

## Influence of river discharge on deposition of marine litter

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Marine litter refers to any manufactured or solid waste entering the marine environment through land, river or sea irrespective of the source. UNEP/IOC has included the following items in the list of marine litter- plastic (moulded, soft, foam, nets, ropes, buoys, monofilament line and other fisheries related equipment, smoking related items such as cigarette butts or lighters, metal (drink cans, bottle caps, pull tabs), glass (buoys, light globes, fluorescent globes, bottles) processed timber (including particle board), paper rubber and cloth. The two major rivers in Mangalore are the Gurupura and the Nethravati River. Both these rivers are of immense importance to the city and it drains into the Arabian Sea. With the variability in weather due to global warming, experts have predicted that it will intensify the hydrologic cycle, resulting in increased flows in the initial few decades but substantially reduced flows thereafter. Hence, river discharge and its management are crucial for the supply of drinking water to the urban and rural population. The complex changes in water availability due to climate change are yet to be understood. An increase in mean temperatures could increase the energy flux for evapo-transpiration. This implies that there could be increased potential for evapo-transpiration in the forests which could trigger changes in the environment. For the agriculturalist this could lead to changes in crop seasons. For the fishermen it could lead to changes in the catch composition. Temperature differences drive the currents. With the winter being colder and summer hotter this influences the timing of the southwest and northeast monsoon.

The Nethravathi and Gurupur estuaries form a transition zone between river and ocean. They are subject to both marine influences, such as tides, waves, and the influx of saline water and riverine

influences, such as flows of freshwater and sediment. The inflows of both seawater and freshwater provide high levels of nutrients in both the water column and sediment, making estuaries the most productive natural habitats. Studies in Gurupur River and nearby coastal beaches of Panambur, Thannerbhavi and Chithrapur have shown that with reduced freshwater flow and increasing sea level pressure, the tidal influence will prevail resulting in lesser flushing out of river water and deposition and accumulation of marine litter. This was observed in Gurupur River (Fig. 1) where large amount of litter accumulated during the high tide on the banks of the river. Changes in intensity of rainfall can lead to varying discharge of rivers and the sedimentation profile of the river. Lesser discharge from river during summer can cause more deposition of debris near the bar mouth and banks of the river. The mangroves act as excellent filter in the river banks and prevent further movement of larger debris entangled. Marine litter in the beaches was observed to be highest during monsoon.

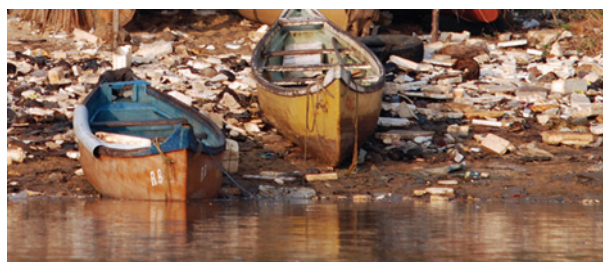


Fig. 1. Marine litter deposited in river bank of Gurupur during high tide

Monitoring and awareness campaign conducted in and around Mangalore by CMFRI and various other organizations has brought about positive changes in the beaches of Mangalore as well as estuarine area. Beach cleaning activities were taken up at

Thanneerbhavi and Panambur beaches. At Thanneerbhavi there was a reduction of 76% in the weight /m<sup>2</sup>/year of marine litter and 56% reduction in the number of items/ m<sup>2</sup>/year compared to the previous year. In Panambur beach the litter from fishing nets is removed and dropped there by the fishermen. There was a reduction of 8% in the weight /m<sup>2</sup>/year and 19% reduction in the number of items/ m<sup>2</sup>/year. But in Chithrapur there was an increase of 5% in the weight /m<sup>2</sup>/year of marine litter and a decrease of 12% in the no: of items/ m<sup>2</sup>/year compared to the previous year. There was not much cleaning activity in the beach and also increasing current during monsoon period brought about large amount of debris from the river. Climate change and resultant sea level rise will lead to increasing loss of the beach due to erosion. This also leads to considerable burial of marine litter and further fragmentation by mechanical action of sediment and wave force. This further transports the beach debris far out into the sea.

The gut of Common dolphinfish (*Coryphaena hippurus*) was found to contain plastic bits of milk cover and other unidentified bits (Fig. 2). Identifying the bits of litter and its origin is an important step towards management of waste. Small pelagic fish like oil sardine and mackerel were also observed to contain strands of nylon and plastic in the gut. Marine litter was also observed in the



Fig. 2. Plastic bits and partially digested fish in gut of Common dolphinfish (*Coryphaena hippurus*)



Fig. 3. Polychaete attached to nylon fragment at 6m depth off Chithrapur

fishing nets and benthos at 6m depth off Chithrapur (Fig. 3). Fish egg mass attached to nylon rope was observed in the trawl net off Mangalore (Fig.4). Litter often hits the fishing boat propeller which puts the fishermen life at risk. The highest percentage of item of debris for all the stations combined was assorted group consisting of cap, spoon, small sachets, syringe, paste tube, straw, pen assorted, plastic bits, bead, hair clips and the plastic and nylon ropes followed by thermocol and sponge. Thermocol and sponge is basically polystyrene products made from petroleum and are used as packaging material. But the biodegradation of this is very less. The plastic bags photo degrade, break into smaller more toxic polymers and could enter the food chain.



Fig. 4. Egg mass attached to nylon rope found in trawl net off Mangalore

Paid access to public places is one of the best ways to manage, as seen in Gurupur “Kudru” where now the amount of debris accumulated is very less as whatever comes from upstream is cleaned by people managing the place (Fig. 5). Rather the rivers

are the veins that supply nutrients to the ocean which acts like a heart purifying the water and supplying nutrients to various life forms. Our civilizations that started around the rivers will choke to death if we continue to ignore and dump litter.

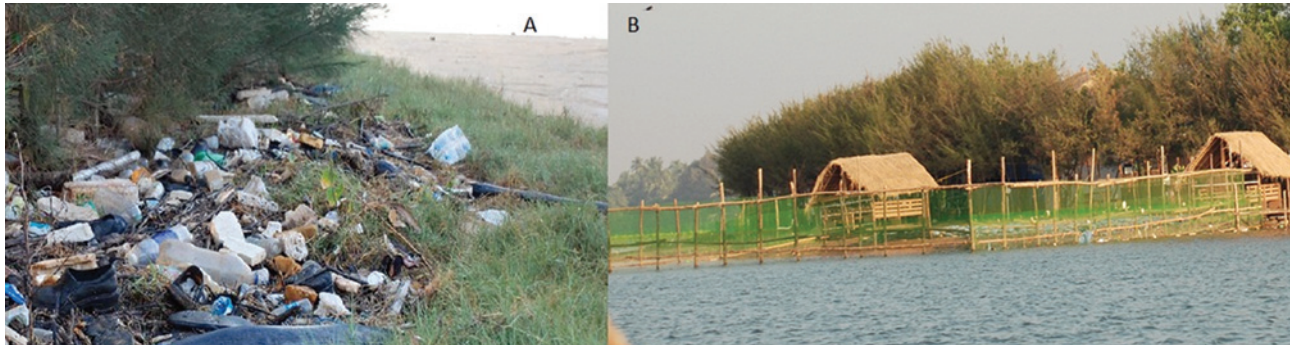


Fig. 5. Kudru in Gurupur river in 2011(A) and in 2013(B)