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Seasonal variability of *Ulva* species (Green seaweed) in Tirunelveli region, the south east coast of Tamil Nadu, India

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Abstract

The present study was carried out to explore the seasonal variation of Ulva species in Tirunelveli region, the south east coast of Tamil Nadu, India. Tirunelveli region was divided in to four stations namely Kootapuzhi, Perumanal, Idinthakarai and Koothankuzhi for the collection and identification of seasonal variability of Ulva species. Monthly survey was conducted regularly for a period of four years from January 2007 to December 2010. The Ulva species were enumerated at random using a quadrate (0.5m^2). A total of four species of Ulva were collected in the study area such as Ulva fasciata, Ulva intestinalis, Ulva lactuca and Ulva reticulata. The frequency and density were calculated and all the Ulva species showed a similar pattern of seasonal variation. Among the seaweeds collected the highest frequency (71.25%) and density (5.41) were observed in Ulva intestinalis during summer season and the lowest frequency (41.75%) and density (2.75) were recorded in Ulva reticulata during post monsoon season. From the present study it was concluded that all the Ulva species (Chlorophyceae) exhibited the maximum frequency and density during the summer season followed by the declined trend was observed in the successive seasons. During the post monsoon season the frequency and density of Ulva species (Chlorophyceae) was minimum in the selected region of south east coast of Tamil Nadu.

Keywords: Chlorophyceae, *Ulva*, seasonal variability, Tirunelveli.

Introduction

Over 80% of world's plant diversity was reported only in the marine environment[1] with more than 150,000 seaweeds or marine macro algae species found in the intertidal zones and tropical waters of the oceans and it is the primary source of natural products[2]. Seaweeds are floating or submerged marine plants of shallow meadows. Seaweeds also have salt tolerance because the osmolarity of cytoplasm is adjusted to match the osmolarity of the seawater so that drought does not occur. Seaweeds are primitive group of marine plants therefore they lack true stems, roots and leaves; however, they have a blade that is leaf like, a stipe that is stem like, and a holdfast that resembles roots like terrestrial plants. Seaweeds also contain photosynthetic pigments and use sunlight to produce food and oxygen from carbon dioxide, and the water[3]. Marine macroalgae are important ecologically and commercially to many regions of the world, especially in Asian countries such as China, Japan, Indonesia and Korea[4].

Seaweeds are a valuable food resource which contains low calories, and are rich in vitamins, minerals, proteins, polysaccharides, steroids and dietary fibers[5,6]. Since as early as 3000 BC, seaweeds were also used for important traditional remedies[7]. The Japanese and Chinese use seaweeds in the treatment of hyperthyroidism and other glandular disorders[8–11]. The unsaturated lipids afford protection against cardiovascular pathogens[12]. Seaweeds are an important source of bioactive metabolites for the pharmaceutical industry in drug development. Many of these compounds are used to treat diseases like cancer, acquired immune-deficiency syndrome (AIDS), inflammation, pain, arthritis, as well as viral, bacterial, and fungal infections[13].

Ulva species are green marine macroalgae (Chlorophyceae), which grows abundantly in the coastal waters of Tirunelveli region, Tamil Nadu, India. Marine macroalgae have been identified in both inter-tidal and deep water regions, and proven to be rich sources of structurally diverse bioactive compounds with valuable biomedical potential[14]. Marine green algae viz., *Ulva* sp. are an important food source in many south-east Asian countries[15] and used in the preparation of soups and salads, and have been reported to possess antioxidant and antibacterial properties[16]. *Ulva* sp. have very high in Fe, protein, essential amino acids, I, Mn, Se, Ni, and vitamins. They exhibit anti-peroxidative and anti-hyperlipidaemic properties[17]. It is important to collect the marine plants at particular period or season for the utility both as medicine and food source. Otherwise the expected plants can not be observed at a particular period or minimal quantity only can be observed. Therefore, in this study, the regular field survey was conducted to investigate the distribution of *Ulva* species at different stations of Tirunelveli region along the south east coast of Tamil Nadu during different season to provide seasonal variability pattern observed in the *Ulva* species according to marine environmental conditions related to its distribution.

Material and Methods

The Tirunelveli region in the south east coast of Tamil Nadu, India extends from Kootapuzhi in the south to Koothankuzhi in the north. The entire study area was categorized in to four stations namely Kootapuzhi (S_1), Perumanal (S_2), Idinthakarai (S_3) and Kootapuzhi (S_4). The survey of seaweeds from the intertidal area was carried out during low tide. For the sampling of seaweeds transect lines and a quadrat ($0.5m^2$) was used. Samples were selected at random as per requirement. This was carried out by selecting sampling points in the area using quadrat. Sampling points were selected in such a manner that every species of the study area has good chance of being selected. The number of quadrats was determined as per the area selected. For this purpose the whole station (For example station S_1) was divided into four segments namely segment A, segment B, segment C and segment D. Quadrats were placed every three meters on four segments. Each segment was 250m long in which 80 quadrats were placed. Monthly 160 quadrats were taken and the number varying according to the tidal height. Seaweed species present in the quadrats were observed, counted species wise and number of individuals in each species was noted for quantitative assessment frequency and density[18]. For the estimation of frequency and density the following formulae were used.

Frequency: Total number of quadrats in which species occurred **/** Total number of quadrats studied.
Density: Total number of species **/** Total number of quadrats studied.

Results and Discussion

Totally four species of *Ulva* namely *Ulva fasciata* (figure -1a), *Ulva intestinalis* (figure -1b), *Ulva lactuca* (figure -1c) and *Ulva reticulata* (Figure -1d) were collected in Tirunelveli region, in the south east coast of Tamil Nadu, India and all the *Ulva* species found in study area were observed throughout the year. Though all the members of *Ulva* showed similar patterns of seasonal distribution, with respect to frequency and density high level of variability was observed between the seasons and stations. Among the four seasons studied, all the taxa of *Ulva* were observed during summer with high frequency and density in the selected study area. A well marked declining in the frequency and density were recorded in the subsequent seasons of pre-monsoon and monsoon. The post-monsoon season was noted to be poor growth of *Ulva* members which showed the lowest frequency and density in the present study.

Among those species which were observed in all the four stations, the species *Ulva intestinalis* showed the highest frequency (71.25%) and the species *Ulva reticulata* showed the lowest frequency (60.00%) during summer in Tirunelveli region. Whereas, during the post-monsoon season *Ulva fasciata* was observed to be the highest frequency (51.25%) and *Ulva reticulata* was with the lowest frequency (41.75%). During pre-monsoon season, the highest frequency was recorded in *Ulva fasciata* (65.00%) and the lowest frequency in *Ulva reticulata* (56.25%) followed by *Ulva fasciata* with the highest frequency (58.75%) and *Ulva intestinalis* (45.00%) with the lowest frequency as shown in table -1.

Figure-1a
***Ulva fasciata* Delile**

Figure-1b
***Ulva intestinalis* Linnaeus**

Figure-1c
***Ulva lactuca* Linnaeus**

Table-1
Seasonal variability of *Ulva* species in the Tirunelveli region

-	-	Post-monsoon		Summer		Pre-monsoon		Monsoon	
S.No.	**Name of the Seaweeds**	**F**	**D**	**F**	**D**	**F**	**D**	**F**	**D**
1.	*Ulva fasciata*	51.25	4.81	68.75	5.21	65.00	5.06	58.75	4.95
2.	*Ulva intestinalis*	42.50	3.77	71.25	5.43	63.75	5.20	45.00	4.87
3.	*Ulva lactuca*	43.75	4.36	63.75	4.95	61.25	4.65	48.75	4.51
4.	*Ulva reticulata*	41.75	2.75	60.00	2.95	56.25	3.26	48.75	3.06

F–Frequency, **D** – Density

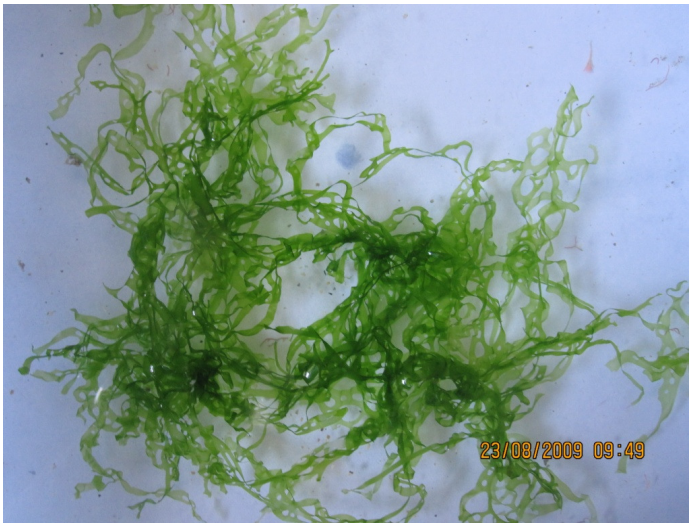

Figure-1d
***Ulva reticulata* Forssk**

Though the members of *Ulva* species showed the similar pattern of seasonal distribution, high level of the variability was observed with respect to density between the seasons and stations. In *Ulva* species, *Ulva intestinalis* showed the highest density (5.43) and the lowest density (2.95) was recorded in *Ulva reticulata* during summer season. The rate of density was increased from post-monsoon to summer. *Ulva reticulate* showed the lowest density (2.75) and the highest density (4.81) was observed in *Ulva fasciata* at post-monsoon season.

The similar studies were conducted in *Caulerpa* species from Tirunelveli region[19] and *Enteromorpha* species from Kanyakumari region[20]. In the previous studies, seasonal variability of green seaweeds (Chlorophyceae) were studied and all the green seaweed showed the similar pattern of seasonal distribution that all the chlorophyceae members were observed to have the highest frequency and density during summer season. The similar results were observed in the present study also. In the present as well as previous studies, it was noted that all the green seaweeds (Chlorophyceae) were observed during summer with the highest frequency and density and during post-monsoon season with the lowest frequency and density.

Conclusion

From the present study, it was concluded that both frequency and density of all the *Ulva* species varied with seasons and stations. All the taxa of *Ulva* exhibited an uniform pattern of increase in frequency and density during summer followed by decrease in frequency and density in the successive seasons such as pre-monsoon and monsoon seasons. In the post-monsoon season, all the green seaweeds were observed with the lowest frequency and density. And the rate of increase or decrease of frequency and density varied with taxa and stations.

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