Montana Invasive Species Council

Panel Report

Woody Invasives Species Environmental and Economic Impacts Science Advisory Panel

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Introduction

An ongoing management concern across Montana has been the invasion of woody invasive species, specifically Russian olive (*Elaeagnus angustifolia*); saltcedar (*Tamarix ramosissima, T. chinensis*, and any hybrids thereof); and common buckthorn (*Rhamnus cathartica*). In years' past, management efforts for these species have been wide ranging in size, funding, and geography. Projects intended to research, treat, remove, monitor, and/or report spread have been implemented on individual parcels up to entire watersheds. However, coordination across all of Montana's habitats and watersheds has been identified as an ongoing need, with particular importance that it address more than one woody invader. A core group of invested individuals established the Woody Invasives Core Planning Group due to this need for coordinated woody invasive species management across the state. For years, the Core Planning Group met and worked together with three ultimate goals: 1) make a comprehensive, united effort for all riparian areas and watersheds across the state; 2) seek larger sources of funding that hadn't previously been available; and 3) draft a statewide management plan. In 2023, a grant was awarded through the Noxious Weed Trust Fund (NWTF) to tackle these objectives. Additionally, Montana Invasive Species Council (MISC) formed a subcommittee for Woody Invasives Best Practices. This subcommittee included Jasmine Chaffee, Montana Department of Agriculture (MDA); Liz Lodman, MISC; and Sara Ricklefs, Invasive Species Action Network (ISAN).

As part of the grant's objectives, ISAN submitted a bid for coordination of the Statewide Woody Invasives Management Plan and Woody Invasives Work Group (WIWG). A contract was awarded and fully executed on June 28, 2023. In which, ISAN agreed to (among other obligations) develop and facilitate two formal Science Advisory Panel meetings in partnership with MISC. A contract for the planning and coordination of the Science Advisory Panels was fully executed between ISAN and Montana Department of Natural Resources and Conservation (DNRC) on September 7, 2023.

The inaugural Science Advisory Panel was held in Billings, Montana on November 20, 2023. Six technical experts representing academic, research, and management fields served as panelists to comprehensively cover topics related to management best practices. Reports outlining the goals, outcomes, and findings from this Science Advisory Panel are available to the public on the MISC website.

Initial planning and preparation for the second Science Advisory Panel occurred with the Core Planning Group. The Panel was held on October 17, 2024 in Helena at the Best Western Helena/Capitol Hotel (with a virtual attendance option via Zoom). Much like the first Panel, this Panel consisted of six experts who presented and facilitated discussion on topics such as the ecological and economic impacts of woody invasives and practical management strategies. The Panel was attended by 36 stakeholders, representing a wide range of partners, agencies, and land managers. Furthermore, a full audio and visual recording of the Panel along with related materials were provided to the full WIWG so that those unable to attend could benefit from the information provided.

Panel Purpose

The Science Advisory Panel addressed topics of impacts (both environmental and economic in nature) for the focal species, common buckthorn, Russian olive, and saltcedar. Specifically, the goal was to seek expertise on potential and realized impacts to Montana's natural resources and economy through lessons learned from other invaded areas. Panelist experts provided information on the state of the science and emerging research in relation to each of their topics.

Panel Outcomes

- Gain a comprehensive understanding of the potential impacts of focal species on Montana's natural resources and economy.
- Identify knowledge and research gaps that will impact Montana's managers.
- Collaborate on and discuss challenges experienced in impacts from woody invasive species and their management within and outside the state's borders.
- Compile information from technical experts for use in the statewide management plan, particularly in prioritization.

Panelists

Panelists (presented in alphabetical order by last name) were identified for their technical expertise and, in some cases, relevant research to Panel topics.

- **Dr. Cameron Douglass,** Agronomist/Weed Scientist, U.S. Department of Agriculture Office of Pest Management Policy

  Cameron Douglass is a Weed Scientist and Agronomist in USDA's Office of Pest Management Policy, and primarily handles policy issues involving registration reviews of herbicides and herbicide resistance management. Dr. Douglass's portfolio also includes invasive species-related matters and serving on USDA's Invasive Species Working Group, as well as working on inter-agency policy issues for the biological control of invasive plants. Dr. Douglass previously worked as a biologist in the Environmental Fate and Effects Division of the U.S. Environmental Protection Agency's (USEPA) Office of Pesticide Programs from 2016 through 2020. Prior to working at USEPA, he was the Thomas McKenna Meredith Postdoctoral Scholar in Environmental Sciences at Trinity College (Hartford, CT). Cameron received his Ph.D. in Bio-agricultural Sciences and Pest Management from Colorado State University, where he studied the environmental impacts of tamarisk (saltcedar) management strategies in Colorado's Arkansas River watershed.

Cameron Douglass presented on known environmental impacts of Russian olive and saltcedar invasions, described within peer-reviewed literature.

- **Dr. Becky Epanchin-Niell,** Associate Professor, University of Maryland Department of Agricultural and Resource Economics

  Becky Epanchin-Niell is a resource economist in the Department of Agricultural and Resource Economics at University of Maryland, College Park, and a Senior Fellow at Resources for the Future. Dr. Epanchin-Niell's research integrates economics and ecology to inform cost-effective ecosystem management, with particular focus on invasive species. She applies quantitative, integrative models and emphasizes collaborations with natural and social scientists, working closely with government, NGO, and the private sector stakeholders. Her research tackles management of invasive species across stages, spanning prevention, early detection and rapid response, slowing-the-spread, and damage mitigation efforts. She has developed bioeconomic models that have been used to guide invasive species management domestically and internationally. She has served in a variety of advisory capacities, including as a member of the New York Invasive Species Research Institute's Advisory Board and the U.S. National Park Service's Invasive Animal Species Independent Science Panel.

  Becky Epanchin-Niell presented on the economics of invasive species and invasive species control.

- **Dr. Sunny Jardine,** Associate Professor/Shimada Faculty Fellow, University of Washington School of Marine and Environmental Affairs

  Sunny Jardine is trained as a resource and environmental economist. Her research is broadly focused on the economics of conservation and management in marine and coastal systems. Current research topics include recreational fisheries management, salmon conservation planning, the economics of harmful algal blooms, and seafood markets. Dr. Jardine uses economic theory and econometric and numerical methods in her research. Jardine received her Ph.D. in agricultural and resource economics from the University of California at Davis in 2013.

  Sunny Jardine presented on monetizing economic impacts.

- **Jennifer Muscha**, Rangeland Management Specialist, U.S. Department of Agriculture-Agricultural Research Service Fort Keogh Livestock and Range Research Laboratory

  Jennifer Muscha is a support Scientist with the USDA-Agriculture Research Service, Fort Keogh Livestock and Range Research Laboratory in Miles City, Montana. She completed her master's degree in Rangeland Ecology and Management at the University of Wyoming in Laramie. She is scientific support for the Research Leader and has been working at Fort

Keogh since 2003. In 2011, Fort Keogh, with partners from the Sidney USDA ARS office, Miles City Natural Resources Conservation Service (NRCS) office and Bridger Plant Materials Center implemented a Russian olive removal and restoration project along the Yellowstone River. Approximately 8 miles of the Yellowstone River flows through Fort Keogh. Fort Keogh has continued to conduct research, monitor the removal sites, and control Russian olives.

Jennifer Muscha presented on known environmental impacts from Russian olive and saltcedar invasions, including Montana's lessons learned via Fort Keogh's ongoing research.

- **Dr. Pamela Nagler,** Research Physical Scientist, U.S. Geological Survey Southwest Biological Science Center

  Pamela Nagler is a Research Physical Scientist specializing in spatial ecohydrology with the U.S. Geological Survey's Southwest Biological Science Center in Tucson, Arizona. She earned a Masters from University of Maryland in Physical Geography and Remote Sensing and a PhD in Soil, Water and Environmental Science from the University of Arizona. Dr. Nagler has published over 250 journal papers on topics ranging widely in the use of remote sensing for measuring landscape metrics by scaling biophysical and spectral data to larger spatial scales. She developed methods for measuring plant water use (evapotranspiration) which has been applied successfully in both agricultural and uncultivated landcover, including urban green spaces, and for native and non-native species. Her work has been recognized with the U.S. Presidential Early Career Award for Science and Engineering (PECASE), the U.S.- Chinese Academy of Sciences, and the Commonwealth Science Industry Research Organization (CSIRO) Office of the Chief Executive Award in Australia. Pamela has been chairing sessions on Remote Sensing of Evapotranspiration at the European and American Geophysical Unions for over a decade each.

  Pamela Nagler presented on water usage of woody invasives species in the American Southwest.

- **Dr. Mark Renz,** Professor/Extension Weed Specialist, University of Wisconsin-Madison College of Agricultural and Life Sciences

  Mark Renz is a professor and extension weed specialist with the University of Wisconsin-Madison. Dr. Renz researches and extends information about the biology and management of invasive plants. Research goals in Dr. Renz's lab are centered on developing information that will improve management by improving the knowledge and understanding of invasive plant biology. Dr. Renz has over 20 years of experience with management of invasive plants throughout the United States in a wide range of habitats including riparian zones, roadsides, floodplains, prairies, wetlands, and forests. Education efforts focus on providing technical information and educational opportunities for agency staff, consultants, companies, and citizens concerned about invasive plants. Dr. Renz also is the president of the Midwest

invasive Plant Network whose mission is to reduce the impact of invasive plants in the Midwestern United States.

Mark Renz presented on known environmental impacts of common buckthorn invasions.

Questions for Panelists and Key Takeaways

Questions were compiled from input provided by members of the WIWG and its Core Planning Group. The questions informed requested presentation topics of the panelists. Between each presentation, a 10-minute period was allotted for open discussion of the presentation topic. The final session of the Panel was an open discussion amongst all panelists and attendees. The questions were:

- What data would be needed to quantify (via model or other tool) the cost of woody invasions and their management in Montana?
- How does water consumption compare in riparian zones between woody invasives and natives? How much water intake is occurring?
- How do researchers evaluate economic impacts?
- Related to common buckthorn: What are the impacts from soybean aphids, alfalfa mosaic virus, crown fungus, and oat rust disease?
- What are our knowledge gaps in ecologic/economic impacts?
- What can we learn from the economic impacts realized in other states with dense infestations of these species?
- What are the environmental impact differences of infestations between small ponds or reservoirs in rangeland settings vs. riparian, river corridors?
- What changes in soil health (including microbial, macroorganisms) are caused by these species?

Each expert fielded questions following their presentation and a great deal of discussion was had during the final Question and Answer session and wrap-up. Discussions covered a wide range of topics, including gaining an understanding of tribal values and considerations in relation to woody invasions; considering impacts from woody invasions to wildfire and other natural disaster resilience; potential topics for the final Working Group meeting; encouraging partnerships with hunting, fishing, and other special interest groups; and ongoing development of resources for risk assessment and evaluation.

Key takeaways and recommendations from the presentations:

- **Understanding Water Usage of Woody Invasives from the American Southwest:**
    - Some conditions allow saltcedar to thrive, including sandy soils. Its attributes and adaptations make it a keen invader:
        - Ability to access deeper groundwater sources

        - High tolerance to stress (fire, heat, drought, flooding)
        - High rates of first year establishment
        - Added salinity discourages other plants
    - A common myth is that saltcedar is a high water user (previous unbased claims up to 200 gallons per day). However, studies have found that it is a moderate water user and often equivalent to other riparian shrubs and trees (native or otherwise).
        - Evapotranspiration is the cause of most water usage. Higher rates of evapotranspiration occur in younger stands of saltcedar when compared to older stands.
        - Since saltcedar uses similar amounts of water as native woody species, removing and replacing saltcedar does not necessarily increase water availability.
        - Factors that impact water usage in riparian areas include assemblage of species present, stand density, rooting depth, and water management (flow) decisions.
        - Therefore, project management goals should be driven by more than water availability if removal and revegetation efforts are conducted.
        - Defoliation from biocontrol beetles (*Diorhabda* spp.) can reduce evapotranspiration. Multiple years of repeated defoliation can cause mortality in individual plants.
            - When mortality occurs, water savings are typically short lived because replacement vegetation will establish within a few years.
            - Reductions in evapotranspiration are highest for areas with either high or low coverage of saltcedar, but not medium coverage.
    - Research is necessary to understand evapotranspiration rates before and after management actions in specific locations. There are many impacts to expected water usage, including density, age, and fractional cover.
- **Russian Olive and Saltcedar Environmental Impacts:**
    - Russian olive and saltcedar are different, but they operate functionally the same in riparian areas and are often seen together.
    - Both species are better adapted to flow regimes, disturbance, and stress than native riparian woody plants. If these conditions persist, they will expand. Human stabilizations of rivers and streams have facilitated the conditions that favor Russian olive and saltcedar.
        - Don’t be surprised that they behave this way – that’s why they were originally introduced.

- Environmental impacts are context dependent:
    - If they persist as understory shrubs in an intact, healthy native riparian gallery, impacts are likely to be neutral. Therefore, management efforts should be prioritized for monotypic stands, especially in open areas.
    - If established in monotypic stands, impacts can be expected to be more extensive. Woody communities are altered when these invasive species are at higher densities.
        - The few species that thrive in the understory of woody invasives are typically other invasive species. Plant community impacts (e.g., secondary invasions) may persist even after removal occurs.
        - Native species within the seed bank can recover after removal. Native species can thrive when invasive species removal is paired with the restoration of historical flood regimes and streamflow conditions.
    - While they may occur in rangeland settings, Russian olive is unlikely to be a dominant species around ponds or reservoirs away from riverine areas. Species occurrences and densities are much greater in riparian corridors. However, dispersal of seeds from upland locations contribute to riparian establishments.
- Russian olive and saltcedar can provide habitat for wildlife (particularly birds), but the habitat is not functionally equivalent to native communities.
- Research has found that Russian olive and saltcedar provide generally neutral impacts to invertebrates and many vertebrates.
    - However, Russian olive has been found to be unsuitable habitat for beavers and deer.
- Saltcedar leaves are not highly flammable, but the growth structure of plants leads to greater fuel loads, ultimately leading to more severe, hotter fires in invaded areas.
    - Due to its ability to resprout from existing root crowns, saltcedar is often the first species to emerge post-fire.
- Fire does not promote germination of Russian olive seeds. Germination and seedling survival is reduced at all fire fuel loads. Thus, wildfire or prescribed fire in the second year after removal may be helpful.
- In situ seed viability studies in Montana suggest that viability is severely reduced (2% viability) within 3 years and removed within 4 years.
- Russian olive and saltcedar establishment facilitate channel narrowing and triggers channel incision, leading to overbank flooding.

        - Removal of whole plants (in comparison to leaving root systems in cut/stump applications) can allow for re-widening of streams and increases in fluvial processes.
    - Lessons learned from Fort Keogh Russian olive restoration efforts:
        - In cut/stump applications, preplan the placement of your slash piles. This is important for potential flood events and where your burning takes place (i.e., surrounding vegetation).
        - Successful reduction of seedlings can occur with the use of loppers (rather than the skidsteer shear attachment). This reduces the use of spray, but increases time and effort.
        - Revegetation increases diversity and native plant cover. Woody tree/shrubs used in revegetation efforts have higher survivability if they are shaded by mature cottonwoods.
            - Plant native trees/shrubs in small clumps and fence around them to increase survivability.
            - Graze early to reduce annual brome and control weeds and seedlings.
        - Restoration takes time (5 years for first evaluation). These types of projects require long term management of seedlings.

- **Common Buckthorn Environmental Impacts:**
    - Currently, the vast majority of studies about common buckthorn invasions have occurred in the midwestern or eastern United States. It's difficult to predict how common buckthorn will behave in Montana. In the upper Midwest, it commonly invades forest and shrublands, but urban and developed areas are most susceptible. Montana likely has heavy environmental constraints in comparison to midwestern ranges.
        - Generally, common buckthorn causes a reduction in native flora and fauna, changes in nutrient cycling, increase in deleterious insects and diseases, and a reduction in recreation and tourism
    - Studies suggest that impacts to native plants are severe with few plants able to grow in dense buckthorn thickets. Possible causes include allelopathy, shading, and higher nitrogen. The presence of buckthorn is often associated with other invasive species, creating a negative feedback loop.
        - Growth and development of native tree species is lower in infested areas. However, these studies were conducted in areas forested with deciduous trees. Results may differ where coniferous natives are dominant.
    - Increased nitrogen in common buckthorn leaf litter results in rapid decomposition. Rapid leaf litter decomposition may attribute to cascading impacts starting with the soil

arthropod community. Additionally, rapid litter decomposition can lead to bare soil and soil erosion.

- High nitrogen inputs from leaf litter can cause a doubling of nitrogen in the soil (inorganic *versus* organic forms are dependent on density). The nitrogen availability will persist after buckthorn removal occurs.
- Other soil property changes attributed to common buckthorn include increases in pH and total carbon.

- Common buckthorn fruit provides less energy for birds than native fruits; they also act as a diuretic, further reducing their value. Many avian species experience reduced nesting success due to increased predation in buckthorn stands.
- Common buckthorn serves as a host to multiple diseases and pests, some of which have negative impacts on agricultural commodities.
  - Host diseases include oat crown rust, alfalfa mosaic virus, armillaria root rot, nectria canker, and sudden oak death. Oat crown rust can reduce grain yields by 10 to 40%. Buckthorn is one of numerous hosts for sudden oak death. Therefore, impacts from buckthorn specifically may be minimal.
  - Common buckthorn is also a host to soybean aphids, which can reduce yields up to 40%. The soybean aphids overwinter on common buckthorn.
    - Studies in the Midwest indicate that preexisting natural predators are effective in suppressing soybean aphids. Research may be needed to determine if natural predators could suppress aphids in Montana and if that suppression will continue to be effective with further climatic change.
- Dense thickets make it difficult for outdoor recreation, including hunting, bird watching, hiking, and foraging.
- Managers in Montana should be prepared and expect existing populations to continue to grow and spread. It may be useful to research what is currently constraining the spread of common buckthorn in the state.

- **Introduction to Economics of Invasive Species:**
  - There are three economic questions to consider with species invasions:
    1. What is the magnitude of the problem? Results can help draw attention and resources to the problem.
    2. How can we allocate scarce resources to management in a cost-effective manner? These results can help prioritize efforts.

3. How can policies help align private incentives to ultimately benefit society? This can help encourage members of the public to participate in control and prevention.

- When evaluating the economic impact of an invasion, it's important to consider both control costs and damage costs.
    - Control costs are often easy to measure (e.g., cost of materials, labor, time). However, you should account for unintended consequences of control methods (e.g., understanding hydrological changes if leaving the root systems).
    - Damages are more difficult to quantify due to the presence of multiple types of damage. Large uncertainty due to context dependency can further hinder quantification.
        - Damages may be measured as a loss to ecosystem benefits and/or as a loss of the flow of ecosystem service values. One-size-fits-all approaches to measurement will not be suitable.
    - Additionally, there are benefits of an ecosystem remaining uninvaded (e.g., agricultural or timber production, recreation, biodiversity, carbon sequestration, water and habitat quality, aesthetics, and existence). Therefore, prevention should always be sought.
- Economic valuation should include both use (gained from interacting with the ecosystem) and non-use values (e.g., sense of wellbeing).
- Total impacts should include both current (or realized) and expected (due to further spread) measurements. Models are likely to be helpful in this endeavor.

- **Monetizing Economic Impacts:**
    - Economic value includes the consumers' willingness to pay and the producers' willingness to accept. This can be calculated to include everyone in the market or specific groups.
        - If the cost of the good or service is lower than the consumer's willingness to pay, this results in a consumer surplus. If the cost is greater than the producer's willingness to accept, this results in a producer surplus. Each of these can be zero and exist for ecosystem goods and services.
    - Non-market valuation quantifies the change in economic value driven by environmental change (e.g., the change in recreational value caused by a species invasion).
        - First, the change in the valued good or service due to the species invasion must be calculated.
        - Secondly, the resulting change in value of the good or service must be calculated.

- Additional value methods include market analysis for impacts to marketed goods, travel cost analysis for impacts to recreation, contingent valuation for impacts to non-users, and benefit transfer for any type of impact.
- Management decisions should address first order impacts for each species.
- Analyses using proprietary software (e.g., IMPLAN or REMI) are often disputed because they utilize a multiplier effect and can inflate impacts. They often ignore environmental and opportunity costs.

- **Economics of Invasive Species Control:**
  - Damage estimates require both scientific and economic approaches. When integrated into models of invasion spread and paired with control costs and efficacy, this can help guide management (i.e., prioritization).
    - Non-market values are expected to have great impact so quantification is critical.
  - Including behavioral and social sciences is important since humans play such an integral role in spread, control, and impacts.
  - Strategies for estimating invasive species control economics may differ based on species and geography. Use of multiple strategies for invasion management may be required in order to leverage resources:
    - Protecting high value areas from invasion with prevention and early detection.
    - Applying suppression and eradication where benefits are greatest.
    - Leveraging landscape attributes (e.g., geographic features) to reduce costs of control.
  - It's important to understand private incentives in relation to invasive species management. Landowners may only incur or perceive some of the damages from the invasion of their land. For instance, some damages may impact broader society, landowners may lack awareness of impacts, and damages of spread onto adjacent properties may not be considered.
    - Since cost of management is likely high, cost share programs and technical support for invasion control is encouraged.
  - Economists use different strategies to understand and quantify cultural values, which is important for invasive species management. There is value in providing motivational insight since different agencies, tribes, group, and organizations will be driven by various needs. These are generally described more qualitatively.

Conclusions and Next Steps

The Science Advisory Panel proved a successful endeavor for gaining a better understanding of woody invasives impacts, initiating collaborative discussion amongst land managers and natural resources professionals in- and out-of-state, and learning more on the status of research and our collective understanding. The insights provided by Panelists and attendees alike will be immensely beneficial to the statewide management plan draft. Next steps for the WIWG include:

- The coordination of one additional WIWG meeting, in accordance with the NWTF grant.
- The development of a woody invasives impact study, led by researchers from the Flathead Lake Biological Station (expected in summer 2025).
- The further development of the statewide management plan with a draft expected for release to the public in 2025.