Mytella strigata: Emerging biofouling concern for coastal cage farmers along Kerala coast

Manju Lekshmi N.*, Neeraj Kumar, Chinnadurai S., Muhamed Ashraf P. and Leela Edwin
ICAR-Central Institute of Fisheries Technology, Cochin-29
**manjuaem@gmail.com*

The fishery sector in India provides livelihood support to14.49 million people participating in main or subsidiary activity (DADF, 2014). The marine capture fishery in the country is at plateau for the last two decades. Aquaculture is considered as a viable and rapidly growing fishery sector in India with an annual growth rate of over 7% which augments fish production as well as ensures livelihood. The increased demand for high value fish has led to large scale cage culture sponsored by government agencies in the coastal waters. The cage culture technology has been adopted at several locations along the Indian coast for all promising species, which helped to advance the design and feasibility of the cages (Aswathy & Imelda, 2020). In aquaculture cages, structure and stability play a critical role and in India high-density polyethylene (HDPE) is the commonly used netting material for cages. The netting keeps the fish in a closed structure and the mesh size of the cage guarantees the water movement. Proper water flow in cages enhances the water quality, reduces stress, improves feed conversion and reduces the mortality of cultured fish.

Cage culture in India still faces some issues during operation like unavailability of good quality seed & feed, high risk of disease within cage reared fish, accumulation of unconsumed feed, faecal wastes and excreta which cause leaching of nutrients to the surrounding waters. Besides, the nets are highly susceptible to biofouling which is a global issue in cage aquaculture (Kumari et al., 2020). Biofouling refers to the growth of unwanted organisms on the surface of any immersed structure in the sea. Biofouling of cages can cause clogging of the webbing/mesh which ultimately reduce the water circulation and creates anoxic condition resulting in reduced growth rate and mortality of fishes. In India, thousands of species belonging to divergent groups are recognized as biofouling organisms which includes bryozoans, algae, barnacles, bivalves, polychaetes, gastropods, isopods, amphipods, crabs, etc. (Kripa et al., 2012; Chinnadurai et al., 2018).

Among the foulers, American brackish water mussel *Mytella strigata*, which has emerged recently in backwaters of Cochin, has become a menace and great concern to the aquaculture farmers in Kerala. The presence of *M. strigata* was reported by Jayachandran et al., (2019) from the Vembanad Lake of Kerala, India. The invasion of this species into the coastal waters of India may be through ballast water or from fouling on ships hulls (Jayachandran et al., 2019). There is no sufficient data regarding their first settlement, but local fishermen from Kerala claim that the widespread distribution of this invasive mussel species was observed after the period around cyclone Ockhi, that struck the Kerala coast in 2017 (Biju et al., 2019). As the invasive species settle and occupy the natural environment in huge densities and dominate over the other native benthic biomass (Joshi, 2006; Sanpanich & Wells, 2019). In certain locations, *Mytella strigata* has replaced the green mussel *(Perna viridis)* and other indigenous clams (Biju et al., 2019). The major foulers from Kerala coast were bryozoans *(Electra spp., Victorella spp.)*, bivalves *(Perna spp., Mytilus spp., Ostrea spp.)* and crustaceans (amphipods, isopods, tanaids, decapods).

Mytella strigata is a euryhaline species that can tolerate salinity ranging from 2 to 40 ppt (Yuan et al., 2010) and water temperatures between 6 and 31°C (Brodsky et al., 2009). Besides, they also have a high egg-laying capacity, short lifespan and good dispersal ability (Willan et al., 2000; Boudreaux and Walters, 2006; Lim et al., 2018). Studies showed that *Mytella strigata* matures at a length of 1.25 cm and grows up to a length of 5.9 cm. They also can change sex (female to male) under starved conditions (Stenyakina, et al., 2010). The young specimens of *Mytella strigata* were found throughout the year indicating the possibility of multiple recruitments in Cochin estuary (Jayachandran et al., 2019). The maximum density of *Mytella strigata* in Cochin backwater was found to be 1451 ind./m² during 2018 (Biju et al., 2019) and the study conducted by ICAR-CIFT, Cochin in 2020 found that the density of this mussel ranged between

6000 - 25000 ind./m² with the highest density during post-monsoon period. *M. strigata* has the capacity to encrust in all structures like concrete, wood, plastics including webbings.

The coastal aquaculture activities including cage culture in Kerala begins after monsoon and at the same time spat of *M. strigata* gets colonized over the polyethylene webbings, which gradually increases the weight of the cage thereby causing a significant change in the structure of the webbing which reduces the water flow, resulting in low dissolved oxygen and high ammonia within the cages (Kumari et al., 2020). Increased weight of the cage brings about risk of structural failure and damage, which also make them more difficult for lifting and cleaning. Studies conducted by ICAR-CIFT estimated a fouling biomass of general foulers in polyethylene webbings was between 65-200 g/100 cm² while for *Mytella*, it was around 500-850 g/100 cm² which depended upon the seasons.

It is estimated that the management of biofouling requires about 25% of the total production cost (Braithwaite et al., 2007) which may bring economic losses to the fishers and also may hinder cage culture operations. Ashraf et al., (2020) developed strategies based on nanotechnology (nano copperoxide and polyaniline) to prevent the common biofoulers in the polyethylene nettings used in cage aquaculture. During field evaluation, nano coated net exhibited increased attack of *Mytella strigata.* The presence of high density of *Mytella strigata* and its attachment on cages could not be controlled by this composite having low concentration of nano copperoxide. Utilisation of high concentration nano materials are not recommended for aquaculture activities in coastal water bodies due to the leaching of metals which may lead to the problems like bioaccumulation. Hence proper management measures need to be taken up during the culture operations like changing of outer cagenet after the spat fall, standardizing feeding strategies to limit the excess nutrient flow to the water body, development and usage of ecofriendly antifouling composites to prevent settling of invasive mussel *Mytella strigata* in aquaculture cages; or else, it can become a severe menace to the emerging cage aquaculture industry in India.

Biofouling of Mytella strigata over aquaculture cages

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