Puducherry mangroves under sewage pollution threat need conservation

Indian mangroves have a rich diversity of soil-dwelling organisms which include micro, meio and macro forms. Mangrove ecosystem provides an ideal nursery and breeding ground for most of the marine and brackish water fish and shellfish. India has only 2.66% of the world's mangroves[1], covering an estimated area of 4827 sq. km. The present study area lies within the margins of lat. 11°90′107″–11°90′703″N and long. 79°80′547″–79°81′851″E. Mangrove exists as fringing vegetation over 168 ha distributed along the sides of Ariankuppam estuary, which empties into the Bay of Bengal (Coromandal coast) at Veerampatinam on the southeastern coast of India[2].

Mangroves are woody trees and shrubs and are known as Sathuppu Nilakadukal in Tamil. Mangrove forests, though common and widespread, are highly threatened. Local communities along with their knowledge about the mangroves are also endangered, while they are still underrepresented as scientific research topics[3]. Mangroves have played an important role in the economics of our coastal population for thousands of years, providing a variety of goods and services, including wood production, support for commercial and subsistence fisheries, aquaculture, salt production and shoreline and coastal erosion control.

The human influence on mangroves has increased over the past three decades, with many countries showing losses of 60–80% or more of the mangrove forest cover that existed in the 1960s; but most of the data showed variable loss rates and there is considerable margin of error in most estimates. The destruction of mangroves is usually proportional to human population density. Major reasons for destruction are urban development, mining, agriculture, overexploitation for timber, aquaculture and overfishing, which can cause imbalance in the mangrove fish communities[4,5]. The remaining mangrove forests are under massive pressure from clear-cutting, encroachment, hydrological alterations, fertilizers and pesticides, oil spills, storms and climate change[5].

In the present study a small patch of mangrove forest in the Puducherry coast, southeast of India was studied (Figure 1). The channels in the mangroves are lined by a luxuriant vegetation of small salt marsh plants, trees, shrubs and thickets, totalling about seven true mangrove species belonging to three families, 16 mangrove associate plants belonging to 12 families recorded in the study area[2]. The *Avicennia* zone forms a small patch of *Avicennia marina* and *A. officinalis* dense stand at the mouth region of estuary of Veerampattinam. The *Rhizophora* zone has four patches of *Rhizophora mucronata* and *R. apiculata* on the southern part of Thengaithittu and four patches of *R. mucronata* and *R. apiculata* near the mouth of estuary. The *Acanthus* zone – *Acanthus ebracteatus* and *A. ilicifolius* forms dense stand at the western and northern side of Ariyankuppan and Murungapakkam. *Bruguiera cylindrica* spreads from the western end of Murungapakkam up to the eastern end of Ashram Islet. *Avicennia* and *Rhizophora* mixed zone spreads near the bridge. The Sunnambar lake reservoir is the main source of water supply to the Puducherry coastal area; the stream travels a long distance and joins the sea at Veerampattinam. Various industrial effluents join the stream and are finally discharged into the inner harbour waters.

Figure 1. A view of Puducherry mangroves.

In recent years we have conducted benthic surveys in various stations of Puducherry mangroves, and found small and unrecorded species[6,7]. A total of 76 species were recorded from all the four mangrove stations. This includes mollusks 37 (bivalves 16 and gastropods 21), crustaceans (22), amphipods (7), polychaetes (6), barnacles (3) and oligochaetes (1). Five species of turtles were found in the coastal water and the Olive ridley turtle was found to be nesting in the Puducherry coastal area; this needs to be protected. In Puducherry the mangroves are increasingly being threatened by population pressure, aquaculture operations and mangrove environment conversion to new shrimp ponds, dredging for landfills, and building ports, industrial estates and housing estates for human habitation[8]. Puducherry coastal area is being polluted due to the discharge of industrial, domestic and agricultural wastes through small tributaries and channels into the Bay of Bengal[9]. Satheeshkumar and Khan reported that dissolved oxygen concentration ranged from 3.71 to 5.33 mg/l and sulphide level was high (40.43 mg/l). Moreover, the piercing odour of H_2S from deeper sediments could also be smelt during the field study.

The immediate need is to maintain the existing sewage treatment plants so that effluent discharge has a minimum of suspended solids. Thus the Puducherry mangroves need urgent monitoring. In addition, maintenance of the undisturbed areas should be a primary objective, as they represent a constant macro faunal diversity.

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Wild boars: is elimination the way forward?

The wild boar (*Sus scrofa*) is suddenly the 'most popular mammal' in Kerala. The latest decision of the Kerala Government to permit the shooting down of crop-raiding wild boars has sharply divided the state's ecologists and environmentalists. Whether to 'shoot it down' or just 'shoo it away' is now hotly debated.

In the tropics, human population growth[1], habitat encroachment[2], changes in land-use patterns[3] and problems in the implementation of nature conservation measures[4] are some reasons for man–wildlife conflicts. Encountered in all continents, except Antarctica[5,6], the wild boar has a high reproductive rate, potentially breeding year round[7]. Man–wild boar conflict continues to be debated because of the inadequacy or ineffectiveness of any single strategy to stop it[8].

Opportunistic omnivores, the wild boars have a marked preference for plant food[9]. Their foraging patterns are strongly influenced by availability[10]. Crop type[11,12], distance of the crops to forest[11], crop ripening period[13], population density[14] and availability of natural forest foods[11] and season of the year also influence crop raiding. Are various abiotic stresses like wild fire, over harvesting by herbal medicine suppliers and drought reducing the wild food base of wild boars? Wild boar is also a crucial link in the forest food chain, as it is an important prey species for larger carnivores. They also 'till the land' exposing the 'soil seed banks' and aid plant germination. They also devour insects, mice and other detrimental organisms[15].

In a forest setting, food 'hunting' by wild animals is a normal survival behaviour. Field crops raised close to the foraging domain of the wild ungulate are easy prey for them. Given an opportunity, they will raid and harvest crops. We still have no evidence of 'habitual offenders' from the world of wild animals, who prefer agricultural crops to wild food. Crop raiding by wild boars is an adaptation behaviour in the wake of both the loss of its natural habitat and progressive decline of its natural wild food base. Easy access to more energy-rich food resources may also have triggered a behavioural (abnormal?) pattern. Interestingly, wild boars also raid crop lands for habitat requirements, like 'wallowing'. But like 'man-eating tigers', 'crop-raiding' wild boars also needs to be managed. Logically, we will have to keep these 'raiders' away from the crop fields on a permanent basis. Use of force has limited options in a crop-raiding scenario involving bigger mammals. Permission to wield guns will only open a Pandora's box, not only for the State Forest Department but also for the police, the peoples' representatives and the judiciary as well.

As the foraging behaviour is strongly influenced by the potential escape cover[16], one viable strategy will be to keep the farm boundaries clear of palatable vegetation. Designing open space buffer zones between croplands and forests can considerably reduce damages[17,18]. In Kerala, crops such as mango ginger (*Curcuma amada* Roxb.), which wild boars detest, have been profitably planted in fields bordering forests. Kerala farmers have a variety of time-tested wild-boar snares which can be good deterrents. Wild boar-proof fences are another option (http://www.wild-boar.org.uk/pdf/WildBoar_fencing.pdf). Electrical (solar-powered too) fencing is another successful deterrent[19,20]. In the West, trained dogs are effective deterrents. In the rubber plantations of central Kerala, white-coloured plastic sheet fences create panic in the herd (Figure 1). 'Field patrolling' by farmer groups on a regular rotation basis can also be a successful crop protection strategy.

Compatible crop combinations are fundamental for the success of any farming activity. Likewise, cropping patterns should also consider the likely threat perceptions from possible biotic factors (e.g. the wild boars) of an area. Financial and technical support must be given to identify the high-risk croplands (which suffer from biotic stresses) of the state and design appropriate 'farm plans'. In a land-scarce state like Kerala, farm produces have tremendous social values and implications in food security. The Government must also consider introducing appropriate crop insurance schemes for these high-risk croplands to mop up the financial loses in the event of a crop raid.