

**California Department of Parks and Recreation
Natural Resources Division**

**Ben Lomond Spineflower (*Chorizanthe pungens* var. *hartwegiana*)
Monitoring At Wilder Ranch State Park**

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I. Introduction

The Ben Lomond spineflower, *Chorizanthe pungens* var. *hartwegiana* Reveal and Hardham (CHPUH), is a small, annual plant of the buckwheat family (Polygonaceae). These plants are erect to decumbent with small distinct heads of pink inflorescences (Ertter 1996). This plant is restricted in habitat and geographic area to the open, sandy areas of the Zayante soil series known as the Santa Cruz Mountains sandhills (Santa Cruz County, California). See IMAP Sandhills report for more information on this unique habitat.

At Wilder Ranch State Park (Gray Whale property) there are patches of sandhills chaparral plant community totaling approximately 110 acres. CHPUH is known to occur at the largest sandhill patch along the access road and among the sandy gaps between chaparral shrubs. CHPUH has been characterized as a winter-spring annual (McGraw and Levin, 1998 and Kluse and Doak, 1999). The seeds germinate after fall rains. These new plants grow through the winter as a rosette of leaves, bolt, and then flower in April or May. After setting seed in June, the plant dies. This Gray Whale population is at a higher elevation than most of the other CHPUH populations. The Gray Whale plants are smaller in size and their phenology is later than the other populations (Jody McGraw, personal communication).

There are two management concerns regarding CHPUH at Wilder Ranch State Park: maintaining the CHPUH habitat and allowable recreational use. The chaparral at this sandhill site is dense due to the absence of fire for many years. McGraw and Levin (1998) found that CHPUH at the Bonny Doon Ecological Reserve (approximately 2.7 miles away by direct line and adjacent to the northern boundary of the Gray Whale property) was that soil type is not a limiting factor but shade intolerance restricts it to open areas. Unfortunately, as the chaparral shrubs grow and become larger in diameter, the gaps between the shrubs will narrow and may eventually disappear, eliminating CHPUH and its habitat.

Currently the Gray Whale property of Wilder Ranch State Park is closed to public access. However, there is some trespassing by hikers, mountain bikers, and equestrians that use the access road and trails (personal observations). There is a single-track trail that occurs on the north (where CHPUH occurs along the trail) to northeast edge of the sandhill. However, at the time of our fieldwork, the Gray Whale property was being evaluated for public access by the Santa Cruz District with input from the public through the Gray Whale Advisory Committee.

Due to habitat loss from sand quarrying and residential development fragmenting remaining CHPUH habitat, CHPUH was listed as endangered species by the United States Fish and Wildlife Service (USFWS 1994). In the Santa Cruz District of State Parks, there are three parks that have sandhills plant communities that support CHPUH. They are Henry Cowell State Park, Big Basin State Park, and Wilder Ranch (Gray Whale acquisition property) State Park. The USFWS

Recovery Plan for this taxon specifies population assessments and development and implementation of a management plan for each of the state park units (USFWS 1998).

The objectives of this project were to gather baseline information about CHPUH at the Gray Whale study site at Wilder Ranch State Park for a management plan:

- Observe the current distribution of the known CHPUH population;
- Describe the habitat of known CHPUH;
- Recommend a monitoring plan for future monitoring.

II. Methods

A.) Site Selection

The CHPUH at Wilder Ranch State Park was known to occur at an area of sandhills chaparral on the Gray Whale property and that area was chosen as the study site. See Study Site Map in Appendix A.

B.) CHPUH Habitat Mapping

The California Department of Water Resources scanned an existing 1999 aerial enlarged color photograph of the sandhills at Wilder Ranch State Park at 12.5 resolution (one cell equal to 0.162 m x 0.162 m; 3 cells equal to approximately 0.5 m).

To register this digital aerial photograph to real world coordinates, four Global Positioning System (GPS) points were collected at road or trail intersections at the perimeter of the sandhill site. These points were used to register the scanned aerial photograph to existing digital-orthogonal quarter quadrangles (DOQQ). Aerial photographs are affected by distortion (see below).

This scanned aerial was used to determine potential CHPUH habitat (gaps between the shrubs). Using ArcINFO with Image Analyst extension, Gary Walter defined gaps in the sandhills chaparral greater than 3 m in one dimension, as this was the minimum distinguishable gap size using the enlarged aerial photograph.

Sections of the aerial photograph were used as “maps” to navigate around the dense chaparral and find the location of mapped 3 m gaps. The best way to maneuver through the chaparral was to go from gap to gap between shrubs or crawling underneath the shrubs to the next gap. This caused little damage to the shrubs. The gaps were ground-truthed with and without GPS unit for the presence and absence of CHPUH and other information. Point features were used for gaps that can be identified on the aerial photograph. Polygon features were used for the GPS user to define and map the gap. The GPS data dictionary included both point and polygon features that included gap dimensions and CHPUH qualitative characterizations (see Appendix B). Gap

length and width were estimates in the point data dictionary. The polygon data dictionary omitted the gap width and gap length because that can be measured in ArcView software. Cover class was used as an indication of plant quantity as it was difficult to identify individuals when the plants are in close proximity to one other and especially when in flower.

Some gaps were ground-truthed without aid of a GPS unit (due to malfunction or no units available). The location of the gap was triangulated from various landmarks (including trees, other gaps, etc.) and marked on the section of the aerial photograph map. Later, the point was drawn on a GIS coverage using the same aerial photograph as the map used in the field. The data collected in the field was manually entered into the GIS database.

C.) Materials and Equipment

- Geographic Position System (GPS) unit
- Data dictionary (see Appendix B) loaded in GPS unit
- Field notebook and pencil(s)
- Paper copies of enlarged aerial photograph
- Digital camera, extra batteries, and spare memory card
- Compass
- Eye protection (safety glasses, sun glasses, etc.)
- Garden gloves (protects the hands when down on all fours crawling through brush)
- White long-sleeve shirt
- Light-colored pants
- Tick repellent
- Water bottle and high-energy food (Power bar, Cliff bar, etc.)

D.) Aerial Photography Distortion

Even when registered to real world locations, the scanned, enlarged aerial photograph has sources of distortion:

- Generally, the center of an aerial photograph is the least affected by distortion of the camera lens. However, the sandhills area was not in the middle of the original aerial photograph and there was distortion.
- The GPS points used to register the scanned aerial photograph to the DOQQ were along trails and road encompassing the perimeter of the Sandhills. Therefore, the further away from the roads and trails, the more distortion occurs, i.e., the interior of the sandhills.
- Changes in elevation, i.e., ridge or knolls, the distortion is also more apparent relative to GPS points used to register the aerial photograph to the DOQQ, i.e., the interior of the sandhills.

III. Findings

A.) Study Site Access

To access the study site from the City of Santa Cruz: Take Empire Grade Road north, beyond the west entrance of the University of California, Santa Cruz. Turn left onto Smith Grade Road. Follow this road for about ½ mile. On the left, across from a turn out, is a gate with a DPR and private locks. Once through the gate, follow the dirt road over a one-lane bridge over Majors Creek and the sandhills study site is on your left as you drive out of the stream embankment on to a fairly level area. The dirt road encompasses two sides of the sandhill study site.

B.) Protocol Changes

The following are changes to the protocol used for the baseline monitoring:

- The polygon coverage was not used as many of the gaps were relatively small and at times it was potentially more damaging to walk the perimeter of the gap trampling the CHPUH plants since they frequently occur at the edge of the shrubs.
- The estimate of gap width and length for the point coverage was not used. It is more accurate to measure the gap dimensions with a meter tape or from the digital aerial photograph using ArcView software.
- The 2001 CHPUH data is a combination of GPS and hand-placed points in GIS. The GPS points collected in the field are more accurate in location than those points hand placed on the registered aerial photograph. In the future, collect all CHPUH data with a GPS unit if possible.

C.) Results

The majority of the gaps of the study site were visited over a five-day period in June 6, 7, and 12-14, 2001. During this time, the CHPUH plants were easily identified by the rose-colored flower with erose, or irregularly toothed, petals and rosette of spatulate leaves. CHPUH was found in open sandy gaps in the chaparral, many times in gaps created by dead manzanita shrubs or knob cone pine trees. The majority of the CHPUH were in gaps with a slight slope on the north and west sides of the sandhill study site. There were also disjunct patches in the SW area of the sandhill site, even in the sandy portion of an abandoned road. CHPUH was not found in gaps on the east side of the study site or in gaps on steep slopes. See 2001 CHPUH Occurrence Map in Appendix A.

Another spineflower, *Chorizanthe diffusa*, was found growing at the sandhill study site with and without CHPUH. *Chorizanthe diffusa* (CHDI) was easily recognized by its white flower with yellow throat and entire petals. [Tim Hyland and Randall Morgan verified the *Chorizanthe* species identifications. Though not State or Federally listed, Randall Morgan believes this species is also rare. (T. Hyland, personal communications)] CHDI was found in most of the gaps in all areas of the sandhill site. It was also found in gaps dominated by *Pteridium aquilinum* (bracken fern) in small openings of sand, edges of small gaps in the

brush, and along game trails. Other occurrences of CHDI outside of the study site include at a property marker and along Twin Oaks trail. See 2001 CHDI Occurrence Map in Appendix A.

To the southeast of the sandhill study site, there was an area that looked similar to the study site on the aerial photograph. During a quick reconnaissance trip on June 26, 2001, both *Chorizanthe* species were observed in gaps in this smaller, very decadent chaparral sandhill. CHPUH with a few flowers was observed in one of the gaps, as this visit was late in the flowering season and the plants were senescent. CHDI was observed in more of the gaps and along feral pig trails.

In the sandhills at Wilder Ranch State Park, the following were the plants consistently associated with CHPUH:

Herbs: *Cryptantha clevelandii*
 Camissonia sp. (not in flower to identify)
 Navarettia hamata ssp. *parviloba*

Shrubs: *Arctostaphylos silvicola*
 Arctostaphylos tomentosa ssp. *crinita*
 Ceanothus cuneatus
 Adenostoma fasciculata

For a more complete list of all the plant species that occur at the sandhill study site, see the Partial Species List of Plants Observed in the Sandhills Chaparral Plant Community of Wilder Ranch State Park (Gray Whale) in Appendix C. It is the same list as found in Appendix D of the IMAP Sandhills report.

IV. **Data Management**

- Field data was copied and is stored in two separate locations at the IMAP office.
- All GPS waypoints were stored in rover files, which were downloaded onto GPS Pathfinder software and differentially corrected. These were stored electronically and used as shapefiles in an Arcview GIS project.
- A CD accompanies the report containing
 1. A copy of the final report and other pertinent documents.
 2. Excel database
 3. A folder containing pertinent digital photographs, titled Chor.
 4. The Arcview project containing CHPUH themes is located in a single project titled Sandhills & chorizanth.apr. This project is found on the CD accompanying the sandhills report.

V. **Future monitoring**

The recommended monitoring of CHPUH is a multifaceted approach based on reasonable management and sampling objectives: 1) CHPUH and other endemic species should be searched for in all sandhill patches; 2) the known CHPUH

population at the study site is monitored for presence/absence data; 3) continued development of using GIS to monitor CHPUH habitat (chaparral gaps) quality; and 4) active management of the sandhills chaparral.

A). Distribution

This baseline study intensively searched for CHPUH at the largest patch of sandhills chaparral on the Gray Whale property. It has been observed from aerial photographs and from field reconnaissance that there are other patches of sandhills chaparral nearby. It is recommended that additional Zayante soil series areas, which is with or without sandhill plant associates be searched for CHPUH, CHDI, and other sandhill endemic species. It also suggested that sandy areas, except coastal beaches, in general at Wilder Ranch State Park also be checked for CHDI. These activities would better portray the distribution of these rare *Chorizanthe* species at Wilder Ranch State Park and this information would assist greatly in management and further monitoring of these rare plants.

B). CHPUH Population Monitoring

Monitoring CHPUH could be time and labor intensive depending on how it is monitored. As an annual plant, CHPUH seed germination can be affected by weather patterns making vegetation measures such as density, cover, and vigor unsuitable for monitoring (Elzinga et al. 1998). However, measuring frequency of CHPUH is a viable monitoring method for the Gray Whale population surveyed in 2001.

Frequency is “the percentage of possible plots within a sampled area occupied by the target species” (Elzinga et al. 1998). Frequency only requires a determination of presence or absence in the study plots, takes little training of individuals to be able to identify CHPUH, and will work on a species like CHPUH provided that the species has a relatively stable spatial germination pattern (Elzinga et al. 1998).

A grid could be generated in ArcInfo and laid over the 2001 CHPUH map with known gaps with CHPUH. The number of cells with CHPUH present is divided by the total number of cells in the grid covering the population multiplied by 100 to get the true frequency. The grid cells sizes could be varied in cell dimensions to find the optimal size. If the grid cell is too large, the presence of CHPUH will be 100%. Frequency values between 30%-70% are good for sensitivity to detect change (Elzinga et al. 1998). To get an estimate of frequency, a subset of cells are randomly selected from the entire grid covering the CHPUH population. To calculate the percent estimated frequency, the number of randomly selected cells with CHPUH present is divided by the total number of randomly selected cells and multiplied by 100. Before entering the field, management and sampling objectives need to be defined (see Elzinga et al. 1998). Once these objectives are determined, study design and statistics must be determined. The cells could be randomly selected or randomly placed along a transect. A pilot sampling should be done to determine which is logistically feasible and least damaging to CHPUH and the chaparral. See Elzinga et al. (1998) for further details. Damage may be

minimized if the transect and the plots are permanently monumented and the field crew followed the existing gaps to get from the selected cells for frequency monitoring instead of following the transect line. There may be a statistical advantage and gap size could be measured over time by returning to the same cells. In Appendix 18 of Elzinga et al (1998), calculations can be done to help determine the advantage of temporary versus permanent monitoring cells.

C). CHPUH Habitat Monitoring

Another facet of monitoring that must be considered is the time and resources that the Santa Cruz District can afford to sustain over time for this important resource. “For some species, such as annuals that fluctuate dramatically from year to year or long-lived perennials that change very little, habitat monitoring may be more sensitive to detecting undesirable change than monitoring the plant species directly” (Elzinga et al. 1998). This could be applied to the annual CHPUH and the perennial chaparral shrubs in the sandhills. “Habitat monitoring is most effective when research has demonstrated a relationship between a habitat parameter and the condition of a species” (Elzinga et al. 1998). McGraw and Levin (1998) have shown that CHPUH at Bonny Doon Ecological Reserve are not soil dependent but rather shade intolerant. By monitoring the chaparral gaps or CHPUH potential habitat, it may be the most cost effective long-term monitoring alternative.

Use of geographic information system is proposed as a method to monitor chaparral gaps and CHPUH as an indicator species to determine the health of the sandhills plant community. IMAP instead purchased 1 m resolution color DOQQs to see if it would provide adequate resolution of the chaparral gaps for CHPUH monitoring. At this time, the enlarged, scanned aerial photograph is superior in gap resolution. The alternative to try is 1-2 feet resolution imagery (high resolution, low elevation aerial photography) if available to see if chaparral gaps are distinguishable and changes in gap size can be detected. It will probably be easier to estimate gap size with ArcView software for large gaps (e.g., ≥ 3 m diameter) and difficult for other gaps. Small gaps will need to be observed over time for canopy closure. Thus as technology improves, this method of monitoring will improve. Regardless, on the ground verification of the presence and absence of CHPUH and a qualitative determination of its health and the quality of its habitat will continue to be necessary but perhaps not as frequently.

D. Experimental CHPUH Habitat Management

It was observed that there is some threshold of disturbance that CHPUH can tolerate. Some of the densest patches of CHPUH were next to a single-track trail at the edge of the chaparral. CHPUH was also growing in and along a former road on the southeast side of the northwest sandhill. Per Ms. McGraw (personal communications), maintaining the gaps between the chaparral shrubs is important for CHPUH and CHDI. She suggested prescribed burning or mechanical removal of shrubs to keep the gaps open for CHPUH. Perhaps a pilot shrub removal could be done to see how CHPUH reacts to increase in size of the gap. If shrub cover is

removed, it should be performed after CHPUH has set seed and before the first rains. Be sure to remove any resulting vegetation remnants or litter because CHPUH occurs in areas of bare sand. If a rake is used to remove the litter, observe the effects of soil disturbance. Although she suggested prescribed burning; the chaparral at the Gray Whale site is very mature/decadent and the fuel load is immense. IMAP recommends experimental methods to maintain or open up the chaparral for CHPUH habitat and suggests recruiting a graduate student to conduct this research.

The Gray Whale acquisition property is currently closed to the public. The Santa Cruz District was in the process of determining the official trail system to open this property to the public. A trail along the northeast side of the sandhills has been proposed as a return route for the existing Woodcutters trail. Because the sandhills area is on Zayante series soils that is known habitat for sandhills endemic plants including CHPUH and CHDI, careful consideration must be undertaken with active input from researchers, i.e., J. McGraw, etc. and regulatory agencies, i.e., California Department of Fish and Game, and U.S. Fish and Wildlife Service.

VI. References

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Talked with Ms. Hillyard on 3/5/01 about proposed monitoring for *Chorizanthe pungens* var. *hartwegiana*. See Appendix D for more information.

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Spoke to Ms. McGraw on 6/29/01 regarding her research on *Chorizanthe pungens* var. *hartwegiana*. She continues to study rare plants (CHPUH and other sandhill endemics) and the role of disturbance for her Ph.D. dissertation at University of California, Berkeley. Ms. McGraw has visited the Gray Whale CHPUH population and taken soil cores (2001) on site. She also has established study plots in the sandhills at Henry Cowell State Park if a prescribed fire is implemented. See Appendix D for more information.

Appendix A

Maps of *Chorizanthe* species at Wilder Ranch State Park, Santa Cruz County:

**Sandhill Study Site Map
2001 CHPUH Occurrence Map
2001 CHDI Occurrence Map**

Appendix B

CHPUH Data Dictionary for Trimble GPS Unit

CHPUH DATA DICTIONARY**POINT FEATURE****

ATTRIBUTE	DEFINITION	CATEGORIES	DEFINITION
Gap #	Unique number for area without perennial shrub vegetation. REQUIRED	None	None
Gap length (m)	Length of gap in meters	None	None
Gap width (m)	Width of gap in meters	None	None
CHPUH width (m)	Width w/in gap that CHPUH actually occupies.	None	None
GapCoverClass	Percent cover that CHPUH occupies w/in the entire gap. REQUIRED	0% 1-10% 11-25% 26-50% 51-75% 76-100%	CHPUH absent
Gap Attributes	Dominant in gap. Helps in aerial photo interpretation of gaps and identification of potential competitors.	Bare sand Grass Shrub Other	None
CHPUH Distribution	Pattern of distribution within gap.	Edge Carpeted Single patch Scattered individuals Scattered patches Mixed Other	Along edge of shrubs Little to no gaps between plants in area A group of individual plants in one area Individual isolated plants w/in gap Groups of individual plants in the gap Any mixture of the above None of the above; describe in Comments
Comments	Any additional information	None	None

**Polygon feature data dictionary same as point feature except Gap length and Gap width omitted.

Appendix C

**Partial Species List of the Wilder Ranch State Park Sandhills Chaparral
Plant Community (Gray Whale), Santa Cruz County**

**Partial Species List of Plants Observed in the Sandhills
Chaparral Plant Community of Wilder Ranch State Park (Gray Whale)**

Adenostoma fasciculatum*
 Aira caryophyllea*
 Arctostaphylos silvicola*
 Arctostaphylos nummularia^
 Arctostaphylos tomentosa ssp. crustacea*
 Arctostaphylos tomentosa ssp. crinita*
 Baccharis pilularis^
 Briza maxima^
 Ceanothus cuneatus*
 Ceanothus papillosa (in bloom)*
 Chorizanthe pungens var. hartwegiana*
 Chorizanthe diffusa^
 Chrysopsis chrysophylla*
 Cryptantha clevelandii^
 Elymus glaucus^
 Ericameria arborescens*
 Eriodictyon californicum^
 Galium sp. (yellow flowers in bloom)*
 Galium sp. (woody perennial, climbing)^
 Garrya elliptica*
 Gnaphalium sp.
 Helianthemum scoparium*
 Heteromeles arbutifolia*
 Hypochaeris radicata^
 Hypochaeris glabra^
 Lithocarpus densiflorus*
 Lotus scoparius*
 Luzula multiflora?^
 Madia madioides*
 Melica imperfecta^
 Mimulus aurantiacus*
 Navareetia hamata ssp. parviloba^
 Pentagramma triangularis^
 Pickeringia montana^
 Pinus attenuata*
 Pinus ponderosa^
 Poaceae sp. (possibly Nasella)*
 Polygala californica^
 Pseudotsuga menziesii var. menziesii*
 Pteridium aquilinum*
 Quercus agrifolia^

Quercus berberidifolia*
 Quercus parvula var. shrevii*
 Rhamnus californica ssp. californica*
 Ribes divaricatum var. pubiflorum*
 Rosa sp.*
 Rubus ursinus*
 Rumex acetosella*
 Sambucus californica^
 Satureja douglasii*
 Sequoia sempervirens*
 Smilacena stellata^
 Spargula arvensis ssp. arvensis*
 Toxicodendron diversifolium*
 Triphysaria pusilla*
 Umbellularia californica*
 Vaccinium ovatum*
 Vulpia octoflora*

*May 4, 2000 by Laurie Archambault

^June 2001 by Tamara Sasaki

Appendix D

**Sandhill and *Chorizanthe pungens* var. *hartwegiana* Notes
Wilder Ranch State Park**

Sandhill and *Chorizanthe pungens* var. *hartwegiana* Notes Wilder Ranch State Park

3/5/01 Deborah Hillyard, DFG 805/772-4318

- *Chorizanthe* is annual. It has wild fluctuation in numbers that can be site specific or regional. Unsure how to interpret. At some sites, the seed bank is being monitored. However, Jody McGraw (researcher) believes that the individuals that grow the next year are from the previous year's seedbank. [Jody McGraw 831/335-5092 has research plots in Quail Hollow County Park, San Lorenzo open space, and the Quarry.] Deb suggested calling Jody McGraw; think she's been at the Gray Whale sandhills site with George Gray.
- Somehow need to document and quantify occupied habitat with suitable habitat.
- At Fort Ord in the monitoring of *Chorizanthe pungens* var. *pungens*, researchers defined "occupied habitat" as any meter-squared area with 1 or more plants. Occupied habitat was mapped. Mean density estimated. Total of suitable habitat and occupied habitat estimated. Since they are doing thousands of acres, density was estimated in classes. They have censused 3 polygons since 1998 and have restoration requirements to meet. Each year monitor (census) preservation polygons and compare to restoration polygons and 3-year average of preservation plots.
- Deb said she would send me a copy of the above protocol.
- Use % cover as an indicator of how the population is doing. If there is a decrease, then it triggers a management action of look at weather, checking with other researchers about other populations, and/or more intensive monitoring.
- Conclusion—Laurie thought about it, and we rethought about it and agreed her proposed monitoring is fine.

4/25/01—Pat Gilbert and I took the day to try to estimate CHPUH rosettes. The plants can be identified by their leaves (spatulate). Some of the plant had formed flower involucre that had not bolted. We took GPS points of where we located CHPUH and estimated rosette densities (countable #, 10's, <50, <100, 100's, <500, <1000, 1000's, 10,000's, and 100,000's). We measured the gap length & width and the amount of area that CHPUH (length & width) occupied within the gap. The difficulty we had was determining/defining a gap.

6/6/01—Gary Walter, Craig Swolgaard, and Tamara Sasaki spent the half-day visiting and GPSing sandhill gaps looking for CHPUH in arbitrarily designated quadrant 1 (NE area). CHPUH in full bloom, easy to identify by pink flowers. Another *Chorizanthe* co-occurs in the gaps, *Chorizanthe diffusa* (white flowers, glabrous involucre, very similar to CHPUH). We created a data dictionary CHP for point and polygon features. Point features contained the following attributes: gap#, gap width (m), gap length (m), CHPUH width (m), CHPUH length (m), Gap veg attributes (bare sand, grass, shrub, other), GapCoverClass (0, 1-10, 11-25, 26-50, 51-75, 76-100%), CHP distribution (edge, carpeted, scattered individuals, scattered patches, mixed, other), and comments. GW (ProXRS) and TS (Geo3) noted in comments whether CHDI and/or CHPUH were in the gap. CS (Geo 3) did not. However, the CHP gap length & width probably includes CHPUH & CHDI (not accurate) as well as the estimate of gap cover class that both

Chorizanthes occur. Ticks not so bad. Very hot work in the afternoon. Bring lots of water.

6/7/01—Gary Walter and Tamara Sasaki (with ProXRS) did part of Quadrant 2 and Quadrant 1 (east most). Quadrant 2 the vegetation is dense. More difficult to get through and poison oak present. Made it to the edge of ridge on east side—very sandy and loose soil. Bright bare areas on the aerial photograph could be from steep and sandy areas with/out vegetation cover. The GPS data from today's field work on the CHPUH length & width and Gap cover class does not include CHDI.

6/12/01—Tamara Sasaki with GeoExplorer3 unit finished up west side of quadrant 1 and began a portion of quadrant 2. Met with Tim Hyland and together we keyed out the pink and white flowered *Chorizanthe* (and he verified other Forest & Woodland Composition unknown plants). I gave him a white *Chorizanthe* and a pink *Chorizanthe* to press. Tim was going to see Randy Morgan on 6/21 and will have him verify our identifications.

6/13/01—Tamara Sasaki w/o GPS unit (NHS Geo3 had graphic display malfunction) and visited sites on quadrant 5 and difficult gaps near the knoll in quadrant 2. Later the GPS unit decided to work, and I was able to get a few gaps in quadrant 3 and 4. Gary Walter (ProXRS) completed quadrant 2 and the side of road.

6/14/01—Tamara Sasaki w/o Geo3 visited more sites on hillside of quadrant 4 (white-flowered *Chorizanthe* only found).

6/19 & 6/20/01—Input of points on *Chorizanthae.apr* file of gaps I visited without GPS unit. You will know because there is no rover file entry and the gap measurements were made via ArcView. The database still needs to be completed with 4/25/01 data and other adjustments (6/6 and 6/7 entries were done under different premise).

6/22/01—Talked to Tim Hyland (Santa Cruz District Resource Ecologist). He met with Randy Morgan on 6/21/01 and showed him the *Chorizanthae*. Randy verified the pink flowered plant was *Chorizanthae pungens* var. *hartwegiana* and the white flowered *Chorizanthae* was *C. diffusa*. Randy told Tim that although CHPUH is listed, that CHDI is probably more rare. I followed up with an email to Roxanne Bittman, NDDB 323-8970/rbittman@dfg.ca.gov, asking her if she can shed any light on the status and distribution of CHDI. Emailed Ed Grumbine [sierrai@cats.ucsc.edu], UCSC professor, who Caitlyn Bean (DFG) mentioned has done work with CHPUH at Wilder Ranch sand hills. He emailed me back and said he would get back to me when he returns from vacation 7/5.

6/26/01—Dinner with Caitlyn Bean (DFG) who has trapped small mammals in the Wilder Ranch Sandhills.

6/27/01—Visited another “sandy Zayante” soils site as potential kangaroo rat habitat (intersection of Enchanted trail and Eucalyptus loop trail in the old corral area). Looked at

chaparral/scrub area between Long meadow and Chinquapin trails (found pot plant). GPSed her trap lines in Sandhills.

6/28/01—Pat Gilbert and Tamara Sasaki visited the smaller sandhill, east of the one CHPUH presence/absence in the gaps were GPSed. The north side of this sandhill is a wooded ridge. The south side is comprised of a very decadent “sand chaparral” plant community. Via a wandering transect through this area, CHDI and CHPUH were found in some of the gaps and their locations GPSed.

6/29/01—Called Jody McGraw (UCB doctorate student) 831/335-5092 studying disturbance and rare plants (CHPUH and *Erysimum* in sandhills in Quail Hollow & Ben Lomand). She said that Bonnie Doon and Gray whale sites (west most of all the sandhills in the county; Zayante soils found all the way in Corrolitos but much different plant community there) are sand chaparral but plant community and physiogomy are very different. Gray Whale is at a higher elevation, so the plant’s phenology is later and the plant themselves are much smaller than other sandhill sites. Jody is George Gray’s niece. He asked her when the “opening of trails” in Gray Whale became an issue for her recommendations and to study CHPUH. She feels that the seed bank is the big issue for CHPUH. She took soil cores at the north east end (by the illegal/unnamed trail). She germinated seeds in April in the greenhouse. The result was low germination—perhaps not enough cues. At this time, she thinks CHPUH seed either has a very innate (deep) dormancy or a very short-lived seed bank. Ed Grumbine also did a census of two patches of CHPUH along the unnamed trail (2 hours with 16? Students). She said he made sweeping recommendation of opening up the Sandhills to recreation will cause demise of CHPUH based on his small amount of census data. Logic—impact of increased trail use will destroy the CHPUH along the trail and the southwest patch in the dirt road. Jody contends that indirect trampling knocks back some of the vegetation (grasses and other competitors) but too much use from equestrians and mtn bikers may be too much. Difficult to determine carrying capacity of the trail with respect to *Chorizanthe*. Her recommendation to George Gray was not to open the Sandhills area for recreational trail use. To keep the area closed and allow the light use of current trespass to help keep the sandhills open. She said that the sandhills @ Henry Cowell State Park are intersected by a fire road (very sandy). Jody said that she put in monitoring plots at Henry Cowell SP waiting for George to burn. I mentioned that the gaps @ Sandhills Wilder Ranch are caused by dead manzanita or knobcone pines. Jody said that Knobcone pines live 50-60 years old. When they begin to die is a sign that a burn needs to occur. At Bonnie Doon Ecological Reserve, the illegal trails that the neighbors have constructed and lightly used have been helpful in keeping openings for CHPUH. Otherwise, the entire area is dominated by *Arctosphylos silvicola*. If one goes to Bonnie Doon Ecological Preserve, be sure to put a sign in your vehicle that you have permission or a right to be at the Preserve. The local residences protect the preserve by slitting vehicle tires. She thinks the sandhills at Henry Cowell, Wilder Ranch, and Bonnie Doon would benefit from fire. Mechanical removal probably would work but expensive. Her first year of experiments used burn boxes (Bruce Pavlik) 1m x 1m. CHPUH increased and the weedy non-native plants decreased. Because of size of burn plots, weeds invaded following year. She also raked areas of leaf litter and that also increased the germination of CHPUH. If

mechanical were done to open the gaps, probably need to rake the manzanita leaf litter away also (alleopathic). CHPUH not a good competitor inter-specifically and in some areas has intra-specific competition. Mass destruction to 90% of the sandhills in the county (most are privately owned and sand mined). Colleen Skully (USFWS/insects), Deb Hillyard (DFG), and Jody all very much into protecting the sandhills. Basically, sandhills are microislands trying to survive habitat fragmentation. Vectors for seed distribution, probably are large mammals, e.g. deer. Now, she herself probably and maybe horses ridden on illegal trails in the sandhills. She will send me a copy of her paper published in Madrono. Jody can be reached also by email: jmmcgraw@socrates.berkeley.edu. She would be willing to read my report and would like to see the maps. She is especially interested in a prescribed burn for the area.