USGS
science for a changing world

Birds of a Feather

Information contained in feathers is helping to understand sage-grouse populations

Feather Collecting on a Grand Scale

Dawn breaks over an expansive Nevada sagebrush landscape, disturbed only by the rumbling of a truck moving along U.S. Route 50. It is late April and prime time for sage-grouse mating. The biologist driving the truck is headed to a communal breeding ground for sage-grouse known as a lek. After taking several side roads, she parks and walks a short distance to a relatively flat, nondescript opening in the sagebrush landscape. The day's round of mating is over, the shuffles and scuffles have ended, and the birds have dispersed for the day. Feathers lost during the dust-ups between males are the main object of the biologist's visit. She collects 20 feathers, packaging each in a labeled envelope and placing the stack in her pack before heading to the next lek. She is part of a team collecting feathers from more than 7,000 leks spread across 11 Western States and 2 Canadian provinces. The feathers contain genetic information, which when extracted and analyzed, will reveal information about movement patterns and population structure useful for management of greater sage-grouse throughout their North American range. The biologist and this project are part of a much larger integrated effort helping to solve one of the most difficult ecological challenges in North America.

Greater sage-grouse gather in groups at a lek to court and mate with females. (Photograph taken by T. Gettelman, USGS, Western Ecological Research Center, March 30, 2012.)

A Complex Conservation Challenge

Greater sage-grouse (*Centrocercus urophasiunus*, hereafter sage-grouse) are broadly distributed, occupy a diversity of sagebrush habitats, and face multiple threats. As a result of these threats, sage-grouse populations are declining and are now absent from almost one-half of their estimated range prior to Euro-American settlement. The risks to sage-grouse are

General facts about greater sage-grouse

- Largest grouse species in North America
- Resident bird managed by state agencies as a native game bird
- Uses communal breeding grounds called leks
- Ground nesting, usually underneath a sagebrush and concealed by grass
- Sagebrush dependent, particularly in winter
- Occurs in 11 States and 2 Canadian provinces, across a range that spans 259,000 square miles
- Annual home-range size can cover 230 square miles or more
- Seasonal ranges can be widely dispersed
- Routinely monitored by state management agencies by counting males at lek sites

General facts about sagebrush

- Most widespread vegetation in Western North America
- Dominant land cover on more than 190,000 square miles within sage-grouse range
- Includes 18 woody plant species of various shapes and sizes
- Co-occurs with native grasses and forbs as a shrub steppe system
- Essential habitat for 350 species, including sage-grouse
- In jeopardy due to altered fire regimes, invasions of nonnative plants, encroachment of trees, anthropogenic land uses, and climate change
- More than 70 percent of sagebrush habitats used by sage-grouse are on public lands managed by Federal or State agencies

U.S. Department of the Interior
U.S. Geological Survey

Printed on recycled paper

Fact Sheet 2014–3049
June 2014

significant enough to merit candidate status for this species for listing under the U.S. Endangered Species Act (Federal Register Notice, March 5, 2010). According to this decision by the U.S. Fish and Wildlife Service in 2010, population and habitat fragmentation coupled with lack of regulatory mechanisms warranted listing, although implementation of actions has been precluded by other priorities.

Candidate status for listing under the Endangered Species Act and possible regulatory action in the near future provide strong motivation to better understand the dynamics of sage-grouse populations and their habitat requirements. The general approach currently taken by managers focuses on maintaining or enhancing sage-grouse populations across their distribution in regions containing the highest densities of breeding birds and their important seasonal habitats, also known as priority areas for conservation (PACs). The rationale behind this approach is that it permits limited resources to be applied in regions that have the greatest potential to benefit the largest proportion of sage-grouse. Development and other forms of land use can then proceed under standard regulations in areas outside PACs. Implementation of this approach requires detailed information about habitat, connections among sage-grouse populations, and approaches to restore and maintain sagebrush. These are important topics of study by the U.S. Geological Survey (USGS) and its research partners.

Minimum Ecological Requirements

Efforts to stabilize or reverse population and habitat declines as well as minimize effects from land use and climate change would benefit from accurate maps delineating where suitable habitats occur, including movement corridors between populations. Defining what constitutes suitable habitat is an essential step toward these goals.

Sage-grouse require sagebrush-dominated landscapes for cover, food, and water. However, not all sagebrush supports sage-grouse because not all sagebrush landscapes are alike. For example, sagebrush can be a dominant feature across large landscapes, as in many parts of Idaho and Oregon, or it can be mixed with agriculture and other habitats, as in parts of Washington and Montana. Site-specific sage-grouse distribution models have contributed to the understanding of relationships between sage-grouse and their habitat. However, translating these habitat relationships into the broad regional maps useful for managers is restricted by limited availability of accurate, consistent data spanning large areas. To alleviate this situation, researchers developed a habitat model for sage-grouse that captured the spatial variability in local environments used by

Some sagebrush landscapes are dominated by sagebrush, but others may be a mosaic of sagebrush and other habitats. (Photograph taken by Steve Knick, USGS, July 2006.)

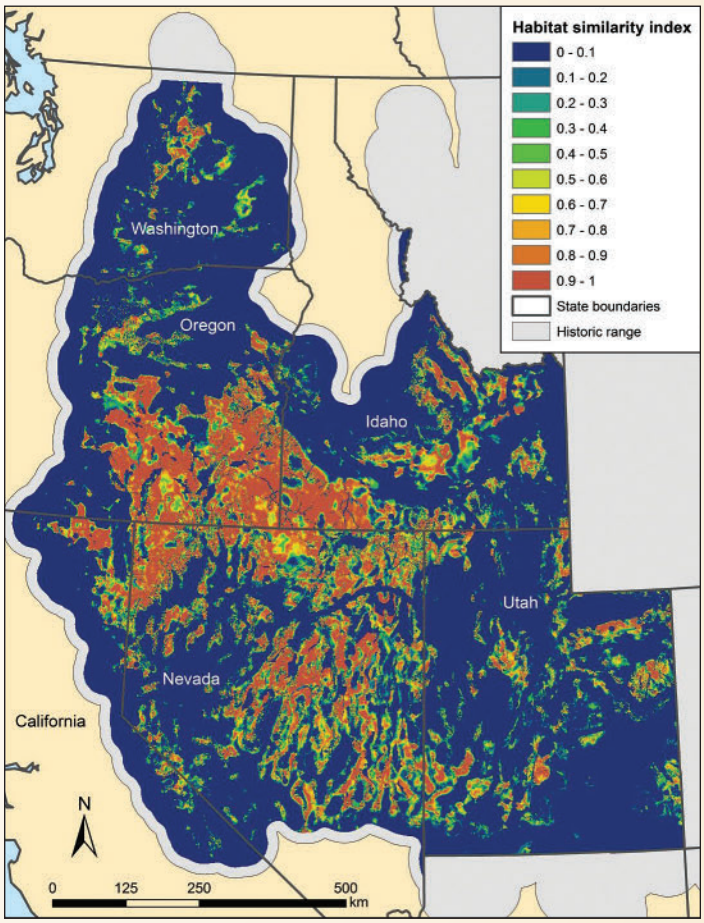

Figure 1. Habitat similarity index values for sage-grouse across their western range. Values represent the relationship of the surrounding environment at map locations to a model of minimum requirements for sage-grouse defined by land cover, anthropogenic variables, soil, topography, and climate (from Knick and others, 2013).

sage-grouse and also maximized accuracy in applications across broad spatial extents (Knick and others, 2013). This was done by examining the environment surrounding active leks within the western portion of the current sage-grouse range. Leks were used as the basis for developing these models because they are important breeding locations and most females nest within the surrounding region.

The importance of sagebrush as required habitat for sage-grouse was affirmed by the assessments made on the environments in which leks were found. The majority of leks occurred where there was at least 40 percent of the surrounding landscape dominated by sagebrush. Most of these leks also contained minimal to no levels of human land use and were further characterized by broad expanses of sagebrush. Other forms of vegetation and climate also influenced lek location. Almost all leks were located in areas containing few conifer trees and few grassland expanses. These results were consistent with other evidence that sage-grouse are vulnerable to decreases in sagebrush due to the spread of invasive plants and the encroachment of junipers and conifer trees.

This is important information for managers because the characteristics identified in the analyses represent the most essential environments required by sage-grouse (table 1) that can be used to target conservation actions (fig. 1).

Population Connectivity

Another challenge for managers of sage-grouse and sagebrush habitats is the potential for human activities to further fragment sagebrush habitat and increase isolation of individual sage-grouse populations. In general, species with multiple interconnected populations are more likely to persist than those with isolated populations. For sage-grouse, leks and the large populations within the interior of their range are highly interconnected by corridors of surrounding lands that had moderate-to-high potential for animal movement. In contrast, smaller populations along the range periphery are isolated and had limited movement potential through habitat corridors to neighboring populations (fig. 2; Knick and others, 2013). This information can be used to consider how habitat changes in the connecting corridors that limit or disrupt sage-grouse movement could further isolate peripheral populations, putting them at greater risk of loss. By developing maps of these habitat corridors, areas critical for connecting sage-grouse populations can be targeted for conservation.

Documenting and addressing how populations actually interact is the next step, and that requires monitoring of animal movement across large areas. This process can be costly and difficult using methods that involve capture, marking, and re-capture. However, the critical information about dispersal and gene flow in sage-grouse populations can be obtained from the DNA coded in the sage-grouse feathers collected at leks.

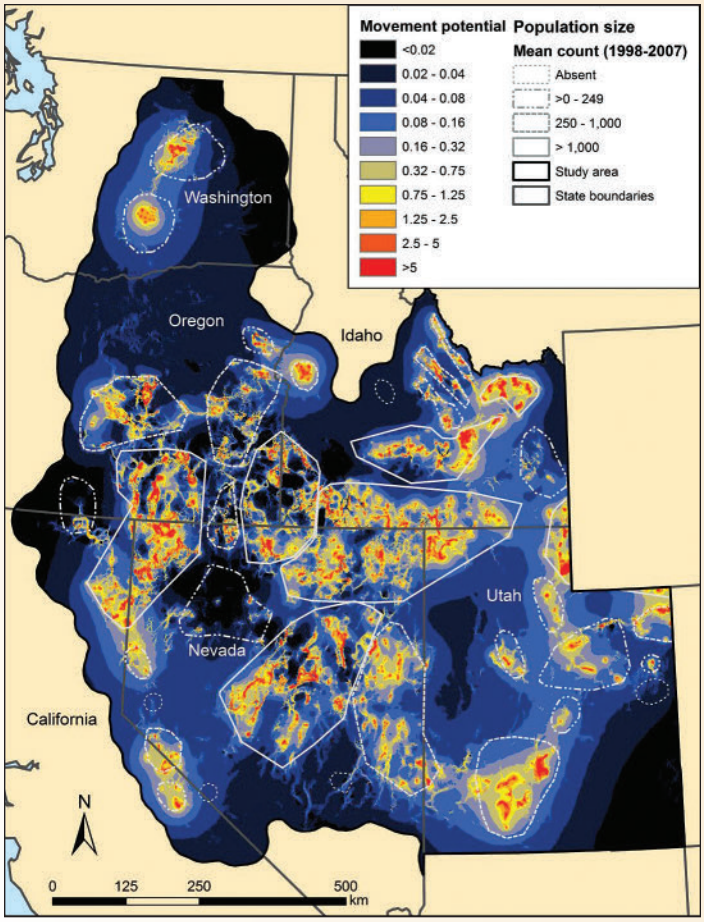

Figure 2. Estimated potential for sage-grouse movement among sage-grouse leks (from Knick and others, 2013).

Monitoring using genetic information is now underway across the entire range of sage-grouse through the efforts of a large consortium of scientists and managers.[1] The biologist mentioned at the beginning is contributing to this effort by collecting feathers. The genetic data extracted from the collected feathers is used to map relatedness among breeding locations and delineate population structure within the range of sage-grouse. When coupled with habitat maps and movement corridors, this genetic data can further the understanding of how geographic distance, topographic characteristics, and land use influence sage-grouse dispersal and genetic diversity. A comprehensive picture emerges of where the pathways for dispersing individuals are located throughout the sage-grouse range and how those pathways will shift in the future.

[1] This research involves the USGS, the Natural Resources Conservation Service through the Sage-Grouse Initiative, the Western Association of Fish and Wildlife Agencies, the U.S. Department of Agriculture Forest Service, University of Montana, and Colorado State University. For more information, visit *https://my.usgs.gov/feathers/*.

More on the Horizon

Sagebrush restoration and rehabilitation are additional considerations for sagebrush conservation. Many scientists and managers are addressing these subjects, often with an appreciation that effective restoration will require a regional approach for prioritizing and identifying management options (Pyke, 2011). Sagebrush restoration and rehabilitation are topics too expansive for this fact sheet, but a few points stand out:

- Managers have a great need for scientific data that can help increase their success at restoring and rehabilitating sagebrush. Efforts are underway to acquire this information to create effective guidelines for restoration.
- Spatial models based on land classification are being developed that indicate where to focus resources to best protect and interconnect intact quality habitats through restoration.
- To determine the intensity of future management, models of how plant communities change in sagebrush landscapes can help managers choose between vegetation manipulation and passive management for restoration.

The biologist collecting feathers in the early morning hours at sage-grouse leks appreciates the difficulties associated with understanding sage-grouse and this iconic species' response to management. She is part of a collaborative effort to assemble scientific information for future management decisions. Her work and that of many others can be an important foundation for rigorously and objectively considering options for sage-grouse and sagebrush management so that future generations also will have a chance to head out at dawn over a dusty road in search of sage-grouse.

Table 1. Average values of selected environmental variables measured at active lek sites and historical, but not longer used, lek locations in western part of the greater sage-grouse range, U.S.A.

[Adapted from Knick and others, 2013. **Abbreviations:** km, kilometer; km/km^2; kilometer per square kilometer]

Environmental variables	Active leks (percent)	Historically occupied leks (percent)
Sagebrush land cover within 5 km of lek	79	28
Conifer forest cover within 5 km of lek	1	3
Grassland cover within 5 km of lek	2	10
Agriculture within 5 km of lek	2	2
Power lines	0.03 (km/km^2)	0.14 (km/km^2)
Communication towers	0.001 ($towers/km^2$)	0.2 ($towers/km^2$)

Greater sage-grouse flying to a lek site. (Photograph taken by T. Gettelman, USGS, Western Ecological Research Center, March 28, 2010.)

References Cited

Knick, S.T., Hanser, S.E., and Preston, K.L., 2013, Modeling ecological minimum requirements for distribution of greater sage-grouse leks— Implications for population connectivity across their western range, U.S.A.: Ecology and Evolution, v. 3, no. 6, p. 1,539–1,551, doi: 10.1002/ece3.557.

Pyke, D.A., 2011, Restoring and rehabilitating sagebrush habitats, *in* Knick, S.T., and Connelly, J.W., eds., Greater sage-grouse—Ecology and conservation of a landscape species and its habitats: Studies in Avian Biology, v. 38, p. 531–548.

Authors

Knick, Steven T.
Gondhalekar, Carmen

Photo Credits

Banner photograph: A greater sage-grouse male struts at a lek. (Photograph taken by Jeannie Stafford, U.S. Fish and Wildlife Service, March 1, 2010.)

Design: Bill Gibbs

For more information contact

Director, Forest and Rangeland Ecosystem Science Center
U.S. Geological Survey
777 NW 9th Street, Suite 400,
Corvallis, Oregon 97330
http://fresc.usgs.gov/

ISSN 2327-6932 (online)
http://dx.doi.org/10.3133/fs20143049