Revolutionized Rangeland Monitoring

Within desolate tracts of land in the Northern Plains and Pacific West areas, mounting dust conceals historic pioneer trails, and wild horses roam free. In quiet desert streams, rare Lahontan cutthroat trout struggle to survive.

Monitoring the health of these vast lands is a challenge to the U.S. Department of the Interior's Bureau of Land Management (BLM). The bureau watches over about 262 million acres and strives to protect the land's resources, including timber, minerals, and even recreational parks.

Now, a partnership with ARS scientists at the Cheyenne, Wyoming-based Rangeland Resources Research Unit (RRRU) is making the daunting task more efficient.

The partnership is a natural fit, because some of these lands also concern ARS scientists who study rangelands' vegetation, wildlife habitats, and endangered plant and animal species. BLM is helping fund cooperative research with RRRU in Wyoming, Nevada, and Idaho. Terry Booth, an RRRU rangeland scientist, coordinates the ARS work.

Cooperating With a Common Goal

Large tracts of mixed private and public lands that are cooperatively monitored are called "grazing allotments." There, private ranching interests and BLM work together to adjust livestock grazing practices and manage vegetative species to improve or maintain rangeland health.

"An important part of the success of these programs is monitoring the response of plant communities to changes made in grazing-management practices," says Carol Evans, a fisheries biologist with BLM in Nevada. "We also look at the health of desert streams."

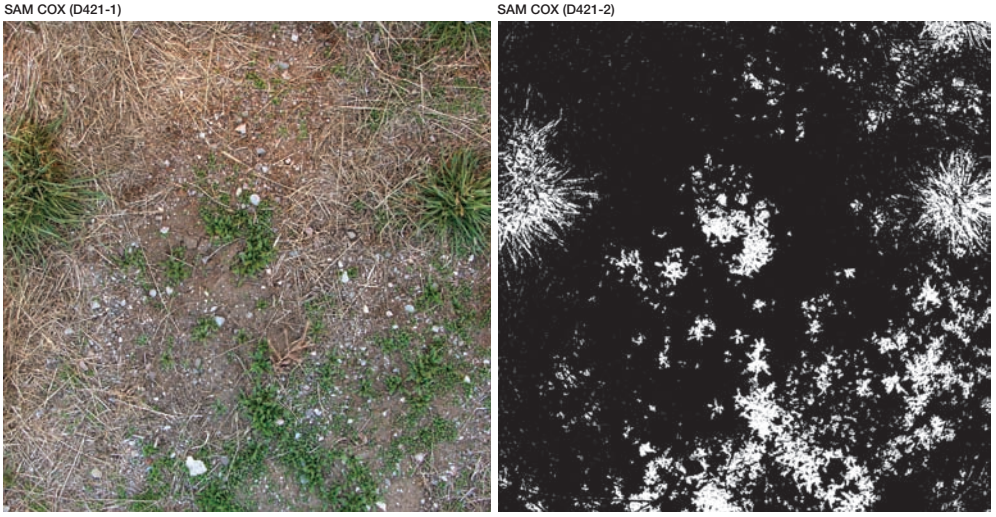
One grazing allotment that Evans monitors in Nevada covers nearly 260,000 acres, most of which are inaccessible by roads. BLM has traditionally taken measurements by hand in a specified area and then remeasured at the exact location 5 years later. "It's time consuming and labor intensive to collect data that way," says Evans, "so finding a more efficient and cost-effective way to obtain reliable data has been a top priority."

SAM COX (D423-1)

This stretch of rangeland in the Muddy Creek Watershed in Wyoming's Red Desert is typical of the vast expanses of publicly owned rangeland that aerial remote sensing is particularly well-adapted to.

SAM COX (D421-1)

SAM COX (D421-2)



A digital image of rangeland (left) is processed by computer software that shows the green vegetation as white (right). This technology enables scientists to remotely monitor and analyze rangeland.

The RRRU work started 6 years ago, after Booth attended a seminar and discussed innovations in rangeland monitoring techniques with BLM colleagues. Since then, Booth and RRRU biological science technician Sam Cox have collaborated with Robert D. Berryman, an independent programming consultant in Boulder, Colorado, to create interrelated, custom-made computer software programs that manage both data collection and analysis. Four programs have resulted, which Booth and Cox are systematically testing for quality and accuracy—and improving.

The researchers use a lightweight, slow-flying airplane equipped with a high-resolution digital still camera, a global positioning system (GPS), and computers loaded with unique navigation software. From within the airplane, the software triggers the camera at regular intervals to take hundreds—or thousands—of photos of the land directly below.

The researchers have also developed methods to analyze the images automatically by computing the bare-ground measurements electronically—a big timesaver. "To manually make the measurements from one photo takes about 15 minutes, but the computer can do about one photo per second," says Booth. "The navigation software records the GPS coordinates for each photo so the same area—give or take 10 meters—can be rephotographed later for comparison."

Faster, Cheaper Monitoring

In her evaluation of the Nevada lands' ecological health, Evans has matched and compared ground-collected data with the new, aerially collected points.

The Wyoming BLM's 18 million acres in grazing allotments also stand to benefit from the RRRU innovation.

One challenge is that normal weather fluctuations change the productivity of grasses and other ground features from year to year. Distinguishing between changes caused by climate and those caused by grazing practices is difficult.

"Getting technicians out in rough country to track changes over time in the vegetation, ground cover, and bare ground is

very expensive," says Jim Cagney, BLM's range-management program leader for Wyoming. But the high-resolution aerial photography is sharp enough to measure bare ground for comparison with percentage of bare ground over time—a primary indicator of rangeland health.

Results from test studies show the innovative method to be efficient and cost effective for monitoring upland sites, which are dry, native rangelands, and riparian sites, which are marked by creeks, streams, and areas with high water tables flush with vegetation.

"The cost of monitoring using ground-based methods is about $8 to $10 per acre. But with the new method pioneered by RRRU, the cost is closer to 75 cents per acre," says John Likins, a rangeland management specialist with BLM's Lander Field Office, Lander, Wyoming.

SAM COX (D424-1)

The Rans S12XL light airplane is capable of using dirt landing strips in remote locations, making it well-suited for rangeland monitoring in the West.

Meanwhile, Streamside

The new ARS-developed technologies make it possible to remotely monitor desert streams, which tend to widen if erosion-slowing vegetation along streambanks is lost. Rain and wind erode the exposed soil, weakening the banks and enlarging stream channels.

"Grazing annually near streams all season long can diminish streamside vegetation that helps hold streambanks together," says Evans. Thunderstorms and excessive runoff can turn a stream into a gulley. While grazing management—such as rotating throughout surrounding pastures—can provide relief, problem areas must first be identified.

"With this new monitoring technology, we can fly the length of a creek and log its width from bank to bank at hundreds of points," says Cagney. "This only takes one afternoon, and the computer will analyze the data." By contrast, a technician would have to drive to the site, walk the stream, measure its width at each sample point by hand, walk back to the vehicle, and then analyze the data.

"The benefits we're getting from the ARS collaboration are twofold," says Cagney. "Not only do we have the high-resolution aerial photography to quickly capture thousands of reference points in a day, but we also have computer software to analyze the photos and tell us what's in them. We're better equipped to identify a trend—negative or positive."—By **Rosalie Marion Bliss,** ARS.

This research is part of Global Change (#204) and Rangeland, Pasture, and Forages (#205), two ARS National Programs described on the World Wide Web at www.nps.ars.usda.gov.

D. Terrance Booth is in the USDA-ARS Rangeland Resources Research Unit, 8408 Hildreth Rd., Cheyenne, WY 82009-8899; phone (307) 772-2433, ext. 110, fax (307) 637-6124, e-mail terry.booth@ars.usda.gov. ✷