REPRODUCTION OF *TILAPIA NILOTICA L.*

By

S. EL-ZARKA, A.H. SHAHEEN

Institute of Oceanographyand Fisheries Alexandria

and

A.A. EL-ALEEM

Head of the Department of Oceanography

Faculty of Science, University of Alexandria

INTRODUCTION

Tilapia is the most important freshwater fish in U.A.R. Its catch was estimated to be about 70% of the total fish production of the country El-Zarka 1956. The economical importance of its fishery make it desirable to have information on its natural history.

Information about certain aspects of reproduction and estimtes of various stages of development of a fish are essential for the planning of fishery management. Detailed studies on breeding, maturity, spawning and sex ratio of *Tilapia zilli* Gerv. were completed El-Zarka 1956, 1962 ; Imam and Hashim 1960. In the present study particular attention was paid to maturity, spawning, length and age at maturity, and sex ratio for another Tilapid species that is *Tilapia nilotica* L. This is a continuation of the biological study of this fish in Lake, Maruit.

MATERIALS AND METHODS

Monthly samples for this study was investigated from the catch of experimental gears and nets used in Lake Maruit through 1958. The fish were discected to fix their sex and to record the stages of maturity for the males and the females. Also total lengths of the fish (from the tip of the snout to the end of the caudal fin) were measured to the nearest millimeters for the two sexes separately.

Maturity :

Knowledge of the biological aspects of the fish population such as maturity, spawning and sex ratio are necessary to the management of a fishery as it will give advantage to advice means of ensuring its fishing.

Sex in *Tilapia nilotica* L. was determined by examining the sexual organs after dissection as there are no external marked difference between the two sexes. The state of maturity and the exact stages of gonads and testies may look difficult to recognise. But the examination of large collections of fish in the different months will facilitate such differentiation and the stages of gonads and testies are classified in the following categories :

Immature :

The ovaries and testies are just thread and transparent. In this stage the two sexes can not be differentiated.

Mature :

The ovaries and testies are very small and occupying a small portion of the body cavity. The eggs are minute, whitish with faint yellow colour. The testies on the other hand are still transparent.

Nearly ripe :

In this stage the gonads are of larger size than those in the previous stage and still about half the body cavity. The testies show whitish colouration and the ovaries have bright yellow colour and contain eggs of different sizes.

Ripe :

The ovaries and testies in this stage nearly fill the whole body cavity. The testies are of milky white colour and the ovaries have yellowish colouration.

Spawning :

There are two distinct types of breeding habits among the species of *Tilapia*. Some lay their eggs in nests and guard them until they hatch (substratum spawners), while the others carry the eggs and fry in their mouths during the whole period of development (mouth breeders).

In U.A.R. it was concluded that *Tilapia zillii* Gerv. is a " substratum spawners " (El-Zarka, 1956, Imam & Hashim, 1960). For *Tilapia nilotica* L. the males as well as the females were found to carry their eggs and fry in their mouths during the whole period of development. The number of females performing mouth incubation is higher than that of the males. This pneomena was the same as that prviously stated by Liebman (1933), Aronson (1949) and Low (1959). So, it could be concluded that *Tilapia nilotica* is a mouth breeder and both sexes perform the function of carrying the eggs and youngs in their mouths.

Examining the genetal organs of *Tilapia nilotica* in Lake Maruit in the different months during 1958 had facilitated the means of following its state of maturity and its breeding season. It is quite apparent from Table 1 and Fig. I that spawning takes place from April to August. The maximum spawning activity is during May and June where ripe fish constituted 33.5% and 21.9% for the two months respectively The spawning of *Tilapia nilotica* in Nouzha Hydrodrome was determined to be from the second half of May until the first half of July (Elster *et al* 1960) which is nearly the same active spawning period of this fish in Lake Mariut.

Sexual dimorphism is quite distinct for *Tilapia nilotica* during its spawning season. Reddish colouration are shown on the bellies and the ventral sides of both sexes, but the males have brighter colour than the females. This colouration began to appear on some fishes in April and on all fishes in May and June which is the most active spawning period. From July, the colouration began to fade and nearly disappear in August. Out of the spawning season (January-March and September-December) ripe fish for both sexes were absent except inJanuary where a small percentage of fish (8.9%) was recorded which may be considered as advanced stages of mature condition.

TABLE 1.— CONDITIONS OF GONADS OF *Tilapia nilotica* L. OF LAKE MARUIT IN THE DIFFERENT MONTHS OF 1958 (PERCENTAGES IN PARENTHESES)

Month	Mean air temperature	Immature	Mature			Ripe		
			Male	Female	Both sex	Male	Female	Both sex
January	14.0	—	60 (95.2)	29 (87.9)	89 (92.8)	3 (4.8)	4 (12.1)	7 (8.9)
February . . .	15.3	—	59 (100)	51 (100)	110 (100)	—	—	—
March	18.0	1 (1.0)	55 (94.8)	34 (94.4)	89 (94.7)	3 (5.1)	2 (5.3)	5 (5.5)
April	19.2	36 (29.9)	62 (91.2)	58 (85.3)	120 (88.4)	6 (8.8)	10 (14.7)	16 (12.5)
May	21.6	20 (19.4)	32 (86.5)	28 (60.8)	60 (74.5)	5 (13.5)	18 (39.1)	23 (33.5)
June	23.8	23 (19.3)	29 (85.3)	47 (75.8)	76 (79.4)	5 (14.7)	19 (23.8)	24 (21.9)
July	25.9	9 (9.8)	34 (82.9)	36 (85.7)	70 (84.3)	7 (17.0)	6 (13.3)	13 (15.3)
August	26.8	2 (3.6)	19 (82.6)	28 (90.3)	47 (87.2)	4 (17.4)	3 (9.7)	7 (14.1)
September . . .	25.2	3 (7.7)	24 (100)	12 (100)	36 (100)	— —	—	—
October	23.1	2 (25.0)	2 (100)	4 (100)	6 (100)	—	—	—
November. . . .	—	23 (42.6)	6 (100)	25 (100)	31 (100)	—	—	—
December . . .	—	2 (9.1)	13 (100)	7 (100)	20 (100)	—	—	—

Ripe gonads and testies began to be represented in March by 5.1% for males and 5.5% for females. The percentage of ripe fishes for both sexes increased from 5.3% in March to its maximum in May 33.5% then decreased to its minimum in August 14.1%.

In relation to the periodicity of spawning of *Tilapia nilotica* Liebman (1933) stated that"... time required for the hatching and development of the young till they are set free hardly allows of more than two oviposition in a season". On the other hand, Elster and Jensen (1960) for the *Tilapia nilotica* of the Nozha Hydrodrome concluded that there was no indication that the same females might spawn twice during the same season. However, my observations that some ripe females of *Tilapia nilotica* have eggs and larvae in their mouths, indicated that there are more than one spawning action for this fish in a season.

Spawning of *Tilapia nilotica* in Lake Maruit seems to be controlled by the temperature (Table 1, Fig. 1). In April, spawning starts when the mean air temperature reaches 19.2 C°. The maximum spawning activity is reached in May and

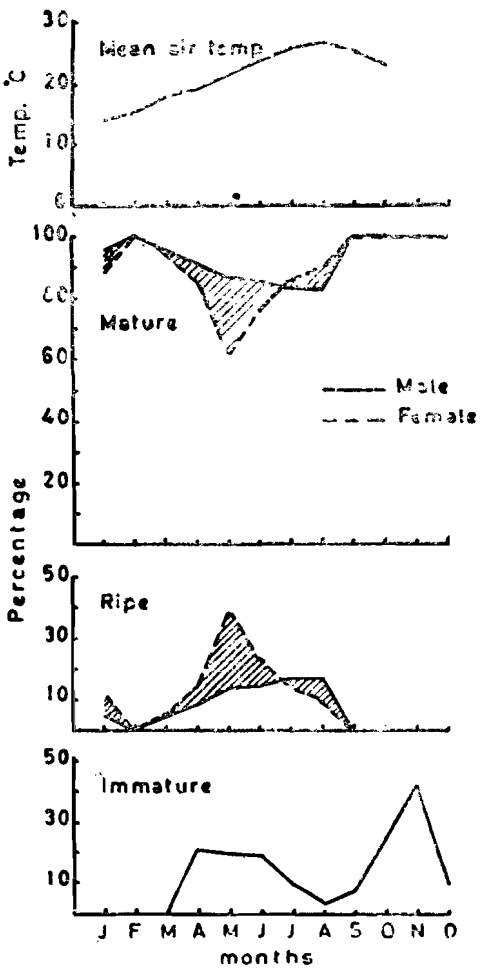

FIG. 1.—Percentage distribution of immature, mature and ripe fish in the collections of different months.

June at a temperature of 21.6 C° and 23.8 C° respectively. During July and August the activity of spawning decreased while the mean air temperature still increasing to 25.9 C° and 268 C° for the two months respectively. In September the spawning of *Tilapia nilotica* stopped as the mean air temperature decreased.

Therefore, the temperature range for the breeding of *Tilapia nilotica* in Lake Maruit was between 19.2 C° and 26.8 C°.

Size and age at maturity :

The size at which the fish reaches its sexual maturity is rather important for the conservation of a minimum legal size that may be needed to secure a spawning part of the fish population. Both the immature and mature fish were recorded throughout the whole year (Table 2). The minimum lenght of ripe females was found to be 8 cm., while that of males was found to be 10 cm.

Table (2) indicates that the small sizes of *Tilapia nilotica* at first maturity give the protection of immature fish to preserve a spawning stock, and this needs no consideration in the management of the fishery. The present size limit of 10 cm. permits conservation of some spawners.

As regards the age at first maturity, it was common to find fishes with mature gonads belonging to age group 0. But the first spawning of these fish would take place after passing their first winter. It could thus be concluded that *Tilapia nilotica* L. in Lake Maruit spawn in their second year of life (having one annulus). Elster & Jensen (1960) also concluded that *Tilapia nilotica* from the Nozha Hydrodrome (near Lake Maruit) spawn at an age of one year, but many of them pass their first year as juveniles.

THE SEX RATIO

The population of *Tilapia nilotica* in Lake Maruit is charcterised by a seasonal variation in the ration of the two sexes in the representative samples. However, a noticeable trend is quite observed (Table 3). The males were most plentiful at the beginning and at the end of the spawning season (March 61% and September 66.7%), while females predominate strongly in the spawning run collections. The percentage of males decreased progressively from 39.5% to 34.0% in the period from April to June. In July and August the percentage of males increased to 44.6% and 41.1% respectively. In the other months; from January to March and from September to December with the exception of October and November (rare samples) the males predominate the females. To show clearly the trend in the dominance of males; the data of Table 3) were grouped according to different seasons in Table 4.

From Table (4) it is clear that the males are taken in low quantities (38.6%) during the spawning season which extends from April to August. In the periods from January to March and from September to December, the percentages of males in the catches increased to 59.8% and to 44.3% respectively.

TALBE 2.— RELATION BETWEEN LENGTH AND SEXUAL MATURITY OF *Tilapia nilotica* L. IN LAKE MARUIT

Length interval mm.	Spawining run samples(1)						Outside the spawning season(2)						Immature
	Male		Female		Sex combined		Male		Female		Sex combined		
	Mature	Ripe (3)	Mature	Ripe	Mature	Ripe	Mature	Ripe	Mature	Ripe	Mature	Ripe	
78 — 87	1	—	5	1	6	1	2	—	—	—	2	—	13
88 — 97	7	—	14	1	21	1	5	—	13	—	18	—	10
98 — 107	11	3	20	5	31	8	29	—	24	—	53	—	16
108 — 117	20	2	28	2	48	4	49	1	47	—	96	1	37
118 — 127	32	1	35	9	67	10	30	—	31	—	61	—	21
128 — 137	35	1	34	6	69	7	19	—	21	1	40	1	13
138 — 147	22	—	13	9	35	9	10	1	10	3	20	4	5
148 — 157	14	2	9	3	23	5	7	1	6	1	13	2	2
158 — 167	9	3	5	2	14	5	5	—	2	—	7	—	—
168 — 177	2	4	3	4	5	8	8	2	3	1	11	3	—
178 — 187	4	1	2	—	6	1	2	1	2	—	4	1	—
188 — 197	—	3	1	—	1	3	2	—	—	—	2	—	—
198 — 207	—	1	—	—	—	1	1	—	—	—	1	—	—
208 — 217	—	—	—	—	—	—	1	—	1	—	2	—	—
218 — 227	—	—	—	1	—	1	—	—	—	—	—	—	—
228 — 237	—	—	—	—	—	—	—	—	1	1	1	1	—
238 — 247	—	—	—	—	—	—	—	—	—	—	—	—	—
248 — 257	—	—	—	—	—	—	—	—	—	—	—	—	—
258 — 267	—	—	—	—	—	—	—	—	—	—	—	—	—
268 — 277	—	1	—	—	—	—	1	—	—	—	—	—	—
278 — 287	—	—	—	—	—	—	—	—	—	—	—	—	—

288 — 297	—	—	—	—	—	—	—	—	—	—	—	—	—
298 — 307	—	—	—	—	—	—	—	—	—	—	—	—	—
308 — 317	—	1	—	1	—	2	—	—	—	—	—	—	—
318 — 327	—	—	—	4	—	4	—	—	—	—	—	—	—
328 — 337	—	1	—	—	—	1	—	—	—	—	—	—	—
Total	157	24	169	48	326	72	170	6	161	7	331	13	117

(1) Combined samples of April, May. June, July. and August 1958.

(2) Combined samples of January, February, March. September, October, November & December 1958.

(3) Fisehs having ripe and nearly ripe gonads were combined.

TABLE 3. PERCENTAGE OF MALES IN THE MONTHLY COLLECTIONS OF *Tilapia nilotica* L. FROM LAKE MARIUT, IN THE YEAR 1958

Date		Number of fish	Percentage	Date		Number of fish	Percentage
January	12	96	65.6	July	8	83	44.6
February	9	110	53.6	August	18	54	41.1
March	5	94	51.0	September	10	36	66.7
April	12	136	39.5	October	8	6	33.3
May	12	85	35.9	November	24	31	11.1
June	7	110	34.0	December	29	20	59.1

TABLE 4.— PERCENTAGE OF MALES OF *Tilapia nilotica* L. DURING THE DIFFERENT SEASONS OF YEAR 1958

Season	Number of fish	Percentage of males
January—February—March	300	59.8
April—May—June—July—August	468	38.6
September—October—November—December	93	44.3

The phenomenon of the dominance of males during spawning was proved to be a common characteristic for many fish species (Deason and Hile 1947, Jobes 1952, Hile 1954, El-Zarka, 1959, 1961). Here in this investigation, females are the more abundant during the spawning season. Many explanations were given for such difference in the sex ratio; Smith (1956) listed the following factors which might be considered responsible for the variability of sex composition :

1.— Segregation of the sexes through various periods of the year including segregation resulting from sex differences in age and size at maturity.

2.— Differences in natural and fishing mortality between the sexes.

3.— Gear selectivity in relation to sex differences in activity and morphology.

For Lake Maruit it is possible to say that all these factors affect the sex ratio of the population of *Tilapia nilotica.*

SUMMARY

The present study is a continuation of the biological investigations of the fishery of *Tilapia nilotica* L. in Lake Maruit.

The stages of maturity for the two sexes had been differentiated into : Immature, mature, nearly ripe and ripe.

Ripe gonads and testies began to be represented for the mixed sexes of this fish by 5.3% in March raised to its maximum 33.5% in May then decreased to its minimum 14.1% in August.

Tilapia nilotica is a mouth breeder and both sexes perform the function of carrying the eggs and young in their mouthes. The spawning extends from April to August with its maximmum activity in May and June. Sexual dimorphism is quite distinct where reddish colouration is shown on the bellies and the ventral sides of both sexes during the spawning season.

Breeding takes place at temperature ranging from 19.2° to 26.8°C. This fish begins to spawn at its second year of life (scale having an annulus). The minimmum length recorded for the mature mlaes and females was found to be 8 cm. and 10 cm. respectively.

Males are represented by low percentage (38.6%) during the spawning season which extends from April to August. In the periods from January to March and from September to December, the percentage of males in the catches increased to 59.8% and to 44.3% respectively.

REFERENCES

ARONSON, L.M., 1949.—An analysis of reproductive behaviour in the mouth-breeding cichlid fish *Tilapia Macrocephals* (Bleeker). Zoologica, **34** : 133–158.

DEASON, H.J.and Hile, R., 1947.—Age and growth of the Kiyi, *Leuchichthys Kiyi* koelz in Lake Michigan. Trans. Amer. Fish. Soc., Vol., 74 (1944), pp. 88–142.

ELESTER, H.J., JENSEN, K.W., 1960.—Limnological and fishery investigations of the Nozha Hydrodrome near Alexandria, Egypt, 1954–1956. Notes and Memoires No. 45, Alexandria Inst. Hydrobiology, U.A.R. pp. 44.

EL-ZARKA, S., 1956.—Breeding behaviour of the Egyptian Cichlid fish, *Tiapia zilli*. Copeia, No. 2, pp. 112–113.

EL-ZARKA, S., 1962.—Tilapia Fishery Investigations in Egyptians Lakes : III. Maturity, spawning and sex ratio of *Tilapia zilli* Gerv. in Lake Qarun. Notes and Memoires No. 67., Alex. Inst. of Hydrobiology, U.A.R., pp. 24,

HILE, R., 1954.—Fluctuations in growth and year-class strength of the Walleye Saginaw Bay. U.S. Fish and Wildl. Sarv., Fish. Bull. 56. p. 7–59.

JOBES,F.W., 1952.—Age growth and production of yellow perch in Lake Erie. Fish Bull. U.S. Fish and Wildl. Serv., Vol. 52, pp. 205–266.

LIEBMAN, E., 1933.—Some observations of the breeding habits of Paestine Cichlidae. Proc. Zool. Soc. London (1933), pp. 885.

ROSEMARY H. LOWER, 1959.—Breeding behaviour pattrns and ecological differeces betweeen Tilapia species and their significance for evolution within the genus. Proc. Zool. Soc., London, Vol. 132 : pp. 30.

SMITH, S.H., 1956.—Life history of Lake Herring of Green Bay, Lake Michigan. U.S. Fish. Bull. vol. 57, No. 190 : pp. 87–138.