The New England Botanical Club
Graduate Student Research Awards
2012 AWARD WINNERS

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Disturbance based management in a changing world: Species composition in Massachusetts sandplain heathlands over the past two decades

As humans increase the amount of available nitrogen on the earth's surface through food and energy production, organisms adapted to low nutrient environments are often outcompeted by those adapted to higher nutrient environments. This has caused the reduction of species diversity in heathlands worldwide. With the increasing threat of nutrient deposition, managers may focus on removing nutrients from the system through techniques such as mowing, prescribed burning, sod cutting, and grazing. These techniques have differing effects on soil nutrients and, as such, can be expected to have differing effects on species composition.

Our goal is to investigate species change over time within coastal sandplain heathlands, especially changes associated with increasing nutrients. In addition, we will assess the efficacy of current management techniques in counteracting increased soil nutrients caused by atmospheric nutrient deposition. In order to complete this goal, we will survey permanent monitoring plots established in 1989 and 2002, using the same methods as the original surveyors (Dunwiddie 1986). Long-term studies (those longer than ten years) are rare and are necessary to disentangle long-term trends from seasonal fluctuations. By looking at species change over twenty years within the sandplain grasslands and heathlands we will be able to better understand how our changing world is affecting these important habitats. Additionally, by examining various management techniques we will be able to better inform managers.

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Toxic nectar in turtlehead (*Chelone glabra*): Pollination by self-medicating bees

Nearly all organisms participate in biotic interactions and face the challenge of simultaneously engaging with mutualists, while deterring antagonists. For example, plants produce toxic secondary metabolites to deter herbivores, but must avoid poisoning pollinators with them. Pollinators themselves interact with parasites and predators, which may alter foraging behavior and could ,thus, have fitness consequences for the plants they visit. Turtlehead (*Chelone glabra*; Plantaginaceae), a plant of northeastern wetlands, requires flower visits by bees in order to set seed. The plant defends its leaves with iridoid glycosides, which are also present in floral nectar and pollen. These compounds may have sublethal effects on the health of bees that consume them, but may also benefit the bees by rendering their guts inhospitable to parasites, as recent research has demonstrated for other plant secondary metabolites. Bees may thus face a trade-off between costs and benefits when they forage on turtlehead.

The goals of this study are to characterize the impact of nectar toxins on pollinator behavior and plant reproductive success, and to examine the costs and benefits of toxin consumption to pollinators. In a combination of field and lab experiments, the following hypotheses will be tested: 1) nectar toxin concentrations are variable within and between sites, and this variability is uncoupled from foliar chemical defense; 2) pollinators prefer plants with less toxic nectar, which alters reproductive outcomes for plants; and 3) consumption of nectar toxins imposes a fitness cost on healthy bees, but lowers parasite virulence in sick bees. The study will explore the multi-species context of plant-insect interactions and will further our understanding of the ecology of plant secondary chemistry.