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Research Paper

Diversity of marine macro algae of Okha cost, Gulf of Kutch, Gujarat

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Abstract: The Okha coast is part of Gulf of Kutch. The Okha coast is blessed with rocky bottom, clear waters and good exposure of coast during the low tides. The diversity of marine macro algae were studied in detail during the period November 2104 to January 2016. Total coastline of the area were surveyed during 21 field trips conducted in different seasons and 74 species of marine macro algae were recorded of these 21 species belongs to Chlorophyceae (28%), 35 species belongs to Rhodophyceae (47%) and 18 species belongs toPheophyceae (25%). The maximum diversity with flourishing growth of the seaweeds was found during the period November to January. The economically important seaweeds like *Gellidelaacerosa*, *Gracillariacorticata*, *Hypneamusciformis*, *Padinateterastomatica*, and species of *Enteromorpha*, *Caulerpa* and *Ulva* were abundantly growing on the coast. *Kappaphycusalvarzii* is cultivated on large scale at these coast.

Keywords: Marine macro algae, diversity, economically important, abundant.

INTRODUCTION

Seaweed or marine algae are the oldest living organisms on the earth that are rather wrongly considered as sea plant. Seaweed is the group of plants that live either in marine or brackish aquatic environment. Like the terrestrial plants seaweed also contains photosynthetic pigments that help them to trap solar energy to produce carbohydrate, with the absorbed nutrients that are present in the seawater. Seaweed does not contain true leaf stem or roots so it is called as thallus.

Seaweed refers to any large marine benthic algae that are multicellular, macro thallic, and thus differentiated from most algae that are of macroscopic size. These plants form an important renewable resource in the marine environment and have been a part of human civilization from time immemorial (Tseng, 2004).

The seaweed industry, which has once at a cottage level, has now grown into a major one at global level and nearly 42 countries in the world are involved with this industry in one way or the other. However, the major ones are China, Japan, South and North Korea, Philippines, Indonesia, Chile,

Norway and to some extent India too. Presently, the total value of seaweed industry in the world is approximately U$ 8.00 billion. Seaweeds as a food takes precedence over the others with many others are following. This implies that seaweeds may have a tremendous potential to play a preeminent role in providing succor to the food-hungry nations in order to balance their food and other social security systems.

Classification of Seaweed: Taxonomically, they are classified mainly on the basis of the pigments they possess and the coloration they reflect. Other criteria used for classification are cell wall composition, reproductive characteristics and chemical nature of their photosynthetic products (starch, oils, and so on). Within each of these groups, they are further classified on the basis of characteristics like plant structure and shape; however the main groups are:

1. Green algae - Division Chlorophyta,
2. Brown algae - Division Phaeophyta and
3. Red algae - Division Rhodophyta.

Green seaweeds are usually found closer to shores because they can tolerate more sun and also drying out, the main photosynthetic pigments are chlorophyll a and b which is called as Chlorophyceae.

Brown seaweeds are usually brown to olive in color. In addition to photosynthetic pigment chlorophyll, it contains fucoxanthin in a sufficient quantity to masks the green colour of the chlorophyll and impart brown colour to these algae are belong to class Pheophyceae.

While red seaweeds contain phycoerythrin and phycocyanin as photosynthetic pigments along with chlorophylls which mask the colour of other photosynthetic pigments and give the colour to these algae (Krishnamurthy and Joshi, 1970).

Brown seaweeds are common in cold waters. They are a source of alginates, used to make water based products thicker, creamier, and more stable such as ice-cream. Red seaweeds live I deeper water where green ones do not survive. In spite of their habitation in deeper water, their red colour permits photosynthesis even in lower light levels. The nori used in Japanese sushi is a red seaweeds (Porphyra spp.) used in jellies and carrageenan, natural gums used to gel and stabilize food such as chocolate, milk and yogurt.

Like other plants of the intertidal zone, seaweeds are affected by reclamation and human activities that result in pollution or increased sedimentation. However some human activities do promote seaweed growth. For example, nutrient rich waters from sewage and other outflows might trigger an explosive growth of seaweeds. This may sometimes cause an imbalance in ecosystem. The dense vegetative stand of rock seaweeds, Irish moss, and kelp are ecologically very important to other flora and fauna of the rocky coast, providing food and shelter for many marine organisms such as green sea urchins and periwinkles which use seaweeds directly as food.

Seaweed potential in World: Most of the seaweeds belong to any one of the three divisions viz., the Chlorophyta (green) the Pheophyta (brown) and the Rhodophyta (red). There are about 900 species of green seaweed, 4000 species of red seaweed and 1500 brown species found in nature. The greatest variety of red seaweeds is found in subtropical and tropical waters, while brown seaweeds are common in cooler, temperate waters.

Seaweed Diversity in India: India has 8219 km of coastline (Lat. 8°4´N; Long. 68°07´ and 97°25´E) with diverse habitats and rich biota (Ayappan, 2006). Coastal ecosystems, unfortunately are experiencing wide range of pressures due to siltation, eutrophication,

coastal development, aquaculture and climate change. Those species that adopt those pressures will expand their living boundaries while others may fade away. Accordingly, the study of coastal biodiversity, the great concern is given globally and it constituents an important element of global change research. Gujarat has 1600 km of coastline, reportedly with rich diversity of seaweeds. Previously published accounts on seaweed diversity were mainly in the form of check list. The earlier among these being the check list of Krishnamurthy and Joshi prepared in early 1970s (Krishnamurthy and Joshi, 1970) and the more recent check list are based almost entirely secondary information (Oza and Zaidi, 2001). Recently Jha et al. (2009) published recorded of seaweed diversity along Gujarat coast.

Seaweeds grow abundantly along the Tamilnadu and Gujarat coasts and around Lakshadweep and Andaman and Nicobar islands. There are also rich seaweed beds around Mumbai Ratnagiri, Goa, Karwar, Varkala, Vizhinjam and Pulicat in Tamilnadu and Chilka in Orissa. Out of approximately 845 species of a marine algae found in both intertidal and deep water zones of the Indian coast, nearly 60 species ae commercially important. Agar yielding seaweeds such as *Gellidiellaacerosa* and *Gracillaria sp.* are collected throughout the year while alginin yielding brown algae such as *Sargassum* and *Turbinaria* and *Cystoseira* are collected seasonally from August to March on Southern coast.

Study site for seaweed diversity: Okha coast is the part joining to Arabian Sea and Gulf of Kutch. It is located on a tapered strip of land i.e. Latitude *: 22° 28′ N* Longitude *: 60° 05′ E*. It is encircled by sea on three sides on Arabian Sea coast. An account of species diversity of seaweeds in a individual area is necessary for several aspects of algal research exclusively for industrial exploitation (Palanisamy and Selvaraj, 1998). The diversity, abundance and distribution of marine macro algae are related to environmental factors such as exposure to desiccation, water depth and movement and biological aspects such as morphology and life cycle and biochemical characteristics (Eliane Marinho-Soriano, 1999).

Studies on diversity of seaweeds for this region are random and incomplete. The pioneer works on the seaweeds of Gujarat coast have been carried out by Krishnamurthy and Joshi, 1970 first check list of India Marine Algae was prepared by them. Oza and Zaidi, 2001 has revised the same. After that Jha et. al., 2009 several other workers had made study on various aspects of the marine macro algae of Gujarat coast. However a thorough survey and study on the diversity of seaweeds from Okha coast has not been made in recent years. Therefore the present study was carried out to document the diversity of marine macro algae along the coast of Okha.

MATERIALS AND METHODS

The survey and the collection of the marine algae along the coast of Okha were carried out from November 2014 to January 2016. During these period totally 483 samples of marine algae were collected. The samples of marine algae were collected randomly during lowest low tides of the month. All the collected samples were thoroughly washed with fresh water. The specimens were sorted out carefully and herbariums were prepared for long term preservation for identification.

All the fresh specimens were examined carefully in the laboratory. They were identified by referring the standard literatures (Srinivasan, 1969; 1973; Desikachary et. al., 1998; Silva et. al., 2009; Krishnamurthy and Baluswamy, 2010). Algae base was used to study classification of the species.

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RESULTS AND DISCUSSION

In the present investigation, totally 74 species of seaweeds was collected. Of these 21 species of green algae (28%) belonging to 19 families, 35 species of red algae (47%) belonging to 19 families and 18 species of brown algae (25%) belonging to 3 families were recorded as shown in table:

Table: List of marine algae along the coast of Okha during present study

Order	Family	Genus & species	Economic importance
PHYLUM: Chlorophyta; CLASS: Ulvophyceae			
Ulvalves	Ulvaceae	*Enteromorphacompressa*	Used for soups and salads dressing, rich in minerals.
		Enteromorphaflexuso	
		Ulva sp.	
Ulotrichales	Ulotrichaceae	*Acrosiphoniaorientalis*	Antiviral activity
Cladophorales	Cladophoraceae	*Cladophoravagabunda*	Helps in neutrilizing tidal effect.
		Chaetomorphacrassa	Salads and dessserts, have gelatinizing property
Siphonocladales	Boodleaceae	*Boodleacomposita*	
	Siphonocladaceae	*Dictyosphaeria cavernosa*	
	Valoniaceae	*Valoniaaegagropila*	
		Valoniautricularis	
	Bryopsidaceae	*Bryopsispennata*	
		Bryopsisplumose	
	Caulerpaceae	*Caulerparacemosa*	Consumed as salad, secondary metabolites are been extracted and rich in mineral.
		Caulerpascalpelliformis	
		Caulerpasertullaroides	
		Caulerpataxifolia	
		Caulerpaveravellensis	
		Caulerpaverticillata	
	Halimedceae	*Halimedamacroloba*	
		Halimeda tuna	Rich in calcium
	Udoteaceae	*Udoteaindica*	
PHYLUM: Rhodophyta; CLASS: Florideophyceae			
SUBCLASS: Nemaliophycidae			
Nemaliales	Scinaiaceae	*Scinaiacarnosa*	Used in preparation of biological gums.
		Scinaiamonoloformis	
	Galaxauraceae	*Tricleocarpafragilis*	
	Ligoraceae	*Liagoraceranoides*	Used as medicine
		Liagoraviscida	
SUBCLASS:Rhodymeniophycidae			

Gelidiales	Gelidiellaceae	*Gellidiellaacerosa*	Used for extraction of biotechnology grade Agar, Cultivation technology available
Gracilariales	Gracilariaceae	*Gracillariacorticata*	
		Gracillariatextori	
Bonnemaisoniales	Bonnemaisoniaceae	*Asparogopsistaxiformis*	Rich in iodine
Halymeniales	Halymeniaceae	*Grateloupiafilicina*	
		Grateloupiaindica	
		Halymeniaporphyraeformis	As nutraceuticals
		Halymeniavenusta	
Gigartinales	Cystoclaniaceae	*Hypneamusciformis*	Extraction of agar
		Hypneavalentiae	
	Solieriaceae	*Kappaphycusalvaezii*	Extraction of carageenan
		Sarconemafiliforme	
Nemastomatales	Nemastomataceae	*Predaeafeldmanni*	
Rhodymeniales	Champiaceae	*Champiaglobulifera*	As bioactive compounds
		Champiaflabellata	
	Rhodymeniaceae	*Botryocladialeptopoda*	
Ceramiales	Wrangeliaceae	*Wrangeliatanegana*	nutraceuticals
		Centrocerasclavulatum	
	Spyridiaceae	*Spyridiaalternans*	
		Spyriduiafilamentosa	
		Spyridiahypnoides	
	Dasyaceae	*Heterosiphoniamulleri*	
	Delesseriaceae	*Membranoptera sp.*	
	Sarcomeniaceae	*Platysiphoniadelicata*	
	Rhodomelaceae	*Acanthophoradendroides*	
		Acanthophoraspecifera	
		Laurenciacruciate	Medicinal uses
		Laurenciamajuscula	
	SUBCLASS:Corallinophycidae		
Corallinales	Corallinaceae	*Amphiroa anceps*	Medicinal uses
		Corallinaberteroi	
		Janiarubens	
PHYLUM: Ochrophyta; CLASS: Pheophyceae			
SUBCLASS: Dictyotophycidae			
Dictyotales	Dictyotaceae	*Dictyopterisacrostichoides*	
		DictyotaCervicornis	
		Dictyotadichotoma	
		Lobophoravariegata	

		PadinaBoergesenni	
		Padinaboryana	
		Padinatetrastomatica	
		Spatoglossumaspernum	
		Stoechospermummarginatum	As food
SUBCLASS: Fucophycidae			
Ectocarpales	Scytosiphonaceae	*Colpomeniasinuosa*	
		Iyengariastellate	As food
Fucales	Sargassaceae	*Cystoseriaindica*	For preparation of seaweed fertilizer and alginin extraction.
		Sargassumjohnstonnii	
		Sargassumlineraifolium	
		Sargassumprismaticum	
		Sargassumswartzii	
		Sargassumtenerrimum	
		Turbinariaornata	

The present investigation revealed the occurrence of variety of economically important marine algae such as *Ulva, Gracilaria, Codium, Hypnea, Gelildiella, Dictyota, Asparagopsis, Sebdenia*and*Sargassum*

The quantitative estimation of all the seaweeds growing in Okha coast has to be carried for the benefit of marine algal based industries.

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