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RESEARCH AT THE USGS WESTERN GEOGRAPHIC SCIENCE CENTER

Geographic Science for Public and Tribal Lands Management

There are more than 650 million acres of U.S. public and Tribal lands, most found west of the Mississippi River. Scientists with the U.S. Geological Survey's Western Geographic Science Center are working to increase the scientific information available for natural resource decision making, while continuing productive collaborations with Federal land managers, Tribal leaders, and local communities.

Denali National Park, Alaska, is part of our Nation's 650 million acres of public lands. Together with lands of Tribal nations, they provide crucial benefits and uses and must be carefully managed. The USGS Western Geographic Science Center is providing scientific data and understanding to address the challenges of managing these lands. The scientist shown in this photograph is studying potential linkages between landscape condition and the health of Dall sheep (*Ovis dalli*) (see inset), a species of concern in the park. (USGS photos by Dennis G. Dye/Ed Pfeifer.)

Healthy, functioning landscapes provide us with food, water, clean air, and many other natural resources and uses. There are more than 650 million acres of U.S. public and Tribal lands, most west of the Mississippi River. More than 94% of these lands are administered by five Federal agencies—Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), U.S. Fish and Wildlife Service, U.S. National Park Service (NPS), and USDA Forest Service (USFS). With the exception of USFS, these agencies are part of the Department of Interior (DOI).

The U.S. Geological Survey (USGS) is DOI's primary science organization. Scientists with its Western Geographic Science Center (WGSC) work to increase the scientific information available for natural resource decision making, while continuing productive collaborations with DOI bureaus, Federal land managers, Tribal leaders, and local communities. Maintaining healthy landscapes is a major challenge for public and Tribal land managers. They must cope with invasive species, pest and disease outbreaks, increased needs for urban and agricultural water resources, catastrophic fires, and other issues. Remotely sensed data from ground- and satellite-based platforms and data from other geographic tools are used to monitor and understand changing landscape conditions.

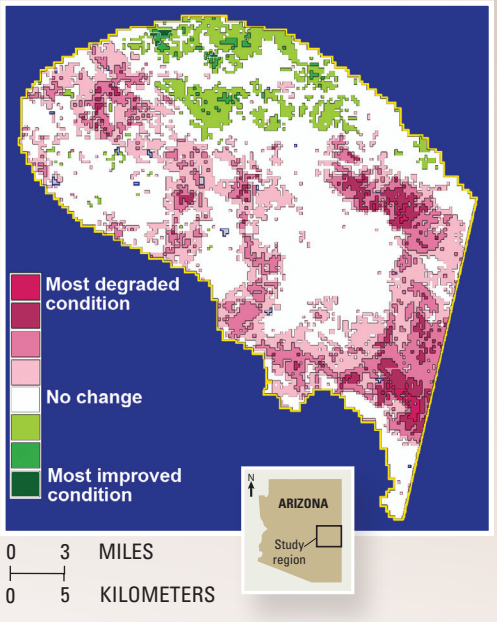
Tools to Assess Landscape Change

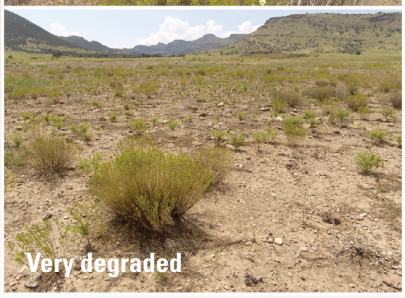
The response of ecosystems to natural variations in weather from year to year often masks longer-term trends that signal change in landscape condition and degradation that can affect biological productivity. These responses can be better understood by measuring and analyzing the timing and vigor of seasonal biological events and growth, a major focus of the science of phenology. WGSC scientists are working on BLM lands to track phenological changes in vegetation using ground-based cameras (phenocams) and data from earth observing satellites.

Phenocams provide daily snapshots of vegetation productivity on the Owhyee Plateau, where Idaho, Oregon, and Nevada converge, the largest contiguous expanse of sagebrush in the Western United States. Productivity measures are critically important in the effective management of various land uses or "co-occurring benefits," such as livestock ranching and habitat for greater sage-grouse (Centrocercus urophasianus). Daily phenocam data are combined with meteorological data and soil-moisture data to explore the relations between the timing of water availability from snow melt, springtime signals (such as longer and warmer daylight periods), and the arrival and abundance of migrant songbird species.

In Arizona, WGSC scientists are working closely with the San Carlos Apache Tribe to use satellite imagery to map and monitor the condition of grasslands in the desert Southwest. It is important to pay close attention to the conditions of rangelands, because desertification processes can be rapidly accelerated during times of drought, and the region is currently experiencing a drought of significant duration and magnitude. WGSC research provides San Carlos land managers with easily interpretable image products that are increasing the effectiveness of Tribal

Mapping and Monitoring Rangelands





In Arizona, WGSC scientists have been working closely with the San Carlos Apache Tribe to develop technology to use satellite imagery to map and monitor the condition of rangelands. This computer generated map shows changing rangeland conditions over a 15-year period. The photographs are from site visits showing rangeland in very good (top), slightly degraded (middle), and very degraded condition. (USGS photos by Barry Middleton.)

rangeland management practices over vast areas. Satellite-based rangeland-condition and seasonal-productivity maps at varying spatial resolutions and across several decades have been collaboratively developed, with very promising results. Close WGSC cooperation with the San Carlos Apache Tribe, along with a program of training in the use and processing of remotely sensed data, is creating custom computer-based tools tailored to Tribal land-management needs. A similar program is underway with the Navajo Nation to analyze desertification processes, sand dune morphology, and changes in vegetation phenology.

Geographic Science for Land Managers

The NPS Vital Signs Program monitors indictors of natural resource health to help land managers take the pulse of their ecosystems. These vital signs—population statistics of species of concern, water quality and flow parameters, air quality and visibility, and other factors—can be analyzed to identify where to concentrate management activities, such as restoring watersheds with endangered Coho salmon (*Oncorhynchus kisutch*). WGSC research focuses on synthesizing these indicators to better understand the feedbacks among system elements to discover how parks as a whole respond to cumulative impacts, such as increased visitation, recovery from prior resource extraction, and other factors such as climate change.

In Denali National Park, Alaska, a species of concern is Dall sheep (*Ovis dalli*), which may provide an early warning of the cascading effects of changing climate. A 30-year analysis of Landsat data for the park shows a 47% decrease in glacial extent, as well as upslope expansion of woody plants in the park. These observations appear to correspond to decreases in the natural forage plants that the sheep eat and increases in tall plant cover that can both create barriers to sheep movement and provide cover for large predators, such as wolves. Ongoing studies are analyzing sheep fecal pellets to see if changes in the availability of forage plants are affecting the diet quality of the animals. Complex landscape factors that could be affecting lamb survival and Dall sheep population dynamics are also being explored.

The work of Western Geographic Science Center (WGSC) scientists to increase the scientific information available for natural resource decision making is only part of WGSC's efforts to better understand the causes and consequences of land-cover change. WGSC works closely with public land managers, Tribal leaders, and local communities to help ensure that they have the crucial information they need to make informed decisions about ongoing and future land-use choices.

WGSC is working to provide Federal land managers with crucial landscape change information. For example, WGSC scientists are tracking phenological changes (the timing and vigor of seasonal biological events) in vegetation on lands on the Owhyee Plateau (Idaho, Oregon, and Nevada) administered by the Bureau of Land Management. This photo shows a scientist installing a ground-based camera or "phenocam" (inset photo). The data from the phenocam is compared to those from satellite-based sensors to gain a better understanding of vegetation changes over the entire ecosystem. (USGS photos by Mara Tongue/ Alicia Torregrosa.)

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