MONTANA STATE LIBRARY

STATE DOCUMENTS COLLECTION

SEP 17 1992

MONTANA STATE LIBRARY
1515 E. 6th AVE.
HELENA, MONTANA 59620

DEMOGRAPHIC MONITORING OF ASTRAGALUS SCAPHOIDES
AT SHEEP CORRAL GULCH, BEAVERHEAD COUNTY, MONTANA
1991 PROGRESS REPORT

Peter Lesica
P.O. Box 8944
Missoula, Montana 59807

October 1991

PLEASE RETURN

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). Extinction is a process requiring an understanding of population dynamics (Menges 1986). Periodic inventories can detect trends but will do little to determine causality or help generate predictive hypotheses (Palmer 1987). Long-term conservation requires a knowledge of many life history parameters including fecundity, recruitment, survivorship, age structure, and population flux. Demographic monitoring techniques can provide information on factors regulating population density and persistence (Palmer 1987). This information, in turn, provides an essential basis for management decisions.

Astragalus scaphoides (Jones) Rydb. (Bitterroot milkvetch) is endemic to a small area of east-central Idaho and adjacent Beaverhead County, Montana. It is a candidate for listing as a threatened or endangered species (C-2) by the U.S. Fish and Wildlife Service (USDI-FWS 1990). It is listed as sensitive in Idaho (Moseley and Groves 1990) and Montana (Lesica and Shelly 1991). Most populations of A. scaphoides in Montana are on public lands

administered by the Bureau of Land Management and are subject to livestock grazing (Lesica 1984).

Previous studies have indicated that Astragalus scaphoides is locally abundant, but is sensitive to predation by livestock in some areas under certain grazing regimes (Lesica and Elliott 1987, 1989). Inflorescence predation and seed predation by insects are other factors that may be adversely affecting A. scaphoides fecundity (Lesica and Elliott 1987, 1989). Lowered fecundity is thought to be the cause of local rarity in a number of plant species (Greig-Smith and Sagar 1981, Hester and Mendelssohn 1987, Cabin et al. 1991). The purpose of this demographic monitoring study is to track population trends for Astragalus scaphoides in Montana and gather life history information that will enable interpretation of these trends.

Methods

Permanent monitoring transects were established in populations of Astragalus scaphoides at Sheep Corral Gulch in Beaverhead County, Montana on 7 July 1986 with the help of Lou Hagener from the BLM Office in Dillon. Two 50-m transect lines were established by permanently marking the start and end points with iron bars driven into the ground. Transect lines are approximately parallel to the slope, one above the other and separated by 10-20 m (Lesica and Elliott 1987). The exact location of the two transects is shown in Figure 1. The east end of the transects are marked by a metal fence post that

Figure 1. Location of Sheep Corral Gulch Astragalus scaphoides monitoring site.

stands well above the sagebrush. From the east end of the transects it is 248° to the top of Bachelor Mountain and 346° to the top of the butte to the north. Vegetation at the site is dominated by Artemisia tridentata and Agropyron spicatum. Aster scopulorum and Phlox hoodii are common forbs. A more complete description of the vegetation is given by Lesica and Elliott (1987, p.14).

Procedures for reading the monitoring transects are outlined in Lesica and Elliott (1987) and Lesica (1987). Transects were subjectively located to maximize the number of A. scaphoides plants recorded. Each transect consisted of 50 1 m² quadrats placed along the transect line on the uphill side. Transects were read from left to right when facing uphill with the lower left corner of the first quadrat placed at the 0.0 mark of the transect line. The position of each A. scaphoides plant encountered in the quadrats was mapped, and each plant was classified for three traits: size class, inflorescence production, and fecundity. The classification system and codes for these traits are as follows:

1) Size Classes:

- S Very small plants with 1-3 leaves
- J Plants with 4-6 leaves
- M Plants with more than 6 leaves

Plants that produced inflorescences were classified by the fate of the individual inflorescences as follows:

2) Inflorescence Production:

- A An inflorescence that produced no fruit
- P An inflorescence that was removed by predation
- F An inflorescence that produced at least one mature fruit

3) Fecundity:

Fecundity is the total number of mature fruit produced by a plant

Plants that produced inflorescences were classified by using combinations of the classifiers followed by numerics. For example, a mature plant with 2 aborted inflorescences, 1 predated inflorescence, and 3 fruit-bearing inflorescences with 10 fruits would be recorded as A2-P1-I3-F10. A complete record of all plants recorded during the study is given in Appendix A. Transects were read between July 1 and July 7 in all six years.

Over the course of the study I found that occasionally a plant would produce only a small amount of ephemeral vegetation in one year. Thus, I would fail to detect this plant in that year, but would detect it again in subsequent years. The presence of these plants can be inferred by comparing transect maps from the full sequence of years. These plants are assigned to a "very small" size class (ss) on those years when they were undetected in the field. The presence of these plants cannot be inferred for either the first or final years of the study.

On years when fruit production was adequate, I collected 50 randomly selected mature fruits from at least 25 plants. I opened the pods, counted the intact seeds, and recorded whether any seeds had been destroyed by insect larvae. I also recorded the presence of cattle, native ungulate, and rabbit droppings in each quadrat.

Population growth rate was determined by the following formula:

$$\text{Population Growth} = \frac{\text{change in number of plants between year } n \text{ and } n+1}{\text{number of plants in year } n}$$

Thus, population growth is negative when the population gets smaller and positive when it gets larger. Recruitment and death rates were determined by the following formulas:

$$\text{Recruitment Rate} = \frac{\text{number of new plants in year } n+1}{\text{number of plants in year } n}$$

$$\text{Death Rate} = \frac{\text{number of deaths between year } n \text{ and } n+1}{\text{number of plants in year } n}$$

Results and Discussion

From 1986 through 1991, the number of plants in the study plots increased from 128 to 235. Although the number of reproductive individuals remained constant, the number of non-reproductive plants nearly doubled (Table 1). Population growth rate was positive for four of the five years, with large positive values coming in 1988-89 and 1990-91 (Table 1).

Table 1. Density and growth of Astragalus scaphoides population at Sheep Corral Gulch from 1986 to 1991.

	1986	1987	1988	1989	1990	1991
Number of Reproductive Plants	46	1	4	32	7	50
Number of Large Non-reproductive Plants	43	95	41	72	45	83
Number of Small Non-reproductive Plants	39	40	69	51	115	102
Total Number of Plants	128	136	114	155	167	235
% Plants Reproductive	36%	1%	4%	21%	4%	21%
% Plants Large Non-repro.	34%	70%	36%	46%	27%	35%
% Plants Small Non-repro.	30%	29%	60%	33%	69%	44%
Death Rate	--	0.18	0.22	0.05	0.10	0.16
Recruitment Rate	--	0.23	0.07	0.39	0.19	0.57
Population Growth	--	0.06	-0.16	0.36	0.08	0.41

Population growth was negative only in 1988, a year of severe drought. Death rate was lowest 1988-89 and 1989-90. Recruitment was highest in 1988-89 and 1990-91. Death rate was highest and recruitment was lowest in 1987-88 (Table 1). These results suggest that the same environmental conditions are often favorable for both survival and recruitment.

Significant flower and fruit production occurred only in 1986, 1989 and 1991 (Table 1). These are the same years that show the greatest population growth (Table 1). Of these three years, the frequency of aborted and predated inflorescences was highest and the frequency of fecund inflorescences was lowest in 1989 (Table 2). Both the mean number of fruits per fecund inflorescence and the mean number of seeds per unpredated fruit were relatively constant for the three years (Table 2). The frequency of predated inflorescences was low compared to that in most Idaho populations (Lesica and Elliott 1989).

In 1986 and 1989 weevil seed predators reduced the seed crop by an estimated 24% and 33% respectively (Table 2). Although this loss seems appreciable, it did not prevent the population from increasing during subsequent years. I did not detect any seed predators in 1991.

Precipitation data for the years of the study are presented in Table 3. There is a tendency for years of high fecundity and population growth to be preceded by a late winter and early spring that are relatively moist (Lesica and Elliott 1989). This correlation is not

Table 2. Measures of fecundity and fate of inflorescences for Astragalus scaphoides population at Sheep Corral Gulch from 1986 to 1991.

	1986	1987	1988	1989	1990	1991
Aborted Inflorescences	25	0	4	31	1	21
Predated Inflorescences	31	2	4	31	11	23
Fecund Inflorescences	78	0	0	33	1	82
Total Inflorescences	134	2	8	95	13	126
% Aborted Inflorescences	19%	0%	50%	33%	8%	17%
% Predated Inflorescences	23%	100%	50%	33%	84%	18%
% Fecund Inflorescences	58%	0%	0%	34%	8%	65%
Total Fruits	396	0	0	115	2	392
Mean Number Seeds per Unpredated Fruit	15.0	--	--	16.2	--	15.0
Mean Number Seeds per Predated Fruit	3.6	--	--	2.2	--	--
Fruits/Fecund Inflorescence	5.1	--	--	3.5	--	4.8
% Fruits with Insect Predation	32%	--	--	38%	--	0%

Table 3. Precipitation (inches) for Dillon, Montana from 1985 through 1991 and the 30-year normals for 1950-80. Source is National Oceanic and Aeronautics Administration monthly records for Montana and NOAA (1982).

	1985	1986	1987	1988	1989	1990	1991	Normal
January	0.28	0.06	0.03	0.01	0.76	0.22	0.06	0.40
February	0.14	0.91	0.05	0.16	0.70	0.03	T	0.28
March	1.30	0.51	0.41	0.45	1.18	--	0.75	0.66
April	0.09	1.48	1.02	1.35	0.76	0.74	1.56	1.22
May	2.01	1.45	4.16	2.34	1.76	2.06	2.97	1.87
June	0.51	1.69	1.97	1.99	1.81	1.71	--	2.09
July	1.24	0.92	4.25	0.00	0.62	1.68	--	1.07
August	1.41	2.30	1.68	0.00	2.19	1.62	--	1.04
September	2.35	1.23	0.03	0.90	0.44	0.23	--	1.02
October	0.60	0.28	0.00	0.22	1.87	0.16	--	0.66
November	0.72	0.56	0.07	0.47	0.02	0.31	--	0.44
December	0.06	0.13	0.61	0.23	0.27	0.11	--	0.35
Total	10.71	11.52	14.28	8.12	9.85	--	--	11.10

strong, and other factors, such as insolation and timing and duration of precipitation events, must also play a role.

Evidence from the frequency of scats indicates that large vertebrate grazers, including livestock, are not overly common at the Sheep Corral Gulch site compared to sites in Idaho (Table 4, Lesica and Elliott 1989). Most inflorescence predation was probably due to insects such as ants, tent caterpillars and cutworms (Lesica, pers. obs.) rather than vertebrate grazers.

Conclusions

In the Sheep Corral Gulch population of Astragalus scaphoides, appreciable flowering and fruit-set occurs only every other year on average. Furthermore, predation of inflorescences may reduce fruit-set by 20-30%, and seed predators often reduce fecundity by an additional 24-33%. Nonetheless, the results of this study suggest that the A. scaphoides population is viable and increasing in size.

Table 4. Frequency (per 100 1-m² quadrats) of feces of vertebrate grazers for Astragalus scaphoides population at Sheep Corral Gulch from 1986 to 1991.

	1986	1987	1988	1989	1990	1991
Frequency of Cattle Droppings	4	3	4	9	7	7
Frequency of Ungulate Pellets	2	0	0	0	0	0
Frequency of Rabbit Droppings	13	3	32	5	10	1

Literature Cited

- Cabin, R. J., J. Ramstetter and R. E. Engel. 1991. Reproductive limitations of a locally rare Asclepias. *Rhodora* 93: 1-10.
- Greig-Smith, J and G. R. Sagar. 1981. Biological causes of local rarity in Carlina vulgaris. In H. Synge (ed.) *The biological aspects of rare plant conservation*. John Wiley and Sons, New York.
- Hester, M. W. and I. A. Mendelssohn. 1987. Seed production and germination response of four Louisiana populations of Uniola paniculata (Gramineae). *American Journal of Botany* 74: 1093-1101.
- Lesica, P. 1984. Report on the conservation status of Astragalus scaphoides. Report submitted to the U.S. Fish and Wildlife Service, Denver, CO.
- Lesica, P. 1987. A technique for monitoring non-rhizomatous, perennial plant species in permanent belt transects. *Natural Areas Journal* 7: 65-68.
- Lesica, P. and J. C. Elliott. 1987. Distribution, age structure, and predation of Bitterroot milkvetch populations in Lemhi County, Idaho. Report submitted to the Bureau of Land Management, Boise, Idaho.
- Lesica, P. and J. C. Elliott. 1989. 1988 monitoring study of Bitterroot milkvetch populations in Lemhi County, Idaho. Report submitted to the Bureau of Land Management, Boise, Idaho.
- Lesica, P. and J. S. Shelly. 1991. Sensitive, threatened and endangered vascular plants of Montana. *Montana Natural Heritage Program Occasional Publication No. 1*, Helena.
- Menges, E. S. 1986. Predicting the future of rare plant populations: demographic monitoring and modeling. *Natural Areas Journal* 6: 13-25.
- Moseley, R. and C. Groves. 1990. Rare, threatened and endangered plants and animals of Idaho. *Idaho Natural Heritage Program*, Boise.
- National Oceanic and Atmospheric Administration. 1982. Monthly normals of temperature, precipitation and heating and cooling degree days. Montana, 1951-1980. *National Climatic Center*, Asheville, NC.
- Palmer, M. E. 1987. A critical look at rare plant monitoring in the United States. *Biological Conservation* 39: 113-127.

Sutter, R. D. 1986. Monitoring rare plant species and natural areas - ensuring the protection of our investment. *Natural Areas Journal* 6: 3-5.

USDI-Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants: Review of plant taxa for listing as endangered or threatened species; Notice of review. *Federal Register* 55: 6184-6229.

Wilson, E. O. 1988. *Biodiversity*. National Academy Press, Washington D.C.

Appendix A. Size and fecundity of Astragalus scaphoides plants in two transects at Sheep Corral Gulch from 1986 through 1991. See Methods section for an explanation of the codes used.

Lower Transect						
	1986	1987	1988	1989	1990	1991
2a	--	--	--	--	--	M
b	--	--	--	--	--	J
c	--	--	--	--	--	S
3a	S	ss	ss	S	S	M
b	--	--	--	--	--	J
c	--	--	--	--	--	S
4a	--	--	--	S	S	--
b	--	--	--	--	S	S
5a	Al-P1-I2-F15M		M	P4	M	Al-I1-F6
b	Al-I5-F52	M	M	P4	S	M
c	--	M	--	--	--	--
d	--	--	--	S	--	--
e	--	--	--	--	--	S
6a	S	M	J	J	J	M
b	I1-F7	ss	ss	M	ss	J
c	J	S	ss	P2	M	Al-I1-F8
d	--	M	--	--	--	--
e	--	--	--	S	--	--
f	--	--	--	--	--	J
7a	S	--	--	--	--	--
8a	S	S	S	J	S	M
b	P1-I1-F11	M	S	Al-I1-F2	J	M
c	J	M	S	J	--	--
d	--	--	--	--	--	J
9a	--	--	--	--	--	S
b	--	--	--	--	--	S
10a	--	--	--	--	--	S
11a	P1-I1-F11	M	--	--	--	--
b	I2-F10	M	ss	ss	ss	S
c	S	S	--	--	--	--
d	--	--	--	--	--	S
e	--	--	--	--	--	S
f	--	--	--	--	--	S
12a	S	--	--	--	--	--
b	--	--	--	--	--	J
c	--	--	--	--	--	S
d	--	--	--	--	--	S
e	--	--	--	--	--	S
13a	--	S	--	--	--	--
b	--	M	S	--	--	--
c	--	--	--	S	--	--
d	--	--	--	S	S	--
e	--	--	--	--	S	S
f	--	--	--	--	--	S
14a	J	S	S	S	S	J
b	S	--	--	--	--	S
c	S	--	--	--	--	S
15a	S	--	--	--	--	--
b	J	M	--	--	--	--
c	--	M	--	M	--	--
d	--	--	S	ss	M	M
e	--	--	--	--	S	--
16a	S	--	--	--	--	--

	1986	1987	1988	1989	1990	1991
b	J	M	M	J	J	I2-F5
c	--	M	ss	M	J	I2-F10
d	--	--	--	--	S	--
e	--	--	--	--	S	S
f	--	--	--	--	S	--
g	--	--	--	--	--	S
h	--	--	--	--	--	S
i	--	--	--	--	--	J
j	--	--	--	--	--	S
17a	--	--	--	--	--	S
b	--	--	--	--	--	S
18a	--	--	--	--	S	J
b	--	--	--	--	--	S
20a	J	M	M	A1-I2-F3	M	P2
b	--	--	--	--	S	S
22a	J	M	S	J	M	J
b	I1-F2	M	S	A1-I2-F1	ss	A1-I2-F13
c	--	--	--	J	J	J
d	--	--	--	S	ss	S
e	--	--	--	A1-I1-F3	P2	P2
23a	A1	ss	ss	J	--	--
b	S	S	--	--	--	--
c	P1-I5-F27	S	M	A1-I1-F1	M	I1-F?
d	A2	M	J	A1	P2	A1-I1-F1
e	--	--	--	M	P2	I1-F1
f	--	--	--	--	--	S
24a	J	M	S	M	--	--
b	J	M	J	S	P2	A1
c	--	--	--	--	--	S
d	--	--	--	--	--	S
25a	I2-F6	--	--	--	--	--
b	S	S	S	--	--	--
c	--	--	--	S	S	J
d	--	--	--	--	S	J
e	--	--	--	--	--	S
f	--	--	--	--	--	S
g	--	--	--	--	--	S
26a	J	S	ss	S	S	J
b	S	ss	ss	S	S	S
c	J	M	S	J	S	M
28a	J	--	--	--	--	--
b	P2	P2	P2	P4	J	P3-I2-F?
30a	J	M	--	--	--	--
31a	J	M	A1	A2-P1-I3-F23M	--	P2-I1-F2
b	--	--	--	S	S	J
32a	S	--	--	--	--	--
b	P2	S	S	S	S	S
c	A2-I1-F5	M	M	P2	M	I4-F22
d	--	S	S	J	S	J
e	--	M	ss	A1-I1-F4	J	S
33a	S	--	--	--	--	--
b	J	M	M	S	J	S
c	S	--	--	--	--	--
d	P1	M	--	--	--	I4-F17
e	P1-I1-F2	M	P2	P2	ss	M
f	S	M	S	J	S	M
g	--	S	--	--	--	--
h	--	--	--	M	S	J
i	--	--	--	--	--	J

	1986	1987	1988	1989	1990	1991
34a	--	M	S	J	S	A1-I1-F2
b	--	--	--	--	S	S
c	--	--	--	--	S	--
d	--	--	--	--	--	S
e	--	--	--	--	--	S
35a	J	M	S	P2	J	A1-I2-F16
b	--	--	--	S	S	I1
36a	I2-F10	S	--	--	--	--
b	--	--	--	--	--	S
c	--	--	--	--	--	S
d	--	--	--	--	--	S
e	--	--	--	--	--	S
37a	S	--	--	--	--	--
b	--	--	--	S	S	--
c	--	--	--	--	S	J
38a	--	--	--	S	aa	S
b	--	--	--	S	S	S
c	--	--	--	--	--	S
d	--	--	--	--	--	S
e	--	--	--	--	--	S
39a	--	--	--	S	S	J
b	--	--	--	--	--	S
40a	J	M	M	M	S	I3-F16
b	--	--	--	S	S	--
41a	--	--	--	--	--	S
42a	J	--	--	--	--	--
b	--	M	S	M	ss	M
43a	A1-I1-F3	M	ss	S	S	J
b	S	--	--	--	--	--
c	--	M	S	J	S	I4-F4
d	--	S	S	--	--	--
e	--	--	--	S	S	S
f	--	--	--	J	S	I6-F30
45a	I1-F3	M	J	M	--	--
46a	J	--	--	--	--	--
b	J	M	M	A1-I5-F17	J	J
c	J	S	S	M	--	--
47a	J	M	J	--	--	--
b	P2-I2-F20	M	--	--	--	--
c	--	--	--	M	ss	M
d	--	--	--	S	S	--
e	--	--	--	S	S	S
f	--	--	--	--	--	S
48a	A1	M	--	--	--	--
b	A1-I1-F5	S	J	A1	S	P1-I1-F7
c	A1-I2-F11	M	M	P2	S	I2-F2
d	J	M	--	--	--	--
e	--	M	--	--	--	--
f	--	--	S	--	--	--
49a	I1-F6	M	M	M	M	P1-I1-F4
b	I1-F1	--	--	J	--	--
c	S	ss	S	M	S	M
d	--	S	--	--	--	--
e	--	--	--	--	S	J
f	--	--	--	--	--	S
g	--	--	--	--	--	S
50a	S	S	ss	J	J	M
b	--	--	--	M	S	I3-F7
c	--	--	--	--	S	S

1986 1987 1988 1989 1990 1991

Upper Line

6a	S	M	J	--	--	--
b	--	--	--	--	J	A1
7a	J	M	J	A1-I3-F15	S	J
b	S	M	J	M	M	A1-I1-F4
c	--	M	S	S	S	S
d	--	M	M	I2-F3	M	P2
e	--	--	J	M	M	--
f	--	--	--	S	ss	M
g	--	--	--	--	--	J
8a	S	S	S	J	--	--
b	--	--	--	J	S	M
c	--	--	--	--	--	S
d	--	--	--	--	--	S
e	--	--	--	--	--	S
9a	--	--	S	S	S	M
b	--	--	--	--	S	S
c	--	--	--	--	--	S
d	--	--	--	--	--	S
11a	S	M	ss	ss	S	M
12a	P1	--	--	--	--	--
b	--	--	--	--	S	S
13a	I1-F2	M	--	--	--	--
b	P3-A1-I2-F8	M	S	A3	M	A1-P1-I1-F12
c	S	S	S	S	--	--
d	S	M	--	--	--	--
e	--	M	S	J	S	--
f	--	S	--	--	--	--
g	--	--	S	S	S	M
h	--	--	--	--	S	J
i	--	--	--	--	--	S
14a	J	M	ss	J	ss	J
b	P2	M	M	M	M	A2-I3-F14
c	--	M	ss	M	S	M
d	--	--	--	--	--	S
15a	A3	M	ss	A2-I6-F28	S	I3-F13
b	S	M	--	--	--	--
c	P3-A1-I1-F1	S	--	--	--	J
d	--	--	--	--	--	J
16a	S	M	S	J	ss	M
b	A2-I3-F15	M	ss	M	J	M
c	A1-I4-F31	M	S	S	ss	S
17a	A1	M	ss	J	J	--
b	--	S	--	--	--	--
c	--	--	--	--	S	--
d	--	--	--	--	--	J
18a	A1-I1-F1	M	J	J	S	J
b	A1-I4-F17	M	J	--	--	--
c	J	M	S	J	S	M
19a	--	--	--	--	--	S
b	--	--	--	--	--	S
c	--	--	--	--	--	S
d	--	--	--	--	--	S
e	--	--	--	--	--	S
f	--	--	--	--	--	S
20a	J	M	A3	P4	J	A1-I3-F15
b	S	M	--	--	--	--
c	J	M	S	J	J	M

	1986	1987	1988	1989	1990	1991
21a	P2	--	--	--	--	--
b	--	--	--	--	--	S
22a	S	S	S	J	S	J
b	P3-A1-I3-F5	--	M	A2-P2	A1	I2-F?
c	S	--	--	--	--	--
d	S	S	S	S	S	J
e	S	S	S	J	S	--
f	--	--	J	J	J	P1
g	--	--	--	J	--	M
23a	P1	M	J	J	J	--
b	P1	M	J	A5-I1-F1	P2	A2-P4-I2-F21
c	--	--	--	--	S	A1-I1-F4
d	--	--	--	--	--	S
e	--	--	--	--	--	S
24a	J	N	S	ss	ss	A1
b	A1-I5-F22	M	J	P2-A1	P1-I1-F2	P3
c	--	--	--	--	--	J
25a	J	ss	J	A1	J	I4-F26
b	--	S	S	S	S	J
c	--	--	--	S	--	--
d	--	--	--	--	--	S
e	--	--	--	--	--	S
26a	P2-I1-F9	M	ss	M	J	S
b	--	--	--	--	S	--
27a	--	--	--	--	--	J
b	--	--	--	--	--	S
28a	P1-I1-F4	M	J	A2	J	A1-I1-F10
b	--	--	--	S	S	--
c	--	--	--	--	--	S
29a	--	--	--	J	--	J
32a	--	--	--	--	S	J
33a	J	M	J	M	ss	M
34a	--	M	ss	M	J	A1-I4-F23
b	--	S	S	J	J	--
35a	--	--	--	S	ss	J
36a	J	M	J	I1-F2	J	A1-I4-F20
37a	J	M	M	M	--	--
b	--	S	S	S	ss	J
c	--	--	--	--	--	S
38a	S	M	M	J	J	I3-F?
b	I1-F5	S	--	A1-I1-F5	S	A1
c	--	M	--	--	--	--
d	--	--	--	--	S	--
e	--	--	--	--	--	S
39a	--	--	--	--	S	--
b	--	--	--	--	--	S
c	--	--	--	--	--	S
40a	--	M	ss	A1-I1-F2	J	I2-F12
b	--	M	J	J	S	M
c	--	--	--	S	S	S
d	--	--	--	S	S	--
41a	A1-I13-F44	M	--	--	--	--
b	--	--	S	S	S	--
c	--	--	S	S	S	S
d	--	--	J	A1-I2-F5	S	J
e	--	--	--	S	S	S
f	--	--	--	--	--	J
42a	J	--	--	--	--	--
b	--	S	S	J	S	I1-F6

	1986	1987	1988	1989	1990	1991
43a	--	S	--	S	S	J
b	--	--	--	J	S	J
c	--	--	--	--	S	J
d	--	--	--	--	--	S
44a	A2	M	ss	J	J	P2
b	--	--	--	S	S	J
45a	S	M	J	J	S	S
b	--	--	--	--	S	--
c	--	--	--	--	S	S
46a	J	M	--	--	--	--
b	--	--	--	S	S	J
c	--	--	--	S	S	J
d	--	--	--	J	S	S
e	--	--	--	--	--	J
f	--	--	--	--	--	S
g	--	--	--	--	--	S
h	--	--	--	--	--	S
i	--	--	--	--	--	S
j	--	--	--	--	--	J
k	--	--	--	--	--	S
47a	J	--	--	--	--	--
b	A1-I5-F25	M	J	M	M	P2-I2-F14
c	S	--	--	--	--	--
d	S	S	S	J	S	--
e	--	--	--	--	S	--
f	--	--	--	--	S	S
g	--	--	--	--	--	S
48a	J	M	S	J	J	M
b	--	--	--	J	J	J
c	--	--	--	S	S	--
d	--	--	--	--	S	S
e	--	--	--	--	--	I2-F4
49a	J	M	J	J	J	M
b	J	M	J	M	--	--
c	--	--	--	--	--	S
50a	J	M	S	J	S	J
b	S	S	S	S	S	J
c	J	M	S	J	ss	I2-F4
d	J	M	S	J	S	M
e	J	M	--	--	--	--
f	--	--	--	J	J	I2-F17
g	--	--	--	--	--	J

MONTANA STATE LIBRARY

This “cover” page added by the Internet Archive for formatting purposes