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CHARRU MUSSELS: THE SILENT INVADERS THREATENING KERALA AND TAMIL NADU'S AQUATIC ECOSYSTEMS

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Abstract

The invasive tropical charru mussel (*Mytella strigata*, Hanley, 1843), originally from the coasts of South and Central America, has been documented for the first time in the Indian subcontinent, rapidly spreading through various estuarine ecosystems. Its rapid spread along the Kerala coast may have been caused by Cyclone Ockhi, a strong tropical cyclone that hit the region in 2017. By 2022, the mussel was also found in the Ennore-Pulicat stretch. Characterized by a curved pallial line, it typically exhibits a black to purplish hue with a dark orange foot. This species can survive across a broad spectrum of environmental conditions, including salinities from 3.85 to 25.96 ppt and pH levels of 7.51 to 8.07, highlighting its invasive potential.

SPECIES ACCOUNTED

Superfamily: Mytiloidea (Rafinesque, 1815)

Family: Mytilidae (Rafinesque, 1815)

Subfamily: Arcuatulinae (Scarlato & Starobogatov, 1979)

Genus: Mytella (Soot-Ryen, 1955)

Species: *Mytella strigata* (Hanley, 1843)

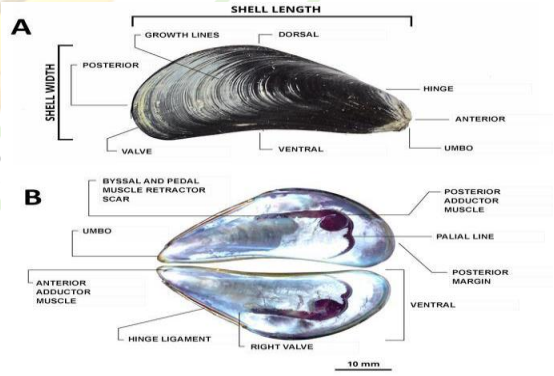

Figure1: External (A) and internal (B) shell morphology of Charru mussel

MORPHOTYPES OF CHARRU MUSSEL IN KERALA

Specimens collected from various estuaries and backwaters in Kerala exhibit a typical mytiliform shell morphology, characterized by nearly terminal or subterminal umbones. Shell color patterns vary significantly, typically displaying four primary forms:

1. Brownish anterior and greenish posterior with cross marks at the postero-lateral side; interior light purple.

2. Brownish-yellow with varying thickness of commarginal lirae; interior silvery purple.

3. Brownish anterior and greenish-yellow posterior; interior dark purple.

4. Brownish anterior and olive-green posterior; interior light purple.

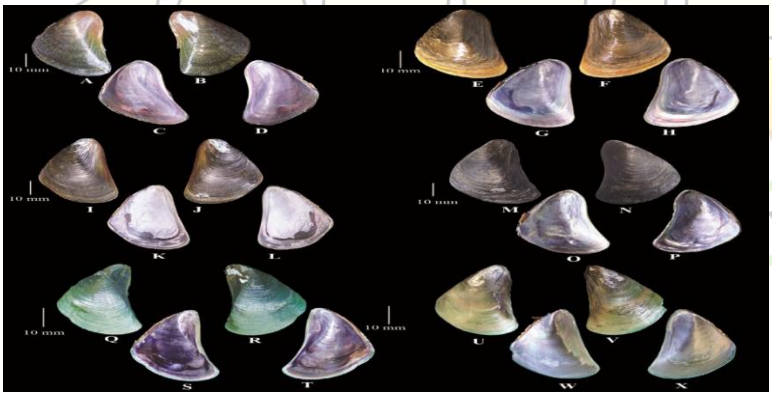

Figure 2: A-X. Morphotypes of Charru mussel collected from the Kerala coast

In all cases, the animal's body is yellowish with brown to black pigmentation along the mantle and foot. The byssus threads are fine and flattened.

MECHANISM OF SPREAD

The rapid spread of *M. strigata* has been associated with Cyclone Ockhi in 2017, which may have facilitated their introduction via ballast water or ship hulls in Kerala's backwaters. These mussels have fully encrusted wharfs and concrete structures, and they have been reported on the hulls of ships, fishing vessels, coconut pillars of Chinese fishing nets, stake nets, and aquaculture systems. Fishermen observed small patches of these mussels adhering to bridge columns and debris following Cyclone Vardah in 2016, and they have spread northward towards Pulicat waters.

DISTRIBUTION RANGE

Surveys conducted along the Kerala coast from 2017 to 2019 identified *M. strigata* in several estuaries and backwaters, including Kadinamkulam, Paravur, Edava-Nadayara, Ashtamudi, Kayamkulam, Vembanad, Chettuvai, and Ponnani. The most intensive invasion has occurred in Ashtamudi Lake, where breeding populations were established in 2018 and 2019. By 2021, the mussel had

spread northward to the Pulicat waters, infesting 11 out of 52 fishing sites in the Ennore-Pulicat stretch.

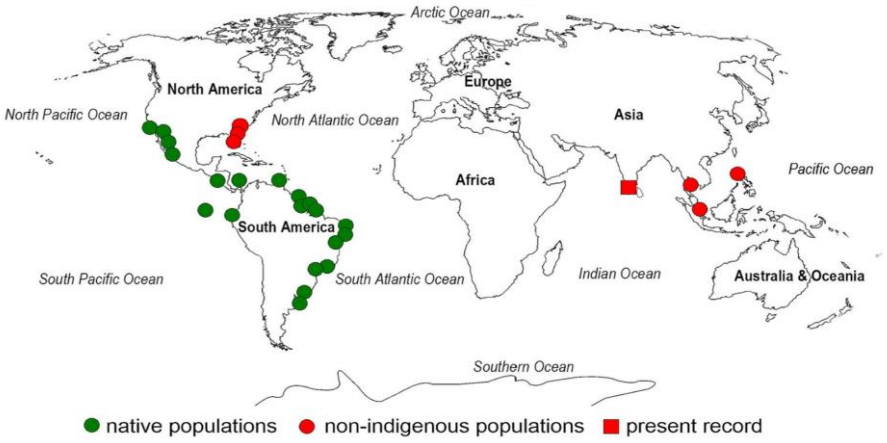

Figure 3: Distribution of *Mytella strigata*

ECOLOGICAL IMPACT OF CHARRU MUSSEL

Kerala Backwaters:

Charru mussels are significantly displacing local species in Kerala's backwaters. In Ashtamudi Lake, a Ramsar site, they have replaced native species such as the Asian green mussel (*Perna viridis*) and edible oysters (*Magallana bilineata*), disrupting established food webs and threatening local biodiversity and the livelihoods of fishermen reliant on these resources. Green mussel communities, once abundant at the estuary's mouth as late as 2017, are now found only in isolated patches. Dense beds of charru mussels inhibit light penetration, crucial for photosynthesis in aquatic plants. Their feeding habits deplete phytoplankton, essential for shrimp larvae growth, further impacting aquatic health. Fisherfolk have noted that less saline areas, used for harvesting black clams (*Villorita cyprinoides*), are also threatened, with densities reaching a maximum of 11,384 individuals per square meter.

Affected Native Species

The native species most impacted by M. strigata in India include:

- Asian Green Mussel (*Perna viridis*): Significantly displaced in areas like Ashtamudi Lake.

- Edible Oyster (*Magallana bilineata*): Faced severe competition and decline due to the invasive mussels.

- Short-necked Clams (*Paphia malabarica*): Threatened as *M. strigata* occupies the same ecological niche, leading to reduced populations.

Ennore-pulicat stretch

Mytella strigata spreads like a carpet over the riverbed, preventing prawns from

grazing or burying themselves in sediment, gradually wiping out prevalent yellow clams and green mussels. The mussels filter hundreds of liters of water daily, resulting in a clearer water column, which is disadvantageous for fishing as fish can easily spot nets. The invasion intensified in 2017 after Cyclone Vardah, and by 2021, it had spread across two kilometers.

ECONOMIC CONSEQUENCES

The charru mussel has significant economic impact for local fisheries and livelihoods in India, particularly in Kerala. Its rapid spread has displaced native species like the Asian green mussel and short-necked clams, threatening the livelihoods of approximately 3,000 fishermen. Native mussel and clam species are vital for aquaculture and the livelihoods of hundreds of fishers. The increasing populations of *M. strigata*, along with its ability to thrive across the intertidal zone, will not only diminish clam resources but also increase labor for fishers who must spend additional time removing invasive mussels from their harvests. The invasion of *M. strigata* in the Gulf of Mannar Marine Biosphere Reserve also impacts mangrove and brackish water molluscan communities.

CONCLUSIONS

The invasion of the charru mussel (*Mytella strigata*) represents a critical ecological and economic threat to India's aquatic ecosystems. This invasive species has displaced native mollusks, disrupting local ecosystems and fisheries. Its ability to thrive in various conditions has facilitated its spread, increased by human activities and natural events like Cyclones Ockhi and Vardah. The economic consequences are severe, with around 3,000 fishermen facing reduced catches and increased labor to manage invasive populations. Immediate action is crucial to mitigate its effects on biodiversity and livelihoods in the region.

Previous control measures for *M. strigata* populations have demonstrated limited effectiveness in reducing their numbers. While some strategies, such as intensive fishing efforts, have been attempted, the species' high fecundity complicates control efforts, indicating that fisheries alone are insufficient for effective population management. In response to the invasion in the Ennore-Pulicat region, the Tamil Nadu government is establishing an expert committee to develop effective mitigation strategies. Planned measures include a ₹160 crore dredging initiative to remove mussels, initiated by the Water Resources Department, along with a micro-plan for removal in consultation with local fishers.

In Kerala, similar challenges have been reported, particularly in Ashtamudi Lake, where the mussels have displaced native

species. The Kerala government is conducting surveys and implementing control measures across affected estuaries.

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livestock monitoring, weather data collection, and rapid post-disaster assessments, expediting insurance claims. As technology evolves, drones offer potential for improved rural connectivity and ongoing innovation, providing farmers with crucial data for informed decision-

making. This technological advancement not only modernizes agriculture but also supports a sustainable approach to meeting global food demands while emphasizing ecological sustainability and farming efficiency.