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DISTRIBUTION OF RECENT BENTHIC OSTRACODA, AROUND PULLIVASAL AND POOMARICHAN ISLANDS, OFF RAMESWARAM, GULF OF MANNAR, SOUTHEAST COAST OF INDIA

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ABSTRACT

The area under investigation is Pullivasal and Poomarichan islands of inner shallow shelf region, Gulf of Mannar. Thirty sediment and bottom water samples were collected during two different seasons, namely, southwest monsoon (September 2016) and northeast monsoon (December 2016) in two groups of stations like, “near shore” and “far shore”. Forty two Ostracoda species were identified belonging to 35 Genera, 18 Families, 6 Superfamilies, 3 Suborders that represent the Order PODOCOPIDA and PLATYCOPINA. Among the 42 species, 3 species belong to the Suborder PLATYCOPA, and Rest of the species belong to the Suborder PODOCOPA. The population of Ostracoda is more in “far shore” stations than the stations that are situated “near shore”. The sediment and water parameters were correlated with the total population and the spatial as well as seasonal variations are determined. Distribution of species as Abundant, Common and Rare, for each and every station is being recorded for both seasons. Seasonally, southwest monsoon favors the abundance of Ostracoda.

Keywords: Recent Benthic Ostracoda, Systematics, Population, Distribution, Sediment and water parameters, Seasons.

INTRODUCTION

Ostracods live in an environment which is congenial for them from freshwater and shallow sea to deep ocean. The most conspicuous factors that control the population of Ostracoda are temperature, bottom topography, depth, salinity, dissolved oxygen, substrate, food supply and organic matter (Puri, 1966) and the major controlling factors governing Ostracod distribution in continental shelf zones and estuarine environment are salinity, water temperature and substrate (Yassini and Jones, 1995). Calcium is often an important component of marine sediments and has been found to be an indicator of provenance and dispersal of terrigenous material (Loring and Nota, 1973). The nature of substrate has a pronounced effect on the composition of Ostracoda communities. It is difficult to assess the influence of depth, as other decisive factors change in close correlation with depth. Some species of Ostracoda tolerate a wide range of temperature while others with a narrow tolerance for temperature change. Some species show weak ornamentation with decrease in salinity. Ostracoda have evolved a wide variety of nutritional systems including filter-feeding and deposit-feeding.

Studies of recent marine and marginal water bodies of the Indian coast include Jain (1978, 1981), Bhatia and Kumar (1979), Khosla *et al.* (1982), Varma *et al.* (1993), Kumar and Hussain (1997), Sridhar *et al.* (1998, 2002), Hussain and Mohan (2000, 2001), Hussain *et al.* (2007), Baskar *et al.* (2013). Kathiresan (2006) identified a research gap like, soil texture, composition, pH, salinity, nutrients and other environmental parameters for the conservation and management of mangrove resources. This study on Recent Benthic Ostracoda and its distribution as well as its correlation with the characteristics of bottom water and sediment in the shallow inner shelf off Rameswaram, Gulf of Mannar fulfils the research gap a step forward.

STUDY AREA

Gulf of Mannar is one out of eighteen Biosphere Reserves of India and one of the richest coastal regions of southeast Asia. It nurtures over 3600 species of flora and fauna; this area is now facing severe threat due to destruction of sensitive ecosystem like corals and sea grass through indiscriminate and intensive trawling, coral mining and dynamic fishing. The monthly average annual atmospheric temperature varies from 25° to 38° C with the minimum and maximum during January and May, respectively. The mean annual rainfall varies from 762 mm to 1270 mm. The coral reefs are of fringing and patchy types and extend from Rameswaram to Tuticorin covering a distance of 140 km. However, a major part of the reef is fringing type arising from the shallow sea floor of not more than 5 m in depth. The substrate consists of coral fragments mixed with comminuted grains of bivalves, molluscan shell materials, calcareous algae which were heaped up forming reef islands around Rameswaram (Kumaraguru, 1999; Muley *et al.,* 2000).

Among the Mandapam group of islands in Gulf of Mannar, Pullivasal (9.23699°N 79.19100°E) and Poomarichan islands (9.24538°N 79.17993°E) are chosen for the study that are situated in the southeast coast of India. They are located 3.5 km south off Pamban bridge. Fig. 1 shows the sample locations of the study area. The aim of this study is to find out the distribution and correlation of Recent Benthic Ostracoda for two different seasons, namely, southwest and northeast monsoon seasons.

MATERIALS AND METHODS

In order to study various environmental aspects of recent saline water Ostracoda, sediment and bottom water samples were collected from the inner shallow shelf region of the study

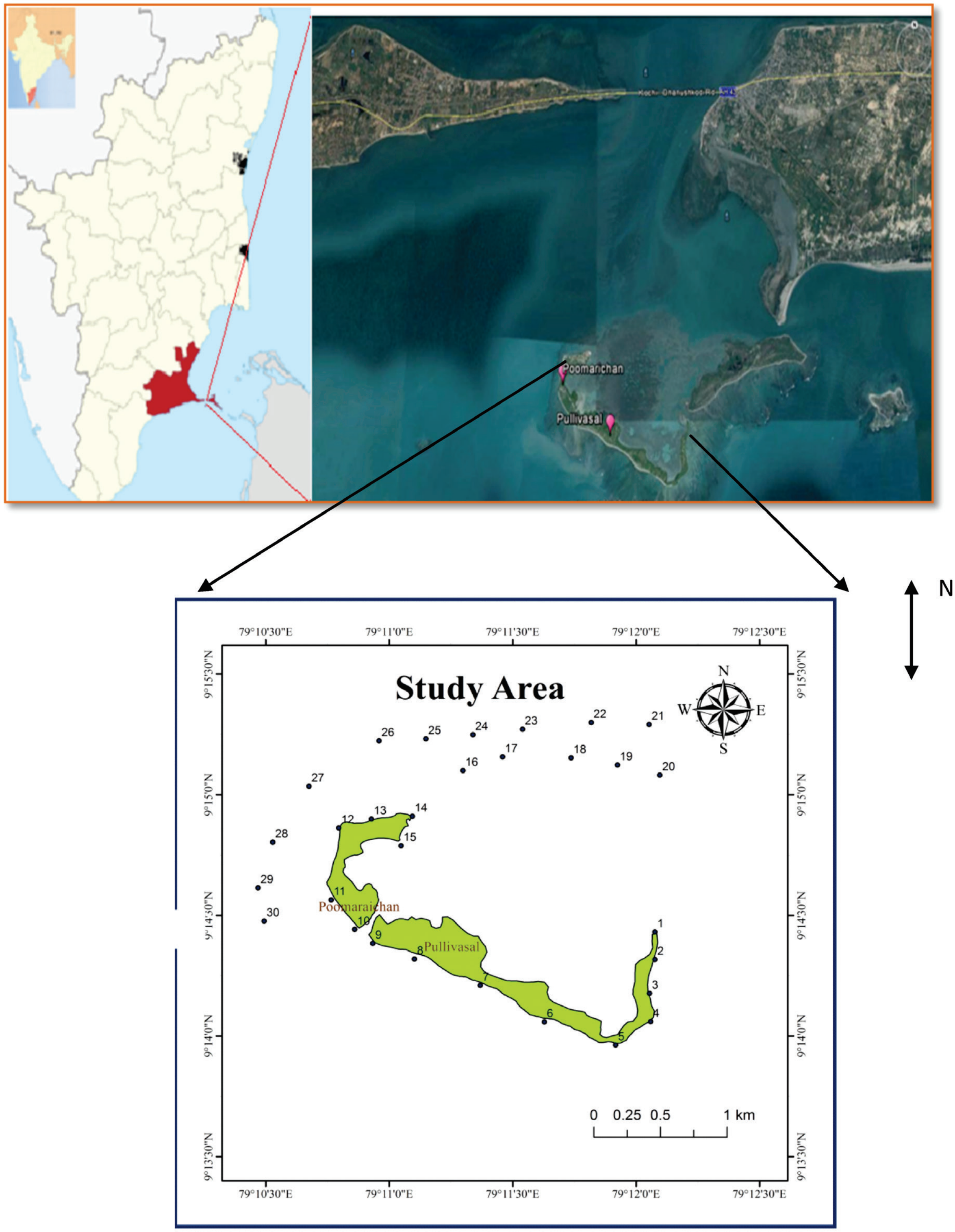

Fig. 1. Study area with sample locations.

area in "near shore" and "far shore" stations around Pullivasal and Poomarichan islands off Rameswaram. In all 60 samples of sediment and bottom water have been collected from 30 stations during each season, namely, southwest (SW) and northeast (NE) monsoon seasons. To the south off the study area, collection of samples could not be done due to the presence of fringing reef that makes the area shallow and the samples will not represent either near shore or far shore region.

By using van Veen grab sampler, sediment samples were collected and top 4 cm were preserved in 10% of formalin with a pinch of sodium carbonate (Walker *et al.,* 1974). The preserved sediment samples were subjected to rose Bengal

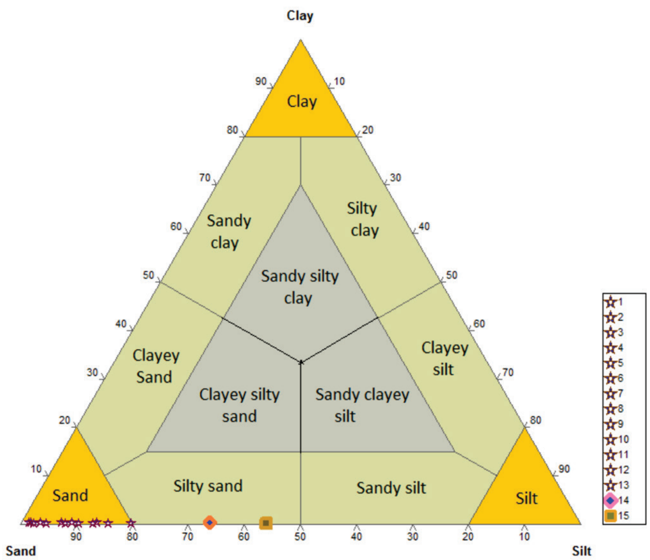

Fig. 2a Types of substrate for near shore during SW monsoon (Trefethen, 1950)

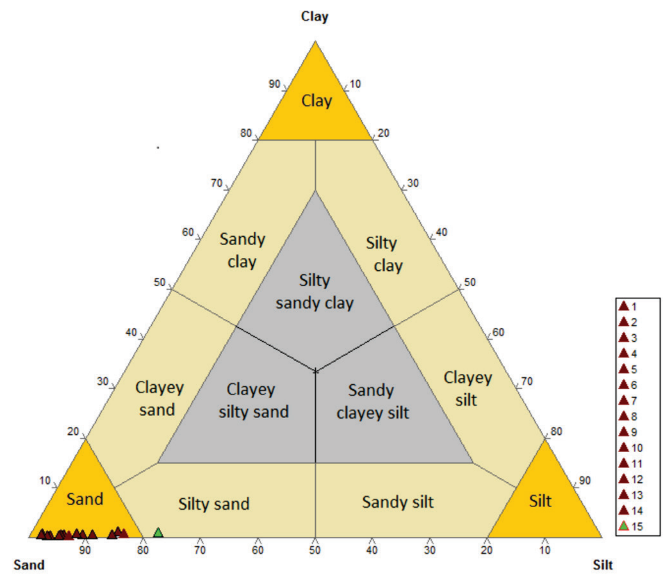

Fig. 2c Types of substrate for near shore during NE monsoon (Trefethen, 1950)

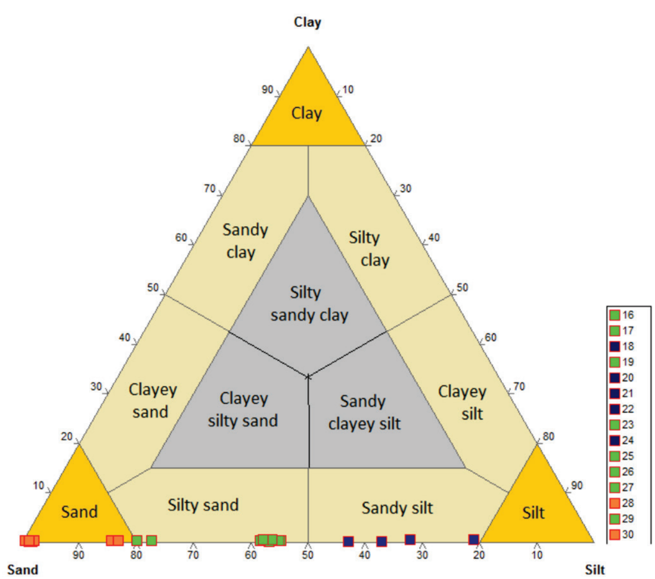

Fig. 2b Types of substrate for far shore during SW monsoon (Trefethen, 1950)

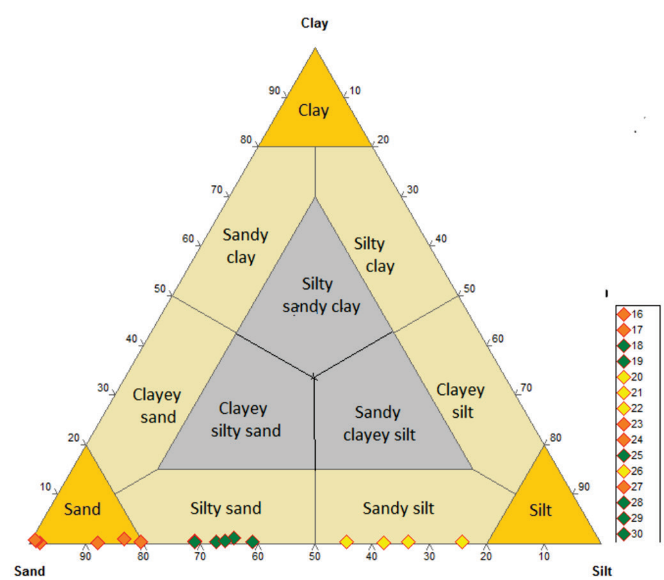

Fig. 2d Types of substrate for far shore during NE monsoon (Trefethen, 1950)

staining technique (Walton, 1952) and subjected to standard micropaleontological techniques in order to retrieve Ostracoda fauna. 500 gm of sediment samples were collected in polythene covers for other analysis to find out $CaCO_3$ (Piper, 1947), type of sediment (Krumbein and Pettijhon, 1983) and organic matter (Gaudette *et al.,* 1974).

The depth of water column were measured at the time of collection of bottom water samples using Aqua trap water sampler from each location and recorded. They range from 1 to 13 m. Temperature and pH of the collected bottom water samples were measured using portable multi-parameter hand held probe in situ. In each sampling station 100 ml of bottom water sample was fixed for dissolved oxygen following Winkler method (Strickland and Parsons, 1968) and 500 ml were taken for further analysis in the laboratory to find out salinity (Knudsen, 1901). Ca, Mg, Na and K were determined following APHA (1995).

SYSTEMATICS

In the present study, widely used classification of Ostracoda, proposed by Hartman and Puri (1974) is followed. According to the classification, a total of 42 Ostracoda species were identified and classified as follows: 42 species belonging 35 Genera, 18 Families, 6 Superfamilies, 3 Suborders that represent the order PODOCOPIDA and PLATYCOPINA. Among the 42 species, 3 species belong to the suborder PLATYCOPA, and rest of the species belong to the suborder PODOCOPA. The Taxonomic chart of Ostracoda, recorded in the study area is shown in Table 1.

Table 1. Taxonomic chart of Ostracoda recorded from off Pullivasal and Poomarichan islands.

Class	Sub Class	Order	Sub Order	Superfamily	Family	Genus	Species
	PLATYCOPA		Platycopina	Cytherelloidea	Cytherellidae	*Cytherella*	*Cytherella semitalis*
							Cytherella sp.
						Cytherelloidea	*Cytherelloidea leroyi*
						Keijcyoidea	*Keijcyoidea praecipua*
			Bairdiocopina	Bairdioidea	Bythocyprididae	*Bythocypris*	*Bythocypris sp*
					Bairdiidae	*Bairdoppilata*	*Bairdoppilata alcyonicola*
						Neonesidea	*Neonesidea crasenticlavula*
						Triebelina	*Triebelina tuticorensis*
				Cytheroidea	Schizocytheridae	*Neomonoceratina*	*Neomonoceratina iniqua*
						Spinoceratina	*Spinoceratina spinosa*
					Cytheridae	*Jankeijcythere*	*Jankeijcythere mckenziei*
						Paijenborchellina	*Paijenborchellina prona*
					Leptocytheridae	*Neocytheromorpha*	*Neocytheromorpha reticulata*
						Tanella	*Tanella gracilis*
					Hemicytheridae	*Neosinocythere*	*Neosinocythere dekrooni*
						Caudites	*Caudites javana*
					Pectocytheridae	*Keijia*	*Keijia demissa*
						Kotoracythere	*Kotoracythere inconspicua*
					Cytherideidae	*Miocyprideis*	*Miocyprideis spinulosa*
					Trachyleberididae	*Actinocytheresis*	*Actinocytheresis scutigera*
						Stigmatocythere	*Stigmatocythere indica*
OSTRACODA	PODOCOPA	PODOCOPIDA	Cytherocopina			*Keijella*	*Keijella karwarensis*
							Keijella nealei
							Keijella reticulata
						Chrysocythere	*Chrysocythere keiji*
						Lankacythere	*Lankacythere coralloides*
							Lankacythere sp.
						Mutilus	*Mutilus pentoekensis*
						Neocytheretta	*Neocytheretta murilineata*
					Loxoconchidae	*Loxoconcha*	*Loxoconcha gruendeli*
							Loxoconcha megapora indica
						Loxocorniculum	*Loxocorniculum lilljeborgii*
					Paracytherideidae	*Paracytheridea*	*Paracytheridea sp.*
					Paradoxosto-mamatidae	*Paradoxostoma*	*Paradoxostoma bhatiai*
					Cytheromatidae	*Paracytheroma*	*Paracytheroma ventrosinuosa*
					Xestoleberididae	*Ornatoleberis*	*Ornatoleberis morkhoveni*
						Xestoleberis	*Xestoleberis sp.*
							Xestoleberis variegata
				Macrocypridoidea	Macrocyprididae	*Macrocyprina*	*Macrocyprina decora*
				Pontocypridoidea	Pontocyprididae	*Propontocypris*	*Propontocypris (S.) bengalensis*
			Cypridocopina				*Propontocypris crocata*
				Cypridoidea	Candonidae	*Phlyctenophora*	*Phlyctenophora orientalis*

RESULTS AND DISCUSSION

Sediment parameters

From the sediment samples, the parameters $CaCO_3$, OM, type of substrate were determined and they were tabulated in Table 2a and 2b. These parameters are discussed spatially and seasonally and are being correlated with the total population.

Calcium carbonate ($CaCO_3$)

In the study area, as near shore stations are of coral sands, the $CaCO_3$ recorded invariably higher values from stations 1 to 15. During SW monsoon, $CaCO_3$ is minimum in station 14 and maximum in station 8. The percentage varies from 66.5% to 99.5% in near shore stations. Far shore, $CaCO_3$ is minimum in station 24 and maximum in station 30 that ranges from 21% to 79%. Spatially, it is observed that the $CaCO_3$ is showing lesser values if the stations are far shore. During NE monsoon, $CaCO_3$ is minimum in station 2 and it is maximum in station 6. The percentage ranges between 73% and 96% in near shore stations. Far shore, it is minimum in station 24 and maximum in station 19. Spatially, it is observed that the $CaCO_3$ is showing lesser values if the stations are far shore. Comparing both the seasons, it is inferred that the $CaCO_3$ is showing lesser values if the stations are far shore.

Seasonally, it is inferred that the near shore stations have coral sands (Marimuthu *et al.,* 2010, Baskar *et al.,* 2013) as their substrate and due to this the $CaCO_3$ are being recorded as higher values. The $CaCO_3$ in these substrate are not only from the sand but it is mainly from corals. In this case, the population of Ostracoda cannot be compared with the $CaCO_3$ values in near

Table 2a. Sedimentological parameters during Southwest monsoon season

Region	St. No.	Depth (m)	$CaCO_3$ (%)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Substrate	Total Population
NEAR SHORE REGION	1	1	88.0	1.36	95.33	4.52	0.15	Sand	1524
	2	1	82.5	1.00	91.92	7.95	0.13	Sand	1477
	3	1	85.5	0.25	87.05	12.78	0.17	Sand	1874
	4	1	94.0	0.20	89.53	10.27	0.20	Sand	1336
	5	1	88.0	0.30	92.58	7.10	0.32	Sand	1142
	6	1	92.5	0.35	97.96	1.70	0.34	Sand	1440
	7	1	92.5	0.30	98.27	1.36	0.37	Sand	1285
	8	1	99.5	0.80	96.25	3.38	0.37	Sand	1866
	9	1	87.5	1.00	86.21	13.49	0.30	Sand	3388
	10	1	81.0	0.75	90.63	9.06	0.31	Sand	1743
	11	1	99.0	0.25	97.45	2.26	0.29	Sand	420
	12	1	83.5	1.21	80.06	19.65	0.29	Sand	980
	13	1	89.0	0.30	84.29	15.57	0.14	Sand	1831
	14	1	66.5	2.51	55.95	43.81	0.24	Silty Sand	4226
	15	1	77.5	0.75	66.01	33.69	0.30	Silty Sand	2317
FAR SHORE REGION	16	2	77.0	0.95	79.89	19.79	0.32	Sand	4856
	17	1	64.0	0.40	56.74	43.02	0.24	Silty Sand	5784
	18	3	49.5	1.56	37.02	62.72	0.26	Sandy Silt	2206
	19	4	70.5	0.65	58.16	41.42	0.42	Silty Sand	2612
	20	4	43.0	3.42	31.94	67.44	0.62	Sandy Silt	6967
	21	5	31.5	1.51	20.68	78.68	0.64	Sandy Silt	666
	22	6	26.0	0.70	42.90	56.92	0.18	Sandy Silt	5356
	23	5	37.0	0.10	54.62	45.06	0.32	Silty Sand	872
	24	4	21.0	0.05	98.58	1.14	0.28	Sand	3393
	25	6	45.0	1.41	54.96	44.72	0.32	Silty Sand	7920
	26	6	25.5	1.41	56.16	43.32	0.52	Silty Sand	4506
	27	8	41.0	1.11	77.26	22.32	0.42	Silty Sand	5922
	28	8	47.5	0.60	84.22	15.36	0.42	Sand	1638
	29	10	35.5	1.36	57.68	41.82	0.50	Silty Sand	3320
	30	10	79.0	0.55	83.08	16.54	0.38	Sand	3556

shore stations. For the study area, it is inferred that seasonally, for the stations far shore, from 16 to 30 the $CaCO_3$ is directly proportional to the total population of Ostracoda as reported by Hussain *et al.* (1997, 2007) off Tuticorin; Sridhar *et al.* (1998) off Rameswaram.

Seasonally, it is inferred that far shore stations 16 to 30, $CaCO_3$ is directly proportional to the total population of Ostracoda (Hussain *et al.,* 1997, 2007; Sridhar *et al.,* 1998). As the near shore stations were of coral sands and due to these recorded higher values of $CaCO_3$ that cannot be compared with the total population. It is inferred that the far shore region is more favorable for the Ostracoda population as far as $CaCO_3$ is concerned.

Organic matter (*OM*)

For the study area, during SW monsoon, the OM is minimum in 4th station and maximum in 14th station, from 0.20% to 2.51%. For far shore stations, the minimum is in 24th station and maximum is in 20th station, from 0.05% to 3.42%. Spatially, it is observed that the OM is showing higher values in far shore region. During NE monsoon, OM in near shore stations is minimum in 14th station and it is maximum in 2nd and 10th stations as 0.36 and 0.86, respectively. For far shore stations, the minimum is in 16th station and maximum is in 21st station as 0.10 and 1.67, respectively. Spatially, it is observed that the OM is showing higher values if the stations are far shore. Seasonally, it is inferred that the OM is showing higher values if the stations are far shore.

For the study area, during SW monsoon, OM is directly proportional to the total population of Ostracoda for near shore and far shore. Lower the OM lower the population and higher the OM higher the population. For the study area, during NE monsoon, OM is inversely proportional to the total population of Ostracoda for near shore and far shore as reported by Sridhar *et al.* (1998); Baskar *et al.* (2013). Seasonally, it is inferred that the relation of OM with total population varies from one season to the other.

Substrate

For the study area, using sand, silt and clay percentages, Trilinear plots proposed by Trefethen (1950) were drawn for SW and NE monsoon seasons are given in Figs 2a to 2d. During SW monsoon, in the study area, it is observed that, sand and silty-sand substrate are being recorded and the most dominant substrate is sand which covers the first 13 stations in near shore region. Far shore, sand, silty-sand and sandy-silt substrate were present. During NE monsoon, it is observed that in the near shore stations, sand is the only substrate except in station 15 which is silty-sand. And far shore, sand, silty-sand and sandy-silt substrate were present. Hence, it is inferred that there is no significant variation in the substrate, seasonally while comparing both seasons.

For the study area, during SW monsoon, in the near shore region, silty-sand at station 14 recorded the highest total population of Ostracoda as 4226. Far shore, silty-sand at station 25 recorded the highest population as 7920. It is inferred that silty-sand is the favorable substrate for the abundance of Ostracoda as reported by Rasheed and Ragothaman (1978), Sridhar *et al.* (1998, 2002). During NE monsoon, in the near shore region, at station 14 the total population is 3915 and the substrate is sand. Far shore, silty-sand at station 25 recorded the highest population as 5662. It is inferred that both sand and silty-sand are the favorable substrate for the abundance of Ostracoda as reported by Sridhar *et al.* (1998, 2002), Hussain *et al.* (2007)

Table 2b. Sedimentological parameters during Northeast monsoon season

	St. No.	Depth (m)	$CaCO_3$ (%)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Substrate	Total Population
NEAR SHORE REGION	1	1	90.0	0.61	93.66	5.88	0.46	Sand	1000
	2	1	73.0	0.86	88.64	10.90	0.46	Sand	800
	3	1	90.0	0.71	90.38	9.20	0.42	Sand	755
	4	1	93.5	0.71	94.26	5.44	0.30	Sand	620
	5	1	92.0	0.61	97.26	2.20	0.54	Sand	520
	6	1	96.0	0.66	96.18	3.68	0.14	Sand	989
	7	1	92.5	0.41	96.60	3.22	0.18	Sand	678
	8	1	94.0	0.56	97.54	2.04	0.42	Sand	636
	9	1	87.5	0.51	94.60	5.24	0.16	Sand	1233
	10	1	75.5	0.86	83.84	15.08	1.08	Sand	1235
	11	1	92.5	0.76	92.98	6.92	0.10	Sand	535
	12	1	83.0	0.76	83.10	16.30	0.60	Sand	856
	13	1	91.0	0.51	85.18	14.46	0.36	Sand	1301
	14	1	92.0	0.36	91.34	7.98	0.68	Sand	3915
	15	1	81.5	0.51	77.08	22.20	0.72	Silty Sand	1458
FAR SHORE REGION	16	2	27.0	0.10	98.08	1.72	0.20	Sand	2624
	17	1	35.0	0.41	82.96	16.04	1.00	Sand	3121
	18	3	35.0	0.96	67.04	32.62	0.34	Silty Sand	1820
	19	4	71.5	0.61	70.74	28.58	0.68	Silty Sand	2010
	20	4	35.5	0.30	33.58	66.02	0.40	Sandy Silt	3857
	21	5	32.5	1.67	24.04	75.52	0.44	Sandy Silt	595
	22	6	32.0	1.47	44.26	55.36	0.38	Sandy Silt	3018
	23	5	39.0	0.51	87.90	11.84	0.26	Sand	782
	24	4	24.0	0.36	98.60	0.88	0.52	Sand	2250
	25	6	31.5	0.76	70.84	28.86	0.30	Silty Sand	5662
	26	6	30.0	0.76	37.94	61.84	0.22	Sandy Silt	3535
	27	8	43.0	0.76	80.40	19.30	0.30	Sand	3829
	28	8	37.0	1.07	63.54	35.22	1.24	Silty Sand	957
	29	10	32.0	0.66	60.78	38.78	0.44	Silty Sand	1375
	30	10	56.0	0.91	65.54	33.96	0.50	Silty Sand	1526

For the near shore stations, seasonally, silty-sand is the most favorable substrate for the total population of Ostracoda. Far shore, it is sand and silty-sand. Hence, it is inferred that the most congenial substrate is silty-sand for the total population of Ostracoda as reported by Rasheed and Ragothaman *et al.* (1978), Sridhar *et al.* (1998, 2002) and Hussain *et al.* (2007).

Total population

During SW monsoon, for the near shore stations, the total population ranges from 420 to 4226. The higher population of 3388 and 4226 were recorded in stations 9 and 14, respectively. Far shore, it ranges from 666 to 7920. Spatially, it is inferred that the stations far shore recorded the highest population. The overall total population is 87,371 out of which 26,849 is from first 15 stations (near shore) and 59,574 is from 16 to 30 stations. During NE monsoon, for the near shore stations, it ranges from 515 to 3915. The highest population of 3915 was recorded in station 14. Far shore, it ranges from 595 to 5662. Spatially, it is inferred that, the stations far shore recorded the highest population. The overall total population is 53,538 out of which 16,531 is from first 15 stations (near shore) and 36,961 is from 16 to 30 stations.

For near shore and far shore, the population of Ostracoda is more during SW monsoon than the NE monsoon. The overall population during SW monsoon (87,371) is also more than the NE monsoon (53,538). It is inferred that, seasonally, SW monsoon favors the abundance of Ostracoda as reported by Sivakumar (2014) and Maniyarasan (2016).

Water parameters

From the bottom water samples, the parameters, depth, temperature, pH, EC, TDS, salinity, DO, Ca, Mg, Na and K were determined and they were tabulated in Table 3a to 3b. These parameters are discussed spatially and seasonally and are being correlated with the total population.

Depth

For the study area, in near shore stations, the depth of water column is 1 m for both the seasons. As the depth remains unchanged, there is no correlation of total population for both the seasons. Far shore, the depth varies between 1 m and 13 m for both the seasons. The depth increases as the stations were away from the shore. It is inferred that spatially and seasonally there is no correlation of depth with the total population as reported by De Deckker *et al.* (1988). It is difficult to assess the influence of depth, as other decisive factors change in close correlation with depth. With increasing depth, stability of the environment generally increases, whereas the energy level of the environment decreases.

Temperature

For the study area, during SW monsoon the temperature ranges from 28.2 ^{0}C to 30.7 ^{0}C with an average of 29.8 ^{0}C in near

Table 3a. Bottom water parameters during Southwest monsoon season.

	St No.	Depth (m)	Temp (°C)	pH	EC (µS/cm)	TDS (ppm)	Salinity (‰)	DO (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Total Population
NEAR SHORE REGION	1	1	28.2	8.40	55069	35244	34.3	3.71	250	840	5860	380	1524
	2	1	28.3	8.55	54896	35133	34.4	4.00	240	720	5810	380	1477
	3	1	29.1	8.25	55278	35378	34.7	4.29	250	840	5920	390	1874
	4	1	29.6	8.24	53663	34344	33.4	4.29	220	660	5955	390	1336
	5	1	29.8	8.20	55608	35589	34.3	4.00	300	900	6015	380	1142
	6	1	29.3	8.11	55365	35433	33.8	3.43	200	600	6935	380	1440
	7	1	28.5	7.95	56302	36033	34.5	2.14	150	480	6215	380	1285
	8	1	29.4	8.17	54115	34633	33.6	3.86	200	600	6585	390	1866
	9	1	30.3	8.30	56493	36156	34.3	4.00	250	840	6270	390	3388
	10	1	30.6	8.16	53924	34511	33.8	4.43	250	840	6780	390	1743
	11	1	30.7	8.23	56632	36244	33.6	3.43	250	840	6560	380	420
	12	1	29.6	8.14	56875	36400	34.5	3.71	260	840	6880	380	980
	13	1	30.4	8.30	59271	37933	34.6	4.29	280	840	7070	390	1831
	14	1	31.5	8.55	57865	37033	34.8	4.43	200	600	7660	400	4226
	15	1	31.7	8.35	58108	37189	34.6	3.71	240	720	7980	390	2317
FAR SHORE STATIONS	16	2	27.5	8.40	59132	37844	32.5	4.57	260	720	6880	390	2624
	17	1	27.5	8.05	58247	37278	32.4	4.29	260	720	6675	380	3121
	18	3	27.5	8.43	58576	37489	32.0	3.86	280	840	6770	330	1820
	19	4	27.5	8.70	59167	37867	32.9	4.14	320	960	6040	310	2010
	20	4	27.4	8.60	59340	37978	33.5	3.71	280	840	6540	390	3857
	21	5	27.5	8.80	60087	38456	32.1	5.14	240	720	6303	370	595
	22	6	27.0	8.90	60347	38622	32.2	3.86	240	720	6380	390	3018
	23	5	27.0	8.80	59965	38378	32.2	4.57	280	840	6770	390	782
	24	4	27.0	8.90	59983	38389	32.4	5.43	280	840	6725	340	2250
	25	6	27.8	7.60	60191	38522	32.9	4.14	320	960	6735	380	5662
	26	6	28.0	7.90	59306	37956	32.8	4.00	240	720	6730	300	3535
	27	8	27.2	8.90	58958	37733	32.2	5.43	240	720	6730	300	3829
	28	8	27.0	8.20	59896	38333	32.1	5.00	280	840	7000	300	957
	29	10	26.9	8.70	59236	37911	31.4	5.00	280	840	7660	340	1375
	30	10	27.0	8.30	59410	38022	31.8	5.29	320	960	7760	360	1526

shore stations. Spatially, the temperature varies for about 2.5 ^{0}C. Far shore, it varies from 28.7 ^{0}C to 30.7 ^{0}C with an average of 29.6 ^{0}C. Spatially, the temperature varies for about 2 ^{0}C. Spatially, the temperature does not vary significantly from the shore to far shore. During NE monsoon, the near shore stations recorded a minimum of 25.5 ^{0}C and a maximum of 30.0 ^{0}C with an average of 26.8 ^{0}C. Spatially, the temperature varies for about 4.5 ^{0}C. Far shore, the stations recorded a minimum of 26.9 ^{0}C and maximum of 28.0 ^{0}C with an average of 27.3 ^{0}C. Spatially, the temperature varies for about 1.1 ^{0}C. Spatially, the temperature does not vary significantly from the shore to far shore. Seasonally, the temperature is less in NE monsoon compare to SW monsoon. It is inferred that there is no correlation of temperature with the total population spatially as well as seasonally.

Hydrogen ion concentration (pH)

For the study area, during SW monsoon, in the near shore stations, pH shows minimum of 7.95 at 7th station and maximum of 8.55 at 2nd and 14th stations with an average of 8.26. Far shore, minimum of 8.22 at 19th station and maximum of 8.52 at 24th station, with an average of 8.39 were recorded. Spatially, it is inferred that the pH is between 8 and 9 for the study area during SW monsoon. For the study area, during NE monsoon, in the near shore region, pH shows a minimum of 7.50 at 11th station and a maximum of 8.89 at 2nd station, with an average of 8.27. Far shore, a minimum of 7.60 at 25th station and a maximum of 8.90 at 22nd and 27th stations with an average of 8.48 were recorded. Seasonally, it is inferred that there is no significant variation of pH in different seasons. As there is no significant variation of pH, there is no correlation of pH with the total population.

Electrical Conductivity (EC)

In the present study, EC has been recorded during SW monsoon that ranges from 53663 to 5927 µS/cm in near shore. Higher values have been observed at 13th station and lower value at 4th station. Far shore, EC ranges from 52535 to 58889 µS/cm. 17th station recorded the highest value and 29th station recorded the lowest value. Spatially, it is observed that the EC is higher in near shore region comparing to far shore. During NE monsoon, the EC ranges from 51823 to 60816 µS/cm in near shore region, higher value have been observed at 12th station and lower value at 1st station. Far shore, EC ranges from 58247 to 60347 µS/cm higher value have been observed at 22nd station and lower value at 17th station.

Seasonally, irrespective of the region, the EC values are increasing during NE monsoon compare to SW monsoon. As SW monsoon recorded more population than the NE monsoon, it is inferred that EC is inversely proportional to the total population as reported by Maniyarasan (2016).

Table 3b. Bottom water parameters during Northeast monsoon season.

	St No.	Depth (m)	Temp (°C)	pH	EC (µS/cm)	TDS (ppm)	Salinity (‰)	DO (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Total Population
NEAR SHORE REGION	1	1	25.5	8.81	51823	33167	31.5	3.71	330	960	6975	370	1000
	2	1	25.5	8.89	55434	35478	31.9	4.57	240	720	6965	380	800
	3	1	25.7	8.80	53559	34278	32.9	4.14	245	720	6975	380	755
	4	1	25.7	8.70	52986	33911	32.2	5.43	250	720	6760	380	520
	5	1	25.7	8.70	54826	35089	31.9	4.57	250	840	6790	380	520
	6	1	25.7	8.70	57118	36556	32.6	5.29	330	960	6450	390	100
	7	1	25.7	8.40	56997	36478	33.0	4.71	240	720	6965	380	61
	8	1	26.7	7.90	58160	37222	33.8	5.29	245	720	6750	390	636
	9	1	26.5	8.30	56858	36389	32.3	4.86	245	720	6750	400	1233
	10	1	28.1	8.10	56788	36344	32.2	5.14	250	720	6855	400	616
	11	1	27.5	7.50	57500	36800	30.9	5.00	280	840	6560	420	45
	12	1	27.6	7.80	60816	38922	33.4	4.29	275	840	6015	390	162
	13	1	27.8	7.60	56892	36411	33.4	5.29	270	840	6885	390	645
	14	1	28.0	7.90	59670	38189	32.7	4.43	275	840	6685	400	1345
	15	1	30.0	7.90	59514	38089	34.1	5.43	270	840	6640	380	716
FAR SHORE STATIONS	16	2	27.5	8.40	59132	37844	32.5	4.57	260	720	6880	390	2624
	17	1	27.5	8.05	58247	37278	32.4	4.29	260	720	6675	380	3121
	18	3	27.5	8.43	58576	37489	32.0	3.86	280	840	6770	330	1820
	19	4	27.5	8.70	59167	37867	32.9	4.14	320	950	6040	310	2010
	20	4	27.4	8.60	59340	37978	33.5	3.71	280	840	6540	390	3857
	21	5	27.5	8.80	60087	38456	32.1	5.14	240	720	6303	370	595
	22	6	27.0	8.90	60347	38622	32.2	3.86	240	720	6380	390	3018
	23	5	27.0	8.80	59965	38378	32.2	4.57	280	840	6770	390	782
	24	4	27.0	8.90	59983	38389	32.4	5.43	280	840	6725	340	2250
	25	6	27.8	7.60	60191	38522	32.9	4.14	320	950	6735	380	5662
	26	6	28.0	7.90	59306	37956	32.8	4.00	240	720	6730	300	3535
	27	8	27.2	8.90	58958	37733	32.2	5.43	240	720	6730	300	3829
	28	8	27.0	8.20	59896	38333	32.1	5.00	280	840	7000	300	957
	29	10	26.9	8.70	59236	37911	31.4	5.00	280	840	7660	340	1375
	30	10	27.0	8.30	59410	38022	31.8	5.29	320	950	7760	360	1526

Total dissolved solids (TDS)

In the present study, TDS has been recorded during SW monsoon that ranges from 34344 to 37933 mg/l in near shore. Higher values have been observed at 13th station and lower value at 4th station. Far shore, TDS ranges from 33622 to 37689 mg/l. The 17th station recorded the highest value and 29th station recorded the lowest value. Spatially, it is observed that the TDS is higher in near shore region comparing to far shore region. During NE monsoon, the TDS ranges from 33167 to 38922 mg/l in near shore. Higher values have been observed at 12th station and lower value at 1st station. Far shore, TDS ranges from 37278 to 38622 mg/l. The 22nd station recorded the highest value and 17th station recorded the lowest value. Spatially, far shore shows higher percentage of TDS.

Seasonally, irrespective of the region, the TDS values are increasing during NE monsoon compare to SW monsoon. As SW monsoon recorded more population than the NE monsoon, it is inferred that TDS in inversely proportional to the total population as reported by Baskar *et al.* (2013)

Salinity

In the present study, during SW monsoon, salinity ranges from 33.4 to 34.7 ‰ in near shore region. Far shore, it ranges between 33.2 and 34.8 ‰. Spatially, there is no significant variation. During NE monsoon, salinity ranges from 30.9 to 34.1 ‰ in near shore region. Far shore, the values range between 31.4 and 33.5 ‰. Spatially, it is observed that, there is no much variation among stations irrespective of near shore and far shore. Seasonally, as salinity decreases during NE monsoon compare to SW, it is inferred that salinity is directly proportional to the total population as reported by Baskar (2014).

Dissolved Oxygen (DO)

For the study area, during SW monsoon, near shore region, the DO is minimum of 2.14 mg/l at 7th station and maximum of 4.43 mg/l at 10th and 14th stations. Far shore, a minimum of 2.71 mg/l at 25th station, maximum of 4.43 mg/l at 21st and 30th stations were recorded. Spatially, there is no significant variation of DO between near shore and far shore. During NE monsoon, near shore region, the DO is minimum of 3.71 mg/l at 1st station and a maximum of 5.43 mg/l at 4th and 15th stations. Far shore, a minimum of 3.71 mg/l at 20th station, maximum of 5.43 mg/l at 24th and 27th stations were recorded. Spatially, there is no significant variation of DO between near shore and far shore. Seasonally, it is observed that DO shows higher values during NE monsoon compare to SW monsoon. It is inferred that DO is inversely proportional to the population as reported by Sridhar (1996).

Table 4a. Distribution of species during Southwest monsoon season around Pullivasal and Poomarichan islands, Gulf of Mannar.

St. \ Sp.	SPECIES NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		Near shore stations															Far shore stations														
1	*Cytherella semitalis*	C	A	C	C	A	A	C	R	C	A	C	C	R	C	C	R	C	A	C	C	C	C	A	C	C	C	C	A	A	C
2	*Cytherella* sp.	R	R	R	C	C	A	C	C	R	C	C	A	C	C	C	A	R	C	C	A	A	A	C	C	R	R	R	C	C	A
3	*Cytherelloidea leroyi*	C	C	C	R	A	C	C	C	A	C	R	C	C	R	R	C	C	A	C	R	C	C	A	C	R	A	C	A	C	R
4	*Keijcyoidea praecipua*	R	R	R	R	R	R	R	R	C	R	R	R	R	C	R	R	C	-	-	R	C	R	R	C	C	R	-	R	R	R
5	*Bythocypris* sp.	R	R	R	R	R	R	R	R	C	R	R	C	R	R	C	-	-	R	R	R	R	R	-	-	-	R	R	R	-	-
6	*Bairdoppilata alcyonicola*	R	R	C	R	R	R	-	C	R	R	R	C	R	R	C	R	R	R	R	-	R	R	R	R	R	R	-	R	R	R
7	*Neonesidea crasenticlavula*	-	-	-	-	R	-	-	-	-	R	C	-	-	R	-	R	R	-	R	C	R	R	-	-	R	R	C	-	R	R
8	*Triebelina tuticorensis*	R	-	-	-	-	R	A	-	-	-	R	-	-	R	R	R	R	-	-	R	R	-	-	R	R	R	-	-	-	R
9	*Neomonoceratina iniqua*	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10	*Spinoceratina spinosa*	C	R	R	R	C	C	A	C	C	R	R	R	R	R	R	C	C	R	R	R	C	C	R	R	R	R	C	R	R	C
11	*Jankeijcythere mckenziei*	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
12	*Neocytheromorpha reticulata*	C	A	A	A	C	C	A	R	C	A	A	C	C	R	C	C	C	A	C	C	A	A	C	C	C	C	A	R	C	A
13	*Tanella gracilis*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
14	*Neosinocythere dekrooni*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
15	*Caudites javana*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16	*Keijia demissa*	R	-	-	-	-	R	C	-	-	-	R	-	-	-	R	C	R	R	-	-	-	R	R	R	-	C	R	C	-	R
17	*Kotoracythere inconspicua*	A	A	A	A	C	C	C	C	A	A	A	A	C	C	C	C	C	A	C	C	A	C	C	A	A	A	C	C	A	C
18	*Miocyprideis spinulosa*	R	R	R	R	C	C	-	A	C	A	A	R	C	C	R	C	C	C	R	C	C	A	C	C	R	C	A	C	C	C
19	*Actinocytheresis scutigera*	R	-	-	-	R	-	A	-	R	-	R	-	R	C	R	R	-	-	R	-	-	-	R	R	C	R	R	C	R	-
20	*Stigmatocythere indica*	A	A	C	C	C	C	R	C	R	C	C	C	C	R	R	C	C	A	R	C	A	C	C	C	C	A	A	R	R	C
21	*Keijella karwarensis*	C	C	R	R	R	R	R	R	C	C	R	R	R	C	C	C	C	C	A	C	C	C	C	A	C	C	C	R	C	A
22	*Keijella nealei*	C	A	C	C	C	R	C	C	A	C	C	C	A	C	R	A	C	C	C	R	C	A	C	C	A	A	C	C	C	A
23	*Keijella reticulata*	C	C	A	C	C	C	A	C	C	C	A	A	A	C	C	C	A	C	R	C	C	C	A	A	C	R	C	A	C	C
24	*Chrysocythere keiji*	C	R	R	R	-	-	R	C	C	C	C	R	-	-	R	C	C	C	A	C	R	C	A	C	C	C	A	C	R	C
25	*Lankacythere coralloides*	R	-	A	R	C	A	A	A	C	C	R	R	A	C	A	C	C	C	A	A	A	R	R	R	C	C	C	A	C	A
26	*Lankacythere* sp.	R	A	C	C	R	R	R	-	C	R	A	C	C	C	C	R	R	-	R	C	R	C	-	C	C	A	C	R	-	R
27	*Mutilus pentoekensis*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
28	*Neocytheretta murilineata*	R	R	C	A	A	A	C	C	R	-	R	R	C	C	R	C	R	R	C	C	C	R	C	C	A	R	A	C	R	C
29	*Loxoconcha gruendeli*	A	A	A	C	C	C	C	C	C	A	A	C	A	C	A	C	A	C	C	A	C	C	A	A	C	C	A	A	C	A
30	*Loxoconcha megapora indica*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
31	*Loxocorniculum lilljeborgii*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
32	*Paijenborchellina prona*	R	R	-	-	R	R	-	-	R	-	-	R	R	R	C	-	-	C	C	A	R	-	-	R	R	A	C	-	R	R
33	*Paracytheridea* sp.	R	R	-	R	R	C	A	R	-	-	R	R	R	R	R	R	-	R	R	R	C	-	R	R	-	R	R	-	R	-
34	*Paradoxostoma bhatiai*	C	C	A	C	R	R	A	A	C	C	A	C	C	A	A	A	C	C	C	A	R	A	A	C	R	R	C	C	A	C
35	*Paracytheroma ventrosinuosa*	C	R	R	R	-	R	R	R	R	-	R	R	-	-	R	C	R	R	-	R	C	R	C	C	R	-	R	R	C	R
36	*Ornatoleberis morkhoveni*	C	C	A	C	R	R	R	-	R	A	R	R	R	A	C	C	C	R	C	A	A	R	R	R	C	A	C	C	A	C
37	*Xestoleberis* sp.	C	C	R	C	A	A	C	A	C	R	C	A	A	A	A	C	A	C	C	C	R	A	C	C	R	R	C	A	C	C
38	*Xestoleberis variegata*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
39	*Macrocyprina decora*	R	-	-	-	R	C	C	R	-	R	R	R	-	R	R	C	R	-	-	R	R	R	-	R	R	C	C	R	-	R
40	*Propontocypris (S.) bengalensis*	R	R	R	-	-	R	-	-	R	-	R	R	-	-	R	R	-	R	R	-	R	C	R	R	R	C	C	R	R	C
41	*Propontocypris crocata*	C	R	R	A	C	R	C	R	R	R	C	C	C	R	R	R	R	C	C	C	C	R	R	R	R	C	R	C	R	C
42	*Phlyctenophora orientalis*	A	C	C	C	A	C	C	R	C	A	C	R	R	C	C	A	C	C	C	A	C	R	R	C	C	C	A	C	C	C

A : > 15; C: 5-15; R: <5

Table 4b. Distribution of species during Northeast monsoon season around Pullivasal and Poomarichan islands, Gulf of Mannar.

St. \ Sp.	SPECIES NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		Near shore stations															Far shore stations														
1	*Cytherella semitalis*	R	C	R	C	C	C	R	R	C	A	A	R	R	C	C	R	R	C	R	C	C	R	A	C	C	R	C	C	A	R
2	*Cytherella* sp.	R	R	R	C	R	C	R	A	R	R	R	C	C	C	R	C	R	R	C	C	A	A	R	C	R	R	C	C	R	R
3	*Cytherelloidea leroyi*	R	C	C	R	C	R	R	C	A	R	R	C	C	R	R	R	R	C	C	R	R	C	A	C	R	R	C	C	C	R
4	*Keijcyoidea praecipua*	R	C	C	R	R	R	C	R	C	R	R	C	C	R	R	R	R	-	-	R	R	-	-	C	C	-	R	R	R	R
5	*Bythocypris* sp.	C	C	R	R	R	R	R	C	C	C	C	C	R	C	C	R	R	R	R	-	-	R	R	R	C	C	R	R	R	R
6	*Bairdoppilata alcyonicola*	R	R	R	C	R	R	R	R	C	-	C	R	R	C	C	C	C	R	C	C	C	R	R	R	-	-	-	-	-	-
7	*Neonesidea crasenticlavula*	-	-	-	-	R	R	-	-	-	-	C	R	-	C	R	R	R	-	-	R	C	R	-	-	R	R	C	C	R	R
8	*Triebelina tuticorensis*	R	-	-	-	-	R	-	-	R	C	-	-	R	-	-	R	R	-	-	R	R	-	-	R	-	-	R	R	R	-
9	*Neomonoceratina iniqua*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
10	*Spinoceratina spinosa*	R	R	R	C	R	R	R	C	C	C	C	R	R	R	R	C	R	R	C	R	-	R	R	-	R	-	C	C	C	R
11	*Jankeijcythere mckenziei*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
12	*Neocytheromorpha reticulata*	R	C	C	A	A	R	C	R	R	-	C	R	R	R	R	R	R	C	R	C	C	C	C	R	A	A	A	A	A	C
13	*Tanella gracilis*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
14	*Neosinocythere dekrooni*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
15	*Caudites javana*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16	*Keijia demissa*	R	-	-	-	-	C	R	C	-	C	R	-	-	-	R	R	R	R	-	-	-	C	R	-	R	C	C	C	A	-
17	*Kotoracythere inconspicua*	C	C	C	C	R	-	R	C	C	C	C	C	R	R	R	R	R	-	C	C	A	A	C	A	R	-	-	-	R	-
18	*Miocyprideis spinulosa*	R	R	C	R	R	R	R	C	C	-	R	C	C	R	R	R	C	C	R	R	C	R	R	C	R	R	R	C	R	-
19	*Actinocytheresis scutigera*	R	-	-	-	R	R	-	-	R	R	R	R	-	R	R	R	-	-	C	-	R	-	R	R	C	C	C	R	R	-
20	*Stigmatocythere indica*	C	C	R	R	C	C	A	A	C	C	R	C	C	R	R	R	R	C	R	R	A	A	C	C	R	R	R	C	R	R
21	*Keijella karwarensis*	R	R	R	C	C	C	R	R	C	C	R	R	C	C	R	R	C	C	R	A	A	C	C	R	A	C	C	R	C	R
22	*Keijella nealei*	R	C	C	C	R	R	R	R	C	R	R	C	R	R	C	C	R	R	C	R	R	C	C	A	A	C	R	R	R	R
23	*Keijella reticulata*	R	R	C	C	R	C	R	R	R	C	C	A	A	R	R	R	C	C	R	R	R	C	R	R	C	C	R	R	C	R
24	*Chrysocythere keiji*	R	R	R	R	-	-	R	R	C	C	C	R	R	-	R	R	R	R	C	R	C	C	C	R	R	R	R	C	C	R
25	*Lankacythere coralloides*	R	C	C	C	R	C	A	A	R	R	C	C	C	R	C	C	C	R	C	C	C	R	R	R	C	C	C	C	C	C
26	*Lankacythere* sp.	R	C	C	R	R	C	R	-	-	C	R	C	C	R	C	R	R	C	C	-	-	R	R	R	-	-	-	R	R	-
27	*Mutilus pentoekensis*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
28	*Neocytheretta murilineata*	R	R	R	A	A	C	C	R	C	R	-	-	R	-	-	R	R	R	C	C	R	R	C	C	R	R	R	A	A	C
29	*Loxoconcha gruendeli*	C	C	A	A	R	R	R	R	R	C	R	R	C	R	R	R	C	C	R	C	C	A	C	R	R	C	C	R	C	C
30	*Loxoconcha megapora indica*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
31	*Loxocorniculum lilljeborgii*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
32	*Paijenborchellina prona*	R	R	-	-	R	R	-	-	R	-	-	-	C	C	C	R	R	-	-	C	R	-	C	-	R	R	R	-	C	R
33	*Paracytheridea* sp.	R	R	-	R	R	R	-	-	R	-	C	C	-	R	R	R	R	R	-	C	-	C	C	R	R	R	-	-	R	R
34	*Paradoxostoma bhatiai*	R	-	C	-	-	-	C	C	-	-	-	-	-	R	-	C	R	R	C	-	C	C	C	R	C	C	R	R	R	R
35	*Paracytheroma ventrosinuosa*	R	R	R	-	-	-	R	R	-	C	C	C	R	-	-	R	R	R	-	R	R	R	C	R	C	R	C	C	C	R
36	*Ornatoleberis morkhoveni*	R	C	C	R	R	R	C	-	R	C	C	R	R	R	A	R	-	C	R	R	-	-	R	R	C	C	R	R	-	-
37	*Xestoleberis* sp.	C	C	R	R	C	C	R	R	R	R	C	R	R	A	A	-	C	-	-	R	-	R	R	R	-	-	-	R	R	-
38	*Xestoleberis variegata*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	R	A	A	A	A	A	A	A	A	A	A
39	*Macrocyprina decora*	-	-	-	-	-	R	R	R	C	-	R	R	R	-	-	R	C	C	R	A	A	A	R	C	C	R	R	R	R	R
40	*Propontocypris (S.) bengalensis*	R	R	-	-	-	-	R	-	-	-	-	R	R	-	-	R	-	-	-	R	C	C	R	R	-	-	-	-	-	-
41	*Propontocypris crocata*	R	R	R	C	C	R	C	R	R	C	C	R	R	C	R	R	R	R	C	R	R	R	C	R	-	-	R	C	C	-
42	*Phlyctenophora orientalis*	C	R	R	C	A	R	R	C	R	C	R	R	C	C	R	C	R	R	A	A	A	C	R	R	C	C	R	C	C	C

A : > 15; C: 5-15; R: <5

Calcium (Ca)

In the present study area, during SW monsoon, near shore region, the values range from 150 to 300 mg/l. Far shore, it ranges from 200 to 285 mg/l. Spatially, it is observed that Ca has no variation from near shore to far shore. During NE monsoon, near shore region, the values range from 240 to 330 mg/l. Far shore, it ranges from 240 to 320 mg/l. Spatially, it is observed that Ca is increasing from near shore to far shore. Seasonally, Ca has higher values during NE monsoon compare to SW monsoon. As the total population decreases during NE monsoon compare to SW monsoon, it is inferred that Ca is inversely proportional to the total population as reported by Sivakumar (2014).

Magnesium (Mg)

For the study area, Mg is minimum of 480 mg/l and maximum of 900 mg/l, during SW monsoon in near shore region. Far shore, Mg is minimum of 600 mg/l and maximum of 840 mg/l during SW monsoon. Spatially, Mg has no variation from near shore to far shore. During NE monsoon, Mg is minimum of 720 mg/l and maximum of 960 mg/l in near shore region. Far shore, Mg is minimum of 720 mg/l and maximum of 950 mg/l. Spatially, there is an increase of Mg from near shore to far shore but not significant. Seasonally, Mg has higher values during NE monsoon compare to SW monsoon. As the total population decreases during NE monsoon compare to SW monsoon, it is inferred that Mg is inversely proportional to the total population as reported by Sivakumar (2014).

Sodium (Na)

For the study area, Na is minimum of 5810 mg/l and maximum of 7980 mg/l during SW monsoon in near shore region. Far shore, Na is minimum of 5680 mg/l and maximum of 7740 mg/l during SW monsoon. Spatially, Na decreases from near shore to far shore. During NE monsoon, Na is minimum of 6015 mg/l and maximum of 6975 mg/l in near shore region. Far shore, Na is minimum of 6040 mg/l and maximum of 7760 mg/l. Spatially, there is no significant variation. Seasonally, Na increases from SW to NE monsoon. It is inferred that Na is inversely proportional to total population as reported by Maniyarasan (2016).

Potassium (K)

For the study area, K is minimum of 380 mg/l and maximum of 440 mg/l during SW monsoon in near shore region. Far shore, K is minimum of 390 mg/l and maximum of 410 mg/l during SW monsoon. Spatially, K increases from near shore to far shore. During NE monsoon, K is minimum of 370 mg/l and maximum of 420 mg/l in near shore region. Far shore, K is minimum of 300 mg/l and maximum of 390 mg/l. Spatially, there is no significant variation. Seasonally, there is no significant variation of K from SW to NE monsoon. It is inferred that K cannot be correlated with the total population as reported by Maniyarasan (2016).

DISTRIBUTION

Taking in to account the total population recorded in each and every stations, it is classified in this study that when the population is recorded up to 5 in number, it is classified as Rare; when it is between 5 and 15, it is classified as Common; and when it is greater than 15, it is classified as abundant. The distribution of each species for SW and NE monsoon seasons is presented in Table 4a and b.

Among the 42 species, nine species were found to be Widespread and Abundant, occurring more than 15 specimens in all the stations during both the seasons. They are, *Neomonoceratina iniqua, Jankeijcythere mckenziei, Tanella gracilis, Neosinocythere dekrooni, Caudites javana, Mutilus pentoekensis, Loxoconchamegapora indica, Loxocorniculum liljeeborgi* and *Xestoleberis variegata* as reported by Maniyarasan (2016).

Twenty eight species were found to be Common, occurring between 5 and 15 specimens. They are *Cytherella semitalis, Cytherella* sp., *Cytherelloidea leroyi, Keijcyoidea praecipua, Bythocypris* sp, *Spinoceratina spinosa, Neocytheromorpha reticulata, Kotoracythere inconspicua, Miocyprideis spinulosa, Actinocytheresis scutigera, Stigmatocythere indica, Keijella karwarensis, Keijella nealei, Keijella reticulata, Chrysocythere keiji, Lankacythere coralloides, Lankacythere* sp., *Neocytheretta murilineata, Loxoconcha gruendeli, Paijenborchellina prona, Paracytheridea* sp., *Paradoxostoma bhatiai, Ornatoleberis morkhoveni, Xestoleberis* sp., *Macrocyprina decora, Propontocypris (S.) bengalensis, Propontocypris crocata* and *Phlyctenophora orientalis.*

Five species were found to be Rare, occurring less than 5 specimens. They are *Bairdopillata alcyonicola, Neonesidea cresenticlavula, Triebelina tuticorensis, Keijia demissa* and *Paracytheromorpha ventrosinuosa.*

CONCLUSIONS

Forty two Ostracoda species were identified belonging to 35 Genera, 18 Families, 6 Superfamilies, 3 Suborders that represent the Order PODOCOPIDA and PLATYCOPINA. Among the 42 species, 3 species belong to the Suborder PLATYCOPA, and Rests of the species belong to the Suborder PODOCOPA. Spatially, it is inferred that the stations that are far shore recorded the highest population in both the seasons. Seasonally, far shore stations are more favorable for the Ostracoda population as far as $CaCO_3$ is concerned; the relation of OM with the total population varies from one season to the other; the most congenial substrate is silty-sand for the total population of Ostracoda; EC is inversely proportional to the total population; TDS is inversely proportional to the total population; salinity is directly proportional to the total population; DO is inversely proportional to the population; Ca is inversely proportional to the total population; Mg is inversely proportional to the total population; Na is inversely proportional to total population. Among the 42 species, nine species were found to be Widespread and Abundant; twenty eight species were found to be Common; and five species were found to be Rare in occurrence. The overall population during SW monsoon (87,371) is more than the NE monsoon (53,538). It is inferred that SW monsoon favors the abundance of Ostracoda.

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