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RESEARCH ARTICLE

BROODSTOCK SEX RATIO IMPROVES FRY PRODUCTION IN NILE TILAPIA(*OREOCHROMIS NILOTICUS*) IN NORTHERN SENEGAL

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Abstract

This present study was conducted to determine fry production in different male-female sex ratios of *Oreochromis niloticus*broodstock in order to improve fry production, which handicapped the development of fish farming in northern Senegal. A total of 180 broodfish (47 males and 133 females) were stocked at a density of 2 fish /$m^2$and was replicated three times for each sex ratio of 1:2, 1:3and 1:4 (male : female). Mean body weight ranges from 136.47±2.13 and 107.27±2.14 g for female and male *O. niloticus*broodstock, respectively. The experiment was conducted for 90 days and the broods were fed on commercial diet containing 32% crude protein.Fish were held in 9 rectangular tanks of 30 m^3 each (10 × 3 × 1) and half-filled. The results showed that number of fry produced at different sex ratios were significantly different, with sex ratio of 1:2 producing a highest number of fry (279.67) per female, followed by the 1:3and 1:4 treatment recorded the lowest.Broodstock sex ratios also did not affect female survival rates and all treatments had 100% survival rates. Temperature, dissolved oxygen and pH values obtained were suitable for good water quality and normal tilapia reproduction.In conclusion, the results of the present study recommend to stock *Oreochromis niloticus* brooders when stocked at a density of 2 fish /m^2 at a sex ratio of 1 male : 2 female in order to obtain the highest fry production.

Introduction:-

Oreochromis niloticus is the main species bred in captivity in the waters of the northern region of Senegal. It is a very resistant strain with regard to the sometimes unfavorable conditions of the breeding environment, its resistance to diseases, its high survival and growth rate. (Celik, 2012). They tolerate and survive in relatively poor environmental conditions such as high stocking density, extremely poor water quality parameters e.g. low dissolved oxygen level, high ammonia and low temperatures and organically polluted water. These characteristics led to its introduction in several African countries outside of its natural distribution areas (Vitule et al., 2009; Lazard et Levêque, 2009). The reproductive biology of tilapia has been widely studied in different parts of the world. It has been shown that reproductive success in many fish species is influenced by environmental factors, among other factors, the spawning stock, stocking density, age, size, sex ratio, nutrition and diet etc. (Tahoun et al. 2008). Chong et al, 2004 ; Tahoun, 2007 ; Hammouda et al, 2008 et Ibrahim et al. 2008).

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Fry production in developing countries is largely insufficient in relation to demand. This low seed production could be attributed to very low stocking density, lack of spawning technique, poor broodstock nutrition, high mortality or inadequate sex ratio. (Salama, 1996).

Earlier studiesindicated that choosing the sex ratio of broodstock could help improve fry production and reduce production costs(Siddiqui et al-harbi. 1997 ; Nour et al. 2008 ; Khalfalla et al, 2008). The objective of this study is to study the effect of the sex ratio on the reproduction of *Oreochromis niloticus*.

Materials and Methods:-

Experimental design:

This study was conducted at the ANIDA farm (DiamaMaraye) located at 45 km from the city of Saint-Louis in northern Senegal. Sex ratio is typically defined in fish as the ratio of ready-to-mate males to ready-to-mate females.

Three sex ratio trials were conducted from March to October, 2018. A total of 180 fish (47 males and 133 females) were randomly assigned to one of three separate treatment groups A, B and C respectively (1:2 ; 1:3 and 1:4). Each treatment was run simultaneously in triplicate with 60 fish per tank at a density of 2ind/m^2. Fish were held in 9 rectangular tanks of 30 m^3each (10 × 3 × 1) and half-filled. The 1:2 sex ratio treatment consisted of forty females and twenty males, the 1:3 sex ratio treatment consisted of forty-five females and fifteen males, and the 1:4 sex ratio treatment consisted of forty eight females and twelve males. Brood-stock fish were fed a commercial diet containing 35% protein at a feeding rate of 3% of their biomass. Broodstock were fed twice daily, at 11:00 am and 6:00 pm.

Collection of seeds:

Reproductive events were detected with the observation of offspring emerging to water surface to breath and were recorded as reproductive success. swim-up fry first appeared after 14 days of pairing. The seeds (eggs, sac-fry and swim-up) were collected and counted every two weeks after stocking up to day 63.

Water quality parameters:

Water temperatures were determined two times a day at 8.00 am and 4.00 pm by using a thermometer. Water dissolved oxygen (DO) content and water pH were measured daily at 8.00 pm using a Handyoxyguard dissolved oxygen meter and a digital Hanna pH meter respectively.

Statistical analysis:

All results are presented as mean ± standard error of the mean (SEM). Data were analyzed by one-way analysis of variance (ANOVA) to test the effect of the broodstock sex-ratio. Where significant differences were found at ($P < 0.05$), a Turkey's test was used to determine which treatment means were significantly different from each other. The statistical analyses were made using XLSTAT (Version 2020 : 5.1)

Results:-

There was no *Oreochromis niloticus* brooders mortality observed during this study.

Mean values for temperature (°C), dissolved oxygen (DO), and pH of water during the experimental period are presented in Table 1.

Table 1:- Water quality parameters ranges recorded during the experimental period.

Treatments	Temperature (ºC)	DO (mg l)	pH
Sex-ratio 1/2	28-32	4.1-12,6	7.5-7.8
Sex-ratio 1/3	28-32	4.5-10.5	7.4-7.9
Sex-ratio 1/4	28-32	5.1- 11.5	7.6-7.8

Temperature, dissolved oxygen and pH values obtained were suitable for good water quality and normal tilapia reproduction.

Tableau 2:- Effect of sex ratio on fry production per female.

Treatments	Mean	SEM
Sex-ratio 1/2	$279,67^a$	3,51
Sex-ratio 1/3	$255,67^b$	3,06

Sex-ratio 1/4	246,67[c]	2,08

[a,b]Means having different alphabet superscript were significantly different ($p<0.05$) as determined by replication and Turkey's comparison of means. a>b>c

The results in Table 2 shows the effect of different sex ratios on fry production per female. Fry production per female was significantly affected by the sex ratio. It can be seen that the production per female with a sex ratio of 1/2 is significantly higher than the other two treatments. The treatment with a sex ratio of 1/3 was significantly higher than the treatment with a sex ratio of 1/4.

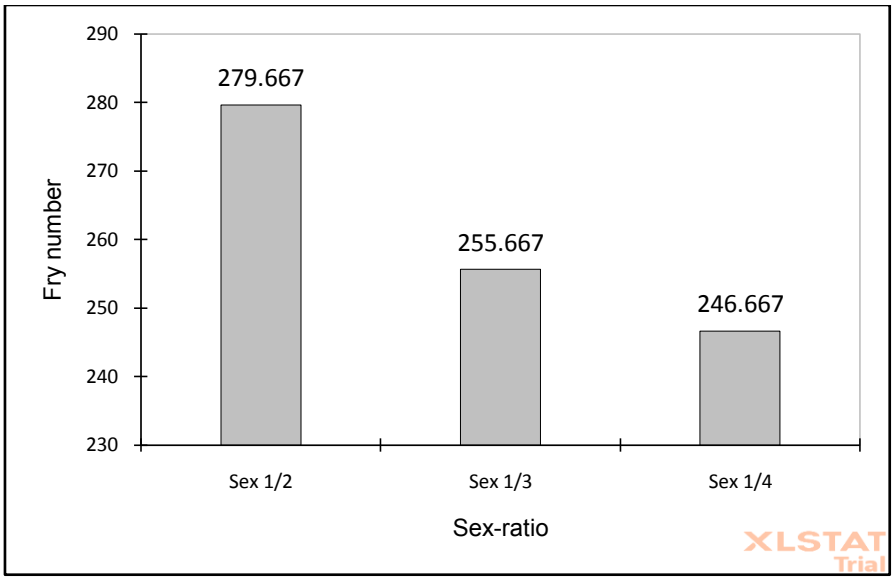

Figure 1:- Effect of sex ratio on fry production per female.

Discussion:-

The results of this study show that the number of fry produced by the three sex ratios are significantly different. The treatmentwith the lower sex ratio 1:2 obtained the highest number of fry, followed by the treatment with the sex ratio1:3 and finally with the treatment with the sex ratio 1:4. This shows that the fry production decreased with the increase of the number of female per male. These results indicate that an increase in the number of males would be more productive. These results are consistent with those of GRANT et al. (1995),Khater (2002) and Mills and Reynolds (2003) who found that there was better reproductive performance with low sex ratios (1/2; 1/3) than with high sex ratios (1/4 or 1/5). In addition, Sallama (1996) also found that the best reproductive performance is obtained with a low sex ratio. The difference was attributed to the efficiency of male fertilization as sometimes there are not enough males available to fertilize all the eggs. Overcrowding can also have counter-productive effects.

The differences between the 1:2 sex ratio and the other experimental sex ratios (1:3 and 1:4 between males and females) have been attributed to the efficiency of male fertilization, as sometimes more than one female is ready to spawn at the same time, while the available males are not sufficient to fertilize the eggs. Higher male density led to increase aggression and male to male competition reduce the opportunity for female to spawn (Grant et al. 1995).

In contrast, many authors found that there were no significant differences on the reproductive performance to different sex ratios, such as Siddiqui and Al-harbi(1997)who studied the influence of four sex ratios 1/2, 1/3, 1/4, 1/5 in ponds and Bautista et al (1988) who studied the influence of (1/4, 1/7, 1/10) sex ratios. Ridha and Cruz (1998) used sex ratios of 1/3, 1/4, 1/5 with temperature and photoperiod under controlled environment and found that fry production was not influenced by the sex ratio.

In their study (Fry Production in Tilapia Rendalli Stocked in Suspended Earthen Pond Hapas at Different Sex Ratios), Chapweteka et al. 2016 found that the 1:5 sex ratio produced more fry than other treatments (1: and 1:3).

Water quality parameters play an important role in the biology and physiology of fish. Throughout the experimental period, the water quality parameters in all the treatments remained within the range required for tilapias boyd, 1990.

Theses parameters were suitable for the normal growth and reproduction of tilapia and warm water fish (Tahoun, 2007). Water quality are directly related to fish farming and are very important to consider in fish culture. The growth and the reproduction of different fish species is also influenced by a different range of factors, among them water quality parameters.

Temperatures ranges between 20 and 36 °C have been reported by various researchers as being suitable for tilapia culture. According to Lazard, 2009 the reproduction occurs in *Oreochromis niloticus* when the temperature is between 28 and 32 °C. These previous studies are consistent with the current study findings in which the water temperature ranged between 28-32°C. Therefore, the differences in number of fry in different sex ratios could not have been attributed to variations in water quality parameters.

Conclusion:-

The results obtained from this study show that the sex ratio have a significant effect on the reproduction of *Oreochromis niloticus*. This shows that the fry production decreased with the increase of the number of female per male.

Contribution of the authors:

MA LY, A Ngom and AB Fall participated in the design of the theme, the collection and organization of the scientific information provided. O Diouf Collected the data, MA LY Performed the data analysis and Wrote the paper. MA LY, A NGOM participated in the reading and correction of the article.

Conflict of Interest Declaration:

The authors declare that there are no conflicts of interest.

References:-

1. Bautista A, Ma Carlos MH, San Antonio AI. 1988.Hatchery production of *Oreochromis niloticus L*. at different sex ratios and stocking densities. Aquaculture. 73(1): 85-89.
Boyd, C.E., 1990. Water Quality in Ponds for Aquaculture. Birmingham Publ. Co., Birmingham, Al. 482.
2. CelikE. 2012. Tilapia culture review. Master of Science in Aquaculture. Norwegian University of LifeSciences. 78pp
3. ChapwetekaD, MzengerezaK,Zidana H. 2016.Fry Production in Tilapia Rendalli Stocked in Suspended Earthen Pond Hapas at Different Sex Ratios. International Journal of MarineScience and Ocean Technology (IJMO).3(5), 50-54.
4. Chong ASC, Ishak SD, Osman Z, Hashim R. 2004. Effect of dietary protein level on the reproductive performance of female swordtails *Xiphophorushelleri* (Poeciliidae).Aquaculture, 234: 381-392.
5. Grant JWA, Bryant MJ,Soos CE. 1995.Operational sex ratio, mediated by synchrony of Female arrival, alters the variance of male mating success in Japanese medaka. Animal Behavior. 49:367-375.
6. Hammouda YAF, Ibrahim MAR, Zaki, El-Din MMA, Eid AMS, MagouzFI,Tahoun AM. 2008. Effect of dietary protein levels and sources on reproductive performance and seed quality ofNile tilapia *Oreochomisniloticus* (L.) broodstock. Abbassa International Journal forAquaculture, 1(A):55-78.
7. Ibrahim MAR,Hammouda YA, Zaki El-Din MMA, Eid AMS, MagouzFI,Tahoun AM.2008. Effect of dietary protein levels and sources on growth performance and feed utilization of Nile tilapia *Oreochromisniloticus* (L.) broodstock. Abbassa International Journal forAquaculture, 1(B):251-274.
8. Khalfalla MM, Hammouda YA, Tahoun AM, Abo-State HAM. 2008. Effect of broodstock sex ratio on growth and reproductive performance of blue Tilapia *Oreochromis Aureus*(Steindachner) reared in Hapas.8th International Symposium on Tilapia in Aquaculture. 116-121.
9. Khater AM.2002. Effect of sex ratio on reproductive performance of Nile Tilapia(*Oreochromis niloticus*) andblue Tilapia(*Oreochromis aureus*).Egyptian Journal Agricultural Research. 80(1): 377-386.
10. Lazard J. 2009. La pisciculture des tilapias. *Cahiers Agricultures*, 18(2-3): 393–401.
11. Lazard J,Levêque C. 2009. Introductions et transferts d'espèces de poissons d'eau douce. CahiersAgricultures, 18(2-3): 157–163. DOI: 10.1684/agr.2009.0290
12. Mills SC, Reynolds .D. 2003. Operational sex ratio and alternative reproductive behaviors in theEuropean bitterling, *Rhodeussericeus*. Behavioral EcologicalSociobiology. 54(2): 98-104.

11. Nour, A.M., El Ebiary,S.&Aboelwafa, M., 2008. Spawning effects of broad tilapia species, fed on two dietary protein levels and two sex ratios on fry production. 32nd Annual Larval Fish Conference, Leibniz Institute of Marine Science (IFM-GEOMAR) Christian Albrechts University Kiel,Germany,4 - 7 August 2008
12. RidhaMT,Cruz EM. 1997.Observations on the seed production of the Tilapia *Oreochromis spilurus* (Gunther) under different spawning conditions and with different sex ratios. Asian Fish.Scientific research. 10(3): 201-210.
13. Salama ME. 1996. Effects of sex ratio and feed quality on mass production of Nile Tilapia, *Oreochromis niloticus* (L.), fry. Aquaculture Research. 27(8): 581-585.
14. Siddiqui AQ, Al-Harbi AH. 1997. Effects of sex ratio, stocking density and age of hybrid tilapia on seed production in concrete tanks in Saudi Arabia. Aquaculture International, 5: 207–216
15. Tahoun AM, A-Ibrahim M,HammoudaYF, EidMS, Zaki El-Din MA,MagouzFI. 2008. Effects of age and stocking density on spawning performance of Nile tilapia, *Oreochromis niloticus* (L.) broodstock reared in hapas. p.329-344. In: International Symposium on Tilapia inAquaculture, Cairo.
16. TahounAMA. 2007. Studies on some factors affecting the production and reproduction of Nile tilapia(Doctoral dissertation, Ph. D. Thesis, University of KafrEl-sheikh, Egypt). 325pp
17. Vitule JRS, Freire CA,Simberloff D.2009. Introduction of non-native freshwater fish can certainlybe bad. Fish and Fisheries, 10(1): 98–108. DOI:10.1111/j.1467- 2979.2008.00312.x.