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Coastal sand dune flora in the Thoothukudi District, Tamil Nadu, southern India

K. Muthukumar [1] & A. Selvin Samuel [2]

[1] No. 9B, Keelakottai, Gangaikondan-via, Tirunelveli, Tamil Nadu 627352, India,
[2] Department of Plant Biology and Plant Biotechnology, St.John's College, Palayamkottai, Tamil Nadu 627007, India
Email: [1] muthukumarbut1976@yahoo.com (corresponding author), [2] selvinsml@yahoo.com

Abstract: Coastal sand dunes (CSD) are found in the Thoothukudi District and the communities living close to the coastal sand dunes know the value of the sand dunes and their bioresources. A study of sand dune flora along coastal sand dune areas was done from March to August 2010. A total of 42 species belonging to 38 genera and 26 families were identified at different distances from the shoreline. The CSD systems are rich and diverse in their floral composition, even over the small areas of Manapadu and Kulasakarapattanam along the Thoothukudi coastal line. CSD constitute a variety of habitats and have vital ecological and economic importance. Such unique sensitive systems have to be protected from habitat degradation in order to protect their native diversity and ecological functions.

Keywords: Coastal sand dunes, ecological, Manapadu, Kulasakarapatinam, Tuticorin.

Coastal sand dunes (CSD) are common in different parts of the world. CSD are natural structures protecting the coast from high waves and saltwater intrusions (Corre 1991). The plants living in sand dunes are called Psammophytes. These psammophytic species play a vital role in protecting the coast from erosion and floods (Desai 2000). The coastal length of India is 7500km with many lagoons, beaches, estuaries, and mangrove swamps, supporting rich biotic and abiotic micro-organisms (Anonymous 1987). With respect to geographic location and physical distinctiveness, the coast of Thoothukudi District is part of the Gulf of Mannar Biosphere Reserve ($08^0$45'36"–$9^0$02'31"N & $78^0$07'17"–$78^0$19'18"E). The recorded forest area is 169km^2, which constitutes 3.66% of the geographic area of the district (Forest Survey Report 2005). There are different types of vegetation on the coast of Thoothukudi, this includes mangroves and their associates—scrub jungles, aquatic vegetation, and coastal sand dune vegetation. A sand dune is a mound, hill or ridge of sand that lies behind the part of the beach affected by tides. They are formed over many years when windblown sand is trapped by beach grasses. Dune grasses anchor the dunes with their roots, holding them temporarily in place, while their leaves trap sand, promoting dune expansion. The sand dune is maintained with the help of sand dune vegetation as wind traps, sand binders and dune stabilizers (Wagner 1964). Temperate coastal dunes are well studied and documented (Koske & Gemma 1997; Sridhar & Bhagya 2007) as compared to studies on tropical coastal dunes (Kulkarni et al. 1997; Sridhar & Bhagya 2007). CSD comprise a variety of flora and fauna, which play a vital role in provisioning ecological and economical services to the coastal communities (Maun & Baye 1989; Martinez et al. 1997). The coastal communities closely associated with sand dune habitats are dependent on CSD vegetation for a variety of benefits: for food, fodder, health, manure and recreation. In fact, very few publications are available on the floral diversity of Indian sand dunes (Sridhar & Bhagya 2007). The objective of the present study was to quantify the abundance, species richness and diversity of the CSD plant community, to understand their ecological and economic importance to the lo-

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cal community of Manapadu and Kulasakarapattanam coastline of Thoothukudi District, Tamil Nadu.

Materials and Methods

Study area: Thoothukudi is located on the south-eastern coast of Tamil Nadu (8^{0}37'15"–8^{0}39'97"N & 78^{0}06'24"–78^{0}05'96"E; Fig. 1). Manapadu and Kulasakarapattanam are coastal villages with sand dune coverage of about 3km^2 and 4km^2 extent respectively. The coastal border has a length of 20km and a breadth ranging from 3 to 500m. Superficially, the coast is flat and sandy. The study area experiences a mean annual temperature of 32^{0}C and a mean annual rainfall of 655mm and humidity 87%. The mean monthly temperature ranges from 29–35 ^{0}C. The climate is tropical and dissymmetric with the bulk of the rainfall occurring during the northeast monsoon October–December (Thoothukudi District website). CSD formations depend on accumulating size and prevailing wind energy (Kumar et al. 1993). Their height differs in response to the availability of sand supply, climate and local topographic features (Barbour et al. 1985). In Manapadu the height of the sand dunes is very high (35m; Image 1) compared to Kulasakarapattanam (6.4m).

Image 1. Sand dune in Manapadu Village

Data collection: A total of 10 quadrates of 5 x 5 m were marked randomly in 10 locations at different distance gradients from the shoreline in each village. Every plant species found along the 10 quadrates was enumerated. Species (Table 1) were identified by using published flora (Daniel & Umamaheswari 2001; Banerjee et al. 2002).

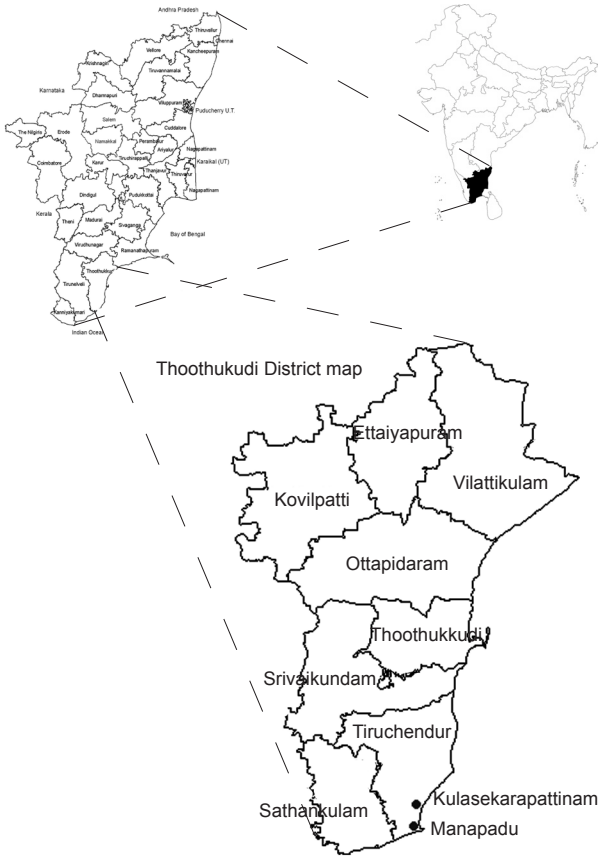

Figure 1. Study area

Results & Discussion

In the study area 42 species belonging to 38 genera representing 26 families were enumerated during this survey. Out of the total Indian CSD plants listed so far (154), nearly one-third (42) of them were recorded in the study area. Indian CSDs consist of 154 species belonging to 108 genera and 41 families (Arun et al. 1999; Rao & Sherieff 2002). The Poaceae family was most common and dominant with five species followed by Malvaceae (4), Asteraceae (3), Euphorbiaceae (3), Cyperaceae (2), Amaranthaceae (2), and Arecaceae (2). Nineteen families were represented only by one species, and over all 25 were medicinal plants (Table 1). Several authors have pointed out that the temperate CSD comprise mainly the members of Poaceae, and the tropics with Asteraceae, Cyperaceae, Fabaceae and Poaceae (Arun et al. 1999; Rao & Sherieff 2002; Sridhar & Bhagya 2007). During the present study Poaceae, Malvaceae, Asteraceae, Euphorbiaceae, Cyperaceae were the most common families. Many authors have mentioned that in various parts of the world many dune ecosystems support high plant richness and diversity values (Musila et al. 2001; Grootjans et al. 2004; Fontana 2005; Celsi & Monserrat 2008). The present study also indicates that

Table 1. The list of sand dune flora from Tuticorin coast

	Scientifice name	Family	Habit	Tamil Name	Uses
1.	*Abutilon indicum* (L.) Sweet.	Malvaceae	Shrub	Thuthi	-
2.	*Acalypha indica* L.	Euphorbiaceae	Herb	Kuppaimeni	+
3.	*Acanthospermum hispidum* DC.	Asteraceae	Herb	Kombu mull	+
4.	*Aerva persica* (Burm.f.) Merr. (Image 2)	Amaranthaceae	Shrub	Perumpulai	+
5.	*Aristida setacea* Retz.	Poaceae	Herb	-	E
6.	Atriplex repens Roth.	Chenopodiaceae	Herb	-	-
7.	*Azadirachta indica* A. Juss.	Meliaceae	Tree	Veppamaram	+
8.	*Boerhavia diffusa* L.	Nyctaginaceae	Herb	Mukurattai	+
9.	*Borassus flabellifer* L. *	Arecaceae	Tree	Panai maram	+, E
10.	*Bulbostylis barbata* (Rottb.) C.B. Clarke. (Image 3)	Cyperaceae	Herb	-	+
11.	*Calotropis gigantea* (L.) R.Br.	Asclepiadaceae	Shrub	Erukku	+, E
12.	*Carica papaya* L.	Caricaceae	Small Tree	Pappali	+
13.	*Cassia italica* (Mill.) Lam. ex F.W. Andrews.	Caesalpiniaceae	Herb	Nilavahai	E
14.	*Casuarina litorea* L. *	Casuarinaceae	Tree	Chavuku	E
15.	*Catharanthus roseus* (L.) G. Don.	Apocynaceae	Herb	Nithyakalyani	+
16.	*Cenchrus ciliaris* L.	Poaceae	Herb	Kolukattaipul	-
17.	*Citrullus colocynthis* (L.) Schrad. (Image 4)	Cucurbitaceae	Herb	Peykkumatti	+
18.	*Cocos nucifera* L.	Arecaceae	Tree	Thennai maram	E
19.	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb	Mannannai chedi	E
20.	*Datura metel* L.	Solanaceae	Herb	Oomathai	+
21.	*Euphorbia hirta* L.	Euphorbiaceae	Herb	Amampatchaiarisi	+
22.	*Euphorbia tortilis* Rottler ex Ainslie.	Euphorbiaceae	Shrub	Tirukukalli	-
23.	*Fimbristylis cymosa* R.Br. * (Image 5)	Cyperaceae	Herb	-	E
24.	*Gisekia pharnaceoides* L* (Image 6)	Aizoaceae	Herb	Manalkeerai	+, E
25.	*Gomphrena serrata* L.	Amaranthaceae	Herb	-	-
26.	*Hibiscus tiliaceus* L. *	Malvaceae	Tree	Neerparuthi	E
27.	*Launaea intybacea* (Jacq.) Beauverd. *	Asteraceae	Herb	-	+
28.	*Launaea sarmentosa* (Willd.) Sch.Bip.ex Kuntze* (Image 7)	Asteraceae	Herb	-	E
29.	*Leucas aspera* (Willd.) Link.	Lamiaceae	Herb	Thumbai	+
30.	*Opuntia stricta* (Haw.) Haw.	Cactaceae	Shrub	Sappathikalli	+
31.	*Panicum repens* L. *	Poaceae	Herb	-	-
32.	*Passiflora foetida* L.	Passifloraceae	Climber	Sirupunaikali	+
33.	*Pedalium murex* L. (Image 8)	Pedaliaceae	Herb	Perunerunji	-
34.	*Phyla nodiflora* (L.) Greene.	Verbenacee	Herb	Koduppai	+
35.	*Prosopis juliflora* (Sw.) DC.	Mimosaceae	Tree	Veelikkaruvai	E
36.	*Pycreus polystachyos* (Rottb.)P. Beauv*	Poaceae	Herb		-
37.	*Sida cordifolia* L.	Malvacece	Herb	Nilathuthi	+
38.	*Spinifex littoreus* (Burm.f.) Merr.*	Poaceae	Herb	Ravanan meesai	+
39.	*Tephrosia purpurea* (L.) Pers.	Fabaceae	Under Shrub	Kolingi	+
40.	*Thespesia populnea* (L.) Sol. ex Correa. *	Malvaceae	Tree	Poovarasu	+
41.	*Tribulus terrestris* L.	Zygophyllaceae	Herb	Nerinji	+
42.	*Vernonia cinerea* (L.) Less.	Asteraceae	Herb	Mukuttipundu	+

E - Economic values; + - Medicinal values; * - Typical CSD plants.

Image 2. *Aerva persica*

Image 3. *Bulbostylis barbata*

Image 4. *Citrullus colocynthes*

Image 5. *Fimbristylis cymosa*

Image 6. *Gisekia pharnaceoides*

Image 7. *Launaea sarmentosa*

the study area preserves a rich floral diversity with a high number of sand dune medicinal plants, because during the survey 25 medicinal plants were found in the two small sample sites, Manapadu and Kulasakarapattanam. In addition, the different vegetation formations together with the dune field geomorphologic heterogeneity provide a wide variety of environmental conditions and habitat types.

We also compared the floristic composition of the two coastal sites, Manapadu and Kulasakarapattanam. Among these two sites Manapadu had 31 species compared to Kulasakarapattanam which had 22 species. The species composition varied across these two sites. Species such as *Fimbristylis cymosa*, *Spinifex littoreus*, *Launaea intybacea*, were only found in the high tide line in both the sites.

Image 8. *Pedalium murex*

Coastal sand dunes have been valued as an important coastal ecosystem offering protection to the hinterland, in maintaining the water table of coastal areas and even protecting the coastal agriculture from the salt laden winds blowing from the sea (Namboothri et al. 2008). Dunes are known to prevent intrusion of saltwater into the fresh aquifers of coastal areas. Coastal sand dunes are also important in maintaining the groundwater level of coastal areas, which is essential to sustain not only the flora and fauna, but also to provide an important source of freshwater for coastal populations. The dunes are occupied by a highly adapted group of plants specially suited to life in such harsh conditions. Critical to the formation, stabilisation and post-storm recovery process, is the presence of specialised dune plants e.g. *Spinifex littoreus*. These plants are capable not only of maintaining dune stability but can also colonize patches of bare sand and grow quickly down an eroded dune face to help build and restore the dune profile. *Spinifex littoreus* are very effective in long-term control of coastal erosion as they can grow to keep up with the movement of sand whereas rigid walls and structures are soon buried or undermined. *Spinifex littoreus* is a sand binding grass found on coastal fore dunes throughout the region. It is one of the few plants able to colonise the seaward face of the fore dune, and it is also considered as a berm to front dunes; primary stabilising plants consisting mainly of herbaceous species, were recorded. This area was composed of herbaceous species like *Leucas aspera*, *Gisekia pharnaceoides*, *Tephrosia purpurea*, coastal tree species like *Borassus flabellifer* and the introduced *Casuarina equisitifolia*.

Very often extensive sand dune systems may have interdunal sand dunes which are also closely integrated to the socioeconomic life of the coastal population. In Manapadu, coastal villages have a high level of sand dune formation and rich floral diversity as a single quadrate of 5 x 5 m harbored 10 different species, which was much higher when compared to the other sand dune areas like Tiruchendur, Kayalpattanam and Kulasekarapattanam of Thoothukudi coast. A very good example of this is the *Borassus flabellifer L.* which is quite common on the sand dunes of southern Tamil Nadu. Before sugar was introduced into markets in India, *B. flabellifer* was a major plantation in southern Tamil Nadu from which jaggery was extracted. Jaggery was not only a major substitute for sugar, it was also a major source of livelihood for the coastal community of southern Tamil Nadu. In another example of *Spinifex littoreus* (Burm.f.) Merr., the extract from the grass was found to be very effective against bacteria and some fungi strains (Thirunavukkarasu et al. 2010) and this species is also very common. Nine species of *Spinfex* and five species of *Fimbristylis* were found, these are also excellent sand binders with medicinal value. Dried grass is used as fuel by fishermen and dry female inflorescence can be used for interior decoration (Daniel & Umamaheswari 2001). Important religious sites were observed during the study. During religious celebrations floral diversity and environmental conditions were affected as human waste, polythene bags, and other solid wastes were deposited on the sand dunes. After the celebrations medicinal herbs and climbers were found destroyed. It is important to initiate efforts to conserve the floral diversity with the help of local communities through awareness creation.

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