

Complex Research Program Moving Ahead at Livermore Woman's Ranch

By Jeff Garberson | Posted: Thursday, September 8, 2016 12:00 am

On a Livermore woman's ranch near Willits, researchers from the University of California at Berkeley are making progress explaining how subsurface geology can determine why one area supports forests and another dry grassland, and why streams rush down one hillside while dry arroyos punctuate another.

In time, the efforts may lead to improved approaches to water management in drought-stricken country with a rising population.

For now, however, the researchers are helping to shed light on the complex and dimly understood relationship between geology, subsurface water storage and the kinds of surface vegetation that can thrive in the annual wet and dry weather cycles of northern California.

The site of many of the studies is the Sagehorn-Russell Ranch, owned by retired Livermore High School field biology teacher Marilyn Russell. Russell grew up and was home schooled there. She retains a love for the land that she covered on horseback as a girl and that she still rides today when she visits from Livermore.

The ranch's terrain is dry and rugged, situated mostly above 1,800 feet in elevation. It is more grassland than forest, located near the headwaters of the south branch of the Eel River, which flows north toward Humboldt Bay and the Pacific Ocean.

Countless measurements

During the past year, the Berkeley researchers have made countless measurements of the soil, water and vegetation on the Sagehorn-Russell and on nearby parts of UC's Angelo Coast Range Reserve, a 4,000-acre site at lower elevation that turns out to have different geology and therefore different capacity for water retention and different plant growth.

The scientists have examined drill cores to learn how moist it is at different depths and different times of year; recorded stream flow during winter rains; mapped the DNA of underground microorganisms; measured tree sap flow under different conditions; and compared the isotopic fingerprints of groundwater with that flowing through nearby plants.

Berkeley graduate student Jesse Hahm is one of those involved. As he explained in an interview, his goal is to create a comprehensive understanding of what is sometimes called hydroecology. This incorporates such factors as the ability of the subsurface earth to hold rainwater like a sponge or shed it like a full bathtub, the likelihood that streambeds will flow all year or will dry up in the summer, the kinds of trees, grasses and bushes that thrive in the local environment and where they draw water from.

The project has found that the Angelo Reserve in some places has a cover of many tens of feet of soil able to soak up heavy winter rain, some of which trickles out in year-around streams and some of which remains available to plants with deep root systems through the dry Northern California summer. As a result, large trees like Douglas fir can grow in the Reserve's characteristic forests and provide homes for a wide range of wildlife.

By contrast, the Sagehorn-Russell lies above a rock type called *mélange*, colloquially called "blue goo," which is heavy in clay and tends to shed rain as runoff. Little deep moisture is available, so grasslands dominate rather than trees.

To Marilyn Russell, the ranch's owner, it was no surprise to hear that a modest amount of rain can cause a lot of runoff flooding. She remembers missing school as a child because the creeks rose suddenly and became impassable, or spending the night away from home with her grandmother because she couldn't return for the same reason.

Once, when her mother was driving her to school in a rain storm, the car stalled in a dangerously rising creek that was just starting to slide sideways when the motor caught and they were able to drive away.

No picnic

Carrying out the research today is no picnic. The terrain is rugged. The summers are hot and dry, the winters cold and sometimes rainy, despite the current prolonged drought. Last winter, Hahm said, the Sagehorn-Russell had 75 inches of rain, around five times Livermore's average annual rainfall total.

Because the ground saturated quickly, most of that rain poured off, racing down creek beds that had been dry in the summer, eventually finding its way to the Eel River. Flow rate is one of the things the scientists measure, wading into streams with flow meters, but last winter the current was so strong that they sometimes had to abandon their efforts for safety.

The Sagehorn-Russell Ranch is a particularly valuable place to do science, Hahm said, because its careful land and cattle management practices have left nature in something close to its original state.

He said it is also “awesome to hang out” with Russell, who visits often from Livermore, who knows every foot of the ranch after growing up there and who is an endless source of information about plants and animals after teaching field biology.

“We’ll frequently be doing research on a ridge and she’ll appear on her horse, slowly making her way to us. It is really fun to learn from her.”

In contrast to modern industrial farms, where cattle are often congregated for efficiency, water and feed on the Sagehorn-Russell are provided at scattered hilltop sites to keep cattle spread thinly and prevent overgrazing in any one area. This is a point of pride for Russell, as is the existence of stands of native perennial grasses on the ranch. She is taking legal steps to preserve and protect the land in perpetuity.

Allowing the research to take place is part of this effort. Although a passion for privacy is a part of the cultural DNA of many ranchers, and of Russell herself, she encouraged the Berkeley teams to visit and study because she believes that detailed scientific understanding of its present status is an essential part of future preservation.

Critical Zones

On a national scale, the Berkeley studies are part of an effort aimed at understanding the so-called Critical Zone, described by the National Science Foundation as “where rock, soil, water, air and living organisms interact to shape the Earth’s surface.”

It is a part of the Earth that is gaining increased attention worldwide, with Critical Zone scientific observatories scattered around the U.S. and as far away as China and Australia.

The Sagehorn-Russell Ranch and Angelo Reserve are within the Eel River Critical Zone. Scientists from other universities and from abroad visit frequently to observe the Berkeley research and share information about comparable work elsewhere.

The scientists also share information at scientific conferences and through publications. Hahm, for example, hopes to present his findings at the upcoming meeting of the American Geophysical Union in San Francisco in December.