This proposal will continue research begun with funding from two VGN Pilot Project grants and will expand the research to investigate the genetic basis of allele divergence and its role in environmental response. Allele divergence at loci regulated by environmental signals may be a major mechanism for organisms to respond to external and downstream internal stimuli. Elucidation of mechanisms for the evolution of physiological response to both external and internal signals is an important goal for both biomedical science and evolutionary biology. The proposed new research will use a mRNA-sequencing experiment to scan the transcriptomes of individuals from warm- and cold-adapted populations of Arabidopsis lyrata, treated to alternate warm and cold temperatures, for loci with allele-specific expression in alternate temperatures. This work will make use of the new massively parallel sequencing capacity at the University of Vermont. Continuation of pilot project research will include the completion of nonstructural carbohydrate (NSC) analysis and DNA fingerprinting to determine the degree of genetic uniqueness among individuals included in the present analyses. Additionally, analysis of the NimbleGen targeted capture of genomic carbohydrate metabolism and transport (CMB) gene sequences will continue and be completed through the summer of 2012. The NSC data will provide physiological corroboration to the CMB gene sequence analysis and also for an initial focus on environmentally regulated CMB loci in the new mRNA-sequencing experiment. Drafting and submission of a manuscript for publication of the population-level CMB gene sequence data is also a primary goal of this proposal.