Causey Knapweed Project Report – Updated Spring 2022

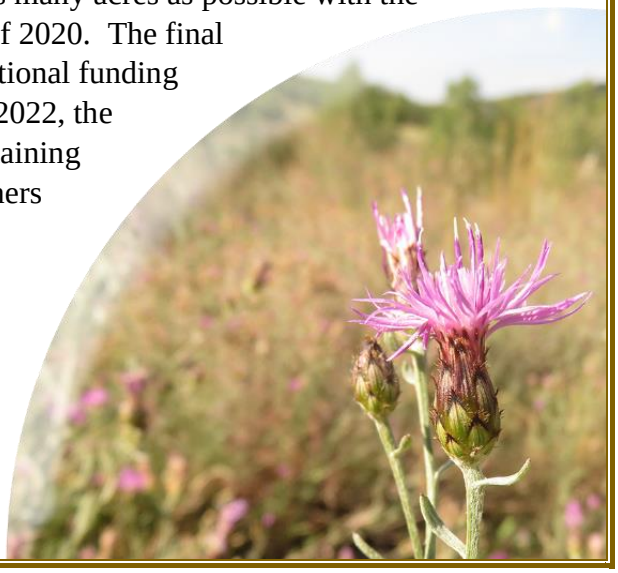
The purpose of this report is to inform the landowners that were part of this project regarding the actions that have been taken by Morgan Mendenhall (Bear River Area Forester – Utah Division of Forestry, Fire, and State Lands) to treat a variety of weed infestations in the Causey area of Weber County. The final goal of this project is to assist the landowners in the area with the control of noxious weeds on various properties in order to allow the landowner to continue the project at routine maintenance level treatments indefinitely.

Project History

In the summer of 2017, large infestations of spotted knapweed (*Centaurea stoebe*) and diffuse knapweed (*Centaurea diffusa*) were found on three separate properties in the Causey area of Weber County. Biocontrol agents were acquired free or at low cost from various sources and released in the fall of 2017 on all three properties. Infested acres were estimated at 200 and a grant was acquired from the Utah Department of Agriculture and Foods (UDAF) Invasive Species Mitigation (ISM) to treat the known knapweed infestations and various other noxious weeds for $57,080 beginning in spring 2018. The original Phase I grant was more than enough to treat the expected 200 acres with a total estimate of 337 acres treated from May-October 2018. Approximately $20,250 in funding was left over from the initial treatment and extended through June 30, 2019 to continue the project.

As a result of the Phase I project, current weed infestations were larger than expected and new infestations were frequently discovered. A Phase II proposal was funded again by the ISM grant for the July 1, 2019 to June 30, 2020 fiscal year for $54,217 with an estimated 559 acres in need of treatment. Once again, more weeds were found during treatment, and 1,495 acres were either treated or visited with herbicide for spot treatment.

With the increase in acreage of weed infestations, additional funding was sought for a Phase III grant of $48,155 from the ISM program. Although ISM was unable to fund the grant, they passed our application to the Utah Weed Supervisors Association (UWSA); which had received U.S. Forest Service funding to prioritize weed control projects that fall within Sage Grouse Management Areas (SGMAs). The grant request was reduced to $39,996 with an expected $40,000 in landowner/FFSL in-kind contributions. A two-month gap in funding from June 30, 2020 to August 27, 2020 resulted in an inability to treat weeds during that critical timing for spraying noxious weeds. Significant effort was made to treat as many acres as possible with the new funding and approximately 897 acres were treated in the fall of 2020. The final $28,000 available was spent through October 2021 with some additional funding becoming available in the fall for additional seed purchase. As of 2022, the Causey Knapweed Project will be considered finished and any remaining treatment costs/labor will become the responsibility of the landowners with continued technical assistance from FFSL as needed.



The information on the following pages provides detailed information such as methods, timing, and specific treatments for each of the three main properties involved in this project.

Sourdough Wilderness Ranch

The Sourdough Wilderness Ranch (SWR) is a unique property along Highway 39. Approximately half of the property is considered wilderness and does not have roads or access to the over 700 members that lease recreation sites throughout the other half of the property. There are approximately 50 miles of roads and trails throughout the property, which are used by the members numerous off-road and recreational vehicles that are also likely used throughout the State on trails and roads. The elevation of SWR ranges from 5,700 feet at the bottom to 7,800 feet near the very top with primarily south facing rangelands at lower elevations and gentle rolling forested areas near the top.

SWR has had weed control challenges for the entire 15 years they have been working with FFSL in both the Forest Stewardship and Wildland Urban Interface programs. For many years, some weed spraying was done by the ranch manager and multiple biocontrol releases were made on the more problematic Canada thistle infestations near Lake East, above the trailer storage area, and along the one-way cutoff road near the bottom of the property. In 2013, attempts were made to organize community wide weed spray days with some success, but with little member participation or interest in continuing the program on a regular basis. At that time, most weed infestations were relatively small along roadsides and fairly easy to access.

In the 5 years since that spray day attempt in 2013, weed populations continued to expand throughout the entire property. The following is a summary of each of the main weeds on the property and information that may be useful for future control efforts.

Spotted knapweed and diffuse knapweed are two very similar plants that are generally treated the same. Most of the knapweed on SWR is spotted knapweed. The presence of this weed is the primary reason funding was provided for this project due to the seriousness of this weed and the implications if the weed continues to spread throughout the State. Originally, the only known knapweed on this property was found across 10-20 acres around the lower switchback. This area was sprayed in 2013 and several biocontrol releases of seed weevils and root weevils have been placed in this area over the years. However; in the early years of the Causey Knapweed Project, it was found that knapweed had spread to several areas on the property and increased to approximately 200 acres. The primary infestation of knapweed is the entire elkhorn area and parts of chaparral circle. Nearly every roadside and many of the private lots have been infested with dense patches of knapweed. Many of these areas are so dense that all other plant species have been crowded out. Most concerning is the ATV course training area located at the entrance to elkhorn that was also heavily infested with knapweed at the beginning of this project. It is extremely likely that infested locations such as that ATV course will lead to a rapid expansion of knapweed into new areas on SWR as well as any other properties these vehicles go to recreate.

Fortunately, there is a highly effective herbicide for knapweed called Milestone. This is the same herbicide that works well on most thistles. In 2019 and 2020, nearly all the roadsides in the elkhorn area were treated including any abandoned lots or lots with owners around that agreed to let us spray their property. Although the entire area still remains infested with knapweed, many of the roadsides have seen tremendous progress using milestone. The project has focused on these high transmission areas such as roadsides and the

ATV course in order to reduce the amount of weed spread on the property. Unfortunately, many of the infestations have gone beyond the reach of ATVs or deep into occupied member lots that we could not spray. It is recommended that a focused effort to educate the members in this area and urge them all to spray their knapweed on their lots or develop a program to spray their lots for them. Although this infestation appeared unmanageable a few years ago, the knapweed is no longer increasing rapidly and could be controlled if the road spraying continued using the proper herbicides and the lot owners took care of their lots.

Dyer's woad and musk thistle were originally only found in a few locations, typically at lower elevations along roadsides, but has now increased to nearly every stretch of the 50 miles of road on the property; even at the highest elevations that are typically not suitable for these weeds. Both of these weeds are annual or biennial plants that can be easily controlled when sprayed in the rosette stage during early growth forms. Although it is more difficult to spot them during this time, it is one of the first plants out in the spring and can be easily sprayed by a trained eye using minimal herbicide. The cheapest and most effective herbicide we have found is 2,4-D used with an appropriate amount of surfactant. Other herbicides that we used regularly to decrease herbicide resistance were Escort/MSM and Dicamba. Milestone also appeared effective when it was sprayed on rosettes during knapweed or Canada thistle treatments. A biological control has been released in numerous locations between the ranch house to the top of the cutoff road to help reduce the populations of dyer's woad. It is a fungus that weakens plants and reduces seed production, but is not generally considered highly effective.

Although significant progress was made on dyer's woad and musk thistle during this project, seeds are easily spread by wind, animals, and vehicles and it has progressed well beyond the easily treated roadsides and into the steep rangelands. Some of these areas are available to spray with ATVs or UTVs with moderate risk of damage from rocks and steep slopes, however many areas are no longer accessible by vehicle and would either need crews with backpack sprayers or potentially aerial application if the infestations continue to get worse. Aerial application would be a logistical challenge given the wide spreading locations in addition to the numerous member lots within target areas and the potential for removing native plants and opening the habitat to more weeds. Because there has been no disturbance, the dyer's woad is becoming naturalized in many areas and occupies only about 5-10% of the available space. This is a natural adaptation to disturbance-based infestations. These plants are essentially spreading rapidly and dropping seed across the mountain, waiting for a large-scale disturbance that they could then capitalize and become the dominant species. As is evident in all of northern Utah, musk thistle and especially dyer's woad have essentially gone beyond our ability to control, but we should continue to aggressively treat any infestations we can access in order to slow the progress of the weed and limit new infestations on adjacent landowners and properties that our vehicles may visit in the future.

Canada thistle has drastically increased its presence on SWR from a small patch approximately 100 x 30 feet along the north shore of Lake East to completely surrounding the lake and the dam. Large infestations have popped up in every wet location such as Rock Creek and Cold Springs, while increasing significantly down by the cutoff road as well. Canada thistle is a very challenging weed to treat because it is both an aggressive perennial plant with deep root reserves that spread underground as well as a prolific seed producing plant that produces large amounts of fluffy seeds that disperse by wind. Higher elevations and wet areas are most conducive to infestation from Canada thistle. Many of the open areas north of Lake East around the burn pile have been infested as well as most of the roads from Lake East to Cold springs with several large pockets of infestations appearing in just the last few years. Any road work taking place in the upper elevations has been shown to rapidly become infested by Canada thistle and dyer's woad. This was particularly evident when the short road leading to Rock Creek from the main road was improved and graded. Both sides of the road became

heavily infested with Canada thistle despite FFSL efforts to reseed and spray this area.

Although Canada thistle is a very difficult weed to control, there have been some very noticeable successes in areas that were given consistent treatments and possibly due to the addition of biocontrol. The most effective herbicide we have found for Canada thistle is Milestone. Most research suggests fall is the best timing for spraying Milestone on perennial weeds such as Canada thistle. For this project, Milestone was part of the tank mix any time we were spraying areas that could be infested with Canada thistle or spotted knapweed; which included early spring spraying on dyer's woad and musk thistle. Our efforts focused on spraying Canada thistle locations essentially summer-long starting in June on any known locations and continuing that effort into the fall until approximately late September. Most efforts were focused on spraying all known weeds prior to flowering and seed production. Unfortunately, given the size of the property and the time/funding constraints, all plants were not always sprayed before they went to seed.

Several areas that were once heavily infested with Canada thistle such as around Norms Pond, cold springs, the lower cutoff road, and the north edge of Lake East have all shown dramatic improvement with grasses coming back to these areas that were once nearly 100% Canada thistle and are likely down to approximately 10% cover or less.

Dalmatian toadflax is found in a few minor locations at lower elevations on the property. There was once a large infestation that originated at the lower switchbacks just past the hanging tree trail. This has been sprayed many times with backpack sprayers and ATVs over the years with several rounds of biocontrol releases. Currently there are very few plants coming back in the spring from seed. The other location is directly west of the ranch house approximately half way up the hillside. This location is a relatively new infestation that is barely accessible by ATV with the necessity for backpack sprayers to get to higher locations. All known infestations have been sprayed either with ATV or backpack sprayer as well as biocontrol weevils that are very effective in other parts of the state; however, it is anticipated we will see more infestations of this weed continue to persist and invade new areas rapidly. Herbicides such as 2,4-D and Escort/MSM can be effective when sprayed at an early stage in the spring around May 15th and with an appropriate surfactant.

Whitetop is a relatively new weed for SWR and has proven to be one of the most difficult to control. The largest concentration is located in the small field between the ranch house and Norm's Pond. It is a perennial weed at a relatively low elevation on the ranch and will flower as early as late April in some year's making it problematic to control. It is also difficult to find until it goes to flower, at which point it will likely set seed even if it is sprayed and therefore continue the cycle. The largest infestation near the ranch house has been heavily sprayed in the spring from 2019-2021 using Escort with good results and a significant reduction in plants. However, new infestations on the east side of the main road near the trailer storage have been difficult to control and there a several infestations in the parking areas around the ranch house, down to the main gate, the pasture below Norm's Pond, the cutoff road, and elkhorn spring.

Escort/MSM is generally considered the most effective herbicide for whitetop. It should be sprayed in early spring when plants become visible or in known locations in the fall. Escort is a slightly difficult chemical to mix because it is a powder that needs an agitated tank for best results. This herbicide has the potential to kill grasses if over-applied, which defeats the purpose of spraying noxious weeds and can leave you with a barren landscape if you're not careful.

SWR Estimated Costs/Time to Implement Weed Control

The following information was consolidated in order to assist the landowner with estimated costs for future treatments if all the actions currently underway were continued into the future. Each section is listed by phase, not by year, but will give some indication on the amount of effort that may be necessary to control the weeds.

Phase I: June 2017-June2019		
Biocontrol	$1,700	Both purchased and freely available biocontrol were released on knapweeds, Canada thistle, and dalmatian toadflax. Typically cost/valued at $1/insect.
Herbicide	$1,623	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at SWR. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Contractor	$3,874	In 2019, a contractor was hired to assist with weed spraying efforts. This cost includes labor and herbicide to treat 75 acres. Results were unsatisfactory and the contractor was not hired in the following years.
Equipment	$300	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	222 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on SWR. It is likely an underestimate on the total time spent on the property to treat weeds.
Seed	180 lbs	Any known bare ground areas were seeded with a desirable grass mix in the fall of 2018.
Acres Treated	416 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times a year over the 2-year period.

Phase II: July 2019-June2020		
Biocontrol	$4,650	Both purchased and freely available biocontrol were released on knapweeds, Canada thistle, and dalmatian toadflax. Typically cost/valued at $1/insect.
Herbicide	$2,430	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at SWR. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Contractor	$4,250	In July 2019, the Utah Conservation Corp (UCC) was contracted to pull/spray dyer's woad and spotted knapweed. This cost includes a 5-person crew for 4 days focused in area above switchbacks.
Equipment	$877	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	199 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on SWR. It is likely an underestimate on the total time spent on the property to treat weeds.
Seed	250 lbs	Any known bare ground areas were seeded with a desirable grass mix in the fall of 2019.
Acres Treated	437 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times a year over the 1-year period.

Phase III: July 2020-September 2021		
Biocontrol	$2,000	Both purchased and freely available biocontrol were released on knapweeds. Typically cost/valued at $1/insect.
Herbicide	$1,250	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at SWR. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Equipment	$1,023	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	82 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on SWR. It is likely an underestimate on the total time spent on the property to treat weeds.
Acres Treated	367 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times over this short period.

Conclusions From The Causey Knapweed Project on Sourdough Wilderness Ranch:

It is estimated that we have been spending approximately **$1,800 per season on herbicide** to treat weeds on SWR. There are approximately **400 acres** on the property that are treatable by ATV/backpack and are likely to still have some weeds present. Our personnel have spent at least **200 hours per season** treating weeds on the property. These are the costs that would be relatively unavoidable should SWR continue to maintain their weeds. This could be entirely contracted or a combination of ranch employees, members, and contractors.

Actionable items SWR can implement to reduce infestations:

- Designate a single point of contact for weed control that is not a frequently changing elected position in order to provide long term consistency in weed management.
- Mandatory weed wash for all vehicles entering the property.
- Weed education for members that encourages proper weed identification and control methods.
- Implement a program that requires all activities that create bare ground (road grader, lot improvement, etc.) must be reseeded the first year they are disturbed, and a plan is in place to spray for weeds at least twice a year for two years
- Regular monitoring for new infestations. Possibly create a small taskforce or workgroup that can identify weeds and willing to travel all the roads and trails multiple times a year to record locations of infestations, which are then treated.
- Increase dependable water sources for weed control (significant time is wasted traveling back to a reliable water source).

Mountain Shadow

Mountain Shadow is a large property with the main entrance along the Skull Crack road just off of Highway 39 on the way to Causey Reservoir. There are approximately 15 miles of unimproved roads and over 12 miles of trails throughout the property, which are used by various visitors to the property for hunting, livestock management, and recreation. The elevation of Mountain Shadow ranges from 5,600 feet at the bottom to over 8,000 feet near the very top with primarily south facing rangelands at lower elevations and gentle rolling forested areas near the top. North faces and canyons are dominated by either maples or aspen with dense shrubs.

Mountain Shadow's weed issues peaked in 2016 around the time they began working with FFSL in the Forest Stewardship program. Although weed control efforts had been made in the past using primarily helicopter to spray musk thistle, the weeds continued to increase. Although the project originated as a possible musk thistle problem on the south side above the corrals, it became more apparent that in addition to the musk thistle, there were large infestations of spotted knapweed, dyer's woad, and Canada thistle.

Spotted knapweed and diffuse knapweed are two very similar plants that are generally treated the same. Most of the knapweed on Mountain Shadow is spotted knapweed; however, several patches of dense diffuse knapweed have been discovered at higher elevations along the main road on south facing aspects. The presence of this weed is the primary reason funding was provided for this project due to the seriousness of this weed and the implications if the weed continues to spread throughout the State. Originally, the only known knapweed on this property was found along the roads across 20 acres around the Wheeler Creek entrance. This area was sprayed in the fall of 2016 and several biocontrol releases of seed weevils and root weevils have been placed in this area over the years. However; in the early years of the Causey Knapweed Project it was found that knapweed had spread to several areas on the property and increased to approximately 150 acres. The primary infestation of knapweed continues to be the Wheeler Creek area especially along the roads north through the Bradshaw section. Other infestations have been found on south faces all the way down to Water Hollow on the south side. While every effort was made to treat these infestations prior to seed formation, plants were inevitably missed and populations will continue into the future unless they are aggressively treated. Currently, there is likely less than 10 acres of knapweed spread over a thousand acres and 15 miles of road. It is highly likely that infested locations along roads will rapidly increase again after any road disturbance or significant vehicle usage.

Fortunately, there is a highly effective herbicide for knapweed called Milestone. This is the same herbicide that works well on most thistles. From 2019-2021, nearly all the roadsides and accessible areas on Mountain Shadow were. Although these areas still remain infested with minor amounts of knapweed, many of the roadsides have seen tremendous progress using milestone. The project has focused on these high transmission areas such as roadsides and the ATV course in order to reduce the amount of weed spread on the property. Unfortunately, many

of the infestations have gone beyond the reach of ATVs or up steep hills that we could not spray. It is recommended that a focused effort to educate anyone who uses this property and urge them all to assist with spraying knapweed and ensure they are washing their vehicles after visiting the property to avoid spreading the weeds further. Although this infestation appeared unmanageable a few years ago, the knapweed is no longer increasing rapidly and could be controlled if a spraying program was implemented using the proper herbicides and correct timing.

Dyer's woad and musk thistle were originally only found on several hundred acres on the south side of the property, especially in the Water Hollow area round the corrals. It is a common weed found in any disturbed or heavily grazed locations especially on dry south faces. Both of these weeds are annual or biennial plants that can be easily controlled when sprayed in the rosette stage during early growth forms. Although it is more difficult to spot them during this time, it is one of the first plants out in the spring and can be easily sprayed by a trained eye using minimal herbicide. These weeds will begin to grow as early as mid-April on Mountain Shadow and continue to germinate and flower though July depending on moisture. The cheapest and most effective herbicide we have found is 2,4-D used with an appropriate amount of surfactant. Other herbicides that we used regularly to decrease herbicide resistance were Escort/MSM and Dicamba. Milestone also appeared effective when it was sprayed on rosettes during knapweed or Canada thistle treatments. A biological control has been released in numerous locations between the ranch house and along some of the ridges just off the main road to help reduce the populations of dyer's woad. It is a fungus that weakens plants and reduces seed production, but is not generally considered highly effective.

Although significant progress was made on dyer's woad and musk thistle during this project, seeds are easily spread by wind, animals, and vehicles and it has progressed well beyond the easily treated roadsides and into the steep rangelands. Some of these areas are available to spray with ATVs or UTVs with moderate risk of damage from rocks and steep slopes, however many areas are no longer accessible by vehicle and would either need crews with backpack sprayers or potentially aerial application if the infestations continue to get worse. A helicopter was used for aerial application in 2019 (250 acres), 2020 (330 acres), and 2021 (500 acres). While the amount of weed per acre was greatly reduced on these aerially treated acres, there are still scattered weeds in these areas that are definitely coming up from the extensive seed bank. While large areal applications are useful and recommended for dense populations there were unintended consequences of removing native plants and opening the habitat to more weeds. The herbicides typically damage or kill desirable perennial plants and shrubs, which forces the transition to entirely grass dominated habitats that may not be entirely desirable. Although most of the dense patches of dyer's woad were nearly controlled, it is becoming naturalized in many areas and occupies only about 5-10% of the available space. This is a natural adaptation to disturbance-based infestations. These plants are essentially spreading rapidly and dropping seed across the mountain, waiting for a large-scale disturbance that they could then capitalize and become the dominant species. As is evident in all of northern Utah, musk thistle and especially dyer's woad have essentially gone beyond our ability to control, but we should continue to aggressively treat any infestations we can access in order to slow the progress of the weed and limit new infestations on adjacent landowners and properties that our vehicles may visit in the future.

Canada thistle has a very small presence on Mountain Shadow despite much of the property being highly susceptible habitat for this species. The largest infestation was originally found around the Coal springs ponds completely covering about 2-3 acres. This area was heavily treated during this project in addition to several biocontrol releases and as of the fall of 2021, no Canada thistle was found at Coal springs. However, other small populations do exist on the property in wet areas near springs and ponds. Canada thistle is a very challenging weed to treat because it is both an aggressive perennial plant with deep root reserves that spread underground as well as a prolific seed producing plant that produces large amounts of fluffy seeds that disperse by wind.

Although Canada thistle can be a very difficult weed to control, there have been some very noticeable successes in areas that were given consistent treatments and possibly due to the addition of biocontrol. The most effective herbicide we have found for Canada thistle is Milestone. Most research suggests fall is the best timing for spraying Milestone on perennial weeds such as Canada thistle. For this project, Milestone was part of the tank mix any time we were spraying areas that could be infested with Canada thistle or spotted knapweed; which included early spring spraying on dyer's woad and musk thistle. Our efforts focused on spraying Canada thistle locations essentially summer-long starting in June on any known locations and continuing that effort into the fall until approximately late September. Most efforts were focused on spraying all known weeds prior to flowering and seed production. Unfortunately, given the size of the property and the time/funding constraints, all plants were not always sprayed before they went to seed. It is highly likely that with a continued diligent spray program, Canada thistle could be completely eradicated from this property.

Whitetop is a relatively new weed for Mountain Shadow and has proven to be very difficult to control. The largest concentration is located directly east of the borrow pit at the Water Hollow gate. Access to this area is easiest from the Skull Crack road. It is a perennial weed at a relatively low elevation on the property and will flower as early as late April in some year's making it problematic to control. It is also difficult to find until it goes to flower, at which point it will likely set seed even if it is sprayed and therefore continue the cycle. This infestation wasn't found until late 2019 and was heavily sprayed the next 2 years in the spring using Escort with good results and a significant reduction in plants.

Escort/MSM is generally considered the most effective herbicide for whitetop. It should be sprayed in early spring when plants become visible or in known locations in the fall. Escort is a slightly difficult chemical to mix because it is a powder that needs an agitated tank for best results. This herbicide has the potential to kill grasses if over-applied, which defeats the purpose of spraying noxious weeds and can leave you with a barren landscape if you're not careful.

Mountain Shadow Estimated Costs/Time to Implement Weed Control

The following information was consolidated in order to assist the landowner with estimated costs for future treatments if all the actions currently underway were continued into the future. Each section is listed by phase, not by year, but will give some indication on the amount of effort that may be necessary to control the weeds.

Phase I: June 2017-June2019		
Biocontrol	$5,500	Both purchased and freely available biocontrol were released on knapweeds, Canada thistle. Typically cost/valued at $1/insect.
Herbicide	$2,923	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at Mountain Shadow. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Helicopter Application	$3,892	Approximately 275 acres were sprayed with escort and 2,4-D using a local helicopter at a cost of around $14 acre targeting steep slopes with dyer's woad and musk thistle that were inaccessible by UTV.
Contractor	$7,103	In 2019, a contractor was hired to assist with weed spraying efforts. This cost includes labor and herbicide to treat 145 acres. Results were unsatisfactory and the contractor was not hired in the following years.
Equipment	$550	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	400 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on Mountain Shadow. It is likely an underestimate on the total time spent on the property to treat weeds.
Seed	325 lbs	Any known bare ground areas were seeded with a desirable grass mix in the fall of 2018.
Acres Treated	752 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times a year over the 2-year period.

Phase II: July 2019-June2020		
Biocontrol	$2,500	Both purchased and freely available biocontrol were released on knapweeds, Canada thistle, and Dyer's woad. Typically cost/valued at $1/insect.
Herbicide	$4,709	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at Mountain Shadow. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Helicopter Application	$4,620	Approximately 330 acres were sprayed with escort and 2,4-D using a local helicopter at a cost of around $14 acre targeting steep slopes with dyer's woad and musk thistle that were inaccessible by UTV.
Equipment	$1,700	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	385 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on Mountain Shadow. It is likely an underestimate on the total time spent on the property to treat weeds.
Seed	250 lbs	Any known bare ground areas were seeded with a desirable grass mix in the fall of 2019.
Acres Treated	847 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times a year over the 1-year period.

Phase III: July 2020-September 2021		
Biocontrol	$6,900	Both purchased and freely available biocontrol were released on knapweeds. Typically cost/valued at $1/insect.
Herbicide	$5,209	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at Mountain Shadow. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Helicopter Application	$6,750	Approximately 500 acres were sprayed with 2,4-D using a local helicopter at a cost of around $13.50 acre targeting steep slopes with dyer's woad and musk thistle that were inaccessible by UTV.
Equipment	$1,100	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	233 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on Mountain Shadow. It is likely an underestimate on the total time spent on the property to treat weeds.
Acres Treated	817 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times over this short period.

Conclusions from The Causey Knapweed Project on the Mountain Shadow property:

It is estimated that we have been spending approximately **$3,200 per season on herbicide** to treat weeds on Mountain Shadow. There are approximately **370 acres** on the property that are treatable by ATV/backpack and are likely to still have some weeds present. Our personnel have spent at least **275 hours per season** treating weeds and reseeding on the property. These are the costs that would be relatively unavoidable should Mountain Shadow continue to maintain their weeds. This could be entirely contracted or a combination of ranch employees, members, and contractors.

Actionable items Mountain Shadow can implement to reduce infestations:

- Mandatory weed wash for all vehicles entering the property.
- Weed education for property visitors and permitees that encourages proper weed identification and control methods.
- Implement a program that requires all activities that create bare ground (road grader, spring improvement, etc.) must be reseeded the first year they are disturbed, and a plan is in place to spray for weeds at least twice a year for two years
- Regular monitoring for new infestations. Possibly designate individuals that regularly visit the property that can identify weeds and willing to travel all the roads and trails multiple times a year to record locations of infestations, which are then treated.
- Increase dependable water sources for weed control (significant time is wasted traveling back to a reliable water source).

Causey Estates

Causey Estates is a beautiful property located just past Causey Reservoir on Skull Crack Road. The community is comprised of more than 150 individual lots, most of which have a cabin or other structures. There are approximately 15 miles of roads and trails throughout the property, which are used by the members numerous off-road and recreational vehicles that are also likely used throughout the State on trails and roads. The elevation of Causey Estates ranges from 5,700 feet at the bottom to 7,700 feet near the very top with primarily north facing woodlands at lower elevations mixed conifer and aspen forested areas near the top.

Causey Estates weed control issues were primarily noticed in about 2016 and the have been working with FFSL in primarily the Wildland Urban Interface programs. Some weed control was being done at the beginning, but it was primarily done with Roundup and having undesirable effects. Multiple biocontrol releases were made prior to the beginning of the Causey Knapweed project on knapweed and Canada thistle. Most weed infestations were originally estimated to be minimal and along roadways; however, upon further investigation, large patches of musk thistle, Canada thistle, and spotted knapweed were found.

In the 4 summer seasons since we began spraying at Causey Estates, weed populations have drastically reduced throughout the property. In large part, it has been the dedication and involvement of the community members and the board to follow through with weed spray days and fully support the project. The following is a summary of each of the main weeds on the property and information that may be useful for future control efforts.

Spotted knapweed and diffuse knapweed are two very similar plants that are generally treated the same. Most of the knapweed on Causey Estates is spotted knapweed. The presence of this weed is the primary reason funding was provided for this project due to the seriousness of this weed and the implications if the weed continues to spread throughout the State. Originally, the only known knapweed on this property was found across 5 acres around lot 130. This area was sprayed in 2018 and several biocontrol releases of seed weevils and root weevils have been placed in this area over the years. However; in the early years of the Causey Knapweed Project it was found that knapweed had spread to several areas on the property and increased to approximately 30 acres. Other infestations were found along Lower Oak road and especially lots 46 & 47. Another patch was found across from the turnoff to the picnic area.

Fortunately, there is a highly effective herbicide for knapweed called Milestone. This is the same herbicide that works well on most thistles. From 2019-2021, all of the known knapweed infestations were sprayed. Although many of these areas may still have minor amounts of knapweed, most of the knapweed has disappeared from the property.

Dyer's woad and musk thistle have been found throughout the property on roadsides and on individual lots. Both of these weeds are annual or biennial plants that can be easily controlled when sprayed in the rosette stage during early growth forms. Although it is more difficult to spot them during this time, it is one of the first plants out in the spring and can be easily sprayed by a trained eye using minimal herbicide. The cheapest and most effective herbicide we have found is 2,4-D used with an appropriate amount of surfactant. Other herbicides that we used regularly to decrease herbicide resistance were Escort/MSM and Dicamba. Milestone also appeared effective when it was sprayed on rosettes during knapweed or Canada thistle treatments.

Although significant progress was made on dyer's woad and musk thistle during this project, seeds are easily spread by wind, animals, and vehicles and it could easily progress well beyond the easily treated roadsides and into the steep rangelands. Most properties are unable to eradicate musk thistle and dyer's woad due to its prevalence and ease of spread. However, Causey Estates is unique and most of the musk thistle and dyer's woad have been drastically reduced from their original territories and could be eradicated with continued weed maintenance. We should continue to aggressively treat any infestations we can find in order to slow the progress of the weed and limit new infestations on adjacent landowners and properties that our vehicles may visit in the future.

Canada thistle is a riparian species that primarily is only found in moist areas or along drainage areas. Canada thistle is a very challenging weed to treat because it is both an aggressive perennial plant with deep root reserves that spread underground as well as a prolific seed producing plant that produces large amounts of fluffy seeds that disperse by wind. Higher elevations and wet areas are most conducive to infestation from Canada thistle. The largest patch is found on the JD Horne property and covers up to 5 acres. It has been difficult to access and treat but we have seen significant reductions. The use of ATVs and backpack sprayers or vehicles with long spray hoses would help with the control of Canada thistle on this part of the property. Any of the other disturbed areas such as the culverts and ditches that are constantly in need of cleaning out and regular disturbance have significant thistle. Most of those drainage ditches have been well sprayed and nearly controlled in most places using Milestone.

Although Canada thistle is a very difficult weed to control, there have been some very noticeable successes in areas that were given consistent treatments and possibly due to the addition of biocontrol. The most effective herbicide we have found for Canada thistle is Milestone. Most research suggests fall is the best timing for spraying Milestone on perennial weeds such as Canada thistle. For this project, Milestone was part of the tank mix any time we were spraying areas that could be infested with Canada thistle or spotted knapweed; which included early spring spraying on dyer's woad and musk thistle. Our efforts focused on spraying Canada thistle locations essentially summer-long starting in June on any known locations and continuing that effort into the fall until approximately late September. Most efforts were focused on spraying all known weeds prior to flowering and seed production. Unfortunately, given the size of the property, access to the weed, and the time/funding constraints, all plants were not always sprayed before they went to seed.

Cause Estates Estimated Costs/Time to Implement Weed Control

The following information was consolidated in order to assist the landowner with estimated costs for future treatments if all the actions currently underway were continued into the future. Each section is listed by phase, not by year, but will give some indication on the amount of effort that may be necessary to control the weeds.

Phase I: June 2017-June2019		
Biocontrol	$3,200	Both purchased and freely available biocontrol were released on knapweeds, Canada thistle. Typically cost/valued at $1/insect.
Herbicide	$866	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at Causey Estates. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Contractor	$2,066	In 2019, a contractor was hired to assist with weed spraying efforts. This cost includes labor and herbicide to treat 30 acres. Results were unsatisfactory and the contractor was not hired in the following years.
Equipment	$160	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	118 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on Causey Estates. It is likely an underestimate on the total time spent on the property to treat weeds.
Seed	100 lbs	Any known bare ground areas were seeded with a desirable grass mix in the fall of 2018.
Acres Treated	227 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times a year over the 2-year period.

Phase II: July 2019-June2020		
Biocontrol	$500	Both purchased and freely available biocontrol were released on knapweeds, Canada thistle. Typically cost/valued at $1/insect.
Herbicide	$1,173	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at Causey Estates. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Equipment	$422	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	100 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on Causey Estates. It is likely an underestimate on the total time spent on the property to treat weeds.
Seed	200 lbs	Any known bare ground areas were seeded with a desirable grass mix in the fall of 2019.
Acres Treated	211 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times a year over the 1-year period.

Phase III: July 2020-September 2021		
Herbicide	$882	This is the amount estimated to have been spent with grant funds on herbicide for spraying weeds at Causey Estates. This includes Milestone, Escort/MSM, 2,4-D, surfactant, and blue dye.
Equipment	$326	Two ATVs and one UTV required constant maintenance on vehicles and spray equipment.
Time	69 Hours	This is the estimate of how much time was spent during this phase by FFSL personnel to spray weeds on Causey Estates. It is likely an underestimate on the total time spent on the property to treat weeds.
Acres Treated	242 acres	This is a rough estimate on how many acres were treated. Many of these areas were spot treated 2-3 times over this short period.

Conclusions from the Causey Knapweed Project on Causey Estates:

It is estimated that we have been spending approximately **$705 per season on herbicide** to treat weeds on Causey Estates. There are approximately **225 acres** on the property that are treatable by ATV/backpack and are likely to still have some weeds present. Our personnel have spent at least **70 hours per season** treating weeds on the property. These are the costs that would be relatively unavoidable should Causey Estates continue to maintain their weeds. This could be entirely contracted or a combination of members, and contractors.

Actionable items Causey Estates can implement to reduce infestations:

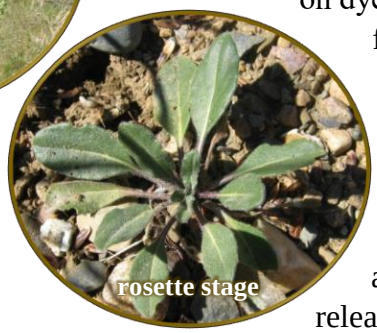
- Mandatory weed wash for all vehicles entering the property.
- Weed education for community members that encourages proper weed identification and control methods.
- Implement a program that requires all activities that create bare ground (road grader, lot improvement, etc.) must be reseeded the first year they are disturbed, and a plan is in place to spray for weeds at least twice a year for two years
- Regular monitoring for new infestations. Possibly create a small taskforce or workgroup that can identify weeds and willing to travel all the roads and trails multiple times a year to record locations of infestations, which are then treated.
- Increase dependable water sources for weed control (significant time is wasted traveling back to a reliable water source).

Causey Project Noxious Weeds and Their Control Methods

Spotted Knapweed (*Centaurea stoebe*) and Diffuse Knapweed (*Centaurea diffusa*)

There are two species of spotted knapweed that are commonly found on this project. Spotted knapweed is generally more perennial and more difficult to control, while diffuse knapweed is a biennial or short-lived perennial. Both plants are controlled in a similar manner with the same chemicals and biocontrols. Look for pink or purple flowers with spots or small spines at the base. Leaves are grayish green, slightly fuzzy, and heavily dissected. Herbicide is most effective when plants are still in rosette stage or later in the fall after flowers appear. Use Milestone at the 7oz/acre rate. There are two biocontrol species that have been released throughout the project; one is a seed weevil that destroys the seed and the other bores into the root to lay eggs and often kill the plant.

Dyer's Woad (*Isatis tinctoria*)



The bright yellow flowers of dyer's woad are hard to miss in the early spring. They can be annuals or biennials with flowers that resemble many species in the mustard family with a large umbrella shape. Look for round purple stems and a white midvein on the basal leaves. Herbicide is most effective when plants are in the rosette stage in the early spring and late fall. Most herbicides work fairly well on dyer's woad when sprayed early in the growth of the plant before flowering. Escort or MSM at 1oz/acre or 2,4-D products at approximately 2 oz/gallon has shown to be effective. Herbicides can be combined, especially if spraying other plants such as whitetop and musk thistle that will be available at the same time of year. Surfactants are always recommended when using 2,4-D. A biocontrol fungus is already present in the area with minor impacts. It has been re-released several times as part of this project.

Musk Thistle (Carduus nutans)

Easily spotted mid-summer with their large purple flower head that nod when mature. Look for a white midrib on the leaves and "wings" on the stems. It is an annual or biennial plant similar to dyer's woad and with a similar life cycle as well as locations it inhabits. Treat at the same time and with the same herbicides as dyer's woad and whitetop. Escort or MSM at 1oz/acre or 2,4-D products at approximately 2 oz/gallon has shown to be effective. Herbicides can be combined, especially if spraying other plants such as whitetop and musk thistle that will be available at the same time of year. Surfactants are always recommended when using 2,4-D. There are no known biocontrol agents for this weed.

Canada Thistle (*Cirsium arvense*)

Most easily distinguished by its small pink flowers in clusters of 3 or more and dark green crinkly leaves with sharp tips. Looks similar to musk thistle, especially when young, but typically only grows to 3 feet and most likely found in moist areas. Herbicide is most effective when plants are still in rosette stage or later in the fall after flowers appear. Use Milestone at the 7oz/acre rate. There is a stem mining weevil and a stem gall fly that provide moderate control on Canada thistle. Both species have been released multiple times throughout the project area.


Canada Thistle


rosette stage

Whitetop (*Cardaria draba*)

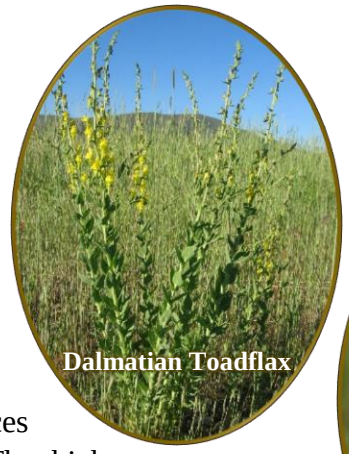
This is a short perennial mustard with bright white flowers visible in the early spring. Plants are usually less than 2 feet tall with white umbrella shaped flower heads and a slightly fuzzy bluish-green leaves. Plants will spread primarily by root but also by seed. Herbicide will be most effective shortly after flowers begin to develop or late in the fall. Escort or MSM are generally considered the most effective herbicides and are typically applied at 1 oz/acre. Care should be taken not to over-apply this herbicide.


Whitetop


Pre-flowering stage

Dalmatian Toadflax (*Linaria dalmatica*)

This weed will appear around the same time dyer's woad plants are flowering and may look similar from a distance. It is related to snapdragon's and will have tall stems with bright yellow flowers. It is a perennial plant with thick, waxy leaves. Plants may spread by root and is also a prolific seed producer. It seems to prefer dry south faces with poor soil and is often difficult to reach for treatments. The thick waxy leaves make herbicide more difficult and requires the use of a surfactant in order to be effective. Various herbicides such as 2,4-D or dicamba have moderate effect as well as Escort and MSM at the normal rates.


Dalmatian Toadflax


flowers

The rates and herbicides listed above are only recommendations based on actual spraying experiences on your property. However, always read the label or consult a certified pesticide applicator prior to using pesticides in addition to using proper personal protective equipment at all times.

Causey Project Spray Methods

Several methods were used to spray weeds throughout the project area during the 4-year duration. The most effective method found during this project was a simple 55-gallon UTV sprayer mounted in the bed of a Polaris Ranger 800. Similar sprayers can be purchased from Warne Chemical (warnechemical.com) for approximately $2,500 depending on accessories. We recommend two reels equipped with handguns and one reel with 100 feet of hose. Boomless nozzles as part of the UTV setup were highly effective in some of the more accessible areas of the project.


UTV Sprayer


ATV Sprayer

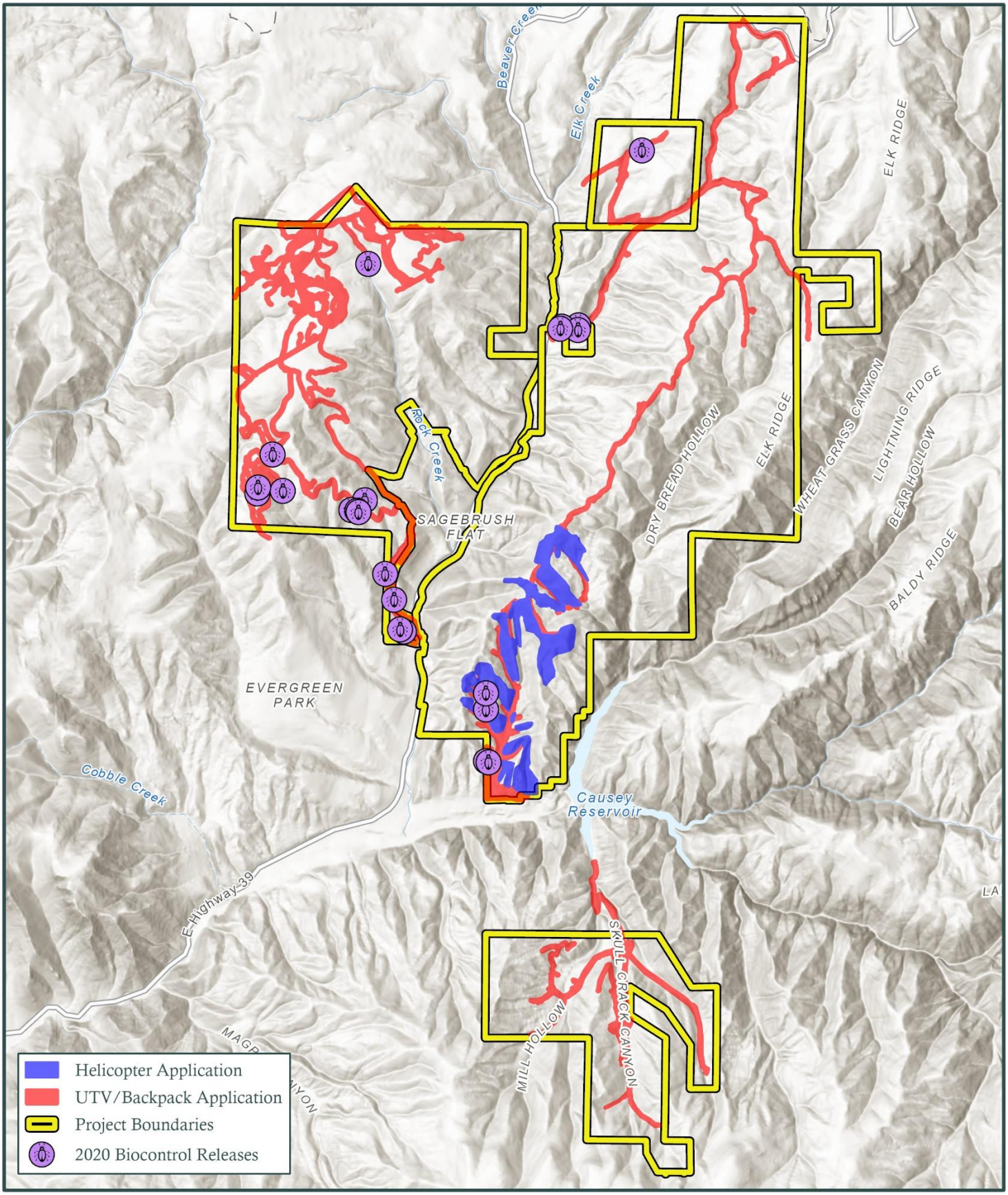
Additionally, 25-gallon ATV sprayers were used extensively on this project. The potential for rollover on steeper slopes is higher, but they proved to be more maneuverable on some of the more difficult trails and narrow areas. Units with right and left boomless nozzles are recommend with at least 15' hose and handgun. These can also be purchased at Warne Chemical for approximately $1,100.

Backpack sprayers became a useful tool in many of the areas that were too steep for vehicles. Most of our sprayers were simple 4-gallon backpack sprayers acquired at typical farm equipment stores for approximately $50. These were a useful tool in areas we couldn't quite catch the weeds with the UTV and would keep them with us to fill off the UTV and climb up the hill to get those few weeds.

Aerial application using helicopters is a viable treatment method and one of the cheapest per acre herbicide treatments available. Most helicopters charge approximately $14/acre not including herbicide. The primary downside is the application to unintended areas and spray drift. However; they can access very difficult terrain using minimal herbicide. Timing is critical and large elevation difference in treatment areas may cause spray windows to close quickly.


Aerial Application

Contractors are another great option for controlling noxious weeds. Typical contractors will charge a per/acre fee that may range as high as $100/acre depending on the treatment area and number of entries needed per year. Although the contractor used during this project in 2019 did not work out well, other contractors do exist and would be a viable option. Contact Morgan Mendenhall or the county weed supervisor for a list of current recommendations.



Causey Knapweed Project

2020-2021 - Treated Areas

0 1 2 Miles

N W E S

Causey Knapweed Project Reseeding Methods and Recommendations

Throughout the course of this project, reseeding was a critical component to the success of these treatments. Seeding is the only viable course of action to return many of these bare ground locations in the project area to desirable vegetation.

The normal progression of noxious weed infestations often originates with a disturbance. This disturbance may take place in the form of road improvements and grading along existing roads, culvert replacement, ditch outs, new construction, wildfires, erosion, or poorly timed weed control efforts. Every time a disturbance takes place, it should be followed by seeding efforts at least in the year of disturbance, but often for several years thereafter. Reseeding is a weather dependent endeavor that may only be successful if moisture is present at the right timing for the seed. Seed should be primarily perennial grasses that are adapted for drier climates and higher elevations. Planting species other than grasses will be counterproductive if future weed treatments take place as they should on a year basis. Most chemicals recommended for this project will only affect broadleaf species and not grasses. Properly executed herbicide treatments should remove noxious weeds, while preserving the grass species to grow and retake the site and reduce erosion.

Seeding should be done in the fall with ATV mounted seeders or hand spreaders. Ideally, the seed must have direct contact with the soil and would get snowed on within approximately a week to cover the seed from predators and push the seed into the soil.

A typical seed mix would use approximately 10 lbs/acre with a variety of species. The following list shows the grass species recommended for this project and rates that could be used in the future.

3 lbs of smooth brome (*Bromus inermis*) var. Lincoln

3 lbs of western wheatgrass (*Pascopyron smithii*) var. Rosana

2 lbs of crested wheatgrass (*Agropyron cristatum*) var. Hycrest

2 lbs of orchardgrass (*Dactylis glomerata*) var Paiute

The specific varieties listed above were chosen for their drought tolerance; however, any combination of the grasses on this list should be adequate.

UTV with seeders

Photopoints from the Causey Knapweed Project

Mountain Shadow - Solar Panels

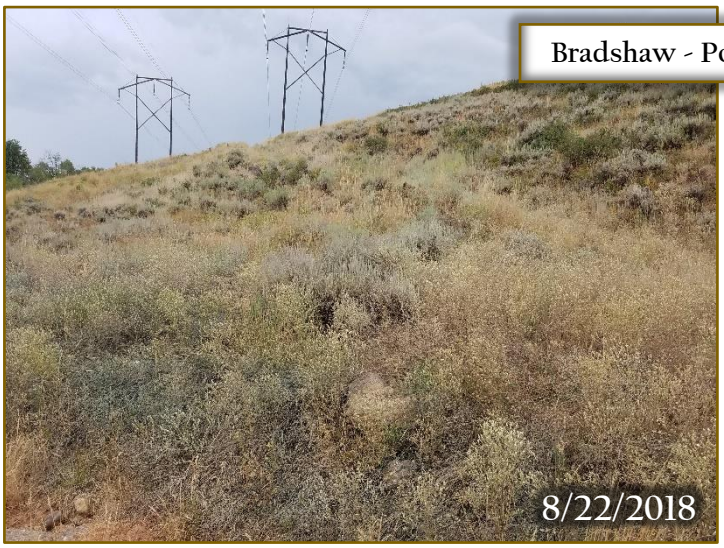
Sourdough - Ranch House

Mountain Shadow - Coal Springs

Mountain Shadow - East Water Hollow

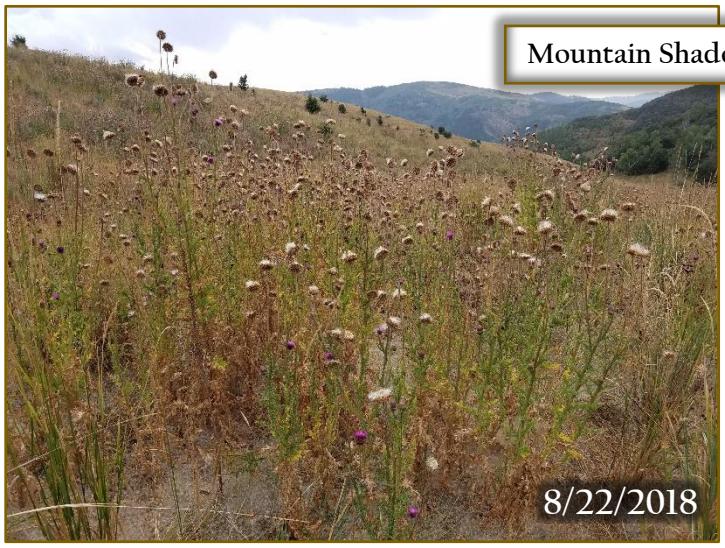
Sourdough - Cutoff Road

Bradshaw - Powerline Road



Mountain Shadow - Gravel Pit

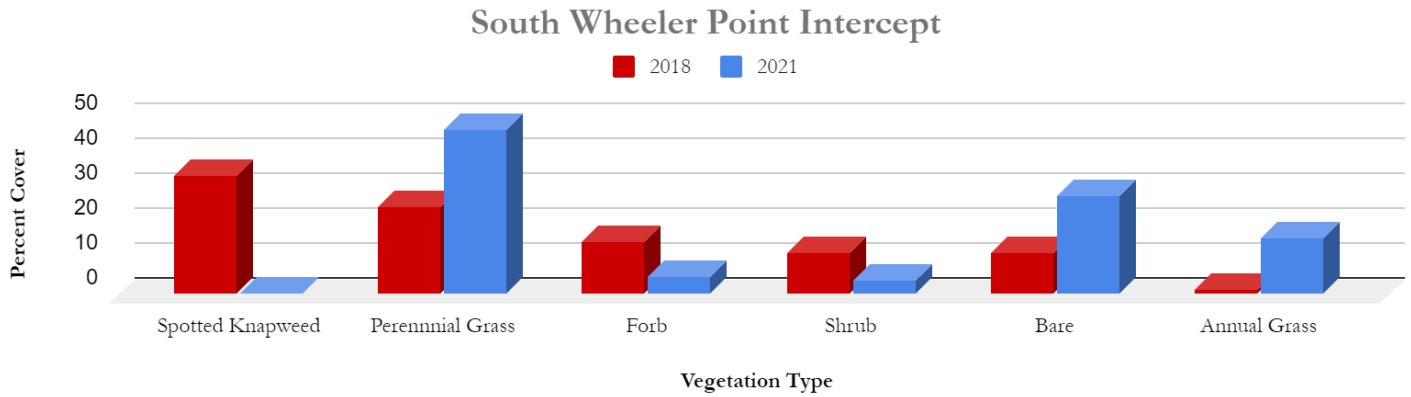
Mountain Shadow - Loop Road

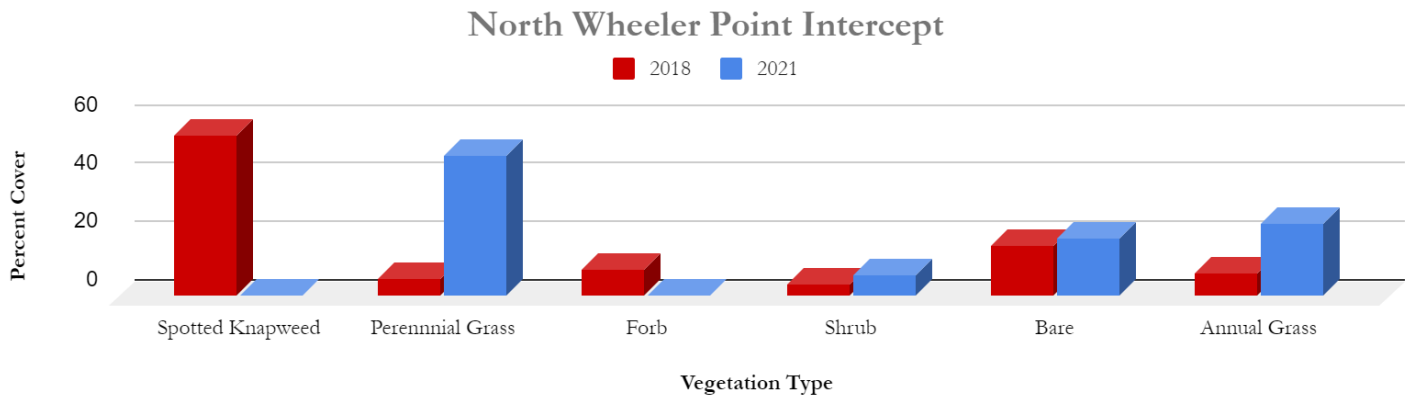


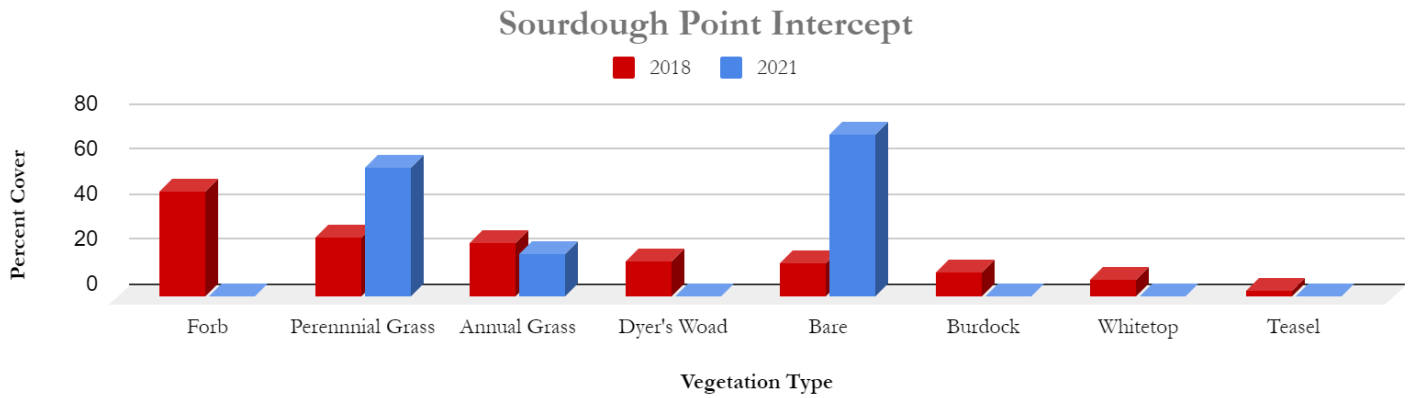
Mountain Shadow - Wheeler Creek Spring

Monitoring the Causey Knapweed Project

Although the monitoring program with this project may not have gone as expected, results from the three primary plots are encouraging. Weed control plots should be initially monitored at the height of weed outbreak at the peak growing season. Unfortunately, these plots were monitored early in the season, prior to significant weed growth and just prior to funding availability for treatment. Data from the three most indicative point intercept plots were charted for the 2018 and 2021 seasons and monitored on nearly the same days three years later. Impressively, the two plots in Wheeler Creek showed dramatic decreases in spotted knapweed with essentially no knapweed found in these plots by spring 2021. Similar results were found at the Sourdough location with almost all weeds removed by 2021 and the only negative aspect is the increase in bare ground. These results are evidence of the effectiveness of the treatment methods and the continued need for reseeding to ensure these areas do not return to weeds.







White Bryony

In approximately 2019, a large population of a weed called white bryony (*Bryonia alba*) was discovered northeast of the ranch house on the Mountain Shadow property. While it is not yet considered a noxious weed in Utah, it is highly invasive and considered noxious in Washington, Idaho, and Oregon. White bryony is a perennial vine with small flowers that produce small dark berries later in the year. Parts of the plant, especially the berries, can be toxic to certain animals.

Currently, it is estimated that 5-10 acres on Mountain Shadow are currently infested. However, a thorough scouting of other maple stands in the general area could easily yield additional acreage. The plant appears to prefer shaded areas under maple stands on north facing slopes. It's unclear how much impact this plant currently has on grazing and wildlife on the property, but the potential for future impacts could be high as more maple stands are taken over with this weed.

Tendrils will climb any tree and spread more than 15 feet high into the canopy. Vines are thick enough to create impenetrable areas that will not be conducive to the movement of wildlife or livestock in addition to the possible poisonous aspects.

Very little control was possible during the Causey Knapweed Project. Access was nearly impossible using vehicles and there was not enough time or funding in the project to attempt to treat this weed. Mechanical pulling is considered ineffective unless the full tuber is removed by digging. One of the most effective methods of control includes the use of glyphosate that becomes more effective if the treatment involves cutting 3-4 inches below the crown of the plant and wetting the surface with herbicide. Treatment will be time consuming and take many years to make progress given the difficulty of the situation with the long vines, steep slopes, and difficulty finding the origin of each vine. Fall aerial applications may be an option with a different broadleaf herbicide but the maple canopy will create a barrier to spraying the vine. Based on the growth and density of these weed, it is highly recommended that Mountain Shadow begins controlling this weed before it gets to a truly uncontrolled status.

Dyer's Woad Biocontrol Trials

An underused biocontrol for Dyer's woad known as *Puccinia thlaspeos* occurs naturally in Dyer's woad populations throughout Utah and can create significant reductions in populations. It appears to vary in effectiveness largely depending on the particular moisture year, elevation, and other environmental factors such as shade or protected areas. Over a 3-year period, more than 30 sites were selected for releases across Mountain Shadow and neighboring properties involved in the Causey Knapweed Project in an attempt to overwhelm the area with rust spores and assist with control on difficult locations out of reach of ATV sprayers. One site was selected for two monitoring transects located just east of the ranch house on Mountain Shadow. Each of these monitoring sites were not sprayed with herbicide and any plants that survived to the flowering stage were clipped or removed from the area. After monitoring data was recorded, rust spores were released throughout the plot area and wetted down with water to assist in adhesion to plants.

Infected dyer's woad rosettes (left) are yellow and deformed compared to healthy (right) rosettes.

According to the monitoring data, the total number or dyer's woad rosettes decreased from 38 per quadrat in 2019 to only 3 per quadrat in 2021. The number of rosettes infected with rust found during a 1-minute timed count increased from 6 per transect in 2019 to 24 per transect in 2020 and 2021. While the rust may not have infected every single dyer's woad plant, a significant increase in rust was noticed and overall plant health was diminished for surviving plants. Although the intent was to cut or remove any flowering plants, very few actually needed removal.

Transects are monitored every year the first week of May.

Each monitoring is followed by a new release which is wetted.