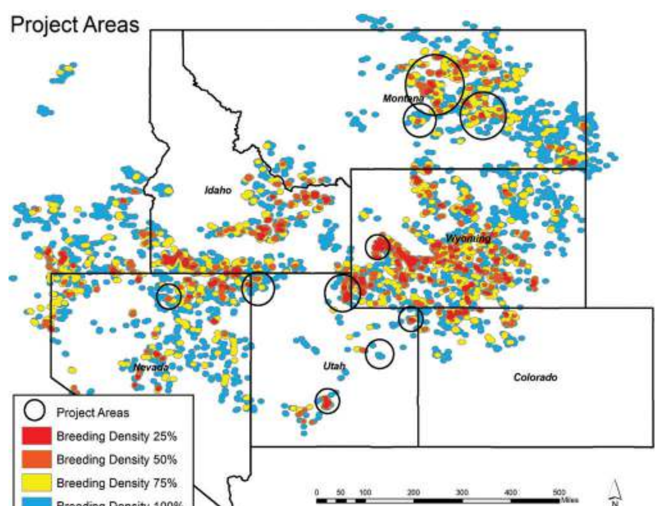
Science to Solutions

Hi-Res Maps Sharpen Focus on Sage Grouse Habitat

In Brief: Traditional field methods used to assess rangeland vegetation are labor intensive and costly. Earth Sense Technology (EST) is a new technique that combines high-resolution photo plots with satellite or aerial imagery to evaluate rangeland condition at multiple scales. For relatively low cost, high-resolution photos from the field are used to "train" geospatial models to interpret aerial photos and satellite imagery, resulting in maps with fine detail and accuracy. This technique gives managers the ability to examine characteristics of sage grouse habitat and range condition from local site to landscape scales, and over time. The BLM and the NRCS-led Sage Grouse Initiative are using this technology to assess rangelands in sage grouse core areas in several states. In Montana, SGI has mapped 500,000 acres to evaluate grazing strategies to benefit sage grouse and livestock.

Land and resource managers have a need to assess the condition of rangeland vegetation and to monitor range condition efficiently over time. For sage grouse to thrive and for grouse and livestock production to co-exist sustainably, habitat managers must evaluate the relative cover of sagebrush, herbaceous plants and bare ground. Traditional field methods can be costly to apply over large landscapes and to repeat regularly. For example, to detect small changes in the amount of vegetation cover requires very large sample sizes, especially for cover types that make up a small percentage of the landscape (<10%).

An ATV is mounted with a DSLR camera on an extended boom to shoot high-resolution images of ground cover. Photo courtesy of Open Range Consulting, Inc.



This technique to better interpret aerial and satellite imagery for detailed land cover mapping was first tested in northern Utah, and has since been applied on nine sage grouse projects in four states. Most of these projects are in sage grouse core areas, which correspond with high-density areas on this map. Map courtesy of Open Range Consulting, Inc.

A new technique, Earth Sense Technology (EST), developed by Eric Sant and Gregg Simonds of Open Range Consulting, Inc. (ORC) combines ground-based high-resolution photo plots with aerial and satellite imagery to create cover maps that deliver spatial data with great detail and accuracy. The Sage Grouse Initiative (SGI) is employing EST to assess range conditions in sage grouse habitat throughout the West, and to help land managers do a better job of vegetation management for grouse and livestock producers.

Rick McEwan

Male and female Sage Grouse.

Jeremy Roberts/Conservation Media

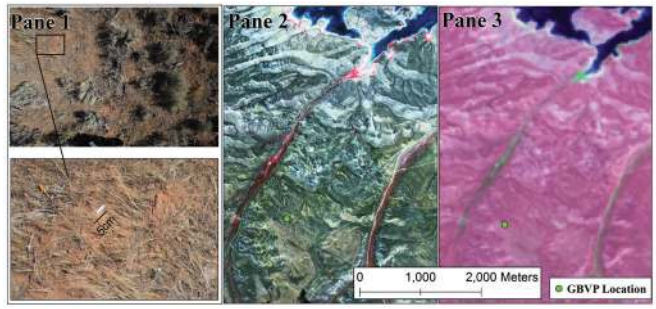
Sage Grouse habitat.

> *"Using the ground-based vertical photography technique creates a high-resolution "legacy image"–we can go back to the photos at any time for more information and analysis. You can't do that with line transects"* ~ Eric Sant, Geospatial Analyst with Open Range Consulting

Legacy Images

In the field, technicians use "ground-based vertical photography" (GBVP) to create a series of high-resolution photo plots. An ATV is mounted with a DSLR camera on an extended boom to shoot "nadir" images of plots (the camera lens oriented straight down). Using a very wide-angle 10mm lens, the photo plot captured is 42 square meters, or approximately one tenth of an acre. The resulting photos show ground cover (shrubs, herbaceous plants, plant litter and bare ground) at a very fine 2mm resolution.

A series of these GBVP photo plots are taken, creating a fine-scale sample representative of the landscape. In addition, the camera is paired with a Trimble GPS to pinpoint the



Very high-resolution DSLR photo plots taken in the field are used to "train" geospatial models to better interpret images from Ikonos and Landsat satellite imagery. This technique delivers accurate land cover information at different scales. In Pane 1, DSLR photo plots capture cover at 2mm resolution with very fine detail; Pane 2 shows 1m-resolution Ikonos imagery; and Pane 3 shows 30m-resolution Landsat imagery. Image from Sant et al., 2014.

location of each plot, and color-coded nails are driven into a sample cover type within each plot to ground-truth the classification of each type of ground cover. In the lab, each GBVP photo plot is analyzed by a technician for cover classification: shrub, herbaceous plants, litter and bare ground.

"We are using these photos to assess percent ground cover at a very fine scale," explains Eric Sant, Geospatial Analyst with ORC. Unlike a line transect, which is limited to the data recorded in the field at the time, the photos provide a visual record that can be revisited in the future for other information. "They are legacy images–you can go back to a photo and reinterpret it for plant species, or to compare to later images for changes over time."

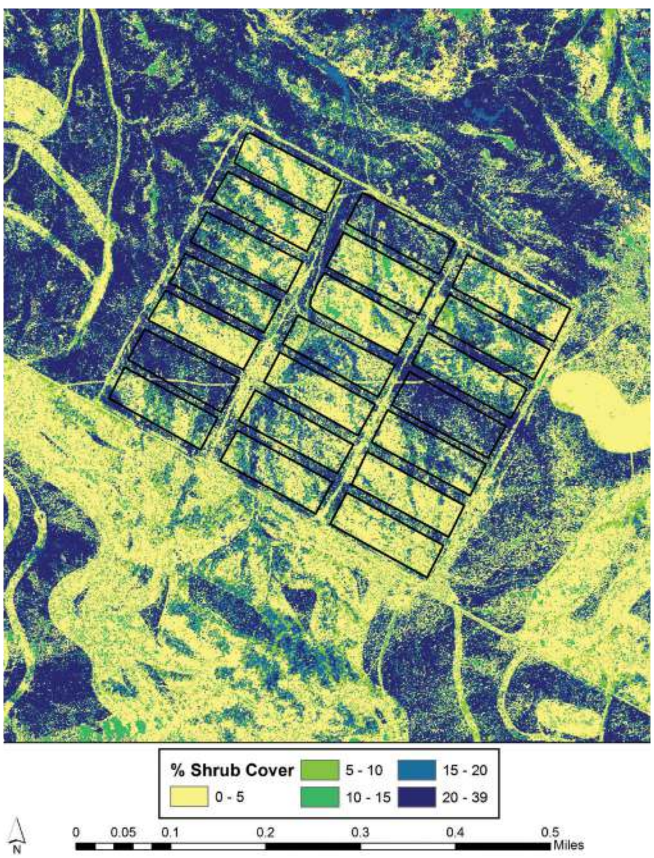
A Sharper Focus on Land Cover

The GBVP photo plots taken in the field provide a representative sample of a landscape and a fine-scale measure of cover types within each small plot. With geospatial modelling, ORC then uses the GBVP photos to "train" larger-scale aerial photos and satellite images to obtain percent cover across entire landscapes with a much greater degree of accuracy than remotely-sensed images portray alone. It's as though you turned the focus on the satellite images from fuzzy to sharp.

In step-wise fashion, the GBVP plots are first used to interpret 1m-resolution aerial or satellite imagery, such as NAIP aerial photos (National Agricultural Imagery Program) or Ikonos satellite images, acquired for the same time period as the photo plots. This results in finely detailed and accurate ground cover maps across a large landscape for shrub, herbaceous cover, litter and bare ground.

The 1m-resolution cover maps are then used to train 30m-resolution Landsat images, producing maps of shrub, herbaceous cover and bare ground (litter cannot be mapped at the Landsat resolution). Although Landsat imagery is at a much coarser spatial resolution, Landsat images are available over many years, which can provide a time series to track change. In short, the EST process can produce detailed maps of ground cover at different scales and over time.

ORC initially tested their EST method on 50,000 acres of the 250,000-acre Deseret Land and Livestock (DLL) Ranch in northern Utah. With the assistance of the study's co-authors from Utah State University and Brigham Young University, the team statistically validated their cover interpretations against field data. Cover classification for GBVP photos was tested against the color-coded nails placed in uniform cover types within each photo, which showed >90% accuracy for cover interpretation. Similarly, interpretation of satellite images was tested against independent field data from a study of sagebrush removal that had produced a set of treatment plots visible on the satellite images. Comparison with these plots showed 85% agreement with the field data. In short, the EST technique proved to be both highly accurate and repeatable.



The EST method of interpreting satellite imagery was validated against field data from an independent study of sagebrush removal. The study test plots can be clearly seen in this Ikonos satellite image. Comparison of the Ikonos cover classification with field data showed an 85% agreement. Image courtesy of Open Range Consulting.

Multiple Scales, Multiple Time Frames

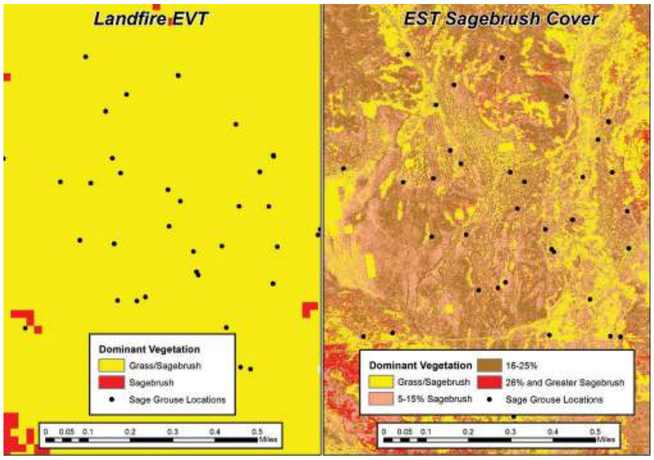
The EST technique provides land managers with the ability to assess habitat cover at multiple spatial scales and over time. The combination of GBVP photos with 1m- and 30m-resolution ground cover maps produces information across spatial scales. Managers and researchers can examine habitat use and range condition from fine-scale features at a local site, to the home range of individuals, to a geographical region at a population scale. The imagery can convey an accurate assessment not only of shrub and herbaceous cover, but also of the amount of bare ground—a key factor in range condition and the state of an ecological site.

"If we combine these maps with sage grouse telemetry data, we can start making assessments at different scales," suggests Sant. "We can ask what this grouse is selecting based on where it's sitting as well as everything around it. We can look at habitat use with quantifiable information across a landscape."

The Landsat satellite program offers an unprecedented 43-year span (1972-2015) of images across the globe. With more accurate ground cover interpretation for Landsat images, managers can take advantage of this archive to examine past range conditions, capture the historic context of sage grouse habitat, and track changes to the present. In addition, the efficiency of the EST technique could allow managers to establish a present day baseline and then revisit sites affordably to track changes in condition.

ORC estimates that a range assessment using the multi-scale EST technique, including GBVP photo plots and aerial or satellite image interpretation, costs a fraction of assessments based on traditional field methods. A single trained technician can produce 15 GBVP photos per day, and it requires 100 to 200 GBVP photos to fully sample the variation in cover in an area of 100,000 to 500,000 acres. Using the GBVP photos to interpret 1m-resolution NAIP or Ikonos images produces a continuous map of cover across a large landscape with high spatial detail.

Because the process of acquiring GBVP photo plots is relatively low cost, very large areas can be sampled and interpreted efficiently, whereas traditional field methods allow agencies to assess only a small fraction of rangelands in a season. The GBVP photo archive can also be revisited for other information, such as differentiating cheatgrass or other species. Further, GBVP photos can be repeated at the exact location if needed, and the method can be used as an effective monitoring tool for adaptive management.



Landfire geospatial maps (left) commonly used by resource agencies provide information on ground cover at a coarse scale. EST cover maps provide a finer level of detail to inform management decisions. Graphic courtesy Open Range Consulting.

Putting It Into Practice

In partnership with SGI, NRCS, and BLM, Open Range Consulting has applied the EST technique to mapping rangeland cover on nine sage grouse-related projects totaling six million acres in four western states. For example, in Wyoming and Nevada, EST cover maps helped inform sage grouse mitigation for oil and gas development, for monitoring wildfire rehabilitation treatments, and for planning and monitoring of sagebrush habitat treatments. In Utah, NRCS and Utah Department of Agriculture and Food (UDAF) created baseline cover maps to help plan juniper removal and habitat conservation projects.

Near Roundup, Montana, SGI, NRCS, and BLM combined four years of sage grouse telemetry with the EST high-resolution cover maps to evaluate habitat across a 500,000-acre sage grouse priority conservation area. The EST cover maps reveal habitat preferences in fine detail, showing grouse habitat selection in relation to percent bare ground, herbaceous cover, and sagebrush cover at multiple scales. The high-resolution maps allow managers to better see, quantify, and understand the big picture: how grouse choose seasonal habitats in the context of habitat patterns and resources across an entire landscape, as well as the fine-scale characteristics at a nest or brood-rearing site.

In the Montana study, this new perspective is being applied to sustainable grazing management. Landowners who signed up to work with SGI are using rotational grazing schedules to sustain perennial grasses and boost rangeland health for the benefit of both grouse and livestock. The high-resolution cover maps allow managers to identify preferred habitat conditions and target sites with potential for habitat improvement. Ultimately, this multi-scale view of habitat use and range condition can help SGI, resource agencies and landowners do a better job of range management for grouse and livestock while saving time and conservation dollars. It is one more powerful tool in the toolkit to help manage rangelands sustainably.

Contacts

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To learn more about the Sage Grouse Initiative and sustainable management of sagebrush rangelands, visit the SGI website at: **http://www.sagegrouseinitiative.com/**

Eric Sant (left) and Gregg Simonds (right) of Open Range Consulting based in Park City, UT, developed Earth Sense Technology, a land cover mapping technique to assess rangeland condition more accurately and at higher resolution than previously possible.

Source

Sant, E.D., G.E. Simonds, R.D. Ramsey and R.T. Larsen. 2014. Assessment of sagebrush cover using remote sensing at multiple spatial and temporal scales. Ecological Indicators 43: 297-305. **http://dx.doi.org/10.1016/j.ecolind.2014.03.014.**

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