

2010 LONG-TERM VEGETATION TREND MONITORING CRATERS OF THE MOON NATIONAL MONUMENT

TRANSECTS:

- #3 (Douglas Fir/ Grassy Cone)**
- #4 (Cinder Garden/ Devil's Orchard)**
- #5 (Limber Pine/ Inferno Cone)**
- #8 (Three-tip Sagebrush / Carey Kipuka)**
- LP – Control (Little Prairie Control)**
- LP - C2 (Little Prairie Complete Burn)**

Steven Bekedam and Sydney Kelly
National Park Service

October 2010



Craters of the Moon National Monument
PO Box 29
Arco, ID 83213

TABLE OF CONTENTS

Table of Contents	1
List of Tables	2
List of Figures	4
Summary	6
Introduction	6
Methods	7
Results	9
Transect Results	18
Results/ Discussion Transect #3: Douglas Fir/ Grassy Cone	18/47
Results/ Discussion Transect #4 Cinder Garden/ Devils Orchard	23/48
Results/ Discussion Transect #5 Limber Pine/ Inferno Cone	27/49
Results/ Discussion Transect #8 Three-Tip Sagebrush/ Carey Kipuka	32/50
Results/ Discussion Transect #LP-Control: Little Prairie Control	27/51
Results/ Discussion Transect #LP-C2: Little Prairie Complete Burn	41/52
Results/ Discussion Transect Height	45/52
Discussion	46
Recommendations	53
Literature Cited	54
Appendix 1	55

LIST OF TABLES

1	2004 Species List for Long-term Vegetation Trends Monitoring Transects #3 (Douglas Fir/ Grassy Cone), #4 (Cinder Garden/ Devil's Orchard), #5 (Limber Pine/ Inferno Cone), #8 (Three-tip Sagebrush / Fescue, Carey Kipuka), LP-Control (Little Prairie Control), and LP-C2 (Little Prairie Complete Burn), at Craters of the Moon National Monument, Idaho.	10
2	2010 Species List, CRMO status, and family categorization for Long-term Vegetation Trends Monitoring Transects #3 (Douglas Fir/ Grassy Cone), #4 (Cinder Garden/ Devil's Orchard), #5 (Limber Pine/ Inferno Cone), #8 (Three-tip Sagebrush, Fescue/ Carey Kipuka), LP – Control (Little Prairie Control) and LP - C2 (Little Prairie Complete Burn) at Craters of the Moon National Monument, Idaho.	13
3	Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #3 (Douglas Fir/ Grassy Cone) – Craters of the Moon National Monument, Idaho, 2010.	18
4	Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #3 (Douglas Fir/ Grassy Cone) between 2004 and 2010 – Craters of the Moon National Monument, Idaho.	18
5	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #3 (Douglas Fir/ Grassy Cone) from 1993-2010 – Craters of the Moon National Monument, Idaho.	20
6	Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Tree Species Found in the 5m x 100m (Douglas Fir) Transect at Transect #3 (Douglas Fir, Grassy Cone) in the Long-term Vegetation Monitoring Program at Craters of the Moon National Monument, Idaho, 2010.	22
7	Comparative Results of Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Trees Found in the 5m x 100m (Douglas Fir) Transect at Transect #3 (Douglas Fir, Grassy Cone) from 1993 – 2004 at Craters of the Moon national Monument, Idaho.	22
8	Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #4 (Cinder Garden/ Devils Orchard) – Craters of the Moon National Monument, Idaho, 2010.	23
9	Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #4 (Cinder Garden/ Devil's Orchard) between 2004 and 2010 – Craters of the Moon National Monument, Idaho.	23
10	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #4 (Cinder Garden/ Devils Orchard) from 1995-2010 – Craters of the Moon National Monument, Idaho.	24
11	Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Tree Species Found in the 10m x 100m (Limber Pine) Transect at Transect #4 (Cinder Garden/ Devil's Orchard) in the Long-term Vegetation Monitoring Program at Craters of the Moon National Monument, Idaho, 2010.	26
12	Comparative Results of Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Trees Found in the 10m x 100m (Limber Pine) Transect at Transect #4 (Cinder Garden/ Devil's Orchard) from 1995 – 2010 at Craters of the Moon national Monument, Idaho.	26
13	Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) – Craters of the Moon National Monument, Idaho, 2010.	27
14	Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) between 2004 and 2010 – Craters of the Moon National Monument, Idaho.	28
15	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) from 1992 - 2010 – Craters of the Moon National Monument, Idaho.	29

16	Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Tree Species Found in the 10m x 100m (Limber Pine) Transect at Transect #5 (Limber Pine/ Inferno Cone) in the Long-term Vegetation Monitoring Program at Craters of the Moon National Monument, Idaho, 2010.	31
17	Comparative Results of Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Trees Found in the 10m x 100m (Limber Pine) Transect at Transect #5 (Limber Pine/ Inferno Cone) from 2002 – 2010 at Craters of the Moon national Monument, Idaho.	31
18	Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #8 (Three-tip Sagebrush / Carey Kipuka) – Craters of the Moon National Monument, Arco, Idaho, 2010.	32
19	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #8 (Three-tip Sagebrush/ Carey Kipuka) – Craters of the Moon National Monument, Idaho.	33
20	Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #8 (Three-Tip Sagebrush/ Carey Kipuka) between 2004 and 2010 – Craters of the Moon National Monument, Idaho.	34
21	Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-Control (Little Prairie Control) – Craters of the Moon National Monument, Idaho, 2010.	37
22	Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-Control (Little Prairie Control) between 1996 and 2010 – Craters of the Moon National Monument, Idaho.	38
23	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect LP-Control (Little Prairie Control) 1993-2010 – Craters of the Moon National Monument, Arco, Idaho.	39
24	Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) – Craters of the Moon National Monument, Idaho, 2010.	41
25	Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) between 2004 and 2010 – Craters of the Moon National Monument, Idaho.	42
26	Comparative Sum Frequencies for All Species Found in Surveys Conducted in the Long-term Vegetation Trends Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) 1994-2010 – Craters of the Moon National Monument, Idaho.	43

LIST OF FIGURES

1	Photo of Proper Placement of Frequency Frame Used in The Crater's of the Moon National Monument Long-term Vegetation Trends Monitoring Program.	8
2	Map Locations of the Craters of the Moon National Monument Long-term Vegetation Monitoring Transects – Craters of the Moon National Monument, Idaho.	17
3	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #3 (Douglas Fir/ Grassy Cone) for the five years (1993, 1997, 2000, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.	21
4	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #4 (Cinder Garden/ Devils Orchard) for the four years (1995, 2000, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.	25
5	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) for the five years (1992, 1996, 1998, 2002, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.	30
6	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #8 (Three-tip Sagebrush/ Carey Kipuka) for the four years (1994, 1998, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.	36
7	Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect LP-Control (Little Prairie Control) for the four years (1993, 1995, 1996, 2010) that the transect has been read – Craters of the Moon National Monument, Idaho.	40
8	Comparative Sum Frequencies for All Species Found in Surveys Conducted in the Long-term Vegetation Trends Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) for the five years (1994, 1995, 1996, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.	44
9	Average transect heights for the five transects in which height was measured in 2010 – Craters of the Moon National Monument, Idaho.	45
10	Transect greatest and smallest measured height for the five transects in which plot height was measured in 2010– Craters of the Moon National Monument, Idaho.	46
11	Photo from Starting Pole of Transect #3 (Douglas Fir/ Grassy Cone) Photo taken 7/08/2010	47
12	Photo from Starting Pole of Transect #4 (Cinder Garden/ Devil's Orchard) Photo taken 6/17/2010	48
13	Photo from Starting Pole of Transect #5 (Limber Pine/ Inferno Cone) Photo taken 6/21/2010	49
14	Photo from starting point of Transect #8 (Three-tip Sagebrush/ Carey Kipuka) Photo taken 6/23/2010	50
15	Photo from starting point of Transect LP-C2 (Little Prairie Complete Burn) Photo taken 6/24/2010	51

16	Photo from starting point of Transect LP-Control (Little Prairie Control) Photo taken 6/24/2010	52
----	--	----

2010 LONG-TERM VEGETATION TREND MONITORING CRATERS OF THE MOON NATIONAL MONUMENT AND PRESERVE

**Steven Bekedam and Sydney Kelly
National Park Service**

Summary

Six long-term vegetation monitoring plots were read in the summer of 2010. The transects read were #3 (Douglas Fir/ Grassy Cone), #4 (Cinder Garden/ Devil's Orchard), #5 (Limber Pine/Inferno Cone), #8 (Three-Tip Sagebrush/ Carey Kipuka), LP–Control (Little Prairie Control), and LP–C2 (Little Prairie Complete Burn). Significant changes in species composition were seen in all but one survey, though dominant species along each transect remained unchanged.

Introduction

While Craters of the Moon National Monument and Preserve may at first glance seem to be almost devoid of vegetation closer observation reveals the presence of surprisingly diverse plant communities. Maintenance of these plant communities and preservation of Monument ecosystems as a whole is part of CRMO's resource management objectives as laid out in the *Craters of the Moon National Monument and Preserve Management Plan*. Sagebrush steppe (and other ecosystem) preservation, fire management, invasive species management, and restoration projects are all impacted in some way by information derived from vegetation monitoring. Sixty percent of the Monument is covered by sagebrush steppe. Fire, agriculture, and grazing have decreased the extent and modified the composition of this vegetation type, though exact impacts on different areas are not always known because of remote access issues. Vegetation structure and composition influence the ability of a plant community to resist infestation of exotic invasives and influence susceptibility to and recovery from fire. Ten species of weeds designated as exotic by Idaho State Law have been identified within the Monument, as well as the state-listed noxious weed cheatgrass. While Craters of the Moon National Monument and Preserve does not support any known threatened or endangered plant species, two BLM sensitive species are known to occur within the monument (USDOI and NPS 2007) and are watched for when possible.

Large tracts of sagebrush steppe – 300,000 acres between 1970 and 2005 – have been lost to fire, including 1,900 acres in Little Prairie. This is an issue of note for the Monument as sagebrush is critical habitat for the Greater sage-grouse, mule deer, and pronghorn. CRMO's Management Plan calls for post-fire stabilization efforts in order to prevent soil erosion and fight the presence of invasive species, especially the exotic annual cheatgrass, that have a history of appearing after fire and which outcompete natives and perpetuate the frequent fire regime. Federal Wildland Fire Policy presents guidelines to restore and maintain ecosystem health within fire prone areas and it is the goal of CRMO to bring its plant communities towards Fire Conditions Class 1 (USDOI and NPS 2007). Fire, weeds, and grazing are all issues that are routinely faced in the

management of CRMO's vegetation resources and it is our vegetation monitoring program that allows managers to determine whether desired conditions are being achieved and to plan restoration and protection projects when they are not.

The Long-term Vegetation Trend Monitoring Program was established in 1991 by Gerry Wright and Steve Bunting of the University of Idaho, Moscow. This was developed as the vegetative component of the Craters of the Moon National Monument's (CMNM) Inventory and Monitoring (I & M) program. The frequency data obtained in this program over the years should provide managers with information regarding species composition and density and indicate any changes/trends that may be occurring in the selected vegetation types. A more complete history of previous vegetation studies completed at CMNM can be found in the report prepared by Sparhawk (1992). As transect monitoring has fallen off the schedule set in 1992 starting in 1999 (see Appendix 1), this year was meant as a catch-up and so included more transects than normally surveyed.

Methods

Eight permanent vegetation-monitoring sites exist at CMNM. Each 100-meter transect is marked at each end by an orange and yellow metal fence post. Two of the eight sites are monitored each year on a rotating basis, resulting in each site being monitored every four years (Appendix 1). A complete description of the methods is reported by Sparhawk (1992). An additional five transects were added in Little Prairie after a fire in 1992 including one control site, two sites that were partially burned, and two sites that were completely burned. These were read intensively for 3-4 consecutive years as they were meant to obtain post fire vegetation recovery data.

In 1992, the Long-term Vegetation Trends Monitoring study began with the reading of the first scheduled transects, #1 (aspen/ research camp) and #5 (Limber Pine/ Inferno Cone). The 1998 survey was the third reading for these two sites. Transects #1 and #5 were read prior to the scheduled rotation because funds were available and the additional data would be beneficial. This survey was the second rotation for transects #2 (Sagebrush/ North Slope) and #8 (Three-tip Sagebrush/ Carey Kipuka), four years after their initial reading. The location of the four transects are shown in Figure 2. Chad Horman, Restoration Ecologist from Environmental Science and Research Foundation Inc., James Glennon, Affiliate Herbarium Curator from Idaho State University and Associate Plant Scientist for Environmental Science and Research Foundation, Inc. and Michael Munts, Resource Management Specialist from Craters of the Moon National Monument, performed the 1998 survey. M. Winter, and K. Holte, Environmental Science and Research Foundation Inc., and B. Colket, Craters of the Moon National Monument, surveyed transects #3 (Douglas Fir/ Grassy Cone) and #4 (Cinder Garden/ Devils Orchard) (Majors 2000). In 2004 Mike Bell, SCA intern, and Paige Wolken, CRMO vegetation ecologist, surveyed transects #3, #4, #8, and LP-C2 (Little Prairie Complete Burn) (Bell and Wolken 2004). The 2010 survey included transects #3, #4, #5, #8, LP-Control, and LP-C2 and was the fourth for transects #3 and LP-C2, the third for #4 and #8, and the fifth for LP-C2 and #5.

GRASSES, FORBS and WOODY SPECIES:

A 100-m tape measure was stretched between the posts at each end of the transect line and a 50 cm X 50 cm (0.25 m²) nested frequency frame was placed to the right of each meter mark on the tape, resulting in 100 readings (Sparhawk 1992). The tape was stretched from the most South-Eastern pole toward the most North-Western pole. The frequency frame was placed on the right side of the meter mark, with the smallest frame on the inside (Figure 1).

Figure 1.

Photo of Proper Placement of Frequency Frame Used in The Crater's of the Moon National Monument Long-term Vegetation Trends Monitoring Program.



The frequency frame consisted of four nested frames of varying sizes: 10cm x 10 cm, 25cm x 25cm, 25cm x 50 cm and 50 cm x 50 cm (Figure 1). Every plant species (grasses, forbs and woody species) rooted in the area enclosed by the frame was assigned a number 1-4, depending on which of the four nested frames the species first appeared. Meaning that if a species was first observed in the 25 cm x 25 cm area it would be given a two or if it first occurred in the 50 cm x 50 cm area it would score a four (Sparhawk 1992). The maximum height of vegetation in each 1m plot was also taken in centimeters and the results averaged to obtain an average height for the transect as a whole. Height was measured to the highest plant material in the plot, including branches overhanging the plot from plants not rooted in the plot. Tree height within the plot was estimated unless the tree was above approximately three meters. Heights labeled “unreadably high” were excluded from transect average and the number of such plots was subtracted from the total plot number of 100 when calculating the average.

TREES:

When trees occurred in the transect, the trees were identified by species, counted and diameter at breast height (dbh) measurements were taken 1.4 meters from the base on the uphill side using a dbh tape for all live trees with a diameter greater than 2 inches. Each trunk on a forked tree was measured, but was only counted as a single tree in the tree count. In aspen and Douglas fir stands, data on every tree within 5 meters of either side of the transect line (resulting in a 10-meter wide transect) were collected. In limber

pine stands, trees within 10 meters of the transect line (resulting in a 20-meter wide transect) were counted (Sparhawk 1992).

REFERENCE PHOTOGRAPHS:

A 1.5 meter pole marked in alternating black and white decimeter bands was placed one meter to the right of the transect pole at the beginning (“0” end) of the transect. A sign indicating the transect location, date and time was placed on the post and a photograph taken (Sparhawk 1992). The camera used this year was a digital 8.0 megapixels 26.3mm Nikon coolpix P1.

DATA ANALYSIS:

Analysis consisted of calculating the sum frequency for each species or group of species. This was done by counting the number of times that a species occurred in one of the four nested frequency areas. Because there were 100 plots, this number represents a percentage of plots in which this species occurred (Sparhawk 1992).

Sum frequency values were used to compare similar readings from past surveys. These values followed a binomial distribution. Due to the binomial distribution, a confidence interval was calculated for each value. Significant differences were determined by comparing confidence intervals. If two values had confidence intervals that did not overlap, they were considered significantly different (Sparhawk 1992). A modified 95% confidence interval table for frequency values observed for 100 plots (Snedecor 1956) was used to determine significant differences. In addition chi-square analysis was used to determine if significant changes in overall species composition had occurred between surveys (Ludwig and Reynolds 1988).

Results

Following the completion of all surveys to be conducted this year a list was created of all of the species found within the six transects. Current nomenclature was used when possible, and an attempt was made to elucidate the differences in names used between the years that surveys have taken place. As part of the purpose of continuing to read these transects is to determine the presence of plants of varying status within Craters of the Moon a table was created that states the known status of each plant as listed by Steve Popovich in the CRMO herbarium. Family groupings were included in order for the surveyors to gain a better sense of how much familial diversity was found in the transects. As not all plants present at Craters were found within the limits of the transect these lists do not provide a complete species list for CRMO but they do give a good sense of what species are found in each of CRMO’s different habitats.

Table 1.

2004 Species List for Long-term Vegetation Trends Monitoring Transects #3 (Douglas Fir/ Grassy Cone), #4 (Cinder Garden/ Devil's Orchard), #5 (Lumber Pine/ Inferno Cone), #8 (Three-tip Sagebrush / Fescue, Carey Kipuka), LP-Control (Little Prairie Control), and LP-C2 (Little Prairie Complete Burn), at Craters of the Moon National Monument, Idaho.

	Species	Duration	Scientific Name	Common Name	#3	#4	#5	#8	LP - Con	LP - C2
Grasses	ACTH*	P	<i>Achnatherum (Stipa) therbereanum</i>	Therber's Needlegrass		x				
	ACOC3	P	<i>Achnatherum (Stipa) occidentale</i>	Western Needlegrass			x			
	AGSP/PSSP	P	<i>Agropyron (Pseudogegneria) spicatum</i>	Bluebunch wheatgrass	x			x		
	BRTE	A	<i>Bromus tectorum</i>	Cheatgrass				x	x	x
	CADO	P	<i>Carex douglasii</i>	Douglas Sedge				x		
	CAFI	P	<i>Carex filifolia</i>	Threadleaf Sedge				x		
	CARU	P	<i>Calamagrostis rubescens</i>	Buckley Pinegrass	x					
	ELELE	P	<i>Elymus elymoides</i>	Squirreltail		x	x	x	x	x
	FEID	P	<i>Festuca idahoensis</i>	Idaho Fescue				x		
	HECO26**	P	<i>Hesperostipa comata</i>	Needle and Thread				x	x	x
	KOMA***	P	<i>Koeleria macrantha</i>	Prairie Junegrass				x		
	LEC14	P	<i>Leymus cinereus</i>	Great Basin Wildrye					x	x
	NEEDLE1	P	<i>Needlegrass spp.</i>	Needlegrass Species	x				x	x
	POSE	P	<i>Poa secunda</i>	Sandberg's Bluegrass		x	x	x	x	x
Forbs	UNK M	P	<i>Unknown grass, milky sap</i>	Unknown Grass					x	
	UNK 1	P	<i>Unknown Grass</i>	Unknown Grass, Strange awns						x
	AGGL	P	<i>Agoseris glauca</i>	Pale Agoseris	x		x	x	x	
	ALLIUM	P	<i>Allium spp.</i>	Onion Species (textile onion?)	x		x			
	ALTE2	P	<i>Allium textile</i>	Textile Onion				x		
	ANMI	P	<i>Antennaria microphylla</i>	Littleleaf Pussytoes	x					
	ARCO	P	<i>Arnica cordifolia</i>	Heartleaf Arnica	x					
	ARLI	P	<i>Arabis lignifera</i>	Desert Rockcress			x	x		
	ARNICA	?	<i>Arnica spp.</i>	Arnica Species	x					
	ASCOCO9	P	<i>Astragalus convallarius var. convallarius</i>	Lesser Rushy Milkvetch				x		

***KOKR formerly

* *also* *ACOC*

Table 2.

2010 Species List, CRMO status, and family categorization for Long-term Vegetation Trends Monitoring Transects #3 (Douglas Fir/ Grassy Cone), #4 (Cinder Garden/ Devil's Orchard), #5 (Limber Pine/ Inferno Cone), #8 (Three-tip Sagebrush, Fescue/ Carey Kipuka), LP – Control (Little Prairie Control) and LP - C2 (Little Prairie Complete Burn) at Craters of the Moon National Monument, Idaho.

	Species	Duration	Scientific Name	Common Name	CRMO Status	Family
Grasses	ACTH*	P	<i>Achnatherum (Stipa) therbereanum</i>	Therber's Needlegrass	Uncommon, Native	Poaceae
	ACOC3	P	<i>Achnatherum (Stipa) occidentale</i>	Western Needlegrass	Uncommon, Native	Poaceae
	AGSP/PSSP	P	<i>Agropyron (Pseudoegneria) spicatum</i>	Bluebunch wheatgrass	Common, Native	Poaceae
	BRTE	A	<i>Bromus tectorum</i>	Cheatgrass	Abundant, Non-Native	Poaceae
	CADO	P	<i>Carex douglasii</i>	Douglas Sedge	Common, Native	Cyperaceae
	CAFI	P	<i>Carex filifolia</i>	Threadleaf Sedge	Uncommon, Native	Cyperaceae
	CARU	P	<i>Calamagrostis rubescens</i>	Buckley Pinegrass	Uncommon, Native	Poaceae
	ELELE	P	<i>Elymus elymoides</i>	Squirreltail	Common, Native	Poaceae
	FEID	P	<i>Festuca idahoensis</i>	Idaho Fescue	Common, Native	Poaceae
	HECO26**	P	<i>Hesperostipa comata</i>	Needle and Thread	Common, Native	Poaceae
	KOMA***	P	<i>Koeleria macrantha</i>	Prairie Junegrass	Common, Native	Poaceae
	LECI4	P	<i>Leymus cinereus</i>	Great Basin Wildrye	Common, Native	Poaceae
	NEEDLE1	P	<i>Needlegrass spp.</i>	Needlegrass Species	Native	Poaceae
	POSE	P	<i>Poa secunda</i>	Sandberg's Bluegrass	Abundant, Native	Poaceae
Forbs	UNK M	P	<i>Unknown grass, milky sap</i>	Unknown Grass		Poaceae
	UNK I	P	<i>Unknown Grass</i>	Unknown Grass, Strange awns		Poaceae
	AGGL	P	<i>Agoseris glauca</i>	Pale Agoseris	Common, Native	Asteraceae
	ALLIUM	P	<i>Allium spp.</i>	Onion Species (textile onion?)		Liliaceae
	ALTE2	P	<i>Allium textile</i>	Textile Onion	Uncommon, Native	Liliaceae
	ANMI	P	<i>Antennaria microphylla</i>	Littleleaf Pussytoes	Common, Native	Asteraceae
	ARLI	P	<i>Arabis lignifera</i>	Desert Rockcress	Uncommon, Native	Brassicaceae

Forbs	ARCO	P	<i>Arnica cordifolia</i>	Heartleaf Arnica	Common, Native	Asteraceae
cont'd	ARNICA	?	<i>Arnica spp.</i>	Arnica Species		Asteraceae
	ASCOCO9	P	<i>Astragalus convallarius</i> var. <i>convallarius</i>	Lesser Rushy Milkvetch	Uncommon, Native	Fabaceae
	ASFI	P	<i>Astragalus filipes</i>	Basalt Milkvetch	Common, Native	Fabaceae
	BASA	P	<i>Balsamorhiza sagittata</i>	Arrowleaf Balsamroot	Common, Native	Asteraceae
	CHDO	P	<i>Chaenactis douglasii</i>	Douglas' dustymaiden	Common, Native	Asteraceae
	CIRO	A	<i>Cistanthe (Calyptridium) rosea</i>	Rosy Pussypaws	Rare, Native	Portulacaceae
	COLI2	A	<i>Collomia linearis</i>	Tiny Trumpet	Common, Native	Polemoniaceae
	COPA3	A	<i>Collinsia parviflora</i>	Maiden Blue-Eyed Mary	Common, Native	Scrophulariaceae
	CORA5	A	<i>Cordylanthus ramosus</i>	Bushy Bird's Beak	Uncommon, Native	Scrophulariaceae
	CRAC2	P	<i>Crepis acuminata</i>	Tapertip Hawksbeard	Common, Native	Asteraceae
	CRGR3	A	<i>Cryptantha gracilis</i>	Narrowleaved cryptantha	Uncommon, Native	Boraginaceae
	CRIN9	P	<i>Cryptantha interrupta</i>	Elko cryptantha	Uncommon, Native	Boraginaceae
	CRT04	A	<i>Cryptantha torreyana</i>	Torrey's cryptantha	Common, Native	Boraginaceae
	CRYPTA	P	<i>Cryptantha spp.</i>	Cryptantha species		Boraginaceae
	CYTE	P	<i>Gymnoterus terebinthus</i>	Desert Parsley	Common, Native	Apiaceae
	DEAN	P	<i>Delphinium andersonii</i>	Anderson's Larkspur	Common, Native	Ranunculaceae
	DEPI	A	<i>Descurainia pinnata</i> var. <i>filipes</i>	Western Tansymustard	Uncommon, Native	Brassicaceae
	ERIGERON	P	<i>Erigeron spp.</i>	Purple Fleabane Species		Asteraceae
	ERHE2	P	<i>Eriogonum heracleoides</i>	Parsnipflower Buckwheat	Common, Native	Polygonaceae
	EROV	P	<i>Eriogonum ovalifolium</i>	Cushion Buckwheat	Common, Native	Polygonaceae
	EROVD	P	<i>Eriogonum ovalifolium</i> var. <i>depressum</i>	Dwarf Buckwheat	Common, Native	Polygonaceae
	ERPU	P	<i>Erigeron punilus</i>	Shaggy Fleabane	Common, Native	Asteraceae
	ERUM	P	<i>Eriogonum umbellatum</i> var. <i>umbellatum</i>	Sulfur-Flower Buckwheat	Common, Native	Polygonaceae
	FORB1	?	<i>Forb spp.</i>	Forb Species, fuzzy		
	GADE2	A	<i>Gayophytum decipiens</i>	Deceptive Groundsmoke	Uncommon, Native	Onagraceae
	GARA	A	<i>Gayophytum racemosum</i>	Blackfoot Groundsmoke	Uncommon, Native	Onagraceae

Forbs	LASE	A	<i>Lactuca serriola</i>	Prickly Lettuce	Common, Non-Native	Asteraceae
cont'd	LOTR2	P	<i>Lomatium triternatum</i>	Nineleaf Biscuitroot	Common, Native	Apiaceae
	LUSE4	P	<i>Lupinus sericeus</i>	Silky Lupine	Common, Native	Fabaceae
	MACA	A	<i>Machaeranthera canescens var. sessiflora</i>	Purple Tansyaster	Common, Native	Asteraceae
	MEAL6	A	<i>Mentzelia albicaulis</i>	Whitestem Blazingstar	Common, Native	Loasaceae
	MINA	A	<i>Mimulus nanus</i>	Dwarf Purple Monkeyflower	Common, Native	Scrophulariaceae
	MISU2	A	<i>Mimulus sukdorffii</i>	Sukdorf's Monkeyflower	Common, Native	Scrophulariaceae
	PECY3	P	<i>Penstemon cyaneus</i>	Pennell Blue Penstemon	Common, Native	Scrophulariaceae
	PHHA	P	<i>Phacelia Hastata</i>	Silverleafleaf Phacelia/ Scorpionweed	Common, Native	Hydrophyllaceae
	PHLO2	P	<i>Phlox longifolia</i>	Longleaf Phlox	Common, Native	Polemoniaceae
	PODO4	A	<i>Polygonum douglasii</i>	Douglas' Knotweed	Common, Native	Polygonaceae
	SECA2	P	<i>Senecio Canus (Packera cana)</i>	Woolly Groundsel	Common, Native	Asteraceae
	SEIN2	P	<i>Senecio integerrimus</i>	Lambstongue Ragwort	Common, Native	Asteraceae
	Senecio	P	<i>Senecio spp.</i>	Ragwort Species		Asteraceae
	THISTLE	P	<i>Asteraceae spp.</i>	Thistle Species		Asteraceae
	VINU2	P	<i>Viola nutallii</i>	Nuttall's Violet	Uncommon, Native	Violaceae
	VIOLA	P	<i>Viola spp.</i>	Viola Species		Violaceae
Woody Species						
	ARTRV	P	<i>Artemisia tridentata ssp. Vaseyana</i>	Mountain Big Sagebrush	Abundant, Native	Asteraceae
	ARTR2	P	<i>Artemisia tripartita ssp. Tripartita</i>	Threetip Sagebrush	Common, Native	Asteraceae
	ERNA10	P	<i>Ericameria (Chrysothamnus) nauseosa</i>	Rubber Rabbitbrush	Common, Native	Asteraceae
	ERVI	P	<i>Ericameria (Chrysothamnus) viscidiflorus</i>	Yellow Rabbitbrush	Common, Native	Asteraceae
	LEPU	P	<i>Leptodactylon pungens var. pungens</i>	Lava Phlox	Common, Native	Polemoniaceae
	PIFL	P	<i>Pinus flexilis</i>	Limber Pine	Common, Native	Pinaceae
	PRVI	P	<i>Prunus virginiana var. melanocarpa</i>	Chokecherry	Common, Native	Rosaceae
	PUTR2	P	<i>Purshia tridentata</i>	Antelope Bitterbrush	Common, Native	Rosaceae

Woody	PSME	P	<i>Pseudotsuga menziesii</i>	Douglas Fir	Uncommon, Native	Pinaceae
cont'd	RICE	P	<i>Ribes cereum</i> var. <i>inebrians</i>	Wax Currant	Common, Native	Grossulariaceae
	SYORU	P	<i>Symphoricarpos oreophilus</i> var. <i>utahensis</i>	Utah Snowberry	Common, Native	Caprifoliaceae

*also ACOC -

Acnatherum occidentale

**formerly STCO3

*** formerly KOGR

STOC = ACOC3

STTH = ACTH

SIHY = ELELE

AGSP = PSSP

Figure 2.

Map Locations of the Craters of the Moon National Monument Long-term Vegetation Monitoring Transects – Craters of the Moon National Monument and Preserve, Idaho.

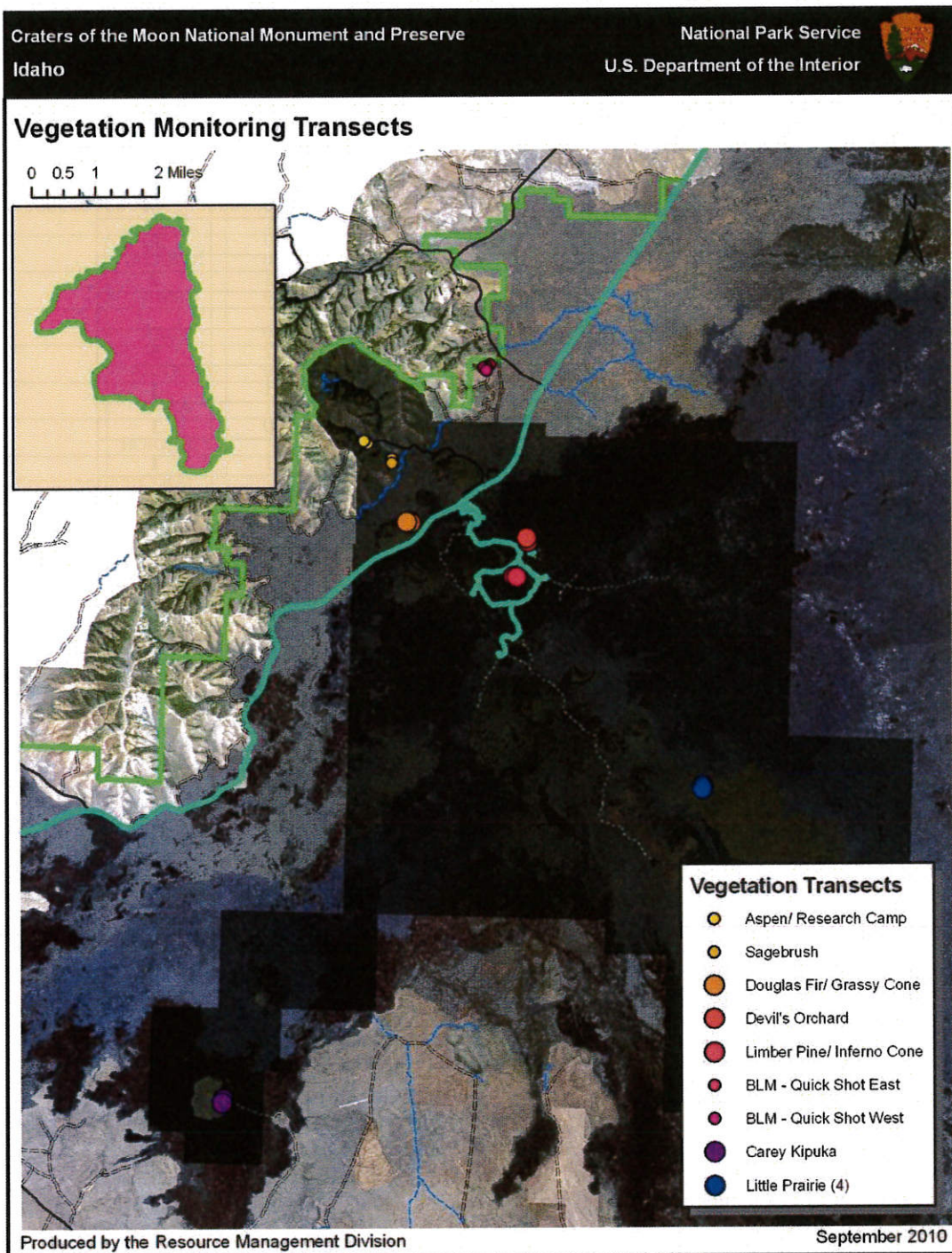


Table 5.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #3 (Douglas Fir/ Grassy Cone) from 1993-2010 – Craters of the Moon National Monument, Idaho.

	Species	1993	1997	2000	2004	2010
Grasses	CARU	1	0	11	0	30
	POA	0	1	6	86	0
	PSSP	22	35	74	20	44
	UNK GRASS	0	0	0	11	2
	Annual Grass	0	0	0	0	0
	Perennial Grass	23	36	91	101	76
Forbs	ANNUAL FORB 1/2/3	0	0	0	9	0
	AGGL	0	0	3	12	5
	AGRE	0	2	0	0	0
	ANMI	2	2	1	0	1
	AMAL	2	0	0	0	0
	ARNICA/ ARCO	0	0	2	5	2
	BASA	12	7	7	4	11
	BORAGE	0	0	0	27	0
	COLI2	4	13	1	14	11
	COPA3	30	35	20	20	43
	CRAC2	25	29	33	31	31
	CRTO/ CRYPTAN	19	19	19	0	0
	PTTE	0	0	0	2	0
	EROV	0	1	0	0	0
	FRAT	1	0	3	0	0
	GAster	0	0	1	0	0
	HEUN	3	0	0	0	0
	LASE	0	0	0	1	3
	LIPA	0	0	1	0	0
	LIRU	0	0	1	0	0
	LOMA/ LOMAT	7	1	1	0	0
	MEAL6	0	0	0	7	0
	MOSS	0	0	1	0	0
	MUSTARD	0	2	0	0	0
	NIAT	8	0	0	0	0
	ORNE	3	0	0	0	0
	POGL/ POAR/ POTEN	4	3	2	0	0
	PHHA	0	1	0	0	0
	PHLO	0	0	6	3	3

Forbs	RAGL/ RANUN	0	0	11	1	0
cont'd	SECA	1	8	8	6	0
	SOLID	3	0	0	0	0
	TAFO	0	0	0	1	0
	UNK FORB	0	0	0	0	3
	VINU2/ VIOLA	8	11	19	17	21
	Annual Forbs	48	48	22	82	68
	Perennial Forbs	84	86	117	76	75
Woody	AMAL	3	0	0	0	0
	CHVI8	0	1	0	0	0
	PIFL	0	1	0	0	0
	PRVI	4	6	12	6	7
	PSME	16	11	54	9	12
	RIBES/ RICE	1	1	0	1	2
	SYORU	31	40	37	30	38
	Woody Plants	55	60	103	46	59

Figure 3.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #3 (Douglas Fir/ Grassy Cone) for the five years (1993, 1997, 2000, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.

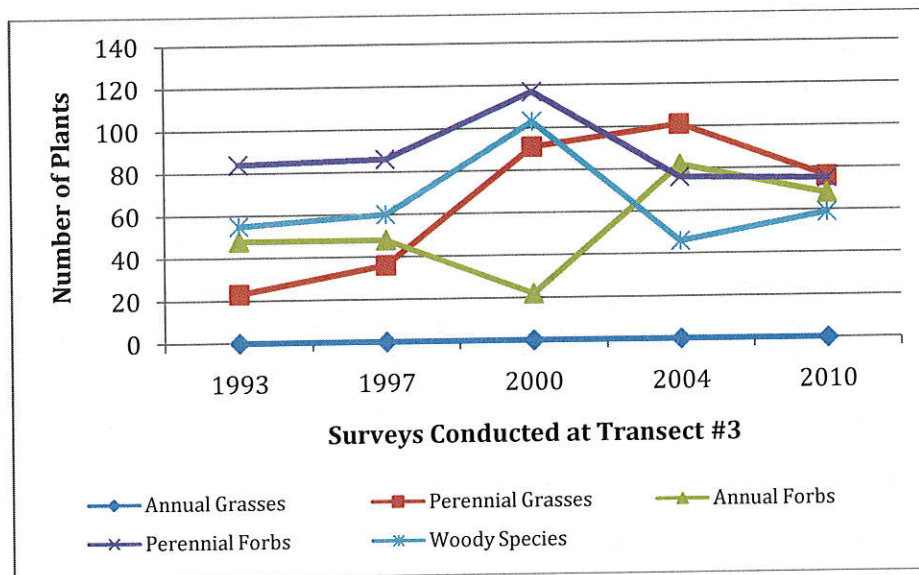


Table 6.

Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Tree Species Found in the 5m x 100m (Douglas Fir) Transect at Transect #3 (Douglas Fir, Grassy Cone) in the Long-term Vegetation Monitoring Program at Craters of the Moon National Monument, Idaho, 2010.

Species	Trees / hectare	Mean DBH (in)	Basal Area (m ² / hectare)
<i>Pseudotsuga menziesii</i>	435	5.69	7.12682517
<i>Pinus flexilis</i>	15	12.58	1.203183845

Table 7.

Comparative Results of Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Trees Found in the 5m x 100m (Douglas Fir) Transect at Transect #3 (Douglas Fir, Grassy Cone) from 1993 – 2010 at Craters of the Moon national Monument, Idaho.

<i>Pseudotsuga menziesii</i>	1993	1997	2000	2004	2010
Trees / hectare	275	275	325	360	435
Mean DBH (in)	7.32	7.97	7.82	7.68	5.69
Basal Area (m ² / hectare)	7.468515846	8.853781245	10.07340553	10.7622826	7.126825172

<i>Pinus flexilis</i>	1993	1997	2000	2004	2010
Trees / hectare	30	35	15	0	15
Mean DBH (in)	10.38	8.12	11.2	0	12.58
Basal Area (m ² / hectare)	1.638307474	1.169659772	0.95368896	0	1.203183845

When surveyed in July of 2010 Douglas Fir/ Grassy Cone was found to contain twenty two species including three grass species, nineteen forb species, and four woody species (Table 3). In the year 2004, this transect contained twenty four species including three grass species, sixteen forb species, and four woody species. This included four grass species and ten species of forbs that were not found in 2010. In addition, the 2010 survey found two species of grass, four species of forb, and one woody species that were not found in 2004 (Table 4). Over the five surveys that have been conducted at this transect there has been a bell-curve change in all three groups (Table 5).

Perennial grasses and perennial forbs had the highest sum frequency along the transect, a pattern seen consistently except in 2000 when woody species were found in a quantity almost double that seen in other years (Table 5). Bluebunch wheatgrass (*Agropyron (Pseudoegneria) spicatum* [PSSP/AGSP]) was the most abundant grass species. The dominant forb was the annual maiden blue-eyed Mary (*Collinsia parviflora* [COPA]) followed by the perennial tapertip hawksbeard (*Crepis acuminata* [CRAC]). The woody species with the highest abundance was Utah snowberry (*Symphoricarpos oreophilus* var. *utahensis* [SYORU]) (Table 3). Douglas fir (*Pseudotsuga menziesii* [PSME]) was the most frequently encountered tree (Table 6).

Chi-square analysis indicated a significant increase in woody plants ($P = 0.017369$) and no significant difference in other groups ($P > 0.05$). Sum frequency values agreed with this analysis (Figure 3).

Douglas fir and limber pine (*Pinus flexilis* [PIFL]) were the only two tree species found in the transect, with Douglas fir being the more numerous (Table 6). Douglas fir density increased from previous surveys while basal area and DBH decreased, indicating the presence of fewer large trees and more saplings. Limber pine increased in number,

basal area, and DBH compared to all surveys except that conducted in 1993 in which density and basal area exceeded that found in 2010 (Table 7.)

Transect #4: Cinder Garden/ Devils Orchard

Table 8.
Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #4 (Cinder Garden/ Devils Orchard) – Craters of the Moon National Monument, Idaho, 2010.

	Species	10 x 10 2010	25 x 25 2010	25 x 50 2010	50 x 50 2010	Total 2010
Grasses	ACTH	2	5	7	13	27
	ELEL	0	3	1	0	4
	POSE	1	1	0	0	2
Forbs	CHDO	1	1	0	3	5
	CARO/ CIRO	0	6	2	5	13
	CRIN9	1	2	1	0	4
	CRGR3	19	13	5	6	43
	CRT04	2	0	0	0	2
	EROVD	0	1	2	3	6
	ERUM	0	1	1	1	3
	GARA	17	22	7	3	49
	MACA	2	1	1	3	7
	MINA	40	16	7	4	67
	MISU2	6	2	2	5	15
	PHHA	4	7	8	15	34
Woody	ERNA10	0	6	4	8	18
	LEPU	0	2	1	4	7
	PUTR	2	9	1	6	18

Table 9.
Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #4 (Cinder Garden, Devil's Orchard) between 2004 and 2010 – Craters of the Moon National Monument, Idaho, 2004.

	Species	10 x 10 2004	10 x 10 2010	25 x 25 2004	25 x 25 2010	25 x 50 2004	25 x 50 2010	50 x 50 2004	50 x 50 2010	Total 2004	Total 2010
Grasses	ACOC3	0	0	9	0	9	0	11	0	29	0
	ACTH	0	2	0	5	0	7	0	13	0	27
	ELEL	0	0	3	3	0	1	2	0	5	4
	POSE	0	1	1	1	1	0	1	0	3	2

Forbs	CHDO	0	1	0	1	1	0	0	3	1	5
	CARO/ CIRO	6	0	24	6	4	2	4	5	38	13
	CRIN9	0	1	1	2	1	1	0	0	2	4
	CRGR3	9	19	15	13	9	5	16	6	49	43
	CRT04	0	2	1	0	0	0	3	0	4	2
	CRYPTA	0	0	0	0	1	0	0	0	1	0
	EROVD	0	0	2	1	4	2	5	3	11	6
	ERUM	0	0	0	1	0	1	0	1	0	3
	GADE2	3	0	4	0	3	0	5	0	15	0
	GARA	2	17	9	22	5	7	8	3	24	49
	MACA	0	2	0	1	0	1	0	3	0	7
	MACHAE	0	0	0	0	1	0	0	0	1	0
	MINA	31	40	33	16	8	7	6	4	77	67
	MISU2	0	6	5	2	4	2	8	5	17	15
	PHHA	0	4	6	7	2	8	4	15	12	34
Woody											
	ERNA10	1	0	3	6	1	4	3	8	8	18
	LEPU	2	0	3	2	3	1	4	4	12	7
	PUTR	2	2	3	9	3	1	6	6	14	18

Table 10.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #4 (Cinder Garden/ Inferno Cone) from 1995-2010 – Craters of the Moon National Monument, Idaho.

	Species	1995	2000	2004	2010
Grasses	AGSP	0	1	0	0
	ACOC3	0	2	29	0
	ACTH	0	0	0	27
	Stipa	0	62	0	0
	ELEL	0	0	5	4
	POA/POSE	0	1	3	2
	Annual Grass	0	0	0	0
	Perennial Grass	0	66	37	33
Forbs	ASCA	7	0	0	0
	Borage	48	6	0	0
	CHDO	1	3	1	5
	CIRO	0	0	38	13
	CRIN9/ CRT04/ CRYPTA	3	67	7	6

Forbs	CRGR3	0	0	49	43
cont'd	Epilobium	0	57	0	0
	EROVD	0	0	11	6
	EROV	14	11	0	0
	ERUM	0	2	0	3
	GADE2/ GAYO/ GARA	53	0	39	49
	MACA/ MACHAE	0	0	2	7
	MIGU	43	0	0	0
	MINA	69	79	77	67
	MISU2	0	8	17	15
	PHHA	18	7	12	34
	PHHE	0	11	0	0
	PORTULACA	0	11	0	0
	PORT	0	27	0	0
	Forb (unknown)	13	1	0	0
	Annual Forb	178	132	222	196
	Perennial Forb	91	158	31	79
Woody	ERNA10	16	11	8	18
	LEPU	0	10	12	7
	PUTR	16	27	14	18
	TECA	6	0	0	0
	Woody Species	38	50	34	43

Figure 4.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #4 (Cinder Garden/ Devils Orchard) for the four years (1995, 2000, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.

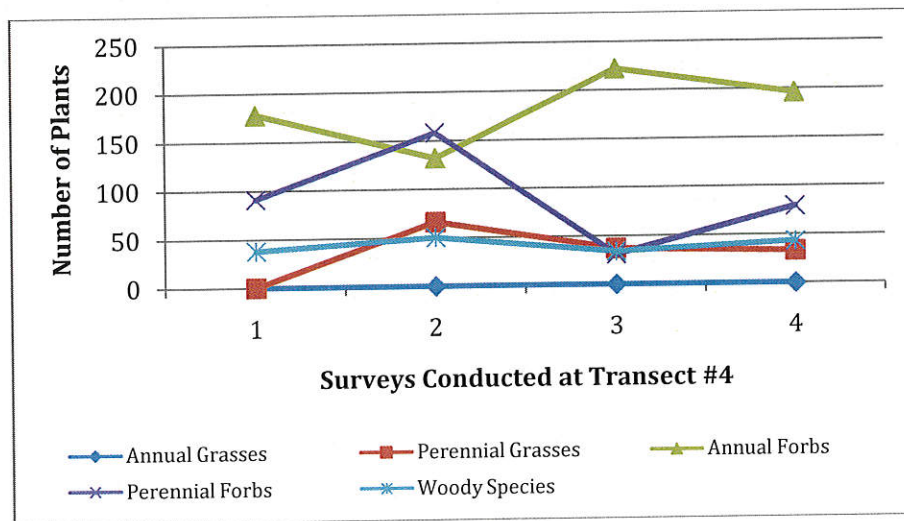


Table 11.

Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Tree Species Found in the 10m x 100m (Limber Pine) Transect at Transect #4 (Cinder Garden, Devil's Orchard) in the Long-term Vegetation Monitoring Program at Craters of the Moon National Monument, Idaho, 2010.

Species	Trees / hectare	Mean DBH (in)	Basal Area (m ² / hectare)
<i>Pinus flexilis</i>	80	9.58	4.187101137

Table 12.

Comparative Results of Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Trees Found in the 10m x 100m (Limber Pine) Transect at Transect #4 (Cinder Garden, Devil's Orchard) from 1995 – 2004 at Craters of the Moon national Monument, Arco, Idaho.

<i>Pinus flexilis</i>	1995	2000	2004	2010
Trees / hectare	120	130	120	80
Mean dbh (in)	9.79	9.06	8.68	9.58
Basal Area (m ² / hectare)	5.82943	5.408529	4.582475	4.187101137

When surveyed in June of 2010, Cinder Garden/ Devils Orchard was found to contain eighteen individual species including three grass species, twelve forb, and three woody species (Table 8). In the survey conducted in 2004 found nineteen individual species including three grass species, thirteen forb species, and three woody species. One species of grass and three species of forbs found in 2004 were not found in 2010. One species of grass and two forb species were found in 2010 that were not found in 2004 (Table 9). Over the four surveys that have been conducted in the past fifteen years perennial grasses have remained very low, annual forbs have alternated increases and decreases in numbers with 2010 finding more than 1995, perennial forbs have alternated increases and decreases in numbers with 2010 finding less than 1995, and woody species have remained fairly steady (Table 10).

Perennial forbs maintained the highest sum frequency within the transect, a pattern seen in all years that this transect has been surveyed (Table 10). Thurber's needlegrass (*Acnatherum thurberianum* [ACTH]) was the most abundant grass species. The most abundant forb was the dwarf monkeyflower (*Mimulus nanus* [MINA]). Two woody species, rubber rabbitbrush (*Ericameria nauseosa* [ERNA]) and antelope bitterbrush (*Purshia tridentata* [PUTR]), tied for highest abundance (Table 8). Limber Pine was the only tree encountered (Table 11).

Chi-squared analysis indicated no significant difference for any group (P always > 0.05). Sum frequency also indicated little difference between the survey conducted in 2010 and those conducted in 2004 (Figure 4).

Limber Pine was the only tree species encountered at the transect (Table 11). Compared to past years surveyed a decrease in density and basal area was observed and an increase in DBH was found (Table 12).

Transect #5: Limber Pine/Inferno Cone

Table 13.

Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) – Craters of the Moon National Monument, Idaho, 2010.

	Species	10x10	25x25	25x50	50x50	Total
Grass	ACOC3	2	3	1	5	11
	ELELE	0	1	0	2	3
	POSE	20	17	9	12	58
Forbs	AGGL	2	2	0	1	5
	ALLIUM	6	7	1	4	18
	BRASSICA	0	0	0	1	1
	COLI2	0	2	3	0	5
	COPA3	32	28	14	5	79
	CORA5	1	0	0	0	1
	CRAC2	0	0	1	0	1
	CRGR3	3	4	4	6	17
	CYTE	0	3	3	1	7
	DEAN	5	10	8	12	35
	EROV	0	1	0	0	1
	ERUM	0	1	2	4	7
	GARA	12	4	5	5	26
	MEAL6	0	0	1	0	1
	MINA	0	4	0	4	8
	MISU2	1	3	2	3	9
	PHHA	3	5	11	10	29
	SECA2	0	0	1	0	1
	SENECIO	0	1	0	0	1
Woody	ARTRV	0	0	0	1	1
	ERNA10	0	6	6	6	18
	PIFL	1	2	2	6	11
	PUTR	4	8	9	11	32
	RICE	8	8	4	9	29

Table 14.

Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) between 2002 and 2010 – Craters of the Moon National Monument, Arco, Idaho, 2010.

	Species	10x10 2002	10x10 2010	25x25 2002	25x25 2010	25x50 2002	25x50 2010	50x50 2002	50x50 2010	Total 2002	Total 2010
Grass	ACTH	2	0	4	0	5	0	5	0	16	0
	ACOC3	0	2	0	3	2	1	0	5	2	11
	ELELE	4	0	6	1	2	0	3	2	15	3
	POSE	16	20	8	17	14	9	11	12	49	58
	PSSP	1	0	0	0	1	0	0	0	2	0
Forbs	AGGL	0	2	0	2	0	0	0	1	0	5
	ALLIUM	0	6	1	7	0	1	0	4	1	18
	BORAGE	1	0	0	0	2	0	1	0	4	0
	BRASSICA	0	0	0	0	0	0	0	1	0	1
	CHENO	0	0	0	0	1	0	0	0	1	0
	COLI2	2	0	0	2	0	3	1	0	3	5
	COPA3	7	32	12	28	8	14	10	5	37	121
	CORA5	0	1	0	0	0	0	0	0	0	1
	CRAC2	0	0	0	0	0	1	0	0	0	1
	CRGR3	0	3	0	4	0	4	0	6	0	17
	CYTE	1	0	1	3	1	3	2	1	5	7
	DEAN	1	5	3	10	0	8	1	12	5	35
	EROV	1	0	0	1	0	0	0	0	1	1
	ERUM	2	0	3	1	2	2	1	4	8	7
	GAYOP/ GARA	5	12	10	4	8	5	7	5	30	26
	MEAL	1	0	0	0	2	1	0	0	3	1
	MINA	0	0	0	4	0	0	0	4	0	8
	MISU2	0	1	0	3	0	2	0	3	0	9
	PHHA	5	3	3	5	8	11	8	10	24	29
	SENECIO	0	0	0	1	0	0	0	0	0	1
	TRDU	0	0	0	0	0	0	1	0	1	0
	SECA2	0	0	0	0	0	1	0	0	0	1
Woody	ARTRV	1	0	0	0	0	0	0	1	1	1
	CHNA	4	0	5	0	6	0	10	0	25	0
	ERNA10	0	0	0	6	0	6	0	6	0	18
	LEPU	0	0	0	0	1	0	0	0	1	0
	PIFL	2	1	1	2	2	2	3	6	8	11
	PUTR	4	4	6	8	8	9	11	11	29	32
	RICE	7	8	7	8	2	4	8	9	24	29

STTH = ACTH
STOC = ACOC3
SIHY = ELEL
AGSP = PSSP

Table 15.
Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) from 1992 - 2010 – Craters of the Moon National Monument, Idaho.

	Species	1992	1996	1998	2002	2010
Grasses	ACHY	0	31	0	0	0
	ACTH	0	0	0	16	0
	ACOC3	24	4	3	18	11
	ELELE	3	9	15	15	3
	POSE/POPR*	35	31	52	49	58
Grasses	PSSP	0	0	4	2	0
cont'd						
	Annual Grass	0	0	0	0	0
	Perennial Grass	62	75	74	100	72
Forbs	AGGL	0	1	1	0	5
	ALLIUM	0	0	0	1	18
	ALTO	0	2	11	0	0
	ARHO	3	1	9	0	0
	ASTER	3	1	1	0	0
	BORAGE	0	0	0	4	0
	BRASSICA	0	0	0	0	1
	CHDO	0	1	0	0	0
	CHENO	0	0	0	1	0
	COLI2	0	0	0	3	5
	COPA2	0	15	66	37	79
	CRAC2	0	0	0	0	1
	CRTO/CRWA/CRGR*	0	27	19	0	17
	CYTE	3	6	7	5	7
	DEAN	0	8	22	4	35
	EROV	0	1	0	1	1
	ERUM	10	9	7	8	7
	GANU	0	0	8	0	0
	GARA/GAYOP	4	43	10	30	26
	LASE	0	0	2	0	0
	MEAL	2	8	4	3	1
	MINA	0	0	20	0	8
	MISU2	7	36	25	24	9

Forbs	PHHA	7	36	25	24	29
cont'd	PODOD	0	0	3	0	0
	SECA2	0	0	0	0	1
	SENECIO	0	0	0	0	1
	TAOF	0	0	2	0	0
	TRDU	0	0	0	0	0
	Annual Forbs	13	129	74	97	136
	Perennial Forbs	16	65	56	47	106
Woody	ARTRV	2	0	2	1	1
	CHNA	25	25	20	25	0
	ERNA10	0	0	0	0	18
	LEPU	1	2	1	1	0
	PIFL	3	4	19	8	11
	PUTR	34	33	28	29	32
	RICE	29	0	28	24	29
	Woody Species	94	64	98	88	91

* Species may have been confused for one another during different surveys

Figure 5.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #5 (Limber Pine/ Inferno Cone) for the five years (1992, 1996, 1998, 2002, 2010) the transect has been read – Craters of the Moon National Monument, Idaho.

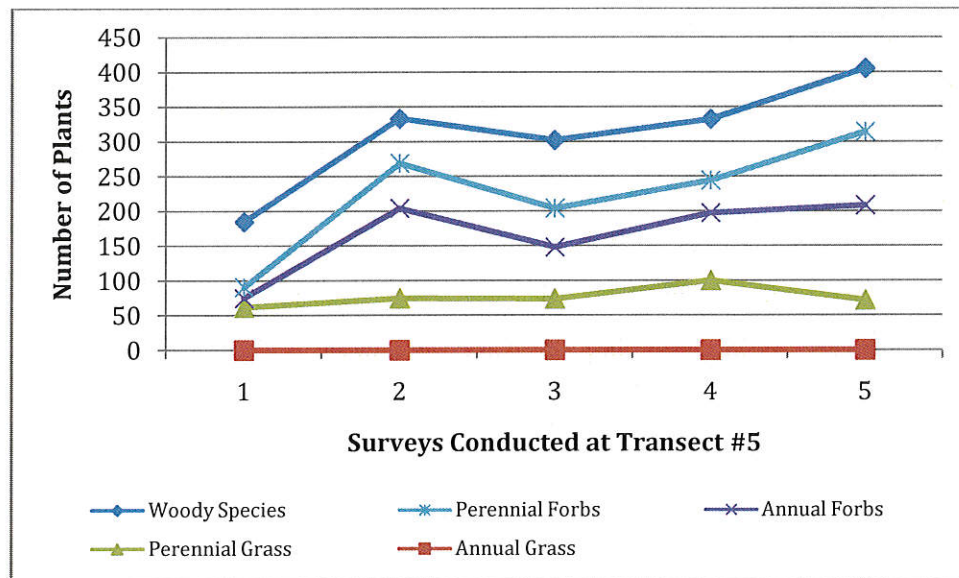


Table 16.

Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Tree Species Found in the 10m x 100m (Limber Pine) Transect at Transect #5 (Limber Pine/ Inferno Cone) in the Long-term Vegetation Monitoring Program at Craters of the Moon National Monument, Arco, Idaho, 2010.

Species	Trees / hectare	Mean DBH (in)	Basal Area (m ² / hectare)
<i>Pinus flexilis</i>	205	6.250192308	4.05900954

Table 17.

Comparative Results of Tree Density, Mean Diameter at Breast Height (dbh) and Basal Area for Trees Found in the 10m x 100m (Limber Pine) Transect at Transect #5 (Limber Pine/ Inferno Cone) from 2002 – 2010 at Craters of the Moon national Monument, Arco, Idaho.

<i>Pinus flexilis</i>	2002	2010
Trees / hectare	505	205
Mean dbh (in)	6.22	6.250192
Basal Area (m ² / hectare)	5.78	4.05900954

When surveyed in June of 2010, Limber Pine/ Inferno Cone was found to contain twenty-seven individual species including three grass species, nineteen forb species, and five woody species (Table 13). In the survey conducted in 2002 twenty-four individual species were found. This included two species of grass, three forb species, and a woody species not found in 2010. The 2010 survey included nine forb species and two woody species not found in 2002 (Table 14). In the five surveys taken starting with 1992 perennial grass consistently increased until 2010 when it dropped in abundance for the first time. Annual and perennial forbs have both dramatically increased since the first survey, though year-to-year the increase has not always been steady. Woody species have remained fairly consistent over time (Table 15).

Annual forbs displayed the highest sum frequency along the transect, followed closely by perennial forbs and woody species. This was a break from 2002 where grasses were a more dominant presence (Table 15). Sandburg bluegrass (*Poa secunda* [POSE]) was the most abundant grass species. The dominant forb was the annual maiden blue-eyed Mary and the most abundant woody species was antelope bitterbrush (Table 13). Limber Pine was the only tree seen.

Chi-squared analysis indicated a significant increase in perennial forbs ($P = 0.00544$) and a significant decrease in annual forbs ($P = 2.82012E-10$). Sum frequency values also indicated differences between years (Figure 5).

Limber Pine was the only tree seen at the transect (Table 16). Compared to the only other year for which tree data is available DBH remained about constant, basal area and density both decreased (Table 17).

Transect #8: Three-Tip Sagebrush/ Carey Kipuka

Table 18.

Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #8 (Three-tip Sagebrush / Carey Kipuka) – Craters of the Moon National Monument, Arco, Idaho, 2010.

	Species	10x10	25x25	25x50	50x50	Total
Grasses	FEID	20	31	15	15	81
	BRTE	34	11	7	8	60
	KOMA*	9	17	11	20	57
	POSE	18	21	6	10	55
	AGSP	1	6	3	3	13
	CAFI	5	0	2	5	12
	HECO26	2	4	4	2	12
	CADO	0	1	1	1	3
	ELEL	0	0	1	0	1
Forbs	GARA	27	18	10	15	70
	COLI2	8	15	10	7	40
	AGGL	3	15	17	13	48
	PODO4	2	12	8	18	40
	ARLI	7	1	9	17	34
	PHLO2	3	4	5	6	18
	COPA3	4	6	5	11	26
	LASE	0	5	9	12	26
	LUSE4	1	5	2	11	19
	CRGR3	2	3	5	6	16
	SEIN2	2	3	2	6	13
	ASCOCO9	1	3	2	7	13
	CORA5	0	1	1	5	7
	MEAL6	3	1	1	2	7
	ASFI	0	2	2	2	6
	LOTR2	2	2	1	0	5
	ALTE2	0	1	0	3	4
	ERUM	0	1	2	1	4
	CRAC2	0	0	1	2	3
	ERV1	1	0	1	1	3
	DEPI	1	1	0	0	2
	MACA	0	0	2	0	2
	ERHE2	0	0	0	2	2
	ASTER 1	0	0	0	1	1
	ERPU	0	0	1	0	1

Woody	ARTRT2	1	14	16	16	47
--------------	--------	---	----	----	----	-----------

*formerly KOGR

Table 19.

Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect #8 (Three-Tip Sagebrush/ Carey Kipuka) between 2004 and 2010 – Craters of the Moon National Monument, Arco, Idaho.

	Species	10x10 2004	10x10 2010	25x25 2004	25x25 2010	25x50 2004	25x50 2010	50x50 2004	50x50 2010	Total 2004	Total 2010
Grasses	FEID	14	20	34	31	19	15	9	15	76	82
	BRTE	5	34	4	11	4	7	7	8	20	60
	KOMA*	5	9	12	17	7	11	16	20	40	57
	POSE	7	18	16	21	12	6	9	10	44	55
	AGSP	3	1	6	6	3	3	13	3	25	13
	CAFI	2	5	2	0	1	2	4	5	9	12
	HECO26	0	2	0	4	0	4	1	2	1	12
	CADO	5	0	5	1	3	1	9	1	22	3
	ELEL	0	0	0	0	0	1	0	0	0	1
	ACOC3	4	0	6	0	5	0	12	0	27	0
	SIHY	0	0	0	0	1	0	0	0	1	0
Forbs	GARA	8	27	20	18	10	10	17	15	55	70
	COLI2	1	8	10	15	3	10	7	7	21	40
	AGGL	5	3	13	15	10	17	16	13	44	48
	PODO4	2	2	6	12	6	8	9	18	23	40
	ARLI	4	7	3	1	1	9	10	17	18	34
	PHLO2	10	3	18	4	8	5	8	6	44	18
	COPA3	1	4	2	6	1	5	2	11	6	26
	LASE	0	0	1	5	2	9	1	12	4	26
	LUSE4	0	1	4	5	4	2	6	11	14	19
	CRGR3	1	2	1	3	1	5	3	6	6	16
	SEIN	1	2	0	3	0	2	1	6	2	13
	ASCOCO9	0	1	0	3	0	2	0	7	0	13
	CORA5	0	0	0	1	2	1	1	5	3	7
	MEAL6	2	3	2	1	3	1	5	2	12	7
	ASFI	0	0	1	2	1	2	0	2	2	6
	LOTR2	0	2	3	2	4	1	2	0	9	5
	ALTE2	0	0	1	1	2	0	2	3	5	4
	ERUM	0	0	0	1	1	2	0	1	1	4
	CRAC2	1	0	3	0	1	1	4	2	9	3
	ERHE2	0	0	0	0	0	0	0	2	0	2

Forbs	ERV1	0	1	0	0	0	1	0	1	0	3
cont'd	DEPI	0	1	0	1	0	0	0	0	0	2
	MACA	0	0	0	0	0	2	0	0	0	2
	ASTER 1	0	0	0	0	0	0	0	1	0	1
	ERIGERON	0	0	0	0	0	1	0	0	0	1
	AGSE	0	0	0	0	0	0	1	0	1	0
	ASTR-FINE	0	0	7	0	2	0	3	0	12	0
	CANU3	1	0	2	0	1	0	1	0	5	0
	GADE2	5	0	1	0	2	0	4	0	12	0
	GAYOP1	1	0	3	0	1	0	3	0	8	0
Woody	ARTRT2	9	1	13	14	13	16	11	16	46	47
	CHVI	0	0	2	0	1	0	1	0	4	0

*formerly KOGR

Table 20.

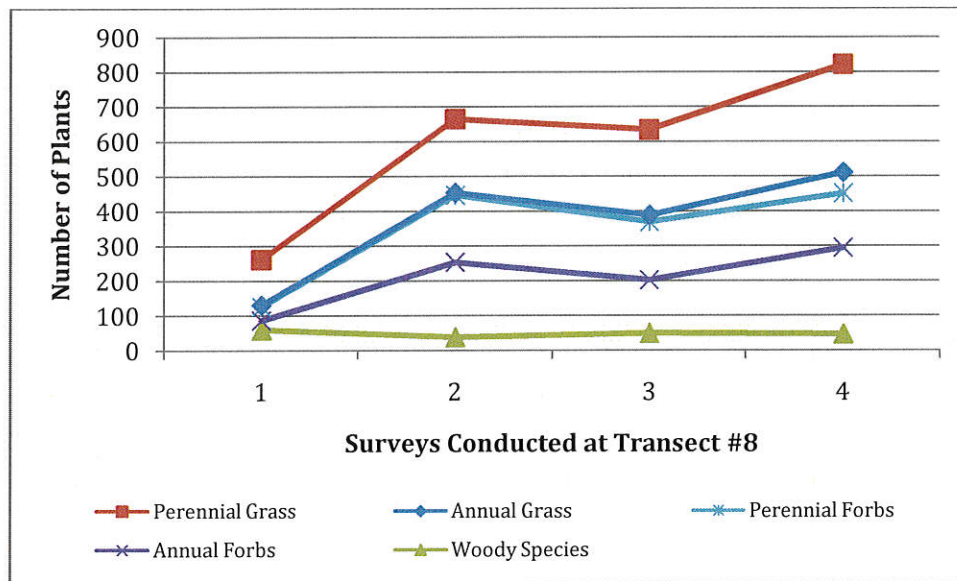
Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #8 (Three-tip Sagebrush/ Carey Kipuka) – Craters of the Moon National Monument, Arco, Idaho.

	Species	1994	1998	2004	2010
Grasses	AGSP	2	10	25	13
	BRTE	4	7	20	60
	CADO	3	5	22	3
	CAFI	3	12	9	12
	ELEL	1	1	1	1
	FEID	53	79	76	81
	HECO26/ ACOC3	4	2	28	12
	KOMA*	53	68	40	57
	LECI	3	0	0	0
	POSE	11	35	44	55
	Annual Grass	4	7	20	60
	Perennial Grass	131	212	245	310
Forbs	ANNUAL FORB	0	0	3	1
	AGGL	0	65	44	48
	ALTE2	11	5	5	4
	ARLI	3	14	18	34
	ASCOCO9	2	15	0	13
	ASFI	2	5	2	6
	AGSE	0	0	1	0

Forbs	ASTER 1	0	0	0	1
cont'd	ASTR-FINE	0	0	12	0
	BASA	2	0	0	0
	CALCO/ CANU3	0	2	5	0
	CIRSIUM	0	1	0	0
	COLI2	0	65	21	40
	COPA3	0	14	6	26
	CORA5	0	3	3	7
	CRAC2	3	9	9	3
	CRYPTA/ CRGR3	2	4	6	16
	DEPI	0	0	0	2
	ERIGERON	0	0	0	1
	ERHE2	0	1	0	2
	ERPU2	0	3	0	1
	ERUM	0	3	1	4
	ERVI	0	0	0	3
	GARA/ GADE/ Gayoph	25	66	75	70
	GILIA	0	5	0	0
	GYMN3	0	1	0	0
	LASE	0	17	4	26
	LIRU	1	0	0	0
	LOTR2	1	7	9	5
	LUSE4	11	30	14	19
	MACA	0	0	0	2
	MEAL6	0	6	12	7
	PHLO2	0	26	44	18
	PODO4	0	33	23	40
	SEIN	0	6	2	13
	STEPH	4	0	0	0
	TRDU	0	1	0	0
	Annual Forbs	27	215	153	248
	Perennial Forbs	40	192	166	156
Woody	ARTRT2	57	35	46	47
	CHVI8	3	4	4	0
	Woody Species	60	39	50	47

Figure 6.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect #8 (Three-tip Sagebrush/ Carey Kipuka) for the four years (1994, 1998, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Arco, Idaho.



When surveyed in June of 2010, Carey Kipuka was found to contain thirty-five different species including nine grass species, twenty-five forb species, and a single woody species (Table 18). When surveyed in 2004 thirty-five species were also found in the transect. At that time there were ten grass species, twenty-three forb species, and two woody species. One grass, six forb, and one woody species were present in 2004 that were not found in 2010. Two grass and five forb species were seen in 2010 that were not present in 2004 (Table 19). Since 1994 annual grasses have steadily increased, perennial grasses initially increased then decreased, annual forbs have increased generally but not steadily, perennial forbs increased initially then decreased, and woody plants have fluctuated and are down in abundance from the first survey of Carey Kipuka (Table 20).

Perennial grasses have consistently been the most abundant plant found in the transect, and that trend continued this year. Annual forbs were the next most abundant, being slightly closer in number to perennial grasses than in previous years (Table 18, Table 20). Idaho fescue (*Festuca idahoensis* [FEID]), was the most abundant grass, as it has always been. For the first time cheatgrass (*Bromus tectorum* [BRTE]) was the second most abundant, edging out prairie Junegrass (*Koeleria macrantha* [KOMA]) for the first time. Blackfoot groundsmoke (*Gayophytum racemosum* [GARA]) was the most abundant forb, consistent with past years. Big sagebrush (*Artemisia tridentata* [ARTR2]) was the sole and thus most abundant woody species seen (Table 18, Table 20). No trees were found at Carey Kipuka.

Chi-squared analysis indicated an increase in annual grasses ($P = 0.000354$), annual forbs ($P = 0.001326014$), and perennial grasses ($P = 1.21E-14$) while perennial forbs were shown to decrease ($P = 0.01071$). Woody species showed no significant statistical change, as shown also by sum frequency analysis (Figure 5).

Transect LP – Control: Little Prairie Control

Table 21.

Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-Control (Little Prairie Control) – Craters of the Moon National Monument, Arco, Idaho, 2010.

	Species	10x10	25x25	25x50	50x50	Total
Grasses	BRTE	9	8	2	12	31
	ELELE	3	8	3	6	20
	HECO	2	12	13	14	41
	Needlegrass spp.*	3	0	3	5	11
	LECI4	0	1	1	0	2
	POSE	3	1	2	5	11
	UNK M**	0	0	0	2	2
Forbs	AGGL	1	0	0	2	3
	CHDO	2	7	4	3	16
	COPA3	15	14	11	9	49
	CRAC2	1	0	1	1	3
	CRGR3	2	0	0	2	4
	DEAN	6	5	6	7	24
Forbs cont'd	ERHE2	5	1	3	2	11
	ERUM	12	13	10	15	50
	GARA	44	18	7	4	73
	LASE	0	1	1	3	5
	MEAL6	5	11	9	17	42
	MINA	0	4	2	7	13
	PHHA	2	5	10	9	26
Woody	ARTR	1	5	8	9	23
	ERNA10	1	0	0	0	1
	ERVI	0	0	0	1	1
	PUTR2	1	7	3	5	16

*HECO1

**ELELE - like with milky sap

Table 22.

Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-Control (Little Prairie Control) between 1996 and 2010 – Craters of the Moon National Monument, Arco, Idaho.

	Species	10x10 1996	10x10 2010	25x25 1996	25x25 2010	25x50 1996	25x50 2010	50x50 1996	50x50 2010	Total 1996	Total 2010
Grasses	ACTH	7	0	13	0	5	0	14	0	39	0
	BRTR	4	0	1	0	1	0	0	0	6	0
	BRTE	3	9	4	8	0	2	4	12	11	31
	ELELE	1	3	2	8	3	3	5	6	11	20
	HECO	4	2	5	12	6	13	3	14	18	41
	Needlegrass spp.	0	3	0	0	0	3	0	5	0	11
	LECI4	2	0	0	1	2	1	1	0	5	2
	POSE	3	3	2	1	2	2	0	5	7	11
	rice grass 1	1	0	2	0	1	0	3	0	7	0
	UNK M	0	0	0	0	0	0	0	2	0	2
Forbs	AGGL	0	1	0	0	0	0	0	2	0	3
	CHDO	0	2	2	7	2	4	1	3	5	16
	CHHA	1	0	0	0	0	0	0	0	1	0
	COPA3	0	15	0	14	0	11	0	9	0	49
	CRAC2	1	1	3	0	2	1	0	1	6	3
	CRGR3	0	2	0	0	0	0	0	2	0	4
	CUNA	1	0	0	0	0	0	0	0	1	0
	DEAN	0	6	0	5	0	6	0	7	0	24
	ERHE2	0	5	0	1	0	3	0	2	0	11
	ERUM	8	12	7	13	9	10	7	15	31	50
	EROV	0	0	0	0	2	0	3	0	5	0
	GARA	1	44	2	18	1	7	5	4	9	73
	LASE	0	0	0	1	0	1	0	3	0	5
	MEAL6	0	5	0	11	0	9	0	17	0	42
	MINA	0	0	0	4	0	2	0	7	0	13
	PHHA	2	2	6	5	5	10	5	9	18	26
Woody	ARTR	11	1	4	5	6	8	7	9	28	23
	ERNA10	4	1	0	0	4	0	2	0	10	1
	ERV1	1	0	1	0	2	0	4	1	8	1
	PUTR2	4	1	3	7	7	3	4	5	18	16

Table 23.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect LP-Control (Little Prairie Control) 1993-2010 – Craters of the Moon National Monument, Arco, Idaho.

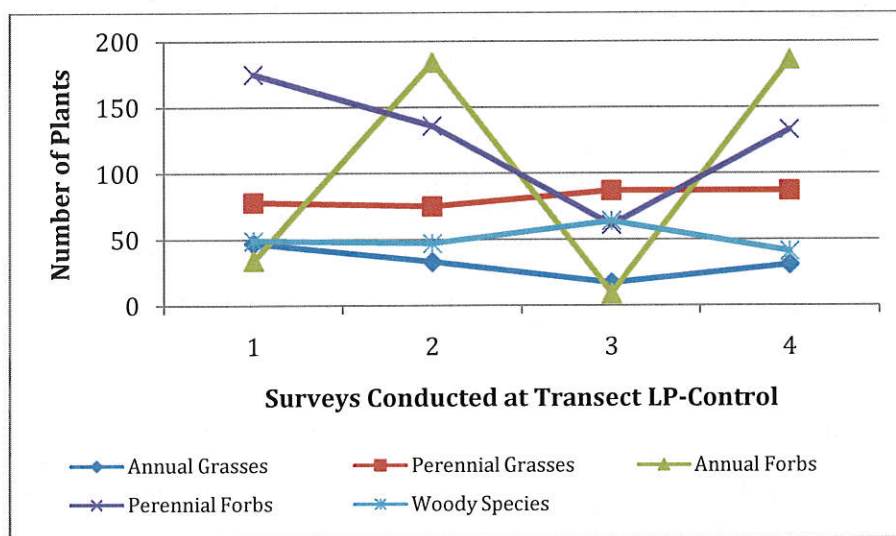
	Species	1993	1995	1996	2010
Grasses	ACTH	14	6	39	0
	BRTR	0	0	6	0
	BRTE	47	33	11	31
	ELELE	14	13	11	20
	HECO	20	10	18	41
	Needlegrass spp.	0	0	0	11
	LECI4	5	6	5	2
	POSE	0	0	7	11
	grass spp.	6	11	0	0
	fescue spp.	0	4	0	0
	rice grass	0	0	7	0
	stipa spp.	19	25	0	0
	UNK M	0	0	0	2
	Annual Grass	47	33	17	31
	Perennial Grass	78	75	87	87
Forbs	AGGL	0	0	0	3
	BORAGE spp	2	3	0	0
	CHDO	22	11	5	16
	CHHA	0	0	1	0
	COPA3	0	38	0	49
	CRAC2	17	18	6	3
	CRGR3	0	0	0	4
	CUNA	0	0	1	0
	DEAN	4	18	0	24
	ERHE2	0	12	0	11
	ERUM	7	4	31	50
	EROV	9	30	5	0
	Eriogonum spp.	13	0	0	0
	GARA	27	53	9	73
	LASE	0	0	0	5
	MEAL6	0	73	0	42
	MINA	4	16	0	13
	NOTHO5	0	4	0	0
	PHHA	28	39	18	26
	Stickleaf	62	0	0	0

Forbs	TRDU	3	0	0	0
cont'd	3 Tip Parsley	0	1	0	0
	UNK Parsley	3	0	0	0
	UNK 1	8	0	0	0
	Annual Forbs	34	184	9	186
	Perennial Forbs	175	136	61	133
Woody	ARTR	17	18	28	23
	ARTRV	0	3	0	0
	ERNA10	8	4	10	1
	ERTE18	0	2	0	0
	ERV1	0	0	8	1
	RICE	1	0	0	0
	PUTR2	23	20	18	16
	Woody Species	49	47	64	41

*five potential plants, not specified

Figure 7.

Comparative Sum Frequencies for All Species Found in Surveys Conducted on the Long-term Vegetation Trends Monitoring Program's Transect LP-Control (Little Prairie Control) for the four years (1993, 1995, 1996, 2010) that the transect has been read – Craters of the Moon National Monument, Arco, Idaho.



When surveyed in June of 2010 Little Prairie Control was found to contain twenty four individual species including seven species of grass, thirteen forb species, and four woody species (Table 21). In 1996's survey twenty species were found: eight grasses, eight forbs, and four woody species. This included three grass species and three forb species not seen in 2010. In 2010's survey two grasses and six forbs were noted that were not found in 1996 (Table 22). This transect has been surveyed four times, starting in

1993. Annual grasses, perennial forbs and woody species have stayed relatively consistent through time, though there seems to have been some abnormal fluctuation in 1996. Annual forbs have alternated to an extreme between low and high abundances, and perennial forbs have shown a slight steady increase over time (Table 23).

Annual forbs showed the highest sum frequency in the transect, followed by perennial forbs, a finding consistent with previous years (Table 23). Needle and thread grass (*Hesperostipa comata* [HECO]) was the most abundant grass species found, followed by cheatgrass. The most dominant forb was groundsmoke, and the woody species with the highest abundance was big sagebrush (Table 21). No trees were seen.

Chi-squared analysis indicated a significant increase in annual forbs ($P = 0.000465258$) and in perennial forbs ($P = 9E-237$). No other group showed significant change. Sum frequency values agreed with statistical analysis (Figure 7).

Transect LP-C2: Little Prairie Complete Burn

Table 24.

Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) – Craters of the Moon National Monument, Arco, Idaho, 2010.

	Species	10x10	25x25	25x50	50x50	Total
Grasses	BRTE	25	16	15	8	64
	ELELE	2	1	3	3	9
	HECO	17	22	15	10	64
	LECI4	4	3	2	3	12
	Needlegrass spp.*	7	6	9	7	29
	POSE	0	0	0	1	1
	UNK 1	0	1	0	1	2
Forbs	CHDO	3	15	14	15	47
	COPA2	3	4	3	13	23
	CRAC2	0	0	2	2	4
	CRGR3	0	2	0	2	4
	ERHE2	0	0	1	1	2
	EROV	0	1	0	0	1
	ERUM	10	6	3	8	27
	GARA	22	27	10	9	68
	LASE	0	1	1	7	9
	MACA	0	1	0	0	1
	MEAL	0	3	6	7	16
	PECY3	1	4	6	13	24
	PHHA	12	24	12	21	69
	THISTLE	0	0	0	1	1

Woody	ARTRV	5	5	3	12	25
	ERNA	0	0	0	1	1
	ERVI	0	0	1	4	5

*HECO1: Long awns and pollen sacs, similar to HECO

Table 25.

Comparative Plant Species Frequency Data for 100 Plots in the Long-term Vegetation Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) between 2004 and 2010 – Craters of the Moon National Monument, Arco, Idaho.

	Species	10x10 2004	10x10 2010	25x25 2004	25x25 2010	25x50 2004	25x50 2010	50x50 2004	50x50 2010	Total 2004	Total 2010
Grasses	BRTE	5	25	8	16	2	15	4	8	19	64
	CADO	0	0	1	0	0	0	0	0	1	0
	ELELE	0	2	0	1	0	3	0	3	0	9
	LECI4	3	4	5	3	2	2	7	3	17	12
	Needlegrass 1	0	7	0	6	0	9	0	7	0	29
	POSE	1	0	3	0	1	0	3	1	8	1
	SIHY	2	0	1	0	0	0	0	0	3	0
	STCO3	0	0	1	0	0	0	0	0	1	0
	STIPA	26	0	45	0	10	0	5	0	86	0
	STOC	0	0	2	0	0	0	0	0	2	0
	UNK 1	0	0	0	1	0	0	0	0	0	1
Forbs	BORAGE	0	0	0	0	3	0	3	0	6	0
	CHDO	20	3	33	15	14	14	11	15	78	47
	CHENOP	0	0	0	0	0	0	1	0	1	0
	COPA2	1	3	8	4	7	3	11	13	27	23
	CRAC2	1	0	0	0	1	2	2	2	4	4
	CRGR3	0	0	0	2	0	0	0	2	0	4
	ERHE2	0	0	0	0	0	1	1	1	1	2
	EROV	1	0	7	1	0	0	5	0	13	1
	ERUM	0	10	0	6	1	3	1	8	2	27
	GARA	0	22	0	27	0	10	0	9	0	68
	GAYOPH	0	0	9	0	7	0	19	0	35	0
	MACA	0	0	0	1	0	0	0	0	0	1
	MEAL	0	0	2	3	0	6	2	7	4	16
	NIAT	1	0	2	0	5	0	4	0	12	0
	PECY3	4	1	5	4	4	6	8	13	21	24
	PEDED2	1	0	0	0	0	0	0	0	1	0
	PHHA	13	12	38	24	17	12	13	21	81	69
	THISTLE	0	0	0	0	0	0	0	1	0	1

Woody	ARTRV	0	5	1	5	4	3	2	12	7	25
	CHVI	0	0	1	0	0	0	0	0	1	0
	ERNA	0	0	0	0	0	0	0	1	0	1
	ERVI	0	0	0	0	0	1	0	4	0	5

Table 26.

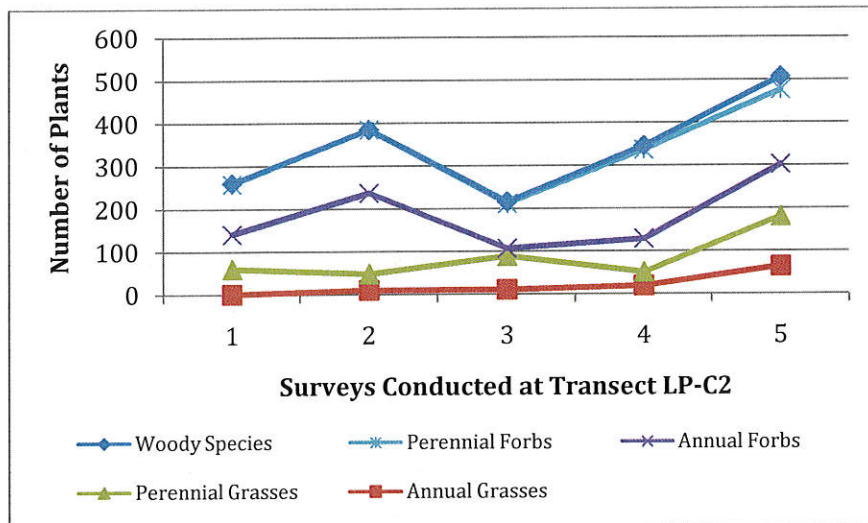
Comparative Sum Frequencies for All Species Found in Surveys Conducted in the Long-term Vegetation Trends Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) 1994-2010 – Craters of the Moon National Monument, Arco, Idaho.

	Species	1994	1995	1996	2004	2010
Grasses	BRTE	1	10	11	19	64
	CADO	0	0	0	1	0
	ELEL	3	0	3	0	9
	HECO	0	45	23	86	66
	GRASS	3	16	0	0	0
	LECI4	14	13	13	17	12
	Needlegrass spp.	0	0	0	0	29
	POSE	0	2	0	8	1
	SIHY	0	0	0	3	0
	STCO3	4	7	10	1	0
	STOC	34	0	52	2	0
	STWE	1	0	0	0	0
	Annual Grasses	1	10	11	19	64
	Perennial Grasses	59	38	78	32	117
Forbs	AGOSERIS	0	3	0	0	0
	ANNUAL FORB	1	0	0	0	0
	BORAGE	4	41	0	6	0
	CHDO	5	27	25	78	47
	CHENOP	1	1	0	1	0
	COPA2	0	11	9	27	23
	CRAC2	16	24	13	4	4
	CRGR3	0	0	0	0	4
	ERHE2	0	0	0	1	2
	EROV	0	0	0	13	1
	ERUM	0	0	0	2	27
	GAYOPH/GARA	32	88	4	35	68
	HALOGENTEN	1	0	0	0	0
	LASE	0	0	0	0	9
	LIRU	3	0	2	0	0

Forbs	MACA	0	0	1	0	1
cont'd	MEAL	49	80	4	4	16
	MINA	0	10	0	0	0
	NIAT	0	0	0	12	0
	PECY3	1	0	3	21	24
	PEDED2	0	0	0	1	0
	PHHA	4	50	60	81	69
	SENECIO	0	2	2	0	0
	WILD TB	8	0	0	0	0
	Annual Forbs	81	189	18	78	121
	Perennial Forbs	117	148	105	208	174
Woody	ARTRV	0	0	1	7	25
	CHNA	0	0	3	0	0
	CHVI	2	0	0	2	0
	ERNA	0	0	0	0	1
	ERVI	0	0	0	0	5
	Woody Species	2	0	4	9	31

Figure 8.

Comparative Sum Frequencies for All Species Found in Surveys Conducted in the Long-term Vegetation Trends Monitoring Program's Transect LP-C2 (Little Prairie Complete Burn) for the five years (1994, 1995, 1996, 2004, 2010) the transect has been read – Craters of the Moon National Monument, Arco, Idaho.



When surveyed in June of 2010 Little Prairie Complete Burn 2 was found to contain twenty three different plant species including seven grass species, thirteen forb species, and three woody species (Table 24). In the survey conducted in 2004 twenty four species were found, including eight grass, fourteen forb, and two woody species. This

included five grass, five forb, and one woody species not seen in 2010. 2010's survey included three grass, four forb, and two woody species not seen in 2004 (Table 25). This transect has been surveyed five times starting with 1994. Annual and perennial grasses have both risen steadily over time. Annual and perennial forbs show a less consistent trend than the grasses, but both show general increase over time. Woody plants have dramatically increased, especially between the two most recent surveys (Table 26).

Perennial forbs showed the highest sum frequency in the transect, followed by annual forbs and perennial grasses at a short distance (Table 26). Cheatgrass and needle and thread grass tied for most common grass species, scorpionweed (*Phacelia hastata* [PHHA]) was the dominant forb followed closely by groundsmoke, and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana* [ARTRV]) was the most abundant woody species (Table 24). No trees were seen.

Chi-squared analysis indicated significant changes in all groups. Annual grasses ($P = 0.00319$), annual forbs ($P = 1.4348\text{E-}14$), and woody species ($P = 8.72\text{E-}27$) all increased. Perennial grasses ($P = 1.69\text{E-}21$) and perennial forbs ($P = 0.000137$) both decreased. These results agreed with those shown by sum frequency values (Figure 8).

Transect Height

Figure 9.

Average transect heights for the five transects in which plot height was measured in 2010– Craters of the Moon National Monument, Arco, Idaho.

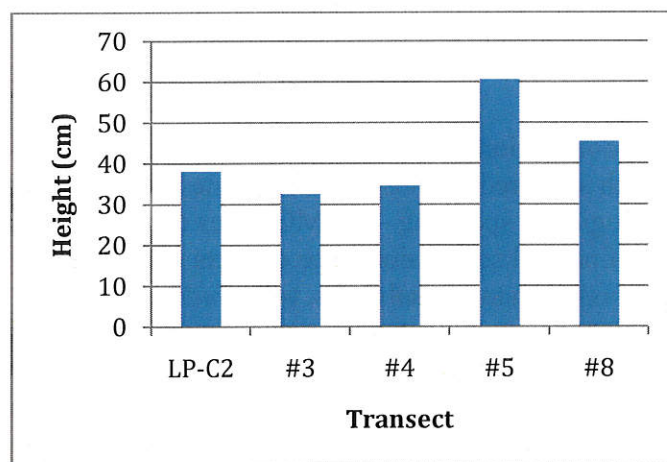
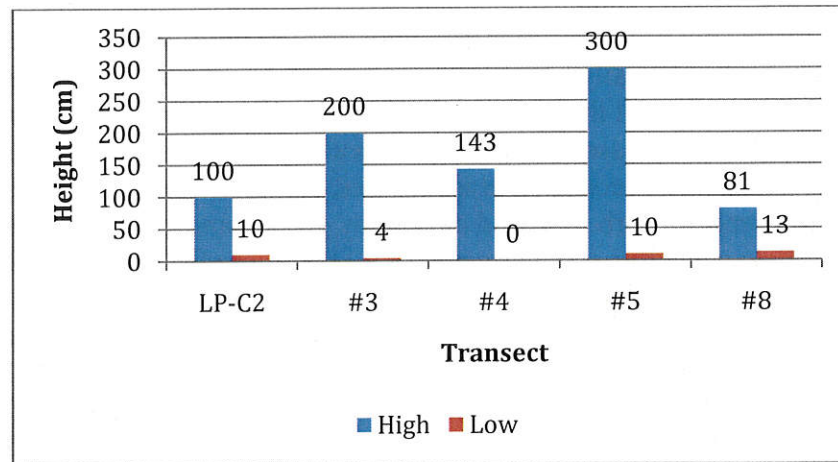


Figure 10.

Transect greatest and smallest measured height for the five transects in which plot height was measured in 2010– Craters of the Moon National Monument, Arco, Idaho.



Variation in average plot height was seen between all five of the transects in which height was measured for each plot in 2010 (Figure 9). All plots showed a difference between greatest and least heights measured, with the transects placed in environments that support limber pine and Douglas fir - #3, #4, and #5 – showing larger differences than those whose tallest plants were those found in sagebrush steppe (Figure 10).

Discussion

Craters of the Moon National Monument and Preserve is composed primarily of extensive lava flows with scattered islands of cinder cones and sagebrush. A relatively “new” landscape – geologically speaking – CRMO gives ecologists a unique opportunity to observe the process of natural succession. One expects under ideal conditions to see first bare cinder, then grasses, then annual forbs, followed by perennial forbs, woody species, and eventually large trees. Vegetation monitoring is useful for this, and also in determining the effects of grazing, the after-effects of and land regeneration resulting from fire, and the expansiveness of invasive exotics. In addition, vegetation monitoring allows managers to determine whether desired conditions as laid out in the CRMO Management Plan are being achieved. The transects surveyed this year were all on Park (rather than BLM) land and covered the majority of the variety of ecosystems existent in Craters of the Moon.

Transect #3: Douglas Fir/ Grassy Cone

Figure 11.

Photo from Starting Pole of Transect #3 (Douglas Fir/ Grassy Cone), taken 7/08/2010.



The Douglas Fir/ Grassy Cone transect is located on a relatively older cinder cone that has developed ecologically to the point of having large Douglas fir and limber pine trees (Figure 11). The area of the transect is not known to be grazed by livestock, has not experienced fire in recent memory, and has little to no occurrence of non-native plants including cheatgrass. Major differences were seen in the composition of grass species between the survey conducted in 2004 and that conducted in 2010 (Table 4). Part of this could be due to misidentification, but as inconsistencies also exist between all five of the surveys conducted so far and the past two surveys were taken so far apart it could also be that the changes are a result of a true change in species composition or that the surveys were taken at slightly different times of the year or that growing seasons varied slightly between years resulting in the proliferation of different species each survey. The one grass that has been consistently found at the transect is bluebunch wheatgrass (*Agropyron (Pseudoegneria) spicatum* [AGSP/PSSP]).

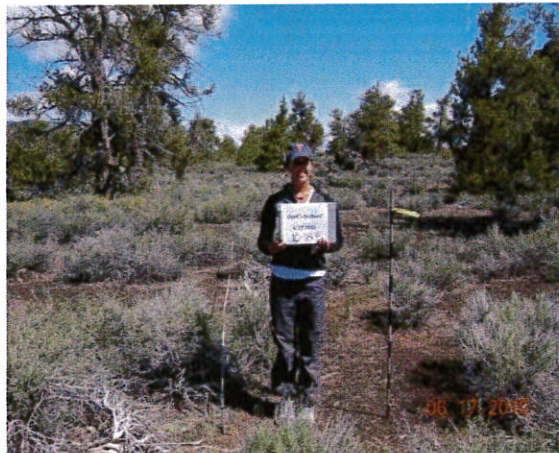
Despite some variation in grass species named, grassy cone has exhibited relative consistency both in species composition in the numbers present in each group. Woody species exhibited a statistically significant change, but the numbers of understory woody shrubs have historically been rather low with the exception of one outlying survey (Table 5). With lower numbers it is easier to see change of statistical significance as small variations can have a large impact. In the case of this survey, the difference can be largely attributed to an increase in Utah snowberry, though the abundance of that species was not out of alignment with findings of surveys conducted before 2004. Grassy cone supports both Douglas fir and limber pine trees, with Douglas fir being the more dominant of the two species. This year's survey showed that Douglas firs increased in number but decreased in basal area and average DBH, indicating that there are more trees but that the trees present are younger and smaller. With the exception of the findings of 2004, which show no presence, limber pines appear to be following a predictable growth rate. The 1993, 1997, and 2000 surveys show a slight but noticeable decrease in tree number but increase in average DBH indicating that there are fewer trees present and that the trees there are older and larger (Table 7). Also seen at Grassy Cone, but not within the transect, were Leopard Lily (*Fritillaria atropurpurea* [FRAT]), Anderson's larkspur, scorpionweed, desert rockcress (*Arabis lignifera* [ARLI]), and rock flax (*Linum rupestre*

[LIRU]). Overall, this transect followed expectations for an older, more established cinder cone ecosystem in its lack of variation and group composition.

Transect #4: Cinder Garden/ Devils Orchard

Figure 12.

Photo from Starting Pole of Transect #4 (Cinder Garden/ Devil's Orchard), taken 6/17/2010.



The Devils Orchard transect is located on a flat stretch of cinder garden on the Devils Orchard lava flow (Figure 12). The area of the transect is not known to be grazed by livestock, has not experienced fire in recent memory, and has little to no occurrence of non-native plants including cheatgrass. The findings of this year's survey were in all ways consistent with previous records. Here grass species have presented some issues, though not to the extent of grassy cone. Records agree that the genus *Stipa* (*Achnatherum*) is dominant in the transect, but whether the species is *thurberianum* or *occidentalis* is up for debate. The 2000 survey took the route of not specifying species but categorizing all as *Stipa*, which if continued may alleviate some confusion. Numbers of annual and perennial forbs have risen slightly over time and remained fairly consistent, though perennial forbs showed a fairly extreme jump in numbers in 2000. Forb species come and go to a small extent, but the dominant species have continuously been dwarf monkeyflower and groundsmoke (Table 10). It is at this transect that surveyors in 2010 first came across the difficulty of differentiating between species of groundsmoke, resulting in all being lumped into the same category. This issue has also occurred in previous years. After re-checking the site several times later in the season still no difference could be observed and it should be considered that there may only be one species with extremely slight morphological variation present at Devils Orchard.

Woody species abundance remained consistent. Rubber rabbitbrush was found in higher numbers than the 2004 survey, but not to such an extent that it did not fit the trend shown since the site was first surveyed. No statistical significance was found among any of the groups, indicating that the environment has remained fairly stable in terms of species composition and abundance. The limber pine count in the transect decreased by a third from 2004 and was at the lowest yet recorded, though mean DBH and basal area were not affected in the same way and mean DBH rose slightly (Table 12). This indicates on paper a continuing presence of a few older/larger trees and a lack of smaller trees though in fact there were a number of saplings too small to be included in the count.

Transect #5: Limber Pine/ Inferno Cone

Figure 13.

Photo from Starting Pole of Transect #5 (Limber Pine/ Inferno Cone), taken 6/21/2010.



Inferno cone (Figure 13) is a geologically younger cinder cone than grassy cone. The cone's north/ north-eastern face has its heaviest vegetation cover, including limber pines. The area of the transect is not known to be grazed by livestock, has not experienced fire in recent memory, and has little to no occurrence of non-native plants including cheatgrass. The grass genus *Acnatherum* again has historically presented challenges in species identification, with different surveys identifying *A. hymenoides*, *A. thurberianum*, and *A. occidentale*. *A. occidentale* is the only *Acnatherum* species to be identified in all surveys to date. The most abundant grass every year surveyed has been Sandberg's bluegrass, and perennial grass abundance has stayed fairly consistent with the exception of 2002 where a 25% increase was noted. This could be due to unusual precipitation in that year or to the time of year the survey was undertaken. A significant increase in perennial forbs and a significant increase in annual forbs was noted but the composition of the groups has not significantly changed. Maiden blue-eyed Mary, Anderson's larkspur (*Delphinium andersonii* [DEAN]), groundsmoke, and scorpionweed have consistently been the most common forbs and this trend was seen to continue in 2010. The only previously dominant forb whose presence was seen to drop was Sukdorf's monkeyflower (*Mimulus sukdorfii* [MISU]) (Table 15). As MISU was commonly observed at Devils Orchard and in other parts of the park at this time it is unlikely that this change has anything to do with time of year of the survey.

Antelope Bitterbrush was for the fifth survey in a row the most common woody species present at Inferno Cone. Wax currant (*Ribes cereum* [RICE]) and rubber rabbitbrush have in the past been tied for second most dominant woody species: in this survey rabbitbrush numbers dropped while wax currant abundance remained the same (Table 15). Only one other year of tree data could be located for this transect. Older records should be re-checked in order to verify that their tree sheets have not been overlooked. Between 2002 and 2010 the density of limber pine dropped by over 50%. The mean DBH remained consistent while basal area dropped (Table 17), indicating the presence of fewer but larger trees. This is in keeping with the theory that as a cone develops there will be slightly fewer, older trees but as there is no intermediary data for the eight year that passed between surveys it remains to be seen if this is in fact the case

or if there was a disruptive event such as a major wind storm between surveys that took out a portion of the trees.

Transect #8: Three-Tip Sagebrush/ Carey Kipuka

Figure 14.

Photo from starting point of Transect #8 (Three-tip Sagebrush/ Carey Kipuka), taken 6/23/2010.



Carey Kipuka (Figure 14) is one of the least disturbed areas of Craters of the Moon. Along with Brass Cap, Sand, and Big Juniper Kipukas, Carey Kipuka has been designated as a Research Natural Area for its long-term value as a reference area (USDOI and NPS 2007). The kipuka is naturally protected by encircling a lava; the shortest path to the kipuka is a $\frac{3}{4}$ mile lava crossing. Because of this protection grazing does not occur and human presence is limited to a few adventurous ecologists and interns. The invasive exotic cheatgrass has been found in increasing abundance in the kipuka every year that it has been surveyed. The 2010 survey was the first in which cheatgrass outnumbered all individual perennial species except Idaho fescue. Idaho fescue and prairie Junegrass have historically been the most abundant of the grasses at Carey Kipuka and they remained the dominant perennial grasses. Both annual and perennial grasses showed statistically significant increases (Table 20).

Annual forbs increased in abundance, though they did not outstrip perennial grasses in number, and perennial forbs decreased significantly. Groundsmoke remained the most abundant forb, in keeping with past years. Tiny trumpet (*Collomia linearis* [COLI2]) was the second most abundant for its second survey after dropping in abundance in 2004. Douglas' knotweed (*Polygonum douglasii* [PODO4]) increased in abundance while longleaf phlox (*Phlox longifolia* [PHLO2]) decreased from previous years. Woody species do not have an exceptionally large presence or variety, but a steady number of big mountain sage have been counted every survey. No rabbitbrush was seen during this survey (Table 20). The main concern brought up by this survey of Carey Kipuka is the increasing presence of cheatgrass. While disturbance of the area is rare windborne grass seeds have still managed to find a way into the kipuka and are competing with native plants in a concerning manner. Also seen at Carey Kipuka but not within the transect were antelope bitterbrush, scabland penstemon (*Penstemon deustus* var. *deustus* [PEDEDE2]), big mountain sage, arrow-leaved balsamroot, and yellow salsify (*Tragopogon dubius* [TRDU]).

Transect LP-Control: Little Prairie Control

Figure 15.

Photo from starting point of Transect LP-Control (Little Prairie Control), taken 6/24/2010



Following the 1992 Little Prairie burn five transects were established in order to determine the pace of land regeneration and to compare the vegetative composition of completely burned, partially burned, and unburned areas of little prairie in the Craters wilderness area. This transect (Figure 15) was untouched by the fire and is meant to act as a base to which the partially and completely burned transects can be compared. As hoped, the control transect has remained fairly steady in terms of species abundance and composition. 1996 showed an abnormal dip in abundance of annual and perennial forbs, potentially because of lack of precipitation in that area in that year. Annual and perennial forbs have increased significantly since this drop, raising their abundances to previously observed levels (Table 23). Identification to species of perennial grasses has been an issue every time this survey has been conducted, primarily because transect location makes bringing out a press inconvenient and travel time makes bringing live plants back difficult. Needle and thread grass has consistently been among the most abundant of the control burn grasses and was among the dominant species found in this year's survey.

Maiden blue-eyed Mary has over the four surveys conducted alternated between not being found on the transect and having a dominant presence: this year it was dominant. Sulfur-flower buckwheat (*Eriogonum umbellatum* var. *umbellatum* [ERUM]) was equally abundant, and has grown in number over the four surveys taken so far. The most dominant species was groundsmoke, as has been the case every year except 1996. With the exception of 1996 forb species present have been consistent, though abundance of each may have changed. Antelope bitterbrush and big sagebrush were and have always been recorded as the most common woody species, with the occasional rabbitbrush species (Table 23). Overall, the control transect has maintained the consistency that was hoped of it as a baseline transect.

Transect LP-C2: Little Prairie Complete Burn

Figure 16.

Photo from starting point of Transect LP-C2 (Little Prairie Complete Burn), taken 6/24/2010.



Following the 1992 Little Prairie burn five transects were established in order to determine the pace of land regeneration and to compare the vegetative composition of completely burned, partially burned, and unburned areas of little prairie in the Craters wilderness area. This transect (Figure 16) is one of two that was completely burned in the fire and is meant to be compared to the control transect in order to help ecologists understand succession after fire in this area. 1996 showed an abnormal dip in abundance of annual and perennial forbs, potentially because of lack of precipitation in that area in that year. As expected, the complete burn transect showed significant change in all groups, rebounding from the 1996 drop and then some. Cheatgrass increase in 2010 was recorded at more than three times what was seen in 2004, almost five times 1996's record. In addition, the complete burn transect had twice as much cheatgrass recorded as the control transect. Needle and thread has remained the most abundant perennial grass, and the numbers of the group as a whole have increased significantly (Table 26). Overall grass abundance is almost twice as high in the complete burn as in the control transect.

Groundsmoke was and has consistently been the most common forb, followed by scorpionweed. Douglas' dustymaiden (*Chaenactis douglasii* [CHDO]) dropped in abundance from 2004 but in 2010 was still more abundant than it had been in 1996 and earlier (Table 26). The common forb species found in the burn transect echo those found in the control transect. The burn transect was found to have slightly more perennial forbs and slightly fewer annual forbs than the control; this could be true for the areas as a whole or it may be more of a reflection of the specific locations of the transects. The number of woody species present in the burn transect has risen over time, with a distinct increase in the last six years. Abundance of woody species is not as high as that of the control, and as plot height measurements were not taken of both transects it cannot be known if the plants counted were more commonly mature or seedlings. No trees were seen at either the control or complete burn.

Transect Height

Transect height was as variant between transects as the environment of the transects. This measurement excluded trees overhanging plots whose height could not be accurately measured or estimated. For this reason the average of transect #3 (Douglas

Fir/ Grassy Cone) was taken out of 97 plots rather than 100 and the average of transect #5 (Limber Pine/ Inferno Cone) was taken out of 99 plots, and the average of transect . The transects whose environment supported limber pine and Douglas fir - #3, #4, and #5 – displayed the highest average plot height (Figure 9) and the greatest recorded plot height (Figure 10). While plot height could be a good indicator of some of the differences between the control and burned transects in Little Prairie this year we did not have time to take height measurements of LP – Control. Future surveys should compare average and high/low height measurements within transects between years in order to better understand the change in the transect between years.

Recommendations:

There remain several issues with the analysis of data from the 2010 native vegetation monitoring, almost all stemming from the fact that all transects had been unobserved for at least six years prior to the 2010 surveys. While conclusions were drawn to the best of the surveyors' knowledge this is a large time gap and any number of events, such as wind storms or years of greater or less than average precipitation, could have occurred and gone undocumented in the context of this monitoring program. It is also true that transects have historically been read at different times of the year depending on staff availability and so some changes may be more realistically attributed to these discrepancies than to changes in transect environment. It should also be noted that as transects cover only part of any particular area there may be commonly present species that are completely missed in transects. Future surveys would optimally plan time to return to sites to check grass species for better identification as field identification was not always certain due to time restraints and what stage the plants were in and if the survey sheet (and protocol) were altered to include notes on any species that were observed at the survey site but not within the transect.

While the plan behind the native vegetation monitoring is fairly sound yearly differences in funding, personnel, and park focus have meant that the rotation schedule for transect monitoring has not been followed well and that surveys have been conducted inconsistently. The general setup seems to have been followed consistently, with the exception of when the transects are surveyed. Craters of the Moon has a fairly short growing season, and any surveys conducted too late in the year will miss a good portion of the plant life, especially of the annual forbs which tend to die off fairly quickly. In addition, surveys conducted at different times during the spring/ summer may show remarkably different plant abundances as certain species will have bloomed while others may have yet to bloom or have passed already.

Carey Kipuka and the two burn transects surveyed, LP-Control and LP – C2, all displayed increasing abundances of cheatgrass. Treatment of this invasive would be optimal; however the three transects are inconveniently located. We do not as yet have a good method of controlling cheatgrass, and the three areas are too far away from the central area of the park to be monitored consistently during or after treatment. The areas' remote locations do have a positive side, however, as it will not be necessary to restrict access to them in an attempt to control invasive species as they are already rarely visited.

Trees appear to have been a trying point for many surveyors both historically and in 2010. Creating a more specific protocol for how to analyze tree data, especially where

to include dead/dying trees and potentially separating trees into age/size groups could be helpful in compiling more statistically useful and ecologically relevant data.

Finally, it would be helpful for future researchers if all past data sheets and reports were scanned and placed in a single file where they would be easily accessible to surveyors before they start the project. Craters of the Moon National Monument and Preserve's long-term vegetation monitoring project has a lot of potential for usefulness and success, and with a few minor adjustments both to the project and its implementation could easily meet and even exceed expectations.

LITERATURE CITED

- Bell, M. and P. Wolken. 2004. *2004 Long-Term Vegetation Trend Monitoring, Craters of the Moon National Monument*.
- Majors, S. 2000. *Long-Term Vegetation Trend Monitoring at Craters of the Moon National Monument and Preserve*.
- Sparhawk, S. 1992. *Background and Standard Operating Procedures, Craters of the Moon Vegetation Transects*.
- United States Department of the Interior and the National Park Service. 2007. *Craters of the Moon National Monument and Preserve Management Plan*.

Appendix 1.

Timeline of long-term vegetation monitoring surveys. Boxes indicate when transects were to have been surveyed according to the original plan, gray boxes indicate when transects were actually surveyed.

Site	Description	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Aspen/ Research Camp																			
5	Limber Pine/ Inferno																			
3	Douglas Fir/ Grassy Cone																			
6	BLM/ East																			
2	Sagebrush/ North End																			
8	ARTETRIP / IDFE - Carey Kipuka																			
4	Cinder Garden/ Devils Orchard																			
7	BLM - West																			
C1	Little Prairie - Burn																			
C2	Little Prairie - Burn																			
P1	Little Prairie - Burn																			
P2	Little Prairie - Burn																			
CTRL	Little Prairie - Burn																			

