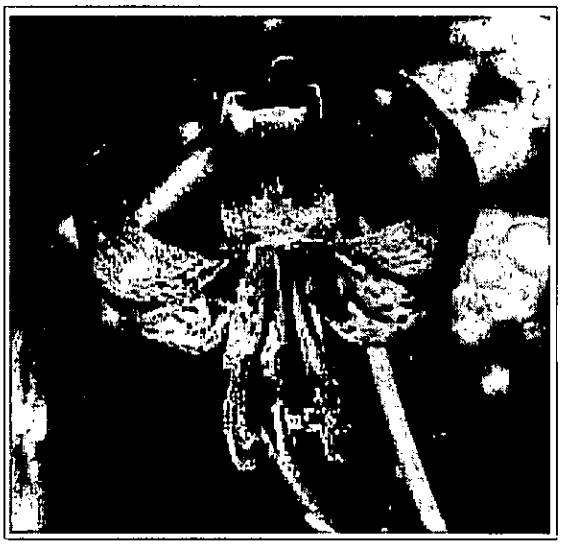
CRESCENT CITY MARSH WILDLIFE AREA

DEL NORTE COUNTY, CALIFORNIA

AND

TABLE BLUFF ECOLOGICAL RESERVE

HUMBOLDT COUNTY, CALIFORNIA
CALIFORNIA DEPARTMENT OF FISH AND GAME



1998 STATUS REPORT
WESTERN LILY VEGETATION STRATEGY

Prepared Under Interagency Agreement
California State University/
California Department of Fish and Game

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INTRODUCTION

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This report includes a compilation of the first year results for all tasks included in the western lily (*Lilium occidentale*) vegetation strategy study, implemented in June 1998. While the study is currently funded through March 2000, many elements of the study involve long term processes (e.g., lily recruitment, vegetation encroachment) that will require monitoring over a significantly longer period in order to maximize benefits from management. As a result, the study was designed with that in mind, and it is anticipated that portions of the study will continue well beyond the current schedule, perhaps for decades.

Formal monitoring of the western lily population at the Table Bluff Ecological Reserve (TBER), Humboldt County, California, began in 1987. Annual monitoring at this and other sites on Table Bluff has documented often severe browsing by deer or small mammals, resulting in loss of up to 50% or more of the reproductive effort during some years. Although no quantitative data are available, natural grazing may also be an important factor affecting mortality of the lily. With the exception of limited monitoring at the Christensen and Barry sites in the early 1990's, there has been no intensive effort to determine the actual annual loss to deer and small mammals, or investigate methods for discouraging mammal depradation. The ability of this plant to remain dormant for one or more years complicates the investigation of grazing impacts. As a result, a study intended to develop an accurate model of the population demographics and various external factors affecting individual and population survival in this species must necessarily track the life history of a large number of seedlings throughout the growing season, and extend over several years.

The monitoring at TBER since 1987 also documented increasing threat to the lily as a result of vegetation growth following removal of cattle. At the same time, removal of approximately 50% of the spruce forest encouraged plant growth on the forest floor, exacerbating the need for vegetation control. Although the removal of spruce allowed many juvenile lily plants to mature, the release caused by tree canopy removal also eliminated many lily seedlings.

We also do not know whether current recruitment at the TBER is adequate to replace the existing stand of mature lilies. Seed plots established in fall 1993 as part of the Experimental Habitat Manipulation Project have exhibited virtually no survival of seedlings in *Coastal prairie*, and relatively low survival in the *Spruce forest*. Abundant seedlings have been documented growing in pedestrian and cattle trails at the reserve (Imper and Sawyer, 1996), and in old cattle trails at another site on Table Bluff. We do not know if these seedlings eventually will mature.

However, evidence suggests that exclusion of cattle from the habitat between 1987 and 1996 negatively impacted both lily recruitment and longevity of mature plants. Passive grazing by cattle over the entire lily habitat at TBER has been allowed for the last 2 years. Other than vegetation transect data collected prior to reintroduction of grazing, there has been no quantitative

assessment of the use of the habitat by cattle or their impact on this vegetation, nor has the impact of cattle grazing on soils compaction or lily recruitment been assessed.

CRESCENT CITY MARSH WILDLIFE AREA

Formal monitoring of the western lily population in the north part of the Crescent City Marsh Wildlife Area ("North" and "South" marshes; Imper and Sawyer, 1992, 1997) was implemented in 1997. The CCMWA population is unquestionably the largest population known, containing more than 5,000 plants, yet is one of the least studied. There has been no detailed study of lily life history, recruitment or population demographics at this site.

Past monitoring of sites on Table Bluff and in southern Oregon indicates the principal threat to the western lily is encroachment by trees and shrubs (Guerrant et al. 1997). The majority of tree and shrub encroachment into lily habitat at the CCMWA appears to date to the early 1980's, apparently coinciding with removal of cattle from the area. Although current growth rate for alder, crabapple, spruce, willow, and other potentially aggressive species in this habitat may be relatively slow (due to high water table), no quantitative growth estimates have been made. Our experience elsewhere indicates encroachment by these species will eventually negatively impact the lily. Even a slow growth rate may be cause for alarm, due to the exponential relationship between lateral growth and aerial cover, particularly in light of the literally 1000's of expanding "islands" (seedlings and saplings) of shrub or tree now scattered throughout the marsh.

The available (limited) data indicate the main CCMWA population is not subject to severe natural grazing pressure; however, the critical importance of this population to this species (50% or more of all known flowering plants) warrants a greater understanding of natural grazing impacts, as well as the general life history of this population.

STUDY OBJECTIVES

TABLE BLUFF ECOLOGICAL RESERVE

This portion of the investigation is generally aimed at quantifying both the beneficial and negative impacts of cattle grazing applied at varying intensities and duration, as a method for maintenance of vegetation at TBER. That information is critical to development of a formal grazing plan for the TBER, and should be applicable many other western lily sites throughout the range.

The principle study objectives at TBER are 1) assess the impacts of cattle grazing applied at different intensities and durations upon vegetation composition and structure, soil compaction, the developmental biology of the lily and recruitment, and 2) determine quantitative impacts of natural grazing on the western lily, and the effect of deer and small mammal fencing and chemical inhibitors in reducing natural grazing. Secondary objectives include further definition of the life

history of the lily, and determination of whether cattle ingestion of the lily seed, under controlled conditions, is a successful mode of recruitment.

CRESCENT CITY MARSH WILDLIFE AREA

Our primary objectives for the investigation at CCMWA are to 1) characterize the current condition of habitat and western lily population, enabling future quantitative assessment of the rate of encroachment by competing species and its impact on the lily, 2) determine the efficacy of manual vegetation control for maintaining suitable western lily habitat, and 3) determine the relative impacts of natural grazing and the effect of deer and small mammal fencing in reducing natural grazing. A secondary objective is to increase our knowledge of the life history of the largest known population of western lily, and develop a quantitative estimate of current recruitment.

RESULTS

TABLE BLUFF ECOLOGICAL RESERVE

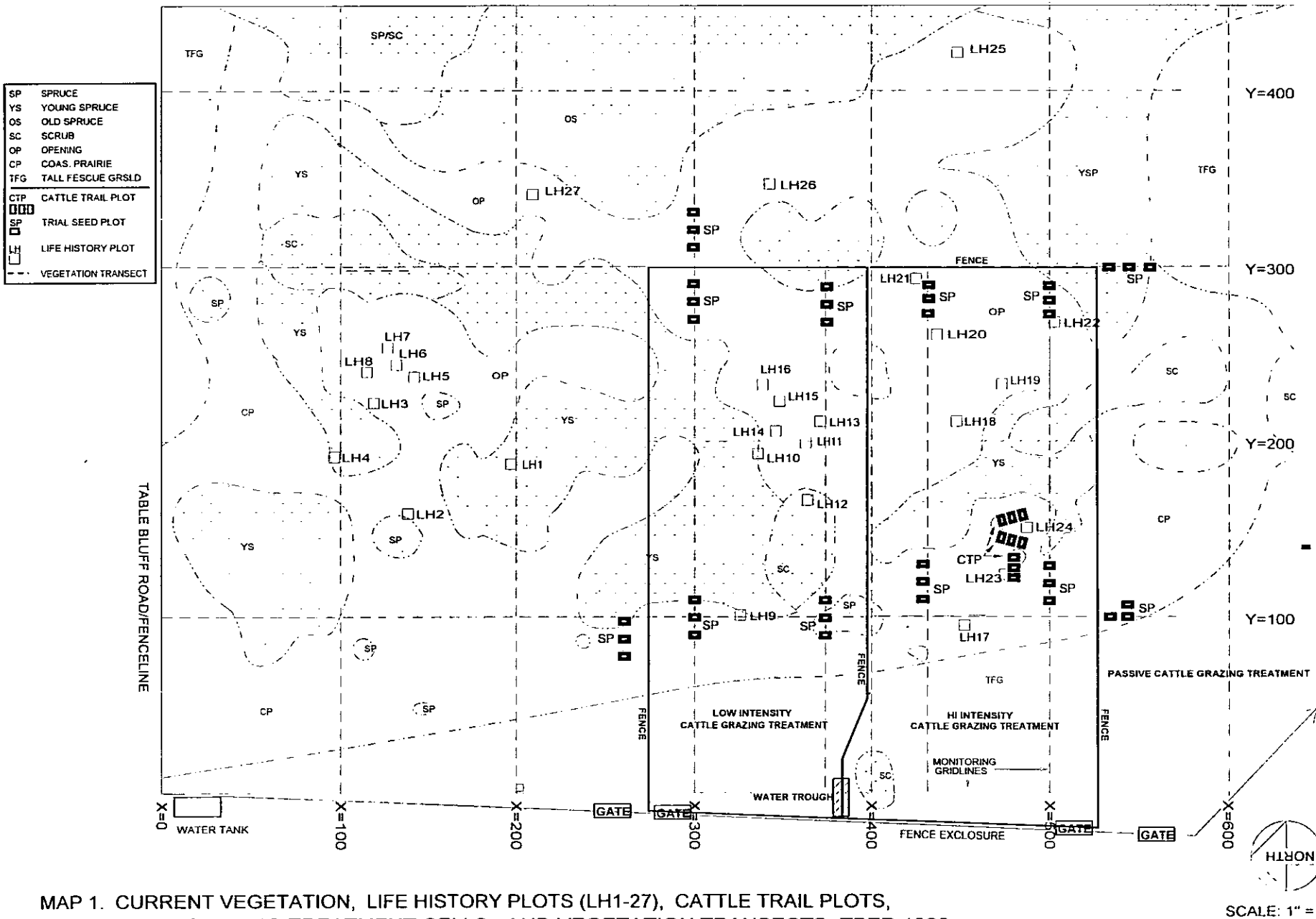
1998 Western Lily Seed Plots

Twelve 1ft^2 seed plots were established in each of the 3 grazing treatment areas (Figure 1). A short rebar stake was placed at the northwest corner of each plot. Locational coordinates and grazing treatment for each seed plot are indicated in Table 1. On October 6, 1998, 50 healthy lily seed were planted in each test plot prior to entry by cattle. Seed plots will be monitored annually hereafter for number and growth of lily seedlings.

Western Lily Life History Plots

Twenty seven 6ft^2 life history plots were permanently marked, allocated among the 3 cattle grazing treatment areas (Table 1, Figure 1). The southwest and northeast corner of each plot was staked with rebar; plot identification, grazing treatment and grid coordinates of the southwest corner are indicated in Table 1. The plots will be divided into various natural grazing exclosure and inhibiton treatments in March 1999 (i.e., deer or small mammal, deer chemical inhibitor, no fencing). In order to coincide with the overall grid coordinate system for the reserve, the X/Y coordinates recorded on the data sheets for each plot (Attachment 1) utilized the northwest corner as the origin. Within each grazing treatment, the plots were located so as to maximize the number of mature lilies and seedlings, and still provide representation throughout the treatment areas.

The plots were monitored from June 18-20, 1998, according to the following methodology: All mature lilies were inventoried and mapped within the 6ft^2 plots. For single-leaf seedlings, subunits of each plot were successively inventoried until not less than 20 single-leaf were recorded; for the purpose of future seedling inventories, the sample plot is considered to be the portion of the original 6ft^2 plot sampled to achieve 20 or more seedlings (or the total present in the 6 foot square plot, whichever is less), as indicated in Appendix A. All mature lilies were characterized as to height, extent of grazing or disease, and flowering status. Cover and height of all associated species were also described.



MAP 1. CURRENT VEGETATION, LIFE HISTORY PLOTS (LH1-27), CATTLE TRAIL PLOTS, SEED PLOTS, GRAZING TREATMENT CELLS, AND VEGETATION TRANSECTS, TBER 1998.

SCALE: 1" = 80'

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Table 1. Locational coordinates of life history plots, cattle trail plots, seed plots and vegetation transects (Map 1) and photopoints, Table Bluff Ecological Reserve.

Location	Plot ID	Cattle treatment	Grazing treatment	X/Y Coordinates		
Life	1	passive		200/184		
History	2	passive		141/156		
Plots	3	passive		122/219		
(SW corner)	4	passive		99/188		
	5	passive		145/234		
	6	passive		135/241		
	7	passive		130/251		
	8	passive		118/237		
	9	no. enclosure		329/98		
	10	no. enclosure		339/190		
	11	no. enclosure		366/196		
	12	no. enclosure		367/163.5		
	13	no. enclosure		374/208.5		
	14	no. enclosure		349/203		
	15	no. enclosure		351/220		
	16	no. enclosure		341.5/229.5		
	17	so. enclosure		455/92		
	18	so. enclosure		450.5/208.5		
	19	so. enclosure		476/230		
	20	so. enclosure		1.7001934236		
	21	so. enclosure		428/290		
	22	so. enclosure		505.5/265.5		
	23	so. enclosure		477.5/121		
	24	so. enclosure		490/148		
	25	passive		451/418.5		
	26	passive		345.5/344		
	27	passive		212/338		
Location	**Plot ID**	**Cattle treatment**		**X/Y Coordinates**		
Seed Plots						
(NW corner)		so. enclosure		430/110	430/120	430/130
		so. enclosure		430/280	430/285	430/290
		so. enclosure		500/110	500/120	500/130
		so. enclosure		500/274	500/280	500/288
		no. enclosure		300/90	300/100	300/110
		no. enclosure		300/270	300/279	300/290
		no. enclosure		375/90	375/100	375/110
		no. enclosure		375/270	375/282	375/290
		passive		260/80	260/90	260/100
		passive		300/310	300/320	300/330
		passive		535/300	540/300	550/300
		passive		535/100	540/100	540/105
Cattle Trail	#1	so. enclosure		479/130		
Plots	#2	so. enclosure		477/142		
(SW corner)	#3	so. enclosure		478/155		

Notes:

Coordinates fo Life History Plots = SW corner (rebar @ diag. corners); for Cattle Trail Plots = SW corner (rebar @ diag. corners) of center 3' x 3' plot; lateral 3' x 3' plots are oriented relative to center plot as follows:#1-90d;#2-20d;#3-356d.

Coordinates for Seed Plots = NW corner (rebar stake) of 12" x 12" plot, 50 seed planted ea. plot 10/6/98.

Table 1. Continued:

Vegetation Transects:	Cattle treatment:		X/Y Coordinates	
(General habitat	passive		Y=100; X=0-270, 530-600	
and grazing trtmt	passive		Y=200; X=0-270, 530-600	
characterization)	passive		Y=300; X=0-270, 530-600	
	passive		Y=400; X=0-600	
	passive		X=100; Y=0-450	
	passive		X=200; Y=0-450	
	passive		X=300; Y=300-450	
	passive		X=400; Y=300-450	
	passive		X=500; Y=300-450	
	no. enclosure		Y=100; X=270-400	
	no. enclosure		Y=200; X=270-400	
	no. enclosure		X=300; Y=0-300	
	no. enclosure		X=375; Y=0-300	
	so. enclosure		Y=100; X=400-530	
	so. enclosure		Y=200; X=400-530	
	so. enclosure		X=400; Y=0-300	
	so. enclosure		X=430; Y=0-300	
Photopoints:	**Cattle treatment:**	**Orientation:**	**X/Y Coordinates**	
General habitat		S	00/00	
istorical photopts)		S	00/50	
		E,S	200/100	
		S,W	400/100	
		E,N	470/100	
		E	125/200	(north glade)
		E,S,N	200/200	
		E,S	200/300	
		S,W	400/200	
		S,W	400/300	
		S,W	200/400	
		S,W,N	400/400	
		E,W	350/200	(south glade)
		E	170/35	(1994 mow trtmt)
		E	235/30	(1994 grzg trtmt)
		E	305/40	burn trtmt-unburned)
Grazing treatments	no. enclosure	S	270/100	
(added 10/8/98)	no. enclosure	S	270/200	
	no. enclosure	W	300/300	
	no. enclosure	W	360/300	
	no./so. enclos.	N,S	400/200	
	no./so. enclos.	N,S	400/100	
	no. enclosure	E	330/0	
	so. enclosure	E	460/0	
	so. enclosure	N	530/100	
	so. enclosure	N	530/200	
	so. enclosure	W	470/300	

Some 246 seedlings and 314 mature lilies were recorded and mapped (Table 3A). Average height of the non-seedling plants was 21 inches, compared to an average of 34 inches for the CCMWA life history plots. Although not directly comparable due to the subjective placement of plots (in average habitat for each site), the average density of seedlings at TBER (0.25/sf) was equivalent to the average for the CCMWA plots (0.10 and 0.41 seedlings/sf for the North and South Marsh plots, respectively). Little evidence of natural grazing and no incidence of disease was observed at TBER. Maps locating all seedlings and mature plants documented in the 27 plots are included in Appendix A. These maps and field data sheets developed for the life history monitoring (Appendix E) will be utilized during future monitoring to streamline the process and enable rapid relocation of all previously documented plants. The 1998 field data sheets are included as Attachment 1.

Soil Compaction Baseline Characterization

Five soil cores were sampled at random locations within each of the 3 grazing treatments. Samples were collected on June 15, 1998 with 1.37 inch diameter x 4 inch thinwall brass tubes, sharpened on the leading edge and driven between 4 and 10 inches below ground surface. Each sample was immediately labeled and sealed with duct tape until weighed to the nearest gram. Samples were then extruded and dried to oven dry weight at 105 degrees C., then reweighed to calculate bulk density and % moisture. Approximate location coordinates, and bulk density and moisture results are listed in Table 2. Dry bulk density ranged from 49 to 74 pounds per cubic foot (pcf); mean bulk density for all samples, including the 6 samples collected from the cattle trail plots, was 60.4 pcf, while moisture content was 36% (a light rainfall had occurred the previous week). These results correlated well with the mean density for samples collected in the *Coastal prairie* in 1992 (59 pcf; n = 4) and 1994 (63 pcf; n = 6). For comparison, the mean bulk density measured in nearby *Tall fescue grassland* soils (unsuitable lily habitat) was 70 pcf (n = 4) in 1992 (Imper and Sawyer, 1994).

Cattle Trail Plots (Western Lily Recruitment and Soil Compaction)

Three $3ft^2$ plots (#1-3; Figure 1) were permanently marked to monitor of lily seedling density and fate, and soil compaction within trails created during the past 2 years of passive winter cattle grazing (and probably impacted by human traffic over the past 11 years as well). Location coordinates are indicated in Table 1. For each plot, a rebar stake was placed at the southwest and northwest corners. On June 15, 1998, all western lilies were recorded and mapped within the plot (centered on the cattle trail) and in two $3ft^2$ plots adjoining the central plot on both sides of the trail. Soil core samples were collected between 4 and 10 inches below the ground surface from each center plot and one of the adjacent plots. Sample methodology and preparation were described above for the soil compaction baseline characterization. Number of lily seedlings and mature plants, and bulk density and moisture results for each plot are reported in Table 1. Average soil density for the 6 plots was 57 pounds per cubic foot, ranging 52-74 pounds in the center plots, and 49-58 in the adjacent plots. Number of lily seedlings within the center plots ranged 17-49, compared to 1-13 seedlings in the 6 offset plots.

These plots will be monitored annually hereafter to determine the fate of seedlings established in the trails, and detect changes in soil density.

General Habitat Monitoring and Baseline Vegetation Characterization for the Cattle Treatments

General habitat monitoring was conducted across the monitoring grid (4650' transect) from October 6-8, 1998, in accordance with the standard protocol for the reserve (Imper *et al.*, 1987). Overall cover for dominant species or groups of species (based on transect intervals) and comparison to previous monitoring conducted in 1989, 1993 and 1996 are reported in Table 3B (field data sheets included as Attachment 2). The indicated cover of several of the dominant vegetation types (e.g., *Tall fescue grassland, Willow scrub, Spruce/salmonberry woodland*) has not changed significantly since 1989, apparently due to the overriding influence of soils and/or soil moisture. Cover by typical *Coastal prairie* increased significantly after removal of cattle in 1987, but has since stabilized. The *Sweet vernal grassland* decreased soon after removal of grazing (i.e., converted to *Coastal prairie* or blackberry) but increased since 1993 in response to thinning of the spruce stand. The *Young spruce forest* (representing the plant community associated with the barren spruce, not the cover by young spruce itself) declined from 32% cover to 7% this year as a result of thinning (largely converted to *Sweet vernal grassland*). Even though the *Old spruce forest* was not thinned, it declined as well due to thinning of the adjacent *Young spruce forest*.

In order to characterize the pre-treatment vegetation in the north and south cattle enclosures, and the existing condition of the passively grazed habitat, two transects were added to the general habitat monitoring transects (i.e., X=375/Y=0-300 - north enclosure; X=430/Y=0-300 - south enclosure), and the resulting data from all transects were segregated by grazing treatment (transect segments allocated to each treatment indicated in Table 1). The species or species group cover values and total transect distance monitored for the 3 treatment areas are indicated in Table 3C. The south enclosure generally had lower spruce cover (37% cover compared to 50-53%), taller average ground vegetation (46 inches compared to 34-36 inches), and intermediate percentage of grassland cover (all types - 77% compared to 67-83%) compared to the north enclosure and passive treatment area.

These data will be compared to future results of monitoring following application of the grazing treatments.

Slide photographs have been taken during the annual flowering plant census at 25 permanent photopoints since 1987; another 3 photopoints were established in 1994, documenting the 3 vegetation treatment areas included in the Experimental Habitat Restoration Study. For this study, 13 photopoints were established to monitor the impact of cattle grazing in the north and south cattle enclosures. Photographs were taken in October, 1998, prior to introduction of cattle. A list of all photopoints, locational coordinates and declinations is included in Table 1. Photodocumentation of the cattle enclosures will be conducted on an annual basis hereafter, during the annual plant census. Copies of slides taken in October, 1998 will be submitted together with post-treatment photodocumentation with the final project report in March, 2000.

Cattle Grazing Treatments

The entire lily habitat (except the north and south cattle enclosures) was opened to passive grazing by cattle on about December 1, 1998, and will remain open until approximately March 15, 1999. Unfortunately, the habitat has recieved little use by cattle so far this winter

due to the temporary removal of the herd off the reserve. The herd was returned on January 21, and has begun to impact the passive treatment area. In the future, an effort should be made to ensure the annual schedule of grazing on the reserve overlaps the period when the lily is dormant (September to March), so that cattle are available when needed for passive grazing within the rare plant exclosure.

In coordination with CDFG personnel and based on advice from the Humboldt County Agricultural Extension Office and a professor in Range Management at Humboldt State University, a tentative experimental grazing regime was developed. The 2 active cattle enclosures, each measuring 130 feet by 300 feet, a 1,000 gallon water tank, and a float-controlled water trough serving the 2 enclosures were installed by CDFG personnel in November and December, 1998 (Figure 1). CDFG staff and California Conservation Corps volunteers also removed the portion of the previous fencing installed for the Experimental Habitat Manipulation Project in 1994, not used in the current grazing plan (i.e., Y=0-300 along X=200; X=200-270 along Y=300). Arrangements were made with Fred Fearrien, the current grazing lessee, to confine 2 cows in the north enclosure (beginning January 4, 1999) and 11 cows in the south enclosure (beginning January 21). Based on a facilities and habitat monitoring schedule developed by CDFG, the enclosures, water supply, and habitat are inspected on a 2-3 day basis throughout the period in which cattle are enclosed. The duration for the low and high intensity grazing treatments is currently being determined based on a combination of the following subjective measures: maximum reduction of shrub cover and establishment of cattle trails within shrub canopies; reduction of the majority of *Calamagrostis nutkaensis* culms to between 6 and 12 inches height; minimal disruption of soil more than one inch deep, particularly in areas known to support the lily.

Lily Seed Ingestion Trial

On January 18, 1999, 500 healthy western lily seed were fed to a cow (Holstein-Guernsey cross) provided by the grazing lessee, confined in a pen at his ranch near Loleta. The cow was initially deprived of food for 24 hours in order to encourage consumption of the grain. The seed was then added to several pounds of grain, and fed to the cow (confined by a stanchion). The excrement was collected every 12 hours thereafter for 36 hours, and transported to TBER, where it was placed in a fenced area near grid coordinates 270/300. The excrement will be monitored annually hereafter for seedling germination, growth and survival.

1999 Task Schedule

1) In early March, 1999, the 27 plots will divided into 4 treatments as follows: 7 plots will be left totally exposed; 7 plots will be enclosed in graduated mesh fencing, designed to exclude all mammals (including deer and voles); 7 plots will be enclosed in 4 inch mesh wire, set slightly above the ground so that deer are excluded, but small mammal herbivory is allowed, and the remaining 6 plots will be left exposed, but will have deer inhibitor compounds applied periodically within 10 feet immediately surrounding the plot. The fence wire will be removed between October and March, to allow grazing by cattle.

2) The life history plots will be monitored on or about the following dates: March 15, April 1, April 15, and June 15, 1999. On each monitoring date, all lilies greater than 2 inches tall within the entire plot, and all single leaf seedlings within the seedling plots will be mapped and characterized for height, extent of grazing or disease, and flowering condition.

3) The cattle trail plots (lily recruitment and soil compaction) located in the south cattle enclosure will be resampled in June 1999 (recruitment) and in February 2000 (soil compaction).

4) The 48 - 3 ft^2 seed plots installed in 1994 as part of the Experimental Habitat Manipulation Study (Imper and Sawyer, 1996) will be monitored for lily survival and growth in June 1999. The seed plots included 12 plots each in the control, seasonal grazed, mowed, and burn (not yet burned) treatments, distributed equally in the *Spruce forest* and *Coastal prairie* at the reserve. Approximately !00 lily seed were sown in each plot.

5) The 2nd year project status report will be submitted by November 15, 1999, providing a brief summary of the 1999 monitoring results. The final project report will be submitted by March 31, 2000, and include 1) an assessment of impacts of varying cattle grazing intensity treatments on soil bulk density, vegetation composition and structure, and lily developmental biology and recruitment, 2) assessment of the impacts of natural grazing and the efficacy of the various means investigated for controlling natural grazing, and 3) discussion of the life history of this population, including annual dormancy rates, phenology, population structure, recruitment and seedling fate observed over the 2 years. Recommendations for continuing the grazing treatments and further monitoring will be included.

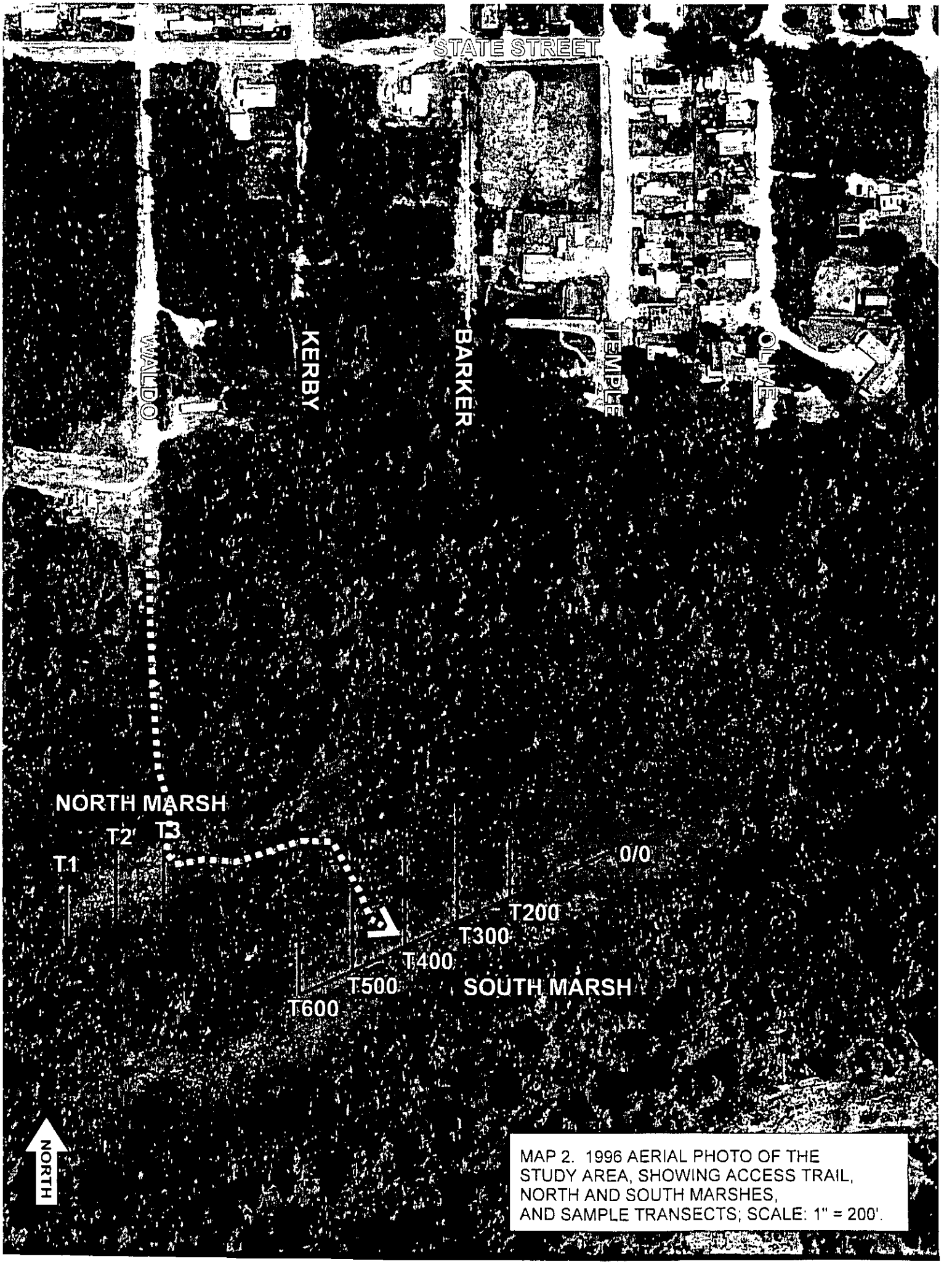
CRESCENT CITY MARSH WILDLIFE AREA

Western Lily Life History Plots

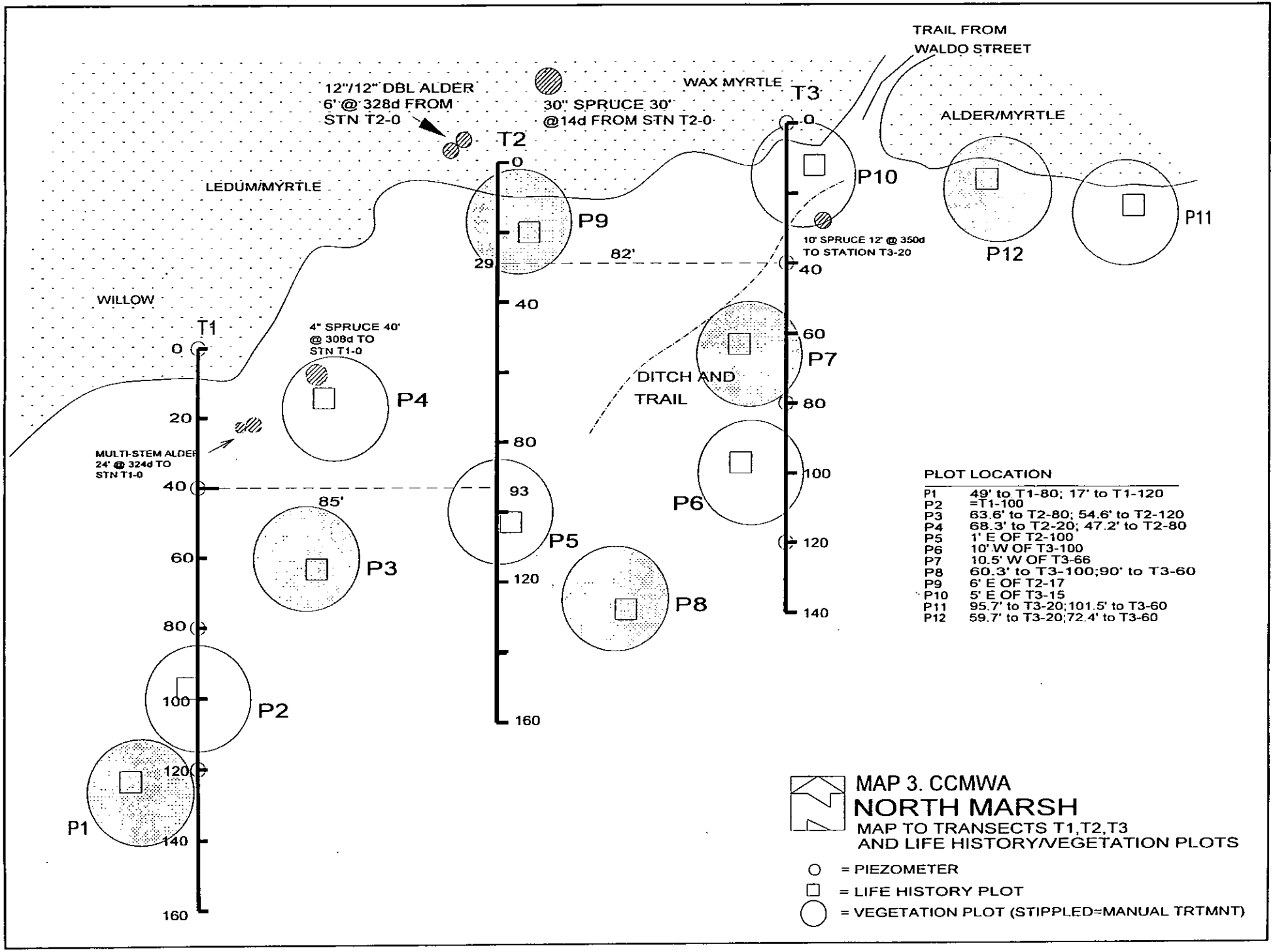
A total of 24 - 6ft^2 plots were permanently marked, including 12 each installed in the North and South marshes (Figures 2-4). Since a comprehensive grid coordinate system has not been developed for the CCMWA population, the life history plots were mapped relative to the existing monitoring framework for the 2 marshes. Specific directions to each plot are indicated in Figures 3 and 4. The plots were staked as follows: a 4 foot rebar stake was placed at one corner of the square plot, corresponding to the center point for the surrounding 30 ft diameter vegetation plot. A 4 foot PVC pipe marker was placed at the diagonal corner of the life history plot. The re;ative position of the opposing stake to the plot center (rebar) is indicated in Figures 3 and 4. Plots were subjectively located so as to include at some mature lilies, maximize the number of seedlings, provide sufficient spacing to separate the 30 foot diameter vegetation plots, and provide similar conditions among paired plots , enabling comparison between plots treated manually and not treated.

The plots were monitored from July 15-17, 1998, using the same methology described above for the Life History Plots sampled at TBER.

Summary statistics for western lily occurring within the plots are indicated in Table 4A. Some 222 seedlings and 156 mature lilies were recorded and mapped in the 2 marshes. Average height of the non-seedling plants was 33 and 35 inches in the North and South marshes, respectively. Little evidence of grazing and no incidence of disease was observed. Maps locating all seedlings and mature plants documented in the 24 life history plots are included in Appendix B. These maps and field data sheets developed specifically for life



MAP 2. 1996 AERIAL PHOTO OF THE STUDY AREA, SHOWING ACCESS TRAIL, NORTH AND SOUTH MARSHES, AND SAMPLE TRANSECTS; SCALE: 1" = 200'.



PLOT LOCATION

P1	49' to T1-80; 17' to T1-120
P2	=T1-100
P3	63.6' to T2-80; 54.6' to T2-120
P4	68.3' to T2-20; 47.2' to T2-80
P5	1' E OF T2-100
P6	10' W OF T3-100
P7	10.5' W OF T3-66
P8	60.3' to T3-100;90' to T3-60
P9	6' E OF T2-17
P10	5' E OF T3-15
P11	95.7' to T3-20;101.5' to T3-60
P12	59.7' to T3-20;72.4' to T3-60

MAP 3. CCMWA

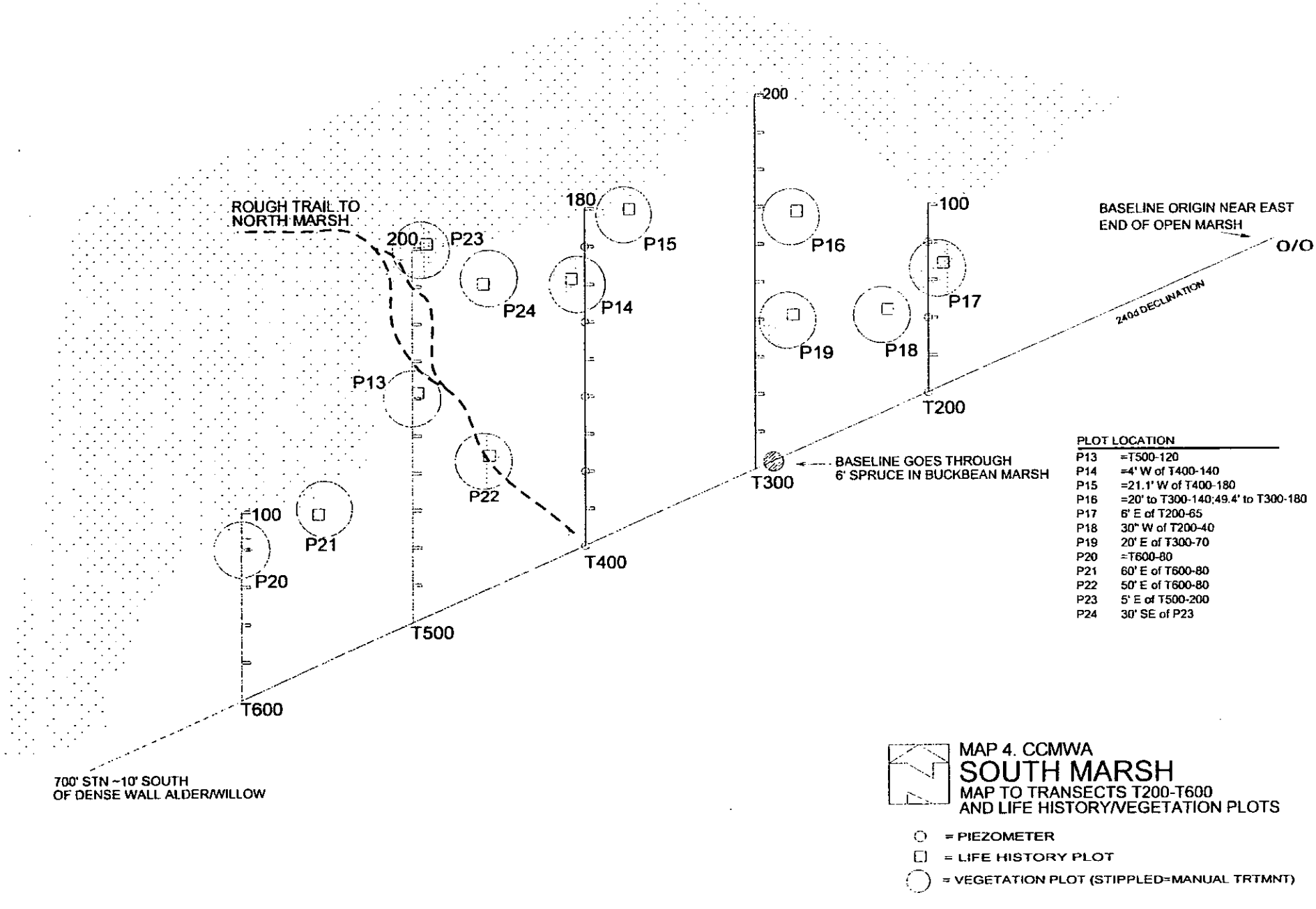
NORTH MARSH

MAP TO TRANSECTS T1,T2,T3
AND LIFE HISTORY/VEGETATION PLOTS

○ = PIEZOMETER

□ = LIFE HISTORY PLOT

◯ = VEGETATION PLOT (STIPPLED=MANUAL TRTMNT)



PLOT LOCATION

P13	=T500-120
P14	=4' W of T400-140
P15	=21.1' W of T400-180
P16	=20' to T300-140;49.4' to T300-180
P17	6' E of T200-65
P18	30" W of T200-40
P19	20' E of T300-70
P20	=T600-80
P21	60' E of T600-80
P22	50' E of T600-80
P23	5' E of T500-200
P24	30' SE of P23

MAP 4. CCMWA

SOUTH MARSH

MAP TO TRANSECTS T200-T600
AND LIFE HISTORY/VEGETATION PLOTS

○ = PIEZOMETER

□ = LIFE HISTORY PLOT

◯ = VEGETATION PLOT (STIPPLED=MANUAL TRTMNT)

history monitoring (Appendix E) will be utilized during future monitoring. The 1998 field data sheets are included as Attachment 2.

Vegetation Plot Baseline Characterization

Twenty four 30 foot diameter plots, centered on one corner of each life history plot were established from July 15-17, 1998. These (and life history) plots were located so as to provide paired plots representing different conditions of vegetation encroachment and lily growth. Maps showing the location of each plot relative to the permanent monitoring framework in each marsh, and indicating which plots were manually treated are included in Figures 3 and 4. All flowering lilies within each plot were recorded and mapped in July. Maps locating all lilies flowering lilies in each plot are included in Appendix B.

Prior to manual treatment of the plots in October, woody shrubs and trees were described and mapped (see sample field data sheet, Appendix E). Variables recorded included crown diameter, stem diameter, and height. Average cover and height for associated species encountered within the plots were also recorded (1998 field data sheets - Attachment 4; compilation of plot data -Appendix D; frequency, average cover and height summarized - Table 4B). Slide photographs were taken of each vegetation plot prior to and following manual removal of vegetation in October, 1998 (location and declination of each photopoint indicated in Figures 3 and 4). These slides will be submitted with the final report, together with photodocumentation completed in July 1999.

The vegetation plots will enable future assessment of the encroachment rate by aggressive species and allow assessment of the efficacy of manual vegetation control.

Manual Vegetation Treatment

In each marsh area, one half of the vegetation plots were cleared of all tree cover, and selected shrub cover from October 28-30, 1998. Trees and shrubs were removed at the base with pruners or a gas powered brush whacker. Target species included *Alnus rubra, A. viridus Lonicera involucrata, Myrica californica, Picea sitchensis, Rhamnus purshiana, Salix hookeriana, S. lasiolepis, Spiraea densiflorus,* and in some cases, *Ledum glandulosum* and *Rubus ursinus.*

*Ledum glandulosum*and *Rubus ursinus* were only removed from a portion of the plots, indicated on the vegetation plot data sheets. Past observation has indicated in most cases the lily is able to tolerate high cover of these species, while the lily rarely occurs in dense stands of *Spiraea.*

Stem cross-sections were collected from the majority of trees and shrubs removed, and will be aged to document the history of encroachment. Those results will be described in the final project report.

1999 Task Schedule

1) In early March, 1999, the 12 life history plots in each marsh will be treated as follows (allocated equally to manual treated and untreated plots): 4 plots will be left exposed, 4 plots will be enclosed in graduated mesh fencing designed to exclude al mammals, and 4 plots will be enclosed in 4 inch mesh deer fencing (deer exclusion only).

2) All Life History Plots will be monitored on or about the following dates: March 15, April 1, April 15, July 15 of 1999. On each monitoring date, all lilies will inventoried as described under life history monitoring for TBER.

3) A census of all flowering lilies within the 24 vegetation plots will be conducted in July 1999. In addition, cover and height of all species present in the plots will be described again in those plots manually cleared in October 1998, in order to assess the results of treatment.

4) Additional research will be conducted on the grazing practices prior to DFG acquisition of the wildlife area in about 1980, expanding on the 1992 investigation conducted by Imper and Sawyer (1992). If available, knowledgeable people will be interviewed (e.g., former property owners or tenants), and historical photographs available at the assessors office or elsewhere will be reviewed.

5) The 2nd year project status report will be submitted by November 15, 1999, briefly describing the results of 1999 monitoring. The final project report will be submitted by March 31, 2000, and include 1) discussion of lily population life history, demographics, phenology, annual dormancy rates, recruitment and seedling fate observed over the 2 years, 2) assessment of impacts of manual vegetation treatment on vegetation composition and structure, and the lily, 3) assessment of the impacts of natural grazing and the efficacy of the various means investigated for controlling natural grazing. A detailed characterization of vegetation plots (species composition, cover and height; age structure of shrubs/trees), species removed, level of effort necessary to treat the plots, and the results of historical research on grazing practices will be included. Recommendations will be made for further monitoring.

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Table 2.. Soil bulk density and moisture results, 10/15/98, and LIOC census in Cattle Trail Plots, 6/15/98:

Location	Sample ID	Moisture (%)	Bulk Dens. (#/cf)	Group B.D. Means	#LIOC seedlings	#LIOC mature
So. Grazing	1	35	54			
Trtmnt	2	45	49			
Cell	3	37	61			
	4	36	55			
	5	34	63	56.4		
No. Grazing	6	36	65			
Trtmnt	7	46	63			
Cell	8	26	64			
	9	42	67			
	10	33	58	63.4		
Passive	11	31	65			
Grazing	12	30	58			
Trtmnt	13	25	63			
	14		64			
	15	21	74	64.8		
Cattle Trail	1ctr	46	60		18	0
Seed	1east	45	49		2	3
Plots	1west				2	0
	2ctr	21	74		49	10
	2north	39	58		10	6
	2south				13	8
	3ctr	46	52		17	3
	3north	44	52		2	2
	3south			57.5	1	1
Overall Avgs.		35.9	60.4			

Notes:

Soil bulk density values are dry weight; samples = 1.37" dia. x 4" brass tubes driven into soil between 4 and 10" below surface; oven dried @105d C. to constant weight.

Cattle trail plots = 3' x 3', centered on cattle trails in optimum LIOC habitat.

Table 3A. Summary statistics for western lily in 27 Life History Plots
Table Bluff Ecological Reserve
Sampled by David Imper, John McRae, June 18-20, 1998

	1998
LIFE HISTORY PLOTS (27-6' sq.)	
Total area sampled (sf):	972
Total LIOC seedlings sampled (single leaf))	246
#LIOC seedlings sampled per sf	0.25
Total LIOC non-seedling sampled	314
Mean ht non-seedling plants (in)	21
% incidence mammal grazing	3
% incidence insect/slug grazing	4
% incidence disease	0

Table 3B. Summary statistics for General Habitat Monitoring
Table Bluff Ecological Reserve
Sampled by David Imper, John McRae, 9/89, 8/93, 8/96, 10/6/98

	1989	1993	1996	1998
% OF GRID WITH SPRUCE DIRECTLY OVERHEAD				
(Based on 4650 ft line intercept data;veg types)	63	51	52	50
% HEMISPHERIC COVER AT 3 ft A.G. (474 pts; 10 ft intervals):	65	69	64	70
Standard deviation	37	25	22	20
GROUND VEGETATION HEIGHT:				
Avg. wtd. hght. [in] (per/ft basis; 4650 ft transect)	16	37	43	37
Standard deviation		19	17	21
GENERAL HABITAT TYPE (% sample grid based on 4650 ft line transect)				
Tall fescue grassland	7	8	8	8
Coastal prairie	0	26	27	27
Sweet vernal grassland	33	24	37	36
Willow scrub	8	9	8	8
Spruce/maianthemum forest				
Young spruce	32	19	7	7
Old spruce	16	12	11	11
Spruce/salmonberry woodland	1	2	2	2
DETAILED HABITAT TYPE (% sample grid based on 4650 ft line transect):				
Tall fescue grassland (typical)	6.4	5.5	3.2	4.3
Sweet vernal grassland (typical)	31.0	29.2	19.3	16.5
Coastal prairie (typical)	0.0	8.0	6.7	7.3
Willow scrub (typical)	7.0	2.6	1.3	2.6
Rubus ursinus	13.0	15.0	21.9	17.3
Rubus spectabilis	0.0	0.0	1.9	13.9
Rubus discolor (himalaya)	0.2	0.1	0.6	0.2
Gaultheria shallon	0.0	0.3	0.6	0.9
Baccharis pilularis	0.9	2.2	3.6	3.7
Polystichum munitum	1.4	3.4	6.1	4.0
Calamagrostis nutkaensis	4.1	11.5	12.7	18.2
Maianthemum dilatatum (incl. Carex obnupta/Iris Douglasiana)	1.2	4.3	7.3	4.3
Sambucus callicarpa	1.5	3.6	2.9	0.4
Erechtites minima	0.0	5.8	11.2	1.8
Barren understory	25.7	6.1	2	3.9

NOTE: Includes all vegetation transects indicated in Table 1, except X=375 and X=430.

Table 3C. Summary statistics for vegetation characterization of the 3 grazing treatment areas
Table Bluff Ecological Reserve
Sampled by David Imper, John McRae, October 6, 1998

GRAZING TREATMENT:	PASSIVE	NORTH	SOUTH
% OF GRID WITH SPRUCE DIRECTLY OVERHEAD			
(Based on 3230', 860' and 860' of line intercept respectively)	50	53	37
% HEMISPHERIC COVER AT 3' above ground:			
(based on 337, 90 and 90 pts, respectively; 10' intervals):	72	64	69
Standard deviation	18	24	26
GROUND VEGETATION HEIGHT:			
Avg. wtd. hght. ["] (per/ft basis; 3230', 860' and 860' transect respectively)	34	36	46
Standard deviation	21	16	22
GENERAL HABITAT TYPE:			
(% sample grid based on 3230 ft, 860 ft and 860 ft line transect respectively)			
Tall fescue grassland	6	16	13
Coastal prairie	26	23	34
Sweet vernal grassland	35	44	30
Willow scrub	6	10	16
Spruce/maianthemum forest			
Young spruce	7	6	7
Old spruce	16	0	0
Spruce/salmonberry woodland	3	0	0
DETAILED HABITAT TYPE:			
(% sample grid based on 3230', 860' and 860' line transect respectively)			
Tall fescue grassland (typical)	3.5	1.9	5.6
Sweet vernal grassland (typical)	19.1	13.4	10.5
Coastal prairie (typical)	6.7	10.1	14.3
Willow scrub (typical)	2.4	3.5	1.0
Rubus ursinus	15.9	23.1	26.6
Rubus spectabilis	14.2	13.0	8.3
Rubus discolor (himalaya)	0.3	1.2	3.0
Gaultheria shallon	1.1	0.0	0.0
Baccharis pilularis	5.0	0.5	0.0
Polystichum munitum	4.9	0.9	2.8
Calamagrostis nutkaensis	13.4	27.8	22.3
Maianthemum dilatatum (incl. Carex obnupta/Iris Douglasiana)	5.3	2.4	1.7
Sambucus callicarpa	0.6	0.0	0.0
Erechtites minima	2.5	0.2	0.0
Barren understory	4.7	0.6	3.8

NOTE: See Table 1 for transect segments included in each grazing treatment characterization.

Table 4A. Summary statistics for western lily in 24 Life History and Vegetation Plots
Crescent City Marsh Wildlife Area
Sampled by David Imper, John McRae, July 15-17, 1998

LIFE HISTORY PLOTS (24-6 ft sq.)		North Marsh	South Marsh
Total area sampled (sf):		432	432
Total LIOC seedlings sampled (single leaf))		43	179
#LIOC seedlings sampled per sf		0.1	0.4
Total LIOC non-seedling sampled		81	74
Mean ht non-seedling plants (in)		33	35
%incidence mammal grazing		3	1
%incidence insect/slug grazing		1	0
%incidence disease		0	0
VEGETATION PLOTS (24-30 ft dia.)			
Total area sampled (sf):		8478	8478
Total LIOC flowering		133	199
#LIOC flowering per sf		0.016	0.023
Mean #flowers		1.6	1.5
Maximum #flwrs		5	7
Mean ht (in)		47	46
Maximum ht (in)		72	70
Phenology (%plts sampled)	Bud	68	63
	Flower	29	32
	Fruit	4	4
	(Infl. Grazed)	0	1
% incidence mammal grazing		2	1
% incidence insect/slug grazing		2	1
% incidence disease		0	0

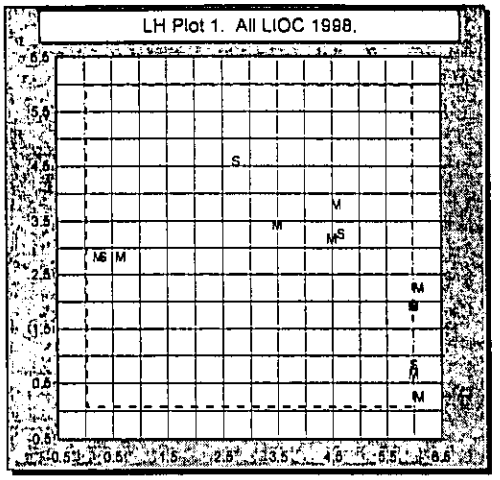
Table 4B. Summary statistics for associated species in 24 Vegetation Plots
Crescent City Marsh Wildlife Area
Sampled by David Imper, John McRae, October 28-30, 1998

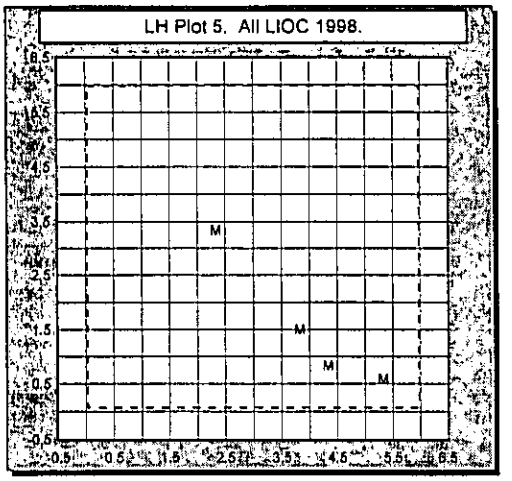
ASSOCIATED SPECIES	%FREQ	%COV	HT (in)
Alnus rubra	17	2	199
Alnus viridis	83	19	83
Angelica genuflexa	92	5	57
Athyrium felix-femina	54	3	41
Blechnum spicant	46	4	38
Calamagrostis nutkaensis	100	58	43
Carex obnupta	88	21	45
Carex spp.	0	0	
Cornus sericea	0	0	
Deschampsia caespitosa	4	0	48
Epipactus gigantea	8	0	18
Equisetum spp.	17	1	27
Galium trifidum	0	0	
Gaultheria shallon	0	0	
Gentiana sceptrum	29	1	26
Holcus lanatus	0	0	
Hypericum formosum	17	0	21
Juncus leseurii	25	2	50
Ledum glandulosum	100	68	50
Lonicera involucrata	67	7	68
Lotus formosissimus	0	0	
Lysichiton americanum	96	12	35
Maianthemum dilatatum	4	1	48
Malus fusca	13	1	152
Menyanthes trifoliata	54	3	14
Myrica californica	46	6	97
Oenanthe sarmentosa	0	0	
Picea sitchensis	50	5	134
Rhamnus purshiana	8	0	36
Potentilla palustris	75	14	32
Pteridium aquilinum	4	0	
Rhododendron occidentalis	50	2	83
Rubus ursinus	58	18	39
Salix spp.	29	7	98
Sanguisorba officinalis	100	27	32
Rubus spectabilis	8	0	54
Aster chilensis	42	1	38
Spiraea douglasii	42	8	60
Veratrum californicum	0	0	

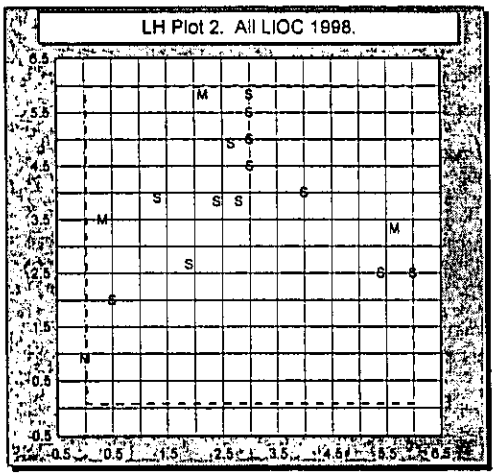
APPENDIX A

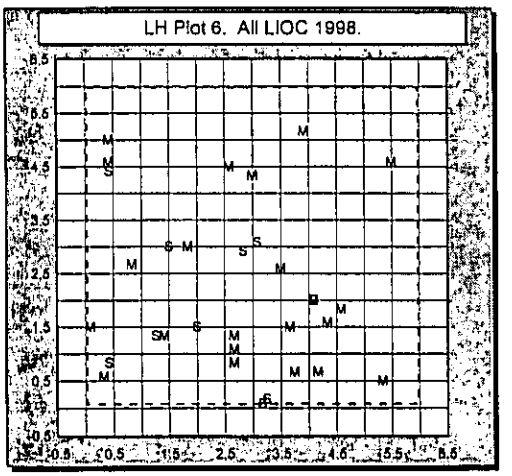
MAPS OF WESTERN LILY LIFE HISTORY PLOTS, TBER

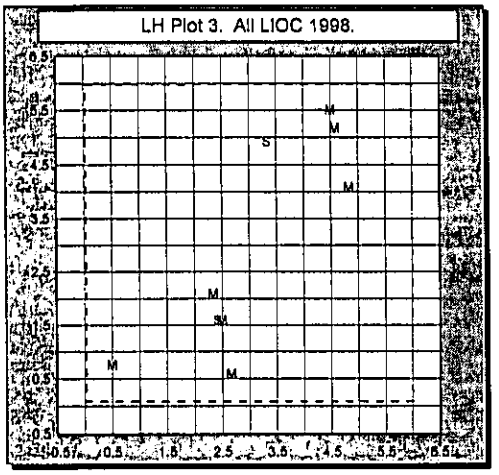
APPENDIX A
TABLE BLUFF ECOLOGICAL RESERVE LIFE HISTORY PLOTS

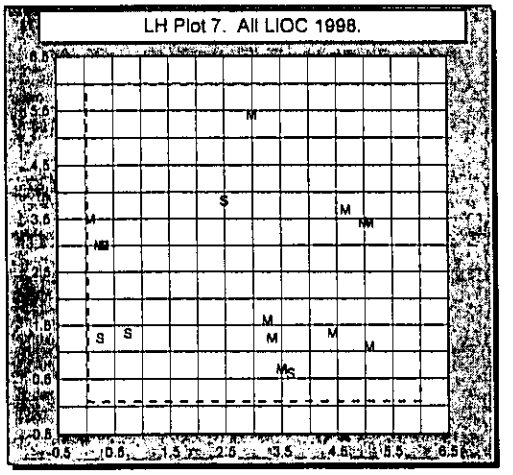


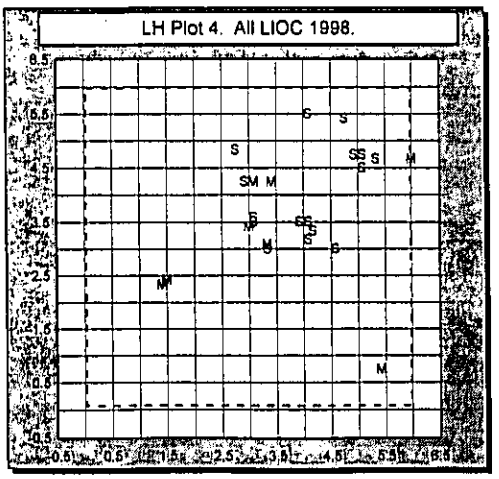


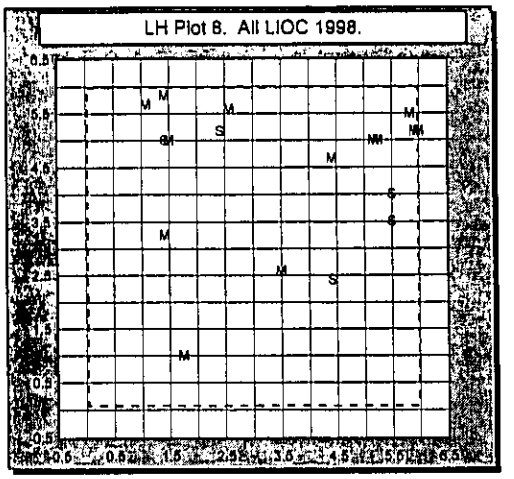






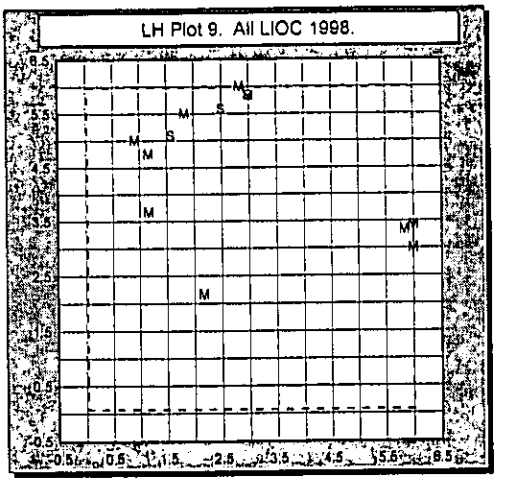


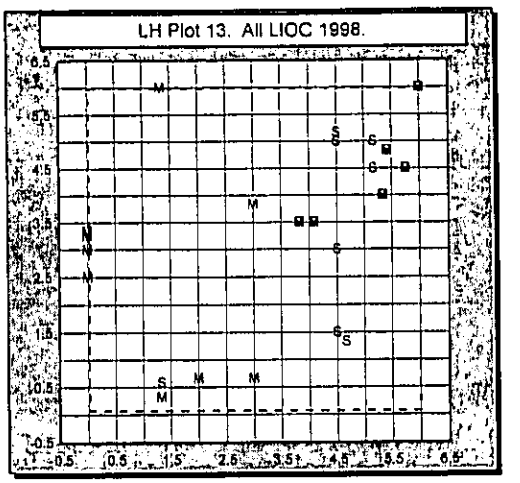


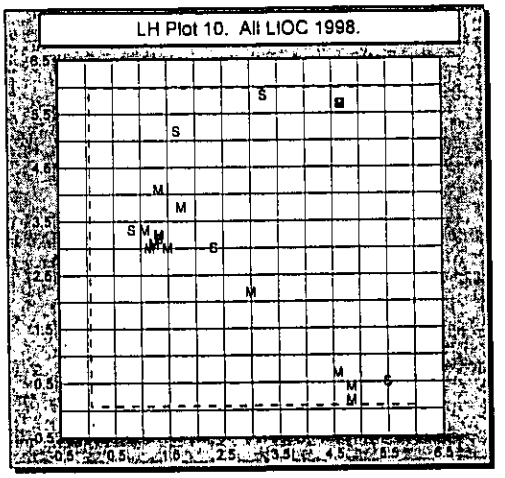


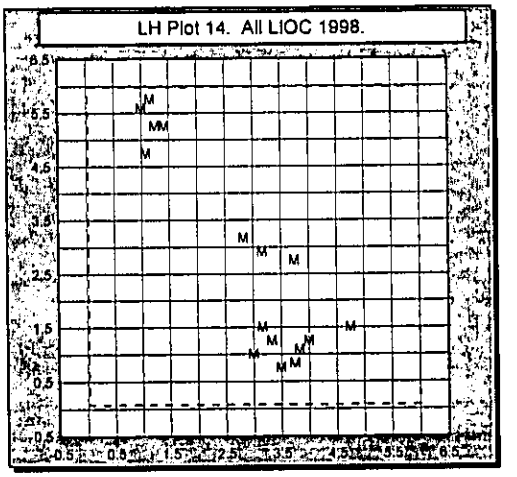
NOTE: S=seedling; M=mature; plots all oriented east, origin = NW corner; unless noted, seedling plots = the entire 6'x6' plot.

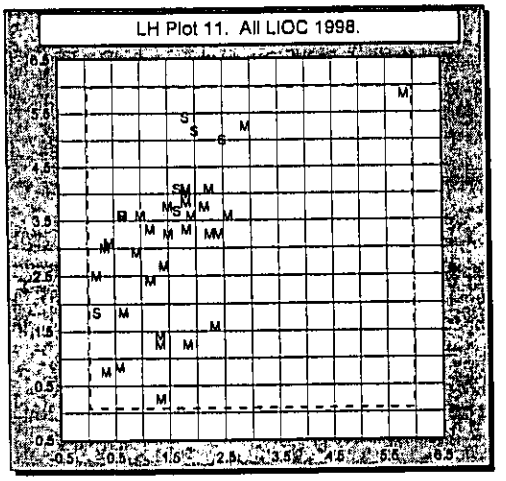
APPENDIX A (CONTINUED)
TABLE BLUFF ECOLOGICAL RESERVE LIFE HISTORY PLOTS

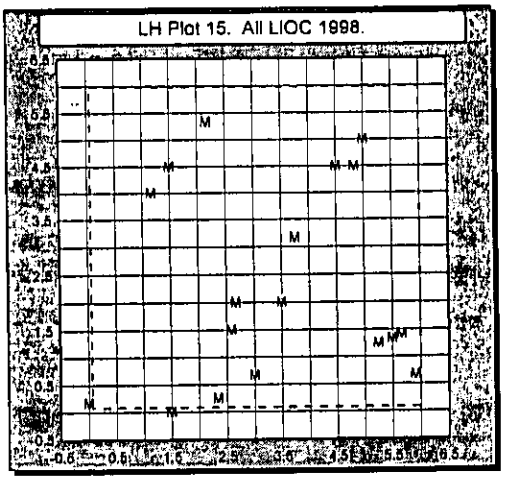


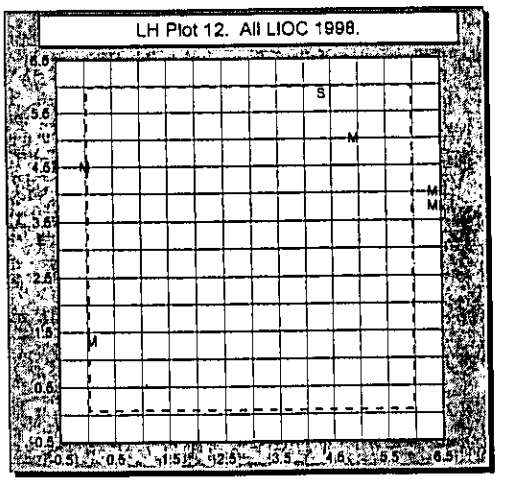


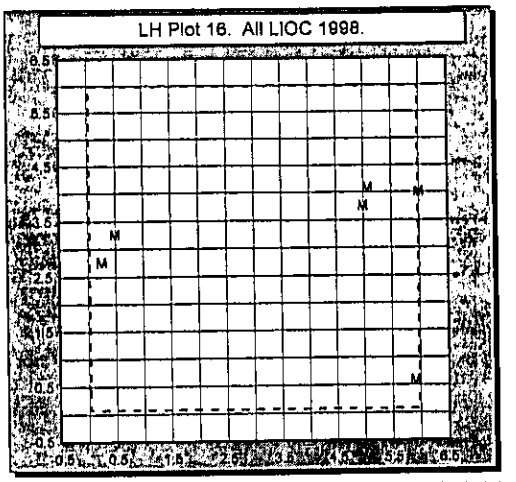






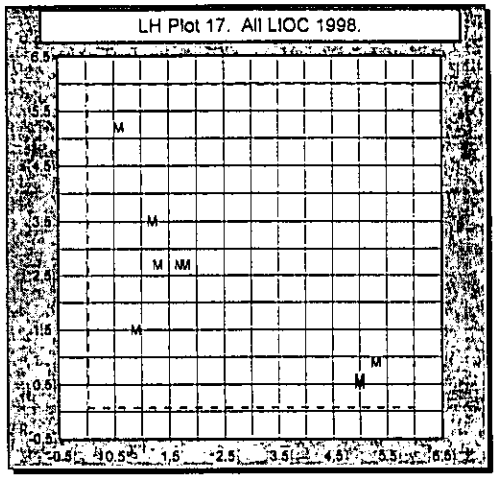


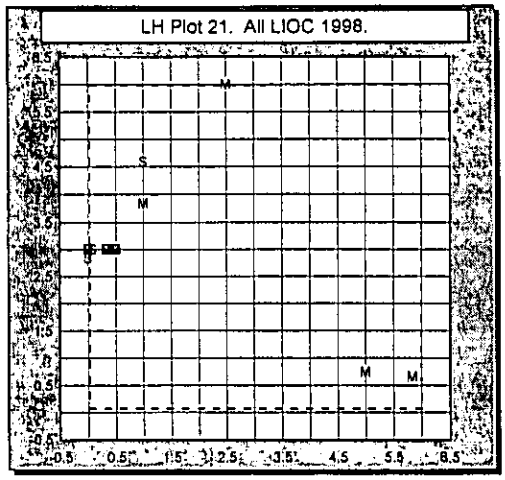


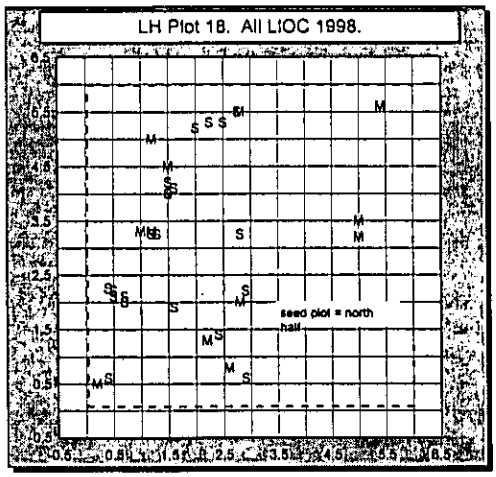


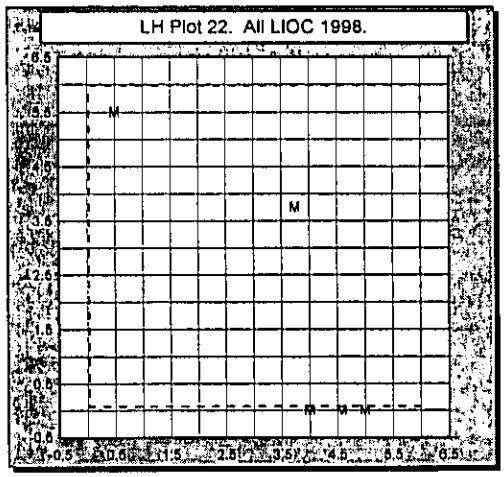
NOTE: S=seedling; M=mature; plots all oriented east, origin = NW corner; unless noted, seedling plots = the entire 6'x6' plot.

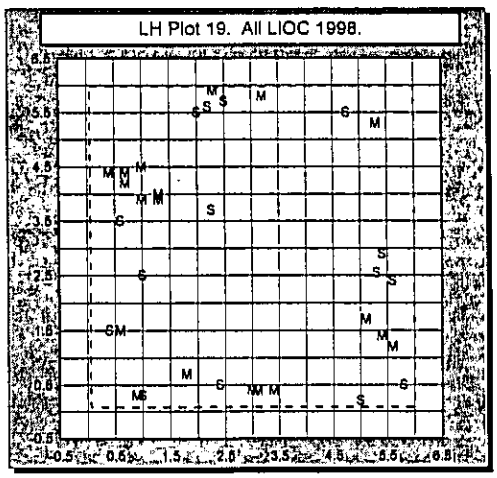
APPENDIX A (CONTINUED)
TABLE BLUFF ECOLOGICAL RESERVE LIFE HISTORY PLOTS

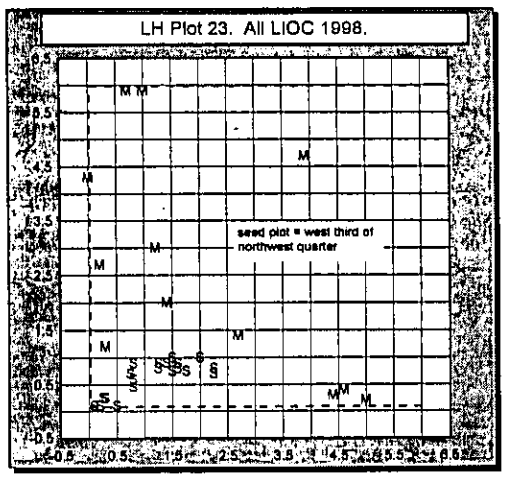


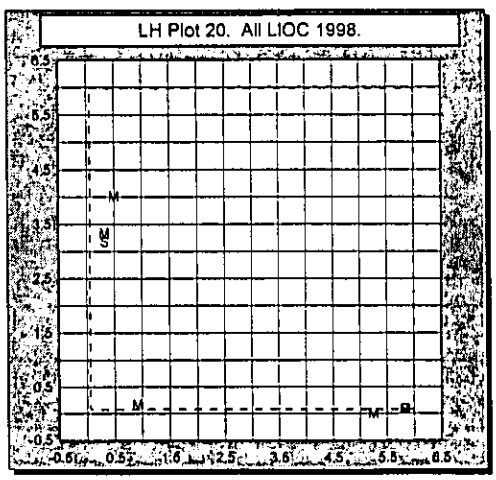


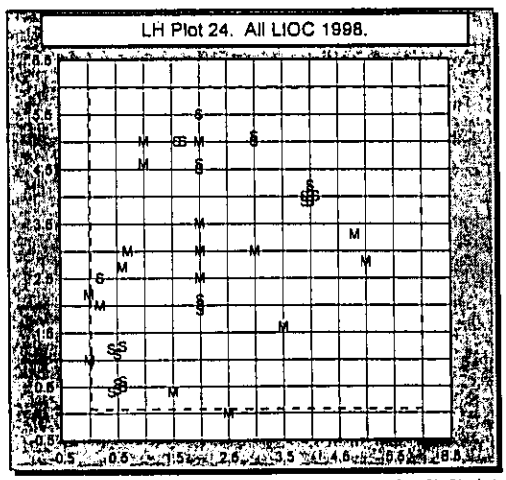






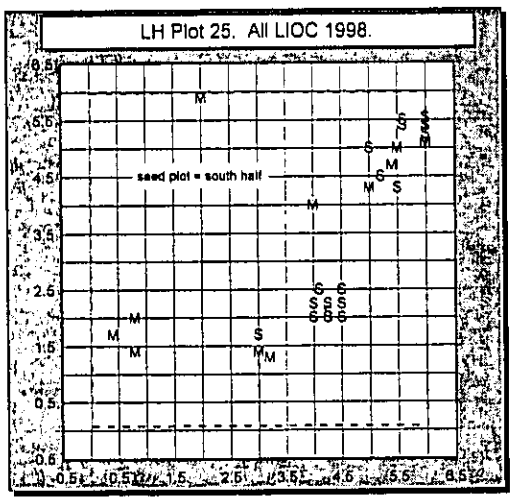


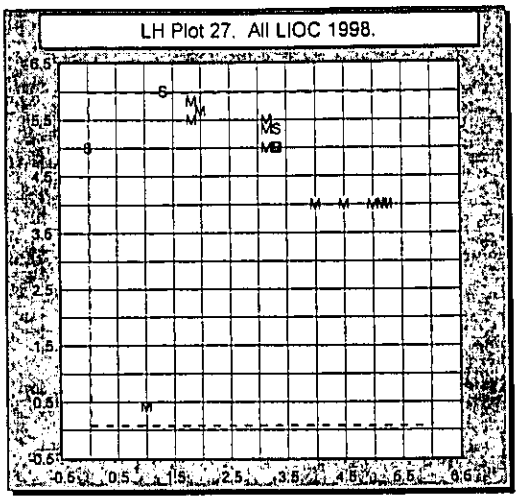


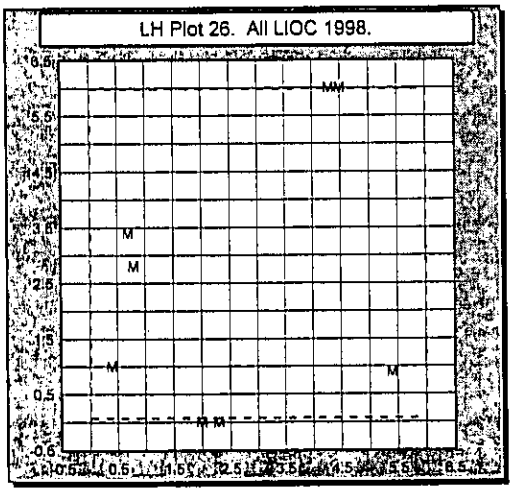


NOTE: S=seedling; M=mature; plots all oriented east, origin = NW corner; unless noted, seedling plots = the entire 6'x6' plot.

APPENDIX A (CONTINUED)
TABLE BLUFF ECOLOGICAL RESERVE LIFE HISTORY PLOTS





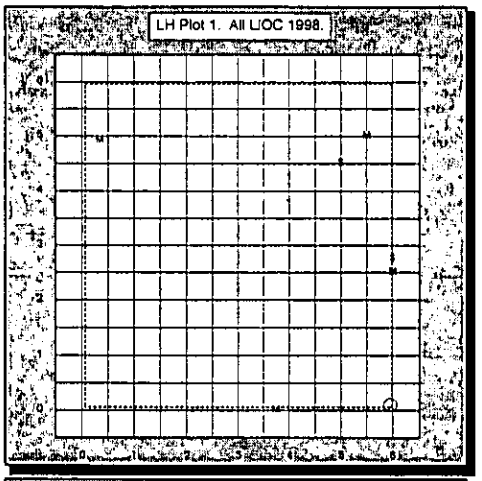


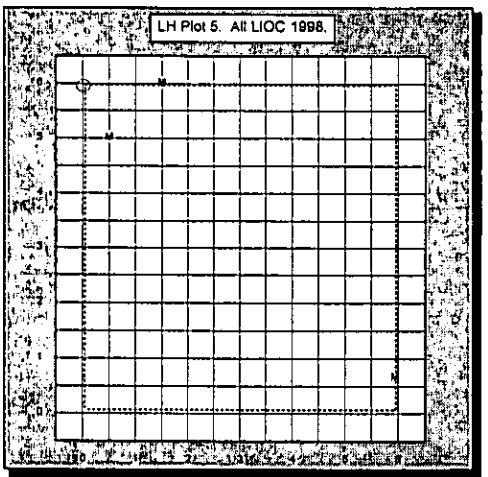
NOTE: S=seedling; M=mature; plots oriented east, origin = NW corner.
Unless indicated, seedling plots = the entire 6'x6' plot.

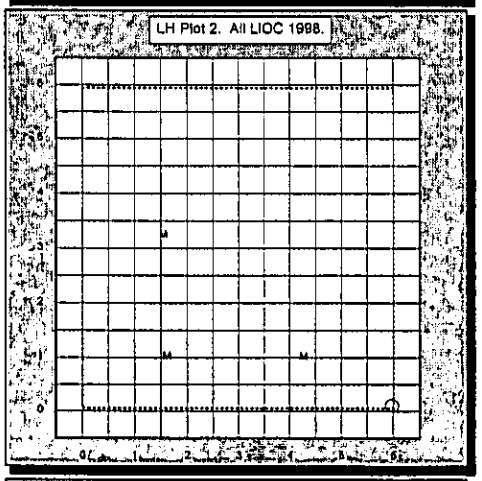
APPENDIX B

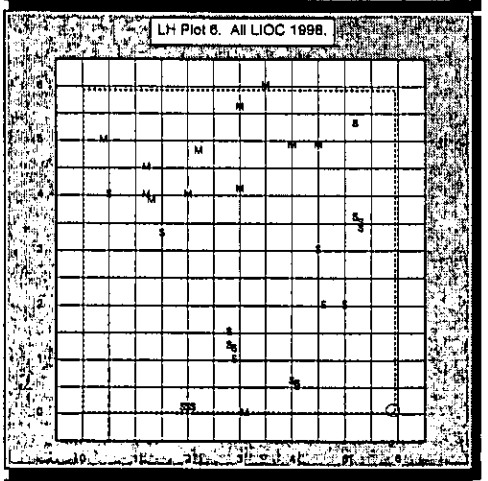
MAPS OF WESTERN LILY LIFE HISTORY PLOTS, CCMWA

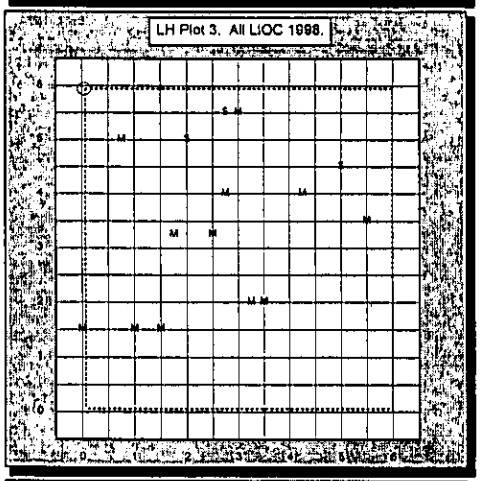
APPENDIX B
CRESCENT CITY MARSH WILDLIFE AREA LIFE HISTORY PLOTS

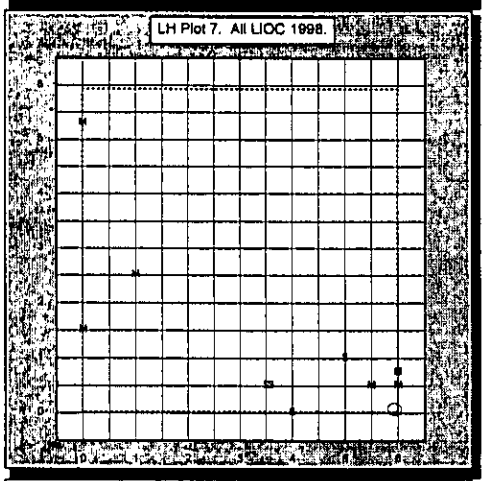


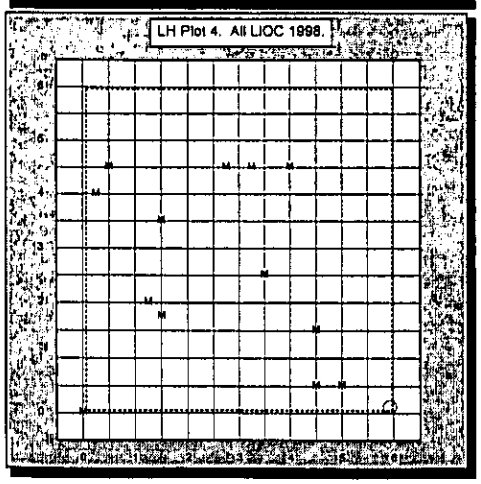


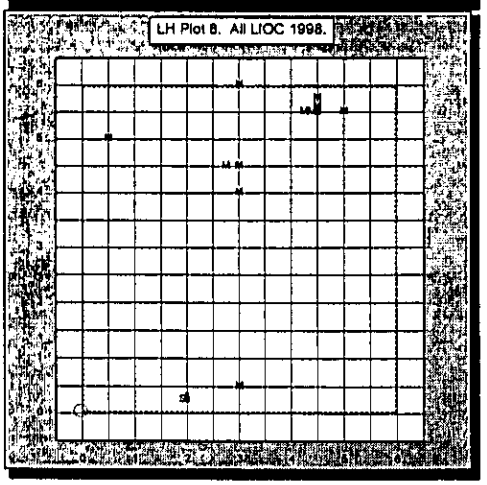






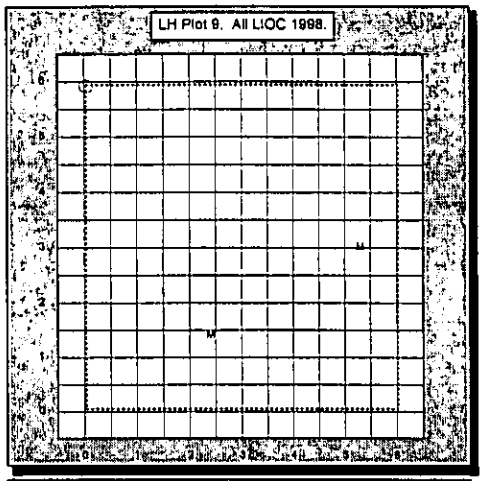


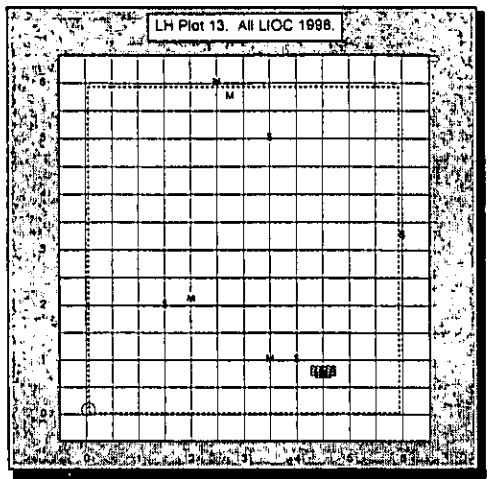


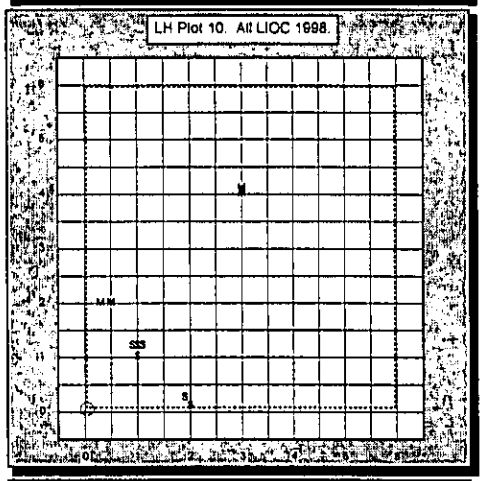


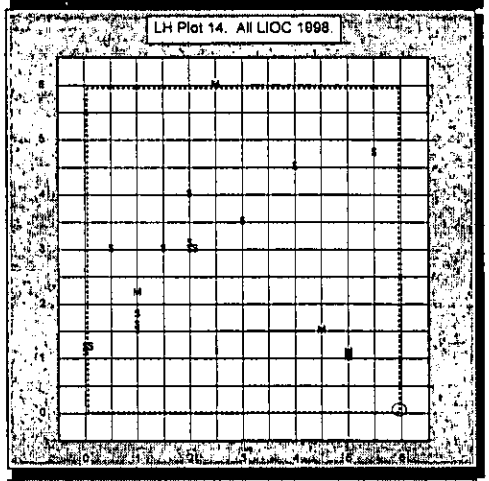
NOTE: s=seedling; m=mature; plots all oriented north; unless noted, seedling plot = entire 6x6' plot; vegetation plot center indicated.

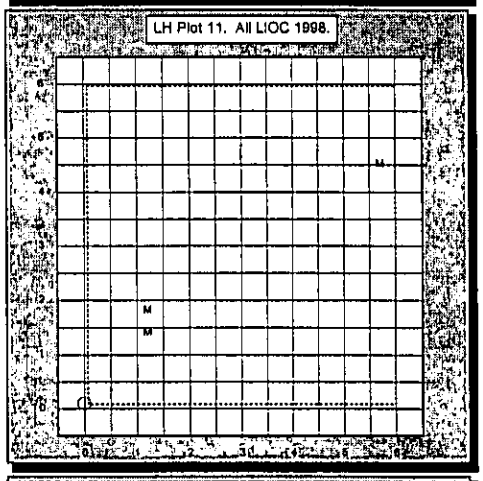
APPENDIX B (CONTINUED).
CRESCENT CITY MARSH WILDLIFE AREA LIFE HISTORY PLOTS

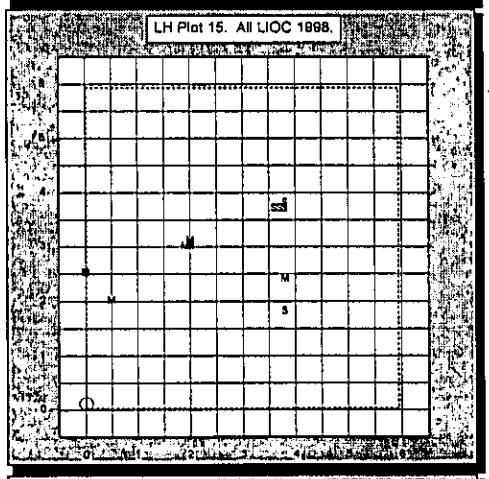


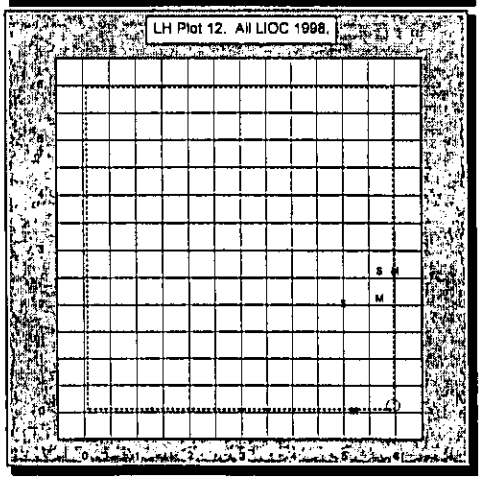


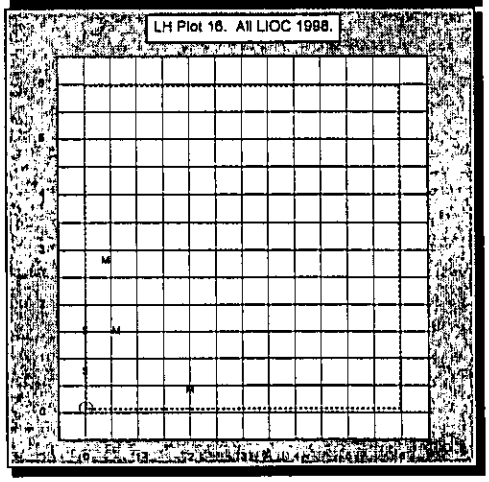






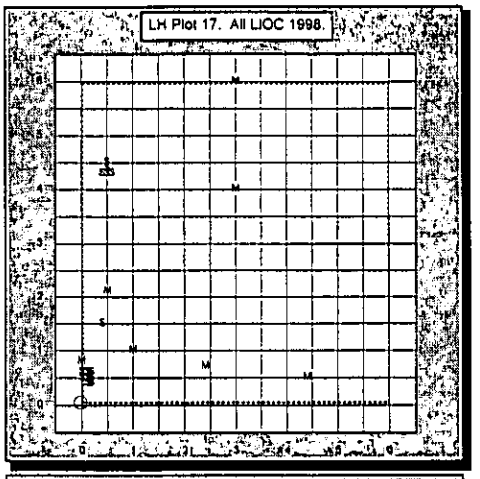


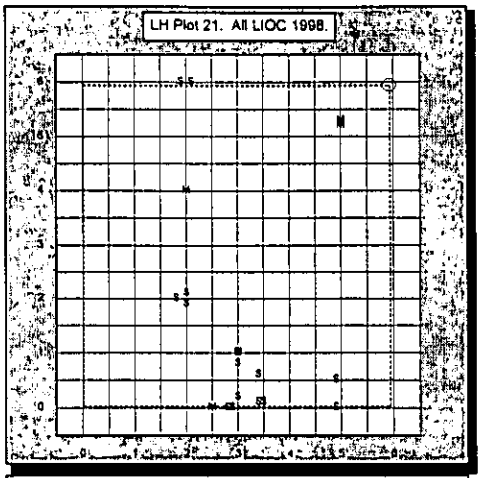


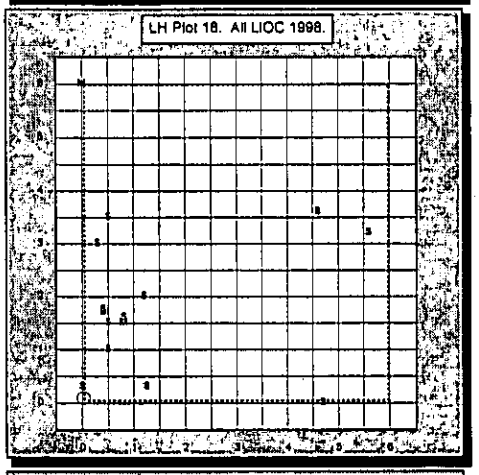


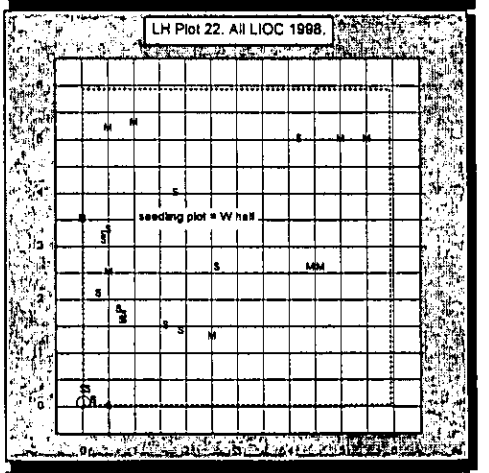
NOTE: s=seedling; m=mature; plots all oriented north; unless noted, seedling plot = entire 6x6' plot; vegetation plot center indicated.

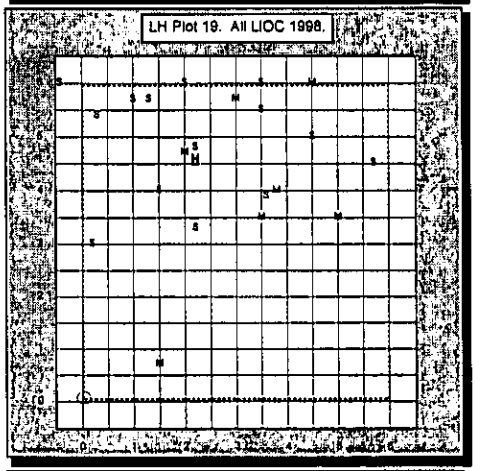
APPENDIX B (CONTINUED).
CRESCENT CITY MARSH WILDLIFE AREA LIFE HISTORY PLOTS

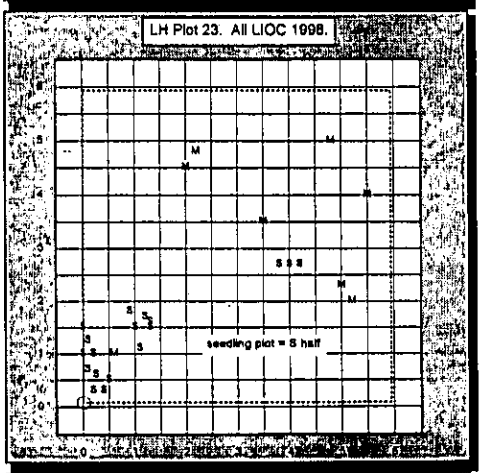


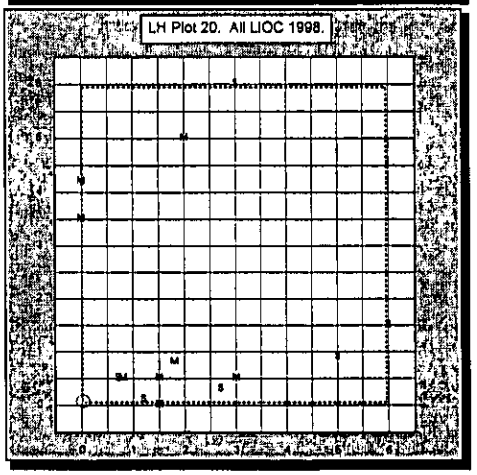


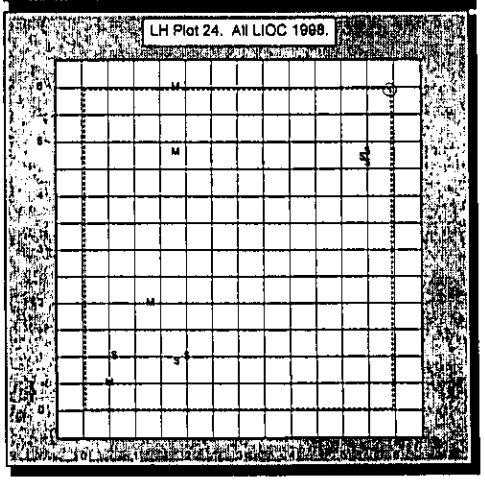












NOTE: s=seedling; m=mature; plots all oriented north; unless noted, seedling plot = entire 6x6' plot; vegetation plot center indicated. Plot 22, seedling plot = west half; Plot 23 seedling plot = south half.

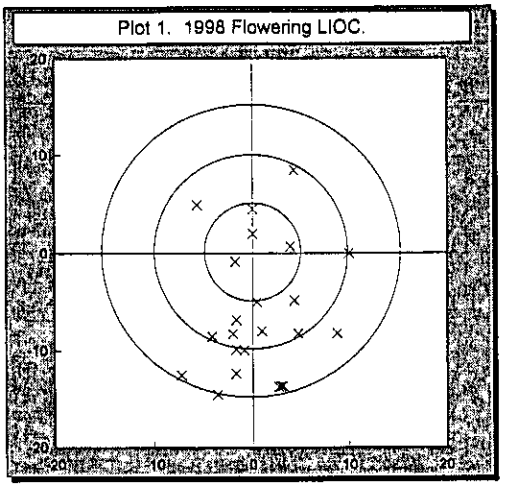
WESTERN LILY VEGETATION STRATEGY

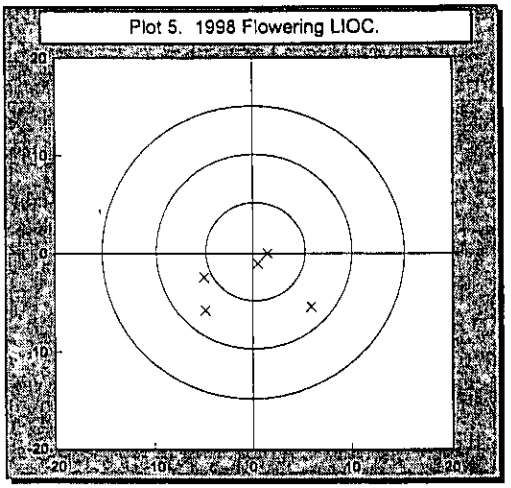
1998 STATUS REPORT

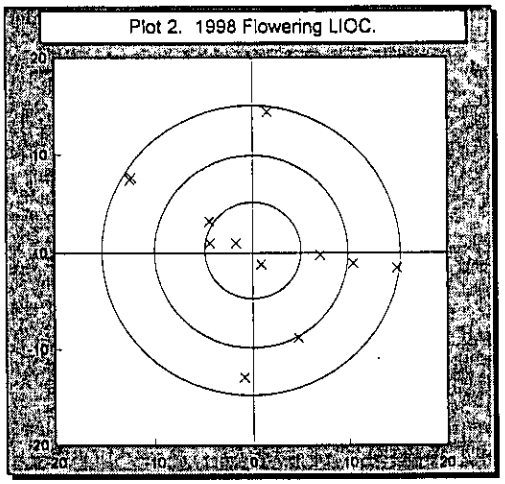
APPENDIX C

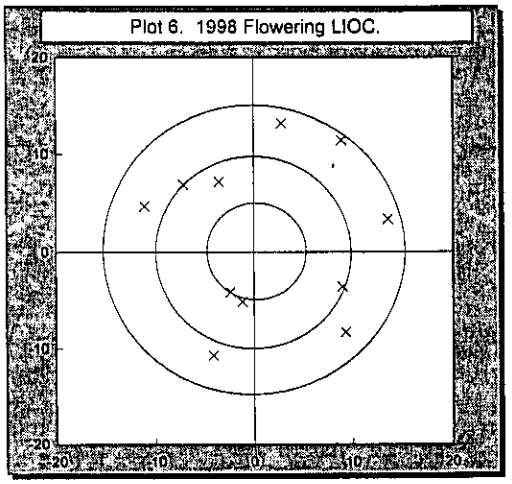
MAPS OF WESTERN LILY VEGETATION PLOTS, CCMWA

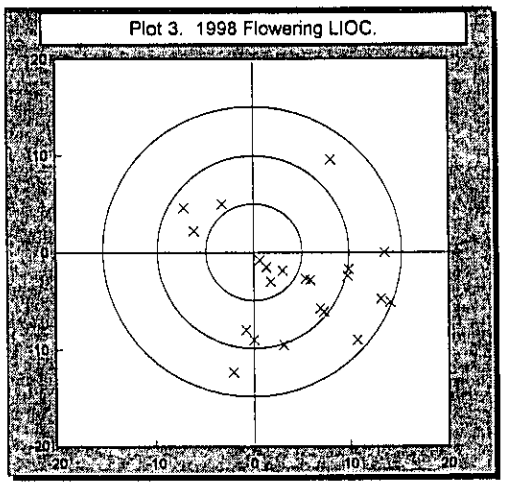
APPENDIX B
CRESCENT CITY MARSH WILDLIFE AREA VEGETATION PLOTS

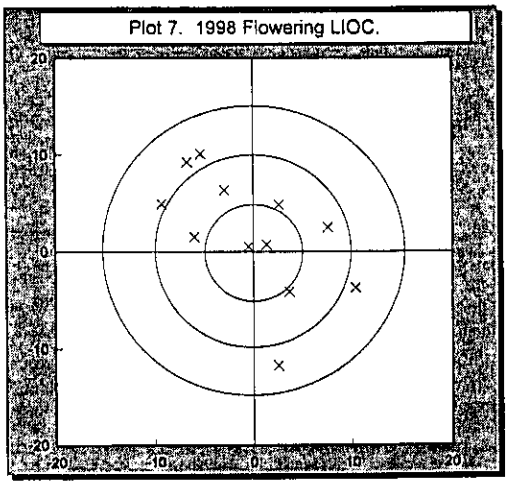


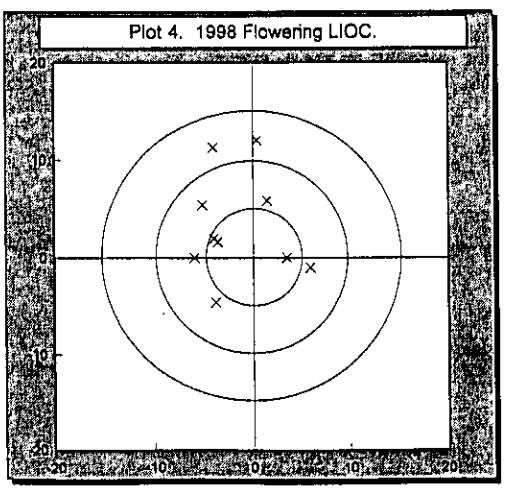


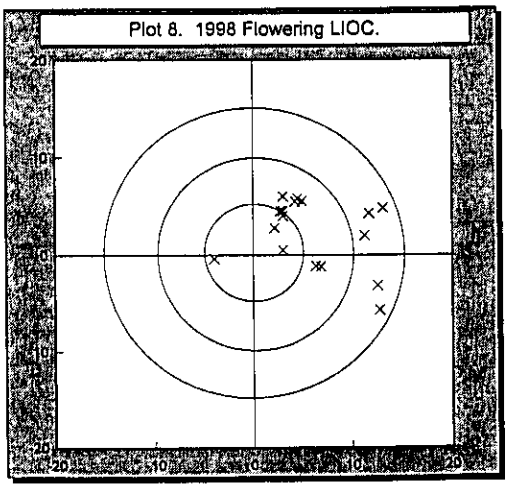






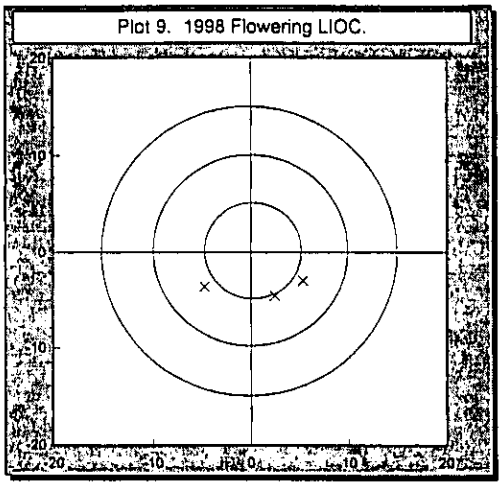


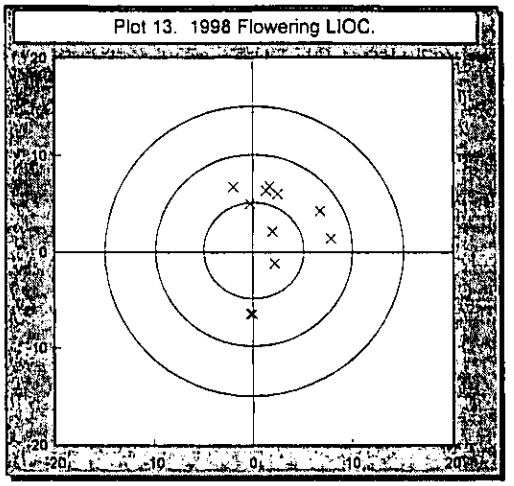


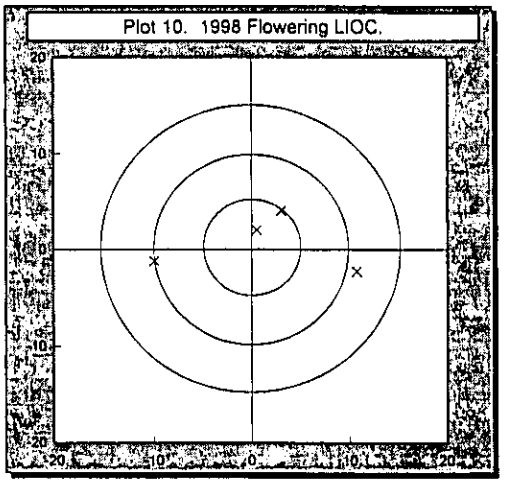


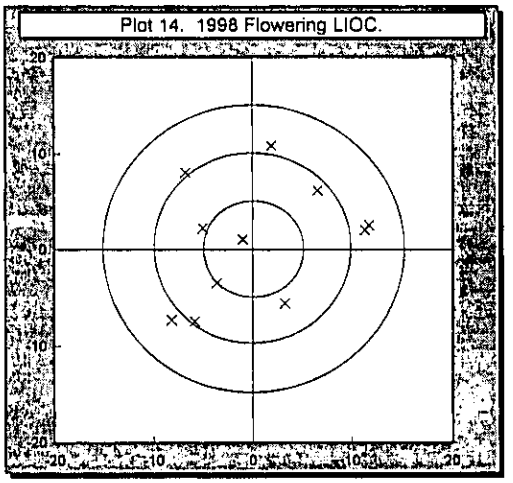
NOTE: plots all oriented north, 30' diameter.

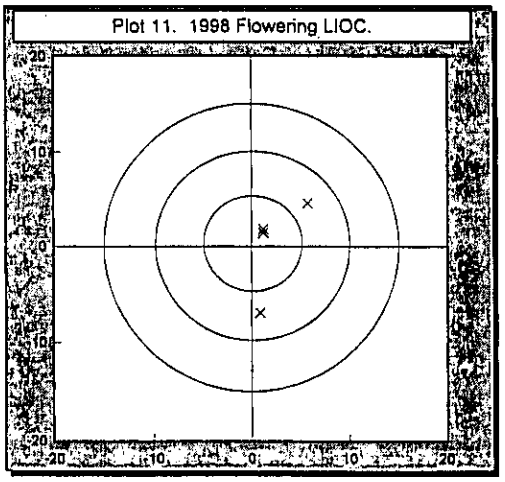
APPENDIX B (CONTINUED).
CRESCENT CITY MARSH WILDLIFE AREA VEGETATION PLOTS

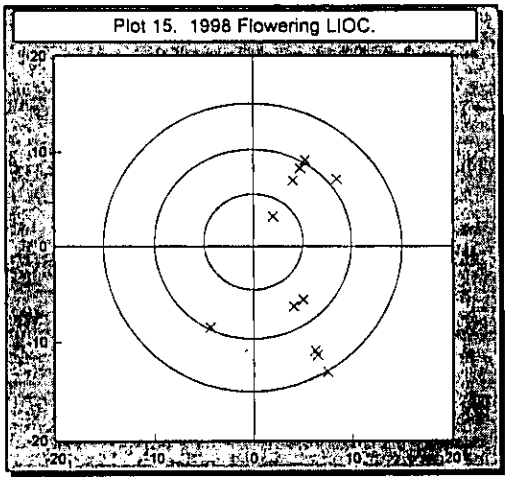


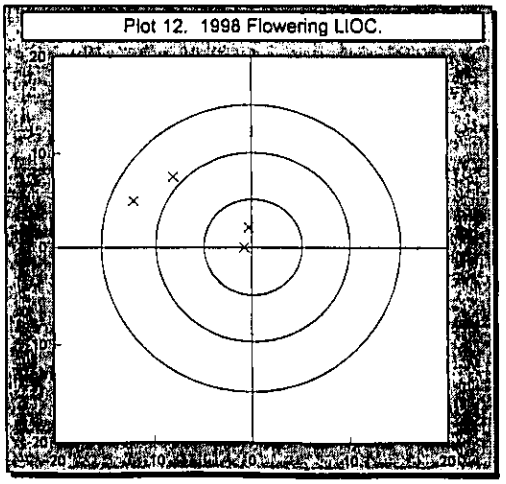


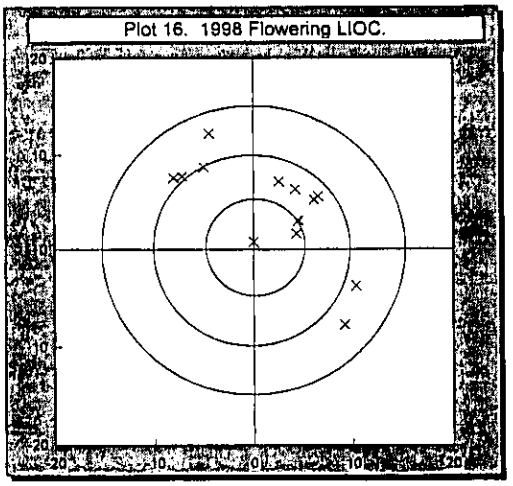






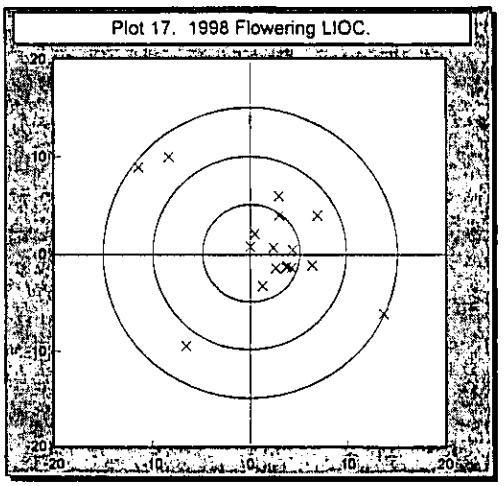


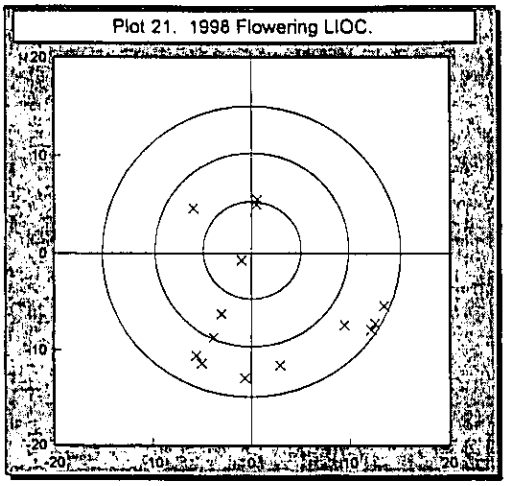


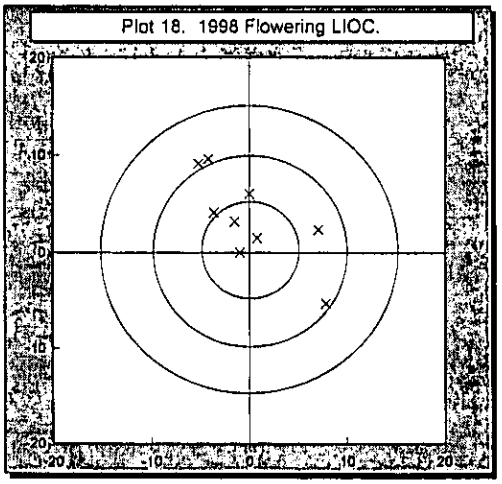


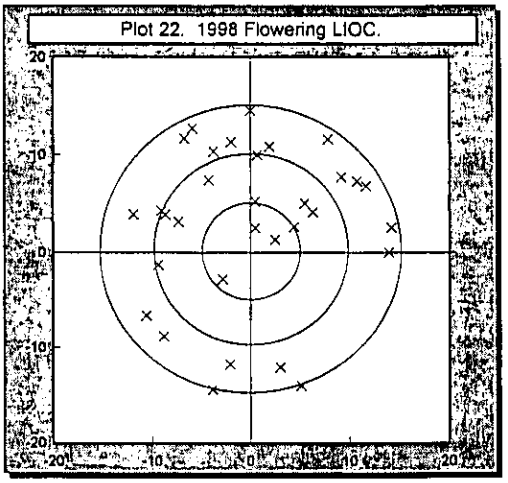
NOTE: plots all oriented north, 30' diameter.

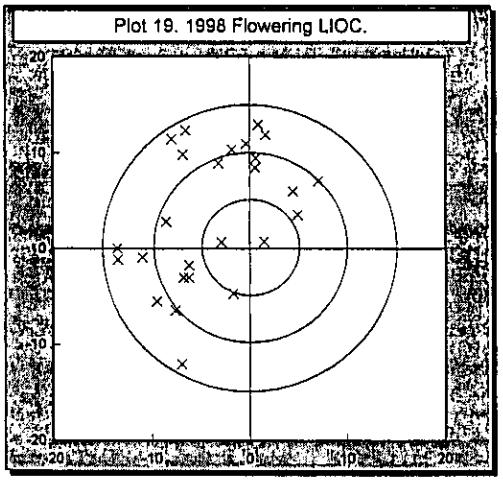
APPENDIX B (CONTINUED).
CRESCENT CITY MARSH WILDLIFE AREA VEGETATION PLOTS

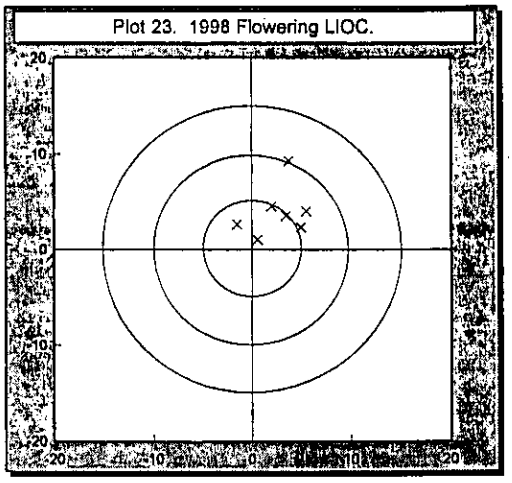


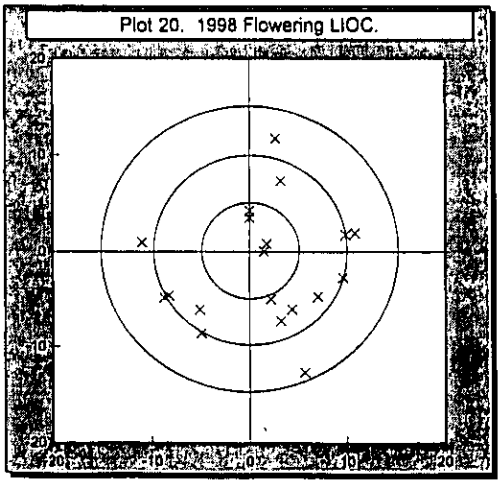


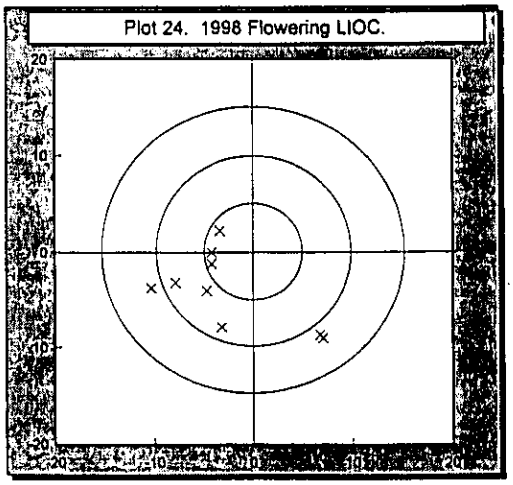












NOTE: plots all oriented north, 30' diameter.

WESTERN LILY VEGETATION STRATEGY

1998 STATUS REPORT

APPENDIX D

VEGETATION PLOT FIELD DATA, CCMWA

APPENDIX D: VEGETATION PLOT 1998 FIELD DATA, CRESCENT CITY MARSH WILDLIFE AREA.

NORTH MARSH																														
PLOT NUMBER	1			2			3			4			5			6			7			8			9			10			11			12		
Vegetation Treated?	Y						Y												Y			Y			Y									Y		
Photopoint orientation	180			90			180			360			180			90			90			180			360			360			360			360		
(taken 20' from plot center)																																				
Vegetation type	ED			ED			ED			CM			ED			ED			CM			TLM			ED			ED			ED			ED		
SPECIES	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht	cov		ht
Alnus rubra																																37		240		2.5	240
Alnus viridis	37		120	15		108	15		84	15		60	15		96	37		96	15		72	37		108												
Angelica genuflexa	15		72	2.5		60	2.5		60	2.5		36	15		72	2.5		72	2.5		60	2.5		60	2.5		36	2.5		72				2.5		60
Athyrium felix-femina													2.5		48	2.5		48				15		48	2.5		36				2.5		48			
Blechnum spicant													2.5		48							2.5		48	2.5		36				15		48			
Calamagrostis nutkaensis	62		36	62		48	62		48	85		42	62		48	87		48	87		36	37		42	62		36	62		36	15		36	62		40
Carex obnupta	37		36	37		48	37		48	15		36	37		48	15		48	15		36	15		42	15		48	37		48	2.5		48	62		48
Carex spp.																																				
Cornus sericea																																				
Deschampsia caespitosa										2.5		48																								
Epilactus gigantea																																				
Equisetum spp.																			15		12				2.5		36	2.5		36				2.5		24
Galium trifidum																																				
Gaultheria shallon																																				
Gentiana sceptrum	2.5		24				2.5		24	2.5		24	2.5		24	2.5		24	2.5		24	2.5		36												
Holcus lanatus																																				
Hypericum formosum				2.5		24	2.5		24																15		48				2.5		60	15		48
Juncus leseurii																																				
Ledum glandulosum	62		60	15		48	37		48	37		48	85		48	97		36	62		36	85		60	37		48	62		48	85		48	62		48
Lonicera involucrata	37		96	15		60	2.5		48	15		72				2.5		48	2.5		48				15		84				15		84			
Lotus formosissimus																																				
Lysichiton americanum	15		48	15		48	15		36	2.5		36	15		36	15		48	15		24	15		24	15		24	2.5		24	2.5		36	15		36
Maianthemum dilatatum																																		2.5		180
Malus fusca																												2.5		12						
Menyanthes trifoliata	2.5		12	2.5		12	2.5		12	2.5		12	2.5		12	15		12	15		12				15		10	37		144	15		96	2.5		72
Myrica californica										15		72				2.5		96																		
Oenanthe sarmentosa																												2.5		120						
Picea sitchensis										15		200				15		225	15		144															
Rhamnus purshiana																2.5		36																		
Potentilla palustris	15		36				15		36	37		24	15		36				37		36	37		36	15		36	15		24				15		24
Pteridium aquilinum																																				
Rhododendron occidentalis	15		60																2.5		48	2.5		72	2.5		72				2.5		72	15		96
Rubus ursinus										15		24				37		48	2.5		36	15		36	62		48	62		36	85		48	62		36
Salix spp.													2.5		48																					
Sanguisorba officinalis	37		24	15		24	15		36	62		30	15		36	37		24	37		36	62		36	15		36	37		36	15		24	15		24
Rubus spectabilis																															2.5		72			
Aster chilensis	2.5		24	2.5		36	2.5		48	2.5		36	2.5		48										2.5		60	15		72	15		72	15		48
Spiraea douglasii	15		72	37		72	37		72	15		36				15		48																		
Veratrum californicum																																				
TOTAL COVER	355			221			248			341			274			385			326			328			281			340			312			351		

NOTES: Plots = 30 ft diameter; Treatment consisted of manual removal trees and selected shrubs (see text); Vegetation Types: ED = edge of marsh to willow scrub; CM = Calamagrostis marsh; TLM = tall ledum marsh; LLM = low LLM = low ledum marsh; WS = willow scrub.

APPENDIX D: (CONTINUED).

SOUTH MARSH																														
PLOT NUMBER	13			14			15			16			17			18			19			20			21			22			23			24		
Vegetation treated?				Y									Y						Y						Y			Y			Y					
Photopoint orientation	180			360			360			360			45			270			90			315			45			180			45			45		
(taken 20' from plot center)																																				
Vegetation type	ED			TLM			ED			ED			LLM			ED			LLM			ED			TLM			LLM			WS			ED		
SPECIES	cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht		cov	ht	
Alnus rubra													15	184														2.5	132								
Alnus viridis	15	96		15	72		2.5	60		15	72		15	48		2.5	108		15	84		37	72		15	72		37	60		37	108		62	72	
Angelica genuflexa	2.5	60		2.5	48		15	72		2.5	60		2.5	60		15	72					15	72		15	48		2.5	36		2.5	36		2.5	24	
Athyrium felix-femina	2.5	48		2.5	30		15	48					2.5	36					2.5	36					15	48		2.5	24					2.5	36	
Blechnum spicant	15	36								2.5	36		15	24								15	36					2.5	36		2.5	24		15	48	
Calamagrostis nutkaensis	85	48		62	48		62	48		85	48		37	42		85	48		62	42		62	48		15	48		62	42		15	36		15	48	
Carex obnupta	37	48								15	48		15	42		15	48		2.5	36		37	48		37	48					15	48		15	48	
Carex spp.																																				
Cornus sericea																																				
Deschampsia caespitosa																																				
Epipactus gigantea										2.5	12								2.5	24																
Equisetum spp.																																				
Galium trifidum																																				
Gaultheria shallon																																				
Gentiana sceptrum																																				
Holcus lanatus																																				
Hypericum formosum										2.5	12											2.5	24													
Juncus leseurii							15	48														2.5	48											2.5	48	
Ledum glandulosum	85	48		62	48		85	60		62	48		62	42		85	48		62	42		85	60		85	48		62	42		85	72		85	60	
Lonicera involucrata	15	60								2.5	48		15	60		2.5	60		2.5	96		15	72		15	72								2.5	84	
Lotus formosissimus																																				
Lysichiton americanum	15	48		15	24		2.5	48		15	48		15	24					15	24		15	48		15	24		15	24		15	24		15	48	
Maianthemum dilatatum																15	48																			
Malus fusca																															15	144		15	132	
Menyanthes trifoliata							15	24		2.5	12					2.5	24		15	12								2.5	12							
Myrica californica	15	96		2.5	120		15	108																							15	156		15	96	
Oenanthe sarmentosa																																				
Picea sitchensis				15	156					2.5	120		2.5	48		2.5	84		15	84					2.5	96		15	96					15	240	
Rhamnus purshiana	2.5	36																																		
Potentilla palustris	2.5	24		15	30		2.5	36					37	36		15	36		37	36		2.5	24		15	36		15	36							
Pteridium aquilinum										2.5	36																									
Rhododendron occidentalis	2.5	48		2.5	60		2.5	72														2.5	72		2.5	36					2.5	48				
Rubus ursinus	15	36		15	36																	15	48		15	36					15	36		15	36	
Salix spp.							37	120		15	84		15	120		37	96		37	144					15	72										
Sanguisorba officinalis	15	24		37	30		15	24		2.5	24		37	36		15	36		37	36		15	36		37	36		37	36		15	36		15	36	
Rubus spectabilis	2.5	36																																		
Aster chilensis				2.5	60					2.5	24					2.5	36								2.5	36		2.5	36							
Spiraea douglasii										15	48																									
Veratrum californicum																																				
TOTAL COVER	327			249			284			247			286			295			305			321			302			258			235			292		

NOTES: Plots = 30 ft diameter; Treatment consisted of manual removal trees and selected shrubs (see text); Vegetation Types: ED = edge of marsh to willow scrub; CM = Calamagrostis marsh; TLM = tall ledum marsh; LLM = low led
LLM = low ledum marsh; WS = willow scrub.

APPENDIX E

BLANK POPULATION AND HABITAT FIELD DATA SHEETS

LIOC LIFE HISTORY PLOT DATASHEET

SITE:_____ DATE:_____ BY:_____ PLOT # _____

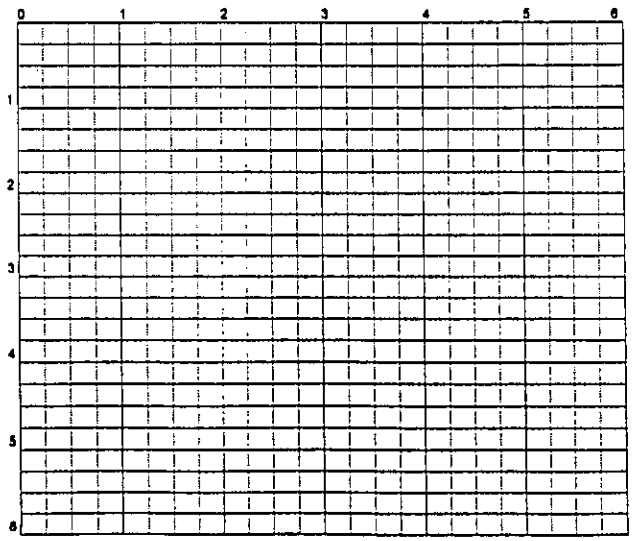
PLOT LOCATION: COORDS-____CORNER | LASER

X	Y	DIST	AZ	(TO) PT	DIST	AZ	(TO) PT

VEG TRTMENT CATEGORY_____

LILY INVENTORY						VEGETATION			
QUADRANT OF 6X6 PLOT	FT FROM____PLT CRN: X (____) Y (____)	HGT (")	SDLG #LVES	FLR #/PH	GRZD/ DISEAS	VEG TYPE	OVRHD CAN%	SPECIES	AVG COV HT NOTES

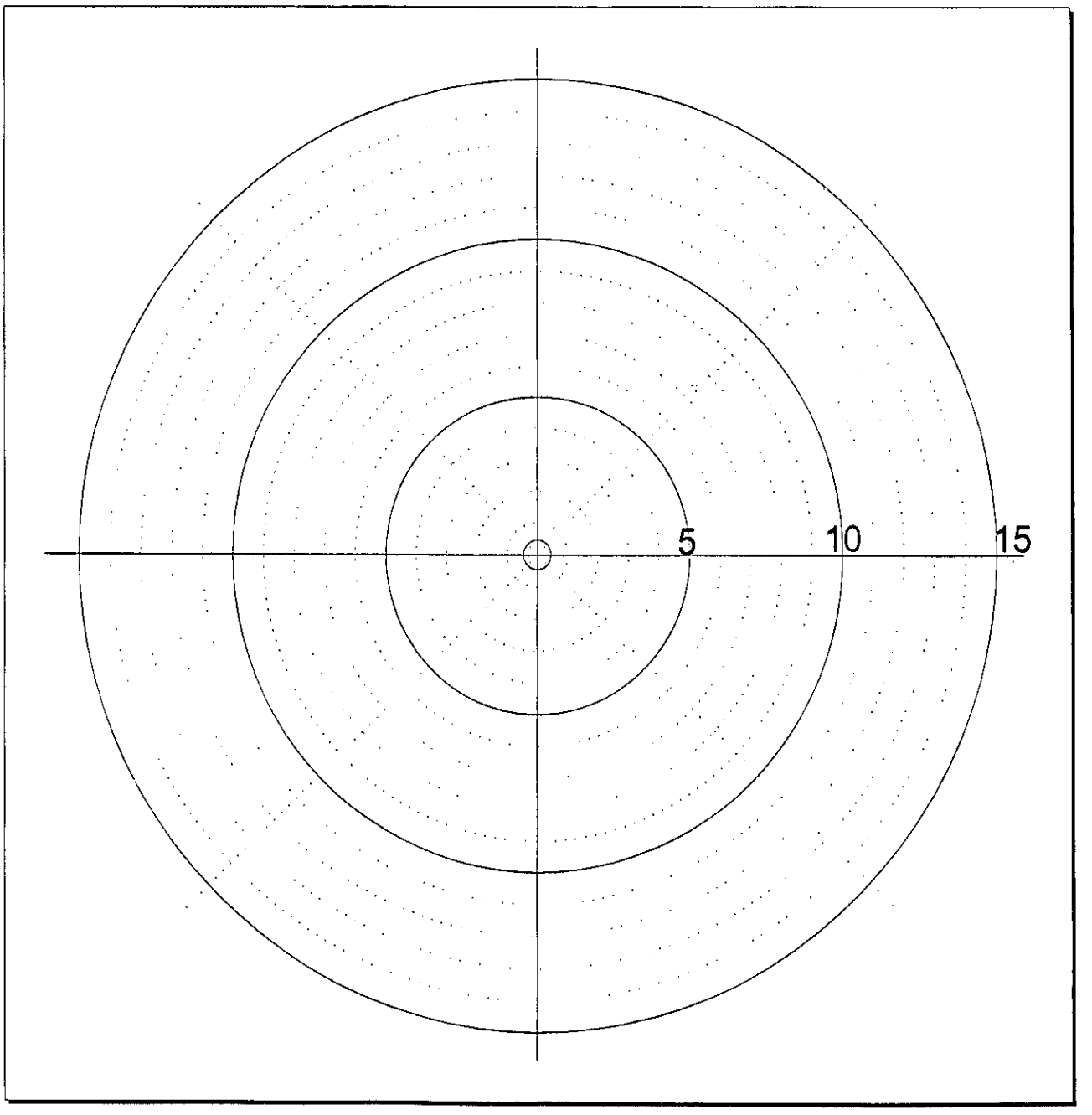
Notes:



CCMWA VEGETATION PLOT DATASHEET

DATE:_____ BY:_____ PLOT#_____

VEG TYPE	OVERHD CAN%	SPECIES	COV CLASS(1-6	AVG HT	NOTES



TBER HABITAT DATASHEET

DATE:_____

BY:_____

REF TRANS	DIST	DOMINANT SPECIES UNDERSTORY	AVG HGT UNDSTY	SPRUCE OVERSTORY?	DIST	%COVER @3'	NOTES
					0		
					10		
					20		
					30		
					40		
					50		
					60		
					70		
					80		
					90		
					100		
					110		
					120		
					130		
					140		
					150		
					160		
					170		
					180		
					190		
					200		
					210		
					220		
					230		
					240		
					250		
					260		
					270		
					280		
					290		
					300		
					310		
					320		
					330		
					340		
					350		
					360		
					370		
					380		
					390		
					400		
					410		
					420		
					430		
					440		
					450		
					460		
					470		
					480		
					490		
					500		
					510		
					520		
					530		
					540		
					550		
					560		
					570		
					580		
					590		
					600		