Tamarisk Beetle Colonization of the Rio Grande in New Mexico

A long-term, multi-faceted study of the spread, impacts, and hybridization of tamarisk beetles along the Rio Grande in central and southern N.M.

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Introduction:
Tamarisk beetles (Diorhabda spp.) are a biocontrol agent used to control non-native tamarisk (Tamarix spp.), a small invasive riparian tree. Tamarisk beetles were first introduced in the USA in 2001. Since, four species of tamarisk beetles have been released across different portions of the West. Our study is the first to combine genetic analysis and on-the-ground field surveys to track the colonization of a large region by multiple species of these beetles, while also studying long-term (8 years) population dynamics and impacts to the target weed.

Methods:
Field Surveys
We surveyed the spread of tamarisk beetles from 2012–2019 using standardized sweep net sample protocols. In addition to sweep net sampling, we began studying tamarisk phenology in 2016, using visual estimations of canopy defoliation, mortality, and flowering.

Genetic Analysis
In 2016 we began collecting tamarisk beetles for genetic analysis to track species movement and potential hybridization. Genetic research consisted of looking at both the mitochondrial DNA and DNA markers from the whole genome. Mitochondrial DNA was analyzed using CO1 (Cytochrome C Oxidase Subunit 1) sequencing to indicate the maternal lineage of the individual and RADseq (Restriction site associated DNA sequencing) was used on the whole genome to look for hybridization among species.

Main Findings:
Field Surveys
Two tamarisk beetle (Diorhabda spp.) populations (one moving north and one moving south) spread rapidly across the study reach from 2013–2016 (Figure 1). These populations began to overlap in 2016. As beetle populations increased tamarisk defoliation increased, leading to modest increases in canopy mortality in the long term (Figure 2) and major decreases in tamarisk flowering in the short term (Figure 3). Tamarisk beetle abundance decreased from 2017–2019, reducing the extent of defoliation events, and characterized a boom and bust dynamic.

Genetic Analysis
We found the two populations of tamarisk beetles spreading across the study reach to be composed of different species (D. carinulata moving south and D. sublineata moving north). Within the D. sublineata population we found genetic evidence of two other species of tamarisk beetles that have been released in the U.S.A. (D. carinata and D. elongata), suggesting these three species are hybridizing in the field. Alternatively, when the populations of D. carinulata and D. sublineata overlapped in our study reach in 2016 we found no evidence of hybridization. Our findings support other’s findings (see Bean et al. 2013) that D. carinulata may be out-competed in parts of the U.S.A. where these other three species of tamarisk beetles succeed.

Literature Cited: