Current status of seaweed diversity and their seasonal availability at Hare Island, Gulf of Mannar

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ABSTRACT

Seaweed diversity and their seasonal availability in Hare Island, Gulf of Mannar were studied during the year 2011-2012. Ninety species were identified of which 11 genera with 30 species, 13 genera with 28 species and 19 genera with 32 species were belonged to chlorophyceae, phaeophyceae and rhodophyceae. Species richness was found to be more in *Caulerpa* (10) followed by *Sargassum* (9) and *Gracilaria* (7). Seasonal distribution of seaweeds revealed that the members of rhodophyceae (*Gracilaria corticata, G. verrucosa* and *G. pygmaea)* and phaeophyceae (*Padina tetrastromatica* and *P. pavonia)* were most abundant in all the seasons (pre-monsoon, monsoon and post-monsoon). Species such as *Turbinaria ornata, T. conoides, Rosenvingea intricata, Pocokiella variegata* and *Scinaia furcellata* were completely absent in pre-monsoon season. Other species showed seasonal fluctuation in their distribution and abundance. The abundance of economically beneficial seaweeds assessed during this survey revealed the feasibility of commercial exploration of seaweeds such as *Gracilaria corticata, G. verrucosa* and *G. pygmaea* (agarophytes), *Padina tetrastromatica P. pavonia, Spathoglossum asperum, Stoechospermum marginatum, Turbinaria ornata, T. conoides* (alginophytes), *Hypnea musciformis, Acanthophora spicifera, Corynomorpha prismatica* and *Kappaphycus alvaerezii* (carrageenophytes) for phycocolloid industry.

KEYWORDS: Hare Island, seaweeds, species richness.

INTRODUCTION

Seaweeds are major coastal resources which have been utilized for the extraction of phycocolloids as alginates from brown algae, agar and carrageenan from red algae. These phycocolloids are currently used in the pharmaceutical and cosmetic and food industries. Seaweeds are known to contain bioactive substances with antibacterial, antiviral and antifungal properties (Trono, 1999; Flora and Maria Victorial Rani, 2012). Further, they are also used for animal nutrition as feed and as fertilizers and soil conditioning agents (Robledo and Freile-Pelegrin, 1997). Edible seaweeds are widely consumed, especially in Asian countries as fresh, dried, or ingredients in prepared foods. Seaweeds are known to be one of the richest sources of minerals, such as iodine, magnesium, calcium, phosphorus, iron, potassium, copper and fluoride (Ensminger *et al*., 1995). Gulf of Mannar, Marine province is situated between India and Srilanka. It runs on its Indian side at its head from Pamban Islands, Southern Coastline which includes the famous pilgrim centre Rameshwaram to Kanyakumari. Diversity and seasonal distribution of seaweeds are known from different coastal regions of Gulf of Mannar (Chacko *et al*., 1955; Umamaheswara Rao, 1969, 1972, 1973; Subbaramaiah *et al*., 1977; Kalimuthu *et al.,* 1992; Kaliaperumal *et al.,* 1995, 1996; Sreekala Devi *et al*., 2004; Domettila and Jeeva, 2013). But, Information about the diversity and frequency of seaweed species of Hare Island, Gulf of Mannar was not available after the reports of Sarojini Menon *et al*., 1993. Hence, this paper presented the current status of seaweed diversity and their seasonal availability at Hare Island, Gulf of Mannar.

MATERIALS AND METHODS

The study area, Hare Island (Pandiyan Thivu or Light House Island) of Gulf of Mannar in the southeast coast of India is situated 4.5km away from Tuticorin Port Beach with a variety of substrata-rocky, silty, muddy and sandy.

Seasonal availability of seaweeds were studied in three seasons namely pre-monsoon (June-September), monsoon (October-January) and post-monsoon (February-May) during the year 2011-2012 and were compared with published data (Sarojini Menon *et al.,* 1993). All the species occurred in the intertidal and littoral zone were collected during low-tide (referred from tidal chart). The availability of the collected seaweeds was categorized as most abundant (++++), abundant (+++), less abundant (++), sparse (+) and absent (-) based on the visible observation made at the sampling site. Collected seaweeds were washed with seawater to remove all the extraneous matter such as epiphytes, shells, associated fauna and adhering sand particles. Later, seaweeds were thoroughly cleaned with fresh water to remove the salt on their surface and preserved by wet (5% formalin in seawater) and dry preservation (herbaria) methods. The preserved samples were further confirmed by using authentic floras and books (Mishra, 1996; Srinivasan, 1969; Kaliaperumal *et al*., 1995; Fritsch, 1977 and Umamaheswara Rao, 2003).

RESULTS AND DISCUSSION

In the study area, Hare Island, Gulf of Mannar, the seaweed growth was always found associated with coral reefs or rocky substratum (Fig. 1). A total number of 90 species of seaweeds belonging to chlorophyceae, phaeophyceae and rhodophyceae were identified and recorded in Table 1. Number of genera was more in rhodophyceae (19) than phaeophyceae (13) and chlorophyceae (11). The highest species diversity was found in rhodophyceae (32 species) whereas the members of chlorophyceae and phaeophyceae were noted with 30 and 28 species respectively. Overall, number of species were rich in the genera *Caulerpa* (10) followed by *Sargassum* (9) and *Gracilaria* (7).

Table 1: Diversity and seasonal availability of seaweeds at Hare Island, Gulf of Mannar

Seaweeds encountered	Availability Status		
	Pre-monsoon	Monsoon	Post-monsoon
Chlorophyceae			
Ulothrix flacca (Dillw.)	+	+	+
Ulva lactuca Linn.	+++	+++	++++
Ulva reticulata Forsk.	++	++	++++
Ulva fasciata Delile	+	+	+
Enteromorpha intestinalis (L.) Link	+	+	++
Enteromorpha compressa (L.) Grev.	++	++	++++
Cladophora glomerata (L.) Kütz.	+	+	+
Cladophora albida Kütz.	+	+	+
Cladophora echinus (Biassoletto) Kütz.	+	+	+
Caulerpa scalpelliformis (R.Br.) Weber-Van- Bosse	+++	++++	++++
Caulerpa verticillata J. Ag.	+	+	++
Caulerpa racemosa (Forsk.) Weber-Van-Bosse	+	+	+++
Caulerpa taxifolia (Vahl) Ag.	+	+	++
Caulerpa sertularioides (Gmelin) Howe	+	+	++
Caulerpa corynephora Montagne	+	+	++
Caulerpa crassifolia (C. Ag.) J. Ag	+	+	++
Caulerpa peltata (Turn.) Lamour	+	+	++
Caulerpa cupressoides (Vahl)Weber-Van-Bosse	+	+	+
Codium bursa (L.) Ag.	+	+	+
Codium elongatum C. Ag.	+	+	+
Codium tomentosum (Hudson) Stack.	+	+	+
Codium geppiorum O. C. Schmidt	+	+	+
Halimeda tuna (Ell. & Sol.) Lamour	+	+	++
Halimeda macroloba Decsne	+	+	+
Udotea indica A. & E.S. Gepp.	+	+	+
Veloniopsis pachynema (Martens) Boergs.	+	+	+
Chaetomorpa crassa (C. Agardh) Kützing	+	+	+

Chaetomorpa melagonium (F. Weber & Mohr) Kützing	+	+	+
Chaetomorpa antennina Borry de Saint- Vincent	+	+	+
Cladophoropsis herpestica (Mont.) M. A. Howe.	+	+	+
Phaeophyceae			
Colpomenia sinuosa (Roth) Derbes & Solier	+	+	++
Iyengaria stellata Boergesen	+	+	+
Chnoospora fastigiata J. Ag. var. pacifica J.Ag.	+	+	++
Dictyota ciliata J. Ag.	+	+	+
Dictyota indica Sonder	+	+	+
Dictyota atomaria Hauck	+	+	+
Dictyota dichotoma (Huds.) Lamour f. implexa	+	+	+
Padina tetrastromatica Hauck	++++	++++	++++
Padina pavonia (L.) Lamour	++++	++++	++++
Padina gymnospora (Kützing)	+	+	+
Padina commersonii Bory	+	+	+
Zonaria latissima Kütz. Vickers.	+	+	+
Dictyopteris woodwardii (Br.) J. Ag.	+	+	+
Spathoglossum asperum J. Ag.	++	++++	++++
Stoechospermum marginatum (Ag.) Kütz.	++	++++	++++
Sargassum duplicatum J. Ag.	++	+	++
Sargassum wightii (Grev.) J. Ag.	++	+	+++
Sargassum swartzii (Turn.) C. Ag.	++	+	++
Sargassum filipendula C. Agardh	+	+	+
Sargassum polycystum C. A. Agardh	+	+	++
Sargassum tenerrimum J. G. Agardh	+	+	++
Sargassum cinereum J. G. Agardh	+	+	+
Sargassum caryophyllum J. G. Agardh	+	+	+
Sargassum ilicifolium (Turn.) G. Ag. var. venusta Grun.	+	+	+
Turbinaria ornata J. Ag.	-	+	++++
Turbinaria conoides Kützing	-	+	++++
Rosenvingea intricata (J. Ag.) Boergs.	-	-	+
Pocokiella variegata (Lamour.) Papenfuss	-	-	+
Rhodophyceae			
Scinaia furcellata (Turn.) Bivonia	-	+	+
Halymenia floresia (Clem.) Ag.	+	+	+
Halymenia porphyroides Boer	+	+	+
Desmia hornemanni Lyngb.	+	+	+
Amphiroa anceps (Lamk.) Decsne	+	+	++
Hypea musciformis (Wulfen) J. V. Lamouroux	++	+++	++++
Hypnea valentiae (Turner) Mont.	++	+++	+++
Gracilaria corticata J. Ag.	++++	++++	++++
Gracilaria verrucosa (Huds.) Papenfuss	++++	++++	++++
Gracilaria pygmaea Boergs.	++++	++++	++++
Gracilaria fergusonii J. Ag.	+	+	+
Gracilaria rostrata Umamaheswara Rao	+	+	+
Gracilaria edulis (S.G.Gmelin)	+	+	+
Gracilaria salicornia C. Agardh	+	+	+
Champia indica Boergs.	+	+	+
Rhodymenia palmata Grev.	+	+	+++
Ceramium ciliatum J. Ellis Ducluzeau	++	++	++
Ceramium flaccidum (Kutz.) Ardiss	+	+	+
Acanthophora spicifera (M.Vahl) Borgesen	++	++++	++++
Acanthophora delilei Lamour.	++	+++	++++
Laurencia pedicularioides Boergs.	+	+	+
Laurencia papilosa (C. Agardh) Greville	+	+	+
Polysiphonia variegata (Ag.) Zan.	+	+	+

Calliblepharis frimbriata (Greville) Kutzing	+	+	+
Corynomorpha prismatica (J. Ag.) J. Ag.	+	+++	++++
Kappaphycus alvaerezii (Doty) Doty ex P.C.Silva	++	+++	++++
Lomentaria articulata (Hudson) Lyngbye	+	+	+
Centroceros clavulatum (C. Agardh) Montagne	+	+	+
Solieria robusta (Grev.) Kylin	+	+	+
Jania capillacea Harvey	+	+	+
Jania adherens J.V. Lamoutoux	+	+	+
Jania tenella (Kutzing) Grunow	++	++	++

Most abundant (++++), Abundant (+++), Less abundant (++), Sparse (+), Absent (-).

Table 2: Comparison of the occurrence of selected seaweeds in Hare Island from 1968 to 2012

Name of the seaweeds	Frequency chart			
	1968**	1978**	1988**	2011-2012
Enteromorpha sp.	++++	++++	++	++++
Ulva reticulata	++++	++++	++	++++
Acetabularia wettstenii	++	+	-	-
Neomeris annulata	++	+	-	-
Caulerpa selago	++++	+++	++	-
Caulerpa crassifolia	++++	+++	++	+
Avrainvillea erecta	+++	++	-	-
Dictyota atomaria	++++	++++	++	+
Dictyopteris delicaluta	+++	++	-	-
Padina gymnospora	++++	+++	++	+
Turbinaria conoides	+++	++	+	++++
Sargassum piluliferum	+++	++	+	-
Corynomorpha prismatica	++	+	-	++++
Gracilaria corticata	+++	++	+	++++
Lomentaria articulata	++	++	+	+
Botrycladia leptopoda	++	+	-	-
Centroceros clavulatum	+++	++	-	+
Acanthophora delile	++++	+++	++	++++

Very abundance (++++), Abundant (+++), Present but not abundant (++), Present sparsely (+), Absent (-).
** Source : Sarojini Menon *et al*., 1993.

Seasonal distribution of seaweeds at Hare Island was shown in Table 1. Among the different seasons studied, species diversity was rich in post-monsoon season followed by monsoon season and less in pre-monsoon season. It was in agreement with the results of Kalimuthu *et al.,* (1992) and Darsis and Arunkumar (2008). In Hare Island, the red algae such as *Gracilaria corticata, G. verrucosa* and *G. pygmaea* (agarophytes) and the brown algae such as *Padina tetrastromatica* and *P. pavonia* (alginophytes) were most abundant in all the seasons. These seaweeds showed good adaptability to the environmental conditions prevailing at Hare Island and these may be ideal species for economical purposes. Some of the species like *Ulva lactuca, U. reticulata, Enteromorpha compressa* (chlorophyceae), *Spathoglossum asperum, Stoechospermum marginatum, Turbinaria ornata, T. conoides* (phaeophyceae) and *Hypnea musciformis, Acanthophora spicifera, Corynomorpha prismatica* and *Kappaphycus alvaerezii* were most abundant in post monsoon season than the other seasons. Species such as *Turbinaria ornata, T. conoides, Rosenvingea intricata, Pocokiella variegata* and *Scinaia furcellata* were completely absent in pre-monsoon season. The study revealed that the occurrence of seaweeds varied seasonally within the same locality as reported by Sreekala Devi *et al*., 2004. This may be due to dynamics of nutritional, environmental status and physico-chemical parameters over the period of time.

Table 2 shows the comparative study on frequency of selected seaweeds during 2011-2012 with the earlier data of Sarojini Menon *et al*., (1993). It is understood that taxa like *Acetabularia wettstenii, Neomeris annulata, Avrainvillea erecta, Dictyopteris delicaluta, Sargassum piluliferum, Botrycladia leptopoda* reported to be rare during 1988, became extinct during 2011 – 2012. This may be due to retrogression in the rocky or reefy substrata as the reefs are most removed for commercial purposes. Pouching of coral reef was one of the common exercises in this area before 1989 and is now prohibited. Species like *Enteromorpha sp., Ulva reticulata, Turbinaria conoides, Corynomorpha prismatica, Gracilaria corticata, Acanthophora delile* were dwindling in frequency during from 1968 to 1988 became abundant during 2011-2012. This may be due to the declaration of Gulf of Mannar as Marine Biosphere Reserve Park on 18.02.1989 (Ramadhas *et al*., 1999).

CONCLUSION

The abundance of economically beneficial seaweeds assessed at Hare Island, Gulf of Mannar revealed the feasibility of commercial exploration of seaweeds such as *Gracilaria corticata, G. verrucosa* and *G. pygmaea* (agarophytes)*, Padina tetrastromatica P. pavonia, Spathoglossum asperum, Stoechospermum marginatum, Turbinaria ornata, T. conoides* (alginophytes), *Hypnea musciformis, Acanthophora spicifera, Corynomorpha prismatica* and *Kappaphycus alvaerezii* (carrageenophytes) for phycocolloid industry. Further, this investigation established the rehabitation of *Enteromorpha sps., Ulva reticulata, Turbinaria conoides, Corynomorpha prismatica, Gracilaria corticata, Acanthophora delile* and extinction of *Acetabularia wettstenii, Neomeris annulata, Caulerpa selago, Avrainvillea erecta, Dictyopteris delicaluta, Sargassum piluliferum, Botrycladia leptopoda* in the study area.

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