

Herbicides in Wildlands

What do we really know about their effects?

The wording of this article has been adjusted to a 7-8th grade reading level. Andrea Barbknecht of the Wyoming Wildlife Federation made the revisions as part of the organization's curricula to engage kids in exploring their Wyoming landscape.

The original article, written by Lauren Dunn for Western Confluence magazine, can be found [here](#).

By Lauren Dunn (May 2020)

Cara Nelson hiked around Missoula's foothills. She noticed abundant knapweed and cheatgrass growing among native bunchgrasses and flowers. Cara is a researcher and professor of ecosystem science and **restoration** at the University of Montana. She is interested in studying approaches to controlling invasive plants. One of the most common techniques is to spray **herbicides** on invasive weeds and plant **native** seeds afterwards. This spraying and replanting didn't seem to be keeping the weeds under control, though. Seeing this, Nelson began by looking at previous research on the effectiveness and effects of herbicides on wildlands. She was surprised to not find much scientific information on the effects of herbicides on complex ecosystems.

Managers want to make decisions based on evidence. They need to understand more about how herbicides impact native plant and soil communities. Nelson decided to work with land managers on scientific studies to increase knowledge on this topic.



A double rainbow lights up the sky over the foothills surrounding Missoula, Montana, where nonnative weeds grow amidst native bunchgrasses and wildflowers.

Herbicides are chemicals designed to kill unwanted plants. They were originally developed for crops. They interrupt normal plant growth in a variety of ways. They can be classified as selective or non-selective. Selective herbicides kill only one kind of plants, like grasses or broadleaf plants. Non-selective herbicides kill all of the plants they come in contact with. This includes both desirable and undesirable plants. The herbicide glyphosate is the one most common used on wildlands, including forests, grasslands, and shrublands. Glyphosate is popular because it spreads quickly through plants, is inexpensive, and breaks down quickly. Regulators have concluded that glyphosate is low risk to

wildlife, but research has also shown it can cause cancer.

Agencies at the federal, state, or county level can label a weed noxious. Noxious is defined as “injurious to public health, agriculture, wildlife, or property.” National policies then require public land managers to control noxious plants. Herbicides are a common method, even in wildlands. For example, the National Park Service sprays herbicide to meet the goal of maintaining historic ecosystem functions. Other agencies spray **rangelands**, areas with a lot of traffic and potential for spread like roads, and areas burned by wildfires.

Herbicides are useful, but there are unwanted side effects. Herbicides kill both native and invasive plants. Spraying can also open the door for even more invasive species. For example, when managers spray and kill knapweed, cheatgrass may take advantage and come in. This can happen even after native seeds are planted. Herbicides can also affect soil, water, and even human health. These hazards are not fully understood. Nelson saw a need to gain a better understanding of how herbicides affect wildlands.

“Walking around Mount Sentinel, you can see areas that were sprayed for knapweed [that] now have cheatgrass,” Nelson explains. Nelson adds that herbicides can be effective at controlling invasive plants. However, in many areas weeds still survive after spraying. Nelson explains that planting native seed helps prevent weeds from coming back, but there is a knowledge gap on how best to replant.



Cara Nelson, a researcher and professor of ecosystem science and restoration at the University of Montana, studies the effectiveness of herbicide spraying and approaches to control invasive plants. (Photo by Linda Thompson/The Missoulian.)

She wondered how effective it was to put seeds on soils that had been recently sprayed. To study this, Nelson and her Restoration Ecology Lab partnered with Morgan Valliant at Missoula County Parks and Recreation. The first study was led by Viktoria Wagner. She found that planting seeds immediately after spraying prevented the seeds of native grasses and leafy plants from germinating. A second study led by Christine McManamen showed that the effects of herbicides lasted a long time. The herbicides reduced seed germination up to a year after spraying. Seeds of some species were more sensitive to herbicides than others. Findings suggest the need to find a balance. Planting too soon will result in poor **germination** but planting too late will allow invasive weeds to come back. These findings were published in the journal *Restoration Ecology* in 2014 and 2018.

Before the research on seeds, Nelson and Wagner collaborated with Canadian researchers and land managers. They were looking for knowledge about the extent and

effects of herbicide spraying across public lands in North America. When they reviewed scientific literature, they found that most research was on the effects of herbicides on crops, not on native plants or soil organisms. The researchers found 40 publications on glyphosate and far fewer on less common herbicides. “That is very low considering how much we use these,” Nelson explains. In addition to few articles, Nelson and her team found study design flaws in more than half the published studies. The research did not stop there.

Nelson and Wagner focused on herbicide use in the United States. They attempted to collect data from seven federal agencies that spray herbicides on wildlands. They found that some agencies did not record herbicide use. Only five agencies recorded herbicide use on federal lands. Of those, only four—the Bureau of Indian Affairs, Bureau of Land Management, Fish and Wildlife Service, and National Park Service—agreed to share their data. The Forest Service did not share their data because they did not know if it was accurate.

Nelson and Wagner’s research showed that the agencies sprayed herbicides on 2.5 million acres of public wildlands between 2007 and 2011. In 2010 alone, managers

sprayed at least 1.2 million acres with over 220 tons of herbicide. That is an area the size of Delaware and enough herbicide to fill two train cars. In 2017, the researchers published their findings in the *Journal of Applied Ecology*.

Nelson’s findings about the amount of herbicides sprayed and the lack of knowledge about their effects show the need for further science. This will help managers better understand and control invasive species on wildlands. Nelson suggests that managers “focus on the ecosystem as a whole rather than a narrow goal such as removing a weed.” She proposes when managers do spray herbicides, they should include monitoring programs. Managers can compare herbicide effects using control and treated sites. Nelson explains that there is enough money for monitoring, but it often fails due to poor experimental design. Effective monitoring needs a plan for how data will be analyzed, stored, and shared. The plan needs to be in place before herbicide treatments. This is the foundation of evidence-based management. It requires systems to be in place to reach broad goals. “When we manage for ecosystems, we have to manage that complexity,” Nelson says.

Glossary

Restoration Bringing an ecosystem back to a functional state after a disturbance

Herbicide A chemical that kills plants

Native A species that normally lives and thrives in a particular ecosystem

Rangeland Open country used for grazing or hunting animals

Germination When a seed starts to grow and puts out sprouts