

Social impact assessment of bio-invasion of *Mytella strigata* in Ennore-Pulicat wetland ecosystem

J. Charles Jeeva*, R. Jeyabaskaran, N. Rudhrumurthy, K. Diwakar, A.K. Abdul Nazar and R. Narayanakumar
Madras Regional Station of ICAR-Central Marine Fisheries Research Institute, Chennai-600 028, Tamil Nadu

* E-mail: jcjeeva@gmail.com

Ennore creek in Tamil Nadu has been supporting the livelihood of many fishing families in neighboring villages, who bore the brunt of the bio-invasion of alien mussel species, *Mytella strigata* or Charru Mussels. There were numerous studies and efforts to monitor introduced species and to study their ecological effects on native species and biodiversity, ecosystem processes, and functioning. Social aspects that related to the invasive species specifically to people and human society, however, are less studied. In this context, a field visit was made to the Ennore Creek of Kosasthalai River on 29th August, 2024. Further, the second visit was made to the affected sites along the coast of 23 kms from Ennore to Pazhaverkadu on 3rd September 2024. These field studies were undertaken with the aim of assessing the social impact of invasive mussels, externalities and the mitigative measures as perceived by the fishing communities. During the field visits, stakeholder meetings, focus group discussions and personal interviews were held with key informants and progressive fishers, using semi-structured questionnaires. The parameters covered during the focus group discussions were; major livelihood ventures

in the locale, number of people involved and average monthly income, the immediate negative consequences as experienced by the fishers in their daily walks of life, the valuable native fishery resources wiped out due to this alien invasion, health issues encountered if any, decline in number of fishing days or fishing hours per day, migration of fishers and fisherwomen to other non-fishery occupations and any ITKs in practice for mitigating the impact of this alien species. The socio economic impact on livelihood of fishers was studied with information collected from Senjiamman Nagar, a tribal dominated fishing village. The major livelihood ventures of the 120 fisher families with a population of 480 was documented (Table 1) In Senjiamman Nagar, the income from the previous day fishing reported by an active fisher with a crew size of 3 reported a catch of 3.5 kg of lady fish (Elops) which was sold at ₹400/ kg and small caranx which was sold for ₹250/-, generating a total revenue of ₹1650/-, though the fishing days per month was found to be 15 days, in which both male and female were involved, and the fishing trip is from 6 am to 5 pm in a fishing day. Depending on the resources spotted, they use the nets viz, gill nets/ cast net or go for hand picking. From



Table 1. Details of Economic activities/livelihood ventures

Economic activities/ livelihood ventures	Number of people involved		Approximate per capita income
	Male	Female	
Fishing	120	120	₹500/- per day for 15 days in a month
Sea cage farming of ICAR-CMFRI	25	25	₹20,000/- to 24,000/- per family as annual income from the 6 sea cages; for 50 families
Daily wage labour (during rainy season-2 to 3 months)	20	20	₹240-320/- per day
MGNREGS	-	30	₹380/- per day (approx. 80 days in a year)



the focused group discussion with a group of 11 respondents from a cluster of three villages viz., Nadur Madhakuppam, Kottaikuppam and Aranikuppam, it was observed that they go for fishing on rotation basis, once in 6 days on rotation basis among the three villages, and the mean fishing days in a year was reported as 60 days. It could be observed that, in a decade, their fishing days have reduced from 200 days earlier to 60 days at present. It was reported that about 50% of fishers from these three fishing villages have migrated to other non-fishery livelihoods or daily wage earnings.

Monitoring of *Mytella strigata* was done regularly in Ennore Creek. It was found attached to protective walls, bridges, pillars, and artificial structures, forming dense mats, covering the benthic layer, altering the benthic community structure, changing the sediment composition and outcompeting native green mussel *Perna viridis* and rock oyster *Crassostrea madrasensis*. Samples were collected from 9 different sites of Ennore Creek i.e.,

1. VNC Bridge Conveyer Belt,
2. Kattu Bridge,
3. Jalli Kuzhi Bridge,
4. Subaar Aazham Bridge,
5. Puliymaram Conveyer Belt,
6. Karukkumaram Bridge,
7. Kandachedi Bridge,
8. Kattupalli Bridge,
9. Hot water discharge point.

Among these stations, the native oyster *Crassostrea madrasensis* and the Windowpane oyster *Placuna placenta* were observed only in the VNC Bridge conveyer belt area. Another native species of Green mussel *Perna viridis* is present only in Pulicat Lake. It is wholly vanished in the Ennore Creek area. The density of Charru mussel was higher in the Puliymaram Conveyer Belt area (688 numbers per square meter area). The abundance of mussels was high in intertidal shallow areas and along the bridges. Most of the Ennore Creek area depth is less than 1 feet. Hence, the fishing boat movement is very much affected. The maximum depth of the creek is 2.70 metres. The abundance of Charru mussels' presence is much less in deeper regions.

Negative externalities as perceived by the fishers were recorded. It could be understood that the valuable fishery resources wiped out due to this alien invasion were; clam, Green mussels, White shrimp (earlier it constitutes 90% of the catch), Tiger shrimp, mullets, and Mud crabs. Diversified livelihood avenues such as handpicking of shrimps and crab fattening too were also hampered. Earlier the fishers used to do crab fattening by releasing the crabs in ponds for 20 days, which used to fetch from ₹300/- per kg for the un-fattened crab to ₹1500/- per kg for fattened ones. Presently, crab fattening has vanished due to the reported high mortality, due to domination of this alien species .

Majority of the fisherwomen, who were in the vending of shrimps, fish, crabs and green mussels have moved out



Infested sites in the Ennore wetlands



of fisheries into non-fisheries occupations as daily wage labourers. Mainly the creek is the bed of shrimps, the resources take shelter in the creek for breeding, then move to sea; presently, the creek water has been polluted to a greater extent, both due to the invasion and industrial pollution, affecting the passage and flow of water, which ultimately affects the flow of resources, and its breeding. Hot water discharged from thermal plant also leads to resource depletion. Reduction in the taste of fish caught from the creek was reported by about 20 per cent of fishers and consumers. Other negative externalities include physical damages to the fishing gears, physical injuries such as injuries in the foot as the fishers used to get into the creek for fishing (injuries are cured by self-stitching of wounds and cuts with ordinary twines used for stitching clothes), and injuries in the palms on manual hand picking of shrimps. Health issues encountered if any could not be ascertained due to this alien invasion, as it has not been tried for edible purpose so far, for the reasons such as the meager meat content and, its suitability for edible purposes is yet to be ascertained.

Mitigative measures for invasive *Charu* Mussel management as

perceived by the local fishing communities was also recorded. They felt that frequent deepening of the Ennore creek should be done to facilitate boat movement. They said that fishing is their primary main source of livelihood, which is drastically affected due to the depth of the creek has been reduced to a minimum of 1 feet. Manual removal of invasive mussels is possible on all the bridges crossing the Ennore Creek and the base of the electric transmission towers. The deepening of the midway (central portion) of the creek should be done by mechanical methods. The mussel growth in the intertidal shallow area can be removed manually, in order to prevent shore erosion. Most fishermen are interested in doing this job as it will provide them with an additional source of income. A village-level invasive mussel management committee can be set up to organize the eradication process, which will rely on the efforts of local fishermen. Manual removal, while labor-intensive, is highly effective in removing both live and dead mussels, thus restoring the natural state of the waterbody. This method involves techniques such as scraping and digging to extract the mussels from their habitat. The shells of *Charu* mussel, dredged out can be tried/ experimented as raw materials for the nearby lime and poultry industry.



Field visits and sample collection from infested sites



Meat content in the Green (left) and Charru mussel (right)



Processing of the shells of Green mussel for poultry feed and lime industries

Sunnambukualm near Gummidipoondi. They procure clam shell/ green mussel shell powder for poultry industry and for lime industry. Though for the past 40 years clam and green mussel shells were used, it was observed that the present day raw materials also consist of the shells of Charru mussels (though they are unaware about the presence of Charru mussel shells too along with other raw materials). Hence, it can be dredged and the raw materials can be diverted to the lime industry after assessing its suitability for this industry. Due to meagre meat content (average of 2.0 g only), and for the reasons yet to be found out, Charru mussels have not been tried as food; its suitability for edible purposes may be ascertained. Any processing methodology for making it edible may be explored.

The native edible green mussel *Perna viridis* population has vanished due to the invasive mussels. Replenishment of green mussels' stock is much needed to restore Ennore Creek and Pulicat Lake. ICAR-CMFRI has hatchery and culture technology for green mussels. Many Kerala fishermen were trained by ICAR-CMFRI, and they are culturing on their own. Development of research on the effect of deepening of water

bodies and removal of invasive mussels on fisheries would contribute to better management. The invasive mussels should be subsequently monitored for three consecutive years. Future directions of research and research areas proposed are;

- Investigate the impact of eradication of *Mytella strigata* and restoration of fishery in Ennore Creek,
- Socio-economic impact assessment of invasion of alien mussels on fishermen's livelihood in Ennore-Pulicat wetlands, and
- Biological control of invasive mussels by the sea ranging of gastropods and bivalves.

From social perspectives, in-depth studies are required on database on socio-economic indicators of marine fisherfolk, sector-wise livelihood status of sea-going and creek-dependent fisherfolk, document on category-wise quantum of welfare measures and corporate social responsibility-benefits realized from the industries, impacts of selected livelihood improvement programmes, and policies for sustainable livelihoods.