Assessing riparian restoration along the Escalante River: does removal of an invasive tree help restore the arthropod community?

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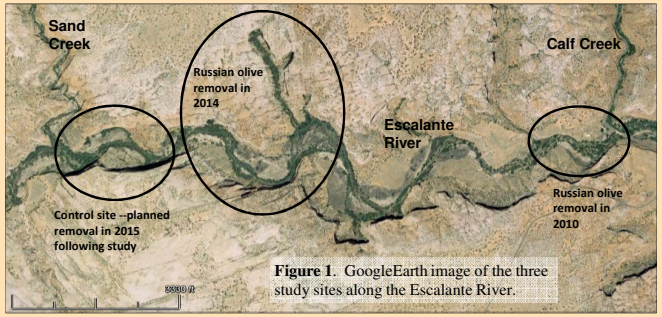


Figure 1. GoogleEarth image of the three study sites along the Escalante River.

Introduction

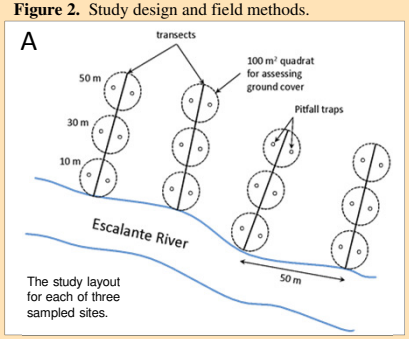
The Escalante River is the last remaining free-flowing river of its size in the western United States, and it faces environmental threats from the invasive Russian olive tree, *Elaeagnus angustifolia* (Reynolds and Cooper 2010). These trees outcompete native species and alter river ecosystems by creating heavy shade and channelizing rivers .

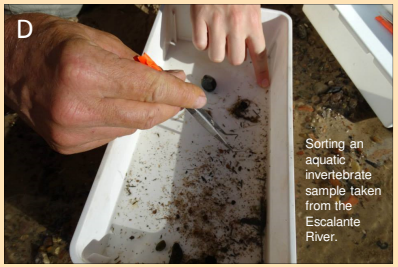
In Grand Staircase Escalante National Monument, efforts are underway to restore the Escalante River corridor through long-term, large-scale removal of Russian olives. In collaboration with the Escalante River Watershed Partnership, we (the Biol-423, Collaborative Research in Biology class) assisted with Russian olive removal on the Escalante River and conducted research to assess the effects of removal on terrestrial and stream-dwelling arthropods. We hypothesized that arthropod richness and abundance would increase in areas where Russian olive was removed, and that these increases would be greater in areas that had more time to recover (Bateman et al. 2008).

Methods

1. Data were gathered from three sites: two in which Russian olive removal had occurred during the years of 2010 or 2014, and a control site (2015) where Russian olive remained (**Fig. 1**).
2. Each site had four, 50m transects set 20m apart and running perpendicular to the river (**Figs. 2A & 2B**). A 100m^2 quadrat was established at 10m, 30m, and 50m along each transect.
3. Within each quadrat, leaf litter depth and percent ground cover were measured.
4. Two pitfall traps were set within each quadrat (**Fig. 2C**). After 6 days, pitfall traps were retrieved and captured arthropods were preserved in vials containing 70% isopropyl alcohol for later identification in the laboratory.
5. Six aquatic invertebrate samples were taken from the streambed adjacent to each study site. Invertebrates were collected with a Surber sampler, sorted (**Fig. 2D**), and preserved in 70% isopropyl alcohol.
6. ANOVA with Tukeys comparisons were used to examine differences among sites.

Figure 2. Study design and field methods.





Results

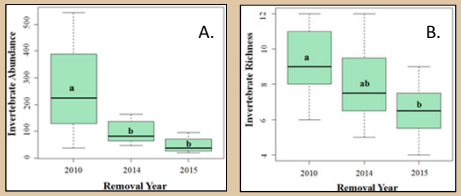


Figure 3. Box plots showing terrestrial invertebrate abundance (A) and richness (B) for the 2010 and 2014 Russian olive removal treatments and the 2015 control. Different letters indicate means that were significantly different (Tukeys $p < 0.05$).

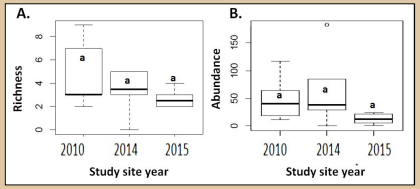
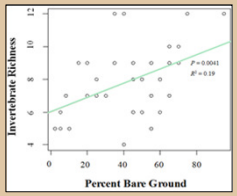


Figure 4. Aquatic invertebrate mean richness (A) and abundance (B) by study site/year. There were no significant differences among sites. ($p = 0.169$).



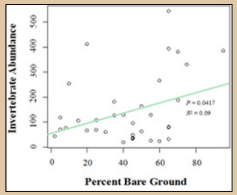


Figure 5. Correlations between bare ground and (A) invertebrate richness and (B) abundance across the 48 quadrats within the 3 study sites. Both relationships were significant.

Discussion

Our data suggest that Russian olive removal had a positive effect on terrestrial arthropods (**Fig. 3**). Arthropod abundance was nearly 5 times greater at the 2010 removal site as compared to the 2015 control. Five taxa showed significantly greater abundances at the 2010 site: Araneae (spiders), Diptera (flies), Collembola (springtails) and Hemiptera (true bugs). Richness was also greater at the 2010 site, averaging approximately 2.5 more taxa than the 2015 control. The recovery time following Russian olive removal was also important. Whereas richness differed between the 2010 and 2015 sites, the 2014 site was not different from the control, suggesting that -year may be insufficient time for arthropod richness to recover.

No significant differences were seen among sites for stream-dwelling arthropods (**Fig. 4**). This may indicate that Russian olive trees impact aquatic communities less than riparian ones, that the stream community responds more slowly or that our sample size (six Surber samples per site) may have been insufficiently large to detect differences.

There was a significant positive relationship between percent bare ground and both the richness and abundance of terrestrial arthropods across sites (**Fig. 5**). Russian olive trees deposit large amounts of leaf litter that becomes densely layered as compared to native trees such as cottonwood (*Populus fremontii*). By increasing ground coverage, Russian olives may create unsuitable habitat for native arthropods adapted to the open ground more typical of desert stream riparian systems.

In conclusion, our data support the hypothesis that removing Russian olive trees helps restore the arthropod community along the Escalante River, and that arthropod numbers and taxonomic richness increase with recovery time. To our knowledge, this is the first study documenting the effects that Russian olive removal has on ground-dwelling arthropods in riparian habitats.

References:

Bateman HL, Chung-MacCoubrey A, Snell HL (2008) Impact of non-native plant removal on lizards in riparian habitats in the Southwestern United States. *Restoration Ecology* **16**:180-190.

Reynolds LV, Cooper DJ (2010). Environmental tolerance of an invasive riparian tree and its potential for continued spread in the southwestern US. *Journal of Vegetation Science* **21**:733-743.

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