Ecological Studies of the Rare Plant
Physaria bellii (Bell's Twinpod)
On City of Boulder Open Space Lands

Alan Carpenter

ECOLOGICAL STUDIES OF THE RARE PLANT

<u>PHYSARIA BELLII</u> (BELL'S TWINPOD)

ON CITY OF BOULDER OPEN SPACE LANDS

1. PERMANENT MONITORING MACROPLOTS

2. EXPERIMENTAL STUDY OF THE EFFECTS OF <u>ACOSTA DIFFUSA</u> (DIFFUSE KNAPWEED) ON <u>P</u>. <u>BELLII</u>

Report to the

City of Boulder Open Space and Mountain Parks

Research / Monitoring Program

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Prepared by

Alan Carpenter
The Nature Conservancy
1244 Pine St.
Boulder, CO 80302
(303) 444-2985 x 105

Background Information About <u>Physaria bellii</u>

<u>Physaria</u> <u>bellii</u> (Bell's twinpod) is a rare, herbaceous, perennial plant species which is a member of the mustard family (Brassicaceae). Its global distribution is limited to barren outcrops of Niobrara Formation, characterized by limey shales, which occurs along the eastern edge of the foothills of the northern Front Range in Jefferson, Boulder, and Larimer counties. This species was classified as Category 2 by the U. S. Fish & Wildlife Service, meaning that it was a candidate for formal listing as endangered or threatened, but more information about the species was required to make a final determination. However, this classification was eliminated recently for all taxa by the U. S. Fish & Wildlife Service.

Significant populations of P. <u>bellii</u> are found on lands owned and managed by City of Boulder Open Space. According to the Colorado Natural Heritage Program, there are twenty-five known occurrences of this species in the world, two of which are found on Boulder Open Space property (Anonymous, 1994). The only occurrences of P. <u>bellii</u> which are formally protected are those owned by City of Boulder Open Space and a population at Rabbit Mountain, which is protected by Boulder County Parks.

Very little is known about the biology and ecology of this species. Apparently, there are no published accounts of the plant except for the paper wherein the species was named. It is likely that this plant is rare because it is confined to specific geological strata which occur over a limited area. It is unlikely that this species was ever common or much more widespread than it is today.

1. PERMANENT MONITORING MACROPLOTS

I. Introduction

Schemske et al. (1994) advocate that the conservation of rare plant species will be best served if research and monitoring are directed towards answering three questions: 1) Given present conditions, is population size increasing, decreasing or stable? 2) What are the life history stages that have the greatest effect on population growth and persistence? 3) What are the biological causes of variation in life history stages that have a major demographic impact? This monitoring project addresses the first of these questions and provides insights into the second question.

During May and June, 1995, a monitoring program was initiated on lands owned and managed by the City of Boulder Open Space Department. The objective of the monitoring program is to determine the trend of numbers of P. bellii growing on CBOS lands over time - is it increasing, decreasing or fluctuating about some mean value? This report presents data from the first two years of monitoring.

II. Methods

Permanent monitoring macroplots were established in sites that represent the range of variation in P. bellii habitat within the City of Boulder Open Space land. Criteria for selecting sites included management history, anticipated future management, proximity to sources of weeds, proximity to recreational use (such as hanggliding), slope, aspect and soil characteristics. Thus, during May - June, 1995, ten sites were selected, in conjunction with staff from City of Boulder Open Space, for permanent monitoring of Physaria bellii (Figure 1). Within areas occupied by P. bellii, the exact locations of the macroplots were subjectively chosen to maximize the internal homogeneity of each plot. Descriptions of the macroplots are contained in Table 1. All permanent macroplots were 10 m x 10 m in size, with the corners marked with lengths of rebar driven into the soil, with the top of each rebar surrounded by a small pile of rocks to facilitate relocating the macroplots. In addition, the locations of all macroplots were recorded using a Geographical Positioning System and are on file at the City of Boulder Open Space operations office (S. Haire, pers. comm.).

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All P. bellii plants in each monitoring macroplot were counted between May 9 and June 2, 1995. This was accomplished by temporarily subdividing each plot into ten 1 m wide x 10 m long strips. These strips were further subdivided into ten 1 m x 1 m temporary microplots in which all P. bellii plants were counted by reproductive, juvenile and seedling size classes. Reproductive plants were defined as those that possessed either flower or fruit structures produced during the 1995 growing season. Juveniles were defined as established individuals that lacked flower or fruit structures produced during 1995. Seedlings were defined as individuals that were born during 1995. Reproductive plants were easy to distinguish from the other two size classes. Occasionally, large seedlings may have been erroneously classified as juveniles; however, in the vast majority of cases, the presence or absence of cotyledons clearly distinguished seedlings from juveniles, respectively.

The numbers of P. bellii plants encountered in the macroplots in 1995 was much greater that I initially anticipated, and required much greater time to census than I expected. Therefore, in 1996, I decided to sample the macroplots rather than census them as I had done in 1995. Within each 1 m x 10 m strip in each macroplot, I randomly selected one 0.25 m x 10 m strip for sampling. Thus, I sampled 25% of each permanent macroplot. The location of each strip was recorded and a nail was driven into the soil at each corner of each strip so it can be resampled in future years as a permanent sampling unit. The sampling design is illustrated for Macroplot Number 1 in Figure 2. Within the sample strips, data were collected from May 14 - May 30, 1996, in the same manner as they were in 1995.

The field data were entered in spread sheets that were designed for this monitoring project. Totals for the number of reproductive, juvenile and seedling individuals, as well as densities, were calculated using standard spread sheet commands. The raw data for the ten macroplots for 1995 and 1996, as well as a generic blank data sheet, are included in Appendix 1.

Changes in densities of P. bellii from 1995 to 1996 were analyzed using using paired t-tests. It is important to note that this is a conservative test because the data for 1995 were censuses of entire 1 m x 10 m strips, while the data for 1996 were derived from samples of each 1 m x 10 m strips. The distribution

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P. bellii plants in each strip that was sampled in 1995 is assumed
to be uniform throughout the entire strip for the purpose of
comparing the 1995 and the 1996 data.

III. Results

A. 1995 Data

Because the 1995 data are censuses and the 1996 data
represent samples of the macroplots, the data for both 1995 and
1996 are presented as densities to facilitate comparisons between
years. Overall, there were 4.2 reproductives, 3.4 juveniles and
14.3 seedlings on average per square meter of macroplot surface
for a total of 21.9 P. belli plants per m^2 (Table 2). In all but
two macroplots, seedlings outnumbered (often substantially) the
reproductives and juveniles. Overall, about two-thirds of the P.
bellii plants encountered were seedlings. Reproductives were
slightly more abundant that juveniles, with reproductives
comprising 19.2% and juveniles comprising 15.6% of the total
number of P. bellii individuals.

There were substantial differences in the structure of the P.
bellii populations among the ten macroplots. The density of
reproductive individuals in the macroplots ranged from 1.3 plants
m^2 to 10.1 plants m^2; expressed in relative terms, the
reproductives contributed between 4.4-52.8% of the individuals in
the macroplots. The range in densities of juveniles among the
macroplots was about the same as for reproductives both in
absolute (0.5-9.2 plants m^2) and relative terms (1.6-51.0%). The
variation in density of seedlings was greater than that for
reproductives or juveniles, ranging from 2.0 to 31.4 plants m^2
across the macroplots. In relative terms, seedlings comprised
between 17.3-91.2% of the total number of P. bellii individuals in
the macroplots.

B. 1996 Data

Overall there were 4.6 reproductives, 5.1 juveniles and 7.2
seedlings on average per square meter of macroplot surface (Table
3). Thus, seedlings comprised the most abundant size class with
42.6% of all plants, followed by juveniles (30.2%) and
reproductives (27.2%).

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As was observed in 1995, there was considerable variation in the percentages of P. bellii individuals in the three size classes among the ten macroplots. The density of reproductive individuals in the macroplots ranged from 1.4 to 12.9 plants m^2; expressed in relative terms, the reproductives contributed between 10.3-53.5% of the total number of individuals in the macroplots. The range in density of juveniles among the macroplots was about the same as for reproductives both in absolute (2.2-11.1 plants m^2) and relative terms (17.2-47.2%). The variation in density of seedlings was greater than that for reproductives or juveniles, ranging from 0.6 to 18.5 plants m^2 across the macroplots. In relative terms, seedlings comprised between 7.0-70.9% of the total number of P. bellii individuals in the macroplots.

C. Comparison of 1995 and 1996 density data

Density data for 1995 and 1996 are presented in Table 4. The average values are the same as those found in Tables 2 and 3, and are repeated here to facilitate comparisons between years and to provide estimates of variability about the mean density values. The results of paired t-tests for 1995 and 1996 density data are presented in Table 5. Overall, the density of juvenile plants increased significantly from 3.4 plants m^2 in 1995 to 5.1 plants m^2 in 1996. Six of the ten macroplots exhibited increases and four exhibited declines, although there was only one significant decrease in juvenile plant density from 1995 to 1996. For seedlings, there was a significant decrease in density from 1995 to 1996. Seven of the macroplots showed declines in density of seedlings, while three showed increases, one of which was significant. Reproductives in four of the macroplots showed significant increases, while two had significant decreases; overall there was no significant change in density of reproductives between 1995 and 1996.

IV. Discussion

With only two years of data collection, it is not yet possible to determine if P. bellii is increasing, declining or fluctuating about a mean value on City of Boulder Open Space lands. When all size classes are combined, there was a statistically significant decline in P. bellii density from 21.9 plants m^2 in 1995 to 16.9 plants m^2 in 1996 which reflects a 50% decline in seedling density from 1995 to 1996 (Table 4). The decline in P. bellii seedling density from 1995 to 1996 was a

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consequence of the large number of seedlings that recruited during the exceptionally wet spring of 1995 and the subsequent drop in seedling recruitment in 1996, with its very dry April. Observations at the Neva Road experimental study plots near Macroplot Number 10 indicate that seedlings emerge during March and April following large precipitation events, especially heavy snows (A. Carpenter, unpublished data). Therefore, the decline in overall P. bellii density from 1995 to 1996 was due to a reduction in seedling density which I attribute to changes in weather and not to any defect in land management.

Changes in weather probably affected seedling density in Macroplot Number 10, although in a counterintuitive way. The density of seedlings was significantly greater in 1996 than in 1995 in this macroplot. Surface runoff collects in this macroplot; the large amount of runoff that occrrred in 1995 may have flooded or eroded some seedlings, while the smaller amount of runoff in 1996 may have benefited seedlings. I do not know why the same pattern was not observed in Macroplot Number 1, which is also a water run-in area.

The large pulse of seedlings observed in 1995 led to the significant increase in juveniles observed in 1996 (Table 5). Seedlings that survive to the following year are, by definition, classified as juveniles unless they reproduce. I have not observed such precocious reproduction in P. bellii at the Neva Road site where I have tagged and followed individual P. bellii plants. There was a non-significant increase in the density of reproductives from 1995 to 1996. The wet conditions in 1995 may have led to an increase in the number of juveniles that grew, survived and became reproductive in 1996; this may have been offset by higher mortality of reproductives in 1995. High reproductive output in one year may reduce survival the following year.

One might expect that the high density of juveniles from 1996 will lead to an increase in the density of reproductives in 1997. P. bellii plants are relatively short-lived perennials that may be able to reproduce by the third year of life under favorable field conditions (A. Carpenter, unpublished data).

A relatively rapid turnover in plants, combined with large variations in weather from one year to the next, could help account for the large variation in densities and proportions of

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seedlings, juveniles and reproductives observed among the macroplots. In addition, environmental conditions are different among the ten macroplots. Stochastic events such as summer thundershowers that fall upon some macroplots but not on others also contribute to variation in P. bellii densities within and among years. The large variation in densities and population structure among the macroplots suggests that monitoring one or two macroplots would not provide an accurate picture of population changes of P. bellii across all City of Boulder Open Space lands.

Shaffer (1981) proposed four types of stochasticity (or random variation) that could affect rare plant populations. They were natural catastrophes, environmental stochasticity, demographic stochasticity and genetic stochasticity. Of these, natural catastrophes, such as disease outbreaks or drought, appear to be the greatest threat by far to populations of rare plants (Menges 1991). Shaffer (1987) estimated that minimum viable population sizes needed to buffer the effects of natural catastrophes range from one thousand to one million individuals. Based on the observed densities in the macroplots and the extent of habitat occupied by the plants, I believe that hundreds of thousands of P. bellii plants grow on City of Boulder Open Space lands. Therefore, it appears that P. bellii is sufficiently abundant at the present time to withstand a natural catastrophe on City of Boulder Open Space lands.

One of the goals of the City of Boulder Open Space program is to maintain viable populations of rare species, such as P. bellii. Achieving this goal involves identifying and implementing management activities which are likely to promote the species, but this is difficult because so little is known about the biology of P. bellii. In order for management to be successful with respect to this species, the consequences of on-going management activities need to be assessed periodically. This can be accomplished by collecting and analyzing data from this monitoring program. If data suggest that the plant species is declining, additional studies can be initiated to determine the probable causes of decline so management activities can be adjusted accordingly.

V. Recommendations

This report covers only the first two years of a long-term project, the value of which will increase substantially as years

go by. I have four suggestions for future work using the permanent monitoring macroplots.

1)   Continue to collect data for each plot during May each year. Collecting the field data required six days of my time in 1996. This was considerably less than in 1995 when all macroplots were censused. An efficient crew consists of an experienced crew boss and two or three volunteers. The work is enjoyable and is appealing to volunteers. I suggest investing in a hand-held computer to enter field data. I have used a Hewlett-Packard Palmtop computer that is very effective and costs only about $800 including software and peripherals. Data can be downloaded to a computer at the office at the end of each day or two, thus eliminating the tedious and time-consuming job transcribing of hand-written field data to the computer. I have worked out the data analysis approach so this does not have to be re-invented each year. If annual monitoring of all macroplots would require greater effort than can be sustained, I recommend selecting, at a minimum, one of macroplots 1-4, one of macroplots 5-6 and one of macroplots 7-10 for annual monitoring. The rest of the macroplots could be monitored less frequently, perhaps every third year.

2) Changes in numbers of P. bellii may be related to changes in vegetation cover of the macroplots. This species tends to grow on areas of bare soil, suggesting that it may not tolerate competition from other plants. If this is true, increases in vegetation cover of other species may lead to declines in densities of P. bellii. It may be helpful to collect vegetation cover data in the macroplots every few years to help rationalize subsequent increases or decreases in P. bellii densities.

3)   Fire is a natural part of the grasslands which comprise the habitat of P. bellii on City of Boulder Open Space lands. There is nothing known about the effects of fire on Physaria species (Hessl and Spackman, 1995), except for a casual observation that P. bellii plants located near macroplot 3 appeared to survive the Old Stage fire in 1990 (A. Carpenter, personal observations). If prescribed burning is considered for these lands, I recommend that the burning be conducted such that some of the macroplots are burned while others are left unburned. Comparison of the burned and unburned macroplots would greatly increase our understanding of fire on P. bellii.

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4) A subset of the macroplots could be used to study the demography of P. bellii. Such a study would entail tagging individual plants and following the fates of these plants from year-to-year. This study addresses question 2 of Schemske et al. (1994). It would also generate data that could be used with existing computer simulation models (e.g., Menges 1991) to answer the questions - What is the probability that a P. bellii population would survive for a particular period of time? What minimum population is necessary for a population of P. bellii to persist for 100 years with a probability of 90%? What populations are increasing or decreasing in size? Demographic data may be able to predict trends in population numbers in less time than the approach employed in the current monitoring, although it requires considerably more effort (Pavlik, 1996).

5) The noxious weed, diffuse knapweed (Acosta diffusa), poses a major threat to P. bellii populations on City of Boulder Open Space lands. I suggest pulling bolted knapweeds from the permanent monitoring macroplots at least once annually and counting the number of weeds pulled, which would serve as an index of knapweed abundance in the macroplots. Alternatively, the pulled weeds could be dried and weighed for a more precise estimate of weed abundance.

6) Develop a specific management objective for P. bellii. For example, an objective might be to maintain populations of P. bellii that do not decline in aggregate density from 1996 to 2006 on City of Boulder Open Space lands. Based on the management objective, develop a monitoring objective. This might be to detect an annual 20% change in density of reproductives and juveniles and 50% change in density of seedlings with 90% confidence, accepting a false-change error rate of 10%, for City of Boulder Open Space lands from 1996 to 2006. Then develop a contingency statement of actions that would ensue if the management or monitoring objectives are not met. For example, this might be to review the management objective and determine if it is reasonable and to make any necessary adjustments.

VI. Acknowledgments

Allison Roll. David Oline performed the statistical analyses. I also thank BCOS staff members Lynn Riedel and Nancy Neupert for their help and encouragement. Jane Bunin provided useful comments on a previous draft of the report. Without your collective help, this study would not have been accomplished.

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Table 1. Descriptions of permanent 10 m x 10 m macroplots established in May-June, 1995, for monitoring of _Physaria bellii_ on City of Boulder Open Space lands.

Macro-Plot Number	Slope Aspect	Slope	Surface Character	Disturbance Factors
1	North-east	Gentle	Vegetated soil	Former prairie dog colony; water run-in area; some water erosion
2	East	Moderate	Vegetated soil	Major water erosion
3	None	None	Very sparsely vegetated black shale	Some water erosion
4	North-west	Steep	Vegetated soil	Major water erosion
5	North	Gentle	Very sparsely vegetated black shaly soil	Old foot and horse trail; some water erosion; heavily dis-disturbed and weedy
6	North	Moder.	Vegetated soil	Old foot and horse trail; moderate water erosion
7	East	Gentle	Very sparsely vegetated black shale	Moderate water erosion
8	North	Moder.	Vegetated soil	Some water erosion
9	North	Gentle	Vegetated granular black	Deposition of eroded shale;
10	South	Gentle	Vegetated soil	Water run-in area; former prairie dog colony adj. to macroplot

Table 2. Density (and percentage) of <u>Physaria</u> <u>bellii</u> individuals (plants m^2) according to reproductive, juvenile and seedling size classes in ten permanent 10 m x 10 m macroplots during May-June, 1995; macroplots are located on City of Boulder Open Space lands. Percentages in some rows do not add to 100% due to rounding errors.

Macroplot Number	Density of Reproductives	Density of Juveniles	Density of Seedlings	Overall Density
1	3.3 (15.8%)	4.6 (22.0%)	12.9 (62.2%)	20.8
2	2.0 (6.5%)	0.5 (1.6%)	28.0 (91.9%)	30.5
3	1.5 (4.4%)	1.5 (4.3%)	31.4 (91.2%)	34.4
4	3.7 (27.8%)	1.9 (14.2%)	7.8 (58.0%)	13.4
5	1.8 (13.8%)	1.0 (8.0%)	10.0 (78.3%)	12.8
6	1.4 (8.9%)	0.9 (5.9%)	13.2 (85.2%)	15.4
7	10.1 (26.0%)	7.4 (18.8%)	21.6 (55.2%)	39.1
8	10.1 (30.6%)	9.2 (27.9%)	13.7 (41.5%)	33.0
9	6.9 (52.8%)	3.9 (29.9%)	2.3 (17.3%)	13.1
10	1.3 (19.3%)	3.5 (51.0%)	2.0 (29.7%)	6.8
Average	4.2 (19.2%)	3.4 (15.6%)	14.3 (65.1%)	21.9

Table 3. Density (and percentage) of <u>Physaria</u> <u>bellii</u> individuals (plants m^2) according to reproductive, juvenile and seedling size classes in ten permanent 10 m x 10 m macroplots during May, 1996; macroplots are located on City of Boulder Open Space lands. Percentages in some rows do not add to 100% due to rounding errors.

Macroplot Number	Density of Reproductives	Density of Juveniles	Density of Seedlings	Overall Density
1	1.4 (10.3%)	4.8 (35.3%)	7.3 (53.7%)	13.6
2	2.1 (32.8%)	2.2 (34.4%)	2.2 (34.8%)	6.4
3	3.3 (22.6%)	5.8 (39.7%)	5.5 (37.7%)	14.6
4	5.2 (22.1%)	11.1 (47.2%)	7.2 (30.6%)	23.5
5	1.9 (10.6%)	3.3 (18.4%)	12.7 (70.9%)	17.9
6	2.0 (15.9%)	5.3 (42.1%)	5.4 (42.9%)	12.6
7	10.2 (42.1%)	5.7 (23.6%)	8.3 (34.3%)	24.2
8	12.9 (34.0%)	6.5 (17.2%)	18.5 (48.8%)	37.9
9	4.6 (53.5%)	3.4 (39.5%)	0.6 (7.0%)	8.6
10	2.0 (20.2%)	3.3 (33.3%)	4.6 (46.4%)	9.9
Average	4.6 (27.2%)	5.1 (30.2%)	7.2 (42.6%)	16.9

Table 4. Average densities (plants m^2) and 1 SEM of P. bellii individuals according to reproductive, juvenile and seedling size classes in ten permanent macroplots for 1995 and 1996; macroplots are located on City of Boulder Open Space lands.

Macropl Number	*********** Reproductives **************				************* Juveniles ****************				***************Seedlings **************				******** For All Size Classes ***********			
	1995 Average	I SEM	1996 Average	I SEM	1995 Average	I SEM	1996 Average	I SEM	1995 Average	I SEM	1996 Average	I SEM	1995 Average	I SEM	1996 Average	I SEM
1	3.3	1.0	1.4	0.4	4.6	1.6	4.8	1.8	12.9	5.6	7.3	3.0	20.8	8.2	13.6	5.2
2	2.0	0.4	2.1	0.8	0.5	0.1	2.2	0.7	28.0	2.5	2.2	0.4	30.5	3.0	6.4	1.9
3	1.5	0.3	3.3	0.9	1.5	0.4	5.8	1.8	31.4	14.5	5.5	2.3	34.5	15.2	14.6	5.0
4	3.7	0.6	5.2	0.9	1.9	0.4	11.1	1.5	7.8	1.1	7.2	1.7	13.4	2.1	23.5	4.1
5	1.8	0.2	1.9	0.3	1.0	0.3	3.3	0.7	10.0	1.8	12.7	2.5	12.8	2.3	17.9	3.4
6	1.4	0.2	2.0	0.3	0.9	0.1	5.3	0.8	13.2	1.7	5.4	0.7	15.5	2.1	12.6	1.8
7	10.1	0.9	10.2	1.7	7.4	2.3	5.7	1.1	21.6	3.5	8.3	1.2	39.1	6.7	24.2	4.0
8	10.1	0.7	12.9	1.0	9.2	0.9	6.5	0.6	13.7	1.6	18.5	3.0	33.0	3.1	37.9	4.6
9	6.9	0.9	4.6	0.7	3.9	0.6	3.4	0.8	2.3	0.4	0.6	0.3	13.1	1.9	8.6	1.8
10	1.3	0.3	2.0	0.5	3.5	0.5	3.3	0.7	2.0	0.4	4.6	1.3	6.8	1.2	9.9	2.4
Overall	4.2	0.5	4.6	0.7	3.4	0.7	5.1	1.1	14.3	3.3	7.2	1.6	21.9	4.6	16.9	3.4

Table 5. Results of paired t-tests comparing the average densities of P. bellii individuals according to reproductive, juvenile and seedling size classes in ten permanent macroplots for 1995 and 1996; macroplots are located on City of Boulder Open Space lands. NS means not significant, assuming p> 0.05.

| Macroplot Number | ***** Reproductives ***** | | | ******* Juveniles ******** | | | ****** Seedlings ****** | | | ** For All Size Classes ** | | |
	1995 Average	1996 Average	P-value	1995 Average	1996 Average	P- value	1995 Average	1996 Average	P-value	1995 Average	1996 Average	P-value
1	3.3	1.4	<.05	4.6	4.8	NS	12.9	7.3	NS	20.8	13.6	NS
2	2.0	2.1	NS	0.5	2.2	<.05	28.0	2.2	<.0001	30.5	6.4	<.0001
3	1.5	3.3	<.05	1.5	5.8	<.05	31.4	5.5	NS	34.5	14.6	NS
4	3.7	5.2	NS	1.9	11.1	<.0001	7.8	7.2	NS	13.4	23.5	<.01
5	1.8	1.9	NS	1.0	3.3	<.05	10.0	12.7	NS	12.8	17.9	NS
6	1.4	2.0	<.05	0.9	5.3	<.01	13.2	5.4	<.01	15.5	12.6	NS
7	10.1	10.2	NS	7.4	5.7	NS	21.6	8.3	<.01	39.1	24.2	<.01
8	10.1	12.9	<.05	9.2	6.5	<.05	13.7	18.5	NS	33.0	37.9	NS
9	6.9	4.6	<.01	3.9	3.4	NS	2.3	0.6	<.01	13.1	8.6	<.001
10	1.3	2.0	<.05	3.5	3.3	NS	2.0	4.6	<.05	6.8	9.9	NS
Overall	4.2	4.6	>0.2	3.4	5.1	<.001	14.3	7.2	<.001	21.9	16.9	<.01

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Figure 1. Approximate locations of ten permanent 10 m x 10 m macroplots established in May-June, 1995, on City of Boulder Open Space lands to monitor populations of _Physaria bellii_.

↑ North ←------- One Mile -------→

(From the "Boulder" 7 1/2 minute USGS quad)

Figure 2. Illustration of macroplot sampling design using
Macroplot Number 1. In 1995, all strips were censused for
Physaria bellii plants. In 1996, the top 0.25 meters of each
strip was sampled for P. bellii. The bottom of each sampled
strip is indicated by a dashed line.

Appendix 1. Copies of raw data sheets, as entered on spread sheets, for monitoring of _Physaria bellii_ on ten permanent 10 m x 10 m macroplots during May-June, 1995, and May, 1996, and located on City of Boulder Open Space lands. Copies of blank data sheets for the ten permanent macroplots.

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Physaria belli███████ twinpod) - Monitoring Data
c:\atc\data\c███████em95a.xls   (formerly c:\atc\123\phbebo.wk3)

Observer(s) Alan Carpenter / Dickson Pratt

Date: May 9, 1995

Microplot Number   1

Location of macroplot : From pedestrian gate on west side of tunnel under US Highway 36 on Foothills Trail, walk 338 m at a bearing of 235 degrees (southwest) to reach the southwest corner
of macroplot 1. This macroplot is about 50m north of CBOS property line. Macroplot slopes gently to the northeast (34 degrees). Former prairie dog colony at macroplot.
Macroplot 1 established May 9, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner and running to the southwest corner).

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

··Distance along strip in meters ···

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	5	10	19	4	3	9	11	13	31	1.1	1.3	3.1
2	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	0	9	4	14	18	0	1	0	9	18	29	0.9	1.8	2.9
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	39	8	3	7	2	1	4	1	3	13	0	1	1	16	14	64	1.6	1.4	6.4
4	1	0	0	0	0	0	0	0	0	12	3	11	11	13	21	9	5	9	0	2	0	2	0	9	8	20	46	4	1	5	47	44	101	4.7	4.4	10
5	0	0	0	1	0	1	3	13	28	28	38	174	18	32	172	10	18	17	0	2	1	0	5	5	3	8	73	0	0	0	63	116	471	6.3	12	47
6	4	0	5	1	4	2	12	16	37	25	50	209	42	34	108	7	21	59	13	14	21	0	1	1	0	0	0	0	1	0	104	141	442	10	14	44
7	0	1	0	0	0	16	4	2	2	8	21	46	14	36	43	13	21	18	4	5	6	0	1	0	0	1	4	0	0	0	43	88	135	4.3	8.8	14
8	1	0	2	1	5	1	3	0	1	2	2	2	6	5	5	3	3	2	0	0	0	0	1	0	2	1	0	1	0	0	19	17	13	1.9	1.7	1.3
9	1	0	1	1	2	0	8	2	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	13	5	3	1.3	0.5	0.3
10	1	0	0	1	0	0	1	0	0	0	0	1	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	3	0.4	0.1	0.3

Grand total for macroplot: 329   457   1292   3.3   4.6   13

Physaria bellii (twinpod) - Monitoring Data   Observer(s) Alan Carpenter / Dickson Pratt
c:\atc\data\c...m95a.xls   (formerly c:\atc\123\phbebo.wk3)

Date: May 9, 1995

Microplot Number   2
Location of macroplot : From southwest corner of macroplot 1, walk 88 m at a bearing of 260 degrees (west) to reach the northwest corner of macroplot 2. Macroplot 2 is located about 10 m north
of CBOS boundary fence. Macroplot 2 is moderately sloping toward the east (85 degrees) and is located on the side of a small ravine.
Macroplot 2 established May 9, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner and running to the southwest corner across the slope.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

· · · Distance along strip in meters · · ·

Strip Number	0-1 Rep	0-1 Juv	0-1 See	1-2 Rep	1-2 Juv	1-2 See	2-3 Rep	2-3 Juv	2-3 See	3-4 Rep	3-4 Juv	3-4 See	4-5 Rep	4-5 Juv	4-5 See	5-6 Rep	5-6 Juv	5-6 See	6-7 Rep	6-7 Juv	6-7 See	7-8 Rep	7-8 Juv	7-8 See	8-9 Rep	8-9 Juv	8-9 See	9-10 Rep	9-10 Juv	9-10 See	Total Rep	Total Juv	Total See	Dens Rep	Dens Juv	Dens See
1	2	1	2	2	2	55	2	1	0	1	0	0	0	0	0	0	0	5	1	1	37	0	0	67	2	0	120	2	0	100	12	5	386	1.2	0.5	38.6
2	5	0	8	7	1	63	0	0	2	3	0	8	0	0	0	0	0	1	0	0	10	1	0	17	3	1	71	1	1	65	20	3	245	2	0.3	24.5
3	3	0	3	3	1	9	7	1	6	7	1	36	2	1	14	0	0	0	0	0	8	4	0	31	3	1	71	2	1	46	31	6	224	3.1	0.6	22.4
4	5	1	27	10	4	62	7	2	9	10	1	68	8	1	43	0	0	1	0	0	3	2	0	46	2	0	25	0	0	59	42	9	343	4.2	0.9	34.3
5	5	0	27	5	0	81	11	0	89	6	1	30	3	0	43	3	1	27	1	1	8	0	0	19	1	0	4	0	0	9	35	3	337	3.5	0.3	33.7
6	2	0	60	1	2	97	0	0	85	0	0	32	3	0	12	3	1	6	2	2	16	1	0	1	0	0	0	1	1	2	13	6	311	1.3	0.6	31.1
7	0	0	60	4	2	137	2	1	60	1	1	47	1	0	19	0	1	0	2	0	9	3	1	5	2	0	1	1	4	9	16	10	347	1.6	1	34.7
8	2	0	25	0	0	30	0	0	26	0	0	10	0	0	5	0	0	3	1	0	7	1	0	10	2	0	13	0	0	25	6	0	154	0.6	0	15.4
9	1	0	21	1	0	16	0	0	10	0	0	20	1	1	12	0	0	9	3	0	14	7	4	23	5	0	20	1	0	23	19	5	168	1.9	0.5	16.8
10	2	0	64	0	0	12	0	0	14	0	0	11	0	0	6	1	1	39	0	1	15	0	0	18	2	0	47	0	0	62	5	2	288	0.5	0.2	28.8

Grand total for macroplot: 199   49   2803   1.99 0.49   28

Physaria bellii (___ twinpod) - Monitoring Data   Observer(s) Alan Carpenter / John Earnst
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Date: May 10, 1995

Macroplot Number   3
Location of macroplot : From macroplot 2, walk at a bearing of 340 degrees (north) for about 400 m. Macroplot 2 is located on an obvious area of bare, black shale,
about 200m east of old railroad grade on the slope above the macroplot and about 200 m southwest of "hangglider" hill. Macroplot 3 is flat with no aspect.
Macroplot 3 established May 10, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner and running to the southwest corner.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

***Distance along strip in meters ***

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	0	2	6	1	0	0	0	0	1	0	2	4	3	2	42	1	1	2	2	0	29	0	0	0	3	3	8	0	0	91	10	10	183	1	1	18.3
2	1	4	50	2	0	3	2	4	28	2	4	19	2	0	0	3	0	0	1	0	27	1	0	43	1	0	19	0	0	11	15	12	200	1.5	1.2	20
3	1	0	8	1	0	6	1	0	5	0	0	0	1	0	0	1	1	3	2	0	3	1	0	12	0	1	95	1	0	38	9	2	170	0.9	0.2	17
4	1	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	1	2	1	19	8	3	23	0.8	0.3	2.3
5	0	0	0	0	0	0	0	0	0	0	0	0	3	10	7	1	0	0	1	0	0	2	1	0	0	0	0	0	1	1	7	12	8	0.7	1.2	0.8
6	0	0	0	0	0	0	0	0	0	4	0	0	3	1	0	0	0	0	0	0	0	3	0	1	2	0	1	1	0	8	13	1	10	1.3	0.1	1
7	0	0	0	2	0	0	1	0	0	10	11	62	9	9	3	3	1	24	1	6	0	1	1	6	3	3	92	8	0	0	38	31	187	3.8	3.1	18.7
8	0	0	0	0	1	0	0	0	0	1	3	18	6	4	43	4	2	16	2	1	0	5	6	55	2	2	64	2	0	0	22	19	196	2.2	1.9	19.6
9	1	3	13	1	5	2	2	0	1	2	3	5	2	10	37	1	0	80	6	5	123	4	5	77	0	1	264	1	2	54	20	34	656	2	3.4	65.6
10	0	4	127	2	4	79	2	1	67	1	2	67	0	1	125	0	3	188	4	9	135	2	1	280	0	0	245	0	0	197	11	25	1510	1.1	2.5	151

Grand total for macroplot: 153   149   3143   1.53 1.49 31.4

Physaria belli(twinpod) - Monitoring Data
c:\atc\data\cem95a.xls   (formerly c:\atc\123\phbebo.wk3)

Observer(s) Alan Carpenter / John Earnst

Date: May 10, 1995

Macroplot Number   4
Location of macroplot : From pedestrian gate on west side of tunnel under US Highway 36 on Foothills Trail, walk 229 m at a bearing of 290 degrees (westnorthwest) to southwest corner of macroplot 4. Macroplot 4 located 305 m at a bearing of 122 degrees (southeast) from southeast corner of macroplot 3. Aspect of macroplot 4 is northwest (310 degrees) and is steeply sloping.
Macroplot 4 established May 10, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the west corner and running to the east corner, across the slope from the bottom of the macroplot.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

··Distance along strip in meters ··

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	11	9	13	11	4	23	2	3	35	7	10	4	6	3	3	0	0	1	6	1	5	2	0	0	1	1	4	10	2	5	56	33	93	5.6	3.3	9.3
2	6	2	10	6	3	20	1	0	5	11	1	3	1	1	2	0	0	1	5	2	1	1	0	0	4	1	0	10	4	3	45	14	45	4.5	1.4	4.5
3	3	0	5	2	1	17	5	2	0	15	2	68	5	0	0	1	1	1	3	3	8	6	3	14	14	5	1	5	2	12	59	19	126	5.9	1.9	12.6
4	0	2	11	0	0	16	2	2	9	5	3	13	1	1	5	3	4	3	3	2	13	4	1	9	4	2	2	3	1	1	25	18	82	2.5	1.8	8.2
5	2	1	5	7	3	46	10	11	12	4	1	48	3	0	9	1	9	0	3	2	5	12	2	8	3	2	5	3	2	5	48	33	143	4.8	3.3	14.3
6	0	0	1	10	7	22	17	8	11	3	1	15	5	3	10	3	4	1	7	4	5	3	5	3	1	2	1	6	4	12	55	38	81	5.5	3.8	8.1
7	0	0	2	1	2	4	12	3	27	11	5	32	1	1	0	0	1	0	0	0	2	1	0	1	1	2	1	0	1	2	27	15	71	2.7	1.5	7.1
8	0	0	1	2	3	5	13	2	10	8	2	13	1	1	0	1	0	1	4	0	1	6	0	1	0	1	0	0	0	6	35	9	38	3.5	0.9	3.8
9	0	0	22	0	0	0	2	4	9	1	0	7	0	0	1	1	0	0	2	1	7	3	1	14	3	0	3	0	0	1	12	6	64	1.2	0.6	6.4
10	2	0	18	0	0	1	1	0	1	0	1	1	0	0	0	1	0	0	1	1	11	2	2	0	0	2	0	4	0	5	11	6	37	1.1	0.6	3.7

Grand total for macroplot: 373   191   780   3.73 1.91   7.8

Physaria bellii (twinpod) - Monitoring Data
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Observer(s) Alan Carpenter / John Earnst

Date: May 12, 1995

Macroplot Number   5
Location of macroplot: From pedestrian gate at Boulder Valley Ranch trailhead, walk for 200 m along gravel path to a gate in fence on east side of gravel path; walk for 168 m at a bearing
of 200 degrees (southsouthwest) to the northwest corner of macroplot 5. Aspect of macroplot is north (8 degrees) and is gently sloping. Plot very disturbed and weedy, with loose, black shale.
Macroplot 5 established May 12, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner across the slope.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

·······································Distance along strip in meters·······································

| Strip | 0-1 | | | 1-2 | | | 2-3 | | | 3-4 | | | 4-5 | | | 5-6 | | | 6-7 | | | 7-8 | | | 8-9 | | | 9-10 | | | Total by Strip | | | Density of plants/m2 | | |
Number	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See
1	0	1	0	0	0	0	1	0	18	0	0	0	2	0	4	0	0	1	4	6	14	1	0	6	3	1	1	3	1	18	14	9	62	1.4	0.9	6.2
2	0	0	0	0	0	1	5	1	9	0	0	4	0	0	0	0	0	1	0	0	1	1	0	0	13	1	28	5	5	21	24	7	65	2.4	0.7	6.5
3	2	0	0	5	0	14	7	1	12	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	5	12	1	0	4	16	6	44	1.6	0.6	4.4
4	0	0	0	1	0	6	0	0	16	4	1	9	0	0	0	0	0	0	0	0	0	0	0	0	2	4	56	3	4	20	10	9	107	1	0.9	10.7
5	0	0	0	0	0	0	0	0	7	0	1	8	0	0	0	0	0	0	0	0	0	0	1	3	6	0	79	4	5	31	10	7	128	1	0.7	12.8
6	0	0	0	0	0	0	0	3	0	1	0	10	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	10	4	7	13	7	19	1.3	0.7	1.9
7	0	0	0	1	0	2	0	0	2	2	0	6	1	1	35	1	0	1	2	0	4	0	0	0	1	0	7	11	1	31	19	2	88	1.9	0.2	8.8
8	5	1	2	2	0	2	1	0	0	2	0	14	3	0	51	1	0	1	1	0	20	0	0	4	2	2	80	1	3	1	18	6	175	1.8	0.6	17.5
9	6	22	34	2	0	4	4	0	4	1	0	1	0	0	2	0	0	8	0	0	14	3	8	39	8	5	3	3	2	11	27	37	120	2.7	3.7	12
10	1	0	6	1	0	10	3	0	12	3	0	28	0	0	6	1	0	3	1	2	13	6	4	32	6	6	61	3	0	22	25	12	194	2.5	1.2	19.4

Grand total for macroplot: 176   102   1002   1.76 1.02 10

Physaria belli[ ] twinpod) - Monitoring Data
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Observer(s) Alan Carpenter / John Earnst

Date: May 12, 1995

Macroplot Number   6

Location of macroplot : From northwest corner of macroplot 5, walk 56 m up hill at a bearing of 145 degrees (southeast) to the northwest corner of macroplot 6. Macroplot 6 has an aspect of 342 degrees (north) and is moderately sloping; northern sweetvetch present in macroplot 6. No weeds present.

Macroplot 6 established May 12, 1995.

Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.

Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner across the slope, beginning at the bottom of the plot.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

Distance along strip in meters

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10*** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	4	4	66	0	2	7	1	1	5	2	0	8	1	0	2	4	4	15	5	1	28	2	2	16	0	1	15	2	3	30	21	18	192	2.1	1.8	19.2
2	3	3	29	2	2	14	3	2	13	0	0	21	3	1	49	1	0	54	0	0	14	1	1	6	0	1	12	2	2	14	20	12	226	2	1.2	22.6
3	2	0	16	3	3	13	2	1	17	1	1	6	0	3	6	1	0	14	0	1	5	1	1	8	1	1	11	0	0	60	11	11	156	1.1	1.1	15.6
4	2	2	11	3	1	11	3	0	14	0	2	5	1	2	6	4	2	6	0	1	16	1	0	9	2	0	13	1	4	23	17	14	114	1.7	1.4	11.4
5	0	2	13	1	1	8	0	0	2	1	0	22	1	0	2	1	0	7	2	0	1	0	0	17	0	0	12	1	1	6	7	4	90	0.7	0.4	9
6	2	0	9	2	1	15	2	0	5	0	6	10	0	1	4	0	0	2	0	0	6	0	0	10	0	1	8	1	0	14	7	9	81	0.7	0.9	8.1
7	1	0	10	3	0	12	1	1	6	4	0	7	0	1	0	0	0	3	0	1	3	1	0	3	0	0	16	2	2	15	12	5	75	1.2	0.5	7.5
8	1	0	25	3	0	50	2	1	39	4	1	36	3	0	5	0	0	3	2	0	14	1	0	5	0	1	12	2	3	2	18	6	191	1.8	0.6	19.1
9	2	1	24	0	0	10	1	1	5	0	1	9	1	0	2	0	0	1	0	0	3	1	1	10	2	0	40	1	1	6	8	5	110	0.8	0.5	11
10	5	0	14	0	2	6	1	1	8	1	1	3	4	1	0	1	1	5	0	1	0	1	0	18	2	0	20	2	0	7	17	7	81	1.7	0.7	8.1

Grand total for macroplot: 138   91   1316   1.38 0.91 13.2

Physaria belli（ twinpod) - Monitoring Data
c:\atc\data\c em95a.xls　　(formerly c:\atc\123\phbebo.wk3)

Observer(s) Alan Carpenter / Dickson Pratt / Teresa   s / Dane Ellingson

Date: May 19, 1995

Macroplot Number　7
Location of macroplot : Beginning at the south corner of the Beech Open Space Pavillion, walk about 250 m at a bearing of 233 degrees (southwest) to macroplot 8. North east corner of macroplot 7 is 42 m from northeast corner of macroplot 8. Macroplot 7 is located on south side of east-west trending barbed wire fence; macroplot 7 is located on black shale.
Macroplot 7 established May 19, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner across the slope beginning at the top of the macroplot.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

········Distance along strip in meters········

Strip Number	0-1 Rep	Juv	See	1-2 Rep	Juv	See	2-3 Rep	Juv	See	3-4 Rep	Juv	See	4-5 Rep	Juv	See	5-6 Rep	Juv	See	6-7 Rep	Juv	See	7-8 Rep	Juv	See	8-9 Rep	Juv	See	9-10 Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	5	1	9	7	1	3	13	27	43	21	19	11	10	17	25	15	5	8	18	17	21	31	12	10	11	2	19	2	1	0	133	102	149	13.3	10.2	14.9
2	5	3	12	8	2	0	9	15	14	21	12	25	29	13	32	4	1	14	13	2	0	6	2	7	7	0	0	6	4	6	108	54	110	10.8	5.4	11
3	16	4	24	24	8	29	19	12	26	7	0	5	0	0	0	2	0	9	1	0	1	8	1	17	6	1	15	0	0	0	83	26	126	8.3	2.6	12.6
4	9	0	11	7	1	11	3	0	1	4	1	0	11	3	10	3	2	0	2	0	0	4	0	3	7	3	6	0	0	0	50	10	42	5	1	4.2
5	25	3	144	14	24	37	11	2	1	30	10	112	22	14	23	3	0	4	8	3	12	2	1	2	12	2	2	4	3	3	131	62	340	13.1	6.2	34
6	17	7	36	26	26	59	9	1	61	17	10	52	4	1	4	3	0	4	0	0	0	1	0	1	27	17	62	12	5	12	116	67	291	11.6	6.7	29.1
7	5	25	15	13	10	18	16	13	35	14	12	135	12	15	19	4	0	3	1	0	1	18	4	39	4	0	0	1	2	0	88	267	265	8.8	26.7	26.5
8	18	9	34	14	4	11	15	5	41	7	4	45	9	2	3	10	0	3	0	1	2	9	0	3	4	0	2	16	12	21	102	37	185	10.2	3.7	18.5
9	4	6	50	8	2	43	2	0	16	5	4	34	2	2	9	7	2	18	12	6	34	2	0	11	2	4	15	29	11	61	73	37	291	7.3	3.7	29.1
10	32	6	36	14	11	32	15	7	143	23	4	24	3	12	28	6	2	13	3	1	10	13	3	35	5	4	22	16	24	35	130	74	378	13	7.4	37.8

Grand total for macroplot:　1014　736　2157　　10.1　7.36　21.6

Physaria belli████ twinpod) · Monitoring Data   Observer(s) Alan Carpenter / Dickson Pratt / Teresa ███s / Dane Ellingson
c:\atc\data\c███m95a.xls   (formerly c:\atc\123\phbebo.wk3)

Date: May 19, 1995

Macroplot Number   8
Location of macroplot : Beginning at the south corner of the Beech Open Space Pavillion, walk 206 m at a bearing of 237 begrees (southwest) to northeast corner of macroplot 8. Macroplot 8
is located 42 m north of macroplot 7. Macroplot 8 is located on north side of east-west trending barbed wire fence. Macroplot 8 is gently sloping to the northeast.
Macroplot 8 established May 19, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner to the southwest corner across the slope, beginning at the top of the plot.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

•••Distance along strip in meters •••

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	1	1	0	9	2	4	8	5	1	24	9	7	19	17	4	14	3	1	8	16	2	4	1	5	13	8	10	10	3	38	110	65	72	11	6.5	7.2
2	1	4	1	10	23	18	8	6	9	12	18	21	26	10	5	27	5	3	10	4	0	4	7	3	9	11	11	15	13	19	122	101	90	12.2	10.1	9
3	1	9	1	4	9	4	6	17	9	12	31	11	7	7	9	25	14	15	15	7	3	9	14	13	11	13	21	9	13	19	99	134	105	9.9	13.4	10.5
4	4	4	5	5	6	6	18	14	15	14	7	13	20	5	13	27	21	5	18	13	3	8	12	8	10	26	36	10	12	18	134	120	120	13.4	12	12
5	5	6	8	14	11	6	9	3	6	8	6	22	24	7	12	14	6	3	15	7	1	5	8	8	14	8	35	11	13	23	119	75	124	11.9	7.5	12.4
6	7	2	2	3	0	5	3	3	3	7	5	2	13	4	9	5	2	9	7	10	4	12	9	7	3	12	56	3	3	26	63	50	123	6.3	5	12.3
7	8	11	4	2	5	3	6	5	17	22	11	30	7	3	22	9	4	7	13	6	16	3	7	4	6	7	18	15	13	58	91	72	179	9.1	7.2	17.9
8	4	6	17	0	2	0	13	9	8	33	29	48	10	6	7	6	15	30	17	18	22	7	12	32	11	12	45	8	11	12	109	120	221	10.9	12	22.1
9	5	3	3	3	9	10	2	11	15	5	8	6	7	4	26	16	13	27	8	10	72	13	11	15	14	15	28	16	11	5	89	95	207	8.9	9.5	20.7
10	0	4	3	1	5	0	0	0	2	3	1	1	9	16	20	13	21	44	9	13	20	4	12	9	19	9	17	17	7	12	75	88	128	7.5	8.8	12.8

Grand total for macroplot: 1011   920   1389   10.1   9.2   13.7

Physaria bellii ● twinpod) - Monitoring Data
c:\atc\data\c ● m95a.xls   (formerly c:\atc\123\phbebo.wk3)

Observer(s) Alan Carpenter / Dickson Pratt / Terri L●

Date: May 26, 1995

Macroplot Number   9
Location of macroplot : Beginning at the south corner of the Beech Open Space Pavilion, walk 181 m at a bearing of 249 degress (westsouthwest) to the northeast corner of macroplot 9.
Northeast corner of macroplot 9 is located 91 m from northeast corner of macroplot 8 at a bearing of 28 degrees (northnortheast). Very dense weeds, including Ayssum sp., C. nutans, A. diffusa.
Macroplot 9 established May 26, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner running to the northeast corner across the slope, beginning at the bottom of the macroplot.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

•••Distance along strip in meters •••

Strip Number	***0-1*** Rep Juv See	***1-2*** Rep Juv See	***2-3*** Rep Juv See	***3-4*** Rep Juv See	***4-5*** Rep Juv See	***5-6*** Rep Juv See	***6-7*** Rep Juv See	***7-8*** Rep Juv See	***8-9*** Rep Juv See	***9-10** Rep Juv See	Total by Strip Rep Juv See	Density of plants/m2 Rep Juv See
1	3 0 1	5 0 2	9 0 1	1 3 0	2 3 8	0 2 2	1 6 0	12 2 1	21 23 2	30 11 8	84 50 25	8.4 5 2.5
2	0 0 6	1 0 0	4 1 1	3 0 0	2 1 2	1 2 0	0 9 0	14 15 5	21 19 5	31 7 4	77 54 23	7.7 5.4 2.3
3	3 2 0	4 0 0	0 0 0	1 0 0	5 10 1	12 3 15	9 11 12	20 12 7	21 2 0	12 2 0	87 42 35	8.7 4.2 3.5
4	2 2 3	2 1 1	20 8 1	4 8 0	2 0 0	15 1 6	5 5 9	7 2 0	23 6 9	13 5 0	93 38 29	9.3 3.8 2.9
5	5 8 1	8 5 1	28 25 3	26 13 3	9 0 0	10 7 25	5 2 0	1 1 0	12 3 0	9 2 3	113 66 36	11.3 6.6 3.6
6	9 11 0	9 4 2	15 5 1	6 10 1	17 5 1	5 7 1	5 0 0	0 0 0	0 0 0	2 0 3	68 43 9	6.8 4.3 0.9
7	9 15 3	11 0 10	22 13 2	7 12 0	6 2 0	6 0 1	6 1 0	0 0 0	1 0 0	0 0 0	68 43 16	6.8 4.3 1.6
8	10 30 12	3 4 0	3 1 0	2 3 0	2 0 0	12 3 23	5 0 1	1 0 0	2 0 0	0 0 0	40 41 36	4 4.1 3.6
9	5 5 10	1 0 0	1 0 3	0 0 0	0 0 0	9 5 3	7 0 0	5 0 0	0 1 0	1 0 0	29 11 16	2.9 1.1 1.6
10	1 0 0	1 1 0	0 0 0	2 1 1	2 0 0	4 0 0	9 0 0	4 0 0	4 0 0	4 0 0	31 2 1	3.1 0.2 0.1
Grand total for macroplot:											690 390 226	6.9 3.9 2.26

Physaria belli_____ twinpod) - Monitoring Data
c:\atc\data\c____bem95a.xls   (formerly c:\atc\123\phbebo.wk3)

Observer(s) Alan Carpenter / Terri Long

Date: June 2, 1995

Macroplot Number   10
Location of macroplot : 78 m south of Neva Road at a point that is a 0.6 mile east of spot where Neva Road bends east after it exits US Highway 36. From east edge of weed study plot 994,
starting at barbed wire fence along Neva Road, walk south (172 degrees) for 78 m to macroplot 10. Macroplot 10 gently slopes to south (173 degrees). Old prairie dog colony adjacent to mp 10.
Macroplot 10 established June 2, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southeast corner running to the northeast corner, beginning at the east end of the macroplot.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

• Distance along strip in meters •

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	5	7	1	2	3	0	5	3	1	6	2	1	4	6	0	4	1	12	1	12	1	1	9	1	1	4	0	1	3	1	30	50	18	3	5	1.8
2	3	2	0	4	0	0	2	6	0	1	4	1	3	3	0	4	4	1	2	13	1	2	11	5	4	6	0	2	2	1	27	51	9	2.7	5.1	0.9
3	2	0	0	2	0	1	2	14	9	1	1	1	2	2	1	3	5	8	0	5	1	5	5	11	3	11	7	3	14	6	23	57	45	2.3	5.7	4.5
4	2	1	1	2	2	1	2	4	1	0	0	4	0	1	1	3	3	1	0	1	1	0	1	1	0	0	0	0	2	0	9	15	11	0.9	1.5	1.1
5	2	2	5	1	3	1	1	4	6	0	9	7	1	1	3	1	6	3	0	4	0	0	0	0	0	0	2	0	0	0	6	29	27	0.6	2.9	2.7
6	4	2	3	1	3	0	2	3	2	2	3	1	0	2	4	0	1	3	1	3	2	0	0	0	0	0	1	1	0	0	11	17	16	1.1	1.7	1.6
7	3	1	1	2	4	0	1	1	4	2	31	6	0	0	0	0	1	2	0	2	1	0	1	0	0	1	0	0	0	0	8	42	14	0.8	4.2	1.4
8	1	1	2	0	1	0	0	0	0	0	4	1	1	1	4	0	4	3	0	1	2	2	1	0	0	0	0	0	0	0	4	13	12	0.4	1.3	1.2
9	0	4	2	0	1	0	1	5	4	0	2	3	1	4	3	4	7	4	2	0	3	0	0	0	0	0	0	0	0	0	8	23	19	0.8	2.3	1.9
10	1	3	2	0	4	0	2	7	5	0	12	10	1	6	9	0	6	2	0	1	1	0	6	1	1	4	1	0	0	0	5	49	31	0.5	4.9	3.1

Grand total for macroplot: 131   346   202   1.3   3.5   2

Physaria bell███ ███ls' twinpod) - Monitoring Data
c:\atc\data\███ ███bem96a.xls   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpe███ ███ Lynn Riedel

Date: May 24, 19██

Macroplot Number   1
Location of macroplot : 120 m south of Foothills Trail; 50m north of fence line; 500m west of US Hwy 36. Plot gently east-facing; former prairie dog colony.
Macroplot 1 established May 9, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner and running to the southwest corner).
The 75-100 cm portion of each 1m x 10m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

Distance along strip in meters **   ***

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	1	0	1	0	3	5	1
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	2	0	13	0	0	0	3	2	14
3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	10	1	1	0	1	0	0	0	1	3	0	0	0	2	5	13
4	0	0	0	0	0	0	0	0	0	2	2	0	4	7	9	1	2	0	0	0	0	0	2	4	1	5	0	0	0	0	8	18	13
5	0	0	0	0	0	0	1	5	8	1	15	23	0	9	31	5	7	18	1	1	0	0	1	0	0	0	0	0	0	0	8	38	80
6	0	0	0	0	1	6	0	1	0	2	20	0	2	12	11	2	3	9	0	0	0	0	0	0	0	0	0	0	0	0	6	37	26
7	0	0	0	0	0	0	1	0	0	1	7	2	1	1	6	2	2	15	0	0	0	0	1	0	0	0	0	0	0	0	5	11	23
8	0	0	2	1	0	0	0	1	9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	11
9	0	0	0	0	0	0	0	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Grand total for macroplot: 36   121   183

Physaria belli[ ]is' twinpod) - Monitoring Data
c:\atc\123\p[ ]6.wk3   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpenter / Lynn [ ] / Birgit Krebs

Date: May 24,1996

Macroplot Number 2
Location of macroplot : 400m west of US Hwy 36 at Foothills Trail under pass; 10m south of barbed wire fence; 100m south of Foothills Trail; 50m west of Physaria bellii permanent monitoring macroplot #1.
Macroplot 2 established May 9, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner and running to the southwest corner).
The 75-100cm portion of each 1mx10m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

•••Distance along strip in meters ••

Strip Number	0-1 Rep	Juv	See	1-2 Rep	Juv	See	2-3 Rep	Juv	See	3-4 Rep	Juv	See	4-5 Rep	Juv	See	5-6 Rep	Juv	See	6-7 Rep	Juv	See	7-8 Rep	Juv	See	8-9 Rep	Juv	See	9-10 Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	2	0	1	0	7	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	9	0	4	18	3	1.6	7.2	1.2
2	0	0	0	1	0	0	0	0	3	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	4	0	2	1	5	4	7	10	1.6	2.8	4
3	1	0	0	1	2	0	3	0	4	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	1	0	1	0	0	2	9	2	7	3.6	0.8	2.8
4	3	0	0	7	0	0	4	1	3	3	1	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	22	2	3	8.8	0.8	1.2
5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0.8	0	0.8
6	0	6	0	1	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	6	2	1.6	2.4	0.8
7	1	0	0	3	0	2	0	0	1	0	0	0	1	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5	2	5	2	0.8	2
8	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	1	5	0	0.4	2
9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	3	8	0	5	10	0	2	4
10	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	6	6	0	3	0	2	11	8	0.8	4.4	3.2
Grand total for macroplot:																															52	54	55	2.1	2.2	2.2

Physaria bellii (Bell's twinpod) - Monitoring Data
c:\atc\123\p   96.wk3   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpenter/ Nancy Neubert/ Birgit Krebs

Date: May 23,1996

Macroplot Number 3
Location of macroplot : 400m west of US Hwy 36; 200m east of old railroad grade; 200m southeast of hangglider hill; gently east-facing; black shale, much bare ground; exposed Pierre shale.
Macroplot 3 established May 9, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner and running to the southwest corner).
The 50-75 cm portion of each 1m x 10m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

Distance along strip in meters

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	0	1	0	0	0	0	1	0	0	2	0	1	5	3	0	1	1	0	1	0	2	0	0	0	3	3	0	3	2	0	16	10	3	6.4	4	1.2
2	3	0	0	0	2	0	4	1	0	6	7	0	1	0	0	0	0	0	2	1	0	1	0	4	0	0	3	1	4	1	18	15	8	7.2	6	3.2
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0.4	0.4	0
4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	1	1	5	1	1	2	0.4	0.4
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	5	4	0	2	1.6	0
7	0	0	0	2	0	1	0	0	0	4	27	0	1	3	0	4	4	0	2	1	0	0	0	0	1	0	14	3	0	1	17	35	16	6.8	14	6.4
8	0	0	0	0	0	0	0	0	0	3	2	1	6	11	9	1	2	0	2	0	0	0	1	0	1	24	8	0	0	0	13	40	18	5.2	16	7.2
9	1	0	11	0	0	0	0	0	0	0	0	0	1	1	4	1	5	7	0	1	0	1	2	2	0	3	20	0	8	0	4	20	44	1.6	8	17.6
10	0	2	0	0	0	0	0	0	0	1	3	1	0	5	1	1	4	13	0	0	0	0	0	3	1	5	7	0	0	22	3	19	47	1.2	7.6	18.8
																															Grand total for macroplot: 82	145	137	3.3	5.8	5.48

Physaria belli... ...s' twinpod) - Monitoring Data
c:\atc\123\p...6.wk3   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpenter/ Nancy ...ert/ Birgit Krebs

Date: May 23,1996

Macroplot Number 4
Location of macroplot : 250m west of US Hwy 36 (at cement plant); 150m west of "Grasslands 05" plot; 250m southeast of Physaria bellis monitoring macroplot #3;moderate sloping, north-facing macroplot.
Macroplot 4 established May 9, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner..
The 25-50cm portion of each 1m x 10m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

••Distance along strip in meters••

Strip Number	***0-1*** Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	2	0	0	5	11	13	1	9	1	5	6	0	1	2	0	0	0	0	0	1	3	2	0	0	0	3	0	6	8	4	22	40	21	8.8	16	8.4
2	2	1	0	1	11	1	0	1	2	0	3	2	0	3	0	0	2	0	3	2	0	0	0	0	0	0	0	3	4	2	9	27	7	3.6	11	2.8
3	0	7	0	1	1	0	1	0	1	4	0	0	0	0	0	0	1	0	2	1	1	1	4	2	5	10	0	1	1	0	15	25	4	6	10	1.6
4	1	2	1	0	1	0	1	2	0	3	4	8	1	0	0	2	3	2	0	3	0	0	1	3	0	4	5	1	0	0	9	20	19	3.6	8	7.6
5	0	3	0	0	8	11	2	13	6	1	3	3	1	9	6	0	2	0	3	5	2	1	2	0	1	2	0	0	2	0	9	49	28	3.6	20	11.2
6	0	1	0	2	4	2	8	9	16	2	3	5	1	11	12	2	1	0	9	5	5	6	0	0	2	0	0	1	3	5	31	37	45	12	15	18
7	0	1	0	1	2	1	2	16	17	5	6	2	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	3	8	27	25	3.2	11	10
8	0	0	0	0	0	0	2	4	3	6	5	4	1	1	0	0	1	0	2	3	0	0	2	0	0	1	0	0	3	0	11	20	7	4.4	8	2.8
9	0	0	0	0	0	2	3	1	7	2	1	7	0	0	2	0	1	0	0	1	0	1	4	4	3	1	0	0	0	0	9	9	22	3.6	3.6	8.8
10	0	1	0	0	0	0	2	1	0	1	2	0	0	0	0	0	0	0	2	8	0	0	1	1	0	0	0	2	9	0	7	22	1	2.8	8.8	0.4
Grand total for macroplot:																															130	276	179	5.2	11	7.16

Physaria bellii (twinpod) - Monitoring Data
c:\atc\123\ph...6.wk3   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpenter/ Lynn Ried... t Krebs

Date: May 24, 1995

Macroplot Number   5

Location of macroplot: From pedestrian gate at Boulder Valley Ranch trailhead, walk for 200 m along gravel path to a gate in fence on east side of gravel path; walk for 168 m at a bearing of 200 degrees (southsouthwest) to the northwest corner of macroplot 5. Aspect of macroplot is north (8 degrees) and is gently sloping. Plot very disturbed and weedy, with loose, black shale.
Macroplot 5 established May 12, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner across the slope.
The 0-25 cm portion of each 1m x 10 m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

••Distance along strip in meters ••

Strip Number	Rep	Juv	See	***1-2*** Rep	Juv	See	***2-3*** Rep	Juv	See	***3-4*** Rep	Juv	See	***4-5*** Rep	Juv	See	***5-6*** Rep	Juv	See	***6-7*** Rep	Juv	See	***7-8*** Rep	Juv	See	***8-9*** Rep	Juv	See	***9-10** Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	4	0	0	2	0	1	10	0	0.4	4
2	0	0	0	0	0	0	1	0	5	0	0	3	0	0	4	0	0	0	0	0	0	1	0	1	1	0	3	0	0	2	3	0	18	1.2	0	7.2
3	0	0	0	0	0	0	2	1	5	0	0	9	0	0	1	0	0	0	0	0	0	0	0	0	2	9	4	2	0	1	6	10	20	2.4	4	8
4	0	0	0	0	4	30	0	0	4	0	1	10	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	4	1	10	5	6	56	2	2.4	22.4
5	0	0	0	0	0	0	2	1	4	0	0	0	0	0	1	0	0	0	0	0	0	1	0	2	6	15	21	0	2	2	9	18	30	3.6	7.2	12
6	0	0	0	0	0	0	1	1	4	3	7	25	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	4	4	8	36	1.6	3.2	14.4
7	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5	0	1	0	0	2	0	0	0	1	0	0	3	5	7	10	5	10	21	2	4	8.4
8	3	1	1	0	0	0	1	0	4	0	1	4	0	0	15	0	0	2	0	0	12	0	2	1	0	0	2	0	4	6	4	8	47	1.6	3.2	18.8
9	0	3	0	0	1	0	2	0	0	1	0	1	0	0	0	0	0	0	0	3	4	0	1	3	2	0	3	0	0	1	5	8	12	2	3.2	4.8
10	0	6	6	2	0	7	0	1	2	0	0	6	2	0	1	0	0	0	0	0	1	2	2	26	0	4	17	0	1	1	6	14	67	2.4	5.6	26.8
Grand total for macroplot:																															47	83	317	1.88	3.32	12.68

Physaria belli... 's' twinpod) - Monitoring Data   Observer(s) Alan Carpenter / Nancy ...pert
c:\atc\123\p... 6.wk3   (formerly c:\atc\123\phbeb096.wk3)

Date: May 28, 1996

Macroplot Number   6

Location of macroplot : From northwest corner of macroplot 5, walk 56 m up hill at a bearing of 145 degrees (southeast) to the northwest corner of macroplot 6. Macroplot 6 has an aspect
of 342 degrees (north) and is moderately sloping; northern sweetvetch present in macroplot 6. No weeds present.
Macroplot 6 established May 12, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner across the slope, beginning at the bottom of the plot.
The 0-25 cm portion of each 1m x 10 m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

•••Distance along strip in meters •••

| Strip | ***0-1*** | | | ***1-2*** | | | ***2-3*** | | | ***3-4*** | | | ***4-5*** | | | ***5-6*** | | | ***6-7*** | | | ***7-8*** | | | ***8-9*** | | | ***9-10*** | | | Total by Strip | | | Density of plants/m2 | | |
Number	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See	Rep	Juv	See
1	1	0	1	0	1	2	0	1	0	1	0	0	0	0	0	1	1	1	1	0	0	0	3	1	0	2	1	0	11	1	4	19	7	1.6	7.6	2.8
2	2	2	2	0	2	2	0	1	2	0	0	1	2	1	0	1	6	0	0	4	2	0	1	0	0	3	0	1	0	4	6	20	13	2.4	8	5.2
3	2	1	1	1	2	8	0	2	0	1	0	1	0	0	1	0	3	1	0	0	1	0	1	0	2	1	0	0	5	0	6	15	13	2.4	6	5.2
4	1	0	0	1	0	0	1	1	3	0	0	0	0	0	0	1	0	2	1	1	4	0	2	0	0	1	2	2	4	2	7	9	13	2.8	3.6	5.2
5	0	0	0	0	2	1	0	1	4	1	0	0	2	2	3	0	0	4	0	0	3	0	0	0	0	2	6	0	1	2	3	8	23	1.2	3.2	9.2
6	1	0	1	0	0	0	1	1	0	1	2	2	0	0	0	0	0	2	0	1	0	0	0	7	0	0	0	0	0	1	3	4	13	1.2	1.6	5.2
7	0	2	3	1	0	0	1	2	3	1	6	5	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	2	4	12	13	1.6	4.8	5.2
8	1	0	0	1	8	0	0	9	1	3	4	17	1	1	2	1	1	1	1	3	0	0	0	1	0	0	0	1	0	0	9	26	22	3.6	10	8.8
9	1	3	0	0	2	0	0	5	3	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	1	2	0	0	0	2	12	7	0.8	4.8	2.8
10	0	0	1	0	0	2	0	0	1	2	0	0	1	2	1	0	0	2	0	0	0	0	0	0	1	6	3	1	0	1	5	8	11	2	3.2	4.4
																												Grand total for macroplot:			49	133	135	2	5.3	5.4

Physaria belli⬤ ⬤ls' twinpod) - Monitoring Data   Observer(s) Alan Carpenter / Nanc⬤ ⬤ert/ Birgit Krebs
c:\atc\123\p⬤ ⬤6.wk3   (formerly c:\atc\123\phbeb096.wk3)
                                                        Date: May 29, 1996

Macroplot Number   7
Location of macroplot : Beginning at the south corner of the Beech Open Space Pavillion, walk about 250 m at a bearing of 233 degrees (southwest) to macroplot 8. North east corner of
macroplot 7 is 42 m from northeast corner of macroplot 8. Macroplot 7 is located on south side of east-west trending barbed wire fence; macroplot 7 is located on black shale.
Macroplot 7 established May 19, 1995.
Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southwest corner and running to the southeast corner across the slope beginning at the top of the macroplot.
The 25-50 cm portion of each 1m x 10 m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

Distance along strip in meters ** *************************

Strip Number	0-1 Rep	Juv	See	1-2 Rep	Juv	See	2-3 Rep	Juv	See	3-4 Rep	Juv	See	4-5 Rep	Juv	See	5-6 Rep	Juv	See	6-7 Rep	Juv	See	7-8 Rep	Juv	See	8-9 Rep	Juv	See	9-10 Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
1	1	0	0	0	0	0	2	0	0	4	1	1	6	0	1	2	1	0	6	2	1	4	1	9	1	0	3	0	0	0	26	5	15	10	2	6
2	3	0	0	1	0	0	5	1	1	15	4	0	13	7	4	0	0	0	2	0	0	2	1	1	1	0	0	0	0	0	42	13	6	17	5.2	2.4
3	4	1	1	4	4	11	9	3	3	2	3	2	0	0	0	0	0	0	0	0	0	2	2	6	0	0	0	0	0	0	21	13	23	8.4	5.2	9.2
4	2	4	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	4	3	0	0	0	0	9	7	16	3.6	2.8	6.4
5	1	0	5	13	5	6	2	0	3	4	5	6	6	2	3	0	0	0	1	0	0	1	0	0	2	1	0	0	0	0	30	13	23	12	5.2	9.2
6	3	0	0	6	5	19	0	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	7	6	9	3	4	0	21	16	30	8.4	6.4	12
7	3	3	1	3	0	8	5	9	23	4	2	5	5	6	2	0	0	0	1	0	0	8	3	0	1	0	0	0	0	0	30	23	39	12	9.2	15.6
8	2	0	13	1	2	2	1	0	0	2	8	1	2	2	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0	0	11	13	16	4.4	5.2	6.4
9	0	2	0	1	1	5	0	0	1	2	0	0	1	0	1	2	0	8	6	0	0	0	0	0	2	0	1	2	2	0	16	5	16	6.4	2	6.4
10	5	17	2	10	5	7	5	1	2	10	5	1	3	1	1	0	0	1	6	1	0	3	1	0	0	2	0	8	3	9	50	36	23	20	14	9.2

Grand total for macroplot: 256   144   207   10   5.8   8.28

Physaria belli...s' twinpod) - Monitoring Data
c:\atc\123\p...6.wk3   (formerly c:\atc\123\phbeb096.wk3)   Observer(s) Alan Carpenter / Nanc...ert / Birgit Krebs

Date: May 29, 1996

Macroplot Number 8

Location of macroplot : Beginning at the south corner of the Beech Open Space Pavillion, walk 206 m at a bearing of 237 begrees (southwest) to northeast corner of macroplot 8. Macroplot 8 is located 42 m north of macroplot 7. Macroplot 8 is located on north side of east-west trending barbed wire fence. Macroplot 8 is gently sloping to the northeast.

Macroplot 8 established May 19, 1995.

Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.

Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner to the southwest corner across the slope, beginning at the top of the plot.

The 75-100 cm portion of each 1m x 10 m strip sampled this date.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep), juvenile (established but non-reproductive = Juv), and seedling (born this year = Seel classes.

**********Distance along strip in meters**********

Strip Number	0-1 Rep	Juv	See	1-2 Rep	Juv	See	2-3 Rep	Juv	See	3-4 Rep	Juv	See	4-5 Rep	Juv	See	5-6 Rep	Juv	See	6-7 Rep	Juv	See	7-8 Rep	Juv	See	8-9 Rep	Juv	See	9-10 Rep	Juv	See	Total Rep	Juv	See	Density Rep	Juv	See
1	1	0	6	2	1	2	2	0	1	8	4	1	7	2	3	5	0	0	3	2	1	1	0	1	4	0	0	2	4	0	35	13	15	14	5.2	6
2	0	2	0	4	6	9	2	1	14	6	7	26	14	1	28	8	1	2	5	0	0	1	0	9	3	0	3	8	0	6	51	18	70	20	7.2	28
3	1	4	1	2	1	1	1	3	2	0	2	4	8	4	4	10	1	1	5	2	2	2	2	14	3	2	2	4	5	9	36	25	45	14	10	18
4	4	4	0	3	3	3	4	2	15	3	2	16	7	0	16	4	0	1	2	1	0	2	1	3	4	2	20	3	2	18	33	16	91	13	6.4	36.4
5	1	9	1	0	0	6	1	0	2	4	4	4	1	3	4	1	1	0	6	1	1	6	0	8	6	2	17	7	6	13	33	26	55	13	10	22
6	4	6	7	0	0	7	0	2	0	0	1	0	3	1	0	0	0	1	2	0	1	2	1	7	9	0	1	2	3	11	22	14	36	8.8	5.6	14.4
7	4	4	2	1	1	1	1	0	4	13	1	3	2	0	3	4	0	3	1	1	0	0	1	0	4	1	11	3	9	28	33	17	57	13	6.8	22.8
8	0	0	1	0	0	2	1	0	0	4	2	2	1	0	2	1	1	2	1	2	2	3	1	7	3	4	14	8	2	14	22	12	45	8.8	4.8	18
9	3	1	0	0	1	4	0	0	3	3	1	1	1	1	1	1	1	6	4	2	4	6	3	2	5	2	9	4	0	2	27	12	33	11	4.8	13.2
10	0	0	0	0	0	1	0	0	0	1	2	2	5	0	0	10	1	0	2	2	2	7	3	8	3	1	4	5	1	1	33	11	15	13	4.4	6
Grand total for macroplot																															325	164	462	13	6.6	18.5

Physaria bell[...] twinpod) - Monitoring Data

c:\atc\123\p[...]6.wk3   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpenter / Birgit[...]

Date: May 29, 1996

Macroplot Number   9

Location of macroplot : Beginning at the south corner of the Beech Open Space Pavillion, walk 181 m at a bearing of 249 degress (westsouthwest) to the northeast corner of macroplot 9.

Northeast corner of macroplot 9 is located 91 m from northeast corner of macroplot 8 at a bearing of 28 degrees (northnortheast). Very dense weeds, including Ayssum sp., C. nutans, A. diffusa.

Macroplot 9 established May 26, 1995.

Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.

Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the northwest corner runnin to the northeast corner across the slope, beginning at the bottom of the macroplot.

The 25-50 cm portion of each 1m x 10 m strip sampled this date.

Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),

juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

• •Distance along strip in meters• •

Strip Number	0-1 Rep	Juv	See	1-2 Rep	Juv	See	2-3 Rep	Juv	See	3-4 Rep	Juv	See	4-5 Rep	Juv	See	5-6 Rep	Juv	See	6-7 Rep	Juv	See	7-8 Rep	Juv	See	8-9 Rep	Juv	See	9-10 Rep	Juv	See	Total Rep	Juv	See	Density Rep	Juv	See
1	1	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	1	0	3	1	3	3	4	0	2	0	0	10	10	3	4	4	1.2
2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	2	0	2	0	3	1	0	5	4	0	4	7	0	13	17	2	5.2	6.8	0.8
3	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	6	0	4	1	0	2	2	0	7	11	0	2.8	4.4	0
4	1	0	0	0	0	0	3	0	0	4	0	0	0	0	0	2	0	0	1	0	0	2	0	0	1	6	0	0	1	0	14	7	0	5.6	2.8	0
5	1	1	0	2	4	7	4	8	0	4	2	1	3	0	0	1	0	0	0	0	0	0	0	0	3	1	0	2	1	0	20	17	8	8	6.8	3.2
6	1	2	0	4	1	0	1	1	0	1	5	1	4	1	0	2	4	0	0	0	0	0	0	0	0	0	0	1	0	0	14	14	1	5.6	5.6	0.4
7	0	0	0	3	0	0	10	1	0	2	2	0	1	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	5	0	7.6	2	0
8	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	1	0	0	0	0	9	3	0	3.6	1.2	0
9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	2	0	0	2	1	0	1	0	0	0	0	0	8	1	0	3.2	0.4	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	0.8	0	0
Grand total for macroplot:																															116	85	14	4.6	3.4	0.56

Physaria bell[●] twinpod) - Monitoring Data
c:\atc\123\p[●]6.wk3   (formerly c:\atc\123\phbeb096.wk3)

Observer(s) Alan Carpenter / Terri [●]

Date: May 30, 1996

Macroplot Number   10
Location of macroplot : 78 m south of Neva Road at a point that is a 0.6 mile east of spot where Neva Road bends east after it exits US Highway 36. From east edge of weed study plot 994,
starting at barbed wire fence along Neva Road, walk south (172 degrees) for 78 m to macroplot 10. Macroplot 10 gently slopes to south (173 degrees). Old prairie dog colony adjacent to mp 10.
Macroplot 10 established June 2, 1995.
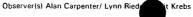Data from permanent monitoring macroplot, 10 x 10 m in size, on City of Boulder Open Space.
Strip refers to 1 m x 10 m belt transect across the macroplot, beginning at the southeast corner running to the northeast corner, beginning at the east end of the macroplot.
The 25-50 cm portion of each 1m x 10 m strip sampled this date.
Data are numbers of Phy bel individuals in reproductive (current year's flowers or fruits = Rep),
juvenile (established but non-reproductive = Juv), and seedling (born this year = See) classes.

•••Distance along strip in meters ••• •••••••••••••••••••••••

Strip Number	0-1 Rep	Juv	See	1-2 Rep	Juv	See	2-3 Rep	Juv	See	3-4 Rep	Juv	See	4-5 Rep	Juv	See	5-6 Rep	Juv	See	6-7 Rep	Juv	See	7-8 Rep	Juv	See	8-9 Rep	Juv	See	9-10 Rep	Juv	See	Total by Strip Rep	Juv	See	Density of plants/m2 Rep	Juv	See
0	2	1	10	1	2	2	4	0	2	0	5	1	1	4	0	0	0	3	2	1	0	2	0	0	0	0	3	1	0	1	13	13	22	5.2	5.2	8.8
2	0	0	0	1	1	0	0	1	0	0	0	2	2	4	0	0	0	0	1	0	0	1	0	1	2	1	2	0	1	1	7	8	6	2.8	3.2	2.4
3	1	0	0	1	1	0	0	0	1	0	0	0	0	2	0	0	0	3	0	1	0	3	0	0	3	0	6	1	1	1	9	5	11	3.6	2	4.4
4	0	0	0	1	8	3	1	0	3	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	3	10	7	1.2	4	2.8
5	0	0	5	0	0	0	0	1	0	1	1	1	0	3	0	3	0	7	0	0	0	0	1	0	0	0	0	0	0	2	4	6	15	1.6	2.4	6
6	0	1	0	3	0	2	0	0	1	0	0	0	1	1	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	2	4	2	9	1.6	0.8	3.6
7	0	0	0	0	0	0	0	1	1	6	3	3	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	6	7	4	2.4	2.8	1.6
8	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	4	0	0.4	1.6	0
9	0	0	0	0	0	0	0	0	2	0	1	0	0	4	2	0	0	2	1	1	2	0	0	0	0	0	0	0	0	0	1	6	8	0.4	2.4	3.2
10	0	0	2	0	2	12	0	0	11	0	1	0	0	15	2	1	0	3	0	0	0	0	2	3	1	0	1	0	1	0	2	21	34	0.8	8.4	13.6
																															Grand total for macroplot: 50	82	116	2	3.3	4.64

2. EXPERIMENTAL STUDY OF THE EFFECTS OF <u>ACOSTA DIFFUSA</u> (DIFFUSE KNAPWEED) ON <u>P. BELLII</u>

I. Introduction

Aggressive, alien weeds may be the most significant threat to <u>P. bellii</u> on Boulder Open Space lands. These weeds include <u>Acosta diffusa</u> (= <u>Centaurea diffusa</u>, diffuse knapweed) and <u>Convolvulus arvensis</u> (field bindweed) and <u>Alyssum alyssoides</u>. Weeds may be a particular problem for <u>P. bellii</u> because occurrences are often located in close proximity to major roads such as U. S. Highway 36 and Neva Road. Continual disturbance along roadsides plus the erodible nature of the shale soils facilitates the invasion and spread of weedy plant species, including the ones mentioned above. Other threats to this species on CBOS lands include road widening or construction, drifting of herbicides sprayed along road rights-of-way, trespass livestock grazing, and trampling from recreation.

I initiated studies in 1993 to assess the effects of <u>A. diffusa</u> on <u>P. bellii</u>. My objective was to determine if <u>A. diffusa</u> has detrimental effects of <u>P. bellii</u> and the plant community of which it is a part. My null and alternative hypotheses are as follows:

Ho1: The presence of <u>A. diffusa</u> has no effect on the recruitment, growth, reproduction, density and seedling survival of <u>P. bellii</u> under field conditions.

Ha1: The presence of <u>A. diffusa</u> reduces the recruitment, growth, reproduction, density and seedling survival of <u>P. bellii</u> under field conditions.

As noted above, very little is known about <u>P. bellii</u> beyond its current distribution. Thus, managing the habitat of <u>P. bellii</u> so as to promote its continued existence is problematic. Natural resource managers are hard-pressed to know what to do or not to do in the absence of needed biological information about the species.

While weeds appear to be a serious threat to the species, it is possible that weeds do not seriously impair this rare species. Embarking on an expensive weed control program focused on "saving the twinpod" may not be prudent at this time. Wester (1994) describes an example from Hawaii where a major program to control an alien weed wasted much money and time, because follow-up monitoring showed that the rare fern in question was able to

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rebound from a temporarily low population without human intervention. A small, test project designed to determine the efficacy of weed control would have been a much better approach. Wester (1994) urges that monitoring projects should be initiated so managers can distinguish short-term fluctuations from long-term trends.

II. Methods

In May, 1993, ten permanent macroplots, each 10 m x 25 m, were established on Boulder County Open Space (now City of Boulder Open Space) property immediately south of Neva Road, about 3/4 mile east of U. S. Highway 36 (Figures 1 and 2). The experimental macroplots are situated between Neva Road and permanent monitoring macroplot # 10. This location was selected because it contains thousands of P. bellii and A. diffusa individuals and is sufficiently large to accommodate a set of experimental plots. It appeared that A. diffusa was expanding at the site; knapweed plants along Neva Road, which is located several meters north of the plots, are probably are the sources of seeds.

Within each macroplot, four permanent transects, each 25 m in length, were established at random locations within each quarter of each macroplot. Along each transect, thirteen permanent microplots, each 0.5 m x 0.5 m in size, were situated at stratified-random locations. In June, 1994, each of the plots was split longitudinally in two equal subplots. For each pair of subplots, the knapweed removal treatment was assigned randomly to one subplot, while the control treatment (no knapweed removal) was assigned to the other subplot. Thus, the experimental design consisted of two treatments, with ten replicates of each treatment, in a randomized, split-plot layout (Figure 3).

No experimental treatment was imposed on the plots in 1993. In June, 1994, all of the A. diffusa individuals which had bolted were pulled by hand and removed from the weed removal plots. The pulled weeds were discarded outside the plots. Weed pulling was greatly facilitated by a heavy rainfall event which occurred the night before the weeds were pulled. In June, 1995, all A. diffusa individuals (rosettes and bolted) were pulled and removed from the weed removal plots. Rosettes were pulled to minimize the need to pull weeds that bolted later in the growing season. The weeds from each weeded subplot were placed in separate plastic mesh or paper sacks for several weeks at ambient outdoor conditions then weighed. In 1996, both knapweeds that had bolted as well as

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rosettes were again pulled by hand, stored in paper sacks, dried
and weighed. The weeds were pulled three times in 1996 as summer
rains stimulated additional recruitment and growth of knapweeds.
The air-dried masses of pulled knapweeds for 1994 are shown in
Table 1.

In June of 1993 and 1994, plant frequency data were
collected. All plant species that were rooted, at least in part,
within each microplot were recorded. The numbers of P. bellii
individuals were counted and classified as seedlings, (born in
1993), juveniles (born prior to 1993 but not reproductive) and
reproductive. In addition, dry-weight-rank data were collected
for the dominant plant species in each microplot (Smith and
Despain, 1987). In the dry-weight-rank procedure, the plant
species with the first, second and third greatest aboveground
masses, as estimated ocularly within each microplot, are assigned
ranks 1, 2, and 3, respectively. A formula is used to convert the
ranks to relative dry weight data. In June, 1995, canopy cover of
all species within each of the microplots was estimated ocularly
to the nearest percent.

In June, 1995, and in June, 1996, data on P. bellii
individuals that occurred in the permanent microplots along the
permanent transects in each plot were collected. All P. bellii
individuals encountered in the microplots were classified as
reproductive, juvenile or seedling, according to the above
criteria and counted. The major and minor diameters for each
juvenile and reproductive plant in the microplots were measured
with a plastic ruler. The areas of rosettes of P. bellii plants
can be accurately calculated as the area of a ellipse because the
plants have a low, compact, circular growth form. In addition,
the number of reproductive stems was counted for each reproductive
individual. Sizes of seedling were not measured because they
could not be accurately measured using rapid field techniques.

The response variables which were used to test the above
hypothesis are the number, reproductive output, and size of P.
bellii. The Physaria data were analyzed statistically using
paired student-t tests for each year of the study; effects across
years were analyzed using repeated measures analysis of variance
(Gurevitch and Chester, 1986).

I had anticipated using survival data for P. bellii plants,
especially seedlings, from 1994 to 1996 as response variables. In
1994, I had tagged all of the P. bellii plants that occurred in

the microplots located along the first transect in each macroplot.
However, at some time between the summer of 1995 and the spring of
1996 vandals removed nearly all of the tags so this part of the
study was abandoned.

III. Results

Data for the reproductive plants is presented in Table 2.
In 1995, the reproductive plants in the weeded macroplots
averaged 48.5 cm^2 in size compared to 34.5 cm^2 in the control
plots; this difference was statistically significant. Contrary
to expectations, there were more reproductive plants in the
control macroplots than in the weeded macroplots during both
years, although the differences were not significant. The average
number of stems per reproductive plant was 27% greater (12.0
versus 9.6 stems per plant) for the plants in the weeded
treatment in 1995, but this difference was not significant.

For the juvenile plants, the size of plants was greater in
the weeded macroplots in 1995, and number of plants was greater
in the weeded macroplots in both years, but these differences
were not significant (Table 2). The number of seedlings was very
similar in the weeded and control plots in 1995 and somewhat
larger in the weeded plots in 1996. The total number of plants
was almost equal for both weeded and control plots for both
years.

IV. Discussion

If the presence of A. diffusa was detrimental to P. bellii,
there should have been a decrease in numbers of P. bellii
individuals, the size of those individuals or their reproductive
output. With one exception, this was not observed. The only
significant difference was the larger size of reproductive plants
in 1995. Other differences may have been obscured by large
variations in the data, as reflected in large standard deviations
about some of the mean values.

The weather was very different between 1995 and 1996, with
the former year having an extremely wet, cool spring, when the P.
bellii plants are growing, and the latter year having a very dry
April. The abundant soil moisture in 1995 may have stimulated
much more weed growth than normal. It is also likely that
diffuse knapweed is more responsive to excess moisture than the
rare plant. In fact, a much larger mass of knapweed was pulled

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from the weeded plots in 1995 compared to 1996. Thus, the
negative effect of the knapweed on the rare plant in 1995
probably reflected its much greater abundance in this wet year.

I further tested the possibility of an interaction between
the knapweed and the rare plant using canopy cover data from
1995. Using data from the microplots that were not weeded, I
regressed cover values of P. bellii against cover values for A.
diffusa. There was a slight negative slope of 8%, but the
relationship was not significant.

I noticed during my field work that P. bellii and A. diffusa
appeared to segregate themselves to a degree in the experimental
macroplots, with P. bellii occupying small ridges which had
rockier soils, and A. diffusa occupying swales that had finer
soils. The ridges appeared to be drier and the swales wetter,
probably due to precipitation running off and collecting on these
areas, respectively. Thus, it is possible that some of the lack
of statistically significant effect may reflect different
microhabitat preferences of the knapweed and P. bellii. If this
were true, then the plants should show a negative association.
To test this possibility, I used frequency data from the
macroplots that had not been weeded. I created a 2 x 2
contingency table with four categories: no knapweed and no rare
plant (N=72);knapweed but no rare plant (N=49); no knapweed but
rare plant (N=99) and both knapweed and rare plant (N=40). The
resulting chi-square statistic was barely non-significant
(p~0.07).

To date at the study site, it does not appear that the
knapweed is limiting the recruitment of seedlings or the survival
of seedlings to the juvenile stage or the survival of juveniles
to the reproductive stage. The main effect of A. diffusa on P.
bellii appears to be reducing the size of reproductive plants in
wet years. The growth of reproductive plants seems to be more
responsive to environmental conditions than growth of juveniles.
It is impossible to say what long-term effects this might have,
if any. Presumably, this might reduce the production of P.
bellii seeds, although they seem to be produced in large
quantities in any event.

V. Recommendations

I have the following recommendations:

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1) Continue weeding the macroplots twice annually over the next two years. I suggest weeding once in May and once in late June, depending on the timing of rainfall events. I suggest collecting, air-drying and weighing the knapweeds so their weights could be used in future analyses of knapweed effects.

2) Collect data on P. bellii in the microplots again in 1997 and 1998. It is possible that the invasion of knapweed has not yet reached the level at which it would have major adverse effects on the rare plant, but this may happen in the future. If effects of knapweed are cumulative, they are more likely to be detected after several more years have elapsed.

3) At the end of 1998, re-evaluate the results of the weeding study to determine if continuing the study is warranted.

4) Continue to work with the weed control personnel of Boulder County so they do not spray along Neva Road within 100 m of the experimental macroplots. Herbicide could drift into the macroplots and accidentally kill the rare plants

VI. Acknowledgments

VII. References

Gurevitch, J. and S. T. Chester, Jr. 1986. Analysis of repeated measures experiments. Ecology 67:251-255.

Smith, E. L. and D. W. Despain. 1987. Dry-weight-rank method of estimating plant species composition. In: G. B. Ruyle (ed.) Some methods for monitoring Arizona rangelands. Division of Range Management, University of Arizona, Tucson. pp. 36-64.

Wester, L. 1994. Weed management and the habitat protection of a rare species: a case study of the endemic Hawaiian fern <u>Marselia villosa</u>. Biological Conservation 68:1-9.

Table 1. Air-dried masses of diffuse knapweeds, including leaves, stems and roots, pulled from the experimental macroplots in 1994.

Macroplot Number	Mass of knapweeds (grams of weed / m2 of weeded area)
991	114
992	132
993	88
994	229
995	No data
996	48
997	31
998	22
999	13
1000	35

Table 2. Plant numbers, plant size, and reproduction data for P. bellii plants in experimental macroplots at Neva Road study site on City of Boulder Open Space lands in 1995 and 1996.   In each macroplot, there are four permanent transects, each of which has 13 permanent microplots. For each macroplot, one-half was weeded annually and the other half was a control that was not weeded.

Plot No.	Treat. 0=cont. 1=weed.	Total no. of repro. plants 1995	1996	Avg. no. of stems per repro. plant 1995	1996	Avg. area (cm^2) of repro. plants 1995	1996
991	0	3	6	4.7	4.3	26.8	13.9
991	1	5	5	8.6	6.0	41.5	28.0
992	0	6	8	8.3	6.5	51.8	24.6
992	1	9	7	10.6	12.7	51.7	25.9
993	1	5	10	12.8	8.0	66.8	17.7
993	0	12	13	7.9	3.3	39.7	15.6
994	0	18	17	8.9	3.9	27.4	14.9
994	1	11	14	9.9	4.3	32.7	28.8
995	1	24	12	7.3	3.3	34.2	21.1
995	0	10	2	10.1	6.0	26.5	12.3
996	0	18	30	8.2	4.5	40.7	14.0
996	1	6	12	16.2	2.2	73.2	23.3
997	1	6	14	17.3	7.0	60.7	20.8
997	0	10	11	8.6	5.0	37.6	18.5
998	1	14	20	12.3	3.0	40.7	12.8
998	0	42	45	9.5	3.7	27.6	9.1
999	0	5	3	20.2	7.7	28.2	32.7
999	1	2	3	16.0	5.0	25.5	13.4
1000	1	5	6	8.6	4.7	58.1	18.3
1000	0	9	7	10.1	3.9	38.4	20.6
Overall Average	Cont.	13.3	14.2	9.6	4.9	34.5	17.6
	Weeded	8.7	10.3	12.0	5.6	48.5	21.0
Overall SD	Cont.	11.2	13.5	4.0	1.4	8.5	6.9
	Weeded	6.4	5.1	3.6	3.1	16.0	5.6

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Table 3. Plant numbers and plant size data for juveniles and numbers of seedlings for P. bellii plants in experimental macroplots at Neva Road study site on City of Boulder Open Space lands in 1995 and 1996. In each macroplot, there are four permanent transects, each of which has 13 permanent microplots. For each macroplot, one-half was weeded annually and the other half was a control that was not weeded.

Plot No.	Treat. 0=cont. 1=weed.	Total no. of juvenile plants 1995	1996	Avg. area of juvenile plants (cm^2) 1995	1996	Total no. of seedling plants 1995	1996	Total no. of plants in all size class 1995	1996
991	0	12	5	6.0	7.9	3	4	18	15
991	1	13	6	12.1	7.5	14	2	32	13
992	0	19	11	8.3	3.3	101	3	126	22
992	1	10	15	8.3	5.0	47	8	66	30
993	1	15	14	15.7	2.3	33	10	53	34
993	0	7	6	14.1	9.1	24	4	43	23
994	0	20	21	7.1	4.8	53	9	91	47
994	1	37	15	3.9	4.2	71	12	119	41
995	1	46	37	8.1	6.2	61	42	131	91
995	0	5	6	8.2	0.9	47	16	62	24
996	0	23	31	14.1	3.8	88	15	129	76
996	1	6	12	46.3	4.3	28	3	40	27
997	1	44	32	9.6	6.8	61	27	111	73
997	0	17	4	5.0	12.7	33	17	60	32
998	1	45	36	8.6	4.5	83	19	142	75
998	0	22	23	11.6	3.7	40	6	104	74
999	0	9	5	12.7	7.8	5	1	19	9
999	1	4	2	4.9	3.0	17	0	23	5
1000	1	2	2	28.7	2.6	1	2	8	10
1000	0	6	3	10.1	1.3	43	3	58	13
Overall Average	Cont.	14.0	11.5	9.7	5.5	43.7	7.8	71.0	33.5
	Weeded	22.2	17.1	14.6	4.7	41.6	12.5	72.5	39.9
Overall SD	Cont.	7.0	9.9	3.3	3.7	31.6	6.0	40.2	24.3
	Weeded	18.5	13.3	13.2	1.7	27.1	13.4	49.0	30.0

Figure 1. Location of _Physaria bellii_ experimental macroplots along Neva Road, about 3/4 mile east of US Highway 36, on City of Boulder Open Space lands. From "Boulder" 7 1/2 minute quad map.
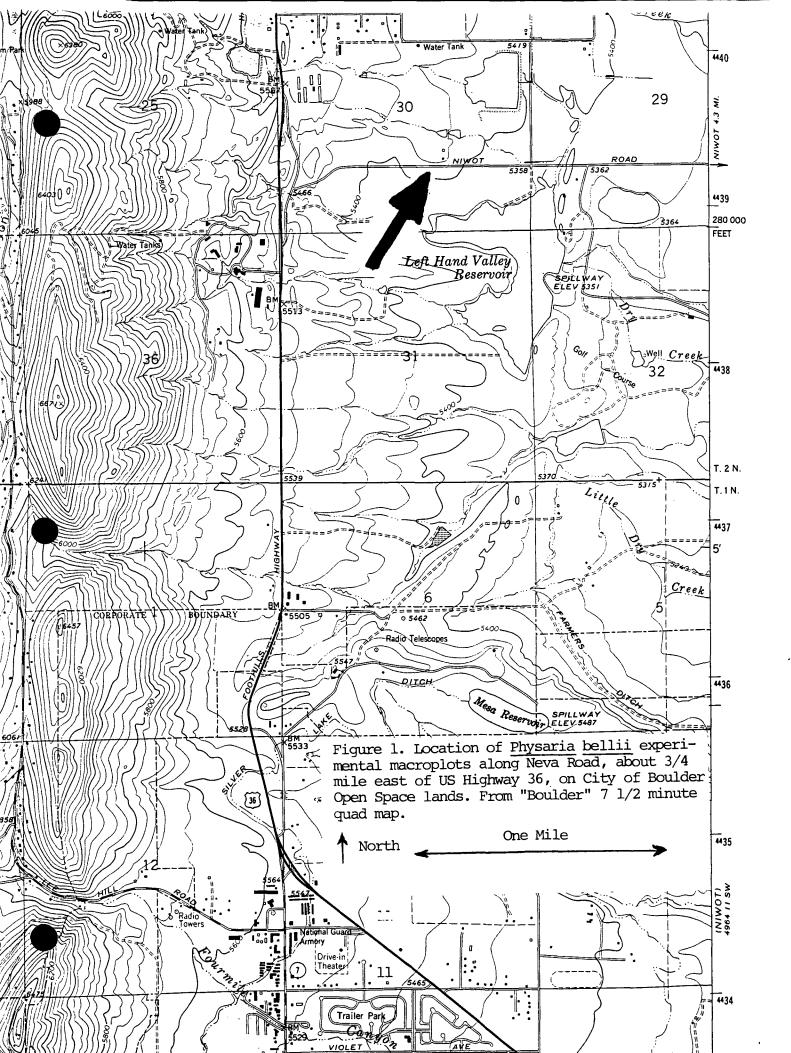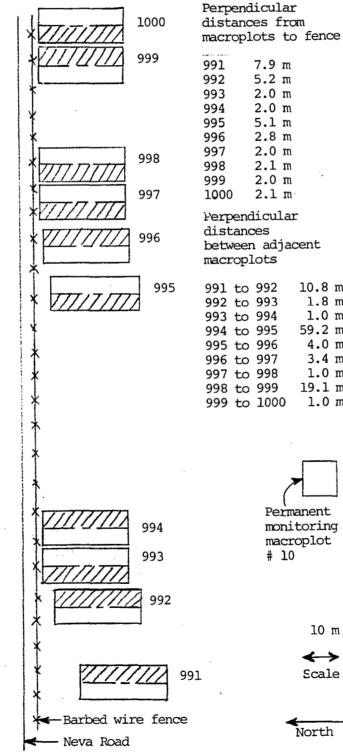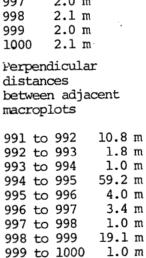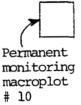
North

One Mile

Figure 2. Diagram showing the layout of the experimental macroplots at the Neva Road study site on City of Boulder Open Space lands. One-half of each macroplot, as indicated by the hatched lines, was weeded at least once annually. The corners of the macroplots were marked with pin flag wires and small rock cairns.
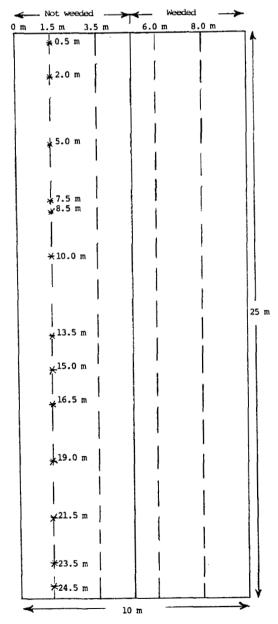

Perpendicular distances from macroplots to fence

991	7.9 m
992	5.2 m
993	2.0 m
994	2.0 m
995	5.1 m
996	2.8 m
997	2.0 m
998	2.1 m
999	2.0 m
1000	2.1 m

Perpendicular distances between adjacent macroplots

991 to 992	10.8 m
992 to 993	1.8 m
993 to 994	1.0 m
994 to 995	59.2 m
995 to 996	4.0 m
996 to 997	3.4 m
997 to 998	1.0 m
998 to 999	19.1 m
999 to 1000	1.0 m

Permanent monitoring macroplot # 10

10 m

Scale

Barbed wire fence

Neva Road

North

Figure 3. Diagram showing an experimental macroplot, using macroplot 991 as an example. The eastern half of this macrolot was weeded at least once annually, while the western half was not weeded. Permanent transects, depicted by dashed lines, were established at 1.5, 3.5, 6.0, and 8.0 m from the northwest corner of the macroplot. The transects run parallel to the long axis of the macroplot; the ends of the transects were marked with pole barn nails driven into the ground. Along each of the transects, thirteen permanent microplots, each 0.5 m by 0.5 m, were established; The microplots were located at distances of 0.5, 2.0, 5.0, 7.5, 8.5, 10.0, 13.5, 15.0, 16.5, 19.0, 21.5, 23.5 and 24.5 m from the north end of each transect. In the diagram, only the microplots along the 1.5 m transect are shown, as indicated by asterisks.

Appendix 1. Copies of raw data sheets, as entered on computer spreadsheets, for P. bellii data collected in experimental macroplots at Neva Road study site on City of Boulder Open Space lands in 1995 and 1996.

c:\atc\data\cbos\phbex9*a.xls	(this is sheet A in file phbex96a.xls)	Date _____

Physaria Bellii Study - City of Boulder Open Space

Experimental Plots at the Neva Road Study Site   Observer(s) _____

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 m
microplots in each half of each macroplot.
Raw data for P. bellii plants for 199___.

Macroplot_____

Number of Phy. bel. plants, # of flowering stems, size (cm x cm) by size class

Transect (m)	Micropl.dist.(m)/#	Number	Reproductive # flw. stems	size of plant	Juveniles Number	size of plant	Seedlings Number

c:\atc\data\cbos\phbex95a.xls
Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Macroplot 991

Data in Microplots
Observer(s): Terri Long
Date: 6/19/95

Transect (m)	Microplot Dist. (m)	Reproductive					Juvenile				Seedlings
		Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				2
	7.5	0					0				0
	8.5	0					1	2.5	1.5	3.1	0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					7	3.0	2.5	5.9	0
								2.0	1.0	1.8	
								2.5	2.0	4.0	
								3.0	2.5	5.9	
								6.0	5.5	26.0	
								3.0	2.5	5.9	
								2.5	2.5	4.9	
	19	0					0				0
	21.5	0					0				0
	23.5	2	6	7.3	7.0	40.2	1	3.7	1.7	5.7	1
			7	7.0	6.0	33.2					
	24.5	0					1	1.5	0.5	0.8	0
3.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					2	2.5	2.0	4.0	0
								2.5	2.3	4.5	
	24.5	1	1	3.5	2.5	7.1	0				0

Number of Phy. bel. plants by size class, diameter (cm x cm) and area (cm2)

c:\atc\data\cbos\phbex95a.xls
Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Macroplot 991

Data in Microplots
Observer(s): Terri Long
Date: 6/19/95

Number of Phy. bel. plants by size class, diameter (cm x cm) and area (cm2)										
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	1	14	10	8.5	67.2	1	2.7	1.5	3.5	1
	15	0					0				0
	16.5	0					0				0
	19	2	12	8.0	9.0	56.7	0				0
			10	7.0	6.0	33.2					
	21.5	0					1	2.5	2	4.0	0
	23.5	0					0				0
	24.5	0					0				0
8	0.5	0					0				0
	2	0					0				0
	5	0					0				1
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				1
	13.5	0					8	2.5	3.0	5.9	5
								2.5	2.5	4.9	
								2.5	2.0	4.0	
								2.5	2.0	4.0	
								3.0	2.0	4.9	
								3.5	2.5	7.1	
								4.5	3.0	11.0	
								5.5	4.0	17.7	
	15	1	1	4.3	3.5	11.9	0				1
	16.5	0					1	2.5	2.3	4.5	3
	19	1	6	7	7	38.5	1	11	9	78.5	0
	21.5	0					1	3	3	7.1	2
	23.5	0					0				0
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no of repro. plants	Avg. no of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
991	0	3	4.7			26.8	12			6.0	3
991	1	5	8.6			41.5	13			12.1	14

Data in Microplots
Observer(s): Terri Long
Date: 6/19/95

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
1.5	0.5	0					0				0
	2	0					0				0
	5	0					1	2.5	3	5.9	1
	7.5	2	6	4.5	4.5	15.9	0				1
			12	8	8	50.3					
	8.5	0					3	5.5	3	14.2	1
								5.5	3	14.2	
								5.5	3	14.2	
	10	0					6	3.5	4	11.0	0
								4	2.5	8.3	
								2.5	2.5	4.9	
								3	3	7.1	
								4	3.5	11.0	
								3	2.5	5.9	
	13.5	2	5	9.3	9	65.8	3	4	3.5	11.0	7
			8	7	8	44.2		4	3.5	11.0	
								4	3.5	11.0	
	15	0					0				42
	16.5	0					0				13
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
							0				
	24.5	0					0				0
3.5	0.5	0					0				2
	2	0					0				0
	5	1	13	9	9	63.6	1	3.5	2.5	7.1	1
	7.5	1	6	9.5	9.5	70.9	0				3
	8.5	0					0				5
	10	0					5	3.5	2	5.9	11
								3.5	2	5.9	
								2.5	2	4.0	
								2	2	3.1	
								2	1.5	2.4	
	13.5	0					0				0
	15	0					0				12
	16.5	0					0				2
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Macroplot 992

Data in Microplots
Observer(s): Terri Long
Date: 6/19/95

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
6	0.5	1	21	11	9.5	82.5	2	3	1.2	3.5	4
							2		1.2	2.0	
	2	1	3	4	2.5	8.3	2	2	2	3.1	1
							2		1	1.8	
	5	1	12	11	11	95.0	0				0
	7.5	0					0				3
	8.5	0					1	2	2	3.1	2
	10	1	4	7	6.5	35.8	0				3
	13.5	0					0				2
	15	0					0				1
	16.5	0					0				3
	19	0					0				0
	21.5	0					0				1
	23.5	1	1	6.5	5.7	29.2	0				0
	24.5	1	17	10	9	70.9	0				2
8	0.5	0					0				0
	2	1	23	8	7.5	47.2	0				0
	5	0					0				0
	7.5	1	11	6	7	33.2	0				3
	8.5	0					1	3	2.5	5.9	15
	10	0					0				1
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				4
	19	0					1	6	5	23.8	0
	21.5	0					0				0
	23.5	0					3	7	4.5	26.0	1
								4	3	9.6	
								2.5	2.3	4.5	
	24.5	1	3	9.8	8.2	63.6	0				1

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
992	0	6	8.3			51.8	19			8.3	101
992	1	9	10.6			51.7	10			8.3	47

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Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/20/95

Macroplot 993

| | | Number of Phy. bel. plants by size, class, diameter (cm x cm) | | | | | | | | | Seedlings |
| | | Reproductive | | | | | Juvenile | | | | |
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				1
	2	1	9	10	10	78.5	10	4	4	12.6	1
								5	5	19.6	
								5	5	19.6	
								3	3	7.1	
								4	4	12.6	
								2	2	3.1	
								3	3	7.1	
								4	4	12.6	
								3	3	7.1	
								3	3	7.1	
	5	0					1	3	3	7.1	0
	7.5	0					0				0
	8.5	0					0				1
	10	0					0				6
	13.5	0					1	3	3	7.1	1
	15	0					0				0
	16.5	1	16	12.0	12.0	113.1	0				1
											0
	19	0					1	8	8	50.3	4
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
3.5	0.5	1	9	6	6	28.3	1	4	4	12.6	1
	2	0					0				0
	5	1	9	8	8	50.3	0				0
	7.5	0					0				1
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				8
	15	0					1	8	8	50.3	1
	16.5	1	21	9	9	63.6	0				5
	19	0					0				0
	21.5	0					0				1
	23.5	0					0				0
	24.5	0					0				1

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Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Macroplot 993

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/20/95

| | | Number of Phy. bel. plants by size, class, diameter (cm x cm) | | | | | | | | | |
| | | Reproductive | | | | | Juvenile | | | | Seedlings |
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				2
	8.5	0					2	3	3	7.1	1
								3	3	7.1	
	10	5	1	6	6	28.3	1	4	4	12.6	0
			10	7	7	38.5					
			1	7	7	38.5					
			16	8	8	50.3					
			27	11	11	95.0					
	13.5	0					0				2
	15	1	5	7.0	7.0	38.5	0				1
	16.5	3	12	8.0	8.0	50.3	1	7	7	38.5	10
			4	6.0	6.0	28.3					
			3	5.0	5.0	19.6					
	19	1	4	5.0	5.0	19.6	0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
8	0.5	1	8	8	8	50.3	0				0
	2	0					0				0
	5	1	4	5	5	19.6	0				0
	7.5	0					2	3	3	7.1	1
								5	5	19.6	
	8.5	0					1	3	3	7.1	1
	10	0					0				1
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				3
	23.5	0					0				1
	24.5	0					0				1

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
993	1	5	12.8			66.8	15			15.7	33
993	0	12	7.9			39.7	7			14.1	24

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Neva Road Study Site

Macroplot 994

Data in Microplots
Observer(s): Terri Long
Date: 6/20/95

Transect (m)	Microplot Dist. (m)	Number of Phy. bel. plants by size, class, diameter (cm x cm)									Seedlings
		Reproductive					Juvenile				
		Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				0
	2	0					0				0
	5	1	15	5	5	19.6	0				2
	7.5	1	13	4.5	3.7	13.2	1	1.5	2	2.4	3
	8.5	1	15	8	7	41.3	0				1
	10	0					0				0
	13.5	1	2	4.5	3.5	12.6	1	4.3	3.3	11.3	1
	15	1	8	9	6.3	58.8	0				0
	16.5	0					1	2.0	1.5	2.4	0
	19	3	7	7	5.5	30.7	2	2	2	3.1	7
			11	7	6	33.2		4	4.5	14.2	
			14	8	7.5	47.2					
	21.5	0					4	4	3.5	11.0	10
								4.3	4	13.5	
								4	4	12.6	
								2.5	1	2.4	
	23.5	0					0				2
	24.5	0					0				3
3.5	0.5	0					0				0
	2	0					0				0
	5	2	5	6	5.5	26.0					1
			19	5	4.5	17.7					
	7.5	0					0				0
	8.5	0					0				0
	10	1	2	8	7.5	47.2	0				1
	13.5	2	14	6.5	5.5	28.3	3	3	2.5	5.9	4
			4	3.5	3	8.3		2	2	3.1	
								1	1	0.8	
	15	0					1	3	2.5	5.9	3
	16.5	1	4	7	6	33.2	3	3	2	4.9	1
								3	2.5	5.9	
								3	2.5	5.9	
	19	4	13	6	4.5	21.6	4	3.5	3.5	9.6	10
			7	5	5.5	21.6		2	1.7	2.7	
			4	4.5	4.5	15.9		5.5	4.7	20.4	
			3	5.5	4	17.7		2	2	3.1	
	21.5	0					0				0
	23.5	0					0				4
	24.5	0					0				0

Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Macroplot 994

Data in Microplots
Observer(s): Terri Long
Date: 6/20/95

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
6	0.5	0					1	2.5	1.5	3.1	2
	2	1	32	7	7.5	41.3	0				0
	5	0					1	3	2.7	6.4	1
	7.5	2	2	4	3.7	11.6	1	2	1.5	2.4	1
			12	5.5	6	26.0					
	8.5	0					0				0
	10	0					1	3	3	7.1	2
	13.5	0					1	2.5	2	4.0	1
	15	0					1	2	1.5	2.4	11
	16.5	0					0	0	0		1
	19	0					0	0	0		0
	21.5	1	11	7	8	44.2	3	1.5	2	2.4	7
								2	1.5	2.4	
								2	1.5	2.4	
	23.5	2	3	5	4	15.9	5	2	2	3.1	7
			15	1	1	0.8		2	2	3.1	
								3	2	4.9	
								2	1.5	2.4	
								2	2	3.1	
	24.5	3	10	9.5	7	53.5	15	2	2	3.1	3
			13	5	4.5	17.7		3	2.5	5.9	
			1	7	6.3	34.7		2	2	3.1	
								2	2.5	4.0	
								3	3	7.1	
								2.5	1.5	3.1	
								3	3	7.1	
								4	3.3	10.5	
								1.5	1.5	1.8	
								3.5	3.5	9.8	
								3.3	1.5	4.5	
								2	2	3.1	
								2	2	3.1	
								4	2	7.1	
								1.5	1	1.2	
8	0.5	0					0				1
	2	0					0				0
	5	0					0				0
	7.5	0					1	2	2	3.1	1
	8.5	2	8	13	11	113.1	0				0
			2	1	1	0.8					
	10	0					0				0
	13.5	0					1	1.5	1.5	1.8	1
	15	0					1	2	1	1.8	29
	16.5	0					0				0
	19	0					0				2
	21.5	0					2	2	1.5	2.4	0
								2	1.5	2.4	
	23.5	0					0				0
	24.5	0					3	2	1.5	2.4	1
								3.5	3	8.3	
								1.5	2	2.4	

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
994	0	18	8.9			27.4	20			7.1	53
994	1	11	9.9			32.7	37			3.9	71

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Neva Road Study Site

Macroplot 995

Data in Microplots
Observer(s): Terri Long
Date: 6/20/95

		Number of Phy. bel. plants by size, class, diameter (cm x cm)								
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	2	16	7	6.5	35.8	0				0
			12	7	7	38.5					
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				1
	19	0					1	2.5	1.5	3.1	1
	21.5	1	8	6.5	5.5	28.3	0				3
	23.5	0	0				0				0
	24.5	0					1	3.5	3	8.3	0
3.5	0.5	0					0				0
	2	1	19	9	9	63.6	0				0
	5	0					9	3	2.5	5.9	7
								2	2	3.1	
								3	2.5	5.9	
								4	2.5	8.3	
								2.5	2.5	4.9	
								2.5	1.5	3.1	
								3	1.5	4.0	
								2.5	1.5	3.1	
								2	1	1.8	
	7.5	4	8	7.3	6	34.7	3	4.5	4	14.2	2
			9	8	7.5	47.2		2.5	2	4.0	
			7	7.5	6.5	38.5		2.5	2	4.0	
			8	6	5.5	26.0					
	8.5	1	12	7.5	6.5	38.5	6	6	4	19.6	8
								6.5	3	17.7	
								7.5	6	35.8	
								2	2	3.1	
								2.5	2	4.0	
								4	3.5	11.0	
	10	2	10	10	7	56.7	4	2	2	3.1	5
			7	10	9	70.9		3.5	1	4.0	
								2.5	1.5	3.1	
								2	1.5	2.4	
	13.5	3	7	5	4	15.9	4	4	4	12.6	4
			9	6	4.7	22.5		3	3	7.1	
			1	7.5	7	41.3		2	2	3.1	
								4	3	9.6	
	15	1	1	5	4.7	18.5	1	3	3		1
	16.5	1	4	6.5	6.5	33.2	1	2	2	3.1	7
	19	1	6	5	5	19.6	2	1.5	1.5	1.8	12
								2	2	3.1	
	21.5	7	7	7.5	7	41.3	8	2	2	3.1	3
			3	6.5	6	30.7		2	2	3.1	
			4	6.3	4.5	22.9		3	3	7.1	
			6	7	5.5	30.7		6	6	28.3	
			2	5	4	15.9		4	4	12.6	
			3	6	5	23.8		5	5	19.6	
			6	7	4.7	26.9		6	6	28.3	
								2	1.5	2.4	
	23.5	0					4	3.0	2.5	5.9	4
								2.5	2.0	4.0	
								1.5	1.5	1.8	
								5.0	5.0	19.6	
	24.5	0					2	3	2.5	5.9	3
								2	2	3.1	

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Neva Road Study Site

Macroplot 995

Data in Microplots
Observer(s): Terri Long
Date: 6/20/95

Transect (m)	Microplot Dist. (m)	Reproductive					Juvenile				Seedlings
		Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
6	0.5	0					0				0
	2	0					0				2
	5	0					0				0
	7.5	0					0				3
	8.5	0					0				11
	10	0					0				2
	13.5	0					1	3	2	4.9	3
	15	2	28	12.5	12.0	117.9	0				12
			20	8.5	7.0	47.2					
	16.5	2	4	3.0	2.7	6.4	0				2
			1	4.5	3.5	12.6					
	19	0					0				1
	21.5	0					0				0
	23.5	0					0				0
	24.5	1	7	4	3.5	11.0	0				0
8	0.5	0					0				0
	2	0					0				0
	5	0					0				1
	7.5	2	1	6	5.5	26.0	0				2
			10	4	3	9.6					
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				1
	16.5	0					0				1
	19	0					2	5	5	19.6	0
								2.5	2.5	4.9	
	21.5	0					2	3.5	3.5	9.6	6
								2	1	1.8	
	23.5	3	14	5.3	4	17.0	0				0
			1	2.5	2.3	4.5					
			15	4.5	3.5	12.6					
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg no. of stems per plant			Avg area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
995	1	24	7.3			34.2	46			8.1	61
995	0	10	10.1			26.5	5			8.2	47

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/20/95

		Number of Phy. bel. plants by size, class, diameter (cm x cm) and area (cm2)									
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				0
	2	0					0				2
	5	0					4	3	3	7.1	6
								4	4	12.6	
								4	4	12.6	
								6	6	12.6	
	7.5	0					1	5	5	19.6	5
	8.5	0					0				13
	10	0					1	3	3	7.1	0
	13.5	2	2	4	4	12.6	0				8
			10	4	4	12.6					
	15	0					1	6.00	6.00	28.3	1
	16.5	1	7	5.0	5	28.3	0				10
	19	1	5	7	7.0	38.5	0				2
	21.5	1	16	15.0	15.0	176.7	0				0
	23.5	0					0				1
	24.5	0					0				0
3.5	0.5	0					0				0
	2	0					0				1
	5	0					3	4	4	12.6	6
								3	3	7.1	
								3	3	7.1	
	7.5	0					0				6
	8.5	6	1	5	5	19.6	1	6	6	28.3	12
			6	5	5	19.6					
			2	6	6	28.3					
			7	8	8	50.3					
			3	5	5	19.6					
			12	7	7	38.5					
	10	1	40	10	10	78.5	4	3	3	7.1	5
								6	6	28.3	
								5	5	19.6	
								5	5	19.6	
	13.5	0					0				1
	15	0					1	6	6	28.3	0
	16.5	1	6	9	9	63.6	2	3	3	7.1	8
								4	4	12.6	
	19	0					1	3	3	7.1	0
	21.5	5	7	7	7	38.5	4	5	5	19.6	1
			11	7	7	38.5		3	3	7.1	
			1	5	5	19.6		3	3	7.1	
			6	5	5	19.6		3	3	7.1	
			6	7	7	38.5					
	23.5	0					0				0
	24.5	0					0				0

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Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/20/95

Macroplot 996

| | | Number of Phy. bel. plants by size, class, diameter (cm x cm) and area (cm2) | | | | | | | | | |
| | | Reproductive | | | | | Juvenile | | | | Seedlings |
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
6	0.5	1	19	9	9	63.6	0				0
	2	0					0				5
	5	0					1	15	15	176.7	1
	7.5	0					0				0
	8.5	0					0				1
	10	0					0				1
	13.5	0					0				1
	15	0					0				0
	16.5	0					0				0
	19	0					0				1
	21.5	0					0				6
	23.5	0					0				0
	24.5	0					1	6	6	28.3	0
8	0.5	0					2	3	3	7.1	0
							4		4	12.6	
	2	2	19	13	13	132.7	1	2	2	3.1	3
			21	8	8	50.3					
	5	0					0				1
	7.5	2	17	10	10	78.5	0				1
			6	9	9	63.6					
	8.5	0					0				2
	10	0					0				0
	13.5	0	0				0				1
	15	0					0				0
	16.5	1	16	8.0	8.0	50.3	0				0
	19	0					0				2
	21.5	0					1	8	8	50.3	1
	23.5	0					0				0
	24.5	0					0				1

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
996	0	18	8.2			41.2	23			14.1	88
996	1	6	16.3			73.2	6			46.3	28

Data in Microplots
Observer(s): Terri Long
Date: 6/23/95

		Number of Phy. bel. plants by size class, diameter (cm x cm) and area)cm2)									
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				1
	2	0					1	2.3	2.1	3.8	1
	5	1	14	8.3	8	52.2	0				0
	7.5	0					1	7	6.2	34.2	0
	8.5	0					0				0
	10	1	14	10	9.5	74.7	0				1
	13.5	0					2	2	1.5	2.4	7
								2.5	2.5	4.9	
	15	0					0				0
	16.5	0					1	2.5	2.3	4.5	2
	19	0					1	2.5	2.5	4.9	2
	21.5	0					9	4	3	9.6	6
								2	2	3.1	
								3	3	7.1	
								6.5	6	30.7	
								9	7	50.3	
								8.5	8	53.5	
								2.5	2	4.0	
								3	2.5	5.9	
								4	3	9.8	
	23.5	1	2	7.3	6.5	37.4	1	5	4.5	17.7	7
							0				
	24.5	0					0				1
3.5	0.5	0					0				0
	2	0					0				0
	5	0					1	2	2	3.1	0
	7.5	0					5	3	3	7.1	0
								3	3	7.1	
								3.7	3.5	10.2	
								3	2.5	5.9	
								3	3	7.1	
	8.5	0					6	3.2	3	7.5	0
								3.5	3	8.3	
								2.7	2.7	5.7	
								3	2.7	6.4	
								2	1.7	2.7	
								3.5	3	8.3	
	10	0					0				3
	13.5	2	27	10.5	9	74.7	5	4	3	9.6	12
			40	12	9	86.6		2.5	2	4.0	
								3.5	3	8.3	
								3	2	4.9	
								3.2	3	7.5	
	15	0					1	3.7	3	8.8	2
	16.5	0					5	4.5	4	14.2	1
								2	1	1.8	
								3.5	2.5	7.1	
								3	2.3	5.5	
								3	2.5	5.9	
	19	0					4	2	2	3.1	7
								3	2	4.9	
								2.7	2	4.3	
								2.7	2.3	4.9	
	21.5	1	7	7	7	38.5	0				5
	23.5	0					1	2.5	2.0	4.0	3
	24.5	0					0				0

Data in Microplots
Observer(s): Terri Long
Date: 6/23/95

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					2	2.5	2.3	4.5	1
							3	2.5	5.9		
	10	2	9	12	11	103.9	1	5.5	5.3	22.9	0
			1	8	7	44.2					
	13.5	0					2	2.5	1.5	3.1	2
							2	1	1.8		
	15	0					0				0
	16.5	0					0				2
	19	0					1	2.3	1.7	3.1	3
	21.5	0					0				2
	23.5	4	2	5.7	3.3	15.9	1	2.7	2.5	5.3	0
			3	8.5	6	41.9					
			4	6	4.3	20.8					
			1	8	7.5	47.2					
	24.5	0					0				1
8	0.5	0					0				0
	2	0					0				0
	5	0					1	4.5	3.5	12.6	0
	7.5	0					0				7
	8.5	0					0				0
	10	0					5	2.5	2.5	4.9	1
								2.5	2.3	4.5	
								3	2	4.9	
								2	1.5	2.4	
								1.5	1	1.2	
	13.5	0					0				1
	15	3	15	4.5	4.5	15.9	1	1.5	1	1.2	0
			24	7.5	6.5	38.5					
			24	7	6	33.2					
	16.5	1	3	5	4	14.2	0.0				7
	19	0					1	2	1.3	2.1	
	21.5						2	2	2	3.1	1
								2	1	1.4	
	23.5	0					0				4
	24.5	0					0				1

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro (cm2)	Total No. of Juv. plants			Avg. Area of Juv (cm2)	Total No. of Seedlings
997	1	6	17.3			60.7	44			9.6	61
997	0	10	8.6			37.6	17			5.0	33

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/23/95

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
1.5	0.5	0					0				0
	2	2	9	5	5	19.6	3	5	3	7.1	0
			10	6	5	23.8		3	3	7.1	
								3	3	7.1	
	5	0					0				2
	7.5	0					0				1
	8.5	1	5	5	5	19.6	1	5	5	19.6	2
	10	1	58	10	10	78.5	0				5
	13.5	0					0				2
	15	1	9	10	10	78.5	1	5	5.00	19.6	11
	16.5	1	15	7.0	7.0	38.5	0				0
	19	2	2	5	5	19.6	6	2	2	3.1	1
			2	5	5	19.6		4.0	4	12.6	
								5.0	3	7.1	
								5.0	5	19.6	
								3	3	7.1	
	21.5	0						4	4	12.6	6
	23.5	0					0				3
	24.5	0					0				3
3.5	0.5	0					0				0
	2	0					0				0
	5	2	25	9	9	63.6	3	4	4	12.6	5
			4	8	8	50.3		3	3	7.1	
								3	3	7.1	
	7.5	1	18	8	8	50.3	0				1
	8.5	0					0				1
	10	1	6	6	6	28.3	3	3	3	7.1	6
								3	3	7.1	
								3	3	7.1	
	13.5	0					0				9
	15	1	1	7	7	38.5	8	3	3	7.1	9
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
	16.5	0					0				10
	19	1	8	6	6		17	4	4	12.6	3
								4	4	12.6	
								3	3	7.1	
								3	3	7.1	
								2	2	3.1	
								3	3	7.1	
								4	4	12.6	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
								3	3	7.1	
	21.5	0					1	4	4	12.6	2
	23.5	0					2	3	3	7.1	0.0
								3	3	7.1	
	24.5	0					0				1

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Neva Road Study Site

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/23/95

Macroplot 998

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
6	0.5	0					0				0
	2	1	5	5	5	19.6	4	5	5	19.6	0
								4	4	12.6	
								4	4	12.6	
								3	3	7.1	
	5	0					2	2	3	3	0
								2	2		
	7.5	1	8	8	8	50.3	1	4	4	12.6	
	8.5	0					0				1
	10	0					3	3	3	7.1	1
								3	3	7.1	
								2	2	3.1	
	13.5	0					0				1
	15	4	1	5.0	5.0	19.6	0				1
			1	5.0	5.0	19.6					
			15	6.0	6.0	28.3					
			15	8.0	8.0	50.3					
	16.5	1	4	6.0	6.0	28.3	0				0
	19	4	6	5.0	5.0	19.6	2	4	4	12.6	1
			10	7.0	7.0	38.5		8	8	50.3	
			11	7.0	7.0	38.5					
			1	8.0	8.0	50.3					
	21.5	0					0				2
	23.5	2	2	5	5	19.6	0				2
			17	7	7	38.5					
	24.5	1	5	7	7	38.5	0				0
8	0.5	2	4	4	4	12.6	0				1
			7	4	4	12.6					
	2	2	1	4	4	12.6	0				2
			25	6	6	28.3					
	5	0					0				2
	7.5	1	16	8	8	50.3	2	4.0	4	12.6	2
								3.0	3	7.1	
	8.5	1	12	6	6	28.3	0				0
	10	0					0				1
	13.5	1	14	6.0	6.0	28.3	0	0			1
	15	1	24	7	7		0	0.0			0
	16.5	8	52	14.0	14.0	153.9	3	2	2	3.1	21
			7	5.0	5.0	19.6		2	2	3.1	
			10	5.0	5.0	19.6		5	5	19.6	
			1	7.0	7.0	38.5					
			4	3.0	3.0	7.1					
			4	4.0	4.0	12.6					
			3	4.0	4.0	12.6					
			9	6.0	6.0	28.3					
	19	1	16	6	6	28.3	2	5	5	19.6	0
								5	5	19.6	
	21.5	11	21	4	4	12.6	3	3	3	7.1	0
			1	3	3	7.1		3	3	7.1	
			2	3	3	7.1		3	3	7.1	
			3	3	3	7.1					
			2	3	3	7.1					
			7	5	5	19.6					
			6	5	5	19.6					
			7	5	5	19.6					
			18	6	6	28.3					
			18	7	7	38.5					
			4	4	4	12.6					
	23.5	0					0				1
	24.5	0					0				0
		0									

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
998	1	14	12.3			40.7	45			8.6	83
998	0	42	9.5			27.6	22			11.6	40

Data in Microplots
Observer(s): Terri Long
Date: 6/23/95

		Number of Phy. bel. plants by size, class, diameter (cm x cm)								
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				0
	2	0					1	2	2	3.1	0
	5	1	15	1	1	0.8	0				1
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	1	10	6	5	23.8	0				0
	16.5	1	13	5.5	5.0	21.6	0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
3.5	0.5	0					1	2	1.7	2.7	0
	2	0					1	4.5	4	14.2	0
	5	0					0				0
	7.5	0					0				1
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					1	2	2	3.1	0
	16.5	0					0				0
	19	1	17	6	5	23.8	3	5.5	4.5	19.6	1
								7.5	5	30.7	
								6.5	5	26.0	
	21.5	0					0				0
	23.5	0					1	3.7	3.0	8.8	1
	24.5	1	46	10	9	70.9	1	3	2.5	5.9	1

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Neva Road Study Site

Macroplot 999

Data in Microplots
Observer(s): Terri Long
Date: 6/23/95

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlings Number of plants
6	0.5	0					2	3	2	4.9	0
								3	2.5	5.9	
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	1	16	7	7	38.5	0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				1
	21.5	0					0				1
	23.5	0					0				0
	24.5	0					0				0
8	0.5	1	16	4.5	3.5	12.6	1	2.5	2	4.0	0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				2
	10	0					1	2.5	1.5		1
	13.5	0					0				0
	15	0					0				4
	16.5	0					0				2
	19	0					0				0
	21.5	0					0				1
	23.5	0					0				0
	24.5	0					0				5

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
999	0	5	20.2			28.2	9			12.7	5
999	1	2	16.0			25.5	4			4.9	17

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Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Macroplot 1000

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/23/95

		Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				1
	8.5	0					0				0
	10	0					1	8	8	50.3	0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
3.5	0.5	0					0				0
	2	2	9	9	9	63.6	0				0
			9	10	10	78.5					
	5	0					0				0
	7.5	1	12	10	10	78.5	0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	1	11	8	8	50.3	0				0
	23.5	1	2	5.0	5.0	19.6	0				0
	24.5	0					1	3	3	7.1	0

Physaria Bellii Study - City of Boulder Open Space
Neva Road Study Site

Data in Microplots
Observer(s): Dickson Pratt
Date: 6/23/95

Macroplot 1000

		Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	1	10	4	4	12.6	1	5	5	19.6	0
	8.5	0					0				0
	10	0					1	5	3	12.6	7
	13.5	0					0				7
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	1	7	7	7		0				0
8	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				1
	8.5	2	16	10	10	78.5	0				1
			19	10	10	78.5					
	10	0					0				4
	13.5	3	7	5.0	5.0	19.6	1	3.0	3.0	7.1	2
			16	6	6	28.3					
			1	4	4	12.6					
	15	0					0				6
	16.5	0					0				2
	19	0					0				2
	21.5	0					2	3	3	7.1	1
								3	3	7.1	
	23.5	0					0				1
	24.5	2	6	7	7	38.5	1	3	3	7.1	9
			9	7	7	38.5					

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
1000	1	5	8.6			58.1	2			28.7	1
1000	0	9	10.1			38.4	6			10.1	43

Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/6/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
⚫w data for P. bellii plants for 1996
⚫acroplot 991

Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
		Reproductive					**Juvenile**				**Seedlings**
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					1	0.70	0.50	0.3	1
	16.5	1	7	4.5	4.0	14.2	3	4.9	4.7	18.1	0
								4.5	2.3	9.1	
								2.4	2.1	4.0	
	19	0					0				0
	21.5	1	9	5.5	4.5	19.6	0				0
	23.5	3	6	4.8	5.0	18.9	0				0
			1	4.8	2.3	9.9					
			2	3.0	2.1	5.1	0				
	24.5	0					0				0
3.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				1
	23.5	1	1	4.5	4.5	15.9	1	3.3	3.2	8.3	2
	24.5	0					0				0

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll

Experimental Plots at the Neva Road Study Site   Date: 6/6/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

●w data for P. bellii plants for 1996

●croplot 991

		Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedlings
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	1	17	11.4	9.5	85.8	0				0
	16.5	1	1	5.6	4.7	20.8	0				0
	19	1	9	2.8	2.7	5.9	0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
8	0.5	0					0				0
	2	0					0				0
	5	0					1	2.0	1.9		0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	1	1	5.0	4.5	17.7	5	3.3	3.4	8.8	0
								4.4	2.4	9.1	
								3.6	2.8	8.0	
								2.6	2.7	5.5	
								3.0	2.6	6.2	
	15	0					0				1
	16.5	1	2	3.8	3.3	9.9	0				1
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
991	0	6	4.3			13.9	5			7.9	4
991	1	5	6.0			28.0	6			7.5	2

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Physaria Bellii Study - City of Boulder Open Space
Experimental Plots at the Neva Road Study Site
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
w data for P. bellii plants for 1996
croplot 992

Observer(s): Alan Carpenter/ Allison Roll
Date: 6/6/96

Transect (m)	Microplot Dist. (m)	Reproductive					Juvenile				Seedl
		Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plan
1.5	0.5	0					0				0
	2	0					0				0
	5	1	3	3.4	2.2	6.2	0				0
	7.5	2	7	4.8	5.8	22.1	0				0
			18	6.3	7.0	34.7					
	8.5	1	3	9.4	6.4	49.0	0				0
	10	3	2	6.4	5.9	29.7	2	4.4	3.6	12.6	0
			1	4.9	3.6	14.2		0.8	1.1	0.7	
			2	3.3	2.5	6.6					
	13.5	0					1	2.9	2.7	6.2	0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
3.5	0.5	0					0				0
	2	0					0				0
	5	0					1	1.5	1.2	1.4	0
	7.5	1	16	7.0	6.2	34.2	0				0
	8.5	0					3	1.5	0.5	0.8	1
								0.8	0.3	0.2	
								1.6	1.5	1.9	
	10	0					4	2.0	2.4	3.8	2
								2.3	0.9	2.0	
								2.1	1.7	2.8	
								2.6	1.8	3.8	
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Physaria Bellii Study - *City of Boulder Open Space*   Observer(s): Alan Carpenter/ Allison Roll

Experimental Plots at the Neva Road Study Site   Date: 6/6/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

w data for P. bellii plants for 1996

acroplot 992

		Number of Phy. bel. plants size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedl
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plan
6	0.5	1	13	8.4	7.6	50.3	6	2.5	2.2	4.3	1
								4.8	3.7	14.2	
								1.0	0.4	0.4	
								1.1	0.6	0.6	
								1.4	1.0	1.1	
								1.7	1.6	2.1	
	2	1	3	4.5	4.0	14.2	0				0
	5	1	27	8.4	8.3	54.8	1	1.0	0.6	0.5	1
	7.5	0					1	1.9	1.6	2.4	1
	8.5	0					1	3.3	3.1	8.0	0
	10	1	9	2.4	2.0	3.8	1	1.4	1.2	1.3	3
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	1	3	6.4	4.5	23.3	0				1
	24.5	0					0				0
8	0.5	0					0				0
	2	1	21	5.3	5.0	20.8	0				0
	5	0					0				0
	7.5	1	13	4.5	3.9	13.9	1	3.0	1.8	4.5	0
	8.5	0					3	1.2	0.3	0.4	0
								2.4	1.6	3.1	
								3.8	2.9	8.8	
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				1
	19	0					1	5.5	5.3	22.9	0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg no. of stems per plant			Avg area of Repro. (cm2)	Total No. of Juv. plants			Avg Area of Juv. (cm2)	Total No. of Seedlings
992	0	8	6.5			24.6	11			3.3	3
992	1	7	12.7			25.9	15			5.0	8

Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/7/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
Raw data for P. bellii plants for 1996
Macroplot 993

Transect (m)	Microplot Dist. (m)	Reproductive					Juvenile				Seedl
		Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plan
1.5	0.5	0					0				0
	2	2	1	2.6	2.1	4.3	1	0.8	0.8	0.5	1
			5	3.0	2.3	5.5					
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				1
	13.5	0					0				0
	15	0					0				0
	16.5	1	26	9.3	9.0	65.8	2	2.5	2.1	4.2	0
								1.6	0.9	1.2	
	19	1	15	6.4	5.5	27.8	2	1.9	1.2	1.9	1
								0.8	0.4	0.3	
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					1	0.8	0.5	0.3	1
3.5	0.5	1	4	3.7	3.1	9.1	0				1
	2	0					0				0
	5	1	7	6.4	5.7	28.7	0				0
	7.5	0					0				1
	8.5	0					0				1
	10	0					0				0
	13.5	1	2	4.0	3.9	12.3	4	2.6	2.5	5.1	0
								2.2	1.5	2.7	
								1.6	1.3	1.7	
								2.0	1.9	3.0	
	15	1	15	4.7	3.6	13.5	2	1.3	0.6	0.7	0
								1.4	1.2	1.3	
	16.5	1	4	3.8	2.6	8.0	2	2.4	1.9	3.6	1
								2.6	2.5	5.1	
	19	0					0				1
	21.5	1	1	1.7	1.6	2.1	0				0
	23.5	0					0				1
	24.5	0					0				0

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Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/7/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
Raw data for P. bellii plants for 1996
Macroplot 993

Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plan
		Reproductive					Juvenile				Seedl
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	2	1	2.8	2.5	5.5	1	1.1	0.8	0.7	0
			1	3.8	3.3	9.9					
	10	6	1	3.8	2.4	7.5	0				2
			7	3.8	3.6	10.8					
			2	4.7	4.4	16.3					
			3	4.8	3.5	13.5					
			4	5.6	4.4	19.6					
			2	5.7	4.5	20.4					
	13.5	0					0				0
	15	1	4	4.1	3.8	12.3	0				0
	16.5	3	8	5.4	4.6	19.6	0				0
			3	2.6	2.3	4.7					
			5	3.7	3.0	8.8					
	19	0					1	5.2	4.8	19.6	0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
8	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					1	6.4	5.9	29.7	0
	8.5	0					1	1.4	1.3	1.4	1
	10	1	2	8.6	7.9	53.5	2	1.6	1.1	1.4	0
								1.3	1.5	1.5	
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				1
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
993	1	10	8.0			17.7	14			2.3	10
993	0	13	3.3			15.6	6			9.1	4

Physaria bellii Study - City of Boulder Open Space
Experimental Plots at the Neva Road Study Site
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
...w data for P. bellii plants for 1996
...croplot 994

Observer(s): Alan Carpenter/ Allison Roll
Date: 6/6/96

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedl Number of plan
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	1	2	3.4	3.3	8.8	0				0
	8.5	1	15	4.7	4.5	16.6	0				1
	10	0					2	1.5	1.4	1.7	0
								1.1	0.9	0.8	
	13.5	1	1	1.1	1.0	0.9	2	3.2	2.0	5.3	0
								1.2	0.8	0.8	
	15	0					0				0
	16.5	1	3	3.8	3.5	10.5	0				1
	19	2	1	1.4	1.3	1.4	3	4.8	4.3	16.3	0
			1	2.0	1.5	2.4		2.2	2.1	3.6	
								0.7	0.5	0.3	
	21.5	3	4	4.5	3.9	13.9	3	4.3	4.2	14.2	1
			1	5.0	4.8	18.9		3.2	2.9	7.3	
			1	3.8	3.4	10.2		2.8	2.4	5.3	
	23.5	0					0				0
	24.5	0					0				1
3.5	0.5	0					0				0
	2	0					0				0
	5	1	1	5.0	4.2	16.6	0				1
	7.5	0					0				0
	8.5	0					0				0
	10	1	17	4.9	3.8	14.9	0				0
	13.5	2	4	8.6	8.4	56.7	1	2.2	1.8	3.1	0
			1	3.0	2.4	5.7					0
	15	0					2	2.8	1.8	4.2	0
								2.0	1.7	2.7	
	16.5	1	6	7.3	6.9	39.6	1	2.4	2.3	4.3	0
	19	3	4	4.4	4.0	13.9	6	1.0	0.5	0.4	4
			3	3.6	2.7	7.8		1.8	1.7	2.4	
			2	4.7	3.8	14.2		3.0	2.3	5.5	
								3.2	1.5	4.3	
								3.9	3.6	11.0	
								2.6	2.3	4.7	
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					1	1.8	1.4	2.0	0

Physaria bellii Study - City of Boulder Open Space

Observer(s): Alan Carpenter/ Allison Roll

Experimental Plots at the Neva Road Study Site

Date: 6/6/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

aw data for P. bellii plants for 1996

acroplot 994

		Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedl
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plan
6	0.5	1	1	4.8	4.4	16.6	0				0
	2	0					0				0
	5	1	5	5.7	5.3	23.8	1	3.8	3.6	10.8	0
	7.5	1	5	6.9	6.4	34.7	1	3.8	3.4	10.2	0
	8.5	0					0				0
	10	3	4	7.0	6.8	37.4	1	1.3	1.1	1.1	1
			2	6.3	5.9	29.2					
			4	6.8	5.3	28.7					
	13.5	1	5	7.2	7.0	39.6	0				0
	15	1	1	4.4	3.9	13.5	1	3.8	3.4	10.2	1
	16.5	0					0				0
	19	0					0				0
	21.5	0					2	2.6	1.8	3.8	2
								2.2	1.9	3.3	
	23.5	1	6	6.5	4.9	25.5	2	1.4	1.2	1.3	1
								3.8	3.0	9.1	
	24.5	3	1	7.2	5.7	32.7	2	1.1	0.9	0.8	6
			4	6.4	4.5	23.3		1.4	0.3	0.6	
			1	3.5	3.2	8.8					
8	0.5	0					0				0
	2.0	0					0				0
	5.0	0					1	1.8	1.2	1.8	0
	7.5	0					2	1.2	0.6	0.6	0
								1.7	1.3	1.8	
	8.5	1	13	8.3	7.8	50.9	0				1
	10.0	1	8	7.2	6.8	38.5	0				0
	13.5	0					1	2.2	1.9	3.3	0
	15.0	0					0				0
	16.5	0					0				0
	19.0	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					1	2.5	2.2	4.3	0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlings
994	0	17	3.9			14.9	21			4.8	9
994	1	14	4.3			28.8	15			4.2	12

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Physaria bellii Study - City of Boulder Open Space

Experimental Plots at the Neva Road Study Site

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.

Raw data for P. bellii plants for 1996

Macroplot 995

Observer(s): Alan Carpenter/ Allison Roll
Date: 6/7/96

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedl Number of plan
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	2	1	7.8	6.3	39.0	0				0
			6	6.5	5.8	30.2					
	10	0					0				0
	13.5	0					0				0
	15	0					0				1
	16.5	0					1	3.6	2.5	7.3	0
	19	0					0				2
	21.5	0					4	1.4	1.2	1.3	3
								1.3	0.7	0.8	
								0.6	0.4	0.2	
								1.6	0.9	1.2	
	23.5	0					0				1
	24.5	0					0				1
3.5	0.5	0					0				0
	2	1	6	6.2	5.6	27.3	0				0
	5	0					5	2.9	2.0	2.0	5
								3.9	3.7	11.3	
								4.5	3.4	12.3	
								4.2	3.5	11.6	
								2.4	1.9	3.6	
	7.5	1	4	7.1	6.9	38.5	5	6.4	5.9	29.7	16
								3.9	3.5	10.8	
								6.2	4.4	22.1	
								2.2	1.8	3.1	
								2.3	1.4	2.7	
	8.5	3	3	6.9	4.2	24.2	3	2.3	1.8	3.3	4
			1	3.5	4.3	11.9		1.8	1.9	2.7	
			1	3.3	2.9	7.6		3.7	2.8	8.3	
	10	2	1	6.5	6.2	31.7	5	3.2	2.4	6.2	1
			2	3.0	3.0	7.1		2.3	1.5	2.8	
								3.8	2.4	7.5	
								1.4	0.9	1.0	
								2.6	2.5	5.1	
	13.5	0					4	1.5	1.0	1.2	2
								4.3	3.6	12.3	
								2.9	2.8	6.4	
								4.4	4.1	14.2	
	15	1	7	2.2	2.2	3.8	0				2
	16.5	0					0				0
	19	1	5	4.3	4.1	13.9	5	1.9	1.3	2.0	3
								1.3	0.8	0.9	
								2.2	1.7	3.0	
								1.5	1.2	1.4	
								1.2	1.0	1.0	
	21.5	1	3	5.9	3.7	18.1	1	2.5	2.0	4.0	0
	23.5	0					1	5.8	4.9	21.6	0
	24.5	0					3	1.3	0.9	1.0	1
								1.2	1.0	1.0	
								1.6	1.1	1.4	

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Physaria bellii Study - City of Boulder Open Space
Experimental Plots at the Neva Road Study Site
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
aw data for P. bellii plants for 1996
acroplot 995

Observer(s): Alan Carpenter/ Allison Roll
Date: 6/7/96

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedl Number of plan
6.0	0.5	0					0				0
	2.0	0					0				1
	5.0	0					0				2
	7.5	0					1	1.3	0.5	0.6	3
	8.5	0					1	1.2	0.8	0.8	0
	10	0					0				0
	13.5	0					0				0
	15.0	0					1	1.6	0.6	1.0	4
	16.5	0					2	1.2	1.0	1.0	0
								1.5	0.7	1.0	
	19.0	0					0				0
	21.5	0					0				0
	23.5	0					1	1.4	1.1	1.2	0
	24.5	0					0				1
8.0	0.5	0					0				0
	2.0	0					0				0
	5.0	0					0				0
	7.5	0					0				0
	8.5	0					0				1
	10.0	0					0				1
	13.5	0					0				1
	15	1	8	4.9	4.5	17.3	0				1
	16.5	0					0				0
	19	1	4	3.2	2.9	7.3	0				1
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro plants	Avg. no. of stems per plant			Avg. area of Repro (cm2)	Total No. of Juv. plants			Avg. Area of Juv (cm2)	Total No. of Seedlin
995	1	12	3.3			21.1	37			6.2	42
995	0	2	6.0			12.3	6			0.9	16

Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll

Experimental Plots at the Neva Road Study Site   Date: 6/12/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

Raw data for P. bellii plants for 1996

acroplot 996

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of fw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedl Number of plan
1.5	0.5	0					0				0
	2	0					0				0
	5	2	1	5.2	4.6	18.9	3	3.8	2.9	8.8	2
			8	5.7	4.9	22.1		3.3	3.5	9.1	
	7.5	1	2	3.8	3.6	10.8	1	3.3	2.5	6.6	1
	8.5	0					2	2.2	1.6	2.8	0
								1.3	0.9	1.0	
	10	0					3	1.3	0.7	0.6	2
								1.8	1.2	1.8	
								0.9	0.4	0.3	
	13.5	1	1	3.5	2.9	8.0	0				0
	15	0					0				1
	16.5	1	7	3.4	2.9	7.8	6	1.3	1.0	1.0	0
								1.4	0.9	1.0	
								1.4	1.1	1.2	
								1.4	1.3	1.4	
								2.2	1.5	2.7	
								2.5	1.7	3.5	
	19	2	13	5.8	5.6	25.5	2	2.1	1.9	3.1	0
			16	6.7	6.2	32.7		2.2	2.1	3.6	
	21.5	0					0				3
	23.5	0					0				0
	24.5	0					0				0
3.0	0.5	0					0				0
	2	0					0				0
	5	0					0				2
	7.5	0					3	2.2	1.5	2.7	2
								2.6	1.9	4.0	
	8.5	7	1	3.0	2.8	6.6	0				0
			2	2.4	2.1	4.0					
			1	2.2	1.6	2.8					
			5	2.5	1.1	2.5					
			1	2.4	2.1	4.0					
			3	2.2	1.5	2.7					
			4	5.5	3.5	15.9					
	10	3	4	5.9	5.5	25.5	5	3.0	2.9	6.8	0
			2	7.3	6.5	37.4		2.8	2.4	5.3	
			7	6.9	6.4	34.7		5.4	2.8	7.5	
								1.8	0.9	1.4	
								1.8	1.7	2.4	
	13.5	1	8	4.0	3.9	12.3	1	1.8	1.5	2.1	0
	15	1	11	5.2	4.9	20.0	0				1
	16.5	2	11	5.3	4.5	18.9	3	2.2	1.8	3.1	0
			1	4.2	3.9	12.9		4.4	3.6	13.2	
								3.1	2.0	5.1	
	19	1	1	5.3	4.8	20.0	0				0
	21.5	8	2	3.2	3.1	7.8	2	2.0	1.8	2.8	1
			7	4.5	4.4	15.6		2.8	2.0	4.5	
			2	4.6	4.3	15.6					
			1	3.3	2.4	6.4					
			1	1.5	1.2	1.4					
			2	2.5	2.0	4.0					
			4	5.2	3.9	16.3					
			6	3.6	3.0	8.6					
	23.5	0					0				0
	24.5	0					0				0

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/12/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
Raw data for P. bellii plants for 1996
Macroplot 996

Transect (m)	Microplot Dist. (m)	Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedl
		Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plan
6	0.5	0					0				0
	2	0					0				0
	5	1	23	7.5	6.4	37.9	0				1
	7.5	1	2	5.0	4.5	17.7	0				0
	8.5	0					1	1.3	0.9	1.0	0
	10	0					0				0
	13.5	0					1	3.2	3.0	7.5	0
	15	0					0				0
	16.5	1	5	4.6	3.9	14.2	0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	1	4	3.8	3.5	10.5	0				0
8	0.5	1	5	2.8	2.6	5.7	1	2.3	2.1	3.8	0
	2	3	8	4.3	4.0	13.5	4	1.9	1.9	2.8	0
			15	6.3	7.5	49.0		1.3	0.9	1.0	
			31	9.5	8.4	62.9		1.3	0.8	0.9	
								2.7	2.6	5.5	
	5	0					1	1.8	1.6	2.3	0
	7.5	2	23	5.0	4.7	18.5	0				0
			16	4.9	4.8	18.5					
	8.5	1	4	5.0	4.4	17.3	1	5.1	5.0	20.0	0
	10	0					0				0
	13.5	0					0				0
	15	0					1	1.2	0.9	0.9	0
	16.5	0					0				1
	19	0					0				0
	21.5	1	10	4.4	3.9	13.5	1	1.9	1.3	2.0	1
	23.5	0					1	2.2	2.0	3.5	0
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlin
996	0	30	4.5			14.0	31			3.8	15
996	1	12	12.2			23.3	12			4.3	3

Physaria bellii Study - City of Boulder Open Space Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site Date: 6/12/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
Raw data for P. bellii plants for 1996
Macroplot 997

Transect (m)	Microplot Dist (m)	Reproductive					Juvenile				Seedl
		Number of plants	no. of flw stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of seed
1.5	0.5	0					0				0
	2	0					1	0.9	0.8	0.6	0
	5	1	20	7.0	6.9	37.9	0				0
	7.5	0					1	2.0	1.9	3.0	0
	8.5	0					0				0
	10	1	25	8.4	7.1	47.2	0				0
	13.5	1	3	5.3	4.9	20.4	3	2.6	2.6	5.3	2
								3.8	3.2	9.6	
								2.4	2.2	4.2	
	15	0					0				2
	16.5	1	3	2.3	2.0	3.6	2	0.8	0.3	0.2	0
								1.9	1.7	2.5	
	19	0					1	2.5	2.4	4.7	0
	21.5	3	11	8.9	8.4	58.8	1	3.5	3.4	9.3	1
			3	4.6	2.9	11.0					
			2	4.3	3.5	11.9					
	23.5	2	12	3.9	3.8	11.6	0				0
			5	5.0	4.8	18.9					
	24.5	0					0				0
3.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	2	1	4.4	4.3	14.9	2	4.4	3.8	13.2	7
			5	4.2	3.6	12.6		2.3	1.6	3.0	
	8.5	0					1	7.7	7.2	43.6	0
	10	1	3	4.8	4.0	15.2	1	4.4	3.8	13.2	
	13.5	1	4	5.7	5.0	22.5	5	2.8	2.7	5.9	9
								3.2	2.4	6.2	
								3.2	2.8	7.1	
								3.9	2.7	8.6	
								2.6	2.4	4.9	
	15	0					0				0
	16.5	0					0				0
	19	1	1	2.8	2.4	5.3	10	2.7	2.6	5.5	2
								3.5	2.8	7.8	
								2.4	2.2	4.2	
								2.8	2.7	5.9	
								2.4	1.8	3.5	
								3.2	2.9	7.3	
								3.5	2.8	7.8	
								2.8	2.5	5.5	
								2.3	1.9	3.5	
								3.2	3.2	8.0	
	21.5	0					3	2.7	2.4	5.1	1
								2.5	2.4	4.7	
								1.6	0.6	1.1	
	23.5	0					1	2.1	0.9	1.8	3
	24.5	0					0				0

Number of Phy. bel. plants by size, class, diameter (cm x cm)

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Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/12/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
ᴡ data for P. bellii plants for 1996
ᴀacroplot 997

Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of seed
		Reproductive					**Juvenile**				**Seedl**
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				
	8.5	2	1	6.2	5.9	28.7	1	4.2	3.6	11.9	3
			3	6.5	5.3	27.3					
	10	2	11	6.5	5.7	29.2	0				0
			2	6.3	5.3	26.4					
	13.5	0					0				4
	15	0					0				0
	16.5	0					1	2.9	2.4	5.5	0
	19	0									0
	21.5	0									
	23.5	4	9	6.1	5.1	24.6	1	3.8	3.7	11.0	0
			7	4.5	3.9	13.9					
			3	2.7	2.3	4.9					
			2	1.9	1.6	2.4					
	24.5	0					0				1
8	0.5	0					0				0
	2	0					0				0
	5	1	4	4.0	3.8	11.9	0				0
	7.5	0									0
	8.5	0									0
	10	0					1	5.7	5.0	22.5	1
	13.5	0					0				0
	15	1	7	4.3	4.2	14.2	0				0
	16.5	0					0				0
	19	1	6	5.5	4.5	19.6	0				0
	21.5	0					0				7
	23.5	0					0				1
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlin
997	1	14	7.0			20.8	32			6.8	27
997	0	11	5.0			18.5	4			12.7	17

Physaria bellii Study - City of Boulder Open Space
Experimental Plots at the Neva Road Study Site
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
Raw data for P. bellii plants for 1996
Macroplot 998

Observer(s): Alan Carpenter/ Allison Roll
Date: 6/12/96

Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of seed
		Reproductive					Juvenile				Seedlin
1.5	0.5	0					0				0
	2	2	8	3.2	2.7	6.8	1	2.4	2.1	4.0	0
			2	2.5	2.2	4.3					
	5	0					1	1.5	0.9	1.1	0
	7.5	0									0
	8.5	2	1	4.0	2.5	8.3	1	1.4	1.1	1.2	0
			1	2.6	1.7	3.6					
	10	1	8	7.2	6.5	36.9	0				0
	13.5	1	1	2.3	2.2	4.0	0				0
	15	2	2	6.7	5.5	29.2	9	3.3	2.8	7.3	3
			1	4.4	3.9	13.5		1.6	1.3	1.7	
								3.4	2.2	6.2	
								2.1	1.4	2.4	
								1.5	1.5	1.8	
								1.5	0.9	1.1	
								2.9	2.4	5.5	
								2.2	1.9	3.3	
								3.8	3.2	9.6	
	16.5	0					0				3
	19.0	1	1	3.8	3.4	10.2	2	2.9	2.8	6.4	1
								3.2	2.5	6.4	
	21.5	0					0				0
	23.5	2	1	4.3	3.7	12.6	0				0
			3	3.3	3.0	7.8					
	24.5	0					0				0
3.5	0.5	0					0				1
	2	0					0				0
	5	2	2	4.8	4.5	17.0	7	1.5	1.5	1.8	0
			5	3.5	3.4	9.3		2.2	2.1	3.6	
								2.9	2.5	5.7	
								2.3	2.2	4.0	
								4.0	3.3	10.5	
								1.4	1.1	1.2	
								1.3	1.2	1.2	
	7.5	1	6	4.7	3.4	12.9	0				0
	8.5	0					0				0
	10	4	1	2.5	2.4	4.7	3	1.1	1.0	0.9	1
			4	5.3	4.5	18.9		1.8	1.4	2.0	
			3	2.9	2.8	6.4		1.9	1.6	2.4	
			3	3.2	2.8	7.1					
	13.5	0					3	2.9	2.5	5.7	1
								2.9	1.9	4.5	
								3.6	3.4	9.6	
	15	0					5	2.4	1.0	2.3	7
								1.8	1.4	2.0	
								3.8	3.3	9.9	
								2.9	2.4	5.5	
								1.8	1.5	2.1	
	16.5	0					0				0
	19	1	3	5.9	5.0	23.3	2	4.9	4.1	15.9	0
								2.6	2.4	4.9	
	21.5	1	3	5.5	4.3	18.9	0				2
	23.5	0					0				0
	24.5	0					2	1.5	1.4	1.7	0
								3.3	1.9	5.3	

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Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/12/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
Raw data for P. bellii plants for 1996
Macroplot 998

| | | Number of Phy. bel. plants by size, class, diameter (cm x cm) | | | | | | | | | |
| | | Reproductive | | | | | Juvenile | | | | Seedlin |
Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of seed
6	0.5	0					0				0
	2	3	4	2.8	2.7	5.9	2	2.4	1.6	3.1	0
			3	3.0	2.8	6.6		3.2	2.8	7.1	
			4	3.3	2.8	7.3					
	5	1	1	4.5	3.0	11.0	1	2.7	2.5	5.3	0
	7.5	1	1	4.2	3.7	12.3	1	3.2	3.1	7.8	0
	8.5	0					1	1.8	1.5	2.1	0
	10	1	2	3.5	3.1	8.6	0				0
	13.5	0					0				0
	15	3	3	5.6	4.4	19.6	1	2.9	2.8	6.4	1
			5	3.2	2.4	8.2					
			2	3.0	2.9	6.8					
	16.5	1	4	3.8	2.7	8.3	0				0
	19	4	7	3.8	3.7	11.0	1	3.1	3.1	7.5	3
			5	3.5	2.8	7.8					
			1	2.9	2.5	5.7					
			1	3.0	2.9	6.8					
	21.5	0					0				0
	23.5	2	4	2.9	2.6	5.9	2	2.3	2.5	4.5	0
			7	6.6	5.9	30.7		2.1	1.6	2.7	
	24.5	1	8	4.8	5.2	19.6	0				0
8	0.5	0					2	1.8	0.7	1.2	0
								2.1	2.6	4.3	
	2	0					1	2.3	1.7	3.1	0
	5	0					0				0
	7.5	2	1	2.1	2.6	4.3	1	2.4	2.2	4.2	0
			10	3.8	4.0	11.0					
	8.5	1	3	3.5	3.9	10.8	1	2.2	0.7	1.7	0
	10	0					0				0
	13.5	1	2	3.0	3.6	8.6	0				0
	15	0					0				0
	16.5	14	1	3.0	3.2	7.5	3	1.3	0.9	1.0	2
			1	2.4	1.5	3.0		1.9	1.6	2.4	
			1	2.1	1.7	2.8		0.5	0.9	0.4	
			2	3.2	2.4	6.2					
			1	1.9	2.3	3.5					
			1	3.7	2.9	8.6					
			1	2.5	2.5	4.9					
			2	3.1	2.5	6.2					
			1	2.5	3.6	7.3					
			5	2.1	2.6	4.7					
			2	2.7	3.3	7.1					
			4	2.7	2.5	5.3					
			1	3.2	3.9	9.9					
			2	3.9	4.0	12.3					
	19	4	4	4.0	3.5	11.0	2	2.2	1.5	2.7	0
			2	3.2	3.6	9.1		2.4	2.3	4.3	
			7	2.2	2.2	3.8					
			14	4.8	3.9	14.9					
	21.5	6	3	3.6	3.2	9.1	3	1.3	1.0	1.0	0
			19	5.0	5.7	22.5		2.5	2.3	4.5	
			1	3.6	2.8	8.0		2.2	2.3	4.0	
			1	5.0	3.0	12.6					
			2	1.8	1.9	2.7					
			12	3.6	3.2	9.1					
	23.5	0					1	2.0	1.7	2.7	0
	24.5	0					0				0

Macro plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg no. of stems per plant			Avg area of Repro. (cm2)	Total No. of Juv. plants			Avg Area of Juv. (cm2)	Total No. of Seedlin
998	1	20	3.0			12.8	36			4.5	19
998	0	45	3.7			9.1	23			3.7	6

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Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll
Experimental Plots at the Neva Road Study Site   Date: 6/12/96
There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,
in each half of each macroplot.
w data for P. bellii plants for 1996
acroplot 999

Number of Phy. bel. plants by size, class, diameter (cm x cm)

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlin+L6 Number of seedl
1.5	0.5	0					0				0
	2	0					1	5.3	5.1	21.2	0
	5	0					1	1.7	1.5	2.0	0
	7.5	0					0				0
	8.5	1	3	5.6	5.5	24.2	0				0
	10	0					0				0
	13.5	0					1	2.3	1.9	3.5	1
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
3.5	0.5	0					1	3.3	3.1	8.0	0
	2	1	6	6.2	4.8	23.8	0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	1	14	8.5	7.5	50.3	0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					1	2.5	2.1	4.2	0
6	0.5	0					2	2.7	1.8	4.0	0
								2.5	1.9	3.8	
	2	0					0				0
	5	0					0				0
	7.5	1	11	5.5	4.9	21.2	0				0
	8.5	1	3	3.5	2.3	6.6	0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter/ Allison Roll

Experimental Plots at the Neva Road Study Site   Date: 6/12/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

w data for P. bellii plants for 1996

acroplot 999

Transect (m)	Microplot Dist. (m)	Reproductive Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Juvenile Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Seedlin+L6 Number of seedl
8	0.5	1	1	4.0	3.9	12.3	0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0

Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlin
999	0	3	7.7			32.7	5			7.8	1
999	1	3	5.0			13.4	2			3.9	0

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Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter

Experimental Plots at the Neva Road Study Site   Date: 7/3/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

w data for P. bellii plants for 1996

acroplot 1000

Transect (m)	Microplot Dist. (m)	Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedlin
		Number of plants	no. of flw stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of seed
1.5	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					1	2.2	1.8	3.1	0
	8.5	0					0				0
	10	1	1	3.5	3.0	8.3	0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
3.5	0.5	0					0				0
	2	2	11	7.4	6.4	37.4	0				0
			8	7.3	6.5	37.4					
	5	0					0				0
	7.5	1	2	3.5	3.0	8.3	0				0
	8.5	0					0				1
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	1	4	4.5	3.1	11.3	1	2.0	1.3	2.1	1
	23.5	0					0				0
	24.5	1	2	3.5	2.5	7.1	0				0

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Physaria bellii Study - City of Boulder Open Space   Observer(s): Alan Carpenter

Experimental Plots at the Neva Road Study Site   Date: 7/3/96

There are 2 permanent transects, each with 13 permanent 0.5 m x 0.5 microplots,

in each half of each macroplot.

w data for P. bellii plants for 1996

acroplot 1000

Transect (m)	Microplot Dist. (m)	Number of plants	no. of flw. stems	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of plants	Diam1 (cm)	Diam2 (cm)	Area (cm2)	Number of seed
		Number of Phy. bel. plants by size, class, diameter (cm x cm)									
		Reproductive					Juvenile				Seedlin
6	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					0				0
	8.5	0					0				0
	10	0					0				0
	13.5	0					0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				0
	21.5	0					0				0
	23.5	0					0				0
	24.5	0					0				0
8	0.5	0					0				0
	2	0					0				0
	5	0					0				0
	7.5	0					1	1.4	1.2	1.3	0
	8.5	1	8	6.9	6.0	32.7	0				1
	10	0					0				0
	13.5	1	3	3.5	3.2	8.8	0				0
	15	0					0				0
	16.5	0					0				0
	19	0					0				1
	21.5	2	1	3.8	3.8	11.3	0				0
			1	3.2	2.6	6.6					
	23.5	0					0				0
	24.5	3	3	5.3	5.0	20.8	2	2.4	2.0		1
			10	8.2	7.8	50.3		2.6	2.5		
			1	4.3	4.0	13.5					
Macro Plot no.	Treatment 0=Control 1=weeded	Total no. of repro. plants	Avg. no. of stems per plant			Avg. area of Repro. (cm2)	Total No. of Juv. plants			Avg. Area of Juv. (cm2)	Total No. of Seedlin