CHAPTER 2

WATER QUALITY AND SEDIMENT CHARACTERISTICS

2.1 WATER QUALITY STATUS IN THE BRACKISHWATER ECOSYSTEM OF PULICAT LAKE

The Pulicat Lake is having a vast water spread area and therefore the entire study region covering the Lake and the surrounding coastal area has been divided into 10 zones (Figure 2.1) and water and bed sediment samples were collected from 61 stations during pre-monsoon period of 1999 and post-monsoon period of 2000 in order to study the status of water quality. The locations of the sampling stations with GPS positions are presented in Table 2.1. Distributions of sampling in different areas are given in Table 2.2.

Mechanized boats were engaged for the sampling in the lake region. Sampling in coastal waters have been done with CRV Sagar Purvi, a coastal research vessel of the Department of Ocean Development, Govt. of India. In total 34 samples were taken in 17 locations (surface and bottom samples in each location) during pre-monsoon period of 1999 in five transects at a depth ranging from 4 m to 20 m with control sampling stations in-between. There was no flow in the rivers Araniar and Kalangi during pre-monsoon period and therefore only bed sediments were collected. Results of water quality analysis for the samples of pre-monsoon period of 1999 and post-monsoon period of 2000 are presented in Tables 2.3 and 2.4.

Water quality studies carried out in the Pulicat Lake and surrounding waters reflect that the quality at present is good. But deterioration has started due to the developmental activities. Increase in temperature is observed near the North Chennai Thermal Power Station (NCTPS) coolant water discharge sites. Their hot waters have intern affecting the biological community. The nutrient load from the aquafarms discharges in the south side of the lake leads to formation of algal bloom in this region will be resulted in eutrophication in near future. Heavy metals concentrations in the lake are within the permissible limit. The average water quality status of the Pulicat Lake is given in Table 2.5. The results of the impacts on water quality by different activities are

shown in Fig.2.2 and 2.3. Mean annual rainfall in this region is around 120 cm (30 years average) with 2/3rd of rainfall occurring during northeast monsoon period (October – December). From March to September, continuous strong winds with an average speed of 9 to 16.4 km/h are observed regularly which play a major role in the circulation of water in the central part of the lake. The results reflect salinity is high in the northeastern part of the lagoon due to lower amount of mixing from the freshwater input, and the region is far off to reach the incoming tides from the bar mouth. SSC concentration is also high in this zone due to higher salinity condition and wind driven waves in this region circulate the bottom settled sediments to resuspended mode (Fig. 2.4 and 2.5).

In order to study the pollution problems of Pulicat Lake, samples were collected for quantitative study on the water quality, heavy metals and other contaminants in the food web of the ecosystem. In total sixteen stations were selected for water samples to know the general pattern of DO, BOD and ammonia level in the Pulicat Lake waters. The results of the analyses are given in the Table 2.6.

Heavy metal analyses have been conducted for the major biological samples in the Pulicat lake region. In total 11 species were identified for the analysis from various locations and the results are shown in Table 2.7 and Fig. 2.6 and 2.7.

Table 2.6 Pattern of DO, BOD and Ammonia in Pulicat Lake Waters

Location Name	Sample No	Water Temp °C	Ammonia (ppm)	DO (ml/l)	BOD
Thermal Plant discharge point	NCTPP 1	41	41.28	3.73	2.45
Coolant water discharge in lake	NCTPP 1A	37	65.45	3.51	1.92
Kattupalli	KAT 2	29	91.79	3.85	2.01
Koraikuppam	KOR 3	28	58.17	6.17	1.68
Araniar South confluence (No flow from river now)	AR-STH 4	28	86.08	6.28	1.57
Sattankuppam	SAT 15	29	63.93	5.90	1.95
Kottaikuppam	KOT 5	28	96.15	3.40	2.08
Musamani lock (Buckingham canal confluence in lake)	ML-BC 6	28	1.56	3.50	1.78
Annamalaichery backwater	ANN-BW 14	29	171.96	3.88	2.1
Annamalaichery (lake region)	ANN 7	28	108.64	3.51	1.5
Central part of the lake	CP 8	28	135.58	5.09	1.37
Arangam Buckingham canal	AGM-BC 9	29	5.86	4.86	1.87
Backwater near Elavur (North of Gummidipoondi)	GP-BW 10	28	3.77	3.81	1.64
Sunnambukulam	SUN 17	27	127.26	5.20	2.08
Arambakkam	ABM 11	27	131.27	6.85	1.85
Kalangi River confluence in lake	KR 12	27	57.66	4.99	1.36
SHAR – Buckingham canal	SHAR-BC 13	26	1.859	3.57	1.52

Table 2.7 Heavy metal concentration (ppm) in biological samples

Location	Species Name	Cd	Pb	Zn	Cr
Pulicat Fish Landing centre	Scylla sp.	0.16	0.91	2.29	1.56
Pulicat Fish Landing centre	Portunus sp	0.03	0.60	11.52	0.89
Pulicat Fish Landing centre	Peneus monodon	0.32	1.33	5.34	0.52
Pulicat Bar mouth	Meretrix meretrix	0.12	0.31	11.33	0.54
Pulicat Bar mouth	M. casta	0.46	1.27	5.15	0.38
Pulicat Bar mouth	Arca sp.	2.44	1.27	11.92	1.26
Pulicat coastal waters	Donax sp	0.08	0.38	11.06	1.68
Satankuppam	Crassostrea sp	0.86	1.22	10.51	0.32
Sattankuppam	Mugil Cephalus	0.24	1.11	11.67	1.26
Azhipallam	Perna viridis	0.03	1.07	10.40	2.35
Azhipallam	Crassostrea sp	0.44	0.54	11.10	2.12

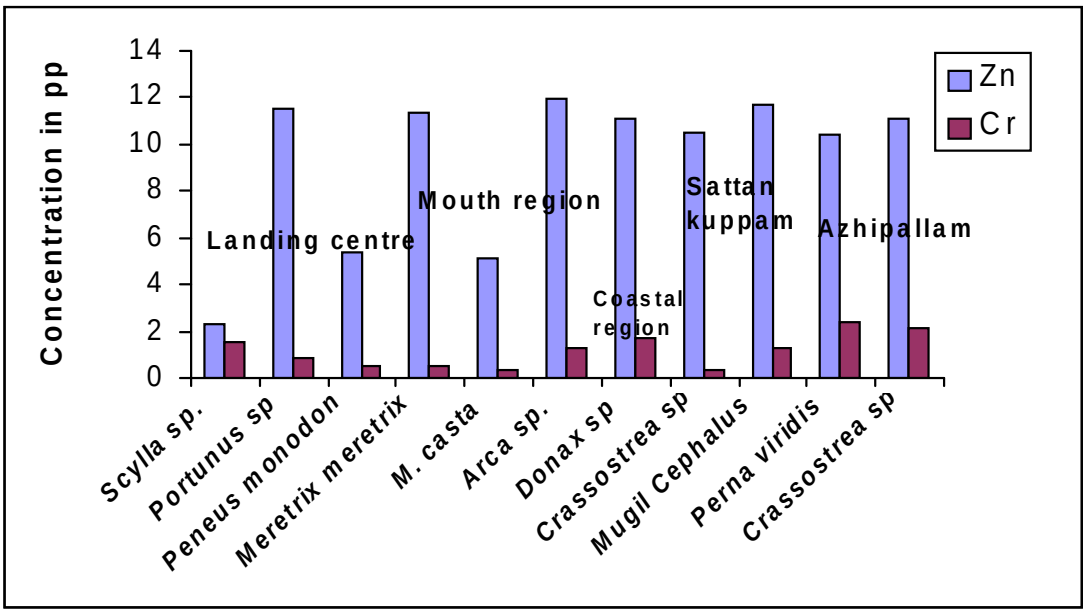


Figure 2.6 Distribution of heavy metals (ppm) (Zn & Cr) in different species of Pulicat Lake ecosystem

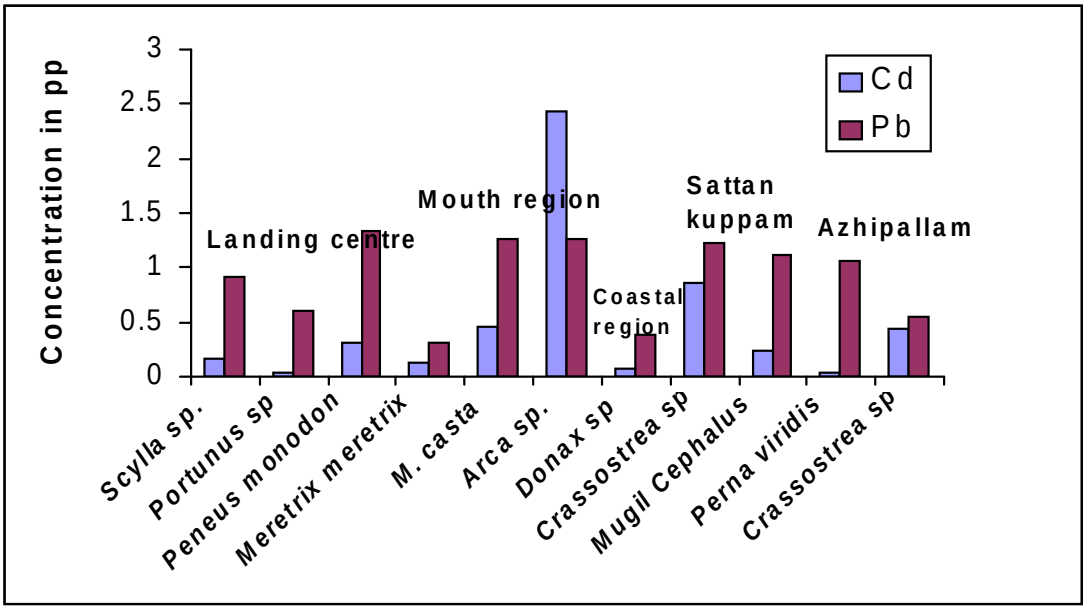


Figure 2.7 Distribution of heavy metals (ppm) (Cd & Pb) in different species of Pulicat Lake ecosystem

Results show higher concentration of heavy metal accumulation in the Arca sp. Zinc concentration is in high level when compared to the other metals (Cd, Pb and Cr) analysed for the present study. Analyses from clamp, prawn, fishes and prawn reveal normal value for the heavy metals indicating no heavy metal contamination in Pulicat lake waters.

Samples were analysed for pathogens distribution in the Pulicat lake waters to know the level of sewage contamination in the lake. Total viable counts were made in Nutrient Agar medium in water and sediment samples. The results of the analyses are given in the Table 2.8

Table 2.8 Pathogens Distribution In The Pulicat Lake Waters

Stations	Water (x 10^3 CFU/ml)		Sediment (x 10^3 CFU/g)	
	24 Hrs	48 Hrs	24 Hrs	48 Hrs
NCTPP – 1	481.50	641.50	107.97	140.47
KAT -2	661.00	936.50	273.63	297.18
KOR – 3	780.00	930.00	CM	CM
AR-S – 4	442.50	670.00	404.65	451.39
KOT – 5	403.00	585.50	643.17	740.90
BC/ML – 6	196.00	276.00	1121.00	1652.63
ANM – 7	344.00	379.50	1068.73	1181.59
CP – 8	210.00	280.00	432.19	656.42
AGM-BC – 9	261.00	359.00	251.87	565.63
GP-BW-10	135.00	161.50	141.11	164.14
ABM – 11	136.50	230.50	50.69	57.20
KR -12	143.50	200.50	221.06	242.98
SHAR – BC – 13	174.00	296.50	257.37	317.64
ANN-BW – 14	213.00	246.50	79.23	89.13
SAT 15	1080.00	1490.00	186.87	219.07
SUN - 16	121.00	153.50	526.21	555.41

The results show that the waters of the Pulicat Lake are not much contaminated. Samples which are taken close to the villages like Sattankuppam, Buckingham canal confluence and near the thermal power plant regions are having slightly higher level of contaminants.

2.2 SEDIMENT CHARACTERISTICS

Sediments are carried into coastal lagoons by tidal currents entering from the sea, and by winds. Deposits in lagoons also include materials of organic origin such as shells, guano and peat, and in arid regions chemically precipitated salt, calcite and dolomite. In one way or other most lagoons are being gradually filled in and replaced by deposited coastal plain. Lagoons fed by rivers received sediments ranging from coarse sand to silt and clay. The coarse material is deposited as the river enters the lagoon, and may be added to lagoon beaches and spread around the shore by wave action, the finer sediment is carried into the lagoon and deposited on the floor, thus progressively reducing the depth.

Totally seven transects have been selected for collecting samples for the analysis of grain size distribution and suspended sediment concentration. Locations of the transects are presented in Table 2.9. The grain size analyses of the sediments collected from near by regions of the Ennore port showed medium to coarse sand sediments on the northern side of the north breakwater, south of Kattupalli village. The south side sediments are recycled from the dredged materials of Ennore creek and they are fine sized sand particles.

Table 2.9 Locations of transects for water sediment samples

Transect No.	Latitude	Longitude	Remarks
Transect 1	13°31’17.0” N	80°19’38.1” E	South of Ennore Creek near EID Parry
Transect 2	13°14’45.4” N	80°20’04.8” E	Just North of Ennore Creek
Transect 3	13°15’07.5” N	80°20’06.2” E	South of South Breakwater of Ennore Port
Transect 4	13°17’02.6” N	80°20’47.7” E	North of North Breakwater
Transect 5	13°17’31.8” N	80°20’43.4” E	South of Kattupallikuppam
Transect 6	13°25’20.0” N	80°19’37.2” E	Pulicat Lighthouse
Transect 7	13°26’02.7” N	80°19’36.4” E	South of Pulicat Lake bar mouth

Suspended sediment is one of the important materials which is transported by the rivers from the land to the oceans. Asian rivers contribute 70% of the global sediment into the oceans and 30% transport of sediments are by rivers from Indian sub-continent. The supply of sediments to the coastal area by rivers plays an important role in stabilizing the shoreline. The suspended sediment concentration observed in the coastal bottom waters ranged between 20 mg/l and 88 mg/l and surface waters between 12 mg/l and 65 mg/l during the year 1999. Suspended sediment concentration of the surface and bottom waters are given in Table 2.10. Reduction in the suspended load is noticed in transects 5 and 6, which are on the northern side of the north breakwater. Suspended sediment concentration in bottom water showed gradual reduction from the southern transects towards the Pulicat mouth region. Maximum SSC load of 87.57 mg/l in the bottom water observed in Transect 2 may be due to the near shore circulation due to dredging operations in this region. Almost constant value of around 40 mg/l was observed for the bottom water samples at different depths of Transect 5. The

surface water suspended concentration did not show any specific trend from all the seven transects (Figure 2.8a). The bottom water suspended sediment concentration shows a gradual decrease in concentration from Ennore creek to Pulicat mouth (Figure 2.8 b).

Grain size of the suspended sediments in the bottom water ranged from 11 micron to 34 micron, which falls in the coarse silt size fraction. The bivariate plot of size with respect to transects show gradual coarseness of the grains towards north as shown in Figure 2.9. The grain size of the bed sediments ranges from 100 to 500 microns. General trend of the grain size shows almost constant result with a mean grain size of 178 microns of fine sand except three samples that were collected at a depth of 3 m from transects 2, 4 and 5. Results of the grain size analyses for the bottom water sediment samples and bed sediments are given in Tables 2.11 and 2.12 respectively.

During May 2001, water and bed sediments were collected various locations from Ennore to Pulicat. Details of locations are shown in Table 2.13 and Fig. 2.10 From the analysis of samples it is observed (Table 2.14) that suspended sediment concentration at a given location is a function of time and it varies between 36.60 and 45.30 mg/l at location C2 (South of Ennore port). For other locations (C1, C3 and C4) suspended sediment concentration is of the order of 29 to 86.5 mg/l. Suspended sediment concentration at a higher level of 86.5 mg/l seen at location B1 (Transect 1) is due to dredging operations at Ennore creek inlet. Suspended sediment grain size distribution (Table 2.15) of the nearshore and offshore waters of Ennore and Pulicat region shows that the D_{50} is of the order of 17 microns to 22 microns. Grain size distribution of bed sediments (Table 2.16) observed at different locations indicate that the D_{50} is of the order of 100 microns for locations B1 to B9 and of the order of 500 microns for the locations B10 to B18. For locations B19 and B20, D_{50} is of the order of 130 microns. Analysis of bed samples indicate the presence of coarse sediment along the offshore boundary of the shoal and the finer sediments along the coastline. This clearly demonstrates that the shoal while interacting with large waves around the offshore boundary reduces the energy of the incoming waves resulting in deposition of coarser sediment along the offshore

boundary of the shoal. Finer fragments of the sediment are carried over the shoal by relatively low energy waves and deposited adjacent to the coastline.

The grain size analyses of lake show 5Ø size as the average grain size of the lake sediments. The channel part near bar mouth it is 2.5Ø size indicating coarser sediments from the coastal region. In the central part of the lake region the sediment size is around 6phi size indicating fine sediment accumulation and less energy circulation in the middle part.

Table 2.12 Grain size (μm) distribution in bed sediments (1999)

Transects	Depth	D_{10}	D_{30}	D_{50}	D_{60}	D_{70}	D_{90}
T1	3 meters	57.15	91.25	116.32	128.2	149	217.39
	5 meters	43.01	84.32	109.49	125	145.23	262.37
	7 meters	82.32	125	164.31	190.25	248	446.17
	Average	60.83	100.19	130.04	147.82	180.74	308.64
T2	3 meters	71.6	177	509.94	520	540	584.14
	5 meters	57.58	98.26	117.02	132.3	149	239.74
	7 meters	75.92	107.8	129.02	139.26	172.5	238.39
	Average	68.37	127.69	251.99	263.85	287.17	354.09
T3	3 meters	65.59	100	133.32	152	210	511.17
	5 meters	42.64	80.25	106.32	121	142	217.94
	7 meters	75.42	108.62	144.35	195.76	262.18	562.25
	Average	61.22	96.29	128.00	156.25	204.73	430.45
T4	1 meter	188.56	270.5	320.64	354	400.25	512.73
T5	3 meters	125.41	354	504.18	510.25	520.25	582.18
	5 meters	63.7	80.25	112.57	118.02	124.5	156.39
	7 meters	53.14	78.27	102.46	118.26	131.2	198.53
	Average	80.75	170.84	239.74	248.84	258.65	312.37
T6	3 meters	101.29	140.25	173.48	198.25	215.2	307.25
	5 meters	99.08	132.5	162.25	182.5	198.5	276.13
	7 meters	100.01	138.1	169.35	185.2	216.2	305.68
	Average	100.13	136.95	168.36	188.65	209.97	296.35
T7	3 meters	57.17	120.2	145.57	155	185.5	290.55
	5 meters	90.91	125	153.76	175.24	190.5	273.79
	7 meters	86.97	121.2	150.4	168.5	187.2	263.83
	Average	78.35	122.13	149.91	166.25	187.73	276.06
T (Average)		74.94	125.68	178.01	195.28	221.50	329.66

Table 2.11 Grain size (μm) distribution in bottom water suspended sediments (1999)

Transects	Depth	D_{10}	D_{30}	D_{50}	D_{60}	D_{70}	D_{90}
T1	3 meters	4.93	10.23	16.24	20.41	25.1	52.59
	5 meters	5.38	11.81	19.06	23.5	30.9	69.34
	7 meters	3.53	7.24	11	13.25	17.78	43.86
	Average	4.61	9.76	15.43	19.05	24.59	55.26
T2	3 meters	3.73	7.89	12.48	15.15	19.5	48.5
	5 meters	4.35	9.55	15.63	20.85	31.2	439.52
	7 meters	5.04	10.95	18.44	25.1	33.13	68.15
	Average	4.37	9.46	15.52	20.37	27.94	185.39
T3	3 meters	4.64	9.75	16.26	21.88	30.9	184.16
	5 meters	5.24	10.96	17.99	23.42	30.8	62.17
	7 meters	4.6	10.23	16.33	21.28	30.85	74.56
	Average	4.83	10.31	16.86	22.19	30.85	106.96
T4	3 meters	5.57	11.74	18.89	25.1	33.7	74.75
	5 meters	5.58	11.7	18.13	22.1	29.2	60.41
	7 meters	7.62	14.2	24.9	30.98	40.28	83.35
	Average	6.26	12.55	20.64	26.06	34.39	72.84
T5	3 meters	5.73	11.75	18.46	23.44	28.9	70.39
	5 meters	8.4	17.7	26.14	30.9	38.2	71.44
	7 meters	5.38	10.89	19.06	23.5	30.9	69.54
	Average	6.50	13.45	21.22	25.95	32.67	70.46
T6	3 meters	6.26	14.25	22.18	27.25	35.5	103.81
	5 meters	7.1	16.15	24.57	30.95	40.73	102.26
	7 meters	6.3	14.5	21.42	26.91	35.4	82.53
	Average	6.55	14.97	22.72	28.37	37.21	96.20
T7	3 meters	8.29	19.2	31.45	40.5	50.11	108.5
	5 meters	6.04	14.2	22.72	30.2	40.73	111.53
	7 meters	7.7	17.78	33.92	50.11	80	338.8
	Average	7.34	17.06	29.36	40.27	56.95	186.28
T (Average)		7.65	14.99	23.79	30.42	40.66	127.56

Table 2.10 Suspended Sediments concentration (mg/l) in Bottom and Surface water samples (1999)

Transects	Depth	Bottom Samples	Surface Samples
T1	3 meters	54.51	39.50
	5 meters	51.82	23.60
	7 meters	43.14	53.10
	Average	49.82	38.73
T2	3 meters	87.57	23.10
	5 meters	75.86	59.40
	7 meters	51.42	21.20
	Average	70.61	34.57
T3	3 meters	58.28	64.70
	5 meters	31.43	32.20
	7 meters	50.86	33.10
	Average	46.86	43.33
T4	3 meters	53.14	43.70
	5 meters	45.14	20.90
	7 meters	31.80	22.50
	Average	43.36	29.03
T5	3 meters	38.29	26.20
	5 meters	39.14	22.80
	7 meters	37.29	14.60
	Average	38.24	21.20
T6	3 meters	49.71	28.10
	5 meters	40.28	52.10
	7 meters	20.00	35.50
	Average	36.66	38.57
T7	3 meters	37.86	56.10
	5 meters	36.00	34.70
	7 meters	34.00	12.50
	Average	35.95	34.42
T (Average)		48.52	34.27

Table 2.14 Suspended sediment concentration (mg/l) of water samples (2001)

Sample No	Depth (m)	SSC mg/l
C2/4.30AM	1	36.60
C2/7.15AM	1	41.20
C2/10.00AM	1	45.30
C2/1.15PM	1	32.80
C2/4.30AM	1	43.60
C2/4.30AM	5	43.50
C2/10.00AM	5	42.10
C2/7.15AM	5	40.60
C2/1.15PM	5	45.20
C2/4.30PM	5	38.70
C3/4.30AM	1	54.80
C3/7.15AM	1	42.80
C3/10.00AM	1	57.80
C3/1.15PM	1	42.50
C3/4.30PM	1	36.00
C4/4.30AM	1	37.30
C4/7.15AM	1	45.80
C4/10.00AM	1	41.00
C4/1.15PM	1	34.50
C4/4.30PM	1	44.40
C1/7.15AM	1	44.70
C1/10.00AM	1	49.10
C1/1.15PM	1	40.30
C1/4.30PM	1	44.20
B1/SUR	1	86.50
B1/BOT	6	38.60
B3/SUR	1	29.90
B3/BOT	7	50.40
B5/SUR	1	35.00
B5/BOT	6	28.80
B6/SUR	1	38.00
B6/BOT	6	39.40

Bed sediments were collected from 24 locations in the study region during May 2001. Results from the study are given below. Grain size in bed sediments show that offshore samples are coarser when compare to the near shore samples (Figure 2.4). This may be due to the obstruction of transporting sediments by the Ennore and Pulicat shoals in the study region.

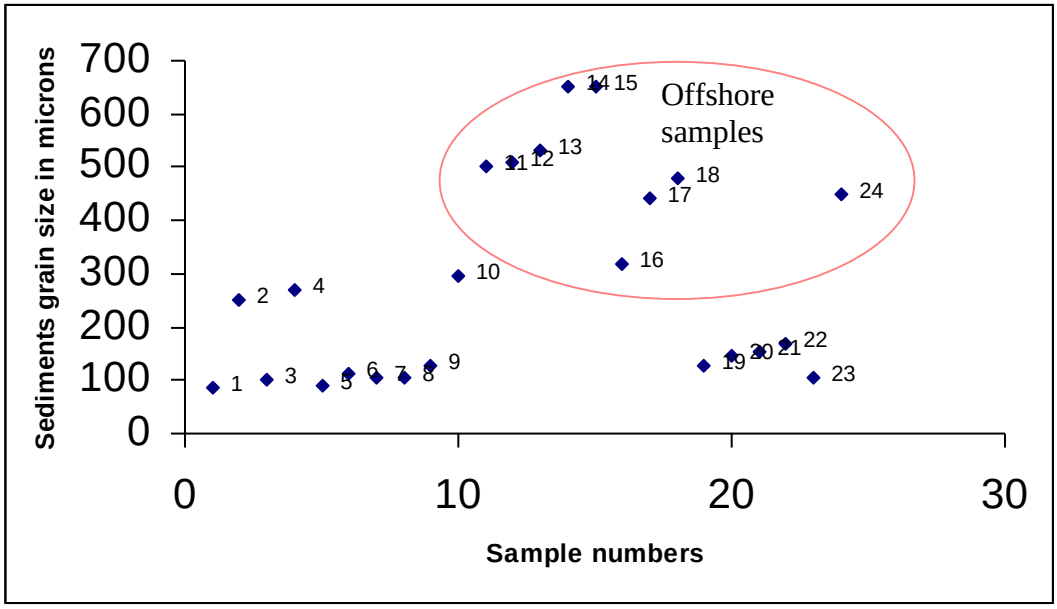


Figure 2.4 Grain Size in Bed Sediments

Table 2.16 Sediment characters of the bed sediments from Ennore to Pulicat Mouth region

	D_{10}	D_{30}	D_{50}	D_{70}	D_{90}
C1	75.01	117.25	152.6	320.45	390.56
C2	83.65	145.25	166.9	350.27	402.81
C3	43.35	95.36	104.27	140.25	162.63
C4	270	360	448	647	1235
1	52.92	75.05	86.11	97.25	129.9
2	125	200	250	290	410
3	59.14	90.25	102.1	140.27	163.67
4	125	210	270	354	420
5	55.39	75.27	91.34	110.25	1338.2
6	68.24	104	112.46	140.26	168.72
7	60.12	85.15	103.03	130.25	153.85
8	61.93	78.53	106.38	140.25	160.95
9	58.08	100.15	125.46	290.25	326.7
10	160	250	297	354	500
11	210	370	500	590	880
12	230	400	510	620	950
13	297	425	530	920	1414
14	320	540	650	841	1160
15	380	500	650	707	900
16	160	297	320	350	410
17	310	400	440	500	820
18	280	390	480	590	1000
19	40.87	95.17	126.08	176.75	207.53
20	64.86	105.27	146.07	196.52	227.67

C1 = Nearshore Ennore creek (7m depth)
C2 = Offshore Ennore creek (17m depth)
C3 = Nearshore Pulicat Lighthouse (7m depth)
C4 = Offshore Pulicat Lighthouse (17m depth)

Suspended sediments were collected for every 3 hours interval during the survey period of one day. Results are given in the Figure 2.11.

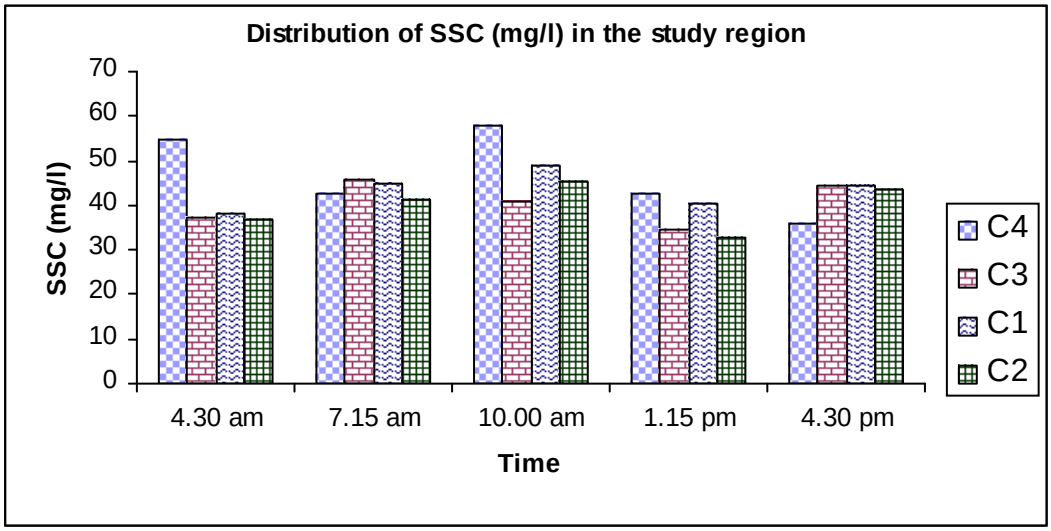


Figure 2.11 SSC Distribution in the Coastal Region of Study Area

Table 2.13 Locations of Samples Collected During May 2001 From Ennore to Pulicat Lighthouse Region

Measurement	Sample ID	Latitude (N)	Longitude (E)	Depth in meters
Tide, Wave & Current measurements for three days	C1	13°14’32.3”	80°20’22.2”	6
	C2	13°13’41.4”	80°21’54.3”	18
	C3	13°25’09.5”	80°20’02.5”	7
	C4	13°25’15.0”	80°21’31.8”	18
East & West side of shoal	W1	0429729	1471619	7
	W2	13°18’38.7”	80°23’14.5”	19
ADV locations in four profiles	B1	13°14’43.9”	80°20’25.1”	6
	B2	13°17’15.7”	80°21’11.9”	
	B3	13°13’0.26”	80°19’5.84”	6
	B4	13°25’10.0”	80°20’02.6”	6
Bed Sediments	BS 1	13°16’15.7”	80°21’12.0”	6
	2	13°16’58.6”	80°21’42.2”	6
	3	13°18’58.5”	80°21’01.8”	6
	4	13°19’16.4”	80°20’59.7”	6
	5	13°19’35.6”	80°20’56.9”	6
	6	13°20’05.9”	80°20’55.0”	6
	7	13°20’49.7”	80°20’48.2”	6
	8	13°21’58.6”	80°20’30.5”	6
	9	13°23’46.0”	80°20’07.6”	6
	10	13°25’09.1”	80°19’57.0”	6
	11	13°24’36.3”	80°21’38.1”	14
	12	13°23’58.7”	80°21’52.4”	14
	13	13°23’04.4”	80°22’07.7”	14
	14	13°22’23.7”	80°22’19.8”	14
	15	13°21’06.4”	80°22’31.9”	14
	16	13°19’31.7”	80°22’49.5”	14
	17	13°18’21.4”	80°22’49.1”	14
	18	13°17’26.1”	80°22’45.4”	14
	19	13°16’12.8”	80°22’20.0”	14
	BS 20	13°15’18.4”	80°22’38.0”	14

Figure 2.10 Locations of Samples Collected During May 2001 From Ennore to Pulicat Lighthouse Region

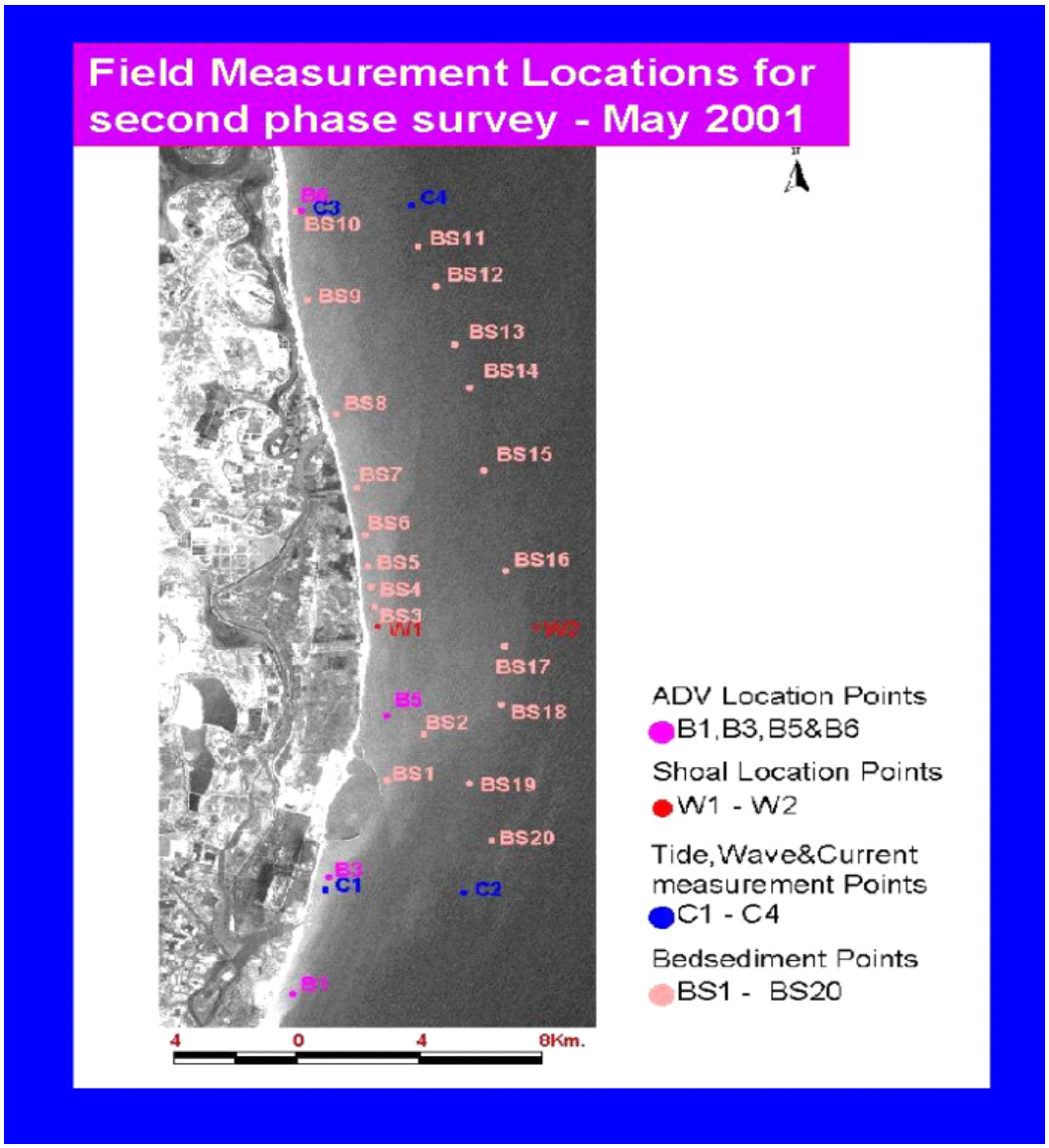


Table 2.15 Suspended Sediments Grain Size Distribution (in Microns) At The Deployment Sites of Wave and Tide Gauges

	D_{10}	D_{30}	D_{50}	D_{70}	D_{90}	Sand %	Silt %
C1/7.15am	13.94	14.01	17.39	29.02	39.67	3	97
C1/10.00am	13.79	17.1	20.27	30.25	42.36	6	94
C1/1.15pm	5.67	7.58	9.14	22.53	28.34	3	97
C1/4.30pm	14.03	18.75	21.61	43.54	51.09	10	90
			17.1025				
C4/7.15am	14.53	20.25	24.72	42.57	50.69	10	90
C4/10.00am	14.43	20	28.07	45	67.73	18	82
C4/1.15pm	14.84	16.2	17.27	19.25	23.43	0	100
C4/4.30pm	7.96	8.12	8.54	8.92	9.15	0	100
			19.65				
C3/4.30am	13.57	15.25	16.51	20.25	23.35	0	100
C3/7.15am	13.45	15.02	17.06	25.45	32	3	97
C3/10.00am	13.48	14.78	16.76	25.05	30.46	2	98
C3/1.15pm	13.97	17.25	20.84	35.45	39.68	3	97
C3/4.30pm	14.01	16.25	18.81	25.45	30.8	2	98
			17.996				
C2/1m/4.30am	13.6	16.45	18.39	25.42	29.11	0	100
C2/1m/7.15am	15.15	17.25	18.52	22.52	25.3	0	100
C2/1m/10.00am	15.6	22.42	26.22	35.45	41.7	2	98
C2/1m/1.15pm	13.65	15.26	16.59	24.25	27.55	2	98
C2/1m/4.30pm	15.57	25.42	29.85	40.26	63.33	17	83
			21.914				
C2/5m/4.30am	14.46	18.48	20.18	30.15	32.01	1	99
C2/5m/7.15am	13.83	16.58	19.69	32.45	36.3	4	96
C2/5m/10.00am	14	18.25	21.7	35.25	46.91	10	90
C2/5m/1.15pm	15.62	17.25	18.33	19.23	19.99	0	100
C2/5m/4.30pm	15.55	22.45	25.41	35.27	38.74	2	98
			21.062				

C1 = Nearshore Ennore creek (7m depth)
C2 = Offshore Ennore creek (17m depth)
C3 = Nearshore Pulicat Lighthouse (7m depth)
C4 = Offshore Pulicat Lighthouse (17m depth)

Suspended sediments are also collected at two depths (1 m and 5 m) from the same location C2 to know the circulation pattern. Results show not much difference between the two sampling depths (Fig 2.12).

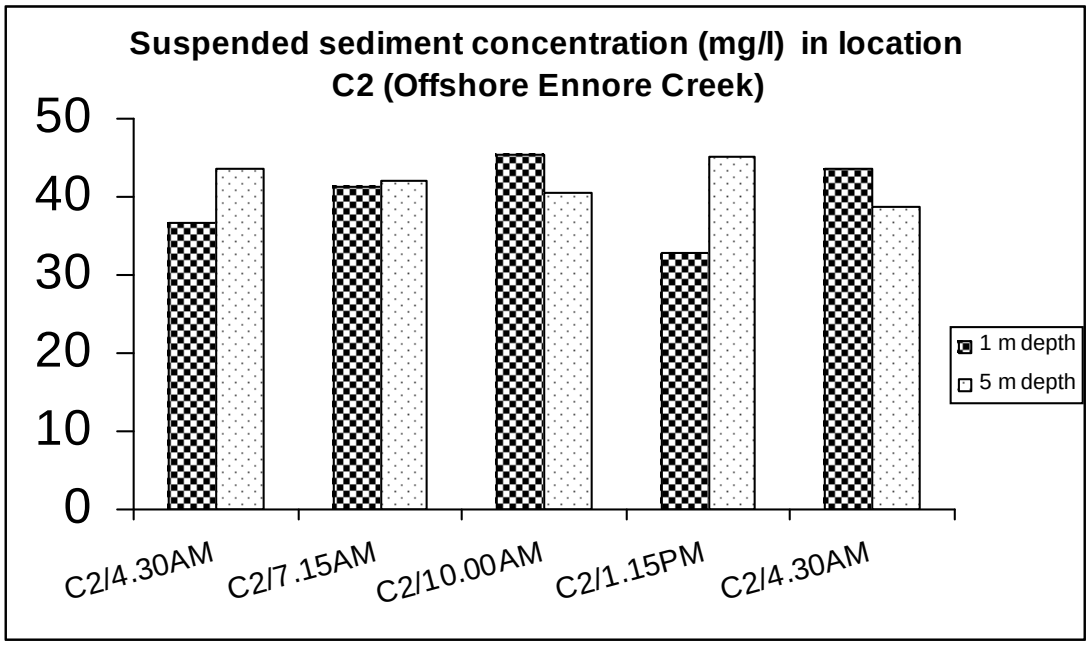


Figure 2.12 Suspended Sediment Concentration at Ennore Offshore (C2)

Bed sediment and clamshell tissues were collected to know the concentration level in different systems. Results of the analyses were given in the Tables 2.17 and 2.7.

Table 2.17 Heavy Metal Concentration in Sediments

Sample number	Heavy metal concentration in sediments (ppm)			
	Cd	Pb	Zn	Cr
NCTPP – 1	0.58	12.56	62.25	23.45
NCTPP – 1A	2.58	38.45	74.45	37.25
KAT -2	2.71	20.15	48.27	52.14
KOR – 3	2.05	11.28	50.26	48.58
AR-S – 4	1.87	15.58	37.48	32.15
KOT – 5	1.92	21.25	50.48	45.98
BC/ML – 6	2.05	8.26	45.58	22.25
ANM – 7	1.05	11.25	32.17	45.58
CP – 8	1.64	7.26	27.28	65.25
AGM-BC – 9	2.04	10.54	52.27	54.25
GP-BW-10	1.87	26.78	74.58	72.25
ABM – 11	1.15	21.25	64.45	28.24
KR -12	1.35	23.56	67.84	35.26
SHAR – BC – 13	1.27	6.41	32.24	26.52
ANN-BW – 14	1.28	12.29	37.48	32.25
SAT 15	1.74	20.25	55.27	25.48
SUN - 16	1.4	9.23	52.27	65.25

Results show not much variation of metal concentration with respect to the stations. Central and northern part of the lake is having least concentration when compared to the southern part in terms of the heavy metals. Distribution is clearly seen from the Figure 2.13.

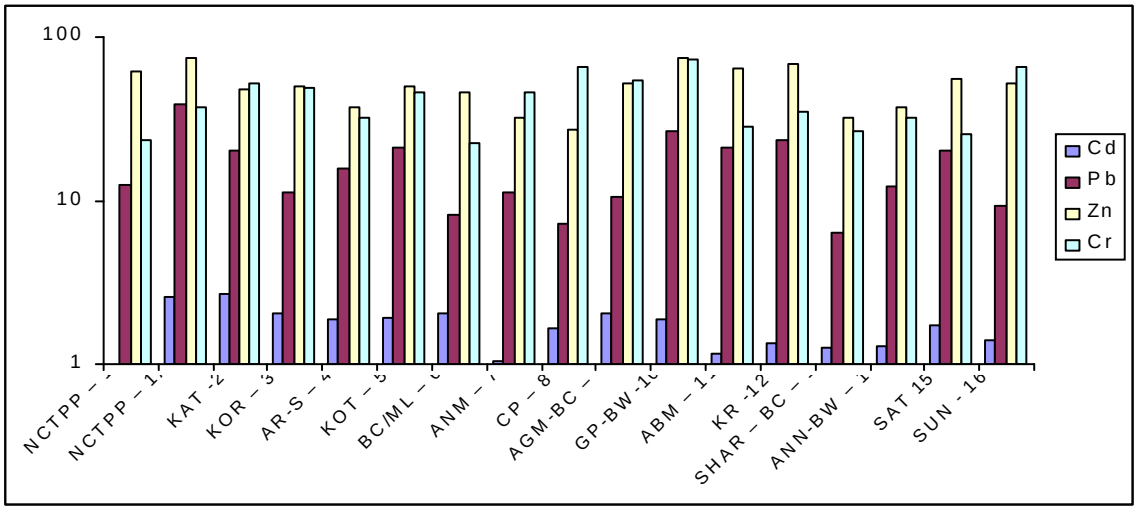


Figure 2.13 Heavy Metal Distribution in Sediments

2.2.1 Nature of the sediments in the coastal stretch from Ennore to Pulicat Lake

The suspended sediment concentration in the coastal surface waters ranges from 20 mg/l to 80 mg/l. Reduction in the suspended load is noticed in the transects 4 & 5 which are in the northern side of the northern break water. Suspended sediment concentration in bottom water showed gradual reduction from the southern transects to towards the Pulicat mouth region. Maximum SSC load in the bottom water was observed in Transect 2 may be because of the near shore circulation of the dumped dredged material in this region. Almost constant value of around 40 mg/l was observed for the bottom water samples in different depths of Transect 5. The bottom water suspended sediment concentration show gradual decrease in concentration from Ennore creek to mouth part.

Grain size of the suspended sediments in the bottom water ranged from 10 micron to 35-micron size, which falls in the coarse silt size fraction. The bed sediments grain size ranged from 100 to 500 microns. General trend of the grain size show almost constant result with a mean grain size of 178 microns of fine sand nature except three samples that were collected at a depth of 3 m from transects 2, 4 & 5.

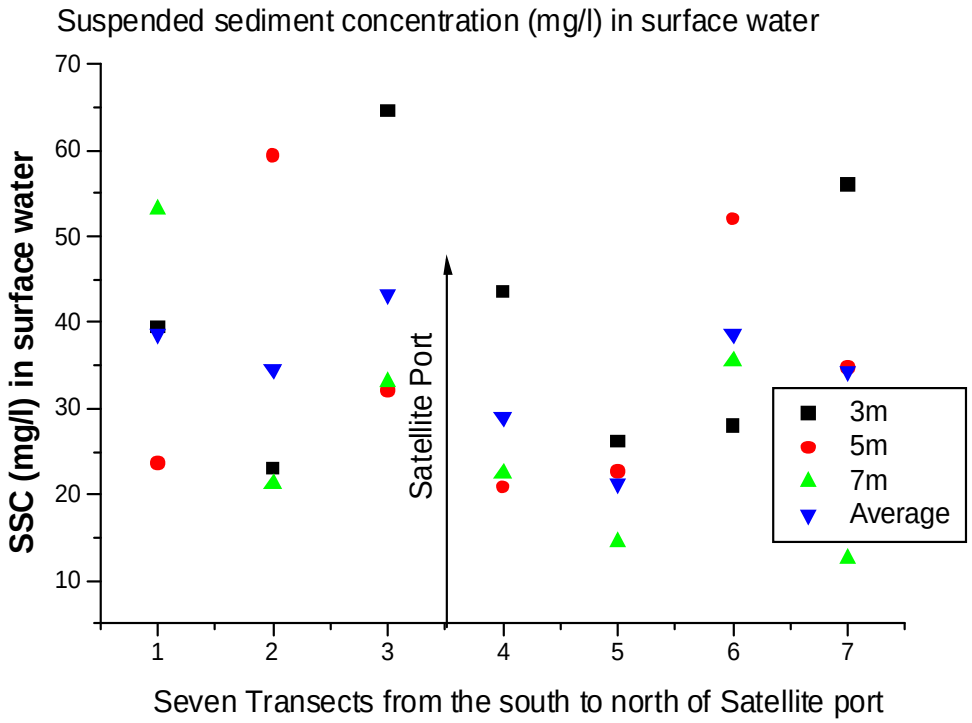


Figure 2.8a SSC (mg/l) in Surface Water

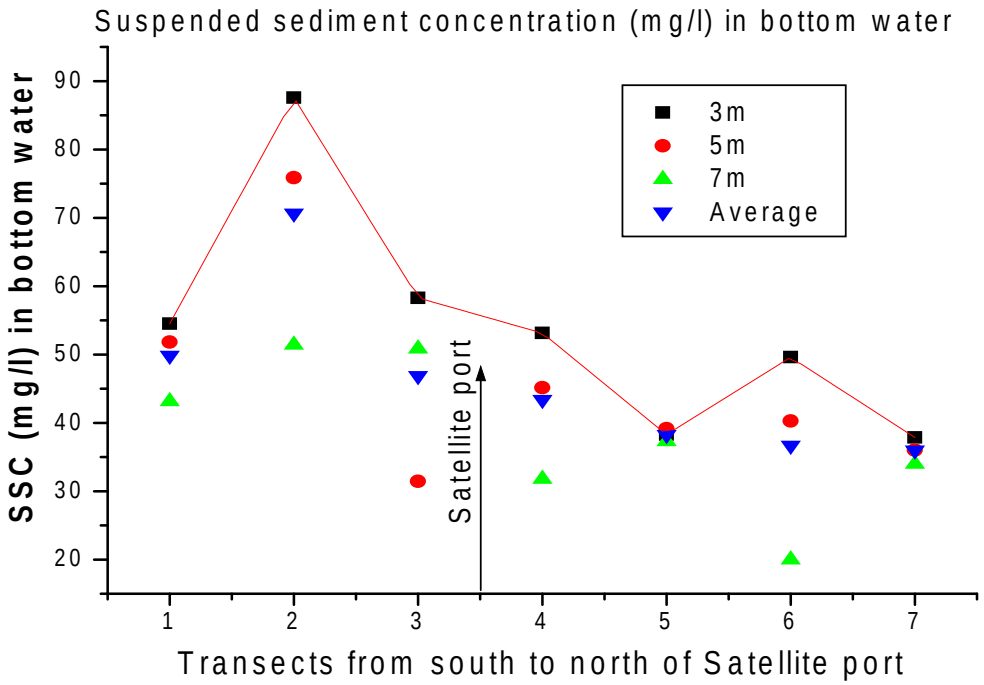


Figure 2.8b SSC (mg/l) in Bottom Water

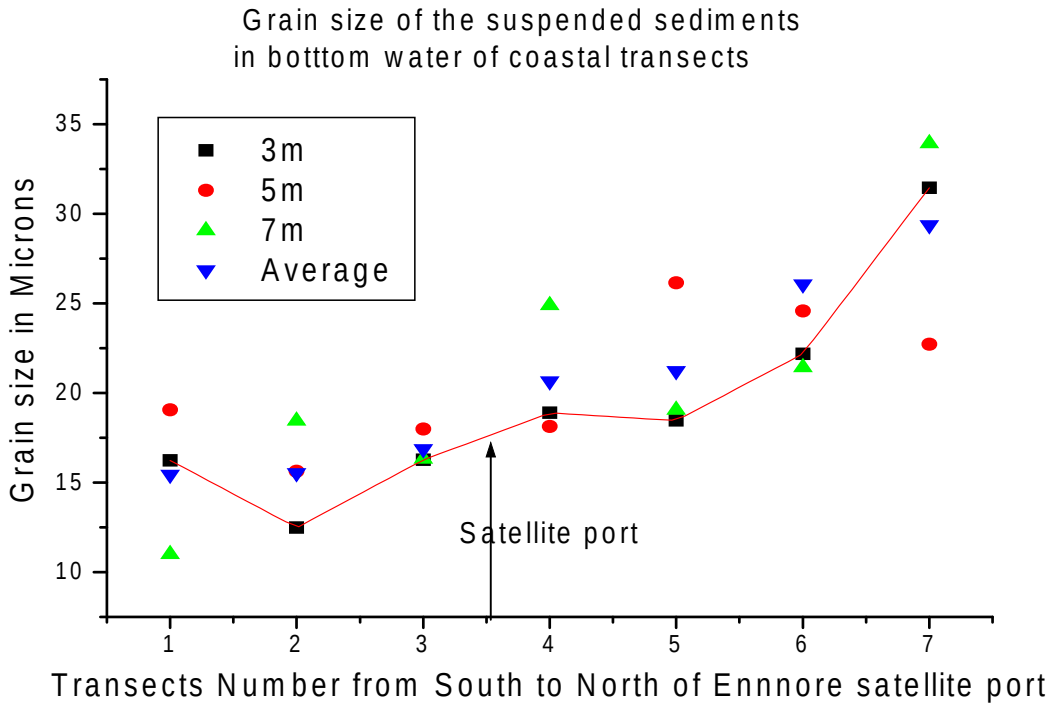


Figure 2.9 Grain Size of Suspended Sediments in Bottom Water

Higher concentration of suspended sediments on the southern side of the port may be due to the repeated dredging from Ennore Creek.

2.3 DEPTH

Comparing with the past data, the total area of the Pulicat lake during 1700 AD is around 481 sq.km, but the present total area is 281 sq.km. It shows that the area of the lake is shrinking by 200 sq.km/300 yrs. The comparative depth data also shows the depth reduction by 2.5 mts/300 yrs. The shrinking of area is mostly in the north. Since we are calculating this area from previously published research papers, now this work is in progress to prove the changes of 300 years through collecting the original data. If the depth is reducing fast in the present rate the lake will extinct in few hundred yrs. Recently managers are thinking about the economic utilization of the lake such as sea ranching of prawn, crab and fish seed to increase the purchasing power of the fishing people and country economy. Figure shows the comparative status of the depth of the lake. Average depth of the lake is 1.5 meters and it ranges between 0.4 m to 3.5 meters. The main feeder channel which connects bar mouth and central part of the lake is a narrow channel extending to a distance of 5 km in NW-SE direction is the deepest portion of the lake with a depth of around 2.5 to 3 meters. Mouth region is having a depth of 1.5 to 2 meters with three opening to the open sea (Fig 2.14). Tidal fluctuation within the lake is 0.6 meters.

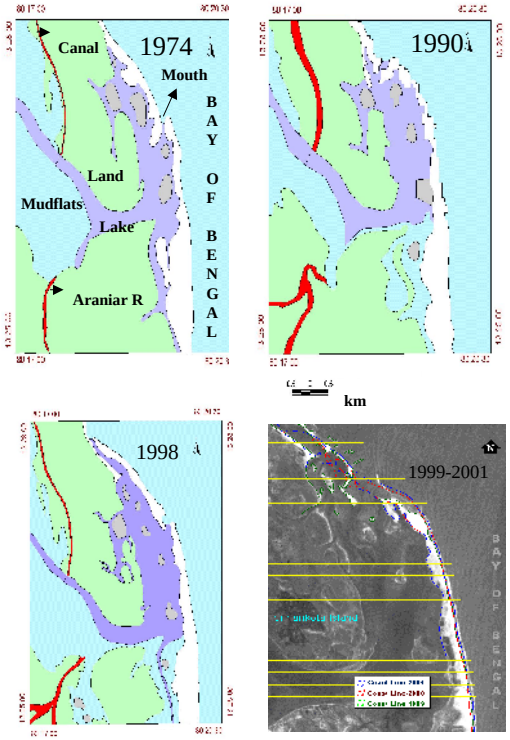
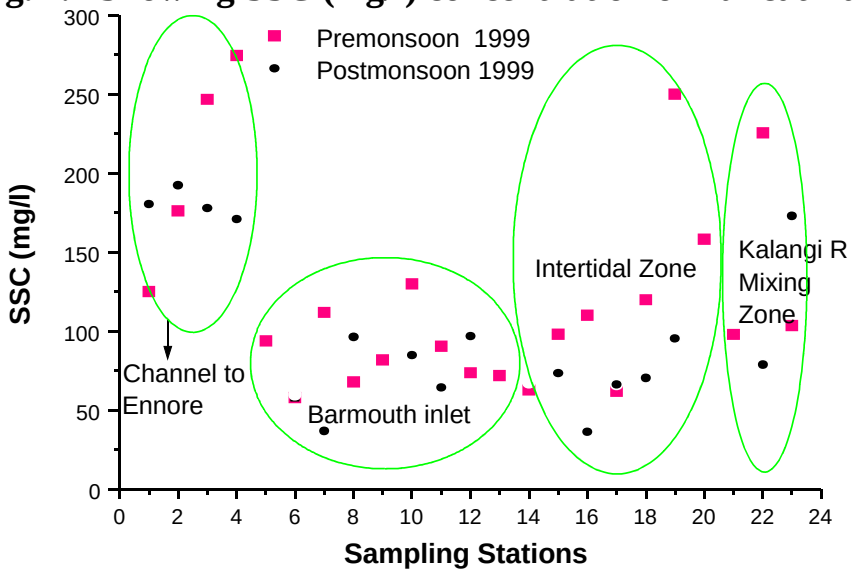


Figure 5.25 Configuration of Pulicat Lake mouth 1974, 1990, 1998 and 1999-2001

Fig

Fig. 2.4 Showing SSC (mg/l) concentration of Pulicat Lake



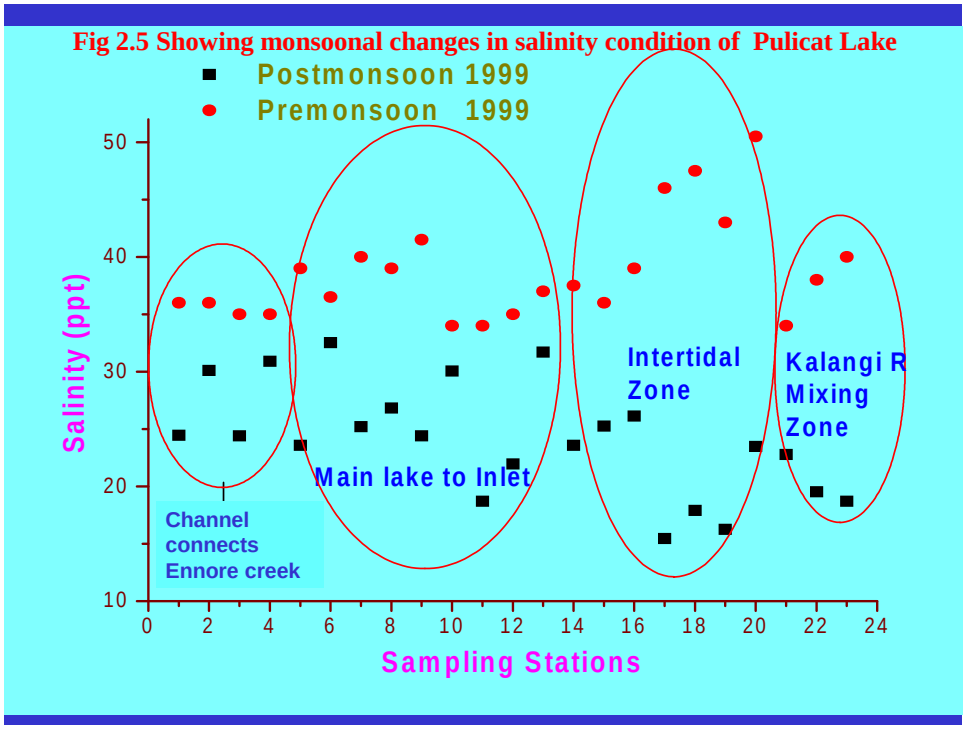
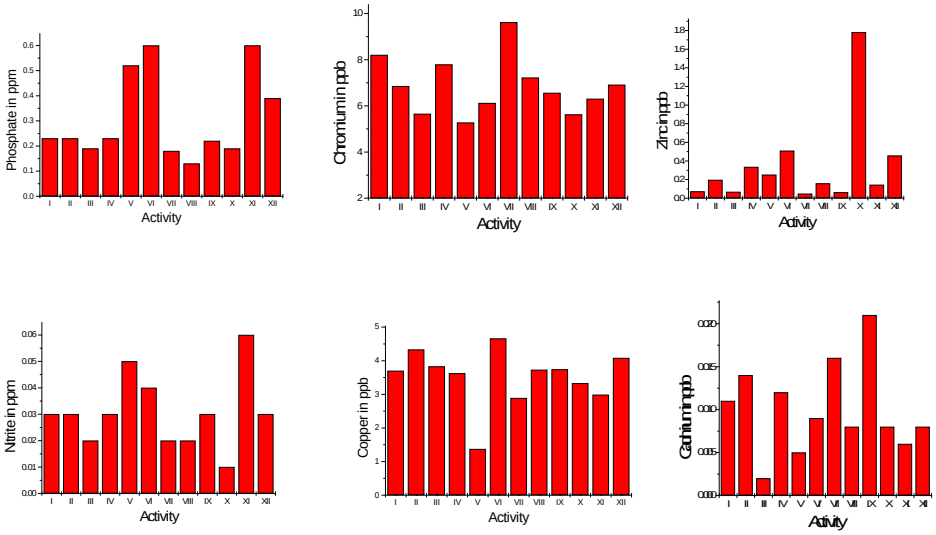


Figure 2.3 Water Quality Results



I Saltpan; II-Aquafarms; III-Agriculture; IV-Shellmining; V-SHAR; VI-Settlements; VII-Regenrated mangrove; VIII-Coastal region; IX-Thermal plant; X-Barmouth; XI-Birds activity; XII-River influence