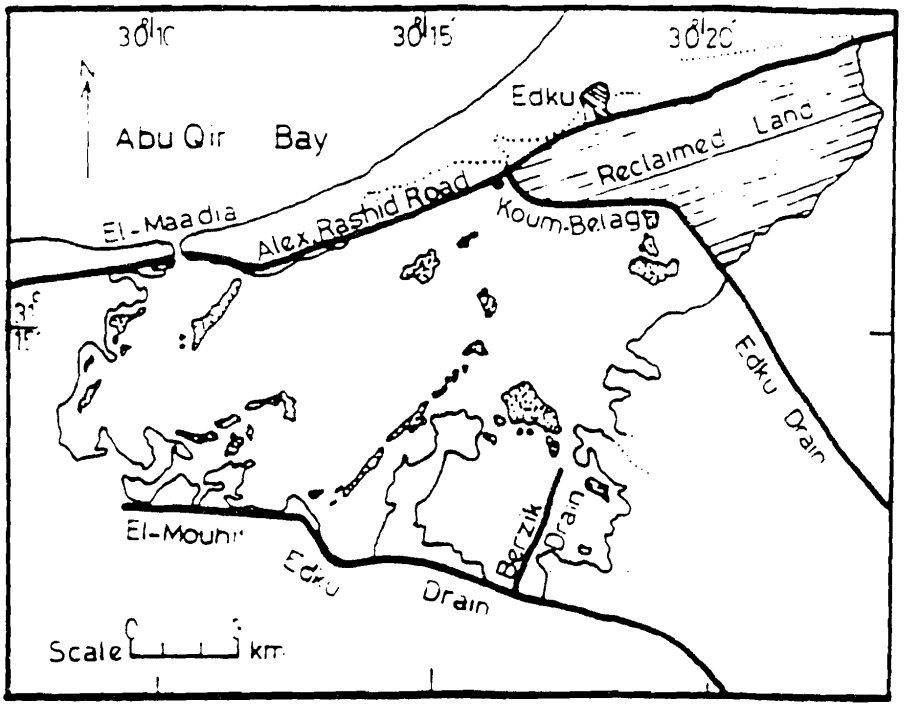

Fig. (2): Map of Lake Edku.

(1985, 1986) who suggested that in morphometric studies, fish populations should be compared in terms of shape varieties free from the effect of size variation .

In the present study, size effects were minimized in the morphometric data by comparing regressions related to the same length group using covariance analysis (ANOVA), meristic characters were analyzed using analysis of variance

Length-weight relationship was determined from the formula of Le Cren (1951). In the present work, this relationship was computed from the combined data for all fish regardless of capture time, sex and state of gonad maturity . However, the gutted weight is used in order to exclude the effect of stomach contents and weight of gonads (Lagler, 1956 and Ricker, 1975) . The coefficient of condition (K) is based on the cube law $K = W / L^3$ (i.e. Fulton condition factor) where W = gutted weight in grams, L = total length in millimeters . This factor is often used as an approximation even when the allometric factor is theoretically more appropriate (Bagenal & Braum, 1971 and Ricker, 1975) . Data of length-weight relationship and condition factor were analyzed using covariance and t-test respectively . Egg diameter estimation was done by counting the ova of six ripe ovaries during pre-spawning period for both types A and B . The two lobes of an ovary from each specimen were carefully removed and preserved in 10% formalin to permit hardening of ova in order to facilitate the counting . Egg diameter was measured by an ocular micrometer . Type difference in egg diameter was tested by two-way analysis of variance . Variation in size composition and type ratios between type A and B were examined by t-test and chi-square test respectively .

RESULTS

I- Morphometric and meristic characters

The comparison of seven morphometric characters in total length and thirteen in head length between type A and type B are presented in Table (1) . It is clear that only preanal length and anal base length related to total length show no significant differences but other five morphometric measurements are standard length, head length, predorsal length, preventral length and dorsal base length show high significance at 1% level between type A and B . Also eight of

Table (1): Comparative relationship of morphometric measurements of types A and B of African catfish in Lake Edku.

Morphometric character	Type A				Type B				FB	FM
	n	a	b	r^2	n	a	b	r^2		
In total length										
Standard length	257.14	0.779	8.599	0.998	244.04	3.660	8.536	0.998	1.093	9.587**
Head length	73.17	7.455	2.198	0.996	70.05	3.711	2.356	0.997	52.372**	30.732**
Predoesal length	87.03	2.374	2.829	0.998	82.78	-0.059	2.944	0.995	19.378**	31.672**
Preventral length	117.12	5.089	3.770	0.997	112.64	-0.332	4.015	0.994	38.844**	42.794**
Preanal length	140.75	3.472	4.596	0.990	133.57	2.109	4.668	0.997	1.156	3.457
Dorsal base length	165.08	-6.409	5.741	0.995	154.03	-1.212	5.544	0.994	8.133**	1.213
Anal base length	113.76	-1.1668	3.848	0.993	106.64	0.947	3.753	0.989	2.937	3.661
In head length										
Snout length	20.38	0.518	0.292	0.981	19.99	0.096	0.281	0.971	2.547	2.577
Eye diameter	5.30	3.317	0.028	0.711	5.18	3.398	0.025	0.707	1.131	11.721**
Interorbital width	27.99	0.852	0.379	0.990	27.64	1.639	0.369	0.993	3.538	1.084
Postorbital length	46.52	-6.418	0.739	0.992	46.16	0.588	0.644	0.969	49.244**	1.236
Lower jaw length	28.36	1.012	0.384	0.975	28.07	1.770	0.372	0.980	1.781	0.399
Upper jaw length	30.27	-4.931	0.493	0.988	29.85	-0.745	0.411	0.942	47.174**	0.445
Head width	44.50	3.949	0.566	0.992	43.94	4.423	0.562	0.979	0.171	1.905
Head depth passing through eyes	13.25	1.467	0.165	0.948	12.90	0.599	0.175	0.951	3.161	3.159
Maximum head depth	22.91	2.839	0.280	0.966	23.09	0.177	0.324	0.974	30.262**	14.211**
Caudal peduncle length	4.52	-0.882	0.078	0.792	4.77	-2.267	0.105	0.839	9.823**	11.453**
prepectoral length	50.64	-0.814	0.749	0.988	51.27	0.955	0.736	0.983	0.505	13.893**
pectoral fin length	33.70	-5.969	0.553	0.994	32.50	1.268	0.440	0.966	138.095**	25.879**
Ventral fin length	25.01	-5.951	0.432	0.984	24.11	0.558	0.332	0.959	119.939**	16.372**

a= intercept b= slope r^2=coefficient of determination FB = test of slope FM= test of adjusted mean ** Significant at 1% level

the thirteen morphometric characters whose regression lines against head length show highly significant differences between types, these are eye diameter, postorbital length, upper jaw length, maximum head depth, caudal peduncle length, prepectoral length, pectoral fin length and ventral fin length . Analysis of the data indicated that the type A fish had a higher mean values than type B fish in all examined morphometric measurements the except maximum head depth, caudal peduncle length and prepectoral length .

The results of meristic counts showed that the ventral rays for both types were the least variable i.e. all examined fish having a count of six rays . The statistical analysis (ANOVA) of vertebrae count, dorsal fin rays, anal fin rays and pectoral fin rays showed no significant difference with largely overlapping ranges and very similar means at both types (Table 2).

Table (2):Comparison of meristic characters of types A and B of African catfish in Lake Edku.

Meristic characters	Type A			Type B			F value
	N	Range	Mean ±SD	N	Range	Mean ±SD	
Vertebrae count	129	56 - 65	60.96 ±1.748	101	57 - 64	60.89 ±1.673	0.087
Dorsal fin rays	132	60 - 77	69.80 ±3.990	114	61 - 78	70.21 ±3.663	0.604
Anal fin rays	128	44 - 61	53.40 ±3.596	111	44 - 61	54.13 ±3.304	2.214
Pectoral fin rays	92	9 - 10	9.33 ±0.474	78	9 - 10	9.45 ±0.504	1.345

II- Length-weight relationship and condition factor

The equations of the length-weight relationship for both types were found to be:

Type A : Log W= 2.1333 + 2.9227 Log L (r= 0.997)

Type B : Log W= 2.0140 + 2.8298 Log L (r= 0.998)

The means of observed and calculated values of fish types A & B are given in Table (3) and the observed values of length and weight were plotted and the calculated length-weight curve fitted to the data (Fig. 4) . Analysis of covariance was employed to test if the regressions were significantly different for the two types, this analysis indicated that type A fish were significantly heavier than type B fish ($F= 17.205$, $P<0.01$) .

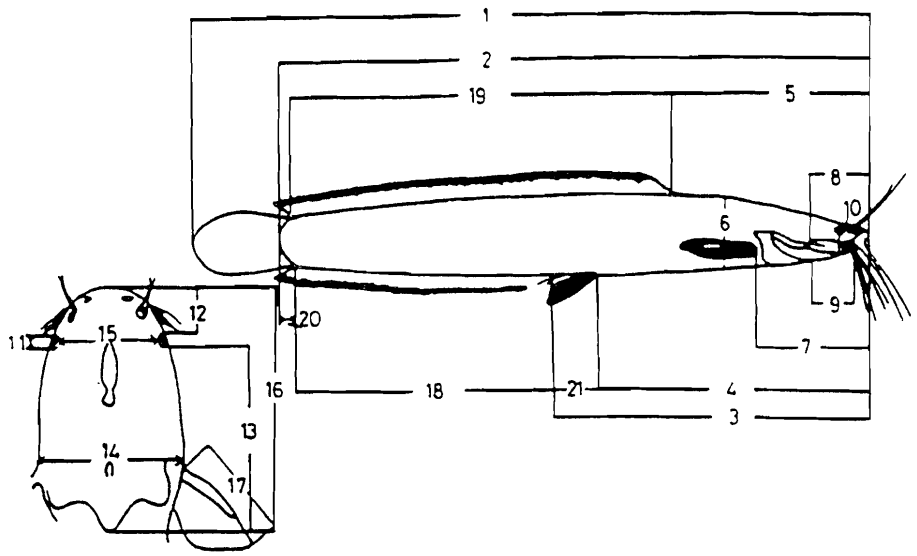

Fig. (3): An outline of African catfish showing the various body measurements.

1- total length	8- Upper jaw length	15- Interorbital width
2- Standard length	9- Lower jaw length	16- Head length
3- preanal length	10- Head depth passing througth eyes	17- Pectoral fin length
4- preventral length	11- eye diameter	18- Anal base length
5- Predorsal length	12- Snout length	19- Dorsal base length
6- Maximum head length	13- Postorbital length	20- Caudal peduncle length
7- Prepectoral length	14- Head width	21- Ventral fin length

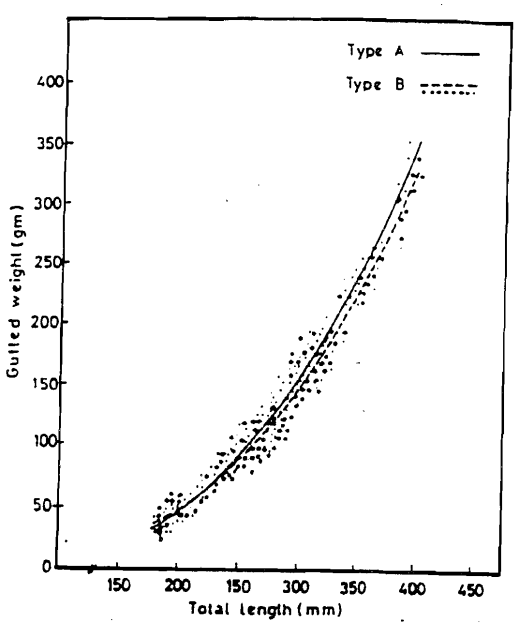

Fig. (4): Length-weight relationship of type A & B.

The means of observed and calculated values of fish types A & B are given in Table (3) and the observed values of length and weight were plotted and the calculated length-weight curve fitted to the data (Fig. 4) . Analysis of covariance was employed to test if the regressions were significantly different for the two types, this analysis indicated that type A fish were significantly heavier than type B fish ($F= 17.205$, $P<0.01$) .

The mean values of condition factor for both fish types of the same length range are shown in Table (3). The difference in condition factor of both types was statistically tested by using t-test. This statistical analysis indicates that there are highly significant differences between the two fish types ($t= 3.643$, $P< 0.01$) i.e. type A fish was heavier than type B fish .

III- Egg size

The frequency distribution of egg diameters of six ripe ovaries of both fish types in pre-spawning period having comparable size range was graphically shown in figure (5) . It was clear that the first mode corresponding to the immature stage was not varied from females of types A and B . The latter modes correspond to the ripe eggs (completely transparent) ready for ovulation were sharply separated i.e. percentage of ripe eggs diameter was varied in types A and B fishes . The egg of type A and B fish ranged from 133 to 1470 .m. and from 133 to 1530 .m. respectively . The egg size of type B was larger than that of type A (= 1014.77 versus 777.89 .m.) . The statistical analysis (ANOVA) indicated that there were high significance differences in the mean egg diameter of both types of fish ($F= 108.168$, $P< 0.01$) .

IV- Size composition

The length frequencies of types A and B catfish in Lake Edku are shown in figure (6). Generally the length of both types ranged from 17 to 45 cm, but the type A was abundant in the length range 23 - 33 cm while type B in the range 25 - 33 cm. Analysis of t-test indicated that differences in length frequencies between fish types were not significant ($t= 0.511$, $P< 0.05$) .

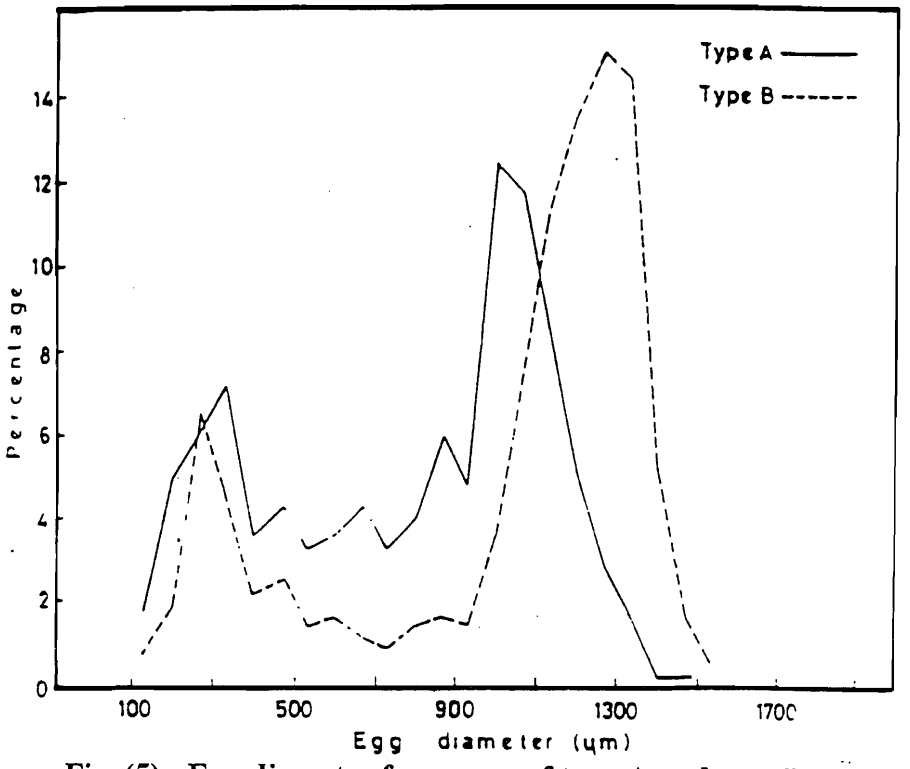

Fig. (5): Egg diameter frequency of type A and type B.

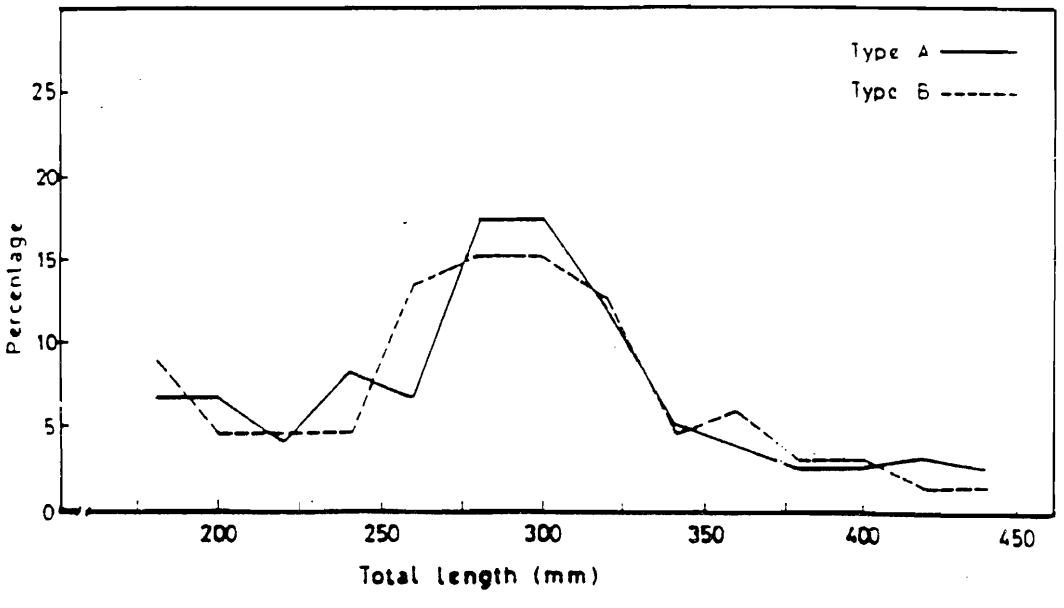

Fig. (6): Length frequency of type A and type B.

Table (3): Mean observed calculated weight and condition factor of types A and B of African catfish in Lake Edku .

Range of total length (mm)	*Type A*				*Type B*			
	No. of fish	Mean observed weight (g)	Calculated weight (g)	Condition factor (K)	No. of fish	Mean observed weight (g)	Calculated weight (g)	Condition factor (K)
170 - 189	10	32.00	34.31	0.549	11	33.33	34.53	0.572
190 - 209	10	46.40	46.69	0.580	6	47.67	46.52	0.596
210 - 229	6	61.67	61.69	0.579	5	62.67	60.92	0.589
230 - 249	12	83.83	79.55	0.606	6	82.67	77.93	0.598
250 - 269	10	104.40	100.51	0.594	18	96.78	97.74	0.551
270 - 289	25	124.08	124.82	0.565	19	120.90	120.55	0.551
290 - 309	26	163.32	152.71	0.605	20	154.30	146.54	0.572
310 - 329	18	172.22	184.41	0.526	16	162.75	175.90	0.497
330 - 349	8	220.00	220.16	0.560	6	199.33	208.82	0.507
350 - 369	5	245.33	260.19	0.526	8	256.00	245.48	0.549
370 - 389	4	285.00	304.73	0.519	4	383.00	286.07	0.516
290- -409	4	357.00	254.02	0.558	4	332.00	330.75	0.519

Table (4): Ratios of types A and B of African catfish in Lake Edku.

Location	**Type A**		**Type B**		X^2
	No.	%	No.	%	
El-Maadia	160	56.34	124	43.66	
Koum-Belag	69	63.89	39	36.11	
Total	229	58.42	163	41.58	11.112*

* Significant at 1% level .

V- Type ratios

Type ratios of African catfish varied in Lake Edku within samples from El-Maadiya and Koum-Belag fish landing centers, it was obvious that the frequencies of type A fishes were higher than those of type B fishes in El-Maadiya and Koum-Belag (Table 4). Statistical analysis (chi-square test) indicated that type A fish was significantly more abundant than type B fish in Lake Edku (X^2= 11.112, P< 0.01).

DISCUSSION

Many fish species include sympatric forms, which are often characterized by distinct life histories and can be separated by their morphology and / or genetic properties. Several instances of sympatric forms within the same lake are known in whitefish (Bodaly, 1979; Bernatchezi & Dodson, 1990; Lindsey ***et al.***, 1970 and Vuorinen ***et al.***,1993), in Pacific salmon (Healey & Heard, 1984) and in river shad (Quddus ***et al.***, 1983) .

In the present study, the results indicated that catfish are divided into two distinct types varied in the shape of vomarine teeth : without posterior median process (type A) or with posterior median process (type B) . This conclusion is supported by significant differences in thirteen of the twenty morphometric measurements and variation in egg size between the two fish types .

Morphological variations in fish are known to be influenced by both genetic and environmental factors (Mc Cart & Andersen, 1967; Vuorinen ***et al.***, 1981 and Beacham & Murray, 1986). Therefore, the two types may differ in the genetic background of these characters, or in environmental conditions occupied at least during some critical time during development, or in both of these aspects. Because the two types appear to inhabit together different lake regions; therefore are exposed to the same environmental conditions during development. The genetic differences between them are probably responsible for the observed morphological differences . Also fish of types A and B varied in egg size which has been shown to have a genetic basis, Ware (1975) pointed out that egg size was remarkably constant for a given marine fish species in a given geographical areas. Variation in egg size among stocks is one method by which the genetic component rate is expressed (Beacham and Murray, 1987). Furthermore, the results of size composition indicated that the age groups were

similarly in both types, also the mean values of length frequency showed that there were no significant differences between the two types . Also the results indicated that the catch by different fishing methods was not responsible for the variations in type ratios found between type A and type B fish in the lake. Therefore, the two types differ in the genetic background of these biological aspects.

The present investigation gives results of length-weight relationship & condition factor which indicated that type A fish was heavier than that of type B fish. Lagler ***et al.*** (1977) mentioned that length-weight relationship leads itself to comparison of individuals within and between different population . According to Ricker (1975) condition factor is used to indicate the suitability of an environment for a certain fish species by comparison with another environment .

The present study demonstrated that type A fish has longer standard length, head length, predorsal length, preventral length, dorsal base length, postorbital length, upper jaw length, pectoral fin length and ventral fin length, it has bigger eye diameter, smaller maximum head depth, shorter caudal peduncle and prepectoral length. Also this fish type have smaller egg size, heavier body weight and are more abundant than type B fish in Lake Edku . From all aspects, it is clear that the environmental conditions in Lake Edku are more suitable for growth type A than type B fish .

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