Land use changes and water quality of Sal River in Goa

Bindu Sulochanan, Lavanya, S., Sampath Kumar, G., Prathibha Rohit and Kripa, V.
Mangalore Research Centre of CMFRI, Mangalore

In the last few decades large scale development of coastal areas has accelerated world over. Several coastal areas have changed from virtual wilderness to haphazardly developed stretches full of concrete buildings and related structures leading to altered ecosystems, land use patterns and the coastal zone landscape. In Goa, this is a sensitive issue mostly with conflict between real estate developers and environmentalists who wanted to conserve areas based on ecological and environmental principles.

Based on recent reports of mortality of short-neck clam *Paphia malabarica, in-situ* observation was conducted on 1.5.2014 from four sites along river Sal. The local fishermen stated that the mortality commenced from March 2014. The site where clam mortality was reported is adjacent to Cavelossim and Mobor. Station 1 and 2 are clam bed sites, station 3 is the river mouth opening to the sea, Station 4 is the site where sewage effluent enters Sal (Fig.1). Oyster beds were observed adjacent to Station 2 which is a clam bed area. Shucked oyster shells were also observed on the river bank, on the upfront of which the hotels and restaurants were located. On the banks as well as upstream of the river, litter was observed (Fig. 2).

Fig. 1 Sampling locations along river Sal

Fig. 2. Oyster shells on river bank

Fig. 3 Litter in river Sal

Developmental activities and impact of urbanization

Cavelossim is an area of high dunes where resorts, hotels and new dwellings are being constructed. Several dune areas have been flattened; sand removed and transported elsewhere. Mobor is occupied by star hotels, resorts and other structures built on sand dunes; and also a former site of sand mining. But at present Goa government has banned sand mining.

The plankton, water and sediment samples were collected from Stations 1 & 2 while only water samples were collected from Stations 3 & 4. The results of parameters estimated are given in tables 1 and 2.

Table 1. Water quality parameters observed in river Sal

Parameters	Stn. 1	Stn. 2	Stn. 3	Stn. 4
Atmospheric temperature (°C)	34.5	32.5	31	30
Surpace water temperature (°C)	32.8	33	32.8	32.6
pH	7.24	7.25	7.26	7.07
Salinity (ppt)	34.7	34.8	34.8	6.2
Dissolved oxygen (DO) (mg/l)	5.9	6.5	6.7	5.04
Phosphate (μg-at/l)	0.226	0.726	0.171	9.104
Silicate (μg-at/l)	8.445	9.189	8.036	107.29
Nitrite (μg-at/l)	0.341	0.127	0.178	3.59
Nitrate (μg-at/l)	1.116	0.441	0.6	7.903
Ammonia (μg-at/l)	0.871	0.906	0.949	102.08
Chlorophyll a (mg/m^3)	5.307	1.769	4.004	61.55
Chlorophyll b (mg/m^3)	0.847	0.282	0.479	0
Chlorophyll c (mg/m^3)	4.73	1.599	1.873	17.153

Table 2. Water quality grading as per US EPA 2004 at the four stations

Stations	DO mg/l	Quality	DIP-mg/l	Quality	DIN-mg/l	Quality	Chlorophyll mg/m^3	Quality
Stn. 1	5.9	Good	0.007	Good	0.0323	Good	5.307	Fair
Stn. 2	6.5	Good	0.022	Fair	0.021	Good	1.769	Good
Stn. 3	6.7	Good	0.005	Good	0.024	Good	4.004	Good
Stn. 4	5.04	Good	0.282	Poor	1.59	Poor	61.55	Poor

Fig. 4 Culture pond between mangroves and coconut plantation

The water quality at station 4 which is very near to the sewage treatment plant was observed to be good. Mangroves of fringing type were observed on the banks of river. Its roots prevent litter from reaching the river and also in the stabilization of sediment. This helps in maintaining the water quality of the river. Destruction of mangrove area for culture ponds and coconut cultivation was also noticed downstream of Station 4.

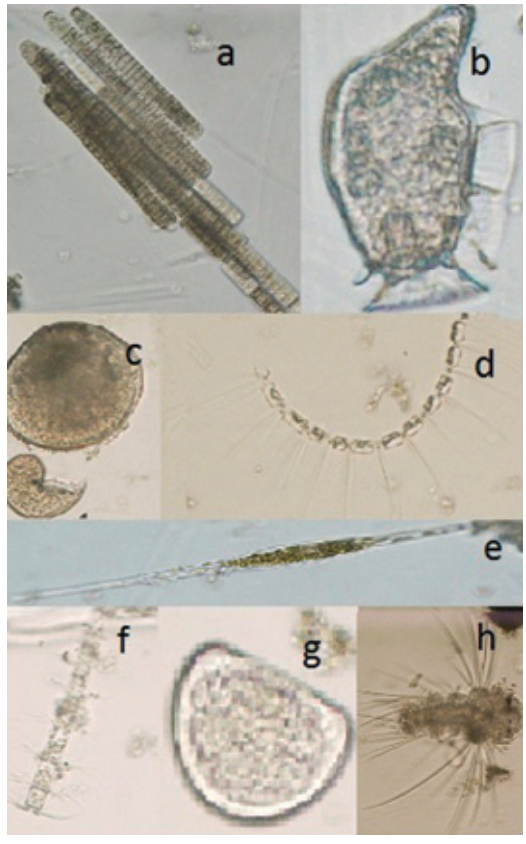

Fig. 5. Plankton specimens observed in stations 1 & 2

The plankton observed in Stations 1 and 2 is given in Table 3. The presence of estuarine and fresh water algae such as *Chaetoceros* spp., *Asterionella* spp., *Nitzschia* sp, *Oscillatoria* spp. and *Merismopedia* spp. were observed at the sampling stations, but were not abundant (Fig. 5). Benthic population included bivalves, gastropods and foraminifera at two stations. The texture of the sediment sample at Station 1 was 3.0% sand, 78.8% silt and 18.2% clay while at Station 2 it was 2.1% sand, 74.4% silt and 23.5% clay. Management of litter and sewage is essential to ensure better water quality in Sal River.

Table 3. Plankton observed at stations 1 & 2

	Nos/m³	
Plankton	**Stn. 1**	**Stn. 2**
Copepods	30000	24000
Copepod nauplii	34000	20000
Gastropods	8000	2000
Bivalve spat	26000	4000
Medusae	2000	0
Decapod larvae	24000	12000
Tintinnids	6000	4000
Polychaete larvae	6000	2000
Foraminifera	2000	2000
Biddulphia spp.	2000	2000
Psuedo-nitzshia spp.	2000	0
Nitzschia longissima	4000	12000
Asterionella spp.	2000	0
Chaetoceros spp.	44000	6000
Chaetoceros decipiens	12000	2000
Bacteriastrum spp.	24000	2000
Ditylum spp.	6000	0
Coscinodiscus spp.	6000	2000
Dinophysis spp.	2000	0
Oscillatoria spp.	12000	44000
Rhizosolenia spp.	2000	4000
Oikopleura spp.	2000	2000