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COASTAL SAND DUNE FLORA OF ODISHA: SOURCE FOR DRUG FORMULATIONS AGAINST ANTIMICROBIAL RESISTANCE

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ABSTRACT

Coastal sand dunes (CSD) are shifting ecosystems with a variety of floral species. The hostile ecosystem of CSD of Odisha harbour some unique flora and fauna, many of which have enormous nutraceutical and pharmaceutical values for example, *Clerodendrum inerme*, *Acanthus ilicifolius*, *Casuarina equisetifolia*, *Opuntia stricta*, *Alternanthera sessilis* etc. Psammophytic plants like *Ipomea biloba*, *Spinifex littoreus* etc. due to their sand binding capacity act as buffer zone and lessen the detrimental effects of high tides, cyclone and tsunami. A survey has been done to emphasize and spread awareness of the great potential of CSD flora of Odisha as a source of novel bioactive compounds. The present study enumerated about 31 common sand dune flora which are used as food, medicine and have sand binding capacities. It is observed that CSD vegetation is under severe threat mainly due to global warming and human interference and thus needs stringent restoration measures for sustainable use for coastal rural development and experimental work for formulation of new drugs.

INTRODUCTION

India is a tropical country with a coastline of about 7500 km. A small stretch of this coastline is shared by the state of Odisha. Better known as the City of Temples, approximately 1/3rd of its geography is covered by forest. Its unspoiled natural landscape remains one of the major attractions. Coastal sand dune (CSD) ecosystem is one of them. A sand dune is a mound of sand formed by the action of wind (eolian process). Dunes can be large geographic features or just small humps (Pattnaik et al. 2008). Based upon occurrence and adaptations, coastal vegetation can be categorized into three major divisions – the Mangroves, the Salt-marshes and the Sand dunes. Amongst these, the sand dune flora occupies the dry sandy area of the coast (Kathiresan 2005). CSD flora are specially adapted to various environmental stresses which allow them to grow, establish and trap sand, so they are mostly represented by herbs, shrubs, creepers or runners (Sridhar et al. 2007; Srinivasu et al. 2017). Under such extreme coastal environment, the vegetation survives by synthesizing certain stress induced metabolites such as steroids, flavonoids, tannins, alkaloids etc (Bandaranayake 2002). The economic and ecological roles of CSD vegetation includes the indirect use of the ecosystem in the form of vital ecological functions such as control of coastal erosion and protection of coastal land by binding the sand and preventing it from being swept away by wind. (Dahm et al. 2005; Kumar and Hota 2014). It provides habitats for specially adapted insects, birds and animals-several of which are threatened (Padmavathy 2010). Apart from this, the

economic benefits are many and varied. CSD flora provides food and a wide range of traditional products for its dwellers. CSD plants as potential source of novel bioactive compounds can also be marked. Most CSD plants have compounds showing anti-microbial properties, for example *Ageratum conyzoides* and *Tamarix troupitii* against diarrhoea and dysentery, *Ipomoea biloba* against skin infections etc. Anti-cancer drugs have been formulated from ribose derivatives of benzoxazoline extracts of *Acanthus illicifolius*; xanthone, biflavonoids, benzophenones from *Calophyllum inophyllum* etc. (Minocha and Tiwari 1981; Kokpol et al. 1984; Goh and Jantan 1991; Kapil et al. 1994; Iinuma et al. 1994). Other CSD flora like *Pandanus odoratissimus* is rich in phenols, lignins and a benzofuran derivative that exhibit antioxidant activity (Jong and Chau 1998; Kthiseran 2006). Some other examples of drug yielding CSD flora include *Pongamia pinata*. Due to the presence of flavonoides (chalcone), it is considered as a source of crude drug for treatment of tumors, piles, skin infections and ulcers (Tanaka et al. 1991; Tanaka et al. 1992). Similarly, due to the presence of xanthone, biflavonoids, benzophenones, neoflavonoides and coumarin derivatives, *Calophyllum inophyllum* extracts are used as anti-cancer and anti-tumor agents (Goh et al. 1991; Iinuma et al. 1994; Munro et al. 1999). Authors carried out literature survey as well as field survey along the coastal belt of Odisha that lies between Gopalpur (19.2647° N , 84.8620° E) to Balasore (21.4934 °N, 86.9135° E). During the field surveys, the authors collected data on the indigenous use of the locally available CSD

species (Table-1) and interviewed members of the local community. This information was noted down in a Passport Data Form. The collection of the plant specimens was also carried out for later taxonomic characterization (Plate 1). Not only that but a variety of insects associated with the floral diversity were also seen. Work previously conducted in CSD of Odisha had reported the presence of a total of about 55 plants distributed across 33 families (Pattanaik et al. 2008) where as in present study about 31 plants were noted belonging to 22 families. Differences were also marked in the abundance of families. Previous studies recorded Arecaceae, Papilionaceae and Poaceae with 4 species in each as the dominant families whereas present study concluded that Fabaceae to be the most dominant family followed by Amaranthaceae, Asteraceae and Poaceae. This indicates the destruction of the CSD vegetation by anthropogenic activities as well as by natural calamities like the recent cyclone *Fani*. Among the plants, herbs were found to be the most abundant followed by trees, shrubs and climbers. This finding is in par with the previous reports although the number of plants belonging to each habit varied (Pattanaik et al. 2006). All the 31 CSD species recorded are of ethnobotanical and nutraceutical values. The psammophytic plants like *Acanthus ilicifolius*, *Borassus flabellifer*, *Jatropha gossypifolia*, *Prosopis spicigera* have been used for their medicinal values against rheumatism, jaundice, asthma, gonorrhoea, skin diseases, dysentery etc by the local tribes. These uses indicate the presence of certain novel bioactive compounds (Chakraborty et al. 2012).

Further work has to be carried out to evaluate the specific bioactive compounds against specific pathogens and their role in Anti-Microbial Resistance (AMR). The pioneer species like *Ipomea biloba*, *Launaea sarmentosa*, (Figure 2) *Sesuvium portulacastrum*, *Hydrophylax maritime* and *Spinifex littoreus* are potent sand binders among the CSD flora, protecting the coastal dune from erosion (Rao et al. 1975). An interesting economic and ecological fact about *Crotalaria falcata* was found. It is known to be used as a component of crop rotation practice, soil fertility improvement and fallowing as a means of reducing or eliminating certain bacteria like *Ralstonia solanacearum* in open fields (Kakuhenzire et al 2013). Herbs like *Salicornia brachiata*, *Sesuvium portulacastrum* and *Suaeda maritima* can be used as an alternative source of food. Apart from these, psammophytes have various economic utilities like the use of *Casuarina equisetifolia* as firewood, *Zornia diphylla* as cattle feed etc. *Spinifex littoreus* is also used as fuel by the locals. The study concluded that the CSD flora not only provides us an alternative source of food but also harbours numerous novel bioactive compounds. They are the reason for socio-economic development of the indigenous people and an integral part of the bio-diversity. The CSD vegetation is under severe threat mainly due to global warming and human interference and thus needs stringent restoration measures for sustainable use for coastal rural development and for formulation of experimental work for new drugs. Their destruction urges immediate

action to be taken for their sustainable utilization and conservation.

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Table 1: Importance of coastal sand dune flora of Odisha

Common Name	Scientific Name	Family	Habit	Local Name	Importance
Whiteweed/ Goat weed	<i>Ageratum conyzoides</i> L.	Asteraceae	Herb	Pokosunga	Medicinal: Herb infusion provides relief from diarrhea,

					dysentery
Sea holly	<i>Acanthus ilicifolius</i> L.	Acanthaceae	Shrub	ND	Medicinal: in asthma and rheumatism
Cashew tree	<i>Anacardium occidentale</i> L.	Anacardiaceae	Tree	Kaju / Bhalia	Medicinal: Bark and leaf paste provides relief from toothache and sore gums Food: kernels consumed as a nutritious dessert
Toddy palm/ Palmyra palm	<i>Borassus flabellifer</i> L.	Arecaceae	Tree	Tala	Medicinal: Root is diuretic and anthelmintic; Fruits are used against skin diseases Food: fruits have edible and nutritious endosperm
Yellow nicker	<i>Caesalpinia bonduc</i> L. Roxb.	Fabaceae	Shrub	Gilo	Medicinal: Leaf paste used during jaundice and rheumatism
Mastwood/ Sultan champa	<i>Calophyllum inophyllum</i> L.	Calophyllaceae	Tree	Poonanga	Medicinal: seed oil is used against skin diseases; Bark is

					astrigent
Crown flower	<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Shrub	Arakha	Medicinal: root is used as expectorant and a mild stimulant; latex contains cardiac-glycosides
Bay bean	<i>Canavalia maritima</i> Thouars.	Fabaceae	Herbaceous vine	Luna samba	Food: young pods and seeds are used as vegetable
Coastal she-oak	<i>Casuarina equisetifolia</i> L.	Casuarinaceae	Tree	Jhaun	Economical: ornamental, firewood, parts are used for bio remediation
Glory Bower/ Indian privet	<i>Clerodendrum inerme</i> (L.) Gaertn. syn. <i>Volkameria inermis</i> L.	Lamiaceae	Shrub	Chiani	Medicinal: leaves possess febrifugal properties; roots used during rheumatoid
Coconut tree	<i>Cocos nucifera</i> L.	Arecaceae	Tree	Nadia	Medicinal: roots are astrigent and diuretic; Food: fruit is nutritious
Rattlepods	<i>Crotalaria falcata</i>	Fabaceae	Herb	ND	Economic: green manure

	Schumach. and Thonn.				Ecological: as green cover
East-Indian water bluet	<i>Hydrophylax maritima</i> L.f.	Rubiaceae	Herb	ND	Ecological: potent sand binder
Morning glory/ Goat's foot	<i>Ipomoea biloba</i> (L.) R.Br.	Convolvulaceae	Herb/ creeping vine	Kansarilata	Medicinal: leaves and roots used against gonorrhoea, skin infections, rheumatism Ecological: sand binder
Bellyache bush	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	Herb	Baigabo	Medicinal: roots used during leprosy; leaves used as blood purifier; bark decoction as emmenagogue
Beach Launaea	<i>Launaea sermentosa</i> (Willd.) Schult-Bip.ex O. Kuntze	Asteraceae	Herb	Banapatri	Medicinal: plant juice against rheumatism Ecological: potent sand binder
Erect prickly pear	<i>Opuntia stricta</i> (Haw.) Haw.	Cactaceae	Shrub	Nagapheni	Medicinal: baked fruit is used against whooping cough

Screw pine/ Umbrella tree	<i>Pandanus fascicularis Lam.</i>	Pandanaceae	Tree	Kia / Kewra	Economic: Flowers used as perfume; leaves used for making mats and baskets
Bara Gokhru	<i>Pedaliium murex L.</i>	Pedaliaceae	Shrub	Gokhara	Medicinal: mucilaginous leaf extracts are used in treatment of urinogenital diseases
Silver date palm /Indian date	<i>Phoenix sylvestris (L.) Roxb.</i>	Arecaceae	Tree	Khajuri	Food: edible ripen fruits; plant sap used as drink
Tall reed	<i>Phragmites karka (Retz.) Steud.</i>	Poaceae	Grass / Herb	Nala	Economic: as fodder; leaves used to make mats and for thatching
Khejri / Golden tree / Wonder tree	<i>Prosopis spicigera Linn.</i>	Fabaceae	Tree	Shami	Medicinal: leukoderma, leprosy, asthma, anticancer, antidibetic
Pickleweed/ Glasswort	<i>Salicornia brachiata Roxb.</i>	Amaranthaceae	Herbs	Batula	Food: edible young leaves and shoot
Toothbrush	<i>Salvadora</i>	Salvadoraceae	Tree	Miriga	Medicinal: root

tree / mustard tree	<i>persica</i> L.				extract provides pain relief from spleen problems; leaf decoction is used in asthma, cough Food: whole plant as salad
Sea purslane / Shore purslane	<i>Sesuvium portulacastrum</i> L.	Aizoaceae	Herb	Gada bani	Food: edible young plants; Ecological: potent sand binder
Littoral spinegrass/ Ravan's Moustache	<i>Spinifex littoreus</i> (Burm.f.) Merr.	Poaceae	Herb	Khurakanka	Ecological: potent sand binder; dried grass used as fuel
Seepweeds/ sea-blites	<i>Suaeda maritime</i> (L.) Dumort.	Amaranthaceae	Shrub	Giria saga	Food: leaves and shoots as vegetable
Indian Tamarisk	<i>Tamarix troupii</i> Hole	Tamaricaceae	Tree	Jaula	Medicinal: used during dysentery, ulcer, sore throat
Wild indigo/ Fish poison	<i>Tephrosia pupurea</i> (L.) Pers.	Fabaceae	Shrub	Bano kuthi	Medicinal: leaves are useful in cough and kidney disorders; plant

					juice is applied externally for eczema
Chaste tree	<i>Vitex negundo</i> L.	Lamiaceae	Shrub	Begunia	Medicinal: leaves used for relief from rheumatism, powered roots used as demulcent and anthelmintic
Two-leaf Zornia	<i>Zornia diphylla</i> (L.) Pers.	Fabaceae	Herb	Chhena kuradia	Medicinal: Root is used as mild sedative; plant used against dysentery Economic: as cattle fodder; green manure

(ND – No Data)

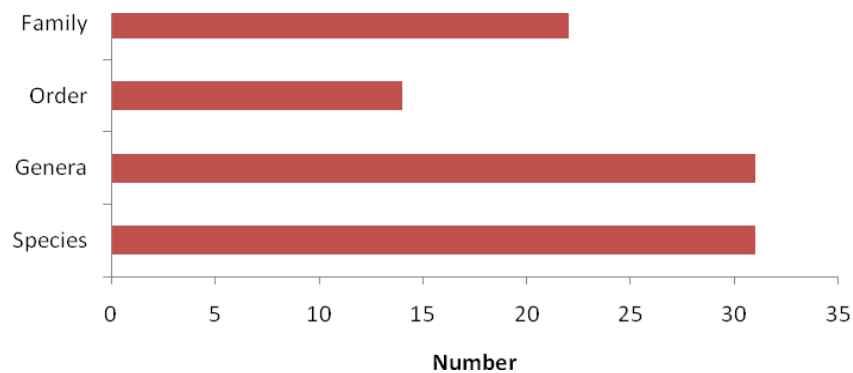


Figure 1: CSD plants of Odisha



Plate 1: Collection of Coastal Sand Dune floras



Figure 2: *Launea sermentosa*: A dominant CSD flora of Odisha