Dinosaur

National Park Service
U.S. Department of the Interior

Dinosaur National Monument

Our Newest Weed Warriors

***Diorhabda carinulata*, the tamarisk beetle.**

The Dinosaur National Monument Weed Warrior Program has a growing army of insect volunteers to combat the invasive exotic tamarisk plant. During the summers of 2006 and 2007, a total of 50,000 tamarisk-eating beetles were released at four separate sites in the monument.

The Problem

Tamarisk, also known as saltcedar, is an invasive exotic plant introduced to North America from Asia in the early 1800s. Originally sold as an ornamental, during the Dust Bowl era it was extensively planted for windbreaks and stream bank stabilization. Because tamarisk didn't arrive with its natural complement of Asian herbivorous insects and diseases, there was little to slow its spread in moist environments across the West.

Here in Dinosaur National Monument tamarisk creates several problems. It invades riparian habitat along the Yampa and Green rivers and their tributaries, creating dense stands inhospitable to most native birds and impenetrable to deer and bighorn sheep. The very qualities that made it attractive as a stream bank stabilizer also impact the natural flows of the rivers, increasing sediment deposition on cobble bars and narrowing the river channels—to the detriment of native fish habitat. Recreational values are compromised as well. Long-time boaters in the monument have seen their favorite lunch and camping beaches turned into dense, unfriendly thickets of brush.

What Can Be Done?

Combating the tamarisk invasion in a wilderness setting can be difficult. Three methods are now used in Dinosaur National Monument.

Physical removal of tamarisk is the most time and labor intensive because it entails digging up and removing the root crown. It also produces the best results and remains the preferred method at sites where park visitation is high. Nearly all physical removal has been done under the auspices of the Dinosaur National Monument Weed Warrior Program. In the past fourteen years, more than 6,000 Weed Warrior volunteers have contributed over 27,000 hours of labor to remove exotic plants from river campsites and other high use areas of the monument. Their contributions have been invaluable and will continue to be so in the future.

Chemical herbicides are hazardous to the environment and require skilled applicators. Application is typically made directly to freshly cut stumps (to minimize the quantity of herbicide used) so considerable labor is still required. Herbicides will continue to have a limited role in Dinosaur's Weed Warrior efforts, especially in sensitive riparian environments.

Biological control involves the introduction of insect herbivores from the same regions of the world that were the source of the invasive plants. Once established, these industrious Weed Warriors are quite happy to work just for a meal. The only insect currently approved for tamarisk is a beetle known as *Diorhabda carinulata*, or more colloquially as the "tamarisk beetle."

Yet Another Exotic? What Are The Risks?

The first reservation most people have about bio-control is by far the most important—"Wait, you want to introduce yet another exotic species? What happens when it starts to eat the native vegetation?" And this reservation is well-founded. In the past there have been a few examples of such "solutions" backfiring and creating additional environmental problems, often even more unmanageable than the original.

Fortunately, with tamarisk we have a bit of a silver lining. Most problems with introducing exotic species to eat other exotic species occur when the "solution" species jumps ship to feast on a desirable species closely related to the intended target. But tamarisk is not closely related to any native North American plant species, making the possibility of species-switching far less likely.

Of course, theory needs to be backed up by research. *Diorhabda carinulata* has been the most intensively studied bio-control agent ever released in North America. Nearly two decades of testing the beetle in association with both native and agricultural plants have shown that they always starve whenever tamarisk is not available as a food source. There are no 100 percent guarantees with bio-control, but this one comes pretty close.

Actual life size of the tamarisk beetle.

How Does The Beetle Control Tamarisk?

Both adults and larvae specialize in consuming tamarisk foliage. Adults and the larger larvae also chew on the bark of smaller twigs, creating damage that causes unconsumed foliage to shrivel and die. If a tamarisk is heavily infested, it can turn completely brown in a matter of days.

A tamarisk's foliage is its food factory, where it gathers energy from the sun and converts it to carbohydrates. When a tamarisk is severely defoliated, growth and reproduction must be put on hold while it regrows its foliage—which begins to deplete the food reserves stored in its roots.

Tamarisk is a remarkably durable plant. A single defoliation event barely breaks its stride. But the beetles are persistent, too, and repeated defoliation will reduce the plant's vigor, allowing the local native species to regain a competitive edge.

While it is unlikely that tamarisk will ever be completely eliminated from Dinosaur National Monument—no bio-control program has ever accomplished such a feat—there have already been substantial impacts on the health of many tamarisk stands in the monument.

Basic Beetle Biology

Adult beetles overwinter in the leaf litter or soil below the tamarisk plants and emerge in the early spring. After feeding, the beetles are ready for mating and egg laying.

A female can lay 10 to 20 eggs a day for the rest of her life—which will likely last only a few weeks. Eggs are laid in small clusters on the tamarisk fronds, and larvae hatch about a week later.

Tamarisk beetle eggs.

The larvae eat voraciously and grow through three distinct stages, called "instars." Each instar period lasts roughly five to seven days, but larval development can be slowed by a cold spring.

A newly hatched first instar larva is jet black and so tiny it's hard to find. Once it molts to become a second instar larva it acquires a faint yellowish stripe along its sides. After another molt, the third instar larva becomes the most striking of all, with distinct creamy-yellow stripes and white spots.

Once the third instar larvae have fully grown, they drop to the ground and enter a "prepupal" dormancy lasting several days. Next they build a pupal case out of silk, soil and leaf litter, from which they emerge as adults about a week later.

Second instar larva.

In Dinosaur National Monument this first generation of new adults emerges in mid to late July, eager to get to work eating, mating and egg laying.

The number of egg-to-adult life cycles the beetle population goes through in a season is governed by day length. By the time the second generation of adults emerges in mid to late September, the shortening days trigger a response called "diapause," in which the beetles cease mating in order to concentrate on building up fat reserves and body fluids with antifreeze properties. Before the onset of winter, the last of these adult beetles will have burrowed back into the leaf litter or soil to await the next spring.

Third instar larva.

Where Are They Now?

Diorhabda carinulata has been steadily expanding its range in Dinosaur National Monument since the original 2006 releases at Echo Park. At least small numbers can now be found in most tamarisk stands along the Green and Yampa rivers.

Beetle populations with densities high enough to create visible defoliation currently exist from Mathers Hole downstream to Echo Park on the Yampa River, and from Disaster Falls to below Split Mountain Canyon on the Green River. Expect to find mid-summer defoliation on many tamarisk stands in these reaches, with even larger areas defoliated by late August. It is anticipated that defoliation will also become common in the upper portions of the Yampa and Lodore canyons within a few years.

Beetle-caused defoliation is easily missed early in the summer. Look for a "frosted" white appearance on leaves at the tips of small stems. Later, as the larvae continue to grow and create more damage, large areas of foliage will begin to shrivel and turn a dramatic yellow-brown color.

Boaters who want to see the beetle up close should look for adults on tamarisk stands in the warmer canyon reaches starting in mid May (later in reaches upstream of Echo Park). By late June or early July expect to see many more larvae than adults. That will change in late July when the first generation larvae pupate into adults, and another round of egg laying begins. Larvae will again outnumber adults in late summer, until the second generation pupates into adults in the fall.