Notes:

What are Sand dunes?

Coastal dunes are large amounts of **sand** that have built over long periods of time which are located immediately behind the active beach zone. The built up sand provides the foundation for unique flora and fauna that form the biotic component of this ecosystem. They absorb the impact of storm surge and high waves, preventing or delaying flooding of inland areas and damage to inland structures.

How are the Sand dunes formed?

- A large supply of **sand**.
- A large flat **beach**.
- Large tidal range to give time for **sand** to dry,
- An onshore **wind** (sea to land) for **sand** to be moved to the back of the **beach**.
- An obstacle for the **dune** to form against e.g pebble or driftwood.

Vegetation on the **beach** and **dunes** tends to occur in zones, according to the degree of exposure to harsh coastal conditions. Closest to the sea is the pioneer zone, extending landward from the debris line at the top of the **beach** in an area called the fore dune or frontal **dune**

Dunes have critical reciprocal interactions with **vegetation**;
Dunes create habitats for plants, while plants help to build **dunes** and promote geomorphological stability. These interactions are also greatly **affected** by disturbances associated with **sand** movement, either in accretion (**dune** building) or in erosion

Dune Vegetation

Coastal vegetation play an important role in maintaining the integrity of our dune systems – they act as a windbreak, trapping deposited sand particles and stabilising the dune system. Without vegetation, this natural protective barrier would be lost to the effects of wind and wave erosion.

Coastal plants have adapted to live in an environment where they are exposed to salt spray, sand blasts, strong winds, high temperatures and flooding. Some of these adaptations include:

- strong root systems that spread rapidly, allowing them to continue growing if part of the plant is buried or uprooted;
- protective waxy and hairy coverings on their leaves and stems to reduce water loss; and

- growing low to the ground, covering the sand and reducing the impact of high wind conditions.

Other plants also use succulent leaves to store moisture during dry periods, and have modified leaf shapes and colours to help promote their survival in this harsh environment.

Primary dune Species: The species which occupy the area closest to the beach (pioneer zone) are highly specialised ones which can survive the harsh conditions of strong winds and salt spray. With features such as waxy and hairy layers on their leaves and stems, plants such as Marram, Sand Spinnifex grow close to the ground to reduce their exposure to the strong winds and moving sands. With a strong root system, they are able to spread rapidly and survive on the lack of nutrients which sand has to offer. The role of these primary species is to provide the rapid stabilisation of the sand dunes after storms and strong winds, rather than preventing the movement of sand from the dune.

Secondary dune species: Species on the foredune are more complex than those in the pioneer zone as the presence of more nutrients means that such plants are able to be supported.

Tertiary dune species: The hind dune is occupied by more complex and developed vegetation such as trees and forests. Protected by the strong winds and salt spray experienced closer to the beach, this area is more protected, making it easier for less hardy and specialized trees to survive. The more complex species in this area result in more humus and organic matter produced, thus providing sufficient nutrients for more species. Eventually plant communities are established in this region, further contributing to the nutrients of the area.

The West coast 267 species and East coast 163 species
Goa has 91 Genera and 106 species.
Sand dune species that are observed during the field verification on October 2016

- *Ipomoea pes-caprae*
- *Spinifex littoreus*
- *Cyperus arenarius*
- *Saccharum spontaneum*
- *Sporobolus virginicus*
- *Dactyloctenium aegyptium*
- *Eragrostis unioloides*
- *Clerodendrum-inerme*
- *Pedalium murex*
- *Physalis minima*
- *Triumfetta rhomboidea*
- *Vitex trifolia* .
- *Calotropis gigantea*
- *Casuarina equisetifolia*