An Inventory, Assessment, and Recommended Management of Sagebrush Steppe Vegetation in Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument and Preserve, Idaho.

Louis P. Jurs, Northwest Natural Resource Services, Spokane, WA

Alan R. Sands, The Nature Conservancy, Boise, ID



QH
541.5
.S18
J87
RES

March 11, 2004

CRMO-RES

Acknowledgements

We gratefully acknowledge the following individuals for taking the time from their busy schedules to review the draft document. Their critical review and insightful comments were especially helpful in identifying and characterizing biotic integrity states and thresholds in the study area.

Ann Debolt, Botanist, *USDA Forest Service, Rocky Mountain Research Station, Boise, ID*

Julie Hilty, Botanist, *USDI Bureau of Land Management, Shoshone Field Office, Shoshone, ID*

Codie Martin, Rangeland Management Specialist, *USDI Bureau of Land Management, Shoshone Field Office, Shoshone, ID*

Steve Monsen, Botanist, *USDA Forest Service, Rocky Mountain Research Station, Provo, UT* (retired)

Mike Pellant, Great Basin Restoration Initiative Lead, *USDI Bureau of Land Management, Idaho State Office, Boise, ID*

Joseph Russell, Fire Use Specialist, *USDI Bureau of Land Management, Shoshone Field Office, Shoshone, ID.*

Nancy Shaw, Botanist, *USDA Forest Service, Rocky Mountain Research Station, Boise, ID*

Rick Vandervoet, Craters of the Moon Monument Manager, *USDI Bureau of Land Management, Shoshone Field Office, Shoshone, ID.*

We would also like to express our sincere appreciation to Carol Jurs and Carolyn Strickling for their untiring assistance in compiling and organizing the data, and editing this manuscript. The GIS help received from Anne Dalton and Denise Tolness is greatly appreciated. Thanks to Robert Kinchey for his able assistance with field data collection.

Cover Photo. A good condition threetip sagebrush/Idaho fescue ecological site in northern Laidlaw Park. Average foliar cover – threetip sagebrush 25%, key native perennial bunchgrasses 62%, native perennial forbs 14%, cheatgrass 6% (Transect LPT-82, Photo 06-18).

Table of Contents

EXECUTIVE SUMMARY 5

INTRODUCTION 7

STUDY AREA 7

METHODS 12

Field Mapping and Vegetation Sampling 12

Data Summary and Analysis 14

RESULTS 15

Paddelford Flat 15

Little Park 18

Laidlaw Park 21

DISCUSSION 28

Management Assumptions 28

Ecological Frame of Reference 28

Rating Biotic Integrity 31

MANAGEMENT RECOMMENDATIONS 33

Fire Management 33

Seeding Treatments 37

Livestock Grazing Management 38

Noxious Weeds 39

Unique Areas 40

Wildlife 41

CONCLUSION 41

LITERATURE CITED 43

Figures

Figure 1 Laidlaw Park, Little Park and Paddleford Flat Vegetation Study Area 8

Figure 2 Craters of the Moon Precipitation 10

Figure 3 Paddelford Flat vegetation polygons and vegetation transect locations 16

Figure 4 Little Park vegetation polygons and vegetation transect locations. 19

Figure 5 Laidlaw Park vegetation polygons and vegetation transect locations. 22

Figure 6 Biotic integrity of plant commun. in Laidlaw Park, Little Park, and Paddelford Flat. 34

Tables

Table 1 Paddelford Plat vegetation polygons and average species foliar cover. 9

Table 2 Little Park vegetation polygons and average species foliar cover. 20

Table 3 Laidlaw Park vegetation polygons and average species foliar cover. 23

Table 4 Vegetation composition and percent cover of relict, recovering, and seeded ecological sites. 29

Table 5 Characterization of biotic integrity of sagebrush steppe ecological sites in Laidlaw Park, Little Park, and Paddelford Flat. 32

Table 6 Key ecological attributes and biotic integrity ratings for vegetation communities in Laidlaw Park, Little Park, and Paddelford Flat. 35

Table 7 Summary of biotic integrity ratings, Laidlaw Park, Little Park, and Paddelford Flat. 42

Appendices

Appendix I Plant species symbols and names.

Appendix II Paddelford Flat step-point vegetation transects and species foliar cover.

Appendix III Little Park step-point vegetation transects and species foliar cover.

Appendix IV Laidlaw Park step-point vegetation transects and species foliar cover.

Appendix V Laidlaw Park ocular reconnaissance sites and species foliar cover estimates.

Appendix VI Laidlaw Park photo locations.

Appendix VII Areas recommended for ecological reference, trend studies, and potential exclosures.

Appendix VIII Incidental wildlife sightings.

Appendix IX CD –Report, supporting data, and photos

An Inventory, Assessment, and Recommended Management of Sagebrush Steppe Vegetation in Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument and Preserve, Idaho

Louis P. Jurs, Northwest Natural Resource Services, Spokane, WA

Alan R. Sands, The Nature Conservancy, Boise, ID

Executive Summary

During the fall of 2001 and the spring of 2002, sagebrush steppe plant communities on public lands in Paddelford Flat (8,200 acres), Little Park (7,600 acres), and Laidlaw Park (84,400 acres) were assessed. Areas of similar dominant vegetation cover were first mapped into discrete polygons. Within each polygon, the vegetation was sampled at a rate of one sample per 320 acres, with a minimum of one sample for polygons less than 320 acres. Sample sites were chosen to be representative of the stand while the direction of the transect was chosen randomly. Each sample consisted of 100 points placed along a paced transect. At each sample point a 4' steel pin was lowered vertically through the vegetation. All interceptions were recorded from top down. In Laidlaw Park, transects were supplemented with ocular reconnaissance estimates. Data obtained included foliar and basal plant cover by species, litter, biological crust, rock, and bare ground.

In Paddelford Flat, 10 polygons of similar vegetation were mapped and 33 transects completed. In Little Park, 6 polygons of similar vegetation were mapped and 20 transects completed. In Laidlaw Park, 42 polygons of similar vegetation were mapped, 110 transects completed, and 78 ocular estimates obtained.

Six ecological sites dominated the study area: 1.) Loamy, 12-16 inch ppt., mountain big sagebrush/Idaho fescue; 2.) Loamy, 12-16 inch ppt., basin big sagebrush/bluebunch wheatgrass; 3.) Loamy, 12-16 inch ppt., threetip sagebrush/Idaho fescue; 4.) Loamy, 11-13 inch ppt., Wyoming big sagebrush/bluebunch wheatgrass; 5.) Loamy, 8-12 inch ppt., basin big sagebrush/bluebunch wheatgrass; 6.) Sandy, 8-12 inch ppt., basin big sagebrush/Indian ricegrass/needle and thread grass. The vegetation composition within each of these sites varied considerably from near potential natural vegetation to highly degraded. Areas that experienced the effects of unmanaged and damaging livestock grazing primarily during the first half of the 20th century had a low coverage and diversity of key native bunchgrasses and forbs today. The exotic annual cheatgrass was present in virtually the entire study area but in some areas it was very abundant and threatened to take over. Some sites had a dense sagebrush cover that was suppressing the recovery of the herbaceous layer.

The biotic integrity of the plant communities were placed into one of three condition categories – Good, Fair, and Poor – using several biological attributes of the community. Acceptable ranges

in coverage for each attribute were estimated, as well as thresholds between categories. Fair condition communities were considered to have the ability to return to good condition with appropriate fire and livestock grazing management. On the other hand, poor condition communities were judged to have crossed a threshold and were unable to return to either fair or good condition within any reasonable timeframe without seeding intervention. Overall, within the study area, biotic integrity was judged to be 29% Good, 30% Fair, and 41% Poor.

Fire and grazing, as disturbance processes, have the potential to cause further retrogression of the plant communities in the study area. Careful management of these two factors is needed to maintain good condition areas and to facilitate recovery of those areas that have not retrogressed below a critical threshold. Although prescribed fire may be a viable tool as part of an integrated recovery or restoration program, wildfires continue to need to be suppressed. To facilitate recovery of fair condition areas, light grazing utilization with periodic rest should be implemented. For areas with a dense sagebrush canopy there is an opportunity to use livestock to assist with recovery. Fall grazing by sheep has been used successfully elsewhere to reduce the canopy of sagebrush while facilitating the recovery of the native herbaceous understory. For highly degraded sites (i.e. poor condition), restoration seeding will be required to return these communities to their productive potential. Some recent mixture seedings within the area demonstrate that the area has not lost its potential to provide a productive, diverse, and resilient sagebrush steppe community.

An Inventory, Assessment, and Recommended Management of Sagebrush Steppe Vegetation in Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument and Preserve, Idaho

Louis P. Jurs, Northwest Natural Resource Services, Spokane, WA

Alan R. Sands, The Nature Conservancy, Boise, ID

Introduction

Craters of the Moon National Monument was expanded by Presidential Proclamation on November 9, 2000, from 54,000 acres to 740,000 acres. The expansion captured most of the remaining volcanic features associated with the Great Rift, the deepest and longest land-based open volcanic rift in the continental United States. Management of the federal lands within the expanded area is shared by the National Park Service (NPS) and the Bureau of Land Management (BLM) with the BLM managing open, vegetated areas, and NPS managing lava flows and volcanic features.

Prior to the expansion of the Monument, BLM, through the process of conducting grazing allotment reviews and fire management planning, had identified the need for additional information on the biotic integrity of the plant communities within portions of the expanded monument. This information was needed to assist with the preparation of detailed restoration and fire management plans (BLM 2002, 2003). The expansion of the monument, with its requirement to prepare a master plan, provided an even greater impetus to undertake such work.

This report describes the results of an intensive vegetation inventory and assessment for Laidlaw Park, Little Park and Paddelford Flat areas within the expanded Monument. The BLM, Shoshone Field Office commissioned and provided funding for this project. This report and all supporting data are included in the enclosed CD (Appendix IX).

Study Area

The 100,200-acre study area is located in south central Idaho, approximately 15 to nearly 40 miles east and southeast of the town of Carey. Three distinct public land areas were surveyed: Laidlaw Park (84,400 acres), Little Park (7,600 acres), and Paddelford Flat (8,200 acres) (Figure 1).

These areas are characterized by sagebrush-dominated plant communities on flat to gently rolling terrain, surrounded by lava flows. The areas and other smaller openings in the lava are referred to

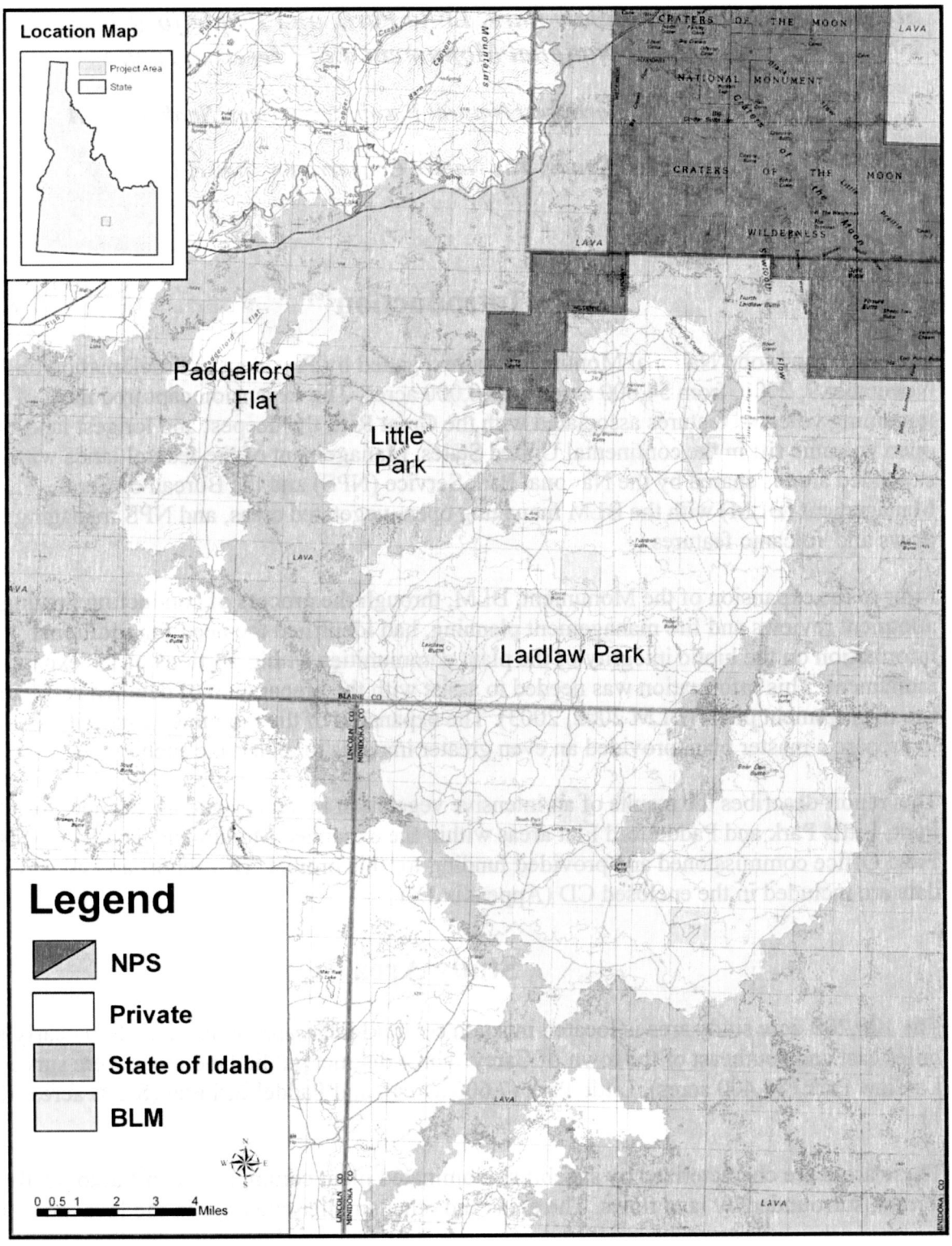


Figure 1. Laidlaw Park, Little Park and Paddelford Flat Vegetation Study Area, Craters of the Moon National Monument, ID.

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

as "parks" or "kipukas." [1] These parks are mostly federally owned with private lands (4,514 acres) and state lands (4,360 acres) making up slightly more than 8% of the area. The area is accessible via five graded gravel roads and many primitive two-track roads. Nevertheless, much of the study area is roadless and some portions have Wilderness Study Area (WSA) status.

Elevations generally increase from south to north in the study area, ranging from 4,450 feet to over 5,500 feet, with a few small volcanic cones and buttes that rise another 200 feet above the relatively flat terrain. Scattered throughout the large lava flows fringing these areas are hundreds of small fissures, basalt outcrops, and rimrocks.

Hot, dry summers and cold winters characterize the climate in the study area. Annual average precipitation ranges from about 15 inches in the northern part of study area to about 10 inches in the south. Precipitation occurs mostly during winter (as snow) and spring (as rain). Summer is the driest period, although infrequent thunderstorms do occur. Data from a nearby weather station located at the headquarters of the Monument revealed that annual precipitation was average for 2001 and about two inches below average for 2002 (Figure 2). However, spring moisture or growing season moisture (March, April, May, and June) was nearly three inches below average in 2001, but only slightly below average in 2002 (Western Regional Climate Center, unpublished data).

Soils are moderately deep to very deep, predominately derived from wind blown deposits (loess and eolian material). Soils in the northern portions of Laidlaw Park, Little Park, and Paddelford Flat are primarily loams and silt loams. Sandy loams dominate soils in the southern portions of these parks, with sandy soils occurring in a few areas (Johnson 1991).

The plant communities of this area are included in the Columbia Plateau Ecoregion (Dorfman 2001) and the Intermountain Sagebrush Province (Bailey 1995). This Province includes sagebrush-dominated plant communities in Idaho, Nevada, Oregon, and Washington and covers 90,000 square miles. Within the study area, natural and seeded plant communities predominately occur in six ecological sites (Johnson 1991), listed generally from north to south, along a decreasing moisture gradient:

Loamy, 12-16 inch ppt., mountain big sagebrush/Idaho fescue (*Artemisia tridentata vaseyana/Festuca idahoensis*).

Loamy, 12-16 inch ppt., basin big sagebrush/Bluebunch wheatgrass (*Artemisia tridentata tridentata/Agropyron spicatum*)

Loamy, 12-16 inch ppt., threetip sagebrush/Idaho fescue (*Artemisia tripartita/Festuca idahoensis*).

---

[1] A variation of the Hawaiian word "puka", meaning hole. Now the term for an island of land completely surrounded by one or more younger lava flows. A kipuka forms when lava encircles a hill or slight rise in the ground as it moves down slope or across flat ground. They are often covered with mature vegetation.(USGS, internet glossary; http://volcanoes.usgs.gov; Sept. 2000.)

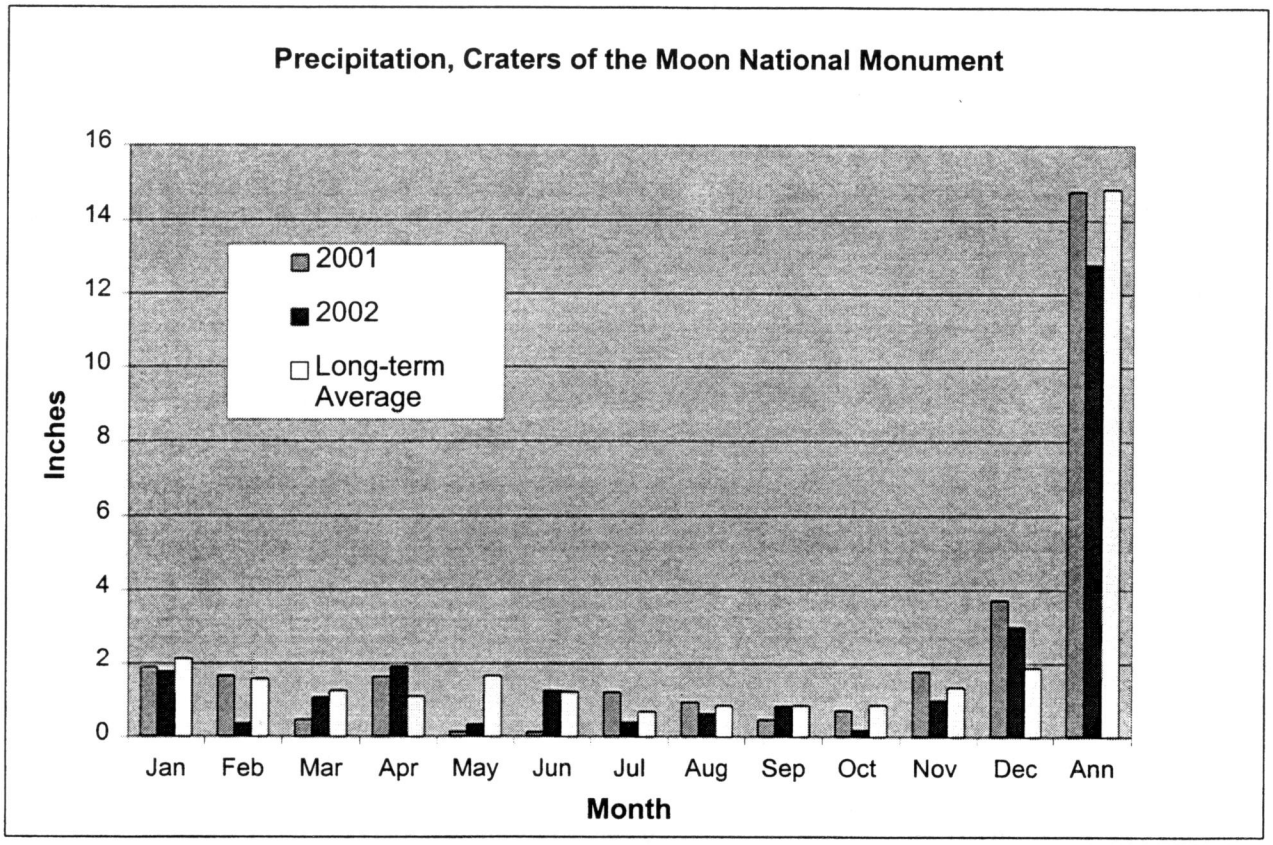


Figure 2. Craters of the Moon Precipitation

- Loamy, 11-13 inch ppt., Wyoming big sagebrush/bluebunch wheatgrass (*Artemisia tridentata wyomingensis/Agropyron spicatum*).
- Loamy, 8-12 inch ppt., basin big sagebrush/bluebunch wheatgrass (*Artemisia tridentata tridentata/Agropyron spicatum)*.
- Sandy, 8-12 inch ppt., basin big sagebrush/Indian ricegrass/needle and thread grass (*Artemisia tridentata tridentata/Oryzopis hymenoides/Stipa comata)*

Approximately 7,000 acres (8%) of Laidlaw Park and 2,100 acres (25%) of Paddelford Flat have been seeded with introduced species or a combination of native and introduced species.

Picabo milkvetch (*Astragulas oniciformis*), a Type 3 BLM Sensitive Species, is the only known rare plant to occur in the area.

Common wildlife species include pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), black-tailed jackrabbits (*Lepus californicus*), cottontail rabbits (*Sylvilagus nuttallii*), greater sage-grouse (*Centrocercus urophasianus*), various passerine birds and raptors, and Great Basin rattlesnake (*Crotalus viridus*). Rocky Mountain elk (*Cervus canadensis*) are occasionally observed.

This study area is considered a key habitat for greater sage-grouse, providing breeding, nesting and winter habitat. More than 60 sage-grouse leks (traditional sites used by groups of displaying males) have been documented but many are currently unoccupied. Sage-grouse are a designated Type 2 BLM Sensitive Species and are currently under consideration for protection under the Endangered Species Act by the U.S. Fish and Wildlife Service.

In addition to sage-grouse, sage sparrow (*Amphispiza belli*), sage thrasher (*Oreoscoptes montanus*), and Brewer's sparrow (*Spizella breweri*) are also of concern as the acreage of sagebrush habitats have declined throughout the West (Paige and Ritter 1999). Townsend's big eared bat (*Corynorhinus townsendii*), another Type 3 BLM sensitive species, is known to hibernate in lava tubes in Laidlaw Park. Pygmy rabbits (*Sylvilagus idahoensis*), a rare sagebrush steppe species also listed as a Type 2 BLM Sensitive Species, may be present (Groves et al 1997).

The current ecological situation in southern Idaho and elsewhere in the Intermountain Sagebrush Province is complex. Prior to European settlement, the vegetation was largely dominated by a complex of sagebrush communities with a perennial grass and forb understory. Infrequent and patchy fires occurred in late summer and fall after native grasses and forbs had gone to seed and entered summer dormancy. Today a significant portion of the perennial grass and forb cover has been replaced over extensive areas by exotic annual species such as cheatgrass (*Bromus tectorum)*. These annuals cure earlier, provide more continuous fuel, and are vulnerable to ignition for a longer period of time than the native perennial herbs. As a result, the frequency and scale in which natural fires occur in the entire area has increased (Whisenant1989, West 1999).

Fire, both lightning and human-caused, has shaped the plant communities in the study area. Although the fire history before the end of World War II was not systematically recorded, major fires burned most of Laidlaw Park in 1941 and 1945. Although there are no records, sheepman in the early part of the century traditionally started fires to remove brush and increase forb and grass production.[2] With improved fire suppression after World War II, no park-wide fires have occurred. However, large fires (>2,500 acs.) have occurred in parts of Laidlaw Park in 1965, 1971, 1982, and 1992 (Bureau of Land Management 2003).

Livestock grazing has occurred over most of the Province since the late-1800's. Prior to the 1950's (later in some areas), grazing was mostly unmanaged and often quite destructive. This unmanaged livestock use depleted the highly palatable native perennial herbaceous plants, allowing their replacement by exotic annual species. Consequently, most of the current plant communities in the Province differ greatly from those communities that existed prior to European settlement (West 1999).

The history of livestock grazing in the study area is somewhat different from the other more accessible areas in southern Idaho. Livestock grazing did not begin until around 1900 when early pioneers such as James Laidlaw and Ira Eldridge trailed their sheep across the lava to access the parks. Sheep exclusively used the parks until the mid-1940s when roads were constructed across the lava to provide access for cattle.[2]

---

[2] Pete Cennarrusa, personal communication

Despite the shorter period of use compared to other areas in the West, there were periods of time when grazing levels were quite high. Sheep use in Laidlaw Park prior to World War II may have exceeded one hundred thousand animals annually. Cattle use was estimated at about 2,000 animals in 1946. Nevertheless, because of the general lack of water (both distribution and time available) over much of the study area, some areas were likely used less intensively than other areas. The remoteness of Little Park and the lack of water in the northern part of Laidlaw Park may have limited the amount of heavy use that occurred during the period of unmanaged livestock use. On the other hand, southern Laidlaw Park with its scattered ephemeral playa ponds likely experienced heavy use (Bureau of Land Management 1991).

Currently, classes of livestock include cattle, sheep, and a few horses. In Paddelford Flat, cattle use the area north of the main east-west access road while sheep use the southern part of the area. Little Park is used solely by sheep (except for occasional trailing of cattle). Both sheep and cattle use Laidlaw Park. Sheep use is authorized in both the spring and fall although no fall use has occurred for many years. Cattle use occurs in spring and early summer. Laidlaw Park has had a six pasture rest rotation grazing system in place since 1992 which provides spring rest from both sheep and cattle in two pastures each year. The average number of Animal Unit Months (AUMs) used by livestock has been significantly below authorized use for more than 20 years (average 54%) but spring and early summer use has averaged 90% of authorized use (Bureau of Land Management 2003).

Methods

Field Mapping and Vegetation Sampling

The assessment was conducted in two phases. The first phase was conducted in October 2001 and included the two smaller parks, Paddelford Flat and Little Park. The larger and more complex Laidlaw Park was assessed in May and June 2002. All field mapping and vegetation sampling was conducted by senior-level natural resource scientists with broad experience and knowledge of sagebrush steppe ecology in the Province.

Investigators mapped the study area by identifying plant communities and placing them into discreet polygons of similar sagebrush steppe vegetation (i.e. similar cover of dominant overstory and understory plants). Investigators traveled through the area and used elevated vantagepoints to perform this part of the mapping task. The polygons were then delineated on 7.5USGS topographic quads. Once completed, the number of samples to be made in each polygon was determined using the standard of taking one sample per approximately every 320 acres, with a minimum sample of one transect for polygons less than 320 acres. Transect locations were subjectively chosen to be representative of the vegetation in the polygon, but the bearing of each transect was determined randomly.

After area mapping was completed, the beginning point of each transect was recorded using a GPS unit. Both transect location and bearing were entered in a data form and noted on USGS 7.5topographic maps. Color photos were also taken from the beginning point of each transect, along the line of sampling (Appendix IX). For each transect, 100 points were sampled using a modified step-point method (Interagency Technical Reference 1996). At the beginning point of

each transect the investigator proceeded along the transect bearing for three steps. At that location, the investigator vertically lowered a 4' pin (1/8" in diameter) at arm's length without looking at the pin until it touched the ground. Holding the pin in place, all interceptions with the pin were recorded from top down. Interceptions were recorded in a data form loaded into a handheld computer or personal digital assistant (PDA), using BLM's Line Point (LP) Cover software. The following categories were recorded: vegetation by plant species or genus, biological soil crust, litter, rock, or bare ground. After recording the data, the investigator moved three steps along the transect bearing and repeated the procedure. One hundred readings were taken for each transect; each transect was approximately 250 yards long. Plant nomenclature followed the format used by Hitchcock and Cronquist (1973) and plant acronyms were comprised of the first two letters of genus followed by the first two letters of the species (Plummer et al. 1977). When plants were only identified to genus, the first 5 letters of the genus were recorded. Plant codes, common, and scientific names are listed in Appendix I.

In Laidlaw Park, step-point transects in large vegetation polygons were supplemented with ocular reconnaissance estimates of plant cover (Interagency Technical Reference, 1996). Ocular estimates were based on a "rolling average", which can be defined as walking through an evaluation locality noting the species and then estimating the cover of each species. The ocular locations were marked on the field maps, and the data were recorded on field write-up forms. To reduce the potential for significant error, these estimates were obtained after conducting the quantitative step-point transects in the same vegetation polygon. Ocular estimates and step-point transect data were included in deriving the average vegetation composition for each polygon.

Information noted on the field maps (USGS 7.5topographic quads) showed vegetation type boundary lines (i.e. polygon boundaries), transect location and direction, and other features observed in the study area. The type lines were based on field observations of major changes in plant community, principally the dominant overstory species and cover. In some locations, type lines were represented as dashed lines. Dashed lines (labeled "ETL") indicated an approximate location, when the boundaries were not actually located from vehicle or on foot, or were not readily distinguishable with available aerial photography. In addition, noxious weed infestations, wildlife sightings, and sheep bed ground locations were noted on the maps.

Although extensive data were collected and recorded, investigators did encounter some limitations while conducting fieldwork in the study area:

- Mapping limitations: Vegetation polygons were mapped based on areas of similar existing vegetation cover. Boundaries were determined by use of ground-level visual observations, odometer tracking, and dated aerial photography. These polygon boundaries were not exact because of the difficulty in accessing some areas, the lack of sufficiently elevated sites to provide good vantage, and unavailability of current, large-scale color aerial photography or other imagery.

- Method limitations: The modified step-point interception method is a relatively simple and easy to use method that yields quantitative information. Large areas can be sampled, particularly if the cover is relatively uniform as it is in the study area. It is suitable for measuring major characteristics of the vegetation and ground cover of an area. However, for samples of 200 points or less, species with low cover values may not be "hit" on transects

and, therefore, do not show up in the study records. Also, if a hit does occur, the hit may not represent the actual average cover in the area. The ocular estimate method does a better job of identifying species richness and trace coverages but the cover values of major species are estimated and subject to error among different observers.

- Data limitations: During the growing season in 2001, the study area experienced well below average precipitation. Consequently, the amount of vegetation cover was likely lower than what it would be during periods of average or above average precipitation. Certain forbs and cheatgrass are especially sensitive to the amount and timing of precipitation. In addition, late season data collection likely resulted in somewhat lower cover values due to plant desiccation and livestock utilization.

  In 2002, early season data collection made some grass and forb identification difficult, due to a lack of critical features for some taxa. Some bunchgrasses and rhizomatous grasses appear similar in the vegetative state and require seed heads for rapid identification. For example, western wheatgrass (*Agropyron smithii*) and thickspike wheatgrass (*A. dasystachyum*) exhibit similar growth forms, and their separation was nearly impossible early in the project. Consequently, these two grass species were recorded as AGROP on data collection sheets. At the altitude and latitude where the field sampling was conducted, postponing fieldwork in the south for another 10 days would have been a more appropriate sampling period. In addition, a time lag of approximately two weeks in phenological development was observed from the south end of Laidlaw Park to the north end.

For the purposes of this assessment, the limitations in mapping, methodology, and data did not seriously affect the utility of the data in assessing the current condition of the plant communities or in identifying appropriate management recommendations.

Data Summary and Analysis

Data collected included foliar and basal plant cover by species or genus, and ground cover (plant, litter, biological soil crust, rock, and bare ground). Raw field transect data and summary plant cover and ground cover tables were downloaded from the PDA into individual Excel files (Appendix IX – CD). Data were assembled into individual vegetation polygons and the species were organized by life forms (e.g. shrubs, perennial grasses and grass-like plants, annual grasses, perennial forbs, and annual forbs). For polygons with more than one transect, individual cover values for each species were averaged. Polygon data summaries for Laidlaw Park depict the average of both step-point and ocular transects. Polygon summaries are depicted in Tables 1, 2, and 3.

In the final analysis, an assessment of the vegetation in each polygon was made relative to its biotic integrity. Using key biological attributes, the vegetation communities were described, using the descriptors good, fair, and poor.

Results

Paddelford Flat

In Paddelford Flat, 10 polygons of similar vegetation were mapped and 33 transects completed (Figure 3). Polygon vegetation cover is summarized in Table 1. Vegetation transect data are located in Appendix II. Photos and raw data are included in the enclosed CD (Appendix IX).

Threetip sagebrush (*Artemisia tripartita*) communities dominated the north half of Paddelford Flat (PFP-01, 02, 03, 05, 06). Cover percentages of threetip sagebrush averaged 31%, except for PFP-05 that had an average threetip sagebrush cover of 10% because of a fire in 1990. Basin and Wyoming big sagebrush (*Artemisia tridentata tridentata* and *A. t. wyomingensis*) cover was extremely low and generally confined to rocky sites. Key bunchgrasses [3] were present, but often in low amounts (Trace to 5%). However, they were better represented in PFP-01,02 and areas away from livestock use. In most cases, the key bunchgrasses within a mile of livestock water had been severely diminished in abundance. Cheatgrass cover averaged 15%. Forb cover and diversity was very low (2-6% cover, 1-3 species with 1% or greater cover) and was primarily represented by longleaf phlox (*Phlox longifolia*) and Hood's phlox (*P. hoodii*).

Vegetation polygons (PFP-03, 04, 05, 06), all threetip sagebrush communities located immediately south of the main east-west road traversing Paddelford Flat (Figure 3), had very depleted herbaceous layers except for PFP-04, a 1990 fire rehabilitation seeding that had 17% cover of seeded Siberian wheatgrass (*Agropyron sibericum*). Key bunchgrasses and forbs had very low cover (trace –2%). PFP-05 also had a high cover (20%) of green rabbitbrush (*Chrysothamnus vicidiflorus*) and conspicuous bare ground. It was apparent that these seriously degraded communities had experienced many years of intense livestock use.

Farther south (PFP-07, 08, 09, 10, 11), the threetip sagebrush gave way to basin big sagebrush (*A. t. tridentata*) as the dominant shrub. Areas with loamy soils were big sagebrush/bluebunch wheatgrass sites while sandy soils supported big sagebrush/Indian ricegrass/needle and thread grass. As in the north, the level of grazing use on perennial grasses decreased with distance from water and the cover of key bunchgrasses increased, but on average it was low (4-11%) except for PFP-07, a 1990 fire rehabilitation with seeded bluebunch and Siberian wheatgrass (total 16% cover). Forb cover was very low to low (trace to 4%). Cheatgrass cover was quite high (29-34%) except in PFP-07 (18%). In the south there was a large acreage of dead sagebrush (PFP-08, 09, 11), due to an Aroga moth (*Aroga* spp.) infestation during 2000 and 2001. PFP-08 had an unusually high cover of green rabbitbrush (29%) and diffuse knapweed (*Centaurea diffusa*) was observed in PFP-07,09, 10.

---

[3] Key bunchgrasses refers to mid-height to tall native perennial bunchgrasses that are vulnerable to loss under continuous heavy grazing. For the study area the term refers to the following species: Thurber needlegrass (*Stipa thurberiana*), needle and thread (*Stipa comata*), bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*), Basin wildrye (*Elymus cinerus*), Prairie junegrass *(Koeleria cristata*), Indian ricegrass (*Oryzopsis hymenoides*), Nevada bluegrass (*Poa nevadensis*) and sedge (*Carex* sp.).

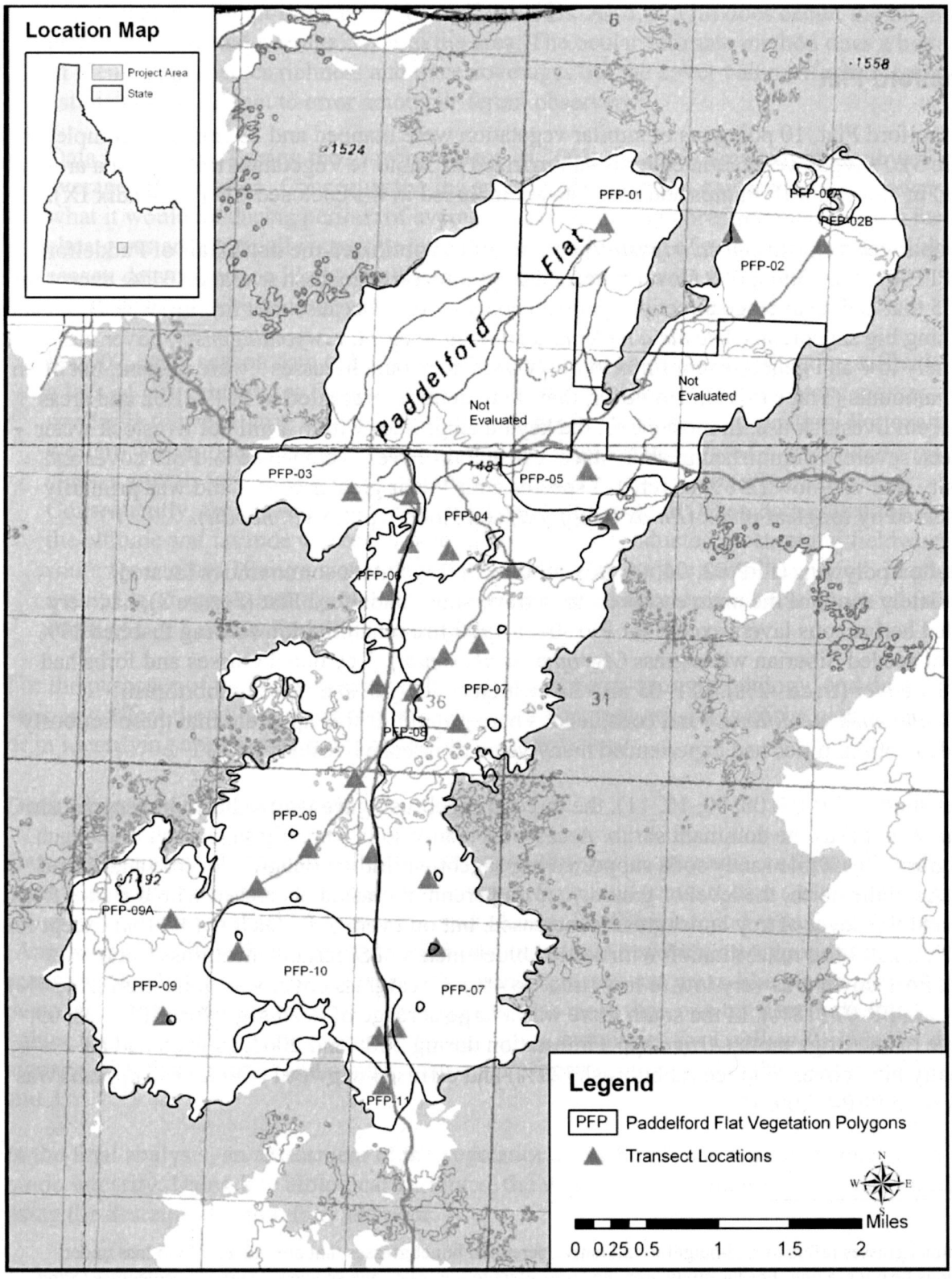


Figure 3. Paddelford Flat Vegetation Polygons and Vegetation Transect Locations, Craters of the Moon National Monument, ID.

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Table 1. Paddelford Flat vegetation polygons and average species foliar cover

(Data collected in October, 2001)

Plants	Vegetation Polygon Number										
	PFP-01	PFP-02	PFP-03	PFP-04	PFP-05	PFP-06	PFP-07	PFP-08	PFP-09	PFP-10	PFP-11
Shrubs											
ARTR	0	0	0	0	2	0	0	3	0	0	19
ARTR4	31	26	33	1	10	33	T	0	T	2	6
CHNA	1	T	0	1	4	1	2	3	3	4	12
CHVI	6	4	0	4	20	3	4	29	9	4	9
PUTR	0	0	0	0	0	0	1	2	0	1	6
TECA	0	0	0	0	0	0	T	0	T	0	0
Dead Shrub	0	1	2	T	0	1	3	7	7	3	9
Perennial Grasses and Grass-like Plants											
STTH	1	0	0	0	0	0	0	0	0	0	0
STCO	0	0	0	0	0	0	T	0	5	6	0
AGSP	1	2	0	0	0	0	5	5	4	5	2
FEID	3	2	0	0	0	0	0	0	0	0	0
ELCI	0	0	0	0	0	0	T	0	T	0	2
KOCR	0	0	0	0	0	0	0	0	0	0	0
ORHY	0	0	0	0	0	0	T	3	1	T	0
AGSM	0	T	0	5	7	0	5	12	1	1	1
SIHY	1	T	4	T	0	2	T	1	1	0	3
PONE	1	0	0	0	0	0	1	0	0	0	0
POSE	16	19	19	9	30	37	8	16	16	20	31
POAM	0	0	0	T	0	0	0	0	0	0	0
AGIN	0	0	0	T	0	0	0	0	0	0	0
AGSI	0	0	0	17	5	0	11	2	0	0	0
AGCR	0	0	0	1	0	0	T	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	1	0	0
Annual Grasses											
BRTE	12	9	19	6	14	19	18	35	29	34	36
Forbs											
PHHO	0	3	1	1	0	2	T	0	T	0	3
PHLO	2	2	2	2	1	2	1	2	T	1	1
ERIO	0	0	0	0	0	0	0	0	0	1	0
LILE	0	0	0	1	0	0	0	0	0	0	0
ALLIU	0	0	0	0	0	1	0	0	0	0	0
LOMAT	0	1	0	0	0	0	0	0	0	0	0
CENTA	0	0	0	0	0	0	1	0	0	1	0
UNPF	1	0	0	0	0	0	0	0	0	0	0
UNAF	1	0	1	0	0	0	T	2	0	0	1

South of the main east-west road and east of the main north-south road (Figure 3), the existing plant communities (PFP-04, 05, 07) were an expression of a wildfire in 1990 and a subsequent fire rehabilitation seeding. This area was a complex of grass and grass-shrub types. Eleven years post-burn, big sagebrush cover was virtually nonexistent except in small, unburned pockets. Bitterbrush (*Purshia tridentata*) was present in PFP-07 but had low coverage (1%). Perennial grass cover varied and consisted primarily of seeded Siberian wheatgrass and some crested wheatgrass (*Agropyron cristatum*), and small patches of native western wheatgrass. Forbs were primarily represented by phlox (*Phlox hoodii* and *P. longifolia*) and seeded blue flax (*Linium perenne*). Diffuse knapweed was present in patches throughout the area with up to 2% cover in individual transects (See PF Transects-28 and 29).

Little Park

In Little Park, 6 polygons of similar vegetation were mapped and 20 transects were completed (Figure 4). Polygon vegetation cover is summarized in Table 2 and transect data are in Appendix III. Raw transect data and photos are included in the enclosed CD (Appendix IX).

Little Park was the smallest of the three parks investigated during this inventory and assessment. Like Paddelford Flat, threetip sagebrush sites (LitP-01, 02, 03, 04) dominated much of the north end of Little Park. Unlike Paddelford Flat, these northern Little Park polygons had a much higher cover of key bunchgrasses (15-40%). Although LitP-03 had a high cover of threetip sagebrush (38%), it supported a relatively high cover of key bunchgrasses (23%). While cheatgrass was present in these four areas, only LitP-02 had high cover (21%). Forb cover was low (4%).

Evidence of long-term continuous sheep grazing was apparent in LitP-02. The general visual aspect was different compared to other threetip sagebrush polygons (LitP-01, 03, 04) with less threetip cover (except Lit-04), more green rabbitbrush cover (except LitP-04), less cover of key bunchgrasses, and cheatgrass cover more than double any of the other threetip polygons.

Polygon LitP-04, area was surrounded by lava on three sides, was located at the eastern edge of Little Park. With only 2% cover of threetip sagebrush, this small (46 acre) area had obviously burned in recent years. It had high key bunchgrass cover (Thurber needlegrass, 22%; Idaho fescue, 16%; bluebunch wheatgrass, 4%) with little cheatgrass (8%). Forb cover was low.

Among the extensive threetip sagebrush communities, one small polygon (LitP-05) contained basin big sagebrush, with occasional bitterbrush, and a high cover of Sandberg bluegrass (*Poa secunda*) (42%) and western wheatgrass (25%). The Sandberg bluegrass appeared especially robust and vigorous.

Little Park contained many very small islands of basin big sagebrush within the dominant threetip sagebrush type. These islands range in size from a few plants up to 40 acres in size. Unlike the adjacent threetip sagebrush communities, no evidence of previous burns was found at these sites.

Vegetation polygon LitP-06, located in the southernmost part of Little Park, appeared to be substantially altered with a high cover of threetip sagebrush and cheatgrass and a low cover of

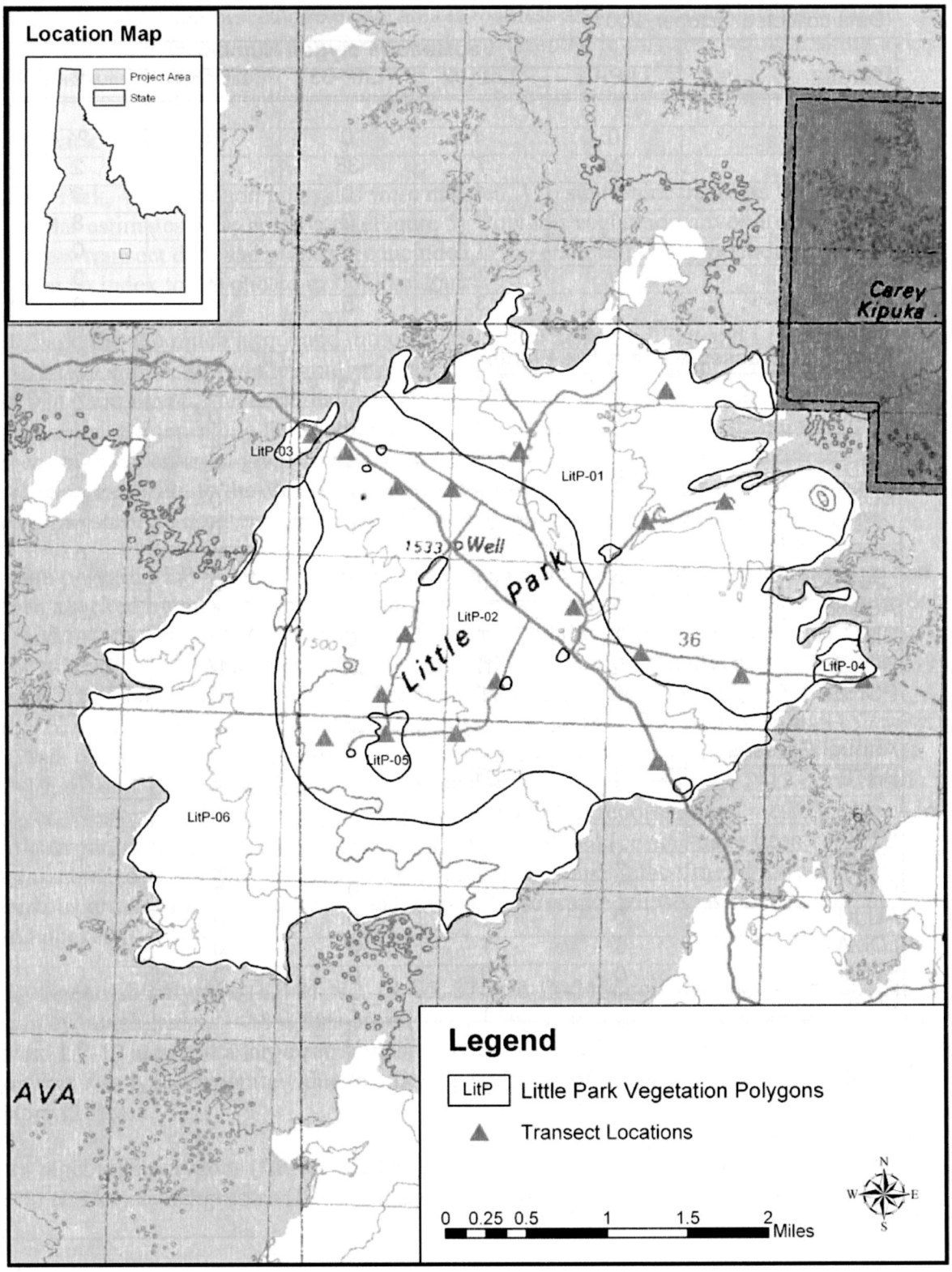


Figure 4. Little Park Vegetation Polygons and Vegetation Transect Locations, Craters of the Moon National Monument, ID.

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Table 2. Little Park vegetation polygons and average species foliar cover

(Data collected October, 2001)

Plants	Vegetation Polygon Number				
	LitP-01	LitP-02	LitP-03	LitP-04	LitP-05
Shrubs					
ARTR	0	4	0	0	21
ARTR4	22	7	38	2	2
CHNA	T	1	0	0	3
CHVI	1	4	2	7	8
PUTR	T	T	0	1	0
TECA	0	T	0	4	0
Dead Shrub	1	3	5	4	6
Perennial Grasses & Grass-like Plants					
STTH	3	7	13	22	0
STCO	0	0	0	0	0
AGSP	2	1	5	4	0
FEID	15	7	4	16	0
ELCI	T	T	0	0	0
KOCR	2	T	0	0	0
ORHY	T	T	0	0	0
CAREX	0	0	1	2	0
AGSM	2	7	2	4	25
SIHY	T	T	6	0	0
POSE	18	17	26	18	42
PONE	0	T	0	0	1
Annual Grasses					
BRTE	10	21	9	8	20
Forbs					
PHHO	4	4	4	3	4
PHLO	T	T	0	1	1
ALLIU	0	T	0	0	0
LOMAT	0	T	0	0	0
SYSIM	0	0	0	0	1
UNAF	T	T	1	0	2

key bunchgrasses. However, this observation was based on a cursory ocular estimate made from the existing roads. A high percentage of the area is roadless and time constraints prevented a more thorough examination. Additional fieldwork is warranted in this area before making a final decision on management actions.

Laidlaw Park

In Laidlaw Park, 42 vegetation polygons were mapped, 110 step-point transects were conducted, and 78 ocular estimates were completed (Figure 5). Polygon vegetation cover is summarized in Table 3. Raw transect data and photos are included in the enclosed CD (Appendix IX). Appendix VI provides an index to the photos in Laidlaw Park.

Laidlaw Park, though much larger and more diverse than Paddelford Flat and Little Park, exhibited many similarities to the smaller areas, including location of plant communities, plant species, and plant cover. The north half of Laidlaw Park was nearly all dominated by threetip sagebrush communities, while the south half was dominated by big sagebrush. Similar to the other areas, native perennial grass cover increased with increased distance from livestock water, livestock inaccessibility to the area (e.g. steep slopes, rock, lava flows), increased elevation (i.e. additional moisture), a northern aspect (i.e. additional moisture), or a combination of these.

Vegetation polygons LP-02, 08, 12, 15, 19, and 26 represented big sagebrush communities that have been attacked by the defoliating Aroga moth. These areas had 19-30% cover of mature dead shrubs, and 8-16% cover of live big sagebrush, occurring either as partially defoliated mature plants or as seedlings. The moth infestation continued to be active after this assessment was completed and apparently additional sagebrush mortality has occurred.[4] Cheatgrass and Sandberg bluegrass were the principal understory grasses, and bottlebrush squirreltail (*Sitanion hystrix*) was common on many transects. Key bunchgrasses were poorly represented in LP-02 and LP-19, though Thurber needlegrass was present in all polygons, and in LP-12 it averaged 13% cover. Western needlegrass (*Stipa occidentalis*) had been reported from mesic locations in the northern part of the park[5], but this species was not observed (or may have been unrecognizable, as needlegrasses were still mostly in-boot stage at the time of the survey). Rhizomatous grasses such as western wheatgrass and thickspike wheatgrass were found in small, scattered pockets.

Five big sagebrush polygons (LP-01, 02, 19, 25, 27) had 11-25% cover of big sagebrush, <10% cover of key bunchgrasses, <18% forb cover, and >18% cheatgrass cover. As noted previously, LP-02 and LP-19 also had a large component of dead sagebrush. LP-25 was a rather unusual polygon that was typed separately due to a large percentage of western wheatgrass in the understory (28%).

Five big sagebrush polygons (LP-09, 11, 16, 22, 41) had considerable cover of big sagebrush (16-33%) and key bunchgrasses (11-18%), and relatively low cheatgrass cover (10-16%). LP-09

---

[4] Joe Russell, BLM fuels specialist, Shoshone Field Office, Shoshone, ID, pers. comm.

[5] Julie Hilty, BLM staff botanist, Shoshone Field Office, Shoshone, ID, pers. comm.

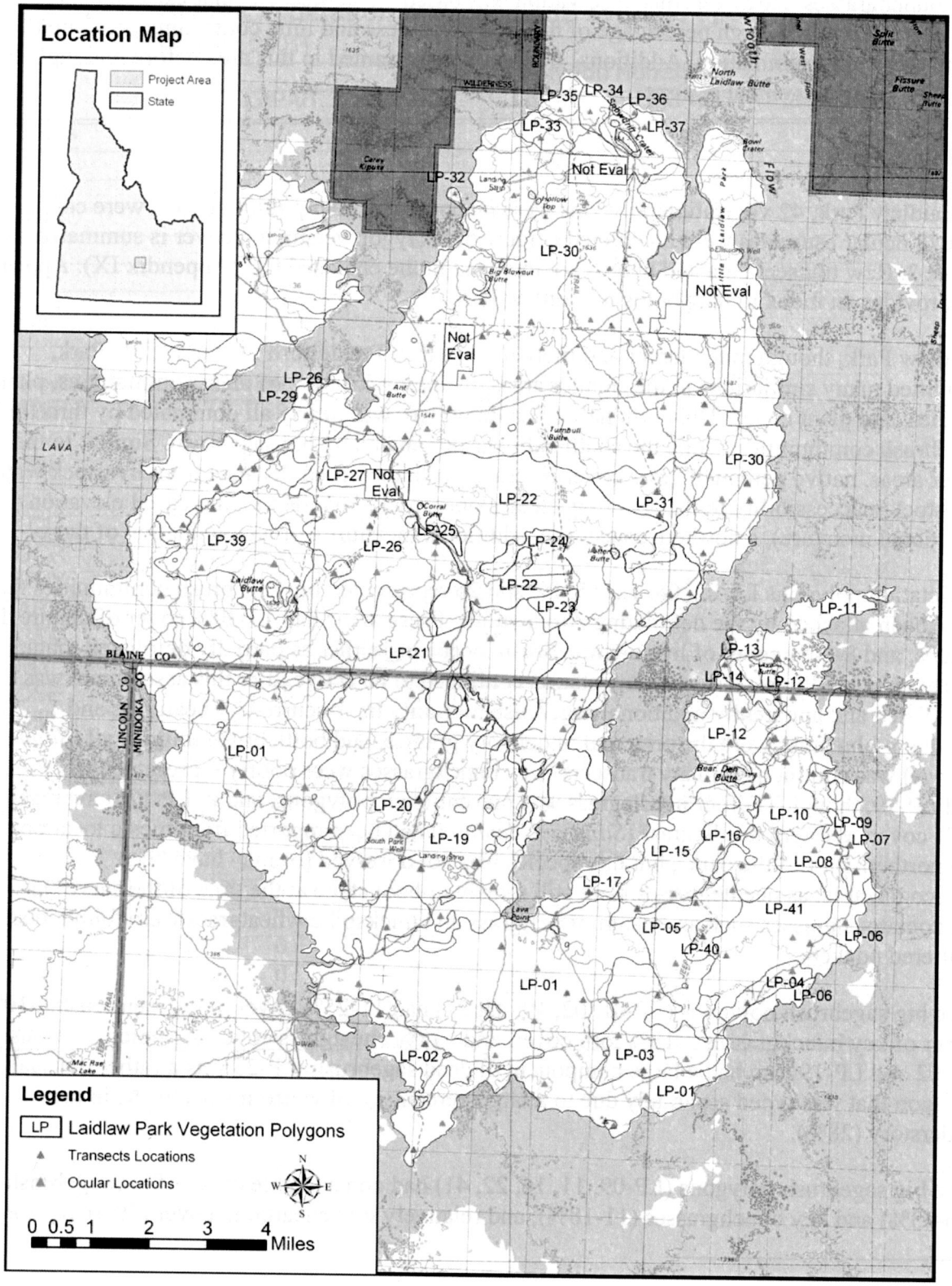


Figure 5. Laidlaw Park Vegetation Polygons, Vegetation Transect Locations, and Ocular Locations, Craters of the Moon National Monument, ID.

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Table 3. Laidlaw Park vegetation polygons and average species foliar cover (page 1 of 3)

(Data collected in May/June 2002)

Plants	Vegetation Polygon Number														
	LP-01	LP-02	LP-03	LP-04	LP-05	LP-06	LP-07	LP-08	LP-09	LP-10	LP-11	LP-12	LP-13	LP-14	LP-15
Shrubs															
ARTR	25	16	5	8	15	5	20	12	33	6	16	15	5	11	8
ARTR4	1	1	TR		1	30	22	9		31		2	31	22	
CHVI	4	6	3	2	4	1	3	2	3	5	9	8	4	5	8
CHNA	3	3	1	6	7		3	3	5	4	5	6	4	1	4
PUTR	TR								TR	1	3	3		5	
LEPU	TR				TR					3					1
OPUNT	TR	TR	1	TR	TR		1			1		1			1
AMAL	TR														
TECA	TR														
ATCA															
SYMPH															
Dead Shrub	5	22		1	3		3	23	4	4	5	19	4	7	30
Perennial Grasses and Grass-like Plants															
STTH	4	1	1	1	2	TR	5	4	18	13	3	13	1	13	4
STCO	2	TR	33		6					2		1			6
AGSP	1		TR	1	1	2	4	1	TR	2	3	4	12	2	TR
FEID	TR			1						2	1		1	1	
ELCI	1	TR	TR		TR				TR	1	3	4		2	1
KOCR					TR		1		TR	3	1				
ORHY	TR	TR	1								1	1	3	2	
CAREX										2					
AGSM	4	2	3	22	TR	10	1	4	8	4	2	5	1		9
AGDA	1	1	12		7					2		TR			14
SIHY	6	6	1		4		7	5	8	5	9	4	7	11	6
POSE	19	22	6	10	7	15	17	12	12	12	21	14	14	10	11
PONE	TR	TR	TR	1	TR				TR			TR	2	2	
POAM			2				3	3		TR	4	TR			TR
AGIN															
AGSI	TR	TR	1		16				TR						3
AGCR	TR				13										7
AGROP				1											
ELJUJ				TR	TR										
Annual Grasses															
BRTE	18	24	5	3	9	10	4	13	15	14	11	12	8	9	14
POBU	TR														
Perennial Forbs															
PHHO	3		TR	2	TR		3			2	1	2	8	3	
PHLO	5	3	8	3	4	5	4	3	4	3	9	6	3	5	7
LOMAT	2	2	1	2	5	5	5	3	4	3	4	4	3	1	1
CREPI	TR	1	1	2				TR		1	1	1			1
ASTRA	2	TR	1	1	1	1	1	2	1	TR		1	2	1	7
AGGL	1	3	2	2	TR	TR	1	1		3	2	2			
DELPH	TR	1	1		TR		2				1				
ALLIU	1	TR	TR	1	1	TR	1	1	1			2		1	1
ERIOG	TR		TR		TR		1		1	1	2	1			
BASA	TR	TR	TR		TR	TR		1			1	1		1	
ERIOG	1	TR	1	TR	TR		1	1	TR	TR		TR			TR
ERIGE	TR	TR	TR		TR	TR				TR	1				TR
CALOC	TR														
SPMU							1								
ANTEN															
CASTI	TR									TR					
LUPIN	TR	TR	TR							TR					
ARNIC															
AMARA															
CIRSI															
LILE															
ONVI				1	TR			1							
ASTER	TR	TR	TR		TR						1				
LIRU										TR	1	1			
HYCA		TR	TR							TR					
PENST	TR		TR	TR	TR					TR				1	TR
ARABI	1	TR	TR			TR		1			1	TR			1
ZIPA	1														
OENOT											1				
UNPF															

Table 3. Laidlaw Park vegetation polygons and average species foliar cover (page 2 of 3)

(Data collected in May/June 2002)

Plants	Vegetation Polygon Number														
	LP-16	LP-17	LP-18	LP-19	LP-20	LP-21	LP22	LP-23	LP-24	LP-25	LP-26	LP-27	LP-28	LP-29	LP-30
Shrubs															
ARTR	30	22		11	16	5	27	11	15	18	10	16	4	2	1
ARTR4	3	21	35	2	11	24	2	3		1	5	1	10	30	22
CHVI	3	7	3	5	6	5	6	5	4	5	7	14	18	2	5
CHNA	9			5	2	2	2			4	4	4	7	2	TR
PUTR						TR			3		1			3	TR
LEPU				TR	1	TR	TR							TR	1
OPUNT	1			TR		TR	TR								TR
AMAL															
TECA				TR		1	TR	8			TR			TR	TR
ATCA							TR								
SYMPH															
Dead Shrub	5	3	1	25	7	3	3		1	3	21	4	8	2	1
Perennial Grasses and Grass-like Plants															
STTH	8	13	4	2	6	11	6	1	5		11	6	1	8	5
STCO	2	1				1	TR	1			1			TR	2
AGSP	1	1		TR	3	3	2	1	30	1	1			TR	7
FEID						1									2
ELCI				1		1	4	3	1	3	2				1
KOCR															7
ORHY			1	TR	1	TR	TR	1			TR				TR
CAREX			25	TR		1					1		18	12	2
AGSM	1	1	3	5	1	1	6	2	2	28	6	3	4	6	
AGDA	5			2	1	1	1	7	2	4	1	6	4		TR
SIHY	10	6	1	8	5	6	6	3	4	7	13	3	9	5	2
POSE	15	11	8	13	24	18	18	14	10	16	18	17	6	15	6
PONE	2			TR	2	1	TR	3	2		1		2	TR	1
POAM			1	TR		TR	TR				1				1
AGIN															
AGSI							TR		3						TR
AGCR															
AGROP															
ELJUJ															
Annual Grasses															
BRTE	14	14	10	24	19	11	16	13	2	20	20	18	14	15	6
POBU															
Perennial Forbs															
PHHO	1	8	4	3	5	4	TR	1	6		5	1	3	1	4
PHLO	6	7	2	5	4	5	6	7	11	9	3	4	8	3	4
LOMAT	2	4	2	3	4	2	2	5	6	1	2	1	1	1	1
CREPIS				TR		TR	TR				TR				TR
ASTRA	2	1	1	TR	2	1	2	1	2	1	TR	2	1		1
AGGL	3	1	1	TR	1	TR	1	1			1		4		1
DELPH															TR
ALLIU	2	2		TR	1	TR	1	1	2	1	1				2
ERIOG						TR	TR								TR
BASA							TR								TR
ERIOG							TR							TR	1
ERIGE				TR	1	TR	TR			1	TR	1		TR	
CALOC						TR									
SPMU				TR		TR									TR
ANTEN						TR									TR
CASTI				TR	1	TR	TR								TR
LUPIN							TR								1
ARNIC															1
AMARA															
CIRSI						TR									TR
LILE							1		19						TR
ONVI									8						TR
ASTER				TR	1	TR	TR								TR
LIRU					1		TR								
HYCA							1								
PENST				TR		TR	TR				TR				TR
ARABI						TR	TR				TR				TR
ZIPA															TR
OENOT															
UNPF															

Table 3. Laidlaw Park vegetation polygons and average species foliar cover (page 3 of 3)

(Data collected in May/June 2002)

Plants	Vegetation Polygon Numbers										
	LP-31	LP-32	LP-33	LP-34	LP-35	LP-36	LP-37	LP-38	LP-39	LP-40	LP-41
Shrubs											
ARTR	13		7						17	10	24
ARTR4	7	16	20		5	5	4	38	5	19	6
CHVI	4	3	6	13	1	5	22		6	1	1
CHNA			1						7	4	1
PUTR		4					1		14		
LEPU				1	2		4	TR	TR		
OPUNT											
AMAL									TR		
TECA		5	1				1				
ATCA											
SYMPH						1					
Dead Shrub	1		8	1						2	1
Perennial Grasses and Grass-like Plants											
STTH	2	9			1				18	6	5
STCO									2	6	1
AGSP	4	32	5	7	18	8	13		7		1
FEID		9		4	4		3		TR		
ELCI	1		9	1	3	2	7		TR		TR
KOCR	6	10	11	10	2		4				TR
ORHY									1		
CAREX		2						TR			
AGSM	3							TR	2		6
AGDA	1									1	4
SIHY	4	1						TR	11	2	1
POSE	5	5	1	2	1	8	9	16	14	7	18
PONE				3	TR	10			1		
POAM	1									1	
AGIN	1										
AGSI										21	TR
AGCR										7	TR
AGROP	2						8				
ELJUJ											
Annual Grasses											
BRTE	3	1	6	15	2	T	4	6	9	9	10
POBU											
Perennial Forbs											
PHHO	2	4							4		2
PHLO	2	6	2	2	2		2	3	3	6	3
LOMAT	1	6	1						2	3	7
CREPIS						4			TR		
ASTRA	1				1			TR		1	1
AGGL		2		24							1
DELPH							1				TR
ALLIU	2	2	1						2		1
ERIOG									1		TR
BASA		1							TR		TR
ERIOG			2								TR
ERIGE											TR
CALOC											
SPMU									TR		
ANTEN									TR		
CASTI		1									
LUPIN		1				2	1		TR		
ARNIC				2	5						
AMARA											
CIRSI											
LILE	10										
ONVI	2				TR						TR
ASTER											TR
LIRU	1								TR		
HYCA											
PENST											TR
ARABI	1	1									
ZIPA				1							
OENOT											
UNPF											

had 18% cover of Thurber needlegrass; LP-16, had 13% cover of Thurber needlegrass, needle and thread, bluebunch wheatgrass, and Nevada bluegrass (*Poa nevadensis*); LP-22 had 12% cover of Thurber needlegrass, bluebunch wheatgrass and Basin wildrye (*Elymus cinereus)*. Forb cover and diversity were relatively high for all the polygons, ranging from 12-26% cover and 5-13 species with at least 1% cover, respectively.

Big sagebrush and threetip sagebrush were co-dominants in five polygons (LP-07, 14, 17, 20, 40). Big sagebrush cover ranged from 10-22% and threetip sagebrush ranged from 11-22%. Understory species were similar to other types. Cheatgrass ranged from 4-19% and native and introduced bunchgrasses ranged from 13-40%. Polygon LP-40 had a large introduced bunchgrass component made up of Siberian (*A. sibericum*) and crested (*A. cristatum*) wheatgrasses (28% combined). These introduced species are the result of a previous post-fire seeding (1965), and continue to dominate the understory. Big sagebrush (10% cover) and threetip sagebrush (19% cover) has reoccupied the site.

Polygon LP-03, was a naturally revegetated burn (1992) on a sandy soil, which was dominated with needle and thread grass (33% cover). Other key bunchgrasses included Indian ricegrass, Thurbers needlegrass, bluebunch wheatgrass, basin wild rye, and Nevada bluegrass. The community also had a diverse assemblage of forbs. Cheatgrass cover was low (5%). Ten year post-burn big sagebrush cover was limited to 5% cover, however.

Polygon LP-04 was a small big sagebrush/rabbitbrush/western wheatgrass/Sandberg bluegrass community. It has burned in the past (1992). Cheatgrass and key bunchgrass cover was low (each 3%), western wheatgrass cover high (22%), and perennial forb cover and diversity were relatively high (14%).

Polygon LP-05, a basin big sagebrush/Indian ricegrass/needle and thread site, burned in 1965 and was seeded with introduced bunchgrasses. Siberian wheatgrass and crested wheatgrass combined for a 29% cover while native key bunchgrass cover was 9%. Forb cover (11%) and diversity were relatively low with only 4 species having at least 1% cover. Thirty-six years post-burn, big sagebrush cover was 15%. Livestock had made moderate use of the introduced wheatgrasses.

Polygon LP-06 (about 700 acres in two polygons), located in the far southeast corner of the Park, was a threetip sagebrush site. Although it had a depleted understory of key bunchgrasses (2%), the long distance from other pure threetip sites in the northern part of the Park made it unusual. Threetip sagebrush occurred nearby, but only as mixed stands with big sagebrush.

Polygon LP-24 was a 1992-burn rehabilitation site using a diverse seed mix of shrubs, grasses and forbs. In spite of the presence of a few non-native species (e.g. Siberian wheatgrass, Lewis flax, Sainfoin (*Onobrychis viciaefolia*), the current community resembles a classic description of sagebrush steppe in a very good condition. Seeded big sagebrush cover was 15%, key bunchgrasses (41% cover) were diverse, but dominated by bluebunch wheatgrass (30%), and forb cover totaled 54%, the highest of any plant community in the study area. Bitterbrush, a highly desirable shrub, was included in the seeding mix (3% cover). Livestock had actively selected these young shrubs, and many show the characteristic "bonsai" shape, typical of a shrub experiencing year after year of heavy utilization.

Polygon LP-30, a threetip sagebrush/Idaho fescue site, was the largest single plant community in Laidlaw Park. It covered the entire northern third of the Park with a long finger south along the eastern edge of the main Park for a distance of about 6 miles. This long, narrow finger was only ¼ to 1 mile wide. Threetip sagebrush cover averaged 22%, key bunchgrasses 27% (mostly prairie junegrass in the north), and forbs 16%. The herbaceous layer contained a variety of native grasses and forbs. Cheatgrass was mostly sparse and discontinuous (6% average cover), with pockets of greater abundance in the drier southern exposures.

Polygon LP-31 was a mixed sagebrush site (big sagebrush and threetip sagebrush) that had been seeded in alternating strips as a range rehabilitation project following a 1992 fire. It appeared that a seed mix similar to that used for polygon LP-24 was used with fair to good success. Big sagebrush cover averaged 13% and threetip sagebrush averaged 7%.

Polygon LP-32, located in the northwest corner of the park, was nearly surrounded by lava and could be referred to as a semi-kipuka. Threetip sagebrush cover averaged 16%, key bunchgrass cover was 62%, dominated by bluebunch wheatgrass and prairie junegrass (*Koeleria cristata*). Bitterbrush was a minor component, though universally present; the forb mix was diverse and cover high (24%). Unlike many other similar ecological sites within the Park, lupine and arrowleaf balsamroot were present in the community.Cheatgrass cover was quite low (1%).

Polygon LP-33, located in the north end of the park, was a small threetip sagebrush site with a significant big sagebrush component (7% cover). It was adjacent to the large nearly pure threetip sagebrush site (LP-30) and a recently burned threetip sagebrush site (LP-35). It is unknown if LP-35 had a big sagebrush component prior to burning, though obvious signs (e.g. charred stumps and limbs) were not observed. Without any apparent changes in soil types between these three polygons, it is unknown whether big sagebrush would have been a significant component of the adjacent threetip sagebrush sites in the absence of relatively frequent fire.

Polygon LP-35, a recently burned (1983) threetip sagebrush site located in the far north end of the Park west of Snowdrift Crater, had 5% cover of threetip sagebrush with 28% cover of key bunchgrasses and 19% cover of forbs. Idaho fescue (13%) and bluebunch wheatgrass (10%) were the dominant grasses.

Polygon LP-36 was a small (40-ac. +/-) recent burn (2000) on the north side of Snowdrift Crater, near the north boundary of the Park. It was a naturally regenerating, sparse stand of bluebunch wheatgrass, Nevada bluegrass, Sandberg bluegrass, and Basin wildrye. The site had very little cheatgrass. A small amount of threetip sagebrush (5%) remained in the post-fire canopy. Further monitoring of this site will provide opportunities to observe the rate of recovery of threetip sagebrush, and whether cheatgrass will invade the area.

Polygon LP-39 was a large polygon which included the top and north aspects of Laidlaw Butte. It was a mixed big sagebrush-bitterbrush site with a relatively abundant bunchgrass understory and some small inclusions of threetip sagebrush. The principal understory bunchgrass was Thurber needlegrass at 18% cover. Other native grasses included bluebunch wheatgrass (7% cover), Sandberg bluegrass, Nevada bluegrass, squirreltail, western wheatgrass, Idaho fescue, and Indian ricegrass. Cheatgrass averaged 9% cover over the polygon. The rocky terrain and slightly elevated moisture regime probably accounted for the rich species diversity. The area had

a heavy shrub cover (49%) with sagebrush (22%) and bitterbrush (14%) accounting for most of the shrub cover. This was the largest sagebrush/bitterbrush co-dominant site in Laidlaw Park. Sheep utilization of the herbaceous vegetation was heavy.

Discussion

Management Assumptions

In this section, we have made conclusions related to the biotic integrity of the plant communities, the ability of depleted communities to recover without major seeding intervention, and needed management in the study area. These conclusions were based on the following assumptions:

- The natural values of the study area are of national significance as demonstrated by its designation as a national monument.

- The overall management goal within the study area is to achieve and maintain a biologically intact sagebrush steppe landscape resilient to environmental perturbations (fire, flood, drought, herbivory, etc.), resistant to the domination of exotic annuals and noxious weeds, and able to sustain viable populations of native wildlife, especially sagebrush dependant species.

- Livestock grazing will continue to be an economic use of the study area as provided for in the monument proclamation.

Ecological Frame of Reference

The data from this inventory revealed that vegetation composition varies considerably within the same ecological site. In order to determine the degree of departure from a biologically intact community, an ecological frame of reference was needed. Four sources of information were used to provide this frame of reference:

- Narrative vegetative descriptions provided by various plant ecologists (Passey and Hugie 1962, Day and Wright 1985, Franklin and Dyrness 1973, Blaisdell et al. 1982, Hironaka et al. 1983, Shiftlet 1994, Reid et al 2002) for similar vegetation communities in an undisturbed state.

- The Natural Resource Conservation Service's (NRCS) (Johnson 1991) ecological site descriptions developed from the examination of undisturbed sites. The data are detailed and quantitative but based on composition by weight and pounds of production per acre. Consequently, direct comparison between these characteristics and foliar cover measurements as used in this survey are problematic. Regardless, the guides were quite useful in identifying characteristic species and relative abundance.

- Undisturbed sites, sites with a long period of recovery from disturbance, or seeded sites where foliar or canopy cover study methods were employed (Table 4). Data were obtained from twenty-two threetip sagebrush/Idaho fescue sites, two big sagebrush/Idaho fescue sites, and five big sagebrush/bluebunch wheatgrass sites. The threetip sagebrush/Idaho fescue sites

Table 4. Vegetation composition and percent cover of relict, recovering, and seeded ecological sites

Ecological Site	ARTR4/FEID				ARTR/FEID		ARTR/AGSP		
Location	E. Wash.(n=19)[1]	Julie's Kipuka[2]	Carey Kipuka[3,4]	Sheep Station[5]	Carey Kipuka[3]	Carey Kipuka[6]	BJ Kipuka[2]	Unamed Kipuka[6]	LP-24 (seeded)[7]
Shrubs									
ARTR	tr	2	tr		13	30	17	18	15
ARTR4	11	19	10	15					
CHNA	tr		tr						
CHVI	1		tr	1			1		4
PUTR			tr	3			3		3
LEPU		7		1					
TECA	1			1			5		
Dead Shrub		13							1
Perennial Grasses and Grass-like Plants						53		43	
STTH		11					4		5
STCO	1	tr							
AGSP	38	7	<1	8	**		6		30
FEID	43	7	7		**				
ELCI	tr			1					1
KOCR	2		<1	tr					
ORHY				tr					
AGSM									2
AGDA									2
SIHY							1		4
PONE									2
POSE	12	4	2	3	**		11		10
POAM	tr								
AGSI									3
CAREX	12	3							
Other PG	4			tr					
Annual Grasses									
BRTE	2	tr	present	1	present		16		2
Forbs									
PHHO		3							6
PHLO	2	2	**		**		1		11
ARFU				tr					6
CRAC	tr		**	1	*		5		
ERIGE	3			tr			1		
ERIOG	2	tr		1					
ASSC		tr							
ALLIU			**		**		10		2
LOMAT	tr	tr	**	tr	**		5		
BASA	2	tr		5			4		
MICRO	1		**		**				
ASTRA			**		*				2
LILE									19
ONVI									8
Other PF	28			2					
Annual Forbs	13	1		2					

[1]Daubenmire, 1970
[2]Julie Hilty, BLM Staff Botanist, Shoshone Field Office, Shoshone, ID, pers. comm.
[3]Tisdale et al, 1965
[4]Grass cover is basal, not canopy or foliar coverage
[5]Bork et al, 1998
[6]Welch and Criddle, 2003
[7]Multi-species Rehabilitation Seeding (big sagebrush, bitterbrush, bluebunch wheatgrass, thickspike wheatgrass, tall wheatgrass, Sodar streambank wheatgrass, Russian wildrye, Lewis flax, sainfoin)

** Principal species
* Minor species

include 19 sites in eastern Washington (Daubenmire 1970), two undisturbed kipukas in Craters of the Moon National Monument (Carey Kipuka, Tisdale et al. 1965 and Julie's Kipuka[6]), and the long-term exclosures at the Dubois Sheep Experimental Station (Bork et al. 1998). The big sagebrush sites are from four undisturbed kipukas in Craters of the Moon National Monument (Carey Kipuka, Tisdale et al. 1965, Welch and Criddle 2003; two unnamed kipukas, Welch and Criddle, 2003; Big Juniper Kipuka[5]), a kipuka located 20 miles west of Idaho Falls (Welch and Criddle, 2003), Idaho National Engineering Laboratory (Anderson and Inouye 2001), and a seeded site within Laidlaw Park (LP-24).

- Transect data from this inventory and assessment on sites that show little or no evidence of historic or current grazing (LitP-04, LP-03, LP-32).

Together these information sources indicated that biologically intact threetip sagebrush sites should have canopies of threetip sagebrush vegetation in the 15-25% range, greater than 20% cover of key bunchgrasses (primarily Idaho fescue and bluebunch wheatgrass), 20% or more cover of forbs, and low cover of cheatgrass. A diverse assemblage of forbs would be present. Characteristic forbs would include phlox, eriogonum (*Erigonum* spp.), Western yarrow (*Achillea millefolium*), arrowleaf balsamroot (*Balsamorhiza sagittata*), fleabane (*Erigeron* spp.), tapertip hawskbeard (*Crepis* spp.), aster (*Aster* spp.), agoseris (*Agoseris* spp.), Indian paintbrush (*Castilleja* spp.), groundsel (*Senecio* spp.), Sego lily (*Calochortus* spp.), desert parsley (*Lomatium* spp.), locoweed (*Astragulus* spp.), lupine (*Lupinus* spp.) and microseris (*Microseris* spp.) (Daubenmire 1970, Johnson 1991, Bork et al. 1998).

Intact mesic big sagebrush sites (12-16" ppt.) would be similar to the threetip site except the threetip would be replaced by big sagebrush (either *tridentata* or *vaseyana* subspecies). Bluebunch wheatgrass and Idaho fescue would continue to be the most dominant key bunchgrasses with total cover still exceeding 20%. Similar forbs would be present but coverage would be lower, but greater than 15% cover (Daubenmire 1970, Johnson 1991, Tart 1996).

Compared to the mesic big sagebrush sites, intact xeric big sagebrush sites (8"-13" ppt.) should be similar with respect to overall shrub cover, slightly lower in grass cover (but still over 20%), and lower in forb cover (10 – 15%) (Welch and Criddle 2003). Idaho fescue would drop out of these sites, leaving bluebunch wheatgrass and Thurber needlegrass as the most abundant key bunchgrasses except in the sandy big sagebrush sites where Indian ricegrass and needle-and-thread grass would dominate. On loamy sites, arrowleaf balsamroot would be present but at lower abundance than mesic big sagebrush sites; penstemon (*Penstemon* spp.) would likely be the forb with the greatest constancy in the sandy site (Daubenmire 1970, Johnson 1991).

Using this information as a frame of reference, it is clear that vegetation communities in the three parks exhibit varying degrees of departure from biologically intact sites. In general, the least altered areas are located in the northern parts of Little Park and Laidlaw Park. Conversely, the most severely altered areas include much of Paddelford Flat, and the southern part of Laidlaw

[6] Julie Hilty, BLM staff botanist, Shoshone Field Office, Shoshone, ID, pers. comm.

Parks. Owing to the abundance of cheatgrass, significant portions of the depleted areas are at high risk of converting to exotic annual grassland if fire occurs in the area.

Rating Biotic Integrity

To categorize the degree of departure among the various ecological sites into discreet categories, we chose to use the concept of biotic integrity. Biotic integrity is defined as "the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region" (Karr and Dudley 1981). Establishing an index or ecological scorecard (Parrish et al 2003) to biotic integrity seeks to describe both the degree of impairment and resiliency. It describes the current condition status and embodies the concept of state and transition models (Westoby et al 1989, Laycock 1991) and rangeland health (National Research Council 1994). We placed biotic integrity into three categories with the following definitions:

Biotic Integrity Categories:

- Good – the plant community has the capacity to sustain its natural biological diversity (plants and animals) and values within the context of normal environmental stress (fire, drought, flood, herbivory, etc.).
- Fair – the community's biological diversity and capacity has been diminished, it is vulnerable to further degradation, but it can return to a higher level of organization if environmental stressors are low and infrequent enough to allow recovery.
- Poor – the community's biological diversity and capacity has been seriously degraded and it has crossed a threshold. It cannot return to higher levels of organization within any reasonable timeframe without substantial external inputs (i.e. seeding).

To place each of the vegetation communities in this assessment into an appropriate biotic integrity category we choose a number of key biological attributes and identified an acceptable range of variation for each attribute for each ecological site. The attributes include sagebrush cover, key bunchgrass species cover and diversity, forb cover and diversity, and cheatgrass cover. The criteria for each attribute for each ecological site are shown in Table 5.

The thresholds for each category are a first approximation. They represent our best professional judgment relative to the study area and the study methods employed. They are based on our synthesis of the literature and our collective experience working in sagebrush steppe communities. In making the final category rating, we did not apply these criteria strictly in every case. We used a "preponderance of evidence" approach. Moreover, we gave greater emphasis to the condition of perennial herbaceous layer (key bunchgrass and forb cover and diversity). For example, even if the sagebrush cover was ranked poor (too little or too much), the site did not get an overall rank of poor unless the perennial herbaceous layer attributes were also predominately poor. This is because a strong perennial herbaceous layer is critical to resiliency of the system. In situations where the sagebrush cover is too low, it will recover with time if the perennial herbaceous layer is intact. If sagebrush cover is too high (i.e., outside the range of acceptable

Table 5. Characterization of biotic integrity ratings for sagebrush steppe ecological sites in Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument, ID.

Ecological Site/Attribute	Biotic Integrity[1] Good	Fair	Poor
Loamy 12-16" ppt. ARTRV/FEID			
Sagebrush cover[2]	15 - 25%	10-15% or 25-30%	<10%, >30%
Key bunchgrass cover[3]	>20%	10-20%	<10%
Key bunchgrass diversity[4]	>4 species	3-4 species	<3 species
Forb cover	>15%	10-15%	<10%
Forb diversity[4]	>6 species	3-6 species	<3 species
Cheatgrass Cover	<10%	10-15%	>15%
Loamy 12-16" ppt. ARTRT/AGSP			
Sagebrush cover[2]	15 - 25%	10-15% or 25-30%	<10%, >30%
Key bunchgrass cover[3]	>20%	10-20%	<10%
Key bunchgrass diversity[4]	>4 species	3-4 species	<3 species
Forb cover	>15%	10-15%	<10%
Forb diversity[4]	>6 species	3-6 species	<3 species
Cheatgrass Cover	<10%	10-15%	>15%
Loamy 12-16" ARTR4/FEID			
Sagebrush cover[2]	15 - 25%	10-15% or 25-30%	<10%, >30%
Key bunchgrass cover[3]	>20%	10-20%	<10%
Key bunchgrass diversity[4]	>4 species	3-4 species	<3 species
Forb cover	>20%	10-20%	<10%
Forb diversity[4]	>6 species	3-6 species	<3 species
Cheatgrass Cover	<10%	10-15%	>15%
Loamy 10-13" ppt. ARTRW/AGSP			
Sagebrush cover[2]	15 - 25%	10-15% or 25-30%	<10%, >30%
Key bunchgrass cover[3]	>20%	10-20%	<10%
Key bunchgrass diversity[4]	>4 species	3-4 species	<3 species
Forb cover	>10%	5-10%	<5%
Forb diversity[4]	>5 species	3-5 species	<3 species
Cheatgrass Cover	<10%	10-15%	>15%
Loamy 8-12" ppt. ARTRT/AGSP			
Sagebrush cover[2]	15 - 25%	10-15% or 25-30%	<10%, >30%
Key bunchgrass cover[3]	>20%	10-20%	<10%
Key bunchgrass diversity[4]	>3 species	3 species	<3 species
Forb cover	>10%	5-10%	<5%
Forb diversity[4]	>5 species	3-5 species	<3 species
Cheatgrass Cover	<10%	10-15%	>15%
Sandy 8-12" ppt. ARTRT/ORHY/STCO			
Sagebrush cover[2]	15 - 25%	10-15% or 25-30%	<10%, >30%
Key bunchgrass cover[3]	>20%	10-20%	<10%
Key bunchgrass diversity[4]	>4 species	3-4 species	<3 species
Forb cover	>10%	5-10%	5-10%
Forb diversity[4]	>5 species	3-5 species	<3 species
Cheatgrass Cover	<10%	10-15%	>15%

[1] "the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the region." (Karr and Dudley 1981)

[2] The natural range of variation for sagebrush cover can vary from 0% to over 30%. The values shown represent the average acceptable range of variation based on meeting the needs of sagebrush steppe wildlife.

[3] Bluebunch wheatgrass, Idaho Fescue, Thurber needlegrass, basin wildrye, prairie junegrass, needle and thread, Indian ricegrass, Nevada bluegrass, and sedge.

[4] Number of species with a minimum cover of 1% (trace species not included)

variation), management can be applied to bring the cover into better balance with the herbaceous understory.

The key bunchgrass and forb diversity thresholds were surrogates for true diversity measures. Calculated diversity would have included both species richness (i.e., all of the native grasses and forbs detected) as well as a measure for abundance for each species. As noted previously, our sampling intensity was insufficient to detect all species or their specific cover unless they were relatively abundant. Consequently, we adopted a convention of using the number of key bunchgrasses and forbs with 1% or greater cover as a measure of diversity to compare among similar ecological sites.

The results of applying these criteria to the vegetation polygons are depicted in Figure 6 and described in Table 6.

Management Recommendations

Fire Management

With many of the sagebrush communities at a high-risk of burning, the study area should remain a high priority for full wildfire suppression. Large wildfires may render much of the area unsuitable for sage-grouse and other sagebrush dependant species for a long period of time (20 – 40 years, assuming it does not burn in the interim). Wildfires would be particularly damaging to the big sagebrush communities with depleted native perennial herbaceous layers and a large amount of cheatgrass. Burning these areas is likely to result in a permanent conversion from sagebrush steppe to exotic annual grassland.

The need for wildfire suppression should not be confused with the opportunity to use prescribed fire as a tool for restoring biotic integrity. Prescribed fire may be especially suited in threetip sagebrush sites with 25% or greater sagebrush cover. Threetip sagebrush is one of the few species of sagebrush that can resprout following fire (Blaisdell et al. 1982, Hironaka et al. 1983). Prescribed fire could provide a "window of opportunity" for the release of the understory in areas that have an adequate remaining understory of key bunchgrasses and forbs (LP-07, 10, 13, 14, 17, 18, 29; LitP-03), or for site preparation for implementing restoration seedings on depleted sites (LP-06, 38; PFP-01, 02, 03, 05, 06).

Caution must be exercised in burning threetip sagebrush communities to ensure that burns are not too large. Despite its ability to resprout and recover more rapidly than big sagebrush, it was apparent from examining recent burns in the study area that fire can cause significant mortality and reduces shrub cover below critical sagebrush steppe wildlife occupancy thresholds for a number of years. For example, LP- 36, a threetip sagebrush site that burned in 2000, had only 5% cover of threetip sagebrush two years post-burn. LP-30 includes a large burn that occurred in 1986. Sixteen years post-burn, the average cover of threetip sagebrush was 17%.

Even greater caution must be exercised in using prescribed fire in big sagebrush communities. Prescribed fire may not be the most appropriate tool to restore big sagebrush sites, unless seeding big sagebrush is part of a restoration effort. Without a successful seeding, several decades may pass before sufficient big sagebrush cover is present to become suitable habitat for sage-grouse

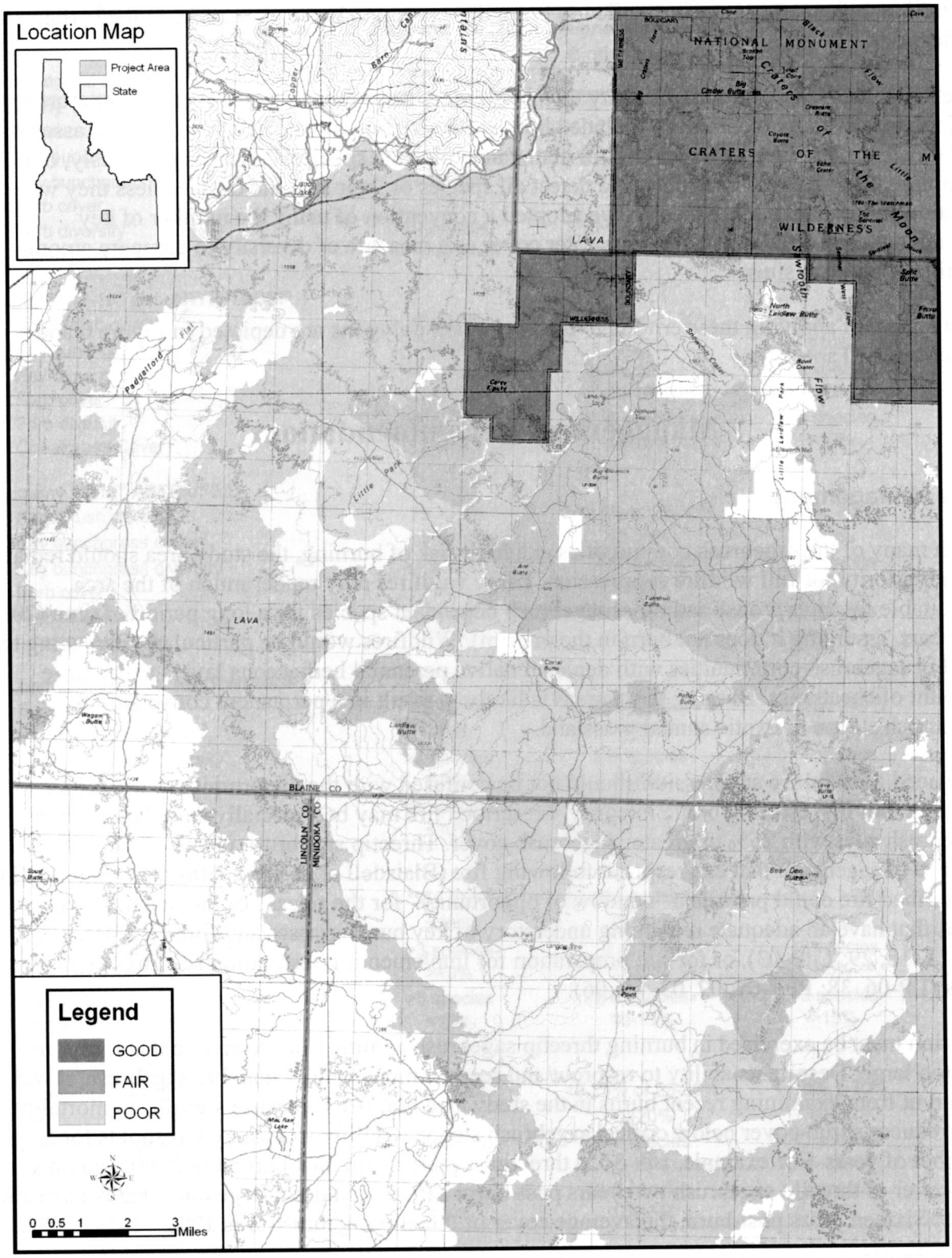


Figure 6. Biotic Integrity of Plant Communities in Laidlaw Park, Little Park and Paddelford Flat, Craters of the Moon National Monument, ID.

Table 6. Key ecological attributes and biotic integrity ratings for vegetation communities in Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument and Preserve, ID

Veg.	ARTR		ARTR4	Key Bunchgrasses[1]		Forb		BRTE	Total	Biotic Integrity	
Polygon	%Cover	%Dead	%Cover	% Cover	Diversity	%Cover	Diversity	%Cover	Acres	Rating	Comments
Laidlaw Park											
LP-01	25	5	1	8	4	10	9	18	21,041	Poor	
LP-02	16	22	1	1	1	10	5	24	1,251	Poor	priority need for restoration
LP-03	5	0	tr	35	3	15	6	5	1,746	Fair	low % sagebrush cover
LP-04	8	1	0	3	3	14	8	3	340	Poor	
LP-05	15	3	1	9	3	11	4	9	1,422	Good	plus 29% seeded grasses
LP-06	5	0	30	2	1	11	3	10	575	Poor	
LP-07	20	3	22	10	3	20	10	4	689	Fair	high % sagebrush cover
LP-08	12	23	9	5	2	14	9	13	552	Poor	plus 3% seeded grass
LP-09	33	4	0	18	1	11	5	15	68	Fair	high % sagebrush cover
LP-10	6	4	31	25	7	13	6	14	1,944	Fair	high % sagebrush cover
LP-11	16	5	0	12	6	26	13	11	1,754	Good	plus 4% seeded grass
LP-12	15	19	2	23	5	21	10	12	1,153	Good	
LP-13	5	4	31	17	4	16	4	8	264	Fair	high % sagebrush cover
LP-14	11	7	22	21	6	13	7	9	113	Fair	high %sagebrush cover
LP-15	8	30	0	11	3	18	6	14	1,356	Fair	low % sagebrush cover
LP-16	30	5	3	13	4	16	6	14	359	Fair	high % sagebrush cover
LP-17	22	3	21	15	3	23	6	14	531	Fair	high % sagebrush cover
LP-18	0	1	35	30	3	10	5	10	41	Fair	high % sagebrush cover
LP-19	11	25	2	3	2	11	3	24	4,196	Poor	priority need for restoration
LP-20	16	7	11	12	4	21	10	19	949	Fair	
LP-21	5	3	24	19	7	12	4	11	5,918	Fair	
LP-22	27	3	2	12	3	14	7	16	8,343	Fair	
LP-23	11	0	3	10	6	16	6	13	236	Fair	
LP-24	15	1	0	36	3	54	7	2	451	Good	exemplary multispecies seeding
LP-25	18	3	1	4	2	13	5	20	105	Poor	
LP-26	10	21	5	16	5	12	5	20	3,514	Fair	plus 1% seeded grass
LP-27	16	4	1	6	1	9	5	18	183	Poor	
LP-28	4	8	10	21	3	17	5	14	62	Fair	very high fair
LP-29	2	2	30	20	2	5	3	15	66	Fair	high % sagebrush cover
LP-30	1	1	22	27	8	16	9	6	18,206	Good	
LP-31	13	1	7	13	4	22	9	3	1,096	Good	plus 2% seeded grasses
LP-32	0	0	16	62	5	24	9	1	39	Good	exemplary condition
LP-33	7	8	20	25	3	6	4	4	289	Good	recent burn; small area
LP-34	0	1	0	22	4	26	2	15	202	Fair	low % sagebrush cover
LP-35	0	0	5	28	5	8	3	2	440	Fair	low % sagebrush cover
LP-36	0	0	0	10	2	6	2	0	49	Fair	low % sagebrush cover
LP-37	0	0	4	27	4	4	3	4	573	Fair	low % sagebrush cover
LP-38	0	0	38	0	0	6	1	6	17	Poor	small area around water
LP-39	17	0	5	27	4	12	5	9	2,140	Good	
LP-40	10	2	19	12	2	10	3	9	187	Good	plus 29% seeded grass
LP-41	24	1	6	7	3	15	6	10	1,979	Poor	
TOTAL									84,439		
Little Park											
LitP-01	0	1	22	22	4	4	1	10	2,239	Good	
LitP-02	4	3	7	15	3	4	1	21	2,903	Fair	
LitP-03	0	5	38	23	4	4	1	9	35	Fair	high % sagebrush cover
LitP-04	0	4	2	44	4	4	2	8	46	Fair	low % sagebrush cover
LitP-05	21	6	2	0	0	5	2	20	53	Poor	POSE & AGSM abundant
LitP-06	few	unknown	30	low	unknown	unknown	unknown	high	2,284	Poor (?)	cursory evaluation only
TOTAL									7,560		
Paddelford Flat											
PFP-01	0	0	31	5	3	3	2	12	692	Poor	
PFP-02	0	1	26	4	2	6	3	9	878	Poor	
PFP-03	0	2	33	0	0	3	2	19	393	Poor	
PFP-04	0	tr	1	0	0	4	3	6	528	Poor	seeded/low % sagebrush cover
PFP-05	2	0	10	0	0	1	1	14	221	Poor	5% seeded grass
PFP-06	0	1	33	0	0	5	3	19	108	Poor	
PFP-07	0	3	tr	5	1	1	1	18	2,274	Poor	plus 11% seeded grass
PFP-08	3	7	0	8	2	2	1	35	49	Poor	plus 2% seeded grass
PFP-09	0	7	tr	11	4	0	0	29	2,368	Poor	priority need for restoration
PFP-10	0	3	2	11	2	3	3	34	529	Poor	priority need for restoration
PFP-11	19	9	6	4	2	4	2	36	132	Poor	
TOTAL									8172		

[1] Key bunchgrasses include bluebunch wheatgrass, Idaho fescue, basin wild rye, Thurber needegrass, needle and thread, prairie junegrass, Nevada bluegrass, and sedge

and other sagebrush dependant species (Harniss and Murray 1973, Peterson 1995). Other less ecologically retrogressive treatments (e.g. Dixie harrow, rotobeating, chaining, and chemical) may be more appropriate and may reduce the length of time in which the area is unsuitable for sagebrush dependant wildlife. The efficacy of using prescribed fire (or other sagebrush treatments) to restore biotic integrity should be determined by taking a landscape view and employing the Sage Grouse Management Guidelines (Connelly et al. 2000). Key questions include:

- What kind of habitat does the proposed treatment area provide for sage-grouse (e.g., nesting, early brood rearing, late brood rearing, wintering)?

- How much of a particular seasonal habitat is potentially but not currently suitable for occupation (e.g., % of area with less than 10 % cover of sagebrush)?

- What is the distribution of currently suitable and temporarily unsuitable habitat in relation to the treatment area?

- With treatment, how much more habitat will be made temporarily unavailable?

If more than 20% of the potentially suitable habitat has insufficient sagebrush cover for sage-grouse use, treatments that make additional areas unavailable should be deferred until the other areas recover sufficiently to support sage-grouse use (Connelly et al. 2000).

The biotic integrity condition ratings translate directly into three proposed general strategies for management action in the event of fire (wild or prescribed): Minimal Treatment After Fire (Good Biotic Integrity). Selectively Seed After Fire (Fair Biotic Integrity), and Full Seeding Treatment (Poor Biotic Integrity)

- **Minimal Treatment After Fire**

  This category includes polygons that had herbaceous layers that were only slightly depleted. These sites are LitP-01, 03, 04; LP-03, 05, 10, 12, 14, 18, 21, 24, 28, 30, 32, 33, 34, 35, 37, 39, 40. They should be able to recover without seeding intervention even if they burn. Nevertheless, if they burn, the composition and cover information provided by transect data should be examined and, if advisable, some seeding may be justified to add back any species that are missing or occurring at much reduced levels than capable or desired (e.g., bluebunch wheatgrass, arrowleaf balsamroot), or are lost during the fire (e.g,. big sagebrush, bitterbrush). Several of these sites had sagebrush canopies above the desired range (e.g.Lit-03; LP-10, 14). Herbaceous layer improvement could be facilitated by some reduction in sagebrush canopy in these areas.

- **Selectively Seed After Fire**

  This category includes areas that have moderately depleted herbaceous layers but retain important elements of native biodiversity. These sites include LitP-02; LP-04, 09, 13, 16, 17, 22, 26, 29, 31, 36. They have the potential to recover without seeding, but are vulnerable to further retrogression from fire and heavy grazing, especially in areas with a large amount of

cheatgrass (e.g., Lit-02; LP-07, 09, 16, 17, 22, 26, 28, 29). Wild fire protection and grazing management that results in only light utilization (20-40%) on key bunchgrasses and forbs coupled with periodic rest should allow the species to increase while simultaneously decreasing the cover of cheatgrass (Westoby et al 1989, Holechek et al 2001).

Recovery of the herbaceous layer in vegetation polygons with heavy sagebrush cover (LP-07, 09, 13, 16, 17, 18, 29) could be accelerated by reducing shrub cover using prescribed fire, mechanical treatments, chemical treatments, or with fall sheep grazing (Bork et al. 1998) or a combination thereof. Areas that burn prior to adequate recovery should be seeded with important species (key bunchgrasses and forbs) to restore the site to a more productive and resilient condition. For big sagebrush sites that burn, sagebrush seed should be included in the mix.

- **Full Seeding Treatment**

This category includes areas with a poor abundance and diversity of key perennial bunchgrasses and forbs, and cheatgrass infested areas. Generally, these sites had sagebrush canopies outside desired levels. Big sagebrush sites had a large component of dead plants, had severely depleted understories (both key bunchgrasses and forbs), and had moderate to high risk of cheatgrass takeover. We believe these areas have crossed a threshold (Westoby et al. 1989) and recovery should not be expected without seeding intervention. These sites include PF-01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11; LitP-05, 06; LF-01, 02, 04, 06, 08, 19, 25, 27, 38, 41. While treatments could wait until these areas burn (as a result of wildfire), proactive treatments are warranted, especially for PF-09, 10 and LP-02, 19. Also, for these sites, full restoration requires multi-species (big sagebrush, desired bunchgrasses, and forbs) seedings. For threetip sagebrush sites, seeding threetip is probably not necessary. After adequate establishment, grazing use at moderate levels and periodic rest should maintain herbaceous productivity, composition, and vigor. Successful restoration is likely to result in much greater productivity and capacity to graze then existed in the community prior to restoration.

Seeding Treatments

For seeding treatments, we advocate the use of native species from regionally adapted sources. We recognize that the lack of seed availability, expense, and difficulty in obtaining many of the species needed to conduct a full native species restoration effort, as well as limitations on current knowledge to successfully reestablish some of these important species, presents many challenges. Regardless, every effort should be made to use native species whenever and wherever possible. Lacking the appropriate native species, non-invasive, non-native species that either mimic the structural characteristics of native species (e.g. Siberian wheatgrass provides similar structure as bluebunch wheatgrass) and/or provides significant food value for livestock and wildlife (e.g., sainfoin) may be substituted.

The Potter Butte Rehabilitation seeding (LP-24) provides an outstanding example of the productive potential of the study area and the benefits of multi-species seedings on depleted sites. This seeding has all the components of a biologically intact big sagebrush/bluebunch wheatgrass site, even though some nonnative species are present. Seeded in the fall of 1992, the

site in 2002 had 22% shrub cover (15% big sagebrush, 4% bitterbrush, 3% others), 59% perennial grass cover (39% key bunchgrasses), 53% forb cover, and 2% cheatgrass. It provides both abundant livestock forage as well as very good wildlife habitat (food and cover). Clearly, the soil productivity was still present on this site prior to the rehabilitation. In terms of vegetation cover and diversity, this seeding serves as a "how to" lesson for future restoration efforts.

We recommend that seed mixes include the plant species that are currently present at less than potential. Generally, in terms of the native grasses, bluebunch wheatgrass and Idaho fescue have been the most seriously reduced. Arrowleaf balsamroot is the most severely reduced native forb species although on some threetip sagebrush sites, tapertip hawksbeard and lupine may have been more abundant prior to depletion. Forbs are a critical nutritional component for many species of wildlife. For sage-grouse, the nutrition of both pre-laying hens (Barnett and Crawford 1994) and chicks are dependant on forbs (Connelly et al 2000). An assortment of desirable forb species should be provided in any seeding mix.

Caution must be exercised in the formulation of multi-species seeding mixes. Seeding grasses at the usual recommended rate for grass seedings can seriously reduce the success of the seeded shrub and forb species because of competition.[7] This tendency to over-seed grasses should be avoided to ensure that forbs and shrubs are not out-competed by the more aggressive grass species.

Idaho fescue, a primary species in the more mesic sagebrush sites (12-16" ppt.), may be at the lower margin of its ecological tolerance in this study area. A study of the vegetation in the Carey Kipuka during the period of 1961-1963 identified considerable mortality of Idaho fescue plants, perhaps due to the drought conditions during the period 1959-61 (Tisdale et al. 1965). The space vacated by Idaho fescue was colonized by cheatgrass, formerly a very minor component of the kipuka. Bluebunch wheatgrass may be better adapted to persisting in the presence of drought stress in the study area.

For threetip sagebrush sites, restoration efforts should consider including some big sagebrush seed at low rates. Although there may be some soil characteristics that preclude big sagebrush from some threetip sagebrush sites, big sagebrush is frequently a component of many of these sites. The current lack of big sagebrush in many threetip sagebrush sites in the study area may be more of an artifact of repeated fire than soil factors. From a wildlife habitat perspective, having a big sagebrush component in these threetip sagebrush stands would be desirable. Use of the appropriate subspecies for the ecological site is recommended.

Livestock Grazing Management

It is likely that unmanaged, heavy livestock grazing in the early decades of the 1900s was responsible for much of the depletion of the native grasses and forbs in the study area. Nevertheless, some continuing problems were apparent during the study. Utilization of preferred grasses and forbs was generally heavy within a mile of water and sheep trailing bottlenecks (e.g.,

[7] Steve Monsen pers. commun., Joe Russell, pers. commun.

south half of Paddelford Flat and central Little Park). During May and June of 2002, Laidlaw Butte (LP-39 and parts of LP-01 and 21) was grazed continually through the growing season by sheep and cattle, resulting in much churning of the soil and heavy utilization of the grasses and forbs.

Livestock grazing needs to be managed to allow good condition herbaceous communities (LP-03, 05, 10, 12, 14, 18, 24, 28, 30, 33, 34, 35, 39, 40) to at least maintain their current condition (i.e. moderate utilization and periodic rest). For those communities with fair condition herbaceous layers (LP-07, 09, 13, 15, 16, 17, 20, 21, 22, 23, 26, 29, 36; Lit-02), no more than light utilization and periodic rest should be allowed. Every opportunity for voluntary non use should be capitalized upon to facilitate recovery, especially for fair condition areas.

An important opportunity exists to use sheep to improve the biotic integrity of some of the plant communities in the study area. Long-term sheep grazing experiments at the U.S. Sheep Experiment Station near Dubois, Idaho, on threetip sagebrush ecological sites similar to those in the study area, have clearly shown that year-after-year spring grazing had negative consequences for the forb component of the vegetation, with arrowleaf balsamroot the most severely affected species (Bork et al. 1998). Moreover, sites that were severely depleted recovered little despite changes in management (exclusion or a change to fall grazing only). Nevertheless, recovery was taking place, but it was slower on excluded areas than areas that were switched from a spring grazing to fall grazing (Bork et al. 1998). For sites on the study area that have a relatively intact understory but a heavy sagebrush overstory cover (LP-07, 10, 13, 14, 17, 18, 21, 29; LitP-03), fall grazing by sheep could result in a reduced cover of sagebrush and an increase in cover of perennial herbaceous plants relatively rapidly, albeit measured in decades. This treatment may also work on big sagebrush sites in similar condition (LP-09, 16, 20, 22).

Continuously used livestock concentration areas (water sources, corrals, salt grounds, and sheep bedding grounds) in the study area were quite degraded. Exotic annual species such as Russian thistle (*Salsola iberica*), mustard (*Sisymbrium altissimum*) and cheatgrass dominated these areas. These areas were not large (5 to 10 acres), but they were distributed over the landscape and increased the potential for noxious weeds to establish in these areas.

Approaches to address this problem often result in a debate between moving these locations regularly or using the areas repeatedly and accepting them as a necessary cost of livestock use. It is our conclusion that they should become permanent, fixed locations, because even short-term concentration of livestock causes rapid degradation of the plant community regardless of the grazing management system employed (e.g., deferment, rest, or short duration). Once the plant community becomes seriously degraded, it will not recover even if grazing is excluded. Seeding with grazing resistant plants (e.g. standard crested wheatgrass, Siberian wheatgrass, and western wheatgrass and streambank wheatgrass) may help reduce weed invasion, but with time, even those sites will become degraded again. Consequently, it is our view that it is better to have a limited number of livestock concentration areas in known locations where regular monitoring can result in early detection and elimination of noxious weeds.

Noxious Weeds

Many small patches of diffuse knapweed were located in the southern part of Paddelford Flat (Transects PFT-09, 13 –17, 24-33). It was less abundant in Little Park, but was noted in the vicinity of a number of transects (LitT-07, 08, 12, 14, 15). It was only noted at one location in Laidlaw Park (ocular survey LOC-05). An aggressive effort is needed to eliminate this weed from the study area, especially in Little Park and Laidlaw Park. Regular monitoring for early detection is warranted. Highly disturbed sites (roads, livestock watering sites, salting sites, and sheep bedding areas) are vulnerable and likely spots for initial noxious weed establishment.

Rush skeletonweed (*Chondrilla juncea*) occurs in the southern end of Laidlaw Park. As with knapweed, an aggressive treatment program is needed to prevent the spread of this plant.

Unique Areas

Several unique areas were noted while conducting fieldwork in the study area. These areas are described below:

- Snowdrift Crater, an interesting geologic feature located in northern Laidlaw Park, also contains some uncommon plant associations. It contains the only aspen (*Populus tremuloides*) stand in the entire study area. In addition, the area supports a small big sagebrush/bitterbrush plant community that enhances the diversity of north Laidlaw Park. Livestock use of aspen seedlings was preventing establishment of new trees. Because of the wildlife values and visual attractiveness of the trees in an otherwise treeless landscape, this very unique area would be best managed by excluding it from livestock grazing.

- A small park nearly surrounded by a lava flow located along the NW boundary of Laidlaw Park (LP-32) contained both threetip and big sagebrush communities in a biologically intact state. Restoring the short gap fence at the entrance to this park and closing the area to livestock grazing should retain the value of this area as a reference site.

- Exclusive to south Laidlaw Park were a number of threetip sagebrush-dominated communities surrounding internal drainage basins (playas). These playas did not make up a significant percentage of the total area, but were unique and interesting from an "island ecology" standpoint. Understory plants were mostly uniform stands of *Carex* sp. western wheatgrass, Nevada bluegrass (*Poa nevadensis*), or forb communities. This understory varied from playa to playa, and did not seem predictable across the landscape. Evidence of fire-killed shrubs on these sites was not apparent. Two transects were run on representative playa types, LP-18 and LP-38. LP-18 had a large *Carex* stand in the understory; LP-38 (more heavily grazed) had mostly annual forbs. Some of the playas within polygon LP-19 contained abundant understories of Nevada bluegrass. These were not assessed separately. Additional study of these sites would provide better overall information about the differences in plant communities and their fire resistance.

- LP-39 contains the largest big sagebrush/bitterbrush co-dominant site in the study area with a good understory of perennial grasses. It also contains a small inclusion of an unidentified sagebrush species on the east flank of Laidlaw Butte at about 5000' elevation (likely early

low sagebrush, *Artemisia longiloba*). A large exclosure (40+ acres) that encompasses both of these sites in this polygon would allow comparative study and monitoring of vegetation dynamics with and without grazing.

- There are a number of other sites in the study area that contain exemplary or unique vegetation. Most are located along the remote edges of the parks but some are within the core of the parks (e.g., LitP-05, LP-03). If there were a need to protect the biotic integrity of some representative plant communities, establishing livestock exclosures at these sites would be appropriate to monitor plant community trends without the influence of livestock grazing. Locations for ecological reference, trend study, and possible exclosure study sites are provided in Appendix VII (and the field maps).

Wildlife

The study area is important to the maintenance of both resident and migratory sagebrush steppe wildlife. It is especially important to sage-grouse. The area provides breeding, nesting, early brood rearing, and winter habitat. The southern half of Laidlaw Park provides winter habitat. Although current habitat conditions are less than optimum for this and other sagebrush steppe wildlife, most of the area retains enough sagebrush cover to provide for their continued presence. Major opportunities exist to improve the quality of the habitat for sage-grouse and other sagebrush dependent wildlife.

Sage-grouse should be a key management species for the study area. They require large areas to meet their annual needs and, as a sagebrush obligate, they are sensitive to changes in habitat. Meeting the habitat needs of sage-grouse will provide for the needs for most other sagebrush dependent species (Dobkin 1995). Decisions on treatments to restore the biotic integrity of the sagebrush communities in the study area should be planned with sage-grouse habitat requirements in mind. As previously stated, we advocate using the Sage Grouse Management Guidelines (Connelly et al. 2000) to guide treatment planning and decisions. Treatments methods that are least disruptive to sage-grouse habitat should be employed.

Wildlife observations made incidental to the vegetation mapping and transects are shown in Appendix VIII.

Conclusion

Similar to many areas in the West, the native sagebrush-perennial grass-mixed forb plant communities in the study area exhibited, to varying degrees, common signs of ecological stress and biological impoverishment brought on by both anthropogenic (human-caused fires, livestock, exotic species introductions, roads, fences, etc.) and natural (fire, wind and water erosion, climate factors, insects, etc.) disturbance over the past century. Where these stresses have exceeded ecological tolerances, community retrogression and simplification has occurred, resulting in reduced values for native sagebrush steppe wildlife and livestock (Sands et al. 1999, West, 1999). More importantly, many areas have reduced resiliency and are vulnerable to further retrogression that provides even fewer natural resource values and societal benefits, and potentially more economic costs for management in the future.

Within the study area, the biotic integrity of the plant communities varies. Some areas are slightly altered (29% good condition), some are moderately altered (30% fair condition), and others are severely altered (41% poor condition), seemingly having crossed a threshold from which recovery is not possible without seeding intervention (Table 7). Large areas are at considerable risk for further degradation. A proactive program of wildfire suppression, improved grazing management, and multi-species restoration seeding of select areas is needed to return this area to a healthy, productive, and resilient state. Careful fire and livestock management (light to moderate utilization and periodic rest) will be necessary to ensure that the area, once recovered, stays within an acceptable range of variation for an intact perennial dominated community of shrubs, grasses, and forbs.

Reestablishment of missing components in current plant associations presents biologic, economic, and social challenges. A restoration program will be expensive, time consuming, and will require rest from grazing during the treatment and recovery. Even a well-planned and executed restoration effort will likely have some failures due to drought conditions during the year of establishment. Regardless, we feel that this area is worth the investment.

Table 7. Summary of biotic integrity ratings, Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument and Preserve, ID.

Biotic Integrity Rating	Laidlaw Park		Little Park		Paddelford Flat		Study Area	
	Acres	%	Acres	%	Acres	%	Acres	%
Good	26,737	32	2,239	30	0	0	28,976	29
Fair	27,463	33	2,984	39	0	0	30,447	30
Poor	30,239	35	2,337	31	8,172	100	40,748	41
Total	84,439	100	7,560	100	8,172	100	100,171	100

Literature Cited

Anderson, J.E. and R.S. Inouye. 2001. *Landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years*. Ecological Monographs 71(4):531-556.

Bailey, R. 1995. *Ecosystem Provinces*. http://www.fs.fed.us/colorimagemap/ecoreg1_provinces.html

Barnett, J.F. and J.A. Crawford. 1994. *Pre-laying nutrition of sage grouse hens in Oregon.* J. Range Manage. 47:114-118.

Blaisdell, J.P., R.B. Murray, and E.D. McArthur. 1982. *Managing intermountain rangelands – sagebrush-grass ranges.* USDA Forest Service, Rocky Mountain Forest and Range Experiment Sta., Ogden, UT. Gen.Tech. Rep. INT-134, 39 p.

Bork, E.W., N.E. West, and J.W. Walker. 1998. *Cover components of long-term seasonal sheep grazing treatments in three-tip sagebrush steppe.* J. Range Manage. 51:293-300.

Bureau of Land Management, 2003. *Livestock grazing permit renewal – Laidlaw Park allotment*, Envir. Assess. No. ID076-2003-0014. BLM, Shoshone, ID. 40p.

_____ 2002. *Laidlaw Park allotment assessment.* BLM, Shoshone, ID. 21p.

_____ 1991. *Environmental assessment for the proposed Laidlaw Park Allotment Management Plan,* Envir. Assess. No. ID050-EA-91018. BLM, Shoshone, ID. 63p.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. *Guidelines to manage sage grouse populations and their habitats.* Wildl. Soc. Bulletin 28(4):967-985.

Daubenmire, R. 1970. *Steppe vegetation of Washington.* Wash. Agric. Experiment Station, Washington State University, Pullman. 131 p.

Day, T.A., and R.G. Wright. 1985. *The vegetation types of Craters of the Moon National Monument.* College of Forestry. Forest, Wildl. and Range Exp. Sta., Univ. Idaho, Moscow. Bull. No. 38, 6 p.

Dobkin, D.S. 1995. Management and conservation of sage grouse, denominative species for the ecological health of shrubsteppe ecosystems. USDI Bureau of Land Management, Portland, OR. 26 p.

Dorfman, D. 2001. *U.S. Ecoregions.* The Nature Conservancy. http://gis.tnc.org/data/MapbookWebsite/map_page.php?map_id=27.

Franklin, J.F., and C.T. Dyrness. 1973. *Natural vegetation of Oregon and Washington.* USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland. OR. Gen. Tech. Rep. PNW-8, 417 p.

Groves, C.R., B. Butterfield, A. Lippincott, B. Csuti, J.M. Scott. 1997. *Atlas of Idaho's Wildlife.* Idaho Department of Fish and Game, Boise, ID. 372 p.

Harniss, R.O., and R.B. Murray. 1973. *Thirty years of vegetal change following burning of sagebrush-grass range.* J. Range Manage. 26:26:322-325.

Hironaka, M., M.A. Fosberg, and A.H. Winward. 1983. *Sagebrush-grass habitat types of southern Idaho.* Forest, Wildl. and Range Exp. Sta., Univ. Idaho, Moscow, ID. Bull. No. 35, 44 p.

Hitchcock, C. and A. Cronquist. 1973. *Flora of the Pacific Northwest.* Univ. of Wash. Press, Seattle, Washington. 730p.

Holechek, J.L., R.D. Pieper, C.H. Herbel. 2001. *Range management – principles and practices.* Prentice Hall, Upper Saddle River, NJ. 587p.

Interagency Technical Reference. 1996. *Sampling vegetation attributes.* USDA Forest Service and Natural Resources Conservation Service, and USDI, Bureau of Land Management. BLM/RS/ST-96/002+1730, 163 p.

Johnson, M. E. 1991. *Soil survey of Blaine County area, Idaho.* USDA Soil Conservation Service, Boise, ID. 368 p.

Karr, J.R., and D.R. Dudley. 1981. *Ecological perspectives on water quality goals.* Environmental Manage. 11:249-256.

Laycock, W.A. 1991. *Stable states and thresholds of range condition on North American rangelands: a viewpoint.* J. Range Manage. 44:427-433.

National Research Council. 1994. *Rangeland health, new methods to classify, inventory, and monitor rangelands.* National Academy Press, Wash., DC. 180 p.

Noss, R. F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. Conserv. Biol. 4:355-364

Paige, C. and S.A. Ritter. 1999, *Birds in a sagebrush sea: managing sagebrush habitats for bird communities*. Partners in Western Flight working group, Boise, ID.

Passey, H.B. and V.K Hugie. 1962. *Sagebrush on relict ranges in the Snake River Plains and Northern Great Basin.* J. Range Manage.15(5):273-278.

Parrish, J.D., D.P. Braun, R.S. Unnasch. 2003. *Are we conserving what we say we are? Measuring Ecological Integrity within protected areas.* BioScience 53(9):851-860.

Peterson, J.G. 1995. *Ecological implications of sagebrush manipulation, a literature review.* Montana Fish, Wildlife and Parks. Helena, MT. Project W-101-R-2. 49 p.

Plummer, A.P., S.B. Monsen, and R. Stevens. 1977. *Intermountain range plant names and symbols.* USDA Forest Service, Ogden, UT. Gen. Tech. Rep. INT-38, 82p.

Reid, M., P. Comer, H. Barrett, S. Caicco, R. Crawford, C. Jean, G. Jones, J. Kagan, M. Karl, G. Kittel, P. Lyon, M. Manning, E. Peterson, R. Rosentreter, S. Rust, D. Tart, C. Williams, and A. Winward. 2002. *International classification of ecological communities: Terrestrial vegetation of the United States. Sagebrush Vegetation of the Western United States. Final Report for the USGS Forest and Rangeland Ecosystem Science Center, Boise, Idaho.* NatureServe, Arlington, VA.

Sands, A.R., S. Sather-Blair, V. Saab. 1999. *Sagebrush steppe wildlife: historical and current perspectives, pp. 27-34.* Sagebrush Steppe Symposium, Boise State Univ., Boise, ID.

Shiftlet, T.N., ed. 1994. *Rangeland cover types of the United States.* Society for Range Management, Denver, CO. 152 p.

Tart, D.L. 1996. *Big sagebrush plant associations of the Pinedale Ranger District.* Final Review Draft. USDA Forest Service, Bridger-Teton Nat'l. For., Pindale, WY. 97p.

Tisdale, E.W., M. Hironaka, and M.A. Fosberg. 1965. *An area of pristine vegetation in Craters of the Moon National Monument, Idaho.* Ecology 46:349-352.

Welch, B. L. and C. Criddle. 2003. *Countering misinformation concerning big sagebrush.* USDA, Forest Service, Rocky Mountain Res. Sta. RMRS-RP-40. 28 p.

West, N. E. 1999. *Synecology and disturbance regimes of sagebrush steppe ecosystems, p. 15-26.* Sagebrush Ecosystem Symposium, Boise State Univ., Boise, ID.

Western Regional Climate Center. *Monthly Precipitation Records, Craters of the Moon NM,* Idaho. http://www.wrcc.dri.edu/cgi-bin/cliMONtpre.pl?idcrat.

Westoby, M., B. Walker, and I. Noy-Meir. 1989. *Opportunistic management for rangelands not at equilibrium.* J.Range Manage. 42:266-274.

Whisenant, S.G. 1990. *Changing fire frequencies on Idaho's Snake River Plains: ecological and management implications, p. 4-10.* Proceedings - Symposium on Cheatgrass Invasion, Shrub Die-off, and Other Aspects of Shrub Biology and Management. USDA Forest Service, Intermountain Res. Sta., Ogden UT. Gen. Tech. Rep. INT-276.

Appendix I. Plant species symbols and names, Laidlaw Park, Little Park, and Paddelford Flat, Craters of the Moon National Monument and Preserve, Idaho

Symbol	Common Name	Scientific Name (Hitchcock and Cronquist)	Scientific Name (NRCS Plants Database)
Shrubs			
AMAL	Saskatoon serviceberry	*Amelanchier alnifolia*	*Amelanchier alnifolia*
ATCA	fourwing saltbush	*Atriplex canescens*	*Atriplex canescens*
ARTR	big sagebrush	*Artemisia tridentata*	*Artemisia tridentata*
ARTR4	threetip sagebrush	*Artemisia tripartita*	*Artemisia tripartita*
CHNA	rubber rabbitbrush	*Chrysothamus nauseous*	*Ericameria nauseosa*
CHVI	green rabbitbrush	*Chrysothamnus viscidiflorus*	*Chrysothamnus viscidiflorus*
LEPU	prickly phlox	*Leptodactylon pungens*	*Leptodactylon pungens*
OPUNT	prickleypear	*Opuntia spp.*	*Opuntia spp.*
PUTR	antelope bitterbrush	*Purshia tridentata*	*Purshia tridentata*
SYMPH	snowberry	*Symphoricarpos spp.*	*Symphoricarpos spp.*
TECA	gray horsebrush	*Tetradymia canescens*	*Tetradymia canescens*
Perennial Grasses and Grass-like plants			
AGCR	crested wheatgrass	*Agropyron cristatum*	*Agropyron cristatum*
AGDA	thickspike wheatgrass	*Agropyron dasystachyum*	*Elymus macrourus*
AGIN	intermediate wheatgrass	*Agropyron intermedium*	*Thinopyrum intermedium*
AGROP	wheatgrass	*Agropyron spp.*	*Agropyron spp.*
AGSI	Siberian wheatgrass	*Agropyron sibiricum*	*Agropyron fragile*
AGSM	western wheatgrass	*Agropyron smithii*	*Pascopyrum smithii*
AGSP	bluebunch wheatgrass	*Agropyron spicatum*	*Pseudoroegneria spicatum*
CAREX	sedge	*Carex spp.*	*Carex spp.*
ELCI	great basin wildrye	*Elymus cinereus*	*Leymus cinereus*
ELJUJ	Russian wildrye	*Elymus junceus*	*Psathyrostachys juncea*
FEID	Idaho fescue	*Festuca idahoensis*	*Festuca idahoensis*
KOCR	prairie junegrass	*Koeleria cristata*	*Koeleria macrantha*
ORHY	Indian ricegrass	*Oryzopsis hymenoides*	*Achnatherum hymenoides*
POAM	big bluegrass	*Poa ampla*	*Poa secunda*
PONE	Nevada bluegrass	*Poa nevadensis*	*Poa secunda*
POSE	Sandberg bluegrass	*Poa sandbergii*	*Poa secunda*
SIHY	bottlebrush squrreltail	*Sitanion hystrix*	*Elymus elymoides*
STCO	needle and thread	*Stipa comata*	*Hesperostipa comata*
STTH	Thurber needlegrass	*Stipa thurberiana*	*Achnatherum thurberianum*
UNPG	unidentified perennial grass		
Annual grasses			
BRTE	cheatgrass	*Bromus tectorum*	*Bromus tectorum*
POBU	bulbous bluegrass	*Poa bulbosa*	*Poa bulbosa*
Perennial Forbs			
AGGL	pale agoseris	*Agoseris glauca*	*Agoseris glauca*
ALLIU	wild onion	*Allium spp.*	*Allium spp.*
AMARA	amaranth	*Amaranthus spp.*	*Amaranthus spp.*
ANTEN	pussytoes	*Antennaria spp.*	*Antenneria spp.*
ARABI	rockcress	*Arabis spp.*	*Arabis spp.*
ARFU	orange arnica	*Arnica fulgens*	*Arnica fulgens*
ARNIC	arnica	*Arnica spp.*	*Arnica spp.*

Appendix I. Plant species (cont.)

Symbol	Common Name	Scientific Name (Hitchcock and Cronquist)	Scientific Name (NRCS Plants Database)
Perennial Forbs cont.			
ASCLE	milkweed	*Asclepias spp.*	*Asclepias spp.*
ASON	spindle milkvetch	*Astragulus oniciflormis*	*Astragulus oniciflormis*
ASSC	Crag aster	*Aster scopulorum*	*Lonactis alpina*
ASTER	aster	*Aster spp.*	*Aster spp.*
ASTRA	milkvetch	*Astragulus spp.*	*Astragulus spp.*
BASA	arrowleaf balsamroot	*Balsamohriza sagittata*	*Balsamohriza sagittata*
CALOC	mariposa lily	*Calochortus spp.*	*Calochortus spp.*
CASTI	Indian paintbrush	*Castilleja spp.*	*Castilleja spp.*
CENTA	knapweed	*Centaurea spp.*	*Centaurea spp.*
CIRSI	thistle	*Cirsium spp.*	*Cirsium spp.*
CRAC	tapertip hawksbeard	*Crepis acuminata*	*Crepis acuminata*
CREPI	hawksbeard	*Crepis spp.*	*Crepis spp.*
DELPH	larkspur	*Delphinium spp.*	*Delphinium spp.*
ERIGE	fleabane	*Erigeron spp.*	*Erigeron spp.*
ERIOG	wild buckwheat	*Eriogonum spp.*	*Eriogonum spp.*
HYCA	pennywort	*Hydrophyllum capitatum*	*Hydrophyllum capitatum*
LILE	Lewis flax	*Linum lewisii*	*Linum perenne*
LIRU	stoneseed	*Lithospermum ruderale*	*Lithospermum ruderale*
LOMAT	desert parsley	*Lomatium spp.*	*Lomatium spp.*
LUPIN	lupine	*Lupinus spp.*	*Lupinus spp.*
MICRO	microseris	*Microseris spp.*	*Microseris spp.*
OENOT	evening primrose	*Oenothera spp.*	*Oenothera spp.*
ONVI	common sainfoil	*Onobrychis viciaefolia*	*Onobrychis viciifolia*
PENST	beardtongue	*Penstemon spp.*	*Penstemon spp.*
PHHO	Hoods phlox	*Phlox hoodii*	*Phlox hoodii*
PHLO	longleaf phlox	*Phlox longifolia*	*Phlox longifolia*
SPMU	Munro globemallow	*Sphaeralcea munroana*	*Sphaeralcea munroana*
ZIPA	foothill deathcamas	*Zigadenus paniculatus*	*Zigadenus paniculatus*
UNPF	unidentified perennial forb		
Annual forbs			
SYSIM	annual mustard	*Sysimbrium spp.*	*Sysimbrium spp.*
LEPE	clasping pepperweed	*Lepidium perfoliatum*	*Lepidium perfoliatum*
MIMUL	monkeyflower	*Mimulus spp.*	*Mimulus spp.*
TRAGO	salsify	*Tragopogon spp.*	*Tragopogon spp.*
UNAF	unidentified annual forb		

Appendix II. Paddelford Flat step-point vegetation transects and species foliar cover (page 1 of 3)

Transect Number	PFT-01	PFT-02	PFT-03	PFT-04	PFT-05	PFT-06	PFT-07	PFT-08	PFT-09	PFT-10	PFT-11	PFT-12
Latitude[1]	43.20.636N	43.20.190 N	43'19.830 N	43.19.766 N	43.19.524 N	43.20.601 N	43.20.554 N	43.20.072 N	43.18.648 N	43.18.835 N	43.18.955 N	43.18.360 N
Longitude[1]	113.45.894W	113.46.281 W	113.46.438 W	113.47.046 W	113.45.705 W	113.44.822 W	113.44.073 W	113.44.609 W	113.47.439 W	113.45.778 W	113.47.928 W	113.47.591 W
Transect Bearing (degr	200	280	185	300	125	20	160	140	100	240	208	208
Elevation (ft)	4980	4990	4960	4911	4906	4997	5072	4995	4895	4931	4830	4855
Date	10/2/01	10/2/01	10/3/01	10/3/01	10/3/01	10/3/01	10/3/01	10/3/01	10/3/01	10/3/01	10/5/01	10/5/01
SHRUBS												
ARTR	0	0	0	0	0	0	0	0	0	0	0	0
ARTR4	33	29	32	29	22	21	31	26	0	3	33	33
CHNA	1	0	0	0	0	0	1	0	1	3	0	1
CHVI	9	2	0	0	6	4	1	5	7	9	0	3
PUTR	0	0	0	0	0	0	0	0	0	0	0	0
TECA	0	0	0	0	0	0	0	0	1	0	0	0
Dead Shrub	0	0	1	2	0	2	1	1	0	0	2	1
GRASSES												
STTH	2	0	0	0	0	0	0	0	0	0	0	0
STCO	0	0	0	0	0	0	0	0	0	0	0	0
AGSP	1	0	0	1	0	4	1	0	0	0	0	0
FEID	1	4	0	3	5	2	3	1	0	0	0	0
ELCI	0	0	0	0	0	0	0	0	0	0	0	0
KOCR	0	0	0	0	0	0	0	0	0	0	0	0
ORHY	0	0	0	0	0	0	0	0	0	0	0	0
SIHY	1	0	0	0	0	1	0	0	0	0	4	2
AGSM	0	0	0	0	0	0	0	1	2	1	0	0
PONE	0	1	0	0	0	0	0	0	0	0	0	0
POSE	14	17	18	18	31	14	27	17	4	22	19	37
POAM	0	0	0	0	0	0	0	0	1	0	0	0
AGIN	0	0	0	0	0	0	0	0	0	1	0	0
AGSI	0	0	0	0	0	0	0	0	34	27	0	0
AGCR	0	0	0	0	0	0	0	0	0	2	0	0
CAREX	0	0	0	0	0	0	0	0	1	0	0	0
BRTE	10	13	18	8	11	9	5	12	2	13	19	19
FORBS												
PHHO	0	0	1	1	1	4	2	3	0	0	1	2
PHLO	0	4	0	2	0	3	2	2	0	0	2	2
ERIOG	0	0	0	0	1	0	0	0	0	0	0	0
LILE	0	0	0	0	0	0	0	0	3	0	0	0
ALLIU	0	0	0	0	0	0	0	0	0	0	0	1
CRUCI	0	0	0	0	0	0	0	0	0	0	0	0
LOMAT	0	0	0	0	0	1	1	0	0	0	0	0
ARABI	0	0	0	0	0	0	0	0	0	0	0	0
SALVIA	0	0	0	0	0	0	0	0	0	0	0	0
CENTA	0	0	0	0	0	0	0	0	0	0	0	0
UNPF	0	2	0	0	0	0	0	0	0	0	0	0
UNAF	1	0	0	1	2	0	0	0	0	0	1	0

[1] degrees and decimal minutes

Appendix II. Paddelford Flat step-point vegetation transects and species foliar cover (page 2 of 3)

Transect Number	PFT-13	PFT-14	PFT-15	PFT-16	PFT-17	PFT-18	PFT-19	PFT-20	PFT-21	PFT-22	PFT-23	PFT-24
Latitude	43.17.788 N	43.17.211 N	43.16.318 N	43.15.727 N	43.17.565 N	43.17.979 N	43.18.518 N	43.18.614 N	43.19.128 N	43.18.946 N	43.17.746 N	43.18.052 N
Longitude	113.47.658 W	113.47.821 W	113.49.315 W	113.49.353 W	113.46.981 W	113.47.114 W	113.46.573 W	113.47.103 W	113.45.972 W	113.47.436 W	113.47.366 W	113.46.825 W
Transect Bearing (degr	230	280	170	230	80	340	160	45	140	10	205	20
Elevation (ft)	4830	4818	4836	4806	4856	4874	4937	4875	4985	4826	4836	4859
Date	10/5/01	10/5/01	10/5/01	10/5/01	10/6/01	10/6/01	10/6/01	10/6/01	10/6/01	10/7/01	10/7/01	10/7/01
SHRUBS												
ARTR	24	18	13	26	3	5	1	2	2	0	3	7
ARTR4	3	0	1	1	0	0	2	0	10	12	0	2
CHNA	5	2	2	7	2	1	2	4	4	0	3	5
CHVI	4	3	10	10	22	10	7	21	20	0	29	6
PUTR	2	2	3	0	5	2	1	0	0	0	2	5
TECA	0	0	0	0	0	3	0	0	0	0	0	0
Dead Shrub	6	8	7	12	10	5	0	1	0	0	7	5
GRASSES												
STTH	0	0	0	0	0	0	0	0	0	0	0	0
STCO	4	13	9	9	1	0	0	0	0	0	0	0
AGSP	3	4	1	3	3	15	0	0	0	0	5	9
FEID	0	1	2	0	0	0	0	0	0	0	0	0
ELCI	0	0	1	0	3	0	1	0	0	0	0	3
KOCR	0	0	0	0	0	0	0	0	0	0	0	0
ORHY	2	2	1	2	5	1	0	0	0	0	3	1
SIHY	1	5	2	1	2	1	1	0	0	0	1	0
AGSM	0	2	0	0	1	1	0	9	7	10	12	5
PONE	0	0	0	0	5	3	0	0	0	0	0	0
POSE	21	18	35	18	8	20	15	7	30	13	16	31
POAM	0	0	0	0	0	0	0	0	0	0	0	0
AGIN	0	0	0	0	0	0	1	0	0	0	0	0
AGSI	0	0	0	0	0	1	35	28	5	8	2	3
AGCR	0	0	0	0	0	0	6	3	0	0	0	0
CAREX	6	0	0	0	0	0	4	0	0	0	0	2
BRTE	31	19	28	34	30	15	10	8	14	2	35	13
FORBS												
PHHO	1	1	0	2	0	4	0	0	0	4	0	1
PHLO	1	2	0	0	1	1	5	1	1	0	2	3
ERIO	0	0	0	1	1	0	1	0	0	0	0	0
LILE	0	0	0	0	0	0	0	0	0	0	0	0
ALLIU	0	0	0	0	0	0	0	0	0	0	0	0
CRUCI	0	0	0	0	3	0	0	0	0	0	1	0
LOMAT	0	0	0	0	0	0	0	0	0	0	0	0
ARABI	0	1	0	0	0	0	0	0	0	0	0	0
SALVIA	0	0	0	0	0	0	0	0	0	0	0	0
CENTA	0	0	0	0	0	0	0	0	0	0	0	0
UNPF	0	0	0	0	0	0	0	0	0	0	0	0
UNAF	1	1	0	0	0	0	2	0	0	0	2	1

[1] Degrees and decimal minutes

Appendix II. Paddelford Flat step-point vegetation transects and species foliar cover (page 3 of 3)

Transect Number	PFT-25	PFT-26	PFT-27	PFT-28	PFT-29	PFT-30	PFT-31	PFT-32	PFT-33
Latitude[1]	43.16.773 N	43.16.536 N	43.16.134 N	43.15.697 N	43.16.611 N	43.16.198 N	43.15.350 N	43.15.645 N	43.16.754 N
Longitude[1]	113.48.186 W	113.48.610 W	113.48.749 W	113.47.409 W	113.47.184 W	113.47.103 W	113.47.509 W	113.47.556 W	113.47.656 W
Transect Bearing (degr	260	100	125	10	175	200	230	300	325
Elevation (ft)	4827	4803	4829	4810	4790	4796	4790	4803	4812
Date	10/7/01	10/7/01	10/7/01	10/7/01	10/8/01	10/8/01	10/8/01	10/8/01	10/8/01
SHRUBS									
ARTR	37	21	15	3	1	0	19	13	1
ARTR4	0	2	4	0	0	0	6	4	32
CHNA	2	4	3	6	1	0	12	5	3
CHVI	12	16	5	9	4	4	9	8	6
PUTR	0	0	0	2	0	0	6	7	2
TECA	0	1	1	0	0	0	0	0	0
Dead Shrub	10	11	30	5	3	6	9	31	5
GRASSES									
STTH	0	0	0	0	0	0	0	0	0
STCO	14	11	12	0	0	0	0	0	0
AGSP	16	7	10	1	0	7	3	0	1
FEID	0	0	0	0	0	0	0	0	1
ELCI	0	0	0	0	1	0	2	0	1
KOCR	0	0	0	0	0	0	0	0	0
ORHY	0	0	1	0	0	3	0	0	0
SIHY	0	0	0	0	0	0	3	0	4
AGSM	6	1	0	19	3	4	1	1	2
PONE	0	0	0	0	0	1	0	0	0
POSE	9	37	30	20	14	14	31	45	19
POAM	0	0	0	0	0	0	0	0	0
AGIN	0	0	0	0	0	0	0	0	0
AGSI	0	0	0	15	24	22	0	0	0
AGCR	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0
BRTE	26	28	32	36	16	19	36	35	37
FORBS									
PHHO	0	1	4	0	0	2	3	0	0
PHLO	1	1	1	0	0	1	1	0	0
ERIO	2	0	1	0	0	0	0	0	0
LILE	0	0	0	0	0	0	0	0	0
ALLIU	0	0	0	0	0	0	0	0	0
CRUCI	0	0	0	0	0	0	0	0	0
LOMAT	0	0	0	0	0	0	0	0	0
ARABI	0	0	0	0	0	0	0	0	0
SALVIA	0	0	0	0	0	0	0	1	0
CENTA	0	0	0	2	2	0	0	1	1
UNPF	0	0	0	0	0	0	0	0	0
UNAF	0	0	1	1	1	0	1	0	0

[1] Degrees and decimal minutes

Appendix III. Little Park step-point vegetation transects and species foliar cover (page 1 of 2)

Transect Number	LITO1	LIT02	LIT03	LIT04	LIT05	LIT06	LIT07	LIT08	LIT09	LIT10
Latitude[1]	43.19.107 N	43.19.063 N	43.18.714 N	43.18.497 N	43.17.875 N	43.17.465 N	43.18.472 N	43.18.351 N	43.17.527 N	43.17.534 N
Longitude[1]	113.41.689 W	113.40.068 W	113.41.135 W	113.41.626 W	113.40.700 W	113.41.258 W	113.39.612 W	113.40.186 W	113.38.544 W	113.39.452 W
Transect Bearing (degrees)	210	130	60	240	270	80	220	350	310	200
Elevation (ft)	5062	5190	5082	5018	5102	5020	5164	5128	5138	5151
Date	10/9/01	10/9/01	10/9/01	10/9/01	10/9/01	10/9/01	10/9/01	10/9/01	10/9/01	10/10/01
SHRUBS										
ARTR4	40	40	41	30	45	33	31	32	2	32
ARTR	0	6	1	0	2	1	1	0	0	1
CHNA	0	2	0	0	0	0	0	0	0	0
CHVI	0	8	1	4	2	3	0	1	7	4
PUTR	0	0	0	0	0	0	0	0	1	3
TECA	0	0	0	0	0	0	0	0	4	0
Dead Shrub	1	0	2	1	3	4	1	1	4	2
GRASSES										
POSE	31	33	18	17	25	27	13	16	18	16
AGSP	2	9	0	3	3	0	1	0	4	1
FEID	25	7	31	30	15	5	20	17	16	2
BRTE	3	10	3	3	18	21	15	11	8	15
AGSM	0	0	2	2	2	5	2	4	4	4
ELCI	0	0	1	0	1	0	0	1	0	0
STTH	0	0	0	6	7	6	12	2	22	3
SIHY	0	0	1	0	0	1	0	0	0	0
KOCR	1	3	0	0	2	0	0	1	0	3
ORHY	2	0	0	1	0	0	0	0	0	0
STCO	0	0	0	0	1	0	0	0	0	0
PONE	0	0	0	0	0	0	0	0	0	0
AVENA	0	0	0	0	0	1	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	2	0
FORBS										
PHHO	6	6	3	5	4	4	2	4	3	5
PHLO	1	0	0	0	0	1	0	0	1	0
ALLIU	0	0	0	0	0	0	0	0	0	0
LOMAT	0	0	0	0	0	0	0	0	0	1
CRUCI	0	0	0	0	0	0	0	0	0	0
UNAF	0	0	0	0	0	1	0	1	0	0

[1] degrees and decimal minutes

Appendix III. Little Park step-point vegetation transects and species foliar cover (page 2 of 2)

Transect Number	LIT12	LIT13	LIT14	LIT15	LIT16	LIT17	LIT18	LIT19	LIT20
Latitude[1]	43.17.702 N	43.17.373 N	43.17.128 N	43.17.159 N	43.17.049 N	43.17.172 N	43.18.500 N	43.18.680 N	43.18.765 N
Longitude[1]	113.41.935 W	113.42.100 W	113.42.508 W	113.42.059 W	113.40.054 W	113.41.541 W	113.42.028 W	113.42.414 W	113.42.674 W
Transect Bearing (degrees)	285	110	160	40	30	170	15	250	215
Elevation (ft)	4998	4999	5000	5005	5038	5000	5026	5049	4985
Date	10/11/01	10/11/01	10/11/01	10/11/01	10/12/01	10/12/01	10/12/01	10/12/01	10/12/01
SHRUBS									
ARTR4	25	23	5	2	45	27	31	35	38
ARTR	3	4	5	21	1	2	0	0	0
CHNA	1	0	2	3	1	2	0	0	0
CHVI	5	6	5	8	5	11	1	2	2
PUTR	0	1	0	0	4	1	0	0	0
TECA	0	0	1	0	0	0	0	0	0
Dead Shrub	3	9	1	6	4	8	3	2	5
GRASSES									
POSE	22	31	30	42	18	25	0	24	26
AGSP	1	1	0	0	0	0	2	1	5
FEID	6	0	0	0	2	0	30	7	4
BRTE	21	26	35	20	22	40	4	16	9
AGSM	20	22	3	25	6	14	2	1	2
ELCI	0	0	1	0	0	0	0	0	0
STTH	5	4	0	0	13	1	24	19	13
SIHY	0	0	0	0	0	0	0	0	6
KOCR	0	0	0	0	3	0	1	1	0
ORHY	0	0	0	0	0	0	0	0	0
STCO	0	0	0	0	0	0	0	0	0
PONE	0	2	0	1	0	0	3	0	0
AVENA	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	1
FORBS									
PHHO	8	1	0	4	3	0	6	7	4
PHLO	0	0	0	1	0	1	0	1	0
ALLIU	0	1	0	0	0	0	0	0	0
LOMAT	0	0	0	0	0	2	0	0	0
CRUCI	0	0	6	1	0	0	0	0	0
UNAF	0	1	0	2	0	0	0	1	1

[1] degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 1 of 10)

Transect Number	LPT01	LPT02	LPT03	LPT04	LPT05	LPT06	LPT07	LPT08	LPT09	LPT10	LPT11
Latitude[1]	43.04.920	43.05.544	43.07.170	43.06.965	43.07.307	43.08.231	43.09.393	43.07.978	43.08.859	43.09.165	43.09.641
Longitude[1]	113.36.709	113.32.944	113.38.320	113.37.456	113.30.065	113.28.840	113.28.174	113.3.424	113.38.355	113.36.808	113.38.666
Bearing (in degrees)	10	40	190	79	245	130	135	221	294	14	45
Date	5/21/02	5/22/02	5/24/02	5/24/02	5/26/02	5/26/02	5/26/02	5/30/02	5/30/02	5/30/02	6/1/02
Shrubs											
ARTR	40	22	19	22	9	28	13	22	10	7	19
ARTR4				2			30	1			7
CHVI	5		2	1	2		2	4	5	6	4
CHNA			5	4	8	2	2		5	4	3
PUTR											
LEPU											
OPUNT									1		
AMAL											
TECA											
ATCA											
SYMP											
Dead Shrub	2	7	8	6	1	1	4	10	25	28	9
Perennial Grasses and Grass-like Plants											
STTH			5			2	4	3			1
STCO		6									
AGSP		5	1	1		2	4	2			1
FEID	2				1						
ELCI				2							
KOCR											
ORHY											
CAREX											
AGSM		3	13	4	15	8	1	4	7	3	1
AGDA											
SIHY	9	3		3			6	6	6	5	7
POSE	37		26	24	12	19	17	12	10	16	32
PONE					1		1				1
POAM							1				
AGIN											
AGSI		3									
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	9	22	16	16		12	5	24	17	22	16
Perennial Forbs											
PHHO	3						3				1
PHLO	11	11	1	8	5		3	2	2	2	1
LOMAT	15			3			5	1			4
CRAC	5			1							
ASON											
AGGL								1	1	1	
DELPH							3				
ALLIU	4						2				
ERIOG	1						2				
BASA						1					
ERIGE											
CALOC											
SPMU							1				
ANTEN											
CASTI											1
LUPIN	1										
ARNIC											
AMARA											
CIRSI											
LILE											
ONVI											
ASTER	2		2				1	1	1		1
LIRU											1
HYCA											
PENT											
ARABI											
ZIPA											
OENOT											
ASCLEP			1	2		1		1	1		
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO											
UNAF	6	3	7	2	3			1	1		1

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 2 of 10)

Transect Number	LPT12	LPT13	LPT14	LPT15	LPT16	LPT17	LPT18	LPT19	LPT20	LPT21	LPT22
Latitude[1]	43.09.398	43.10.422	43.11.845	43.12.365	43.12.739	43.12.415	43.11.693	43.11.416	43.10.907	43.10.674	43.14.827
Longitude[1]	113.39.021	113.40.573	113.30.704	113.30.802	113.30.640	113.29.818	113.36.030	113.35.543	113.34.190	113.34.775	113.30.484
Bearing (in degrees)	250	270	315	190	187	108	170	18	110	55	146
Date	6/1/02	6/1/02	6/1/02	6/1/02	6/1/02	6/1/02	6/2/02	6/2/02	6/2/02	6/2/02	6/4/02
Shrubs											
ARTR	23	20	11	11	5	20	27	5	22		1
ARTR4				22	31			25	12	35	27
CHVI	1			5	4	12	6			3	10
CHNA	2	4	4			1			3		1
PUTR											
LEPU											
OPUNT											
AMAL											
TECA							1	4	8		
ATCA											
SYMP											
Dead Shrub	4	6	16	7			6			1	2
Perennial Grasses and Grass-like Plants											
STTH	1	8	9	4			5		5	4	14
STCO											
AGSP	1				12						2
FEID											
ELCI	2			2		1	3		2		3
KOCR											2
ORHY					3	2				1	
CAREX										26	1
AGSM	3		3			2		3	3	3	7
AGDA											
SIHY	6	8	4	11	8		2	5		1	8
POSE	22	23	15		14	17	27	21	17	8	11
PONE	1										
POAM										1	4
AGIN											
AGSI											
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	24	23	16		8	4	22	14	18	10	13
Perennial Forbs											
PHHO	1	2		3	8					4	2
PHLO	1		4					7	5	2	5
LOMAT	1						4			3	1
CRAC											
ASON										1	
AGGL	1							1		1	1
DELPH						1					
ALLIU		1		1				2			1
ERIOG											
BASA						1					
ERIGE											
CALOC											
SPMU											
ANTEN											
CASTI											
LUPIN											2
ARNIC											
AMARA											
CIRSI											
LILE											
ONVI											
ASTER	1				1						
LIRU											
HYCA											
PENT				1							
ARABI	1		1								
ZIPA											
OENOT											
ASCLEP	1	2									
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO											
UNAF	1									2	

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 3 of 10)

Transect Number	LPT23	LPT24	LPT25	LPT26	LPT27	LPT28	LPT29	LPT30	LPT31	LPT32	LPT33
Latitude[1]	43.14.012	43.13.339	43.13.350	43.12.834	43.11.745	43.11.625	43.10.354	43.09.910	43.10.807	43.10.964	43.11.283
Longitude[1]	113.31.372	113.31.477	113.31.960	113.33.278	113.33.683	113.33.720	113.34.802	113.28.509	113.28.932	113.29.545	113.29.836
Bearing (in degrees)	266	212	320	249	283	147	290	243	215	196	100
Date	6/4/02	6/4/02	6/4/02	6/5/02	6/5/02	6/5/02	6/5/02	6/5/02	6/5/02	6/6/02	6/6/02
Shrubs											
ARTR		5	26	22	26	8	13	14	15	6	12
ARTR4	35	17	2			22	1	8	17	31	
CHVI	3	6	10	3	6	4	1	3	10	4	5
CHNA			3	1			5	3	4	4	9
PUTR										2	5
LEPU											
OPUNT									1	2	
AMAL											
TECA	2						2				
ATCA											
SYMP											
Dead Shrub	1		2		5	2	23	26	5	5	7
Perennial Grasses and Grass-like Plants											
STTH	15	7	7	12	4	5	8	8	15	12	2
STCO	1	1								1	
AGSP	2	1			1	1		1	1	1	
FEID											
ELCI		3	2	4	4		1			1	5
KOCR	1								2	2	1
ORHY						1	2				
CAREX	1										
AGSM	8	1	10	11	4	1	7	7	3	9	2
AGDA											
SIHY	5	5	12	2	6	5	12	9	10	7	3
POSE	11	15	13	17	21	19	13	13	18	9	25
PONE					1						
POAM	3	1	1	2	1				1	1	
AGIN											
AGSI		5									
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	7	7	11	14	23	11	21	20	10	14	18
Perennial Forbs											
PHHO	4						10		2	3	
PHLO	3	7	11	13	2	8	4	3	6	7	9
LOMAT	2		7			3	6	4	4	4	5
CRAC											2
ASON	2	3		3		2		2	1		
AGGL	1	1	1		1	2		1	2	5	3
DELPH		1									
ALLIU	1		1	1		2			1		
ERIOG		1						2	2	3	3
BASA				2				2			1
ERIGE											1
CALOC											
SPMU											
ANTEN											
CASTI							1				
LUPIN		1									
ARNIC											
AMARA											
CIRSI											
LILE		2									
ONVI		1									
ASTER	2	3									1
LIRU											1
HYCA											
PENT		1		1		1					
ARABI								1			1
ZIPA											
OENOT											1
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											5
TRAGO					1	1	1	1	1		
UNAF		1	2	3	2			1		1	

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 4 of 10)

Transect Number	LPT34	LPT35	LPT36	LPT37	LPT38	LPT39	LPT40	LPT41	LPT42	LPT43	LPT44
Latitude[1]	43.11.903	43.11.066	43.06.198	43.06.203	43.14.614	43.14.992	43.15.182	43.06.534	43.07.326	43.07.411	43.08.094
Longitude[1]	113.29.733	113.30.444	113.32.164	113.28.615	113.41.226	113.40.587	113.40.255	113.36.558	113.32.810	113.31.899	113.30.747
Bearing (in degrees)	284	275	44	55	355	152	50	170	103	162	136
Date	6/7/02	6/7/02	6/8/02	6/8/02	6/8/02	6/8/02	6/8/02	6/9/02	6/9/02	6/9/02	6/9/02
Shrubs											
ARTR	13	6	1	20	10	22	4	16	3	11	23
ARTR4		8			10	6	10		1	1	7
CHVI	8	5	1	2	11	5	18	3	2		2
CHNA	6	7		1		6	8	2	1	7	
PUTR	4	9			1	1					
LEPU						1					
OPUNT	3	1		2					1		
AMAL											
TECA											
ATCA											
SYMP											
Dead Shrub	27	25		4	5	7	9	20		1	2
Perennial Grasses and Grass-like Plants											
STTH	21	14	1	3	6	1	1				9
STCO	2	4	29	16					43	8	3
AGSP	4	2		1	1	1					
FEID											
ELCI	1	3		1	1	2					
KOCR	2										1
ORHY	1	1	2								
CAREX							18		1		
AGSM	1	7	4	1	10	3	4				
AGDA		1	17	12	1	1	4	1	7	3	13
SIHY	4	5		2	4	15	9	7	2	5	2
POSE	9	12	4	12	11	25	6	25	11	4	22
PONE				3			3		2	1	
POAM	1		3								
AGIN											
AGSI									1	21	1
AGCR										16	
AGROP											
ELJUJ										1	
Annual Grasses											
BRTE	10	13	6	9	13	22	14	27	5	3	11
Perennial Forbs											
PHHO	1				1		3				4
PHLO	8	9	10	13	3	5	8	3	10	5	4
LOMAT	7			2	1	1	1	1	1	5	11
CRAC	2		1					1			
ASON							1		1	1	1
AGGL	1	2	1		2	2	5	4			
DELPH								1	1		
ALLIU	2				2					1	2
ERIOG	3	1									1
BASA	1										
ERIGE					1						1
CALOC											
SPMU											
ANTEN											
CASTI											
LUPIN											
ARNIC											
AMARA											
CIRSI											
LILE											
ONVI											
ASTER											1
LIRU	2										
HYCA											
PENT											
ARABI											
ZIPA											
OENOT											
ASCLEP				2							
UNPF											
Annual Forbs											
LEPE											
MIMU		1									
CRUCIF								1			
TRAGO	1	1	1	1		1	2			1	1
UNAF	1	1	2		1		1	1		1	

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 5 of 10)

Transect Number	LPT45	LPT46	LPT47	LPT48	LPT49	LPT50	LPT51	LPT52	LPT53	LPT54	LPT55
Latitude[1]	43.11.438	43.11.850	43.10.561	43.09.381	43.09.613	43.08.307	43.08.863	43.08.676	43.09.234	43.08.873	43.07.380
Longitude[1]	113.40.566	113.38.959	113.30.151	113.30.328	113.30.731	113.31.044	113.31.305	113.32.376	113.35.644	113.33.323	113.33.730
Bearing (in degrees)	240	180	187	128	315	127	213	14	315	20	85
Date	6/9/02	6/9/02	6/10/02	6/10/02	6/10/02	6/10/02	6/10/02	6/10/02	6/11/02	6/11/02	6/11/02
Shrubs											
ARTR	20	25	1	5	30	10	12	5	12	22	20
ARTR4			32	38	3	19			2	21	
CHVI	5	4	3	4	3	1	6	6	5	7	5
CHNA	2	2	5	3	9	4	6	4	4		
PUTR											
LEPU	1		9	3				1			
OPUNT			2		1			1			
AMAL											
TECA											
ATCA											
SYMP											
Dead Shrub	5	6	3	3	5	2	2	32	21	4	
Perennial Grasses and Grass-like Plants											
STTH	5	11	16	11	8	6	3	2	2	13	3
STCO		2	3	1	2	6	6	6		1	
AGSP		1	3	1	1		1		1	1	
FEID			3								
ELCI	2	2	1					1	1		
KOCR			5								
ORHY	1										
CAREX			7	3							
AGSM					1			12	8	1	5
AGDA			3	3	5	1	4	13	5		4
SIHY	8	6	4	4	10	2	2	6	11	7	4
POSE	23	27	13	20	15	7	10	11	13	11	9
PONE		2	2		2					1	
POAM	1	1				1			1		1
AGIN											
AGSI						21	17	1			4
AGCR						7	10	3			6
AGROP											
ELJUJ											
Annual Grasses											
BRTE	27	19	11	20	15	10	10	15	17	14	13
Perennial Forbs											
PHHO	7	7	5	1	1				3	9	
PHLO	3	6		2	6	6	4	7	7	7	6
LOMAT	4	2	3	3	2	3	2	8	9	4	
CRAC				2				1			1
ASON	4	4		1	2	1				1	1
AGGL		1		6	3					1	
DELPH											
ALLIU	1				2			1		2	
ERIOG											
BASA											
ERIGE											
CALOC											
SPMU											
ANTEN											
CASTI		1		1							
LUPIN											
ARNIC											
AMARA											
CIRSI											
LILE											
ONVI											
ASTER	4	4		1				7	2	1	
LIRU			2								
HYCA											
PENT											
ARABI								1			
ZIPA	1										
OENOT											
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											1
TRAGO		1						1	1	1	
UNAF	1							1	1		2

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 6 of 10)

Transect Number	LPT56	LPT57	LPT58	LPT59	LPT60	LPT61	LPT62	LPT63	LPT64	LPT65	LPT66
Latitude[1]	43.08.041	43.13.876	43.13.333	43.14.013	43.07.907	43.09.303	43.09.575	43.10.144	43.10.875	43.12.471	43.15.083
Longitude[1]	113.35.100	113.34.714	113.34.129	113.34.132	113.37.512	113.38.542	113.37.213	113.36.858	113.36.484	113.36.429	113.30.549
Bearing (in degrees)	264	60	205	96	60	223	284	278	300	337	244
Date	6/11/02	6/11/02	6/11/02	6/11/02	6/12/02	6/12/02	6/12/02	6/12/02	6/12/02	6/12/02	6/13/02
Shrubs											
ARTR	31	16	11	43	15	31	4	13	1	4	2
ARTR4			4			1	2	15	32	33	25
CHVI		4	5	1	4	3	6	7	3	5	10
CHNA	1			1		1	11	1			
PUTR		3		1							
LEPU	1							2		1	
OPUNT											
AMAL											
TECA			8						1		
ATCA				1							
SYMP											
Dead Shrub	1	1		3	29	5	23	4	4		1
Perennial Grasses and Grass-like Plants											
STTH	5	5	1	5	1		3	11	14	2	9
STCO			1	1					2	2	
AGSP		31	1	4				4	4	1	12
FEID											
ELCI		1	3	3			1			2	4
KOCR											9
ORHY			1	1				2		2	
CAREX									7		
AGSM	2	2	2	7	1	4	4				2
AGDA		2	7	1	3	2	2	1	3	6	5
SIHY	8	4	3	5	8	7	4	3	5	4	7
POSE	23	10	14	21	20	25	18	15	10	25	12
PONE		2	3	2				2	2	1	5
POAM											6
AGIN											
AGSI		3									
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	21	2	13	6	46	27	39	22	18	9	7
Perennial Forbs											
PHHO	1	6	1				1	4	3	6	5
PHLO	4	11	7	4	7	6	6	7	6	8	6
LOMAT	5	6	5			3	1	4	1	2	1
CRAC											
ASON	1	2		3				2		1	1
AGGL	1				1	2	2	1			1
DELPH											
ALLIU		2	1					1			
ERIOG											
BASA											
ERIGE	1					1		2	1	2	
CALOC						1			1		
SPMU										1	
ANTEN											
CASTI	1										
LUPIN				2							1
ARNIC											
AMARA											
CIRSI											
LILE		20		5							
ONVI		8									
ASTER	1							1		1	
LIRU											
HYCA				1							
PENT										1	
ARABI										1	
ZIPA											
OENOT											
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO			2		1		2	1	1		
UNAF	1				1						

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 7 of 10)

Transect Number	LPT67	LPT68	LPT69	LPT70	LPT71	LPT72	LPT73	LPT74	LPT75	LPT76	LPT77
Latitude[1]	43.14.493	43.14.908	43.15.612	43.14.209	43.14.412	43.13.339	43.13.057	43.12.231	43.16.232	43.17.343	43.19.133
Longitude[1]	113.32.271	113.32.346	113.34.662	113.38.117	113.38.033	113.39.558	113.39.637	113.40.287	113.37.168	113.37.287	113.36.455
Bearing (in degrees)	247	13	139	235	60	330	132	162	345	84	240
Date	6/13/02	6/13/02	6/13/02	6/13/02	6/13/02	6/14/02	6/14/02	6/14/02	6/7/02	6/7/02	6/7/02
Shrubs											
ARTR	16	21	13	15	11	11	13	28	1		
ARTR4	2	2	14		4	7	18		48	39	16
CHVI	6	5	5	5	10	10	7	5	4	4	3
CHNA				3	1	9	2	6		1	
PUTR						17	1				4
LEPU								1			
OPUNT	1										
AMAL											
TECA	1									1	5
ATCA											
SYMP											
Dead Shrub		1		16	22	4	2	5		1	
Perennial Grasses and Grass-like Plants											
STTH	6	4	15	13	9	21	21	2	8	17	9
STCO			4			3	2				
AGSP	1	6	9	1	1	11	12	7	5	10	32
FEID						1	7			5	9
ELCI	7	1	2	2	3	1	1	1		1	
KOCR		9							5	2	10
ORHY			1	1		2	1	1			
CAREX			1	1	3				4	3	2
AGSM	15	5	3		4		1				
AGDA	4	2			2		1		4	2	
SIHY	2	7	7	22	15	12	7	7	6		1
POSE	11	5	11	21	21	12	16	23	9	4	5
PONE			2		2	2	1		2		
POAM	1	1							1		
AGIN		1									
AGSI		3									
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	10		7	25	25	12	11	27	10	15	1
Perennial Forbs											
PHHO				8	6		3	12	4	3	4
PHLO	11	5	5	3	3	4	4	1	3	4	6
LOMAT		2	1	4	3	1	2		2	2	6
CRAC				1							
ASON	2	1	3		1			1		2	
AGGL	2			2					3		2
DELPH											
ALLIU	2	1		3		2		1	1	2	2
ERIOG							1				
BASA											1
ERIGE											
CALOC											
SPMU											
ANTEN											
CASTI							1				1
LUPIN											1
ARNIC											
AMARA											
CIRSI											
LILE	1	21	3								
ONVI		3									
ASTER										2	
LIRU		1									
HYCA											
PENT					1						
ARABI		1			1						1
ZIPA											
OENOT											
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO	1				1						
UNAF						1					

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 8 of 10)

Transect Number	LPT78	LPT79	LPT80	LPT81	LPT82	LPT83	LPT84	LPT85	LPT86	LPT87	LPT88
Latitude[1]	43.18.506	43.20.062	43.20.180	43.20.283	43.18.233	43.17.431	43.19.214	43.17.144	43.17.009	43.15.590	43.15.348
Longitude[1]	113.33.112	113.34.979	113.34.046	113.33.020	113.35.209	113.36.045	113.35.416	113.35.018	113.34.073	113.35.525	113.36.277
Bearing (in degrees)	13	90	360	196	90	182	240	340	120	180	10
Date	6/8/02	7/13/02	6/9/02	6/9/02	6/9/02	6/9/02	6/10/02	6/10/02	6/10/02	6/10/02	6/10/02
Shrubs											
ARTR		8			2						
ARTR4	24	27		8	25	14	21	13	28	27	27
CHVI	6	6	13	23	3	1	2	11	3	2	1
CHNA		1									
PUTR				1			1				
LEPU			1	8	2	7		3	1		
OPUNT											
AMAL											
TECA	3	1		1				1	1		
ATCA											
SYMP				3							
Dead Shrub	2	8	1		1			2	1		1
Perennial Grasses and Grass-like Plants											
STTH	3	5			2		22	3	4		
STCO					1	13	5	3	9	4	2
AGSP	12	5	7	22	25	24	7	15	2	1	2
FEID			4	5	15				2		
ELCI	4	9	1	13	2		1				
KOCR	17	11	10	7	15		1	13	9	19	15
ORHY											
CAREX					2				5	1	
AGSM								26	1	16	6
AGDA											
SIHY						7	5	1	2		2
POSE	3	1	2	9	5	15	3	2	9	3	3
PONE			3						2		1
POAM											
AGIN											
AGSI											
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	9	6	15	3	6	19	4	3	3	3	3
Perennial Forbs											
PHHO	4					6		7	1	6	6
PHLO	11	2	2	4	3	2	2	6	1		
LOMAT	3	1			1	6	3			2	2
CRAC											
ASON							1			3	2
AGGL			24								
DELPH				1	1				1		
ALLIU		1			5		6	2	1	7	10
ERIOG		2				1	4	2		3	
BASA											
ERIGE											
CALOC											
SPMU											
ANTEN											
CASTI											
LUPIN	1			1							
ARNIC	14		2		2						
AMARA											
CIRSI											
LILE					1						
ONVI											
ASTER											
LIRU											
HYCA											
PENT											
ARABI											
ZIPA	4		1		1		3		6		
OENOT											
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO											
UNAF		1			2						

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 9 of 10)

Transect Number	LPT89	LPT90	LPT91	LPT92	LPT93	LPT94	LPT95	LPT96	LPT97	LPT98	LPT99
Latitude[1]	43.17.141	43.15.512	43.15.446	43.16.228	43.16.358	43.17.293	43.17.358	43.18.161	43.18.322	43.15.527	43.15.370
Longitude[1]	113.35.515	113.34.487	113.32.535	113.31.434	113.32.434	113.33.038	113.33.430	113.33.164	113.33.198	113.37.475	113.37.870
Bearing (in degrees)	180	154	23	360	277	45	360	90	270	10	259
Date	6/11/02	6/11/02	6/11/02	6/11/02	6/12/02	6/12/02	6/12/02	6/12/02	6/12/02	6/12/02	6/14/02
Shrubs											
ARTR		1									7
ARTR4	16	15	27	22	16	28	7	14	10	20	18
CHVI	4	6	7	4	4	4	17	2	7	3	7
CHNA											1
PUTR											
LEPU	1		1	4				3			
OPUNT											
AMAL											
TECA					1		1	1	2	2	
ATCA											
SYMP											
Dead Shrub						1	1				21
Perennial Grasses and Grass-like Plants											
STTH		1	1				5	2	22	5	12
STCO		5	1	3	1	2		2			4
AGSP	3	2	4	1	20		4	3	9	5	
FEID	4	1	2	3	3	1		4	1		
ELCI						1					1
KOCR	16	4	12	7	5	21	21	4	1	3	
ORHY											
CAREX		4	3	6	3	10		22	10	3	
AGSM	14	24	5	5	10	3	20	2			9
AGDA											4
SIHY	1								1		7
POSE	5	3	4	1	6	5	2	3	2	5	13
PONE	2	3	3	2	1			10	5	1	1
POAM											2
AGIN											
AGSI											
AGCR											
AGROP											
ELJUJ											
Annual Grasses											
BRTE	8	2	5	3		7	1		4	6	15
Perennial Forbs											
PHHO	12	2	7	2	2	4		2	2	14	3
PHLO		5	2	2	8	1	3	2	5		3
LOMAT		2	1	1	2	1					1
CRAC											
ASON		5	1		2	3	2				1
AGGL											1
DELPH											
ALLIU		2	9	1	3	1		1	1		1
ERIOG		1		1	2	1					
BASA											
ERIGE											
CALOC											
SPMU											
ANTEN											
CASTI											
LUPIN			1								
ARNIC					1	2	2	1	11		
AMARA											
CIRSI											
LILE					7						
ONVI											
ASTER											
LIRU											
HYCA											
PENT											
ARABI											
ZIPA					1	1		4	1		
OENOT											
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO											1
UNAF											

[1] Transect beginning point measured in degrees and decimal minutes

Appendix IV. Laidlaw Park step-point vegetation transects and species foliar cover (page 10 of 10)

Transect Number	LPT100	LPT101	LPT102	LPT103	LPT104	LPT105	LPT106	LPT107	LPT108	LPT109	LPT110
Latitude[1]	43.14.932	43.14.409	43.14.041	43.13.585	43.07.291	43.15.811	43.14.461	43.14.068	43.12.113	43.11.836	43.11.997
Longitude[1]	113.39.226	113.39.270	113.36.733	113.36.182	113.33.408	113.39.498	113.41.412	113.41.911	113.41.970	113.41.585	113.37.694
Bearing (in degrees)	86	295	346	40	269	39	136	292	271	206	46
Date	6/14/02	6/14/02	6/15/02	6/15/02	6/15/02	6/15/02	6/15/02	6/15/02	6/16/02	6/16/02	6/16/02
Shrubs											
ARTR	16	18	18	19	27	5	22	14	23	35	5
ARTR4	1	2	1			8		8			31
CHVI	15	6	5	7		7	1	6		5	6
CHNA	4	15	4	3	6	3	6	5	4	1	1
PUTR						2	12	1			
LEPU							1	1		2	
OPUNT					1						
AMAL										1	
TECA				1		1		1			
ATCA											
SYMP											
Dead Shrub	4	2	3	3	9	18	6	1	2	3	3
Perennial Grasses and Grass-like Plants											
STTH	6	11		3	2	7	13	10	9	6	16
STCO				1		2		1		1	
AGSP		1	1	4		2	1				8
FEID											
ELCI			3	4		1					4
KOCR											
ORHY		2						1			
CAREX									1		
AGSM	3	9	29	8	2	13	3	7	9		
AGDA	6	6	4		3	1					
SIHY	3	12	7	8	4	4	10	11	5	8	2
POSE	18	12	16	15	25	18	25	12	28	20	16
PONE				1		1	1	1		1	1
POAM											
AGIN											
AGSI					7						
AGCR					4						
AGROP											
ELJUJ											
Annual Grasses											
BRTE	18	13	21	19	25	21	10	9	13	24	12
Perennial Forbs											
PHHO	1			1			9	2	1	4	6
PHLO	5	2	10	3	8	2	1	3	5	2	4
LOMAT	1		1		5		2	5	2	1	6
CRAC											
ASON	2		1		4			1		4	2
AGGL		2			1	1		1			1
DELPH											
ALLIU			1		1		2	1	1		
ERIOG					1						
BASA											
ERIGE	1		1		1				1	3	2
CALOC										1	
SPMU											
ANTEN										1	
CASTI										1	1
LUPIN											
ARNIC											
AMARA											
CIRSI											
LILE											
ONVI											
ASTER									1		1
LIRU											
HYCA				2							
PENT				1							
ARABI											1
ZIPA											
OENOT											
ASCLEP											
UNPF											
Annual Forbs											
LEPE											
MIMU											
CRUCIF											
TRAGO	3			2		2					
UNAF	1		1			1		1			1

[1] Transect beginning point measured in degrees and decimal minutes

Appendix V. Laidlaw Park ocular reconnaissance sites and species foliar cover estimates (page 1 of 5 pages)

(Data collected in May/June 2002)

Plants	Ocular reconnaissance sites														
	LOC-01	LOC-02	LOC-03	LOC-04	LOC-05	LOC-06	LOC-07	LOC-08	LOC-09	LOC-10	LOC-11	LOC-12	LOC-13	LOC-14	LOC-15
Shrubs															
ARTR	35		5	20	15	8	20	5	10	25	28	10	25	25	20
ARTR4		38		TR			10	30	10	20	4	2			TR
CHVI	3		3	5	10	1	1	1	1	TR	4	5	1		8
CHNA			2	5	2	3	2		2	2		3	1	5	5
PUTR	1														TR
LEPU					TR										
OPUNT						TR									TR
AMAL															
TECA															
ATCA															
SYMPH															
Dead ARTR	5			10	25				20			35			!%
Dead Shrub													6		
Perennial Grasses															
STTH				5	2	1	2	TR			TR		1	6	12
STCO			30				TR								
AGSP				TR	TR	1	2	2	TR	5	TR		1		5
FEID															
ELCI					1		TR		TR		2	TR	1	TR	3
KOCR															
ORHY				TR											
CAREX		TR													
AGSM	2	TR	2	10	5	30	10	10			3	5	2	1	6
AGDA			12												
SIHY	1	TR	1	TR	TR		TR			3	6	5	5	8	4
POSE	30	16	4	20	15	8	15	15	20	15	12	10	20	22	15
PONE					TR	TR									
POAM									5	5					
AGIN															
AGSI			TR				TR								
AGCR							TR								
AGROP						TR									
ELJUJ						TR									
Annual Grasses															
BRTE	10	6	2	10	15	4	8	10	15	TR	30	20	25	15	10
BRJA															
POBU															
Perennial Forbs															
PHHO							1			2				4	3
PHLO															
PHLOX	10	3	3	2	2	1	2	5	2	3		4	1	5	4
LOMAT	2		TR		2	2	5	5	*	5			1	*	
CRAC			TR						*						
CREPI	1			TR	1	3									TR
ASTRA	TR	TR	1	2			TR	1	*	1	TR	TR	1	TR	1
AGGL			*		1	2	*	TR	*		TR		TR		2
DELPH			*				*			1					
ALLIU	1		TR			2	TR	TR	1				TR	*	1
BASA			TR				TR	TR	TR						1
ERIOG			*			TR	TR								TR
ERIGE								TR							
CALOC															
SPMU													TR		
ANTEN															
CASTI															
LUPIN															
ARNIC															
AMARA															
CIRSI															
LILE															
ONVI						1	1		1						
ASTER								TR							
LIRU															
HYCA															
PENST			TR			TR	TR								
ASON															
ARABI								TR		TR				*	TR
ZYPA														TR	
OENOT															
BORAG															
LITHO															
PHACE															
ZYGAD															
CENTA					TR										
SAXIF															
UNPF															
Annual Forbs															
LEPE					TR										
MIMU														TR	
CRUCIF	TR		*												
SISYM															
TRAGO				TR	1	2	TR				1	TR		*	
UNAF	6			5	1	3	*	5			2	1			
			* when combined, total equals 8%				* when combined, total equals 3%		* when combined, total equals 5%					* when combined, total equals 5%	

Appendix V. Laidlaw Park ocular reconnaissance sites and species foliar cover estimates (page 2 of 5 pages)

(Data collected in May/June 2002)

Plants	Ocular reconnaissance sites															
	LOC-16	LOC-17	LOC-18	LOC-19	LOC-20	LOC-21	LOC-22	LOC-23	LOC-24	LOC-25	LOC-26	LOC-27	LOC-28	LOC-28A	LOC-29	LOC-30
Shrubs																
ARTR	30	2	25	4	28	32	33	8	22	12	15	20	22	20	18	10
ARTR4	TR	30	2	22	1	TR		30	10		5			10	1	
CHVI	4	12	15	10	5	4	3	8	5	3	6	3	2	10	5	5
CHNA	4	1	3	TR	2	1	5	5	3	5	8	3	2		5	
PUTR		TR		TR			TR	1			3			1		
LEPU									1	2	2	1			1	
OPUNT	TR	TR						1			1		1			2
AMAL																
TECA	1										TR					
ATCA																
SYMPH																
Dead ARTR	5					2	4									
Dead Shrub		1	2					5	8	25	4	3		5	22	
Perennial Grasses																
STTH	5	15	8	10	10	4	18	10	10	9	13	1	2	5	1	1
STCO								TR	TR		1	12	15			30
AGSP	TR	1				TR	1	1	TR		1	TR				
FEID																
ELCI	3	2	5	3	2	1	TR		1	1	3			TR		
KOCR		TR					TR	1			TR					
ORHY	TR	TR							TR		2	TR				1
CAREX										TR	TR				1	
AGSM	1	10	10	8	8		8	8	3	4	3	2		10	2	4
AGDA									1	2	2	3	8	1	2	10
SIHY	5	5	10	10	5	5	8	7	5	10	2	2	4	4	9	
POSE	25	10	10	12	15	20	12	10	15	14	20	10	10	10	24	4
PONE	TR					TR	TR	TR				2	3			
POAM		3	TR		TR	TR		TR	1	1						3
AGIN																
AGSI			TR	1			TR					TR			TR	
AGCR																
AGROP																
ELJUJ																
Annual Grasses																
BRTE	25	15	12	10	15	23	15	16	18	23	14	12	12	16	28	5
BRJA																
POBU																
Perennial Forbs																
PHHO	TR	1				1		3		8		1		2		1
PHLO									3		10					
PHLOX	1	5	15		10		4	7		4		10	10	3	3	8
LOMAT	3	1	8	5			4	1	*	1	4	1	1	1	1	
CRAC											1	TR			TR	TR
CREPIS																
ASTRA	TR	TR	TR	1	3	*	1	TR			TR	4			1	*
AGGL	TR		TR	TR	TR	*		5	*	TR	TR		TR	1	3	TR
DELPH												TR			TR	*
ALLIU	TR	TR	1	1	1		1		*	TR	TR		TR	TR	TR	
BASA		TR	TR	TR	1						TR	TR			TR	TR
ERIOG	TR	TR		TR			1	3	TR		3	TR	TR		TR	TR
ERIGE									*	1	TR			TR	TR	TR
CALOC																
SPMU		TR														
ANTEN		TR														
CASTI	TR									TR						
LUPIN		1	1	TR				TR								
ARNIC																
AMARA																
CIRSI		TR														
LILE				1												
ONVI				1												
ASTER	TR	TR	TR								TR				TR	
LIRU																
HYCA																
PENST		TR	TR	TR	1				TR			TR				*
ASON									TR			TR				
ARABI	TR				TR	*					TR				TR	
ZYPA																
OENOT											TR					
BORAG									TR							
LITHO									TR		TR					
PHACE															TR	
ZYGAD																
CENTA																
SAXIF																
UNPF																
Annual Forbs																
LEPE								TR								
MIMU																
CRUCIF																
SYSIM																*
TRAGO	1		TR		TR	*	1	TR	TR	1			TR	TR	TR	*
UNAF	1		2		3	2		2						2	2	2
						* when combined, total equals 5%			* when combined, total equals 5%							* when combined, total equals 2%

Appendix V. Laidlaw Park ocular reconnaissance sites and species foliar cover estimates (page 3 of 5 pages)
(Data collected in May/June 2002)

Plants	Ocular reconnaissance sites																
	LOC-31	LOC-32	LOC-33	LOC-34	LOC-35	LOC-36	LOC-37	LOC-38	LOC-39	LOC-40A/B	LOC-41	LOC-42	LOC-43	LOC-44	LOC-45	LOC-46	LOC-47
Shrubs																	
ARTR	20	25	28	8	18	10	18	22	22	38	10	24	2	4	TR	10	10
ARTR4	1			28	1		4		2		2	1	30	30	30	1	14
CHVI		6	6	4	10	10	9	4	3	8	5	3	3	4	9	8	10
CHNA	6	3	2	4	8	4	4		3	1	3	3				3	7
PUTR																	
LEPU		2	TR		TR												
OPUNT				1				TR									
AMAL																	
TECA													1	1	TR		
ATCA										TR							
SYMPH																	
Dead ARTR																	
Dead Shrub	2	4	10	3	5	28	25		3	2	30	5	3			20	4
								4									
Perennial Grasses																	
STTH	5	3		16		5	2	3	5	4		7	15	2	12	15	12
STCO	5		1	1	6	5				1			2	2			
AGSP				5		TR			TR	3			5		10	1	TR
FEID				5													
ELCI		1		TR			TR		TR	3		1	TR	TR	TR	2	
KOCR				5											7		
ORHY		TR								TR			1	TR		TR	
CAREX				TR			TR				TR				1		TR
AGSM						5	8		2	5	4	4	TR	3	2		2
AGDA	3			3	10	15	12	5		1	4	2	2	4	5		
SIHY		7	7	4	4	6	7	5	5	5	8	7	6	5	4	15	7
POSE	5	21		12	10	11		10	23	15	15	16	10	24	10	18	20
PONE	1			3						2	2		2		8		1
POAM		TR		3		TR	TR							1	6		
AGIN																	
AGSI	15				*	5		5									
AGCR	12				*	10		10									
AGROP																	
ELJUJ	TR																
Annual Grasses																	
BRTE	8	24		8	15	12	14	13		8	30	23	12	14	7	20	9
BRJA																	
POBU									TR								
Perennial Forbs																	
PHHO		5	4		TR		2		1		1	2	4	4	2	5	4
PHLO																	
PHLOX	4	1	1	TR	4	6	5	5	6		5	5	6	7	8	4	
LOMAT	5	5	2	5	2		5		5		4	1	1	2	1	4	
CRAC				TR				TR	TR							1	
CREPI													TR				
ASTRA		4	4		1	6	1		1		1	1	TR	2	1		TR
AGGL			1	1							1	1	TR	1		2	
DELPH									TR								
ALLIU	3	TR		TR		1	TR		1			1	TR	1		4	TR
BASA																	
ERIOG						TR											
ERIGE				TR		TR	TR		TR			TR	1	1			
CALOC												TR	TR				
SPMU							TR							TR			
ANTEN													TR				
CASTE									TR				TR				TR
LUPIN																	
ARNIC																	
AMARA															TR		
CIRSI																	
LILE																	
ORVI																	
ASTER							TR						TR				
LIRU				TR													
HYDRO				TR													
PENST				TR		TR	TR				TR			TR			
ASON								TR									
ARABI						1						TR					
ZYPA															TR		
OENOT																	
BORAG																	
LITHO																	
PHACE																	
ZYGAD		TR					1										
CENTA																	
SAXIF																	
UNPF																	
Annual Forbs																	
LEPE							TR										
MIMU																	
CRUCIF																	
SISYM								1									
TRAGO	1		1	TR		1	TR		1		1	1	1	1	TR		
UNAF	1	1					1	2	2		1	2		1			

* when combined, total equals 25%

Appendix V. Laidlaw Park ocular reconnaissance sites and species foliar cover estimates (page 4 of 5 pages)
(Data collected in May/June 2002)

Plants	Ocular reconnaissance sites																
	LOC-48	LOC-49	LOC-50	LOC-51	LOC-52	LOC-53	LOC-54	LOC-55	LOC-56	LOC-57	LOC-58	LOC-59	LOC-60	LOC-75	LOC-76	LOC-77	LOC-78
Shrubs																	
ARTR	16	25	2	1	8	12	14	22	25	2	18	20	25	TR			
ARTR4	4		26	26	4	3	2	3	1	30	3	4		40	20	4	8
CHVI	6	5	3	3	3	8	8	6	3	2	5	6	8	5	2	5	
CHNA	6	5			12	4	4	3	5	2	7	2	5				
PUTR	12									3	15	TR	3				
LEPU		1								TR	1	1					6
OPUNT									1								
AMAL																	
TECA			TR	TR						TR				TR			
ATCA																	
SYMPH																	
Dead ARTR																	
Dead Shrub	6	5	1	2	28	21	20		8	2	5	8	5				
Perennial Grasses																	
STTH	20	4	3	3	6	12	10	3		8	16	5	4	10	30		2
STCO	TR		3					1		TR	2		TR	TR			
AGSP	8	5	3	TR		1	TR	2	1		9		10	8	15		10
FEID	TR												TR		8		13
ELCI	1	1	TR			2	2	3				2	1			2	8
KOCR			14	TR										5	4		3
ORHY	1	1				TR	TR	TR			1	TR	1				
CAREX			3	TR		TR				12				3	4		
AGSM	TR		8	2	9	5		7	3	6	2	4	2	TR			
AGDA					TR	1		TR				1		5	6	34	
SIHY	10	7	2		7	18	15	8	3	5	10	6	6	4			
POSE	12	21	4	9	13	20	20	20	20	15	18	18	20	10	1		2
PONE	1		1	TR	TR	TR		1			2			2		1	
POAM												TR		1			
AGIN																	
AGSI									TR								
AGCR									TR								
AGROP																	
ELJUJ																	
Annual Grasses																	
BRTE	10	27	3	18	15	24	20	18	18	15	11	20	20	5	1	8	
BRJA																	
POBU																	
Perennial Forbs																	
PHHO	3	10	7	8	2	6	7	1		1	6	5	10	8	3		
PHLO														5			6
PHLOX	3	3		1	1	3	3	3	8	3		3	2		8		
LOMAT	1	3	2	TR		3	4		3	1		3	2	3			
CRAC	TR					TR	1		1								
CREPI																	
ASTRA	TR	3	2					2	1			4	1			1	
AGGL						1	2		1			1	2	4			
DELPH									1								
ALLIU	TR	TR	3		1	1	2		1			1	1	TR	2		
BASA																	
ERIOG	1		2							TR			1				
ERIGE					TR				1	TR			TR	TR			
CALOC									TR								
SPMU																	
ANTEN	TR													TR			
CASTE																	
LUPIN								TR					TR	TR			
ARNIC																2	13
AMARA																	
CIRSI																	
LILE																	
ORVI																1	
ASTER																	
LIRU																	
HYDRO								TR									
PENST								TR									
ASON																	
ARABI						TR	1										
ZYPA															2		
OENOT																	
BORAG																	
LITHO																	
PHACE																	
ZYGAD												1					
CENTA																	
SAXIF																	
UNPF																	
Annual Forbs																	
LEPE																	
MIMU																	
CRUCIF																	
SISYM	TR																
TRAGO						1	1	1	1	TR			TR	TR	TR		
UNAF				1					2			1					

Appendix V. Laidlaw Park ocular reconnaissance sites and species foliar cover estimates (page 5 of 5 pages)
(Data collected in May/June 2002)

Plants	Ocular reconnaissance sites														
	LOC-79	LOC-80	LOC-81	LOC-82	LOC-83	LOC-84	LOC-85	LOC-86	LOC-87	LOC-88	LOC-89	LOC-90	LOC-91	LOC-92	LOC-93
Shrubs															
ARTR		2				25						5			
ARTR4	17	10			2		16	15	15	22	18	12	16	20	12
CHVI		1	5	20		2	2	2	3	1	9	3	2	4	8
CHNA															
PUTR															
LEPU							2								
OPUNT											TR				
AMAL															
TECA		2				1	1			1			1		
ATCA															
SYMPH			1												
Dead ARTR															
Dead Shrub															
Perennial Grasses															
STTH								2			4				4
STCO							2	4		2			3		2
AGSP		12	8	4		12	14	10	4	1	3	2	4	4	5
FEID	19								3	1	3				
ELCI		8	2												
KOCR	7	10					6	2	12	2	6	2			12
ORHY							2								
CAREX	8							4						6	
AGSM	1					10	20	5	15	5	5		5	3	14
AGDA															
SIHY						2			1						
POSE			8	8		2	4			3	5	5		6	2
PONE			10						2						
POAM															
AGIN															
AGSI															
AGCR															
AGROP				16	46							3			
ELJUJ															
Annual Grasses															
BRTE				4		2	2		5	2	2	6		10	2
BRJA															
POBU															
Perennial Forbs															
PHHO							5	10	8	6	5	4	2		2
PHLO	2	4					5			2				2	
PHLOX				2		11									
LOMAT							3		3				1		
CRAC															
CREPI			4												
ASTRA												1	1		2
AGGL															
DELPH							1								
ALLIU	2						4	1	1			2	2	1	
BASA															
ERIOG						1				1					
ERIGE															
CALOC															
SPMU															
ANTEN															
CASTE															
LUPIN	3	TR	2			4		2	1		1				
ARNIC	2	4												3	2
AMARA															
CIRSI															
LILE															
ORVI															
ASTER															
LIRU															
HYDRO															
PENST													1		
ASON															
ARABI															
ZYPA	6													1	
OENOT															
BORAG															
LITHO															
PHACE															
ZYGAD															
CENTA															
SAXIF															
UNPF															
Annual Forbs															
LEPE															
MIMU															
CRUCIF															
SISYM															
TRAGO															
UNAF															

Appendix VI. Laidlaw Park Transect Photo Locations (Page 1 of 5)

Date	Site	Photo	Bearing	Lat./Long	Elevation	Ocular T/R/S	Poly #
5/20	LPT-01	01-01	10 deg	43.04.920/113.36.709	4472		LP-01
	LOC-01	01-02	Photo NE		4440	T4SR24ES9ne	LP-01
5/22	LOC-02	01-03	Photo SE		4475	T4SR24ES12nw	LP-38
	LPT-02	01-04	40 deg	43.05.544/113.32.944	4472		LP-01
	LOC-03	01-05 03-12	NW N		4620	T4SR24ES6n1/2	LP-03
5/24	LPT-03	01-06	190 deg	43.07.170/113.38.320	4541		LP-01
	LOC-04	01-07	W		4560	T3SR24ES32w1/2	LP-01
	LOC-05	01-08	N		4500	T4SR24ES5ne1/4 T3SR24ES32s1/2	LP-02
	LPT-04	01-09	70 deg	43.06.965/113.37.456	4505		LP-01
5/26	LPT-05	01-10	245 deg	43.07.307/113.30.065	4646		LP-04
	LOC-06	01-11	SE		4680	T3SR25ES28sw1/4	LP-04
	LPT-06	01-12	130 deg	43.08.231/113.28.840	4753		LP-41
	LOC-07	01-13	W		4740	T3SR25ES28nw1/4 S29ne1/4	LP-41
	LOC-08	01-14	S		4760	T3SR25ES22sw1/4 S27nw1/4	LP-06
	LOC-09	01-15	NW		4800	T3SR25ES16s1/2, S21ne1/4	LP-08
	LPT-07	01-16	135 deg	43.09.393/113.30.424	4583		LP-07
	LOC-10	01-17	SE		4830	T3SR25ES15w1/2	LP-07
	LPT-08	01-18	221 deg	43.07.978/113.30.424	4583		LP-01
	LOC-11	01-19	SE		4620	T3SR24ES29w1/2	LP-01
	LPT-09	01-20	294 deg	43.08.859/113.38.355	4669		LP-19
	LOC-12	01-21	S		4620	T3 SR24ES20	LP-19
	LPT-10	01-22	14 deg	43.09.165/113.36.808	4675		LP-19
6/1	LPT-11	01-23	45 deg	43.09.641/113.38.666	4626		LP-20
	LPT-12	01-24	250 deg	43.09.980/113.39.021	4646		LP-01
	LOC-13	01-25	NE		4650	T3SR23ES12e1/2 T3 SR24ES7w1/2	LP-01
	LPT-13	02-01	270 deg	43.10.422/113.40.573	4669		LP-01
	LOC-14	02-02	NE		4646	T3SR23ES11,12	LP-01
	LPT-14	02-03	315 deg	43.11.845/113.30.740	4934		LP-12
	LOC-15	02-04	NE		4900	T3SR25ES5	LP-12
	LPT-15	02-05	190 deg	43.12.365/113.30.802	4961		LP-14
	LPT-16	02-06	187 deg	43.12.739/113.30.640	4967		LP-13
	LPT-17	02-07	108 deg	43.12.415/113.29.818	4948		LP-11
6/2	LPT-18	02-08	170 deg	43.11.693/113.36.030	4810		LP-22
	LOC-16	02-09	SE		4720	T3SR24ES3, 10	LP-22
	LPT-19	02-10	18 deg	43.11.416/113.35.543	4780		LP-21
	LPT-20	02-11	110 deg	43.10.907/113.34.190	4767		LP-22
	LPT-21	02-12	55 deg	43.10.674/113.34.775	4705		LP-18
6/4	LPT-22	02-13	146 deg	43.14.827/113.30.484	5059		LP-30
	LOC-17	02-14	SW		4960	T2SR25ES18se1/4 S 19n1/2	LP-30
	LPT-23	02-15	255 deg	43.14.012/113.31.372	4951		LP-30
	LPT-24	02-16	212 deg	43.13.339/113.31.477	4948		LP-30
	LPT-25	02-17	320 deg	43.13.350/113.31.960	4951		LP-22

Appendix VI. Laidlaw Park Transect Photo Locations (Page 2 of 5)

Date	Site	Photo	Bearing	Lat./Long	Elevation	Ocular T/R/S	Poly #
6/4	LOC-18	02-18	W		4920	T2SR24ES25	LP-22
	LOC-19	02-19	NE		4860	T2SR24ES36	LP-30
6/5	LPT-26	02-20	249 deg	43.12.834/113.33.278	4890		LP-22
	LOC-20	02-21	NW		4840	T2SR24ES35s1/2	LP-22
	LPT-27	02-22	283 deg	43.11.745/113.33.683	4816		LP-22
	LPT-28	02-23	147 deg	43.11.625/113.33.720	4833		LP-30
	LOC-21	02-24	W		4780	T3SR24ES2sw1/4 S3e1/2	LP-22
	LPT-29	02-25	290 deg	43.10.354/113.34.802	4691		LP-19
	LPT-30	03-01	243 deg	43.09.910/113.28.509	4813		LP-08
	LOC-22	03-02	NW		4840	T3S4R5ES16ne1/4	LP-09
	LPT-31	03-03	215 deg	43.10.807/113.28.932	4879		LP-07
6/6	LPT-32	03-04	196 deg	43.10.964/113.29.545	4875		LP-10
	LOC-23	03-05 03-07	SE		4880	T3SR25ES8, 9, 16nw1/4, 17	LP-10
	LOC-24	03-06	E		4685	T3SR24ES14, 15	LP-22
	LOC-25	04-15	W		4640	T3SR24ES15w1/2 S16e1/2	LP-l9
6/7	LPT-33	03-08	100 deg	43.11.283/113.29.836	4898		LP-11
	LOC-26	03-09	NE		4900	T2SR25ES33 T3SR25ES4nw1/4	LP-11
	LPT-34	03-10	284 deg	43.11.903/113.29.733	4944		LP-12
	LPT-35	03-11	275 deg	43.11.066/113.30.444	4866		LP-12
6/8	LPT-36	03-13	44 deg	43.06.198/113.32.164	4577		LP-03
	LOC-27	03-14	S		4640	T4SR25ES6s1/2 T4SR24ES1se1/4	LP-01
	LPT-37	03-15	55 deg	43.06.203/113.33.615	4524		LP-01
	LOC-28	03-16	SW		4515	T4SR24ES2	LP-01
	LPT-38	03-17	355 deg	43.14.614/113.41.226	4879		LP-01
	LOC-28A	03-18	NW		4900	T2SR23ES14	LP-01
	LPT-39	03-19	152 deg	43.14.992/113.40.587	4948		LP-01
	LPT-40	03-20	50 deg	43.15.183/113.40.255	4944		LP-28
6/9	LPT-41	03-21	170 deg	43.06.534/113.36.558	4485		LP-02
	LOC-29	03-22	N		4470	T4SR24ES3	LP-02
	LOC-30	03-23	E		4600	T3SR24ES36s1/2, T4SR24ES1n1/2	LP-03
	LPT-42	03-24	103 deg	43.07.326/113.32.810	4616		LP-03
	LPT-43	03-25	62 deg	43.07.411/113.31.899	4718		LP-05
	LOC-31	04-01	W		4700	T3SR25ES30w1/2	LP-05
	LPT-44	04-02	136 deg	43.08.094/113.30.747	4747		LP-41
	LPT-45	04-03	240 deg	43.11.438/113.40.566	4816		LP-01
	LOC-32	04-04	SE		4900	T3SR23ES1	LP-01
	LPT-46	04-05	180 deg	43.11.850/113.38.959	4882		LP-01
	LOC-33	04-06	N		5000	T2SR23ES36e1/2, T2SR24ES31w1/2	LP-01
6/10	LPT-47	04-07	187 deg	43.10.561/113.30.151	4905		LP-10
	LOC-34	04-08	W		4850	T3SR25ES7	LP-10
	LPT-48	04-09	128 deg	43.09.818/113.30.328	4849		LP-10
	LPT-49	04-10	315 deg	43.09.613/113.30.731	4856		LP-16

Appendix VI. Laidlaw Park Transect Photo Locations (Page 3 of 5)

Date	Site	Photo	Bearing	Lat./Long	Elevation	Ocular T/R/S	Poly #
6/10	LPT-50	04-11	127 deg	43.08.307/113.31.044	4761		LP-40
	LPT-51	04-12	213 deg	43.08.863/113.31.305	4813		LP-05
	LOC-35	04-13	S		4800	T3SR25ES19, 20	LP-05
	LPT-52	04-14	14 deg	43.08.676/113.32.376	4738		LP-15
	LOC-36	04-15	N		4750	T3SR25ES18, 19n1/2	LP-15
6/11	LPT-53	04-16	315 deg	43.09.234/113.35.644	4593		LP-19
	LOC-37	04-17	SE		4600	T3SR24ES22w1/2	LP-19
	LPT-54	04-18	20 deg	43.08.873/113.33.323	4659		LP-17
	LPT-55	04-19	85 deg	43.07.807/113.33.730	4603		LP-01
	LOC-38	04-20	W		4620	T3SR24ES26w1/2 S27e1/2	LP-01
	LPT-56	04-21	264 deg	43.08.041/113.35.100	4603		LP-01
	LOC-39	04-22	S		4560	T3SR24ES33, 34	LP-01
	LPT-57	no pic	60 deg	43.13.876/113.34.714	4934		LP-24
	LPT-58	04-23	205 deg	43.13.333/113.34.129	4961		LP-23
	LPT-59	04-24	96 deg	43.14.013/113.34.132	4971		LP-22
	LOC-40	04-25	E		5000	T2SR24ES14s1/2 S23n1/2	LP-22
6/12	LPT-60	05-01	60 deg	43.07.907/113.37.512	4564		LP-19
	LOC-41	05-02	SE		4580	T3SR24ES28n1/2	LP-19
	LPT-61	05-03	223 deg	43.09.303/113.38.542	4659		LP-01
	LOC-42	05-04	W		4600	T3SR23ES13s1/2 S24	LP-01
	LPT-62	05-05	284 deg	43.09.575/113.37.213	4652		LP-19
	LPT-63	05-06	278 deg	43.10.144/113.36.858	4682		LP-20
	LPT-64	05-07	300 deg	43.10.875/113.36.484	4734		LP-21
	LOC-43	05-08	SW		4800	T3SR24ES5	LP-21
	LPT-65	05-09	337 deg	43.12.471/113.36.429	4843		LP-21
	LOC-44	05-10	E		4850	T2SR24ES33e1/2 S34	LP-21
6/13	LPT-66	05-11	244 deg	43.15.083/113.30.549	5056		LP-30
	LOC-45	05-12	S		5200	T2SR24ES12ne1/4 T2SR25ES7nw1/4	LP-30
	LPT-67	05-13	247 deg	43.14.493/113.32.271	4993		LP-22
	LPT-68	05-14	13 deg	43.14.908/113.32.346	5102		LP-31
	LPT-69	05-15	139 deg	43.15.612/113.34.662	5177		LP-30
	LPT-70	05-16	235 deg	43.14.209/113.38.117	5030		LP-26
	LOC-46	no pic			5100	T2SR24ES29, 30	LP-26
	LOC-47	05-19	E		5140	T2SR24ES30w1/2	LP-21
	LPT-71	05-17	60 deg	43.14.412/113.38.033	5010		LP-26
6/14	LPT-72	05-18	330 deg	43.13.339/113.39.558	5164		LP-39
	LPT-73	05-20	132 deg	43.13.057/113.39.637	5243		LP-21
	LOC-48	05-21	W		5200	T2SR23ES25s1/2 S36n1/2	LP-39
	LPT-74	05-22	162 deg	43.12.331/113.40.287	5138		LP-01
	LOC-49	05-23	N		5000	T2SR23ES35	LP-01
	LOC-50	08-01	E		5040	T2SR24ES17n1/2	LP-30
6/7	LPT-75	06-01 06-02	345 deg	43.16.232/113.37.168	5141		LP 30

Appendix VI. Laidlaw Park Transect Photo Locations (Page 4 of 5)

Date	Site	Photo	Bearing	Lat./Long	Elevation	Ocular T/R/S	Poly #
6/7	LOC-75	06-03	NE		5130	T2SR24ES4, 5	LP-30
	LPT-76	06-04	84 deg	43.17.343/113.37.287	5211		LP-30
	LOC-76	06-05	SE		5284	T1SR24ES28	LP-30
	LPT-77	06-06	240 deg	43.19.133/113.36.455	5370		LP-32
6/8	LPT-78	06-07	13 deg	43.18.506/113.33.112	5445		LP-30
	LOC-77	06-08	S		5573	T1SR24ES23	LP-35
	LOC-78	06-09	N		5515	T1SR24ES15	LP-35
	LPT-79	06-10	90 deg	43.20.019/113.35.019	5407		LP-33
	LOC-79	06-11	E		5360	TlSR24ES22	LP-30
6/9	LOC-80	06-12	W		5400	TISR24ES22	LP30
	LPT-80	06-13	360 deg	43.20.180/113.34.046	5550		LP-34
	LOC-81	06-14	NE		5600	TlSR24ES14	LP-36
	LPT-81	06-15	196 deg	43.20.283/113.33.020	5590		LP-37
	LOC-82	06-16	NE		5640	T1SR24ES24	LP-37
	LOC-83	06-17	E		5430	T1SR24ES23	LP-35
	LPT-82	06-18	90 deg	43.18.233/113.35.209	5292		LP-30
	LPT-83	06-19	182 deg	43.17.431/113.36.045	5350		LP-30
6/10	LPT-84	06-20	240 deg	43.19.214/113.35.416	5372		LP-30
	LPT-85	06-21	340 deg	43.17.144/113.35.018	5301		LP-30
	LOC-84	06-22	N		5280	T1SR24ES35	LP-30
	LPT-86	06-23	120 deg	43.17.009/113.34.073	5255		LP-30
	LOC-85	07-01 07-02	W		5237	T2SR24ES3	LP-30
	LOC-86	07-03	N		5229	T2SR24ES3	LP-30
	LPT-87	07-04	180 deg	43.15.590/113.35.525	5197		LP-30
	LPT-88	07-05	10 deg	43.15.548/113.36.277	5183		LP-30
6/11	LPT-89	07-06	180 deg	43.17.141/113.35.515	5279		LP-30
	LOC-87	07-07	SE		5214	T2SR24ES4	LP-30
	LOC-88	07-08	SE		5078	T2SR24ES8	LP-30
	LPT-90	07-09	154 deg	43.15.512/113.34.487	5229		LP-30
	LOC-89	07-10	SW		5201	T2SR24ES11	LP-30
	LPT-91	07-11	23 deg	43.15.446/113.32.535	5168		LP-30
	LOC-90	07-12	NE		5081	T2SR24ES13	LP-31
	LPT-92	07-13	360 deg	43.16.228/113.31.434	5257		LP-30
	LOC-91	07-14	NW		5160	T2SR25ES7	LP-30
6/12	LPT-93	07-15	277 deg	43.16.358/113.32.434	5216		LP-30
	LOC-92	07-16	SE		5280	T2SR24ES1	LP-30
	LPT-94	07-17	45 deg	43.17.293/113.33.038	5370		LP-30
	LPT-95	07-18	360 deg	43.17.358/113.33.430	5342		LP-30
	LOC-93	07-19	E		5400	T1SR24ES23	LP-30
	LPT-96	07-20	90 deg	43.18.161/113.33.164	5325		LP-30
	LPT-97	07-21	270 deg	43.18.322/113.33.198	5420		LP-30
	LPT-98	07-22	10 deg	43.15.527/113.37.475	5086		LP-30
6/14	LPT-99	08-02	259 deg	43.15.370/113.37.870	5043		LP-26
	LOC-51	08-03	NE		5020	T2SR24ES7s1/2	LP-30
	LOC-52	08-04	W		4850	T2SR23ES13ne1/4 T2SR24ES18nw1/4	LP-26
	LPT-100	08-05	86 deg	43.14.932/113.39.226	4954		LP-27
	LOC-53	08-06	E		4960	T2SR24ES19n1/2	LP-26

Appendix VI. Laidlaw Park Transect Photo Locations (Page 5 of 5)

Date	Site	Photo	Bearing	Lat./Long	Elevation	Ocular T/R/S	Poly #
6/15	LPT-101	08-07	295 deg	43.14.409/113.39.270	4984		LP-01
	LOC-54	08-08	W		4960	T2SR24ES20, 28,29	LP-26
	LPT-102	08-09	346 deg	43.14.041/113.36.733	4993		LP-25
	LPT-103	08-10	40 deg	43.13.585/113.36.182	4931		LP-22
	LOC-55	08-11	NE		4900	T2SR24ES33e1/2 S34	LP-22
	LPT-104	08-12	269 deg	43.07.291/113.33.408	4603		LP-01
	LOC-56	08-13	SW		4520	T3SR24ES34e1/2, S35w1/2	LP-01
	LPT-105	08-14	39 deg	43.15.811/113.39.498	4940		LP-26
	LOC-57	08-15	SW		5000	T2SR23ES12ne1/4	LP-29
	LPT-106	08-16	136 deg	43.14.461/113.41.412	4934		LP-39
	LPT-107	08-17	292 deg	43.14.068/113.41.911	4910		LP-01
	LOC-58	08-18	E		5100	T2SR23ES23s1/2, S26n1/2, S27ne1/4	LP-39
	LOC-59	08-19	SW		4900	T2SR23ES27s1/2, S26s1/2	LP-01
6/16	LPT-108	08-20	271 deg	43.12.113/113.41.970	4806		LP-01
	LPT-109	08-21	206 deg	43.11.836/113.41.585	4849		LP-01
	LOC-60	08-22	NE		5050	T2SR23ES35	LP-01
	LPT-110	08-23	46 deg	43.11.997/113.37.694	4866		LP-21

Appendix VII: Areas recommended for ecological reference, trend studies, and potential exclosures.

Vegetation Polygon	T/R/S	Vegetation Type	Notes
Paddelford Flat			
PFP-02A	1S/23E/8,9	ARTR/PUTR/AGSP/FEID/BASA	
PFP-09A	2S/22E/3	ARTR/PUTR/STCO	Cheatgrass present
Little Park			
North part LitP-01	1S/23E/24	ARTR/ARTR4/POSE/FEID	Semi-kipuka; needs gap fence
LitP-04	2S/24E/31	CHVI-MixPer. Grass	Monitor fire recovery
LitP-05	2S/23E/3	ARTR/PUTR/POSE/AGSM	Cheatgrass present
Laidlaw Park			
LP-03	4S/24E/l	STCO Grassland Mix	big sagebrush recovery/experime
LP-15	3S/25E/19	ARTRT/STTH/STCO	Monitor sagebrush recovery from Aroga moth kill
LP-13, LP-14	2S/25E/32	ARTR4/PUTR/STTH/AGSP	big sagebrush experiments
LP- 18	3S/24E/10	Carex	Williams Lake Playa
LP-19A-F	3S/24E/Var.	PONE	Playas
LP-24	2S/24E/22,23	ARTR/AGSP Seeding	Exemplary multispecies seeding
LP-32	1S/24E/21	ARTR4/PUTR/AGSP-Mix	Semi-kipuka; repair gap fence
LP-34	1S/24E/14	ARTRV/FEID ecol. site	big sagebrush experiments
LP-37C	1S/24E/13	Aspen	Only aspen in study area
LP-39	2S/23E/23	ARTR/PUTR/Mix Per. Grass	

Additional notes:

1. These are suggested locations for reference/study; doubtless there are other sites, as well.
2. Exclosures should be as large as possible; 40 acres minimum.
3. For threetip sagebrush sites, recommend seeding and/or planting experiments with various subspecies of big sagebrush to determine adaptability and add species diversity.

Appendix VIII –Incidental Wildlife Sightings.

Paddelford Flat:

Date	Species	Number	Location
10/02/01	N. Harrier	1	T1S R23E S18 NESW
10/02/01	Sage Grouse	1	T1S R23E S19 NWNW
10/02/01	Sage Grouse	1	T1S R23E S19 SWSW
10/08/01	Sage Grouse	3	T1S R22E S23 SESE
10/10/01	Sage Grouse	5	T1S R23E S19 NESW
10/12/01	Sage Grouse	2	T1S R23E S19 NWSE
10/18/01	Sage Grouse	1	T2S R22E S1 SWSW

Little Park:

10/11/01	Gray partridge	4	T1S R23E S35 NWNW
10/10/01	Sage Grouse	1	T1S R23E S35 NESE

Laidlaw Park:

05/22/02	Sage Grouse	6	T3S R25E S19 SWSW
06/03/02	Am. Pronghorn	2	T2S R24E S20 SWNE
06/04/02	Am. Pronghorn	2	TI S R24E S36 SWSW
06/04/02	Sage Grouse	1	T2S R25E S19 SENE
06/05/02	Am. Pronghorn	1	T3S R25E S9 NWNE
06/09/02	Sage Grouse	1	T3S R25E S30 SWNE
06/11/02	Sage Grouse	2	T3S R24E S22 NWNW
06/15/02	Sage Grouse	1	T2S R23E S22 NESE

Note: A few mule deer, many ravens, coyotes, meadowlarks, horned larks, mountain bluebirds, etc. were also seen but not cataloged.

Appendix IX. CD – Final report, supporting data, and photos.

