M.L. 2014 Projects

MN Laws 2014, Chapter 226, Section 2 (beginning July 1, 2014)

MN Laws 2014, Chapter 312, Article 12, Section 8 (beginning July 1, 2014)

Visit the LCCMR website for the most up-to-date project information and reports

Subd. 06 Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Enhancing Pollinator Landscapes

Subd. 06a $864,000 TF

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Appropriation Language
$864,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to identify sources of nectar and pollen for native pollinators and honey bees and coordinate ongoing and future efforts to enhance pollinator habitat and opportunities for pollinator nesting and foraging. This appropriation is available until June 30, 2017, by which time the project must be completed and final products delivered.

Project Overview

Pollinators play a key role in ecosystem function and in agriculture, including thousands of native plants and more than one hundred U.S. crops that either need or benefit from pollinators. However, pollinators are in dramatic decline in Minnesota and throughout the country. The causes of the decline are not completely understood, but identified factors include loss of nesting sites, fewer flowers, increased disease, and increased pesticide use. Fortunately, there are known actions that can be taken to help counteract some of these factors. Researchers at the University of Minnesota are using this appropriation to conduct efforts aimed at increasing reliable supplies of nectar and pollen for pollinators by surveying for existing populations, identifying plants that contribute the most resources to pollinator production and survival, and identifying areas where pollinators nest and overwinter. Information will be used to develop maps, demonstration sites, best management strategies, and long term plans for sustaining pollinators that will assist private landowners and public land managers in efforts to enhance landscapes for the benefit of pollinators.

OVERALL PROJECT OUTCOME AND RESULTS

There is a large knowledge gap regarding the distribution, floral preferences, habitat use, and nesting ecology of the more than 400 native bee species in Minnesota. This funding provided the first important and comprehensive step to fill this gap. For Activity 1, the University of Minnesota hired Dr. Daniel Cariveau in September 2015. Since starting as an Assistant Professor, Dr. Cariveau has built a large, highly productive lab group focusing on native bee ecology and conservation. This includes five graduate

students, three postdoctoral research associates, four full-time research staff and over 20 undergraduate research technicians. He has raised over $3 million in state and federal funds and has published seven manuscripts in that time. He has also helped organize projects throughout the state and has built relationships with MNNDR, Pheasants Forever, MNDOT, USFWS, and The Nature Conservancy. For the second activity we collected over 10,000 specimens of 268 species and verified the identity of over 13,000 specimens and nearly 350 species from historic collections. We have thus documented the current and past distribution and abundance of Minnesota's native bees. This provides critical baseline data that will inform native bee conservation. For the third activity, we compiled data on over 45,000 native bee by plant interactions. We sampled bees in urban and prairie ecosystems. We have used these collections to develop lists of plants for habitat and these data have generated research into minimizing restoration costs. In the fourth activity, we documented how plant species and management activities influence nesting of stem-nesting bees. This work is a critical step as most research addresses only floral use by bees. The results of this work can be used by homeowners to better manage nesting habitat. We are in the process of publishing results in peer-reviewed journals. Data will be open access upon publication.

PROJECT RESULTS USE AND DISSEMINATION

Using this funding we were able to reach a wide array of audiences. For one, we held a total of four organizational symposia that focused on ongoing pollinator work being funded by the Environmental and Natural Resources Trust Fund. At these symposia, individuals with projects funded through ENRTF discussed the scope, results and importance of their findings. A major goal of these symposia was to prevent overlap and encourage collaboration. Therefore, we also held break-out sessions at these meetings and discussed new project ideas along with how to share results from current research. These symposia typically involved 15 – 20 presentations with 30-50 participants. Staff and LCCMR members attended a number of these symposia. In addition, we presented nearly 30 outreach talks and 3 scientific presentations that focused on the research being conducted from this proposal. Some of these talks included large audiences and were broadcast widely, such as interviews with the Minnesota Public Radio. In addition, we also spent the summer of 2017 managing a novel, multi-tiered mentorship program. Drs. Cariveau and Rodgers mentored two University of Minnesota undergraduate students. These students received their own funding through the Undergraduate Research Opportunity Program at the University of Minnesota. In addition, the City of Minneapolis recruited two Urban Scholars to participate in sampling. The Urban Scholars program provides mentorship and funding to undergraduate students from diverse backgrounds to conduct scholarly work with the City of Minneapolis. Drs. Cariveau and Rodgers also recruited a Step-Up student. The Step-Up program is aimed at providing internships to high school students that experience barriers to employment. Finally, we created an outreach document titled Nesting Habitat for Stem Nesting Bees. All of the content of this document is compiled and the design is being finalized.

Project Completed: 06/30/2019 [Extended in M.L. 2015, Chapter 76] **FINAL REPORT**

Dredged Sediment for Forest Restoration on Unproductive Minelands

Subd. 06j $300,000 TF

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Appropriation Language

$300,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota-Duluth for the Natural Resources Research Institute to restore up to 136 acres of unproductive mine stockpile while improving the treatment of municipal sewage and biosolids near Virginia using clean Erie Pier dredged sediment and managed forestry techniques. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

Project Overview

Mine stockpiles are unproductive due to soil deficiencies of organic matter, nutrients, and soil organisms, which are essential to supporting healthy plant growth, diversity, and succession. Waste products, including biosolids, composts, and dredged materials, have the potential to be used to address some of these deficiencies and make the lands productive again. Researchers at the Natural Resources Research Institute at the University of Minnesota in Duluth are using this appropriation to demonstrate and evaluate methods for using dredged sediment and treated biosolids as a substrate for restoring up to 136 acres of unproductive minelands to productive forestland. If effective this technique could be applied more broadly to minelands in Minnesota and elsewhere with potential benefits including production of materials for the biofuels and forest products industries, increased wildlife habitat, restoration of unproductive lands, and re-utilization of waste products.

OVERALL PROJECT OUTCOME AND RESULTS

This project investigated using sediment dredged from the Duluth-Superior Harbor for enhancing mineland restoration, beyond what is required by state reclamation requirements, and to demonstrate potential economic gain from purpose-grown trees for biofuel. Funding was provided by ENRTF. The NRRI secured supplemental funding from the U.S. Army Corp of Engineers and the U.S. Department of Commerce to support transport of 4,500 cubic yards of dredge material to the Virginia, Minnesota landfill project site.

The Virginia Landfill property was cleared of existing vegetation in 2015 and three study plots were constructed, totaling approximately 4.5 acres. Dredge material was applied in two of the plots at 6-inch and 12-inch thicknesses; the remaining plot (control) did not receive sediment. Cottonwood, Tamarack, and White Pine were planted in 2017 and 2018.

Major project tasks included: counting surviving trees and measuring their heights; soil fertility sampling; and floristic inventories of all plants. For comparison purposes, tree-planting success at two sites previously treated with dredge sediment was also evaluated.

Tamarack had the lowest survival rate and White Pine had the highest, regardless of the plot. Cottonwood were more successful in the sediment plots than in the control. Average tree heights ranged from less than a foot to 2.5 feet at the project site, while high mortality and inconsistent growth rates were observed at the two comparison sites.

The economic potential from purpose-grown trees cannot be estimated with so short a growing time. Trees require 20 to 90 years' growth to attain a marketable height of 40 to 50 feet. Consequently, the greater near-term value of applying dredge material to disturbed or mined land is associated with

shortening the time it takes to establish good vegetative cover. Based on the study results and observations, creating pollinator habitat could be another beneficial dredge material use.

PROJECT RESULTS USE AND DISSEMINATION

Results from this project, including soils and vegetation data were shared with St Louis County Environmental Services (2017), Minnesota Department of Natural Resources Mineland Reclamation program (2019), and United Taconite personnel (2019).

Project Completed: 06/30/2019 **FINAL REPORT**

Subd. 07 Land Acquisition, Habitat, and Recreation

Metropolitan Regional Park System Acquisition

Subd. 07b $1,500,000 TF

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Appropriation Language
$1,500,000 the second year is from the trust fund to the Metropolitan Council for grants for the acquisition of lands within the approved park unit boundaries of the metropolitan regional park system. This appropriation may not be used for the purchase of habitable residential structures. A list of proposed fee title and easement acquisitions must be provided as part of the required work program. This appropriation must be matched by at least 40 percent of nonstate money that must be committed by December 31, 2014, or the appropriation cancels. This appropriation is available until June 30, 2017, by which time the project must be completed and final products delivered.

Project Overview

The Twin Cities area is host to a nationally renowned system of regional parks and trails that provides numerous outdoor recreational opportunities for the public while preserving green space for wildlife habitat and other natural resource benefits. Currently the regional parks and trails system consists of 51 parks and park reserves containing more than 54,000 acres, more than 300 miles of interconnected trails, and has more than 46 million visits each year. Through an existing grant program, the Metropolitan Council is using this appropriation to partner with local metropolitan communities to partially finance the acquisition of approximately 200 acres to be added to existing metropolitan regional parks. Priority will be given to lands with shoreland, lands that provide important natural resource connections, and lands containing unique natural resources.

OVERALL PROJECT OUTCOME AND RESULTS

The Metropolitan Regional Parks System is a natural resource-based system, with an emphasis on lands that are contiguous to lakes, rivers, or other water bodies. Natural resource protection and restoration

is a key objective for the system. The 2014 ENRTF appropriation of $1.5 million was matched with $1 million of Metropolitan Council bonds and $833,000 of regional park implementing agency funds for a total of $3.3 million for acquisition for the Regional Park System. Approximately 114 acres were acquired through this appropriation. The parcels acquired contain high quality natural resources and are located within the boundaries of regional parks, regional park reserves or regional trails.

Nine properties were acquired for the Regional Park System. Dakota County acquired a 2.5-acre inholding for the Lebanon Hills Regional Park that will be restored to oak savanna. Washington County acquired an 8-acre hardwood forest inholding for the Big Marine Park Reserve that includes a portion of Pitzl Pond.

Three Rivers Park District acquired three properties totaling 19.6 acres for the Rush Creek Regional Trail. Rush Creek runs through these properties and these acquisitions will protect .75 miles of shoreline along with the creek's wetlands and uplands.

Three Rivers Park District also acquired two properties totaling 65 acres for the Baker Carver Regional Trail. One of these properties contains wetlands, woods, and a creek that feeds into Lake Minnetonka and Minnehaha Creek. The other property contains uplands with mature trees, and nearly 3 acres of wetland with frontage on Six Mile Creek.

Finally, Three Rivers Park District acquired two properties totaling 18.5 acres for the West Mississippi Regional Trail. These properties contain wooded ravines and a half mile of shoreline, protecting the Mississippi River along the regional trial.

These nine acquisitions will add over 100 acres to the Regional Park System for all Minnesotans to enjoy, while protecting valuable natural resources for the region.

PROJECT RESULTS USE AND DISSEMINATION

The three Regional Parks Implementing Agencies that acquired property through this project- Dakota County, Three Rivers Park District, and Washington County- each conducted their own dissemination activities. Washington County issued a news release after acquiring the property for Big Marine Park Reserve and posted an ENRTF sign at the site. Dakota county also posted an ENRTF sign at the property acquired for Lebanon Hills Regional Park, and they had significant public attention and engagement while updating their Master Plan and developing a new Natural Resource Management Plan for the park. Three Rivers Park District acquired 7 properties and issued news releases for each one and will be posting signs as the properties become accessible to the public. The news releases for each property are included in the Work Plan Final Report.

Project Completed: 06/30/2019 [Extended in M.L. 2018, Chapter 214] **FINAL REPORT**

Invasive Terrestrial Plants and Pests Center

Research Project

Sec. 08 $1,460,000 TF

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Appropriation Language
$490,000 in 2015 is from the environment and natural resources trust fund for the Invasive Terrestrial Plants and Pests Center requested under this act, including a director, graduate students, and necessary supplies. This is a onetime appropriation and is available until June 30, 2022.

$970,000 from the environment and natural resources trust fund appropriated in Laws 2011, First Special Session chapter 2, article 3, section 2, subdivision 9, paragraph (d), Reinvest in Minnesota Wetlands Reserve Acquisition and Restoration Program Partnership, is transferred to the Board of Regents of the University of Minnesota for the Invasive Terrestrial Plants and Pests Center requested under this act, including a director, graduate students, and necessary supplies and is available until June 30, 2022.

Project Overview

Terrestrial invasive species are species that are not native to a location and that pose critical ecological and economic challenges once they become established in that location. They come in the form of plants, animals, insects, pathogens, and microbes that can cause harm to natural habitat, urban landscapes, and agricultural systems. The problems posed by terrestrial invasive species continue to grow as existing infestations expand and new exotic species arrive, many of which are poorly understood. New ideas and approaches are needed to develop solutions and to stay on top of emerging threats. The University of Minnesota is using this appropriation to help launch a new interdisciplinary Terrestrial Invasive Species Research Center charged with using scientific findings to support policy-making, application, and resource management practices that address the terrestrial invasive species affecting Minnesota. The center will coordinate initiatives focused on prevention of establishment, early detection and rapid response, development of new control methods and technology, integrated pest management, and minimizing non-target impacts of control. Proven tools and techniques developed at the center are intended to be implemented statewide as applicable.

Sub-Projects M.L. 2014, Sec. 08:

- *01: Metagenomic approaches to develop biological control strategies for aquatic invasive species* - $299,363
- *02: Attracting carp so their presence can be accurately assessed* - $682,269
- *03: Common carp management using biocontrol and toxins* - $384,231
- *04: Developing and evaluating new techniques to selectively control invasive plants phase I: manipulating sunfish to enhance milfoil weevils and factors influencing selective herbicide control of curlyleaf pondweed* - $194,415

Project Completed: 06/30/2022 **Work Plan**

Sub-Project 01: Novel Diagnostic Tools for Rapid and Early Detection of Oak Wilt - 271,911 TF

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OVERALL PROJECT OUTCOME AND RESULTS

Oak trees (Quercus spp.) play a significant role in the ecosystem and are considered economically important for several reasons. They are prone to oak wilt disease, caused by the fungus, Bretziella fagacearum, which is of huge concern due to the reduced profitability in their production. Affected trees cannot be cured and so, early, and rapid identification of the infection is necessary to prevent spreading. The objectives of this study include the development of cell separation method of woodchips and DNA extraction method, followed by the development of a rapid detection assay in combination with a handheld system. Infected and healthy red oak wood chip samples were collected from different parts of Minnesota followed by DNA extraction and testing using the chemiluminescence-based chemical assay. In phases I and II of this project, we developed a novel Nanoparticles Enhanced Chemiluminescence (NEC) assay. The major accomplishments include: (1) Combination of the DNA extraction protocol with NEC assay detection. (2) Application of the NEC assay on real-world samples (wood chips from healthy and infected red oak trees) and determination of the sensitivity (88.8 %) and specificity (73%) of the NEC assay. (3) Optimization of the reaction conditions. Additionally, MITPPC phase III proposal has been approved to expand the NEC assay to various invasive forest pathogens of high priority to Minnesota and conduct third party validation of the technology. The major impact of this project will be the improvement of diagnostic capabilities of plant diagnostic clinics and laboratories by offering a highly sensitive and cost-effective tool for rapid identification of oak wilt. The spread of the disease can be stopped at an early stage by administering treatments and implementing preventative measures. The proposed technology will help protect Minnesota natural resources and reduce the financial burden of oak tree removal.

PROJECT RESULTS USE AND DISSEMINATION

The research findings were disseminated through regular updates to the Minnesota Invasive Terrestrial Plants and Pests Center, non-peer reviewed outlets (e.g., newsletters or websites), and peer-reviewed publications. This project was also discussed through formal and informal presentations to stakeholder groups and scientific societies.

Subproject 01 Completed: 06/30/2020 **FINAL ABSTRACT**

Sub-Project 02: Early Detection, Forecasting and Management for Halyomorpha halys - $420,535 TF

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OVERALL PROJECT OUTCOME AND RESULTS

Oak trees (Quercus spp.) play a significant role in the ecosystem and are considered economically important for several reasons. They are prone to oak wilt disease, caused by the fungus, Bretziella fagacearum, which is of huge concern due to the reduced profitability in their production. Affected trees cannot be cured and so, early, and rapid identification of the infection is necessary to prevent spreading. The objectives of this study include the development of cell separation method of woodchips and DNA extraction method, followed by the development of a rapid detection assay in combination with a handheld system. Infected and healthy red oak wood chip samples were collected from different parts of Minnesota followed by DNA extraction and testing using the chemiluminescence-based chemical assay. In phases I and II of this project, we developed a novel Nanoparticles Enhanced Chemiluminescence (NEC) assay. The major accomplishments include: (1) Combination of the DNA extraction protocol with NEC assay detection. (2) Application of the NEC assay on real-world samples (wood chips from healthy and infected red oak trees) and determination of the sensitivity (88.8 %) and specificity (73%) of the NEC assay. (3) Optimization of the reaction conditions. Additionally, MITPPC phase III proposal has been approved to expand the NEC assay to various invasive forest pathogens of high priority to Minnesota and conduct third party validation of the technology. The major impact of this project will be the improvement of diagnostic capabilities of plant diagnostic clinics and laboratories by offering a highly sensitive and cost-effective tool for rapid identification of oak wilt. The spread of the disease can be stopped at an early stage by administering treatments and implementing preventative measures. The proposed technology will help protect Minnesota natural resources and reduce the financial burden of oak tree removal.

PROJECT RESULTS USE AND DISSEMINATION

The research findings were disseminated through regular updates to the Minnesota Invasive Terrestrial Plants and Pests Center, non-peer reviewed outlets (e.g., newsletters or websites), and peer-reviewed publications. This project was also discussed through formal and informal presentations to stakeholder groups and scientific societies.

Subproject 02 Completed: 06/30/2019 **FINAL ABSTRACT**

Sub-Project 03: Climate Change and Range Expansion of Invasive Plants - $206,335 TF

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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.

Subproject 03 Completed: 06/30/2019 **FINAL ABSTRACT**

Report on Palmer Amaranth in Scientific Reports

Sub-Project 04: Cover It Up! Using Plant to Control Buckthorn - $327,000 TF

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OVERALL PROJECT OUTCOME AND RESULTS

Buckthorn is an invasive shrub that outcompetes native plants and degrades Minnesota forests. Removal of buckthorn is a common management activity but often only provides short-lived benefits since buckthorn rapidly re-establishes. In grasslands, heavily seeding native species can often restore native communities and inhibit invasion, but this approach is rarely used in forest management (Schuster et al. 2018). We investigated whether we could similarly establish enough native plants to prevent buckthorn from re-establishing in forest using three separate experiments.

First, we surveyed sites at 24 properties in Minnesota where buckthorn management had taken place to identify the most successful techniques (Wragg et al. in review). Management success was highly variable, but sites where more native vegetation had been re-established tended to have lower buckthorn abundance.

Second, we measured the growth and survival of buckthorn seedlings in a forest biodiversity experiment. There, we found that canopies that permitted less than 10% of incoming light had significantly reduced buckthorn growth and canopies that permitted less than 3% light, particularly in the spring and fall, completely excluded buckthorn (Schuster et al. 2020).

Third, we established a series of experiments across 7 sites that had recently had buckthorn removed. In those experiments, we tested how densely seeding or planting native plants affected buckthorn seedlings. After 3 years, we found that planting trees and shrubs, particularly Sambucus shrubs, greatly reduced light levels and excluded buckthorn (Wragg et al., Schuster et al. in prep). Other seeding and planting treatments had more moderate effects and may require additional years to become fully

effective. We also found that the rarely-used herbicide fosamine ammonium was effective at controlling buckthorn (Schuster et al. in review).

The Cover It Up! project illustrates that it is possible to curate native plant communities in a way that makes them resistant to buckthorn invasion. In general, we recommend that forests be managed to promote the establishment of shrubs and trees that provide heavy shade in the spring and fall. Our findings suggest that by doing so, managers can simultaneously increase forest health, inhibit invasion, and reduce the need for investment in future buckthorn removals.

PROJECT RESULTS USE AND DISSEMINATION

Results were disseminated through diverse media to a wide range of stakeholders. Findings from Cover It Up! were included in five academic journal articles to date. Stories about our project were featured in media from unaffiliated parties, including KARE 11, Pioneer Press, National Park Service social media, and Science Museum of Minnesota Field Notes. Our findings were also conveyed through 12 in-person presentations for over 500 attendees.

Subproject 04 Completed: 06/30/2019 **FINAL ABSTRACT**