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BEMP
Bosque Ecosystem Monitoring Program

THE UNIVERSITY of NEW MEXICO

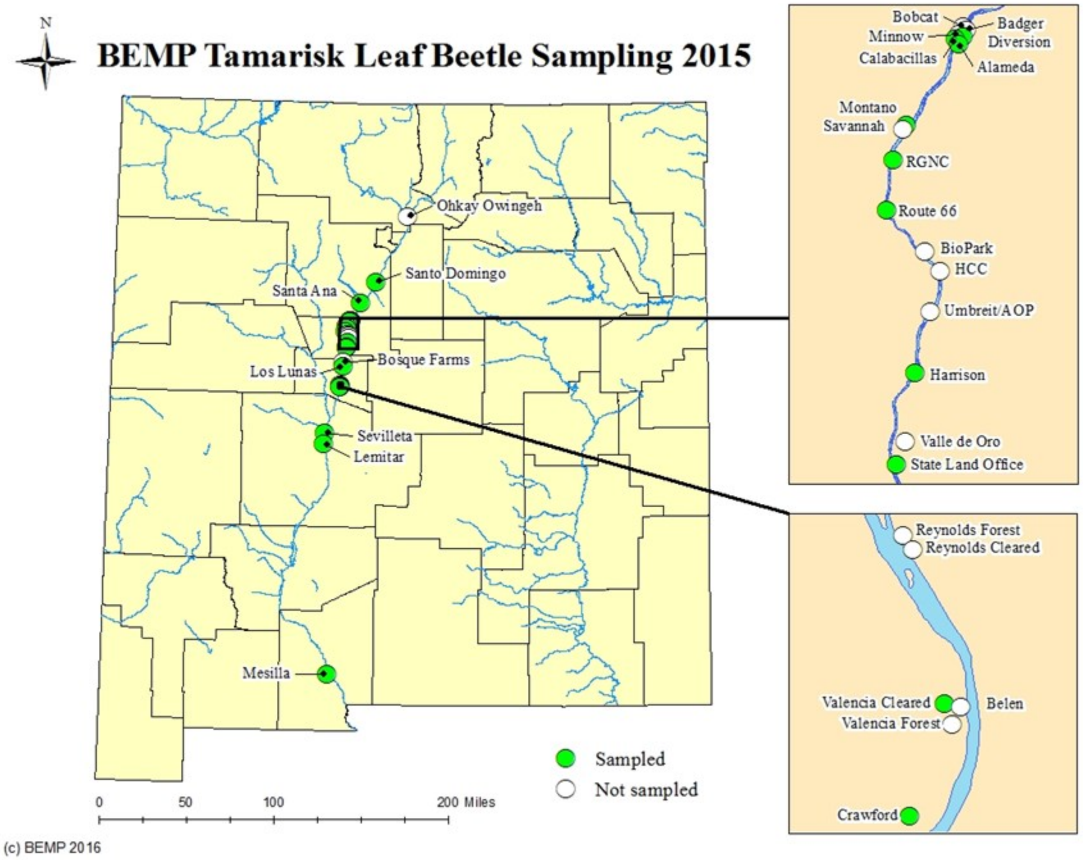
Annual Report: Tamarisk Leaf Beetle Monitoring
May-August 2015

Introduction

The expanding range of the tamarisk leaf beetle (*Diorhabda* spp.) throughout the western United States continues to be a pressing ecological issue for land managers. From 2001-2010, four species of *Diorhabda* were released in several western states as a biological control agent for tamarisk (*Tamarix* spp.), a riparian shrub native to Eurasia (Dowdy 2010, Tracy et al 2015). It has been the target of a variety of eradication efforts since the 1950s, primarily due to concerns that tamarisk outcompetes and uses more water than native plant communities (Chew 2009). While recent data have called this assertion into question (Cleverly 2013), of continuing concern are data suggesting that tamarisk acts as a ladder fuel into native cottonwood canopies and intensifies fire in riparian systems (Stuever, 2000). Tamarisk is tolerant of a variety anthropogenic stressors (Cleverly 2013), rendering it difficult to eradicate using physical and chemical methods—making the release of a biocontrol agent an attractive prospect. Early releases of *Diorhabda* suggested successful control, with tamarisk mortality at 40% within four years at some sites in Nevada (Dudley et al. 2006).

Concerns were quickly raised for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), a riparian specialist which has adapted to nest in thick tamarisk stands (Sogge et al. 2003). A buffer zone was established prohibiting releases of *Diorhabda* within 200 miles of designated critical flycatcher habitat (Dudley and Bean 2012), and releases were halted entirely in 2010 to protect the bird. However, *Diorhabda'*s range has expanded dramatically in the five years since, including into New Mexico. While the beetle was never released along the Rio Grande due to the buffer zone, since 2010 *Diorhabda* has been expanding its range along the riparian corridor, likely from separate populations in Colorado and Texas (Tamarisk Coalition 2015).

BEMP began monitoring for tamarisk leaf beetle in May 2013, and has continued to monitor sixteen sites in a roughly 260-mile stretch of the Rio Grande from Santo Domingo Pueblo in the north to Mesilla Valley Bosque State Park in Las Cruces to the south (Figure 1). Our goals are to help document the range expansion of *Diorhabda* in the Middle Rio Grande Valley, to assess changing arthropod population dynamics in the wake of the tamarisk leaf beetle's arrival, especially among its competitors and predators, and, finally, to track any changes in native and exotic plant cover as tamarisk is reduced or perhaps eliminated in some areas.



[Figure 1: Map of BEMP sites where tamarisk leaf beetle monitoring was conducted in 2015. We sampled sixteen of BEMP's then-thirty permanent sites (two new sites were added, one in December 2015 and the other in March 2016, bringing the total to thirty-two).]

Methods

BEMP staff, interns, and student volunteers conducted monitoring for tamarisk leaf beetle at sixteen of our permanent sites (Figure 1). One new site, State Land Office, was added in 2015, and one site from 2014, Bosque Farms, was removed from the monitoring program. Each site was monitored once per month from May through August, encompassing the peak activity season for *Diorhabda*. Our field sampling methods were adapted from protocols developed by the Colorado Department of Agriculture, Tamarisk Coalition, and University of California- Santa Barbara (Jamison and Lanci 2012). At each site, five tamarisk trees, at least five meters apart, were sampled using sweep nets. The contents of the sweep nets were emptied into plastic bags and frozen for later identification. The same trees, identified via metal tags, were sampled each month. Photographs were taken of each tree from the same vantage point at the time of sampling to document defoliation and, in some cases, refoliation, over the course of the season. We measured defoliation as a percentage of total leaves exhibiting damage from tamarisk leaf beetle or leafhopper, which will be summarized as minimal (<15%), moderate (15-40%), or severe (>40%) (Figure 2).

[Figure 2: Examples of each defoliation category. From left to right: Calabacillas saltcedar #3, minimal; Calabacillas saltcedar #2, moderate; Diversion saltcedar #2, severe. Photos by BEMP, August 2015]

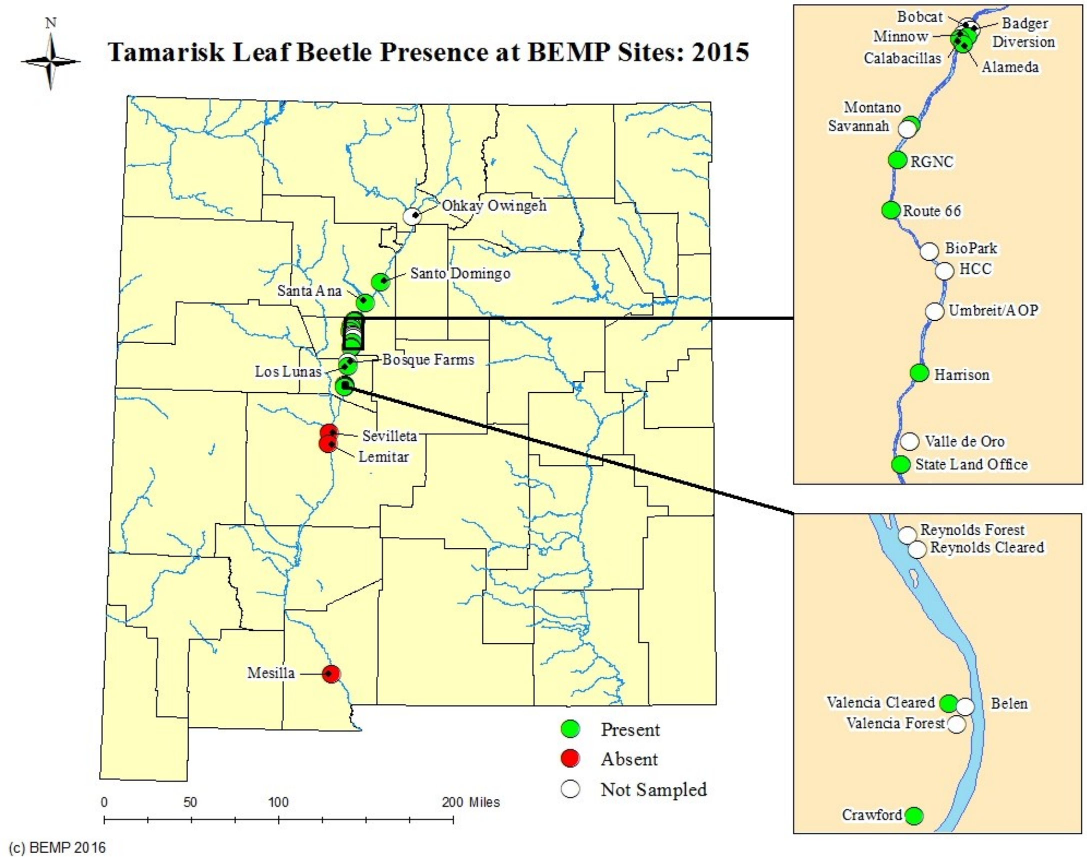
The frozen samples were identified at BEMP's UNM laboratory by BEMP staff and college interns using a dissecting scope. Numbers of tamarisk beetle adults, larvae (divided into early—1st and 2nd instar—and late—3rd and 4th instar), and egg masses were tallied. Other introduced tamarisk specialists, the splendid tamarisk weevil (*Coniatus splendidulus*) and the tamarisk leafhopper (*Opsius stactogalus*) were also counted. Possible predators of the tamarisk beetle, spiders and ants, were tallied. Other arthropods were counted and identified to at least order.

Results

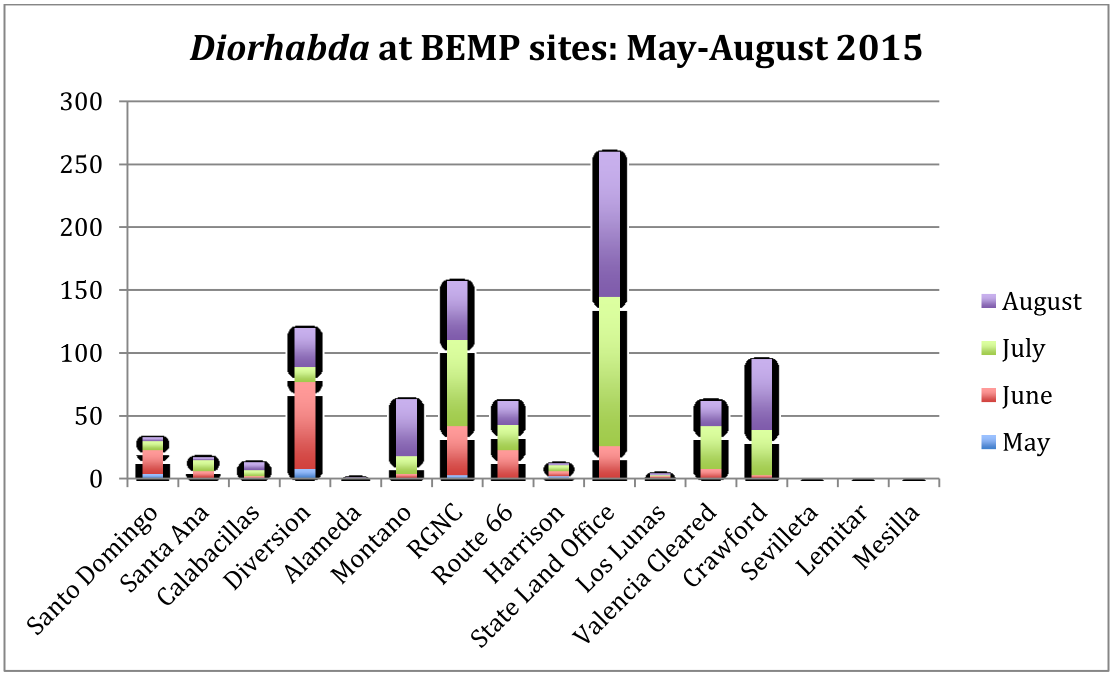
We found *Diorhabda* at thirteen of sixteen sites throughout the sampling season (Figure 3). Generally, we captured more beetles in the Albuquerque area and Belen than at the northern Pueblo sites (Figure 4). We did not find *Diorhabda* at Sevilleta, Lemitar, or Mesilla (Figure 4), though we did find other tamarisk specialists at these sites (Figures 5, 6). The highest number of individual beetles was captured at the State Land Office site in the South Valley of Albuquerque (Figure 3). A month-by-month summary of monitoring results can be found in Appendix I.

By the end of the sampling season, severe defoliation was observed at seven sites starting in August; there was moderate defoliation at five sites, and minimal defoliation at the remaining four. We observed only minimal refoliation at one site, State Land Office. Some defoliation was observed at sites where *Diorhabda* was not present due to the presence of the tamarisk leafhopper.

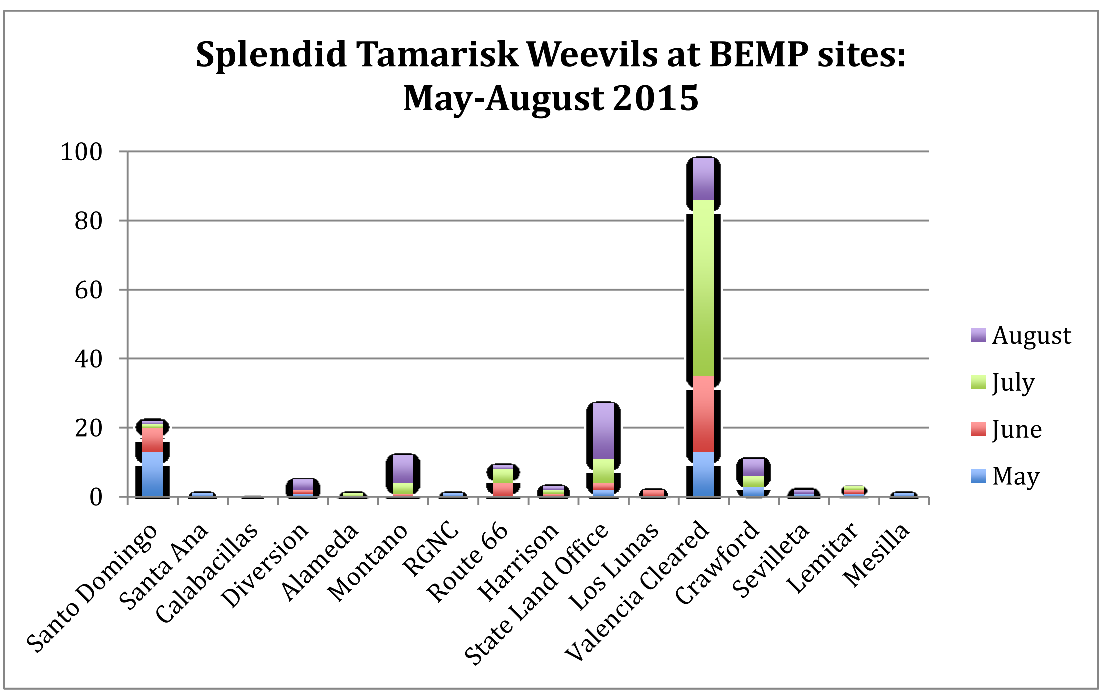
The number of splendid tamarisk weevils (Figure 5) and leafhoppers (Figure 6) observed varied widely across sites throughout the sampling season, and was not significantly correlated with the presence or absence of *Diorhabda.* Similarly, the abundance of spiders (Figure 7), ants (Figure 8), or other arthropods (Figure 9) was not significantly correlated with the presence or absence of *Diorhabda* or any other tamarisk specialist.



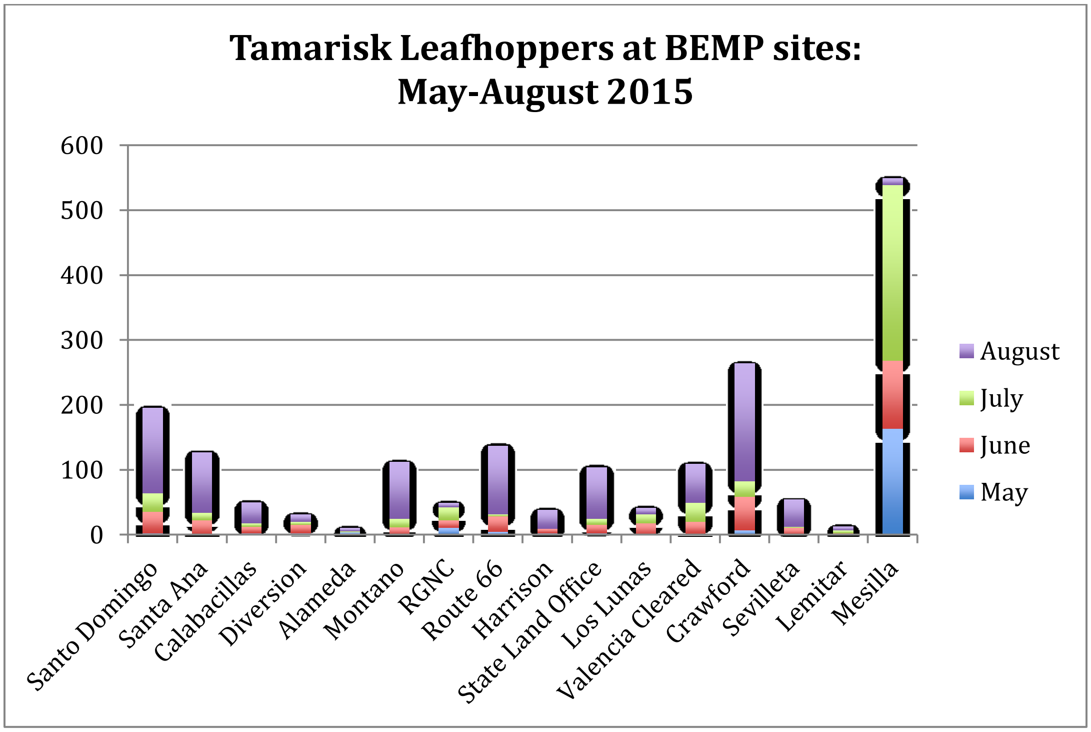
[Figure 3: Map of tamarisk leaf beetle presence at BEMP sites in 2015. Beetles were present at all sites sampled except for the three southernmost sites of Mesilla, Sevilleta, and Lemitar.]



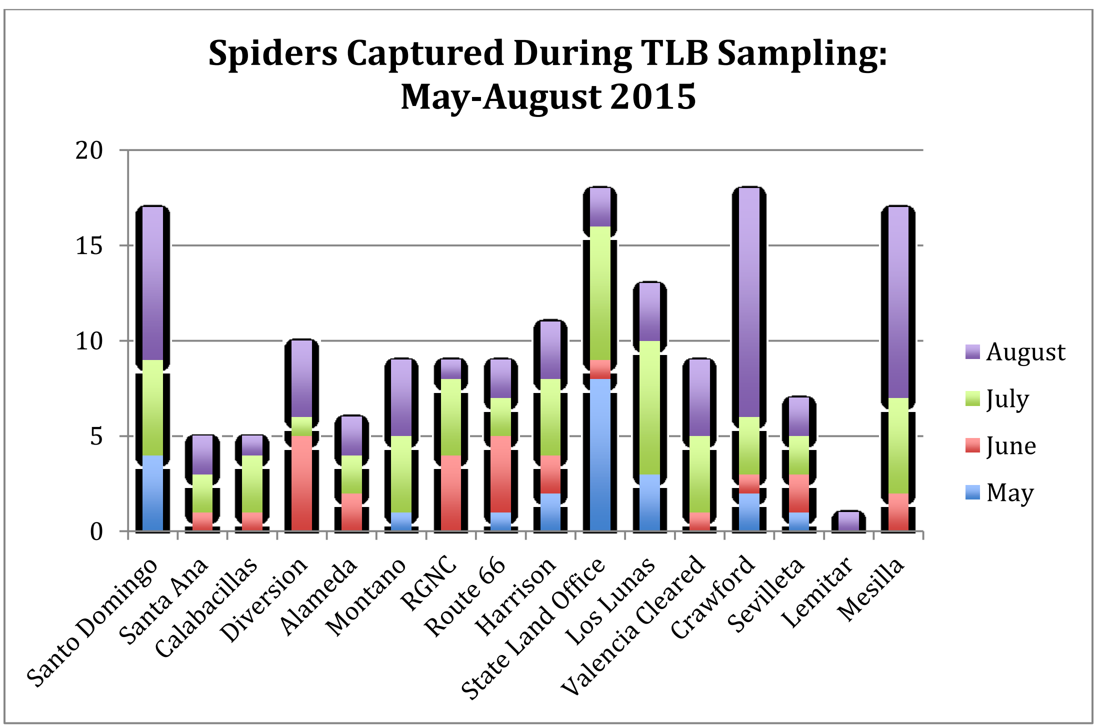
[Figure 4: Seasonal totals for tamarisk leaf beetle adults and larvae found at BEMP sites in 2015. Most individuals were collected in July and August. The highest populations were at sites in Albuquerque and Belen, with fewer beetles at the northern Pueblo sites.]



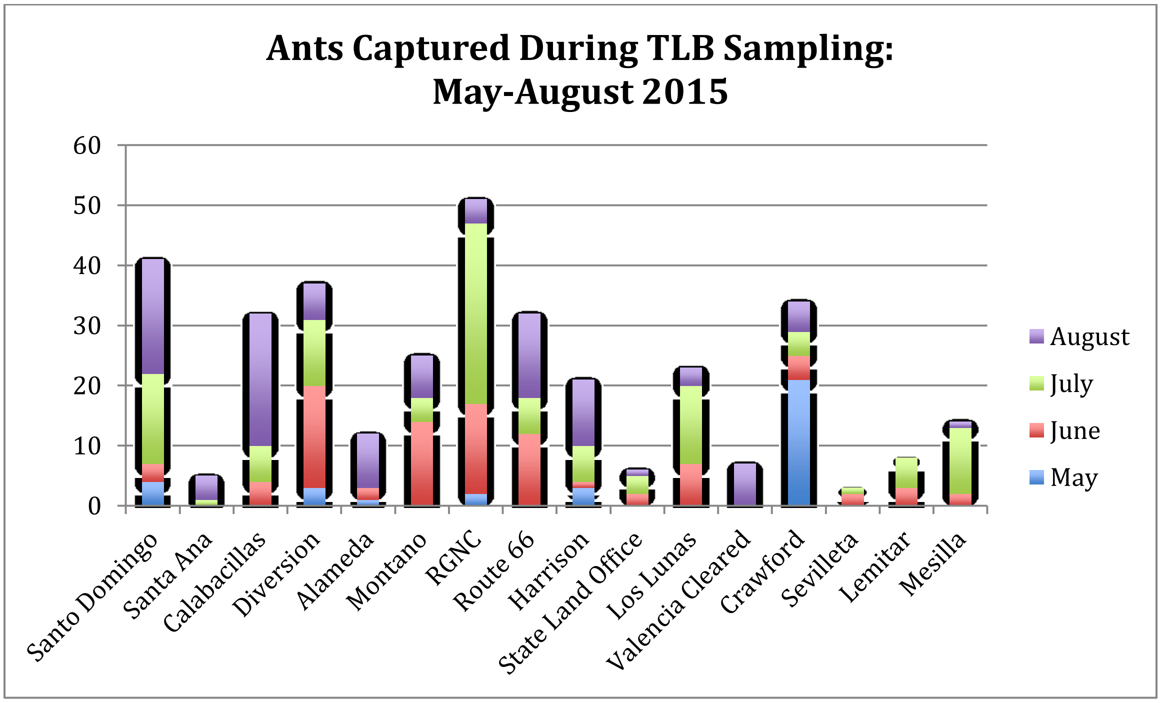
[Figure 5: Seasonal totals for splendid tamarisk weevils collected at BEMP sites in 2015. Valencia Cleared had a markedly higher number of weevils than any other site. Note the shift in the Y-axis.]



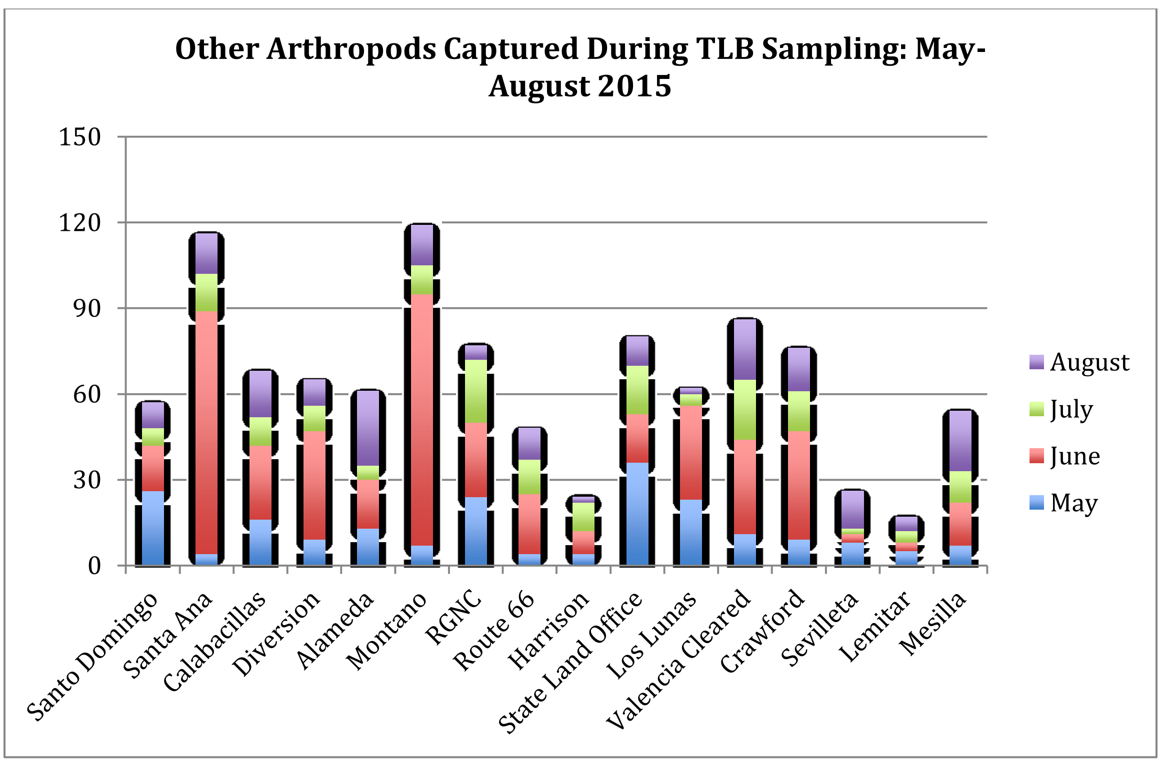
[Figure 6: Seasonal totals for tamarisk leafhopper at BEMP sites in 2015. Mesilla had a markedly higher number of leafhoppers than any other site. Note the shift in the Y-axis.]



[Figure 7: Seasonal totals for spiders collected at BEMP sites during tamarisk leaf beetle sampling in 2015. Note the shift in the Y-axis.]



[Figure 8: Seasonal totals for ants collected at BEMP sites during tamarisk leaf beetle sampling in 2015. Note the shift in the Y-axis]



[Figure 9: Seasonal totals for combined other arthropods captured during tamarisk leaf beetle sampling in 2015. Other arthropods captured varied widely but included Attalus beetles, hemipterans, flies, lacewings, and even pillbugs. Note the shift in the Y-axis.]

Discussion

Our data this year show a markedly different pattern from our monitoring in 2013 and 2014. *Diorhabda* populations seem to be shifting southward: sites in the South Valley of Albuquerque and in Belen experienced higher defoliation in 2015 than in 2014, and the number of individuals captured during sampling increased four- to nearly tenfold in these areas. Correspondingly, populations in the north appear to have dropped: Santo Domingo, which in 2013 and 2014 had the highest beetle populations and most severe defoliation, experienced mostly minimal defoliation this year and the number of individuals sampled fell by nearly 85%. Severe defoliation was observed in June and July in 2014, but was not observed until August in 2015. We observed virtually no refoliation following severe defoliation this year, compared with substantial leaf recovery at four sites in 2014. However, because severe defoliation occurred over a month later in 2015, it is possible that leaf recovery may have occurred in September, after the end of our sampling period.

While the peak population appears to be moving southward in the Middle Rio Grande Valley, we have not observed *Diorhabda* occupying any new sites to the south in our three years of monitoring. However, other surveying efforts in 2015 have documented beetles expanding their range into new areas, particularly in the area of Elephant Butte (Tamarisk Coalition 2015). It appears that this expansion was driven by beetles moving northward from Texas rather than southward through the Middle Rio Grande Valley, though these two populations will likely meet in the near future (Tracy et al. 2015).

We continued to collaborate with Northern Arizona University researchers in 2015 to monitor tamarisk leaf beetle populations in the Middle Rio Grande Valley. A comprehensive summary of the combined results was reported to the US Army Corps of Engineers (Johnson et al. 2015) and presented by NAU researchers at the 2016 Tamarisk Coalition Conference in Grand Junction, Colorado. As in past years, our data were incorporated into the Tamarisk Coalition's tamarisk leaf beetle survey database.

BEMP will continue monitoring tamarisk leaf beetle in 2016, expanding to all thirty-two permanent sites as part of our long-term ecological monitoring program. We plan to conduct analysis to determine the type and extent of habitat change driven by the tamarisk leaf beetle in the Middle Rio Grande Valley, drawing on our other long-term monitoring datasets including leaf litter, vegetation transect, surface-active arthropod, and core weather data, from our thirty-one permanent sites both with and without tamarisk. BEMP sites have experienced a variety of different ecological management strategies over time and cover a wide geographic range from Santo Domingo Pueblo to Mesilla Valley Bosque State Park in Las Cruces. Therefore, our data will be useful for land managers seeking to understand the rapidly evolving ecological impacts of the tamarisk leaf beetle in the southwest, and what management strategies will be necessary and effective in the wake of these changes.

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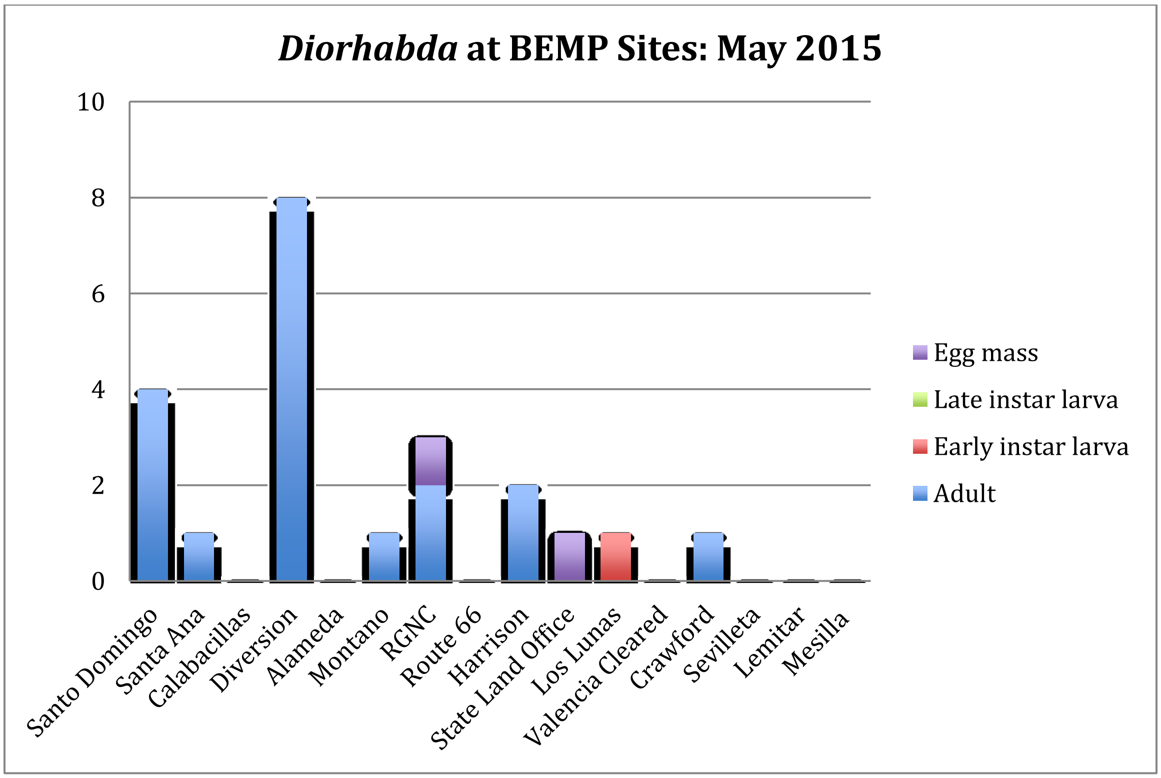
Appendix I: Month by Month Summary of Diorhabda Monitoring

May

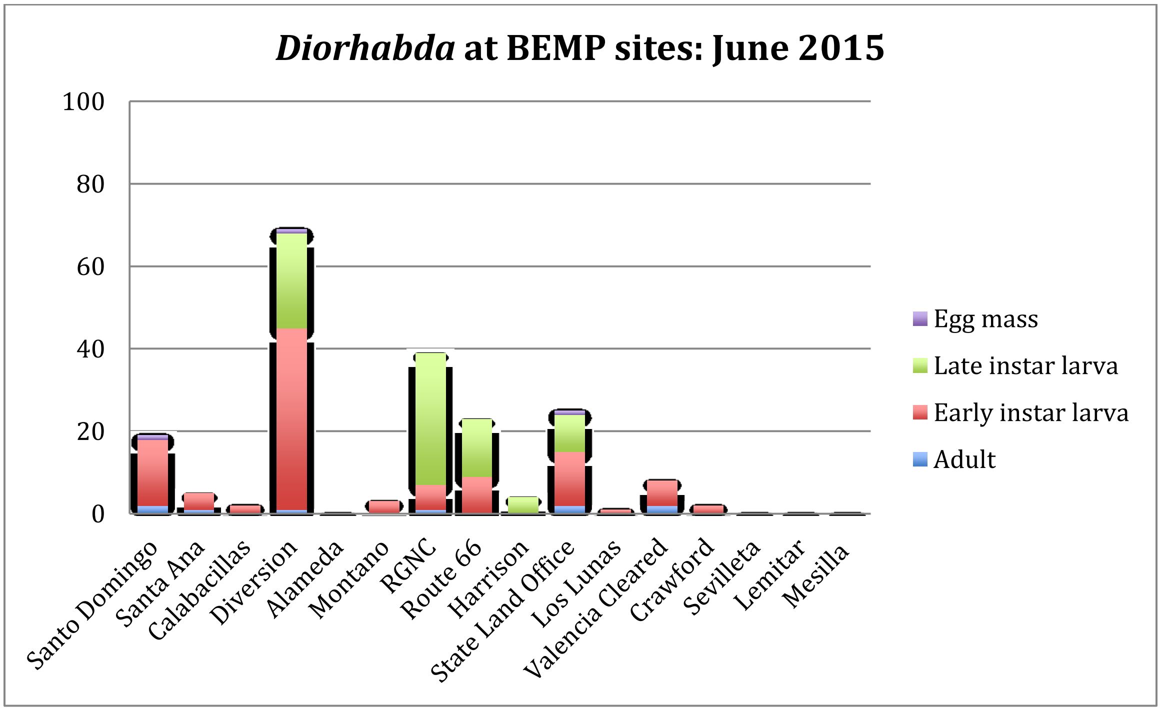
In May, we found *Diorhabda* at nine of sixteen monitoring sites, encompassing a general geographic area from Santo Domingo Pueblo to Belen (Figure X). Diversion, in northern Albuquerque, had the highest number of beetles, with 8 adults. Almost all beetles sampled were adults, with the exception of Los Lunas, where one larva was found. One egg mass was also found at the Rio Grande Nature Center (RGNC). We observed only minimal to no defoliation this month, mainly in Albuquerque and Belen.



[Figure 10: Tamarisk leaf beetles were present at eight of our sixteen monitoring sites in May 2015; an egg mass was found at a ninth site.]

June

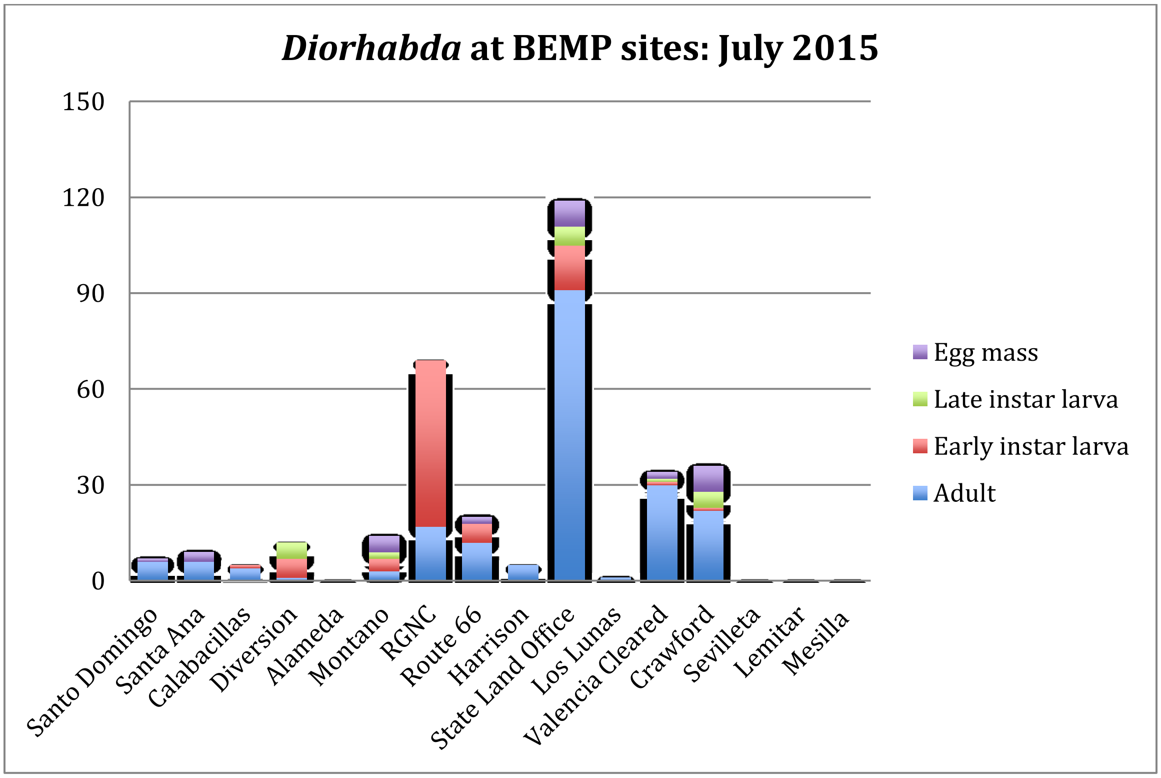
In June, we found *Diorhabda at* twelve of our sixteen monitoring sites, from Santo Domingo Pueblo to Belen (Figure X). Diversion again had the highest number of individuals, at sixty-seven. Most *Diorhabda* sampled were early-instar larvae, with few adults or egg masses. We again observed minimal to no defoliation at most sites, with the exception of Valencia Cleared, where defoliation was moderate.



[Figure 11: Tamarisk leaf beetles were present at twelve of sixteen sites in June 2015. Nearly all individuals sampled were larvae. Note the shift in the Y axis.]

July

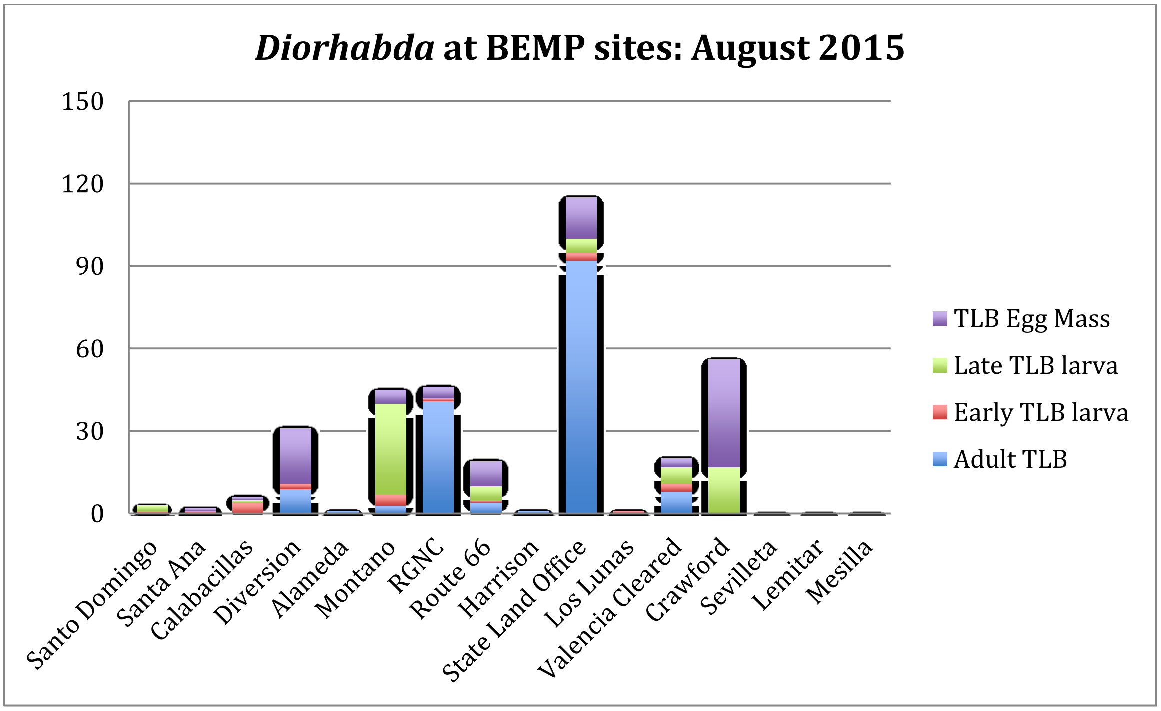
In July, we found *Diorhabda* at twelve of fourteen monitoring sites, from Santo Domingo Pueblo to Belen (Figure X). State Land Office, in the South Valley of Albuquerque, had the most individuals, at 111, not counting egg masses. The majority of the sampled population were adults. Defoliation in the study area was minimal to moderate, generally increasing north to south, with some pockets of severe defoliation at Santo Domingo and Valencia Cleared.



[Figure 12: Tamarisk leaf beetles were present at twelve of sixteen sites in July 2015. Note the shift in the Y-axis.]

August

In August, we found *Diorhabda* at thirteen of sixteen sites, from Santo Domingo Pueblo to Belen (Figure X). State Land Office again had the most individuals, at 100, not counting egg masses. The large number of adult beetles found at State Land Office skews the total age class dominance towards adults; however, we found a mix of age classes at the remaining sites, including the most egg masses of any month (97). Eight sites in the Albuquerque to Belen area exhibited severe defoliation, the remainder mostly moderate. This was the only month we observed refoliation; it was a minimal amount at one site, State Land Office, on only one tree. The Mesilla site showed moderate damage from tamarisk leafhopper this month.



[Figure 13: Tamarisk leaf beetles were found at thirteen of sixteen sites in August 2015. Most beetles were found in Albuquerque and Belen, with far fewer at the northern Pueblo sites.]