

# ANIMAL-PLANT INTERACTIONS IN AN *ATRIPLEX CANESCENS* DOMINANT COMMUNITY BROWSED BY CATTLE

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## ABSTRACT

*Atriplex canescens* is a relatively widespread shrub in rangelands of the western United States, with a longstanding reputation as a valuable browse resource for ruminants. The breeding system of tetraploid populations has been extensively studied both in common gardens and in natural populations. However, browser-driven alterations of shrub sex ratios, and the probable mechanisms involved in such processes, have received relatively little attention in these populations. We report results from a preliminary study conducted in a stand of *A. canescens* at a site on the shortgrass steppe. Numbers of young shrubs decreased with increasing shrub density. Sex ratios did not differ from the expected 55:35:10 pistillate : staminate : monocious ratio in grazed plots, but did differ significantly from this ratio in exclosures, where they were clearly more female-biased. We discuss probable grazing-related mechanisms that could account for these results.

## KEYWORDS

*Atriplex canescens*, sex ratios, density, recruitment, shortgrass steppe

## INTRODUCTION

Fourwing saltbush (*Atriplex canescens* (Pursh.) Nutt.) is a dioecious, wind-pollinated, fairly short-lived shrub. Tetraploid populations of this species are trioecious, exhibiting female, male, and monocious individuals (McArthur and Freeman 1982). McArthur (1977) proposed a theoretical 55:35:10 pistillate:staminate:monocious ratio, that was found to be fairly constant across populations in western United States (McArthur and Freeman 1982; Barrow 1987).

Relatively little is known about the ability of browsers to alter sex ratios in tetraploid *Atriplex canescens* populations. Such alterations were described for *Atriplex vesicaria* Heward ex. Benth. grazed by sheep in Australia (Williams *et al.* 1978). Sex-biased herbivory producing either differential mortality of sexes or sex phenotype shifting towards maleness could be responsible for increasing the proportion of male shrubs (Williams *et al.* 1978; McArthur 1977).

We conducted a preliminary study in order to determine shrub sex ratios and densities in protected areas and long term winter- and summer-grazed pastures. The objective of our study was to gain insight into patterns of cattle browsing in a stand of *A. canescens* identified as a predominantly tetraploid population (Sanderson, S. Shrub Sciences Laboratory, Forest Service, pers. com.).

## METHODS

In August and September 1995, we placed two 50 m transects in two exclosures and two pastures on a floodplain area at the Central Plains Experimental Range in northeastern Colorado. *Atriplex canescens*, *Bouteloua gracilis* (H.B.K.) Lag. ex Steud. and *Pascopyrum smithii* (Rydb.) A. Love, are the dominant plant species at the site. Soils of the area are loamy to sandy loams (Liang *et al.* 1989). Most of the rainfall occurs between April and September, with a mean annual precipitation of 320mm.

The two pastures had been historically lightly grazed by heifers, one of them in summer and the other in winter. The two exclosures had been protected from cattle-grazing for approximately 50 and 25 years,

respectively. We recorded sex phenotype on the closest shrub to each 1 meter interval point along the transect, examining 100 individuals in each plot by ocular inspection. Shrubs were classified as either “females”, “males”, “monocious”, or “zeros” depending on whether they exhibited utricles, staminate flower remnants, both staminate flower remnants and utricles, or neither of them, respectively. Individuals with no sexual expression classified as “zeros” were small (young) shrubs in almost all cases. We estimated shrub density using the closest individual method (Cottam and Curtis 1956).

Sex ratio data were analyzed by building a two-way contingency table and performing a  $\chi^2$  test of independence of shrub sex phenotype versus grazing treatment (Ott 1993). Sex ratios were also compared to the theoretical 55:35:10 pistillate:staminate:monocious ratio (McArthur 1977) using a  $\chi^2$  goodness-of-fit test (Ott 1993). Finally, we related information on shrub density and sex phenotype counts to assess variations in sex ratios along a shrub density gradient.

## RESULTS AND DISCUSSION

Sex phenotype was related to grazing treatment ( $\alpha=0.05$ ) when we analyzed all sex phenotype class counts together (Table 1). When we excluded young individuals from the analysis, the hypothesis of independence was not rejected. We found an apparent linear decrease in numbers of young individuals with an increase in estimated shrub density (Fig. 1).

Greater recruitment and possibly higher rates of population turnover may be occurring in the grazed plots at this site. Low counts of young individuals in the exclosures, in the 25 year old exclosure in particular, could be a consequence of a combination of density-dependent seedling mortality and density-independent processes of competition with the rhizomatous grass *Pascopyrum smithii*, protected from grazing and extremely aggressive in the use of shrub interspace resources. Utricle fill and germination performance were greater in utricles collected from exclosures compared to those from shrubs of the winter grazed plot (Cibils and Beker, unpublished data), thus supporting the idea of higher seedling mortality within exclosures.

Sex ratios of adult plants in the grazed pastures, did not differ significantly ( $\alpha=0.05$ ) from the expected ratio, but they did differ significantly ( $\alpha=0.05$ ) from the expected ratio in both exclosures (Table 1). We observed an apparently linear increase in the number of females with an almost threefold increase in estimated shrub density (Fig.1). Numbers of male and monocious individuals remained fairly constant across the shrub density gradient.

Because females, with relatively greater energetic requirements, ought to be at a competitive disadvantage in high density stands (Freeman and Harper 1980), we would have expected them to be under-represented in the exclosures. However, the opposite occurred. This might be explained by the fact that grazers may discriminate shrubs on the basis of sex, as occurs in *A. vesicaria* where female-biased herbivory has been reported to occur (Williams *et al.* 1978, Graetz *et al.* 1978), thus altering shrub sex ratios. Theoretical sex ratios described previously for tetraploid *A. canescens* might, in fact, be browser-controlled.

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