

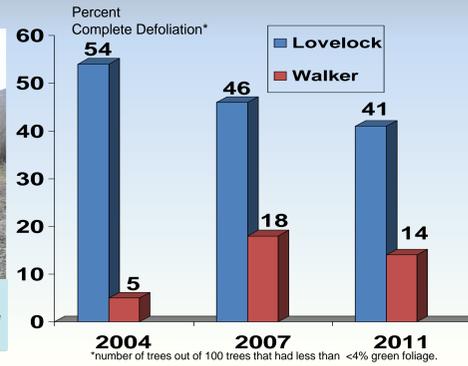
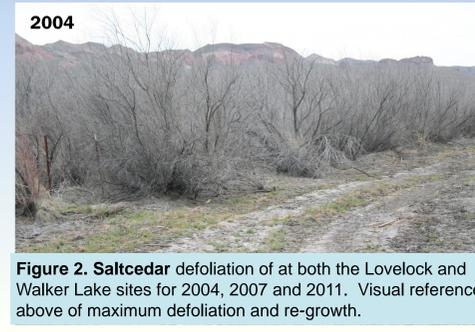
Introduction

Diorhabda carinulata and Saltcedar Control: Ten Years Later

Charlie D. Clements, Daniel N. Harmon, James A. Young and Jeff Knight
 USDA-ARS Great Basin Rangelands Research Unit
 920 Valley Rd. Reno, Nevada
 Chearlie.Clements@ars.usda.gov



Saltcedar (*Tamarix ramosissima*), a small tree native to Central Asia has invaded more than 1.9 million hectares in the western United States. Planted in the early 1800s as an ornamental and later for windbreaks and soil stabilization, it escaped cultivation, infesting riparian and adjacent communities. In an effort to control saltcedar, the USDA-Agricultural Research Service investigated a number of potential control insects in the 1970s. By the 1990s a foreign leaf eating beetle (*Diorhabda carinulata* formerly *D. elongata*), was chosen for release by USDA.



Results

After measuring defoliation for a decade, complete defoliation (>96% tree) reached a high of 54% in 2004 at the Lovelock site and a high of 18% at the Walker site in 2007 (Figure 2). By 2011, complete defoliation was recorded at 41% and 14%, respectfully.

2001 Lovelock vegetation cover directly under the saltcedar tree was 10.51%(Table1)(Figure 3). Saltgrass occurred in 47% of the quadrats with an average cover of 9.26%. Tall whitetop was also present in 47% of the quadrats beneath the canopy with an average cover of 12.68%. By 2011 tall whitetop was not present in the quadrats and saltgrass had increased to a presence of 50% beneath the canopy with an average cover of 48.46%.

Primary Species	Year	% Presence		Ave. % Cover	
		Below	Edge	below	Edge
Saltgrass	2001	47	26	9.26	6.42
Tall Whitetop	2001	47	28	12.68	10.26
Annual Kochia	2001	2	3	6.00	4.33
Russian Knapweed	2001	1	3	5.00	15.67
Total	2001	62	46	10.51	6.22
Saltgrass	2004	39	36	6.59	8.00
Tall Whitetop	2004	7	4	4.00	3.00
Annual Kochia	2004	1	0	2.00	.00
Russian Knapweed	2004	0	7	.00	3.86
Total	2004	43	42	3.20	3.38
Saltgrass	2007	10	21	15.00	16.90
Tall Whitetop	2007	6	0	20.00	.00
Annual Kochia	2007	86	82	81.22	80.91
Russian Knapweed	2007	2	1	40.00	1.00
Total	2007	93	89	76.50	71.30
Saltgrass	2011	50	54	48.46	45.19
Tall Whitetop	2011	0	0	.00	.00
Annual Kochia	2011	36	40	27.83	20.68
Russian Knapweed	2011	7	5	11.29	16.00
Total	2011	59	66	35.04	33.47

Table 1. Primary vegetation cover below and at the edge of saltcedar canopies at the Lovelock site from 2001 to 2011.

In 1999 we constructed three bio-control quarantine cages in North-western Nevada; Lovelock (40°01.219'N 118°31.389'E) Stillwater (39°31.493'N 118°30.823'E) Walker, (38°53.529'N 118°46.780'E). Beetle reproduction in the wild was to be observed in the cages before full release. Five other states also constructed cages. In 2001 the leaf beetle was released. At only two of three release sites (Walker and Lovelock) did the beetle initially establish.

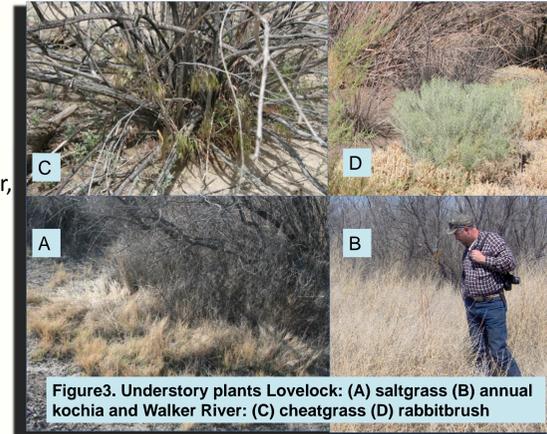


Figure3. Understory plants Lovelock: (A) saltgrass (B) annual kochia and Walker River: (C) cheatgrass (D) rabbitbrush

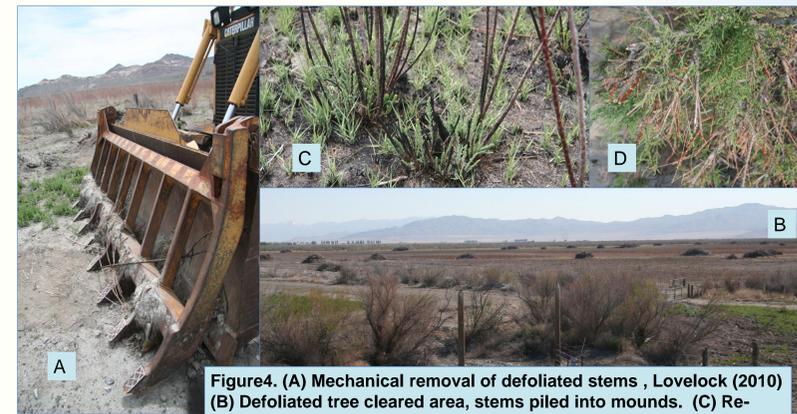


Figure4. (A) Mechanical removal of defoliated stems, Lovelock (2010) (B) Defoliated tree cleared area, stems piled into mounds. (C) Re-growth from roots after stem removal, Lovelock (D) Significantly cattle browsed stems re-sprouted at the Walker site

Discussion

Our question is whether the release of the leaf beetle resulted in death or defoliation of the trees and does the aftermath of the bio-control lead to improved habitat. Previous reports suggest rapid beetle defoliation is significant and death can occur within 3-5 years. We observed a high percent of re-growth of near completely defoliated trees after removing the defoliated-stem overstory (Figure 4 & 5). In 2011 the beetle was absent, which along with the nature of salt cedar; deep rooted, re-spouting (after fire or flood), drought tolerant, long lived, makes control unlikely. Irregardless, there still seems to be debate over the effectiveness of the beetle to control saltcedar. The interpretation of a dead saltcedar tree further clouds this reality. We follow the guidelines that “dead trees do not grow” in our assessment of true senescence. A defoliated saltcedar tree that may look dead and gray actually has tremendous potential to re-grow. Removal of defoliated standing biomass (a necessity for revegetation and wildlife use), stimulates re-growth (Figure 5). Based on our observations we find it most probable that heavy equipment and herbicides will continue to be the tools that will ultimately control saltcedar.

The Walker site has much more vegetation diversity (Table 2). Cheatgrass (Figure 3) and Tansy mustard were the most frequently recorded species with cheatgrass occurring in 42% of the quadrats with an average cover of 7.14%. Tansy mustard was present in 19% of the quadrats with an average cover of 1.95%. By 2011 the there had been a significant decrease in vegetation presence (2001-49% vs. 2011-2%) and cover (2001-5.38% vs. 2011-0.01%).

Primary Species	Year	% Presence		Ave. % Cover		Year	% Presence		Ave. % Cover	
		Below	Edge	Below	Edge		Below	Edge		
Cheatgrass	2001	42	65	7.14	6.92	2004	4	7	8.78	4.00
Saltgrass	2001	7	7	4.43	2.29	2004	5	12	4.20	3.08
Tansy Mustard	2001	19	22	1.95	1.55	2004	3	3	4.00	2.00
Russian Thistle	2001	4	0	1.25	0	2004	5	25	1.40	3.96
Rabbitbrush	2001	0	0	0	0	2004	0	0	0	0
Indian ricegrass	2001	0	3	0	1.67	2004	1	1	2.00	1.00
Total	2001	49	71	5.38	6.33	2004	14	34	0.79	2.45
Cheatgrass	2007	1	2	5.00	3.00	2011	0	3	0	12.67
Saltgrass	2007	2	6	5.00	6.00	2011	0	4	0	6.75
Tansy Mustard	2007	0	3	0	1.67	2011	0	2	0	6.00
Russian Thistle	2007	9	15	9.67	6.53	2011	1	5	2.00	4.80
Rabbitbrush	2007	5	7	41.00	23.57	2011	1	12	7.00	47.92
Indian ricegrass	2007	0	3	0	2.67	2011	0	0	0	0
Total	2007	13	19	3.07	3.53	2011	2	28	0.01	6.85

Table 2. Primary Vegetation cover below and at the edge of saltcedar canopies at the Walker Lake site from 2001 to 2011.

Walker River

The site was under lake level as recent as 1928. Up-stream diversion resulted in a dramatic Lake level drop. As the lake receded the exposed muddy delta provided opportunity for saltcedar establishment. (Figure 1a.) Willows and cottonwood (*Populus fremontii*) are abundant on the rivers edge, yet the extensive stands of saltcedar limit their recruitment. The adjacent rivers edge is dominated by an *Atriplex/Sarcobatus* salt desert community with a saltgrass (*Distichlis spicata*) or sparse Indian ricegrass (*Achnatherum hymenoides*) understory.

Lovelock

The site is adjacent to production agricultural fields. (Figure 1b.) Before the rapid invasion of saltcedar following the flood of 1985, the site was dominated by black greasewood (*Sarcobatus vermiculatus*) with saltgrass (*Distichlis spicata*) understory. Occasional willows (*Salix* spp.) line the Humboldt river and diversion ditches. Cottonwood trees historically never occurred at the Humboldt River delta. The site flooded for most of the growing season in 2006.

Vegetation Monitoring

In May 2001 at each site, we began annual saltcedar measurements of plant morphology of 100 marked trees [e.g. height, diameter, densitometer (percent), foliage/stem status (green, defoliated (dead leaf /stem), re-growth, and flowering]. We measured nearest shrub and primary vegetation under the canopy along with presence or absence of beetles. These measurements were taken (last week in May) from 2001 through 2011. Vegetation monitoring was cancelled at the Stillwater site after a few years because of lack of beetle presence, likely due to a dense saltgrass understory and annual flooding which eliminates soil over wintering for the beetle.



Figure 5. Lovelock site: (A) Re-growth stimulated after defoliated stem removal, (B) three years after stem removal, beetle absent. Walker site: (C) Stimulated re-growth first year after removal of defoliated stems (D) No stimulated growth if the dead stems were not removed