

Mechanical Removal of Juniper and its Effects on Plant Diversity



Kyle D. VanVleet, John D. Krenz and Christopher T. Ruhland

Department of Biological Sciences, Minnesota State University, Mankato MN 56001 USA

Introduction

The increase in density of juniper (*Juniperus* spp.) in sagebrush communities throughout the Western US, primarily as a result of fire suppression and over-grazing, has had detrimental effects on livestock forage and wildlife habitat (Burkhardt and Tisdale, 1969).

Our main objective of this study was to show how removal of juniper may affect species richness and abundance of forbs in the immediate surrounding area. We hypothesized that juniper removal is a disturbance that can affect other plant species.



Typical sagebrush community with junipers. Photo credit: Red Cliffs Desert Reserve

Materials and Methods

Our study site was located in North-central Wyoming, on the Southern edge of the Bighorn National Forest at The Nature Conservancy's Tensleep Preserve near Ten Sleep, Wyoming. We estimated species richness and abundance of forbs in rectangular plots at three types of locations (treatments): live juniper, removed juniper (stump present with masticated juniper detritus), and non-juniper (random locations with no juniper or stump). Plots (6 x 2 m north to south) at live and removed tree locations were centered on the tree or stump.

We counted the number of species and the number of forbs in the north and south halves of each plot because of potential shading or slope effects. We conducted normality and equality of variance tests prior to using either t-test or Mann-Whitney U-tests on differences in species richness and abundance comparing north to south and among treatments.

Results

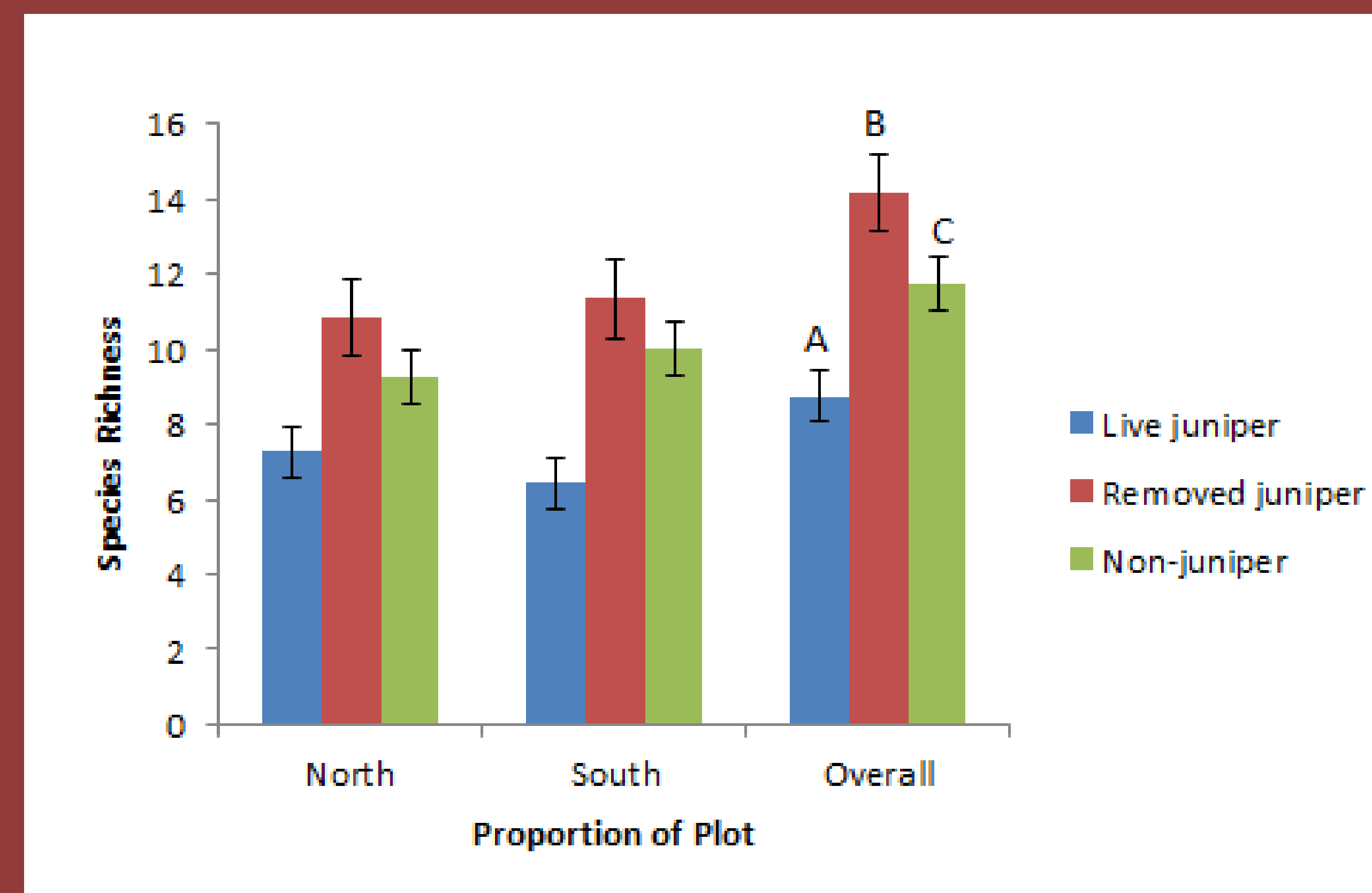


Figure 1: Mean number of forb species observed on the north and south sides (and pooled) by treatments. Error bars are 1 SE. No significant difference in species richness was observed when comparing north to south within treatments. Species richness differed among treatments. Plots with removed juniper had 62% more forb species than plots with live juniper (Mann-Whitney, $p < 0.001$). Non-juniper plots had 34% more forb species than plots with live juniper (Mann-Whitney, $p = 0.001$). Plots with removed juniper had 21% more forb species than non-juniper plots (t-test, $p = 0.012$). Letters indicate statistically significant differences: plot types with different letters are different.

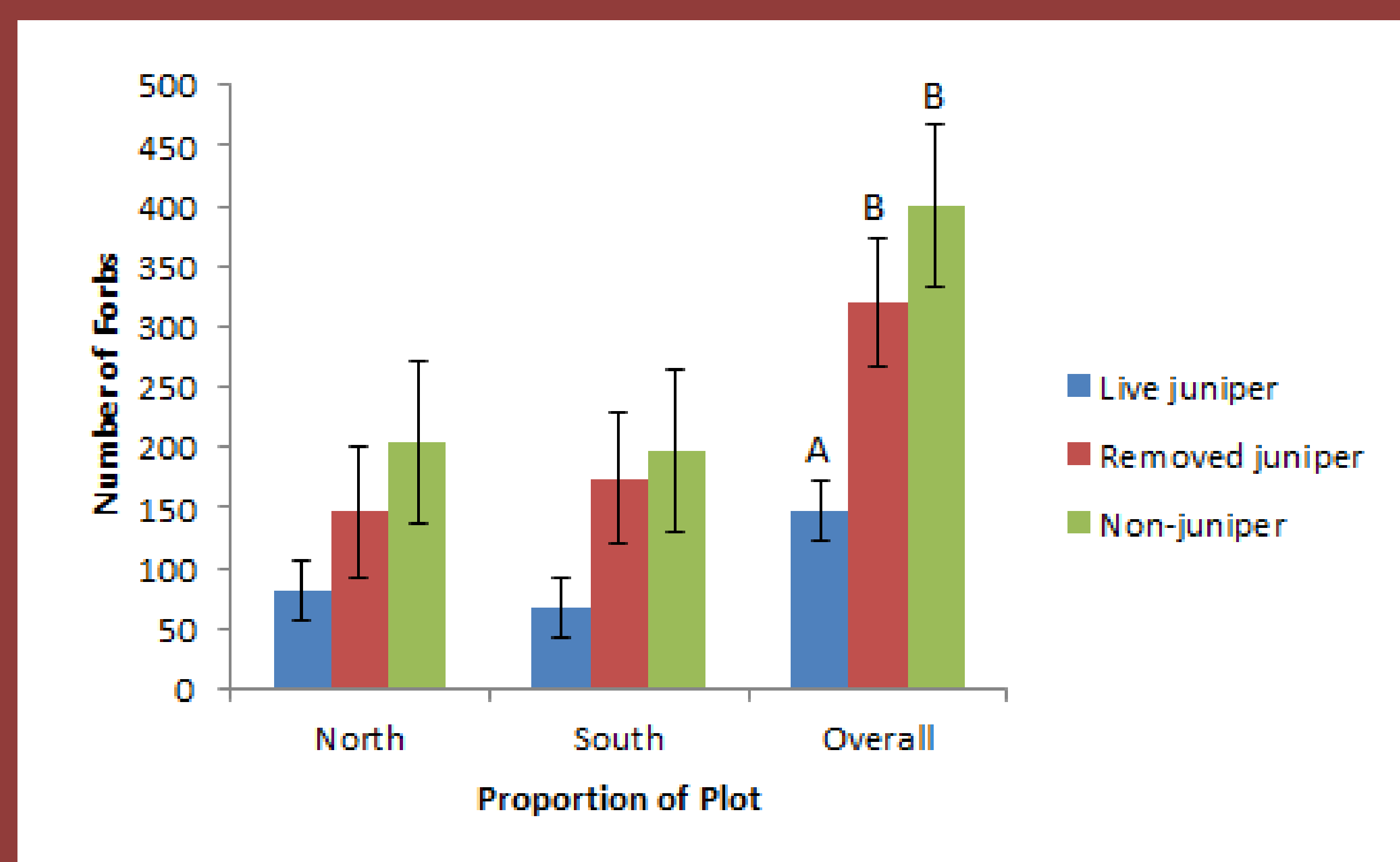


Figure 2: Mean number of forbs observed in the north and south sides and overall sites by treatments (live, removed and non-juniper). Error bars are 1 SE. No significant difference in number of forbs was observed between north and south. Plots with removed juniper had 116% more forbs than plots with live juniper (Mann-Whitney, $p < 0.001$). Non-juniper plots had 170% more forbs than plots with live juniper (Mann-Whitney, $p < 0.001$). No significant difference was detected in the number of forbs between plots with removed juniper and non-juniper plots. (T-test, $p = 0.102$). Letters indicate statistically significant differences: plot types with different letters are different.

Discussion

We found that junipers may reduce forb diversity and abundance and that mechanical removal of junipers caused higher forb diversity (species richness). Increases in understory productivity after mastication of juniper may result from an increase in resource availability in the surrounding area (Bates et al. 2000, 2005, Young et al. 2012, 2013). Mechanical removal of juniper may reduce competition for nutrients and soil water thus increasing productivity and diversity of other plants. (Bates et al. 2000, Young 2012).

Mastication of juniper creates a disturbance facilitating the invasion of exotic annual weeds and grasses, or even the regeneration of juniper (Evans and Young 1985, Miller et al. 2005, Vaitkus and Eddleman 1987). Five out of the twelve mechanically removed juniper sites that we evaluated during this study had juniper saplings present, which may be an indication of the degree of juniper dominance in the area.

Plant responses to juniper removal may be highly site-specific and governed by a number of factors, such as soil characteristics, seedbed composition, pretreatment site diversity of forbs, and means of removal. Remaining questions are on the duration of diversity effects of disturbance and on the impacts of disturbances of higher and lower intensities and frequencies.

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