



Our Newest Weed Warriors



Diorhabda elongata, the tamarisk beetle. NPS

The Dinosaur National Monument Weed Warrior Program has a new 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 salt cedar, is an invasive exotic plant introduced to North America from Asia in the 19th century. Originally sold as an ornamental, tamarisk was soon aggressively promoted for windbreak plantings and as a streambank stabilizer. It quickly escaped into the wild and began to colonize river systems throughout the West.

Here in Dinosaur National Monument, tamarisk creates several problems. Introduced without its natural complement of co-evolved insect herbi-

vores, tamarisk invades riparian habitat along the Yampa and Green rivers, creating dense monocultures inhospitable to most native birds and impenetrable to deer and bighorn sheep. The very qualities that made it attractive as a streambank stabilizer also impact the natural flows of the rivers, increasing sediment deposition on the banks and narrowing the river channels—to the detriment of native fish habitat. 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 dozen years, more than 5,000 Weed Warrior volunteers have contributed over 20,000 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 has only recently become available for tamarisk. Bio-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 elongata*, or more colloquially as the "tamarisk beetle."

Yet Another Exotic? What Are The Risks?

I'm a picky eater!



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 many examples of such "solutions" backfiring and creating additional environmental problems, often even more recalcitrant 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 desir-

able 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 elongata* 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. NPS

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 in turn 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 begin to slowly starve the plant to death.

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—it is our expectation that the beetle will reduce its vigor and allow the local native species to regain a competitive edge.

Basic Beetle Biology

Adult beetles overwinter in the leaf litter or soil below the tamarisk plants and reemerge 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 might only last another two weeks or so. Eggs are laid in small clusters on the tamarisk fronds, and larvae hatch about a week later.



Tamarisk beetle eggs. NPS

The larvae eat voraciously and grow through three distinct stages, called “instars.” Each instar period lasts roughly five to seven days, but larval development is also affected by the ambient temperature—a cold spring will slow their progress.

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



Second instar larva. NPS

they emerge as adults about a week later. 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 summer is governed by day length. By the time the second generation of adults emerges in September, the shortening days of fall trigger a response called “diapause,” in which the beetles cease mating in order to



Third instar larva. NPS

concentrate on building up fat reserves and body fluids with antifreeze properties. Before the onset of winter, the last of these beetles will have burrowed back into the leaf litter or soil to await the next spring.

Where Are They Now?



Diorhabda elongata has been gradually extending its range within the monument since the original 2006 release. By the end of the 2008 season scattered adults and larvae could be found along the entire length of the Green River in the monument, and from just below Laddie Park to Echo Park on the Yampa River.

Beetle populations with densities high enough to create visible defoliation exist along the last two miles of the Yampa River above Echo Park, and in the Canyon of Lodore just above Rippling Brook and downstream of Limestone Draw. Expect to find severe defoliation on tamarisk stands at the confluence of the rivers in Echo Park, in Mitten Park, and in the narrows at the head of Whirlpool Canyon. Individual defoliated tamarisk will also

occur farther downstream in Whirlpool Canyon.

Don't confuse last year's flowering twigs—which look like short bare stems—for beetle damage. Beetle defoliation produces branches with yellow-brown shriveled leaves. Defoliation will be limited in early spring, but once the larvae are out in full force it should become much more striking.

The “lunch beach” in Mitten Park is an excellent stop for boaters who want to see the beetle close up. Adults will begin emerging here sometime in late May and will be numerous by early June. By late June or early July expect to see many more larvae than adults. That will change in late July when the first generation of hatched adults emerges and the life cycle begins again.