

Documenting Coastal Forest Retreat Along Barnegat Bay and Delaware Bay, New Jersey from 1970 to 2017

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Abstract

One of the many consequences of sea level rise is evident along the East coast of the United States in “ghost forests,” which are standing dead trees seen along the boundary between salt marsh and coastal forest. Ghost forests are particularly apparent on the East coast due to accelerated rates of sea level rise (Sallenger et al. 2012). Sea level rise increases salinity in the substrate and contributes to rising water levels in coastal forests, leading to forest dieback. It is important to understand the pace at which these forests are migrating inland in order to measure carbon flux to the atmosphere that might occur as forest transitions to marsh, as well as to determine what kinds of wildlife may be impacted by a loss of habitat (Smart et al. 2020). My study furthers the knowledge of this phenomenon by analyzing coastal forest loss from **1970 to 2017** at three different intervals at **Glades Wildlife Refuge** on the Delaware Bay and **Cattus Island County Park** on the western shore of Barnegat Bay in New Jersey. Aerial photography and the **Digital Shoreline Analysis System (DSAS)** were used to study forest migration. Overall, my study provides an estimation of the magnitude of coastal forest migration in New Jersey and highlights some of the disadvantages of using aerial photography to study coastal forest loss.

Methods

- Aerial photography from 1970, 2006, 2013 and 2017 from njgin.nj.gov
- Tree lines were digitized in DSAS (Fig. 2) and the **Net Shoreline Movement (NSM)** and **End Point Rate (EPR)** metrics were utilized
- Site visits for observations and photos

Results

- Cattus Island tree line migrated a greater average distance than Glades from 1970 to 2017
- At both sites, greatest average net distance of migration was between 1970 and 2006 and greatest average rate of migration was between 2006 and 2013 (Fig. 3 & 4)
- *Phragmites* growth at forest marsh boundary at both sites (Photo 1)

Discussion

It is important to note that results are accurate within a range of ± 10 meters due to the DSAS uncertainty value that accounts for inaccuracies in the tree line digitization and the aerial photographs (Himmelstoss et al. 2018). The greater average distance of migration at Cattus Island was unexpected based on Sacatelli (2020) and sand mining at Glades, which increases salinity levels in the soil. The greater average rate of migration between 2006 and 2013 may reflect recent observations of coastal forest migrating landward at an accelerated pace. In comparing my results to previous research on coastal forest retreat along the mid-Atlantic coast, I found that the rates of migration were of similar magnitude, despite differences in the timeframes studied (Smith 2013; Schieder & Kirwan 2019).

Conclusion

By using aerial photography to document coastal forest loss, I provided estimations for the extent of coastal forest loss in New Jersey since 1970 and I found rates of migration that I was able to compare to other studies. While aerial photography is a useful tool for documenting forest loss over several years, stands of forest are effectively dead once they stop regenerating (Williams et al. 1999). So, future studies should incorporate field work that includes observations of population dynamics and soil monitoring over time to determine whether sea level rise has impacted a forest's ability to regenerate.



Photo 1. Example of a “ghost forest”

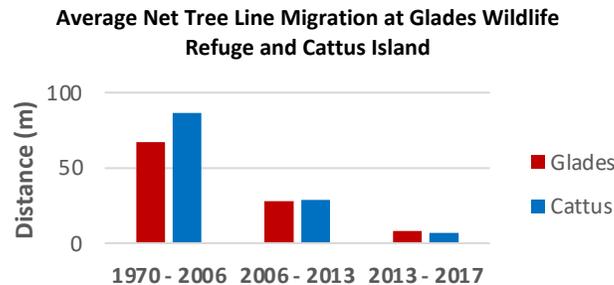


Fig 3. Comparison of net distance of tree line migration at each site

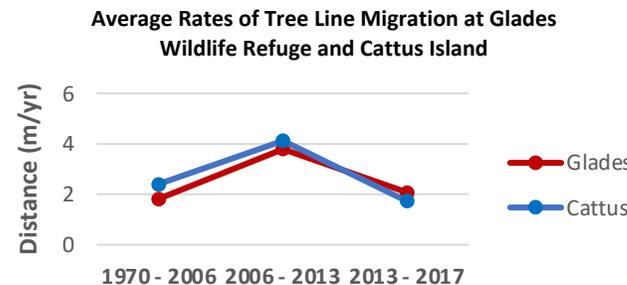


Fig 4. Comparison of average rate of tree line migration at each site

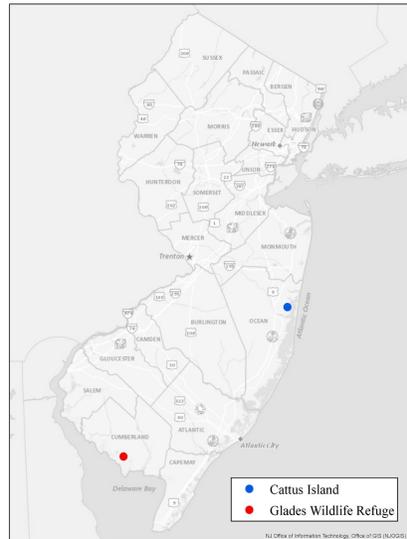


Fig 1. Location of study sites

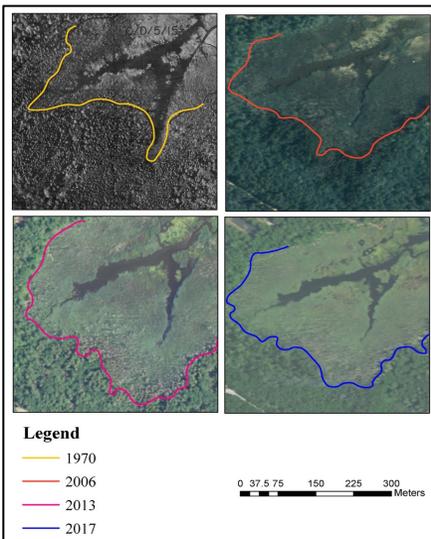


Fig 2. Digitized tree lines at Cattus Island County Park

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