



Preliminary Studies on the Potentialities of *Brycinus nurse* (Ruppell, 1832) for Aquaculture in Nigeria

¹Abdulkarim, M., ^{2*}Yusuf, Z. A. and ³Suleiman, S. B.

¹Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Nigeria

²Department of Biological Sciences, Abubakar Tafawa Balewa University Bauchi, Nigeria

³Department of Fisheries, University of Maiduguri, Maiduguri, Nigeria

Received: November 18, 2016

Accepted: February 24, 2017

ABSTRACT

The preliminary study was aimed at exploring the potentialities of *Brycinus nurse* as an aquaculture candidate in aquaculture in Nigeria. Samples of *B. nurse* were collected from Gubi dam, Bauchi State for a period of twelve months. The fish total lengths (L) were measured and were dissected for analysis of stomach contents, determination of fecundity (F) and sex ratio (SR). Proximate composition of the stomach contents (SC) and fish muscles (FM) were carried out for %dry matter (DM), % ash (AS), % crude protein (CP), % ether extracts (EE) and % crude fibre (CF) for both dry and wet seasons' samples. The result revealed that *B. nurse* stomach contains animal and plant materials, zooplanktons, algae, detritus and sand particles. The mean proximate composition of the FM and SC were DM = 83.13; AS = 12.43; CP = 67.67; EE = 8.36; CF = 1.96 and DM = 47.71; AS = 11.39; CP = 31.27; EE = 11.57; CF = 0.73 respectfully. Absolute fecundity ranges from 334 to 2879 eggs and Fecundity-length relationship model is $F = 14.04 + 0.00042 \times L$ ($r = 0.280$, $p > 0.05$, $L: 12 - 17\text{cm}$). Male to female sex ratio was 1 to 1.170. It can be concluded that *B. nurse* is omnivorous. It is recommended that further studies should be carried out on the possibilities of artificial reproduction of the fish.

Key words: Potentials, *Brycinus nurse*, Fecundity, proximate composition, Aquaculture potentials, Nigeria.

INTRODUCTION

Fish is a rich source of protein, vitamins and minerals (Gubta, 2006). Fish and fish products can play an important role in addressing hunger and malnutrition. *Brycinus nurse* (Rüppell, 1832) belongs to the family Alestidae which is among the three genera and fifteen species found in Nigeria. According to Reed *et al.* (1967), *Brycinus* species are elongated, the bodies are streamlined in shape and covered with cycloid scales. It has deeply forked caudal fins. The dorsal fin has 10 rays, the first two simple and the others branched. There are 27 – 32 large scales in the lateral line. The colour is generally silvery on the sides and olive - bronze on the back. The dorsal, anal, ventral and adipose fins, and less commonly the pectorals are tinged with red. The fish species utilize various kinds of food resources that may be available in its habitat

This species is native to the fresh water system in Africa and some parts of South American continents, thriving well in both lentic and lotic water (Saliu, 2008; Echi and Ezenwaji, 2016). *Brycinus nurse* is found in most freshwaters of Nigeria; including Lake Chad, Tiga Dam in Kano State, River Benue and Niger as well as Gubi Dam. *Brycinus nurse* spawns during the peak of the floods with the specific months varying with the locality, July and October in Chad (Blache, 1964), July and September in Ivory Coast, (Paugy, 1980), June and July in River Asa and Galma, Nigeria (Omotosho, 1990).

Omotosho, (1990) investigated the aspects of the reproductive biology of *B. nurse* including the estimation of fecundity rate. The Reproductive Biology of *Brycinus nurse* in Asa Reservoir, Ilorin, Nigeria have been reported by Saliu and Fagade (2003). Albaret, (1980) as cited by Saliu and Fagade (2013) reported the absolute fecundities of *Brycinus nurse* to be 15,500, while Paugy (1980) as cited by Saliu and Fagade (2013) documented absolute fecundity to be 16,720 and the relative fecundity of

*Corresponding Author: email: zecology@yahoo.com

368,000 eggs /kg of body weight was recorded. Female dominance in *B. nurse* population has been reported from four basins of Ivory Coast by Paugy (1980) as cited by Saliu and Fagade (2013). *Brycinus nurse* has also been known to carry out migratory movements, prior to spawning (Reynolds, 1973). Saliu and Fagade (2013) also reported Female dominance of 1.0 male to 1.78 female in Asa Reservoir, Ilorin, Nigeria

Bello *et al.* (2016) reported the seasonal variation in proximate composition of *Brycinus nurse* caught from Lake Alau, Borno State; protein content ranges from 14.00 to 32.56 % in dry season, fat content for harmattan period was 40.00 %, ash content in wet season 1.5%, crude fibre for harmattan period was 45.00, and dry matter was 37.50 % dry season.

Brycinus species fishery is among the commercial fishery in Gubi dam (Abdulkarim *et al.*, 2005). Yusuf and Abdulkarim (2015) reported that *A. nurse* (*B. nurse*) population stock parameters in Gubi dam had a growth performance index of 2.68cm per year with 20cm and 80.23g as the asymptotic length and weight respectively. Fish in the wild fend for themselves, but when farmed, there is the need to have information on their nutritional requirements (Pitcher, 1982).

Knowledge of fish fecundity is required in establishing the potentials of fish and its exploitation and management (Fawole and Arawomo, 2000). The potentials of *Brycinus* species for aquaculture are yet to be fully exploited. The objectives of this research are to investigate the stomach content of *B. nurse*, proximate composition, fecundity, and sex ratio of *B. nurse* in Gubi Dam with the view to consider *B. nurse* as a candidate for aquaculture in Nigeria.

MATERIALS AND METHODS

Study area

This study was conducted in Gubi dam in Ganjuwa Local Government area of Bauchi State. Ezra and Nayaya (1999) reported that Gubi dam is a product of damming four major rivers (Gubi, Makaranta, Ran and Tagwaye), located at latitudes 9° 3' - 12° 3' North and longitudes 8° 50' - 11° East. It has a total area of 590 ha and catchment area of 179 km². The dam has a total storage capacity: 3.84 x 10⁶ m³ and a maximum height of 27 km² (Anon, 2005).

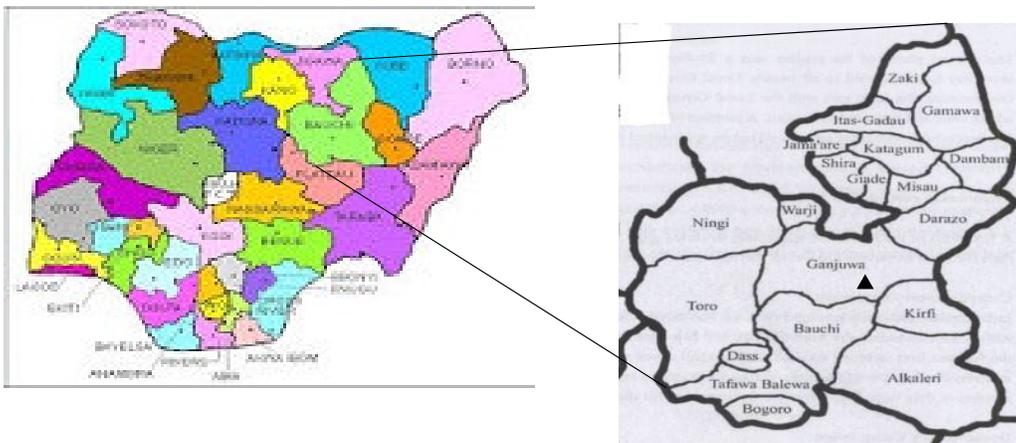


Fig 1: Map of Gubi Dam showing sampling site

Key: ▲ Sampling site

Fish sample collection

Two hundred (200) *Brycinus nurse* were samples were randomly collected at Kwari landing site from local fishermen weekly (7:30 to 10:30 am) for the period of twelve (12) months. The fish were caught using cast net in both wet and dry seasons. The fish samples were conveyed in plastic container cover

with ice to the Department of Animal Production laboratory Abubakar Tafawa Balewa University. The fish were identified following Reed *et al.* (1967) description.

Stomach content analysis

The frequency and occurring methods was used to assess the stomach content. Each fish was dissected, the stomach contents were removed and opened and mixed with 1ml of distilled water per gram in a petri dish. Microscope and hand magnifying lens were used to identify the food materials. Phytoplankton in the stomach was identified using Needham and Needham (1962) and Mellanby (1975). Plankton identification kits. Relative importance index of food items was estimated according to Hyslop (1980): $AI_i = F_i V_i$. Where AI_i is a Importance Index of the identified food item in the sample, F_i is the occurrence frequency of the item and V_i is the volumetric analysis index of the item.

Proximate composition of *B. nurse*

Proximate composition of *B. nurse*'s muscle (flesh) and food materials obtained from its stomach content were separately grounded into powder and each stored in a bottle. The samples were analysed for ash, crude protein, crude lipid and crude fibre according AOAC (1990).

Ash content

This was determined by measuring the initial weight of oven dried sample in a pre - weighed crucible. The samples were separately incinerated overnight in a muffle furnace at 550°C. The ash samples were cooled in desiccators and weighed. Percentage ash was calculated as follows from the samples:

$$\% \text{ Ash} = (\text{initial weight} - \text{final weight}) \times 100 / \text{initial weight.}$$

Crude protein

This involved digestion, distillation and titration; 0.5g each of fish and food material samples were separately weighed and each was placed into a digestion flask. 10ml of concentrated H₂SO₄ acid was added to each sample. A tablet of mercury catalyst was added to the samples. Digestion took place in a digestion block at 450°C until the solution turns clear. This was then followed by distillation; 10ml of Sodium hydroxide was added to digest in a micro Kjeldahl steam distillation apparatus. This produced Ammonia (NH₃) which was trapped in 2% boric acid containing methyl red indicator. The distillate was titrated against 0.01M of hydrochloric acid. The titre value obtained was used in the following formulae: $\% \text{ CP} = [(T_s - T_b) \times 0.014 \times 6.25 \times 100] / W$, Where CP is the Crude protein, T_s = the Titre value for the sample, T_b is the Titre value for blank and W is the weight of the sample.

Dry matter

A known weight (5g) of the samples was taken and oven dried at 60°C to constant weight. The hot dried samples were cooled in desiccators before weighing and % dry matter content was determined as follows: $\% \text{ Dry Matter} = (\text{initial weight} - \text{final weight}) \times 100 / \text{initial weight.}$

Lipid (Ether Extract) and crud fibre

The samples were grounded separately. A known weight (5g) of the sample was put in a pre-weighed thimble. Cotton wool was used as stopper and the weight was taken before extraction and placed in soxhlet extraction flask and extracted with 50ml of ethanol over a heating mantle until the solution in the extraction flask clears. The extracted sample in thimble was removed and dried in an oven, cooled in desiccators and weighed. Percentage lipid was calculated thus: $\% \text{ Ether Extract} = (\text{initial weight} - \text{final weight}) \times 100 / \text{initial weight.}$ The final weight obtained above was considered to be the initial weight for crud fibre. The sample was incinerated for about eight hours in a muffle furnace at 550°C, removed, cooled and weighed to obtain the final weight. Percentage crude fibre was calculated as below: $\% \text{ Crude Fibre} = (\text{initial weight} - \text{final weight}) \times 100 / \text{initial weight.}$

Fecundity analysis of *Brycinus nurse*

One hundred and eighty (180) *Brycinus nurse* were obtained from fishers in the months of July-August and February- March for rainy and dry seasons respectively. The fish were sacrificed. Total lengths were measured to the nearest 1cm using 30cm metric ruler. Then, fish were dissected and the Ovaries were collected, weighed to the nearest 0.1gram using top loading electronic weighing balance with model number: CS 200. The ovaries were preserved using 5% formaldehyde. Dry method of gravimetric sub - sampling was followed to count the preserved eggs (Bagenal, 1978). The fecundity (F) was estimated by weighing all the eggs and 0.1 gram was taken twice from the sample and counted. The sub - samples were separately spread on filter paper that was divided into four quadrants. A quadrant was selected randomly and the eggs counted: $F = [4 \times (\text{Average No. of eggs in a quadrant}) \times \text{total weight of all eggs per fish}] / 0.1$.

Relationship between fecundity and length of *Brycinus nurse*

The relationship between fecundity and the length of *Brycinus species* was determined according to the method described by Bagenal, (1955 and 1978): $F = a \times L^b$, Where F is the Fecundity of the fish species, L is length (Total or Standard Length), 'a' and 'b' being constants of regression coefficients from logarithmic transformation of equation 8: $\ln F = b \times \ln L + a$.

Statistical analysis

Descriptive statistics such as simple percentages and mean, were used where applicable.

RESULTS AND DISCUSSION

Food and feeding habit of *B. nurse*

Common food items found in the stomach *Brycinus nurse* caught from Gubi dam is shown in Table 1. This may be due to the lentic condition of the dam. The most preferred food items in the stomach of *B. nurse* were insect parts in wet season (F = 16.78% and AI = 600), followed by leaf part (F = 14.47% and AI = 484) and Fish parts (F = 11.18% and AI = 336) while in dry season were insect parts, detritus and maize bran with F = 17.20% and AI = 80. The range of food items found agreed with the findings of Reed *et al.* (1967) and Ikomi and Sikoki (2001).

Nutrient composition of *Brycinus nurse*

Proximate composition of the fish muscle (FM) of *B. nurse* revealed that the fish has 83.13, 12.43, 67.67, 8.36 and 1.96 % mean DM, Ash, CP, EE and CF, respectively, while the mean proximate composition of the stomach content (SC) were 47, 11.90, 31.27, 11.57 and 0.73 % DM, Ash, CP, EE and CF, respectively (Table 2). The proximate composition values of *B. nurse* during the wet season recorded in this study is higher than those reported by Bello *et al.* (2016). This variation could be due to the differences in the water bodies where these fish were sampled.

The high accumulation of DM and CP in the dry season may be due to efficient utilization of food materials in the water due to low water level and absence of energy consuming activities such as reproduction and locomotion. The %ether extract in both wet and dry seasons were higher (FM = 9.89% and FM = 6.83%; mean = 8.36) in the fish muscle is an indication that the flesh of the fish species is not oily as reported by Reed *et al.* (1967) and mean value of %ether extract of the SC is 11.57% and within 10 – 15% lipids recommended by Dupree and Hunner (1985). The mean CP value for the SC in this research is 31.27% and falls within 30% - 35% protein recommended by Lovell (1979).

Fecundity of *Brycinus nurse* from Gubi dam

Brycinus nurse with total length of between 16 and 17cm had higher number of eggs 2879 compared to the total length between 12 and 13cm which had fewer (334) eggs (Table 3). The 16 and 17cm with higher number of eggs reported in this study differed from the report of Yusuf and Abdulkarim (2015) who reported 13.3 cm as length as a maturity length for *Alestes nurse* caught from Gubi dam. The relative fecundity of *B. nurse* in this study ranged from 214 to 1117 eggs/cm body length with 2879

eggs as the highest absolute fecundity. The higher absolute fecundity recorded in this study was lower than 18, 281 eggs documented by Saliu and Fagade (2003) for *B. nurse* from Asa reservoir.

Table 1: Common food items found in the stomach *B. nurse* caught from Gubi dam

Food items	Wet season		Dry season	
	Frequency of Occurrence (%)	Relative Importance Index	Frequency of Occurrence (%)	Relative Importance Index
Zooplankton				
Daphnia	10 (3.29)	25	4 (4.30)	3
Rotifer	5 (1.64)	3	2 (2.15)	1
Algae				
<i>Bacillario phyceae</i>	24 (7.89)	21	3 (3.23)	2
Chlorophyceae	13 (4.28)	46	2 (2.15)	7
Animal Materials				
Fish parts	34 (11.18)	336	12 (12.90)	36
Insets parts	51 (16.78)	600	16 (17.20)	80
Worms	13 (4.28)	143	2 (2.15)	1
Plant Materials				
Leaf part	44 (14.47)	484	7 (7.54)	13
Maize bran	30 (9.87)	165	16 (17.20)	41
Plant seed	34 (11.18)	268	3 (3.23)	2
Others				
Detritus	22 (7.25)	119	16 (17.20)	80
Stone particles	24 (7.89)	132	10 (10.75)	26

Table 2: Proximate composition of muscles and stomach content of *B. nurse* caught from Gubi dam

Season	Dry Matter (%)	Ash Content (%)	Crude Protein (%)	Ether Extract (%)	Crude Fibre (%)
Fish muscle					
Wet	82.29	16.23	66.73	9.89	1.31
Dry	83.96	8.63	68.61	6.83	2.61
Mean	83.13	12.43	67.67	8.36	1.96
Stomach content					
Wet	33.89	15.52	26.78	16.31	0.42
Dry	61.53	7.26	35.75	6.82	1.03
Mean	47.71	11.39	31.27	11.57	0.73

Fecundity and total length relationship of *B. nurse*

The total length-fecundity relationship of *B. nurse*, $F = 14.04 + 0.000427 \times L$ ($r = 0.280$, $p > 0.05$) show higher correlation (r). The higher correlation reported in this study is lower than $F = 1831.65 + 197.41 \times L$ ($r = 0.002$, $p > 0.05$) reported by Saliu and Fagade (2003) for *B. nurse* caught from Asa reservoir.

Sex ratio (SR)

Female *B. nurse* were observed to be slightly dominated (1: 1.17 = 1:1) by male than female in Gubi dam (fig. 2). The male: female sex ratio recorded in this study varied with 1: 1.78 (1: 2.0) reported by Saliu and Fagade (2003) for same species from Asa reservoir. This variation could be due to the differences in the geographical location and for the fact that male are known for the migratory behaviour

for spawning as opined by Fagade *et al.* (1984) and Reynolds (1973). Ham (1981) also attributed these disparities in male: female ratio to differential survival over certain environmental conditions.

Mean crude protein composition *Brycinus nurse* was observed to 67.67% and has moderate fecundity which is predictable from the total length-fecundity relationship.

Table 3: Mean fecundity estimate of *Brycinus nurse* caught from Gubi dam

Total Length	Frequency (%)	Absolute Fecundity
12 – 13	2	334 ± 19.80
13 – 14	5	1055 ± 76.00
14 – 15	5	1629 ± 77.49
15 – 16	7	2474 ± 65.32
16 – 17	5	2879 ± 57.45

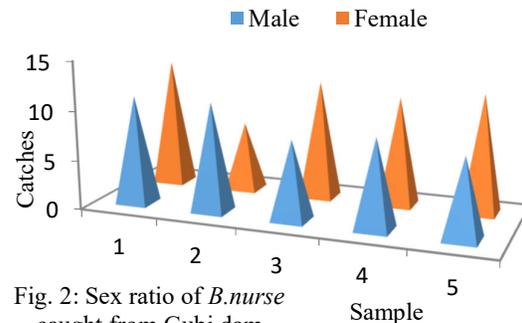


Fig. 2: Sex ratio of *B. nurse* caught from Gubi dam

The sex ratio of male to female is 1: 1.17. It is omnivore and feed can be formulated for the fish when farmed within the range of 26.78-35.75% crude protein. Therefore, it is recommended for aquaculture. However, further studies should be carried out on artificial breeding of *B. nurse* in captivity.

REFERENCES

- Abdulkarim, M. and Lamai, S. L. (2012). Water Quality Assessment and Dietary Habits of *Alestes nurse* in Gubi Dam, Bauchi State. *Journal of science, Technology and Education* 1(2): 12 – 16.
- Abdulkarim, M., Bununu, K. and Mohammed, A. (2005). Fish and Fisheries of Gubi Dam Ganjuwa Local Government Area Bauchi. *Journal of League of Researchers in Nigeria* 7(1):7 – 12.
- Anonimous (2005). Bauchi State Economic Empowerment and Development Strategy (BASEEDS, 2005-2007). 66 – 70.
- Bagenal, T. A. (1955). A Note on the Relations of Certain Parameters Following a Logarithmic Transformation. *J. Mor. Biol. Ass.* U.K. 34:289 – 296.
- Bagenal, T. B. (1978). *Methods for Assessment of Fish Production in Fresh Waters*. Third edition. IBP Hand Book Nos.3. Blackwell, Oxford. U. K. 101–136.
- Bello, M. M. and Oyelese, O. A. (2016). Seasonal Variations in the Proximate Composition of Nurse Tetra (*Brycinus Nurse*) from Alau Lake Maiduguri, Nigeria, *Animal Research International*, 13(3): 2470 – 2474.
- Dupree, H. and Hunner, J. V. (1985). *Nutrition, Feeds and Feeding Practices*; Third Report to the Fish Farmers. U. S. Fish and Wild Life Service, Washington D C. 23-45.
- Echi, P.C and Ezenwaji, H.M.G (2016). Length-Weight relationship and food and feeding habit of some Characids (Osteichthyes: Characidae) from Anambra River, Nigeria. *Animal Research International*, 13(1):2316-2320.
- Ezra, A. G. and Nayaya, A. J. (1999). Studies on fresh water algae from Gubi Reservoir, Bauchi State - Nigeria. *Journal of Basic and Applied Sciences*. 8: 97-104.
- Fagade, S.O., Adebisi, A. A. and Atanda, A. N. (1984). The breeding cycle of *Sarotherodon galilaeus* in the I.I.T.A Lake, Ibadan, Nigeria. *Arch. Hydrobiol.*, 100(4):493 – 500.
- Fawole. O. O and Arawomo, G. A. O. (2000). Fecundity of *Sarotherodon galilaeus* (Pisces Cichlidae) in the Opa reservoirs, Ile – Ife, Nigeria. *Rev. Boil. Trop.*48 (1):1-5.
- Gubta, M. V. (2006). Challenges in sustaining and increasing fish production to combat hunger and poverty. *International Centre for Living Aquatic Resource Management (ICLARM) Quarterly*, 4 – 10.

- Ham, R. (1981). The ecology of six native and two introduced fish species in Enoggera creek system, South east, Queensland. *Bsc. (Hons) Thesis*. Griffith Univ. Brisbane. 157Pp.
- Helrich, K. [Ed.] (1990). Official Methods of Analysis of Association of Analytical Chemists (15th Ed.) Association of Official Analytical Chemists Inc. Virginia, U. S. A., 746 Pp.
- Hyslop, E. J. (1980). Stomach content analysis: a review of methods and their application *Journal of Applied Biology*, 17(4):411 – 429.
- Ikomi, R. B. and Siskoki, F. D. (2001). Studies on the Distribution, Abundance, Growth Pattern and Dietary Habits of *Brycinus nurse* Ruppell, 1(Osteichthyes: Characidae) in the River Jamieson, Nigeria. *Act Ichthyol. Piscat*, 31(1): 27 – 44.
- Lovell, R. T. (1979). *Formulating diets for Aquaculture species*. Reprint from feeds contents. Universidade Estadual Paulista, AV. 24 – A, Rio Claro, Sao Paulo, Brazil, 56 -87.
- Machena, C. and Moehl, I. (2000). Sub – Saharan Africa aquaculture: regional summary. Aquaculture in the third Millennium. *Technical Proceedings of the Conference on the third Millenium. Bangkok*. NACA. 365 – 381.
- Mellanby, H. (1975). *Animal life in freshwater: A Guide to Freshwater Invertebrate*. Sixth edition, Chapman Hall, London, 323Pp.
- Needham, P. R. and Needham, J. G. (1962). *A Guide to the Study of Freshwater Biology*. Holden Day Inc, Sanfransisco, 108Pp.
- Omosho, J.S. (1990). Some aspects of the biology and distribution of fish in *Alestes nurse* (Ruppell). *Nig. J. Sci* (in press.)
- Pitcher, T. J. and Hart, P. J. B. (1982). *Fisheries Ecology*. The AVI Publishing Company. INC., London, 414Pp.
- Reed, W. J., Burchard, A., Hopson, J., Jennes, J. and Yaro, I. (1967). *Fish and Fisheries of Northern Nigeria* Gaskiya Corporation, Zaria. 226Pp.
- Saliu, J. K and Fagade, S. O. (2003). The reproductive biology of *Brycinus nurse* (Paugy, 1986), Pisces: Characidae in Asa reservoir, Ilorin, Nigeria. *Turkish Journal of Fishery Aquaculture Science*, 3: 5-9.
- Saliu, J. K. (2008). Size, sex and Seasonal dynamics in the dietary composition of *Brycinus nurse* (Pisces: Characidae) from Asa reservoir, Ilorin, Nigeria. *Rev. Bio. Trop.* 50 (1):233 – 238.
- Yusuf, Z. A. and Abdulkarim, M. (2015). The Dynamics of Population of *Alestes nurse* (African Pink) in Gubi Dam, Bauchi State: Using Simplified Empirical Models. *International Journal of Agricultural Policy and Research (IJAPR)* 3 (7): 300 – 307 Retrieved 14th July, 2015 from <http://www.journalissues.org/ijpar>.