LENGTH-WEIGHT RELATIONSHIP, CONDITION FACTOR AND INTESTINAL-BODY LENGTH RELATIONSHIP OF *Synodontis courteti* And *Chrysicthys walkeri* IN OVIA RIVER (Iguoriakhi), EDO STATE.

BY

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DEPARTMENT OF ANIMAL AND ENVIRONMENTAL BIOLOGY

FACULTY OF LIFE SCIENCES

UNIVERSITY OF BENIN

FEBURARY, 2025

A DISSERTATION PRESENTED TO THE DEPARTMENT OF ANIMAL AND ENVIRONMENTAL BIOLOGY IN PARTIAL FULFILLMENT FOR THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE B. Sc. (Hons) IN ANIMAL AND ENVIRONMENTAL BIOLOGY, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA

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CERTIFICATION

This is to certify that this project was carried out by **Hazel Ikwenmhosa UWAGBAE,** with matriculation number **LSC2002981** in the Department of Animal and Environmental Biology, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria.

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(HEAD OF DEPARTMENT)

EXTERNAL EXAMINER **DATE**

DEDICATION

This work is dedicated to God Almighty, the provider of wisdom and the giver of life, through whom everything is made possible and also to my family for their love, help and advice to ensure a continued success in my academic journey.

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I give God Almighty all the honour for his love, grace and mercy shown to me during my time in the University.

I sincerely thank my mother Mrs. O.H. Uwagbae for her support throughout my stay in school. May God continually bless you Mommy. I want to sincerely appreciate my siblings and my cousins (Mishel, Shemaih, Jedidiah, Angel and Kelechi) for their love and support throughout my stay in school

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ABSTRACT

The morphometric analysis of *Synodontis courteti* and *Chrysicthys walkeri* was carried out in Ovia River, Edo State, Nigeria. A total of fifty-four specimens of the two species were sampled over a period of six months, June to November, 2024. Specimens were transported to the laboratory and morphometric indices such as Total Length (TL), Standard Length (SL), Head Length (HL), Body Weight (BW), Intestinal Length (IL) and Body Depth (BD)were assessed using standard methods. The standard length and body weight of *S. courteti* ranged from 11.3 to 17.6cm and 40 to 225g, while the standard length and body weight of *C.walkeri* ranged from 10 to 19.4cm and 40 to 100g.The growth coefficient (b) was between 1.539 and 0.980 for *S. courteti* and *C. walkeri*. Results showed that both species exhibited a negative allometric growth. The intestinal length of *S. courteti* ranged from 9 to 21.0 while the intestinal length of *C.walkeri* ranged from 7.2 to 13.2. Following standard gut-length relationship for feeding classification, (<100 carnivore and >100 omnivore), both species were classified as carnivores having ratios of 87.77% and 72.67% respectively.

CHAPTER 1

1.0. INTRODUCTION

1.1 Background of Study

Fish are ectothermic vertebrates that have adapted to the aquatic environments using gills for breathing and fins for movement (Madakai *et al*., 2022). With over 32,000 species, they represent more than half of all vertebrates and can be found in nearly every body of water on Earth (Braga *et al.,* 2012). Many fish species are highly reproductive, releasing a vast number of eggs during spawning. The precise order is impossible to establish at the moment, and will be for several decades, because systematic ichthyology is an active field with new species being described every year and reviews of existing literature and specimens removing some species found in the past, as they are found not to be distinct (Wheeler and Jones,1989).

An argument could be made that fishes have provided humankind with the greatest abundance and variety of benefits than any other animal group. Fishes have helped improve human health since various pharmaceuticals have been derived from fish (Parson, 2022). Fish have historically provided humans with a diverse range of resources. They play a significant role in nutrition, medicine, and economic sustenance, particularly in areas where communities rely on marine resources for survival (Wheeler & Jones, 1989; Basurto *et al.,* 2017). Fish are an essential food source, offering high-quality protein that is easily digestible and contains all essential amino acids (Hei, 2018). They contribute approximately 17% of the global animal protein supply and are particularly crucial in Nigeria, where the population exceeds 178.5 million (Oladipo *et al.,* 2018).

Fish vary greatly in size, ranging from the tiny Indonesian minnow (*Paedocypris progenetica*), which is just 8mm long, to the massive whale shark (*Rhincodon typus*), which reaches 12m in length (Braga *et al.,* 2012). Their dietary habits are equally diverse with species occupying nearly every trophic level, from primary consumers (herbivores) to top predators and decomposers (Gerking, 1994; Wootton, 1998).

The study of fish morphology, particularly morphometric analysis, has been central to ichthyological research for centuries, with roots tracing back to Galileo Galilei (Froese, 2006).

Morphometric analysis is widely used for species identification, taxonomic reclassification, phylogenetic studies, and assessing fish health (Kocovsky *et al.,* 2009; Morrison *et al.,* 2006). A common application is to support description of new species based on morphological dissimilarity to closely related species. (Kocovsky *et al.,*2009).

A key aspect of fish morphometry is the relationship between body length and weight. The mathematical basis for this relationship was first introduced by Fulton (1906), whose condition factor remains a fundamental tool in fisheries science for evaluating fish health and well-being (Froese, 2006; Nash *et al.,* 2006) Length-weight models are critical for assessing fish growth and condition, which in turn influence feeding requirements and stock assessments (*Jones et al.,* 1999). By analyzing these measurements along with age data, researchers can estimate stock composition, maturity, lifespan, mortality rates, and overall productivity (Diaz *et al.,* 2000).

Condition factor indicates the fish welfare in the habitat (Gomiero and Braga, 2005). The condition factor of a fish serves as key indicator of its health and suitability to its environment (Gomiero and Braga, 2005). Monitoring these changes allows aquaculturists to detect early signs of stress, disease, or overpopulation allowing for timely intervention before mortality rates rise (Jones *et al.,* 1999).

The length of a fish's digestive tract is also important in understanding its feeding behavior. In vertebrates, including fish, birds, and mammals, gut length can indicate dietary preferences (Karachle & Stergiou, 2010). Carnivorous fish tend to have shorter intestines, herbivorous fish have longer and coiled intestines, while omnivores fall somewhere in between (Edema & Aiguobasinmwin, 2008). Gut length may also change due to growth and diet shifts. Studies on *Hoplias malabaricus* show that intestinal length decreases with starvation but increases once feeding resumes, suggesting compensatory growth (Susilo *et al.,* 2021).

1.2 Statement of the Problem

Research on fish gut structure is scarce, with most studies only providing basic gut length (GL) or relative GL values (GL-to-body length ratio). Very few have explored the connection between gut length and body size or weight, and studies linking gut length to trophic levels remain limited (Karachle & Stergiou, 2010).

1.3.1 Aim

This research aims to analyze the relationships between length, weight, condition factor and intestinal length in two fish species: *Synodontis courteti* and *Chrysichthys walkeri.*

1.3.2 Objectives

1. To establish the length-weight relationship of *Synodontis courteti* and *Chrysichthys walkeri* in Ovia River.
2. To determine the condition factor of these species to assess their overall health in relation to their environment.
3. To examine the correlation between gut length and body length and use it to infer dietary habits and habitat conditions in Ovia River.

1.4 Significance of the Study

This study will contribute to improving aquaculture efficiency and provide valuable ecological insights into *Synodontis courteti* and *Chrysichthys walkeri.*

1.5 Scope of the Study

The research will focus exclusively on *Synodontis courteti* and *Chrysichthys walkeri* in Ovia River, examining only their body length, weight, and intestinal length.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 *Synodontis courteti*

The *Synodontis courteti* commonly known as the up-side down catfish belongs to the family Mochokidae, which consist of three primary genera, *Mochocus, Synodontis and Chinoglanis*. Among the catfishes the largest genus of the catfishes of the order Siluriformes, and most widely distributed. (Akombo *et al.,* 2016). The genus contains approximately 110 species and hence, have more species than any teleost genus in Africa other than *Barbus and Haplochromis* (Lalèyè *et al.,* 2006). *Synodontis* accounts for an important part of the commercial catches in Northern Nigeria (Shinkafi *et al.,* 2010). Reed *et al.* (1967) stated that they are available throughout the year. African catfish of the genus *Synodontis* vary in their habits, from inverted plankton eaters to normally oriented benthos eaters (Green, 1997). Species belonging to Mochokidae show a naked body without scales. Mochokidae lack nasal barbels, but possess three (3) mental pairs of barbels comprising a pair of maxillary barbels and two (2) pairs of mandibular barbels, except in some fishes where the lips are modified in an adhesive disk, a sucker. (Arame *et al.,* 2019). The species is seen as a nuisance by local fishermen because it frequently entangles itself in their gillnets, and its sharp, serrated spines make it difficult to disentangle (Ukpatu and Asuquo, 2023). They are small to medium sized fishes commonly called "squeakers" due to their ability of producing stridulating sounds through their pectoral spines when disturbed (Ajiboye and Owolabi, 2013).

Synodontis species are omnivorous and generally browses on benthic deposits. Adults feed mostly on chironomids, plant material and aquatic insects. The genus displays sexual dimorphism by having a short urino-genital papilla in most adult males (Ofori-Danson, 1992).

Synodontis species are currently restricted to freshwater of Africa occurring mostly in Central and West Africa and throughout Africa except in the southern-most parts. They are the most widely distributed mochokid genus, occurring throughout most of the rivers of sub-Saharan Africa and Nile River systems (Essien-Ibok *et al.,* 2015). Several species of this genus regularly invert and swim on their backs (Willoughby, 1976). The growth of *Synodontis spp.* is not uniform throughout its life but it is fast during the first and third years and slow down during the second and fourth years where it remains the same in the succeeding years. However, the increment in length and weight do not show exactly the same pattern during the life of the fish. The fish seems to add more weight rather than increase in length in older stages (Bishai and Gideiri, 1995).

2.2 *Chrysicthys walkeri*

Chrysicthys walkeri is a Siluroidae belonging to the family Claroteidae. The species of catfish *Chrysicthys* are widely distributed in fresh and brackish waters in West Africa where they are commercially important fish with great potentials for aquaculture (Duwal *et al.,* 2016). It occurs in shallow waters of (less than 4m) and is confined to the mud and fine sand bottom. They are Omnivorous in nature feeding on varieties of food stuffs which include seeds, insects, bivalves and detritus (Reed et al., 1967). George and Atakpa (2015) reported that the richness and variety of various tropical aquatic habitats provide a wide range of possible food organisms for fishes. These originate either from within the aquatic ecosystem itself (autochthonous food sources) or from outside (allochthonous food sources). The culture of the species of *Chrysicthys* is widely practiced in many countries of the West Africa and constitutes one of the largest freshwaters cultivated fish. The African catfish of genus *Chrysicthys* contains more than 35 species which are not easily distinguished morphologically because of great morphological resemblance between these species, which makes their taxonomic separation very difficult (Ouattara *et al.,* 2014).

Chrysicthys is sought after for its flavour and chemical composition (Olopade *et al.,* 2015). The silver catfish, *Chrysicthys spp* occurs in most of the major rivers and coastal zones of Africa including Nigeria, Senegal, Gambia, Ivory-coast, Liberia, Zaire, and Gabon. *Chrysicthys spp* is a benthic euryhaline teleost fish which migrates to freshwater to spawn, but spends most of its life in estuaries (Nwafili *et al.,* 2010). There is acute reduction in population of this species in Nigeria because of the over-exploitative nature of indigenous fishers that destroy the habitats of this species (Offem *et al.,* 2016).

Fish of the genus *Chrysicthys* commonly referred to as "machoiron" have a naked body characterized by the presence of four pairs of barbels, of which those of the lower jaw are unbranched and barely exceed the humeral spine. They have a pair of dorsal fins: the first is radiated and has 5 to 6 gill rays, the first is ossified and used for age determination. In the absence of scales, the second fin is small, fat and never has a radiated structure. A pair of pectoral fins of 8 to 11 soft rays, preceded by a strong spine, well denticulate on the posterior edge. A pair of ventral fins, implanted approximately in the middle of the body; a medium-sized anal fin comprising 3 to 5 single rays and 9 to 10 branching rays. The eyes with free edges, are lateral and large. The body is moderately elongated, 4 to 6 times as long as high (Tossou *et al.,* 2023).

Chrysicthys spp exhibit dimorphism among mature and immature individuals. Mature males can be recognized by their swollen heads and enlarged mouths, while mature females are overweight. *Chrysicthys spp* is a euryhaline fish with a preference for oligomesohaline waters. In fish of the genus *Chrysichthys*, a black spot is observed behind the operculum. There is a pronounced dimorphism between mature and immature individuals (Tossou *et al.,* 2023). They experience constant fluctuations in growth due to changes in food consumption, environmental variables like temperature, food, pollutants, population density, sound, light, and parasites and spawning conditions. However, environmental degradation, including oil spillages, pollution and destruction of mangrove swamps have had considerable impacts on the breeding and nursery ground of the fish, particularly in Nigeria (Emmanuel and Momodu, 2021). *Chrysichthys spp* is reportedly an opportunistic feeder that feeds on different food items in different systems. In Nigeria, while some populations feed widely on fish, crustaceans, mollusks, rotifers, phytoplankton and plant materials others consume mainly mollusks (Okyere and Boahemaa-Kobil, 2020).

2.3. LENGTH - WEIGHT RELATIONSHIP

Parameters of length–weight relationship are commonly used in fisheries management and fisheries biology applications (İlkyaz *et al.,* 2008). Length–weight relationships (LWR) have been used to assess populations and communities in fisheries science since the beginning of the 20th century (Jellyman *et al.,*2013).

The length-weight relationship is one of the standard methods that yield authentic biological information and is of great importance in fishery assessments. It establishes the mathematical relationship between the two variables, length and weight, and helps in assessing the variations from the expected weight for the known length groups. This is particularly useful for computing the biomass of a sample of fish from the length-frequency of that sample (Kuriakose, 2017). According to Moslen and Miebaka (2017), length – weight relationship (LWR) evaluation is a crucial component of fish ecology while Bashir *et al.,* (1993) stated that length-weight ratio of fish change with the condition of life in the environment. Length-weight relationship study is also important since it helps to comprehend the general health and growth patterns of a fish population. According to Guarrizzo *et al.,* (2015) fish body length and body weight are two essential empirical variables in stock evaluation, population biology, community and ecosystem ecological studies. It provides useful information on fish species according to the given geographic area (Pallemulla *et al.,* 2024). The relationship of length-weight estimates condition factor of the fish species and fish biomass through the length frequency (Odo *et al.,* 2022).

It must be noted, however, that LWRs differ among fish species depending on the inherited body shape and the physiological factors such as maturity and spawning. This relationship might change over seasons or even days (De Giosa *et al*., 2014). In addition, the growth process can differ in the same species dwelling diverse locations, influenced by numerous biotic and abiotic factors (Jisr *et al.,* 2018). Relationship between length and weight is required for setting up yield equation and sometimes it may be useful as a character to differentiate "small taxonomic units". It also helps in converting one variable into another. Of the two, length is easier to measure and can be converted into weight in which the catch is invariably expressed. The length weight relationship also provides means for finding out the "condition factor" and the seasonal changes in the condition factor are useful to determine the biological changes in the fish (Kuriakose, 2017).

LWRs are expressed in a formula, which allows the estimation of the fish weight (W) using a particular length (L), and can be applied to studies on gonadal development, feeding rate and maturity condition (Jisr et al.,2018). According to Pauly (1993), among the important uses of length-weight relationships (LWR) are the conversion of the fish average weight at a certain length class and the conversion of an equation of growth in weight and vice versa. The change in length-weight of fish can be described by the relationship $W=aL^{b,}$ where W is the observed fish weight, L is observed fish length and a and b are estimated by the relationship W= log a + log L (a is a regression intercept and b is a regression slope).

Riedel *et al* (2007) reported that allometric growth occurs when b values are $< \text{or} > 3$. According to Olurin and Aderibigbe (2006), a fish is said to have a negative allometric growth when value of b is <3, meaning that the fish becomes thinner as it increases in weight and the fish is said to have a positive allometric growth when the value of b is > 3, meaning that the fish becomes thinner stouter or deeper-bodied as it increases in length. Isometric growth occurs when length increases in equal proportions with body weight with constant specific gravity. Froese (2006) and Zhang *et al*., (2018) recorded that an ideal fish or other aquatic fauna is said to have isometric growth when the regression coefficient 'b' is =3, indicating maintenance of dimensional equality as the organism grows. They also observed that in field survey, growth pattern can be used to convert length to weight and vice versa, especially when only length or weight measurement is available.

Arame *et al.,* (2020) in the study of Mochokid fishes in Niger River in Northern Benin reported that seven Mochokid species showed significant negative allometric growth, among which was *Synodontis violaceus* with a value of 2 .8306 ($P < 0.05$). In contrast, one species, *Synodontis clarias* exhibited significant positive allometric growth, ($b > 3$; $P < 0.05$). With regards to sizes, standard length (SL) of *Synodontis violaceus* ranged between SL:8.0-17.5

Obhasohan *et al*. (2012) reported that all fish species investigated from Ibiekuma stream, Ekpoma, Edo state exhibited negative allometric growth pattern with regression exponent 'b' values <3, while the correlation coefficients (r) obtained which ranged from 0.850 to 0.963 revealed a high degree of positive correlation. The implication being that the body weights of the fishes increased with increase in body length, but the rate of increase in weight was less than the rate of increase in length.

According to Adeyemi *et al.* (2009), negative allometric growth pattern in fish implied that the weight increases at a lesser rate than the cube of the body length. King (1996) reported similar negative allometric growth pattern in many fishes in the Nigerian freshwaters Negative allometric growths have also been reported for *Heterobranchus longifilis* from Idodo River Nigeria, according to Anibeze (2000), Odedeyi *et al*. (2007) reported for *Mormyrus rume* from River Osse, South Western Nigeria and Bolaji *et al*. (2011) also reported for *Parachanna obsura* from Igwu and Itu Rivers' wetlands, Nigeria. Famoofo and Abdul (2020) reported that near isometric growth patterns were recorded for *Hyperopius bebe occidentalis* (2.970), *S. uranoscopus* (3.012) and *P. afer* (3.013) Onimisi *et al.* (2013) recorded 3.814 for the males and 4.019 for females.

2.4. CONDITION FACTOR

In the field of fisheries science, much literature has been devoted to the study of fish condition (Richter *et al.,* 2000). The condition factor is an index reflecting physiological conditions of fishes in relationship interaction between biotic and abiotic factors and can be used to assess the status of the aquatic ecosystem where the fish dwells (Getso *et al.,* 2017; Anene, 2005). The condition factor varies among fish species in different locations and season. In ecological studies, the condition factor (K) is employed to evaluate the wellbeing of fish. Fish is said to exhibit isometric growth when length increases in equal proportion with body weight. (Odo *et al.,* 2022). An additional important biometric tool is the relative condition factor (K_n) that was derived from the LWRs. Condition factor measures the deviation of an organism from the average weight in a given sample in order to assess suitability of a specific water environment for growth of fish (Jisr *et al.,* 2018). Condition factor is useful in determining the feeding intensity, age and growth in fishes (Ndimele *et al.,* 2010).

The relationship of length weight relationship can be used in estimation of condition factor (K) of fish species. In fisheries species, the condition factor is used to compare the condition, fatness or wellbeing of fish (Ahmed *et al.,* 2011). It is based on the hypothesis that heavier fish of a particular length are in better physiological condition (Begenal and Tesh, 1978). Condition factor decreases with length and influences the reproductive cycle in fish (Abowei, 2004).

During periods when fish have high energy intake, the growth of tissues and the storage of energy in muscle and liver can cause an individual to have a greater -than-usual weight at a particular length. This excess is usually revealed by the coefficient of condition factor(k).

$$K = \frac{100W}{L^3}$$

where K = Fulton’s condition factor, W = the weight of the fish, and L is the length (usually total length) (Nash *et al.,* 2006; Schreck and Moyle, 1990).

According to Oni *et al.,* (1983), it can be used to compare the inter and intra-specific “condition,” “fatness” or wellbeing of fish from the same or contrasting habitats. In a similar way to LWR, studies about K are extensive, example, the condition factors of different tropical finfish species have been reported (King 1996: Ezewanji, 2004).

2.5. INTESTINAL LENGTH RELATIONSHIP

Fish biologists have long assumed a link between intestinal length and diet, and relative gut length (Gut type and modes of intestinal morphology have been used for the categorization of fish in relation to feeding. Furthermore, it has been shown that for a given body length, gut length (GL) of herbivorous fish is larger than that of omnivores, and that of omnivores larger than that of carnivorous species. Ecomorphological studies focus only on relating GL to diet and to a lesser extent on its relation to habitat (Karachle and Stergiou, 2010).

According to Duque- Correa *et al., (*2024), differences in intestinal lengths among trophic groups are so widely accepted that this measurement often captured as a ratio to the body length is commonly used to classify fish species into one of the three conventional trophic levels: herbi, omni, or faunivore. The most widespread ratio used in this context is the relative intestine length (RIL), calculated as total intestine length divided by the total body length (tip of the snout to the end of the longer lobe of the caudal fin) or the standard length (excluding the length of the caudal fin) (Jamaluddin *et al.,* 2015). It is generally accepted that the lowest RILs are found in faunivorous species, mid-range values are typical for omnivorous ones, and the highest values are characteristics of herbivores. However, the respective cut-of thresholds differ with respect to the taxonomic groups in consideration, and there are overlaps between trophic groups.

Idodo-Umeh stated that fish exploit food substance in their aquatic environment according to the adaptation possessed (mouth, dentition, gill rakers, gut configuration), the fish's mouth can be classified into:

Terminal: this when the mouth is positioned at the tip of the snout

Sub-terminal: this is when the mouth is located a little distance from the snout.

Inferior: this is when the mouth is at the ventral position

Oblique: this is when the mouth is superior upturn (dorsal to the terminal)

Protrusible: this is when the mouth is pushed forward (protracted) and withdrawn(retracted). The mouth is protracted when food is being captured and retracted when food is being swallowed.

Superior: the mouth is positioned above the tip of the snout or the mouth is directed upward

Idodo-Umeh (2003) reported that there is variation in the mouth depending on the diet. Terminal mouths occur in carnivores and herbivores, superior mouth in carnivores and inferior mouth in omnivores. Welcome (1979) stated that is generally possible to classify fish species into broad categories scolding to their predominantly feeding habits though complications are introduced by lack of specialization and the degree of opportunism exhibited in the selection of food by many species.

Fishes have a one-way digestive system which begins at the mouth and ends at the anus. The entire digestive system of a fish has adapted itself over the cause of evolution to the composition of food using it to the optimum (Ted Klenk,2006).

The classification system of Matthes (1964) as explained by Welcome (1979) is used to group the fishes into trophic spectra according to their feeding habits. Also, the structure of digestive tract and length of intestine are closely related to the type of diet they take.

Detritus feeders: They are fishes that feed on vegetable, debris, leaf litters, and associated communities.

Mud feeders: They are also known as limnivores. They are fishes that feed on finely divided silt together with microorganisms and organic matter products.

Omnivores: they feed on both plants and animals and have moderate intestine.

Herbivores: they are fishes that feed on plant materials and are separated into micro herbivores which feed on algae and diatoms, and macro-herbivores which feed on higher plant materials. There are also planktivores that feed mainly on plankton (Welcome, 1979). Herbivores have small stomach and long guts which could be more than 100% of the length of the body., intricately coiled in several spirals which serves as an adaptation for lengthy digestion of plant carbohydrate (Hickman *et al.,*2001).

Carnivores: they are fishes that are predatory in nature and feed on animal matters. Carnivores are divided into meso-predators and the micro-predators. Mesopredators are further divided into neuston feeders, bottom feeders and browsers. Macropredators can be classified as generalized predators that feed on fish (piscivorous), insects (insectivorous), as well as large decapod, a large crustacean (Adebisi,1981; Idodo-Umeh,1987). Hickman *et al.,*2001 reported that carnivores feed on animals or other fishes and have a shorter gut compared to their body length.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1. Study Area

The study was carried out in Ovia River (Iguoriakhi) along the Lagos-Benin express road which is located about 23.9km from Benin City. The river takes its source from Akpata hills in Ekiti state and flows through Iguoriakhi within Benin City metropolis, Southern Nigeria. This river is a major tributary which the Ovia River downstream.

3.1.1. Geography

Ovia River is the major river the forms the boundary between Ovia North-West and Ovia South-West Local Government Area of Edo State Nigeria and lies between latitudes 06023’42.76” – 06027`10.15” N, and longitude 005025’55.0” -005029’36.20” E. Ovia River flows in a North-Southerly direction, originating from Owan in Ovia North-East Local Government into the river from Apkata Hills in Ekiti State. It flows through a forest in which runoff and the presence of organic matter in the surrounding vegetation add to allochthonous input. Flowing through several towns and village, it then flows further downstream to the Benin River before it empties into the Atlantic Ocean by the Niger delta.

3.1.2. Geology of the Study Area

The study area is characterized by the Benin formation which is composed of a mixture of coarse sand interspaced with lignite and patches of clay and mud which comprises of decaying plant materials.

3.1.3. Vegetation

The vegetation of the area is mainly evergreen forest which makes it suitable for farming The river flows through a dense wet tropical rainforest in which runoff and organic matters from surrounding vegetation adds to allochthonous input. It is a flowing freshwater body with plants with a vegetation of canopy of predominantly shrubs, trees and grasses. Plants predominantly found there are Bahamas grass, guinea grass (*Pannicum maximum*), water hyacinth (*Eichhornia crassipes*), palm trees (*Elais guinesis*) and floating *Salvinia spp*

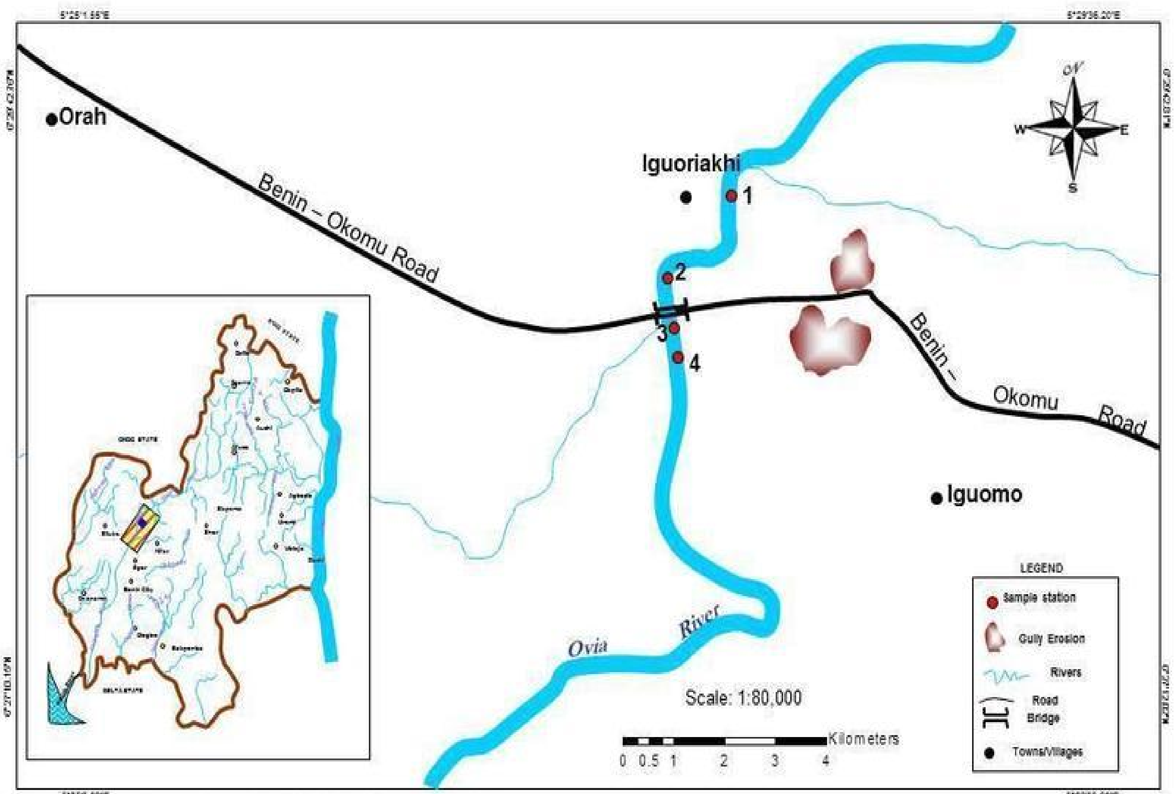

Figure 3.1: Map of Study Area

Plate 3.1: Surrounding vegetation of Ovia River

3.1.4. Climatic Condition of Study Area

The climate in Benin is typically tropical with pronounced seasonality of rainy and dry periods. There is a variation of timing of these seasons from year to year. The volume in Ovia River decreases drastically in dry seasons while in the rainy season there is a gradual increase in the volume of water. Rainy season starts from April to October, while dry season starts from November to March.

3.1.5. Human Activities

The study area supports the activity of fishing. The fishermen and women make use of manually operated wooden canoes, using multi-gears to harvest fish. They also set traps and gill nets at the bank of the river. Other human activities done there are farming which are sometimes done at the bank, hunting, crafting and oil palm and transportation of goods.

3.2. Collection of Sample

The fish samples were collected every month for a period of 6 months from June 2024 to November 2024. Fishing activities were carried were carried out by local fishermen with the aid of fishing equipment such as boats, casts, nets, gears, hooks and lines. The sample of selected fish were collected and placed in a bucket and transported to the AEB laboratory at the University of Benin.

3.3. Fish Measurement

In the laboratory, measurements of standard length (SL), head length (HL) and the body depth were taken using a meter rule. Length measurements was made to the nearest0.1cm and the fishes were weighed on a weighing balance (scale) and the values were recorded to the nearest 0.1g.

3.3.1. Total Length (TL)

This was taken from the anterior part of the snout to the end of the caudal fin

3.3.2. Standard Length (SL)

This was measured from the anterior tip of the snout to the base of the caudal fin.

3.3.3. Head Length (HL)

This was taken by placing the meter rule from the tip of the snout to the posterior margin of the operculum of the fish

3.3.4. Body Depth (BD)

This was taken from the point of insertion to the dorsal fin to the ventral part of the fish.

3.3.5. Body Weight

This was taken using a weighing balance after mopping each fish dry with a blotting paper to remove the surface water and recorded it to the nearest 0.1g.

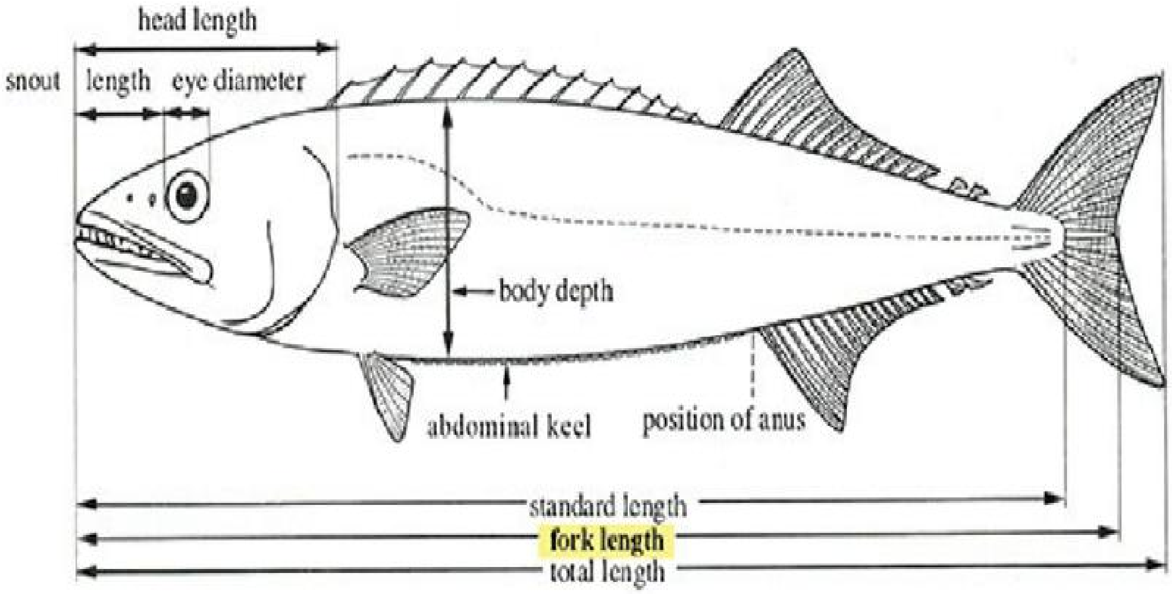

Plate 3.2: Illustration of fish measurement

3.3.4. Intestinal Length

The fish specimens were dissected, with abdominal cavity exposed and careful removal of the intestine from the abdominal cavity using a forceps. The intestinal length was measured from the point of attachment from the stomach to the anus using a meter rule. The measurement was recorded to the nearest 0.1 centimeters(cm).

3.5. Data Analysis

3.5.1. Length-weight Relationship

The relationship between the length and weight was evaluated by using the mathematical equation (Pauly,1993)

$W=aL^b$

Where:

W= Weight of fish (g)

L= Total length of fish (cm)

a= Constant of proportionality(intercept)

b= Allometry coefficient(slope)

The value of a and b were obtained from a linear regression of length and weight of the fishes; b is the slope usually between 2 and 4 while a is the intercept on the length axis (Begenal, 1978)

Through a logarithmic transformation, the equation becomes

Log W= log a+ blog L (it gives a straight-line relationship)

3.5.2. Condition Factor

The condition factor (K) is estimated using the mathematical equation:

$$K = \frac{100W}{L^3}$$

Where;

K= Condition factor

L= Total length of fish (cm)

W= Body weight of fish (g)

3.5.3. Intestinal (gut) and Body Length Relationship

The standard length (SL) was taken as body length. The intestinal length was measured incm and expressed as a percentage of the standard length. This gives the number of times the intestine length contained in the body length. The scatter-diagram suggests a relationship to which the calculated b is gradient or slope and R^2 tells the percentage amount of variation due to regression or correlation. The relationship between standard length and body length were carried out by regression coefficient method using Ms Excel. The regression line equation ;$Y= a + Bx$

Where;

X= standard length (SL) (cm)

Y= gut length (GL)

a=y (intercept)

b= slope

R^2= coefficient of determination

3.5.4. Ratio of Intestine Length to Body Length

This was calculated using the formula:

$$\frac{\textit{Intestine length}}{\textit{Body length}} \times 100$$

CHAPTER FOUR

4.0 RESULTS

A total of fifty-four (54) specimens of fish species Plate 4.1 and Plate 4.2 belonging to the Families Mochokidae and Claroteidae were collected during the six months sampling period

(June 2024 -November 2024). Thirty-one (31) specimens represented *Synodontis courteti* and twenty-three (23) specimens represented *Chrysicthys walkeri*.

The length-weight relationship was used to estimate the average weight of the fish based on the length of each species and also to estimate the pattern of growth exhibited by each species.

The gut-length relationship provided insights to the feeding habits and digestive strategies of each species.

The result of the analysis of the length-weight and intestinal-body length relationship is represented in Table 4.1

4.1.

With the use of morphometric and meristic features, the fish samples were identified to species level according to Idodo-Umeh (2003)

SPECIMEN 1

Kingdom – Animalia

Phylum – Chordata

Class – Actinopterygii

Order – Siluriformes

Family – Mochokidae

Genus – *Synodontis*

Species – *Synodontis courteti*

Plate 4.1: *Synodontis courteti*

SPECIMEN 2

Kingdom – Animalia

Phylum – Chordata

Class – Actinopterygii

Order – Siluriformes

Family – Claroteidae

Genus – *Chrysichthys*

Species – *Chrysichthys walkeri*

Plate 4.2: *Chrysichthys walkeri*

4.2 Morphometric Characteristics of *S.courteti and C. walkeri*

MONTH	TL (cm)	SL (cm)	HL	WIDTH	IL (cm)	WEIGHT	KFACTOR

4.2.1. Morphometric Characteristics of *S.courteti*

In the month of June, seven *S.courteti* specimens were randomly collected with mean total length and standard length of 19.6 and 14.43 respectively.

In July, four specimens were recorded with average total length, standard length and k-factor of 22.88, 18.28 and 1.11 respectively.

In August, seven specimens of *S. courteti* were recorded with mean total length and standard length of 18.30 and 13.84 to be precise. The k-factor recorded for that month was 1.22.

In September, five specimens were recorded with mean total and standard length of 17.50 and 13.26. The mean k-factor for this month was 0.05.

Five specimens were recorded in the month of October. The mean total and standard length were 18.12 and 15.56 respectively. The mean condition factor recorded for that month was1.41

In November, three specimens were recorded. The average total and standard length recorded were 17.87 and 13.93 respectively. The mean k-factor was 1.46.

			(cm)	**(cm)**		**(g)**	
JUNE	**19.66**	**14.43**	**3.19**	**3.89**	**15.34**	**98.57**	**1.34**
JULY	**22.88**	**18.28**	**4.33**	**4.56**	**10.88**	**137.50**	**1.11**
AUGUST	**18.30**	**13.84**	**4.6**	**3.91**	**11.99**	**76.43**	**1.22**
SEPTEMBER	**17.50**	**13.26**	**2.68**	**3.08**	**12.66**	**92.00**	**0.05**
OCTOBER	**18.12**	**15.56**	**2.48**	**2.42**	**15.02**	**84.00**	**1.41**
NOVEMBER	**17.87**	**13.93**	**2.90**	**2.87**	**12.47**	**85.00**	**1.46**
MEAN	**19.06**	**14.88**	**3.363**	**3.455**	**13.06**	**95.58**	**1.098**

Table 4.1: Morphometric Characteristics of *Synodontis courteti*

The total standard length of *Synodontis courteti* specimen collected in six months shows a standard deviation (SD) of 2.03 and a mean of 14.74 while the body weight had a standard deviation (SD) of 33.95 and a mean of 93.87. The intestinal (gut) length had a standard deviation (SD) and mean

of 2.76 and 13.25 respectively.

4.2.2. Morphometric Characteristics of *C. walkeri*

In the month of June, three (3) *Chrysichthys walkeri* specimens were randomly collected. The mean total and standard length recorded were 14.43 and 11.87cm. The mean condition factor recorded was 1.90

In July, five (5) specimens were gotten with mean total and standard length of 18.98 and 15.28cm respectively. The mean condition factor was 1.11.

In August, four (4) samples were collected with average total length and standard length of 18.47 and 14.18cm. The k-factor recorded was 1.80

Four (4) samples were gotten in the month of September. The mean total and standard length recorded were 17.61 and 15.14cm. The mean k-factor recorded was 1.43

In October, four (4) specimens were collected with mean total and standard of 16.23 and 13.13. The k-factor recorded was 1.92

Three (3) samples were collected in November. Their mean total and standard length were 18.77 and 15.37 respectively. The condition factor recorded was 1.35

Table 4.2: Morphometric Characteristics of of *Chrysichthys walkeri*

MONTH	TL (cm)	SL (cm)	HL (cm)	WIDTH (cm)	IL (cm)	WEIGHT (g)	KFACTOR
JUNE	14.43	11.87	3.10	2.47	9.73	56.67	1.90
JULY	18.98	15.28	3.58	3.90	11.68	75	1.11
AUGUST	18.47	14.18	2.83	2.50	11.88	68.75	1.80
SEPTEMBER	17.61	15.14	4.07	2.74	11.80	70.75	1.43
OCTOBER	16.275	13.13	3.18	2.88	11.35	80.00	1.92
NOVEMBER	18.77	15.37	3.60	3.87	11.17	88.33	1.35
MEAN OF MEANS	17.42	14.16	3.39	3.06	11.27	73.25	1.59

The total standard length of *Chrysichthys walkeri* collected in six months shows a standard deviation (SD) of *2.26* and a mean of 14.30. The body weight has a standard deviation (SD) of 15.70 and a mean of 73.48. The intestinal length has a standard deviation (SD) of 1.34 and a mean of 11.35.

4.3. Length–Weight Relationship of *Synodontis courteti* and Chrysicthys Walkeri over The Sampling Duration

The relationship between standard length (the independent variable) and weight (the dependent variable), which are growth characteristics, of *Synodontis courteti* and *Chrysicthys walkeri* across the sampling duration of June to November 2024 are presented in the table 4.3 and figures 4.1 and 4.2 below respectively.

The LW relationship was modelled according to the power law equation, $W = aL^b$

Where: W = weight of fish, L = length of fish, a = intercept, and b = exponent.

The log-transformed LW relationship equation is Log(W) = log(a) + b*log(L)

Where: W = weight of fish, L = length of fish, a = intercept (antilog of log(a)), and b = growth exponent or slope. The results were presented in scatter graphs with the line of fit.

Table 4.3: Length – weight relationship of *Synodontis courteti* and *Chrysicthys walkeri*

Species	**LWR equation**	**B**	**R^2**	**Growth pattern**	**P value**
Synodontis courteti	Log W = 0.1586 + 1.539 × log L	1.539	0.4568	Negative allometric	< 0.0001
Chrysicthys walkeri	Log W = 0.7214 + 0.9795 × log L	0.980	0.5123	Negative allometric	0.0004

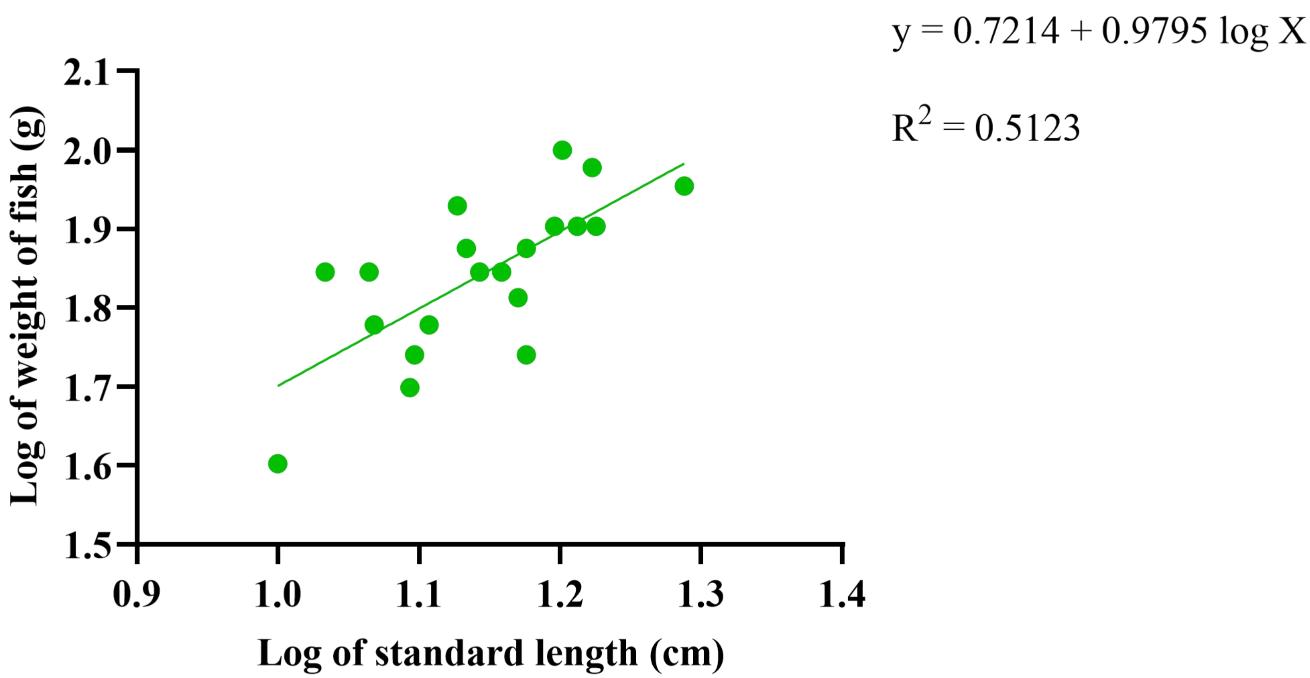

Figure 4.1: Scatter graph depicting the standard length – weight relationship of *Synodontis courteti*

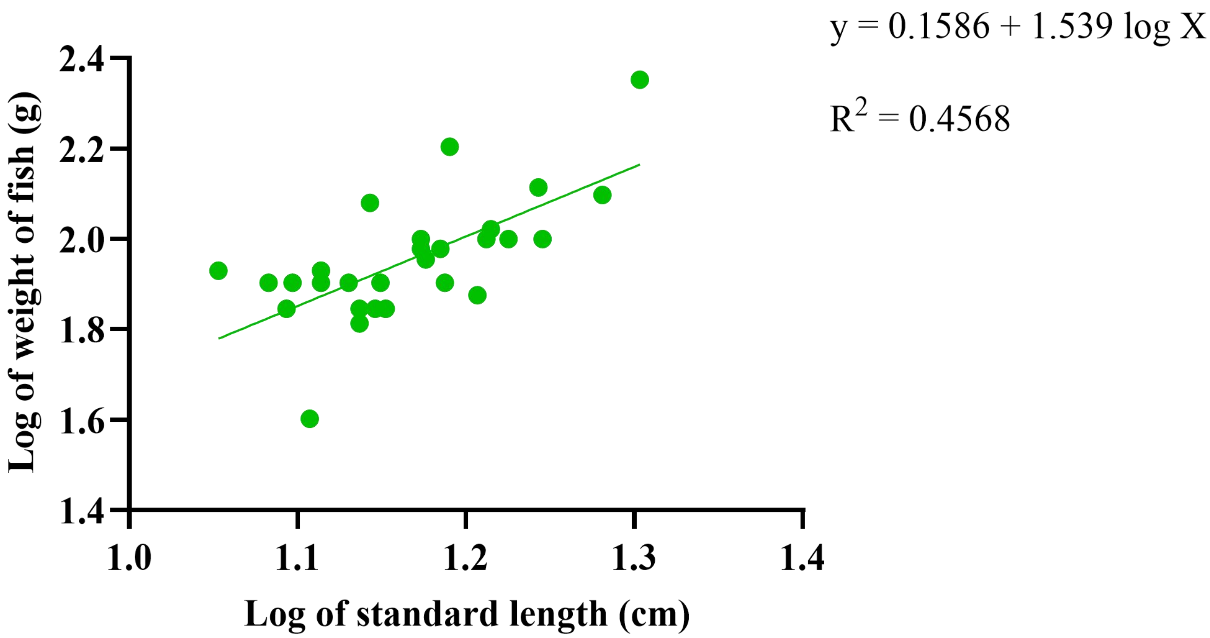

Figure 4.2: Scatter graph depicting the standard length – weight relationship of *Chrysicthys walkeri*

From table 4.3 and Figures 4.1 above, the regression of the standard length – weight relationship of *Synodontis courteti* is given by the equation, Log W = 0.1586 + 1.539 × log L. The coefficient of determination, $R^2 = 0.4568$, indicates that the standard length explained 45.68% of the variability in the weight**.** The slope (1.539) indicates that the fish exhibit negative allometric growth, i.e., the fish become lighter as they grow. The P value of < 0.0001 shows that the standard length – weight relationship between standard length and weight was statistically significant at level of significance, $\alpha = 0.05$.

From table 4.3 and Figures 4.2 above, the regression of the standard length – weight relationship of *Chrysicthys walkeri* is given by the equation, Log W = 0.7214 + 0.9795 × log L. The coefficient of determination, $R^2 = 0.5123$, indicates that the standard length explained 51.23% of the variability in the weight**.** The slope (0.9795) indicates that the fish exhibit negative allometric growth, i.e., the fish become lighter as they grow. The P value of = 0.0004 shows that the relationship between standard length and weight was statistically significant at level of significance, $\alpha = 0.05$.

4.4: Relationship between standard length and intestinal length of *Synodontis courteti* and *Chrysicthys walkeri* over the sampling duration

The relationship between standard length (the independent variable) and gut length (the dependent variable), which are growth characteristics, of *Synodontis courteti* and *Chrysicthys walkeri* across the sampling duration of June to November 2024 are presented in the table 4.4 and figures 4.3 and 4.4 below respectively.

The LW relationship was modelled according to the power law equation, $G_L = a(S_L)^b$

Where: G_L = gut length of fish, S_L = standard length of fish, a = intercept, and b = exponent.

The log-transformed LW relationship equation is $\text{Log } G_L = \log(a) + b * \log S_L$

Where: G_L = gut length of fish, S_L = standard length of fish, a = intercept (antilog of log(a)), and b = growth exponent or slope. The results were presented in scatter graphs with the line of fit.

Table 4.4: Relationship between standard length and intestinal length of fish species

Species	**LWR equation**	**b**	$\mathbf{R^2}$	**Growth pattern**	**P value**
Synodontis courteti	$\text{Log } G_L = 1.080 + 0.031\times \text{ log } L$	0.031	0.0005	Negative allometric	< 0.0001
Chrysicthys walkeri	$\text{Log } G_L = 1.028 + 1.740\times \text{ log } L$	1.740	0.2411	Negative allometric	0.0004

From table 4.4, the coefficient of determination (R^2) between standard length and gut length in *S.courteti* (0.0005) indicates a weak correlation between body and gut length.

For *Chrysicthys walkeri,* the coefficient determination (R^2) between standard length and gut length in *Chrysicthys walkeri* (0.2411) shows a moderate correlation between body and gut length.

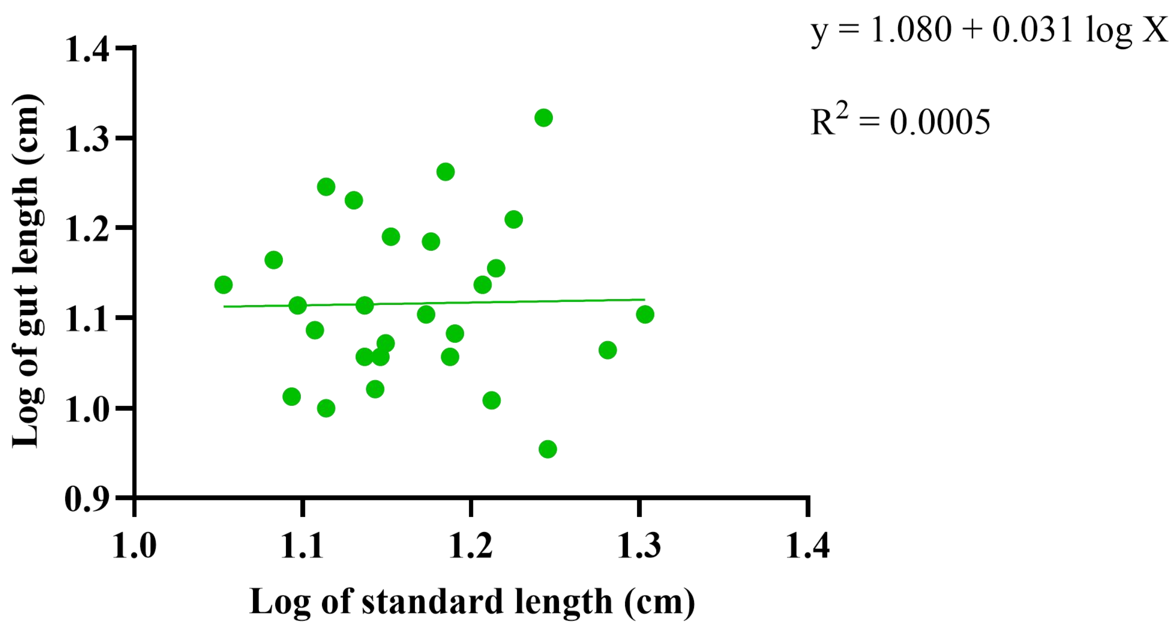

Figure 4.3: Scatter graph depicting the relationship between standard length and intestinal length of *Synodontis courteti*

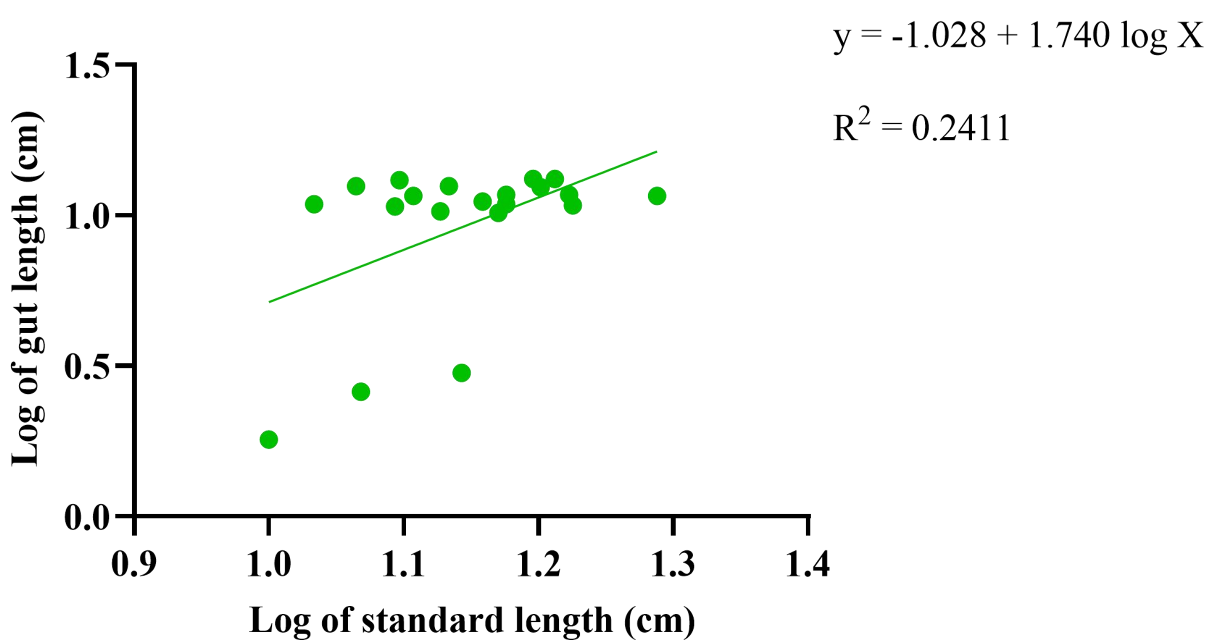

Figure 4.4: Scatter graph depicting the relationship between standard length and intestinal length of *Chrysicthys walkeri*

4.5. Ratio of Intestine (Gut) Length to Body Length

The results of the measurements are presented in table 4.5. The ratio of the intestine length to body length is less than 1, that is 100% in both species. Considering the relevance of the body depth in accommodating the gut, the body depth (BD) of two species was measured and expressed as a percentage of the standard length (SL). The results are presented in table 4.5. It was revealed that the body depth of *S. courteti* and *C. walkeri* is**.** 0.23 and 0.25 respectively

Table 4.5: The mean intestine length (IL), body depth (BD), head length (HL) is expressed as the percentage of standard length

TAXA	N	IL	SL	IL/SL	(IL/SL) %	HL	HL/SL	BD	BD/SL	REMARKS
S.courteti	31	13.06	14.88	0.88	87.77	3.36	0.22	3.45	0.23	Carnivorous
C.walkeri	28	11.17	15.37	0.73	72.67	3.6	0.23	3.87	0.25	Carnivorous

CHAPTER FIVE

5.0 DISCUSSION

The study has shown variations in the length-weight relationship, condition factor and intestinal length of two freshwater fishes (*Synodontis courteti* and *Chrysicthys walkeri*) sampled at Ovia River, Edo state, Nigeria. These parameters are used because they provide basic information for fish assessment in order to evaluate the growth patterns, general health, habitat conditions and trophic level of the fishes.

The length-weight relationship of these two species from the river shows considerable variations in fish sizes implying that the sample was properly collected. In *S. courteti,* the minimum weight recorded was 40 g in August. While the maximum weight recorded was 225g in July. While in *C. walkeri,* the minimum weight recorded was 40g in the month of June while the highest weight recorded was100g in the month of June and November.

5.1. Length-weigh relationship

Fishes are known to exhibit two patters of growth which could either be isometric or allometric and their growth can be influenced through the combined effect of food quality, quantity, and the environment. When regression coefficient (b) is equal to 3, it is known as isometric growth. This pattern of growth implies that there is a simultaneous increase in length and weight. When $b<3$, it is known as a negative allometric growth, which implies that the fish becomes more slender and lighter in weight as size increases. When $b>3$, it is considered to be a positive allometric growth. This implies that the fish develops more body weight as size increases (Akombo *et al.,*2014). Fagbenro *et al* (1991) stated that isometric growth is rare among fishes. The result of this study shows that all 59 specimens belonging to two species exhibited a negative allometric growth. A similar result to this study was reported by Falaye and Fagbenro (2024) for selected mochokid species in the lower Benue River, Nigeria. This result showed that *S. courteti* showed a negative allometric growth. Dongo *et al.,* (2020) reported that *C. walkeri* from the Solomougou Dam Lake Cote d'Ivoire exhibited a negative allometric growth.

Condition factor expresses the condition of a fish such as the degree of wellbeing, relative plumpness or fatness in numerical terms (Largler *et al.,* 1964). According to Manorarima and Ramanujam (2014), condition factor is strongly influenced by biotic and abiotic factors and can be used as an index to assess in status of aquatic ecosystem in which the fish live The fishes in this study were observed to exhibit a negative allometric growth as their values were less than 3.

Abowel *et al*. 2009 reported a range of 0.941-0.945 for fish species from Nkoro river, Niger Delta. The condition factor of the fish species showed slight variations within the months. The result of the condition factor obtained in this study is a reflection of limited food sources, food water quality of the river as suitable habitat for this fish species.

According to Edema and Aiguobasinmwin (2006), fish species with an intestinal percentage of less than 100 are classified as carnivores, an intermediary range of greater than 100 but less than 200 are omnivores that is, omnivores have a moderate gut of about 100% of the Body length and herbivores have a very long gut which is more than 100% of the body length that is greater than 200 are classified as herbivores. However, there is no demarcatory ratio for ominivores between carnivores and herbivores, and since the carnivores limit may extend close to 2 (Edema and Ojeh, 2006),

According to Butler (2004), carnivores are fish eating fishes and they have large stomach with short intestine (gut), herbivores are plant eater feeding frequently on plant and possessing a long intestine. Omnivores feed on a variety of food (both plant and animal alike), they have relatively long intestine longer than those of carnivores but shorter than those of herbivores. Limnivores according to him are constantly feeding and have a small stomach with a long intestine. Chapman and Hall (2001) in categorizing fishes according to their feeding habit stated the gut length of carnivores (0.2-2.5), omnivovers (0.6-8.0), and herbivores (0.8-15.0) times their body length. The result of this study therefore suggests that *Synodontis courteti* and *Chrysicthys walkeri*, can be grouped as carnivore because from the result, the gut length is <100% of body length and this is due to abundance of diet of animal matter in the water body.

5.1. CONCLUSION

This study focused on some aspects of the morphometrics of *Synodontis courteti* and *Chrysicthys walkeri* in Ovia River. Findings from this study, showed that both species exhibited a negative allometric growth. The knowledge of the morphometrics of these two species is essential for increase in yield and proper management of the fishery resources. Though it is not feasible to exhaust the knowledge of the morphometrics of these two species, it is hoped that the information provided in this study will pave way for further understanding of these fish and other related species.

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APPENDICES

APPENDIX 1

Length-weight Relationship of *Synodontis courteti*

S/N	TL (Cm)	LOG TL	Body weight (g)	LOG BW
1.				
2.	18.8	1.274158	80	1.90309
3.	21.5	1.332438	160	2.20412
4.	24	1.380211	130	2.113943
5.	22	1.342423	90	1.954243
6.	18.5	1.267172	70	1.845098
7.	16.8	1.225309	80	1.90309
8.	16	1.20412	80	1.90309
9.	18.8	1.274158	80	1.90309
10.	21.5	1.332438	160	2.20412
11.	24	1.380211	130	2.113943
12.	21.5	1.332438	100	2
13.	19.7	1.294466	100	2
14.	26.6	1.424882	225	2.352183
15.	23.7	1.374748	125	2.09691
16.	21.5	1.332438	100	2
17.	18.2	1.260071	70	1.845098
18.	19.3	1.285557	85	1.929419
19.	20.1	1.303196	100	2
20.	17.8	1.25042	65	1.812913
21.	14.9	1.173186	40	1.60206
22.	20.9	1.320146	105	2.021189
23.	17.8	1.25042	95	1.977724
24.	17.3	1.238046	80	1.90309

25.	19.4	1.287802	120	2.079181
26.	19.7	1.294466	100	2
27.	19	1.278754	95	1.977724
28.	16.4	1.214844	70	1.845098
29.	18.3	1.262451	80	1.90309
30.	17.2	1.235528	75	1.875061
31.	19.4	19.4	19.4	19.4

MORPHOMETRIC MEASUREMENTS OF *Synodontis courteti*

MONTH	S/N	TL	SL	HL	BW	IL	WEIGHT	K-

		(cm)	(cm)	(cm)	(cm))	(cm)	(g)	FACTOR
JUNE	1	18.8	13.5	3.0	4.0	17.0	80	1.2040
	2	21.5	15.5	3.3	4.2	12.1	160	1.6099
	3	24.0	17.5	3.4	4.6	21.0	130	0.940394
	4	22.0	15.0	3.5	4.0	15.3	90	0.845229
	5	18.5	14.0	2.9	3.2	11.4	70	1.105561
	6	16.8	13.0	3.2	3.8	17.6	80	1.687183
	7	16.0	12.5	3.0	3.4	13.0	80	1.953125
	MEAN	**19.66**	**14.43**	**3.19**	**3.89**	**15.34**	**98.57**	**1.34**
JULY	1	21.5	17.6	4	3.9	9	100	1.00620071
	2	19.7	16.3	4.1	4.3	10.2	100	1.30798066
	3	26.6	20.1	5	5.6	12.7	225	1.19546704
	4	23.7	19.1	4.2	4.5	11.6	125	0.93899867
	MEAN	**22.88**	**18.28**	**4.33**	**4.58**	**10.88**	**137.50**	**1.11**
AUGUST	1	18.2	12.4	5.2	3.2	10.3	70	1.1611381
	2	19.3	13	5.5	4	10	85	1.18235257
	3	20.1	14.9	6.2	5.1	12.7	100	1.23143595
	4	17.8	13.7	3.4	2.9	11.4	65	1.15253295
	5	14.9	12.8	2.2	2	12.2	40	1.20920849
	6	20.9	16.4	6.4	5	14.3	105	1.15013929
	7	16.9	13.7	3.7	5.2	13	70	1.45023348
	MEAN	**18.30**	**13.84**	**4.66**	**3.91**	**11.99**	**76.43**	**1.22**
SEPTEMBER	1	17.8	14.9	2.8	3.6	12.7	95	0.05053414
	2	17.3	14.1	2.2	3.1	11.8	80	0.04635248
	3	19.4	13.9	3.4	4	10.5	120	0.04930572
	4	16.8	12.1	2.6	2.7	14.6	80	0.05061548

	5	16.2	11.3	2.4	2	13.7	85	0.05997844
	MEAN	**17.5**	**13.26**	**2.68**	**3.08**	**12.66**	**92**	**0.051**
OCTOBER	1	19.7	16.8	3.3	2.9	16.2	100	1.30798066
	2	19	15.3	2.8	2.3	18.3	95	1.38504155
	3	16.4	14.2	1.9	1.7	15.5	70	1.58696188
	4	18.3	15.4	2.3	3.1	11.4	80	1.30537929
	MEAN	**18.12**	**15.56**	**2.48**	**2.42**	**15.02**	**84**	**1.41**
NOVEMBER	1	19.4	13.9	3.4	4	10.5	120	1.64352402
	2	17.8	13.7	3.4	2.9	11.4	65	1.15253295
	3	16.4	14.2	1.9	1.7	15.5	70	1.58696188
	MEAN	**17.87**	**13.93**	**2.9**	**2.87**	**12.47**	**85**	**1.46**

Morphometric measurement of *Chrysicthys walkeri*

MONTH	SPECIMEN NUMBER	TL (cm)	SL (cm)	HL (cm)	WIDTH (cm)	IL (cm)	WEIGHT (g)	K-FACTOR
JUNE	1	16.8	13.9	3.5	3	12	70	1.47628496
	2	14	11.7	3.3	2.6	10	60	2.18658892
	3	12.5	10	2.5	1.8	7.2	40	2.048
	MEAN	**19.66**	**14.43**	**3.19**	**3.89**	**15.34**	**98.57**	**1.34**
JULY	1	18.5	15	4.1	3.9	10.9	55	0.86865536
	2	20.3	15.7	3.1	3.6	13.2	80	0.95631699
	3	20	15.9	4	5	12.4	100	1.25
	4	19.7	15	3.9	3.9	11.7	75	0.98098549
	5	16.4	14.8	2.8	3.1	10.2	65	1.47360746
	MEAN	**22.88**	**18.28**	**4.33**	**4.56**	**10.88**	**137.50**	**1.11**
AUGUST	1	18.6	16.3	3	2.4	13.2	80	1.24322906
	2	16.8	12.4	2.2	2	10.7	50	1.05448926
	3	19	13.6	2.8	2.6	12.5	75	1.09345386
	4	19.6	14.4	3.3	3	11.1	70	0.92967216
	MEAN	**18.30**	**13.84**	**4.6**	**3.91**	**11.99**	**76.43**	**1.22**
SEPTEMBER	1	21.1	19.4	5.6	3.8	11.6	90	0.95806537
	2	19	16.8	4.7	2.9	10.8	80	1.16635078
	3	14.6	12.5	3.3	2.1	13.1	55	1.76727495
	4	14.9	12.8	3.9	2.4	11.6	60	1.81381273
	MEAN	**18.30**	**13.84**	**4.6**	**3.91**	**11.99**	**76.43**	**1.22**
OCTOBER	1	13.8	10.8	3.1	2	10.9	70	2.66354955
	2	15.6	11.6	3.6	2.7	12.5	70	1.8438443
	3	17.3	13.4	2.1	3.7	10.3	85	1.64165017
	4	18.4	16.7	3.9	3.1	11.7	95	1.52500103
	MEAN	**18.12**	**15.56**	**2.48**	**2.42**	**15.02**	**84.00**	**1.41**
NOVEMBER	1	17.3	13.4	2.1	3.7	10.3	85	1.64165017
	2	19	16.8	4.7	2.9	10.8	80	1.16635078
	3	20	15.9	4	5	12.4	100	1.25

	MEAN	**17.87**	**13.93**	**2.90**	**2.87**	**12.47**	**85.00**	**1.46**