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RELATIVE YIELD AND SEX RATIO OF THE WEST AFRICAN FIDDLER CRAB *UCA TANGERI* IN MBO RIVER, NIGER DELTA, NIGERIA

Ating Emmanuel A.[1] and Sikoki Francis D.[2]

[1]Department of Oceanography and Fishery Science, Maritime Academy of Nigeria, Oron.

[2]Department of Animal and Environmental Biology, University of Port Harcourt.

[*]Corresponding Author's Email: nuelating@yahoo.com

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ABSTRACT: *The study of the relative yield and sex ratio of the West African fiddler crab (Uca tangeri) in Mbo river of Akwa Ibom State, Niger Delta, Nigeria, was conducted for 12 consecutive months. Uca tangeri exhibited sexual dimorphism with a sex ratio of 1.2:1.0, which was significantly biased in favour of males. The yield isopleths demonstrate the response of the crab to both variation in E (exploitation level) and Lc/L∞ (a proxy for mesh size). Yield contours with Lc/L∞ = 0.74 usually consist of four quadrants, each with its characteristics. The yield isopleths with Lc/L∞ = 0.74 and E = -1.62 belong to quadrant B, which implies that large specimens were caught at high effort level.*

KEYWORDS: Weight, Fecundity, Crab, Mbo.

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INTRODUCTION

The West African fiddler crab (*Uca tangeri*) is a species of fiddler crab that lives in the eastern Atlantic Ocean. It is the largest species in the genus Uca, with a carapace up to 50 millimetres (2.0 in) wide, and up to 25 mm (1.0 in) long. The males have one claw much larger than the other, which they use for communication. The carapace is violet to black, or sometimes yellowish in females, while the appendages are yellowish brown. The range of *Uca tangeri* extends from southern Portugal southwards to Angola; it is the most abundant crab in the Gambia (Hartnoll, 1988). Length-weight relationship is regarded as more suitable for assessing not only fish, but also crustaceans (Sukumaran & Neelakantan, 1997; Tabash, 2001). The relationships between carapace length and weight of the crabs have many uses. They are often used to calculate the standing stock biomass, condition indices, analysis of ontogenetic changes and several other aspects of crustacean population dynamics (Atar & Seçer, 2003). In addition, they are used for the management of population. According to Lagler (1968), the relationship can be used to estimate the recovery of edible meat from crabs of various sizes. Body weight, total length and carapace length are the most frequently used dimensions in the study of crustaceans (Sukumaran & Neelakantan, 1997). The earliest published estimate of crab population densities was that of Turnbull-Kemp (1960), who calculated the density of *Potamonautes perlatus* individuals greater than 17 mm CW at Inyanga (Zimbabwe) as 0.8–1.3 m-2, with a combined wet weight of 5.5–13.6 g m-2. This is low in comparison with an estimated density of the same species in the Buffalo River (Cape Province, South Africa) at 1.7–5.2 crabs m-2 (based only on specimens >25 mm CW) and a (dry) biomass of 54–136 g m-2 (Hill & O'Keefe, 1992). In the work of Bello-Olusoji et al. (2009), there was a strong relationship (r2 = 0.81) between length and weight of males and females and the entire crab population. The LWR was allometric for all crabs. Results also showed that there was a weak correlation (r2 = 0.36) between fecundity and total body weight of the crabs. The length-weight distribution pattern did not show remarkable differences between species, sexes, and populations. Abowei and George (2009) examined the length-weight relationship and condition factor of *Callinectes amnicola* from Okpoka Creek in the Niger Delta area of Nigeria for a period of one year. Growth generally exhibited a negative allometry in all the sexes. Generally, the regression equations revealed high correlation in all the sexes. The monthly K values of the males ranged from 0.0984 and 0.1503 (mean = 0.1214). The estimated K value for both sexes combined was 0.1260. Similarly, estimated K values for the females ranged from 0.0889 – 0.1524.The overall mean K value for the females was 0.1229. The minimum K value (0.0984) for the males was observed in February. The female *C. amnicola* minimum K value (0.0889) and Kmax (0.1580) values were obtained in November.

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MATERIALS AND METHOD

The Study Area: Mbo River (Fig. 1) is a tributary of the Cross River and lies between longitude 8º:00¹ – 8º:30¹E and latitude 4º:30¹-4º:45¹N, and falls within the tropical rainforest belt with equatorial climate regime. The location of the study area is just north of the Equator and within the humid tropics, which makes the area generally humid. The crabs were collected with the assistance of the local fishers who used artisanal baited pots, traps and hands (manual) to pick and dislodge them from their nest. They were placed in clean polythene bags and taken to the laboratory for analysis.

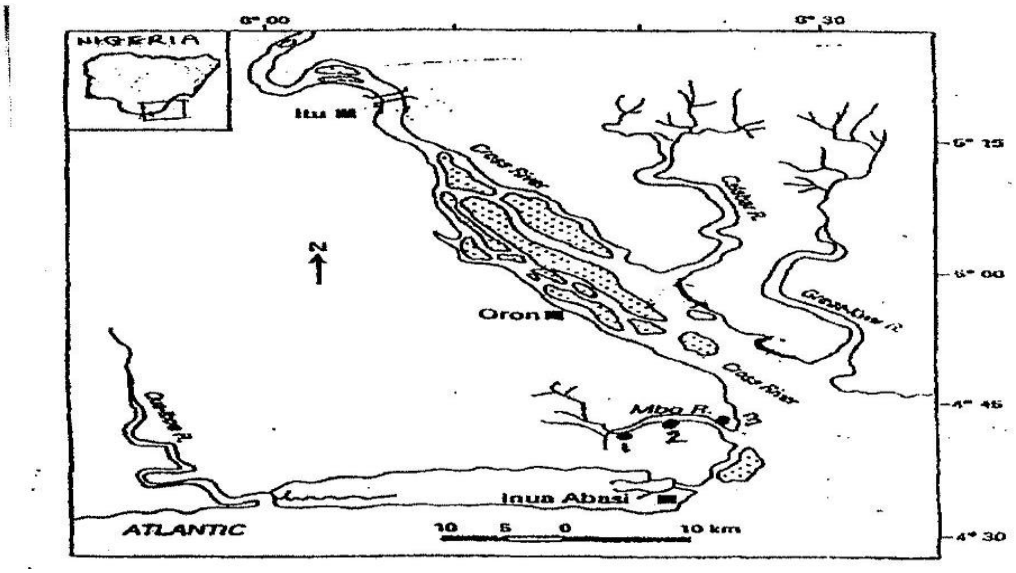

Figure 1: Map of Mbo River showing the sampling stations

(Insert: Map of Nigeria showing the location of the study area)

Determination of Sex Ratio: The sexes of the crabs were distinguished by making use of the species conspicuous external morphological features. Male crabs have narrow abdomens while females have wider abdomens where pleopods are retained (Kwei, 1978; FAO, 1990). The sex ratio was expressed in terms of the total number of males to females. The Chi-square ($\chi 2$) test of fitness was applied to determine a departure from the expected or theoretical 1male:1female ratio. $\chi 2$ was expressed as:

$$\chi 2 = \Sigma i(Oi\text{-}Ei)2/(Ei)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where,

Σi=Summation,

Oi =Observed ratio,

Ei=Expected ratio.

The calculated and tabulated $\chi 2$ values were compared at α=0.05 to determine level of significance. The yield contours were additionally plotted to assess the impact on yields of changes in E and Lc/L∞.

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Determination of the Relative Yield per Recruit and Relative Biomass per Recruit: The relative yield per recruit (Y^1/R) and relative biomass per recruit (B^1/R) were estimated by applying Beverton and Holt(1966) model, modified by Pauly and Soriano (1986). The maximum exploitation rate (E_{max}) associated with relative yield per recruit was then estimated along with $E_{0.1}$ (the rate at which the marginal increase of Y^1/R is 1/10) of its value at E=0 and the value of E corresponding to 50% of unexploited B^1/R ($E_{0.5}$). This formula was incorporated into the FISAT software.

Determination of Y/R was calculated using Beverton and Holt method (1966)

$$\frac{Y}{R} = F.L\infty.\frac{1}{Z} + \frac{3S}{Z+K} + \frac{3S^2}{Z+2K} + \frac{S^3}{Z+3K} \quad \text{.....(1)}$$

Where:

S = e -K(tc-to)

K = index of the growth curve of von Bertalanffy

to = theoretical age at length of time the crab = 0

tc = age of the first capture

tr = age at the time of entry crab fishery (recruiting)

F = fishing mortality rate

M = natural mortality rate

Z = total mortality rate = F + M

From the above model, the parameters that can be controlled are F and tc, while the other parameters are natural. Therefore the model Y /R is considered as a function of F and tc.

To assess the influence of changes in Lc to the Y/ R, re-parameters made by Beverton and Holt (1966) as follows:

$$Y^1 = \left(\frac{Y^1}{R}\right) = \frac{Y}{N_{(t0)}L\infty} = (1-c)\frac{M}{K}Y \quad \text{.....(2)}$$

Where:

N (to) = number of existing cohorts at the age to

To simplify the calculation, the equation can be written as:

$$(^Y/_R)^1 = E * U^{M/K} * \left(1 - \frac{3U}{1+m}\right) + \frac{3U^2}{1+2m} + \frac{3U^3}{1+3m} \quad \text{.....(3)}$$

Where: m = K/Z

U = 1 – Lc/L∞

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$E = F/Z$

The relative yield (Y ') is a function of exploitation rate (E), U (1 - Lc / L∞) and M/K. The first two parameters, namely E (F / Z) and c(Lc / L∞) can be controlled, while the M / K are biological parameters needed in the analysis. This model can be used to determine the optimum combination of number of fishing efforts (measured with a fishing mortality rate (F), and age or length of first capture (Lc), which will produce the maximum sustainable yield, while biomass per recruit can be obtained by the equation:

$B^1 / R = Y^1 / R * 1 / F$……(4)

RESULTS AND DISCUSSION

A total of 360 crabs were examined. Out of which 194(53.89%) were males and 166(46.11%) were females, giving a sex ratio of males 1.2:1.0 female. This was significantly different from the expected 1:1 ratio (Chi-square test). The males were predominant over the females in the months of May, June, October of 2022 and February 2023 with a sex ratio of 1.3:1, 1.3:1, 1.7:1 and 1.3:1, respectively. The monthly variation in sex ratio of *Uca tangeri* is shown in Table 1.

The males were significantly more than the females (1.2:1.0). This differed from the nearly 1:1 ratio obtained for *Callinectes amnicola* in the Lagos Lagoon by Lawal-Are (2010). The numerical preponderance of males over females may indicate sex-related differences in mortality or longevity. It may also mean that males of this size are more vulnerable to sampling than their female counterparts.Variation in sex ratio has been attributed to activity differences between males and females in Mbo river. This is however contrary to the findings of Arimoro and Idoro (2007), in the lower reaches of Warri river, in which they observed that females of *Callinectes amnicola* were predominant over males although not significantly different from the expected 1.1 ratio.

The knife-edge procedure used in executing the relative yield-per-recruit and relative biomass-per-recruit of the crab gave the following results: $E_{max} = 0.42$, $E_{0.1} = 0.36$ and $E_{0.5} = 0.28$ (Fig. 2). Using the yield isopleths (Figure 3), the response of the yield-per-recruit was stimulated to changes in length at first capture Lc and exploitation rate E over a wide range of values. The yield isopleths demonstrate the response of the crab to both variation in E (exploitation level) and Lc/L∞ (a proxy for mesh size). Yield contours with Lc/L∞ = 0.74 usually consist of four quadrants (Pauly and Soriano, 1986), each with its characteristics. The yield isopleths with Lc/L∞ = 0.74 and E = -1.62 belong to quadrant B, which implies that large specimens were caught at high effort level.

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Table 1: Monthly Variation in Sex Ratio of *Uca tangeri* in Mbo River

Month	Sample size	Male (M)	Female (F)	Ratio	P-value	Significance level
April 2022	30	16	14	1.1:1	0.6128	Not significant
May 2022	30	17	13	1.3:1	0.3098	Not significant
June 2022	30	17	13	1.3:1	0.3098	Not significant
July 2022	30	15	15	1:1	1	Not significant
August 2022	30	16	14	1.1:1	0.6128	Not significant
September 2022	30	14	16	1:1.1	1	Not significant
October 2022	30	19	11	1.7:1	0.0394	Significant
November 2022	30	16	14	1.1:1	0.6128	Not significant
December 2022	30	16	14	1.1:1	0.6128	Not significant
January 2023	30	15	15	1:1	1	Not significant
February 2023	30	17	13	1.3:1	0.3098	Not significant
March 2023	30	16	14	1.1:1	0.6128	Not significant
Summary	**360**	**194**	**166**	**1.2:1**	**0.0253**	**Significant**

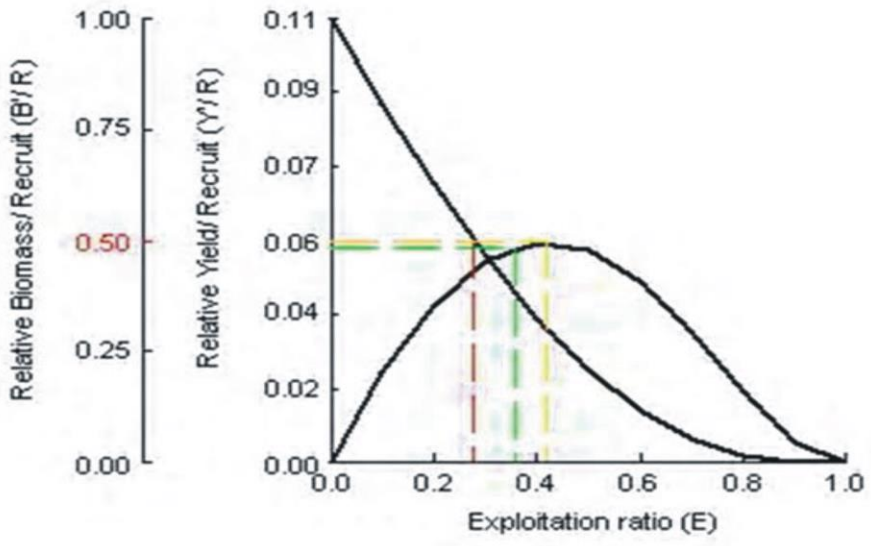

Figure 2: Relative Yield per Recruit/Relative Biomass Per Recruit of *Uca tangeri* in Mbo River

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