Impact of plastic litter - a quantitative and qualitative investigation in selected mangrove distributions, Kerala, India

Shylaja G.*, Kripa V. and Ranith Raj

ICAR-Central Marine Fisheries Research Institute, Kochi-682 018, Kerala

*E-mail: g.shylajacmfri@gmail.com

Mangrove forests possess an incredible biodiversity and the ecosystem services they provide include food, shelter and nursery to number of species. The services they contribute to human are also valuable as their capacity to protect us from natural disasters namely shore line stabilization, carbon sequestration and many more. But, today the developmental pressures caused by growing human population seriously impacts this fragile ecosystem resulting in its degeneration to a great extent. Apart from the pollution caused by thermal, agrochemical, heavy metal and oil spill, one of the burning issues which results in its imbalance today is the accumulation of non-degradable plastic litter, which gets entrapped in the root system caused due to mismanaged waste disposal. The partially emerged root system of mangroves forms an effective filter that attenuates wave energy and turbulence and may possibly trap objects transported by currents, like floating plastic objects. (Horstman *et al*., 2014; Norris *et al*., 2017). This results in preventing gas exchange and releases harmful chemicals associated with plastic materials.

The study for assessing accumulation and quantification of non-degradable litter was conducted in the selected mangrove fringes of Ernakulam district. Twelve stations were fixed for the survey, six on the southern side of bar mouth (Kannammali, Kandakadav, Kumbalangi, Kumbalam, Nettoor, Panangad) and remaining on the northern side (Valllarpadam, Panambukad, Mulavukad, Puthuvyp, Njarackal and Mangalavanam).

Fig.1 A view of the Mangrove area of Kumbalangi eco-tourism village

Fig 2. Accumulated Litter in the mangroves of Nettoor, adjacent to Maradu vegetable market.

For macro litter sampling, visual census survey was conducted in these locations with a 1x1 m^2quadrat and the number and type of items present were counted, to estimate the abundance as per UNEP (2009) guidelines. The observed litter quantities were raised to a 10 sq. m area and classified to give litter codes based on their material composition (PL) and their form (Remote Litter Class, RLC).

Sediment samples were taken with a Van Veen grab, in triplicate for estimating the microplastic abundance in the area. Grab samples were processed as per NOAA protocol (Masura *et al*., 2015).The micro plastics were size fractionized after extraction and categorized as per their shape, colour, dimension and material composition. Identification of the recovered plastics were validated with Fourier transform infrared spectroscopy (FT-IR).

Environmental parameters like water salinity, temperature, pH, total suspended solids, dissolved oxygen and biochemical oxygen demand of the selected sites were also analysed. Sediment characteristics like pH, oxidation reduction potential, salinity, soil texture, and abundance of benthic fauna were also estimated.

To study the impact of plastic litter on benthic community on controlled conditions, a simulation experiment was designed and conducted in two selected mangrove soils, one at Mangalavanam and the other at Njarackal. Double layered woven plastic sheets of size 2mx 2m were laid above the substratum in triplicates, in both the locations, with proper mooring, simulating a situation similar to settling of macroplastic in mangrove area. Sediment sampling was done every third month for a period of one year, for assessing, the impact on abundance on micro plastics and benthic faunal community structure and other ecological changes.

The survey indicated that the accumulation of macro plastics and bundled solid domestic waste were more, where anthropogenic accessibility was high. Macroplastics were found to be entrapped in the root system resulting an anoxic condition and subsiding the aesthetic look. Protected areas like Mangalavanam and Puthuvup (Fisheries station) were seen almost clean since public access to these locations are restricted.

The study revealed that, there is statistically significant variation in micro-plastic content across different locations with maximum plastic count from Kumbalangi and Panangad locations ($F(1,114) = 1.397$, $p<0.05$). Simulation experiment indicated statistically significant reduction in benthic communities ($F(1,19) = 4.613$, $p<0.05$). Details of the survey and the simulation experiment along with recommendations for healthy mangrove ecosystems are presented.