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Short Communication

Assessment of Abundance and Density of Phaeophyceae Group of Seaweed along the Sikka Coast, Gulf of Kachchh, Gujarat

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The abundance and density of Phaeophyceae group of seaweeds from two different sites (GSFC jetty and Vador site) along the Sikka coast of Gujarat were carried out in the current investigation. Sampling stations were chosen due to varying environmental conditions and the magnitude of seaweed colonization. Seaweed abundance and density at the Sikka coast were studied for six months (October 2020 to March 2021) using the belt transect random sampling method. There were variations in abundance and density of brown algae between sites with a total of 18 and 16 species found at the GSFC jetty and Vador site respectively. Among the two sites, the abundance and percentage density of phaeophyceae was highest at GSFC Jetty than at the Vador site because of the more anthropogenic activity and pollution there. The highest abundance and density were recorded for *Padina gymnospora* followed by *Ectocarpus* sp. at both the sites. This research not only provides a foundational understanding of brown seaweed ecology on the Sikka coast but also offers insights into potential commercial harvesting and conservation strategies in the region.

(***Key words:*** *Abundance, Density, Gulf of Kachchh, Phaeophyceae*)

Seaweeds are most abundantly found along the West Coast, Andaman and Nicobar Islands and Lakshadweep, but are less frequently along the East Coast (Saxena, 2012). The seaweed diversity of the Tamil Nadu and Gujarat coasts were explored by the CSMCRI team (Jha *et al.,* 2009) for their relative abundance and found that these two states are home to 366 seaweed species that cover nearly half of the total seaweed diversity of India. About 221 species of seaweeds are utilized commercially. Of these, about 145 species are used for food and 110 species for phycocolloids production. Because of its importance, seaweed investigations on diversity and abundance have been carried out (Hashim and Nisha, 2023).

Along the west coast of India in the Arabian Sea, the Gulf of Kachchh (22° 15' - 23° 40' N; 68° 20' - 70° 40' E) is the biggest gulf. This gulf is endowed with 42 islands fringing with corals and mangroves that are responsible for a pleasant habitat for seaweed growth. About 70 species were recorded of which 24 species belonged to Chlorophyta, 15 species to Phaeophyta and 31 species to Rhodophyta. There were about 44, 49, 33 and 31 species of seaweeds found from Chaad, Dedeka-Mundaka (Dk-Mk), Goose and Narara respectively (Roy *et al.,* 2015).

Phaeophyceae, a group of seaweed also known as brown algae (derived from the Greek word Phaeos, meaning "brown") are more or less exclusively marine. They achieve their greatest abundance, size and diversity in cold temperate water. Around 1500 species of brown algae are solely found in marine habitats. A brown pigment called fucoxanthin present in seaweed is the reason behind its brown colour. *Sargassum, Tubinaria, Padina,* and *Dictyota* are the most common brown seaweed species found along the Indian coast (Sahoo, 2010). Brown seaweeds such as *Sargassum*, *Turbinaria*, *Cystoseira*, *Spatoglossum*, *Hydroclathrus*, *Padina* and *Dictyota* are mostly distributed in the Gulf of Kachchh, Okha, Dwarka, Bombay, Goa, Karwar, Vizhinjam, Muttam, Kovalam, Tuticorin, Mandapam,

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Mahabalipuram, Madras, Pulicat, Visakhapatnam and Andaman-Nicobar coasts of India as per their preferred geographical area (Chennubhotla *et al.,* 1991). Phaeophyceae play a crucial role in marine ecosystems, serving as primary producers and providing habitats and food for various marine organisms. Understanding their abundance and density helps in assessing the overall health and functioning of marine ecosystems.

There are mainly four orders of brown seaweeds found along the Gujarat coast such as *Ectocarpales, Dictyotales, Scytosiphonales* and *Fucales*. Under these orders, about 35 species of Phaeophyta from 16 genera are identified. These brown seaweed species are mainly occurr in the infra-littoral fringe and sublittoral zone, tide pools, wave-exposed stones, Lower mid-littoral zone, mid-littoral zone, tide pools with coarse sand, rock pools, tidal streams, etc. and distributed in different regions of Gujarat (Porbandar, Okha, Dwarka, Adri, Veraval, Shivrajpur, Kotda). The abundance of these species in different regions of Gujarat is moderate or scanty as per the diversity of seaweed. Most of the brown seaweed species are found during November-April along the Gujarat coast (Jha *et al.,* 2009). Many species of Phaeophyceae are important components of marine biodiversity. Monitoring their abundance and density provides insights into the status of these species and helps in designing conservation strategies to protect them from threats such as habitat loss, pollution, and climate change.

Sikka coast *i.e.*, the Gulf of Kachchh is one of the marine protected areas. Hence as compared to other sites lesser anthropogenic activities affect the coastal environment at Sikka coast. From the study of the abundance, the number of individual species of brown seaweed can be determined. Anthropogenic activities and climate change will significantly harm natural resources, especially seaweeds, due to global warming. The Gulf of Kachchh is famous for its seaweed diversity and productivity. A robust understanding of the patterns of brown seaweed in this region can offer insights into the health of the marine ecosystem, potential commercial harvest opportunities, and the ecological balance of the Sikka coast. In this context, the study was carried out to assess the basic status of brown seaweed, its abundance and percentage density at Sikka coast, Gujarat.

The study was conducted for six months from October 2020 to March 2021along the two different sites of Sikka coast *viz.*, GSFC Jetty (Gujarat State Fertilizers and Chemicals Ltd.) (22°27'32.8"N and 69°48'21.6"E) and Vador (22°27'23.2"N and 69°48'14.8"E) which is situated in the centre of the southern coast of Gulf of Kachchh and is one of the most important places of interest for algal growth in India.

The sampling was undertaken at the selected study locations (GSFC Jetty and Vador site) once a month for making ecological observations and for the collection of brown seaweed species. The sampling at the field was conducted during the low tides as predicted by the tide table. For the determination of quantitative abundance and percentage density of brown seaweeds in a given area, a belt transect was used. A quadrate measuring 1 m^2 area was laid perpendicular to the coast from the high tide mark to the low tide mark covering all the tidal levels of about 3-4 km, with the help of a graduated long rope. Sampling points along the rope were marked depending on the gradient and the expanse of the intertidal area. If there was a small intertidal area, the sampling points were marked at 3 m intervals along the rope and if the intertidal area was quite large the sampling point was marked at 8 or 10 m along the rope. All the species of brown seaweeds present within the quadrant were estimated, identified and the number of individuals was recorded for the abundance.The average quantitative abundance and percentage density of phaeophyceae group of seaweeds at both sites of Sikka were calculated using the formulae given below Ghani *et al.* (2017).

$$\text{Abundance} = \frac{\text{Total no. of individuals recorded}}{\text{Total no. of quadrate where the individuals occurred}} \quad \ldots (1)$$

$$\text{Density (\%)} = \frac{\text{Total no. of individuals recorded from the quadrate}}{\text{Total area sampled}} \times 100 \quad \ldots (2)$$

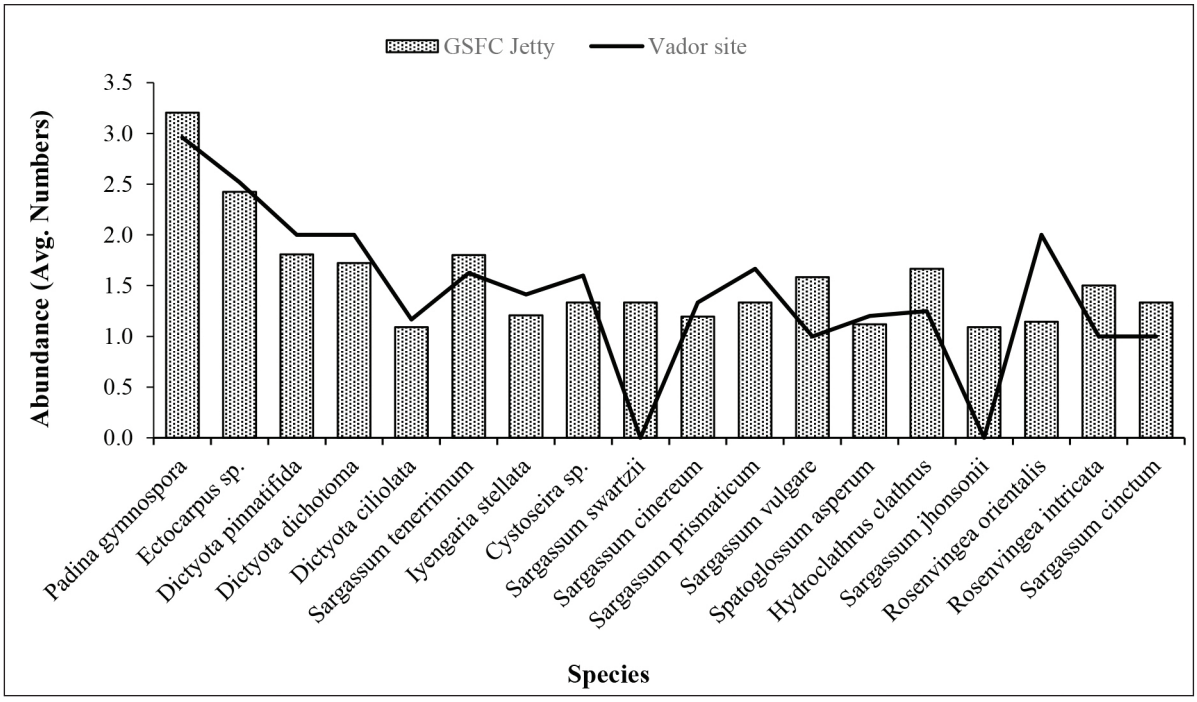

Fig. 1. Quantitative *abundance of Phaeophyceae along GSFC Jetty and Vador site, Sikka*

The quantitative variation in the abundance of Phaeophyceae along the GSFC Jetty and Vador site ranged between 1.09 - 3.21 and 0.00 - 2.96 (avg. numbers), respectively (Fig. 2). At the GSFC jetty, the highest abundance was recorded for *Padina gymnospora* (3.21) followed by *Ectocarpus* sp. (2.42). At the Vador site, the highest abundance was recorded for *Padina gymnospora* (2.96) followed by *Ectocarpus* sp. (2.52). The overall abundance of Phaeophyceae was found higher at the GSFC jetty as compared to the Vador site. According to Qari (2017), the abundance of *Padina pavonica* was found highest during April and lowest during December. *Dictyota dichotoma* and *Padina antillarum* were also abundantly observed in Kudankulam coastal waters (Satheesh and Wesley, 2012). Canciyal (2014) reported that *Padina* and *Sargassum* were the most dominant species of Phaeophyceae at Tuticorin coastal waters.

The variation in percentage density of Phaeophyceae along the GSFC Jetty and Vador site ranged between 0.89 - 36.33% and 0.00 - 8.22%, respectively (Fig. 2). At GSFC jetty, the highest density was observed for *Padina gymnospora* (36.33%) followed by *Ectocarpus* sp. (21.00%). At the Vador site, the highest abundance was recorded for *Padina gymnospora* (8.22%) followed by *Ectocarpus* sp. (7.00%). The overall density of Phaeophyceae was found higher at GSFC jetty as compared to Vador site. Nakar *et al.* (2011) reported that the maximum density of *Padina tetrastromatica* was observed in November (42±0.42 m^{-2}) while Pathak *et al.* (2020) reported a percentage density of 8.40% for *Sargassum johnstonii* and 8.02% for *Padina tetrastromatica* from the Sikka coast.

There was no significant correlation (p-0.017) found in terms of abundance between GSFC Jetty and Vador site while there was a significant correlation (p-0.001) found in the density of Phaeophyceae between GSFC and Vador site.

The present study concluded that GSFC Jetty has higher diversity, abundance and density of Phaeophyceae compared to the Vador site, Sikka. Among all species, *Padina gymnospora* and *Ectocarpus* sp. were recorded to be abundantly available species. During the study period of six months, there was a gradual increase in the diversity and abundance of Phaeophyceae after December at both sites and it declined after March month-end. This decline in the number of Phaeophyceae could be a result of seasonal changes. Continuous

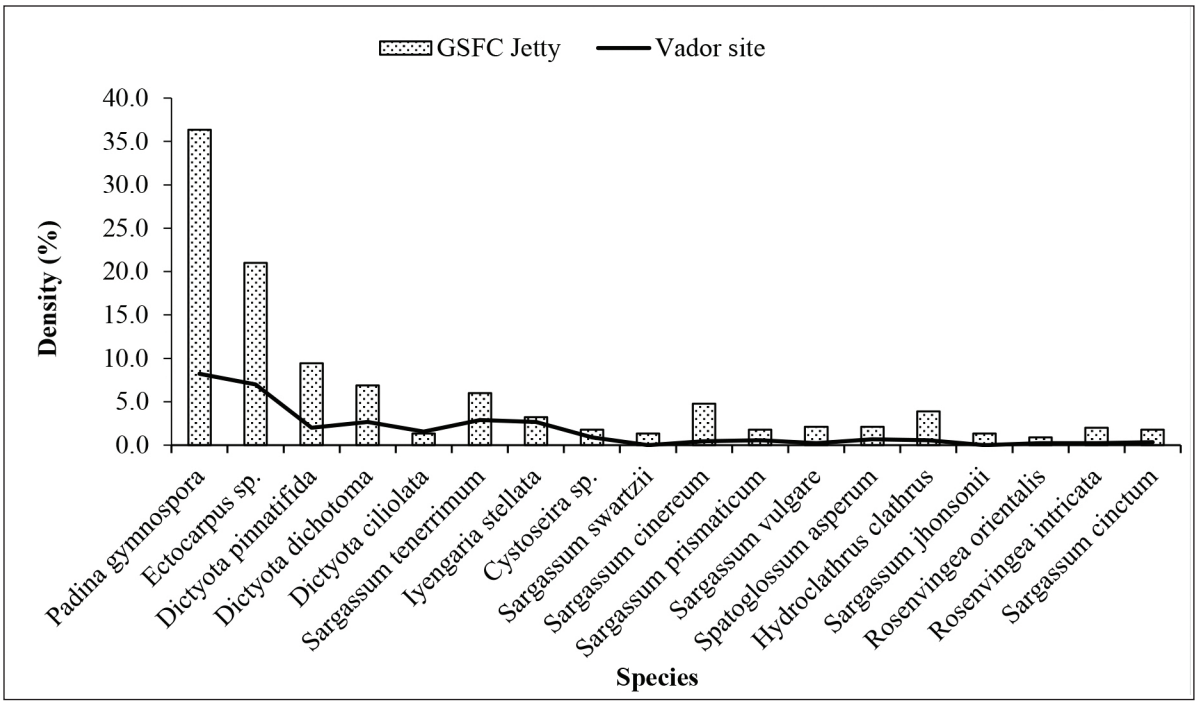

Fig. 2. *Percentage density of Phaeophyceae along GSFC Jetty and Vador site, Sikka*

monitoring and research in this area will be essential for conservation efforts, ensuring sustainable use, and predicting future changes in brown seaweed abundance and density in the context of global climate change and local developments.

CONFLICTS OF INTEREST

The authors declare no competing interest.

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