Monitoring Manual

Elk-Effects Vegetation Monitoring Program for Tomales Point Elk Range Point Reyes National Seashore, California

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PROGRAM SUMMARY

The monitoring program for elk effects on Tomales Point vegetation is designed to provide information on how tule elk grazing affects plant communities and rare species. The basic objective of the program is to show whether the elk are driving the vegetation into an unacceptable state by their grazing. The expectation is that as elk numbers increase, grazing pressure will increase too, resulting in unacceptable levels of any or all of the following: low vegetation ground cover, poor nutritional quality for the elk, undesirable increases in weedy species, unacceptable loss of native plant biodiversity, population declines in rare plants, population declines in plants used for food and nectar by the endangered silverspot butterfly, and increased erosion.

The monitoring program has 3 basic components designed to provide complementary information on different aspects of the elk-vegetation system. Long-term plant community monitoring along permanent transects will show how plant species composition and cover are changing since cattle removal in 1979, and it will show whether any of the undesirable traits listed above are developing in the vegetation. However, monitoring these transects alone will not tell us what the effects of continued grazing by elk are apart from changes the vegetation would be undergoing anyway. In order to tease apart the elk effects from change that is happening because of cattle removal, elk exclosures are needed. By sampling inside and outside exclosures, we will be able to see how elk are modifying the rates and directions of change in the vegetation that would be happening in their absence. In a sense, the exclosures serve as a “check” on elk effects. They will allow us to interpret how much of the change is due to elk and how much can be attributed to other processes such as natural succession or weather patterns. This information will allow us to analyze whether changing elk management will have a desirable effect on the vegetation. Finally, periodic mapping and counting of plants in rare plant populations will show whether plant population ranges are expanding and populations are stable or growing. If not, then management actions can be taken to improve habitat conditions for the plants.

A general summary of the rationale and sample design for each of the 3 components of the elk-effects monitoring program follows. Field sampling for the entire program should require about 15 weeks for a 2 to 3-person team, and data processing, analysis, and report writing should require about 9 weeks. Time and labor estimates for this program are given in Table A-1. In addition to elk-effects monitoring, Point Reyes staff periodically monitor fire transects and residual dry matter plots on Tomales Point. They are not included as part of the elk-effects monitoring program and they are described elsewhere. Protocols for fire and residual dry matter sampling are not included in the time estimate for the elk- effects monitoring program.

Long-Term Plant Community Monitoring or “Gogan Transect Monitoring”

Long-term plant cover data collected along permanent transects show how the diversity and abundance of species are changing on the elk range as the vegetation recovers from cattle grazing. The literature on recovery from cattle grazing in northern coastal prairie and coastal scrub ecosystems like Tomales Point (Foin and Hektner 1986, Hektner and Foin 1977, Grams et. al. 1977, Elliott and Wehausen 1974, McBride 1974, McBride and Heady 1968) indicates that several changes should occur gradually: an increase in shrub cover and density, particularly the native shrub *Baccharis pilularis*; a decrease in weedy plant species that thrive on continued soil disturbance by cattle trampling and trailing; and an increase in plants that were palatable to cattle. These processes occur over time scales of decades and may occur at erratic rates depending on the weather. In 1979 and 1980 Peter Gogan (1986) established 18 permanent transects at the elk range to document community status. These transects were to be sampled periodically to document changes in plant species composition and abundance over the years since grazing. Bartolome (1993) resampled 17 of these transects in 1992 and concluded that the vegetation of the elk range appears to be changing as the direct result of the removal of cattle in 1979. Bartolome's interpretation was that the change was in an undesirable direction with an apparent increase in shrubs that are unpalatable to cattle. From a range perspective, the replacement of grasses by shrubs may be undesirable; but from the perspective of restoration ecology, the return of native shrubs to their former habitats is a positive sign. Thus, the interpretation of the data for management depends on management goals.

In order to get better resolution on what is happening with the vegetation and for greater statistical confidence in the data, these 17 transects should be sampled annually for at least 3 years, beginning in 1999, using the point-line-intercept method. After 3 years, the data will be evaluated to determine whether a reduction in frequency to biannual or some longer sample interval is appropriate. This decision will be made by analyzing the variability between transects and between years. If variability is low, a longer sample interval may be warranted.

Elk Exclosure Sampling

Twelve elk-proof exclosures were established on the Tomales Point elk range in the winter of 1997–1998. The exclosures are in contrasting high and low elk-use areas of the range documented by monitoring of elk habitat use from October 1996 to October 1997. There are 4 exclosures in each of the 3 main vegetation types on the range, with 2 in high-use areas of each vegetation type and 2 in low-use areas of each type. The vegetation types are: open grassland, lupine grassland, and *Baccharis* grassland. Exclosure locations were selected by gridding a combined vegetation and elk-use map and choosing grid nodes at random for exclosure placement. Each exclosure is paired with an adjacent unfenced control area, also chosen at random. Each exclosure-control area pair was sampled in 1998, 1999 and 2001. Results 1998 to 1999 are presented in McEachern et al, 2001. Results from 1998, 1999 and 2001 will be evaluated for their variability and a decision will be made on a revised sample frequency, as with the Gogan transects. Data from inside and outside the exclosures will be compared to determine the differences between ungrazed and grazed vegetation. Differences will be inferred to be mainly due to elk grazing since other environmental factors (such as slope, aspect, soil type, weather, and plant species composition) at the sites are equivalent.

The expectation is that differences will show up first in the cover, abundance, and diversity of herbs palatable to elk and in canopy cover and density of the shrubs, particularly *Baccharis pilularis*. This is because palatable herbs will be kept at low abundance levels, or driven to lower levels, by continued grazing outside the plots, whereas they will increase in relative abundance inside the plots. Young *Baccharis* shoots may be palatable to cattle (McBride 1974), and judging by the pruned appearance of most of the *Baccharis* plants on the range, they were eaten by the Tomales Point cattle. They are not so readily browsed by elk (Gogan and Barrett 1995, 1994; Gogan 1986; Caughley and Lawton 1981), whereas the grasses and herbs that compete with the *Baccharis* are more heavily grazed. If plant competition is an important factor in reducing shrub establishment rates or limiting large plant growth rates, then the shrubs in the grazed control areas should increase faster than in the ungrazed exclosures as grazing keeps competition down. If increased shrub density or cover is a problem for elk from the standpoint of nutrition and bulk diet, then we will be able to see how fast the elk are making conditions intolerable for themselves.

The exclosures and control areas are approximately 36 meters by 36 meters, a little more than 0.10 hectare. Plant cover will be sampled in the exclosures and in the control areas along 3 randomly located and permanently staked point-line-intercept transects each for a total of 6 permanent transects at each exclosure-control area pair. This sample methodology is the same as the Gogan transects, so data should be comparable. In addition to the cover sampling, shrub density will be sampled in the *Baccharis* grassland exclosures and control areas to get better resolution on changes in that species. Ten 1-meter by 5-meter density plots will be randomly located within each *Baccharis* grassland exclosure and control area for 3 years, and all *Baccharis* shrubs rooted in the density plots will be counted by size class. Data will be summarized to show whether expected increases in shrub density are apparent, and they will be analyzed to determine the appropriate sample interval.

Rare Plant Population Monitoring

There are 3 rare plant taxa on the elk range (Skinner and Pavlik 1994, Clark and Fellers 1986) that may be affected by either vegetation recovery from cattle grazing or by elk grazing. These are *Blennosperma nanum* var. *robustum, Triphysaria floribunda,* and *Cordylanthus maritimus* var. *palustris*. Some populations of these plants have been monitored annually by the California Native Plant Society (CNPS) since the 1980's, and more recently by NPS staff along with CNPS. Monitoring techniques have included mapping population boundaries by hand on USGS topographic maps and visually estimating numbers of plants within the boundaries. Monitoring should be continued annually. The technique should be modified to include direct counts of individuals. In populations where direct counts of individuals are impossible or inaccurate because of high plant density, counts in randomly placed belt transects should be used. Additionally, Global Positioning System (GPS) units should be used in the field to map population boundaries for computer analysis of between-year contrasts in population extent.

Time and Labor Estimates for Tomales Point Vegetation Monitoring

Table A-1 outlines the time and labor it should take annually to do the Tomales Point monitoring. The ideal time to sample the vegetation extends from early May to early July, when the annual plants are present and can be identified. This is a sampling window of about 10 to 12 weeks. Experience from 1998 to 2001 shows that the exclosure and control area monitoring requires about 14 weeks for a 2-person team, shrub density takes 1 week for a 2-person team, and the Gogan transects 4 weeks for 2 people (see Table A-1). It is best to have 2-5 people in the field at once to get the field work done within the spring/summer season. Data processing should take about 8 weeks for 1 person.

The field time estimate assumes that a team of 3 is able to read 1 cover transect in about 3 to 4 hours once they become familiar with the plants and the technique. The shrub density sampling should require 2 people about 20 minutes per 1 X 5-meter density plot. Rare plant monitoring time estimates are what the CNPS has done at Tomales Point in the past. Additional staff time should be budgeted to coordinate the work and run the GPS equipment.

Data processing includes data entry and proofreading, data summarization and analysis, and report writing. Data entry times assume that data are recorded on data forms and that they have to be entered and proofread on the computer. Data entry time can be reduced if the data are entered directly into palmtop computers in the field. This purchase would cut about 10 days off the estimated total data processing time. The field work needs to be done during the spring when the grasses are beginning to flower and the herbs are still green and identifiable. This window of time typically occurs during May and June at Tomales Point.

The exclosure fences should be inspected twice yearly—in the early spring and in the fall. Repairs should be made if necessary. Fence inspection takes 1 person on foot about 2 days.

MONITORING METHODS

Use the point-line intercept method for recording cover of all species occurring on 30-meter transects (Bonham 1989). This method will be used for monitoring the Gogan transects and the elk exclosure and control areas. [For conversion: 1 meter = 39.37 inches; 1 centimeter = 0.39 inches.]

Recording Cover

Stretch the meter tape straight and tight as close to the ground as possible. Use chaining pins to anchor the tape at the 0 and 30 meter ends of the transect. Rubber-tipped clamps can be used to secure the tape to the pins to save wear and tear on the tapes. Starting at the 0.30-centimeter mark, place the welding rod “pin” vertical to the ground on the right side of the tape and record all species touching the rod. Record each species only once regardless of how many times it touches the rod. Record the tallest species touching the rod first and record the height where it touches the rod, estimated to the nearest centimeter. When the wind is blowing, record the species that touch the rod most of the time. Use the Integrated Taxonomic Information System (ITIS) species codes (http://plants.usda.gov, Appendix C). Record species this way every 30 centimeters up to the 30-meter mark for a total of 100 points on the transect. Appendix C gives the list of species sampled in 1998 through 2001. Record substrate for all points in categories of litter, soil, rock, and moss.

Locating Gogan Transects

Figure B-1 shows the Gogan transect locations and Table A-2 gives Universal Transverse Mercator (UTM) coordinates for each transect. Each transect location is marked with a weathered green steel fence T-post. One meter south of the fence post is an approximately 12-inch (0.3 meter) piece of rebar pounded into the ground flush with the ground surface and capped with an orange plastic cap that is approximately 1 inch (2.5 centimeters) in diameter. Stretch the tape out to 30 meters, going 0 degrees magnetic north from the rebar with the zero end at the orange-capped rebar. Record cover along the transect.

Sample Design for Cover Transect Sampling in Exclosures and Control Plots

There are 3 permanently located cover transects in each exclosure and control area. Figure B-1 shows the exclosure and control plot locations, and Figure B-2 is a generalized schematic showing how transects are located within each plot. Figures B-3 through B-17 contain detailed layout diagrams for each plot. Table A-3 gives UTM coordinates for the corner post at each exclosure plot. Table A-4 gives UTM coordinates for transect beginning and end stakes in each control plot. The transects are 30 meters long running upslope within each exclosure and control area (or as nearly upslope as exclosure orientation allows). Use the exclosure fence as a baseline transect for locating the sample transects. Each of the 3 transects in the exclosure was originally located by going a random number of meters down the baseline (the number was chosen in the office before going to the field) and then going 3 meters into the plot perpendicular to the baseline. That point 3 meters from the baseline became the beginning point for the transect; each transect runs 30 meters uphill perpendicular to the baseline, starting 3 meters from the baseline at the fence. In 1999, the 0-meter and 30-meter ends of each transect were staked with steel rebar topped with yellow plastic caps. Round aluminum tags were wired to the exclosure fence indicating the 0-meter and 30-meter rebar locations. Three transects were located in each control area by the same methods using the downhill side of the control area as the baseline. Appendix B shows transect location measurements taken in 2001.

Locating Exclosure and Control Transects

In 1998, round aluminum tags were wired to the exclosure fences indicating the 0-meter and 30-meter rebar locations. Approximately 25% of these tags remained in 2001. The 0-meter and 30-meter ends of each transect were staked with steel rebar topped with yellow plastic caps. Approximately 25% of the caps remained in 2001.

Rebar ends were painted blue in 1999, but no traces of the paint remained in 2001. Apparently, written descriptions, diagrams and photographs will be the most important aids in relocating transects for sampling. Therefore, the locations of stakes were carefully measured in 2001, and they are included in site diagrams in Appendix B. This appendix contains graphics showing the location of each exclosure relative to other exclosures and major landmarks, the orientation of the controls relative to each exclosure, and the layout of each transect.

The site diagrams contain tables with detailed measurements to further assist in locating stakes. Original distances were remeasured and new measurements taken, such as distances between rebar stakes and height of each rebar above the ground. Whether each stake is in the open or in a shrub is also noted as a further help in finding stakes. Azimuths included are in geographic north (with a declination of 15 degrees.) Azimuths were read as magnetic north in the field and recalculated to geographic north in the office by adding 15 degrees. A metal detector was used successfully to locate difficult to find stakes. See Appendix E for a description of how the metal detector was used.

Control stakes were located using a geographic positioning system in NAD 83, UTM Zone 10. A Trimble ProXR unit with an average accuracy of 1 meter was used for these measurements. These GPS locations may be useful as a last resort in finding difficult stakes. See Table A-4 for coordinates. Finally, in 2001 field crews were unable to locate two stakes; these were restaked with fresh rebar and are indicated on the plot diagrams.

Data Processing and Analysis

Record data on the data forms provided in Appendix D or enter data directly into palmtop computers in the field and download the data each evening to a desktop computer. Enter written or palmtop data into a spreadsheet designed like the data form. Calculate relative frequency and cover for each species on each transect. Use a classification or clustering program to group the Gogan transect data into plant communities, and analyze species cover, frequency, richness and diversity, and dominance in each community (Bonham 1989). Calculate the variance in cover for dominant or special interest species, and analyze the statistical power of the sample to predict the true population means. For multi-year data, construct a trend analysis to show changes in vegetation. Use analysis of variance procedures to test for significant differences between exclosure and control areas for cover, frequency, and density of dominant and important species by vegetation type and elk use level. See McEachern et al (2001) for analysis techniques.

Shrub Density Sample Methods

Shrub density will be sampled only in the *Baccharis* grassland exclosures and control areas. Randomly locate ten 1 X 5-meter density plots in each exclosure and each control plot. Count numbers of stems rooted within each plot in size/stage class categories of young, mature, decadent, and dead. Record the number of elk scats in each plot, counting 1 fecal pile as 1 scat. These plots are not permanently located; they will be randomly chosen and sampled by the same methods each year.

A collapsible 1x5 meter PVC frame can be used to more easily outline the shrub density plots. Meter tapes and flagging can also be used for this purpose.

Locating Plots

Plots will be located by going a number of meters down a baseline transect and then a number of meters perpendicular to that baseline. Both numbers of the pair will be chosen from a random numbers table. The point located will be the lower left corner of the shrub density plot. Use the fence line or control area border that most closely parallels the contour of the slope on the downhill side as the baseline.

Stem Counts

Count every *Baccharis* shrub stem rooted within the plot; that is, count stems emerging singly at ground level, moving aside litter if necessary to follow stem to its point of attachment or to the ground. If you have made a reasonable effort to move litter aside and the stem appears to emerge from the ground it counts as a stem. Count stems, not shrubs. Record counts in these categories:

Young: Small, generally unbranched shrub, lacking thick or heavy woody tissue and an obvious browse scar; a plant whose stem tissue appears young and which has not been browsed off and resprouted.

- Mature: Small to large stem with up to 25% dead tissue.
- Decadent: Small to large stem with more than 25% dead tissue.
- Dead: Standing dead small to large stem with no live tissue; that is, a stem that is still rooted in the ground but is dead. Stems lying on the ground with no obvious connection into the ground do not count.

Stems rooted on the boundary of the plot are counted as follows: count the stem IN if it is on the lower or left plot boundary, count the stem OUT if it is on the right or upper plot boundary.

Data Processing

Record data on the data forms provided in Appendix D or enter data directly into palmtop computers in the field and download the data each evening to a desktop computer. Enter written or palmtop data into a spreadsheet designed like the data form. Calculate the average number of stems per size class in each plot and average them to get average stem densities by exclosure and by control area. Calculate the standard error of the 10 plot densities for each exclosure and control area, and calculate the power of the sample to detect the true mean density. If sample errors are low, pool the data by community type (that is, *Baccharis* grassland). Contrast inside and outside exclosure samples using correlation and regression analyses. For multi-year data, analyze trends in shrub density by size class.

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APPENDIXES

APPENDIX A

Tables

Table A-1 Annual time and labor estimates for Tomales Point elk-effects vegetation monitoring, Point Reyes National Seashore

Protocol	Field Sampling	Data Processing
Gogan cover transects (17 transects total)	4 weeks for a 2-person team	2 weeks for 1 person
Exclosure-control area cover transects (6 transects per exclosure-control pair equal 72 transects total)	14 weeks for a 2-person team	3 weeks for 1 person
Exclosure-control area shrub density; *Baccharis* grassland only (20 density plots per exclosure-control area equal 80 density plots)	1 week for a 2-person team	1 week for 1 person
Rare plant monitoring	1 week for a 2-person Point Reyes team plus 10 days of California Native Plant Society teamwork	2 weeks for 1 person
Total Time and Labor Estimate [a]	20 weeks for a 2-person team, plus 10 days of CNPS teamwork	8 weeks for 1 person

a Add 2 days in early spring and 2 days in fall for exclosure fence inspection

Table A-2 UTM (Universal Transverse Mercator) coordinates (Zone 10, NAD 83) for steel fence posts marking vegetation transects established on Tomales Point by Peter Gogan

Transect #	X-Coordinate	Y-Coordinate
38	501548	4230864
50	501975	4230438
88	502367	4229490
141	503028	4228274
142	503257	4228361
163	503409	4227895
165	503772	4227893
169	504602	4227901
195	504145	4227311
204	503629	4227090
205	503813	4227086
216	503412	4226890
217	503564	4226886
263	503416	4226309
299	503827	4225941
302	504397	4225943
317	504391	4225708

Table A-3 UTM (Universal Transverse Mercator) coordinates (Zone 10, NAD 83) for corner posts in exclosure plots on Tomales Point and locations of adjacent unfenced control plots relative to exclosures

Exclosure	X-Coordinate	Y-Coordinate	Control [a]
BH01	503766	4227089	NW
BH02	503621	4227213	NE
BL01	504556	4225974	SSE
BL02	504141	4225928	NE
LGH1	503610	4226344	SW
LGH2	503513	4226242	S
LGL1	503446	4226486	WNW
LGL2	503365	4226284	SW
OGH1	504135	4227694	NW
OGH2	504043	4227682	W
OGL1	503370	4228146	NW
OGL2	503182	4228276	SSE

[a] *Control plot location relative to exclosure.*

Table A-4 UTM (Universal Transverse Mercator) coordinates (Zone 10, NAD 83) of control transect stakes on Tomales Point

Control Transect	Transect Stake	Easting	Northing
***Baccharis* Grassland**			
BHO1C1	0 end	503746	4227095
	30 end	503722	4227111
BHO1C2	0 end	503748	4227097
	30 end	503724	4227114
BHO1C3	0 end	503757	4227107
	30 end	503732	4227122
BHO2C1	0 end	503659	4227223
	30 end	503638	4227244
BHO2C2	0 end	503660	4227224
	30 end	503639	4227245
BHO2C3	0 end	503664	4227227
	30 end	503642	4227249
BLO1C1	0 end	504559	4225945
	30 end	504587	4225957
BLO1C2	0 end	504565	4225932
	30 end	504594	4225941
BLO1C3	0 end	504569	4225923
	30 end	504597	4225934
BLO2C1	0 end	504166	4225933
	30 end	504193	4225948
BLO2C2	0 end	504155	4225948
	30 end	504180	4225964
BLO2C3	0 end	504151	4225952
	30 end	504174	4225972

Control Transect	Transect Stake	Easting	Northing
Open Grassland			
OGH1C1	0 end	504118	4227711
	30 end	504089	4227720
OGH1C2	0 end	504111	4227693
	30 end	504082	4227701
OGH1C3	0 end	504109	4227689
	30 end	504080	4227698
OGH2C1	0 end	504017	4227658
	30 end	504015	4227686
OGH2C2	0 end	504012	4227657
	30 end	504010	4227686
OGH2C3	0 end	503990	4227673
	30 end	503997	4227684
OGL1C1	0 end	503343	4228144
	30 end	503314	4228152
OGL1C2	0 end	503345	4228148
	30 end	503316	4228157
OGL1C3	0 end	503351	4228162
	30 end	503323	4228171
OGL2C1	0 end	503187	4228253
	30 end	503204	4228229
OGL2C2	0 end	503191	4228256
	30 end	503210	4228233
OGL2C3	0 end	503199	4228261
	30 end	503217	4228237

Control Transect	Transect Stake	Easting	Northing
Lupine Grassland			
LGH1C1	0 end	503608	4226310
	30 end	503636	4226321
LGH1C2	0 end	503610	4226306
	30 end	503638	4226317
LGH1C3	0 end	503618	4226293
	30 end	503645	4226305
LGH2C1	0 end	503531	4226206
	30 end	503501	4226203
LGH2C2	0 end	503531	4226199
	30 end	503501	4226199
LGH2C3	0 end	503532	4226192
	30 end	503502	4226188
LGL1C1	0 end	503423	4226475
	30 end	503394	4226483
LGL1C2	0 end	503425	4226484
	30 end	503396	4226490
LGL1C3	0 end	503427	4226494
	30 end	503400	4226499
LGL2C1	0 end	503332	4226258
	30 end	not surveyed	
LGL2C2	0 end	503330	4226255
	30 end	503353	4226236
LGL2C3	0 end	503325	4226248
	30 end	503348	4226229

APPENDIX B

Figures

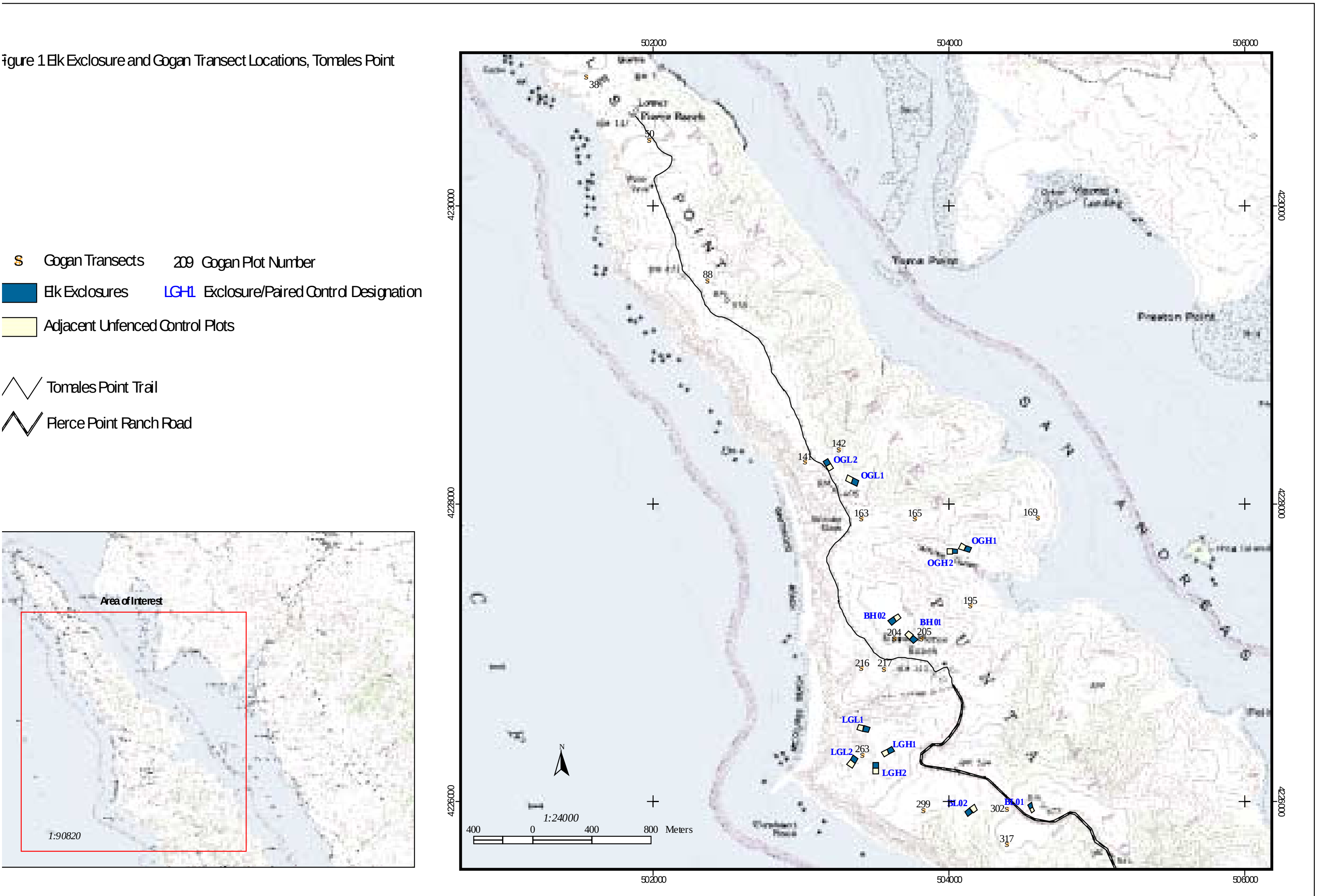


Figure B-1 Elk exclosure and Gogan transect locations, Tomales Point

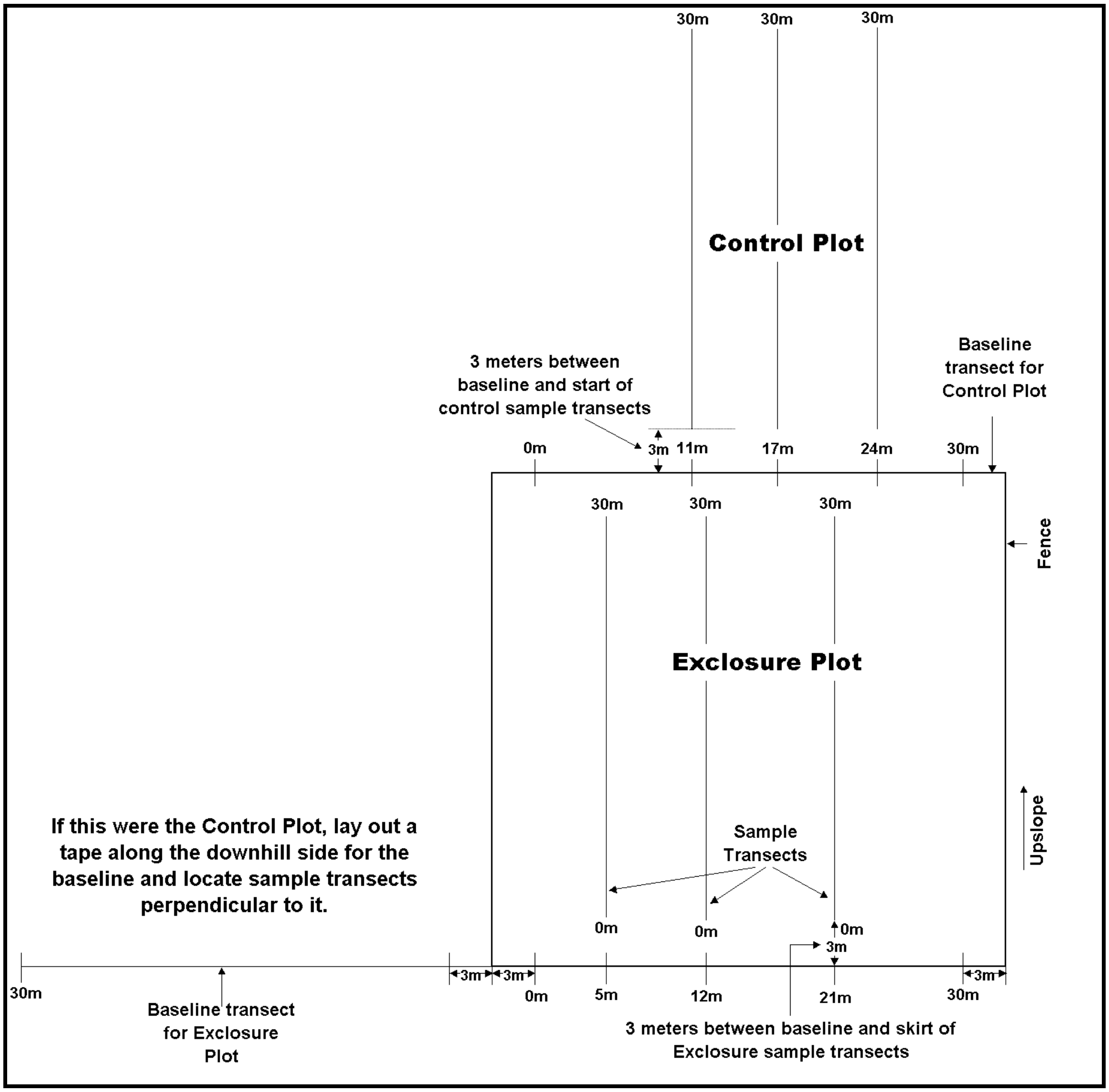


Figure B-2 Sample design for Tomales Point exclosure and control plots

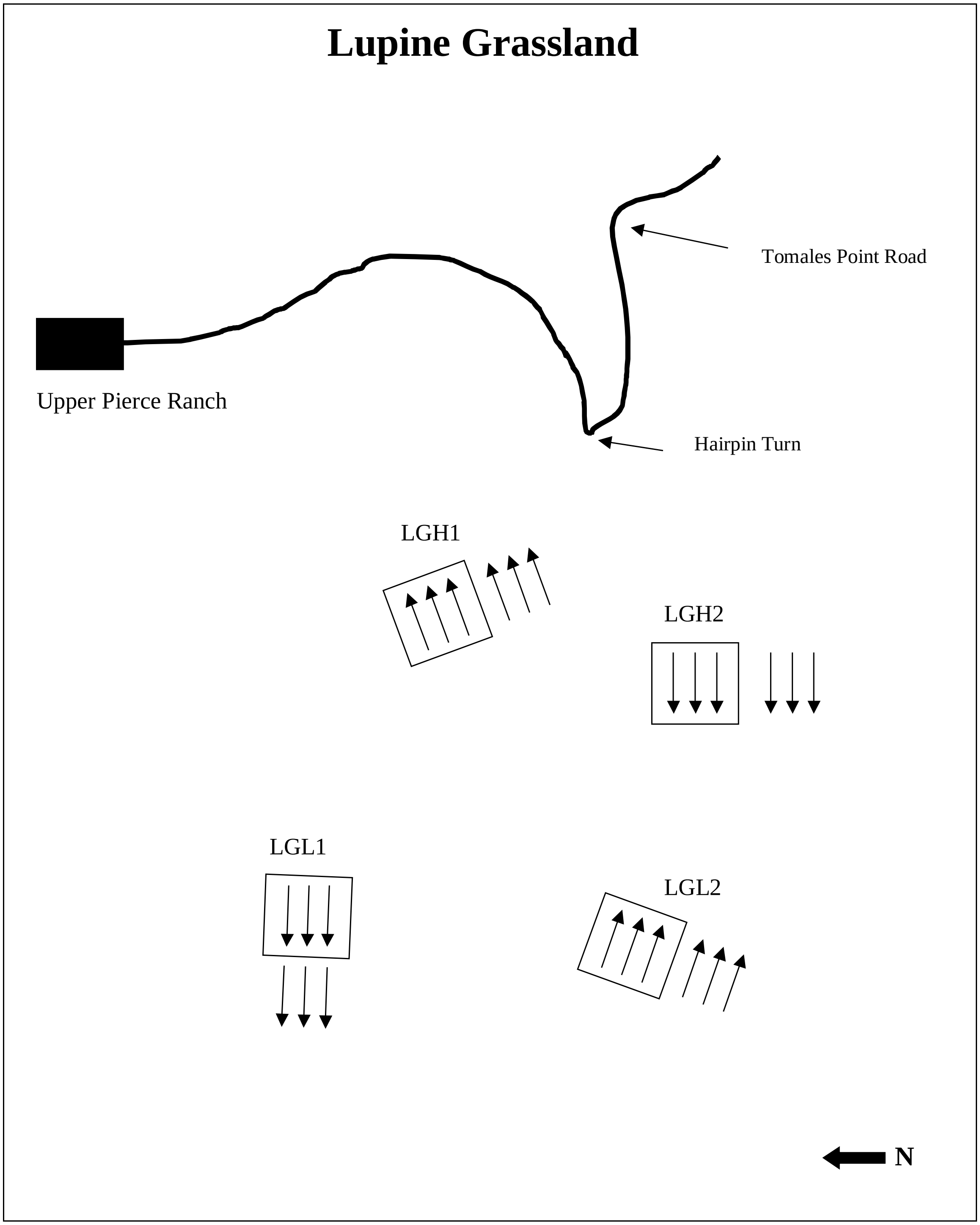
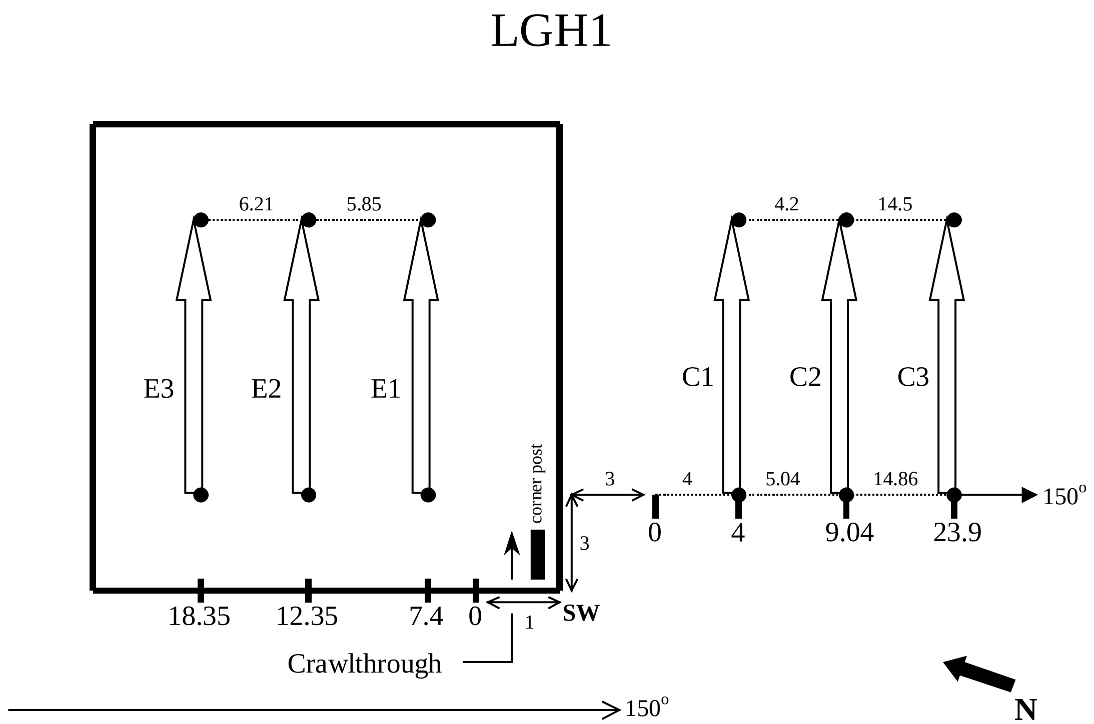


Figure B-3 Lupine grassland exclosure and control plot locations, Tomales Point, Point Reyes National Seashore



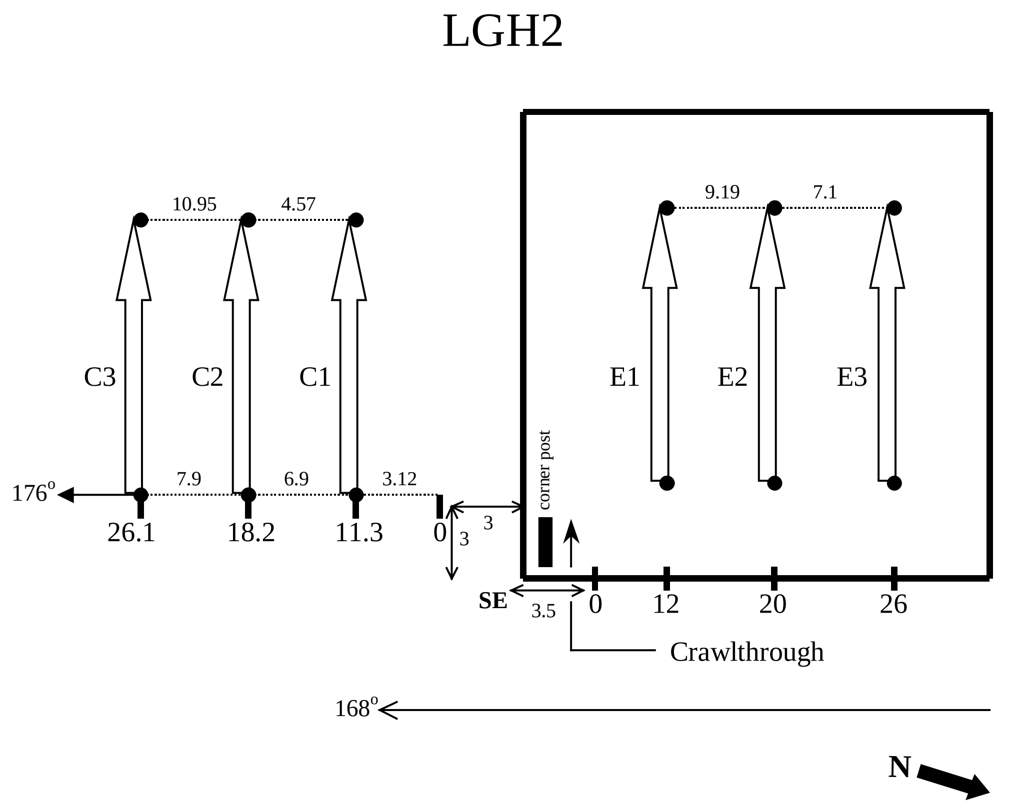
EXCLOSURE—Transect baseline zero-end is **1 meter** from the **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	7.4 m	3.04 m	22 cm (In a dead BAPI)	72°	29.75 m	21 cm (In the open)
E2	12.35 m	3.11 m	28 cm (Near a LUAR stem)	61°	29.5 m	30 cm (In a LUAR)
E3	18.35 m	3.05 m	24 cm (In the open)	61°	29.5 m	25 cm (In the open)

CONTROL—Transect baseline zero-end is **3 meters** from **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	4 m	NA	17 cm (In the open)	67°	30 m	13 cm (In the open)
C2	9.04 m	NA	11 cm (In the open)	66°	29.94 m	7 cm (In a LUAR)
C3	23.9 m	NA	12 cm (In the open)	66°	29.97 m	17 cm (In the open)

Figure B-4 LGH1: Lupine grassland high-use exclosure and control plot 1, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



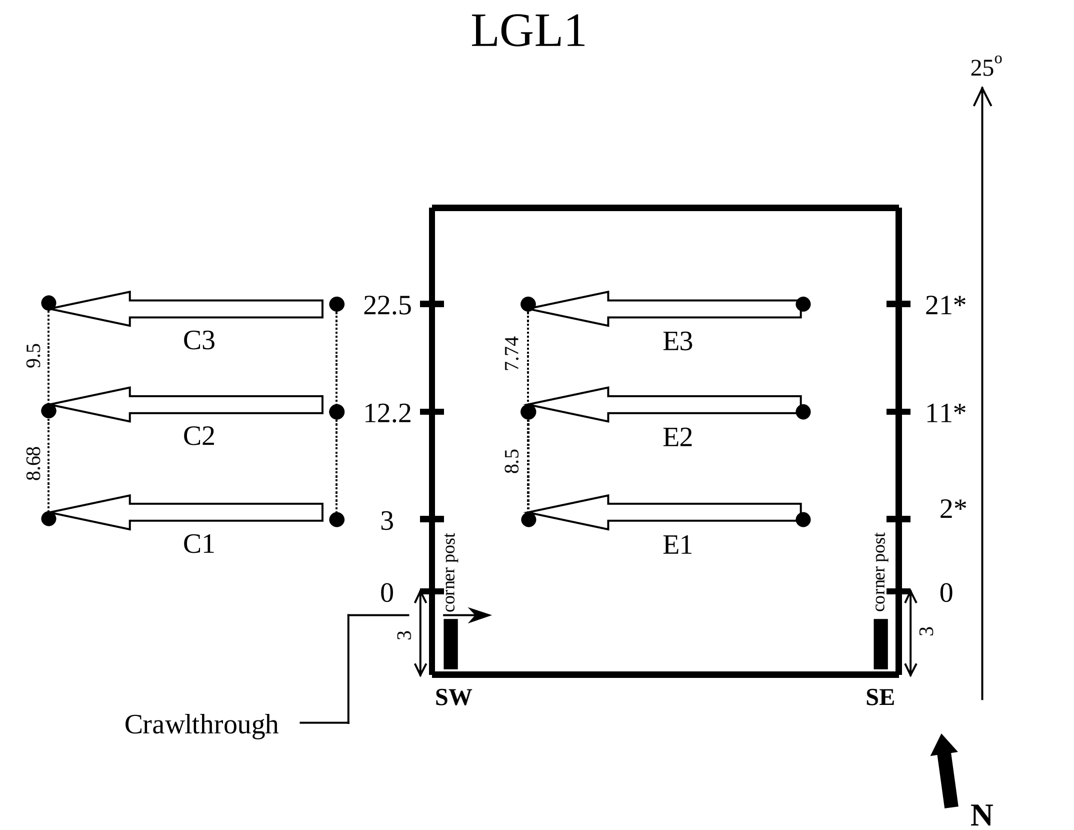
EXCLOSURE—Transect baseline zero-end is **3.5 meters** from the **SE** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	12 m	3.1 m	22 cm (In the open)	263°	30 m	12 cm (In the open)
E2	20 m	3.1 m	18 cm (In the open)	264°	30 m	10 cm (In the open)
E3	26 m	3 m	21 cm (In the open)	263°	30 m	16 cm (In the LUAR)

CONTROL—Transect baseline zero-end is **3 meters** from **SE** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	11.3 m	NA	16 cm (In the open)	259°	30.1 m	30 cm (In the open)
C2	18.2 m	NA	15 cm (In the open)	260°	29.9 m	16 cm (In the open)
C3	26.1 m	NA	20 cm (In the open)	259°	30 m	34 cm (In the open)

Figure B-5 LGH2: Lupine grassland high-use exclosure and control plot 2, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



EXCLOSURE—Transect baseline zero-end is **3 meters** from the **SE** corner post

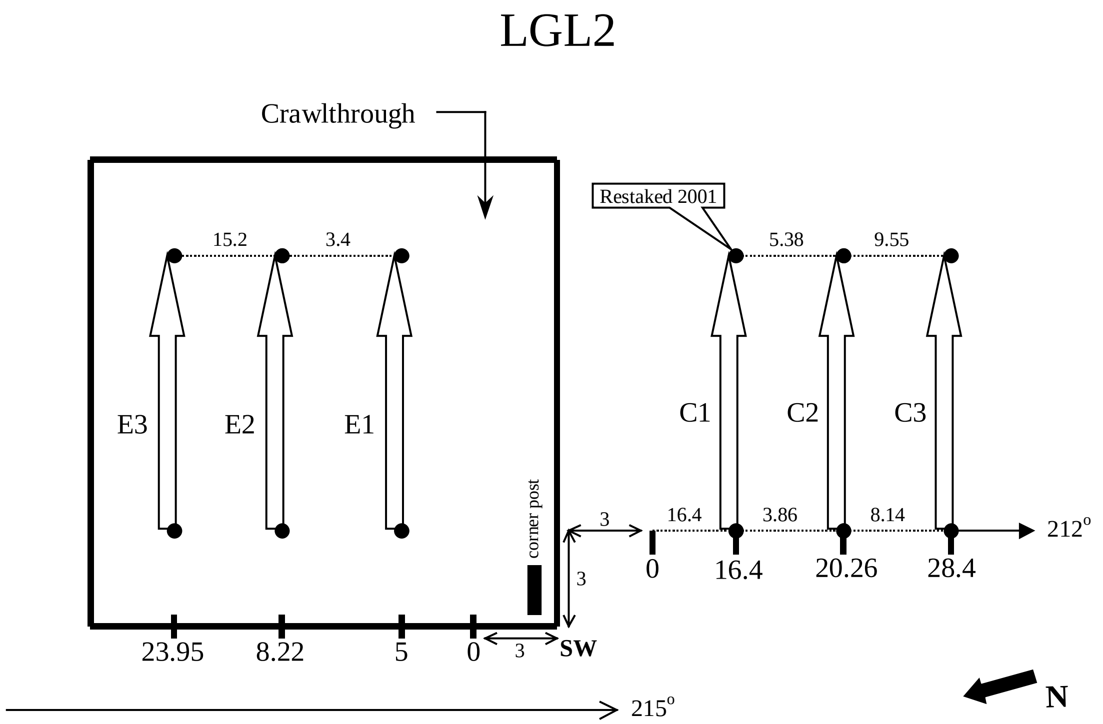
	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	2 m*	3 m*	14 cm (In the open)	297°	30 m	13 cm (In the open)
E2	11 m*	3 m*	12 cm (In the open)	293°	30 m	20 cm (In the open)
E3	21 m*	3 m*	22 cm (RUUR nearby)	293°	29 m	18 cm (In the open)

* = Measurement not verified 2001

CONTROL—Transect baseline zero-end is **3 meters** from **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	3 m	3 m	15 cm (In a LUAR)	282°	27.95 m	10 cm (In a BAPI)
C2	12.2 m	2.85 m	12 cm (In a BAPI)	282°	30 m	10 cm (In the open)
C3	22.5 m	2.95 m	7 cm (In the open)	282°	32 m	23 cm (In the open)

Figure B-6 LGL1: Lupine grassland low use exclosure and control plot 1, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



EXCLOSURE—Transect baseline zero-end is **3 meters** from the **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	5 m	3 m	16 cm (In the open)	124°	30 m	18 cm (In a RUUR)
E2	8.22 m	3 m	20 cm (In the open)	122°	31 m	20 cm (In a RUUR)
E3	23.95 m	3 m	19 cm (In the open)	124°	30 m	10 cm (In the open)

CONTROL—Transect baseline zero-end is **3 meters** from **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	16.4 m	NA	20 cm (In the open)	127°	30 m	20 cm (In the open)
C2	20.26 m	NA	14 cm (In the open)	128°	30 m	18 cm (In the open)
C3	28.4 m	NA	10 cm (In the open)	127°	30 m	14 cm (In the open)

Figure B-7 LGL2: Lupine grassland low use exclosure and control plot 2, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)

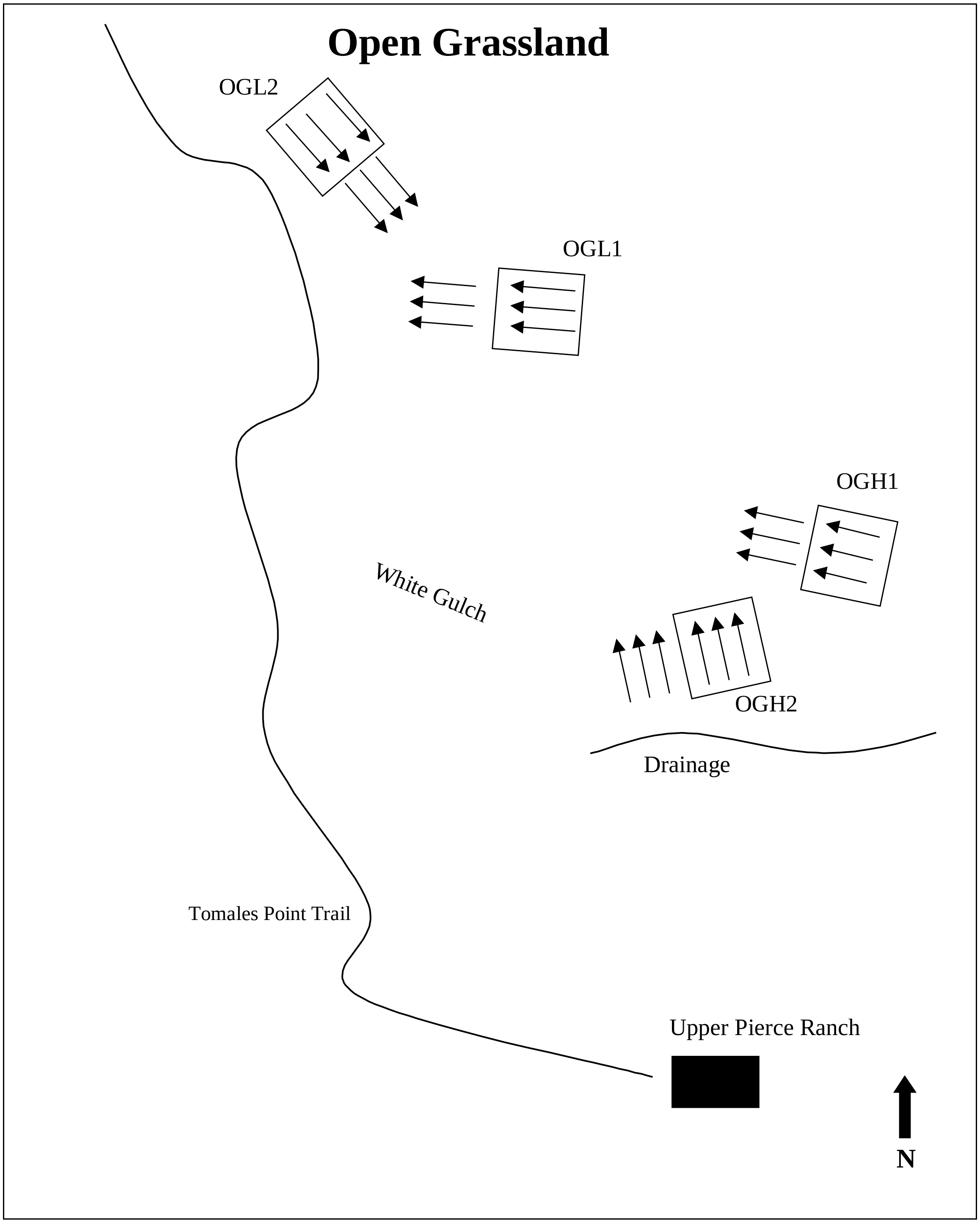
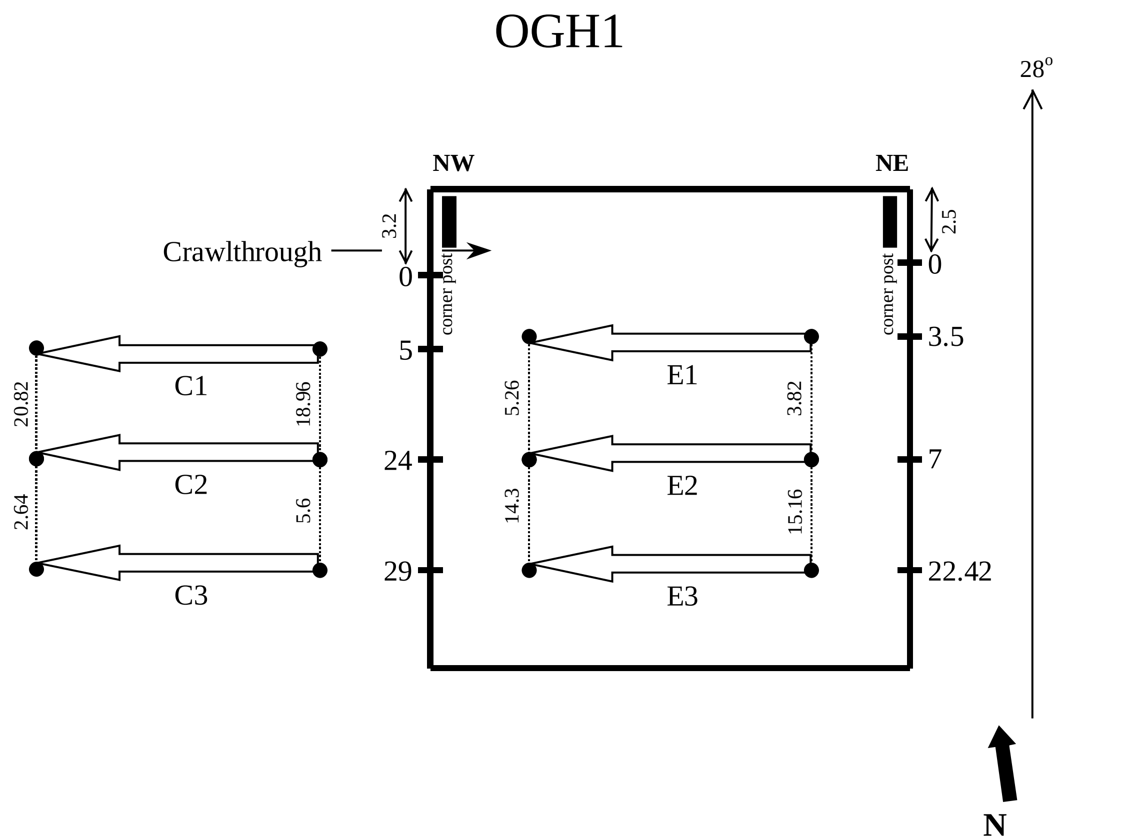


Figure B-8 Open grassland exclosure and control plot locations, Tomales Point, Point Reyes National Seashore



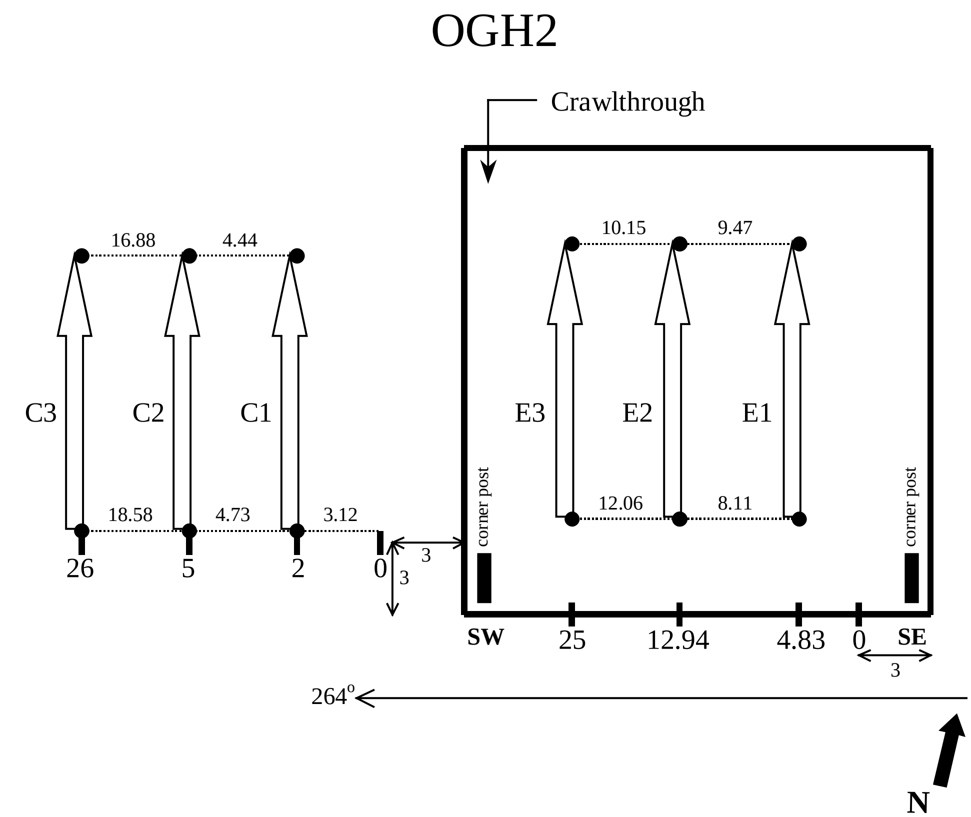
EXCLOSURE—Transect baseline zero-end is **2.5 meters** from the **NE** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	3.5 m	3.02 m	21 cm (In the open)	285°	30 m	19 cm (In the open)
E2	7 m	2.97 m	24 cm (In the open)	284°	30 m	23 cm (In the open)
E3	22.42 m	3 m	25 cm (In the open)	285°	30 m	20 cm (In the open)

CONTROL—Transect baseline zero-end is **3.2 meters** from **NW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	5 m	2.95 m	14 cm (In the open)	284°	30 m	16 cm (In the open)
C2	24 m	3 m	15 cm (In the open)	284°	30 m	15 cm (In the open)
C3	29 m	2.86 m	12 cm (In the open)	287°	30 m	13 cm (In the open)

Figure B-9 OGH1: Open grassland high-use exclosure and control plot 1, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



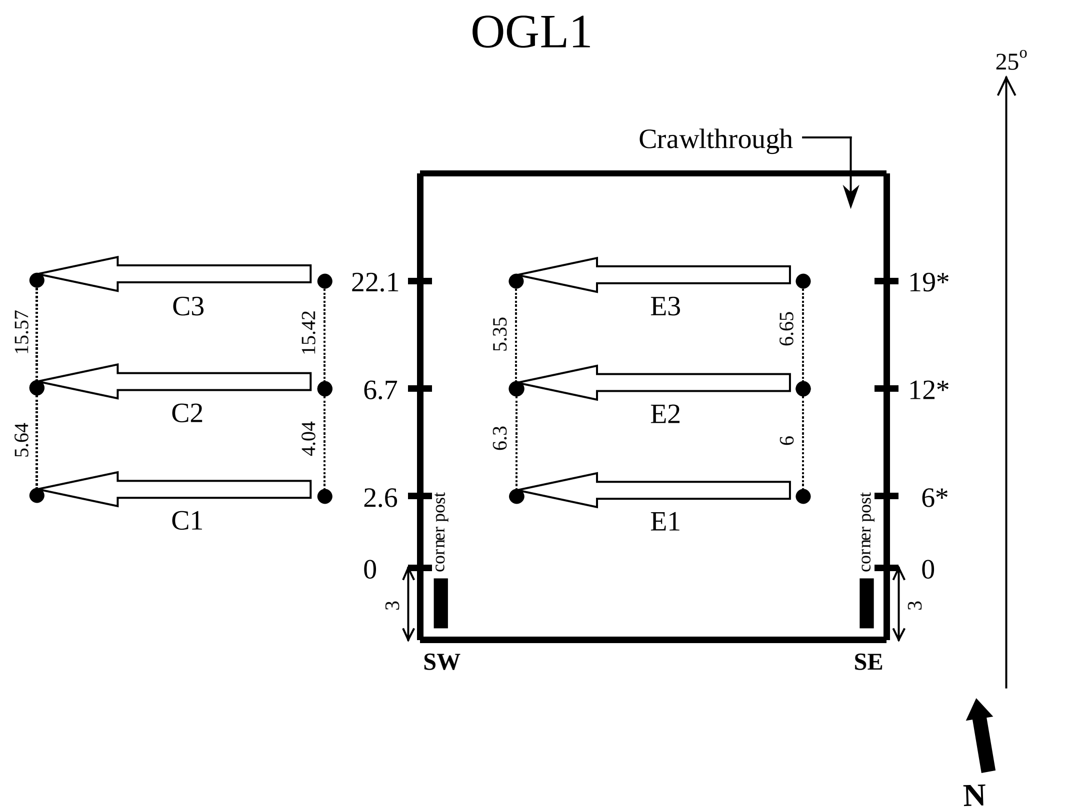
EXCLOSURE—Transect baseline zero-end is **3 meters** from the **SE** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	4.83 m	3 m	26 cm (In the open)	358°	30 m	29 cm (In the open)
E2	12.94 m	3 m	23 cm (In an IRDO)	358°	30 m	17 cm (In the open)
E3	25 m	3 m	23 cm (In BAPI and RUUR)	358°	30 m	24 cm (In the open)

CONTROL—Transect baseline zero-end is **3 meters** from **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	2 m	NA	19 cm (In the open)	353°	30 m	21 cm (In the open)
C2	5 m	NA	18 cm (In the open)	354°	30 m	22 cm (In the open)
C3	26 m	NA	17 cm (In the open)	5°	29.5 m	23 cm (In the open)

Figure B-10 OGH2: Open grassland high-use exclosure and control plot 2, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



EXCLOSURE—Transect baseline zero-end is **3 meters** from the **SE** corner post

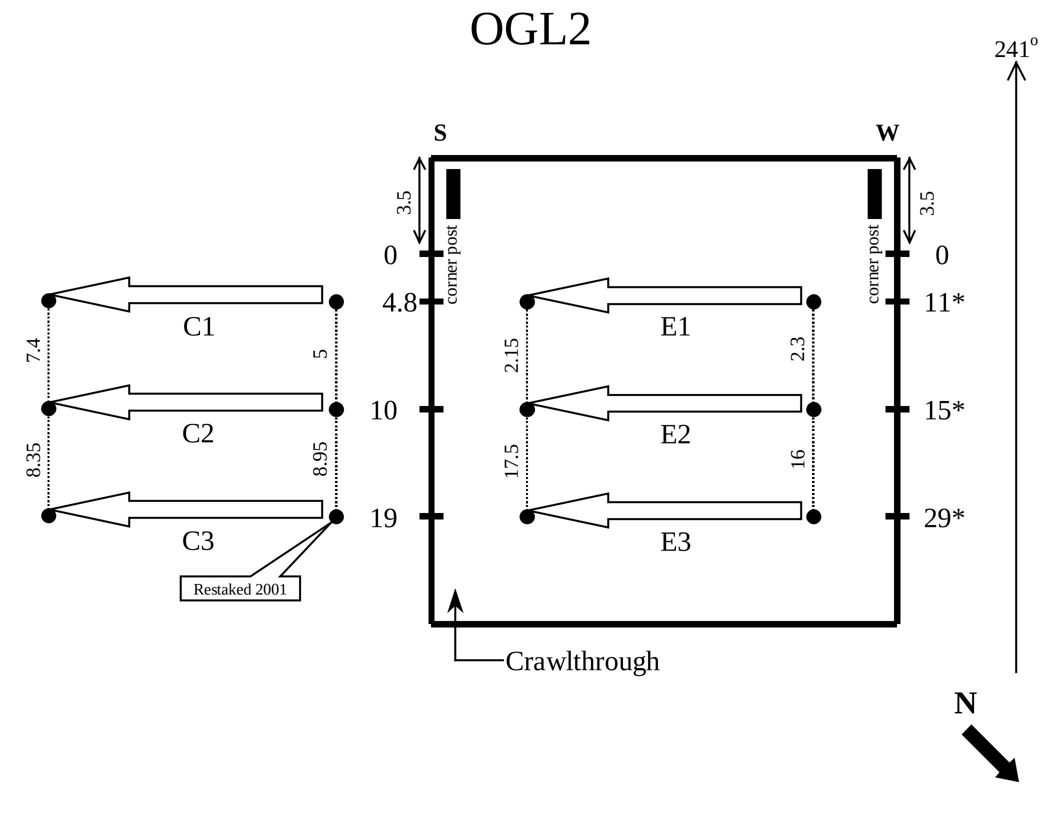
	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	6 m*	3 m*	35 cm (In a BAPI)	282°	29.95 m	35 cm (In the open)
E2	12 m*	3 m*	18 cm (In the open)	282°	30 m	18 cm (In the open)
E3	19 m*	3 m*	19 cm (Near a BAPI)	282°	30 m	19 cm (In the open)

* = Measurement not verified 2001

CONTROL—Transect baseline zero-end is **3 meters** from **SW** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	2.6 m	3.04 m	15 cm (In the open)	283°	30.05 m	6 cm (In the open)
C2	6.7 m	2.9 m	20 cm (In the open)	283°	30 m	14 cm (In the open)
C3	22.1 m	2.73 m	8 cm (In the open)	283°	30.05 m	11 cm (In the open)

Figure B-11 OGL1: Open grassland low use exclosure and control plot 1, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



EXCLOSURE—Transect baseline zero-end is **3.5 meters** from the **W** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	11 m*	3 m*	18 cm (In the open)	146°	30 m	10 cm (In the open)
E2	15 m*	3 m*	11 cm (In the open)	145°	30 m	22 cm (In the open)
E3	29 m*	3 m*	13 cm (In the open)	145°	30 m	25 cm (In the open)

* = Measurement not verified 2001

CONTROL—Transect baseline zero-end is **3.5 meters** from **S** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	4.8 m	3.1 m	15 cm (In the open)	145°	30 m	18 cm (In the open)
C2	10 m	2.95 m	10 cm (In the open)	141°	30 m	12 cm (In the open)
C3	19 m	3 m	32 cm (In the open)	141°	30 m	8 cm (In the open)

Figure B-12 OGL2: Open grassland low use exclosure and control plot 2, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)

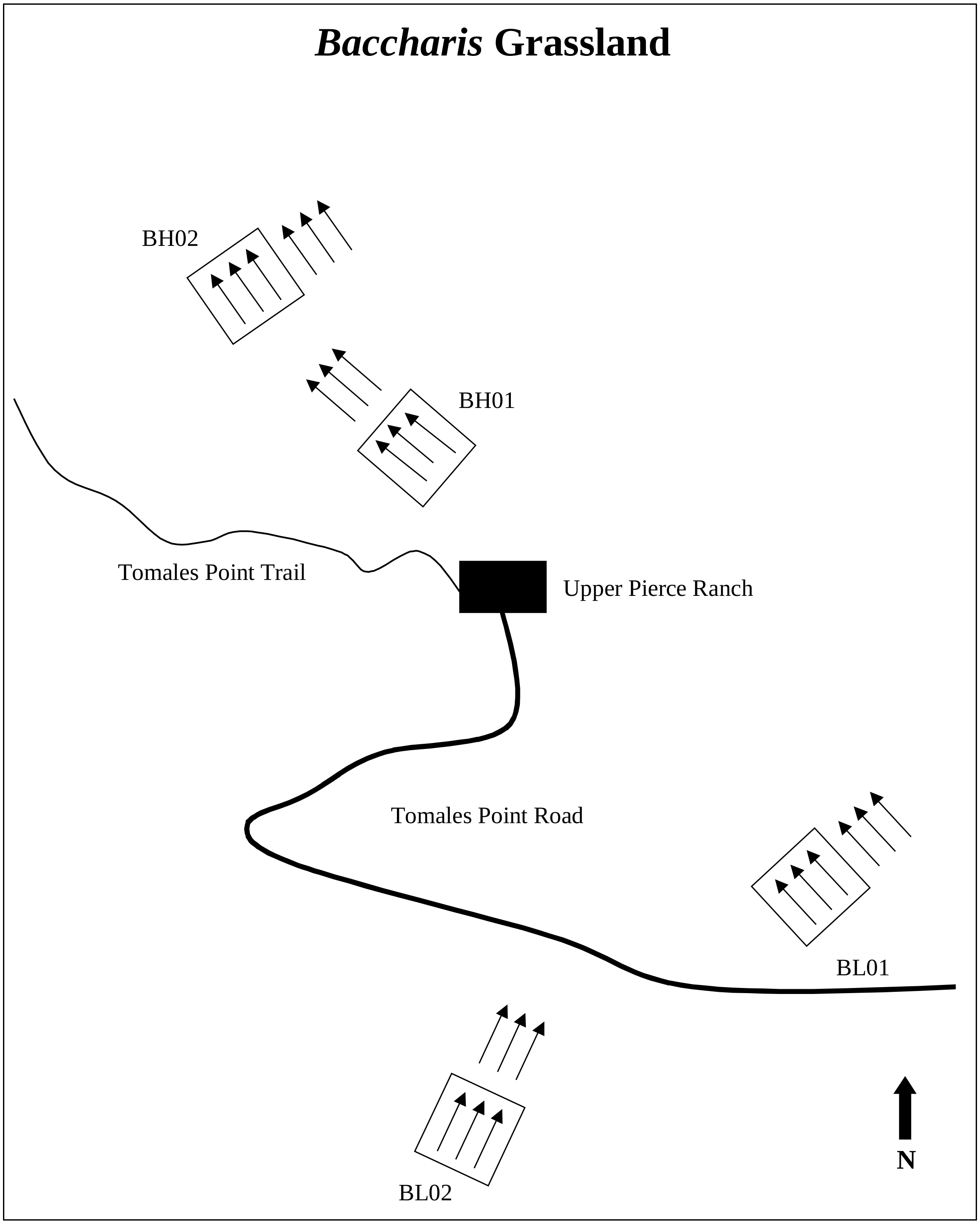
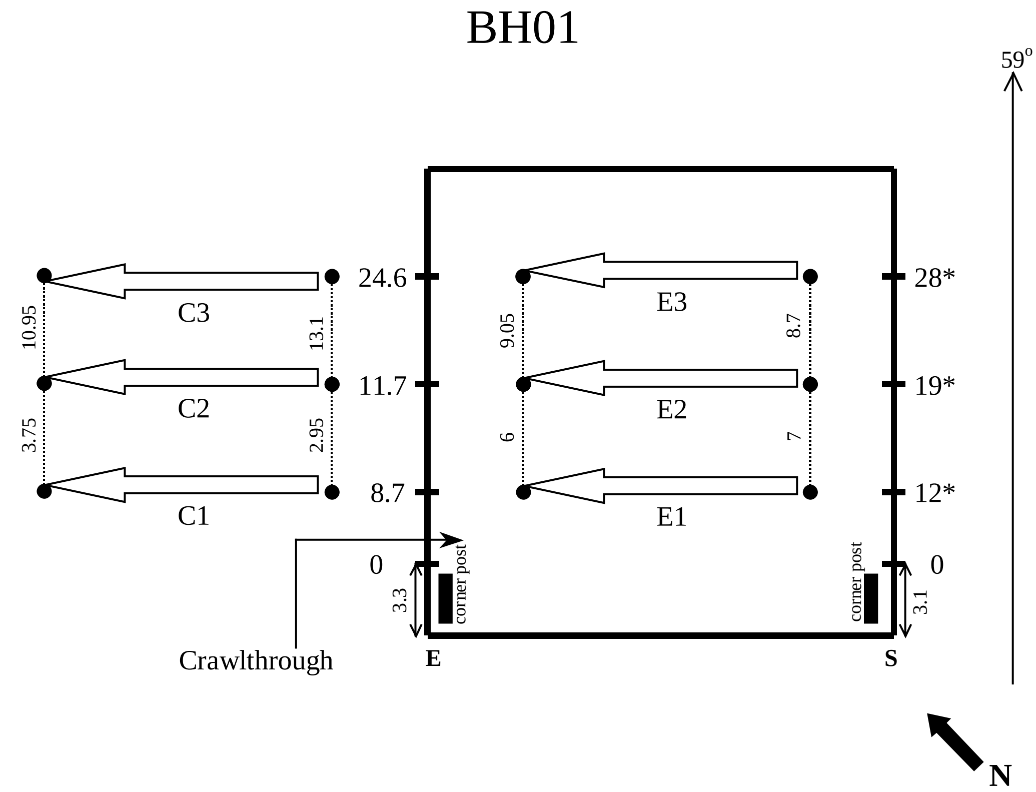


Figure B-13 *Baccharis* grassland exclosure and control plot locations, Tomales Point, Point Reyes National Seashore



EXCLOSURE—Transect baseline zero-end is **3.1 meters** from the **S** corner post

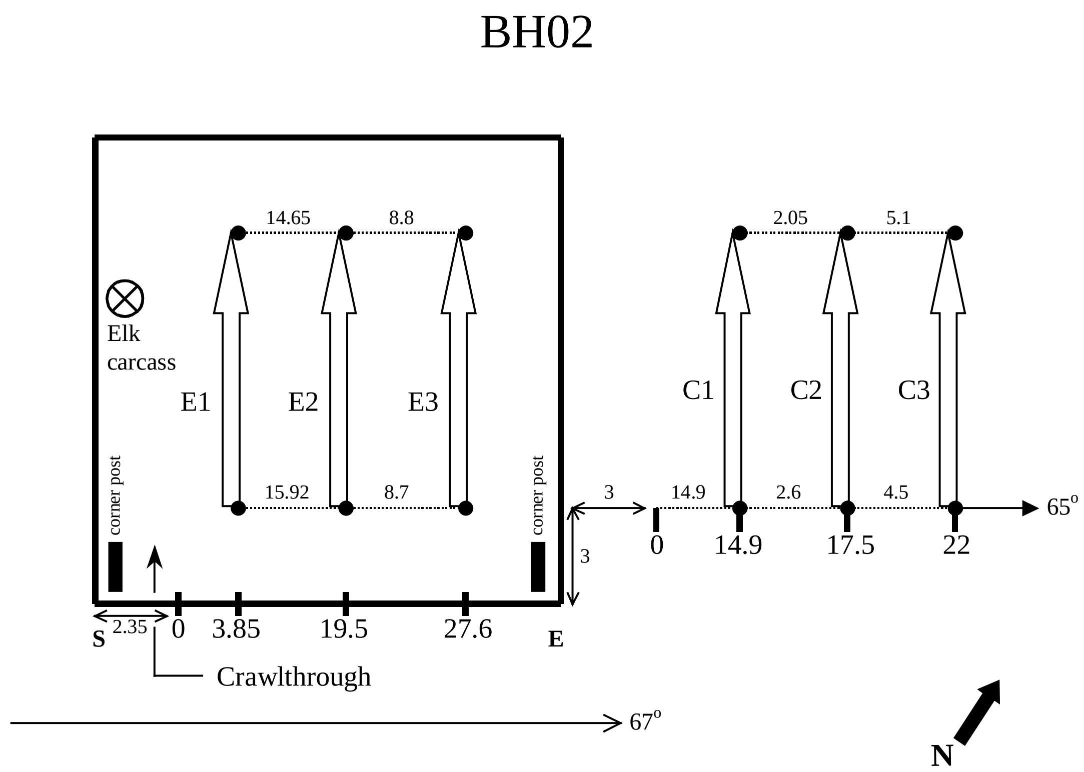
	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	12 m*	3 m*	33 cm	304°	29.9 m	25 cm
E2	19 m*	3 m*	30 cm	304°	29.9 m	27 cm
E3	28 m*	3 m*	24 cm	304°	30 m	23 cm

* = Measurement not verified 2001

CONTROL—Transect baseline zero-end is **3.3 meters** from **E** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	8.7 m	2.9 m	23 cm	304°	29.8 m	22 cm
C2	11.7 m	2.9 m	25 cm	304°	29.8 m	24 cm
C3	24.6 m	2.9 m	20 cm	301°	29.9 m	20 cm

Figure B-14 BH01: *Baccharis* grassland high-use exclosure and control plot 1, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



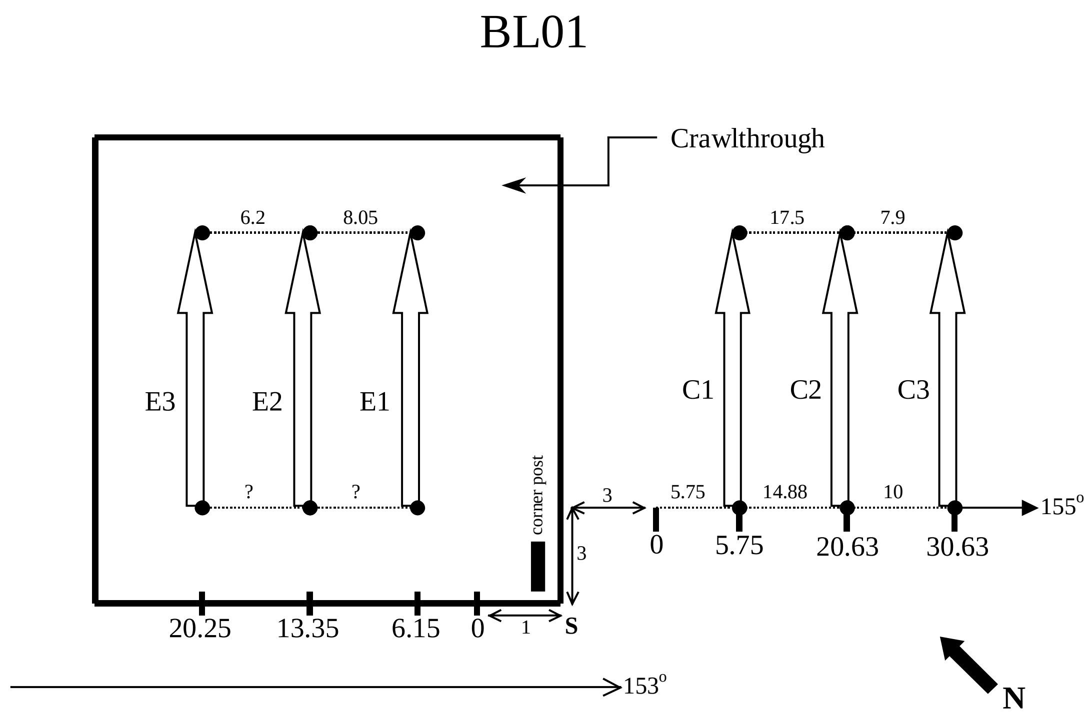
EXCLOSURE—Transect baseline zero-end is **2.35 meters** from the **S** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	3.85 m	3 m	25 cm	315°	30 m	24 cm
E2	19.5 m	3 m	12 cm	315°	30 m	23 cm
E3	27.6 m	3 m	23 cm	313°	29.9 m	23 cm

CONTROL—Transect baseline zero-end is **3 meters** from **E** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	14.9 m	NA	14 cm	337°	30 m	15 cm
C2	17.5 m	NA	19 cm	338°	29.7 m	21 cm
C3	22 m	NA	24 cm	339°	32 m	18 cm

Figure B-15 BH02: *Baccharis* grassland high-use exclosure and control plot 2, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



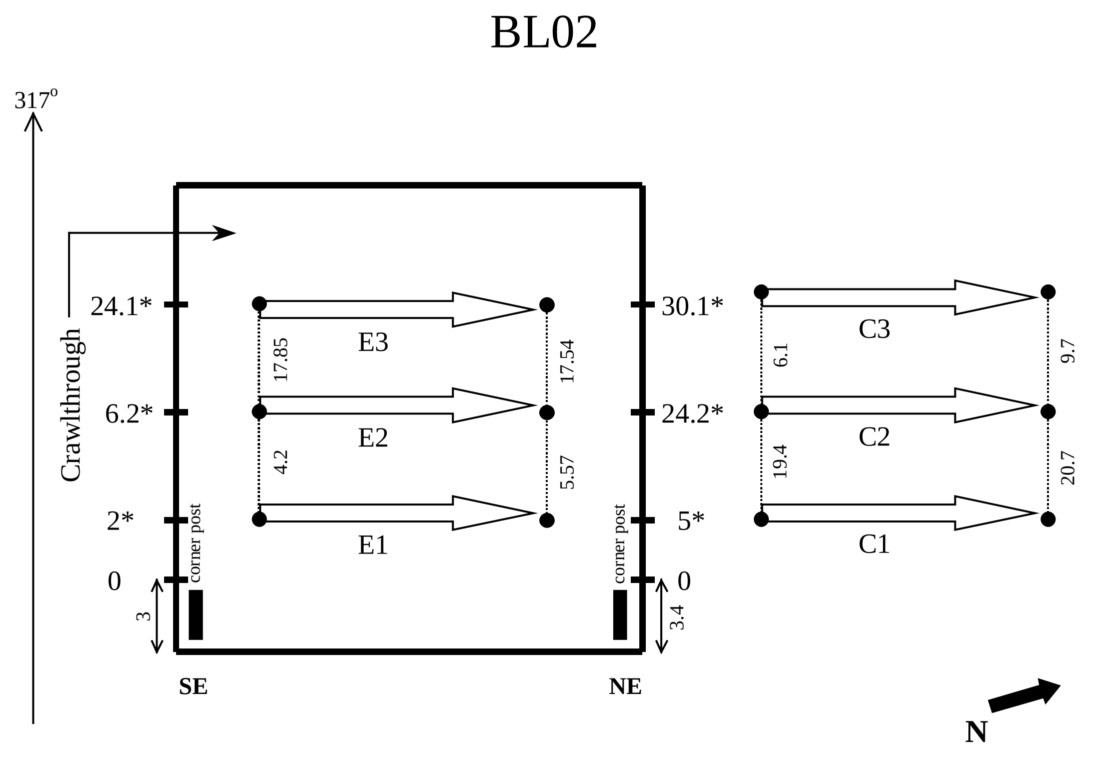
EXCLOSURE—Transect baseline zero-end is **1 meter** from the **S** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	6.15 m	1.55 m	26 cm (In the open)	60°	24.95 m	29 cm (In a BAPI)
E2	13.35 m	1.55 m	20 cm (In the open)	60°	24.9 m	21 cm (In the open)
E3	20.25 m	1.5 m	30 cm (In RUUR and open)	59°	24.84 m	36 cm (In the open)

CONTROL—Transect baseline zero-end is **3 meter** from **S** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	5.75 m	NA	14 cm (In a BAPI)	63°	29.96 m	10 cm (In a BAPI)
C2	20.63 m	NA	16 cm (In the open)	69°	30 m	5 cm (Middle of large open)
C3	30.63 m	NA	19 cm (In the open)	65°	29.95 m	17 cm (In the open)

Figure B-16 BL01: *Baccharis* grassland low use exclosure and control plot 1, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)



EXCLOSURE—Transect baseline zero-end is **3 meters** from the **SE** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
E1	2 m*	2.9 m*	21 cm (In a BAPI)	52°	29.93 m	17 cm (In the open)
E2	6.2 m*	3.05 m*	20 cm (In the open)	48°	29.83 m	21 cm (In a BAPI)
E3	24.1 m*	3.2 m*	27 cm (In the open)	47°	29.87 m	19 cm (In a BAPI)

* = Measurement not verified 2001

CONTROL—Transect baseline zero-end is **3.4 meters** from N**E** corner post

	Distance along baseline	*Distance from baseline to 0-end*	*Stake height 0-end (Location description)*	*Azimuth 0 to 30-end*	*Distance to 30-end*	*Stake height 30-end (Location description)*
C1	5 m*	2.87 m	12 cm (In the open)	57°	29.9 m	15 cm (In the open)
C2	24.2 m*	3.1 m	8 cm (In the open)	55°	29.96 m	16 cm In a BAPI)
C3	30.1 m*	2.86 m	15 cm In a BAPI)	48°	29.98 m	5 cm (In the open)

Figure B-17 BL02: *Baccharis* grassland low use exclosure and control plot 2, Tomales Point, Point Reyes National Seashore (azimuths are adjusted to geographic north (15 degrees added to magnetic north)

APPENDIX C

Species List

Sampled on Gogan transects and elk exclosures and control plots in 1998, 1999 and 2001, Tomales Point Elk Range, Point Reyes National Seashore

Code [a]	Family	Genus/species	Lifeform	Native/Exotic
ABLA2	Nyctaginaceae	*Abronia latifolia*	Herb-perennial	N
ACMI2	Asteraceae	*Achillea millefolium*	Herb-perennial	N
ACPIC2	Rosaceae	*Pceana pinnatifida var. californica*	Herb-perennial	N
AGPA8	Poaceae	*Agrostis pallens*	Grass-perennial	N
AICA	Poaceae	*Aira caryophyllea*	Grass-annual	E
AMMEI2	Boraginaceae	*Amsinckia menziesii var. intermedia*	Herb-annual	N
ANAR	Primulaceae	*Anagallis arvensis*	Herb-annual	E
ANHE	Apiaceae	*Angelica hendersonii*	Herb-perennial	N
ARDO3	Asteraceae	*Artemisia douglasiana*	Herb-perennial	N
ASCH2	Asteraceae	*Aster chilensis*	Herb-perennial	N
AVBA	Poaceae	*Avena barbata*	Grass-annual	E
BAPI	Asteraceae	*Baccharis pilularis*	Shrub	N
BEPI	Berberidaceae	*Berberis pinnata ssp. pinnata*	Shrub	N
BLNAR	Asteraceae	*Blennosperma nanum var. robustum*	Herb-annual	N
BRCA	Poaceae	*Bromus carinatus*	Grass-perennial	N
BRCAM	Poaceae	*Bromus carinatus var. maritimus*	Grass-perennial	N
BRDI3	Poaceae	*Bromus diandrus*	Grass-annual	E
BRHO2	Poaceae	*Bromus hordeaceus*	Grass-annual	E
BRMA	Poaceae	*Briza maxima*	Grass-annual	E
BRMI2	Poaceae	*Briza minor*	Grass-annual	E
CABR8	Cyperaceae	*Carex brevicaulis*	Sedge-perennial	N
CABU2	Brassicaceae	*Capsella bursa-pastoris*	Herb-annual	E
CACI2	Portulacaceae	*Calandrinia ciliata*	Herb-annual	N
CADE8	Cyperaceae	*Carex densa*	Sedge-perennial	N
CAOC6	Convolvulaceae	*Calystegia occidentalis*	Herb-perennial	N
CAOV4	Onagraceae	*Camissonia ovata*	Herb-perennial	N
CAPUP2	Convolvulaceae	*Calystegia purpurata ssp. purpurata*	Herb-perennial	N
CAPY2	Asteraceae	*Carduus pycnocephalus*	Herb-annual	E
CARA3	Caryophyllaceae	*Cardionema ramosissimum*	Herb-perennial	N
CAREX	Cyperaceae	*Carex sp.*	Sedge-perennial	N
CATU3	Cyperaceae	*Carex tumulicola*	Sedge-perennial	N
CEAR4	Caryophyllaceae	*Cerastium arvense*	Herb-perennial	N
CEGL	Rhamnaceae	*Ceanothus gloriosus*	Shrub	N
CHCU3	Polygonaceae	*Chorizanthe cuspidata*	Herb-annual	N
CHCUC	Polygonaceae	*Chorizanthe cuspidata var. cuspidata*	Herb-annual	N
CHPOD	Liliaceae	*Chlorogalum pomeridianum var. divaricatum*	Herb-perennial	N
CIOC	Asteraceae	*Cirsium occidentale*	Herb-biennial	N
CIQU2	Asteraceae	*Cirsium quercetorum*	Herb-perennial	N
CIVU	Asteraceae	*Cirsium vulgare*	Herb-biennial	E
CLPEP	Portulacaceae	*Claytonia perfoliata ssp. perfoliata*	Herb-annual	N

Code [a]	Family	Genus/species	Lifeform	Native/Exotic
CLPUP	Onagraceae	*Clarkia purpurea ssp. purpurea*	Herb-annual	N
COAR4	Convolvulaceae	*Convolvulus arvensis*	Herb-perennial	E
CRLE4	Boraginaceae	*Cryptantha leiocarpa*	Herb-annual	N
CYEC	Poaceae	*Cynosurus echinatus*	Grass-annual	E
DAGL	Poaceae	*Dactylis glomerata*	Grass-perennial	E
DANCA	Poaceae	*Danthonia californica*	Grass-perennial	N
DECE	Poaceae	*Deschampsia cespitosa*	Grass-perennial	N
ELGL	Poaceae	*Elymus glaucus*	Grass-perennial	N
ERBO	Geraniaceae	*Erodium botrys*	Herb-annual	E
ERCI6	Geraniaceae	*Erodium cicutarium*	Herb-annual	E
ERLA5	Polygonaceae	*Eriogonum latifolium*	Herb-annual	N
ERMI6	Asteraceae	*Erichtites minima*	Herb-annual	E
ERODI	Geraniaceae	*Erodium sp.*	Herb-annual	N
ERST9	Asteraceae	*Eriophyllum staechadifolium*	Shrub	N
ESCA2	Papaveraceae	*Eschscholzia californica*	Herb-annual	N
FEAR3	Poaceae	*Festuca arundinacea*	Grass-perennial	E
FERU2	Poaceae	*Festuca rubra*	Grass-perennial	N
FIGA	Asteraceae	*Filago gallica*	Herb-annual	E
FRCH	Rosaceae	*Fragaria chiloensis*	Herb-perennial	N
FRVE	Rosaceae	*Fragaria vesca*	Herb-perennial	N
GAAP2	Rubiaceae	*Galium aparine*	Herb-annual	E
GACA3	Rubiaceae	*Galium californicum*	Herb-perennial	N
GALIU	Rubiaceae	*Galium sp.*	Herb-annual	N
GEDI	Geraniaceae	*Geranium dissectum*	Herb-annual	E
GEMO	Geraniaceae	*Geranium molle*	Herb-annual	E
GNPU2	Asteraceae	*Gnaphalium purpureum*	Herb-biennial	
GRIND	Asteraceae	*Grindelia sp.*	Herb-perennial	N
HEAR5	Rosaceae	*Heteromeles arbutifolia*	Shrub	N
HELA4	Apiaceae	*Heracleum lanatum*	Herb-perennial	N
HIIN3	Brassicaceae	*Hirschfeldia incana*	Herb-biennial	E
HOBR2	Poaceae	*Hordeum brachyantherum*	Grass-perennial	N
HOLA	Poaceae	*Holcus lanatus*	Grass-perennial	E
HOMU	Poaceae	*Hordeum murinum*	Grass-annual	E
HYGL2	Asteraceae	*Hypochaeris glabra*	Herb-annual	E
HYRA3	Asteraceae	*Hypochaeris radicata*	Herb-perennial	E
IRDO	Iridaceae	*Iris douglasiana*	Herb-perennial	N
JUBO	Juncaceae	*Juncus bolanderi*	Rush-perennial	N
JUBU	Juncaceae	*Juncus bufonius*	Rush-perennial	N
JUEF	Juncaceae	*Juncus effusus*	Rush-perennial	N
JUPA2	Juncaceae	*Juncus patens*	Rush-perennial	N
LAVE2	Fabaceae	*Lathyrus vestitus var. vestitus*	Herb-perennial	N
LEPA12	Poaceae	*Leymus pacificus*	Grass-perennial	N
LIAP	Apiaceae	*Ligusticum apiifolium*	Herb-perennial	N
LITT	—	*Litter*	Litter	—
LOHIV	Caprifoliaceae	*Lonicera hispidula var. vacillans*	Shrub	N
LOHU2	Fabaceae	*Lotus humistratus*	Herb-annual	N
LOLIU	Poaceae	*Lolium sp.*	Grass-annual	E

Code [a]	Family	Genus/species	Lifeform	Native/Exotic
LOMU	Poaceae	*Lolium multiflorum*	Grass-annual	E
LOPE	Poaceae	*Lolium perenniale*	Grass-perennial	E
LOPU3	Fabaceae	*Lotus purshianus var. purshianus*	Herb-annual	N
LOTUS	Fabaceae	*Lotus sp.*	Herb-annual	N
LUAR	Fabaceae	*Lupinus arboreus*	Shrub	N
LUBI	Fabaceae	*Lupinus bicolor*	Herb-annual	N
LUCO6	Juncaceae	*Luzula comosa*	Rush-perennial	N
LUPIN	Fabaceae	*Lupinus sp.*	Herb-annual	N
LUVA	Fabaceae	*Lupinus varicolor*	Herb-annual	N
MAFA3	Cucurbitaceae	*Marah fabaceus*	Herb-perennial	N
MASA	Asteraceae	*Madia sativa*	Herb-annual	E
MEPO3	Fabaceae	*Medicago polymorpha*	Herb-annual	E
MEPU	Lamiaceae	*Mentha pulegium*	Herb-perennial	E
MIGU	Scrophulariaceae	*Mimulus guttatus*	Herb-annual	N
NAPU4	Poaceae	*Nassella pulchra*	Grass-perennial	N
NEME	Hydrophyllaceae	*Nemophila menziesii*	Herb-annual	N
OESA	Apiaceae	*Oenanthe sarmentosa*	Herb-perennial	N
OXALI	Oxalidaceae	*Oxalis sp.*	Herb-annual	N
OXALP	Oxalidaceae	*Oxalis albicans ssp. pilosa*	Herb-perennial	N
OXPE	Oxalidaceae	*Oxalis pes-caprae*	Herb-perennial	E
POAN	Poaceae	*Poa annua*	Grass-annual	E
PHCA	Hydrophyllaceae	*Phacelia californica*	Herb-perennial	N
PLER3	Plantaginaceae	*Plantago erecta*	Herb-annual	N
PLLA	Plantaginaceae	*Plantago lanceolata*	Herb-perennial	E
POA	Poaceae	*Poa sp.*	Grass-annual	N
POMU	Dryopteridaceae	*Polystichum munitum*	Fern	N
POPRP2	Poaceae	*Poa pratensis ssp. pratensis*	Grass-perennial	E
PRVU	Lamiaceae	*Prunella vulgaris*	Herb-perennial	N
PTAQP2	Dennstaedtiaceae	*Pteridium aquilinum var. pubescens*	Fern	N
PTDR	Polygonaceae	*Pterostegia drymariodes*	Herb-annual	N
RACA2	Ranunculaceae	*Ranunculus californicus*	Herb-perennial	N
RASA2	Brassicaceae	*Raphanus sativus*	Herb-annual	E
RHCA	Rhamnaceae	*Rhamnus californica*	Shrub	N
RUAC3	Polygonaceae	*Rumex acetosella*	Herb-perennial	E
RUPA	Rosaceae	*Rubus parviflorus*	Shrub	N
RUUR	Rosaceae	*Rubus ursinus*	Herb-perennial	N
SABI3	Apiaceae	*Sanicula bipinnatifida*	Herb-biennial	N
SADO5	Lamiaceae	*Satureja douglasii*	Herb-perennial	N
SIBE	Iridaceae	*Sisyrinchium bellum*	Herb-perennial	N
SIGA	Caryophyllaceae	*Silene gallica*	Herb-annual	E
SIMA3	Asteraceae	*Silybum marianum*	Herb-annual	E
SIMAM	Malvaceae	*Sidalcea malviflora ssp. malviflora*	Herb-perennial	N
SOAS	Asteraceae	*Sonchus asper*	Herb-annual	E
SOIL	—	*Bare ground*	Soil	—
SONCH	Asteraceae	*Sonchus sp.*	Herb-perennial	E
SOOL	Asteraceae	*Sonchus oleraceus*	Herb-annual	E
STAJ	Lamiaceae	*Stachys ajugoides var. ajugoides*	Herb-annual	N

Code [a]	Family	*Genus/species*	Lifeform	Native/Exotic
STAJU	Lemnaceae	*Stachys ajugoides*	Herb-annual	N
STELL	Caryophyllaceae	*Stellaria sp.*	Herb-annual	N
STLI	Caryophyllaceae	*Stellaria littoralis*	Herb-perennial	N
STME2	Caryophyllaceae	*Stellaria media*	Herb-annual	E
TODI	Anacardiaceae	*Toxicodendron diversilobum*	Shrub	N
TRCA5	Fabaceae	*Trifolium campestre*	Herb-annual	E
TRDU2	Fabaceae	*Trifolium dubium*	Herb-annual	E
TRGL4	Fabaceae	*Trifolium glomeratum*	Herb-annual	E
TRGR2	Fabaceae	*Trifolium gracilentum*	Herb-annual	N
TRIFO	Fabaceae	*Trifolium sp.*	Herb-annual	N
TRMA2	Fabaceae	*Trifolium macraei*	Herb-annual	N
TRMI4	Fabaceae	*Trifolium microcephalum*	Herb-annual	N
TRPU16	Scrophulariaceae	*Triphysaria pusilla*	Herb-annual	N
TRWI3	Fabaceae	*Trifolium willdenovii*	Herb-annual	N
TRWO	Fabaceae	*Trifolium wormskioldii*	Herb-perennial	N
UNKHE	—	*Unknown herb*	—	
UNKSP	—	*Unknown sp.*	—	
VIAD	Violaceae	*Viola adunca*	Herb-perennial	N
VIAM	Fabaceae	*Vicia americana*	Herb-perennial	N
VIHI	Fabaceae	*Vicia hirsuta*	Herb-annual	E
VISA	Fabaceae	*Vicia sativa*	Herb-annual	E
VUBR	Poaceae	*Vulpia bromoides*	Grass-annual	E
VULPI	Poaceae	*Vulpia sp.*	Grass-annual	N
VUMYH	Poaceae	*Vulpia myuros var. hirsuta*	Grass-annual	E
WYAN	Asteraceae	*Wyethia angustifolia*	Herb-perennial	N

[a] Natural resources Conservation Service species code

APPENDIX D

Data Forms and Field Equipment List

- Vegetation Transect Data Form (Page 1)
- Vegetation Transect Data Form (Page 2)
- Shrub Density Data Form
- Field Equipment List

VEGETATION TRANSECT DATA FORM

Point Reyes National Seashore, Tomales Point

Elk exclosure and control plots, Gogan plots (circle one)	**Page 1 of 2**	**Plot ID:**
Sampling done by:	**Date:**	**Transect:**

POINT	MAXHGT	SPP1	SPP2	SPP3	SPP4	SPP5	SPP6	SPP7	SUBSTR	Comments
0.3										
0.6										
0.9										
1.2										
1.5										
1.8										
2.1										
2.4										
2.7										
3										
3.3										
3.6										
3.9										
4.2										
4.5										
4.8										
5.1										
5.4										
5.7										
6										
6.3										
6.6										
6.9										
7.2										
7.5										
7.8										
8.1										
8.4										
8.7										
9										
9.3										
9.6										
9.9										
10.2										
10.5										
10.8										
11.1										
11.4										
11.7										
12										
12.3										
12.6										
12.9										
13.2										
13.5										
13.8										
14.1										
14.4										
14.7										
15										

VEGETATION TRANSECT DATA FORM

Elk exclosure and control plots, Gogan plots (circle one)	Page 2 of 2	Plot ID:
Sampling done by:	Date:	Transect:

POINT	MAXHGT	SPP1	SPP2	SPP3	SPP4	SPP5	SPP6	SPP7	SUBSTR	Comments
15.3										
15.6										
15.9										
16.2										
16.5										
16.8										
17.1										
17.4										
17.7										
18										
18.3										
18.6										
18.9										
19.2										
19.5										
19.8										
20.1										
20.4										
20.7										
21										
21.3										
21.6										
21.9										
22.2										
22.5										
22.8										
23.1										
23.4										
23.7										
24										
24.3										
24.6										
24.9										
25.2										
25.5										
25.8										
26.1										
26.4										
26.7										
27										
27.3										
27.6										
27.9										
28.2										
28.5										
28.8										
29.1										
29.4										
29.7										
30										

Shrub Density Data Form

Elk exclosure and control plots, *Baccharis* grassland	**Page of**	**Plot ID:**
Sampling done by:	**Date:**	

Plot #	**Young**	**Mature**	**Decadent**	**Dead**	**Comments**

FIELD EQUIPMENT LIST

- ☐ 100 meter tape for transect baseline
- ☐ 30 meter tapes for transects
- ☐ Compass (adjusted to 15 degree declination)
- ☐ Welding rod measuring “pin” (one per transect reader)
- ☐ Chaining pins (candy-cane stakes, two per transect)
- ☐ Flagging
- ☐ Palmtop and datasheets
- ☐ Palmtop operating instructions
- ☐ Clipboard
- ☐ Pencils
- ☐ Elk Effects Monitoring Manual (especially Appendix B, Figures B-2 through B-17, Plot Orientation and Layout Diagrams)
- ☐ Maps (exclosure locations)
- ☐ Plant list (elk vegetation plant list, Park list)
- ☐ Radio, cell phone
- ☐ Digital camera
- ☐ Metal detector
- ☐ Spare batteries (AA for palmtop)
- ☐ Jepson manual
- ☐ Grass ID aids

NOTES

APPENDIX E

Sample Annual Field Summary

Elk Effects Vegetation Monitoring Program

2001 Field Summary

This was the third year of elk effects vegetation monitoring at Tomales Point, Point Reyes National Seashore. Fieldwork began May 17th and ended by July 31st, 2001. Future fieldwork should be scheduled to begin mid- to late April depending on field conditions and by May 1st at the latest. 2001 was a very dry spring due to low rainfall the previous winter. Grasses at Tomales Point were in peak phenology early in the spring and for a short period of time. By late July, due to the dry conditions, Lolium and Vulpia were identifiable to genus only. Because of late phenology, certain small, delicate, or early season herbs such as Claytonia perfoliata or Stellaria media may have become part of the litter layer by the time we sampled and therefore undercounted or missed. Claytonia perfoliata did not show up on the transects this year although it had been found in previous years. After a brief check on identification characteristics, a Carex occuring in plot BHO1E (Carex tumulicola) was assumed to be the same species that had been recorded and identified in that same location in 1999. A number of native perennial species appeared on the transects for the first time this year, among them Angelica hendersonii, Artemisia douglasiana and Leymus pacificus.

This season we had anywhere from one to five people in the field with an average of a 3.4-person crew working for 9 1/2 weeks to complete the field work, with the exception of the Gogan plots and the rare plant survey, which we did not tackle this year due to the short season. This works out to approximately15 weeks of work for a two-person team to read the exclosure-control transects and sample the shrub density plots. Exclosure structures were not inspected in 2001.

Our biggest obstacle in getting started on the transect reading was the difficulty in locating the rebar stakes which mark the 0 and 30 meter ends of each transect in the exclosure and control plots. Previous written directions for locating the transects for each plot were sometimes incorrect for the exclosure/control layout, and many of the stakes — control stakes in particular — were extremely hard to locate. Approximately 3/4 of the stakes no longer had their yellow rubber caps or metal tags, and many of them were very low to the ground (only protruding two inches or so above the ground) both inside and outside of the exclosures. Spray-painting the control plot stakes orange or pink and recapping them at the beginning of each season as necessary may make it easier to locate them in the future. Blue spray paint was used to mark the stakes in 1999, but no traces were noticed in 2001.

To find the stakes, we utilized meter tapes from two directions (from the found end of the transect as well as from the next post over, if possible), compass, and a metal detector. The metal detector was most useful in grassy areas and in loose, sandy soil. One rebar stake was located with the metal detector buried a couple of inches beneath the surface. This technique was not useful in thickets of *Baccharis* because a constant sweeping motion of the metal detector is required for accurate readings. The brush impedes this and prevents getting as close to the ground as needed for a reading to occur. After several days of attempting to locate all stakes by these means, only two missing rebars had to be replaced. LGL2C1/30, OGL2C3/0 were never found; these rebars were restaked. LGL1C1/0 was found buried a couple of inches below the surface in loose, sandy soil. The old rebar was removed and it was replaced with longer pieces. LGH2C1/30 was found lying in the grass a couple of meters away from its original hole with chew marks in the flagging. It appears to have been pulled from the loose soil by an animal. It was replaced in the same hole with new rebar.

Because of these difficulties, the control plot stakes were GPS'd this year, and a detailed illustration of each plot was created which outlines the orientation of each exclosure; the baseline locations for the control and exclosure transects; the meter mark of each transect on the baseline; directions in which the transects run in relation to the exclosures; the distances between transects; the distance of the zero end of each transect from its baseline; and the UTM's of each control rebar stake. These graphics are included in Appendix B, Figures B-3 through B-17.

This year we had good luck with a few tools and techniques which aided our work in the field. We used palmtop computers to enter all transect data in the field. With the large amount of data collected for each transect, this helped reduce our data processing time by eliminating the need to enter data from a data sheet in the office. If using a palmtop it is important to save your data often—a good guideline is every five meters along the transect. The palmtops were virtually flawless in the field, although after the data was downloaded, importing it to Access was troublesome and time-consuming. A newer model with the capabilities to enter the data directly into Access in the field would be ideal. An Access database was created for the Elk veg project data for the first time this year. All 1998, 1999, and 2001 data are located in this database on the Point Reyes network at N:\ResMgt_Databases\ElkVeg\Elk_veg.mdb. Data is backed-up nightly on the network at Point Reyes.

It worked well to secure the transect tape to chaining pins (candy cane stakes) with rubber-tipped clamps. This reduced wear and tear on the tapes caused by wrapping or tying them to the stakes. We took digital photos of each transect, utilizing a dry-erase board to identify the plot name, and placed it in the foreground of each photo. The photos were taken when the tape was first set with as much of the 30 meter line in view as possible and plot/transect ID included. Photos were intended to be a record of the general appearance of the transect and are of limited use as an aid in finding rebar stakes. Digital photos are stored as JPEG files on the Point Reyes network at: N:\ResMgt\Vegetation\ElkVeg\Photos

We constructed a collapsible 1 x 5 meter PVC frame which we used to outline each of the 10 brush density plots read per exclosure and control. Gloves are highly recommended for the brush density stem counts to avoid blackberry thorns and poison oak. The thick carpet of Holcus lanatus in most of the *Baccharis* plots made stem counts very difficult and may have eliminated the other understory plants. Holcus had to be removed to find the stems in most cases.

Due to the rush of fieldwork in a short, dry season, we put office data management on the back burner and subsequently got behind on the importing and validating of the data. In the future I would suggest keeping up on these tasks on a weekly basis at least. This would save time by working out mistakes and computer problems more efficiently and, if any files or data were lost, there may still be time to re-do field work as necessary for the season. I also found with several people working on data processing and management at different times, that file management was a challenge. This may be solved with one or two people assigned to file management tasks for the season and a checklist of work done posted to update.

2001 ACKNOWLEDGEMENTS

Our special thanks to Natalie Gates, NPS Wildlife Biologist, for obtaining funding for this season's work through a grant from the National Park Foundation. Dave Schirokauer, NPS GIS Biologist, supervised this year's field effort and provided expert technical advice and staff to assist with critical data management issues.

Our 2001NPS field crew, Rowena Forest and David Lammers, did a great job, ably assisted by project intern Erin Gottschalk. The crew completed their field work on time unfazed by elusive rebar stakes, dense fog, rapidly curing grasses, and the elk contraceptive darting project. Rowena and David also contributed substantially to portions of this report. Julia Brenta and Jim Whitlock, our energetic high school interns, provided invaluable assistance with field work as did NPS staff members Wende Rehlaender and Isaiah Hirschfield.