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Effect of Sex Ratio on Reproductive Performance of Broodstock Nile Tilapia (*Oreochromis Niloticus*) in Suspended Earthen Pond Hapas

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ABSTRACT

This study was carried out to investigate the effect of sex ratio on reproductive performance of broodstock nile tilapia, *Oreochromis niloticus* using suspended earthen pond hapa nets . Four groups of breeds total were used in the experiment according to sex ratio as follows: 1:1.5,1:2,1:2.5 and 1:3 (male: female) with three replicates per treatment. Total number of broodstock 96 were placed in the hapa(4 x 6 m), each with a combination of either 39 male: 57 female(group1), 32 male :64 female (group 2), 28 male : 68 female (group 3)and 24 male : 72 female (group 4) , respectively. Tilapia seeds (fertile ova , new hatched fry with yolk sac and free swimming fry without yolk sac) were collected every 20-day post-stocking. Present results revealed that , group 3 and 4 produce large number of seeds in comparing with group 1 and group2. The mean number of seeds after twenty days were about 19040 ±876.4 (for group3) and 19440 ±734.1 (for group 4). The mean number of seeds in the second clutch were about 18360 ± 795.1 (for group 3) and 18000 ± 823.1 (for group 4). The mean number of seeds in the thired clutch were about 19720±763.2 (for group 3) and 19440 ±745.1 (for group 4).

Keywords:

INTRODUCTION

The commercial production of tilapia has increasingly gained expansion in many countries due to its suitability to variety of pond farming conditions, resistance to diseases, high survival and growth rate (Onumah et al.,2010). Tilapias have certain reproductive fish species (Lorenzen, 2000). The reproductive biology of tilapia has been widely investigated from different parts of the globe (Hatikakoty and Biswas, 2002). In many species of fishes reproductive success has been shown to be

influenced by brood stock, sex ratios, stocking density age, size, nutrition and feeding regime (Tahoun et al., 2008). Usually, tilapia is cultured in ponds, net cages (hapas) and concrete tanks (Bautista *et al*., 1988). Hapas are commonly used for breeding tilapia in the Philippines and Thailand (Little *et al*., 1997). Productions of fry and fingerlings in hapas have several advantages. They are design to allow the fish to be collected at one end so that the female can be removed with minimum disturbance to examine eggs or sac fry. Thus, the eggs can be harvested as frequently as every 5 to 10 days. Hapas are easy to construct for handling broodstock and harvesting eggs and fry. They are also cheaper and more flexible than tanks.

Low production of tilapia seeds could be attributed to very low density of broodstock, lack of spawning techniques, poor broodstock nutrition, high fry mortality and inappropriate sex ratio (Salama, 1996). Earlier studies (Mires, 1982; Siddiqui and Al-Harbi, 1997; Nour *et al*., 2008 and Khalfalla *et al*., 2008) have indicated that choosing the appropriate sex ratio of broodstock could help to improve fry production, reduce wasting of resources and reduce cost of production.

Hence, the aim of the present work was to investigate the effect of sex ratio on reproductive performance of different broodstock Nile tilapia groups in suspended earthen pond hapas.

MATERIALS AND METHODS

The present study was conducted at Abbassa Fish hatchery, Central Laboratory for Aquaculture Research, Abbassa. A total number of 1152 apparently healthy *Nile tilapia* broodstock males: females with an average body weight of 150:200and 140 : 180 g respectively (Table 4). In April - June 2011, when climatic conditions were suitable for spawning and average daily water temperature was 26-28 ^{o}C. Hapas nets with a mesh size of 1.5 mm and surface area dimension of 4x6 m for breeding studies were installed in a 1000 m3 experimental pond at Abbassa experimental ponds and broodstock were fed with a commercial pelleted diet at 3% body weight daily. The fish pellets were contained 30% protein. Collection of seeds, Swim-up fry first appeared after 15 days of pairing. The seeds (fertile oval , new hatched larvae with yolk sac and Swim-up fry) were collected and counted every 20 days after stocking up . The complete set of seeds collected from each hapa was referred to as a clutch. Collected seeds

(fertile oval , new hatched larvae with yolk sac and Swim-up fry) were either placed in artificial incubators or in hapa. The experiment was completed in three months .Hapa installation**,** Hapa nets with a mesh size of 1.5 mm and surface area dimension of 2x1 m were prepared and suspended in the experimental pond to maintain a water depth of 0.6 m inside the hapa. Four groups of broodstock were used according to sex ratios as follows: 39 male: 57 female(group1), 32 male :64 female (group 2), 28 male : 68 female (group 3)and 24 male : 72 female (group 4) respectively, were tested in three replicates. Altogether, twenties(12) hapas were utilized.Experimental fish,Nile tilapia broodstock were collected from Abbassa Fish hatchery, Central Laboratory for Aquaculture Research, Abbassa. Larger-sized male broodstock were avoided to prevent injury to female broodstock during spawning. In this study, 369 male and 783 female broodstock were used for spawning. Broodstock maturity and sex were determined before they were stocked in the breeding hapas. Sex ratios of broodstock used were 1:1.5, 1:2, 1:2.5 and 1:3 male to female. Water quality parameters such as temperature, pH, dissolved oxygen, nitrate, nitrite and salinity in the hapas were water quality was measured according to (Dewis and Freiles 1970) twice daily (Table1).

Statistical analysis all statistics were carried out using statistical analysis systems (SAS, 2004).

RESULTS AND DISCUSSION

Table (2) : shows the effect of broodstock sex ratios on seed production of Nile tilapia in first harvesting throughout the breeding period indicated that there are highly significant difference ($p>0.05$) in mean number of seed ,number of seed / female ,seed female /day and relative fecundity between group 3 and group4 than group 1 and group 2, however the differences between group 3 and group 4 was not significant the sex ratios in the 1st clutch.

In the 2nd clutch (Table 3)mean number of seed ,number of seed / female ,seed female /day and relative fecundity was higher significantly difference ($p>0.05$) in group 3 than group 2 and group 1 and group 2 than group 1,also in group 3 than in group 4 in relative fecundity, however the differences between group 3 and group 4 was not significant in mean number of seed ,number of seed / female ,seed female /day .

In Table 4, group 3 (sex ratio of 1:2.5 male to female) or group 4 (sex ratio of 1:3 male to female) produced higher, mean number of seed, number

Table1: ***Physico-chemical characteristics of earthen water ponds during climatic period during experiment of Nile tilapia.***

Items	Mean	Items	Mean
Temperature(c)	26-28 ^{o}C	Nitrate (mg/l)	0.01
PH	8.7	Nitrite (mg/l)	0.02
Oxygen (mg/l)	8.1	Salinity (mg/l)	0.3

Salinity was calculated by relation (1000 micromos =0.7g salinity according to Dewis and Freila, 1970.

of seed / female ,seed female /day and relative fecundity than group2 and group 1 (the sex ratio of 1:1.5 and 1:2 male to female), there are highly significant group 2 than group1,also there are highly significant group 3 than group 4 in mean number of seed and relative fecundity .The present results were in agreement with those of Grant *et al*. (1995), Khater (2002) and

Table (2): ***The relationship between average weight of female Nile tilapia and mean number, average weight and length of resulting seeds according to sex ratio of broodstock after twenty days in first harvesting (clutch1).***

Item	Group 1	Group 2	Group 3	Group 4
Ave. body weight/ females (g)	161.2 ± 8.9a	165.5 ± 11.5a	159.8 ± 7.5a	167.9 ± 13.1a
Ave. body weight/fry(mg)	6.8 ±1.3a	6.9 ±1.6a	6.2 ±1.7a	6.5 ±1.6a
Ave. body length/ fry (mm)	8.8 ±1.3a	8.7 ±0.9a	6.6 ±1.5a	7.5 ±1.7a
Mean number of seed	10830 ±734.1c	13440 ±675.1b	19040 ±876.4a	19440 ±734.1ab
Number of seed / female	190.0 ±26.2c	210.0 ±45.2b	280.0 ±32.6a	270.0 ±23.1ab
Seed female / day	9.5 ±1.6c	10.5 ±1.9b	14.0 ±1.4a	13.5 ±0.8ab
Relative fecundity*	1.2 ±0.1c	1.3 ±0.2b	1.7 ±0.4a	1.6 ±0.1ab

Relative fecundity = number of seed / female / body wt. of female.
a, b,c: means within the same raw having the same superscripts don't differ (p<0.05) significantly otherwise they do.

Table (3): ***The relationship between average weight of female Nile tilapia and mean number, average weight and length of resulting seeds according to sex ratio of broodstock after twenty days in second harvesting (clutch2).***

Item	Group 1	Group 2	Group 3	Group 4
Ave. body weight/ females (g)	163.2 ± 8.9a	168.5 ± 11.5a	161.8 ± 7.5a	168.9 ± 13.1a
Ave. body weight/fry(mg)	7.1 ±1.2a	7.5 ±1.5a	7.3 ±2.0a	6.9 ±0.9a
Ave. body length/ fry (mm)	9.2 ±0.8a	10.1 ±1.7a	10.0 ±1.8a	9.5 ±1.3a
Mean number of seed	11400±587.1c	14720 ±669.4b	18360 ±795.1a	18000 ±823.1ab
Number of seed / female	200.0 ±25.1c	230.0 ±27.0b	270±24.1a	250.0 ±19.6ab
Seed female / day	10.0 ±1.5c	11.5 ±1.2b	13.5 ±2.0a	12.5 ±1.2ab
Relative fecundity*	1.2 ±0.3c	1.4 ±0.2b	1.7 ±0.3a	1.5 ±0.5b

Relative fecundity = number of seed / female / body wt. of female.
a, b,c: means within the same raw having the same superscripts don't differ (p<0.05) significantly otherwise they do.

Table (4): ***The relationship between average weight of female Nile tilapia and mean number, average weight and length of resulting seeds according to sex ratio of broodstock after twenty days in third harvesting (clutch3).***

Item	Group 1	Group 2	Group 3	Group 4
Ave. body weight/ females (g)	165.3 ± 8.9a	170.4 ± 11.5a	164.0 ± 7.5a	171.0 ± 13.1a
Ave. body weight/fry(mg)	7.2 ±1.5a	7.5 ±1.2a	7.0 ±1.3a	6.9 ±0.8a
Ave. body length/ fry (mm)	9.5 ±0.7a	9.9 ±1.4a	8.8 ±1.3a	8.5 ±1.1a
Mean number of seed	11970±765.4c	16000 ±854.3b	19720 ±763.2a	19440 ±745.1b
Number of seed / female	210 ±44.1c	250.0 ±45.1b	290.0±28.3a	270.0 ±10.4ab
Seed female / day	10.5 ±1.8c	12.5 ±1.4b	14.5 ±1.9a	13.5.0 ±1.2ab
Relative fecundity*	1.3 ±1.3c	1.5 ±1.8b	1.8 ±1.1a	1.6 ±0.9b

Relative fecundity = number of seed / female / body wt. of female.
a, b,c: means within the same raw having the same superscripts don't differ (p<0.05) significantly otherwise they do.

Mills and Reynolds (2003), they found better performance of females stocked at lower sex ratios 1 :2 and 1:3 (male : female) than those stocked at higher 1:4 and 1:5 (male : female)sex ratios. However, Siddiqui and Al-Harbi (1997) studied four sex ratios of 1:2, 1:3, 1:4 and 1:5 male to female in hybrid tilapia reared in concrete tanks. They stated that there were no significant differences in seed production between all treatments.

Similarly, Bautista *et al*. (1988) found that seed production in *O. niloticus* was not significantly different ($p>0.05$) using sex ratios of 1:4, 1:7 and 1:10 male to female.

Ridha and Cruz (1998) used male to female sex ratio of 1:3, 1:4 and 1:5 with water temperature and photoperiod under controlled conditions. Their result showed that seed production was not influenced by sex ratio. Nevertheless, M'Hango and Brummett (1998) found that fry production was significantly higher in 1:1 male to female (111 fry/ female) compared to 1:3 sex ratio (66 fry/ female) for *O. shiranus*. Khater (2002) reported that sex ratio of 1:3 male to female was better economically for fry production.

In the present study, there are some unfertilized eggs were observed in the 1st clutch of 1:1.5 sex ratio treatment. This may be due to competition between males during spawning activity that caused some eggs to remain unfertilized. Grant *et al*. (1995) stated that higher male density led to increase aggression and male-male competition which could reduce the opportunity for female to spawn. Present opinion is supported by Mills and Reynolds (2003) who concluded that there was low competition between males and higher spawning frequency with females occurred when fewer males were encountered during spawning activity.

In the present study, for (group1, 2^{nd} and 3^{rd}), it was observed that seeds harvested in the 2^{nd} and 3^{rd} clutches were mostly at the swim-up fry stage ,while the 1^{st} clutch consisted mostly of eggs and new hatched larvae. The increase in spawning frequency of females in group 3 could have contributed to the observation of more swim-up fry in the 2nd and 3nd clutches.Nile tilapia broodstock performance mean total seed and seed female / day group 3 produced higher mean seed production than all groups, also group 2 and group 4 higher significantly than group 1,however group 1 . Khalfalla *et al*. (2008) reported that seed output of blue tilapia broodfish using sex ratios of 1:1, 1:2 and 1:3 male to female were not significantly different among the ratios.

CONCLUSION

According to the present results, in order to produce a total lot of seed production (fertile ova , new hatched fry with yolk sac and free swimming fry without yolk sac) each 3 months ,needs to the sex ratio of 1 : 2.5 male to female(group 3) followed by sex ratio of 1 : 3 male to female(group 4), the differences between group 3 and group 4 was not significant produced higher seed (fertile ova , new hatched fry with yolk sac and free swimming fry without yolk sac) than group 2 and group 1 and needs to prepare O. niloticus female of average body weight ranging between 140- 180 g/ female, approximately.

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تأثير النسبة الجنسية علي الكفاءة التناسلية لآمهات اسماك البلطي النيلي في هابات الاحواض الترابية

عادل محمد عبدالحميد عكر

المعمل المركزي لبحوث الثروة السمكية بالعباسة – ابوحماد – شرقية

الغرض من هذه الدراسة هو تأثير النسبة الجنسية للامهات علي الكفاءة التناسلية لاسماك البلطي النيلي باستخدام هابات الآحواض الترابية تمت الدراسة علي اربع مجموعات من الامهات وكانت النسبة الجنسية المستخدمة كالآتي : ١ ذكر : ١,٥ انثي (المجموعة الاولي) ، ١ذكر : ٢ انثي (المجموعة الثانية) ، ١ ذكر : ٢,٥ انثي (المجموعة الثالثة) و ١ ذكر : ٣ انثي (المجموعة الرابعة)

تم استخدم عدد ٩٦ ام لكل هابة من الاربع هابات والتي تبلغ مساحتها (٤ x٦ م) وقد تم جمع زريعة البلطي(بيض مخصب – يرقات تحمل كيس المح- يرقات متحررة) كل ٢٠ يوم وكانت فترة جمع الزريعة شهرين علي ثلاث مرات .

وكانت النتائج كما يلي :

اثبتت هذه الدراسة ان المجموعة الثالثة والرابعة قد انتجت عدد اكبر من الزريعة وذلك بالمقارنة بالمجموعة الاولي والثانية . متوسط عدد الزريعة الناتجة بعد ٢٠ يوم من بداية التجربة (الحصاد الاول) ١٩٠٤٠ ٤و٨٧٦ زريعه (المجموعة الثالثة) اما بالنسبة للمجموعة الرابعة ١٩٤٤٠ ١و٧٣٤ زريعه .

متوسط عدد الزريعة بعد ٤٠ يوم من بداية التجربة (الحصاد الثاني) ١٨٣٦٠ ١و٧٩٥ زريعه (المجموعة الثالثة) اما بالنسبة للمجموعة الرابعة ١٨٠٠٠ ١و٨٢٣ زريعه. متوسط عدد الزريعة بعد ٦٠ يوم من بداية التجربة (الحصاد الثالث) ١٩٧٢٠ ٢و٧٦٣ زريعه (المجموعة الثالثة) اما بالنسبة للمجموعة الرابعة ١٩٤٤٠ ١و٧٤٥ زريعه.