CONSERVATION BIOLOGY OF THE SANTA CRUZ TARPLANT

Annual Report for 1990

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INTRODUCTION

This report will serve as a brief progress synopsis on the status of ecological research pertaining to populations of the Santa Cruz Tarplant (*Holocarpha macradenia*) in Santa Cruz County and Monterey County, California. J. Lohr Properties Inc. has proposed a 900-unit housing development ("The Villages", formerly Landmark Estates) near Watsonville, California for a site that supports a population of *H. macradenia*. The proposed project would result in significant impacts to the population.

As part of anticipated mitigation requirements, the project proponent has begun a research program on the ecology of *H. macradenia* in Santa Cruz County. This research is directed under a Memorandum of Understanding with the California Department of Fish and Game obtained in April, 1990. Previous summarization of the biology, status and ecology of *Holocarpha macradenia* discussed in a previous report are incorporated here by reference (BSAI 1990).

This annual report provides information on:

1) quantitative census of the Landmark population of *H. macradenia*;

2) results of fecundity monitoring of the population;

3) clarification of the number and status of all Monterey Bay populations;

4) results of field searches for new populations;

5) results of a introduction experiment;

Population Monitoring - we sampled the population in early-September, 1990 to obtain quantitative population data. The objectives of this sampling was to 1) determine the size of the population, 2) determine the area of the population.

A sampling protocol similar to the procedure used by the Habitat Restoration Group (1989) was utilized. Line transects were established traversing the site of the population. The short axis of the population was subdivided into 11 10-meter wide segments. A single transect was randomly established within each segment. The transects were between 120 and 160 meters long. The number of plants was counted in $1m^2$ quadrats spaced at 3-m intervals along each transect.

Fecundity - counts of heads per plant and seeds per head were made utilizing systematic transect sampling. The census transects were sampled utilizing a point-quarter method. The nearest pair of plants within each quadrant, defined by points at 3 meter intervals along the transect, were sampled. The number of heads per plant was counted on each plant. All heads on one individual (randomly chosen by coin toss) were collected, and seed production determined. The number of disk and ray achenes was counted. Achenes with evidence of insect predation were tabulated.

Population Status Clarification - we conducted a review of all reported populations of *H. macradenia* in Monterey Bay area. The objective of this review was to accurately map all extant populations in the region. Confusion over the status of many populations has resulted from incomplete or inaccurate information in published reports or in Natural Diversity Data Base records. Several of the populations mapped in our 1989 MOU application were determined to be inaccurate as the results of this review. This review was conducted with the collaboration of Roy Buck (U.C. Berkeley and BioSystems) and Randall Morgan (Santa Cruz Chapter, California Native Plant Society).

Field Searches - areas of suitable habitat for *H. macradenia* in the vicinity of the Landmark population were searched for undocumented populations. These searches concentrated in annual grassland vegetation on lands lying west of Highway 1.

Introduction Experiment - efforts to establish an artificially introduced population of *H. macradenia* on the Watsonville Wildlife Area, owned by the California Department of Fish and Game, were begun in 1990. As permitted in the MOU, we obtained *H. macradenia* seed from the Landmark population for the introduction experiments.

The introduction experimental work conducted in 1990 consisted of two components: 1) an initial, brief trial (established on April 8, 1990) and a replicated plot experiment (conducted in October 1990).

In the initial brief field trial, four $1m^2$ quadrats were spaded to remove competing annual vegetation, seeded with 100 seeds of *H. macradenia*, and watered. The introduction plots were located on the southeast hill of the Wildlife Area. The purpose of this initial trial was to demonstrate *ex situ* establishment of *H. macradenia*, albeit in an highly artificial manner.

A more complete and comprehensive introduction experiment was established in the fall of 1990. Approximately 130,000 seeds had been collected in the fall of 1989 in anticipation of establishing a full scale introduction experiment at that time. Delay in execution of a MOU prevented a full scale experiment. Because this seed lot could not be considered representative of the entire population, approximately 100,000 of these seeds were returned to the donor population, being spread in a random manner over the population area in November (coincident with the time of *in situ* seed ripening and dispersal). The remainder of this seed (ca. 30,000) was retained in laboratory storage for anticipated yearly tests of viability.

Replacment seed was collected from the donor population in 1990 in two lots. The randomly selected lot (consisting of ca. 24,894 seeds) was taken in conjunction with fecundity monitoring. Each head from these plants was separately bagged for later data collection. The purpose of this sampling method was to insure even and systematic representation of all genotypes in the population.

A second lot of seed was selectively obtained by collecting large heads from large individuals. Approximately 50,393 seeds were gathered in this manner. The ca. 75,287 seeds so collected represent ca. 5.5 percent of the total estimated fecundity of the population in 1990. The two seed lots were thoroughly mixed with dry, washed beach sand for ease and uniformity of spreading at the introduction site. An aliquot representing 10 percent of seed-sand mixture was removed. The two samples were brought to equal volume with additional sand, and remixed.

At the introduction site (Watsonville Wildlife Area), 10 m by 10 m plots were established for the introduction trial. A randomized, split-plot design was utilized, varying seeding density and thatch density (raked vs. unraked). Plots were seeded at two approximate densities (differing by one order of magnitude): 114 seeds/m^2, and 11.4 seeds/m^2. The dense thatch of the previous year's annual grasses were removed from half of the plots by raking and disposal off-site. Care was taken to not result in chruning of the surface soil during raking. Three replicates were established, for a total of 12 plots (2 densities x 2 thatches X 3 replicates). Treatments were assigned to plots by flip of a coin.

A deviation from the initial introduction description specified in the MOU was implemented following consultation with Armand Gonzales, DFG representative: two replicates (8 plots) were established on the southeast hill of the Wildlife Area (as specified in the MOU), and a third replicate (4 plots) was established at a second location north of the entrance trail on the Lee Road side of the Area. This latter modification was undertaken for two reasons: 1) ease of access to the introduction site for tours, and, more importantly, because this portion of the Area supports a population of Hayfield Tarweed (*Hemizonia luzulaefolia*/ssp. *luzulaefolia*). Previous research by Havlick (1987 and pers. communication) used sympatry with this tarweed as a key habitat attribute for selecting sites for conducting experimental introduction of *H. macradenia*.

RESULTS

Population Census

The following tabulation provides a summarization of the results of our 1990 population census using transect sampling:

	1989	1990
Transects Sampled	8	11
Quadrats Sampled	472	451
Mean Density (plants/m^2)	30.08	2.004
S.D.	75.65	8.23
Population Area	13,597m^2	19,099m^2
Estimated Population Size	409,000	38,276
95% Confidence Limits	±37,000	±7400

Figure 1 depicts the density distribution of *H. macradenia* on the Landmark site. This figure was prepared by utilizing a distance-based least-squares smoothing and contouring algorithm of the quadrat density data. The location of transects and quadrats is shown (note the scale factor is equivalent to 3 meters between quadrat). The density of shading indicates the probability of a tarplant individual occurring within a quadrat in five intervals: >95%, >50%, >5%, >0.05% and <0.05%. As can be seen from this figure, there are essentially three dense concentrations of plants in the population this year, as was the case in 1989. A comparative density mapping of the population will be possible using the 1989 data collected by the Habitat Restoration Group, but will require surveying and mapping of their transect locations.

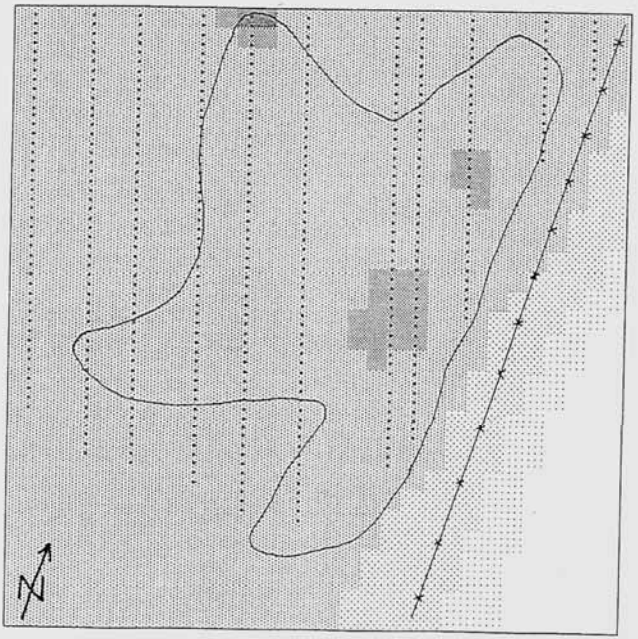
Overall, the population size this year was considerably less than in 1989 - by a factor of 90%. The 1990 growing season was considerably dryer than normal, and dryer than in 1989. This decline is significantly more than should be expected due to drought alone, however. A significant factor in the decline this year is due to cessation of cattle grazing on the site. The property was last grazed in 1988. Now, two growing seasons later, non-native annual grasses (principally *Avena barbata*) have increased in density, resulting in less-favorable conditions for *H. macradenia*, which is partially intolerant of grass competition.

This year, the population has seemingly occupied a somewhat larger area than in 1989, but this may be due largely to systematic error associated with mapping the boundary of the population in 1989. Our map was carefully drawn with the aid of air photos, and as such is sufficiently accurate to characterize the location of the *H. macradenia* population for management and conservation purposes. In years past, plants may grow outside of the mapped, but these should be considered insignificant unless a secular trend in location can be detected over several years. A descripency between the stated area of the population given in Habitat Restoration Group (1989) - 14992m^2 and the area used in that report to derive population estimates - 13597m^2 - can not be explained

Figure 1. Density of Santa Cruz tarplant (*Holocarpha macradenia*) at the Landmark Population during 1990. This figure was prepared by utilizing a distance-based least-squares smoothing and contouring algorithm on the quadrat data. The location of transects and quadrats is shown (note the scale factor is equivalent to 3 meters between quadrat). The density of shading indicates the probability of a tarplant individual occurring within a quadrat in five intervals: >95%, >50%, >5%, >0.05% and <0.05%. As can be seen from this figure, there are essentially three dense concentrations of plants in the population this year, as was the case last year.

Legend:

x---x fenceline
_____ population boundary
■ ■ ■ quadrats



Fecundity Monitoring

Quantitative data on the fecundity characteristics were collected. Since this data represents the some of first data of this type for the species, little comparison can be drawn at this time. To provide some degree of comparison, similar data was obtained from garden grown plants (originating from the Winkle Avenue population, see Appendix 1).

The following tabulation summarizes these data:

	Heads/Plant	Seeds/Head			
		Ray		Disk	
		Viable	Non-viable	Viable	Non-viable
		Landmark Population - 1990			
N	153	91	91	91	91
Mean	3.13	4.36	3.74	0.65	3.30
SD	5.22	3.56	3.19	1.44	3.92
		Garden Grown Plants			
N	-	45	45	45	45
Mean	-	8.91	0.31	2.64	11.48
SD	-	3.92	0.18	2.90	5.82

Overall fecundity in garden grown plants was much greater (on a per head basis) than from plants in the Landmark population in 1990. In the garden, plants of *H. macradenia* become much larger than any plants do in nature, and can support several hundred heads/plant. The high number of non-viable disk achenes produced in garden grown plants is an artifact of the available seed material, which was not initially collected for comparative purposes. Cultivated plants exhibit an indeterminant growth pattern, and continue to produce flowers well into winter. Because of this, many immature un-filled disk achenes are produced in late season flowers, and hence skewed the results of this comparison, which was taken from plants harvested prior to their natural senescence.

We observed a high level of seed predation by insects at the Landmark population this year. Larvae of Diptera (flies) were observed to eat seeds of *H. macradenia*. The rate of seed predation seems to be very high - over half of potential fecundity was lost to predation. The majority of non-viable ray and disk achenes observed could be attributed to this predation, as obvious damage was evident to the seeds in most cases. Only a small proportion of evidently non-viable seed appeared to be non-filled (shriveled) achenes. We are attempting to determine the identity of this insect, and will continue to conduct life-history observations as appropriate. Entry holes observed on *H. macradenia*

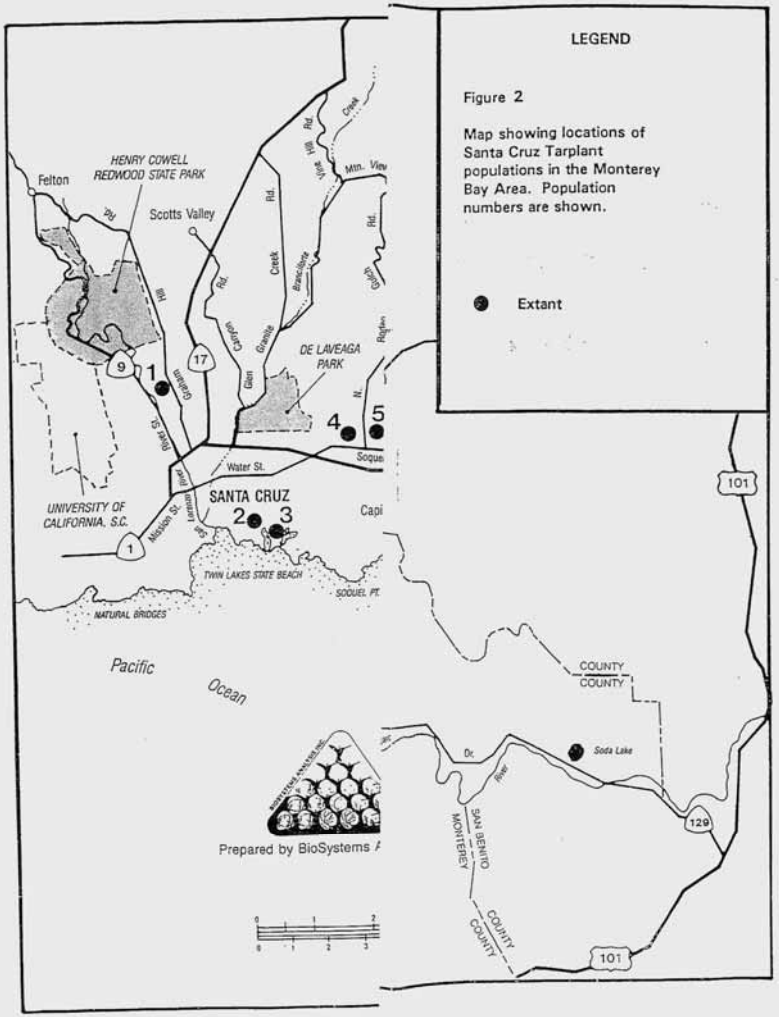
suggest that oviposition occurs on the peduncle. The pith of the upper peduncle and receptacle are consumed, as are seeds.

Introduction Efforts - due in large measure to the tardy start on the 1990 introduction experiment this work is just getting underway. During the 1990 growing season, a much reduced introduction trial was instituted, resulting in a population of 11 plants of *H. macradenia* growing on the DFG introduction site. However inauspicious this number may seem, it is an empirical demonstration that introduction of seed introduction can result in establishment.

Seedlings and seed germination are being tracked. Germination of *H. macradenia* was first observed on the experimental plots in early-December. By contrast, seedlings were first evident at the Landmark Population in mid-January. The difference is probably due to nothing more than small seedlings being easy to observe on the raked experimental plots.

Status of Monterey Bay Populations - review of the status of *H. macradenia* populations in the Santa Cruz-Watsonville region confirmed that 12 extant populations remain in the region. Figure 2 provides a map showing the general location of these populations. Appendix 1 provides a detailed status and location information for each population.

Locating Undocumented Populations - field searches of suitable habitat were conducted to locate previously undocumented populations of *H. macradenia*. These surveys concentrated on the west side of Highway 1 in the vicinity of Harkins Slough. A single population, consisting of two major colonies, was located this year. Considerable area of unsurveyed habitat occurs in this region in the general vicinity of Watsonville. It is very likely that additional searches in 1991 will other previously undocumented populations.


LEGEND
Figure 2
Map showing locations of Santa Cruz Tarplant populations in the Monterey Bay Area. Population numbers are shown.
Extant
HENRY COWELL REDWOOD STATE PARK
Felton
Scotts Valley
DE LAVEAGA PARK
SANTA CRUZ
UNIVERSITY OF CALIFORNIA, S.C.
TWIN LAKES STATE BEACH
SOQUEL PT.
NATURAL BRIDGES
Pacific
Ocean
Water St.
Mission St.
Bay Dr.
Soda Lake
SAN BENITO COUNTY
MONTEREY COUNTY
101
129
17
1
9
Prepared by BioSystems

References Cited

BioSystems Analysis, Inc. 1990. Conervation biology of the Santa Cruz Tarplant (*Holocarpha macradenia*). unpublshed proposal to the California Department of Fish and Game, Endangered Plant Program, Sacramento, CA.

Habitat Restoration Group, Inc. 1989. Biological Resources, Heritage Park North Development EIR, Watsonville, California. City of Watsonville Planning Department.

Havlick, N. 1987. The 1986 Santa Cruz tarweed relocation project. pp. 421-423 in: T. Elias [Ed.], Conservation and Management of Rare and Endangered Plants California Native Plant Society, Sacramento, CA.

Appendix 1
Population Reports

Population Number: 1 NDDB E.O. Number: 21

Documentation: "E of Paradise Park, W side Graham Hill Rd, from horse track S to near Mosswood Dr.", Brett Hall, 1977, NDDB record.

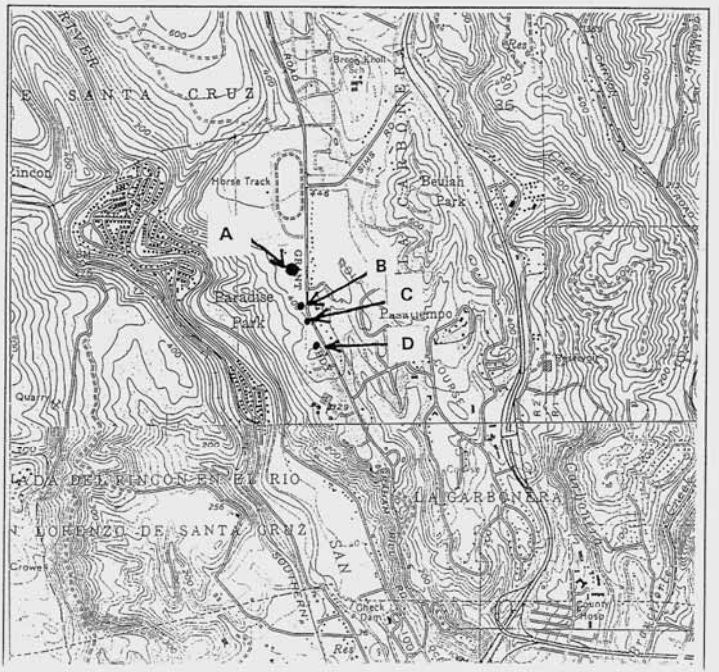
Mapping Precision: Specific.

Status: Stable. Total population size has ranged from 100-10,000 plants in the years 1977-1986 (Habitat Restoration Group 1989). Subpopulation A had thousands of plants in 1990. Subpopulations B-D were not checked in 1990, but Subpopulations C and D had a few plants each in 1988, while Subpopulation B had none. Invasion of French broom (*Cytisus monspessulanus*) is a threat to Subpopulations B and C.

Habitat Conditions: Grassland on level coastal terrace, with many native coastal prairie species. Subpopulation A is grazed by horses; in Subpopulations B-D, which are ungrazed, habitat conditions appear to be becoming less suitable for tarplant as competing vegetation becomes denser.

Land Uses: Subpopulation A: Grazing by horses. Subpopulations B-D: None.

Quadrangle: Felton 7½' (CNDDB 3712211 CNPS 408D)



Population Number: 2 **NDDB E.O. Number:** 6; 2(?)

Documentation: "proposed road extension of Broadway and Brommer at Santa Cruz city limit.", Randall Morgan, NDDB record. NOTE: *W. R. Dudley s.n.* (DS), from "fields back of Twin Lakes near Santa Cruz" (see Population # 3), may represent this population.

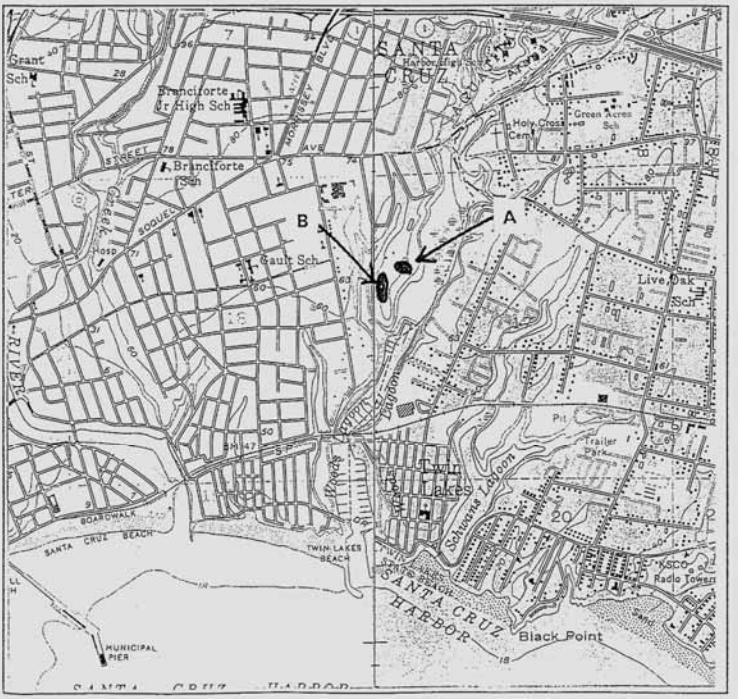
Mapping Precision: Specific.

Status: Stable. A population size of 115,000 plants was estimated in 1986 and 1988 (Habitat Restoration Group 1989). Both subpopulations had plants present in 1989; thousands of plants were present in total.

Habitat Conditions: Grassland dominated by non-native species on light sandy soil on gentle slopes of eroded coastal terrace. Some patches of grassland on the site support native coastal prairie species, but tarplant mostly occurs with non-natives. Area has been grazed for many years but was not grazed in 1990. This is one of the largest extant populations.

Land Uses: Grazing.

Quadrangle: Santa Cruz 7½' (CNDDB 3612281 CNPS 387B)



Population Number: 3

NDDB E.O. Number: 2(?)

Documentation: "fields back of Twin Lakes near Santa Cruz", *W. R. Dudley s.n.*, 28 November 1908 (DS). NOTE: The Dudley collection could represent the Small Craft Harbor population (#2) or another population (of which the present population could be a remnant) in this now mostly urbanized area. "Twin Lakes" refers to both Schwann (= Schwans) Lagoon, adjacent to this population, and Woods Lagoon, site of the present Small Craft Harbor.

Mapping Precision: Specific.

Status: Declining. 120 plants were seen in 1986, 50 in 1988. Although this does not necessarily represent a significant decline, the population's small size and apparent dependence on disturbed habitat where competition from aggressive non-native weeds is reduced indicate that the long-term prospects for the survival of this population are poor. Invasion of the site by French broom (*Cytisus monspessulanus*) is an additional threat to this population.

Habitat Conditions: Level grassland on coastal terrace with dense cover of mostly non-native, weedy species but with some native perennial bunchgrasses. Most plants were growing adjacent to a path, where the density of competing vegetation was reduced due to trampling.

Land Uses: State park, heavily used for jogging, hiking, and other recreational uses.

Quadrangle: Soquel 7½' (CNDDB 3612188 CNPS 387B)

Population Number: 4 **NDDB E.O. Number:** 37

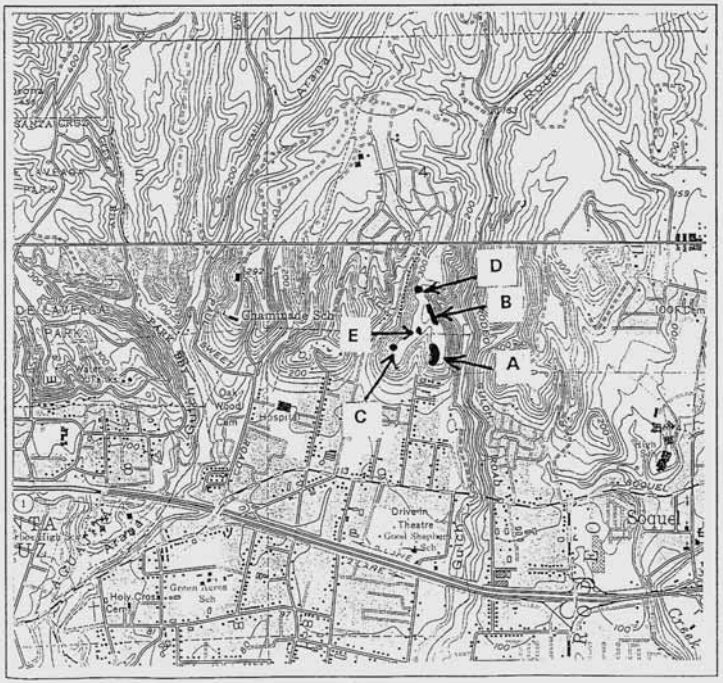
Population Documentation: "N of end of Winkle Ave., just W of Rodeo Gulch Rd.; NW of Soquel.", Randall Morgan, NDDB record. **NOTE:** Locality is N of the end of lower Winkle Ave. and S of the end of non-connecting upper Winkle Ave.

Mapping Precision: Specific.

Status: Declining. Subpopulation A, the largest subpopulation, was extirpated by construction of a housing development in 1986. Plants have not been seen in Subpopuation B and Subpopulation E (which consisted of only a single plant) since 1987. Subpopulation C is apparently stable; plants were seen there in 1990. Subpopulation D is an artificial subpopulation apparently established when topsoil from Subpopulation A was dumped during construction of the housing development in 1986. Plants were seen in this subpopulation in 1986 and 1990. Drought conditions since 1987 may have contributed to the decline (and possible extirpation) of Subpopulation B.

Habitat Conditions: Subpopulations B-E: Nearly level ridgetop (dissected coastal terrace) and adjacent uppermost slope with grassland largely dominated by native coastal prairie species. These sites are not grazed or otherwise subject to ongoing disturbance, except perhaps trampling from recreational use by residents of nearby residental areas. No habitat remains at the site of Subpopulation A, located within a housing development.

Land Uses: Subpopulation A: Housing. Subpopulations B-E: None.
Quadrangle: Soquel 7½' (CNDDB 3612188 CNPS 387B)



Population Number: 5 **NDDB E.O. Number:** 11

Documentation: "N of Soquel Ave. between Old San Jose Rd. and Rodeo Gulch Rd. on hilltop and NE of hilltop", Jon Libby, 1979, NDDB record.

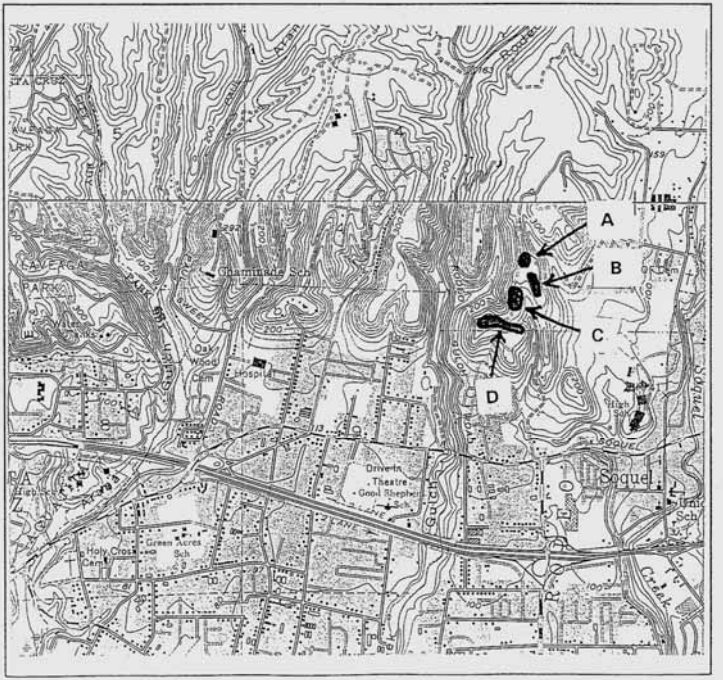
Mapping Precision: Specific.

Status: Stable. Although divided into several subpopulations, this population appears never to have been large. Habitat Restoration Group (1989) cites estimates of 300-2,000 plants for three years: 1979, 1984, and 1986. Randall Morgan (NDDB record) indicates no plants were seen in 1985. It also appears from repeated surveys during recent years that plants do not appear in every subcolony in every season. As of 1988, plants were present in Subpopulations A and C and absent in Subcolonies B and D.

Habitat Conditions: Low grassland with some native coastal prairie species in addition to non-native annual species, on summit and uppermost slopes of ridge which is a dissected coastal terrace remnant. The site is heavily grazed.

Land Uses: Grazing.

Quadrangle: Laurel 7½' (CNDDB 3612188 CNPS 387B)



Population Number: 6 **NDDB E.O. Number:** 33

Documentation: "E of Soquel on grassy slopes on former site of Monterey Bay Golf and Country Club", *D. D. Keck and J. Clausen 2631*, 3 November 1933 (CAS). NOTE: NDDB maps this locality on the Soquel quad, on which part of the former Monterey Bay Heights Golf Course is located. The present population, discovered by Randall Morgan in 1989, is adjacent to the former golf course. There has been additional past confusion as to the location of this population. The NDDB record states, "R. Morgan [in 1979] searched area just W of Tannery Gulch, between Soquel Dr. and Hwy. 1 and did not find sp." This locality, approximately 3/4 mi. south of the population and located on the Soquel quad, is adjacent to the Cabrillo College golf course. Randall Morgan's 1979 search of this area was apparently motivated by an early, erroneous NDDB map of the locality based on confusion between the Monterey Bay Heights and Cabrillo College golf courses.

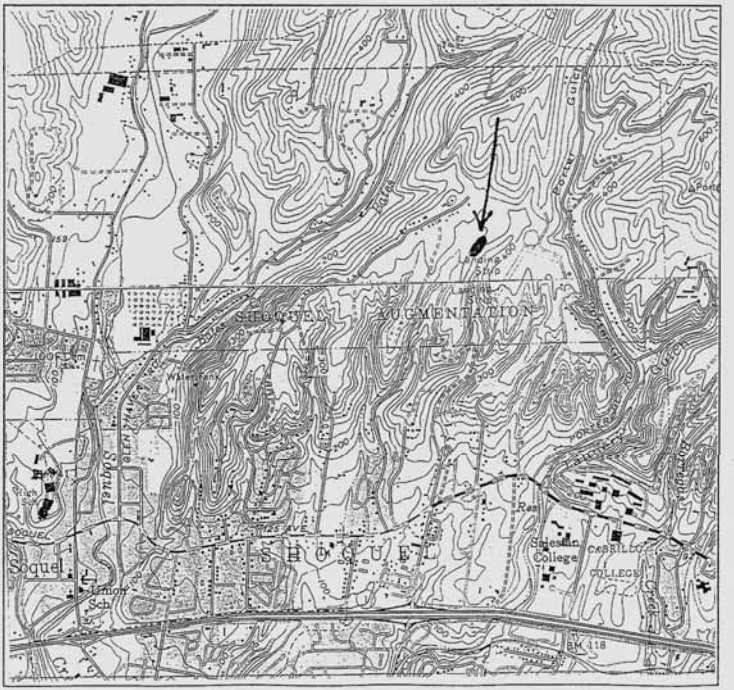
Mapping Precision: Specific.

Status: Presumed stable. Approximately 5,000 plants were present in 1989.

Habitat Conditions: Grassland, largely dominated by native coastal prairie species, on upland (dissected coastal terrace remnant). Grazed.

Land Uses: Grazing.

Quadrangle: Laurel 7½' (CNDDB 3612188 CNPS 387B)



Population Number: 7 NDDB E.O. Number: 13

Documentation: "on edge of plowed field N of Hwy. 1 and S of Watsonville Airport", Brett Hall, 1978, NDDB record.

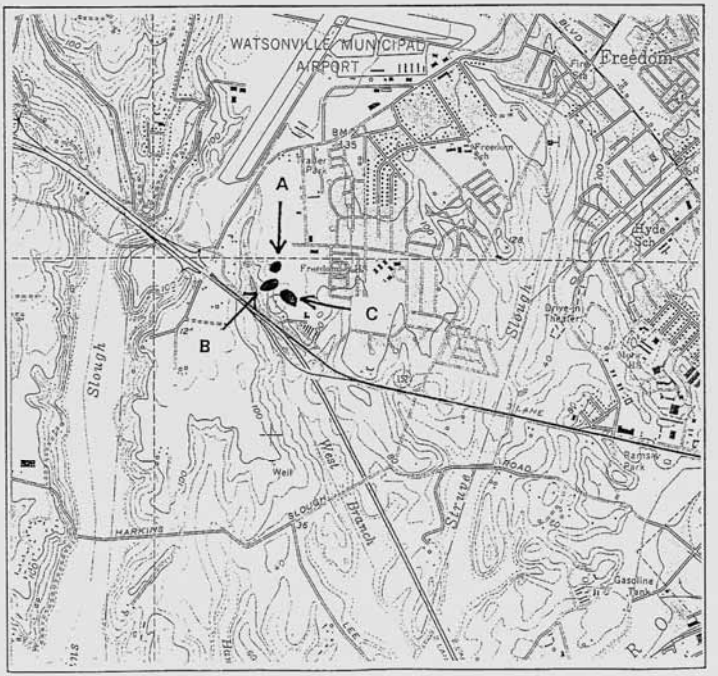
Mapping Precision: Specific.

Status: Declining. The mapped subpopulations constitute the remnants of a much larger population which extended to the north, most of which was removed by the construction of an industrial park and a new street (Anna St.) in the early 1980's. Subpopulation A contained several hundred plants in 1988. No plants have been seen in Subpopulation B since 1986 or in Subpopulation C since 1985.

Habitat Conditions: Subcolonies A and B are on a level coastal terrace in a patch of grassland largely dominated by native coastal prairie species. Subcolony C is on a W-facing slope with mostly non-native grasses and herbs. All three subcolonies are subject to regular mowing, which when conducted during the tarplant's flowering period constitutes a threat to its capacity to reproduce on the site.

Land Uses: None at present. Future development is planned.

Quadrangle: Watsonville West 7½' (CNDDB 3612187 CNPS 387A)



Population Number: 8 **NDDB E.O. Number:** 5

Documentation: "E of Hwy. 1, N of Harkins Slough Rd. but S of Hwy. 152 (Main St.) near Watsonville.", Randall Morgan, NDDB record.

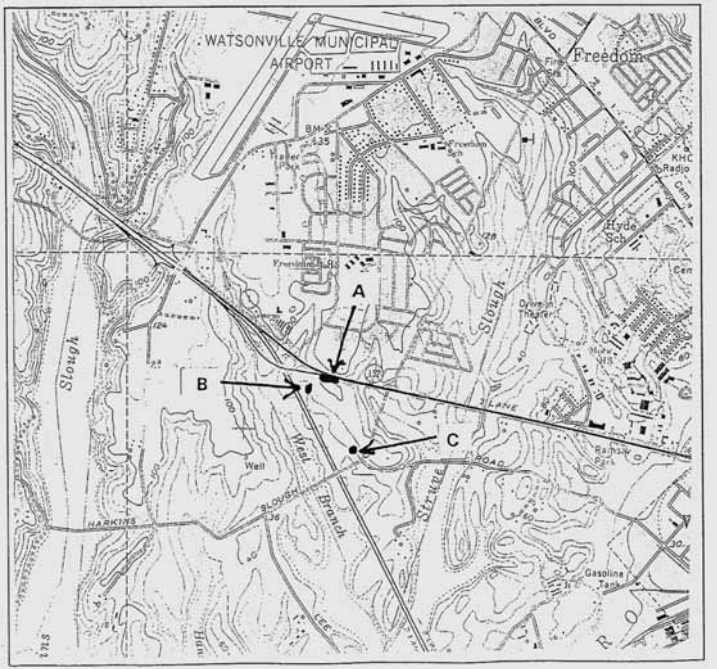
Mapping Precision: Specific.

Status: Declining. Subpopulation A contained approximately 3,000 small plants in a dense colony in 1988, but this subpopulation occupies a small, fragmentary strip of relatively undisturbed habitat between Hwy. 152 and a housing development. Subpopulations B and C were extirpated by construction of the housing development in the mid-1980's.

Habitat Conditions: Subpopulation A is in a small patch of relatively undisturbed grassland habitat, with some native coastal prairie species, on a gently sloping coastal terrace. No habitat remains on the sites of Subpopulations B and C.

Land Uses: Subpopulation A: None. Subpopulations B and C: Housing.

Quadrangle: Watsonville West 7½' (CNDDB 3612187 CNPS 387A)



Population Number: 9

NDDB E.O. Number: None

Documentation: E side of Harkins Slough just S of Harkins Slough Road, Dean Wm. Taylor, 1990, pers. observation.

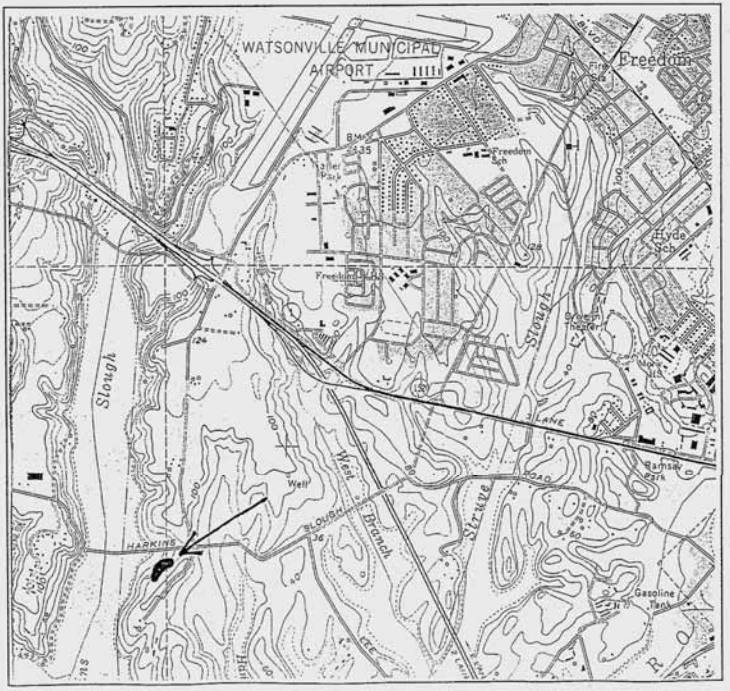
Mapping Precision: Specific.

Status: Discovered in 1990. A single diffusely distributed population in heavily grazed pasture of *Lolium perenne*; the site is used as pasture of a dairy operation. Approximately 40 plants were observed, sympatric with a population of *Hemizonia luzulaefolia*.

Habitat Conditions: plants in this population were extremely small (3-5" tall) and exhibited low fecundity. The population occupied an area of ca. 3 acres adjacent to Harkins Slough.

Land Uses: grazing in unmanaged pasture

Quadrangle: Watsonville West 7½' (CNDDB 3612187 CNPS 387A)



Population Number: 10

NDDB E.O. Number: 34

Documentation: "Watsonville. Low hill between branches of SW-draining tributary of Struve Slough. Ca. 0.6 km. NE of CA Hwy. 1, 1.7 km. W of downtown Watsonville.", *R. E. Buck and R. A. Morgan 511*, 26 August 1984 (JEPS). Other Specimens Known: *G. Deghi s.n.*, 9 August 1986 (DS). NOTE: This is the Landmark study site.

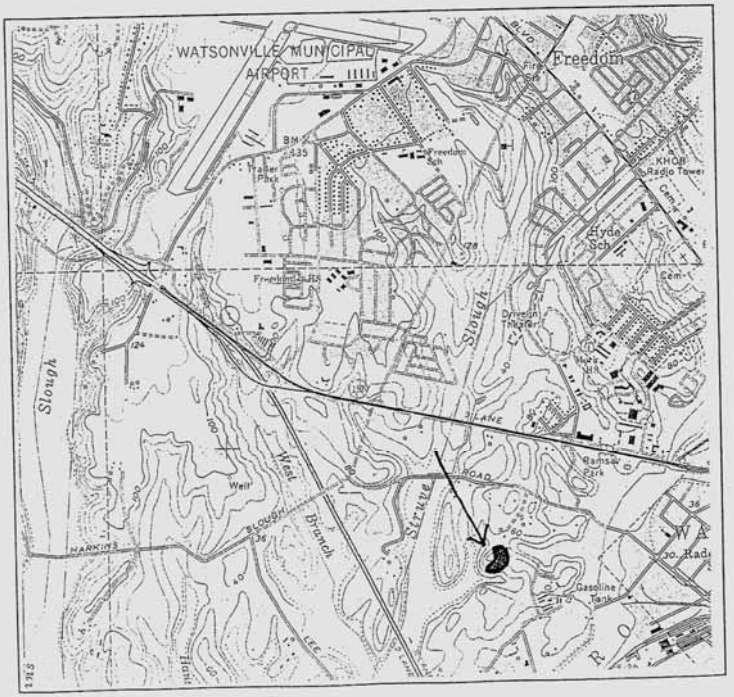
Mapping Precision: Specific

Status: Stable. Our transect sampling resulted in an estimate of 38,000 plants in 1990. A 1989 survey (Habitat Restoration Group 1989) estimated 409,000 plants. Estimates of 5,000-100,000 plants in previous seasons (Habitat Restoration Group 1989) indicate that 1989 was an unusually favorable year for the species on this site.

Habitat Conditions: Annual grassland on gentle slopes of low hill, mostly dominated by slender wild oat (*Avena barbata*), with low species diversity and few other native species. The site has been fairly heavily grazed in previous years, but has not been grazed since 1989.

Land Uses: None at present. A housing development is proposed for this site.

Quadrangle: Watsonville West 7½' (CNDDB 3612187 CNPS 387A)



Population Number: 11 **NDDB E.O. Number:** None

Documentation: Spring Hills Golf Course, William Davilla, 21 July 1989, pers. observation.

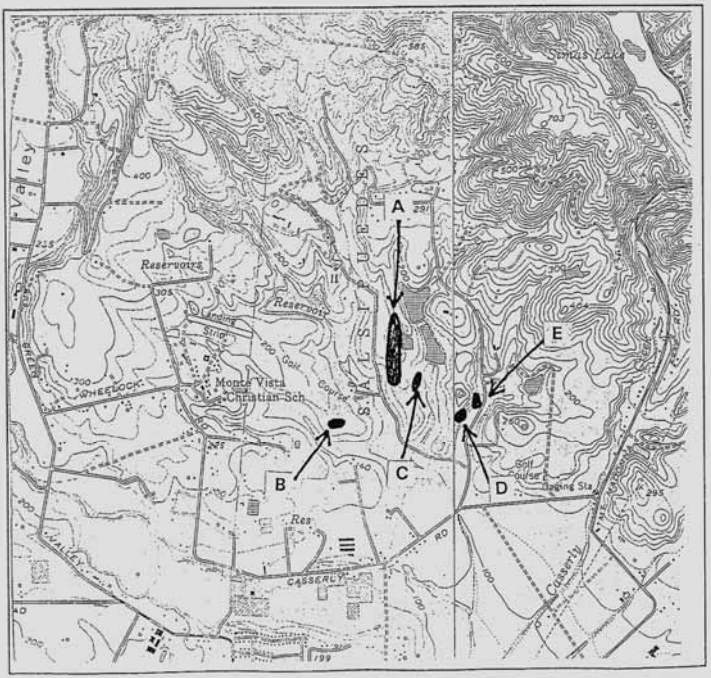
Mapping Precision: Specific.

Status: Stable. Subpopulation A had 2,000-3,000 plants and Subpopulations B-E had 100-400 plants each in 1989 and 1990.

Habitat Conditions: Slopes of dissected coastal terraces with hard-packed soil, in local grassy openings dominated by weedy non-native species, in un-landscaped areas between fairways of golf course.

Land Uses: Golf course.

Quadrangles: Watsonville West 7½' (CNDDB 3612187 CNPS 387A)
Watsonville East 7½' (CNDDB 3612186 CNPS 386B)



Population Number: 12 **NDDB E.O. Number:** 19

Documentation: "2 mi. S of Pajaro on E side of junction at Hall Rd. and Elkhorn Rd.", *Robert F. Hoover 11523* (OBI).

Mapping Precision: Specific.

Status: Stable. Habitat Restoration Group (1989) reports estimates of 1,500-2,500 plants in 1984 and 18,000 in 1986. Several thousand plants were present in 1988; ca. 43000 in 1989; ca. 35000 in 1990.

Habitat Conditions: Dry grassland, mostly with non-native annuals, but also with native coastal prairie species. Grazed. This site is somewhat unusual in that plants are mostly in the bottom of a small canyon, rather than on a coastal terrace or upper slope, as in most populations.

Land Uses: Grazing.

Quadrangles: Prunedale 7½' (CNDDB 3612176 CNPS 386C)