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STAC Salinity Risks Workshop 26 May 2026

# Ghost Forests as Indicators of Salinity Change

*Thresholds and Adaptation Pathways*

Harry R. Hughes CENTER FOR AGRO-ECOLOGY

AGROECOLAB

Kate Tully (UMD)

Keryn Gedan (GWU)

# Ghost forests emerge as a result of sea level rise effects in the coastal zone

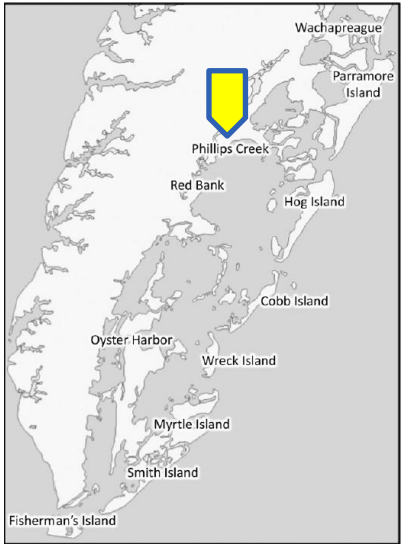
Photo: Tyler Messerschmidt


Causes
Sea Level Rise
Storm and Tides
Drought
Water Management
Connectivity
Salinization
Impacts
Marsh Migration
Yield Declines
Eutrophication
Coastal Forest Loss
Species Invasion
Go.umd.edu/salt

# Ghost forests emerge as a result of sea level rise effects in the coastal zone

- **Saltier soils → water uptake harder**
- Trees **close leaf pores** to conserve water → **slower growth + less photosynthesis**
- **hydraulic failure** → **crown dieback**
- **Fewer leaves** → even **less photosynthesis** and recovery capacity
- **Salt toxicity** can directly damage tissues → more dieback
- Tree enters a **self-reinforcing loop**: water stress + low energy (“carbon starvation”) → **mortality if conditions don’t improve**

# One of the world's best studied ghost forests




Let's fly over Brownsville Preserve, Eastern Shore of Virginia

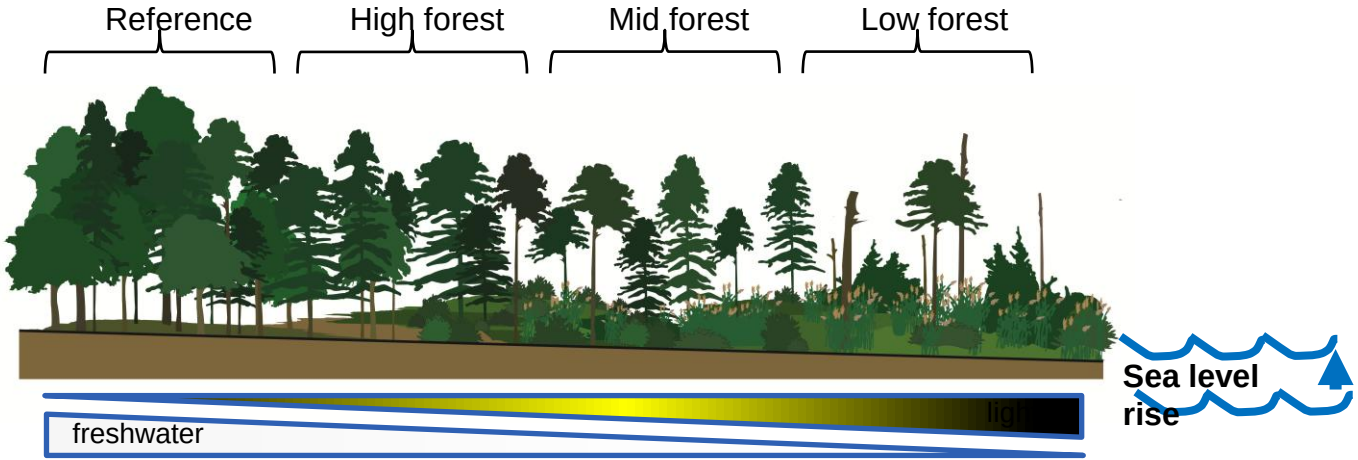
Slide courtesy of Keryn Gedan

# Shifting Zone of Transition

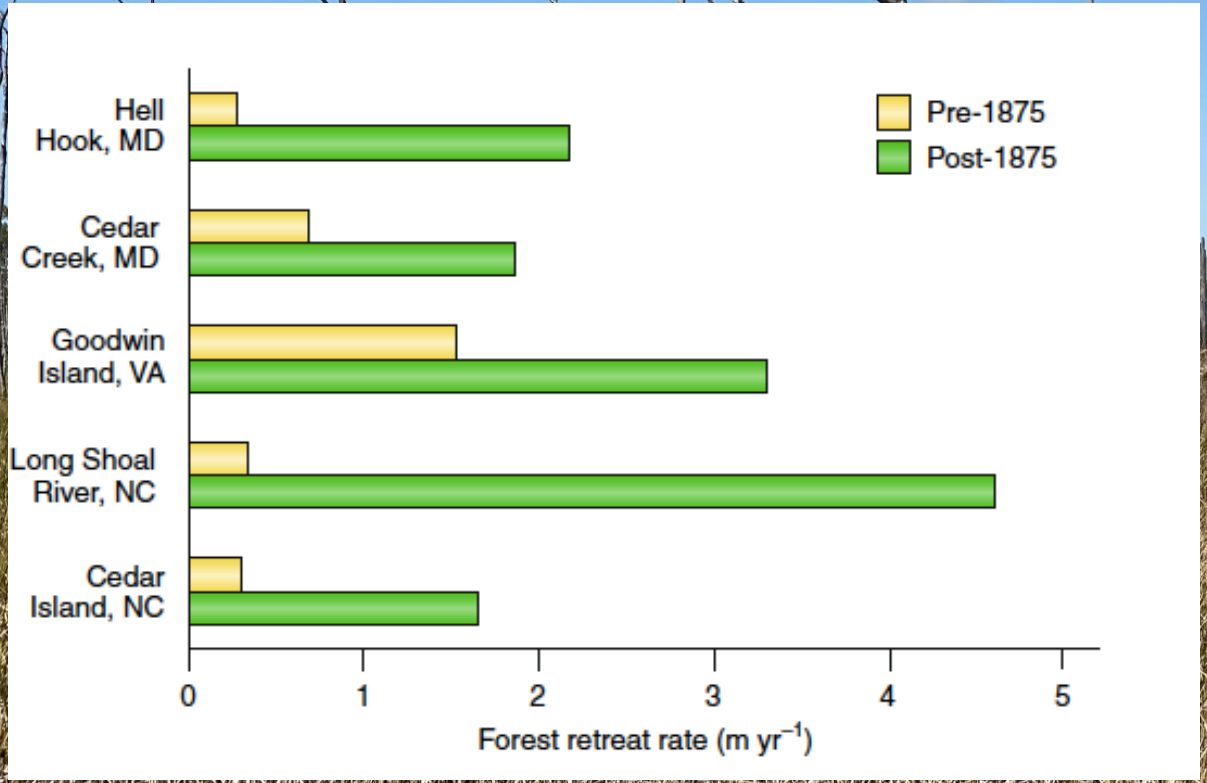
**TOP VIEW**


Jobe and Gedan 2021
*Ecology*

**SIDE VIEW**

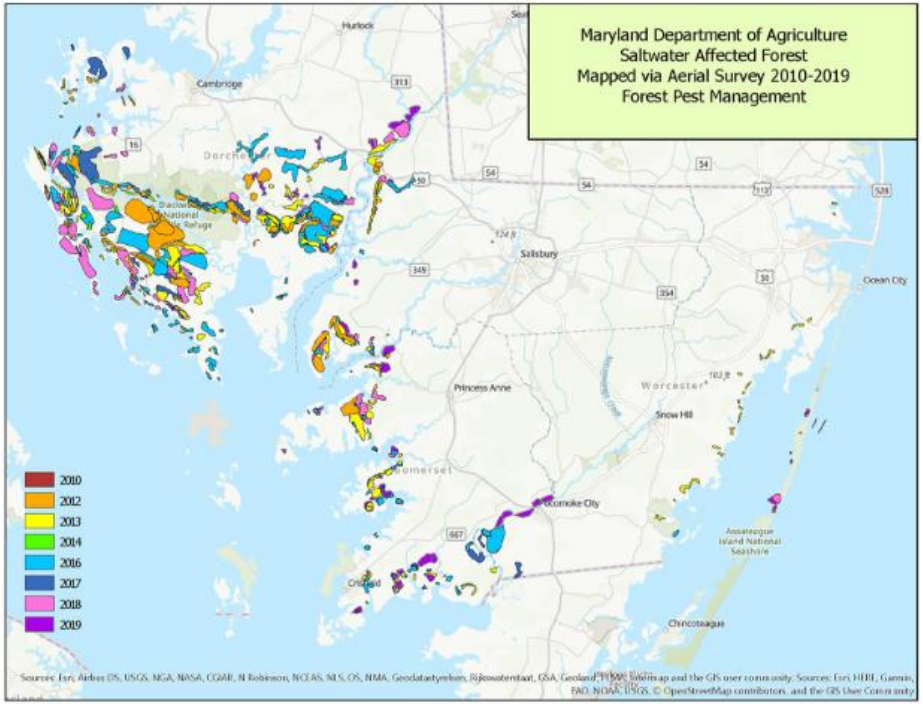


# Saltwater intrusion in uplands creates ghost forests




Kirwan and Gedan 2019 - Nature

# Rapid expansion of ghost forest on MD's lower eastern shore




Source: Heather Disque, MD Dept of Agriculture, Forest Pest Management

*(Maryland Department of Agriculture, 2022).*

| County | Acres of forest affected by saltwater intrusion |
|---|---|
| Dorchester | 60,575 |
| Somerset | 8,249 |
| Wicomico | 9,799 |
| Worcester | 5,758 |

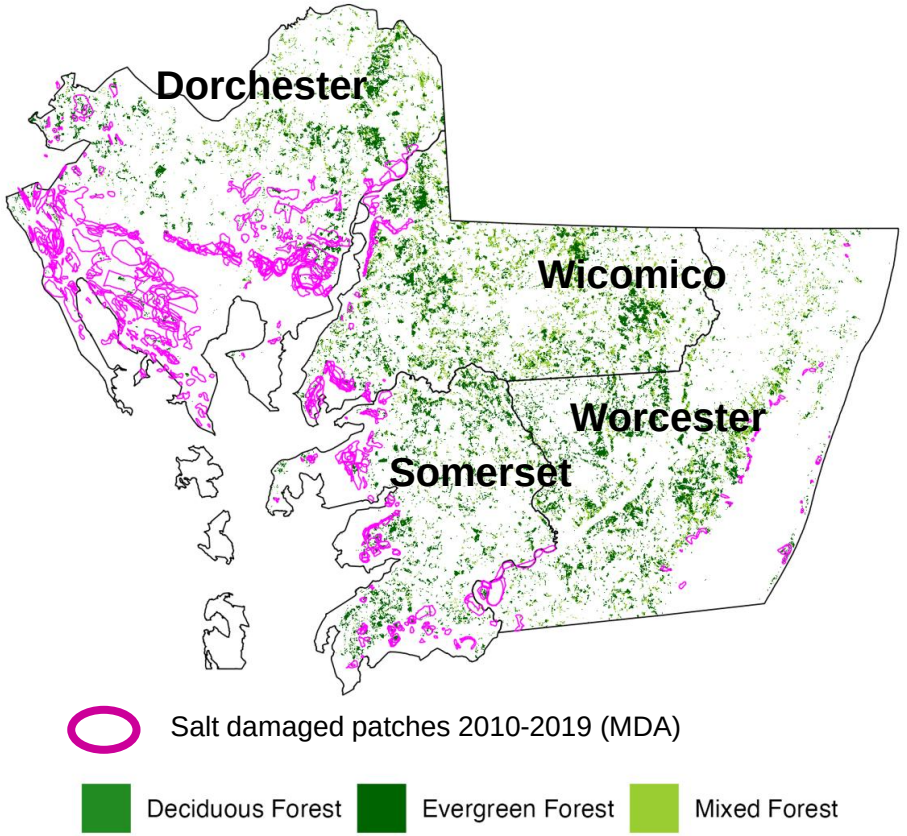
Increasing trend:

- 2013: 18,116 acres
- 2016: 50,406
- 2020: 50,365
- 2022: 84,831

# Salt Damaged Forests Associated with Elevation Relative to Sea Level (MHHW) 2010-2019

**Elevation of Salt damaged patches**
Mean: 0.27 m (above historic MHHW)
Median: 0.16 m

**Elevation of Forest (NLCD 2011)**
Mean: 7.12 m (above MHHW)
Median: 6.72 m



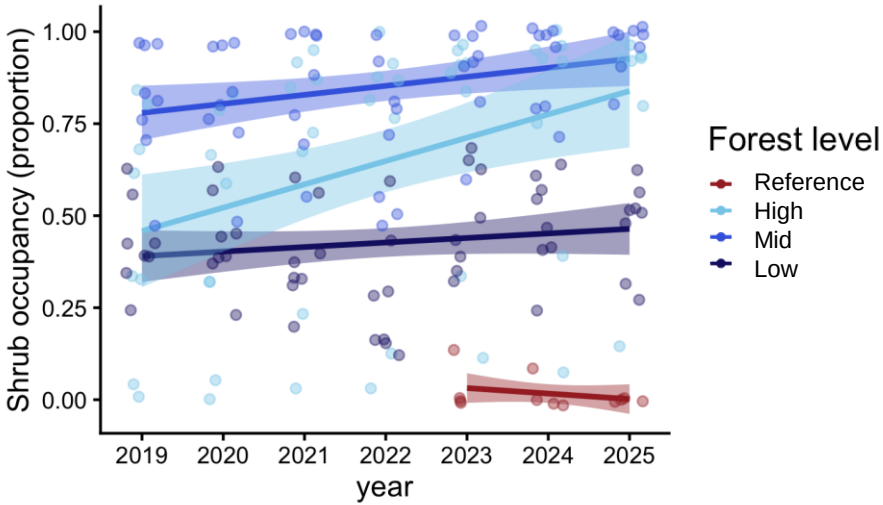

Salt Damage Data: Biff Thompson & Heather Disque

# Ecological changes in the ecotone

- Loss of hardwoods, longer survival of pines and red cedar
- Canopy opening, changes in the light availability of the understory
- **Initially, an increase in shrub cover**
  - especially wax myrtle, *Morella cerifera*


Photo: USDA Forest Service

Wax myrtle, *Morella cerifera*
A nitrogen-fixing, moderately salt-tolerant shrub




Sward et al. 2023, *Front. Forests and Global Change*

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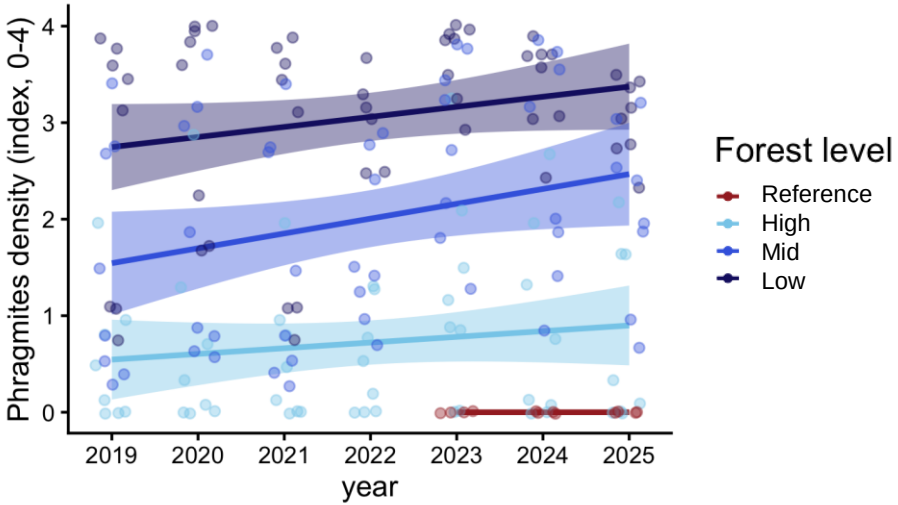
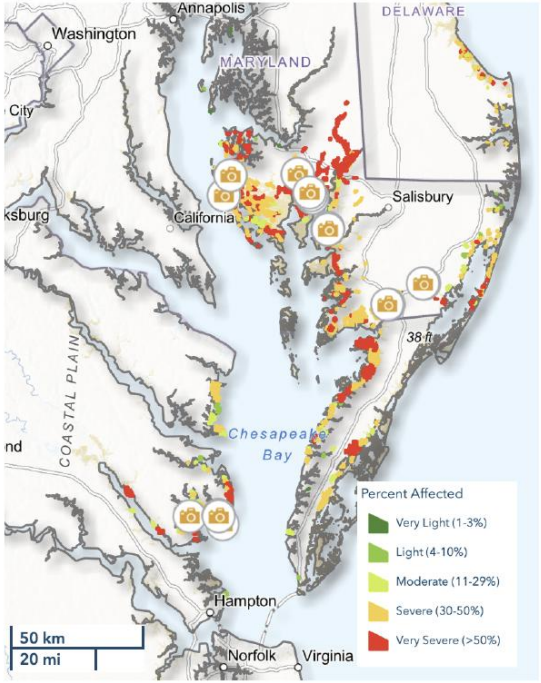
- **Colonization of the invasive common reed, *Phragmites australis***




Sward et al. 2023, *Front. Forests and Global Change*

# Forest health impacts of coastal saltwater intrusion in Chesapeake Bay tributaries




MDA forest mortality observations contribute to Coastal Ghost Forest Mapping Project for Regions 8 and 9.

Keryn Gedan (lead), Kate Tully, Becky Epanchin-Niell, Pinki Mondal, Biff Thompson and Heather Disque.

**Objective**: Investigate the changes occurring in the forests of the Eastern Shore of Maryland to understand **linkages among environmental factors (saltwater intrusion, pest outbreaks, drought, flooding), forest composition, and forest mortality. [Lags, prediction, interacting drivers]**

Harry R. Hughes
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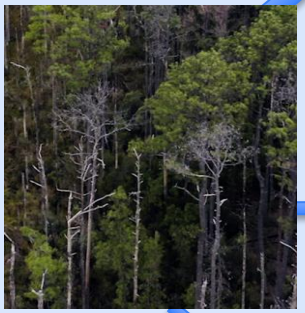
# Coastal Forest response to SLR and SWI

*Sea level rise and saltwater intrusion*

Tide gates
Berms/Buffers
Ditches

SLR & SWI



- Early Harvest
- Planting more salt-tolerant trees
- Planting salt-tolerant shrubs and grasses
- *Phragmites australis* control

**Outcomes**

- Profitability
- Hunting and recreational
- Conservation/ biodiversity
- Water quality
- Carbon storage
- Flood mitigation

**Economic, social, environmental and policy context of land and landowner**

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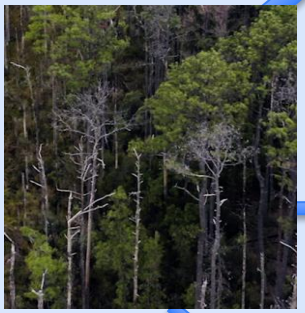

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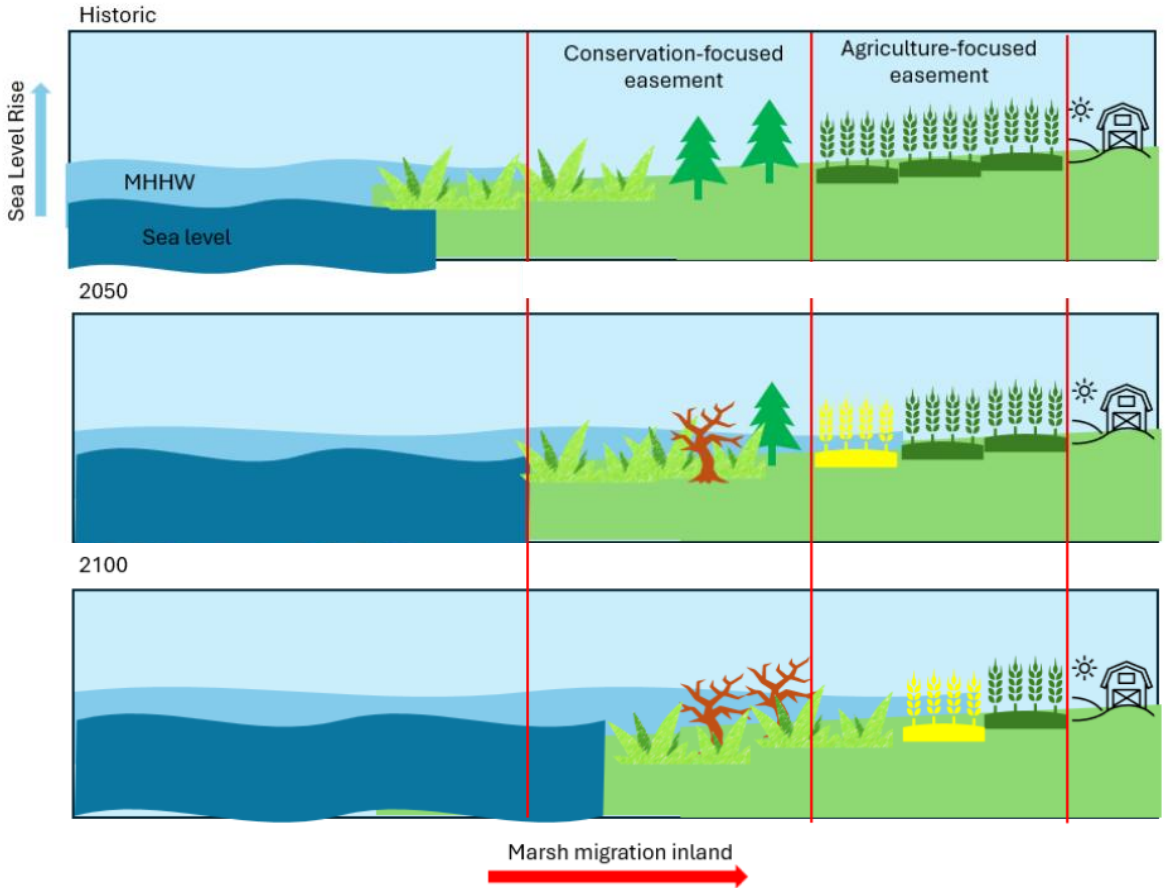
- EQIP/CREP/CSP
- Easements
- Fed, state, local gov't, NGOs
- Hunting leases
- Extension/ research

# Static easements in a dynamic landscape




In Maryland's tidewater counties:

Highly exposed easement area (< MHHW) is projected to increase by 7,500 acres by 2050 and by 19,000 acres by 2100.

Epanchin-Niell & Thompson in Prep

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## *Salinity-Affected Lands in Transition (SALT) Program*

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Causes Impacts Diagnose Your Land Management Options Discover More Get Involved

go.umd.edu/salt

Options for Adapting to Rising Seas (OARS)


Thank you!

# Conclusions

- Ghost forests are a widespread signal of sea level rise
  - Forest retreat goes hand-in-hand with marsh migration
- Ecological changes go beyond tree mortality
  - Whole community transformation
- Coastal change not only affects communities, but is shaped by landowner decisions
  - Affected by policies, information provision, economics, values
- Predicting coastal change will help coastal communities adapt to climate change and plan for conservation of tidal marsh habitats