MARINE ALGAE DIVERSITY AT COASTAL AREA OF VERAVAL, GUJARAT

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ABSTRACT
The Veraval coast situated at (20º54’30º N 76º21’20º E) the gulf of Kachchh, western coast of Gujarat, India. This site has a rich diversity of marine algae, corals and gastropods at intertidal region. The main aim of present study focused on occurrence and diversity of marine algae at coastal site. The study carried out in month of December 2019. Algae collection was done during low tide situation, at this condition algae were collected with their holdfast/rhizoid. Total 33 species of algae were collected from three different phylum. Among these maximum 18 species were recorded from red algae, 8 species were recorded from green algae and 7 species were recorded from brown algae.

INTRODUCTION
In the marine ecosystem, marine algae are a primary producer. They are developing the base of the aquatic food chain thus they are significant for the ecosystem and almost all aquatic animals depend on Primary producer (marine algae) (Hyhn and Seredial, 2006). The rapid growth of marine algae makes the important to every ecosystem that exists on the earth. Marine algae are divided into three types based on their pigments which absorb specific wavelengths and gave them the particular colour of green, brown, and red the group is known as Chlorophyta, Phaeophyta, and Rhodophyta (Dave et al., 2019 and Muth et al., 2019). The diversity of marine algae supports several other taxa and supply required ecosystem services in the coastal zone (Wernberg et al., 2011). Generally, they found in the shallow part (Tahira, 2011) of the ocean because they need light to survive and grow in salt water. In India, marine algae grow abundantly in the coastal zones of Gujarat, Tamilnadu, Andaman-nikobar and Lakshadweep (Rao and Mantri, 2006).

India’s coastal zone is endowed with a wide range of mangroves, coral reefs, sea grasses, salt marshes, sand dunes, estuaries, lagoons, and unique marine and terrestrial flora and fauna. At about 1600 km, Gujarat on the west coast has the longest coastline amongst the Indian states. The Gujarat coast is having two gulfs, namely, Gulf of Kachchh and Gulf of Khambhat. Both of the Gulfs are highly diversified due to their varied coastal features including geomorphology, physiography, and coastal processes. Total seven estuaries exist in Gulf of Khambhat and delivering large amount of water and sediments, whereas in Gulf of Kachchh riverine inputs are very little (GEER, 2004). In Gujarat coast, seaweeds occur abundantly at Okha, Dwarka, Porbandar, Veraval, Diu and Gopnath (Kaliaperumal et al., 1987 and 1995). The different coastal areas of India provide ideal habitat to the marine algae for their growth (Rao and Mantri, 2006). The first diversity of marine algae in India was carried out in 1970 and they had reported only 153 species belonging to 95 genera from the beach of Gujarat (Krishnamurthy and Joshi, 1970).

Marine algae are a rich source of minerals, macro, and micronutrient, protein, carbohydrate, vitamin, amino acid, etc. The extract of brown algae Laminaria showed anticoagulant and antibiotic properties (Anantharaman et al., 2010). Macroalgae are used in thyroid disorders because they are the source of trace nutrients in thyroid disorders (Schuch and Empt, 2007). Marine algae are always exhibit in harsh environment such as high temperature, salinity, UV-radiation, high oxygen concentration etc., the harsh condition promote the formation of oxidizing agents and secondary metabolites (Dang et al., 2018), these type of compound can potentially link with biological systemand give significant pharmacological and nutraceutical properties (Gupta and Ghannam, 2011). The main objective of the present study is to check the diversity of marine algae at Veraval chowpati, Gujarat.
STUDY AREA
Biodiversity of marine algae was studied from Veraval coast and Veraval is situated on the western coast of Gujarat, India. The algae were collected in December month, 2019 during low tide schedule. Samples were collected at a minimum tidal height (0.28 meter) to get more exposure at the collection site. Firstly algae were quickly identified using reference photographic plate then collected in separate zip-locked plastic bags with labels. After that transported in wet condition to the laboratory. The material was cleaned thoroughly to remove debris and other foreign materials by repeated washing in water and again washed in distilled water and finally stored in 5% formalin in lab identified by using a standard taxonomic reference book (Jha et al., 2010). Further all the samples were preserved in standard bottle with labels.

RESULTS
Total of 33 species of marine algae recorded at the coastal site of Veraval (Fig 2). Out of these 8 species were belonged to Chlorophyta phylum, 7 species belonged to Phaeophyta phylum, and 18 species belonged to Rhodophyta phylum (Table 1 and Fig 3). Among 8 species of Chlorophyta maximum species recorded from caulerpaceae (4 species) family followed by ulvaceae (1 species) family, bryopsidaceae (1 species) family, cladphoraceae (1 species) family, and Siphonocladaeaceae (1 species) family. Veraval coast has the least diversity for Phaeophyta phylum compared to Chlorophyta and Rhodophyta phylum. Total 7 species of Phaeophyta recorded at the study site, of which maximum species recorded from dictyotaceae (5 species) family followed by sargassaceae (2 species) family. It was found that among the three groups of marine algae, the majority of algae collected from rhodophyta group. Red algae represent an as dominant group with 18 species from cystocloniaceae (5 species) family followed by gracilariaceae (3 species) family, corallinaceae (3 species) family, champiaceae (1 species) family, lomentariaceae (1 species) family, rhodophyta (1 species) family, gelidillaceae (1 species) family, halyeniaceae (1 species) family, rhodomelaceae (1 species) family, and galaxuraceae (1 species) family (Table 1 and Fig 4). Generally, different groups of marine algae are found in zonation pattern but at Veraval coast, all three groups of algae are present in small puddles like structure, no zonation pattern was observed at collection site (Fig 5).

DISCUSSION
In present study the maximum 4 species collected from caulerpaceae family, 5 species collected from dictyotaceae family and 5 species collected from Cystocloniaceae family, were as the biodiversity study of marine algae from the Beyt Dwarka coast was conducted and they collected maximum 3 species from caulerpaceae family, 4 species collected from dictyotaceae family and 5 species collected from gracilariaceae family (Kalsariya et al., 2019). Similarly, a biodiversity study was conducted from the Okha coast and collected a total of 39 species of marine algae from which, 16 species from Chlorophyta, 10 species from Phaeophyta and 13 species from Rhodophyta phylum (Dave et al., 2019).

CONCLUSION
The Veraval coast is a rich in diversity of marine algae; the rocky coast with many puddles gave the best support to marine algae for their habitat. This coastal site consists of three major orders bryopsidales, dictyotales and gigartinales. The higher diversity of red marine algae suggested that the ecosystem is healthy for the growth of red algae.

Table 1: List of algae recorded at coastal site of Veraval, Gujarat

| Sr. No. | Group of Algae | Scientific name of algae | Order | Family |
|---------|----------------|--------------------------|-------|--------|
| 1. | Ulva conglubata | Kjellman | Ulvales | Ulvaceae |
| 2. | Bryopsis pennata | Lamourous | Bryopsidales | Bryopsidaceae |
| 3. | Caulerpa racemosa | Forsskal J.Agardh | Bryopsidales | Caulerpaceae |
| 4. | Caulerpa scalpelliformis | (Brown ex Turner) | Bryopsidales | Caulerpaceae |
|     | C. Agardh var. denticulate | |       |     |
|   | Chlorophyceae | Phaeophyceae | Rhodophyceae |
|---|--------------|--------------|--------------|
| 5. | Caulerpa sertularioides (S. Genelin) Howe f. brevipes (J. Agardh) Svedelius | *Padina boergisenii* (Allender&Kraft) | *Amphiroa anceps* (Lamark) Decaisne |
| 6. | Caulerpa veravalensis (Thivy&Chauhan) | *Padina tetrastromatica* Hauck | *Coraline chilensis* |
| 7. | Chaetomorpha spiralis Okamura | *Padina boryana* Thivy | *Jania cultrate* (Harvey) |
| 8. | Chamaedoris auriculata Borgesen | *Stoechospermum Marginatum* (C. Agardh) Kiitzing | *Champielia compressa Harvey* |
| 9. | | | *Gelidiopsis variabilis* (J. Agardh) Schmitz |
| 10. | | | *Rhodymenia sonderi* P. Silva |
| 11. | | | *Gelidiella acerosa* (Forsskal) Feldmann and Hamel |
| 12. | | | *Gelidariosalicornia* (C. Agardh) Dawson |
| 13. | | | | *Gracilaria corticata* (J. Agardh) |
| 14. | | | | *Gracilaria foliifera* (forsskal) Borgesen |
| 15. | | | | *Halymenia Porphyraeformis* Parkinson |
| 16. | | | | *Hypnea esperi Bory de saint-Vincent* |
| 17. | | | | *Hypnea musciformis* (Wulfen) Lamouroux |
| 18. | | | | *Hypnea pannosa J. Agardh* |
| 19. | | | | *Hypnea valentiae* (Turner) Montagne |
| 20. | | | | *Hypnea spinella* (C. Agardh) Kiitzing |
| 21. | | | | *Laurenci apapillosa* (C. Agardh) Greville |
| 22. | | | | *Ceramiales* |
| 23. | | | | *Rhodomelaceae* |
| No. | Species                          | Family            | Order       |
|-----|---------------------------------|-------------------|-------------|
| 33. | Tricleocarpa fragilis (Linnaeus) | Galaxauraceae     | Nemaliales  |

Fig 1: Location of marine algae collection. A. Map showing coastal site. B. Map showing Veraval beach. C. Collection site

Ulva
Caulerpa
Caulerpa scalpelliformis
Caulerpa veravalensis
Bryopsi
Chaetomorph
Chamaedoris
Cystoseira indica  Padina boergesenii  Padina
Padina boryana

Sargassum cinctum  Sargassum  Stoechospermum

Amphiroa anceps  Coralline chilensis  Jania cultrate  Champa compressa

Gelidiopsis  Rhodymenia  Gelidiella acerosa  Gracilaria
Gracilaria

*Hypnea musciformis*
Gracilaria foliifera

*Hypnea pannosa*
Halymenia

*Hypnea valentiae*
Hypnea esperi

*Hypnea spinella*
Fig 3: Distribution of collected marine algae from Veraval coast
Fig 4: Occurrence of different family from collected marine algae.

Fig 5: Habitat of marine algae in small puddle.

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