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Working Papers in Southwestern
Ponderosa Pine Forest Restoration

# Controlling Invasive Species as Part of Restoration Treatments

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## Working Papers in Southwestern Ponderosa Pine Forest Restoration

The Ecological Restoration Institute at Northern Arizona University is a pioneer in researching, implementing, and monitoring ecological restoration of southwestern ponderosa pine forests. These forests have been significantly altered through more than a century of fire suppression, livestock grazing, logging, and other ecosystem changes. As a result, ecological and recreational values of these forests have decreased, while the threat of large-scale fires has increased dramatically. The ERI is helping to restore these forests in collaboration with numerous public agencies. By allowing natural processes such as fire to resume self-sustaining patterns, we hope to reestablish healthy forests that provide ecosystem services, wildlife habitat, and recreational opportunities.

Every restoration project needs to be site specific, but the detailed experience of field practitioners may help guide practitioners elsewhere. The Working Papers series presents findings and management recommendations from research and observations by the ERI and its partner organizations.

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**1: Restoring the Uinkaret Mountains: Operational Lessons and Adaptive Management Practices**

**2: Understory Plant Community Restoration in the Uinkaret Mountains, Arizona**

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## Introduction

Thinning, prescribed fire, and other treatments can restore ecological integrity in southwestern ponderosa pine forests that are at risk of unnaturally severe crown fires and bark beetle outbreaks. Such treatments can promote the survival and recruitment of native plant and animal species, but they also represent a significant disturbance that can allow invasive plants to spread. Invasive plants are a serious threat to the biological integrity of lands in western North America and elsewhere. Mitigating their impact must be a high priority during the planning and implementation of restoration treatments. This publication presents an overview of methods to prevent and control their spread.

## Why Are Invasive, Exotic Plants Harmful?

Invasive plants, many of them imported from other regions, can cause significant ecological and economic problems (Olson 1999). Invasive plants are generally considered those vigorous, persistent, prolific, and widespread enough to cause serious economic and environmental impacts (Vitousek et al. 1996; Novak and Mack 2001). The spread of these species can cause harmful ecological effects at a number of levels:

- At the **soil** level, they can cause changes in soil organic matter, microbial activity, salinity, and nitrogen availability.
- At the **plant** community level, invasives tend to be early successional species that reproduce rapidly and absorb nutrients rapidly. As a result, they can spread rapidly and outcompete much native vegetation. In some cases invasive species change basic ecological processes such as fire regimes.
- At the **animal** level, native animal species often cannot use nonnative plants for food or shelter. In ecosystems dominated by invasive species native soil organisms, plants, and animals often do not, and cannot, function viably in the long term.

## Invasive Plants and Forest Restoration

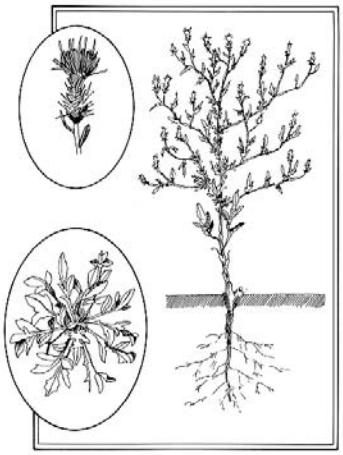


Most invasive exotic plant species prefer disturbed areas for colonization (Sheley et al. 1999). For this reason, restoration sites are a highly suitable place for invasive plant migration and proliferation. Severe soil disturbances, including those caused by restoration thinning and by prescribed fire, may provide an ideal colonization site for these opportunistic species (Sieg et al. 2003) and result in profound changes in understory vegetation.

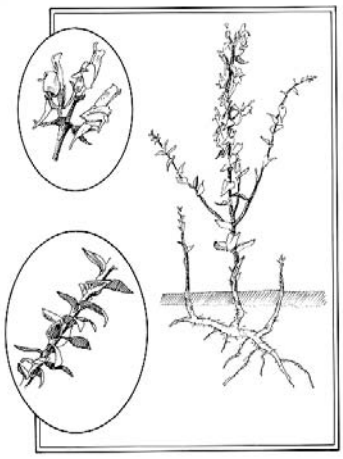
Leaving forests untreated, though, is not an effective means of dealing with invasive species. Severe wildfires, such as those that have occurred in many overly dense southwestern ponderosa pine forests, can promote the spread of many invasive exotic species (Crawford et al. 2001). When carefully planned and implemented, restoration treatments that prevent severe fires can help prevent their spread.

## Species of Concern

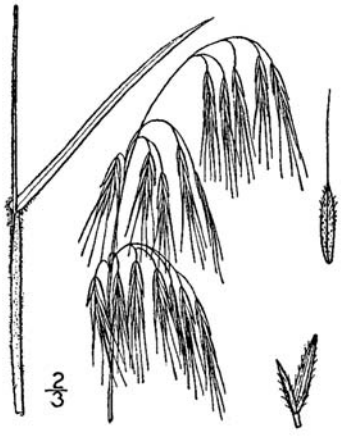
Learning to identify invasive plant species is a primary step in minimizing their threat at a restoration site. Seig et al. (2003) provide a comprehensive list of invasive exotic species found within southwestern ponderosa pine ecosystems. In addition, numerous books and Web sites are also available with pictures and tools for identification—see the inside back cover for links. Diffuse knapweed (*Centaurea diffusa*), cheatgrass (*Bromus tectorum*), and Dalmatian toadflax (*Linaria dalmatica*) are three of the troublesome invasive exotics commonly found in southwestern forests (illustration).



**Diffuse knapweed**
(***Centaurea diffusa***)



**Dalmatian toadflax**
(***Linaria dalmatica***)



**cheatgrass**
(***Bromus tectorum***)

## Preventing the Spread of Invasive Plants During Restoration Treatments

It may be impossible to avoid the colonization of invasive, exotic plant species at a restoration site. However, by paying attention to the following precautions, their distribution and abundance can be minimized.

**Research the land-use history of the restoration site**. Concentrations of invasive seeds may be present within the seed bank at sites where disturbances such as construction, road building, seeding, livestock grazing, and logging occurred in the past. Present-day disturbance in these locations could encourage their emergence from the soil seed bank (Korb et al. in review).

**Take a plant inventory before work begins**. The planning process for restoration thinning or prescribed burning should include an inventory of existing plant species located on and near the restoration site. Where possible, areas heavily infested with invasives should not undergo restoration treatments until the infestations have been controlled (Sieg et al. 2003).

**Prioritize**. Where invasive exotics are present on part of a site, thin and burn areas without infestations first, and control existing populations of invasives—otherwise invasives will spread into areas that are currently weed-free. Ensure that heavily trafficked sites, such as roads, staging areas, and log landings, have no invasives present.

**Control invasives before work begins on the ground**. If invasives are present in only small numbers in or around the restoration site, it may be feasible and is certainly advisable to eradicate them before any restoration work begins. A little bit of control before any soil disturbance occurs can avert the need to do a lot of control later on.

**Don't transfer seeds to the restoration site**. The seeds of many invasive species are easily carried by vehicles, field workers, and animals. Avoid their spread by washing the undercarriage of field vehicles; avoiding carrying mud on vehicles; and having field workers wear gaiters when walking through areas infested with invasive species. Use certified weed-free hay for horses.

**Minimize soil disturbance during restoration logging**. Do so by limiting the extent of the area traveled by vehicles and by not working when soils are too wet. Read more about this in *Working Paper 5: Limiting Damage to Forest Soils During Restoration.*

**Leave some slash broadcast on the ground**. By holding moisture in the soil and collecting seeds, broadcast slash can create a favorable microclimate for native grasses and other understory plants. Leaves, needles, and wood also provide nutrients to the soil as they decompose.

**Minimize severity of slash pile fires**. It is best to burn slash piles with low-intensity, short-duration fires. High-intensity burning of slash piles can occur when piles are very large or conditions are dry; it can cause the loss of seeds and microscopic plants and animals within the soil, reducing the chances that native plants will naturally colonize the site (Korb and Springer 2003). Excessive soil heating can also lead to a loss in nutrients.

**Don't rely on fire to control invasive exotics**. Burning may control or even eradicate a few nonnative plants, but most invasive species commonly found in the Southwest cannot be eliminated with fire. For example, cheatgrass densities may be minimized by burning, but fire will stimulate the remaining plants to produce more seeds than normal (Mosley et al. 1999).

**Promote the growth of native species**. Many invasive exotic species do well in areas of high disturbance. Restoration sites with a thriving native vegetative community will offer only limited colonization opportunities for invasives. Seeding with fast-growing native species such as squirreltail (*Elymus elymoides*) or penstemon species may slow the spread of invasive exotics.

**Use weed-free seed when reseeding after treatment**. Native plant seed that is certified weed-free is often more expensive than noncertified seed, but the extra expense is well worth it.

**Monitor**. The prevention of colonization by invasive exotic plants does not end when on-the-ground restoration activities are complete. Monitoring after treatment is vital and should be done annually. Include intermediate targets, rather than only end targets, in order to ensure that restoration objectives are being met along the way (Fulé 2003). For ideas on monitoring methods, see Fulé 2003.

### Specific Questions to Ask During Restoration Planning

1. What plants, native and nonnative, currently exist at and near the restoration site?
2. How invasive are the nonnative species? Which are the highest priorities?
3. What means are readily available for control of invasive exotic plants, both before and after restoration treatments?
4. How will the introduction of invasive exotics be avoided during on-the-ground restoration activities?
5. How, and for how long, will the restoration site be monitored after treatment to ensure that invasive exotics have not colonized?

## Removing Invasive Species After Treatment

Regardless of the best efforts at prevention, some nonnative species likely will appear following restoration treatments. Some are more a problem than others. For example, common mullein (*Verbascum thapsus*) has invaded many restoration sites in the Flagstaff area shortly after treatment. It tends to be replaced during the course of successional changes within a few years (Sieg et al. 2003), although viable seeds may remain plentiful in the soil seed bank. Other more aggressive species may persist and spread unless managed.

**Remove small infestations immediately**. It is much easier to remove invasive plant infestations when they are small. A few hours spent dealing with weeds soon after thinning or burning, and before plants reach the reproductive stage, can avert larger infestations later.

**Pull weeds**. Some species can be controlled through manual and mechanical means such as pulling, mulching, or even burning. Be aware that these techniques can expand the problem for some species that produce additional stems when cut or pulled. See Web sites on inside back cover or consult local experts for specific techniques. Any plants that have already produced seeds should be double-bagged and either incinerated or sent to a properly managed landfill to prevent further spread.

**Consider using herbicides if necessary**. Herbicides are not appropriate for all situations, but they can be highly effective in controlling some invasive exotics, particularly if other control methods have failed. A variety of ecological, regulatory, and social concerns must be weighed and considered before utilizing herbicides; proper training is also essential.

**Focus on specific species**. Methods for removing invasive exotic plants vary depending on site conditions and on which species are present. What works in controlling one species may not work against another.

**Get help**. Local county extension offices and the Forest Service can often provide accurate and up-to-date information regarding effective eradication strategies for a given species. The Web sites listed on the inside back cover also provide resources.

**Take advantage of volunteer energy**. Volunteer groups can furnish labor for weed monitoring and control efforts. Existing groups such as Boy and Girl Scout troops, Audubon societies, high school or college clubs, service societies, and others can get a great deal of work done during volunteer weed-pulling outings.

## References


Crawford, J. A., C.-H. A. Wahren, S. Kyle, and W. H. Moir. 2001. Responses of exotic species to fires in *Pinus ponderosa* forests in northern Arizona. *Journal of Vegetation Science* 12:261–268.

Fulé, P. Z. 2003. Monitoring. Pp. 402–416 in *Ecological restoration of southwestern ponderosa pine forests*, ed. P. Friederici. Washington, D.C.: Island Press.

Korb, J. E., and J. D. Springer. 2003. Understory vegetation. Pp. 233–250 in *Ecological restoration of southwestern ponderosa pine forests*, ed. P. Friederici. Washington, D.C.: Island Press.

Korb, J. E., J. D. Springer, S. R. Powers, and M. M. Moore. In review. Soil seed banks in southwestern ponderosa pine forests: Clues to site history and vegetation restoration potential.





Mosley, J. C., S. C. Bunting, and M. E. Manoukian. 1999. Cheatgrass. Pp. 175–188 in *Biology and management of noxious rangeland weeds*, ed. R. L. Sheley and J. K. Petroff. Corvallis: Oregon State University Press.

Novak, S. J., and R. N. Mack. 2001. Tracing plant introduction and spread: Genetic evidence from *Bromus tectorum* (cheatgrass). *BioScience* 51:114–122.

Olson, B. E. 1999. Impacts of noxious weeds on ecological and economic systems. Pp. 4–18 in *Biology and management of noxious rangeland weeds*, ed. R. L. Sheley and J. K. Petroff. Corvallis: Oregon State University Press.

Sheley, R. L., S. Kedzie-Webb, and B. D. Maxwell. 1999. Integrated weed management on rangelands. Pp. 57–68 in *Biology and management of noxious rangeland weeds*, ed. R. L. Sheley and J. K. Petroff. Corvallis: Oregon State University Press.

Sieg, C. H., B. G. Phillips, and L. P. Moser. 2003. Exotic invasive plants. Pp. 251–267 in *Ecological restoration of southwestern ponderosa pine forests*, ed. P. Friederici. Washington, D.C.: Island Press.

Vitousek, P. M., C. M. D'Antonio, L. L. Loop, and R. Westbrooks. 1996. Biological invasions as global environmental change. *American Scientist* 84:468–478.

## Additional Resources

In addition to the references above, the following books and Web sites can provide more information about invasive species and their control.

Sheley, R. L., and J. K. Petroff, eds. 1999. *Biology and management of noxious rangeland weeds.* Corvallis: Oregon State University Press.

Whitson, T. D., ed. 1996. *Weeds of the West.* Laramie: University of Wyoming and Western Society of Weed Science.

**plants.usda.gov**
**www.invasivespecies.gov**
**www.weedcenter.org**
**www.ams.usda.gov/lsg/seed/seed_pub.htm**
**www.usgs.nau.edu/SWEPIC/**
**ag.arizona.edu/agnic/az/weeds/home.html**

## For More Information

For more information about forest restoration, contact the ERI at 928-523-7182 or **www.eri.nau.edu**.

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Cover: Cheatgrass is one of the troublesome invasive species in southwestern ponderosa pine forest restoration projects. Photo courtesy of Ken Henke and Bureau of Land Management Wyoming Office.

Cheatgrass drawing courtesy of USDA PLANTS Database


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