

Effect of salinity and dissolved nutrients on the occurrence of some seaweeds in Manakkudy estuary

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Manakkudy estuary, located on the South-West coast of India has production of seaweeds to an amount of 15.59 kg/m²/yr. Four different types of seaweeds viz., *Chaetomorpha aerea*, *Enteromorpha compressa*, *Gracilaria verrucosa* and *Hypnea musciformis* were observed in this estuary. Highest production of biomass (*C. aerea* = 842.33 ± 32.21 g/m²; *E. compressa* = 619 ± 16.09 g/m²; *G. verrucosa* = 563.33 ± 13.32 g/m² and *H. musciformis* = 225.67 ± 10.79 g/m²) of seaweeds could be recorded in May. During November i.e., a period of peak monsoon rain it is not present. Sea weeds were observed to occur in the euryhaline salinity range of 11.15 ± 0.48 to 27.18 ± 0.88 ppt and the temperature ranging between 23.57 ± 1.00 and 31.70 ± 0.82°C. The quantity of seaweed is more when levels of nutrients were moderately high.

[**Keywords** : Saliniton, biomass, nutrient, coast seaweed]

Introduction

Seaweeds have gathered much scientific and industrial concern as human food, livestock feed and fertilizer. The distribution of seaweeds in the six estuaries of Tamilnadu has already been investigated.¹

The present investigation was carried out on the temporal variations of the availability of four different seaweeds in Manakkudy estuary of Tamilnadu along with variations in vital hydrographical parameters during 2000.

Materials and Methods

Manakkudy estuary is located on the South-West coast of India (Lat. 8° 05'; Long. 77° 32') about 8 km North west of Kanyakumari in the mouth of Pazhayar river. It consist an area of 150 hectares. The present study was carried out in the gradient zone of the estuary (depth between tides – 0.78 ± 0.16 m) which is situated at a distance of one kilometre from the mouth region. This region has clayey silt bottom with abundant algal growth. Seaweed samples were collected using an iron frame quadrat of 0.25 m² size. Samples were identified using a standard key.² After identification the biomass of the different seaweeds was recorded. Basic environmental factors were analysed following the standard methods³. Quantity of ammonia – N, nitrite – N, nitrate – N,

phosphate – P and silicate – Si present in the filtered water samples were determined in the laboratory⁴

Results

The temporal variations of different environmental parameters and nutrients recorded during different months are furnished in Tables 1 and 2. The temporal variations of the biomass of the four different seaweeds namely *Chaetomorpha aerea*, *Enteromorpha compressa*, *Gracilaria verrucosa* and *Hypnea musciformes* recorded in Manakkudy estuary are presented in Table 3. Generally, high biomass production could be observed to occur during premonsoon period. The highest biomass production of the four seaweeds viz., *C. aerea* (842.33 ± 32.21 g/m²), *E. compressa* (619 ± 16.09 g/m²), *G. verrucosa* (563.33 ± 13.32 g/m²) and *H. musciformis* (225.67 ± 10.79 g/m²) was recorded in the month of May followed by April. All these seaweeds were observed to be totally absent in November that is a month of peak North East monsoon. The minimum biomass of these four seaweeds could be recorded in December when the salinity reached the lowest value of 11.15 ± 0.48 ppt.

Correlation of environmental parameters with the biomass of the four seaweeds is furnished in Table 4.

Parameters like atmospheric temperature and water temperature were observed to exhibit significant positive correlation with the biomass of *C. aerea*, *G.*

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Table 1 — Temporal variation of different environmental parameters in the study area

Months	Atmospheric Temperature (°C)	Water temperature (°C)	Salinity (ppt)	Dissolved oxygen (ml/l)	Carbon Dioxide (mg/l)	pH	Alkalinity (mg/l)	Euphotic Zone (cm)	Secchi depth (cm)
January	27.00±0.20	29.43±0.15	15.57±0.86	5.73±0.31	4.35±0.26	8.20±0.95	26.04±0.80	237.41±5.30	84.93±6.04
February	27.27±0.49	29.90±0.26	12.31±0.12	6.45±0.53	3.38±0.87	8.10±0.37	28.57±0.81	151.97±4.80	65.99±6.01
March	28.70±0.35	30.93±0.74	17.49±0.92	6.65±0.12	2.37±0.80	8.30±0.54	29.41±0.79	168.11±1.89	60.12±3.59
April	29.57±0.57	31.20±0.82	22.75±0.54	7.12±0.55	1.24±0.38	8.33±0.37	52.43±0.93	215.24±0.52	77.64±3.55
May	30.43±0.67	31.70±0.82	27.18±0.88	6.45±0.84	7.78±0.86	7.87±0.65	15.34±1.02	163.01±6.43	58.89±4.67
June	25.43±1.27	26.13±0.55	18.30±0.73	5.60±0.89	8.71±0.98	8.05±0.39	25.01±0.64	140.13±2.00	50.93±3.34
July	23.90±0.20	25.70±0.36	17.18±0.86	5.74±0.84	4.85±0.87	8.08±0.38	29.37±0.31	191.92±1.51	67.40±1.65
August	24.20±0.26	26.03±0.45	11.62±0.90	7.73±0.16	0.00±0.00	8.35±0.34	35.30±0.95	88.82±2.67	32.19±0.94
September	24.47±0.32	26.23±1.01	12.21±0.16	5.48±0.30	0.00±0.00	8.42±0.33	38.33±0.52	128.53±6.97	46.40±6.10
October	25.33±0.38	27.60±0.80	12.11±0.14	5.58±0.66	6.39±0.76	7.97±0.37	29.52±0.28	122.72±3.90	45.39±5.65
November	24.23±0.74	26.47±0.72	7.34±0.5	5.84±0.15	6.74±0.92	8.06±0.40	40.18±0.54	102.92±2.94	38.21±3.64
December	22.20±0.53	23.57±1.00	11.15±0.48	4.36±0.75	6.35±0.21	8.03±0.14	43.58±0.66	149.07±4.57	53.84±2.51

Table 2 — Temporal variation of different nutrients in the study area

Months	Nitrite (µg.at-N / l)	Nitrate (µg.at-N / l)	Ammonia (µg.at-N / l)	Phosphate (µg.at-P / l)	Silicate (µg.at-Si / l)	Ammonia – N / Phosphate – P	Ammonia – N + Nitrate – N / Phosphate – P
January	0.27±0.02	10.25±0.11	3.90±0.30	0.64±0.07	120.13±2.88	6.10±0.17	22.23±1.72
February	0.26±0.05	11.26±0.23	2.91±0.49	0.87±0.08	136.66±1.60	3.31±0.28	16.28±1.04
March	0.42±0.03	16.26±0.21	3.22±0.64	0.63±0.06	115.55±5.52	5.16±1.46	30.97±3.91
April	0.24±0.06	4.54±0.10	5.52±0.27	0.25±0.04	85.50±6.01	22.29±2.36	40.68±4.90
May	0.26±0.09	13.29±0.09	6.75±0.22	0.61±0.05	66.94±5.68	11.20±1.27	33.20±3.06
June	2.73±0.05	17.45±0.17	24.83±0.66	0.62±0.03	109.88±3.18	39.94±2.99	67.98±4.60
July	0.88±0.04	50.62±0.58	9.11±0.04	0.75±0.06	116.66±1.31	12.26±1.03	80.30±5.80
August	2.27±0.08	35.37±0.32	13.42±0.38	0.88±0.10	142.57±2.85	15.41±2.12	55.94±6.76
September	0.26±0.08	15.53±0.39	4.24±0.60	0.64±0.09	140.00±4.77	6.59±0.10	31.00±2.81
October	0.36±0.09	12.72±0.11	7.45±0.51	0.32±0.05	136.03±1.56	23.18±1.64	63.04±7.11
November	2.57±0.08	23.16±0.10	3.40±0.17	1.36±0.07	160.21±4.98	2.50±0.24	19.56±1.09
December	0.27±0.07	6.27±0.14	8.42±0.03	0.88±0.09	138.85±0.71	9.64±0.96	16.82±1.73

verrucosa and *H. musciformis*. Salinity showed highly significant positive correlation with the biomass of all the four species of seaweeds. Dissolved oxygen, carbondioxide, pH and alkalinity did not show significant correlation with the biomass of these seaweeds. Among nutrients, silicate and phosphate present in the water had highly significant negative correlation with the biomass of the four seaweeds. All other essential plant nutrients did not show significant relationship with the biomass of the four seaweeds occurring in Manakkudy estuary.

Discussion

There are four different types of seaweeds in appreciable biomass in the Manakkudy estuary. The growth period and location of observations of the four different species of seaweeds investigated in the

present study along with previous reports are furnished below for making comparison.

G. verrucosa has been reported to be the most common species of the South West and West coast of India.⁸ *Enteromorpha* species has been reported to be the widely occurring species in Chilka lake.⁹ *Chaetomorpha* is known to occur as the pest of *Gracilaria* under culture.¹⁰

It has been reported that *C. aerea*, *E. compressa*, *G. verrucosa* and *H. musciformis* could tolerate wide range of salinity (13 to 40 ppt) and water temperature of 25 – 33°C.¹¹ In the present study, all these four species of seaweeds were observed to occur when the salinity ranged from 11.15 to 27.18 ppt and the water temperature ranged from 23.57°C to 31.70°C. All the four types of seaweeds occurred in abundance when

Table 3 — Biomass (g/m²) of different seaweeds at gradient zone

Months	<i>C. aerea</i>	<i>E. compressa</i>	<i>G. verrucosa</i>	<i>H. musciformis</i>
January	527.33±10.69	323.67±14.64	340.00±13.11	122.00±15.72
February	524.67±17.16	347.67±5.13	367.00±7.21	136.67±7.64
March	668.33±31.13	423.67±10.97	411.67±21.08	163.33±11.06
April	758.67±17.01	488.33±5.77	536.00±10.15	172.33±9.07
May	842.33±31.21	619.00±16.09	563.33±13.32	225.67±10.79
June	545.00±20.95	602.67±12.34	448.00±3.46	149.33±4.51
July	523.33±12.00	543.33±11.37	375.00±24.27	129.00±5.29
August	361.67±11.85	394.00±8.54	214.67±5.51	103.67±5.69
September	422.33±11.85	422.67±21.13	226.67±3.79	110.67±14.01
October	364.33±16.01	248.67±2.08	193.67±2.89	95.33±9.50
November	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
December	243.67±28.92	124.33±9.29	134.00±10.15	54.33±4.16

Mean±SD; n=3;

Table 4 — Correlation of environmental parameters with the biomass of the four eq. seaweeds

Parameters	<i>C. aerea</i>	<i>E. compressa</i>	<i>G. verrucosa</i>	<i>H. musciformis</i>
Air Temperature	0.820**	0.509 ^{NS}	0.788**	0.796**
Water Temperature	0.741**	0.389 ^{NS}	0.691*	0.707*
Salinity	0.918**	0.806**	0.927**	0.908**
DO	0.409 ^{NS}	0.370 ^{NS}	0.393 ^{NS}	0.428 ^{NS}
CO ₂	-0.111 ^{NS}	-0.075 ^{NS}	-0.002 ^{NS}	-0.067 ^{NS}
pH	0.05 ^{NS}	0.083 ^{NS}	-0.014 ^{NS}	0.000 ^{NS}
Alkalinity	-0.365 ^{NS}	-0.441 ^{NS}	-0.364 ^{NS}	-0.468 ^{NS}
Euphotic zone	0.601*	0.342 ^{NS}	0.608*	0.480 ^{NS}
Secchi depth	0.601*	0.313 ^{NS}	0.614*	0.485 ^{NS}
Nitrite nitrogen	-0.464 ^{NS}	-0.096 ^{NS}	-0.318 ^{NS}	-0.384 ^{NS}
Nitrate nitrogen	-0.186 ^{NS}	0.190 ^{NS}	-0.140 ^{NS}	-0.134 ^{NS}
Ammonia nitrogen	0.028 ^{NS}	0.408 ^{NS}	0.162 ^{NS}	0.110 ^{NS}
Phosphate phosphorus	-0.701*	-0.568 ^{NS}	-0.638*	-0.658*
Silicate silicon	-0.905**	-0.767**	-0.916**	-0.889**
Ammonia nitrogen/phosphate phosphorus	0.227 ^{NS}	0.455 ^{NS}	0.336 ^{NS}	0.263 ^{NS}
Ammonia nitrogen+ nitrate nitrogen/phosphate phosphorus	0.164 ^{NS}	0.519 ^{NS}	0.226 ^{NS}	0.210 ^{NS}

Species	Locality	Growth period	Period of maximum growth	Author
Chlorophyta				
<i>E. compressa</i>	Visakhapatnam	Part of the year	November – December	Umamaheswara Rao M. and T. Sree Ramulu ⁵
“	Mandapam (Gulf of Mannar)	Most part of the year	June – August and November – December	Umamaheswara Rao M. ⁶
“	Mandapam (Palk Bay)	5-6 Months in the year	November – December	- do -
“	Manakkudy estuary	Annual except November	April – June	Present study
<i>C. aerea</i>	Manakkudy estuary	Annual except November	April – May	Present study
Rhodophyta				
<i>Gracilaria sp.</i>	Visakhapatnam	Throughout the year	October – December	Umamaheswara Rao M. and T. Sree Ramulu ⁵
<i>G. verrucosa</i>	Manakkudy estuary	Annual in interior stations (except in November)	April – June	Present study
<i>H. musciformis</i>	Veraval	October-June	December-February	Rama Rao K. ⁷
“	Manakkudy estuary	Annual in interior stations (except November)	April – June	Present study

the level of nutrients (ammonia, nitrate and phosphate) remained moderately high. Similar observation has been reported in the south eastern part of Tamilnadu¹². The silicate level remained very low during the period of high biomass production of these seaweeds exhibiting negative correlation with salinity.

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