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

AHMED MOSTAFA KHATER

Central Laboratory for Aquaculture Research, Agricultural Research Centre, Ministry of Agriculture, Dokki, Giza, Egypt.

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Abstract

This study was carried out in circular earthen ponds belonging to Central Laboratory for Aquaculture Research (CLAR), at Abbassa, Sharkia Governorate. The study aimed the investigation of the effect of different 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 significant differences between mass spawning of *Oreochromis niloticus* and *Oreochromis aureus* at the different sex ratios 1:1, 1:2 and 1:3 in number 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 / m^2 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 m^2 and as large as 78 m^2. The best fry production per month was between 500 and 800 fry / m^2.

There is a great deal of conflicting literature concerning the effects of size and age on tilapia fry yields. Silvera, (1978) observed a positve 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 condition . 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 .

Aureli 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 Herhberger (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 (1962) found a ratio of one male to three females at stocking rate of 11 fish / m^2 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), Abbassa, 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 m^2 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 m^2) 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 cm^2 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 ℃. *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 nilotica.*

Sex ratio	Rep. No.	No. of Males	No. of Females	Avg. wt / Male (g)	Avg. wt / Female (g)	Duration in days
1 : 1	3	25.00	25.00	225.18	108.26	21
1 : 2	3	10.00	20.00	223.00	113.83	19
1 : 3	3	10.00	30.00	235.00	128.33	18

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

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

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 m^2 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.

Sex ratio	No. of Females	Avg. wt of Female	Avg. no. of Fry / females	Avg. no. of fry/ Female	Avg. no. fry/gm of female Body weight.
1 : 1	25	108.26	6467.67	258.86±42.92 a	2.36±0.28 a
1 : 2	20	113.83	4806.00	240.33±7.17 a	2.11±0.09 a
1 : 3	30	128.33	8151.67	271.7±10.47 a	2.12±0.05 a

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 large 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.

Sex ratio	No. of Females	Avg. wt of Female	Avg. no. of Fry / females	Avg. no. of fry / Female	Avg. no. fry / g of female Body weight.
1 : 1	30	113.11	9281.00	309.39±21.87 a	2.74±0.26 a
1 : 2	60	59.44	9593.67	159.90±11.43 b	2.69±0.21 a
1 : 3	30	62.64	4634.00	154.46±5.98 b	2.51±0.27 a

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 auras* :

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 positve 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), when they 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.

Species	sex ratio	Avg. wt. of female (g)	Avg. no. of fry / Female	Avg. no. fry / g of female Body wt.
Oreochromi niloticus	1 : 1	108.26	258.86±42.92 a	2.36±0.28 a
Oreochromi aureus	1 : 1	113.11	309.39±21.87 a	2.74±0.26 a
Oreochromi niloticus	1 : 2	113.83	240.33±7.17 a	2.11±0.09 a
Oreochromi aureus	1 : 2	59.44	159.90±11.43 b	2.69±0.21 a
Oreochromi niloticus	1 : 3	128.33	271.70±10.47 a	2.12±0.05 a
Oreochromi aureus	2 : 3	62.64	154.33±5.85 b	2.51±0.27 a

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

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تأثير النسب الجنسية على إنتاج زريعة أسماك البلطي النيلي والاوريا

أحمد مصطفى خاطر

المعمل المركزي لبحوث الثروة السمكية بالعباسة – مركز البحوث الزراعية – وزارة الزراعة – الدقى – جيزة – مصر

أجريت هذه الدراسة فى أحواض ترابية دائرية فى المعمل المركزى لبحوث الثروة السمكية بالعباسة أبو حماد شرقية. وذلك لدراسة تأثير النسب الجنسية المختلفة على إنتاج زريعة أسماك البلطي داخل النوع الواحد وكذلك بين نوعين من البلطى النيلى والاوريا. دلت النتائج على عدم وجود إختلافات معنوية بين النسب الجنسية المختلفة بالنسبة لعدد الزريعة لكل أنثى وعدد الزريعة لكل جرام من وزن الانثى بالنسبة للبلطى النيلى. ودلت النتائج أيضا على وجود إختلافات معنوية بين النسب الجنسية المختلفة ١:١ ، (٢:١، ٣:١) فى عدد الزريعة لكل أنثى . بينما لم توجد إختلافات معنوية بين النسب الجنسية المختلفة ١:١ ، ٢:١ ، ٣:١ في عدد لزريعة بالنسبة للبلطى الاوريا. كما دلت النتائج أيضا على أنة لا توجد إختلافات معنوية بين التفريخ الكمي لأسماك البلطى النيلى والاوريا عند النسبة الجنسية ١:١ . بينما كان هناك إختلافات معنوية بين بين التفريخ الكمي لأسماك البلطى النيلى والاوريا عند النسب الجنسية ٢:١ ، ٣:١ فى عدد الزريعة لكل أنثى. أما عند دراسة الكفاءة التناسلية النسبية لأسماك البلطى النيلى والاوريا (عدد الزريعة لكل جرام من وزن الانثى) فقد وجد أنة لا توجد إختلافات معنوية بين التفريخ الكمي لأسماك البلطى النيلى والاوريا عند النسب الجنسية ١:١ ، ٢:١ ، ٣:١ . وأظهرت الدراسة أيضا أنة لا توجد إختلافات معنوية بين التفريخ الكمي لأسماك البلطى النيلى والاوريا عند النسب الجنسية المختلفة (١:١ ،١:٢ ،١:٣) فى عدد الزريعة لكل جرام من وزن الانثى. كما أن النسبة الجنسية ١:٣ هي الاكثر إقتصادية لانتاج الزريعة.