

Plant Physiology Study Hopes to Unlock Secrets of Exotic Invasive Species

Dr. Jennifer Nagel, Visiting Professor, Connecticut College

About one quarter of the plant species in Great Smoky Mountains National Park are not native to this area, or even to this continent. Most of these are limited to disturbed sites and do not out-compete native species in more intact natural areas. However, a handful of species do have the capacity to invade natural areas and completely overwhelm natural communities, requiring the park to spend tens of thousands of dollars each year to control them. Predicted changes in climate could further exacerbate this situation, potentially turning innocuous exotic plant species into efficient invaders. A lot of money and effort could be saved if park managers could predict which exotic species were likely to become invasive so that they could be controlled before they spread.

Dr. Jennifer Nagel received a National Parks Ecological Research Program Post-Doctoral Fellowship in 2004 to work in the Smokies. Her work in the park was conducted in collaboration with Dr. Jake Weltzin at the University of Tennessee's Old-Field Community Climate and Atmospheric Manipulation Project at Oak Ridge National Laboratory. Based on some of her earlier work in New York and Nevada, she hypothesized that species that use energy (from photosynthesis) most efficiently (for growth/production of biomass) would be the most productive within a given community. At Oak Ridge, she studied the responses of her test plants to a variety of controlled exposures to different

levels of carbon dioxide, air temperature, and soil moisture. **In the field, she established test plots at two sites in the park:**

- 1) Cades Cove, where she looked at native and non-native grasses, as well as native goldenrod and non-native clover and plantain;
- 2) Purchase Knob, where she looked at non-native brown knapweed and several native forbs.

The analysis of this and related studies is ongoing, but thus far some interesting findings have assisted with the development of a model that illustrates the complexities of the system. First, by measuring photosynthetic activity throughout a 24-hour period, she determined that not all species achieved their highest levels of photosynthetic activity at solar noon, as had been previously assumed. *Lesson: when collecting the baseline data for exotic species and the communities into which they've been introduced, measurements must be made at several times during the day.*

Second, the predictor of the most successful species (measured by percent ground cover) changed during the season. Early in the season, successful species were those that were most efficient at energy gain, but this predictor was replaced later in the season by efficiency with which new biomass could be produced, and eventually, by the efficiency with which limiting nutrients such as nitrogen could be utilized. Certain nutrients may be in short supply by the end of the growing season; thus, more efficient plants can set and ripen more seed or otherwise position themselves to expand their population at the expense of other species. *Lesson: baseline data needs to be collected several times throughout the season.*

Dr. Nagel is proceeding on to work in Cape Cod National Seashore, looking at a system where an invasive exotic is a nitrogen fixer, and then on to Hawaii, where she will continue to develop this model. Photo credit: Jennifer Nagel



An Environmental Mystery: Abnormal Morphologies of a Diatom in Great Smoky Mountains National Park

Paula Furey, Bowling Green State University

As part of the All Taxa Biodiversity Inventory (ATBI) taking place in Great Smoky Mountains National Park, the Algal Taxonomic Working Group has been sampling aquatic habits throughout the park. What is great about algae, especially diatoms (a group of algae that

have a silica-based case...essentially a glass house), is that different species have different environmental tolerances and preferences and they are able to integrate and respond to the biotic and abiotic elements of the environment. This makes them ideal indicators of changes in

the condition of aquatic ecosystems, such as those caused by acid pollution.

We have been focusing on the acid loving diatom genus *Eunotia Ehr.*, which can flourish in the park because of habitats that are more

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