MONITORING POPULATIONS OF SHOSHONEA PULVINATA IN THE PRYOR AND BEARTOOTH MOUNTAINS, CARBON COUNTY, MONTANA

1992 Progress Report

Prepared by

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INTRODUCTION

Passage of the Federal Endangered Species Act of 1973 and subsequent recognition of the value of conserving biotic diversity (Wilson 1988) have resulted in many government agencies becoming active in species conservation. Surveys to determine the location and size of populations of rare species are being conducted on public lands throughout the west. These surveys are necessary in any species conservation program; however, knowing the location and size of populations at any one point in time is only the first step in a long-term protection strategy. (Sutter 1986). Understanding the population dynamics of long-lived perennials is especially difficult because noticeable changes usually occur slowly, and important growth-limiting population-level events, such as bouts of recruitment or catastrophic mortality may occur only at infrequent intervals (Braughman and Murphy 1990). Thus, long-term monitoring of growth, fecundity, recruitment and mortality is essential for understanding the condition and trends of plant populations, particularly long-lived, slow-growing species.

Shoshonea (Shoshonea pulvinata Evert & Constance) is a long-lived, mat-forming perennial in the Carrot Family (Apiaceae). This recently described species (Evert and Constance 1982) comprises a monotypic genus endemic to the Beartooth and Pryor mountain ranges of Carbon County, Montana and the Absaroka and Owl Creek ranges of Park and Fremont counties, Wyoming (Lesica and Shelly 1988). In Montana, shoshonea is generally restricted to shallow, calcareous soils of exposed limestone outcrops, rims, ridgetops and talus slopes at 6,800-7,800 ft (Lesica and Shelly 1988). In Montana, there are no apparent, immediate threats to populations of shoshonea. However, the species is threatened in the Beartooth Mountains by potential mining or oil and gas development and, in the Pryor Mountains, by grazing of wild horses. The species is ranked as G2G3/S1 (globally threatened, state endangered) by the Montana Natural Heritage Program and is considered sensitive in Montana (Lesica and Shelly 1991). Shoshonea is listed as sensitive by Region One of the U.S. Forest Service (Lesica and Shelly 1991) and is a candidate for listing as a threatened or endangered species by the U.S. Fish and Wildlife Service (USDI-FWS 1990).

The purpose of this study is to learn details of the life history of Shoshonea pulvinata by following mapped individuals for many consecutive years. In addition, results of the monitoring can be used to detect overall population trends at these sites. Permanent monitoring transects were established at three sites in 1991 (Lesica and Achuff 1991). Here I report the results of the first two years of the study.

METHODS

Locations and methods for reading the transects are provided in Lesica and Achuff (1991). The Mystery Ridge and Mystery Road sites are in the Pryor Mountains, while the Grove Creek site is on the east slopes of the Beartooth Mountains.

In order to examine differences in population structure, I placed Shoshonea pulvinata plants into one of three size classes:

(1) juvenile, area of ≤ 15 cm^2
(2) small mature, area of 16-80 cm^2
(3) large mature, area of >80 cm^2

The smallest plants observed flowering were 16 cm^2. These "immature" plants comprise the juvenile class. Plants larger than 16 cm^2 are potentially capable of reproduction and are considered mature. I arbitrarily divided these plants into two size classes, small and large.

Reproductive rate is the number of plants producing inflorescences divided by the number of plants in the mature size classes. Mortality rate is the number of plants that died between year t and year $t+1$ divided by the total number of plants present in year t. Recruitment rate is the number of new plants appearing between year t and year $t+1$ divided by the total number of plants present in year t.

Some plants that were recorded as more than one individual in 1991 were recorded as one in 1992 and vice versa. Consequently, changes had to be made in the 1991 summary statistics, so what is presented this year for 1991 will not match what was presented in Lesica and Achuff (1991).

RESULTS AND DISCUSSION

Shoshonea pulvinata size class distribution at the three sites in 1991 and 1992 are presented in Figure 1. At each site, size class distribution was similar both years; however, it was very different at the three sites. Grove Creek in the Beartooth Mountains had a large proportion of immature plants and few large reproductive plants. Mature plants, especially small mature plants, dominated the populations at the Mystery Ridge and Mystery Road sites in the Pryor Mountains.

The Grove Creek transect population increased between 1991 and 1992, while the two sample populations in the Pryor Mountains declined (Table 1). The percent of mature plants producing flowers varied between 37% and 71% and was indistinguishable among the three sites (Table 1). The Mystery Ridge site, which had the highest proportion of large mature plants (Figure 1), had

Table 1. Summary statistics for Shoshonea pulvinata at three monitoring sites in 1991-92. Reproductive rate is the number of plants producing inflorescences/number of mature plants. Mortality rate is number of dead plants in year t/number of plants in year t-1. Recruitment rate is the number of new plants in year t/number of plants in year t-1.

	Grove Creek		Mystery Ridge		Mystery Road	
	1991	1992	1991	1992	1991	1992
Total plants	57	68	33	24	50	47
Mature plants	28	26	31	20	44	38
Reproductive plants	16	11	22	13	30	14
Reproductive rate	57%	42%	71%	65%	68%	37%
Inflors./reproductive (±SD)	6.1 (6.5)	3.4 (4.0)	16.7 (16.5)	12.2 (9.6)	3.6 (4.2)	3.1 (2.9)
Mortality	--	3	--	10	--	4
Mortality rate	--	5%	--	30%	--	8%
Recruitment	--	14	--	1	--	1
Recruitment rate	--	25%	--	3%	--	2%

significantly more inflorescences per mature plant than the other two sites (Table 1). Mortality in 1991-92 was noticeably high at the Mystery Ridge site, while recruitment for the same period was significantly higher at the Grove Creek site (Table 1).

Demography of Shoshonea pulvinata was similar at the two Pryor Mountain sites. The only striking difference was the high mortality rate at the Mystery Ridge site where six mature plants died between 1991 and 1992. I do not know the reason for these deaths. The Grove Creek population appears to have very different demography than populations in the Pryor Mountains. Recruitment rate was high, and numbers of individuals declined in the larger size classes. In the Pryors, recruitment rate was low, and there were more mature plants than juveniles. One possibility is that bouts of recruitment are more sporadic in the Pryors. It may also be that mature plants survive longer in the Pryor Mountain populations; however, the high mature mortality at the Mystery Ridge site argues against this explanation. Continued monitoring should help elucidate these questions.

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Appendix A. Scores for vegetation area (A, cm^2) and number of inflorescences (I) for plants of Shoshonea pulvinata at three sites.

Grove Creek

	1991	1992	
1a	A144-I0	A128-I0	
b	A4-I0	A4-I0	
c	A16-I0	A12-I0	
d	A8-I0	A8-I0	
e	A4-I0	A4-I0	
f	A16-I0	A16-I0	
g	--	A4-I0	
h	--	A4-I0	
2a	A4-I0	A4-I0	
b	A4-I0	A4-I0	
c	A4-I0	A4-I0	
d	A4-I0	A4-I0	
e	A228-I6	A240-I1	
f	A4-I0	A4-I0	
g	A40-I5	A44-I0	
h	A28-I2	A28-I0	
i	A16-I1	A16-I0	
j	A4-I0	A8-I0	
k	A4-I0	A4-I0	
l	--	A4-I0	
m	--	A4-I0	
3a	A4-I0	A4-I0	
b	A20-I0	A28-I0	
c	A36-I3	A40-I2	
d	A4-I0	A8-I0	
(e	--	A12-I0)	probably not counted in in 1991
(f	--	A40-I4)	" "
4a	A8-I0	A4-I0	
b	A4-I0	--	
c	A4-I0	--	
d	A4-I0	A8-I0	
e	A20-I1	A16-I0	
f	A4-I0	A4-I0	
g	A4-I0	--	
h	A4-I0	A4-I0	
i	A104-I2	A108-I1	
j	A4-I0	A4-I0	
k	--	A4-I0	
l	--	A4-I0	
m	--	A4-I0	
n	--	A4-I0	
o	--	A4-I0	
p	--	A4-I0	
q	--	A4-I0	
5a	A40-I1	A76-I4	

b	A64-I7	A64-I3
c	A8-I0	A12-I0
6a	A116-I11	A108-I3
b	A68-I12	A60-I3
c	A16-I0	A16-I2
d	A80-I5	A84-I2
e	A108-I7	A112-I1
f	A4-I0	A4-I0
g	A4-I0	A4-I0
h	A4-I0	A8-I0
i	A4-I0	A4-I0
j	--	A4-I0
7a	A24-I0	A28-I0
b	A12-I0	A12-I0
c	A16-I0	A16-I0
8a	A112-I0	A120-I0
b	A116-I4	A132-I0
9a	A52-I0	A60-I0
b	A20-I0	A28-I0
c	A16-I0	A16-I0
c	--	A4-I0
10a	A532-I27	A500-I15
b	A4-I0	A4-I0
c	A16-I3	A20-I0
d	A4-I0	A4-I0
e	A4-I0	A4-I0
f	A4-I0	A4-I0
g	--	A4-I0

Mystery Cave Ridge

1a	A116-I20	A108-I6
b	A196-I12	A220-I0
c	A348-I24	A352-I4
2a	A20-I0	--
b	A244-I43	A244-I26
c	A408-I21	A436-I9
d	A80-I6	A84-I0
e	A16-I1	--
f	A44-I31	A48-I3
3a	A80-I20	A84-I15
b	A16-I4	--
c	--	A4-I0
4a	A16-I4	--
b	A28-I9	--
5a	A16-I5	--
b	A16-I3	--
c	A14-I0	--
d	A4-I0	--
6a	A56-I0	A52-I5
b	A64-I11	A84-I2
c	A28-I0	A28-I0

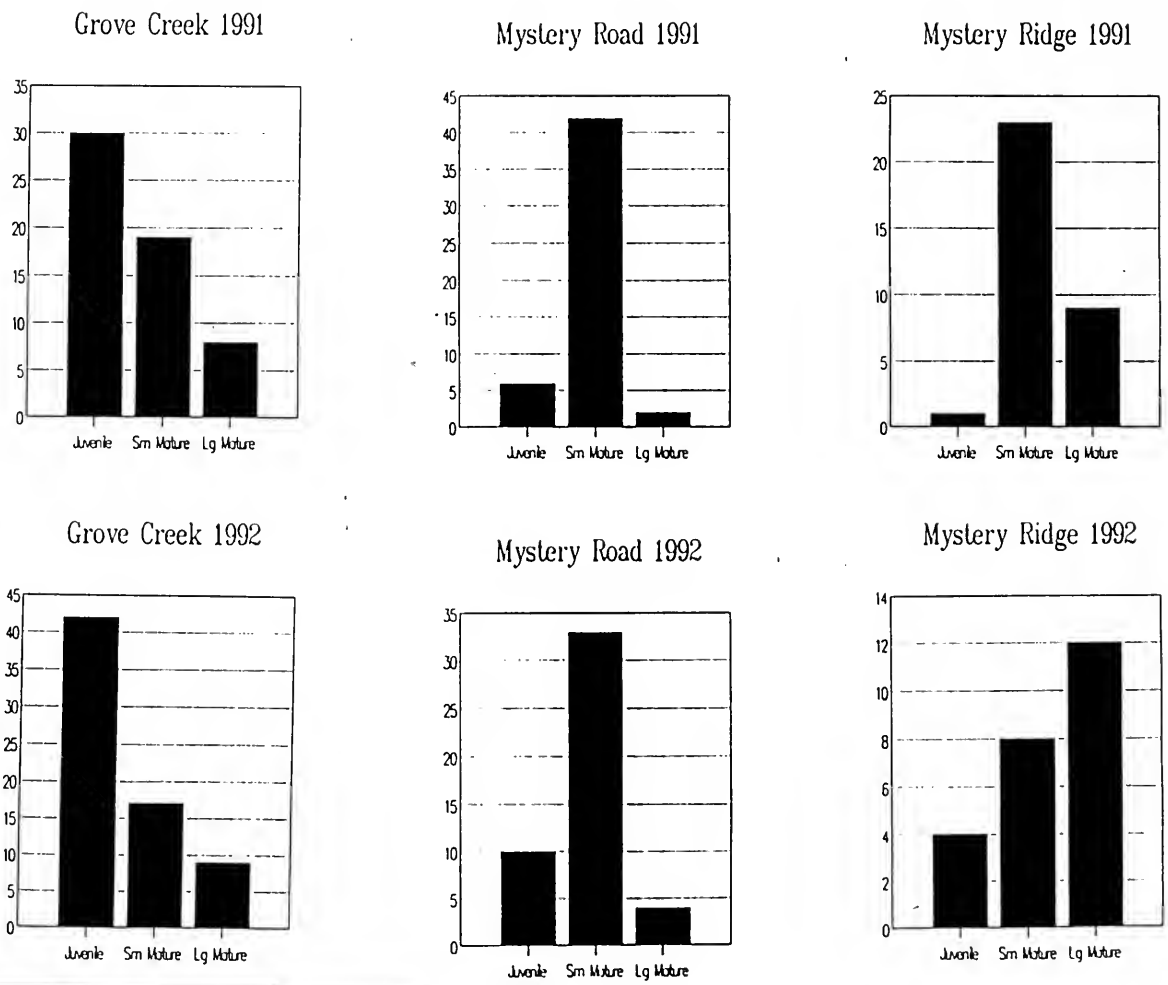
d	A16-I0	--	
7a	A16-I0	A12-I0	
b	A32-I2	A44-I0	
c	A16-I0	A24-I0	
d	A24-I0	A32-I0	
8a	A128-I23	A120-I19	
b	A88-I11	A88-I9	
9a	A16-I0	A8-I0	
b	A16-I0	A4-I0	
c	A160-I34	A204-I32	
d	A48-I11	A56-I8	
10a	A236-I69	A188-I21	
11a	A32-I2	A32-I0	

Mystery Cave Road

3a	A48-I2	A52-I0	
b	A76-I6	A44-I3	
c	A48-I1	A44-I0	
d	A20-I2	A32-I0	
e	A16-I0	--	
f	A52-I1	A76-I0	
g	A24-I1	A16-I0	
h	A16-I1	A16-I0	
i	A24-I0	A24-I0	
j	A16-I0	A8-I0	
k	A16-I1	A8-I0	
l	A4-I0	--	
m	A32-I0	A24-I0	
n	A24-I2	A32-I0	
o	A56-I4	A16-I0	
p	A16-I1	A8-I0	
(q	--	A28-I0	probably not counted in 1991)
4a	A52-I0	A40-I0	
b	A20-I2	A16-I0	
c	A16-I0	--	
d	A40-I3	A48-I0	
e	A16-I0	--	
f	A24-I5	A32-I0	
g	A64-I1	A36-I1	
5a	A56-I4	A68-I1	
b	A60-I0	A60-I2	
c	A96-I1	A96-I0	
d	A132-I20	A140-I8	
6a	A80-I7	A84-I4	
7a	A24-I2	A28-I1	
b	A24-I2	A40-I2	
8a	A80-I11	A96-I11	
b	A36-I5	A44-I3	
c	A64-I12	A56-I3	
d	A20-I0	A24-I0	

e	A16-I0	A24-I1	
11a	A20-I0	A20-I0	
b	A40-I2	A44-I0	
c	A24-I1	A28-I0	
d	A36-I1	A32-I0	
e	A16-I0	A8-I0	
(f	--	A48-I0	probably not counted in 1991)
12a	A64-I4	A64-I0	
b	A64-I0	A48-I0	
c	A48-I1	A48-I3	
d	A24-I0	A16-I1	
e	A44-I3	A32-I0	
f	A4-I0	A4-I0	
g	A4-I0	A4-I0	
h	A4-I0	A14-I0	
i	A4-I0	A8-I0	
j	A4-I0	A12-I0	
k	--	A4-I0	

Figure 1. Shoshonea pulvinata size class distribution at three monitoring sites in 1991 and 1992.



start at. South end

SHOSHONEA MONITORING FORM

Date 21 June 92 Site Grove Creek

Recorder(s) Lesica DeVelice Page No. 1 of 3

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
1A	0	32	0	1,1,1,3,2,2,1.4,4,13.4.2,1,2	32	
1B	0	22	0	1	1	
C	5	41	0	1,1,1	3	
D	15	7	0	2	2.	
E	85	18	0	1	1	
F	95	25	0	4	4	
G	12	28	0	1	1	NEW 4Bus
H	55	33	0	1	1	NEW 4Bus
2A	110	48	0	1	1	
B	110	41	0	1	1	
C	112	47	0	1	1	
D	116	42	0	1	1	
E	115	31	1	1,2,3,2,3,4,4,3,3,4,3,3,3,2,3,3,3,3,1	60	
				1,2,2,2		
F	132	31	0	1	1	
G	142	27	0	3,2,3,3	11	
H	144	20	0	1,1,2,3	7	
I	152	26	0	4	4	
J	186	35	0	2	2	
K	188	40	0	1	1	
L	121	44	0	1	1	new 3Bus
M	139	20	0	1	1	new
3A	207	32	0	1	1	
B	248	25	0	3,1,2,1	7	
C	298	36	2	4.1,1,3,1	10	
D	300	21	0	2	2	
E	220	48	0	2,1	3	(not in other new plants
F	271	48	4	4,1,1,2,2	10	new?
4A	304	38	0	1	1	
D	337	39	0	2	2	
E	343	25	0	4	4	

SHOSHONEA MONITORING FORM

Date 21 June 92 Site Grove Creek

Recorder(s) Lesica, DeVelice Page No. 2 of 3

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
4F	348	24	0	1	1	5 ivs
H	367	21	6	1	1	hoof print
I	380	33	1	4,4,4.4,3,1,4,3	27	
J	388	29	0	1	1	
K	338	36	1	1	1	new
L	342	39	0	1	1	new
M	343	41	0	1	1	new
N	343	60	0	1	1	new
O	347	22	0	1	1	new
P	342	49	0	1	1	new
Q	351	25	0	1	1	new w/ Enitia/chia
5A	435	41	4	3,4,3,3,3,2,1	19	Poss w middle
B	457	8	3	4,3,2,1,3,2,1	16	
C	492	34	0	3	3	
6A	563	32	3	4,3,1,1,4,4,2,1,3,3,1	27	
B	518	27	3	2,4,3,1,1,2,2	15	dead center
C	527	23	2	4	4	
D	534	17	2	1,1,4,4,4,3,2,1,1	21	
E	538	47	1	4,3,1,4,3,3,1,1,3,4,1	28	
F	558	39	0	1	1	
G	568	9	0	1	1	
H	568	44	0	2	2	
I	585	31	0	1	1	2 ivs
J	553	34	0	1		new
7A	616	8	0	1,4,2	7	
B	625	2	0	3	3	
C	637	24	0	4	4	
8A	775	27	0	1,1,1,4,4,3,1,1,3,4,3,1,1,2	30	eroded on downhill
B	780	39	0	1,1,2,1,2,4,4,1,3,3,3,1,3,3,1	33	
9A	823	23	0	1,2,1,4,3,2,2	15	
B	846	21	0	1,2,1,2,1	7	

SHOSHONEA MONITORING FORM

Date 21 June 92 Site Grove Creek

Recorder(s) Lesica DeVelice Page No. 3 of 3

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
9C	855	11	0	4	4	
D	818	6	0	1	1	new 3 lvs
10A	943	19	15	1,1,1,1,2,4,4,4,3,1,2,3,4,3,4	38 125	Pstr in center
				4,1,3,3,4,4,3,3,3,4,3,4,4,	42	slightly podistelled
				4,2,1,4,4,4,3,4,3,1,3,3,4,3,	45	
				1,1		
B	963	17	0	1	1	
C	975	31	0	1,1,3	5	
D	974	43	0	1	1	
E	984	32	0	1	1	
F	993	38	0	1	1	
G	960	50	0	1	1	new 3 lvs

SHOSHONEA MONITORING FORM

Date 19 June 92 Site Mystery CAVE Road

Recorder(s) Lesica, DeVelice Page No. 1 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
3A	212	11	0	2,2,2,2,3,1,1	13	
B	217	33	3	3,1,2,3,2	11	
C	220	18	0	2,1,1,3,3,1	11	all one
D	220	25	0	2,1,1,1,1,2	8	plant
F	234	23	0	1,3,2,1,1,4,3,2,1,1	19	tracking
G	237	3	0	2,2	4	up?
H	224	6	0	1,2,1	4	
I	244	39	0	3,2,1	6	
J	250	20	0	2	2	
K	267	33	0	2	2	
M	275	48	0	3,2,1	6	
N	280	38	5	2,1,2,2,1	8	
O	294	25	0	1,1,2	4	
P	294	7	0	2	2	
Q	264	8	0	1,2,1,2,1	7	new?
4A	301	15	0	2,1,4,1,1,1	10	
B	307	20	–	4	4	
D	316	42	0	2,3,3,1,2,1	12	
	326	4	0	2,3,3,3,4,1,2,1	22	Not counted in
F	344	36	0	3,2,2,1	8	
G	391	30	1	2,3,2,1,1	9	hollow center
5A	403	45	1	1,3,1,1,3,2,2,1,3	17	
B	410	28	2	1,1,3,3,3,1,2,1	15	broken up
C	426	30	0	1,1,2,3,2,2,3.2,3.2,1,2	24	broken w/ Pfl seed
D	445	12	8	2,2,1,3,4,2,1,2,1,2,3,1,4,4,1,2	35	hollow center
6A	590	27	4	1,4,4,1,1,2,1,2,1,2,2	21	hollow center
7A	692	23	1	3,2,2	7	
B	696	29	2	1,1,3,3,1,1	10	
8A	702	10	11	3,3,4,2,2,4,4,1,1	24	
B	705	30	3	2,4,2,1,2	11	
C	709	16	3	3,1,1,4,3,2	14	

SHOSHONEA MONITORING FORM

Date 19 June 92 Site Mystery Cave RD

Recorder(s) Lesica, DeVelice Page No. 1 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
8D	712	28	0	1,2,3	6	
E	759	50	1	3,3	6	
11A	1025	32	0	1,4	5	
B	1029	39	0	2,3,1,2,2,1	11	
C	1058	35	0	3,2,1,1	7	
D	1095	38	0	2,3,2,1	8	
E	1095	46	0	2	2	
F	1611	7	0	2,2,1,3,1,2,1	12	new? hollow center
12A	1126	10	0	2,1,3,3,3,3,1	16	
B	1134	5	0	1,4,2,2,3	12	
C	1134	29	3	1,3,1,2,4,1	12	
D	1149	10	1	4	4	
E	1155	32	0	2,1,1,1,1,2	8	hollow center
F	1151	16	0	1	1	2 lvs
G	1151	43	0	1	1	
H	1166	34	0	3	3	
I	1177	33	0	2	2	
J	1176	50	0	3	3	
K	1109	19	0	1	1	seedlings?

SHOSHONEA MONITORING FORM

Date 20 June 92 Site Mystery Cave Ridge

Recorder(s) Lesica, DeVelice Page No. 1 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
1A	16	12	6	1,2,1,3,3,1,2,2,2,1,4,1	27	
B	27	23	0	2,2,2,1,4,4,2,4,2,4,4,4,3,1,3,4,1,1,	55	
				2,1		
C	72	25	4	2,3,3,1,3,4,4,4,2,2,1,3,2,2	88	broken in middle
				2,3,3,3,4,4,4,4,2,3,4,4,2,1,1		
2B	111	37	26	1,2,1,2,4,4,2,4,4,4,2,3,3,4,4,2,1,4	61	
				1,3,2,1		
C	163	21	9	1,3,2,2,4,4,3,1,4,4,4,4,3,1,5	109	
				4,4,4,3,4,4,4,4,2,4,2,2,2,2,	55	
				1,1,1		
D	178	16	0	3,1,3,3,1,4,4,1,1	21	
E	177	40	—	dead		
F	178	46	3	1,2,4,1,3,1	12	
3A	260	39	15	1,4,3,2,4,3,1,3	21	part of plant in road
B	268	43	—	dead		
C	271	38	0	1	1	new 3 lvs
4A	323	42	—	dead		
B	397	36	—	dead		
5A	424	42	—	dead		
B	424	48	—	dead		
C	427	34	—	dead		
D	431	42	—	dead		
6A	501	36	5	1,2,3,2,1,1,1,1,1	13	
B	536	35	2	1,2,1,2,2,2,2,1,2,4,2	21	dead center
C	537	48	0	3,3,1	7	
7A	613	40	0	3	3	
B	637	30	0	2,4,2,2,1	11	
C	644	20	0	1,2,3	6	
D	650	30	0	3,2,2,1	8	
8A	724	22	19	1,4,4,1,1,4,1,2,1,2,3,2,3,1	30	dead center
B	799	9	10	1,3,1,1,1,2,1,3,2,3,3,1	22	dead center

SHOSHONEA MONITORING FORM

Date 20 June 92 Site Mystery Cave Ridge

Recorder(s) Legard, DeVelice Page No. 2 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
9A	803	18	0	2	2	
B	825	23	5	1	1	4 lvs
C	847	30	32	1,1,1,3,2,3,4,3,1,3,2,1,4 3,1,2,3	51	stones in center
				3,1,3,4,2,1		
D	893	23	8	3,1,1,3,2,1,3,1	14	dead center
10A	910	22	21	1,2,1,1,4,1,3,4,1,1,1,3,12	47	dead center
				2,2,2,3,3,2,1,1,3,1		
11A	1016	49	6	3,2,2,1	8	

SHOSHONEA MONITORING FORM

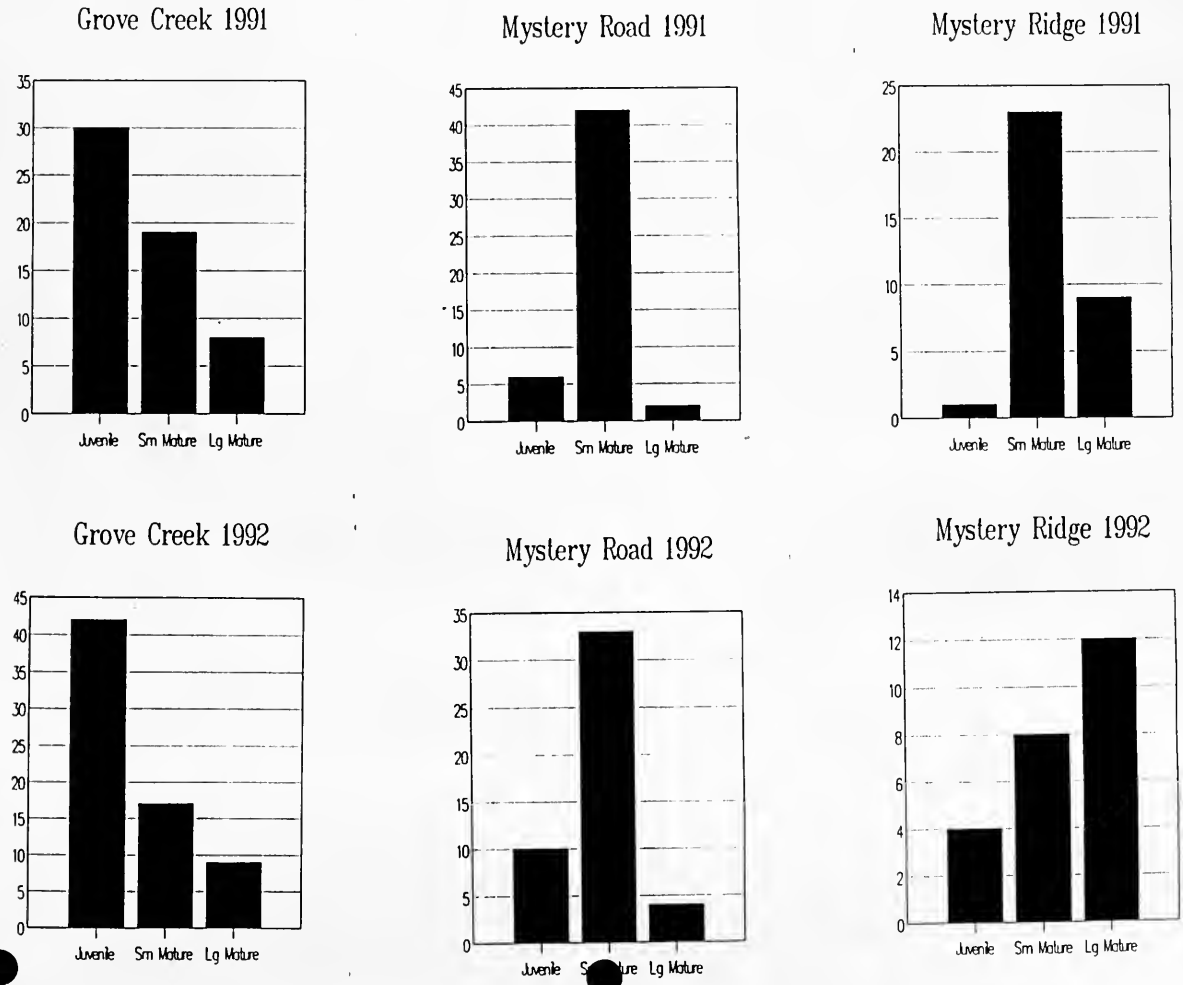
Date____________________ Site______________________________

Recorder(s)____________________________________ Page No.__________

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments

Figure 1. Shoshonea pulvinata size class distribution at three monitoring sites in 1991 and 1992.



start at. South end

SHOSHONEA MONITORING FORM

Date 21 June 92 Site Grove Creek

Recorder(s) Lesica DeVelice Page No. 1 of 3

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
1A	0	32	0	1,1,1,3,2,2,1.4,4,1.3.2 2,1,2	32	
1B	0	22	0	1	1	
C	5	41	0	1,1,1	3	
D	15	7	0	2	2.	
E	85	18	0	1	1	
F	95	25	0	4	4	
G	12	28	0	1	1	NEW 4 JUS
H	55	33	0	1	1	NEW 4 JUS
2A	110	48	0	1	1	
B	110	41	0	1	1	
C	112	47	0	1	1	
D	116	42	0	1	1	
E	115	31	1	1,2,3 2,3,4,4,3,3,4,3,3,3,2,3,3,3,3,1	60	
				1,2,2,2		
F	132	31	0	1	1	
G	142	27	0	3,2,3,3	11	
H	144	20	0	1,1,2,3	7	
I	152	26	0	4	4	
I	186	35	0	2	2	
K	188	40	0	1	1	
L	121	44	0	1	1	new 3 JUS
M	139	20	0	1	1	new
3A	207	32	0	1	1	
B	248	25	0	3,1,2,1	7	
C	298	36	2	4.1.1.3.1	10	
D	300	21	0	2	2	
E	220	48	0	2,1	3	(not) new single plants
F	271	48	4	4,1,1,2,2	10	new ?
4A	304	38	0	1	1	
D	337	39	0	2	2	
E	343	25	0	4	4	

SHOSHONEA MONITORING FORM

Date 21 June 92 Site Grove Creek

Recorder(s) Lesica, DeVelice Page No. 2 of 3

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
4F	348	24	0	1	1	5 lvs
H	367	21	6	1	1	root point
I	380	33	1	4, 4, 4, 4, 3, 1, 4, 3	27	
J	388	29	0	1	1	
K	338	36	1	1	1	new
L	342	39	0	1	1	new
M	343	41	0	1	1	new
N	343	50	0	1	1	new
O	347	22	0	1	1	new
P	342	49	0	1	1	new
Q	351	25	0	1	1	new w/Eritrichium
5A	435	41	4	3, 4, 3, 3, 3, 2, 1	19	Potr in middle
B	457	8	3	4, 3, 2, 1, 3, 2, 1	16	
C	492	34	0	3	3	
6A	503	32	3	4, 3, 1, 1, 4, 4, 2, 1, 3, 3, 1	27	
B	518	27	3	2, 4, 3, 1, 1, 2, 2	15	dead center
C	527	23	2	4	4	
D	534	17	2	1, 1, 4, 4, 4, 3, 2, 1, 1	21	
E	538	47	1	4, 3, 1, 4, 3, 3, 1, 1, 3, 4, 1	28	
F	558	39	0	1	1	
G	568	9	0	1	1	
H	568	44	0	2	2	
I	585	31	0	1	1	2 lvs
J	553	34	0	1		new
7A	616	8	0	1, 4, 2	7	
B	625	2	0	3	3	
C	637	24	0	4	4	
8A	775	27	0	1, 1, 1, 4, 4, 3, 1, 1, 3, 4, 3, 1, 1, 2	30	eroded on downhill
B	780	39	0	1, 1, 2, 1, 2, 4, 4, 1, 3, 3, 3, 1, 3, 3, 1	33	
9A	823	23	0	1, 2, 1, 4, 3, 2, 2	15	
B	846	21	0	1, 2, 1, 2, 1	7	

SHOSHONEA MONITORING FORM

Date 21 June 92 Site Grove Creek

Recorder(s) Lesica DeVelice Page No. 3 of 3

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
9C	855	11	0	4	4	
D	818	6	0	1	1	new 3 lvs
10A	943	19	15	1,1,1,1,2,4,4,4,3,1,2,3,4,3,4	38	125 Pofr in center
				4,1,2,3,4,4,3,3,3,4,3,4,4,	46	slightly soddisticked
				4,2,1,4,4,4,3,4,3,1,3,3,4,3,	45	
				1,1		
B	963	17	0	1	1	
C	975	31	0	1,1,3	5	
D	974	43	0	1	1	
E	984	32	0	1	1	
F	993	38	0	1	1	
G	960	50	0	1	1	new 3 lvs

SHOSHONEA MONITORING FORM

Date 19 June 92 Site Mystery Cave RD

Recorder(s) Lesica, DeVelice Page No. 1 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
8D	712	28	0	1, 2, 3	6	
E	759	50	1	3, 3	6	
11A	1025	32	0	1, 4	5	
B	1029	39	0	2, 3, 1, 2, 2, 1	11	
C	1058	35	0	3, 2, 1, 1	7	
D	1095	38	0	2, 3, 2, 1	8	
E	1095	46	0	2	2	
F	1611	7	0	2, 2, 1, 3, 1, 2, 1	12	new? hollow center
12A	1126	10	0	2, 1, 3, 3, 3, 3, 1	16	
B	1134	5	0	1, 4, 2, 2, 3	12	
C	1134	29	3	1, 3, 1, 2, 4, 1	12	
D	1149	10	1	4	4	
E	1155	32	0	2, 1, 1, 1, 1, 2	8	hollow center
F	1151	16	0	1	1	2 lvs
G	1151	43	0	1	1	
H	1166	34	0	3	3	
I	1177	33	0	2	2	
J	1176	50	0	3	3	
K	1169	19	0	1	1	seedling?

SHOSHONEA MONITORING FORM

Date 19 June 92 Site Mystery CAVE Road

Recorder(s) Lesica, DeVelice Page No. 1 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
3A	212	11	0	2,2,2,2,3,1,1	13	
B	217	33	3	3,1,2,3,2	11	
C	220	18	0	2,1,1,3,3,1	11	all one plant
D	220	25	0	2,1,1,1,1,2	8	
F	234	23	0	1,3,2,1,1,4,3,2,1,1	19	tracking 22?
G	237	3	0	2,2	4	
H	224	6	0	1,2,1	4	
I	240	39	0	3,2,1	6	
J	250	20	0	2	2	
K	267	33	0	2	2	
M	275	48	0	3,2,1	6	
N	280	38	0	1,2,1	8	
O	294	25	0	1,1,2	4	
P	294	7	0	2	2	
Q	264	8	0	1,2,1,2,1	7	new?
4A	301	15	0	2,1,4,1,1,1	10	
B	307	20	—	4	4	
D	316	42	0	2,3,3,1,2,1	12	
	326	4	0	4,1,2,1	22	Not counted in
F	344	36	0	3,2,2,1	8	
G	391	30	1	2,3,2,1,1	9	hollow center
5A	403	45	1	1,3,1,1,3,2,2,1,3	17	
B	410	28	2	1,1,3,3,3,1,2,1	15	broken up
C	426	30	0	1,1,2,3,2,2,3,2,3,3,1,2	24	broken w/ Pfl seedlin
D	445	12	8	2,2,1,3,4,2,1,2,1,3,1,4,1,2	35	hollow center
6A	590	27	4	1,4,4,1,1,2,1,2,1,2,2	21	hollow center
7A	692	23	1	3,2,2	7	
B	696	29	2	1,1,3,3,1,1	10	
8A	702	10	11	3,3,4,2,2,4,4,1,1	24	
B	705	30	3	2,4,2,1,2	11	
C	709	16	3	3,1,1,4,3,2	14	

SHOSHONEA MONITORING FORM

Date 20 June 92 Site Mystery Cave Ridge

Recorder(s) Lesica, DeVelice Page No. 1 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
1A	16	12	6	1,2,1,3,3,1,2,2,2,1,4,1	27	
B	27	23	0	2,3,2,1,4,4,2,4,2,4,4,3,1,3,4,1,1,	55	
				2,1		
C	72	25	4	2,3,3,1,3,4,4,4,2,2,1,3,4,2,2	88	broken in middle
				2,3,3,3,4,4,4,4,2,3,4,4,4,2,1,1		
2B	111	37	26	1,2,1,2,4,4,2,4,4,4,2,3,3,4,4,2,1,4	61	
				1,3,2,1		
C	163	21	9	1,3,2,2,4,4,3,1,4,4,4,4,4,3,3	109	
				4,4,4,2,4,4,4,4,2,4,2,2,2,		
				1,1,1		
D	178	16	0	3,1,3,3,1,4,4,1,1	21	
E	177	40	—	dead		
F	178	46	3	1,2,4,1,3,1	12	
3A	260	39	15	4,3,2,4,3,1,3	21	part of plant in bed
B	268	43	—	dead		
C	271	38	0	1	1	new 3 lvs
4A	323	42	—	dead		
B	397	36	—	dead		
5A	424	42	—	dead		
B	424	48	—	dead		
C	427	34	—	dead		
D	431	42	—	dead		
6A	501	36	5	1,2,3,2,1,1,1,1,1	13	
B	536	35	2	1,2,1,2,2,2,2,1,2,4,2	21	dead center
C	537	48	0	3,3,1	7	
7A	613	40	0	3	3	
B	637	30	6	2,4,2,2,1	11	
C	644	20	0	1,2,3	6	
D	650	30	0	3,2,2,1	8	
8A	724	22	19	1,4,4,1,1,4,1,2,1,2,3,2,3,1	30	dead center
B	799	9	10	1,3,1,1,1,2,1,3,2,3,3,1	22	dead center

SHOSHONEA MONITORING FORM

Date 20 June 92 Site Mystery Cave Ridge

Recorder(s) Legeau, DeVerica Page No. 2 of 2

ID = alpha numeric code; Tape = position on transect tape; Stick = distance off of baseline; Infl. = No. of inflorescences; 1/4-squares = No. of 1/4 squares filled by vegetation; Total = total 1/4-squares.

ID	Tape	Stick	Infl.	1/4-squares	Total	Comments
9A	803	18	0	2	2	
B	825	23	5	1	1	4 lvs
C	847	30	32	1,1,1,3,2,3,4 3,1,3,2,1,2 3,1,2,3	51	stones w. center
				3,1,3,4,2,1		
D	893	23	8	2,1,1,3,2,1,3,1	14	dead center
10A	910	22	21	1,2,1 1 2,1,3,2 3,1 1 2 3,1 2	47	dead center
				2 3,2,3 3,2,1,1,2,1		
11A	1016	49	6	3,2,2,1	8	

SHOSHONEA MONITORING FORM

Date________________________ Site________________________________

Recorder(s)____ Page No.__________

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ID	Tape	Stick	Infl.	1/4-squares	Total	Comments