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Preliminary Notes on the Length-Weight Relationships and Condition Factor for *Cynoglossus browni* and *Cynoglossus senegalensis* (Pisces: Cynoglossidae) off the East Coast of the Niger Delta, Nigeria

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Abstract: Length-Weight relationships were estimated for *Cynoglossus browni* and *Cynoglossus senegalensis* caught by artisanal and local trawl fishers, in the gulf of Guinea off the eastern coast of the Niger Delta, Nigeria. The slopes (b) of length-weight relationships were 1.88 for *Cynoglossus browni* and 2.00 for *Cynoglossus senegalensis* indicating negative allometry in the two fish species sampled. There was a significant positive correlation ($P < 0.05$) between length and weight with r^2 values of 0.79 and 0.76 for *C. browni* and *C. senegalensis* respectively. The condition indices (K) were 1.52 and 1.85 for *C. browni* and *C. senegalensis* respectively. There was no distinct pattern shown by both growth parameters during this study period.

Key words: Demersal fish · Bight of Bonny · Allometric · Parameters · Fishing folks

INTRODUCTION

Length and weight relationships are of great importance in fisheries research because they provide information on population parameters [1- 2].

First, a change in length and weight tells the age and year classes of fishes, which are important in fisheries.

The data can also be used to estimate the mortality rate, as well as assessing the sustaining power of a fisheries stock [2]. In addition data on length and weight can provide important clues to climate and environmental changes and the change in human subsistence practices. Length weight relationships are also useful for comparing life history and morphological aspects of populations inhabiting different regions [3]. Despite the utility of length-weight relationships in fisheries science and the importance of the Gulf of Guinea for Nigerian fisheries, information about the length-weight relationships of *Cynoglossus browni* and *Cynoglossus senegalensis* in this gulf region (Bight of Bonny) is scarce and incomplete [4].

Knowledge on the condition and well-being of some demersal fishes such as *Cynoglossus browni* and *Cynoglossus senegalensis* in tropical marine waters is scarcely documented [5]. The present study is aimed at determining the growth performance of *C. browni* and *C. senegalensis* through their length-weight relationships and estimating their condition indices in the coastal waters of the Bight of Bonny, east of the Niger Delta, where there is a high level of petroleum exploration and drilling activities.

MATERIALS AND METHODS

Study Area: The study area covers the south eastern coastline and continental shelf of the Bight of Bonny in the Gulf of Guinea, adjacent to the Cross River, Akwa Ibom and Rivers States of Nigeria. It stretches from the mouth of the Cross river estuary in the eastern flank to the mouth of the Bonny river estuary in the western flank (Lat.4°25'4°35'N and Long.7°00'-8°20'E, Fig. 1).

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Fig. 1: Gulf of Guinea showing study area (indicated with a black arrow)

Three easily distinguishable, vegetation types are common here namely, the saline water swamp forest, the fresh water swamp forest and the rainforest. The vegetation consists of a thick mangrove forest dominated by red mangrove *Rhizophora racemosa* and *Rhizophora mangel*. In some areas, the White mangrove *Avicenna africana* are interspersed with *Nipa* palms (*Nypa frutican*). The lowest inter-tidal zone is usually bare of vegetation, with clay, peat and sand deposits [6]. Mean annual rainfall is 3,500 mm, relative humidity ranges from 60 to 90 percent with a mean evaporation rate of 4 mm. day^{-1} and an average temperature range of between 23 and 31°C.

Fish Sample Collection and Analysis: The length-weight relationships (LWR) of *C. browni* and *C. senegalensis* were determined from individual fish samples collected from the local fishermen or fishing folks at the fish market (Ukpenekang village) located off the coast of Akwa Ibom State. The fish were caught using fishing gear ranging from seine nets, cast nets and fishing trawlers operated by artisanal and local commercial fishermen or fishing folks. Samples were collected fortnightly between the months of April and June, 2010. The fishes were sampled randomly from a mixture of fishermen who had landed their catches at the time of sampling and transported in iced coolers (Thermostatic plastic chests) to the Institute's laboratory for further analysis.

Total lengths of individual fish were measured in centimeters from the tip of the snout to the tip of the caudal fin using a measuring board. Body weights were measured to the nearest gram using a top loading meter balance (Avery), after thawing and blot-drying excess water and ice from the fish body. The relationships between lengths and weights of the fish species were examined by simple linear regression analysis.

The length-weight relationship was expressed by the equation:

$$W = aL^b$$

Where

W = The weight of the fish in grams

L = The Total length of the fish in centimeters

a = Exponent describing the rate of change of weight with length (= the intercept of the regression line on the Y axis)

b = The slope of the regression line (also referred to as the Allometric coefficient).

The linear transformation of this equation was made using natural logarithm at the observed lengths and weights [7]. The expression of the relationship is represented by the following formula:

$$\text{Log } W = \text{Log } a + b \log L$$

Determination of Condition Index (K): This is the degree of well-being or relative robustness of the fish represented by the "coefficient of condition", 'K' in the expression shown below:

$K = 100.\ W.\ L^{-3}$ or $K = 100.\ W.\ L^{b}$ [8].

Where

- K = Condition index when the exponent 'b' (slope) is equal to 3.0
- W = Wet weight of the fish in grams
- L = The total length of the fish in centimeters
- b = The value obtained from the length-weight equation formula

The exponent '3' on L is the value of the slope 'b' when the fish is experiencing isometric growth.

RESULTS

Two hundred and seventy-three individuals in two species of the family Cynoglossidae (*C. browni* and *C. senegalensis*) were sampled during a three month sampling period (April-June). The samples consisted of 195 specimens of *C. browni* and 78 specimens of *C. senegalensis*. The ranges in total lengths as well as their wet weights and mean condition indices are shown in Table 1. A positive relationship between the total length and wet weight for *C. browni* was observed (Figure 2). The expression of weight as a function of length for *C. browni* (Log W = log 1.39 + 1.88 log L) was statistically significant ($P < 0.05$). For *C. senegalensis*, there was also a positive relationship between the total length and the weight (Fig. 3). The expression of weight as a function of length for this fish (Log W = 1.25 + 2.00 Log L) was statistically significant ($P< 0.05$).

Table 1: Length and weight ranges and mean condition indices for two Cynoglossid species in the Gulf of Guinea coastal waters, April - June 2010

Fish species	N	Total length range (cm)	Weight range (g)	K (mean ± SD)
C. browni	195	4.0 - 47	1 - 45	1.52± 0.06
C. senegalensis	78	11.5 - 39	3 - 40	1.85± 0.02

N= sample size, K= Condition index

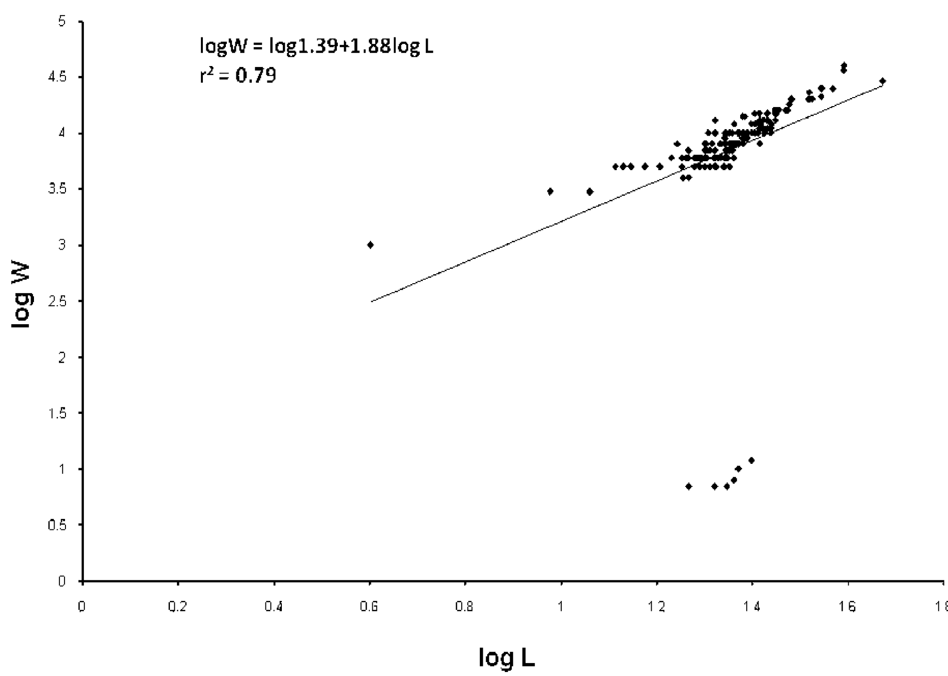

Fig. 2: Length-weight relationship of *Cynoglossus browni*

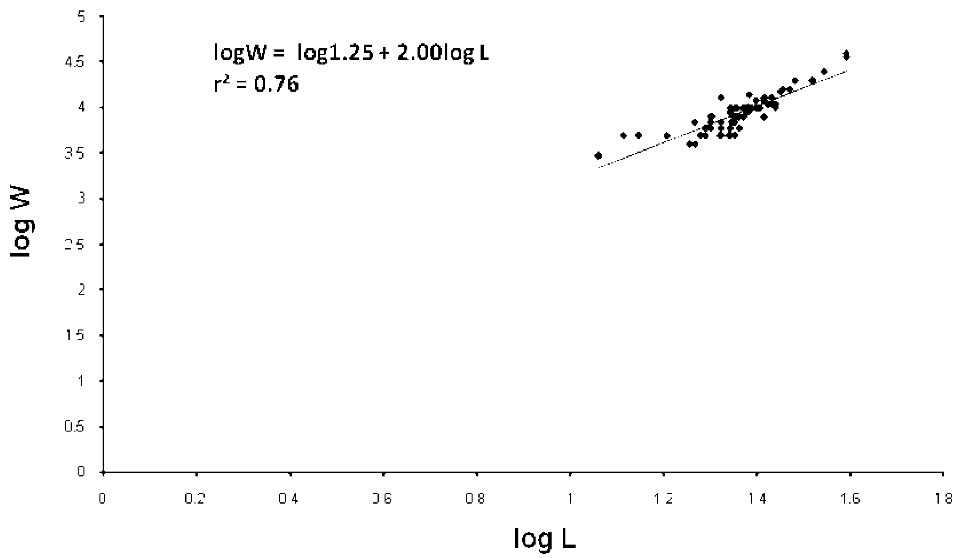

Fig. 3: Length-weight relationship of *Cynoglossus senegalensis*

The two species had K values that were below 2.0 and b values of less than 3.0 thereby exhibiting negative allometric growth.

DISCUSSION

Very scanty information exists on the biology of *Cynoglossus browni* and *Cynoglossus senegalensis* [4]. The Allometric coefficients ‘b’ (1.88 and 2.00, respectively) for *C. browni* and *C. senegalensis* estimated in this study were in the negative range and a little below the expected range of 2.4 - 3.5 for positive allometry and isometric growth [9, 1]. And according to some authors, the expected values may range from 2 to 4 [10-11].

The findings of length-weight relationships in some marine flatfish species in other environments have also shown negative allometry in growth. This was seen in the flounder *Citharus linguatula* [12-15]. However, in some other studies, positive allometric growth was reported for this species [16-17]. This indicates that a fish species could express positive or negative allometric growth under different circumstances depending, probably, on seasonal or other environmental conditions. Isometric growth, where the coefficient ‘b’ is equal to 3.0 has been recorded for some other demersal marine fishes [18].

The length-weight relationship parameters (a, b) of a fish are affected by a series of factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in the environmental conditions [10,19]. The low values of ‘b’ obtained for *C. browni* and *C. senegalensis* could be ascribed to one or a combination of most of the factors mentioned above. Length ranges of the species sampled as well as the duration of sampling can, as well, be included as some of the reasons for the observed values of these parameters in the present study [13].

Condition index (K) is one of the standard practices in fisheries ecology which is used as an indicator of the variability attributable to the growth coefficient (b). Here, the individual fish species condition is determined based on the analysis of length-weight data reflecting that the heavier fish at a given length is in better condition [20], hence indicating a favorable environmental condition. The mean condition index (K) for *C. browni* was 1.52 and 1.87 for *C. senegalensis.* Generally, there was no specific pattern observed in the K values for the two species throughout the sampling period. Variations in the K values of fish species could be a reflection of the state of sexual maturity, degree of nourishment, age of the fish and, in some species, sex of the fish [21-22].

There are also suggestions that fish condition can be influenced by certain extrinsic factors such as changes in temperature and photoperiods [23]. For *C. browni* and *C. senegalensis* in the coastal waters of the Bight of Bonny, the temperature and photo period elements might be insignificant factors because of the tropical nature of this environment. In general, the fish is not likely to have experienced any great difference in condition with respect to temperature and photoperiod throughout the period of this study when compared with a similar situation in the high latitude marine waters that experience long spells of cold winters and warm summers. The oxygen content, total suspended solids and macro-nutrients of the water would be among the physicochemical variables that may be relatively high in the coastal waters [24]. However, these physicochemical variables might cause only a minor effect or no effects on the species because these species are already adapted to demersal life.

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