The Effects of *Tamarix* on Functional Feeding Groups along the Dolores River, Big Gypsum Valley, CO.

Kylie Morris, Ryan Dorsey and Dr. Deborah Kendall

Fort Lewis College Department of Biology
Durango, CO 81301

INTRODUCTION

Functional feeding groups occur in arthropod speciation as they do in other orders of species. Arthropods make up a diversity of the landscape and fill niches as predators, herbivores, omnivores, and detritivores. Diversity can help in determining the health of certain environments. Non-native plants also have an effect on surrounding native flora and fauna. Tamarisk, *Tamarix* sp. *(*Tamaricaceae) is a nonnative species that grows along the riparian habitat of the lower Dolores river. An important and vital way for researchers to consider the effects of *Tamarix* on an environment is for them to analyze and understand the bottom of the food chain. In this case, detritivores make up the bottom of the food chain. Detritivores are heterotrophs, which gain nutrients by consuming detritus—decomposing plant and animal parts as well as fecal matter (Wetzle 2001). They make up only a portion of functional feeding groups among riparian arthropods, including herbivores and predators.

Many nonnative plants may not be the ecological equivalents of the native plants they displace in terms of their most important ecological function: generating food for higher trophic levels (Ballard, Hough-Goldstien & Bellamy, 2013). Although *Tamarix* may be nonnative, it may be beneficial to non-plant specific arthropods, as organic matter from riparian vegetation is a source of nourishment for organisms (Naiman & Decamps, 1997).

Species diversity may actually increase when a mixture of native and nonnative plants is present (Ballard, Hough-Goldstien & Bellamy, 2013).

Adversely, exotic riparian plants can exert potentially powerful stresses by altering allochthonous trophic pathways. (Hladyz, Abjörnsson, Giller, et al., 2011). The consideration here is, how *Tamarix* is effecting the low levels of the food chain and if those levels of the food chain are being effected by the *Tamarix*, what are the ripple effects throughout the environment.

HYPOTHESIS

Is there evidence that the type of plant community affects the presence of functional feeding groups? We will use a level of significance of alpha = 0.05 to conduct a two-variable chi-square test.

H_0: Type of plant community is not related to functional feeding group presence.

H_1: H_0 is false. Type of plant community is related to functional feeding group presence.

STUDY OBJECTIVES

* Compare functional feeding groups across three different sites: native desert shrub, *Tamarix* dominated riparian, and willow riparian along the Dolores River, CO.

* Investigate the effect of invasive *Tamarix* on the diversity of functional feeding groups.

* Determine whether or not *Tamarix* varies the amounts and types of predators, omnivores, detritivores, and/or herbivores observed in comparison to native riparian types.

* Determine what effects *Tamarix* may have on the environment as a nonnative species in the Western United States.

Figure 1A. Aerial image of the study site along the Dolores River, Montrose County, Colorado.

Figure 1B. DEM projection of our study site along the Dolores River, Montrose County, Colorado. Each point of collection differentiated by vegetation species.

EXPERIMENTAL DESIGN AND METHODS

Three habitat sites were established within the riparian corridor of the Dolores River in Big Gypsum Valley, CO. The three habitat sites consisted of one dominated by *Tamarix ramosissima*, one by native willow (*Salix exigua*), and one by native desert shrubs (*Atriplex canescens*, *Guitierrezia* spp., *Forestiera pubescens*, and *Sarcobatus vermiculatus*). The native shrub site was viewed as the control. Each habitat was marked at the following coordinates; Tamarisk- N 38°09'27.0" W 108 °53'23.1", Shrub- N 38°09'27.4" W 108°53'23.3", and Willow- N 38°09'35.9" W 108°53'14.8". The replicate sites were placed every 10 meters at 22°NE for shrub and tamarisk, and 20°NE for willow. Each habitat had three replicated sites within them, made of an "X" pattern of 9 pit fall traps, all one meter apart.

Pit traps consisted of 250 ml plastic cups, 97 mm in height, and tapered to 7 mm at the bottom, were buried at soil surface level. Traps were filled with 20% ethanol and 80% water; the ratio at which arthropods would not desiccate nor swell. Each site within each habitat was compiled to give three samplings for three habitats. Trapping was conducted for 48 hour periods, over 7 dates in 2013; Our dates were April 12-14, May 10-12, June 13-15, July 12-14, August 9-11, and October 4-6.

Arthropods were filtered from the water: ethyl alcohol mixture, and placed in dated and labeled jars. Specimens were brought back to the Zoology lab at Fort Lewis College to determine taxonomy and for preservation in 80% ethanol. Arthropods were identified to the lowest possible taxon, and functional feeding group was determined with the help of experts, both online with photographs (bugguide.net), and through specimens reference guides (keys). We evaluated our final data by conducting a 2 way chi-squared analysis, using an alpha value of 0.05 for significance.

Figure 10. *Tamarix spp.* Along the lower Dolores River.

RESULTS

- A two variable chi-squared test with alpha = 0.05 was used to determine the effect of plant type on the presence of functional feeding groups.
- The presence of *Tamarix* did have a significant effect on ant abundance, χ^2 (22, n= 6015) = 32030.00, p = 0.000.
- A two variable chi-square shows detritivores within *Tamarix* and shrub to have the least numbers when compared with their expected numbers; Detritivores in *Tamarix* equaled 3.6% and detritivores in Shrub equaled 10.8%. Detritivores within willow made up 85.6% of their expected quantity.
- *Tamarix* had a lower quantity of omnivores and predators when compared native sites.
- *Tamarix* contained a greater quantity of herbivores than the native shrub and willow sites.

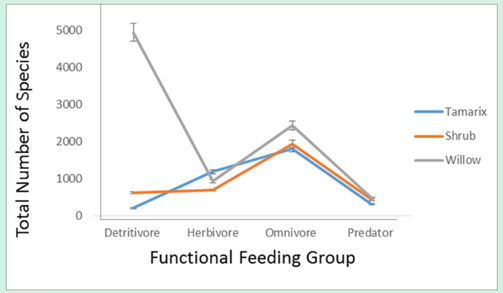

Figure 9. Number of species in each Functional feeding group among the three different sites: *Tamarix*, shrub, and willow from 12 April 2013 through 6 October 2013.

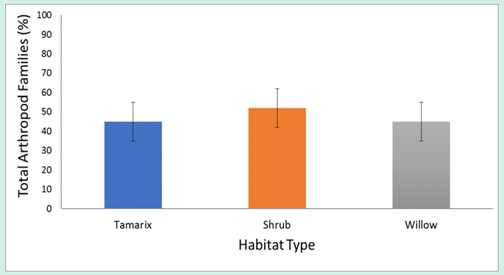

Figure 2. Total percent of all arthropod families collected from *Tamarix*, Shrub and Willow from 12 April 2013 through 6 October 2013.

Figure 3. Honeypot ants consuming a candy-coated shell. *Myrmecocystus mexicanus* (Formicidae), omnivore.

Figure 4. Springtail, *Pseudachorutes sp.* (Neanuridae), detritivore. Collembola

Figure 5 Sawfinger scorpion, *Serradigitus sp.* (Vaejovidae), predator.

Figure 6. Snout beetle, *Coniatus splendidulus* (Curculionidae), herbivore.

DISCUSSION

Detritivores within our willow site made up 85.6% of the total (4939 total species) number of detritivores. This outlier was caused by the abundance of Springtail, *Pseudachorutes sp.* (Neanuridae), class Collembola, during the dates 9-11 August 2013. Excluding this outlier (Figure 9), we can assume that the total number of detritivores would be similar in all sites, but *Tamarix* exhibited a smaller total percentage (Figure 9) than the overall expected number for detritivores. *Tamarix* did, however, contain more herbivores, and fewer omnivores and predators on average (Table 1) than the native sites.

This leads to the conclusion that nonnative *Tamarix* affects the functional feeding groups differently than that of native shrub and willow on functional feeding groups in a geographically similar location. Willow exhibited greater total number of arthropod species overall (54.9%), in part due to Collembola (Figure 4), but also to increased quantity of leaf litter and canopy cover.

Table 1. Results of a 2 variable chi-squared statistical analysis. Shows derivation from number of actual species to the expected number of species in each functional feeding group among vegetation type.

		Functional Feeding Group Type				Total
		Detritivores	Herbivores	Omnivores	Predators	
Tamarix	Actual Count	207	1191	1813	317	3528
	Expected Count	1270.9	623.2	1361.4	272.5	3528.0
	% within FFG	3.6%	42.1%	29.3%	25.6%	22.0%
Shrub	Actual Count	623	695	1936	438	3692
	Expected Count	1329.9	652.2	1424.7	285.2	3692.0
	% within FFG	10.8%	24.6%	31.3%	35.4%	23.1%
Willow	Actual Count	4939	943	2431	482	8795
	Expected Count	3168.2	1553.6	3393.9	679.3	8795.0
	% within FFG	85.6%	33.3%	39.3%	39.0%	54.9%
Totals	Actual Count	5769	2829	6180	1237	16015
	Expected Count	5769.0	2829.0	6180.0	1237.0	16015.0
	% within FFG	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 11. Velvet ant, *Sphaeropthalma arota* (Mutillidae), predator.

Figure 12. Wood ant, *Formica neoclara* (Formicidae), omnivore.

Figure 13. Skin beetle. *Apsectus sp.* (Dermestidae) , detritivore.

Figure 7. The lower Dolores River running through the study site. Willow habitat along the river bank. Shrub habitat at the base of the slope.

Figure 8. Cobweb spider. *Asagena medialis* (Araneae), predator.

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