Lassoing Wicked Weeds of the West

The Wild West.

It's an apt term when you consider how many leafy, exotic "outlaws" are overrunning pastures, hills, and valleys west of the Mississippi.

But ARS scientists and others are giving chase, pitting their knowledge and sustainable, science-based strategies against invasive weeds to stop their spread.

One of the most aggressive of these intruders is leafy spurge. This lanky perennial, actually a distant cousin of the poinsettia, made its way here from Europe and Asia. The yellow-flowered weed has doubled in acreage every 10 years since the early 1900s. It now infests over 5 million acres in 35 states and Canada, costing land managers around $144 million a year in control costs and other losses.

With the ambitious goal of cutting off—or at least slowing—spurge's relentless march across the Great Plains, ARS scientists at the Northern Plains Agricultural Research Laboratory in Sidney, Montana, formed "The Ecological Areawide Management of Leafy Spurge Program," or "TEAM Leafy Spurge" for short. Over 6 years, this cooperative, multiagency effort proved to many in the region—and elsewhere—that biologically sound tactics can make a significant dent in spurge populations.

Their most convincing accomplice in this "purge-the-spurge" endeavor?

A tiny beetle.

NORMAN REES (K2602-21)

Leafy spurge overtaking a hillside in Colorado.

(K2602-4)

***Aphthona flava* flea beetle feeding on leafy spurge.**

Miniscule, Yet Mighty

It may be slight—less than one-half-inch long—yet the flea beetle, genus *Aphthona,* could be a rancher's best weapon against spurge. This insect gets its "flea beetle" moniker from its tendency to briskly hop about. Unlike its namesake, however, it doesn't bother people, pets, or livestock.

The beetle has a well-honed taste for spurge, having been associated with the plant for thousands of years. That's according to David J. Kazmer, an ARS entomologist at Sidney involved in TEAM Leafy Spurge.

Flea beetles provide a powerful, two-pronged attack, says Kazmer. Adults nibble away on the plant's leaves and bracts, while their translucent, grublike larvae chew their way through the roots—a "direct hit to the plant's food reserves," Kazmer notes.

Aphthona beetles have reduced leafy spurge canopy cover and stem densities by as much as 95 percent at sites where they've been turned loose. Ranchers and landowners got to see the insects' impact with their own eyes during field tours and other popular TEAM Leafy Spurge events.

ARS scientists working in the United States and Europe began searching for natural enemies of spurge more than 20 years ago. Their studies revealed *Aphthona's* aptitude for stopping spurge and later confirmed that it feeds only on leafy spurge and does not pose a threat to crops or garden plants.

TEAM Leafy Spurge has logged some impressive stats. An estimated 45 million beetles were put to work over the length of the project. Many of those were given to landowners.

Beetles—or another spurge-suppressor, sheep—knocked back leafy spurge by 90 to 100 percent at the program's four main research and demonstration sites in North Dakota, South Dakota, Montana, and Wyoming. Plus, thanks to ambitious tech-transfer efforts, a core group of ranchers and land managers is now using beetles, sheep, or both to tame leafy spurge.

There's more. Herbicide use is expected to be reduced by at least 768,000 pounds in

the 4-state project area by 2008. Within the same period, increasingly healthy grasslands are expected to support an additional $1 million in livestock production.

The project, especially its efforts to reach out to and educate landowners, is largely regarded as a great success.

But scientists—including Kazmer—aren't finished yet.

"We're looking at enhancing our biological control strategies by using synthetic versions of the pheromones the beetles emit when hundreds of them cluster in one spot," he says. Releasing such compounds into the air might entice the beetles to expanses of spurge that have yet to feel their bite.

Squelching Saltcedar

Meanwhile, another diminutive beetle is sating its appetite on the leaves and twig bark of another aggravating weed—saltcedar. Though attractive and graceful, this tree is an unwanted invader of streamsides and riverbanks throughout much of the West. But the brown-and-yellow, nearly quarter-inch-long *Diorhabda elongata* beetle now has a solid track record of tackling saltcedar, also known as "tamarisk."

Native to a region stretching from Asia to the Mediterranean, saltcedar was brought to America for the best of reasons: To stabilize soil. Today, it is shunned as a troublemaker in more than 20 states—from Wyoming south to Texas and west to California. It crowds out native species like willows and cottonwoods and creates impenetrable thickets that block livestock and wildlife—as well as rafters and canoeists—from reaching water. Where this renegade sheds its salt-rich foliage, other plants can't thrive.

ARS's interest in stopping saltcedar dates back to the 1970s and more recently took shape in extensive federal, tribal, state, and university collaborations coordinated through the Saltcedar Biological Control Consortium. As in the assault on spurge, the beetle recruited to whip saltcedar has won center stage and is now feasting on the plant in several western states. More states are waiting for the permissions needed to put the beetle to work.

Collected by ARS scientists and colleagues in China, Greece, and elsewhere, and vetted in laboratory, greenhouse, and outdoor-cage studies, *D. elongata* achieved its greatest impact—so far—along the Humboldt River outside Reno, Nevada. There, it expanded from a modest 8 acres in 2003 to 65,000 acres by 2006.

The beetles' prowess there is easy to see in imagery taken by the National Aeronautics and Space Administration (NASA) from far above Earth. The pictures allow the researchers to measure the beetle's progress more effectively than perhaps any other wildland biological control agent has ever been monitored.

A collaboration launched in 2006 between ARS and NASA focuses on this spectacular imagery and builds on NASA's computerized, math-based models that predict winds and temperatures for vast landscapes. To these models, ARS will add the newest data on the biology and ecology of the beetle and the tree, to reliably predict the future of both.

***Arundo donax:* A Persistent Giant!**

Yet another spoiler of western waterways—giant reed or *Arundo donax*—has become such a nuisance that it now ranks as a top target for ARS entomologist John A. Goolsby and teammates.

JOHN GOOLSBY (D823-1)

At an APHIS quarantine facility near Weslaco, Texas, ARS technician Ann Vacek measures growth of *Arundo donax* plants exposed to the *Tetramesa romana* wasp (left enclosure) and plants not exposed (right enclosure).

Arundo is "tenacious and aggressive, and it's been around for centuries in North America," says Goolsby. *Arundo* can easily grow 3 to 7 inches a day and reach up to 30 feet in height.

Sometimes called "carrizo cane" or "Spanish reed," this exotic was brought to North America in the 1600s from Mediterranean Europe for making baskets and roof thatching.

Even though *Arundo* can still be put to beneficial uses, such as making fine-quality reeds for musical instruments, "its negatives far outnumber any positive traits," Goolsby notes.

Giant reed invades riparian habitats and irrigation canals, leading to loss of biodiversity, catastrophic streambank erosion, and damage to bridges. Also, it increases costs for chemical and mechanical control along waterways. Like saltcedar, it competes for water in arid regions—at the expense of farms, cities, and the environment.

Today, *Arundo* has made inroads in Virginia, Kentucky, and other eastern states and has overtaken large areas of the American Southwest and northern Mexico. It has become especially problematic in the Rio Grande basin.

Goolsby, who works at the ARS Beneficial Insects Research Laboratory in Weslaco, Texas, and collaborators James H. Everitt—a rangeland scientist—and agricultural engineer Chenghai Yang are using remote sensing to delineate *Arundo*'s distribution and density along the Rio Grande and its tributaries. With Texas A&M University scientists, Weslaco specialists are assessing how much water *Arundo* actually uses.

Biological control using insects from the native range of *A. donax* may be the best option for long-term management of the weed, says Goolsby. *Arundo* is an especially good target for biological control because it has no close relatives in North or South America, he points out.

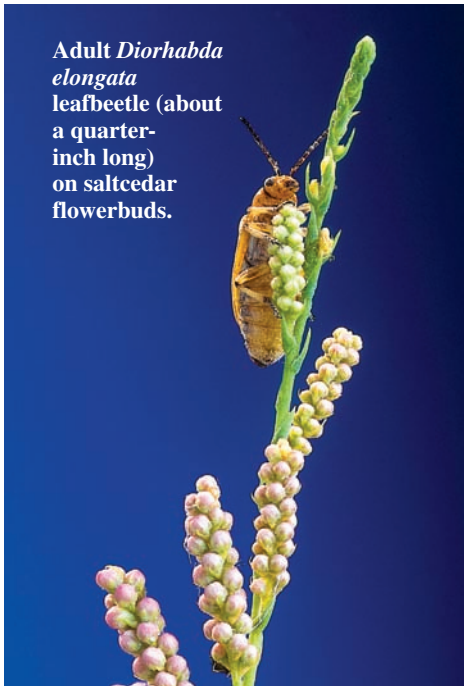
So far, three insects seem to offer the most promising long-term solution. *Tetramesa romana,* a wasp that's harmless to humans and animals, feeds on new *Arundo* shoots and canes. The wormlike larvae of *Cryptonevra* flies prefer the tightly compacted new shoots. *Rhizaspidiotus donacis,* a flat-bodied scale insect, favors *Arundo* roots and tubers.

ARS scientists based at the European Biological Control Laboratory in Montpellier, France—right in the heart of *Arundo*'s native range—identified these insects as excellent candidates and determined that they feed only on *Arundo*. Now those researchers—laboratory director Walker Jones and entomologist Alan A. Kirk—have shipped the insects to Weslaco for further scrutiny. Insects that pass rigorous lab and greenhouse tests might be okayed for outdoor use in 2 to 3 years. That would make these tiny weed whackers the first ever used to quell *Arundo* in the United States.

JOHN GOOLSBY (D824-1)

A *Tetramesa romana* larva (bottom) chews its way through this cross section of *Arundo donax* stem.

PEGGY GREB (K11821-1)



Adult *Diorhabda elongata* leafbeetle (about a quarter-inch long) on saltcedar flowerbuds.

Managing Medusahead

While *Arundo* attempts a takeover of western waterways, another menace has rapidly dominated millions of acres in the Pacific Northwest. Aggressive and unruly in appearance, medusahead edges out native plants. And with far more silica than most grasses—11 to 15 percent, compared to 1 to 3 percent—it is less palatable to grazing animals.

Fortunately, new research and outreach efforts are helping landowners manage

BRETT BINGHAM (D822-1)

Medusahead.

JACK DYKINGA (K8770-1)

Saltcedar, an invasive exotic weed, crowds out native vegetation along the Gila River in Arizona.

this monster. ARS ecologist Roger L. Sheley, at Burns, Oregon, leads a research team that has organized several groups in eastern Oregon to improve regional weed management—with a special focus on medusahead.

"Often, weeds are the symptom of some underlying ecological problem," Sheley says. "Until that problem is identified and corrected, the weeds will dominate and resist efforts to kill them."

With research leader Anthony J. Svejcar and ecologist Jane M. Mangold, Sheley has developed a decisionmaker's tool to identify the three leading conditions necessary for a weed to prevail: disturbance, colonization, and species performance. "For a weed to prosper," says Sheley, "an ecological disturbance must create a site where it can grow, the weed must arrive there, and the environment must favor its growth." The decision tool helps managers address these three conditions.

In 2003, Sheley spearheaded the "Medusahead Challenge," involving about 130 landowners and managers from California, Idaho, Nevada, Oregon, Utah, and Washington. This program "teaches participants to recognize the causes underlying changes within plant communities and gives them strategies for developing weed-resistant plant communities," says Sheley. In fact, the Medusahead Challenge has helped establish prevention plans for about 150,000 acres, he says.

A key component of this research is "adaptive management," Sheley notes. This involves encouraging managers to test different strategies, frequently assess the effects, and adapt accordingly. Treatments are compared to untreated controls that show what would have happened if nothing had been done. "That's critical for an accurate assessment," he says.

Sheley is currently testing several ecological management theories to see whether and how they can be practically applied to the Great Basin and Columbia Plateau, where medusahead is a severe problem.

For example, the Burns scientists have studied the consequences of range-restoration techniques such as disking, a management method that involves slicing into the soil to break up weeds' root systems and to help desirable vegetation thrive. But scientists point out that disking disturbs the soil, creating a nitrogen-rich environment that could benefit fast growing weeds at the expense of desirable, but slower growing, plants.

"It's important to understand how our actions influence soil nitrogen—and, in turn, this weed," says Svejcar.

Observations like this have already helped managers establish invasion-resistant plant communities in localized areas within the region.—By **Marcia Wood, Alfredo Flores, Laura McGinnis,** and **Erin Peabody,** ARS.

This research is part of Crop Protection and Quarantine, an ARS national program (#304) described on the World Wide Web at www.nps.ars.usda.gov.

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HERB PILCHER (D577-1)

Tropical spiderwort.

Tackling Tropical Spiderwort

At the same time that weeds like medusahead are commanding ARS scientists' attention in the western United States, agency colleagues in the Southeast tangle with Bengal dayflower, also known as "tropical spiderwort," a troublesome newcomer to cottonfields there.

A savvy solution for sending this weedy pest packing? Plant early! If given a head start, cotton may hold its own against the weed. ARS agronomist Theodore M. Webster, in ARS's Crop Protection and Management Research Unit, at Tifton, Georgia, and university colleagues came up with this Earth-friendly, sustainable strategy for sidestepping spiderwort.—By **Sharon Durham,** ARS.