STUDY ON DENSITY AND BIOMASS OF SEAWEEDS AT PORT OKHA, GUJARAT-A CASE STUDY

R.N. Nakar, N. H. Joshi[1] and B.A. Jadeja[2]

Department of Agriculture Botany, Junagadh Agricultural University, Junagadh.
[1]Fisheries Research Station, Junagadh Agricultural University, Okha.
[2]Department of Botany, M.D.Science college, Porbandar.

Abstract: The species diversity, density and biomass of seaweeds were measured by transect method quadrate using one m^2 quadrate during August-2007 to February-2008 at Okha coast in the year 2007-08. 36 species of seaweeds were recorded from the coast. Rhodophyceae and Chlorophycea were found to be dominant with 16 and 14 species respectively. Phaophyceae were very few in numbers with 7 species. The mean density and biomass of algal species were described and discussed. Density of all three classes Chlorophycae, Phaophyceae and Rhodophyceae were maximum in Jan- Feb, 2008.

Keywords: Biomass, density, okha, seaweeds, port

INTRODUCTION

The Saurashtra coast harbors many species of marine algae of the families Rhodophyceae, Chlorophyceae and Phaophyceae, which are rich in phycocoloid content. Port Okha coast, which is known for its luxuriant growth of a diverse assemblage of seaweeds on Saurashtra coast, is found to have abundant quantities of seaweeds being drifted and washed ashore every year. Port Okha is located at 22^o 28' N latitude and 69^o 05' E longitude and is situated within the opening of Gulf of Kachh, has a flat rocky intertidal belt, with many tide pools, gullies and crevices. The substratum is made of limestone rock. The sandy beach gradually slopes into the rocky intertidal belt from landward side.

Port Okha, supports a rich growth of the economically important species. However, due to over exploitation there is a decline in the population. An investigation was conducted to study some ecological aspects of different species during their growing season. Seaweeds on the coast are harvested and utilized for a variety of purposes such as feed, fertilizer and as a source of raw material for industrial production of photochemicals of commercial importance (Kirkman and Kendrick 1997). Seaweeds that were washed ashore provide valuable floristic information about the intertidal and near shore sub-tidal algae of the respective regions. Although natural senescence of seaweeds is one of the major factors, strong currents primarily forced by tides, also contribute to the uprooting and subsequent drifting of seaweeds on to the coast. This ultimately causes changes in floristic features of the existing algal beds (Thakar *et al*., 2008). It has also been earlier reported that the phycocolloid content of the drift seaweeds is comparable with that of those obtained from freshly harvested biomass (Krishnamurthy 1967).

Earlier studies on seaweeds in India were on taxonomy and zonation pattern (Krishnamurthy 1954, Prasanna Varma, 1959). Mishra, (1960) observed that seasonal succession of marine algae on different Indian coasts is not a marked process with respect to the zonation along the intertidal belt. Murthy *et al*. (1978) made preliminary ecological investigations on the intertidal algae at Port Okha. They described the zonation pattern of different dominant seaweed species and estimated monthly biomass values, based on a systematic belt transect method. According to them species diversity, by virtue of the richness component in the seaweed flora, increased during winter when their growth exhibited the maximum.

MATERIAL AND METHOD

Seaweed resource survey was conducted for 7 months during August 2007 to February 2008 to get an idea of abundance and distributional pattern of the seaweeds. Physicochemical properties of seawater at Port Okha are as follows: temperature remains from 21.5 to 30◦C, salinity from 35.46 to 37.32 PSU, D.O. from 5.3 to 6.7 ppm, turbidity from 0 to 200 ppm, phosphate phosphorus from 0.1 to 1.05 μg atom/l, nitrate nitrogen from 2.0 to11.5 μg atom/l (Chauhan 1965).

Algal vegetation was surveyed monthly for its quantitative phyto-sociological attributes during low water of the spring tides. Belt transects of 1 meter width were run across the shore covering intertidal belt. Along each transect, structure of seaweed vegetation was studied at distance of 50 meters at regular intervals. Samples were collected from quadrate of 1 m^2. In all, a minimum of 30 quadrates was surveyed every month. According to earlier surveys done at Port Okha, algal season is said to be from August to February or March whereas during other months very few species are available. (Joshi and Murthy, 2004).During April to July (monsoon season of Gujarat) the wave action is very high and so the exposure is very less. From the pooled replicate values of abundance from all the sample plots surveyed, density of a species was calculated per meter^2 area as per Misra (1968), as follows:

$$\text{Density} = \frac{\text{Total number of individulas of a species}}{\text{The area of sample plot } (1 \text{ m}^2)\text{studied}}$$

Then values of density were converted into mean monthly density by taking mean of the values. After recording abundance, the entire biomass within each quadrate was harvested along the base of the plant. The collected biomass from each sample plot was separated by species. Epiphytes, if any, were removed, and seaweeds were cleaned in clean sea water. The biomass fractions, thus separated by species, were collected in polythene bags and brought to the laboratory. They were thoroughly washed in tap water to remove all foreign particles adhering to the thalli. Fresh weight (in gms) was recorded after blotting.

RESULTS AND DISCUSSION

Altogether 36 species has been recorded during the study period out of which 14 were Chorophyceae, 7 Phaeophyceae and 15 Rhodophyce members (Table-1).

It is clear from the study that the mean density of Chlorophyceae was found to be maximum during the month of October (12.35 $\pm$ 1.30) m^{-2}, while the lowest mean density of Chlorophyceae was found during the month of August (7.43 $\pm$ 0.93) m^{-2} . Among these members *Caulerpa racemosa* shows the maximum density (62.32 $\pm$ 6.12) m^{-2}. The mean biomass of the Chlorophyceae was maximum in February (4.42 $\pm$ 0.44) gm/m^2, while among the species it was *Caulerpa peltata* with biomass of (32.16 $\pm$ 2.46) gm/m^2 in February.

The maximum mean density of Pheophycean members was in November (9.19 ± 0.54) m^{-2} in seasin-2, while the lowest in August (2.29 $\pm$ 0.72) m^{-2}, *Padina tetrastomatica* showed the maximum density (42.0 $\pm$ 0.42) m^{-2} in November. Maximum mean biomass was found in January (3.76 $\pm$ 0.76) gm/m^2 and lowest (0.87 $\pm$ 0.52) gm/m^2 in August, while the species *Sargassum tenerrimum* exhibited the highest (8.88 $\pm$ 1.11) gm/m^2 biomass content in February.

Among the family Rhodophyceae the highest mean density was observed in January (7.69 $\pm$ 0.83) m^{-2} and lowest in August (2.80 $\pm$ 0.71) m^{-2}. The species *Gracilaria corticata* showed the highest density (26.57 $\pm$ 1.65) m^{-2} in January. The maximum mean biomass content was observed in January (3.0 $\pm$ 1.01) gm/m^2 in and lowest in August (0.86 $\pm$ 0.56) gm/m^2, while *Gracilaria corticata* showed the highest biomass content (8.86 $\pm$ 0.98) gm/m^2 in December in among all red algae. Graphs for increasing values of density and biomass study for seaweeds are shown in figure-1 (1.1, 1.2 and 1.3) and figure-2 (2.1, 2.2 and 2.3) for each of the class of seaweeds. Mean monthly density and biomass are depicted in respective tables and figures.

CONCLUSION

In the present study Rhodophyceae was found in maximum number followed by Chlorophyceae and Phaeophyceae. Mean monthly maximum density, was (7.69 $\pm$ 0.83) m^{-2} in January for Rhodophyceae, (9.19 $\pm$ 0.54) m^{-2}, in November for Phaophyceae and (12.35 $\pm$ 1.3) m^{-2}, in October for Chlorophyceae. Mean monthly maximum biomass (4.69 $\pm$ 0.5) gm/m^2 was observed in November for Chlorphyceae, (3.76 + 0.76) gm/m^2 and (3.03 $\pm$ 1.01) gm/m^2 in January for Phaophyceae and Rhodophyceae respectively. It was clear from the month wise survey of density and biomass that algal growth was continuously increased for all the three families Chorophyceae, Phaophyceae and Rhodophyceae from August-2007 to February-2008.

Table1. List of algal species recorded at Port Okha in the year 2008.

No.	Name of species	Class	No.	Name of species	Class
1	*Acetabularia mobii*	C	19	*Sargassum tennrrimum*	P
2	*Bryopsis plumosa*	C	20	*Spathoglossum asperum*	P
3	*Caulerpa peltata*	C	21	*Turbinaria conoides*	P
4	*Caulerpa racemosa*	C	22	*Amphiroa anceps*	R
5	*Caulerpa scalpellformis*	C	23	*Botryocladia leptopoda*	R
6	*Caulerpa sertularioides*	C	24	*Champia indica*	R
7	*Caulerpa taxifolia*	C	25	*Champia parola*	R
8	*Chaetomorpha media*	C	26	*Clathrum opuntia*	R
9	*Codium dwarkense*	C	27	*Gastroclonium iyengarii*	R
10	*Halimeda opuntia*	C	28	*Gracilaria corticata*	R
11	*Halimeda tuna*	C	29	*Grateloupia indica*	R
12	*Udotea indica*	C	30	*Hypnea musciformis*	R
13	*Ulva lactuca*	C	31	*Laurencia pedicularioides*	R
14	*Ulva reticulata*	C	32	*Pockioella variengata*	R
15	*Colpomenia sinuosa*	P	33	*Polysiphonia variegata*	R
16	*Dictyota dichotoma*	P	34	*Scinaia hatei*	R
17	*Galaxora indica*	P	35	*Solieria robusta*	R
18	*Padina tetrastromatica*	P	36	*Sebdenia polydactyla*	R

Where C= Chlorophyceae; P= Phaeophyceae; R= Rhodophyceae

Table2. Mean monthly density of sea weeds

No.	Name of species	Class	August-07	September-07	October-07	November-07	December-07	January-08	February-08
1	*Acetabularia mobii*	*C*	5.24 ± 0.51	2.45 ± 0.24	2.62 ± 0.45	3.36 ± 0.23	3.74 ± 0.65	4.6 ± 0.83	3.18 ± 0.6
2	*Bryopsis plumosa*	*C*	-	1.92 ± 0.28	2.33 ± 0.29	-	3.54 ± 0.37	3.52 ± 0.45	2.71 ± 0.66
3	*Caulerpa peltata*	*C*	12.11 ± 1.12	20.4 ± 0.98	32.16 ± 4.82	28.14 ± 4.68	24.71 ± 3.68	42.12 ± 6.98	52.1 ± 5.82
4	*Caulerpa racemosa*	*C*	22.8 ± 3.62	16.12 ± 2.23	62.32 ± 6.12	46.18 ± 4.18	33.12 ± 4.18	28.68 ± 3.55	24.12 ± 2.18
5	*Caulerpa scalpellformis*	*C*	8.4 ± 0.64	9.05 ± 0.73	9.49 ± 0.49	10.04 ± 0.38	10.67 ± 0.61	10.79 ± 0.61	9.84 ± 0.22
6	*Caulerpa sertularioides*	*C*	5.47 ± 0.57	5.9 ± 2	6.44 ± 0.38	6.93 ± 0.33	7.06 ± 0.87	7.5 ± 0.44	6.75 ± 0.78
7	*Caulerpa taxifolia*	*C*	9.32 ± 1.46	12 ± 1.63	9 ± 0.57	10.12 ± 2.12	8.16 ± 1.14	18.12 ± 3.1	14.68 ± 1.24
8	*Chaetomorpha media*	*C*	0.75 ± 0.44	1.38 ± 0.34	1.7 ± 0.36	2.21 ± 0.29	2.8 ± 0.57	3.63 ± 0.88	2 ± 0.31
9	*Codium dwarkense*	*C*	-	2.03 ± 0.48	-	5.79 ± 0.52	3.35 ± 0.41	3.8 ± 0.84	2.13 ± 0.21
10	*Halimeda opuntia*	*C*	10.12 ± 1.1	12.2 ± 1.43	8.2 ± 1.21	4.11 ± 1.32	2.76 ± 0.69	2.92 ± 0.63	4.67 ± 1.83
11	*Halimeda tuna*	*C*	7.94 ± 0.76	9.33 ± 0.49	9.18 ± 0.38	9.58 ± 0.46	10.83 ± 0.61	11.12 ± 0.87	9.01 ± 0.59
12	*Udotea indica*	*C*	7.68 ± 0.75	8.68 ± 0.25	9.04 ± 0.29	9.36 ± 0.41	10 ± 0.62	10.68 ± 0.59	8.68 ± 0.71
13	*Ulva lactuca*	*C*	12.12 ± 1.23	9.12 ± 1.1	14.32 ± 1.5	16.2 ± 1.36	9.12 ± 0.8	11.21 ± 0.68	16.15 ± 1.22
14	*Ulva reticulata*	*C*	2.1 ± 0.87	2.58 ± 0.3	6.12 ± 1.29	3.2 ± 0.22	14.71 ± 0.52	4.45 ± 0.81	9.96 ± 1.12
	***Mean*± Sd**		**7.43 ± 0.93**	**8.08 ± 0.89**	**12.35 ± 1.3**	**11.09 ± 1.18**	**10.33 ± 1.12**	**11.65 ± 1.52**	**11.86 ± 1.25**
15	*Colpomenia sinuosa*	*P*	2.11 ± 0.78	2.11 ± 0.68	3.03 ± 0.54	3.12 ± 0.31	4.24 ± 0.57	4.48 ± 0.75	3.01 ± 0.42
16	*Dictyota dichotoma*	*P*	1.03 ± 0.91	4.6 ± 0.48	2.14 ± 0.83	3.28 ± 1.4	5.21 ± 1.77	9.29 ± 2.71	6.85 ± 1.44
17	*Galaxora indica*	*P*	1.02 ± 0.51	1.95 ± 0.57	2.14 ± 0.52	2.63 ± 0.47	3.28 ± 0.46	3.48 ± 0.56	2.15 ± 0.44
18	*Padina tetrastromatica*	*P*	1.95 ± 0.54	14.53 ± 2.14	22.16 ± 1.69	42.08 ± 0.42	18.12 ± 1.62	14.68 ± 1.01	22.08 ± 2.12
19	*Sargassum tennrrimum*	*P*	6.59 ± 0.86	6.83 ± 0.22	7.56 ± 0.7	7.5 ± 0.39	11.94 ± 0.9	12.91 ± 0.75	16.75 ± 3.34
20	*Spathoglossum asperum*	*P*	2.05 ± 0.69	2.7 ± 0.37	3.06 ± 0.59	3.05 ± 0.41	4.44 ± 0.86	4.69 ± 1.07	4.91 ± 1.26
21	*Turbinaria conoides*	*P*	1.31 ± 0.78	1.81 ± 0.24	2.16 ± 0.45	2.64 ± 0.39	2.8 ± 0.78	2.88 ± 0.83	1.67 ± 0.55
	***Mean*± Sd**		**2.29 ± 0.72**	**4.93 ± 0.67**	**6.04 ± 0.76**	**9.19 ± 0.54**	**7.15 ± 0.99**	**7.49 ± 1.09**	**8.2 ± 1.37**
22	*Amphiroa anceps*	*R*	2.65 ± 1.06	15.64 ± 0.72	15.4 ± 0.33	16.31 ± 0.61	16.41 ± 0.66	17.3 ± 0.88	15.74 ± 0.42
23	*Botryocladia leptopoda*	*R*	1.12 ± 0.44	1.9 ± 0.32	1.67 ± 0.63	2.81 ± 0.6	3.36 ± 0.45	3.76 ± 0.82	2.22 ± 0.4
24	*Champia indica*	*R*	1.99 ± 0.74	2.81 ± 0.53	3.57 ± 0.46	4.09 ± 0.46	4.24 ± 0.71	5.02 ± 0.65	3.6 ± 0.4

25	*Champia parola*	*R*	1.99 ± 0.58	1.55 ± 0.14	2.05 ± 0.52	2.23 ± 0.24	3.33 ± 0.66	3.42 ± 0.61	2.05 ± 0.43
26	*Clathrum opuntia*	*R*	1.08 ± 0.57	1.75 ± 0.25	1.75 ± 0.38	2.66 ± 0.52	2.79 ± 0.68	3.79 ± 1.02	1.72 ± 0.36
27	*Gastroclonium iyengarii*	*R*	0.5 ± 0.46	1.36 ± 0.14	2.17 ± 0.99	1.93 ± 0.39	2.87 ± 0.37	3.24 ± 0.6	1.76 ± 0.25
28	*Gracilaria corticata*	*R*	6.9 ± 1.44	2.44 ± 1.36	12.64 ± 1.53	18.66 ± 1	24.12 ± 1.24	26.57 ± 1.65	12.09 ± 1.35
29	*Grateloupia indica*	*R*	2.02 ± 0.57	2.66 ± 0.61	2.89 ± 0.71	4.02 ± 0.51	4.48 ± 0.37	5.05 ± 0.85	3.51 ± 0.42
30	*Hypnea musciformis*	*R*	1.75 ± 0.66	2.16 ± 0.19	2.37 ± 0.36	3.25 ± 0.51	4.07 ± 0.71	3.56 ± 0.61	2.83 ± 0.57
31	*Laurencia pedicularioides*	*R*	3.28 ± 0.69	3.7 ± 0.15	3.88 ± 0.35	4.33 ± 0.34	5.48 ± 0.58	5.74 ± 0.79	4.08 ± 0.18
32	*Pockioella variengata*	*R*	7.5 ± 0.92	6.57 ± 2.14	7.75 ± 0.62	8.89 ± 0.62	9.68 ± 0.77	15.57 ± 0.46	16.9 ± 0.34
33	*Polysiphonia variegata*	*R*	1.65 ± 0.73	2.82 ± 0.18	2.85 ± 0.41	11.38 ± 1.32	14.05 ± 1.5	4.79 ± 0.82	10.34 ± 1.54
34	*Scinaia hatei*	*R*	2.64 ± 0.72	3.53 ± 0.38	4.18 ± 0.43	4.4 ± 0.26	5.71 ± 0.92	5.71 ± 0.74	4.11 ± 0.22
35	*Solieria robusta*	*R*	2.12 ± 0.6	2.8 ± 0.58	3.08 ± 0.62	3.62 ± 0.5	4.9 ± 0.61	4.24 ± 0.95	3.65 ± 0.43
36	*Sebdenia polydactyla*	*R*	4.8 ± 0.52	5.59 ± 0.35	5.93 ± 0.54	6.43 ± 0.52	6.63 ± 0.58	7.55 ± 1.01	6.07 ± 0.68
	***Mean*± Sd**		**2.8 ± 0.71**	**3.82 ± 0.54**	**4.81 ± 0.59**	**6.33 ± 0.56**	**7.47 ± 0.72**	**7.69 ± 0.83**	**6.04 ± 0.53**

Table3. Mean monthly biomass of sea weeds

No.	Name of species	Class	August-07	September-07	October-07	November-07	December-07	January-08	February-08
1	*Acetabularia mobii*	C	0.56 ± 0.31	0.037 ± 0.09	0.88 ± 0.023	0.09 ± 0.03	0.185 ± 0.59	0.4 ± 0.52	0.19 ± 0.42
2	*Bryopsis plumosa*	C	-	0.16 ± 0.21	0.25 ± 0.11	-	0.61 ± 0.88	0.54 ± 0.1	0.56 ± 0.18
3	*Caulerpa peltata*	C	18.1 ± 2.15	22.12 ± 1.28	15.4 ± 1.65	28.11 ± 2.11	18.32 ± 2.18	24.12 ± 3.42	32.16 ± 2.46
4	*Caulerpa resimosa*	C	4.3 ± 1.1	6.18 ± 1.11	8.12 ± 2.11	11.4 ± 1.42	8.11 ± 2.11	9.4 ± 1.1	8.4 ± 1.16
5	*Caulerpa scalpellformis*	C	2.12 ± 0.65	3.1 ± 0.1	4.12 ± 0.32	3.64 ± 0.23	5.19 ± 1.1	3.45 ± 1.1	5.1 ± 0.98
6	*Caulerpa sertularioides*	C	1.18 ± 0.46	2.12 ± 1.1	1.15 ± 0.45	2.12 ± 0.12	2.16 ± 0.11	3.12 ± 0.98	2.11 ± 0.22
7	*Caulerpa taxifolia*	C	3.32 ± 0.98	4.12 ± 0.78	3.33 ± 0.23	4.12 ± 1.11	3.86 ± 0.98	6.11 ± 1.23	5.14 ± 0.66
8	*Chaetomorpha media*	C	0.09 ± 0.12	0.98 ± 0.12	0.78 ± 0.11	1.12 ± 0.12	2.11 ± 0.44	1.65 ± 0.43	1.11 ± 0.11
9	*Codium dwarkense*	C	-	1.05 ± 0.19	-	2.19 ± 0.19	1.18 ± 0.51	1.72 ± 0.5	1.18 ± 0.18
10	*Halimeda opuntia*	C	3.32 ± 0.98	4.12 ± 0.78	3.33 ± 0.23	4.12 ± 1.11	3.86 ± 0.98	6.11 ± 1.23	5.14 ± 0.66
11	*Halimeda tuna*	C	3.18 ± 0.46	4.12 ± 1.1	3.15 ± 0.45	5.12 ± 0.12	7.16 ± 0.11	6.12 ± 0.98	3.11 ± 0.22
12	*Udotea indica*	C	0.98 ± 0.65	0.92 ± 0.1	1.12 ± 0.32	1.64 ± 0.23	1.12 ± 0.1	1.45 ± 0.1	1.1 ± 0.48

13	*Ulva lactuca*	*C*	0.22 ± 0.19	0.16 ± 0.11	0.14 ± 0.11	1.12 ± 0.11	1.1 ± 0.15	0.98 ± 0.1	1.21 ± 0.87
14	*Ulva reticulata*	*C*	0.1 ± 0.19	0.16 ± 0.11	0.45 ± 0.11	0.88 ± 0.11	0.34 ± 0.15	0.32 ± 0.1	1 ± 0.87
	***Mean*± Sd**		2.68 ± 0.59	3.52 ± 0.51	3.02 ± 0.44	4.69 ± 0.5	3.95 ± 0.74	4.68 ± 0.85	4.82 ± 0.68
15	*Colpomenia sinuosa*	*P*	1.12 ± 0.65	1.1 ± 0.1	4.12 ± 0.32	3.64 ± 0.23	5.19 ± 1.1	3.45 ± 1.1	5.1 ± 0.98
16	*Dictyota dichotoma*	*P*	0.68 ± 0.85	2.33 ± 0.66	4.45 ± 1.11	1.8 ± 1.56	3.77 ± 1.33	6.34 ± 1.11	4.56 ± 0.68
17	*Galaxora indica*	*P*	0.23 ± 0.4	0.88 ± 0.21	1 ± 0.66	1.35 ± 1.11	1.32 ± 0.88	1.89 ± 0.66	1.11 ± 0.23
18	*Padina tetrastromatica*	*P*	0.24 ± 0.12	3.88 ± 0.21	6.12 ± 0.66	5.35 ± 1.11	3.32 ± 0.88	4.89 ± 0.66	2.11 ± 0.23
19	*Sargassum tennrrimum*	*P*	2.11 ± 0.73	3.32 ± 0.24	2.1 ± 0.65	5.55 ± 0.22	8.111 ± 0.62	7.12 ± 0.98	8.88 ± 1.11
20	*Spathoglossum asperum*	*P*	1.64 ± 0.72	1.53 ± 0.38	1.44 ± 0.43	2.11 ± 0.26	2.68 ± 0.92	1.98 ± 0.74	1.12 ± 0.22
21	*Turbinaria conoides*	*P*	0.1 ± 0.19	0.16 ± 0.11	1.1 ± 0.11	0.88 ± 0.11	0.98 ± 0.15	0.68 ± 0.1	0.66 ± 0.87
	***Mean*± Sd**		**0.87 ± 0.52**	**1.89 ± 0.27**	**2.9 ± 0.56**	**2.95 ± 0.66**	**3.62 ± 0.84**	**3.76 ± 0.76**	**3.36 ± 0.62**
22	*Amphiroa anceps*	*R*	0.72 ± 0.47	6.2 ± 1.12	5.12 ± 1.11	8.1 ± 2.2	5.9 ± 0.75	8.18 ± 1.6	7.2 ± 0.58
23	*Botryocladia leptopoda*	*R*	0.22 ± 0.14	0.12 ± 0.19	0.12 ± 0.15	0.28 ± 0.2	0.28 ± 0.22	0.32 ± 0.22	0,12 ± 0.12
24	*Champia indica*	*R*	0.72 ± 0.47	1.18 ± 0.15	1.22 ± 0.21	3.12 ± 0.98	2.49 ± 0.75	3.65 ± 1.6	2.12 ± 0.58
25	*Champia parola*	*R*	0.9 ± 0.65	1.36 ± 0.33	1.4 ± 0.39	2.3 ± 1.16	1.67 ± 0.93	2.83 ± 1.78	1.3 ± 0.76
26	*Clathrum opuntia*	*R*	0.23 ± 0.4	0.88 ± 0.21	1 ± 0.66	1.35 ± 1.11	1.32 ± 0.88	1.89 ± 0.66	1.11 ± 0.23
27	*Gastroclonium iyengarii*	*R*	0.72 ± 0.47	1.18 ± 0.15	1.22 ± 0.21	3.12 ± 0.98	2.49 ± 0.75	3.65 ± 1.6	2.12 ± 0.58
28	*Gracilaria corticata*	*R*	1.32 ± 0.98	1.12 ± 0.78	5.33 ± 0.23	4.12 ± 1.11	8.86 ± 0.98	8.11 ± 1.23	4.14 ± 0.66
29	*Grateloupia indica*	*R*	1.12 ± 0.65	1.1 ± 0.1	4.12 ± 0.32	3.64 ± 0.23	5.19 ± 1.1	3.45 ± 1.1	5.1 ± 0.98
30	*Hypnea musciformis*	*R*	0.23 ± 0.4	0.88 ± 0.21	1 ± 0.66	1.35 ± 1.11	1.32 ± 0.88	1.89 ± 0.66	1.11 ± 0.23
31	*Laurencia pedicularioides*	*R*	1.32 ± 0.98	1.12 ± 0.78	1.33 ± 0.23	1.12 ± 1.11	2.86 ± 0.98	1.41 ± 1.23	1.14 ± 0.66
32	*Pockioella variengata*	*R*	2.12 ± 0.65	1.1 ± 0.1	3.1 ± 0.32	3.64 ± 0.23	5.19 ± 1.1	5.45 ± 1.1	5.1 ± 0.98
33	*Polysiphonia variegata*	*R*	0.1 ± 0.19	0.16 ± 0.11	0.14 ± 0.11	0.12 ± 0.11	0.98 ± 0.15	0.21 ± 0.1	1 ± 0.87
34	*Scinaia hatei*	*R*	1.12 ± 0.65	0.87 ± 0.1	1.12 ± 0.32	1.64 ± 0.23	1.19 ± 1.1	1.45 ± 1.1	1.1 ± 0.98
35	*Solieria robusta*	*R*	0.98 ± 0.65	0.32 ± 0.1	1.12 ± 0.32	1.64 ± 0.23	0.89 ± 0.1	1.45 ± 0.1	1.1 ± 0.48
36	*Sebdenia polydactyla*	*R*	1.12 ± 0.65	2.1 ± 0.1	2.1 ± 0.32	2.64 ± 0.23	1.19 ± 1.1	1.45 ± 1.1	2.1 ± 0.98
	***Mean*± Sd**		**0.86 ± 0.56**	**1.31 ± 0.3**	**1.96 ± 0.37**	**2.55 ± 0.75**	**2.79 ± 0.78**	**3.03 ± 1.01**	**2.55 ± 0.64**

Figure 1. Mean monthly Density (number of plants/m^2) for seaweeds at Port Okha.

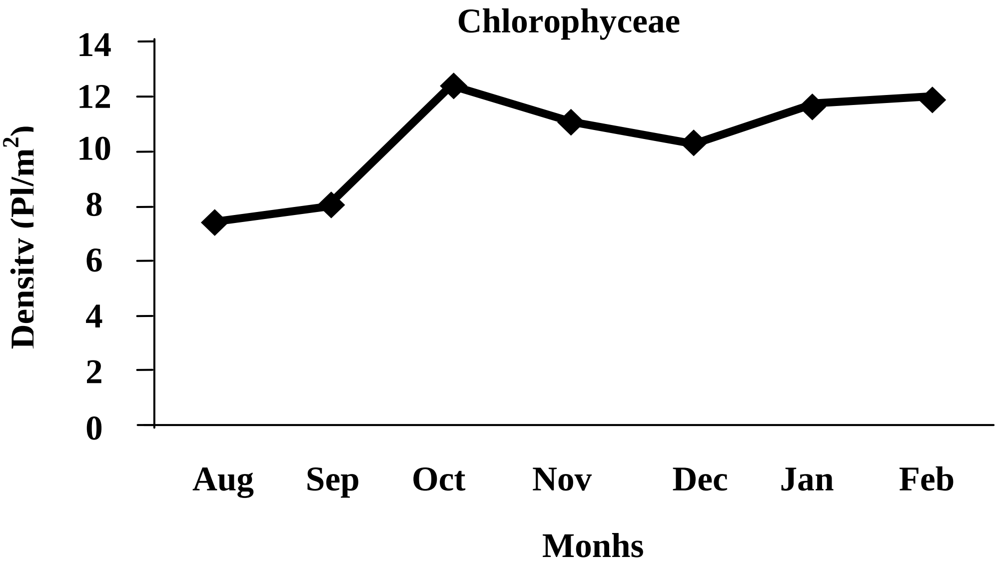

Figure 1.1 Mean monthly Density for Chlorophyceae

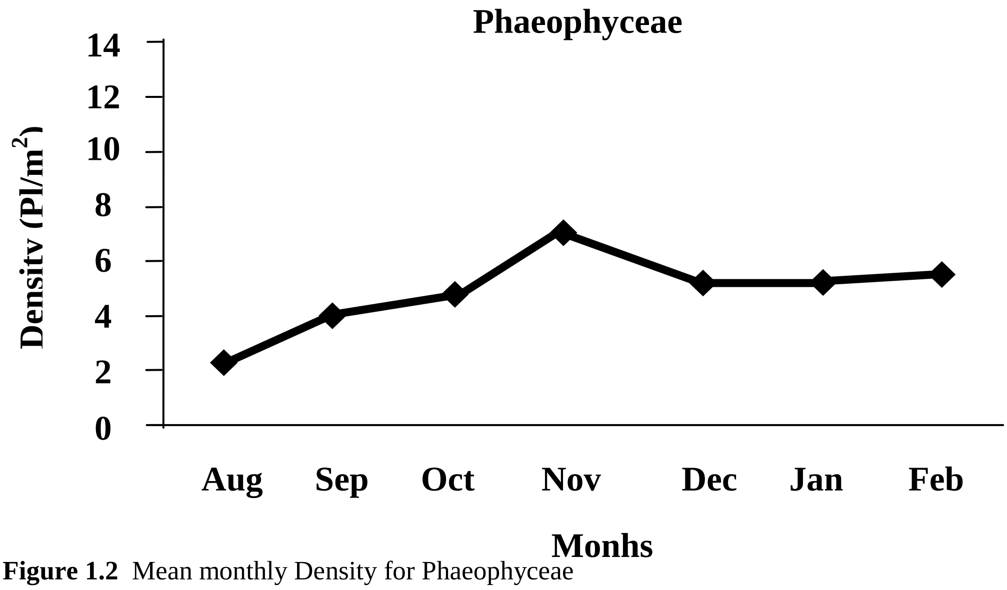

Figure 1.2 Mean monthly Density for Phaeophyceae

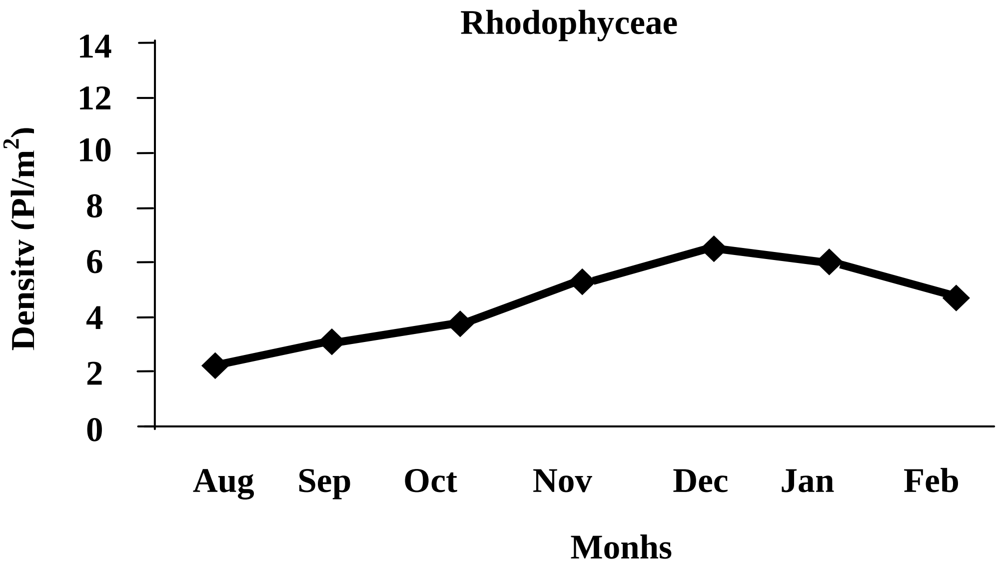

Figure 1.3 Mean monthly Density for Rhodophyceae

Figure 2. Mean monthly Biomass (gm/m^2) for seaweeds at Port Okha

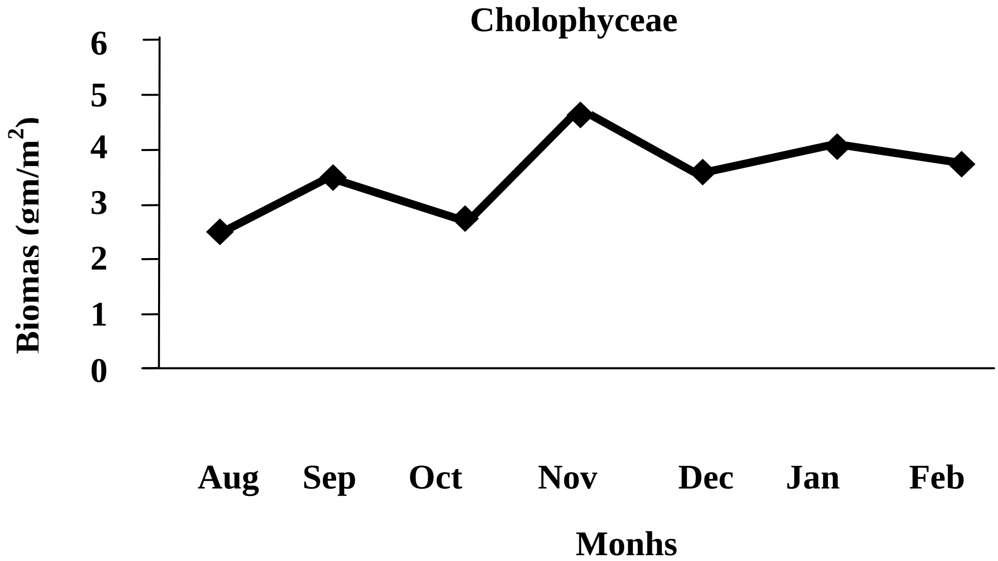

Figure 2.1 Mean monthly Biomass for Chlorophyceae

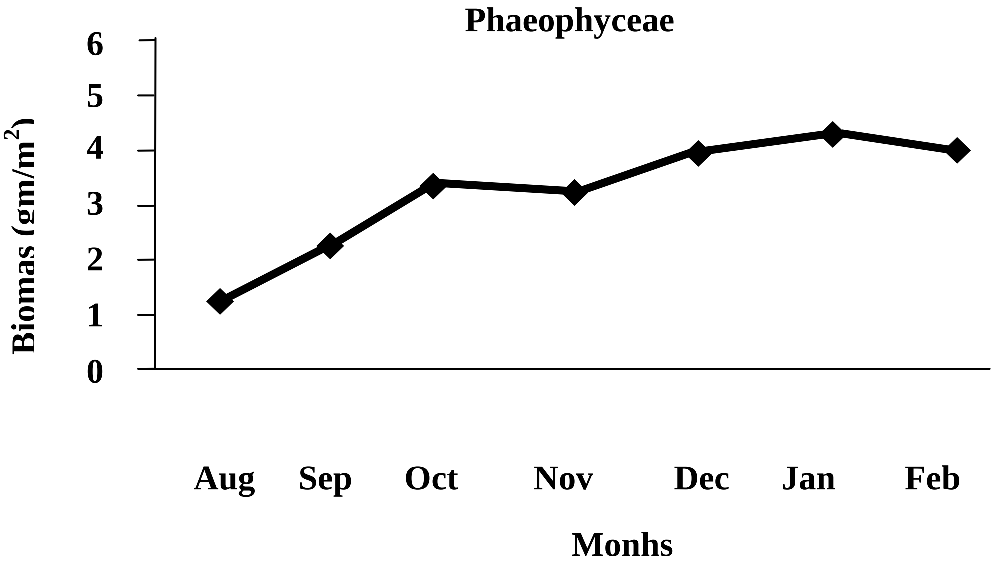

Figure 2.2 Mean monthly Biomass for Phaeophyceae

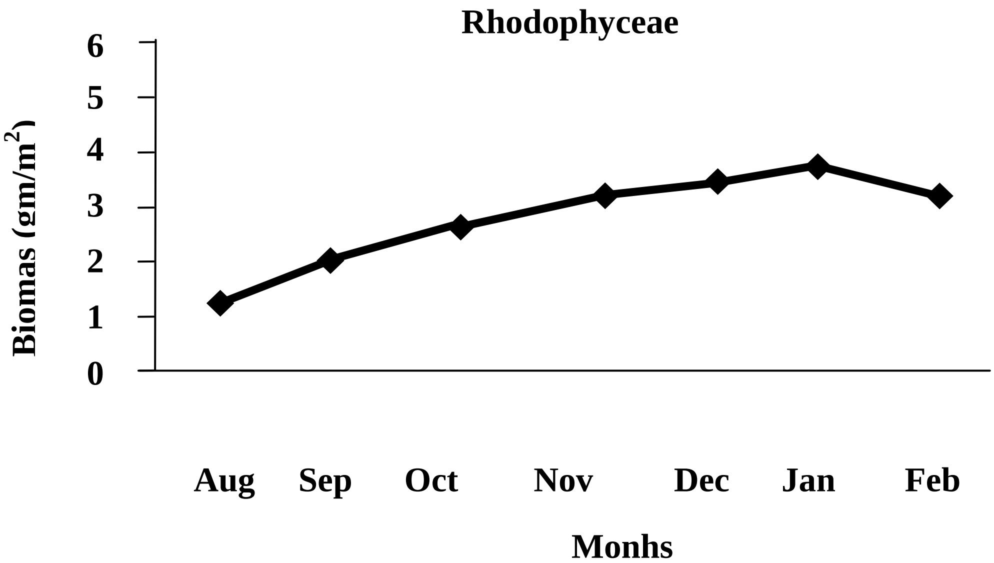

Figure 2.3 Mean monthly Biomass for Rhodophyceae

ACKNOWLEDGEMENT

The authors are thankful to Dr. P.V. Subbarao (CSMCRI, Bhavnagar) and Dr. K.L.Jetani, (Research Head & D.D.O. of Fisheries Research Station, Okha), Junagadh Agricultural University for their constant help throughout the study.

REFERENCES

Chauhan, V. D. (1965). Some observations of chemical and physicalconditions of seawater at Port Okha; *Proceedings of the seminar on sea, salt and plants*, Bhavnagar; 41–45.

Joshi, N. H. and Murthy, M.S. (2004). Ecological studies on *sargassum* species at Port Okha (Gujarat). *Seaweed Res. Utiln.*, **26** Sp Issue: pp. 63-71.

Kirkman, H. and Kendrick, G. A. (1997). Ecological significance and commercial harvesting of drifting and beachcast macroalgae and seagrasses in Australia: A review; *J. Appl. Phycol.* **9 :** 311–326.

Krishnamurthy, V. (1967). Seaweed drift on the Indian coast. Proceedings of the Symposium "Indian Ocean"; *Bull. Nat. Inst. Sci. India* **38 :** 657–666.

Krishnamurthy, V. (1954). Ecology and seasonal succession of algal flora of a salt marsh at madras. *J. Madras Univ*. B. **24**:161-178.

Misra, R. (1968). *Ecology Work Book.* Oxford and IBH Publishing Co. New Delhi.

Mishra, J. N. (1960). The ecology, distribution and seasonal succession of the littoral algal on the west coast of India. *Proc. Symp. Algal.* (Ed. P. Kachroo), Indian Council of Agricultural Research, New Delhi. Pp. 187-203.

Murthy, M.S., Bhattacharya, M. and Radia, P. (1978). Ecological studies on the intertidal algae from port Okha (India). *Bot. Mar*. **21**: 381-386.

Prasanna varma, R. (1959). Studies on the succession of marine algae on the fresh substratum in Palk bay. *Proc. Ind. Acd. Sci.* (B) **49**: 245-263.

Thakur, M. C, Reddy, C. R .K., Jha, Bhavyatha (2008). Seasonal variation in biomass and species composition of seaweeds stranded along Port Okha, northwest coast of India. *J. Earth Syst. Sci.* **117**(3): 211–218.