EFFECT OF SEX RATIOS ON REPRODUCTIVE
PERFORMANCE OF NILE TILAPIA (OREOCHROMIS
NILOTICUS) AND BLUE TILAPIA (OREOCHROMIS AUREUS)

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Abstract

This study was carried out in circular earthen ponds belonging to
Central Laboratory for Aquaculture Research (CLAR), at Abbassa, Shark-
ia Governorate. The study aimed at the investigation of the effect of differ-
ent sex ratios on fry production intra species and between two species
of Oreochromis niloticus and Oreochromis aureus. The results indicated
that there were no significant differences among different sex ratios for
number of fry / female and number fry / gm of female body weight of
Oreochromis niloticus. There were significant differences between the
different sex ratios 1:1 and 1:2, 1:3 in number fry / female, while
there were no significant differences between different sex ratios 1:1,
1:2 and 1:3 in number fry / gm of female body weight of O. aureus. The
results indicated that there were no significant differences between
mass spawning of Oreochromis niloticus and Oreochromis aureus at sex
ratio 1:1, while there were significant differences between Oreochromis
niloticus and Oreochromis aureus at sex ratios 1:2 and 1:3 in number of
fry / female. The relative fecundity (number fry / gm of female body
weight) showed that there were no significant differences between mass
spawning of Oreochromis niloticus and Oreochromis aureus at different
sex ratios 1:1, 1:2 and 1:3. This study showed that there were no signifi-
cant differences between mass spawning of Oreochromis niloticus and
Oreochromis aureus at the different sex ratios 1:1, 1:2 and 1:3 in num-
ber fry / gm of female body weight. However, the sex ratio of 1 male to
3 females is more economical for fry production.

INTRODUCTION

Stocking density and sex ratio are on enquire whether they are more important
than spawning area for optimal fry production. Uchida and King (1962) and Hida et al.
(1962) found that Tilapia mossambica stocked at about 10 brood fish / m² of bottom
at a sex ratio of 3 female to 1 male produced the most fry. They used tanks with a
bottom area as small as 4.5 m² and as large as 78 m². The best fry production per
month was between 500 and 800 fry / m².
There is a great deal of conflicting literature concerning the effects of size and age on tilapia fry yields. Silvera, (1978) observed a positive correlation between the weight of Tilapia nilotica female and the number of fry produced. Rothbard (1979) reported that large tilapia females produced more eggs than the smaller females. Siraj et al. (1983) found that year class I and II Oreochromis niloticus females spawned at intervals of 7 to 12 days when eggs were taken from incubating females, whereas, year class III females spawned at intervals of 10 to 20 days under similar environmental and harvesting conditions. Hughes and Behrends (1983) reported that year class I Oreochromis niloticus females have a greater fecundity (seed/gm female/day) than year class II females when spawned in hapas. Apparently, the reduced number of eggs/females found for small tilapia is offset by an increased spawning frequency. However, Broussard et al., (1983) reported that there was no correlation between size of tilapia brood fish and fingerling production under pond conditions. Those authors suggested using relatively large brood fish for production of Oreochromis niloticus fingerlings in earthen ponds. Guerrero and Garcia (1983) reported that fry production/female Oreochromis niloticus declined as female body weight increased. They suggested the use of 50 to 100 g females for fry production in net cages.

The size of female brood fish is an important factor affecting fry production. Theoretical production based on fecundity and counts of eggs and fry were discussed by Guerrero & Guerrero (1985). They tested the effect of Oreochromis niloticus brood stock size on fry production in concrete pools, and concluded that bigger females produced more fry.

Aurlli and Torrancy, (1988) found that the number of eggs per spawn per female ranged from 97 to 1042, weight of females was positively correlated with the number of eggs per spawn. Also, Myers and Herberger (1991) found that the fecundity and spawning frequency for Oreochromis species depended on genetic and husbandry factors. Also, egg yields for O. niloticus, O. mossambicus and O. niloticus x O. mossambicus females averaged 4.54, 10.86 and 10.36 eggs per g of female body weight per spawn, respectively.

Tilapia are polygamous fish since the male has the ability to mate with more than one female in mouth-brooding species (Fryer and Iles, 1972). The number of males
stocked into the spawning ponds is usually less than the number of females. Uchida and King (1982) found a ratio of one male to three females at stocking rate of 11 fish / m² in redwood raceway tanks provided optimum conditions for courtship and spawning of Tilapia mossambica. Lovshin et al. (1974) stated that, in case of hybridization between female Oreochromis niloticus & male T. hornorum the optimum sex ratio for fry production in earthen ponds was one male to three female. Silvera (1978) concluded that a ratio of one male to six females was optimum for Oreochromis niloticus spawning in plastic pools. Guerrero and Garcia (1983) conducted a study on the fry production of Tilapia nilotica in net cages suspended in Lake Laguna in the Philippines. They used two different sex ratios: 1 male to 3 females, and 1 male to 5 females. They concluded that there were no significant differences in fry production among the sex ratios tested. However, they suggested that a ratio of 1 male to 3 females was more efficient and economical for fry production. The study was carried out to investigate the effect of different sex ratios on fry production of Oreochromis niloticus and Oreochromis aureus.

**MATERIALS AND METHODS**

The study was conducted at the Central Lab for Aquaculture Research (CLAR), Abbassia, Abou- Hammad, Sharkia.

**1. Pond preparation and stocking of broodstock**

This study was carried out in the circular earthen ponds as mass spawning ponds. Each pond had a surface area of 175 m² and the water depth was 75 cm before being stocked with broodfish. The ponds were drained completely from water and the remaining water puddles were treated with calcium hypochloride (1 kg / pond) to get rid of all wild fish, larvae and eggs. Then, the ponds were left to be exposed to sun radiation for 10 days till complete dryness.

Each pond was equipped with a (2 x 2.5 m²) concrete harvest sump with the drain pipe located at the middle of the sump. Prior to pond inundation, a piece of square knotted nylon netting was draped over the harvest sump; the edge of the netting extended approximately 25 cm² out over the pond bottom and was held in place by rocks.
Ponds were filled with water filtered through screen on the water inlets to prevent the entrance of any wild fish, larvae, eggs into the ponds. Water temperature during the study ranged from 27-33 °C. *Oreochromis niloticus* and aureus broodfish were allocated randomly to and concurrently stocked in each pond. Number of fish (males and females) and average individual weights are shown in Tables (1, 2).

**Table 1. Average number and weight for broodfish at different sex ratio of spawning *Oreochromis niloticus*.**

<table>
<thead>
<tr>
<th>Sex ratio</th>
<th>Rep. No.</th>
<th>No. of Males</th>
<th>No. of Females</th>
<th>Avg. wt / Male (g)</th>
<th>Avg. wt / Female (g)</th>
<th>Duration in days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 : 1</td>
<td>3</td>
<td>25.00</td>
<td>25.00</td>
<td>225.18</td>
<td>108.25</td>
<td>21</td>
</tr>
<tr>
<td>1 : 2</td>
<td>3</td>
<td>10.00</td>
<td>20.00</td>
<td>223.00</td>
<td>113.83</td>
<td>19</td>
</tr>
<tr>
<td>1 : 3</td>
<td>3</td>
<td>10.00</td>
<td>30.00</td>
<td>235.00</td>
<td>128.33</td>
<td>18</td>
</tr>
</tbody>
</table>

**Table 2. Average number and weight for broodfish at different sex ratio of spawning *Oreochromis aureus*.**

<table>
<thead>
<tr>
<th>Sex ratio</th>
<th>Rep. No.</th>
<th>No. of Males</th>
<th>No. of Females</th>
<th>Avg. wt / Male (g)</th>
<th>Avg. wt / Female (g)</th>
<th>Duration in days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 : 1</td>
<td>3</td>
<td>30.00</td>
<td>30.00</td>
<td>92.84</td>
<td>113.11</td>
<td>21</td>
</tr>
<tr>
<td>1 : 2</td>
<td>3</td>
<td>30.00</td>
<td>60.00</td>
<td>54.84</td>
<td>59.44</td>
<td>21</td>
</tr>
<tr>
<td>1 : 3</td>
<td>3</td>
<td>10.00</td>
<td>30.00</td>
<td>121.00</td>
<td>62.64</td>
<td>16</td>
</tr>
</tbody>
</table>

2. **Feeding and management of broodfish**

Broodfish were fed on a pelleted commercial fish diet with the following specifications: crude protein not less than 25.97 %, crude fat not more than 4.75 %, crude fiber not more than 5.22 %, moisture 10.24 %.

Fish were fed 7 days per week at a rate of 3 % of their biomass daily and feed was introduced once / day.

3. **Pond drainage and fry harvesting**

After 16 to 23 days from stocking of the broodfish, ponds were drained using a 3 inch pump to complete the draining of the water from the ponds. A cylindrical Mattel frame approximately 1 meter long was mounted on the draining pipe covered with 1.25 m² square mesh plastic netting. The purpose of this extended drain screen was to reduce the suction caused by draining and to minimize the number of fry impaled on the
drain screen. Pond water was lowered until the level of the top edge of the harvest sump, at which time broodfish were removed from the sump by lifting the previously placed nylon netting, then, broodfish were transferred to concrete holding tank for re-stocking.

Fry were harvested from the sump with dip nets equipped with 1.6 mm nylon mesh from catch basic.

RESULTS AND DISCUSSION

1. Spawning of Tilapia nilotica

Results of average number of fry per female of O. niloticus were 258.86, 240.33 and 271.7 fry at different sex ratio (1:1, 1:2 and 1:3), respectively (Table 3). The results showed that the highest number of fry / female (271.7 fry) was obtained from sex ratio 1:3 followed in a decreasing order by those of sex ratio 1:1 (258.86 fry) and sex ratio 1:2 (240.33 fry). The statistical analysis indicated that, differences in average number of fry per female between the different sex ratio were insignificant (P<0.05) (Table 3). The relative fecundity (number fry per g of female body weight were 2.36 fry, 2.11 fry and 2.12 fry per g of female body weight at different sex ratio (1:1, 1:2 and 1:3), respectively. The highest values were 2.36 fry at sex ratio 1:1, and lowest value was 2.11 fry at sex ratio 1:2 male to female. Analysis of variance indicated that, differences in average number fry / g of female body weight between the different sex ratio 1:1, 1:2 and 1:3 at (P<0.05) were insignificant.

Table 3. Fry production for different sex ratios of Oreochromis nilotica spawners.

<table>
<thead>
<tr>
<th>Sex ratio</th>
<th>No. of Females</th>
<th>Avg. wt of Female</th>
<th>Avg. no. of fry / Female</th>
<th>Avg. no. of fry /gm of female Body weight.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1</td>
<td>25</td>
<td>106.26</td>
<td>6467.67</td>
<td>258.86±42.92 a</td>
</tr>
<tr>
<td>1:2</td>
<td>20</td>
<td>113.33</td>
<td>4806.00</td>
<td>240.33±7.17 a</td>
</tr>
<tr>
<td>1:3</td>
<td>30</td>
<td>128.33</td>
<td>8151.67</td>
<td>271.7±10.47 a</td>
</tr>
</tbody>
</table>

Means with same letter in the same column are not significant differences (P<0.05).

2. Spawning of Tilapia aureus

Table 4, shows the average of fry production for different sex ratios of Oreochromis aureus. Numbers of fry per female were 309.39 , 159.90 and 154.46 fry for 1:1,
1:2 and 1:3 sex ratio, respectively. The results indicated that the sex ratio 1:1 recorded the highest results of fry production followed in a decreasing order by those of sex ratio 1:2 and 1:3, respectively. Analysis of variance indicated that there were significant differences in average number fry / female among the different sex ratio 1:1 and (1:2, 1:3). These differences may be due to higher average body weight of females (113.11 g) at sex ratio 1:1 than other sex ratio 1:2 and 1:3. The results are in agreement with those obtained by Rothbard (1979) who reported that tilapia females produced more eggs than the smaller females. On the other hand, there were no significant differences between the sex ratio 1:2 and 1:3 at \( P < 0.05 \) in number fry / female. Average number of fry / (g) of female body weight were 2.74, 2.69 and 2.51 fry at the different sex ratios 1:1, 1:2 and 1:3, respectively. The results indicated that sex ratio 1:1 was numerically the highest in relative fecundity, while, at sex ratio 1:3 it was the lowest one. Analysis of variance indicated that there were no significant differences in average number fry / (g) of female body weight between the different sex ratios 1:1, 1:2 and 1:3 at \( P < 0.05 \).

Table 4. Fry production for different sex ratios of Oreochromis aureus spawners.

<table>
<thead>
<tr>
<th>Sex ratio</th>
<th>No. of Females</th>
<th>Avg. wt. of Female</th>
<th>Avg. no. of Fry / Females</th>
<th>Avg. no. of fry / Female</th>
<th>Avg. no. fry / g of female Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1</td>
<td>30</td>
<td>113.11</td>
<td>9281.00</td>
<td>309.39±21.87</td>
<td>2.74±0.26 a</td>
</tr>
<tr>
<td>1:2</td>
<td>60</td>
<td>59.44</td>
<td>9593.67</td>
<td>159.99±11.43</td>
<td>2.69±0.21 a</td>
</tr>
<tr>
<td>1:3</td>
<td>30</td>
<td>82.04</td>
<td>4634.00</td>
<td>154.46±5.98</td>
<td>2.51±0.27 a</td>
</tr>
</tbody>
</table>

Means with same letter in the same column are not significant differences \( P < 0.05 \).

3. Comparative studies between spawning of Oreochromis niloticus and Oreochromis aureus:

Table 5 illustrated number of fry per females and number of fry per g of female body weight for mass spawning of Oreochromis niloticus and mass spawning of Oreochromis aureus at different sex ratios 1:1, 1:2 and 1:3. The results indicated that there were no significant differences between Oreochromis niloticus and Oreochromis aureus at sex ratio 1:1 in number of fry / female, while, there were significant differences between Oreochromis niloticus and Oreochromis aureus at sex ratios 1:2 and 1:3. The differences may be attributed to the greater average weight of females Oreochromis niloticus than Oreochromis aureus. The present results agreed with those obtained by
Silvera (1978) who observed a positive correlation between the weight of Tilapia nilotica female and the number of fry produced. There were no significant differences between mass spawning of Oreochromis niloticus and Oreochromis aureus at different sex ratios 1:1, 1:2 and 1:3 in number of fry / (g) of female body weight at (P 0.05). These results are in agreement with those reported by Guerrero and Garcia (1983), who conducted a study on the fry production of Tilapia nilotica in net cages suspended in Lake Laguna in the Philippines. They used two different sex ratios: 1 male to 3 females, and 1 male to 5 females. However, they suggested that a ratio of 1 male to 3 females was more efficient and economical for fry production.

Table 5. Comparative studies between spawning of Oreochromis niloticus and Oreochromis aureus at different sex ratio.

<table>
<thead>
<tr>
<th>Species</th>
<th>sex ratio</th>
<th>Avg. wt. of female (g)</th>
<th>Avg. no. of fry / Female</th>
<th>Avg. no. fry / g of female Body wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oreochromis niloticus</td>
<td>1 : 1</td>
<td>108.26</td>
<td>258.86±42.26</td>
<td>2.36±0.28</td>
</tr>
<tr>
<td>Oreochromis aureus</td>
<td>1 : 1</td>
<td>113.11</td>
<td>309.39±21.87</td>
<td>2.74±0.26</td>
</tr>
<tr>
<td>Oreochromis niloticus</td>
<td>1 : 2</td>
<td>113.83</td>
<td>240.33±7.17</td>
<td>2.11±0.09</td>
</tr>
<tr>
<td>Oreochromis aureus</td>
<td>1 : 2</td>
<td>59.44</td>
<td>169.90±11.43</td>
<td>2.69±0.21</td>
</tr>
<tr>
<td>Oreochromis niloticus</td>
<td>1 : 3</td>
<td>128.33</td>
<td>271.70±10.47</td>
<td>2.12±0.05</td>
</tr>
<tr>
<td>Oreochromis aureus</td>
<td>2 : 3</td>
<td>62.84</td>
<td>154.39±5.85</td>
<td>2.51±0.27</td>
</tr>
</tbody>
</table>

Means with same letter in the same column are not significant differences (P < 0.05).
REFERENCES


تأثير النسب الجنسية على إنتاج زراعة أسماك البلطي الديلي والأوريا

أحمد مصطفى خاطر

المعمل المرئي لبحوث الأحياء السمكية بالعباسة - مركز البحوث الزراعية - وزارة الزراعة - الدقى - جيزة - مصر

أجريت هذه الدراسة في أحواض ترابية ناشئة في المعامل المرئي لبحوث الأحياء السمكية بالعباسة أبو حمادة شرقية، وذلك لدراسة تأثير النسبة الجنسية المثلثة على إنتاج زراعة أسماك البلطي داخل النمو الإجهاض وكذلك بين نوعين من البلطي الديلي والأوريا. نمت النباتات على نبض وجدت النتائج أيضاً على وجود إختلافات معنوية بين النسب الجنسية المثلثة لعدد الزراعة لكل ذكر وعدد الزراعة لكل أنثى لكل جرام من وزن الأثاث بالنسبة للبلطي الديلي. وجدت النتائج أيضاً على وجود إختلافات معنوية بين النسب الجنسية المثلثة في عدد الزراعة لكل ذكر، بينما لم توجد إختلافات معنوية بين النسب الجنسية المثلثة في عدد الزراعة. كما أن النتائج أيضاً على أن لا يوجد إختلافات معنوية بين التصفيح الديلي والأوريا عند النسب الجنسية المثلثة 1/2، بينما كان هناك إختلافات معنوية بين النسب الجنسية المثلثة 1/21 في عدد الزراعة لكل ذكر، أما عند دراسة الكفاءة التناسلية بالنسبة للبلطي الديلي والأوريا (عدد الزراعة لكل جرام من وزن الأثاث) فقد وجد أن لا يوجد إختلافات معنوية بين التصفيح الديلي والأوريا عند النسب الجنسية m 1/21 و 1/20، وأظهرت الدراسة أيضاً أن لا يوجد إختلافات معنوية بين التصفيح الديلي والأوريا عند النسب الجنسية المثلثة 1/2 و 1/21 في عدد الزراعة لكل جرام من وزن الأثاث. كما أن النسبة الجنسية 1/2 هي الأكثر اقتصادية لإنتاج الزراعة.