

Differing Effects of Increased Salinity on Density and Growth of Temperate Deciduous Forests: Coastal versus Inland

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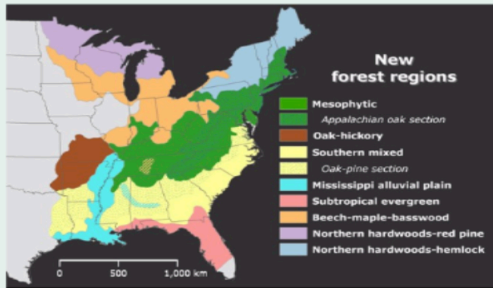


Figure 3. Regions of the Eastern Deciduous Forest, Dyer 2006 National Parks Service.

Study Design:

Temperate Deciduous forests span across much of the Northeast regions of the United States, ranging from both coastal to landlocked regions. (figure 3) These forests are heavily influenced by environmental constraints that determine much of their growth, including soil composition, nutrients, atmospheric conditions, and climate. However, in our research into the constraints that temperate forests experience, we could find little information about the relationship between salinity of local water bodies and the forests nearby. The biodiversity of forests greatly impacts their function and successional growth, but the impact of salinity on biodiversity is not nearly as explored as it should be.

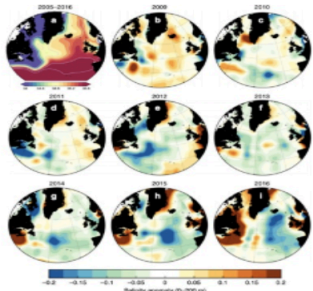


Figure 4. The mean salinity of the shallow upper ocean in the subpolar North Atlantic, between 2009 and 2016. The warmer the colors the higher the salinity and the cooler the colors the lower the salinity. This figure was created by P Holliday of Nature Communications, 2020.



Figure 1. Graphs exhibiting the prediction of the relationship between salinity and biodiversity, and salinity and tree growth.

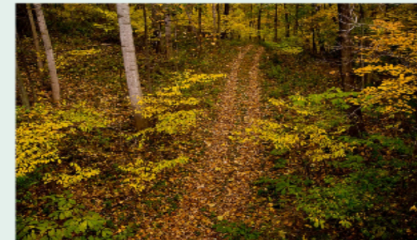


Figure 2. Temperate Deciduous Forests in the northeastern region of the U.S. are biodiverse with a wide variety of tree species. National Park Service, Thomas Paradis.

Hypothesis:

We hypothesize that there is a relationship between the salinity of bodies of water that border deciduous hardwood forests and the biodiversity and growth of those forests. (Figure 1)

Predictions:

We predict that as the salinity of the water body increases, the amount of biodiversity in tree species and their growth decreases (figure 1). As salinity decreases, biodiversity in tree species and their growth increases (Conner, McLeod, & McCarron, 1997). However, regions with saltwater tidal change have experienced a better turnover of nutrients throughout an ecological system than a freshwater system (Lugo, Brown, & Brinson, 1988). This could balance out the negative impacts of high salinity water bodies neighboring forested regions.

Background & Motivation:

Temperate Deciduous forests span across much of the Northeast regions of the United States, ranging from both coastal to landlocked regions (figure 2 forest pic). These forests are heavily influenced by environmental constraints that determine much of their growth, including soil composition, nutrients, atmospheric conditions, and climate. However, in our research into the constraints that temperate forests experience, we could find little information about the relationship between salinity of local water bodies and the forests nearby. The biodiversity of forests greatly impacts their function and successional growth, but the impact of salinity on biodiversity is not nearly as explored as it should be. This impact raises concerns regarding increases in salinity in freshwater and oceanic environments, specifically coastlines and headwater streams (Timpano, Zipper, Soucek, & Schoenholz, 2018).

Expected Benefits:

A better understanding of the salinity of groundwater and soil composition in relation to temperate forest biodiversity would have benefits regarding knowledge of human impacts. As the ocean's experience a decrease in salinity from melting ice sheets due to climate change it is important to understand the impact this will have on temperate forests along the coasts.

The North Atlantic ocean experienced a major freshening in the middle of the ocean and a higher salinity in coastal regions during the 2010s at a much higher rate than previously seen over the past 120 years (Holliday, 2020). (Figure 4) There is very little research into the effect of coastal salinity levels on the temperate deciduous forests that line their shores along the northeast of America. These effects can be understood through the observation and study of similar forest structures along varying salinities at different water bodies. This knowledge would better prepare future land management practices in regards to potential coastal flooding and changing water body compositions.

Intended Analysis:

Two separate tests will be analyzed, each of which will be compared using ANOVA, or Analysis of Variance Analysis, due to the multiple sites that are completely independent of one another. The first comparison will be drawn between the salinities of each site and the biodiversity of the tree species found. The second will be between the salinities of each site and the diameter breast height of each tree. These tests will allow for comparisons to be drawn between biodiversity and tree growth in relation to their dependence upon soil salinity as an environmental constraint to their growth (Keough, Keddy, & Fraser, 1999).

Conner, W., McLeod, K. & McCarron, J. Flooding and salinity effects on growth and survival of four common forested wetland species. *Wetlands Ecology and Management* 5, 99–109 (1997). <https://doi.org/10.1023/A:1008251127131> (https://link.springer.com/article/10.1023/A:1008251127131) Lugo, A. E., Brown, S., & Brinson, M. M. (1988). Forested wetlands in freshwater and salt-water environments. *Limnology and Oceanography*, 33(4part2), 894-909. (<https://aslopubs.onlinelibrary.wiley.com/doi/10.4319/lo.1988.33.4part2.0894>) http://apps.webofknowledge.com.ezproxy.uvm.edu/full_record.do?product=WOS&search_mode=GeneralSearch&qid=9&SID=8ARaz2CzmDvoSnTeM4&page=2&doc=17&cacheurlFromRightClick=no Schmitz, Verheyden, N.A., Beeckman, H., Kairo, J.G., Koedam, N., Influence of a Salinity Gradient on the Vessel Characters of the Mangrove Species *Rhizophora mucronata*, *Annals of Botany*, Volume 98, Issue 6, December 2006, Pages 1321–1330, <https://doi.org/10.1093/aob/mcl224> <https://www.nps.gov/im/nem/eastern-deciduous-forest.htm> Holliday, N.P., Bersch, M., Berc, B. *et al.* Ocean circulation causes the largest freshening event for 120 years in eastern subpolar North Atlantic. *Nat Commun* 11, 585 (2020). <https://doi.org/10.1038/s41467-020-14474-y> Timpano, A., Schoenholz, S., Zipper, C., & Soucek, D. (2018). Benthic macroinvertebrate community response to salinization in headwater streams in Appalachia USA over multiple years. *Ecological Indicators*. 91. 10.1016/j.ecolind.2018.04.031. Keddy, P., & Fraser, L. H. (1999). On the diversity of Land Plants. *Ecoscience*, 1-15. Eastern Deciduous Forest (U.S. National Park Service). (n.d.). Retrieved November 29, 2020, from <https://www.nps.gov/im/nem/eastern-deciduous-forest.htm>