

Field Notes – Summer 2018

Hopkins Forest: *Life on the Edge...*

Are species natural ranges limited primarily by abrupt changes in environmental conditions, population genetics or a combination of the two? This is the basic question that Ph.D. students Antoine Perrier and Dario Sanchez Castro, from the University of Basel in Switzerland, set out to answer in a study hosted partially in Hopkins Forest this past year. Throughout the year, passers-by might have noticed various structures -- including a portable greenhouse and a fenced in plant nursery -- in the field beside the Rosenberg Center. This was the location where nearly 1400 potted lyre-leaved rock cress (*Arabidopsis lyrata*) plants from some 20 source populations were propagated to address questions of genetic and environmental constraints on adaptation and range expansion.

Hopkins Forest is one of five sites in the eastern US selected by this team of researchers to test how plants from different geographic sources respond to growing in a variety of climates. The other four sites span from northern New York to Virginia to North Carolina to Georgia. The Williamstown location represents climatic conditions in the northern part of this small mustard plant's native distribution.



This June -- after almost a year in the nursery and much tending by project assistant and Hopkins Forest gardener Debra Rogers-Gillig -- the results began to come in. Antoine and Dario took to the lab in the Rosenberg Center to size up the vigor of the plants that had germinated the previous fall and had overwintered as rosettes in the nursery. Combining germination and survival rates, tallies of fruits and flowers, and estimates of growth (using weekly generated digital imagery), the researchers aim to identify the most fit individuals and from which populations and geographic areas they have come.

One would expect plants from northern seed stock to do relatively well in Williamstown, while those taken from the southern reaches of their range, North Carolina for example, would struggle when trying to cope with climatic conditions so foreign to them. This would be an example where environmental conditions limit the capacity for adaptation and range expansion. If such results proved not to be the case, that might point to genetically derived limits to range expansion -- such as founder effect and drift load.



Lyre-leaf rock cress

To test the magnitude of these genetic factors, Antione and Dario stocked their nurseries with crosses from known populations within the plant's range. The "drift load" hypothesis suggests that individuals from the far edges of their ranges -- where numbers are low and isolation and inbreeding are high -- would exhibit genetically mitigated problems in vigor and evolutionary fitness. Consequently, offspring from parents confined to these edge populations would show lower measures of fitness (growth, vigor, reproduction, etc.) than hybrids from crosses between individuals from the edge and core populations.

The students are in the process of examining their plants to see if this is truly turning out to be the case. It will take more months of counting, compiling and analyzing before all of the answers are in; but, when all is said and done, Hopkins Forest will have made a meaningful contribution to the science of species range expansion at a time when it is highly topical in our rapidly changing world.



-Drew Jones
June 2018

Photos: Antoine Perrier