

Research Notes

Identifying sources of mussel invasion risk into the West

By: Travis Warziniack (twwarziniack@fs.fed.us), Research Economist, RMRS Human Dimensions Program, Fort Collins, CO

The oversight required to ensure compliance of invasive species programs adds costs to resource users and government, and it raises the question of the ‘appropriate’ probability of invasion. Balancing tradeoffs between cost of policy and benefits of protected ecosystems was the focus of a study by economists from the Rocky Mountain Research Station and members of the Integrated Systems for Invasive Species team (see Warziniack and others 2011 in the Recent Publications section for the complete citation). The authors measured (1) lost economic output due to zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena rostriformis bugensis*) invasions in the Western United States and (2) the threat of introduction into the Columbia River basin. They found that an invasion in the Columbia River basin could cause \$64 million in damages and that only extreme policies are likely to reduce the risk of invasion.

Prior to the study, it was believed that invaded bodies of water in the East were the largest sources of risk. The new study highlighted the role Western bodies of water play in risk to the Columbia River basin through what is called “stepping stones” for invasion. Stepping stones are ecosystems that currently pose no direct risk of introduction but, because of their economic and ecological ties with invaded ecosystems,



The quagga mussel (*Dreissena rostriformis bugensis*) has already infested numerous lakes in the Northeastern and Southwestern United States; these photos were taken of mussels in Lake Mead. There is concern that mussel invasion into currently uninfested areas of the West, such as the Columbia River Basin, would cause millions of dollars in damages. Photos by Marion Wittman.

may become invaded themselves and thus pose an indirect risk of introduction to the Columbia River basin. Recreational boating was identified as the largest source of risk of introduction. Because the number of boats from currently uninvaded Western

basins entering the Columbia overwhelms the number of boats from invaded Eastern basins, these stepping stones pose the greatest source of risk to the Columbia River basin.

Prevention efforts such as quotas, inspection stations, and fines decreased expected impacts only when consideration was limited to Eastern sources of risk. Accounting for sources of risk in the West, prevention efforts did little. Other nearby basins already had a large number of boaters arriving from invasive mussel source areas, so policies in the Columbia were predicted to impose costs on residents but were not expected to change the basin’s probability of becoming invaded. Boat inspections had a number of advantages over quotas, primarily by bringing the probability of an invasion down quicker than a quota system. Inspection of more than 75 percent of all boats, however, was needed to reduce risk low enough to make the policy worthwhile.

Unfortunately, localized policies are not likely to significantly change the probability of invasion. Regional policies are needed. The large numbers of boaters that move between basins integrates the basins even though geography isolates the actual water systems. Strict policies in one basin can redirect boaters to other nearby basins. Lack of cooperation at agency levels can transfer the risk of invasion from one basin to another and do little to mitigate damages. A uniform effort between agencies of inspecting boats and installing wash stations at launch sites is likely the only way to effectively reduce the risk of exotic mussel invasion.

Biogeography of plant invasions

By: Dean Pearson (dpearson@fs.fed.us), Research Ecologist, and Yvette Ortega, Ecologist, RMRS Wildlife and Terrestrial Ecosystems Program, Missoula, MT

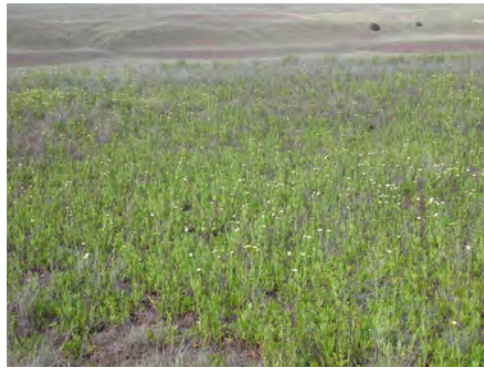
The fact that most of our worst animal and weed pests come from other continents is no coincidence. Biological invasions are fundamentally a biogeographic phenomenon. That is to say, there is something rather significant about taking an organism from a specific evolutionary history and ecological context and casting it into an entirely new

environment that can profoundly change ecological interactions. This fact has been largely ignored over much of the history of research on exotic species invasions; most of this research is done in the invaded range, and some in the native range, but very little involves comparative work in both ranges. No doubt, some of this oversight is due to the grand challenges associated with studying species at global scales. Nonetheless, this constraint has greatly hindered understandings in invasion biology and applications of weed management. How can we manage a species if we do not know why it is invasive?

To address this fundamental question, RMRS researchers have initiated a collaboration with Ozkan Eren, a professor at Adnan Menderes Universitesi in Aydin, Turkey, which is part of the native range for many plant invaders in Montana, and Jose Hierro, a professor at La Universidad Nacional de La Pampa Santa Rosa, Argentina, another system invaded by exotics from Eurasia. This team is conducting plant surveys and experiments over large regions in each of these countries to examine how over 34 species of exotic plants change in abundance between native and invaded ranges and to try to relate these changes in

abundance to processes such as disturbance and natural enemies to better understand causes of invasion.

Additional comparisons between the two invaded ranges in Montana and Argentina are interesting because central Argentina's grasslands are superficially similar to Montana's Intermountain grasslands yet appear much more resistant to invasion. These studies are in their early stages but are already generating powerful data sets that are allowing the researchers to empirically rank invader impacts using on-the-ground data and relate invasiveness to underlying processes such as enemy release and competitive release. The expectation is that this new information will help to better prioritize weeds for management based on their real-world threat and refine and better integrate pest management strategies for each species.



Sulfur cinquefoil (*Potentilla recta*) is increasingly invasive in its introduced range in Western Montana (**left**) where surveys rank it as one of the top invaders in west-central Montana. However, this species is much less common in Turkey where it tends to occur as populations of a few scattered plants such as this roadside population (**right**). However, other invaders such as cheatgrass (*Bromus tectorum*) can be quite common in disturbed areas of the native range.



How will climate change affect invasive plants and their management?

By: Justin Runyon (jrunyon@fs.fed.us),* Research Entomologist, Bozeman, MT | Megan Friggens,* Ecologist, Albuquerque, NM | Jack Butler,* Research Ecologist, Rapid City, SD | Jeanne Chambers,* Research Ecologist, Reno, NV | Susan Meyer,* Research Ecologist, Provo, UT | Stanley Kitchen,* Research Botanist, Provo, UT | Sharlene Sing,* Research Entomologist, Bozeman, MT | Marcus Warwell,** Geneticist, Moscow, ID

*RMRS Grassland, Shrubland, and Desert Ecosystems Program

**RMRS Forest and Woodland Ecosystems Program

A suite of RMRS scientists recently contributed to research that is assessing our knowledge of how climate change could affect invasive plants and the tools used to manage them. These reports (see Friggens and others 2012 and Runyon and others 2012 in the Recent Publications section for full citations) were part of a larger document summarizing climate change research and potential effects on grasslands, shrublands, and desert ecosystems. The take-home message is that climate change is predicted to have potentially profound effects on invasive plants, but we simply don't know enough to predict and adequately prepare for these changes. Findings include:

- Climate change could convert nonnative plants considered benign today into the noxious weeds of tomorrow, but we lack the knowledge to predict which species might be favored.
- Climate change can affect the distribution of current weeds. For example, cheatgrass (*Bromus tectorum*) is predicted to move northward with increased risk in Idaho, Montana, and Wyoming but reduced risk in Southern Nevada and Utah. Spotted knapweed (*Centaurea stoebe*) is expected to expand into new areas of California and Nevada and invade higher elevations in interior states (e.g., Montana, Wyoming, Colorado, and Utah).
- Biological control is a powerful tool, but climate change could alter its effectiveness by disrupting synchrony between biocontrol insects and their invasive host plants.
- Climate-induced changes in plant-insect interactions could also impact biocontrol. For example, there is evidence that biocontrol insects might eat more as carbon dioxide levels increase, and eating more of invasive plants could be a good thing and might improve our ability to control them. But there's also evidence that weeds could grow larger, so we don't understand enough to be sure what will happen.

These publications highlight how little we know about how climate change will impact invasive plants and their management. Research is needed so we can better predict changes and keep pace with and limit the damage caused by invasive species.

