Hydrological Effects of Dams to The Specific Leaf Area of Russian Olive Trees

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Background

Russian olive (*Elaeagnus angustifolia*) is a non-native tree that has spread along riparian ecosystems in the western USA since its introduction from Eurasia. It was originally brought in as a windbreaker in the late 1800s (Olson and Knopf 1986; Katz and Shafroth 2003).

Plant Functional traits are measurable ecological attributes that impact the fitness of an individual organism (Diehl et al, 2017).

Specific Leaf Area (SLA) is a plant functional trait that is correlated to many metrics of plant fitness, one example being relative growth rate (Pérez-Harguindeguy et al, 2013).

SLA Equation :

$$\text{SLA} = \frac{\text{Leaf area (cm}^2\text{)}}{\text{Leaf dry weight (g)}}$$

Research Question

Is the SLA of Russian olives near dams higher upstream or downstream ?

Hypothesis:
Dams stress trees that are downstream by limiting water resources.

Prediction:
The SLA of Russian olive trees upstream of dam will be higher than Russian olives downstream of a dam.

Independent Variable: Dam location relative to the site

Dependent Variable: SLA of leaf samples from each site

Figure 1: Image of the Cherry Creek Dam (Harry Weddington)

Methods

Data Collection: The study was conducted at seven sites across Colorado. A total of 1020 Russian olives leaves were sampled. These leaves were collected from the Mideast, Midwest, Top east, and Top west canopies of Russian olives trees that were mature and most exposed to sunlight. Leaves were weighed to obtain fresh mass, ran through an area meter to obtain leaf area, and dried to obtain dry leaf mass.

Analysis: For the analysis of this data, a mixed model ANOVA with leaf nested within tree as a random variable and location (upstream vs downstream) as the fixed variable to explain specific leaf area (SLA). Untransformed SLA values were used as the dependent variable and locations (upstream vs downstream) were used as independent variable. The mixed model was used to test the null hypothesis that upstream SLA does not differ from downstream SLA.

Results

The mixed model ANOVA explains specific leaf area (SLA) with location above versus below the dam was significant (n= [1020], F= [11.2787] df= 1, $p<0.0008$), which means that the null hypothesis of no difference is rejected. The transformed SLA was higher in upstream locations (mean= 154.8) than in downstream (mean= 142.6)(Figure 3).

Figure 3: A Russian olive along Clear Creek at Prospect Park (Jason Agyemang)

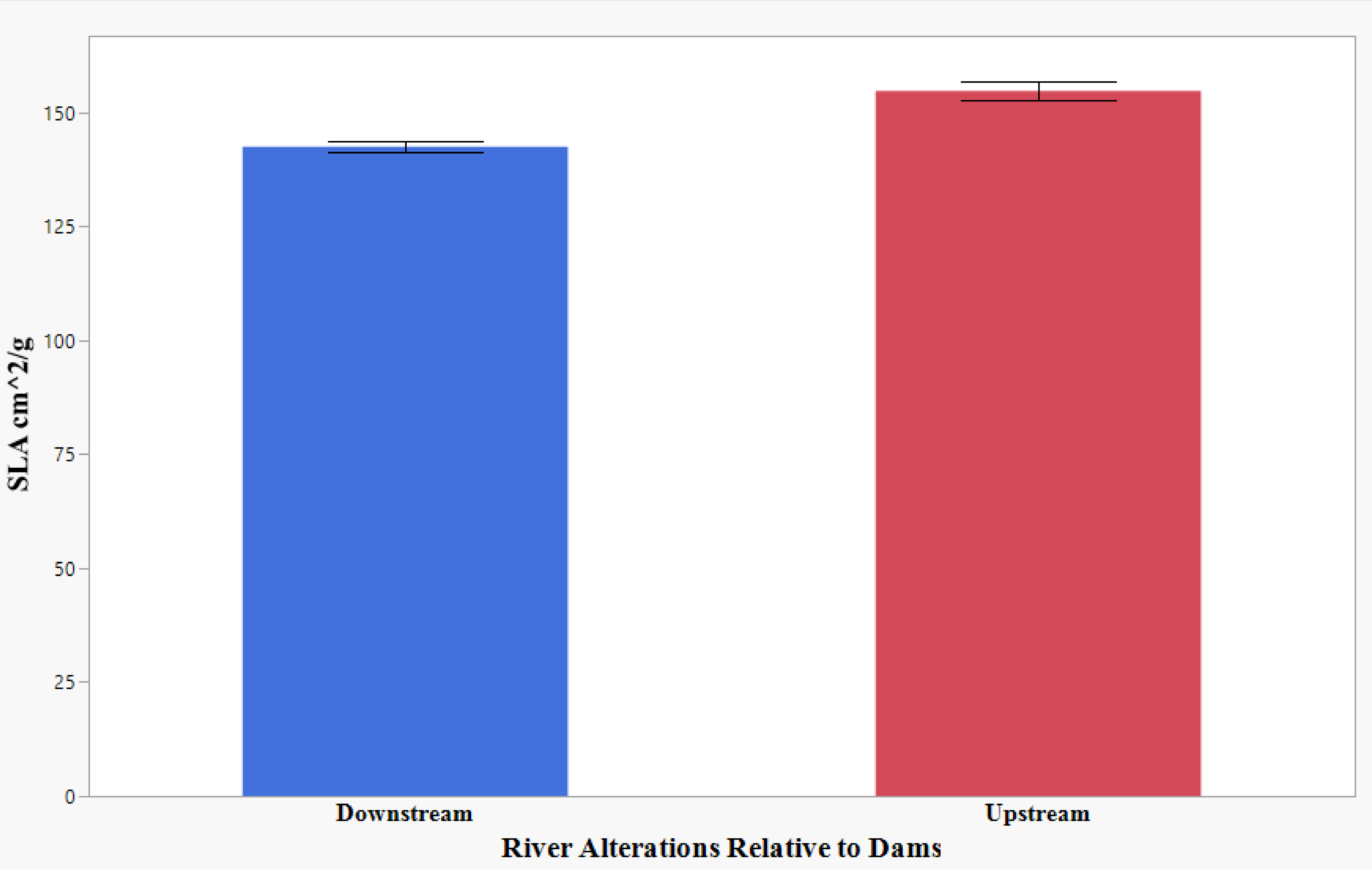

Figure 2 :Untransformed mean comparison of SLA of Russian olive in river sites above versus below a dam. Error bars are 1SE.

Discussion

We would expect the SLA of upstream Russian olives to be higher than downstream Russian olives because they have less stress put on them by the dams because of their location. Large Dams tend to create downstream riverbed incisions. This increases the length that roots of vegetation must grow to reach the water table (Schmutz & Moog, 2018) and creates overall water stress. This is potentially causing the stress on the Russian olives in this study enough to significantly alter the SLA.

Conclusion

This is the first study that investigates how the SLA of Russian olive trees responds to the stress of a dams. The use of river alterations caused by dams in assessing differences in SLA of Russian olives did produce results of significant difference. Understanding how the SLA of Russian olives respond to dams could provide encouraging future advancement in understanding the dynamics of the invasion of Russian olives. This study helps inform riparian and functional ecology overall.

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