4.2 SPATIAL DISTRIBUTION OF PHYTOPLANKTON

4.2.1 Occurrence of Phytoplankton at Different Stations (ST1, ST2 and ST3)

The total number of phytoplankton species recorded during the study for ST1, ST2, and ST3 are 73, 81, and 83 respectively. The number of phytoplankton species common to all the three stations and two stations was 70 (86.9%) and 13 (14.2%) respectively. Only 1 species was found in one station. The relative frequency (RF) value for all the species that common to three stations and two stations were 1.27% and 0.85% respectively. The RF value for the species found in one station only was 0.42%. The relative density (RD) value for each of the phytoplankton species recorded during this study was in the range of 0.03 to 49.23% with the *Peridinium cinctum* and *Skeletonema costatum* recorded the lowest and highest value respectively. Detailed information on the distribution of phytoplankton species in the three stations is shown in Table 4.2.

Cell accumulative abundance, diversity (H') and Evenness (*E*) for phytoplankton communities at ST1, ST2, and ST3 are shown in Table 4.3. ST3 recorded the highest cell accumulative abundance with 2.24 x 10^7 cells/L, followed by ST2 1.68 x 10^7 cells/L and ST1 1.39 x 10^7 cells/L. There was no significant difference in cell accumulative abundance between ST2 and ST3 at $p< 0.01$. Cell accumulative abundance was significantly different between ST1 and ST2 and between ST1 and ST3 at $p< 0.01$.

ST1 showed the highest H' and *E* values with the readings of 3.721 and 0.601, respectively (Table 4.3). H' value at ST2 was 3.254 and ST3, 3.142, while the *E* values were 0.513 and 0.493 respectively. One way ANOVA showed the H' values between station ware significantly different at $p< 0.01$.

Table 4.2: Spatial occurrence of phytoplankton species at ST1, ST2 and ST3 with relative density (RD) and relative frequency (RF). '+' indicates presence, '-' indicates absence

Species		Phytoplankton occurence			RD (%)	RF (%)
		ST1	ST2	ST3		
1	*Amphiphora alata* Kut	+	+	+	0.19	1.27
2	*Amphora quadrata* Breb	+	+	+	0.21	1.27
3	*Asterionellopsis glacialis*	+	+	+	0.77	1.27
4	*Bacillaria paradoxa* Gmelin	+	+	+	0.09	1.27
5	*Bacteriastrum comosum*	-	+	+	0.45	0.85
6	*Bacteriastrum delicatulum*	+	+	+	0.18	1.27
7	*Bacteriastrum varians* Lauder	+	+	+	0.39	1.27
8	*Bellerochea horologicalis*	+	+	+	0.78	1.27
9	*Biddulphia longicruris*	+	+	+	0.16	1.27
10	*Biddulphia mobiliensis*	+	+	+	0.29	1.27
11	*Campylodiscus daemilianus*	+	+	+	1.13	1.27
12	*Chaetoceros constrictum* Gran	+	+	+	0.57	1.27
13	*Chaetoceros constrictus*	+	+	+	0.39	1.27
14	*Chaetoceros curvisetus*	+	+	+	3.63	1.27
15	*Chaetoceros debilis*	-	+	+	0.21	0.85
16	*Chaetoceros decipiens*	+	+	+	0.41	1.27
17	*Chaetoceros delicatulum*	-	+	+	0.12	0.85
18	*Chaetoceros distans*	+	+	+	0.22	1.27
19	*Chaetoceros laciniosum*	+	+	+	0.21	1.27
20	*Chaetoceros Lauderii* Ralfs	+	+	+	0.52	1.27
21	*Chaetoceros lorenzianus*	+	+	+	0.39	1.27
22	*Chaetoceros neglectus*	-	+	+	0.04	0.85
23	*Chaetoceros socialis*	+	+	+	0.6	1.27
24	*Chaetoceros* sp.2	+	+	+	0.18	1.27
25	*Chaetoceros* sp.3	-	+	+	0.04	0.85
26	*Chaetoceros* sp.4	-	+	+	0.04	0.85
27	*Chaetoceros subtilis* Cleve	+	+	+	0.23	1.27
28	*Chaetoceros tenuissimus*	+	+	+	0.13	1.27
29	*Corethron criophilum*	+	+	-	0.11	0.85
30	*Coscinodiscus asteromphalus*	+	+	+	0.15	1.27
31	*Coscinodiscus centralis*	+	+	+	0.18	1.27
32	*Coscinodiscus concinnus*	+	+	+	0.39	1.27
33	*Coscinodiscus gigas*	+	+	+	0.08	1.27
34	*Coscinodiscus lineatus* Ehr	+	+	+	0.29	1.27
35	*Coscinodiscus rothii* Grunow	+	+	+	0.09	1.27
36	*Coscinodiscus* sp. 1	+	+	+	0.12	1.27
37	*Coscinodiscus* sp. 2	+	+	+	0.12	1.27
38	*Coscinodiscus subtilis* Ehrenberg	+	+	+	0.13	1.27
39	*Cyclotella meneghiana*	-	+	+	0.06	0.85
40	*Cymbella tumida*	+	+	+	0.68	1.27
41	*Diatoma elongatum*	+	+	+	0.1	1.27
42	*Ditylum Brightwelli*	+	+	+	0.2	1.27

Table 4.2 continued

43	*Fragilaria* sp.	+	+	+	0.06	1.27
44	*Fragillaria pinnata* var trigona	+	+	+	0.07	1.27
45	*Frustulia vulgaris*	+	+	+	0.05	1.27
46	*Guinardia flaccida*	+	+	+	0.14	1.27
47	*Gyrosigma scalproides*	+	+	+	0.06	1.27
48	*Gyrosigma spencerii*	+	+	+	0.06	1.27
49	*Lauderia borealis* Gran	+	+	+	1.53	1.27
50	*Leptocylindrus danicus* Cleve	+	+	+	1.27	1.27
51	*Mastogloia smithii* Ehr	-	+	+	0.11	0.85
52	*Melosira moniliformis* Agardh	+	+	+	1.36	1.27
53	*Melosira nummuloides*	-	-	+	1.38	0.42
54	*Navicula peticolasii*	+	+	+	0.11	1.27
55	*Navicula radiosa Kutz*	+	+	+	0.3	1.27
56	*Nitzschia acicularis*	+	+	+	0.08	1.27
57	*Nitzschia longissima*	+	+	+	0.04	1.27
58	*Pseudo- nitzschia pungens* Cleve	+	+	+	4.85	1.27
59	*Pinnularia acuminata*	+	+	+	5.19	1.27
60	*Pinnularia* sp.	+	+	+	0.49	1.27
61	*Pinnularia tabellaria*	+	-	+	3.29	0.85
62	*Planktoniella sol*	+	+	+	0.13	1.27
63	*Pleurosigma angulatum*	+	+	+	0.09	1.27
64	*Pleurosigma directum* Grunow	+	+	+	0.11	1.27
65	*Pleurosigma elongatum*	+	+	+	0.17	1.27
66	*Pleurosigma* sp.1	+	+	+	0.05	1.27
67	*Pseudo-Nitzschia cuspidata*	+	+	+	0.07	1.27
68	*Rhizosolenia alata* Brightwell	+	+	+	0.19	1.27
69	*Rhizosolenia hebetata*	+	+	+	0.18	1.27
70	*Rhizosolenia imbricata*	+	+	+	0.2	1.27
71	*Rhizosolenia setigera*	+	+	+	0.17	1.27
72	*Rhizosolenia striata*	+	+	+	0.15	1.27
73	*Skeletonema costatum*	+	+	+	49.23	1.27
74	*Stauroneis obtusa* Lagerst	+	+	+	0.1	1.27
75	*Stauroneis pusilla* Cleve	+	+	+	0.07	1.27
76	*Thalassionema nitzschoides* Grunow	-	+	+	0.07	0.85
77	*Thalassiothrix frauenfeldii*	+	+	+	1.27	1.27
78	*Triceratium favus* Ehr f quadrata	+	+	+	0.15	1.27
79	*Triceratium* sp. Ehrenberg Grun	+	+	+	0.14	1.27
	Division Chlorophyta					
80	*Mougeotia* sp.	+	-	+	0.25	0.85
81	*Cosmarium humile* Breb	+	+	+	0.07	1.27
82	*Rhizoclonium* sp.	+	+	+	5.4	1.27
	Division Pyrrophyta					
83	*Peridinium cinctum* Ehrenberg	-	+	+	0.03	0.85
	Division: Cyanobacteria					
84	*Oscillatoria tenuis* Roth	+	+	+	6.06	1.27

Table 4.3: Comparison of cells abundance, species richness, H' and *E* among communities

Spatial trends	**ST1**	**ST2**	**ST3**
Total phytoplankton			
Cells abundance (cells/L)	1.39×10^7	1.68×10^7	2.24×10^7
No. of species	73	81	83
Shannon Weiner Index (H')	3.721	3.254	3.143
Evenness (*E*)	0.601	0.513	0.493

4.2.2 Similarity Analysis between Sampling Stations

Similarity index between ST1, ST2, and ST3 is shown Table 4.4. Highest similarity index value was obtained ST2 and ST3. Clusters of sampling stations, based on Modified Morisita's Similarity Index of phytoplankton communities, are shown in Table 4.4.

Cluster analysis on the ST1, ST2, and ST3 produce two distinct clusters. The first cluster consists of ST1 whereas the second cluster consists of ST2 and ST3.This is shown in Fig 4.2.

Table 4.4: Similarities in phytoplankton community determined by Modified Morisita's Similarity.

	ST1	ST2	ST3
Station 1 (ST1)	1		
Station 2 (ST2)	0.954	1	
Station 3 (ST3)	0.954	0.971	1

Figure 4.2 proves that there was high species overlapped occur between ST2 and ST3. However, though the dendogram shows ST1 as different group, the percentage of similarity of ST1 with both ST2 and ST3 was still high, which more than 90%.

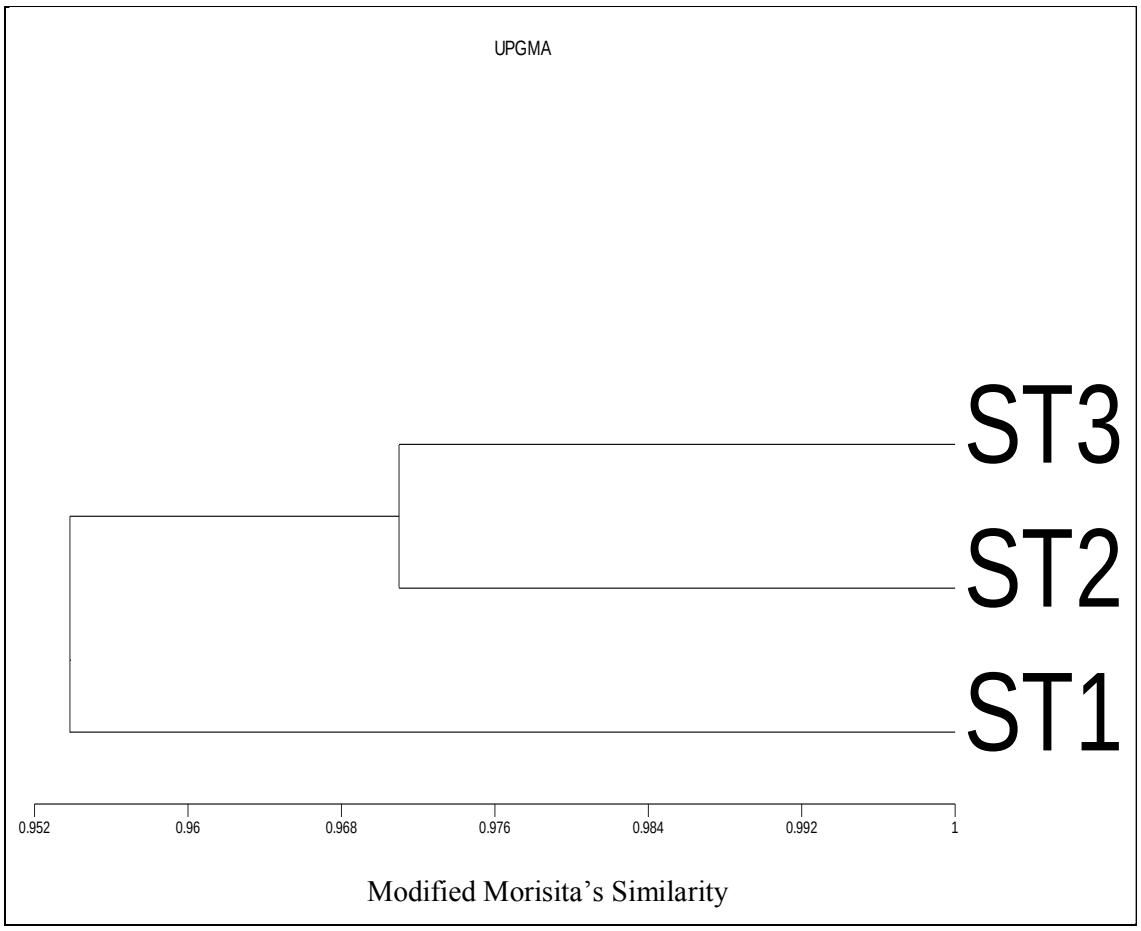

Figure 4.2: Dendogram of similarities in species composition among the communities determined by Modified Morisita's Similarity.