Timothy Dwyer,

NSF Graduate Fellow

NSF GK-12 Project: Northeastern University
GK-12-PLUS (Partners Linking Urban Schools)
URL: http://www.gk12.neu.edu

Thesis Title: The impact of prior shell damage on growth rate in an intertidal snail (*Nucella lapilus*)

College/University: Northeastern University

Research Advisor: Geoffrey C. Trussell

Degree Sought
M. S.

University Department and/or Lab
Department of Biology

Research Focus
I'm working to discern how snails alter the allocation of energetic resources for shell and body growth after non-lethal damage.

Description of Research
For the predatory dogwhelk, *Nucella lapillus*, life can be pretty rough. These small snails have evolved to inhabit the intertidal zone, the thin strip of rocky coastline exposed by the tides roughly every twelve hours. On one hand, spending half their time out of the water gives them a periodic refuge from predation by fish and crabs that most remain submerged. On the other hand, these snails are exposed to a broad range of environmental conditions that would give pause to the most hardened of 19th century explorers. Baked to over 130 degrees on some summer days and chilled well below freezing in the winter, the intertidal zone is one of the worst places in the world to live. In New England, winter storms routinely pummel the shoreline with thirty-foot waves and scouring ice flows while summer sunshine rapidly heats and evaporates the cooling and protective water left behind by the falling tide. To deal with all of this, the snails have developed various behavioral and structural adaptations. Hiding in the face of waves and possessing a tough, watertight shell that protects against dehydration have proven to be effective evolutionary strategies. But then, there are the crabs.

In the face of effective (but occasional) intertidal predators such as the green crab (*Carcinus maenas*), individual dogwhelks are not without options. However, each alternative carries a cost associated with the ultimate benefit of survival. Crawl into a crack and death-by-crab may be avoided, but there will likely be little food. Grow a thicker shell and crabs will have difficulty with it, but then that heavy shell will need to be carried around when predators are absent. Tradeoffs are the nature of the game.

Frequently, shells get cracked but the snail survives. My research explores how dogwhelks deal with this non-lethal damage, presumably an indicator of mortal peril. When crabs (which the dogwhelks can actually smell) are present, do they risk feeding to gain the energy necessary for repair? Do they avoid feeding and use up energy reserves stored in their soft tissue to thicken their shell? How does this compare to damaged snails in the absence of a predator? By looking at rates of shell and body tissue growth under various experimental conditions, I hope to eventually answer questions about how energy (food) resource allocation is prioritized.

Example of how my research is integrated into my GK-12 experience

As a graduate student based at Northeastern University's Marine Science Center on the coast of Massachusetts, I have access to a prime location for the study of terrestrial and marine field biology. Through field trips and lab exercises, I will incorporate real and relevant scientific data collected by students into classroom units on community and population ecology as well as evolutionary biology.