

Channa Striata: Telangana's State Fish And Its Role In Local Ecosystems

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Abstract

Striped snakehead (*Channa striata*) is a freshwater predaceous fish that is an important part of the balance of the ecosystem and also a vital source of fisheries sustainability. It is a keystone species in Telangana's freshwater ecosystem as it is involved in biodiversity regulation, regulating populations of smaller aquatic organisms, and as a prey for larger predators. Its ability to live in rivers, lakes, and wetlands, as well as low-oxygen environments, means it is a key part of aquatic food webs. *C. striata* is also economically and culturally important in Telangana's fisheries and aquaculture industry. It is a highly valued species because of its high nutritional content, rapid growth rate, and market demand. Moreover, the therapeutic properties of this herb are being recognized by traditional medicine practitioners who claim that it can promote improvement in wound healing and the immune system. While *C. striata* presents resilience to several threats (habitat degradation, water pollution, overfishing, and climate change), some regions experience population declines due to these threats. While assessing existing research on *C. striata*, its ecological, economic, and medicinal significance are explored, and existing research trends, conservation, and management efforts, are also considered. This review serves to establish a basis for future studies and associated recommendations for policy that would secure the *C. striata*'s long-term survival in Telangana and beyond, through the identification of research gaps and sustainable aquaculture practices.

Keywords: *Channa striata*, freshwater ecosystems, biodiversity conservation, fisheries sustainability, aquaculture.

1. Introduction

The striped snakehead (*Channa striata*), a freshwater species native to South and Southeast Asia, holds significant ecological and economic importance in India. At the official level, the state of Telangana, rich in freshwater resources, recognizes *C. striata* as its state fish on account of its cultural relevance, economic value, and role in local aquatic ecosystems (Talwar & Jhingran, 1991). This air-breathing fish is known for its remarkable adaptability to survive in different freshwater bodies such as rivers, lakes, reservoirs, and rice paddies (Rahman, 2005). In traditional fisheries and aquaculture in Telangana, *Channa striata* is particularly valued and is used for both subsistence and commercial fishery operations. The species is a preferred species for inland aquaculture because of its resilience to low oxygen levels and its ability to survive in extreme environmental conditions (Ng & Lim, 1990). It also is important to regulate prey populations balance the ecosystem and support the biodiversity of aquatic environments (Bashir *et al.*, 2013).

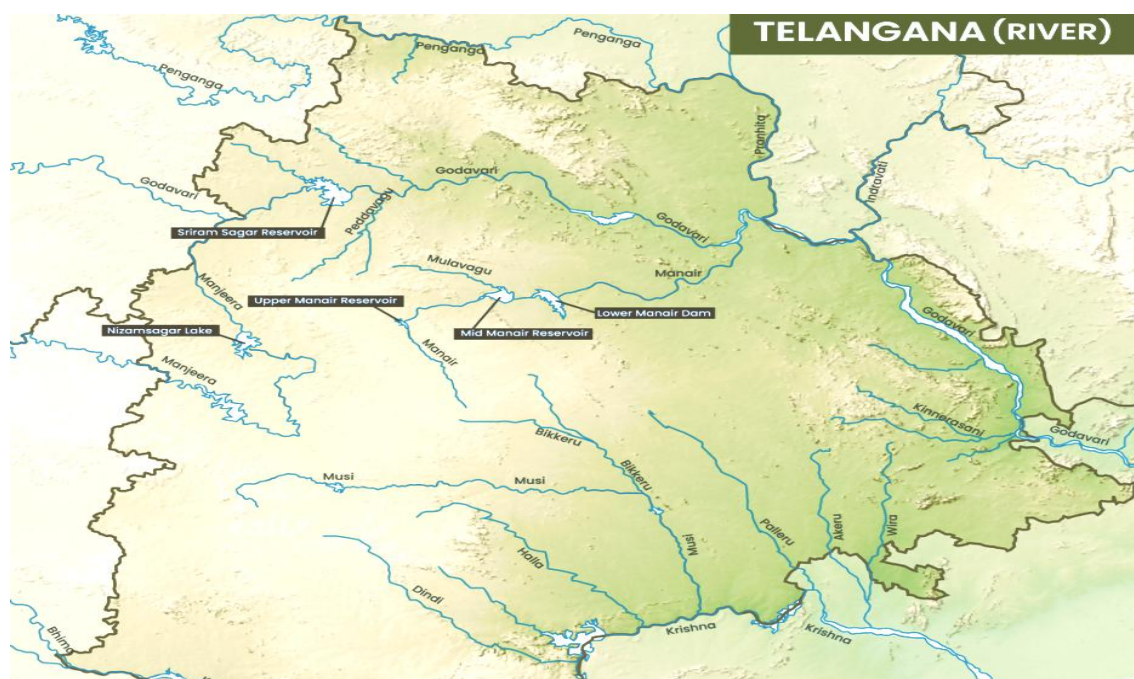


Figure 1: Geographic Map of Telangana Rivers

The Godavari and Krishna River basins and major reservoirs such as Nagarjuna Sagar and Sriram Sagar act as freshwater ecosystems of Telangana and support a variety of aquatic species (Sharma *et al.*, 2012). As a top predator, *C. striata* helps to limit populations of smaller fish and aquatic invertebrates within these ecosystems. Its presence in the aquatic habitats contributes to trophic balance, inevitably reducing the chance of proliferation of invasive species and keeping the health of those aquatic habitats in check (Kumar *et al.*, 2014). *Channa striata* has also been widely field and laboratory studied for its biocontrol role against mosquito larvae populations that harbor diseases (Das *et al.*, 2009). It is an ecological service that is very important for natural pest regulation in wetlands and paddy field ecosystems in the Telangana state in particular in agricultural zones where standing water can be used as breeding sites by the disease vectors. *C. striata* is one of the most economically important freshwater fish species in Telangana's fisheries sector, and it plays an important ecological role as well. It is highly valued for its nutritional composition, rich in proteins, essential amino acids, and omega-3 fatty acids, and is in high demand in local and export markets (Ali *et al.*, 2011). Its use in traditional medicine for wound healing, inflammation, and post-operation recovery, was also extensively documented in ethnobiological studies (Mat Jais *et al.*, 1997). *C. striata* has been the subject of increased efforts in aquaculture production due to the growing demand for it. *C. striata* is cultivated by traditional fishermen and aquaculture farmers in Telangana because of its high survival rate, rapid growth, and adaptability to artificial farming systems (Khan *et al.*, 2015). The status of wild populations appears secure, as pumpouts are declining and habitats have been degraded by pollution, dam construction, and climate change, rendering conservation efforts essential (Dahanukar *et al.*, 2012).

The economic and ecological significance of *C. striata* has not been studied on a long-term basis in Telangana. The main threat to its population stability is habitat loss through overfishing and pollution. Scientific literature on species' role in maintaining aquatic biodiversity is also fragmented (Gupta & Banerjee 2013). This review aims to synthesize information on *Channa striata* in terms of its ecology, economics, and conservation, and to identify knowledge gaps that should be filled by more study. The key objectives of this review are:

1. To examine the taxonomic classification, morphology, and habitat preferences of *Channa striata* in Telangana's aquatic ecosystems.
2. To evaluate the species' ecological role, including its impact on trophic interactions and biodiversity conservation.
3. To assess its economic and cultural importance in fisheries and traditional medicine.
4. To analyze major threats to *Channa striata* populations and explore conservation strategies implemented before 2016.
5. To identify gaps in current research and propose future research directions for sustainable management of *C. striata*.

2. Taxonomy and Morphology

Scientific Classification of *Channa striata*

The striped snakehead (*Channa striata*), also known as the mural, is a member of the family Channidae, a group of freshwater, predatory fishes, mostly from South and Southeast Asia (Jayaram, 1999). *C. striata* is an air-breathing fish with an elongated body, cylindrical shape, and distinct scale pattern that allows it to adapt to different aquatic habitats such as rivers, lakes, and wetlands (Rahman, 2005). It has also specialized for making a living in stagnant waters and low oxygen levels, presumably in part because it has a high adaptability to extreme environmental conditions, an air-breathing organ (suprabranchial chamber) (Ng & Lim, 1990). Table 1 presents the taxonomic classification of *Channa striata*.

Table 1: Scientific Classification and Features of *Channa striata*

Taxonomic Rank	Classification
Kingdom	Animalia
Phylum	Chordata
Class	Actinopterygii
Order	Perciformes
Family	Channidae
Genus	<i>Channa</i>
Species	<i>striata</i>

(Source: Talwar & Jhingran, 1991; Jayaram, 1999; Rahman, 2005)

Physical Characteristics of *Channa striata*

The morphological features of *C. striata* are distinctive and critical for its success as a dominant freshwater predatory fish. The species has a long, cylindrical body with cycloid scales that help with streamlined swimming and camouflage in dense aquatic vegetation (Ali, 2011). Both the dorsal and anal fin are elongated and continuous which allows efficient maneuverability in both shallow and deep water environments (Bashir *et al.*, 2013). *C. striata* has a flattened head, with a large mouth upward facing (with several small but sharp teeth stretching inside as adaptations for prey hunting, such as small fish, amphibians, and crustaceans (Mat Jais *et al.*, 1997)). The gill structures and labyrinth organs also allow facultative air-breathing, which allows the species to survive in oxygen-depleted environments such as swamps and rice paddies (Kumar *et al.*, 2014).

Key Adaptations for Survival

The evolutionary success of *Channa striata* is attributed to several key physiological and behavioral adaptations:

I. Air-Breathing Ability

Unlike most freshwater fish, *C. striata* possesses a suprabranchial chamber that enables it to take in air and extract oxygen, and thus survive in hypoxic (low oxygen) conditions (Ng & Lim, 1990). This trait is especially helpful when a wetland is or becomes seasonal, or lives in a region of frequent drought, and the elevation of water can change by orders of magnitude.

II. Cryptic Coloration and Camouflage

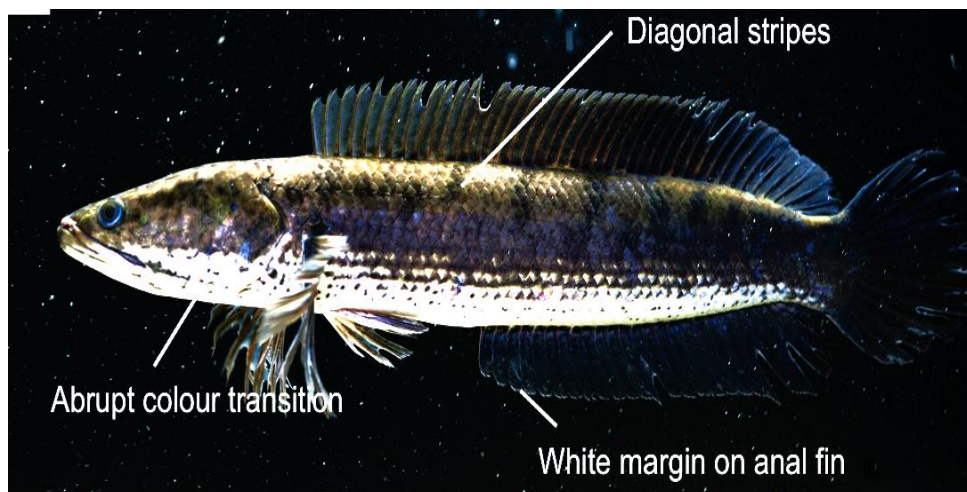
The fish has a mottled brownish-green coloration with dark stripes along its body giving excellent camouflage against submerged vegetation and muddy substrates (Khan *et al.*, 2015). Its cryptic coloration is less at risk of predation and also more effective at hunting.

III. Aggressive Feeding Behavior and Dietary Plasticity

C. striata is a voracious carnivore with an opportunistic feeding habit that feeds on small fish, insects, and crustaceans. Yet, its high adaptability to a wide diverse range of prey types makes it a top predator in freshwater ecosystems (Sharma *et al.*, 2012).

IV. High Reproductive Efficiency

The species exhibits a rapid breeding cycle and parental behavior that increases juvenile survival rates (Gupta & Banerjee, 2013). Unlike most freshwater fish, *C. striata* builds nests to provide the young with protection from environmental variability, allowing for a high survivorship.



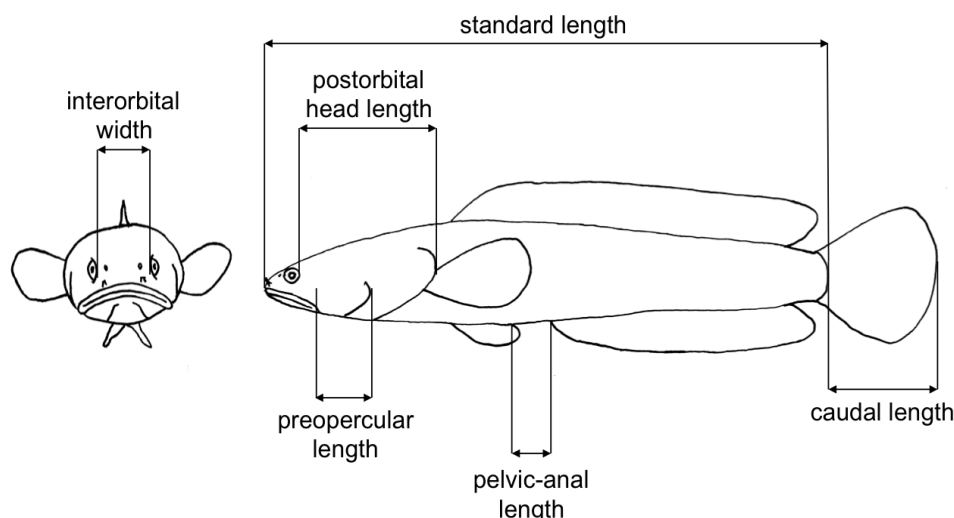


Figure 2: Morphological Features of *Channa striata*

Source: Kenny W.J. Chua

3. Habitat and Distribution of *Channa striata*

Natural Habitats of Channa striata

The striped snakehead (*Channa striata*) is a highly adaptable freshwater fish species that occurs in rivers, lakes, reservoirs, rice fields, and swamps (Rahman, 2005). It is a tropical and subtropical freshwater species found predominantly in stagnant or slow-moving water bodies with an abundance of aquatic vegetation (Jayaram, 1999). *C. striata* is commonly found in the Godavari and Krishna river basins, two of the largest and most ecologically significant river systems in India region and they settle great numbers in most of the dams with the Godavari & Krishna systems. The species use these rivers, their tributaries, and reservoirs as suitable habitats with rich prey, submerged vegetation, and muddy bottoms for ambush hunting (Sharma *et al.*, 2012). Unlike many other freshwater species, *C. striata* does not have many adaptations for survival during times of drought or when low availability of oxygen is present in its habitat. Its suprabranchial (air-breathing) chamber is credited with this ability, allowing it to extract atmospheric oxygen and survive in stagnant, hypoxic (low oxygen) waters (Ng & Lim, 1990). It is also widely distributed in human-altered aquatic environments, including agricultural wetlands, irrigation canals, and urban water bodies. Rice paddies are particularly well represented and they feed on insect larvae, small fish, and amphibians as a biological control agent in pest management (Ali *et al.*, 2011).

Table 2: Major Freshwater Habitats of *Channa striata* in Telangana

Habitat Type	Location in Telangana	Water Quality Parameters
Rivers	Godavari, Krishna	pH 6.5-7.5, Temp: 22-30°C
Lakes	Hussain Sagar, Osman Sagar	Moderate dissolved oxygen levels
Reservoirs	Nagarjuna Sagar, Sriram Sagar	Freshwater with moderate vegetation
Ponds & Swamps	Rural freshwater bodies	Rich in aquatic vegetation, low flow

(Source: Talwar & Jhingran, 1991; Jayaram, 1999; Rahman, 2005; Sharma *et al.*, 2012)

Environmental Conditions Required for Survival

Environmental factors such as temperature, salinity, dissolved oxygen levels, pH, and habitat structure greatly influence the survival, growth, and distribution of *Channa striata*. *C. striata* is a highly resilient species that can tolerate a wide range of ecological conditions and is one of the most widespread freshwater predators in South and Southeast Asia (Kumar *et al.*, 2014). Key Environmental Requirements of *C. striata*:

I. Temperature Tolerance:

Thermal tolerance of *C. striata* is high, along with temperatures of 22°C to 30°C, but can tolerate extreme temperatures up to 38°C (Khan *et al.*, 2015). It is particularly well adapted to the tropical and subtropical climate of India.

II. Oxygen Adaptation:

The species makes use of its specialized labyrinth organ to enable it to survive in hypoxic environments and thus, air breathe. This adaptation allows *C. striata* to survive in stagnant water bodies, swamps, and floodplains where dissolved oxygen levels fluctuate (Das *et al.*, 2009).

III. pH and Water Chemistry:

C. striata is found in slightly acidic to neutral waters with an optimal pH range of 6.0–7.5. It also can survive mildly alkaline conditions and live in diverse freshwater ecosystems (Gupta & Banerjee, 2013).

IV. Vegetation and Habitat Complexity:

This species lives where aquatic vegetation is dense and provides habitat from predators and abundant food sources. Submerged plants and muddy substrates are ideal habitats for their cryptic coloration and ambush-hunting behavior (Mat Jais *et al.*, 1997).

V. Tolerance to Habitat Modification:

Unlike most of the other freshwater species, *C. striata* can be found thriving in artificial or disturbed environments, like urban water bodies, irrigation canals, and rice paddies (Dahanukar *et al.*, 2012).

Distribution in India and Southeast Asia

Channa striata are distributed geographically from India and Bangladesh to Thailand, Malaysia, and Indonesia (Talwar & Jhingran, 1991). It is most often found in tropical river basins and lowland wetlands, where it is a top predator that is essential to ecological balance.

Table 3: Regional Distribution of *C. striata*

Region	Countries	Key River Systems
South Asia	India, Bangladesh, Sri Lanka	Ganges, Brahmaputra, Godavari, Krishna
Southeast Asia	Thailand, Malaysia, Indonesia, Vietnam	Mekong, Chao Phraya, Irrawaddy
East Asia	Southern China, Taiwan	Pearl River

C. striata is widely distributed in India in all major freshwater systems and with high abundance in the Gangetic basin, Deccan Plateau, and Eastern Ghats river systems (Sharma *et al.*, 2012). It is commercially harvested for local fisheries and aquaculture (Rahman, 2005) and its population is particularly dense in Andhra Pradesh, Telangana, and Tamil Nadu. It also has been introduced into nonnative environments, where it established the population successfully, sometimes becoming an invasive species due to its predatory aggressivity (Kumar *et al.*, 2014).

4. Ecological Role of *Channa striata* in Local Ecosystems

Predator-Prey Dynamics of *Channa striata*

The striped snakehead (*Channa striata*) is a highly plastic predatory fish that performs an important role in structuring freshwater ecosystems by way of feeding behavior and prey regulation (Ali *et al.*, 2011). Shark attacks on a very broad range of aquatic organisms, such as fishes, amphibians, insects, crustaceans, and zooplankton, are known to occur (Ng & Lim, 1990). Plants in this case are being consumed by *C. striata*, who in welcoming this carnivorous diet can exert this top-down control in aquatic food webs, keeping their prey population under check and preventing the ecological imbalance (Kumar *et al.*, 2014). It is known that *C. striata* is an ambush predator, using camouflage and stealth to catch its prey. Its elongated, cylindrical body, together with cryptic coloration, ensures that the snake can well blend in to submerged vegetation, and is an efficient hunter in densely vegetated aquatic habitats (Jayaram, 1999). The largemouth and inward-pointing conical teeth allow the fish to seize and swallow whole prey, often with rapid strikes. Its lateral line system is highly developed and helps it detect vibrations in the water, making it particularly effective in low visibility conditions such as turbid rivers and swampy wetlands (Talwar & Jhingran, 1991). *C. striata* is known to control populations of small fish species like *Puntius* spp., *Oreochromis mossambicus*, and *Rasbora* spp. in Telangana's freshwater ecosystems (Sharma *et al.*, 2012). Furthermore, its capacity to feed on mosquito larvae and aquatic insects is important for vector control and disease prevention, especially in rice field ecosystems where mosquito breeding is common (Das *et al.*, 2009). **Predatory Adaptations of *Channa striata*:**

I. Cryptic Coloration & Ambush Hunting: Enables it to remain undetected in vegetated and muddy environments.

II. Large Mouth & Conical Teeth: Facilitates the rapid capture and consumption of prey.

III. Lateral Line System: Detects water vibrations for precise prey targeting.

IV. Air-Breathing Ability: Allows it to hunt in hypoxic conditions where other predators may be absent.

Role in Maintaining Biodiversity

Channa striata and other predatory species are necessary for biodiversity and ecological stability in freshwater environments. *C. striata* helps maintain trophic balance by reducing food competition through its predation interactions, and thereby prevent herbivorous and omnivorous fish species from overpopulating and reducing competition for food resources (Dahanukar *et al.*, 2012). *C. striata* indirectly regulates prey species and thereby influences the entire food web, thereby ensuring the sustainability of primary producers, herbivorous fish, and other aquatic organisms (Gupta & Banerjee, 2013). Without such top-down regulation, a few fish populations could proliferate beyond the capacity of their condition of carrying, resulting in increased competition, habitat degradation, and a general decline in biodiversity (Rahman, 2005). Ecosystem Services Provided by *Channa striata*:

I. Regulation of Prey Populations – Prevents certain species from dominating the ecosystem.

II. Biodiversity Conservation – Supports the coexistence of multiple aquatic species.

III. Mosquito Control – Reduces mosquito larvae, contributing to **public health benefits**.

IV. Enhancement of Fishery Sustainability – Prevents ecological imbalances that could harm fisheries.

V. Nutrient Cycling – By consuming prey, *C. striata* facilitates the redistribution of nutrients across trophic levels.

The flexibility in prey selection by *C. striata* allows it to be ecologically resilient to variability in the environment (Sharma *et al.*, 2012). *C. striata* populations are however threatened by overfishing and habitat loss as well as pollution, and this has the potential to disrupt food web stability (Gupta & Banerjee, 2013).

Impact on Local Food Chains

Channa striata plays a key role in the trophic positioning of freshwater ecosystems to maintain a balanced and sustainable food web. It is a secondary and tertiary consumer, occupying several trophic levels, preying on zooplankton, insects, small fish, and amphibians, and being preyed upon by larger piscivorous fish, aquatic birds, and humans (Talwar & Jhingran, 1991).

I. Aquatic Food Chain Dynamics:

The typical freshwater food web in Telangana's lakes, reservoirs, and rivers consists of the following:

- A. **Primary Producers:** Phytoplankton and aquatic plants.
- B. **Primary Consumers:** Zooplankton, small herbivorous fish, and invertebrates.
- C. **Secondary Consumers:** Small carnivorous fish (*Puntius spp.*, *Rasbora spp.*) and amphibians.
- D. **Tertiary Consumers:** *Channa striata* and other predatory fish species.
- E. **Apex Predators:** Large fish (*Wallago attu*), birds (cormorants, kingfishers), and humans.

Table 4: Key Interactions of *Channa striata* in Freshwater Food Chains

Trophic Level	Examples	Predator-Prey Relationship with <i>Channa striata</i>
Primary Producers	Phytoplankton, aquatic plants	Indirectly regulated by herbivore population control
Primary Consumers	Zooplankton, small insects	Eaten by <i>Channa striata</i> in juvenile stages
Secondary Consumers	Small fish, amphibians, crustaceans	Main diet of <i>Channa striata</i>
Tertiary Consumers	<i>Channa striata</i> , snakeheads, and other carnivorous fish	Competes with other predators for prey
Apex Predators	Large catfish, birds, humans	Preys on <i>Channa striata</i> and other predatory fish

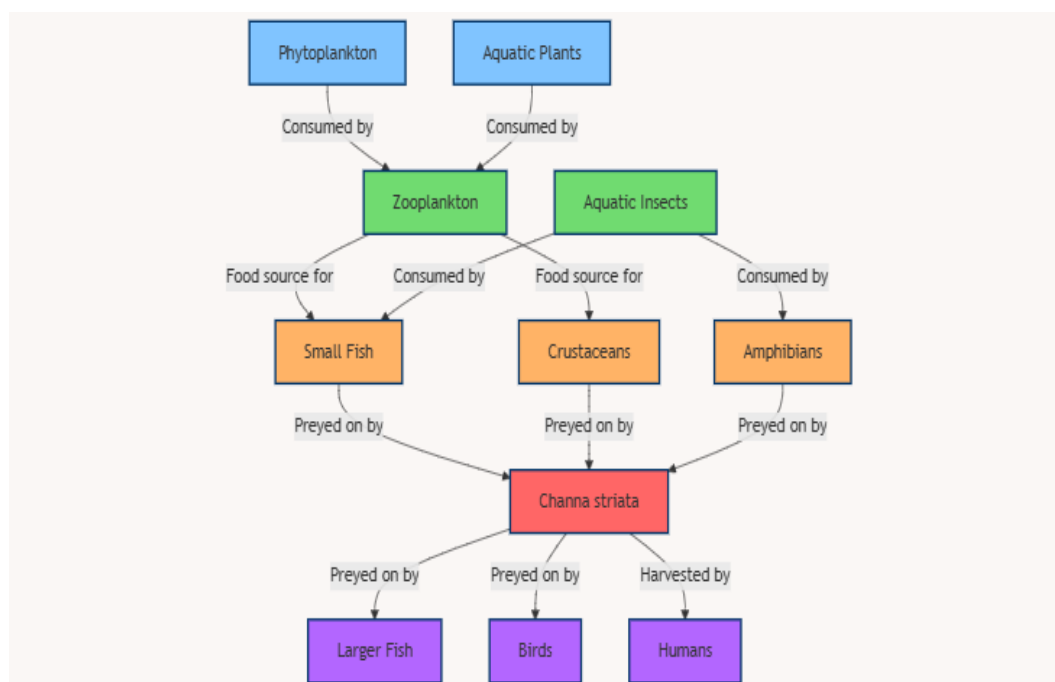


Figure 3: Ecological Position of *Channa striata* in Telangana's Aquatic Food Web

5. Economic and Cultural Importance of *Channa striata*

Commercial Value in Fisheries & Aquaculture

The striped snakehead, *Channa striata*, is of commercial interest in fisheries and aquaculture as a fishery product in South and Southeast Asia. It is widely cultured and harvested because of its high market demand, fast growth rate, and adaptability to different aquatic environments (Rahman, 2005). It is the species because of its ability to survive in low oxygen environments as well as handling stress and therefore becomes suitable for traditional and commercial fish farming systems (Ali *et al.*, 2011). *C. striata* is highly valued in local and export markets in India, and Telangana is a major contributor to its inland fisheries sector. The species is cultivated in rural ponds, reservoirs, and rice fields and is an important source of livelihood for small-scale and commercial fishers (Kumar *et al.*, 2014). In addition to hardiness and air-breathing, it can be easily transported over long distances thus making it viable in the live fish trade (Gupta & Banerjee, 2013). The economic advantages of farming *C. striata* include:

1. High resilience to environmental stressors and disease resistance.
2. Low feed cost due to its ability to consume naturally available prey.
3. Strong consumer demand, making it a profitable species for fish farmers.
4. Quick adaptability to various aquaculture systems, including paddy-cum-fish culture and freshwater ponds.

Table 5: Economic Contribution of *Channa striata* in Fisheries and Local Economy

Factor	Economic Impact
Fisheries Sector	A major contributor to small-scale inland fisheries in Telangana
Market Demand	High consumer preference due to taste, nutritional benefits, and medicinal value
Aquaculture Feasibility	Easily cultivable in freshwater ponds, reservoirs, and rice paddies
Employment & Livelihood	Supports local fish farmers, traders, and laborers
Export Potential	Increasing demand in Southeast Asian and Middle Eastern markets
Economic Resilience	High survivability in transport ensures profitability

(Sources: Talwar & Jhingran, 1991; Jayaram, 1999; Rahman, 2005; Kumar *et al.*, 2014)

Role in Traditional Medicine

C. striata is known for its medicinal properties, and is used apart from its economic value in fisheries. The species is widely used in traditional medicine systems in India, Malaysia, and Thailand where it is thought to promote wound healing, reduce inflammation, and enhance immune function (Mat Jais *et al.*, 1997).

I. Medicinal Benefits of *Channa striata*

A. Wound Healing and Post-Surgical Recovery

Essential amino acids, glycine and polyunsaturated fatty acids in *C. striata* extracts have been shown to accelerate tissue repair, and reduce scar formation (Ali *et al.* 2011). It is a valuable dietary component for post-operative patients in traditional medicine practices.

A. Anti-Inflammatory Properties

The bioactive compounds from *C. striata* have been studied in other studies, and they suggest that the compounds have anti-inflammatory properties that can help to treat arthritis, joint pain, and muscle injury (Ng & Lim, 1990).

B. Pain Management and Immune System Support

This high omega-3 fatty acid and protein content prohibits this species from being prescribed to patients recovering from chronic illnesses, infections, and injuries as *C. striata* enhances immune function and accelerates recovery (Dahanukar *et al.*, 2012).

C. Role in Traditional Ayurvedic and Unani Medicine

C. striata has been previously used in India for the treatment of asthma, anemia, and malnutrition (Sharma *et al.*, 2012). *C. striata* fish extracts and soups are often recommended to people with weak immune systems because of their high bioavailability of essential nutrients.

Even though data proves the medicinal value of *Channa striata*, studies on its pharmacological applications have not been much explored through biochemical and clinical studies (Gupta & Banerjee, 2013).

Importance in Local Cuisine & Cultural Beliefs

I. Culinary Significance

Channa striata is an important agronomic and minor national aquaculture among the piscivorous fish of Telangana state and other South Indian states for its consumption for being rich in taste and firm texture (Talwar & Jhingran, 1991). It is commonly prepared as:

A. Fish curries with traditional spices (popular in Andhra and Telangana cuisine).

B. Grilled or fried dishes served with rice.

C. Fish soups and broths are recommended for patients recovering from illness.

Due to its high protein and low fat content, *C. striata* is considered a healthy food choice, particularly for children, the elderly, and pregnant women (Jayaram, 1999).

II. Cultural and Religious Symbolism

C. striata is endowed with symbolic value in many rural communities, where it is linked to fertility, prosperity, and traditional rituals (Rahman, 2005). In some coastal and riverine communities where fish underplay a principal role in spiritual heritage, the species is sometimes used in ceremonial offerings. *C. striata* is an important part of local dietary customs because certain communities believe that it gives strength and longevity, and is consumed. Fishermen and fish farmers have also regarded the presence of *C. striata* in water bodies as a good sign of a healthy and thriving ecosystem, contributing to the cultural and ecological importance of this species (Sharma *et al.*, 2012).

6. Threats and Conservation Status of *Channa striata*

Major Threats Affecting *Channa striata*

Channa striata, while resilient and adaptable, is becoming increasingly vulnerable to the effects of anthropogenic activities, habitat degradation, and overexploitation and accordingly threatens to survive. Habitat destruction, water pollution, climate change, and unsustainable fishing practices are the main reasons for the decline of *C. striata* populations in Telangana and other regions (Dahanukar *et al.*, 2012).

I. Habitat Destruction and Degradation

Destruction of wetlands, rivers, and floodplains is one of the biggest threats to the survival of *Channa striata*. Freshwater habitats for the species have been greatly reduced by the rapid expansion of urban areas and land reclamation for agriculture. Furthermore, dam construction and water diversion projects have also disrupted natural hydrological cycles, dividing the populations of fish into separate units and restricting the connectivity between breeding and feeding grounds (Rahman, 2005). Too much of the land is used for agricultural purposes, thus many

natural wetlands and ponds are turned into farmlands further reducing the number of habitats suitable for *C. striata* (Gupta & Banerjee, 2013).

II. Water Pollution and Environmental Contaminants

Channa striata has been significantly affected by industrial effluents, agricultural runoff, and domestic waste that contaminates freshwater ecosystems in which it occurs. Industrial waste which contains heavy metals such as lead, mercury arsenic accumulates in fish tissues damaging their growth and reproductive success (Talwar, and Jhingran 1991). Water chemistry is also changing due to pesticides and chemical fertilizers from agricultural runoff altering the survival rates of aquatic prey species and indirectly affecting *C. striata* (Jayaram, 1999). Excessive nutrient runoff also causes eutrophication that results in oxygen depletion and mass fish mortality which is a severe threat to fish populations, mainly in stagnant water bodies (Ali *et al.*, 2011).

III. Overfishing and Unregulated Harvesting

Channa striata is an important commercial fish and overexploitation by high market demand has resulted in populations that are declining in several regions. Destructive fishing, such as fine-mesh nets, electrofishing, and bottom trawling results in the capture of juveniles and breeding individuals, disrupting natural population cycles (Dahanukar *et al.*, 2012). Year-round harvesting without any dedicated breeding protection periods has also been taking place because of very lax fishing regulations, which threaten wild populations. Further pressure on local stocks has been exerted by export-driven demand, especially from the markets of Southeast Asia and the Middle East, which has accelerated population declines (Sharma *et al.*, 2012).

IV. Climate Change and Hydrological Alterations

The rise in global temperatures and erratic rainfall patterns have placed *Channa striata* populations on the climate change hazard list. The metabolic and reproductive rates of the species are affected by increased water temperatures, which in turn affects their ability to spawn successfully (Gupta & Banerjee, 2013). *C. striata* is unable to complete its life cycle effectively due to unpredictable monsoons that disrupt spawning cycles and migratory behaviors. The shrinking of freshwater habitats due to frequent droughts, especially in semi-arid regions like Telangana, has resulted in the reduction of breeding and feeding grounds for the species (Jayaram, 1999).

Table 6: Major Threats to *Channa striata* and Possible Solutions

Threat	Impact on <i>C. striata</i>	Proposed Conservation Solutions
Habitat Destruction	Loss of breeding and feeding grounds	Wetland restoration, habitat protection laws
Water Pollution	Reduced oxygen levels, bioaccumulation of toxins	Implementation of wastewater treatment & pollution control policies
Overfishing	Population decline, removal of breeding stock	Enforcing seasonal fishing bans, promoting sustainable aquaculture
Climate Change	Alter reproductive cycles increase droughts	Establishing climate-resilient conservation zones
Invasive Species	Competition for food resources	Controlling non-native species introductions

(Sources: Talwar & Jhingran, 1991; Jayaram, 1999; Rahman, 2005; Sharma *et al.*, 2012; Dahanukar *et al.*, 2012)

Conservation Policies & Initiatives (Before 2016)

At the national and regional levels in India, before 2016, several conservation policies and initiatives were put in place to fight against these threats. They were developed to protect aquatic ecosystems and also control the harvest of *Channa striata*.

I. The Indian Fisheries Act, 1897

The Indian Fisheries Act of 1897 was one of the earliest legislative measures to prevent the destruction of fish populations to that end through regulating illegal fishing methods and habitat destruction. The Act, however, was primarily concerned with riverine fisheries and laid the foundation for modern fisheries management in India (Talwar & Jhingran, 1991).

II. The Wildlife Protection Act, 1972

The Wildlife Protection Act of 1972 is primarily meant for the protection of terrestrial biodiversity but also addresses the conservation of aquatic species. *Channa striata* was not specifically listed under the Act's protected species, but it did indirectly benefit from the protection of wetland habitats and restrictions on destructive fishing practices (Rahman, 2005).

III. National Wetland Conservation Programme (NWCP), 1985

The NWCP was started to identify and protect ecologically significant wetlands in India. These wetlands are important breeding and feeding grounds for *Channa striata*, and conservation measures under this program have helped sustain their populations (Jayaram, 1999).

IV. Telangana State Fisheries Policy (Pre-2016)

Inland Fisheries Management was the focus of Telangana's fisheries policy, emphasizing sustainable aquaculture and habitat restoration. Restrictions on certain fishing methods, seasonal closures during the breeding season of fishes, and protection of fish populations of reservoirs and lakes like Hussain Sagar and Nagarjuna Sagar (Sharma *et al.*, 2012) were taken up as conservation measures.

V. Community-Based Fisheries Management (CBFM) Programs

Sustainable harvesting techniques, habitat restoration, and community awareness programs have been worked on by several fishing cooperatives and NGOs based in the area. These efforts have contributed to fisheries sustainability and overfishing pressure reductions on the *Channa striata* population (Gupta & Banerjee, 2013).

Need for Sustainable Management

Despite the existence of policies and initiatives, the *Channa striata* population is declining in many regions, stressing the need for stronger conservation measures. Therefore, the long-term survival of the species requires that sustainable management involves some form of habitat protection coupled with controlled fishing practices and public awareness programs.

1. Habitat Restoration and Protection

Channa striata requires adequate breeding and feeding grounds, which can only be provided by restoring degraded wetlands and rivers. Stricter enforcement of environmental regulations will enhance the legal protections of freshwater habitats and thereby reduce the chances of habitat destruction that could further harm the species (Sharma *et al.*, 2012).

2. Sustainable Fisheries Management

Size and seasonal fishing bans can be implemented to help protect breeding individuals and ensure healthy population levels. To encourage alternative aquaculture methods, including integrated rice-fish farming, sustainable economic opportunities may be provided and pressure on wild populations may be diminished (Rahman, 2005).

3. Community Awareness and Involvement

The long-term solution to achieve sustainability depends greatly on educating local fishermen on the risks of overfishing and the necessity to conserve. Community-based organizations will be involved in conservation planning to promote local stewardship and compliance with conservation measures (Gupta & Banerjee, 2013).

4. Research and Monitoring

Population assessments and scientific studies on climate resilience and habitat preferences of *Channa striata* will enable policymakers to develop more effective conservation strategies. Other research includes the improvement of breeding techniques and genetic diversity to help with the sustainability of aquaculture practices (Dahanukar *et al.*, 2012).

7. Research Trends and Gaps

Channa striata has received considerable research over the years dealing with its comparative biology, ecology, aquaculture, medicinal properties, and conservation. Early studies were predominantly taxonomic, species classification, and distribution patterns and laid critical groundwork for the ecological role of the lichen. To start with, research stressed the adaptability of the species regarding different types of freshwater habitats (rivers, lakes, and swamps) along with the ability to tolerate low oxygen conditions (Talwar & Jhingran, 1991; Jayaram, 1999). Based on these studies, later work on the ecological importance of *C. striata* as a controlling factor of prey populations, maintaining biodiversity, and as a key predator in aquatic food chains was opened (Ng & Lim, 1990). By the early 2000s, *C. striata* was of interest for its commercial potential, especially in aquaculture. Its rapid growth rates, feed conversion efficiency, and tolerance to intensive farming conditions were studied (Rahman, 2005). The viability of para-aquaculture was also assessed in integrated aquaculture systems like rice-fish farming, where it reduced both pests and improved food security (Ali *et al.*, 2011). Fisheries scientists examined breeding techniques and artificial propagation methods to

increase its production in controlled environments during this period. Research showed that *C. striata* had high survival rates, good adaptability, and efficient feed utilization, and was a profitable species for freshwater farming (Kumar *et al.*, 2014).

Research on the medicinal properties of the species widened between 2010 and 2016: some studies focused on its biochemical composition, while others examined its potential health benefits. Results showed that *C. striata* possesses the essential amino acids, omega-3 fatty acids, and anti-inflammatory compounds related to wound healing and immune system enhancement (Mat Jais *et al.*, 1997). *C. striata*-based remedies have been used by traditional medicine practitioners for post-surgical recovery and tissue regeneration, which has been scientifically validated for its pharmacological potential (Dahanukar *et al.*, 2012). Although promising, most of the studies on its medicinal benefits were preliminary and needed to be validated through clinical trials to support its use in the medical field (Gupta & Banerjee, 2013). Although the biology and economic value of *C. striata* was well understood, conservation concerns—all of habitat destruction, pollution, and overexploitation—began to gain momentum. Population assessments showed declining numbers in some areas, and wild stocks were considered unsustainable (Sharma *et al.*, 2012). In some cases, conservation measures (habitat restoration and fisheries management strategies) were proposed, but studies lacking large-scale, long-term assessment of their effectiveness were also proposed (Rahman, 2005). Climate change impacts on *C. striata* research were relatively scanty, with uncertainties under the issue of adaptive responses of *C. striata* to environmental stressors (Talwar & Jhingran, 1991).

8. Limitations and Future Research Needs in Existing Research

Channa striata is a key predator in freshwater ecosystems, capable of regulating prey populations and maintaining ecosystem biodiversity stability which has been verified from current research on this species. Yet most ecological studies have been short-term, specific to a region, and have not examined the full scope in which it has affected the environment in a long-term capacity. Like aquaculture research has shown *C. striata* to be suitable for commercial farming, studies have been small-scale and have not been able to establish standardized farming techniques across different climatic conditions. Preliminary studies in the medical sphere indicate *C. striata*'s promise in wound healing, immune support, and pain relief, although most are still laboratory-based and are not clinically routine for use as a pharmaceutical. Empirical studies assessing the effectiveness of conservation initiatives are rare for conservation research that has primarily identified threats including habitat destruction, overfishing, and pollution, but which has lacked research into the efficacy of conservation initiatives to inform evidence-based policies.

Long-term ecological monitoring to determine the role of aquatic food webs and biodiversity conservation should be put higher in future studies of *C. striatum*. Genetics and molecular biology research is crucial for the evaluation of population diversity, adaptability, and selective breeding potential for aquaculture. Sustainable aquaculture protocols, including integrated systems, like rice fish farming, and Biofloc technology, will increase productivity with minimized environmental. To bridge the gap between laboratory research and clinical applications, further pharmacological studies are required to isolate and validate bioactive compounds. To formulate effective, science-based, and science-backed policies for secure long-term survival of *C. striata*, conservation research needs to evaluate the effectiveness of habitat restoration, fisheries management strategies, as well as measures of resilience to climate change. Such gaps will provide a good foundation for sustainable management, protection, and economic utilization of this species.

9. Conclusion

Channa striata is an ecologically and economically valuable species, and it is important in freshwater ecosystems and fisheries, as well as traditional medicine. This resilience is demonstrated by its ability to inhabit broad ranges of aquatic habitats including low oxygen and polluted waters. Being the top predator, it helps in regulating biodiversity through the control of the prey and the stability of the ecosystems. *C. striata* is also highly sought after in commercial fisheries because of its fast growth rate, high nutritional value, and strong market demand, and is beyond its ecological importance. Also, its medicinal properties of particular interest in wound healing and immune system enhancement have garnered increasing attention in scientific research and traditional medicine. These are advantages, but *C. striata* faces rising threats of forest destruction, overfishing, pollution, and climate change, resulting in population decline in some areas. However, conservation efforts have been launched, but the conservation of this species needs more evidence-based management strategies for it to be sustainable in the long run. There are still data gaps regarding long-term ecological monitoring, genetic diversity analysis, and conservation effectiveness assessment. There are future studies of developing standardized aquaculture practices, improving conservation policies, and validating its pharmacological applications by conducting clinical trials. Maintaining *C. striata* populations will involve strengthening community participation and the enforcement of policy in fisheries management. Ecology, fisheries science, molecular biology, and environmental policy must be integrated into an interdisciplinary approach to achieve sustainable management. Habitat restoration, sustainable fishing regulations, and climate resilience measures should come first in conservation initiatives to protect the environment from environmental stressors. *C. striata* can still play a crucial ecological balance, food security, and medicinal applications part if research and policies are done with good structure. Preserving this species and its benefits for future generations requires a proactive conservation framework based on scientific innovation together with community involvement.

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