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Impact of Climate Change on the Morphometric Characteristics of Silver Catfish (*Chrysichthys nigrodigitatus*) in the Face of Food Scarcity

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ABSTRACT

Climate change presents a considerable threat to the sustainability of fisheries, particularly in tropical regions, where ecosystems are more vulnerable to environmental changes. This study focuses on the impact of climate change on the morphometric characteristics of silver catfish (*Chrysichthys nigrodigitatus*), a species of significant ecological and economic value. Given the increasing concerns over food scarcity and environmental shifts, this research will explore how varying temperatures, pH, and food availability influence the growth, development, and overall health of silver catfish. To achieve this, the study combines both field and laboratory experiments to simulate climate-related stressors and observe their effects on the species' morphology. By assessing factors such as body size, shape, and other physical characteristics under altered environmental conditions, this research aims to understand the broader implications of climate change on aquatic species. The findings will provide essential insights into how climate change disrupts the morphology and ecology of silver catfish, with implications for fisheries management. This study's results will help inform adaptive strategies for maintaining sustainable fisheries, ensuring that they can withstand the challenges posed by a rapidly changing climate.

Keywords: Climate change**,** sustainability**,** morphometric.

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1. INTRODUCTION

Climate change is increasingly recognized as a major driver of environmental changes that are affecting aquatic ecosystems globally. Rising temperatures, changing pH levels, and fluctuations in food availability are altering the conditions in which aquatic species, including fish, thrive. These environmental shifts have profound implications for the growth, development, and survival of fish populations, with potential disruptions to their morphology, reproductive success, and overall ecological roles (IPCC, 2019). The impacts of climate change on fish populations are of particular concern in tropical regions, where ecosystems are more sensitive to environmental stressors.

Silver catfish (*Chrysichthys nigrodigitatus*) is a tropical fish species that plays an essential role in West African artisanal fisheries. It is a key species in the local economy and an important food source for communities across the region. Despite its significance, the effects of climate change on the ecology and morphology of silver catfish are not well understood. Limited research has focused on how changes in environmental parameters, such as temperature, pH, and food availability, influence the biological characteristics of this species.

While there have been numerous studies exploring the effects of temperature and pH on the growth and development of various fish populations, the specific impacts on the morphometric characteristics of tropical fish, such as silver catfish, remain underexplored. Existing studies have primarily focused on broad ecological impacts, but few have concentrated on how these changes might alter the physical attributes of individual species within tropical freshwater systems (IPCC, 2019; FAO, 2018). Research by Mensah et al. (2020) highlights that, while climate change is likely to affect fish morphology, there is a lack of detailed studies on species like silver catfish, which are integral to the livelihoods of local populations.

Morphometric characteristics, such as body size and shape, are critical to understanding how fish adapt to environmental stressors. Changes in these traits can have significant consequences for the species' fitness, reproductive success, and ability to survive under altered conditions. In addition, changes in the structure of fish populations can lead to shifts in community dynamics and affect the sustainability of fisheries.

Given the critical role of silver catfish in West African fisheries and the potential risks posed by climate change, there is a pressing need for research that examines how environmental factors influence their morphology and overall health. This study aims to fill this gap by investigating how temperature, pH, and food scarcity impact the growth and development of silver catfish, intending to inform strategies for sustainable fisheries management in a changing climate.

2. MATERIALS AND METHODS

This study will be conducted in two phases: a field survey and a laboratory experiment.

2.1. Field Survey

- Study Sites
  The study will take place in three rivers in the Niger Delta, Nigeria, selected based on variations in water temperature, pH, and food availability (Ogutu-Ohwayo *et al*., 2013).

These factors are crucial for understanding the growth and development of silver catfish, as they can significantly influence fish health (Hassan *et al.,* 2021). The sites will represent different levels of environmental stress, including temperature and pH fluctuations (Moyle & Cech, 2000).

- Fish Sampling
  Silver catfish will be sampled using gillnets and hook-and-line fishing, ensuring a diverse sample across different fish sizes (Adebayo *et al*., 2017). Gillnets will be deployed at various depths, and hook-and-line fishing will target larger individuals (Khan *et al.,* 2021). Sampling will occur over a month, including different times of the day to account for diel behavioral changes in fish (Janssen *et al*., 2012).

- Morphometric Measurements
  Morphometric measurements, including total length, standard length, weight, and condition factor, will be taken for each fish (Lee *et al*., 2016). These will provide insights into the catfish's growth patterns in response to environmental conditions (Hokanson *et al.,* 1977).

2.2. Laboratory Experiment

- Experimental Design
  A 3x3 factorial design will assess the effects of temperature (25°C, 28°C, 31°C), pH (6.5, 7.5, 8.5), and food availability (low, medium, high) on silver catfish growth (O'Brien & McDonald, 2011). This setup mirrors the environmental variations from the field survey to understand interactive effects (Fujimoto *et al*., 2005).

- Fish Rearing
  Fish will be reared in 12 tanks (100 liters each), with 10 fish per tank (Wang et al., 2016). Each treatment group will have specific environmental conditions, with food availability adjusted accordingly (Ham *et al*., 2017).

- Water Quality Monitoring
  Water quality will be monitored daily, including temperature, pH, and oxygen levels, using a probe (Hochachka & Somero, 2002). Regular water changes will ensure consistency and prevent waste buildup (Mao *et al*., 2019).

This methodology will provide a thorough analysis of the effects of environmental factors on silver catfish growth, both in the field and under controlled conditions.

2.3. Data Analysis

- Statistical analysis: The effects of temperature, pH, and food availability on the morphometric characteristics of silver catfish will be analyzed using a three-way analysis of variance (ANOVA).
- Regression analysis: Linear regression analysis will be used to examine the relationships between morphometric characteristics and environmental variables.

3. RESULTS AND DISCUSSION

The results of this study are expected to provide valuable insights into the impacts of climate change on the morphometric characteristics of silver catfish. The expected outcomes include:

- Significant effects of temperature, pH, and food availability on the morphometric characteristics of silver catfish.
- Significant interactions between environmental variables and morphometric characteristics.
- Regression models that predict the relationships between morphometric characteristics and environmental variables.

The results of this study will be discussed in the context of the current literature on the impacts of climate change on fish populations.

4. CONCLUSIONS

This study will contribute to our understanding of the impacts of climate change on the morphometric characteristics of silver catfish. The results of this study will inform strategies for sustainable fisheries management and provide insights into the ecological and evolutionary responses of fish populations to climate change.

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