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Diversity and distribution of seaweeds in the Muttom coastal waters, south-west coast of India

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ABSTRACT Seaweeds are found in the coastal region between high and low tide, and in the sub-tidal region up to a depth where 0.01% photosynthetic light is available. Plant pigments, light, exposure, depth, temperature, tides and the characteristics of the shore combine to create different environments that determine the distribution and variety of seaweeds. The present study was conducted at Muttom, formed of different inter-tidal rock shores with rich algal vegetation. During the study period (January to December 2011), a total of 38 species of seaweeds were recorded. Among them, *Ulva fasciata* and *U. lactuca* (green algae); *Sargassum wightii*, *S. duplicata* and *Padina tetrastomatica* (brown algae); *Gracilaria corticata* and *G. pygmaea* (red algae), were present throughout the study period.

KEY WORDS Diversity; Muttom; Seaweeds; South West Coast of India.

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INTRODUCTION

In the vast ocean realm, several forms of life, starting from unicellular to multi-cellular flourish, multiply and disintegrate. It is believed that the first living cell that appeared on the planet Earth emerged from the ocean. In all its forms, Life has developed from the growth of mono-cellular algae (Dhargalkar & Pereira, 2005). It was estimated that about 90% of the species of marine plants are algae and about 40% of the global photosynthesis is contributed from algae (Andersen, 1992).

Seaweeds, known as macroalgae, are among the most important primary producers and act as ecological engineers on rocky coasts of the world's oceans. They are primary producers, shelter, nursery grounds and food sources for marine organisms. Seaweeds are not only of high ecological, but also of great economic importance. Dried thalli are directly used as human and animal food and also as fertilizer. Extracted seaweed substances are used as stabilizers and stiffeners in food industry, cosmetics, pharmaceutical industry, and biotechnology (Jeeva & Kiruba, 2009; Wiencke & Bischof, 2012). Recent research has pointed to new opportunities, particularly in the field of medicine, associated with bioactive molecules extracted from seaweeds (Baby et al., 2012; Jeeva et al., 2012). Moreover, due to their habitats and biology, seaweeds are relatively easy to observe, manipulate and measure. Therefore, they have been widely used as model organisms for studying biogeographic patterns and testing various ecological theories, both in intertidal and subtidal habitats (Murray & Littler, 1984; Bolton et al., 2004; Prathep, 2005).

India has a vast coastline of more than 7000 km, which harbours a large diversity of marine algal species (Sahoo et al., 2003). The seaweed flora of

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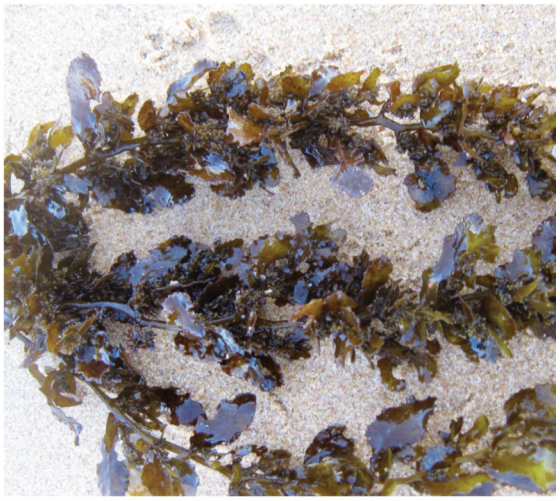

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Figures 1-6. Seaweeds from Muttom coastal waters of southwest coast of India. Fig. 1: *Caulerpa racemosa*. Fig. 2: *Gracilaria fergusonii*. Fig. 3: *Gracilaria pygmaea*. Fig. 4: *Hypnea musciformis*. Fig. 5: *Padina pavonica*. Fig. 6: *Sargassum duplicatum*.

Figure 7. Map showing the study site: Muttom coastal waters, south-west coast of India.

India is highly diversified and comprises mostly of tropical species, but boreal, temperate and subtropical elements have also been reported. 1153 taxa of marine algae, including forms and varieties belonging to 271 genera have been enumerated till date from the Indian waters. Many of the rocky beaches, mudflats, estuaries, coral reefs and lagoons along the Indian coast provide ideal habitats for the growth of seaweeds (Rao & Mantri, 2006); rich seaweed beds occur around Visakhapatnam in the eastern coast, Mahabalipuram, Gulf of Mannar, Tiruchendur, Tuticorin, Kanyakumari and Kerala in the southern coast; Veraval and Gulf of Kutch in the western coast; Andaman and Nicobar Islands and Lakshadweep (Kaliaperumal & Pandian, 1984; Selvaraj & Selvaraj, 1997; Sahoo, 2001; James et al., 2004; Manilal et al., 2009; Christobel & Jeeva, 2009; Paul & Raja, 2011; Jeeva et al., 2012; Satheesh & Wesley, 2012).

Southwest coast of India is a unique marine habitat infested with diverse seaweeds. In recent years, only a few investigations have been carried out on various applications and uses of macroalgae in Kanyakumari district (Bai et al., 2007; Christobel, 2008; Christobel et al., 2011; Jeeva et al., 2012). However, more studies on various aspects of macroalgae are still needed, especially, on diversity and species richness. Such information could provide a baseline for future more complex ecological studies and coastal management, as well as applied aspects of the uses of seaweed. Therefore, the present study was initiated to explore the richness of seaweeds in Muttom coastal waters of southwest coast of India.

MATERIALS AND METHODS

The present study was carried out at Muttom coast in southwest coast of India (Fig. 7), in the Arabian Sea. Muttom sports a beautiful and tidy beach with rocky shores showing an astonishing biodiversity. Huge rocks standing at either sides of the beach give it a pristine look. Since the shore is usually no

No	BOTANICAL NAME	PHYLUM	CLASS	FAMILY
1	*Amphiroa anceps* (Lamarck) Decaisne	Rhodophyta	Florideophyceae	Corallinaceae
2	*Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon	Rhodophyta	Florideophyceae	Bonnemaisoniaceae
3	*Caulerpa peltata* J.V.Lamouroux	Chlorophyta	Bryopsidophyceae	Caulerpaceae
4	*Caulerpa racemosa* (Forsskål) C. Agardh (Fig. 1)	Chlorophyta	Bryopsidophyceae	Caulerpaceae
5	*Caulerpa scalpelliformis* (R. Brown ex Turner) C.Agardh	Chlorophyta	Bryopsidophyceae	Caulerpaceae
6	*Centroceras clavulatum* (C. Agardh) Montagne	Rhodophyta	Florideophyceae	Ceramiaceae
7	*Ceratodictyon variablile* (C. Agardh) R. E. Norris	Rhodophyta	Florideophyceae	Lomentariaceae
8	*Chaetomorpha antennina* (Bory de Saint-Vincent) Kützing	Chlorophyta	Ulvophyceae	Cladophoraceae
9	*Chnoospora implexa* C. Agardh	Ochrophyta	Phaeophyceae	Scytosiphonaceae
10	*Chondrophycus ceylanicus* (C. Agardh) M.J.Wynne, Serio, Cormaci et G. Furnari	Rhodophyta	Florideophyceae	Rhodomelaceae
11	*Dictyota bartayresiana* J. V. Lamouroux	Ochrophyta	Phaeophyceae	Dictyotaceae
12	*Dictyota ciliata* C. Agardh	Ochrophyta	Phaeophyceae	Dictyotaceae
13	*Dictyota dichotoma* (Hudson) J. V. Lamouroux	Ochrophyta	Phaeophyceae	Dictyotaceae
14	*Enantiocladia prolifera* Falkenberg	Rhodophyta	Florideophyceae	Rhodomelaceae
15	*Gelidiella indica* Sreenivasa Rao	Rhodophyta	Florideophyceae	Gelidiellaceae
16	*Gelidium pusillum* (Stackhouse) Le Jolis	Rhodophyta	Florideophyceae	Gelidiaceae
17	*Gracilaria corticata* (C. Agardh) C. Agardh	Rhodophyta	Florideophyceae	Gracilariaceae
18	*Gracilaria fergusonii* C. Agardh (Fig. 2)	Rhodophyta	Florideophyceae	Gracilariaceae
19	*Gracilaria foliifera* (Forsskål) Børgesen	Rhodophyta	Florideophyceae	Gracilariaceae
20	*Gracilaria pygmaea* Børgesen (Fig. 3)	Rhodophyta	Florideophyceae	Gracilariaceae
21	*Grateloupia lithophila* Børgesen	Rhodophyta	Florideophyceae	Halymeniaceae
22	*Hypnea musciformis* (Wulfen) J. V. Lamouroux (Fig. 4)	Rhodophyta	Florideophyceae	Cystocloniaceae
23	*Hypnea valentiae* (Turner) Montagne	Rhodophyta	Florideophyceae	Cystocloniaceae
24	*Laurencia poitei* (J. V. Lamouroux) M. A. Howe	Rhodophyta	Florideophyceae	Rhodomelaceae
25	*Neurymenia fraxinifolia* (Mertens ex Turner) C. Agardh	Rhodophyta	Florideophyceae	Rhodomelaceae
26	*Padina pavonica* (Linnaeus) Thivv (Fig. 5)	Ochrophyta	Phaeophyceae	Dictyotaceae
27	*Padina tetrastomatica* Hauck	Ochrophyta	Phaeophyceae	Dictyotaceae
28	*Palisada flagellifera* (C. Agardh) K.W.Nam	Rhodophyta	Florideophyceae	Rhodomelaceae
29	*Portieria hornemannii* (Lyngbye) P. C. Silva	Rhodophyta	Florideophyceae	Rhizophyllidaceae
30	*Sargassum duplicatum* (C. Agardh) C. Agardh (Fig. 6)	Ochrophyta	Phaeophyceae	Sargassaceae
31	*Sargassum linearifolium* (Turner) C. Agardh	Ochrophyta	Phaeophyceae	Sargassaceae
32	*Sargassum polycystum* C. Agardh	Ochrophyta	Phaeophyceae	Sargassaceae
33	*Sargassum swartzii* C. Agardh	Ochrophyta	Phaeophyceae	Sargassaceae
34	*Sargassum wightii* Greville ex C. Agardh	Ochrophyta	Phaeophyceae	Sargassaceae
35	*Trichosolen mucronatus* (Børgesen) W. R. Taylor	Chlorophyta	Bryopsidophyceae	Bryopsidaceae
36	*Ulva fasciata* S. G. Gray	Chlorophyta	Ulvophyceae	Ulvaceae
37	*Ulva lactuca* Linnaeus	Chlorophyta	Ulvophyceae	Ulvaceae
38	*Ulva reticulata* Forsskål	Chlorophyta	Ulvophyceae	Ulvaceae

Table 1. List of species found in the study area with their scientific names, class and family.

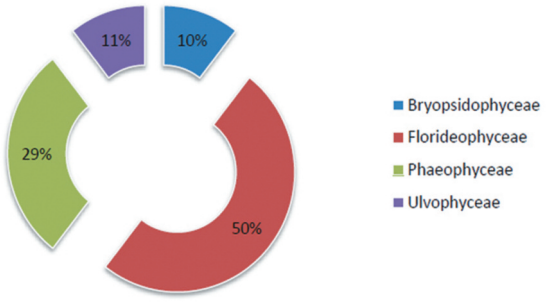

Figure 8. Class-wise distribution percentage of species richness in the study area.

crowded, it is an excellent spot for tourists to enjoy its beauty.

Field surveys were undertaken in the selected sampling stations of the Muttom coast over a period of twelve months from January to December 2011. The algal samples were collected in every season during the study period by detaching a portion from the seaweed bed, keeping it in polythene bags with fresh seawater, transporting to the laboratory and fixing in 4% formaldeyde for further studies. The seaweeds were identified using the taxonomic keys provided by Srinivasan (1969; 1973), and the nomenclature was updated using Appeltans et al. (2012) and Guiry & Guiry (2012).

RESULTS AND DISCUSSION

Taxonomically, a total of 38 taxa belonging to 3 phyla (Chlorophyta, Ochrophyta and Rhodophyta), 4 classes (Bryopsidaceae, Florideophyceae, Phaeophyceae and Ulvophyceae), 23 genera and 18 families were inventoried in the Muttom coastal waters (Table 1). Among the 18 families, Dictyotaceae, Rhodomelaceae and Sargassaceae were the most richest ones (5 species each), followed by Gracilariaceae (4 species), Caulerpaceae and Ulvaceae (3 species each) and Cystocloniaceae (2 species), whereas the remaining families (Bonnemaisoniaceae, Bryopsidaceae, Ceramiaceae, Cladophoraceae, Corallinaceae, Gelidiaceae, Gelidiellaceae, Halymeniaceae, Lomentariaceae, Rhozophyllidaceae and Scytosiphonaceae) were monospecific.

Of the 38 species, 19 were from the class of Florideophyceae (50%), 11 species from Phaeophyceae (28.9%), while the remaining eight species from Bryopsidophyceae and Ulvophyceae (10% and 11% each) (Fig. 8). Finally, the seaweeds observed in the present study are similar to those reported from the nearby Kudankulam coast (Satheesh & Wesley, 2012); and the very high richness of seaweeds species in Muttom coastal waters may be due to the presence of intertidal rocky reefs.

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