San Nicolas Island Vegetation Monitoring Report 1993–1996

Katherine A. Chess
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Technical Report No. 56

United States Geological Survey
Cooperative Park Studies Unit
The University of Arizona ◆ Tucson, Arizona

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Prepared in cooperation with:

U.S. Geological Survey, California Science Center, Channel Islands Field Station

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Figures and Tables

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Abstract

During 1993–1996, vegetation monitoring was conducted on San Nicolas Island of the California Channel Islands. Permanent point-intercept line transects were surveyed in the spring of each year (March to early May). Methods used on San Nicolas Island are identical to those used to monitor vegetation communities at Channel Islands National Park. This report presents the data and summarizes community trends for 4 years.

Thirty-seven transects were sampled encompassing 8 plant communities on San Nicolas Island. During 1993, the first year of transect sampling, 75 plant species were recorded on transects. The lowest number of total plant species encountered occurred in 1994 with 54 species recorded. In 1995, 62 species were observed on transects and in 1996, 58 plant species were recorded. This report contains brief plant community descriptions and compares spring frequencies of important species surveyed during the 4 years.

Introduction

After more than a century of grazing, ranching, and military activities, the California Channel Islands maintain and support unique vegetation communities in various stages of recovery. To better understand vegetation dynamics and to effectively manage toward ecosystem recovery, long-term plant community monitoring is conducted on each of the northern islands (Halvorson et al. 1988).

San Nicolas Island (SNI), the most geographically isolated of the 8 California Channel Islands, is located 98 km south-southwest of Ventura, California (Fig. 1). The island is oval-shaped, approximately 58 sq km in size, and its main axis runs from northwest to southeast. From a distance San Nicolas presents a low, table-like profile. Island topography consists of a narrow marine terrace surrounding a broad sandstone/siltstone terrace or mesa; this mesa covers most of the surface area of the island (Halvorson et al. 1996). San Nicolas Island is presently owned by the U.S. Navy and managed as an outlying landing field for the Naval Air Weapons Station at Point Mugu, California.

In 1992, the U.S. Navy contracted with National Park Service (NPS) biologists to establish the San Nicolas vegetation monitoring program. During the spring of 1992, community relevé data were collected and permanent vegetation transects were installed in representative plant communities as defined by *Plant Communities of San Nicolas Island, California* (Halvorson et al. 1996). Transect installation was conducted by William Halvorson and Joy Hosokawa, Cooperative Park Studies Unit (CPSU); Steve Junak, Santa Barbara Botanic Garden; and Cathy Schwemm, Channel Islands National Park. Starting in 1993, transects were sampled by different groups of researchers and trained volunteers each year (Appendix 1). In 1995 and 1996, monitoring was conducted by a research specialist employed by CPSU through The University of Arizona and stationed at USGS Channel Islands Field Station along with various groups of assistants. In 1995, 4 Student Conservation Association volunteers, trained in data collection procedures, assisted with monitoring. From 1993–1996, the San Nicolas Island Biologist has assisted with transect sampling.

This report presents species frequencies recorded on transects for 1993, 1994, 1995, and 1996. It also gives a brief synopsis of fluctuations of important species within the 9 vegetation communities sampled.

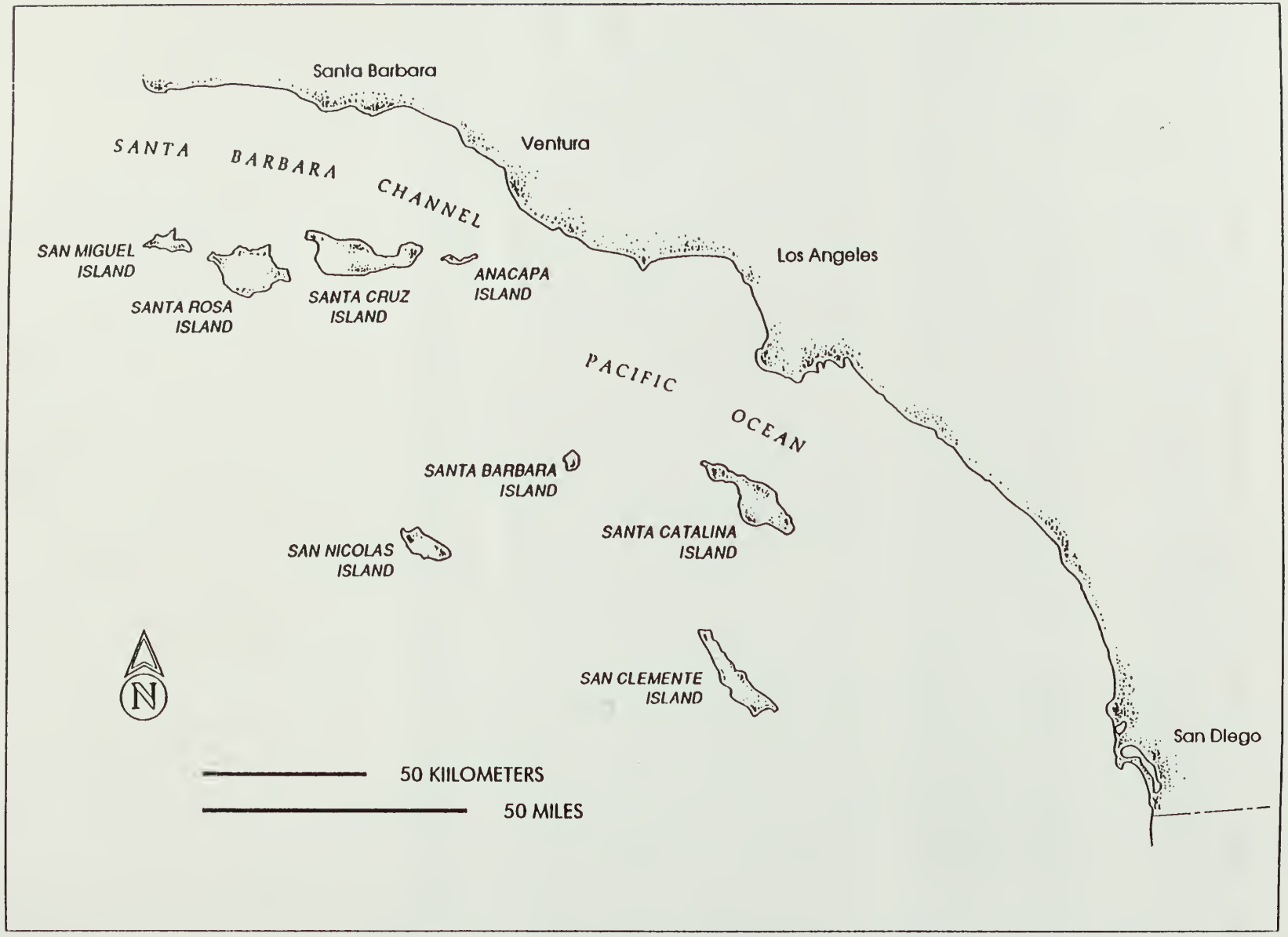

Figure 1. San Nicolas Island and geographic relationship to the other Channel Islands.

Methods

Sample Design and Data Management

Monitoring and data management protocols for San Nicolas Island vegetation transects are the same as those developed at Channel Islands National Park and implemented by NPS staff (Halvorson et al. 1988). The protocol uses the point-intercept method online transects (30 m, 100 points) to sample and quantify island vegetation (Bonham 1989).

Methods of data handling have been, and are being, updated since the publication of the *Terrestrial Vegetation Monitoring Handbook* (Halvorson et al. 1988). Transect data for San Nicolas Island have been managed by staff at Channel Islands National Park; in 1995 and 1996 the CPSU research specialist managed and summarized the 4 years of data collected to date. Field data sheets are stored at Channel Islands National Park, the Cooperative Park Studies Unit at The University of Arizona, and the Environmental Division of Point Mugu Naval Air Weapons Station. Data were stored in dBase software prior to 1994. The park converted to Microsoft Fox Pro during the summer of 1994, and a summarizing program was written by a contracted computer specialist in August of that year. This program summarized species hits producing a report of species frequencies per transect by sample year. This method replaced the earlier method described in Halvorson et al. (1988).

In 1995, the park began conversion to Microsoft Access for all biological/resource data management, and in 1996 developed new summarizing techniques. Data summaries were generated using slightly different queries (and/or files with slightly different data arrangements) in 1995 and 1996. The summary generated in 1995, reports spring vegetation frequencies for 1993–1995 seasons. A similar query produced a report of spring vegetation frequencies for 1996. Results from these queries were compared and analyzed for accuracy of reported details, and then combined to form Appendix 4. Data for 1993–1996 are now stored as Microsoft Access data files.

1993–1996 Vegetation Monitoring

San Nicolas Island transects (Fig. 2) were sampled on the dates listed in Table 1. Monitoring began 7 March 1993 and was finished 20 May 1993. An accidental burn occurred on the west end of the mesa in July and 4 additional transects (33, 34, 35, 36) were established and sampled at the burn site in August. Transects 33 and 34 are interpreted as part of the *Baccharis* scrub community, while 35 and 36 are designated as *Isocoma/Baccharis* scrub. Accidental fires occur occasionally in this region as a result of military launching activities in the area above these transects (Grace Smith, pers. com.). During the 1994 season, monitoring took place periodically from 16 March to 14 April. Monitoring for the 1995 season was conducted periodically from 31 March to 3 May. The monitoring of all transects was completed 13 April, but transect 4 had been oriented incorrectly and was replaced and resampled 3 May 1995. Monitoring for 1996 began 9 April and was completed 30 April.

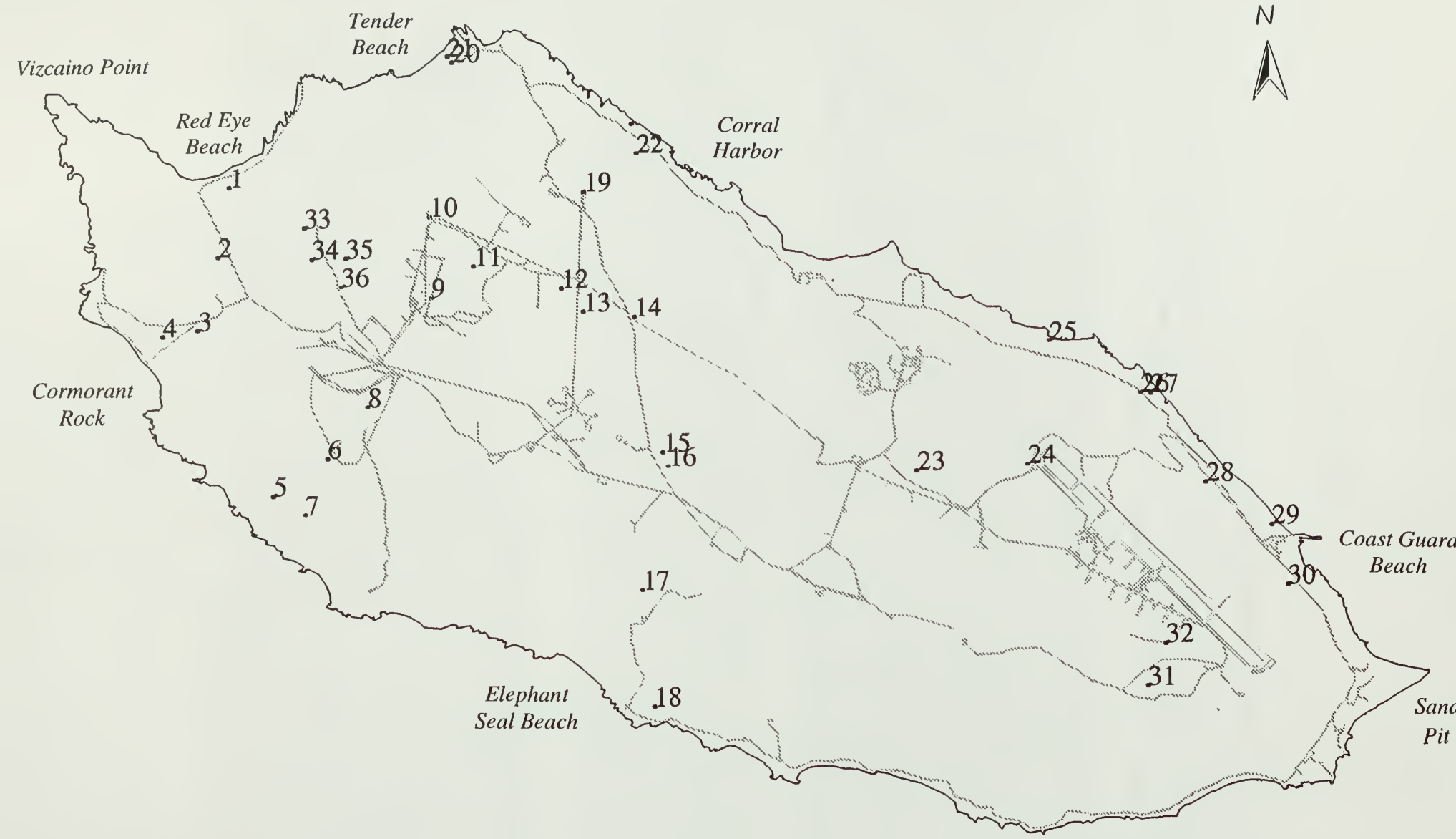

Figure 2. Location of transects on San Nicolas Island, California.

Table 1. Vegetation transect monitoring dates, San Nicolas Island, 1993–1996.

Year	Transect monitoring dates	Total days
1993	March 7–10, May 5, 20, August 17–18*	8 days
1994	March 16–17, April 9–14	8 days
1995	March 31–April 4, April 11–13, May 3	14 days
1996	April 9–10, 16–18, 22–24, 30	9 days

*Transects 33 through 36 were established and sampled in mid-August following a burn.

Sampling periods vary between years for several reasons. First, the spring bloom onset varies depending on winter and early spring rainfall patterns. Also for data comparability, the key factor used to determine a monitoring schedule is grass species anthesis. At this phase grasses, as well as all other taxa, can usually be identified to species/subspecies. Second, logistics generally require that research trips are 1 week or less in duration. This, coupled with occasional military activities, restricts researcher visitation resulting in irregular breaks of up to several days in the sampling period. In addition, rain prohibits vehicles from using dirt roads, thus increasing the monitoring time frame.

Changes Made and Problems Identified in 1995 and 1996

Species names used in the transect database are according to Hickman (1993) for all 4 years of data, except in some cases where island endemics were not recognized. For these taxa, taxonomy was according to Munz and Keck (1968) and Munz (1974). See Appendix 2 for specific taxonomic changes and other taxonomic issues.

In the field, it is often difficult to identify plant species within several genera (e.g., *Avena, Gnaphalium, Vulpia*) especially when plants are young. It is possible that some species were misidentified within a given genus during the 1993 and 1994 assessments (e.g., *Avena barbata* and *A. fatua*). Therefore, treating these plants by genus clarifies monitoring results. This treatment is best applied only to introduced species within the same genera whose ecological roles are so similar that they can be treated at the generic level. In 1995 and 1996, whenever species identity in the field was uncertain, data were simply recorded as "*Avena* species," and notes were made on which possible species were present. Data collected in this manner are reported in the summary table as " *Avena barbata/fatua*," indicating these are the species that occur on the island and that either or both could be present on the transect.

Another change for the 1995 season concerns field data collection procedures. Approximately 50% of the field data were entered directly into a Hewlett Packard lX200 palmtop computer and the other 50% were recorded on data sheets. Palmtop data were proofread and data from the data sheets were entered into the same database and proofread. The entire original database was printed and filed as a hard copy to be archived. In contrast, during the 1993, 1994, and 1996 seasons, field data were recorded on data sheets (to be archived), and then entered and proofread in the database.

One problem identified in 1995 concerns transect 23. During 1994, researchers could not locate this transect, so they relocated the transect to a nearby area. In 1995, both transects were found and one was renamed transect 37. It is not clear which one was read as transect 23 in 1993, and which in 1994. Fortunately, the habitats are sufficiently similar, and any ecological differences are not likely significant. During 1995, new maps were made and locating instructions were clarified for both transects to prevent future confusion.

A problem that became evident in 1996 concerns field collection of substrate data. Upon close observation of substrate data presented in Appendix 4, it is apparent that substrate designation varies, largely due to interpretation by researchers. It is possible that some discrepancies are due to climatic and ecological changes like sand deposition by wind.

Additionally, for comparison with burn transects and to provide a baseline for shrub mortality, hits on dead shrubs were recorded on all transects in 1996. These data are not included in the calculation of species frequency for each transect. Rather, they are presented as additional information.

Possible misidentification of species and other data collection inconsistencies have been identified during the 4 years of data collection. These will be given particular attention during future monitoring. Detailed descriptions of problems identified are presented in Appendix 3.

Discussion and Results

Raw species frequency data for all years sampled are listed by transect in Appendix 4. A general summary of the data by community follows.

Plant Communities of San Nicolas Island

Grassland Community

As of 1995, 6 grassland transects have been established on San Nicolas Island (15, 23, 24, 31, 32, 37). During 1993 and 1994, there were 5. The explanation for this was given above in the "changes made" section, concerning transects 23 and 37. This community is most often dominated by an overstory of nonnative *Avena* species (*A. barbata* and/or *A. fatua*) and *Bromus* species (*B. diandrus, B. hordeaceus* and/or *B. madritensis* s. *rubens*). Most grassland regions exhibit a diverse understory of additional nonnative grasses, various introduced and native herbs, a few native shrubs, which appear to be slowly invading this community (Halvorson et al. 1988), and an occasional native grass, such as *Hordeum intercedens*. *Hordeum intercedens* is the only native grass that occurs in the grassland community as described in Halvorson et al. 1996. Of the 6 transects, only 23, 31, and 32 have reported *H. intercedens* on transects. During 1994, transect 23 had only 1 hit of this grass. However, transects 31 and 32 have several *H. intercedens* hits for 1994 and 1996, and 1993, 1994 and 1996, respectively. Most grassland transects showed slight fluctuations in species richness (Appendix 4). Transects in this community support between 6 (transect 37 in 1996) and 20 species (transect 15 in 1995). However, transect 24 had a significant drop in species richness between 1993 and 1994; 1995 data show a partial recovery of species numbers followed by a slight decrease in 1996. This fluctuation may be in response to 1994 drought conditions. In 1995, there was a significant increase in numbers of species present on transect 32 followed by a decrease in 1996.

Coastal Dune Community

On San Nicolas Island, dune communities have been divided into stabilized and unstabilized types. The coastal dune (unstabilized) community refers to actively moving dunes nearest the ocean. The following are 5 unstabilized dune transects:1, 4, 21, 26, 29. Transect data indicate 2 *Abronia* species (*A. maritima* and *A. umbellata*), *Ambrosia chamissonis,* and *Cakile maritima* as dominant in this community. Data also show that species richness on transects varies from 2, on several transects over several years, to 5 species (transect 1 in 1995 and 1996). Transects 1 and 26 have low frequencies of *Malacothrix incana*, a coastal native shrub, which may indicate an early step toward stabilization. Rarely seen in these areas is the federally classified category 2 species *Dithyrea maritima* (beach spectacle pod), observed only on transect 1 in very low numbers during 1993, 1995, and 1996 monitoring (Appendix 4). For a detailed discussion on rare plants of San Nicolas Island, see CPSU/UA Technical Report 51: Sensitive Plants of San Nicolas Island, California (Phase 1), (Junak et al. 1995).

Inland Dune Community

Inland (stabilized) sand dunes are more protected from wind and salt deposition and have much more diverse species compositions and higher plant frequencies (see Appendix 4) than coastal dunes. Six stabilized dune transects exist (2, 3, 5, 7, 20, 27). Species present in this community

include coastal dune plants, introduced and native grasses and herbs, and several native shrubs such as *Astragalus traskiae* and *Isocoma menziesii*. Transects in this community support between 10 (transect 2 in 1996) and 21 species (transect 27 in 1995). Data for transects 5, 7, and 27 show an increase in species richness in 1995, approximately 33% more species were present than in the previous 2 years. Data from 1996 for these 3 transects show a slight decrease in species richness compared to 1995. Transects 2, 3, and 20 have nearly constant numbers of species present.

Coastal Scrub Community Complex

Coastal scrub is the dominant vegetation type on SNI, covering more than 50% of the island (Halvorson et al. 1996). It is subdivided into 5 plant communities based on dominant shrub species. Four of these scrub communities are described in Plant Communities of San Nicolas Island, California (Halvorson et al. 1996): 1) *Isocoma* scrub, 2) *Baccharis* scrub, 3) *Coreopsis* scrub, and 4) *Lupinus* scrub. For transect treatment, the *Isocoma* scrub community was subdivided into 2 types, *Isocoma* and *Isocoma/Baccharis*.

Isocoma Scrub Community

The *Isocoma* scrub is the most prevalent scrub type, covering nearly 50% of the island. It is also the most diverse, yet no single species dominates over large areas. This community varies widely in size, species composition, and species richness. 66% of plant species found in this community are native (Halvorson et al. 1996). The 7 transects located within this community (6, 9, 14, 16, 17, 33, 34) support between 2 (transect 17 in 1994) and 20 (transect 14 in 1993 and 1995) plant species. Transects 17 and 14 probably represent the extremes in low and high species richness, respectively, within this community.

Transect data indicate the most frequent species include *Avena barbata*, *Bromus diandrus*, *Bromus madritensis* s. *rubens*, *Erodium cicutarium*, *Isocoma menziesii*, *Lupinus albifrons*, and *Medicago polymorpha* and, occasionally, *Astragalus traskiae* and *Lotus argophyllus* s. *argenteus*. Data for transects 6, 9, 14, and 17 show slight fluctuations in *Isocoma* frequencies over the 4 years. On transect 16, *Isocoma* frequencies are low, but have been increasing since 1994. Transects 33 and 34 are located in an area that is subject to occasional fires resulting from military activities (Grace Smith pers. com.). Both transects burned in 1993; all of transect 33 and a portion of transect 34 burned again prior to sampling in 1996. On transect 33, *Isocoma* frequencies were relatively high and stable from 1993 through 1995. The 1996 fire resulted in a decrease in species richness (from 13 species in 1995 to 7 in 1996) and *Isocoma* frequencies (from 49 hits in 1995 to 16 hits in 1996). For transect 34, data show no *Isocoma* in 1993 and 1994, followed by slight recovery in 1995 (1 hit). In 1996, transect 34 was oriented approximately 90° off, so data cannot be directly compared with previous years; however the data show similar community structure to that recorded for 1993, 1994, and 1995 (Appendices 3 and 4).

Baccharis Scrub Community

The *Baccharis* scrub community exists in scattered drainages on the north side of the island where wetter conditions prevail (Halvorson et al. 1996). Transects in this community (8, 12, 13) support between 11 species (transect 12 in 1994) and 20 species (transect 13 in 1995). Four years of data indicate species richness is relatively stable on these transects, except on transect 13 where a significant increase in numbers of species present occurred between 1994 and 1995. The 1995 data for all 3 transects show a decrease in *Baccharis pilularis* frequency compared with the

2 previous years. Transect 8 had an increase between 1993 and 1994, dropped in 1995 and increased in 1996. *B. pilularis* decreased steadily on transect 12 over all 4 years. On transect 13, *B. pilularis* frequencies decreased dramatically in 1995 and 1996 relative to the 1993 and 1994 counts. This may be due to sample error or shrub mortality.

Isocoma/Baccharis Scrub Community

The term *Isocoma/Baccharis* scrub is applied to the San Nicolas Island community that has characteristics of both scrub types; it may represent an ecotone or a seral successional stage between the 2 different communities. The 2 transects, 35 and 36 that sample this community, were placed in a burn location in 1993 and sampled 1 month after the fire occurred. These transects support between 10 (transect 36 in 1993) and 16 species (transect 36 in 1995). Species richness appears to be stable on transect 35, and gradually increasing on transect 36. Transect 35 data show a steady increase in *Baccharis pilularis* frequencies from 1993 through 1995. In 1996 transect 35 was not sampled due to trouble locating the transect and time constraints. On transect 36 there was an increase in *B. pilularis* frequency during 1994 followed by its total disappearance in 1995; data for 1996 had 1 hit on this transect. The disappearance may be due to a small accidental burn that occurred in 1994. Data for transect 35 show a very slow development of the native shrubs *Isocoma menziesii, Lotus argophyllus,* and *Lupinus albifrons*. Transect 36 data is similar except that *Isocoma menziesii* frequency decreased in 1995 and increased in 1996 towards frequency levels of 1993 and 1994.

Coreopsis Scrub Community

The *Coreopsis* scrub is the most impressive community on the island. *Coreopsis* communities on north-facing slopes maintain a nearly closed canopy and may exceed 2 m in height. Within this community other native shrubs may be found including: *Isocoma menziesii, Lotus argophyllus, Lupinus albifrons* and *Malacothrix incana*. An understory of vines, grasses, herbs, and other shrubs of varying densities grow beneath the *Coreopsis* overstory. Five transects are being monitored within this community (18, 19, 25, 28, 30). Transect data indicate that *Coreopsis* scrub supports a minimum of 12 plant species (transect 28 in 1994 and 1996) and a maximum of 23 (transect 30 in 1993). Four years of data also show relative stability of species richness on transects 18, 19, and 28. Species richness was relatively stable on transect 25 from 1993 through 1995, but decreased from 17 species in 1995 to 12 in 1996. Transect 30 data show high species richness for 1993 and 1995 (23 and 22 species present, respectively) and a lower number of species present during 1994 and 1996 (15 species). Data for 1994 show a decrease in *Coreopsis* frequencies compared to 1993 for all 5 transects. The greatest decline occurred on transects 28 and 30. However, 1995 data show an increase in *Coreopsis* frequencies on all 5 transects since 1994 with the greatest increase on transect 25. Transect 25 is the only *Coreopsis* transect with a higher *Coreopsis* frequency in 1995 than in 1993. Data from 1996 indicate a similar decline in *Coreopsis* frequency to that observed in 1994 (Appendix 4). This pattern is likely attributed to rainfall patterns: 1993 was the year that drought broke in southern California and 1995 was an unusually wet year.

Lupinus Scrub Community

The Lupinus scrub community is characterized by high frequencies of *Lupinus albifrons* (15% to 90%) within what would otherwise be an *Isocoma* community. Transects in this community (10, 11, 22) support between 7 (transect 11 for several years) and 17 species (transect 22 in 1993). Data indicate a gradual decline in species richness, especially on transect 22. Data show species

richness on transect 10 is relatively stable. Data for transect 10 show a dramatic increase in *L. albifrons* between 1993 and 1994 then a sharp decrease between 1994 and 1995 followed by another decrease in 1996 (Appendix 4). For transect 11, *L. albifrons* frequencies were constant in 1993 and 1994 (77 hits) but fell substantially in 1995 (20 hits) and 1996 (4 hits). It appears that a major dieback is occurring on this transect. Transect 22 data show *L. albifrons* at stable frequencies over the 4 years.

Species of Special Concern

Invasive Weedy Species

Only *Centauria melitensis,* one of several species considered to be invasive weeds by the Environmental Division of Point Mugu Naval Air Weapons Station (Grace Smith pers. com.), has been found on various transects. It occurs on *Isocoma* scrub and grassland transects. *C. melitensis* has occurred on transects 14, 15, 16, 32, and 34 in varying frequencies. Low frequencies are recorded on transects 14, 15, and 32 with transects 14 and 15 supporting this weed only in 1995. Transect 16 has a high frequency of *C. melitensis* for 1993 (28 hits), a disappearance in 1994, and a return in 1995 (19 hits), and 1996 (14 hits). Transect 34 data show a gradual increase from no hits in 1993 to 11 in 1995 and a disappearance in 1996. See Appendix 4 for detailed frequency data.

Single Island Endemics

San Nicolas Island flora includes 19 plant species endemic to 1 or more of the Channel Islands. Of these only 4 are single island endemics: *Eriogonum grande* v. *timorum, Lycium verrucosum, Malacothrix polycephala,* and *Phacelia cinerea* (Junak 1992). Only 1 of these 4, *Malacothrix polycephala,* was ever observed on or near transects. This species has been recorded on 9 transects (13, 14, 18, 19, 22, 25, 27, 28, 30) although in very low numbers on transects 13, 14, 18, and 30 during 1 or 2 of the 4 years of data collection. The remaining 5 transects show a disturbing decrease in *Malacothrix polycephala* frequencies since 1993 (Appendix 4).

Shrub Mortality

Shrubs constitute an important part of historical vegetation communities on the California Channel Islands. Restoration efforts may depend on a better understanding of ecological shrub dynamics. During 1996 monitoring, several transects had shrubs that were dead or dying back. In order to quantify dead shrubs and determine dieback trends, counting hits on shrub species that were dead began in 1996. Table 2 lists the hits on dead shrubs and the transects where they occurred; sometimes species identification was possible and a record was made. These data are not included in the analysis of live species frequency reported in Appendix 4.

Table 2. Shrub mortality on San Nicolas Island, California, 1996.

Transect	Species	Frequency	Total dead hits
1	Unknown	5	5
2	Unknown	8	8
3	*Lupinus albifrons*	3	
3	Unknown	1	4
7	*Ambrosia chamissonis*	1	
7	*Lupinus albifrons*	3	
7	Unknown	2	6
9	*Lupinus albifrons*	1	
9	Unknown	3	4
10	*Lupinus albifrons*	11	
10	Unknown	6	17
11	*Lupinus albifrons*	3	
11	Unknown	25	28
12	*Baccharis pilularis*	7	
12	*Lupinus albifrons*	3	
12	Unknown	10	20
13	*Baccharis pilularis*	6	6
14	*Isocoma menziesii*	3	
14	*Lupinus albifrons*	2	5
15	*Isocoma menziesii*	1	
15	Unknown	1	2
18	Unknown	7	7
19	*Lupinus albifrons*	3	3
20	Unknown	5	5
21	*Abronia maritima*	29	29
25	*Coreopsis gigantea*	1	
25	Unknown	5	6
27	*Lupinus albifrons*	2	
27	Unknown	3	5
33	*Astragalus traskiae*	1	
33	*Isocoma menziesii*	5	
33	*Mesembryanthemum crystallinum*	1	
33	Unknown	19	26
34	*Ambrosia chamissonis*	1	
34	*Isocoma menziesii*	1	
34	*Mesembryanthemum crystallinum*	1	
34	Unknown	7	10
36	Unknown	2	2
37	*Isocoma menziesii*	2	2

Recommendations

Grassland transects should be read later in the season, after the other transects, when all grasses are in flower. Data for 1995 may be lacking certain grass species because they were not present or recognizable in early April. For example, on transects 31 and 32 *Hordeum intercedens* was not observed in early April 1995, but was present in high numbers when the area was checked 1 month later in early May. Transect data from 1993 and 1994 support this recommendation. In 1993, transect 31 was sampled in mid-March and *H. intercedens* was not observed; transect 32 was sampled in early May and *H. intercedens* was recorded. Monitoring in 1994 (a dry year) occurred in early April and *H. intercedens* was encountered on both 31 and 32. As with many species, anthesis of *H. intercedens* appears to depend on the specific years' winter and/or spring rainfall pattern. In 1996, a normal, relatively dry rainfall year for southern California, *H. intercedens* was present on both transects during mid to late April. As mentioned earlier, monitoring scheduling depends on seasonal anthesis of grasses which can vary temporally per species.

Future surveyors need to check bearings of transect ends and other directional locators as there have been inconsistent direction bearings given for transect location. Directional procedures were initiated in 1995 and 1996, but should still be double checked for consistency.

Conclusion

Transects located within 8 plant communities were sampled on San Nicolas Island during the flowering seasons of 1993, 1994, 1995, and 1996. Fluctuations in the number of species and species frequencies on transects over the 4 years are probably due to climatic variability and to a lesser extent, sampling error. Approximately 75% of the transects had elevated species richness and frequencies in 1993 and 1995 as compared to 1994 and 1996. This is attributable to heavy precipitation during the 1993 and 1995 growing seasons.

The California Channel Islands vegetation monitoring program is designed to annually sample and quantify island vegetation within recognized plant communities. Over many years this program can measure natural recovery and effectiveness of management actions to restore native island communities.

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Appendix 1

List of Researchers Involved in Sampling Transects for the San Nicolas Island Vegetation Monitoring Program

Year	Researchers	Position
1993	Sarah Chaney	Botanist, Channel Islands N.P.
	Karen Danielson	Botanist, Los Padres N.F.
	* William L. Halvorson	Unit Leader, USGS CPSU
	Joy Hosokawa	Volunteer, Student Conservation Assoc. (SCA)
	Steve Junak	Herbarium Curator, SBBG
	Kathryn McEachern	Research Ecologist, Channel Islands
	Kathy Rindlaub	Botanist Consultant
	Cathy Schwemm	Wildlife Biologist, Channel Islands N.P.
	Linda Vorobik	Scientific Illustrator
	Todd Wills	Biological Technician, NBS
1994	Teresa Goo	Volunteer
	* William L. Halvorson	Unit Leader, USGS CPSU
	Joy Hosokawa	Biological Science Technician, NPS
	Amy Johnson	Biological Science Technician, NPS
	Grace Smith	Biologist, U.S. Navy
1995	Katie Burke	Volunteer, SCA
	* Katie Chess	Research Specialist, The University of Arizona
	David Friedland	Volunteer, SCA
	William L. Halvorson	Unit Leader, USGS CPSU
	Erika Kassop	Volunteer, SCA
	Mark Lemon	Volunteer
	Rebecca Richter	Volunteer, SCA
	Grace Smith	Biologist, U.S. Navy
1996	Alisa Baldwin	Volunteer
	Winter Bonnin	NPS Volunteer
	Brittny Calabrese	Volunteer
	* Katie Chess	Research Specialist, The University of Arizona
	Misty Gonzales	Volunteer
	Derek Lohuis	NPS Volunteer
	Tracy Markley	Environmental Protection Specialist, U.S. Navy
	Grace Smith	Biologist, U.S. Navy

* Indicates team leader.

Appendix 2

Record of San Nicolas Island Vegetation Monitoring Program Nomenclatural Issues

Taxonomic changes, 1995

MUNZ	JEPSON
Amsinckia intermedia	*A. menziesii v. intermedia*
Brassica geniculata	*Hirschfeldia incana*
Bromus rubens	*B. madritensis s. rubens*
Bromus mollis	*B. hordeaceus*
Baccaris pilularis v. consanguinea	*B. pilularis*
Carpobrotus aequilaterus	*C. chilensis*
Crassula erecta	*C. connata*
Dichlostemma puchella v. pauciflora	*D. capitatum*
Gnaphalium chilense	*G. stamineum*
Haplopappus venetus s. furfuraceous	*Isocoma menziesii v. menziesii*
Haplopappus venetus s. vernonioides	*Isocoma menziesii v. vernioides*
Hordeum californicum	*H. brachyantherum s. californicum*
Lotus argophyllus v. ornithopus	*L. argophyllus v. argenteus*
Melilotus albus	*M. alba*
Melilotus indicus	*M. indica*
Poa scabrella	*P. secunda s. secunda*
Trifolium palmeri	*T. gracilentum v. palmeri*
Trifolium tridentatum v. tridentatum	*T. willdenovii*

Other taxonomic issues, 1995

Malacothrix polycephala is not recognized by Munz or Jepson, but is recognized in An Illustrated Flora of San Nicolas Island, California (Junak 1992).

Appendix 3

San Nicolas Island Vegetation Monitoring Program: Plant Species Misidentifications and Inconsistencies that Require Special Attention During Future Monitoring

1. *Camissonia micrantha* (tr 5, 1993), *Lotus scoparius* (tr 20, 1993), *Lupinus arboreus* (tr 6, 1993) and *Polypogon interruptus* (tr 15, 1994) appear in the SNI transect data. The handbook of species lists and transect locations include these species for those specific transects (except *L. arboreus* - tr 6), but they do not appear in the Flora for San Nicolas Island. It is likely that these were misidentifications. Standard procedure for future monitoring should include comparing plant identities against SNI Flora and if discrepencies occur, promptly reconcile them through the Santa Barbara Botanic Garden. Collect and label voucher specimen from the area of the transect (not from the transect!) for future comparisons.

2. Transect 12 had a *Trifolium* species reported for 1993 that has not been seen since. Look for it. Also for transect 12, two *Gnaphalium* species may be present. In 1993 *G. bicolor* was reported, but in 1995 *G. stramineum* was reported. One of them could be misidentified or both may inhabit the community. The *G. stramineum* reported for 1995 was in basal rosette form and was identified as such based on wooliness of foliage.

3. Transect 13 has a similar *Gnaphalium* issue; apparently both species inhabit the area and should be observed closely during future sampling.

4. On transect 15, a *Trifolium* species was reported in 1993 which has not been observed since; future surveyors should look for it.

5. Transect 20 data show *Hordeum brachyantherum* ssp. *californicum* present in 1993 (33 hits), but missing in 1994 and 1995. Future surveyers should look for this species in the transect area.

6. Transect 23, in 1995, had an unknown *Bromus* species that needs to be identified; it may be *B. trinii*. *Hordeum intercedens* and *H. murinum* were reported for transect 23 in 1994. Future researchers should carefully record *Hordeum* species on this transect because *H. intercedens* is native, while *H. murinum* is an introduced, opportunistic weed.

7. Transect 30 data show three *Trifolium* species present in 1993: *T. amplectens, T. palmeri* (rare) and *T. wildenovii*. Data for 1995 report only *T. amplectens* and *T. wildenovii*. Surveyors in 1995 did not know the slight character differences between *T. palmeri* and *T. wildenovii*, so only the latter was recorded. It is probable that *T. palmeri* was encountered but misidentified in 1995. This detail needs to be addressed in the future.

8. Transect 30 1994 data show *Poa secunda* (=*P. scabrella*) present. This plant has not been observed in 1993 or 1995. It may be a misidentification of *Vulpia octoflora* (a native grass species).

9. During 1996 monitoring, transect 34 was sampled incorrectly: an additional end marker mysteriously appeared, transect was set up approximately 90° off of original transect bearing and sampled. This situation will be corrected prior to the 1997 monitoring season.

10. End point markers for transect 35 could not be found in 1996. It is necessary to relocate original end positions and replace transect end markers. This situation will be corrected before the 1997 monitoring season.

Appendix 4

Vegetation Frequency Data from Permanent Point-intercept Line Transects on San Nicolas Island, California, 1993–1996

* = Taxon not native to the Channel Islands.

TRANS.	SPECIES	1993	1994	1995	1996
1	**Coastal Dune - Unstablized Dune**				
	Abronia maritima	78	70	16	39
	Ambrosia chamissonis	19	21	20	14
	* *Cakile maritima*	8	6	23	9
	Dithyrea maritima	2		1	2
	Malacothrix incana		6	12	13
	Litter	5	7	22	5
	Sand	5	8	29	33
	Total Plant Hits	107	103	72	77
	Total Substrate Hits	10	15	51	38
	TOTAL HITS	**117**	**118**	**123**	**115**
2	**Inland Dune - Stablized Dune**				
	Abronia umbellata	15	6		3
	Ambrosia chamissonis	3	1	1	3
	Astragalus traskiae	43	33	32	19
	Atriplex semibaccata				1
	* *Bromus diandrus*		1	7	10
	* *Bromus madritensis* s. *rubens*	46	39	53	37
	* *Cakile maritima*	2			
	Camissonia cheiranthifolia	1	1		
	* *Erodium cicutarium*	64	15	43	25
	* *Erodium moschatum*			4	
	* *Hordeum murinum*		3	4	
	Isocoma menziesii	7	9	12	10
	Lupinus albifrons	5	15	12	10
	Malacothrix incana	7	10	13	13
	* *Medicago polymorpha*			1	
	* *Mesembryanthemum crystallinum*		1	1	
	* *Sonchus oleraceus*	1	3	18	
	Litter	1	15		7
	Sand	3	2	4	4
	Total Plant Hits	194	137	201	131
	Total Substrate Hits	4	17	4	11
	TOTAL HITS	**198**	**154**	**205**	**142**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
3	**Inland Dune - Stabilized Dune**				
	Abronia umbellata	1	3		
	Achillea millefolium	1			
	Ambrosia chamissonis	1	4	1	1
	Astragalus traskiae	8	13	8	13
*	*Atriplex semibaccata*	2	4	6	3
*	*Avena barbata*	10	47		66
*	*Avena barbata/fatua*			82	
*	*Bromus diandrus*	1	12	7	5
*	*Bromus hordeaceus*		2	15	17
*	*Bromus madritensis* s. *rubens*	81	41	38	74
	Calystegia macrostegia s. *macrostegia*	24	26	26	24
*	*Carpobrotus edulis*			1	2
*	*Erodium cicutarium*	27	4	17	12
*	*Erodium moschatum*	19		1	
*	*Hordeum murinum*	1		1	2
	Isocoma menziesii	9	9	8	11
	Lotus argophyllus s. *argenteus*	13	7	1	2
	Lupinus albifrons	10	21	15	17
	Malacothrix incana		1		
*	*Medicago polymorpha*	14	17	9	20
*	*Melilotus indicus*	3			1
*	*Sonchus oleraceus*	4	2	4	
	Litter		1	1	
	Sand				1
	Soil			1	
	Total Plant Hits	229	213	240	270
	Total Substrate Hits	0	1	2	1
	TOTAL HITS	**229**	**214**	**242**	**271**
4	**Coastal Dune -Unstabilized Dune**				
	Ambrosia chamissonis	3	2	3	11
*	*Cakile maritima*	1	2	1	1
	Litter	2	2		3
	Sand	94	94	96	84
	Total Plant Hits	4	4	4	13
	Total Substrate Hits	96	96	96	87
	TOTAL HITS	**100**	**100**	**100**	**100**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
5	**Inland Dune - Stabilized Dune**				
	Abronia umbellata	9	7	3	11
	Amblyopappus pusillus	44	9	11	3
*	*Atriplex semibaccata*	11	6	12	12
*	*Bromus madritensis* s. *rubens*	39	25	59	49
*	*Cakile maritima*			1	
	Calystegia macrostegia s. *macrostegia*		3		4
	Camissonia cheiranthifolia	1		1	2
	Camissonia micrantha	3			3
*	*Carpobrotus edulis*			1	1
	Daucus pusillus			1	
*	*Erodium cicutarium*	38	2	24	19
*	*Erodium moschatum*			11	
*	*Hordeum murinum*	4	6	3	7
	Isocoma menziesii	17	16	17	21
	Lotus argophyllus s. *argenteus*	35	30	15	25
*	*Medicago polymorpha*	6	4	8	2
*	*Melilotus indicus*	1		2	
*	*Mesembryanthemum crystallinum*	32	8	5	11
*	*Mesembryanthemum nodiflorum*	3			
*	*Parapholis incurva*			1	
*	*Sonchus oleraceus*		1	11	1
	Crust			1	6
	Litter		11	1	1
	Sand		14	8	4
	Soil	13		4	
	Total Plant Hits	243	117	186	171
	Total Substrate Hits	13	25	14	11
	TOTAL HITS	**256**	**142**	**200**	**182**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
6	**Isocoma Scrub**				
	Abronia umbellata	1	2		2
	Achillea millefolium	1		2	1
*	*Bromus diandrus*		1		1
*	*Bromus hordeaceus*		2	3	
*	*Bromus madritensis* s. *rubens*	28	13	21	24
	Camissonia cheiranthifolia				1
	Daucus pusillus	18	5	6	6
*	*Erodium cicutarium*	3	4	2	4
*	*Erodium moschatum*			2	
	Isocoma menziesii	19	18	21	20
	Lepidium lasiocarpum v. *lasiocarpum*	2		4	2
	Lotus argophyllus s. *argenteus*	12	7	2	1
	Lupinus albifrons	9	20	25	19
	Lupinus arboreus	1			
	Mesembryanthemum nodiflorum				1
*	*Medicago polymorpha*	2		1	5
*	*Melilotus indicus*		2	7	
*	*Mesembryanthemum crystallinum*		1		2
*	*Parapholis incurva*	2	6	13	3
*	*Plantago ovata*	2			
*	*Sonchus oleraceus*	4	2	6	1
	Crust			6	27
	Litter		1	1	3
	Rock	17	1	5	5
	Sand		45		4
	Soil	31		30	5
	Total Plant Hits	104	83	115	93
	Total Substrate Hits	48	47	42	44
	TOTAL HITS	**152**	**130**	**157**	**137**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
7	**Inland Dune - Stabilized Dune**				
	Abronia umbellata	24	3	1	10
	Ambrosia chamissonis	17	9	17	17
	Astragalus traskiae	13	15	10	12
*	*Atriplex semibaccata*	1		4	2
*	*Bromus diandrus*		1	2	
*	*Bromus madritensis* s. *rubens*	49	37	49	27
*	*Cakile maritima*	4	7	3	3
	Calystegia macrostegia s. *macrostegia*		1		
	Camissonia cheiranthifolia	1		2	
	Daucus pusillus			1	1
*	*Erodium cicutarium*	44	10	48	31
*	*Hordeum murinum*			1	2
	Lepidium lasiocarpum v. *lasiocarpum*	2		1	1
	Lotus argophyllus s. *argenteus*	9	24	12	9
	Lupinus albifrons	9	20	20	24
*	*Medicago polymorpha*	1		1	
*	*Mesembryanthemum crystallinum*	2	2	7	2
*	*Sisymbrium orientale*			3	1
*	*Sonchus oleraceus*	3	1	12	1
	Crust			1	
	Litter	10	8	4	3
	Sand		8		10
	Soil	4			
	Total Plant Hits	179	130	194	143
	Total Substrate Hits	14	16	5	13
	TOTAL HITS	**193**	**146**	**199**	**156**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
8	**Baccharis Scrub**				
	Achillea millefolium	28	26	19	14
	Astragalus traskiae	5	10	11	10
*	*Atriplex semibaccata*	21	20	11	9
*	*Avena barbata*	40	64		44
*	*Avena barbata/fatua*			58	
	Baccharis pilularis	7	11	3	8
*	*Bromus diandrus*		46	70	65
*	*Bromus madritensis* s. *rubens*	42	16	4	12
	Caprobrotus chilensis				8
*	*Carpobrotus chilensis*		5	6	
*	*Erodium cicutarium*	5	2	1	1
*	*Erodium moschatum*	5			
	Gnaphalium stramineum			1	
*	*Hordeum murinum*	2			
	Isocoma menziesii	4		5	6
	Lotus argophyllus s. *argenteus*	3			
	Lupinus albifrons	23	23	35	39
*	*Medicago polymorpha*	9	8	8	11
*	*Melilotus indicus*			7	2
*	*Parapholis incurva*			3	
*	*Sonchus oleraceus*	1	4	3	
	Rock		1		
	Moss				1
	Soil	1	1	1	
	Total Plant Hits	195	235	245	229
	Total Substrate Hits	1	2	1	1
	TOTAL HITS	**196**	**237**	**246**	**230**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
9	**Isocoma Scrub**				
	Achillea millefolium	29	33	28	22
	Amblyopappus pusillus	1			
	Ambrosia chamissonis		1		
*	*Atriplex semibaccata*	3	3		1
*	*Avena barbata*	44	55		44
*	*Avena barbata/fatua*			57	
*	*Bromus diandrus*		49	79	83
*	*Bromus hordeaceus*		1	4	2
*	*Bromus madritensis* s. *rubens*	66	22	6	6
	Crassula connata	4			
*	*Erodium cicutarium*	26	11		2
*	*Hordeum murinum*	3			
	Isocoma menziesii	33	35	29	31
	Lotus argophyllus s. *argenteus*			2	3
	Lupinus albifrons	3	9	16	17
*	*Medicago polymorpha*	5	5	3	14
*	*Melilotus indicus*			1	1
*	*Parapholis incurva*			1	
*	*Sonchus oleraceus*	2			
	Soil		1	1	
	Total Plant Hits	219	224	226	226
	Total Substrate Hits	0	1	1	0
	TOTAL HITS	**219**	**225**	**227**	**226**

TRANS.	SPECIES	1993	1994	1995	1996
10	**Lupine Scrub**				
	Achillea millefolium	10	11	12	15
	Ambrosia chamissonis	3		2	2
*	*Atriplex semibaccata*	1	1	4	4
*	*Avena barbata*	45	60		36
*	*Avena barbata/fatua*			65	
*	*Bromus diandrus*	69	87	88	90
*	*Bromus hordeaceus*		2	4	7
*	*Bromus madritensis* s. *rubens*	15	2	1	1
*	*Erodium cicutarium*	2			
*	*Erodium moschatum*	7			
	Isocoma menziesii	3	4	3	5
	Lupinus albifrons	30	66	37	22
	Malacothrix incana	1	3	4	11
*	*Medicago polymorpha*	4	6	2	11
*	*Melilotus indicus*			2	1
*	*Sonchus oleraceus*	12	1		
	Liter				4
	Total Plant Hits	202	243	224	205
	Total Substrate Hits	0	0	0	4
	TOTAL HITS	**202**	**243**	**224**	**209**
11	**Lupine Scrub**				
	Ambrosia chamissonis	4	5	9	5
*	*Bromus diandrus*	31	61	81	82
*	*Bromus madritensis* s. *rubens*	2	1	1	1
*	*Carpobrotus edulis*	12	21	30	29
*	*Hordeum murinum*		1		
	Isocoma menziesii	4			
	Lupinus albifrons	77	77	20	4
	Malacothrix incana	3	11	6	7
*	*Medicago polymorpha*	1			
*	*Sonchus oleraceus*	3		12	3
	Litter	6	3	3	1
	Sand	2		1	6
	Total Plant Hits	137	177	159	131
	Total Substrate Hits	8	3	4	7
	TOTAL HITS	**145**	**180**	**163**	**138**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
12	**Baccharis Scrub**				
	Achillea millefolium	29	32	48	32
*	*Atriplex semibaccata*	1	1		
*	*Avena barbata*	8	11		16
*	*Avena barbata/fatua*			24	
	Baccharis pilularis	18	12	8	6
*	*Bromus diandrus*	14	33	50	63
*	*Bromus madritensis* s. *rubens*	34	9	30	11
	Crassula connata	3		2	
*	*Erodium cicutarium*	1			
	Gnaphalium bicolor	3			
	Gnaphalium stramineum			6	1
	Heterotheca grandiflora			1	1
*	*Hordeum murinum*	1			
	Isocoma menziesii	9	9	17	26
	Lupinus albifrons	5	14	9	8
	Malacothrix incana	2	1	2	1
	Malacothrix saxatilis v. *implicata*			2	
*	*Medicago polymorpha*	1	2		
*	*Melilotus indicus*	8		11	1
*	*Senecio vulgaris*			1	
*	*Sonchus oleraceus*		1	7	2
	Trifolium species	3			
	Litter	17	24	4	5
	Sand	3	1	3	4
	Soil			1	
	Total Plant Hits	140	125	218	168
	Total Substrate Hits	20	25	8	9
	TOTAL HITS	**160**	**150**	**226**	**177**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
13	**Baccharis Scrub**				
	Achillea millefolium		1		2
	Ambrosia chamissonis		3	2	11
*	*Atriplex semibaccata*	7	4	1	7
*	*Avena barbata*	22	21		36
*	*Avena barbata/fatua*			30	
	Baccharis pilularis	15	13	2	4
*	*Bromus diandrus*	27	61	35	83
	Bromus hordeaceus				30
*	*Bromus madritensis* s. *rubens*	53	10	9	7
	Calystegia macrostegia s. *macrostegia*	17	13	16	15
	Claytonia perfoliata v. *perfoliata*	2		1	
*	*Erodium cicutarium*	3			
	Gnaphalium bicolor	3		3	
	Gnaphalium stramineum			3	2
	Hirschfeldia incana				15
	Hordeum murinum				6
	Isocoma menziesii	11	10	11	18
	Lotus argophyllus s. *argenteus*	2	8	2	
	Lupinus albifrons	2	19	5	
?	*Malacothrix saxatilis*			1	
	Malacothrix incana	21	17	4	6
	Malacothrix polycephala			2	1
	Melilotus indicus				4
*	*Medicago polymorpha*	1		2	3
*	*Melilotus indicus*	2		12	
*	*Parapholis incurva*			4	2
*	*Sonchus oleraceus*	2		10	
	Litter	1	4		
	Sand	2	1		
	Soil			35	
	Total Plant Hits	190	180	155	236
	Total Substrate Hits	3	5	35	0
	TOTAL HITS	**193**	**185**	**190**	**236**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
14	**Isocoma Scrub**				
	Achillea millefolium	1		1	2
	Atriplex californica	1			1
*	*Atriplex semibaccata*	2	2	1	2
*	*Avena barbata*		10		17
*	*Avena barbata/fatua*			22	
*	*Bromus diandrus*	4	19	17	21
*	*Bromus hordeaceus*	4	34	32	32
*	*Bromus madritensis* s. *rubens*	68	34	31	18
*	*Centaurea melitensis*			2	
	Crassula connata	8			
*	*Cynodon dactylon*	1			
	Daucus pusillus	6	1	4	12
*	*Erodium cicutarium*	16	8	3	2
*	*Erodium moschatum*	13		16	
*	*Hordeum murinum*	4		2	5
	Isocoma menziesii	38	33	39	34
*	*Lamarckia aurea*		1		
	Lepidium nitidum v. *nitidum*	1			1
	Lotus argophyllus s. *argenteus*	6	3	11	4
	Lupinus albifrons	15	22	10	22
	Malacothrix polycephala		4	2	
*	*Medicago polymorpha*	25	26	22	31
*	*Melilotus indicus*			7	
*	*Parapholis incurva*	5	11	17	3
*	*Sonchus oleraceus*	7	3	10	6
	Spergularia macrotheca v. *macrotheca*	2	3		1
*	*Vulpia myuros* v. *hirsuta*			11	4
	Crust			1	2
	Litter	1			3
	Rock	6	2	2	3
	Soil	1	2		
	Total Plant Hits	227	214	260	218
	Total Substrate Hits	8	4	3	8
	TOTAL HITS	**235**	**218**	**263**	**226**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
15	**Grassland**				
	Achillea millefolium	22	8	6	3
	Ambrosia chamissonis	8	1	2	2
*	*Atriplex semibaccata*		2		
*	*Avena barbata*	1	9		11
*	*Avena barbata/fatua*			18	
*	*Bromus hordeaceus*		12	14	17
*	*Bromus madritensis* s. *rubens*	28	21	19	12
	Calystegia macrostegia s. *macrostegia*	12	4	7	7
*	*Centaurea melitensis*			2	
	Crassula connata	9		1	1
	Daucus pusillus	1	1	1	2
*	*Erodium cicutarium*	16	8	10	16
*	*Erodium moschatum*			8	
	Gnaphalium bicolor	1			
	Gnaphalium stramineum				1
	Isocoma menziesii	18	17	12	23
*	*Lamarckia aurea*	5		7	8
	Lotus argophyllus s. *argenteus*	10	10	11	3
	Lupinus albifrons	1	2	1	1
*	*Medicago polymorpha*	39	14	32	19
*	*Parapholis incurva*	9		23	8
*	*Polypogon interruptus*		13		
	Sagina apetala	1			
*	*Sonchus oleraceus*	1	7	3	1
	Spergularia macrotheca v. *macrotheca*			1	
	Trifolium species	3			
*	*Vulpia myuros* v. *hirsuta*	8	21	20	14
	Crust			7	22
	Litter			1	2
	Sand	28		13	9
	Rock				2
	Soil		33	7	
	Total Plant Hits	193	150	198	149
	Total Substrate Hits	28	33	28	35
	TOTAL HITS	**221**	**183**	**226**	**184**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
16	**Isocoma Scrub**				
	* *Atriplex semibaccata*	17	16	8	10
	* *Avena barbata*	64	75		54
	* *Avena barbata/fatua*			73	
	* *Bromus diandrus*		78	69	66
	* *Bromus hordeaceus*	42	55	58	64
	* *Bromus madritensis* s. *rubens*	52	5	10	12
	Calystegia macrostegia s. *macrostegia*	12	4	3	1
	* *Centaurea melitensis*	28		19	14
	* *Erodium cicutarium*	59	3		2
	* *Erodium moschatum*			36	
	Gnaphalium bicolor		14	8	
	* *Hordeum murinum*	17	1	12	5
	Isocoma menziesii	3	2	6	10
	* *Medicago polymorpha*	43	24	60	8
	* *Sonchus oleraceus*	2	1	6	1
	* *Vulpia myuros* v. *hirsuta*	4	1	23	16
	Total Plant Hits	343	279	391	263
	Total Substrate Hits	0	0	0	0
	TOTAL HITS	**343**	**279**	**391**	**263**
17	**Isocoma Scrub**				
	Achillea millefolium	2	1	3	3
	Atriplex semibaccata				2
	* *Bromus madritensis* s. *rubens*	4		3	1
	Isocoma menziesii	5	7	2	7
	Lotus argophyllus s. *argenteus*	3		2	3
	* *Mesembryanthemum nodiflorum*	10		7	4
	Crust				17
	Litter	6	2	1	
	Rock	57		39	43
	Sand		90		
	Soil	18		46	22
	Total Plant Hits	24	8	17	20
	Total Substrate Hits	81	92	86	82
	TOTAL HITS	**105**	**100**	**103**	**102**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
18	**Coreopsis**				
	Achillea millefolium		2		1
	Amblyopappus pusillus	3	3	1	
	Atriplex californica	5	1	6	4
*	*Atriplex semibaccata*	2	5	4	3
	Bromus diandrus				1
*	*Bromus hordeaceus*		7	16	20
*	*Bromus madritensis* s. *rubens*	58	56	51	56
	Coreopsis gigantea	26	17	24	19
	Crassula connata	8			1
	Daucus pusillus	11	5	19	7
	Hordeum murinum				1
	Isocoma menziesii	43	30	24	34
	Lomatium insulare	26	11	21	15
	Lotus argophyllus s. *argenteus*		6	6	7
	Lupinus albifrons	21	27	22	22
	Malacothrix polycephala	1			1
*	*Melilotus indicus*			1	
*	*Mesembryanthemum crystallinum*	1			
*	*Mesembryanthemum nodiflorum*	2			
*	*Parapholis incurva*		4	17	1
*	*Sonchus oleraceus*	17	1	14	1
	Crust			1	
	Sand		1		1
	Soil			1	
	Total Plant Hits	224	175	226	194
	Total Substrate Hits	0	1	2	1
	TOTAL HITS	**224**	**176**	**228**	**195**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
19	**Coreopsis**				
	* *Atriplex semibaccata*	3			
	* *Avena barbata*	3	6		6
	* *Avena barbata/fatua*			5	
	* *Bromus diandrus*	10	20	37	35
	* *Bromus hordeaceus*		16	27	30
	* *Bromus madritensis* s. *rubens*	17	8	23	31
	Calystegia macrostegia s. *macrostegia*	3	15	16	15
	Coreopsis gigantea	67	54	58	45
	Crassula connata	26			
	Daucus pusillus	2		1	2
	* *Erodium cicutarium*	3		1	
	Gnaphalium stramineum				1
	Isocoma menziesii	3	3	8	12
	Lotus argophyllus s. *argenteus*		3	2	
	Lupinus albifrons	8	21	7	6
	Malacothrix incana	7	22	14	14
	Malacothrix polycephala	24	9	1	3
	* *Melilotus albus*		3		
	* *Melilotus indicus*	5	1	15	
	* *Parapholis incurva*			1	
	* *Sonchus oleraceus*	3		2	
	Litter	2	6	4	
	Rock		3	3	2
	Wood				3
	Soil	6	1		5
	Total Plant Hits	184	181	218	200
	Total Substrate Hits	8	10	7	10
	TOTAL HITS	**192**	**191**	**225**	**210**

TRANS.	SPECIES	1993	1994	1995	1996
20	**Inland Dune - Stabilized Dune**				
	Abronia umbellata	8	2	1	1
	Amblyopappus pusillus		7	8	3
	Ambrosia chamissonis	8	2	8	5
	Amsinckia menziesii v. *intermedia*	12			
	Atriplex leucophylla				1
*	*Atriplex semibaccata*	3	1	1	
*	*Bromus madritensis* s. *rubens*	1	8	16	20
	Camissonia cheiranthifolia	1			
	Coreopsis gigantea	17	10	37	28
	Daucus pusillus		2	11	
	Distichlis spicata v. *stolonifera*			22	
*	*Erodium cicutarium*	45	6	16	10
	Hordeum brachyantherum s. *californicum*	33			
*	*Hordeum murinum*	1		7	2
	Isocoma menziesii	12	14	24	31
	Lasthenia californica	6			
	Lotus argophyllus s. *argenteus*		42	28	15
	Lotus scoparius	23			
	Lupinus albifrons	10	13	9	15
	Malacothrix incana			3	3
*	*Mesembryanthemum crystallinum*	15	1		
*	*Parapholis incurva*		21	2	5
	Platystemon californicus	9	1		1
*	*Sonchus oleraceus*			2	
	Litter	1	13	3	12
	Sand		1		
	Soil	2		1	
	Total Plant Hits	204	130	195	140
	Total Substrate Hits	3	14	4	12
	TOTAL HITS	**207**	**144**	**199**	**152**
21	**Coastal Dune - Unstabilized Dune**				
	Abronia maritima	70	58	35	34
	Abronia umbellata	1			
*	*Cakile maritima*	1	1	10	2
	Litter		11	18	4
	Sand	29	30	41	60
	Total Plant Hits	72	59	45	36
	Total Substrate Hits	29	41	59	64
	TOTAL HITS	**101**	**100**	**104**	**100**

TRANS.	SPECIES	1993	1994	1995	1996
22	**Lupine Scrub**				
	Ambrosia chamissonis	9	12	3	9
*	*Avena barbata*	18	19		12
*	*Avena barbata/fatua*			19	
*	*Bromus diandrus*	18	17	21	8
*	*Bromus madritensis* s. *rubens*	49	37	34	43
	Coreopsis gigantea	49	49	57	59
	Crassula connata	2	1		
	Cressa truxillensis	1			
	Daucus pusillus	9	1	4	2
*	*Erodium cicutarium*	1	1	4	1
	Isocoma menziesii	3	1	2	3
	Lotus argophyllus s. *argenteus*	3	2	5	6
	Lupinus albifrons	26	25	23	28
	Malacothrix incana	2	1		
	Malacothrix polycephala	14	2	2	
*	*Medicago polymorpha*	1			
*	*Melilotus indicus*	2			
*	*Plantago ovata*	2	1		
	Crust			1	4
	Litter		1		
	Sand	2	5	9	5
	Total Plant Hits	209	169	174	171
	Total Substrate Hits	2	6	10	9
	TOTAL HITS	**211**	**175**	**184**	**180**
23	**Grassland**				
*	*Atriplex semibaccata*	44	38	14	27
*	*Avena barbata*	86	23		
*	*Avena barbata/fatua*			52	52
	Bromus carinatus				1
*	*Bromus diandrus*	97	99	94	100
*	*Bromus hordeaceus*	2			
*	*Bromus madritensis* s. *rubens*	12	4	1	
*	*Bromus species*			6	
*	*Erodium moschatum*			1	
	Hordeum intercedens		1		
*	*Hordeum murinum*	1	2	10	11
	Isocoma menziesii	1		1	3
	Lotus argophyllus s. *argenteus*	3			
*	*Medicago polymorpha*	9	2	7	5
*	*Sonchus oleraceus*	4	2	2	1
*	*Vulpia myuros* v. *hirsuta*	32	7	3	2
	Total Plant Hits	291	178	191	202
	Total Substrate Hits	0	0	0	0
	TOTAL HITS	**291**	**178**	**191**	**202**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
24	**Grassland**				
	Achillea millefolium		1		1
	Amblyopappus pusillus	1			
*	*Atriplex semibaccata*	19	30	3	5
*	*Avena barbata*	84	87		82
*	*Avena barbata/fatua*			93	
*	*Bromus diandrus*	42	49	6	17
*	*Bromus hordeaceus*	71	76	63	86
*	*Bromus madritensis* s. *rubens*	1	8	7	13
	Bromus species				1
*	*Conyza bonariensis*	3			
	Coreopsis gigantea	1		1	1
	Crassula connata			1	
	Daucus pusillus	1			
	Dichelostemma capitatum			17	
	Erodium cicutarium				4
*	*Erodium moschatum*			20	
	Frankenia salina	2			
	Hemizonia clementina	2	1	12	3
*	*Hordeum murinum*	2	7	20	9
	Isocoma menziesii	5	4	9	23
	Juncus bufonius	1		3	
*	*Lactuca serriola*	3			
*	*Lolium perenne*	6			
*	*Medicago polymorpha*	19		33	2
*	*Sonchus oleraceus*	60	1	10	
*	*Vulpia myuros* v. *hirsuta*	2		2	5
	Total Plant Hits	325	264	300	252
	Total Substrate Hits	0	0	0	0
	TOTAL HITS	**325**	**264**	**300**	**252**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
25	**Coreopsis**				
	Amblyopappus pusillus		3		
	Ambrosia chamissonis		1		
*	*Atriplex semibaccata*	7	1	2	
*	*Avena barbata*	14	13		
*	*Avena barbata/fatua*			24	25
*	*Bromus diandrus*	5	14	14	19
*	*Bromus hordeaceus*		36	47	43
*	*Bromus madritensis* s. *rubens*	73	55	43	39
	Calystegia macrostegia s. *macrostegia*	10	9	17	13
	Claytonia perfoliata v. *perfoliata*	24		1	
	Coreopsis gigantea	38	30	48	36
	Crassula connata	2			
	Daucus pusillus	21	4	2	2
*	*Erodium cicutarium*	1			1
*	*Erodium moschatum*	5			
*	*Galium aparine*	4		7	1
	Isocoma menziesii	36	36	22	24
*	*Lamarckia aurea*		1		
	Lasthenia californica	8		1	
	Lotus argophyllus s. *argenteus*	2	2	3	5
	Lupinus albifrons	4	4	4	9
	Malacothrix polycephala	8	1		
*	*Medicago polymorpha*	3		2	
*	*Melilotus indicus*		1		
*	*Sonchus oleraceus*	9		4	
?	*Unknown plant*		1		
*	*Vulpia myuros* v. *hirsuta*		1	4	
	Vulpia octoflora v. *hirtella*	1			
	Litter	1		6	1
	Total Plant Hits	275	213	245	217
	Total Substrate Hits	1	0	6	1
	TOTAL HITS	**276**	**213**	**251**	**218**

TRANS.	SPECIES	1993	1994	1995	1996
26	**Coastal Dune - Unstabilized Dune**				
	Abronia maritima	9	2	10	8
	Ambrosia chamissonis	6	13	11	10
*	*Cakile maritima*	1	3	3	12
	Malacothrix incana	3		1	3
	Litter	1	10		
	Sand	82	75	80	74
	Total Plant Hits	19	18	25	33
	Total Substrate Hits	83	85	80	74
	TOTAL HITS	**102**	**103**	**105**	**107**
27	**Inland Dune - Stabilized Dune**				
	Amblyopappus pusillus		3	2	4
	Ambrosia chamissonis	3	2	2	2
	Astragalus traskiae			1	2
	Atriplex californica			2	
*	*Avena barbata*	6	6		3
*	*Avena barbata/fatua*			20	
*	*Bromus diandrus*	1	19	7	13
*	*Bromus hordeaceus*		15	8	19
*	*Bromus madritensis* s. *rubens*	77	58	35	45
	Calystegia macrostegia s. *macrostegia*		1	1	5
	Cirsium occidentale				2
	Claytonia perfoliata v. *perfoliata*	13		2	2
	Coreopsis gigantea	21	15	22	19
	Crassula connata	11			1
	Daucus pusillus	23	12	19	7
*	*Erodium cicutarium*			5	
	Frankenia salina			1	
*	*Galium aparine*	2		2	3
	Isocoma menziesii	37	50	34	35
*	*Lamarckia aurea*		1		
	Lomatium insulare	4	1	3	2
	Lupinus albifrons	2	13	9	9
	Malacothrix polycephala	20	2		3
*	*Medicago polymorpha*		2	12	
*	*Melilotus indicus*	14	5	4	8
*	*Sonchus oleraceus*	3		1	
	Litter	2	1	4	3
	Moss			1	
	Sand	1	2	4	3
	Soil	2		4	
	Total Plant Hits	237	205	192	184
	Total Substrate Hits	5	3	13	6
	TOTAL HITS	**242**	**208**	**205**	**190**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
28	**Coreopsis**				
	* *Atriplex semibaccata*	2	3	3	6
	* *Avena barbata*	7	48		2
	* *Avena barbata/fatua*			42	8
	* *Bromus diandrus*	24	2	3	12
	* *Bromus hordeaceus*	1	60	62	51
	* *Bromus madritensis* s. *rubens*	50	49	68	40
	Coreopsis gigantea	83	64	74	70
	Crassula connata	4		1	
	Daucus pusillus	16	3	5	1
	Gnaphalium bicolor	2	1	2	
	Isocoma menziesii	13	18	19	26
	Lotus argophyllus s. *argenteus*	6	8	10	13
	Malacothrix polycephala	12		1	
	* *Medicago polymorpha*			1	
	* *Melilotus indicus*	6	4	2	
	* *Sonchus oleraceus*	20	3	9	1
	* *Vulpia myuros* v. *hirsuta*	43		9	5
	Litter	1			1
	Total Plant Hits	289	263	311	235
	Total Substrate Hits	1	0	0	1
	TOTAL HITS	**290**	**263**	**311**	**236**
29	**Coastal Dune - Unstabilized Dune**				
	Abronia maritima	71	59	46	51
	Ambrosia chamissonis		1		2
	Bromus maritimus		9		
	* *Cakile maritima*	5	9	17	9
	* *Parapholis incurva*			1	
	Sonchus oleraceus				1
	Litter	6		18	10
	Sand	19	27	23	30
	Total Plant Hits	76	78	64	63
	Total Substrate Hits	25	27	41	40
	TOTAL HITS	**101**	**105**	**105**	**103**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
30	**Coreopsis**				
	* *Atriplex semibaccata*	3	2	2	
	* *Avena barbata*		32		
	* *Avena barbata/fatua*	2		31	4
	* *Bromus hordeaceus*		39	63	60
	* *Bromus madritensis* s. *rubens*	39	40	50	40
	Coreopsis gigantea	74	48	59	49
	Crassula connata	14		3	
	Daucus pusillus	9		7	1
	Dichelostemma capitatum	29	2	18	
	Distichlis spicata v. *stolonifera*	2			
	* *Erodium cicutarium*	1		3	
	* *Erodium moschatum*	1			
	Gnaphalium bicolor			1	2
	Hemizonia clementina	5	1	15	1
	Isocoma menziesii	24	33	20	33
	Lotus argophyllus s. *argenteus*	5	5	3	3
	Malacothrix polycephala	1			
	* *Medicago polymorpha*	5	5	7	
	* *Melilotus indicus*	5	2	18	5
	Opuntia oricola		2		
	Opuntia prolifera	1		2	2
	Poa secunda v. *secunda*		1		
	* *Senecio vulgaris*			1	
	* *Sonchus oleraceus*	2		1	
	Trifolium amplectens	3		2	
	Trifolium palmeri	1	1		3
	Trifolium willdenovii	5		8	2
	* *Vulpia myuros* v. *hirsuta*	37	9	33	16
	Vulpia octoflora v. *hirtella*	2		12	4
	Crust			1	2
	Litter		1		3
	Total Plant Hits	270	222	359	225
	Total Substrate Hits	0	1	1	5
	TOTAL HITS	**270**	**223**	**360**	**230**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
31	**Grassland**				
	Amblyopappus pusillus		3	12	5
*	*Atriplex semibaccata*	11	29	11	21
*	*Avena barbata*	18	10		20
*	*Avena barbata/fatua*			20	
*	*Bromus hordeaceus*	24	53	88	85
*	*Bromus madritensis* s. *rubens*	52			
*	*Erodium cicutarium*	26	6		16
*	*Erodium moschatum*	46		13	
	Hordeum intercedens		54		28
*	*Lamarckia aurea*	5	5	18	
	Lasthenia californica	40			
*	*Medicago polymorpha*	43		50	1
*	*Mesembryanthemum nodiflorum*	4	9	2	5
	Parapholis incurva				1
*	*Sonchus oleraceus*	4	5	17	
	Spergularia macrotheca v. *macrotheca*	12	21	21	20
	Soil		5		1
	Total Plant Hits	285	195	252	202
	Total Substrate Hits	0	5	0	1
	TOTAL HITS	**285**	**200**	**252**	**203**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
32	**Grassland**				
	Amblyopappus pusillus			1	
*	*Atriplex semibaccata*	13	17	9	19
*	*Avena barbata*	20	30		31
*	*Avena barbata/fatua*			24	
*	*Bromus hordeaceus*	99	85	36	58
*	*Bromus madritensis* s. *rubens*		1	24	7
*	*Centaurea melitensis*	2		1	
	Crassula connata			2	
*	*Erodium cicutarium*	1	2	1	10
*	*Erodium moschatum*			22	
	Hemizonia clementina	8	16	13	15
	Hordeum intercedens	39	30		30
*	*Lamarckia aurea*	27	25	32	7
	Lasthenia californica	1		1	
*	*Medicago polymorpha*	2	1	32	
	Microseris douglasii	1			
*	*Parapholis incurva*	8		14	3
*	*Sonchus oleraceus*		1	6	1
	Spergularia macrotheca v. *macrotheca*	20	20	17	11
	Trifolium albopurpureum			2	
*	*Vulpia myuros* v. *hirsuta*			15	2
	Litter				1
	Crust				1
	Soil		3	3	2
	Total Plant Hits	241	228	252	194
	Total Substrate Hits	0	3	3	4
	TOTAL HITS	**241**	**231**	**255**	**198**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
33	**Isocoma Scrub**				
	Achillea millefolium			1	
	Ambrosia chamissonis	1	1	1	
	Astragalus traskiae	47	48	27	15
*	*Atriplex semibaccata*		1		
*	*Avena barbata*		2		
*	*Bromus diandrus*			9	
*	*Bromus hordeaceus*		1		
*	*Bromus madritensis* s. *rubens*		53	70	13
	Daucus pusillus			1	2
*	*Erodium cicutarium*		2	2	1
*	*Erodium moschatum*			5	
	Isocoma menziesii	45	41	49	16
	Lepidium lasiocarpum v. *lasiocarpum*				1
	Lotus argophyllus s. *argenteus*		1	2	
*	*Medicago polymorpha*		1		
*	*Melilotus indicus*			2	
*	*Mesembryanthemum crystallinum*	8	34	10	11
*	*Sonchus oleraceus*		3	7	
?	*Unknown grass*	70			
	Ash				42
	Litter			3	8
	Rock				3
	Sand		2		8
	Soil	2		1	
	Total Plant Hits	171	188	186	59
	Total Substrate Hits	2	2	4	61
	TOTAL HITS	**173**	**190**	**190**	**120**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
34	**Isocoma Scrub**				
	Amblyopappus pusillus		2	1	1
	Ambrosia chamissonis		4	10	6
	Astragalus traskiae		2	10	16
*	*Avena barbata*		9		14
*	*Avena barbata/fatua*			1	
*	*Bromus diandrus*			19	
*	*Bromus hordeaceus*		3	15	
*	*Bromus madritensis* s. *rubens*		47	56	59
*	*Centaurea melitensis*		3	11	
*	*Erodium cicutarium*		71	28	24
*	*Erodium moschatum*			31	
	Isocoma menziesii			1	4
	Lepidium lasiocarpum v. *lasiocarpum*		1		
	Lotus argophyllus v. *argenteus*				5
	Malacothrix incana				1
*	*Medicago polymorpha*		1	2	
*	*Melilotus indicus*		1	7	
*	*Mesembryanthemum crystallinum*		46	27	10
*	*Sonchus oleraceus*		2	4	2
	Ash				16
	Litter				5
	Rock	15	1	6	4
	Sand				2
	Soil	47	2		
	Total Plant Hits	0	192	223	142
	Total Substrate Hits	62	3	6	27
	TOTAL HITS	**62**	**195**	**229**	**169**

Appendix 4—Continued

TRANS.	SPECIES	1993	1994	1995	1996
35	**Isocoma/Baccharis Scrub**				
	Ambrosia chamissonis			3	
	Astragalus traskiae			1	
*	*Avena barbata*		3		
	Baccharis pilularis		9	19	
*	*Bromus diandrus*			7	
*	*Bromus hordeaceus*		1	20	
*	*Bromus madritensis* s. *rubens*		41	58	
*	*Carpobrotus edulis*	1	1	1	
*	*Erodium cicutarium*		67		
*	*Erodium moschatum*			69	
	Hordeum brachyantherum s. *californicum*		1		
*	*Hordeum murinum*			2	
	Isocoma menziesii	1	2	3	
	Lotus argophyllus s. *argenteus*		1	2	
	Lupinus albifrons		3	3	
*	*Medicago polymorpha*		5	17	
*	*Melilotus indicus*		23		
*	*Mesembryanthemum crystallinum*		1	3	
*	*Sonchus oleraceus*		2		
	Rock	6	7		
	Soil	38	1	1	
	Total Plant Hits	2	160	208	
	Total Substrate Hits	44	8	1	
	TOTAL HITS	**46**	**168**	**209**	

TRANS.	SPECIES	1993	1994	1995	1996
36	**Isocoma/Baccharis Scrub**				
	Astragalus traskiae	21	27	20	18
*	*Atriplex semibaccata*	3	1	1	2
*	*Avena barbata*	4	5		17
*	*Avena barbata/fatua*			11	
	Baccharis pilularis	6	12		1
*	*Bromus diandrus*			1	3
*	*Bromus hordeaceus*		29	36	37
*	*Bromus madritensis* s. *rubens*		18	13	7
*	*Carpobrotus edulis*	2			
	Daucus pusillus			6	4
*	*Erodium cicutarium*		9	2	3
*	*Erodium moschatum*			13	
	Isocoma menziesii	52	52	34	42
	Lotus argophyllus s. *argenteus*		1	1	3
	Lupinus albifrons	3		4	6
*	*Medicago polymorpha*		1	5	5
*	*Melilotus indicus*	6	6	11	1
*	*Mesembryanthemum crystallinum*	1			
*	*Parapholis incurva*			5	
*	*Sonchus oleraceus*		9	7	5
	Unknown grass	55			
	Litter			4	1
	Rock	18	10	13	16
	Soil	2		2	1
	Total Plant Hits	153	170	170	154
	Total Substrate Hits	20	10	19	18
	TOTAL HITS	**173**	**180**	**189**	**172**
37	**Grassland**				
*	*Atriplex semibaccata*			6	
*	*Avena barbata/fatua*			40	52
*	*Bromus diandrus*			96	100
*	*Centaurea melitensis*			1	
*	*Erodium cicutarium*			3	
*	*Erodium moschatum*			1	
*	*Hordeum murinum*			5	1
	Isocoma menziesii			11	10
*	*Medicago polymorpha*			8	3
*	*Sonchus oleraceus*			28	2
*	*Vulpia myuros* v. *hirsuta*			3	
	Total Plant Hits			202	168
	Total Substrate Hits			0	0
	TOTAL HITS			**202**	**168**

As the nation's principal conservation agency, the U.S. Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting fish, wildlife and plants, preserving the environmental and cultural values of national parks and historic places, and providing for enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.