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Length – Weight Relationship, Fecundity and Gonadal Development of The African Catfish (*Clarias gariepinus)* From Doma Dam, Nasarawa State, Nigeria

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Abstract

This study investigated the reproductive biology of African catfish (Clarias gariepinus) in Doma dam as well as the relationship between fish length, weight and fecundity. It was discovered that fecundity ranges between 180 and 84,440 eggs. The different maturation stages were determined by visual observation of the gonads. Results show that comparison of total body weight (TBW) and standard length (SL) of male and female sampled were 205 ± 21$_g$ and 208 ± 22$_g$ respectively. The mean standard length ± standard error (SE) of both males and females were 26.13 ± 90cm and 25.55 ± 0.96cm respectively. The maturity stages recorded ranged from stages I to VII, but none of stages VIII was recorded in the study due to none availability. Result indicated that gonad maturation of both male and female of Clarias gariepinus is similar.

Key Words*: Clarias gariepinus, Fecundity, Maturation stages*,

Introduction

Aquaculture is the farming of aquatic organisms in enclosed water bodies such as ponds, dams, pens, raceways, aquaria etc. One can hardly speak about aquaculture today without the mentioning of artificial propagation of fish seed of a culturable species, (e.g. *Clarias gariepinus)* for commercial purposes. This fish species is most often chosen for its fast growing nature and its acceptability to consumers especially in Africa, Nigeria included.

Huisman (1976) stated that *Clarias gariepinus* have proved to be a very suitable species for high density culture. Fishermen prefer *Clarias ssp* because among the various species it attains the biggest size (7kg) and is very tasty and therefore fetches high price (Eyo and Mgbenka 1992). Aquaculturists seek out improved fry and fingerlings of *Clarias gariepinus* to stock their ponds because in fish culture trials they grow fast and have an efficient feed conversion especially the males as reported by Huisman (1976); it is hardy and can tolerate poor water quality conditions

(Hogendoorn *et al*, 1983), and it also matures and reproduces in captivity (Hogendoorn, 1980 and Viveen *et al,* 1985).

For artificial spawning to take place efficiently, it is important that a breeder know the developmental history of the fish in questions, this will enable him to know when and how to administer the sex hormone. Such developmental history would include the gonad maturity stages, its fecundity, the spawning season, the length and weight at first maturity, which makes it viable to be chosen as a fish for artificial propagation.

The African catfish (*C. gariepinus)* is omnivorous, bottom feeders and warm water fish species.

The male and female *Clarias gariepinus* are separate individuals, fertilization is external and large number of eggs are produced by females on an annual basis. The gonad refers to the testes in the male and ovaries in the female, these two represent the primary sex characteristics of the fish. The developmental stages of these gonads is one study which should be looked into with a keen interest to ascertain the most appropriate period to select a fish for artificial propagation. Thus this study is part of a continuous study on the growth and production of *Clarias gariepinus.*

Materials and Method

Sampling Site and Period

The samples of fish were obtained from Doma dam, Nasarawa State between March and July 2012. They were caught with baited hook and line on weekly basis.

Doma dam is a small water body of a mean depth of 21.25m with a surface area of 828m^2 which was impounded in 1978 for irrigation and water supply purpose.

The impoundment of the dam by the lower Benue River basin Authority in the 1970's made it attractive for Fisheries Scientist to conduct various research works especially on the biology of the fish inhabiting the water body.

This laboratory aspects of the study were carried out at the College of Agriculture Lafia in the anatomy and physiology laboratory of the Department of Fisheries.

Collections Estimation and Preservation Of Gonads

A total number of 67 (sixty – Seven) *Clarias gariepinus* were obtained for this study. Each one was weighed using top weighing balance model 180, its standard and total length were also measured and recorded. They male fish were sacrificed and dissected to remove the testes. The female fishes were also sacrificed to check the gonadal development and maturation of eggs while matured ovaries containing eggs were analyzed for fecundity. Total weight and length of ovaries and testes were also recorded.

The ovaries were weighed by using sensitive Metla-balance pm 2000. Prior to weighing, the eggs were separated and kept on blotting paper until all adhering water had been absorbed, which was ensured by using the binocular microscope, according to the methods of Imevbore (1970, Bagennal 1978 and Peters 1983). 0.25 gram sample from ovaries with eggs were counted on a Petri dish placed on a dark background, 20mls of saline water was poured over the eggs to spread out for easy counting. The total egg number (fecundity) was estimated using the formula of Bagenal (1978) as presented below.

$$\text{Fecundity} = \frac{\text{Total weight of ovary} \times \text{number of eggs in sub sample}}{\text{Weight of sub sample}}$$

The percentage fecundity (% fecundity) of individual fish in relation to the body weight were calculated using the formula.

$$\%\ \text{Fecundity} = \frac{\text{Total body weight} \times 100}{\text{Total number of eggs (fecundity)}}$$

After determining the fecundity, the testes and ovaries were preserved in Gilson's fluid, solution remained fresh but hydrated. They also maintained their normal size, shape and color.

Laboratory identification of gonad maturity stages and presentation was done using the methods of (Richter *et al*, 1987, Schnick 1974 and Simpson 1951)

Results

Result of the gonadal maturity stages of male and female *Clarias gariepinus* on Table 4 and 5 show the various maturity stages observed in this study; the comparison of total body weight (TBW) and standard length (SL) of male and female samples of *Clarias gariepinus* from Doma Dam are also shown in Table 1. The mean TBW ± standard error (SE) for both males and females of the fish were 205 ± 21g and 208 ± 22g respectively. The T-test analysis showed that the relationship between TBW of male and female; and the standard length (SL) of both male and female were not significantly different ($P > 0.05$). The mean standard length ± standard error (S.E) of both males and females were 26.13 ±0.90cm and 25.55 ±0.96cm respectively. The comparison of gonad weight (GWT) and gonad length (GL) of male and female samples of *Clarias gariepinus* are shown in Table2. The comparison of Gonado somatic index (GSI) / condition factor (k) of both male and female samples of the samples are shown in Table 3. Morphometric characteristics GSI and condition factors of male and female sampled fish are shown in Table 4 and 5 respectively. The mean fecundity of the sampled female *Clarias gariepinus* are also shown in Table 5. The regression equations, correlation and coefficients analysis of the length, weight and gonad weight (GWT) of *Clarias gariepinus* from Doma Dam. However there is a close correlation between fecundity and body size. Figures 1, 2, 3 and 4 respectively show the relationships

between total body weight (TBW) and standard length (SL) Gonad weight (GWT) and total body weight (TBW) of both males and females fish sampled. The maturation stages recorded in the study ranged from stages I to VII, none of stage VIII was recorded during this study.

It was also observed that a high linear relationship existed between the GWT and TBW of male *Clarias gariepinus* as depicted by the regression model in figure 1, y = -0.2388 + 0.06 x (r^2 = 0.582, N = 36). The same study also indicated a high linear relationship between the log total body weight (TBW) and Log standard length (LSL) of male *Clarias gariepinus* as shown by the regression model in figure 2. y = -1.227 + 1.979x, (r^2 = 0.717, N = 36).

The relationship for both GWT/TBW and log TBW and log SL findings is significant. Conversely the relationship between the gonad weight/total body weight (TBW) of female *C. gariepinus* showed a low linear relationship as depicted by the regression model in figure 3. y = 6.782 + 0.03467x, (r^2 = 0.131, N = 31), thus the relationship is not significant. Furthermore a very high relationship existed between log TBW and log SL of female *Clarias gariepinus* as indicated in the regression models y = -2.230 + 2.290x (r^2 = 4.658, N = 31).

Table 1: Comparison of total body weight and standard length of male and female *Clarias gariepinus* from Doma Dam.

	TBW (g)		**S L (cm)**	
	Male	Female	Male	Female
Mean	205	208	26.13	25.55
S E	21	21.6	0.90	0.96
t – value	**0.09 (P>0.05)**	**0.44(P>0.05)**		

Table 2: Comparison of Gonad weight and gonad length of male and female *Clarias gariepinus* from Doma Dam.

	GWT		**GL**	
	Male	Female	Male	Female
Mean	0.90	13.98	3.81	5.90
S E	0.17	2.07	0.19	0.38
t – value	**6.31 (P>0.05)**	**4.92 (P>0.05)**		

Table 3: Comparison of GSI and condition factors of male and female *Clarias gariepinus* from Doma Dam.

	GSI		**K**	
	Male	Female	Male	Female
Mean	0.3822	7.161	0.00664	0.007226
S E	0.0445	0.901	0.00036	0.0000277
t – value	**7.51 (P>0.05)**		**1.30 (P>0.05)**	

TABLE 4: Some Morphometric Measurements, GSI and K Factor of Male *Clarias gariepinus* From Doma Dam.

		MEAN ± S.E	**C.V**	**RANGE**
1	TBW (g)	204.8 ±210	61.62	29.1 – 500
2.	SL (cm)	26.133 ±0.900	20.66	15.000 – 37.000
3.	SL t (cm)	29.79 ± 1.03	20.79	17.00 – 43.00
4.	GL t (cm)	3.811 ± 0.191	30.09	1.500 – 6.000
5.	G wt (g)	0.902±0.167	110.89	0.0100 – 5.100
6.	GSI	0.3822±0.0445	69.84	0.0200 – 1.1300
7	K	0.006639±0.00357	32.24	0.006000 – 0.016000

TABLE 5: Some Morphometric Measurements, GSI and K Factor of Female *Clarias gariepinus* From Doma Dam.

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		MEAN	**C.V**	**RANGE**
1	TBW (g)	207.6±21.6	57.85	14.1 – 500.0
2.	SL (cm)	25.548 ± 0.963	20.99	15.500 – 37.000
3.	S L t (cm)	29.33 ± 1.06	20.11	18.00 – 40.00
4.	GL t (cm)	5.897 ± 0.378	35.73	1.800 – 9.000
5.	G wt (g)	13.98±2.07	82.26	0.180 – 42.36
6.	GSI	7.161±0.901	70.08	0.440 – 16.170
7	K	0.007226±0.000277	21.35	0.002000– 0.010000
8	FECUNDITY	17743± 3238	101.59	180 - 84440

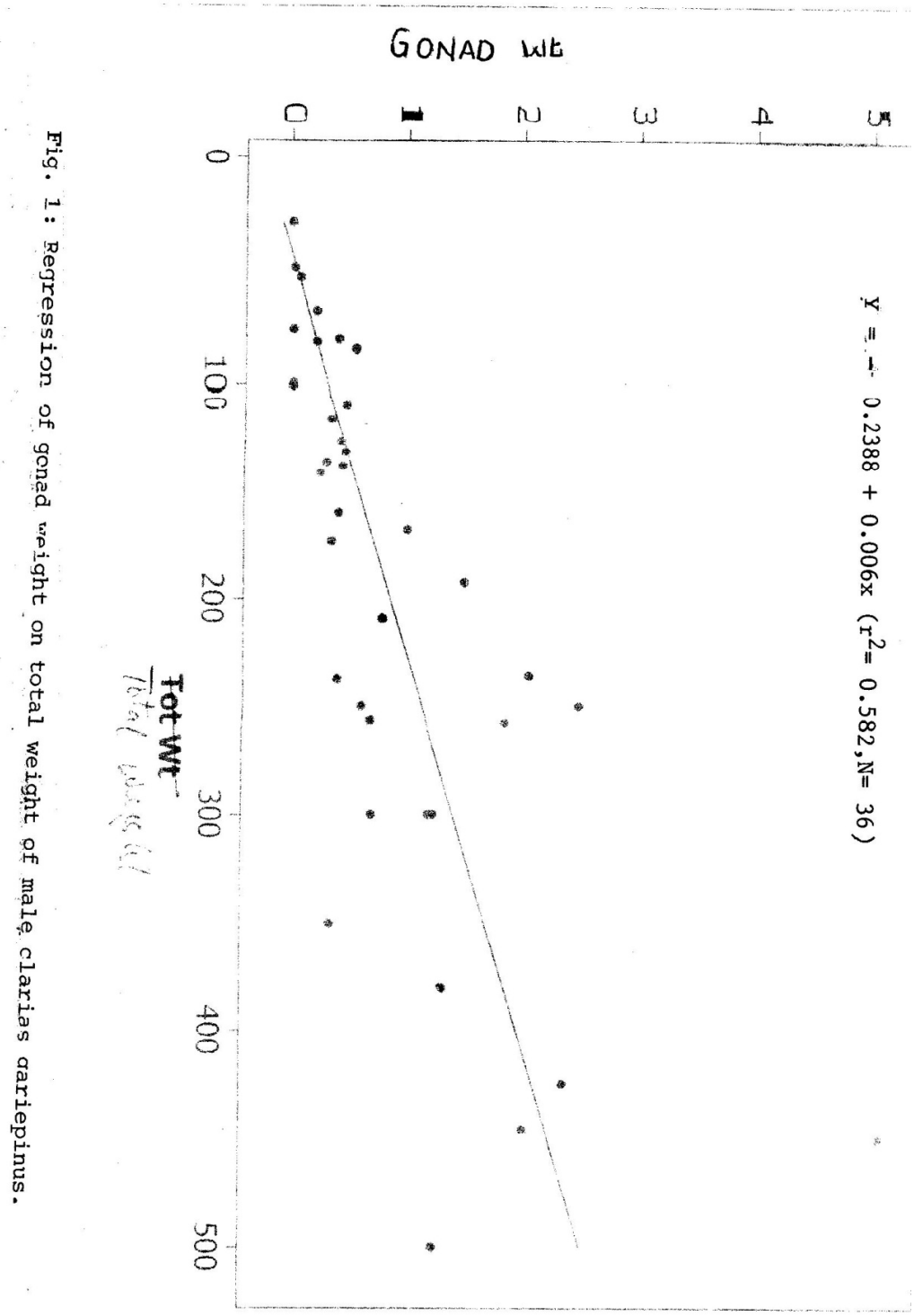

Fig. 1: Regression of gonad weight on total weight of male clarias cariepinus.

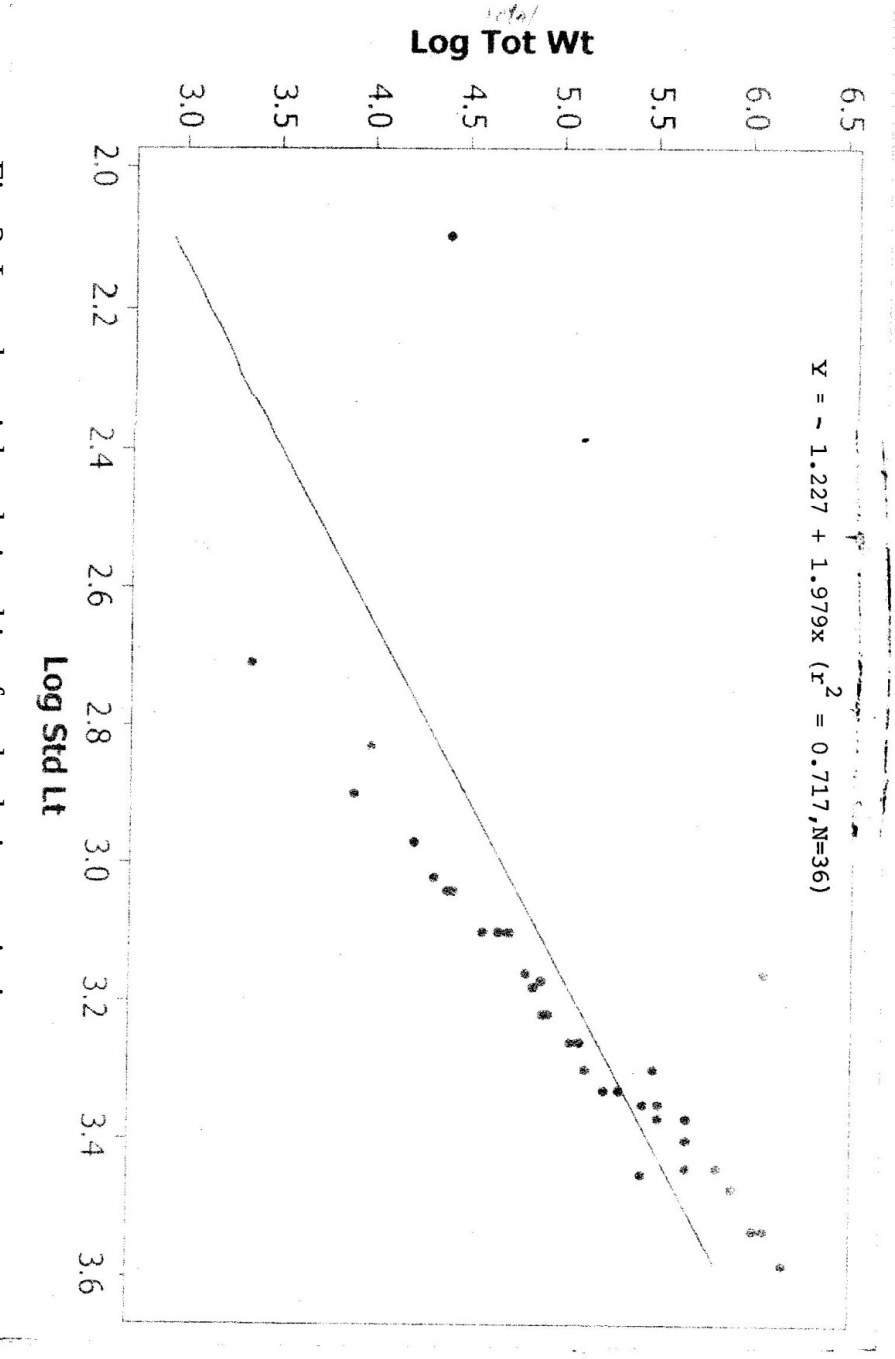

Fig. 2: Length weight relationship of male claries gariepinus

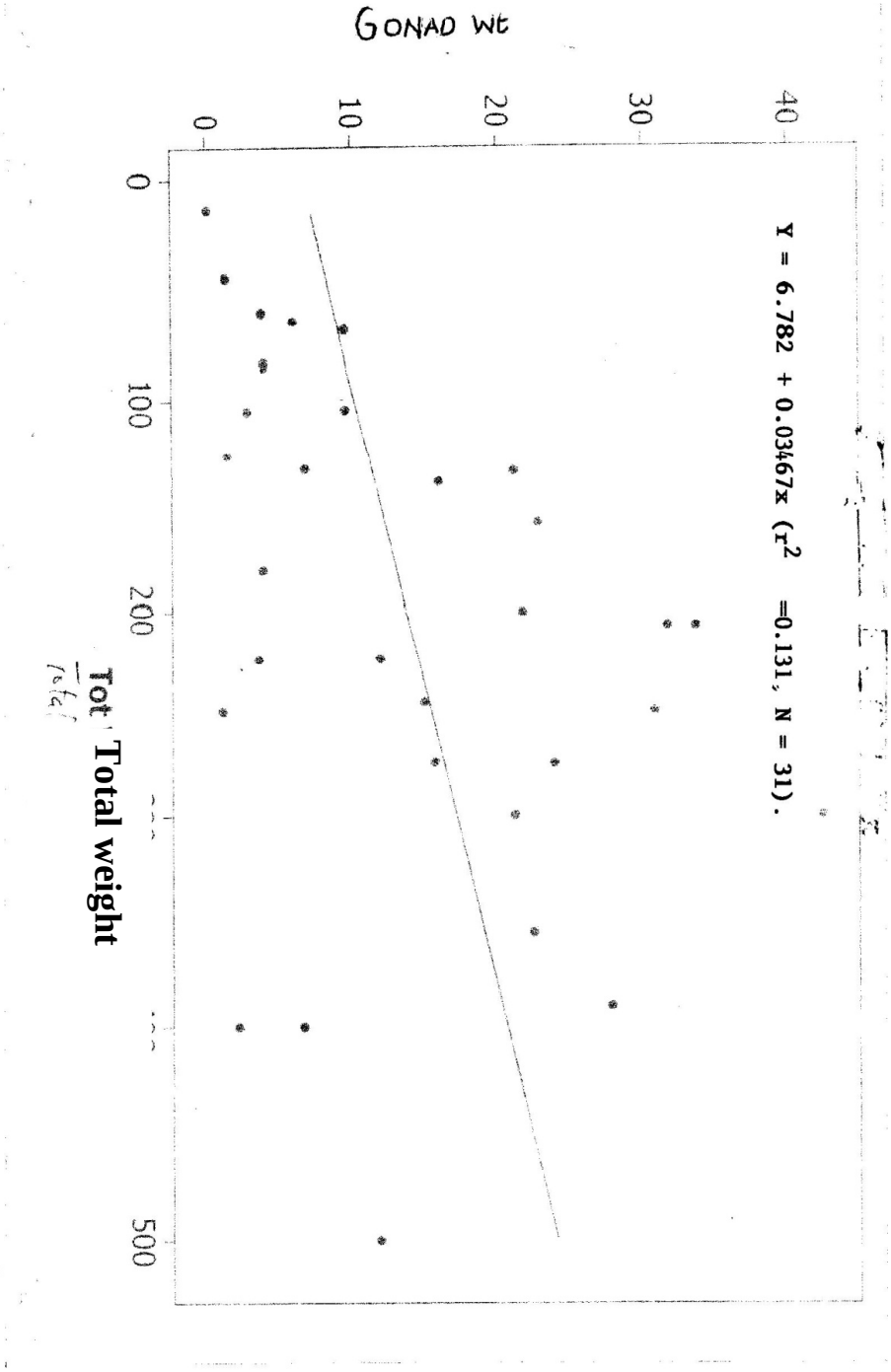

Fig. 2: Regression of gonad weight on total body weight of female *Clarias gariepinus*.

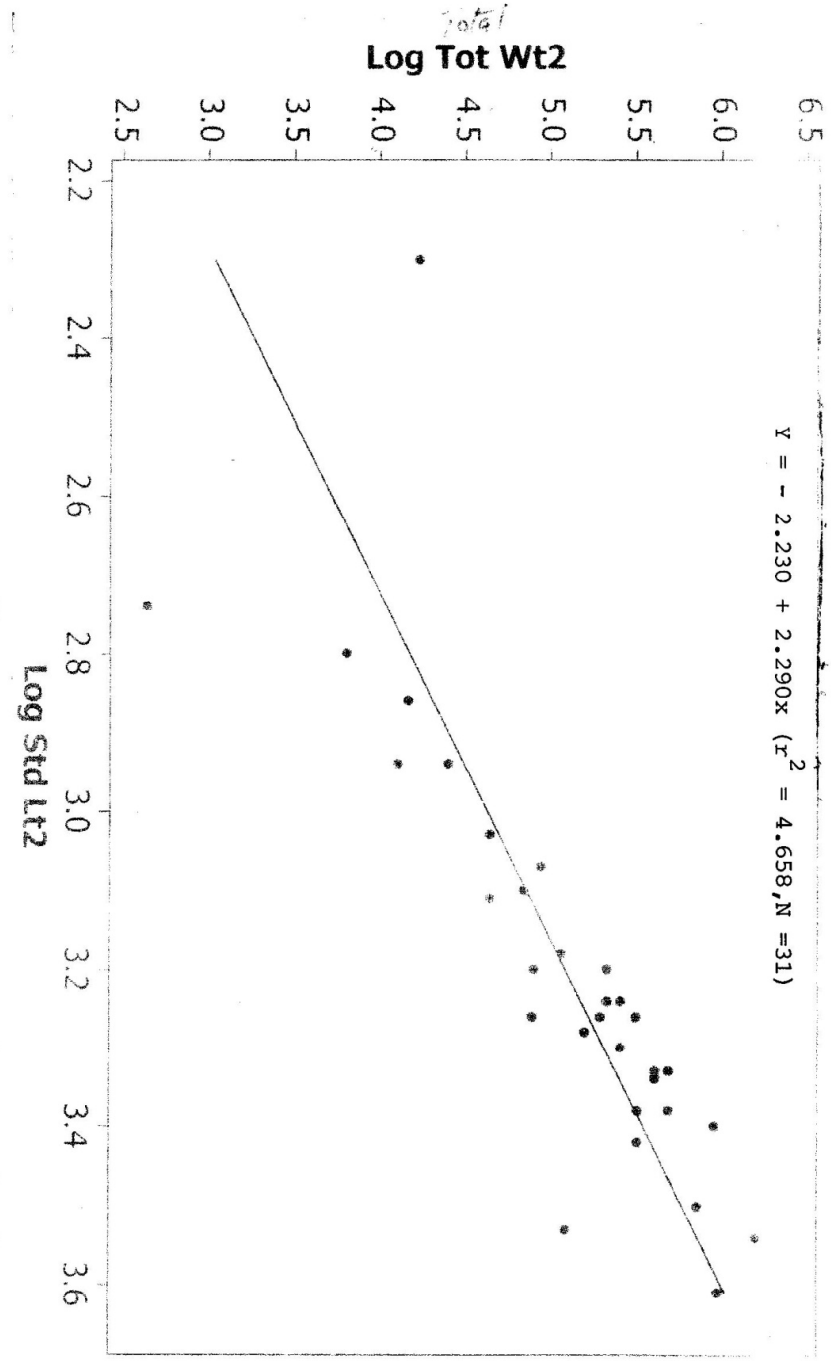

Fig.4: Length weight relationship of female clarias gariepinus.

Discussion

From the study, the insignificant different (P > 0.05) between the total body weight (TBW) and standard length (SL) of male and female respectively is similar to the findings of Ezenwaji, (1989) for *C.albopuntatus* in Anambra River.

The insignificant differences as indicated in table 3, of the T – test analysis (P < 0.05) is an indication of the deposition of materials for gonad formation which leads to an increase in weight and subsequent reduction due to spawning, this agreed with the findings of Bayagbona, (1968) of an annual cycle of low and high condition factor relative to peak and minimum spawning for *pseudotoliothus typus.* For instance, female have a mean GSI of 7.16± 0.90 and mean condition factor of 0.00723 ± 0.00028.

The variations recorded among the morphometric characteristics assess are due to the seasonality associated with spawning, which is an indication of a cyclic pattern of maturation. A similar cyclic pattern of maturation has been demonstrated for *Clarias gariepinus* in Lake Kabira, Mcllwaine and Kyle and in Zimbabwe as reported by (Holl, 1968). Thus the variation could be associated with the onset of rains as rain is an indicator of spawning and development of a fish interplaying with other factors. This also agrees with the observation of Green wood, (1955), Holl (1968) and Clay, (1979) who also reported that the onset of spawning of *Clarias spp* was short after heavy rain.

The mean condition factors are 0.006639 ± 0.00357 and ranged from 0.006000 – 0.016000 for male and mean K for female was 0.007226 ± 0.000277 and the range was 0.002 – 0.010000. This Variation in condition factor is an indication of the peak and minimum spawning periods respectively. This agreed with the findings of Bayagbona, (1968) of an annual cycle of low and high condition factor (K) relate to peak and minimum spawning for *pseudotolithus* and *P. senegalenesis* caught off the coast of Lagos, Nigeria.

The females recorded very high fecundity of 17743 ± 3288 eggs, increasing from 180 to 84440 eggs. It agrees with the findings that, it is generally accepted that the number of eggs produced by females increase by their age, length and weight whereas their relative fecundity decreases (Bagenal and Tesch 1978; Woottoh 1979; Mills and mann 1979; Hislop 1984; Rana 1986).

The experimental fish have a high fecundity during the study and this is in agreement with the findings of Hogendorn (1980) and Sydenham (1980). Sydenham, (1980) pointed out that the high fecundity of the Africa cat fish seemed to protect the species as they do not show parental care to their young. It is also an indication of the season as high fecundity is usually recorded during peak of rains, this period favours survival of cat-fish since flooding exposes more foraging area to fish, making food and hiding places available to both young and adult fish. This agrees with the observation of Green Wood (1955), Holl (1968), and Clay (1979) who reported that the onset of spawning in *Clarias spp.* was shortly after the heavy rains.

The maturation stages in fish can be related to the size of the ovary, which follows a similar pattern in lake Kariba as reported by (Clay 1979).

Conclusion and Recommendation

The result of this study indicated that gonad maturation of both male and female *Clarias gariepinus* is similar. There is a high potential for fingerling which help to improve overall/abundance of catfish in Doma Dam. This can be achieved by adoption an effective management practices designed for the water body.

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