Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Asian Journal of Plant Science and Research, 2015, 5(6):69-76

ISSN : 2249-7412
CODEN (USA): AJPSKY

Studies on the coastal sand dune phytoresources at Visakhapatnam, Bay of Bengal, India

S. Aparna and Raja Sekhar P. S.

Department of Environmental Sciences, Andhra University, Visakhapatnam, A.P

ABSTRACT

The coastal sand dunes (CSD) are unique and dynamic ecosystems between marine and terrestrial realms. They are the coastal armouring with bind of biota and sand grains. The coastal sand dune flora has ecological significance and socio-economic values. Thus the present study provides the Phytoresources of coastal sand dune flora with reference to ecological, economic and medicinal importance of each plant species. Altogether a total of 103 species belonging to 94 genera 37 families was recorded during November 2010 to December 2014. The survey has been done by adopting appropriate methodology by conducting direct interviews and information gained from native villagers of traditional base and Ayurvedic practitioners. As per distribution of sand dune flora is most abundant and richness in species composition at leeward dunes (37%) rather than hinterland dunes (28%), foredunes (18%) and marshy/saline areas (17%). In view of the greater ecological significance and socio-economic importance conservation management plans have been suggested for the protection, of this importance of sand dune flora of Visakhapatnam coast from natural and anthropogenic threats i.e. coastal erosion, cyclonic storms, developmental recreational projects.

Keywords: Coastal sand dunes, Phytoresources, Socio-economic values, Visakhapatnam

---

INTRODUCTION

Sand dunes the very words conjure up images of vast seas of shifting sand barren of plants and hostile to human's habitation. In the Visakhapatnam, sand dunes are playing vital role like a coastal barriers. These are covered more by grasses and shrubs. Because of their unique characteristics dune areas have drawn the attention of many kinds of people. CSDs are dynamic, but fragile buffer zones of sand and vegetation are formed, where the following three characteristics can be found: large quantities of sand, persistent wind capable of moving the sand and suitable locations for sand to accumulate [11] Many plant species are able to colonize supralittoral sands, despite initially poor nutrient conditions, lack of moisture, and sometimes very high temperatures. Such colonization may, on sheltered beaches, begin at or just above the strandline - aided by accumulations of wrack and tidal litter, which reduce the sand temperature and increase its moisture content.

The sand dune flora extremely important resources, which play a vital role in the medicinal, economic and social life nearby people [7][9][11][12] Higher up the shore, perennial grasses may be able to establish themselves, acting as a sand trap that may result in the establishment of a fore dune a meter or two in height. This ability to bind sand depends on the development of extensive horizontal and vertical rhizome systems [3]

Much of the vegetation is found on coastal dunes and thus an understanding of their morphology is important. Coastal sand dunes (CSD) are unique and dynamic ecosystems between marine and terrestrial realms. They are the coastal armouring with bind of biota and sand grains. This CSD flora has not only medicinal value but also maintain the coastal and marine niche. These habitats have been severely affected by natural and anthropogenic activities resulting in loss of habitat and dependent flora and fauna [9] thus such unique ecological systems have to be protected from degradation in order to conserve their native diversity and ecological functions [8].

Visakhapatnam is a maritime districts of north coastal Andhra Pradesh situated between 17^{o} 15' to18^{o} 32' Latitudes and 18^{o} 54' to 83^{o} 30' Longitudes (Figure 1). This coast line has diversified topographical and geomorphology features of 132km shoreline in length extends along Bay of Bengal from Bheemunipatnam(north) to Pentakota (South) and including mangrove vegetation in Thandava, Sarada , Gosthani river areas. A total of 14 field stations were selected (Bheemili, INS kalinga, Thotlakonda, Ramanaidu beach, Rushikonda, Telineelapuram, RK beach, Yarada, Pudimadaka, Seetamplaem, Bangarammapalem, Nakkapalli, Pentakota, Rambilli,) along the coastline for vegetation analysis.

MATERIALS AND METHODS

Vegetation analysis:
Coastal sand dune area at each field station of Visakhapatnam coastline was divided into Foredunes, Leeward, and Hinter land [8]. Different season an area of 10mX10m sand dune sampling sites were selected in which 1mX1m quadrate along the transect perpendicular to the shore were laid randomly to study species composition.

Data were collected systematically during year from 2010 to 2014 by investigating the fishermen community as well as local people using a specific questionnaire prepared for the purpose to document. The uses of CSD plant species, parts of the plants used etc. questionnaire was to gather document of traditional knowledge mainly on food, fodder, fertilizer, pharmaceutical, religious and cultural uses of CSD plants[10]. Each of the plant material was noted a field note books and documented as to Binomials with family, local name, part used and therapeutic uses, plant parts that were identified as useful in ethno-botany were collected. The voucher specimens were collected and identified by referring to standard flora [5]. The voucher specimens were maintained in the herbarium at Department of Botany Andhra University, Visakhapatnam, India.

Physiographically, the shoreline of Visakhapatnam is divided into two types. One is sandy shore and another one rocky shore [6].The coastal ecosystem of India has extensively studied and sand dune vegetation found in different zones is placed under strand vegetation [4]. For ecological survey the Visakhapatnam coastal sand dune environments were divided into three biotic zones. Fore dune or pioneer dune is nearest towards sea and covered by some sand binders species like *Ipomoea pes-caprae and spinifex littoreus* etc; mid dune or leeward dune dominated by shrubs and is more or less stable. These dunes are commonly shifting towards land because of wind direction; Hinterland dunes consist of large shrubs, herbs and trees with long roots. In the hinterland dunes flora and fauna play vital role in sand dune ecosystem.

RESULTS AND DISCUSSION

Sand dune vegetation contains many specific flora species. They are growing in such harsh conditions in salty, marshy and swampy areas. In this area lot of floristic composition [1].Sand dune vegetation play vital role in the economic and social life of nearby people [6]vegetation uses not only as a sand binders but they are identified unique values as medicinal (Table 1), food (Table 2), fodder and economy (Table 3). Mainly CSDs have high ecological values like soil binders (Table 4), major role in aquifers, develop and stabilization of dunes, produce humus, and mobilize the dune system. Dune vegetation store house rich in genetic diversity along with high ecological values [2].

Fig 2: Species distribution in dunes

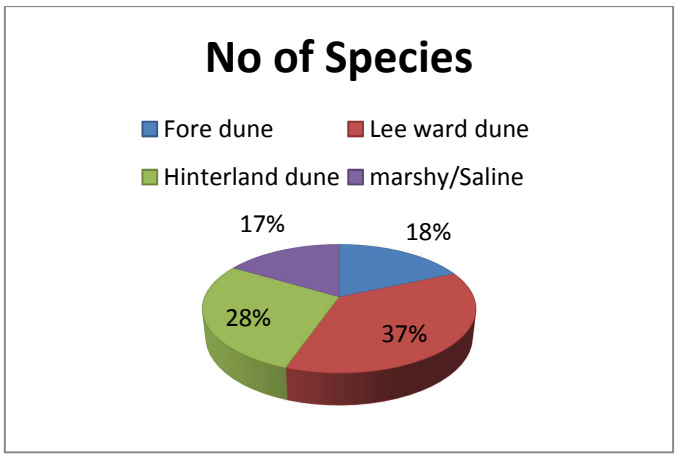

Table 1: List of CSD plants used as medicinal purpose

Scientific name	Family	Telugu name	Uses
Abutilon indicum(L.) sweet	*Malvaceae*	Adivi Benda	Various parts of the plant are use as a demulcent, aphrodisiac, laxative, diuretic, sedative, astringent, expectorant, tonic, anti-inflammatory, anthelmintic, and analgesic and to treat leprosy, ulcers, headaches, Gonorrhoea, and bladder infection.
Acalypha indica L.	*Euphorbiaceae*	Muripinidi	A leaf paste ,mixed with common salt, is use to cure eczema and chest pain
Acanthus ilicifolius L	*Acanthaceae*	Alchi	use as medicine in asthma and rheumatism
Achyranthes aspera	*Amaranthaceae*	Uttareni	Use in gynaecological diseases
Aeluropus lagopoideS(L)	*Poaceae*	-	Used as wound healing and pain killer
Aerva lanata (Burm.f.) merr.	*Amaranthaceae*	Pindi koora	The plant is use for the treatment of snakebite.
Anacardium occidentale L.	*Anacardiaceae*	Jidi mamidi	seeds into a poultice for treating snakebites, apply nut oil to cracked heels or as an antifungal agent, and use the fruits, bark, and leaves for many other purposes including anti-fungal activity, for sores and rashes, or as an antipyretic, and for anti diarrheal applications.
Apluda mutica	*Poaceae*		The whole plant used in treatment of diuretic, gonorrhoea
Argemone maxicana L.	*Papaveraceace*	–	Leaves are useful in cough and skin diseases. Roots are useful in guinea worm infection, skin diseases and leprosy.
Asystasia gangetica	*Acanthaceaea*	-	Used as treatment for asthma
Azadirachta indica A.Juss.	*Meliaceae*	Vepa	Seed oil is use in skin diseases and in lice. Bark is useful in malarial fever. Tender twigs are use as tooth brush. Leaf paste applied for mumps.
Barleria prionitis	*Acanthaceae*	Mulla gorinta	Treating fever, respiratory diseases, toothache, joint pains and a variety of other ailments; and it has several cosmetic uses. A mouthwash made from root tissue is used to relieve toothache and treat bleeding gums. The whole plant, leaves, and roots are used for a variety of purposes in traditional Indian medicine
Barringtonia acutangula Gaertn.	*Barringtoniacea e*		Fruit is bitter, anthelmintic, astringent. Leaf juice is given in diarrhoea.
Boerhavia diffusa L.	*Nyctaginaceae*	Atikamamidi	Whole plant was use. Diuretic, anti – inflammatory, anti-arthritic, spasmolytic, antibacterial.
*Borassus flabellifer L**	*Arecaceae*	Tadi	Root is diuretic and anthelmintic. Fruits are useful in dyspepsia, flatulence, colic and skin diseases.
Caesalpinia bonduc	*Caesalpinaceae*	Gachakaya	it sometimes ground up to make a medicinal tea
Calophyllum inophyllum L.	*Clusiaceae*		Seed oil is use as a stimulant embrocating in rheumatism and gout; oil cures scabies and other
Calotropis igantean (L.)R.Br	*Asclepiadaceae*	Nalla jilledu	Root bark is diaphoretic and expectorant; acts as mild stimulant. Powered root bark gives relief in diarrhoea and dysentery
Cassia occidentalis L.	*Fabaceae*	Tangedu	Roots are use in treating snake bites. Seeds and leaves are use to cure skin diseases.
*Casuarina equisitifolia L**	*Casuarinaceae*	Sarugudu	Wood is use for house posts, rafters and masts of country made crafts, for fencing. Bark is a tonic and astringent, useful in diarrhoea and dysentery
Catharanthus roseus (L.) .Don	*Apocynaceae*	Billa ganneru	Whole plant is powdered and mixed with cow's milk and taken orally to treat diabetes
Catunaregam spinosa	*Rubiaceae*	-	The rind and fruit have useful emetic, diaphoretic and antispasmodic properties. The fruit is useful in cases of acute bronchitis and asthma. The fruit is applied externally in fever
Cissus quadrangularis L.	*Vitaceae*	Nalleru	Stem and root paste is use in bone fractures.
Cleome viscose L.	*Cleomaceae*	Kukkavamita	Used as treatment of infertility
Clerodendrum inerme(L.) Gaertn.	*Verbenaceae*	-	Fresh and dry leaves posses alternative and febrifugal properties. Root boiled in coconut oil is useful in kidney infection, jaundice etc
Cocos nucifera L.	*Arecaceae*	Coconut	Water from tender fruit is use for fever, urinary disorders, gastroenteritis and as a source of K for cholera patients. Fruit for stomachic, laxative, diuretic, styptic, sedative, useful in dyspepsia and burning sensation. Oil from endosperm- antiseptic; use in alopecia. Root- astringent; use in urinary and uterine and disorders. Shell and fibre-antimicrobial.
Croton bonplandianum Baill	*Ephorbiaceae*	Kukka vaminta	Use as a "liquid bandage", as well as for other medicinal purposes, by native peoples.
Cuscuta reflexa	*Convolvulaceae*	Seetamma pogunulu	Used as the medicine in Osteoporosis
Cyperus kyllingia	*Cyperaceae*	-	Used in treatment of fever
Cyperus rotundus	*Cyperaceae*	Nut grass	The root extract oil instilled into eyes in conjunctivitis reduces the pain, redness and ocular discharges. Used in treatment of fever , digestive system disorders
Dactyloctenium egyptium	*Poaceae*	Crow-foot	Astringent, bitter tonic, anthelmintic. Use for polyurea; externally for wounds and ulcers. Intestinal, bleary and urinary diseases.
Derris trifoliate	*Fabaceace*	Nalla tege	leaves and roots are use as laxative
Emilia sonchifolia	*Asteraceae*	-	The juice of the leaves is used in treating eye inflammations, night blindness, cuts and wounds and sore ears
Erargostis viscose Retz.	*Poaceae*	Banka sigarantha	Use as livestock fodder
Euphorbia hirta	*euphorbiaceae*	Nanubala	Female disorders, respiratory ailments (cough, coryza, bronchitis, and asthma), worm infestations in children, dysentery, jaundice, pimples, gonorrhoea, digestive problems, and tumours.

Evolvulus alsinoides (L.) L.	*Convolvulaceae*	-	Herb is use to cure dysentery, chronic bronchitis, fever, hiccups and jaundice and as antiseptic.
Ficus benghalensis	*Moraceae*	Marri chettu	The leaves are used to treat chronic diarrhoea and dysentery. The latex of the tree, when taken with milk, has a healing effect on piles. One should clean their teeth using the roots of this tree. This helps in protecting the gums against all kinds of infections and also keeps the teeth exceptionally clean
fimbristylis cymosa	*Cyperaceae*	-	Root extract is mixed with milk to cure dysentery.
Gisekia pharnaceoides L.	*Aizoaceae*	Ishi Rashukura	The plant possesses antibacterial, and depressant and anthelmintic activity.
Gomphrena globosa	*Amaranthaceae*	-	Used in coughs, pneumonia, rheumatism, piles, boils, skin eruptions, kidney stone and colic. The ash of the plant is used in cases of asthma and coughs; mixed with orpiment, the ash is used externally in the treatment of ulcers and warts.
Hedyotis herbacea(L.) Lam	*Rubeaceae*	Chiruveru	The leaves are pounded, soaked in warm water and the liquid drunk to treat stomach disorders. They are used externally as a poultice to treat sores and sore eyes
Hedyotis umbellata	*Rubeaceae*		This plant is well known in Siddha Medicine for its styptic property. It is also a drug that can be administered for bronchial asthma
Hemidesmus indicus (L.)	*Asclepiadaceae*	Barri sungandhi	Root and black pepper paste is use in stomach pain and diarrhoea
Hyptis suvelensis	*Lamiaceae*	Sirna Tulasi	Used as a traditional treatment for diarrhea
Ipomoea purpurea L.	*Convolvulaceae*	Morning glory	It is used in the treatment of oedema, oliguria, ascariasis and constipation. This has been used medicinally in the treatment of various mental disorders.
Ipomoea pes-caprae	*Convolvulaceae*	Horse shoe Creeper	Astringent, stomachic, laxative, anti-diarrhoeal, antiemetic, analgesic. Leaf diuretic, anti-inflammatory. Use in colic, prolapsus anti; externally in rheumatism. Essential oil of leaves is antagonistic to histamine. Leaf extract is use for different types of inflammations including injuries cause by poisonous jelly-fish
Jatropha gossypifolia	*Euphorbiaceae*	Nallamudamu	Roots are use for leprosy; bark decoction as emmemagogue; leaves to cure stomach ache, venereal diseases and as blood purifier.
Justicia procumbens	*Acanthaceae*		the treatment of asthma, cough, backache, flatulence and many skin conditions
Kylinga triceps Roth.	*Cyperaceae*	Gandala	The juice of the leaves is use in the skin injury by the ethnic races.
Lantana camara	*Verbenaceae*	Akshanthalu pulu	Invasive species of this particular zone.
Launaea sarmentosa (wild)	*Astaraceae*	Ajasringi	Good sand binder and plant juice is applied for the treatment of rheumatism
Leucas aspera(wild.) Link	*Lamiaceae*	Tella tummi	Leaf juice is use for chronic skin eruptions and painful swellings.
Mimosa pudica	*Mimosaceae*	Nidrakanthi	Leaf- astringent, alterative, antiseptic, styptic, blood purifier. Use for diarrhoea, dysentery, haemophilic conditions, leucorrhoea, morbid conditions of vagina, piles, fistula, hydrocele and glandular swellings. Root- use in gravel and urinary complaints. A decoction is taken to relieve asthma
Oldenlandia umbellate	*Rubiaceae*	Chiru veru	Root paste in the water collected after washing the raw rice is given orally for the snake bite. Leaf paste is applied to glandular swellings.
Opuntia stricta (Haw.) Haw	*Cactaceae*	Naga mullu	Baked fruit is given for whooping cough.
Pandanus fascicularis L.	*Pandanaceae*	Mogali	Flowers are use in perfumes. Leaves are useful in making mats and Baskets.
Pedalium murex L.	*Pedaliaceae*	Pedda palleru	The mucilaginous infusion formed from leaves, fruits or seeds in water or milk is use in the treatment of urinogenital diseases such as Gonorrhoea, dysuria etc.
Pennisetum orientale	*Cyperaceae*	Nakka toka gaddi	Used as ornamental plant
Perotis indica	*Cyperaceae*	Nakka toka	Cooling, laxative. Use in respiratory disorders. Gum- use in diarrhoea and genitourinary diseases. Fresh sap- laxative.
Phoenix sylvestris L and Roxy	*Arecaceae*	Eetha chettu	Dried leaves are use as brooms. Fruits are eaten after ripening. It is also use in fencing.
Phrosopis juliflora	*Mimosaceae*	Sarcar tumma	Mesquite is commonly used to treat eye conditions, open wounds and dermatological ailments
Phyla nodiflora (L)Greene	*Verbanaceae*	Mosali pappu	Fresh plant paste or poultice is applied as sappurent for boils, swollen cervical glands and chronic indolent ulcers.
Randia Dumetorum	*Rubiaceae*	Manga chettu	The fruit of plant has anti-inflammatory/ inflammation reducing, emetic/inducing vomiting and abortifacient/abortion causing properties. The tree bark is applied externally to relieve pain of bruises and rheumatism
Ricinus communis L.	*Euphorbiaceae*	Amudamu	Seed oil gel is useful in dermatitis; protective in occupational
Salichornia brachiata L.	*Amaranthaceae*	Glass wart	Its seeds yield high quality edible oil
Salvadora persica L.	*Salvadoraceae*	Pedha gogu	Used for centuries as a natural toothbrush, its fibrous branches have been promoted by the World Health Organization for oral hygiene use.
Sesbania bispinosa	*Fabaceae*	Etteejanga	It can be use like industrial hemp for rope, fish nets, sackcloth and sailcloth. Its fibres are similar to those of birch trees and show promise as a source of paper fibre. The foliage makes a good fodder for livestock and the beans can be fed to fowl. The plant has been also use as a famine food by people
sesuvium portulacastrum	*Aizoaceae*	Tikka kura	A very good sand binder. Young plants are edible after boiling to remove the excess the salt
Sida cordifolia L.	*Malvaceae*	-	Using in Ayurvedic medicines this herb are very useful in arthritis and other diseases which affect joints. These oils help to reduce pain and inflammation.
Spermacoce hispida	*Rubiaceae*	Madanaku	Used as treatment in obesity
Spinifex littoreous (Burm.f.)	*Poaceae*	Sea pinks	It is an excellent soil binder. Dried grass is use as fuel.
Themeda triandra	*Poaceae*	Pedha yerra	Used as ornamental plant
Thespesia populnea	*Malvaceae*	Indian tulip	Roots are use for relief from Cholera and dysentery.

*(L)S.Correa**			
Tinospora cordifolia	*Menispermaceae*	Tippa tega	Used as in Ayurvedic medicine
Tribulus terrestris L.	*Zygophyllaceae*	Cat head/bull head	Leaves and fruits are use in Ayurvedic medicine. It is believed to be useful in kidney, bladder, urinary tract and urogenital related conditions, where it is said to act as a diuretic
Tridax procumbens	*Asteraceae*	Gaddi chamanthi	Use in wound healing, as anticoagulant, antifungal and insect repellent. It is also use in diarrhoea and dysentery. Its leaf extracts were known to treat infectious skin diseases in folk medicines. It is a well-known Ayurvedic medicine for liver disorders or hepatic-protective nature besides gastritis and heart burn
Tylophora indica	*Asclepiadaceae*	Kakapala	It is traditionally used as a folk remedy in certain regions of India for the treatment of bronchial asthma, inflammation, bronchitis, allergies, rheumatism and dermatitis.
Vernonia cinerea (L.)Less.	*Asteraceae*	Sahadevi	Use to cure urinary disorders and skin diseases.
Vitex negundo	*Verbenaceae*	Vavili	Roots and leaves use in eczema, ringworm and other skin diseases, liver disorders, spleen enlargement, rheumatic pain, gout, abscess, backache
Waltheria indica	*Malvaceae*	Nalla benda	Flowers and roots are used in some medicinal cultures

Table 2: List of plant species use as vegetables

Scientific Name	Family	Uses
Aerva lanata (Burm.f.) merr.	*Amaranthaceae*	Whole plant, especially the leaves, is edible. The leaves are put into soup or eaten as spinach or as a vegetable. The plant provides grazing for stock, game and chickens
Canavalia maritime (Aubl.) Thou.	*Fabaceae*	Young pods and seeds are use as vegetables
Salicorina brachiata Rox	*chenopodiaceae*	Leaves and young shoots are eaten
Ipomoea aquatic L.	*Convolvulaceae*	Leaves are eaten as vegetables with high food value
Salvadora persica L.	*Salvadoraceae*	Plants are use for making salads and are often taken as fried snacks with rice
sesuvium portulacastrum	*Aizoaceae*	Use as vegetable in fishing time
Saueda martima	*Amaranthaceae*	Used as vegetable
Anacardium occidentale L.	*Anacardiaceae*	The shell of the cashew seed yields derivatives that can be use in many applications from lubricants to paints, and other parts of the tree have traditionally been use for snake-bites and other folk remedies.
Zizyphus jujuba	*Rhamnaceae*	Controlled clinical trial found the fruit helpful for chronic constipation. In another clinical trial, and effective against neonatal jaundice. In Persian traditional medicine it is use in combination with other herbal medicines to treat colds, flu and coughing
Hibiscus micranthus	*Malvaceae*	Used as vegetable

Table 3: List of plant species used as fodder and house materials

Scientific name	Family	Uses
Acacia auriculiformis	*Mimosaceae*	Its wood and charcoal are widely used for fuel. Gum from the tree is sold commercially
Agarostis maxima	*Poaceae*	Used as house hold material
Aristida setacea	*Poaceae*	Used as broom stick
Caesalpinia bonduc	*Caesalpinaceae*	Use as a ornament
Calophyllum inophyllum	*Clusiaceae*	Making of wooden showpiece and other wooden equipment
Causurina equisetifolia L.	*Casuarinaceae*	Wood is use for house post, rafters and masts of country made crafts; for fencing. Bark is a tonic and astringent, useful in diarrhoea and dysentery.
Cocos nucifera L.	*Arecaceae*	Use total plant for oil, fibre and making houses etc.
Crotalaria retusa L.	*Papilonaceae*	Root powder mixed with spices use as a remedy for colic. Leaves are use in fevers. It also yields fibre, which use cordage and canvas.
Crotalaria verrucosa L.	*Fabaceae*	Yields hemp-like strong fibres
croton bonplandianum Baill	*Ephorbiaceae*	More economical source of Biofuel
Cynodon dactylon	*Poaceae*	which are too salt-damaged to support agricultural crops; it was successfully irrigated with saline water and use to graze cattle
Hibiscus tiliaceus	*Malvaceae*	The wood of this tree has used, such as sea craft construction, firewood, and wood carvings. It is easy to plane and turns well, so it is regarded by many as a high quality furniture wood. Its tough bark can be made into durable rope and used for sealing cracks in boats.
Ipomoea fistulosa L.	*Convolvulaceae*	Though it is an invasive species but it is often use by the people in demarcation of their house area.
Pandanus fasicularis Lam.	*Pandanaceae*	Flowers are use in perfumes. Leaves are useful in making mats and baskets.
Phoenix paludosa (L.)	Arecaceae	Fruits are use edible. Popularly use as thatching material and fencing
Phoenix sylvestris L and Roxy	Arecaceae	Dried leaves are use as brooms. Fruits are eaten after ripening. It is also use in fencing
Salichornia brachiata L.	Amaranthaceae	It is also a good fodder for cattle, sheep and goat. Plant material is also use as raw material in paper and board factories. Its seeds yield high quality edible oil
Salvadora persica L.	Salvadoraceae	use as a drought-resistant fodder plant for cattle
Setaria verticillata L.	Poaceae	Seeds of the grass are use to make beer in some places
Zornia dyctiocarpa	Fabaceae	Used as fodder
Zornia gibbosa	Fabaceae	Used as fodder

In dune wise abundances the herbaceous community was predominantly spread between primary dunes and fore shore (17%) and Leeward dunes (37%) of species: *Spinifex littoreous, Ipomoea pescaprae (*Fig 6), *Launea sermentosa, Ttribulus terrestris (*Fig 4) and *pedalium murex. Crotalaria verrucosa* (Fig 7), *Pandanus fascicularis* (

Fig 8) and in the salty areas the species are mostly develop with the fresh water (17%). At hinterland the shrubs and trees (28%) of natural origin were in highest abundance (Fig 2). Comparatively more species like psammophytes and Climbers are dominant in leeward dunes *Tridax procumbens*(Fig 9). In between the leeward dunes dune slacks also contained the hydrophytes and some herbs.

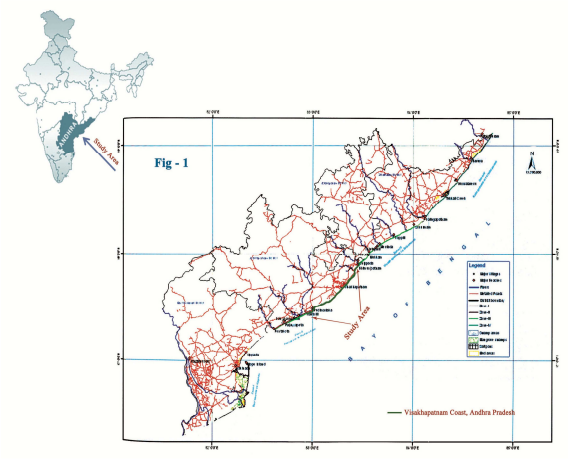

Figure 1 Study area: Visakhapatnam

Fig 3.*Lantana camera*

Fig 4. *Tribulus terrrestris*

Fig 5. *mimosa pudica*

Fig 6 *Ipomoea pes-caprae*

Fig 7 *Crotalaria verrucosa*

Fig 8 ***Pendanus facsicularis***

Fig 9 ***Tridax procumbens***

In the Visakhapatnam coastal dune area 103 species were distributed among 94 genera 37 families were enumerated from the study. Poaceae was more dominant family in CSD and followed by Fabaceae, Malvaceae. Among all these genera was most notable *Ipomoea and Phoenix* with two and three species respectively. In foredunes are most abundant by the creepers and Most of the vegetation grassy variety so it is has an important effect in helping to bind together the sand by their complex root system and thus help to protect the dune erosion. In leeward and hinterland dunes commonly more dominant species are herbs (47 sp.) and shrubs (28 sp.) than trees.

Table 4: List of potential sand binder plant species

Scientific name	Family	Uses
Bulbosttylis barbata Roth.	*Cyperaceae*	Potent soil binding species
Hydrphylax maritime L.f.	*Rubiaceae*	It is a good sand binder and protect the coast from erosion
Ipomoea pes-caprae(L.)R.Br	*Convolvulaceae*	It is a sand binder; leaves and roots are useful for gonorrhoea, rheumatism, skin infection and stomach ache
Launea sermentosa (Wild)	*Asteraceae*	Good sand binder and plant juice is applied for the treatment of rheumatism
Panicum repens L.	*Poaceae*	This species also a dangerous weeds but this species could be use for soil erosion control
Pendanus facsicularis	*Pendanaceae*	Play vital role in sand binding
sesuvium portulacastrum	*Aizoaceae*	A very good sand binder. Young plants are edible after boiling to remove the excess the salt
Spinifex littorious (Burm.f.)(Merr.	*Poaceae*	It is an excellent soil binder. Dried grass is use as fuel.
Suaeda monoica	*Amaranthaceae*	Play vital role as sand binder
Suaeda nudiflora	*Amaranthaceae*	Play vital role in sand binding
Saccharum spontaneum	*Cyperaceae*	The species flowers and fruits at the end of the rains in India and is therefore capable of colonizing areas such as soil and sand left bare by retreating floods. The root system is extremely extensive and the grass acts as an effective soil binder

Causes of dune degradations and conservation:

In east coast of Andhra Pradesh dunes are most important to the coastal areas. They are protecting from the natural hazards and also maintain the coastal aquifers. Dune degradation causes by two types. One is Anthropogenic and second one is natural disasters.

a) Anthropogenic activities like tourism, developmental recreational projects (figure 10), road constructions, human trampling, parking etc.

b) Natural disasters like heavy storms, like tsunami, Hud hud (figure 11), Neelam which have dropped Visakhapatnam zone in the years 2004, 20013, 2014.

In sampling areas like R.K Beach, Rushikonda, some species like *Ipomoea pes-caprae*, *Spinifex littoreus* degrading gradually by the tourism development programs from the 2012-2014. And rapid expansions of invasive species like *mimosa pudica*(Fig 5) *Calotropis gigantea, Lantana camara* (Fig 3), *Pendanus facsicularis(*Fig 8) leading to the loss of native species in INS Kalinga area. The alternative restoration methods should be developed. Sand dune restoration, fencing, and dune nourishment, and plantation in leeward dunes are most preferable methods to maintain and sustaining the dune ecosystem. Creating public awareness in schools, colleges and local communities to maintain flora and fauna in the coastal line is the major point in the east coast area.

Figure 10: Destruction of flora near RK Beach

Figure 11: Hud hud effect at INS Kalinga

CONCLUSION

The coastal sand dune plant species of Visakhapatnam coast are extremely important resources, which play a vital role in the economic and social life of local people. Restoration and conservation of the psammophytes are most important for the future generations. Inventory of 81 plant species from different sand dune zones is the major study in the East coast of Visakhapatnam. The main species which are play as sand binders are most to be protective. CSD plants maintaining sustainable ecological balance in the ecosystem.

Acknowledgement
The authors are duly acknowledged the Head, department of Botany, Andhra University for allowing us to refer the herbarium collections and earlier literature for identification of sand dune flora. We extend our thanks to the research scholars of the department of Environmental Sciences, Andhra University for their voluntary participation and help rendered during field survey of Visakhapatnam coastal areas.

REFERENCES

[1] Aparna S, Raja Sekhar PS, *J. Nature Conservation*, **2013,** 25, 73.
[2] Banerjee LK, (**1994**) ,*Bull Bot Survey India*, 36 : 160.
[3] Brown RL, *J.Soil and Water Conservation*, **1948**, 3: 69.
[4] Devall MS, *J.Coastal Research*, **1992**, 8, 442
[5] Hooker JD, The Flora of British India, London: L. Reeve, **1875**, pp 97.
[6] Jagannadha Rao M, Greeshma Gireesh AG, Avatharam P, Anil NC and Karuna Karudu T**,** *J. Indian Geophysical Union*, **2012**, **16(4),** 179-187
[7] Muhammad Qasim, Zainul Abideen, Muhammad Yousuf Adnan, Raziuddin Ansari1, Bilquees Gul, Muhammad AjmalKhan, *J. coastal life medicine*, **2014,** *2*, 2.
[8] Namboothri N, Subramanian D, Muthuraman B and Sridhar A, *Ashoka Trust for Research in Ecology and the Environment*, Bangalore, India, **2008**.
[9] Padmavathy K, Poyyamoli G and Balachandran N, Puducherry, *Check List*, **2010,** 6(2), 198.
[10] Pattnaik Reddy CS, Dhal N K, *Indian j. Traditional Knowledge*, **2008,** 7; 263-268
[11] Rodrigues RS, *Ocean & Coastal Management* ,**2011**, 54, 181
[12] Tamal Chakraborty, Amal Kumar Mondal and Sanjukta parui, *I. J.Science and Nature*, **2012**, 3, 745.