Department of Zoology,
Fac. of Science, Assiut University,
Head of Dept. Prof. Dr.

INTRA- AND INTER-SPECIFIC VARIATIONS IN THE MERISTIC CHARACTERISTICS OF SOME TILAPIINE SPECIES OF EGYPT.

(With 11 Tables and 3 Figures)

By
I. A. A. MEKKAWY

(Received at 25/6/1995)

التباينات النوعية وبين النوعية فى الخصائص العددية لبعض انواع البلطى من مصر

إمام عبد الغنى احمد مكاوى

فى البحث الحالى ظهرت -بدلالة الخصائص العددية وطرق التحليل وحيدة ومتعددة المتغيرات- إختلافات نوعية وبين نوعية فى بعض عشائر أسماك البلطى من الأنواع : اوريوكرومس نيلوتكس (البلطى النيلى) واوريوكرومس اسماعيلنسس واوريوكرومس اوريس (البلطى الأزرق) وساروسيرودون جاليليس (البلطى الجاليلى) وتلابيا زيلى (البلطى الأخضر) وتلابيا اسماعيلنسس من مياه مصرية متباينة. سجلت كذلك تغيرات من عام الى آخر فى بعض الصفات العددية لنوعى اوريوكرومس نيلوتكس وساروسيرودون جاليليس. وقد قورنت نتائج هذا البحث مع نتائج أبحاث آخرى ، أجريت فى مناطق أفريقية وآسيوية وظهرت إختلافات جغرافية. وفى هذا البحث تحليل تشعيبى لعشائر البلطىالمصرية المدروسة حتى الآن على أساس صفاتها العددية. إضافة" الى ما سبق شيد الباحث مفتاحا" تصنيفيا" لتعريف أنواع البلطى المدروسة فى مصر.

SUMMARY

In the present work, intra- and inter-specific variations of *Oreochromis niloticus, O. ismailiaensis, O. aureus, Sarotherodon galilaeus, Tilapia Zillii*, and *T. ismailiaensis* from different Egyptian waters were revealed in terms of their meristic characteristics by univariate and multivariate analyses. Year-to-year variations were recorded with respect to some meristic characters of *Oreochromis niloticus* and *Sarotherodon galilaeus*. The present results were compared with those of other authors working in different African and Asian regions. Clustering of populations of the species considered was given. Moreover, a key for identification of such populations was built up.

Keywords: *Intraspecific variations, interspecific variations, meristic characteristics, tilapiine species, Egypt.*

INTRODUCTION

Several species of the family Cichlidae have become popular with aquaculturists and aquarists *(TREWAVAS, 1982)* and were accordingly introduced into many tropical and subtropical countries of the world *(McANDREW and MAJUMBAR, 1984)*. This possibly led to changes in their morphometric and meristic characteristics because the fish were brought into contact with different environmental factors. Several authors reported on the influence of environmental changes on these characteristics of several fish species. *WITTE (1984)* commented on the implications of epigenetic changes (of morphological characters and behavior caused by environmental factors) on the morphology and taxonomy of cichlids. Qualitative characteristics such as color, as well as morphometric measurements are often used in the identification and classification of fishes, although one seldom finds identical individuals in populations due to the occurrence of morphological, physiological and biochemical differences *(MOYLE and CECH, 1982)*. Therefore, the identification of taxa and cultured stock, is central to aquaculture and effective fishery management of *Tilapia*s.

This situation and the frequent changes due to eutrophication and pollution in our Egyptian lakes *(BELTAGY, 1985; EL-OTIFY, 1985; ELEWA and AZAZY, 1986; SAMAAN and ABDEL MONEIM, 1986)* give rise to the present work. In a univariate and multivariate sense, this work is an attempt to determine the patterns of intra- and inter-specific variations in the meristic characteristics of four tilapiine species namely: *Oreochromis niloticus (LINNAEUS, 1758)* and *Sarotherodon galilaeus (LINNAEUS, 1758)* from Lake Nasser, Aswan, and Ismailia canal, Ismailia, Egypt and *Oreochromis ismailiaensis MEKKAWY 1995* and *Tilapia Zillii* (Gerv.) from Ismailia canal, Ismailia. Moreover, the results of the present investigation will be compared with those of *BISHARA (1973)*, *SALEH (1980)*, *TREWAVAS (1983)*, *LIBOS-VARSKY* and *BISHARA (1987)* and *MEKKAWY (1995 a,b)* to elucidate geographical variations in Egyptian (Fig.1), African and Asian populations of the species considered.

MATERIAL and METHODS

The present work, in December, 1989 - July 1993 period, was based on the examination of 807 specimens of *O.niloticus* (722 specimens from Lake Nasser, Aswan, 90-600 mm in total length (TL) & 85 specimens from Ismailia canal, Ismailia, 133-170 mm in TL); 1978 specimens of *S.galilaeus* (1878 specimens from Lake Nasser, 130-440 mm in TL & 100 specimens from Ismailia canal, 113-186 mm in TL); 56 specimens of T. *Zillii* (103-155 mm in TL) and 99 specimens of *O. ismailiaensis* (108-191 mm in TL) from Ismailia canal. The following meristic counts were studied; since each of the aforementioned species has discontinuous lateral line (upper portion and lower one); the pored scales and the unpored ones on their extension, anteriorly or posteriorly, were considered including those on the caudal fin.

1. Upper pored lateral line scale counts (UPLLS).
2. Upper unpored lateral line scale counts (UULLS).
3. Total upper lateral line scale counts (TULLS).
4. Lower pored lateral line scale counts (LPLLS).
5. Lower unpored lateral line scale counts (LULLS).
6. Total lower lateral line scale counts (TLLLS).
7. Caudal peduncle scale counts (CPS).
8. Soft rays of anal fin (AFSR).
9. Dorsal fin spines (DFS).
10. Soft rays of dorsal fin (DFSR).
11. Total dorsal fin rays (TDFR).
12. Total gill rakers on the first gill arch (TGR).
13. Precaudal vertebral counts (PCV).
14. Caudal vertebral counts (CV).
15. Total vertebral counts (TV).
16. Vertebral formula (VF).

The basic statistics (Frequencies, means (x) & standard deviations (SD) were given for the meristic characters considered. Such characters were subjected to chi-square test to detect intra- and inter-specific variations at 0.05 & 0.01 level of significance. The correlation coefficients between the meristic characters and standard length were insignificant at 0.05 level and, therefore, were omitted here.

The meristic characters were also treated by canonical variates analysis (CVA) using *BLACKITH and REYMENT'S (1971)* program and by sheared principal components analysis (PCA) *(HUMPHRIES et al., 1981)* using *MEKKAWY'S (1987)* program to detect these variations in a multivariate sense. The Egyptian populations of the species considered were subjected to weighted pair group method cluster analysis *(DAVIS, 1973)* in terms of Euclidian distance matrix of the meristic characters studied.

RESULTS

Meristic characters of *Oreochromis niloticus*, *O.ismailiaensis*, *Sarotherodon galilaeus* & *Tilapia zillii* are summarized in Table 1 in terms of their frequency distributions. Such a table refers to wide ranges for most meristic counts of tilapiine species considered; such wide ranges were due to their prolonged spawning periods. Chis-quare analyses referred to the presence of few sexual variations in *Oreochromis niloticus* , O.*is-maili-aensis*, and *Sarotherodon gali-laeus;* no sexual dimorphism was recorded in *Tilapia zillii* (Table 2).

During the whole period of investigations, Geographic variations in the distributions of upper pored lateral line scale, dorsal fin spine, dorsal fin soft ray, total dorsal fin ray, anal fin ray, total gill raker and total vertebral counts of *O.niloticus* and S.*galilaeus* were recorded. These characters were also valuable in elucidating the interspecific differences in their distributions (Table 2).

Examination of the meristic counts studied shows, in general, a possible discrimination between *Tilapia zillii* and the remainder species, especially by gill raker counts (Table 1). The distributions of the meristic characters considered also suggest that Lake Nasser and Ismailia populations of *O.niloticus* and S.*galilaeus* were isolated races. O.*ismailiaensis* became nearer to *O.niloticus* as regards the upper pored lateral line scale, anal soft fin ray, and caudal vertebral counts or nearer to S.*galilaeus* as regards total lower lateral line scale, caudal peduncle scale, dorsal fin spine, total dorsal fin ray, total gill raker and vertebral counts or occupied an intermediate position as regards the remainder characters.

The aforementioned interspecific discrimination became more obvious when the meristic characters studied were treated simultaneously by CVA & PCA (Table 3 & Fig. 2). *O.niloticus* populations were differentiated from S. *galilaeus* populations on CVI (59.84%); O. *ismailiaensis* occupied an intermediate position between *O.niloticus* and S.*galilaeus* populations of Ismailia. *Tilapia zillii* was separated from the other tilapiine species studied, especially Lake Nasser populations. The discriminating power of CVI was given by vertebral counts of these species (TV versus PCV & CV).

On CVII (34.84%), *Tilapia zillii* exhibited complete separation from the remainder species. On such a vector, Lake Nasser and Ismailia populations of *O.niloticus* and S.*galilaeus* became differentiated (Fig.2A,B). The discriminating power of CVII was due to AFSR. CVIII (4.40%) exhibited a low discriminating power for discrimination between species studied; such a power was due to DFS versus PCV & TV (Table 3). The application of sheared PCA, on the meristic characters studied in addition to SL as a measure of size, showed an intra- and inter-specific pattern of discrimination other than that reflected by CVA. *Tilapia zillii* was separated from the remainder species by size on PCI (49.80%); SL, the size measure, had the highest loading on that vector. Also, the size differences between Lake Nasser and Ismailia populations were evident on PCI. PCIII (10.69%), the shape vector, was able to differentiate *Tilapia zillii* from other tilapiine species studied in terms of TGR count which has the highest loading (Fig. 2C, Table 3). The size components present in PCII (25.90%) & PCIII (10.69%) were removed by sheared PCA (Fig.2D, Table 3). Before shearing, UULLS has the highest loading on PCII, whereas after shearing SL and TGR have the highest loadings. Accordingly, the discriminating power of the sheared PCII was almost similar to that of PCIII. This means that differentiation between *Tilapia zillii* and the remainder species and between Lake Nasser and Ismailia populations were due to shape components given by gill raker counts and standard length and not due to size component given on PCI. The picture on sheared PCII was similar to that on PCIII before shearing. This means that no size components were found in PCIII (Fig.2 C&D, Table 3). These results were confirmed by the absence of correlations between the meristic characters studied and fish size.

Populations analyses (Tables 4&5) of *O.niloticus* and *S.galilaeus* were achieved in terms of sexual dimorphism and variability of samples within localities, between year classes and between different localities using the meristic counts considered. Each sample was differentiated according to sex into two subsamples.

Samples examined of *O.niloticus* of Lake Nasser and Ismailia exhibited no association between sex and meristic count distributions as regards LPLLS, LULLS, PCV, TV &VF. However, as regards each of the remainder meristic counts, only one sample of 17 samples examined revealed sexual dimorphism. The accumulative information failed to give evidence of sexual dimorphism in the meristic characters studied. Since Lake Nasser and Ismailia samples revealed homogeneous results in different years, pooling of data was possible. Results of the pooled data revealed that the sex affected only UULLS (Lake Nasser), and TGR (Ismailia) counts.

Ismailia samples within year class 1991, as regards LPLLS, CV &

VF counts and Lake Nasser samples within 1989, as regards TULLS, LPLLS, TLLLS, CPS, AFSR counts and within 1990, as regards VF counts were not homogeneous (Table 4). Accordingly, it may be concluded that those samples of Ismailia in 1991 and Lake Nasser in 1989 & 1990 represent different local populations of the same localities. Year-to-year variations were recorded in Lake Nasser samples as regards UULLS, AFSR, TGR, PCV, VF counts. Geographical variations in *O.niloticus* were recorded in different years in terms of all characters studied except UPLLS (in 1990), UULLS, LULLS counts (Table 4). Accordingly, Lake Nasser and Ismailia samples may be considered morphologically as isolated races.

Except one sample of 17 samples studied of *S.galilaeus* as regards TULLS, LPLLS, CPS, DFSR, AFSR, & VF counts, all Lake Nasser and Ismailia samples exhibited no association between sex and different meristic counts considered; also the accumulative information exhibited insignificant sexual differences. Since Lake Nasser and Ismailia samples showed homogeneous results, pooling of data was possible . The pooled data revealed association between sex and LPLLS & LULLS counts of Lake Nasser and TLLLS counts of Ismailia.

As regards LPLLS, LULLS, TLLLS, DFSR (also in 1990) & TV counts, only Lake Nasser samples of S. *galilaeus* within year class 1989 were heterogeneous (Table 5). The other samples were homogeneous in the remainder localities in different year classes. Accordingly, Lake Nasser samples in 1989 and 1990 represent different local populations of the same locality.

In meristic characters studied except TLLLS, AFSR & TGR, year-to-year variations were not recorded in Lake Nasser populations of *S.galilaeus* (Table 5). Geographical variations of *S.galilaeus* were recorded by all meristic characters studied in different years (except by UULLS in 1989 and by LULLS, UULLS, CPS, DFS, DFSR & PCV in 1990). Lake Nasser and Ismailia populations of *S.galilaeus* may be considered as isolated races.

The distributions of the meristic characters considered in the present investigation were compared with those of other authors working on the same species at different Egyptian regions (Tables 6-8). These tables and the previous ones refer to the fewer geographic variations in the majority of meristic characters of

T.zillii in spite of the wide spectrum of environmental factors; gill rakers and upper pored lateral line scale counts exhibited obvious differences between the populations of that species. Little geographic differences were revealed by the means of the meristic characters (except those of gill rakers of Lake Nasser and Ismailia) of S. *galilaeus*, whereas the patterns of distributions of these characters referred to obvious geographic variations; Ismailia distributions included meristic counts that not found in other regions. In some meristic characters of *O.niloticus*, the patterns of distributions exhibited geographic variations, especially between Ismailia and upper Egypt populations. No clear association between the meristic counts of Tilapiine species studied and latitude can be detected in Egypt.

Figure 3 shows the overall pattern of intra- and inter-specific variations of the species studied in relation to *Oreochromis aureus (BISHARA, 1973)* from Lake Manzalah and *Tilapia ismailiaensis (MEKKAWY, 1995b)* from Ismailia canal. *BISHARA (1973)* recorded low gill raker counts in *O.aureus* (10 & 12) in three specimens only; such low counts may be due to misidentification, therefore, they were not taken into consideration in the present comparisons. This figure reveals that T.*zillii* and *T.ismailiaensis* populations were clearly separated from those of the remainder species considered. Figure 3 also shows that species populations other than those of *Tilapia* species were divided into two subclusters: the first included Aswan and Ismailia populations of *O.niloticus* and the second grouped the remainder populations of *O.niloticus* and those of S.*galilaeus*, O.*ismailiaensis* and O.*aureus*.

Tables 9-12 exhibit that *O.niloticus* and S.*galilaeus* populations of Egypt were different from those of other African and Asian populations. In Egyptian populations of *O.niloticus*, a wide range of total vertebral counts (25-36) with new counts (> 33) were recorded to differentiate them from those of other regions (Table 9).

DISCUSSION

BEN-TUVIA (1963 a,b) mentioned that the number of vertebrae of *Sardinella aurita* varies according to the water temperature, and since that fish spawns more than once during the season, there is a progressive decrease in the number of vertebrae of larvae spawned later, because the sea water becomes warmer as the summer progresses. *PIVNICKA (1970)* found that the means for almost all the meristic characters of burbot vary in association with temperature. *BISHARA (1973)* reported that the effect of temperature may explain the considerable wide range in the number of fin rays of *Tilapia* species which occurred in the following order: *O.niloticus*, O.*aureus*, S.*galilaeus* and *Tilapia zillii* since the fish have extended spawning period which amounts to about 9 months; some populations develop the early stages in the highest temperature of summer months, while others develop their early stages in comparatively lower temperature during spring and autumn. Similar conclusions were recorded in the present work for *O.niloticus*, S.*galilaeus* and T.*zillii* and no obvious trends towards the increase or decrease of the meristic characters considered with latitude were recorded. The absence of a definite trend toward increase or decrease with latitude may be due to eutrophication and pollution recorded in the Egyptian lakes; such conditions disturb temperature influences on the meristic characters in the sensitive periods of their production.

Year-to-year variations in meristic characters were reported by *BEN-TUVIA (1963 a,b), RAFAIL (1970)* in *Sardinella aurita* and *Sardinella jussieu* respectively and by *MEKKAWY (1980)* in *Alestes nurse*. *RAFAIL (1970)* interpreted the variability of vertebral counts from year to year to be due to year-to-year variations in the physical environment during spawning and early developmental stages. However, *RAFAIL (1970)* found that the vertebral counts of *Sardinella sirm* did not change from year to year in the same locality and he attributed this result to the relative insensitivity of vertebral number of that species to environmental factors during the critical early stages of development. In the present investigation, year-to-year variations were recorded in UPLLS, AFSR, TGR, PCV, VF of *O. niloticus* of Lake Nasser ; no such variations were also recorded in TLLLS, AFSR, TGR of S.*galilaeus*. Moreover, comparing the present results with those of other authors revealed year-to-year variations.

Many investigators tried to assess the relative contributions of genetic or environmental influences on meristic variations. *SCHMIDT (1919)* concluded that while the numbers of fin rays or vertebrae are influenced by the environment, the possible range is determined genetically. *HUBBS (1928)* indicated that environmentally related clinal variation in meristic characters may reflect some degree of genetic differences. *GORDON (1957)* considered that many of the meristic traits that distinguish geographic races of fish are inherited, but that environmental conditions strongly influence the final expression. He thought that variability of such traits may be due to genetic drift. *ITAZAWA (1959)* in a study of *Channa argus*, found that though siblings differed in vertebral count according to the temperature at which they developed, genetic factors seemed to have more effect than environmental ones on the number of vertebrae present. *BARLOW (1961)* believed that regular changes in meristic counts such as those occur in geographic clines may reflect adaptive changes of genetic nature and he reviewed evidence that there is sometimes a selective advantage in a species having a given number of meristic elements in a given environmental situation. Thus, one may conclude that the meristic variations of geographic races or isolates are based partly upon environmental modifications, the extent of which is partially controlled by the genotype in an adaptive manner. *McDOWALL (1972)* stated that the assumption, that concordance between meristic variation and ecological-geographic gradients signifies that variation is environmentally induced, and is, therefore, of no significance in taxonomy, is unwarranted. He also mentioned that the assumption, that various isolates are all conspecific because their differences are largely related to environment, may sometimes be invalid. In the present investigation geographic variations in most of the meristic characters of species studied were recorded in different years by different analyses referring to interference of the genetic factors with environmental ones in their determination *LIBOSVARSKY and BISHARA (1987)* studied the morphometric characters of four Egyptian tilapiine species namely: *Oreochromis niloticus*, *Oreochromis aureus*, *Sarotherodon galilaeus* and *Tilapia zillii*. These authors discriminated in a multivariate shape sense between the first three species as one cluster and *Tilapia zillii* as another one. *Oreochromis aureus* occupied an intermediate position between *Oreochromis niloticus* and *Sarotherodon galilaeus* in terms of some shape patterns (raw traditional characters) and became in the side of *Oreochromis niloticus* in terms of some other ones (indices and residuals). Using multivariate analyses of traditional and truss morphometric size and shape patterns, *MOHAMAD (1994)* gave no obvious discrimination between four tilapiine species namely: *Oreochromis niloticus*, *Oreochromis variabilis* (identified later by the author as *Oreochromis ismailiaensis*), *Sarotherodon galilaeus* and *Tilapia zillii*. However, this author recorded geographic morphometric variations in *O. niloticus* and S.*galilaeus* on size and shape bases. The meristic distributions and patterns of variations, recorded in the present work in univariate and multivariate senses, revealed obvious intra- and inter-specific variations. T.*zillii* became completely differentiated from the remainder tilapiine species studied in terms of the majority of patterns of variations illustrated. Also, Lake Nasser populations of *O.niloticus* and S.*galilaeus* were clearly separated from those of Ismailia. *Oreochromis ismailiaensis* occupied an intermediate position between Ismailia populations in a multivariate sense, whereas in univariate sense it occupied an intermediate position according to some meristic characters, or became nearer to *O.niloticus* or to S.*galilaeus* according to another ones. *MEKKAWY (1995a)* discriminated between that species and *O.niloticus*, S.*galilaeus* and *O.aureus* by electrophoretic analysis of their muscle proteins. He also pointed out that *O.ismiliaensis* was clearly differentiated from O.*aureus* in their external morphology including coloration. In the present work, O.*ismailiaensis* was grouped with the majority of S.*galilaeus* populations and some of *O.niloticus* populations, where-as *O.aureus* was clustered with Lake Manzalah population of S.*galilaeus*. Accordingly, one can conclude that inspite of the broad meristic size-free variations of the tilapiine species studied, their usage in race and species identification is more preferable than that of the morphometric characteristics.

On the bases of the present results, and those of *BISHARA (1973)*, *LEVEQUE <u>et</u> <u>al</u>. (1992), and MEKKAWY (1995 a,b)*, the following key for the field identification of the Egyptian tilapiine species considered was built up.

1- Lower pharyngeal bone broader than long with anterior lamella not larger than dentigerous surface; 9-20 total gill-rakers on the first arch; 7-15 lower pored lateral line scales .... **2**.

-Lower pharyngeal bone longer than broad with anterior lamella longer than dentigerous surface; 18-34 total gill-rakers on the first arch; 10-24 lower pored lateral line scales .... **3**.

2- Body elongated with straight ventral outline; straight head profile; relatively large eyes with extreme dorsolateral positions; dorsal fin originating just above the vertical of the posterior edge of the operculum; the width of the lower pharyngeal in its length is 1.66; 9 wide vertical bars on the flank with more obvious longitudinal lines; neither regular nor irregular yellow or white spots on the black caudal and dorsal fins.......................*Tilapia ismailiaensis*.

-Body oval with curved ventral outline; slightly curved head profile; relatively small eyes with lateral positions; dorsal fin originating behind the vertical of the posterior edge of the operculum; the width of the lower pharyngeal in its length is 1.33; no obvious vertical bars on the flank; no obvious longitudinal lines; regular or irregular yellow or white spots on the caudal and dorsal fins ....*Tilapia zillii*.

3- Scales between pectorals and pelvics much smaller than scales on the flanks; genital papilla of male and female well developed; 12-25 upper pored lateral line scales with mode of 23; 10-24 lower pored lateral line scales with mode of 18 .... **4**.

-Scales between pectorals and pelvics not much smaller than scales on the flanks; genital papilla of male small and simple; 12-24 upper pored lateral line scales with mode of 20; 11-20 lower pored lateral line scales with mode of 16 ....*Sarotherodon galilaeus*.

4- Caudal fin with regular vertical black size-related stripes (5-13) throughout its depth; 27-33 total dorsal fin rays and spines with mode of 30; 18-34 total gill-rakers on the first arch with mode of 29 .... *Oreochromis niloticus*.

-Caudal fin without regular vertical stripes; 26-30 total dorsal fin rays and spines with mode of 29; 20-30 total gill-rakers on the first arch with mode of 25 or 26 .... **5**.

5- Red caudal fin with its pink dorsal side; head with curved profile; silvery iris ; pink red color along the dorsal fin edge; no obvious vertical bars on the body; 20-30 total gill-rakers with mode of 25 (24.61 ± 1.93)........... ....*Oreochromis aureus*.

-Dark red caudal fin with a black pyramid extending from its base to its margin; head with straight profile; black iris with a red circle around the pupil; black striations in a limited portion on the posteriormost soft dorsal fin rays; 7-8 obvious vertical bars on the body; 20- 29 total gill-rakers with mode of 26 (26.42 ± 1.78)......... ....*Oreochromis ismailiaensis*.

ACKNOWLEDGMENTS

I would like to thank S. H. Mohamad, Assistant Lecturer, Faculty of Education, Suez Canal University, for her help in specimen collection.

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Table 1: Cont.

Counts	*O. niloticus* Ismailia M.	F.	C.	*O. niloticus* Aswan M.	F.	C.	*O. ismailiaensis* Ismailia M.	F.	C.	*S. galilaeus* Ismailia M.	F.	C.	*S. galilaeus* Aswan M.	F.	C.	*T. zillii* Ismailia M.	F.	C.
Lower unpored lateral line scale counts																		
9	2	-	2															
10	1	-	1	1	1	2												
11				2	2	4	2	1	3	2	-	2						
12	2	1	3	17	5	22	6	5	11	3	2	5	2	2	4			
13	8	1	9	31	11	42	10	7	17	7	6	13	17	5	22	1	-	1
14	9	6	15	48	27	75	15	8	23	7	5	12	62	24	86	5	4	9
15	11	14	25	55	28	83	9	7	16	14	13	27	72	71	143	10	2	12
16	7	4	11	28	20	48	8	6	14	8	10	18	48	23	71	9	3	12
17	2	2	4	10	13	23	2	-	2	5	7	12	5	6	11	2	1	3
18	1	2	3	1	2	3	-	1	1	1	-	1	2	-	2	3	1	4
19	1	1	2	3	-	3										1	-	1
20				1	-	1				-	1	1				1	-	1
Total lower lateral line scale counts																		
25																-	1	1
26	-	1	1				1	1	2	1	3	4						
27							7	1	9	2	-	2						
28	2	1	3				20	7	27	2	5	7	3	3	6	2	-	2
29	1	2	3	3	1	4	11	6	17	4	12	16	20	13	33	7	6	13
30	4	5	9	5	1	6	2	-	2	20	9	29	61	44	105	19	7	26
31	13	8	21	27	11	38				11	8	19	97	61	158	17	18	35
32	21	9	30	61	31	92				10	13	23	25	8	33	7	7	14
33	9	7	16	83	47	130				1	-	1	5	3	8	5	-	5
34	1	2	3	19	19	38							1	-		-	1	1
35				2	1	3												
36				-	1	1												

Table 1: Cont.

Counts	*O. niloticus*						*O. ismailiaensis*			*S. galilaeus*						*T. zillii*		
	Ismailia			Aswan			Ismailia			Ismailia			Aswan			Ismailia		
	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.
Caudal peduncle scale counts																		
15	-	1	1				-	1	1	1	2	3	1	-	1	6	3	9
16	1	1	2	1	-	1	7	6	13	17	22	29	47	40	87	32	9	41
17	5	1	6	4	-	4	21	12	33	9	9	18	86	50	136	3	2	5
18	8	7	15	24	18	42	26	13	39	12	8	30	65	32	97			
19	22	13	35	70	40	110	5	5	10	9	4	13	13	12	25			
20	10	6	26	66	32	98		1	1	2	3	5	4	-	4			
21	2	2	4	46	24	70												
22	3	2	5	2	5	7												
23				1	-	1												
Dorsal fin spines																		
XIV										1	1	2				2	2	4
XV	1	4	5				9	9	18	10	11	21	2	1	5	35	11	46
XVI	8	3	11	8	3	11	45	27	72	37	31	68	182	116	298	5	3	8
XVII	34	24	58	144	80	230	5	4	9	2	7	9	32	19	53			
XVIII	8	3	11	60	36	99												
Soft rays of dorsal fin																		
9														1	1			
11	-	1	1				-	2	2	1	1	2				11	6	17
12	19	12	33	17	10	27	18	4	22	16	16	32	12	12	25	26	6	32
13	27	16	43	123	55	181	38	32	70	29	28	57	107	65	172	4	3	7
14	2	6	8	73	47	125	3	2	5	5	4	9	95	57	154			
15				2	5	7							1	-	1			

Table 1: Cont.

Counts	*O. niloticus*						*O. ismailiaensis*			*S. galilaeus*						*T. zillii*		
	Ismailia			Aswan			Ismailia			Ismailia			Aswan			Ismailia		
	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.
Dorsal fin spines and rays																		
24															1			
26									1			2						15
27			4						2			7						28
28			4			1			24			29			11			9
29			29			11			64			50			157			1
30			35			142			5			9			177			
31			12			161									7			
32						23												
33						2												
Soft rays of anal fin																		
7				-	1	1												
8	1	1	2				1	-	1							13	2	15
9	19	12	31	26	9	37	11	5	16	6	6	12				22	11	33
10	27	18	45	142	78	234	39	32	71	25	31	56	10	10	20	6	1	7
11	3	4	7	33	30	63	8	3	11	19	11	30	139	77	218			
12				1	1	2				1	2	3	70	49	120			
13													-	1	1			

Table 1: Cont.

Counts	*O. niloticus*						*O. ismailiaensis*			*S. galilaeus*						*T. zillii*		
	Ismailia			Aswan			Ismailia			Ismailia			Aswan			Ismailia		
	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.
Total gill rakers																		
10																1	-	1
11																2	1	3
12																13	5	18
13																14	6	20
14																9	2	11
15																1	-	1
18				-	1	1												
19										1	-	1						
20							1	-	1									
21										-	1	1						
22							-	1	1	-	2	2						
23	1	-	1				1	-	1	1	4	5						
24	1	-	1				6	3	9	8	6	14	2	1	3			
25	2	4	6	2	-	2	7	9	16	9	4	13	8	4	12			
26	5	2	7	2	-	3	11	7	18	12	8	20	34	11	45			
27	7	3	10	9	4	13	9	8	17	6	6	12	50	31	82			
28	9	2	11	34	17	52	12	4	16	8	4	12	59	46	106			
29	11	5	16	54	36	90	4	8	12	3	4	7	40	22	62			
30	2	7	9	53	30	86				1	3	4	21	12	34			
31	5	8	13	32	20	52				-	1	1	2	2	4			
32	5	2	7	16	7	24							2	1	3			
33	-	1	1	11	3	14												
34				1	-	1												

Table 1: Cont.

Counts	*O. niloticus*						*O. ismailiaensis*			*S. galilaeus*						*T. zillii*		
	Ismailia			Aswan			Ismailia			Ismailia			Aswan			Ismailia		
	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.	M.	F.	C.
Total vertebral counts																		
27	1	1	2				-	1	1	1	-	1				5	2	7
28							1	-	1	5	6	11	3	1	4	33	10	43
29	2	2	4	2	1	3	8	1	9	7	11	18	140	103	249	3	2	5
30	7	5	12	10	4	14	30	22	52	13	23	54	129	73	212	-	1	1
31	31	16	47	158	72	236	17	11	28	5	8	13	7	3	10			
32	8	10	18	91	45	137	2	1	3	1	-	1	-	-	1			
33	1	-	1	2	2	4												
Precaudal vertebral counts																		
14							2	-	2	1	1	2				11	4	15
15	2	3	5	2	2		10	8	18	12	14	26				28	10	38
16	24	14	38	81	34		43	25	68	34	29	63				2	1	3
17	24	16	40	180	88		4	3	7	4	5	9						
18				3	1													
Caudal vertebral counts																		
11	1	-	1															
12	-	1	1				-	1	1	2	1	3	-	1	1	4	2	6
13	1	-	1	4	1	5	5	2	7	8	9	17	158	105	263	27	7	34
14	24	12	36	106	46	152	30	16	46	34	30	64	119	73	192	8	4	12
15	22	19	41	145	78	223	23	16	39	7	8	15	3	1	4	1	1	2
16	-	1	1	9	3	12	1	1	2									
17	1	-	1															

Cont.

al n	*Oreochromis niloticus*				*Sarotherodon galilaeus*			
	Assiut		Ismailia		Assiut		Ismailia	
	Males	Females	Males	Females	Males	Females	Males	Females
							1	1
				1			1	
					3		3	5
	1		1	1	4	4	5	7
	6	6	1	1			2	2
			1					
						1	1	1
	1	1	1		138	97	2	4
	7	2	6	4	116	56	25	19
	55	24	15	9	3	1	4	5
	9							
			1					
	2				13	6	2	1
	96	42	16	7	4	2	1	1
	82						1	
		1						
	1							
	2	1						

2 : Results of intra- and inter-specific differences of tilapiine species studied by Chi-square
= insignificant; * = significant at 0.05; **= significant at 0.01).

s	Sex differences						Locality differences		Interspecific
	O. niloticus		*S. galilaeus*		*O.ismailiaensis*	*T. zillii*	*O.*	*S.*	differences
	Aswan	Ismailia	Aswan	Ismailia	Ismailia	Ismailia	*niloticus*	*galilaeus*	
	-	-	-	-	-	-	*	**	**
	*	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
	-	-	*	-	-	-	-	-	-
	-	-	**	-	-	-	-	-	-
	-	-	-	*	-	-	-	-	-
	-	-	-	-	-	-	**	**	**
	-	-	-	-	*	-	**	**	**
	-	-	-	-	-	-	**	**	**
	-	-	-	-	-	-	**	**	**
	-	*	-	-	-	-	**	**	**
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	**	**	**
	-	-	-	-	-	-	-	-	-

Table 3 :Canonical variates and principal components derived from CVA and PCA of certain meristic characters of tilapiine populations considered as combined sexes ; SL was included in PCA (coefficient x 1000).

Meristic characters	Canonical variates			Principal components				
	CVI	CVII	CVIII	PCI	PCII	Sheared PCII	PCIII	Sheared PCIII
SL	-	-	-	858	043	046	-473	-466
UPLLS	044	-178	109	099	-199	004	176	176
UULLS	007	-160	122	-058	962	001	026	026
LPLLS	025	058	-046	196	-036	010	443	442
LULLS	014	045	-100	-019	025	-001	-279	-278
CPS	083	-098	-099	129	-060	007	142	142
DFS	162	346	-609	082	-022	004	079	079
DFSR	039	333	-304	085	033	005	017	017
AFSR	-166	701	-044	085	103	005	-035	-034
TGR	002	219	093	404	116	022	638	637
PCV	-538	245	445	069	-005	004	075	075
CV	-494	-028	492	038	-038	002	137	136
TV	633	-311	194	055	-020	002	104	103
Variance	59.84	34.84	4.40	49.8	25.9		10.69	

Table 4 : Variability of certain meristic characters of *O. niloticus* (combined sexes) within and between localities and between year classes.

Meristic counts	UPLLS			UULLS			TULLS			LPLLS			LULLS		
Comparison	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P
1- Homogenity of samples within localities and within year classes (YC):															
a- Aswan, YC 1989	53.9	40	0.1-0.05	49.3	40	0.2-0.1	43.8	32	0.05-0.25	124.4	80	P<0.005	63.2	72	0.75-0.7
b- Aswan, YC 1990	7.9	12	0.9-0.75	6.9	8	0.75-0.5	2.6	4	0.75-0.5	8.7	14	0.9-0.75	24.7	20	0.25-0.1
c- Ismailia, YC 1991	14.9	10	0.25-0.1	6.4	10	0.9-0.75	7.5	4	0.25-0.1	35.7	20	0.02-0.01	18.1	18	0.5-0.25
2- Within locality and between year classes:															
Aswan, YC 1989,1990	13.9	6	0.05-0.03	2.8	5	0.75-0.5	4.6	4	0.5-0.25	11.7	11	0.5-0.25	8.0	10	0.75-0.5
3- Within year classes and between localities:															
a- Aswan and Ismailia, YC 1989	74.1	7	P<0.01	2.9	5	0.75-0.5	30.1	5	P<0.01	63.9	11	P<0.01	1.2	9	P>0.995
b- Aswan and Ismailia, YC 1990	4.3	6	0.75-0.5	0.4	4	0.99-0.975	12.3	4	0.25-0.01	33.2	11	P<0.01	8.8	11	0.75-0.5

Meristic counts	TLLLS			CPS			DFS			DFSR			AFSR		
Comparison	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P
1- Homogenity of samples within localities and within year classes (YC):															
a- Aswan, YC 1989	125.1	56	<0.005	103	56	<0.005	21.9	16	0.25-0.1	73.7	24	<0.01	57.3	32	<0.005
b- Aswan, YC 1990	4.6	6	0.75-0.50	4.9	8	0.9-0.75	2.2	4	0.75-0.5	12.7	6	0.05-0.025	5.7	6	0.5-0.25
c- Ismailia, YC 1991	13.4	10	0.25-0.10	13.1	8	0.25-0.1	6.3	6	0.5-0.25	17.1	6	0.01-0.005	0.9	4	0.95-0.9
2- Within locality and between year classes:															
Aswan, YC 1989,1990	5.7	7	0.75-0.50	4.7	7	0.75-0.5	1.1	2	0.75-0.5	3	3	0.5-0.25	11	4	0.05-0.025
3- Within year classes and between localities:															
a- Aswan and Ismailia, YC 1989	80.4	8	<0.01	21.3	7	<0.01	58.8	3	<0.01	67.5	3	<0.01	72.6	5	<0.01
b- Aswan and Ismailia, YC 1990	31.8	7	<0.01	34.8	7	<0.01	13.4	3	<0.01	18.7	3	<0.01	24.9	3	<0.01

Meristic counts	TGR			PCV			CV			TV			VF		
Comparison	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P
1- Homogenity of samples within localities and within year classes (YC):															
a- Aswan, YC 1989	76.9	72	0.3-0.25	24.7	24	0.5-0.25	23.9	24	0.5-0.25	28.1	32	0.6-0.5	78.3	80	0.6-0.5
b- Aswan, YC 1990	20.3	16	0.25-0.1	3.1	4	0.75-0.5	2.2	4	0.75-0.5	4.7	6	0.75-0.5	25.8	8	<0.005
c- Ismailia, YC 1991	18.1	20	0.75-0.5	10.4	4	0.05-0.025	10.8	4	0.05-0.025	5.6	4	0.25-0.1	21.5	10	0.025-0.01
2- Within locality and between year classes:															
Aswan, YC 1989,1990	24.0	10	0.01-0.005	9.8	3	0.025-0.01	3.3	3	0.5-0.25	3.3	4	0.75-0.5	45.2	11	<0.005
3- Within year classes and between localities:															
a- Aswan and Ismailia, YC 1989	42.6	9	<0.01	15.8	3	<0.01	69.9	5	<0.01	66.5	5	<0.01	89.7	12	<0.005
b- Aswan and Ismailia, YC 1990	19.8	9	0.025-0.01	8.1	2	0.025-0.01	8.1	3	0.02-0.025	17.9	5	<0.01	24.6	7	<0.005

Table 5 : Variability of certain meristic characters of *S. galilaeus* (combined sexes) within and between localities and between year classes.

Meristic counts	UPLLS			UULLS			TULLS			LPLLS			LULLS		
Comparison	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P
1- Homogenity of samples within localities and within year classes (YC):															
a- Aswan ,YC 1989	67.9	72	0.6-0.5	72.6.	64	0.2-0.1	58.6	48	0.2-0.1	130.0	56	<0.005	82.2	48	<0.005
b- Aswan ,YC 1990	10.4	8	0.25-0.1	7.5	8	0.5-0.25	6.9	4	0.25-0.1	12.2	10	0.5-0.25	14.8	10	0.25-0.1
c- Ismailia ,YC 1991	12.1	12	0.5-0.25	10.9	10	0.5-0.25	7.7	10	0.75-0.5	17.6	20	0.75-0.5	16.3	12	0.25-0.1
2- Within locality and between year classes:															
Aswan ,YC 1989,1990	5.5	9	0.9-0.75	2.3	8	0.97-0.95	3.1	6	0.9-0.7	4.8	7	0.75-0.5	4.6	6	0.75-0.5
3- Within year classes and between localities:															
a- Aswan and Ismailia ,YC 1989	43.8	10	<0.01	2.9	8	0.95-0.9	70.1	7	<0.01	85.5	9	<0.01	36.5	7	<0.01
b- Aswan and Ismailia ,YC 1990	18.0	6	<0.01	10	5	0.1-0.05	49.2	3	<0.01	20.3	6	<0.01	4.3	5	0.75-0.5

Meristic counts	TLLLS			CPS			DFS			DFSR			AFSR		
Comparison	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P
1- Homogenity of samples within localities and within year classes (YC):															
a- Aswan ,YC 1989	113.6	48	<0.005	40.6	40	0.5-0.4	20.5	16	0.25-0.1	145.3	32	<0.005	24.3	16	0.1-0.05
b- Aswan ,YC 1990	5.4	6	0.5-0.25	4.1	6	0.75-0.5	2.6	4	0.75-0.5	26.1	6	<0.005	3.2	4	0.75-0.5
c- Ismailia ,YC 1991	18.3	10	0.1-0.05	18.2	10	0.1-0.05	12.9	6	0.05-0.03	12.1	6	0.1-0.05	4.8	4	0.5-0.25
2- Within locality and between year classes:															
Aswan ,YC 1989,1990	15.4	6	0.025-0.01	8.5	5	0.25-0.1	1.3	2	0.75-0.5	9.3	4	0.1-0.05	10	3	0.03-0.01
3- Within year classes and between localities:															
a- Aswan and Ismailia ,YC 1989	65.5	8	<0.01	36.3	5	<0.01	84.3	2	<0.005	32.8	3	<0.005	142.2	3	<0.01
b- Aswan and Ismailia ,YC 1990	20.9	4	<0.01	7.6	4	0.25-0.1	1.9	2	0.5-0.25	4.5	3	0.25-0.1	17.1	3	<0.01

Meristic counts	TGR			PCV			CV			TV			VF		
Comparison	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P	χ^2	DF	P
1- Homogenity of samples within localities and within year classes (YC):															
a- Aswan ,YC 1989	72.8	64	0.2-0.1	17.6	16	0.5-0.25	26.6	24	0.5-0.25	47.3	32	0.03-0.01	71.4	56	0.2-0.1
b- Aswan ,YC 1990	12.9	16	0.75-0.5	2.3	4	0.75-0.5	2.3	2	0.5-0.25	4.3	4	0.5-0.25	8	8	0.5-0.25
c- Ismailia ,YC 1991	19.6	14	0.5-0.25	3.5	6	0.75-0.5	5.9	6	0.5-0.25	10.2	10	0.5-0.25	16.3	20	0.75-0.5
2- Within locality and between year classes:															
Aswan ,YC 1989,1990	26.5	8	<0.005	4.1	2	0.25-0.1	1.4	3	0.75-0.5	2.3	4	0.75-0.5	5.9	7	0.75-0.5
3- Within year classes and between localities:															
a- Aswan and Ismailia ,YC 1989	92.0	12	<0.005	107.2	2	<0.005	69.8	3	<0.005	14.9	4	<0.005	143.1	8	<0.005
b- Aswan and Ismailia ,YC 1990	19.3	9	0.025-0.01	1.9	2	0.5-0.25	25.7	3	<0.005	15.5	3	<0.005	26.7	6	<0.005

Table 6 : Comparisons of some meristic characters of *O. niloticus* in different Egyptian waters.

Counts	Bishara (1973)	Saleh (1980)		Present work	
	Lake Manzalah	The Nile at Sohag	The Nile at Aswan	Aswan	Ismailia
		Upper pored lateral line scale counts			
12					1
17		2			
18		2	1		
19		1	2	2	1
20		7	-	2	4
21		16	5	30	7
22		22	33	118	34
23		28	47	146	30
24		4	8	38	4
25		1	1	3	
26		1	-	-	
27		-	1		
$\bar{X}\pm SD$		21.91±1.56	22.90±1.84	22.89±0.91	22.12±1.49
		Soft anal fin rays ***			
7				1	
8		29	7	-	2
9	50	74	96	37	31
10	58	16	11	234	45
11		1	1	63	7
12				2	-
$\bar{X}\pm$	9.54±0.50	8.91±0.64	9.05±0.44	10.08±0.58	9.67±0.66
		Total vertebral counts			
25	1				
26	1				
27					2
28	3				
29	1	1		3	4
30	9	7	1	14	12
31	13	13	4	236	47
32	5	68	29	137	18
33	2	18	40	4	1
34	3				
35	1				
36	2				
$\bar{X}\pm SD$	31.02±2.27	31.89±0.79	32.46±0.67	31.32±0.59	30.91±0.98
		Precaudal vertebral counts			
14		1			
15				4	5
16		11		115	38
17		58	29	268	40
18		37	45	4	
$\bar{X}\pm SD$		17.22±0.7	17.62±0.5	16.69±0.5	16.42±0.6
		Caudal vertebral counts			
11					1
12					1
13			1	5	1
14		35	16	152	36
15		72	50	223	41
16			7	12	1
17					1
$\bar{X}\pm SD$		14.67±0.5	14.85±0.6	14.62±0.57	14.49±0.77

*** Anal spines = III

Table 6 .Cont.

Counts	Bishara (1973)	Saleh (1980)		Present work	
	Lake Manzalah	The Nile at Sohag	Aswan	Aswan	Ismailia
		Soft rays of dorsal fin			
11	7	29	4	-	1
12	42	56	52	27	33
13	55	40	61	181	42
14	2			125	8
15	-			7	
X̄	12.49	12.09	12.49	13.33	12.68
SD	0.65	0.74	0.57	0.65	0.66
		Dorsal fin spines			
XV	1				5
XVI	26	8	2	11	11
XVII	72	96	78	230	58
XVIII	7	21	35	99	11
XIX			2		
X̄	16.80	17.10	17.32	17.26	16.88
SD	0.56	0.74	0.54	0.51	0.69
		Dorsal fin rays and spines			
25					
26					
27	3	1			4
28	8	21	1	1	4
29	53	60	32	11	29
30	39	39	73	142	35
31	3	4	11	161	12
32				23	
33				2	
X̄	29.29	29.19	29.80	30.59	29.56
SD	0.77	0.78	0.61	0.70	0.96
		Total gill rakers			
18				1	
20		3	1		
21	7	6	-		
22	11	4	1		
23	7	4	-		1
24	5	11	2		1
25	5	18	3	2	6
26	14	14	9	3	7
27	4	11	16	13	10
28	14	21	25	52	11
29	9	17	22	90	16
30	7	12	23	86	9
31	14	5	8	52	13
32	1	3	2	24	7
33			1	14	1
34				1	
X̄	26.49	26.61	28.37	29.64	28.67
SD	3.29	2.86	2.01	1.64	2.23

Table 7 : Comparisons of some meristic characters of *S. galilaeus* in different Egyptian waters

Counts	Bishara (1973)	Saleh (1980)	Present work	
	Lake Manzalah	The Nile at Aswan	Aswan	Ismailia
		Upper pored lateral line scale counts		
12				3
15			1	-
16			3	1
17			2	1
18		2	8	6
19		7	50	13
20		20	164	29
21		15	99	22
22		10	18	12
23		3	1	3
24		1	1	5
25		1		-
$\bar{X}$		20.71	20.15	20.2
SD		1.37	1.02	2.13
		Soft rays of dorsal fin		
9			1	
10	1			
11	7			2
12	43	11	25	30
13	35	38	172	56
14	1	3	154	9
15	2		1	-
$\bar{X}$	12.38	12.85	13.36	12.74
SD	0.79	0.50	0.66	0.65
		Dorsal fin spines		
XIV	4			2
XV	18		5	21
XVI	58	46	298	68
XVII	9	6	53	9
$\bar{X}$	15.81	16.12	16.13	15.84
SD	0.67	0.32	0.38	0.59
		Dorsal fin spines and rays		
24			1	
25				
26	1			2
27	10			7
28	50	9	11	29
29	27	36	157	50
30		7	177	9
31			7	
$\bar{X}$	28.17	28.96	29.49	28.59
SD	0.67	0.56	0.66	0.84

Table 7 : Cont.

Counts	Bishara (1973)	Saleh (1980)	Present work	
	Lake Manzalah	The Nile at Aswan	Aswan	Ismailia
Total gill rakers				
19				1
20	5	1		-
21	7			1
22	9			2
23	6			5
24	8	2	3	14
25	15	13	12	13
26	19	10	45	20
27	7	17	82	12
28	4	7	106	12
29	3	5	62	7
30		4	34	4
31	1		4	1
32			3	-
$\bar{X}$ ± SD	24.33 ± 2.69	26.66 ± 1.79	27.81 ± 1.40	26.02 ± 2.18
Soft anal fin rays ***				
9	5	1		12
10	67	34	20	56
11	17	25	218	30
12		2	120	3
13			1	
$\bar{X}$ ± SD	10.13 ± 0.48	10.46 ± 0.59	11.28 ± 0.56	10.24 ± 0.69
Total vertebral counts				
27				1
28	2		4	11
29	18	4	249	18
30	27	2	212	54
31	1	24	10	13
32		6	1	1
$\bar{X}$ ± SD	29.56 ± 0.62	30.89 ± 0.82	29.49 ± 0.57	29.71 ± 0.91
Precaudal vertebral counts				
14				2
15			11	26
16		11	429	63
17		19	25	9
18		6		
$\bar{X}$ ± SD		16.86 ± 0.68	15.79 ± 1.69	15.79 ± 0.62
Caudal vertebral counts				
12			1	3
13		6	263	17
14		23	192	64
15		5	4	15
16		2		
$\bar{X}$ ± SD		14.08 ± 0.73	13.43 ± 0.52	13.92 ± 0.66

*** Anal spines = III

Table 8 : Comparisons of some mesistic characters of *Tilapia zillii* in different Egyptian waters

Counts	Bishara (1973)		Saleh (1980)		Present work
	Lake Manzalah	Lake Qarun	The Nile at Sohag	Lake Qarun	Ismailia
			Upper pored lateral line scale counts		
6					1
8					1
10					2
15					1
16					2
17			2		1
18			2	2	5
19			10	4	6
20			31	13	20
21			28	14	8
22			8	5	
23			1	-	
24			1	1	
$\bar{X}$			20.37	20.51	18.51
SD			1.16	1.17	3.41
			Soft anal fin rays		
7			6	2	
8	8	2	86	31	15
9	68	79	33	2	33
10		3			7
$\bar{X}$	8.89	9.01	8.22	8.00	8.85
SD	0.31	0.25	0.52	0.34	0.62
			Soft rays of dorsal fin		
10	2	1	3		
11	29	18	36	9	17
12	61	19	76	25	29
13	6	18	12	1	7
$\bar{X}$	11.83	11.96	11.76	11.77	11.81
SD	0.56	0.85	0.65	0.49	0.65
			Dorsal fin spines		
XIV	3		18		2
XV	72	38	101	26	43
XVI	23	18	8	9	8
$\bar{X}$	15.20	15.32	14.92	15.26	15.11
SD	0.48	0.47	0.45	0.44	0.42
			Dorsal fin spines and rays		
25			6		
26	22	9	37	5	15
27	61	23	75	24	28
28	15	23	9	6	9
29		1			1
$\bar{X}$	26.93	27.29	26.69	27.03	26.92
SD	0.61	0.76	0.68	0.57	0.73

Table 8 : Cont.

Counts	Bishara (1973)		Saleh (1980)	Present work	
	Lake Manzalah	Lake Qarun	The Nile at Sohag	Lake Qarun	Ismailia
		Total vertebral counts			
26		1			
27	4	2	3		7
28	34	53	9	9	43
29	26	6	58	27	5
30			17	8	1
$\bar{X}$	27.28	28.03	29.02	28.98	28.00
SD	1.45	0.44	0.66	0.63	0.54
		Precaudal vertebral counts			
14			34	13	15
15			38	17	38
16			15	14	3
$\bar{X}$			14.78	15.02	14.78
SD			0.72	0.79	0.53
		Caudal vertebral counts			
12					6
13			11	13	34
14			44	20	12
15			32	11	2
$\bar{X}$			14.24	13.96	13.19
SD			0.66	0.74	0.68
		Total gill rakers			
9			3		
10	12		6	11	1
11	18		15	24	3
12	20		37	15	18
13	30		42	10	20
14	7		23	3	11
15	6		9		1
16			5		
17			1		
20			1		
$\bar{X}$	12.21		12.79	11.52	12.74
SD	1.37		1.60	1.11	0.97

Table 9 : Comparisons of total vertebral counts of *O. niloticus* in different waters.

Vertebrae	25	26	27	28	29	30	31	32	33	34	35	36
Asian and African regions (Trewavas, 1983)												
O. n. niloticus												
Israel (coastal)						7	27	1				
Lower Nile							11	3				
Niger							9	1				
Egypt												
Lake Manzalah (Bishara 1973)	1	1	-	3	1	9	13	5	2	3	1	2
The Nile at Sohag Egypt (Saleh, 1980)					1	7	13	68	18			
Lake Nasser, Aswan, Egypt (Saleh, 1980)						1	4	29	40			
Lake Nasser, Aswan, Egypt (present work)					3	14	236	137	4			
Ismailia canal (present work)			2		4	12	47	18	1			

Table 10 : Comparisons of some meristic characters of *O. niloticus* in different waters.

	Dorsal fin spines				Dorsal fin spines & rays						
	XV	XVI	XVII	XVIII	27	28	29	30	31	32	33
Africa (Trewavas, 1983)											
O. n. niloticus											
West Africa	1	2	16	5			3	19	4		
R. Yarkon		6	22	1			2	17	10		
Nile		2	33	6			4	22	14	1	
Egypt											
Lake Manzalah (Bishara, 1973)	1	26	72	7	3	8	53	39	3		
Lake Nasser, Aswan (present work)		11	230	99		1	11	142	161	23	2
Ismailia canal (present work)	5	11	57	11	4	4	29	35	12		

Table 11 : Comparisons of total vertebral counts of *S. galilaeus* in different waters.

Total vertebral counts	27	28	29	30	31	32
Asian & African regions (Trewavas, 1983)						
S.g.galilaeus						
Jordan Valley			15	22	1	
Na'aman, Kishon, Yarkon			5	13	1	
Lower Nile and Khartoum			8	6		
Lake Turkana (Rudolf)						
Lake Albert			6	1		
R.Ubanghi						
W. Africa	1	17	152	16		
Lake Chad						
Lake Manzalah ,Egypt (Bishara, 1973)		2	18	27	1	
Lake Nasser, Aswan,Egypt (Saleh, 1980)			4	2	24	6
Lake Nasser, Aswan, Egypt (Present work)		4	249	212	10	1
Ismailia Canal,Egypt (Present work)	1	11	18	54	13	1

Table 12 : Comparisons of some meristic characters of *S. galilaeus* in different waters.

	Dorsal fin spines				Dorsal fin spines & rays							Soft anal fin rays				
	XIV	XV	XVI	XVII	24	26	27	28	29	30	31	9	10	11	12	13
Asian & African regions (Trewavas, 1983)																
S. g. galilaeus																
Jordan Valley		1	26	4				11	20				16	14		
Medit. rivers			19	2				4	15	2			3	15	1	
Lower Nile & Khartoum		1	27	5				5	26	2			8	10	2	
Lake Turkana		3	4					4	2	1			2	4	1	
Lake Albert		6	9				3	10	2			2	8	3		
Ubangui R.		1	7					6	2				5	2		
West Africa	1	42	120	2			3	30	41	1		3	56	107	2	
Lake Chad		4%	96%													
Egypt																
L. Manzalah (Bishara 1973)	4	18	58	9		1	10	50	27	1		5	67	17		
The Nile at Sohag (Saleh 1980)	-	-	-	-				9	36	7		1	34	25	2	
Lake Nasser, Aswan (Present work)		5	295	53	1			11	157	177	7		20	218	120	1
Ismailia canal (Present work)	2	20	66	9		2	7	29	50	9	-	12	56	30	3	

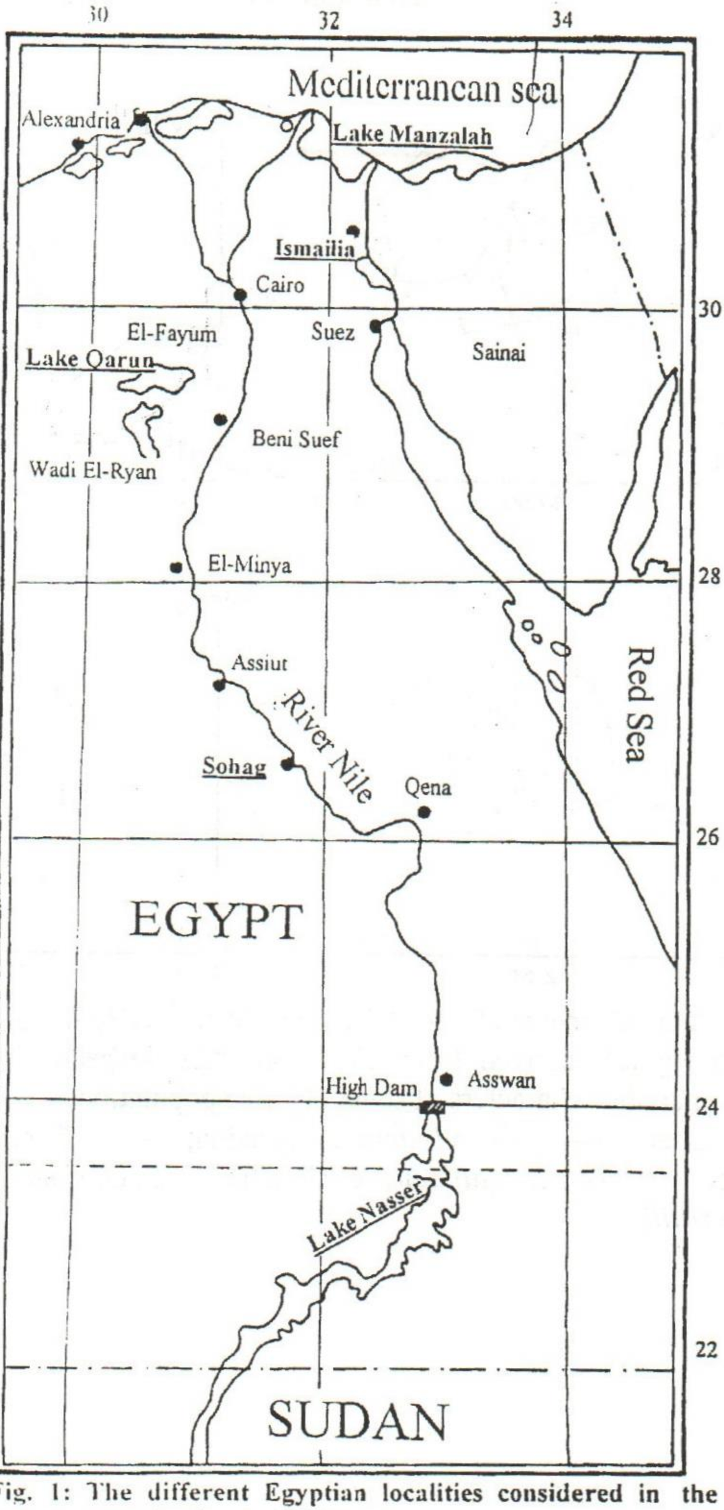

Fig. 1: The different Egyptian localities considered in the present investigation (underlined).

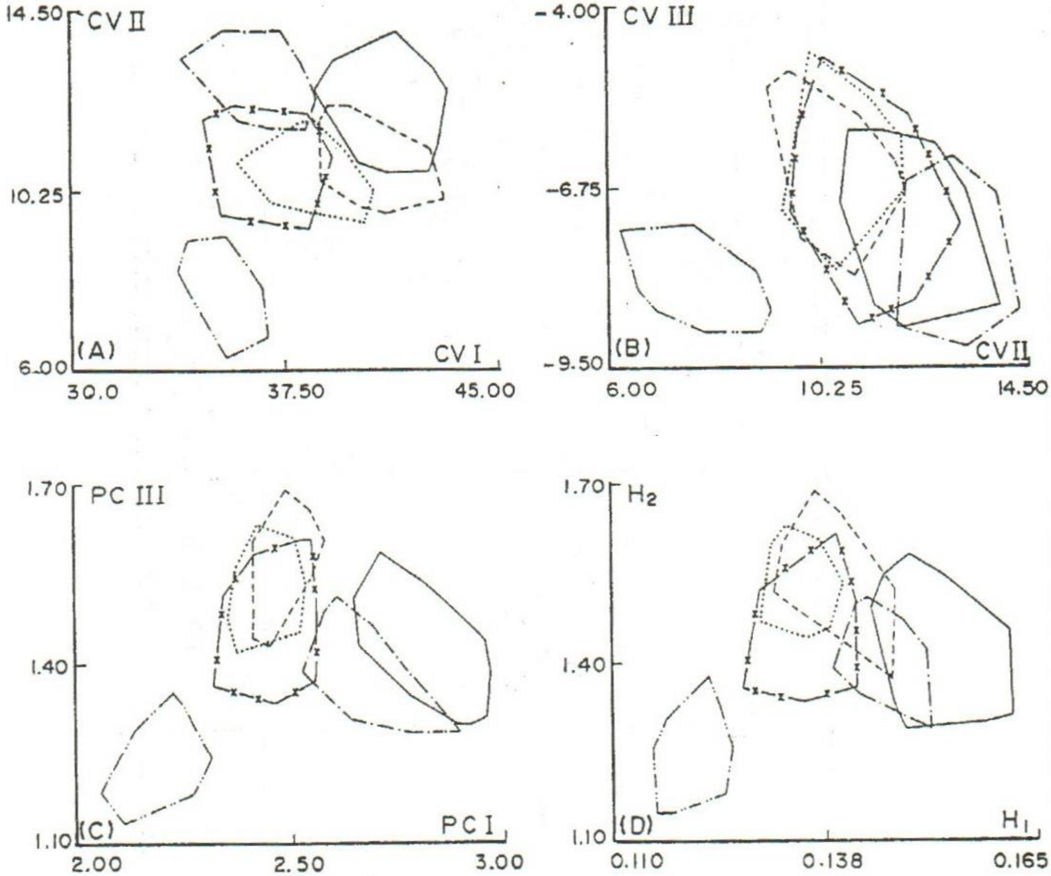

Fig.2 :Plots of scores of CVI, CVII and CVIII (A&B) and of PCI, PCIII(C), H_1 and H_2 (D) derived from CVA and PCA respectively carried out on certain meristic characters of some tilapiine populations (—, *O. niloticus* of Lake Nasser; ------, *O. niloticus* of Ismailia; —-—, *S. galilaeus* of Lake Nasser; -x-x-, *S. galilaeus* of Ismailia; ...., *O. ismailiaensis*; —·—·—, *Tilapia zillii*).

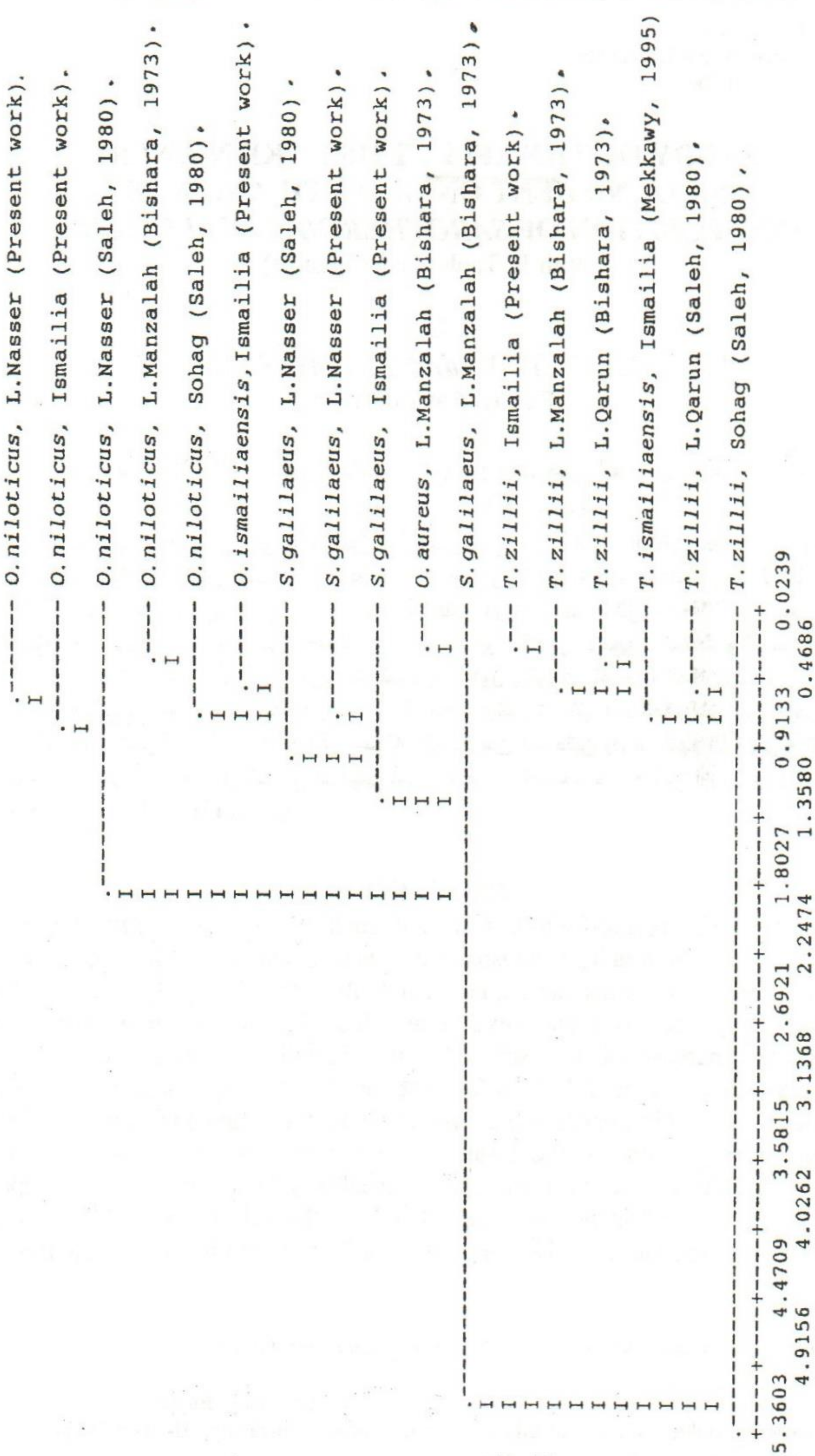

Fig. 3 .Dendrogram from weighted pair group method cluster analysis on Euclidian distance matrix of the meristic characters of the Egyptian tilapiline species studied.