As human activities continue to expand, an increasing number of plant species face habitat loss and fragmentation. The shrubby reed-mustard (Schoenocrambe suffrutescens)—a federally listed endangered perennial shrub endemic to the Uinta Basin in northeastern Utah—is one such plant.

Natural gas and oil extraction projects have grown recently in this part of Utah, and increasing construction of roads and well pads has fragmented shrubby reed-mustard habitats and threaten the species with extinction. Recent population surveys have indicated there are fewer than 3,000 individuals in the wild.

A study in the March–April 2016 issue of the Soil Science Society of America Journal reports on a computer model that might help preserve the shrubby reed-mustard. Janis Boettinger, an SSSA member and soil scientist at Utah State University, and her colleagues combined field observations of soil properties with computer models built using large-scale, publicly available satellite and topographic data to accurately map and predict habitat for the shrubby reed-mustard in northeastern Utah.

Boettinger expects these models to “provide an important tool for land managers” and “help focus time, manpower, and monetary efforts into areas with greater potential for success in shrubby reed-mustard conservation efforts.”

But the utility of this computer model is not limited to the shrubby reed-mustard alone. It can also be a useful tool for efforts to conserve other plants that have special niches, Boettinger says. “If a plant species grows in areas with distinct soil characteristics, this model can be very useful to identify and predict its habitat.”

### Building the Models

Part of the challenge that researchers and land managers face in their quest to conserve the shrubby reed-mustard—and other plant species in growing in remote areas that are difficult to access—is not knowing where exactly the plants are growing.

“With the model we developed, we can look at large areas very quickly,” says study co-author Julie Baker, a soil scientist at USDA-NRCS.

“Our idea was to find large-scale information—such as soil color—from pre-existing satellite maps and digital databases that we could then connect to the known locations of shrubby reed-mustard plants,” Boettinger says.

The researchers already had GPS information for a number of sites where shrubby reed-mustard plants were growing. They combined that information with satellite maps, such as ones generated by the Landsat collection of space-based, remote-sensing data and information derived from the Digital Elevation Model, or DEM, which digitally represents elevation across landscapes.

“We found that some of the soil characteristics where shrubby reed-mustard grows have a visual component that shows up on the satellite images,” says study co-author Brook Fonnesbeck.

For example, the shale soils where shrubby reed-mustard plants grow were lighter in color while surrounding areas where shrubby reed-mustard isn’t commonly found comprised redder and darker sandstone soils.

Landsat maps also detect vegetation cover and showed that shrubby reed-mustard plants typically grow in low-vegetation areas.

The researchers initially visited 25 locations where shrubby reed-mustard plants were growing and 24 locations without the plant to measure several soil characteristics. They found that several soil characteristics, including calcium carbonate content above 450 g kg⁻¹ of soil, silt content over 50%, and pH values over 8.5, positively correlated with shrubby reed-mustard habitats.

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Lower Big Pack Mountain in the Uinta Basin in northeastern Utah. Photo by Julie B. Baker.
These soil measurements were combined with data derived from the Landsat and DEM databases to create a model, called the Spectral-Topographic, or ST, model. The researchers used the ST model to try to predict where shrubby reed-mustard plants would be found.

The ST model worked with an accuracy of about 70% when tested against a database of almost 1,700 shrubby reed-mustard sites. For several of the locations that the model missed, “we were very close to the presence of shrubby reed-mustard,” Boettinger says, “but the satellite images didn’t have the spatial resolution we needed to be more exact.”

Boettinger is working to further refine the model. “If we can quickly and accurately model potential habitats, then we can know where to put roads or well pads to minimize disturbance and habitat fragmentation,” she says. “Additionally, if we have a map of potential habitats, we can quickly search for previously undiscovered populations and pinpoint locations with the highest potential for success if we have to reintroduce a species into the wild.”

Plants not only provide us with vital resources such as food and medicines, but also provide ecosystem services such as reducing soil erosion and filtering ground water. “We need to protect plant biodiversity to maintain ecosystems and conserving rare plants like the shrubby reed-mustard is an important part of that effort,” Boettinger says.

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