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Inside this Issue:

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Bird Community Changes after Pinyon-Juniper Treatments

Since the 1850s, junipers and pinyon pine in the intermountain west have expanded – in some places up to 600 percent beyond their historic range. This slow encroachment has ecological consequences for more than just plant communities. Some bird species, especially sagebrush obligates (greater sage-grouse, Brewer's sparrow, sagebrush sparrow, and sage thrasher), experience population decline when conifers expand. Managers use prescribed fire and mechanical treatments to reduce or eliminate conifers, to restore plant communities and to improve habitat quality for greater sage-grouse – but, until recently, there has been little research on what actually happens to birds during the transition after woodland treatment. Most information on bird community response to habitat change in these systems has come from short-term surveys conducted after a disturbance like wildfire. Those studies lacked pre-treatment baselines or were done in locations that had especially intensive habitat changes.

In research published in 2017, Steven Knick, Steven Hanser and others reported on a survey of bird and vegetation measurements initiated several years before treatment and continuing for seven years after treatment at SageSTEP sites. They looked at sagebrush-obligate passerine (perching) birds in 13 locations where prescribed fire and mechanical methods were used to remove pinyon and juniper trees in Oregon, California, Idaho, Nevada, and Utah. (While the authors did not directly study sage-grouse populations, the habitat needs of sagebrush-obligate birds are sufficiently similar so the findings of this study can be used to infer potential effects on sage-grouse.) The study was designed to understand how measured bird species were influenced by the bird community that existed before the disturbance, to find out more about how species were influenced by transitioning habitat conditions, and to discover how broad-scale dynamics of bird populations might influence site-specific observations. They also wanted to understand how regional dynamics of bird populations might moderate local observations after site-specific treatments.

What they found was a tight correlation between the population makeup of the pre-treatment bird community and that occurring at a site seven years later. This suggests a greater stability in avian communities in treated pinyon-juniper woodlands over time than anticipated.

"Managers sometimes conduct treatments in woodlands and expect a response from sagebrush-obligate birds in two or three years," said Hanser. "However, getting a desired bird response is not just about creating a certain vegetation structure, but also having a nearby populations, and the speed

Figure 1. Because sagebrush obligate birds, like this sage thrasher, are extremely sensitive to even a few standing trees in their landscape, patches of live trees and scattered tree skeletons left after prescribed fire could still make an area feel unwelcoming.

of transition in the environmental conditions as the treated vegetation changes over time."

These days, management treatments are designed to reverse conifer expansion and restore habitat for sagebrush-obligate wildlife. The scope and cost of these efforts are enormous, but the effectiveness of these actions to create habitat for sagebrush-obligate birds depends on size of the treatment, completeness of woodland removal, and location of bird populations relative to existing sagebrush. The question then is: how large and intense a change in habitat is enough to shift bird communities?

The past management focus on pinyon-juniper has been almost exclusively directed toward prescribed fire to reduce woodland density over broad areas and to reduce the risk of large-scale stand-replacement fires. But prescribed fire in this case is unlikely to effect a major change in the bird community, at least in the short-term. Fires are patchy, leaving both live and standing dead trees across the burned landscape. Because shrubland birds are extremely sensitive to even a few standing trees in their landscape, those live tree patches and scattered tree skeletons still make an area feel unwelcoming.

On the other hand, mechanical thinning that eliminates trees from large areas (>300 ha blocks) in southern Utah and near existing sagebrush landscapes result in larger changes in the bird community and colonization by sagebrush-obligate birds. This is because mechanical treatments eliminate *all* standing stems, which makes the landscape more acceptable to sagebrush-obligate birds. In addition, the likelihood of converting a site from woodland into a grassland or sagebrush system occurs over significant time and when in proximity to sagebrush-obligate bird strongholds. For example, a mechanical treatment that removed all stems and was applied to a pinyon-juniper woodland that was directly adjacent to a healthy sagebrush steppe system had a better chance of attracting sagebrush-obligate birds.

Finally, from the perspective of the bird community, the difference between woodland and shrubland likely increases nonlinearly with the later successional phases of woodland development, requiring progressively stronger impacts to create shifts in the bird community. Therefore, if managers set out to create suitable habitat for sagebrush-obligate bird species in well-established woodlands (Phase III), the intensity of disturbance required for change may be too great to justify the benefits to the avian population, especially in the short-term. Creating habitat for sagebrush-obligates will necessarily reduce habitat for bird species that prefer denser woodlands. And other species prefer early seral stage Pinyon-Juniper (ecosystems in sites after a stand-replacement disturbance and before re-establishment of a closed forest canopy). Consideration of the larger landscape may improve the overall long-term effectiveness of treatments, so that there remains habitat for different bird communities of all types.

Figure 2. Although the authors of this research did not directly study sage grouse populations, the habitat needs of sage-obligate birds are sufficiently similar so that the findings of this study can be used to infer potential effects on sage grouse.

For treatments to create a shift in bird communities from woodland species to sagebrush/grassland species, it's necessary to have both a nearby source of sagebrush/grassland birds to colonize the new site, and thorough removal of standing woody material over a large enough area that the habitat is attractive to sagebrush-obligate birds. This may explain why some treatments have been less effective than others for supporting bird populations. This research suggests that removing Phase I juniper is more likely to be effective than removing Phase III – partly because there's still sagebrush and grass in the site but also because the site was likely more recently occupied by sagebrush-obligates.

Dr. Steven Knick is a research ecologist retired from the Forest and Rangeland Ecosystem Science Center at the Snake River Field Station.

Dr. Steven Hanser is a landscape ecologist with the USGS Forest and Rangeland Ecosystem Science Center.

Using Predictive Modeling Tools to Improve Timing of Seeding Treatments

Researchers at BYU used SageSTEP soil moisture and temperature data to develop a tool that predicts germination in the sagebrush steppe and shows how some species are more likely to experience premature germination when sown in the fall – a step toward better rangeland seeding practices.

Figure 1. Seeding treatments in the sagebrush-steppe typically occur in the fall, with the expectation that seeds will remain dormant over winter and germinate in spring. But planting too early in the year can result in early germination and mortality over winter. Understanding appropriate seeding dates could prevent premature germination and subsequent winter mortality – and ultimately improve the success of restoration projects.

Matt Madsen knows that getting seeds to grow in sagebrush-steppe can be tricky. Timing of germination strongly impacts whether or not seeds eventually survive – and timing depends on multiple factors including exposure to pathogens, available nutrients, soil moisture, temperature, light, and herbivory. Managers could leverage these factors to make seeding efforts more successful, but tracking of seed germination in the field is difficult and time consuming – and produces limited useful information anyway, since short-term studies can't take into account high annual variability in weather.

Seeding treatments in the sagebrush-steppe typically occur in the fall, with the expectation that seeds will remain dormant over winter and germinate in spring, said Madsen, assistant professor of Plant and Wildlife Sciences at Brigham Young University. But planting too early in the year can result in early germination and mortality over winter. Understanding appropriate seeding dates could prevent premature germination and subsequent winter mortality – and ultimately improve the success of restoration projects.

Understanding germination characteristics of individual species may help guide land managers in their restoration efforts. For example, planting sagebrush (*Artemisia tridentata*) in mid-October is late enough to avoid winter germination on average; but species like bluebunch wheatgrass (*Pseudoroegeneria spicata*) germinate more quickly, and need to be planted in mid-December to avoid high rates of germination over the winter. To complicate things further, seeding plans carefully developed for one site do not necessarily translate to other sites or years with different soil temperature and moisture regimes.

To help managers improve the success of their seeding efforts, researchers like Madsen have turned to predictive germination models. These use the natural processes within seeds that regulate germination timing (mostly a function of temperature and moisture for non-dormant seeds). Researchers have learned to predict germination of cool-season species through wet-thermal accumulation models, which predict the rate that seeds will germinate in the field based on soil temperature when soil moisture is above set threshold. They've found that wet-thermal accumulation models are fairly accurate at predicting seed germination timing in the field. But even with this model, large amounts of data and processing are needed to develop accurate estimates.

Now that process can be easier. To make models more usable for managers, Madsen and coauthors created a programmed workbook called Auto-Germ which allows users to process seed germination data and predict germination timing in the field. It helps

users create wet thermal accumulation models from laboratory germination trials conducted over a range of temperatures. Auto-Germ gives users an interface to apply the wet-thermal accumulation models to historic field soil moisture and temperature data sets to estimate seed germination timing.

This information can help managers know how planting dates may influence germination and subsequent chances for viability based on growing conditions. Research published in 2018 provides instructions on how to use Auto-Germ. It uses a case study to calculate various germination indices under different constant temperatures on species commonly used for restoration projects in the Great Basin. It also calculates germination timing for six years across ten sites to estimate the planting date required for 50% or more of the simulated population of seeds to germinate in spring when conditions could be more conducive for plant establishment.

Based on their results, Madsen anticipates that Auto-Germ will be applicable to non-dormant seeds of most species. Both land managers and researchers could benefit from this program, which provides them with a better understanding of how seeds may respond to a site's unique soil temperature and moisture regimes.

You can access the Auto-Germ Program, and the case study research by following these links.

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