2016 Project Abstract
For the Period Ending June 30, 2020

PROJECT TITLE: Elimination of Target Invasive Plant Species – Phase II

PROJECT MANAGER: Monika Chandler, MDA, and Angela Gupta, UMN Extension
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2016, Chp. 186, Sec. 2, Subd. 06e

APPROPRIATION AMOUNT: $511,000 to MDA and $239,000 to UMN
AMOUNT SPENT: $ 511,000 (depended on rebudget) and $237,061
AMOUNT REMAINING: $ 0 and $1,939

Sound bite of Project Outcomes and Results
We educated about, found, documented and managed highly damaging invasive plant populations before they spread statewide. We also initiated a response to Palmer amaranth in conservation plantings that was continued by the project Palmer Amaranth Detection and Control. Mitigating these invasive plant threats protected Minnesota forests, grasslands and riparian areas.

Overall Project Outcome and Results
The goal was to eliminate highly damaging target invasive plants before they became widespread by 1) training people to identify and report invasive plants, 2) survey, coordinate control and monitor target plants, 3) control target plants and 4) implement the invasive species management database system from Phase 1. Targeted plants that cause severe ecological harm include black swallow-wort, dalmatian toadflax, cutleaf and common teasels, Grecian foxglove, Japanese hops, brown and meadow knapweeds, Oriental bittersweet and Palmer amaranth.

University of Minnesota Extension led the education and outreach efforts outlined in the dissemination section. The drone team transitioned from research to survey work by testing several different types of drones, cameras, weather conditions and self-produced and commercial post-processing software. We determined that surveying for Oriental bittersweet is best done with sturdy quadcopter drones and a high quality camera on mild winter days after leaf drop but with snow on the ground so the red fruit is most visible. High quality, stitched-together and geo-coded maps can now be produced in post processing and inform accurate eradication efforts.

The Minnesota Department of Agriculture (MDA) and Conservation Corps Minnesota (CCM) led invasive plant management. MDA led survey, invasive plant report follow up, monitoring and coordinated control with landowners and partners. CCM led the control effort with 157 unique crew members working on this project.

Plant Name	New Infestation Reports*	New Infestation Acres Reported	Acres Treated**
Black swallow-wort	5	5	9
Dalmatian toadflax	no new reports	0	828
Common teasel	6	1	302
Cutleaf teasel	99	65	1,832
Grecian foxglove	119	47	1,368
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Oriental bittersweet	203	2,937	1,462
Total	**977**	**3,490**	**14,070**

*New infestation reports were recorded during the project period. We continued control work on infestations identified during our Phase 1 project (2013-2016).

**Acres were spot treated because the invasive plants were scattered within some large areas. Many infestations were treated in multiple years and the acreage of each treatment was recorded and included in the total.

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Project Results Use and Dissemination

University of Minnesota Extension led the education and outreach funded specifically by this project. Reaching 1,108 people via 11 workshops, field tours and public and professional presentations. Developed two national award winning videos: Planning invasive species events: Tips for working with volunteers and Planning invasive species events: Working with a natural resources professional. Created 14 innovative educational materials including: 3D-printed models of Palmer amaranth, Japanese hops and Grecian foxglove; pull-up banners for Palmer amaranth and giant hogweed; and identification kits available at the public library for Palmer amaranth, wild parsnip and Oriental bittersweet. Produced two new educational handouts and printed and distributed about 10,875 educational materials.

In addition, the University of Minnesota and Minnesota Department of Agriculture (MDA) team members won numerous national, regional and state awards for effort including this project, from across an impressively wide spectrum of content areas. There were 13 media pieces about project activities; 13 presentations or booths reaching 5,137 gardeners, tribal youth, Extension volunteers and others; and 30 presentations or posters at 14 different professional conferences representing a broad spectrum of expertise reaching almost 1,000 natural resource or invasive species professionals. Two professional, peer reviewed articles were published that reference this work. MDA organized and led 6 field tours, gave 43 presentations, provided project updates at 32 meetings, authored 14 articles, sent an annual report to stakeholders and trained Conservation Corps Minnesota crew members at multiple workshops each year.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan Final Report

Date of Report: **October 1, 2020**

Final report

Date of Work Plan Approval: **June 7, 2016**

Project Completion Date: **June 30, 2020**

Does this submission include an amendment request? Yes

PROJECT TITLE: Elimination of Target Invasive Plant Species – Phase II

Project Manager: Monika Chandler

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Location: Statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$ 511,000**
	Amount Spent:	**$ 506,466**
	Balance:	**$ 4,534**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 06e1 as extended by M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 19

Appropriation Language:

$750,000 the second year is from the trust fund. Of this amount, $511,000 is to the commissioner of agriculture and $239,000 is to the Board of Regents of the University of Minnesota to train volunteers and professionals to find, control, and monitor targeted newly emergent invasive plant species. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

Carryforward; Extension (a) The availability of the appropriations for the following projects is extended to June 30, 2020: (10) Laws 2016, chapter 186, section 2, subdivision 6, paragraph (e), Elimination of Target Invasive Plant Species - Phase II;

I. PROJECT TITLE: Elimination of Target Invasive Plant Species - Phase 2

II. PROJECT STATEMENT: Eliminating highly damaging target invasive plant species before they become widespread prevents ecological and economic damage. Currently, these species have limited distributions in Minnesota. It is feasible to control them before they proliferate by continuing the strategic effort initiated in Phase 1. To date, we trained 521 people to identify target invasives, surveyed over 10,000 acres, initiated control on 450 acres and are developing an invasive species management database system with broad applicability for terrestrial and aquatic invasives. We will continue these activities in Phase 2. In addition, we will expand our training capacity by developing online training, test whether a drone will increase survey efficiency and add to the target species list.

Target Invasive Plant List: Species include but are not limited to the following. They are listed in order of feasibility to eradicate based upon their abundance and distribution. All target species are prohibited noxious and invasive weeds on the eradicate list (Minnesota Statutes, Section 18.78) providing a legal backing.

1. **Black swallow-wort** is a milkweed vine that overgrows other vegetation. Small infestations have been reported in Hennepin and Ramsey Counties and are being controlled. (New in Phase 2)
2. **Dalmatian toadflax** forms dense stands in grasslands and reduces biodiversity, wildlife habitat, and livestock production. Infestations in the Halma and Lutsen areas are reduced but not eliminated yet.
3. **Cutleaf and common teasels** overtakes grasslands and riparian areas reducing species diversity and wildlife habitat. There are scattered infestations in southeastern Minnesota. (Common teasel is new in Phase 2)
4. **Grecian foxglove** is highly toxic to humans, wildlife, and livestock. It also displaces native plants. As of spring 2015, most infestations are in Washington County.
5. **Japanese hops** are annual vines that grow so rapidly that they smother other plants. There is an extensive infestation along the Root River and a small infestation on the Mississippi.
6. **Brown and meadow knapweeds** are spreading across meadows in northern Minnesota. (New in Phase 2)
7. **Oriental bittersweet** is a woody vine that is destroying swaths of forest in Red Wing and Winona by girdling and breaking the trees then covering and shading the remains so that little else grows.
8. **Palmer amaranth** is an annual plant native to the arid southwestern United States and northwestern Mexico. It has spread to the southeastern and Midwestern US and become problematic. It grows very quickly to heights reaching 10 feet. It also produces massive amount of seed. These qualities give it a competitive advantage against row crops and native vegetation plantings. During the battle against Palmer amaranth, this plant developed resistance to multiple classes of herbicides. Palmer amaranth now causes extensive losses where it is abundant including in corn and soybeans.

Our long-term goal is to eradicate these problematic species from Minnesota to protect forest and grassland habitats. All of the invasive plants listed harm natural areas and degrade wildlife habitat.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of November 30, 2016:
We hit the ground running in Phase 2 of this project. We monitored treatments done in Phase 1 of this project and were pleased with outcomes. We followed up on numerous new reports of target species. It is clear that educational efforts made in Phase 1 of this project have paid off. A wide variety of partners are able to identify and report target species. We are beginning to plan 2017 survey and control work.

Our rapid response to the discovery of Palmer amaranth in Minnesota in September 2016 demonstrated the importance of the infrastructure developed during Phase 1 of this project. We were able to survey sites and initiate treatments this fall. This fast action greatly increased the odds of averting an agricultural disaster. MDA's emergency funds were used for this work. MDA amended our contract with CCM by a $15,000 increase to contain and control Palmer amaranth infestations. These funds are MDA emergency funds. It is feasible that there will be additional future amendments of MDA funds. There is no budget amendment for ENRTF dollars for Palmer amaranth. Use of MDA funds are reported in section VI. Project Budget Summary under Other Funds.

Amendment Approved by LCCMR January 17, 2017
As part of this project, Extension received ENRTF dollars to purchase tablets for CCM so that CCM will field test ISMTrack. Extension also received ENRTF dollars to purchase tablets for training. Extension will use other funds to pay for the data that will be used for training.

In order to utilize ISMTrack in Activity 4, CCM needs data plans with their tablets. We tried using mobile hotspots but they were cumbersome and did not work as readily as a device with a data plan. We request that CCM include data costs for their project tablets with their regular invoices to MDA. The cost will be $20 per month per tablet for 10 tablets which would be $2,400 per year. The total data cost for this project would be $5,800. This would be using ENRTF dollars for data. There would be no change in the budget amount. Use of $5,800 for data would result in one week less fieldwork by a five person crew. We consider the investment in advancing ISMTrack technology worthwhile. Use of this technology will increase efficiency for MDA in mapping and keeping track of work done.

Amendment Approved by LCCMR March 17, 2017
We request utilizing project funds to hire a Plant Health Specialist to monitor Palmer amaranth infestations and survey conservation plantings. This would be a new position at MDA. This work would be within Activity 2 Part A. Hiring this position this spring will enable us to begin work at the start of the 2017 growing season. We will submit a proposal for ENRTF emerging issues funding to expand this work.

Most of the funds for this position's salary and fringe of $30,000 were shifted from other project positions. Funding for the Research Scientist 1 position was reduced from $224,000 to $212,000 because insurance costs were less than budgeted. Single rather than dependent care coverage that was budgeted has been used. Additionally, funds were shifted from a part-time Plant Health Specialist position from $67,000 to $50,000 and the position was reduced from a 3 year to a 2 year part-time position. As a result, we will not be able to manage meadow and brown knapweed infestations in 2017 and they will continue to spread in northern Minnesota.

Project Status as of May 31, 2017:
Delimiting bittersweet infestations was a focus during this project period. This information will enable us to determine best management strategies for each infestation. It also enabled us to create better geodatabases to help coordinate work involving over 50 people in an area. Details of these databases are reported in Activity 3.

Weed 'Em Out trainings (Activity 1) directly resulted in a report of the largest black swallow-wort infestation in Minnesota. This infestation is scheduled for control next month (Activity 3). Many have raised concerns about the expansion of poison hemlock, a highly toxic invasive plant. U of M, CCM and MDA have all been mapping locations. This will inform the poison hemlock risk assessment that MDA's Noxious Weed Advisory Committee is conducting.

There has been significant outreach on Palmer amaranth. MDA posted a position to work on Palmer amaranth detection and management. Update 07/31/17 – MDA hired Shane Blair to work on Palmer amaranth and he started on 07/26/17.

Project Status as of November 30, 2017:
We accomplished much during this period. CCM crews from northern stations rotating into southeastern Minnesota to control Oriental bittersweet, Japanese hops and teasels. In addition to increasing crew members available for this work, the crew members learned to identify these species. They will be trained eyes on the lookout for these species. We have made excellent progress with Dalmatian toadflax control in all locations and are now just managing the seedbank. In contrast, Japanese hops control proved to be challenging. High water levels in 2016 prevented treatment so the hops population exploded. We are planning ways to get a better handle on it. A survey with many partners on St. Croix documented that there is very little Oriental bittersweet on the river and the scattered vines will be controlled. Poison hemlock outreach was big with 61 media outlets covering the story. The public responded well and we learned about many, mostly small, infestations.

Amendment Request November 30, 2017, Amendment Approved by LCCR 12/13/2017
MDA requests combining part time work on this project with part time work on our Tactical Plan Invasive Plant Management Plan Development project for full time positions in Duluth and Rochester. There would be no position on both projects in St. Paul. The rational for decentralizing these positions is housing them in the northern and southern regions where they will be working. This will enable the positions to develop essential local partnerships. Once housing for these positions is secured, MDA will post the positions. Fortunately, DNR agreed to house the southern position at their office in Rochester at no charge to MDA. We are in the process of working out a no charge lease agreement for the space. Extension was asked to house the position in the interim and we await a response. The city of Duluth is considering housing the northern position at City Hall. If approved, we would no longer have a full-time Research Scientist 1 position. We would have two approximately 75% time Plant Health Specialist positions instead.

Our Palmer Amaranth Detection and Eradication project was funded. As a result, we were able to charge costs to that project so would like to eliminate the position on this project. Having the funds available on this project enabled us to go through the hiring process before Palmer specific project funds were available. This saved us months in the hiring process.

Project Status as of May 31, 2018:
We continued to add capacity to this project with the hiring of Mari Hardel in Duluth and Christina Basch in Rochester as Noxious Weed Specialists at MDA. They both work half time on Activity 2 of this project. In addition to our continued progress on survey, coordination and control of target species with ENRTF support, MDA received pass through funds to local units of government for control of eradicate list species. This funding is much appreciated and is very helpful but adds to MDA's administrative and coordination roles.

Our project is low on funding for CCM to do control work. We would like to improve this situation with budget amendments. Extension's budget amendment report requested contracting with CCM for $25,000 and up to $45,000 should the full funds be available. MDA is submitting a budget amendment request to move $35,000 from salary to contract with CCM.

Amendment Request June 11, 2018, Amendment Approved by LCCMR 06/14/2018
MDA requests to amend our budget by moving $35,000 from MDA's salary and fringe (Activity 2) to amend our contract with CCM for additional control work (Activity 3). We have the salary savings because it took months to fill our new positions and because there has been an ongoing difference between insurance dependent care coverage budgeted and single care coverage utilized.

Project Status as of November 30, 2018:
Adding capacity with staff and related funding resulted in an accelerated control effort. Control work was done on over 1,000 acres more than previous years of this project. Assessing infestations and coordinating work with landowners and crews has been very involved, almost overwhelming, but we are pleased with results. The Minnesota Invasive Species Advisory Council recognized efforts of the project partners and collaborators with the Carol Mortensen team award. It was presented at the Upper Midwest Invasive Species Conference.

For the first time, MDA's grant assistance account was funded and funds were awarded to grant recipients in 2018. The appropriation language of this funding gave preference to local units of government responding to Palmer amaranth or other weeds on the eradicate list. This funding has been important for target species control. We have coordinated with grant recipients to best utilize MDA pass through and ENRTF funds. In several cases, the local governments didn't have the knowledge and/or capacity to complete the projects without coordination by the noxious weed specialists on this project. A list of grant awards is in the Activity 3 update.

Amendment Request December 14, 2018 – Amendment signed into law 05/31/19
We request to extend this project deadline one year to June 30, 2020. There is a need to continue target plant species control. Extending the project would enable us to continue this control work another field season for survey, monitoring and management on at least 500 acres. U of M Extension has a staffing issue due to a medical situation where the person hired on this project can't work full-time as budgeted. As a result, MDA assumed Activity 4 of this project and would hold at least 2 additional ISMTrack training workshops if the project is extended. U of M's staffing issue may result in additional unspent funds but the exact amount can't be determined until near the current project end of June 30, 2019. Subject to approval, these funds could be reallocated to accomplish more.

Amendment Approved by LCCMR 12/17/2018
MDA requests to amend our budget by moving $10,000 from MDA's salary and fringe (Activity 2) to amend our contract with CCM for additional control work (Activity 3). We have the salary savings because there has been an ongoing difference between insurance dependent care coverage budgeted and single care coverage utilized. This will enable us to do additional target species control.

Project Status as of May 31, 2019
We continued to make good progress with oriental bittersweet management and outreach despite challenging winter conditions. Extreme cold and snow slowed efforts but there were 22 days of bittersweet control work and extensive travel for outreach and connecting with partners. Extensive fieldwork planning with partners, including MDA grant recipients has us prepared for the upcoming summer season.

Amendment Request May 31, 2019, Amendment Approved by LCCMR 06/20/19
MDA requests to amend our budget by moving $102 from MDA's salary and fringe (Activity 2) to the Supplies category. We do not anticipate any additional supply purchases for this project. We also request to amend our budget by moving $23,000 from MDA's salary and fringe (Activity 2) to the Travel category. With two people on the project, travel has doubled. The original travel budget was for one person's travel.

Project Status as of November 30, 2019
Much went well during the growing season with survey, monitoring and treatments. Infestations are now better delimited. Treatments were done on 5,107 acres. These were spot treatments within the acreage. We continue to see a decrease in Dalmatian toadflax, common teasel, cutleaf teasel and Grecian foxglove infestations. Unfortunately, there were new finds of black swallow-wort, poison hemlock and meadow knapweed. It will take a lot of outreach, coordination and crew time to control them. On land Japanese hops treatments went well but

on river treatments continued to be challenging. We will maintain our momentum as we continue this work in the Noxious Weed Detection and Eradication project.

Amendment Request October 1, 2020

We request to move $152.00 from travel to supplies. We could not travel during COVID 19 restrictions this spring so didn't spend all travel funds. We needed a small amount of supplies. The budget for travel would decrease from $43,000 to $42,848. The budget for supplies would increase from $1,602 to $1,754.

Amendment Approved by LCCMR 10/19/2020

Overall Project Outcomes and Results:

The goal was to eliminate highly damaging target invasive plants before they became widespread by 1) training people to identify and report invasive plants, 2) survey, coordinate control and monitor target plants, 3) control target plants and 4) implement the invasive species management database system from Phase 1. Targeted plants that cause severe ecological harm include black swallow-wort, dalmatian toadflax, cutleaf and common teasels, Grecian foxglove, Japanese hops, brown and meadow knapweeds, Oriental bittersweet and Palmer amaranth.

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IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Train People to Identify and Report Target Invasive Species
Description: University of Minnesota (U of M) will train professionals, volunteers and impacted landowners to prevent, identify, report, monitor and manage target species. The U of M Extension will deliver educational trainings to:

A. Natural resource professionals to identify terrestrial invasive species of special concern and native plant species that could be confused with these invasives (2 workshops per year),
B. Natural resource professionals and volunteers will conduct target invasive species surveys (2 surveys/workshops),
C. Minnesota Master Naturalist Instructor Training - a weekend-long training and field tour dedicated specifically to terrestrial invasive species of special concern, their prevention, identification, reporting, monitoring and management to incorporate this information into Master Naturalist volunteer trainings across the state. (1 event),
D. Develop supportive, online training and outreach materials for Invasive Blitz volunteers (Master Naturalist and other master volunteers that lead invasive species removal activities in their community). This will include a video with volunteer management considerations like training volunteers, risk assessments and recruiting and maintaining active volunteers.

We will create 5 high quality traveling learning material kits about target invasive species that can be checked-out by natural resource professionals and volunteers.

This work will be done across the state. An effort will be made to find free workshop locations. It may be necessary to charge workshop participants a registration fee to cover room rental (if free room is not available) and food costs for all day and weekend workshops. Registration fees would go to Extension. In the event that workshop registration received exceeds workshop costs, Extension will use these funds for outreach for Environmental and Natural Resources Trust Fund projects. Training partners include the University of Minnesota, Extension, Minnesota Departments of Agriculture, Natural Resources and Transportations, and various local partners.

Summary Budget Information for Activity 1:	**ENRTF Budget:**	**$ 0**
	Amount Spent:	**$ 0**
	Balance:	**$ 0**

Outcome	Completion Date
1. 9 Statewide training sessions/workshops/field trainings conducted and evaluated	06/10/2019
2. Develop online training and outreach materials that are publicly available	06/10/2019

3. Create high quality display materials and 5 invasive plant learning kits for check out by educators (schools, nature centers, master gardeners, etc.) and agency staff for outreach	06/10/2019

Activity Status: See U of M report for activity status.

ACTIVITY 2: Survey, Coordinate Control and Monitor
Description:
Part A (MDA)
Minnesota Department of Agriculture (MDA) will verify reports, survey potentially infested areas and delineate infestations. Conservation Corps Minnesota (CCM) will participate in large area surveys. Presence/absence data for all target species will be collected along assigned survey routes. Surveys will be done in collaboration with agency partners when practical.

MDA will contract with the St. Croix River Association (SCRA) for survey along the St. Croix River main stream and Brown's Creek, a designated trout stream. The St. Croix watershed is a high priority conservation area where Oriental bittersweet and Grecian foxglove have been found. SCRA will monitor approximately 130 river miles by boat. Highest risk areas will be surveyed multiple times and seasons to have the best chance of seeing each target species at its most visible stage. For example, Grecian foxglove is most visible in the summer and Oriental bittersweet in the fall. We will engage SCRA staff, National Park Service partners and volunteers in survey and outreach efforts.

All survey data will be entered into EDDMapS (www.eddmaps.org). MDA will contract and coordinate with CCM and landowners for target species control. This will include writing agreements with landowners where CCM will do control work. Agreements will specify that landowners will monitor the site to prevent reinfestation for at least three years after the control work is completed. The coordinator will train the landowners how to identify and monitor for the species and report any reinfestation issues that arise.

Part B (U of M)
The U of M Unmanned Aerial Vehicle Lab will test its drone fleet with the goal of increasing survey efficiency. Tests will determine best available sensor, concept of operations, and post processing requirements outlined below. We are working with the Federal Aviation Administration on regulatory requirements before we can legally fly outside of our permitted area (currently only covers Umore park in Rosemount, MN.)

Sensor
Every sensor has trade offs in terms of cost, size, weight, resolution, speed, type of data sensed, etc. Often the required sensor drives the choice of aerial platform. We will select the sensors with the best chance of producing useful data for detecting invasive species from the air. The best sensor might not be a camera. If it is a camera we need to determine if our objective is the highest resolution possible, or is it more important to capture a certain band(s) of the visible spectrum.

Concept of Operations
Depending on the aircraft and the sensor choices the time of day and lighting may be an important consideration. We may need to consider sunny vs. overcast conditions and the best season(s) for detecting specific invasive species. We need to think through optimal routes and patterns for data collection. The type of sensor chose may drive the choice of altitude and limit the amount of area that can be covered. If significant terrain is involved, that could complicate flight planning. Is the best vantage point straight down from above (nadir view) or is an oblique view better, or even a side view from below the tree tops?

Post Processing Requirements

Will the data be reviewed manually? Are there computer algorithms that could be leveraged to highlight areas of concern in the data (i.e. some sort of threshold or blob detection?) What characteristics in the data would indicate a target invasive species is detected? For the longer term, we will evaluate economic factors including the cost to image an area vs. the likelihood or reliability of spotting invasive plants.

Summary Budget Information for Activity 2 Part A:	**ENRTF Budget:**	**$ 307,800**
	Amount Spent:	**$ 303,289**
	Balance:	**$ 4,511**

Outcome	Completion Date
1. Drones will be tested for survey capability. Testing will determine the appropriate sensor, calculate the impact of variable light conditions and chart the optimal flying pattern.	03/01/2018
2. Surveys are conducted and infestations are documented	05/30/2020
3. Treated sites are monitored to determine whether additional control is needed	06/10/2020

Activity 2 Status as of November 30, 2016:
Part A (MDA) – see U of M report for Part B
For coordinating control with landowners and CCM, it was necessary to renew agreements to continue work. Agreements were sent to 166 landowners and 132 signed agreements were returned. We will follow up on remaining agreements.

Black swallow-wort: Infestations of black swallow-wort in Hennepin and Ramsey counties were monitored. Landowners have been controlling swallow-wort to kept populations from spreading. Ramsey County Cooperative Weed Management Area involvement with monitoring infestations has been much appreciated.

Dalmatian toadflax: We did not have funds in place for early summer Dalmatian toadflax treatments. Fortunately, Kittson County and MnDOT stepped up to spot treat Dalmatian toadflax on their lands. County, state and private lands will be surveyed in Kittson County in early summer 2017. Both the Kittson County and north shore infestations are contained.

Cutleaf and common teasels: Reports of cutleaf teasel in southeastern Minnesota were verified and infestations treated in 2015 were monitored. Infestations were greatly reduced in large part thanks to efforts by our DNR and MnDOT partners. There were no new county finds. Two new county finds of common teasel were verified in Nobles and Wright counties. In both cases, the County Agricultural Inspector found the infestations and are working with the landowners to eradicate the populations.

Grecian foxglove: Grecian foxglove infestations treated in 2015 were monitored. Many sites showed distinct improvement. Landowners continue to manage infestations and report progress to MDA. MDA is working closely with the Washington Conservation District (WCD) to continue survey, outreach and treatment efforts. Additional reports resulting from a WCD mailing will be ground truthed. Correct reports will be entered into EDDMapS and considered for treatment.

Japanese hops: Infestations of Japanese hops along a 30 mile stretch of the Root River that were treated in 2015 were monitored by MDA and project partners. Treatments were very effective. Due to high water levels all summer, 2016 treatments only took place at boat landings.

Brown and meadow knapweeds: A relatively large brown knapweed infestation was reported by the Hubbard County Agricultural Inspector. There are a number of small patches on roadsides and one infested pasture.

MDA confirmed and mapped the infestation. MDA will reach out to the landowner and the Natural Resource Conservation Service for help with the pasture.

A small infestation of meadow knapweed near the Mississippi headwaters was found and reported by the Clearwater County Agricultural Inspector. MDA confirmed and mapped the infestation. It was treated by the county. A small infestation of meadow knapweed was also confirmed at Tettegouche State Park. It was reported by a Superior National Forest botanist. An area DNR resource specialist assessed the infestation. A course of action will be planned over the winter.

Oriental bittersweet: There was a new county find of Oriental bittersweet in Wright County. It was a small infestation and has been controlled and will be monitored for several years for resprouting. New reports in Dakota, Hennepin, Houston, Ramsey, and Washington Counties were verified. Infestations on private land were monitored for treatment activity and regrowth. DNR found and treated bittersweet infestations at the Whitewater Wildlife Management Area and in the Richard J. Dorer Memorial Hardwood State Forest in Houston County.

Palmer amaranth: Palmer amaranth infestations found in Lyon and Yellow Medicine counties were mapped by MDA. To date, there are 13 sites of first year conservation plantings that have been documented as potentially infested or confirmed infested. Some sites have multiple plantings within the site for a total of 30 plantings. Labor, travel and other costs for this effort were not charged to this project.

Activity 2 Status as of May 31, 2017:
Delimiting infestations with polygons is significantly more informative than collecting a point for each infestation. The data enabled tablets from Activity 4 make it possible for CCM crews to collect polygon rather than point data while surveying. We are now collecting polygon data for all sizeable infestations.

The contract with St. Croix River Association was executed. Survey work will begin in summer 2017. A large survey event involving project partners and volunteers is being planned for early fall 2017.

Black swallow-wort: One day was spent surveying for black swallow-wort. An infestation was reported through EDDMapS in Ramsey County and confirmed on May 10, 2017. The report was a direct result of a "Weed 'Em Out" training which is Activity 1 of this project. The infestation is approximately 1.5 acres and is on county land near a yard waste compost area. The infestation will be treated next month. MDA will work with Ramsey County Cooperative Weed Management area to monitor treatments.

Dalmatian toadflax: Infestations will be monitored and mapped during the summer 2017. Project partners from Kittson County and MnDOT will contribute to mapping and treatment efforts.

Cutleaf and common teasels: Two days were spent mapping cutleaf teasel. A new county find of cutleaf teasel was confirmed in January in Hennepin County. On May 9th the County Agricultural Inspector, in cooperation with MDA, visited the site to map rosettes. Only a dozen were found, and the landowner was cooperative and planning to treat the rosettes. Follow-up monitoring will be conducted by Hennepin County and the MDA in 2018.

Grecian foxglove: New agreements were set up with 14 landowners. Two days were spent mapping infestations in Washington County. MDA is working with the Washington Conservation District to work with landowners and map previously unreported infestations.

Japanese hops: Sites treated in 2015 will be monitored in 2017. On March 9th, MDA, DNR, CCM, Fish and Wildlife Service (FWS), and Army Corps of Engineers (ACOE) strategized mapping and treatments plans for 2017. A survey of the north branch of the Root River is planned for 2017, and infestations east of Hwy 26 will be documented. The FWS and ACOE will survey areas of the Mississippi River and document infestations.

Brown and meadow knapweeds: Due to the impact of adding Palmer amaranth to the project, the part time Plant Health Specialist position funds were diverted to fund a position to work on Palmer. The result of this was that work on brown and meadow knapweeds has been delayed.

Oriental bittersweet: Red Wing and Winona area were surveyed to determine the extent of infestations on the bluffs. The terrain was difficult but CCM crews and MDA staff managed to delimit all infestations with polygons and document the density of each infestations. Total hours spent on survey was 337 in Red Wing and 270 in Winona.

Poison hemlock: Infestations of poison hemlock are increasing in Minnesota. Project partners spent 4 days surveying and mapping poison hemlock in Rochester and SE Minnesota.

Activity 2 Status as of November 30, 2017:
Multi-species survey events

- Teams of CCM, Extension, DNR and MDA surveyed assigned sections of the Root River for Japanese hops and knotweeds on September 14th. We confirmed that hops treatments were effective and observed dense hops in many areas that the crew could not treat due to time constraints. We observed the difficulty for a CCM crew to treat hops vines on riverbanks with swiftly moving water and steep banks. Knotweed locations were marked and later treated using DNR funds.
- St. Croix River Association organized a Partner's Day Survey on October 20th. The day started off at the Scenic Overlook North of the Boomsite Landing in Stillwater at 9:30. Emilie Justen led a short I.D. course and passed out handouts to the group. Oriental Bittersweet was also found at the Scenic Overlook which allowed the group to see it up close and get a good idea of what was being looked for. There were three boats volunteered by the National Park Service and another boat from St. Croix County's Land and Water Resources. A total of 22 people participated representing the St. Croix River Association, National Park Service, Minnesota Department of Agriculture, St. Croix County Land and Water Resources, Minnesota Department of Natural Resources, Conservation Corps of Minnesota, and a few community volunteers. A stretch of about 18 miles was covered with 8 confirmed sightings of Oriental Bittersweet and nine more unconfirmed or possible sightings. Unconfirmed/possible sightings are defined as a bittersweet species without fruit on it and there wasn't a great distinction of the leaves using the Leicht-Young et al.'s key to distinguish native from invasive bittersweets. Another possibility for an unknown label was not being able to get a close enough look at the species from the boat. All sightings occurred North of Bayport. The day concluded around 3:00 when the last group returned.

Black swallow-wort: One day was spent monitoring the new site in Ramsey County after it had been treated on June 6, 2017. Approximately 80% of the infestation showed effects of herbicide treatments and very few seedpods were observed.

Dalmatian toadflax: Project partners monitored and treated infestations in Cook County and observed only a handful of plants remaining. MDA staff monitored the Kittson County site in July and observed many dead plants from the June treatment. MDA staff monitored the Kittson County site again in October and spend a day pulling and bagging plants. Only a handful of plants formed seeds, but many plants that appeared to have dead tops still had live crowns and rhizomes. Infestations are greatly reduced and limited to sandy edges of inactive gravel pits.

Cutleaf and common teasels: Three days were spent mapping cutleaf teasel. New infestations were recorded in Fillmore and Hennepin Counties and new landowner agreements were set up with three landowners. One day was spent cutting and bagging seedheads in Hennepin County.

Grecian foxglove: Two days were spent monitoring Grecian foxglove sites in Washington County. June treatments were very effective with approximately 85% of plants showing signs of stress or death. Follow up communications with landowners were positive, and landowners continue to monitor and treat infestations on their own properties.

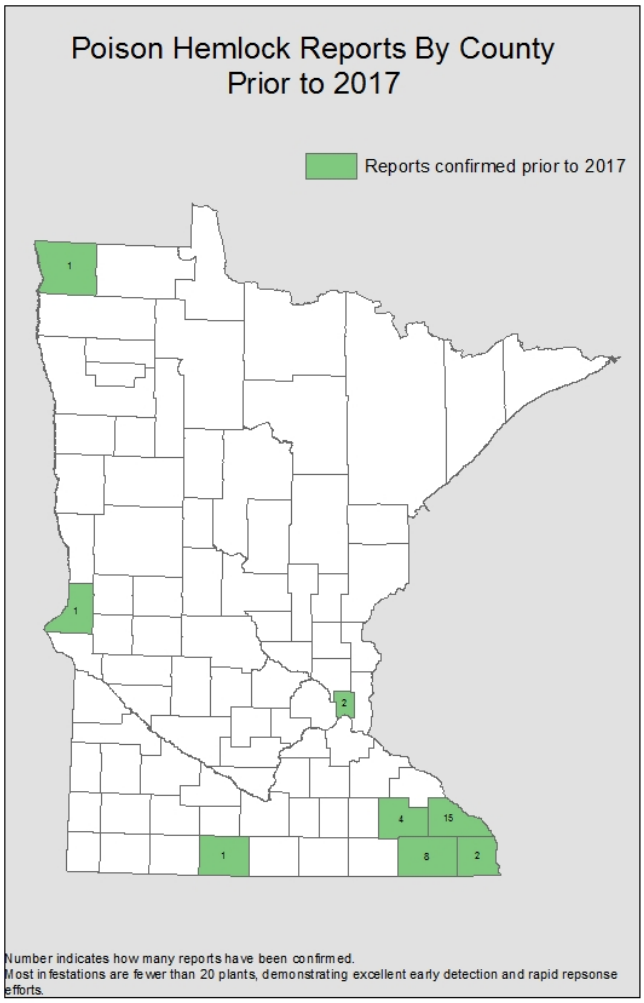
Japanese hops: In addition to the Root River survey event mentioned previously, one day was spent assessing infestations on the Root River and at boat landings and on roadsides. We observed that Japanese hops had spread extensively between 2016 and 2017. High water levels in summer 2016 prevented treatments on the river. As a result, hops spread in many locations along the river, at landings and along some roadsides. The MDA is working collaboratively with DNR, CCM, and Root River Watershed District partners to devise management and treatment plans for Japanese hops.

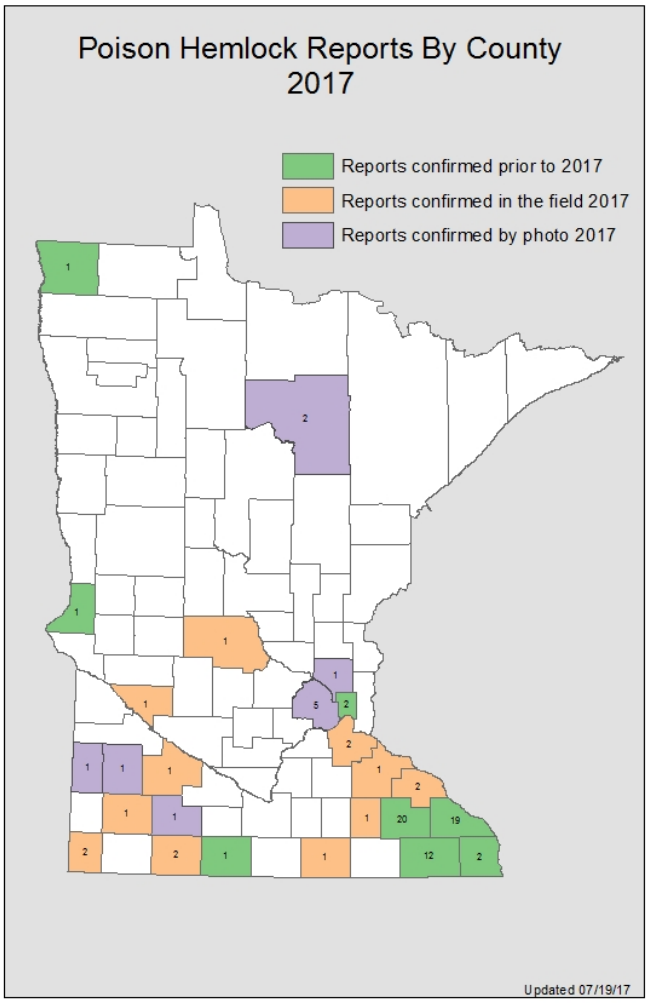
Brown and meadow knapweeds: An intern with Pine County spent multiple days mapping meadow knapweed at Audubon Center of the North Woods.

Oriental bittersweet: MDA staff assisted DNR with a one day survey of the Zumbro River Bottoms State Forest. No additional infestations were recorded. MDA also conducted a road survey near known Oriental bittersweet infestations in Wright County and did not record any new infestations. In Washington County, two new landowner agreements were set up ahead of November treatments. The Washington County infestations are less than two acres.

Palmer amaranth: Palmer amaranth survey activities will be reported in the Palmer Amaranth Detection and Eradication status report due January 31, 2018.

Poison hemlock: Four days were spent mapping and collecting voucher specimen of poison hemlock infestations. A press release in late June resulted in over 400 reports of poison hemlock, of which only 48 have been positively identified as poison hemlock to date. Prior to the media release, we were aware of poison hemlock in eight counties. After the media release, we learned that it is in 25 counties. With a few sizeable exceptions, most infestations were less than 20 plants and landowners controlled them.





Activity 2 Status as of May 31, 2018:

Black swallow-wort: We assessed the Ramsey County infestation in late May. Additional treatment is necessary. The Ramsey Cooperative Weed Management Area has MDA pass through funding for controlling target species within the county. They plan to contract with a private applicator to treat this infestation in 2018.

Dalmatian toadflax: We plan to assess infestations in the northeast in June or July. Kittson County has MDA pass through funding for controlling target species within the county. The county plans to contract with either CCM or a private applicator to treat this infestation in 2018.

Cutleaf and common teasels: DNR has some remaining grant funds on their contract with CCM that will be used for controlling teasel and other target species in the southeast. MDA will coordinate June teasel treatments on private land and has reached out to MnDOT about teasel on ROW.

Grecian foxglove: Washington Conservation District (WCD) has MDA pass through funds for summer 2018 treatments. Because no CCM crews are available during the treatment period, WCD plans to contract with a private applicator for these treatments. MDA will coordinate treatments with landowners. One difficulty is that MDA's agreements with landowners are for CCM to treat, not for a private applicator. Therefore, WCD will need to write new agreements with landowners.

Japanese hops: Hops infestations on the Root River are in Fillmore and Houston counties. Fillmore Soil Water Conservation District (Fillmore SWCD) applied for MDA pass through funds for hops treatments. Fillmore SWCD also applied for and received BWSR funds for CCM to control hops accessible by land. No entity in Houston County applied for funds so there is a funding gap. Fillmore SWCD issued a request for proposals for hops treatments accessible by boat. Potential contractors were already committed to other projects, there were no bids. The group will try to work with a contractor on a more limited scope of control if that can be arranged. MDA will coordinate control efforts with the organizations and landowners involved.

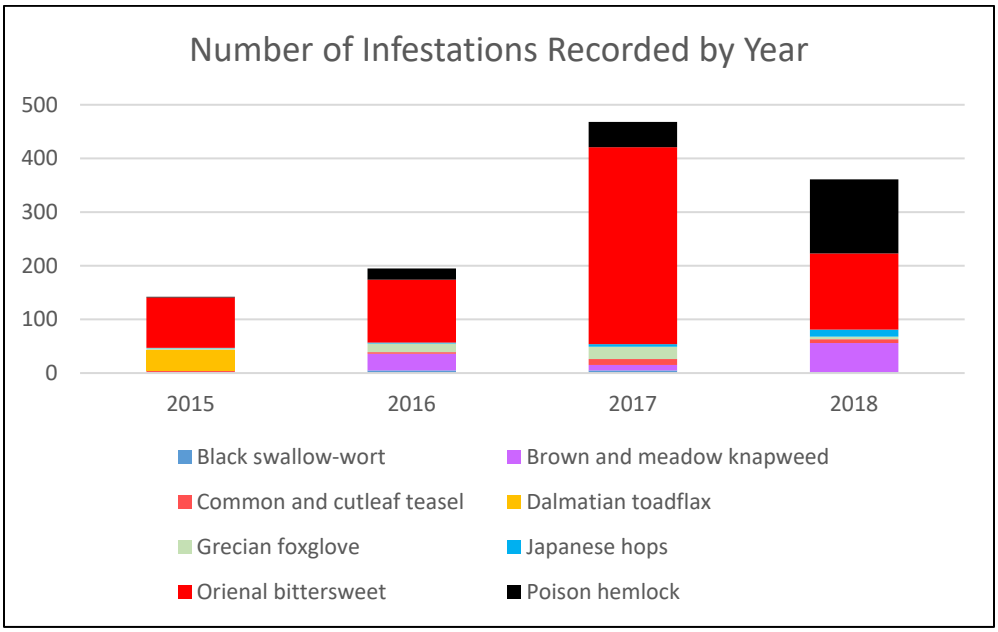
Brown and meadow knapweeds: We assessed these knapweeds at Audubon Center of the North Woods in Pine County on 05/30/18. We will prepare a detailed plan with priorities and treatment methods for infested areas. Becker, Hubbard and Koochiching counties received MDA pass through funds to treat these knapweeds and other target species in summer 2018. We learned that Koochiching plans to control infestations only on public land. We will look into coordinating control of infestations on private land.

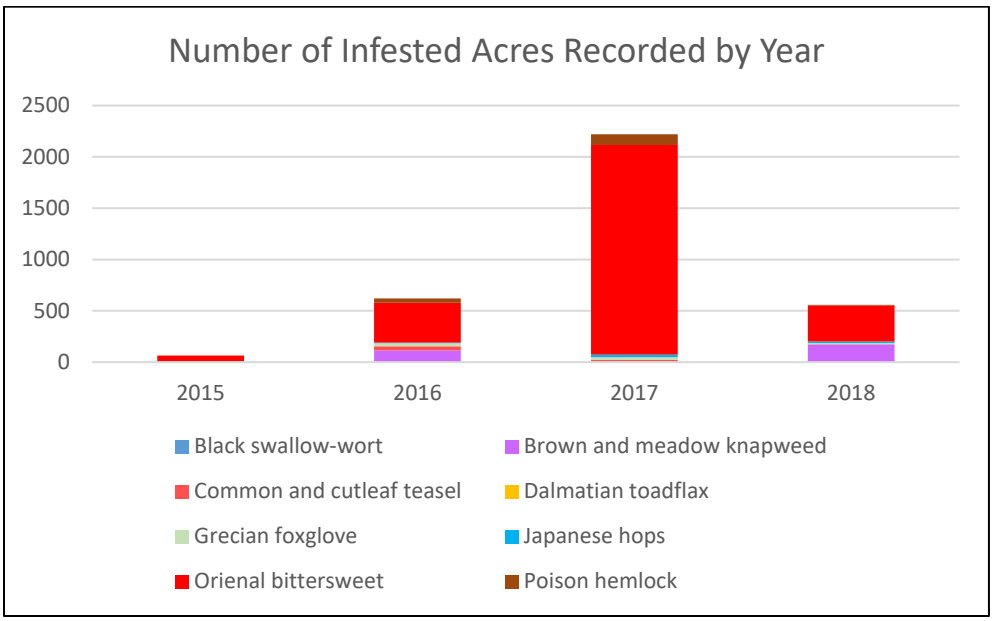
Oriental bittersweet: We verified and documented infestations in Douglas and Sherburne counties on 12/06/17 and 12/19/17 respectively. These were new county finds. The infestation in Sherburne is very small and will be controlled by the landowner. We plan to continue treatments in the fall of 2018. Douglas County received MDA pass through funds to treat the one known infestation in the county in 2018. Winona County received MDA pass through funds to hire an intern to assess infestations and work with volunteers to control small infestations. This is very helpful for our project and we are coordinating with the county.

The St. Croix River Assoc. plans to conduct late summer and early fall monitoring on reports of vines that could not be definitely identified previously. They will also monitor the following stretches of the St. Croix: Afton Marina to the Confluence of the Mississippi, County Road O Landing to Never's Dam Landing and Riverside Landing to Norway Point Landing. They will also continue outreach efforts.

Poison Hemlock: DNR has some remaining grant funds on their contract with CCM that will be used for controlling poison hemlock and other target species in the southeast. MDA will coordinate June teasel treatments in the Lanesboro area. Ramsey, Chippewa and Kittson counties received MDA pass through funds to control poison hemlock and other target invasives. Ramsey will hire a private applicator. We have not heard yet how the other counties will control the poison hemlock.

Activity 2 Status as of November 30, 2018:
We pushed to delimited infested areas in 2017 and 2018 to have good handle on the size and distribution of infestations. This push is visible in the charts below for recording new infestations and delimiting infested areas. We think we have recorded most of the target species infestations throughout the state. We anticipate that there will be fewer new reports in the future.





Black swallow-wort: There was a new find at the U of M Arboretum in Carver County that was controlled by Arboretum staff. There was a new find in Chisago County, a first for this county. The landowner tried to control the infestation then requested help. We aim to have a crew help the landowner in spring 2019.

Dalmatian toadflax: There have been no new infestations found for several years. Although we need to stay the course of controlling plants at infested areas for many more years, eradication is very feasible. This is a big accomplishment. Dalmatian toadflax is the number one reported weed in EDDMapS because it is so abundant and troublesome in the west.

Cutleaf and common teasels: New infestations were found in Fillmore, Houston and Winona counties. We think we have a good handle now on teasel infestation locations. Christina revisited the Nobles County site and found that control efforts were not occurring. MDA staff changes and a new County Agriculture Inspector for

Nobles County made previous follow-up difficult. A landowner agreement was signed, seed heads were clipped and rosettes were sprayed on 10/1/2018.

Grecian foxglove: Grecian foxglove had been reported at Weaver Dunes SNA on 06/15/09. There were only a few plants in 2009 and they were controlled. We followed up in June 2018 and did not find any Grecian foxglove at this location. This infestation was eradicated. There have been no new finds at other locations. Some landowners no longer request assistance because the foxglove levels are low enough for them to control.

Japanese hops: There have been new finds of small infestations within the city of Winona. We are not sure yet how the hops are moving. Hops infestations along the Root River are extensive and on river treatments are challenging. There is a need to better engage landowners. With our Fillmore and Houston Soil Water Conservation District and Extension partners, we are reaching out to impacted landowners and communities. MDA sent a letter to 200 private landowners along the Root River where there are hops infestations. The letter explained the hops issue and included a fact sheet about identification and control. There will be two informal outreach events for people to learn about Japanese hops and poison hemlock identification and management. Information about these meeting was included in the mailing and Extension did a media release to get the word out.

November 29th	
3:00 – 5:00 pm	MiEnergy, 31110 Cooperative Way, City of Rushford Village
6:00 – 8:00 pm	Houston County Nature Center, 215 W. Plum St., Houston
April 4th	
3:00 – 5:00 pm	Houston Community Center, 109 W. Maple St., Houston
6:00 – 8:00 pm	MiEnergy, 31110 Cooperative Way, City of Rushford Village

Brown and meadow knapweeds: Met with Koochiching Land Commissioners about knapweeds on 06/04/18. County Agricultural Inspectors/Land Commissioners found and mapped brown and/or meadow knapweed at new locations in Becker, Hubbard and Koochiching counties. All three counties were able to utilize their MDA grant funds for treatments. MnDOT found and treated in infestation in Itasca County. On 07/03/18, MDA monitored areas where these knapweeds had previously been found in St. Louis County and either pulled plants (if only a few present) or notified MnDOT about the locations where these knapweeds are present. The largest infestations are at Audubon Center of the North Woods in Pine County. Additional infestations at this location were mapped by MDA this summer and fall. We are concerned that knapweeds appear to be hybridizing into unrecognizable species.


Bracts (on flower head) are an identifying characteristic but were highly variable indicating high genetic variability. The species on the left is not readily identifiable.

Oriental bittersweet:
MDA followed up on five bittersweet reports on 07/02/18 in Duluth. Most reports were of other species but we confirmed one backyard infestation in Duluth. An agreement for treatment has been signed with this landowner. MnDOT has been managing some small infestations on I35 in Duluth. Mari Hardel monitored the treatments and notified MnDOT about the need to control some vines that were missed.

The St. Croix River Assoc. conducted late summer and early fall monitoring on reports of vines that could not be definitely identified previously. They also monitored the following stretches of the St. Croix: Afton Marina to the Confluence of the Mississippi, County Road O Landing to Never's Dam Landing and Riverside Landing to Norway Point Landing. Additionally, oriental bittersweet was confirmed and controlled at Interstate Park. There is a synergy between the efforts of Winona County, Winona SWCD, city of Winona, MnDOT, MDA and CCM. We collaborate to share resources for the best outcomes. Winona County and MDA have conducted initial assessments of new reports. If the infestations are small, interns working with the county have worked alongside landowners to control them. Vines in the most heavily infested areas will be downed with a forestry mower if the slope is not too steep for the mower. Funding for this mowing is from a BWSR Cooperative Weed Management Area grant to the SWCD. CCM and MDA are focused on large or dense infestations that are unsuitable for forestry mowing. Additionally, Anne Morse, the Sustainability Coordinator and Assistant County Agricultural Inspector, organized workshops in each impacted neighborhood and hosted by a resident. Workshop participants learned how to identify and manage oriental bittersweet. There has been good media coverage of these efforts. Building this community involvement is essential for long-term success.

Poison Hemlock: There were some new reports of small infestations. New infestations were reported in Chippewa and Blue Earth counties. Both infestations were immediately treated and no rosettes were found in the fall. Poison hemlock appears to be moving downriver in Fillmore and Houston on the Root River. A survey was conducted along West Indian Creek in Wabasha County. This stream flows direction into the Zumbro River. A total of 125 new hemlock locations were found. Wabasha County will utilize MDA grant funds for treatments.

Project Status as of May 31, 2019
Factsheets were developed for poison hemlock, black swallow-wort, Grecian foxglove, common and cutleaf teasels, and Dalmatian toadflax.

Common and cutleaf teasels

- A previously treated infestation at Pine Creek was scouted and only a few teasel rosettes were present. This is very promising.
- Populations along the Canadian Pacific Railway in Rochester have been reduced. Flowering and seed production have been prevented for 3 years.
- Treatments will continue through June on 43 different sites.

Grecian foxglove
Washington Conservation District has MDA grant funds and is lining up treatments. They will contract with CCM for a few days then finish the work with one of their crews.

Japanese hops and poison hemlock

- Open house meetings about Japanese hops and poison hemlock were held back to back on 11/29/19 in Rushford and Houston. Participation was low but included some township officials so the meetings were a good first step.
- Christina and Monika presented Japanese hops, poison hemlock and knotweeds to the Water Resources Advisory Committee in Rochester. They were interested and said that they would pass along information about these species to their staff.
- Flooding may have impacted hops spread. There was obvious riverbank erosion on the Root River.
- We held a detailed planning meeting for hops treatments with Fillmore and Houston SWCDs, Stantec (contractor) and city of Winona. Both Fillmore and Houston SWCDs have MDA grant funds to contract control treatments. Outfitting a boat to handle the upper stretch has proved difficult so they will start treatments from Peterson to Rushford the week of June 3rd then try the upper stretch afterward. City of Winona also participated in the meeting and will assess whether they need help with any of the hops infestations in the city.
- Wabasha SWCD has MDA grant funds for poison hemlock treatments along W. Indian Creek. The SWCD, DNR and MDA have been jointly planning the treatments.

Brown, meadow and diffuse knapweeds

- Pine County has MDA grant funds for and will prioritize treating brown and meadow knapweeds in two gravel pits. This will reduce spread via gravel. They will also ask the contractor to treat the relatively flat areas of Audubon Center of the North Woods. CCM will smaller and less accessible infestations at Audubon.
- Hubbard County has MDA grant funds for treating all known infestations this year. Mari is in contact with the county on surveying along with documenting infestations and treatments.
- Koochiching County has MDA grant funds for treating meadow knapweed and has been in contact with Mari about entering management data into ISMTrack.
- The only known diffuse knapweed infestation was monitored and remaining plants will be pulled or sprayed this summer.

Oriental bittersweet

- Christina assessed bittersweet at the Great River Bluffs State Park bike camp then lined up treatment.

- Previously, DNR found bittersweet at Beaver Valley Creek State Park and controlled it. CCM surveyed the surrounding area this winter and found additional infestations. These infestations are a high priority for control.
- SCRA plans to inventory the last stretch of the river which is from Afton to the confluence, monitor known infestations, follow up with identification of young vines to determine if they are American or oriental bittersweet.
- SCRA held their annual forestry conference in March. Christina gave a presentation on bittersweets, barberries and burning bush at the conference.

Dalmatian toadflax

- Mari and Christina assessed the Dalmatian toadflax sites in northeastern Minnesota near Lutsen and Tofte. They found very few plants. Mari has been in contact with MnDOT about 2019 treatments.

Project Status as of November 30, 2019

MnDOT Metro District did extensive invasive plant surveys during the summer and fall. The two people surveying recorded 864 priority infestations including 12 Grecian foxglove and 28 oriental bittersweet infestations. If an infestation was very small, it was hand pulled immediately. Oriental bittersweet treatments began in fall 2019. This MnDOT effort was much appreciated.

There were 3 reports of dodder, a parasitic vine. Two reports were confirmed to be swamp dodder, a native species. We have not received confirmation about the final dodder species. The concern is that it may be a non-native dodder species.

Mari assessed populations of red bartsia (*Odontites vernus*) and small-leaf bramble (*Rubus parvifolius*), both newly reported in Minnesota.

Common and cutleaf teasels

- Christina followed up on reports and surveyed for teasels. She documented 7 new infestations.
- She also monitored previously treated teasel sites and saw a large decrease in infestations size.

Grecian foxglove

- Christina surveyed and documented 2 additional infestations.

Black swallow-wort

- There were 2 new black swallow-wort finds reported by citizens in Minneapolis and Oakdale in Hennepin and Washington counties respectively.
- An assessment of a previously treated infestation in Ramsey County led to a plan to control buckthorn at the site as people treating the swallow-wort couldn't access the vines in dense buckthorn stands.
- Master Gardeners have been very helpful about getting out the word on black swallow-wort. We provided them a presentation and outreach materials.
- A letter was sent to 54 landowners in an infested area of the Longfellow neighborhood in Minneapolis.

Japanese hops and poison hemlock

- Hops survey resulted in an additional 5 infestations found. Infestations in the city of Winona appear to be associated with new fill brought to the site.
- Hops leaf and seed samples were provided to a U of M researcher.
- There were many new poison hemlock finds. These 43 new finds were startling because they were in many different areas of the state. Most infestations were very small, just a few plants, with no apparent

seed source nearby. We don't know how poison hemlock is moving but there appears to be an association with rail right of way.

Brown, meadow and diffuse knapweeds

- Populations were better mapped. We had previously documented general locations for most of these infestations, but additional delimiting was needed to guide treatments and identify where additional survey is needed.
    - Mari and the Pine County Ag Inspector surveyed for meadow knapweed and documented an additional 52 infestations.
    - Mari surveyed for brown knapweed in Hubbard County and documented 4 new infestations.
    - Mari did additional survey for brown and meadow knapweeds in St. Louis and Koochiching counties and 9 new infestations were documented in Koochiching. Additional survey work is planned for July 2020 on the LCCMR project titled Noxious Weed Detection and Eradication.
- The one known diffuse knapweed infestation was monitored and is decreasing.
- A report of diffuse knapweed turned out to be spotted knapweed.

Oriental bittersweet

- St. Croix River Assoc. surveyed from Afton to Prescott and didn't find any oriental bittersweet. They surveyed in St. Croix State Park but the only bittersweet found was native. They will check status at Brown's Creek.
- Christina and Monika detected 13 new infestations. There was a new county find in Northfield in Rice County.
- A letter was sent to 53 landowners in Nicollet County to notify them about a new find in their area.
- Monika visited areas with reports of possible oriental bittersweet. Fortunately, many were American bittersweet, a native species.

Dalmatian toadflax

- Mari monitored populations in Cook county and found few toadflax seedlings. She pulled the plants. This greatly reduced infestation is very encouraging.

Final Report Summary:

Survey and follow up on reports from the public was very productive. A total of 977 new infestations with a total acreage of 3,490 were documented during this project period. Many of the infestations were small or low density scattered over a large area. It was ideal to find and control these small infestations before they proliferated. The outreach and education offered in Activity 1 led to many successful finds of new infestations.

The work of communicating with landowners and coordinating control has been essential to the success of this project. Much of the work of invasive plant control is in careful planning and communicating with landowners and partners. Emilie Justen, Christina Basch and Mari Hardel did an excellent job of this and persuaded private landowners to work with us. Their careful planning also increased the efficiency of control efforts by designing efficient travel routes for crews.

ACTIVITY 3: Control Target Species

Description: MDA will contract with CCM for trained and equipped field crews to control target invasive species on an estimated 660 acres (75 ac. Dalmatian toadflax, 5 ac teasels, 130 ac Grecian foxglove, 50 ac Japanese hops, 150 ac meadow and brown knapweeds, and 250 ac Oriental bittersweet). CCM crews trained in identification and control of target species will conduct control work starting with known infestations of Oriental

bittersweet and continuing with control of other target species. Large infestations of Oriental bittersweet will be controlled using basal bark and/or cut-stump treatment with a systemic triclopyr based herbicide in basal oil which is specific to broadleaf plants and will reduce potential impact on non-target species. Smaller infestations of young plants or infestations in sensitive areas that prohibit use of herbicides will be controlled by hand or mechanical pulling with a focus on removing and properly disposing of all plant parts including all roots and fruit to prevent re-sprouting and/or seeding. Timing of control will focus on late fall and winter when non-target species are dormant to reduce impacts on desirable species. Control of additional target species will involve mechanical and chemical control methods following established best management practices for each species based on size and location of infestations.

Summary Budget Information for Activity 3:	**ENRTF Budget:**	**$ 203,200**
	Amount Spent:	**$ 203,177**
	Balance:	**$ 23**

Outcome	**Completion Date**
1. Acres treated are documented	06/30/2020

Activity 3 Status as of November 30, 2016:
Japanese hops: Due to high water levels on the Root River, crews were unable to access infestations boat. Hops were treated at boat landings. We did not have funding in place for these treatments. DNR used grant funds to cover the treatment costs.

Oriental bittersweet: Treatments are planned for winter 2016/17 and spring 2017 in Red Wing, Winona, and Washington Counties.

Palmer amaranth: MDA's contract with CCM was amended by an additional $15,000 to cover Palmer amaranth treatments. MDA emergency funds were used for this purpose. In order to reduce seed, Palmer plants including seedheads were incinerated at 4 sites with an approximate total of 60 acres. Propane torches were used to burn the plants. An additional 6 small plantings within one site were checked and no Palmer was found. One final flame weeding treatment is planned for 12/07/16, weather permitting, on a 51 acre site. Some sites had been mowed too closely to flame weed. Use of prescribed fire on at least 4 sites is planned for spring 2017. Other management methods may be used as well. Treatment costs to date were $6,570 and were reported in section VI. Project Budget Summary under other funds used.

Activity 3 Status as of May 31, 2017:
Black Swallow-wort: One day is scheduled to treat the infestation in Ramsey County. MDA is working closely with Ramsey CWMA to monitor small infestations in other parts of the county that are being treated by the landowners.

Dalmatian toadflax: A total of nine days are scheduled for treatments for June, July, and September in Kittson County.

Cutleaf and common teasels: Treatments are planned with our MnDOT and DNR partners for infestations in Southeastern Minnesota. Coordination between the Departments of Natural Resources, Transportation, and Agriculture have resulted in reduced infestations.

Grecian foxglove: Twelve days are scheduled for treatments in June and 12 days are scheduled in September, in cooperation with the Washington Conservation District.

Japanese hops: Treatments are planned for summer 2017. MDA will work closely with DNR to utilize funds and CCM crew time.

Brown and meadow knapweeds: Due to the impact of adding Palmer amaranth to the project, funds were diverted to work on Palmer treatments and work on brown and meadow knapweeds has been delayed.

Oriental bittersweet: CCM treated 69 acres of Oriental bittersweet in December, March, and April. In Winona, 34.5 acres were treated; in Red Wing 31.5 acres were treated; in Bloomington 1.5 acres were treated; and in Grant 1.5 acres were treated.

Palmer amaranth: We torched Palmer amaranth plants on December 7th at site Yellow Medicine 11. MDA emergency fund amount of $4,155 was used for this activity.

On April 21st, we used prescribed fire at six infested plantings. Insufficient vegetation made it impossible to burn all sites. We focused on areas of infestation where burning the entire sites was not possible. MDA emergency fund amount of $2,700 was used for this activity.

CCM burning a Palmer amaranth infested conservation planting on 04/21/17. Photo by MDA.

Poison Hemlock: Due to increased reports of poison hemlock infestations, the project partners agreed to add the species to the project. Infestations in Rochester and SE Minnesota will be treated in summer 2017.

Mapping Invasive Plant Management: Project partners, including MDA and city of Red Wing GIS experts, are creating user-friendly interactive maps that aggregate data from EDDMapS, ISMTrack, municipalities and counties and related projects. We can better understand what was done, where it was done and priority areas for future work. A rough draft of a Red Wing invasive plant management map is at http://arcg.is/2pgHIw4. A geodatabase for Palmer amaranth management is in development. We used MDA general fund amounts of $2,000 for Red Wing mapping and $5,000 for Palmer geodatabase development. In order to automatically feed ISMTrack data into these geodatabases, an application program interface (API) needed to be created. MDA contracted with EDDMapS for this API and improvements to ISMTrack with $5,000 general funds. We are working with a very basic API now and will receive an API with more capability by the end of June.

Activity 3 Status as of November 30, 2017:
There were 51 crew members involved with target plant control during this period. Crews from Bemidji, Brainerd, Duluth, Gooseberry Falls State Park and Moose Lake rotated into the southeast. These rotations occurred from July 17th to August 14th. These additional crew members were much needed for controlling our target species. Also, crew members became familiar with the target species. They are now on the lookout for target species in their areas. To keep costs down, crews camped in Rochester. Crews also worked eight 10 hour days in a row to reduce travel time and costs. CCM managers and coordinators went above and beyond to handle the complex logistics involved with the rotations seven days a week.

Black Swallow-wort: A large infestation in Ramsey County was treated and treatment was very effective. MDA continues to work closely with Ramsey CWMA to monitor small infestations in other parts of the county that are being treated by the landowners.

Dalmatian toadflax: Treatments in June and July were very effective at reducing the population in Kittson County. MDA evaluated these treatments and hand pulled all remaining plants in October. MnDOT surveyed for toadflax in Cook County and found only a handful of seedlings that were destroyed.

Cutleaf and common teasels: There were new and some sizeable teasel finds in the southeast. That said, all teasel infestations in the state were treated and seedheads were removed then incinerated. Some of this achievement was due to our DNR partners coordinating and paying for some treatments.

Grecian foxglove: Treatments were done in cooperation with the Washington Conservation District and DNR. This collaboration maximized efficiency of working across property lines and helped with treatment costs. Grecian foxglove populations have been greatly reduced over the years.

Japanese hops: Japanese hops treatments on the Root River were challenging. Since 2016 high water levels prevented treatments, the hops population exploded. The crew faced a daunting amount of hops and it was technically difficult to control hops with swift moving water and steep banks. The crew on the river diligently controlled hops from Preston to an area between Lanesboro and Whalen. Rotating crews from the north controlled hops along the Root River Trail. CCM, DNR, MDA and other partners in the Root River Watershed District will attempt to secure additional funds and plan for hops management.

Brown and meadow knapweeds: Some of the meadow knapweed was treated at the Audubon Center of the North Woods. There was far more meadow knapweed this year than previous years. Audubon has been managing the knapweed but asked for help this year. We scheduled an additional treatment this fall that was canceled because crews deployed to Texas, Florida and Puerto Rico for hurricane relief. We plan to treat this site in the spring.

Oriental bittersweet: Follow up treatments were done at all selected sites in Winona and Red Wing. A foliar treatment was applied to regrowth. Crews continue to cut and treat vines this fall in Washington County and Red Wing.

Palmer amaranth: Activities will be recorded in the Palmer Amaranth Detection and Eradication report due on January 31, 2018.

Poison Hemlock: Poison hemlock infestations in the Lanesboro area were treated. As a result of outreach, there were numerous new poison hemlock infestations found. Small infestations were controlled by landowners.

Moth Mullein
Moth mullein is an early detection species that DNR manages. Crews working with MDA helped for a couple of days to prevent moth mullein from going to seed and setting back the eradication effort.

Activity 3 Status as of May 31, 2018:
Black Swallow-wort: Ramsey Co. treated.

Dalmatian toadflax: MDA will follow up regarding treatments by Kittson County, MnDOT and Cook County Highway Department.

Cutleaf and common teasels: Treatments begin in June utilizing DNR funding (see Activity 2).

Grecian foxglove: Washington Conservation District will fund summer 2018 treatments by a private applicator coordinated by MDA. The aim is for MDA to have an amended contract with CCM for fall 2018 treatments.

Japanese hops: CCM will treat hops accessible by land beginning in July. A group is working to line up a private applicator for on river treatments but that may not come together in 2018.

Brown and meadow knapweeds: Infestations at the Audubon Center of the North Woods will be treated in summer 2018. Becker, Hubbard, and Koochiching counties are handling treatments (see Activity 2).

Oriental bittersweet: We aim to continue control work in fall 2018.

Poison Hemlock: Treatment of poison hemlock in the Lanesboro area will continue utilizing DNR funding. Some counties will work on poison hemlock control utilizing MDA pass through funds (see Activity 2).

Activity 3 Status as of November 30, 2018:
In collaboration with numerous state and local partners, we are containing and controlling target infestations. Now that known infested areas have been mapped, we are accelerating the control effort as evidenced by the comparatively large number of acres controlled to date in 2018 (see table below). Oriental bittersweet control done in late November and early December 2018 is not included in the table.

Year	Acres
2016	1,673
2017	1,476
2018	2,679
Total	**5,827**

Black Swallow-wort: Ramsey Cooperative Weed Management Area (CWMA) in 2018 treated the largest infested areas in summer 2018 using MDA pass-through grant funds. Christina Basch, noxious weed specialist on this project assessed swallow-wort development and advised Ramsey CWMA about treatment timing.

Dalmatian toadflax: On the North Shore, the Forest Service and MnDOT treated infestations. There are few flowering plants remaining so the control effort is focused on young plants. This is excellent progress. The other area of infestation is in Kittson County near Halma. The Kittson SWCD had MDA pass-through grant funds to address the toadflax. The county sprayed in the summer. However, Monika Chandler visited the sites afterward and found many toadflax plants were missed and the treated plants were re-sprouting. It is difficult to kill toadflax with herbicides along due to their extensive rhizome system. A CCM crew was brought in to hand pull remaining plants on 11/08/18. This treatment and weed material disposal were overseen by Monika Chandler and Mari Hardel, noxious weed specialist on this project. Kittson SWCD paid for the crew time with MDA grant funds.

Herbicides top-killed this Dalmatian toadflax plant but hand-pulling the plant revealed a healthy root and rhizome (underground stem) system that is sending up new shoots. Because it is so difficult to kill toadflax by herbicide treatment alone, hand-pulling is an important control measure.

Cutleaf and common teasels: DNR funded CCM to control common teasel on 5 sites and cutleaf teasel on 22 sites. The work began in May and progressed throughout the summer (weeks of 06/04, 06/11 and 08/06).

Coordination with landowners in addition to overseeing, evaluating and documenting treatments was done by Christina Basch. In Nobles County, seedheads were clipped and rosettes were sprayed on 10/1/2018

Grecian foxglove: Washington Conservation District will fund summer 2018 treatments by a private applicator using MDA pass through grant funds (06/27, 06/28, 07/02 and 07/05). Landowner agreements and treatments were coordinated, evaluated and documented by Christina Basch. CCM did a follow up treatment 11/06 to 11/08 using our ENRTF funds. The crew had to hand pull plants when it rained and sprayed plants when it was not raining. Control work was done on 4 of 5 sites. The site that was not treated will be a high priority for spring 2019.

Japanese hops: On water treatments were very challenging. Fillmore SWCD used MDA grant funds to hire a contractor to treat hops growing on the riverbanks. The combination of moving water, river rocks and a boat weighted down with two people and a herbicide tank made the application unsafe. We decided to try again in the late spring with a more maneuverable boat. Treatments along or near the Root River Trail were successful. Fillmore SWCD used a BWSR grant for CCM crew time to control hops along the trail and at boat landings in Fillmore County. These efforts, including writing agreements with landowners on the Root, were coordinated by MDA. Hops treatments occurred the weeks of 07/06, 07/23, 07/30 and on the following dates 08/09 and 08/13. DNR Parks and Trails controlled hops along the trail in Houston County. We observed an approximately 90% kill rate.

Brown and meadow knapweeds: Audubon Center of the North Woods was treated twice by CCM crews. The first treatment was the week of 06/25 with follow up on 09/02 and 09/14. Becker, Hubbard, and Koochiching counties handled their treatments, including all coordination, with MDA grant funds. MnDOT treated meadow knapweeds in Itasca and St. Louis counties.

Oriental bittersweet: Treatments started in the early fall and will continue through winter. Treatments were in Red Wing, Winona and the Stillwater areas. Bittersweet treatment dates are the weeks of 09/24, 10/01, 10/08, 10/15, 10/22, 10/29, 10/12 and 11/26. There will be three crews working on bittersweet in Winona the week of 12/03.

National Park Service and St. Croix River Association controlled bittersweet in the Fairy Falls area of Washington County in Stillwater.

Poison Hemlock: Fillmore SWCD used their BWSR funding for CCM crew time for treatments the week of 06/25. MDA coordinated these treatments near the Root River. DNR treated poison hemlock at a wildlife management area near Slayton in June. It is good news that Canadian Pacific Railroad treatments done in 2017 were very effective at almost eliminating poison hemlock along the railroad in the Rochester area.

MDA pass through grant funds were very helpful for target species control. Recipients listed below received the following amounts to work on the same target species as this project. Funds awarded to work on other species were not included with this list.

Local Government Unit	Target Species	Amount Received
Becker SWCD	Meadow knapweed, poison hemlock	$9,273.00
Chippewa County	Wild parsnip, poison hemlock	$5,000.00
Clearwater County Environmental Services	Meadow knapweed	$3,000.00
Douglas County	Oriental bittersweet	$10,750.00
Fillmore SWCD	Japanese hops	$25,300.00
Hubbard County	Brown knapweed	$5,883.00
Kittson SWCD	Dalmatian toadflax	$5,000.00
Koochiching County	Meadow knapweed	$12,000.00
Ramsey Conservation District/CWMA	Black swallow-wort, cutleaf teasel, oriental bittersweet	$20,000.00
Traverse SWCD	Wild parsnip, poison hemlock	$6,000.00
Washington Conservation District	Grecian foxglove, cutleaf teasel, oriental bittersweet	$12,500.00
Winona County	Oriental bittersweet	$22,607.00
Wright County	Oriental bittersweet, cutleaf teasel	$15,600.00
	Total	**$152,913.00**

Project Status as of May 31, 2019

Teasels

Teasel treatments began this year at Pine Creek. A parsnip predator shovel was used to dig taproots of scattered teasel rosettes over 178 acres in the Pine Creek area. DNR funding covered the crew time.

Japanese hops

- Fillmore and Houston SWCDs have BWSR funding for CCM crew time to control hops along the Root River Trail.
- Last year, CCM tested torching a small area of hops seedlings. Christina monitored these sites and no additional seedlings emerged. This year, DNR has funding for torching seedlings at 10 sites along the Root River. Burn permits are in place. The torching will be done on a rainy day.

Oriental bittersweet

- Good progress was made with bittersweet control in Mazeppa, Stillwater, Red Wing and Winona but significant populations remain in Red Wing and Winona. Christina worked with 6 CCM crew members

for 22 days to achieve this progress. Most of the bittersweet in Mazeppa is under control but follow up monitoring is needed. Work was done at 14 sites on 244 acres.
- Oriental bittersweet on private property in downtown Duluth was treated on December 17, 2018 by CCM. This was a single vine so there is no significant acreage to report.

Poison hemlock
- An outfitter treated poison hemlock at the Whalen canoe access on the Root River.
- A parsnip predator shovel was used to dig taproots of scattered hemlock rosettes over 316 acres in the West Indian Creek area.

Treatment priorities for remaining project funds include the following.
- Black swallow-wort in Chisago County.
- Common teasel infestation in Nobles County.
- Oriental bittersweet in Scandia in Washington County.
- Oriental bittersweet near Beaver Valley Creek State Park in Houston County.

Project Status as of November 30, 2019
Dalmatian toadflax: Dalmatian toadflax plants in Schroeder were hand pulled on 06/27/19.

Cutleaf and common teasels
- Common teasel was treated at 2 sites on 06/24/19 and 06/22/19. The infestations were 0.68 and 0.53 acres.
- A total of 264 acres of cutleaf teasel was treated at 18 sites from 06/13/19 to 09/18/19.

Grecian foxglove: Washington Conservation District received MDA grant funds and coordinated 2019 treatments.

Japanese hops
- A total of 4,219 acres were treated at 40 locations between 06/05/19 and 10/15/19. Early and late season treatments included burning with propane torches to kill seedlings and seed.
- All on land treatments (Root River Trail, boat landings, adjacent pastures, and city of Winona) went well. On river treatments continue to be challenging for a boat with 2 people and a 50 gallon tank to access upper stretches of the Root River.

Brown, meadow and diffuse knapweeds
- Diffuse knapweed plants were hand pulled on 07/10/19.
- MnDOT treated a new find on Hwy 71 near International Fall.
- Becker, Hubbard and Pine counties used MDA grant funds to treat infestations. Mari coordinated treatments in Pine County.

Oriental bittersweet:
- A total of 74 acres were treated at 16 locations between 06/20/19 and 11/21/19. Treatments will continue throughout the winter.
- National Park Service treated vines in the Ferry Falls area of Stillwater.
- Using MDA grant funds, Ramsey County treated bittersweet at all locations where treatment was needed.
- Also using MDA grant funds, Winona County hired 2 interns to assess infestations and train landowners to control the vines on their property.

Poison Hemlock:

- A total of 549 acres were treated at 35 locations between 06/05/19 and 10/24/19.
- The city of St. Charles in Winona County actively manages poison hemlock. An infestation popped up again. It was mowed then treated.
- New finds in Chippewa County were treated by the county and the city of Watson.
- A new find in Clay County was treated using MDA grant funds.
- USDA NRCS is managing an infestation in Freeborn County after Christina confirmed the infestation.

MDA pass through grant funds were very helpful for target species control. A list of recipients and amounts spent will be included in the final report.

Final Report Summary:
A total of 14,070 acres were treated. Many were small infestations or were spot treatments of invasive plants scatted over large areas. Many infestations were treated in multiple years and the acreage of each treatment was recorded and included in the total. We made significant progress at finding, containing and controlling target infestations. This important work is continued in the Noxious Weed Detection and Eradication project.

ACTIVITY 4: Implement Invasive Species Management Database System from Phase 1
Description: In the field, CCM will use tablets with a database system developed in Phase 1 to collect data on target invasive species control treatments and monitor infestation changes. This platform will enable us to communicate across organizations and efficiently summarize activities and outcomes. Extension will train agencies and other organizations to utilize this system.

A. Purchase 20 tablet computers; 10 for Extension trainings for database system users and 10 for CCM crews to use while managing and monitoring on target invasive species,
B. Natural resource manager database system trainings (using the tablets, 2 per year).

Summary Budget Information for Activity 4:	**ENRTF Budget:**	**$ 0**
	Amount Spent:	**$ 0**
	Balance:	**$ 0**

Outcome	**Completion Date**
1. 6 training workshops will be conducted for vegetation managers	05/30/2020
2. Tablets and software will be utilized for data collection in the field	06/10/2020
3. Summary reports of activities and outcomes will be run	06/10/2020

Activity 4 Status as of November 30, 2016:
See U of M report for activity status.

Activity 4 Status as of May 31, 2018:
MDA has assumed responsibility for training people to utilize ISMTrack.

Activity 4 Status as of November 30, 2018:
Winona and Stearns County Agricultural Inspectors were trained to use ISMTrack. The Steans Co Ag Insp was added to the development team and will facilitate implementation. A multi-county training was held on Nov 27th. Additional trainings will be conducted over the winter. MDA is requiring that MDA grant fund recipients report management activities in ISMTrack.

Project Status as of May 31, 2019
There were 5 EDDMapS and ISMTrack workshops held. One workshop scheduled in Redwood Falls was canceled due to poor travel conditions and has not been rescheduled yet.

Participants	Date and Location
County Agricultural Inspectors, Southeastern MN	Jan 9, Owatonna
County Agricultural Inspectors, Northeastern MN	Jan 16, Mora
Duluth Stream Corps	Jan. 31, Duluth
County Agricultural Inspectors, Northwestern MN	Feb. 20, Detroit Lakes
Invasive species managers with multiple affiliations	Mar. 13, Duluth

Project Status as of November 30, 2019
A training workshop was held for District 4 County Ag Inspectors in Redwood Falls on 11/06/19 with 19 participants. With this, we met our commitment of 6 workshops. Additionally, Beltrami and Mille Lacs county individuals were trained then successfully used ISMTrack.

Final Report Summary:
CCM consistently utilized ISMTrack for this project. We were pleased with how well this tool facilitated revisiting sites for follow up treatments. At the Upper Midwest Invasive Species Conference this fall, Christina Basch will present ISMTrack's role in facilitating management using data from this and related projects.

There are currently 147 ISMTrack users. That number will continue to increase. The workshops helped us to get the word out about this tool. Outreach about ISMTrack will be ongoing.

V. DISSEMINATION:
Description: We will communicate about target invasive plant species with the public, natural resource professionals, County Agricultural Inspectors, highway and road crew employees and Cooperative Weed Management Areas. The web will be used for communication with at www.mda.state.mn.us/en/plants/pestmanagement/weedcontrol/targetplants.aspx and www.myminnesotawoods.umn.edu/ (this location may shift as we develop additional online training and outreach materials and target specific audiences). Communication with the public will be via workshops, news media (print, television, and radio), online and via social media such as YouTube, Facebook, Twitter and Pinterest. We will communicate updates at County Agricultural Inspector meetings and in trade publications such as "The Scoop" published by the Minnesota Nursery Landscape Association. We expect to present this project during at least one peer-reviewed professional conference such as the Association of Natural Resource Extension Professionals Conference or the Upper Midwest Invasive Species Conference (both biannual conferences).

Status as of November 30, 2016:
The following field trips and presentations were given at the Upper Midwest Invasive Species Conference in La Crosse, WI, October 16-18.

- Chandler, M., K. Kearns and B. Johnston. "Kick" Around Riparian Invasives. Field trip showcased Japanese hops.
- Gentry, A., T. Wolbers and E. Justen. Invasives by Land, Lake and Stream. Field trip toured an Oriental bittersweet infestation.
- Dahlberg, A. and J. Osthus. Hatch a Plan in Genoa. Field trip included identification and management of cutleaf teasel.

- Justen, E. Successful Japanese Hops (*Humulus japonicus*) Early Detection and Management in Southeastern Minnesota.
- Justen, E. and L. Anderson. Grecian Foxglove (*Digitalis lanata*) Management Success: A Collaborative Effort.

Status as of May 31, 2017:

Presentations

- Emilie Justen and Monika Chandler were trainers at the Weed 'Em Out workshops in Virginia, Morris and Baxter that are on the U of M report.
- Justen, E. Early Detection and Rapid Response of Invasive Plants in Minnesota. Western Weed Coordinating Committee, Las Vegas, NV. November 30, 2016. MDA general funds ($735) were used for this travel.
- Chandler, M. Knotweed, Barberries and Bittersweets. Duluth Invaders (volunteer organization), Duluth, MN. December 14, 2016.
- Chandler, M. Weed Biocontrol and Invasive Plant Early Detection. New County Agricultural Inspector Training, St. Cloud, MN. February 7, 2017.
- Justen, E. Invasive Plant Management. Wabasha Forestry Day, Millville, MN. February 10, 2017.
- Chandler, M. Noxious Weed Update. Clay County/Township Meeting, Dilworth, MN. March 20, 2017.
- The *Elimination of Target Invasive Plant Species* project webpages have been updated and include summaries from Phase 1 and the 2017 ETIPS stakeholder report: www.mda.state.mn.us/plants/pestmanagement/weedcontrol/targetplants.aspx
- MDA's Noxious Weed Advisory Committee received updates at the December 20th March 1st and May 24th 2017 meetings.
- MDA seed and weed staff provided updates on Palmer amaranth at all county and regional meetings with County Agricultural Inspectors.

Articles and Media Coverage

- There was too extensive of media coverage about Palmer amaranth in Minnesota to track.
- Chandler, M., A. Cortilet, E. Justen and C. Watrin. **Palmer amaranth management in Minnesota** in Plant Pest Insider newsletter, Fall 2016.
- **Superweed introduced to Minnesota with conservation seed mix** (www.startribune.com/superweed-introduced-in-minnesota-with-conservation-seed-mix/408439906/). *Star Tribune.* December 28, 2016
- Cortilet, A. and M. Chandler. **Palmer amaranth in Minnesota** in *Soybean Business* Vol X, Issue 2, March-April 2017.
- Chandler, M. and T. Cortilet. **Palmer amaranth in Minnesota** in *Minnesota Township Insider*, Pages 9-11, 2017 Spring Issue.
- **Beware of garden thugs – invasive plants** www.startribune.com/beware-garden-thugs-invasive-plants/420746273/?platform=hootsuite *Star Tribune* April 28, 2017.

Status as of November 30, 2017:

Presentations

- Emilie Justen and Monika Chandler were trainers at the Weed 'Em Out workshop for 82 CCM members in Red Wing on June 12, 2017 that is included with the U of M report.
- Grecian foxglove and other invasive plant species were featured on the Wetland Professionals Association field trip on June 23, 2017 at Lake Elmo Park and Belwin Conservancy. Monika and partners with Washington County Parks, Washington Conservation District and Belwin Conservancy organized the trip.
- MDA's Noxious Weed Advisory Committee received an update on September 7, 2017 in Arden Hills.

- Emilie gave a talk on woody invasive plants at the Tree Inspector Training in Brainerd on October 9, 2017.
- Emilie gave a talk on the Noxious Weed List to District 1 MnDOT employees on October 19, 2017 in Duluth.
- Emilie co-presented with Tara Kline of Washington Conservation District at the Board of Water and Soil Resources (BWSR) training academy on November 2, 2017. They talked about managing multiple grants with multiple landowners to avoid duplicating treatment and mapping efforts.
- Shane Blair taught a workshop about Oriental bittersweet and knotweeds identification and management in Winona on October 30, 2017.

Articles and Media Coverage

- Poison hemlock press release on June 22nd. Emilie interviewed with KAAL in Rochester on June 26th, KARE 11 on July 5th. 61 media outlets across the state and North Dakota, South Dakota, and Wisconsin picked up the story.
- Oriental bittersweet was featured as MDA's Weed of the Month series that is run in multiple media outlets in rural Minnesota.

Status as of May 31, 2018:

- A project update was given to MDA's Noxious Weed Advisory Committee on February 18th and May 24th 2018 in Arden Hills.
- Chandler, M. presented biological control and invasive plant early detection at the new County Agricultural Inspector training on February 20, 2018 in St. Cloud.
- MDA and Three Rivers Parks District taught an invasive plant session at CCM training on February 22, 2018 in Annandale.
- Updates were given at Ramsey and Anoka CWMA meetings on February 21 and April 10, 2018 respectively.
- A stakeholder report on project progress was sent to participating landowners, County Agricultural Inspectors, members of the Noxious Weed Advisory Committee and LCCMR commissioners.

Status as of November 30, 2018:

- Chandler, M. presented "Invasive Species Data Management" about EDDMapS including ISMTrack at the annual Minnesota Association of County Agricultural Inspectors Short Course in Waite Park on July 18, 2018.
- Justen, E. presented about weed law, Japanese hops and wild parsnip at a Fillmore County roadside vegetation workshop in Preston on August 28, 2018.
- Justen, E. presented about oriental bittersweet at a buckthorn and bittersweet management workshop at Big Marine Park Reserve on September 18, 2018.
- Chandler, M. gave a project update to MDA's Noxious Weed Advisory Committee on September 25, 2018.
- Mari Hardel presented on noxious weeds at a University of Minnesota Master Woodland Owner course on September 29, 2018 and spoke specifically about meadow knapweed and related species.
- Basch, C., M. Chandler, E. Justen, A. Gupta, D. Littleton, D. Looman and Z. Dieterman authored and Christina Basch presented the talk "The Progression of Oriental Bittersweet (*Celastrus orbiculatus*) Eradication in Minnesota" at the Upper Midwest Invasive Species Conference in Rochester from October 15-18, 2018.
- Basch, C. spoke at Saint Cloud State University about eradication and coordinating efforts for eradicate list species in Minnesota on November 29th, 2018.
- An Extension/MDA/CCM video about oriental bittersweet identification and management created in Phase 1 of this project with Farm Bill funds continues to educate people and now has 15,580 views. Defeating a killer vine: Oriental bittersweet management https://www.youtube.com/watch?v=7wmZ1Zuho1c

Articles and Media Coverage

- Oriental bittersweet was featured as MDA's Weed of the Month series in November that is run in multiple media outlets in rural Minnesota.
- Due to increased treatment efforts in Winona County, the Post Bulletin in Winona ran an article in the paper and online about efforts to kill Oriental bittersweet: https://www.postbulletin.com/news/local/winona-county-s-fight-against-oriental-bittersweet-a-notorious-woodland/article_7ac5a9ac-e819-11e8-8361-8f15cd6668c1.html
- Christina was interviewed by MPR and featured in the following article: https://www.mprnews.org/story/2018/11/19/winona-county-vine
- Poison hemlock was featured as MDA's Weed of the Month series in June.
- Oriental bittersweet was featured as MDA's Weed of the Month series in November that is run in multiple media outlets in rural Minnesota.

Project Status as of May 31, 2019

- Chandler, M. provided an update to the Minnesota Association of County Agricultural Inspectors Board on December 12, 2018 in St. Paul (14 participants).
- Chandler, M. gave project updates to MDA's Noxious Weed Advisory Committee on December 19, 2018 in Arden Hills and on February 27, 2019 in Roseville (23 and 25 participants respectively).
- Hardel M. presented about the Noxious Weed Law and target species in the Northeast Minnesota region at the Duluth Cooperative Invasive Species Management Area meeting on January 8, 2019 (15 participants) and discussed target species at meetings on March 26 and May 14, 2019 (14 and 12 participants, respectively).
- Basch, C., M. Chandler and S. Blair gave updates at the southeastern region County Agricultural Inspectors meeting on January 9, 2019 (15 participants).
- Basch, C. and E. Justen attended the Washington County CWMA Meeting. Christina talked about plans for bittersweet, Grecian foxglove and teasel eradication work on January 10, 2019 in Oakdale.
- Hardel, M. gave updates at the County Agricultural Inspector northeastern region meetings on January 10, 2019 and March 14, 2019 in Ogilvie.
- Chandler, M. presented early detection and rapid response to target species at new county agricultural inspector training on February 12, 2019 (14 participants).
- Justen, E. provided noxious weed training to new CCM members on February 21, 2019 in Annandale (38 participants).
- Basch, C., M. Chandler and S. Blair trained new CCM in southern Minnesota to identify target species followed by Extension training on safe herbicide use on February 28, 2019 at Whitewater State Park (17 participants).
- Hardel, M. trained new CCM in northeastern Minnesota to identify target species on March 1, 2019 in Duluth (20 participants).
- Gupta, A. and M. Hardel trained workshop participants to identify target plants at a joint Society of American Foresters and Wildlife Society conference on February 21, 2019 in Duluth (20 participants).
- Basch, C. presented target plant identification and reporting at the Dakota County/Township meeting on March 5, 2019 in Farmington (25 afternoon session and 7 evening session participants).
- Basch, C. and M. Chandler presented about Japanese hops, poison hemlock and knotweeds to the Water Resources Advisory Committee on March 6, 2019 in Rochester (13 participants).
- Hardel, M. discussed target species status and management at the Cook County Invasive Team meeting in Grand Marais on March 6, 2019 (10 participants)
- Hardel, M. and M. Chandler provided an update at a northeastern region invasive species meeting on March 13, 2019 in Duluth (14 participants).

- Chandler, M. gave a presentation titled "Woody Invasive Plant Detection and Management Update" at the Shade Tree Short Course on March 19 and 20, 2019 in Roseville (12 and 23 participants respectively).
- Basch, C. presented on bittersweet, barberry and burning bush at the St. Croix River Association Forestry Conference March 28-29, 2019 in Siren, WI (35 participants).
- Basch, C. presented about target species at the Houston County/Township meeting on April 2, 2019 in Caledonia (22 participants).
- Basch, C. presented about Japanese hops and poison hemlock to landowners within infestation areas in Houston and Rushford on April 4, 2019 (5 and 15 participants respectively).
- Chandler, M. presented a webinar titled "An update on invasive plants in Minnesota forests" as part of the Sustainable Forests Education Cooperative and UMN Extension Forestry Webinar Series on April 16, 2019 (45 participants). A recording is available at https://www.youtube.com/watch?v=yVamE7cefuY
- Hardel, M. discussed knapweeds and wild parsnip at the Koochiching Cooperative Weed Management Area meeting on April 17, 2019 in International Falls (17 participants).
- Chandler, M. discussed target species status and future management at the Ramsey County Cooperative Weed Management Area meeting on April 17, 2019 in Shoreview (9 participants).
- Basch, C. discussed target species management with the Wright Cooperative Weed Management Area meeting on April 17, 2019 (26 participants).
- Basch, C. discussed target species management at the Wabasha Cooperative Weed Management Area meeting on April 23, 2019 (27 participants).
- Hardel, M. presented about hybridizing target species at the Gathering Partners of Natural Resources conference on May 19, 2019 in Willmar (14 participants).
- We participated in spring 2019 MnDOT district meetings including weed identification training and weed management discussions at the following locations: Bemidji (4/24), Detroit Lakes (4/25), Arden Hills (5/10), Mankato (5/13), Rochester (5/15) and Duluth (5/30).

Articles and media coverage

Weed of the Month articles ran in multiple media outlets in outstate Minnesota. Articles related to this project include *Managing Invasive Plants in a Forest* (December 2018), *Grecian Foxglove – Not for the Faint of Heart* (February 2019), and *Japanese Hops* (April 2019).

Project Status as of November 30, 2019

- Basch, C. trained a Winona County bittersweet volunteer group on June 11, 2019. (12 participants)
- Basch, C. provided updates at a Dakota County CWMA (Cooperative Weed Management Area) Steering Committee meeting on July 16, 2019. (20 participants)
- Hardel, M. and Chandler, M. participated in and presented on meadow and brown knapweeds at a Pine County workshop with a field tour on August 8, 2019. (20 participants)
- Hardel, M. presented identification information and control recommendations to the Itasca County Local Weed Inspectors on August 1, 2019. (30 participants)
- Chandler, M. provided updates at a Ramsey CWMA meeting on August 21, 2019. (10 participants)
- Hardel, M. and Chandler, M. assisted in planning and presented on target species at the MISAC field tour for land managers, natural resource professionals, and master naturalists on September 5, 2019. (33 participants)
- Hardel, M. gave project updates at the District 2 County Ag Inspector meeting on September 12, 2019 in Ogilvie.
- Chandler, M. provided project updates at MDA's Noxious Weed Advisory Committee on September 17, 2019 and November 21, 2019 in Arden Hills. (20 and 21 participants respectively)
- Basch, C. presented oriental bittersweet to the Dellwood Garden Club on September 18, 2019 in Dellwood. (18 participants)

- Hardel, M. attended the Duluth CISMA partner meetings on September 24, and October 12, 2019 in Duluth.
- Chandler, M. gave a project update at the Anoka CWMA meeting on September 24, 2019 in Andover. (24 participants)
- Chandler, M. was a panelist at the Drones vs. Invasive Species symposium hosted by the Minnesota Invasive Terrestrial Plants and Pests Center on September 25, 2019 in St. Paul. She discussed our use of aerial survey for bittersweet detection.
- Basch, C. provided updates at a District 3 County Ag Inspector meeting on September 25, 2019.
- Hardel, M. participated in the Minnesota Department of Transportation district 1 vegetation team meeting in Virginia on October 10, 2019.
- Chandler, M. presented oriental bittersweet at a workshop organized by Washington Conservation District on October 10, 2019 in Oakdale. (9 participants)
- Basch, C. and M. Chandler provided updates and strategized with Winona County CWMA partners on October 23, 2019 in Winona. (15 participants)
- Hardel, M. participated in a District 1 County Ag Inspector meeting on October 24, 2019 in Mahnomen.
- Hardel, M. gave a presentation on target species identification, reporting and management to environmentally focused local units of government at the 2019 BWSR Academy at Breezy Point Resort on October 29, 2019. (55 participants).
- Basch, C. provided updates at a District 4 County Ag Inspector meeting on November 6, 2019. (19 participants)
- Basch, C. guest lectured about invasive plants at St. Cloud State University on 11/26/19. (3 participants)
- Basch, C. presented about teasels species and potential hybrids at MDA's Noxious Weed Advisory Committee on 11/21/19. (21 participants)

Articles and media coverage

Weed of the Month articles ran in multiple media outlets in outstate Minnesota. Articles related to this project include *Cutleaf Teasel* (July 2019), *Black Swallow-wort* (August 2019), *Dalmatian Toadflax* (September 2019), *Invasive Plants Escape from Cemeteries* (October 2019) and *Weeds that Impact Hunters* (November 2019).

- Invasive vine infesting southeastern Minnesota https://www.kimt.com/content/news/Invasive-vine-infesting-southeastern-Minnesota-528153221.html (08/08/19)
- Invasive vine found in Southeast Minnesota, public asked for help to control the weed https://www.news8000.com/news/invasive-vine-found-in-southeast-minnesota-public-asked-to-help-control-the-weed/1107212160 (08/08/19)
- Invasive vine found in Southeast Minnesota, public asked for help to control the weed https://www.austindailyherald.com/2019/08/invasive-vine-is-spreading-through-southeast-minnesota-mda-officials-ask-for-the-publics-help-in-controlling-the-weed/
- Noxious plant taking root in Oakdale, Washington County https://www.lillienews.com/articles/2019/09/27/noxious-plant-taking-root-oakdale-washington-county (09/27/19)

Final Report Summary:

MDA organized and led 6 field tours, gave 43 presentations, provided project updates at 32 meetings, authored 14 articles, sent an annual report to stakeholders and trained Conservation Corps Minnesota crew members at multiple workshops each year. Tour participants included public land managers, tribal resource managers, researchers, Extension volunteers and County Agricultural Inspectors. The formality of presentations ranged from moderated presentations at the Upper Midwest Invasive Species Conference to garden clubs. Updates at meetings were provided to Cooperative Weed Management Areas, County Agricultural Inspectors, and MDA's

Noxious Weed Advisory Committee. Dissemination about target species was consistent throughout the project with the exception of poison hemlock. There was a media flurry resulting in hundreds of potential infestations that needed follow up.

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 292,000	Research Scientist 1 and Plant Health Specialist
Professional/Technical/Service Contracts:	$ 197,500	Contracts with Conservation Corps Minnesota for $175,000 and the St. Croix River Association for $22,500
Equipment/Tools/Supplies:	$ 1,500	Flagging, tags and herbarium supplies
Travel Expenses in MN:	$ 20,000	Mileage $11,200, lodging $4,500 and meals $4,300
TOTAL ENRTF BUDGET:	**$ 511,000**	

Explanation of Use of Classified Staff: NA

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:
One 1.2 year full time Research Scientist 1 = 1.25 FTE
Two 2.0 year part time Plant Health Specialist = 3.0 FTE
Total FTEs = 4.25

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:
MDA will contract with CCM for target invasive plant control. Crews will work an estimated 8,775 hours.
FTEs = 8,775/2080 = 4.2 FTE
MDA will contract with St. Croix River Association for survey for an estimated 750 hours
FTE = 750 hrs/2080 = 0.36 FTE
Total FTEs = 4.56

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
St. Croix River Association will have 1:1 match funds ($22,500) from WI DNR to survey on the WI side of the St. Croix.	$ 22,500	$ 22,500	
State			
In-kind Services During Project Period: MDA: Field equipment, computing/software, GIS and data management, and project management for 3 years ($30,000) and CCM: Approximately $2.50/hr difference between actual cost per member ($23.50/hr) and billing rate ($21.00/hr) = $20,830.	$ 50,830	$ 59,830	
MDA general funds for salary ($7,138) and in-state travel ($73) and travel to out-state meeting ($735). These funds			

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
were also used for IT expenses for geodatabase development ($7,000) and contract for ISMTrack API ($5,000)			
Palmer amaranth emergency funds contract with CCM		$ 13,425	
MDA pass through grant funds for local governments		$ 152,913	
TOTAL OTHER FUNDS:	**$ 73,330**	**$ 248,668**	

VII. PROJECT STRATEGY:

A. Project Partners:

Receiving funds: Angela Gupta (U of M) will lead the educational components. Curtis Olson (U of M) will lead the survey drone test. Monika Chandler (MDA) will lead survey, coordination of target species control with CCM and follow up monitoring. Dorian Hasselmann (CCM) will lead target species control activities. All organizations will provide in-kind equipment, facilities, and GIS/technical support.

Not receiving funds: We will draw from Extension's existing statewide base of volunteers which totals over 102,000 active, trained volunteers. We will collaborate with DNR and MnDOT, other federal and state agencies, counties, municipalities, and private landowners.

B. Project Impact and Long-term Strategy:

Preventing highly destructive invasive plant species from spreading throughout the state has an enormous impact. All of the selected species would become widespread without intervention. They would overtake habitats and be prohibitively costly to control on a large scale. Controlling these target species across property lines protects the investment by agencies such as MnDOT on their lands. Eradication is defined as target species absence for six years after the last seed was produced. Therefore, eradication must be achieved in a long-term effort and ongoing monitoring is critical. ENRTF funds will be leveraged for (1) Extension funding for online training development cost not included in this proposal and (2) federal funding for volunteer training.

Project partners are working closely with other agencies and land management organizations to optimize and integrate the use of the invasive species management software into invasive species work across the state in a variety of landscape. A comprehensive management inventory should help optimize management impacts while reducing costs.

Continued engagement and empowerment of trained volunteers to identify, detect, survey, monitor and manage invasive species as both immediate and long-term impacts. These volunteers are actively training others and management invasive species while also influencing local policies and action. Sustain engagement and additional outreach should continue to grow citizen understanding and action.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
LCCMR Elimination of Target Invasive Plant Species (Phase 1) project $350,000 from ENRTF of which $135,000 was for MDA, $65,000 was for U of M and $150,000 was for CCM. In-kind was $85,000 of which $20,000 was from MDA and $30, 000 from CCM.	07/01/2013-06/30/2015 LCCMR In-kind Total	 $ 350,000 $ 50,000 $ 335,000
DNR received $60,000 for early detection and rapid response invasive plant management. These funds were used for CCM crews to survey for and control some of our joint target plant species such as Japanese hops, cutleaf teasel and Oriental bittersweet.	2014 - 2015	$ 60,000
Winona Soil Water Conservation District received $15,000 from the Board of Water and Soil Resources to work on target invasive plant control and site restoration in Winona County	2014 - 2016	$ 15,000

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: NA

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan Final Report

IX. VISUAL COMPONENT or MAP(S):

Conservation Corps controlling Oriental bittersweet in Red Wing

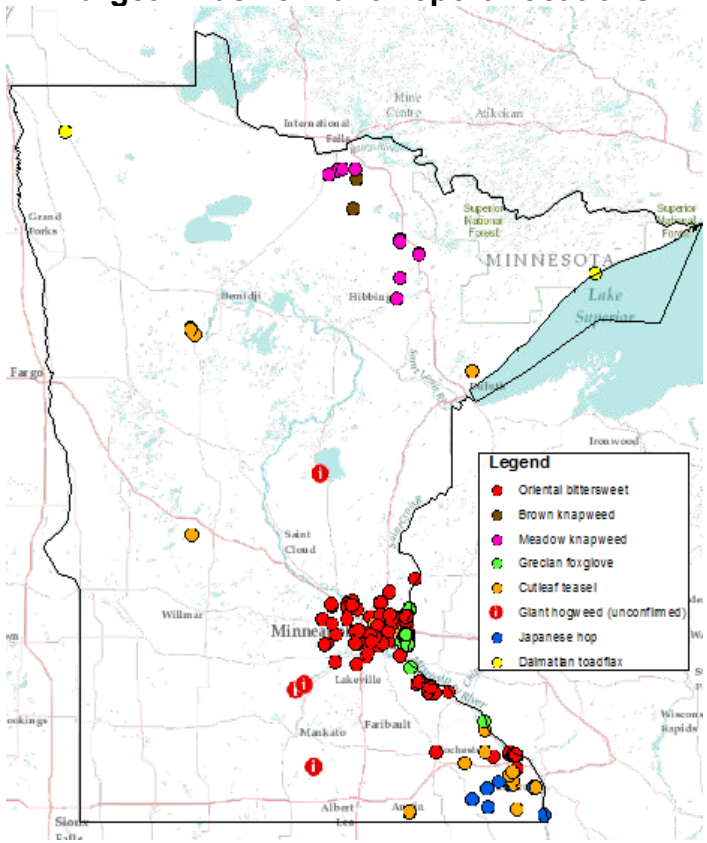
Oriental bittersweet vines overwhelming and killing trees in Red Wing

Unmanned Aerial Vehicle Lab students will test a drone for survey

Training people to identify and report target species.

To prevent environmental and economic damage, we will detect, contain and control target species before they become widespread.

Target Invasive Plant Report Locations



Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan Final Report

X. RESEARCH ADDENDUM: NA

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than November 30, 2016, May 31, 2017, November 30, 2017, May 31, 2018, November 30, 2018, May 31, 2019 and November 30, 2019. A final report and associated products will be submitted between June 30 and August 15, 2020.

Environment and Natural Resources Trust Fund
M.L. 2016 Project Budget

Project Title: Elimination of Target Invasive Plant Species – Phase II
Legal Citation: M.L. 2016, Chp. 186, Sec.2, Subd. 06e1
Project Manager: Monika Chandler
Organization: Minnesota Department of Agriculture
M.L. 2016 ENRTF Appropriation: $ 511,200
Project Length and Completion Date: 4 Years, June 30, 2020
Date of Final Report: October 1, 2020

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Revised Budget	Amount Spent	Activity 2 Balance	Revised Budget 12/17/18	Amount Spent	Activity 3 Balance	Activity 4 Budget	Amount Spent	Activity 4 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	***Train People to Identify and Report Target Invasive Species***						***Control Target Species***			***Implement Invasive Species Management Database System***				
Personnel (Wages and Benefits)				$223,898	$219,769	$4,129							$223,898	$4,129
Research Scientist 1: $85,000 (62% salary, 38% fringe); 100% FTE for approximately 1.2 years														
Two Plant Health Specialists: $207,000 (67% salary, 33% fringe); approximately 75% FTE for 1.5 years														
Professional/Technical/Service Contracts														
Conservation Corps Minnesota for survey for and initial control of target species ($21/hr per crew member includes equipment, training and travel costs) and for $5,800 for data plans for tablets so that CCM can utilize ISMTrack.				$16,800	$16,800	$0	$203,200	$203,177	$23				$220,000	$23
Contract with St. Croix River Association for survey along the St. Croix River main stream and Brown's Creek (personnel $19,000, equipment & supplies $2,500 and mileage $1,000)				$22,500	$22,500	$0							$22,500	$0
Equipment/Tools/Supplies														
Supplies: Includes tags, flags, herbarium supplies, etc. for Activity 2				$1,754	$1,754	$0							$1,754	$0
Travel expenses in Minnesota														
Travel for Activity 2 project coordination for Research Scientist 1 and project manager. Milage $11,200, lodging $4,500; meals $4,300				$42,848	$42,466	$382							$42,848	$382
COLUMN TOTAL	**$0**		**$0**	**$307,800**	**$303,289**	**$4,511**	**$203,200**	**$203,177**	**$23**	**$0**		**$0**	**$511,000**	**$4,534**

2016 Project Abstract
For the Period Ending June 30, 2020

PROJECT TITLE: Elimination of Target Invasive Plant Species – Phase II

PROJECT MANAGER: Monika Chandler, MDA, and Angela Gupta, UMN Extension
AFFILIATION: Minnesota Department of Agriculture and University of Minnesota Extension
MAILING ADDRESS: 625 Robert Street North and 863 30th Ave. SW
CITY/STATE/ZIP: St. Paul, MN 55155 and Rochester, MN 55904
PHONE: 612-327-3857 (mobile) and 507-280-2869
E-MAIL: monika.chandler@state.mn.us and agupta@umn.edu
WEBSITE: https://www.mda.state.mn.us/plants-insects/noxious-invasive-weed-program
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2016, Chp. 186, Sec. 2, Subd. 06e

APPROPRIATION AMOUNT: $511,000 to MDA and $239,000 to UMN
AMOUNT SPENT: $ 511,000 (depended on rebudget) and $237,061
AMOUNT REMAINING: $ 0 and $1,939

Sound bite of Project Outcomes and Results
We educated about, found, documented and managed highly damaging invasive plant populations before they spread statewide. We also initiated a response to Palmer amaranth in conservation plantings that was continued by the project Palmer Amaranth Detection and Control. Mitigating these invasive plant threats protected Minnesota forests, grasslands and riparian areas.

Overall Project Outcome and Results
The goal was to eliminate highly damaging target invasive plants before they became widespread by 1) training people to identify and report invasive plants, 2) survey, coordinate control and monitor target plants, 3) control target plants and 4) implement the invasive species management database system from Phase 1. Targeted plants that cause severe ecological harm include black swallow-wort, dalmatian toadflax, cutleaf and common teasels, Grecian foxglove, Japanese hops, brown and meadow knapweeds, Oriental bittersweet and Palmer amaranth.

University of Minnesota Extension led the education and outreach efforts outlined in the dissemination section. The drone team transitioned from research to survey work by testing several different types of drones, cameras, weather conditions and self-produced and commercial post-processing software. We determined that surveying for Oriental bittersweet is best done with sturdy quadcopter drones and a high quality camera on mild winter days after leaf drop but with snow on the ground so the red fruit is most visible. High quality, stitched-together and geo-coded maps can now be produced in post processing and inform accurate eradication efforts.

The Minnesota Department of Agriculture (MDA) and Conservation Corps Minnesota (CCM) led invasive plant management. MDA led survey, invasive plant report follow up, monitoring and coordinated control with landowners and partners. CCM led the control effort with 157 unique crew members working on this project.

Plant Name	New Infestation Reports*	New Infestation Acres Reported	Acres Treated**
Black swallow-wort	5	5	9
Dalmatian toadflax	no new reports	0	828
Common teasel	6	1	302
Cutleaf teasel	99	65	1,832
Grecian foxglove	119	47	1,368
Japanese hops	202	85	8,171
Brown/meadow knapweeds	343	351	97
Oriental bittersweet	203	2,937	1,462
Total	**977**	**3,490**	**14,070**

*New infestation reports were recorded during the project period. We continued control work on infestations identified during our Phase 1 project (2013-2016).

**Acres were spot treated because the invasive plants were scattered within some large areas. Many infestations were treated in multiple years and the acreage of each treatment was recorded and included in the total.

This project enabled us to find, document and manage infestations before they spread. We also initiated a response to Palmer amaranth in conservation plantings that was continued by the project Palmer Amaranth Detection and Control. Mitigating these invasive plant threats protected Minnesota forests, grasslands and riparian areas.

Project Results Use and Dissemination

University of Minnesota Extension led the education and outreach funded specifically by this project. Reaching 1,108 people via 11 workshops, field tours and public and professional presentations. Developed two national award winning videos: Planning invasive species events: Tips for working with volunteers and Planning invasive species events: Working with a natural resources professional. Created 14 innovative educational materials including: 3D-printed models of Palmer amaranth, Japanese hops and Grecian foxglove; pull-up banners for Palmer amaranth and giant hogweed; and identification kits available at the public library for Palmer amaranth, wild parsnip and Oriental bittersweet. Produced two new educational handouts and printed and distributed about 10,875 educational materials.

In addition, the University of Minnesota and Minnesota Department of Agriculture (MDA) team members won numerous national, regional and state awards for effort including this project, from across an impressively wide spectrum of content areas. There were 13 media pieces about project activities; 13 presentations or booths reaching 5,137 gardeners, tribal youth, Extension volunteers and others; and 30 presentations or posters at 14 different professional conferences representing a broad spectrum of expertise reaching almost 1,000 natural resource or invasive species professionals. Two professional, peer reviewed articles were published that reference this work. MDA organized and led 6 field tours, gave 43 presentations, provided project updates at 32 meetings, authored 14 articles, sent an annual report to stakeholders and trained Conservation Corps Minnesota crew members at multiple workshops each year.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2019 ENRTF Final Report (Main Document)

Date of Report: August 15, 2020

Date of Next Status Update Report: **Final Report**

Date of Work Plan Approval: June 7, 2016

Project Completion Date: June 30, 2020

PROJECT TITLE: Elimination of Target Invasive Plant Species – Phase II

Project Manager: Angela Gupta

Organization: University of Minnesota Extension

Mailing Address: 863 30th Ave. SE

City/State/Zip Code: Rochester, MN 55904

Telephone Number: (507) 280-2869

Email Address: agupta@umn.edu

Web Address: https://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/targetplants

Location: Statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$239,000**
	Amount Spent:	**$237,061**
	Balance:	**$1,939**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 06e2

Appropriation Language:
$750,000 the second year is from the trust fund. Of this amount, $511,000 is to the commissioner of agriculture and $239,000 is to the Board of Regents of the University of Minnesota to train volunteers and professionals to find, control, and monitor targeted newly emergent invasive plant species. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Elimination of Target Invasive Plant Species - Phase 2

II. PROJECT STATEMENT: Eliminating highly damaging target invasive plant species before they become widespread prevents ecological and economic damage. Currently, these species have limited distributions in Minnesota. It is feasible to control them before they proliferate by continuing the strategic effort initiated in Phase 1. To date, we trained 521 people to identify target invasives, surveyed over 10,000 acres, initiated control on 450 acres and are developing an invasive species management database system with broad applicability for terrestrial and aquatic invasives. We will continue these activities in Phase 2. In addition, we will expand our training capacity by developing online training, test whether a drone will increase survey efficiency and add to the target species list.

Target Invasive Plant List: Species include but are not limited to the following. They are listed in order of feasibility to eradicate based upon their abundance and distribution. All target species are prohibited noxious and invasive weeds on the eradicate list (Minnesota Statutes, Section 18.78) providing a legal backing.

1. **Black swallow-wort** is a milkweed vine that overgrows other vegetation. Small infestations have been reported in Hennepin and Ramsey Counties and are being controlled. (New in Phase 2)
2. **Dalmatian toadflax** forms dense stands in grasslands and reduces biodiversity, wildlife habitat, and livestock production. Infestations in the Halma and Lutsen areas are reduced but not eliminated yet.
3. **Cutleaf and common teasels** overtakes grasslands and riparian areas reducing species diversity and wildlife habitat. There are scattered infestations in southeastern Minnesota. (Common teasel is new in Phase 2)
4. **Grecian foxglove** is highly toxic to humans, wildlife, and livestock. It also displaces native plants. As of spring 2015, most infestations are in Washington County.
5. **Japanese hops** are annual vines that grow so rapidly that they smother other plants. There is an extensive infestation along the Root River and a small infestation on the Mississippi.
6. **Brown and meadow knapweeds** are spreading across meadows in northern Minnesota. (New in Phase 2)
7. **Oriental bittersweet** is a woody vine that is destroying swaths of forest in Red Wing and Winona by girdling and breaking the trees then covering and shading the remains so that little else grows.
8. **Palmer amaranth** is an annual plant native to the arid southwestern United States and northwestern Mexico. It has spread to the southeastern and Midwestern US and become problematic. It grows very quickly to heights reaching 10 feet. It also produces massive amount of seed. These qualities give it a competitive advantage against row crops and native vegetation plantings. During the battle against Palmer amaranth, this plant developed resistance to multiple classes of herbicides. Palmer amaranth now causes extensive losses where it is abundant including in corn and soybeans. (Added in an approved amendment in Phase 2)

Our long-term goal is to eradicate these problematic species from Minnesota to protect forest and grassland habitats. All of the invasive plants listed harm natural areas and degrade wildlife habitat.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of November 30, 2016:
We hired Dawn Littleton, the new Extension Invasive Plant Program Coordinator, purchased two tablets and data, started training on ISMTrack, tried one unmanned aerial vehicle launch and completed several presentations at professional conferences about this project.

Amendment Request November 30, 2016:
We request the addition of Palmer amaranth, *Amaranthus palmeri S. Watson*, to the Target Invasive Plant List above. This will allow us to explicitly include Palmer amaranth in the workshops and training opportunities already included in this project. We are not asking for a budget amendment.

Project Status as of May 31, 2017:
During this project period we completed 3 weed identification trainings reaching 183 natural resource professionals; engaged 100s of volunteers, citizens and other natural resource professionals at 8 programs with our 3D printed weed models, and updated and printed various educational materials. On March 23, 2017 we launched 4 unmanned aerial vehicle (UAV or drones) flights at Memorial Park in Red Wing, MN and learned a great deal about camera quality, type and size of UAV and which aspects of equipment and data processing to improve as we continue to survey for Oriental bittersweet. Extension trained 220 pesticide applicators on ISMTrack invasive species management tracking software, established a naming convention for ISMTrack private properties to be respectful of homeowner privacy, and purchased 18 more tablets for use by Extension and Conservation Corps Minnesota (CCM) while using ISMTrack. This work was disseminated in 8 media articles, 2 academic/professional presentations, and in 8 presentations to natural resource professionals, volunteers or citizens reaching 514 individuals.

Amendment Request 7/5/17
We are adding one month of AmeriCorps volunteer time to work on video production ($1,650); this money was allocated for the Project Coordinator but she didn't start until November so we're hoping to back-fill some of her work and salary to complete this activity.
Approved 7/6/17

Project Status as of November 30, 2017:
Our long-term, dedicated, innovative and collaborative network is even more effective and efficient in controlling prohibited species through our continued work. Our network of natural resource professionals, volunteers, landowners and others are increasingly engaged and informed as we create new partners (e.g. American Public Works Association of MN). Since our report last May, we have spoken to over 450 community members interested in learning about invasive species and trained over 200 pesticide applicators seeking their license. Our web presence is growing as we have developed or improved three online materials for poison hemlock and Oriental bittersweet viewed thousands of times in a few short months and reviewed very positively by UMN Natural Resources faculty. We have presented at four national and international conferences. Our new audiences include the Regional Parks and Trails Commission and Prairie Island Indian Community. We have realized this work has enabled our extensive network in Minnesota to become a national leader and budding world leaders via our holistic and synergistic methods. There is still much to be done but thank you for the funding that enables Minnesota the opportunity to be a world leader in collaborative invasive species early detection and management!

Project Status as of May 31, 2018:
ETIPS 2 MDA, UMN, CCM staff visit UMN Aerospace Lab after a team's meeting in May:

I start this Project Status report with a team photo, because without this great team this project would not be getting done! Please note this pictures includes University, MDA and CCM staff. A strong collaboration even in trying times!

Since our last report in November Extension and the UMN, with the help of the above project team, has: completed 2 Weed 'Em Out workshops (96 participants); participated in 7 additional presentations to 435 community members; printed 500 more educational resources; developed 2 new 3D invasive plant models plus 2 new large educational invasive plant identification banners; tested and started developing new UAS software for drone image assessment; and had 1 media article.

Amendment Request 5/31/18:
Do to serious unplanned health issues Extension's Invasive Plants Coordinator has only been able to work about half of her full time position since last September. Unfortunately this situation is likely to continue for the foreseeable future. The good news is the whole Elimination of Target Invasive Plant Species – Phase II team, including Extension, the MDA and CCM, are on target to finish all grant deliverables on time and within budget; however that accomplishment is do to incredible team commitment, extra (unpaid) hours by team leaders and this, and possible future, amendment requests.

This Amendment Request is to:

1. Move $45,000 from the Extension's Invasive Plants Program Coordinator salary to a new contract for service budget item, in Extension's budget, to enable CCM to continue their eradication and survey work (Activity 3 on the MDA budget). Additionally, Extension will take on some CCM management tasks

related to the $45,000 CCM contract, and the MDA will take some of the Activity 4 ISMTrack training duties, previously done by Extension. We are not requesting a budget change in the total amount; only a change in work team responsibilities and budget allocation as we accommodate the health issues of Extension's Program Coordinator.

2. A smaller budget Amendment Request is to move $2,211 from Activity 4 to Activity 1 "materials for training" to support additional printing of the Minnesota Noxious Weeds book, a key educational material for Weed 'Em Out workshops. Activity 4 deliverables are well-in-hand and unlikely to require the $2,211 money we'd like to move.

It's possible Extension will need, at the end of the project period, a no-cost extension. During which we'll keep the Program Coordinator on, at reduced hours allowable by her doctor and the budget, to continue the project until her salary is exhausted.
Approve 6/14/2018

Project Status as of November 30, 2018:
Since our last report UMN Extension has produced a Palmer amaranth identification kit that can be checked-out from any public library in the state, completed two online videos about how to lead, organize and host invasive species removal events, and taught a 2 day Invasive Species Instructor Training in Mankato. Our unmanned aerial vehicle (UAV) work has benefited from similar work related to Palmer amaranth and applied that new information to test and improve the capabilities of our survey system and is learning how to efficiently use a new UAV (drone). This reporting period had many dissemination opportunities including a new invasive species field guide produced by the UMN Extension; successful applications of new 360/virtual reality glasses videos for Oriental bittersweet education; a large and well visited augmented reality display in the 4-H building at the MN State Fair; 6 professional presentations at the Upper Midwest Invasive Species Conference (UMISC) that touched on this work; the launch of a new program, EmpowerU, to help citizens engage decision makers in invasive species management; and last, but certainly well deserved, several members of this project team won the Team Achievement Award from the Minnesota Invasive Species Advisory Council at UMISC for their great work in early detection and rapid response in SE Minnesota.

Project Status as of December 21, 2018:
Amendment Request (12/21/18): Amendment Approved by LCCMR 1/15/19.
Activity 1 bus rental in Mankato was more expensive than anticipated. We were able to partner closely with the MN Master Naturalist program to reduce materials spending by tapping into donated materials from Play Clean Go and the Master Naturalist Foundation. This budget amendment moved $700 from Activity 1 Materials to cover the unexpectedly high Activity 1 Bus rental.

Project Status as of May 31, 2019:
I'm delighted to report our educational video series was a national Gold Award from the Association of Natural Resource Extension Educators. While we're on target to reach grant deliverables the extensive and severe medical issues of key staff has necessitated a request for a no-cost one year extension and another budget related amendment request. Extension and project partners completed 2 additional Weed 'em Out workshops (104 participants), one intended field training (moved indoors because of flooding) to 6 master volunteers, and the 4 remaining library kits are almost complete.

Amendment Request as of May 31, 2019: Amendment Request signed into law 5/31/19
We request to amend completion dates from 06/30/2019 to 06/30/2020. Final payment for the high quality videos was $3,000 more than expected. I request permission to use money currently allocated to Program Coordinator staff salary (unused because of medical issues) to cover that expense. In addition, I request

permission to transfer the anticipated unused Program Coordinator staff salary of $13,786, after the position ends on June 30, 2019 to increase the CCM Contract by that amount: $13,786.

Project Status as of November 30, 2019:
I'm delighted to note that the dissemination of this report includes six awards for materials, ideas or people for work associated with this project! In addition our UAS (unmanned aerial system) has transitioned from research to Oriental bittersweet survey work that precedes eradication efforts. In addition the final 4 noxious weed library identification kits are in the library system via the Rochester public library.

Amendment Request as of November 30, 2019: Amendment Approved by LCCMR 01/22/20
As we continue to finish this project and because of the major health issues of the project coordinator hired to do much of Extension's work, I'm requesting one final rebudget. Dawn Littleton completed her tenure with Extension on June 30 and the dust has settled on the remainder of her intended salary and the final estimated costs to compete all the grant deliverables.

Activity 1:
I am requesting a rebudget to actually reflect Dawn's actually paid salary, slightly less than expected display materials expenses, and increased expenses for workshop materials to cover a new printing of the MN Noxious Weed book that will reflect new changes in the MN Noxious Weed Law for 2020 and a tiny adjustment to travel.

Activity 2:
I'm requesting a slight increase in Curt Olson's salary so he can continue to work on Oriental bittersweet drone surveys during this unexpected 4th year of the project this money is left from Dawn's unused salary because of her unexpected medical issue.

Activity 3:
With the final salary payment to Dawn and the team decision to have Curt work more on this project during the winter 2019-2020, we're requesting a slight decrease, $3,708, in the new CCM crew time for a new contract of $10,078. This will complete the original salary that was intended, at the grant initiation for Dawn, Extension's program coordinator, but couldn't be spent because of her medical issues.

Activity 4:
We're requesting a $499 overall reduction to reflect the final expenses for Extension's work on this activity because MDA partners took over this task in a reallocation of Dawn's work in the November 2018 Work Plan Report.

Amendment Request April 3, 2020
In response to COVID 19 social distancing guidelines and Governor Walz' Stay at Home order, we request to reassign 6 CCM field specialists from invasive plant control to aerial image analysis. This work can be done safely from home and will further project progress. This would increase the scope of work that CCM does.

Tens of thousands of aerial images of Oriental bittersweet infestations were collected with drone flights. An automated process for image analysis to find Oriental bittersweet has not been invented yet. By having the field specialists review and mark Oriental bittersweet on images, we gain their analysis. We also gain data about analysis patterns that may inform machine learning/artificial intelligence development for future image analysis.

There is no budget amendment request; the budget will remain the same.

Overall Project Outcomes and Results:
For consistence this abstract is the same as the MDA's because this was a joint project.

Amendment request: For the Period Ending June 30, 2020, we request a small budget revision, moving $358 from Activity 2: Personnel to increase Activity 1: Professional/Technical/Service Contracts by $60 and Activity 1: Equipment/Tools/Supplies by $298.

Amendment Approved by LCCMR 10/27/2020

2016 Project Abstract

Sound bite of Project Outcomes and Results

We educated about, found, documented and managed highly damaging invasive plant populations before they spread statewide. We also initiated a response to Palmer amaranth in conservation plantings that was continued by the project Palmer Amaranth Detection and Control. Mitigating these invasive plant threats protected Minnesota forests, grasslands and riparian areas.

Overall Project Outcome and Results

The goal was to eliminate highly damaging target invasive plants before they became widespread by 1) training people to identify and report invasive plants, 2) survey, coordinate control and monitor target plants, 3) control target plants and 4) implement the invasive species management database system from Phase 1. Targeted plants that cause severe ecological harm include black swallow-wort, dalmatian toadflax, cutleaf and common teasels, Grecian foxglove, Japanese hops, brown and meadow knapweeds, Oriental bittersweet and Palmer amaranth.

University of Minnesota Extension led the education and outreach efforts outlined in the dissemination section. The drone team transitioned from research to survey work by testing several different types of drones, cameras, weather conditions and self-produced and commercial post-processing software. We determined that surveying for Oriental bittersweet is best done with sturdy quadcopter drones and a high quality camera on mild winter days after leaf drop but with snow on the ground so the red fruit is most visible. High quality, stitched-together and geo-coded maps can now be produced in post processing and inform accurate eradication efforts.

The Minnesota Department of Agriculture (MDA) and Conservation Corps Minnesota (CCM) led invasive plant management. MDA led survey, invasive plant report follow up, monitoring and coordinated control with landowners and partners. Conservation Corps Minnesota led the control effort with 157 unique crew members working on this project.

Plant Name	New Infestation Reports*	New Infestation Acres Reported	Acres Treated**
Black swallow-wort	5	5	9
Dalmatian toadflax	no new reports	0	828
Common teasel	6	1	302
Cutleaf teasel	99	65	1,832
Grecian foxglove	119	47	1,368
Japanese hops	202	85	8,171
Brown/meadow knapweeds	343	351	97
Oriental bittersweet	203	2,937	1,462
Total	**977**	**3,490**	**14,070**
*New infestation reports were recorded during the project period. We continued control work on infestations identified during our Phase 1 project (2013-2016).			
**Acres were spot treated because the invasive plants were scattered within some large areas. Many infestations were treated in multiple years and the acreage of each treatment was recorded and included in the total.			

This project enabled us to find, document and manage infestations before they spread. We also initiated a response to Palmer amaranth in conservation plantings that was continued by the project Palmer Amaranth Detection and Control. Mitigating these invasive plant threats protected Minnesota forests, grasslands and riparian areas.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Train People to Identify and Report Target Invasive Species
Description: University of Minnesota (U of M) will train professionals, volunteers and impacted landowners to prevent, identify, report, monitor and manage target species. The U of M Extension will deliver educational trainings to:

A. Natural resource professionals to identify terrestrial invasive species of special concern and native plant species that could be confused with these invasives (2 workshops per year),
B. Natural resource professionals and volunteers will conduct target invasive species surveys (2 surveys/workshops),
C. Minnesota Master Naturalist Instructor Training - a weekend-long training and field tour dedicated specifically to terrestrial invasive species of special concern, their prevention, identification, reporting, monitoring and management to incorporate this information into Master Naturalist volunteer trainings across the state. (1 event),
D. Develop supportive, online training and outreach materials for Invasive Blitz volunteers (Master Naturalist and other master volunteers that lead invasive species removal activities in their community). This will include a video with volunteer management considerations like training volunteers, risk assessments and recruiting and maintaining active volunteers.

We will create 5 high quality traveling learning material kits about target invasive species that can be checked-out by natural resource professionals and volunteers.

This work will be done across the state. An effort will be made to find free workshop locations. It may be necessary to charge workshop participants a registration fee to cover room rental (if free room is not available) and food costs for all day and weekend workshops. Registration fees would go to Extension. In the event that workshop registration received exceeds workshop costs, Extension will use these funds for outreach for Environmental and Natural Resources Trust Fund projects. Training partners include the University of Minnesota, Extension, Minnesota Departments of Agriculture, Natural Resources and Transportations, and various local partners.

Summary Budget Information for Activity 1:

ENRTF Budget:	**$150,268**
Amount Spent:	**$150,186**
ENRTF Balance:	**$82**

Outcome	Completion Date
1. 9 Statewide training sessions/workshops/field trainings conducted and evaluated	06/10/2020
2. Develop online training and outreach materials that are publicly available	06/10/2019
3. Create high quality display materials and 5 invasive plant learning kits for check out by educators (schools, nature centers, master gardeners, etc.) and agency staff for outreach	06/10/2020

Activity Status as of November 30, 2016:

- Hired Dawn Littleton, Extension Invasive Plants Program Coordinator. She started on November 1. Dawn has been a dedicated invasive species volunteer for years through the Master Naturalist program and a co-founder of the Friends of Indian Heights Park in Rochester. She's also worked with Dakota and other Native American peoples through her extensive volunteering at Indian Heights. She's following her passion and shifting careers to invasive plants from her former position as Head of Public Services at the Mayo Clinic Libraries where she's been a librarian and supervisor. She has a PhD in Work, Community, and Family Education from the UMN.
- Have started exploring options to get invasive plant display/educational materials into the UMN Library system including 3D models for their collections and circulation.

Activity Status as of May 31, 2017:

- Conducted 3 Weed 'Em Out workshops in Virginia (3/29/17), Morris (4/18/17) and Baxter (5/3/17) to 183 natural resource professionals and road maintenance professionals.
- Printed: 400 copies of the 2017 Minnesota Noxious Weeds booklet from MnDOT.
- Printed: 2,000 MDA Arrest the Pest stickers after updating with GLEDN app contact information.

- Printed: 7,000 MDA Oriental Bittersweet brochures after updating with new web address.
- 3D print materials development: project partners are working to develop new mixed media educational displays. Current 3D weed models were used at 8 different events statewide to engage managers, volunteers and citizens in MN Noxious Weed education. This is in addition to the workshops above.

Activity Status as of November 30, 2017:

- Because of audience demand, printed 500 additional copies of the 2017 Minnesota Noxious Weeds booklet from MnDOT with Minnesota Department of Agriculture funds ($4,175).
- Olmsted County Fair Conservation Building booth entitled **"ID or Report Minnesota's BAD Plants"** viewed by ~200 fair visitors.
- **Weed 'Em Out workshop**, trained about 80 CCM and Nature Conservancy staff (Red Wing, 6-12-17)
- UMN Extension Education booth at the Stewards of Hope/People of Hope trail opening celebration viewed by ~75 attendees and Master Naturalists (Rochester, 8-2-17)
- UMN Extension **Terrestrial Invasive Species Education** booth for "Starry Trek" AIS Day viewed by ~25 attendees (Winona, 8-5-17)
- Toured Prairie Island Indian Community with Gabe Miller, Prairie Island's Environmental Program Manager, to see success and challenges of managing invasives on a reservation (Prairie Island 8-4-17)
- Presented to the American Public Works Association Minnesota Chapter, **"Minnesota's Noxious Plants and their Look-A-Likes"** ~60 in attendance (Brooklyn Center, 11-16-17)
- Presented to the American Public Works Association Fall Expo **"Minnesota's Noxious Plants and their Look-A-Likes"** ~35 in attendance (St. Cloud, 10-5-17)
- **"Parks and Invasive Plants"** presented at the Greater Minnesota Parks & Trails Association Annual Meeting Association ~45 in attendance (Little Falls, 10-18-17)
- Prepared 35 CCM members using hands-on demos and practice to distinguish Oriental bittersweet from other vines immediately prior to CCM Red Wing and Winona eradication work (August and September)
- Working with the UMN Center for Agriculture, Food and Natural Resources Business Development Coordinator in developing a system to create, sell and market multi-media models for invasive species identification education. Expect to have 3D models of invasive species for sale in January 2018. From those models we're also developing 3D digital images for invasive species education. These educational outreach materials are being developed, expanded and enhanced through connections with Extension's Communication team and the U's Advanced Imaging Service for Objects and Spaces (AISOS) lab as our network members learn the possibilities of new technologies for target invasive species detection and eradication.
- Established dedicated email: InvasiveEd@umn.edu for learners and instructors and furthered collaboration with invasive species specialists for creation of learning materials.

Activity Status as of May 31, 2018:

- Conducted 2 Weed 'Em Out workshops in Duluth (3/27/28) and in Chaska (4/4/18) for 96 natural resource professionals and road maintenance professionals.
- Extension's Program Coordinator presented Houston County Invasive Plants and their look-alikes (2/13/18) in collaboration with Mike Cruse, Extension Educator in SE Minnesota with 30 attendees.
- Printed 500 copies of the new 2018 DOT Minnesota Noxious Weeds book. This printing included poison hemlock and Japanese barberry updates.
- Developed 2 new 3D printed Palmer amaranth models of the rosette and flower.
- Developed 2 new educational, large, pull-up banners of Palmer amaranth and giant hogweed.
- Project partners and Three Rivers Park District staff presented about these and other invasive species at CCM training to ~ 120 members and staff.
- In progress:
    - The two day, August 9-10, 2018, Instructor institute entitled *FORTIFY: Actions, Knowledge, Habitat* has been finalized through Minnesota Master Naturalists Instructor Training at the Floyd Roberts Jr. Pavilion in Mankato, Minnesota where expert speakers and practitioners explain invasion ecology and best practices for reporting and managing Minnesota's invasive species.

- Several inspirational true stories of volunteer successes related to invasive plant management videos and educational invasive species removal videos of volunteer leaders are in production for Outcome 2. Develop online training and outreach materials that are publicly available.
- Palmer amaranth library check-out kits and testing display model materials for the highest quality durability. Rochester Public Library (RPL) staff is eager to host a grant-based Palmer Amaranth educational kit. Per their recommendations, the kit will consist of two parts - a large tough RPL bag to fit the hard case for the samples as well as the paper/canvas products. This bag is typical for the kits they provide regularly and has the needed pocket for shipping and handling paperwork.

Activity Status as of November 30, 2018:

- Palmer amaranth identification kit (library catalog title: *Palmer amaranth (Amaranthus palmeri) kit*) completed and now available through the public library system. This identification kit can be checked-out, via interlibrary loan, from any library in the state. This is one of the "high quality display materials and 5 invasive plant learning kits" mentioned in Activity 1, D.
  - Dawn Littleton, Extension's Terrestrial Invasive Plant Program Coordinator, hired on this project, presented about this Palmer amaranth library kit at the Upper Midwest Invasive Species Conference in Rochester, MN October 15-18 tp ~38 Natural Resource professionals. The peer reviewed presentation was titled Novel Outreach: *Library Distributed Training Kits for Prohibited Plant Identification*.
- Complete two educational videos to support: *Planning invasive species events: Tips for working with volunteers* https://youtu.be/5rB4zjQwbQQ (90 views as of 11-29-18 published on 11-2-18) and *Planning invasive species events: Working with a natural resources professional* https://youtu.be/CJNsD-1KVnc (44 views as of 11-29-18 published on 11-2-18). These are Activity 1, A deliverables to "develop supportive, online training and outreach materials for Invasive Blitz volunteers…that are publicly available."
- Completed Activity 1, C, "Minnesota Master Naturalist Instructor Training - a weekend-long training and field tour dedicated specifically to terrestrial invasive species of special concern, their prevention, identification, reporting, monitoring and management to incorporate this information into Master Naturalist volunteer trainings across the state." August 9-10 Extension Natural Resources hosted the Invasive Species Instructor Institute in Mankato, MN. Twenty dedicated invasive species volunteers and professional participated in a 2-day workshop including 2 field tours and topics including: invasion ecology, identification of selected invasives, teaching strategies, tools for species observation (iNaturalist) and reporting (EDDMaps), and field trips to several locations with invasive plants present and where management actions have removed invasive plants. 95% of participants agreed or strongly agreed that they have a deeper understanding of the subject matter as a result of the session and 90% agreed or strongly agreed have situations in which they can use what they learned in the session.

Activity Status as of May 31, 2019:

- Award Winner! The 2-part video series, *Planning invasive species events: Tips for working with volunteers* https://youtu.be/5rB4zjQwbQQ and *Planning invasive species events: Working with a natural resources professional* https://youtu.be/CJNsD-1KVnc, won the 2019 National Gold Award in the TV, VIDEO category for the National Association of Natural Resources Extension Professionals.
- Completed 2 more Weed 'Em Out workshops in Mankato (4-30-19) and Bemidji (5-2-19) for a total of 104 road side mowers and similar professionals as part of Activity 1. Ordered additional MN DoT Noxious Weed books for workshop participants.
- Hosted an Invasive Plant ID and survey workshop at in Rochester, relocated and moved indoors because

of severe water at Whitewater State Park for anglers and master volunteers as required in Activity 2. Six master volunteers attended.
- Continue work for on time completion of the remaining four library kits (1 more Palmer amaranth, 2 wild parsnips and 1 Oriental bittersweet).
- The latest Palmer seedling model was 3D printed. A stronger resin was used but unfortunately, it has a low melting point which proved problematic. The new seedling design will be printed with the formerly used resin that has a higher melting point.

Activity Status as of November 30, 2019:
- Four additional library kits are now in the public library system: 1 additional Palmer amaranth identification kit; 2 wild parsnip identification kits; and Oriental bittersweet identification kit. These identification kits can be checked-out, via interlibrary loan, from any library in the state. This completes Activity 1, D deliverables.

Final Report Summary:
During the last reporting period we printed 475 2020 Noxious Weed books and began distributing them. We also purchased one kayak for CCM crew members to survey Japanese hops and other targeted species. Renting a kayak at specific places along various rivers is troublesome and not reliable. This kayak will allow crew members to access rivers more efficiently.

We achieved all grant deliverables for a total impact reaching about 1,108 people via 11 activities including workshops, field tours and public and professional presentations. The videos we developed: Planning invasive species events: Tips for working with volunteers and Planning invasive species events: Working with a natural resources professional won a national gold award from the Association of Natural Resource Extension Professionals and have been viewed by about 450 individuals. We printed and distributed about 10,875 noxious weed educational publications. We developed 14 innovative new educational materials including 2 pull-up banners one each for Palmer amaranth and giant hogweed, 5 library identification kits for Oriental bittersweet (1), Palmer amaranth (2) and wild parsnip (2) and developed scientifically accurate 3D printed models for Palmer amaranth (3 models), Japanese hops (2 models) and Grecian foxglove (2 models).

ACTIVITY 2: Survey, Coordinate Control and Monitor
Description:
Part A (MDA)
Minnesota Department of Agriculture (MDA) will verify reports, survey potentially infested areas and delineate infestations. Conservation Corps Minnesota (CCM) will participate in large area surveys. Presence/absence data for all target species will be collected along assigned survey routes. Surveys will be done in collaboration with agency partners when practical.

MDA will contract with the St. Croix River Association (SCRA) for survey along the St. Croix River main stream and Brown's Creek, a designated trout stream. The St. Croix watershed is a high priority conservation area where Oriental bittersweet and Grecian foxglove have been found. SCRA will monitor approximately 130 river miles by boat. Highest risk areas will be surveyed multiple times and seasons to have the best chance of seeing each target species at its most visible stage. For example, Grecian foxglove is most visible in the summer and Oriental bittersweet in the fall. We will engage SCRA staff, National Park Service partners and volunteers in survey and outreach efforts.

All survey data will be entered into EDDMapS (www.eddmaps.org). MDA will contract and coordinate with CCM and landowners for target species control. This will include writing agreements with landowners where CCM

will do control work. Agreements will specify that landowners will monitor the site to prevent reinfestation for at least three years after the control work is completed. The coordinator will train the landowners how to identify and monitor for the species and report any reinfestation issues that arise.

Part B (U of M)
The U of M Unmanned Aerial Vehicle Lab will test its drone fleet with the goal of increasing survey efficiency. Tests will determine best available sensor, concept of operations, and post processing requirements outlined below. We are working with the Federal Aviation Administration on regulatory requirements before we can legally fly outside of our permitted area (currently only covers Umore park in Rosemount, MN.)

Sensor
Every sensor has trade offs in terms of cost, size, weight, resolution, speed, type of data sensed, etc. Often the required sensor drives the choice of aerial platform. We will select the sensors with the best chance of producing useful data for detecting invasive species from the air. The best sensor might not be a camera. If it is a camera we need to determine if our objective is the highest resolution possible, or is it more important to capture a certain band(s) of the visible spectrum.

Concept of Operations
Depending on the aircraft and the sensor choices the time of day and lighting may be an important consideration. We may need to consider sunny versus overcast conditions and the best season(s) for detecting specific invasive species. We need to think through optimal routes and patterns for data collection. The type of sensor chose may drive the choice of altitude and limit the amount of area that can be covered. If significant terrain is involved, that could complicate flight planning. Is the best vantage point straight down from above (nadir view) or is an oblique view better, or even a side view from below the tree tops?

Post Processing Requirements
Will the data be reviewed manually? Are there computer algorithms that could be leveraged to highlight areas of concern in the data (i.e. some sort of threshold or blob detection?) What characteristics in the data would indicate a target invasive species is detected? For the longer term, we will evaluate economic factors including the cost to image an area versus the likelihood or reliability of spotting invasive plants.

Summary Budget Information for Activity 2 Part B:

ENRTF Budget:	**$ 24,245**
Amount Spent:	**$23,396**
ENRTF Balance:	**$1,513**

Outcome	Completion Date
1. Drones will be tested for survey capability. Testing will determine the appropriate sensor, calculate the impact of variable light conditions and chart the optimal flying pattern.	03/01/2018
2. Surveys are conducted and infestations are documented	05/30/2019
3. Treated sites are monitored to determine whether additional control is needed	06/10/2019

Activity Status as of November 30, 2016:
Part B (U of M) – see MDA report for Part A
Status for Part B: Field tested one UAS (Unmanned Aerial System) in September but experienced major technical difficulties. Are working on improvements and have another scouting/possible test flight scheduled for December.

Activity Status as of May 31, 2017:
Part B (U of M) – see MDA report for Part A

Photo of Memorial Park, Red Wing, MN taken from Flight 4's fixed-wing UAV.

- On March 23, 2017 flew 4 survey missions at Memorial Park, Red Wing, MN.
  - Flight 1: Quadcopter, aborted due to battery issue.
  - Flight 2: Quadcopter, captured 193 images with a 4-lens multispectral camera (772 total images.)
  - Flight 3: Quadcopter, captured 202 images with a 4-lens multispectral camera (808 total images.)
  - Flight 4: Fixed-wing Unmanned Aerial Vehicle (UAV) aborted about 4 minutes into the flight due to winds aloft in excess of 25 knots (kts). The UAV was landed safely under manual pilot control.
- Weather conditions at the time of the survey flights were extremely windy and overcast. This adversely impacted image quality by increasing motion blur and smearing.
- Lessons learned:
  - The quadcopter successfully operates in higher wind conditions compared to the fixed wing aircraft. (Specific vehicles have specific ranges of useful operating conditions.)
  - Drones can operate safely in less than ideal conditions, but the risk of a mishap increases with worsening conditions; also image quality is adversely affected.
  - Ideally winds aloft would be < 20 kts, relatively low turbulence, with sunny skies.
  - The 4-lens multispectral camera tested on the quadcopter is fairly low resolution, slow shutter speed, and produces images with a lot of unwanted artifacts. These images require substantial

post processing before they can be used.
    - Initial inspection of the additional image channels (each with filters that let through specific wavelengths of light) didn't show any promise for identifying Oriental bittersweet.
    - It appears we will have better success with improved lens optics, faster shutter speeds, and a higher resolution CMOS sensor.
- To address the camera/imager quality needs, we have purchased a Sony A6000 digital mirrorless camera with 20mm fixed focal length lens. We also purchased a remote trigger with precise GPS geotagger to interface with the UAV autopilot.
- A system has been designed and built to mount the new (and larger) camera on the fixed wing UAV.
- We invited media to the drone flight which resulted in several media reports : Eagle's-eye view: Using drones to spot invasive plants; Researchers test drones to spot invasive plants in Minnesota; and A Drone's Eye View of Oriental Bittersweet, *The Forestry Source*, May 2017.

Activity Status as of November 30, 2017:

This picture was taken by a camera mounted on the U's UAS vehicle for the Weed 'Em Out training in Sorin's Bluff Park, Red Wing. This shows CCM and Nature Conservancy participants and instructors using ETIPS Phase 2 purchased tablet computers to practice ISMTrack data entry.

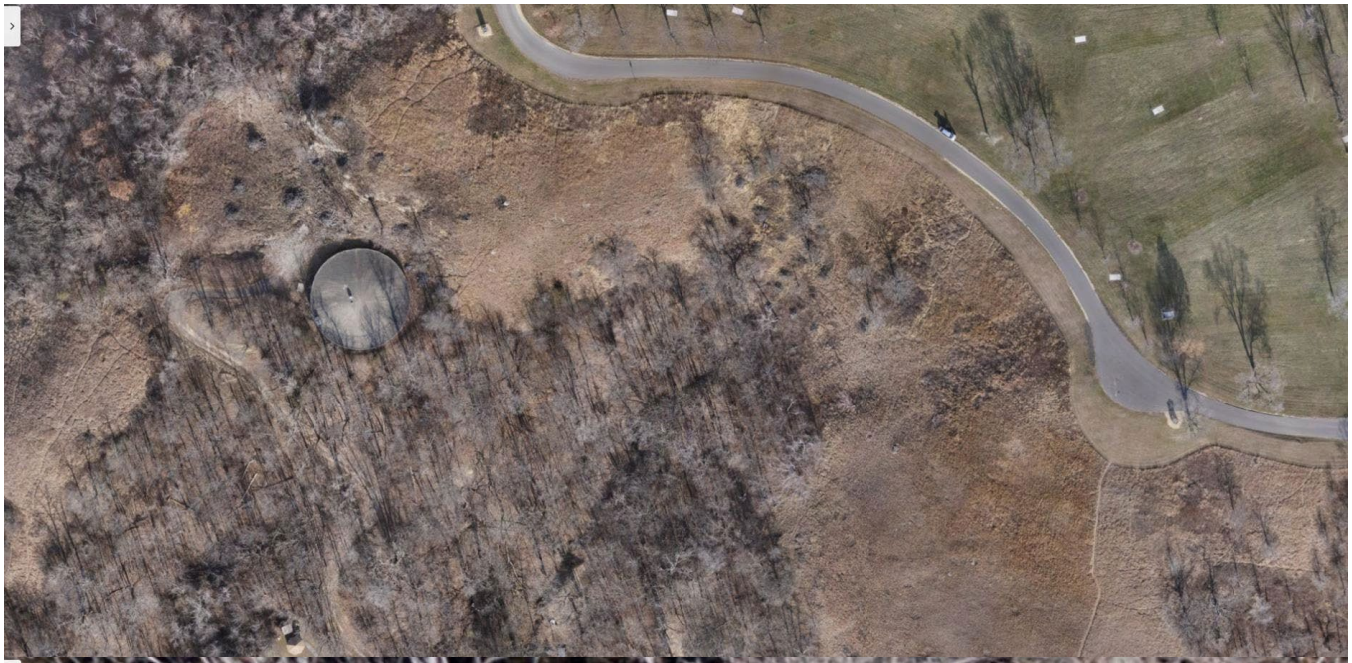
- We tested the integrated Sony a6000 digital mirrorless 24 megapixel camera in the aerial survey system. This camera provides a higher quality imager and lens compared to most quadcopter-based mapping systems. It yields improved resolution, detail and color quality.
- In Red Wing (6-12-17) we flew a demonstration flight for a weed identification training class. The captured images (sample shown above) were used to construct a 3D model of the hill top area in a park that is a focus of our Oriental bittersweet eradication work.

- On September 27, 2017 we flew two Palmer Amaranth survey flights in Yellow Medicine county and two flights in Lyon county. These flights helped refine our procedures and led to improvements in camera setup, camera triggering, lens choice and survey patterns. This was done for our Palmer amaranth detection project but has useful implications for this project.
- On October 11, 2017 we flew three survey flights over invaded areas of Nebraska and Iowa for our Palmer amaranth detection project. These flights over actual invaded areas continued improvement of our survey processes and camera setup.
- We developed a survey planning and mapping tool that works with our aircraft's autopilot. This software can now be used to create a database of survey areas, and then transmit those areas to the flying aircraft which generates an optimal survey pattern for current wind conditions, camera field of view, and desired image overlap.
- On November 29, 2017 we flew 3 survey flights at Memorial Park in Red Wing. The flights covered approximately 120 acres and yielded 2500 high resolution images. In the later fall and winter months the leaves are off most of the trees, but the oriental bittersweet berries are still on the vine. These berries have a distinct reddish/orange color and contrast clearly against the dull winter colors. Examining the raw aerial images showed that concentrations of oriental bittersweet were clearly visible throughout the park.
- Rochester Extension ETIPS 2 staff surveyed Northern Heights Park with Rochester City Forester for effectiveness of last year's treatment of Oriental bittersweet. Several plants survived last year's treatment and the City Forester will retreat. (Rochester, 6-8-17)

Activity Status as of May 31, 2018:

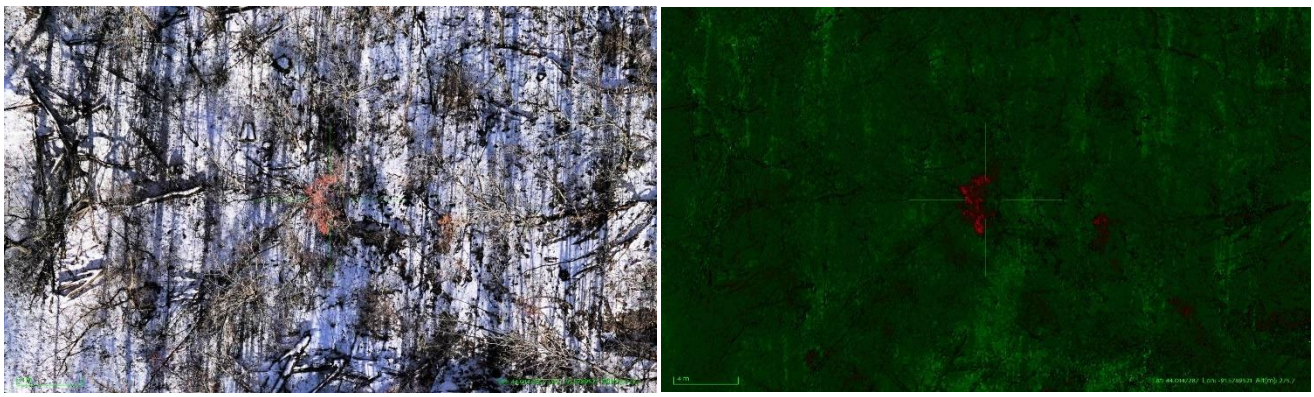
- Improved ground station and airborne flight control software for generating more optimal survey patterns.
- UAV flight control: optimize 180 turn direction (at the end of each survey transact) to minimize wasting time turning around and flying the next transact. Turning up wind saves substantial time and energy over turning down wind and helps fly more complete and accurate survey patterns.
- Pix4d mapping software processed Red Wing's Memorial Park survey imagery to create detailed maps of the park. Pix4d takes all the individual images collected during the flight and fits them together in a single unified map. This map can be explored online and shared with project contributors. Pix4d will generate a 2D orthophoto as well as a detailed 3D surface map. This software was purchased for the Palmer Amaranth Detection and Eradication project but is also helping this related project.
- The Oriental bittersweet survey late November 2017 covered 237 acres of the park. In total, 2,626 images were captured over 3 flights. This imagery yielded a final map resolution of approximately 1 cm per pixel.
- Continued work on in-house tools to enable more detailed inspection and analysis of the survey imagery compared to what the available commercial tools offer.

First image below: Stitched together picture of Memorial Park.
Second image below: Zoomed in detail, from first pictures, that shows Oriental bittersweet fruit.



Activity Status as of November 30, 2018:
This summer we continued to test and improve the capabilities of our survey system. We greatly improved the reliability and safety of our auto-launch system, and made further refinements to our auto-landing system. Drone Deploy software, purchased with other funds, has been used to help with data post processing: image stitching, mapping, and locating areas of interest from the imagery. We also completed assembly of a new survey aircraft that has improved payload capacity, endurance, and more stable flight characteristics.

Activity Status as of May 31, 2019:



Natural and enhanced image of Oriental bittersweet survey in Winona.

This winter and spring we flew oriental bittersweet surveys near Winona, Elm Creek Park Preserve, and Hay Creek. We determined that oriental bittersweet surveys can be conducted throughout the winter season with diminishing returns once March arrives and the weather begins to warm up. Surveys can begin as soon as the leaves drop in the fall, but the ideal conditions for best results is with a layer of snow on the ground. This helps hide fallen leaves and other plants at ground level and creates the best visual contrast with the colorful berries.

The trade off with surveying primarily during the winter season is that here in Minnesota we can get long stretches of unflyable weather. Concerns include excessive cold, excessive wind, snow (and rain), fog and freezing fog.

In January we purchased a DJI Phantom 4 Pro v2.0 with a Sentera multispectral camera. The Sentera camera images 5 distinct bands of the color spectrum: near infrared, red edge, red, green, and blue. The bands are carefully filtered to minimize any bleed through between neighboring bands. The DJI system is capable of vertical take off and landing and can operate in more constrained areas compared to our fixed wing system. However it has much shorter flight times, covers a smaller area, and the cameras and images are lower quality compared to our larger fixed wing unmanned aircraft system.

Through the winter we optimized our fixed wing route following algorithms and improved our camera triggering system. We continue to refine our in-house mapping and analysis software. This winter we created a graphical visualizer that displays all the original aerial images precisely fitted and scaled together as a nearly seamless map. This preserves all the detail and resolution of the original images (because we are drawing the original images), makes all the images (i.e. all the overlapping perspectives) for any point of interest available for viewing, and presents all of this as an intuitive ortho map.

We anticipate the tools, techniques, experience, and software developed through this project will continue to be improved upon, and continue to be used for future invasive projects as well as other related university research.

Activity Status as of November 30, 2019:
Collaborative and complementary work from the Palmer amaranth project, also funded by LCCMR and in conjunction with the same MDA team, is helping to further refine the flight and post-flight data processing for the Oriental bittersweet survey work in this project.

I'm delighted to report that we've successfully transitioned from primarily testing drones for research to deploying this technology to survey for Oriental bittersweet in the field so Oriental bittersweet can be better managed MDA and CCM crews. The research worked and is being deployed on the ground!

Final Report Summary:

During the final reporting period, the team:

- Completed several Oriental bittersweet survey drone flights, with local invasive species managers, in Red Wing in and around Hay Creek.
- Completed several drone survey flights around Spring Grove to inform CCM crew Oriental bittersweet management. See photo immediately below. The image is a mosaic of the drone images from this survey overlaid with ground-truthed Oriental bittersweet points, to refine ground truth and drone survey methods.
- Improved in-house post processing software to better handle heavily forested areas and significant terrain. In addition to improving final map presentation tools and the annotation system.
- Built and connected images to the Zooniverse online people-powered citizen science platform to work on Oriental bittersweet drone photo review using CCM crew members during the COVID-19 stay-at-home order. See the MDA's 2020-07-31 Noxious Weed Detection Eradication WP for more details of this work.

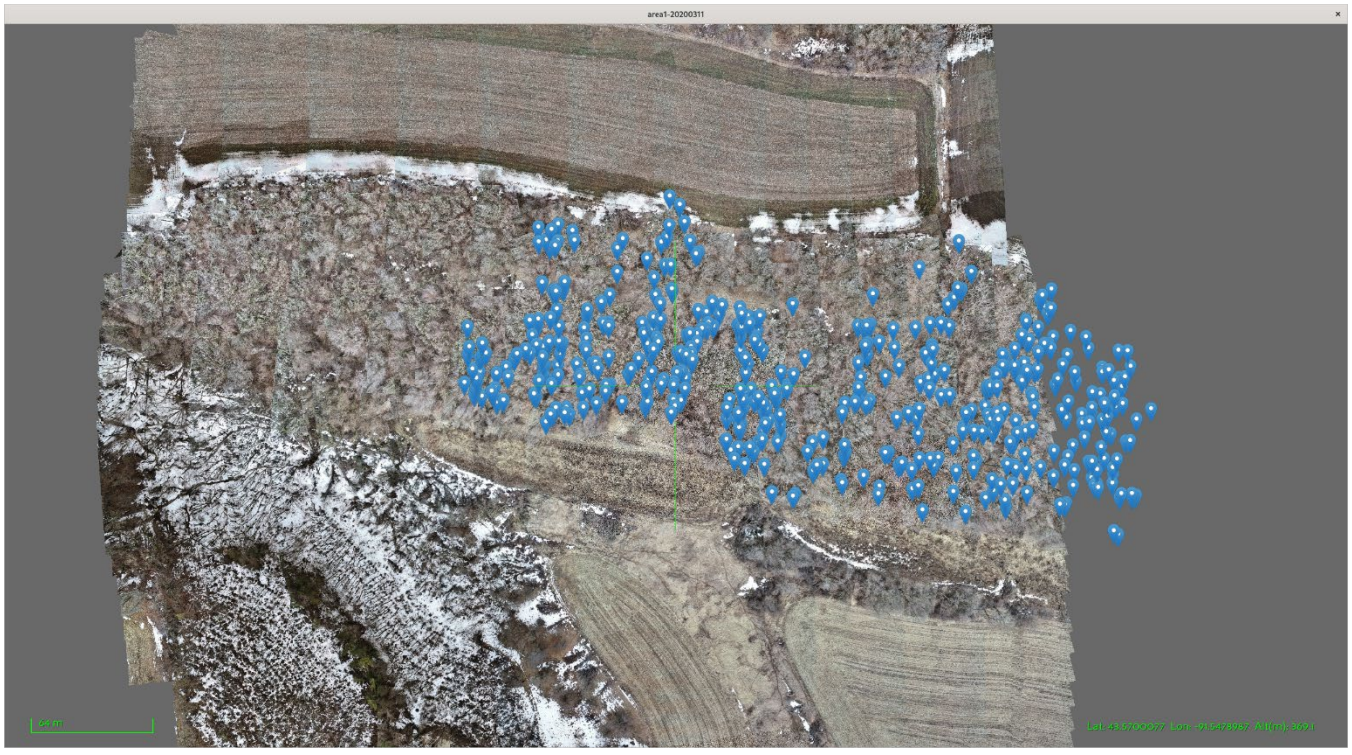


Photo by Curtis Olson, UMN, composite drone images of steep terrain in southeaster Minnesota after post processing via software Curt developed with ground truthed Oriental bittersweet points overlayed.

During the course of meeting all the grant deliverables project team members transitions from flying drones for research to using them for Oriental bittersweet surveys over tricky terrain on mild winter days to inform CCM crew eradication efforts. We tested various sizes and styles of fixed-wing and quadcopter drones and discovered that quadcopters work best for this work but there's constant tension between size, maneuverability and

payload (camera) capacity. Several different sizes and types of cameras and lenses were tested, including light and wave characteristics and coupled with seasonal influences like leaves and snow. It became clear that mild winter days worked best because the drones and cameras work, most leaves are gone and white snow creates visual contrast to orange and red Oriental bittersweet berries. These conditions led to the best images that will then be reviewed by humans. (Wave length variation did not prove helpful.)

Curt Olson developed a post processing software system and improved it throughout the project while also comparing it to several commercial post processing software products. An example of his work is the immediately above photo which is created by several different drone surveys' thousands of images stitched together to create an interactive, highly detailed and GPS specific map that is overlaid with ground-truthed Oriental bittersweet reports.

ACTIVITY 3: Control Target Species

Description: MDA will contract with CCM for trained and equipped field crews to control target invasive species on an estimated 660 acres (75 ac Dalmatian toadflax, 5 ac teasels, 130 ac Grecian foxglove, 50 ac Japanese hops, 150 ac meadow and brown knapweeds, and 250 ac Oriental bittersweet). CCM crews trained in identification and control of target species will conduct control work starting with known infestations of Oriental bittersweet and continuing with control of other target species. Large infestations of Oriental bittersweet will be controlled using basal bark and/or cut-stump treatment with a systemic triclopyr based herbicide in basal oil which is specific to broadleaf plants and will reduce potential impact on non-target species. Smaller infestations of young plants or infestations in sensitive areas that prohibit use of herbicides will be controlled by hand or mechanical pulling with a focus on removing and properly disposing of all plant parts including all roots and fruit to prevent re-sprouting and/or seeding. Timing of control will focus on late fall and winter when non-target species are dormant to reduce impacts on desirable species. Control of additional target species will involve mechanical and chemical control methods following established best management practices for each species based on size and location of infestations.

Amendment Request:

Activity Status as of May 31, 2018:

Extension will manage the $45,000 contract in our amendment request to increase funding for control work by CCM. MDA will work with Extension and coordinate the control work with landowners and CCM.
Approved 6/14/2018

Summary Budget Information for Activity 3:	**ENRTF Budget:**	**$ 55,078**
	Amount Spent:	**$54,734**
	ENRTF Balance:	**$344**

Outcome	Completion Date
1. Acres treated are documented	06/30/2019

Activity Status: See MDA report for activity status.

Activity Status as of November 30, 2018:

Elimination of target invasive plant species activities in SE Minnesota. Surveying and treating by CCM. Detailed reporting on activity provided in the MDA report.

Activity Status as of November 30, 2019:

Extension managed a contract with CCM, at the direction of MDA partners (see their report for details of CCM crew activities). Extension is proposing a rebudget request to further contract with CCM to use much of the remaining program coordinator salary that was unable to be used because of serious medical issue that arose and prevented her from working as expected.

Final Report Summary:
During the final reporting period for this project Extension managed a contract with CCM, at the direction of MDA partners (see their report for details of CCM crew activities) that also included work Zooniverse to look for Oriental bittersweet infestations.

Activity 3 is an excellent of project team member's dedication to success and teamwork. The designated staff hired for this project by Extension experienced a major medical issue part way through the project which significantly reduced her ability to work. That reduction in salary led to an increase in funds that were reallocated, via budget request, to CCM to do more on the ground eradication work. The ability of team members from Extension and the Minnesota Department of Agriculture to work collaborative and flexibly to problem solve enabled us to complete and far exceed exceptions in Activity 3. For a detailed summary of CCM's efforts please see the MDA's report.

ACTIVITY 4: Implement Invasive Species Management Database System from Phase 1
Description: In the field, CCM will use tablets with a database system developed in Phase 1 to collect data on target invasive species control treatments and monitor infestation changes. This platform will enable us to communicate across organizations and efficiently summarize activities and outcomes. Extension will train agencies and other organizations to utilize this system.

A. Purchase 20 tablet computers; 10 for Extension trainings for database system users and 10 for CCM crews to use while managing and monitoring on target invasive species,
B. Natural resource manager database system trainings (using the tablets, 2 per year).

Amendment Request:
Activity Status as of May 31, 2018:
MDA will take on some of the few remaining duties mentioned above,+ predominately the natural resource manager database system field trainings.
Approved 6/14/2018

Summary Budget Information for Activity 4:	**ENRTF Budget:**	**$ 6,910**
	Amount Spent:	**$6,910**
	ENRTF Balance:	**$0**

Outcome	Completion Date
1. 6 training workshops will be conducted for vegetation managers	05/30/2020
2. Tablets and software will be utilized for data collection in the field	06/10/2020
3. Summary reports of activities and outcomes will be run	06/10/2020

Activity Status as of November 30, 2016:

- Invasive Species Management (ISMTrack) an hour and 40 minute training for about 30 natural resource professionals was also presented at the Upper Midwest Invasive Species Conference on October, 19, 2016.
- Bought 2 tablets plus data; working on data plans with CCM.
- Scheduled to teach ISMTrack at 8 Minnesota Pesticide Information and Education workshops in 2017 and

2018.

Activity Status as of May 31, 2017:

- **Pesticide Information and Education Course for Minnesota** for 220 pesticide applicators seeking their license Detroit Lakes Holiday Inn (1/31/17) and Alexandria (2/2/17).
- **ISMTrack** - Data assistance for site names
  A portal of county based parcel identification numbers to aid site name creation while keeping some privacy for a home. Site name for homes will rely on county assessor' Parcel Identification number. Portal for Minnesota counties: https://sites.google.com/umn.edu/pins
- **Hardware/cellular support for CCM crews**
  To enable the goal "Implement Invasive Species Management Database System" to develop invasive species apps (GLEDN, EDDMapS and ISMTrack) we piloted the 2 tablets to monitor the emerging Palmer amaranth population in western Minnesota prairies. The new concern about Palmer amaranth and the context in which the tablets were tested were reported in the December 28 *Star Tribune* article "Superweed introduced to Minnesota with conservation seed mix." The pilot received positive reviews for functionality. Eighteen more tablets and cases were purchased for the use by Extension Invasive Plant Program Coordinator and the Conservation Corps of Minnesota and Iowa (CCM). Cellular data for ten grant purchased tablets is provided by the existing CCM Verizon plan. Data for the other 10 tablets will purchased as needed.
- Upcoming activities: Conservation Corps MN volunteer training for ISMTrack and Noxious Weed identification, June 12, Red Wing, MN and ISMTrack will be used in another UMN Research and Extension project to track soybean aphids use of buckthorn.

Activity Status as of November 30, 2017:

- Key staff in the Rochester DNR/CCM/Quarry Hill Park offices adopted ISMTrack for management data.
- SWCD (Soil, Water, Conservation District) in Lake County was trained to use ISMTrack.
- CCM crews are using 10 ETIPS 2 grant-purchased tablets that are connected via CCM's Verizon accounts to track invasive species management.

Activity Status as of May 31, 2018:

- Extension ETIPS 2 staff joined the MDA and ISMTrack development staff in St. Paul (2/13/18) for working group meeting to learn current status of ISMTrack, discuss future development and to address issues including data entry and management for herbicide rates, drawing polygons, site definitions, non-ISMtrack usage and feasibility of drawing site polygons over large areas.
- MDA has assumed responsibility for training people to utilize ISMTrack. CCM members were introduced to ISMTrack as part of their general training on February 22, 2018. MDA will work one on one with CCM crew leaders as they begin to utilize ISMTrack. On April 16, 2018 there was a training session for Anoka, Ramsey and Washington CWMAs and the St. Croix River Association in Arden Hills.

Activity Status as of November 30, 2018:
See the MDA report. MDA's May 2018 work plan amendment request was approved on 06/14/18. Since then, MDA has been doing this work.

Activity Status as of May 31, 2019:
See the MDA report. MDA's May 2018 work plan amendment request was approved on 06/14/18. Since then, MDA has been doing this work.

Activity Status as of November 30, 2019:
See the MDA report. MDA's May 2018 work plan amendment request was approved on 06/14/18. Since then, MDA has been doing this work.

Final Report Summary:
See the MDA report. MDA's May 2018 work plan amendment request was approved on 06/14/18. Since then, MDA has been doing this work.

Extension completed 4 workshops to 250 professionals and purchased 20 tablets to test ISMTrack on and eventually enable CCM crews to use ISMTrack to record eradication efforts. After Extension's staff member's medical issues began MDA took over the remaining work in this section. Please see their Final Report for specific details. I'm incredibly grateful for this team's dedication to success and the group effort that went into making sure all grant deliveries were met. This required tireless work from the MDA and flexibility from LCCMR staff. Thank you everyone!

V. DISSEMINATION:
Description: We will communicate about target invasive plant species with the public, natural resource professionals, County Agricultural Inspectors, highway and other road crew employees, and Cooperative Weed Management Areas. The web will be used for communication at www.mda.state.mn.us/en/plants/pestmanagement/weedcontrol/targetplants.aspx and www.myminnesotawoods.umn.edu/ (this location may shift as we develop additional online training, outreach materials and target audiences). Communication with the public will be via workshops, news media (print, television, and radio), online and via social media such as YouTube, Facebook, Twitter and Pinterest. We will communicate updates at County Agricultural Inspector meetings and in trade publications such as "The Scoop" published by the Minnesota Nursery Landscape Association. We expect to present this project during at least one peer-reviewed professional conference such as the Association of Natural Resource Extension Professionals Conference or the Upper Midwest Invasive Species Conference (both biannual conferences).

Status as of November 30, 2016:
Upper Midwest Invasive Species Conference (UMISC):
Work from this project was highlighted in three different formats at the UMISC in LaCrosse, WI from October 16-19, 2016.

- Extension Using Mobile Technology, 3D Printing & UAVs to Battle Invasive Species was presented by Angela Gupta (additional authors: Monika Chandler & Curtis Olson) to about 35 natural resource professionals.
- Master Naturalist Making a Difference: Volunteer Impact Analysis by Christian Wood, an AmeriCorps Volunteer hired under the Elimination of Target Invasive Plant Species Phase 1 (additional authors: Angela Gupta & Andrea Lorek Strauss), was presented.
- Invasive Species Management (ISMTrack) An hour and forty minutes training for approximately 30 natural resource professionals was also presented.

Board of Water and Soil Resources Academy

- Tools and Techniques for Effective invasive Plant Management was presented by Monika Chandler and Michael Reichenbach to 60 soil and water conservationists. We covered reporting invasive species with the Great Lakes Early Detection Network (GLEDN) using ISMTrack.

Society of American Foresters (SAF) National Convention:
Work from this project was highlighted in one presentation at the SAF Convention in Madison, WI from November 1-5, 2016.

- **Extension Forestry Using Mobile Technology, 3D Printing, and UAVS to Battle Invasive Species** was

presented by Angela Gupta to about 38 foresters and other natural resource professionals.

Status as of May 31, 2017:

Image: Citizen Scientists Influencing Forest Invasive Species Management in Minnesota UMN Extension presentation

- **Noxious Weed Identification – What am I looking for? Oriental Bittersweet and Japanese hops** Winona, (3/22/17) 22 city and council officials.
- **Coming to a Prairie Near You** - sponsored by Prairie Smoke of Minnesota, Chatfield (2/26/17), 36 attendees.
- **Oriental Bittersweet and its Look-alikes** - sponsored by Friends of the Bluffs in Red Wing (3-21/17), 53

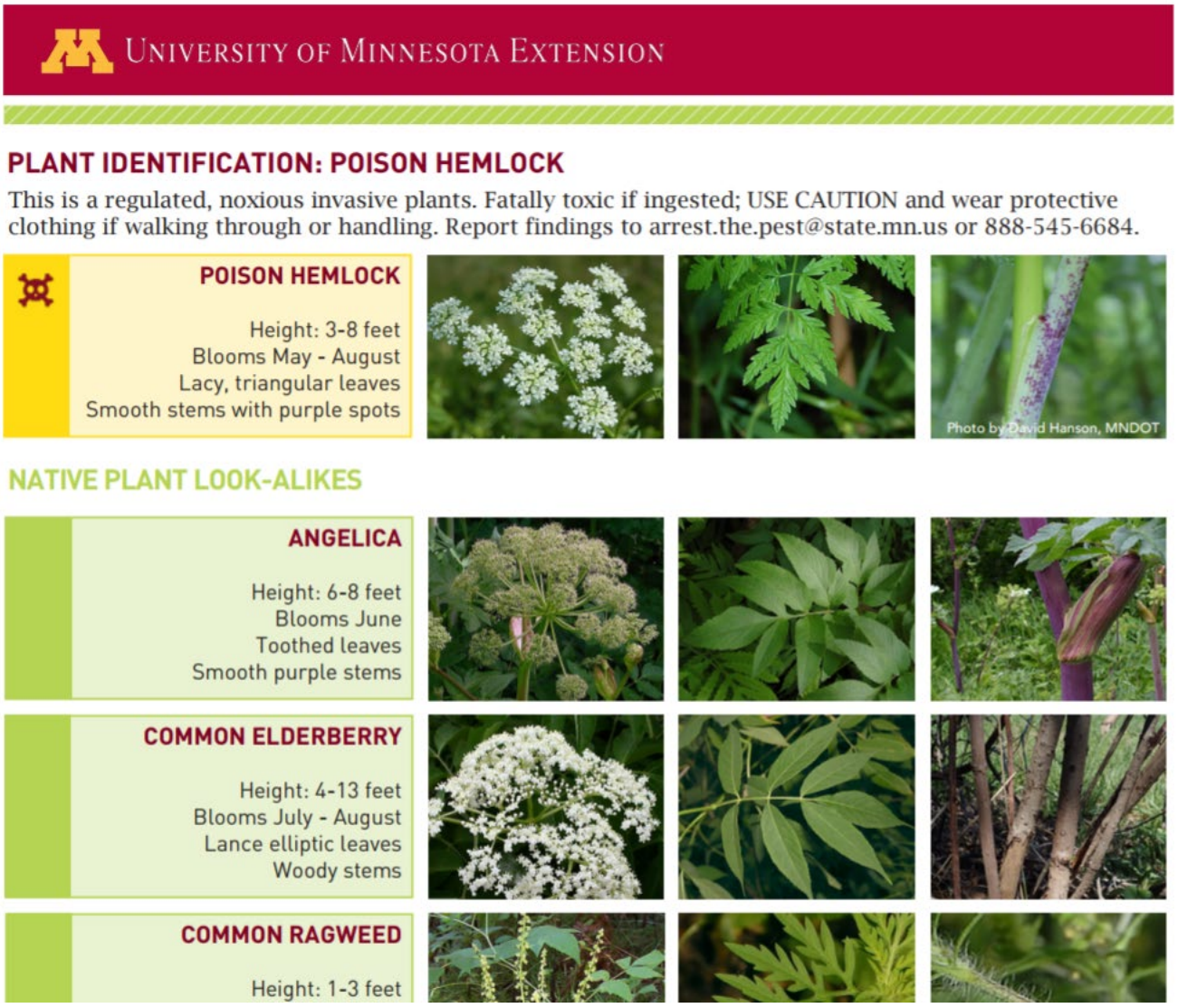
attendees.
- **Weed 'Em Out workshops** in Virginia (3/29/17), Morris (4/18/17) and Baxter (5/3/17) to 183 natural resource professionals and road maintenance professionals.
- **Pesticide Information and Education Course for Minnesota** for 220 pesticide applicators seeking their license Detroit Lakes Holiday Inn (1/31/17) and Alexandria (2/2/17).

Presentations to professional audiences
- Gupta, A. (2017). **MN's First Detectors: Past, Present and Future**. Minnesota Shade Tree Advisor Committee Forum. St. Paul, MN. (Audience: ~30 arborist and urban tree care professionals. 1/19/17
- Gupta, A. & Littleton, D. (2017). **Citizen Scientists Influencing Forest Invasive Species Management in Minnesota**. Poster for Citizen Science Association Conference. St. Paul, MN. 5/18-21/17. (Image above)

Media Coverage
- Superweed introduced to Minnesota with conservation seed mix. *Star Tribune.* December 28, 2016
- 2017 Invasive Species Calendar January's photo acknowledges CCM youth pulling Grecian foxglove at Afton State Park. Minnesota Invasive Species Advisory Council
- "Help Eradicate Dangerous Plants from Minnesota" *Technology Exchange (*Minnesota Local Technical Assistance Program) newsletter (expected publication June 2017)
- Red Wing Republican Eagle: Eagle's-eye view: Using drones to spot invasive plants
- A Drone's eye view of Oriental bittersweet. Society of American Foresters. *The Forestry Source,* 2017 22(5):5
- "Drones spot invasive plants" *University of Minnesota Extension Quarterly Report- Southeast Region* 2017 (1):3
- "Invasive species education goes statewide" *University of Minnesota Extension Quarterly Report-Southeast Region* 2017 (1):5
- Drones can spot invasive Oriental bittersweet vine: MyMinnesotaWoods: Researchers test drones to spot invasive plants in Minnesota, Extension highlights, University of Minnesota Extension - Quarterly Reports
- My Minnesota Woods's Facebook page 228 people reached as of 5/10/17.

Status as of November 30, 2017:
Since the last report, it has become evident that ENRTF funding (and Phase 1 funding) has strengthened and created connections with local and statewide invasive species partners. This was realized when Angela Gupta (Project PI) presented at the International Union of Forest Research Organizations (IUFRO) 125th Anniversary Congress in Freiburg, Germany. While attending sessions it became clear that Minnesota's collaborative, committed and innovative invasive species partnerships create an extensive network of professionals, volunteers and citizens that identify, report, manage and educate on invasive species. These systems and networks shine on the international stage. Our ETIPS 2 funds not only support our critical connections but also provide evidence that Minnesota is already doing invasive species work in every area recommended for global impact. Specifically, this Minnesota network is working strategically across organizational boundaries to tackle invasive species. Our network utilizes professionals, volunteers, regulatory updates and new technologies to achieve reduction and elimination of prohibited species in Minnesota. Our network, rich in passion and dedicated professionals, produces unforeseen advantages in knowledge sharing and project management. Our network's effectiveness was viewed favorably when Extension staff was awarded *Empowering citizens to engage resource managers to minimize the impact of invasive species on forests and across ecosystems*, ($115,000) from USDA National Institute of Food and Agriculture (with A. Gupta as PI). This USDA project is interwoven with the successes and partnerships created through ENRTF funds. Thank you for your support and enabling us to achieve this level of coordination and integration.

- Gupta, A. (2017). Beware of Oriental Bittersweet in Holiday Decorations. *Women Owning Woodlands* post updated and revised.
- Creation and dissemination of Poison Hemlock page on UMN Extension website
- Creation and dissemination of UMN Extension's Poison Hemlock's Look Alike factsheet (excerpt below)



http://www.myminnesotawoods.umn.edu/wp-content/uploads/2017/06/Poison-Hemlock-Lookalikes-3-types.pdf

- Met with Olmsted County Waste to Energy Facility (OCWE) staff to address poison hemlock plants adjacent to finished compost and the DM&E railroad track. In response to our concerns, OCWE staff ran an article entitled **"Poison Hemlock Spreads Throughout Area"** in their environmental resources community newsletter (August)
- 10 grant-funded tablets used for White Earth Reservation education summer camp (45 youth) including outreach on target terrestrial species (July).
- Introductory meeting with American Public Works Association Minnesota Chapter President to arrange for invasives species presentations at upcoming professional meetings. (6-19-17)
- MN Local & Tribal Assistance Program (LTAP) Technology newsletter "Help eradicate dangerous plants

from Minnesota". (June)

Presentations, Papers and Posters to professional audiences

- Gupta, A. Chandler, M., Wood, C. & Littleton, D. (2017). E**mpowering volunteers in early detection and management of forest invasive species using 3D printed models, online tracking systems and UAVs** (Abstract, pg 175). International Union of Forest Research Organizations (IUFRO) 125th Anniversary Congress, Freiburg, Germany. (Audience: ~55 international natural resource professionals). Gupta presentee. (This conference trip was paid for by several other funds and scholarships, not by ENRTF. $2,208)
- Gupta, A., Rager, A., Weber, M., Larkin, D. & Littleton, D. (2017). Let's Chat: Extension and invasive species. UMN Extension Program Conference. Brooklyn Park, MN. (Audience: ~36 Extension professionals). Gupta was the co-facilitator and co-organizer.
- Littleton, D., & Gupta, A. (2017). Citizen Scientists Influencing Forest Invasive Species Management in Minnesota. UMN Extension Program Conference, Brooklyn Park, MN. Poster presented.
- Presented "MN Invasive Plants: Mapping, Reporting and Tracking" at the **Pesticide Information and Education Course for Minnesota** for applicators seeking their license ~ 210 attendees (Mankato, 11/7/17)

Staff Updates:

- A. Gupta, RREA (Renewable Resource Extension Act) Focus Funds: Empowering citizens to engage resource managers to minimize the impact of invasive species on forests and across ecosystems. Received $115,000 from the USDA National Institute of Food and Agriculture. Gupta is the PI leading the effort to work with 4 additional states on flipped classroom, normative messaging approach to empower citizens to engage decision makers over 2 years. As of 11-28-17 about 50% of states applied to work with us on this project!
- Angie Gupta and Dawn Littleton begin planning for the MISAC/NAISMA Joint meeting invasive species tours planned for October 15-18 2018
- Christian Wood, formerly an AmeriCorps volunteer partially supported by Phase 1 of this project, will start as a full time permanent employee at UMN Extension as a Web Developer! This is very exciting news for Extension and a great continuation of Christian's promising career.
- Extension Program Coordinator attended Minnesota Invasive Species Advisory Council (MISAC) meeting
- Angela Gupta is the 2017 MISAC chair.

Status as of May 31, 2018:

- Update poison hemlock website: http://www.myminnesotawoods.umn.edu/poisonhemlock/
- Presented on Synergies of Invasive Species work in Minnesota in Winona (1/16/18) for ~ 35 engaged residents.
- Staffed an Extension booth about invasive species, including ETIPS 2 species, at Saint John's University in Collegeville (2/10/18) for ~100 attendees.
- Provided Q and A assistance, 3D-print models and other resources for target invasive plants at Wabasha County Forestry Day (2/9/18).
- Conducted 2 Forest Pest First Detector workshops, which includes Oriental bittersweet: Andover (2/28/18) and Mankato (3/21/18) for 21 natural resource volunteers and professionals.
- Presented (~14) and staffed a booth at the Gathering Partners Conference in Brainard (5/19/18) to some of the ~200 Extension natural resource audiences including volunteers.
- The team was contacted by
    - Khem So of USFWS in Oregon in April to access ISMTrack to aid development of a national standard for management action tracking at National Wildlife Refuges. He is interested in

seeing what/how the system tracks treatments.
- Corey Engle of Prairie Restorations - A statewide commercial retailer/wholesaler of prairie plants and restoration services requested access to ISMTrack for use in managing invasives.

Media

- Torching Noxious Weeds. By Shane Blair, http://www.pinecitymn.com/news/torching-noxious-weeds/article_1a7da684-02ab-11e8-9075-cbe5773d40ec.html

Presentations, Papers and Posters to professional audiences

- Presented at the Association of Natural Resource Extension Professionals (ANREP) national conference in Biloxi, MS in May.
- Presented at the CitSci Symposium, a professional gathering o ~115, in Andover (12/1/17), that includes some of this work.

Staff Updates

- October 2018 MISAC/NAISMA Joint Meeting programming and tours have been finalized with dates, times and maps.
- UMN Extension Dean Durgen received updates on ETIPS 2 during her visit to the Rochester Extension office (5/10/18).
- Olmsted County Waste to Energy Facility (OCWE) staff met to address poison hemlock plants adjacent to finished compost and the DM&E railroad track. Follow-up management to eradicate poison hemlock from the site and prevent spread happened in the fall, early spring and continues. OCWE reached out the Minnesota Pollution Control Agency (MPCA) to temporarily move the yard waste compost windrows on the adjacent farm field property that is currently owned by the County (formerly Minnesota DNR Area District Office). Poison hemlock has sparked additional conversations with MPCA about invasive plant disposal.

Status as of November 30, 2018:

Media

Angela Gupta and others developed augmented reality (AR) displays for MN State Fair 4-H Building for: boot brush and garlic mustard and wild parsnip; egg mass and gypsy moth; firewood and emerald ash borer; trap and zebra mussels; silver carp; rusty crawfish; and boat and invasive species prevention. We used the Zappar app to create 7 different augmented reality pieces. UMN Extension estimates that “One in five people who attend the state fair visit the 4-H Building. That's more than 320,000 in 12 days!” Zappar app analytics captured 3804 zaps total (ranging from the boot brush with 664 zaps to zebra mussel with 333 zaps). Display was staffed by 4-H. Gupta helped developed emerald ash borer, gypsy moth and boot brush AR displays with UMN Printing Services AR expertise. Online article and video: Invasive Species AR Exhibit at the MN State Fair, http://news.printing.umn.edu/invasive-species-augmented-reality-exhibit-at-the-mn-state-fair/

UMN Extension IT and communications staff worked with Angela Gupta to develop 360 images of Oriental bittersweet and buckthorn for virtual reality glasses for educational use, https://extension.umn.edu/invasive-species/invasive-species-360-degree-images This tool was used for the first time while teaching Oriental bittersweet at the Upper Midwest Invasive Species Conference during a special identification workshop and they worked really well.

- Coyle, D., **Gupta, A**., Ambourn, A. (2018) Know the Problem: Tips to Identifying Invasive Forest and Range Pests. Upper Midwest Invasive Species Conference, Rochester, MN. (Audience: ~20 Natural Resource professionals) Gupta was a workshop session presenter.

Presentations, Papers and Posters to professional audiences

UMN Extension Invasive Species Community of Practices created a new invasive species field guide, including all the early detection plants in this project. The field guide, *By Land and By Sea*, was self-funded by Extension. For this project Extension created and crowd sources a new invasive species photo library for UMN Extension education and sales.

UMN Extension invasive species programming currently uses a flipped classroom educational approach for much of its teaching. This approach was developed over many years and in part because of experiences in the Weed 'em Out training funded by this project. The September issue of the peer reviewed publication Journal of Extension was dedicated to innovation and Angela was a co-author on the Flipping the Classroom to Train Citizen Scientists in Invasive Species Detection and Response paper.

- Larkin, D., Weber, M., Galatowitch, S., Gupta, A., & Rager, A. (2018) Flipping the Classroom to Train Citizen Scientists in Invasive Species Detection and Response. *Journal of Extension*. https://joe.org/joe/2018september/tt1.php Blind-Juried or Refereed Publication.
- Gupta, A., Weber, M., Larkin, D., Rager, A. (2018) Flipped classroom: What are they and how can I use them? Upper Midwest Invasive Species Conference, Rochester, MN. (Audience: ~32 Natural Resource professionals)

Another project Angela Gupta is primary investigator on is the EmpowerU: Empowering Citizens to Engage Decision Makers in Invasive Species Management. This is a national project with federal funding support from the Renewable Resources Extension Act. The first local and train the trainer workshop was held in on October 13 and 15 in Rochester, MN for 27 Extension professionals and invasive species volunteers and landowners. This is a flipped classroom curriculum with 8 one-hour online modules followed by a one day in-person training. Participants finish the course with an engagement plan. Several participants included species in this project in their engage plans.

- Kallestad, B., Gupta, A. (2018) EmpowerU: Invasive Species. Rochester, MN. (Audience: 27 natural resources volunteers, woodland owners, Extension professionals both local and national). Gupta co-organized the event and is primary investigator on the whole project. 100% of 19 respondents reported: a deeper understanding of how to engage with decision makers, have a situation in which they can use what was learned and will follow the important steps to prepare for civic engagement.
- Kallestad, B. & Gupta, A. (2018) Empowering Citizens to Engage Resource Managers and Decision Makers. Upper Midwest Invasive Species Conference, Rochester, MN. (Audience: ~37 Natural Resource professionals)
- Gupta, A. & Kallestad, B. (2018) Empowering citizens to engage resource managers to minimize the impact of invasive species on forests and across ecosystems. Poster. Association of Natural Resource Extension Professionals (ANREP) National Conference. Biloxi, MS. (Audience: Extension natural resource professionals)

Dawn Littleton presented on the new Palmer amaranth library kit launched through this project and was able to present about the kit at the Upper Midwest Invasive Species Conference (UMISC) in Rochester, MN.

- Littleton, D. & Gupta, A. (2018) Novel Outreach: Library Distributed Training Kits for Prohibited Plant Identification. Upper Midwest Invasive Species Conference, Rochester, MN. (Audience: ~38 Natural Resource professionals) Gupta collaborated on the project and presentation.

Also presented at UMISC was this project about including noxious weed education in pesticide applicator trainings.

- Wyatt, G., Gupta, A. & Herzfeld, D. (2018) Incorporating Noxious Weeds and Invasive Species Lessons into Pesticide Trainings. Upper Midwest Invasive Species Conference, Rochester, MN. (Audience: ~45 Natural Resource professionals) Gupta collaborated on the project.

Staff Updates

Team Achievement Award – Minnesota Invasive Species Advisory Council, Carol Mortensen Invasive Species Management Award. Upper Midwest Invasive Species Conference. Rochester, MN. This award was given to several members of this team for their effort in invasive species early detection and rapid response in SE Minnesota.

Dawn Littleton had another major survey at the end of October and is out on medical leave during her recovery. We believe the surgery went well and will be working with human resources and her medical team during her recovery. As was agreed in the May 2018 project rebudget her unused salary will support additional CCM field work and MDA has taking over most of what remained of Extension's ISMTrack deliverables.

Status as of May 31, 2019:

Presentations, Papers and Posters to professional audiences

- Gupta, A. (2019) Augmented Reality, Virtual Reality & 3D-Printed Models: New Tools for Education & Engagement. MN Society of American Forester & MN Wildlife Society Chapter Conference, Duluth, MN.
- Gupta, A., Flory, J., Hardel, M., Sagor, E. & Zamora, D. (2019) Workshop #1: Identification of Terrestrial Invasive Species. MN Society of American Forester & MN Wildlife Society Chapter Conference, Duluth, MN.
- Gupta, A, Ambourn, A, Mutschler, K, & Schwingle, B. (2019) Forest Pest First Detector workshop. St. Cloud, MN.
- Dawn Littleton, project staff, hosted an educational booth at the 4th Annual Best Practices for Pollinators Summit in St. Anthony. About 300 participants attended the event.
- Littleton, D. (2019) Palmer amaranth Library Kit, Giant Hogweed, and Palmer amaranth banners presentation at Prairie Smoke Spring Meeting, Chatfield, MN.
- Black swallowwort, 3D print model and new educational poster on display at the Rochester Public Library, March 26-April 22.
- Gardening Day at Heinz Center had approximately 300 participants and new materials were a hit.
- Gupta, A. (2019) Augmented Reality, Virtual Reality & 3D-Printed Models: New Tools for Education & Engagement Lunch & Learn. UMN Department of Forestry, St. Paul, MN.
- Gupta, A & Weber, M. (2019) Bringing science to life through immersive imagery and 3-D modeling. Waste to Worth conference, Minneapolis, MN.

Staff Updates

Dawn Littleton, project staff, is back-up to full time employment after a long medical related work reduction.

Media

- Anne Morse, Winona County Agricultural Inspector, lined up great outreach about the drone flights for oriental bittersweet detection. She issued a media release and there was interest in the story.
  - Winona Daily News - Winona County gets more help in fight against Oriental bittersweet

- KWNO Oriental Bittersweet Battle
- Greg Taylor interviewed Curt and Shane. To listen to the interview, click the link below CURT OLSON AND SHANE BLAIR U OF M MN DEPT OF AG .mp3
- News 800 - Winona County receives assistance to combat invasive plant
- Fox 47 - Researchers use drone technology to find Oriental bittersweet in Winona County

Activity Status as of November 30, 2019:
Presentations, Papers and Posters

- The UMN Bell Museum of Natural History is hosting a traveling exhibit called Wicked Plants, during Saturday, October 5 of the opening weekend MN Master Naturalist volunteers staffed a UMN Extension booth with many of the noxious weed materials developed through this project on display, including the giant hogweed and Palmer amaranth banners, all 4 invasive plant 3D models, and lots of additional educational materials.
- Holland, A., Tuck, B., Gupta, A., Mamedov, S., Weber, M., & Weisenhorn, J. (2019) Rethinking "teaching" in Extension. UMN Extension Program Conference. Duluth MN. (Audience: ~ 40 UMN Extension professionals). Gupta, served on the panel and discussed lessons learned during this project.
- Gupta, A., Weber, M., & Holland, A. (2019) Implementing engaging technology in Extension programming: AR, VR and more. UMN Extension Program Conference. Duluth MN. (Audience: ~25 UMN Extension professionals). Gupta represented aspects of this project on the panel.
- Gupta, A. Kasten, K., Olson, C. & Wright, D. (2019) Panel Discussion: Drones and citizen science: opportunities and challenges. CitSciMN 2019 Symposium. St. Paul, MN. (Audience: ~19 citizen scientist professionals). Gupta organized and Gupta and Olson served on the panel discussing what we've learned from this project.
- Gupta, A. Blinn, C., & Peterson, R. (2019) MLEP: Introduction to Invasive Species. Cloquet, MN. (Audience: 20 MN loggers). Gupta co-developed the agenda, taught the introduction, leafy spurge, Japanese knotweed, common tansy and reed canary grass sections, and facilitated the discussions. Many materials, display items and messages were borrowed from this project.
- Gupta, A. Blinn, C., & Peterson, R. (2019) MLEP: Introduction to Invasive Species. Palisade, MN. (Audience: 8 MN loggers). Gupta co-developed the agenda, taught the introduction, leafy spurge, Japanese knotweed, common tansy and reed canary grass sections, and facilitated the discussions. Many materials, display items and messages were borrowed from this project.
- Gupta, A. (2019) Technologies for Education and Outreach: Augmented Reality, 360 Images and Virtual Reality, 3D Printing, and Crowdsourcing Project Funds and Media. International Union of Forest Research Organizations (IUFRO). Duluth, MN. (Audience: ~20 international foresters). Gupta developed and presented the presentation, some of the materials were from work done during this project.
- Gupta, A. & Reichenbach, M.R. (2019) New Tools for Education and Engagement around invasive species using augmented reality, virtual reality and 3-D printed models. Minnesota Agricultural Inspectors Association Annual Meeting, Baudett, MN. (Audience: 45 participants). Reichenbach presented, Gupta co-developed content, much of the content was borrowed from this project.
- During the MN State Fair this year, the Palmer amaranth banner, developed and used for this project, was on display in the 4-H building as part of the augmented reality invasive species display. (To learn more about this award winning project please view this 2018 video: https://youtu.be/9L8cIMo6DuQ) We improved and expanded the display in 2019 and added augmented reality to the Palmer amaranth

banner (see Zappar app code below that looks like lightening, if you download the Zappar app to a smart device you can see the augmented realty content). During the Minnesota State Fair, a total of 3,356 zaps (scans) were recorded in the exhibit for a total of 31 hours of time spent exploring within the AR scenes across the 12 State Fair days.

Staff Updates & Staff Awards

- Dawn Littleton ended her tenure with UMN Extension, as anticipated, on June 30. Monika Chandler and the MDA team on this project have been WONDERFUL throughout Dawn's medical and work trials.
- **AWARD**: I'm delighted to report that Monika Chandler received the Minnesota Epsilon Sigma Phi Pi Chapter Friend of Extension award this year for her dedicated, professional and lasting contributions to Extension's invasive species programming. Please join me in congratulating Monika!
- **AWARD**: I, Angela Gupta, won the Visionary Leadership Award from the Minnesota Epsilon Sigma Phi Pi Chapter, in part because of work done on this project.

Media & Program Awards

- **AWARD**: Exhibit Award for Invasive Species Augmented Reality. National Association of Extension 4-H Agents Professional Communicator Award. Team members: Margo Bowerman, Bradley Rugg, Angela Gupta, Megan Weber, Lisa Anderson, & Jalil Shabazz. This included the Palmer amaranth augmented reality piece.
- **AWARD**: Exhibit for Invasive Species Augmented Reality. North Central Region-National Association of Extension 4-H Agents Professional Communicator Award Team members: Margo Bowerman, Bradley Rugg, Angela Gupta, Megan Weber, Lisa Anderson, Jalil Shabazz. This included the Palmer amaranth augmented reality piece.
- **AWARD:** Exhibit for Invasive Species Augmented Reality. Minnesota Association of Extension 4-H Youth Development Professional Communicator Award. Team members: Margo Bowerman, Bradley Rugg, Angela Gupta, Megan Weber, Lisa Anderson, Jalil Shabazz. This included the Palmer amaranth augmented reality piece.
- **AWARD:** Book, National Award winner (top 4 in the country) - "By Land and By Sea" (Invasive Species of Minnesota). The National Association of Agricultural Agents (NACAA) communications awards. 2019 Annual Conference. Fort Wayne, IN. Gupta collaborator. This included all the Noxious Weed eradicate invasive plants.
- Media: Black swallow-wort: http://www.lillienews.com/articles/2019/09/27/noxious-plant-taking-root-oakdale-washington-county
- Media: Black swallow-wort: https://www.messagemedia.co/aitkin/outdoors/home_garden/report-and-remove-black-swallow-wort-plant/article_e6fde7e6-e553-11e9-9c3c-47a1df7a90e7.html
- Early American Life magazine, Volume 50, No. 5. October 2019. Itchy Organic reader writing in column, with answer about Oriental bittersweet derived from this project.

Final Report Summary:

Project Results Use and Dissemination

University of Minnesota Extension led the education and outreach funded specifically by this project. Reaching 1,108 people via 11 workshops, field tours and public and professional presentations. Developed two national award winning videos: Planning invasive species events: Tips for working with volunteers and Planning invasive species events: Working with a natural resources professional. Created 14 innovative educational materials including: 3D-printed models of Palmer amaranth, Japanese hops and Grecian foxglove; pull-up banners for Palmer amaranth and giant hogweed; and identification kits available at the public library for Palmer amaranth, wild parsnip and Oriental bittersweet. Produced two new educational handouts and printed and distributed about 10,875 educational materials.

In addition, the University of Minnesota and Minnesota Department of Agriculture (MDA) team members won numerous national, regional and state awards for effort including this project, from across an impressively wide spectrum of content areas. There were 13 media pieces about project activities; 13 presentations or booths reaching 5,137 gardeners, tribal youth, Extension volunteers and others; and 30 presentations or posters at 14 different professional conferences representing a broad spectrum of expertise reaching almost 1,000 natural resource or invasive species professionals. Two professional, peer reviewed articles were published that reference this work. MDA organized and led 6 field tours, gave 43 presentations, provided project updates at 32 meetings, authored 14 articles, sent an annual report to stakeholders and trained Conservation Corps Minnesota crew members at multiple workshops each year.

Final Report Summary:
During this final reporting period Angela Gupta presented a one hour online presentation titled: Citizen science solving invasive species issues through early detection and management to 41 international foresters, mostly Canadians, through the Canada Institute of Forestry webinar series.

During the 4 years of this project, coming on the heels three years of work for Phase 1, it has had many long-lasting and national impacts demonstrated most clearly in the scope and scale of awards project team members have been included in, that, in part or whole, were possible because of this work. The videos produce for this project won the Gold award from the national Association of Natural Resource Extension Professionals. Monika Chandler won the Friend of Extension work from Minnesota Epsilon Sigma Phi (ESP) Pi Chapter, a National Extension fraternity. She was then nominated for a national ESP award. Angela Gupta was part of teams that won invasive species awards, including work or products developed through this project, from the National 4-H Association, National Association of Extension Agriculture Agents, and Angela won the Visionary Leadership Award from the MN ESP chapter. Several project team members were included in the Team Achievement Award presented at the Upper Midwest Invasive Species Conference in 2018.

In addition to winning awards, during the four years of this project, two peer reviewed articles have been published that include work from this project. There have been 13 media pieces from national to local outlets. Two new educational publications for Minnesotans were produced. Thirteen presentations or booths to various natural resource audiences reached 5,137 gardeners, tribal youth, prairie enthusiasts, Minnesota Master Naturalists, local decision makers, and many others. Team members presented three professional conference posters and 27 professional presentations at 14 different conferences, reaching almost 1,000 natural resource and invasive species professionals!

VI. PROJECT BUDGET SUMMARY:
A. ENRTF Budget Overview:

Budget Category	Amount	Overview Explanation
Personnel:	$ 126,759	Program coordinator and UAV scientist

Professional/Technical/Service Contracts:	$ 79,449	For video development and creation of quality display materials. Amendment request includes CCM invasive plant management work.
Equipment/Tools/Supplies:	$ 23,515	
Travel Expenses in MN:	$ 8,177	
Other: Bus rental	$ 1,100	
TOTAL ENRTF BUDGET:	**$ 239,000**	

Explanation of Use of Classified Staff: NA

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:
One 3 year full time Program Coordinator = 3 FTE; amendment request for health reasons, about 1 year full FTE; about 2 years of ½ FTE.
One single year 25% graduate student = 0.25 FTE
Total = 3.25 FTE; amendment request, new total: 2.25 FTE.

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF
Total FTEs = estimated 250 hours worked by contractors/2080 = 0.12 FTE; amendment request: ~1.12 FTE.

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
Extension will work to procure an additional $40,000 to support work related to this project from non-state funding sources (likely Federal, $35,000 and private, $5000).	$ 40,000	$5,300	Extension income funding for ISMTrack development and food for Weed 'em Out workshops.
Extension self-funded from program income	$9,609	$9,609	Printing of the new invasive species field guide By Land and By Sea.
Master Naturalist Foundation donation funds	$3,613	$3,613	Master Naturalist Instructor Institute on Invasive Species programming.
Federal Renewable Resource Extension Act funding	$115,000	$69,221	EmpowerU project funds that will likely impact these species.
State			
In-kind Services During Project Period: U of M: One Extension Educator at 10% time for 3 years ($18,700) Printing (MDA general funds $4,175)	$ 18,700	$18,700	Grant implementation including hiring Dawn and working on invasive plant program development.
TOTAL OTHER FUNDS:	**$ 186,922**	**$106,440**	

A. Project Partners:

Receiving funds: Angela Gupta (U of M) will lead the educational components. Brian Taylor (U of M) will lead the survey drone test. Monika Chandler (MDA) will lead survey, coordination of target species control with CCM and follow up monitoring. Brian Miller (CCM) will lead target species control activities. All organizations will provide in-kind equipment, facilities, and GIS/technical support.

Not receiving funds: We will draw from Extension's existing statewide base of volunteers which totals over 102,000 active, trained volunteers. We will collaborate with DNR and Mn/DOT, other federal and state agencies, counties, municipalities, and private landowners.

B. Project Impact and Long-term Strategy:

Preventing highly destructive invasive plant species from spreading throughout the state has an enormous impact. All of the selected species would become widespread without intervention. They would overtake habitats and be prohibitively costly to control on a large scale. Controlling these target species across property lines protects the investment by agencies such as Mn/DOT on their lands. Eradication is defined as target species absence for six years after the last seed was produced. Therefore, eradication must be achieved in a long-term effort and ongoing monitoring is critical. ENRTF funds will be leveraged for (1) Extension funding for online training development cost not included in this proposal and (2) federal funding for volunteer training.

Project partners are working closely with other agencies and land management organizations to optimize and integrate the use of the invasive species management software into invasive species work across the state in a variety of landscape. A comprehensive management inventory should help optimize management impacts while reducing costs.

Continued engagement and empowerment of trained volunteers to identify, detect, survey, monitor and manage invasive species as both immediate and long-term impacts. These volunteers are actively training others and management invasive species while also influencing local policies and action. Sustain engagement and additional outreach should continue to grow citizen understanding and action.

C. Funding History:

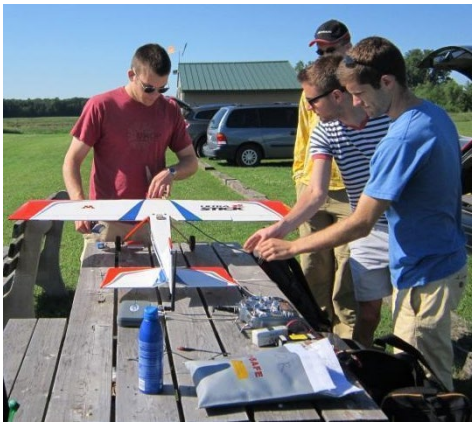
Funding Source and Use of Funds	Funding Timeframe	$ Amount
LCCMR Elimination of Target Invasive Plant Species (Phase 1) project $350,000 from ENRTF of which $135,000 was for MDA and $150,000 was for CCM and $65,000 UMN Extension. In-kind was $85,000 of which $20,000 was from MDA and $30, 000 from CCM.	07/01/2013-06/30/2015 LCCMR In-kind Total	 $ 285,000 $ 50,000 $ 335,000
DNR received $60,000 for early detection and rapid response invasive plant management. These funds were used for CCM crews to survey for and control some of our joint target plant species such as Japanese hops, cutleaf teasel and Oriental bittersweet.	2014 - 2015	$ 60,000
Winona Soil Water Conservation District received $15,000 from the Board of Water and Soil Resources to work on target invasive plant control and site restoration in Winona County	2014 - 2016	$ 15,000
Minnesota Department of Agriculture funded printing of 5,000 updated Department of Transportation Noxious Week booklets used in extensive training for ETIPS 2 audiences	June 2017	$4,125
UMN Extension supplied and was awarded travel scholarships for Angela Gupta to attend the IUFRO 125th Anniversary Congress in Freiburg, Germany. She presented on information including this project.	September 2017	$2,208

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: NA

IX. VISUAL COMPONENT or MAP(S):

Conservation Corps controlling Oriental bittersweet in Red Wing

Oriental bittersweet vines overwhelming and killing trees in Red Wing



Unmanned Aerial Vehicle Lab students will test a drone for survey

Training people to identify and report target species.

X. RESEARCH ADDENDUM: NA

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than November 30, 2016, May 31, 2017, November 30, 2017, May 31, 2018, November 30, 2018, June 2019, December 2019. A final report and associated products will be submitted between June 30 and August 15, 2020.

Environment and Natural Resources Trust Fund
M.L. 2016 Final Project Budget

Project Title: Elimination of Target Invasive Plant Species – Phase II
Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 06e2
Project Manager: Angela Gupta
Organization: University of Minnesota
M.L. 2016 ENRTF Appropriation: $ 239,000
Project Length and Completion Date: 3 Years, June 30, 2019
Date of Report: 10/27/2020

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activty 1 Final Revised Budget	Amount Spent 6/30/2020
BUDGET ITEM		
Personnel (Wages and Benefits)	$102,156	$102,156
Program Coordinator: ~~$161,350~~ $102,156 (73% salary, 27% benefits); 100% FTE each year for 3 years		
AmeriCorps Volunteer - includes 1 month AmeriCorps time for video production: $1,650		
UAV Scientist: ~~$22,700~~ $24,603 (66% salary, 34% benefits); 16% FTE for 1 Year		
Professional/Technical/Service Contracts		
Develop video for online training for Activity 1	$13,000	$13,000
Quality display materials and 5 invasive plant learning kits for check out by educators (schools, nature centers, master gardeners, etc.) and agency staff for outreach	$11,432	$11,432
CCM Contract		
Equipment/Tools/Supplies		
Materials for trainings and volunteer surveys (identification guides and survey equipment such as safety vests)	$17,001	$17,001
Tablets (20 @ $400 each) for field data collection for Activity 4 for with 10 tablets for Extension training sessions and Extension will provide 10 tablets to Conservation Corps. Tablet purchase is an exception to enable field use of a sophisticated database system.		
Supplies for Activity 2 survey drone test (will use existing U of M drone fleet and sensors)		
Travel expenses in Minnesota		
Travel for program coordination, U of M instructors and drone tests. Milage $5,624; lodging $1,300; meals $1,775	$5,579	$5,497
Other		
Bus rental for in-depth field training of 40 Master Naturalist instructors	$1,100	$1,100
COLUMN TOTAL	**$150,268**	**$150,186**

Activity 1 Balance 6/30/2020	Activity 2 Final Revised	Amount Spent 6/30/2020	Activity 2 Balance 6/30/2020	Revised Activity 3 Budget 1-22-2020	Amount Spent 6/30/2020
$0	$24,245	$23,396	$849		
$0					
$0					
				$55,078	$54,734
$0					
	$1,000	$712	$288		
$82	$1,500	$1,125	$375		
$0					
$82	**$26,745**	**$25,232**	**$1,513**	**$55,078**	**$54,734**
$82			$1,513		

Activity 3 Balance 6/30/2020	Activity 4 Budget 1/22/2020	Amount Spent 6/30/2020	Activity 4 Balance 6/30/2020	Revised TOTAL BUDGET 6/30/2020	TOTAL BALANCE 6/30/2020	Revised TOTAL BALANCE
				$126,401	$850	$850
				$13,000	$0	$0
				$11,432	$0	$0
$344				$55,078	$344	$344
				$17,001	$0	$0
	$5,812	$5,812	$0	$5,812	$0	$0
				$1,000	$288	$288
	$1,098	$1,098	$0	$8,177	$457	$457
				$1,100	$0	$0
$344	**$6,910**	**$6,910**	**$0**	**$239,000**	**$1,939**	**$1,939**
$344			$0		$1,939	

C