LONG-TERM STRATEGY FOR RUSSIAN OLIVE AND SALTCEDAR MANAGEMENT

YELLOWSTONE RIVER CONSERVATION DISTRICT COUNCIL

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Cover photo credit: Tom Pick. Left side: Plains cottonwood seedlings on bar following 2011 runoff. Top: Saltcedar and Russian olive infest the shoreline of the Yellowstone River between Hysham and Forsyth, Montana. Bottom: A healthy narrowleaf cottonwood (*Populus angustifolia* James) stand adjacent to the channel provides benefits for wildlife and livestock in addition to bank stability and storing floodwater for later release.

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Agreement

The Yellowstone River Conservation District Council (YRCDC) adopts this long-term plan and the goals and objectives identified herein as their guide to Russian olive and saltcedar management efforts. Using an adaptive approach, the plan will be revised as technology and objectives change over time.

Endorsement of this plan by any partners or agencies named within this plan in no way limits any partners' or agencies existing legal authority, mandate, or responsibility and is subject to available funds and human resources.

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Chairperson, YRCDC Board of Directors Date

_____ _____

Chairperson Resource Advisory Council (RAC) Date

Executive Summary

The Yellowstone River Conservation District Council (YRCDC) was organized in 1999 to study a broad range of issues associated with the sustainability of the Yellowstone River system in Montana and North Dakota. The riparian studies conducted as part of the effort indicated that Russian olive (*Elaeagnus angustifolia L.)* and saltcedar (*Tamarix ramosissima* and *T. chinensis* and their hybrids) invasion comprise serious threats to the integrity and function of riparian and floodplain areas along the Yellowstone River. Both of these invasive species have characteristics that promote spread far beyond their current distribution and create numerous negative impacts on river function, native plant and wildlife species population dynamics, wildlife habitat, and water quality and quantity. The YRCDC adopted Best Management Practice #1, Managing Russian Olive in the Yellowstone River Valley, in 2007 to address this issue. This document serves as a strategic plan to carry out a coordinated and comprehensive management effort throughout the length of the Yellowstone River in Montana and North Dakota.

Russian olive is classified as a Priority 3 "regulated plant" in Montana, while it is not classified at all in North Dakota. Saltcedar is classified as a Priority 2B Noxious weed in both states.

The YRCDC's management objectives will be based on the following goals:

- Goal 1 – Prevent New Infestations.
- Goal 2 – Eradication of All Infestations within the River Corridor.
- Goal 3 – Manage Populations Outside of the River Corridor.

To achieve these goals, YRCDC will utilize the following strategies and priorities in treatment:

- Prevention is the most effective and efficient strategy. Uninfested sites and headwaters areas will have top priority for treatment and maintenance.
- Riparian and floodplain areas with light infestations will have second priority to prevent expansion and reinfestation following treatment.
- Areas of special concern will be identified and treatment plans developed to protect their inherent values and features.
- Densely infested areas will be treated to remove monotypic stands and meet landowner objectives using appropriate restoration techniques and practices.
- Uplands and tributaries adjacent to the river corridor will be identified and treated to remove Russian olive and saltcedar populations that threaten reinfestation of the Yellowstone River corridor. Alternatives to existing upland plantings of Russian olive seed sources will be promoted while control of all saltcedar populations will be sought.

Recommended management techniques are dependent owner objective, density of infestation, and site conditions. An array of proven management techniques are available and are described in the plan for utilization in carrying out this strategy. Early detection and management of Russian olive and saltcedar free areas is the preferred and most cost effective strategy, where possible. References for specific herbicide products and treatment rates are provided. An adaptive, integrated pest management approach is

recommended. Some sites will require a combination of mechanical and herbicide treatment for full success. Heavy infestations will likely require restoration practices to establish desirable vegetation. In severe infestations, cost of treatment and restoration may be very high. In nearly all cases, follow-up treatment is required to prevent reinfestation.

Key to long-term success of this strategy is development of a systematic and coordinated inventory and mapping of Russian olive and saltcedar using a combination of remote and field based tools. Where available, spatial models will be used to identify potential expansion sites in order to identify future invasions early on when treatment costs are less.

Public education and communication is another aspect of the plan that is critical for success. Public meetings, tours, demonstration projects and school outreach activities will be used to emphasize the size and seriousness of the problem to all sectors of the public. PSAs featuring the Russian olive video developed by the YRCDC Resource Advisory Council will be utilized throughout the Yellowstone basin. Similar products and messages for saltcedar will be developed and utilized.

The YRCDC will continue to work with academic and research institutions to further identify treatment options and related impacts associated with Russian olive and saltcedar infestation in the Yellowstone River corridor. Additional partnerships will be investigated and developed to further the knowledge base on this topic.

Following treatment, monitoring techniques will be used to document benefits and efficacy of treatment and to track levels of infestations over time. Monitoring will be conducted at the landscape and field scale in order to best capture meaningful results. Photopoints, general observation, plots, transects, and qualitative assessments will be used individually or in conjunction depending on the objective and intent of the monitoring, to document before and after conditions and change over time.

Close collaboration with other partners who manage land in the Yellowstone River corridor or provide technical or financial assistance to landowners is necessary to fully implement all aspects of this long-term strategy. Missouri River Watershed Coalition, Center for Invasive Species, Montana and North Dakota Noxious Weed program, Montana Fish, Wildlife and Parks, USDA-Natural Resources Conservation Service, County Conservation Districts, and County Weed Districts are all key partners delivering diverse technical and financial resources to help carry out the strategy.

New and future Plains cottonwood seedlings struggle to get a foothold on life in fresh sediment. Photo credit: Tom Pick

Long-Term Strategy for Russian Olive and Saltcedar Management

1.0 Introduction

The Yellowstone River Conservation District Council (YRCDC) was organized in 1999 to study a broad range of issues associated with the sustainability of the Yellowstone River system in Montana and North Dakota. Out of these studies came the recognition that invasive species present critical challenges to the integrity and continuity of riparian habitat, as well as other human-influenced functions associated with the Yellowstone River corridor. While there are many species found in the Yellowstone River corridor that are considered to be invasive in the sense that they spread aggressively and displace native species, two species in particular stand out as having the potential to dramatically alter the appearance and function of the River corridor: Russian olive (*Elaeagnus angustifolia L.)* and saltcedar (*Tamarix ramosissima* and *T. chinensis* and their hybrids). The YRCDC adopted *Best Management Practice #1*, *Managing Russian Olive in the Yellowstone Valley*, in 2007 to address this issue.

Recognizing that collaboration and communication with many partners, landowners and the public over the long-term is key to the effective treatment of these threats, an effort was begun to create a strategic management plan that links all partners and treatment alternatives with actions, priorities, and responsibilities. Adaptive management is a principle component of this plan. Technology changes and practical experience with management strategies and results will drive the need to revise and update this plan over time. This document then serves to present the current strategy with respect to the identification and control of these two exotic, invasive plants along the approximately 557 mile Yellowstone River corridor running from the Montana – Wyoming State line just north of Yellowstone National Park to its confluence with the Missouri River in North Dakota.

Figure 1. Russian olive and saltcedar displace native riparian species along the bank of the Yellowstone River.

1.1 Biology and Ecology of Russian Olive and Saltcedar (See Appendix A and B)

1.12 Russian Olive (*Elaeagnus angustifolia L.)*

Russian olive is a deciduous, tall shrub or small tree that grows up to 10 m (35 ft.) in height. The top is often rounded in shape. The trunk bark on an old plant is dark grey/brown and peels away in thin strips. Young branches are flexible, reddish brown and covered with a silvery gray pubescence. Older branches are brown with occasional 2 inch thorns and are covered with silver scales.

Photo Credit: USDA-NRCS

Very fragrant flowers bloom in May and June. They are silver on the exterior and yellow inside 1.2 to 1.5 cm (0.5 in.) wide. One to three flowers appear within the leaf axils. A deep taproot is supported by a well developed, lateral root system. Plants begin to produce viable seed at 6 to 10 years of age. The single-seeded fruit are 1.0 cm. (0.4 in.) long, reddish in color early and maturing to yellow and covered densely with silver scales. The large seed (up to 1 cm (0.4 in.) long) is light brown with distinguishing longitudinal striations. Seeds must undergo cold stratification to germinate but apparently remain viable for up to 28 years under laboratory conditions. Russian olive reproduces by seed or root sprouts.

Control of young plants is least expensive and offers the most potential for success. While planted extensively in shelterbelts and wildlife plantings on dry upland sites, Russian olive will reproduce in habitats that are moist in nature, either natural or with an artificially elevated water table such as irrigated pastures and moist meadows or even wetlands. It is also tolerant of salinity and moderate sodicity. Russian olive is most commonly found in and near riparian areas east of the continental divide in Montana and western North Dakota. It is somewhat shade tolerant and able to germinate and survive as an understory to plains cottonwood *Populas deltoides*) and green ash (*Fraxinus pennsylvanica*) as well as in direct sunlight. It does not tolerate long-term flooding.

1.13 Saltcedar (*Tamarisk* spp.)

Saltcedar is a relatively long-living, deciduous shrub growing up to 25 feet tall in the northern Great Plains. The plant is adapted to colonizing fresh alluvium after disturbance. Elevation range is from 2,000 to 5,000 feet elevation. Saltcedar is susceptible to shading. It is highly tolerant of saline and alkaline soil and water. A deep taproot up to 30 feet in length is supported by a well developed, secondary root system that branches profusely upon contact with water.

Photo Credit: USDA-NRCS

The grayish green leaves are small (1.5 cm) and often overlap on the stem giving the false appearance of an evergreen. Leaves turn golden brown in autumn before dropping. The smooth bark on an old plant is reddish brown that furrows and divides with age. Saltcedar is able to reproduce by seed, root sprouts, and cuttings. The plant flowers at 3 to 5 years of age or earlier and produces up to 600,000 seeds annually. Slender spikes of deep pink flowers bloom from May to as late as October. Flowers are about 1.5 mm across, with 5 petals. The seed pods or capsules are pinkish red to greenish yellow and break into 3 to 5 parts when mature. Each pod holds thousands of tiny seeds that are viable for at least several months. A tuft of fine, silky hair crowns the tip of each seed facilitating spread by wind and water. Seedlings grow slowly and require continuously moist soil in which they develop a deep taproot which allows the plant to survive extended drought conditions once established. Several months of continuous flooding may be necessary to kill the plant. Side shoots quickly sprout from buds on the root crown when the plant's top is physically damaged or killed by cold temperatures.

Following establishment, flow regulation (decreased flood disturbance) benefits development of dense, pure, saltcedar stands. Fire and grazing preference (beaver and cattle don't utilize saltcedar) favors saltcedar. Shed leaves contain high concentration of salts which form a saline crust beneath the plant making germination difficult for competing species.

1.2 Distribution and Spread (See Appendices C and D Distribution Maps)

Russian Olive - In the 1800s, Russian olive was reportedly brought to the US where it was planted by Russian immigrants. By the 1900s it was cultivated in many western states and occurrences were noted in Montana. It was promoted widely by federal and state conservation agencies for windbreaks and wildlife plantings throughout the Great Plains by the middle of the century. By the 1980s naturalized populations outside of cultivation were noted more frequently. The lag time between initial plantings and recognition of its invasive nature is due to the fact that Russian olive is known as a relatively slow invader. Several observers have noted that Russian olive is more prevalent in the river corridor near cultivated plantings. It primarily reproduces by seed and the large seed size represents an impediment to rapid movement since it must rely on animal, water, or ice transport, as well as the fact that fruit bearing plants must reach about 7 years age to produce viable seed. Russian olive was designated as a 'regulated plant' by the State of Montana in September 2012 which means that it can no longer be legally sold or planted in Montana. Russian olive has no similar designation in North Dakota.

Environmental conditions related to Russian olive spread are similar to those described below for salt cedar, however, Russian olive is more adapted to shade and thus can invade existing native tree stands better than saltcedar. It is perhaps even more favored by flow regulation (less flood disturbance) than is saltcedar and withstands cold better than saltcedar. Russian olive's relatively long seed viability (at least 28 years) gives it a competitive advantage over native species that have seed with short viability.

Saltcedar - Several species of saltcedar were introduced to the US in the 19th century and have since hybridized. The majority of naturalized saltcedar in Montana are either *T. chinensis* or *ramosissima* or a hybrid between these two species. Spread came into the upper Yellowstone River basin via the Big Horn, Powder, and Tongue Rivers from Wyoming to the south where saltcedar was used widely for streambank erosion control. Ornamental plantings of saltcedar in the Yellowstone River basin have also led to locally naturalized populations. Invasive populations have also moved up the Yellowstone from the Missouri River. Environmental conditions favoring the spread of salt cedar in Montana are thought to involve increased cold weather adaption, riparian disturbance, salinization, and flow regulation. Saltcedar shows a strong negative correlation with mean annual minimum temperatures which demonstrates its frost sensitivity. A warming environment could lead to an increase in its potential range northward or to higher elevations, as well.

Current estimates of saltcedar extent in Montana is over 40,000 acres in the eastern half of the state along river corridors and shore margins of reservoirs. This relative abundance and distribution estimate is known to be very uncertain as there has been no consistently applied salt cedar inventory in Montana to date.

1.3 Summary of Impacts

Riparian areas and floodplains make up a relatively small portion of the landscape in Montana; less than 2 percent by many accounts. Yet, the importance of riparian areas to stream function and native wildlife communities is well known and documented. Undisturbed new and established cottonwood riparian communities in Montana support up to 114 animal and 58 plant species respectively, compared to only 29 species (animal and plant) in Russian-olive dominated stands. Riparian areas and floodplains also provide needed forage production and shelter for livestock. Riparian areas help provide flood water storage and energy dissipation by detaining flood waters and holding streambank soil in place. Some of the negative impacts noted in past and ongoing studies associated with these two invasive exotic species are:

- Russian olive and saltcedar invasion adversely impacts riparian area health and sustainability; that is, the self replacement of the native riparian plant communities over time. The mechanics and result of impact focuses on their capacity to displace and dominate native vegetation such as cottonwoods and willows. The displacement then alters wildlife species (bug, mammal, amphibian and bird) diversity and abundance as the resulting plant community composition, density, and structure changes.
- Alterations to the food cycle created by dropped Russian olive and saltcedar leaves has been shown to affect terrestrial and aquatic invertebrate and vertebrate communities thorough changes in the food web. Saltcedar leaves are used by few species. Insect numbers and diversity are lower in saltcedar and Russian olive communities than comparable native riparian communities.
- Habitat quality for most native species is adversely affected while forage production and accessibility for domestic livestock is reduced by dense stands of Russian olive and saltcedar.
- Effects on water quality and quantity due to the dominance of these invasive species have also been documented by researchers, although impacts on stream flow and aquatic life may be less dramatic here in Montana than has been observed in the more arid southwest US.
- Aesthetic values of the stream corridor are degraded, and access to streams for recreation (e.g., boating, fishing, hunting, hiking, and bird watching) is lost.
- Dense stands of saltcedar and Russian olive on stream banks may gradually cause narrowing of the channel and an increase in flood elevation. Channel narrowing along with exotic species-induced stabilization of stream banks, bars, and islands may lead to changes in stream channels that can impact aquatic and terrestrial habitat which in turn affects the organisms living there.
- Dense stands of saltcedar and Russian olive influence livestock use by reducing forage and blocking access to surface water. Both plants are not considered preferred forage for livestock.
- Nitrogen-fixing bacteria can form on Russian olive roots providing extra nutrients to enhance growth and potentially enrich groundwater and surface runoff leading to reduced water quality.

Russian olive is acknowledged to have some positive benefits to wildlife. It is known to support important wildlife habitat niches, particularly when it occurs as a smaller component of the riparian community with reports showing that more than 50 kinds of birds and mammals may eat the fruit of Russian olive. A few caveats to these benefits are:

- Many of the benefited species are exotics or predators that compete with or prey on native species.
- Food and structural cover provided by Russian olive benefit both native and introduced wildlife species although insect-eating and cavity-nesting bird and bat species are often displaced by severe Russian olive infestation.

Saltcedar plants, in particular, have been shown to have water uptake rates similar to or slightly exceeding native cottonwood and willow, however, saltcedar has the potential to create dense, monotypic stands that effectively increase the water use rate over native communities. Saltcedar in the southwest has been shown to have some nesting benefit for certain native bird species. This positive functional habitat niche hasn't been shown to be present in the northern Great Plains.

1.4 Legal Framework

The "Montana County Weed Control Act" (MCA Title 7, Chapter 22, Part 21)
was passed In 1939. This law created a process for the establishment of weed districts at the county level. The Montana Department of Agriculture administers the law and identifies the various statutory requirements for the management of "noxious weeds" in Montana. A noxious weed in Montana is defined as: "any exotic plant species that is established or that may be introduced in the state that may render land unfit for agriculture, forestry, wildlife, or other beneficial uses or that may harm native plant communities". The Weed Control Act

has gone through many levels of revision and repeal, is still the driving force behind much of the management of exotic plant species in Montana. The Montana County Weed Act also establishes the ability to designate which invasive plant species are defined as "noxious". Both the Department of Agriculture and County Weed Control Boards have the authority to designate noxious weeds. The noxious designation becomes legally important in regard to which species have a designated priority. Montana has created a priority system to address the control and treatment of noxious weeds and undesirable plants. Species that have been designated as "noxious" and higher priority are subjected to a greater amount of regulation and control. Appendix C lists the current designation of noxious weeds in Montana.

Saltcedar is currently classified as a Priority 2B noxious weed in Montana. Category 2B weeds are abundant in Montana and widespread in many counties. Management criteria will require eradication or containment where less abundant.

Russian olive was classified as a Priority 3 regulated plant in Montana in September 2010. Regulated plants are introduced species have the potential to have significant negative environmental and economic impacts. The plant may not be intentionally spread or sold other than as a contaminant in agricultural products. Unlike designated Noxious Weeds control measures or management are not mandated. These species are determined by Rule of the Montana Department of Agriculture (MDA) under the provisions of the Montana County Weed Control Act. The state recommends research, education, and prevention to minimize the spread of this regulated plant.

North Dakota has similar laws and regulations addressing noxious weeds in creating a statewide and (provisions for) county–based noxious weed lists. North Dakota's statewide noxious weed list includes saltcedar, but does not list Russian olive nor does McKenzie County's supplemental noxious weed list. Appendix D lists the North Dakota and McKenzie County noxious weed priority designations.

2.0 Strategic Management Objective and Goals

The YRCDC Board of Directors and the Resource Advisory Council (RAC) will work with all willing partners to carry out the following goals and objectives. These goals and objectives will be reviewed with public and private partners and modified as needed to attain the overall objective of protecting the health and function of the Yellowstone River and associated resources.

2.1 Goal 1: Prevent New Infestations (Control spread)

The most cost effective control is to prevent spread outside of known infestations using a combination of landowner awareness and citizen involvement to report new locations in a timely manner. Implementation of this goal will be slightly different given the differences in mode of spread and current extent of Russian olive and saltcedar along the Yellowstone River corridor.

Russian Olive - Since it is likely that only sections of the corridor immediately below Yellowstone National Park in Wyoming are totally free of Russian olive, these areas should have the highest priority for prevention strategies.

Saltcedar – While salt cedar is found in all Yellowstone River counties, it occurs less abundantly in the upper reaches (Regions PC, A, and B). Landowners and river users in these regions should be made aware of the effort to prevent spread and provided with a salt cedar identification guide and contacts for notification. Predictive models using combinations of climate, soil, and topography have been developed by researchers and the United States Geological Survey (USGS). The models show a greatly expanded extent of potential saltcedar invasion sites in Montana (USGS map). Many of these potential expansion sites are outside of river corridors

and consist of thousands of shoreline miles along lakes and ponds. Given the relative ease of saltcedar seed transport by wind, water, and avian wildlife carriers, a high degree of vigilance and rapid response will be necessary to prevent future spread of saltcedar into currently uninfested upper and middle basin locations. Recreational outfitters and citizens floating the upper reaches of the River should be made aware of this issue and provided with a saltcedar identification guide and contacts for notification.

2.2 Goal 2. Eradication of All Infestations Within the River Corridor

All currently mapped infestations of Russian olive and saltcedar on public and private land within the Yellowstone River corridor will be targeted. Public and private landowners will be contacted and urged to begin control work. Work with County Weed Management Districts to pursue designation of 'special management zones' as provided in the Montana Weed Control Act, within each weed district for Russian olive eradication. Designation allows for the application of Noxious Weed Trust Funds that otherwise would not be possible for Russian olive control. The goal is to remove all mature plants prior to 7 years of age before they begin to produce seed. Because saltcedar is already designated as a noxious weed, no further designation is necessary to utilize the Noxious Weed Trust Fund.

Figure 2. Russian olive (second row from left) has been planted extensively in farmstead and wildlife shelterbelts since the 1950s. Photo credit: USDA-NRCS.

2.3 Goal 3. Manage Populations Outside of the River Corridor

Conservation Districts comprising the YRCDC will collaborate with county weed districts, state agencies, U.S.D.I. Bureau of Land Management, and U.S.D.A. Forest Service offices and the public to develop plans to address Russian olive and saltcedar source areas that provide seed and plant materials that can create new infestations of Russian olive and saltcedar. One objective will be to encourage landowners adjacent to the Yellowstone River valley and in tributaries to manage their Russian olive populations to prevent further expansion. In particular, plantings of Russian olives used for wildlife habitat and shelterbelts in uplands immediately adjacent to the Yellowstone River valley and tributaries should be replaced, over time, with less invasive species. NRCS and other organizations are working to identify and develop alternatives to Russian olive. Recommendations for replacement of Russian olives will be based on the results of these investigations. The Council recommends that any live, ornamental plantings of saltcedar within the Yellowstone watershed should be immediately destroyed unless used for educational purposes by a responsible and qualified agency.

3.0 Treatment Strategies and Priorities

The best control approaches typically address whole management systems and integrate the landowner's objectives for the parcel. Additionally, the chosen treatment will vary by site and stand characteristics. As a rule, removing or controlling isolated patches of invasive plants first before attacking large, contiguous areas of a weedy species, is the best long-term strategy for noxious weed control. Once an aggressive program is in operation for these isolated patches, managers' focus can be shifted to the large patches. Regardless of the control strategy selected, care should be taken to create the least ground disturbance possible so as to minimize invasion by other noxious weed species. Following are the YRCDC priorities for treatment of saltcedar and Russian olive in the Yellowstone River watershed.

Importantly, treatment plans must also evaluate and address ecological processes that may be driving the invasion of invasive species. Maintaining maximum productivity and diversity in native plant communities is

usually the best means of preventing infestation by less desirable species. Changes to land management practices should be considered to favor native plants over invasive species, where possible.

3.1.Uninfested Sites and Headwaters Areas.

Goal: Prevent the spread of saltcedar into un-infested headwater areas along the Yellowstone River corridor and currently 'clean' tributaries.

Action: The highest management priority will be keeping currently un-infested areas devoid of saltcedar and Russian olive by adopting an aggressive, early detection and rapid response process.

Russian olive – Russian olive currently infests nearly the entire extent of the Yellowstone River corridor throughout Montana and North Dakota. The headwaters in Park County consists of scattered cultivated plantings associated with residences and agricultural operations and lesser numbers of naturalized plants along the river below the town of Gardiner. While there are relatively limited expansion sites in the headwaters corridor, all occurrences of Russian olives serve as sources of seed to infest areas downstream so control in the headwaters area is critical. This goal applies to Reaches PC and A-1 to A15. These reaches have a relatively minor extent of Russian olive infestation within the 100-year floodplain boundary due to the climate and geology compared to reaches downstream of Reach A15 (below the confluence with the Clark's Fork of the Yellowstone River). High risk sites such as irrigation ditches, wet-saline pastures, and receding bank lines should be checked annually. Closer to currently infested areas, the understory and edges of existing stands of cottonwood should be checked for new seedlings.

Saltcedar – Presently, Park and Stillwater Counties have relatively few known locations of saltcedar and are the main focus of this priority action along the Yellowstone River corridor. Landowners and interested citizens are encouraged to contact their local conservation or weed district to report new sightings of this species. Efforts to eradicate the infestation will be made quickly with public notification. Landowners and recreationists will be targeted in the information campaign to help carry out this action. High risk areas such as exposed gravel bars, disturbed saline wetlands, riverbank shorelines and irrigation ditches should be checked annually following runoff.

3.2 Riparian/Floodplain Sites with Light Infestation

Goal: The priority in these areas is to prevent further infestation and increased densities of invasive species. Lightly infested areas are defined generally as having younger plants (usually less than 10 years of age) with smaller stem diameters and desirable understory vegetation present.

Action: Work with landowners and managers to remove/treat salt cedar and Russian olive, reduce upstream seed sources, and protect and enhance existing native riparian plant communities to combat further infestation. Implement annual monitoring following treatment to promptly detect root sprouts and new plants generated from the seed bank.

3.3 Areas of Special Concern

Goal: The priority is to identify riparian areas or wetlands that have a special focus (recreational, cultural, or critical habitat for threatened, endangered or sensitive species) and to preserve, create, or enhance the unique attributes on such sites.

Action: Identify areas of special concern within each county and develop site specific plans to prevent the loss of the unique attributes of each site relative to saltcedar and Russian olive invasion and control/removal.

Figure 3. Motorized shears cut and remove large, mature Russian olive understory prior to cut stump treatment. Photo Credit: USDA-ARS.

Densely Infested Sites

Goal: The priority is to remove dense or monotypic stands of saltcedar and Russian olive and to restore desirable native plant species to achieve riparian function and/or site specific objectives of the land owner or manager. Dense stands typically are typically older plants (more than 10 years of age) and do not have desirable understory vegetation present.

Action: Work with landowners and managers to identify large blocks of dense stands of saltcedar and Russian olive followed by development of site specific treatment and restoration plans that return the land to sustainable productivity and function. Priorities should focus first on the plants that are situated high on stream terraces that are likely to survive future floods and reseed the stream corridor.

3.4 Uplands and Tributaries Adjacent to the River Corridor

Goal: Reduce the threat of spread from adjacent uplands into the Yellowstone River floodplain and tributaries.

Action: Work with partners to develop and promote non-invasive alternatives to the use of Russian olive in upland windbreaks and encourage replacement of Russian olive over time in tributaries and uplands adjacent to the River corridor. Promote removal of all saltcedar ornamental plantings.

4.0 Management Techniques and Costs

A number of treatment methods have proven successful for the control of saltcedar and Russian olive; the best method for a particular site chosen based on level of infestation and cost. No one method is one-hundred percent effective as follow-up surveys and treatment be required for many years. An adaptive management approach, as new management techniques and technologies are developed and made available to the public, will be utilized to revise this plan. The goal of any treatment plan should be to incorporate as many components of an Integrated Pest Management (IPM) Plan as possible. IPM is the application of multiple management actions that are mutually supportive such as the enhancement of competitive native plants along with actions that suppress undesirable plants. IPM also serves to optimize treatment expenses and pesticide applications by better applying concepts of prevention, early detection, containment, and population reduction. Inherent is understanding and applying actions to affect the life cycle and dispersal mechanism of the weed or pest. Mechanical, chemical, cultural, and biological (when permitted) treatments are all used in collaboration to successfully treat invasive species using IPM. See Appendix E for herbicide manufacturers' product information and recommended treatment rates. Approximate costs of the treatment alternatives described below are provided in Table 2.

4.1 Light areas and Areas of Special Concern

Lightly infested areas are defined generally as having younger plants (usually less than 10 years of age) with smaller stem diameters and desirable understory vegetation present. Areas of special concern may have unique environmental circumstances such as cultural resources, endangered, threatened, or at-risk species present. Selection of treatment approach for sites in this category will be driven by the density and size of invasive trees or shrubs and the degree of soil disturbance that can be tolerated.

4.11 Manual removal

Young plants (up to one year old and less than 2 feet tall) can be hand pulled or grubbed out. Most of the root system must be removed to effectively destroy the plant. Both saltcedar and Russian olive can sprout vigorously from cut stems and buried roots. Labor cost can be excessive unless performed by volunteers or family members, however, early detection and treatment forgoes the high cost of treatment land and plant restoration required for heavier infestations. Regular follow-up is necessary to check for new sprouts.

4.12 Selective Mechanical Grubbing

Where access is not a problem, the entire root system of individual trees can be excavated with a backhoe or similar device where density is not too high. To be effective, the root system should be removed from the site and burned. This may take up to a year to dry enough to burn. Chipping is another option however it may not destroy seed attached to the plant. Disturbance to native vegetation will vary with the level of treatment needed but desired vegetation should be restored with sod or seed/plant treatment, as necessary.

4.13 Low Volume Basal Bark Herbicide Application

Basal herbicide treatments can control small plants and regrowth (stems less than 2-3 inches in diameter at ground level and less than 8 feet in tall). Selective application of herbicide (ester formulation) mixed with vegetable oil or approved carrier) is made to the base of the individual tree or group of plants using a backpack sprayer. For best results, thoroughly spray (no drip or runoff) the lower portion of the stem. Fall through spring applications are best. Treatment can be made any time of year, although damage to desirable plants is minimized when treatment is made when they are dormant. This method is cost effective for selective control of small diameter trees and for follow-up re-treatment of previously treated sites.

4.14 Cut Stump Herbicide Application

Older, larger diameter plants with thicker bark can be selectively treated using a low volume application of herbicide to the stump cut just above the ground using a chainsaw or mechanized tree shear. Immediately apply an approved herbicide to the cut stump surface using a hand or backpack sprayer or the sprayer attached to the shear. The herbicide is drawn into the plant to destroy the root system. The application should be nearly immediate to avoid exuded resins interfering with herbicide uptake. Cost per acre depends on the density of plants treated and costs associated with removal or chipping of the woody debris. This technique may be most suitable for controlling light to moderate infestations of mature, established Russian olives in a cottonwood gallery understory to prevent damage to the cottonwood community. Retreatment of sprouts the following year will be needed to prevent reinfestation.

Figure 4. Cut stump is treated immediately with herbicide and oil emulsion sprayer on mechanized shear to maximize herbicide movement to roots. Photo credit: USDA-ARS.

4.15 Foliar Herbicide Application

When selective basal herbicide treatment is not possible due to size of trees or the density of the stand favors foliar application, a treatment using a foliar herbicide spray is effective. The most effective applications take place between June and September. A nonionic surfactant added to the spray mix is recommended. Spray in June has been shown to be effective, however August and September is often more effective when plants are moving food reserves into the root system. Complete foliar coverage with spray is

needed but without injuring non-target plants. Broad spectrum herbicides will injure or kill plants that receive the spray solution. Apply the spray with a backpack or ATV mounted sprayer equipment. Foliar treatment is cost effective where mechanical treatment or individual cut stump treatment is not feasible, although the large volume of herbicide solution does increase the cost per tree. The standing dead tree/shrub skeletons may interfere with future land uses and may be a consideration in method selection for some sites.

4.2 Densely Infested Sites

Densely infested sites are defined as those that have a closed or nearly closed canopy and do not have an understory present. These sites may also be described as having a greater number and proportion of older plants (greater than 10 years age) with larger diameter stems (greater than 4 inches at the ground level). Densely infested sites typically require restoration activities such as site preparation and clearing due to the need to remove tree skeletons and to replant with desired vegetation. Due to the greater intensity of work required to treat densely infested sites, a thorough evaluation of treatment objective, potential effectiveness, short- and long-term cost, restoration potential, and the potential for unintended environmental consequences is needed before setting priorities for treatment sites. Densely infested sites may also have additional invasive species present due to the lack of ground cover under the canopy. The invasive species present may influence the choice of treatment method.

4.21 Mechanical Removal

Mechanical removal is not recommended in riparian areas. Removal of the abundant stems and branches by heavy equipment is practical where damage to associated desirable vegetation is not a concern such as pasture restoration. Stem removal during the winter when the ground surface is frozen may result in less surface disturbance. Root plowing and raking, typically used in the southwestern US, is done is the summer to aid in drying out and killing roots. Mechanical removal requires follow-up to treat root sprouts and new seedlings. Site renovation is typically needed to discourage invasion by other invasive species. Root plowing is not recommended in Montana because of the high cost and potential for invasion by leafy spurge and other noxious weeds following the extensive soil disturbance. Control and restoration costs can be very high but may be the only practical way to restore productivity to improved pasture where there are dense infestations present.

4.22 Aerial Herbicide Application

Dense infestations that are large in extent can be controlled with an aerial application of herbicide, however, this method has the potential to severely affect non-target plants. For this reason, it generally would not be used adjacent to perennial or intermittent waterways. Aerial and ground spray treatments are usually made with the addition of a nonionic surfactant to improve the herbicide's contact with the leaf surface. The late August through September time period when plants are actively growing prior to fall leaf-color change is recommended. Fixed wing aircraft can be less expensive when treating large blocks that don't require precision application. Helicopters work best for more precise application work or complex applications around water or other sensitive locations. Because this method relies on slow acting uptake of herbicides, treated trees should not be removed for at least 3 years to allow for complete 'root kill'. Follow-up control is required until plant densities are within acceptable levels. Revegetation is usually required on large scale areas with dense infestations for sustainable, long-term control and to achieve the goals of the treatment program. Control and revegetation costs can be quite high with this method of treatment.

4.23 Combination of Control Methods

Large scale mechanical and aerial spray treatments can be combined with burning or shredding treatments to reduce costs and economically prepare sites for restoration. Given the potential high costs for removing exotic species on large, monotypic stands, removal projects should be prioritized based on the

potential for natural regeneration or the need to replant as part of a site restoration plan. As noted previously, an additional consideration is the potential for infestation by other commonly occurring invasive species such as leafy spurge (*Euphorbia esula* L.), Canada thistle (*Cirsium arvense*) or one of the several knapweed species (*Centaurea spp.) that* frequently occur within the Yellowstone River corridor.

4.24 Best Management Practices (BMPs) for Site Restoration

Restoration practices are intended to return sites to plant communities consisting of native or desirable species using natural regeneration or artificial planting techniques. Restoration with desirable plants will protect and enhance riparian and hydrologic function, improve wildlife habitat, and help to discourage the reinvasion of exotic species. Figure 5 depicts the planning process

Stream systems, like the Yellowstone and many (but not all) of its tributaries, have predominately unaltered hydrology (not dam controlled)that are well suited to natural regeneration of native species, as opposed to systems where the natural flow pattern has been altered or regulated. Unregulated streams usually have a high connectivity between ground water and surface water in the channel. The connectivity provides for flooding and sediment deposition outside the channel on a regular basis which creates an ideal establishment surface for native vegetation such as willows, cottonwood, and riparian herbaceous vegetation. Evaluation of the channel classification for the pertinent reach of the Yellowstone River should provide some insight into the likelihood of overbank flows and the feasibility of relying on natural regeneration. Aerial spraying, followed by burning to remove the dead stems and branches for an improved pasture, may be an acceptable combination of practices where natural regeneration can be expected with a high degree of certainty.

Table 1. Estimated costs per acre and expected percent of control for individual treatments and large scale control methods (adapted from Taylor and McDaniel 2004).

Control Treatment	Cost per Acre	Percent Control
Individual Plant Treatments		
Manual Removal (Young Plants)	0-$5,000	95-100
Mechanical Grubbing	$40-$300	97-99
Low-volume Herbicide Application [1]	$30-$60	80-95
Cut Stump Herbicide Application [2]	$1,600-$2,500 [6]	60-80
Ground-based Foliar Herbicide	$40-$300	97-99
Large Scale Control		
Mechanical	$700	97-99
Combination Airplane Herbicide-Burn	$300	93
Combination Helicopter Herbicide-Burn [4]	$240	89
Combination Airplane Herbicide-Shred [3,5]	$400	97-99
Combination Helicopter Herbicide-Shred [4]	$510	97-99
Combination Airplane Herbicide-Burn-Mechanical	$380	97-99
Combination Helicopter Herbicide-Burn-Mechanical [4]	$490	97-99

[1]Doug Parker 2003 Personal Comm. Cited in NMIWAG, 2004.
[2]Duncan 2003
[3]McDaniel and Taylor 2003a
[4]McDaniel and Taylor 2003b
[5]Includes 2 years of follow-up using ground-based foliar herbicide treatment
[6]The majority of the cost will be for tree cutting and removal or chipping, and the herbicide cost can vary from $20 to $60 per acre.

Densely infested sites on high terraces above the current floodplain or within well entrenched (incised) reaches are likely not suited to natural regeneration due to the land surface height above the local ground water level and recurrent flooding and sediment deposition to prepare a seedbed. Artificial treatment means are usually required to prepare a planting seedbed for herbaceous cover and/or to establish woody vegetation. Considerations in selecting a specific artificial treatment prescription are depth to ground water and soil characteristics (depth, water holding capacity, and salinity). Excessive depth to ground water should rule out the artificial establishment of native woody riparian vegetation in which case, the objectives for treatment and management should be examined. Table 1 and 3 gives estimates costs while Table 3 provides additional comments on some specific land restoration practices.

Table 2. Description and comments on restoration and land rehabilitation practices following saltcedar and Russian olive control (adapted from Taylor and McDaniel 2004).

Method	Timing	Effectiveness	Comments
Controlled flooding: Flood areas when seeds from desirable species are present.	Flooding: When native or desirable seeds are available on site (generally late spring to early summer).	Cottonwood and willow survival 20% to 70% after 2 years.	Continuing control of invasive exotics is critical.
Pole Plantings: Cutting and planting stems of willows and cottonwoods from established trees. Butt ends are soaked in water 7 to 10 days prior to planting into water table.	Planting: During dormant season prior to budding at beginning of growing season. Usually late fall or late spring when ground is not frozen.	Plant survival 50% or less after 3 years.	For minimum wildlife benefit, density should be at least 100 trees and shrubs per acre (approx. 20 ft. x 20 ft. spacing).
Nursery stock: Place understory plants with at least 30 cm (12 inches) of root length into holes that are augured to the water table depth.	Planting: Dormant season prior to leafout in spring or leaf drop and hardening off in fall. Supplemental water may be required for several months.	Plant survival 90% with proper species selection and maintenance.	Survival decreases if the water table is greater than 5 feet. Density should be at least 100 trees or shrubs per acre (approx. 20 ft. x 20 ft. spacing) for minimum benefit wildlife.
Seeding herbaceous permanent vegetative cover.	Spring or early summer when adequate soil moisture is present or late fall after seed dormancy (after November 1 is usually good)	95% if proper site preparation and seed placement is practiced.	Select species based on objectives for use, soil type, and other site conditions. See NRCS Conservation Practice Code 510 - Forage and Biomass Planting.

Table 3. Estimated costs for restoration practices following saltcedar or Russian olive removal (adapted from Taylor and McDaniel 2004).

Revegetation Technique	Cost per Acre
Deep Pole Planting	$900
Containerized Nursery Stock	$2,700
Seedbed Prep, Seed, and Seeding Permanent Vegetative Cover	$120

5.0 Inventory Needs and Methods

A good landscape-scale baseline measurement of the extent of saltcedar and Russian olive invasion along the Yellowstone River at this time is necessary so that some estimation can be made of how much work and financial resources are needed to address the problem. A baseline inventory will also allow measurement of success over time. Baseline surveys also allow can help prioritize scarce financial and technical resources so they have the most direct impact. Several individual, locally organized mapping efforts for saltcedar have been completed in the past (2002-Yellowstone Co. and 2004-McKenzie Co., ND) which provides a starting point for future coordinated inventory of these species.

5.1 Remote Sensing and Interpretation

Remote sensing techniques gather information about a subject without making physical contact. In terms of this plan, remote sensing means the use of aerial images to identify individual plants and populations of saltcedar and Russian olive. NRCS completed a Russian olive distribution map product in 2011 for the Yellowstone River and major tributaries in Montana using imagery from the 2009 National Agricultural Imagery Program (NAIP) and a remote sensing program (Feature Analyst) in ArcMap. Richland County in ND was not mapped. The inventory identified nearly 500,000 polygons (a polygon is a closed shape representing the outline of an individual Russian olive or cluster of plants) representing a Russian olive color signature. These polygons ranged in size from as small as 3 square meters to 42 acres (9.71 hectares) in area. Ground truth checking and on-screen editing was used to reduce error in the automated process. A total of 7,200 acres were mapped as occupied by Russian olive within the mapping corridor and tributaries, although this area represents only the actual area of a plant canopy and not the full area impacted. The impacted area is likely 2 to 3 times larger. The study authors also recognized that the method probably underreported Russian olive growing in the understory beneath cottonwood. Table 4 provides the relative acreage surveyed for each county. An objective of this plan will be to see that the Russian olive distribution map is updated at a minimum of every 4 years (NAIP imagery is updated every 2 years). Agreement on this objective should be reached

Table 4. Russian Olive Distribution Mapping for the Yellowstone River and Tributaries in Montana (NRCS, 2009)

County	Acres mapped	Maximum polygon size (acres)	Minimum polygon size (acres)
Big Horn	1102.43	6.71	0.01
Carbon	644.14	4.66	0.01
Carter	0.02	0.01	0.01
Custer	922.38	22.81	0.03
Dawson	310.49	10.93	0.02
Park	43.27	1.46	0.01
Powder River	796.66	10.52	0.03
Prairie	163.15	1.69	0.02
Richland	527.63	5.77	0.02
Rosebud	1043.03	42.29	0.02
Stillwater	64.53	0.74	0.01
Sweet Grass	15.12	1.1	0.01
Treasure	490.93	28.79	0.01
Wibaux	2.91	0.5	0.01
Yellowstone	1073.77	5.79	0.01

Figure 5. Vegetation sampling site at USDA-ARS Ft. Keogh, August 2012. Photo credit: Scott Bockness,

with partners interested in invasive species management.

At this time, there does not appear to be a consistently applied, basin-wide saltcedar mapping process or product in place. An unsuccessful, remote sensing demonstration project was attempted in Yellowstone County in 2011 as part of a USDA-NRCS grant. Saltcedar's image 'signature' is not as unique as is Russian olive's and apparently can't be used to accurately identify infestations of this plant using image analysis techniques. Efforts to map saltcedar distribution using remote sensing techniques will be pursued if and when technology allows more accurate mapping.

5.2 Predictive Models for Potential Expansion of Distribution

USGS and other researchers have created spatially-based habitat suitability models to predict potential saltcedar and Russian olive invasion sites (beyond current known distribution) in Montana. These mapping models use a number of available topographic, climatic, and geologic factors to predict potential invasion sites at regional and local scales. The models generally show a lot of potential for these species to move well beyond their current distribution within Montana and the Yellowstone basin. This sends the message that there is a lot of work to do and it's better to begin now than later.

While such models are useful for large scale, 'big picture' planning and management efforts, it's assumed that on the ground efforts to manage invasive species will have to rely on local knowledge and awareness to detect new infestations early on. Models, however, can help to identify the annual rate and maximum possible extent of invasives' spread if left untreated as a component of efforts to budget management activities and funding necessary to meet the projected challenge. Efforts to develop local models will continue.

5.3 Invasive species mapping efforts

A field-based process should be initiated by partners to create a saltcedar baseline mapping product for the reasons described above for Russian olive. Without an accurate, locally coordinated and supported baseline distribution map, it will be difficult to determine whether saltcedar control strategies are successful over time. It is recommended that CDs and county weed districts work with the Center for Invasive Species at MSU to develop and conduct a coordinated, saltcedar mapping project.

The Center for Invasive Species Management (CISM) has instituted a 'smart phone'-based application, known as the Early Detection & Distribution Mapping System West (EDDMapS West) to allow users to interactively map the location of invasive species infestations. This app is part of a regional approach created for the Missouri River Watershed Council and should be used by all Yellowstone River basin weed warriors to locate and provide early warning of new infestations of all invasive species in addition to saltcedar and Russian olive. The app should be a component of every invasive species partners' public outreach effort. See and download the application **"EDDMapS West" at http://www.eddmaps.org/mrwc/.**

To better aid in tracking progress and understanding population distribution (Russian olive and saltcedar) over time, a program to track implementation of control efforts by individual landowners and land management agencies (US Forest Service, Bureau of Land Management, Montana Fish, Wildlife & Parks, and Montana Department of Natural Resources and Conservation – State Trust Lands Division) will also be investigated and undertaken. NRCS offices and weed districts commonly provide technical and financial assistance to landowners

to carry out Russian olive and salt cedar control on private land. County weed district supervisors are the likely 'keepers' of an implementation tracking tool.

6.0 Public Education and Communication Activities

Key to the success and long-term sustainability of this invasive species strategy are public education and communication. Following are activities that will be undertaken by the YRCDC, its member conservation districts, and partners to carry out this long-term plan.

6.1 Public meetings and outreach

The YRCDC, through its Resource Advisory Committee (RAC), will carry out an aggressive campaign to host public meetings and take comment each year in the upper, middle, and lower basin to review this long-term plan to control invasive species , particularly saltcedar and Russian olive. Involvement of the general public, in addition to river users, and adjacent landowners is critical to the long-term success of this project. The YRCDC will promote discussion of invasive species at Area, Statewide, and National functions of conservations districts such as at Montana Association of Conservation District and National Association of Conservation District sponsored events through project updates and speaker/panel discussions.

6.2 Russian Olive Video Promotion

The RAC created and released the DVD "The Russians Are Already Here" in 2012 to inform the public of the serious problems that Russian olives are causing with impacts to river function, agricultural grazing land, recreation, irrigation infrastructure, and wildlife habitat. In its first year of use, the DVD was featured in 3 public service announcements (PSAs) and a number of public meetings generating numerous inquiries from the public. The approximately 5-minute video will continue to be used at public gatherings such as county fairs, tours, and field days, as well as online (YouTube) to promote the awareness of the need to manage Russian olives within the river corridor. The goal of this activity is to fully utilize PSAs with radio and television stations throughout the Yellowstone River basin in Montana and North Dakota to promote the DVD and its message to the general public.

6.3 Demonstration Projects

YRCDC will support and encourage additional demonstration projects to showcase innovative control technologies and management strategies to reduce the effects of saltcedar and Russian olive infestation and practices to mitigate structural wildlife habitat loss following removal. Current demos will be promoted.

6.4 Tours and Field Days

The YRCDC will partner with county weed districts and conservation districts to promote local tours and field days to view areas infested with saltcedar and Russian olives as well as demonstration and treatment projects so as to share success stories and lessons learned throughout the Yellowstone River watershed and with other watersheds.

6.5 School outreach activities

YRCDC will work with local school districts, educational specialists, and other partners in the watershed to develop and carry out grade-appropriate educational outreach activities that help school age youth to learn about the adverse impacts of exotic, invasive species like saltcedar and Russian olive on the natural resources and native plant communities associated with the Yellowstone River.

6.6 Academic Research Needs

Academic research helps to fulfill educational needs within the community as well as to find proven solutions to local needs. The YRCDC will continue to partner with academic institutions in Montana to target the available financial and technical resources on the control and management of saltcedar and Russian olive while minimizing negative environmental impacts on the people and resources in the Yellowstone River basin.

6.61 Agricultural Research Service (ARS)

ARS is currently studying plant community dynamics and response to control at its Fort Keogh and Sidney, Montana Research Laboratories as well as at a number of other field treatment sites in Montana, Wyoming, and South Dakota. The out-of-state treatments are conducted in conjunction with the Missouri River Watershed Council. These long-term research projects are designed to provide insight into more effective restoration strategies by evaluating Russian olive resprout and seedling return rates, secondary invasion by other weeds, native herbaceous, shrub and tree diversity, soil health, and insect diversity and abundance.

6.62 USDA-NRCS Bridger Plant Materials Center

The Bridger Plant Materials Center (PMC) is owned by the CD associations in Montana and Wyoming. The physical facilities are staffed and operated by the USDA-NRCS Montana office. Currently, the PMC has several field-scale, collaborative projects in place to test deep planting restoration techniques, native species adaptation, Russian olive replacement species, and longevity of Russian olive seed viability. YRCDC will continue to support collaborative partnerships with the Bridger PMC and other organizations to find solutions to restore dense Russian olive stands and replacement/substitution for Russian olive in windbreak and shelterbelt plantings in North Dakota and Montana.

Figure 6. Demonstration and field planting to test effectiveness of deep planting containerized stock restoration technique at USDA-ARS Ft. Keogh by ARS, Custer Co. Conservation District, and Bridger PMC. Photo credit: Tom Pick.

7.0 Monitoring Objectives and Techniques

The YRCDC encourages the use of monitoring techniques to document the benefit of saltcedar and Russian olive control work, as well as to help evaluate the relative efficacy of various management techniques. Monitoring at both the landscape and field scale is needed to provide accurate, multi-scale feedback to guide adaptive management adjustment. Landscape scale monitoring can be accomplished through periodically repeating or updating baseline landscape scale inventories (Sec. 3.0). Field scale monitoring will help to answer the questions of treatment efficacy and benefit.

The adaptive management approach that is part of this plan also requires that some level of monitoring be used so as to provide qualitative and quantitative information to aid in decision making. Following are suggested monitoring techniques. Typically, monitoring occurs more frequently in the initial stages of a program and then becomes more selective over time as information is gathered. The selection of a particular technique is

dependent on the objectives of the land manager and the detail needed. In some cases, the use of several methods will be beneficial.

7.1 Photo Point

As is often repeated, a picture is worth a thousand words, especially if taken before invasive species control work began and can then be compared to a later photo. Annual photopoints are a low cost and effective way to monitor the success of invasive species management. Photopoint location should be permanently marked using a wooden stake, rebar (metal) rod, or suitable monument made for the purpose. A flattened aluminum can pinned flush to the ground with a metal spike is an effective, visible marker and can be relocated with a metal detector, if need be. A metal fence post or capped pipe also makes a good marker if it won't create a safety issue or be damaged by livestock. The location of the point should be recorded using standard global positioning system (GPS) coordinates of latitude and longitude. Orient the camera direction so as to capture a scene typical of the site. Record the camera height and compass azimuth or quadrant that the camera lens is aligned with so that the same picture can be recreated over time. Having a visible landmark in the scene also helps improve repeatability. Retake the picture at approximately the same date and time of day each year for the best results.

7.2 Observation

Another low cost option for monitoring simply involves walking throughout the area before treatment and estimating the canopy coverage of invasive and desirable species. Do the same walk annually following treatment and record the canopy coverage again. It's pretty standard to expect at least a 10 percent re-sprouting response following treatment for a good control effort. Monitor the retreatment as a guide to determining if and when follow-up treatment is needed.

7.3 Plot

When some level of repeatable, quantifiable number is desired, one or more plots can be located which will reflect the change in vegetation over time. A plot or plots should be located to reflect conditions typical for the site. Plots can be circular or square, sized to be a known proportion of an acre. Canopy cover, stem numbers, or other metric can be recorded to document prevalence and frequency of the invasive species present. Subsequent plot records will reflect the change over time. Locate and monument a plot the same as described for a photopoint. In fact, a photopoint is often used to help to document the location and orientation of a plot or transect.

Figure 7. Monitoring transect used to evaluate post-treatment success and vegetation response. Basal bark spray applied to saltcedar in foreground and cut stump treatment to Russian olive on right - applied Sept. and Nov, 2012 respectively. Photo Credit: Scott Bockness, CISM.

7.4 Transect

A transect is simply a straight line instead of a circular or square plot. The number of stems tangent to the line or within a predetermined width along a line are recorded. Canopy cover, in addition to or instead of stem numbers, can also be recorded, if desired. Transects are usually a minimum of 100 feet in length, although as long as the same length is used each time, it's not too important. The longer the line, the more data points,

which provides better accuracy over time. Mark both ends of the transect as for a photopoint and record the GPS coordinates and compass azimuth or quadrant from start to end. Repeat the transect, as needed.

7.5 Qualitative

A number of qualitative evaluation processes are available to help evaluate the performance and document the change after restoration treatment.

- The NRCS Riparian Assessment uses 11 questions to evaluate the ecological and physical stability of riparian habitat. The assessment process requires training to properly use and is best conducted using a team approach. **http://www.mt.nrcs.usda.gov/technical/ecs/environment/technotes/envtechnoteMT2.html.**

- Bird and wildlife counts can be used to document the response of wildlife to management actions within riparian and floodplain landscapes. Actual observation of bird species numbers over set distance or time periods, as well as bird calls, as a surrogate for visual sightings, can be effective monitoring techniques that provide trend data over time.

- Collect and record site or field attributes that reflect unique characteristics that may be related to before/after native vegetation composition such as annual precipitation, depth to shallow groundwater, soil texture, distance (horizon and vertical) to stream channel, site history, wildlife and livestock utilization, disease, insect, or other damage.

8.0 Collaborative Efforts

Following is a listing of primary invasive weed species partners along with a summary of their purpose and programs.

8.1 Conservation Districts (CDs)

Since 1940, local CDs, under the direction of an all volunteer, elected Board of Supervisors, have worked to help land managers implement soil, water, and related natural resource management programs and practices on private lands in Montana. Ten CDs, corresponding to county boundaries along the Yellowstone River in Montana and North Dakota, make up the YRCDC. Each District has a designated representative who sits on the Council. Contact your local CD for information about technical and financial assistance programs to help with invasive species control. Visit **http://www.yellowstonerivercouncil.org/** for contact info.

8.2 Missouri River Watershed Coalition

To maintain productive, biodiverse riparian ecosystems that provide quality water, habitat, recreation, and power to meet the economic and ecological needs of the Missouri River Watershed region, the state weed coordinators from Colorado, Montana, Nebraska, North Dakota, South Dakota, Kansas, and Wyoming and other interested parties began the process of forming what would come to be known as the Missouri River Watershed Coalition (MRWC) in 2005. Since its inception, the Coalition has coordinated its efforts with federal, state, and local agencies, tribes, businesses, universities, conservation groups, and private landowners concerned with the spread of invasive plants throughout watersheds that cross jurisdictional boundaries. With shrinking state budgets, the national economic downturn, predicted geographic expansion of well-established noxious weeds due to climate change, and the potential for many new invasions (aquatic and terrestrial species) on the horizon, the need to cooperate and pool limited resources on the watershed level has never been more important and needed. Visit **http://www.weedcenter.org/mrwc/index.html** to learn more about the MRWC.

8.3 Center for Invasive Species Management (CISM) at Montana State University - Bozeman

Mission: To promote ecologically sound management of invasive species in western North America by sponsoring research, conducting public education, and facilitating collaboration and communication among researchers, educators, policy makers, natural resource managers, and the concerned public. CISM serves as a respected western regional hub for invasive species expertise with four objectives:

1. Support and sponsor comprehensive invasive species research and implement timely technology transfer between natural resource managers and scientists;
2. Serve as a regional science-based information clearinghouse;
3. Provide a western regional voice for ecologically sound invasive species issues at the state and national levels; and
4. Create hands-on education and outreach products and tools for natural resource managers and private citizens.

Working with state and federal agencies, Tribes, farmers, ranchers, the research community, Extension services, county weed districts, and conservation organizations over the past ten years, the Center has established strong partnerships in Montana, throughout the western region, and nationwide which have helped promote broader awareness and progressive, sustainable solutions to invasive species problems. See **http://www.weedcenter.org/.**

8.4 Montana and North Dakota Noxious Weed Program

Both Department's noxious weed programs assist with the management of land- and water-based weeds on their Noxious Weeds List. The Montana Noxious Weed Trust Fund grant program, Noxious Weed Seed Free Forage certification program and the Biological Control Program assist counties, individuals, local communities, researchers, and educators in their efforts to solve noxious weed problems in Montana. The Montana Noxious Weed Trust Fund grant program was established by the 1985 Montana Legislature to provide funding for the development and implementation of weed management programs. It also provides for research and development of innovative weed management techniques including biological control, and supports research and education projects.

The grant program is designed to assist counties, local communities, researchers, and educators in their efforts to solve a variety of noxious weed problems in Montana. The program provides assistance with a 50% cost-share, with landowner matching funds, for herbicides and commercial application to participating landowners in a local cooperative weed management area. Other types of projects involve noxious weed education and research, including non-chemical research and demonstration projects. See http://agr.mt.gov/agr/Producer/Weeds/ and http://www.nd.gov/ndda/program/noxious-weeds.

North Dakota County and city weed boards may develop and compile their own list of noxious weeds, provided the list includes all weeds determined to be noxious by the North Dakota Agriculture Commissioner. See Appendix F for the North Dakota and McKenzie County Noxious Weed Lists.

The North Dakota Noxious Weed Team distributes funding through two programs, Targeted Assistance Grants (TAG) and Landowner Assistance Program (LAP). These funds are available to weed boards and landowners for controlling weeds on the state and county weed lists. LAP provides weed boards with cost-share assistance for noxious weed control. Weed boards must levy at least 3 mills for noxious weed control, or budget an amount equal to the revenue that could be raised by a levy of three mills to be eligible to receive LAP funds. Historically a majority of weed boards have provided landowners with herbicide cost-share assistance with these funds. Eligible county and city weed boards are responsible for developing a LAP cost-share program for their areas.

North Dakota's TAG Program targets noxious weed control needs and provides a cost-share opportunity to county and city weed boards to meet those needs. TAG proposals describe a noxious weed problem within the county or city weed board's jurisdiction and proposes a management strategy. For more information about North Dakota's Program visit http://www.nd.gov/ndda/program/noxious-weeds.

8.5 Montana/North Dakota County Weed Districts - Montana Weed Control Association

The MWCA is a 501(c)3 non-profit, which was developed over 50 years ago. Over the years this group has expanded to include professional weed managers, weed control businesses (grazing, commercial applicators, bio-control agent providers, re-vegetation and planning specialists), ranchers/farmers, educators, researchers, students, government officials at the city, county, state and federal levels, recreationalists, visitors to Montana and private landowners. The organization's purpose is to encourage working together to strengthen and support noxious weed management efforts in Montana. For a list of county weed districts and boards in North Dakota visit: http://www.nd.gov/ndda/files/resource/2011CountyCityWeedBoardsDirectoryFeb2012.pdf

8.6 Montana Fish, Wildlife & Parks

Montana Fish Wildlife & Parks (FWP) is responsible for noxious weed management at about 610 sites across the state on more than 500,000 acres. Some 52 of these sites, covering nearly 2,500 acres, occur within the corridor along the Yellowstone River main stem. In collaboration with other state, federal, county, and city entities, FWP uses the latest integrated pest management methods to help control noxious weeds on these public lands, including herbicide application, mechanical control, targeted grazing, and biological control insects, as appropriate. In FY 2011, FWP spent over $650,000 on the ground for weed treatment and associated education/outreach activities.

FWP has developed a priority system for aquatic nuisance species. Seven of the state listed noxious weeds are found on that list. Saltcedar is listed as Priority Class 4. These species are present and have the potential to spread in Montana but there are management strategies available for these species. These species can be managed through actions that involve mitigation of impact, control of population size, and prevention of dispersal to other waterbodies. For more information about FWP's noxious weed management, visit: **http://fwp.mt.gov/fishAndWildlife/habitat/noxiousWeeds/**

8.7 USDA –Natural Resources Conservation Service (NRCS) Technical and Financial Assistance

USDA-NRCS provides technical and financial assistance through authorized Farm Bill programs to private landowners who face threats to soil, water, and air quality; wildlife habitat; surface and groundwater conservation; energy conservation; and related natural resources on their land. The primary financial assistance program utilized to address invasive species management is the Environmental Quality Incentives Program (EQIP). The purposes of the Environmental Quality Incentives Program (EQIP) are to promote agricultural production, forest management, and environmental quality as compatible goals; optimize environmental benefits; and help farmers and ranchers meet Federal, State, Tribal, and local environmental regulations. Applications are accepted on a continuous basis throughout the year. Cutoff dates are established to allow for ranking, prioritization, and selection of applications for funding. Eligible applicants may apply for EQIP by completing an application, form NRCS-CPA-1200 and appendix at any USDA Service Center by phone, email, fax, or letter. For more information on NRCS's programs and policies for weed education and management , visit **http://www.mt.nrcs.usda.gov/technical/ecs/invasive/** or **http://www.nrcs.usda.gov/wps/portal/nrcs/site/nd/home/.**

USDA-NRCS Financial and Technical assistance programs may be able to help with Russian olive and saltcedar control. Contact the local NRCS field office. For more information visit

http://www.mt.usda.nrcs.gov/programs or http://www.nrcs.usda.gov/wps/portal/nrcs/main/nd/programs/.

8.8 Montana State University Agricultural Extension Agents

MSU Extension is a statewide educational outreach network that applies unbiased, research-based university resources to practical needs identified by the people of Montana in their home communities. A local county Extension Agent provides service to every county. Visit MSU http://www.msuextension.org/ to find the location and contact information for your local office. MSU Extension offers weed diagnostic help and a pesticide education program in addition to many other services to the rural and urban community.

For information regarding McKenzie County's Extension Program in ND, visit http://www.ag.ndsu.edu/mckenziecountyextension.

9.0 Additional Sources of Information

- **Montana Noxious Weed Management Plan** (rev. 2008) at: http://agr.mt.gov/agr/Programs/Weeds/PDF/2008weedPlan.pdf

- **Zero Spread Noxious Weed Awareness Campaign**. Montana Department of Agriculture and Montana State University in conjunction with other local, state, and federal partners created the Zero Spread Noxious Weed Awareness Campaign. This campaign has two primary goals: one, to increase participation in weed management groups in areas where they are established; and two, to increase awareness of weed issues and management options statewide. For more information, visit: http://www.weedawareness.org

- **Invasives database.** Invasive.org is a joint project of the Center for Invasive Species and Ecosystem Health and USDA APHIS PPQ, with additional support from USDA National Institute of Food and Agriculture and USDA Forest Service. The University of Georgia - Warnell School of Forestry and Natural Resources and College of Agricultural and Environmental Sciences. Invasives.org also hosts BugwoodImages which is a grant-funded project that was started in 1994 by the University of Georgia's Center for Invasive Species and Ecosystem Health. The website was launched in 2001 and has only grown and received much recognition since. The site has nearly 200,000 images, most of which are in the realm of public sector images free for use. See http://www.invasive.org/.

- **National Invasive Species Information Center** (NISIC): Gateway to invasive species information, covering Federal, State, local and international sources. Visit: http://www.invasivespeciesinfo.gov.

- **National Invasive Species Council** (NISC) was established by Executive Order (EO) 13112 to ensure that Federal programs and activities to prevent and control invasive species are coordinated, effective and efficient: http://www.invasivespecies.gov/

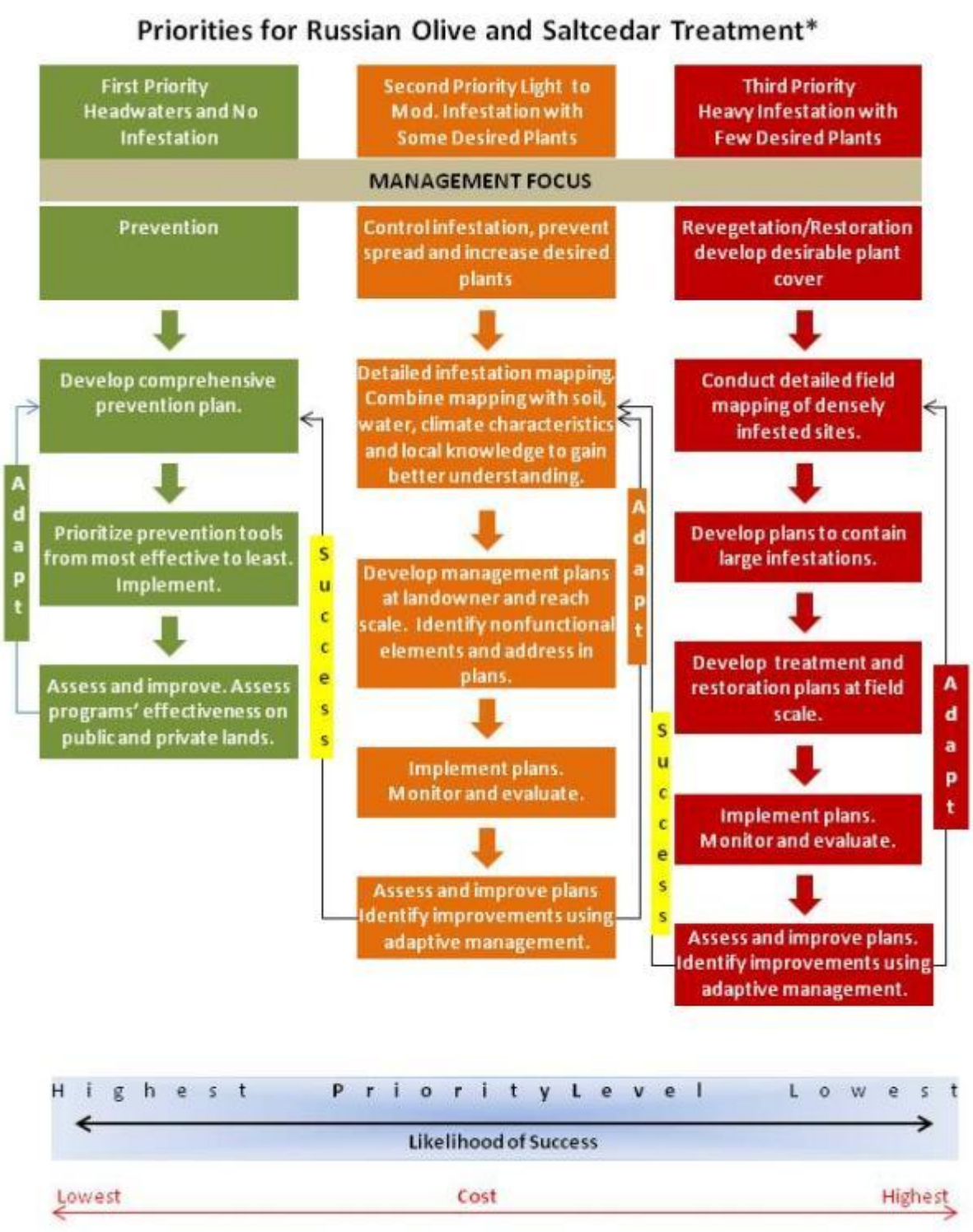

Figure 8. Flow chart depicting the for prioritized strategies and actions for Russian olive and saltcedar treatment in the Yellowstone River corridor. * Chart adapted from Sheley, et. al. 2012.

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Appendix A –Invasive Species Reference Guide

Russian Olive

(Elaeagnus angustifolia)

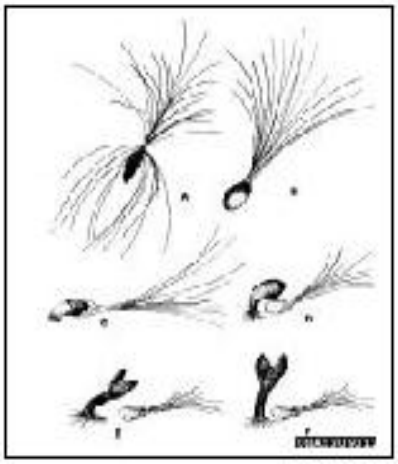
US Distribution of Russian olive

Distribution map of Russian olive along the Yellowstone River and its major tributaries taken from 2000 USDA-NRCS mapping project.

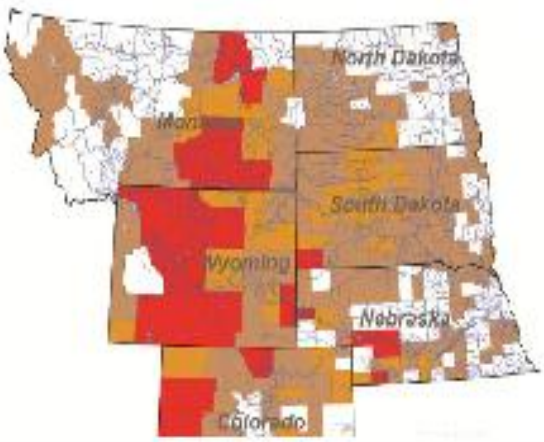
Russian Olive (***Elaeagnus angustifolia L.***)	
Status:	Listed as a Priority 3 'regulated' plant in MT; not listed in ND
History:	Russian olive is a native of southern Europe and western Asia. It was introduced to the US in specimen and windbreak plantings in the early 1800s. By the mid-1900s it had escaped cultivation and began to naturalize in the western US. Only recently have plantings been suspended in many locations and selectively planted in others.
Habitat:	While planted extensively in shelterbelts and wildlife plantings on dry upland sites, Russian olive will reproduce in habitats that are moist in nature, either natural or with an artificially elevated watertable such as irrigated pastures and meadows. It is also tolerant of salinity and moderate sodicity. It is most commonly found in and near riparian areas east of the continental divide in Montana and western North Dakota. It is somewhat shade tolerant and able to germinate and survive as an understory to plains cottonwood (Populus deltoids) as well as in direct sunlight. It does not tolerate long-term flooding.
Growth Habit:	Russian olive is a deciduous, tall shrub or small tree that grows up to 10 m (35 ft.) in height. The top is often rounded in shape.
Leaves:	The foliage is made up of simple, alternate, and lanceolate to oblong-lanceolate leaves that are 3-10 cm. (1 to 4 in.) long and have small silver scales on both sides of the leaf creating a unique appearance.
Bark/Stem:	The trunk bark on an old plant is dark grey/brown and peels away in thin strips. Young branches are flexible, reddish brown and covered with a silvery gray pubescence. Older branches are brown with occasional thorns and are covered with silver scales.
Flower:	Very fragrant flowers bloom in May and June. They are silver on the exterior and yellow inside 1.2 to 1.5 cm (0.5 in.) wide. One to three flowers appear within the leaf axils.
Roots:	A deep taproot is supported by a well developed, lateral root system that allows the plant to draw moisture from deep depths on drier sites once established.
Fruit:	Plants begin to produce viable seed at 6 years of age. The single-seeded fruit are 1.0 cm. (0.4 in.) long, reddish in color early and maturing to yellow and covered densely with silver scales. The large seed (up to 1 cm (0.4 in.) long) is light brown with distinguishing longitudinal striations. Seeds must undergo cold stratification to germinate but appear to remain viable for up to 30 years in lab tests giving the plant a distinct advantage over native riparian plants.
Other notes:	Reproduces by seed or root sprouts. Control of young plants is least expensive and most successful.

Salt Cedar

(Tamarix spp.)



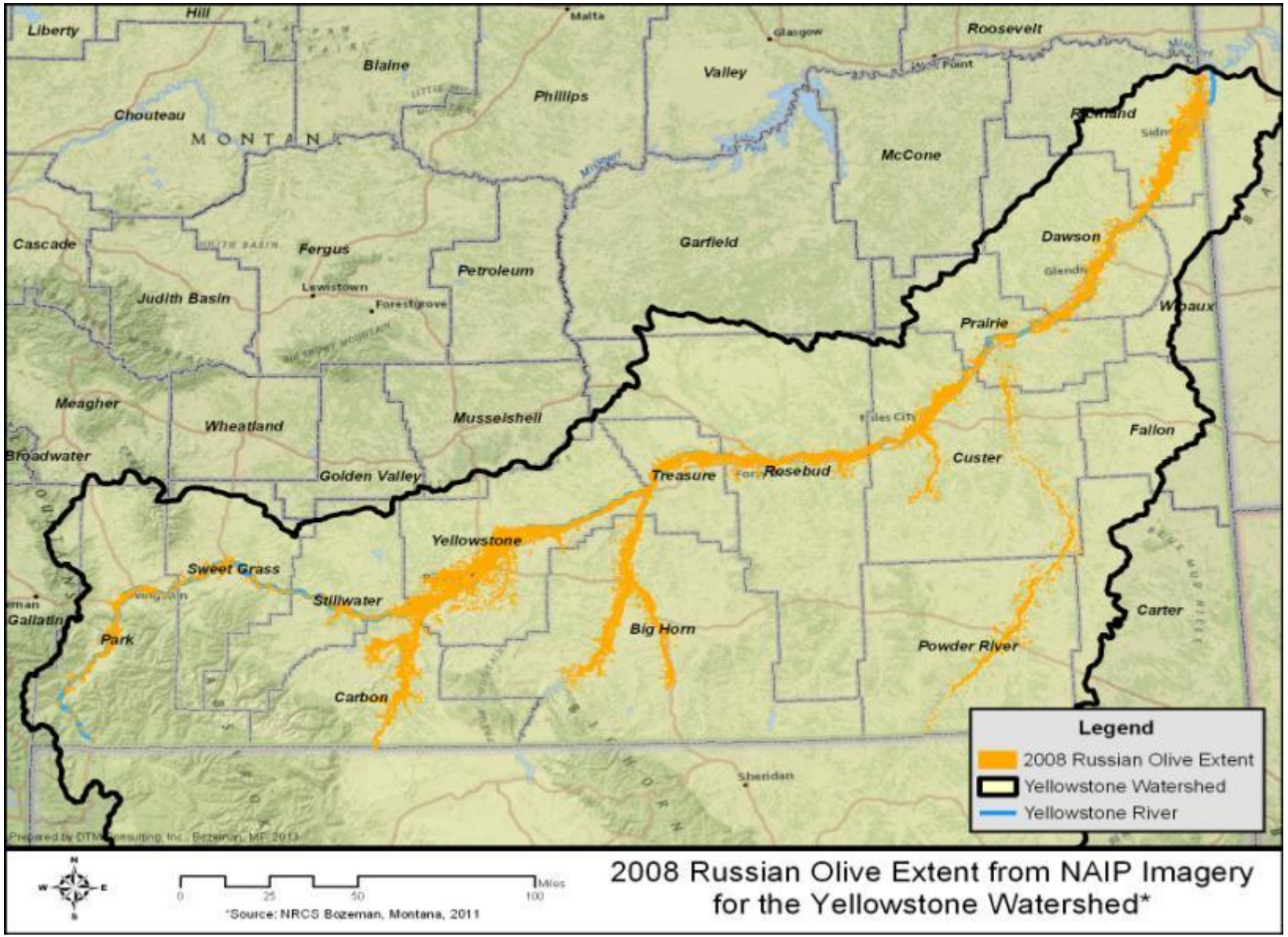
Distribution Map Western US



Known saltcedar infestations in Montana are primarily along the lower Missouri and Yellowstone Rivers.

Saltcedar (***Tamarix ramosissima, T. chinensis, and hybrids***)	
Status:	Priority 2B noxious weed in MT and listed as a 'noxious weed" in ND
History:	Saltcedar is native to southern Europe, Asia and N. Africa. A number of *Tamarix* species have been transported to the US since the early 1900s but the most common naturalized species in Montana are T. ramosissima and T. chinensis and hybrids of these two. Saltcedar are present in all Yellowstone River counties in MT and ND.
Habitat:	Saltcedar is adapted to colonizing fresh alluvium after disturbance. The plant flowers at three years of age or earlier and produces up to 600,000 seeds annually. Seedlings grow slowly and require continuously moist soil in which they develop a deep taproot which allows the plant to survive extended drought conditions once established. Several months of submergence may be necessary to kill the plant. Top growth resprouts quickly from the root when damaged or killed by cold temperatures. Cut stems and shoots readily take root. Profuse sprouts originate at the root crown creating dense, stands that dominate slower growing native vegetation. Once established, flow regulation (decreased flood disturbance) benefits development of pure, saltcedar stands.
Growth Habit:	Saltcedar is a deciduous, tall shrub or small tree in Montana that grows up to 6 m (20 ft.) in height. Elevation range is from 2,000 to 5,000 feet elevation. Salt- cedar is susceptible to shading. The plant is highly tolerant of saline and alkaline soil and water.
Leaves:	The grayish green leaves are small (1.5 cm) and often overlap on the stem giving the false appearance of an evergreen. Leaves turn golden brown in autumn before dropping.
Bark Stem:	The smooth bark on an old plant is reddish brown that furrows and divides with age.
Flower:	Slender spikes of deep pink flowers bloom from May to as late as October. Flowers are about 1.5 mm across, with 5 petals.
Roots:	A deep taproot up to 30 feet in length is supported by a well developed, secondary root system that branches profusely upon contact with water.
Fruit:	The seed pods or capsules are pinkish red to greenish yellow and break into 3 to 5 parts when mature. Each pod holds thousands of seeds. A tuft of fine, silky hair crowns the tip of each seed facilitating spread by wind and water. Seeds are relatively short-lived (1 to 2 mos.) but because of the long flowering period, can germinate throughout the growing season.
Other notes:	Reproduces by seed, root sprouts and cuttings. Fire and grazing preference (beaver and cattle don't utilize saltcedar) favors saltcedar. Shed leaves contain high concentration of salts which form a saline crust beneath the plant. Displaces native riparian vegetation and provides relatively poor wildlife habitat.

Appendix C.


Liberty
Hill
Blaine
Malta
Glasgow
Roosevelt
Valley
Phillips
Chouteau
MONTANA
McCone
Richland
Cascade
Fergus
Garfield
Dawson
Petroleum
Judith Basin
Lewistown
Forestgrove
Prairie
Wibaux
Meagher
Wheatland
Musselshell
Fallon
Broadwater
Golden Valley
Treasure
Rosebud
Custer
Yellowstone
Sweet Grass
Stillwater
Carter
Gallatin
Park
Big Horn
Powder River
Carbon
Sheridan
Legend
2008 Russian Olive Extent
Yellowstone Watershed
Yellowstone River
Miles
0
25
50
100
*Source: NRCS Bozeman, Montana, 2011
2008 Russian Olive Extent from NAIP Imagery
for the Yellowstone Watershed*

Appendix D.


Liberty
Hill
Blaine
Malta
Glasgow
Roosevelt
Valley
Phillips
Chouteau
MONTANA
McCone
Sidney
Cascade
Fergus
Garfield
Dawson
Petroleum
Judith Basin
Lewistown
Forestgrove
Prairie
Wibaux
Meagher
Wheatland
Musselshell
Fallon
Broadwater
Golden Valley
Treasure
Rosebud
Custer
Yellowstone
Sweet Grass
Billings
Stillwater
Gallatin
Park
Big Horn
Carter
Powder River
Carbon
Legend
Tamarix Cooperative Mapping Initiative - 1965 Extent
Tamarix Cooperative Mapping Initiative - Points
Yellowstone Watershed
Yellowstone River
0
25
50
100
Miles
Existing Saltcedar (Tamarix) Data
for the Yellowstone Watershed

Appendix E. MT Noxious Weed list (2010)

Montana Noxious Weed List

Effective: September 2010

Priority 1A	These weeds are not present in Montana. Management criteria will require eradication if detected; education; and prevention. - Yellow starthistle (*Centaurea solstitialis*)
Priority 1B	These weeds have limited presence in Montana. Management criteria will require eradication or containment and education. - Dyer's woad (*Isatis tinctoria*) - Flowering rush (*Butomus umbellatus*) - Japanese knotweed complex (*Polygonum spp.*) - Purple loosestrife (*Lythrum spp.*) - Rush skeletonweed (*Chondrilla juncea*) - Eurasian watermilfoil (*Myriophyllum spicatum*) - Scotch broom (*Cytisus scoparius*) - Curlyleaf pondweed (*Potamogeton crispus*)
Priority 2A	These weeds are common in isolated areas of Montana. Management criteria will require eradication or containment where less abundant. **Management shall be prioritized by local weed districts.** - Tansy ragwort (*Senecio jacobaea*) - Meadow hawkweed complex (*Hieracium spp.*) - Orange hawkweed (*Hieracium aurantiacum*) - Tall buttercup (*Ranunculus acris*) - Perennial pepperweed (*Lepidium latifolium*) - Yellowflag iris (*Iris pseudacorus*) - Bluewood (*Echium vulgare*) - Hoary alyssum (*Berteroa incana*)
Priority 2B	These weeds are abundant in Montana and widespread in many counties. Management criteria will require eradication or containment where less abundant. **Management shall be prioritized by local weed districts.** - Canada thistle (*Cirsium arvense*) - Field bindweed (*Convolvulus arvensis*) - Leafy spurge (*Euphorbia esula*) - Whitetop (*Cardaria draba*) - Russian knapweed (*Centaurea repens*) - Spotted knapweed (*Centaurea stoebe* or *maculosa*) - Diffuse knapweed (*Centaurea diffusa*) - Dalmatian toadflax (*Linaria dalmatica*) - St. Johnswort (*Hypericum perforatum*) - Sulfur cinquefoil (*Potentilla recta*) - Common tansy (*Tanacetum vulgare*) - Oxeye daisy (*Chrysanthemum leucanthemum or Leucanthemum vulgare*) - Houndstongue (*Cynoglossum officinale*) - Yellow toadflax (*Linaria vulgaris*) - Saltcedar (*Tamarix spp.*)
Priority 3	Regulated Plants: (NOT MONTANA LISTED NOXIOUS WEEDS) These regulated plants have the potential to have significant negative impacts. The plant may not be intentionally spread or sold other than as a contaminant in agricultural products. The state recommends research, education and prevention to minimize the spread of the regulated plant. - Cheatgrass (*Bromus tectorum*) - Hydrilla (*Hydrilla verticillata*) - Russian olive (*Elaeagnus angustifolia*)

Appendix F. North Dakota Noxious Weed List (3/26/2013)

Subject Name	Scientific Name ↓	Family	Order
absinth wormwood	*Artemisia absinthium* L.	Asteraceae	Asterales
musk thistle	*Carduus nutans* L.	Asteraceae	Asterales
diffuse knapweed	*Centaurea diffusa* Lam.	Asteraceae	Asterales
spotted knapweed	*Centaurea stoebe ssp. micranthos* (Gugler) Hayek	Asteraceae	Asterales
Russian knapweed	*Rhaponticum repens* (L.) Hidalgo	Asteraceae	Asterales
Canada thistle	*Cirsium arvense* (L.) Scop.	Asteraceae	Asterales
leafy spurge	*Euphorbia esula* L.	Euphorbiaceae	Euphorbiales
Dalmatian toadflax	*Linaria dalmatica* (L.) P. Mill.	Scrophulariaceae	Scrophulariales
purple loosestrife	*Lythrum salicaria* L.	Lythraceae	Myrtales
Russian knapweed	*Rhaponticum repens* (L.) Hidalgo	Asteraceae	Asterales
smallflower tamarisk	*Tamarix parviflora* DC.	Tamaricaceae	Violales
saltcedar	*Tamarix ramosissima* Ledeb.	Tamaricaceae	Violales
tamarisk	*Tamarix spp.* L.	Tamaricaceae	Violales

McKenzie County, ND supplemental noxious weed list (December, 2012).

black henbane	Hyoscyamus niger	Solanaceae	Solanales
common burdock	Arcticum minus	Asteraceae	Asterales
houndstongue	Cynoglossum officinale L.	Boraginaceae	(unplaced)
halogeton	Halogeton glomeratus (M. Bieb)	Chenopodiaceae	Caryophyllales
baby's breath	Gypsophila repens L.	Caryophyllaceae	Caryophyllales

Appendix G. Herbicide Manufacturers Recommendations

Salt Cedar and Russian Olive Control Recommendations

The difficulty in controlling these invasive plants is the rapid resprouting after cutting. Systemic herbicides are one of the most effective methods to control infestations.

From preliminary research, it was concluded that Milestone® herbicide (aminopyralid) alone does not provide acceptable control of Russian olive or salt cedar. However, **adding aminopyralid to triclopyr does improve control** of Russian olive and salt cedar compared to triclopyr alone. A tank-mix of Milestone herbicide with Garlon® 4 Ultra or Remedy® Ultra (triclopyr ester) specialty herbicides will control salt cedar and Russian olive without damage to grasses. Additionally, the tank-mix provides residual control of broadleaf weeds and enables grasses to flourish. The desirable plants, left to grow and reproduce, become competitors with re-sprouts and seedlings of salt cedar and Rusian olive decreasing the potential for re-invasion.

Foliar Treatment to Re-sprouting Plants after Mowing or Cutting

After cutting, mowing, or shredding operations, salt cedar and Russian olive will re-sprout. Allow time for the plants to regrow and develop adequte leaf area for more herbicide uptake with a foliar application. This may mean the application will need to be done the year after cutting or, at least, in the late summer after mowing the previous winter or early spring. Apply Milestone at 7 fluid ounces per acre plus Remedy Ultra (or Garlon 4 Ultra) at 3 quarts per acre with a non-ionic surfactant at 0.25% v/v or 1 quart/ acre of methylated seed oil (MSO). This treatment will also control broadleaf weeds such as Canada thistle, musk thistle, Russian knapweed, and many others that may invade the area after cutting (see label for complete list of weeds). Salt cedar and Russian olive control may not be complete with just a single application. Treated sites will still need to be monitored in subsequent years and re-sprouts treated for complete control.

Foliar Treatments to Individual Trees (less than 6 feet in height)

Treatments can be made to small plants or to plants that have re-sprouted after cutting or shredding. Wait at least 6 months after cutting to treat re-sprouts. It is important to determine the amount of the herbicides applied per acre, even with a backpack sprayer or a hose and gun application from a main tank. Typically about 100 gallons per acre (GPA) are sprayed when "spraying to wet" without significant run-off from the leaves. When applying 100 GPA, mix 7 fluid ounces (0.055% v/v) of Milestone and 3 quarts (0.75% v/v) of Garlon 4 Ultra in 100 gallons of water with 1 quart (0.25% v/v) of surfactant. Treated sites will still need to be checked for re-sprouts after application and follow up treatments may be necessary in subsequent years for complete control.

Label precautions apply to forage treated with Milestone and to manure from animals that have consumed treated forage within the last three days. Consult the label for full details.

Some states require an individual be licensed if involved in the recommendation, handling or application of any pesticide. Contact your local Extension office for information regarding licensing requirements.

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Always read and follow label directions. 901-000-089 (4/10) DAS 010-57758

Salt cedar regrowth ready to be treated

Russian olive re-growth

Milestone+Remedy Ultra is a selective treatment allowing grasses in the understory

Non-selective treatment

Dow AgroSciences

Appendix H. Suggested Invasive Species Control Monitoring Record

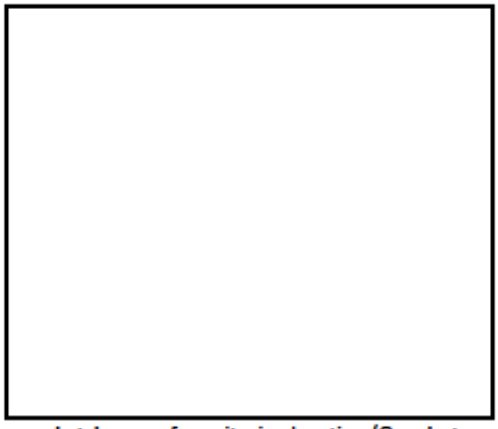
Site Name:_____ Name of Recorder: _____ Date:_____

Monitoring Purpose: _____

Location Narrative Description:_____

Species Treated:_____ Date of Treatment:_____ Method of Treatment:_____

Section_____Township____Range____ Soil map unit or texture:_____ Land Use:_____



Insert aerial image or sketch map of monitoring location (Θ = photo point; X = transect)

Photo Point ID	Location (GPS)	Azimuth° or Quadrant Bearing	Photo numbers	Narrative

Transect ID	Location (GPS)	Azimuth° or Quadrant Bearing	Length	Narrative

Note type of monument installed for each above:_____

Notes and Observations

_____

_____

_____

_____

YRCDC Long-Term Strategy for Russian Olive and Saltcedar Management