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BALDWIN LAKE ECOLOGICAL RESERVE
BIOLOGICAL MONITORING REPORT
FOR
SIDALCEA PEDATA
THELYPODIUM STENOPETALUM
AND
ECHINOCEREUS ENGELMANNII VAR. MUNZII

Prepared for

California Department of Fish and Game
Endangered Plant Program
1416 Ninth Street
Sacramento, CA 95814

Prepared by

Katherine Barrows
53-277 Avenida Diaz
La Quinta, CA 92253

Funded by

U.S. Fish and Wildlife Service Grant-in-aid;
and
California Endangered Species Tax Check-off Fund
Contract FG-7605

October 1990

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INTRODUCTION

In 1989 a Management Plan and Operations and Maintenance Schedule was completed for the Department of Fish and Game's Baldwin Lake Ecological Reserve in San Bernardino County, CA (Barrows 1989). This plan called for a monitoring plan for the state-listed endangered species on the reserve. There are two state-listed species, the bird-footed checkerbloom (*Sidalcea pedata*) and the slender-petaled thelypodium (*Thelypodium stenopetalum*). Both species are state-listed Endangered and also on the U.S. Fish and Wildlife Service's endangered species list. In addition, a monitoring program was implemented for an additional rare species, the Munz's hedgehog cactus (*Echinocereus engelmannii* var. *munzii*); this species is being monitored at other pebble plain sites in the vicinity (Neel 1989).

The attached reports detail the monitoring program and results for each of the three species included in this 1990 monitoring program. The format used is adapted from a standard format used by The Nature Conservancy, California Regional Office, for biological monitoring reports. These reports include details on the design and layout of monitoring plots and transects on the site.

A total of three transects were established to monitor the slender-petaled thelypodium; 54 plants were included in these three transects and an additional 8 plants were located outside the transects for a total of 62 thelypodium plants at this site. This represents the known population of this species within the Reserve boundary in 1990, a drought year. A new subpopulation of this species was discovered in the course of monitoring by John Stephenson and Nancy Gill of The Nature Conservancy. Individual thelypodium plants have been mapped and measured for long-term demographic monitoring of this species.

A total of 66 one meter-square plots were established to monitor the bird-footed checkerbloom; 66 individual plants were marked for long-term demographic monitoring. Within these plots a total of 718 plants were counted, 286 flowering plants and 432 non-flowering plants. In addition a more detailed map of the location of subpopulations of this species on the site was completed for future monitoring purposes.

Four belt transects were established to monitor Munz's hedgehog cactus; 64 individual plants were included in this monitoring effort. Information on vegetative characteristics and reproductive effort were gathered on each of these plants. Future monitoring at this site will provide data for comparison with data gathered on this species at other sites in the vicinity of Baldwin Lake.

The results of each monitoring program are included in the attached reports. All plots and/or transects are marked on the site with rebar stakes and aluminum tags so they can be relocated in the future.

Also included in the reports for each species are recommendations for future monitoring within the Reserve. It is recommended that the monitoring program be continued for at least the next two consecutive years to establish a baseline of data for these rare species. Subsequent monitoring needs can be evaluated after several years of data have been accumulated. This baseline information will serve as means to evaluate population trends for these species and, to some extent, to evaluate management and protection goals on the Reserve.

BIOLOGICAL MONITORING REPORT
1990

ELEMENT: *Sidalcea pedata*

COMMON NAME: Bird-footed Checkerbloom

SITE NAME: Baldwin Lake Ecological Reserve

RANK: G1 S1.1 FEDERAL LISTING: E STATE LISTING: E

DATA STORAGE: California Department of Fish and Game, Natural Heritage Division; Big Bear Ranger Station, USFS. The Nature Conservancy, Coachella Valley Preserve.

PREPARED/UPDATED: Katie Barrows, 15 October 1990.

The bird-footed checkerbloom, *Sidalcea pedata* (SIPE), is endemic to Big Bear Valley in the San Bernardino Mountains. This species is listed as sensitive by the U.S. Forest Service (USFS), endangered by the U.S. Fish and Wildlife Service (USFWS), and endangered by the California Department of Fish and Game (CDFG). One of the significant populations is protected within the boundaries of the North Baldwin Lake Ecological Reserve, managed by CDFG with cooperation from Big Bear Ranger District, USFS, and The Nature Conservancy.

Monitoring at North Baldwin Lake is a continuation of a monitoring program begun in 1989 (Barrows 1989, Stephenson 1989). In 1989 the number of plants in two subsections of the population were counted in two groups, non-flowering and flowering. Monitoring of the bird-footed checkerbloom was also conducted in 1989 and 1990 at other locations in the Big Bear Valley, including Metcalf Bay, Eagle Point, Bluff Lake, and Pan Hot Springs. The methods and results of monitoring at North Baldwin Lake are reported here. Results of monitoring at other locations are reported in a separate monitoring report (Stephenson 1990).

The location of the reserve and the general area where *Sidalcea pedata* occurs within its boundaries are shown in Figure 1; more specific locations (CNDDB 1989) for SIPE sub-populations are shown in Figure 2. These maps are taken from the management plan for the reserve (Barrows 1989). The monitoring program includes all portions of the population where SIPE plants have been observed in the past two years. No SIPE plants have been observed in two other subpopulations, marked with an asterisk on Figure 2, for at least the last four years.

GOALS:

When a monitoring program for this species was first initiated in 1989 at North Baldwin Lake (Stephenson 1989), the distribution of SIPE had been well documented (Krantz, personal communication; CNDDB 1989) but little was known about the size of the population, about annual population fluctuations, or about life history characteristics. Life history information, such as seedling survival and annual reproductive output, is useful in determining population trends (Travis and Sutter 1986). Information on plant density and reproductive output can, to some extent, be used to predict the influence of variations in habitat parameters, such as moisture availability, on the species. Baseline documentation of SIPE plants on this site may indicate present or future disturbances that could pose a threat to the long-term protection of the species. To meet these information needs, the goals for the monitoring program are as follows:

1. Determine the trend for SIPE population at this site
2. Establish a baseline to assess the annual variation in SIPE population.
3. Determine what, if any, threats to SIPE population are present.

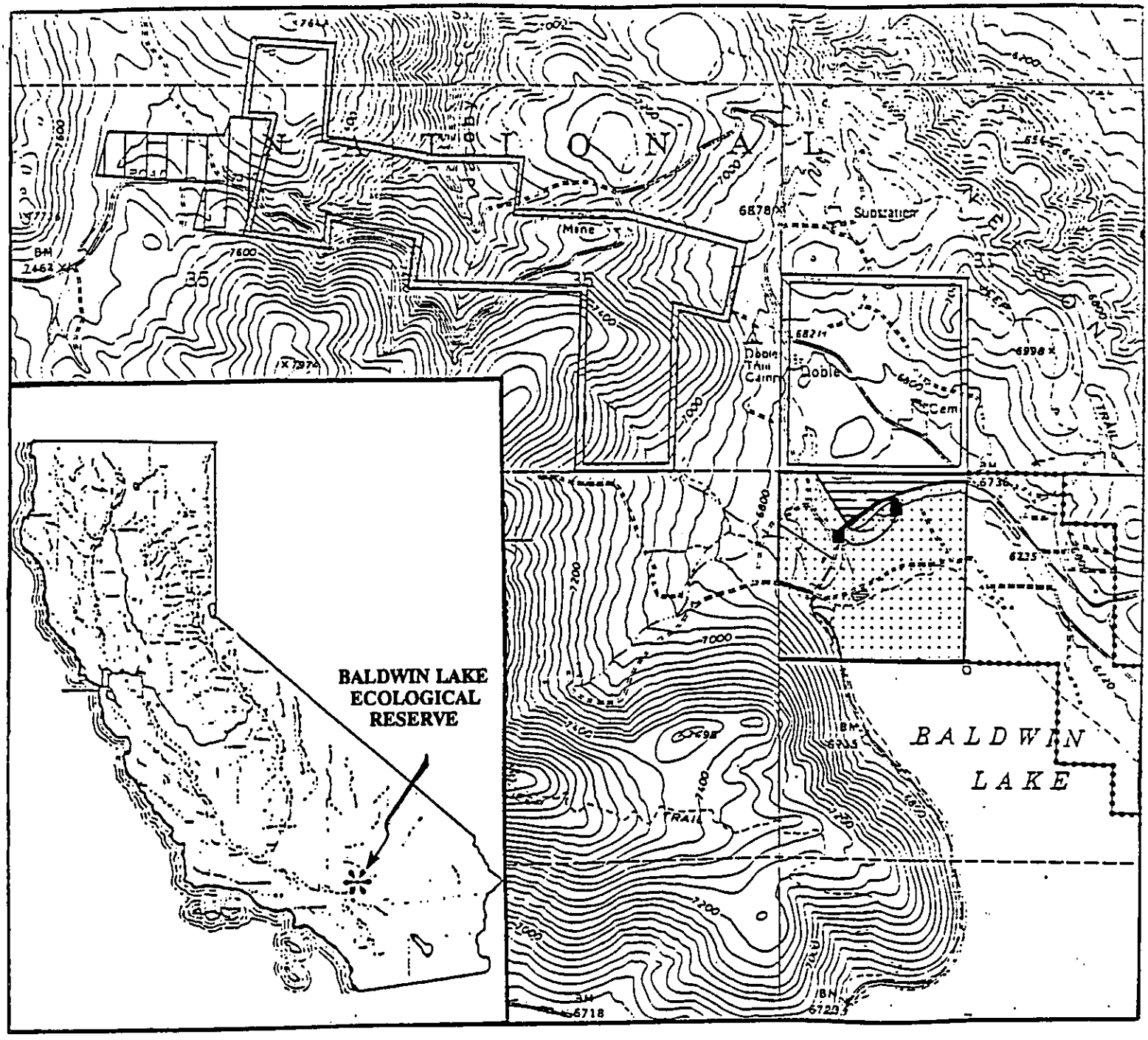

Figure 1. Location of the Baldwin Lake Ecological Reserve in the San Bernardino Mountains of San Bernardino County, CA. Map is from USGS 7.5 minute Big Bear City quad.

= Baldwin Lake Ecological Reserve

= General location of *Sidalcea pedata* populations

= Privately held land (Cemetary parcel)

= U.S.F.S. land

Baldwin Lake Ecological Reserve

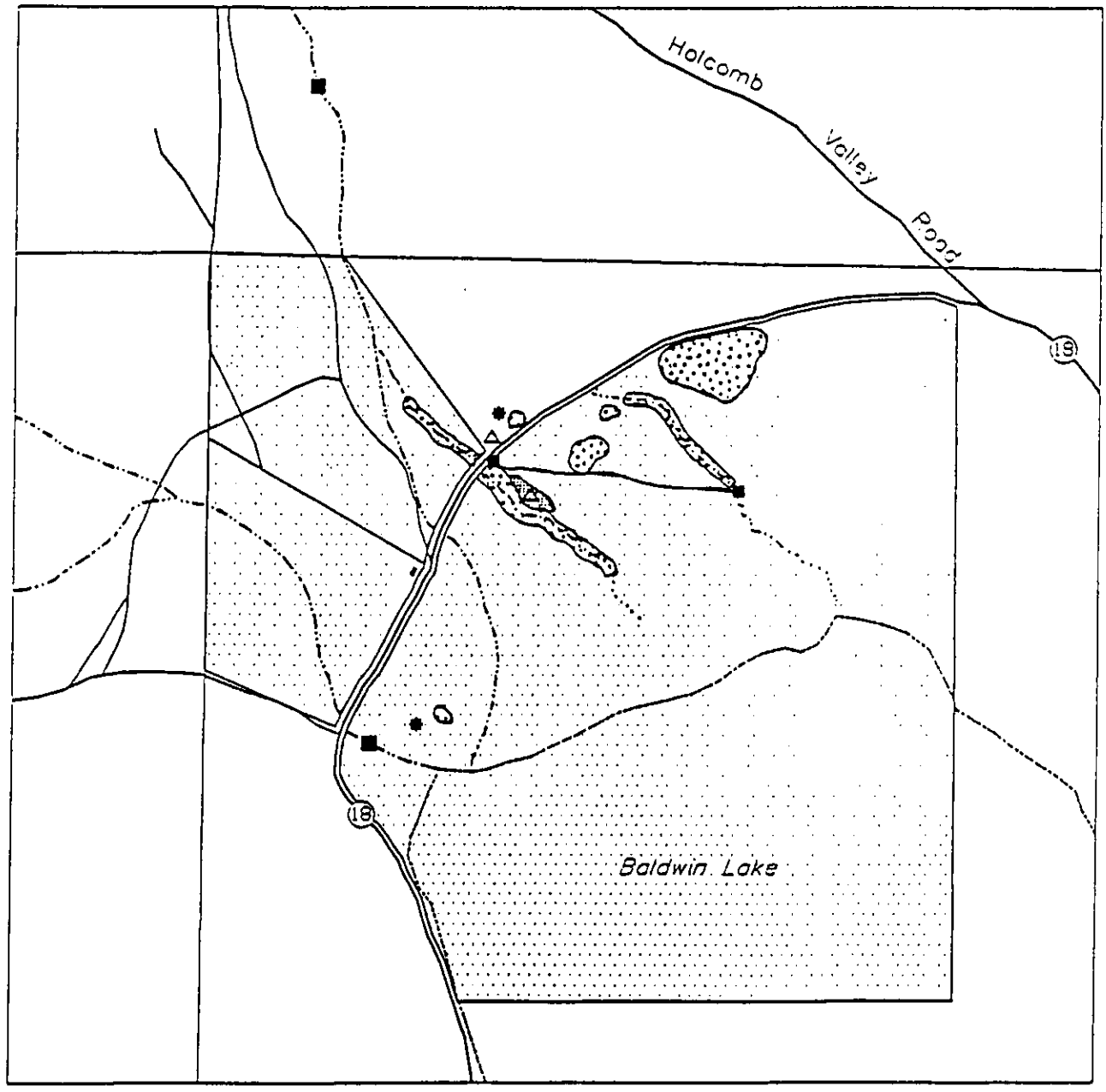

Figure 2. Location of rare plant populations on the Baldwin Lake Ecological Reserve, San Bernardino County, CA. Trail and swales are also indicated.

= *Sidalcea pedata*

= *Thelypodium stenopetalum*

= No Plants Present in 1990

Δ = *Poa atropurpurea*

= Foot Trail

= Swale or Drainage Area

0 1000

Feet

N

MONITORING OBJECTIVES AND PARAMETERS MEASURED:

To meet the goals of the monitoring program, the following objectives will be pursued:

1. Obtain baseline information on location of the SIPE subpopulations.
2. Obtain basic life history data on seedling survival, reproductive output, vegetative growth.
3. Establish baseline information on population density and estimated population size.

The following parameters will be tracked for each subpopulation within the Baldwin Lake Ecological Reserve.

1. Areal extent of the subpopulation (mapped).
2. Density of *Sidalcea pedata* individuals, flowering and non-flowering, within 1 m^2 circular plots.
3. On one marked individual (flowering or non-flowering) per plot:
   a. number of vegetative stems
   b. number of flowering stems
   c. number of fruits
   d. number of flowers
   e. longest vegetative stem (cm)

MONITORING METHODS:

The monitoring effort at the Baldwin Lake Ecological Reserve involved the establishment of permanent 1 m^2 circular plots within known populations of bird-footed checkerblooms. Prior to plot establishment, the area was walked to determine the distribution and extent of the checkerbloom populations at the site. Records maintained by the California Natural Diversity Data Base (CNDDB) and by Tim Krantz were used to check on all element occurrences. Subpopulations of the species were designated with a code based on topographic features on the reserve. The location of each subpopulation is shown in Figure 2.

At North Baldwin Lake, there are two swales where *Sidalcea pedata* is concentrated; the first of these swales is bisected by Highway 18. The upper (northwest) side of the road is designated NB-1U and the lower (southeast) side of the road is designated NB-1L. The second swale is designated NB-2.

Between these two swales *Sidalcea* is widely scattered in patches amongst the sagebrush (*Artemisia tridentata*). A third subpopulation, NB-3, is designated as the plants occurring between the two swales. A fourth subpopulation, NB-4, refers to plants which occur on the east side of swale #2.

The monitoring method used was selected because plants occur in a fairly small, discrete area but are patchily distributed within this area. Establishing transects would be difficult because the size of these patches of plants, and the number of individuals in a patch, varies considerably. The current method makes it difficult to assess the level of error (how many plants are missed?) because it does not rely on a random location of plots; this method should be evaluated before future monitoring is implemented.

The individual plots were established in a systematic manner in order to maximize the number of individuals sampled. Where *Sidalcea pedata* occurs in shallow swales or drainages, plots were established along a transect at random distances from a subjectively determined starting point. In the more scattered subpopulations (NB-3 and NB-4) plots were established in areas where plants were found; the compass direction and distance in meters from a known point to the center of the plot was recorded. In each case, the starting reference point was located along the fence line which parallels Highway 18. Metal tags were placed on the fence to indicate the starting point of each transect; the compass direction and distance to the first plot center was then recorded. The location of the transects and plots is shown in Figure 3.

It should be noted that the data from monitoring plots established at North Baldwin Lake may not be directly comparable to plots established at other locations in the Big Bear Valley. While the method of sampling and marking plots, and the data collected on SIPE plants within those plots is comparable, the method of locating plots is not directly comparable. Plots at Eagle Point and Bluff Lake were laid out in a

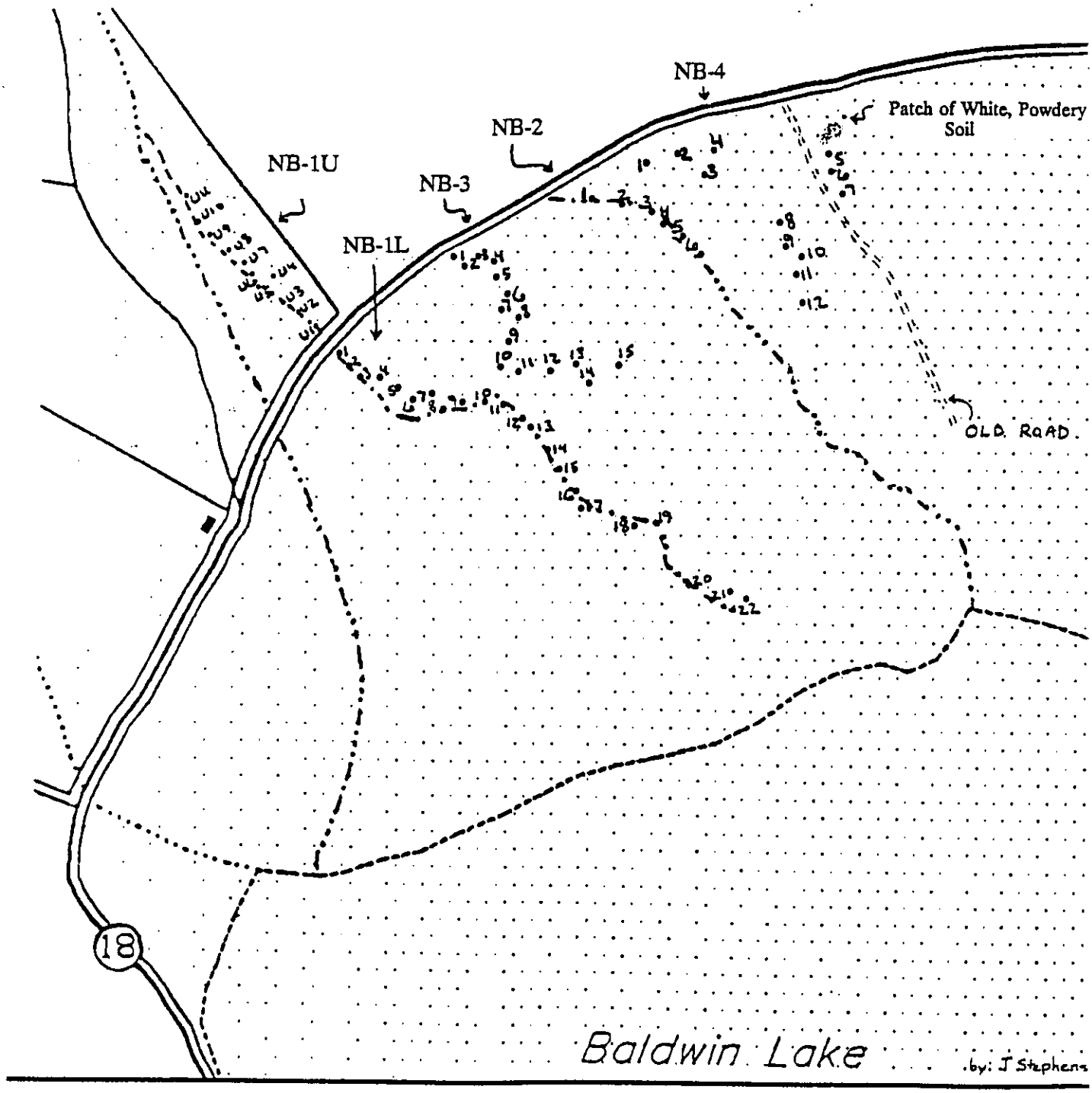

Figure 3. Location of monitoring plots for *Sidalcea pedata* at Baldwin Lake Ecological Reserve, San Bernardino County, CA in 1990.

—·—·— = Drainage or Swale

● = Monitoring plot

random manner within subpopulations (Stephenson 1990); at these locations SIPE plants are more continuous in large patches. The systematic method used at North Baldwin Lake was employed to maximize the number of plants sampled; it cannot be used to give an accurate estimate of plant density or population size in comparison to the aforementioned sites.

At each sampling point, a rebar stake or large nail was placed at the center of the plot. The stake was labeled with a metal tag, indicating the plot number (eg. SIPE-1) and the sampling date. A $1m^2$ circular plot was centered on the stake and all *Sidalcea pedata* individuals were counted in two categories, flowering and non-flowering. Within each circular plot, one individual SIPE plant was randomly selected for demographic monitoring; flowering and non-flowering individuals were alternately selected in subsequent plots on a rotating basis. Random selection was accomplished by dividing the circular plot into quarters based on compass direction (N, S, E, W); a random number between one and four was then selected to determine which quarter would be sampled. A second random number was then chosen to determine which plant within the selected quarter would be marked. Each individual was marked with a metal tag, anchored to a 6-inch nail next to the plant. For each plant, the number of vegetative stems, number of flower-bearing stems, number of fruits, and number of flowers were counted.; the length of the longest leaf-bearing stem was measured in centimeters. A sample data sheet is shown in Figure 4.

MONITORING SCHEDULE:

The data was collected in mid-June; at this time the plants were in the latter part of the blooming period. Most of the plants that flowered this year were in fruit at the time of sampling.

Monitoring Dates	Site	Personnel
6 June 1990	NB-1U, NB-1L, NB-2, NB-3 (part)	K. Barrows, N. Gill
19 June 1990	NB-3 (part), NB-4	J. Stephenson, N. Gill

Monitoring of SIPE at Baldwin Lake Ecological Reserve should continue annually for the next three years. Thereafter, sampling should be done on a three-year cycle. Monitoring should be completed between May 15 and June 15 to obtain reproductive data on this species. It is preferable to sample when plants are in fruit; this schedule probably minimizes the damage to plants before they complete their reproductive cycle.

The monitoring effort takes approximately two full days with two people working together, for a total of four person-days to complete the program for this species.

SITE/FIELD CONDITIONS:

The Big Bear Valley has received less than average precipitation for the last six years. The last three years have been described as drought years. According to Tim Krantz, a botanist who is very knowledgeable about this species and this site, the wet meadow habitats are the driest they have been in over ten years (Krantz, personal communication).

RESULTS

A total of 66 plots were established in four different subpopulations of SIPE with a total of 718 plants counted. In addition 66 individual plants were marked and measured for demographic parameters. Results of monitoring for 1990 are given in the following tables. Table 1 summarizes the total number of plants and the mean number per 1 m^2 plot in each subpopulation. Table 2 summarized data on the

Sidalcea pedata

Biological Monitoring Data Sheet

Location _____ Date _____

Habitat _____ Observer(s) _____

Subpopulation No. _____ Plot No(s). _____ to _____

Compass Dir. _____ _____

****

Plot #	Location ♦	No. of Plants W/ Flws.	W/O Flws.	No.	Individual Plants Frts/Flws.	Leaf(cm)	#Stems Veg/Flw

♦ = Given in meters from the last plot

Figure 4. Sample of data sheet used for *Sidalcea pedata* monitoring at Baldwin Lake Ecological Reserve.

TABLE 3. Summary of vegetative characteristics for flowering and non-flowering plants of *Sidalcea pedata* at Baldwin Lake Ecological Reserve. Numbers given include total number of stems/average number of stems per plant.

SUBPOPULATION NO.	NO. OF STEMS VEGETATIVE	NO. OF STEMS FLOWERING	LENGTH LONGEST STEM
NB-1L	104/9.4	14/1.3	7.0
NB-1U	245/11.1	27/1.2	7.2
NB-2	39/6.5	7/1.2	7.0
NB-3	185/12.3	17/1.1	7.2
NB-4	97/8.1	13/1.1	6.1
TOTAL	670/10.2	78/1.2	7.0

DISCUSSION

In 1990 66 plots were established which sampled an area of 66 m^2 on the Baldwin Lake Ecological Reserve; of this total area, 39 plots or 39 m^2 were within the areas designated as NB-1U, NB-1L, or NB-2. In 1989 a total population count was completed, which included the subpopulations designated in this report as NB-1U, NB-1L, and NB-2. The subpopulations designated as NB-3 and NB-4 were not counted in 1989. A comparison of the results for the two years suggests that the 1990 sampling may overestimate the population, perhaps substantially. Within a comparable area (subpopulations NB-1 and NB-2), in 1989 689 flowering (0.34 plants/m^2) and 1322 non-flowering (0.64 plants/m^2) SIPE plants were counted in a total area of 2052 m^2. In 1990 184 flowering (4.7 plants/m^2) and 257 non-flowering (6.5 plants/m^2) SIPE plants were counted in a much smaller area of 39 m^2, 1.90% the area surveyed in 1989. Qualitative observations would suggest that the density of SIPE plants was not that much greater in 1990 than 1989. Unfortunately, the systematic plot layout used in 1990 appears to produce an overestimate of the total population.

The ratio of non-flowering to flowering plants in 1989 was 1.8:1; in 1990 the ratio for all subpopulations at North Baldwin Lake was 1.5:1. The proportion of the total population made up of non-flowering plants is roughly comparable for the two years; for the most part the count of non-flowering plants reflects the number of seedlings present in the population. The monitoring initiated this year wll provide data on the survival of these seedling plants at this location.

It may be of interest to note that in 1989 during monitoring of SIPE, observation of plants counted in subpopulation NB-2 indicated that many of the inflorescence-bearing stems had been clipped off, apparently by browsing herbivores (rabbits, burros?) (Barrows 1989). The same pattern of heavy herbivore damage was not apparent in any of the plants sampled this year. The impacts of non-native burros on this species are still not well known; monitoring within the Ecological Reserve will provide data on the impacts of the burros by following marked plants in an area exposed to burro activity. Barriers and gate closures have been erected to reduce burro impacts within the SIPE habitat.

PROGRESS TOWARD GOALS: This is the first year of quantitative monitoring at Baldwin Lake Ecological Reserve, hence there has not yet been sufficient baseline data collected to evaluate this SIPE population. This is the fourth year of drought; the abundance of this species in "good" years may vary considerably. At least three years of data will probably be needed before management goals can be set.

INTERPRETATION OF TRENDS. No trends can be assessed in the first year of quantitative monitoring. However, several interesting trends can be considered. The observation of many clipped stems

of SIPE observed in 1989 was not repeated this year; the potential impact of burros on this species should continually be evaluated. The known distribution of SIPE within this population at North Baldwin Lake has increased each year since 1988, simply becaused increased efforts to locate plants are made each year. The presence of permanent plots will allow information on annual fluctuations on population numbers and distribution at this site.

RECOMMENDATIONS:

The monitoring program in 1990 was the first time that permanent plots to monitor demographic parameters for SIPE were established at Baldwin Lake. This monitoring effort produced some valuable data about the species at this site; distribution and abundance was more accurately mapped and a baseline of information on the population was established. However, the monitoring program also revealed some inadequacies in the current sample design and indicated the need for changes and additions to the monitoring scheme. The following recommendations are proposed for 1991:

1. Evaluate the current layout of plots; consider changing the sample design to include plots selected randomly from a grid which covers the entire known population area. If population distribution changes, new plots may need to be added.

2. Consider collecting point-intercept data along transects within SIPE populations to establish plant community composition. This data might also indicate the number and distribution of exotic species.

3. Continue to collect observational data on the impacts of burro activity in SIPE habitat on the Baldwin Lake Ecological Reserve. Establish permanent photopoints along known trails within SIPE habitat, to monitor changes in burro use of the area.

4. Collect data on seed production from a subsample of the SIPE plants included in the individual monitoring. Permission to collect these data will need to be obtained from both the USFWS and CDFG.

PERSONNEL

TNC: Nancy Gill, John Stephenson
Consultant: Katherine Barrows

REFERENCES CITED

Barrows, K. 1989. Operations and Maintenance Schedule for Baldwin Lake Ecological Reserve (and adjacent lands). Report to California Department of Fish and Game, Endangered Plant Program. August 1989.

CNDDB. 1989. California Natural Diversity Data Base records for *Sidalcea pedata*, Big Bear City 7.5' quad. Natural Heritage Division, California Dept. of Fish and Game, Sacramento, CA.

Krantz, T. Personal communication, April-June 1988. Mr. Krantz is very knowledgeable about the biology and status of rare plants throughout the Big Bear Valley.

Stephenson, J. 1989. Monitoring Report, 1989: *Sidalcea pedata*. Unpublished report to The Nature Conservancy.

Travis, J. and R. Sutter. 1986. Experimental Designs and Statistical Methods for Demographic Studies of Rare Plants. Natural Areas Journal 6(3):3-12.

BIOLOGICAL MONITORING REPORT
1990

ELEMENT: *Thelypodium stenopetalum*

COMMON NAME: Slender-petaled thelypodium

SITE NAME: Baldwin Lake Ecological Reserve

RANK: G1 S1.1 **FEDERAL LISTING:** E **STATE LISTING:** E

DATA STORAGE: California Department of Fish and Game, Natural Heritage Section; Big Bear Ranger Station, USFS, The Nature Conservancy.

PREPARED/UPDATED: Katie Barrows, 19 August 1990.

The slender-petaled thelypodium, *Thelypodium stenopetalum* (THST), is endemic to Big Bear Valley in the San Bernardino Mountains. This species is listed as sensitive by the U.S. Forest Service (USFS), endangered by the U.S. Fish and Wildlife Service (USFWS), and endangered by the California Department of Fish and Game (CDFG). One of the significant populations is protected within the boundaries of the Baldwin Lake Ecological Reserve, managed by CDFG with cooperation from Big Bear Ranger District, USFS and The Nature Conservancy. The location of the reserve is shown in Figure 1.

Monitoring at North Baldwin Lake is a continuation of a monitoring program begun in 1988 (Barrows 1989, Stephenson 1989). In 1988 one belt transect was established at North Baldwin Lake; the general distribution and abundance of THST was described at this site. In 1989, in addition to resampling of this belt transect, a more intensive effort was made to count all individuals in all known populations of THST; this count was conducted by USFS and TNC personnel. The known extent of the population was mapped and previous records (CNDDB) for the species were checked. Other populations in the Big Bear Valley were also monitored in 1989 (Stephenson 1989). In 1990 two additional permanent belt transects were established; one of these transects is in a newly discovered subpopulation of THST. The location of sensitive plant species, and swales and trails is shown in Figure 2.

GOALS OF THE MONITORING PROGRAM:

When a monitoring program for this species was first initiated in 1988 at North Baldwin Lake (Barrows 1989), the distribution of THST had been well documented (Krantz, personal communication; CNDDB 1989) but little was known about the size of each known population or about the life history of this species. Life history information, such as seedling survival and annual reproductive output, is useful in determining population trends. To some extent, the threat to populations of THST can be monitored by tracking distribution and abundance at each site. To meet these information needs, the goals for the monitoring program are as follows:

1. Monitor the distribution and abundance of the element at the site.
2. Assess the trends for populations of THST at the site.
3. Establish baseline information on plant life history and population density.

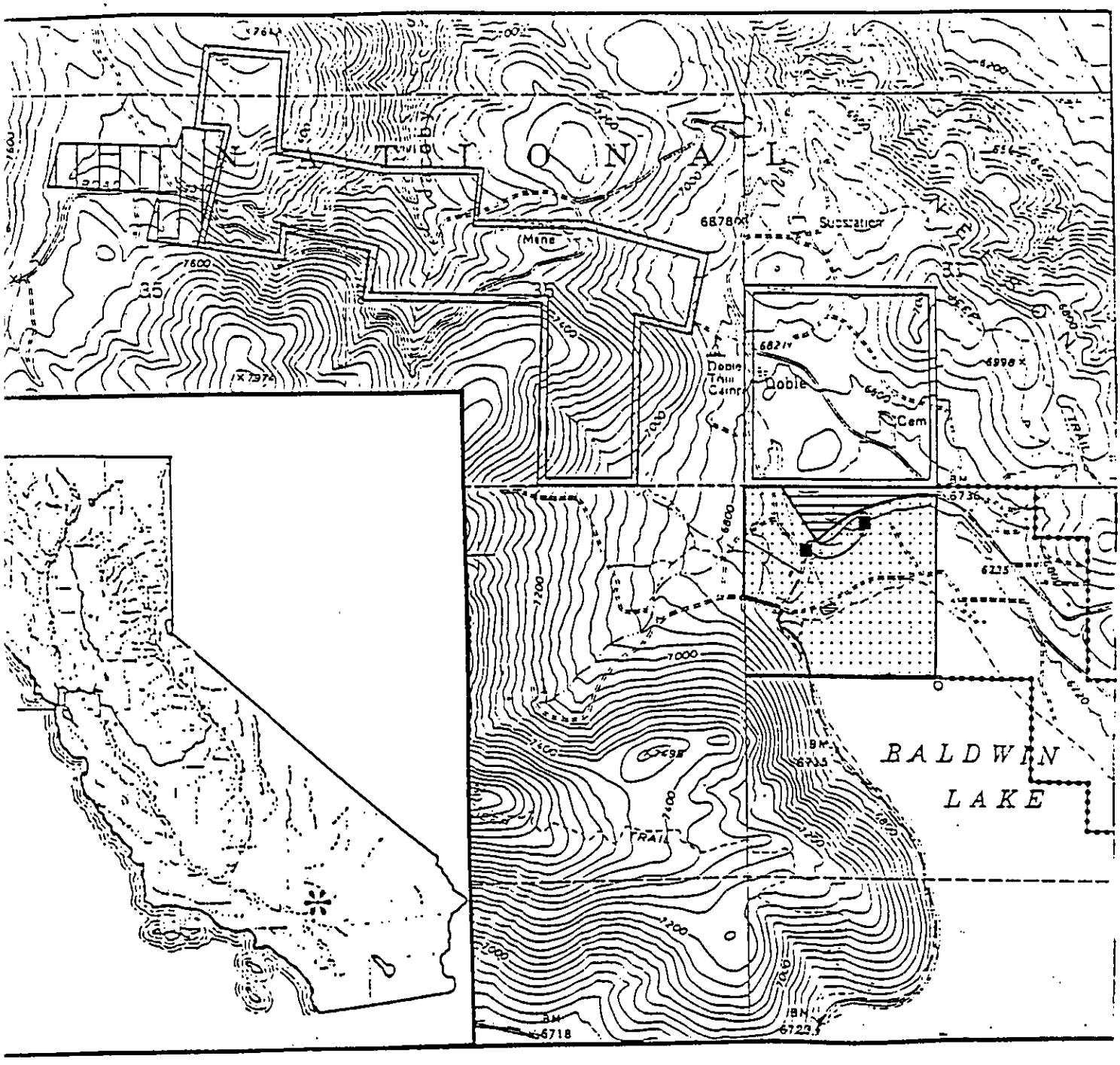

Figure 1. Location of the Baldwin Lake Ecological Reserve in the San Bernardino Mountains of San Bernardino County, CA. Map is from USGS 7.5 minute Big Bear City quad.

= Baldwin Lake Ecological Reserve

= General location of rare plant populations

N

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FEET

PARAMETERS MEASURED:

1. Areal extent of THST populations (mapped).
2. Position of each individual is mapped according to its position along transect.
3. For each plant within belt transect:
   a. life history stage: rosette or flowering.
   b. number of buds, flowers, fruits.
   c. height of plant, diameter of basal rosette.
   d. number of vegetative stems.

MONITORING METHODS:

Monitoring of THST focused on obtaining information on distribution and life history of this rare species. This species occurs in a very patchy spatial distribution; plants usually occur at low densities ($\geq$ 3 plants/m^2) within these patches. For this reason random sampling of the population would be difficult to accomplish. Therefore, permanent belt transects (rectangular plots) were established to monitor reproductive vigor and survivorship. The method used is adapted from Lesica (1987). Because THST is a biennial plant, the number of first year plants -- which occur as basal rosettes of leaves -- and second year plants are both counted.

Belt Transects. Three belt transects have been established in areas where plants were concentrated. Transects were sampled in the period between 14 May and 13 July 1990; exact dates are given below. The location of each of these plots is given in Figure 3. Each belt transect is 15 meters long and 2 meters wide. The belt transects are marked with a rebar or steel stake at each corner; aluminum tags on these stakes give the transect number, date, and position (eg. NE corner, SE corner) of each stake. The compass direction and distance from the beginning of each transect to a reference point was also recorded. The reference point for Transects #1 and #2 is located at the fenceline along Hwy 18, on one of the anchor posts; the reference point for Transect #3 is a very large juniper tree located along the trail. These reference points are indicated in Figure 3.

Within each belt transect, the position of each plant was mapped on grid paper according to "x" and "y" coordinates. A code was then designated for each plant which indicates the following information:

1. A = adult; S = seedling
2. H = height in cm;
3. D = diameter of basal rosette in cm.
4. B = number of buds.
5. R = number of fruits.
6. F = number of flowers.
7. I = number of aborted fruits

For example an adult plant 12 cm high with a basal diameter of 3.5 cm, 4 buds, 7 flowers, 3 fruits and 5 aborted (undeveloped) fruits would be coded as: AH12D3.5B4F7R3I5.

Total Counts. Total counts of all individuals that could be located in the 1990 monitoring season were made at North Baldwin Lake. These counts were conducted by carefully searching known THST locations from previous years and suitable habitat at the site. In most cases only second-year, adult plants were counted. Seedling rosettes are often difficult to locate as they grow underneath great basin sagebrush or other shrubs. It is difficult to determine whether some seedlings are being missed, resulting in an unreliable count.

The data gathered is entered in DBASE III+ files and summarized for presentation in the following tables.

Baldwin Lake Ecological Reserve

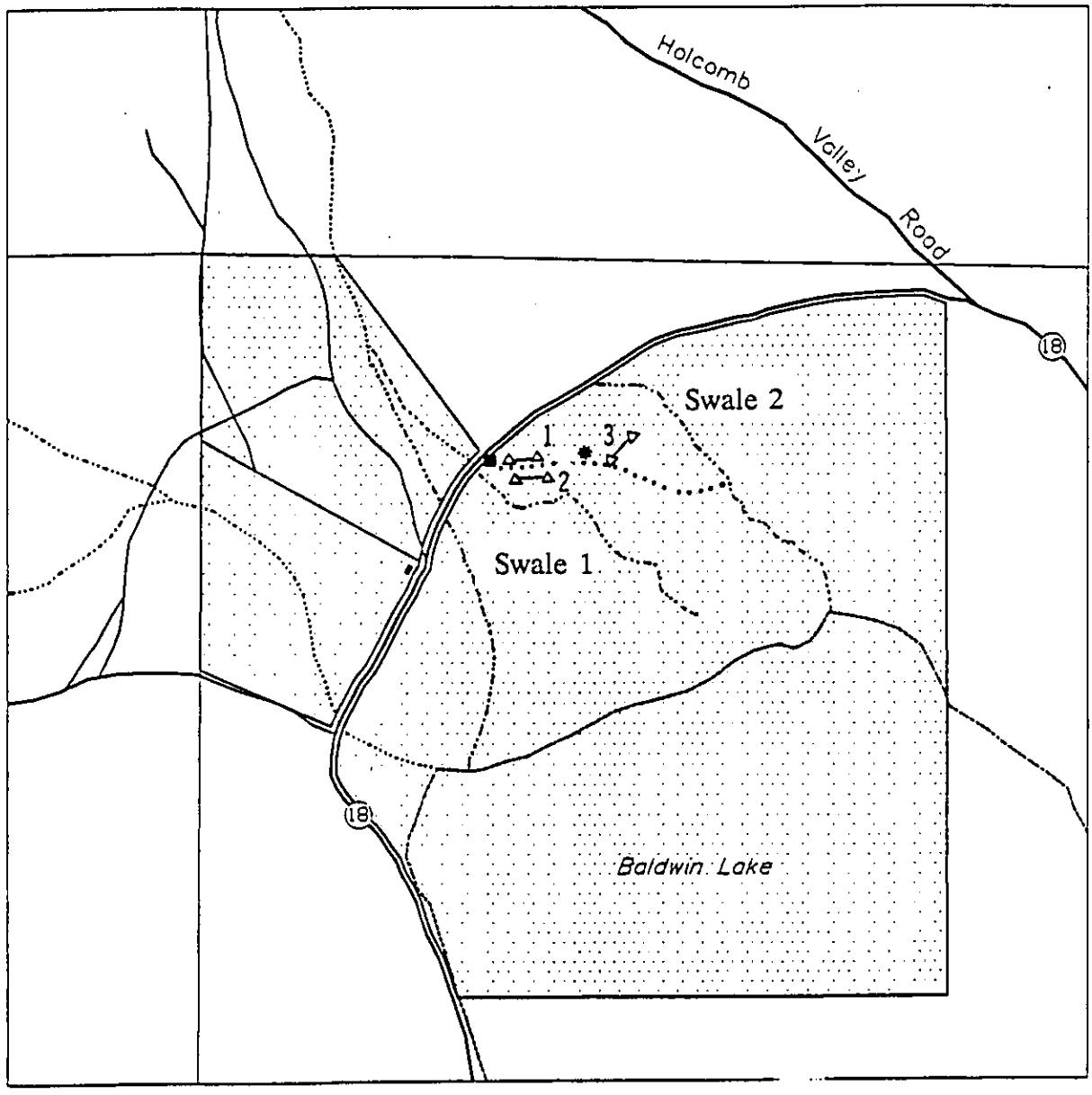

Figure 3. Location of monitoring transects for *Thelypodium stenopetalum* at Baldwin Lake Ecological Reserve.

△—△ = Monitoring transects

■ = Fencepost reference point

····· = Foot trail

✱ = Juniper tree reference point

0 1000

Feet

N

MONITORING SCHEDULE:

Data were collected over the period from mid-May to mid-July. Ideally monitoring should be carried out within a narrower range of time; the last sampling date was because the subpopulation at Transect #3 was only discovered at this time. Depending on the phenology in a given year, monitoring should be accomplished between 1 May and 30 June.

Monitoring Dates	Personnel
1. May 14, 1990	Katie Barrows
2. June 11, 1990	Katie Barrows, Nancy Gill, Maile Neel
3. July 13, 1990	Katie Barrows

Sampling this year indicates the population status under drought conditions; population distribution in "good" years may vary considerably. At least three years of data will probably be needed before management goals can be assessed.

SITE/FIELD CONDITIONS:

The monitoring this year was indicative of conditions during a drought that has affected the Big Bear Valley for the last three years. Below average rainfall has been recorded in the region for the last six years.

RESULTS

A total of 54 plants were counted in three transects, 29 flowering and 25 non-flowering (rosette) individuals. A new sub-population of THST was discovered east of the population as mapped in 1989; this subpopulation is sampled by Transect #3. No seedlings were observed on Transect #3, but the sampling of the latter transect was conducted late in the season. In addition to the transects a general search was made of the area surrounding the transects for additional THST plants. Individuals located outside the transects include five adult plants located in the vicinity of Transect #2 and three adults observed in the vicinity of transect #3 for a total of eight additional plants. In summary, a total of 37 adult plants were observed within the boundaries of the Baldwin Lake Ecological Reserve; this total is the known population of adult THST at this site in 1990.

A comparison of result for three years of THST sampling on one transect are given in Table 1. The measured characteristics of plants in each category for each of three transects are given in Table 2.

Table 1. Comparison of results for *Thelypodium stenopetalum* for three years on Transect #1 at North Baldwin Lake Ecological Reserve. Data for Transects #2 and #3 are not included because they were sampled for the first time in 1990. Data on rosettes were not obtained in 1988 as indicated by an asterisk (*).

POPULATION/ TRANSECT	YEAR	NUMBER OF PLANTS FLOWERING	ROSETTES
North Baldwin			
Transect #1	1988	11	*
	1989	13	9
	1990	4	10

Table 2. Summary of the number of plants and measured characteristics of *Thelypodium stenopetalum* on three transects at North Baldwin Lake Ecological Reserve. All characters listed, with the exception of Diameter (rosette), are data from second-year plants.

CHARACTER	TRANSECT #1 Total # Plants		TRANSECT #2 Total # Plants		TRANSECT #3 Total # Plants	
Mature Plants [1]	4		4		21	
Rosettes [2]	10		15		0	
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Height (mature)	22.6	14.3	26.2	10.7	41.1	18.5
Diameter (mature)	3.4	1.0	3.3	0.3	4.9	3.5
Diameter (rosette)	2.3	0.7	2.5	1.7	-	-
Number of Buds	22.0	10.6	4.8	4.4	0.9	1.7
Number of Flowers	1.7	2.9	3.6	4.3	0.1	0.5
Number of Fruits	1.7	3.5	9.0	6.9	17.0	13.7
Aborted Fruits	0	-	0	-	0	-
Stalks/Plant	1	0	1.2	0.5	2.3	1.6

[1] = Numbers given in this row are the total number of second year plants. All of these plants were flowering this year.

[2] = Numbers given in this row are for first-year plants or basal rosettes.

DISCUSSION:

The lower number of adult THST found in Transect #1 (four) in 1990 compared with 1988 (11) or 1989 (13) may be as a result of continued drought conditions. However, the number of rosettes located is comparable for the two years data are available. There is clearly not enough data to indicate any trends in the population of THST.

Observations of the *Thelypodium stenopetalum* population at North Baldwin Lake indicate that burro trampling through the area northwest of Swale #1 (Transects #1 and #2) continues to be a concern. Qualitative observations suggest that burro use of this trail was heavier than in the spring/summer of 1989. The trail entry was closed in May of 1990; it may be that not enough time has elapsed for the gate closure to affect burro access to this area.

The number of flowering individuals of THST was reduced from the same area in 1989 when a total of 19 individuals were counted along Transect #1, north of the trail and the area south of the trail; in 1990 a total of 11 individuals were counted. The presence of a fair number of seedlings is encouraging. These

seedlings will be followed in 1991 to determine survivorship of the first year rosettes; the results for transects #1 and #2, where two to three times as many seedlings as adults were observed may indicate that survivorship is low.

Research is needed on the life history characteristics and habitat parameters for this very rare species. A cooperatively funded research effort might be developed between the California Department of Fish and Game (N. Baldwin Lake), the U.S. Forest Service (Belleville, Holcomb Valley), and The Nature Conservancy (Eagle Point).

RECOMMENDATIONS:

Monitoring of THST on the Baldwin Lake Ecological Reserve has produced some valuable data about the status and distribution of this species at this site. The monitoring program has also helped to refine some of the questions that need to be further addressed with respect to this species. One aspect of the plant's life history that has not been monitored is reproductive output, in terms of seed production. The low numbers of this endangered species at this site are an impediment to gathering such data without compromising the protection of THST. However, some method of assessing reproductive output, especially in comparison with seedling germination and survival, could provide important information about the factors that influence the status of this species. The feasibility of gathering such data might be evaluated in a future research program.

1. Continue monitoring the established transects to document population size and survivorship.
2. Evaluate the potential for research on the population dynamics, life history features, and habitat characteristics.
3. Determine whether quantitative monitoring of burro impacts is needed.
4. Develop a research program to investigate life history and habitat characteristics of THST.

Monitoring should continue on an annual basis for THST. The rarity of this species warrants annual effort to determine population pattern.

PERSONNEL:

TNC: Nancy Gill, intern
USFS: Maile Neel, botanist
CONSULTANT: Katie Barrows, botanist

REFERENCES CITED:

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BIOLOGICAL MONITORING REPORT
1990

ELEMENT: *Echinocereus engelmannii* var. *munzii*

COMMON NAME: Munz's Hedgehog Cactus

SITE NAME: Baldwin Lake Ecological Reserve

RANK: G1 S1.1

DATA STORAGE: California Department of Fish and Game, Natural Heritage Division; Big Bear Ranger Station, USFS.

PREPARED/UPDATED: Katie Barrows, 15 September 1990.

The Munz's hedgehog (*Echinocereus engelmannii* var. *munzii*) is a species of limited distribution which occurs in the San Bernardino Mountains, the San Jacinto Mountains, the Laguna Mountains, and the Sierra Juarez of Baja California. This species is listed as sensitive by the U.S. Forest Service (USFS), and as category 2 candidate by the U.S. Fish and Wildlife Service (USFWS). One of the significant populations is protected within the boundaries of the Baldwin Lake Ecological Reserve, managed by the California Department of Fish and Game (CDFG), and adjacent U.S. Forest Service land, managed as part of the North Baldwin/Holcomb Valley Special Interest Area.

Monitoring at North Baldwin Lake is a continuation of a monitoring program begun in 1989 (Neel 1989). The monitoring method used is comparable to that developed by M. Neel for other populations in the Big Bear Valley. In 1989 monitoring of ECENM focused on USFS land in the pebble plain known as the "knoll", located just north of the Ecological Reserve; 39 transects were established within this population (Neel 1989).

Monitoring of Munz's hedgehog this year focused on a small population located on the pebble plain behind the Reserve visitor center; a portion of this pebble plain occurs on USFS land but monitoring was limited to CDFG land. The location of the pebble plain is shown in Figure 1.

GOALS OF THE MONITORING PROGRAM:

The Munz's hedgehog is not a state listed species. However, small populations of this species occur in the vicinity of the Baldwin Lake Ecological Reserve visitor center and are adjacent to an interpretive trail. For this reason it was included in the monitoring program to develop baseline information about the population; this information might be useful for evaluating future impacts or trends in the population. The goals for monitoring of this species are:

1. Determine the population trend for ECENM within the Reserve.
2. Establish a baseline of data on reproductive effort, rate of recruitment, mortality, and cloning.
3. Determine if adequate protection is being provided for this species.

PARAMETERS MEASURED:

1. Number of individuals intercepting transects.
2. Location of each individual along each transect.
3. Number of columns per individual.
4. Number of flower buds (living vs. aborted), flowers and fruits per individual
5. Number of Fruits (successful vs. aborted) from the previous year.

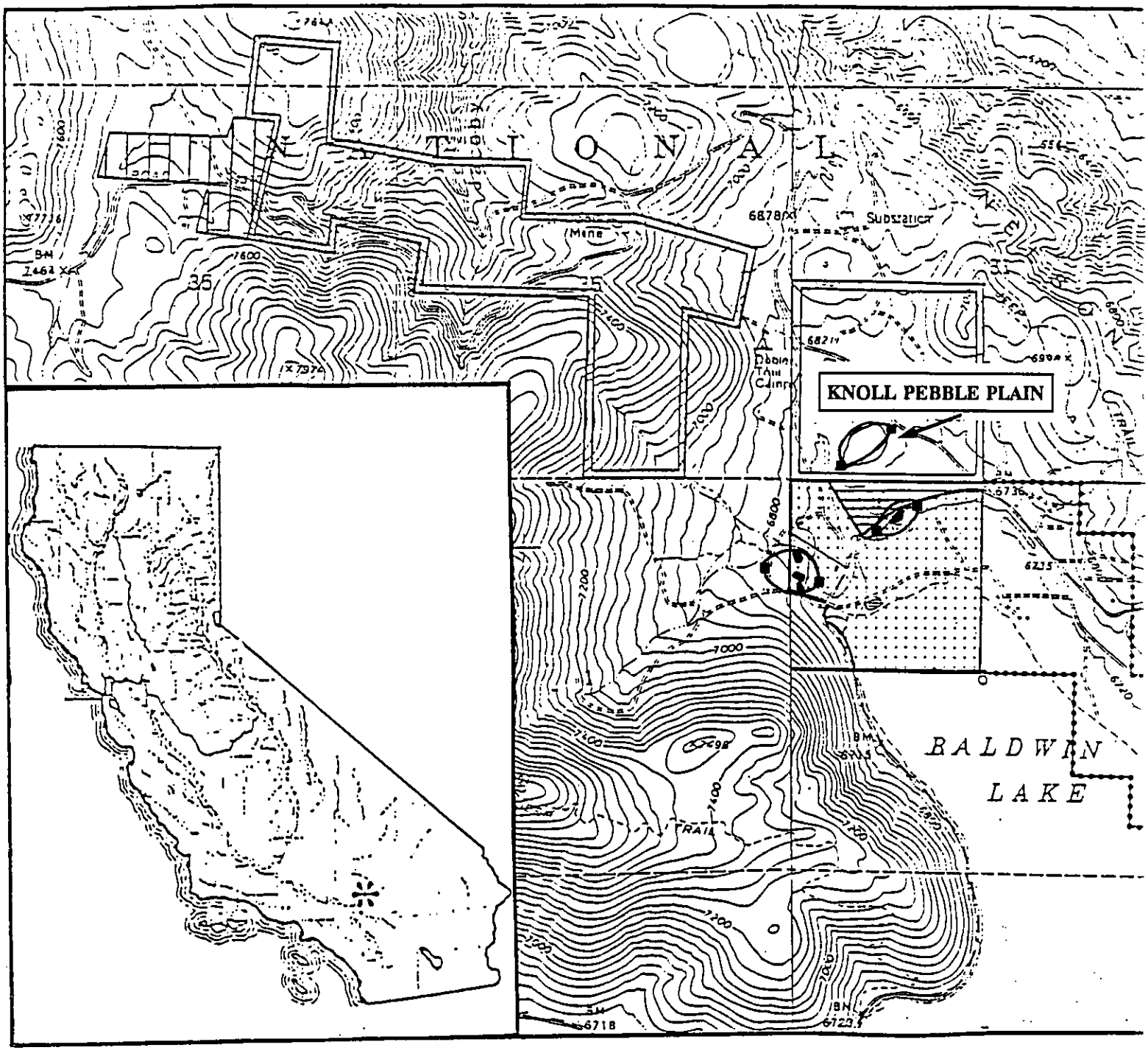

Figure 1. Location of the Baldwin Lake Ecological Reserve in the San Bernardino Mountains of San Bernardino County, CA. Map is from USGS 7.5 minute Big Bear City quad.

= Baldwin Lake Ecological Reserve

= General location of rare plant populations

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MONITORING METHODS:

The monitoring method used for ECENM is based on a line-intercept transect 15 meters in length (Neel 1989). This method was selected because plants occur in a fairly small, discrete area but are patchily distributed within this area. Establishing transects on the pebble plains was a reasonable choice because the distribution of plants is fairly continuous, though patchy. Transect #1 was specifically located to monitor an isolated population with a relatively large number of individual cactuses.

Four permanent transects were located in a random-systematic manner at the pebble plain (Transects #2, #3, and #4) and in a small isolated population adjacent to the pebble plain (Transect #1). The location of these transects is shown in Figure 2. A random compass direction and distance were selected from a known point, the trail signpost at the northeast edge of the pebble plain. Transect starting points were located the random distance and direction from the post and thence run in an east to west direction for 15 meters. A rebar stake is located at each end of the transect, marked with an aluminum tag with species name, date and transect number. All plants intercepting the transect were counted and the position on the meter tape was noted. The parameters listed above were recorded for each individual on each transect. A sample data sheet, developed by Maile Neel of the U.S. Forest Service, is shown in Figure 3.

The four transects established resulted in insufficient numbers of plants counted for long-term monitoring purposes. Additional transects would result in a large number of rebar stakes within the pebble plain which is used for public education purposes. It was determined that existing transects could be used but they could be considered as belt transects. Thus, ECENM plants occurring within one meter on either the north or south sides of the transect were recorded; their position along the tape was recorded and the same parameters discussed above were recorded.

Table 1. Location of each transect from a standard reference point.

TRANSECT NO.	REFERENCE POINT	DISTANCE	DIRECTION
Transect #1	USFS boundary post	28 m	170° SSE
Transect #2	Trail post #1	19 m	164° SSE
Transect #3	Trail post #1	*	*
Transect #4	Trail post #1	*	*

* These data were not collected during the 1990 field season but will be obtained in April 1991.

MONITORING SCHEDULE

The monitoring of Munz's hedgehog populations on the Baldwin Lake Ecological Reserve was conducted on 21 July 1990. Monitoring should be completed between July 15 and August 1 to sample plants during the period when reproductive success can be evaluated.

In the future monitoring could be carried out once every three years or a similar schedule. However, because sampling of this species has so far only occurred under drought conditions it would be advisable to complete the monitoring transects should a wet year occur.

SITE/FIELD CONDITIONS:

The last three years have been considered drought years in the Big Bear Valley. Less than average rainfall has been recorded for the last six winters.

Baldwin Lake Ecological Reserve

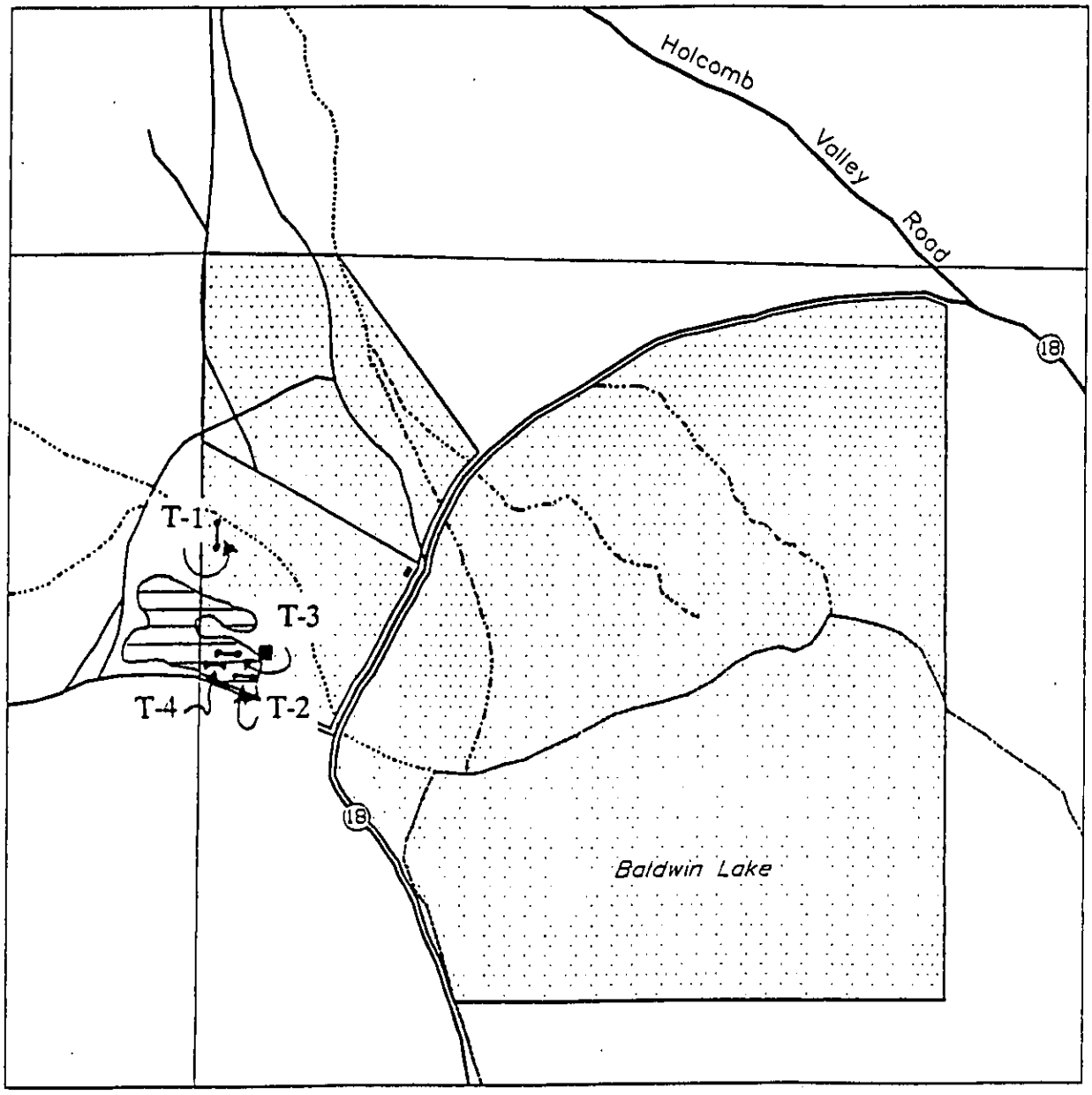

Figure 2. Location of monitoring transects for *Echinocereus engelmannii* var. *munzii* at the Baldwin Lake Ecological Reserve.

= Pebble plain habitat

= Trail signpost

= Monitoring transect

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RESULTS:

A total of 5 individuals were sampled on four line-intercept transects. An additional 59 individuals were counted along the modified belt transects of 15 meters length and 2 m width. The mean, range, and standard deviation (S.D.) for all measured characteristics are summarized in Tables 2, 3, and 4. The results for Belt Transect #1 are given in Table 2; this transect was not randomly located and is in a separate subpopulation located north of the pebble plain. The results for Line-Intercept Transects 2, 3, and 4 are given in Table 3; these transects are all located on the pebble plain southwest of the reserve visitor center.
The results for belt Transects #2, #3, and #4 are given in Table 4.

Table 2. Summary statistics for Belt Transect #1 at Baldwin Lake Ecological Reserve.

PARAMETER	TRANSECT #1 MEAN (n=22)	RANGE	S.D.
# of Live Columns	2.5	0-13	2.98
# of Dead Columns	1.4	0-17	3.84
# of Flowers	1.0	0-12	2.60
# of Fruits	1.0	0-12	2.60
# of Successful Fruits	0.37	0-2	0.59
# of Aborted Fruits	0	-	-

Table 3. Summary statistics for three Line-intercept transects in *Echinocereus engelmannii* var. *munzii* population at Baldwin Lake Ecological Reserve.

PARAMETER	TRANSECT #2 MEAN	RANGE (n=3)	S.D.	TRANSECT #3 MEAN	RANGE (n=1)	S.D.	TRANSECT #4 MEAN	RANGE (n=1)	S.D.
# of Live Columns	4.0	1-7	3.0	3	-	-	3	-	-
# of Dead Columns	0	-	-	0	-	-	1	-	-
# of Flowers	1.3	0-5	1.5	0	-	-	0	-	-
# of Fruits	1.3	1-3	1.5	0	-	-	0	-	-
# of Successful Fruits	0	-	-	0	-	-	0	-	-
# of Aborted Fruits	0.34	0-1	0.58	0	-	-	0	-	-

Table 4. Summary statistics for three Belt transects in *Echinocereus engelmannii* var. *munzii* population at Baldwin Lake Ecological Reserve.

PARAMETER	TRANSECT #2 MEAN	RANGE (n=3)	S.D.	TRANSECT #3 MEAN	RANGE (n=1)	S.D.	TRANSECT #4 MEAN	RANGE (n=1)	S.D.
# of Live Columns	3.7	1-44	3.8	1.8	1-48	1.5	0	-	-
# of Dead Columns	0.08	0-1	0.3	0.8	0-1	3.8	0	-	-
# of Flowers	1.0	1-3	1.7	0.8	0-2	3.4	0	-	-
# of Fruits	1.0	1-6	1.9	0.1	1-2	0.4	0	-	-
# of Successful Fruits	0.25	0-1	0.45	0	-	-	0	-	-
# of Aborted Fruits	0	-	-	0	-	-	0	-	-

There were very few flowers in evidence this year on ECENM plants at Baldwin Lake. Very few fruits were present; the very dry year may be one of the primary reasons for this lack of reproduction. Few successful or aborted fruits from the previous year were observed. This is the first year for sampling in this population.

DISCUSSION

The number of individuals of *Echinocereus engelmannii* var. *munzii* is comparatively lower at North Baldwin Lake then at other populations in the Big Bear Valley. Maile Neel (1989) reported a similar pattern for monitoring transects on the Knoll pebble plain at North Baldwin Lake; she found a mean of 0.667 individuals per transect at North Baldwin, compared with 2.10 per transect at Mojave View and 4.53 per transect at South Baldwin Ridge. The cactus plants occur in a much more patchy distribution at this site.

The reproductive biology of this species is little known so it is difficult to interpret the low reproductive rate. Apparently fruits are rapidly eaten by ants, often before they mature and produce seeds (Neel 1989). The effects of drought on the reproductive output will be better understood after subsequent years of monitoring at all sites. There do not appear to be any human-related threats to this species at the present time; however increased use of this area for interpretive purposes might result in some limited impacts.

RECOMMENDATIONS

1. Continue the monitoring program. It might be advisable to add more transects so that more individuals are represented in the samples. Evaluation of the time/effort involved in additional transects is an important part of this decision.

2. It might be valuable to sample the associated species in Munz's hedgehog habitat by a point-intercept sample along the transects.

PERSONNEL:

Katherine Barrows, consultant.

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