

DISTRIBUTION AND SEASONAL VARIATION OF SOME GRACILARIA SPECIES (RHODOPHYCEAE) IN THOOTHUKUDI REGION FROM THE SOUTH EAST COAST OF TAMIL NADU, INDIA

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ABSTRACT

The present study was aimed to carry out the seasonal variation of *Gracilaria* species in Thoothukudi region in the south east coast of Tamil Nadu, India. Thoothukudi region was divided in to four stations namely Manapad, Trichendur, Thoothukudi and Vembar for the collection and determination of seasonal variability of *Gracilaria* species. Monthly survey was conducted regularly and the *Gracilaria* species were enumerated at random using a quadrat (0.5m²). A total of seven species of *Gracilaria* were collected in the study area such as *Gracilaria corticata*, *Gracilaria cylindrica*, *Gracilaria dura*, *Gracilaria edulis*, *Gracilaria fergusonii*, *Gracilaria tuticorinensis* and *Gracilaria verrucosa*. The frequency and density were calculated and all the *Gracilaria* species showed a similar pattern of seasonal variation. Among the *Gracilaria* species collected the highest frequency (66.25%) and density (4.56) were observed in *Gracilaria fergusonii* during monsoon season and the lowest frequency (16.25%) and density (1.01) were recorded in *Gracilaria corticata* during summer season. From the present study it was concluded that all the *Gracilaria* species (Rhodophyceae) exhibited the maximum frequency and density during the monsoon season followed by the declined trend was observed in the successive seasons. During the summer season the frequency and density of *Gracilaria* species was minimum in the selected Thoothukudi region of the south east coast of Tamil Nadu, India.

INTRODUCTION

Seaweeds have been one of the richest and most promising sources of bioactive primary and secondary metabolites and their discovery has significantly expanded in the past few decades [1,2]. The seaweeds synthesize a variety of compounds such as carotenoids, terpenoids, xanthophylls, chlorophyll, vitamins, saturated and polyunsaturated fatty acids, amino acids, antioxidants such as polyphenols, alkaloids, halogenated compounds and

polysaccharides such as agar, carrageenan, alginate, laminaran, rhamnan sulfate, galactosyl glycerol and fucoidan [3-5]. These compounds probably have diverse simultaneous functions for the seaweeds and can act as allelopathic, antimicrobial, antifouling and herbivore deterrents or as ultraviolet-screening agents [6]. They are also used by the pharmaceutical industry in drug development to treat diseases like cancer, acquired immune-deficiency syndrome (AIDS), inflammation, pain, arthritis, infection for virus, bacteria and fungus [7].

Compounds with cytostatic, antiviral, antihelminthic, antifungal and antibacterial activities have been detected in green, brown and red seaweeds [8,9]. Among them, red seaweeds produce pure forms of the fatty

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Research Article



acids found in human milk that appear to be building blocks for mental and visual development and have been extensively screened for syntheses of new drugs [10]. During the 1970s, Ryther and collaborators evaluated numerous species of red seaweeds for the potential growth rates and dry weight yields [11]. They demonstrated that the genus *Gracilaria* was the most attractive candidate because of its ability to achieve high yields and while producing commercially valuable extracts [12]. *Gracilaria* Greville genus (Gracilariales, Rhodophyta) is a macro algae group with more than 300 species of which 160 have been accepted taxonomically. These are usually red or greenish brown with a three phase cycle and can be found in tropical and subtropical seas [13]. The *Gracilaria* species are important for the industrial and biotechnological uses because they have phycocolloids, the main source of agar α -(1,4)-3,6-anhydro-L-galactose and β -(1,3)-D-galactose with little esterification in cell wall [14]. The primary and secondary metabolites present in *Gracilaria* and other group of seaweeds are variable in every season or even every month. The distribution of the particular seaweed especially *Gracilaria* species in a specific place is also very important for the collection. Hence the present study was carried out to know the distribution and seasonal variation of the selected red seaweed *Gracilaria* in Thoothukudi region from the south east coast of Tamil Nadu, India.

MATERIALS AND METHODS

The Thoothukudi region in the south east coast of Tamil Nadu, India extends from Manapad in the south to Vembar in the north. The entire study area was categorized into four stations namely Manapad (S_1), Trichendur (S_2), Thoothukudi (S_3) and Vembar (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 quadrates 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. Quadrates were placed every three meters on four segments. Each segment was 250m long in which 80 quadrates were placed. Monthly 160 quadrates were taken and the number varying according to the tidal height. Seaweed species present in the quadrates were observed, counted species wise and number of individuals in each species was noted for quantitative assessment such as frequency and density [15]. For the determination of frequency and density the following formulae were used.

Frequency: Total number of quadrates in which species occurred / Total number of quadrates studied x 100

Density: Total number of species / Total number of quadrates studied.

RESULTS AND DISCUSSION

There are totally seven *Gracilaria* species such as *Gracilaria corticata*, *Gracilaria cylindrica*, *Gracilaria dura*, *Gracilaria edulis*, *Gracilaria fergusonii*, *Gracilaria tuticorinensis* and *Gracilaria verrucosa* were collected from Thoothukudi region (Figure 1). Among the seven species, five *Gracilaria* species were found throughout the year whereas three species namely *Gracilaria dura* was seen only during the monsoon and post-monsoon season, *Gracilaria tuticorinensis* and *Gracilaria verrucosa* were observed during pre-monsoon, monsoon and post-monsoon season only. Although all the members of *Gracilaria* 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 *Gracilaria* observed during monsoon with high frequency and density in the study area. A well-marked declining in the frequency and density were recorded in the subsequent seasons of post-monsoon, summer and pre-monsoon. The summer season was noted to be poor growth of *Gracilaria* members which showed the lowest frequency and density in the present study. Among the species which were collected in all the four stations, the species *Gracilaria fergusonii* was found with the highest frequency (66.25%) and the species *Gracilaria tuticorinensis* showed the lowest frequency (38.75%) during monsoon season, while during the summer season *Gracilaria edulis* was observed to be the highest frequency (26.25%) and *Gracilaria corticata* was with the lowest frequency (16.25%) as shown in Table 1. During the summer season *Gracilaria dura*, *Gracilaria tuticorinensis* and *Gracilaria verrucosa* were disappeared completely. Next to the monsoon season all the species of *Gracilaria* were started to decline the growth. In the post-monsoon season, *Gracilaria fergusonii* showed with the highest frequency only 63.75% and *Gracilaria tuticorinensis* with the lowest frequency only 31.25%. During the pre-monsoon season, *Gracilaria fergusonii* was observed with the highest frequency of 57.5% and *Gracilaria tuticorinensis* with the lowest frequency of 22.5%. The only *Gracilaria* species *Gracilaria dura* was still not found during the pre-monsoon season (Figure 2).

Among the species collected in all the four stations, the species *Gracilaria fergusonii* was found with the highest density (4.56) and the species *Gracilaria dura* showed the lowest density (0.96) during monsoon season, while during the summer season *Gracilaria fergusonii* was observed to be the highest density (2.47) and *Gracilaria corticata* was with the lowest density (1.01) as shown in Table 1. During the summer season *Gracilaria dura*, *Gracilaria tuticorinensis* and *Gracilaria verrucosa* were not found completely. Next to the monsoon season all the species of *Gracilaria* were come to decline the growth. In



the post-monsoon season, *Gracilaria fergusonii* showed with the highest density only 3.75 and *Gracilaria dura* with the lowest density only 0.78. During the pre-monsoon season, *Gracilaria fergusonii* was observed with the highest density of 3.31 and *Gracilaria corticata* with the lowest density of 1.21. The only *Gracilaria* species *Gracilaria dura* was still not found during the pre-monsoon season (Figure 3).

From the present investigation, it was noted that both frequency and density of all the *Gracilaria* taxa varied with seasons and stations. All the taxa of *Gracilaria* exhibited an uniform pattern of increase in frequency and density during the monsoon season followed by decrease in frequency and density in the successive season of post-monsoon. During the summer season, both the frequency and density of *Gracilaria* was very low. In the pre-monsoon season, the frequency and density were increased as compared with summer season. The rate of increase or decrease of frequency and density varied with taxa and the stations. The similar pattern of distribution was noted that both frequency and density of all the *Laurencia* (Red seaweed) taxa varied with seasons and stations. All the taxa of *Laurencia* exhibited an uniform pattern of increase

in frequency and density during monsoon season followed by decrease in frequency and density in the successive post-monsoon season, during the summer season all the *Laurencia* species were disappeared and the *Laurencia* species reappeared during pre-monsoon season. The rate of increase or decrease in frequency and density varied with taxa and stations [16].

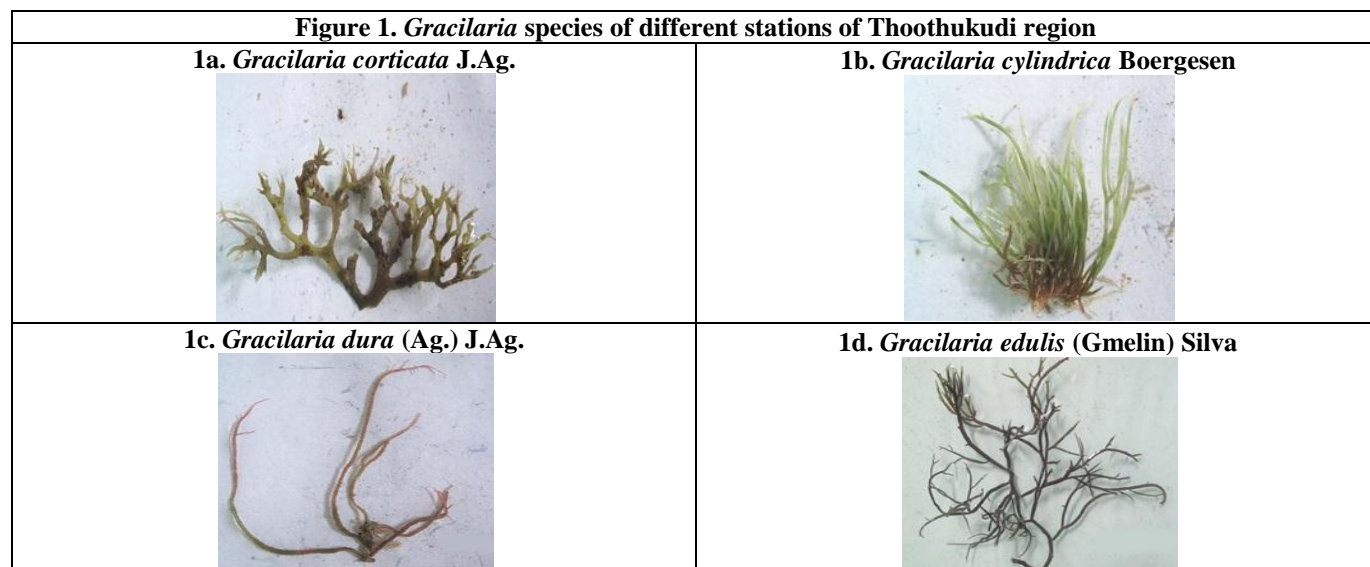
In the concordance of present study with previous studies, it was noted that all the *Caulerpa* species (green seaweeds) were observed during summer with the highest frequency and density and during post-monsoon season with the lowest frequency and density. In contrast, it was also recorded in *Caulerpa* species from Kanyakumari [17], Tirunelveli region [18], *Enteromorpha* species from Kanyakumari region [19], *Ulva* species [20] and *Chaetomorpha* species [21] from Tirunelveli region. In the earlier reports, seasonal variability of green seaweeds (Chlorophyceae) were recorded and all the green seaweeds showed the similar pattern of seasonal distribution that all the chlorophyceae members were observed to have the highest frequency and density during summer season followed by decline trend were observed in the successive seasons (pre-monsoon and monsoon).

Table 1. Seasonal variability of *Gracilaria* species in Thoothukudi region of the southern coast of Tamil Nadu, India

S.No.	Name of the Seaweeds	Post-monsoon		Summer		Pre-monsoon		Monsoon	
		F	D	F	D	F	D	F	D
1	<i>Gracilaria corticata</i>	47.50	1.25	16.25	1.01	43.75	1.21	60.00	1.41
2	<i>Gracilaria cylindrica</i>	43.75	2.13	22.50	1.51	36.25	1.82	63.75	2.35
3	<i>Gracilaria dura</i>	46.25	0.78	-	-	-	-	50.00	0.96
4	<i>Gracilaria edulis</i>	50.00	1.60	26.25	1.21	51.25	1.76	58.75	1.87
5	<i>Gracilaria fergusonii</i>	63.75	3.75	23.75	2.47	57.50	3.31	66.25	4.56
6	<i>Gracilaria tuticorinensis</i>	31.25	1.56	-	-	22.50	1.58	38.75	1.72
7	<i>Gracilaria verrucosa</i>	32.50	2.06	-	-	38.75	1.68	48.75	2.18

F- Frequency D- Density

Figure 1. *Gracilaria* species of different stations of Thoothukudi region



1e. *Gracilaria fergusonii* J.Ag.



1f. *Gracilaria tuticorinensis* Krish. et Rajend.



1g. *Gracilaria verrucosa* (Hudson) Papenfus



Figure 2: Seasonal Distribution (Frequency) of *Gracilaria* species in Thoothukudi Region

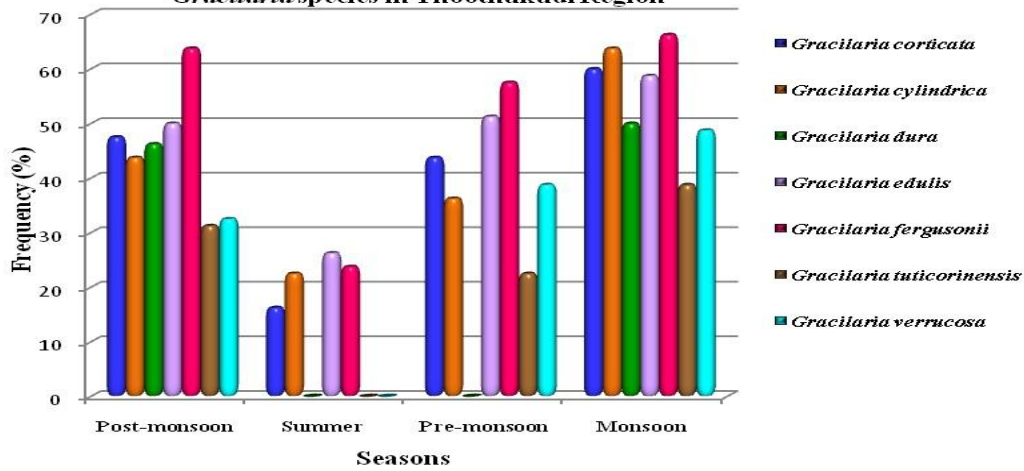
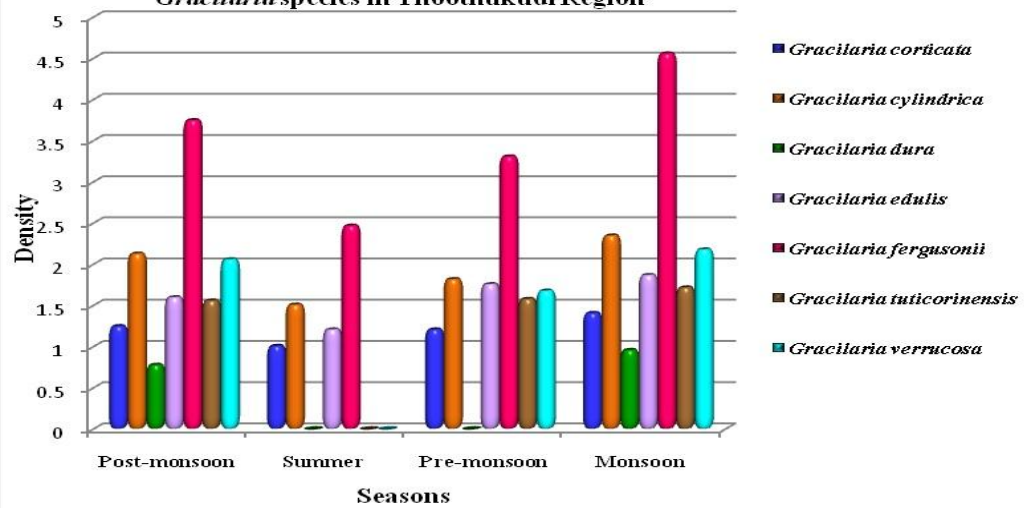


Figure 3: Seasonal Distribution (Density) of *Gracilaria* species in Thoothukudi Region



CONCLUSIONS

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

with the lowest frequency and density. During the pre-monsoon season, the frequency and density were increased and the rate of increase or decrease of frequency and density varied with taxa and seasons.

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CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

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