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Influence of the quality of pond waterfish farms on the growth of *Heterobranchus isopterus* in the peri-urban area of N'Zérékoré, Guinea

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ABSTRACT

To promote the breeding of *Heterobranchus isopterus* in the peri-urban area of N'Zérékoré, a study of the effect of the water quality of two fish ponds on the growth of *Heterobranchus isopterus* was carried out from October 15, 2019 to March 10, 2020. This study covered on two (2) E1 and E2 ponds of average depth (1.5 m) and respective surfaces of 4 ares and 11 ares.. The quantities of fish (fry) on loading are 80 for E1 and 220 for E2. The fish were fed by rice bran, oil decant, cassava leaf and potato. Pig slurry and goat droppings were used as pond fertilizers.The parameter measurements (temperature, dissolved oxygen and saturation) were performed at two depth levels (30 cm and 90 cm) of each pond and at the following times: 7:30 am, 12:30 pm and 5:30 pm. The evaluation of the growth of the 4 month old fish was based on measurements of weight, size, height and width of the fins. The results obtained showed that the parameters (temperature, dissolved oxygen and turbidity) of the two ponds E1 and E2 are relatively the same and remain favorable. the development of *H. isopterus* at a depth of 90 cm, but the results of the E1 pond are more recommended for a traditional fish farming. The average weights of the fish in both ponds increased from 26.5 g to 722.5 g, with an average daily increase of 3.865 g.

Keywords: Breeding, Water Quality, Growth of *Heterobranchus isopterus*

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INTRODUCTION

Maritime catches have decreased considerably due to the pressure on the resource and its impacts, illegal, unreported and unregulated fishing. Likewise, poor practices in inland fishing contribute to the decrease in the quantities fished and the degradation of the river environment. This set of factors negatively influences the availability of fish products and thus the supply of the populations [1].

This situation would explain in part the low level of per capita consumption estimated at 13 kg per capita per year in 2012 against 11 kg per capita per year in 1998, well below the forecast of around 17 kg per capita per year for 2015. In view of this situation, the development of aquaculture is a necessity and the unavoidable alternative for the sustainable satisfaction of the population's demand for fish. This is justified by the fact that the Republic of Guinea has large areas of land where water control is possible, estimated at 520,000 ha, including 140,000 ha of mangrove and mangrove back lands, 200,000 ha of riverine alluvial plains and 180,000 ha of lowlands.

Between 1986 and 2012, pilot fish farming actions were implemented, mainly in Forest Guinea, a zone with very abundant rainfall of about 10 months of rain per year. Out of about ten pilot actions, only the fish farming project in Forest Guinea, financed by the French Agency for Development, is continuing in its second phase under the name of Project for the Development of Rice and Fish Farming in Forest Guinea [2].

Fish farming is a socio-economic activity that allows fish to be raised in a pond. It is practiced by about 3,050 fish farmers on the basis of the extensive system in earthen ponds and seasonally in ponds and retained by village communities. In Guinea, annual fish production is estimated at 200 tons, with a variable average per hectare of 1.5 t for ponds, 1 t for ponds and 0.5 t for reservoirs. Production techniques are based on polyculture and the association of fish farming with other livestock (especially pig farming) and with rice cultivation. This rice-fish combination in ponds

(rice-fish culture), tested in Forest Guinea, produces 1t of fish and 2.5t of rice per hectare [3]. There are two main types of fish farming in Guinea (extensive, semi-intensive fish farming) and mainly two types of pond structures (diversion pond and dam pond) [4, 5, 6].

Heterobranchus isopterus is one of the most economically important fish for fish farming. Its world production is estimated at more than 140,000 tons/year and is currently the fourth most important freshwater fish species after carp, salmonids and tilapia [7]. Heterobranchus isopterus is found almost everywhere in Africa and is a potamodromous species (migrating only in freshwater rivers) [8]. Heterobranchus isopterus is a very large species, belonging to the Clariidae family. It has a naked, elongated, subcylindrical body, with a broad, flattened head and four pairs of well-developed barbels. The radiated dorsal fin is followed by an adipose fin, the bases of these two fins being approximately equal with the rounded caudal fin [9]. Their feeding activity is intense at sunrise and sunset. Light is a factor that increases the consumption of Heterobranchus isopterus. As food consumption is lower, the more organic matter invades the environment and releases a waste product, the main one being ammonia, which is harmful to the fish through a progressive lack of oxygen. The quality of the pond water should therefore be monitored regularly. Fish need a suitable environment to grow and reproduce.

Temperature is one of the key ecological factors in the life of fish, it affects the appetite; more the temperature is high, more the animal needs food. On the other hand, the significant decrease in temperature causes the fish to hibernate, and therefore lives on its reserves.

High turbidity is harmful to the life of the fish because the suspended matter in the water can accumulate in the gills and disturb the breathing of the fish, which may die. The high turbidity also prevents solar rays from penetrating the water and therefore prevents photosynthesis, plankton development and therefore water productivity is reduced. This results in a reduction in the availability of plankton considered as food by the fish, poor growth of the fish and a low weight gain after the regulatory time.

In view of this reality, the present work proposes to evaluate certain abiotic parameters of fish pond waters influencing the growth of Heterobranchus isopterus in the urban commune of N'Zérékoré.

MATERIAL AND METHODS

Geographical location of the study area

The Prefecture of N'Zérékoré is one of the 33 prefectures of the Republic of Guinea, located in the south of the country. It covers an area of 3,871 km2. It is located at 7 ° 25 'and 8 ° 20' north latitude and 8 ° 35 'and 9 ° 15' west longitude, with an average altitude of 520 m. It includes 10 sub-prefectures which are Bounouma, Gouécké, Kobéla, Koropara, Koulé, Palé, Samoé, Soulouta, Womey, Yalenzou and the Urban Commune. It has a population of 396,118 inhabitants (2014)[10].

Pond water quality and fish growth

The study focused on two (2) ponds E1 and E2 of average depth (1.5 m) and of respective surfaces 4 ares and 11 ares. The quantities of fish on loading are respectively 80 and 220 fry. The fish are fed by the rice bran, decanted oil, cassava and potato leaves, with 6.7 kg / are and 1 to 2 times as the daily distribution frequency. Slurry from pigs and goat droppings served as pond fertilizers. The fish were reared for a period of six (6) months.

The measurements of the abiotic parameters of the waters of the two ponds (temperature, dissolved oxygen and saturation) were done by using a thermometer, a multifunction oximeter and an ichthyometer for the measurement of individuals. These measurements were made at two depth levels (30 cm and 90 cm) for each pond, in the following time intervals at: 7:30 am, 12:30 pm and 5:30 pm. A difference of 5 hours was placed between the periods of temperature measurements for clear observation of the displayed values. Fish growth assessment was based on measurements of size weight, fin heights and widths using an electronic scale and ichthyometer after a feeding period. For this, a random sampling was carried out on a batch of 4 month old fish from the two ponds, which was subjected to weighing and then to measurements. The stages of this experimental study are illustrated by the photos of the following figures.

Figure 1 : Temperature and oxygen measurement in pond E1

Figure 2 : Temperature and oxygen measurement in pond E1

Figure 3: Caught fish

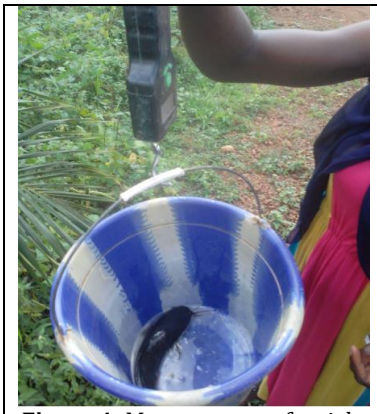

Figure 4: Measurement of weight

Figure 5: Length measurement

Figure 4 : Measuring the length of the fins

RESULTS AND DISCUSSION

III.1 RESULTS

The various results obtained relate to the abiotic parameters of the waters of the two ponds (temperature, dissolved oxygen, saturation) and the growth of the fish.

III.1 Abiotic parameters

The abiotic parameters of the waters of the two ponds E1 and E2 are shown in Table 1.

Table 1: Abiotic parameters of the water in E1 and E2 ponds

Hour	Depth (cm)	Pond E1			Pond E2		
		T (°C)	Oxygen (mg/l)	Saturation (%)	T (° C)	Oxygen (mg / l)	Saturation (%)
7:30	30	22.9	2.5	101	22.7	1.6	63
	90	22.6	1.9	123	21.3	0.8	115
12:30 p.m.	30	28.8	6.4	53	25.5	6.1	56
	90	27.2	5.6	83	25.0	4.6	102
5.30 p.m.	30	25.7	3.7	55	24.3	2.2	33
	90	25.2	2.8	94	23.5	2.0	68

The results of the growth of the fish are shown in Tables 2 and 3.

Table 2: Growth of sampled fish

Ponds	Weight of fry put in charge (g)	Harvest Weight (g)	Weight added during breeding(g)	Daily weight added (Average daily gain) (g)
E1	25	810	785	4.36
E2	28	635	607	3.37

Table 2: Measurement of an individual of *Heterobranchus isopterus* at 4 months

No.	Weight (g)			Length (cm)		
1	Total	Eviscerated	viscera	Total	Standard	
	320	240	80	38	33	
2	Fin height (cm)					
	Dorsal	Pectoral		Ventral	Anal	Caudal
	2.4	4		3.6	5	5.3
3	Fin widths (cm)					
	Dorsal	Fat	Pectoral	Ventral	Anal	Caudal
	11.5	7.3	-	-	13.5	4.6
4	Department numbers					
	27	-	8	6	43	17

III.2 DISCUSSION

The abiotic parameters of the waters of E1 and E2 ponds are shown in Figures 5 and 6.

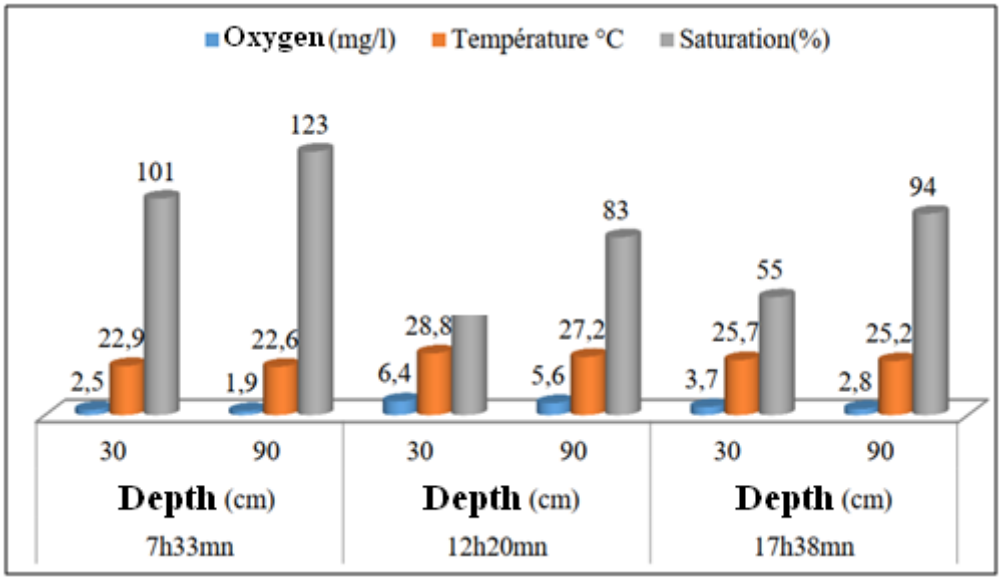

Figure 5: Abiotic parameters of pond E1

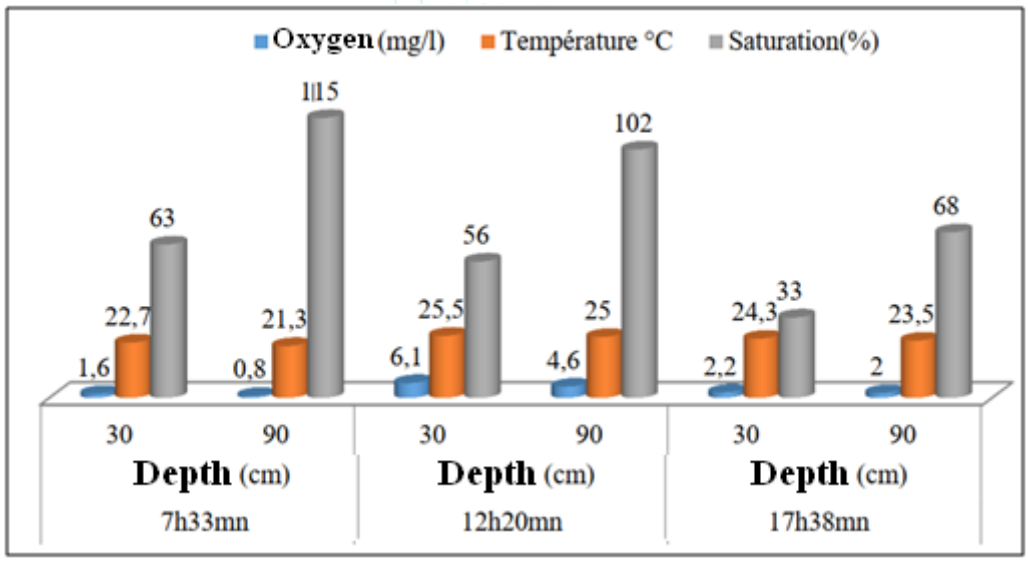

Figure 6: Abiotic parameters of pond E2

The two figures 5 and 6 show that the abiotic parameters of the waters of fish ponds vary as a function of depth and time.

The figure 5 shows that in pond E1, at 7:30 am the temperature varies respectively from 22.9 ° C (30 cm) and 22.6 ° C (90 cm); at12:30 p.m., it varies from 28.8 ° C (30 cm) to 27.2 ° C (90 cm) and at 5.30 p.m. we have 25.7 ° C (30 cm) to 25.2 ° C (90 cm). The average daily temperature of the two depths is 25.40 ° C. Dissolved oxygen varies between: 2.5 mg / l (30 cm) and 1.9 mg / l at 7:30 a.m. 6.4 mg / l (30 cm) and 5.6 mg / l at 12:30 p.m. and 3.7 mg / l (30 cm) and 2.8 mg / l at 5.30 p.m. The daily mean dissolved oxygen is 3.82 mg / l. Saturation varies between: 101% (30 cm) and 123% at 7:30 am; 53% (30 cm) and 83% at 12:30 p.m. and 55% (30 cm) and 94% at 5:30 p.m. The daily average of saturation is 84.83%.

The figure 6 shows that in pond E2, at 7:30 am the temperature varies respectively from 22.7 ° C (30 cm) and 21.3 ° C (90 cm); at12:30 p.m., it varies from 25.5 ° C (30 cm) to 25 ° C (90 cm) and at 5.30 p.m. we have 24.3 ° C (30 cm) to 23.5 ° C (90 cm). The average daily temperature is 23.72 ° C. Dissolved oxygen varies between: 1.6 mg / l (30 cm) and 0.8 mg / l at 7:30 a.m. 6.1 mg / l (30 cm) and 4.6 mg / l at 12:30 p.m. and 2.2 mg / l (30 cm) and 2.0 mg / l at 5.30 p.m. The daily average dissolved oxygen is 2.88 mg / l. Saturation varies between: 63% (30 cm) and 115% at 7:30 am; 56% (30 cm) and 102% at 12:30 p.m. and 33% (30 cm) and 68% at 5:30 p.m. The daily average saturation is72.83%.

The variations of the parameters (temperature, dissolved oxygen and turbidity) at different depths and as a function of time, are due respectively to sunshine, food and the movement of fish during the day. It should be noted that in the two figures, the oxygen level varies slightly as a function of the temperature.These results show that the abiotic parameters of these two ponds E1 and E2 are relatively the same and remain favorable for the development of *H. isopterus* at a depth of 90 cm, but the results of the E1 pond are more recommended for a traditional fish farming.

Table 2 shows that, in ponds E1 and E2, the *H. isopterus* fry loaded have an average weight of 25 g and 28 g respectively, after four (4) months of rearing the weights are785 g and 635 g with added daily weights (mean daily gain) of 4.36 and 3.37 g.

The average weights of the fish according to the two ponds increased from 26.5 g to 722.5 g, with adaily increase of 3.865 g.

Table 2: Measurement of an individual of *Heterobranchus isopterus* at 4 months

No.	Weight (g)			Length (cm)		
1	Total	Eviscerated	viscera	Total	Standard	
	320	240	80	38	33	
2	Fin height (cm)					
	Dorsal	Pectoral		Ventral	Anal	Caudal
	2.4	4		3.6	5	5.3
3	Fin widths (cm)					
	Dorsal	Fat	Pectoral	Ventral	Anal	Caudal
	11.5	7.3	-	-	13.5	4.6
4	Department numbers					
	27	-	8	6	43	17

Measurement of a 4-month-old *Heterobranchus isopterus* individual

In order to know in depth the different measurements of the species at 4 months under the abiotic conditions studied above, a sample was taken and all the possible measurements were carried out.At 4 months already, this species has a considerable weight and total length which are respectively 320 g and 38 cm. If food is available with normal ecological factors, its values can double or even more. This size is already half that of *Heterobranchus longifilis* (maximum size = 61 cm) which is of the same genus as *H. isopterus*, but generally more than *H. isopterus*.(Melanie LJ Stiassny; Guy G. Teugels; Carl D. Hopkins: Freshwater and Brackish Fishes of Lower Guinea, West Central Africa VOLUME I; Tropical Fauna and Flora Collection 42 Paris, 2007 page 656.

The length of the dorsal fin is 34.84% of the standard length of the fish; that of the fat fin is 22.12% of the standard length and the anal fin is 40.90% of the standard length. The anal fin contains the greatest number of soft rays (43); the dorsal fin contains 27 soft rays and the ventral fin contains the smallest number (6). The caudal fin measures 5 cm and occupies 13.16% of the total length of the fish and has 17 soft rays.

There are 26 - 35 soft rays in the dorsal fin; 40-51 soft rays for anal. The gait of the dorsal length is 27-36% of its standard length, the length of the fat fin is 24-34% of the standard length. Our results are within the range given by Fish Base due to the species definition[11].

CONCLUSION

This study has shown that the abiotic parameters (temperature, dissolved oxygen and turbidity) of picola ponds have an influence on the growth of fish in general, in particular on *Heterobranchus isopterus*. Thus, regular monitoring of these abiotic parameters of rearing water is necessary for good fish farming technique. When the species' diet is well monitored with abiotic conditions, *Heterobranchus isopterus* can double in size.

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