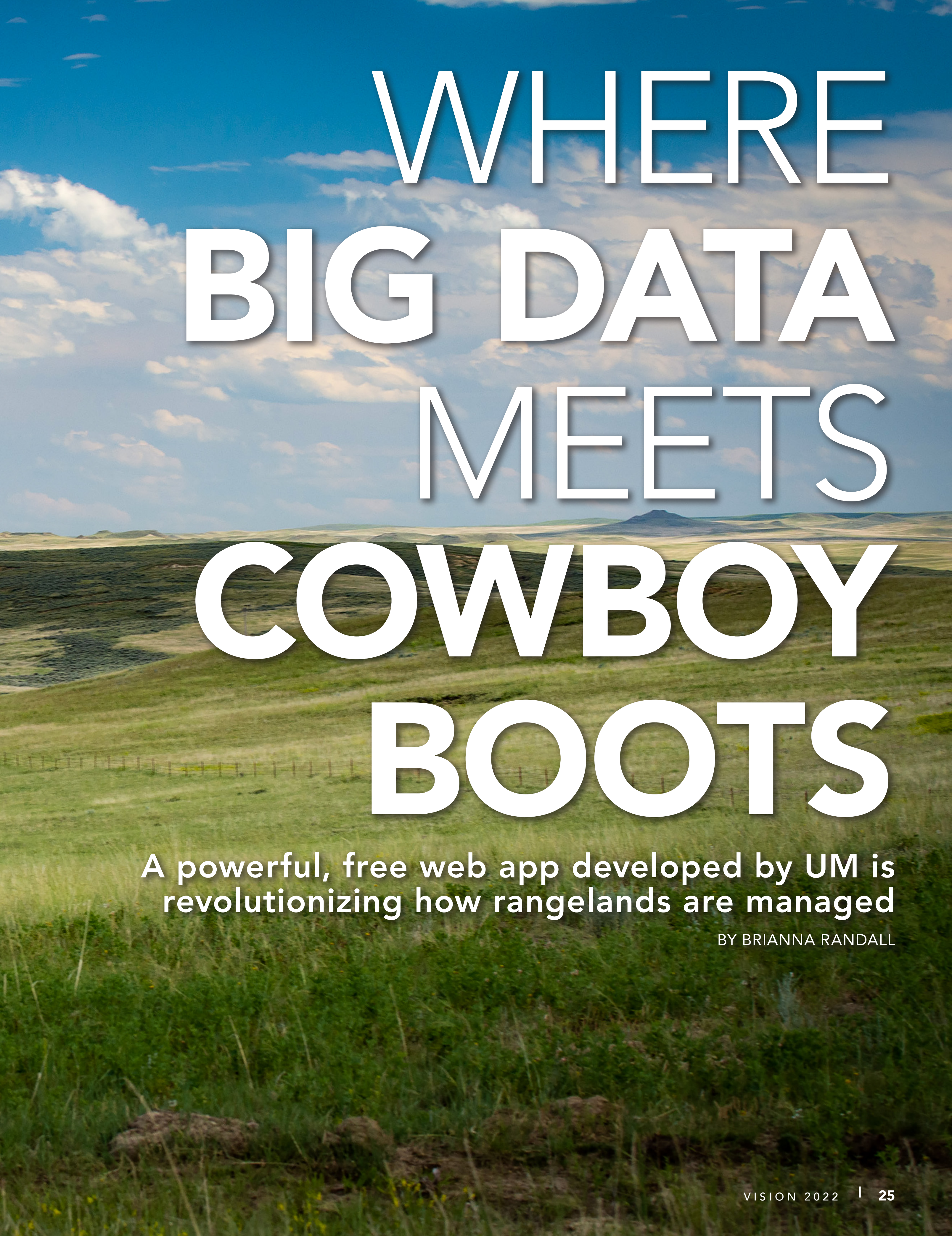

WHERE BIG DATA MEETS COWBOY BOOTS

A powerful, free web app developed by UM is revolutionizing how rangelands are managed

BY BRIANNA RANDALL

Sage grouse strut during their elaborate mating dances while cattle graze in the background. (Photo by Ken Miracle)

To get deeper into the weeds – as well as the vital grasses and shrubs they replace – Brady Allred realized he needed to zoom out. All the way to space.

"To move the needle on rangeland conservation, I wanted to better understand what was happening on these landscapes – not just on one plot in the backyard, but across the whole continent," says Allred, a rangeland ecologist and professor in the University's W.A. Franke College of Forestry and Conservation.

Rangelands are places where wildlife or livestock graze on grasses and shrubs:

Think rolling waves of grass and the vast sagebrush sea. These lands cover one-third of the United States, producing food, fiber and important ecosystem services. Unfortunately, they also are some of the most imperiled ecosystems on Earth.

"Our goal is to conserve large, intact rangelands," says Allred, gesturing at colorful maps splayed across his laptop in UM's Interdisciplinary Science Building. "This is where our beef comes from, where carbon is stored, where wildlife lives. But to be successful, we first need to know what kind of vegetation grows where, how much and how it's shifting."

Allred teamed up with fellow UM researchers David Naugle, a wildlife biologist, and Matthew Jones, a remote sensing specialist, to create a revolutionary web app called the Rangeland Analysis Platform, which tracks vegetation and its production over time and space. Known as RAP, it pairs data from satellite imagery with thousands of on-the-ground field plots to show how plant communities have changed across the western half of the U.S.

Plants – especially native perennial grasses – provide the foundation for productive and profitable rangelands. But there hasn't been an accurate and easy way to see how much grass is growing across large landscapes. Instead, landowners and resource managers had to leaf through 50-year-old resource surveys or laboriously cut, dry and weigh the plant material growing on a square meter of ground to get an estimate for a parcel of land. As for satellite imagery datasets or models that analyzed vegetation at broad scales, the information would normally come as enormous, unwieldy, often intractable files – ones that require special training to process.

Now, thanks to RAP, tracking plant growth across time and space is as simple as a few clicks of a mouse.

"We're definitely not the first people to propose harnessing satellite data as a way to monitor vegetation," Allred says. "We were simply able to serve it up in a way that makes it easy for everyone to use."

Part of what makes RAP revolutionary is that it's powered by Google Earth Engine, which lets anyone instantaneously visualize vegetation cover from the Mississippi River to the Pacific Ocean. The app gives an estimate of the percentage of annuals, perennials, shrubs, trees or bare ground. Data can be displayed and downloaded for a baseball-diamond-sized pasture or for the entire Great Plains – all in less than one minute.

Plus, app users can compare how plants have changed from year to year all the way back to 1984, when Landsat satellite imagery first began, or even month to month. This is handy for showing where unwanted trees are taking over prime prairie, where plows have removed native plants over the past decade or where invasive cheatgrass is increasing wildfire risk in the western U.S.'s Great Basin.

UM researcher Brady Allred led the creation of the Rangeland Analysis Platform.

Private landowners across the West are finding immense value in being able to track vegetation. A rancher in Wyoming can quickly create a map showing where to target weed treatments and then evaluate whether it boosted range health. A farmer in Kansas can calculate how much grass has been lost to encroaching eastern redcedar trees. A livestock owner in Oregon can see how a bad drought affected high-elevation pastures.

Government agencies also are jumping at the chance to use this powerful app. Public land managers like the Bureau of Land Management and the U.S. Forest Service are using RAP to track the health of grazing allotments, evaluate outcomes from restoration projects and identify where to conserve habitat for imperiled species like sage grouse. The USDA's Natural Resources Conservation Service is integrating RAP into its field assessments on private agricultural lands to help create sustainable grazing plans that protect water, soil and grass.

According to RAP co-creator Naugle, who is also a science adviser for NRCS Working Lands for Wildlife, the app gives "supporting evidence" for how, where and why to conserve rangelands in the American West.

"From a wildlife perspective, we need large, resilient, interconnected landscapes," Naugle says. "RAP gives us a way to surgically address the biggest threats facing these at-risk biomes: encroaching trees, invasive annual grasses and land conversion."

In the Great Plains, Naugle points to landowner-led groups who are using RAP to plan prescribed burns that will keep eastern redcedar at bay and restore prairies. In eastern Montana's grasslands, the Nature Conservancy is using RAP to pinpoint where conservation easements can protect biodiverse grasslands from being plowed up to become marginal cropland. RAP's online platform also includes a tool that overlays an area's resilience and resistance to stressors like drought or wildfire.

"RAP is providing the spatial context for targeting almost $1 billion of federal Farm Bill conservation investments in the West," says Naugle. "It's big data meets cowboy boots, and it's a win for everyone."

Scientists also are using RAP to answer important research questions. For instance, Joseph Smith with UM's Numerical Terradynamic Simulation Group – which has designed software for NASA environmental monitoring satellites – is using RAP to better predict wildfires. He recently published a RAP-powered study that evaluated how much of the Great Basin has been overtaken by highly flammable cheatgrass, which helps resource managers identify and maintain remaining strongholds of healthy, native plants.

Another NTSG researcher, Scott Morford, is using RAP to model yield gaps on rangeland – how much grass the land could produce versus how much it actually produces – which is the first step for understanding how and where to restore the land's productivity.

Allred says the team plans to continue to improve and build upon these datasets, as well as create new ones.

"All of us believe in the co-production of science," Allred says. "That means first listening to what people need from researchers, and then going the very last mile to get that information into their hands so they can change the world." •