Decomposition in aquatic and terrestrial invaded systems (DATIS): a collaboration among ecologists at primarily undergraduate institutions

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Introduction

Leaf decomposition is a critical process which mediates nutrient availability, accumulation of organic matter, and carbon storage. Decomposition rates are controlled by a combination of litter quality and site factors, many of which are driven by regional climate patterns. These processes have been studied extensively for many species yet litterbag protocols vary between terrestrial and aquatic experiments and few studies have examined both ecosystems in concert. Introduction and spread of invasive species also have the potential to strongly influence leaf decomposition via inputs of high quality leaf litter and modifications to the soil environment. Often, but not always, decomposition of invasive species is faster than native counterparts (Ehrenfeld, 2003, 2010). However, it is not yet clear how invaded a site needs to be before ecosystem processes are visibly altered.

Objectives

1. Develop and test integrative protocols for aquatic and terrestrial decomposition
2. Experimentally test whether decomposition rates of invasive species are faster than the decomposition rates of native species across a wide range of environments as previously suggested by Ehrenfeld (2003, 2010).
3. Identify the invasive abundance necessary to affect decomposition rates in ecosystems.

Methods

Senescing leaf litter was collected by gently shaking or brushing leaves off branches during peak litterfall of a native and invasive pair relevant to an area near each campus. To simulate different levels of invasion, litterbags (1mm mesh on bottom, 15mm on top) were filled with 8 grams of air-dried leaf material in five invasive:native combinations of 8g:0g, 6g:2g, 4g:4g, 2g:6g, 0g:8g. Ten replicates of each treatment were deployed into a stream and also into a nearby upland area at each site. Aquatic bags were collected after 1-2 months and 3-4 months; terrestrial bags were/will be collected after 3-4 months and 12 months.

Invasive	Native
Buckthorn	Alder, Black Cherry, or Gray Dogwood
Honeysuckle	Spice bush
Norway maple	Sugar maple or Sycamore
Privet	Texas mountain laurel
Tree of heaven	Smooth sumac

Discussion

Scientific and Educational Lessons:

- While invasive litter did often decay faster than native counterparts, this pattern was not universal for all species or at all sites.
- Decay in some mixtures appear nonadditive, though this also is inconsistent.
- The DATIS project was incorporated into undergraduate teaching in a variety of ways, each with unique benefits and challenges. Pairing an independent study student with a course or pairing multiple courses are some ways to manage the large amount of lab processing required while providing maximal student engagement.

Future Plans:

- After protocol modifications, Phase 2 will begin in the fall 2013. Methodological videos will eventually posted on the website alongside protocols.
- Communication among students at participating institutions could be encouraged via Skype visits to share data and experiences.

Collaboration Model

EREN
Ecological Research as Education Network

The Ecological Research as Education Network (EREN) is an NSF-RCN designed to create a model for collaborative ecological research by faculty and students at primarily undergraduate institutions (PUIs). Specifically, EREN projects aim to

1. fit the constraints of scientists with significant teaching responsibilities
2. maximize student engagement in authentic science and
3. generate publication quality data that can address regional to continental-scale questions.

Members of the network are participating in a variety of pilot projects to test the efficacy of this model of undergraduate data collection, sharing, and analysis that is coordinated across multiple PUIs. The DATIS project is one of these pilot experiments.

Aquatic Results

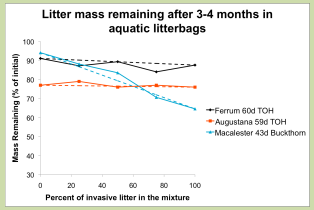


Figure 1. Observed mass loss at 3 college sites. Dotted lines represent the additive decay model.

Contrary to expectations, invasive species did not consistently decay more quickly than native litter. Invasive buckthorn lost more mass than native black cherry in streams but tree of heaven decayed at a similar rate as native sumac, suggesting the importance of species-specific litter quality.

The most frequently reported challenge for aquatic processing with classes was sediment accumulation. We are revising protocols to include specific methods for ensuring consistency within and among classes.

Terrestrial Results

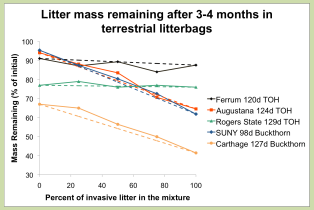
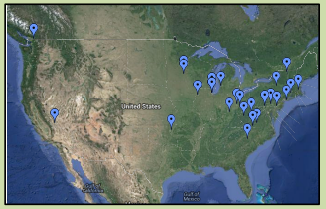


Figure 2. Observed mass loss at 5 college sites. Dotted lines represent the additive decay model.

Similar to aquatic samples, we saw greater mass loss when more buckthorn was in the mix. Decay rates for tree of heaven mixes were more variable: faster decay with increasing invasive abundance at only one of the three reporting sites. More sites will allow analysis of the impact of climate and site factors.

The most frequently reported challenge for aquatic processing with classes was litterbag construction and durability. We plan to order pre-made bags for future iterations to improve consistency.

DATIS Participation



Thirty-one faculty at 27 different institutions have expressed interest in the project and ten participated this first test year. For more information or to add your school to the 2013-2014 participant list, contact the lead scientists:

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Protocols and curricular support are also available at www.erenweb.org/datis