



## The War on Terra

### NASA Helping to Develop Technology to Detect and Prevent Spread of Invasive Species

Research scientist Thomas Stohlgren is drawing the battle lines to combat what he describes as the number one environmental threat of the 21st century – invasive species. More specifically, Stohlgren, an employee of the United States Geological Service (USGS), alongside Colorado State University Professor K. George Beck, are partners with the National Aeronautics and Space Administration (NASA) to map the presence of invasive plants across the United States.

Invasive plants cost the nation billions of dollars in damages. Some are poisonous to cattle and wildlife. Others compete with native plants and degrade the environment. It has been difficult to develop strategies to control these plant populations because they are poorly mapped and documented. This is where Stohlgren steps in. Using a combination of remote sensing (satellite images and aerial photography), high-performance computing, and new spatial models developed by Colorado State University in cooperation with NASA, Stohlgren and his team are able to identify where invasive species are growing and pinpoint potentially vulnerable areas.

The project began with what seemed like a modest goal: Catherine Crosier, a Ph.D. student, was hired to gather datasets on the top 25 weeds in Colorado. She soon found out that there were more than 40 different weed data services, including the USGS, wildlife refuges, and state heritage sites, that all were collecting data in different formats. Eventually, a team of researchers including Crosier and Stohlgren succeeded in combining the datasets and creating a predictive model.

To create the model, samples were taken by county weed coordinators and resource managers of different environmental areas in Colorado. The most dangerous species were identified, and areas vulnerable to invasion were quantified. It was necessary for the model to provide good predictions of where species are likely to invade because sampling is costly and almost impossible over such a huge area.

While looking at a colorful map that shows the web-like spread of the tamarisk along Colorado's waterways, Stohlgren says, "Our emphasis is on early detection and rapid response. We treat the presence of invasive plants like a wildfire. We look for where we can place containment boundaries and extinguish young populations like spot fires."

Tamarisk, or salt cedar, is one of Colorado's top ten invaders. It has pretty flowers but accumulates salt in its tissues and later releases the salt in the soil, making it unfit for many native species. Leafy spurge, Canada thistle, field bindweed, Russian olive, musk thistle, and knapweeds are also high on the list of plant invaders. "In the last century, many invasive plants used to come in to the country with forage seeds," Stohlgren says. "Now, horticulture often brings them in. Kudzu was brought in to stabilize soil in the southern United States. Tamarisk was brought in from Asia as an ornamental. Sometimes, it's like we're playing Johnny Appleweed."

Invasive plants like the same conditions that native plants do: high light, high water, high nitrogen. They are found in agricultural fields, along roads and disturbed areas, and in low areas in riparian zones and wetlands. Stohlgren says that one of the things that surprised him was how his research shows that

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the rich just keep getting richer. "Areas rich in native species," he explains, "also attract more weeds. There's no sign of competitive exclusion: High plant diversity does not create an environment that precludes coexistence.



So far, there are few extinctions in these rich environments but lots of coexistence." Of course, this may change in the future. All sorts of things may change in the future.

Stohlgren warns that we are living in a time of "Darwin on steroids." Ecology seems to be moving at a faster pace than at any time in human history. "In response," he says, "we need to become much smarter faster." Stohlgren looks with hope towards an invasive species technology forecasting system that

NASA is helping to develop. "What seems impossible today will be possible tomorrow," he says. As an example of the way technology has helped to speed up the chase, Stohlgren points out that models that used to take

16 days to run on a workstation now take less than two minutes on the NASA/USGS supercomputer.

The threat of invasive species delivers a call for collaboration. Right now, Stohlgren and his team are responding with research that establishes the idea of a virtual institute where everyone – from Larimer County

junior high school students to Cooperative Extension, from the Nature Conservancy to the USGS – contributes. Each year, the Colorado Agricultural Experiment Station contributes about \$25,000 to this project, which leverages almost \$1.5 million per year from NASA. The findings of this cooperative effort are disseminated using scientific papers, Web sites, and training. Combining funds, expertise, and data is the only way to win the war.

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## One if by Land, Two if by Sea

Thomas Stohlgren likes to point out that invasive plants should be looked at as a part of a greater invasive species problem. "Compared to many invasive species, plants are more immediately identifiable and more easily controlled, but we need to remember that we're being invaded by a variety of species by land and by water. We all need to be vigilant."

Current invaders of concern include:

- Whirling disease – This parasitic infection attacks juvenile trout and salmon. Whirling disease has been found in 22 states including Colorado.
- Purple loosestrife – This highly ornamental plant from Europe can be seen along waterways throughout Colorado. When not controlled, a wetland can become a monoculture of loosestrife, impeding irrigation flows and endangering waterfowl habitat.
- West Nile Virus – In the past few years, Colorado has been the poster state for this invader. Humans, horses, and birds are most severely affected by the virus. In 2003, West Nile Virus killed 63 people in Colorado.