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## BIOLOGY AND FISHERIES OF *Clarias gariepinus* IN NIGERIAN INLAND WATERS: Review

D. Y. Bawa

Department of Forestry and Fisheries  
Kebbi State University of Science and Technology, Aliero.

**Abstract:**

*In response to escalating global hunger and poverty rates, aquaculture emerges as a vital avenue for bolstering food production. This review delves into the biology and fisheries of Clarias gariepinus, a significant freshwater air-breathing catfish species native to Africa and widely cultivated across the continent. Despite its popularity in aquaculture, challenges persist in consistent seed production due to low larval survival rates, particularly in the early stages. Various studies have explored larval development, behavior, and physiology, crucial for enhancing seed quality and subsequent adult fish production. Aquaculture, including the farming of C. gariepinus, has become pivotal in meeting the escalating demand for fish protein. The species' adaptability to diverse environmental conditions, high fecundity rate, and tolerance to high-density farming contribute to its significance in aquaculture. Widely distributed across Africa and parts of Asia, C. gariepinus inhabits calm lakes, rivers, and swamps, especially those subject to seasonal flooding. Understanding its biology and fisheries is imperative for sustainable aquaculture practices and meeting the growing global demand for fish.*

**Keywords:** *Clarias gariepinus*, aquaculture, freshwater fish, larval development, fisheries, food security, Africa, adaptation, seed production, protein demand.

## INTRODUCTION

As a result of increase in population and continued depletion of natural resources resulting from exploitation in developing countries, the cost of living is rising exponentially and so are the rates of hunger and poverty which have surged to very high levels (Akinrotimi et al., 2007); (Akinrotimi et al., 2015a). As a result of this factor, cost and demand for food especially the dietary fish protein has also risen considerably. In view of this, agriculture and science have been coming up with better ways of accelerating productivity to meet the population needs (Bekibele & Onunkwo, 2007); (Akinrotimi et al., 2015b). Over the past decades aquaculture has expanded and diversified in response to the increasing global demand for fish as a major source of protein (Gabriel & Akinrotimi, 2011). The production from capture fisheries has thus reached its maximum potential as the catch is dwindling with each passing day (Gabriel et al., 2007b). According to FAO (2006), fish supplies from capture fisheries will therefore not be able to meet the growing global demand for aquatic food.

The African Catfish, *Clarias gariepinus* is a choice fish for culture as it commands good market, consumers like its taste and farmers find it easy to culture due to its hardiness. It has been a principal cultured species across most parts of Africa. It is mostly used to generate income and provide food for subsistence farmers (Gabriel et al., 2007a). It is cultured conveniently under mono and poly culture system (Akinrotimi et al., 2011a). The high demand of fish fingerlings in the high growing aquaculture industry has stimulated the need for artificial propagation of cultured warm water fisheries (FAO, 2007). The increase in human population and reports of large numbers of undernourished or starving people, especially in the developing countries has made the need for food production a major worldwide issue of concern. For most of our lakes, rivers and oceans, the maximum sustainable fishing limit has been exceeded. Therefore, fish production will depend on aquaculture to bridge the gap of fish supply. Hence there is need for alternative culture approaches (Akinrotimi et al., 2011b).

Traditionally, Nigeria can be classified as a country of fishermen existing in the Niger Benue river system i.e the Lake Chad, the Kainji Lake and the vast lower Niger region. However, the importance of fish in the diet of Nigeria further significantly increased after the Sahara drought of 1971 to 1979. This drought which greatly decimated the cattle population put the price of livestock virtually in affordable in the majority of Nigeria. This trend thus triggered an increase in the demand for fish alternative source of animal protein (Omeru & Solomon, 2016).

## BIOLOGY

*Clarias gariepinus* (Burchell 1822) is a species of freshwater air breathing catfish native to Africa. Their unique characteristic as an omnivorous feeder, able to stand in harsh condition including low dissolved oxygen, change of temperature and high level of water pollution, high resistance of diseases, and delicious taste make them a popular aquaculture species (Hecht & Appelbaum, 1988; Hogendoorn et al., 1983). *Clarias gariepinus* is characterized with nated skin and dougate with fairly long dorsal aid anal fins. The dorsa fin has 61-80 soft rays and anal fin has 45-65 soft rays. They have strong pectoral fins with spines that over serrated on the outer side (Teugels, 1986). It possesses nasal and maxillary barbells and somewhat smallish eyes, their coloring is dark Frey or black dorsally and green colored ventrally. Adult possess a dark longitudinal lies on either side of the head. However, this is absent in young fish the head is large, depressed and heavily boned. The mouth is quite large and subternuials (Shoelton, 1993) and (Teugels, 1986). In *C. garipinus*, exchange of respiratory gases i.e. oxygen and carbohydrate takes place through the gills. Like other

mudfish, it has accessory breathing carborescent organs which enable the fish not only live in stagnant pools but to travel over damp ground. *Clarias gariepinus* differs from other catfish in having an auxiliary breathing organ in this special pochet attached to the second and fourth gillarches and are responsible for the ability of *Clarias gariepinus* to live out of much longer than other catfish.

*C. gariepinus* has pseudo-lungs, long bodies and a high capacity to produce mucous as adaptations to live in stagnant environments or out of water (Donnelly, 1973). In its natural range it is omnivorous, feeding on plant material, plankton, arthropods, mollusks, fish, reptiles, and amphibians (YALÇIN et al., 2001a). Its reproduction is seasonal with gonadal maturation associated to periods of flooding. The maturation process is influenced by changes in water temperature and photoperiod, but the increase of water level is the principal factor for their reproduction (YALÇIN et al., 2001b).

### **LAVAL DEVELOPMENT**

Despite the popularity of this fish, the seed production is still inconsistent due to low larval survival particularly during the early larval stage (Graaf & JANSSEN, 1996; Hecht & Appelbaum, 1988). This obstacle still exists even though the protocol for controlled spawning and larval rearing of *C. gariepinus* has been established (Graaf & JANSSEN, 1996; Hecht & Appelbaum, 1988; Hecht et al., 1996; Sudarto, 2007). Larval development of *C. gariepinus* has been studied on the topic of by a number of people focusing on digestive system (Verreth et al., 1992), cost of growth in relation to food intake and oxygen consumption (Conceição et al., 1995), survival, growth, metabolism and behavior of early larval stages under different light conditions (Appelbaum & Kamler, 2000), embryo-larval toxicity tests (Nguyen & Janssen, 2002), feeding practices, growth and nutritional physiology (Verreth et al., 1993) and others larval development study under different condition. The knowledge of larval biology in this critical short period is a key element for effective larviculture that directly affects the seed quality and later of adult (Hansen et al., 2011). Larval behaviour is closely related to the morphogenesis and sensory organs development (Hubbs & Blaxter, 1986; Mukai et al., 2008). Fish larvae directly affected with a fluctuating and harsh environment. The larvae demonstrated several types of responses and behaviour that undertaking to their survival when they perceive stimuli from the environment.





Photomicrographs showed the typical pattern of early larval stage of *Clarias gariepinus* from hatching to 120 hours after hatching (hAH). Scale bar, 1 mm. (A = Anus, Bb = Barbels, Ey = Eye, Ie = Inner ear, Pi = Peristaltic intestine, J = Jaw, Pf = Pectoral fins, Ys = Yolk sac). (Ing & Chew, 2015).

## AQUACULTURE

Fish farming has become a worldwide practice and has been for years. Increase aquaculture production is clearly needed to meet this demand in the third millennium because capture fisheries are at capacity of showing perception decline due to over fishing, habitat destruction and pollution (Omeru & Solomon, 2016). Aquaculture therefore remains the only viable alternative for increasing fish production in order to meet the protein demand of people. One of the aquaculture is the increase in the production aid growth rate of fish that will meet the demand of increase population. The favored catfish species in Nigeria aquaculture includes *Clarias gariepinus*, *Heterobranchus bidorsalis* and *Clarias nigrodigitatus*. *Heterobranchus* species is the more commonly cultured fish in the South eastern parts of Nigeria. Africa catfish is popular in the market and has great potentials to boost the rapidly growing Nigeria aquaculture.

*Clarias gariepinus* is generally considered to be one of the most important tropical fresh water fish species for aquaculture whose aquaculture potential have been documented (Dada & Wonah, 2003). (Bruton, 1979) pointed out that *C. gariepinus* has also high fecundity rate, grows faster, tolerates high density and environmental extremes. It also adopts wide range of natural and artificial food and adapts to a variety of feeding modes in expanded niches.

## DISTRIBUTION

*Clarias gariepinus* is widely distributed in Africa and parts of Asia (Israel, Syria and south of Turkey). Its main habitats are calm lakes, rivers and swamps in areas that flood on a seasonal basis (Graaf & JANSSEN, 1996). *Clarias gariepinus* is generally considered one of the most important tropical species of the aquaculture. It has an almost pan-African distribution ranging from the mid to West Africa and from Algeria to Southern Africa. They also occur in Asia Minor (Israel, Syria and South of Turkey). *Clarias gariepinus* at various geographical locations bears different values. It is called *Clarias lazera* in Northern and central Africa, *Clarias gariepinus* in South Africa (Spataru et al., 1987).

## MONETARY VALUE

*Clarias gariepinus* is very popular to fish farmers for high market price, fast growth rate, good food conversion ratio, resistance to diseases infection and ability to withstand adverse paid conditions especially low oxygen content and high turbidity. The culture of *Clarias gariepinus* dry as seed for fish production is becoming increasingly essential as the fish is contributing to the food abundance and nutritional benefit to the family health, income generation and employment opportunities (Bamidele, 2007).

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