

## Quantitative analysis on the diversity of algal flora along some selected coastal sites of the Red Sea at Haql, Tabuk, Saudi Arabia

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### Abstract

All the food chains in any ecosystem starts with the plants. They perform photosynthesis and transfer the energy to all other organisms. To understand the diversity and distribution pattern of some selected algal flora along the coastal sites of the Red Sea, this preliminary research was conducted in November-2019. Three common quantitative parameters for diversity studies viz. frequency, density and abundance were determined for the five selected algal species namely *Padina*, *Sargassum*, *Dictyota*, *Polysiphonia* and *Ulva*. The results of this research showed different patterns of occurrence and distribution of algal flora along the selected coastal sites of the Red Sea at Haql. The overall results on frequency, density and abundance reveals that among all the algal species *Sargassum sp.* was recognized as highly dominant species whereas *Ulva sp.* as rare species at the six different study sites at Haql.

**Keywords:** seaweeds, algae, diversity, red sea, coastal ecosystem

### Introduction

Aquatic ecosystems are well known for their rich biodiversity [1, 2]. Any change in environment may cause habitat loss and the extinction of a species as it influence the morphology, physiology, biochemistry and life cycles [3]. Environmental monitoring and impact assessment on algal biodiversity is a need of the hour for ecosystem productivity, phytoremediation, flow of energy and nutrient cycling [4]. To identify the mechanism behind biodiversity changes in aquatic ecosystems is a great challenge of today due to lack of data and experimental evidences especially from field studies [5]. The water pollution is an important factor results into habitat destruction and biodiversity loss [6]. Many plant species are under the threat of water pollution [7]. The plant species composition, area, altitude, trophic status, and water quality helps in predicting the health of an aquatic ecosystem. Anthropogenic and climate change are potential threats to plant biodiversity [8]. Algal flora contributes a major part of photosynthesis, which actively grow in different habits and habitats [9]. Higher the nutrient availability in an aquatic ecosystem enhances growth of phytoplankton community [10].

### Materials and Methods

Quantitative survey for the diversity of aquatic flora in terms of frequency, density and abundance was carried out in the month of November 2019. The coastal station of the Red Sea at Haql (29° 17'9.9" N 34° 56' 18.9" E) near Tabuk, Saudi Arabia was selected for this study. After every 2 Kilometers six study sites S1, S2, S3, S4, S5 and S6 were selected at Haql. Quantitative survey for the diversity and distribution of algal flora along the selected coastal sites of the Red Sea was carried out using quadrats of 1m<sup>2</sup>. Five algal species were selected for this study namely *Padina*, *Sargassum*, *Dictyota*, *Polysiphonia* and *Ulva* on the basis of

their availability at the time of this study. At each study site laid down 5 replicates of quadrats to collect the data on three common parameters for diversity studies viz. frequency, density and abundance (Table1).

### Calculations and data analysis for frequency, density and abundance of each plant species:

To determine the diversity and distribution of algal flora along the coastal areas studied in this research, from the data collected in table 1, frequency, density and abundance of each species were calculated as:

Total number of the quadrats in which species has occurred

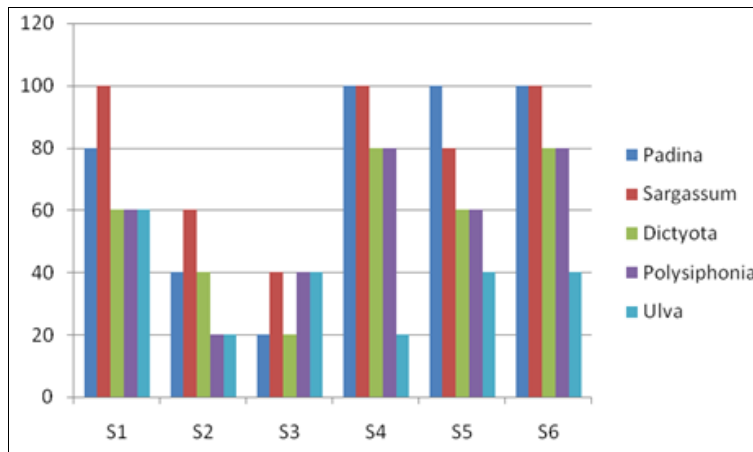
$$\text{Frequency} = \frac{\text{Total number of the quadrats in which species has occurred}}{\text{Total number of quadrats studied}} \times 100 =$$

$$\text{Density} = \frac{\text{Total number of individuals of species in all the quadrates}}{\text{Total number of quadrates studied}} =$$

$$\text{Abundance} = \frac{\text{Total number of individuals of species in all the quadrates}}{\text{Total number of the quadrates in which species has occurred}} =$$

### Results

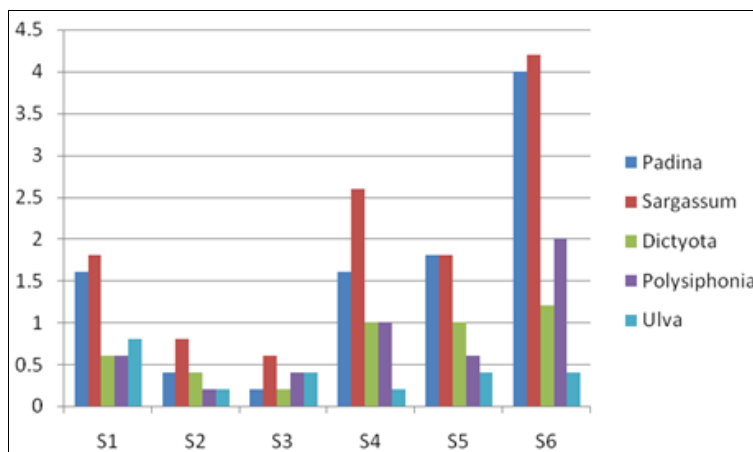
Fig 1 shows different patterns of frequency calculated in six different study sites at Haql. Frequency of *Padina* was highest 100% at site S4, S5 and S6 and lowest at site S3. Highest 100% frequency of *Sargassum* was recorded at site S1, S4 and S6 and lowest 40% at site S3. Frequency of *Dictyota* was higher as 80% at site S4 and S6 and only 20% at site S3. *Polysiphonia* shows 80% frequency at site S4 and S6 and only 20% at site S2. *Ulva* frequency was its highest 60% at site S1 and 20% at site S2 and S4.



**Fig 1:** Frequency of selected plant species studied at six different sites of Haql.

Fig 2 shows variation in density at varying study sites at Haql. Density of *Padina* was very high as 4 at site S6 and lowest only 0.2 at S3. Highest 4.2 density of *Sargassum* was observed at site S6 and it was low as 0.6 at site S3. Density

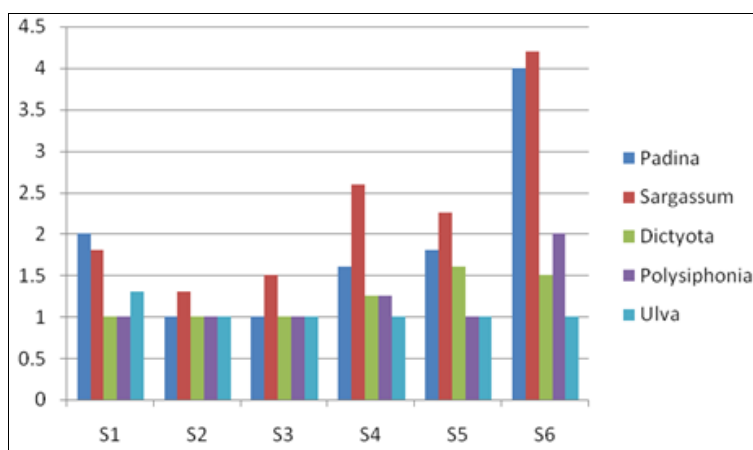
of *Dictyota* was higher as 1.2 at site S6 and it was only 0.2 at site S3. Density of *Polysiphonia* was maximum 2 at site S6 and and only 0.2 at site S2. *Ulva* density was highest 0.8 at site S1 and only 0.2 at site S2 and S4.



**Fig 2:** Density of selected plant species studied at six different sites of Haql.

Fig 3 shows variation in abundance of algal flora at varying study sites of Haql. Abundance of *Padina* was highest as 4 at site S6 and lowest only 1 at S2 and S3. *Sargassum* was highly abundant (4.2) at site S6 and it was low as 1.3 at site S2. Abundance of *Dictyota* was 1.6 at site S5 and only 1 at

site S1, S2 and S3. *Polysiphonia* was highly abundant at site S6 and abundance was only 1 at site S1, S2, S3 and S5. Abundance of *Ulva* showed almost similar pattern at all the study sites.



**Fig 3:** Abundance of selected plant species studied at six different sites of Haql.

Fig 4 (a, b, and c) shows overall patterns of algal diversity (based on mean of data on each plant). The overall results

on frequency, density and abundance reveals that among all the algal species studied in this research *Sargassum* can be

recognized as highly dominant species whereas *Ulva* as rare species at the six different study sites at Haql.

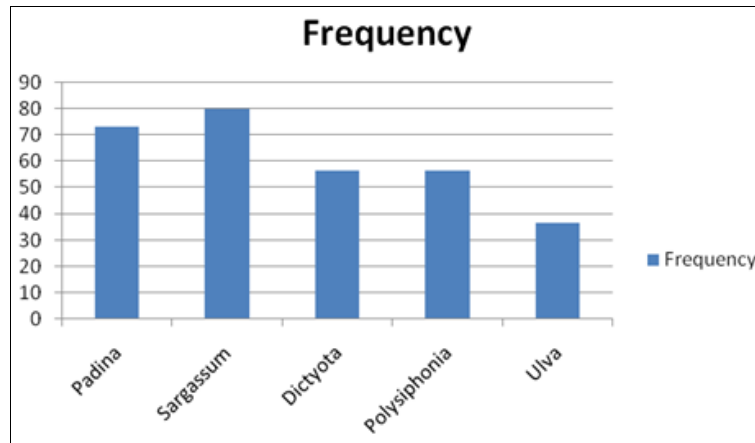


Fig 4a: Overall frequency (mean of data) of selected algal flora studied at six different sites of Haql.

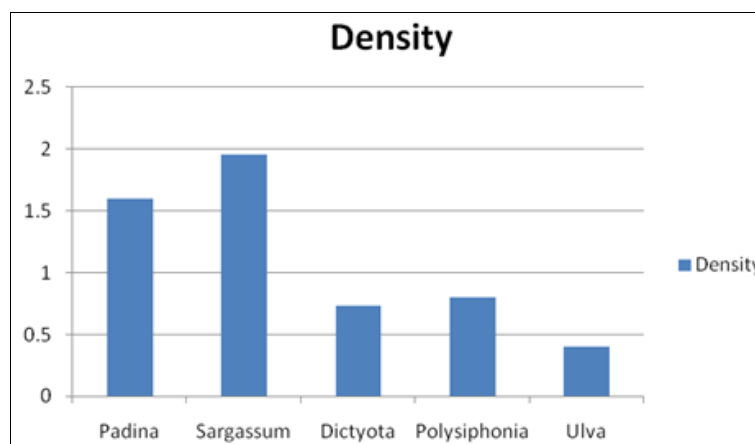


Fig 4b: Overall density (mean of data) of selected algal flora studied at six different sites of Haql

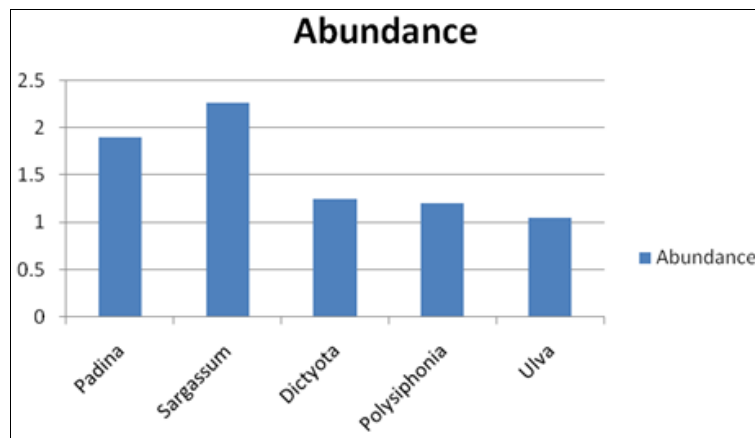


Fig 4c: Overall abundance (mean of data) of selected algal flora studied at six different sites of Haql

Table 1: Data on number of individuals of each alga collected at different study sites (S) using quadrats (Q).

	S1					S2					S3					S4					S5					S6				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
<i>Padina</i>	2	1	2	0	3	0	0	1	1	0	0	0	0	1	0	2	1	2	1	2	3	2	1	1	2	5	3	4	3	5
<i>Sargassum</i>	3	1	2	2	1	1	0	0	1	2	1	0	0	2	0	5	3	2	1	2	4	2	0	2	1	7	5	3	4	2
<i>Dictyota</i>	0	1	1	0	1	0	1	0	0	1	0	0	1	0	0	2	0	1	1	1	1	2	0	0	2	2	0	1	2	1
<i>Polysiphonia</i>	1	0	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1	1	2	1	1	0	0	1	2	1	2	2	3
<i>Ulva</i>	1	0	2	0	1	0	0	0	1	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0

**Discussion**

In this study three common parameters for diversity studies viz. frequency, density and abundance were measured for

the five selected algal species namely *Padina*, *Sargassum*, *Dictyota*, *Polysiphonia* and *Ulva*. The results showed different patterns of occurrence and distribution of algal

flora along the selected coastal sites of the Red Sea at Haql. The overall results on frequency, density and abundance reveals that among all the algal species studied in this research *Sargassum sp.* was recognized as highly dominant species whereas *Ulva sp.* as rare species at the six different study sites at Haql. Among all the study sites, site S6 was found very rich in algal diversity as it was far away from the human settlements. This coastal site (S6) of the Red Sea at Haql could be considered as the most suitable site for the collection of algal flora for environmental and medicinal studies.

Biotic and abiotic stresses influence the survival and existence of a species which results into changes and loss of biodiversity [11, 12, 13]. Aquatic ecosystems are under the control of many biotic and abiotic factors [14, 15, 16, 17]. Light reduction and an increase in organic matter of aquatic ecosystems are two major causes of habitat destruction [18]. Anthropogenic inputs to aquatic ecosystems are also significant factors affecting algal habitat and diversity [19]. Temperature is the limiting factor for all the vital activities [20]. pH regulates the absorption of nutrients and physiology of living organisms [21]. The species diversity of an aquatic ecosystem is directly correlated with the physicochemical characteristics of waters [22]. The data and knowledge on life histories of various species helps in predicting the future of a species in terms of its existence or extinction [23]. Algal flora is important indicator of water quality [24]. Several algal species have been identified for their values as potential bio-indicators of water quality and diversity [25]. The species richness and biomass are potential parameters and indicators of biodiversity [26]. Plant biodiversity is itself an indicator for the health of an aquatic ecosystem [27]. Algal flora being highly sensitive to various factors is the potential indicator of aquatic environments [28].

Measuring frequency, density and abundance of the plant species in a community is useful for a quantitative estimation of aquatic floral diversity [29]. Frequency is the number of sampling units in which a particular species occurs. The number of individuals of the species in any unit area is its density. It gives the degree of competition in an ecosystem. The abundance is the number of individuals of any species per sampling unit of occurrence [29]. Diversity indices are the useful tools for biodiversity assessment which gives a ratio between number of species and number of individuals in that community. The species richness index, Palmer's generic index, Margalef's index are common in use for biodiversity assessment [29]. The future of aquatic biodiversity can be saved only through the effective policies on aquatic ecosystems [30]. Algal flora is integral part of marine ecosystem and serves as good source of food and various organic and inorganic chemical compounds [31, 34]. The coastal region of Tabuk and its harbors has a huge food and biomedical potential that has not been investigated yet and must be explored for its proper utilization.

## Conclusions

It can be concluded from the following research that the coastal regions of Red Sea are very rich in algal diversity. The study reveals that brown algae *Sargassum* and *Padina* are dominating species whereas *Ulva* is a rare species at the coastal sites of Red Sea. Among all the study sites, site S6 was found very rich in algal diversity as it was far away from the human settlements. This coastal site (S6) of the

Red Sea at Haql could be considered as the most suitable site for the collection of algal flora for environmental and medicinal studies.

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