

Missouri River Watershed Coalition

Saltcedar Management Plan

By Dave Burch, Montana Department of Agriculture; Mitch Coffin, Nebraska Department of Agriculture; Rachel Siefert-Spilde, North Dakota Department of Agriculture; Ron Moehring, South Dakota Department of Agriculture; and Slade Franklin, Wyoming Department of Agriculture

The Water Resources of the Missouri Headwaters – An Economic and Ecological Treasure

The headwaters of the mighty Missouri River flow out of the western states of Montana, Wyoming, Nebraska, and North and South Dakota. The streams, reservoirs, ponds, and other water bodies that are part of the headwaters system are heavily depended upon by these states for their economic and ecological health. These waters support and provide for agriculture, recreation, tourism, wildlife habitat, irrigation, drinking water, power generation, and livestock throughout these states. The state weed coordinators from each of these states attest to the importance of these water systems for the states' livelihoods:

“Montana rivers are the lifeline for agriculture, recreation, and wildlife. Montana rivers must be protected to ensure continued use and benefit of this most valuable resource.”

– Dave Burch, Montana State Weed Coordinator, MT Dept of Agriculture

“North Dakota’s river systems are valued economic and biological resources that North Dakotans depend on every day for drinking water, power generation, recreation/tourism, irrigation, and other agricultural uses. These river systems serve as and/or maintain critical wildlife habitat. The future of our population, ecological biodiversity and economy will depend on how we are able to maintain and control our water resources.”

– Rachel Seifert-Spilde, Noxious Weed Specialist, ND Dept of Agriculture

“The river system in South Dakota is the lifeblood of our economy. South Dakota’s two major industries are agriculture and tourism and without a sufficient supply of water, both industries suffer greatly. The Grand, Cheyenne, Missouri, James, and Sioux [rivers] provide water for thousands of acres of crop ground. The impoundments on the Missouri, Grand, and Cheyenne are a mecca for sportsmen and recreationists. The river system is also being called upon to supply the water needs for our rural homeowners, ranches, and cities through an ever-increasing system of rural and city water systems.”

- Ron Moehring – South Dakota State Weed Coordinator, SD Dept of Agriculture

“The river systems in Wyoming have a significant impact on Wyoming’s economic stability. Over 80% of the water put to beneficial use in the state is used by agriculture. Therefore, the agricultural producers and suppliers have a direct economic interest in the continued and predictable availability of water for crops and livestock. Water is used by industry for process, de-watering, coalbed methane production, power generation, etc., and a guaranteed supply is important to retaining industrial jobs. In addition, it plays an important role in Wyoming’s tourism industry and the overall quality of life Wyoming residents have come to expect. Therefore it’s crucial that Wyoming manage and maintain the ecological health of the seven river basins that divide our state.”

– Slade Franklin, Wyoming State Weed Coordinator, WY Dept of Agriculture

Conservation Target for the Missouri Headwaters

The conservation target for the water resources of the Missouri Headwaters is to maintain productive, healthy, stable, and biodiverse riparian ecosystems that are able to provide quality water, habitat, recreation/tourism, and power to meet the needs of the five states.

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I. Justification and Goals

Saltcedar Biology, Ecology, and Climax Community

Biology & Ecology: Saltcedar (tamarisk) is a member of the Tamaricaceae family. No research data has been collected for growth limits of saltcedar in the Montana environment as of yet, but in the more favorable growing conditions of southwestern United States, saltcedar is a long-lived (50-100 years) and dense, deciduous shrub or tree that can grow to 30 feet tall. One site on the Musselshell displayed stem age of 6-7 years, while growth rings on the taproots indicated two to three times that. Aside from an occasional urban ornamental, it is unlikely tamarisk will ever exceed more than 15 to 20 feet in Montana.

It has numerous slender branches with smooth reddish-brown bark that becomes furrowed and ridged with age. The crown of the plant is narrow or rounded. Branches are covered with minute, scale-like leaves. Saltcedar produces thousands of small white to pink, 5-petaled flowers throughout the spring and summer.

It is a self-compatible plant that is primarily insect pollinated. A mature plant can produce up to 600,000 seeds annually. It generally flowers in its third year of growth or later, but can flower during the first or second year. Seeds are extremely small, with a tuft of hair at one end, which aids in dissemination by wind and water. Seeds are generally viable for only a few weeks, especially at high temperatures. The seeds will germinate on saturated soils or while afloat. Viable seed usually germinate within 24 hours, regardless of light conditions, once in contact with water. Montana based research on this topic has yet to be done, but information gleaned from other regions indicates viability results are likely accurate for the environmental conditions of Montana as well.

Seedlings grow slowly and require saturated soils throughout the first 2 to 4 weeks of growth. They will not survive more than one day without moist soil. Seedlings can survive submergence for several weeks but are uprooted by weak currents. Slowly receding water levels along river and reservoir margins create mudflats that are being colonized by saltcedar, but permanent survival may require several months without subsequent flooding. Seedlings are very resistant to desiccation. Adult plants can also be drowned with several months of submersion.

The primary root of saltcedar grows straight down with little branching until it reaches the water table. Secondary root branching is profuse upon contact with water.

In Montana, tamarisk buds generally break dormancy in March. Flowering can begin in early May, or as late as July and continue through October. Water stressed individuals may stop flowering following the spring blooming period.

Saltcedar sprouts from the root crown and shoots. Cut stems and shoots of saltcedar readily root in moist soil. Adventitious roots sprout from submerged or buried stems. A deep-rooted plant, tamarisk obtains its water from the water table or the layer of soil just above it. Its roots may penetrate soil 30 feet or more, but the plant cannot survive if moisture is suddenly removed from the taproot zone. It generally grows where the depth of the water table does not exceed 25 feet and normally where it is less than 15 feet. Dense stands will grow only where the water table is between 5 and 20 feet below the soil surface. If the water table is less than 5 feet from the surface, plants branch profusely and do not form a dense stand. Established plants can tolerate drought, fire, and flooding. By shedding its leaves and halting growth, it can withstand lengthy drought periods. Additionally, established saltcedar plants can tolerate water inundation for up to 3 months.

Saltcedar grows well in moist, sandy, sandy loam, loamy, and clayey soil textures. It has a wide range of tolerance to saline and alkaline soil and water. It has been found growing in Death Valley, California, where the ground water contains as much as 5 percent dissolved solids. It tolerates high concentrations of dissolved solids by absorbing them through its roots and excreting excess salts through glands in its stems and leaves. Eventually, these salts end up on the ground beneath the plant, forming a saline crust.

Saltcedar is susceptible to shading; established plants under a mature cottonwood stand grow, but reproduction is reduced. Shaded plants have altered leaf morphology. Saltcedar grows from below sea level to more than 7,000 feet elevation; in Montana the range lies between 2000 to 5000 feet elevation.

Climax community: Saltcedar is a permanent climax community, an invasive colonizing species that establishes on fresh, exposed alluvium, sand and gravel bars, and stream banks or other flood plains after disturbance, and will continue to spread opportunistically. A decrease in river fluctuations can rapidly shift sites from habitats dominated by native vegetation to pure stands of saltcedar. Seedling plant growth rate is slow, and does not initially compete well in established communities. Throughout most of its range, periodic burning, clearing, and flooding have caused the aboveground saltcedar plant communities to remain in an immature stage.

Ecological Impacts of Saltcedar in the Missouri Headwaters

As downstream water demands increase, it is imperative that the Missouri Headwater states consider all aspects of water conservation. A major impact on the health of the riparian areas is the effect of certain invasive and noxious weeds. Saltcedar, a non-native tree, is an example of a plant that is having a significant impact on the riparian areas in the Missouri Headwaters. The ecological impacts of saltcedar include:

- Saltcedar out-competes the **native vegetation** including riparian grasses, forbs, cottonwoods, willows, and many species of native shrubs along many streams, rivers, and lakes.

- Saltcedar consumes approximately 80 to 120 gallons of **water** a day per mature tree.
- Saltcedar's importance to **wildlife** is minimal as it does not provide nourishment or usable cover. The population and diversity of birds, rodents, and insects decrease in saltcedar-infested areas.
- Saltcedar infestations reduce **forage** and alter livestock and wildlife **habitat**. It is relatively unpalatable to most classes of livestock and wildlife and it has been rated as poor in energy and protein value. It provides fair to good cover for cattle and wildlife species such as elk, deer, small mammals, upland game birds, and waterfowl for a short time, then with increasing infestation the area becomes unusable for livestock or wildlife. There are sites with heavy infestations of saltcedar with understories that are either bare or composed of almost exclusively invasive plants.
- High densities of saltcedar can congest river channels and create potential **flood** hazards.
- Saltcedar reduces channel widths by decreasing water velocities and thereby increasing deposition of **sediment**.
- Once saltcedar has invaded an area, it prevents native species from reestablishing by exuding **salt** from its leaves, increasing the salinity of the surrounding soils.
- **Wildfires** are more frequent in saltcedar thickets, but the plants usually survive and grow faster than many native plants.
- Saltcedar's rooting zone has been shown to have a much lower **water holding capacity**, which affects water flows throughout the season.

Economic Impacts of Saltcedar in the Missouri Headwaters

The economic impact of saltcedar in the Missouri Headwaters has only been estimated, but that estimate is in the **millions of dollars** just over the last few years. Economic impacts include cost of control, water loss, recreation and tourism losses, costs of early detection and rapid response (such as survey, mapping, control, and education), cost of monitoring, impacts of herbicide on native plants, and loss of power generation. Following is a summary of various costs by each of the five headwater states.

Montana has spent over \$1 million over the last five years. The estimated cost per year is \$350,000 for control and lost revenue from saltcedar. Educating land managers on Saltcedar is critical and must be given the highest priority. We need to contain current infestations and eradicate new infestations.

Nebraska has currently 15,000 to 20,000 acres infested with saltcedar. At a loss of 7.7 acre feet of water/acre for saltcedar, Nebraska is losing 115,000 acre feet of water at a cost of \$31.25/ac.ft. This is a loss of \$3.6 million to the state each year for irrigation use. The Corps of Engineers at Harlan County reservoir and Twin Valley Weed Management Area treated 600+ acres of saltcedar using a helicopter in 2006. This treatment cost \$87,000. At a cost of \$150-200 per acre, treating only 10,000 acres of the dense stands would cost \$1,500,000-2,000,000. The loss of recreation on these reservoirs due to a

combination of low water levels and unwanted vegetation could range up to millions of dollars.

North Dakota has spent in excess of \$1.5 million combating saltcedar through early detection rapid response (EDRR), including survey, mapping, control, and education over the last four years. The North Dakota Department of Agriculture has expended \$500,000 of special legislatively appointed dollars over the last two bienniums. In addition, the U.S. Army Corps of Engineers at Oahe spent: 2003-\$3,700; 2004-\$7,500; 2005-\$48,000; and in 2006-\$54,000. The U.S. Army Corps of Engineers at Garrison spent: 2002 - \$5,000; 2003 - \$125,000; 2004 - \$175,000; 2005 - \$250,000; and in 2006 - \$225,000.

South Dakota's infestations along their rivers are costing the counties between \$500 and \$2,000 per mile for herbicide treatment. The effect of herbicide treatments also negatively impacts some of the surrounding vegetation. This impact means areas are opened up for other invasive plant species which requires repeated trips back for further treatments.

Wyoming's direct economic impact from saltcedar on its overall economy has not yet been quantified; however, various studies throughout the west demonstrate the impact on water availability and the environment. Recently a study in Kansas estimated that controlling saltcedar in riparian corridors reduced the groundwater consumption by 30-40% (Kluitenberg 2005). It has also been estimated that \$16-\$44 million of hydropower generation is lost annually due to the saltcedar invasion in the United States. Yet another study showed that it was more economically feasible to combat saltcedar than to look for alternative mechanisms to obtain water (Zalaveta 2000). Each year, saltcedar infestations across the western U.S. use nearly 800 billion gallons more water than the native plants would have used. This water would be enough for 4.8 million people. Controlling saltcedar in Wyoming also has an economic impact on other states. Scott Cameron, former USDI deputy assistant secretary, has said, "New Mexico and Colorado may do a great job inside their own borders on tamarisk, but if tamarisk trees in Wyoming keep on sending seeds south, then ultimately New Mexico and Colorado will fail."

The Cost of Doing Nothing to Manage Saltcedar in the Missouri Headwaters

Why have the state weed coordinators of the Missouri Headwaters decided to take immediate and focused action to collaborate on the management of saltcedar? Left to spread, saltcedar can replace native vegetation and create dense monocultures along our riparian and wetland areas restricting access for irrigation, wildlife, and outdoor enthusiasts to the Missouri River and its tributaries. Saltcedar will wipe out habitat used by threatened and endangered species and may reduce the amount and quality of water required by agriculture, recreation/tourism, wildlife, power generation, and human consumption. The Missouri Headwater states will potentially lose all but the spring flows in some of their major irrigation and recreation rivers. Rangeland water supplies will be

greatly diminished causing the loss of wildlife and cattle-carrying capacities, which results in economic hardship on producers and businesses.

Costs of managing saltcedar will skyrocket as infestations become more dense, trees mature, and seed production increases. Even when mature saltcedar is controlled, adjacent soil erodes and has an extremely high salinity that makes it sterile.

A Strategy to Protect the Water Resources of the Missouri Headwaters from Noxious and Invasive Plant Species

Recognizing the critical need for protecting the water resources of the Missouri Headwaters, the state weed coordinators from Montana, Nebraska, North Dakota, South Dakota, and Wyoming and other interested parties have formed a coalition to strategize invasive species management and water resources in this region. This plan outlines this broad strategy and the coalition. The overall goal of this plan is to protect and improve agriculture, recreation, aesthetics, water systems, habitats, and ranching/grazing by minimizing the effects of saltcedar and other noxious and invasive species within the five-state area. The plan organizes project surveys and treatment and compiles necessary information to best use the states' limited collective resources.

The Missouri River Watershed Coalition will coordinate its efforts with the state Departments of Agriculture, Native American sovereign nations, weed districts, county weed boards, and other county, state, and federal agencies concerned with the spread of saltcedar throughout watersheds that cross jurisdictional boundaries.

The goals of the Missouri River Watershed Coalition are:

- Reduce the introduction and spread of invasive riparian plants in the northern headwaters region.
- Increase regional coordination and communication to reduce impact of invasive riparian plants to soil, water, and wildlife resources.
- Maximize funding efficiency for public education, control, research, and reclamation projects on riparian corridors.
- Team universities, government, businesses, and conservation groups in a public-private partnership.
- Provide other support necessary to combat saltcedar and other invasive species within the five-state area.
- Support funding for weed control.
- Encourage education and information sharing and training.
- Create a group and a mechanism to apply for grants.

Management Goals for Saltcedar to protect the Water Resources of the Missouri Headwaters

The overall invasive plant management goal in the Missouri headwaters is to reduce non-native invasive plants that impact conservation targets. Our goal specific to saltcedar is to coordinate and combine efforts to control or prevent the spread of saltcedar which reduces the quality and quantity of water in our watersheds that would otherwise be available for uses such as public consumption, wildlife, fisheries, cities, irrigation, endangered species, and recreation.

The lack of water for other uses across this region continues to be a concern. During extended drought conditions, it becomes more difficult each year to improve already depleted water levels. Because saltcedar is not an efficient user of water, it is critical to reduce the saltcedar population to make water more available for native plants.

Principles and goals of this plan specific to saltcedar to protect water resources in the Missouri headwaters:

Known Infestations

- Contain all known infestations
- Eradicate existing infestations
- Contain large infestations
- Treat all known infestations
- Conduct routine inspections of known infestations
- Prioritize control of infestations
- Retreat re-growth and emerging plants

New Infestations

- Stop spread down-river
- Stop spread of saltcedar to new areas
- Eradicate saltcedar in new sites
- Prioritize surveys for new, small, emerging infestations

Un-infested and Favorable Sites

- Protect non-infested areas
- Inspect un-infested but favorable habitats
- Prioritize areas of concern

Education

- Develop a public education program
- Educate people on saltcedar impacts
- Gain public support for elimination/control of saltcedar
- Increase public, landowner, and land manager awareness

Geographical Survey

- Develop a clear survey plan
- Develop a delimitation survey to find the outer boundaries of infestations
- Map areas where saltcedar does not currently exist

Restoration

- Restore infested areas with desirable vegetation
- Develop a long-term implementation program of management tied to rehabilitation and restoration for areas with large contiguous acres of saltcedar infestation

Cooperation and Collaboration

- Work cooperatively between states and provinces
- Coordinate with water management programs

Risk Assessments & Monitoring

- Develop risk assessment
- Develop a monitoring program on effectiveness and rate of spread

Research

- Develop a research program that studies the interactions of plants in the riparian habitat
- Develop a research program to learn more about how the plant responds to regional conditions and what beneficial species may compete with saltcedar.

II. Extent of the Problem

The Current Extent of Saltcedar in the Missouri Headwaters

One of the first steps to deal with any invasive plant is to determine the current extent of the infestation. Each of the states in the Missouri Headwaters has different methods for conducting surveys/inventories of their invasive and noxious plants. Also, each of the states is at a different stage in mapping their infestations. One of the major goals of this collaboration is to increase cooperation on the mapping efforts. To determine a rough estimate of the current state of the saltcedar infestation in the region, each of the five state weed coordinators estimated acres of saltcedar for each of the counties within their states (see Appendix A). The state weed coordinators also provided a narrative of their states' survey or inventory program and the level of infestation within their state.

Montana: It is estimated that Saltcedar currently infest over 40,000 acres in Montana. Saltcedar has invaded the Missouri, Yellowstone, Big Horn, Tongue, Musselshell, Clarks Fork, Milk and Powder rivers. It has invaded major water reservoirs in Eastern Montana, and is invading drainage areas away from the rivers. Projections have been made that saltcedar has the potential to replace the existing native plant communities - cottonwood, ash, willow, native grasses, forbs, and shrubs - especially along the river corridors. There are several ornamental plantings across the state that have been reported as well.

Nebraska: Infestation data is collected and reported to the Nebraska Department of Agriculture by each county weed superintendent in Nebraska. Most infestations of saltcedar on our river systems have not been of a serious nature. Currently, most saltcedar populations occur in scattered stands that can be treated more easily than dense infestations. However, certain critical areas throughout the region are also heavily infested and are presenting difficult management scenarios. For example, Nebraska's largest infestations of saltcedar are on three large reservoirs, two which are used for irrigation. All three have recreational activities which have been jeopardized by low water levels and increased unwanted vegetation. Areas of the North Platte River have larger infestations scattered among old growth stands of cottonwoods and willows making locating infestations and treatment difficult.

North Dakota: An estimated 2,371 acres of saltcedar were reported in 2006. New, unexpected, and isolated infestations are occurring in ditches and uplands. Overall, North Dakota currently has saltcedar in check. Saltcedar infestations that are found are mapped, treated, and reported to the North Dakota Department of Agriculture as soon as possible. Saltcedar has not yet had a chance to impact our soils or water to a great degree. Infested acres were reported to the NDDA by county weed control officers and the U.S. Army Corps of Engineers. Acreages are based upon actual surveys and saltcedar findings.

South Dakota: The reported acres of saltcedar this year in South Dakota is 6,272 acres. This is an increase of 1,311 acres since 2005. As we educate more people to the

dangers of saltcedar, we are getting more reports of infestation on waterholes, stock dams, and dugouts in western South Dakota and on lakes and sloughs in the eastern part of the state. Our county weed supervisors report acres based on acres needing treatment. Many of our river areas have been surveyed and GPS'd by the state Department of Agriculture working with the counties, tribes, and agencies along river.

Wyoming: The accuracy of Wyoming's infestation map varies by county. Several counties such as Fremont and Big Horn have funded large-scale county mapping programs for saltcedar. Other counties, which lack the economic resources for a comprehensive map, have made estimates based on field observations. This variation in mapping methods is one of the important aspects of Wyoming's program that needs to be addressed. A comprehensive map for the entire state would help demonstrate where initial control efforts should be intensified. It would also establish baseline information on the infestations' trends. Several counties have reported saltcedar infestations extending farther away from the riparian corridors, therefore mapping of entire drainages is becoming more of a necessity.

III. Current Efforts

The Current Management of Saltcedar in the Missouri Headwaters

The current management of saltcedar in the Missouri Headwaters varies by state. Management methods include:

- integrated approaches (combinations of herbicide, mechanical, and biological treatments)
- exclusive use of herbicide (by helicopter, spot treatment, cut-stump with direct application, foliar or basal bark herbicide, and cut-stump after slash treatment)
- goat grazing
- high-priority area surveys
- survey databases
- biological control with the saltcedar-defoliating beetle *Diorhabda elongata*
- Early Detection and Rapid Response

Montana is using an integrated approach to managing saltcedar which involves the use of herbicide, mechanical, and biological treatments. Herbicide treatments are still the most effective management tool we have. However, several releases of *Diorhabda elongata* have been made and are starting to show progress. All treatment practices are being utilized from cutting and stump treatments to helicopter treatments to basal bark treatments. The basal bark treatments seem to be the most effective.

Nebraska's control efforts on saltcedar have been mainly by the use of herbicides. These applications have been by helicopter on large infestations and spot treatment on small infestations. In some cases single plants have been cut and stumps treated with approved herbicides. Some goat grazing has been conducted and the results will be evaluated in 2007. Three biocontrol releases for saltcedar were made in 2006 by USDA/APHIS/PPQ. These sites will continue to be monitored for establishment and control. We are hopeful for additional releases in 2007. Biocontrol may take several years before noticeable results are documented.

North Dakota's known infestations, large or small, have been treated with herbicide with the goal of eradication. At this point in time it appears that this practice has been very effective. Nearly all saltcedar surveys being completed in North Dakota are carried out by county weed boards or private contractors with funds from the counties, North Dakota Department of Agriculture, or in most cases, the U.S. Army Corps of Engineers. Surveys are conducted in high-priority areas and include both mapping and control. Survey data is then entered into a statewide online database and maps are made.

South Dakota, for the most part, has treated all infestations by either foliar or basal bark herbicide treatments. The saltcedar-defoliating beetle, *Diorhabda elongata*, has been

released at seven locations. Trees located in a landscape setting are treated by cutting and removing the slash and treating the stumps.

Wyoming's control efforts vary from county to county. Counties with larger infestations such as Big Horn have implemented an aggressive biocontrol program in addition to their chemical and manual control efforts. Counties such as Converse and Teton have implemented an "Early Detection and Rapid Response protocol for their programs. Both counties eradicate any known saltcedar tree along the riparian corridors. Chemical control with Arsenal™ is the primary method used for saltcedar control in Wyoming. Although Arsenal™ has a high efficacy rate against saltcedar, it impacts the ability of other species to grow. Proper control can only be obtained with a comprehensive plan that includes restoration.

The Current Restoration of Saltcedar-Degraded Sites in the Missouri Headwaters

The ultimate goal of managing saltcedar is to protect or restore the valued water resources of the Missouri Headwaters. Simply controlling saltcedar will not necessarily achieve this end, particularly in areas that have been treated with chemicals that may impact other species to grow, areas that no longer have seed or plant material sources for native or desired species, or have somehow been modified so that the native or desired species cannot return on their own. For these reasons, weed coordinators in the Missouri Headwaters consider restoration to be a critical management tool in certain situations. In order to conduct effective restoration, more research is needed to find the best possible restoration practices for this region. Considering the labor and monetary cost of restoration, it is important to manage to prevent situations that require it.

In **Montana**, very little restoration is being conducted.

In **Nebraska**, restoration has not been utilized in most areas. The large infestations on reservoirs are somewhat dry sites now because of low water levels. Conditions are not suitable for saltcedar germination and areas will be scouted to see which plants will fill in treated areas. Most of these areas will most likely have cottonwood and willows emerge.

In **North Dakota**, restoration has not been an issue because saltcedar has been controlled before the populations have become large infestations.

In **South Dakota**, restoration efforts have been confined to preventing other invasives from moving in on treated sites until native vegetation reestablishes on its own.

In **Wyoming**, various programs through the state have attempted revegetation following saltcedar removal; species planted have included Lodorm green needlegrass, alkali sacaton, and various other wheatgrass and wildrye species. Reclamation of treatment sites proves to be one of the more difficult aspects of a successful control

program. Dry weather, soil salinity, and chemical residue all play a part in hampering re-vegetation efforts in Wyoming.

Prevention, Outreach & Education Programs for Saltcedar in the Missouri Headwaters

Prevention is the most efficient and economical invasive plant management strategy. Key components of prevention are increasing public education and awareness. All of the five Missouri Headwaters states value and have had success with their prevention and education programs which often are conducted by several different groups within the state. Sharing and coordinating current efforts would enhance the established programs in each state.

Montana: Education of people is possibly the best prevention to get them not to plant saltcedar as an ornamental or for windbreaks. Education is also the best way to have people understand the seriousness of the saltcedar problem. The use of chemicals on existing stands of saltcedar, and eradication of new, small infestations and monitoring is the only way to stop saltcedar from spreading further along our waterways, reservoirs, ditches, creeks, and wetlands. Mechanical means - cutting and/or mowing and immediately treating with chemical - is another way to prevent the spread of this plant. Biological control in Montana is still in the experimental and early-release stages.

Nebraska: Nebraska's public awareness campaign has been very successful the past several years. Landowners and land managers are concerned about new invasive plants encroaching onto their property. County weed superintendents have been instrumental in getting the word out to the public in their county. Weed Managements Areas have also played a major role and are able to reach the public in a large geographical area. The Nebraska Weed Control Association works very hard to inform the public and sponsors an educational booth at farm and home shows throughout the year. The key to public awareness is to get private landowners to inform other landowners concerning the negative consequences of allowing invasive plants to become established on their property. The public tends to believe information relayed from local landowners. Sometimes the public does not want to be told by local and state government to control weeds. Landowners are concerned and want to protect their property. However, cost of control and difficult access to infestations limits control efforts. We have published information brochures to assist private landowners and sponsored tours and presented conferences regarding invasive plants.

North Dakota: Two noxious weed task forces were organized in cooperation with the U.S. Army Corps of Engineers. These task forces were set up to support funding for surveys and weed control, encourage education and information-sharing and training, create a group and a mechanism to apply for grants, and provide other support necessary to combat saltcedar and other noxious weeds on the Garrison and Oahe reservoirs. In addition, educational outreach materials have been developed, including placemats,

license holders, large signs, brochures, etc. Task forces distribute educational information and facilitate information-sharing between states/regions.

South Dakota: We have an extensive education program in place working with the county extension educators, weed supervisors, tribes, and agencies to get the message out on the impacts of saltcedar. We present programs at fairs, stock shows, schools campgrounds, service clubs, and public meetings. We have also produced an Extension fact sheet - "Saltcedar An Environmental Threat" - that is in its second printing of 20,000 copies each.

Current Research on Saltcedar in the Missouri Headwaters

Montana: Some research is being conducted in Montana. But critical areas of future research on revegetation and saltcedar biological characteristics need to be conducted. Montana State University needs to become more active in this role and provide research to county weed districts and land managers that will help them contain and control this species.

Nebraska: Research is being conducted mainly through Weed Management Areas with assistance from chemical companies. The University of Nebraska is assisting the Platte Valley Weed Management Area and Twin Platte Management Area with mapping, grant applications, and graduate assistance in documenting infestations and control efforts. The University is also using spatial mapping to identify invasive plants on the Platte River from the Wyoming border to Lake McConaughy. More studies from Lake McConaughy to North Platte are planned. The USGS/Nebraska Cooperative Fish and Wildlife Research Unit has just employed a full-time coordinator for invasive plants.

North Dakota: The North Dakota Department of Agriculture is unaware of any saltcedar research occurring in North Dakota.

South Dakota is working on control costs and methods. University of South Dakota may be looking at some research on the effects of saltcedar infestations on the riparian habitat and its effects on birds.

Wyoming: Current saltcedar research in Wyoming is minimal. Past projects have already addressed best management practices for chemical control. The research being done as of 2007 focuses on the distribution of the *Diorhabda elongata* flea beetle and on post-application reclamation practices such as re-seeding and restoration.

IV. Action plan

The Missouri Headwater states have outlined the following Action Plan to meet their management goals (stated on pages 8 and 9). The members of this coalition believe that achieving these broadly defined actions will protect the water resources of the Missouri Headwaters from saltcedar and achieve the overall goals of stopping the spread of saltcedar and containing or eradicating current infestations.

A. Management

- 1) Develop a clear plan to survey tamarisk in the entire area.
 - a) Current state of knowledge about tamarisk distribution in Headwaters (e.g., a map).
 - b) Areas (water courses, etc.) that have or have not been surveyed.
 - c) Prioritization of survey needs.
 - d) Who is, or could be surveying, and what the level of coordination between agencies and state.
 - e) Development of survey technique standardization.
 - f) Develop and maintain an online area-wide GIS database of tamarisk infestations.
- 2) Continue to control, contain, and prevent saltcedar in five-state area
- 3) Prioritize management
 - a) Protect non-infested areas; prioritize control of scattered infestations; contain and control known infestations.
 - b) Restore infested areas with desirable vegetation.
 - c) Prioritize areas of concern, including: irrigation canals and projects, reservoirs, dry slough areas, and railroad rights-of-way. Target small watersheds.
- 4) Discuss ongoing efforts
- 5) Create template to standardize data collection
- 6) Develop a risk assessment and monitoring program to determine program (and control site/method) effectiveness and rate of spread of saltcedar in area.

B. Education

- 1) Develop saltcedar management handbook for landowners and resource managers
- 2) Develop catalog of saltcedar resources and information
- 3) Develop an educational program that targets the general public (sportsmen, landowners, horticulturists, nurseries, etc.) and the removal/replacement of all ornamental plantings of saltcedar

C. Communication\Coordination (intergroup)

- 1) Compile and distribute county contact information for state borders (to encourage cross-border communication)
- 2) Pursue funding
- 3) Publish five-state map

- 4) Coordinate mapping efforts
- 5) Maintain listserv of missouri river watershed participants and others interested
- 6) Develop one-page summary of this project for peers, policymakers, potential funders, and the general public.

D. Coordination (outside of the group)

- 1) Letters of support to partnering agencies
- 2) Share information with other groups
- 3) Invite agencies to this meeting
- 4) Review national legislation
- 5) Work cooperatively with neighboring states and provinces.
- 6) Coordinate with water management programs, including dam management and management on regulated rivers.

E. Research

- 1) Improve communication between land managers and scientists
- 2) Compile list of research that's been done and is underway
- 3) Identify research areas that would improve ability to manage
- 4) Develop a research program that studies the interactions of plants in the riparian habitat.

V. Program Requirements

Resources Needed to Achieve Goals in the Missouri Headwaters

To achieve the items in the action plan, more resources are required for the five-state region. The members of the Missouri Headwater states are confident that with increased resources to achieve their action plan, they can drastically increase their ability to protect the water resources of the Missouri Headwaters. The state weed coordinators have estimated that collectively they will need approximately \$1,840,000 per year for the next five years to successfully fulfill the action plan. Summaries of estimated resources needed by state are listed below.

Montana: The state has spent over \$1,000,000 during the last five years. The estimated cost per year is \$350,000 for control and lost revenue from saltcedar.

Nebraska: The largest infestations would require herbicide applications by helicopter. These applications run about \$150-\$200 per acre including application and herbicide. At this rate it would take \$2,000,000-\$2,700,000 to treat the larger infestations a single time. This does not include follow-up control measures or support personnel for a spraying operation which would have an estimated cost of \$500,000.

North Dakota: If the current trend of saltcedar spread and control continues North Dakota will need in excess of \$500,000 a year to manage the problem. The amount of funds needed is dependent upon the funding levels of local U.S. Army Corps of Engineers offices. Currently the majority of infested acres in the state lie on Corps property. If Corps funding continues or increases local funding can remain relatively static. However, if the federal funds decrease local and state funding will need to increase exponentially.

South Dakota: To get control of saltcedar we would need an estimated additional \$500,000 a year for the next three to five years.

Wyoming:

Policies or Programs That Support Management Efforts

Several policies and programs throughout the five states support current management efforts. State noxious weed laws and Cooperative Weed Management Areas are the most commonly cited as supportive to these efforts. Local, state, and federal agencies and tribal governments are also very helpful, particularly when they work collectively. Some unique programs have been especially beneficial such as North Dakota's and South Dakota's programs to issue GPS units to all counties.

Constraints to Achieving Management Goals

The Missouri Headwater states have several groups and programs that have the capability to achieve the management goals outlined in this plan. However, all of these groups are constrained by lack of funding or inadequate staffing, technology, educational tools, equipment, and ability to travel and attend meetings.

Control efforts of large infestations or of topographically sensitive areas can be expensive and beyond the financial means of landowners and counties involved. The formation of weed management areas, with their abilities to coordinate control efforts and apply and receive grant funding, will allow control of our larger infestations and topographically sensitive areas. However, most county budgets do not have the funds or resources to force control on a landowner and be able to wait to be reimbursed by the landowner.

We need to approach all noxious weeds as a whole and not one at a time. When we focus on controlling any single species, the species that have been ignored may hinder the efforts of controlling the target weed species.

Management of noxious weeds is compromised by a lack of funding to fully staff permanent, adequately-paid weed officers. Inadequate funding also causes counties to lack technology, educational tools, equipment, staff, and the ability to travel and attend meetings.

VI. Evaluation and Coordination

Evaluation and Measures of Success

The success of the Missouri Headwaters Coalition will be evaluated annually at a joint meeting. The Coalition will review the Action Plan each year and assess the status of each of the items in the plan. The key measures of success will be:

- Buy-in by additional agencies, groups, and individuals not currently involved with saltcedar control.
- Commitment of the five states to continue the group
- Increased awareness of the saltcedar problem
- Increased funding from internal and external sources
- Increased research on all aspects of saltcedar
- Increased coordination of management efforts

State-to-State Coordination and Communication

The Missouri Headwaters Coalition will coordinate and communicate through at least semi-annual face-to-face meetings, through the established listserv, and through emails. Regional groups such as the Center for Invasive Plant Management may assist in continuing to help coordinate these efforts. At each joint meeting the states and the different entities in the group will give status reports. As each state reports its activities, other members can evaluate and compare them to their own situations. This will provide one of the opportunities for the different entities to decide on collaborative efforts. The group will act as a clearinghouse where projects can be discussed, analyzed, and coordinated between the states and various entities.

Long-Term Leadership

The leadership of the committee will be jointly held by all members with each state's delegates in a shared, principal volunteer role. Each state's delegates need to accept responsibility for the viability of the five-state group to be able to collectively receive information and funds in the pursuit of a common goal, stated within this plan. Subcommittees and a part- or full- time coordinator will be formed as needs arise and resources become available.

Report compiled and edited by Mara Johnson, Technology Transfer Coordinator, Center for Invasive Plant Management, Bozeman, MT. maraj@montana.edu.



www.weedcenter.org

The Center for Invasive Plant Management (CIPM) at Montana State University – Bozeman is serving as the initial project coordinator at the request of the five-state Missouri River Watershed Coalition. For more information, contact Janet Clark, CIPM Director, at (406)994-6832 or cipm@montana.edu.