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Some aspects of the reproductive biology of *Gymnarchus niloticus* Cuvier, 1829 (Knifefish) in Lekki Lagoon, Nigeria

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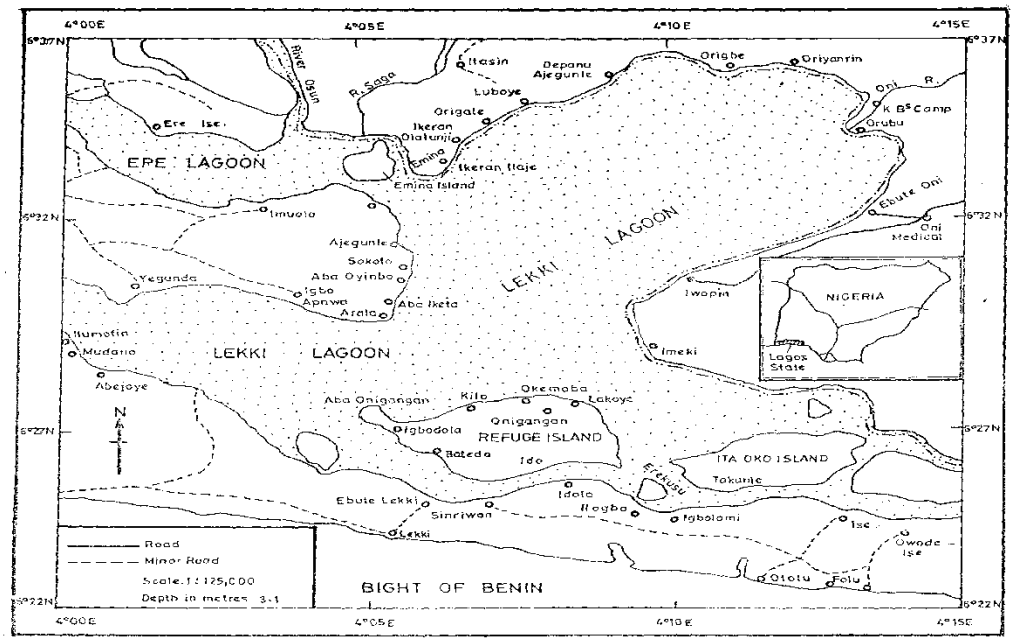
Abstract
Studies were conducted on the gonad morphology, gonadosomatic index (GSI), fecundity and egg size of *Gymnarchus niloticus* in Lekki lagoon. 420 fish samples comprising of 150 females and 270 males were examined giving a female to male ratio of 1:1.8. Gonad morphology revealed unpaired gonad in both sex. Fecundity ranged "between" 750 to 1291 with a mean of 925.61 ± 106.90SD and it correlated significantly ($P<0.05$) with gonad weight ($r=0.63$) and standard length ($r=0.64$). Mean oocyte diameter was 5.41 ± 1.29 mm and it had significant relationship ($P<0.05$) with total weight (TW), gonad weight (GW) and maturity stage (MS). Fully matured gonads were observed from May to July and November to January while spent gonads were found in August and September. Mean GSI were 1.928 ± 0.304SD and 0.007 ± 0.164SD in female and male respectively. *G. niloticus* in Lekki Lagoon exhibited gonochoristic reproductive strategies having low fecundity but large ova with iteroparous life history.

Keywords: Reproductive biology, Morphometric measurement, *Gymnarchus niloticus*, Lekki lagoon.

1. Introduction
Reproduction is one of the basic biological features that enable continuity of any species [23]. Comprehensive knowledge of reproductive strategies employed by a species in response to environmental factors will determine the degree of survival of that species in such environment. Fecundity, derived from the word fecund, generally refers to the ability to reproduce [24] and when used in relation to fish it refers to the number of ripe eggs in an ovary prior to spawning [19]. As the body weight of fish increases, the number of eggs produced would also increase due to continuous growth of fish after fecundity has stabilized [11].
Gymnarchus niloticus is the only member of the family Gymnarchidae in the order Osteoglossiformes [20]. While most Osteoglossiformes breed during the rainy season and gonad maturation is triggered by decreasing water conductivity in elephant fishes [7], reproduction in knifefishes is not well known. Although, breeding behaviour of *G. niloticus* has been reported by some authors [5, 15, 20, 21], a detail study of its gonad morphology, fecundity, sex ratio, reproductive season and other reproductive traits in Lekki lagoon are yet to be documented, hence this study.

2. Materials and Methods
2.1 Study Area
The fish samples were collected from Lekki lagoon which is situated in the eastern part of Lagos State, Nigeria. (Fig. 1) Lekki lagoon covers an area of nearly 247 km^2 and lies between longitude 4° 00' and 4° 15'E and latitude 6° 22' and 6° 37'N [10]. The lagoon is fed by River Oni in the North-east while Rivers Oshun and Saga flow into the North western parts [9, 12].

2.2 Fish Samples
A total of 420 samples of *G. niloticus* were collected from Lekki lagoon on monthly basis for 24 months with assistance of artisanal fishermen using fishing traps, cast and gill nets of various mesh sizes. The fish were transported on an ice chest to the laboratory of National Institue of Oceanography and Marine Research (NIOMR), at Badore in Ajah, Lagos State Nigeria where the morphometric measurements were carried out.



Source: Field Survey, 2009

Fig 1: Map of Lekki Lagoon, Nigeria showing fish landing sites and surrounding villages

Sex of fish was determined by dissection and examination of the gonads since this was impossible via visual examination of the fish.

Only matured gonads (Stages III and IV) were used for fecundity analysis. Matured gonads were carefully excised from the body cavity and weigh to the nearest grams using a top loading balance. The mature ovaries were preserved in 4% formalin for 24 hours. During this period, the jar was shaken repeatedly to separate the eggs from the ovarian tissue and assist in the penetration of the preservative. After 24 hours, the 4% formalin fluid was decanted and replaced by water in order to clean the eggs. Fecundity of each fish was obtained by actual count of all the eggs in the sample [4].

The relationship between fecundity and fish length/weight was described by the equation:

$F = aX^b$

Where:
F is Fecundity
X is body length in centimeters or body weight in grams
b is the slope of the graph of F versus X
a is the intercept [13, 19]

The logarithmic transformation of the equation is

$\log F = \log a + b \log X$

The diameters of the eggs in each ovary were measured by using a graduated Vernier caliper. The mean diameter of the eggs was obtained by measuring a total of 250 eggs that were randomly selected [18].

The maturity stages of the ovary were classified as follows using the modified Kesteven's scale as described by [3]:

Stage I Immature, inactive
Stage II Ripening
Stage III Maturing
Stage IV Mature (Ripe)
Stage V Spent

The gonadosomatic index (GSI) was calculated for each gonad as described by [14] using the equation:

$$G.S.I. = \frac{\text{Weight of gonad (g)}}{\text{Body weight (g)}} \times 100$$

3. Results

A total number of 420 fish samples were analyzed of which 150 (35.71%) were females, and 270 (64.29%) were males, giving a ratio of 1:1.8 which was significantly different ($P<0.05$) from the expected 1:1 ratio of many species. Fish that had immature gonads (Stages I and II) were found in February to April with a peak in April for female and February for male *G. niloticus*. Fish that were still developing (Stage III) occurred in April to May and September to October. Fully matured gonads (Stage IV) were observed from May to July and November to January. Fish with spent gonads (Stage V) were found in August and September (Fig. 2 and 3).

Fecundity ranged between 750 to 1291 eggs with a mean of 925.61 ± 106.90 eggs in females of standard length range of 63.00 to 130.50 cm. The relationship between fecundity (F) and weight (W) and fecundity and standard length (SL) are presented by the equation below:

$\log F = 710.79 + 0.06\ W$ and
$\log F = 175.89 + 7.34\ SL$

Fecundity had a significant correlation ($P<0.05$) with both somatic weight ($r = 0.627$) and standard length ($r = 0.637$) of fish. The gonadosomatic index (GSI) for females ranged between 1.25% and 2.34% with a mean of 1.93 ± 0.30% while it ranged between 0.007% and 0.164% with a mean of 0.072 ± 0.037% in males *G. niloticus.* Ova diameter ranged between 3.3 and 8.2 mm with a mean of 5.41 ± SD1.29 mm and it had significant relationship ($P<0.05$) with total weight, gonad weight and maturity stage.

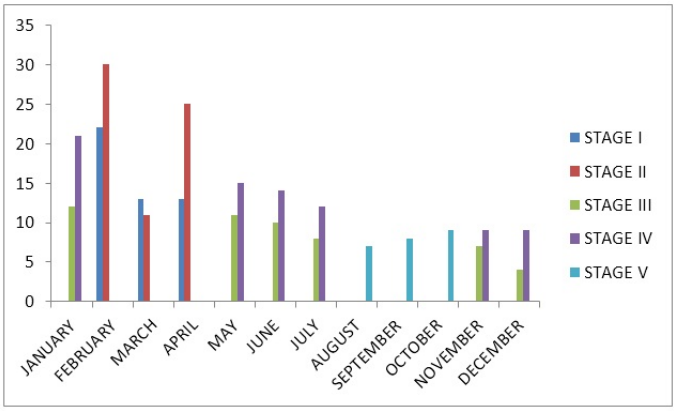


Fig 2: Stages of gonad maturation in female *G. niloticus*

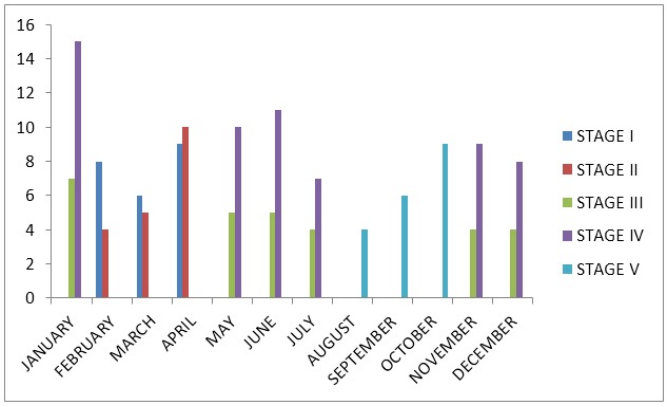


Fig 3: Stages of gonad maturation in male *G. niloticus*

Table 1: Length, weight, fecundity, egg diameter and gonadosomatic index for *Gymnarchus niloticus*

Tot. length (cm)	Std length (cm)	Weight (g)	Log weight	Egg no	Log fecund	Egg diameter (cm)	GSI (%)
105	95	3000	3.4771	912	2.9599	4	2.1667
105	95	3000	3.4771	900	2.9542	3.9	2.1667
100	90	3000	3.4771	912	2.9599	3.3	2.1667
105	95	3000	3.4771	850	2.9294	4.2	2.1667
125	109	5000	3.6990	1070	3.0293	7	1.8400
138	130	8250	3.9165	1291	3.1109	8.2	1.8182
110	99	4000	3.6021	750	2.8751	5.3	1.2500
110	99	4000	3.6021	811	2.9090	5.8	1.5000
125	113	5300	3.7243	850	2.9294	7.7	1.5094
130	118	5300	3.7243	984	2.9930	7.5	1.5849
110	102.5	3500	3.5441	903	2.9557	5	1.8571
110	101	3500	3.5441	939	2.9727	5.2	2.0000
110	102	3500	3.5441	912	2.9600	4.8	2.0000
113	101	4000	3.6021	820	2.9138	5.5	1.5000
125	109	5000	3.6990	840	2.9243	6.9	1.5600
110	102.5	3500	3.5441	949	2.9773	4.6	2.0000
110	102.5	3500	3.5441	950	2.9778	4.5	2.1429
110	102.5	3500	3.5441	944	2.9750	4.8	2.3429
120	109	4500	3.6532	1050	3.0212	6.4	2.0000
105	95	3000	3.4771	912	2.9600	5.1	2.1667
107	96	3000	3.4771	900	2.9542	5.1	2.2667
100	90	3000	3.4771	922	2.9647	4.8	2.1667
105	95	3000	3.4771	918	2.9628	4.8	2.1667

Plate 1: Adult *Gymnarchus niloticus* (2.5 kg)

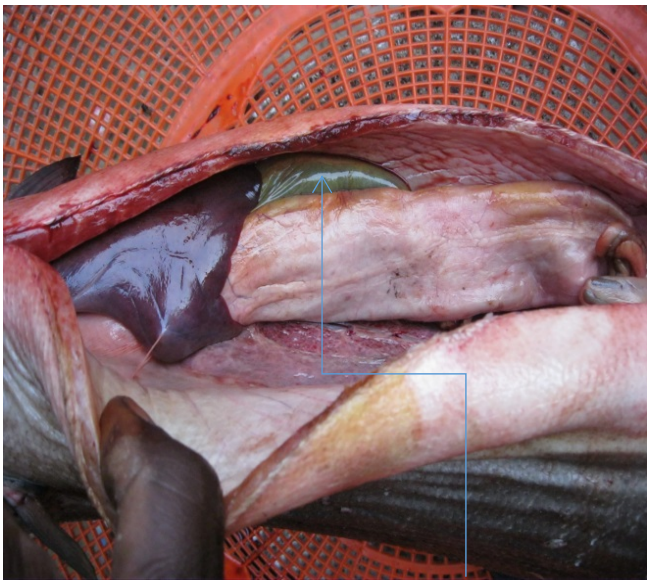


Plate 2: Body cavity of *Gymnarchus niloticus* showing unpaired ovary (in arrow)

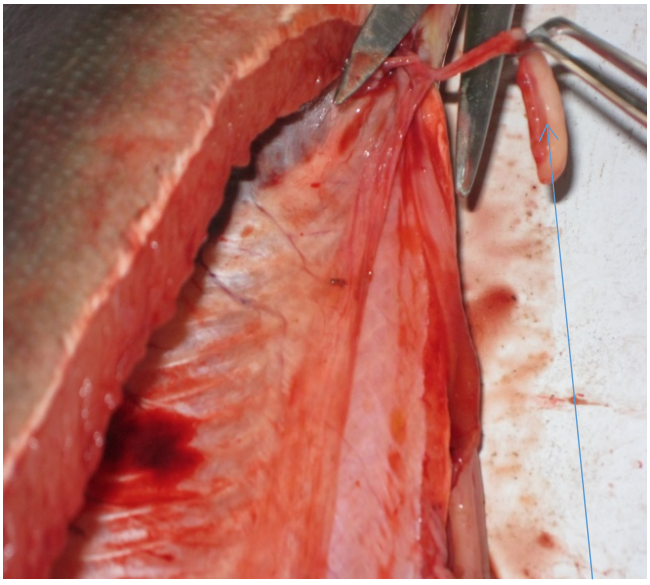


Plate 3: Body cavity of *Gymnarchus niloticus* showing unpaired testis (in arrow)

Plate 4: Detached Single Ovary of *G. niloticus*

Plate 5: Detached Single testis of *G. niloticus*

4. Discussion

Gymnarchus niloticus was found to possess an unpaired gonad. This means that male has only one testis and female possess single ovary. An unpaired gonad has been reported also in *Notopterus notopterus* and *Heterotis niloticus* respectively [6, 22]. Otherwise most fish exhibit a paired gonad structure [8].

There were more male than female *G. niloticus* in this study. Ratio of 1:1.8 (almost twice), a departure from the theoretical 1:1 ratio expected in nature [19] could be a reproductive strategy to ensure that there are enough males to fertilize very small quantity of eggs being layed by *G. niloticus*. The extended breeding period of 6 months (May to July and November to January) could be a strategy to ensure that *G. niloticus* offspring reach a relatively bigger size that places them in a better position to predate on fry and fingerlings of other fish species that would breed later in the year when rain becomes stable. An extended intense reproduction period of 8 months was reported for *Sarotherodon melanotheron* in Onah lake, Nigeria [17]. It has been observed that breeding of most tropical fishes coincided with rainy season when physicochemical conditions of the aquatic environment are favourable [16], although continuous all year round breeding has been reported in some tropical fish species like *Pseudotolithus senegalensis* and *P. typus* [2].

The fecundity of *G. niloticus* recorded in this study varied between 750 and 1291 with an average of 925.61 eggs suggesting that the species has low fecundity. Earlier works [15, 20] recorded an average of 1000 eggs as fecundity for *G. niloticus*. Low fecundity characterizes species that exhibit high parental care [26]. An average fecundity of 2991 eggs was also reported for *Mormyrus rume* at Lekki lagoon [9] whereas a higher fecundity (7,130 to 73,000 eggs) was recorded for *Synodontis schall* in Lake Kainji [25]. The significant correlation ($P<0.05$) of fecundity with both somatic weight ($r = 0.627$) and standard length ($r = 0.637$) suggests that fecundity increases with increase in weight and length of *G. niloticus*. An earlier work [11] reported that number of eggs produced increased as the body weight of fish increased, while some authors reported insignificant correlation in the length and fecundity [8, 10, 23].

The mean GSI value in this study indicates that the species invest 1.93% of its body weight in egg production; however, it

fluctuates even among fish of similar sizes. Higher GSI value of 13% was reported for *S. eupterus* in River Rima, North-west Nigeria [23].

5. Conclusion

Gymnarchus niloticus in Lekki Lagoon exhibited gonochoristic reproductive strategies having low fecundity but large ova with iteroparous life history. They are small brood spawner with asynchronous breeding strategy. This study revealed that *G. niloticus* has an unpaired gonad in both sexes and also provided baseline information on some aspects of reproductive biology of *G. niloticus* in Lekki lagoon.

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7. References

1. Akinsanya B, Otubanjo OA, Ibidapo CA. Helminth bioload of *Chrysichthys nigrodigitatus* (Lacepede 1802) from Lekki lagoon Lagos, Nigeria. Turkish journal of fisheries an aquatic SC 2007; 7:83-87.
2. Anyanwu AO. Some aspects of the reproductive biology of the croakers, *Pseudotolithus senegalensis*, (C & V) and *P. typus* (Bleaker) off the coast of Lagos, Nigeria. Journal of Aquatic Sciences 1990; 5:59-64.
3. Bagenal TB, Braun B. Egg and early life history. In: Bagenal, T.B. (Ed.), Methods for the Assessment of fish production in freshwaters, Blackwell Scientific Publication, Oxford, 1978, 165-201.
4. Bagenal TB. Methods for assessment of fish production in fresh water. Blackwell Scientific publications Ltd. Oxford 1978; 40-46:165-178.
5. Carmouze JP, Durand, Leveque C. Lake Chad: Ecology and productivity of a shallow tropical ecosystem. Dr. W. Junk publishers, The Hague 1993; 279:334-440.
6. Dalela RC, Rani M, Verma SR. Comparative study of morpho-histology of gonads of three teleost fishes. Gegenbaurs Morphol Jahrb 1976; 122(4):570-585.
7. Elsayed AK, Mohammad MNA. Interaction of the momyrid fish *Mormyrus kannume* (Forskal, 1775) reproduction and feeding intensity with the environment in a Nile Delta Canal, Egypt. J Aquat Biol & Fish 2012; 16(1):73-94.
8. Fagade SO, Adebisi AA. The Fecundity of *Chrysichthys nigrodigitatus* (Lacepede) of Asejire Dam, Oyo State, Nigeria. Nigerian Journal of Natural Science 1979; 1:127-131.
9. Fawole OO. Morphometry diet of *Mormyrus rume* in the Lekki Lagoon Lagos, Nigeria. International Journal of Trop. Bio. And Conservation 2002; 50(2):689-694.
10. Ikomi RB, Odum O. Studies on aspects of the ecology of the catfish Chrysichthys auratus Geoffrey St. Hilaire (Osteichthyes; Bagridae) in the River Benin (Niger Delta, Nigeria) Fisheries Research 1998; 35:209-218.
11. King RP. Length – fecundity relationship of Nigeria fish population. International Centre for Living Aquatic Resources Management (ICLARM). Quarterly 1997; 20(1):29-33.
12. Kuton MP. The Biology of Cichlid fishes from Badagry, Lagos and Lekki lagoons, Southwest Nigeria. Ph.D Thesis. University of Lagos, 2006.
13. Lagler KL. Freshwater Fishery Biology. Publ. W.M.C. Brown Company Publishers, Dubuque, Iowa, USA. 421pp. Longhurst, AR (1964). Bionomics of the Sciaenidae of Tropical West Africa. J Con Int Explor 1970; 24:1.
14. Mbu-oben P. Age, growth and reproductive biology of some Mormyrid species in Lekki lagoon, Nigeria. Ph.D. Thesis. University of Ibadan, 1995.
15. Oladosu GA, Ayinla OA. Environmental induction of natural spawning in Gymnarchus niloticus (Cuvier 1829) in earthen pond. NIOMR Tech 1996; 104:10.
16. Olatunde AA. Some aspects of the biology of *Synodontis schall* (Bloch Schneider) in Zaria, Nigeria. Journal of Aquatic Sciences 1989; 4:49-54.
17. Olele NF. Reproductive biology of *Sarotherodon galilaeus* (Artedi, 1757) in Onah Lake, Delta State, Nigeria J of Applied Sci Res 2010; 6(12):1981.
18. Omorinkoba WS. Biology of *Heterotis niloticus* (Cuvier, 1829) in relation to hatchery management in Kainji freshwater lake, Nigeria. Ph.D Thesis. University of Ibadan, 2005, 141.
19. Oniye SJ, Onimisi HU. Some aspects of the reproductive biology of *Hyperopisus bebe* occidentalis (Gunther) in Zaria dam, Nigeria. Nigerian Journal of fisheries 2011; 8(1):232-235.
20. Reed W, Barchard J, Hopson AJ, Jennes J, Yaro I. Fish and fisheries of Northern Nigeria. Edn 1, Ministry of Agriculture, Northern Nigeria, 1967, 31–32.
21. Sagua VO. Preliminary report on the biology of *Gymnarchus niloticus* in Lake Chad. In: Annual report of Lake Chad research institute 1983, 61-65.
22. Serge-eric M, Jean K, Victor P, Patrick K. Biology and prospect for aquaculture of African Bonytongue, *Heterotis niloticus* (Cuvier, 1829): A review. Aquaculture 2009; 289(3-4):191-198.
23. Shinkafi BA, Mamman T. Gonadosomatic index, fecundity and egg size of *S. eupterus* (Boulenger) in River Rima, North-Western Nigeria. Proceedings of the 26th Annual Conference of the Fisheries Society of Nigeria 2011, Minna, Nigeria, 2011, 135-143.
24. Wilkipedia dic. Wikimedia Foundation, Inc. Retrieved from http://en.wikipedia.org/wiki/Gymnarchus-niloticus. 5 May, 2008.
25. Willoughby N. The ecology of the genus *Synodontis* (Pisces: Siluroidei) in Lake Kainji, Nigeria. Ph.D Thesis. University of Southamton, 1974.
26. Yirgaw T, Demeke A, Seyoum M. Breeding season, maturation and fecundity of *Oreochromis niloticus* L. (Pisces: Cichlidae) in Lake Chamo, Ethiopia. Ethiopia Journal of Science 2001; 24(2):255-264.