

Fecundity and Reproductive Habits of *Bostrychus africanus* from Upper New Calabar River Nigeria.

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Abstract

The reproductive behaviour and fecundity of Bostrychus africanus from Upper New Calabar River was studied with samples collected for twenty months across four stations. Three stages of gonadal development was identified namely; immature, mature and spent. Size at maturity was determined as the length at which 50% of samples were in gonad stage II. The fish was observed to breed all year round with peak period running from August to December as revealed by the relative fecundity and gonadosomatic index. Absolute fecundity ranged from 1609 to 10051. Analysis of the fecundity/ length relationship showed that fecundity increased with length. While the females had increasing gonadosomatic index (GSI) from January through the months which peaked between August and December, the males had a stable gonadosomatic index all year round.

Key words: *Breeding, Biology, Reproductive, Fecundity, Bostrychus africanus.*

Introduction

Eleotrids are small, most measuring between 3cm and 20 cm, although one species, *Oxyeleotris marmorata*, reaches 66 cm. They are similar to members of the family Gobiidae, with similar head shape, and an elongate body. They have no lateral line, and two separate dorsal fins. They are generally distinguished from Gobiidae on the basis of their separated pelvic fins that do not form a sucking disc. The degree of pelvic fin separation varies, however, and cannot reliably be the only characteristic used to identify eleotrids (Allen and Robertson, 1994).

Eleotrids can have cycloid or ctenoid (rough-edged) scales. They lack sensory pores, and have canals only on the head. Their mouths, filled with several rows of conical teeth, can be upturned or terminal, but never inferior. The first dorsal fin contains two to eight flexible spines, and a single spine heads the second. Many eleotrids have a well-developed swim bladder, although they are generally benthic (bottom-dwelling). Some have dull, brownish or dark coloration, while others are colorful. One species that lives in wells and sinkholes, *Milyeringa veritas*, is white or pinkish and has no eyes. Some eleotrids may be permanently sexually monomorphic (males and females alike), as is the case with most reef-dwelling gobies, but males of some species develop distinctive coloring for courtship, or when excited by the presence of a competitive male. During the breeding season a hump on the head behind the eyes appears on males in the species *Hypseleotris galii*, (Graham, 1997; Kuitert, 1993; Nelson, 1994).

Many freshwater eleotrids are amphidromous: after hatching they float downstream to brackish or marine waters where they pass through a planktonic larval stage, growing and feeding for a few months before they migrate back to fresh water as juveniles. This marine

stage is thought to indicate that Eleotridae originated as a marine family. Some freshwater gobies develop without a planktonic larval stage, becoming a benthic juvenile directly after hatching, and this may be the case for some eleotrids as well (Moyle and Cech, 2000; Nelson, 1994).

Thresher (1984) includes Eleotridae in his general account of reproduction in the suborder Gobioidae. Gobies have efficient reproduction which ensures the success of the species. Gobies have developed a prolific ability to spawn and reproduce. Instead of producing eggs once or twice a year, the goby can spawn many times throughout the summer season. Each time the female goby lays a batch of eggs that are visited by a male; the result will be thousands of fertilized eggs. While not all of these will survive to adulthood, the ability of the goby to produce numerous batches of eggs each season means that the population can quickly multiply (Debra, 2013). Many marine gobies are hermaphrodites, and can change sex as needed (from male to female where there are too many males and few females, and vice versa). Some gobies, especially those that occur on islands, have a lifecycle in which the fish migrate between fresh and salt water (International Goby Society, 2013). Similarly, eleotrids attach their eggs to vegetation or a substrate (bottom surface). Females of *Hypseleotris compressa* deposit up to 3000 eggs while the Males guard the nest. Their life span is placed at about one to two years. (Berra, 2001; Thresher, 1984). The objective of this research was to provide insight into the breeding behavior and fecundity capacity of *Bostrychus africanus* in Upper New Calabar River.

Materials and Methods

The samples were collected from the Upper New Calabar River which lies at 4.4167° N, and 7.0333°E. *Bostrychus africanus* samples were collected from four stations. These stations were about one kilometer apart coastward. Samples were collected bi-weekly for each month from January 2015 to August 2016. The fish were caught using traps made from bamboo.

Reproductive Biology

Gonads were studied microscopically to determine stage of gonad development. Three stages were identified (Ezenwaji and Offiah, 2003).

- i** - Immature
- ii** - mature
- iii** - Spent.

Size at maturity was determined at the length at which 50% of samples were in gonad stage II. Fecundity is defined as the number of spawnable oocytes in both ovaries (Vinicius *et al.*, 2004). The relationship between fecundity and gonad weight, and total weight, was determined by linear regression, Relative Fecundity will be calculated by the number of oocytes per milligram of females total body weight. The values of total fecundity were regressed against total length, total weight and gonad weight to verify how they are related. (Adebisi 1987, Vinicius *et al.* 2004, Inyang and Ezenwaji 2004). Maturity size: Length at 50% maturity (L_m) was estimated by fitting proportions of cumulative frequency of occurrence on matured samples and total length, TL (Thanitha, 2008).

The length and weight of samples was correlated against fecundity. Physiochemical parameters were also correlated against fecundity. Fecundity was tested for monthly and stations variation by one way Analysis of Variance (ANOVA) and where there is significance Duncan Multiple Range Test (DMRT) was used to separate the means. Fecundity was tested

for seasonal variation, using t test. The annual mean, absolute, and relative fecundities for first and second years were tested for variation by T test.

Gonadosomatic Index

The gonadosomatic index (GSI) which is a ratio of gonad mass to total body mass and a higher value indicates a large investment in reproduction (Kate and Sanso, 2012) was determined as

$$GSI = W_1 / W_2 \times 100\%$$

Where W_1 - gonad weight (g)

W_2 - fish weight (g) less gonad weight.

(Vinicius *et al.*, 2004, Ezenwaji and Offiah, 2003).

The monthly GSI was analyzed for variations using one way ANOVA and where there was significant difference DMRT was used to separate the means. The annual mean GSI for both male and females was tested for variation by using t test, and cross tested between the first and second years for the same parameters. GSI was also tested for correlation with physiochemical parameter.

Results

Absolute fecundity of *B africanus* varied from one station to another but without any significant difference ($P < 0.05$). The range was from 1609 – 10051 for the first year (2015) and 2151 – 9681 for the second year of the study (Tables 1 and 2). The mean absolute fecundity for the wet season was 5708.27 ± 186.97 and 6372.20 ± 406.85 for 2015 and 2016 respectively. For dry season fecundity was 6511.50 ± 572.15 for 2015 and 5608.33 ± 762.51 for 2016. This reflects a higher fecundity in the dry season in 2015, but a reverse of this was observed in 2016. Total absolute fecundity was 6109.97 ± 257.39 and 6085.96 ± 137.26 .

Relative fecundity was 601.16 ± 42.44 and 632.06 ± 48.19 for 2015 and 2016. Monthly changes in relative fecundity showed a steady increase from January to December with various fluctuations (Fig 1) and increasing fecundity with length (Fig 2). Size at maturity was 8.3cm, 8.2cm, 7.6cm, and 8.5cm from stations one to four with a mean of 8.15cm.

Mean Gonadosomatic index for females was 5.26 ± 0.144 in 2015 and 6.41 ± 0.138 in 2016, in the males it was 0.632 ± 0.041 and 0.61 ± 0.025 for both years respectively. A plot of monthly gonadosomatic index for females indicated high values in April and July and a low in May (Fig 3). The male monthly gonadosomatic index showed a major peak in April and a minor one in October, Low values were observed in February, (May – July) and November (Fig 4).

Table 1: Fecundity, Relative Fecundity and Gonadosomatic index with standard error for *B africanus* (2015)

Parameter	Station 1	Station 2	Station 3	Station 4	Mean
Absolute Fecundity (Wet Season)	5771.38±860.25	5344.95±735.49	5513.08±653.75	6203.67±782.92	5708.27±186.97
Absolute Fecundity (Dry Season)	6534.17±921.00	5897.83±790.71	8106.33±691.81	5507.67±543.94	6511.50±572.15
Absolute Fecundity Wet +Dry	6152.80±609.43	5621.39±761.87	6809.86±544.08	5855.81±663.99	6109.97±257.39
Absolute Fecundity Range	1609-9897	2695-8365	2230-10051	2615-9257	2285 - 9392
Relative Fecundity per Length	598.22±35.93	524.71±41.29	720.19±59.30	561.83±40.41	601.16±42.44
Gonadosomatic Index (female)	5.49±0.54	5.27±0.63	5.43±0.70	4.85±0.62	5.26±0.144
Gonadosomatic Index (Male)	0.612±0.062	0.613±0.103	0.554±0.097	0.747±0.126	0.632±0.041

Table 2: Fecundity, Relative Fecundity and Gonadosomatic index with standard error for *B africanus* (2016)

Parameter	Station 1	Station 2	Station 3	Station 4	Mean
Absolute Fecundity (Wet Season)	6732.20±781.32	5540.00±673.13	5882.80±777.01	7333.80±747.50	6372.20±406.85
Absolute Fecundity (Dry Season)	5833.00±919.65	6363.33±431.44	6832.67±1803.85	3404.33±979.11	5608.33±762.51
Absolute Fecundity Wet +Dry	6395.17±579.41	5849.00±452.18	6239.18±771.01	5860.50±905.13	6085.96±137.26
Absolute Fecundity Range	3698 - 8146	3111 - 7122	3491 - 9681	2151 - 8921	3112 - 8467
Relative Fecundity per Length	581.93±72.58	678.60±30.89	741.53±44.08	526.18±30.18	632.06±48.19
Gonadosomatic Index (female)	6.77±0.850	6.48±0.613	6.26±0.520	6.14±0.602	6.41±0.138
Gonadosomatic Index (Male)	0.61±0.066	0.65±0.070	0.54±0.058	0.64±0.092	0.61±0.025

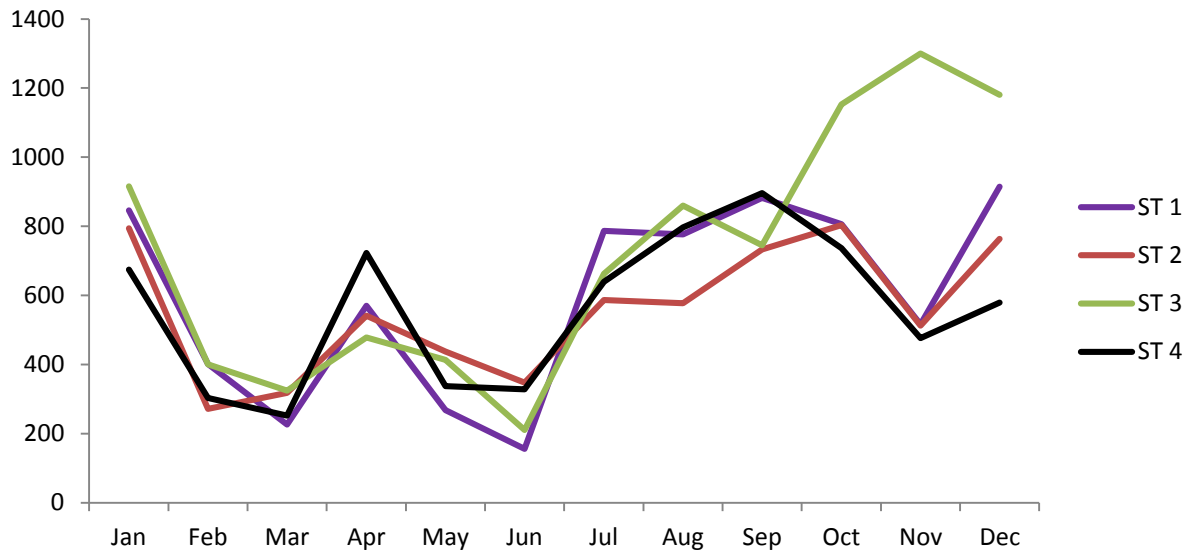


Figure 1: Relative Fecundity *B africanus* in upper new Calabar River.

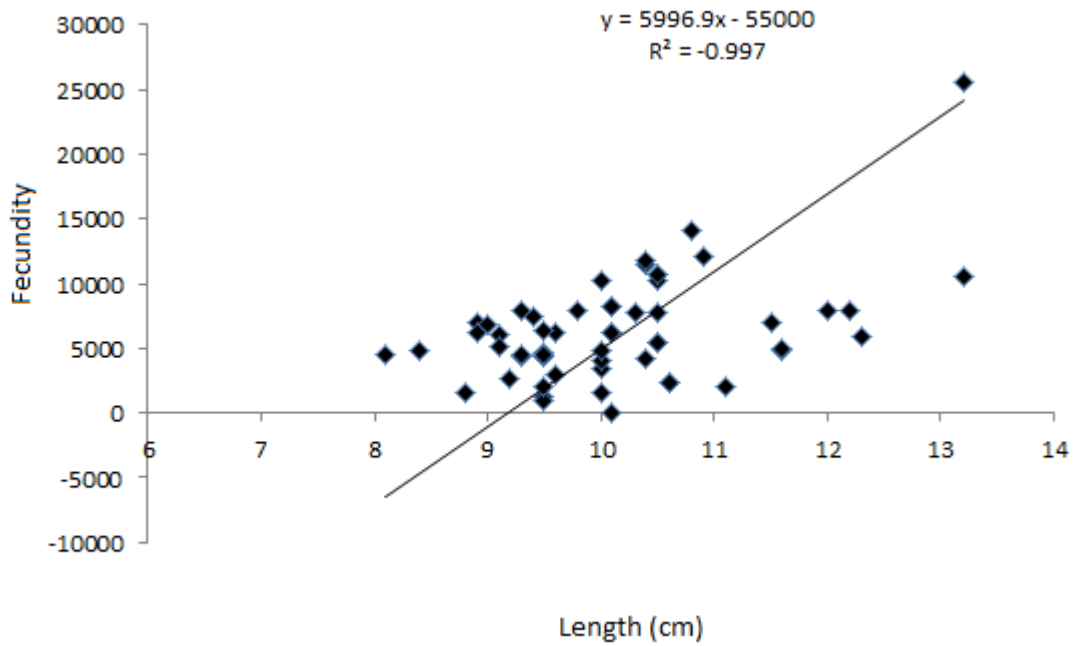


Figure 2: Relative fecundity per length for *B africanus* in upper new Calabar River

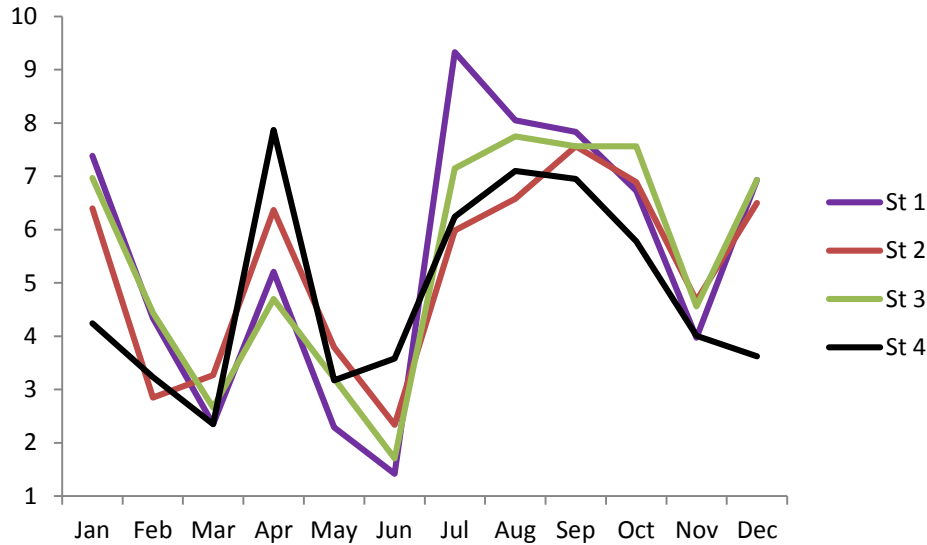


Figure 3: GSI Female *B africanus* in upper new Calabar River.

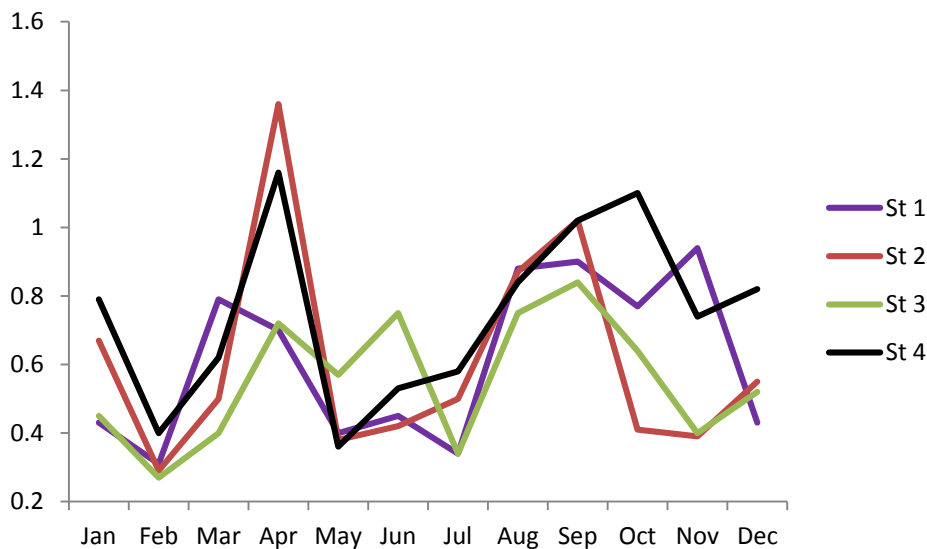


Figure 4: GSI male *B africanus* in upper new Calabar River.

Discussion

Absolute fecundity recorded classifies *B africanus* in the medium category of species with regards to population sustenance or resilience to exploitation (Froese *et al.*, 2005). Canale *et al.* (2012,) defined reproductive resilience as ‘the ability to maintain a constant reproductive output despite unexpected environmental disturbances. Lowerre-Barbieri *et al.*, (2015) described reproductive resilience as the reproductive capacity of a population to maintain the level of reproductive success needed to result in long-term population stability despite disturbances such as environmental perturbations and fishing. Furthermore, Shafi (2012) stated that changes in the environment such as temperature, salinity and oxygen in turn bring remarkable changes in absolute fecundity. The species breeds all year round with peak between August to December, this evident by the increased relative fecundity around this period and supported by the gonadosomatic index within the same period which peaks

indicating higher reproductive activities. GSI increases with maturation of fish and is highest during spawning season and after spawning it decline (Lone and Hussain, 2009; Alam and Pathak, 2010). Furthermore with an overall sex ratio of 1:0.89 shows a male dominant population.

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