



Level 2: Decomposition and Microbial Growth in Tivoli Bay Plants

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Typha angustifolia (Cattail)
Credit: <http://flora.huh.harvard.edu>



Marsh Wren
Credit: Alan W. Wells



Phragmites australis (Common Reed)
Credit: Cornelia Harris

- ❖ **Background Information:** *Typha angustifolia* is a type of cattail that is native to wetlands in the Northern Hemisphere. Cattails provide food and protection for many types of wildlife. Birds such as marsh wrens and a few species of blackbirds create nests among these plants. Salamanders and frogs lay their eggs among cattails' long submerged stems so that predators cannot eat them. Cattails also regulate the amount of nitrogen entering the ecosystem, which helps to offset eutrophication. Eutrophication occurs when a body of water has excessive nutrient levels, often as a result of sewage or agricultural runoff. It often leads to dense algal and bacterial blooms, which deplete the oxygen needed by other organisms to survive. Thus, cattails can be an important regulator of water quality.

Phragmites australis is an invasive reed that can replace other aquatic plants such as *T. angustifolia*. In many cases, invasive species are targets for removal by government and environmental organizations. These removal plans require time and money, so it is important to study the effects of invasive species in order to decide if they should be removed.

One of the key differences between these species is the amount of nitrogen retention each population provides to their ecosystem. Nitrogen is an important nutrient that can limit growth if levels in the ecosystem are too low or cause eutrophication if levels are too high. Nitrogen retention can be defined as the amount of nitrogen exiting the ecosystem. While it is difficult to measure the amount of nitrogen in living plants, the detritus these plants create (fallen leaves, etc.) provide essential

minerals and compounds for microbes. By measuring the amount of microbial growth on a fallen leaf, scientists can extrapolate how much nitrogen is available for those organisms to consume.

Dr. Stuart Findlay, a scientist at the Cary Institute of Ecosystem Studies, worked with Susan Dye and Kevin Keuhn to study the effects of the invasive *P. australis* by measuring the nitrogen retention in ecosystems with these plants. They also studied the decomposition rates of each of these plant species in order to better understand the rates at which organic compounds (such as nitrogen) are released back into the ecosystem.

By looking at these variables, a decision can be made as to whether or not *P. australis* is dramatically affecting nitrogen levels in wetlands and if it should be removed.



❖ **Dataset Timeframe:** 1998-2002

- ❖ **Data Collection Methods:** Leaf litter was collected from each type of plant and dried out. This allowed the scientists to compare the mass of plant tissue in each sample without having to worry about differences in moisture level. The dried litter was brought back to the marsh and left in the ecosystem for an extended period of time. It was then brought to the lab and massed. Fungal and bacterial abundances were measured using the amount of carbon found on 3cm segments of litter. The data from these segments were averaged for each collection date.

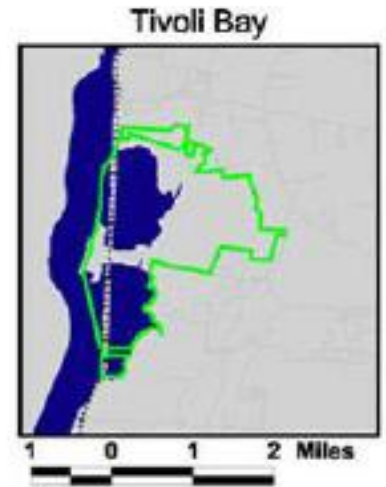
❖ **Dataset Variables:**

- **% mass remaining:** Once the leaf litter was dried, it was massed. Over a period of time, the litter was massed again in order to measure the amount of decay occurring. *Note: you will notice a few points where the % mass remaining is >100%. This means that the leaves briefly increased in mass before beginning to rapidly decay.
- **µgC/gDW/hr (fungal production):** This unit is read as micrograms of carbon per gram of dry weight per hour. These units explain how much fungal growth will happen on a gram of dried plant matter in an hour.
- **ngC/gDW/hr (bacterial production):** This unit is read as nanograms of carbon per gram of dry weight per hour. *Remember that nanograms (bacterial unit) are smaller than micrograms (fungal unit). These units explain how much microbial growth will happen on a gram of dried plant matter in an hour.

❖ Information about Site:

Dr. Findlay and his colleagues chose to study a stand of *P. australis* surrounded by *T. angustifolia* in the Tivoli North Bay, which is a large intertidal marsh at ~HRM 98. At this site, nutrient-rich freshwater enters the ecosystem. It is tidal, so the plants experience partial submersion during high tides.

- ❖ **Source of Datasets:** Stuart Findlay, Cary Institute of Ecosystem Studies. Data were published in Findlay, S., Dye, S., and K. A. Kuehn. 2002. Microbial growth and nitrogen retention in litter of *Phragmites australis* compared to *Typha angustifolia*. *Wetlands*, 22(3):616-625.



Map credit:

<http://www.dec.ny.gov/lands/92370.html>

❖ Inquiry Idea Starters:

- *Did the two plants decay at different rates?*
- *Which plant supported higher bacterial production?*
- *Do fungal and bacterial production levels follow the same pattern as each other over time?*
- *Does the amount of decay correlate with an increase in microbial production?*

❖ Extension Ideas:

- Is *P. australis* creating a significant nitrogen change in the Tivoli North Bay ecosystem?
- Why might the amount of decay lead to an increase or decrease in microbial growth?
- How might different shorelines along the Hudson respond to *Phragmites australis* compared to *Typha angustifolia*?
 - You can combine data from Level 2: Freshwater Plant Decomposition on Hudson River Shorelines to answer this question.
- Does the data from Tivoli North Bay correlate with data from another site? Is *Phragmites australis* behaving in the same way at other sites?

References:

- Findlay, S., Dye, S., and K. A. Kuehn. 2002. Microbial growth and nitrogen retention in litter of *Phragmites australis* compared to *Typha angustifolia*. *Wetlands*, 22(3):616-625.
- Nature Conservancy (2018). Cattails [Fact Sheet]. Retrieved from <https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/utah/placesweprotect/fact-sheets-producers-1.pdf>
- *Typha angustifolia* L. in GBIF Secretariat (2017). GBIF Backbone Taxonomy. Checklist Dataset <https://doi.org/10.15468/39omei> accessed via GBIF.org on 2018-02-23.