Biological Control of Saltcedar in the Texas Panhandle: 2008 Report and 2009 Statement of Work

A report to the Canadian River Municipal Water Authority and the National Park Service.

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Introduction

*Diorhabda elongata* (Coleoptera: Chrysomelidae) was introduced into North America from Fukang, China for the biocontrol of saltcedar (*Tamarix* spp.) in western United States (DeLoach et al. 2004, Lewis et al. 2003). The first open-releases took place in 2001 (DeLoach et al. 2004). The beetles successfully established at several sites above 38° N in latitude (e.g. in Nevada, Colorado and Wyoming), with hundreds to thousands of hectares of *Tamarix* defoliated within five years at some sites (DeLoach et al. 2004). However, despite multiple releases, the beetles failed to establish at sites below 38° N in latitude due to the insects day length requirements (Lewis et al. 2003). As a result beetles with shorter day length requirements originating from more southern locations for have been imported to release below 38° N (DeLoach et al. 2004). Page 2 of this report contains a detailed map of all releases done in the United States and their current status. The map not only shows the success of the beetles north of the 38 parallel but also success of beetles from Greece in Central Texas.

Texas AgriLife Research, formerly Texas Agriculture Experiment Station, has been actively releasing beetles from Posidi, Greece and Uzbekistan at Lake Meredith and on the Canadian River to establish a biological control program for saltcedar, in the Texas Panhandle.
Map of the Western United States showing the distribution of the Diorhabda elongata species group where introduced with occurrences of selected Tamarix spp. Some symbols for Diorhabda and Tamarix spp. overlap (Tracey et al. in press).
Lake Meredith

Over the last four years, 602 beetles from Posidi, Greece, have been released at Mullinaw Crossing in a release cage. Though overwintering was successful at Lake Meredith in 2004, the population has struggled to establish. A small population was present over the first 3 years but was not large enough to defoliate the caged tree. However, in the spring of 2008 a large population appeared in the cage. In anticipation of the plan to initiate chemical control of saltcedar at Lake Meredith in the fall of 2008, 1,600 adult beetles were collected from this cage in June and released at Plum Creek. A cage was assembled at Plum Creek on June 30th and 200 beetles were place inside to help establish an aerial pheromone cloud. The other 1,400 beetles were released into the open at Plum Creek a week later. About 200 more beetles collected on July 7th at Mullinaw Crossing were taken to the Texas AgriLife Research station in Bushland and placed in a rearing cage to mass produce beetles for releases at Plum Creek over the next few years. In 2007 four 14’w x 10.5’h x 24’l rearing cages were assembled and filled with saltcedar grown from cuttings in the research green houses. These cages currently contain beetles from Posidi, Greece and Uzbekistan. The Posidi population has increased in number to about 2,000 beetles which will be overwintering in Bushland and released at Plum Creek next spring. These beetles are considered valuable to the biological control program in the Texas Panhandle since they have lived at Lake Meredith long enough to become climatically adapted to living in this area and may be the key to biological control of saltcedar in this area.

Johnson Ranch

Johnson Ranch is located on the Canadian River just north of Borger Texas. Researchers from Texas AgriLife Research have been releasing beetles on saltcedar trees over the last 3 years. The releases begin by assembling a large cage and adding beetles. Spiders, ladybugs and other predators are removed from the cages by researchers using cardboard collection containers and relocated to other trees outside of the cages to provide a safe environment for the beetles to reproduce in and become acclimatize to their new environment. After the beetle populations have grown to several hundred or
more the cage is removed to release these beetles into the open where they spread to the surrounding trees. In an effort to release a larger number of beetles into the open at the same time, five large cages were set up very close to each other and about 50 beetles were put in the cages in the spring. The beetle populations grew to several hundred in each cage but the caged trees were not defoliate throughout the summer. The beetles will over winter inside the cages and in the spring they will all be released in at the same time. Additional beetles will be added to this release from rearing cages in Bushland.

**Other Activities**

As noxious weeds are controlled whether it is by biological, chemical or mechanical control, the effects of the surrounding environment must be monitored to measure human impact on the ecosystem. Bioindicators can be used to monitor these changes over time. This data can be used when making land management decisions in the future.

Texas AgriLife Research has been conducting vegetation surveys and collecting ground beetles (Coleoptera: Carabidae) as tools to monitor the impact of the biological control agent since 2005 at Mullinaw Cross and since 2006 at Johnson Ranch. Five habitats were selected last fall for ground beetle collections at Plum Creek and significant difference were found across the habitats. Vegetation survey data from Mullinaw Crossing and Johnson Ranch was collected following the USDA APHIS protocol this year as it has been in the last 4 years. In addition to these two sites, sentinel trees were selected at Plum Creek this year in transect lines and the usual survey was conducted according the protocol.

Widespread establishment of the beetles has yet to occur. We have released two “strains” of *Diorhabda* at Lake Meredith; Posidi from Greece and a strain from Uzbekistan. According to previous research, both should be suitable for this area, however, the latitude of Lake Meredith places both strains on the cusp of the potentially best adapted geographic conditions. This fact, coupled with the wide variations in temperature and rainfall for the past three years is probably the reason we have not yet seen the massive numbers of beetles we’d need for large-scale defoliation. It appears that with each passing year the beetles do show signs of becoming better adapted and the numbers are increasing. Since we now have a nursery at Bushland to further enhance production of the beetles, we expect large numbers of them to be present in the years to come.

*Photo 2. Each saltcedar flower can produce thousands seeds.*
In 2008 we completed a laboratory experiment focused on determining the development thresholds for several species/ecotypes of *Diorhabda*. The results of the experiment are shown in Table 1.

**Plans for 2009**

Working cooperatively with other saltcedar researchers across the United States leads us to believe that the *Diorhabda* populations at Lake Meredith will increase to damaging numbers given sufficient time for the beetles to acclimate and increase reproduction. In order to fine tune the implementation project at Lake Meredith, we propose three additional studies for the summer of 2009.

1. **Evaluation of ant predators.** We believe, based on the experience of other researchers in Texas, that ants may prey on beetle larvae, and thus reduce beetle numbers. There are techniques developed by Dr. Allen Knutson with the Texas AgriLife Extension Service that we want to try at Lake Meredith in 2009 to find out the relative abundance of ants in the area and perhaps look at some type of short-term control when we make our releases to allow the beetles to colonize the release site.

2. **Evaluation of Cidetrak as a feeding stimulant for *Diorhabda*.** One of the problems we’ve encountered when releasing adult *Diorhabda* is that they readily fly away from the release site if not caged. Cidetrak is an organic spray made from gourds that contains a feeding stimulant called cucurbatacin. This compound has been used commercially to attract rootworms (a beetle best of corn that is in the same family as Diorhabda) to areas in a field sprayed with insecticides. We intend to use it in a different manner, and determine if we can hold the beetles in a release area longer by eliciting a feeding response rather than a flight response. In research using Cidetrak with insecticides, the results indicated that beetles immediately started feeding on the substrate sprayed with the compound. We believe that this might be an interesting and rewarding technique.

3. **Finally, toward the end of 2009, we would like to implement an overwintering study with *Diorhabda* with the goal of determining how the beetles go into diapause (hibernation) and when they break diapause in the spring. Since we have released and established two different ecotypes of the beetles, we are noticing differences in their emergence habits. We need to know if our climate is influencing them in a bad way, possibly causing them to break diapause early and starving before saltcedar starts to bud. If this is the case, we might need to look at a different ecotype, such as the Fukang strain which we have in Colorado.

We believe that the Lake Meredith region may be on the cusp of adaptability for the Posidi and Uzbekistan beetles we’ve released. We still are very optimistic that there will be an outbreak of the beetles in the future as they adapt to our climate. However, in the interim, we want to conduct projects that are directed toward answering some of the questions that have been raised and make the project a success.
We would also like to thank the Canadian River Municipal Water Authority for funding this project in the past and hope to continue the cooperative effort.

**Proposed Budget 2009**

<table>
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<tr>
<th>Salaries and wages</th>
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<tr>
<td>Technician 1/2 Salary</td>
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<td>Summer workers, 2 @ $9.50/hr for 12 weeks</td>
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<td>Travel</td>
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<td><strong>Materials and Supplies</strong></td>
<td>5,000</td>
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<tr>
<td><strong>Total</strong></td>
<td>29,814</td>
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**References**


Tracy, J.L., T.O. Robbins, and C.J. DeLoach. (in press) Taxonomic revision and biogeography of the Tamarix-feeding Diorhabda elongata (Brullé) species group (Coleoptera: Chrysomelidae: Galerucinidae: Galerucini) and analysis of their potential in biological control of tamarisk. Zootaxa.
Table 1. Development thresholds (t) and degree days above the threshold necessary to complete development (K) for five *Diorhabda* species/ecotypes.

<table>
<thead>
<tr>
<th>Species (Ecotype)</th>
<th>Regression equation</th>
<th>$r^2$</th>
<th>$t^a$</th>
<th>$K^b$</th>
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<tbody>
<tr>
<td><em>D. carinulata</em> (Fukang)</td>
<td>$y=0.005x-0.073$</td>
<td>0.46</td>
<td>14.63</td>
<td>200</td>
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<td><em>D. carinata</em> (Uzbekistan)</td>
<td>$y=0.004x-0.055$</td>
<td>0.87</td>
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<td><em>D. elongata</em> (Posidi)</td>
<td>$y=0.003x-0.021$</td>
<td>0.96</td>
<td>7.00</td>
<td>333</td>
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<td><em>D. elongata</em> (Crete)</td>
<td>$y=0.002x-0.002$</td>
<td>0.93</td>
<td>0.88</td>
<td>435</td>
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<td><em>D. carinulata</em> (Turpan)</td>
<td>$y=0.0014x-0.009$</td>
<td>0.76</td>
<td>13.63</td>
<td>714</td>
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</table>

$^a$ $t$ – x-intercept, development threshold °C.

$^b$ $K$ – 1/slope, degree days above threshold to complete development.