JOURNAL OF THE
ARABIAN AQUACULTURE SOCIETY

Vol. 8 No 3 **December 2013**

Effect of Different Stoking Densities and Sex Ratios on Reproductive Performance of Nile tilapia, *Oreochromis niloticus* (L.) During Spawning Process

Mohamed Wafeek* and Ahmed Abdalla Abdel Rahman Ali
Fish Physiology and hatching Dept. Central Laboratory for Aquaculture Research, Agriculture Research Center, Ministry of Agriculture, Egypt

*Corresponding Author dr.wafeekm@yahoo.com

ABSTRACT

A study was conducted on the effects of the different stocking densities of females Nile tilapia, *Oreochromis niloticus* (L.)/m^2 on the reproductive performance (egg production, egg number, egg weights, fertilization rate and hatching rate), during spawning season in hapas suspended in earthen ponds in special fish farm (Elhosania, Sharkia, Egypt). Results showed that the first treatment (T1) has density 4 fish/m^2, second treatment T2 has 6 fish/m^2 and third treatment (T3) has 9 fish/m^2 gave good results in T1 then T2 and followed by T3. The highest egg productions per female were noticed in T1 (585 eggs/female) & T4 (558 eggs/female), whereas, the highest average hatching percentage per female was noticed in T1 (85.55 %/female) & T4 (82.47 %/female). The highest average fries productions per female were noticed in T1 (472.84 fry/female) & T4 (445.25 fry/female) followed by T2 (394.09 fry/female) & T5 (369.50 fry/female) whereas, the lowest fry number/female were showed in T3 (353.25 fry/female) and T6 (324.42 fry/female).

Keywords:

INTRODUCTION

Tilapia culture has been growing at an outstanding rate during the past two decades. The production of farmed tilapia has witnessed a 6-fold increase during the past 15 years, increasing from 383,654 mt in 1990 to 2,096,187 mt in 2005 (FAO, 2007). Broodstock density is one of the important biological factors that have considerable influence on fry production in tilapia (Obi & Shelton, 1988). Moreover, the manipulation of broodstock density is one of several techniques applied to improve mass production of tilapia fry (Abella & Batao, 1989). In general, low broodstock densities gave better fry production than higher densities (Bautista *et al*, 1988; Ridha *et al*, 1998). In ponds, the low production of tilapia fry has been attributed to a suboptimal broodstock density (Mires, 1982). On the other hand, under intensive hatching systems, broodstocks are often stocked at high densities in small and confined breeding units such as aquaria, tanks and net enclosures (hapas), resulting in aggression and fighting between males, and thus, affecting fry production (Behrends *et al*, 1993). The aforementioned studies on the effect of broodstock density on fry production were conducted in aquaria, plastic pools, ponds and hapas. However, scarce studies have been conducted in water recirculating systems using biological filters.

The low fecundity and asynchronous breeding habit of the maternal mouth-brooding tilapia of the genus *Oreochromis*, represents one of the major constraints that hinder expansion in tilapia reproduction. Therefore, some techniques have been developed to counteract this problem, such as optimum stocking rate of broodstock per unit area (Bautista, *et al*, 1988; Little, 1989; Ridha *et al*, 1998), broodstock exchange and conditioning at regular intervals (Little, 1989; Little *et al*, 1993), frequency of periodic seed removal from the brooding females (Verdegem & McGinty, 1987; Little, 1989; Little *et al*, 1993) and temperature manipulation (Behrends & Smitherman, 1983).

Reproductive cycles of tilapia broodstock under intensive farming conditions are asynchronous (Jalabert and Zohar, 1982), leading inevitably to variable supplies of fry. Evolution of parental care in tilapia is associated with an increase in egg size and a corresponding reduction in the number of eggs per clutch (Noakes and Balon, 1982).Thus, low fecundity in combination with the asynchronous nature of spawning behavior in cultured tilapia necessitates the use of extensive fish-holding facilities and Time -consuming management of large numbers of broodstock to maintain continual production of sufficient fry. These requirements may be reduced, in part, by selecting and utilising broodstock exhibiting optimal reproductive traits, such as egg size, fecundity and egg to body weight ratio (Rana, 1988). In Egyptian *T. zillii*, for example, lipid from the liver was mobilised during ovarian maturation prior to first spawning in June, while a second spawn in September was associated with a depletion of both liver and muscle (El-Maghraby et al., 1972). Most studies of reproduction tend to consider fecundity and egg size as separate indicators of reproductive performance. It is generally accepted, however, that there is an inverse relationship between fecundity and egg size: fish produce either more eggs of a smaller size or fewer eggs of a larger size (Springate et al., 1985; Bromage et al., 1992).

Getinet et al., (2007) suggest that same age female Nile tilapia appear to ensure consistent quality of egg diameter, protein and lipid levels, fertilization and hatchability at a cost of altering fecundity (eggs spawn^{-1}) and spawning interval.

A study was conducted on the effects of the different stocking densities and sex ratios of Nile tilapia, *Oreochromis niloticus* (L.)/m^2 bred in hapa cages on the reproductive performance (egg production, egg number, fertilization rate, hatching rate and fry number) after 6 followed harvests during spawning season.

MATERIALS AND METHODS

Broodstock and Management

Nile tilapia, *Oreochromis niloticus*, used in the present study was caught originally from special fish farm in Elhosania, Sharkia, Egypt using a cast net. Three broodstock densities (2 (T1), 3 (T2) and 4 (T3) fish/m^2) of Nile tilapia, *Oreochromis niloticus* (L.), in sex ratio 1 male: 2 females and the same densities with sex ratio 1 male: 3 female T4, T5, and T6 were assigned according to (6x3) a factorial design. Each treatment was represented in three replicates giving a total of 18 spawning hapas, Hapa net cages with mesh of 0.5 mm. The hapas in the earthen pond are suspended from either fixed bamboo posts or floating bamboo modules arranged in series. The hapas are submerged at a depth of at least 1.0 m, leaving an allowance of 0.5 m of the net above the water surface as showed in figure (1). Each hapa measuring 4.0x2.0x0.5 m (LxWxH) and total number of broodstock fish was 432. The upper maxillary bone of the males was removed to minimize injury as a result of aggressive behaviour (Lee, 1979). All fish were sampled every two weeks for weight measurements. Eggs, yolk-sac fry were collected during sampling of broodstock. In the present experiment, hatcheryrates were determined as percentage of swim-up fry produced from the total spawned eggs. Breeders were fed three times daily at 1.5 % body weight per day with 3 mm sinking fish pellets (32%

crude protein). The amount of feed was adjusted every two weeks after broodstock weighing.

Water quality monitoring

Temperature (°C) and dissolved oxygen (mg/l) were measured by oxygen meter Aqua Lytic OX 24, pH by pH meter Orion 543, salinity g/l was measured using a conductivity meter Orion. Ammonia (mg/l), nitrite (mg/l), nitrate (mg/l), total alkalinity as $CaCO_3$ (mg/l), and total hardness (mg/l) were also measured once a week using standard methods (APHA 1989).

Egg sampling and counting

The mean number of eggs per female was calculated for eggs harvested of different stages (Little et al, 1993) using the following formula:

Mean number of eggs female^{-1} = Total weight of eggs /(FXE).

Where F is the total number of females from the same hapa and E is the mean individual weight of eggs.

Mean individual egg weights were based on counts of 200 individual stage 1 eggs from each hapa at each harvest; eggs of stages 2 and 3 were assumed to be of the same size then calculate mean egg weight for each stage then calculate individual weight of eggs by summation means egg weight all stages divided by 3.

Fertilization rate and hatching were estimated according to Gheyas *et al.* (2001) as follows:

$$\text{Fertilization rate} = \frac{100\ \text{Number of fertilized eggs}}{\text{Total number of eggs}}$$

$$\text{Hatching rate} = \frac{100\ \text{Number of hatched fry}}{\text{Total number of fertilized eggs}}$$

Statistical analysis

Statistical analysis was performed using the analysis of variance (ANOVA) and Duncan's Multiple Range test to determine differences among fish stocking densities and sex ratios. All statistics were carried out by using Statistical Analysis Systems (SAS) program (SAS 1985).

Figure (1)

RESULTS

Some physic-chemical parameters of water were measured and recorded in Table (1). Water temperature (°C) was ranged from 26.2 to 26.8 ^{0}C through all treatments in which suitable water temperature for spawning Nile tilapia, dissolved oxygen was ranged from 6.1 to 6.5mg/L, pH was ranged from 7.3 to 7.7, salinity from 0.52 to 0.62 g/l, total alkalinity from 249.9 to 256.2 mg/l, total ammonia 0.35 to 0.45 mg/l, unionized ammonia 0.004 to 0.008 mg/l, nitrite was ranged from 0.12 to 0.19 mg/l and nitrate from 4.15 to 4.45 mg/l.

In Table (2) the average body weight of females was measured and ranged from 152.3 to 159.2 g, while the average body weight of males was (mature and suitable for sperms production) 165.3 to 174.5g. Fertilization rate % can be calculated as mentioned before and recorded in Table (2). The data showed that the fertilization rate was highly significant increased in T1 (96.2%) followed by T2 (87.4 %) and T3 (81.5 %).

Table (3) illustrated the eggs/female for all 6 treatments within 6 harvests and average eggs/female. The average egg production at harvest per female was recorded in Table (3). The highest egg production per female was noticed in T1 (585 eggs/female) & T4 (558 eggs/female) followed by T2 (515 eggs/female) & T5 (490.50 eggs/female) whereas, the lowest egg production was showed in T3 (440.83) and T6 (413.25 eggs/female). The previous results were noticed after each harvest for 6 following

Table (1): ***Mean values of some physic-chemical parameters of water in earthen ponds that hapas were suspended during spawning season until 90 days***

Items	T1	T2	T3	T4	T5	T6
Water temperature (°C)	26.4 ± 2.2[a]	26.2 ± 1.8[a]	26.8 ± 1.5[a]	26.4 ± 2.2[a]	26.2 ± 1.8[a]	26.8 ± 1.5[a]
Dissolved oxygen (mg / L)	6.3 ± 0.5[a]	6.1 ± 0.3[a]	6.5 ± 0.7[a]	6.3 ± 0.5[a]	6.1 ± 0.3[a]	6.5 ± 0.7[a]
pH	7.5 ± 0.8[a]	7.7 ± 0.5[a]	7.3 ± 0.6[a]	7.5 ± 0.8[a]	7.7 ± 0.5[a]	7.3 ± 0.6[a]
Salinity (ppt)	0.62 ± 0.02[a]	0.54 ± 0.01[a]	0.52 ± 0.03[a]	0.62 ± 0.02[a]	0.54 ± 0.01[a]	0.52 ± 0.03[a]
Total alkalinity (mg / L)	256.2 ± 9.5[a]	260.4 ± 8.9[a]	249.9 ± 7.9[a]	256.2 ± 9.5[a]	260.4 ± 8.9[a]	249.9 ± 7.9[a]
Total ammonia (NH_3-N) (mg / L)	0.35 ± 0.02[a]	0.41 ± 0.03[a]	0.45 ± 0.03[a]	0.35 ± 0.02[a]	0.41 ± 0.03[a]	0.45 ± 0.03[a]
Unionized ammonia (NH_3) (mg / L)	0.004 ±0.001[a]	0.005± 0.002[a]	0.008 ± 0.02[a]	0.004 ±0.001[a]	0.005±0.002[a]	0.008 ± 0.02[a]
Nitrite (NO_2-N) (mg / L)	0.12 ± 0.01[a]	0.16 ± 0.02[a]	0.19 ± 0.03[a]	0.12 ± 0.01[a]	0.16 ± 0.02[a]	0.19 ± 0.03[a]
Nitrate (NO_3-N) (mg/L)	4.15 ± 0.2[a]	4.32 ± 0.01[a]	4.45 ± 0.03[a]	4.15 ± 0.2[a]	4.32 ± 0.01[a]	4.45 ± 0.03[a]

Mean values with the same superscripts are not significantly (P>0.05) different within the same row for same parameters

Table (2): ***Average body weight of fish (g) and fertilization rat (%) at different treatments during spawning season (90 days).***

Items	T1	T2	T3	T4	T5	T6
Female weight g	152.3±3.4[a]	159.2±4.2[a]	152.7±5.6[a]	157.4±4.3[a]	154.6±6.3[a]	150.8±6.6[a]
Male weight g	165.3±5.8[a]	170.3±6.1[a]	168.6±7.2[a]	172.4±6.1[a]	173.6±5.1[a]	174.5±5.2[a]
Fertilization rate %	96.2±3.8[a]	87.4±2.6[b]	81.5±5.2[b]	91.4±2.6[a]	84.3±3.2[b]	79.5±4.2[c]

Mean values with the same superscripts are not significantly (P>0.05) different within the same row for same parameters.

Table (3). ***The average egg production per female after each harvest for 6 followed harvests and average egg production per female throughout 6 harvests***

Treats	Harvest 1	Harvest 2	Harvest 3	Harvest 4	Harvest 5	Harvest 6	Average
T1	585.00[a] ±5.00	560.00 [a] ± 10.00	552.50 [a] ± 3.50	545.00 [a] ±5.00	547.00[a] ±1.00	525.00[a] ±5.00	552.42 [a] ± 1.25
T2	515.00 [c] ± 5.00	498.50[b] ±6.50	486.50[b] ± 4.50	466.50[b] ± 4.50	458.50 [c] ± 2.50	439.50 [c] ± 4.50	477.42[c] ± 4.58
T3	486.00 [d] ± 4.00	461.00 [c] ±1.00	439.00[d] ± 4.00	429.50[d] ± 1.50	423.00 [e] ± 2.00	406.50[d] ± 4.50	440.83 [e] ± 2.00
T4	558.00 [b] ± 2.00	550.00 [a] ±2.00	548.00 [a] ± 2.00	539.50 [a] ±1.50	535.50[b] ± 0.50	507.50[b] ± 2.50	539.75 [b] ± 1.58
T5	490.50 [d] ± 0.50	480.50[b] ± 1.50	459.50 [c] ± 1.50	449.00[b] ± 1.00	442.50[d] ± 2.50	430.50 [c] ± 1.50	458.75[d] ± 0.92
T6	440.50 [e] ± 0.50	428.00[d] ±4.00	419.50 [e] ± 1.50	411.50 [e] ± 3.50	401.50 [f] ± 3.50	378.50[e] ± 2.50	413.25 [f] ± 2.42

Mean values with the same superscripts are not significantly (P>0.05) different within the same coloum for same harvest.

harvests and showed that there are very highly increasing in eggs number after first harvest (585 eggs/female) and very highly decreasing were showed after 6 harvests in T6 (378.50 eggs/female).

Hatching percentage at different sex ratios and different densities of Nile tilapia were recorded in Table (4). The average hatching percentage per female was recorded in Table (4). The highest average hatching percentage per female was noticed in T1 (85.55 %/female) & T4 (82.47 %/female) followed by T2 (82.49 %/female) & T5 (80.49 %/female) whereas, the average lowest hatching percentage/female was showed in T3 (80.04 %/female) and T6 (78.40 %/female). The previous results were shown after each harvest for 6 following harvests and noticed that there are very highly increasing in hatching percentage after third harvest (85.52 %/female) and very highly decreasing were showed after 6 harvests in T6 (74.77 %/female).

The average fry production per female was recorded in Table (5). The highest average fries productions per female were noticed in T1 (472.84 fry/female) & T4 (445.25 fry/female) followed by T2 (394.09 fry/female) & T5 (369.50 fry/female) whereas, the lowest fry number/female was shown in T3 (353.25 fry/female) and T6 (324.42 fry/female). The previous results were noticed after each harvest for 6 following harvests and showed that there are very highly increasing in fry number after first harvest (516 fry/female) and very highly decreasing were showed after 6 harvests in T6 (357.0 eggs/female).

Table (4) ***The average hatching per female after each harvest for 6 followed harvests and average hatching per female throughout 6 harvests***

Treats	Harvest 1	Harvest 2	Harvest 3	Harvest 4	Harvest 5	Harvest 6	Average
T1	88.21[a] ± 0.07	86.52 [a] ± 0.16	85.52 [a] ± 0.09	85.05 [a] ± 0.05	84.10 [a] ± 0.34	83.90 [a] ± 0.25	85.55 [a] ± 0.11
T2	83.60 [b] ± 0.33	84.26 [b] ± 0.09	83.05 [b] ± 0.05	82.10[b] ± 0.07	81.03 [b] ± 0.55	80.89 [b] ± 0.26	82.49 [b] ± 0.19
T3	82.31 [c] ± 0.07	81.67 [d] ± 0.15	80.41 [d] ± 0.41	79.40[d] ± 0.19	78.25 [c] ± 0.13	78.23 [c] ± 0.12	80.04 [c] ± 0.00
T4	84.32 [b] ± 0.21	83.09 [c] ± 0.06	82.67 [b] ± 0.24	82.39[b] ± 0.42	81.52 [b] ± 0.20	80.79 [b] ± 0.40	82.47 [b] ± 0.02
T5	82.16 [c] ± 0.12	82.00 [d] ± 0.05	81.28 [c] ± 0.06	80.29[c] ± 0.16	78.99 [c] ± 0.33	78.17 [c] ± 0.15	80.49 [c] ± 0.13
T6	81.05 [d] ± 0.55	80.85 [e] ± 0.05	79.26 [e] ± 0.31	78.37[e] ± 0.06	76.09 [d] ± 0.21	74.77 [d] ± 0.56	78.40 [d] ± 0.26

Mean values with the same superscripts are not significantly (P>0.05) different within the same coloum for same harvest.

Table (5) ***The average fry number per female after each harvest for 6 followed harvests and average fry number per female throughout 6 harvests.***

Treats	Harvest 1	Harvest 2	Harvest 3	Harvest 4	Harvest 5	Harvest 6	Average
T1	516.00[a] ± 4.00	484.50[a] ± 9.50	472.50[a] ±2.50	463.50[a] ± 4.50	460.00 [a] ± 1.00	440.50 [a] ±5.50	472.84 [a] ± 1.66
T2	430.50[c] ± 2.50	420.00[c] ± 5.00	404.00[c] ± 4.00	383.00[c] ± 4.00	371.50 [c] ±0.50	355.50 [c] ±2.50	394.09 [c] ± 2.91
T3	400.00[d] ± 3.00	376.50[e] ± 1.50	353.00[e] ± 5.00	341.00[e] ± 2.00	331.00 [e] ± 1.00	318.00 [e] ± 4.00	353.25 [e] ± 1.58
T4	470.50[b] ± 0.50	457.00[b] ± 2.00	453.00[b] ± 3.00	444.50[b] ±3.50	436.50 [b] ± 1.50	410.00 [b] ± 0.00	445.25 [b] ± 1.25
T5	403.00[d] ± 1.00	394.00[d] ± 1.00	373.50[d] ± 1.50	360.50[d] ± 1.50	349.50 [d] ± 0.50	336.50 [d] ± 0.50	369.50 [d] ± 0.17
T6	357.00[e] ± 2.00	346.00[f] ± 3.00	332.50[f] ± 2.50	322.50 [f] ± 2.50	305.50 [f] ± 3.50	283.00 [f] ± 4.00	324.42 [f] ± 2.91

Mean values with the same superscripts are not significantly (P>0.05) different within the same coloum for same harvest.

DISCUSSION

All water quality parameters throughout the present work were within safe ranges and acceptable limits for the spawning and growth of tilapia fries, and were comparable with those reported by Lin & Lui (1989) and Hassan (1992). The high broodstock density had a depressing effect on growth as a result of competition between individuals for space and food (Obi & Shelton, 1988).

Generally, the lowest broodstock density (T1 & T4) resulted in the highest egg number, egg weight per female, fertilization rate and hatching rate per female. These results are in agreement with those reported for many tilapia species in different aquaculture systems. Hughes & Behrends (1983) indicated that a breeder's density of 5 fish/m^2 *O. niloticus* stocked in hapas at a male: female ratio of 1:2 produced a fry yield of 150 fry / kg female / day. However, Behrends & Smitherman (1983) found that the inter-specific spawning of *O. mossambicus* females with *O. hornorum* males in hapas with broodstock density of 3.6 fish / m^2 at a male: female sex ratio of 1:1 to be the optimum density for fry production (338 fry / kg female / day). On the other hand, an inverse relationship was reported by Allison *et al* (1976) between the broodstocking density of *Oreochromus aureus* and the average number of fry produced. The higher peaks of fry production at a density of 2 fish / m^2 in the present results compared with the other densities indicated a more synchronous spawning, however, increasing stocking density 4 fish m^{-2} was not effective in improving fry production, that conclusion was in close agreement with the findings of Bautista *et al.* (1988). Moreover, Little (1989) obtained a maximum daily fry production at the broodstock density of 8 fish / m^2 and the lowest fry / kg female / day (119) from high density such as 4.7 females / m^2 (9.5 fish / m^2). Tharwat (2007) found that higher number of fry stocks could be produced at a higher stocking density might be true as long as broodstock density did not exceed the optimum density. The significantly low production of fry at higher densities in the mouth-brooding tilapia is contributed to several factors, such as competition between individuals for space, which may interfere with the spawning behavior, and therefore, disrupt and depress breeding.

The present study showed that the increasing hatching percentage followed by increasing fry production was observed within treatments with low density and low sex ratios 1male:2 female. The fertilization rate and subsequently spawning rate was increased in the lowest broodstock density 2 fish / m^2 to indicate that more synchronous than at the medium and higher brood-stock densities. Similar observations for *0erchromous niloticus* in hapas were reported by Little (1989). However, the reduced fry production at a higher stocking density indicates a lower fertilization success of eggs and those females were less successful in incubating the fry (Little, 1989), and this was attributed to the increased interference during spawning and the stress during incubation (Little, 1989). Moreover, the released fry might be eaten by non-spawning fish in crowded spawning tanks. The reduced fry production at higher stocking densities may also results of the fewer eggs released due to depressed ovulation. Stocking density can influence seed production in tilapia in culture conditions (Obi and Shelton, 1988). The effect of various stocking densities and sex ratios on hatching production of tilapia was reported in land-based (concrete tanks) and lake-based (hapa nets) systems (Bautista et al., 1988). Low broodstock densities and low sex ratios generally resulted in higher fingerling production (Hughes and Behrends, 1983)

REFERENCES

Abella, T.A. and Batao, M.N. (1989). Broodstock exchange technique for maximum production of *Oreochromis nilolicus* egg and fry in hapas. In: Aqua. Res. in Asia: Management Techniques and Nutrition (ed. by E.A. Huisman, N. Zonneveld & A.H.M. Bouwmans), pp. 9-18, Pudoc, Wageningen.

Allison, R., Smitherman, R.O., Cabrero, J., 1976. Effects of high density culture and form of feed on reproduction and yield of Tilapia aurea. In: Pillay, T.O.R., Dill, W.A. (Eds.), Advances in Aquaculture. Fishing News Book Ltd, Farnham, pp. 168–170.

APHA, 1989. Standard Methods for the Examination of Water and Wastewater. 17th edn. American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, DC, 1467 pp.

Bautista, A., Ma Carlos, M.H. and San Antonio, A.I. (1988). Hatching production of *Oreochromis niloticus* L. at different sex ratios and stocking densities. Aqua., *73:* 85-89.

Behrends, L.L. and Smitherman, R.O. (1983). Use of warm water effluent to induce winter spawning of tilapia in temperate climate. In: Proceedings of the First International Symposium on Tilapia in Aquaculture (ed. by L. Fishelson & Z, Yaron), pp. 446-454.

Behrends, L.L.; Kingsley, IB, and Price, A.H., EH (1993). Hatching production of blue tilapia, *Oreochromis aureus* (Steindachner), in small hapa nets. Aqua. & Fish. Manag., *24:*237-243

Bromage, N.R., Jones, J., Randall, C., Thrush, M., Davies, B., Springate, J., Duston, J., Barker, G., 1992. Broodstock management, fecundity, egg quality and the timing of egg production in the rainbow trout *(Oncorhynchus mykiss*). Aquaculture 100, 141–166.

El-Maghraby, A.M., Ezzat, A., Saleh, H.H., 1972. Fat metabolism in *Tilapia zillii* Gerv. Bull. Inst. Oceanogr. Egypt 2, 297–332.

Food and Agriculture Organization of the United Nations (FAO), (2007). FAO Fish Stat Plus. Aquaculture Production 1970–2005. Rome, Italy.

Getinet G. Tsadik, Amrit N. Bart (2007). Effects of feeding, stocking density and water-flow rate on fecundity, spawning frequency and egg quality of Nile tilapia, *Oreochromis niloticus* (L.) Aquaculture 272, 380–388.

Gheyas, A. A.; Mollah, M. F.; Islam, M. S. and Hussain, M. G. (2001). Cold shock inducation of diploid gynogensis in stinging catfish, *Heteropneustes fossilis*. Journal of Applied Aquaculture, 11 (4):227-240.

Hassan, R., 1992. Acute ammonia toxicity of red tilapia and seabass. Fish Bulletin of the Department of Fisheries, Malaysia, p. 73.

Hughes, D. and Behrends, L. (1983). Mass production of *Tilapia nilotica* fry in suspended net enclosures. In: Proceedings of the First International Symposium on Tilapia in Aquaculture (ed. by L, Fishelson & Z. Yaron), pp. 394- 401.

Jalabert, B., Zohar, Y., 1982. Reproductive physiology in cichlid fishes, with particular reference to *Tilapia* and *Sarotherodon*. In: Pullin, R.S.V., Lowe-McConnell, R.H. Eds.., The Biology and Culture of Tilapias, ICLARM conference proceedings 7, International Center for Living Aquatic Resources Management, Manila, Philippines, pp. 129–140.

Lee, J.C. (1979). Reproduction and hybridization of three cichlid fishes, *Tilapia aurea* (Steindachner), *Tilapia hornorum* (Trewavas) and *Tilapia nilotica* (Linnaeus) in aquaria and plastic pools. Ph.D. Dissertation, Auburn University, Auburn, AL, USA.

Lin, C.C., Lui, C.I., 1989. Test for ammonia toxicity of cultured hybrid tilapia. In: Hirano, R., Hanyu, I. (Eds.), Proceedings of the Second Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines, pp. 457–460.

Little, D.C. (1989). An evaluation of strategies for production of Nile tilapia *{Oreochromis niloticus* L.) fiy suitable for hormonal treatment. Ph.D. Th.$_5$ Instit. of Aqua., Univ. of Stirling, Stirling,

Little, D.C; Macintosh, DJ. and Edwards, P. (1993). Improving spawning synchrony in the Nile tilapia, *Oreochromis niloticus.* Aqua. & Fish. Manag., *24:* 399- 405.

Mires, D. (1982). A study of the problem of mass production of hybrids. In: The Biology and Culture of Tilapia, ICLARM Conf. Proc. 7, pp. 317-329.

Noakes, D.L.G., Balon, E.K., 1982. Life histories of tilapias: an evolutionary perspective. In: Pullin, R.S.V., Lowe-McConnell, R.H. _Eds.., The Biology and Culture of Tilapias, ICLARM conference Proceedings 7, International Center for Living Aquatic Resources Management, Manila, Philippines, pp. 61–82.

Obi, A. and Shelton, W.L. (1988). Effects of broodstock stocking density on fry production in *Oreochromis hornorum* (Trewavas). J, of Aqua, in the Trap., 5: 107-110.

Rana, K.J., 1988. Reproductive biology and the hatching rearing of tilapia eggs and fry. In: Muir, J.F., Roberts, R.J. _Eds.., Recent Advances in Aquaculture. Croom Helm, London, 3, pp. 343–406.

Ridha, M.; Cruz, E.M. and Al-Ameeri, A.A. (1998). Tilapia hatching refinement and maximizing fry production. Final Report No. *KISR5275*, Kuwait Institute for Scientific Research, Kuwait.

SAS (1985). SAS/STAT User's Guide. SAS Instruction Incorporation, Cary. NC. 956 pp.

Springate, J.R.C., Bromage, N.R., Cumaranatunga, P.R.T., 1985. The effects of different ration on fecundity and egg quality in the rainbow trout _*Salmo gairdneri*.. In: Cowey, C.B., Mackie, A.M., Bell, J.G. _Eds.., Nutrition and Feeding in Fish. Academic Press, London, UK, pp. 371–391.

Tharwat Adel A. (2007). The productivity of Nile tilapia, Oreochromis niloticus (L.) reader under different broodstock densities and photoperiods in a recycling water system. Egypt. J. Aquat Biol. & Fish, Vol. II, No.2: 43- 64.

Verdegern, M.C. and McGinty, A.S. (1987). Effect of frequency of egg and fiy removal on spawning by Tilapia nilotica in hapas. The Progress. Fish-Cult, 49: 129-131.

تأثير الكثافات والنسب الجنسية المختلفة على الكفاءة التناسلية لسمكة البلطى النيلى اثناء عملية التفريخ

محمد وفيق على واحمد عبدالله عبدالرحمن
قسم التفريخ والفسيولوجى
المعمل المركزى لبحوث الثروة السمكية العباسة ابوحماد شرقية مصر

تمت هذه الدراسة باحدى المزارع الخاصة بالحسنية شرقية وأجريت لدراسة تأثير الكثافات والنسب الجنسية المختلفة من أسماك البلطى النيلى على الكفاءة التناسلية، حيث وضعت ثمانية عشرة هابه من الشباك النيلون معلقة داخل احواض ترابية قسمت الى ستة مجموعات الاولى بها ٢ سمكة/م٢ ،الثانية ٣ سمكة/م٢ ،الثالثة ٤ سمكة/م٢ مع نسبة ذكور ١:٢ اناث ،الرابعه ٢ سمكة/م٢ ،الخامسة ٣ سمكة/م٢ ،السادسة ٤ سمكة/م٢ مع نسبة ذكور ١:٣ اناث. وتم دراسة خواص المياه الفيزوكيميائية وتبين أن درجة الحرارة والأس الهيدروجينى والملوحة والأكسجين فى داخل الحدود المسموح بها لعملية تفريخ البلطى النيلى. أما الكفاءة التناسلية للأسماك فتم دراسة عدد البيض ،معدل الاخصاب ،معدل الفقس بعد كل عملية حصاد حيث تم الحصاد ستة مرات متتالية. وكان أفضل المعاملات هى المعاملة الأولى والرابعة ثم الثانية والخامسة وأقل المعاملات الثالثة والسادسة فى الكفاءة التناسلية من حيث عدد البيض لكل انثى نسبة الاخصاب معدل الفقس عدد الزريعة بعد كل حصاد. حيث وصل متوسط عدد البيض ٥٥٢,٤٢ بيضة ومعدل الاخصاب ٩٦,٥% ونسبة الفقس ٨٥,٥٥% وعدد الزريعة ٤٧٢,٨٤ لكل انثى فى المعاملة الاولى. بينما كان متوسط عدد البيض ٤١٣,٢٥ بيضة ومعدل الاخصاب ٧٩,٣% ونسبة الفقس ٧٨,٤٠% وعدد الزريعة ٣٢٤,٤٢ لكل انثى فى المعاملة السادسة.