Research Article

STUDY OF THE ZOOTECHNICAL PERFORMANCE OF TILAPIA CABRAE AND OREOCHROMIS SCHWEBISCHI IN A CONTROL ENVIRONMENT: THE CASE OF THE MBOLET FISH FARM IN LAMBARÉNÉ, GABON

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Abdourhamane Ibrahim Toure. STUDY OF THE ZOOTECHNICAL PERFORMANCE OF TILAPIA CABRAE AND OREOCHROMIS SCHWEBISCHI IN A CONTROL ENVIRONMENT: THE CASE OF THE MBOLET FISH FARM IN LAMBARÉNÉ, GABON. J Aqua Fish 2021;2(5):1-17.

The study of the zootechnical performance of Tilapia cabrae and Oreochromis schwebischi was carried out at the Mbolet fish farm in Lambaréné, Gabon. It was carried out with the aim of evaluating the growth and reproduction performance of these two species.

For this purpose, 226 subjects, including 113 of T. cabrae with an average weight of 30.55 ± 9.5 g, and 113 O. schwebischi with an average weight of 20.64 ± 10.5 g, were distributed in four 6 m2 tanks with two replicates per species for the growth phase, which lasted 60 days. For the reproduction phase, 42 mature fish were selected, including 6 males and 36 females of each species. These were placed in six 2 m2 ponds with three replicates per species. The reproduction was monitored for 78 days. The survival rate, the number of reproductions per species and the absolute, relative and system productivity were determined.

It was found that the average weight gain, individual daily growth and specific growth rate were significantly ($p<0.05$) higher in T. cabrae, 48.1±5.51 g, 0.8±0.092 g/day and 1.57±0.066% g/day respectively, than in O. schwebischi, 27.11±9.23 g, 0.45±0.15 g/day and 1.38±0.051% g/day respectively. At the end of reproduction, the absolute productivity of T. cabrae (234.75±24.71 larvae/female/egg-laying) was significantly higher ($p<0.05$) than that of O. schwebichi (104.68±46.64 larvae/female/egg-laying). The number of reproductions and system productivity were significantly high ($p<0.05$) in O. schwebichi, 16.66±1.11 and 11.34±2.29 larvae/m2/day respectively, compared to those of T. cabrae, 2.66±0.89 and 4.12±1.73 larvae/m2/day respectively. Survival rates were above 80% during growth and reproduction.

Thus, on a fish farm, the use of these species may be possible.

Keywords: Tilapia cabrae; Oreochromis schwebichi; growth performance; reproductive performance; Gabon.

INTRODUCTION

The increase in the world's population has led to a correspondingly greater demand for proteins, particularly animal proteins (1). At the fisheries level, the improvement of fishing techniques and the extension of fishing areas leading to an increase in catches have made it possible to satisfy part of this protein demand (2), thus leading to a doubling of total catches between 1962 (~40 000 t) and 1987 (~80 000 t) (3). According to reported catch statistics (4), global fisheries production has steadily increased. Capture fisheries and aquaculture have produced about 142 million tonnes of fish. Of this total, 115 million tonnes were destined for human consumption, giving an apparent per capita supply of 17 kg of fish, an all-time high. However, it appears that many fish resources can no longer sustain the often uncontrolled intensification of their exploitation. Indeed, at the global level, it is estimated that 61% of fish stocks are exploited to their maximum and 29% are overexploited (5). The stocks directly threatened by exploitation are mainly those of economic interest (6). They are particularly targeted and are subject to strong fishing pressure that is often beyond their level of viability. This situation of overexploitation can also be observed in Africa in general (7), and in Gabon in particular. In Gabon, and in the Moyen Ogooué in particular, fishing is used by the local population as a means of subsistence by providing them with an income (8). Much of their catch is transported to the capital Libreville, and neighbouring towns. However, the need for fish remains uncovered and continues to grow with the increase in population. This forces an overexploitation of the region's fisheries, thus leading to a qualitative and quantitative decline in resources (8). For this reason, the Mbolet fish farming station recommends the implementation of a project that consists of producing marketable fish using the most caught species in order to satisfy part of the demand and massively produce fry of species from these fisheries, notably Oreochromis schwebischi and Tilapia cabrae for sequential restocking. Indeed, these species are the most encountered and caught in the fishing areas (8). Moreover, the captive breeding of these two species, which are still poorly understood, considerably limits the implementation of such a project.

The general objective of this work is to contribute to the knowledge of the zootechnical performance of the species Oreochromis schwebischi and Tilapia cabrae.

MATERIALS AND METHODS

Study environment

This study was carried out at the Mbolet fish farm in Lambaréné in the province of Moyen-Ogooué in Central-West Gabon. The province is subdivided into two departments, the Abanga-Bignéay department with Ndjolé as its chief town and the Ogooué and Lakes department with Lambaréné as its chief town, at an altitude of 0° 46' 48" South and a longitude of 10° 14' 2".The climate in this area is of the humid tropical savannah type (Aw). The average annual temperature is 26.1°C and the average rainfall is 1999 mm (9). It is located in the quarter of "Petit Paris 3", behind the regional hospital, on the shore of Lake Mbolet at the coordinates -0.698681 and 10.253984.

Biological materials

Two species of fish were used in this test. These were Tilapia cabrae and Oreochromis schwebischi. These fish were caught in the fisheries of Moyen-

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Ogooué and brought to the station. The experimental samples were taken at the fingerling stage with an average weight of 30.55 ± 9.5 g for T. cabrae and 20.64 ± 10.5 g for O. schwebischi. In order to monitor the growth of these two species in a controlled environment, they were conditioned for one month.

Experimental facilities

At the end of the conditioning, 113 subjects were used for each species. Four lots were made up, two for each lot of each species. The loading of the fish took into account the number of fish, their weight and density (Table 1).Tanks of 6 m2 were used for each lot. Water was pumped into the ponds from the surrounding lake. This phase lasted 2 months and allowed not only the development of the fish but also the maturation of their gonads.

Table1: Loading conditions.

Species	Oreochromis schwebischi		Tilapia cabrae	
Ponds	B1Os	B2Os	B1Tc	B2Tc
Total	56	57	56	57
Mean weight (g)	14.62 ± 10.8	26.66 ± 4.02	32.08 ± 5.01	29.02 ± 2.4
Surface (m2)	6	6	6	6
Density (individuals/ m2)	9.33	9.5	9.5	9.5

The fish were fed three times a day (9am, 12pm and 3pm) with the feed which characteristics are given in Table 2. The feed was presented in the form of 4 mm diameter pellets to the animals (Figure 1).

Table2: Incorporation rate of the ingredients and chemical composition of the formulated feed.

Ingredients	Incorporation rate (%)
Fine wheat bran	19.45
Peanuts	19.45
sardine Crums	48.62
Wheat flour	4.86
Cassava flour	4.86
Palm oil	2.43
Salt	0.16
Vitamin	0.16
Total	**100**
Chemical composition	
Dry matter (%)	74
Organic matter (%MS)	90
Ashes (%MS)	10
Crude protein (%MS)	30
Lipids (%MS)	2.4
Crude Cellulose (%MS)	6

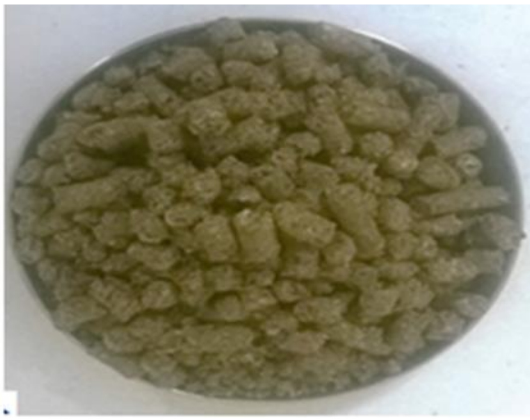

Figure1: 4 mm diameter granules

Monitoring fisheries, carried out every 15 days, allowed the determination of weight gain; the quantity of feed distributed; the number of deaths.

At the end of the two months of growth, sexing was carried out in the different batches on the basis of the sexual dimorphism that is marked in these species. Thus, the observation of the genital papilla allowed to identify the male from the female (figure 2).

Swollen genital papilla with red protrusion Swollen genital papilla with pink protrusion

Figure2: Female of T. cabrae (Tc) and female of O. schwebischi (Os)

For breeding, after the selection of genitors, the fish were distributed in six 2 m2 ponds. There were 15 individuals per tank with a sex ratio of four females to one male and a density of 7.5 fish per square metre. Therefore, 3 males and 12 females could be found in each tank. The total numbers of 72 fish, of which 36 T. cabrae and 36 O. schwebishi were used. They were weighed and divided into 6 batches, 3 batches of each of these species. The loading of the fish took into account the number of fish, their weight and density (Table 3). In all breeding ponds, males were selected according to their size in order to avoid possible aggression from females during the breeding process.

Table 3: Selected genitors.

Species	T. cabrae			O. schwebischi		
Ponds	B1Tc	B2Tc	B3Tc	B1Os	B2Os	B3Os
Number of males	3	3	3	3	3	3
Number of females	12	12	12	12	12	12
Total	45			45		
Males Mw (g)	110,83 ± 6,11			63 ± 4,38		
Females Mw (g)	46,05 ± 1,96			30 ± 3.33		

* MW : mean weight; B1Tc: Pond1 of T. cabrae; B2Tc: Pond2 of T. cabrae; B3Tc: Pond3 of T. cabrae; B1Os: Pond1 of O. schwebischi; B2Os: Pond2 of O. schwebischi; B3Os: Pond3 of O. schwebischi.

Larvae and/or juveniles were collected every fortnight depending on the species. For T. cabrae, the water was lowered to a level that facilitated the fishing of juveniles and the females that produced them; the captured females are weighed and then released into the tank and the fingerlings are counted. In the case of O. schwebischi, the tank is completely emptied by lowering the drain pipe; all females were inspected, those with larvae in their mouths were collected by a fine-mesh net and the fry were counted ; isolated females are weighed before being released into the pond. The monitoring of the reproduction was spread over a period of 78 days during which the data on the number of dead spawners; the number of reproductions carried out in each lot, the number of larvae produced per female and the weight of the females that produced them were collected. The food used during this phase is identical to that used during the grow-out phase. The fish are fed three times a day (9:00 am, 12:00 pm and 3:00 pm), except the day before the control fisheries. The food was weighed using a Kologn manual scale with a capacity of 5 kg and an accuracy of 1 g. For the weighing of fish, an electronic scale of the brand Orurudo, with a capacity of 5 kg and an accuracy of 1 g was used. The collection of pH and temperature was carried out daily three times a day (9:00am, 12:00 pm and 15:00pm) using a VWR multi-functional pH meter and the transparency using a Secchi disk every day at 12:00pm.The statistical analysis of the results (on growth performance) was done using the 95% confidence interval (95% CI) method (Appendix 8). When the 95% confidence intervals of two compared means are disjoint, then there is a significant difference at the 5% threshold between them. For reproductive performance, the statistical analysis of the results (reproductive participation, absolute productivity, relative productivity and system productivity) was carried out using the R software commander version 3.4.3. The test used was Student's mean comparison at the 5% level.

RESULTS

Physico-chemical parameters of the water during the growth phase

Samples of the physico-chemical parameters of the water during grow-out are summarized in Table 7.

Table 4: pH, temperature and transparency of the water used as a function of the sampling time.

Parameters	9 h	12 h	15 h
pH	8.43 ± 0.40a	8.97 ± 0.49a	9.16 ± 0.42a
Temperature (°C)	28.41 ± 0.36a	29.02 ± 0.55a	29.9 ± 0.55a
Transparency (cm)	46.66 ± 5.11		

From this table it can be seen that no significant differences ($p>0.05$) were observed between the different times with regard to pH and temperature. The pH varied from 8.43 ± 0.40 to 9.16 ± 0.42 and the temperature from 28.41 ± 0.36 to 29.9 ± 0.55°C. Transparency averaged 46.66 ± 5.11cm.

Growth performances

Evolution of mean weights (MW)

Figure 3 shows the evolution of the average weights of the two fish species during the two months of grow-out.

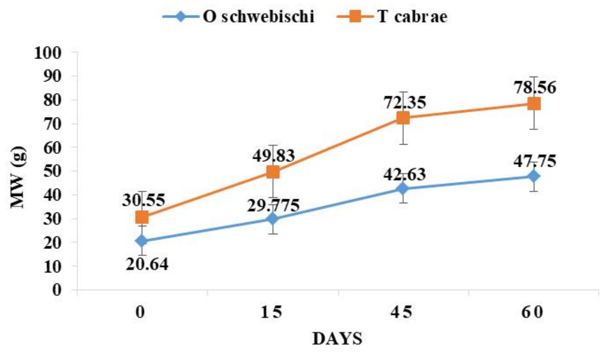

Figure3: Evolution of the mean weights according to the days

Figure 3 shows that the average weights of all fish species increased from the beginning of the trial to the end (day 60). Indeed, during this period, the average weight of T. cabrae increased from 30.55 g to 78.56 g and that of O. schwebischi from 20.64 g to 47.75 g. The total weight growth recorded was 48.01 g and 27.11 g for T. cabrae and O. schwebischi respectively. Statistical analysis showed that there was a significant difference ($p<0.05$) between these total weights.

Evolution of absolute weight gain (AWG)

The evolution of the absolute weight gain (AWG) of the two fish species during the two months of grow-out is presented in Figure 4.

Figure 3 shows that, irrespective of the fish species, absolute weight gains increased from the beginning of the trial to the end (day 60). Indeed, during this period, the absolute weight gain of T. cabrae increased from 832.44 g to 2459.22 g and that of O. schwebischi from 497.93 g to 1504.48 g. The total absolute weight gain obtained was 1626.78 g and 1006.55 g for T. cabrae and O. schwebischi respectively. Statistical analysis showed that there was a significant difference ($p<0.05$) between these total absolute weight gains.

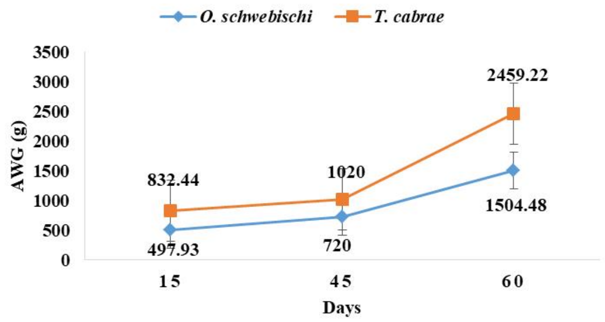

Figure4: Evolution of AWG of T. cabrae and O. schwebischi

Individual daily growth (IDG)

Figure 5 shows the individual daily growth of the two fish species during the two months of grow-out.

Figure 5 shows that, for all fish species, individual daily growth rates decreased from the beginning of the trial to the end (day 60). During this period, the individual daily growth of T. cabrae decreased from 1.475 g to 0.8 g and that of O. schwebischi from 0.7 g to 0.45 g. Thus, at the end of the trial, the average IDG recorded was 0.45 g/day for O. schwebischi and 0.8 g/day for T. cabrae. Statistical analysis revealed that there was a significant difference ($p<0.05$) between these IDG.

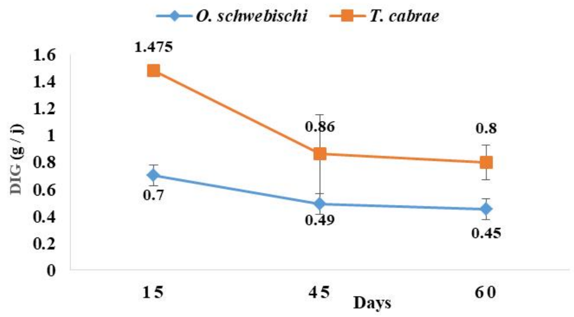

Figure5: Evolution of IDG (g /day) by species

Specific growth rate (SGR)

Figure 6 shows the specific growth rate of the two fish species during the two months of grow-out.

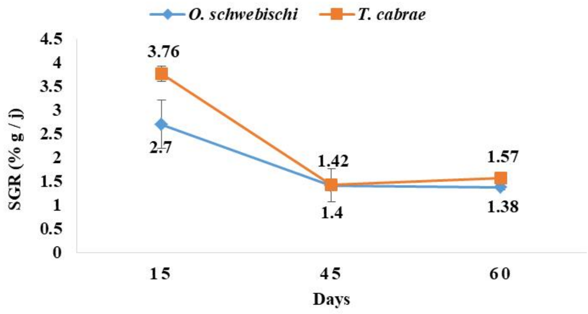

Figure6: Evolution of SGR (% g /day) of T. cabrae and O. schwebischi

Figure 6 shows that for all fish species, the specific growth rates (SGR) were decreasing from the beginning of the trial to the end (day 60). Indeed, during this period, the SGR of T. cabrae decreased from 3.76 to 1.57% g/day and that of O. schwebischi from 2.7 to 1.38% g/day. Thus, at the end of the trial, the average SGR obtained was 1.38% g / day for O.schwebischi and 1.57% g / day for T.cabrae. Statistical analysis revealed that there was a significant difference ($p<0.05$) between these SGR.

Consumption index (CI)

The consumption index (CI) of the two fish species during the two months of grow-out is presented in Figure 7.

From Figure 7, it can be seen that, irrespective of the fish species, the CIs were increasing from the beginning of the trial to the end (day 60). Indeed, during this period, the CI of T. cabrae increased from 3.05 to 3.64 and that of O. schwebischi from 1.86 to 2.93. Thus, at the end of the trial, the recorded CIs were 3.64 for O. schwebischi and 2.93 for T. cabrae. Statistical analysis revealed that there was no significant difference ($p<0.05$) between these CIs.

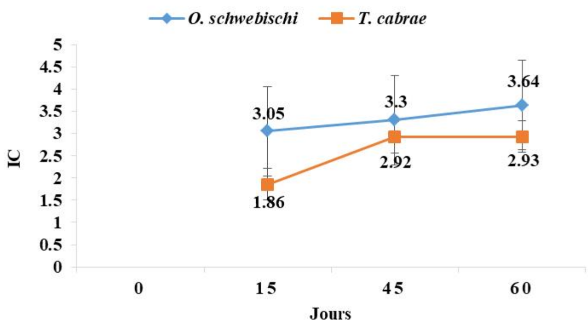

Figure7: Evolution of CIs by day

Protein efficiency coefficient (PEC)

The protein efficiency coefficient (PEC) of the two fish species during the two months of grow-out is shown in Figure 8.

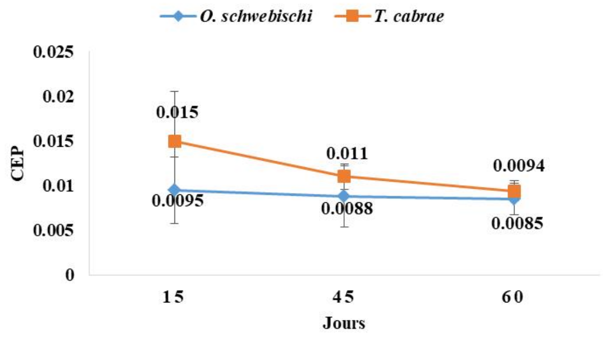

Figure8: Evolution of PEC by species

Figure 8 shows that the PECs of all fish species decreased from the beginning of the test to the end (day 60). In fact, during this period, the PEC of T. cabrae increased from 0.015 to 0.00994 and that of O. schwebischi from 0.0095 to 0.0085. Thus, at the end of the trial, the mean PECs recorded were 0.00994 for T. cabrae and 0.0085 for O. schwebischi. Statistical analysis revealed that there was no significant difference ($p>0.05$) between these PECs.

Growth parameters measured in T. Cabrae and O. Schwebischi species are recorded in Table 5.

Table5: Summary of growth parameters according to T. cabrae and O. schwebischi species.

Parameters	O. schwebischi	T. cabrae
Average weight gain (g)	27.11 ± 9.23a	48.01 ± 5.51b
IDG (g / day)	0.45 ± 0.15 a	0.8 ± 0.092 b
SGR (% g / day)	1.38 ± 0.051 a	1.57 ± 0.066 b
CI	3.64 ± 0.64 a	2.93 ± 0.57 a
PEC	0.0085 ± 0.0013a	0.094 ± 0.0008 a

Survival rate (SR)

The survival rates of O. schwebischi and T. cabra species are given in Table 6.

Table6: Survival rate of O. schwebischi and T. cabrae females

Parameters	initial Population	final Population	SR (%)
O. schwebischi	113	112	99.11
T. cabrae	113	99	87.61

From this table it can be seen that the highest survival rate (99.11%) was recorded for O. schwebischi and the lowest (87.61%) for T. cabrae.

Physico-chemical parameters during the breeding phase

The sampling of physico-chemical parameters of the water during the grow-out phase is summarized in table 7.

Table7: pH, water temperature and transparency in the ponds.

Parameters	9 h	12 h	15 h
pH	8.83 ± 0.44a	9.16 ± 0,36a	9.64 ± 0.35a
Temperature (°C)	28.61 ± 0.12a	29.41 ± 0.16a	30.30 ± 0.09a
Transparency (cm)	51± 1.25		

From this table it can be seen that no significant differences (p>0.05) were observed between the different times with regard to pH and temperature. The pH varied from 8.83 ± 0.44 to 9.64± 0.35 and the temperature from 28.61 ± 0.12 to 30.30± 0.09°C. Transparency averaged 51± 1.25 cm.

Breeding performance

Involvement in breeding

This parameter corresponds to the average number of breedings in a pond. Thus, the number of breedings according to the fish species is shown in figure 9. From this figure, it appears that the number of breedings observed in O. schwebischi was significantly (p< 0.001) higher than that of T. cabrae, 16.66 and 2.66 respectively.

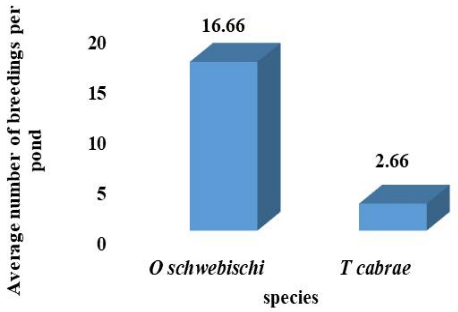

Figure9: Number of breeedings according to fish species

Absolute productivity (AP)

The absolute productivity (AP) of O. schwebischi and T. cabrae females is shown in figure10.

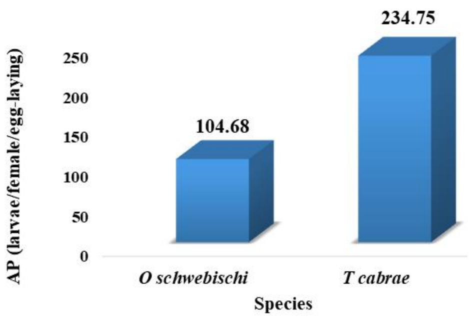

Figure10: Absolute productivity according to females of O. schwebischi and T. cabrae

Figure 10 shows that the absolute productivity of O. schwebischi was significantly (p< 0.001) lower than that of T. cabrae, 104.68 and 234.75 respectively.

Relative productivity (RP)

Figure 11 shows the relative productivity of O. schwebischi and T. cabrae species.

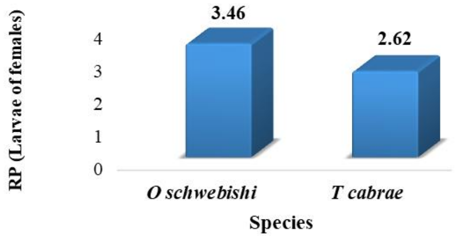

Figure11: Relative productivity according to females of O. schwebischi and T. cabrae.

From figure 11, it can be seen that the relative productivity recorded in O. schwebischi was significantly (p< 0.001) higher than that of T. cabrae, 3.46 and 2.62 respectively.

System productivity (SP)

Figure 12 shows the system productivity of O. schwebischi and T. cabrae species.

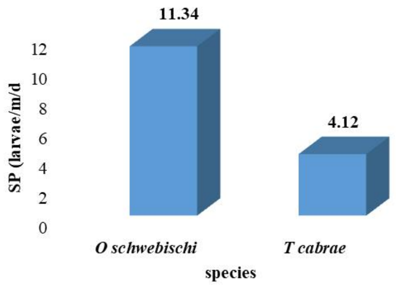

Figure12: Productivity of the system according to the females O. schwebischi and T. cabrae

From figure 12 it can be seen that the productivity of the system in O. schwebischi was significantly (p< 0.001) higher than that of T. cabrae, 11.34 and 4.12 respectively.

The breeding parameters measured in T. cabrae and O. schwebischi species are given in Table 8.

Table8: Summary of reproduction parameters on T. cabrae and O. schwebischi species.

Parameters	O. schwebischi	T. cabrae
Number of breedings	16.66 ± 1.11a	2.66 ± 0.89b
AP (larvae / female / egg-laying)	104.68 ± 46.64a	234.75 ± 24.71b
RP (larvae / g of female)	3.46 ± 0.62 a	2.62 ± 0.32 a
SP (larvae / m2/ d)	11.34 ± 2.29 a	4.12 ± 1.73b

Survival rate (SR)

The survival rate of female O. schwebischi and T. cabrae is summarised in Table 9.

Table9: Survival rate of O. schwebischi and T. cabrae females

Parameters	initial Population	final Population	SR (%)
O.schwebischi	48	45	93.75
T.cabrae	36	33	91.67

From this table it can be seen that the highest survival rate (93.75%) was recorded for O. schwebischi and the lowest (91.67%) for T. cabrae.

DISCUSSION

Physico-chemical parameters during the growth phase

The average pH values recorded during the present study vary from 8.43 ± 0.40 to 9.16 ± 0.42; these values are higher than those obtained by, i.e. 7.86±0.08 and 7.9±0.07 with growing Oreochromis niloticus fingerlings in Côte d'ivoire. These values are also higher than those of, 5.27±0.47 and 5.62±0.39 in O. niloticus in Burkina Faso. Although the ecological zones are different, these values are within the tolerance limit (6.52< pH <10.84) recommended by. Thus, these values obtained would not have negatively influenced the growth of the fish.

The average temperatures obtained during the present study varied from 28.41 ± 0.36 to 29.9 ± 0.55°C. These values corroborate those advised by who pointed out that in farming, the ideal temperature for fish growth should be between 24 and 32°C. This would mean that these temperatures recorded during this trial are within the rearing standards.

With regard to transparency, the average value observed during grow-out was 46.66 ± 5.11 cm. According to, the ideal transparency interval for the evolution of a certain number of fish is 45 to 60 cm. The observed mean turbidity value is included in this range, which would imply that the transparency during the grow-out did not affect the well-being of the fish.

Growth performance

Average weight gain (AWG), individual daily growth (IDG), specific growth rate (SGR), consommation index (CI) and protein efficiency coefficient (PEC)

The results of the present study showed that AWG, IDG and SGR are more interesting in T. cabrae than in O. schwebischi. CI and PEC are comparable for both species. In general, T. cabrae seems to be more interesting than O. schwebischi.

Moreover, the average weight gains obtained in T. cabrae and O. schwebischi, being respectively 48.01 ± 5.51 g and 27.11 ± 9.23 g, are lower than those observed in Oreochromis niloticus (65.3; 95.7 and 101.6 g/fish) by. In this study, the IDG of T. cabrae (0.8± 0.092 g/day) and O. schwebischi (0.45± 0.15 g/d) are lower than those reported by and, respectively 1.20 g/day; 1.77 g/day and 1.36 g/day in Oreochromis niloticus, a fish of the same family.

The TCS values recorded during the present study were 1.57 ± 0.066 % g / d for T. cabrae and 1.38 ± 0.051%g /day for O. schwebischi. Regardless of the species and food, a SGR of less than 2 is considered poor for the species under consideration. These values are higher than those obtained by, in Benin, with Tilapia zillii and T.

guineensis. Indeed, these authors recorded a SGR of 0.85% g/d for T. zillii and 0.74% g/day for T. guineensis. Furthermore, they are lower than the SGR of 4.11% g/day; 4.17% g/day; 3.79% g/day and 3.56% g/day recorded by for Oreochromis niloticus.

With regard to CI, Lacroix (2004) states that when using a balanced compound common in fish feed, the CI should be between 1.5 and 2.5. The CIs of T. cabrae (2.93 ± 0.57) and O. schwebischi (3.64 ± 0.64), obtained in this study, are above the recommended standards; which reflects the poor utilisation of the food by these species. Furthermore, the protein efficiency coefficients of T.
cabrae (0.0094 ± 0.0008) and O. schwebischi (00.0085 ± 0.0013) observed during grow-out monitoring are much lower than those reported by, which were 2.43 for 17% protein in the diet and 1.36 for 35% protein, and also lower than that recorded (0.99) by.The differences observed between these results would be related not only to the animal species, stocking density, physiological condition and origin of the fish but also to the quality of the food.

Survival rate during the growth phase

The survival rates obtained when growing T. cabrae and O. schwebischi are 86.84% and 99.11% respectively. These data are based on mortalities recorded after control fisheries. This would reflect the sensitivity of these fish to handling. However, these rates are in line with the standards recommended by; according to these authors, well-monitored farms should have survival rates above 80%.

Physico-chemical parameters during the breeding phase

The pH values (8.83 to 9.64) recorded during the present study are within the tolerance limit interval (6.52<pH<10.84) given by, making the environment suitable for the breeding of these species.

The temperature, with a minimum of 28.61°C and a maximum of 30.30°C, is within the range recommended by, who state that the ideal temperature for tilapia breeding should be between 28°C and 35°C. Thus, the temperature obtained during the study is suitable for the reproduction of these species.

The average turbidity observed during this study for the breeding was 51 ± 1.25 cm. According to, a transparency between 40 cm and 60 cm is optimal for fish production. Thus, the average turbidity recorded during the study is suitable for the reproduction of these species.

Breeding performance

Participation in breeding

Breeding participation was better in O. schwebischi genitors than in T. cabrae. This may be explained by a better ability of O. schwebischi broodstock to adapt to life in captivity compared to T. cabrae. Indeed, after loading the fish, the females with larvae were encountered for the first time on day 14 of monitoring in the O. schwebischi lot, whereas in the T. cabrae lot they had to wait until day 28.A limited number of sexually active females would also lead to this fact. In fact, in all the ponds where the species T. cabrae is found, reproduction was only carried out by the females with the greatest weight. In relation to this phenomenon point out that within the same Tilapia population, a hierarchy is established, and the heavier females dominate the other females and reproduce more frequently.

In addition to this, behavioural change may also occur. Indeed, the simple fact of rearing individuals captured in an environment different from that of the wild can lead to a change in behaviour. Reproductive behaviours, specific to each fish species, are essential to the success of breeding in the wild. Among the different behaviours observed, those found in Tilapia cabrae and O. schwebischi are nest building, courtship, egg guarding and parental care. In captivity, these behaviours would have been unexpressed in T. cabra, hence the poor reproductive performance recorded. Similar behaviours were observed in gilthead seabream by, and in female Atlantic salmon by, where the lack of spawning was due to the absence of reproductive behaviour resulting in the retention of oocytes.

Absolute productivity

The number of larvae produced by a female T. cabrae (234.75 ± 24.71 larvae / female / oviposition) during an oviposition is higher than that of a female O. schwebischi (104.68 ± 46.64 larvae / female / oviposition). These results could be due to the level of intensified parental care and egg size. Indeed, in order to ensure the survival of their young, T. cabrae species perform parental care (passive parental care) whereas O. schwebischi females perform oral incubation (active parental care). However, fish having passive parental protection in order to ensure the survival of the greatest number produce more eggs, and therefore more larvae, than those that actively ensure their survival. Furthermore, the number of eggs produced by females of the same weight depends on the size of the eggs. Indeed, species that lay small eggs (0.3 to 1 mm in diameter) produce more eggs and therefore more larvae than those producing large eggs (1.5 to 2.5 mm in diameter). According to, substrate layers, such as T. cabrae species, produce small eggs while oral incubators produce large eggs. These values are lower than the 778.5 larvae/female/oviposition reported by in females

Oreochromis niloticus. This difference could be justified not only by the reproductive behaviour but also by the animal species studied.

Relative productivity

In this study, the relative productivities were 3.46 ± 0.62 in Oreochromis niloticus and 2.62 ± 0.32 in T. cabrae; these values are lower than those reported by (9.3 larvae/g of female). The difference observed could be justified not only by the stress caused by handling and life in captivity but also by the animal species studied.

System productivity

In the present study, system productivity was higher in females of O. schwebischi (11.34 larvae/m2 /d) than in females of T. cabrae (4.12 ± 1.73). This seems to be related to the high participation of the latter in the breeding processes. However, the reproductive performance obtained in these genitors is lower than that reported by in Oreochromis niloticus females. Indeed, these authors recorded system productivities of 17.2, 32.5 and 11.9 larvae/m2 /day. This observed difference may be justified by the stress caused by handling, life in captivity and the animal species studied.

Survival rates during the breeding phase

At the end of the breeding monitoring, T. cabrae and O. schwebischi showed survival rates of 91.67% and 93.75%, respectively. These rates are higher than the one recommended by; according to this author, in fish farming, a fish survival rate is said to be good when it is higher than 80%.

CONCLUSION

At the end of this work based on the contribution to the knowledge of growth and breeding performance of Tilapia cabrae and Oreochromis schwebischi in captivity, it was found that Tilapia cabrae showed good growth performance in terms of average weight gain, individual daily growth and specific growth rate compared to O. schwebischi. Regarding breeding, although T. cabrae females showed the highest absolute productivity, the number of breedings, relative and system productivity obtained were better in O. schwebischi females. Furthermore, irrespective of species and rearing stage (growth, breeding) survival rates were above 80% and the main cause of fish mortality would be handling. Based on these results, the use of Tilapia cabrae and Oreochromis schwebischi in captivity can be recommended.

REFERENCES

1. Caillavet F, Fadhuile A et Nichèle V. L'évolution de la consommation de produits animaux en France : de multiples enjeux. Numéro spécial : de grands défis etdes solutions pour l'élevage. INRA,Productions animales 2019 ; 32: 132-146.
2. Adeoti EOB, Yabi I.,Akpo MA et Ogouwale E. Effets socioéconomiques de la pêche artisanale dans le Doublet Adjohoun-Dandbo au Bénin.JSTOR, Afrique et Développement 2018 ; 43: 173-189.
3. La situation mondiale des pêches et de l'aquaculture, département des pêches et de l'aquaculture, Rome, 244 p.
4. Kumar R, Kumar RR, Stauvermann PJ et Arora P. Effect of fisheries subsidies negotiations on fish production and interest rate. Journal of Risk and Financial Management, 2020 ; 13: 16
5. Lallemand P, Bergh M, Hansen M, Purves M, Estimating the economic benefits of MSC certification for the South African hake trawl fishery. Fisheries Research, 2016: 81-95.
6. DPPAMO. Fiches de données de laDirection Provinciale des Pêches et de l'Aquaculture du Moyen-Ogooué, 2019.
7. FDNS. Information for MSKU as of August 2004.
8. Kone M, Cisse M, Ouattara M et Fatondji A. Biosécurité et productivité du tilapia du Nil,Oreochromis niloticus (Linnaeus, 1758) élevé en zone rurale ivoirienne. Tropicultura 2012 ; 30: 117-121.
9. Diallo K. Diversification des systèmes de production piscicole : élevage de Oreochromis niloticus (Linné, 1758) en cage et en trou à poisson. Université Polytechnique de Bobo-Dioulasso, Burkina Faso. Mémoire de fin de cycle en vue de l'obtention du diplôme d'Ingénieur du développement rural 2012 ; 69
10. Ouédrago S. Biologie de la reproduction de Oreochromisniloticus du lac de barrage de la Comoé. Université Polytechnique de Bobo-Dioulasso, Burkina Faso. Mémoire de fin de cycle en vue de l'obtention du diplôme d'Ingénieur du développement rural 2000 ; 64
11. Amoussou OT, Toguyeni A, Imorou TI. Caractéristiques biologiques et zootechniques des tilapias africains Oreochromis niloticus (Linnaeus, 1758) et Sarotherodon melanotheron (Rüppell, 1852) : une revue. International journal of biological and chemical sciences 2016; 10: 1869-1887.
12. Zerbi A. Introduction à la gestion de la qualité de l'eau dans l'aquaculture. Montpellier 2004 ; 50
13. IgaIga R. Contribution à la mise au point d'aliments pour tilapia Oreochromis niloticus à base d'intrants locaux : cas du Gabon ; Mémoire de fin d'études Pour l'obtention du Master Sciences Agronomiques et Agroalimentaires Spécialité Sciences Halieutiques et Aquacoles Dominante Aquaculture, Agro campus 2008, 47.