Influence of Herbaceous Understory on Native Shrub Recruitment

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Several studies in the Sagebrush Association of the Great Basin Region have reported that competition from introduced grasses negatively affects shrub recruitment (Holmgren 1956, Hormay 1943, Hubbard 1959, Monsen and Shaw 1982, Price and Brotherson 1987). However, there is little information available on shrub recruitment in native shrub stands and the effect of understory composition. This study investigated how various life form groups of understory species affect shrub recruitment in native stands of antelope bitterbrush and Stansbury cliffrose. It was hypothesized that natural shrub recruitment is lower in areas where introduced annual grasses dominate the understory and higher in populations where native perennial bunchgrasses are dominant.

Methods

Twenty-two sites from northern to central Utah were sampled during the late summer and early fall of 1992 and 1993 (Table 1). Of those sites, nine supported antelope bitterbrush and thirteen supported Stansbury cliffrose. Only sites that provided at least 14 percent understory basal cover and were relatively uniform in slope and aspect were included in the study.

Five 3 ft X 150 ft belt transects were distributed uniformly through each shrub stand. Shrub density and age-classes were evaluated within each transect. Age-classes were determined by the following criteria: Seedling--fewer than four main branches and less than 6 inches tall; Juvenile--6 inches to 24 inches tall, but not reproductively mature; Mature--taller than 24 inches and/or reproductively mature; and Decadent--greater than fifty percent of canopy cover dead. Relative shrub recruitment rates were determined for each site by summing all seedlings and juveniles and dividing that value by the total number of shrubs in all age-classes and then multiplying by 100 (Table 2). Understory basal cover composition was characterized using an eight-point sampling frame placed at ten random locations along each transect. Understory species were divided into the following groups; PBL--perennial broadleaf herbs, PBG–perennial bunchgrasses, AG–annual grasses, and ABL–annual broadleaf herbs. Total understory basal cover was determined by summing absolute cover of all understory groups. Relative basal cover for each of the four groups was then calculated by dividing the absolute cover for each group by total cover and multiplying by 100. The relative cover of each life form group as well as total cover were used in multiple regression analyses. Absolute cover of bare ground, rock, and litter were also recorded at each study site and related to shrub recruitment using simple linear regression.

Elevation at each study site was taken from 7.5 minute USGS quadrangle maps and precipitation data at each site was taken from an isohyetal map of Utah based on annual precipitation averaged over the thirty year period, 1930-1960 (Table 1). These environmental data were also correlated with shrub recruitment using simple linear regression.

Deer Creek Site #21— bitterbrush.

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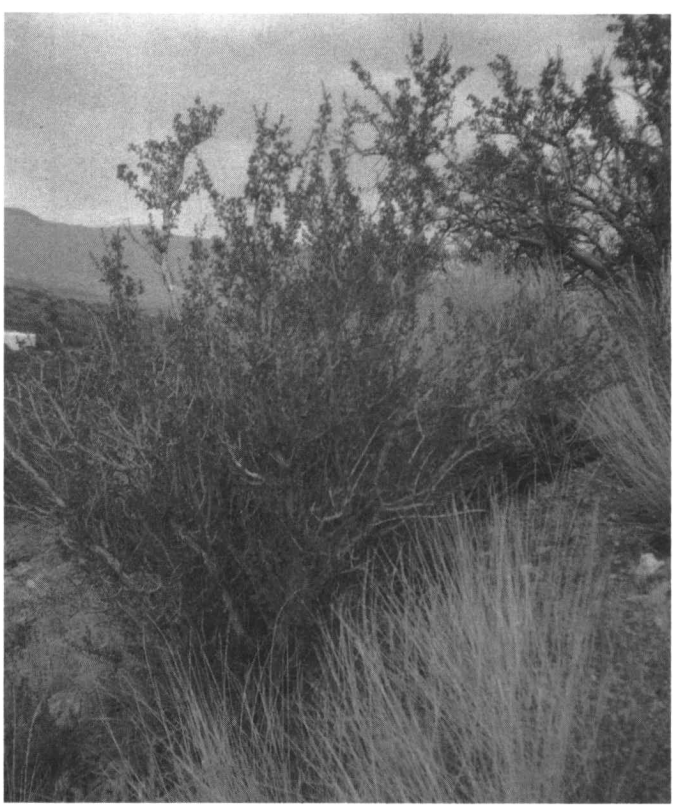
Table 1. Site descriptions and data collection year for 22 native shrub sites in Utah.

Site Number Location	Year	Shrub spp.	Elev. (feet)	Precip. Inches)	Dominant Grass spp.
1-Maple Canyon	92	Cliffrose	5548	20.1	Cheatgrass
5-Payson Canyon So.	92	Cliffrose	5447	20.1	Cheatgrass
6-Santaquin North	92	Cliffrose	5350	20.1	Cheatgrass
7-Santaquin South	92	Cliffrose	5447	20.1	Cheatgrass
11-Fillmore	92	Cliffrose	5350	15.0	Cheatgrass
12-Spring Lake	92	Cliffrose	5151	18.1	Cheatgrass
13-Edgemont South	93	Cliffrose	5249	20.9	Cheatgrass
14-Edgemont North	93	Cliffrose	5051	20.1	Cheatgrass
15-Payson Can. No.	93	Cliffrose	5151	20.1	Cheatgrass
16-Payson Can. Mid.	93	Cliffrose	5151	20.1	Cheatgrass
17-Mona North	93	Cliffrose	5447	20.1	Cheatgrass
18-Mona Middle	93	Cliffrose	5548	20.1	Cheatgrass
19-Mona South	93	Cliffrose	5645	20.1	Cheatgrass
2-Logan Canyon	92	Bitterbrush	5447	25.2	Cheatgrass
3-Tremonton #1	92	Bitterbrush	5447	16.1	Bluebunch
4-Tremonton #2	92	Bitterbrush	5447	16.1	Bluebunch
8-Lake Mountain	92	Bitterbrush	7381	20.1	Cheatgrass
9-Mt. Pleasant No.	92	Bitterbrush	6042	14.2	Bluebunch
10-Mt. Pleasant So.	92	Bitterbrush	6042	14.2	Bluebunch
20-Scipio	93	Bitterbrush	6143	18.9	Bluebunch
21-Deer Creek Res.	93	Bitterbrush	5645	18.9	Bluebunch
22-Heber	93	Bitterbrush	5645	16.1	Bluebunch

It should be noted that most of the annual grasses were introduced species, particularly cheatgrass. Essentially all of the perennial bunchgrasses were native, with bluebunch wheatgrass being the dominant species. All percentage data were arcsin transformed in an attempt to normalize the data set. A principal components analysis was used to evaluate the similarity of cliffrose and bitterbrush sites considered in this study.

Payson Canyon Site #15 —Cliffrose



Payson Canyon SIte #15—Cliffrose.

Table 2. Shrub recruitment and relative basal cover for perennial broadleaf herbs (PBL), perennial bunchgrasses (PBG), annual grasses (AG), annual broadleaf herbs (ABL) and absolute basal cover for plants, bare ground, rock, and litter for 22 native shrub sites in Utah.

Site Number Shrub spp.	Shrub Recruitment	PBL (%)	PBG (%)	AG (%)	ABL (%)	Total Plant Cover (%)	Bare (%)	Rock (%)	Litter (%)
1-Come	3.3	10.3	12.9	59.6	17.2	75.5	.8	13.8	10.0
5-Come	7.0	.6	37.0	55.3	7.2	45.3	2.5	10.3	42.0
6-Come	8.6	3.6	32.0	50.3	14.2	42.3	8.0	18.0	31.8
7-Come	9.7	45.2	10.3	34.8	9.7	38.8	14.0	19.0	28.3
11-Come	18.7	2.9	6.7	61.9	28.6	52.5	4.8	5.5	37.3
12-Come	8.3	1.5	14.6	77.7	6.3	51.5	7.3	11.0	30.3
13-Come	11.0	1.0	0.0	80.9	18.1	51.0	2.8	9.0	37.3
14-Come	7.4	.9	22.5	62.4	14.2	54.5	7.3	13.0	25.3
15-Come	11.1	1.5	6.0	70.2	22.4	33.5	7.0	25.5	34.0
16-Come	2.6	1.5	7.4	71.9	19.2	50.8	2.0	20.3	27.0
17-Come	27.4	8.3	9.6	71.6	10.6	54.5	3.5	10.8	31.3
18-Come	6.5	5.1	18.6	50.9	25.4	44.3	6.8	19.0	30.0
19-Come	5.0	0.0	29.9	49.7	20.4	39.3	7.0	19.3	34.5
2-Putr	14.6	27.9	17.9	42.1	12.1	70.0	4.0	5.8	20.3
3-Putr	11.9	4.8	86.2	6.4	2.7	47.3	6.3	9.0	37.5
4-Putr	9.4	4.0	76.7	11.4	8.0	44.0	6.3	9.5	40.3
8-Putr	8.4	31.0	25.9	41.4	1.7	14.5	6.0	9.5	70.0
9-Putr	4.1	24.0	57.9	17.8	.4	60.5	9.0	3.0	27.5
10-Putr	21.4	20.8	78.6	0.0	.6	43.3	19.8	6.5	30.5
20-Putr	31.3	10.4	88.0	0.0	1.6	31.3	10.5	25.5	32.8
21-Putr	9.1	26.5	35.5	16.9	21.2	47.3	.5	0.0	52.3
22-Putr	6.1	5.0	83.2	9.2	2.5	29.8	10.8	13.0	46.5

Results

Nine variables (precipitation, elevation, and absolute cover of bare ground, rock, litter, perennial broadleaf herbs (PBL), perennial bunchgrasses (PBG), annual grasses (AG), and annual broadleaf herbs (ABL)) were utilized in a principal components analysis. Cliffrose sites had 62% vegetative composition of annual grasses while bitterbrush sites had only 16% ($p<.01$). The same trend held true for annual broadleaf herbs with cliffrose having 16% composition and bitterbrush having 1% ($p<.01$). Price and Brotherson (1987) reported similar site preferences for cliffrose. Conversely bitterbrush sites had 64% composition of perennial bunchgrasses and cliffrose had 16% ($p<.01$) (Table 2). Because of the differential site preferences, recruitment for these two species was analyzed separately. Regression analysis for relative recruitment of cliffrose and bitterbrush indicated that recruitment was not significantly correlated ($p> .1$) with any of the understory composition groupings. Recruitment for both shrub species was negatively correlated with surface rock. A comparison of the signs for r-values for recruitment of these two species suggests that bitterbrush and cliffrose probably respond differently to understory and environmental variables.

Conclusions

Bitterbrush and cliffrose occupy different kinds of sites and the various life form groups in their respective understories may affect shrub recruitment of these two species quite differently. The data resulting from this study do not support the original hypothesis and suggest that some other factor or combination of factors influence shrub recruitment success to a greater extent than does understory composition. The uneven distribution of size/aged individuals in these shrub populations suggest episodical recruitment. Natural shrub recruitment may be a stochastic event that only occurs when several environmental factors (both biotic and abiotic) combine to allow shrubs to produce abundant seed and subsequent environmental conditions are favorable for germination and survival of seedlings. When this recruitment is triggered, understory vegetative composition may still affect recruitment success.

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