# SEXUAL MATURATION, SPAWNING ACTIVITY AND FECUNDITY OF *Drepane africana* (OSÓRIO, 1892) OFF THE NIGER DELTA COAST, NIGERIA

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**ABSTRACT**
*Drepane africana is an economically important fish species in Nigerian brackish and marine waters, also prominent in shrimping trawl catches and coastal artisanal shrimping. Information on the maturation and spawning activity of D. africana is needed to establish necessary knowledge on its reproduction off the Niger Delta coast to promote sustainable exploitation. The sex ratio, gonadal stages, fecundity, and gonadosomatic index (GSI) of D. africana were studied between April 2013 and September 2015 (n = 2,124) to establish its sexual maturation and spawning activity off the Niger Delta coast. Sex ratio 1.5: 1 (female: male) was significantly different (p < 0.05). Fecundity ranged from 13,000 to 204,516 eggs with mean of 121,770±76,507 for fish of 10.2 – 39.4cm (24.6±5.5) and 17.9 – 1,350g (381±302.5) body weight and gonad weight range of 16.0 – 43.0g (mean 26.0±4.2). Gonadosomatic indices were higher in females 0.8 – 4.9% (2.3±1.2) than in males 0.2 – 1.6% (0.6 ±0.4). The GSI was high between August - February with the peak in November for this species. Five gonadal stages were observed. The species is an annual spawner; its exploitation during the spawning season should be regulated for proper management in the study area.*

**Keywords**: African sickle fish; Gonadosomatic indices; Spawning season; Niger Delta.

## INTRODUCTION

The African sickle fish, *Drepane africana* is an economically important fish species in Nigerian brackish and marine waters, also prominent both in fishing and shrimping trawl catches and coastal artisanal shrimping. *The species* is a major bycatch species in the shrimp trawl fishery in Nigeria. However, there are indications of a decline of the species in catch caught (Carpenter *et al*., 2015). This calls for careful monitoring of the species off the Niger Delta coast, a region with a high rate of fishing activities because of its high productivity.

Most of the Nigerian brackish and marine fish resources are over-exploited especially off the Niger Delta coast. Information on the maturation, spawning activity, sex ratio, and fecundity is needed to establish necessary knowledge on the reproduction of *D. africana* off the Niger Delta coast to promote sustainable exploit marine resources.

The present study was therefore carried out to determine the sex ratio, spawning activity, sexual maturation, and fecundity of *D. africana* off the Niger Delta coast, the information obtained will be useful for the management and conservation of the species in the study area.

## MATERIALS AND METHODS

### Study area

The Niger Delta, south-south Nigeria, is among the largest deltas in the world. It is the third-largest in Africa, covering about 20,000km$^2$ while the waters cover an area of about 680km$^2$ (UNCSD, 1997). Niger Delta opens into the Atlantic Ocean through a host of rivers. The Niger Delta area is the richest part of Nigeria's coastal waters in terms of fin and shellfish resources. Niger Delta is wide and serves as a fishing ground for shrimp and fish trawlers. Commercial trawlers (both shrimping and fishing trawlers) are abundant in this region (Amire, 2003).

### Sampling stations

The study area was the coastal marine waters off Akwa Ibom and River States in the Niger Delta (Fig. 1). Seven sampling stations were selected along the coast; they were about 16km apart and 15km away from the coast.

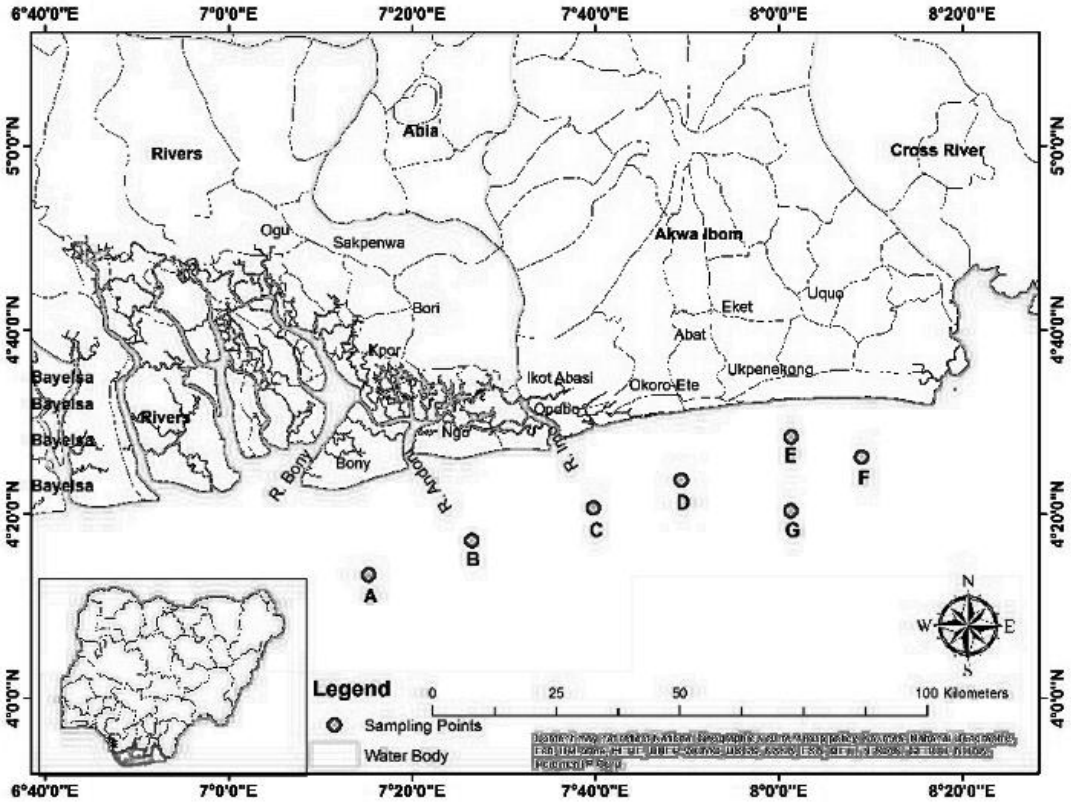


**Figure 1: Map of Rivers and Akwa Ibom States coastal areas showing the sampling stations (Map of Nigeria inserted)**

**Sample collections**

Samples were collected monthly from April 2013 – September 2015 from the commercial fishing trawlers. The samples were preserved in an ice chest and transported to the Laboratory.

**Identification of fish sample**

The fish species were identified by a fish taxonomist using a fish identification guide by Schneider (1990).

**Examination of fish**

The total length of each fish sample was measured to the nearest 0.1 cm. The total weight of each fish sample was also recorded to 0.01g. The sex of 2,124 samples of *D. africana* was determined by examination of gonads macroscopically under a binocular microscope. The gonads were removed after dissection of fish and weighed (g) separately. Gonads were preserved in Gilson's fluid.

**Determination of sex ratio**

The ratio of males to females was calculated based on the proportions of the two sexes relative to one another in the samples collected.

**Determination of stages of gonadal development**

Stages of gonad development were determined in different months to verify maturation stages and development of gametes. Gonadal stages were classified using the scale described by Nikolsky (1963) as reported by Adebiyi (2013). Spawning season was estimated based on the availability of gonad maturation during the study and the monthly gonadosomatic indices.

**Determination of fecundity**

Fecundity was determined using the gravimetric method (i.e. weighing all the eggs from ovaries). Subsamples were taken; the ratio of the total weight of eggs to the weight of each subsample taken was multiplied (King, 1991). The linearity of the fecundity-length and the fecundity-weight relationship was determined using the equation reported by King (1991):

$$F = aX^b$$

$$\text{Log } F = \text{Log } a + b \text{ Log } X$$

Where, Y = fecundity, X = length (cm) or weight (g) of fish depending on the relationship,

a and b = Constants and Correlation Coefficient (r) was determined from regression analysis.

**Determination of gonadosomatic index**

Gonadosomatic Index (GSI) was determined as the percentage of the ratio of gonad weight to fish weight. The monthly gonadosomatic indices were calculated for females and males separately to determine the spawning period of *D. africana* using the formula described by Jahan *et al.* (2014) as follows:

$$\text{GSI} = \frac{\text{Gonad weight}}{\text{Fish weight}} \text{X } 100$$

The linearity of the gonadosomatic index–weight relationship was determined using the equation reported by Jahan *et al*. (2014) as follows:

Log Y = Log a + b Log X

Where Y = gonadosomatic index,

X = weight of the fish (g)

a and b = regression constants

**Statistical Analysis**

Data were analysed with descriptive statistics using Microsoft Excel Statistical Tool pack (2007). Chi-square was used to test the deviation of sex ratio from the expected ratio. Pearson correlation coefficient and linear regression analysis were used to test the relationship between fish length and weight with fecundity, and fish length and gonadosomatic index. One way ANOVA was also used to test variation in monthly GSI.

**RESULTS**

The present research work is based on 2,124 samples of *Drepane africana* with a total length range of 10.2 – 39.4 cm (24.6±5.5). Out of the 2,124 specimens examined, 1,287 were females and 837 were males. The estimated sex ratio 1.5: 1 (female: male) was significantly different ($p < 0.05$). Fecundity ranged from 13,000 to 204,516 eggs with mean of 121,770±76,507 for fish of 21.8 – 39.4 cm in total length (mean 28.4±5.6), 284 – 1,350g (mean 740±305.2) body weight and gonad weight range from 16.0 – 43.0g (mean 26.0±4.2). The maximum number of eggs was observed in a fish measuring 39.4cm in total length with an ovary weight of 43.0g. Logarithmic transformation of fecundity-length relationship and fecundity-weight relationship were represented by the following regression equation:

Log F = 2.16 + 2.09 Log TL (r = 0.42, n = 402)

Log F = 2.86 + 0.84 Log BW (r = 0.48, n = 402)

The correlation between fecundity and total length and the correlation between fecundity and body weight was low.

Gonadosomatic indices (GSI) were higher in females 0.8 – 4.9% with a mean value of 2.3±1.2 than in males 0.2 – 1.6 % with a mean value of 0.6±0.4. Monthly variations in GSI of both males and females are illustrated in Figure 2.

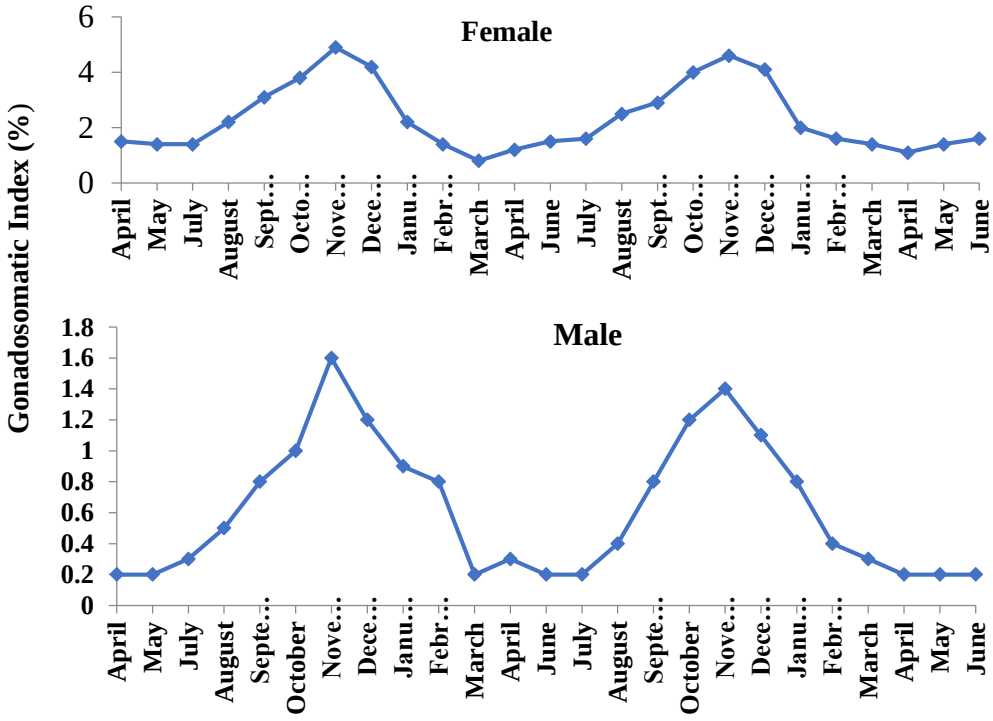


**Figure 2: Monthly variation in gonadosomatic indices of *Drepane africana* off Nigerian coast at Niger Delta**

The lowest mean values were obtained in March 2014; 0.8±0.6 for females and in March, April, and May 2014 and April, May, and June 2015; 0.2±0.8 each for male respectively, while the highest values of 4.9±0.8% and 1.4±1.7% were recorded in November 2013 and 2014 for both males and females respectively. Five gonadal stages were observed. The gonadal stages of the species are described in Table 1.

**Table 1: Macroscopic description of gonad stages of *Drepane africana* off Nigerian coast at Niger Delta**

| Gonad Stages | Macroscopic Description | |
|---|---|---|
| | Male | Female |
| II&III: Immature (Developing) | Testis was thin with white patches | Ovaries were small, eggs were visible to the naked eye |
| IV: Mature | Testis was firm and more enlarged, cream in colour | The ovary contained yellow-like oocytes. |
| V: Running | Testes were swollen, creamy-white with a reddish tint. | Ovarian wall ruptured, eggs extruded easily and sometimes noticed on the papilla |
| VI: Spent | Testis flaccid and reduced | Flaccid ovary, yellowish in colour, with little or no eggs. |

## DISCUSSION

In this present study, there was a deviation from the 1:1 expected sex ratio, the obtained sex ratio for *D. africana* in this study indicated more females than males were caught off the Niger Delta. Peña-Mendoza *et al*. (2005) and Liang *et al*. (2005) opined that deviation of sex ratio of fish species from the expected ratio of 1:1 may be attributed to the activities and energy used for the activities in the environment. Variation in the sex ratio may also suggest that some groups of males and females move separately to the spawning and feeding grounds in the study area.

Fagade *et al*. (1984) reported that the large number of females over males in a particular area of study may be a means for stock regulation and ways of adaptations for survival. The dominance of the female specimens as reported in this study may also be due to the migration of female fish to the breeding site or trawlers are trawling close to the breeding ground of the species off the Niger Delta coast. Sexually mature female *D. africana* were bigger than the sexually mature male. This may be as a result of the size of the gonad.

African sickle fish in this study is a highly fecund fish; this is replenishment essential for the preservation and continuity of the species and its abundance. Fecundity was dependent on the habits, low fecundity is only common with the species of fish that have parental habits while high fecundity is common with the species that lack parental habits(Fawole and Aramowo, 2000), and also on the size of fish, the larger the fish, the higher its egg number and this may be due to more available visceral volume for holding the eggs as reported by King (1996 and 1997), Variation in fecundity may be due to the existence of a varied mixture of age classes.

The gradual increase, change, and growth of oocytes with various maturity stages of the gonadal cycle shows the different shifting of modes of egg sizes with the progression of each gonadal stage. The high gonadosomatic indices recorded in August – February with the peak in November for both sexes suggests that it is the spawning period with peak spawning in November for *D. africana* off the Niger Delta coast, Nigeria. The result also indicates that both the males and females mature at the same time of the year. The GSI results indicate that breeding and spawning in *D. africana* takes place during the late rainy season and early dry season and that the reproductive cycle is annual. Therefore, the species has one spawning season in the study area.

## CONCLUSION

The output of this research work showed that the early maturity and high fecundity will provide the replenishment essential for the preservation and high rapid of the species. However, the species is an annual spawner from August-February, therefore its exploitation during the period should be regulated for proper management and conservation of the species in the study area.

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