Invasive Species

Clockwise from the top: Russian olive removal project in eastern Wyoming (Dustin Hill); Quagga mussels on boat propeller (Utah Division of Wildlife Resources); Fish infected with whirling disease (The Whirling Disease Initiative); Rusty crayfish (USGS); Canada thistle (Danny Dalton, Wyoming Pest Detection Program); Leafy spurge (Danny Dalton, Wyoming Pest Detection Program); Cheatgrass (Richard Old, www.xidservices.com).

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Background

An invasive species is a species that is: "1) non-native to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health" (Executive Order 13112, Appendix 1, 1999). Invasive species can include both terrestrial and aquatic plants and animals, and even pathogens such as West Nile virus. Not all non-native species become invasive; many, including agricultural crops and game animals, support human livelihoods and quality of life. However, some non-native species have the potential to cause significant environmental damage.

Terrestrial invasive plants can reduce forage production for wildlife and livestock; diminish breeding, escape, and thermal cover for wildlife; alter hydrologic cycles; change fire regimes; increase sedimentation and erosion rates; and change nutrient cycles and soil properties (Wyoming State Weed Team 2003). Invasive aquatic species can further affect aesthetics, drainage for agriculture and forestry, commercial and sport fishing, drinking water quality, flood control, human and animal health, hydropower generation, irrigation, recreational boating, swimming, water conservation and transport, and land values (Rockwell 2003). In the U.S. alone, damage and losses from invasive species are estimated at approximately $120 billion annually (Pimentel et al. 2005).

Most invasive species have been introduced into this country from abroad. As a result, they often do not have natural control agents or competitors and thus have the potential to dominate the native habitats they occupy. An increase in international trade and travel has worsened the intentional and unintentional introduction of invasive species. Ships are a common pathway for the unintentional introduction of invasive species, whether they travel by clinging to hulls, wrapping on propellers, or traveling within ballast water, or as cargo. Passengers traveling by ship, airline, train, motor vehicle, or even on foot are also common means of transport. Intentional pathways include pet, aquarium, aquaculture, and horticulture trades. In Wyoming, roads serve as conduits to spread invasive species through the creation of disturbed areas and vehicle traffic. Weeds frequently blow off hay being transported along the interstate, rural, and public lands roads.

Invasive species are a major cause of wildlife extinctions worldwide. For example, globally, invasive species have been identified as at least contributing to 48–62% of fish extinctions (68% of North American fish extinctions), 50% of bird extinctions, and 48% of mammal extinctions (U.S. Environmental Protection Agency 2008). In the United States, as many as 49% of all threatened and endangered species are adversely impacted by invasive species to some degree (Wilcove et al. 1998).

Scope and Challenges of Invasive Species and Wildlife Conservation

Terrestrial

Invasive terrestrial plants including noxious weeds inhabit about 1.3 million acres (~ 2%) in Wyoming (Wyoming State Weed Team 2003). The importance and impact of a particular weed species often vary by watershed. Additionally, the attention given to an individual species can shift with changing conservation issues and priorities as well as with the occurrence of new species.

Invasive terrestrial plant species are typically well suited to quickly colonize bare ground and disturbed sites resulting from both human and natural causes (Sheley et al. 1999). This attribute contributes to invasive species being a principal component of, or compounding, other negative effects associated with habitat impacts such as rural subdivision, energy development, disruption of natural disturbance regimes, overgrazing, and off-road vehicle use.

Increasing levels of outdoor recreation aid the spread of invasive species which are commonly

transported on vehicles, boats, and felt-soled fishing boots. Invasive weeds have been transported to alpine areas in hay for recreational horseback riding, although the required use of certified weed-free forage has reduced this problem in some areas.

Climate change and associated changes in atmospheric carbon dioxide levels, modified precipitation regimes, increased ambient temperatures, and altered nitrogen distribution is expected to intensify problems associated with invasive species. While some species are anticipated to experience range reductions, the ranges of others will expand. Additionally, climate change may result in new habitat types or conditions favorable to nonnative species (U.S. Environmental Protection Agency 2008). Climate change may also increase the frequency and intensity of natural disturbances; including fire and drought which could benefit those invasive species that are tolerant of changing hydrologic conditions and easily regenerate after wildfire (see Wyoming Leading Wildlife Conservation Challenges – Climate Change).

Tamarisk (commonly known as *saltcedar*), Russian olive, and cheatgrass (downy brome) may be the terrestrial invasive plant species with the greatest statewide recognition. Tamarisk was introduced into the U.S. from the Mediterranean region and likely escaped cultivation in the 1870s. It is an aggressive colonizer that often forms monotypic stands, outcompeting willows, cottonwoods, and other native riparian vegetation. It received its common name of *saltcedar* from the ability of the stems and leaves of mature plants to secrete salt. This salt forms a crust above and below ground that inhibits other plant growth (Sudbrock 1993). Tamarisk has a long tap root and is an enormous water consumer, which leads to its propensity to lower ground water levels, drying up springs and marshy areas. Additionally, large stands of tamarisk with extensive roots systems can contribute to flooding by choking stream beds (Rush 1994). Infestations often have a detrimental impact on wildlife; however some recent studies suggest that the effects of tamarisk invasion on wildlife vary depending on the ratio of tamarisk to native vegetation, wildlife taxa, and the quality and type of adjacent habitat (Shafroth et al. 2010). Although it provides some shelter, its foliage and flowers provide little food value for native wildlife species. (Shafroth et al 2005).

Problems associated with Russian olive are similar to those associated with tamarisk. Russian olive is a native plant from Eurasia that was introduced to many Great Plains and southwestern states in the early 1900s. The trees were extensively planted to provide windbreaks at first, and then federal conservation programs promoted their use for wildlife habitat among other uses. The Natural Resources Conservation Service (NRCS) continued to subsidize Russian olive seedlings for conservation plantings until the 1990s (Wyoming Game and Fish Department 2010 a). Currently, Russian olive is present in every western state, and occurs in most drainages across Wyoming except for portions in the far west and at higher elevations. In 2007, Wyoming joined other states (CO, CT, NM, and UT) with its listing of Russian olive as a noxious weed by the Wyoming Department of Agriculture. In addition, United States Congress passed the Saltcedar and Russian Olive Control Demonstration Act in 2006, which directs the Secretary of Interior to assess and develop programs to control these two plant species, and to provide a comprehensive scientific assessment of the distribution, abundance, and impacts of the two plant species (Shafroth et al. 2010).

Russian olives can out compete native riparian vegetation, interfere with natural plant succession and nutrient cycling, and tax water reserves. The spread and establishment of Russian olives has been accelerated by water development projects. Controlling, minimizing, or eliminating flushing flows and the formation of gravel bars is detrimental to the regeneration and establishment to native vegetation such as willows and cottonwoods, but has little effect on Russian olive or tamarisk reproduction. Cottonwood declines have been associated with flow alterations on the North Platte (Miller et al.

1995) and Bighorn (Akashi 1988, Bray 1996) Rivers in Wyoming. Although Russian olives can provide food and cover, they typically replace native vegetation favored by many wildlife species. Cottonwoods in particular are important to birds by providing structural diversity for foraging and nesting as well as suitable dead and dying trees for cavity nesters. Some studies have found that Russian olives harbor fewer bird species than native vegetation (Brown 1990, Knopf and Olson 1984), but more recent research generally finds that some species prefer habitat created by Russian olives and some do not, depending in part on the density of the nonnative trees and the surrounding habitat (Shafroth et al. 2010).

Cheatgrass is an annual brome grass from Eurasia that has the capacity to reduce the productivity of desirable forage plants as well as decrease plant species diversity. Cheatgrass has become a particular problem in large areas within the Great Basin, including western Utah, Nevada, and southern Idaho. High densities of cheatgrass increase fire severity by increasing fine fuel loads and shorten the time period between fires due to rapid regrowth. This altered fire regime can change entire plant communities. In some locations cheatgrass-fueled wildfires have converted native grasses and sagebrush habitats to cheatgrass-dominated landscapes. Of special concern are the loss of crucial sage-grouse habitat and other wildlife habitat along with secondary weed invasions from species such as rush skeletonweed and Medusa-head wild rye (Smith and Enloe 2006). Cheatgrass is adapted to surviving continuous years of drought and may grow vigorously when water becomes available. Its adaptation to fire and drought tolerance may make it well suited to thrive in a climate that is warmer and has more variability in precipitation which is commonly predicted for Wyoming in many climate change models (Bradley et al. 2008).

Aquatic

Aquatic invasive species (AIS), including fish, amphibians, mollusks, crustaceans, plants, and pathogens, are currently present in Wyoming. While a number of species cause problems and need to be prevented and controlled, the most significant threat to Wyoming is from zebra and quagga mussels (Wyoming Game and Fish Department 2009).

Zebra and quagga mussels have not been documented in Wyoming's waters, but as of 2008, instances of zebra and quagga mussels have occurred in Colorado, Utah, Nebraska, Kansas, Nevada, Arizona, and California (Benson 2009b, Benson 2009c). Zebra and quagga mussels have high reproductive potentials and spread rapidly. They negatively impact water delivery systems and power generation facilities by clogging pipes, pumps, turbines, and filtration systems. They have harmful impacts on fisheries by removing plankton from the water, reducing the productivity of waters. There are high economic and social costs once these mussels become established, including decreased boating and angling and increased water delivery and electricity costs (Wyoming Game and Fish Department 2009). Both species naturally disperse through water currents, but human transport via recreational watercrafts trailered from infested waters is the primary vector for movement to new aquatic systems (O'Neill 1996). As a headwater state, Wyoming's control activities are important in preventing the spread of these organisms and other invasive species to downstream locations.

Wyoming will likely continue to experience energy development, rural subdivision, and recreational use in the future. Additionally, climate change may alter existing habitats as well as create new ones favorable for invasive species. New species are likely to arrive as world trade and travel becomes more commonplace. All these factors suggest that threats from invasive species to Wyoming's native wildlife will increase in the future and continue to present new challenges to wildlife and natural resource managers.

Current Initiatives to Control Invasive Species

Federal

Most federal land management agencies have invasive species programs. Invasive species management is addressed in US Forest Service and Bureau of Land Management Forest and Resource Management Plans. Executive Order 13112, issued in 1999, mandated the establishment of the National Invasive Species Council to help ensure a coordinated, cost-efficient, and effective federal response to invasive species. Part of the Council's work included the creation of an Early Detection and Rapid Response (EDRR) strategy to prevent the establishment of invasive species.

State and Local

Twenty-three Weed and Pest Control Districts have been established in Wyoming as a result of the Wyoming Weed and Pest Control Act of 1973. Weed and Pest Control Districts provide cost-sharing assistance to landowners to eradicate or slow the spread of invasive species. Districts also have crews who treat weed outbreaks along county, state, and federal roads and in the backcountry. Public and professional training and education on weed identification, treatment, and prevention are important components of their work. Weed and Pest Control Districts are funded by mill levies on property.

Wyoming's Weed and Pest Council is comprised of one representative from each Weed and Pest District. The purpose of the council is to encourage the exchange of information and cooperation between districts and other agencies relative to the control of weeds and pests. The council also plays an educational role for the public and professionals in serving as a clearing house for information on weeds and invasive species. When needed, the Weed and Pest Council sponsors appropriate weed and pest laws. It receives funding from a pesticide registration fee, US Forest Service and state private forestry grants, the Wyoming Department of Transportation, and the Wyoming Office of State Lands and Investments for weed control on state highways and state lands, respectively. The Council has previously received a bi-annual legislative grant from special management program funds for leafy spurge control.

Growing problems with invasive species and increasing numbers of private individuals and professionals with interests or responsibilities associated with weed control have led to the formation of the Wyoming Weed Management Association (WWMA) in 2006. The WWMA's purpose is to promote collaboration and education on weed management issues among interested parties.

Wyoming has a list of Designated Noxious Weeds (S. 11-5-102 (a)(xi)) and Prohibited Noxious Weeds W.S. (11-12-104). There are currently 26 species on this list, the composition of which usually determines how resources and money are allocated for weed management at the county and state level. Species are added to the list through a joint resolution by the Weed and Pest Council and the Wyoming Board of Agriculture. The process is initiated at the request of one or more Weed and Pest Control Districts. Public hearings are held at the county level and by the Board of Agriculture. Wyoming counties often have independent ranked lists of weed species which guide the allocation of local resources.

Cooperative efforts comprised of multiple agencies and/or counties are becoming increasingly common for invasive species control. Examples include the North Platte Weed Initiative, the Big Horn Exotic Plant Group, Greater Yellowstone Coordinating Committee Invasive Species Program, and the Wyoming Green River Basin Healthy Lands Initiative. Coordinated Resource Management (CRM) teams have used a collaborative, stakeholder-based model to address land management issues in Wyoming since 1975. Currently, there are approximately 40 CRM teams in Wyoming, most of which have a weed management component. The CRM process works well with the Weed and Pest's Weed

Management Area designation. CRMs help to identify the ecological needs of the area, to address monitoring and any needed reclamation to ensure success of the control method being used, and to keep control of future invader through good management practices.

The Wyoming Game and Fish Department (WGFD) has actively participated on a statewide basis with almost all 40 CRMs and additional smaller groups which deal with invasive species within specific watersheds, basins, or sub-basins. WGFD habitat biologists and land managers are well trained on invasive species issues and provide input for coordinated management efforts. The WGFD has also substantially increased invasive species control efforts on department-managed lands during the last five years.

Presently, the Wyoming Weed and Pest Council is tracking of the location and spread of terrestrial invasive species beyond county-level presence and absence through a coordinated effort lead by their GIS/Mapping committee. Data from the effort is housed within the Fremont County Weed and Pest Control District. There is; however, no annual reporting requirements on statewide weed and pest activities. All though the mapping effort is coordinated and centralized, there are data-sharing limitations, particularly for data about invasive species located on private lands, as approval from the landowner is required to share this information. The Bureau of Land Management, National Park Service, and US Forest Service have programs to map and track invasive species on their lands. However their data is not readily shared nor do their mapping standards always parallel the district's standards. The WGFD has taken several actions to prevent the spread of AIS across state borders into Wyoming and within Wyoming's borders. The WGFD has used funds from the Wyoming Legislature to renovate hatcheries to effectively manage and control the spread of whirling disease (Beers1999). Additional efforts include regulations to combat illegal fish introductions, chemical removal of rusty crayfish, Hazard Analysis and Critical Control Point efforts for department activities, and education and outreach (Wyoming Game and Fish Department 2009). The Department has also been involved in regional and national coordination on AIS issues. The best source for current information on AIS in Wyoming and other states is the Nonindigenous Aquatic Species database housed by the USGS (http://nas.er.usgs.gov/).

The Wyoming AIS Management Plan was developed by the WGFD in response to the invasive species threats that are currently impacting Wyoming's waters and the imminent threats that are afflicting the waters of neighboring states. The management plan is meant to help coordinate all levels of efforts to prevent, control, monitor, and, whenever possible, eradicate AIS populations that are threatening Wyoming's waters. Specific plan objectives to achieve this goal are: 1. To coordinate and implement a comprehensive management program, 2. To prevent the introduction of new AIS into Wyoming, 3. To detect, monitor, and eradicate AIS in Wyoming, 4. To control and eradicate established AIS that have significant impacts on Wyoming waters, 5. To educate resource user groups about the risks and impacts of AIS and how to reduce their harmful impacts, and 6. To support research on AIS in Wyoming and develop efficient systems to disseminate information to research and management communities (Wyoming Game and Fish Department 2010 b).

In order to achieve the aforementioned goals, the WGFD is undertaking extensive efforts to inspect and decontaminate watercrafts that are being launched on Wyoming's waters, as well as monitor those waters for AIS. It is also carrying out public outreach and awareness campaigns including educating boaters on how to perform an AIS self-check on their watercraft and evaluating potential control methods. The management strategies that are included in the AIS Management Plan are proactive and realistic and are intended to be implemented in coordination with federal, state, tribal, and local entities. To date, WGFD outreach efforts have been intensive with the hope that generating

public awareness will be the most effective way to prevent additional AIS from becoming established in Wyoming's waters.

The plan ranks AIS into one of four priority classes, which indicate varying levels of urgency regarding addressing these threats. Priority Class 1 and 2 species are the main focus of the management plan, with special focus on the mussels that are currently impacting the waterways of neighboring states and are easily transported on watercrafts to other bodies of water. The AIS Management Plan is designed to be adaptable in order to address future AIS threats and to coordinate with other agency/organization programs that are already established to address this issue. In November 2011, Wyoming's AIS Management Plan was approved by the national Aquatic Nuisance Species Task Force, making it eligible for funding through the National Invasive Species Act.

The Wyoming Aquatic Invasive Species Act was passed in 2010 by the Wyoming Legislature. WGFD has a permanent AIS coordinator position to facilitate the development, coordination, and implementation of the AIS program.

Current Challenges for Effectively Controlling Invasive Species

Need for greater coordination for invasive species control efforts at the regional and state level.
While coordination on invasive species control activities is effective at the county level, greater coordination is needed between state and federal agencies. The Wyoming Governors Task Force on Forests recommendation 4.2 identified the need to expand multi-jurisdictional cooperation for mapping, monitoring, and controlling non-native invasive species (Governor's Task Force on Forests 2015). Areas where coordination can be improved include the sharing of goals and priorities; coordinating educational initiatives; and enhancing understanding of individual agency regulations, policies, and guidelines. Federal land management agencies are required to follow state directives; however, at times there is insufficient coordination with federal land management agencies on invasive species issues to achieve this requirement.

Lack of the necessary consistent, multi-year funding required for establishing and implementing effective invasive species control efforts.
Most invasive species funding in Wyoming is allocated annually which makes it difficult to develop long-term programs needed for the effective treatment and monitoring of invasive species. Additionally, funds are often allocated based upon acres treated and less directed toward efforts preventing the spread of invasive species or by the success of past control efforts. Anticipated federal and state budget cuts, due to weak economies and federal deficits, will likely reduce funding for invasive species control in the near future.

Increasing subdivision.
Soil disturbance from construction, the year-round grazing of horses and other hobby livestock, and the use of nonnative plants as ornamentals can facilitate the establishment of invasive species (Maestas et al. 2002). As the number of property owners increases, it becomes more likely that at least some will not adopt invasive species control efforts. This in turn creates source areas for future infestation making it more difficult for surrounding neighbors to control weeds. One study of 162 ranchers in the Sierra Nevada foothills of California found that 25% of interviewees reported that neighbors with weed sources on their properties reduced their investment in control efforts, because of the cost associated with continual reinvasion (Epanchin-Niell et al. 2010).

Inflexible or inconsistent monitoring and enforcement of existing invasive species regulations.
Monitoring and enforcement of invasive species management regulations and contracts on

public and private lands are inconsistently enforced. These regulations often pertain to surface disturbance from sources such as road building.

Inadequate statutory authority or invasive species regulations.
Through the Aquatic Invasive Species Act, the WGFD received the statutory authority to inspect and decontaminate boats that are being launched on Wyoming waters. However, there is not adequate control regarding the importation and sale of plants that are not on the list of Designated Noxious Weeds. Stronger education, recognition, and regulatory response to the importation and sale of plants recognized as an invasive species is encouraged

Need to increase public and professional knowledge about invasive species and invasive species management.
Knowledge levels about invasive species control and monitoring techniques vary considerably among land management and wildlife agency employees. The same is true for construction personnel, including those associated within the oil, gas, and wind development industries, who are responsible for preventing the spread of invasive species. Frequent employee turnover can diminish local knowledge, momentum, and follow-through for invasive species management programs.

In addition to educating land management and natural resource professionals, there is a need to increase invasive species knowledge levels among suburban residents and those engaging in outdoor recreation. Increasing awareness about the impacts of invasive species is necessary to encourage activities to limit the spread of invasive species and to build public support for control efforts. It is often difficult to get the public to attend workshops or other types of training. In addition to increasing general awareness, educational efforts should include information on where to get further technical assistance on controlling invasive species.

Difficulties in keeping pace with the increasing numbers of invasive species as well as the intensification of the causes accelerating their spread.
Control efforts are not growing at the rate necessary to meet the challenges posed by the increasing numbers of invasive species, greater development pressures, higher levels of outdoor recreation and international trade, and mounting influences from climate change. Frequently, there is only time and money for treatment, and little attention is directed toward monitoring or subsequent efforts to re-establish native species.

Recommended Conservation Actions

Establish a statewide inter-agency working group to coordinate invasive species control efforts.
A statewide inter-agency invasive species working group should be established to facilitate coordination among invasive species control efforts. Responsibilities of the working group could encompass serving as a clearing house for information about invasive species including current treatment efforts and their level of success, increasing awareness about technical and financial assistance available for invasive species management, identifying common conservation goals among agencies, and coordinating educational efforts. Coordinating activities, especially for educational efforts, can reduce costs for individual organizations. The Wyoming State Weed Team, which created Wyoming's Weed Management Strategic Plan, has expressed interest in assuming some of these responsibilities.

Increase consistent, long-term funding for invasive species control efforts.
To effectively control invasive species, funding should be multi-year and consistent. This would enable not only adequate treatments, but also the necessary follow-through including post-treatment monitoring and the re-establishment of desired species. Invasive species funds should be line items in federal and

state agency budgets and not subject to annual appropriations. Pesticide registration fees should continue to be directed toward invasive species management. The Wyoming Legislature provided for the use of pesticide registration fees to be used for special projects through a grant process. This enabled the Weed and Pest Districts to utilize a source of funds for targeted invasive species management. Grant-writing training should be provided to weed management coordinators to enhance funding opportunities.

Federal funding available to implement State AIS Plans through the USFWS Aquatic Nuisance Species Task Force should be increased. This funding is currently available through the National Invasive Species Act of 1996, but funds are limited to around $30,000 annually for each state with an approved AIS plan.

Better prioritization systems should be established for the allocation of invasive species funding.
Invasive species funding efforts are not always consistent within or between organizations. Additionally, grants are often not allocated according to need or treatment effectiveness. Invasive species control efforts should be focused on the watershed/basin level, and where appropriate, treatment should begin at the top of the watershed to ensure invasive species are not re-established from upstream sources in treated areas. Efforts should be made to involve multiple landowners in coordinated, watershed-level invasive species management plans.

Unify and increase invasive species educational efforts.
The Wyoming Governors Task Force on Forests recommendation 4.1 identifies the need for a statewide plan for public education on the threat of non-native species. Such a plan would facilitate coordination among federal, state, and local governments and funding mechanism to prevent, mitigate, and manage non-native species (Governor's Task Force on Forests, 2015).

Education material needs to be provided at points of entry including road accesses to public lands; trailheads for off-road vehicles, hiking, and horseback riding; walk-in fishing and hunting areas; boat launches; and visitor information centers for tourists. The number and type of educational opportunities should be increased for developers and contractors who are required to treat invasive species, or who have an impact on their ability to spread. General invasive species awareness should increase among land managers and wildlife personnel, including increasing the number and diversity of employees attending trainings. Educational efforts should be designed for specific audiences with regard to how the group best receives and applies information.

Educational programs should be working cohesively to ensure a broad spectrum of the public is reached. A unified message would also be cost-effective, by minimizing the amount of time and effort needed to create individual messages.

Increase Early Detection and Rapid Response (EDRR) capabilities.
Funding should be provided for the creation of an invasive species EDRR program in Wyoming. Reducing the spread of invasive species is less expensive and more effective than control efforts after the species is established. Projected costs for a Wyoming EDRR program are $3 million and $2 million annually for terrestrial and aquatic species, respectively. EDRR funding should be accompanied by increased coordination between the Weed and Pest Council, WGFD, and all other state and federal agencies for both terrestrial and aquatic species.

Coordinate the development of consistent invasive species monitoring protocols among local, state, and federal agencies.
Different land management and wildlife agencies presently use different methods to monitor the spread of invasive species and the effectiveness of control techniques. This lack of

consistency makes quantifying and compiling data from different agencies on a regional or statewide basis difficult or impossible. The incorporation of basic protocols with a limited number of standardized descriptive fields into the monitoring protocols of each agency or organization would facilitate data sharing and enhance future invasive species control efforts. Such standardization of basic nomenclature, including units and rating, could facilitate data sharing without limiting each organization in pursuing its individual mission and monitoring needs.

Evaluating/monitoring Success

Increased attention should be given to monitoring the effectiveness of control efforts.
The level of invasive species monitoring among agencies and landowners varies according to funding, time availability, and the priority placed upon monitoring. Currently, federal land management agencies have little financial or personnel capacity to establish comprehensive invasive species monitoring programs. Demands to address immediate treatment needs and respond to public requests prevent Weed and Pest Control Districts from putting significant resources into monitoring. However, only through monitoring can the cost effectiveness of treatments be evaluated and treatment techniques improved. The cost of monitoring programs can be reduced through multi-organizational cooperative efforts.

Monitoring efforts should be designed to evaluate habitat goals rather than just the success of killing targeted species.
Invasive species should not be monitored in isolation, but as part of overall integrated habitat plans. Current monitoring often examines only the effectiveness of treatments. Which species replace treated invasive species is equally as important as both evaluating the success of eliminating the targeted plant or animal and equating that change to impact on the habitat, positive or negative. The success of efforts to prevent the spread of invasive species should also be monitored and quantified.

Greater attention should be placed on monitoring the long-term effects of invasive species management activities on wildlife.
Many past invasive species monitoring efforts have largely focused on evaluating changes in forage production for livestock. When possible, monitoring efforts should include components to determine benefits to wildlife.

It is important that monitoring plans are tailored to the resources level, expertise, and degree of interest of the intended user.
No monitoring technique is effective if it is not actively applied. Invasive species monitoring techniques should be customized not only for the specific species, but also for the intended monitoring personnel. SamplePoint monitoring, created by USDA Agriculture Research Services, is an easy, quick, and effective monitoring method without the need for extensive expertise or training. Free SamplePoint Software can be downloaded at http://www.samplepoint.org/. The University of Wyoming Cooperative Extension Service and Society for Range Management make available terrestrial invasive plant species monitoring protocols. The WGFD developed AIS monitoring protocols in 2010 as part of its Wyoming AIS Plan.

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Additional Resources

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Bozeman, MT 59717-3120
Phone: (406) 994-5557
Email: weedcenter@montana.edu

Nonindigenous Aquatic Species Database
http://nas.er.usgs.gov/

University of Wyoming Cooperative Extension Service
Dept 3354
100 E. University Avenue
Laramie, WY 82071
Phone: (307) 766-5124

U.S. Forest Service R2/R4
Wyoming Capitol City Coordinator
Herschler Building 3 West, Room 3603
122 W. 25th St.
Cheyenne, WY 82002-0600
Phone: (307) 777-60870

USDA Natural Resource Conservation Service Exotic Plant Database
http://plants.usda.gov/java/noxiousDriver

Wyoming Association of Conservation Districts
517 E. 19th Street
Cheyenne, WY 82001
Phone: (307) 632-5716
http://www.conservewy.com/index.htm

Wyoming Cooperative Agricultural Pest Survey (CAPS) / Pest Detection Program
University of Wyoming
Renewable Resources
Department 3354
1000 E University Avenue
Laramie, WY 82071
Phone: (307) 766-5278
http://www.uwyo.edu/capsweb/

Wyoming Game and Fish Department
5400 Bishop Boulevard
Cheyenne, WY 82006
Fish Division
Phone: (307) 777-4559
Aquatic Invasive Species hotline: 1-877-WGFD-AIS
Terrestrial Habitat Division
Phone: (307) 777-4565

Wyoming Natural Diversity Database
1000 E. University Ave.
Dept. 3381
2nd Floor, Wyoming Hall
Laramie, WY 82071
Phone: (307) 766-3023
http://www.uwyo.edu/wyndd/

Wyoming Weed and Pest Control Districts
http://www.wyoweed.org/about/district-offices

Wyoming Weed and Pest Coordinator
Wyoming Department of Agriculture
1510 E. 5th Street
Cheyenne, WY 82002
Phone: (307) 777-6585

Wyoming Weed Council
http://www.wyoweed.org/