

Reproductive Potentials of *Brycinus nurse* (RUPPELL, 1832) in Goronyo Reservoir, Sokoto State Nigeria

Abstract

Reproductive study is important aspect of stock assessment, it describes the reproductive strategies and potentials of fishes in aquatic ecosystem. Fecundity is described as batch fecundity, breeding season fecundity, life time fecundity, relative fecundity or absolute fecundity in stock assessment studies. The objective of this study to describe the reproductive potentials of *B. nurse* in Goronyo reservoir, Sokoto state Nigeria. The ovaries maturation stages of *B. nurse* specimens were determined by sing standard protocol. The gonads were removed and weighed and the fecundity and GSI stimations were carried out. Data was analyzed in descriptive statistics, t-test and compared ANOVA at ($p < 0.05$) level using Excel sheets and SPSS version 25. The study revealed sex ratio dominated by bigger males sampled between June and August with more male specimens at Stage III and female specimens at stage IV and VI of gonads maturation. Similarly, highest mean gsi values were recorded in June to September in male *Brycinus nurse* specimens and lower mean gsi values were recorded in August indicating this was the period the species spawns. The mean fecundity was highest in August to October in gravid *Brycinus nurse* specimens. The study recommends adoption of closed season management strategy between June and October to allow an uninterrupted breeding activity of this species in Goronyo reservoir.

Keywords: fecundity, breeding season, gonads, stock assessment

Introduction

Reproductive study is important aspect of stock assessment, it describes the reproductive strategies and potentials of fishes in aquatic ecosystem, (Floyd and Petty, 2020). Nearly all fishes reproduce sexually and most species have separate sexes (male and female) and those without separate sexes avoid self-fertilization by producing sperm and eggs at different times, (CK-12, 2024). Fish reproduce by bearing life young ones called fry or by laying eggs,

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(Weitzman and Vari, 1998; Floyd and Petty, 2020; Weizmann and Parenti, 2024). Understanding the reproductive potential of fish species for management purposes require fecundity Studies, (Bagenal and Tesch, 1978; Shinkafi *et al.* 2013; Esa *et al.* (2023). Fecundity is the number of eggs a female fish produces in each reproductive cycle, (Bagenal and Tesch, 1978; Eyo *et al.*, 2016; Opiyo *et al.*, 2017; Mimoune *et al.*, 2023). It is the potential reproductive capacity of a gravid fish and usually increase with size and age and changes with prevailing aquatic conditions, (Berek and Novak, 2007; FishBase, 2017; Esa *et al.*, 2023). Fecundity is described as batch fecundity, breeding season fecundity, life time fecundity, relative fecundity or absolute fecundity in stock assessment studies, (Bagenal and Tesch, 1978; FishBase, 2017, Patrick *et al.* 2020).

Several studies are been conducted for assessing fecundity in fishes, for instance, Jan and Ahmad (2016) studied fecundity of Snow trout (*Schizothorax plagiostomus*) in river Lidda. The authors observed mean fecundity which was related to size of 12,964 eggs. Similarly, Olusegun *et al.* (2019) reported fecundity ranging from 5,838 eggs to 29,208 eggs and relative fecundity ranging 441 eggs to 3,597 eggs on *Brycinus macrolepidotus* in Akomoje reservoir. Paugy and Shaefer (2007) reported mean fecundity of 300 eggs in *Alestes dentex* in Nile basin. Furthermore, Saliu and Fagade (2003) observed fecundity ranging from 1,720 eggs to 68,700 eggs and relative fecundity ranging from 19,933 eggs to 49,453 eggs in *Brycinus nurse* in Asa reservoir. Offem *et al.* (2008) studied an African silver catfish and observed that the breeding period of the species in Cross River was between April and August. According to the authors, the female species had a mean fecundity ranging between 4,522±1,924 eggs and 20,321±5,543 eggs. Kingdom and Allison (2011), Obah *et al.* (2013) and Nandikeswari *et al.* (2014) and Patrick *et al.* (2020) reported that fecundity is influenced by the weight of the fishes, gonads and season. However, Kingdom and Allison (2011) did not observe significant

seasonal differences between fecundity and season and Obah *et al.* (2013) did not observe positive relationship between fecundity and length of the fishes.

Studies on reproduction also involve investigating Gonado-somatic index (GSI) which reveal the ratio of gonad weight to somatic weight in fishes, (Bagenal and Tesch, 1978; Shinkafi *et al.* 2013; Esa *et al.* (2023). The GSI is particularly helpful in estimating the maturity ogive, identifying days and season of spawning, this is because the ovaries of spawning gravid females swiftly increase in size just prior to spawning, (Flores *et al.*, 2015). In lake Albert, Kasozi *et al.* (2013) investigated the ovarian development in *Alestes baremose* specimens. The authors observed the female GSI varied across the 12 months of the study. Minimum (2.1±2.0%) observed *GSI* occurred in December and the maximum GSI value of 5.4±1.8% was reached in January followed closely with 5.3±1.8% in October. In another study, Yusuf *et al.* (2013) investigated gonads development in *Clarias gariepinus* in Doma Dam and observed GSI mean value of 0.38% and 7.16% for both male and female specimens. Similarly, Kaur *et al.*, (2018) investigated GSI in some fish species in river Sutlej, to determine the spawning season. The authors observed the fishes had higher mean GSI in pre-monsoon and lower in monsoon and post monsoon indicating their spawning period was in Jun/Jul season.

There is paucity of information on *Brycinus nurse* reproductive potentials. Therefore, it's the objective of this study to describe the reproductive potentials of *B. nurse* in Goronyo reservoir, Sokoto state Nigeria.

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Materials and Methods

Description of Study Area/Location

Goronyo Reservoir (Figure 1) is located between latitudes 13°30' N to 14° N and longitudes 5° 30' E to 6° E in Goronyo Local Government Area, Sokoto State, Northwest Nigeria, (Ita, 1993a, Elisha *et al.*, 2016). The reservoir was impounded on river Rima, completed in 1984 and commissioned in 1992, (Sambenelli and Consulting, 2011). It has a length of about 20 km with a width of about 10 km and an area of about 200 km² with a storage capacity of 976,000,000 m³ (Sambenelli and Consulting, 2011). The study area is part of the Sokoto-Rima basin, which has a total catchment area of about 193,000 km² distributed in Nigeria and the Niger Republic (Gill, 1974). The Sokoto-Rima basin has a semi-arid tropical climate with a prolonged dry season from October to May and a short-wet season from end of May to early October (Wheather & Climate., 2020). The three landing sites were selected because of their high fishing activities and include Rimawa fish landing village on coordinates 13° 29' 51.6" N, 5° 52' 50.676" E, Katsira fish landing village (figure 2) on coordinates 13° 31' 48.57" N, 5° 52' 51.024" E and Kaita fish landing village on coordinates 13° 31' 44.79" N, 5° 52' 50.862" E (Sambenelli and Consulting, 2011; Abubakar and Aliyu, 2017; Field work, 2023). Temperatures depict both seasonal and diurnal variations in the area and averaged at 32.19 °C, 2.73 % higher than Nigeria's averages (Davis, 1982, Wheather. and Climate., 2020). During the rainy season, the diurnal range of temperature in the area is low but during the dry season it is high (Davis, 1982, Wheather. & Climate., 2020). The mean annual rainfall varies from about 700 mm in the northern part of the Rima basin to about 1,100 mm in the south (Gill, 1974; Davis, 1982; Muhammad *et al.* 2020).

Studies on Reproduction

The ovaries maturation stages of *B. nurse* specimens were determined as described by Kasozi *et al.* (2013) as follows: Immature, developing, imminent spawning, spawning, partial post spawning and spent ovary.

Gonads Weights: The gonads were removed and weighed as described by Hunter and Beverly (1980) Cao *et al.* (2009) and Suresh (2014) at fisheries and aquaculture, laboratory of Usmanu Danfodiyo University, Sokoto. The fecundity and GSI estimations were carried out as described by Hunter and Beverly (1980), Pepin *et al.* (2007), Waidi (2015) and Esa *et al.* (2023). using below equations:

Fecundity = $W_a - W_b \times N$, where

W_a = weight of specimen before ovary removal,

W_b = weight of specimen after ovary removal,

g = gram and

N = number of eggs per 1 gram,

or

Fecundity = $N * W/V$ where;

N = no. of the eggs

W = weight of the eggs

V = volume of displaced water

Data Analysis

Data was analyzed in descriptive statistics, t-test and compared ANOVA at ($p < 0.05$) level using Excel sheets and SPSS version 25.

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Results

Results obtained on Figure 3 showed sex ratio (M: F) of 1:1.4 in the *Brycinus nurse* specimens sampled in Goronyo reservoir. Male specimens dominated (n=441) and accounted for about 57.80% compared to female (n=322) specimens which accounted for about 42.20%.

Similarly, results on Figure 4 showed seasonal variation in abundance of male and female *Brycinus nurse* specimens sampled in Goronyo reservoir. More males were sampled in July while majorly females were sampled in August.

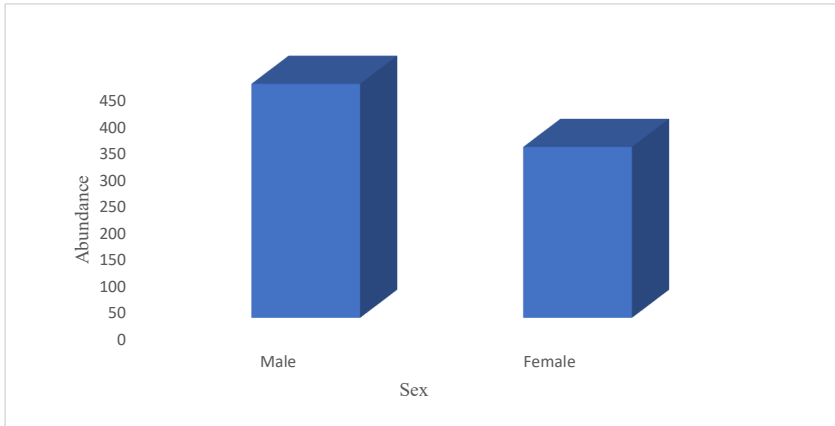


Fig. 3: Sex Ratio (M:F) of *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria.

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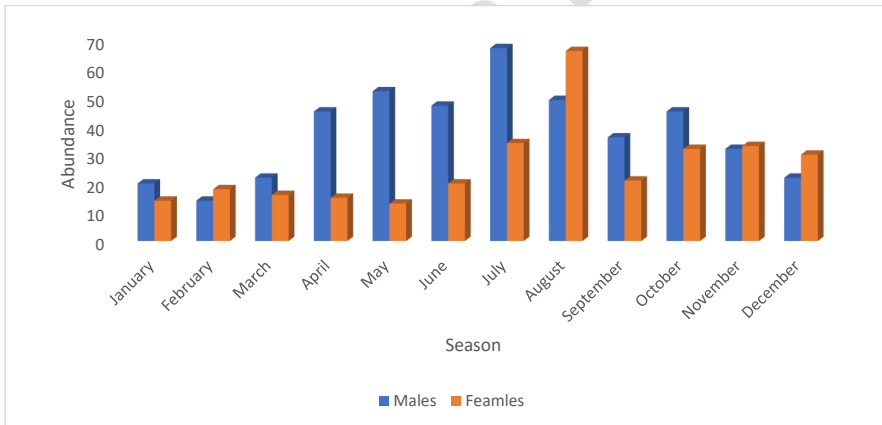


Fig.4: Seasonal Variation in Abundance of Male and Female *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

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Results obtained on Table 1 revealed the ANOVA results the variation in abundance of male and female specimens of *B. nurse* specimens sampled in Goronyo reservoir. The results showed significant difference (0.001) at 95% confident interval of the mean of the two sexes.

Table 1: ANOVA on Abundance of Male and Female *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State, Nigeria

Sex	Frequency	Percent	Mean	Std.	Sex Ratio	
Males	446	58.50	1.42	0.49	1:1.4	
Females	317	41.50				
Total	763	100				
t-test						
	t	df	Sig.(2-tailed)	Mean	95% Confidence interval of the	
					Lower	Upper
	79.287	762	0.001	1.42	1.38	1.45

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Results obtained on Figure 5 revealed testes maturation stages in male *Brycinus nurse* specimens sampled in Goronyo reservoir. Stage III was more encountered than any other stage with stage V been the least recorded.

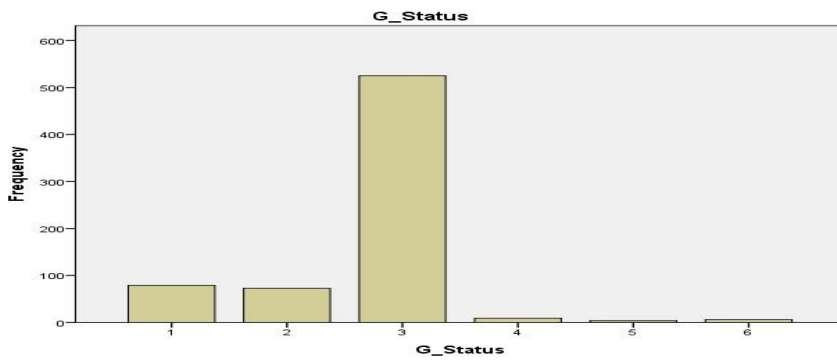


Fig. 5: Testes Maturation stages in Male *Brycinus nurse* specimens in Goronyo reservoir, Sokoto State Nigeria

Results shown on Figure 6 revealed ovary maturation stages in female *Brycinus nurse* specimens sampled in Goronyo reservoir. Stage IV of ovary maturation was the most common in this species while the least recorded was stage II.

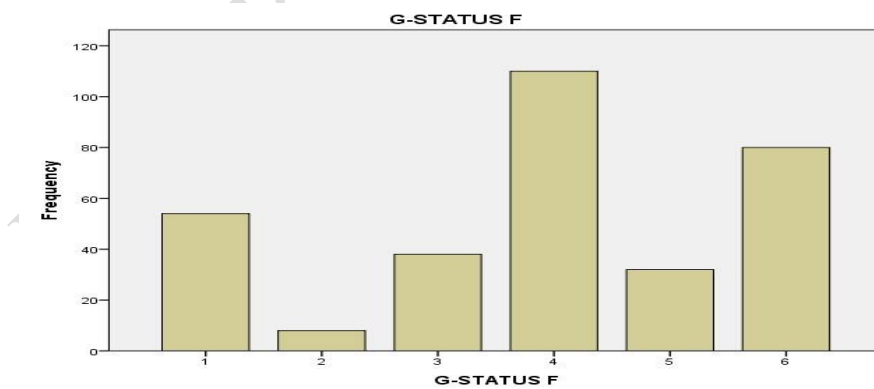


Fig. 6: Ovary Maturation Stages in Female *Brycinus nurse* Specimens in Goronyo Reservoir Sokoto State Nigeria

Results obtained on Table 2 revealed ovary maturation stages in male and female specimens of *Brycinus nurse* Sampled in Goronyo Reservoir. Stage IV was the most common in the female specimens while stage III was the most abundant in males.

Table 2: Ovary Maturation Stages of Male and Female Specimens of *Brycinus nurse* in Goronyo Reservoir Sokoto State Nigeria.

No.	Maturity	Number	Percent	Mean	Mode	Percentile		
						25	50	75
Males								
1	Stage I	81	18.40	2.53	3	2	3	3
2	Stage II	65	14.70					
3	Stage III	383	64.20					
4	Stage IV	8	1.80					
5	Stage V	4	0.90					
6	Stage VI	0	0.00					
Females								
1	Stage I	54	16.80	3.93	IV	3	4	5
2	Stage II	8	2.50					
3	Stage III	38	11.80					
4	Stage IV	110	34.20					
5	Stage V	32	9.90					
6	Stage VI	80	24.80					

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Results obtained on Tables 3 and 4 and Figure 8 revealed seasonal variations in mean testes and ovaries weights (g) of *Brycinus nurse* specimens sampled in Goronyo reservoir. The mean testes weight ranged from a minimum of $0.53g \pm 0.33$ in August to a maximum of $4.01g \pm 0.79$ in July. Similarly, the mean ovary weights ranged from $1.64g \pm 0.68$ in August to $7.59g \pm 1.36$ in July.

Table 3 Seasonal Variation in Mean Testes Weights (g) of *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

Season	Minimum	Maximum	Mean	Std.
January	0.20	3.40	0.84	0.89
February	1.30	2.90	2.00	0.60
March	0.30	3.30	2.20	0.73
April	1.10	3.20	2.23	0.64
May	0.20	6.30	1.72	1.37
June	0.20	3.50	2.89	0.89
July	2.90	5.30	4.01	0.79
August	0.20	1.10	0.53	0.33
September	0.13	3.20	1.09	1.03
October	0.20	5.30	2.09	1.73
November	0.20	3.50	1.71	1.37
December	0.20	3.50	0.78	0.96

Table 4: Seasonal Variation in Mean Ovaries Weights (g) of *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

Season	Min.	Max.	Mean	Std.
January	3.00	3.70	3.30	0.32
February	0.10	4.60	2.64	1.90
March	0.80	3.50	3.11	0.65
April	2.50	4.90	3.25	0.50
May	2.90	5.70	4.17	0.84
June	3.40	7.20	6.05	1.40
July	5.30	9.30	7.59	1.36
August	0.98	3.00	1.64	0.68
September	1.10	3.00	1.80	0.66
October	0.20	4.50	1.99	1.81
November	0.20	5.30	2.80	1.51
December	0.20	3.80	2.17	1.64

Results obtained on Table 5 and Figure 8 revealed seasonal variation in mean values of Gonado-somatic index of male and female *B. nurse* specimens sampled in Goronyo reservoir. The GSI mean value ranged from $0.95\% \pm 0.57$ in December to $3.99\% \pm 0.31$ in July in males while the highest mean value ($7.12\% \pm 0.58$) was obtained in July in female specimens.

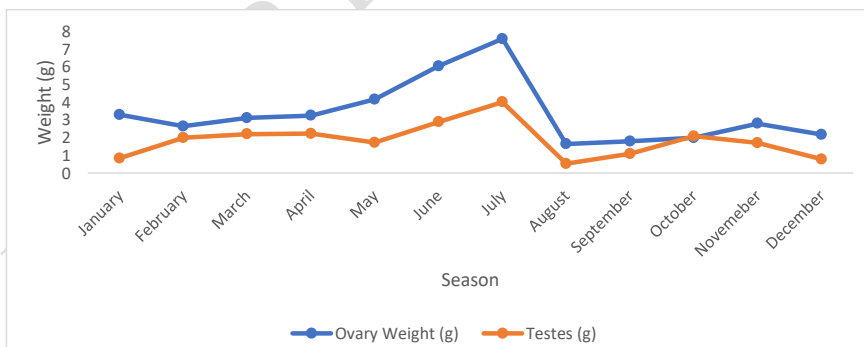


Figure 7: Seasonal Variation on Mean Gonads Weights (g) of Male and Female *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State, Nigeria

Table 5: Seasonal Variation in Mean Values of Gonado-somatic Index in Male and Female *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State, Nigeria

Season	Males				Females			
	Min.	Max.	Mean	Std.	Min.	Max.	Mean	Std.
January	0.45	2.45	1.87	0.60	1.20	2.8	1.99	0.41
February	1.50	2.25	1.75	0.27	1.15	2.26	1.16	0.87
March	0.83	3.21	1.85	0.64	0.99	2.83	1.73	0.56
April	1.16	1.41	1.25	0.08	0.82	1.6	1.29	0.14
May	0.29	3.45	1.62	1.00	0.80	3.52	2.97	0.62
June	0.22	2.46	2.09	0.71	0.42	5.35	4.74	0.78
July	0.44	4.56	3.99	0.31	0.41	10.23	7.12	0.58
August	0.76	2.15	1.11	0.40	1.14	1.71	1.48	0.22
September	0.75	2.08	1.58	0.45	1.11	1.95	1.37	0.26
October	1.03	2.76	1.56	0.50	0.56	2.40	1.37	0.59
November	0.51	2.32	1.48	0.67	0.92	2.84	1.78	0.60
December	0.43	2.09	0.95	0.57	0.36	2.75	1.66	0.71

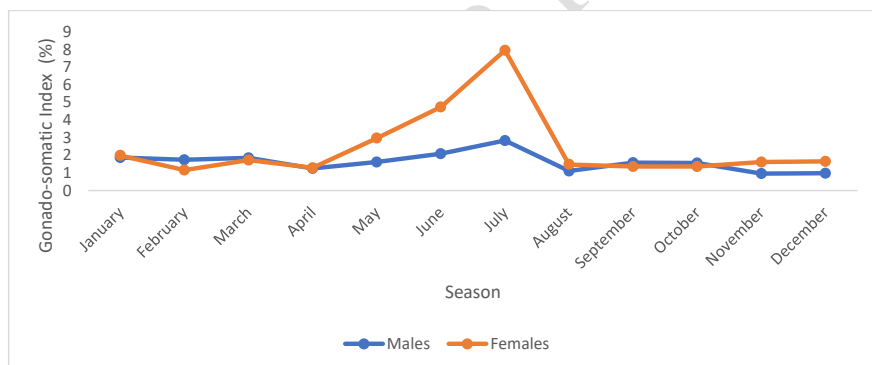


Fig. 8: Seasonal Variation in Mean Values of Gonado-somatic Index in Male and Female *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State, Nigeria

Results obtained on Figure 9 showed seasonal variation in mean GSI (%) of male *Brycinus nurse* specimens sampled at Rimawa, Katsira and Kaita landing sites of Goronyo Reservoir. The mean gsi values were higher (2.32%) in September, 2023 at Rimawa landing site while the least (0.26%) was in July at Kaita landing site but did not significantly ($p>0.05$) varied at the landing sites.

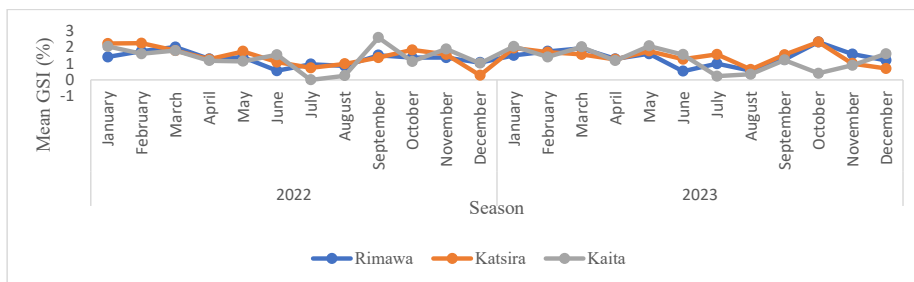


Fig. 9: Seasonal Variation in Mean Gonado-somatic Index (%) of Male *Brycinus nurse* Specimens at Rimawa, Katsira and Kaita Landing Sites of Goronyo reservoir, Sokoto State Nigeria

Results obtained on Figure 10 revealed seasonal variation in mean Gonadosomatic Index (%) of female *Brycinus nurse* Specimens sampled at Rimawa, Katsira and Kaita landing sites of Goronyo reservoir. The highest (9.1%) mean value was recorded in July, 2022 while the least (0.71%) was in September, 2022 at Kaita landing site but did not differed significantly ($p>0.05$) at the landing sites.

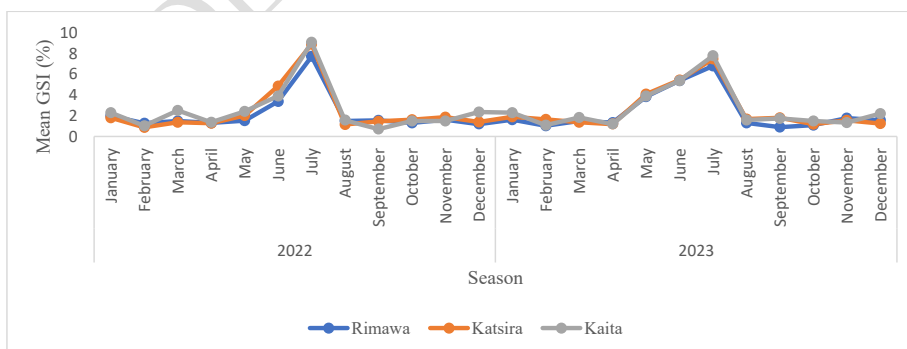


Fig. 10: Seasonal Variation in Mean Gonado-somatic Index (%) of Female *Brycinus nurse* Specimens at Rimawa, Katsira and Kaita Landing Sites of Goronyo reservoir, Sokoto State Nigeria

Results obtained on Table 6 revealed seasonal variation in mean fecundity of gravid *Brycinus nurse* specimens sampled in Goronyo reservoir. The mean fecundity ranged from 544 ± 77 eggs in December to $10,447 \pm 1,648$ eggs in June.

Table 6: Seasonal Variation in Mean Fecundity in Gravid *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

Season	Minimum	Maximum	Mean	Std.
2022				
February	13,000	41,000	6,133	296
April	3,500	45,000	8,765	935
June	1,120	16,000	8,613	824
August	1,550	33,200	6,424	930
October	13,000	40,000	2,667	1,208
December	13,000	33,400	1,625	604
2023				
February	1,300	37,000	9,254	1,232
April	1,400	45,300	8,678	1,329
June	6,000	8,330	10,447	1,648
August	10,000	28,000	7,465	685
October	2,000	23,000	1,200	556
December	300	20,000	544	77

Results obtained on Figure 11 revealed seasonal variation in mean fecundity in gravid *Brycinus nurse* specimens sampled in Goronyo reservoir. The fecundity was highest in July.

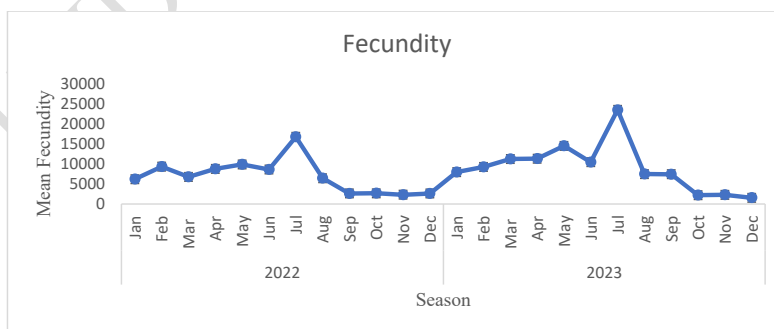


Fig.11: Seasonal Variation in Mean Fecundity of Gravid *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

Results obtained on Table 7 revealed total weight of the female *Brycinus nurse* ranged from a minimum of 31.80g to >116.30g. The relative fecundity in *Brycinus nurse* ranged from 5,431-19,150 eggs.

Table 7: Relative Fecundity in Gravid *Alestes dentex* and *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

No.	Body Weight (g)	No. of Gravid	Relative Fecundity
1	<100	8	5,431
2	100-130	216	19,150
3	131-160		
4	>160		

Results obtained on Figure 12 showed relationship between ovary weight and fecundity in gravid *Brycinus nurse* specimens sampled in Goronyo reservoir. There was a moderate ($R^2=0.56$) relationship between ovary weight and fecundity of the regressions.

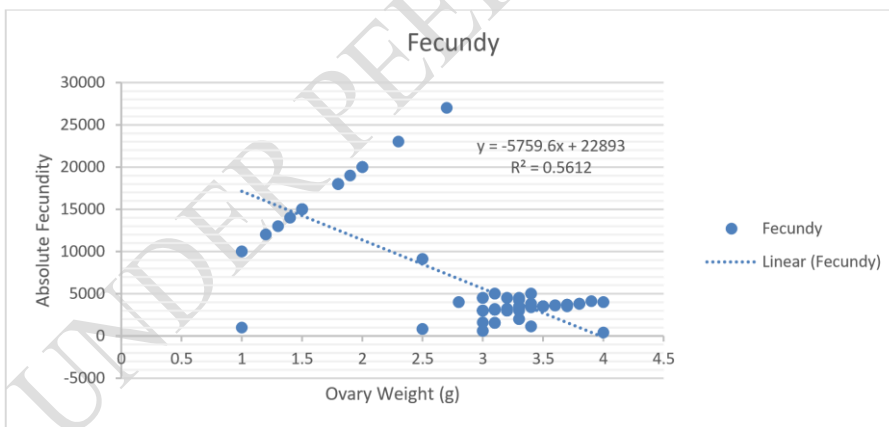


Fig. 12: Ovaryweight-Fecundity-Relationship of *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria.

Results obtained on Figure 13 showed relationship between testes weight and somatic weight in male *Brycinus nurse* specimens sampled in Goronyo reservoir. There was a strong goodness of fit ($R^2=0.92$) of the regression in male *Alestes dentex* specimens.

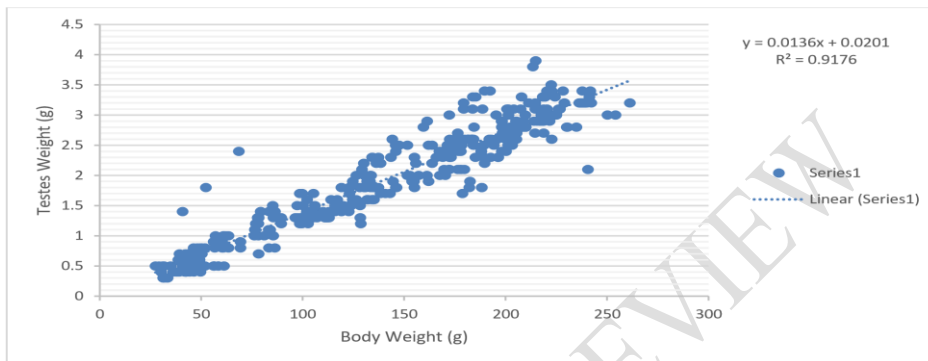


Fig.13: Testes weight-Body Weight-Relationship in Male *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

Results obtained on Figure 14 showed a body weight and fecundity relationship in gravid *Brycinus nurse* specimens sampled in Goronyo reservoir. A very strong goodness of fit ($R^2=94$) indicated that there was a strong relationship between fecundity and gravid somatic weight in the specimens.

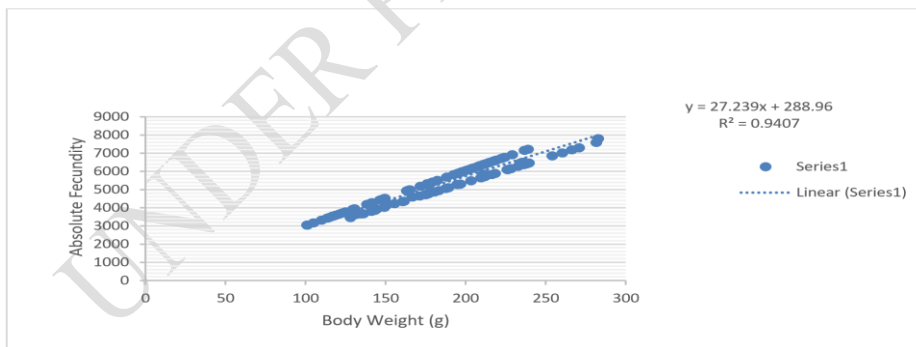


Fig. 14: Bodyweight-Fecundity-Relationship in *Brycinus nurse* Gravids in Goronyo Reservoir, Sokoto State, Nigeria.

Results obtained on Figure 15 revealed a weak ($R^2 = 0.19$) goodness of fit of the relationship between total length and fecundity of *Brycinus nurse* specimens in Goronyo Reservoir.

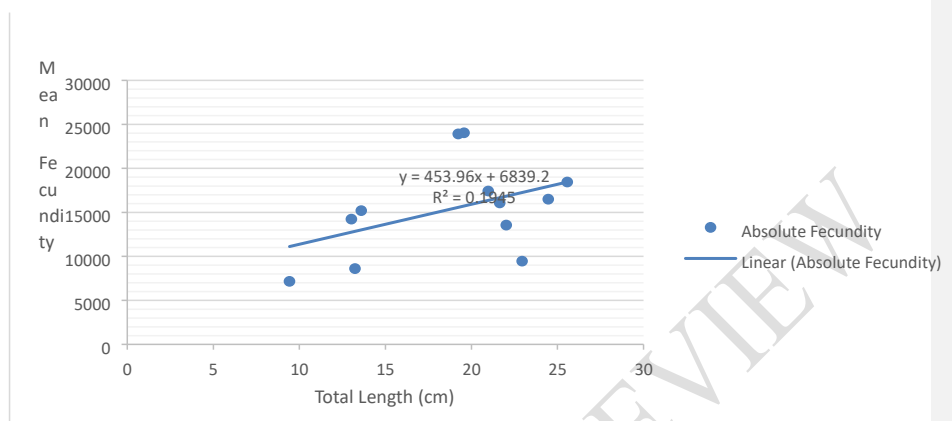


Fig. 15: Total Length-Fecundity-Relationships in *Brycinus nurse* Specimens in Goronyo Reservoir, Sokoto State Nigeria

Discussion

Spawning and breeding activities take place when there are adequate number of spawners and mostly in the tropical water bodies this starts in April to August, (Dadebo, 2000&2011; Grau *et al.*, 2016). The correct ratio of Male:female (M: F) is very important in breeding processes in waterbody and most studies reported various number of M:F ratios of spawning stocks in the tropical water bodies, (Paugy, 2001; Kamugisa *et al.*, 2010; Grau *et al.*, 2016). Dadebo (2000) reported a M: F ratio almost equivalent to unitary number of spawners in both sexes. Boot and McKinlay (2001) reported F:M of 4.8:1 (floodplain) and 2.2:1 (riverine) for *Brycinus lateralis* which contrasted with the findings in this study. Furthermore, Dadebo *et al.* (2011) reported more males caught in Jan-Oct. As was similarly reported in this study.

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Gonads Maturation Stages

Gonads are the sexual organs of the fish specimen, testis for the male and ovary for the female, (Bagenal and Tech, 1978; Gabr, *et al.*, 1998). The authors observed that fish species gonads undergo different stages of gonads development as the fish mature. For instance, Shinkafi *et al.* (2013) had categorized the gonads development of female Nile perch (*Lates niloticus*) specimens in River Rima into five stages namely; unripe, maturing, matured, spent and resting. Similarly, Oboh *et al.* (2013) also studied and reviewed reproduction strategies in *Synodontis schall* in Jamieson River and divided the ovary maturation stages in the female specimens into five stages namely; immature, recovery, maturing, ripe and spawning. Furthermore, Kasogi *et al.* (2013) classified ovary development in female *Alestes baremose* in Albert Lake based on six stages which is adopted by this study namely; immature, developing, imminent spawning, spawning, post spawning and spent stage with stage IV been more popular thereby indicating a short spawning period for the species. This study also revealed that stage IV as the most popular.

Gonadosomatic Index (GSI)

Gonado-somatic-index (*gsi*) is the weight of the ovary or the testis relative to that of the somatic weight of the fish specimen, (Meio *et al.* 2011). In a related study on *Lates niloticus* in River Rima, Shinkafi *et al.* (2013) citing Rhodes and Sadovy (2002) reported that, Gonado-somatic index (*gsi*) was a tool used for measuring the sexual maturity of animals in correlation to ovary and testis development. Rhodes and Sadovy (2002) reported that *gsi* was a good indicator of reproductive activity used in determining fish reproductive cycle. Saliu and Fagade (2003) reported *gsi* values ranging from 0.02-29.25% with mean value of 6.43% varying with season, size, sex and stage of gonad maturity as was similarly reported in this study. Similarly, Offem *et al.* (2008), Shinkafi *et al.* (2013), Yusuf *et al.* (2013) and Kasogi *et al.* (2013) reported mean GSI values as reported by this study.

Fecundity

Fecundity is the total number of eggs a gravid fish contains in its productive cycle in the ovaries prior to spawning, (Bagenal and Tesch, 1978; Eyo *et al.* 2016; Opiyo *et al.*, 2017; Saleh *et al.*, 2020; Mimoune *et al.*, 2023). In demographic studies, fecundity is the actual reproductive rate of an organism or population measured by the number of gametes, eggs, seed set, or asexual propagules, (Berek and Novak, 2007). The fecundity is important and well-studied in the field of population studies. Fecundity can increase or decrease in a population according to the current conditions, aquatic environment and certain regulating factors, (Berek and Novak, 2007). For instance, in times of hardship for a population, such as a lack of food, juveniles and eventually adults' fecundity has been shown to decrease (i.e. due to lack of resources the juvenile individuals are unable to reproduce, eventually the adults will run out of resources and reproduction will cease). This study revealed mean fecundity ranged from 544 ± 77 eggs to $10,447 \pm 1,648$ eggs in *Brycinus nurse* gravids in Goronyo reservoir. Similarly, Saliu and Fagade (2003), Offem *et al.* (2008), Kingdom and Allison (2011), Yusuf *et al.* (2013), Nandikeswari *et al.* (2014), Abdulkarim *et al.* (2017) and Nguvan *et al.* (2024) reported fecundity ranges from 348 eggs to 155, 920 eggs in various water bodies. The fecundity was also shown to be dependent on total length (Kabir and Quddus, 2013; Nandikeswari *et al.*, 2014), body size and season (Kingdom and Allison, 2011; Abdulkarim *et al.* (2017; Nguvan *et al.* 2024).

Fecundity-Ovary Weight-Relationship

This study revealed a moderate relationship between fecundity and ovary weight in *Brycinus nurse* specimens. Obah *et al.* (2013) and Nandikeswari *et al.* (2014) reported high relationship between fecundity and ovary weight in *Terapon jarbua* specie in an Indian water therefore confirming the findings in this study.

Fecundity-Total Bodyweight-Relationship

The study revealed a strong fecundity and total somatic weight relationship in *Brycinus nurse* specimens therefore confirming somatic weight as best indicator of fecundity as reported by Kingdom and Allison (2011).

Fecundity-Total Length-Relationship

One of the main goals of estimating fecundity is to establish a fecundity-size (length/weight/age) relationship which can be used to estimate spawning stock biomass or spawners abundance, (Morua *et al.*, 2003). This study revealed a weak relationship in fecundity and total lengths in *Brycinus nurse* specimens in Goronyo reservoir. This finding was further corroborated by the report of Kingdom and Allison (2011) who observed that total length was not the best predictor of fecundity in *Pellonula leonensis* in Run River. Obah *et al.* (2013) reported positive correlation between fecundity-weight and fecundity-ovary weight but insignificant relationship in fecundity-length relationship in *Synodontis schall* in Jamieson River as was similarly reported in this study. However, Kabir and Quddus (2013) reported significant relationships ($p < 0.01$) between fecundity and total length and standard length in a study on a small *cyprinid* in a small pond in Paridpur district.

Conclusion

The study investigated the reproductive potentials of *Brycinus nurse* species in Goronyo reservoir. The study revealed sex ratio dominated by bigger males sampled between June and August with more male specimens at Stage III and female specimens at stage IV and VI of gonads maturation. Similarly, highest mean gsi values were recorded in June to September in male *Brycinus nurse* specimens and lower mean gsi values were recorded in August indicating this was the period the species spawns. The mean fecundity was highest in August to October in gravid *Brycinus nurse* specimens. All other reproductive indices had shown high relationships with specimens' somatic weight, gonads weight, season except total length. Conclusively, this species spawns in August and has high reproductive potentials in Goronyo reservoir.

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Recommendation

The study recommends adoption of closed season management strategy between June and October to allow an uninterrupted breeding activity of this species in Goronyo reservoir.

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