

Lovesome chum of the aquarium are wreaking havoc in East Kolkata Wetlands, India

Ajmal Hussan¹, J.K. Sundaray^{1*}, Ratna Ghosal² and Suman Mallick²

1. ICAR - Central Institute of Freshwater Aquaculture, Bhubaneswar 751002, Odisha, India, *email: jsundaray@gmail.com;
2. Biological and Life Sciences, School of Arts & Sciences, Ahmedabad University, Ahmedabad 380009, Gujarat, India.



Pterygoplichthys sp.

Many of you might have seen a peculiar creature attached face-first to the glass of freshwater aquaria. These creatures are the suckermouth or armoured catfishes of the neotropical family Loricariidae. Originally native to South America, these catfishes are among the most popular freshwater fishes sold in the aquarium trade, where they are marketed as 'plecos' or 'algae eaters'. In Florida, there are currently about 170 farms where loricariids are cultured to supply the domestic demand for common varieties (e.g., *Ancistris* spp., *Hypostomus* spp., *Pterygoplichthys disjunctivus*, and *P. multiradiatus*). There is a report that in the year 2000, more than one billion wild-caught and captive-bred sailfin catfish were bought and sold in over 100 countries. Among these loricariids, *Pterygoplichthys* spp., commonly known as janitor fish, sailfin armoured catfish or in India as suckerfish, are among the most common plecos seen on sale, due to competitive prices and bulk exports from South-East Asia. Species such as *P. pardalis* and *P. multiradiatus* have been regularly bred and exported from Singapore. The problem is, when the plecos grow beyond aquarist hobbyist size, hobbyists find it difficult to accommodate them in the aquarium, and often release them into nearby freshwater sources where they can become abundant

and change the way ecosystems look and function. Once introduced, *Pterygoplichthys* establish very rapidly because of their competitive advantages over existing fish fauna due to their hardiness, and ability to feed on algae from all submerged surfaces.

Loricariid establishment pathway

The Loricariidae, otherwise known as the "armored" or "suckermouth" catfishes, is the largest family of catfishes, with around 825 nominal species, 709 of which are considered valid to date. A distinguishing characteristic of this South American fish family is their bony plate armouring that extends along three rows across their entire upper surface. The body is flattened, with the lower surface of the fish wider than the height of the fish, such that in cross-section they appear somewhat triangular. All species possess a sub-terminal mouth that is developed for sucking organic matter and algae from the substrate; hence the term, "suckermouth" commonly used to name these fishes.



Sewage-fed pond of the East Kolkata Wetlands.

The aquarium trade pathway is the most significant source of loricariid introductions globally. The demand for these fishes in the aquarium trade is such that, in North America, Loricariids are considered to be a 'bread and butter' fish of the aquarium trade. There is a report that, in United States alone, more than 170 farms are currently involved with the culture and/or breeding of loricariids to supply the domestic demand for common varieties such as *Ancistris* spp., *Hypos-tomus* spp., *P. disjunctivus*, and *P. multiradiatus*). In many countries where wild populations of loricariids have become established, many people become involved in the collection of egg masses deposited in the wild, and the subsequent incubation and grow-out of fry from these egg masses to supply the aquarium trade. States such as Malaysia, Hong Kong SAR, USA (California, Florida, Michigan), Singapore, Sri Lanka, Colombia, Vietnam, Czech Republic, Taiwan Province of China, Cuba, Thailand, Trinidad and Tobago, Brazil, Peru, Venezuela and Ecuador are already actively engaged in the trade of loricariids to meet the demand of aquarists.

Colonisation potential of loricariids

Loricariids have tolerance to a wide variety of water quality conditions and, therefore, have potential to invade both polluted and unpolluted waters. Though they prefer soft waters, in hard waters also they can adapt very quickly and thrive. They also can thrive in a range of acidic to alkaline waters (pH 5.5 to 8.0) and also a certain level of salinity. Modifications of the digestive tract function as an accessory respiratory organ, which allow these fishes to tolerate polluted environments through their air breathing ability. Loricariids,



Indigenous switch-gate in the sewage feeder channel to regulate inflow to fish ponds.



Suckermouth catfish attached to glass of aquarium are a familiar sight to the hobbyist.



Uptake of sewage water from feeder channel into fish culture bheries through bamboo fencing.

particularly species that can grow to larger sizes, can be aggressive about defending territory and can compete for food. Most species within the family are generally nocturnal bottom feeders, mainly feeding on benthic detritus and algae along with worms, insect larvae, and various bottom-dwelling aquatic animals. Most loricariids are burrow spawners, exhibit male parental care for eggs and early fry and can withstand drought conditions in stagnant water or humid burrows, because of their capability of breathing air by swallowing it and extracting oxygen through the gut lining. Moreover, these catfishes possess large-sized blood cells and large amounts of DNA per cell, which allow these fishes to down regulate their metabolism as well as tolerate changes in body fluid composition, in adverse physiological conditions during periods of hypoxia or during drought periods. Collectively, these aspects of their physiology have provided loricariids with a physiological advantage over the other less tolerant native fishes, and paved the way for their colonisation worldwide.

Sewage-fed aquaculture in the East Kolkata Wetlands and invasion of loricariids

The East Kolkata Wetlands (EKW), a complex of natural and man-made wetlands with rich biodiversity, colloquially called the “kidneys of Kolkata”, is the only Ramsar site in West Bengal and largest among the 26 Ramsar sites in India. Previously known as the Waste Recycling Region (WRR),

EKW is the world’s largest wastewater fed aquaculture system, where city sewage is utilised for traditional practices of aquaculture and agriculture. An estimated 30–50% of the sewage from central Kolkata is treated and reused by the fishponds of the EKW, prominently to culture Indian major carps and exotic carps. In general, large Indian major carp fingerlings and exotic carps of an average weight of 10–15 g are stocked @ 5–7 individuals/m². Supplementary feed is used by many farms, particularly during the monsoon season when the supply of wastewater is insufficient for the ponds¹. Mustard oil cake and mohua cake are traditional supplementary feeds, but owing to their relatively high cost, leather milk - a waste product of the leather industry, and hotel dust consisting of organic waste from hotel kitchens were also being used by many farmers. Multiple stocking and multiple harvesting are carried out with 1 kg of seed stocked for each 5 kg of harvested fish². Most farms yield from 3 to 5 t ha⁻¹ year⁻¹. Currently the wetland system produces over 15,000 MT of fish per annum from its 264 functioning aquaculture ponds, locally called bheries.

Loricarid catfish species of the genus *Pterygoplichthys* have extensively invaded the East Kolkata Wetlands in West Bengal. These non-native fishes were introduced in EKW around 2002 or 2003 by an aquarist, who released three specimens of *Pterygoplichthys* in a sewage feeder channel. It is believed that from there these fishes proliferated and invaded the water bodies of EKW and are now found in enormous numbers. The first official reports of breeding populations of *P. disjunctivus* and *P. pardalis* (Family: Loricariidae) in Gomokpota beel under EKW were made in the DARE/ICAR Annual Report (2008–2009). Since then,



Fishermen after completing a haul.



Transport of captured fishes from far end of bheries.



Loricarids captured during a seine net operation.



Harvested fishes from East Kolkata Wetland.



A seine of 0.6 ha yielded 86.2 kg of catfish (261 individuals).



Identification of loricariids based on external morphology.



Variations in ventral colouration, spot and pattern of the armored catfish taken from East Kolkata Wetlands.



Adult male *Pterygopichthys* 498, mm total length and 1.2 kg.



Berried female *Pterygopichthys* with orange coloured eggs.



Algal mat in East Kolkata Wetlands pond - a major food for *Pterygopichthys*.

because of the availability of a congenial environment for shelter and breeding in the form of water hyacinth and ample food in the form of detritus, loricariid catfishes, particularly of genus *Pterygoplichthys*, have invaded widely in the fish culture bheries of EKW, particularly through the sewage feeder channels, and proliferated profusely³.

Ecological and economic impact of loricariids and EKW

Loricariids have capacity to alter the ecosystem and biodiversity of the invasion sites, by physically altering the invaded habitats and by competing with native animals for food and space. Being large and a bewilderingly resilient bottom feeder, these catfishes reduce the food availability for natives by grazing on benthic algae and detritus, and also incidentally ingest the substrate-attached eggs of native fishes while consuming the bottom periphyton. These catfishes also plow the bottoms of the water bodies while foraging, and thus can uproot or shear aquatic plants and reduce the abundance of beds of submersed aquatic vegetation used by many native fishes as refuge and/or breeding ground. These catfishes have the capacity to sequestrate nitrogen and phosphorus of the system through their body armour, which can result in depletion of fish food organism production. In EKW, the population of once abundant small indigenous *Puntius* sp. and *Chanda* sp. has reduced drastically after the establishment of loricariid catfish. In loricariid-invaded water bodies of EKW, farmers are compelled to use an average of an additional 500,000 litres of sewage per hectare per year to maintain plankton productivity, which comes to approximately Rs. 3,000 as calculated cost. Per unit productivity of commercially cultured fish has also declined by approximately 10 percent on average in EKW due to proliferation of these catfishes. Loricariids dig deep horizontal and branching nesting burrows in the banks or dykes of the water bodies, and sometimes form a large “spawning colony” in which several dozen occur in very close proximity. These colonies can compromise the stability of the banks or dykes and also can increase erosion and suspended sediment loads. Sometimes they even occupy the burrows of other aquatic animals such as crabs or tilapia. Moreover, these fishes cause direct economic losses to fishermen by damaging fishing nets. Bruises in cultured fishes such as the Indian major carps and exotic carps, due to the hard dorsal and pectoral spines of *Pterygoplichthys* are also damaging to the fishermen of EKW economically. Moreover, additional time and labour requirements to catch the same quantity of cultured fish in haul seine fisheries due to the huge biomass of loricariids, as well as additional costs from discard fees for loricariid catfish caught are impacting economics of EKW fishers and fisheries.

Management/utilisation of loricariid catfish and EKW

Once established it is very difficult or almost impossible to eradicate these fishes. In EKW, to prevent new introductions, farmers are sieving sewage water through multilayer screens before taking it into their ponds and are also practicing intensive netting to limit upsurge of the existing population. Though these fishes are harvested in bulk daily, very few fishermen of EKW claim to have tasted these loricariids, and those mainly



Redness due to abrasion with Pterygoplichthys during haul.



A portion of a small burrow colony in dykes of bheries. Pterygoplichthys burrow openings are often triangular.



Captured loricariids dispersed on pond embankment.



Skeletons of decomposed loricariids.



Above, below: Loricariids are boiled before descaling to collect flesh for consumption.



due to curiosity. Because of their very hard external armour, these fishes are boiled in water as a whole and then descaled by hand to obtain the flesh, which is either taken plain or cooked further using spices. But in general EKW farmers are avert of eating these fishes and there is no market for them elsewhere in India as food, both for reasons of taste and smell, and as a result farmers cull loricariids taken as by-catch during commercial fishing. Moreover, because of the very high ash content and lower flesh yield, as well as the difficulty of handling due to the hard spiny outer shell, their use as ingredients, for example as fish meal for animal feed preparation or other means through value addition has not yet made any progress.

Loricariids and human health issues

Invading organisms, such as loricariids, that alter nutrient dynamics have the potential to change food availability in a system and affect all of the other organisms that depend on those resources. As farmers are throwing loricariids on the shore of water bodies to decompose, the fish constitute a source of environmental pollution and potential public health problems. Also, fishermen often injure themselves while segregating these fishes from the haul of commercial fishes, mainly because of the spiny scales.

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