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**“MANGROVE DIVERSITY IN THE YANAM REGION AND CLIMATE STRESS
IMPACTS ON MANGROVE & ESTUARINE ECOSYSTEM HEALTH”**



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Mangrove Diversity in the Yanam Region and Climate Stress Impacts on Mangrove & Estuarine Ecosystem Health

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Yanam Region, Union Territory of Puducherry

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Mangrove Diversity in the Yanam Region and Climate Stress

Impacts on Mangrove & Estuarine Ecosystem Health

ABSTRACT

The Yanam region of the Puducherry Union Territory lies at the point where the River Coringa (Atreya) branches off from the Gautami Godavari into two channels. The region covers an area of 30.0 sq. km and is bounded on the east and south by the Gautami Godavari River, which discharges into the Bay of Bengal after flowing approximately 14 km eastward from the Yanam entry point. The mangrove vegetation of the Yanam region extends up to the Coringa Wildlife Sanctuary and estuary located in the East Godavari District (Kakinada) of Andhra Pradesh. Mangrove forests are distributed among five islands, namely:

Island No. 1, adjacent to Coringa Wildlife Sanctuary, north of Savitrinagar and Giriampeta;

Island Nos. 2 and 4, south of Savitrinagar and Giriampeta;

Island No. 3, in and around Dariyalathippa and Farampeta;

Island No. 5, near the Yanam river beach along the border of Andhra Pradesh river water territory. Some mangrove patches are also located in the Farampeta, Kurasampeta, Mettakur, and Bheemnagar areas along the backwater canals. During field visits conducted in various mangrove areas in 2024 and 2025 by the Department of Botany, rich diversity of mangrove vegetation was observed, including species of *Avicennia*, *Bruguiera*, *Ceriops*, *Excoecaria*, *Lumnitzera*, *Rhizophora*, *Sonneratia*, *Acanthus*, and *Myriostachya*, along with their associates. However, there is no comprehensive data available till date on the documentation and inventorisation of the exact number of species distributed in the Yanam region and their correct identification.

In recent decades, the impact of climate change and environmental stress on mangroves, estuaries ecosystem and islands has been observed. Major contributing factors include oil rigging activities by Reliance and ONGC, which handle deep-sea gas drilling, dehydration, and compression processes. Temperature and thermal stress are caused by the disposal of wastewater from the Onshore Gas Terminal of Reliance Industries' Gadimoga unit. Sea-level rise has led to habitat loss of island species, altered hydrology, and potential inundation. Island No. 4 has almost vanished due to increasing water levels. Island No. 5, which once supported healthy mangrove vegetation, is now experiencing habitat range shifts and is increasingly occupied by sandy vegetation and thorny weeds, making mangroves rare

on the island. A major ONGC gas pipeline leak occurred on August 21–22, 2025, on Dariyalathippa Island, causing a large fire and widespread panic. Surrounding mangrove vegetation, including large trees, was affected, and most of it died. Recent field visits also revealed the disposal of solid waste and dead cattle, dogs, goats, etc., into the Godavari River by local residents in certain wards, creating pollution stress on mangroves and the estuarine ecosystem.

Based on the aforementioned facts, it is proposed to study the mangrove vegetation and the effects of climate stress on the health of the estuarine ecosystem as a whole.

The objectives of the study are as follows:

- To conduct field trips to all five islands of the Yanam region
- To carry out inventorisatation of mangrove diversity in the Yanam region
- To identify the causes of climate stress on mangroves and estuarine ecosystem
- To study the impact of various climate stresses on the health of the estuarine ecosystem
- To recommend best practices for enhancing mangrove vegetation and reducing the effects of climate change stress.

The primary data generated from the present study may strengthen regional climate resilience strategies and provide policy-relevant information for future policymakers under the State Action Plan on Climate Change (SAPCC) of the Puducherry Union Territory, India.

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Introduction

The Yanam region of the Puducherry Union Territory lies at the point where the River Coringa (Atreya) branches off from the Gautami Godavari into two channels. The region covers an area of 30.0 sq. km and is bounded on the east and south by the Gautami Godavari River, which discharges into the Bay of Bengal after flowing approximately 14 km eastward from the Yanam entry point (¹Yanam Admin. Govt. Website). The mangrove vegetation of the Yanam region extends up to the Coringa Wildlife Sanctuary and estuary located in the East Godavari District (Kakinada) of Andhra Pradesh. Mangrove diversity of Yanam region is distributed among five islands, namely: Island No. 1, adjacent to Coringa Wildlife Sanctuary, north of Savitrinagar and Giriampeta; Island Nos. 2 and 4, south of Savitrinagar and Giriampeta; Island No. 3, in and around Dariyalathippa and Farampeta; Island No. 5, near the Yanam river beach along the border of Andhra Pradesh river water territory.

Some mangrove patches are also located in the Farampeta, Kurasampeta, Mettakur, and Bheemnagar areas along the backwater canals. During field visits conducted in various mangrove areas in 2024 and 2025 by the Department of Botany, rich diversity of mangrove vegetation was observed, including species of *Avicennia*, *Bruguiera*, *Ceriops*, *Excoecaria*, *Lumnitzera*, *Rhizophora*, *Sonneratia*, *Acanthus*, and *Myriostachya*, along with their associates (²Sudhakar, 2024). However, there is no comprehensive data available until date on the documentation and inventorisation of the exact number of species distributed in the Yanam region and their correct identification.

In recent decades, the impact of climate change and environmental stress on mangroves, estuaries ecosystem and islands has been observed. Major contributing factors include oil rigging activities by Reliance and ONGC, which handle deep-sea gas drilling, dehydration, and compression processes. Temperature and thermal stress are caused by the disposal of wastewater from the Onshore Gas Terminal of Reliance Industries' Gadimoga unit. Sea-level rise has led to habitat loss of island species, altered hydrology, and potential inundation. Island No. 4 has partially vanished due to increasing water levels (³Satellite Maps & Locals Data, 2025). Island No. 5, which once supported healthy mangrove vegetation, is now experiencing habitat range shifts and is increasingly occupied by sandy vegetation and thorny weeds, making mangroves rare on the island (⁴Sudhakar, 2024). A major ONGC gas pipeline leak occurred on August 21–22, 2025, on Dariyalathippa Island, causing a large fire and widespread panic (⁵The New Indian Express, 2025). Surrounding mangrove vegetation, including large trees, was affected, and most of it died. Recent field visits also revealed the disposal of solid waste and dead cattle, dogs, goats, etc., into the Godavari River by local residents in certain wards, creating pollution stress on mangroves and the estuarine ecosystem.

Based on the aforementioned facts, it is proposed to study the mangrove vegetation and the effects of climate stress on the health of the estuarine ecosystem as a whole in Yanam region.

Objectives

- To conduct field trips to all five islands of the Yanam region
- To carry out inventurisation of mangrove diversity in the Yanam region
- To identify the causes of climate stress on mangroves and estuarine ecosystem
- To study the impact of various climate stresses on the health of the estuarine ecosystem
- To recommend best practices for enhancing mangrove vegetation and reducing the effects of climate change stress.

Study Area

The study area selected for present work of Mangrove diversity and Climate Stress Impacts on Mangrove & Estuarine Ecosystem Health is Yanam region which is the part of Union Territory of Puducherry and geographically located in Godavari river estuarine region of East Godavari District (present Kakinada District) of Andhra Pradesh. Mangrove diversity of Yanam region is distributed among five islands, namely:

Island No. 1, adjacent to Coringa Wildlife Sanctuary, north of Savitrinagar and Giryampeta;

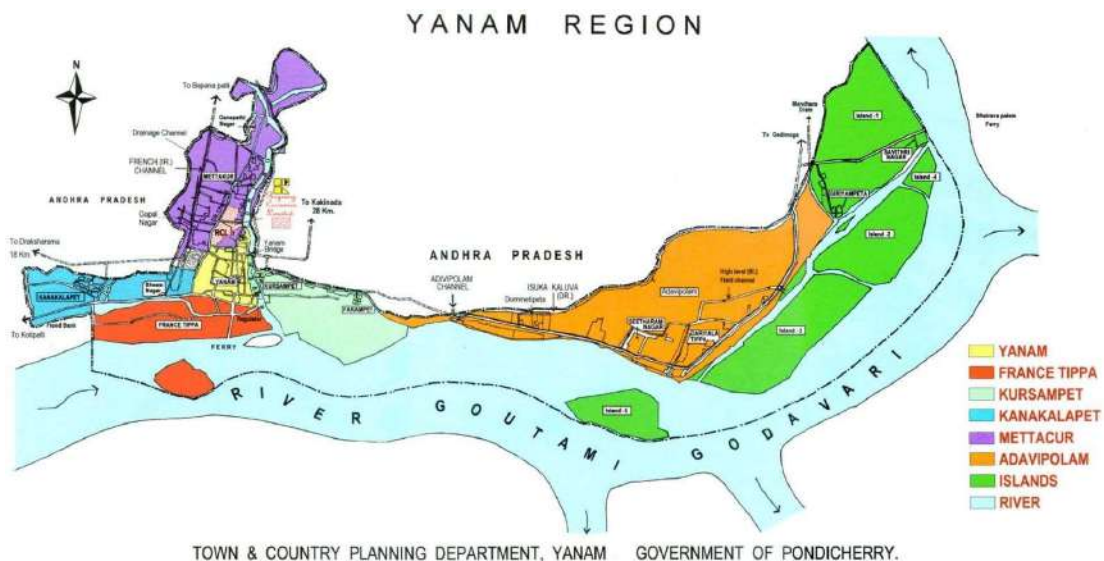
Island Nos. 2 and 4, south of Savitrinagar and Giryampeta;

Island No. 3, in and around Dariyalathippa and Farampeta;

Island No. 5, near the Yanam river beach along the border of Andhra Pradesh river water territory.

Some mangrove patches are also located in the Farampeta, Kurasampeta, Mettakur, and Bheemnagar areas along the backwater canals.

The map of study area



Literature Survey

C.E.C. Fischer reported documentation of Mangrove diversity of south India first time in the Gamble (1915-1938) volume 3. Consequently Venkateswarlu (1944) published The estuarial flora of the Godavari. Brief descriptions of common Mangroves reported by Cooke (1967) in his Flora of the Presidency of Bombay. Blasco (1975) explained about Mangroves of India, which was published from French Institute, Pondicherry. Subbareddi (1982) worked on The Mangroves of Godavari estuary. Krishnamurthy *et al.* (1987) submitted status report of Mangroves in India to the Ministry of Environment and Forests.

Uma Maheswara Rao *et al.* (1988) published Mangrove populations of the Godavari Delta Complex. Identification Manual for Indian Mangroves brought by Banerjee *et al.* (1989). Kar *et al.* & Banerjee *et al.* (1990) reported Mangrove diversity of Orissa coast. One of the literature adjacent to Mangroves of Yanam region was 'Management Plan for Coringa Wildlife Sanctuary, Andhra Pradesh by Rajesh Mittal (1993). Spalding *et al.*, (1997) prepared World Mangrove Atlas.

Balu *et al* (1998) carried Botanical studies on Mangroves of Tamil Nadu. The Food and Agricultural Organisation FAO (1994) outlined the guidelines for Mangrove Forest Management. Kathiresan (1996, 2000, 2001, 2002) studied the development and diversification of vegetation along Ariankuppam river, Puducherry; Flora and Fauna of Mangrove ecosystems; Biology of Mangroves and mangrove ecosystems; Why mangroves are degrading?; Fishery resources and economic gain in three mangrove areas on the south-east coast of India.

Chelliah (2001) explained the how Mangrove forests are becoming threatened ecosystems. Blasco and Aizpuru (2002) studied Mangroves along the coastal stretch of the bay of Bengal. Ramaswamy (2003) worked on Survey, Phenology, Morphology conservation and afforestation of Mangroves of Pondicherry. Ramasubramanian *et al.* (2003) published Mangroves of Andhra Pradesh: identification and conservation manual, which is relevant publication for the Mangroves of Yanam region. Ravishankar and Ramasubramanian (2004) prepared Manual on Mangrove Nursery Raising Techniques from M.S. Swaminathan Research Foundation. Ramasubramanian *et al.* (2020) brought out Manual on Mangrove Nursery and Mangrove Genetic Resources Conservation Centre located adjacent to Coringa Wildlife Sanctuary. There is no comprehensive work or data available till date on the documentation and inventorisation of the exact number of species distributed in the Yanam region which is located in the Godavari estuarine ecosystem.

Methodology

The important localities of the five Islands such as Savitrinagar, Giriampeta, Dariyalathippa, Farampeta and River beach of Yanam region, where mangrove and mangrove-associated vegetation occur, were initially identified and made primary surveys.

The study area was delineated using survey maps of the wards and islands obtained from the Regional Administrative Office, Government of Puducherry, Yanam. Regular field visits were conducted in 2024 and 2025 by the Department of Botany students, and recently on January and February 2026 by scholars to identify access routes to different locations around the waterway. Survey maps were utilized to demarcate inundated areas and to determine the spatial distribution of mangroves and mangrove-associated vegetation.

The approximate extent of tidal inundation and the distribution of mangroves and associated plant species at various locations were measured and noted in the field notebooks. The plant specimens of 30 cm twigs with flowers and fruits were collected for documentation, study of diagnostic characters in detail and for the preparation of herbarium specimens for future reference. The specimens were identified with the help of available published literature, field photographs, descriptions etc. Apart from the geographical and ecological characteristics of the study area, which were observed and recorded to provide a preliminary understanding of the habitat's environmental conditions.

The team also visited various oil and gas operational sites, including the Onshore Gas Terminal of Reliance Industries at Gadimoga and facilities operated by ONGC. These sites are involved in deep-sea gas drilling, dehydration, and gas compression processes. The team further visited the location of the major ONGC gas pipeline leak that occurred on August 21–22, 2025, at Dariyalathippa Island within the mangrove patch along the Godavari River (⁵The New Indian Express, 2025). This visit was conducted to observe and document the adverse environmental effects of the incident.

In addition, climate-related stresses such as rising sea levels, increasing temperatures, pollution in the Godavari estuarine areas, and the dumping of garbage along the riverbanks by local inhabitants were assessed for their impacts on mangrove and estuarine ecosystem health. These impacts were evaluated using collected field data and photographic documentation from the study area.

Field visits to Farampeta, Dariyalathippa Islands by research team and guide



Field visits



Mangrove Explorations at Island number 3. In and around Dariyalathippa



Mangrove Explorations at Island number 2 & 3. In and around Dariyalathippa and Savitrinagar

Data Analysis and Results

Mangrove Diversity in the Yanam Region

Filed data noted during field visits and diagnostic characters data of collected specimens were analysed. The results show a total of **13** Mangroves and their associated species were reported throughout habitats of all five Islands. The check list of the all the species tabulated in Table 1 & 2.

Field characters and easy identifying features of the **True Mangroves diversity of Yanam region and some important Mangrove associates** are provided here in alphabetical order along with their family, local vernacular names, field photographs for easy identification, and ready reference for future researchers, scientific communities etc.

Table 1. List of True Mangroves diversity in Yanam region

S. NO	COMMON NAME	SCIENTIFIC NAME	FAMILY
1.	Eng.: River Mangrove or Black Mangrove Tel.: Gugillam	<i>Aegiceras corniculatum</i> (L.) Blanco	Myrsinaceae
2.	Eng.: Api Api Mangrove Tel.: Vilava mada	<i>Avicennia alba</i> Blume	Avicenniaceae
3.	Eng.: Grey Mangrove, White Mangrove Tel.: Thella Mada	<i>Avicennia marina</i> (Forssk.) Vierh.	Avicenniaceae
4.	Eng.: Indian Mangrove Tel.: Nalla Mada	<i>Avicennia officinalis</i> L.	Avicenniaceae
5.	Eng.: White Burma Mangrove Tel.: Urudu	<i>Bruguiera cylindrica</i> (L.) Blume	Rhizophoraceae
6.	Eng.: Large Leaf Mangrove, Red Mangrove Tel.: Thuddu Ponna, Kandringa	<i>Bruguiera gymnorhiza</i> (L.) Savigny	Rhizophoraceae
7.	Eng.: Flat Leaf Spurred Mangrove Tel.: Podapa, Getharu	<i>Ceriops decandra</i> (Griff.) Ding Hou	Rhizophoraceae
8.	Eng.: Blinding tree, River Poison tree, Milky mangrove Tel.: Thilla, Tella, Chilla	<i>Excoecaria agallocha</i> L.	Euphorbiaceae
9.	Eng.: Black mangrove Tel.: Thanduga, Kadavi, Kadivi, Than, Podapa	<i>Lumnitzera racemosa</i> Willd.	Combretaceae

S. NO	COMMON NAME	SCIENTIFIC NAME	FAMILY
10.	Eng.: Tall-Stilt Mangrove Tel.: Uppu Ponna, Kaki Ponna	<i>Rhizophora apiculata</i> Blume	Rhizophoraceae
11.	Eng.: Loop Root Mangrove, Red Mangrove Tel.: Uppu Ponna, Kandla, Adavi Ponna	<i>Rhizophora mucronata</i> Poir.	Rhizophoraceae
12.	Eng.: Mangrove Apple Tel.: Kalinga (Chinna), Kyalanki	<i>Sonneratia apetala</i> Buch.-Ham.	Sonneratiaceae
13.	Eng.: Cedar Mangrove Tel.: Senuga	<i>Xylocarpus moluccensis</i> (Lam.) M. Roem.	Meliaceae

1. *Aegiceras corniculatum* (L.) Blanco

Family: Myrsinaceae

Vernacular names: Telugu: Guggilam

Habit: Tree

Diagnostic characteristics:

Small, 2-4 m tall evergreen trees.

Stems much branched, with brownish grey bark and broom-shaped stilt roots arising from base.

Leaves 4-8.5 x 2-4.5 cm, alternate, obovate or ovate oblong, coriaceous.

Flowers 1.5-2 cm long, white, fragrant, subsessile, mostly in leaf-opposed umbels.

Fruits 6-8 cm long, falcate, sharply pointed, coriaceous, yellowish brown with persistent imbricate calyx.

Field observations: Common in Island no. 1, 2, 3 & 4: Dariyalathippa, Savitrinagar, Giryampeta



2. *Avicennia alba* Blume

Family: Avicenniaceae

Vernacular names: Telugu: Vilava mada

Habit: Small tree or Large Shrub

Diagnostic characteristics:

Shrubs or small trees, 4-10 m tall

Stems 20-50 cm in diam., glabrous, black coloured with thin lenticellate bark.

Tap roots absent. Pneumatophores 8-15 cm long, straight, narrowly pointed, often hooked at apex.

Leaves 8-15 x 2.5-4 cm, lanceolate, dark green or black, shining above, silvery papillose below.

Flowers 3-6 mm across, yellow, fragrant, arranged in axillary or terminal spikes.

Capsules 3-4 cm long, ovoid or ellipsoid, narrowly acuminate, slightly curved at apex, densely tomentose throughout.

Field observations: **Rare.** Located in Island no. 1 & 2 only in undisturbed areas of Savitrinagar and Giriyampeta



4. *Avicennia marina* (Forssk.) Vierh.

Family: Avicenniaceae

Vernacular names: Telugu: Thella mada

Habit: Small tree or Large Shrub

Diagnostic characteristics:

Shrubs or small bushy trees 3-6 m tall, 10-20 cm in diam.

Stems glabrous, much branched; bark thin, yellowish-grey. Tap root absent;

Pneumatophores 3-10 cm long, narrowly pointed, straight, not branched or hooked.

Leaves 5-6 x 2.5-3 cm, elliptic-oblong, coriaceous, dark green, shining above, yellowish papillose beneath.

Flowers 2-4 mm across, yellow, fragrant, 6-10, crowded in terminal condensed cymes.

Capsules ovoid, small size, apiculate at apex.

Field observations: **Common** in Islands: 1, 2, 3. Dariyalathippa, Savitrinagar, Giriyampeta



3. *Avicennia officinalis* L.

Family: Avicenniaceae

Vernacular names: Telugu: Nalla mada

Habit: Tree

Diagnostic characteristics:

Trees, 4-10 m tall

Stems 70-150 cm in diam., glabrous, much branched;

Tap roots absent. Pneumatophores 10-20 cm long, straight, pointed, lenticellate, often forked with hook-like bending at apex

Leaves 6-10 x 3-6.5 cm, obovate or broadly ovate-oblong, coriaceous, dark-green above, silvery-papillose beneath

Flowers up to 1 cm long, yellow, fragrant, in axillary or terminal head-like congested cymes;

Capsules broadly ovoid, almond-shaped, densely silvery papillose, beaked at apex

Field observations: **Common** in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta and patches in Kurasampeta



5. *Bruguiera cylindrica* (L.) Blume

Family: Rhizophoraceae

Vernacular names: Telugu: Urudu

Habit: Small Tree or Large Shrub

Diagnostic characteristics:

Small Tree or Large Shrub, 2-3 m. tall, stems smooth,

Stems base buttressed, with

many knee roots; twigs bronze-coloured with stipular

Leaves 8-16.5 x 5.5-6.5 cm, oblanceolate, or rarely elliptic, thick, coriaceous, bronze-green,

Flowers white, 1-1.3 cm across, 3, in axially pedunculate cymes;

Hypocotyle 10-14 cm long, 5 mm in diam., more or less cylindric, straight or slightly curved towards apex.

Field observations: **Rare.** Located in Islands 2 & 3. Undisturbed areas of Dariyalathippa, Savitrinagar, Giryampeta.



6. *Bruguiera gymnorhiza* (L.) Savigny

Family: Rhizophoraceae

Vernacular names: Telugu: Kandringa

Habit: Small Tree or Large Shrub

Diagnostic characteristics:

Small Tree or Large Shrub, 2-4 m tall, 30-60 cm in diam.;

Bark rough, fissured, corky lenticellate;

stem base shortly buttressed with many geniculate pneumatophores.

Leaves 12.5-20.5 x 5.5-7.5 cm, elliptic oblong or ovate-elliptic, thick coriaceous, dark green,

Flowers scarlet, up to 3.5-4 cm, solitary;

Petals as many as calyx lobes, 13-17 mm long, two-lobed, caducous, embracing a pair of stamens

Hypocotyl angular, cigar shaped, 15-17 x 1.5-2.5 cm, narrowed at apex.

Field observations: **Rare.** Located in Islands 1, 2 & 3. Undisturbed areas of Dariyalathippa, Savitrinagar, Giriampeta.



7. *Ceriops decandra* (Griff.) Ding Hou

Family: Rhizophoraceae

Vernacular names: Telugu: Thogara

Habit: Tree

Diagnostic characteristics:

Trees, 2-6 m. tall. Stem reddish brown, much-branched;

Stem base pyramidal in outline, with many stilt roots.

Bark lightgrey, lenticular fissures, peeling in thin flakes; Leaves 5-14 x 4-10 cm, obovate or ellipticoblong, coriaceous. Flowers white, 3-4 mm across, resinous, 8-14 flowered, condensed cymes arranged in the axils of several nodes or from upper axils of branchlets;

Fruits ovoid, conical, hypocotyle 12-14 cm long, angular, sulcate.

Field observations: **Common** in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giriampeta, Farampeta



Mangrove Habitats of Yanam region



Dariyalathippa: In and around Island 2 & 3



Savitrinagar: In and around Island 1 & 3

8. *Excoecaria agallocha* L.

Family: Euphorbiaceae

Vernacular names: Telugu: Thilla

Habit: Tree

Diagnostic characteristics:

Evergreen trees with milky acrid juice, 3-8 m tall, 10-40 cm in diam.,

Barks greyish-white, smooth, lenticellate, wood soft, light. Tap root insignificant, lateral roots spreading like snakes intermingled each other supraterranean bands produce elbow-shaped pegs instead of pneumatophores.

Leaves 2-8 x 1.5-3 cm, ovate, ovate-elliptic or ovateoblong, coriaceous, shining dark-green, turning red before shedding. Flowers unisexual, fragrant, male flowers 2-3 mm across, sessile, yellow, in axially many flowered catkinlike spikes spikes 3-7 cm long;

Fruits 1-1.5 cm across, depressed globes, 3-lobed.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta, backwaters of Kurasampeta, Mettakur and Bhimnaga.



9. *Lumnitzera racemosa* Willd.

Family: Combretaceae

Vernacular names: Telugu: Thanduga

Habit: Small tree

Diagnostic characteristics:

Small trees, 2-4 m tall, without pneumatophores bark reddish-brown, lenticellate.

Leaves 4-8.5 x 1.5-3.5 cm, obovate, thick, coriaceous.

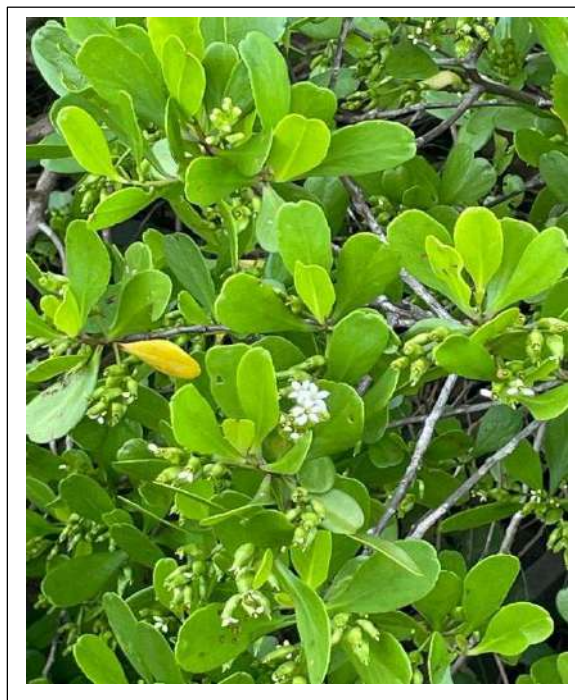
Flowers 9-11 mm long, white, sessile in axillary spikes;

Receptacles 3-5 mm long, tubular, with two adnate, persistent bracteoles.

Fruits 8-10 x 4-6 mm, compressed, woody, ellipsoid, 1-seeded drupes.

Seeds elongated, pointed towards apex.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta.



10. *Rhizophora apiculata* Blume

Family: Rhizophoraceae

Vernacular names: Telugu: Ponna

Habit: Tree

Diagnostic characteristics:

Trees, 5-6 m tall, 30-100 cm in diam.;

Stem base without tap root system from beginning;
supporting stilt roots aerial, manybranched;
branches sympodial.

Leaves 10-20 x 5-9 cm, ellipticoblong, sub-lanceolate or obovate,
coriaceous,

Flowers 10-12 mm long, yellow, sessile,

paired in upper axils from cupular involucre,

Fruits 2.5-3 cm across, obpyriform, solid, brown;

Hypocotyle 20-30 cm long, smooth, cylindrical, pointed towards the radical end.

Field observations: **Rare.** Located in Islands 1, 2 & 3. Undisturbed areas of Dariyalathippa, Savitrinagar, Giriampeta.



11. *Rhizophora mucronata* Poir.

Family: Rhizophoraceae

Vernacular names: Telugu: Ponna

Habit: Tree

Diagnostic characteristics:

Trees, up to 5 m. tall, with many upwardly growing branches; leaf scars prominent, close.

Stem - base supported by numerous branched stiltroots.

Leaves 10-18 x 4-10 cm, broadly elliptic or ovate-oblong, coriaceous, abruptly acute or blunt with a rolled up tip (mucro) at apex, cuneate at base.

Flowers in axillary cymes, 4-8 in number, pedicellate, cream coloured, fragrant;

Hypocotyle 30-65 cm long, cylindrical

Field observations: **Rare.** Located in Islands 1, 2 & 3. Undisturbed areas of Dariyalathippa, Savitrinagar, Giriampeta.



12. *Sonneratia apetala* Buch.-Ham.

Family: Sonneratiaceae

Vernacular names: Telugu: Kaalinga

Habit: Tree

Diagnostic characteristics:

Trees, 4-6 m. tall, 30-80 cm in diam., with dense crowns; Stems with many pale-green, soft drooping branches; Bark thin, light brown, irregularly fissured; Stem base not buttressed, provided with 15-30 cm long, peg-like, corky pneumatophores; Pneumatophores sometimes forked twice or thrice.

Leaves 5-14 x 2-3.5 cm, narrowly elliptic-oblong or oblanceolate, coriaceous, attenuate at base, tapering towards apex.

Flowers 1.5-2 cm across, apetalous, green or yellowish-white, in axially solitary or terminal 3-flowered dichasia or 7-flowered cymes from the branch-axils.

Fruits 2-2.5 cm across, smooth globes, many seeded berries, shortly pointed at apex. **Field observations:** Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giriampeta, Farampeta.



13. *Xylocarpus moluccensis* (Lam.) M. Roem.

Family: Meliaceae

Vernacular names: Telugu: Senuga

Habit: Tree

Diagnostic characteristics:

Large trees up to 10 m tall, trunk up to 60 cm in diam. at base, buttressed:

Bark red with thick flakes; wood red in colour; pneumatophores woody

Leaflets 7-12 x 3-6 cm, ovate, acute at apex, oblique at base

Flowers 2-3 cm across, white with red glands inside;

Fruits 10-15 cm across, globose.

Field observations: Rare. Located in Islands 1, 2 & 3. Undisturbed areas of Dariyalathippa, Savitrinagar, Giriampeta.



Table 2. List of Important Mangroves Associates diversity in Yanam region

S. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY
1.	Eng.: Holly-leaved acanthus, Holy mangrove Tel.: Aalchi	<i>Acanthus ilicifolius</i> L.	Acanthaceae
2.	Eng.: Bonduct nut, Fever nut Tel.: Rakkisi	<i>Caesalpinia crista</i> L	Fabaceae (Ceasalpiniaceae)
3.	Eng.: Indian privet Tel.: Pisingi	<i>Clerodendrum inerme</i> (L.) Gaertn	Verbenaceae
4.	Eng.: Thorny liana Tel.: Chillinga	<i>Dalbergia spinosa</i> Roxb.	Fabaceae
5.	Eng.: Derris Tel.: Nalla theega	<i>Derris trifoliata</i> Lour.	Fabaceae
7.	Eng.: Sea Morning Glory Tel.: Balabantaige	<i>Ipomoea pes-caprae</i> (L.) R. Br.	Convolvulaceae
6.	Eng.: Moon flower Tel.: Thella theega	<i>Ipomoea tuba</i> (Schl.) G. Don.	Convolvulaceae
8.	Eng.: Spikegrass Tel.: Darbha gaddi	<i>Myriostachya wightiana</i> (Nees ex Steud.) Hook. f	Poaceae
9.	Eng.: Mangrove fern Tel.: Palaboddu theega	<i>Sarcolobus carinatus</i> Wall.	Asclepiadaceae
10.	Eng.: Sea Purslane Tel.: Vangaredu Koora	<i>Sesuvium portulacastrum</i> (L.) L.	Aizoaceae
11.	Eng.: Seepweed Tel.: Eelakura	<i>Suaeda maritima</i> (L.) Dumort	Chenopodiaceae
12.	Eng.: Tamarix Tel.: Palivelu	<i>Tamarix troupii</i> Hole	Tamaricaceae
13.	Eng.: Sea hibiscus or Coast cottonwood Tel.: Attakanara	<i>Hibiscus tiliaceus</i> L.	Malavaceae
14.	Eng.: Portia tree Tel.: Gangaraavi	<i>Thespesia populneoides</i> (Roxb.) Kostel.	Malavaceae

1. *Acanthus ilicifolius* L.

Family: Acanthaceae

Vernacular names: Telugu: Aalchi

Habit: Undershrub or herb

Diagnostic characteristics:

Erect, ascending or scandent, thistly herbs or undershrubs, 0.3-1 m. tall;

Stems terete, often provided with aerial roots, glabrous, with two sharp spines in leaf axils.

Leaves 5-11 x 3-10 cm, decussate, ovate-oblong or lanceolate, coriaceous, margins spiny, narrowed at base, spiny at apex.

Flowers 3.5-4 cm long, violet, pubescent within, arranged in terminal spikes; spikes simple or branched, 5-20 cm long.

Capsules 2-3 cm in diam., ovoid-oblong, compressed, apiculate, shining green or brown.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giriyaampeta, Farampeta, backwaters of Kurasampeta, Mettakur and Bhimnagar. Mostly associated with *Myriostachya wightiana* and *Fimbristylis* sp.



2. *Caesalpinia crista* L.

Family: Fabaceae (Caesalpinaceae)

Vernacular names: Telugu: Rakkisi

Habit: Large climber

Diagnostic characteristics:

Large climbers, armed with hooked prickles.

Leaves 18-30 cm long, decomposed; pinnae 2-6 pairs;

Rachies unarmed or sparingly aculeate, 3-10 cm long;

Leaflets ovate or elliptic-oblong, subcoriaceous, pale glaucous beneath,

Flowers 1.5-2 cm long, deep yellow, fragrant, in axially or supra-axillary branched racemes.

Pods 4-5 x 3-3.5 cm, ellipsoid, flat, compressed, beaked.

Seeds 1, flat, smooth.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giriyaampeta, Farampeta, backwaters of Kurasampeta and Mettakur.



3. *Clerodendrum inerme* (L.) Gaertn

Family: Verbenaceae

Vernacular names: Telugu: Pisingi

Habit: Straggling Shrub

Diagnostic characteristics:

Straggling, much-branched shrubs 1-3 m tall;

branches adpressed pubescent when young.

Leaves 1.5-6 x 1-3 cm, ovate-elliptic or oblong

lanceolate, glabrous,

Flowers 3-3.5 cm long, tubular, white, in terminal or axillary, 3-flowered pedunculate cymes;

Drupes 1.5-2 cm long, obovoid, 4-lobed, breaking into 4 pyrenes.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta..



4. *Dalbergia spinosa* Roxb.

Family: Fabaceae

Vernacular names: Telugu: Chillinga

Habit: Small brushy trees or Woody thorny liana

Diagnostic characteristics:

Small brushy trees or Woody thorny liana, 4-8 m tall;

Branchlets many, horizontal, ending in a hard spine

Leaves 6-9 cm. long, crowded at the nodes of spinous branchlets;

Leaflets 9-11, alternate, each 1-2.5 X 0.5-1 cm, elliptic or obovate, glabrous,

Flowers 2-3 mm across, whitish purple, in axially lateral racemes.

Pods 2.5-3 cm long, thin, glabrous, kidney-shaped, 1-2 - seeded.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta.



5. *Derris trifoliata* Lour.

Family: Fabaceae

Vernacular names: Telugu: Nalla theega

Habit: Large woody climbing shrubs

Diagnostic characteristics:

Large woody climbing shrubs,

Branches wiry, strong, lenticellate.

Leaves imparipinnate, 6-15 cm. long;

Leaflets 5-10 x 2-3.5 cm, ovate-oblong, acute at apex, rounded at base, shining.

Flowers white, 4-6 cm, across, in axillary racemes.



Pods 3-4 cm, flat narrowly winged along the suture, 1-seeded.

Field observations: Common in all Islands: 1, 2, 3 & 4. Dariyalathippa, Savitrinagar, Giriampeta, Farampeta.

6. *Ipomoea pes-caprae* (L.) R. Br.

Family: Convolvulaceae

Vernacular names: Balabantaige

Habit: Sandy Creeper

Diagnostic characteristics:

Sandy Creeper, Stems slender,

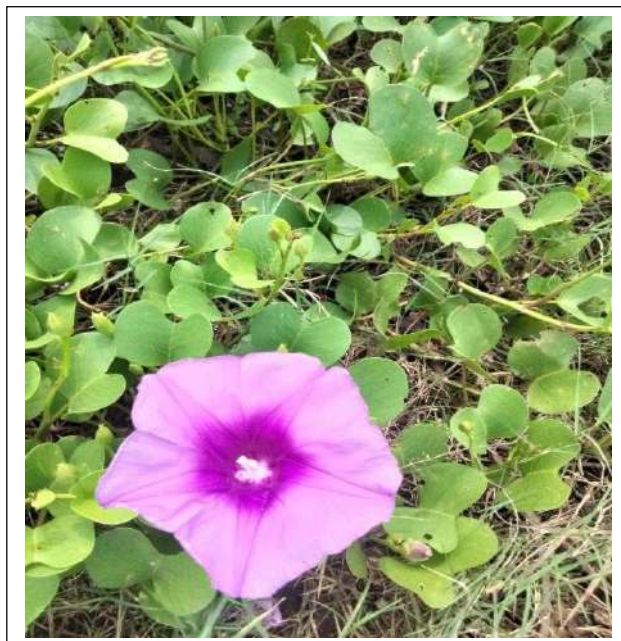
Leaves emarginately more or less deeply 2-lobed, prostrate herbs of the sea-shore

sepals oblong, obtuse, apiculate, the outer smaller than the inner, 3-5 in. long, glabrous

corolla tubular-funnel-shaped, up to 2-5

in. long; leaves thick, fleshy, parallel-nerved up to 2 in. long, 3-5 in. broad ;

Seeds with golden brown pubescence, 3 in. in diam.



Field observations: Common in all Islands: 1, 2, 3, 4 & 5. Dariyalathippa, Savitrinagar, Giriampeta, Farampeta, backwaters of Kurasampeta and Mettakur.

6. *Ipomoea tuba* (Schl.) G. Don.

Family: Convolvulaceae

Vernacular names: Telugu: Thella theega

Habit: Large Twinner

Diagnostic characteristics:

Glabrous, perennial twiners

Stems more or less woody, longitudinally wrinkled, straw-coloured.

Leaves 7-14 x 6-11 cm, broadly ovate or orbicular, entire

Flowers 6-15 cm long, white, axially, solitary or rarely in 2-flowered cymes;

Fruits 2-3 cm in diam., globose, pale brown. Seeds 4, hairy along margins.

Field observations: Common in all Islands: 1, 2, 3, 4 & 5. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta, backwaters of Kurasampeta and Mettakur.



7. *Myriostachya wightiana* (Nees ex Steud.) Hook. f.

Family: Poaceae

Vernacular names: Telugu: Darbha gaddi

Habit: Herb

Diagnostic characteristics:

Gregarious perennial grass,

Stem densely tufted, erect from a sheathed rootstock, 1-2 m tall.

Leaves 1-1.5 m long, linear, smooth, acuminate.

Ligule absent.

Panicle 15-20 cm with smooth rachis.

Spikelets smooth, pedicellate, compressed; glumes unequal with scaberulous keels.



Field observations: Common in all Islands: 1, 2, 3, 4 & 5. Dariyalathippa, Savitrinagar, Giryampeta, Farampeta, backwaters of Kurasampeta and Mettakur.

8. *Sarcolobus carinatus* Wall.

Family: Asclepiadaceae

Vernacular names: Telugu: Palaboddu theega

Habit: Twining shrubs

Diagnostic characteristics:

Glabrous, twining shrubs with fleshy-rhizomes bearing roots.

Leaves fleshy, variable, 3-7.5 x 2-5.5 cm, broadly elliptic or narrowly ellipticoblong, entire coriaceous, Flowers 2-3 mm across, yellowish-white, in axially pedunculate cymes;

Follicles 4-6 x 2.5-3 cm, ellipsoid, keeled along the dorsal suture;

Seeds flattened, shortly-winged, not comose.

Field observations: **Rare.** Located in Islands 1, 2 & 3. Undisturbed areas of Dariyalathippa, Savitrinagar, Giriyampeta.



9. *Sesuvium portulacastrum* (L.) L.

Family: Aizoaceae

Vernacular names: Telugu: Vangaredu Koora

Habit: Herb

Diagnostic characteristics:

Succulent, perennial herbs with long taproots stems creeping, much branched, greenish or red, rooti

Leaves 2-6 x 0.5-1.5 cm, lanceolate, oblanceolate or spatulate, very thick, glabrous,

Flowers 5-8 mm long, deep purple or pinkish-violet, axillary, solitary

Capsules 5-7 mm across, included within the perianth, many seeded.

Seeds black, reniform, smooth, with long funicles.

Field observations: **Common** in all Islands: 1, 2, 3, 4 & 5. Dariyalathippa, Savitrinagar, Giriyampeta, Farampeta, backwaters of Kurasampeta and Mettakur on Muddy tidal flats.



10. Suaeda maritima (L.) Dumort**Family:** Chenopodiaceae**Vernacular names:** Telugu: Eelakura**Habit:** Herbs or Undershrubs**Diagnostic characteristics:**

Erect or ascending herbs or undershrubs;

Stems glabrous, woody, muchbranched, often reddish purple.

Leaves 11-35 mm long, linear-oblong, crowded, occasionally purple-coloured.

Flowers 1 mm or less across, whitishgreen,

in axially clusters or on slender, elongated spikes, laxly arranged.

Utricles ovoid. Seeds 0.8-1 mm in diam., horizontal shining, brown.

Field observations: Common in all Islands: 1, 2, 3, 4 & 5. Degraded areas, salty lands, banks of back water canals of Dariyalathippa, Savitrinagar, Giryampeta, Farampeta,.**11. Tamarix troupii Hole****Family:** Tamaricaceae**Vernacular names:** Telugu: Palivelu**Habit:** Large shrubs**Diagnostic characteristics:**

Large shrubs, 3-4 m tall.

Leaves 2-3 mm long, subulate, semiamplexicaule at base, adpressed to the younger twigs, not sheathing.

Flowers 3-4 mm across, white or pink, bisexual, in lateral and terminal, pendulous racemose panicles.

Capsules 4-5 mm across, 3-4-valved, tapering towards the apex.

Seeds 8-10, tufted, silky hairy at apex.

Field observations: **Rare.** Located in Island 5. Sandy Godavari river bank.

Climate Stress Impacts on Mangrove & Estuarine Ecosystem Health

Mangrove and estuarine ecosystems are among the most productive and ecologically significant environments on Earth. Mangroves are salt-tolerant forests that grow along tropical and subtropical coastlines, while estuaries are semi-enclosed coastal water bodies where freshwater from rivers mixes with seawater. These ecosystems provide vital services such as coastal protection, nursery habitats for fish and shellfish, carbon sequestration, nutrient cycling, and support for local livelihoods.

However, climate change has emerged as a major threat to these ecosystems. Increasing global temperatures, sea-level rise, changes in precipitation patterns, extreme weather events, and ocean acidification are placing significant stress on mangrove and estuarine environments. These climate-related pressures alter ecosystem structure, function, and biodiversity, ultimately affecting ecosystem health and sustainability.

Importance of Mangrove and Estuarine Ecosystems: Mangrove forests and estuaries play crucial ecological, economic, and social roles.

Ecological Importance

1. Biodiversity Hotspots

Mangroves and estuaries support a wide range of organisms including fish, crustaceans, birds, mollusks, and microorganisms. Many marine species depend on these areas as breeding and nursery grounds.

2. Carbon Storage (Blue Carbon)

Mangroves are among the most efficient natural carbon sinks. They store large amounts of carbon in their biomass and sediments, helping mitigate climate change.

3. Nutrient Cycling

Estuaries are highly productive because nutrients from rivers mix with marine nutrients, promoting primary productivity.

4. Coastal Protection

Mangrove roots stabilize coastlines and reduce the impact of storms, tidal waves, and coastal erosion.

Socio-Economic Importance: Support fisheries and aquaculture; Provide timber, fuelwood, and medicinal resources; Support tourism and recreation; Protect coastal communities from natural disasters. Despite these benefits, climate stress is increasingly degrading these ecosystems.

Major Climate Stressors Affecting Mangrove and Estuarine Ecosystems

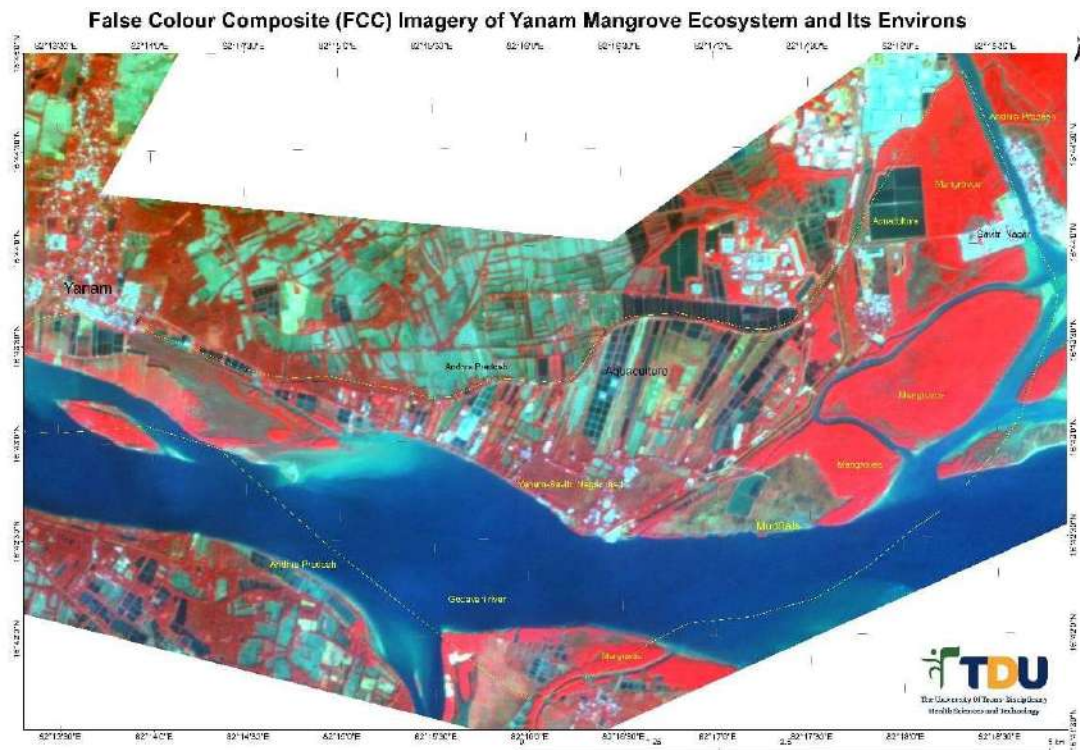
i. Sea Level Rise: One of the most significant impacts of climate change on mangrove ecosystems is sea-level rise.

Island No. 4 has almost vanished due to increasing water levels where Godavari river water enters in the Bay of Bengal. Now it is represented only with small land area and few mangrove species.

Effects on Mangroves

- **Submergence of Mangrove Forests:** Rising sea levels can inundate mangrove forests, affecting root oxygen availability.
- **Alteration of Sediment Dynamics:** Mangroves rely on sediment accumulation to maintain elevation relative to sea level.
- **Habitat Loss:** If sediment deposition cannot keep up with sea-level rise, mangroves may drown.

Island No. 5, which once supported healthy mangrove vegetation, is now experiencing habitat range shifts and is increasingly occupied by sandy vegetation and thorny weeds, making mangroves rare on the island.



Source of image: TDU (FRLHT), Bangalore

Effect of Sea level rise on Islands no. 4 near sea water & Island 5 in Godavari river

Effects on Estuaries

- Increased salinity intrusion into freshwater zones
- Changes in estuarine circulation patterns
- Altered habitats for aquatic species

This may lead to loss of biodiversity and ecosystem imbalance.

ii. Increasing Temperature: Global warming leads to higher air and water temperatures, affecting both mangrove vegetation and estuarine organisms.

In recent major ONGC gas pipeline leak occurred on August 21–22, 2025, on Dariyalathippa Island, near Godavari riverbank causes a large fire and widespread panic. Due to high temperature effect the surrounding mangrove, vegetation, including large trees, were affected, and most of them were died.



Patch of Mangrove vegetation damaged due to ONGC gas pipeline leak

Impacts on Mangrove Vegetation

- Increased evapotranspiration leading to water stress
- Reduced photosynthetic efficiency in extreme heat
- Increased vulnerability to pests and diseases

Impacts on Aquatic Species

- Fish migration changes; Reduced dissolved oxygen levels;
- Increased mortality of temperature-sensitive species;

Higher temperatures can also promote harmful algal blooms, which negatively affect water quality.

iii. Changes in Rainfall and Freshwater Flow: Climate change alters rainfall patterns, affecting river discharge into estuaries.

Reduced Rainfall

- Increased salinity levels in estuaries
- Reduced freshwater input affecting nutrient balance
- Stress on mangrove seedlings and salt-sensitive species

Excessive Rainfall and Flooding

- Increased sediment load
- Nutrient enrichment leading to eutrophication
- Physical damage to mangrove forests

Both extremes can destabilize ecosystem functioning.

iv. Ocean Acidification: Rising atmospheric carbon dioxide increases the absorption of CO₂ in oceans, forming carbonic acid and lowering pH levels.

Impacts on Estuarine Organisms

- Reduced shell formation in mollusks and crustaceans
- Impaired growth of coral and calcifying organisms
- Altered food web interactions

Since many commercially important species depend on estuarine habitats, this can affect fisheries and coastal economies.

v. Increased Frequency of Extreme Weather Events: Climate change is increasing the intensity and frequency of storms, cyclones, and storm surges.

Impacts on Mangrove Ecosystems

- Physical damage to trees
- Uprooting of mangrove vegetation
- Loss of canopy cover

Impacts on Estuaries

- Sudden changes in salinity and turbidity
- Sediment redistribution
- Habitat disruption for aquatic species

However, healthy mangrove forests can also reduce cyclone damage, highlighting their importance for coastal resilience.

vi. Ecological Consequences of Climate Stress:

Loss of Biodiversity: Climate stress can lead to shifts in species composition and local extinctions. Sensitive species may disappear, while invasive or tolerant species may dominate.

Habitat Degradation: Changes in salinity, sedimentation, and hydrology degrade critical habitats for fish, birds, and invertebrates.

Disruption of Food Webs: Alterations in primary productivity and species distribution disrupt food chains within estuarine ecosystems.

Reduced Ecosystem Services: Climate-induced degradation reduces the benefits provided by mangrove and estuarine ecosystems, including Fisheries productivity, Carbon sequestration, Coastal protection, Water purification.

viii. Effects of River Pollution on Mangrove diversity: Recent field visits also revealed the disposal of solid waste, dead cattle, dogs, goats, etc., into the Godavari River or River bank by local residents in certain wards, creating pollution stress on mangroves and the estuarine ecosystem.



Godavari and Mangrove habitats pollution by local residents



vii. Impacts on Human Communities of Yanam region: Coastal populations mainly fisherman community of this region rely heavily on mangrove and estuarine ecosystems. Climate stress on these systems affects:

Fisheries and Livelihoods

Many commercially important fish, crabs and shrimp species use mangroves as nurseries. Ecosystem degradation reduces fish stocks and crabs of this region which adversely affects fish and crab catchers.



Fishing is the livelihood of Yanam region communities

Coastal Protection

Loss of mangroves increases vulnerability to storm surges, coastal flooding, and erosion. Every year Yanam region facing floods and most of the low level human settlement colonies are submerging under flood water.



Effects of Floods in Yanam coastal colonies

Food Security

Reduced fish production can threaten the food security of coastal communities of this region.

Economic Losses

Tourism, aquaculture, and coastal industries may suffer due to declining ecosystem health.

Recommendations / Adaptation Strategies

Based on the aforementioned facts, data analysis and results of the present study the team recommended the following Conservation strategies and Adaptations for the restoration of Mangrove vegetation and healthy estuarine ecosystem development.

Mangrove Restoration

Reforestation programs can restore degraded mangrove areas and improve ecosystem resilience.

In this context, the Forest Department of Yanam has recently established a mangrove nursery at the Dariyalathippa Mangrove area, where almost all true mangrove species are being propagated. The nursery is also exporting mangrove seeds and saplings to the Puducherry region for restoration programs.



Sustainable Coastal Management

Implementation of Integrated Coastal Zone Management (ICZM) helps balance conservation with economic development.

Sediment Management

Ensuring adequate sediment supply allows mangroves to keep pace with sea-level rise.

Climate-Resilient Policies

Puducherry and Central Govt. Policies should integrate climate adaptation strategies to protect coastal ecosystems.

Community Participation

Local communities play a crucial role in conservation through sustainable fishing, mangrove protection, and ecosystem monitoring. Under this, several awareness programs to be conducted for effective management and conservation of Mangroves and healthy estuarine ecosystems.

Conclusions

The present study on mangrove diversity in the Yanam region reveals that the species richness of this area is nearly comparable to that of the adjacent Coringa Wildlife Sanctuary and the Godavari River riverine ecosystem. Approximately 13 true mangrove species were recorded across one to four islands in the Yanam region, while about 15 mangrove associate species were observed across almost all five islands. This relatively high diversity contributes significantly to the ecological stability of the Yanam region by providing natural protection against floods, cyclones, and high tidal surges.

Mangrove and estuarine ecosystems are critical components of coastal environments, supporting rich biodiversity, stabilizing shorelines, and sustaining the livelihoods of local communities. However, these ecosystems are increasingly threatened by climate change. Rising sea levels, increasing temperatures, altered rainfall patterns, ocean acidification, and more frequent extreme weather events are placing significant stress on mangrove and estuarine habitats. These climate-related stressors can lead to habitat degradation, biodiversity loss, and a decline in essential ecosystem services.

Therefore, the conservation of mangrove diversity in the Yanam region and the protection of estuarine ecosystems require integrated management approaches, effective conservation strategies, and targeted restoration efforts. In addition, climate-adaptive policies from the governments of Puducherry and India are essential to address the emerging challenges posed by climate change. Strengthening ecosystem resilience and maintaining healthy estuarine systems will not only safeguard biodiversity but also support the long-term sustainability of coastal communities. Ultimately, these measures will contribute to improving local livelihoods, strengthening regional economies, and reducing the adverse impacts of climate change.

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