

Science

FINDINGS

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issue ninety one / march 2007

“Science affects the way we think together.”

Lewis Thomas

SAGEBRUSH IN WESTERN NORTH AMERICA: HABITATS AND SPECIES IN JEOPARDY



M. Wisdom

The sagebrush ecosystem is one of the largest ecosystems in the United States. It is also considered highly imperiled.

*“Peel the outer skin, and surprises
lurk beneath first impressions.
The landscape reveals itself...
The Great Basin reminds us
to take nothing for granted.”*

—Stephen Trimble, *The Sagebrush Ocean*

One of the largest ecosystems in the United States is suffering a death by a thousand cuts. Although it may be hard to imagine, we are witnessing the collapse of the American sagebrush ecosystem. Invasive species, overgrazing, fire suppression, and many other insults have combined to bring this habitat to its knees. Now, hundreds of species are imperiled, and only the most dedicated campaign of conservation and restoration can secure their future.

Sagebrush ecosystems once encompassed up to 150 million acres—virtually half of the American West. They were home to sage grouse, pronghorn, and collared lizards. In the past century, this ocean of sagebrush was degraded from all sides and much of it transformed into rangelands, whose primary utility was livestock grazing. And alas, sagebrush isn't palatable to cows.

It wasn't until the 1980s that attitudes toward sagebrush really started to change. Before then, it was routinely “improved,” meaning: dug up, chained, burned, or sprayed with herbicides to make room for better cattle forage—crested wheatgrass, usually. Just about the same time that sagebrush was being reconsidered as a valuable native species as opposed to a weed, it was also discovered that intact sagebrush habitats were disappearing fast, and reversing their decline would be a Herculean task.

IN SUMMARY

Sagebrush habitats are declining rapidly across western North America, with over 350 associated plant and animal species at risk of local or regional extirpation. The sagebrush ecosystem is one of the largest in the United States, and it is vulnerable to a litany of threats. Chief among them is invasion of cheatgrass into the understory, followed by high-severity fires that cheatgrass promotes. The expansion of pinyon-juniper woodlands into sagebrush habitat and other human impacts, such as overgrazing by livestock and energy development, are also major sources of concern.

Regional studies of sagebrush habitats during the 1990s and 2000s conducted in the interior Columbia Basin, the Great Basin, and the Wyoming Basins have identified areas with high potential for conservation and restoration, as well as those areas most vulnerable to degradation. The resulting maps and analyses have provided scientists with new methods of landscape analysis and provided managers with information for conserving and restoring sagebrush habitats and species. The analyses have also examined the efficacy of sage grouse as an “umbrella species” for the conservation of other sagebrush-associated species. Findings suggest that although some species would benefit from this approach, many would not.

“The ills of the sagebrush ecosystem are well documented,” says Michael Wisdom, a wildlife biologist at the PNW Research Station in La Grande, Oregon. “It is considered to be one of the most imperiled of all ecosystems in the United States. Millions of acres have been converted to agriculture, cities, roads, energy developments, exotic plants, and woodlands. Worse yet, management intervention has been ineffective at even abating the loss, let alone reversing it.”

“Even though you can see sagebrush everywhere,” says Mary Rowland, a wildlife biologist, also based at the Station’s La Grande Lab, “less than 10 percent of the remaining habitat is unspoiled, in terms of historical structure and composition. As a result, more than 350 plant and animal species are at risk of local or regional extirpation.”

Working right in the heart of sagebrush country, Wisdom and Rowland for the past 10 years, have been investigating the decline of sagebrush habitat and species. They have collaborated on several major landscape analyses including the Interior Columbia Basin Ecosystem Management Project, the Great Basin Ecoregional Assessment, and the Wyoming Basins Ecoregional Assessment. These projects have transformed perspectives regarding sagebrush habitat and have provided managers with information for conserving and restoring sagebrush.



M. Rowland

A variety of land uses and undesirable processes pose a threat to sagebrush habitats and species of concern.

| KEY FINDINGS | |
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| <ul style="list-style-type: none"> • More than 10 million acres of existing sagebrush habitat in the Great Basin are at moderate or high risk of displacement by cheatgrass. More than 2 million acres of existing sagebrush in eastern Nevada and western Utah are at moderate or high risk of displacement by pinyon-juniper woodlands. | |
| <ul style="list-style-type: none"> • Moderate to strong habitat declines for sagebrush-associated species have been documented for nearly half of the watersheds in the interior Columbia Basin. Declines are associated with grazing, invasion of exotic plants, altered fire regimes, and conversion to agriculture. | |
| <ul style="list-style-type: none"> • Despite declining habitat trends for many sagebrush species, potential exists to conserve and restore native sagebrush where large-scale loss and degradation have not yet occurred. Intensive management practices, however, are needed for sufficient restoration in many areas. | |

The approach taken by Wisdom, Rowland, and their colleagues has involved broad-scale modeling of environmental conditions on both public and private lands. Sophisticated vegetation simulation models designed to run on millions of acres, and literally hundreds of state-and-transition models, were used to assess past and current conditions, and to predict effects of future land management scenarios on sagebrush and grassland-associated vertebrates in the interior Columbia Basin.

“The first time anybody really looked at this ecosystem—about 15 years ago in the interior Columbia Basin—it was clear that the status and trends of species in sagebrush habitat mirrored those of other species in other ecosystems that were already listed as threatened or endangered. This sparked a widespread change in research and management thinking about the ecosystem’s status, particularly because conditions were not predicted to improve,” says Rowland.

HIT FROM ABOVE AND BELOW

If you had to pick just one, cheatgrass invasion is perhaps the greatest threat to sagebrush habitat. A scourge to land managers, this exotic annual grass has been reshaping the West since the late 1870s, when it arrived from Eurasia. The name cheatgrass is a reference to its life history strategy, which uses a headstart early in the spring, thereby outcompeting native grasses for needed water and nutrients, and “cheating” livestock out of valuable forage.

“Cheatgrass can live out its entire life cycle in just a few weeks in spring,” says Wisdom. “After that, it’s useless as forage and becomes a dangerous fuel-bed for wildfire. By mid-summer, it is tinder waiting to fuel a high-severity fire, which can kill the overstory sagebrush and clears the way for more cheatgrass in following years.”

Cheatgrass perpetuates itself through fire. Many native species of sagebrush, forbs, and bunchgrasses are not adapted to frequent,

intense fire. Cheatgrass exploits that characteristic to get the competition out of the way. It then relies on its tremendous seed production to fill in the gaps, eventually creating monocultures of cheatgrass.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
 USDA Forest Service
 P.O. Box 3890
 Portland, Oregon 97208
 (503) 808-2137

Send new subscriptions and change of address information to pnw_pnwpubs@fs.fed.us

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Science Findings is online at: <http://www.fs.fed.us/pnw/>

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“Once an area has succumbed to dense cheatgrass invasion, there isn’t much you can do,” says Rowland. “People have tried restoration on small scales, but once a threshold is crossed, restoration is nearly impossible without tremendous inputs.”

From their landscape assessments in the Great Basin, Wisdom and Rowland estimate that more than 50 percent of existing sagebrush habitat has been invaded by cheatgrass. That’s more than 10 million acres. About 10 percent of that is likely a cheatgrass monoculture.

The problem is at its worst at lower elevations. In the colder, moister environments of higher elevations, sagebrush habitat is being assaulted by a wholly different plant community—and this time it’s native.

“Pinyon-juniper woodlands have expanded throughout the West and have displaced millions of acres of sagebrush habitat,” explains Wisdom. Whereas the problem was too much fire at low elevations, up high the problem is, in part, owing to the absence of fires that once burned every decade or two, keeping woodlands in check.

A SAGE ICON

Greater sage grouse are the signature species of sagebrush ecosystems.

They are the largest grouse in North America and have beautiful courtship displays every spring. Like the ecosystem they depend on, sage grouse were once so abundant that their current plight would have been unimaginable. Settlers called them “sage chickens,” and ate them alongside domestic poultry. The past notwithstanding, sage grouse are in trouble.

“Their life cycle is tightly linked to the composition and structure of native sagebrush habitat,” explains Rowland. “When cheatgrass enters the system, native understory plants are quickly displaced and with them go the insects. Sage grouse, in turn, are deprived of the forbs and protein that are the primary food sources needed for raising their young. Sagebrush itself is the grouse’s only food source throughout the winter. Without healthy sagebrush habitat, there is simply no way to support the sage grouse.”

The association between sage grouse and its habitat has prompted land managers to nominate sage grouse as an “umbrella species.” The idea is: if we protect the sage grouse, we will simultaneously be protecting all the lesser known species that also rely on sagebrush habitat. Protections designed for the grouse, it is hypothesized, could shelter the entire ecosystem.



M. Rowland

Once a site has converted to a cheatgrass monoculture it is nearly impossible to restore the native sagebrush ecosystem.

“Fire suppression, cattle grazing, and global warming have a combined effect of increasing the amount of pinyon-juniper woodlands,” he says. “And as woodlands expand, sagebrush habitat contracts.”

Often, at moderate elevations, the insult is twofold. Cheatgrass and pinyon-juniper woodlands encroach together, extirpating sagebrush habitat. Eventually intense, cheatgrass-driven fires kill the woodlands too, and exotic grass is all that’s left.



Gary Kramer

For many, sage grouse are synonymous with the sagebrush ecosystem.

Rowland and Wisdom wanted to know exactly which species would benefit from this approach; they wanted to understand whether sage grouse can function as a sufficiently large umbrella.

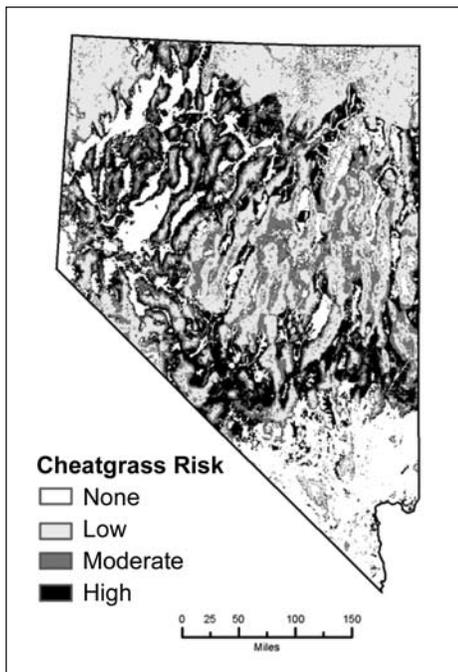
“If the objective is to conserve and restore multiple species through the improvement of habitats for the umbrella species, several criteria need to be met. The first, of course, is co-occurrence. A species will only benefit

from grouse conservation if it is found in the same general location. Also, specific resource requirements must overlap with the sage grouse, and management strategies must benefit all the targeted species,” says Rowland.

Wisdom, Rowland and several colleagues examined the potential conservation coverage of 39 sagebrush-associated vertebrate species from sage grouse habitat conservation. They mapped the range of habitats for all the species to determine spatial overlap with sage grouse and evaluated similarity in habitat associations. They also used a cheatgrass risk model to delineate regions likely to be lost as sagebrush habitat altogether.

“We found that management for sage grouse habitat likely would offer relatively high conservation coverage for sagebrush obligates, such as the pygmy rabbit, but far less protection for other more generalist species, such as the lark sparrow,” says Rowland. “Most species of conservation concern in our analyses would benefit only marginally from conservation and restoration of sage grouse habitats. About half the species considered had a neutral response to the umbrella strategy.”

“Our analyses suggest that the paradigm of sage grouse as an umbrella for other sagebrush species may need to be reevaluated,” adds Wisdom.



Cheatgrass is predicted to displace existing sagebrush and other susceptible land cover types in much of Nevada during the next 30 years. Over half of Nevada is mapped as moderate or high risk area for displacement.

RESTORATION POTENTIAL

The vast area of sagebrush at risk of displacement by cheatgrass and pinyon-juniper poses daunting challenges for conservation of sagebrush species. The trick for land managers is determining which areas to focus their energy on.

Wisdom and Rowland have pioneered methods for landscape assessment in sagebrush ecosystems that are helping managers prioritize sites for protection and conservation. According to Wisdom, by mapping sagebrush habitats that are highly vulnerable to invasion by cheatgrass, versus areas that are highly vulnerable to encroachment by pinyon-juniper woodlands, they can provide spatially specific knowledge needed to target each threat with the appropriate management prescriptions.

“Despite declining habitat trends for many sagebrush species, there is potential to conserve native sagebrush where large-scale loss and degradation have not yet occurred, and to restore degraded communities that retain native components,” says Rowland.

“Understory vegetation communities in high-risk areas—usually low elevations and warmer, drier sites—are likely to be dominated by

cheatgrass, and these sites may convert to pure cheatgrass in the near future if nothing is done,” says Wisdom.

“Intensive management practices, including changes in livestock grazing, are needed for sufficient restoration in many areas,” he says. “Sagebrush habitats at high risk of displacement by pinyon-juniper woodlands require immediate management attention through the use of prescribed fire or mechanical treatments to reduce density of encroaching woodlands.”

Most areas with high potential to maintain or restore sagebrush communities are concentrated in Wyoming, eastern Idaho, and northern Nevada. Areas with low potential are concentrated in Washington, parts of Oregon, western Idaho, and much of Nevada.

Wisdom’s and Rowland’s methods and findings have recently been published as a book, which has been distributed to federal and private land managers throughout the West.

A GLIMMER OF HOPE?

“There is an ecologically driven urgency to start now,” says Wisdom. “This ecosystem is so vulnerable to threshold effects that, once crossed, are nearly impossible to reverse. It is far easier to prevent the system from reaching thresholds than it is to mitigate them after the fact.”

“Unlike some other ecosystems, a hands-off approach simply won’t work. Exotic plants, altered fire regimes, and historical land use effects all will continue to degrade the sagebrush ecosystem if we don’t intervene,” says Wisdom. “If we don’t actively manage, then one of the largest ecosystems in North America will disappear.”

Reversing the trend of habitat loss will take a massive commitment. Indeed, one simulation study that Wisdom and Rowland were involved with found that even a six-fold increase in the areas treated with active restoration in the interior Columbia Basin would only slow the decline of sagebrush habitat, not reverse it.

Thankfully, and in part owing to Wisdom’s and Rowland’s research, momentum has been building toward finding solutions in sagebrush. In fact, a grant of \$13 million was recently awarded by the Joint Fire Sciences Board to over 20 scientists, representing four federal agencies and six universities, who are

collaborating on integrated sagebrush research across the Great Basin.

“We’ve seen throughout the past decade an upsurge in interest in sagebrush ecosystems. This trend toward increasing management budgets and research is exactly what is needed. And it must continue,” says Wisdom.

“To further belabor the many ills of the sagebrush ecosystem is to ignore the real question of importance: What can be done to improve the situation?”

“I listened carefully for clues whether the West has accepted cheat as a necessary evil, to be lived with until kingdom come, or whether it regards cheat as a challenge to rectify its past errors in land-use. I found the hopeless attitude almost universal.”

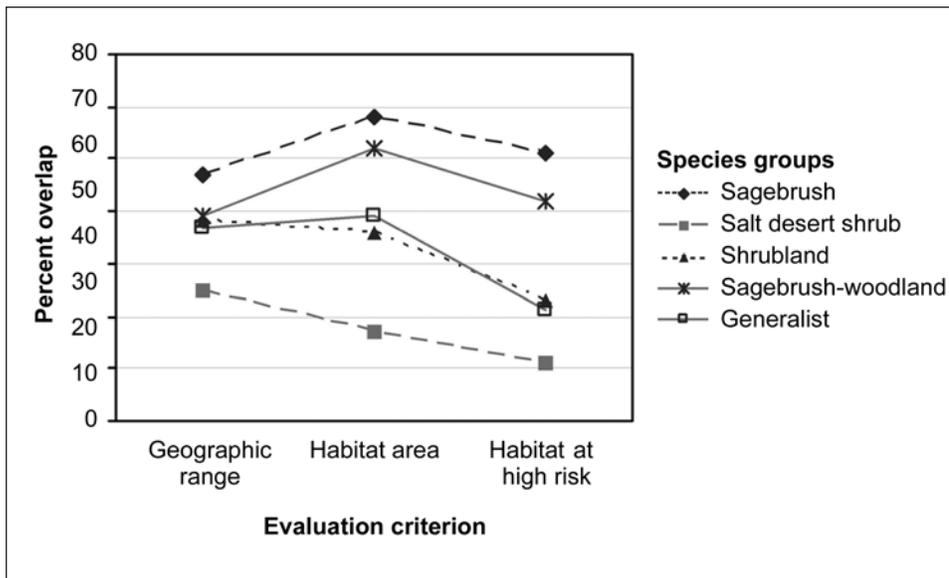
—Aldo Leopold, *A Sand County Almanac*, 1949



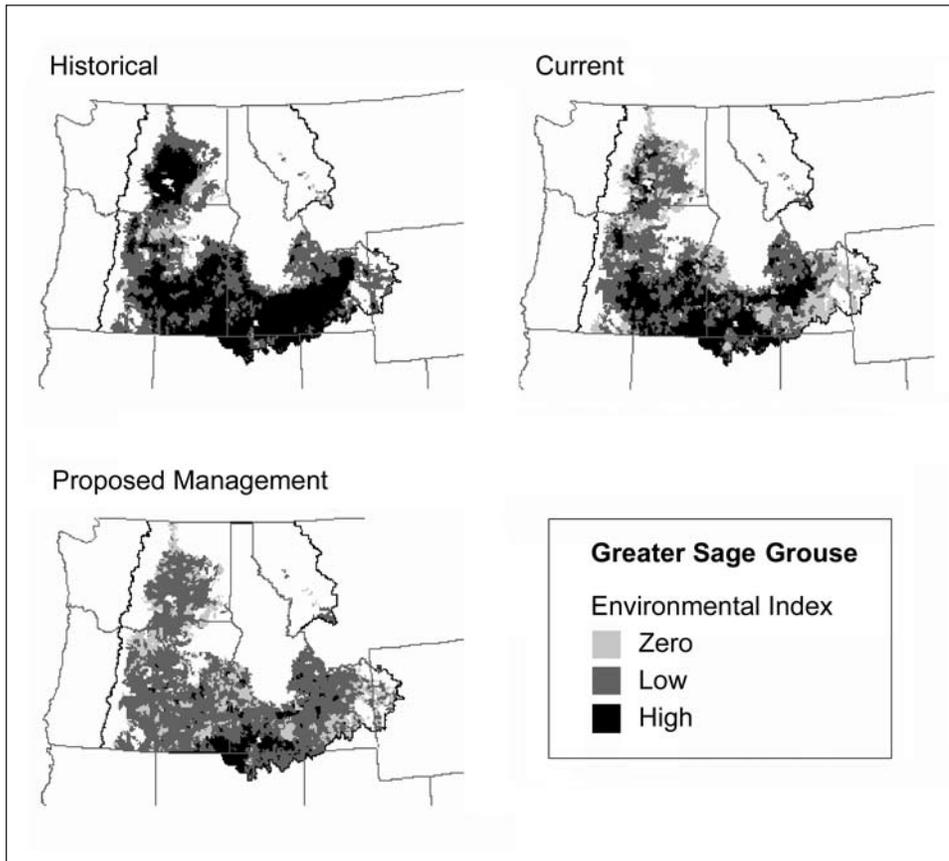
LAND MANAGEMENT IMPLICATIONS



- Passive restoration, such as changes in management of livestock, coupled with active fire suppression at lower elevations and exotic plant management (e.g., herbicides followed by native plant seeding), can be used to restore native grasses and forbs in the understory of sagebrush habitats within 30 to 50 years.
- Sagebrush at high risk of displacement by pinyon-juniper requires immediate management attention through the use of prescribed fire or mechanical treatments to reduce density of encroaching woodlands.
- Management of sage grouse habitats is likely to provide substantial conservation coverage for other species tightly linked to sagebrush, but less coverage for species with more general habitat requirements. This suggests that the paradigm of sage grouse as an umbrella for other, nonobligate sagebrush species may need to be reevaluated.



Several species groups that are associated with sagebrush were evaluated in relationship to their overlap with sage grouse. Species with higher overlap with sage grouse would be better conserved through the “umbrella species” approach.



These maps show the quality and quantity of greater sage grouse habitat in the interior Columbia Basin for three time points: (1) historical (circa 1850–1890), (2) current (1995), and (3) under proposed management 100 years in the future.

FOR FURTHER READING

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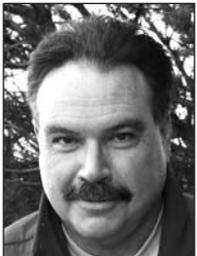
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SCIENTIST PROFILES



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and species in the Western United States since the genesis of the Interior Columbia Basin Ecosystem Management Project in 1994. He also serves as a scientist on the Starkey Project, conducting research on mule deer, elk, and cattle. He has worked for the Forest Service and Bureau of Land Management during the past 25 years on a variety of wildlife research topics.



MARY ROWLAND is a wildlife biologist at the Pacific Northwest Research Station and is based in La Grande, Oregon. She previously worked for the Bureau of Land Management as a terrestrial biologist on

the Interior Columbia Basin Ecosystem Management Project. Much of her research of the past 5 years has focused on landscape-scale analyses of sagebrush habitats and associated wildlife. Her current work involves evaluation of the pinyon-juniper and cheatgrass risk models developed for the Great Basin assessment, and serving as project manager and editor of a technical guide for monitoring wildlife habitat on Forest Service lands.

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