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Food and Growth of *Sardinella Maderensis* from New Calabar River, Rivers State, Nigeria

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Abstract
Samples of Sardinella maderensis were collected from New Calabar River, Port Harcourt Rivers State Nigeria, for the study of its food and growth. Food studies were done using frequency of occurrence and points method. While growth data was subjected to regression analysis, condition factor was estimated using fulton's equation ($k = W100/L^3$) Analysis of food importance by Index of food significance (IFS) had Melosira varians (13.30%) and Melosira distans as the most preferred items for the small (9.0 – 12.0cm) and big (13 – 13.5cm) groups respectively. Other food items found in the fish gut were Melosira ambigua, Melosira italic, Melosira granulate. Cyclotella comate, Cyclotella glomerata, Cyclotella atomus, Cyclotella ocellata, Diatoma elegatum, Fragineria capusina, Pinularia sp, Synedria tabutata, and Tabellaria flocullosa. Analysis of length–weight data indicated that the fish had a negative allometric growth (2.1717±0.0624), with condition factor of 0.9160±0.047. This study revealed that Sardinella maderensis feed predominantly on algae and would therefore require a moderate protein compounded feed for rearing in captivity.

Key words: *Clupeids, foods, habits, feeding, condition.*

Introduction

Food consumed by fish fluctuates from season to season because temperature variations throughout the year affect not only the available food organisms but also the quantity of food fish consumes. Fish growth, condition factor, fecundity, and mitigation patterns have all been proven to be significantly influenced by fish food (Adeyemi et al., 2009). Fish stomach contents are frequently analyzed as a means of learning more about fish diets and, consequently, of characterizing the food webs and chains that various species share. These investigations also show how different species interact). A crucial component of fisheries management is the precise evaluation of fish diets. Growth in fish requires intricate physiological processes, including both anabolism and catabolism, which are connected to an individual's gains from eating (food and energy consumption) and losses (excretions, solid waste, and production of heat in the process of metabolism). The growth process suggests that these organisms begin as eggs and progress through the larval, young, and adult phases, contingent upon their chosen reproductive strategy(Kenneth et al., 2004).

The Length-Weight connection uses a mathematical equation to illustrate the relationship between the two parameters and provides the average weight of fish at a given length. Both isometric and allometric modes of growth are possible for fish. When a fish grows isometrically, it means that its weight and length are growing at the same rate. Growth in allometry can be positive or negative. Positive allometric means that when a fish grows longer, it gets bigger or has a deeper body. A negative allometric means that as the fish grows longer, it gets thinner (Sakar et al., 2013).

Condition factor (CF) is an estimation of overall fish health and is predicated on the idea that larger fish tend to be in better condition than smaller ones. When the condition factor is one or above, the fish are in good condition; when it is less than one, the fish are in poor condition. Season, sex, the kind of food organism the fish eats, the age of the fish, the amount of fat it reserves, and environmental factors can all have an impact on the condition factor (Ogamba et al., 2014).

This study aims to extract relevant information that would enhance the rearing of *Sardinella maderensis* in captivity with better production and reduced cost.

Materials and Methods

The study was carried out in the New Calabar River with coordinates of 4.4167o N, and 7.0333oE. The brackish stream is home to a wide variety of aquatic life, such as fish, crabs, shrimp, and different aquatic plants like nypa palms (*Nypafructican*). For a duration of three months, samples of *Sardinella maderensis* were randomly collected form fishermen in the vicinity of the New Calabar River and preserved in plastic containers with 10% formaldehyde solution and promptly sent to the laboratory for examination.

Samples were analyzed by the following procedures;

Points method:
Points were awarded to various food items based on their quantity (size) in relation to the other, this was expressed as follows:

$$\text{Percentage by number (\%N)} = \frac{\text{Total Points of the particular food item}}{\text{Total Points of all food items}} \times 100$$ (Ezenwaji and Offiah, 2003)

Frequency of Occurrence Method
Frequency of occurrence of each diet was expressed as:

$$\%\ \text{Occurence of the food item} = \frac{\text{Total Number of stomachs with the particular food item}}{\text{Total number of stomachs with food}} \times 100$$

(Ezenwaji and Offiah, 2003; Chukwu and Princewill, 2019)

Index of Food Significance (IFS)

IFS= $\frac{\%F\times\%P}{\sum\%F\times\%P} \times 100$ (Ezenwaji and Offiah, 2003; Chukwu and Oyanna 2022) Where,
IFS= Index of Food Significance
%F= Percentage frequency of occurrence of food item.
%P= Percentage Number of food item.
The growth data was analyzed using the equation;

$W=aL^b$ regression ----------(1)
Where,
W= Weight of the Fish (grams)
a= Intercept of the regression
L= Observed Total length (cm)
b= (Growth coefficient)
The condition factor (K) was calculated using:

$K = \frac{100W}{L^3}$ (Chukwu and Pepple 2021).

Where:
W= Weight (grams)
L= Observed Total length (cm)
K= Condition Factor

RESULTS

The results on the foods of *Sardinella maderensis*from New Calabar River showed that it fed mainly on algae such as; (*Melosiradistans, Melosiravarians, Melosiraambigua, Melosira italic, Melosiragranulata, cyclotellacomata, Cyclotella glomerata, Cyclotella atomus, Cyclotella ocellata, Diatomaelegatum, Fragineriacapusina, Pinulariasp, Synedria tabutata, Tabellariaflocullosa)* across all size ranges (Tables 1 and 2)
Samples of *Sardinella maderensis*(9.0cm-12cm) in table 1 showed that *Melosiravarians*recorded the highest percentage IFS value of 13.80, while for the larger group 13.0cm-13.5cm) *Melosiradistans* (14.61) was most preferred by the fish.

Table 1; Stomach content of *Sadinella maderensis* (9.0cm-12cm)

Food Item	%RF	%Point	IFS	%IFS
Melosira distans	7.81	11.12	86.85	11.40
Melosira varians	7.81	13.46	105.12	13.80
Melosira ambigua	7.03	8.06	56.66	7.44
Melosira italic	7.81	11.60	90.59	11.89
Melosira granulata	7.81	11.85	92.55	12.15
Cyclotella comata	7.81	8.78	68.57	8.99
Cyclotella glomerata	7.81	8.30	64.82	8.51

Cyclotella atomus	5.47	1.69	9.24	1.21
Cyclotella ocellata	4.69	1.13	5.30	0.70
Diatoma elegatum	5.47	1.29	7.06	0.93
Fragineria capusina	7.03	3.06	21.51	2.82
Pinularia sp	7.81	5.40	42.17	5.53
Synedria tabutata	7.81	11.68	91.22	11.97
Tabellaria flocullosa	7.81	2.58	20.15	2.64

Table 2; Stomach content of *Sadinella maderensis* (13.0cm-13.5cm)

Food Item	%RF	%Point	IFS	%IFS
Melosira distans	7.63	14.84	113.22	14.61
Melosira varians	7.63	9.13	69.66	8.99
Melosira ambigua	6.87	7.32	50.28	6.49
Melosira italic	7.63	10.73	81.87	10.57
Melosira granulata	6.87	6.62	45.48	5.87
Cyclotella comata	7.63	11.23	85.68	11.06
Cyclotella glomerata	6.87	9.23	63.41	8.19
Cyclotella atomus	6.87	5.62	38.61	4.99
Cyclotella ocellata	6.11	4.61	28.17	3.64
Diatoma elegatum	6.87	4.11	28.24	3.65
Fragineria capusina	6.87	6.02	41.36	5.34
Pinularia sp	7.63	7.72	58.90	7.61
Synedria tabutata	7.63	6.32	48.22	6.23
Tabellaria flocullosa	6.87	3.11	21.37	2.76

The fish registered a negative allometric growth of 2.1717±0.0624, an intercept value of -1.1696±0.0653
and the r square value was 0.6468.
The condition factor for the species was 0.9160±0.047, with a peak value in June and lowest point in May (Figure 1)

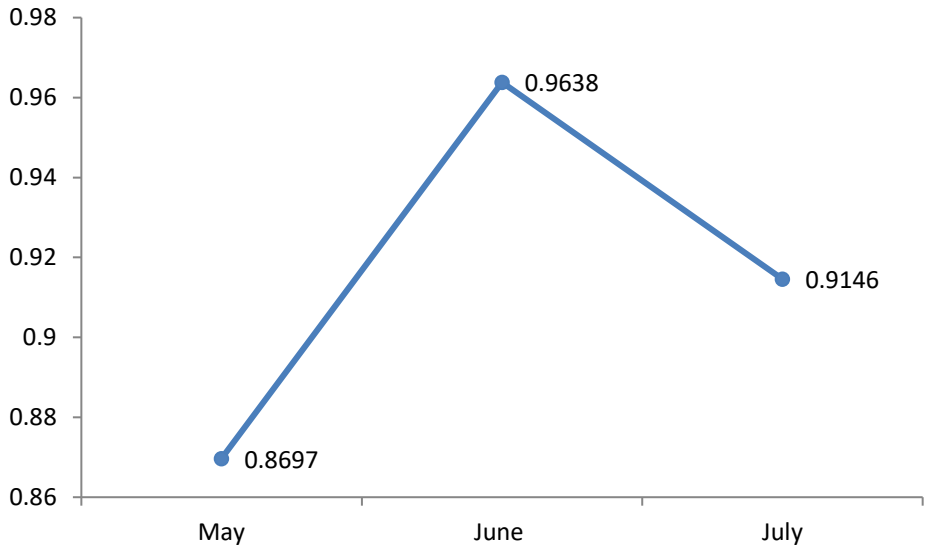

Figure 1: Monthly condition factor of *S maderensis* from New Calabar River.

DISSCUSSION

It was evident that *Sardinella maderensis* had a negative allometric growth, as indicated by its growth coefficient of 2.1717±0.0624. This suggests a fish that becomes increasingly lean as it grows (King 1996; Francis and Elenwo 2012). Both internal and external influences may have an impact on this kind of growth. When intrinsic factors play a key role, cultivating these species in captivity might not yield high feed conversion ratios. If an external elements are the primary cause of the negativity in allometry , effective culture methods and water quality control measures could aid in achieving the intended outcomes with regards to growth and robustness.

The fish was not at its optimal level of wellbeing, as indicated by the observed condition factor (0.9160±0.047) being below one. This could be linked to poor environmental conditions and inadequate food supply.
The contents of the fish's stomach revealed that it is a fish that consumed fourteen different species and seven families of phytoplankton (Gushchin and Corten 2015). There are two main elements that might affect the food an organism takes in: availability and choice. Additionally, several species exhibit changes in their feeding habits and dietary preferences as they mature, however *Sardinella maderensis* did not exhibit any of these changes, with the exception of the most popular food item for each class, *Melosiravarians* for the small class and *Melosiradistans* for the bigger class, which did exhibit some variation.

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