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Preliminary documentation of the occurrence of marine macroalgal flora in submerged reefs of Lakshadweep archipelago

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Abstract

Marine macroalgae play a vital functional role as primary producers in the marine environment. The present article reports the preliminary study on the occurrence of macroalgal resources in three submerged reefs of the Lakshadweep archipelago for the first time. The study was carried out from October 2018 to October 2021 to record the occurrence and abundance of macroalgae from intertidal zones to 25 m depth, covering three submerged reefs, namely, Cheriyabani Reef, Byramgore Reef and Perumal Par of Lakshadweep Archipelago. Considering the important documentation of macroalgae resources, we carried out a comprehensive documentation of these valuable resources in these submerged reefs for the first time.

Keywords: Seaweed, submerged reef, Lakshadweep, Algae.

Introduction

Marine algae are valuable renewable living resources for humans and are a highly diversified tropical species. Algae are commonly found on hard substrata like rocks, pebbles, dead corals, and shells up to a maximum depth of 180m, with abundance in the shallow coastal bottom. The most comprehensive account for Indian waters reported that 841 species belong to 216 genera of 68 families in Indian waters (Oza and Zaidi, 2001). Macroalgae belonging to the three phyla, namely, Chlorophyta (Green algae), Phaeophyta (Brown algae) and Rhodophyta (Red algae), are present in these papers. However, a recent study estimated 871 species of macroalgae from Indian waters (Kaliaperumal, 2017). Devaraj *et al*. (1999) reported the total standing crop of seaweeds in the Indian waters as more than one hundred thousand tons in wet weight. Various institutions did earlier work on resources assessment of seaweeds in Lakshadweep reef (Anon, 1978; Untawale *et al.,* 1983 and Kaliaperumal *et al.*,1989), which was reviewed by Kaladharan (2001) and reported nearly 10,000-19,000 tonnes wet weight, which comprises 114 species belonging to 62 genera in these atolls. However, the studies on the occurrence and distribution of the macroalgal resources in Lakshadweep are limited. A review of the literature reveals that no studies have been conducted to document the occurrence of marine macroalgae resources from submerged reefs. The present study has attempted to document the distribution of macroalgae in three submerged reefs, i.e. Cheriyabani Reef, Byramgore Reef and Perumal Par, for the first time from this Archipelago. The present study can help to formulate site-specific resource characteristics and distribution patterns of macroalgae in and around the reefs of this Archipelago.

Materials and Methods

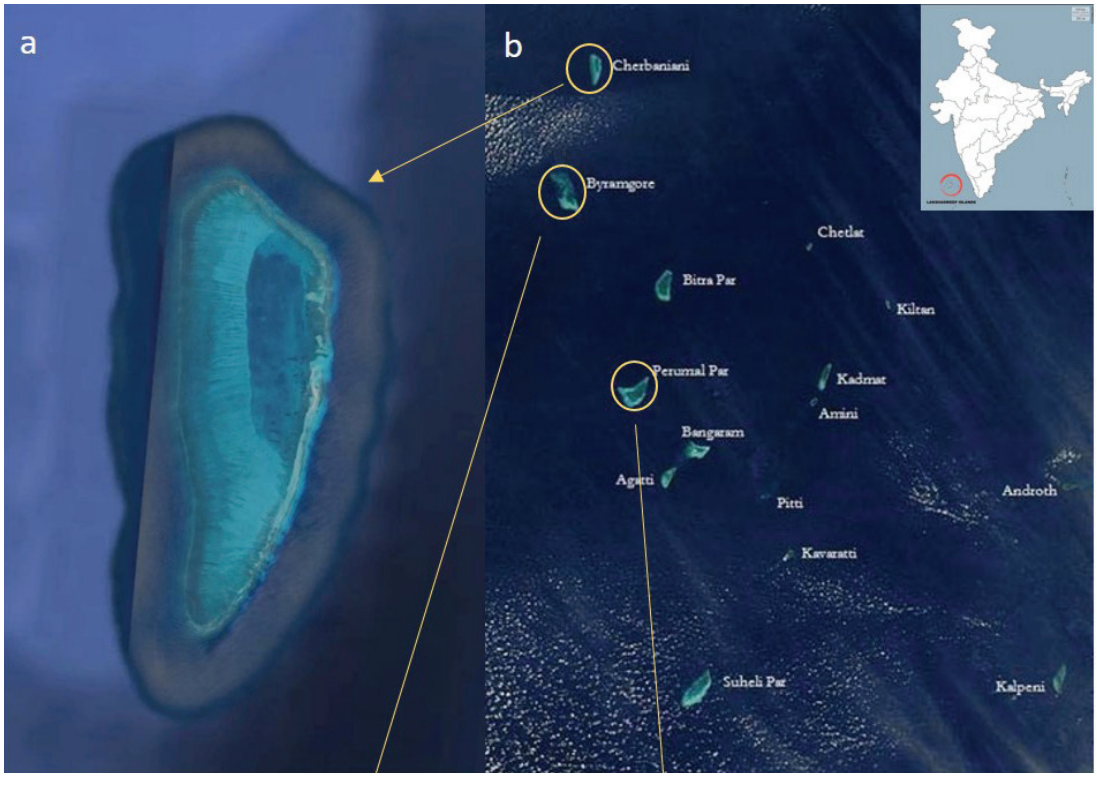
Study area: We conducted exploratory surveys in three submerged reefs of Lakshadweep from October 2018 to October 2021 to assess the occurrence and distribution of macroalgae in different submerged reef Cheriyabani Reef, Byramgore Reef and Perumal Par, respectively (Table-1 and Figure.1). Cheriyabani Reef (= small submerged reef), also known as Valiyapani by local people, is located at 12°18′N 71°53′E. It is the northwestern most reef of the Lakshadweep archipelago. The atoll has a roughly oval shape and was first described by ornithologist Hume Allan in 1876; its total lagoon area is 57.46 Km^2, which is of 14 km long coral reef that encloses the lagoon. Byramgore Reef is, also known as

Cheriyabani Reef by local people, located 33 km south of Cheriyabani Reef and 41 km to the northwest of Bitra Par, in the northwestern area of Lakshadweep at 11°54′N 71°49′E. The whole northern part of the atoll is submerged and a sandbar alone exposed during hightide towards the southwestern part. The total length of the atoll is 21.5 km, with a maximum width of 6.3 km, lagoon area is about 172.59 km^2. Perumal Par is an uninhabited coral atoll belonging to the Amindivi Subgroup of islands of the Union Territory of Lakshadweep. Perumal Par is located at 11.164°N 72.05°E, 33 km south of Bitra Par and 25 km northwest of Bangaram Atoll, with lagoon area of 83.02 km^2.

Collection and documentation: Specimens were collected using snorkelling and SCUBA. The specimens were photographed *in situ* to document the habitat to show the environmental conditions and the general view of the algal association. Collected specimens are preserved by fixing them in 3-5 % formalin-seawater mix and kept as herbarium vouchers. The seaweeds were identified following the Algaebase (www.algaebase.org) and confirmed with the identification key provided by Rao (1987). Specimens are labelled adequately with the collection date, locality, and time for further reference and deposited in the Marine Taxonomy Reference Laboratory (MTRL), Department of Science and Technology Union Territory of Lakshadweep.

Table -1 Locations, lagoon area of studied submerged reef Lakshadweep islands

Sl. No	Island	Latitude	Longitude	Lagoon Area
1	Cheriyabani Reef	12°18′N	71°53′E	57.46 km^2
2	Byramgore Reef	11°54′N	71°49′E	172.59 km^2
3	Perumal Par	11.164°N	72.05°E	83.02 km^2



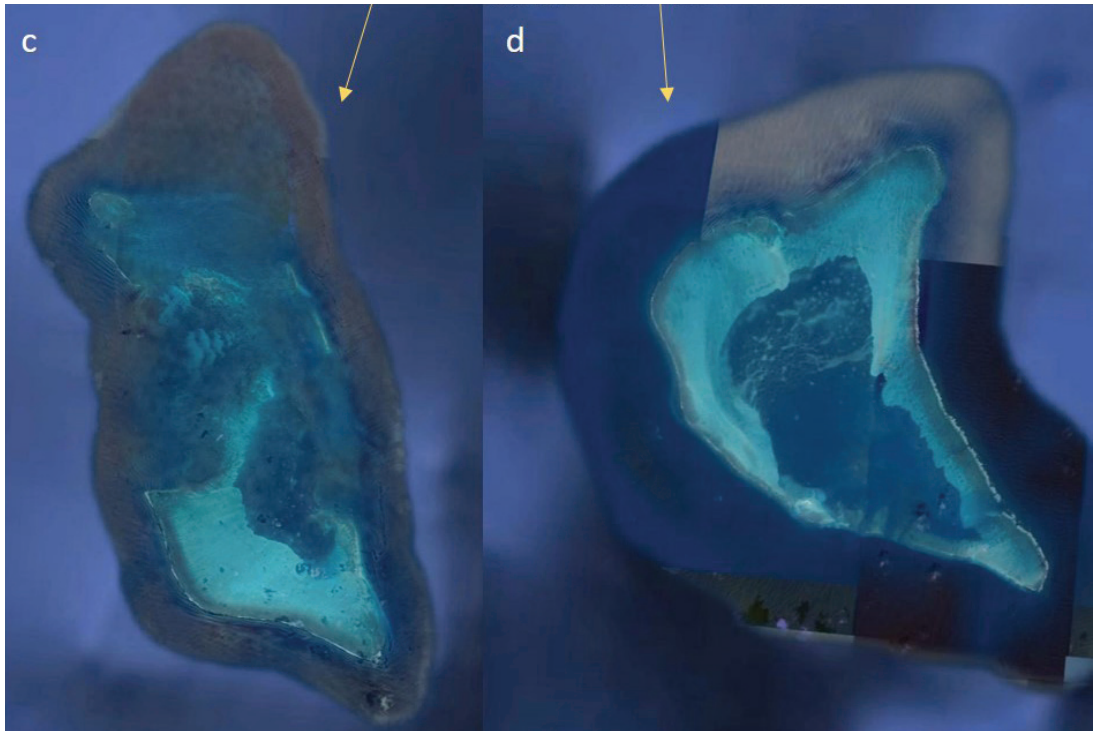
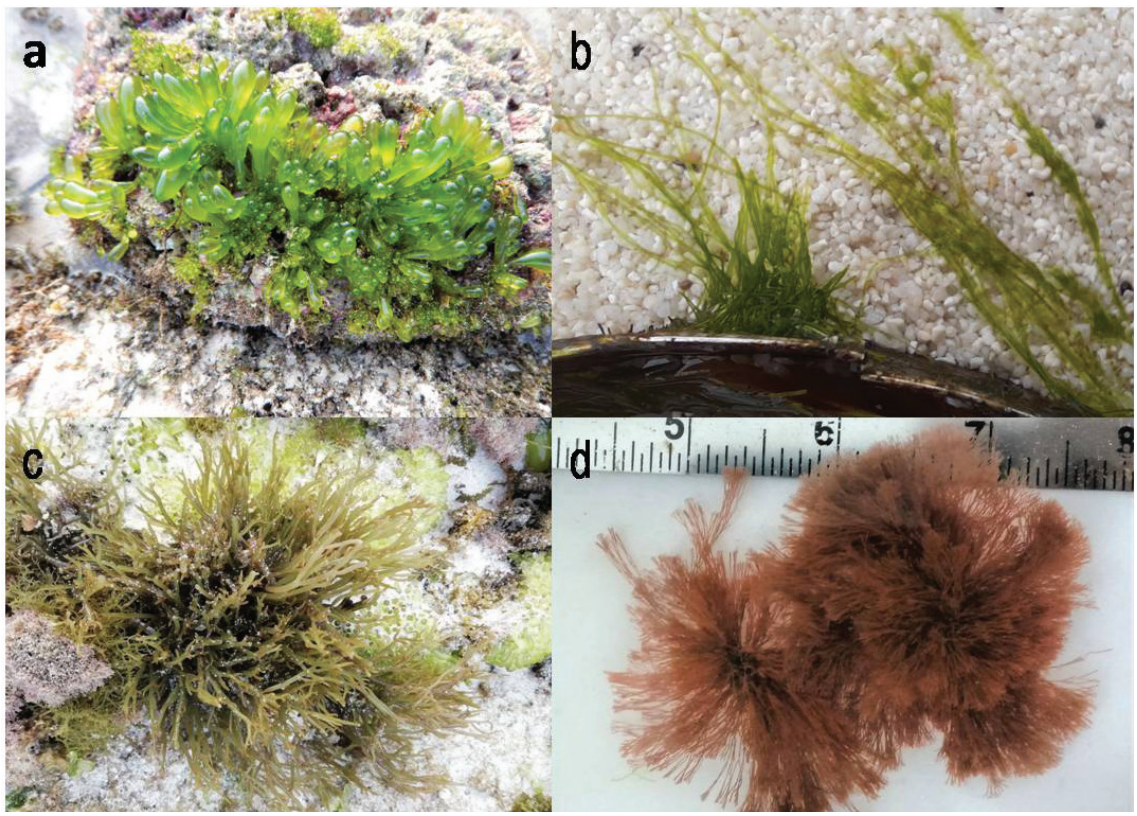


Fig.1: Location of Islands and submerged reef of Lakshadweep Archipelago. a. Cheriyabani Reef, b. location of Islands and submerged reefs, c. Byramgore Reef and d. Perumal Par



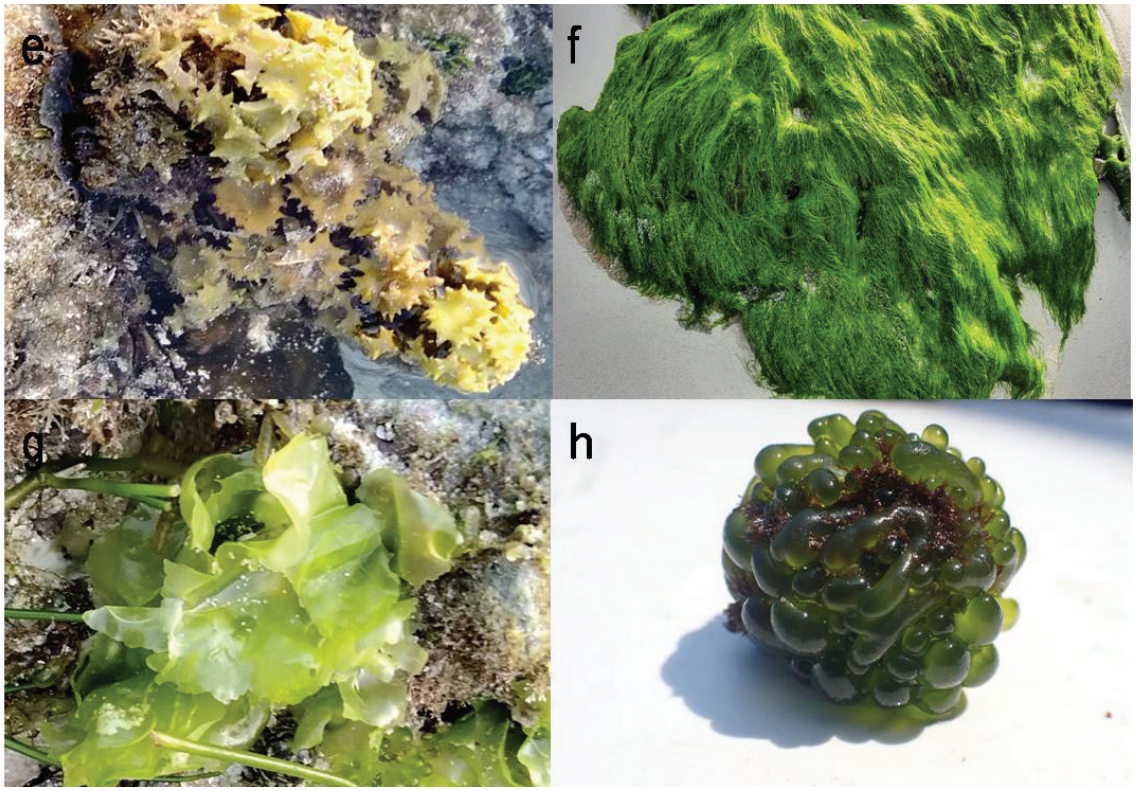


Fig.2- Macroalgae commonly found in three submerged reef of Lakshadweep Archipelago.a. Boergesenia forbesii, b. *Chaetomorpha linum*, c. *Hydropuntia edulis*, d. *Jania adhaerens*, e. *Turbinaria ornate*, f. *Ulva intestinalis*, g. *Ulva lactuca* and h. *Valonia aegagropila*

Results

During the present study, 41 species of marine macroalgae belonging to 18 families under three phyla, Rhodophyta, Chlorophyta and Phaeophyta, were recorded from Lakshadweep (Table 2). Marine macroalgae were distributed mainly on rubbles and rocky substrata, which comprise sand, mud, rocks, pebbles, and sand-mud mixtures in this reef region. Higher macroalgae species diversity was observed in the Cheriyabani Reef (34 species), followed by the Byramgore Reef, with 22 species. More species were observed from Chlorophyta (20 species), followed by Rhodophyta (12 species) and Phaeophyta (9 species) in this reef. The occurrence of macroalgae was higher in the lagoon and intertidal regions, with sandy, corals and rocky habitats. The occurrence of macroalgae showed a marked variation between different submerged reefs of Lakshadweep. We prepared a checklist of the macroalgae for the region and presented the same in Table 2.

Collected, and deposited during the present study (MTRLDST-Marine Taxonomy Research Laboratory Department of Science and Technology). *Present study, _ Absent.

Discussion

In the submerged reef macroalgae are found attached to the solid bottom substrate like rocks, dead corals, pebbles, shells, and other plant materials, which showed a marked difference in the atoll reefs of Lakshadweep. It may be due to the preference of macroalgae to get attached to the available solid bottom substratum. At the same time, macroalgae grow on hard substrates (e.g., dead coral, rock) or epiphytically or on other animals using holdfasts to anchor themselves (Macreadie *et al*., 2017). Marine macroalgae live either in marine or brackish water environments. They perform vital ecological functions like reef structure stabilisation, production of tropical sands, nutrient maintenance and recycling, and primary productivity (Fong and Paul, 2011).

Table -2 Occurrence of marine macroalgae in various Submerged reef of Lakshadweep

	Division	Family	Species Name	Cheriyabani Reef	Byramgore Reef	Perumal Par
1	Rhodophyta	Bonnemaisoniaceae	*Asparagopsis taxiformis* (Delile) Trevisan 1845	*	-	*
2		Ceramiaceae	*Ceramium* sp.	*	*	*
3		Corallinaceae	*Jania adhaerens* J.V.Lamouroux, 1816	-	*	-
4			*Jania capillacea* Harvey, 1853	*	*	-
5		Cystocloniaceae	*Hypnea musciformis* (Wulfen) J.V.Lamouroux 1813	*	-	*
6			*Hypnea pannosa* J. Agardh, 1847		*	*
7		Gracilariaceae	*Hydropuntia edulis* (S.G.Gmelin) Gurgel&Fredericq, 2004	*	*	*
8			*Gracilaria* sp.	*	-	-
9		Gelidiellaceae	*Gelidiella acerosa* (Forsskål) Feldmann&G. Hamel, 1934	-	*	-
10		Lomentariaceae	*Ceratodictyon repens* (Kützing) R.E.Norris, 1987	-	-	*
11		Rhodomelaceae	*Acanthophora spicifera* (M.Vahl) Børgesen, 1910	*	*	*
12			*Laurencia papillosa* (C. Agardh) Greville, 1830	*	-	-
13	Chlorophyta	Bryopsidaceae	*Bryopsis pennata* J.V.Lamouroux, 1809	*	*	*
14			*Bryopsis plumosa* (Hudson) J.Agardh, 1823	*	*	*
15		Caulerpaceae	*Caulerpa racemosa* (Forsskål) J.Agardh, 1873	*	*	*

	Division	Family	Species Name	Cheriyabani Reef	Byramgore Reef	Perumal Par
16			*Caulerpa scapelliformis* (R.Brown ex Turner) C.Agardh 1817	*	*	-
17			*Caulerpa serrulata* (R.Brown ex Turner) C.Agardh 1817	*	*	-
18			*Caulerpa macrophysa* (Weber Bosse) Feldmann, 1955	*	-	-
19		Cladophoraceae	*Chaetomorpha linum* (O.F.Müller) Kützing, 1845	*	-	-
20			*Chaetomorpha spiralis* Okamura 1903	-	*	-
21		Codiaceae	*Codium fragile (Suringar) Hariot 1889*	*	-	-
22		Halimedaceae	*Halimeda incrassata* (J.Ellis) J.V.Lamouroux, 1816	*	-	-
23			*Halimeda tuna* (J.Ellis & Solander) J.V.Lamouroux, 1816	*	-	*
24			*Halimeda minima* (W.R.Taylor) Hillis-Colinvaux 1968	*	-	-
25			*Halimeda macroloba* Decaisne, 1841	*	-	-
26		Siphonocladaceae	*Boergesenia forbesii* (Harvey) Feldmann, 1938	*	*	*
27		Ulvaceae	*Ulva lactuca* Linnaeus, 1753	*	*	*
28			*Ulva intestinalis* Linnaeus 1753	*	*	*
29			*Ulva compressa* Linnaeus, 1753	*	-	-
30		Valoniaceae	*Valonia aegagropila* C.Agardh, 1823	*	*	-

	Division	Family	Species Name	Cheriyabani Reef	Byramgore Reef	Perumal Par
31			*Valonia fastigiata* Linnaeus 1753	*	-	-
32			*Valonia* sp.	*	*	*
33	Ochrophyta	Dictyotacea	*Padina pavonica* (Linnaeus) Thivy in W.R.Taylor 1960	*	*	*
34			*Padina tetrastromatica* Hauck, 1887	-	-	*
35			*Dictyota dichotoma* (Hudson) J.V. Lamouroux, 1809	*	-	-
36			*Dictyota divaricata* (J.Agardh) J.Agardh, nom. illeg. 1882	*	-	*
37		Sargassaceae	*Turbinaria ornata* (Turner) J.Agardh 1848	*	*	_
38			*Turbinaria turbinata* (Linnaeus) Kuntze, 1898	*	-	*
39			*Turbinaria conoides* (J.Agardh) Kützing, 186	_	_	*
40			*Turbinaria decucrrence* Bory,1828	*	*	-
41			*Sargassum* sp.	*	*	*

The present study revealed that species diversity is greatest in Cheriyabani Reef, with 34 species belonging to 18 families. The present study could record 41 species from this submerged reef. Since there is no earlier record of the occurrence of the macroalgae resources from this region, comparative studies on the degradation of the macroalgal community due to natural or anthropogenic issues or any other status of the decline of the macroalgal distribution in this region can't be carried out. The results of the present study can be used as baseline information or a preliminary status on the occurrence and distribution of macroalgae resources of these submerged reefs.

These activities can be made sustainable by creating awareness among the stakeholders on these unique habitats, and with their involvement, the area can be protected and co-managed. With the involvement of fishermen visiting this region for fisheries and allied activities, we should frame a model conservation strategy framed with the local administration and government agencies to protect the environment. These reef regions are one of the potential sites to develop as conservation reserves to protect macroalgae, considering their potential for fishing activities. The lagoon and reef area of these submerged reefs also play a significant role as feeding and breeding grounds for marine turtles. Being ecologically sensitive, these islands should be prioritised as a conservation site by declaring as a marine sanctuary for macroalgae, turtles and other marine life.

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