ML 2014, Chapter 312, Article 12, Section 8 Project Abstract
For the Period Ending June 30, 2019

PROJECT TITLE: MITPPC Sub-project #3 Climate change and range expansion of invasive plants
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APPROPRIATION AMOUNT: $206,335
AMOUNT SPENT: $206,335
AMOUNT REMAINING: $0

Sound bite of Project Outcomes and Results
This project provided maps to describe the climate suitability and invasion risk for ten invasive species in Minnesota now and in the future. These findings can be used to guide management decisions about surveillance and eradication efforts for these species.

Overall Project Outcome and Results
In our project, 'Climate change and range expansion', our goal was to use public records of species presences and available environmental data to build models that predicted the habitat suitability and invasion risk under current and future climate scenarios for 10 invasive species of interest to MN. Those species were: Common Tansy, Wild Parsnip, Palmer Amaranth, Oriental Bittersweet, Narrowleaf Bittercress, Japanese Hops, Common Teasel, Dalmatian Toadflax, Brown Knapweed, and Black Swallowwort. We originally planned to include Grecian Foxglove, but were unable to obtain enough data to build reliable models. We developed species distribution models (SDMs) using multiple techniques (Maxent, Boosted Regression Trees, and Joint Distribution Modeling of Communities) and multiple scales (North American continent and Upper Midwest) to validate results. We wrote a report with detailed finding from our SDMs titled, "Species Distribution Model Projections for Incipient Invasive Species of Minnesota". Our findings can be used to help guide management decisions about surveillance and eradication efforts for these species. Additionally, we have published on our findings on methods for producing accurate models of invasive species and specific SDMs for the species of interest in academic peer-reviewed journals. We have also presented our work at the UMISC-NAISMA and Palmer Amaranth Conferences and have participated as presenters in USFS land manager training. The project supported or trained one postdoctoral scholar, one postgraduate research assistant, two undergraduate students, and one graduate student. One undergraduate student decided to continue as a graduate student working on invasive species and is an author on all of the manuscripts and data products. The management document and all of the underlying data, models, and projections are archived at the Data Repository for U of M (DRUM) and are freely available to Minnesotans to access to gain a better picture of the potential distributions of the listed species.

Project Results Use and Dissemination

Our project has resulted in four publications, five major presentations to disseminate our findings at national and regional meetings, and 80 data products that can be accessed by all Minnesotans and natural resource professionals. We have published our SDM results for Palmer amaranth in the open-access journal *Scientific Reports*, which is freely available to the public. We have presented the result of this paper at the UMISC-NAISMA Joint Conference in Oct 2018 in the Palmer amaranth session to scientists and professionals interested in the problem of rapid, invasive spread of Palmer amaranth. We also presented to work as a poster at the first MITPPC Palmer Amaranth Summit in Jan 2019 and Dr. Briscoe Runquist participated in the conference management working groups as scientific expert on the biology and potential for spread of the species. We have also presented this work to the MN NWAC Management and Policy Subcommittee. Additionally, we provided training to US Forest Service professionals about the underlying mechanics of species distribution models and how and when they can be used to effectively forecast and manage the spread of invasive species under current and future climate conditions. Lastly, we produced a document specific to predicted habitat suitability in MN to be used by MN natural resource professionals for surveillance and eradication decision-making. This document will be housed with the MITPPC in hard copy form and will be accessible as a pdf on their website for download.

During the course of this project, we have generated 80 multi-layered data products that have been archived at the Data Repository for U of M (DRUM) with DOI numbers that can be used to quickly access the data. These data products can be used for further analyses for researchers and natural resource professionals. For each of the species, we have collated a list of occurrence records (current through 2018) that are sourced from multiple databases and have been cleaned for problematic records. They are ready for use in multiple applications that require verified occurrence data. We have also generated multiple SDMs, their validation metrics, and current and future projections based on these models for all ten species. We have provided the models and the raster projections for these SDMs as downloadable files. Further, for 3 species, Narrowleaf Bittercress, Oriental Bittersweet, and Japanese Hops, we developed Joint Species Distribution models (JSDMs) to compare with traditional SDMs using DNR relevé data, environmental data, and a Bayesian method for joint attribute modeling. The input data (climate data, species co-occurrence matrices) and output data (models and projections) are also available for use. These models provide data on projections for the invasive species, as well as for other potential plant community members of interest.