Issue of Concern: Sea Level Rise

Sea levels have risen by one foot across the Northeast since 1900, and there is strong evidence that this trend will continue as a result of climate change and the unique geography of the northeastern United States. Where sea-level rise inundates new coastal areas, impacts include changes in groundwater hydrology and an increase in flooding and storm surges. These effects can stress nearby forests, and potentially lead to tree dieback and conversion away from forest cover. Evidence supports a variety of forest adaptation and management strategies that can ameliorate some of the early impacts of sea-level rise and delay conversion, or facilitate transition in areas where that may be deemed inevitable or desirable.

Climate Change Impacts

Sea levels are expected to rise along with temperatures globally. The complex factors that cause seal-level rise make projecting the exact magnitude difficult (Landerer et al. 2007, Sallenger et al. 2012, Yin et al. 2009), but the entire East Coast is subject to "hot spots" of sea-level rise where a combination of ocean currents, weather patterns, and geology can lead to oceans rising substantially more than the global average (Valle-Levinson et al. 2017; Dagendorf et al. 2019). Rising sea levels progressively inundate coastal land, and even inland and upland areas not directly affected will experience warmer water temperatures, increased water salinity and acidity, and other changes in ecosystem dynamics (Moser et al. 2014). Additionally, coastal ecosystems serve as a buffer to the most extreme coastal conditions, and declines in these systems can reduce their ability to protect inland systems from increased salinity and storm surges (Dupigny-Giroux et al. 2014).

The stresses of sea-level rise can occur gradually along with the rates of rise itself, but they can also occur in sudden bursts when storm surge and flooding can kill entire stands of upland forests. Additionally, the salt deposited by storm surges can linger long after waters have receded, stressing forests well after individual events (Kirwan & Gedan 2019). There is also risk that if a stand dies back suddenly it may not successfully convert to marshland, but could instead be captured by invasive species such as the common reed, which take advantage of the sudden nature of this disturbance (Kirwan & Gedan 2019). For the most part, these dynamics are affecting New Jersey, Maryland, and coastal areas farther south (Dupigny-Giroux 2018). There is evidence that forests in southern New England are not exhibiting similar signs of dieback. White oak and swamp white oak are both dominant species at the marsh-to-forest boundary in southern New England, and are currently unaffected by sea-level rise(Field et al. 2016). However, it is difficult to predict when this boundary might reach a tipping point caused by an extreme storm surge point capable of causing rapid and widespread tree death (Field et al. 2016).

If forest dieback due to inundation or salinization becomes an issue of greater magnitude in Southern New England, efforts to resist sea-level rise may be successful in the short-term, but ultimately more damaging if a given region is subject to inevitable conversion. Given the value of adjacent wetlands, managers may want to consider how to facilitate the migration of wetlands so that their services are not impaired, further threatening adjacent upland systems (Sacatelli et al. 2020, Field et al. 2017)

Adaptation Actions for Forests

Additional actions are described in the Adaptation Strategies and Approaches for Forests.

Site Condition	Adaptation Approaches	Example Adaptation Actions
Site is already experiencing stress or conversion due to sea-level rise	• Facilitate managed retreat of coastal ecosystems • Maintain and enhance connectivity pathways to allow for species movement • Move at-risk species to locations expected to provide habitat • Favor or restore native species that are expected to be adapted to future conditions • Protect future-adapted seedlings and saplings	• Accept ecosystem conversion and consult with coastal ecosystem experts/managers to determine if any adaptive management actions would be supportive • Promote tree regeneration above the tide zone or areas affected by forest retreat • Allow species to migrate into areas where they were not historically present, if they are already establishing and are likely to do well there under future climate conditions • Plant or seed a species at risk of extirpation in areas of newly suitable habitat outside its current range • Plant species or genotypes that are tolerant of saltwater inundation or high soil salinity • Collect seed from any rare or threatened species or genotypes
Site is threatened by future impacts of sea-level rise	• Maintain or restore hydrology • Increase freshwater retention • Reduce or prevent soil salinity or soil salt damage • Favor or restore native species that are expected to be adapted to future conditions • Disfavor species that are distinctly maladapted • Manage forest structure to reduce severity or extent of physical wind and wave damage • Protect future-adapted seedlings and saplings	• Protect and enhance salt marsh areas adjacent to forest stands in order to reduce the effects of storm surge • Underplant a variety of native species to increase overall species richness and provide more options for future management • Prevent and remove nonnative and competitive plants to support desired plant communities • Collect seed from any rare or threatened species or genotypes

On-the-ground Examples

- Narragansett Bay National Estuarine Research Reserve: Prudence Island Heritage Unit
    - This forested area on Prudence Island in Narragansett Bay is recognized as critical habitat in Rhode Island's wildlife action plan, but is threatened by a range of current and potential future disturbances such as persistent invasive species and saltwater intrusion. Managers are considering actions to capture freshwater flows during extreme precipitation events in order to improve recharge capacity and provide backpressure in surface flows and bedrock fractures (reducing the potential for saltwater intrusion).

Potential Monitoring Items

- NOAA provides local relative sea level trends through their monitoring and mapping efforts.
- Tree vigor and regeneration where forests have experienced or are adjacent to coastal sea water inundation

Additional Resources

- The USDA Northeast Climate Hub has published an in-depth report detailing the Climate Change Impacts on Coastal Forests along the mid-Atlantic and Southern New England coast.
- The Massachusetts Sea Level Rise and Coastal Flooding Viewer includes interactive maps of flooding extent and water level elevations associated with sea level rise scenarios, current coastal flood zones, and hurricane surge modeled by the National Oceanic and Atmospheric Administration (NOAA), Federal Emergency Management Agency (FEMA), and U.S. Army Corps of Engineers (USACE).
- The Connecticut Institute for Resilience & Climate Adaptation (CIRCA) has research, reports and maps about sea level rise.