**Aims:**

1. Do genetic differences exist?
2. What factors might be influencing the evolution of genetic differences?
3. Can the seed transfer distance affect fitness?

**Materials and Methods:**

***Physiological measurements:***

Stomatal characteristics were assessed on both abaxial (lower) and adaxial (upper) leaf surfaces. Guard cell length (stomatal size), the number of stomata per unit leaf area (stomatal density), the overall area of the leaf occupied by stomata (stomatal area index) were determined. Measurements were conducted by taking impressions of the leaf surfaces using a thin layer of Newskin “liquid bandage”. Impressions from two leaves per individual were taken based on methods described in Greer et al. 2017 (N=650, 417 Great Lake alvar, 91 Manitoba alvar, 142 Prairie). Impressions were mounted onto slides and photographed using a using a Zeiss Stereo Discovery (V8) digital microscope (Carl Zeiss Microscopy, LLC, Thornwood, NY, USA) with a Canon Rebel T3 E0S 1100D digital camera (Canon Virginia Inc., Newport News, VA, USA). Photographs were standardized to a 0.32 x 0.42mm grid and measurements were taken using ImageJ (v1.52a, National Institutes of Health, USA).Abaxial and adaxial stomatal size is reported as the average of three stomatal guard cell lengths. Stomatal density of adaxial and abaxial surfaces was calculated by dividing the total number of stomata per slide by the area of view. Stomatal area index was calculated as the product of average guard cell length and stomatal density (taken from Bertel *et al*. 2016).

To quantify integrated water-use efficiency we used carbon isotope composition. Leaf samples from approximately five individuals per population (**N=,** 53 Great lake alvar individuals,9 Manitoba alvar individuals, and 31 Prairieindividuals) were sampled from the field common garden and oven-dried at 55 ℃ over 24 hours. Following this, leaf samples were homogenized into a fine powder using a TissueLyser II (Qiagen, Hilden, Germany) and 4-5 mg of each sample were weighed and placed into a tin capsule **(**Costech, Valencia, CA, USA**)** for 13C isotope analysis using a continuous flow isotope ratio mass spectrometer (Sercon Ltd., Cheshire, UK) at UC Davis Stable Isotope Facility (Davis, CA, USA). The reported 𝛿13C is expressed relative to the Vienna Pee Dee Belemnite.

***Physiological trait response to source climate variables:***

Climate data for the Great Lake alvar and prairie populations was 30 year average data for 4 climate variables (CMD\_sp, CMD\_sm, Tmax\_sp, Tmax\_sm) corresponding to population source latitude, longitude, and elevation. Data was sourced from ClimateNA database (v5.50, University of British Columbia, Vancouver, BC, Canada).

***Fitness Components:***

***Statistical analyses:***

Data analysis was performed using the R software (**version)**. A one-way ANOVA was used to test for genetic differences in the common garden. Bartlett test for homogeneity of variance and Shapiro-Wilk test for normality were run to verify validity. A Tukey post-hoc analysis was run to test significant differences between regions. Relationships between climate response variables and physiological traits were assessed using linear and quadratic regressions (**Pearsons)**.

**Results:**

Genetic Differences Between Regions:

Regional Climate Variation responses:

Fitness Data: