Cheatgrass Control Efforts Completed By The Wyoming Game and Fish Department

2000 – 2014

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Executive Summary

Cheatgrass is an invasive, non-native annual grass that has become established in Wyoming, threatening many of the state's native plant communities. Increased time and funding has been allocated to try and find a way to manage the plant on the landscape. The plant's presence is cause for concern for many consumptive and non-consumptive users of the state's natural resources.

Introduction

This white paper was developed to provide the Wyoming Game and Fish Department (WGFD), Wyoming Wildlife and Natural Resource Trust, federal and state land management agencies, county governments, private landowners, and non-profit conservation organizations with a comprehensive review of cheatgrass control efforts completed by the WGFD's Terrestrial Habitat Biologists in the last 14 years. The threats to the integrity of Wyoming's wildlife habitats are numerous. Cheatgrass has become the highest threat to our lower elevation shortgrass, mixed grass, desert shrub, and mixed mountain shrub communities. The WGFD is committed to finding the appropriate management tools and implementing the appropriate management strategies required to sustain healthy wildlife habitats. We continue to learn as much from our failures as our successes. It is important that we share these results with our partners so that we may collectively push on and be fiscally responsible as we look for answers to long term, effective cheatgrass control. To date, the WGFD has partnered with Rocky Mountain Elk Foundation, Wyoming Wildlife and Natural Resource Trust, Mule Deer Foundation, Muley Fanatic Foundation, Wyoming Governor's Big Game License Coalition, Sage Grouse Conservation Fund, Wyoming Chapter of the Wild Sheep Foundation, local conservation districts, Bureau of Land Management, County Weed and Pest Control Districts, University of Wyoming, and private landowners to fund cheatgrass mitigation projects.

Background

Cheatgrass (*Bromus tectorum*) is a member of the Grass Family (Poaceae). Cheatgrass is an annual or winter annual, softly downy to short-hairy throughout, and generally 4"- 24" inches tall at maturity. Stems are solitary or in a few-stemmed tuft. The roots are fibrous and usually quite shallow. The inflorescence is a soft and drooping, multiple branched, open panicle, usually becoming a dull reddish-purple color as it matures to a tan- buff color when fully cured. Flowering occurs from April to mid-June depending on climate and location, with elevation playing a significant role in plant maturation dates. Reproduction is by seed only. Germination occurs in fall through winter to early spring, depending on climate and precipitation.

Cheatgrass generally grows in areas receiving 6”- 22” of precipitation. It does particularly well under conditions where rainfall occurs in fall, winter and early spring. During periods of multiple year droughts, it may appear to be missing from a plant community and then reappears as moisture conditions improve. Cheatgrass prefers well drained soils of any soil texture, however, it is most often found on coarse-textured soils and does not typically grow as well on heavy, dry, and/or saline soils.

Cheatgrass can be found at almost any elevation, but it does particularly well at elevations ranging from 3,125’ – 6,500’ in Wyoming. In recent years, elevational limits we once thought existed have been breached, as cheatgrass has now been documented at elevations pushing 9,000’. South-facing aspects and steep, well-drained slopes seem to also favor the annual. Its ability to invade into areas, particularly following major disturbance, is unrivaled. Cheatgrass has an extensive root system, particularly for an annual plant. The wide-spreading lateral roots are one of the keys to the survival of this plant. Studies have shown the plant’s capability to deplete soil moisture to a depth of over 24”, resulting in reduction of perennial plant vigor and health, and shortening an “already short growing season” in our state.

The seeds are dispersed by wind, small rodents, or attachment to animal fur or hooves. They are also moved as a contaminant in hay, grain, straw, purchased seed, and machinery. Seed production is highly dependent on plant densities found. Under optimal conditions, it may produce 400 pounds of seed per acre with 150,000 seeds per pound. The seeds maintain high viability in dry storage, lasting over 11 years. In the field, under buried conditions, most seeds lose viability in 2–5 years. In more arid areas, seed remain viable for longer periods. Inadequate moisture appears to be the primary limiting factor to cheatgrass germination. Seeds can withstand high soil temperatures, even surviving wildfires or prescribed fires. They germinate most quickly when covered with soil, but seeds do not need to be in contact with bare soil. Some leaf litter cover will generally improve germination and establishment of seedlings by protecting the soil surface from desiccation. Seedlings emerge rapidly from the top 1" of soil and a few plants will emerge from depths of up to 3". Cheatgrass will grow in almost any type of soil, including B and C horizons of eroded areas and areas low in nitrogen. Areas of high nitrogen (applied as fertilizer) or present on-site due to quick release of carbon (i.e. fire) provide environments for cheatgrass successful establishment. An increase in fire return intervals favors annual species at the expense of many perennials. High fire frequencies can result in total loss of perennial vegetation, particularly shrubs. Due to its tendency to mature early and dry out quickly, cheatgrass gains a competitive advantage through the promotion of fire.

Problem

Cheatgrass has become more prevalent throughout the arid West, and nearly all of Wyoming's diverse habitat types have been impacted to some degree, excluding some high elevation habitats (alpine, sub-alpine). The invasion by this annual has far reaching impacts for management of wildlife habitat, agricultural lands, and the wildland/urban interface. Forage quality and quantity is negatively impacted (nutritional content, nesting, hiding and fawning/calving cover), and potential wildfire frequencies are increased. Animal performance can be negatively impacted due to injury (eyes, mouth, nose, ears, and feet) caused by seed awns as well. The presence of cheatgrass ties the hands of habitat managers, as it can severely restrict tools available for habitat improvement, most importantly prescribed or managed wildfire which have historically been one of the most cost-effective methods to rejuvenate mixed mountain shrub communities, and create mixed age classes of timber and shrubs that fulfill nutritional and cover requirements of big game species. Managing cheatgrass has proven to be a costly endeavor. Collectively, managers of rangelands and croplands have tried numerous methods to date, with very mixed results. Ruggedness of terrain and remoteness of infested sites further complicates implementation, increases expenses, and can limit control techniques that may be implemented. In many cases, a single treatment does not appear to be sufficient to provide long term control.

Minimizing Impacts

Disturbances that do not enhance habitat within intact plant communities should be avoided. Roads are often the vector for establishment of new weed infestations. Excessive roadside and rangeland disturbance in areas currently free of cheatgrass should continue to be avoided. Increased monitoring and surveillance along heavily or frequently disturbed sites is critical. Vehicles, equipment, and implements should be cleaned of adhering seed after driving in or working in cheatgrass-infested areas prior to moving to new locations. When completing habitat restoration, reclamation, or enhancements, Integrated Pest Management strategies should be included.

Integrated Pest Management

Integrated Pest Management (IPM) refers to the careful consideration of all available weed control techniques and subsequent integration of appropriate measures that discourage the development of weed populations and keeps use of herbicides and other methods to levels that are economically justified, and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop (rangeland, pastureland, row crop, or other) with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

In the case of cheatgrass, a combination of chemical, biological, and sometimes mechanical means may be necessary to prevent infestations from occurring or to control existing infestations. Herbicide applications may not be 100% effective or provide long-term control without a combination of biological control methods.

Herbicide Control Methods

Use of herbicides to control undesirable vegetation has been utilized in the United States since the 1940's. 2,4-D was the first herbicide offered to agricultural producers in 1946. Prior to the 1940's soil fumigation through the use of methyl bromide and diesel fuel aided weed control efforts. Glyphosate entered the scene in 1974, and has been used extensively to control vegetation in cropland, rangeland, roadsides, lawn and turf sites. Selective and non-selective herbicides are presently the primary chemicals available for control of cheatgrass. Since non-selective herbicides can kill all vegetation they contact, not just the target weed, extreme caution must be taken to ensure that they do not contact desirable plants, or can be applied at reduced rates that only result in short-term injury to perennial plant versus death. Application of herbicides when non-targeted vegetation is dormant can also assist in increasing the selectivity of non-selective chemicals.

Herbicides that have been recommended for cheatgrass management include glyphosate, imazapic, and several others that have only been tested in small plots. Gramoxone Extra®, Arsenal®, Hyvar-X®, Krovar I®, Karmex®, Princep®, Telar®, Matrix®, and Spike® are just a few of the other herbicides that have been tried experimentally by weed scientists, chemical companies, and others.

Imazapic, a selective herbicide for both the pre- and post-emergent control of some annual and perennial grasses and some broadleaf weeds (i.e. leafy spurge, Dalmatian toadflax), kills plants by inhibiting the production of branched chain amino acids, which are necessary for protein synthesis and cell growth. The herbicide is often mentioned by its trade name, Plateau®. For control of cheatgrass, it is most effective when applied as a pre-emergent in late summer / early fall. For efficacy, the herbicide must come in contact with the soil profile, where it will kill the cheatgrass plant in the early stages of germination. Adequate soil moisture is important for optimum herbicide activity. When adequate soil moisture is present, it will provide residual control of susceptible germinating weeds. Activity on established weeds will depend on the weed species and rooting depth. Post-emergence application is the method of choice in some instances, particularly for perennial species. It may be applied in the dormant or growing season for weed control. Tolerance of desirable grass species to imazapic herbicide may be reduced when grasses are stressed due to insect damage, disease, environmental conditions, shade, poorly drained soils or other causes. In the last 14 years, imazapic has been the most

widely used herbicide for cheatgrass control in Wyoming and throughout the Intermountain West. In 2014, a granular form of the herbicide was introduced to the market, and shows promise. Advantages to use of a granular form may include: ability to apply with fixed wing aircraft at a higher elevation in rugged topography, less drift of chemical resulting in over application or misapplication, reduced costs for application through use of fixed wing versus helicopter, less potential injury to non-targeted plants in the overstory (i.e. brush species), ability for granule to penetrate thru dense plant litter and get to soil surface for activation, and wider timing of application windows. Current livestock grazing restrictions applied to use of the granular form of the herbicide likely limit its wide use and application at this time. A glyphosate / imazapic mix herbicide has been used in rangeland situations. This herbicide acts to control germinated cheatgrass, as well as providing residual control on not-yet germinated cheatgrass seed. Caution must be used to reduce impacts to non-targeted perennial vegetation when using this product. Imazapic was often mixed with a non-ionic surfactant in the early 2000's on some of the first large scale projects completed. The surfactant was found to increase injury to non-targeted plants (chokecherry, antelope bitterbrush, others), and is an unnecessary component when applying the product for control of ungerminated cheatgrass seed. Surfactants have been found to be useful when utilizing imazapic for broadleaf weed control, particularly on plants with waxy leaves (i.e. Dalmation toadflax).

It has been recommended by chemical company representatives that imazapic herbicide not be applied immediately post-fire, as ash from fire may bind the active ingredients, resulting in no effective control. After several moisture events, the ash should be well incorporated into the soil or swept away by winds, and control will again be possible. It has been difficult to react quickly post-wildfire, due to funding application periods, mapping/inventory efforts, coordination and cooperation of land managers or landowners, so in many cases it may be one year post-fire before initial application is actually implemented.

To date, the WGFD has utilized Matrix® on one large project (245 acres), and at small experiment/trial sites on the Thorne Williams Wildlife Habitat Management Area (WHMA) in Sybille Canyon. No significant value was seen in utilizing this product versus imazapic.

Glyphosate, commonly referred to by the trade name, RoundUp® controls cheatgrass by inhibition of biosynthesis of amino acids. It is applied to above ground parts, since the active ingredient is absorbed and made inactive by soil particles. Following absorption, glyphosate is translocated to underground structures and should only be applied during active growth periods of targeted plants. Growth is inhibited soon after application, and visual impacts to vegetation are usually seen within 10-20 days. Glyphosate, a systemic non-selective herbicide, is used in no-till burndown and for weed control in crops genetically modified to resist its effects. Reduced application rates of glyphosate have been applied experimentally on

rangelands, causing death in germinated cheatgrass plants and only slightly injuring perennial vegetation. Rates to accomplish this are typically < 12 oz/acre.

Re-Seeding Control Methods

Re-seeding with introduced or native plant species may be required to out-compete cheatgrass in areas where perennial species are currently lacking. Many areas where cheatgrass occurs are not conducive to planting with traditional grass drills. Broadcast of seed with fixed wing aircraft, helicopter, or ATV may be required. In some cases, "intermediary" plant specie(s) may need to be utilized to transition a plant community dominated by annuals to a more diverse perennial plant community. While often recognized as an undesirable plant for wildlife as a forage resource or cover type, crested wheatgrass, or other tame wheatgrasses, may serve a purpose in establishing a species that will out-compete aggressive cheatgrass. Planting of tame wheatgrasses may help facilitate the transition from an area dominated by annual weeds to something more desirable. Due to the bare ground often associated with crested wheatgrass stands, it is possible to interseed into an established stand in later years, particularly when combined with a light tillage practice and/or herbicide application. In cultivated fields, mowing cheatgrass before seeds are formed provides temporary control. Clean cultivation practices assist in longer term control. In cropland and hayland, the best control is often achieved by fallowing or planting continuous spring crops for two or more years before attempting to plant perennial vegetation.

Biological Control Methods

Soil bacterium which causes crown rot may be a potential biological control for cheatgrass in the arid environment of the western U.S. A strain of D7 rhizobacterium, *Pseudomonas fluorescens* strain D7 (P.f. D7), has been found to produce a phytotoxin that inhibits root elongation and is specific for cheatgrass and related species. Native plants and crops are not affected by the species specific bacteria. This strain is currently being evaluated in experimental plots in Wyoming and initial results are promising. This method has the ability to be combined with an herbicide such as imazapic and applied aerially to produce both short-term and longer-term control of cheatgrass. P.f. D7 grows well under cooler conditions of the fall, coinciding with the early root growth of fall annual weeds. Survival of the bacteria and establishment in the soil is critical for the suppression of the weed. The activity levels of bacteria populations are reduced in hot, dry summers and they enter a dormancy phase. P.f. D7 only moves in soil by traveling on the growing root or with water, and it is bacteria growth along the root that positions the bacteria to deliver the inhibitory compound to the root. Unlike many of the herbicide applications completed, the use of P.f. D7 appears to provide

longer term control as bacterium grows (3 – 5 years for successful establishment in the soil profile).

P.f. D7 is currently not commercially available due to on-going federal approval processes. However, WGFD has had the opportunity to work with the Converse County Weed & Pest (CCWP) to acquire the bacteria and apply some test plots (10 acres) in the fall of 2013 to gauge applicability of the treatment in Wyoming's climate. Aerially applied plots haven't shown significant cheatgrass reduction within the first year, presumably due to greater loss in bacteria at application since less water can be applied aerially than with ground applications. These plots will continue to be monitored and tests are underway to ensure that the bacteria survived the application and still exist in the soil profile. However, ground applications that CCWP applied showed up to 90% reduction in cheatgrass, compared to control plots, within the first year. This indicates high potential for cheatgrass control by the bacteria and demonstrates the need for further work to understand the appropriate and economically feasible application conditions for successful control in Wyoming.

Livestock grazing with cattle, sheep, goats, or other class/type of livestock may provide limited control of cheatgrass. In most cases, long-term control is difficult to achieve with grazing alone. The period of cheatgrass plant palatability is very short, and concentration of domestic animals is crucial to achieving any success. Careful timing of grazing is required to control cheatgrass and simultaneously provide growing season grazing rest/deferment for perennial grasses to outcompete the aggressive annual. Cheatgrass remains palatable until the seedheads progress from the dough stage to maturity. At plant maturity, seed awns become prickly and livestock use diminishes quickly due to decreased palatability and nutritional content. Intensive grazing in early spring may reduce fire hazards associated with fully mature stands of cheatgrass. Use of electric fencing, active herding / riding, and control of timing and duration of grazing use are critical components to provide effective biological control.

Prescribed fire may be used to remove accumulated plant litter, exposing the soil surface for follow-up seeding, herbicide application, or mechanical ground preparation (tillage). Some seeds are consumed by fire on the surface of the ground, but cheatgrass seed has been shown to remain viable in the soil profile unless fire intensities are very high. Fire, by itself should not be utilized as a method of control, but can be a critical component when combined with a follow-up herbicide application, re-seeding, or both.

WGFD Cheatgrass Control Efforts Summary

Herbicide Application

In total, the Department has treated more than 59,000 acres with imazapic herbicide between 2000 and 2014. Other herbicides utilized include Matrix® (5 oz/acre, 245 acres), and a combination of imazapic and glyphosate (6oz/acre and 6oz/acre, 750 acres). The majority of applications were completed via fixed wing aircraft or helicopter. Numerous small test plots have been completed (<5 acres) with ATV or truck/boom sprayer equipment.

Herbicide rates varied from a low of 2 oz/acre on CRP land post-prescribed fire where grass seeding occurred to a high of 8 oz/acre on sites that had been burned by wildfire, prescribed fire, or were unburned. Gallons of water utilized as a carrier varied from a low of 2 gallons/acre to a high of 10 gallons/acre. Non-ionic surfactants were utilized in approximately half of the projects completed. Surfactants were utilized due to 1) recommendation provided by chemical company or pilot or 2) potential germination of cheatgrass within treatment area at time of application. Control of invasives in virtually all treatments was 95% - 100% in year 1, 75% - 85% in year 2, and highly variable rates of control in year 3 and beyond. If the initial treatments were completed post-germination, these sites were often considered failures within the first year, and re-application was necessary. In some cases, cheatgrass prevalence has returned to pre-treatment levels at the end of the third year following treatment. High variability between treatments may have been caused by: cheatgrass germination prior to treatment, high litter quantities covering the soil which resulted in little contact of herbicide with soil profile, applicator error caused by faulty equipment (mis-calibration), over-application of herbicide due to spray drift or faulty aerial flight assistance equipment/pilot error, soil type, timing and amounts of precipitation received post-treatment, excessive herbivory by wildlife or livestock, weakened perennial plant communities unable to respond to treatment due to loss of plant vigor, or other factors or combinations of factors not yet fully understood or identified.

Some non-targeted plant species injuries have been noted by WGFD personnel, but most appear to be short-term in nature, and include seedhead suppression on perennial grasses, delayed leaf-out and retarded leader growth in shrubs in the first year following treatment. Eliminating use of surfactants in tank mixes has reduced non-targeted plant injury substantially.

Re-Seeding

The WGFD has not re-seeded native rangeland acres in combination with prescribed fire or herbicide applications. The only re-seeding efforts have been on previously cultivated lands converted to perennial grass / legume cover. In this scenario, lands are cultivated through plowing/disking and are packed and planted using a grass drill with legume box attachment. Extensive and deep cultivation appears to place cheatgrass seed deep in the soil profile, where it cannot properly germinate and grow. A clean, firm seedbed prepared prior to seeding is

critical. The Department has planted hundreds of acres of WGFD lands with various combination(s) of legumes, introduced cool season (native and introduced) grasses, wildflowers, and native warm season grasses for nesting cover with high success and minimal cheatgrass invasion.

Prescribed Fire

Prescribed fire has been utilized as a management tool to reduce above ground litter accumulations to improve herbicide efficacy and to prepare the seedbed for interseeding of desirable perennial vegetative species (i.e. Conservation Reserve Program - CRP). On a CRP tract near LaGrange, WY (Goshen County), a marginal stand of introduced wheatgrasses with high percentages of bare ground and high prevalence rates of cheatgrass required the agricultural producer to improve the stand to stay in USDA program compliance. Prescribed fire was utilized in March on the 640 acre stand, followed by a herbicide (glyphosate 12 oz/acre and imazapic 2oz/acre) application after Spring green-up, and was followed by a perennial grass/legume seeding. Control of cheatgrass was high (90%+) for 2 years post-application, but the perennial cover seeding was unsuccessful. Post treatment monitoring revealed that planting depths were likely too deep in the sandy soils present versus the seeding being negatively impacted by the herbicides used.

Livestock Grazing

High Intensity / Short Duration (HI/SD) grazing regimes have been utilized to a small extent for control of cheatgrass. Due to the variability of timing and amounts of precipitation, early spring grazing is effective at reducing herbaceous growth, but one timely precipitation event can help cheatgrass produce seed after the grazing event is completed. In Platte County, HI/SD grazing practices have been implemented in small riparian pastures, where uplands were dominated by cheatgrass and riparian areas lacked woody vegetation (willows, cottonwoods). Over a 10 year period, control of cheatgrass was considered “effective” in 4 of 10 years. In no time within the 10 year period was control gained for more than 2 consecutive years. Annual grasses continue to dominate the uplands at this site. Precipitation timing and amounts received in early spring heavily influenced the amount of biomass produced and the seed production.

In the majority of projects completed with WGFD planning and assistance, intensified livestock grazing management has been required post-herbicide application. Up to 2 consecutive years of growing season deferment are typically required to allow for perennial vegetation recovery in the absence of competition from cheatgrass. While not completed to date, there may be value in utilizing livestock to reduce cheatgrass above-ground biomass prior to herbicide application in order to reduce interception of herbicide before it gets to the soil profile.

Conclusion

Based on our Department's successes and failures at controlling cheatgrass to date, the following observations and recommendations are worth considering:

Protect "intact" plant communities and reduce / eliminate threat of major unplanned disturbances in these areas. Development of road/travel management plans, and obliteration and reclamation of unnecessary roads with desirable vegetation should be undertaken.

At the present time, imazapic herbicide application has been the most effective and most widely used method of application. **6 oz/acre rate**, coupled with water applied at **minimum of 5 gallons/acre** or more have provided the best control. Water application should be increased with increasing levels of standing vegetation or litter. In most cases, use of surfactants is not necessary for cheatgrass pre-emergent control. If the initial herbicide application can be timed correctly, two years control (75% or greater) can be expected, with varying rates of success in later years. A second herbicide application (i.e. post year two following initial treatment) is often necessary, and should be planned for, especially since cheatgrass seed viability under most conditions is likely >5 years.

The best control of cheatgrass to date has been achieved following prescribed or wildfire, when above ground litter does not intercept applied herbicide. Heavy litter layers and standing plant material play a large role in herbicide efficacy. If fall precipitation has resulted in cheatgrass germination prior to herbicide application, two options exist: addition of glyphosate to the herbicide mix or deferring treatment until the following year. **Complete imazapic herbicide applications within the first year post-fire** (wild or prescribed) when plant litter is minimal, allowing herbicide to reach the soil profile for improved efficacy. Herbicide can also be applied at lighter rates (i.e. 6 oz/acre or less), reducing potential negative impacts to non-targeted vegetation when plant litter is minimal.

We do not feel that cheatgrass control projects can be a one-time, one practice entry or application. Cheatgrass control requires a multi-faceted approach. **Projects involving Integrated Pest Management (IPM) techniques should be strongly considered** for funding and given priority over projects that are one dimensional in nature. We recommend strongly considering the IPM approach to cheatgrass control, and only contribute funding to those projects that address the weed issue in a multi-faceted approach.

The Department typically requires up to two years rest or growing season deferment from livestock grazing following herbicide applications to allow for perennial plant recovery. **Improving vigor of desired vegetation is important to achieve long term natural control of invasives**. Particularly post-fire, it is important to build back ground litter for improved moisture retention in the soil profile, decrease surface erosion and water runoff, and reduce

bare ground. Livestock grazing, by itself, is not considered an effective long-term means of cheatgrass control. However, implementing livestock grazing management plans that involve rest and recovery periods during the growing season will help maintain or improve perennial plant health and vigor, likely adding to the efficacy of long-term cheatgrass control. Incorporation of livestock grazing management into herbicide treatments, providing for partial to full growing season deferment post-treatment to allow for recovery (improved health and vigor) of perennial, preferred plant species should assist with achieving recovery goals. In addition, the use of livestock to reduce above ground biomass prior to herbicide application should be further explored.

Defining a percent cheatgrass composition threshold (i.e. < 15%) post-treatment is necessary to aid in the decision making process in order to determine when a second follow-up treatment should be applied. Timing and amounts of precipitation, as well as overall health and vigor of the perennial, native plant community affect the rate of recovery and the plant community's ability to keep cheatgrass at low rates of prevalence. Developing trigger points or thresholds for cheatgrass prevalence in different habitat types and vegetative communities will assist managers with decisions on re-application of herbicides or implementation of additional IPM management techniques to improve control (i.e. 15% composition of cheatgrass = reapplication of imazapic herbicide).

With the limited options for long term control measures at the present time, **we recommend the use of soil bacterium (P.f. D7 or other) be considered** in combination with herbicides that provide early and short term control as soon as this product is approved for landscape use.

We recommend increasing collaborative efforts between state and federal land management agencies, non-governmental conservation organizations, county government, University of Wyoming's College of Agriculture and Ag Extension Services, weed and pest control districts, and private landowners. Improve educational outreach efforts by all stakeholders to the public about the cheatgrass problem, and methods of prevention and control. Due to the time and money involved in treating cheatgrass, we recommend **continuation of cooperative work with all potentially affected interests**, which will result in effective use of resources and prevent entities from having to "re-invent the wheel". Toward those ends monitoring pre- and post-treatment is critical and should be required when utilizing federal, state or county government, non-profit conservation organization, or private dollars. Sharing the information gathered through proper monitoring will allow us to make better, more informed decisions about control techniques that provide the short and long term control desired. Native and introduced grass and forb species should be monitored to determine their effectiveness in maintaining cheatgrass at low densities in plant communities, where re-seeding may be a viable option.

Perennial and annual native and introduced plant responses to herbicides should also be monitored, particularly at varying herbicide rates.

Unfortunately, some landscapes that have undergone significant alteration of soils or native plant composition may not respond well to any treatment(s) prescribed. The WGFD supports the effort spearheaded by Brian Mealor and Cara Noseworthy at the University of Wyoming to **prioritize habitats statewide**. Technical and financial resources should be focused in those areas that will provide the greatest return in vegetative and wildlife species diversity, forage production for wildlife and livestock, and overall habitat value.

Existing cheatgrass prevalence or areas at high risk for potential invasion or encroachment (i.e. south facing aspects and steep slopes) **should be mapped prior to planned large scale ground disturbance activities (i.e. prescribed fire)**, and methods of control/treatment planned accordingly. It is difficult to plan ahead for wildfires and subsequent rehabilitation. Having a source of immediate funding to assist with rehabilitation efforts, including cheatgrass control is important. **"Emergency requests" to funding sources should be given consideration** to allow land managers the ability to start rehabilitation efforts immediately after unplanned disturbances. Provide emergency funding for control of cheatgrass immediately post-disturbance (planned or unplanned) in important native habitats, or where properly functioning plant communities are threatened.

Funding entities should be prepared to assist with additional treatments more than 2 years post-initial treatment. This can be accomplished by securing funding for additional treatments at the time of first funding application, or given weighted preference if/when the applicant returns with a funding request for a follow-up treatment once certain pre-determined thresholds have been exceeded. Again, projects utilizing IPM techniques should be given priority for funding.

Coordinate with Wyoming Department of Transportation, County Road and Bridge Departments, municipalities, and Weed and Pest Control Districts to control cheatgrass on roadside areas and other disturbed sites that may serve as vectors for cheatgrass invasion. To protect federal and state lands, we recommend passing and **enforcing laws requiring the use of certified, weed free hay / straw** by recreationists and for use in reclamation activities following ground disturbance. Land disturbances on private lands (pipelines, right of way easements, installation of conservation practices through federal and state conservation programs) should also be required to utilize weed-free materials in reclamation work. Improve land reclamation standards and practices utilized on federal, state, and private lands in right of way, pipeline, or other soil disturbance activities, including washing of equipment before entering and upon leaving job sites, use of certified seed for re-seeding efforts, use of certified weed free hays and

straws for reclamation, and implementing more stringent follow-up monitoring and weed control requirements post-reclamation.

We recommend **considering adding cheatgrass to the state declared list of noxious weeds**. The advantages and disadvantages associated with designating cheatgrass as a state declared noxious weed should be considered and vetted. Cost and efficacy of treatments have historically hindered the effort to list cheatgrass. Recently, some counties in Wyoming have added cheatgrass to their county declared noxious weed list. As long-term treatment efficacy continues to increase and more cost-effective treatment methods are developed we urge all affected parties to consider this approach.