



# EX-SITU CONSERVATION OF MANGROVES IN NON-TIDAL CONDITIONS OF EASTERN INDIA

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## Abstract

Mangroves are facultative halophytes and can grow in fresh water. However, mangrove systems achieve optimal development globally in low-lying regions with relatively large tidal fluctuations. Mangrove ecosystems are rapidly disappearing due to extensive exploitation, rising salinity, and pollution load in their habitat. The increase in sea levels in these regions owing to climate change also poses a risk of submerging the mangroves in near future. Consequently, *in-situ* conservation plots exclusively implemented for mangroves, are likewise at significant risk of submergence. Therefore, we have undertaken a long-term adaptation trial to aid the *ex-situ* conservation approaches of mangrove species in Eastern India. The aim of the study was to assess the survival and establishment of these mangrove species in non-tidal and lateritic soil of eastern plateau region of India. We carried out an initial biodiversity survey in the mangrove forests of Sundarbans, West Bengal and Bhitarkanika, Odisha in 2012. Seedlings of 15 different mangrove species were collected and planted in the campus of the institute in the same year. We have successfully established a Mangrove Germplasm Bank containing 11 distinct mangrove species, including *Heritiera fomes*, an IUCN-listed endangered species. Our conservation efforts for a decade demonstrated remarkable success with the development of pneumatophores in species like *Sonneratia apetala* and *H. fomes*, indicating successful adaptation to the *ex-situ* climatic conditions. Four species including *H. fomes* exhibited flowering and fruiting, further confirming their natural proliferation ability *ex-situ*. We also examined various propagation methodologies, including traditional seed propagation and advanced clonal techniques to aid the conservation measures. *In-vitro* shoot initiation was successfully achieved for *Aegiceras corniculatum* and *H. fomes*. Our study represents the first successful *ex-situ* conservation of mangrove species in Eastern India, establishing a foundation for future mangrove *ex-situ* conservation efforts and research.

**Keywords:** Climate change; *ex-situ* conservation; *Heritiera fomes*; mangroves

## Introduction

- Mangroves consist of salt-tolerant plant communities, encompassing a limited number of 70 to 73 species of trees and shrubs, which thrive in the tropical and sub-tropical intertidal zones globally. (Spalding et al., 2010).
- India has a total mangrove cover of 4,992.32 km<sup>2</sup> covering 0.15% of country's total geographic area (ISFR, 2021). Eastern India alone accounts for around 47.53% of the mangrove cover found in the states of West Bengal (2113.77 km<sup>2</sup>) and Odisha (258.98 km<sup>2</sup>).
- At present, 11 mangrove species face an elevated threat of extinction with many others at high risk of disappearance by the next decade if protective measures are not enforced (Polidoro et al., 2010).
- Due to rapid climate change, increasing salinity and anthropogenic pressures, global mangrove cover is declining by a rate of 3.4% during last two decades (Bunting et al., 2022). Adding to this, natural habitat of mangroves is highly prone to submergence owing to rising sea-level.
- Population density of major mangrove species like *Heritiera fomes* (Sundari) in Eastern India, especially in Sundarbans is reducing at an alarming rate (Mandal et al., 2021).

## Objectives

- Assessing the survival and establishment of mangrove species in non-tidal and lateritic soil of eastern plateau region of India.
- Long-term adaptation trial by evaluating growth to aid the *ex-situ* conservation approaches of mangrove species in Eastern India.

## Methodology



### BIODIVERSITY SURVEY

Mangrove forests of Sundarbans, West Bengal and Bhitarkanika, Odisha



### COLLECTION OF PROPAGULES

Floating seeds from rivers and shoveling natural seedlings available in estuaries



### PLANTING IN NON-TIDAL ZONE

Direct planting of propagules in campus (23.357° N; 85.243° E; 719 msl). Irrigation with 0.45% salt water twice in a week for 9 months



### ESTABLISHMENT OF GERmplasm BANK

Studied survivability, adaption, growth parameters, reproductive phenology *ex-situ* for a decade



### MACRO & MICRO-PROPAGATION

Stem cutting and Air layering, *In-vitro* propagation



Figures: Successful stem cutting, air layering and *in-vitro* propagation

## Results

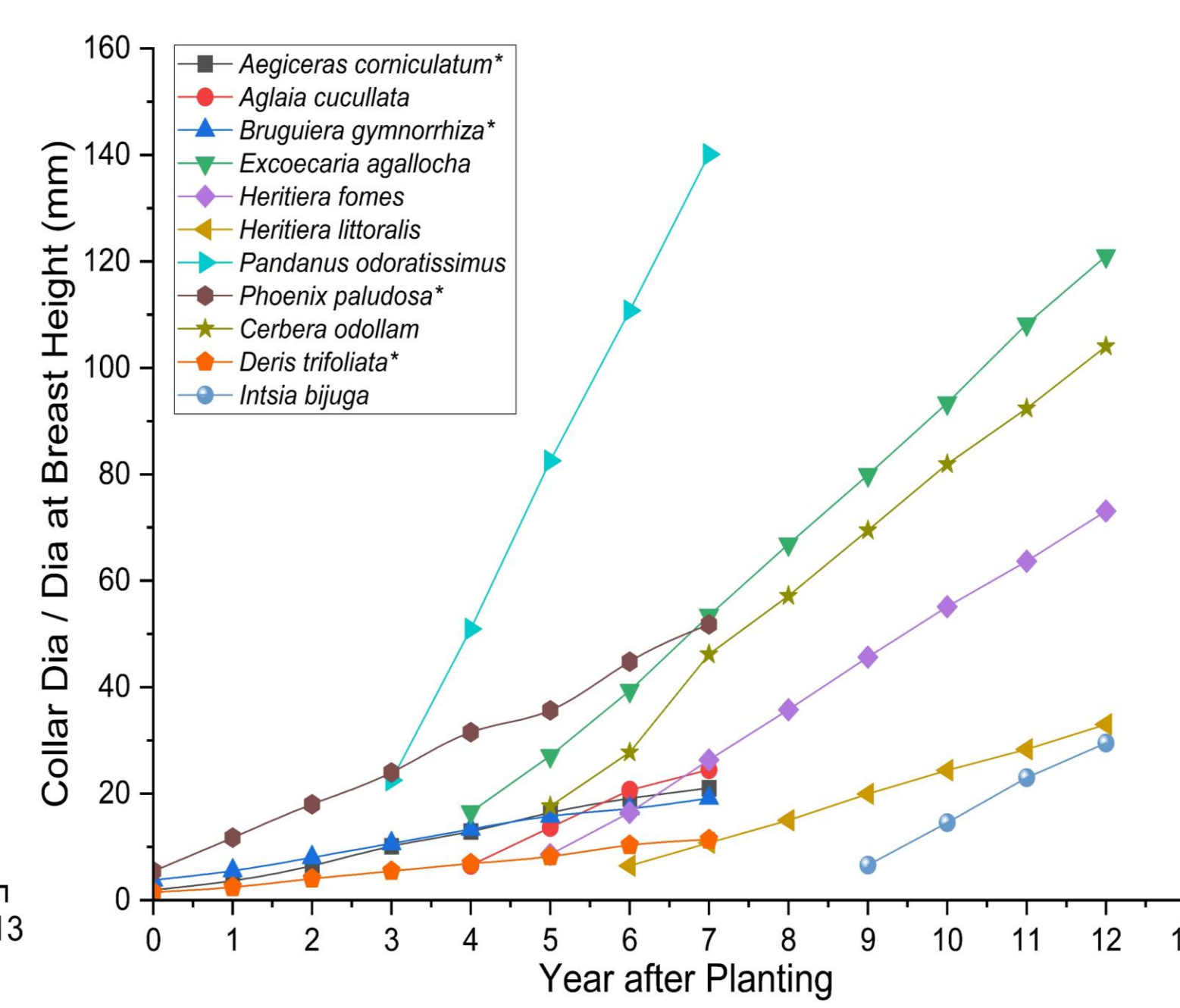
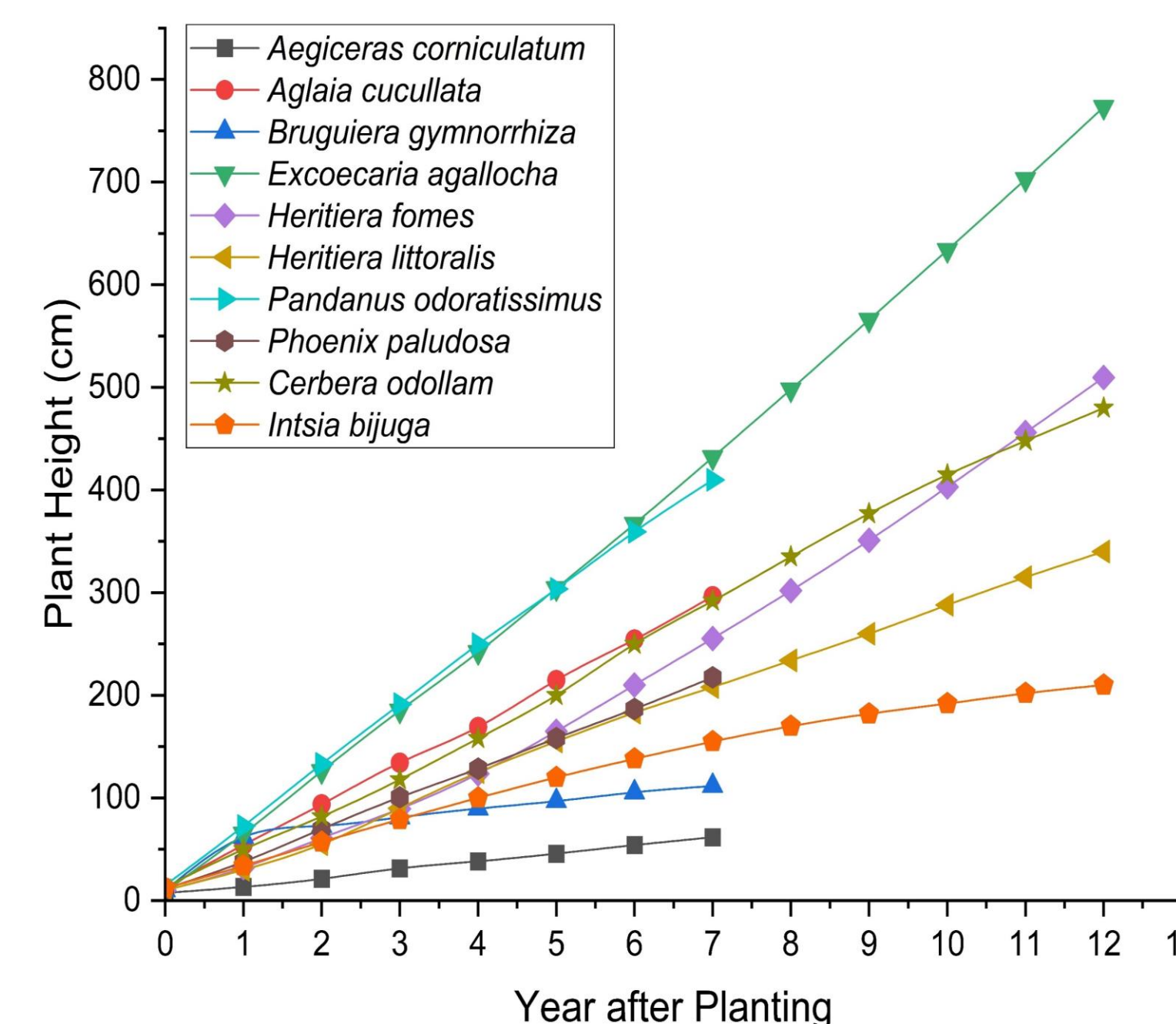


Table 1: Species in Mangrove Germplasm Bank, ICFRE-IFP

Sl. Species	Common name	Family
1 <i>Aegiceras corniculatum</i>	Kholsi	Primulaceae
2 <i>Aglaia cucullata</i>	Amur	Meliaceae
3 <i>Bruguiera gymnorrhiza</i>	Kankra	Rhizophoraceae
4 <i>Excoecaria agallocha</i>	Gneoa	Euphorbiaceae
5 <i>Heritiera fomes</i>	Sundari	Malvaceae
6 <i>Heritiera littoralis</i>	Sundari	Malvaceae
7 <i>Pandanus odoratissimus</i>	Kunda	Pandanaceae
8 <i>Phoenix paludosa</i>	Hental	Arecaceae
9 <i>Cerbera odollam</i>	Suicide tree	Apocynaceae
10 <i>Deris trifoliata</i>	Panlata	Fabaceae
11 <i>Intsia bijuga</i>	Intsia	Fabaceae



Figures: Pneumatophores, still roots, flowering and fruiting of different mangrove species ensuring successful adaptation to the *ex-situ* non-tidal conditions



## Wider impacts of the work

- As *in-situ* conservation plots of mangroves are threatened by the global climate change, these effective *ex-situ* conservation strategies for mangroves are need of the day.
- It is expected that our findings will provide guideline information for sustainable management of mangrove species in *ex-situ* conservation plots situated at non-tidal regions and conserving their forest genetic resources for future.

## Conclusion

- This study marks a significant achievement as the first *ex-situ* conservation effort on mangrove species under non-tidal conditions of Eastern India.
- Macro-propagation techniques will be employed to other mangrove species. Besides, though *in-vitro* shoot initiation in *A. corniculatum* and *H. fomes* has been achieved, further studies are required for successful *in-vitro* root initiation.
- Long-term monitoring is required to enhance our understanding the *ex-situ* conservation strategies of mangrove species.

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## Acknowledgements

Authors sincerely acknowledge the institutional support provided by the Director, ICFRE-IFP, Ranchi. Authors also acknowledge the assistance of the State Forest Departments (SFDs) during the field surveys. Authors also extend their heartfelt thanks to all the nursery workers of ICFRE-IFP, Ranchi for their support in this experiment.

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