

GRANTEE: **FRIENDS OF THE YAMPA**

PROJECT NAME: **YAMPA RIVER LEAFY SPURGE PROJECT**

ROUNDTABLE: **Yampa-White-Green**

[NTP Date: 19 November 2018]

General Project Status

- All Tasks described in the Yampa River Leafy Spurge Project (YRLSP) are presently on schedule and within budget (budget summary appears below).
- In-kind contributions are accruing, as anticipated, from partners and additional cooperators.
- Another successful community outreach event was held in Maybell on January 7, 2020. Moffat County Weed and Pest provided dinner for attendees. NRCS (Craig Office) provided funding for venue rental and mailing invitations to approximately 175 land owners and community members, including Maybell Ditch water users. YRLSP and the University of Wyoming team provided updates on their work to the local community.
- Updates were provided to Routt & Moffat County Commissioners in December & January.
- Last year, leafy spurge was mapped along approximately 60 miles of the Yampa River, from Hayden through Little Yampa Canyon. Maps are best viewed on our web site: <https://www.yampariverleafyspurgeproject.com/maps>. We have begun work on contacting land owners for 2020 mapping access permissions in the reach from Duffy Mountain to Cross Mountain Canyon.
- Plans are in place with CDA for a YRLSP team to travel to the Front Range in late June to collect biological control insects to bring back to our project area in an effort to bolster local biocontrol insect populations. We are prepared for a Covid-19 delay until 2021, if necessary.
- A second biocontrol youth engagement event is tentatively planned for July 7-8, 2020 in collaboration with Routt and Moffat County CSU Extension, BLM and CPW, if it seems appropriate, given Covid-19 conditions.

| YRLSP BUDGET—SUMMARY—19 May 2020 | | | | | |
|--|-------------------|------------|-----|--|-------------------------------|
| CONTRIBUTOR | AMOUNT Committed | % of TOTAL | | AMOUNT Contributed or Invoiced To-Date | % of Total Project Commitment |
| CASH | | | | | |
| YWG Basin WSRF Request | \$ 89,000 | 54% | 54% | \$ 46,467 | 52% |
| Moffat County | 15,000 | 9% | 26% | \$ 15,000 | 100% |
| Routt County | 15,000 | 9% | | \$ 15,000 | 100% |
| University of Wyoming | 12,572 | 8% | | \$ 6,286 | 50% |
| IN-KIND | | | | | |
| YRLSP volunteers | 20,000 | 12% | 20% | \$ 17,740 | 89% |
| Other Partners (BLM, NPS, TNC, CDA, CPW, Moffat County, Routt County, CSU Extension) | 14,000 | 8% | | \$ 11,762 | 84% |
| TOTAL PROJECT COST | \$ 165,572 | | | | |

Status of Tasks Identified in the Statement of Work

Task #1 [\$40,900 allocated from CWCB/YWG Basin account—45.5% invoiced—estimated percent completion for Task #1 = 40%]

Develop a watershed scale management framework for leafy spurge in the Yampa Valley through mapping and predictive modelling.

This task involves two distinct components:

1. Field mapping of leafy spurge in riparian habitat along the Yampa River—conducted by YRLSP volunteers.
2. Geospatial analysis, remote sensing and predictive modelling—conducted by the University of Wyoming.

Field Mapping Report

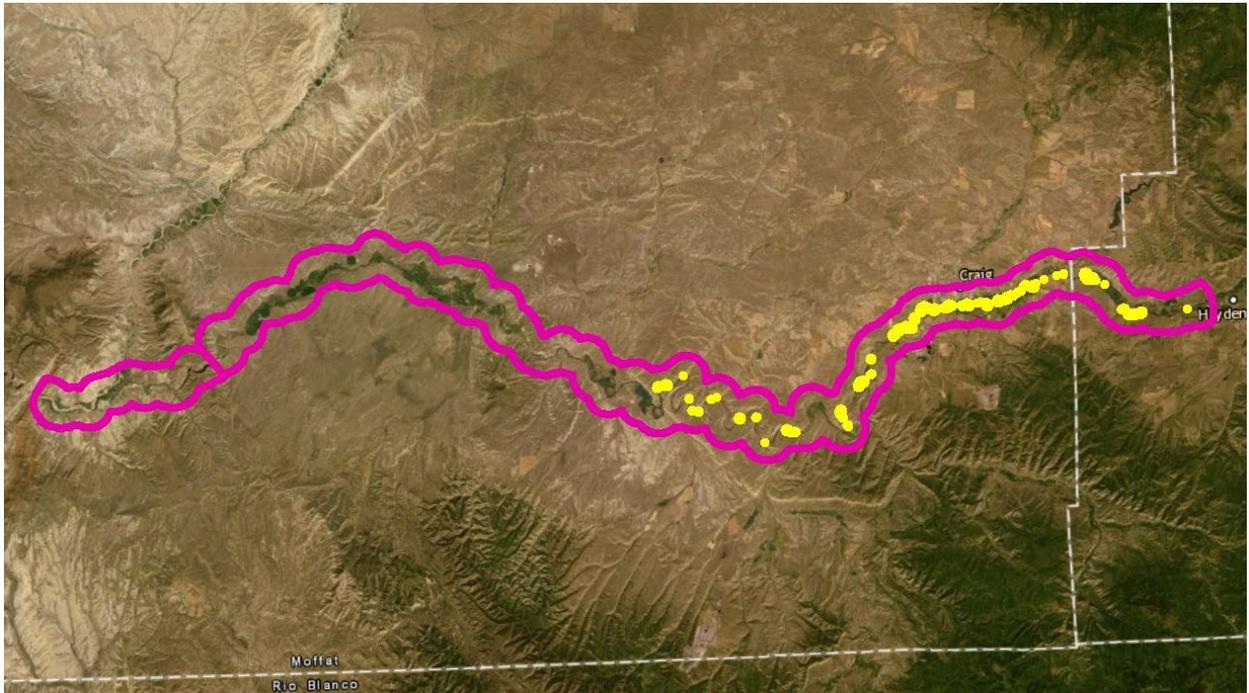
- YRLSP volunteer Peter Williams developed and maintains GIS products and systems to facilitate field mapping of leafy spurge, using electronic tablets.
- YRLSP volunteers John Husband and Ben Beall developed a landowner permission/access form and tracked down busy landowners to seek permission for field mapping of approximately 60 miles of the Yampa River from Hayden through Little Yampa Canyon in 2019. Landowners and/or managers granted permission for accessing land along the river for mapping and data sharing on approximately 80 percent of that 60-mile distance.
- In 2019, Peter Williams and Ben Beall, with logistical assistance from additional volunteers, mapped leafy spurge along both banks (where permission allowed) of that same 60-mile reach. The maps resulting from this work are available on the YRLSP web site: <https://www.yampariverleafyspurgeproject.com/maps>.
- Leafy spurge mapping data were provided to the University of Wyoming for use in their spatial analysis and predictive modelling work.
- Plans for 2020 include seeking additional access permissions from landowners and continuing field mapping downstream from Little Yampa Canyon to Cross Mountain Canyon and, if time allows, from Cross Mountain Canyon to Dinosaur National Monument. Approximately 50 landowners have been contacted by mail and access permission forms are beginning to come back. Mapping will occur in July.

University of Wyoming Report

(Submitted by Chloe Mattilio and Dan Tekiela, PhD – University of Wyoming,
Department of Plant Sciences – 5 May 2020)

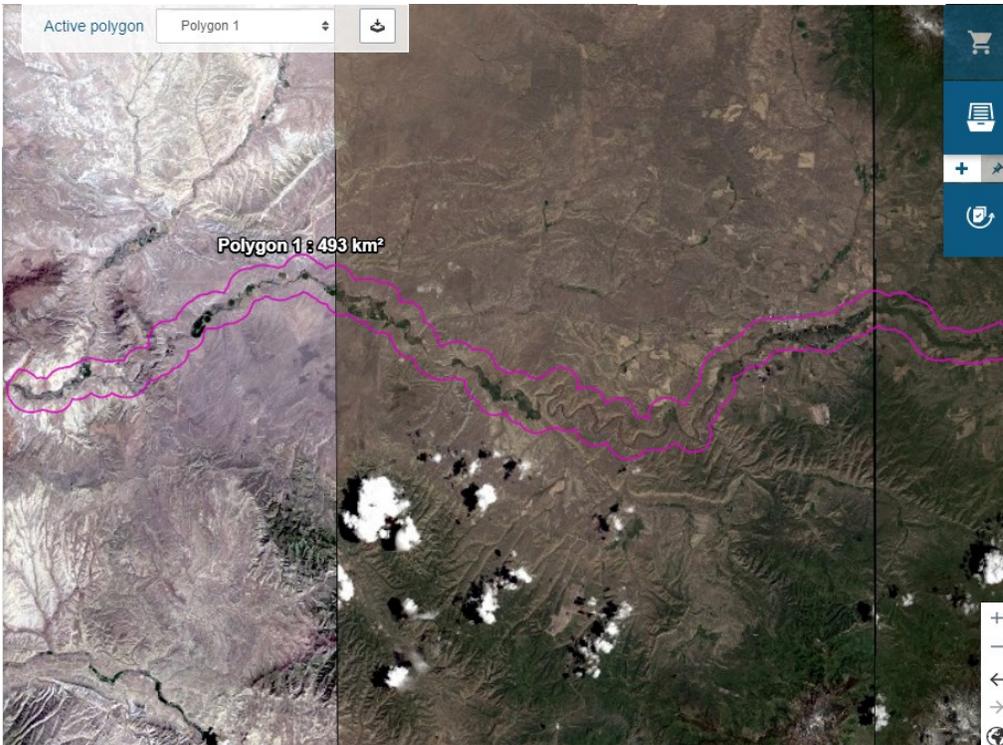
Update on Remote Sensing Imagery for Yampa River Leafy Spurge Mapping

1. We have trimmed down our Area of Interest (AOI), shown below, with the outline of the study area in pink, and current 2019 spurge presence mapping in yellow.



This brought the cost of imagery down significantly and kept our efforts (and analysis) focused on the Yampa River.

2. We evaluated imagery samples, comparing visual reflectance in the imagery with mapped spurge presence points, with successful differentiation of spurge in the multispectral imagery.
3. We purchased our first imagery set (Imagery overview picture below, extent outlined in pink)



This is SPOT satellite imagery from L3Harris Geospatial. It was collected on July 3rd and 9th, 2019 (causing the difference in illumination, shown by the seam), with the following parameters:

- **Product Description:** Standard Archive Imagery
- **License:** Educational
- **Product Type:** 1.5m Pan + 6m MS 4-band bundle
- **Geometric Processing:** Orthorectified and Mosaiced (level 3B)
- **Accuracy:** <4 m CE90
- **Projection (coordinate system); Datum; Units:** UTM; WGS84; meters
- **Format:** GeoTIFF
- **Bit Depth:** 16 bits / band

| Part Number | Description | Unit Price | Units | Discount | Extended Price (USD) |
|-------------|---|------------|-------|------------|----------------------|
| 801SATE0495 | Airbus DS SPOT 6/7 - 1.5 meter Color Standard Archive Imagery | \$4.75 | 493 | \$1,170.87 | \$2,341.75 |
| | July 2019 Imagery | | | | |
| 800SERV0057 | Orthorectification | \$0.50 | 493 | | \$246.50 |
| | Sub Total | | | | \$2,588.25 |
| | Discount | | | | \$1,170.87 |
| | Sales Tax | | | | \$0.00 |
| | Total | | | | \$1,417.38 |

We purchased this on an educational license, which gave us a discount on data, and the total cost came out to \$1,417.38

Imagery, processing, data training, and classification will occur, with the following steps:

- Pan-sharpening imagery (using 1.5m pixel panchromatic band to resample 6m pixel multispectral band,
~ 4m pixel multispectral image, for further work.
 - Digitizing spurge presence locations in purchased imagery, using visual estimates, to build Yampa River leafy spurge training samples and spectral reflectance profile.
 - Classify imagery, using training reflectance data, and assess classification accuracy.
 - Compare classification output to presence of leafy spurge mapped by YRLSP efforts.
4. Finally, with the reduced cost of data, we may consider purchasing additional dates of the same or similar imagery. This may improve leafy spurge classification accuracy by capturing asynchronous timing and duration of leafy spurge bloom.

**Task #2 [\$40,800 allocated from CWCB/YWG Basin account—55.5% invoiced—
estimated percent completion for Task #2 = 50%]**

Identify best integrated management practices for reducing leafy spurge seed production in riparian habitat in the Yampa Valley.

YRLSP received permission to access many private parcels for research purposes. The University of Wyoming team found suitable conditions on two private parcels, one Moffat County parcel, and one Colorado Trust Land parcel. We are grateful for the amount of community support received from landowners and public agencies. One of the private parcels was withdrawn from the study due to changing management priorities of the landowner.

University of Wyoming Report

(Submitted by Hannah Kuhns – Master’s student – University of Wyoming, Department of Plant Sciences – 1 May 2020)

Since preliminary data exploration, I have worked primarily on consolidating the data to most effectively analyze it. For parameters like percent cover, this can be done simply by averaging across the sites; however, when working with the stem and seed counts, I chose to represent that data in terms of mature stems i.e. the stems capable of producing seeds. To do this, I had data recorded for how many stems of the subset used to quantify seed production were first year growth or too far senesced. For example, of the randomly selected ten stems in each quadrat that were used to quantify seed production sometimes all of the stems were capable of seed production i.e. 100% mature stems. In other cases, fewer than the total were capable of seed production e.g. only seven of the ten stems were capable of seed production i.e. 70% mature stems. This mature stem percentage was then applied to the total stem count for each quadrat. From there, I averaged across the five quadrats per plot (treatment) and then further averaged across all sites based on treatment. Finally, when calculating total seed production for a given unit of area, I was able to apply my average seed count per stem to the total mature stem count.

In order to analyze the data, I built ANOVA models to statistically analyze the data. Each model has one response variable (e.g. leafy spurge percent cover, mature stem count, etc.) and two factors (grazing and herbicide). I also included an interaction term between the grazing and herbicide factors because the herbicide treatments were applied after the grazing treatment, essentially nesting the herbicide factor within the grazing factor. All models were run in JMP Pro 14.

Leafy spurge percent cover (Figure 1) was significantly reduced by the grazing treatment ($p = 0.0173$). There was no effect of herbicide treatment alone on leafy spurge percent cover ($p = 0.7079$). Mature stem count (Figure 2), burst seed counts (Figure 3), capsule seed counts (Figure 4), and bract seed counts (Figure 5) were not significantly impacted by either the grazing or herbicide treatment ($p = 0.8062, 0.8567, 0.7177, \text{ and } 0.6645$, respectively).

The germination trials I conducted along temperature and moisture gradients last fall were not fruitful. There was less than 1% total germination across the two trials I did, prompting me to think about how to improve the project. Likely, there is an afterripening component that was not included, due to time constraints. An afterripening consideration that could be applied is storing

the seeds at a cold temperature over a period of three or four months, essentially inducing an overwintering period.

Future directions: I am currently planning on collecting the same data (percent cover, stem counts, and seed counts) again this summer. Due to Covid-19 pandemic, the University of Wyoming has suspended all field research through July 30, 2020. However, there is an exemption request process for mission critical research. The exemption request form was submitted on April 29, 2020 with a stipulation for collecting the second-year data at the end of July in order to most effectively capture any change in the leafy spurge populations due to treatment.

For the germination trials, I am planning on collecting leafy spurge seeds from this growing season, subjecting them to an afterripening treatment (as described above), and running more trials in January 2021.

I have also been exploring ideas related to leafy spurge vegetative propagules, mainly, the root system/root fragments and exposure to moisture. In the Yampa River Valley, although leafy spurge populations spread directly to the riverbank and potentially provide some amount of bank stabilization, I have personally witnessed the extensive erosion and sloughing off of bank sides into the river. This phenomenon got me thinking about root fragments as an additional plant component with the potential for being dispersed via water and establishing new populations. Leafy spurge roots produce root buds, which can produce shoots/new plants. Leafy spurge root fragments are known to regenerate root buds and I am interested in exploring the relationship between root fragment size, submergence time, and root bud formation. I will collect root material this growing season and conduct laboratory/greenhouse experiments to deduce an answer.

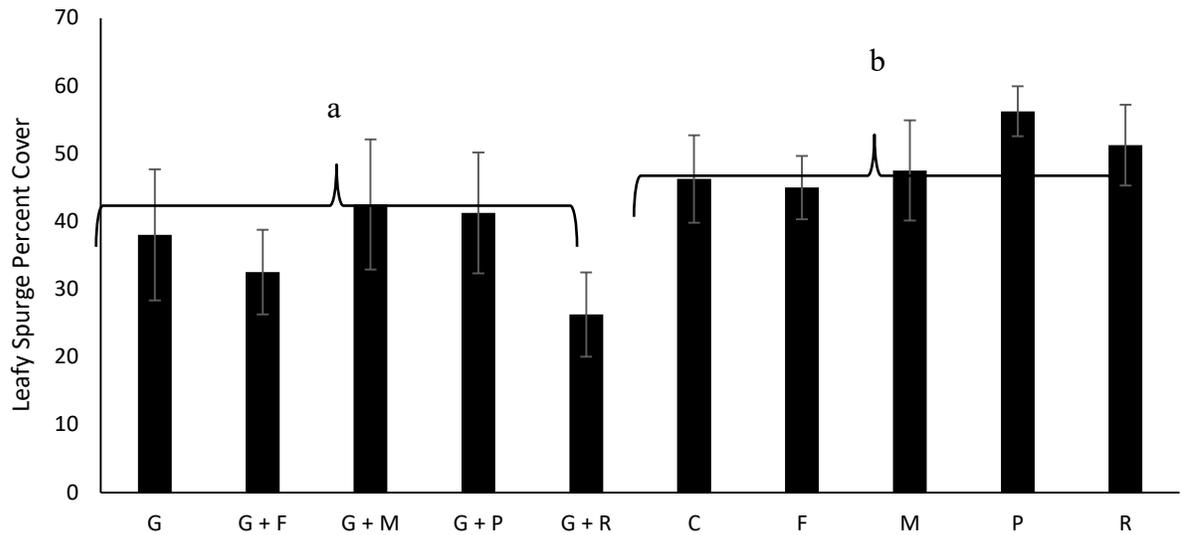
Figures:

Figure 1. Leafy spurge percent cover for each treatment, averaged across four sites. Error bars represent standard error. G = grazed, G + F = grazed + Facet L, G + M = grazed + Milestone, G + P = grazed + Plateau, G + R = grazed + Rinskor, C = control, F = Facet L, M = Milestone, P = Plateau, R = Rinskor. The early season grazing treatment significantly reduced leafy spurge percent cover ($p = 0.0173$) while the herbicide treatments on their own had no effect ($p = 0.7079$)

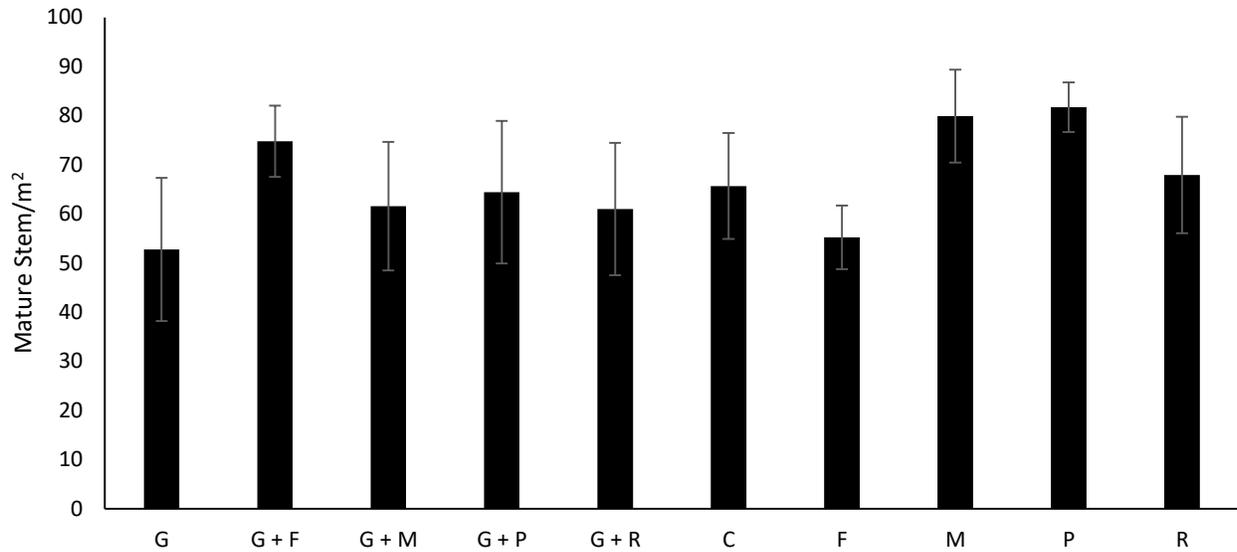


Figure 2. Leafy spurge mature stem counts/m² for each treatment, averaged across four sites. Error bars represent standard error. G = grazed, G + F = grazed + Facet L, G + M = grazed + Milestone, G + P = grazed + Plateau, G + R = grazed + Rinskor, C = control, F = Facet L, M = Milestone, P = Plateau, R = Rinskor. There is no significant effect of grazing or herbicide on mature stem count/m² ($p = 0.8062$).

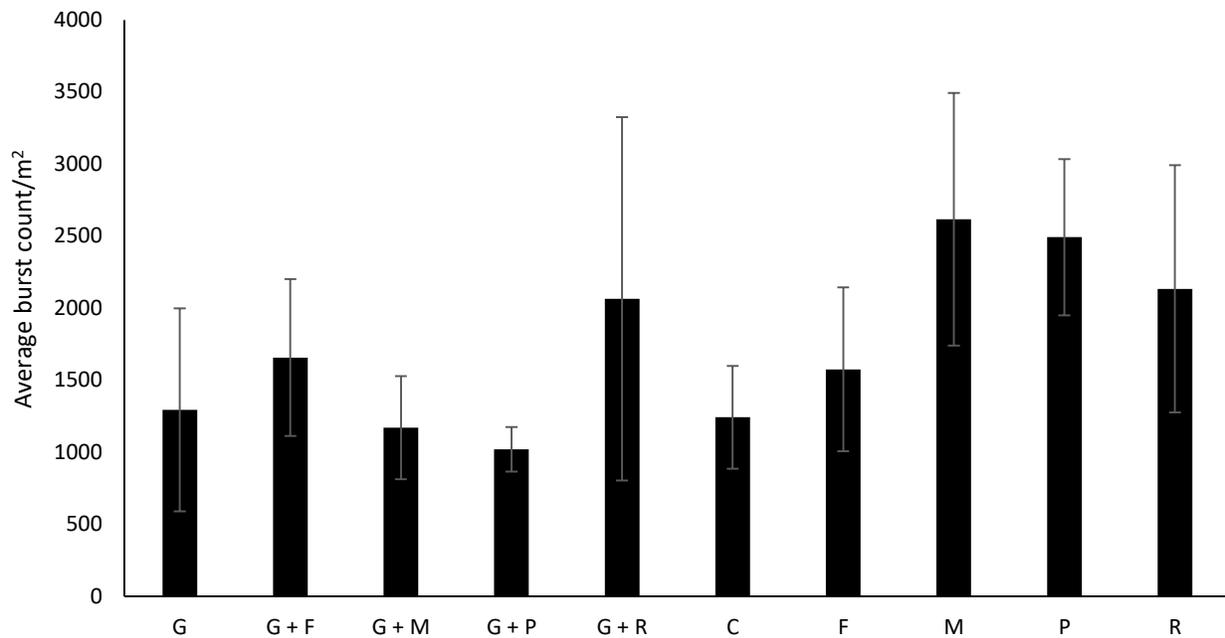


Figure 3. Leafy spurge burst seed counts/m² for each treatment, averaged across four sites. Error bars represent standard error. G = grazed, G + F = grazed + Facet L, G + M = grazed + Milestone, G + P = grazed + Plateau, G + R = grazed + Rinskor, C = control, F = Facet L, M = Milestone, P = Plateau, R = Rinskor. There is no significant effect of grazing or herbicide on burst seed count/m² ($p = 0.8567$).

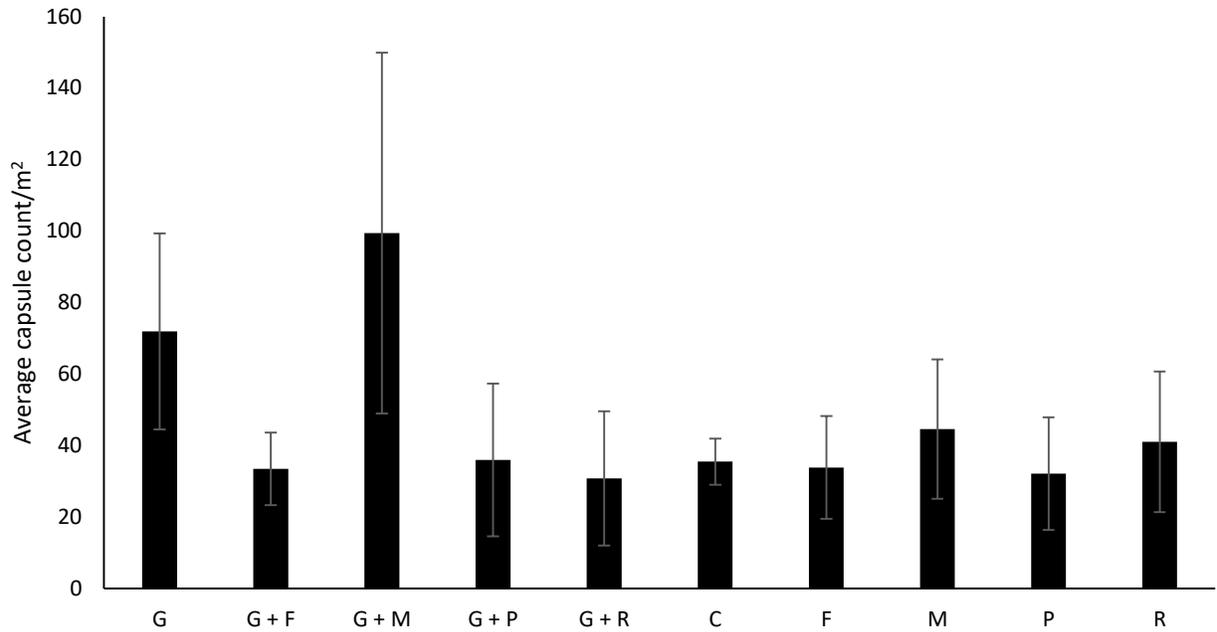


Figure 4. Leafy spurge capsule seed counts/m² for each treatment, averaged across four sites. Error bars represent standard error. G = grazed, G + F = grazed + Facet L, G + M = grazed + Milestone, G + P = grazed + Plateau, G + R = grazed + Rinskor, C = control, F = Facet L, M = Milestone, P = Plateau, R = Rinskor. There is no significant effect of grazing or herbicide on capsule seed count/m² ($p = 0.7177$).

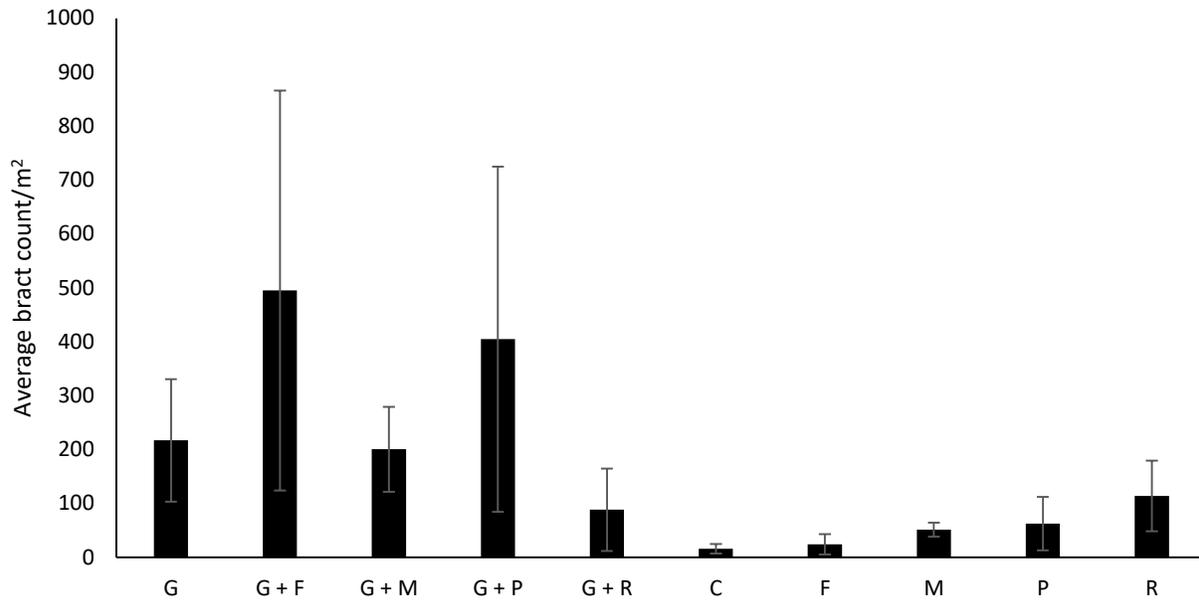


Figure 5. Leafy spurge bract seed counts/m² for each treatment, averaged across four sites. Error bars represent standard error. G = grazed, G + F = grazed + Facet L, G + M = grazed + Milestone, G + P = grazed + Plateau, G + R = grazed + Rinskor, C = control, F = Facet L, M = Milestone, P = Plateau, R = Rinskor. There is no significant effect of grazing or herbicide on bract seed count/m² ($p = 0.6645$).

Task #3 [\$ 3,000 allocated from CWCB/YWG Basin account—65.6% invoiced—estimated percent completion for Task #3 = 40%]

Education and Outreach—Engage youth in the Yampa River Leafy Spurge Project, using biological control as a means to encourage learning, participation and productive involvement.

Responsibility for completing Task #3 lies with YRLSP volunteers and partner agencies.

- CSU Extension—Moffat and Routt Counties
- Colorado Parks and Wildlife
- Colorado Department of Agriculture
- BLM—Little Snake Field Office

In July, 2019, the YRLSP sponsored a two-day kids' workshop on invasive weeds and biological control. Partner agencies contributed time and expertise to ensure the Boys and Girls Club kids had a quality educational and fun experience. Kids spent a half day of invasive weed orientation at Loudy Simpson Park in Craig. They were joined by Routt County Master Gardeners for a second day of leafy spurge biocontrol field science at the Highway 40 Rest Area between Hayden and Craig. The event wrapped up with a picnic lunch and good reviews from the young field scientists. More photos are available on the YRLSP web site: <https://www.yampariverleafyspurgeproject.com/events>.



The success of the 2019 youth engagement event has encouraged YRLSP partners plan and host a similar event in 2020.

YRLSP volunteer Peter Williams and Colorado Department of Agriculture (John Kaltenbach) worked together to develop an educational information sheet on leafy spurge biological control insects presently available for use in managing leafy spurge. This document is available for download from the YRLSP website:

<https://www.yampariverleafyspurgeproject.com/resources>

YRLSP volunteers collected information from a variety of sources to document historical releases of biological control insects in Moffat and Routt Counties. This effort yielded 44 records on 42 sites, dating back as far as 1989 (30 years). In July, 2019, YRLSP volunteer Tamara Naumann tracked down 23 records on 21 sites in the field, with help from Tyler Jacox (CPW), Chris Rhyne (BLM), John Husband (YRLSP), Jesse Schroeder (Moffat County), Hannah Kuhns (UW) and Todd Hagenbuch (CSU Extension). Each site was evaluated, using a field protocol developed with assistance from John Kaltenbach (CDA). Results are summarized below.

- 13 sites still had spurge *and* leafy spurge biocontrol beetles (see table below)
- 6 sites had clearly been sprayed with herbicide and now support little or no leafy spurge—most of these are now occupied primarily by annual weeds
- 1 site was an older record with obviously incorrect coordinates, so its history could not be reliably assessed
- 1 site was inaccessible (island in a pond), so could not be assessed (although leafy spurge was visible on the island)

| Site Name | Release Year | Spurge Density | Years Since Release |
|----------------------|--------------|----------------|---------------------|
| ROUTT COUNTY | | | |
| YRSWA 19 | 1991 | Moderate | 28 |
| YRSWA 6 | 1994 | Low | 25 |
| YRSTL 9 | 1997 | Moderate | 22 |
| J Quarter ○ 4 | 1998 | Low | 21 |
| YRSWA 20 | 1999 | Low | 20 |
| YRSTL 22 | 2008 | Moderate | 11 |
| YRSWA 34 | 2016 | Low | 3 |
| YRSWA 37 | 2016 | Low | 3 |
| MOFFAT COUNTY | | | |
| BLM CR38 43 | 2016 | High | 3 |
| FOURMILE 42 & 44 | 2016 & 2017 | Moderate | 3 & 2 |
| PEROULIS N 33 | 2016 | High | 3 |
| PEROULIS S 41 | 2016 | Moderate | 3 |
| WAGNER | 2016 | High | 3 |

These preliminary results were surprising because many people believed that local biological control efforts had failed. Although a sample size of 13 sites is small, it is notable that *ALL* of the visited sites that still support leafy spurge also support small numbers of biological control insects. These results are encouraging.

As observers visited an increasing number of these sites during the field season, a possible pattern began to emerge with respect to the appearance of sites occupied by biological control insects. While it is not possible to know with certainty how each of the sites looked at the time of release (because no photos or quantitative data were recorded), standard procedure for biological control involves using this management tool in areas where large, dense weed populations are present. It is reasonable to assume that historical release sites supported large, dense leafy spurge populations in most, if not all cases. Currently, most of the sites support low or moderate spurge densities, especially on sites where biocontrol insects were released more than three years prior. A significant proportion of these sites present with stunted, non-flowering individual spurge plants distributed throughout a matrix of more desirable vegetation. Scattered small patches of dense, flowering leafy spurge also occur in many of these sites. The small sample size precludes definitive conclusions regarding efficacy of biocontrol in local riparian environments, but this pattern is consistent enough to suggest it may be beneficial to work toward enhancing local biological control efforts, including a more robust program of monitoring for efficacy.

All of the identified sites proximate to the mainstem Yampa River were visited in 2019. Plans for 2020 include visiting an additional dozen sites scattered around the area (pending access permission). Data will be collected using the protocol developed in collaboration with the Colorado Department of Agriculture. The protocol is available on the YRLSP website: <https://www.yampariverleafyspurgeproject.com/resources>. A companion digital version of the data sheet facilitates field data collection on tablets and subsequent data management.

It is notable that the leafy spurge mapping crew detected biocontrol insects in areas along the Yampa River that are significantly distant from known biocontrol release sites. This suggests that biocontrol agents have been present and active in the Yampa Valley for some time, possibly for nearly three decades. If biocontrol agents have been active in the Yampa Valley for +/-30 years, as it now appears, it is possible that the leafy spurge infestation has been thwarted to some degree over this same period of time.

The Colorado Department of Agriculture (John Kaltenbach) has made additional leafy spurge biological control insects available to the YRLSP, free of charge, in exchange for the data we are collecting on historical and current release sites. As a result, five new biocontrol releases occurred in 2019—four on the Yampa River SWA and one adjacent to the Hwy 40 Rest Area between Hayden and Craig. Data and photographs were collected at the time of release.

YRLSP will work with interested partners and private landowners in the coming years to identify appropriate sites for release of additional biological control insects in the future. The overarching goal would be to provide a rapid and significant boost to the biocontrol insect population in the Yampa Valley. CPW has secured funding for purchase of biocontrol insects from Montana for release on five new sites on the State Wildlife Area with assistance from volunteers in 2020. Moffat County has also provided funding to make additional biocontrol insects available in 2020.

Several YRLSP volunteers plan to travel to the Front Range to collect enough biocontrol insects for an additional five new release sites this year. These plans may need to be revised, given Covid-19 pandemic conditions, but we are hopeful that it will be possible to stay on track. Data will be collected for each new release site, using the protocol developed with CDA.

IN-KIND MATCHING SUMMARY—YRLSP Partners

Yampa River Leafy Spurge Project—CWCB Water Supply Reserve Fund grant—18 Month Progress Report 5-19-2020

Partner In-kind Contributions—Cumulative since project NTP date (19 Nov 2018)

| PARTNER | DESCRIPTION | Human Resources | | | Services & Materials | | | percent of total commitment |
|---------------|--|-----------------|-------------|-------|----------------------|-------|-------|-----------------------------|
| | | hours | hourly rate | TOTAL | unit | value | TOTAL | |
| TNC | (Geoff Blakeslee) | | | | | | | |
| | Lodging for UWYO graduate students and/or faculty at Carpenter Ranch, as needed, @ \$50 per person per night | | | | 16 | 50 | 800 | 40% |
| | Staff time for planning, coordination, meetings, assigned tasks, etc. | 7 | 45 | 315 | | | | 32% |
| YRLSP | volunteers (Ben Beall, Tamara Naumann, Peter Williams, John Husband and . . .) | | | | | | | |
| | Meetings and coordination related to grant-specific activities | 215 | 20 | 4,300 | | | | 72% |
| | Field Mapping, GIS, data processing and map production | 344.5 | 20 | 6,890 | | | | 69% |
| | Labor for youth engagement/biocontrol project | 327.5 | 20 | 6,550 | | | | 164% |
| BLM | (Chris Rhyne) | | | | | | | |
| | Staff time for planning, coordination, implementation, etc. | 35 | 65 | 2,275 | | | | 114% |
| | Materials and supplies for grant-specific activities | | | | 360 | 0.5 | 180 | 72% |
| NPS | (Emily Spencer) | | | | | | | |
| | Staff time for planning, coordination, implementation, etc. | 5 | 35 | 175 | | | | 9% |
| | Materials and supplies for grant-specific activities | | | | | | 150 | 60% |
| CPW | (Tyler Jacox) | | | | | | | |
| | Staff time for planning, coordination, implementation, etc. | 43 | 30 | 1,290 | | | | 121% |
| | Materials and supplies for grant-specific activities | | | | | | 532 | |
| CDA | (John Kaltenbach) | | | | | | | |
| | Staff time for planning, coordination, implementation, etc. | 33 | 28 | 924 | | | | 51% |
| | Materials and supplies for grant-specific activities | | | | 3 | 30 | 90 | |
| ROUTT County | (Todd Hagenbuch—CSU Extension & Greg Brown—Routt County Weed Dept) | | | | | | | |
| | Staff time for planning, coordination, implementation, etc. (Hagenbuch) | 16.5 | 35 | 578 | 35 | 3 | 105 | 107% |
| | Staff time for planning, coordination, implementation, etc. (Brown/Carls) | 9 | 75 | 675 | 1 | 500 | 250 | |
| MOFFAT County | (Jessica Counts—CSU Extension & Jesse Schroeder—Moffat County Weed & Pest Dept) | | | | | | | |
| | Staff time for planning, coordination, implementation, etc. (Counts) | 25 | 45 | 1,125 | 2 | 30 | 60 | 186% |
| | Staff time for planning, coordination, implementation, etc. (Schroeder) | 28 | 30 | 840 | | | 760 | |