POPULATION MONITORING AND CONSERVATION ASSESSMENT OF IDAHO PHLOX (*PHLOX IDAHONIS*)

by

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ABSTRACT

Phlox idahonis (Idaho phlox) is a narrow endemic restricted to within a 6 km radius of Headquarters, Clearwater County, Idaho. *Phlox idahonis* is a tall rhizomatous herb of montane meadows. Its historical habitat has been reduced and altered by road and railroad construction, livestock grazing, and land development. It is currently a U.S. Fish and Wildlife Service (USFWS) Species of Concern. Ninety-eight percent of *P. idahonis* habitat is owned by Potlatch Corporation, a large timber products company. Seven permanent plots containing *Phlox idahonis* were established in four meadows throughout its range in 1978. Plots were relocated and reread in 1993 and a Management Plan was written. Plots were read for the third time in 2000. This report summarizes 22-year changes within the plots, in the frequency and density of *P. idahonis*, and in composition of the meadow communities. Plots differed as to plant community and grazing history, and one plot had been burned. *Phlox idahonis* has been nearly extirpated from one plot by heavy livestock grazing. In three other plots the density of *P. idahonis* ramets was lower in 2000 than in 1978, and in three plots it was higher. Differences were not tested for significance, but the increases measured were very large (from 90 to over 1,000 %) whereas decreases were on the order of 35%. Changes in frequency corresponded to those in density in five of the seven plots. Only a small proportion (1-5%) of *P. idahonis* ramets bear flowers. No flowering ramets were captured in any of the microplots. Because *P. idahonis* is a rhizomatous species, the number of ramets produced from year to year might be highly variable, and frequency, a measure of dispersion, might be a better indicator of population vigor. There has been a trend in most plots of increasing graminoid cover and decreasing forb cover. Shrub and tree invasion of the prime meadow habitat does not appear to be a threat. Several new threats were identified including potential development of land adjacent to *P. idahonis* habitat, and the appearance of additional, aggressive weed species. Although *P. idahonis* is not in imminent risk of extinction, its rarity and the potential for harm via grazing or land development warrants federal candidate status for this species. Our recommendations include protection for all populations, exclusion of grazing from meadows containing *P. idahonis*, and continued monitoring. In addition, a formal Conservation Agreement should be developed between the landowners and USFWS, to protect and manage *P. idahonis* populations and avoid further habitat loss.

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INTRODUCTION

Phlox idahonis (Idaho phlox) is a narrow endemic known from only four metapopulations located within a 6 km radius of Headquarters, Clearwater County, Idaho. It is a tall rhizomatous herb with an inflorescence of large, lavender flowers (Appendix 1). Once thought to be closely allied to *P. maculata* and *P. carolina* of eastern North America (Wherry 1955), recent molecular-genetic studies have shown the species to be related most closely to the common western species *Phlox longifolia* (long-leaf phlox; Schultz 2000). *Phlox idahonis* occurs in montane meadows surrounded by *Thuja plicata* (western redcedar) forest. Its historical habitat has been reduced and altered by road and railroad construction, livestock grazing, and land development. Ninety-eight percent of its habitat is owned by Potlatch Corporation (Potlatch). A status review of the species including detailed descriptions of the plant and its habitat can be found in Moseley and Crawford (1993). *Phlox idahonis* is currently a USFWS Species of Concern.

As part of his thesis research at the University of Idaho, Rex Crawford established seven permanent plots containing *Phlox idahonis* in four meadows throughout its range in 1978 (Crawford 1980). These plots were reread in 1993, to determine 15-year changes in abundance of the species, and a Management Plan was written (Moseley and Crawford 1993). Analysis of the 1993 data indicated that livestock grazing intensity explained a majority of the floristic variation among plots. No grazing and moderate levels of grazing were not detrimental to population viability. *Phlox idahonis* populations exhibited different trends among the meadows, disappearing completely from one plot, apparently as a result of heavy livestock grazing (Moseley and Crawford 1993, 1995). Shrub and tree invasion of the prime meadow habitat did not appear to be a threat during the initial 15-year monitoring period. Recommendations in the 1993 report included protection for all populations, exclusion of grazing from heavily grazed meadows, and a 5-year monitoring schedule. However, monitoring plots were not read again until 2000. This report summarizes all monitoring results to date and contains updated information about the status of the population.

Three tasks were accomplished in 2000 and are covered in this report:

Monitoring of permanent plots– Plots were relocated, read, and photographed in June of 1993. In 2000, using the methods of previous years, we again measured the frequency of all species, density of *P. idahonis*, and canopy cover of shrubs, forbs, and graminoids. Repeat photos were taken.

Population monitoring–The four metapopulations of *P. idahonis* are tracked by the Idaho Conservation Data Center (CDC) as eight Element Occurrences (EO), each with a corresponding record (EOR) in the CDC database containing information on population

size, habitat, and threats. These records were updated in 2000 by walk-through surveys of each known occurrence.

Collection of seed for long-term storage–As an additional conservation measure, we collected seed from seven populations for long-term storage at the Berry Botanical Garden in Portland, Oregon. These seeds represent ex-situ gene conservation and may be useful in restoration efforts in the event that any subpopulation is extirpated.

MONITORING PLOTS

Methods

Seven permanent, 90 m^2 plots containing *Phlox idahonis* were randomly established during June 1978, in meadow habitat at four areas: Eureka Meadows, Alder Creek, North Casey Meadow, and the Clearwater-Potlatch Timber Protective Association (CPTPA) Meadow (Crawford 1980; Table 1; Appendix 2).

Table 1. Site names and environmental attributes of seven permanent plots containing *Phlox idahonis* in Clearwater County, Idaho (Crawford 1980).

Plot No.	Plot Name	Grazing Intensity *	Soil Mottling	Meadow Type
1	Eureka Meadows (Upper)	Moderate; grazed on and off since 1970s.	Absent	Short
2	Eureka Meadows (Lower)		Absent	Short
3	Alder Creek		Present	Tall
4	North Casey Meadow	High; long-time location of a cow camp.	Absent	Short
5	CPTPA Meadow (Upper)	Low; grazed on and off since 1970s; no current lease.	Present	Tall
6	CPTPA Meadow (Middle)		Present	Intermediate
7	CPTPA Meadow (Lower)		Present	Tall

* Based on Crawford's 1978 assessment and a recent conversation with Property Specialist, Potlatch, Corp.

All plots are 10 x 9 m in dimension. Forty, 0.1 m^2 (2 x 5 dm) microplots are distributed at 1 m intervals along four parallel 10 m transects that are 3 m apart (hence the 9 m side; Appendix 3). The two outside lines are marked with steel stakes or fenceposts. Looking down each transect from the beginning point, microplots are placed perpendicular to it on the right side. Orientation of the transects is illustrated in Appendix 3.

In 2000, steel fence posts marked the starting points of lines 1 and 4 at plots 2, 5, 6, and 7, but were missing from plots 1, 3, and 4. Short pieces of rebar that had been used to mark the other two corners of the macroplot could not be located at any of the plots. Therefore plots 1, 3, and 4 had to be reestablished from landmarks described in the 1993 report (Appendix 3) and from photos. Reestablishing the plots was very tedious, but was accomplished with a high level of confidence. Plots were "squared" by running a hypotenuse from the beginning of line 4 to the end of line 1. Missing fenceposts were replaced with 0.75-m lengths of rebar, with steel cans placed over the top. At some plots rebar stakes used to mark the ends of the two center transects (lines 2 and 3) were left in place (Appendix 3).

Within the macroplot, vegetation and *Phlox idahonis* population data were collected in the 40, 2 x 5 dm microplots (Daubenmire 1959). In 1978, cover and frequency were recorded for all species, and *Phlox* ramets were counted in each microplot. In 1993 and 2000, species frequency and *Phlox* ramet density were again measured, but cover was estimated only for three life-form classes: shrubs, forbs, and graminoids.

In 1993, 15-year differences in life-form cover and *Phlox* ramet density within each plot were analyzed using a t-test (Zar 1974). In 2000 we tested for differences between 1993 and 2000 data in cover of shrubs, forbs, and graminoids and in *Phlox* ramet density, but used a paired t-test (Sokal and Rohlf 1969). The paired t-test is often much more powerful in detecting changes within permanent plots (Elzinga et al. 1998).

We encountered some difficulty in reconciling community data between years. It became apparent that we differed from Moseley and Crawford in our determinations of several species. When *Phlox* is in bloom, meadow grasses are still in the vegetative stage, making identification difficult. Field data sheets from 1993 helped resolve some of the problems. Assumptions we made concerning several of the discrepancies are detailed in Appendix 6. In some cases the taxa in question were ecologically equivalent and we simply combined them when tabling our results.

Results

Phlox ramet density
The most notable results of the 1993 sampling were: 1) the loss of *Phlox* from plot 4, 2) a ten-fold increase in ramet density in plot 1, and 3) a 75% decrease in plot 3 (Figure 1; Appendix 4). In 2000, *Phlox* was again not found in any of the plot 4 microplots, although a few ramets were present in the macroplot. Between 1993 and 2000, *Phlox* density increased by more than 90% in plots 1, 2, 3, and 6. However, plot 3 still had a lower density than in 1978, as did 5 and 7. Overall density has gradually increased over the three monitoring years. However, this is of limited importance, because from the standpoint of gene conservation, maintenance of all subpopulations is critical (Schultz 2000).

Only a small proportion (1-5%) of *P. idahonis* ramets bear flowers and these are the tallest stems, which grow in tall meadow vegetation. No flowering ramets were captured in any of the microplots.

Phlox frequency
Phlox ramets exhibit a highly clumped distribution, with a clump possibly representing a single genet. Because it is a rhizomatous species, the number of ramets produced from year to year (i.e., density) might be highly variable. Therefore frequency, which is a measure of dispersion, might be a better indicator of population vigor. An increase in frequency (the number of microplots containing *Phlox)* means that either a) an existing genet(s) expanded in extent, or b) new individuals were recruited from seed. In plot 1, *Phlox* increased in both frequency and density over both monitoring intervals (Figures 1 and 2).

In all but plots 2 and 5, changes in frequency (increases or decreases) have been accompanied by a corresponding change in density (Figures 1 and 2). In plot 2, density increased sharply over 1993 while frequency stayed about the same. In plot 5, density increased during the first interval, while frequency decreased; then in 2000 both were lower than they had been in 1978. In 2000, in plots 3, 4, 5, and 7, *Phlox* occupied only 60% or fewer of the microplots occupied in 1978.

Life-form cover

Between 1978 and 1993, there was a general trend toward increasing graminoid cover and decreasing forb cover (Figure 3). Increased graminoid cover was statistically significant for all plots except #3. A significant decrease in forbs occurred in all but plot 4 which saw an increase in both graminoid and forb cover.

The graminoid species with possibly the most cover is *Poa pratensis* (Kentucky bluegrass), which showed pronounced increases in frequency in plots 2, 5, 6, and 7. Much of the increase in graminoid cover may be due to increases in this disturbance-indicative grass, but our data is not sufficient to answer this question. *Carex aquatilis* (water sedge), a native, was also high in cover, and increased in frequency at plots 1 and 2.

Figures 1 and 2 – see tabular results, Appendix 4

Figure 3 – see tabular results, Appendix 4

Between 1993 and 2000, there was little change in life-form cover in all but two of the plots (7 and 5). All plots showed a decreased forb cover, but this was only significant for plot 7 (CPTPA-low). Graminoids increased slightly or remained about the same on all but plot 5 (CPTPA-upper), where they decreased significantly. No significant increase in shrub cover was observed over either of the monitoring intervals. Between 1978 and 2000, shrub cover increased from 6 to 21% in plot 7 (CPTPA-low), but the 1978 data are not available for testing. Only plots 3, 5, and 7 have more than incidental amounts of shrubs–*Symphoricarpos albus* (snowberry) in plot 3 and *Rhamnus alnifolia* (alder buckthorn) in 5 and 7 (Appendix 5).

There has been a notable decrease in *Phlox* abundance in Plot 5, CPTPA-upper, for which the cause is unknown. Both density and frequency have decreased by nearly 50% since 1978. The plot is in a *Veratrum-Heracleum* tall meadow, but a portion of it overlaps a shallow overflow channel dominated by *Carex aquatilis*. In contrast to the rest of plot 5, forbs are nearly absent in this seasonally wet microsite and *Phlox* is not found there. A similar sedge community makes up a portion of plot 3 (Alder Creek), and also lacks *Phlox*. One possibility is that this depression within plot 5 is expanding as a result of natural erosional processes and reducing the amount of *Phlox* habitat in the plot.

Composition of Phlox idahonis *meadow communities*
Native species with the highest constancies among plots are *Achillea millefolium* (yarrow), *Aster* sp., *Calamagrostis canadensis* (bluejoint reedgrass), *Carex aquatilis* (water sedge), *Ranunculus uncinatus* (little buttercup), *Solidago canadensis* (goldenrod), and *Thermopsis montana* (golden banner; Appendix 5). Of these, *Achillea millefolium*, *Thermopsis montana*, and *Ranunculus uncinatus* occur in a wide range of habitats and often benefit from disturbance. *Carex aquatilis* is an abundant and constant associate of Phlox idahonis, except in plot 3 (Alder Creek), where it is replaced by *C. arcta*. Other highly constant species (5 or more plots in 2000) include: *Poa pratensis* (Kentucky bluegrass), *Taraxacum officinale* (common dandelion), *Penstemon procerus* (small-flowered penstemon), and *Fragaria virginiana* (strawberry). Two species,*Veratrum californicum* (false hellebore) and *Heracleum lanatum* (cow parsnip), are underrepresented in the data because of their large size, but low stem density (we only counted plants rooted in the microplot). Along with *Mertensia paniculata* (panicle bluebells) they form a tall forb layer at plots 5 and 1, and are common associates of *Phlox* at other, unsampled meadows.

Changes in community composition
There are many difficulties inherent in detecting changes in community composition over time. There appears to be a great deal of variation in occurrence and abundance of many species between years (Appendix 5), but it is difficult to say how much is attributable to real change. For example, species that are sparse (the majority of them) may not be detected by the sampling each year. Most of the forbs involved can remain dormant over one or more growing seasons (Lesica and Steele 1994), so will not be present to the same extent in all years. *Camassia quamash* (camas) is particularly variable in presence and abundance. Grasses and sedges do not experience this dormancy, but are difficult to identify and separate in early phenological stages. No distinction is made on the data

sheets between seedlings and established plants, but it would not be unusual for a flush of seedlings to be present one year, of which none survive. In 2000, *Angelica arguta* (sharptooth angelica), *Ranunculus uncinatus* and *Senecio pseudaureus* (streambank groundsel) were present mostly as seedlings or small, vegetative plants.

Some of the differences between years are apparently due to difficulty in distinguishing different species, especially graminoids (e.g., the case of *Calamagrostis canadensis;* Appendix 6). Notes on the field data sheets helped us reconcile some disparities, but there are still some that cannot be explained. *Agrostis alba* (redtop bentgrass) was not detected in 2000 sampling, and *Calamagrostis canadensis* was absent from several plots in 1993. Plot 3 had a common sedge in 1993 that was apparently not referrable to *C. arcta*.

Some changes and trends in the community data appear to be real however. Moseley and Crawford found no *Potentilla recta* (sulfur cinquefoil)–a noxious weed detected at two plots. *Senecio sphaerocephalus* (mountain-marsh butterweed), while still abundant in plot 5 this year, has all but disappeared from plot 2, as has *S. triangularis* (arrow-leaf groundsel). Asters were not nearly as abundant in plots 5, 6, and 7 (CPTPA meadows) as they were in 1978. *Scirpus microcarpus* (small-fruited bulrush) appears to be increasing in plot 3. *Phleum pratense* (timothy) has increased in plots 1 and 4. *Carex deweyana* (Dewey's sedge) may have disappeared from all 5 plots in which it once occurred. Plot 4 had a common sedge species in 1978 that was barely if at all detected in subsequent monitoring.

Weeds

Poa pratensis is pervasive and high in cover in all plots. *Phleum pratense* is abundant in plot 1 (Eureka Meadows–upper) and plot 4 (North Casey Meadows). In both cases it increased during the first monitoring interval. *Potentilla recta* has appeared at plot 4 where the vegetation has been degraded by heavy grazing and *Phlox idahonis* has largely been eliminated. *Cirsium arvense* (Canada thistle) was very common in plot 7 (CPTPA Meadows), representing a large increase from 1993. This could be an indication of degradation of vegetation condition in this plot.

SEED COLLECTION

Seeds were collected from eight populations of *Phlox idahonis* on August 15 and 16, 2000. At that time more than half of the capsules had dehisced and dispersed seed. Dried inflorescences or portions thereof were collected in paper envelopes. Nearby ramets that were likely part of the same genet were combined. Multiple genets were combined when the number of seeds was very low. Seeds were sent to the Berry Botanical Garden, Portland, Oregon, for long-term storage (Table 2).

Table 2. *Phlox idahonis* seed collections sent to the Berry Botanical Garden.

Population (EOR#)	Sample No.	Approx. No. of Genets	No. of Seeds	Accession No.
CPTPA-lower (001)	1	1	55	SB2000-0788

CPTPA-upper (002)	1	1	80	SB2000-0775
	2	1	103	SB2000-0776
	3	1	31	SB2000-0777
North Casey Meadow (003)	1	1	19	SB2000-0779
Casey Meadow (004)	1	6	154	SB2000-0778
Parallel Creek (005)	1	2-6	142	SB2000-0784
	2	3	59	SB2000-0785
	3*	1	24	SB2000-0786
	4	1-5	340	SB2000-0787
Alder Creek (006)	1	3-10	247	SB2000-0774
Eureka Mdws-low (007)	1	1	41	SB2000-0780
	2	1	122	SB2000-0781
	3	1	54	SB2000-0782
	4	multiple	122	SB2000-0783
Headquarters (008)	1	multiple	189	SB2000-0789
Total			1782	

*White-flowered genet.

THREATS

Although Idaho phlox is not presently at risk of extinction, the potential for harm exists. Threats to the viability of Idaho phlox were identified in the Management Plan (Moseley and Crawford 1993) and are reiterated here along with discussion of two newly identified threats: weed invasion and land development.

Leaf rust - This is the least well understood threat. Basic information, such as the identity of the fungus and the alternate host, is still lacking. The short- and long-term effects of rust infection on population and species viability are not known. Although this may explain some of the population dynamics experienced in the last 15 years, it is probably a lower priority than other protection and management actions.

Shrub and tree invasion - This was considered a serious threat in the 1970s, and an experimental burn was done in the CPTPA meadow to study the effects of fire on Idaho phlox habitat. After the first monitoring interval this did not appear to be a problem, and the 2000 data support this conclusion. Continued monitoring will determine if this is a threat in the longer-term.

Livestock grazing - The 1993 data analysis indicated that livestock grazing is a severe threat at high intensity, but not at moderate to low intensities. Unfortunately, we have no grazing records, such as the number of animals, season of use, and use patterns, from which to quantify intensities. To our knowlege, the Headquarters site is not currently grazed, CPTPA-upper has been grazed on and off for many years, but there is no current grazing lease (Dan Jones, pers. comm.). CPTPA-lower has also

been grazed at certain times, most recently the portion east of Highway 11 which was fenced for horses and llamas; the pasture was not used last year. Eureka Meadows, Alder Creek, Parallel Creek, Casey Meadow, and Casey Meadow North are all part of the same grazing allotment. The first three sites receive only moderate grazing, but Casey Meadow is the center of cattle operations. Casey Meadow and Casey Meadow North have received heavy grazing. In 2000, Potlatch took the initiative to withdraw the meadows from grazing on a trial basis. However, cattle were present in Casey Meadow in June and the temporary fences designed to protect phlox populations had been knocked down. Moseley and Crawford (1993) considered past grazing use in Eureka Meadows to be compatible with maintenance of Idaho phlox, however patches of the meadow have been converted to weeds, and these provide centers of dispersion.

Weed invasion - The vegetation at all monitoring sites has been altered by the naturalization of Kentucky bluegrass–the most ubiquitous exotic species in Idaho phlox habitat. High amounts of timothy or Canada thistle in several cases may be signs of degradation due to past grazing or seed influx from nearby roadsides. These, or an aggressive weed such as sulfur cinquefoil, may inhibit recovery of Idaho phlox habitat in degraded microsites that occur in most populations, and have the potential to invade high quality meadow vegetation.

Land development - The Headquarters population along North Fork Reeds Creek, immediately upstream of Headquarters, is bisected by a wide, abandoned railroad bed with a road on it. Through unknown circumstances this section of railroad right-of-way has changed ownership and there may be plans for some type of development. The floodplain of Reeds Creek has already been hugely altered by the railroad bed and roads. Any earth moving activity or developments that attract concentrated use by humans or livestock would seriously threaten the remaining phlox habitat.

RECOMMENDATIONS

In consideration of the intrinsic rarity of Idaho phlox and its apparent susceptibility to changes in management or land use, we recommend the following management, monitoring, and research actions:

Continue monitoring - The plots have yielded very useful management information. We recommend that they be reread at five-year intervals. This is a long enough frequency that it is not too burdensome financially, but short enough to yield useful and timely information. The CDC is willing to continue the monitoring program and to archive the data and reports.

Metal fence posts were lost from Plots 1, 3, and 4 and had to be replaced with short lengths of rebar that will easily be displaced. Rebar should be replaced with more resilient, yet inconspicuous markers.

Idaho phlox survey - The Management Plan recommends additional surveys for Idaho phlox. In spite of intensive previous surveys, in 1993 Bob Moseley extended the limits of

the Headquarters 008 population at least one mile upstream from where it was previously known. Additional surveys over a wider area in the Headquarters area may yield similar results.

Population genetics - Recent genetic work funded by Potlatch Corporation indicates that important genetic variation occurs among, rather than within, populations (Schultz, pers. comm.). This points to the importance of protecting all populations in order to maintain the evolutionary potential of the species. Related work by Schultz and her colleagues may further clarify the implications of observed low levels of genetic diversity in this species.

Research on land ownership - Current land ownership of Idaho phlox habitat should be researched. It is possible that Burlington Northern retains ownership of some of the railroad right-of way that traverses the phlox meadows. All landowners should be included in any partnerships formed and should be advised of the conservation concerns related to Idaho phlox habitat.

Partnerships - A partnership between Potlatch, Idaho Department of Lands (IDL), and USFWS was recommended in the Management Plan. Such a partnership could provide a higher level of protection for Idaho phlox habitat and preclude problems such as land transfers that would threaten remaining populations.

A Conservation Agreement among USFWS, Potlatch, IDL, and possibly Burlington Northern could help preclude listing of Idaho phlox under the Endangered Species Act. Conservation Agreements are pre-listing conservation strategies for candidate species developed between the USFWS and the owners or agency with management responsibility. A majority of the phlox is owned by Potlatch, with a small portion of the Parallel Creek (005) population, and an unknown proportion of the Eureka Meadows population, in State ownership managed by IDL. The Management Plan can serve as the basis for the Conservation Agreement, which would contain a status review; management strategies to assure long-term persistence; and monitoring, management, and agreement implementation.

Cooperative management agreement - The Management Plan could also serve as a cooperative management agreement between Potlatch and Idaho Department of Fish and Game–CDC, and The Nature Conservancy whereby Potlatch can benefit from natural area and rare plant population management expertise of the CDC and The Nature Conservancy. Surveys, monitoring, management, and research can be coordinated through this forum.

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MANY APPENDICES NOT AVAILABLE ON WEB

Appendix 1

Line drawing of *Phlox idahonis* (from Cronquist 1959)

Appendix 2

Locations of the seven permanent *Phlox idahonis* monitoring plots

All plots are 10 m x 9 m in dimension. Forty 0.1 m^2 (20 cm x 50 cm) microplots are distributed at 1 m intervals along four, parallel 10 m transects that are 3 m apart (hence the 9 m side). Metal fence posts or short pieces of rebar mark the corners. Microplots are placed on the right side of the transect (and perpendicular to it) as you face the macroplot from the side marked by the fenceposts (posts 1 and 2). [Fence posts have been replaced by rebar at plots 1, 3, and 4.]

Sketch maps of the plot layouts follow the narrative. Coordinates are in the Potlatch GIS. Comments from 2000 fieldwork are in [ ]. A declination of 19° E was used for all year 2000 bearings.

Plot 1 - This plot is located at the upstream end of Eureka Meadows, just upstream from the confluence of the North Fork of Reeds Creek with main Reeds Creek. From the bridge over the North Fork, go approximately 60 m south on road that heads up main Reeds Creek; turn west (downstream) on smaller road that parallels Eureka Meadows for ca. 60 m (paced); go 30 m north into the meadow to what in 1978 was a live, pole-sized Douglas-fir, dead in '93, [a tall stump in 2000, coming out of an older cedar stump]. From stump go 5.15 m at 34° to stake 1 [based on photos, this should be stake 2]. The transects run at ca. 350°. [Rebar marks all corners; 35 m (paced) from plot baseline to road.]

Plot 2 - This plot is located at the downstream end of Eureka Meadows, on the south side of Reeds Creek. Go west for 1 mile from the road junction above the confluence of the North Fork and main Reed creeks (road parallels Reeds Creek on north side); a line of grand fir run perpendicular to the road on an old railroad spur; this spur also runs perpendicular to Reeds Creek; proceed to the creek along this line of trees; go downstream along the north bank for ca. 80 m (paced) to a large gray boulder in the bank; it is surrounded by thin-leaf alder and serviceberry and is actually easier to see from the meadow on the south bank of the creek; on the side of the boulder near the water there is a small brown spot where Rex chipped the lichens away in 1978, and still remains bare; go 14.9 m at 242° across the creek to the fence post, post 1. Post 2 is 9 m at 272°. [Fenceposts still present in 2000–side of plot toward creek.]

Plot 3 - From confluence of Casey and Alder creeks, near junction of two major roads, go east (toward Headquarters) for ca. 0.5 mile along the Alder Creek Road; on south side of road is a meadow in a depression caused by fill from the Alder Creek Road and an old railroad grade; from the east end of the meadows where the old railroad grade intersects the Alder Creek Road, go ca. 100 m (paced) west along the old grade; then go north, down into the meadow for ca. 9 m to 2 old cedar stumps; stake 1 is 1 m north of the western stump; stake 2 is north across the meadow toward the road near the end of a downed tree.

Plot 4 - Plot 4 is in what we call North Casey Meadow, approximately 0.5 mile upstream (N) along the road from Casey Meadow; at the southern end of the meadow is an old railroad grade that intersects the road from the west; proceed along the railroad bed for 310 m (paced) to a 25', 8" dbh (1992) grand fir on the left (W) edge of the bed just as the railroad bed emerges from an alder-dominated area and enters the meadow; stake 1 fence post is 12 m at 36°; stake 2 is 9 m at 71°.

Plots 5, 6, and 7 - These three plots are located at the CPTPA-Upper site, upstream along Reeds Creek, ca. 0.25 mile from the CPTPA office. All measurements were made from the old Deer Creek Road, which takes off east from the paved Highway 11 immediately north of the CPTPA office. An abandoned corral is located on the south side of the road (now closed to traffic).

Plot 5 (upstream plot) - From junction of old Deer Creek Road and Highway 11, go 250 m (paced) south along the highway; go 30 m east into the meadow to three stumps; from center stump [hidden under Rhaaln] go 7 m at 45° to post 1. [Rebar marking end of line 1 is ca. 5.5 m @ 60° from a western white pine (shown in photo); post 1 is 12 m at 60° from the same pine. Post 2 is slightly farther than 9 m @ 360°.]

Plot 6 (middle plot) - From junction of old Deer Creek Road and Highway 11, go 220 m (paced) south along the highway; go 20 m east into the meadow past subalpine fir sapling with tag at dbh [10" dbh; no tag found]; go 2 m at 100° [90°] to post 1.

Plot 7 (downstream plot) - From junction of old Deer Creek Road and Highway 11, go 100 m (paced) south along the highway; go 20 m east into the meadow to pole-sized grand fir with tag at dbh [not found]; go 5.5 m at 54° to post 1. [Post 1 is 3 m @ 114° from a large cedar stump at the edge of the trees. Post 2 is only 7 m @ 150° from post 1.]

Appendix 3

Layout of the seven permanent *Phlox idahonis* monitoring plots

Appendix 4

Tabular results of *Phlox idahonis* monitoring–1978, 1993, and 2000

Table 1. Density of *Phlox idahonis* ramets in monitoring plots in each of three monitoring years (number of ramets in 40, 2 x 5 dm microplots, expressed as ramets/sq m).

Plot	Site	Density (ramets/sq m)		
		1978	1993	2000
1	Eureka - upper	2.2	20.2	34.5
2	Eureka - lower	16.0	13.8	26.5
3	Alder Creek	8.0	1.8	5.2
4	No. Casey Mdw	1.5	0	0
5	CPTPA Mdw - upper	35.2	42.5	21.5
6	CPTPA Mdw - middle	22.5	18.5	43.0
7*	CPTPA Mdw - lower	9.2	4.8	6.0

*Burned in Oct. 1977

Table 2. Frequency of *Phlox idahonis* in monitoring plots in each of three monitoring years (number of 2 x 5 dm plots occupied expressed as a percent; total = 40).

Plot	Site	Frequency (%)		
		1978	1993	2000
1	Eureka - upper	25	48	60
2	Eureka - lower	58	55	52
3	Alder Creek	43	8	18
4	No. Casey Mdw	18	0	0
5	CPTPA Mdw -upper	98	70	45
6	CPTPA Mdw - middle	65	60	78
7*	CPTPA Mdw - lower	50	25	30

*Burned in Oct. 1977

Table 3. Changes in plant life-form cover between 1978 and 2000 in *Phlox idahonis* monitoring plots. Values are % cover (+ = .02%).

Plot	Site	Cover (%)								
		Shrubs			Graminoids			Forbs		
		1978	1993	2000	1978	1993	2000	1978	1993	2000
1	Eureka - upper	0	0	+	78	86	94	99	55	50
2	Eureka - lower	0	0	0	34	52	77	100	84	75
3	Alder Creek	4	8	1	55	61	71	70	40	29
4	N. Casey Mdw	0	0	0	68	78	92	61	86	66
5	CPTPA-upper	6	4	10	21	92	72	100	79	60
6	CPTPA-mid	3	1	+	18	56	52	100	87	76
7*	CPTPA-lower	6	9	21	38	71	81	99	86	56

*Burned in Oct. 1977

Appendix 5

Frequencies for vascular plant species in seven *Phlox idahonis* monitoring plots in 1978, 1993, and 2000

Appendix 6

Notes on taxonomic determinations

Notes on taxonomic determinations:

In tabling the frequency data for all species in the Idaho phlox monitoring plots (Appendix 5) it became obvious that some of the differences between years were the result of difficulty in identifying or distinguishing certain species. Some of these problems were resolved by examining the 1993 field data sheets or by lumping similar species that are ecologically equivalent. When we combined two taxa we give Crawford's name first followed by the name given in 2000. The following notes explain the assumptions we made in combining data from 3 monitoring years in the Appendix 5 table. They should also help investigators anticipate problems when the plots are read in the future.

- Based on its frequency in the plots, we decided that Crawford's "*Agrostis* sp.*"* was probably *Calamagrostis canadensis* and we combined the two in Appendix 5. Notes on 1993 data forms indicating confusion as to whether this plant was an *Agrostis* or a *Calamagrostis* provide further evidence. (When Idaho phlox is in bloom the grass is still vegetative). This assumption makes the data more consistent across years.

  In plots 1 and 2, the absence of any *Agrostis/Calamagrostis* in 1993, while prevalent in 1978 and 2000, is troubling. In plot 1, *Calamagrostis*, *Agropyron* sp., and *Phleum* sp. are mixed together and difficult to sort out. Because *Phleum* is very abundant the other two may have been overlooked in the mix. We felt fairly confident we could at least tell *Phleum* from the other two, and *Phleum* was beginning to head-out which helped.

- *Poa trivialis* is a rarely collected species that was common in the plots in 2000, but not recorded previously. It is a very ethereal grass like many *Agrostis* spp. and has very tiny spikelets with only two florets each. At first we called it an *Agrostis*. On the 1993 data sheets there was a species referred to as "Agrostoid Poa" which they eventually tabled as simply *Poa* sp. (except in plots 2 and 3 where they apparently tabled it under "*Agrostis* spp." In Appendix 5 we assumed these both to be *P. trivialis*, making the data more consistent across years. (It is possible that "Poa sp." of plots 4, 5, 6 and 7 is also *Poa trivialis*.)

- Group VIII Carices: *Carex pachystachya*, *C. multicostata*, or both occur in several plots. We were uncertain which of these our material was attributable to; and as they are ecological equivalents (small, caespitose, incidental sedges) we lumped them in Appendix 5. Crawford (1980) found both *C. pachystachya* and *C. multicostata* in plots 1 and 3.

- Asters: these are also vegetative when Idaho phlox is blooming. *Aster modestus* is abundant in the phlox meadows and vegetatively can even be confused with Idaho phlox at a glance because of its leaf shape and vestiture (however it has alternate leaves). However, *A. modestus* was rarely encountered in the plots in 2000. Primarily what we found was a short, mostly-glabrous, nonglandular aster with lines of hairs from the leaf bases, which is indicative of *A. hesperius*, *A. occidentalis*, and *A. foliaceus*. We made some scanty collections in August 2000 when we returned for seed collection. *Aster hesperius* was collected from plot 2 (Eureka Meadows) but the *Aster* collected from plot 7 keyed to *A. occidentalis*. Crawford had not recorded *A. occidentalis* in any of the plots. In Appendix 5 we combined the non-glandular asters.

- We had difficulty in determining whether the common *Galium* species was *triflorum* or *aparine*. It seemed too weedy for *G. triflorum*. However, we are certain ours was not *Galium boreale*, the species commonly encountered by Crawford. Lichthardt later collected *G. asperrimum* from the vicinity of plot 7.

- What we called *Senecio serra* in plots 4 and 5 and "tall Senecio" in plot 1 was probably *S. sphaerocephalus*.

- *Angelica arguta*, *Ranunculus uncinatus,* and *Senecio pseudaureus* were present mostly as seedlings or small, vegetative plants.

- *Veratrum californica* and *Heracleum lanatum* are very characteristic of Idaho phlox habitat, but may be underrepresented in the data because of their low stem density. Possibly their cover should be recorded separately from the other forbs.

Appendix 7

Occurrence records from the Conservation Data Center for *Phlox idahonis*

Appendix 8

Distribution of *Phlox idahonis* (as recorded in year-2000 surveys)

Appendix 9

Slides of *Phlox idahonis* monitoring plots