

GROWTH PATTERN AND PROBABILITY OF CAPTURE OF THE CRAB *UCA TANGERI* IN MBO RIVER, NIGERIA

¹ATING, E. A., ²F.D. SIKOKI, AND ³C.B. IKELE

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

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

³Department of Zoology and Environmental Biology, University of Nigeria, Nsukka, Nigeria.

Corresponding Author: chika.ikele@unn.edu.ng

ABSTRACT

Studies on the growth pattern and probability of capture of the crab *Uca tangeri* in Mbo River of Akwa Ibom State, Nigeria, was conducted for 12 consecutive months (April 2012 – March 2013). Length-frequency data was analyzed using FiSAT software. Using Shepherd's method, asymptotic length (L_{∞}) was 3.99cm, while the Von Bertalanffy Growth Function (VBGF) K was 0.10. Meanwhile, Powell-Wetheral plot estimated asymptotic length (L_{∞}) was 3.58cm and Z/K was 0.72yr⁻¹. The natural mortality (M) of *Uca tangeri* was 0.71yr⁻¹. However, using a length-converted catch curve, total mortality (Z) was estimated to be 0.27yr⁻¹. The instantaneous fishing mortality (F) was calculated to be -0.44yr⁻¹, indicating that it was not a highly fished species.

Keywords: growth, mortality, recruitment pattern, crab

INTRODUCTION

Freshwater crabs are a strangely neglected component of the world's inland aquatic ecosystems. The knowledge of the ecological significance of Crabs irrespective of their distribution in both temperate and tropical zones persists. This is nowhere more truly than in Africa, where crabs occur in almost every freshwater system, yet even fundamentals such as their higher taxonomy are yet to be determined or known. Some of the crabs occur in a large size range, with some species reaching adulthood with a carapace width (CW) of 20–30 mm, whereas others reach maturity at CW 50 mm or more. Older specimens of the larger species can have CWs over 100 mm. (Cumberlidge, 1999).

Crabs have been known to be predated upon by a variety of organisms, particularly otters and, in Central and West Africa, otter shrews, but also fish, young crocodiles, monitor lizards, mongooses, civets, drills and birds such as storks and There was a difference in the size of crabs eaten by these species, with trout feeding on the smaller individuals while otters (and other predators such as eels) catch larger individuals from the stream bed Very little is known about the susceptibility of freshwater crabs to disease, or about parasitism. In many areas, they may be infested with *Simulium* larvae and pupae, but there is no evidence that these have a detrimental influence on the crabs themselves. In Lake Barombi, Mbo, they fall victim to prey stealing activities by cichlid fishes, with two species of fish that employ 'sit-and-wait' predatory tactics being especially suited to this activity (Ajayi, 1997). Furthermore, this species constitutes about 50% of the annual catch of crabs from the Mbo River and it generates about 35% income for fishermen. From the foregoing, the growth pattern and probability of capture were evaluated to formulate a better management and conservation policies as well

as fishery development for *Uca tangeri* in Mbo River, Oron, Nigeria.

2.0 MATERIALS AND METHODS

2.1 The Study Area: Mbo River (Fig. 1) is a tributary of the Cross River. It lies between longitude 8°:00' – 8°:30'E and latitude 4°:30'–4°:45'N, and falls within the tropical rainforest belt with equatorial climate regime. The location of the study area is north of the Equator and within the humid tropics and its proximity to the sea makes the area generally humid. The crab specimens were collected with the assistance of fishermen using 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.

2.2 Determination of Growth Pattern and Probability of Capture: The annual growth pattern was obtained from the von Bertalanffy Growth Function (Pauly and Munro, 1984) as follows:

$$L_t = L_{\infty} (1 - \exp[-k(t - t_0)]) \text{ ----- (1)}$$

Where

L_t = length-at-age t

t_0 = is a constant and represents length-at-age zero

L_{∞} = asymptotic length i.e. length of very old fish allowed to grow indefinitely.

K = growth co-efficient, expressing the rate $1/T$ (yr⁻¹) at which growth approaches the asymptote and t_0 (yr) is the hypothetical age at which length is zero.

L_t was estimated following Pauly's integrated length-frequency distribution plot. The distribution plot was obtained from all the monthly length-frequency data of *Uca tangeri* from the Mbo river.

The L_t was estimated at the points where the curved growth line of the distribution plot cut the histogram along the time axis for a particular year.

Exp = constant

L_{∞} and K was obtained from the Von Bertalanffy plot (Pauly, 1983) using the formula

$$L_{t+1} = a + bL_t \text{-----(2)}$$

Where

a = axis intercept

b = slope of a regression line

L_t = length –at-age t

L_{t+1} = length –at-next age

L_t and L_{t+1} are separated by a constant time interval of one year.

Hence:

$$L_{\infty} = \frac{a}{1-b} \text{ and } K = -\log b \text{----- (3)}$$

The estimate of t_0 is made by plotting:

$$t_0 - t = \left[\frac{L_{\infty} - L_t}{L_{\infty}} \right] = a + bt \text{----- (4)}$$

$$t_0 = \left[\frac{L_{\infty} - L_t}{L_{\infty}} \right] \text{----- (5)}$$

a = intercept:

b = slope of a regression line

This method is incorporated in the FiSAT programme and the values of L_{∞} and K obtained.

L_{∞} was estimated using the method of Wetherall (1986) as modified by Pauly (1986). In the Wetherall method, the monthly length-frequency data of the crabs were pooled together. The length-frequency pattern was then broken into different class sizes. The lowest limit of each class size acts

as the cut off the length (L^1). The mean length \bar{L} of all crabs from each cut-off length (L^1) upwards was

computed. A series of pair L^1 s was obtained. The

difference between each pair L^1 and $L(\bar{L} - L^1)$

was plotted against the corresponding L^1 and a regression line fitted to that part of the curve about crab fully recruited to the gear. The regression line

has the form $\bar{L} - L^1 = a + bL^1$.

The point where L^1 cuts the regression lines give the estimate $Z/K = \frac{(1+b)}{-b}$ and $L_{\infty} = \frac{-a}{-b}$ of \bar{L} .

The Wetherall method has been incorporated in the FiSAT computer programme (Gayaniilo and Pauly,

1997) hence, used to obtain \bar{L} , t and $\frac{Z}{K}$. Where Z

is total mortality and K is the growth coefficient.

The growth coefficient (K) values were obtained through the scan of K values in the automatic routine in ELEFAN. The best K value was indicated by the highest value of R_n (goodness of fit index). The

Winter Point (WP) is an optional parameter in ELEFAN 1 which shows the time of the year in a fraction when growth is slowest.

K was evaluated as:

$$K = -\log_e b$$

And $K = -\ln(b)$

Estimate of t_0 was made by plotting $\ln[(L_{\infty} - L_t)/L_{\infty}] = a + bt$ Where $a = \ln[(L_{\infty} - L_t)/L_{\infty}]$ axis intercept and

b = slope of regression line.

The intercept of the resulting straight line on x-axis gave t_0

The asymptotic lengths were obtained from the following sources:

- (a) L_{∞} a defined the asymptotic lengths obtained from the Powell-Wetherall plot as incorporated in FiSAT.
- (b) L_{∞} b denotes asymptotic length assessed through the length-at-age routine in FiSAT.
- (c) The final L_{∞} was evaluated using the ELEFAN 1 routine with the growth curves superimposed on the Length-Frequency plot. The best pair of growth parameters (L_{∞} and K) was obtained using the automatic search routine in ELEFAN 1.

The length growth performance index \dot{O} was based on Pauly and Munro (1984) formula;

$$\dot{O} = \log_{10} K + 2\log_{10} L_{\infty} \text{-----(6)}$$

Longevity was calculated by the formula $t_{max} = 3/K$(7)

The method of Pauly (1987) was used to analyze the probability of capture P of each size class I using the ascending left arm of the length-converted catch curve. This entails dividing the numbers of crabs sampled by the expected numbers (obtained by backward extrapolation of the straight portion, i.e. the descending part of the catch curve) in each length class of the ascending part of the catch curve. Plotting the cumulative probability of capture against mid-length gives a resultant curve from which the length at first capture L_c was taken as corresponding to cumulative probability at 50%.

RESULTS

The black and white bars in Fig. 3 are positive and negative deviations from the weighted moving average of the three-length classes. The analysis of the probability of capture of each class of the crab shows that the length at first capture L_c was 2.97cm (Fig. 2). Fig. 6 shows the recruitment pattern of *Uca tangeri* in Mbo River having two peaks in the dry season.

DISCUSSION

Asymptotic length is the maximum theoretical average length that a species could attain (granted it grows throughout life) in its habitat given the ecological peculiarities of the environment, and the K value of the VBGF constant is the parameter which indicated the speed at which the species

grows towards this final size. Using Shepherd's method, asymptotic length (L_{∞}) was 3.99cm, while the Von Bertalanffy Growth Function (VBGF) K was 0.10. Meanwhile, the Powell-Wetherall plot (Fig. 4), estimated asymptotic length (L_{∞}) was 3.58cm and Z/K was 0.72yr^{-1} . The natural mortality (M) of *Uca tangeri* was 0.71 per year. However, using a length-converted catch curve (Fig. 5), total mortality (Z) was estimated to be 0.27yr^{-1} . The mortality of fish estimated at -0.44yr^{-1} indicated high activity of fishing. Natural mortality (M) being greater than total mortality (Z) suggested that small animals have higher mortality or the assumptions of catch curve are not met.

The growth coefficient (b) values have some implications and significant impacts on the well-being of fishes (including shellfish) and fishery. The negative allometric growth ($b < 3$) means the crabs were lighter than their body weights. Fish with high b ($b > 3$) values are heavy for their lengths, while those with low b are lighter (Wootton, 1999). Positive allometric growth is an indication of a crab's heaviness and by implication; the crabs are heavier than their lengths. Lawal-Are et al (2010) opined that the food, maturity stage, degree of robustness, season, shape, physical (temperature) and chemical (salinity) factors were dependent on

the value of b with variations in seasonality and habitat.

The regression coefficient (b) for *Uca tangeri* exhibited a negative allometric growth < 3 . This agreed with the negative allometric growth observed in *Callinectes amnicola* obtained from Okpoka Creek, Niger Delta, Nigeria (Abowei and George 2009). However, the findings are contrary to the positive allometric growth in *Callinectes pallidus* obtained in Ojo creek estimated at $b > 3$ (Akin-Oriola et. al. 2005).

CONCLUSION

Growth of fish is not linear, as a result, direct comparison of these coefficients do not make so much biological sense as one species or stock can grow faster than the other when young and slower when old. Thus, growth comparison must be taken as a multivariate problem in which both the asymptotic length and growth rate are simultaneously considered. As a result, the Pauly and Munro (1984) relationship are suitable for computing the index of overall growth performance $\bar{\phi}$ of different species of fish stocks. From the Powell-Wetherall plot (Fig. 4), Z/K was 0.72 which indicated a growth-dominated population.

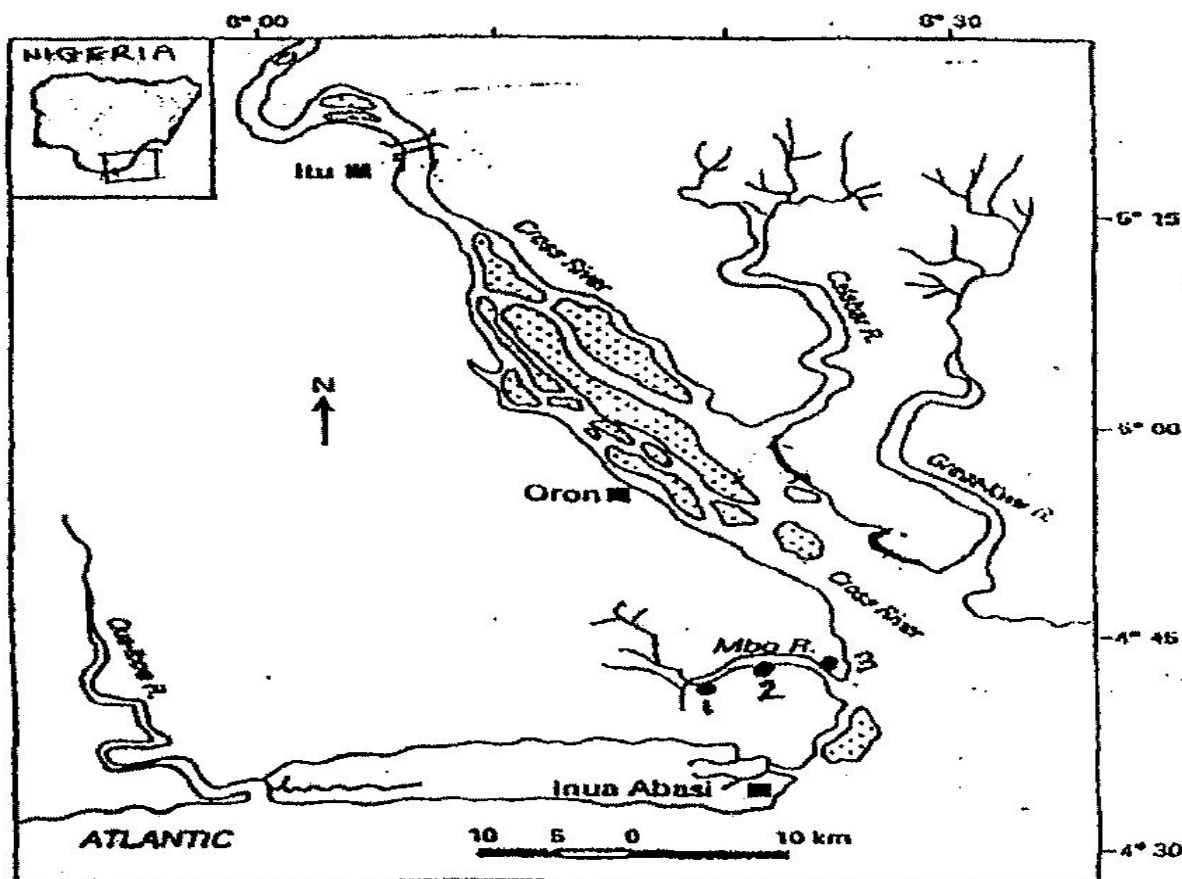


Fig. 1: Map of Mbo River showing the sampling stations

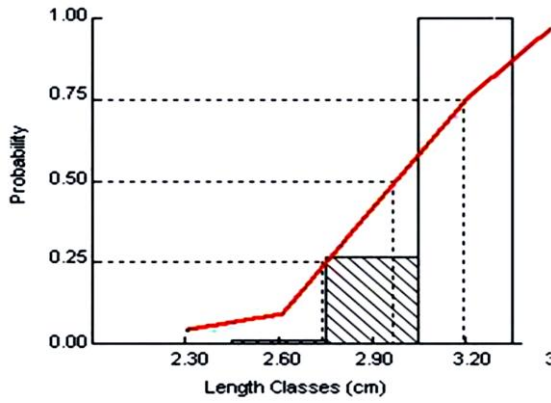


Fig. 2: Probability of Capture of *Ucatangeri* in Mbo River

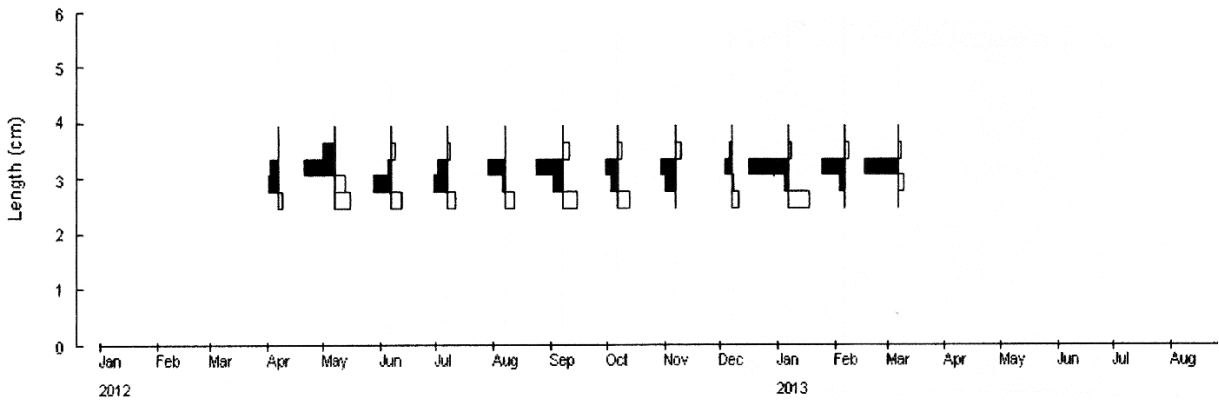


Fig. 3: Von Bertalanffy Growth Function of *Ucatangeri* with restructured frequencies.

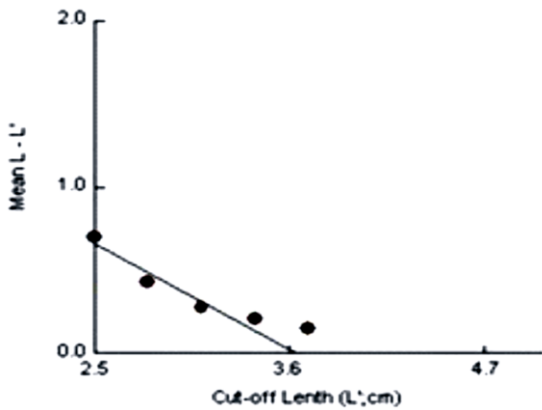


Fig. 4: Powell-Wetherall Plot for *Ucatangeri* in Mbo River

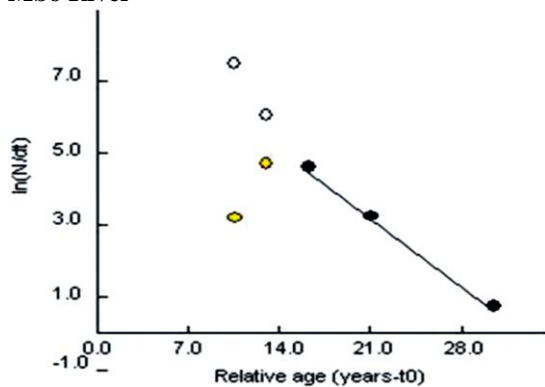


Fig. 5: Length-Converted Catch Curve of *Ucatangeri* in Mbo River

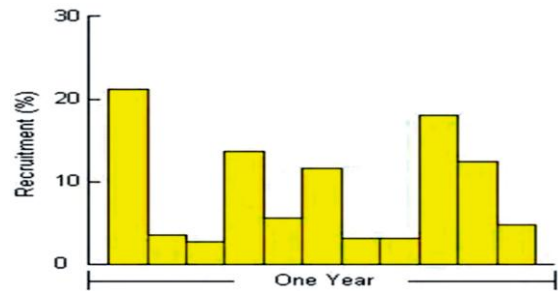


Fig. 6: Recruitment Pattern of *Ucatangeri* in Mbo River

REFERENCES

Abowei, J.F.K., and George, A.D.I. (2009). A Study of the Length -Weight Relationship and condition Factor of *Callinectes amicola* (De Rochebrune, 1883) from Okpoka Creek, Niger Delta, Nigeria. *International Journal of Animal and Veterinary Advances* **1**(2): 66-72, 2009.

Ajayi, T.O. (1997). The status of the marine fisheries resources of the Gulf of Guinea. In: C.A. Ibe and S.G. Zabi (Eds.) State of the Coastal and Marine Environment of the Gulf of Guinea: 131-157

Cumberlidge, N. (1999). A taxonomic revision of fresh-water crabs (*Brachyura*, Potamoidea, Gecarcinucidae) from the upper Guinea forest of West Africa. *Crustaceana*, **69**, 681-695.

- Gayanilo Jr., F. C. and Pauly, D. (1997). FAO-ICLARM Stock Assessment Tools (FiSAT). FAO Computerised Information Series (fisheries) No. 8, pp. 262.
- Lawal-Are, A. O. (2010). Reproductive Biology of the Blue Crab, *Callinectes amnicola* (De Rocheburne) in the Lagos Lagoon, Nigeria. *Turkish Journal of Fisheries and Aquatic Sciences* **10**: 1-7
- Pauly, D., (1983). Some simple methods for the assessment of tropical stocks. *FAO Fish. Technical Paper* **234**, pp: 52.
- Pauly, D. (1986). On improving the operation and use of the ELEFAN programs. Part III: Correcting length -frequency data for effects of gear selection and /or incomplete re-enactment. *ICLARM Fishbyte*, **4(2)**:11-13.
- Pauly, D. (1987). A review of the ELEFAN system for analysis of Length-frequency data in fish and aquatic invertebrates. In Pauly and Morgan (eds). Length-based methods in fisheries research. *ICLARM conference proceedings* 13, pp. 7-34.
- Pauly, D. and Munro J.L. (1984). Once more on the comparison of growth in fish and invertebrate. *ICLARM, Fishbyte*, **2(1)**: 21
- Powell, D. G. (1979). Estimation of mortality and growth parameters from the length-frequency in the catch. *Rapp. P.-v. Reun CIEM* **175**:167-169.
- Udoh, J. P. and Nlewadim, A.A. (2011). Population characteristics of the swimming crab *Callinectes amnicola* De Rocheburne, 1883 (Crustacea, *Brachyura*, Portunidae) in the Qua Iboe River estuary, Nigeria. *AACL Bioflux*, 2011, Volume 4, Issue 3.
- Wetherall, J.A. (1986). A new method for estimating growth and mortality parameters from length-frequency data. *Fishbite*, **4(1)**: 12-14
- Wootton, R.J. (1999). Ecology of Teleost fishes. *Fish and Fisheries Series*, Kluwer Academic Press, London