

COOPERATIVE PARK STUDIES UNIT

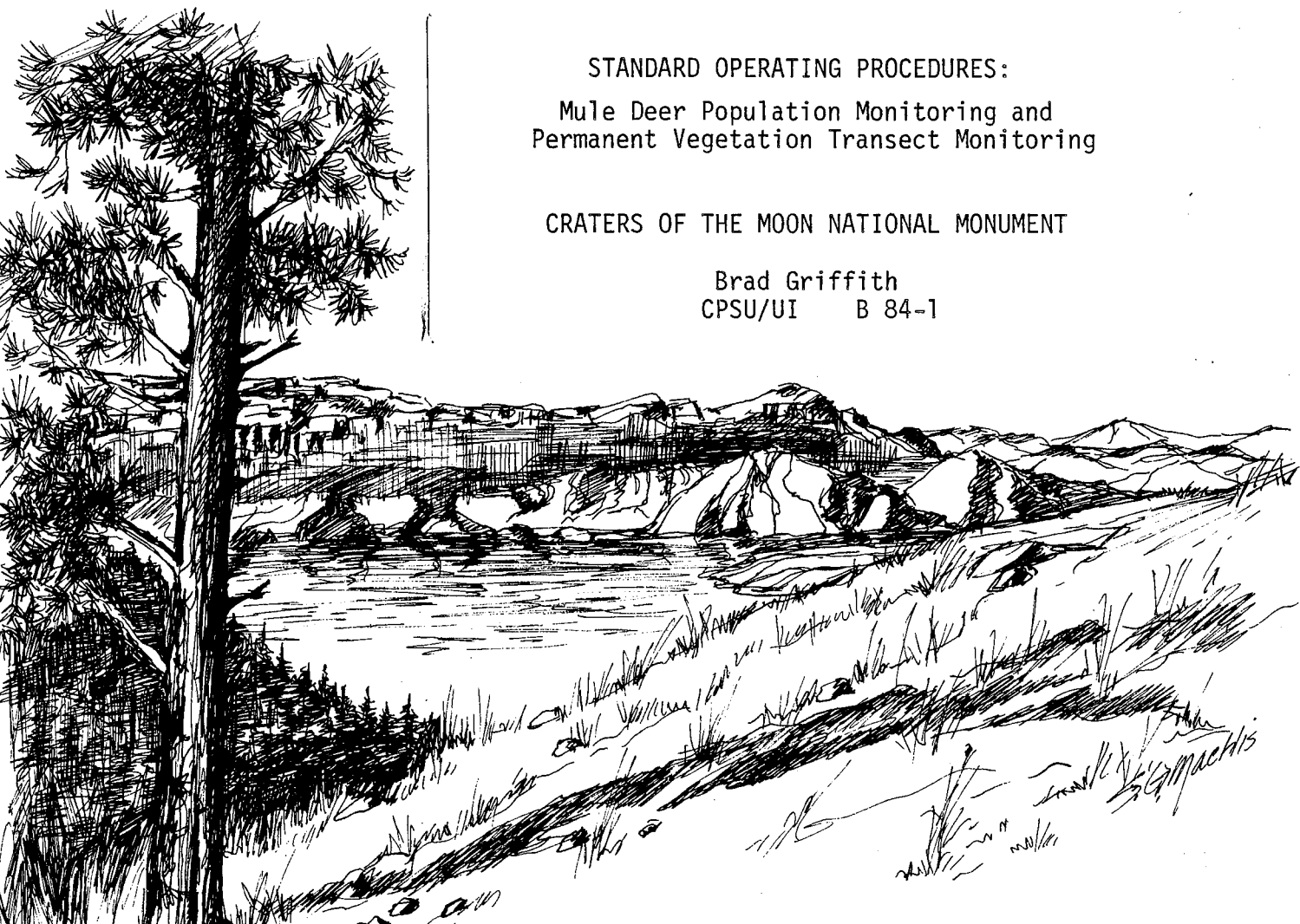
UNIVERSITY OF IDAHO

STANDARD OPERATING PROCEDURES:

Mule Deer Population Monitoring and
Permanent Vegetation Transect Monitoring

CRATERS OF THE MOON NATIONAL MONUMENT

Brad Griffith
CPSU/UI B 84-1



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Final Report
National Park Service
Pacific Northwest Region

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1.0 INTRODUCTION

This report contains standard operating procedures for mule deer population monitoring and permanent vegetation transect monitoring for Craters of the Moon National Monument (CRM0), Idaho. An additional section discusses trends in vegetation on the permanent transects as indicated by data collected in 1967, 1971, and 1980-1982.

The standard operating procedures were developed over a three-year period, 1980-1982, concurrent with a study of ecological characteristics of the mule deer herd which summers on CRM0. The results of the mule deer study are presented in Report B83-2 of the Cooperative Park Studies Unit, University of Idaho.

2.0 CRATERS OF THE MOON NATIONAL MONUMENT

Standard Operating Procedure 83-3

Mule Deer Population Monitoring (MDPM)

A. Purpose

The deer monitoring program is designed to provide yearly indices to the Craters of the Moon mule deer population level, herd productivity, and over-winter fawn survival. Combined with the vegetation monitoring program, it will provide information regarding the dynamics of the mule deer/forage system on Craters of the Moon National Monument. Since the Craters herd does not exclusively occupy national monument lands, the objective is to obtain information which will complement data obtained by Idaho Fish and Game (IFG) and Bureau of Land Management (BLM) programs. To this end, representatives from IFG and BLM should be invited to participate in the censuses each year.

B. Sampling Frequency

The deer censuses are to be conducted in the spring (April-June) and in late summer (August-September) of each year. This is necessary in order to build an understanding of year-to-year variation in the population and to identify long-term changes that may occur.

C. Sampling Method

1. Spring Classification

As soon as deer begin to arrive on the monument in April, begin documenting the sex and age of all deer seen. Sampling should continue throughout the month of May and the first two weeks of June. Classify

deer and adult males, adult females, yearlings, or unknown. Yearlings may be differentiated from adults based on body size and the ratio of ear length to lower jaw length. Deer with ears longer than the lower jaw should be classed as yearlings and those with ears the same length or shorter than the lower jaw should be classed as adult. Use a spotting scope or binoculars to obtain a profile view when ageing the deer. Continue documenting the sex and age of the deer until at least 100 and preferably 200 animals have been classified. To obtain the larger and more precise sample it may be necessary to conduct early morning walking censuses in the wilderness area and early morning roadside censuses in the north end of the monument. Attempt to obtain the sample from various areas of the monument rather than repeatedly classifying deer from one location (e.g., Inferno Cone). When data collection is complete, calculate the yearling:adult doe ratio as ($\# \text{ yearlings} / \# \text{ adult does}$). The spring yearling:adult doe ratio can be compared to the fawn:doe ratio collected during the previous late summer to index over-winter fawn survival for the preceding winter. For example, in the late summer of 1982, there were 94 fawns per doe and in the spring of 1983 there was an estimated classification ratio of 73 yearlings per adult doe; over-winter survival is then indexed as $(73/94) \times 100$ or 88 percent. This convention will over-estimate over-winter survival of fawns depending on the winter mortality of does. The more does that die in winter, the greater will be the over-estimation.

The proportion of does that are adult may be estimated by assuming that one-half of the yearlings are female. Yearling:doe ratios for 1980-1982 are presented and analyzed by Griffith (1983, Coop. Park Studies Unit, Univ. of Idaho, Report B83-2).

2. Late Summer Census

The basic sampling method in late summer is an early morning road-side census from a vehicle. The total number of deer seen on such censuses during 1980-1982 was highly ($r = 0.99$, $P \leq 0.01$) correlated with the total population estimated by mark-recapture techniques (Griffith, 1983, CPSU, Univ. Idaho Rep. B83-2).

Each year between 15 August and 15 September conduct six early morning censuses from a vehicle along the 3.9 mile section of secondary road that runs from Highway 26 north to the old Martin Mine site. During this period the majority of the Craters of the Moon herd will be resident in the north end of the monument, and fawns will be following their mothers.

Do not conduct censuses during consistent rain or when winds consistently exceed 10 mph. Begin censuses 10 minutes after sunrise. It will take approximately 1-2 hours to complete each census. Drive slowly and search the terrain carefully to ensure that no deer are missed. Record all deer visible from the road. At Martin Mine turn-around park the vehicle and step outside. Include in the census all deer which can be seen from this point. Throughout the census use binoculars to scan distant hillsides and a spotting scope to classify the age and sex of each deer seen. Classify deer as either adult males, yearling males, females, or fawns. Consider all two-point or spike bucks to be yearlings and larger bucks to be adults. Do not distinguish between yearling and adult females.

Record the sex and age of the deer observed in groups as they are seen (e.g., 1 doe 2 fawns, 2 yearling bucks, 1 adult male, etc.). A group

is a number of deer which catches the observer's attention, not a social unit. When the census is complete transfer the data to the standard form and retain the list of groups of deer with the standard form. A copy of the standard form is included in this S.O.P. (Table 2.1).

3. Road Kills and Hunter Kills

During 1980-1982 Griffith (1983, op cit.) documented significant ($P \leq .01$) direct relationships between the estimated total population and total number of deer killed on the highway within the monument boundaries, and total documented hunter kill around the boundaries of the north end of the monument. Since the road kills and hunter kills provide an estimate of population trend independent of the late summer censuses, they should be documented each year as a check on the roadside censuses.

Each year document the date, number, sex, and age (fawn, yearling, or adult) of all deer killed on U.S. Highway 20/26 within the monument boundary. Age deer by comparing patterns of tooth wear with the reference collection of jaws which is maintained by the Ranger Division. At summer orientation each year alert the maintenance crew to report road kills they find.

During hunting season patrols each year record the number of hunter contacts and the date, number, sex, and age of deer killed by these hunters. Include in this documentation reliable reports of deer killed but not actually seen by the Rangers on hunting patrol and deer killed in the Big Cottonwood Creek area.

D. Procedures for Data Analysis

1. Number of Deer per Census

The average (mean) number of deer seen per census is the yearly index to population trend. Calculate the mean, standard error of the mean, and the confidence interval on the mean for the total number of deer in each sex and age class for the six samples collected each year. Consult a standard statistical text (e.g., An Introduction to Statistical Methods and Data Analysis by Lyman Ott, 1977, Wadsworth Publishing Co.) for procedures for these calculations. A copy of the appropriate portions of this text are filed in the deer population monitoring folder in the Ranger files.

To obtain an approximate test for statistically significant differences between years, compare the confidence intervals. If the confidence intervals overlap then the difference is not significant. If the confidence intervals do not overlap then there is a statistically significant difference.

2. Sex and Age Ratios

Combine the data from the six censuses and calculate the ratio of adult males, yearling males, and fawns per 100 females. To accomplish this, divide the total number in each age and sex class by the number of females and multiply by 100. For example, consider a series of censuses which yielded a total of 75 deer that included 10 adult males, 4 yearling males, 25 females, and 31 fawns. The classification would be calculated as follows:

Calculations

$$\begin{array}{l} \frac{10 \text{ adult males}}{25 \text{ females}} \times 100 = 40 \text{ adult males} \\ \text{to} \\ \frac{4 \text{ yearling males}}{25 \text{ females}} \times 100 = 16 \text{ yearling males} \\ \text{to} \\ \frac{25 \text{ females}}{25 \text{ females}} \times 100 = 100 \text{ females} \\ \text{to} \\ \frac{31 \text{ fawns}}{25 \text{ females}} \times 100 = 124 \text{ fawns} \end{array}$$

Disregard deer of unknown sex and age classes and groups which contain unknown individuals when making these calculations. Procedures for calculating confidence intervals on the ratios are relatively complex. Consult the University of Idaho Cooperative Park Studies Unit for assistance. Appropriate confidence intervals cannot be calculated unless the groups of deer seen on the censuses are recorded and retained.

File the data sheets and copies of the calculations in the Ranger files. Prepare a summary sheet (as in Tables 2.2-2.4) and send copies of the spring classification summary, the late summer census summary, and the tabulation of road kills, hunter kills, and number of hunter contacts, to the cooperators listed at the end of this S.O.P. each year.

E. Estimating the Number of Deer in the Craters Herd

An estimate of the number of deer in the late summer population may be obtained utilizing the relationship between the average daily standard census totals and the mark-recapture population estimates determined during 1980-1982 (Griffith, op. cit.). Where y = mark-recapture population estimate and x = average daily standard census total, the

Table 2.2

Summary of Standard Deer Censuses
Craters of the Moon National Monument, 1980

Sex and Age		Date 1980						Mean	Standard Error
		8/3	8/28	9/15	9/27	9/30	10/8		
Adult Males	#	3	2	7	6	8	4	5.0	(0.97)
	Ratio	8	8	35	29	38	13	21.8	
Yearling Males	#	3	3	5	5	7	5	4.7	(0.61)
	Ratio	8	13	25	24	33	17	20.0	
Females	#	36	24	20	21	21	30	25.3	(2.60)
	Ratio	100	100	100	100	100	100	100.0	-
Fawns	#	36	26	17	19	28	27	26.0	(3.18)
	Ratio	108	108	85	90	133	90	102.3	
Unknown	#	3	3	1	0	0	0	2.7	(0.76)
Total	#	84	58	50	51	64	66	62.2	(5.11)

Table 2.3

Summary of Standard Deer Censuses
Craters of the Moon National Monument, 1981

<u>Sex and Age</u>		<u>Date 1981</u>						<u>Mean</u>	<u>Standard Error</u>	<u>Change From Previous Year</u>	
		<u>8/13</u>	<u>8/14</u>	<u>8/16</u>	<u>8/20</u>	<u>9/1</u>	<u>9/3</u>				
Adult Males	#	8	5	4	1	3	13	5.7	(1.74)	+14%	n.s.
	Ratio	18	21	18	3	11	45	19.3	-	-	
Yearling Males	#	16	7	11	4	6	11	9.2	(1.78)	+96%	n.s.
	Ratio	36	29	50	11	22	38	31.0	-	-	
Females	#	44	24	22	36	27	29	30.3	(3.37)	+20%	n.s.
	Ratio	100	100	100	100	100	100	100.0	-	-	
Fawns	#	30	24	19	22	19	15	21.5	(2.11)	-17%	n.s.
	Ratio	68	100	86	61	70	52	72.3	-	-	
Unknown	#	1	0	0	0	0	11	2.0	-	-	
Total	#	98	60	56	63	55	79	68.5	(6.88)	+10%	n.s.

n.s.: Not statistically significant at the 95% confidence level.

Table 2.4

Summary of Standard Deer Censuses

Craters of the Moon National Monument, 1982

<u>Sex and Age</u>		<u>Date 1982</u>							<u>Mean</u>	<u>Standard Error</u>	<u>Change From Previous Year</u>	
		<u>8/15</u>	<u>8/16</u>	<u>8/18</u>	<u>8/30</u>	<u>8/31</u>	<u>9/1</u>	<u>9/2</u>				
Adult Males	#	5	0	6	0	9	5	10	5.0	(1.48)	-12.3%	n.s.
	Ratio	10	0	35	0	90	28	50	23.5	-	-	-
Yearling Males	#	2	0	2	0	6	0	4	2.0	(0.87)	-78.3%	*
	Ratio	4	0	12	0	60	0	20	9.4	-	-	-
Females	#	50	26	17	8	10	18	20	21.3	(5.30)	-29.7%	n.s.
	Ratio	100	100	100	100	100	100	100	100.0	-	-	-
Fawns	#	22	20	13	11	15	23	18	17.4	(1.73)	-19.1%	n.s.
	Ratio	44	77	77	138	150	128	90	81.9	-	-	-
Unknown	#	0	0	0	0	0	0	0	0	0	-	-
	Ratio	0	0	0	0	0	0	0	0	-	-	-
Total	#	79	46	38	19	40	46	52	45.7	(6.82)	-33.3%	n.s.

n.s.: not statistically significant at the 95% confidence level.

* : statistically significant at the 95% confidence level.

regression equation relating y and x is $y = 7.295x + 19.056$. To estimate the late summer total deer population (y), substitute the average daily standard census total for x in this equation and solve for y .

The 95 percent confidence interval on this estimate is given by

$$y \pm 12.706 \sqrt{43.22(1.33 + \frac{(x - 58.8)^2}{277.26})}$$

For example, suppose the average daily standard census total (x) is 50.

Then

$$y = (7.295)(50) + 19.056 = 384 \text{ deer}$$

and the 95 percent confidence interval on y is

$$384 \pm 12.706 \sqrt{43.22(1.33 + \frac{(50 - 58.8)^2}{277.26})}$$

which is equivalent to 384 ± 106.0 . In other words, there is 95 percent confidence that the total number of deer lies between 278 and 490.

These calculations will be appropriate for average daily standard census totals that range between 46 and 68 since values in this range were used to develop the regression equation. If census totals for a year fall outside this range, much less confidence should be placed on the estimate of late summer total deer population.

F. Interpretive Guidelines

Some year-to-year variation in data obtained from the censuses is to be expected. This will be due to actual changes in population

characteristics and to variance in observers' abilities to accurately detect deer. For example, the total number of deer seen on comparison censuses conducted by two observers in 1982 differed by 20 percent even though the censuses were conducted on the same days at the same time of day, from the same vehicle. Between-year variations on the order of 20-40 percent from a long-term, 3-5 year average should cause little concern.

A consistent year-to-year decrease or consistent increase of the same magnitude over a period of 3-5 years would suggest that real changes in the total number of animals or proportions in the various sex and age classes were occurring. If real changes are suspected under these guidelines, consult the confidence intervals to determine if a statistically significant change has occurred.

The adult female segment of the population is the key to the long-term stability of the herd and trends in this segment are particularly important. The adult females will be combined with yearling females (which generally do not produce fawns) in the late summer, however. Multiply the estimated proportion of does that are adult (obtained from spring classification data) times the number of does seen on late summer censuses to obtain an estimate of the number of adult females seen on late summer censuses.

It is important to remember that the estimates of classification ratios and numbers of deer may be a function of factors influencing the deer herd which are not directly related to Craters of the Moon. For example, an especially severe winter may cause high fawn mortality on winter ranges. During the following August, fewer of the deer classed as females would be unproductive yearlings. As a result, given constant

fecundity of adult females, an increased fawn:doe ratio might be observed. The same conditions might produce a lower proportion of yearling bucks. Conversely, a mild winter may result in an increased proportion of yearlings and a lower fawn:doe ratio the following August. Use the year-to-year variation in spring yearling:adult doe ratios to estimate the direction of bias in the late summer fawn:doe ratios.

Since no previous long-term monitoring of deer has been conducted on Craters of the Moon, it will take a few years to determine if the herd is stable, decreasing, or increasing. One year of data in itself is of limited usefulness. Therefore, it is essential that the spring classification, censuses, and documentation of road kills and hunter kills be conducted each year so no gaps in future knowledge will exist.

List of Cooperators to Receive Yearly Summary

Dr. John Beecham, Research Supervisor
Idaho Department of Fish and Game
600 South Walnut, P. O. Box 25
Boise, ID 83707

Mr. Tracy Trent, Regional Game Manager
Idaho Department of Fish and Game
Region 6
1515 Lincoln Road
Idaho Falls, ID 83401

Mr. Craig Kvale, Regional Game Manager
Idaho Department of Fish and Game
Region 4
868 East Main
Jerome, ID 83338

Mr. Russ McFarling, District Wildlife Biologist
Idaho Falls District Office
USDI, Bureau of Land Management
940 Lincoln Road
Idaho Falls, ID 83401

Mr. Bob McCarty, Area Wildlife Biologist
Idaho Falls District Office
USDI, Bureau of Land Management
940 Lincoln Road
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Mr. Larry Mangan, District Wildlife Biologist
Shoshone District Office
USDI, Bureau of Land Management
P. O. Box B
Shoshone, ID 83352

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Dayville, OR 97825

3.0 CRATERS OF THE MOON NATIONAL MONUMENT

Standard Operation Procedure 83-4

Permanent Vegetation Transect Monitoring (PVTM)

A. Purpose

The permanent vegetation transects are designed to provide information regarding long-term trends in percent cover, density, frequency, and age distribution for plant species on Craters of the Moon National Monument. The transects are primarily intended to monitor changes in the quality of the mule deer forage base and accordingly are located in areas of regular mule deer usage. The transects are additionally important as a long-term monitoring system for unmanipulated plant communities.

B. Sampling Frequency

Transects were initially sampled for 3 consecutive years--1980, 1981, and 1982. This provided a data base which allowed an appraisal of year-to-year and observer-to-observer variation. Henceforth, use an alternating sequence of three consecutive years of sampling. Under this system the transects will be sampled in 1986, 1987, and 1988, again in 1992, 1993, and 1994, and in appropriate three-year sets thereafter. Each three-year set of samples should reflect an average effect of year-to-year and observer-to-observer variability.

C. Sampling Methods

There are four transect clusters. Each is comprised of six 15-meter line-intercept transects (Canfield, 1941, J. Forestry 39:388-394) and six photo points. The Line Intercept Method (LIM) was chosen

because all parameters are measured rather than estimated. Transects and photo points should be sampled during the first week of July. It will take one person approximately 3-4 days to complete the sampling. If a second person records data while one makes the measurements, the time required can be shortened considerably.

D. Location of Transects

Transect cluster No. 1 is located on a south facing slope at the upper end of the aspen stand which grows in the draw heading NE from the old Martin Mine site; cluster No. 2 is on a south facing slope at the mouth of YCC canyon, approximately 75 m up from the road; cluster No. 3 is located two-thirds of the total distance up the ^{WSW} side of Crescent Butte ^{mostly dead} about 30-50 m above ~~(two large hedged serviceberry bushes)~~, and cluster No. 4 is located one-third of the total distance up the north side of Coyote Butte above an uprooted dead tree. Locations of the clusters are plotted on maps in the Ranger files.

Within each cluster, each transect is marked at each end with a steel fence post. The head posts of the transects are red or silver, while posts at the bottom ends are green. The bottom end posts on transects in clusters 1, 3, and 4 are only one-half normal length. The transects within each cluster are numbered A1, A2, B1, B2, C1, and C2. The A transects are highest on the slope and C transects the lowest. As the observer faced uphill, the number 1 transect of each lettered pair is on the left (Fig. 3.1). From the same vantage point the headposts of each transect are on the observer's left.

post's 1/2 length on crescent &

looking straight at Coyote Butte

"Cluster No. 1"

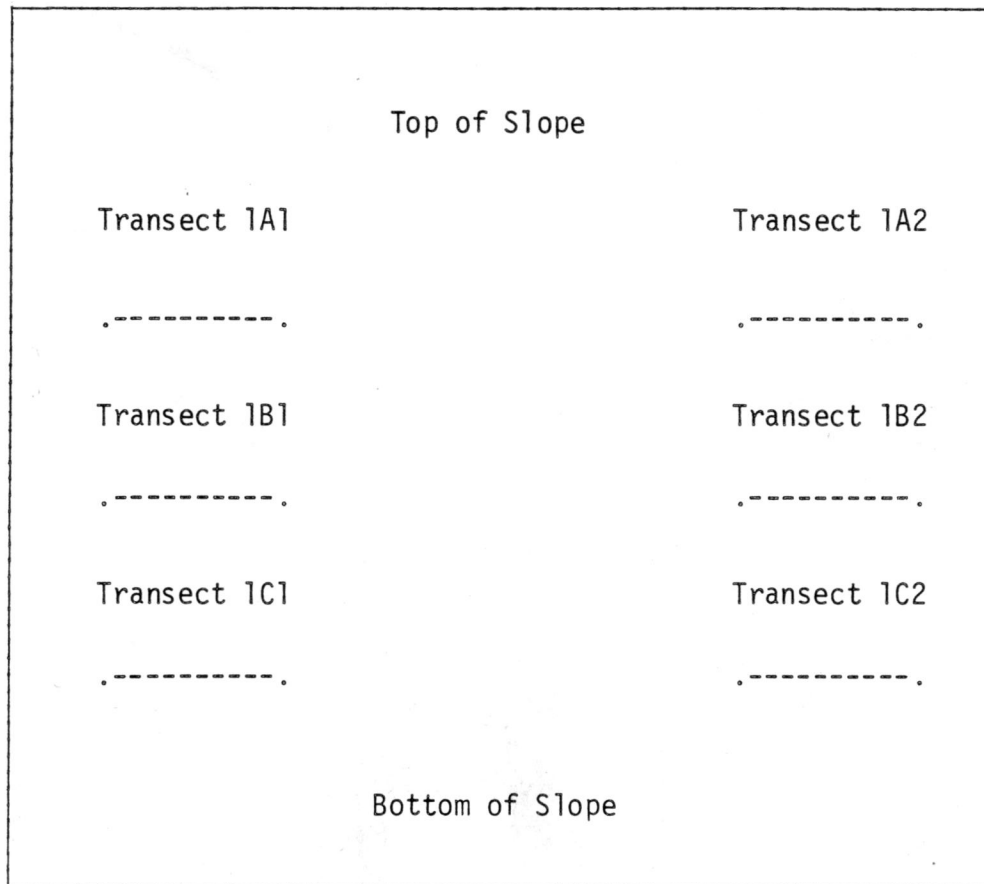


Figure 3.1. Example schematic of transect layout within a transect cluster on Craters of the Moon National Monument permanent vegetation transects.

E. Procedures for Data Collection

Obtain the sampling equipment which is kept in a box labeled "Vegetation Sampling Gear" which is stored in the Ranger bay of the maintenance building. Make sure that the following items are included: ✓ 15 meter steel tape, ✓ 3 meter retractable tape, ✓ 2 steel rings, ✓ 2 turnbuckles, ✓ 20 meter long steel cable, and a steel rod 1.5 meters long painted in alternate black and yellow 1 decimeter stripes. In addition, a camera, a tripod, a roll of 36 exposure ASA 64 color slide film, a clipboard, an 8" x 10" white plastic coated card, a grease pencil, and a small adjustable wrench to adjust the length of the cable will be needed. Blank data sheets will be found in the files under CRMO C-41.

Persons not familiar with the plant species to be encountered should visit the transects during the week prior to sampling and learn to recognize the plants. Familiarization work should be done in the area of the transects but be careful not to trample the transects or collect specimens directly from them. Key out unknown plants using Flora of the Pacific Northwest by C. L. Hitchcock and A. Cronquist. Many of the species which will be encountered are included in the Craters of the Moon herbarium. Use the herbarium specimens to aid in identification. A set of mounted specimens which can be used in the field during sampling is located in the Chief Ranger's files. A list of species which may be encountered on the transects is provided in Table 3.1. As additional species are found or corrections needed, amend the attached list.

1. Photo Points

At each transect take one photo. Place the tripod, with the camera mounted 5 feet above ground level, at the head post and point the camera

Red/silver

Table 3.1

List of Plant Species that May Be Encountered on Permanent Vegetation Transects, Craters of the Moon National Monument

Species	Code	Common name
<i>Pinus flexilis</i>	PIFL	Limber Pine
<i>Agropyron spicatum inerme</i>	AGIN	Beardless Bluebunch Wheatgrass
<i>Elymus cinereus</i>	ELCI	Giant Wild Rye
<i>Melica bulbosa</i>	MEBU	Oniongrass
<i>Poa sandbergii</i>	POSA3	Sandberg's Bluegrass
<i>Bromus tectorum</i>	BRTE	Cheatgrass Brome
<i>Stipa compata</i>	STCO	Needle and Thread Grass
<i>Stipa occidentalis</i>	STOC	Subalpine Needlegrass
<i>Sitanion hystrix</i>	SIHY	Bottlebrush Squirreltail
<i>Oryzopsis hymenoides</i>	ORHY	Indian Ricegrass
<i>Ribes cereum</i>	RICE	Wax Currant
<i>Artemisia tridentata</i>	ARTR	Big Sagebrush
<i>Purshia tridentata</i>	PUTR	Antelope Bitterbrush
<i>Symphoricarpos oreophilus</i>	SYOR	Mountain Snowberry
<i>Chrysothamnus viscidiflorus</i>	CHVI	Green Rabbitbrush
<i>Chrysothamnus nauseous</i>	CHNA	Rubber or Gray Rabbitbrush
<i>Tetradymia canescens</i>	TECA	Gray Horsebrush
<i>Calochortus</i> spp.	CALOC	Mariposa, Sego Lily
<i>Cryptantha intermedia</i>	CRIN2	
<i>Cryptantha torreyana</i>	CRT0	Torrey Cryptantha
<i>Hackelia patens</i>	HAPA	Stickweed
<i>Lappula redowski</i>	LARE	Western Stickseed
<i>Lithospermum ruderales</i>	LIRU	Wayside Gromwell, Stoneseed
<i>Mertensia oblongifolia</i>	MEOB	Oblong Leaf Bluebells
<i>Silene</i> spp.	SELEN	Wild Pink, Campion
<i>Chenopodium album</i>	CHAL	Lambs Quarters, Goosefoot
<i>Agoseris glauca</i>	AGGL	Pale Agoseris
<i>Aster conspicus</i>	ASCO	Showy Aster
<i>Machaeranthera canescens</i>	MACA2	Tansy Aster
<i>Balsamorhiza sagittata</i>	BASA	Arrowleaf Balsamroot
<i>Chaenactis douglasii</i>	CHDO	Douglas chaenactis
<i>Cirsium vulgare</i>	CIVU	Bull Thistle
<i>Crepis acuminata</i>	CRAC	Tapertip Hawksbeard
<i>Microseris nutans</i>	MINU	Nodding Microseris
<i>Tragopogon dubius</i>	TRDU	Salsify, Goats Beard

Table 3.1

Continued

Species	Code	Common name
<i>Arabis holboellii</i>	ARHO	Holboell Rockcress
<i>Arabis sparsiflora</i>	ARSP2	Sickle-pod Rock Cress
<i>Descurania pinnata</i>	DEPI	Pinnate Tansymustard
<i>Descurania richardsonii</i>	DERI	Western Tansymustard
<i>Descurania sophia</i>	DESO	Flixweed Tansymustard
<i>Phacelia hastata</i>	PHHA	Silverleaf Phacelia
<i>Phacelia heterophylla</i>	PHHE	Varileaf Phacelia
<i>Astragalus convallarius</i>	ASCOS	Timber Poisonvetch
<i>Lupinus laxiflorus</i>	LULA2	Spur Lupine
<i>Lupinus leucophyllus</i>	LULE	Velvet Lupine
<i>Mentzelia albicaulis</i>	MEAL2	Whitestem Mentzelia
<i>Gayophytum ramosissimum</i>	GARA	Hairstem Groundsmoke
<i>Collomia linearis</i>	COLI	Collomia
<i>Phlox longifolia</i>	PHLO	Longleaf Phlox
<i>Eriogonum heracleoides</i>	ERHE	Wyeth Eriogonum
<i>Eriogonum microthecum</i>	ERMI	Slenderbrush Eriogonum
<i>Eriogonum umbellatum</i>	ERUM	Sulfur Eriogonum
<i>Eriogonum vimineum</i>	ERVI	Broom Eriogonum
<i>Delphinium andersonii</i>	DEAN	Anderson Larkspur
<i>Galium boreale</i>	GABO	Bedstraw
<i>Collinsia parviflora</i>	COPA	Littleflower Collinsia
<i>Mimulus nanus</i>	MINA	Dwarf Monkeyflower
<i>Penstemon cyaneus</i>	PECY	Blue Penstemon
<i>Cymopterus terebinthinus</i>	CYTEF	Desert Parsley
<i>Lomatium dissectum</i>	LODI2	Biscuitroot
<i>Viola</i> spp.	VIOLA	Violet

along the axis of the transect. Plant the yellow and black striped steel rod 3 meters out from the camera on the transect line. Make sure the flat plate of the steel rod is flush with the ground so the 1 decimeter painted bands on the rod can be used to measure the height of vegetation. Write the complete transect number and date on the white card and place it next to the striped rod. Ensure that you write the information on the card legibly and distinctly enough that it will record on the film and that the card is positioned such that reflections do not obscure the information. Take a meter reading with the camera by pointing it at the ground so the brightness of the sky does not cause underexposure of the foreground vegetation. Compose the photograph with the card and painted rod at the bottom center of the frame and make the exposure. When the film has been developed, review and write the transect number and date on each photo. File the completed slides in the Chief Ranger's files in plastic slide mount pages.

2. Line Intercept Transects

Slip the steel ring with the attached cable over the head post of each transect. Stretch the cable out toward the bottom end of the transect and attach it to the steel post using the steel ring and turnbuckles. It may be necessary to loosen the clamp on the cable so the turnbuckle will reach the post. Maneuver the cable so it rests underneath large shrubs as much as possible, but ensure that the cable runs straight between the posts. Tighten the cable with the turnbuckle.

The portion of the transect to be read is the 15 m long segment between the soldered balls on each end of the cable. Additional soldered balls are located along the cable, and they divide the transect into five

3 m segments. Keeping the data for each 3 m segment separate, record the length of the intercepts of the vertical projection of the cable with each plant. Make all measurements in the metric system. Record values to the nearest 0.005 m. Record intercepts of less than 0.005 m as traces (T).

• 5 cm
Measure grass and forb basal area at ground level. If forbs are single-stemmed, measure them on the stem diameter but if they have a rosette growth form, measure the intercept with the basal leaves. Do not include grasses or forbs whose stems merely overhang the transect. The transect must intersect the basal area of the plant for it to be tallied. For bunch grasses and rosette growth from forbs, record the actual intersection of the transect with the basal area of the plant. Do not record the greatest length of the basal area. It may be necessary to straddle the transect to determine where the vertical projection of the transect crosses the basal area of a plant.

Measure the intersection of the transect with the crown spread of each shrub encountered. The position of the main stem of the shrub relative to the transect is immaterial. Assign an age class to each shrub as follows: (a) shrubs with stems up to 0.3 cm diameter at the base are seedlings, (b) those between 0.31 cm and 0.60 cm are young, (c) those over 0.60 cm are mature, and (d) any living shrub which has 25 percent or more of its crown surface made up of deadwood is decadent. Thus, for each shrub encountered two items of information will be recorded: length of intercept and age. The attached facsimile data sheet suggests a method for recording the data (Table 3.2).

F. Procedures for Data Analysis

Sum the number of times each species was encountered on each transect. This will provide an index to density of each species for each transect. The values for the six transects in each cluster may be averaged for each species.

Sum the intercepts of each species for each transect. Percent cover is then obtained by dividing the sum of the intercepts (in meters) by the total transect length of 15 meters. Multiply this quotient by 100 to give a percent value. The values thus obtained for each species may be averaged as for the density index.

To calculate the frequency of occurrence for each species consider each 3 m segment of each transect to be one sample. For each transect cluster determine the number of segments in which each species was found and divide by the total of 30 segments. For example, a species found in 15 of 30 segments in a cluster would have a frequency of 50 percent. In these calculations ignore the number of times a species was found in a segment. Consider a species as present or not within a segment.

For shrubs make a tabular listing of the intercepts and age classes for each species for each cluster. Combine all the transects in each cluster for this tabulation. Sum the number of shrubs of each species in each age class and calculate the percent of the total in each age class.

When complete, there will be an estimate for each species and each transect cluster of (1) average percent cover for each forb and grass, (2) average index to density for each forb and grass, (3) percent

frequency of occurrence, (4) percent cover for each shrub, and (5) percentage age distribution for each shrub species.

Consult the summary report of the 1980 sampling of the transects as an example of how to present the above data (Tables 4.3-4.6). File the completed summary sheets in the appropriate folder under N22.

G. Interpretive Guidelines

A number of factors may influence the year-to-year and long-term variability of the data obtained from the permanent transects. These include precipitation and temperature during May and June, changing observers, the normal competitive interactions between plant species and the resultant successional changes in plant communities, and grazing pressure by mule deer. Although the transects are primarily intended to monitor mule deer habitat, it is not necessary to assume that deer foraging will cause all changes observed.

Frequency and density of forbs will likely show a strong response to precipitation and temperature from year to year. Departures from sampling during the first week of July will result in a different mix of forb species due to variation in flowering seasons.

For between-year comparisons, when observers have changed, there should be a 100 percent increase or a 50 percent decrease in a value such as cover or density before a real change is suspected. Even then, a three-year series will often show that a trend does not exist. See, for example, the comparison of data collected at transect cluster No. 1 in 1967, 1971, and 1980 for sagebrush and bitterbrush (Table 4.1).

4.0 TRENDS IN VEGETATION

A. 1967-1980

Four permanent transect clusters were established in Craters of the Moon in 1967. They were located in Martin Mine Draw, YCC Canyon, on Crescent Butte, and Coyote Butte. YCC Canyon and Martin Mine transects were read in 1967, 1971, and 1980 (Table 4.1); Crescent Butte and Coyote Butte transects were read in 1967 and 1980 (Table 4.2).

Since the transects were read by different persons in each year forage production values (Tables 4.1 and 4.2) are difficult to interpret. Variations in moisture and temperature may cause production to vary considerably from year to year, but evidently there was considerable variation between observers in assessing the current year's growth and the weight of production in grams. As a result, this discussion will focus on the average frequencies of occurrence which are less susceptible to observer and weather bias.

On the transects in the north end (Table 4.1) bunchgrass appeared relatively stable. Suggestions of a decline in beardless bluebunch wheatgrass (Agropyron spicatum inerme) from 1967 to 1971 were nullified in 1980. There was a consistent decline in the frequency of cheatgrass (Bromus tectorum) in each year sampled for both transects, however. This speaks favorably for the health of the grass community as cheatgrass is an undesirable disturbed site invader.

Forbs on transects in the north end remained stable as a group. The number of species of forbs on each transect remained fairly constant although the mix of species found each year varied. This variation was probably influenced by weather fluctuations and the time of transect

Table 4.1 Average frequency of occurrence and forage production (grams) determined from 20 0.96 square foot circular plots sampled on each of 3 100 foot transects in permanent transect cluster No. 1, Martin Mine, and permanent transect cluster No. 2, YCC Canyon, for 1967, 1971, and 1980, Craters of the Moon National Monument, Idaho

	Transect Cluster No. 1						Transect Cluster No. 2					
	Average Frequency of Occurrence (Percent)			Forage Production (grams)			Average Frequency of Occurrence (Percent)			Forage Production (grams)		
	7/18	7/16	6/26	7/18	7/16	6/26	7/19	7/10	6/19	7/19	7/10	6/19
	1967	1971	1980	1967	1971	1980	1967	1971	1980	1967	1971	1980
<i>Agropyron spicatum inerme</i>	53	32	41.7	73	105	180	53	42	45	435	701	189
<i>Elymus cinereus</i>	13	13	11.7	142	628	213	2	2	1.7	36	45	35
<i>Melica bulbosa</i>	3	--	--	2	--	--	--	--	--	--	--	10
<i>Poa sandbergii</i>	2	--	--	T	--	--	--	--	--	--	--	T
<i>Bromus tectorum</i>	77	37	28.3	17	23	14	95	30	5	11	19	T
<i>Calochortus spp</i>	5	--	--	3	--	--	--	--	--	--	--	--
<i>Lappula redowski</i>	--	--	56.7	--	--	53	--	--	25	--	--	10
<i>Cryptantha intermedia</i>	35	33	--	6	21	--	--	--	--	--	--	--
<i>Lithospermum ruderales</i>	3	2	5	49	1	30	--	--	1.7	--	--	45
<i>Silene spp</i>	2	--	--	2	--	--	27	--	--	2	--	--
<i>Chenopodium album</i>	3	5	1.7	T	3	T	22	12	13.3	2	7	T
<i>Agoseris glauca</i>	--	--	--	--	--	--	3	3	--	T	2	--
<i>Machaeranthera canescens</i>	2	3	--	2	16	--	--	3	--	--	6	--
<i>Balsamorhiza sagittata</i>	50	32	48.3	1056	2046	1661	53	42	41.7	633	1396	735
<i>Chaenactis douglasii</i>	--	2	--	--	1	--	--	2	1.7	--	1	T
<i>Cirsium vulgare</i>	--	--	--	--	--	--	2	2	--	T	1	--
<i>Crepis acuminata</i>	5	5	6.7	3	12	13	--	--	1.7	--	--	T
<i>Mertensia oblongifolia</i>	3	--	--	4	--	--	--	--	--	--	--	--
<i>Tragopogon dubius</i>	2	--	3.3	5	--	10	3	8	5	2	14	13
<i>Arabis holboellii</i>	--	--	8.3	--	--	8	--	--	--	--	--	--
<i>Arabis sparsiflora</i>	--	--	--	--	--	--	--	--	1.7	--	--	2
<i>Arabis lignifera</i>	2	--	--	2	--	--	--	--	--	--	--	--
<i>Descurania pinnata</i>	--	--	--	--	--	--	--	2	--	--	1	--
<i>Descurania richardsonii</i>	--	--	10	--	--	5	--	--	40	--	--	15
<i>Descurania sophia</i>	--	--	--	--	--	--	--	2	--	--	1	--
<i>Phacelia hastata</i>	--	3	5	--	36	5	35	42	333	14	766	122
<i>Astragalus convallarius</i>	2	5	1.7	4	85	2	2	2	1.7	1	1	3
<i>Lupinus laxiflorus</i>	--	--	23.3	--	--	187	--	--	--	--	--	--
<i>Lupinus leucophylla</i>	7	2	--	138	57	--	--	--	--	--	--	--
<i>Mentzelia albicaulis</i>	2	8	18.3	5	2	12	28	12	38.3	4	7	66

Table 4.1

Continued

Species	Transect Cluster No. 1						Transect Cluster No. 2					
	Average Frequency of Occurrence (Percent)			Forage Production (grams)			Average Frequency of Occurrence (Percent)			Forage Production (grams)		
	7/18 1967	7/16 1971	6/26 1980	7/18 1967	7/16 1971	6/26 1980	7/19 1967	7/10 1971	6/19 1980	7/19 1967	7/10 1971	6/19 1980
<i>Gayophytum ramosissimum</i>	2	2	3.3	T	1	T	5	20	41.7	1	12	7
<i>Orobanche californica</i>	--	2	--	--	5	--	--	--	--	--	--	--
<i>Collomia</i> spp	--	--	1.7	--	--	2	--	--	--	--	--	--
<i>Phlox longifolia</i>	--	--	--	--	--	--	42	52	65	2	46	24
<i>Galium boreale</i>	1	1	3.3	2	2	5	13	--	--	--	--	--
<i>Collinsia parviflora</i>	63	43	55	7	41	35	7	2	61.7	T	1	64
<i>Viola</i> spp	3	--	--	T	--	--	--	--	--	--	--	--
<i>Artemesia tridentata</i>	42	20	28.3	484	4530	699	5	5	23.3	52	671	674
<i>Purshia tridentata</i>	23	10	16.7	76	1099	99	10	3	6.7	27	90	13
<i>Symphoricarpos oreophilus</i>	18	15	20	31	1485	82	2	2	1.7	2	5	20
<i>Chrysothamnus viscidiflorus</i>	2	--	1.7	15	--	100	12	5	6.7	52	180	39
Percent Ground Cover												
Rock	7	9	10.5				4	2	7.4			
Bare soil	14	29	6.0				51	54	33.3			
Vegetation and litter	79	26	83.5				42	36	59.3			
Shrubs	26	23	40.0				8	8	13.1			
Forbs and grasses	30	25	42.5				23	16	40.0			

Table 4.2 Average frequency of occurrence and forage production (grams) determined from 20 0.96 square foot circular plots on each of 3 100 foot transects in permanent transect Cluster No. 3, Crescent Butte, and permanent transect Cluster No. 4, Coyote Butte for 1967, 1971, and 1980, Craters of the Moon National Monument.

Species	Transect Cluster No. 3				Transect Cluster No. 4			
	Average Frequency of Occurrence (Percent)		Forage Production (grams)		Average Frequency of Occurrence (Percent)		Forage Production (grams)	
	7/25	7/3	7/25	7/3	7/27	7/1	7/27	7/1
	1967	1980	1967	1980	1967	1980	1967	1980
Agropyron spicatum inerme	--	--	--	--	3.3	--	2	--
Poa sandbergii (secunda)	10	15	T	9	38.3	67.7	3	41
Stipa columbiana <i>occidentalis</i>	--	1.7	--	3	53.3	26.7	22	36
Stipa comata	11.7	8.3	9	3	--	--	--	--
Oryzopsis hymenoides	3.3	3.3	4	1	--	1.7	--	8
Elymus cinereus	23.3	23.3	194	99	51.7	25.3	283	298
Sitanion hystrix <i>-Bottlebrush</i>	5.0	1.7	3	1	5.0	5.0	8	4
Bromus tectorum	58.3	1.7	4	T	73.3	--	10	--
Hackelia patens	13.3	--	T	--	1.7	--	T	--
Lappula redowski	--	5	--	2	--	3.3	--	T
Mertensia oblongifolia	3.3	13.3	7	24	3.3	--	T	--
Aster conspicuus	--	--	--	--	5.0	--	2	--
Machaeranthera canescens	--	--	--	--	--	1.7	--	3
Chaenactis douglasii	--	1.7	--	1	36.7	26.7	3	74
Crepis acuminata	20	23.3	27	11	58.3	47.7	322	239
Microseris nutans	1.7	21.7	T	19	--	--	--	--
Arabis sparsiflora	--	3.3	--	9	--	--	--	--
Phacelia hastata	16.7	30	5	180	76.7	45.7	22	84
Lupinus leucophyllus	--	--	--	--	--	3.3	--	2
Mentzelia albicaulis	46.7	41.7	3	19	5	47.7	2	14
Gayophytum ramosissimum	26.7	6.7	1	2	23.3	30.7	1	2
Eriogonum heracleoides	--	--	--	--	1.7	3.3	T	3
Eriogonum microthecum	13.3	8.3	20	5	--	--	--	--
Eriogonum umbellatum	--	--	--	--	8.3	20	129	50
Eriogonum vimineum	--	--	--	--	5.0	1.7	T	T
Delphinium andersonii	--	5	--	11	--	3.3	--	2
Collinsia parviflora	43.3	63.3	2	14	6.7	5	T	1
Mimulus nanus	--	--	--	--	--	6.7	--	T
Penstemon cyaneus <i>-desert parsley</i>	--	--	--	--	--	1.7	--	T
Cymopterus terebinthinus	--	--	--	--	--	5.0	--	13
Lomatium dissectum	50	50	17	66	3.3	5.0	3	3
Ribes cereum	--	--	--	--	--	1.7	--	2
Artemisia tridentata	50	65	484	399	3.3	5.0	62	11
Purshia tridentata	16.7	6.7	39	29	21.7	49.0	142	288
Chrysothamnus nauseosus	--	--	--	--	--	14.0	--	56
Pinus flexilis	--	--	--	--	1.7	3.3	T	210
Percent Ground Cover								
Rock	0	0			0	0.4		
Bare Soil	38.3	3.5			47.8	17.3		
Vegetation and litter	61.3	96.5			50.2	82.3		
Trees	0	0			T	T		
Shrubs	20.0	40.5			8.7	36.3		
Forbs and grass	16.8	48.0			29.3	41.7		

reading compared to flowering times for the species. Arrowleaf balsamroot (Balsamorhiza sagittata) remained relatively constant in frequency. This is a desirable indicator forb and its stability further reflects the acceptable condition of the forb community.

Shrubs on transect clusters 1 and 2 (Table 4.1) appeared relatively stable across the three samplings. Martin Mine transects showed a decrease in big sagebrush (Artemisia tridentata) and bitterbrush (Purshia tridentata) from 1967 to 1971, but in 1980 the frequency of both species increased to an approximate average of the first two years. Bitterbrush showed a similar trend on transects in YCC Canyon while sagebrush was considerably more frequent in 1980 than 1967 or 1971 (Table 4.1). These transects had a larger percentage of ground cover accounted for by vegetation and litter and a lower proportion of bare soil from in 1980 compared to 1967-1971. Sagebrush may have increased on this site.

Ground cover measurements for the northern transects (Table 4.1) suggested stability since 1967 with vegetation and litter increasing, if anything. Soils were evidently stable and the maturing vegetation would have been expected to produce an increase in percentage of the ground covered.

The southern transects, Crescent Butte (No. 3) and Coyote Butte (No. 4) were sampled only in 1967 and 1980 (Table 4.2), so interpretations are more tenuous. A trend suggested by two years may be nonexistent over 3 years as seen on transects 1 and 2 (Table 4.1). On both southern transects the percentage of ground cover classed as bare soil decreased and vegetation and litter increased from 1967 to 1980. This indicates a stabilizing influence on soil as would be expected over 13 years on undisturbed sites.

On both southern transects (Table 4.2) there was a decrease in the frequency of cheatgrass as was observed on transects in the north end. Great Basin wildrye (Elymus cinereus) was less frequent on Coyote Butte in 1980 as was subalpine needlegrass (Stipa occidentalis). Sandberg's bluegrass (Poa sandbergii) was more frequent on Coyote Butte in 1980.

Forbs on southern transects demonstrated no remarkable trends between 1967 and 1980. Both transects 3 and 4 has 3-4 more forb species in 1980, but this may have been due to the exceptional flowering conditions in 1980.

In summary, all four transects revealed stability in the frequency of grasses, shrubs, and forbs from 1967 through 1980. The notable exception was the consistent decline in frequency of cheatgrass at all four sites. All sites also demonstrated increases in the vegetation and litter proportion of ground cover which reflected the increasing age of communities samples.

B. 1980-1982

In 1980 the sampling method for the permanent vegetation transects was changed from circular plots to the line intercept method (see Section 3.0), but the same transect locations were retained. The method was changed so that parameters are measured rather than estimated to help eliminate future variability in the data when observers change from year to year. Due to different collection procedures, the 1980-1982 data are not directly comparable to data and analyzed in the preceding section of this report. Transects were sampled by the same individual in 1980 and 1981 but by a different person in 1982. In subsequent samples the

observer will most likely change each year and equivalent observer-to-observer variability would be expected.

The 1980-1982 data collection (Tables 4.3-4.6) completed the first data set for the routine monitoring of the permanent vegetation transects. Subsequent data are to be collected in three-year sets, and it is intended that comparisons be made between three-year sets, not within the sets. This procedure will allow the calculation of averages for each three-year set, and statistical comparisons between three-year data sets can then be made.

Within data set variation observed will most likely be due to different observers, year-to-year variance in temperature and precipitation, and some actual change in plant communities.

In the 1980-1982 samplings the number of forb species remained relatively constant although the species mix varied somewhat (Tables 4.3-4.5). This is to be expected due to differences in phenology which are influenced by weather.

Cheatgrass (Bromus tectorum) remained relatively constant during 1980-1982 (Tables 4.3-4.5) after a decline from 1967-1980 (Tables 4.1 and 4.2). This is a promising trend for a grass that out-competes native bunchgrass in drier areas. Precipitation at the monument may be sufficient to allow native bunchgrasses to compete successfully against cheatgrass. Beardless bluebunch wheatgrass (Agropyron spicatum inerme) showed a stable trend (most of the unknown grasses in 1982 were probably this species) throughout the three years which would be expected in a lightly grazed community.

Shrubs demonstrated no strong trend during 1980-1982 (Tables 4.3-4.5) in relative density, percent frequency, or percent cover. There is a possibility that gray rabbitbrush (Chrysothamnus nauseosus) was misidentified as green rabbitbrush (Chrysothamnus viscidiflorus)--that which was called green rabbitbrush may be a green variety of gray rabbitbrush. Samples should be collected in flower and sent to the herbarium at Idaho State University for positive identification.

During 1980 and 1981 the proportion of bitterbrush in seedling and young age classes remained relatively constant but in 1982 the proportion in these two age classes declined drastically (Table 4.6). This decline may have been due to a different observer in 1982, the drought during the summer of 1981 causing mortality of young plants, the high deer population in 1981 removing the young plants from the population, or a combination of these factors. Data collected on the next sampling run will allow a more adequate evaluation of the trend in age distribution of bitterbrush.

Table 4.3 Mean relative density (individuals per transect) of plant species on permanent vegetation transect clusters, Craters of the Moon National Monument, Idaho, 1980-1982. Data are the mean of six 15 m transects within each cluster.^a

Species	Mean Relative Density (individuals per transect)											
	Transect Cluster No.1			Transect Cluster No.2			Transect Cluster No.3			Transect Cluster No.4		
	Martin Mine			YCC Canyon			Crescent Butte			Coyote Butte		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
GRASSES:												
Agropyron spicatum	2.00	5.3	5.83	8.50	6.2	10.17				0.17	0.2	0.33
Bromus tectorum	5.17	5.2	5.17	0.17	.2	0.50		0.2	0.17			
Elymus cinereus		0.7	0.83			0.17	0.83	3.3	2.0	1.67	4.7	5.0
Melica bulbosa	0.17	0.3				0.67						
Oryzopsis hymenoides								0.3	0.33	0.17	0.2	0.17
Poa sandbergii		0.8	0.33		.3	0.33	2.17	1.5	0.50	7.67	13.0	6.17
Sitanion hystrix							0.50	0.7	1.33		0.5	
Stipa occidentalis									0.33	1.50	3.0	
Stipa comata			0.17				0.33	0.8	0.33			
Unknown			1.83			1.17			0.33			1.67
Total Grasses	7.34	12.30	14.16	8.67	6.7	13.01	3.83	6.80	5.32	11.18	21.60	13.34
FORBS:												
Agoseris glauca												
Arabis sparsiflora				0.17						0.17		
Astragalus convallarius		0.3	0.33	0.17	0.2							
Balsamorhiza sagittata	2.00	3.5	4.17	2.17	2.7	3.67						
Chenopodium album		0.2	0.17	0.17		0.50						
Chaenactis douglasii				0.33		0.17				1.33	3.8	1.33
Cirsium vulgare				0.17	0.2	0.17						
Collinsia parviflora	6.67	0.3	2.17	25.83	0.7	5.17	10.50	9.3		0.50	0.8	0.33
Colomia sp.	0.17	0.2		1.00								
Crepis accuminata		0.3	0.50			0.17	1.50	2.0	1.50	0.17	3.2	4.17
Cymopterus terrebinthinus									2.83		2.0	0.83
Delphinium andersonii							0.17				0.8	0.33
Descurania richardsonii	0.33		0.17	5.83		0.33						
Eriogonum heracleoides										0.17		
Eriogonum microthecum								1.8	0.50			0.50
Eriogonum umbellatum										1.00	2.7	0.50
Eriogonum vimum											0.2	0.17
Gallium boreale		0.2	0.50						0.67			
Gayophytum ramosissimum	0.67			14.83	0.3	5.00	1.83	0.4	0.83	3.33	2.8	1.50
Hackelia patens		0.2	1.0			0.33			0.17			
Lappula redowski	12.00			5.50			0.50			0.50	0.5	
Lathyrus sp.												
Lithospermum ruderae		0.3	0.50			0.17						0.17
Lomatium dissectum							0.33	3.3	0.83		0.2	0.33

Table 4.3 Continued

Species	Mean relative density											
	Martin Mine			YCC Canyon			Crescent Butte			Coyote Butte		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Lomatium triternatum						0.17						
Lomatium sp.				0.33								
Lupinus laxiflorus	0.17	1.8	2.17	0.17	0.2	0.50						0.17
Lupinus leucophyllus										0.17	0.5	
Machaeranthera canescens										0.17		
Mentzelia albicaulis	4.67	0.7		7.83	1.2	0.33	6.00	1.5	0.67	4.17	1.2	0.83
Microseris nutans							2.17	0.2	0.50		0.2	
Mimulus nanus										0.50	0.5	
"Moss"											0.2	0.33
Penstemon cyaneus		0.2						1.5	1.00	0.17	0.5	0.17
Phacelia hastata	0.17			1.00		0.17	1.00	3.3	0.33	1.67	4.5	1.50
Phacelia heterophylla												
Phacelia leucophyllus		0.7										
Phlox longifolia				13.17	6.0	6.50						
Tragopogon dubius			0.33	0.50	0.2	0.33						
Viola nutans		0.3										
Unknown	0.33	1.5	0.33	0.67	0.2	1.00	2.50				0.2	0.17
Total Forbs	27.18	10.70	12.34	79.84	11.90	24.68	26.50	23.30	9.83	14.02	24.80	13.33
SHRUBS:												
Artemisia arbuscula						0.17						
Artemisia tridentata	6.00	6.8	5.0	4.17	4.7	3.67	8.33	8.0	6.83	1.50	0.8	0.67
Chrysothamnus nauseosus	0.17	0.2	0.17	1.67	0.8	0.50				2.50	2.8	0.33
Chrysothamnus viscidiflorus	0.33	0.3	0.17	1.33	0.8	1.00						
Purshia tridentata	3.83	4.7	4.17	1.83	1.3	1.50	2.00	0.8	1.00	4.33	4.5	3.33
Symphoricarpos oreophilus	2.17	1.8	1.50	0.50	0.5	0.33						
Total shrubs	12.50	13.80	11.01	9.50	8.10	7.17	10.33	8.80	7.83	8.33	8.10	4.33
TREES:												
Pinus flexilis										0.17	0.2	0.17
Date transect sampled	7/3	7/9	7/8	6/30	7/2	7/8	7/3	7/5	7/6	7/1	7/5	7/7

a The observer was the same in 1980 and 1981, but changed in 1982.

Table 4.4. Percent frequency of plant species on permanent vegetation transect clusters, Craters of the Moon National Monument, Idaho, 1980-1982.^a

Species	Percent frequency											
	Cluster No. 1 Martin Mine			Cluster No. 2 YCC Canyon			Cluster No. 3 Crescent Butte			Cluster No. 4 Coyote Butte		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
<u>Grasses</u>												
Agropyron spicatum	83.3	100.0	100.0	100.0	100.0	100.0				16.7	16.7	16.7
Bromus tectorum	66.7	66.7	8.3	16.7	16.7	33.3	16.7	16.7				
Elymus cinereus		16.7	33.3			16.7	33.3	100.0	83.3	50.0	83.3	83.3
Melica bulbosa	16.7											
Oryzopsis hymemoides						33.3		33.3	33.3	16.7	16.7	16.7
Poa sandbergii		66.7	16.7		16.7	33.3	83.3	66.7	50.0	100.0	100.0	100.0
Sitanion hystrix							16.7	33.3	83.3		33.3	
Stipa occidentalis									16.7	66.7	100.0	
Stipa comata			16.7				33.3	50.0	50.0			
Unknown		16.7	66.7			50.0			33.3			33.3
Total grasses	7.34	12.30	14.16	8.67	6.7	13.01	3.83	6.80	5.32	11.18	21.60	13.34
<u>Forbs</u>												
Agoseris glauca										16.7		
Arabis sparsiflora				16.7								
Astragalus convallarius		16.7	33.3	16.7	16.7			16.7				
Balsamorhiza sagittata	83.3	83.3	100.0	100.0	100.0	100.0		100.0				
Chenopodium album		16.7	16.7	16.7		33.3						
Chaenactis douglasii				33.3		16.7				66.7	83.3	50.0
Cirsium vulgare				16.7	16.7	16.7		16.7				
Collinsia parviflora	100.0	33.3	66.7	100.0	33.3	83.3	100.0	66.7	16.7	33.3	33.3	16.7
Colomia sp.	16.7	16.7		16.7								
Crepis accuminata		16.7	33.3			16.7	66.7	83.3	83.3	16.7	100.0	83.3
Cymopterus terrebinthinus									100.0		16.7	16.7
Delphinium andersonii							16.7				33.3	16.7
Descurania richardsonii	33.3		16.7	100.0		33.3						
Eriogonum heracleoides										16.7		
Eriogonum microthecum								83.3	50.0			50.0
Eriogonum umbellatum										66.7	66.7	50.0
Eriogonum vimum											16.7	16.7
Gallium boreale		16.7	50.0						66.7			
Gayophytum ramosissimum	16.7			100.0	33.3	100.0	50.0	33.3	66.7	83.3	83.3	100.0
Hackelia patens		16.7	50.0			16.7			16.7			
Lappula redowski	100.0			100.0			33.3			33.3	33.3	
Lathyrus sp.												
Lithospermum ruderales		33.3	33.3			16.7						16.7

Table 4.4. Continued

Species	Percent frequency											
	Cluster No. 1 Martin Mine			Cluster No. 2 YCC Canyon			Cluster No. 3 Crescent Butte			Cluster No. 4 Coyote Butte		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Forbs (continued)												
Lomatium dissectum							33.3	100.0	66.7		16.7	33.3
Lomatium triternatum						16.7						
Lomatium sp.				33.3								
Lupinus laxiflorus	16.7	66.7	83.3	16.7	16.7	50.0		16.7				16.7
Lupinus leucophyllus										16.7	50.0	
Machaeranthera canescens										16.7		
Mentzelia albicaulis	50.0	66.7		100.0	50.0	16.7	100.0	50.0	66.7	100.0	66.7	33.3
Microseris nutans							50.0	16.7	33.3		16.7	
Mimulus nanus										33.3	33.3	
"Moss"											16.7	16.7
Penstemon cyaneus		16.7						100.0	100.0	16.7	33.3	16.7
Phacelia hastata	16.7			50.0		16.7	33.3	66.7	33.3	83.3	100.0	66.7
Phacelia heterophylla		16.7										
Phacelia leucophyllus												
Phlox longifolia				100.0	100.0	83.3		100.0				
Tragopogon dubius			33.3	33.3	16.7	33.3		16.7				
Vioia nutans		33.3										
Unknown	33.3	66.7	16.7	16.7	16.7	33.3	16.7	16.7			16.7	16.7
Shrubs												
Artemisia arbuscula						16.7						
Artemisia tridentata	100.0	100.0	100.0	83.3	83.3	83.3	100.0	100.0	100.0	50.0	50.0	50.0
Chrysothamnus nauseosus	16.7	16.7	16.7	16.7	33.3	33.3				67.7	50.0	16.7
Chrysothamnus viscidiflorus	33.3	33.3	16.7	100.0	50.0	50.0						
Purshia tridentata	100.0	100.0	100.0	83.3	66.7	33.3	50.0	50.0	50.0	83.3	100.0	66.7
Symphoricarpos oreophilus	83.3	66.7	33.3	33.3	33.3	50.0						
Trees												
Pinus flexilis										16.7	16.7	16.7
Date transect sampled	7/3	7/9	7/8	6/30	7/2	7/8	7/3	7/5	7/6	7/1	7/5	7/7

^aThe observer was the same in 1980 and 1981, but changed in 1982.

Table 4.5 Mean percent cover of plant species on permanent vegetation transect clusters, Craters of the Moon National Monument, Idaho, 1980-1982. Data are the mean of six 15 m transects within each cluster.^a

[illegible]

Table 4.5. Continued

Species	Mean Percent Cover											
	Transect No.1 Martin Mine			Transect No.2 YCC Canyon			Transect No.3 Crescent Butte			Transect No.4 Coyote Butte		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
FORBS (cont.)												
Lomatium dissectum							T	T	T		T	0.01
Lomatium triternatum						T						
Lomatium sp.				T								
Lupinus laxiflorus	0.06	0.02	0.57	T	T	0.16						0.01
Lupinus leucophyllus						0.06				0.08	T	
Machaeranthera canescens										0.05		
Mentzelia albicaulus	T	T		T	T		T	T	T	T	T	T
Microseris nutans							T	T	T		T	
Mimulus nanus										T	T	
"Moss"											0.1	0.11
Penstemon cyaneus		T						0.2	0.03	0.07		T
Phacelia hastata	0.05			0.09			T	0.5	T	0.16		0.08
Phacelia heterophylla		T										
Phacelia leucophyllus												
Phlox longifolia				0.02	T	0.01						
Tragopogon dubius			T	T	T	0.01						
Viola nutans		T										
Unknown	T	T	0.12	T	T	T	T				T	T
Total Forbs	1.77	2.5	4.62	3.09	2.4	4.27	T	2.7	0.15	1.13	0.1	1.04
SHRUBS:												
Artemisia orbuscula						T						
Artemisia tridentata	24.37	31.7	12.31	12.04	13.7	12.76	49.72	45.0	15.39	2.19	1.5	12.31
Chrysothamnus nauseosus	0.95	0.8	0.38	0.87	1.0	0.93				4.01	2.8	.38
Chrysothamnus viscidiflorus	1.18	1.2	0.15	1.69	1.3	1.47						.15
Purshia tridentata	17.29	16.2	8.49	5.28	6.8	2.68	4.19	2.8	4.49	20.16	21.8	8.49
Symphoricarpos oreophilus	8.15	5.2	1.59	0.88	1.7	0.39						
Total Shrubs	51.94	55.1	22.92	20.76	24.5	18.23	53.91	47.8	19.88	26.36	26.1	21.33
TREES:												
Pinus flexilis										1.03	1.17	
Total percent ground cover of living vegetation	54.41	61.7	33.82	26.18	29.60	32.99	54.60	51.30	22.10	32.29	32.07	28.75
Date transect sampled	7/3	7/9	7/8	6/30	7/2	7/8	7/3	7/5	7/6	7/1	7/5	7/7

a The observer was the same in 1980 and 1981, but changed in 1982.

Table 4.6. Age distribution of bitterbrush and sagebrush on permanent vegetation transects, Craters of the Moon National Monument, Idaho, 1980-1982.

Transects	Year	Seedling	Young	Mature	Decadent	Total number
<u>Percent total--bitterbrush</u>						
North end	1980	0	7.3	43.9	48.8	41
	1981	5.4	2.7	73.0	16.2	37
	1982	0	0	87.1	12.9	31
Wilderness	1980	20.6	5.9	73.5	0	34
	1981	12.5	12.5	71.9	3.1	32
	1982	0	6.3	81.3	12.5	16
Combined	1980	10.8	7.7	66.2	15.4	75
	1981	7.5	7.5	74.6	10.4	69
	1982	0	2.1	85.1	12.8	47
<u>Percent total--sagebrush</u>						
North end	1980	11.5	11.5	52.5	24.6	61
	1981	4.3	7.2	79.7	8.7	69
	1982	0	5.7	83.0	11.3	53
Wilderness	1980	0	1.9	83.0	15.1	53
	1981	0	0	69.8	30.2	53
	1982	0	12.0	72.0	16.0	50
Combined	1980	6.1	7.0	66.7	20.2	114
	1981	2.5	4.1	75.4	18.0	122
	1982	0	9.5	81.0	9.5	103