Knowing Where To Look for Infestations of Leafy Spurge

Using NASA's advanced hyperspectral sensor, the Airborne Visible Infrared Imaging Spectrometer (AVIRIS), Raymond Hunt and colleagues have developed and tested a new method for locating leafy spurge *(Euphorbia esula),* a noxious invasive weed that causes more than $200 million a year in losses in the Great Plains and western United States.

Hunt is a physical scientist with the Agricultural Research Service's Hydrology and Remote Sensing Laboratory at the Henry A. Wallace Beltsville [Maryland] Agricultural Research Center.

Blossoms of leafy spurge, *Euphorbia esula.*

ARS PHOTO (D1415-1)

Leafy spurge is a 1- to 2.5-foot-tall perennial herb that displaces native vegetation and spreads both by seeds and by underground rhizomes. Shoots produce a milky-white sap that is toxic to cattle and horses. It is a serious problem in Montana, North Dakota, South Dakota, Nebraska, and Wyoming. Infestations of leafy spurge can be controlled by goats, biological control (*Aphthona* flea beetles), or pesticides.

Hunt and colleagues were among the first researchers to detect invasive weeds by using algorithms developed to detect minerals in rocks and soil by hyperspectral remote sensing. The method works by analyzing visible and near-infrared sunlight, reflected off vegetation back to the AVIRIS sensor aboard NASA aircraft.

They used the algorithms to detect leafy spurge during its flowering stage, in June and July. The flowers have yellow-green bracts that are very showy. "This is the only time we can distinguish leafy spurge from surrounding native vegetation in grasslands or along streambanks," Hunt says.

The method locates leafy spurge because its flowers reflect different colors of light than the surrounding grass and other green vegetation do. When tested against field data, the method proved to be 85 to 95 percent accurate—much higher than other methods of remote sensing tested in the same area.

This research was originally started under the auspices of TEAM Leafy Spurge (www.team.ars.usda.gov), a consortium that brought together ARS, USDA's Animal and Plant Health Inspection Service, university scientists, and other federal and state agencies to study methods for controlling this invasive weed.

Working with John Gillham of the USDA Forest Service, Hunt is also refining the Weed Invasion Susceptibility Prediction (WISP) model to show areas where leafy spurge and other invasive species are likely to grow. Gillham developed the model when he was a graduate student at the University of Wyoming. "This software guides humans searching on the ground," Hunt says.

The problem is that there is often insufficient ground data to accurately characterize where leafy spurge grows. Hunt used the AVIRIS remote-sensing data to improve the WISP model.

The model was validated with remote-sensing data at Devils Tower National Monument in Wyoming, Fishlake National Forest in Utah, and the Theodore Roosevelt National Park in North Dakota. Having maps of favorable habitat improves the efficiency of field crews for monitoring leafy spurge. "This is especially true for levels of infestation that are too small to be spotted by remote sensing," Hunt says. "Fighting leafy spurge and other invasive weeds requires techniques for predicting where they may grow," Hunt says.

The WISP model can be used by anyone with access to ESRI's (Redlands, California) ArcGIS Geographic Information Systems software, which includes all federal agencies as well as an increasing number of state agencies, weed and pest districts, farmers, and ranchers.

At Fishlake National Forest in Utah, where leafy spurge had not been found before, researchers found 17 infested sites. The model had predicted 14 of those sites, including all of the major infestations.—By **Don Comis,** ARS.

This research is part of Water Availability and Watershed Management, an ARS national program (#211) described on the World Wide Web at www.nps.ars.usda.gov.

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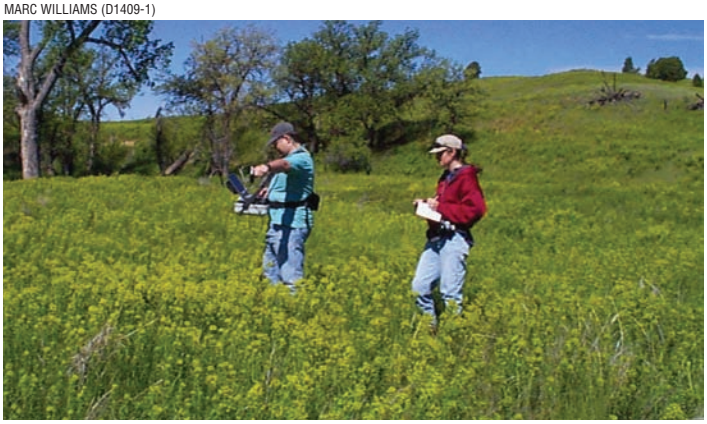

Physical scientist Raymond Hunt (left) and Amy Parker Williams, formerly a graduate student at the University of Wyoming, measure spectral reflectance of flowering leafy spurge with a spectrometer. The field data was used to calculate the amount of leafy spurge for each pixel in aircraft and satellite images.