Implementing Biological Control of Saltcedar in the Upper Colorado River Watershed

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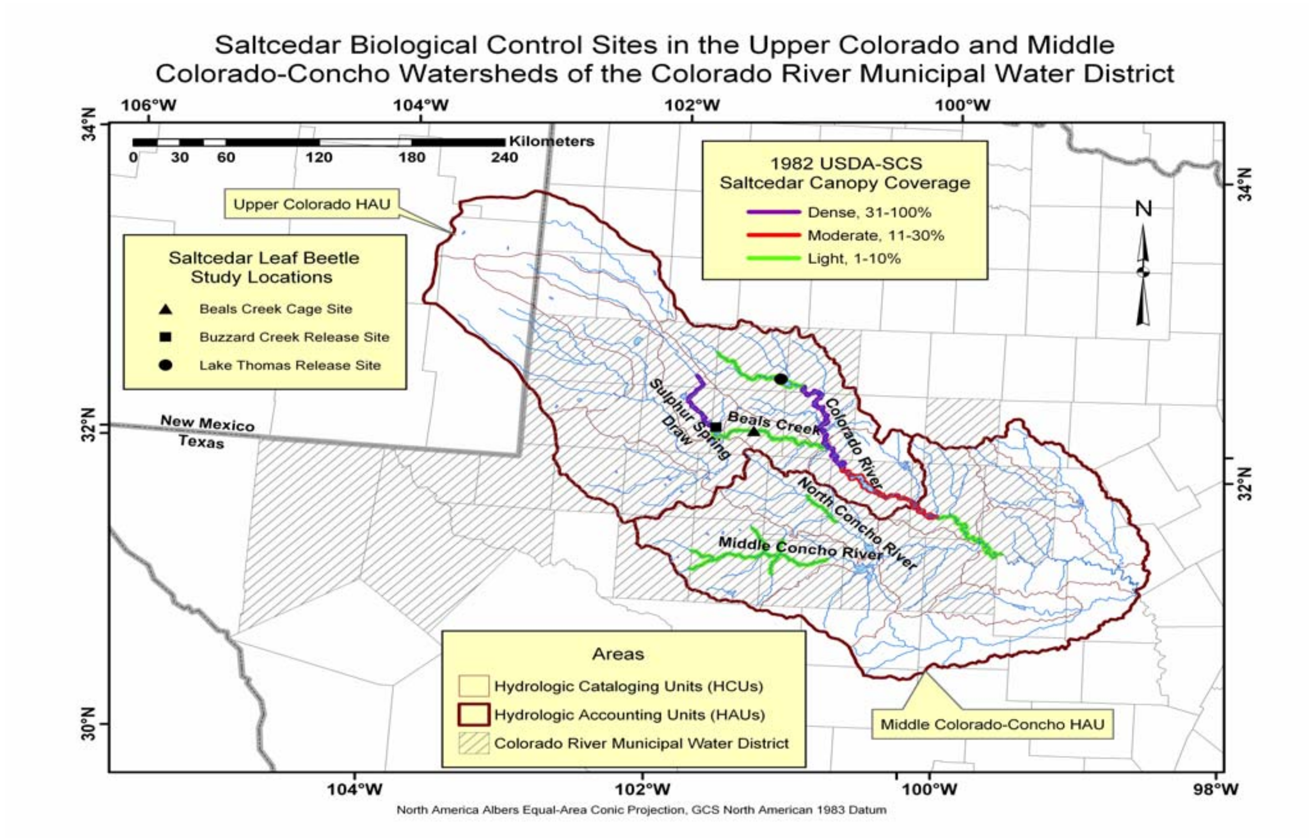
Introduction

Saltcedar is an exotic plant, introduced into the United States in the 1800s as an ornamental and later planted along waterways and stream banks for erosion control. Saltcedar soon naturalized and by the 1920 was rapidly spreading throughout western Texas and adjacent states. Today, saltcedar infests an estimated 500,000 acres of stream banks and water courses in Texas. Saltcedar is an aggressive invader, grows in extensive, monotypic stands, and displaces native vegetation. The greatest economic impact of saltcedar is the high water use of extensive saltcedar stands. Studies have shown that along the upper portion of the Pecos River in Texas, an acre of dense saltcedar consumes an estimated 5-7 acre feet of water, or 2.5 million gallons, each year. Roots of saltcedar can grow deeper than native cottonwoods and willows and as a result saltcedar can extend across more of the river basin, tapping deeper layers of water.

The high water consumption resulting from extensive stands of saltcedar is especially serious in west Texas where long-term drought conditions have prevailed since 1992. In 2002, the combined capacity of the Colorado River Municipal Water Authority's three reservoirs, Lake Thomas, Lake Spence and Lake Ivie, fell below 25 percent. These reservoirs provide water to 450,000 citizens in west central Texas, including the cities of Midland, Odessa, Big Spring and Abilene. There is an estimated 16,000 acres of saltcedar in the basins of these reservoirs and an additional 6,000 acres grow along the Colorado River and its tributaries. The Colorado River Municipal Water Authority estimates that saltcedar annually consumes enough water to meet the yearly needs of the city of Odessa.

Area-wide control of saltcedar can be achieved with herbicides applied by helicopter or airplane at a cost of about $200 per acre. In recent years, 6,300 acres of saltcedar have been treated with herbicide along the Pecos River in Texas. A program planned for 2005 to apply herbicide to the 22,000 acres of saltcedar in the Upper Colorado will cost an estimated $3.2 million. Herbicides are toxic to native trees and plants which limits their use to areas where saltcedar is the dominant vegetation.

Biological control uses natural enemies to limit the competitiveness of exotic plants like saltcedar. Biological control programs using imported natural enemies have been used to control rangeland and aquatic weeds for many years in the U.S. and are currently being used to control maleluca in Florida, purple loosestrife in the northern states, leafy spurge in the plains states, and



yellow star thistle in California. This approach is closely regulated by state and federal agencies and has a long history of safety and effectiveness.

Saltcedar is an excellent target for biological control as it is widely regarded as a pest species and has no close relatives in North America, reducing the risk that imported natural enemies could damage non-target plants. Saltcedar is a native of Europe and Asia, and was introduced without the many natural enemies that attack it in its native home. Introduction of selected natural enemies will help re-establish the natural enemy complex that is expected to suppress saltcedar survival and reproduction, making it less competitive with native plants. Biological control will not eradicate saltcedar, and it is much slower than the use of herbicides. However, once populations of natural control agents are established, they are self-sustaining and no additional releases are necessary.

Biological control has the potential to provide a low-cost and sustainable compliment and in many areas is an alternative to the sole reliance on herbicides for area-wide management of saltcedar in west Texas. Aerial application of herbicides is best suited to extensive, monotypic stands of saltcedar as costs are minimized and in areas where there are few or no native trees which are susceptible to the herbicide. Herbicide programs are not cost-effective when saltcedar stands are small and intermixed with desirable native vegetation. Biological control is well suited to both situations.

The saltcedar leaf beetle, *Diorhabda elongata*, is the first insect approved for introduction into the U.S. for biological control of saltcedar. Research by Dr. Jack DeLoach, USDA-ARS at Temple, TX, has demonstrated that the saltcedar leaf beetle feeds only on saltcedar (genus *Tamarix*) and does not attack any plant of economic importance or any endangered species of plant. The USDA Animal and Plant Health Inspection Service, the U.S Fish and Wildlife Service, and the Texas Department of Agriculture, have approved release of this beetle in Texas. The saltcedar leaf beetle is highly specific, feeding only on saltcedar, and thus effective where saltcedar is mixed with native trees. Once saltcedar infestations are reduced by herbicides or natural enemies, it is expected that saltcedar beetles will persist at low levels and feed on seedling plants, thus limiting re-invasion of treated areas by saltcedar. In fact, the value of these beetles may be especially significant in the control of seedling plants which invade newly exposed mud flats and regrowth from root pieces which re-infest areas cleared of saltcedar by herbicides, fire or mechanical means.

Objectives

The saltcedar leaf beetle was released at three sites near Big Spring, Texas in 2003-2004 and a small population established in the field in 2004. The goal of this project is to increase beetle numbers and re-distribute them along saltcedar infested areas of the Upper Colorado River and its tributaries. This mass rearing and redistribution program is needed to speed the increase and spread of beetles and maximize their potential benefit in reducing saltcedar infestations.

The objectives of the project are to:

1. Establish additional nursery sites for rearing large numbers of saltcedar beetles in field cages in west Texas.
2. Collect beetles from the field and nursery cages and release them at selected sites on the upper Colorado River and its tributaries in cooperation with the Colorado River Municipal Water Authority and local landowners.
3. Determine the establishment rate and quantify the increase in beetle numbers, their dispersal from the release site and the defoliation of saltcedar trees by beetles.
4. Conduct research to improve establishment by optimizing the number of beetles released, timing of release, and evaluate cutting back trees to stimulate new growth attractive to egg-laying beetles.

Maintain and Monitor Nursery Site on Beals Creek

The population of saltcedar leaf beetles established on Beals Creek in 2004 overwintered and steadily increased in numbers and distribution in 2005. By late July, the beetles had moved ca. 200 meters from the original release site and completely defoliated about 100 saltcedar trees. By mid-July, beetle numbers had increased such that we felt confident we could collect beetles for release at additional sites without risking the loss of the Beals Creek population. In August, this population had completely defoliated about 200 saltcedar trees. The Beals Creek site was intensively monitored by Dr. Jack DeLoach, ARS Research Entomologist and his staff from Temple, TX.

Release at New Sites and Evaluation of Release Methods

Three transects were established along Sulphur Springs Draw, Beals Creek and on the Davidson Ranch southwest of Big Spring, TX in May and June 2005. Each transect consisted of 6-9 release trees spaced 0.2 miles apart following the drainage along which saltcedar grew. 5,200 beetles were released at these sites in July and September and several release methods were evaluated as described below.

Trial 1. July-August, 2005. Methods and Materials

The objective of this trial was to determine the optimum number of beetles per cage as measured by the subsequent number of eggs and larvae recovered per cage and to evaluate large branch cages for releasing adults. A second objective was to determine if cutting trees back in the spring to encourage succulent regrowth prior to releasing beetle influenced the number of egg masses deposited by released adults or survival of resulting larvae. Three of the six trees on Beals Creek were cut back to about 3 feet above the ground in April. The resulting regrowth appeared more succulent than foliage on the uncut trees which was more woody.

On July 23-23, about 1,000 beetles were collected from the field nursery site on Beals Creek and 200 from the nearby field cages. Beetles were collected by hand and also by beating branches into a bucket fitted with a funnel. All beetles were expected to be in good condition and recently emerged. Adult beetles were separated from larvae and other insects, counted and placed in sleeve cages made from nylon mesh and measuring 12 inches wide by 36 inches long. Cages were open at one end and designed to be slipped over a branch and the open end fastened around the base of the branch. A total of 10, 20 or 30 beetles was placed into each bag. A small saltcedar twig was placed in the bottom of each bag and the bags held overnight at 70 °F. The following morning, the sleeve cages were pulled onto saltcedar branches on trees in the field and the ends were tied to cage the beetles on the branch.

Three release rates were used: 40 beetles/tree (4 cages of 10 beetles each), 80 beetles/tree (4 cages of 20 beetles each) and 180 beetles/tree (6 cages of 30 beetles each). Release rates were replicated four times (4 trees) and a total of 1,200 adults were released into cages. Two replications (six trees) were positioned along the Beals Creek transect and the other two replications (six trees) were along Sulphur Springs Draw transect. Foliage on the release trees was in good to excellent condition with very little or no evidence of scale insects. The area had received rains several weeks earlier and many of the saltcedars were blooming. Also, predator densities were very low on the released trees.

On August 4, 12 days later, each cage on every tree on both transect was opened and the number of egg masses and living adults were recorded. The adults were retained in the cage and caged on a nearby branch, designated “branch two.” Ten days later, August 14, the cages along the Beals Creek transect were again opened and the number of egg masses, larvae and living adults was counted. The cage was removed and the remaining adults freed on the tree. Also, the number of larvae on Branch 1 was recorded. On August 22, the number of larvae on branches 1 and 2 were recorded as well as the percent defoliation of each branch. Each release tree was also searched for larvae and adults. Due to heavy rainfall and flooding on August 14-15, the Sulphur Springs transect was inaccessible. The cages on this transect were opened August 21 and the number of egg masses, larvae and adults and percent defoliation of the branch was recorded. The cages were removed at this time and adults were liberated on the tree.

Trial 1. July-August, 2005. Results

Egg Mass Density:
When egg mass data were subjected to ANOVA a significant cut or non-cut tree by adult release rate per cage interaction occurred. Therefore, data were reanalyzed by whether trees had been cut or not. This analysis revealed that in the cut trees total egg mass densities were significantly higher in the 20 beetles per cage release rate relative to the 10 beetle, but not the 30 beetle release rates (Table 1). However, the mean number of egg masses in the 30 adults/cage treatment (16.2 masses) was numerically less than in the 20 adults/cage (23.9 egg masses), suggesting that overcrowding of adults may have reduced fecundity. Egg mass densities were significantly higher when counts were made at 14 days post beetle release relative to the 22 day post beetle release rate, indicating most of the eggs were deposited during the first two weeks. In the non-cut trees, egg mass density was not significantly influenced by beetle release rate or sample date (Table 1). Two weeks after adults were released in the cages, the mean number of egg masses per cage for the cut trees (22.6) was greater than for not cut trees (13.3) for all release rates.

Table 1. Effect of release rate (adults/cage) and days post beetle release on number of egg masses per cage based on cut or non-cut trees: Beals Creek 2005.

Tree	Add Release Rate	Egg Masses /Cage	Day Post Adult Release	Egg Masses/Cage
Cut	10	9.5a	14	22.6a
	20	23.9b	23	10.3b
	30	16.2ab		
LSD (P=0.05)	7.8		6.2	
P>F	0.0066		0.0006	
Not Cut	10	8.4	14	13.3
	20	9.6	23	9.0
	30	14.0		
LSD (P=0.05)	NS		NS	
P>F	0.0967		0.0905	

The number of egg masses deposited per beetle, rather than total egg masses/cage, is also of interest in terms of optimizing beetle fecundity. Analysis of variance by sample date indicated that adult release rate and tree cut significantly influenced the number of eggs laid per adult beetle at 14 days, but not at 23 days after adults were released into the cages (Table 2). The number of egg masses deposited per beetle for the 10 and 20 adults/cage release rates were significantly greater than for the 30 adults/cage at 14 days after release. This result again suggests that overcrowding occurred in the high release rate cages and depressed beetle fecundity. The adults transferred to branch two continued to oviposit and ten days later egg masses and young larvae were present in the cages on the six trees at Beals Creek. However, neither adult release rate nor cut vs. uncut trees influenced density of egg masses 23 days after release (Table 2). At this time, only 14-31 percent of the originally released adults were alive in the cages. Some beetles had escaped through holes in the cage or while opening the cages and others were found dead in the cage. In the 30 adult/cage release rate, only 4 and 9 live beetles were observed per cage. This decline in beetle numbers may have reduced the overcrowding effect and subsequent reduction of egg mass production per adult beetle as observed on the first date. Also, beetle fecundity (masses/beetle) was significantly greater on cut trees (1.2 masses/beetle) than on not cut trees (0.70 masses/beetle) and confirmed the conclusion based upon total egg masses/ cage (Table 1). Fewer eggs were recovered from the second branch 23 days after adult release and these effects of adult release rate and tree cut were not observed.

These results suggest that 1) 20 beetles/cage is an optimum release rate as measured by egg masses/beetle and total egg masses deposited, and that 2) beetles respond to cut trees by depositing more eggs per beetle. Female beetles deposit masses of about 20 eggs/mass and a total of about 190 eggs (8-9 masses) during a three week life span. However, the number of egg masses deposited per beetle in these cages (about 1) is only one-fourth the expected fecundity of 8 egg masses/female (four masses per beetle). Assuming a 1:1 sex ratio, releasing 20 adults/cage should have resulted in a mean of 80 egg masses/cage (10 females X 8 egg masses/female). The results reported herein suggest that many of the eggs were missed in searching branches, or beetles had deposited egg masses prior to being field collected and released in the cages or that beetle fecundity of field-reared beetles is much lower than expected.

Table 2. Effect of beetle release rate and tree cut or not cut on eggs laid per beetle. Beals Creek 2005.

Day Post Adult Release	Adult Release Rate	Eggs laid/Beetle	Tree Status	Egg Masses per/Beetle
12 Days	10	1.25a	Cut	1.20a
	20	1.20a	Not cut	0.70b
	30	0.59b		
LSD (P=0.05)	0.51		6.2	
P>F	0.0214		0.0190	
22 Days	10	0.54	Cut	0.48
	20	0.47	Not Cut	0.46
	30	0.42		
LSD (P=0.05)	NS		NS	
P>F	0.8920		0.8154	

Larval Density.
Results of ANOVA of the influence of number of beetles released per cage (10, 20, 30), saltcedar trees cut or not cut, study site location, and number of days post adults released in cages on saltcedar beetle larvae densities indicated that all main effects were significant and also interactions between location by beetles per cage and days post release by cut or uncut trees. Thus, data were reanalyzed by location and days post beetle release. This analysis takes the cut or uncut trees and the days post beetle release effect out of the Sulfur Springs data since none of the trees were cut at this site
For the Sulphur Springs Draw trees, the number of beetles released per cage had no significant effect on the number of larvae recovered per cage at 23 days after release (Table 3). However, a release rate of 20 beetles per cage resulted in numerically higher larva densities relative to the 30 and 10 beetles per cage.

Table 3. Effect of beetles/cage on number of larvae 23 days after beetles placed in cage: Sulfur Springs 2005.

Beetles/Cage	Mean Larvae/Cage
10	57.1
20	92.5
30	64.9
LSD (P=0.05)	NS
P>F	0.3079

When Beals creek data were subjected to ANOVA all interactions were significant (ie. days post release by beetles per cage, days post release by cut or non-cut trees, and beetles per cage by cut or non-cut trees). Thus data were subjected to ANOVA by days post beetle release. Analysis of the data collected at 23 days post beetle release resulted in no interaction effect but significant main effects of cut or non-cut trees and number of beetles per cage. Results of the analysis indicated that releasing 20 or 30 beetles per cage resulted in a significantly higher densities of larvae per cage relative to the 10 beetles per cage release rate (Table 4). As before, the mean number of larvae was numerically greater in the 20 adults/cage relative to the 30 adults/cage. Releasing beetles on the regrowth from cut trees also resulted in a significantly greater number of larvae per cage relative to the non-cut trees at 23 days post beetle release (Table 5).

Table 4. Effect of beetles/cage on number of larvae 23 days after beetles placed in cage: Beals Creek 2005.

Beetles/Cage	Mean Larvae/Cage
10	11.5b
20	43.6a
30	32.2a
LSD (P=0.05)	
P>F	0.0120

Table 5. Effect of cutting or not cutting release trees on number of larvae 23 days after beetles placed in cage: Beals Creek 2005.	
Beetles/Cage	Mean Larvae/Cage
Cut	43.0a
Not Cut	16.1b
LSD (P=0.05)	15.0
P>F	0.0015

The number of larvae per cage counted at 30 days post beetle release indicated a significant interaction effect of number of adults released per cage by cut or non-cut trees. Larva data were reanalyzed by adult release rate. Results of the analysis indicate that regardless of whether trees were cut or not there was no significant difference in larva densities at the 10 and 20 beetles per cage release rate. At 30 beetles per cage; however, larva densities were significantly higher in the cut trees relative to the non-cut trees (Table 6). The cages at Sulphur Springs Draw were not examined until August 21 due to flooding along this draw the previous week. Adults had been caged for 18 days and in some cages all of the foliage had been consumed by adults and larvae and some insects had died. All of the trees at Sulphur Springs Draw were not cut trees and the larval mortality in these cages may have contributed to the lower density reported in Table 6 for the not cut trees.

Table 6. Effect of tree cut and adults per cage on number of larvae per cage 30 days after beetles placed in cage: Beals Creek and Sulphur Springs. 2005.			
	Beetles Released/Cage		
Tree	10	20	30
Cut	5.5	7.5	35.5a
Not Cut	4.0	3.2	13.7b
LSD (P=0.05)	NS	NS	17.82
P>F	0.6520	0.4781	0.0208

When data were analyzed by beetle release rate, densities of larvae were numerically or significantly higher in the 30 beetles per cage release rate relative to the 10 and 20 beetles per cage release rate regardless of whether trees had been cut or not (Table 7). Thus, even though each adult deposited fewer eggs per adult at the highest adult density, the greater number of resulting eggs per cage yielded a greater number of larvae per cage. This is in contrast to 23 days after beetle release when the mean number of larvae/cage was not significantly different for the 20 and 30 adults/cage treatments (Table 4). For each adult released, an average of 1-2 larvae or less were recovered 23 days after release (Table 4) or 30 days after release (Table 7). As each female deposits about 190 eggs, and assuming a 1:1 sex ratio, and 50 percent larval mortality, each beetle should have resulted in about 47 larvae (0.5 females X 190 X 0.5). As observed with egg density estimates, the released beetles either had deposited many eggs prior to being released in the cages, field fecundity is less than estimated, or mortality of eggs and larvae is very high.

Table 7. Effect of number of beetles released/cage on number of larvae/cage 30 days after beetles placed in cage: Beals Creek and Sulphur Springs. 2005.		
Beetles/Cage	Mean Larvae/Cage (Not Cut Trees)	Mean Larvae/Cage (Cut Trees)
10	5.5	4.0a
20	7.5	3.25a
30	13.7	35.5b
LSD (P=0.05)	NS	15.9
P>F	0.2384	0.0004

Three of the six trees on Beals Creek were cut back to about 3 feet above the ground in April. The resulting regrowth appeared more succulent than foliage on the three uncut trees which was more woody. There were significantly more eggs/beetle deposited on cut foliage and significantly more larvae present in cages on cut foliage than on uncut. This suggests the flush of new growth that follows cutting back a tree may stimulate greater egg deposition.

On August 22, 30 days after release, only one adult was observed on the six release trees at Beals Creek. On two of the six trees, a few larvae were observed on branches other than the branches on which the adults were released. However, defoliation was only evident on release branches. Branches one and two, which were caged for about 10 days, showed highly variable degrees of defoliation (range 1-100 percent). There was no relationship between percent defoliation and release rate.

A total of 3.5 inches of rain fell on August 14 and early on August 15. Examination of the cages on August 15 showed no evidence that larvae or adults drown or died from other causes while in the cages during this time.

Trial 2. September. Methods and Materials

The objective of this study was to compare the establishment rate of adults released in branch cages relative to the release of adults on trees without the use of cages. The later method is used by the multi-state release program initiated in 2005 in the northwestern US.

The two treatments were 1) 25 beetles/cage and 20 cages/tree for a total of 500 beetles /tree and 2) 500 adults released per tree without a cage. Each treatment was replicated three times (three trees) for a total release of 3,000 beetles. These beetles were collected from the field nursery site on Beals Creek on September 5, 2005, during 2 hours of collecting. Trees from which beetles were collected were 99.9 percent defoliated. Beetles were collected during the evening, counted, separated from other insects, placed in branch cages or cardboard tubes and provided saltcedar foliage. Beetles were held overnight at 70 °F. On September 6, beetles in branch cages were placed on trees along a transect on the Davidson Ranch near Big Spring, Texas. Each of the six trees was 0.2 miles apart. The open field release was made about one hour before sunset to encourage beetles to remain on the release tree and not disperse which often happens when released during the heat of the day. On September 12, 7 days post-release, each bag was opened and the number of adults, egg masses and larvae were counted. Cages with adults were transferred to a new branch on the same tree as tied shut as before. Each open field release tree was visually searched for five minutes and then adjacent trees were visually searched for five minutes for adults and larvae. On September 21, 15 days post-release, each cage was opened again and the number of eggs, larvae and adults was counted. Open release trees were visually searched as before.

Trial 2. September. Results.
On September 12, 7 days post-release, an average of 36 percent, 48 percent and 56 percent of the beetles were dead in the cages on the three cage-release trees. Very few eggs or larvae were present. The average number of eggs per cage was 0.1, 0.1 and 0.3 while the average number of larvae per cage was 0.1, 0.1 and 0.3 for the three release trees. Cages and living adults were moved to the second branch on each tree. No adults or larvae were observed on the three open field release trees. On September 21, 15 days post-release, very few eggs or larvae were present in the cages. The average number of eggs was 0.2, 0.6 and 1.0 per cage and the average number of larvae was 0.05, 0.05 and 0.2 per cage. The average number of adults per cage was 0.9, 0.6 and 1.3. As each cage originally held 25 adults, about 96 percent of the adults collected on September 5 had died by September 21. A visual search of the open field release trees failed to detect any adults or larvae.

Beetles collected September 5 were assumed to be recently emerged adults because they were present in high numbers. However, the high mortality of adults experienced in this trial suggests the beetles collected September 5 were actually old beetles of the previous generation that had deposited all of their eggs and were soon to expire. The larvae present in the field in early September must have represented those which, as adults, would overwinter. The lesson from this trial is that beetles should not be collected for re-distribution in late summer or fall as the age and fecundity (egg-load status) of the beetles is unknown. Also, many beetles enter diapause at this time and although they will overwinter, they will not deposit eggs in the fall.

Additional Nursery Cage Site

Two additional caged-nursery sites were located southwest of Big Spring and near Ft. Stockton, Texaa. In 2005. The purpose was to establish a new populations of beetles in the event the Beals Creek population should suffer a disaster and to serve as sources of beetles for later release in the open field. Beetles were released in a 10 X 10 X 6 foot screened cages. The site at Big Spring was on property owned by the Colorado Municipal Water Authority. Three cages were established at this site in the fall of 2004 and 25-50 beetles released into each cage. However, no beetles or larvae were observed in these cages the following spring on April 6, 2005. Two additional cages were set up at this site on April 13 and 7-8 beetles were released into each of these cages. A search of these cages on May 25 revealed 12-34 larvae observed in a 4 minute search. On July 23, no larvae or beetles were present in Cage 1. Grasshoppers in the cage had stripped the bark on many branches. Grasshoppers were removed and the tree cut back to encourage new growth. In cage 2, only 2 beetles were present and 30 new beetles were released inside. In cage 3, only one beetle was observed and 50 adults and 10 larvae were added to the cage. Trees in both cages were 60-80 percent defoliated by leafhoppers. On August 4, no larvae or beetles were present in Cage 2 and only one beetle was observed in Cage 3. On September 6, 300 adults and 100 larvae were released into Cage 2 and 100 adults and 50 larvae were released into Cage 3. Foliage in both cages was abundant and in good condition. These insects should overwinter in the cages and provide an additional source of insects for release in 2006.

A second field cage was established near Ft. Stockton, TX under the supervision of Dr. Mark Muegge. Beetles were released into this cage in the late summer to establish a local population for release along the Pecos River in 2006.

Conclusions

A total of 5,200 beetles were released at 18 new sites along two saltcedar-infested watercourses southwest of Big Spring during July through September, 2005. Large numbers of eggs were deposited on the release trees from releases made in July, but not from releases made in early September. The success of these releases in establishing new populations will not be known until the 2006 summer when established populations should increase to detectable numbers.

Studies on release methods suggest the following protocol for establishing new populations of saltcedar leaf beetles:

1. Beetles should be released at new sites as soon as beetles can be collected in sufficient numbers in the spring (April through June). Also, beetles should be collected soon after emergence to increase chance that they carry a large proportion of their eggs.

2. Trees planned for caging should be cut back to 2 to 3 feet above the ground in the winter or early spring (April) to encourage regrowth that appears to stimulate greater egg deposition and larval survival.

3. Beetles can be transported in and caged on release trees inside 1 x 3 foot fabric cages. Each cage is slipped over a saltcedar branch. Cage seams should be double-sewn for strength and loose threads removed so they do not snag adjacent branches.

4. A release rate of 20 adult beetles per cages results in an optimum number of eggs/adult but a release rate of 30 adults per cage results in a greater total number of larvae per cage. These results suggest a release rate of 25 adults/cage may be optimum.

5. Ten days after release, each cage should be opened to allow larvae to disperse to new foliage. The adults should be retained and caged on a second branch to continue egg deposition. After one week, the cage should be removed from this second branch and the adults released. This procedure provides protection from predators during caging and concentrates eggs on the release tree.

Plans for 2006

Beetles will be collected from the field nursery site and field cages at Beals Creek and released during April through June, 2006 following the protocol detailed above. The relationship between the total number of released beetles per tree and establishment rate has not been determined. We propose to release 25 beetles per cage and evaluate the release of 100 beetles (4 cages), 200 beetles (8 cages) and 400 beetles (16 cages) per site. Additional releases will be made in large 10 X 10 X 6 foot field cages enclosing a saltcedar tree at 1-2 sites in Borden, Scurry, Mitchell and Howard Counties and on the Pecos River in Pecos County. The goal is to establish field populations of beetles at these sites for local distribution. These releases will be conducted in cooperation with the Texas Cooperative Extension and the USDA Natural Resource Conservation Service.

Predicted Water Conservation Benefits Expected From This Project

Recent studies by Texas A&M University have shown that along the upper portion of the Pecos River in Texas, an acre of dense saltcedar consumes an estimated 5-7 acre feet of water (2.5 million gallons per acre) each year. There are an estimated 16,000 acres of saltcedar in the basins of the reservoirs on the Colorado River (Lakes Thomas, Spence and Ivie) and an additional 6,000 acres along the Colorado River and its tributaries. The Colorado River Municipal Water Authority estimates that saltcedar annually consumes enough water in the district to meet the yearly needs of the city of Odessa or about 7 billion gallons (Annual Report 2002. Colorado River Municipal Water Authority, Big Spring, Texas). These and other studies predict that a reduction in saltcedar acreage will have water conservation benefits.

The impact of beetle feeding on saltcedar survival and reproduction is only now being documented and results indicate biological control of saltcedar will be slow process requiring years. Research by Jeremy Hudgeons, MS student at Texas A&M and a partner on this project, indicates that repeated defoliation by saltcedar beetles may deplete stored carbohydrates in the tree. This suggests that as stored energy needed to regrow leaves and shoots declines over time, saltcedar trees will suffer dieback and small trees may die. Experience in Nevada indicates five or more years of repeated defoliation by beetles may be necessary before large trees begin to die. However, during this time water use by defoliated trees is less than trees not fed upon by beetles. Seedlings and small tress with less stored energy in the root crown should die more quickly.

The net amount of water saved by controlling saltcedar is difficult to predict for a variety of reasons. First, the impact of beetles on tree survival and water use has not been yet been determined and will likely vary by location across the state. Also, the impact of biological control will depend on how rapidly beetles increase in numbers and the success of programs to distribute beetles across Texas. As saltcedar density declines, native trees and shrubs will re-establish and consume water once used by saltcedar. However, roots of saltcedar can grow deeper than native cottonwoods and willows and as a result saltcedar can extend across more of the river basin, tapping deeper layers of water. This suggests there will be a net water savings as saltcedar is replaced by native vegetation. In conclusion, insufficient time has elapsed to document the impact of biological control on saltcedar survival and reproduction in Texas and therefore no estimate of water conservation benefits is possible at this time.

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