
**Effects of controlled-burns on native and non-native
vegetation in mid-elevation dry meadows of the
Umpqua National Forest**

2001 Progress Report

January 2002

Thomas N. Kaye
Jen Cramer
Institute for Applied Ecology
Corvallis, Oregon
www.appliedeco.org



A challenge Cost Share Project funded jointly by

Institute for Applied Ecology
Umpqua National Forest

PREFACE

This report is the result of a cooperative Challenge Cost Share project between the Institute for Applied Ecology (IAE) and a federal agency. IAE is a non-profit organization dedicated to natural resource conservation, research, and education. Our aim is to provide a service to public and private agencies and individuals by developing and communicating information on ecosystems, species, and effective management strategies and by conducting research, monitoring, and experiments. IAE offers educational opportunities through 3-4 month internships. Our current activities are concentrated on rare and endangered plants and invasive species.

Questions regarding this report or IAE should be directed to:

Thomas N. Kaye
Institute for Applied Ecology
227 SW 6th
Corvallis, Oregon 97333
phone: 541-753-3099
fax: 541-753-3098
email: kayet@peak.org

Acknowledgments

The following individuals contributed their valuable time and expertise toward planning, field work and/or data entry during this project: Jen Cramer (IAE staff), Lauren Spaderna, Djibo Zanzot, Jon Kart, Jon LeRoy (2001 IAE/NPSO Interns), Melissa Kirkland, Cindy Barkhurst, Richard Helliwell, and Bev Reed (Umpqua National Forest).

Table of Contents

Introduction	1
Pre-field review	1
2001 Monitoring	1
Study sites	2
Plot establishment	2
Vegetation plot sampling	2
Soil depth	2
Base-line results	3
Total cover	3
Harvey Meadow	3
Layng Meadow	3
Control of <i>Cynosurus echinatus</i> and <i>Taeniatherum caput-madusae</i>	3
Proposed analysis	4
Literature cited	12

Tables and Figure

Table 1. Average percent cover for all species and environmental variables in the control and burn plots at Harvey and Layng Meadows in 2001 (prior to burning).

Figure 1. Harvey Meadow on the Umpqua National Forest, Cottage Grove Range District (prior to controlled burns).

Figure 2. Aerial photograph of Layng Meadow showing location of plot areas.

Figure 3. Layng Meadow sketch-map of plot layout.

Figure 4. Aerial photograph of Harvey Meadow showing location of plot areas.

Figure 5. Harvey Meadow sketch-map of plot layout in the control portion of the meadow.

Figure 6. Harvey Meadow sketch-map of plot layout in the burn portion of the meadow.

Introduction

Several mid-elevation dry meadows on the Cottage Grove District, Umpqua National Forest, have been selected for controlled-burning to enhance their biodiversity, restore natural ecological processes, and reduce resident fuel loads. The specific objectives of these fires are to 1) release native plant seed banks, 2) increase in vigor of native bunch grasses and forbs, and 3) reduce existing non-native plant populations, including noxious weeds and annual grasses. However, the specific responses to fire of the species in the existing plant communities of these dry meadows are unknown (e.g., some native species may be reduced by fire while some noxious weeds could benefit). The purpose of this progress report is to document monitoring methods and baseline data designed to measure the effects of burning. This burning has not been implemented, but is anticipated in fall of 2002.



Figure 1. Harvey Meadow on the Umpqua National Forest, Cottage Grove Range District (prior to controlled burns).

Pre-field review

A pre-field meeting to review the project monitoring was conducted on 15 February 2001 with staff from IAE and Umpqua National Forest. Review of materials discussed at this meeting and other information (e.g., maps, aerial photographs, site descriptions and field notes, and burn plans) indicated that long-term monitoring to document the effects of controlled-burning on the native and non-native vegetation was feasible and justifiable. A plan for this monitoring was developed and its implementation is presented below.

2001 Monitoring

In 2001, IAE coordinated with Forest Service botanists and fire personnel to establish monitoring plots in two dry meadows on the Cottage Grove Ranger District, Harvey Meadow and Layng Meadow (Spaderna 2001). At each site, two sets of monitoring plots were established, one set in the areas to be burned, and another set in unburned areas to serve as controls.

The monitoring and proposed analysis for the dry meadows targets specific plant taxa, including native perennial grasses such as *Stipa lemmonii*, and non-native grasses such as *Cynosurus echinatus*, *Bromus mollis*, and *Aira caryophyllea*. This sampling procedure allows for quantification of the effects of fire on all vascular plants, as well as species richness and abundance of exposed rock and soil. Also, this technique allows the documentation of additional noxious or invasive weeds not previously noted from

the sites if they are encountered.

Study sites

After screening various meadows, two study sites were selected. These were Layng and Harvey Meadows, both on the Cottage Grove District of the Umpqua National Forest. Both meadows were steep, south facing meadows with relatively shallow soil and patchy exposure of bedrock and loose rock. Harvey Meadow was located at T21S R1E NE $\frac{1}{4}$ Sec. 27 and Layng Meadow was located at T21S R1E SW $\frac{1}{4}$ Sec 28.

Plot Establishment

In each meadow, a control area and burn area was designated based on natural fire barriers and feasible and safe burn methods as determined by Bev Reed (Umpqua National Forest). A reference line perpendicular to the aspect of each meadow was established as a base line from which to choose and locate plots in both control areas and areas to be burned. These reference lines were marked with metal conduit posts placed at intervals. At Harvey Meadow, three different lines were placed (see Map X) to accommodate the variable aspect. Coordinates were then randomly selected for sample plot locations. The coordinates were based on the distance along the reference line (x-axis), as well as a distance perpendicular to the reference line (y-axis). At each point chosen, a 0.5 m² plot (0.5×1 m) was established. Spikes (10 inch steel nails) were pounded into the upper left and lower right corners of each plot to ensure that plots could be re-located. Due to the rocky conditions of Layng and Harvey Meadows, however, the stakes occasionally had to be pounded into a different corner; this was individually noted on the data sheets and maps.

Vegetation plot sampling

Within each plot, the percent cover of all vascular plant species was recorded. Additionally, the percentages of moss, lichen, litter, bare ground, loose rock or cobble and bedrock were estimated. Cover values were based on ocular estimation to the nearest percent. Cover values of less than 1% were noted as trace amounts, and recorded as 0.5% for data summaries. We used cards of standardized sizes to assist with ocular estimation. For example, each field recorder had cards cut to 1%, 2%, 4%, and 14% (the size of a clipboard). In addition, all field recorders sampled 3 plots together to calibrate their estimation techniques.

Soil depth

A soil probe (narrow, pointed steel surveyor's spike) was used to determine soil depth in each corner of each plot. The spike was pushed firmly into the soil until it hit hard, firm rock. The depth of spike penetration was then measured to the nearest 0.5 cm. The four depths were averaged to produce a mean soil depth for each plot.

Baseline Results

Total cover

Total cover averaged between 101.7% and 106.2% for each site. Cover data were acquired based on a multi-layered canopy, so total cover estimates were often over 100%. Non-vascular plant, litter, rock and bare ground cover contributed a significant portion of each plot, averaging 59.5% and 62.4% cover at Harvey control and burn plots, respectively, and 44.6% and 54.9% cover at Layng control and burn sites, respectively (Table 1).

Harvey Meadow

Control plots at Harvey averaged 37.7% moss cover and plots to be burned had a mean of 44.3% moss. Bare ground covered an average of 7.9% for control plots and 4.8% for burn plots. Litter covered a large portion of each plot averaging 10.3% for control and 7.1% for burn. The target species, *Cynosurus echinatus*, covered 4% and 13% of control and burn plots, respectively. Additionally, *Taeniatherum caput-medusae* has 3.1% cover in control plots at Harvey. Other species dominating plots at Harvey were *Brodiaea* sp., *Aira caryophyllea*, *Bromus mollis*, *Lomatium lyallii*, *Plectritis congesta*, and *Trifolium variegatum* (Table 1).

Layng Meadow

Bare ground covered 7.7% and 9.1% of control and burn plots, respectively. Moss was less prevalent at Layng, comprising an average of only 14.3% and 24.4% while litter cover was higher at 14.3% and 24.4%. Loose rock was also a significant contribution to cover with 2.3% and 6% for control and burn plots. The target species, *Cynosurus echinatus*, covered 23% and 14.1% of control and burn plots, respectively. *Taeniatherum caput-medusae* was absent from all plots at Layng. Other species dominating plots at Layng were *Brodiaea* sp., *Aira caryophyllea*, *Bromus mollis*, and *Sherardia arvensis*.

Elymus glaucus, *Stipa lemmonii* and *Danthonia californica*, species targeted for enhancement, were absent or minimal in all plots at both sites (Table 1).

Control of *Cynosurus echinatus* and *Taeniatherum caput-madusae*

A search of the published scientific literature on the effect of fire on *Cynosurus echinatus* yielded no results, as did an internet search and a query of the USDA Fire Effects information System (www.fs.fed.us/database/feis). *Taeniatherum caput-madusae*, which was present at Harvey Meadow, is an Oregon List B Noxious weed. Brooks and Pyke (2000) report that this species thrives in post fire environments in North American deserts and can develop fine fuel loads that make future fires carry more easily. In addition, the species is resistant to decomposition, and can create conditions conducive to fires in northern grasslands; *Sitanion hystrix* and other bunchgrasses are candidates for replacing *Taeniatherum* in some ecological systems (Hironaka 1994). The species is also often avoided by herbivores and seed eaters

(Young 1992). Most research on this species has been conducted in desert areas and the Great Basin. Its response to fire in Cascade Range meadows is not known, but it is likely to benefit from some fires, at least in the short term. However, no *Taeniatherum* was recorded in plots in the area to be burned at Harvey Meadow, and the abundance of native plants at that site may reduce the risk of *Taeniatherum* expansion in a post-fire environment.

Proposed Analysis

After burning in the fall of 2002 and subsequent resampling in 2003, it will be possible to test for the effects of fire on the vegetation of the individual meadows (Layng and Harvey). A t-test will be an appropriate statistical tool to compare burned and control vegetation, with special emphasis on the effects of fire on native vs. non-native plants, invasive weeds, and native grasses.

If additional meadows are incorporated into the study to provide replication of fire treatments at different meadows, it will be possible to make comparisons with regional inference. Sampling from control and burned areas of several dry meadows over a period of several years (both pre- and post-fire) will allow for statistical tests of the effects of fire in mid-elevation dry meadows on the Cottage Grove District. The results can be generalized to most similar dry-meadows on the District. Statistical tests for the effects of fire on specific plant taxa, native and non-native species, noxious weeds, bare soil and rock, species richness, and possibly cryptogamic abundance, will be possible. The breadth of these analyses may make it possible to predict the effects of fire on additional mid-elevation dry meadows in the region prior to burning. In this case, "region" refers to the geographic area over which the dry meadows included in this study are considered representative (have similar vegetation, slope, elevation, soils, etc.). Again, this area will cover at least the Cottage Grove District, but could be interpreted more widely if these meadows are typical of a larger geographic area.

Tests for the effects of fire on the vegetation of individual meadows (the control area vs. the burned area), will be most appropriate in the short term and may be useful if the effects of fire differ substantially from one meadow to another.

Table 1. Average percent cover for all species and environmental variables in the control and burn plots at Harvey and Layng Meadows in 2001 (prior to burning).

<u>Species or envt'l variable</u>	Site / Treatment area			
	Harvey		Layng	
	control	burn	control	burn
Grasses				
<i>Agrostis microphylla</i>	0	0.03	0	0
<i>Aira caryophyllea</i> †	4.6	4.8	2	1.5
<i>Bromus carinatus</i>	0.07	0	0	0.3
<i>Bromus mollis</i> †	4.9	6.3	5	2.7
<i>Cynosurus echinatus</i> †	4	13.5	23	14.1
<i>Danthonia californica</i>	0.007	0	0	0
<i>Elymus glaucus</i>	0	0.9	0	0
<i>Festuca californica</i>	0	0.007	0	0.2
<i>Koeleria cristata</i>	0	0	0	0.8
<i>Luzula campestris</i>	0	0	0	0.08
<i>Poa</i> sp.	0	0.007	0	0
<i>Stipa lemmonii</i>	0.04	0.2	0.09	0.7
<i>Taeniatherum caput-medusae</i> †	3.1	0	0	0
<i>Vulpia</i> sp. †	1.5	1.1	0	0
Total grasses	18.2	26.8	30.8	20.4
Herbaceous Species				
<i>Achillea millifolium</i>	0.6	0.8	0.04	0
<i>Agoseris</i> spp.	1.1	0.3	3	0.7
<i>Allium</i> sp.	0	0	0.009	0
<i>Arenaria douglasii</i>	0	0	0	0.4
<i>Aspidotis densa</i>	0	0	0	0.25
<i>Berberis aquifolium</i>	0	0	0	0.5
<i>Brodiaea</i> spp.	8.7	2.4	15.3	14.5
<i>Cerastium arvense</i>	0	0.5	0.14	0.08
<i>Chrysanthemum leucanthemum</i> †	0	0	0	0.008
<i>Clarkia</i> sp.	0.6	0.9	0.3	0.09
<i>Collinsia parviflora</i>	0.1	0	0.1	0
<i>Cryptantha intermedia</i>	0	0	0.09	0.008
<i>Daucus pusillus</i>	2.2	0.7	1	1.8
<i>Galium</i> sp.	0	0	0	0.4
<i>Gilia capitata</i>	0.3	0.3	0.2	0.3
<i>Githopsis specularioides</i>	0.007	0	0.009	0

†Non-native species

Table 1. Continued ([†]=Non-native species).

Species or envt'l variable	Site / Treatment area			
	Harvey		Layng	
	control	burn	control	burn
<i>Hypericum perforatum</i> [†]	0	0	0	0.008
<i>Linanthus bicolor</i>	0.8	0.8	0	0
<i>Lomatium lyallii</i>	1.8	2.2	0.6	2
<i>Lomatium triternatum</i>	0.3	0.007	0	0
<i>Lotus micranthus</i>	1.3	0.2	0.2	0.13
<i>Lotus purshianus</i>	0	0	0	0.13
<i>Lupinus bicolor</i>	0	0	0.04	0
<i>Madia gracilis</i>	1.7	1.1	1.3	0.008
<i>Marah oreganum</i>	0	0	0	2.5
<i>Mimulus guttatus</i>	0.07	0	0.8	0.12
<i>Orthocarpus hispidus</i>	0.4	0	0	0
<i>Orthocarpus pusillus</i>	0.03	0	0	0.04
<i>Plectritis congesta</i>	2.5	0	0.09	1.4
<i>Ranunculus occidentalis</i>	0	0	0	0.25
<i>Sanicula crassicaulis</i> var <i>bip.</i>	0	0	0	0.008
<i>Selaginella wallacei</i>	0	0	0.3	0.04
<i>Sherardia arvensis</i> [†]	0.8	0.5	1.4	1.4
<i>Sidalcea</i> sp.	0	1	0	0
<i>Taraxacum officinale</i> [†]	0	0	0	0.08
<i>Trifolium microcephalum</i>	2.3	0.2	1.1	0.3
<i>Trifolium variegatum</i>	2.6	1.1	0.09	0.4
<i>Veronica</i> sp.	0	0.007	0	0
<i>Zygadenus venenosus</i>	0	0.07	0	1.1
Total herbaceous species	28.5	13.2	26.3	28.2
Other				
bare ground	7.9	4.8	7.7	9.1
lichen	0.4	0	0	0.13
moss	37.7	44.3	14.3	24.4
litter	10.3	7.1	19	13.5
bedrock	0.8	0.4	1.3	1.8
loose rock	2.5	5.8	2.3	6
Total other	59.5	62.4	44.6	54.9
Total cover native species	23.1	11.3	24	25.3
Total cover non-native species	17.4	26.2	31.4	19.8
Total percent cover	106.2	102.38	101.7	103.5
Total native species richness	22	22	21	30
Total non-native species richness	6	5	4	7
Soil depth (cm)	9.1	8.1	11.8	11.1

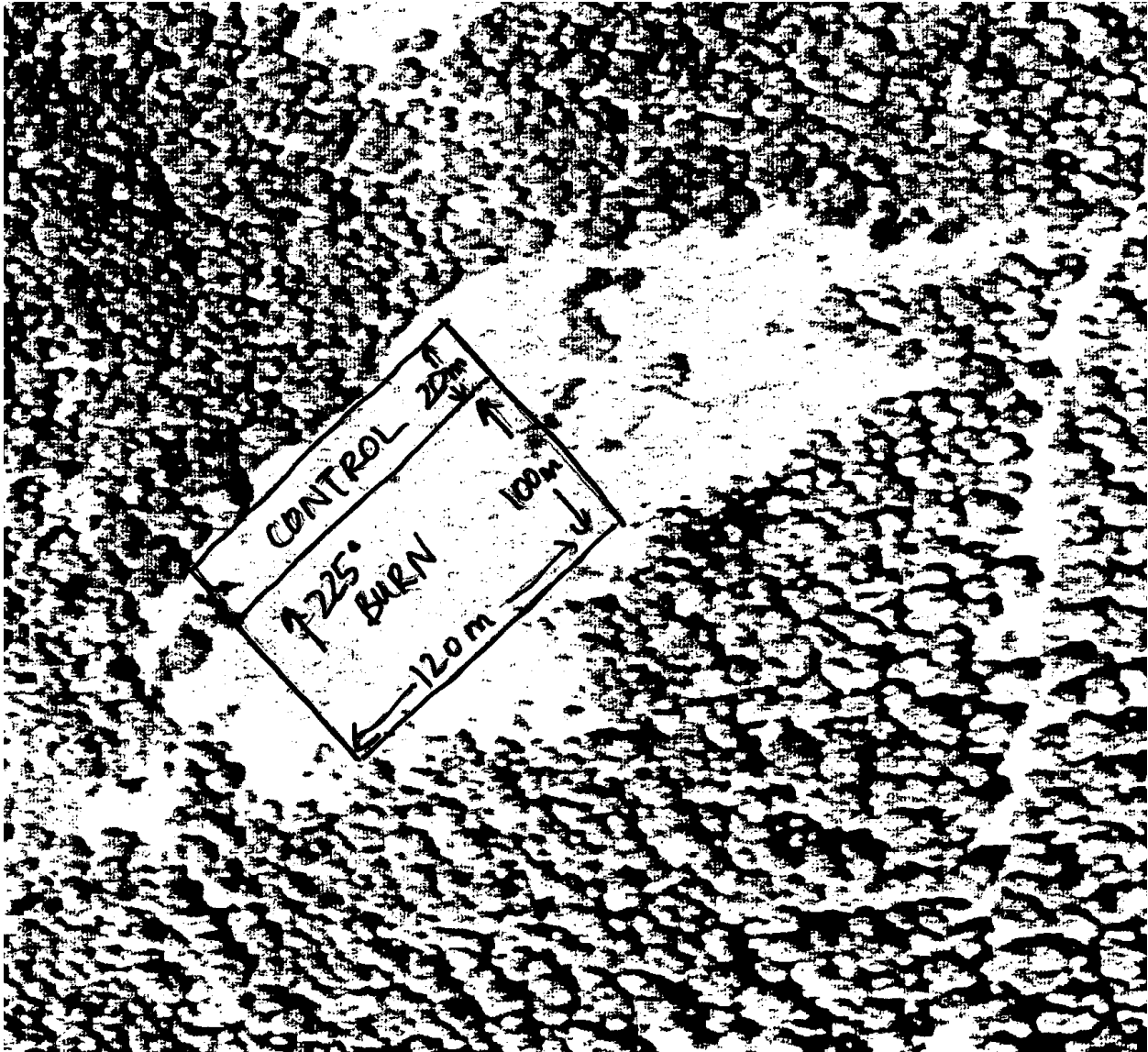


Figure 2. Aerial photograph of Layng Meadow showing location of plot areas.

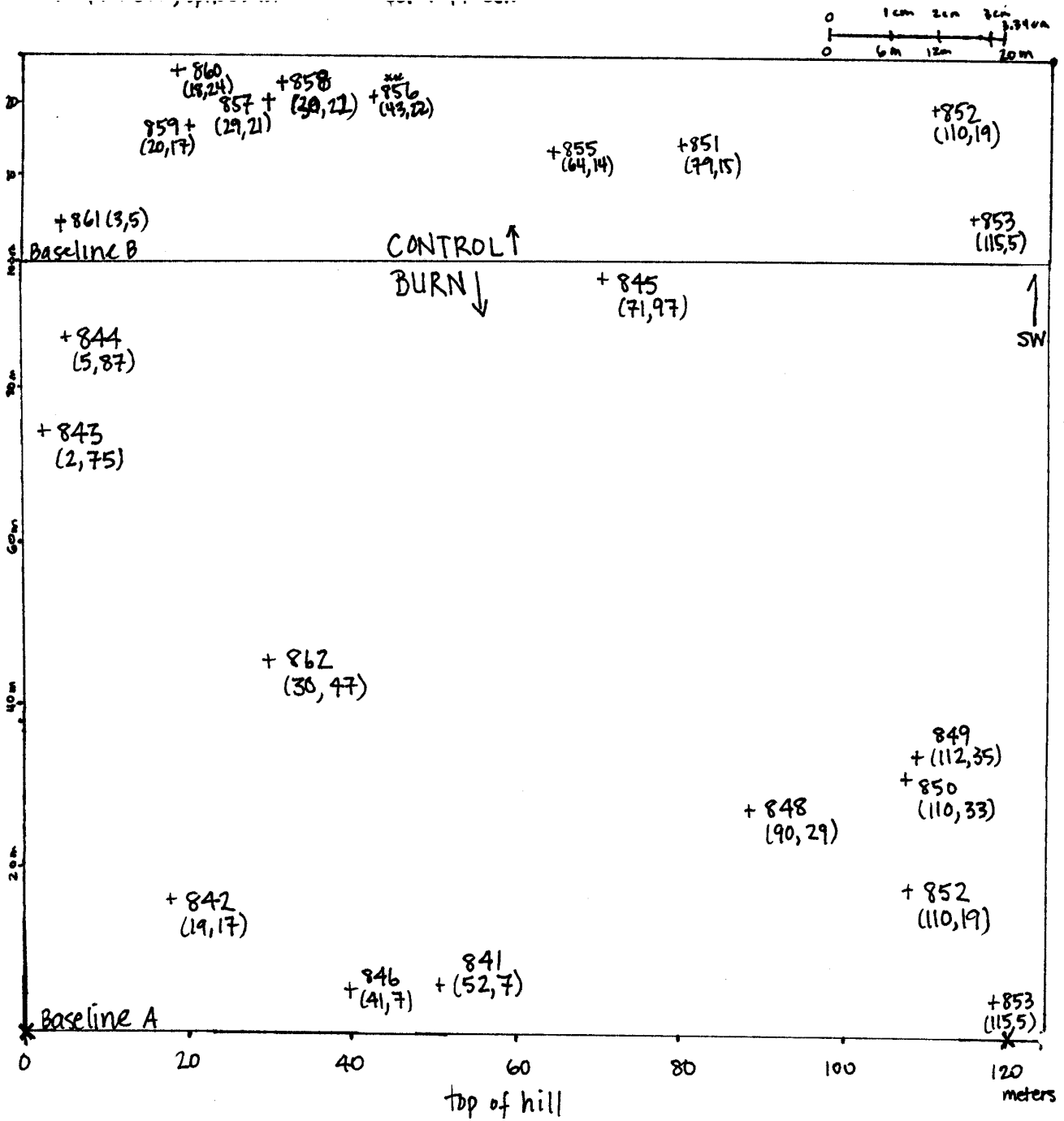


Figure 3. Layng Meadow sketch-map of plot layout. A “+” indicates a plot location, and the numbers indicate the plot number and coordinates in parentheses, e.g., “841 (52,7).” The coordinates are relative to Baseline A.

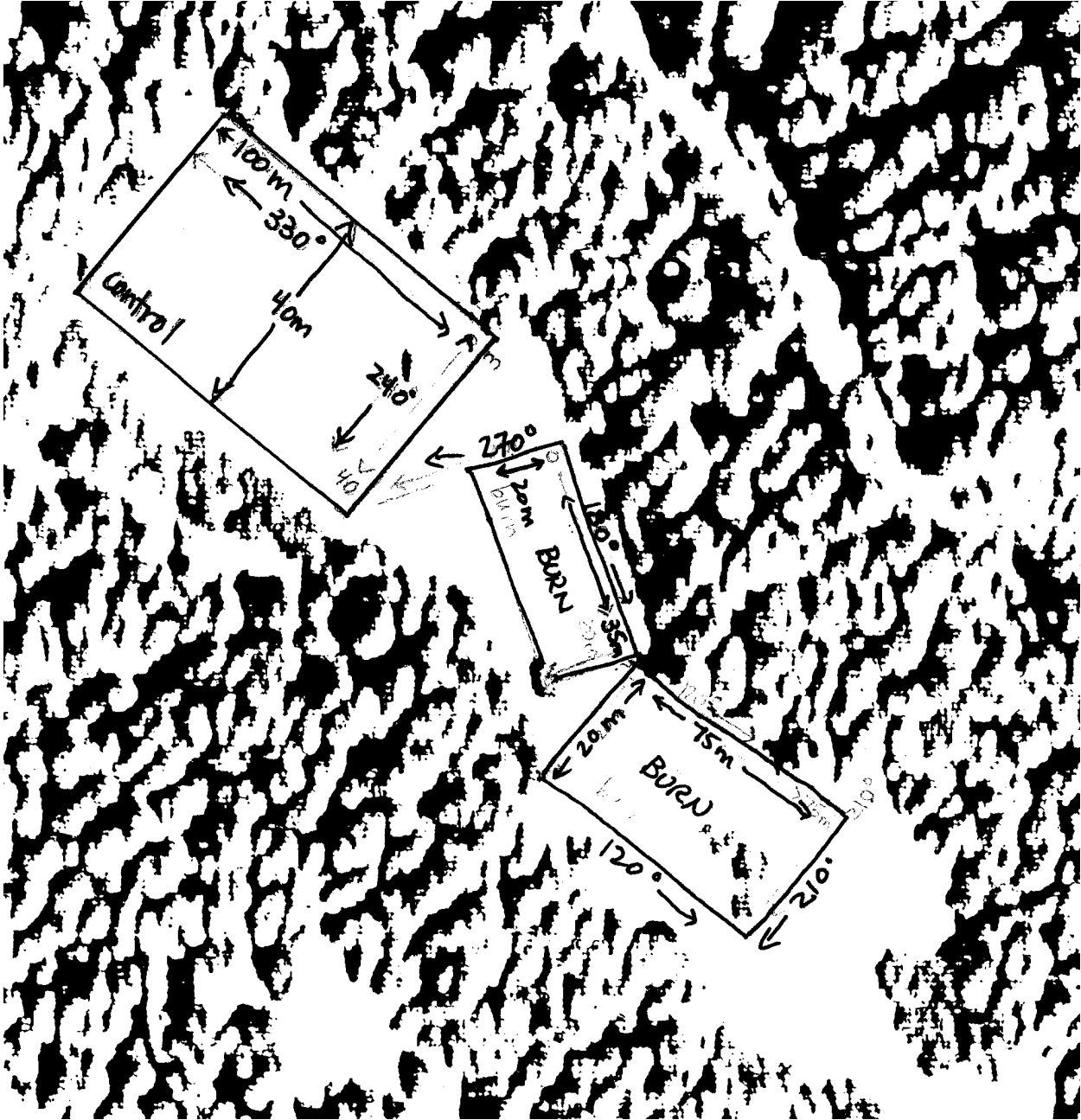


Figure 4. Aerial photograph of Harvey Meadow showing location of plot areas.

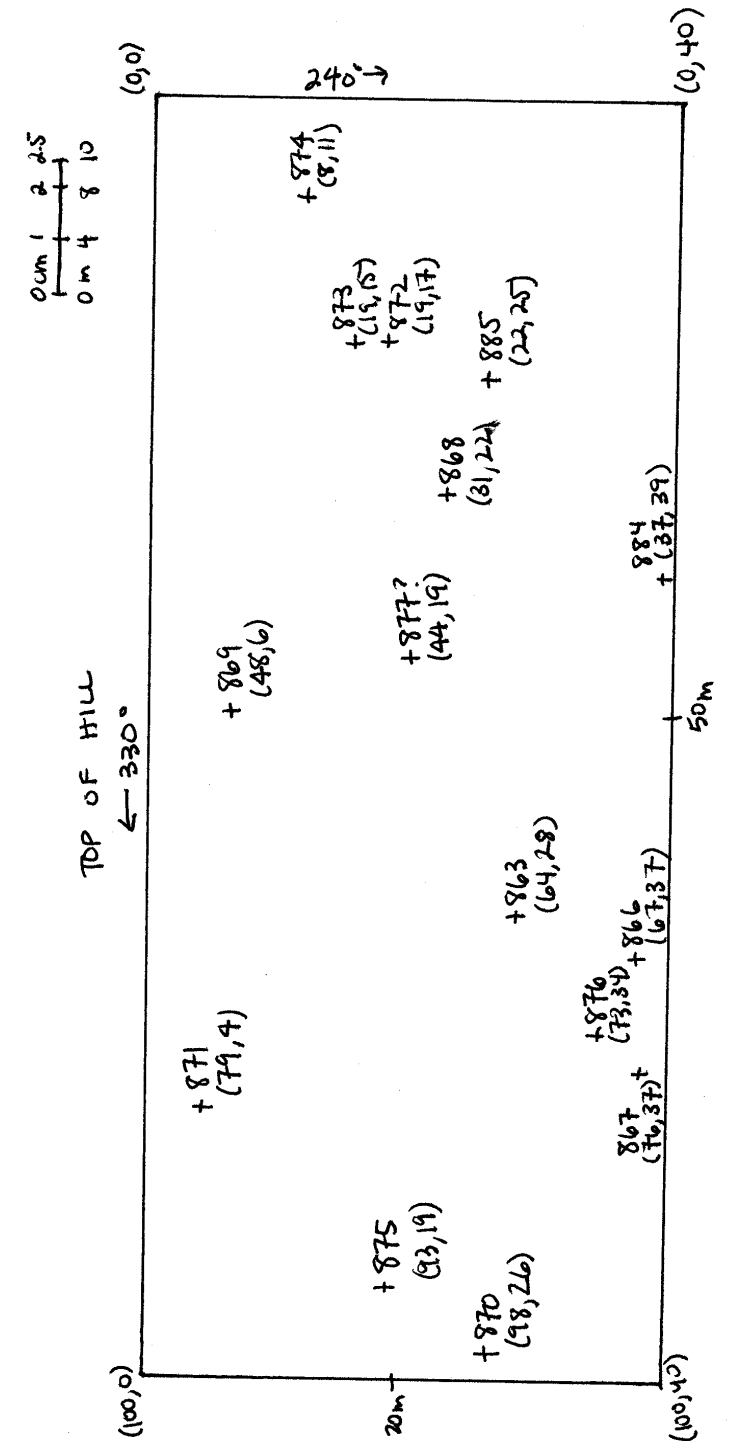


Figure 5. Harvey Meadow sketch-map of plot layout in the control portion of the meadow. A “+” indicates a plot location, and the numbers indicate the plot number and coordinates in parentheses, e.g., “841 (52,7).”

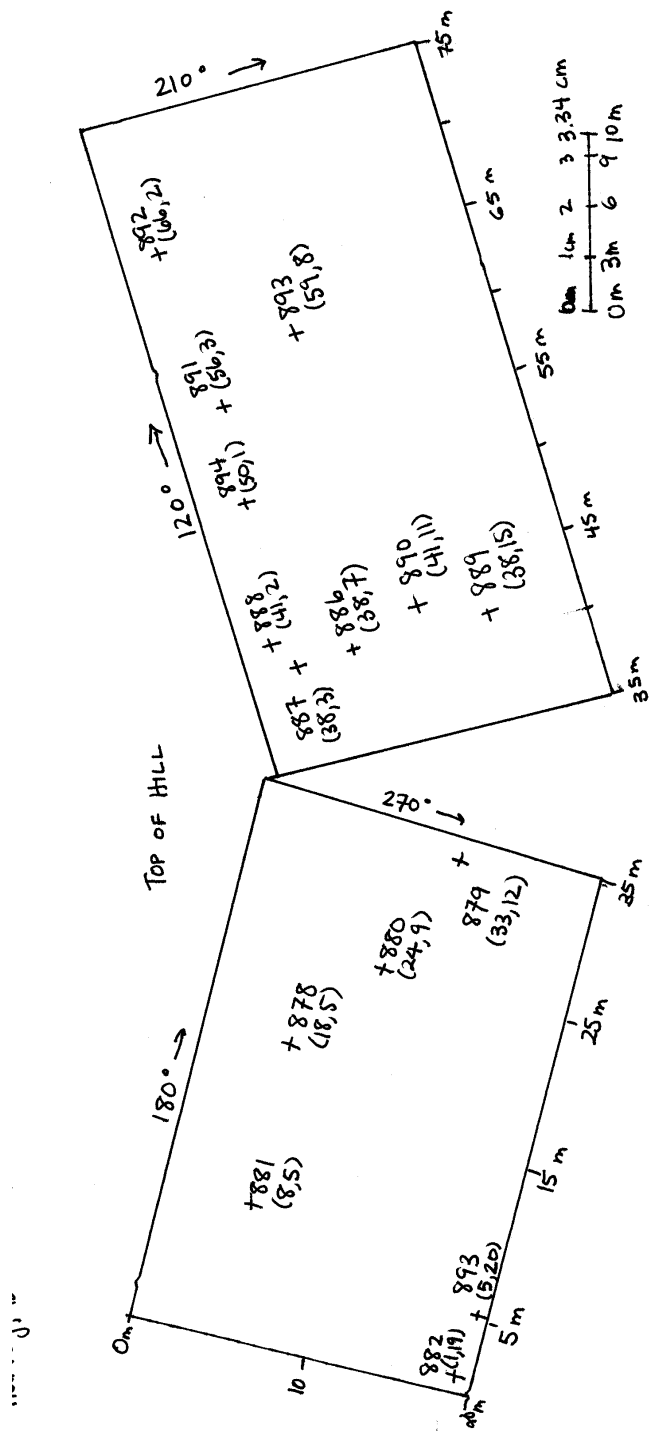


Figure 6. Harvey Meadow sketch-map of plot layout in the burn portion of the meadow. A "+" indicates a plot location, and the numbers indicate the plot number and coordinates in parentheses, e.g., "841 (52,7)."

Literature cited

Brooks, M. and D. Pyke. 2000. Interactions between fire and invasive plants in the deserts of North America in Fire Conference 2000: The First National Congress on Fire Ecology, Prevention and Management. Pages 1-2 University Extension, University of California, Davis, Davis, CA.

Hironaka, M. 1994. Medusahead: natural successor to the cheatgrass type in the northern grasslands in Proceedings-Ecology and Management of annual rangelands. Pages 89-91 in Monsen, S. B. and S. G. Kitchen (eds.) . General Technical Report. USDA Forest Service, Intermountain Research Station , Ogden, UT.

Spaderna, L. 2001. Fire in the dry meadows of the western Cascades. Bulletin of the Native Plant Society of Oregon 34:121-130.

Young, J. A. 1992. Ecology and management of medusahead (*Taeniatherum caput-medusae* ssp. *asperum* [Simk.] Melderis). Great Basin Naturalist 52(3): 245-252.