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16. ABSTRACT

This report (Phase II) completes an evaluation of 3 sets of 5 artificial vernal pools located on Travis AFB in Solano County CA. The research was done to determine if artificial vernal pools constructed on Travis AFB in 1993 maintained vernal pool characteristics and to determine if any of the five treatments used to develop the artificial pools are useful for mitigating vernal pool impacts. Phase II consisted of collecting data during the spring of 2002 from artificial pools and the source pools (TR1-TR5) to determine the vegetative success of the vernal pools over time. The artificial vernal pools support a diverse plant population, but lack the vegetative diversity of natural pools. The artificial pools exhibited zonation of plant species correlating with the length of inundation. The greater depth of the artificial pools allowed longer inundation periods than occurred in the nearby natural pools. Plant species associated with longer inundation periods (*Plagiobothrys stipitatus, Eryngium aristulatum)* are benefiting from the design of the artificial pools. By collecting data during Phase II, and comparing that data with previously collected data we determined that plant species vary from year to year in artificial and natural vernal pools at Travis AFB. *Navarretia intertexta, Epilobium pygmaeum, and Lythrum hyssopifolium* were present in 2002, but absent in last year's data (2001).

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LONG TERM EVALUATION OF CHARACTERISTICS IN AN ARTIFICIAL NORTHERN CALIFORNIA VERNAL POOL SYSTEM

RESEARCH PROJECT:

F2000EN214 Final Report

FHWA/CA/TL-2002/24

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DISCLAIMER STATEMENT

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the STATE of CALIFORNIA, Department of Transportation or the FEDERAL HIGHWAY ADMINISTRATION (FHWA). This report does not constitute a standard, specification, or regulation.

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LONG TERM VEGETATION AND FAUNAL SUCCESSION IN AN ARTIFICIAL NORTHERN CALIFORNIA VERNAL POOL SYSTEM

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Executive Summary

This summarizes the final report for California Department of Transportation's (Caltrans) research project F 2000 EN 214 Long Term Vegetation and Invertebrate Succession in an Artificial Northern California Vernal Pool System Phase II. The main objectives of this project are:

- To determine if artificial vernal pools constructed at Travis AFB in 1993 maintained vernal pool characteristics
- To determine if plant species vary from year to year in vernal pool systems
- To determine if any of the five treatments used to develop the artificial pools are useful for mitigating vernal pool impacts

Several aquatic invertebrates and plants that are listed as threatened or endangered under the federal Endangered Species Act, are restricted to vernal pools. Because of the presence of these listed species and uniqueness of the biota, vernal pool impacts from transportation projects may require mitigation. The future development and maintenance of the transportation system will require a better understanding of how highway facilities impact nearby vernal pools and how to preserve the vernal pool habitat.

The report briefly summarizes Sonoma State University's work at Travis for the Department that took place from 1993-1996. Additionally, this report presents the results of Caltrans in-house work performed by the authors at the research site during 2001 and 2002.

The current research was developed to determine how the vernal pool habitat characteristics in the artificial vernal pools at the Travis AFB study area fared over the course of time. In 2001 and 2002, data was collected and evaluated on three sets of five artificial vernal pools. In 2001 and 2002, the data collected included vegetation, hydrology, and soil samples to determine the status of these artificial pools.

Each artificial pool was divided into three zones and a quadrat was used in each zone at random to collect the data. The quadrats were then marked with stakes to insure that it would be placed in the same location on each visit. A digital camera was used to rapidly gather high quality images of the vegetation for analysis. The series of electronic images provided an accurate record of the conditions within the pools during the study.

The following conclusions are based on the observations made in Spring 2001 and Spring 2002.

1. The artificial pools are generally deeper than the natural pools. Inundation periods tend to be longer in the deeper artificial pools than in the shallower natural pools. *Plagiobothrys stipitatus* dominates the deeper zones in most of the artificial pools, but is absent in the shallower natural pools TR16 and SP1. De Weese (1998) observed a shift in species cover in artificial vernal pools starting in the third year after construction, or sometimes sooner. Species preferring longer inundation periods expanded their cover in artificial pools that she surveyed.

2. Species varied from year to year in the artificial and source pools. There were species present in 2002 that were absent in 2001. New species observed in 2002 were *Navarretia squarrosa, Epilobium pygmaeum, Lythrum hyssopifolium, and Navarretia intertexta*.

3. Although the artificial and source pool have similar species. Both the source and the artificial pools appear to be losing diversity over time. The fencing of the source and artificial pools is interfering with a disturbance regime that is needed for the self-sustainability of the pools. The artificial pools appear to have lost plant species since 1996. From 1993 – 1996 Northen, Holve-Hensill and Eakins concluded that out of twenty-four native wetland plants, sixteen showed good to high coverage in the artificial pools (Northen, Holve-Hensill and Eakins, 1998). In 2001, we observed fourteen native species in the artificial pools with seven native species having good coverage.

4. There was a shift in the vegetation zones in the artificial pools from 2001 – 2002. The deep zone species of 2001 shifted to the middle zone in 2002 due to the higher rainfall and longer inundation periods. In the deep zones of some of the artificial pools the longer inundation periods in 2002 created a bare soil zone in the bottom of the pools. Concentric rings of vegetation grew around the outer edges of the bare zones. Species producing distinct rings included *Downingia concolor*, *Plagiobothrys stipitatus*, *Lasthenia glaberrima*, and *Psilocarphus brevissimus*.

5. Vac2 out performed the other inoculation treatments in terms of native versus non-native relative cover. The Blocks, Soil, and Control treatments had greater amounts of non-native species compared to Vac2. In Northen, Holve-Hensill and Eakins report, the Soil treatment out performed Vac2 and Blocks (Northen, Holve-Hensill and Eakins, 1998).

6. After eight years, vegetation spread is limited in the Blocks treatment. The Blocks treatment appears to be the least desirable inoculation treatment.

Long-term studies are needed to collect sufficient data to fully determine the vegetative success of the vernal pools. For example, in the two years of our study we observed some different species in the vernal pools on Travis AFB. Several years of sampling may be necessary to truly characterize a pool.

In determining if an area contains vernal pool plants, a single visit during any given year may not be sufficient to identify all species. There is a shift from early blooming species to late blooming species in the Travis AFB vernal pools. *Downingia concolor* and *Lasthenia glaberrima* were apparent early in the season and absent later in the season. In contrast *Hemizonia fitchii* and *Eremocarpus setigerus*, grew significantly in the late season. It may not be appropriate to visit a vernal pool system only in the later months of the year to determine its vegetative classification.

The amount of rainfall in a season can play a role in the apparent vegetation during an individual year in a vernal pool system. In the first year (2001) of our study, there was a lower amount of rainfall producing shorter inundation periods than in 2002. In 2002 the pools had a higher amount of relative cover and fewer invasive grasses than in 2001. Vegetation in a drought season can be different than a season with sufficient rainfall.

INTRODUCTION

Purpose of the Report

This is the final report for California Department of Transportation's (Caltrans) research project F 2000 EN 214 *Long Term Vegetation and Invertebrate Succession in an Artificial Northern California Vernal Pool System Phase II*. The objectives of this project are:

- to determine if artificial vernal pools constructed at Travis AFB in 1993 maintained vernal pool characteristics,
- to determine if plant species vary from year to year in vernal pool systems,
- to determine if any of the five treatments used to develop the artificial pools are useful for mitigating vernal pool impacts.

The report briefly summarizes Sonoma State Universities work at Travis for the Department that took place from 1993 to 1996 and CSU Fresno's work in Madera County for the Department that took place from 1993 to 1996. Additionally, this report presents the results of Caltrans in-house work performed by the authors at the research site during 2001 and 2002.

Definition of Vernal Pools

Vernal pools are seasonal wetlands that form in shallow depressions underlain by a shallow substrate that restricts water percolation. The pools fill during the winter rainy season and dry out during the spring (Sawyer and Keeler-Wolf, 1995). Vernal pools have unique vegetation communities that often exhibit showy displays of springtime wildflowers.

The wet season inundation periods of vernal pools vary greatly from a few days to several months. An individual pool may undergo several cycles of inundation and drying during one winter, but the soil in a pool usually remains saturated until spring. Although inundation occurs during the winter, in most years the temperatures in lowland California are high enough for plant growth to occur when pools contain water. The pools finally dry out during the spring or early summer and remain desiccated until the rains of the following wet season. When completely dry the soil moisture in the pool is the same as the soil moisture of the adjacent uplands.

The seasonal variation between inundation and complete desiccation limits the flora that can occupy vernal pool habitat. Most upland plants are precluded by the presence of freestanding water and saturated soil for extended periods during the rainy season, while most wetland plants are precluded by the complete desiccation of the pool soils during the summer. Only a few species tolerate the alternately extreme conditions of inundation and drought.

Importance of Pools and Vernal Pool Studies

Several species of shrimp and plants that are restricted to vernal pools are listed as threatened or endangered under the federal Endangered Species Act. Because of the presence of these listed species and the uniqueness of the biota, vernal pool impacts from transportation projects may require mitigation. Yet there is significant controversy

concerning the use of habitat creation and restoration to mitigate vernal pool losses (Sutter and Francisco 1998). Attempts at creating vernal pools for mitigation have only been partially successful (Barbour 1998, De Weese 1998). Both direct and indirect impacts will result from the expansion and operations of the state highway system. These impacts will require appropriate mitigation. The future development of and maintenance of the transportation system will require a better understanding of how highway facilities impact nearby vernal pools and how to preserve vernal pool habitat.

For habitat mitigation to be successful one must not only show that the habitat can be initially created, but also that the habitat can be maintained over time. De Weese noted that in her experience, constructed vernal pools appear to have comparable plant diversity to natural source pools for the first two years (De Weese 1998). However, later species that prefer longer inundation periods begin to become more dominant. The major question in this current study is whether or not the constructed vernal pools at Travis AFB continue to maintain the hydrological, faunal, and floral characteristics of vernal pools.

Location of the Study Site

The study site is located on Travis AFB in Solano County CA southwest of the David Grant USAF Medical Center and near the western boundary of the base. A complete description of the study site including maps and aerial photographs is found in Northen, Holve-Hensill and Eakins (1998). The location of natural pools TR1-TR5 is southwest of the artificial vernal pools located on Travis AFB.

Summary of Sonoma State Study

This study is the continuation of the work done from the autumn of 1993 to the summer of 1996 at the Travis AFB study site by Sonoma State University. In November 1993, fifteen 3m x 10m rectangular artificial vernal pools were constructed to determine if then current methods of artificial vernal pool restoration could be successful in the southern Sacramento Valley. The deep end of each pool was excavated to a depth of 80 cm on the downhill side. The pool was then excavated to form a plane that merged with the soil surface at the uphill end of the pool. Side slopes were graded to approximately 30 degrees. The pools were constructed in this way to facilitate statistical comparisons among the treatments.

The artificial vernal pools at Travis AFB were developed to compare four different planting techniques:

- scraping and vacuuming source materials from the soil surface of natural pools and placing the collected materials on the natural soil surface of artificial pools,
- cutting blocks of soil from the bottom of source pools and placing these blocks in shallow trenches in artificial pools,
- spreading crushed vernal pool soil on the bottom of artificial pools,
- letting artificial pools lie fallow.

Vegetation, hydrology, and invertebrates were monitored during 1993, 1994, 1995 and 1996. This work was performed for the Department by Sonoma State University under contract 65T343. The final report for the original project is: Northen, Philip T., Susan Holve-Hensill and Doug Eakins. April 15, 1998. *Techniques for Mitigating Loss of Vernal*

Pools: an Experimental Approach. California Department of Transportation. Sacramento CA.

The Sonoma State team reached the following major conclusions:

1. All artificial pools behaved as functional vernal pools during the 2-3 year period of observation.
2. Waiting through one wet season before inoculating a vacuum/scrape pools did not improve success.
3. Inoculating artificial pools with pulverized soil is superior to vacuum/scrape pools and block methods in creating successful vernal pools.
4. The source pools in the study lost plant diversity rapidly over the four years of observation and began developing thatch. Central valley vernal pools may require regular disturbance to maintain high diversity and other wetland values.

The propagule removal methods differed in how they affected the source pools. Creating shallow, unfilled depressions by removing soil had no adverse effects, and is the preferred method for removing inoculum.

<u>The CSU Fresno Study</u>

The Department sponsored another vernal pool creation study in the San Joaquin Valley in Madera County. A research team from CSU Fresno performed the research. The objective of this study was to develop methods for:

- enhancing existing degraded vernal pools,
- creating artificial pools with the characteristics of natural vernal pools in the San Joaquin Valley.

The final report for the CSU Fresno study is Stebins, John C., James R Brownwell and William Traylor. September 1, 1996. *Effective Mitigation Techniques for Central Valley Vernal Pools.*

The research team observed and recorded the physical and botanical aspects of vernal pools in Madera and Fresno Counties. Specific vascular plant species were matched to vernal pool features such as depth, slope, overall dimensions and soil type. Using the collected data the research team supervised construction of 17 pools and swales at a site adjacent to the Madera Equalization Reservoir during September 1993. Specific sites were selected based primarily on slope, soil characteristics, vegetation present and proximity to natural vernal pools.

Unlike the Travis AFB site, the artificial pools at the Madera site were not constructed to provide replicates for statistical analysis. Two basic types were constructed, swale-like and bowl-like. The swale-like pools were between 8 to 12 inches deep. These pools were sloped with the deep side at one end. Bowl-like pools were deeper 12 to 18 inches and had the deepest portion at the center. Four pools were bowl-liked, eleven pools were swale-like and two pools were intermediate. In some instances bentonite was used to reduce soil permeability. The pools were planted with propagules collected from local pools during the spring and summer of 1993.

Vegetation data were collected along a permanent transect bisecting each pool which passed through the deepest site in each pool. Data were collected from within a 10 cm X

10 cm frame at 20 cm intervals along the transect. Vigor and success of sensitive species were determined via field observations and professional judgment.

Among the findings of the CSU Fresno team:

- Bowl-like and deeper swale-like pools held water sooner and for longer periods than shallow swale like pools, all created pools containing bentonite held water earlier and longer than nearby natural pools;
- absolute cover measurements suggested that many of the created pools were similar to natural pools, however a large portion of the cover was of weedy species;
- absolute cover was not a good measure for success;
- in most pools *Hordeum murinum* was dominant; In the third season some pools were dominated by hydrophytic species, while others were dominated by weedy species;
- bowl-like and deeper pools appeared to be the most suitable for establishment of obligate wetland species;
- cover values vary for each species from year to year, when the same species retains dominance over time those species are good indicators of a pool's character;
- *Hordeum murinum* is often associated with the moist disturbed edges of central valley vernal pools;
- bowl-like pools with moderate depth and intermediate type pools demonstrated greater stability in water holding capacity and seem to be a more appropriate design for many plant species;
- many of the swale-like pools became infested by invasive grasses which produced a heavy thatch which prevented the growth of more desirable species;
- deep bowl-like pools developed centers without vegetation probably due to the long inundation periods;
- shallower bow-like and intermediate pools seemed to provide more vernal pool vegetation habitat.

There appears to be significant variability in relative cover for vernal pool species in the same pool from year to year.

<u>The Current Study</u>

The research project F 2000 EN 214 *Long Term Evaluation of Characteristics in an Artificial Northern California Vernal Pool System Phase II* is the second phase of a study developed to determine how the vernal pool habitat characteristics in the artificial vernal pools at the Travis AFB study area fared over the course of time. Consequently, the research site was revisited in 2001 and 2002. During these visits data was collected on vegetation, hydrology, and soils to determine the status of the artificial pools and make observations on the methods used by Sonoma State to develop the artificial vernal pools. Originally the project envisioned a study of the fauna of the artificial pools and samples were collected during the spring of 2002. However, due to the time required for analyzing the vegetation data the faunal aspect was dropped from the project.

The objectives of this project are:

- to determine if artificial vernal pools constructed at Travis AFB in 1993 maintained vernal pool characteristics,

- to determine if plant species vary from 2001 to 2002 in vernal pool systems,
- to determine if any of the five treatments used to develop the artificial pools are useful for mitigating vernal pool impacts.
- to determine if artificial vernal pools sustained source pool characteristics

VEGETATION METHODS

Purpose of the Vegetation Study

The purpose of the vegetation study was to describe and analyze the vegetation in the artificial vernal pools and the source pools to determine:

- if the artificial vernal pools contained vernal pool plant communities,
- how the vegetation in the artificial vernal pools compared to the vegetation in the source pools,
- how the vegetation currently in the source pools compared to the vegetation in the source pools in 1994.

Use of the digital Camera to gather data

The vernal pool blooming season, when plants can be best identified, and cover abundance observed occurs during a relatively short period in the spring. During the spring, the vegetation apparent in the vernal pools changes rapidly as temperatures rise and the soil becomes dry. It was not practical to use only manual methods to develop the needed quantities of data in the limited time available. Therefore, we used an Olympus 2500 digital camera to rapidly gather high quality images of the vegetation for analysis. The high color fidelity and sharpness of the images produced the digital camera allow proper identification of plant species, estimates of percent cover and analysis of other vegetation characteristics. The series of electronic images provides an accurate record of the conditions within the pools over the course of the study. Digital images can be compared within a season and from year to year.

Description of Vegetation Sampling Methods During 2001

We visited the research site on: 01/17/01, 02/01/01, 03/01/01, 03/22/01, 03/29/01, 04/10/01, 04/26/01, 05/03/01, and 06/08/01 to gather vegetation data. On each visit wide angle and close up images were taken of each artificial and natural pool. One wide-angle image of each entire pool was taken from the pools shallow end.

Natural vernal pools often exhibit vegetation zonation due to differing lengths of inundation in the deeper versus the shallower portions of pools. Different vernal pool plant species form rings at different elevations around the perimeter of a pool because each species is adapted to growing in soil inundated for a particular period of time. Species adapted to longer inundation periods tend to grow lower in pools than species adapted to shorter inundation periods. The design of the artificial pools with a deep end sloping to a shallow end led to such vegetation zonation. We decided to stratify the pools into deep, middle, and shallow zone.

Close ups were taken of the deep, middle, and shallow zone of each artificial pool as defined by pool depth. The close up images were of representative homogenous areas of the strata in the pools. Plant species in each artificial and natural pool were identified

on site. If we were not able to identify the plant on site a close up image or sample of the plant in question was collected for identification. Species identifications are according to the corrected third printing of The Jepson Manual: Higher Plants of California (Hickman ed., 1996).

Description of Vegetation Sampling Methods During 2002

We visited the site on several dates: 03/08/02, 03/21/02, 04/02/02, 04/08/02, 04/12/02, 04/19/02, 04/22/02, 05/01/02, 06/05/02, 06/14/02, and 06/21/02. On each date field notes were taken on the condition of the pools. If a pool was filled with water, muddy, or had plants too small to be identified, it was not possible to collect vegetation data. We selected 04/19/02, 05/01/02, and 06/05/02 for vegetation data analysis. These dates were selected, because we had complete vegetation data and they were very close to data analysis dates in 2001 thus enhancing year-to-year comparison. The rest of the data collected is in the appendix.

On each visit wide angle and close up images were taken of each artificial and natural pool. One wide-angle image of each entire pool was taken from the pools shallow end. Close ups of plots were taken of the deep, middle, and shallow zone of each artificial pool as defined by pool depth (Photo 1). All the data was collected by Craig Moore and Monica Bastian.

Based on the observations of 2001 the pools were stratified into deep, middle, and shallow zones. Data collection points were randomly selected at random within each stratum in each pool. To sample the vegetation in the pools, we used quadrats of (1864.5 cm^2). The quadrants were delineated by a frame with the dimensions of 43.18 centimeters, constructed from PVC pipe (Photo 2). Plant species in each quadrat were identified on site (photo 1). In addition, field notes were taken on the plant species in each zone.

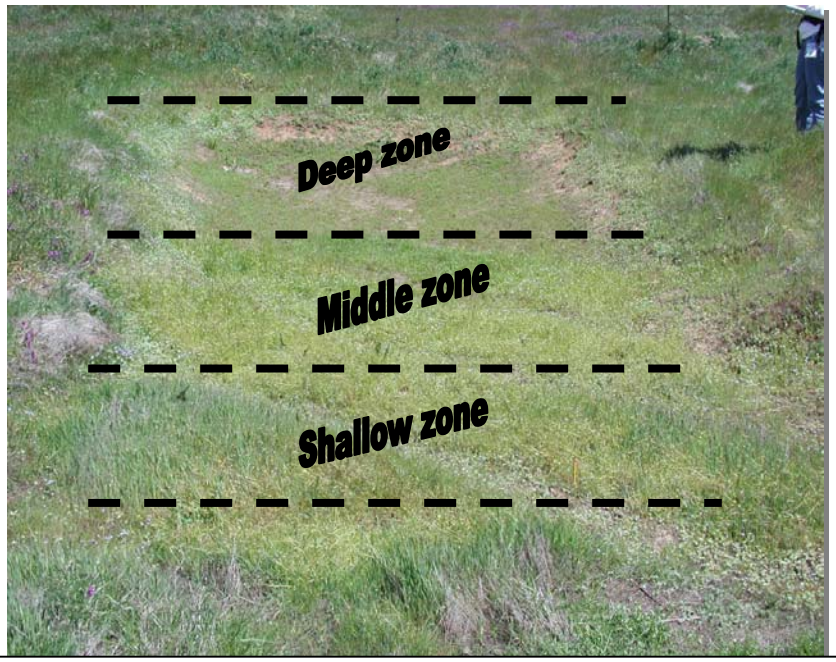


Photo 1. Wide-angle image of Artificial Pool B1 with lines indicating deep, middle, and shallow zones.

Photo 2. Close up image of quadrat.

If we were not able to identify the plant on site a close up image or sample of the plant in question was collected for identification. Species identifications are according to the corrected third printing of The Jepson Manual: Higher Plants of California (Hickman ed., 1996).

Data Analysis

We designed the data analysis to meet the objectives for the vegetation study indicated above. The final analysis design is based on the experience obtained during the Sonoma State, CSU Fresno studies, review of the literature, and the first year of the present study.

One of the objectives of Sonoma State's study was to develop sets of experimental replicate vegetation stands to compare the results of the four different planting treatments. Therefore, the experimental design contained three replicates for each of the four inoculation methods and three fallow pools for controls. Parametric statistical comparisons were made among the sets of replicates (Northern, Holve-Hensil, Eakins, 1998).

However, subsequent analysis indicated high variability within the replicate sets. This high variability combined with the small number of replicates precludes parametric statistical analysis in the current study. Consequently, we decided to use tabular comparisons (Mueller – Dombois and Ellenberg, 1974) to analyze and compare the vegetation in both the natural and artificial pools based on floristic criteria.

The photos of each artificial and natural pool were analyzed using 2001 Vernal Pool Classification – Releve Data Forms (Witham, 2000). Each individual image was used as a releve. Each plant species on the image was identified and the percentage of cover abundance for each species was ocularly estimated. The percentages of plant cover for each plant species were converted to an absolute scale value using the Braun – Blanquet Cover Abundance Scale Table (Mueller – Dombois and Ellenberg, 1974).

Table 1. *Braun-Blanquet Cover-Abundance Scale.*

ABSOLUTE SCALE VALUE	PERCENTAGE OF RELATIVE COVER
5	Any number, with cover more than ¾ of the reference area (>75%)
4	Any number, with ½ - ¾ cover (50 – 75%)
3	Any number, with ¼ - ½ cover (25 – 50%)
2	Any number with 1/20 – ¼ cover (5-25%)
1	Numerous, but less than 1/20 cover, or scattered, with cover up to 1/20 (5%)
+	Few, with small cover
r	Solitary, with small cover

(Mueller – Dombois and Ellenberg, 1974)

A Raw Table and a Constancy Table were constructed for each date and for each zone following the method of floristic comparisons (Mueller – Dombois and Ellenberg, 1974). A raw table consists of a list of all species and all releves and the cover abundance ratings for each releve in tabular form to facilitate further floristic analysis. The Raw Table is assembled with a vertical column allotted for each releve (or picture). The species are listed in a horizontal column and the percentage number of species found in the releve is entered beneath. This table allows certain species to be emphasized right away (i.e. those that are more abundant are clearly visible). Following the Raw Data Table, species were sorted according to their "degree of constancy." Constancy refers to the number of times a species occurs for a given number of releves. Species that are found in a high proportion of the releves have high constancy. Those species that are found in a low proportion of the releves have low constancy. The order of species is then arranged from high to low "constancy." The purpose of the constancy table is to allow an immediate comparison of the individual releves to one another; for example, species that are similar in constancy can be distinguished.

The Zone Average Tables represents the average relative cover of each species for each of the inoculation techniques on an individual date. For example, inoculation technique Vac1 consists of artificial pools A1, B4, and C3. For each inoculation technique, the absolute scale values of each artificial pool were added together and averaged. The average number was designated as the Relative Cover for each inoculation technique. After calculating the zone averages a graph was constructed showing the Relative Cover on each date.

The Native vs. Non-native Species Tables was compiled using the Zone Average Tables for each date. The vernal pool species of each inoculation technique, artificial pool, and natural/source pool were arranged according to native and non-native species. The zone averages of each species were added together to compare the cover of the native versus non-native species in each artificial pool and natural vernal pools. Species were identified as Native or Non-native according to the corrected third printing of The Jepson Manual: Higher Plants of California (Hickman ed., 1996).

After data collection was completed in 2002, photos, data sets, and tables for 2001 were reviewed for accuracy and in some cases were corrected. The corrected data were used in the 2002 analysis.

Natural Source Pool TR17

After observing the condition of source pool TR17, it was decided to exclude it from our analysis because the vegetative composition of the pool was considerably different from its composition in 1994. Non-native plants now dominate the pool. Any comparison would lead to TR17 failing to resemble the artificial pools it had inoculated. TR17 was the source pool for the B series artificial pools. Northern, Holve-Hensill, and Eakins (1998) stated that the source pools lost plant diversity rapidly over the four-year study and begin developing thatch.

Photos 3 and 4 compare TR17 as pictured in 1994 and again in 2002. In 1994, TR17 appeared to have fewer amounts of invasive species and higher amounts of native species. In 2002, our study shows that TR17 developed many invasive species and thatch. TR17 is fenced in which prevents grazing and other disturbances.

Photo 3. Source Pool TR17 in 1994 (Northern, Holve-Hensil, Eakins 1998).

Photo 4. Source Pool TR17 in 2002.

VEGETATION RESULTS FOR 2001

Species Constancy in the Shallow, Middle and Deep Zones on 04/26/01

We observed eleven plant species growing in the artificial pools on 04/26/01 (Tables 2-4). *Downingia concolor* appears to succeed in the shallow to middle zones, where the most abundant and constant species is *Psilocarphus brevissimus*. In the deep zone, *Plagiobothrys stipitatus* was the most abundant and constant species. The grasses appeared in the shallow zones on this date.

Table 2. Species constancy in Shallow Zone on 04/26/01.

Constancy Table 042601	Shallow Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	2	2	2	1	2		1	4	4		1		2	3	3
Downingia concolor			1	1	r		+	1	r	r				+	1
Lasthenia glaberrima		3		3	+	2		+			5				
Erodium botrys			1			2		1					1		
Eryngium aristulatum				1			+			1	2				
Plagiobothrys stipitatus	+	2				+								+	1
Convolvulus arvensis	2				+			+							
Lupinus bicolor						2	+								
Anagalis arvensis							1								
Hemizonia fitchii			2												
Lasthenia macrantha ssp. bakeri															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Asclepias fascicularis															
Cyperus eragrostis															
Rumex crispus															
Eleocharis macrostachya															
Grasses															
Hordeum murinum	2			2	3	3	3	2	1	3			2	3	2
Taeniatherum caput-medusae															
Polypogon monspeliensis															
Lolium multiflorum															
Other															
bare soil	2	2	3	2	2	1	2	1	3	3	1		3	3	2
algae/algal matting															

Table 3. Species constancy in the Middle Zone on 04/26/01.

Constancy Table 042601	Middle Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	2	1	5		1	2	3	2	4	2	1		3	3	3
Plagiobothrys stipitatus		2	1	1	5	2		1	2	1	2	3		2	4
Lasthenia glaberrima	r	4		5	1		1	3		3	5	3			
Eryngium aristulatum	2	1		1			1		1		2				
Downingia concolor			r			1	+			1		1			
Convolvulus arvensis										1			r		
Anagalis arvensis						1									
Erodium botrys													+		
Lupinus bicolor															
Lasthenia macrantha ssp. bakeri															
Hemizonia fitchii															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Asclepias fascicularis															
Cyperus eragrostis															
Rumex crispus															
Eleocharis macrostachya															
Grasses															
Hordeum murinum	2		1			2	1			1			1		
Taeniatherum caput-medusae															
Polypogon monspeliensis															
Lolium multiflorum															
Other															
bare soil	2	2	2	1		1	3	2	2	2	1	1	3	2	2
algae/algal matting					2										

Table 4. Species constancy in the Deep Zone on 04/26/01.

Constancy Table 042601	Deep Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Plagiobothrys stipitatus	4	5	4	5	5	5	3	3	4	3	5	5		3	5
Psilocarphus brevissimus	1		2				3	2				1	3	2	2
Eryngium aristulatum	1	1		1					2	1	+		1		
Lasthenia glaberrima				1			2	2		3	1				
Convolvulus arvensis							1			+					
Anagalis arvensis															
Downingia concolor															
Erodium botrys															
Lupinus bicolor															
Lasthenia macrantha ssp. bakeri															
Hemizonia fitchii															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Asclepias fascicularis															
Cyperus eragrostis															
Rumex crispus															
Eleocharis macrostachya															
Grasses															
Hordeum murinum							2	1					1		
Taeniatherum caput-medusae															
Polypogon monspeliensis															
Lolium multiflorum															
Other															
bare soil	2	2	3		1	1	1	2	2	2		1	3		2
algae/algal matting				2	2						2			2	

Plagiobothrys stipitatus had the highest average cover among species present on 04/26/01. Among the inoculation treatment, Vac2, had the highest relative cover (7.02). The relative cover ranged from 5.69 to 7.02 (Table 5 and Figure 1).

Table 5. Average cover of species present in all zones in each inoculation treatment on 04/26/01.

Zone Averages 042601	Inoculation Treatments				
List of Species	Vac1	Blocks	Vac2	Soil	Control
Plagiobothrys stipitatus	2.01	2.56	1.44	2.11	1.67
Psilocarphus brevissimus	1.89	0.67	2.56	0.56	2.67
Eryngium aristulatum	0.56	0.33	0.45	0.67	0.11
Downingia concolor	0.11	0.22	0.12	0.22	0.12
Lasthenia glaberrima	0.78	1.34	0.89	2.22	
Erodium botrys	0.11	0.22	0.11		0.12
Convolvulus arvensis	0.22	0.006	0.12	0.12	
Anagalis fascicularis		0.11	0.11		
Lupinus bicolor		0.11	0.11		
Hemizonia fitchii		0.11			
Eremocarpus setigerus					
Centaurium muehlenbergii					
Xanthium strumarium					
Asclepias asperula					
Cyperus eragrostis					
Lasthenia macrantha ssp. bakeri					
Rumex crispus					
Eleocharis macrostachya					
Grasses					
Hordeum murinum	0.56	1.11	1.11	0.44	1
Lolium multiflorum					
Taeniatherum caput-medusae					
Polypogon monspeliensis					
Other					
bare soil	2.22	1	1.89	1.22	2.22
algae/algal matting		0.67		0.22	0.22
Relative Cover (average)	6.24	6.79	7.02	6.34	5.69

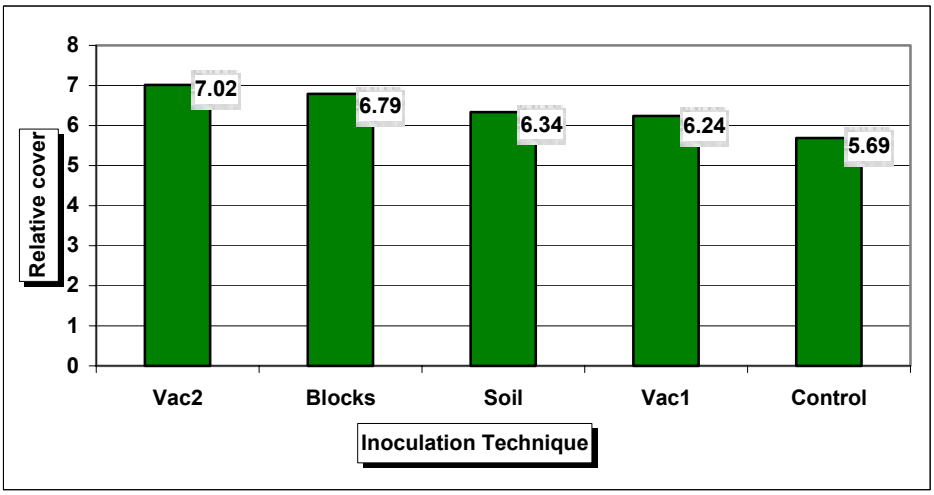


Figure 1. Relative Cover on 04/26/01.

Species Constancy in the Shallow, Middle, and Deep Zones on 05/03/01

There were ten plant species observed in the artificial pools on 05/03/01 (Tables 6-8). In the shallow zone, *Downingia concolor* was the most constant species, but *Psilocarphus brevissimus* had a greater amount of relative cover. In the middle zones, *Psilocarphus brevissimus* was the most constant and abundant species. *Lasthenia glaberrima* grew in all zones, but had higher relative cover in the middle zones. In the deep zone, *Plagiobothrys stipitatus* was the most abundant and constant species. The amount of grasses increased compared to 04/26/01.

Table 6. Species constancy in the Shallow Zone on 05/03/01.

	Shallow Zone														
Constancy Table 050301	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Downingia concolor	+		+	1	1	1	+	+	+	1	r	1		1	
Psilocarphus brevissimus	2	3	4	2	4		2	3	4		3		2	3	4
Eryngium aristulatum	2	2		1			2	1	1	1	2		1		
Lasthenia glaberrima	+	1		2	1	1	1	+	+		1				
Plagiobothrys stipitatus		+			2	1								+	+
Erodium botrys						1	+					1			
Anagalis arvensis							1					1			
Convolvulus arvensis			+												
Hemizonia fitchii															
Lasthenia macrantha ssp. bakeri															
Lupinus bicolor															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Asclepias fascicularis															
Cyperus eragrostis															
Rumex crispus															
Eleocharis macrostachya															
Grasses															
Hordeum murinum	2	2		3		4	2	3	1	4	2	4	3	3	1
Lolium multiflorum		1					1								
Taeniatherum caput-medusae															
Polypogon monspeliensis															
Other															
bare soil	3	3	2	2	2	2	1	3	2	2	1	1	3	3	3
algae/algal matting															

Table 7. Species constancy in the Middle Zone on 05/03/01.

Constancy Table 050301	Middle Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	2	2	3	1	2	3	3	3	4	2	2	1	3	2	4
Plagiobothrys stipitatus		1	1	+	4	+		+	+	1	1	1		2	2
Lasthenia glaberrima	+	2		3	1		+	1		2	4	1			
Eryngium aristulatum	2	1		2			1	1	2		2		2		
Downingia concolor				1		2	+			1		1		1	
Convolvulus arvensis			+	1						+			+		
Hemizonia fitchii			2												
Asclepias fascicularis															
Erodium botrys															
Lasthenia macrantha ssp. bakeri															
Lupinus bicolor															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Asclepias asperula															
Cyperus eragrostis															
Rumex crispus															
Eleocharis macrostachya															
Grasses															
Hordeum murinum	2						2	1					1	1	
Lolium multiflorum													1		
Taeniatherum caput-medusae															
Polypogon monspeliensis															
Other															
bare soil	3	2	3	3	1	+	3	2	3	3	1	+	3	3	3
algae/algal matting					2										

Table 8. Species constancy in the Deep Zone on 05/03/01.

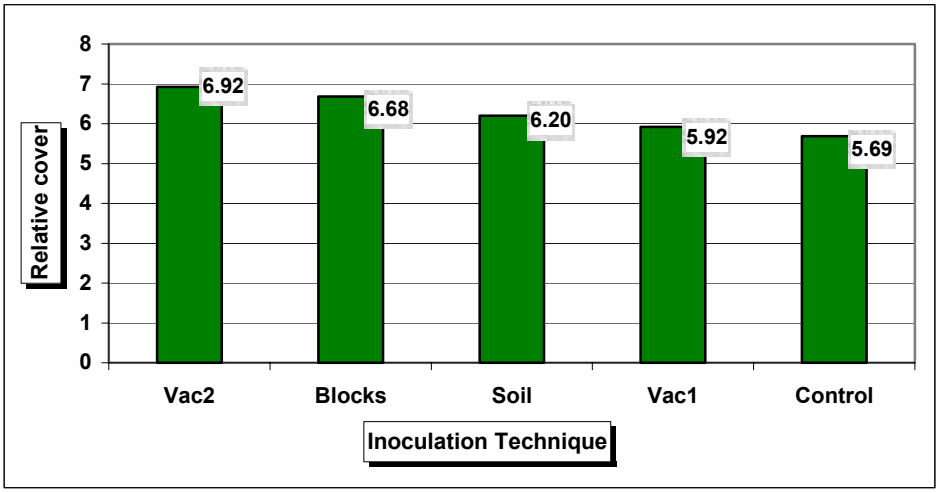
Constancy Table 050301	Deep Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Plagiobothrys stipitatus		2	4	r	3	4	+	+	3	r	4	2		3	3
Psilocarphus brevissimus	1	2	1		1		3	2	1			1	2		2
Eryngium aristulatum	1	2		2			2	+	2	2	1		1		
Lasthenia glaberrima		1		2			1			2	+			+	
Convolvulus arvensis	1						1						1		
Downingia concolor	1			1						1					
Anagalis arvensis															
Erodium botrys															
Lupinus bicolor															
Hemizonia fitchii															
Lasthenia macrantha ssp. bakeri															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Asclepias fascicularis															
Cyperus eragrostis															
Rumex crispus															
Eleocharis macrostachya															
Grasses															
Hordeum murinum	1					2	2	2				3	+		2
Lolium multiflorum															
Taeniatherum caput-medusae															
Polypogon monspeliensis															
Other															
bare soil	4	2	3	3		1	2	4	3	3	3	2	4		3
algae/algal matting					3									3	

Psilocarphus brevissimus had the highest average cover on 05/03/01 (Table 9). *Plagiobothrys stipitatus* dominated the deep zone early in the season and declined over time. Inoculation treatment, Vac2, had the highest relative cover (6.92). Relative Cover on 05/03/01 ranged from 5.69 to 6.92 (Figure 2).

Table 9. Average cover of species present in all zones in each inoculation treatments on 05/03/01.

Zone Averages 050301	Inoculation Technique				
List of Species	Vac1	Blocks	Vac2	Soil	Control
Psilocarphus brevissimus	2.22	1.44	2.78	1	2.44
Plagiobothrys stipitatus	0.89	1.57	0.36	1	1.12
Eryngium aristulatum	1.11	0.56	1.34	0.89	0.44
Lasthenia glaberrima	0.46	1.11	0.35	1.12	0.006
Downingia concolor	0.12	0.78	0.35	0.56	0.22
Convolvulus arvensis	0.12	0.11	0.11	0.006	0.12
Asclepias fascicularis		0.11	0.006	0.11	
Erodium botrys			0.11	0.11	
Hemizonia fitchii	0.11				
Lasthenia macrantha ssp. bakeri					
Lupinus bicolor					
Eremocarpus setigerus					
Centaurium muehlenbergii					
Xanthium strumarium					
Asclepias asperula					
Cyperus eragrostis					
Rumex crispus					
Eleocharis macrostachya					
Grasses					
Hordeum murinum	0.78	1	1.4	1.4	1.23
Lolium multiflorum	0.11		0.11		0.11
Taeniatherum caput-medusae					
Polypogon monspeliensis					
Other					
bare soil	2.78	2.11	2.56	1.78	1.23
algae/algal matting		0.56			0.33
Relative Cover (average)	5.92	6.68	6.92	6.2	5.69

Figure 2. Relative Cover on 05/03/01.



Species Constancy in the Shallow, Middle, and Deep Zones on 06/08/01

Fifteen plant species were observed in the artificial pools on 06/08/01 (Tables 10-12). The early blooming vernal pool species declined and were not observed in the artificial pools and the number of grass species increased. *Psilocarphus brevissimus* dominated the shallow and middle zones. The late summer blooming species; *Eremocarpus setigerus*, *Hemizonia fitchii*, and *Eryngium aristulatum*, appeared in all zones. *Eremocarpus setigerus* was the most constant species in the deep zone.

Table 10. Species constancy in the Shallow Zone on 06/08/01.

	Shallow Zone														
Constancy Table 060801	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	2	2	1	1	3		2	3	2		1		2	3	3
Hemizonia fitchii		2	2		2	1		2	2		1		1	2	2
Eryngium aristulatum	3	2		2	+		3	+		1	3		1		
Eremocarpus setigerus		1			1			1		+	1	2		2	2
Convolvulus arvensis	1				1			1					1		1
Asclepias fascicularis															r
Centaurium muehlenbergii									1						
Rumex crispus											r				
Anagalis arvensis															
Lasthenia macrantha ssp. bakeri															
Lasthenia glaberrima															
Cyperus eragrostis															
Downingia concolor															
Erodium botrys															
Eleocharis macrostachya															
Lupinus bicolor															
Plagiobothrys stipitatus															
Xanthium strumarium															
Grasses															
Hordeum murinum	2	2	2	2	3	3	2	2	1	2	2	3	3	4	2
Lolium multiflorum	2	+	1	1	+	1	2	+	1	3	1	1	2	+	+
Taeniatherum caput-medusae	2	+	1	2	+	1	2	1	2	1	1	1	2	1	1
Polypogon monspeliensis					1						1	2			
Other															
bare soil	2	3	2	1	2	2	2	2	1	+	2	2	2	2	2
algae/algal matting															

Table 11. Species constancy in the Middle Zone on 06/08/01.

	Middle Zone														
Constancy Table 060801	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	1	2	2	1	3		2	2	2	1	1		2	2	3
Hemizonia fitchii		2	2		2	1		2	2		1		1	2	2
Eryngium aristulatum	3	2		2			2	1	1	1	3	2	1		
Eremocarpus setigerus		1			1			1		1	1	2		2	1
Convolvulus arvensis		1		1						1			1		1
Eleocharis macrostachya				1											
Xanthium strumarium										1					
Anagalis arvensis															
Lasthenia macrantha ssp. bakeri															
Lasthenia glaberrima															
Cyperus eragrostis															
Downingia concolor															
Erodium botrys															
Asclepias fascicularis															
Lupinus bicolor															
Centaurium muehlenbergii															
Rumex crispus															
Plagiobothrys stipitatus															
Grasses															
Hordeum murinum	2	1	2	2	1	2	1	3	1	2	2	2	2	2	
Lolium multiflorum	1	+	1	2	1	+	2	+	+	1	1	+	+	1	2
Taeniatherum caput-medusae	1	1	1	+		1	1	+	2		1	1	+	1	
Polypogon monspeliensis											1	+			
Other															
bare soil	3	3	2	1	3	2	2	2	2	2	2	2	3	2	3
algae/algal matting															

Table 12. Species constancy in the Deep Zone on 06/08/01.

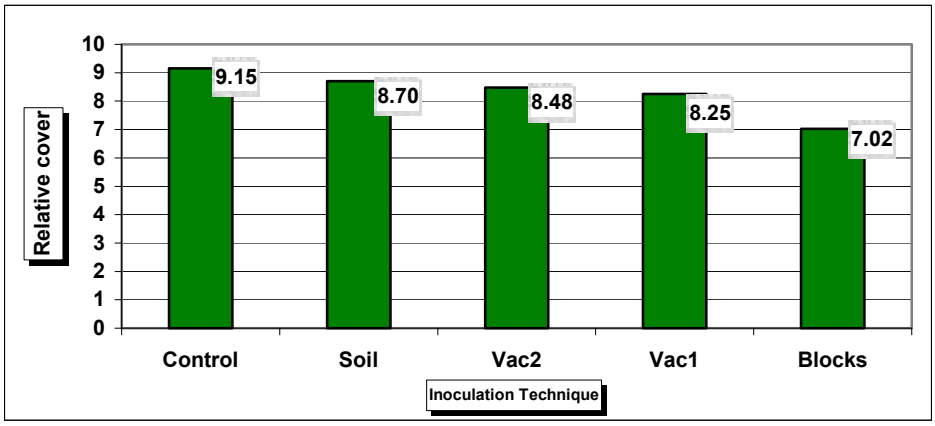
Constancy Table 060801	Deep Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Eremocarpus setigerus		+		r	1	1		2		+	2	2		2	2
Eryngium aristulatum	2	2		2	1		2	1	1	3	2		1		
Psilocarphus brevissimus	1	1	2		2		1	+	2			1	1		2
Hemizonia fitchii		1	2		1			2	2		1		1	+	2
Convolvulus arvensis			2	1	1		1			+			+		
Cyperus eragrostis	r														
Eleocharis macrostachya				1											
Xanthium strumarium										1					
Anagalis arvensis															
Lasthenia macrantha ssp. bakeri															
Lasthenia glaberrima															
Downingia concolor															
Erodium botrys															
Asclepias fascicularis															
Lupinus bicolor															
Centaurium muehlenbergii															
Rumex crispus															
Plagiobothrys stipitatus															
Grasses															
Taeniatherum caput-medusae	1	1	+	+	1	1	1	+	2	+	1	1	2	1	1
Hordeum murinum	1		1		+	2	1	1	1	2	1	1	+	2	+
Lolium multiflorum	1	1	1	1	1	+	2	+	+	1		1	1	1	
Polypogon monspeliensis											1	2			1
Other															
bare soil	4	3	3	2	4	2	2	3	3	2	3	3	4	2	3
algae/algal matting															

On 06/08/01, *Psilocarphus brevissimus* had the highest average cover throughout the artificial pools (Table 13). The control had the highest relative cover (9.15) compared to the other artificial pools. Relative cover ranged from 7.02 to 9.15 on 06/08/01 (Figure 3).

Table 13. Average cover of species present in all zones in each inoculation treatments on 06/08/01.

Zone Averages 060801	Artificial Pools				
List of Species	Vac1	Blocks	Vac2	Soil	Control
Psilocarphus brevissimus	1.56	1.11	1.67	0.78	2.11
Hemizonia fitchii	1.22	0.78	1.33	0.33	1.45
Eryngium aristulatum	1.56	0.78	1.23	1.67	0.33
Eremocarpus setigerus	0.23	0.44	0.44	1.23	1.22
Convolvulus arvensis	0.44	0.44	0.22	0.12	0.45
Xanthium strumarium				0.11	
Centaurium muehlenbergii			0.11		
Eleocharis macrostachya		0.22			
Anagalis arvensis					
Lasthenia macrantha ssp. bakeri					
Lasthenia glaberrima					
Cyperus eragrostis					
Downingia concolor					
Erodium botrys					
Rumex crispus					
Lupinus bicolor					
Plagiobothrys stipitatus					
Asclepias fascicularis					
Grasses					
Hordeum murinum	1.44	1.67	1.44	1.89	1.68
Lolium multiflorum	0.9	0.79	0.81	1.01	0.79
Taeniatherum caput-medusae	0.9	0.68	1.23	0.78	1.01
Polypogon monspeliensis		0.11		0.78	0.11
Other					
bare soil	2.78	2.11	2.11	2.01	2.56
algae/algal matting					
Relative Cover (average)	8.25	7.02	8.48	8.7	9.15

Figure 3. Relative Cover on 06/08/01.



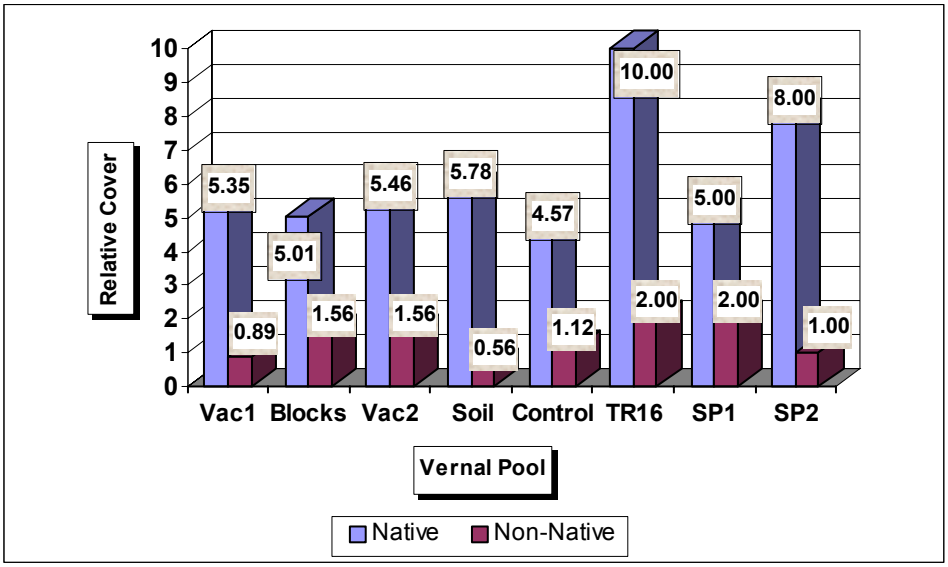
Native vs. Non-Native Species in each Inoculation Technique and Natural Pools

On 04/26/01, there were more native plant species than non-native in each pool. We observed six native species in the artificial pools and six native species in the natural pools (Table 14). The six species are constant with the exception of *Hemizonia fitchii* and *Lasthenia macrantha ssp. bakeri*. *Hemizonia fitchii* was present only in the artificial pools, while *Lasthenia macrantha ssp. bakeri* was present in the natural pools. Five non-native species were present in the artificial pools and three non-native species were present in the natural pools. Among the non-native species, *Erodium botrys*, *Anagalis arvensis* and *Lupinus bicolor* were only present in the artificial pools. *Lolium multiflorum* was present in SP1 and absent in all the other pools (Figure 14).

Table 14. Native vs. Non-Native species on 04/26/01.

Native vs. Non-native spp. 042601	**Inoculation Technique**					**Natural Pools**		
Native Species	Vac1	Blocks	Vac2	Soil	Control	TR16	SP1	SP2
Eryngium aristulatum	0.56	0.33	0.45	0.67	0.11	2.00	2.00	2.00
Psilocarphus brevissimus	1.89	0.67	2.56	0.56	2.67	2.00	2.00	
Lasthenia glaberrima	0.78	1.12	0.89	2.22		2.00		3.00
Plagiobothrys stipitatus	2.01	2.56	1.44	2.11	1.67			3.00
Downingia concolor	0.11	0.22	0.12	0.22	0.12	2.00		
Lasthenia macrantha ssp. bakeri						2.00	1.00	
Hemizonia fitchii		0.11						
Eleocharis macrostachya								
Eremocarpus setigerus								
Cyperus eragrostis								
Xanthium strumarium								
Relative Cover (Native Species)	5.35	5.01	5.46	5.78	4.57	10.00	5.00	8.00
Non-Native Species								
Hordeum murinum	0.56	1.11	1.11	0.44	1.00	1.00	1.00	1.00
Convolvulus arvensis	0.22	0.01	0.12	0.12		1.00		
Erodium botrys	0.11	0.22	0.11		0.12			
Anagalis arvensis		0.11	0.11					
Lupinus bicolor		0.11	0.11					
Lolium multiflorum							1.00	
Asclepias asperula								
Centaurium muehlenbergii								
Rumex crispus								
Taeniatherum caput-medusae								
Polypogon monspeliensis								
Relative Cover (Non-Native Species)	0.89	1.56	1.56	0.56	1.12	2.00	2.00	1.00
Other								
bare soil	2.22	1.00	1.89	1.22	2.22	1.00	2.00	1.00
algae/algal matting		0.67		0.22	0.22			

Figure 4. Native vs. Non-Native Relative Cover on 04/26/01.

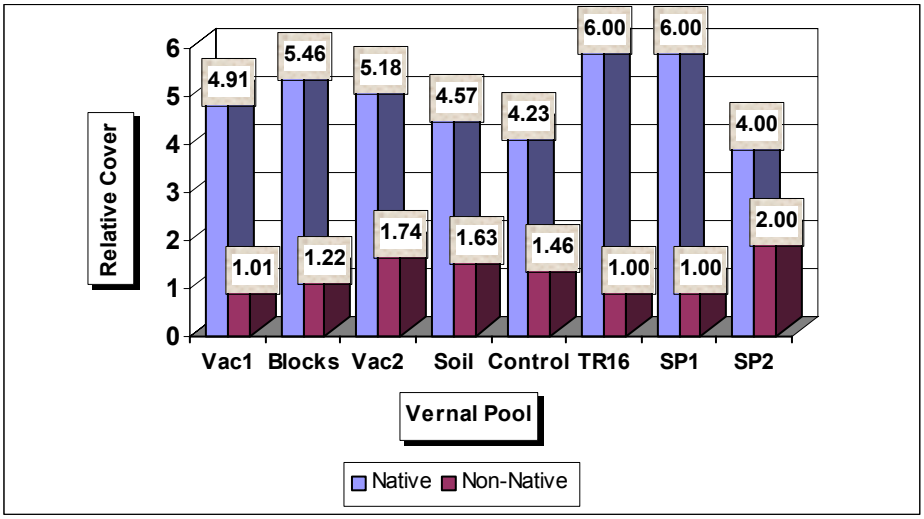


On 05/03/01, we observed six native species in the artificial pools and five native species in the natural pools (Table 15). *Lasthenia macrantha ssp. bakeri* remained present in the natural pools, while *Hemizonia fitchii* was present in the artificial pools. There were five non-native species in the artificial pools compared to only two species in the natural pools. Among the non-native species, *Convolvulus arvensis*, *Taeniatherum caput-medusae*, *Anagalis arvensis*, and *Erodium botrys* were present in the artificial pools and *Lolium multiflorum* was present in the SP1. There was a greater amount of native coverage than non-native coverage in each artificial and natural pools (Figure 5).

Table 15. Native vs. Non-Native species on 05/03/01.

Native vs. Non-Native Species 050301	Inoculation Technique					Natural Pools		
Native Species	Vac1	Blocks	Vac2	Soil	Control	TR16	SP1	SP2
Eryngium aristulatum	1.11	0.56	1.34	0.89	0.44	2.00	3.00	4.00
Psilocarphus brevissimus	2.22	1.44	2.78	1.00	2.44	2.00	1.00	
Lasthenia glaberrima	0.46	1.11	0.35	1.12	0.01		1.00	
Plagiobothrys stipitatus	0.89	1.57	0.36	1.00	1.12		1.00	
Downingia concolor	0.12	0.78	0.35	0.56	0.22			
Lasthenia macrantha ssp. bakeri						2.00		
Hemizonia fitchii	0.11							
Cyperus eragrostis								
Xanthium strumarium								
Eremocarpus setigerus								
Eleocharis macrostachya								
Relative Cover (Native Species)	**4.91**	**5.46**	**5.18**	**4.57**	**4.23**	**6.00**	**6.00**	**4.00**
Non-Native Species								
Hordeum murinum	0.78	1.00	1.40	1.40	1.23	1.00	1.00	1.00
Convolvulus arvensis	0.12	0.11	0.11	0.01	0.12			
Taeniatherum caput-medusae	0.11		0.11		0.11			
Anagalis arvensis		0.11	0.01	0.11				
Erodium botrys			0.11	0.11				
Asclepias asperula								
Centaurium muehlenbergii								
Lolium multiflorum								1.00
Lupinus bicolor								
Polypogon monspeliensis								
Rumex crispus								
Relative Cover (Non-Native Species)	**1.01**	**1.22**	**1.74**	**1.63**	**1.46**	**1.00**	**1.00**	**2.00**
Other								
bare soil	2.78	2.11	2.56	1.78	1.23	1.00	2.00	2.00
algae/algal matting		0.56			0.33			

Figure 5. Native vs. Non-Native Relative Cover on 05/03/01.

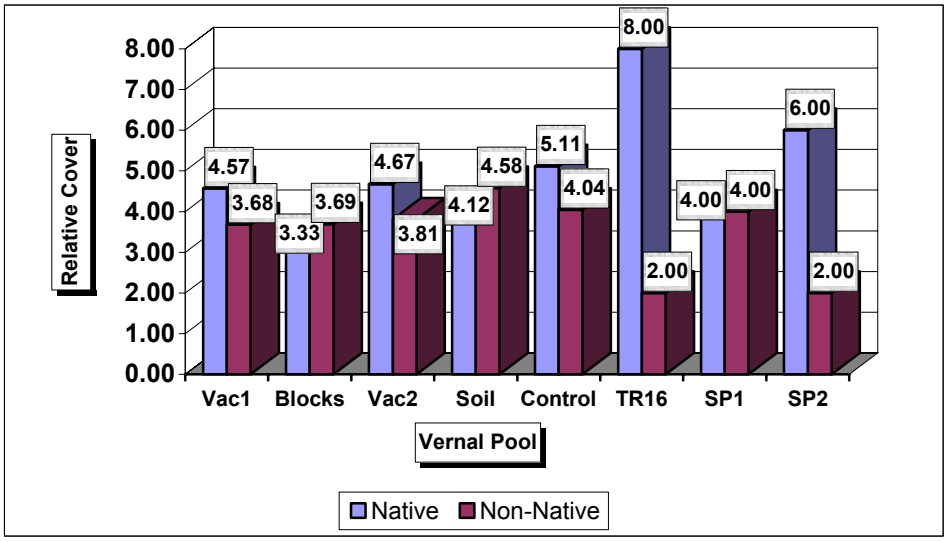


On 06/08/01, Vac1, Vac2, Control, TR16, and SP2 all had a greater amount of native versus non-native species (Table 16). The Blocks and Soil treatments had a greater amount of non-native species. SP1 had equal amounts of native and non-native relative cover. We observed six native species in the artificial pools and four native species in the natural pools. *Xanthium strumarium* and *Eleocharis macrostachya* were present in the artificial pools and absent in the natural pools. There were six non-native species in the artificial pools and four in the natural pools. Among the non-native species, *Convolvulus arvensis, Taeniatherum caput-medusae*, *Polypogon monspeliensis*, and *Centaurium muehlenbergii* were present in the artificial pools, but were absent in the natural pools. A small coverage of *Asclepias fascicularis* was in TR16 only. *Rumex crispus* was present in the natural pools, but absent in the artificial pools (Figure 6).

Table 16. Native vs. Non-Native species on 06/08/01.

Native vs. Non-Native Species 060801	**Inoculation Technique**					**Natural Pools**		
Native Species	Vac1	Blocks	Vac2	Soil	Control	TR16	SP1	SP2
Eryngium aristulatum	1.56	0.78	1.23	1.67	0.33	2.00	3.00	2.00
Hemizonia fitchii	1.22	0.78	1.33	0.33	1.45	1.00		2.00
Eremocarpus setigerus	0.23	0.44	0.44	1.23	1.22	3.00		2.00
Psilocarphus brevissimus	1.56	1.11	1.67	0.78	2.11	2.00	1.00	
Xanthium strumarium				0.11				
Eleocharis macrostachya		0.22						
Lasthenia glaberrima								
Lasthenia macrantha ssp. bakeri								
Cyperus eragrostis								
Spergularia arvensis								
Downingia concolor								
Relative Cover (Native Species)	4.57	3.33	4.67	4.12	5.11	8.00	4.00	6.00
Non-Native Species								
Hordeum murinum	1.44	1.67	1.44	1.89	1.68	1.00	2.00	2.00
Lolium multiflorum	0.90	0.79	0.81	1.01	0.79		2.00	
Convolvulus arvensis	0.44	0.44	0.22	0.12	0.45			
Taeniatherum caput-medusae	0.90	0.68	1.23	0.78	1.01			
Polypogon monspeliensis		0.11		0.78	0.11			
Rumex crispus						1.00		
Asclepias asperula						r		
Centaurium muehlenbergii			0.11					
Anagalis arvensis								
Erodium botrys								
Lupinus bicolor								
Relative Cover (Non-Native Species)	3.68	3.69	3.81	4.58	4.04	2.00	4.00	2.00
Other								
bare soil	2.78	2.11	2.11	2.01	2.56	1.00	2.00	2.00
algae/algal matting								

Figure 6. Native vs. Non-Native Relative Cover on 06/08/01.



VEGETATION RESULTS FOR 2002

Species Constancy in the Shallow, Middle and Deep Zones on 04/19/02

Twelve plant species grew in the artificial pools on 04/19/02 (Tables17-19). In the shallow zones, *Downingia concolor* grew in every artificial pool. *Downingia concolor* appears to prefer the shallower zones of the pools, as noted by its constant appearance and abundance. It also grew in the middle and deep zones; however, its cover was lower. In the middle zone, *Plagiobothrys stipitatus* was the most abundant and constant species. The deep zone consisted of muddy soil with concentric rings around the outer edge of *Downingia concolor, Plagiobothrys stipitatus, and Psilocarphus brevissimus.*

Table 17. Species constancy in the Shallow Zone on 04/19/02.

	Shallow Zone														
Constancy Table 041902	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Downingia concolor	1	2	2	3	2	2	2	1	2	1	1	2	2	3	1
Psilocarphus brevissimus	2	3	3		3	2	3	2	4		2	2	3	3	2
Plagiobothrys stipitatus	1	3		2	3	2	1	2	2		2	2	1	3	2
Eryngium aristulatum	2	2		2	1		2	1	1	2	2				
Lasthenia glaberrima		3		3	3		2	2		2	3	4			
Eleocharis macrostachya	2			1											
Lupinus bicolor							r							+	
Anagalis arvensis													r		
Cotula coronopifolia				r											
Rumex crispus													+		
Lasthenia fremontii															
Convolvulus arvensis															
Hemizonia fitchii															
Brodiaea elegans															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Navarretia squarrosa															
Navarretia intertexta															
Lythrum hyssopifolium															
Epilobium pygmaeum															
Cyperus eragrostis															
Grasses															
Hordeum murinum	2			2	2	3	2	3		4			2		2
Pleuropogon californicus											3	2			
Polypogon monspeliensis															
Lolium multiflorum															
Other															
bare soil	2	2	3	2	1	1	3	2	2	1			3	2	3

Table 18. Species constancy in the Middle Zone on 04/19/02.

Constancy Table 041902	Middle Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Plagiobothrys stipitatus	2	2	3	3	3	3	2	2	3	2	3	3	2	2	3
Psilocarphus brevissimus	3		3	3	3	3	2	2	3		2	2	2	2	2
Downingia concolor	1		2	2	2	2	2	2		2		2	2	2	2
Lasthenia glaberrima	1	2		3	3		3	2			3	2			
Eryngium aristulatum	2	2		2			2	1	2	2	2				
Eleocharis macrostachya	2			2			3			2				2	3
Lasthenia fremontii										3					
Rumex crispus						r									
Lupinus bicolor															
Anagalis arvensis															
Cotula coronopifolia															
Convolvulus arvensis															
Hemizonia fitchii															
Brodiaea elegans															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Navarretia squarrosa															
Navarretia intertexta															
Lythrum hyssopifolium															
Epilobium pygmaeum															
Cyperus eragrostis															
Grasses															
Pleuropogon californicus					1	2				2	2				
Hordeum murinum													2		
Polypogon monspeliensis															
Lolium multiflorum															
Other															
bare soil	2	3	3	2	2	2	3		2	1	1		3	2	2

Table 19. Species constancy in the Deep Zone on 04/19/02.

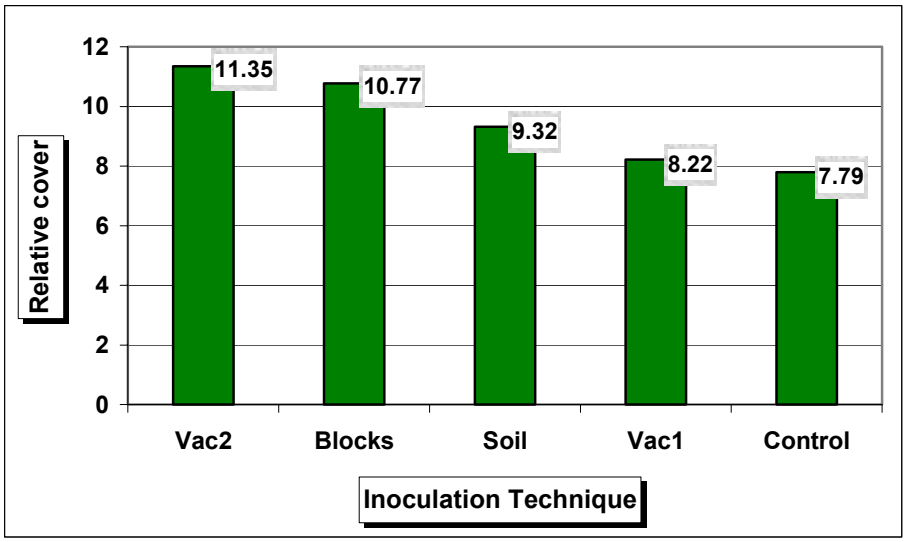
Constancy Table 041902	Deep Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Plagiobothrys stipitatus	3		3	3	2	3	3	2	2	3		3	3	2	2
Psilocarphus brevissimus	3		3	2	2	3	3	2	2			2	2	2	2
Downingia concolor	1		2	2	2		2	2	2	2		2	1	2	2
Eryngium aristulatum	2			3			2		3	2			2		
Eleocharis macrostachya	2			2			2			1					
Lasthenia glaberrima							3			4		3			
Lasthenia fremontii															
Rumex crispus															
Lupinus bicolor															
Anagalis arvensis															
Cotula coronopifolia															
Convolvulus arvensis															
Hemizonia fitchii															
Brodiaea elegans															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Navarretia squarrosa															
Navarretia intertexta															
Lythrum hyssopifolium															
Epilobium pygmaeum															
Cyperus eragrostis															
Grasses															
Pleuropogon californicus															
Hordeum murinum															
Polypogon monspeliensis															
Lolium multiflorum															
Other															
bare soil	2	4	3	2	2	2	2	2	2	2	4	3	3	5	3

Plagiobothrys stipitatus had the highest average cover among species observed on 04/19/02. Among the inoculation treatment, Vac2, had the highest relative cover (11.35). The relative cover ranged from 7.79 to 11.35 on 04/19/02 (Table 20 and Figure 7).

Table 20. Average cover of species present in all zones in each inoculation treatment on 04/19/02.

Zone Averages 041902	Inoculation Technique				
List of Species	Vac1	Blocks	Vac2	Soil	Control
Plagiobothrys stipitatus	1.89	2.67	3.11	2	2.22
Psilocarphus brevissimus	2.22	2.33	2.56	1.11	2.22
Downingia concolor	1.22	1.89	1.67	1.33	1.89
Eryngium aristulatum	1.33	0.89	1.56	1.11	0.22
Lasthenia glaberrima	0.67	1.33	1.33	1.67	
Eleocharis macrostachya	0.67	0.55	0.56	0.33	0.56
Lasthenia fremontii				0.33	
Rumex crispus					0.006
Convolvulus arvensis					
Anagalis arvensis					
Lupinus bicolor					
Hemizonia fitchii					
Brodiaea elegans					
Navarretia squarrosa					
Navarretia intertexta					
Lythrum hyssopifolium					
Epilobium pygmaeum					
Eremocarpus setigerus					
Centaurium muehlenbergii					
Xanthium strumarium					
Cotula coronopifolia					
Cyperus eragrostis					
Grasses					
Hordeum murinum	0.22	0.78	0.56	0.44	0.67
Pleuropogon californicus		0.33		1	
Lolium multiflorum					
Polypogon monspeliensis					
Other					
bare soil	2.67	1.78	2	1.44	2.89
Relative Cover (average)	8.22	10.77	11.35	9.32	7.79

Figure 7. Relative Cover on 04/19/02.



Species Constancy in the Shallow, Middle, and Deep Zones on 05/01/02

There were fourteen plant species observed in the artificial pools on 05/01/02 (Tables 21-23). *Downingia concolor, Psilocarphus brevissimus, and Plagiobothrys stipitatus* were the most constant species in all the zones. In the shallow, middle, and deep zones, *Psilocarphus brevissimus*, *Plagiobothrys stipitatus,* and *Downingia concolor* had the greatest amount of relative cover. *Plagiobothrys stipitatus* grew in the middle zones of all the artificial pools. *Lasthenia glaberrima* grew in all zones, but was more successful in the middle zone. In the deep zone, there were areas of bare soil with concentric rings around the outer edge of *Downingia concolor, Plagiobothrys stipitatus, and Psilocarphus brevissimus*.

Table 21. Species constancy in the Shallow Zone on 05/01/02.

	Shallow Zone														
Constancy Table 050102	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Downingia concolor	1	2		3	2	1	2	1	2	1	1	2	2	3	1
Plagiobothrys stipitatus	1	2	2	2	3	t	1	2	2		2		1	3	2
Psilocarphus brevissimus	2	3	2		3	1	3	2	4		2	2	3	3	2
Eryngium aristulatum		1		2			2	1	2	2	2	1			1
Lasthenia glaberrima		2		3	3			1		2	3	1			
Eleocharis macrostachya	t			1			2							t	
Rumex crispus													t		1
Lupinus bicolor							r								
Cotula coronopifolia				r											
Hemizonia fitchii													3		
Navarretia intertexta			3												
Lasthenia fremontii															
Anagalis arvensis															
Convolvulus arvensis															
Brodiaea elegans															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Navarretia squarrosa															
Lythrum hyssopifolium															
Epilobium pygmaeum															
Cyperus eragrostis															
Grasses															
Hordeum murinum	2			2	2	3	2	3		4			2		
Pleuropogon californicus											3	3			
Lolium multiflorum										2					
Polypogon monspeliensis															
Other															
bare soil	2	2	2	2	2	2	2	2	2	1		1	3	2	2

Table 22. Species constancy in the Middle Zone on 05/01/02.

	Middle Zone														
Constancy Table 050102	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Plagiobothrys stipitatus	2	3	3	3	3	2	2	3	3	2	3	4	2	2	3
Psilocarphus brevissimus	3	1	2	2	3	3	2	3	3		2	1	2	2	3
Downingia concolor	1		3	2	2	3	2	2	1	2		2	2	2	2
Eryngium aristulatum	2	2		2			2	1	2	2	2	1	2		
Lasthenia glaberrima	1	3		3	3		3			3	3				
Eleocharis macrostachya	2			2			2			1				2	3
Rumex crispus						r									
Hemizonia fitchii													3		
Lupinus bicolor															
Cotula coronopifolia															
Navarretia intertexta															
Lasthenia fremontii															
Anagalis arvensis															
Convolvulus arvensis															
Brodiaea elegans															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Navarretia squarrosa															
Lythrum hyssopifolium															
Epilobium pygmaeum															
Cyperus eragrostis															
Grasses															
Pleuropogon californicus					1					2	2				
Hordeum murinum												t	2		
Lolium multiflorum															
Polypogon monspeliensis															
Other															
bare soil	2	3	2	2	2	2	3	2	2	2	1	2	3	2	2

Table 23. Species constancy in the Deep Zone on 05/01/02.

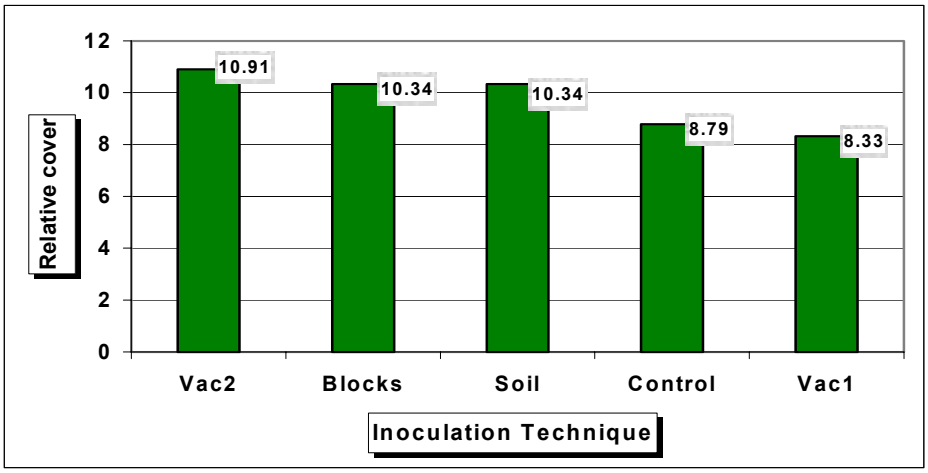
Constancy Table 050102	Deep Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Downingia concolor	2	1	2	2	2	3	2	2	2	2	2	2	1	2	2
Plagiobothrys stipitatus	3	1	2	3	3	3	3	3	2	3		2	3	2	2
Psilocarphus brevissimus	3	1	2	2	2	3	3	3	2		3	2	2	2	2
Eryngium aristulatum	2	2		3			2	2	3	2	2	1	1		
Eleocharis macrostachya	2			2			2	+		1					2
Lasthenia glaberrima		1					3	1		4					
Hemizonia fitchii													3		
Convolvulus arvensis							+						+		
Rumex crispus															
Lupinus bicolor															
Cotula coronopifolia															
Navarretia intertexta															
Lasthenia fremontii															
Anagalis arvensis															
Brodiaea elegans															
Eremocarpus setigerus															
Centaurium muehlenbergii															
Xanthium strumarium															
Navarretia squarrosa															
Lythrum hyssopifolium															
Epilobium pygmaeum															
Cyperus eragrostis															
Grasses															
Pleuropogon californicus											2				
Hordeum murinum													1		
Lolium multiflorum															
Polypogon monspeliensis															
Other															
bare soil	2	3	3	2	3	2	2	3	2	2	3	3	3	3	3

Plagiobothrys stipitatus had the highest average cover on 05/01/02 (Table 24). Inoculation treatment, Vac2, had the highest relative cover (10.91). Relative Cover on 05/01/02 ranged from 8.33 to 10.91 (Figure 8).

Table 24. Average cover of species present in all zones in each inoculation treatments on 05/01/02.

Zone Averages 050102	Inoculation Technique				
List of Species	Vac1	Blocks	Vac2	Soil	Control
Plagiobothrys stipitatus	2.11	2.45	2.33	1.78	2.22
Psilocarphus brevissimus	2.11	2.11	2.78	1.33	2.33
Downingia concolor	1.33	2.22	1.78	1.56	1.33
Eryngium aristulatum	1	0.78	1.89	1.67	0.44
Lasthenia glaberrima	0.78	1.33	0.89	1.78	
Eleocharis macrostachya	0.45	0.56	0.67	0.22	0.78
Convolvulus arvensis			0.006		0.006
Rumex crispus					0.12
Navarretia intertexta	0.33				
Hemizonia fitchii					1
Lasthenia fremontii					
Anagalis arvensis					
Lupinus bicolor					
Brodiaea elegans					
Navarretia squarrosa					
Lythrym hyssopifolium					
Epilobium pygmaeum					
Eremocarpus setigerus					
Centaurium muehlenbergii					
Xanthium strumarium					
Cotula coronopifolia					
Cyperus eragrostis					
Grasses					
Hordeum murinum	0.22	0.78	0.56	0.45	0.56
Pleuropogon californicus		0.11		1.33	
Lolium multiflorum				0.22	
Polypogon monspeliensis					
Other					
bare soil	2.33	2.11	1.44	1.67	2.56
Relative Cover (average)	8.33	10.34	10.91	10.34	8.79

Figure 8. Relative Cover on 05/01/02.



Species Constancy in the Shallow, Middle, and Deep Zones on 06/05/02

We observed seventeen plant species in the artificial pools on 06/05/02 (Tables 25-27). The early blooming vernal pool species or flowering plants; *Downingia concolor*, *Plagiobothrys stipitatus*, and *Lasthenia glaberrima,* were no longer dominant in the artificial pools and the number of non-native grass species increased. The summer blooming species; *Eremocarpus setigerus*, *Hemizonia fitchii*, and *Eryngium aristulatum* increased in cover abundance in each zone. In the shallow and middle zones, the most constant species observed were *Hemizonia fitchii* and *Psilocarphus brevissimus*. In the deep zone, *Psilocarphus brevissimus* and *Eryngium aristulatum* had the highest constancy.

Table 25. Species constancy in the Shallow Zone on 06/05/02.

	Shallow Zone														
Constancy Table 060502	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Hemizonia fitchii		2	3		3	3		3	2			3	3	3	3
Psilocarphus brevissimus	2	2	2		2		2					t	2	2	1
Eryngium aristulatum	3			2			3	2		2	3				
Eremocarpus setigerus		2			1			2	2			2		2	2
Convolvulus arvensis		t	t	r			1	t				t			
Rumex crispus					t	t					t		t		1
Epilobium pygmaeum									2			2		2	2
Centaurium muehlenbergii						2			t						
Navarretia intertexta			4												
Eleocharis macrostachya				2											
Lythrum hyssopifolium															2
Cyperus eragrostis															1
Navarretia squarrosa														1	
Brodiaea elegans									t						
Downingia concolor															
Plagiobothrys stipitatus															
Lasthenia glaberrima															
Lupinus bicolor															
Cotula coronopifolia															
Lasthenia fremontii															
Anagalis arvensis															
Xanthium strumarium															
Grasses															
Hordeum murinum	3	3		2	3	3	2	3	3	3		3	2		3
Pleuropogon californicus											3				
Lolium multiflorum										2					
Polypogon monspeliensis															
Other															
bare soil	1	2	1	2	t	1	1	t	1	2	2	1	3	1	2

Table 26. Species constancy in the Middle Zone on 06/05/02.

Constancy Table 060502	Middle Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	2		2	1	2	3	2	2	2	1	1	t	1	2	
Hemizonia fitchii		2	3		3	1		3	3		2	3	4	1	2
Eryngium aristulatum	3	3		2			3	2	3	2	3		1		
Eremocarpus setigerus					2	3		3		2	2	3		3	2
Epilobium pygmaeum		2	3		2				3		2	2		3	3
Eleocharis macrostachya	2			3			3			1	2			3	3
Convolvulus arvensis	t			t		1	t						t	t	
Lythrum hyssopifolium					1										2
Plagiobothrys stipitatus												2			
Rumex crispus											t				
Cyperus eragrostis															1
Centaurium muehlenbergii															
Navarretia intertexta															
Navarretia squarrosa															
Brodiaea elegans															
Downingia concolor															
Lasthenia glaberrima															
Lupinus bicolor															
Cotula coronopifolia															
Lasthenia fremontii															
Anagalis arvensis															
Xanthium strumarium															
Grasses															
Hordeum murinum			t										2		
Pleuropogon californicus					2										
Lolium multiflorum															
Polypogon monspeliensis															
Other															
bare soil	2	3	3	3	2	2	2	1	2	3	2	1	2	2	2

Table 27. Species constancy in the Deep Zone on 06/05/02.

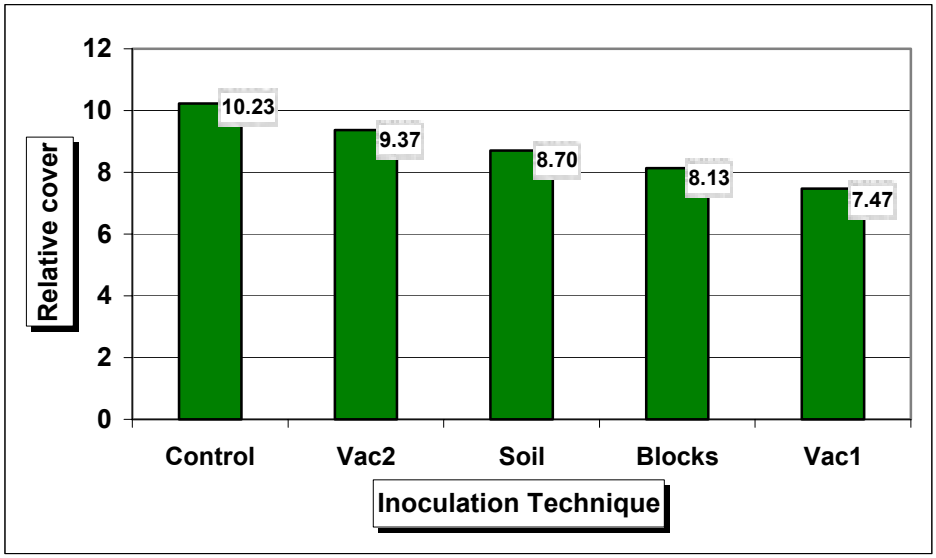
Constancy Table 060502	Deep Zone														
	Vac1			Blocks			Vac2			Soil			Control		
List of Species	A1	B4	C3	A4	B1	C5	A2	B2	C2	A5	B5	C4	A3	B3	C1
Psilocarphus brevissimus	1		2	2	2	3	2	2		1	2	1	2	1	1
Eryngium aristulatum	3	3		3			3	2	4	3	3	2	2		
Eremocarpus setigerus		2		2	2	3		3			2	3		3	2
Hemizonia fitchii		2	3		2			2	2		2		3		3
Convolvulus arvensis	t		t	t	t	1	t					t	t		
Plagiobothrys stipitatus					1			1		1	2			2	1
Epilobium pygmaeum								2			2	2		3	
Eleocharis macrostachya	2			2			3								2
Cyperus eragrostis	1														
Xanthium strumarium										1					
Lythrum hyssopifolium															
Rumex crispus															
Centaurium muehlenbergii															
Navarretia intertexta															
Navarretia squarrosa															
Brodiaea elegans															
Downingia concolor															
Lasthenia glaberrima															
Lupinus bicolor															
Cotula coronopifolia															
Lasthenia fremontii															
Anagalis arvensis															
Grasses															
Hordeum murinum													2		
Pleuropogon californicus															
Lolium multiflorum															
Polypogon monspeliensis															
Other															
bare soil	3	2	3	2	3	2	2	3	2	2	2	3	3	3	2

On 06/05/02, *Hemizonia fitchii* had the highest average cover throughout the artificial pools (Table 28). The control had the highest cover abundance (10.23) compared to the other artificial pools. Relative Cover ranged from 7.47 to 10.23 on 06/05/02 (Figure 9).

Table 28. Average cover of species present in all zones in each inoculation treatments on 06/05/02.

Zone Averages 060502	Inoculation Technique				
List of Species	Vac1	Blocks	Vac2	Soil	Control
Hemizonia fitchii	1.67	1.33	1.67	1.11	2.44
Eryngium aristulatum	1.67	0.78	2.44	2	0.33
Psilocarphus brevissimus	1.44	1.67	1.56	0.68	1.33
Eremocarpus setigerus	0.44	1.44	1.11	1.56	1.56
Epilobium pygmaeum	0.56	0.22	0.78	1.11	1.44
Eleocharis macrostachya	0.44	0.78	0.67	0.33	0.89
Plagiobothrys stipitatus		0.11	0.11	0.56	0.33
Convolvulus arvensis	0.028	0.35	0.13	0.011	0.017
Rumex crispus		0.011		0.011	0.12
Centaurium muehlenbergii		0.22	0.006		
Lythrum hyssopifolium		0.11			0.44
Cyperus eragrostis	0.11				0.22
Brodiaea elegans			0.006		
Navarretia squarrosa					0.11
Xanthium strumarium				0.11	
Navarretia intertexta	0.44				
Downingia concolor					
Lasthenia glaberrima					
Lasthenia fremontii					
Anagalis arvensis					
Lupinus bicolor					
Cotula coronopifolia					
Grasses					
Hordeum murinum	0.67	0.89	0.89	0.67	1
Pleuropogon californicus		0.22		0.33	
Lolium multiflorum				0.22	
Polypogon monspeliensis					
Other					
bare soil	2.22	1.89	1.56	2	2.22
Relative Cover (average)	7.47	8.13	9.37	8.7	10.23

Figure 9. Relative Cover on 06/05/02.



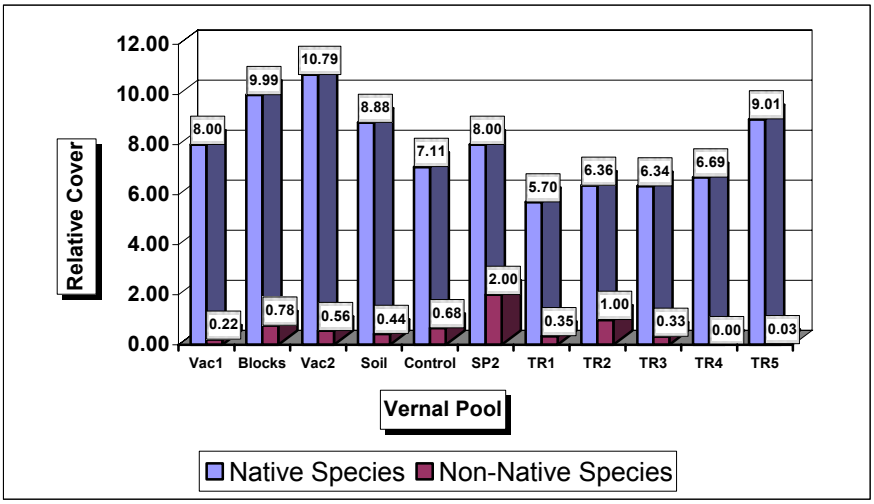
Native vs. Non-Native Species in each Inoculation Technique and Natural Pools

On 04/19/02, we observed eight native species in the artificial pools and in the natural pools (Table 29). The native species *Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, Eleocharis macrostachya, and Pleuropogon californicus* were detected in both artificial and natural pools. We observed two non-native species in the artificial pools and five non-native species in the natural pools. Among the non-native species *Hordeum murinum* and *Rumex crispus* were present in both artificial and natural pools. Overall on 04/19/02 in the artificial and natural pools, there was a greater amount of native species coverage than non-native species coverage (Figure 10).

Table 29. Native vs. Non-Native Species on 04/19/02.

Native vs. Non-native spp. 041902	Inoculation Technique					Natural Pools					
Native Species	Vac1	Blocks	Vac2	Soil	Control	SP2	TR1	TR2	TR3	TR4	TR5
Plagiobothrys stipitatus	1.89	2.67	3.11	2.00	2.22	3.00	2.33	1.00	1.33	2.00	2.00
Downingia concolor	1.22	1.89	1.67	1.33	1.89	2.00	2.00	2.67	0.66	2.00	1.00
Psilocarphus brevissimus	2.22	2.33	2.56	1.11	2.22	2.00			0.66	1.67	0.02
Lasthenia glaberrima	0.67	1.33	1.33	1.67			0.33	0.67	3.67	0.02	3.33
Eryngium aristulatum	1.33	0.89	1.56	1.11	0.22	1.00					1.67
Eleocharis macrostachya	0.67	0.55	0.56	0.33	0.56						0.66
Pleuropogon californicus		0.33		1.00			0.67	2.00		1.00	0.33
Cyperus eragrostis							0.37	0.02	0.02		
Lasthenia fremontii				0.33							
Hemizonia fitchii											
Eremocarpus setigerus											
Navarretia squarrosa											
Navarretia intertexta											
Brodiaea elegans											
Epilobium pygmaeum											
Xanthium strumarium											
Relative Cover (Native Species)	8.00	9.99	10.79	8.88	7.11	8.00	5.70	6.36	6.34	6.69	9.01
Non-Native Species											
Hordeum murinum	0.22	0.78	0.56	0.44	0.67			0.67			
Convolvulus arvensis							0.33	0.33	0.33		
Rumex crispus					0.01		0.02				
Lolium multiflorum						2.00					0.02
Cotula coronopifolia											0.02
Lythrum hyssopifolium											
Anagalis arvensis											
Lupinus bicolor											
Centaurium muehlenbergii											
Polypogon monspeliensis											
Relative Cover (Non-Native Species)	0.22	0.78	0.56	0.44	0.68	2.00	0.35	1.00	0.33	0.00	0.03
Other											
bare soil	2.67	1.78	2.00	1.44	2.89	2.00	0.67	1.33	2.00	0.35	0.02

Figure 10. Native vs. Non-Native Relative Cover on 04/19/02.

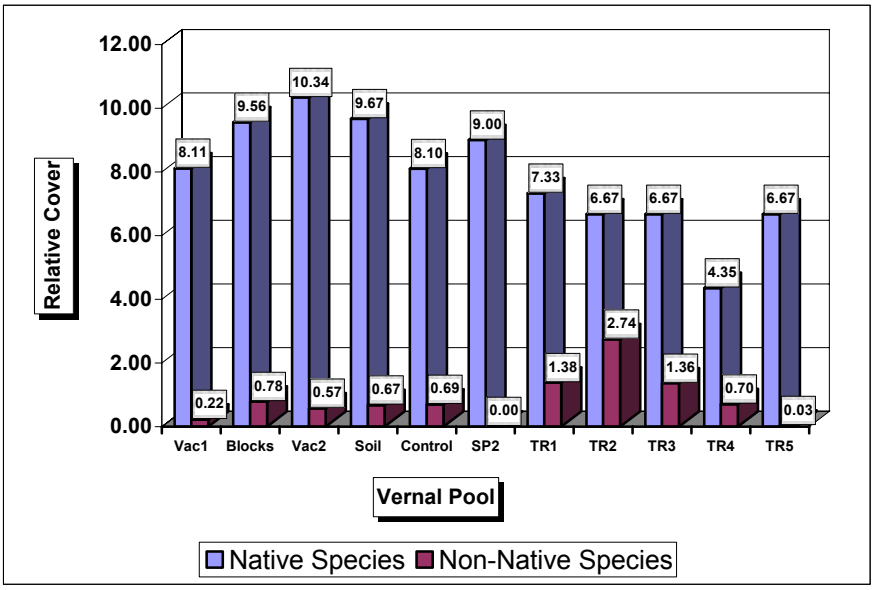


On 05/01/02, we observed nine native species in the artificial pools and in the natural pools (Table 30). The native species *Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, Eleocharis macrostachya, Navarretia intertexta, and Pleuropogon californicus,* were detected in both artificial and natural pools. We observed four non-native species in the artificial pools and the same amount in the natural pools. Among the non-native species *Hordeum murinum*, *Convolvulus arvensis, Rumex crispus, Lolium multiflorum* were present in both artificial and natural pools. Overall on 05/01/02 in the artificial and natural pools, there was a greater amount of native species coverage than non-native species coverage (Figure 11).

Table 30. Native vs. Non-Native Species on 05/01/02.

Native vs. Non-native spp. 050102	Inoculation Technique					Natural Pools					
Native Species	Vac1	Blocks	Vac2	Soil	Control	SP2	TR1	TR2	TR3	TR4	TR5
Plagiobothrys stipitatus	2.11	2.45	2.33	1.78	2.22	3.00	2.33	0.67	1.67	1.33	1.67
Downingia concolor	1.33	2.22	1.78	1.56	1.33	2.00	2.00	3.00	2.00	0.67	1.33
Psilocarphus brevissimus	2.11	2.11	2.78	1.33	2.33	2.00			0.67	1.33	
Eryngium aristulatum	1.00	0.78	0.89	1.67	0.44	2.00				0.02	1.00
Lasthenia glaberrima	0.78	1.33	1.89	1.78			2.00		2.33		1.00
Eleocharis macrostachya	0.45	0.56	0.67	0.22	0.78						1.00
Pleuropogon californicus		0.11		1.33			0.67	2.67		1.00	0.67
Cyperus eragrostis							0.33				
Navarretia intertexta	0.33							0.33			
Hemizonia fitchii					1.00						
Lasthenia fremontii											
Eremocarpus setigerus											
Navarretia squarrosa											
Brodiaea elegans											
Epilobium pygmaeum											
Xanthium strumarium											
Relative Cover (Native Species)	8.11	9.56	10.34	9.67	8.10	9.00	7.33	6.67	6.67	4.35	6.67
Non-Native Species											
Hordeum murinum	0.22	0.78	0.56	0.45	0.56		1.33	2.00	1.33	0.67	
Convolvulus arvensis			0.01		0.01		0.02	0.05	0.03	0.03	0.02
Rumex crispus					0.12		0.02				0.02
Cotula coronopifolia							0.02	0.02			
Lolium multiflorum				0.22							
Lythrum hyssopifolium								0.67			
Anagalis arvensis											
Lupinus bicolor											
Centaurium muehlenbergii											
Polypogon monspeliensis											
Relative Cover (Non-Native Species)	0.22	0.78	0.57	0.67	0.69	0.00	1.38	2.74	1.36	0.70	0.03
Other											
bare soil	2.33	2.11	1.44	1.67	2.56	2.00	1.00	1.33	2.00	1.33	0.03

Figure 11. Native vs. Non-Native Relative Cover on 05/01/02.

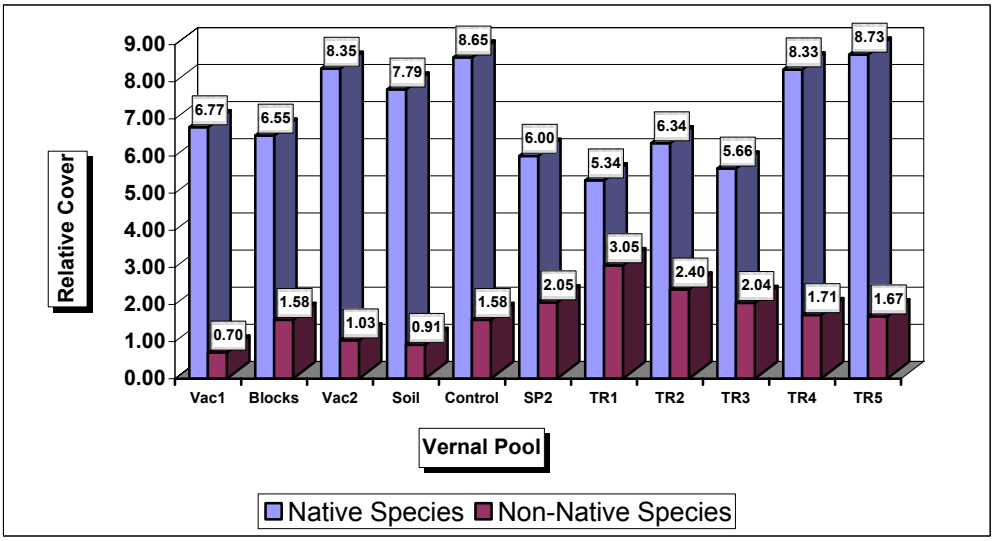


On 06/05/02, we observed thirteen native species in the artificial pools and eleven native species in the natural pools (Table 31). The native species *Eremocarpus setigerus*, *Epilobium pygmaeum*, *Plagiobothrys stipitatus, Psilocarphus brevissimus, Eryngium aristulatum, Hemizonia fitchii, Eleocharis macrostachya, Navarretia intertexta, Pleuropogon californicus*, *Brodiaea elegans*, and *Xanthium strumarium* were detected in both artificial and natural pools. We observed six non-native species in the artificial pools compared with five non-native species in the natural pools. Among the non-native species *Hordeum murinum*, *Convolvulus arvensis, Rumex crispus, Lolium multiflorum* and *Lythrum hyssopifolium* were present in both artificial and natural pools. Overall on 06/05/02, there was a greater amount of native species coverage than non-native species coverage in the artificial and natural pools (Figure 12).

Table 31. Native vs. Non-Native Species on 06/05/02.

Native vs. Non-native spp. 060502	Inoculation Technique					Natural Pools					
Native Species	Vac1	Blocks	Vac2	Soil	Control	SP2	TR1	TR2	TR3	TR4	TR5
Eremocarpus setigerus	0.44	1.44	1.11	1.56	1.56	2.00	3.00	3.00	3.00	2.33	3.00
Epilobium pygmaeum	0.56	0.22	0.78	1.11	1.44	1.00			1.33	1.33	
Psilocarphus brevissimus	1.44	1.67	1.56	0.68	1.33				0.33	1.33	0.37
Hemizonia fitchii	1.67	1.33	1.67	1.11	2.44		1.67	2.00		2.67	
Eryngium aristulatum	1.67	0.78	2.44	2.00	0.33	3.00					1.67
Eleocharis macrostachya	0.44	0.78	0.67	0.33	0.89						2.00
Plagiobothrys stipitatus		0.11	0.11	0.56	0.33				1.00		
Pleuropogon californicus		0.22		0.33			0.67	0.67		0.67	
Cyperus eragrostis	0.11				0.22						
Navarretia intertexta	0.44							0.67			
Brodiaea elegans	6.33		0.01								0.02
Xanthium strumarium				0.11							1.67
Navarretia squarrosa					0.11						
Lasthenia glaberrima											
Downingia concolor											
Lasthenia fremontii											
Relative Cover (Native Species)	6.33	6.55	8.35	7.79	8.65	6.00	5.34	6.34	5.66	8.33	8.73
Non-Native Species											
Convolvulus arvensis	0.03	0.35	0.13	0.01	0.02	0.05	0.03	0.05	1.02	0.05	
Hordeum murinum	0.67	0.89	0.89	0.67	1.00		2.33	1.33	0.67	1.33	
Rumex crispus		0.01		0.01	0.12		0.02	0.35	0.35		1.00
Lolium multiflorum				0.22							0.67
Centaurium muehlenbergii		0.22	0.01								
Lythrum hyssopifolium		0.11			0.44	2.00	0.67	0.67		0.33	
Cotula coronopifolia											
Anagalis arvensis											
Lupinus bicolor											
Polypogon monspeliensis											
Relative Cover (Non-Native Species)	0.70	1.58	1.03	0.91	1.58	2.05	3.05	2.40	2.04	1.71	1.67
Other											
bare soil	2.22	1.89	1.56	2.00	2.22	2.00	2.00	0.67	2.00	1.02	0.35

Figure 12. Native vs. Non-Native Species on 06/05/02.



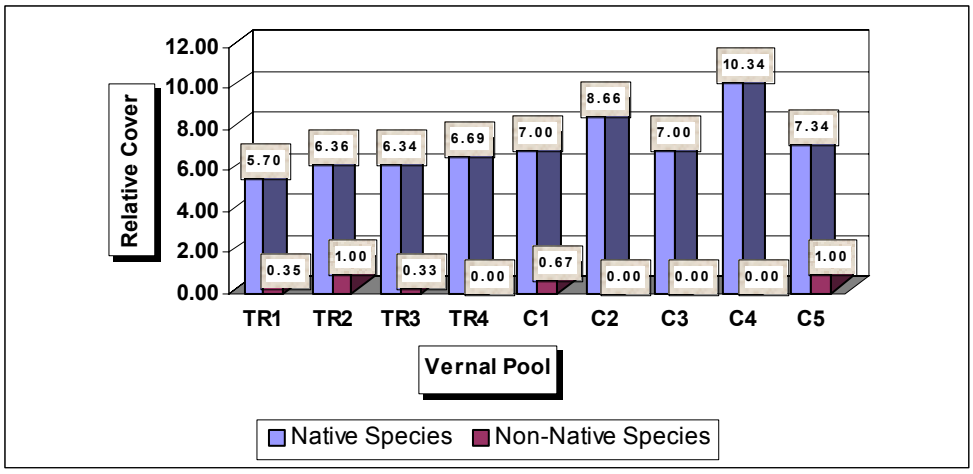
Native vs. Non-Native Species in the Source Pools vs. Artificial Pools

On 04/19/02, we observed seven native species in the source pools and the same amount of native species in the artificial pools (Table 32). The native species *Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, and Pleuropogon californicus* were detected in both source and artificial pools. We observed three non-native species in the source pools and one non-native species in the artificial pools. Among the non-native species *Hordeum murinum* was observed in both artificial and source pools. Overall on 04/19/02 in the artificial and source pools, there was a greater amount of native species coverage than non-native species coverage (Figure 13).

Table 32. Native vs. Non-Native species in TR1-TR4 vs. C1-C5 on 04/19/02.

4/19/2002									
Native Species	**TR1**	**TR2**	**TR3**	**TR4**	**C1**	**C2**	**C3**	**C4**	**C5**
Plagiobothrys stipitatus	2.33	1.00	1.33	2.00	2.33	2.33	2.00	2.67	2.67
Downingia concolor	2.00	2.67	0.66	2.00	1.67	1.33	2.00	2.00	1.33
Psilocarphus brevissimus			0.66	1.67	2.00	3.00	3.00	2.00	2.67
Pleuropogon californicus	0.67	2.00		1.00				0.67	0.67
Lasthenia glaberrima	0.33	0.67	3.67	0.02				3.00	
Eryngium aristulatum		0.02				2.00			
Eleocharis macrostachya					1.00				
Cyperus eragrostis	0.37		0.02						
Hemizonia fitchii									
Brodiaea elegans									
Eremocarpus setigerus									
Navarretia squarrosa									
Xanthium strumarium									
Lasthenia fremontii									
Navarretia intertexta									
Epilobium pygmaeum									
Relative Cover (Native Species)	**5.70**	**6.36**	**6.34**	**6.69**	**7.00**	**8.66**	**7.00**	**10.34**	**7.34**
Non-Native Species									
Hordeum murinum		0.67			0.67				1.00
Convolvulus arvensis	0.33	0.33	0.33						
Rumex crispus	0.02								
Lolium multiflorum									
Lythrum hyssopifolium									
Cotula coronopifolia									
Anagalis arvensis									
Lupinus bicolor									
Centaurium muehlenbergii									
Polypogon monspeliensis									
Relative Cover (Non-Native Species)	**0.35**	**1.00**	**0.33**	**0.00**	**0.67**	**0.00**	**0.00**	**0.00**	**1.00**
Other									
bare soil	0.67	2.00	2.00	0.35	2.67	2.00	3.00	1.00	1.67
Total Relative Cover	**6.05**	**7.36**	**6.67**	**6.69**	**7.67**	**8.66**	**7.00**	**10.34**	**8.34**

Figure 13. Native vs. Non-Native Relative Cover in TR1-TR4 and C1-C5 04/19/02.

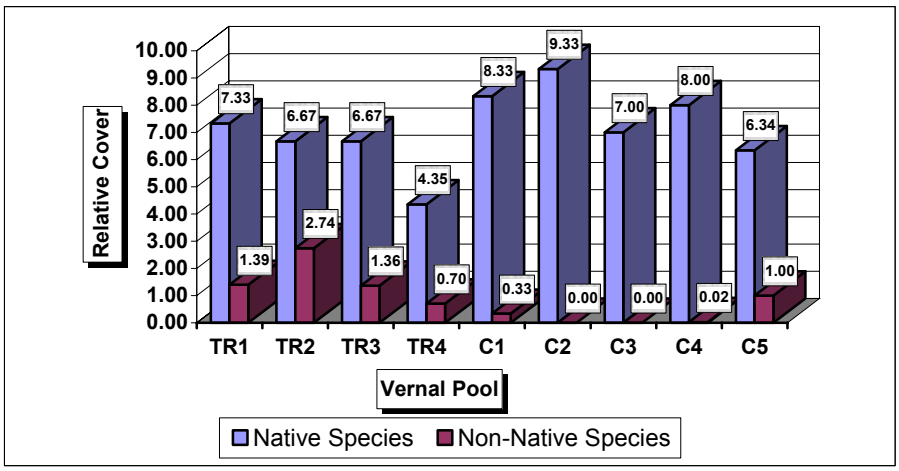


On 05/01/02, we observed eight native species in the source pools and the same amount in the artificial pools (Table 33). The native species *Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, Navarretia intertexta, and Pleuropogon californicus,* were observed in both artificial and source pools. We observed five non-native species in the source pools compared with two non-native species in the artificial pools. Among the non-native species *Hordeum and Rumex crispus* were present in both artificial and source pools. Overall on 05/01/02 in the source and artificial pools, there was a greater amount of native species cover than non-native species cover (Figure 14).

Table 33. Native vs. Non-Native species in TR1-TR4 vs. C1-C5 on 05/01/02.

5/1/2002									
Native Species	**TR1**	**TR2**	**TR3**	**TR4**	**C1**	**C2**	**C3**	**C4**	**C5**
Plagiobothrys stipitatus	2.33	0.67	1.67	1.33	2.33	2.33	2.33	2.00	1.68
Downingia concolor	2.00	3.00	2.00	0.67	1.67	1.67	1.67	2.00	2.33
Psilocarphus brevissimus			0.67	1.33	2.33	3.00	2.00	1.67	2.33
Pleuropogon californicus	0.67	2.67		1.00				1.00	
Eryngium aristulatum				0.02	0.33	2.33		1.00	
Lasthenia glaberrima	2.00		2.33					0.33	
Navarretia intertexta		0.33					1.00		
Eleocharis macrostachya					1.67				
Cyperus eragrostis	0.33								
Hemizonia fitchii									
Brodiaea elegans									
Eremocarpus setigerus									
Navarretia squarrosa									
Xanthium strumarium									
Lasthenia fremontii									
Epilobium pygmaeum									
Relative Cover (Native Species)	**7.33**	**6.67**	**6.67**	**4.35**	**8.33**	**9.33**	**7.00**	**8.00**	**6.34**
Non-Native Species									
Hordeum murinum	1.33	2.00	1.33	0.67				0.02	1.00
Convolvulus arvensis	0.02	0.05	0.03	0.03					
Rumex crispus	0.02				0.33				
Cotula coronopifolia	0.02	0.02							
Lythrum hyssopifolium		0.67							
Lolium multiflorum									
Anagalis arvensis									
Lupinus bicolor									
Centaurium muehlenbergii									
Polypogon monspeliensis									
Relative Cover (Non-Native Species)	**1.39**	**2.74**	**1.36**	**0.70**	**0.33**	**0.00**	**0.00**	**0.02**	**1.00**
Other									
bare soil	1.00	1.33	2.00	1.33	2.33	2.00	2.33	2.00	2.00
Total Relative Cover	**8.72**	**9.41**	**8.03**	**5.05**	**8.66**	**9.33**	**7.00**	**8.02**	**7.34**

Figure 14. Native vs. Non-Native Relative Cover in TR1-TR4 and C1-C5 05/01/02.

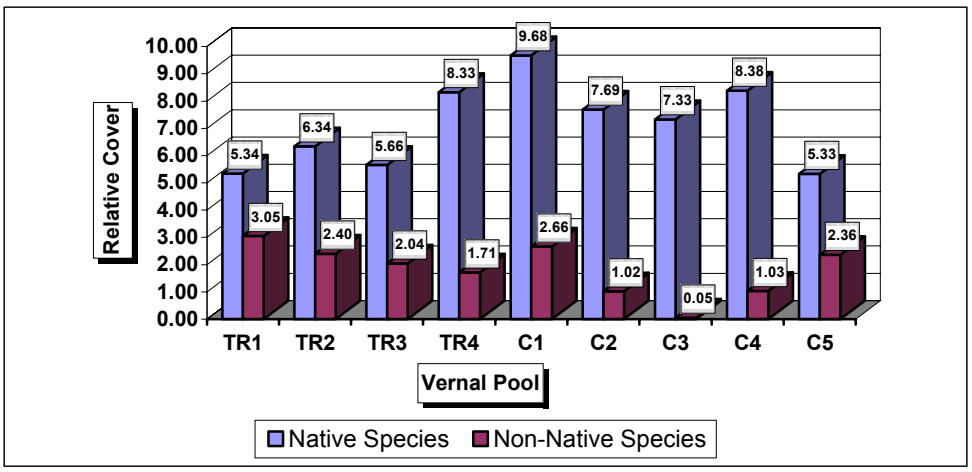


On 06/05/02, we observed seven native species in the source pools and ten native species in the artificial pools (Table 34). The native species *Eremocarpus setigerus*, *Plagiobothrys stipitatus, Psilocarphus brevissimus, Hemizonia fitchii, Navarretia intertexta,* and *Epilobium pygmaeum* were detected in both source and artificial pools. We observed four non-native species in the source pools compared with five non-native species in the artificial pools. Among the non-native species *Hordeum murinum*, *Convolvulus arvensis, Rumex crispus, and Lythrum hyssopifolium* were present in both artificial and source pools. Overall on 06/05/02, there was a greater amount of native species coverage than non-native species coverage in the artificial and source pools (Figure 15).

Table 34. Native vs. Non-Native species in TR1-TR4 vs. C1-C5 on 06/05/02.

6/5/2002									
Native Species	**TR1**	**TR2**	**TR3**	**TR4**	**C1**	**C2**	**C3**	**C4**	**C5**
Hemizonia fitchii	1.67	2.00		2.67	2.67	2.33	3.00	2.00	1.33
Eremocarpus setigerus	3.00	3.00	3.00	2.33	2.00	0.67		2.67	2.00
Psilocarphus brevissimus			0.33	1.33	0.67	0.67	2.00	0.37	2.00
Epilobium pygmaeum			1.33	1.33	1.67	1.67	1.00	2.00	
Plagiobothrys stipitatus			1.00		0.33			0.67	
Pleuropogon californicus	0.67	0.67		0.67					
Eryngium aristulatum						2.33		0.67	
Navarretia intertexta		0.67					1.33		
Cyperus eragrostis					0.67				
Eleocharis macrostachya					1.67				
Brodiaea elegans						0.02			
Lasthenia glaberrima									
Downingia concolor									
Navarretia squarrosa									
Xanthium strumarium									
Lasthenia fremontii									
Relative Cover (Native Species)	**5.34**	**6.34**	**5.66**	**8.33**	**9.68**	**7.69**	**7.33**	**8.38**	**5.33**
Non-Native Species									
Hordeum murinum	2.33	1.33	0.67	1.33	1.00	1.00	0.02	1.00	1.00
Convolvulus arvensis	0.03	0.05	1.02	0.05			0.03	0.03	0.67
Rumex crispus	0.02	0.35	0.35		0.33				0.02
Lythrum hyssopifolium	0.67	0.67		0.33	1.33				
Centaurium muehlenbergii						0.02			0.67
Cotula coronopifolia									
Lolium multiflorum									
Anagalis arvensis									
Lupinus bicolor									
Polypogon monspeliensis									
Relative Cover (Non-Native Species)	**3.05**	**2.40**	**2.04**	**1.71**	**2.66**	**1.02**	**0.05**	**1.03**	**2.36**
Other									
bare soil	2.00	0.67	2.00	1.02	2.00	1.67	2.33	1.67	1.67
Total Relative Cover	**8.39**	**8.74**	**7.70**	**10.04**	**12.34**	**8.71**	**7.38**	**9.41**	**7.69**

Figure 15. Native vs. Non-Native Relative Cover in TR1-TR4 and C1-C5 06/05/02.

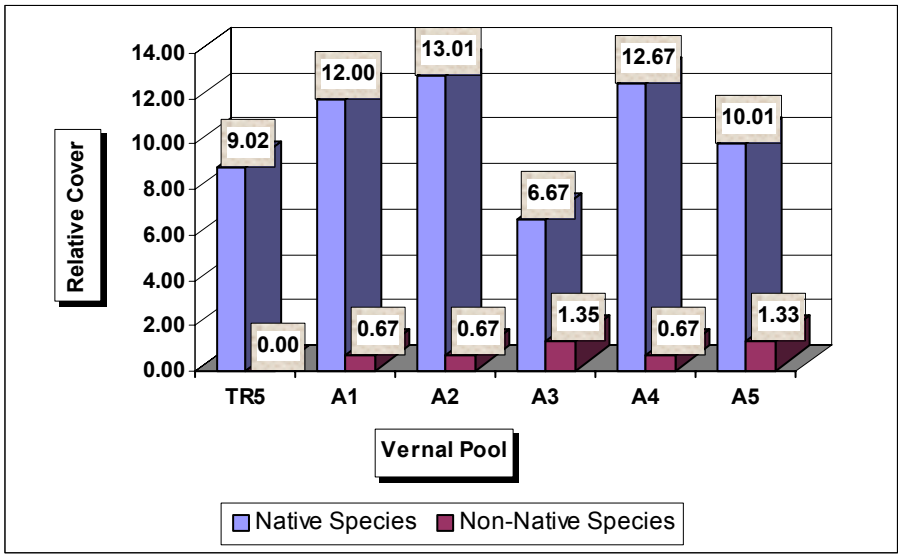


On 04/19/02, we observed seven native species in the source pool TR5 compared with eight native species in the artificial pools A1-A5 (Table 35). The native species *Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, Pleuropogon californicus, and Eleocharis macrostachya* were detected in both source and artificial pools. There was a greater amount of native species coverage than non-native species coverage in TR5 and A1-A5 (Figure 16).

Table 35. Native vs. Non-Native species in TR5 vs. A1-A5 on 04/19/02.

4/19/2002	Vernal Pool					
Native Species	**TR5**	**A1**	**A2**	**A3**	**A4**	**A5**
Plagiobothrys stipitatus	2.00	2.00	2.00	2.00	2.67	1.67
Eryngium aristulatum	1.67	2.00	2.00	0.67	2.33	2.00
Downingia concolor	1.00	3.00	2.00	1.67	2.33	1.67
Psilocarphus brevissimus	0.02	2.67	2.67	2.33	1.67	
Lasthenia glaberrima	3.33	0.33	2.67		2.00	2.00
Eleocharis macrostachya	0.67	2.00	1.67		1.67	1.00
Pleuropogon californicus	0.33					0.67
Lasthenia fremontii						1.00
Hemizonia fitchii						
Brodiaea elegans						
Navarretia squarrosa						
Navarretia intertexta						
Epilobium pygmaeum						
Eremocarpus setigerus						
Xanthium strumarium						
Cyperus eragrostis						
Relative Cover (Native Species)	**9.02**	**12.00**	**13.01**	**6.67**	**12.67**	**10.01**
Non-Native Species						
Hordeum murinum		0.67	0.67	1.33	0.67	1.33
Rumex crispus				0.02		
Convolvulus arvensis						
Lythrum hyssopifolium						
Cotula coronopifolia						
Anagalis arvensis						
Lupinus bicolor						
Centaurium muehlenbergii						
Lolium multiflorum						
Polypogon monspeliensis						
Relative Cover (Non-Native Species)	**0.00**	**0.67**	**0.67**	**1.35**	**0.67**	**1.33**
Other						
bare soil	0.02	2.00	2.67	3.00	2.00	1.33
Total Relative Cover	**9.02**	**12.67**	**13.68**	**8.02**	**13.34**	**11.34**

Figure 16. Native vs. Non-Native Relative Cover in TR5 and A1-A5 04/19/02.

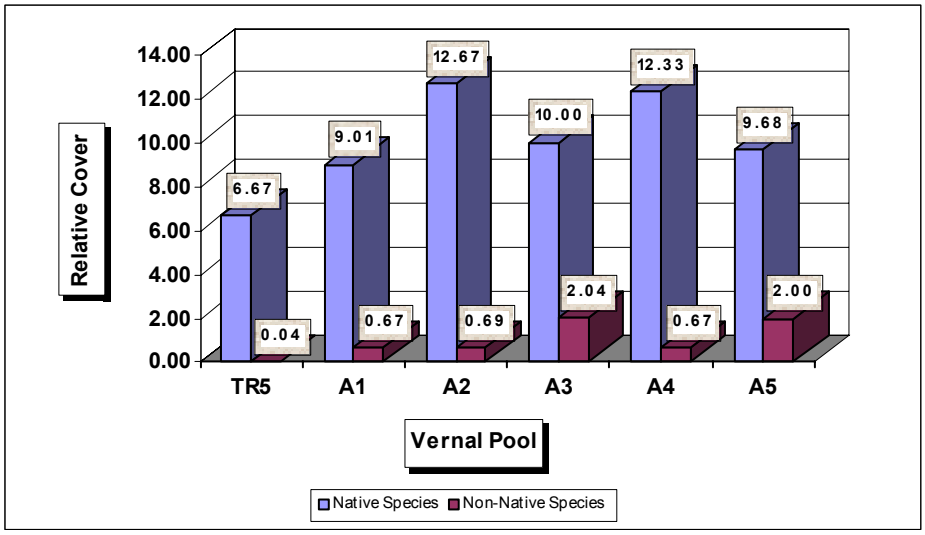


On 05/01/02, we observed six native species in the source pool TR5 and eight native species in the artificial pools A1-A5 (Table 36). The native species *Plagiobothrys stipitatus, Downinngia concolor, Eryngium aristulatum, Lasthenia glaberrima, Eleocharis macrostachya, and Pleuropogon californicus* were observed in both artificial and source pools. We observed two non-native species in the source pools compared with four non-native species in the artificial pools. Among the non-native species *Convolvulus arvensis and Rumex crispus* were present in both artificial and source pools. Overall on 05/01/02 in the source and artificial pools, there was a greater amount of native species coverage than non-native species coverage (Figure 17).

Table 36. Native vs. Non-Native species in TR5 vs. A1-A5 on 05/01/02.

5/1/2002	Vernal Pool					
Native Species	**TR5**	**A1**	**A2**	**A3**	**A4**	**A5**
Plagiobothrys stipitatus	1.67	2.00	2.00	2.00	2.67	1.67
Eryngium aristulatum	1.00	1.33	2.00	1.00	2.33	2.00
Downingia concolor	1.33	1.33	2.00	1.67	2.33	1.67
Lasthenia glaberrima	1.00	0.33	2.00		2.00	3.00
Eleocharis macrostachya	1.00	1.35	2.00		1.67	0.67
Psilocarphus brevissimus		2.67	2.67	2.33	1.33	
Pleuropogon californicus	0.67					0.67
Hemizonia fitchii				3.00		
Lasthenia fremontii						
Brodiaea elegans						
Navarretia squarrosa						
Navarretia intertexta						
Epilobium pygmaeum						
Eremocarpus setigerus						
Xanthium strumarium						
Cyperus eragrostis						
Relative Cover (Native Species)	**6.67**	**9.01**	**12.67**	**10.00**	**12.33**	**9.68**
Non-Native Species						
Hordeum murinum		0.67	0.67	2.00	0.67	1.33
Convolvulus arvensis	0.02		0.02	0.02		
Rumex crispus	0.02			0.02		
Lolium multiflorum						0.67
Lythrum hyssopifolium						
Cotula coronopifolia						
Anagalis arvensis						
Lupinus bicolor						
Centaurium muehlenbergii						
Polypogon monspeliensis						
Relative Cover (Non-Native Species)	**0.04**	**0.67**	**0.69**	**2.04**	**0.67**	**2.00**
Other						
bare soil	0.03	2.00	2.33	3.00	2.00	1.67
Total Relative Cover	**6.71**	**9.68**	**13.36**	**12.04**	**13.00**	**11.68**

Figure 17. Native vs. Non-Native Relative Cover in TR5 and A1-A5 05/01/02.

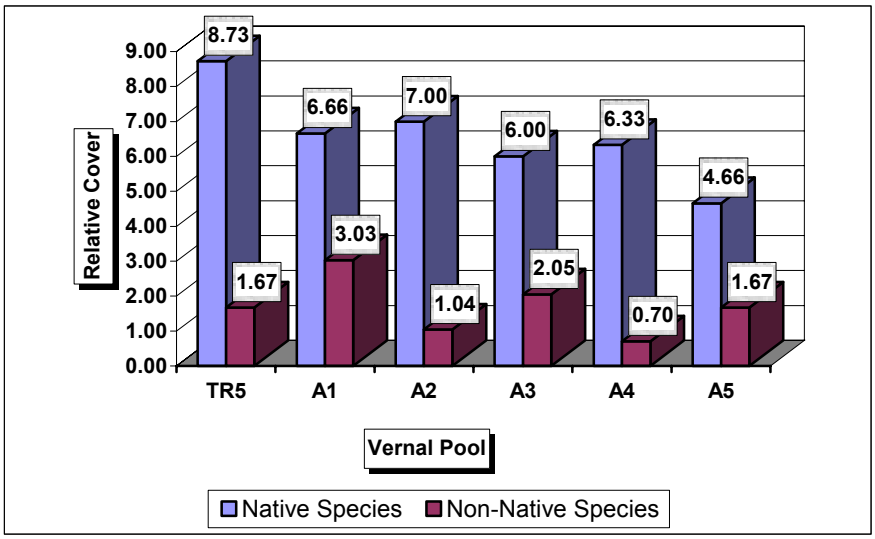


On 06/05/02, we observed six native species in the source pool TR5, and eight native species in the artificial pools A1-A5 (Table 37). The native species *Psilocarphus brevissimus, Eryngium aristulatum*, *Eleocharis macrostachya*, *Xanthium strumarium* were detected in both source and artificial pools. We observed two non-native species in the source pools compared with four non-native species in the artificial pools. Among the non-native species *Rumex crispus* and *Lolium multiflorum* were present in both artificial and natural pools. Overall on 06/05/02, there was a greater amount of native species coverage than non-native species coverage in the artificial and source pools (Figure 18).

Table 37. Native vs. Non-Native species in TR5 vs. A1-A5 on 06/05/02.

6/5/2002	Vernal Pool					
Native Species	**TR5**	**A1**	**A2**	**A3**	**A4**	**A5**
Eryngium aristulatum	1.67	3.00	3.00	1.00	2.33	2.33
Psilocarphus brevissimus	0.37	2.00	2.00	1.67	1.00	0.67
Eleocharis macrostachya	2.00	1.33	2.00		2.33	0.33
Xanthium strumarium	1.67					0.33
Downingia concolor					0.67	0.67
Hemizonia fitchii				3.33		
Plagiobothrys stipitatus						0.33
Brodiaea elegans	0.02					
Eremocarpus setigerus	3.00					
Cyperus eragrostis		0.33				
Navarretia squarrosa						
Pleuropogon californicus						
Lasthenia fremontii						
Navarretia intertexta						
Epilobium pygmaeum						
Lasthenia glaberrima						
Relative Cover (Native Species)	**8.73**	**6.66**	**7.00**	**6.00**	**6.33**	**4.66**
Non-Native Species						
Hordeum murinum		3.00	0.67	2.00	0.67	1.00
Convolvulus arvensis		0.03	0.37	0.03	0.03	
Rumex crispus	1.00			0.02		
Lolium multiflorum	0.67					0.67
Lythrum hyssopifolium						
Cotula coronopifolia						
Anagalis arvensis						
Lupinus bicolor						
Centaurium muehlenbergii						
Polypogon monspeliensis						
Relative Cover (Non-Native Species)	**1.67**	**3.03**	**1.04**	**2.05**	**0.70**	**1.67**
Other						
bare soil	0.35	2.00	1.67	2.67	2.33	2.33
Total Relative Cover	**10.40**	**9.69**	**8.04**	**8.05**	**7.03**	**6.33**

Figure 18. Native vs. Non-Native Relative Cover in TR5 and A1-A5 06/05/02.



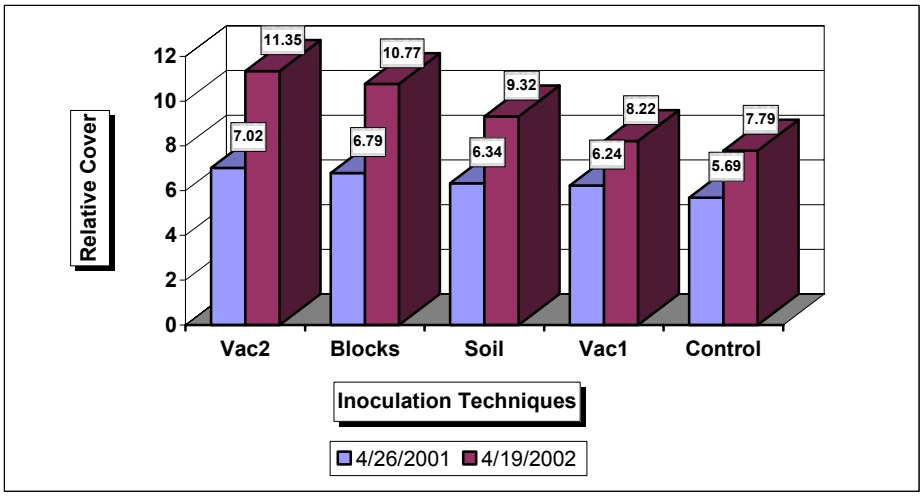
Data Comparison 2001 vs. 2002

Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, and *Hordeum murinum* were detected in 04/26/01 and 04/19/02 (Table 38). *Eleocharis macrostachya* was observed in 2002, but absent in 2001. It appears that there was a larger group of non-native species like; *Convolvulus arvensis, Anagalis arvensis, Lupinus bicolor,* and *Erodium botrys* in 2001, which did not appear in 2002. Overall the month of April displayed greater amounts of relative cover in both years. The inoculation technique Vac2 had the highest relative cover in both 2001 and 2002 (Figure 19).

Table 38. 04/26/01 vs. 04/19/02.

Zone Averages 042601 vs. 041902	2001 Inoculation Techniques					2002 Inoculation Techniques				
List of Species	Vac1	Blocks	Vac2	Soil	Control	Vac1	Blocks	Vac2	Soil	Control
Plagiobothrys stipitatus	2.01	2.56	1.44	2.11	1.67	1.89	2.67	3.11	2.00	2.22
Psilocarphus brevissimus	1.89	0.67	2.56	0.56	2.67	2.22	2.33	2.56	1.11	2.22
Eryngium aristulatum	0.56	0.33	0.45	0.67	0.11	1.33	0.89	1.56	1.11	0.22
Downingia concolor	0.11	0.22	0.12	0.22	0.12	1.22	1.89	1.67	1.33	1.89
Lasthenia glaberrima	0.78	1.34	0.89	2.22		0.67	1.33	1.33	1.67	
Eleocharis macrostachya						0.67	0.55	0.56	0.33	0.56
Erodium botrys	0.11	0.22	0.11		0.12					
Convolvulus arvensis	0.22	0.01	0.12	0.12						
Anagalis arvensis		0.11	0.11							
Lupinus bicolor		0.11	0.11							
Lasthenia fremontii									0.33	
Rumex crispus										0.01
Hemizonia fitchii		0.11								
Brodiaea elegans										
Navarretia squarrosa										
Navarretia intertexta										
Lythrum hyssopifolium										
Epilobium pygmaeum										
Eremocarpus setigerus										
Centaurium muehlenbergii										
Xanthium strumarium										
Cotula coronopifolia										
Cyperus eragrostis										
Grasses										
Hordeum murinum	0.56	1.11	1.11	0.44	1.00	0.22	0.78	0.56	0.44	0.67
Pleuropogon californicus							0.33		1.00	
Lolium multiflorum										
Polypogon monspeliensis										
Other										
bare soil	2.22	1.00	1.89	1.22	2.22	2.67	1.78	2.00	1.44	2.89
Relative Cover (average)	6.24	6.79	7.02	6.34	5.69	8.22	10.77	11.35	9.32	7.79

Figure 19. Relative Cover of each inoculation technique 04/26/01 vs. 04/19/02.

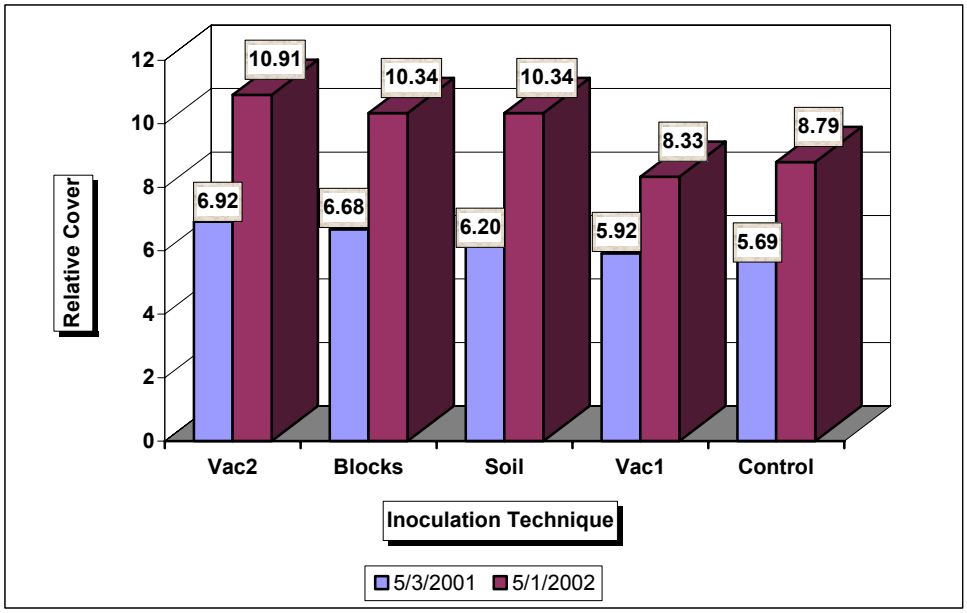


Plagiobothrys stipitatus, Downinngia concolor, Psilocarphus brevissimus, Eryngium aristulatum, Lasthenia glaberrima, Hemizonia fitchii, Convolvulus arvensis, Hordeum murinum, and *Lolium multiflorum* were detected in 05/03/01 and 05/01/02 (Table 39). *Eleocharis macrostachya* was observed in 2002, but absent in 2001. Overall, there was a greater amount of relative cover in May 2002 than 2001. The inoculation technique Vac2 had the highest relative cover in May 2001 and 2002 (Figure 20).

Table 39. 05/03/01 vs. 05/01/02.

Zone Averages 050301 vs. 050102	**2001 Inoculation Techniques**					**2002 Inoculation Techniques**				
List of Species	Vac1	Blocks	Vac2	Soil	Control	Vac1	Blocks	Vac2	Soil	Control
Plagiobothrys stipitatus	0.89	1.57	0.36	1.00	1.12	2.11	2.45	2.33	1.78	2.22
Psilocarphus brevissimus	2.22	1.44	2.78	1.00	2.44	2.11	2.11	2.78	1.33	2.33
Eryngium aristulatum	1.11	0.56	1.34	0.89	0.44	1.00	0.78	1.89	1.67	0.44
Downingia concolor	0.12	0.78	0.35	0.56	0.22	1.33	2.22	1.78	1.56	1.33
Lasthenia glaberrima	0.46	1.11	0.35	1.12	0.01	0.78	1.33	0.89	1.78	
Convolvulus arvensis	0.12	0.11	0.11	0.01	0.12			0.01		0.01
Eleocharis macrostachya						0.45	0.56	0.67	0.22	0.78
Anagalis arvensis		0.11	0.01	0.11						
Erodium botrys			0.11	0.11						
Hemizonia fitchii	0.11									1.00
Rumex crispus										0.12
Navarretia squarrosa						0.33				
Lupinus bicolor										
Lasthenia fremontii										
Brodiaea elegans										
Navarretia intertexta										
Lythrum hyssopifolium										
Epilobium pygmaeum										
Eremocarpus setigerus										
Centaurium muehlenbergii										
Xanthium strumarium										
Cotula coronopifolia										
Cyperus eragrostis										
Grasses										
Hordeum murinum	0.78	1.00	1.40	1.40	1.23	0.22	0.78	0.56	0.45	0.56
Lolium multiflorum	0.11		0.11		0.11				0.22	
Pleuropogon californicus							0.11		1.33	
Polypogon monspeliensis										
Taeniatherum caput-medusae										
Other										
bare soil	2.78	2.11	2.56	1.78	1.23	2.33	2.11	1.44	1.67	2.56
Relative Cover (average)	5.92	6.68	6.92	6.20	5.69	8.33	10.34	10.91	10.34	8.79

Figure 20. Relative Cover of each inoculation technique 05/03/01 vs. 05/01/02.

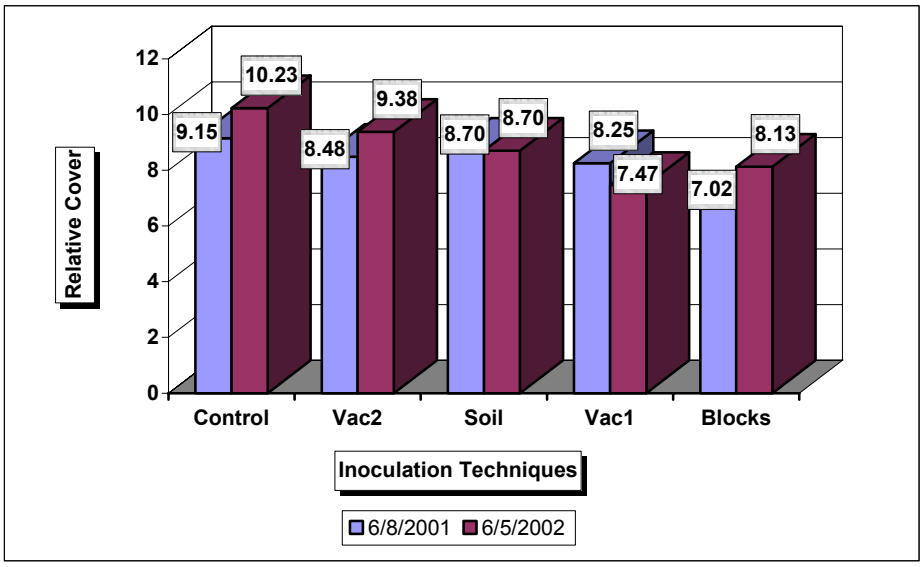


Eremocarpus setigerus, Psilocarphus brevissimus, Eryngium aristulatum, Convolvulus arvensis, Hemizonia fitchii, Centaurium muehlenbergii, and *Xanthium strumarium* were detected in 06/08/01 and 06/05/02 (Table 40). *Eleocharis macrostachya* was detected in one pool in June 2001 and was seen in all of the pools in June 2002. There was a larger group of non-native grasses in June 2001 compared to June 2002. Relative cover was higher in June 2002 than June 2001. The Control had the highest relative cover in June of both years (Figure 21).

Table 40. 06/08/01 vs. 06/05/02.

Zone Averages 060801 vs. 060502	2001 Inoculation Techniques					2002 Inoculation Techniques				
List of Species	Vac1	Blocks	Vac2	Soil	Control	Vac1	Blocks	Vac2	Soil	Control
Eremocarpus setigerus	0.23	0.44	0.44	1.23	1.22	0.44	1.44	1.11	1.56	1.56
Psilocarphus brevissimus	1.56	1.11	1.67	0.78	2.11	1.44	1.67	1.56	0.68	1.33
Eryngium aristulatum	1.56	0.78	1.23	1.67	0.33	1.67	0.78	2.44	2.00	0.33
Convolvulus arvensis	0.44	0.44	0.22	0.12	0.45	0.03	0.35	0.13	0.01	0.02
Hemizonia fitchii	1.22	0.78	1.33	0.33	1.45	1.67	1.33	1.67	1.11	2.44
Eleocharis macrostachya		0.22				0.44	0.78	0.67	0.33	0.89
Epilobium pygmaeum						0.56	0.22	0.78	1.11	1.44
Plagiobothrys stipitatus							0.11	0.11	0.56	0.33
Centaurium muehlenbergii			0.11				0.22	0.01		
Rumex crispus							0.01		0.01	0.12
Xanthium strumarium				0.11					0.11	
Cyperus eragrostis						0.11				0.22
Lythrum hyssopifolium							0.11			0.44
Brodiaea elegans								0.01		
Navarretia squarrosa										0.11
Navarretia intertexta						0.44				
Erodium botrys										
Lasthenia fremontii										
Anagalis arvensis										
Lupinus bicolor										
Downingia concolor										
Lasthenia glaberrima										
Cotula coronopifolia										
Grasses										
Hordeum murinum	1.44	1.67	1.44	1.89	1.68	0.67	0.89	0.89	0.67	1.00
Taeniatherum caput-medusae	0.90	0.68	1.23	0.78	1.01					
Lolium multiflorum	0.90	0.79	0.81	1.01	0.79				0.22	
Polypogon monspeliensis		0.11		0.78	0.11					
Pleuropogon californicus							0.22		0.33	
Other										
bare soil	2.78	2.11	2.11	2.01	2.56	2.22	1.89	1.56	2.00	2.22
Relative Cover (average)	8.25	7.02	8.48	8.70	9.15	7.47	8.13	9.38	8.70	10.23

Figure 21. Relative Cover of each inoculation technique 06/08/01 vs. 06/05/02.



VEGETATION CONCLUSIONS

The following conclusions are based on the observations made in Spring 2001 and Spring 2002. The 2001 season had low rainfall than the 2002 season producing short inundation periods in both artificial and natural pools.

1. The overall pattern of vegetation growth in the artificial pools is strongly influenced by the pools' design. The artificial pools were constructed with a downhill slope, a deep end of 80 cm and side slopes graded to 30 degrees. This design resulted in a lack of vegetation on the side slopes. Artificial pools have been designed with gentle slopes that are more likely to have vegetated slopes (De Weese, 1998).

2. The artificial pools are generally deeper than the natural pools. Inundation periods tend to be longer in the deeper artificial pools than in the shallower natural pools. *Plagiobothrys stipitatus* dominates the deeper zones in most of the artificial pools, but is absent in the shallower natural pools TR16 and SP1. De Weese (1998) observed a shift in species cover in artificial vernal pools starting in the third year after construction, or sometimes sooner. Species preferring longer inundation periods expanded their cover in artificial pools that she surveyed.

3. There was a shift in the vegetation zones in the artificial pools from 2001 – 2002. The deep zone species of 2001 shifted to the middle zone in 2002 due to the higher rainfall and longer inundation periods. In the deep zones of some of the artificial pools the longer inundation periods in 2002 created a bare soil zone in the bottom of the pools. Concentric rings of vegetation grew around the outer edges of the bare zones. Species producing distinct rings included *Downingia concolor*, *Plagiobothrys stipitatus*, *Lasthenia glaberrima*, and *Psilocarphus brevissimus*, (photo 3 and photo 4)

Photo 5. Artificial Pool B4 on 04/26/01.

Photo 6. Artificial Pool B4 on 04/19/02.

4. Species varied from year to year in the artificial and source pools. There were species present in 2002 that were absent in 2001. New species observed in 2002 *Navarretia squarrosa, Epilobium pygmaeum, Lythrum hyssopifolium, Navarretia intertexta*. This year to year variation was also apparent in Northen, Holve-Hensill and Eakins, 1998.

5. In 2001, the non-native grass species grew in greater cover abundance in the artificial pools than in the natural pools. *Hordeum murinum*, *Lolium multiflorum*, and *Taeniatherum caput-medusae* successfully invaded the shallow to middle zones of all the artificial pools.

6. In 2002, invasive species such as *Hordeum murinum*, *Convolvulus arvensis*, and *Anagalis arvensis,* in the artificial pools had lower amounts of relative cover than in 2001. The higher rainfall and longer inundation periods in 2002 appear to have limited the invasive species and benefited the native species that are present in the artificial pools.

7. *Psilocarphus brevissimus* grew best in areas with little competition from other species. In some of our artificial pools *Psilocarphus brevissimus* dominated the deeper zones in the absence of *Plagiobothrys stipitatus*. This is evident by *Plagiobothrys stipitatus* growing significantly higher in the deep zones where little or no amounts of *Psilocarphus brevissimus* were apparent.

8. Vac2 out performed the other inoculation treatments in terms of native versus non-native relative cover. The Blocks, Soil, and Control treatments had greater amounts of non-native species compared to Vac2. In Northen, Holve-Hensill and Eakins report, the Soil treatment out performed Vac2 and Blocks (Northen, Holve-Hensill and Eakins, 1998).

9. After eight years, vegetation spread is limited in the Blocks treatment. The Blocks treatment appears to be the least desirable inoculation treatment.

Photo 7. Artificial Pool A4 on 04/10/01with arrows indicating limited growth.

10. Although the artificial and source pool have similar species. Both the source and the artificial pools appear to be losing diversity over time. The fencing of the source and artificial pools is interfering with a disturbance regime that is needed for the self-sustainability of the pools. The artificial pools appear to have lost plant species since 1996. From 1993 – 1996 Northen, Holve-Hensill and Eakins concluded that out of twenty-four native wetland plants, sixteen showed good to high coverage in the artificial pools (Northen, Holve-Hensill and Eakins, 1998). In 2001, we observed fourteen native species in the artificial pools with seven native species having good coverage.

11. A group of native species *Plagiobothrys stipitatus*, *Lasthenia glaberrima*, *Downingia concolor, Psilocarphus brevissimus*, and *Eryngium aristulatum* dominated the deep and middle zones of the artificial pools. At this point in time these species appear to form a vernal pool community type for the research site at Travis AFB.

12. During each individual year there is a shift from early appearing species to late appearing species. For instance, *Downingia concolor* and *Lasthenia glaberrima* were apparent early in the season (April, May) and disappeared later in the season (June, July). Compared to *Hemizonia fitchii* and *Eremocarpus setigerus*, which grew significantly in the late season (June through August). Therefore, it is useful to make several visits during an individual year to the same pool to gather vegetation data to help to insure that all plant species in a pool are identified.

VEGETATION DISCUSSION

Artificial Pool Design

During our study, we concluded that the vegetation present in artificial pools appears to be, in part, dependent upon the design of the pool. The increased depth of the artificial pools at Travis AFB led to longer inundation periods when compared to the natural pools, which have shallower depths and shorter inundation periods. *Plagiobothrys stipitatus* dominated the deeper zones in most of the artificial pools, but is absent in the shallower natural pools TR16 and SP1 (Photo 6). De Weese (1996) observed that starting in the third year and sometimes sooner, there is a shift in species cover, with species preferring longer inundation periods becoming more dominant.

The artificial pools were constructed with a downhill slope, a deep end of 80 cm and side slopes graded to 30 degrees. This design resulted in a lack of vegetation on the side slopes. In recent years artificial pools have been designed with gentle slopes that are more likely to have vegetated slopes (De Weese, 1998). We recommend that the construction of artificial pools should mimic natural pools being generally round and having gentle slopes inward to the center. Originally, the plan at Travis AFB was to flatten the side slopes after the research was completed.

In the CSU Fresno study, there were two types of artificial pool designs, swale-like and bowl-like. The swale-like pools were relatively shallow, 8-12 inches deep, and were constructed so that water collected against a levee and backed up with additional precipitation (Stebbins, Brownell, Trayler 1996). Bowl-like pools were deeper, 12-18 inches and as the name implies sloped towards the center of the pool rather than towards a single side (Stebbins, Brownell, Trayler 1996). The CSU Fresno study also found that pool design influenced the success of specific vernal pool plants. Bowl-like pools of moderate depth and intermediate type pools that fill earlier and hold water longer seem to be a more appropriate for many plant species, including *Orcuttia* species than shallower pools(Stebbins, Brownell, Trayler 1996).

Photo 8. Closeup of B2 deep zone on 04/26/01.

Source Pools on Travis AFB

When Sonoma State started work at the site in 1993, it was considered necessary to fence the source and artificial pools to control the conditions of the study and protect sensitive species (Northen, Holve-Hensill and Eakins, 1998). However, fencing the source pools has appeared to reduce the vegetation diversity over time. Before the beginning of the research project the study area was grazed by livestock and the source pools maintained a high vegetative diversity under the grazing regime and other disturbance. The most notable change has occurred in pool TR17, which now contains a high percentage of thatch and non-native plants (photo 2). Over time we believe that the other source pools TR1-TR5 will resemble TR17 due to the fencing. In 2002, TR1-TR5 has lost plant diversity, but not to extent of TR17 (photos 7 & 8).

Photo 9. Source Pool TR5 in 1994 (Northern, Holve-Hensil, Eakins 1998).

Photo 10. Source Pool TR5 in 2002.

Currently horses graze the portion of TR5 located outside of the fence. Inside the fence there is a greater cover of thatch and non-native plants than outside of the fence (photo 7). Since the fencing of the source pool TR5, there has been a shift in the species diversity within the fenced area.

Photo 11. Outside of fenced Source Pool TR5 in 2002

It appears that at Travis AFB grazing has helped to maintain the vegetative diversity in the vernal pools. Removal of the fencing may help restore the appropriate disturbance regimes to the vernal pools. Maintenance practices such as mowing or hand weeding are labor intensive and costly. Most vernal pool mitigation sites are not suited for controlled burns. Herbicides are generally not used in vernal pools (DeWeese 1996; Barry 1996). A grazing management plan for the Travis AFB pools may help to sustain vegetative diversity in the system.

Community of Plants in the Artificial and Source Pools

Artificial and source pools demonstrated a distinct community of plants during the two years of our study. *Plagiobothrys stipitatus*, *Lasthenia glaberrima*, *Downingia concolor Psilocarphus brevissimus*, and *Eryngium aristulatum* were in both artificial and natural pools. However, these species had greater frequency and relative cover values in the artificial pools than in source pools. Due to the non-disturbance conditions existing in both the artificial and source pools, it may be possible these plants also prefer a non-disturbance regime. Overall species diversity in the artificial and source pools may be limited to plants that prefer longer inundation and or a non-disturbance regime (Table 29 & 38).

Vegetation Sampling Methodology

In the CSU Fresno Study, vegetation data was collected along a permanent transect bisecting through each pool and passing through the deepest site in the pool. The study

concluded two distinct problems with this type of sampling method. First, during the collection of data along the transect soil and vegetation were disturbed. Secondly, the permanent transects through the deepest part of the pool limited the sampling method by excluding the zonation of vernal pool plants. In many cases data collection along the transect did not include species that were present in high numbers but were limited in distribution or present in broken rings (Stebbins, Brownell, Trayler 1996). To help avoid the second shortcoming during our study, we divided the artificial pool into deep, middle, and shallow zones. During data collection each artificial pool had a deep, middle, and shallow zone data plot. The data collected in the three plots produced a view of the characteristics of the artificial pools without neglecting the zonation of our artificial pools.

Long-term studies are needed to collect sufficient data to conclude the vegetative success of the vernal pools. For example, in the two years of our study we observed some different species in the vernal pools on Travis AFB. Several years of sampling may be necessary to truly characterize a pool.

In determining if an area contains vernal pool plants, a single visit during any given year may not be sufficient to identify all species. There is a shift from early blooming species to late blooming species in the Travis AFB vernal pools. *Downingia concolor* and *Lasthenia glaberrima* were apparent early in the season and absent later in the season. In contrast *Hemizonia fitchii* and *Eremocarpus setigerus*, grew significantly in the late season. It may not be appropriate to visit a vernal pool system in the later part of the season to determine its vegetative classification.

The amount of rainfall in a season can play a role in the apparent vegetation during an individual year in a vernal pool system. In the first year (2001) of our study, there was a lower amount of rainfall producing shorter inundation periods than in 2002. In 2002 the pools had a higher amount of relative cover and fewer invasive grasses than in 2001. Vegetation in a drought season can be different than a season with sufficient rainfall.

A digital camera can provide a series of electronic images allowing proper identification of plant species, estimates of percent cover, and analysis of other vegetation characteristics. Although the series of electronic images provides an accurate record, researchers must be cautious when identifying individual plant species. Close-ups, samples and careful analysis must be used to remove any potential errors when identifying individual plant species.

HYDROLOGY

Vernal pools are seasonal wetlands occurring in shallow depressions over a substrate that limits water percolation. During the winter rainy season water accumulates in the pools and remains present for a variable period of time depending on such factors as: rainfall, evaporation, volume of the pool and permeability of the underlying layer. Pools remain inundated for periods ranging from a few days to several months. It is this seasonal inundation and drying that creates the physical habitat conditions in which the vernal pool biota lives. Therefore, to restore or replicate vernal pool conditions to a site, seasonal inundation must be developed and maintained.

The Travis AFB vernal pool study is primarily a vegetation study. In the original design only limited consideration was given to hydrology. The Sonoma State team used water depth measurements to determine zones for vegetation analysis. They measured the water depth in the artificial pools at each meter point from a sampling baseline at approximately two-week intervals during the 1995/1996 rainy season. Additionally, invertebrate collectors noted the presence or absence of surface water during collections in all years of the original study (Northen, Holve-Hensill and Eakins, 1998).

Hydrology Methods

For the present study we visited the natural and artificial pools at Travis AFB in February 15, 2000, January 2001 through July 2001 and January 2002 through July 2002. On each visit we recorded electronic images of each pool to document the presence or absence of surface water. Surface water presence or absence data from Northen, Holve-Hensill and Eakins for the 1993/1994, 1994/1995 and 1995/1996 rainy seasons was compared to the 2000/2001 and 2001/2002 data.

Hydrology Results

Tables 41-43 summarize the inundation data derived from Northen, Holve-Hensill and Eakins. Table 44 summarizes the inundation data from the rainy season of 2000/2001. Table 45 summarizes the inundation data from the rainy season of 2001/2002. Table 46 summarizes the rainfall in the nearby city of Fairfield from 1993/1994 to 2001/2002. On tables 41-45; *Yes* indicates standing water was present, while *No* indicates the absence of standing water in the pool on the date.

On 02/15/2000 all of the pools, both natural and artificial, contained surface water. On 02/01/2001 none of the pools contained surface water. On 03/01/2001 all of the pools, both natural and artificial, contained surface water. No pools contained surface water on or after 04/26/01. The smaller natural pools SP1, SP2, TR14 and TR15 contained no surface water by 03/22/01. The large pool TR17 contained surface water through 03/22/01, but was dry by 03/29/01. TR16 contained no surface water by 04/01/01.

Table 41. Presence of Surface Water in Travis Pools for the 1993/1994 Rainy Season.

Date	2/4	2/18	3/4	3/18	4/1	4/15	4/22	4/30	5/14
Pool									
A-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-3	Yes	Yes	Yes	No	No	No	No	No	No
A-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-4	Yes	Yes	Yes	Yes	No	No	No	No	No
B-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
C-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TR17	No	Yes	Yes	No	No	No	No	No	No

Yes = standing water was present in the pool on the date indicated.
No = no standing water was present in the pool on the date indicated.

Table 42. Presence of Surface Water in Travis Pools for the 1994/1995 Rainy Season.

Date	12/17	12/29	1/16	1/30	2/13	2/25	3/11	3/26	4/8	4/21	5/7
Pool											
A-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-3	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
A-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
B-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
B-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
C-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
C-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
C-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TR17	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No

Yes = standing water was present in the pool on the date indicated.
No = no standing water was present in the pool on the date indicated.

Table 43. Presence of Surface Water in Travis Pools for the 1995/1996 Rainy Season.

Date	12/16	12/30	1/14	1/28	2/11	2/25	3/10	3/24	4/6	4/21
Pool										
A-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
A-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
B-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C-5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TR17	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Yes = standing water was present in the pool on the date indicated.
No = no standing water was present in the pool on the date indicated.

Table 44. Presence of Surface Water in Travis Pools for the 2000/2001 Rainy Season.

Date	2/1/01	3/1/01	3/22/01	3/29/01	4/10/01	4/26/01
Pool						
A-1	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
A-2	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
A-3	**No**	**Yes**	**Yes**	**No**	**No**	**No**
A-4	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
A-5	**No**	**Yes**	**Yes**	**No**	**No**	**No**
B-1	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
B-2	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
B-3	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
B-4	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
B-5	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
C-1	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
C-2	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
C-3	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
C-4	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
C-5	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**
SP1	**No**	**Yes**	**No**	**No**	**No**	**No**
SP2	**No**	**Yes**	**No**	**No**	**No**	**No**
TR14	**No**	**Yes**	**No**	**No**	**No**	**No**
TR15	**No**	**Yes**	**No**	**No**	**No**	**No**
TR16	**No**	**Yes**	**Yes**	**No**	**No**	**No**
TR17	**No**	**Yes**	**Yes**	**No**	**No**	**No**

Yes = standing water was present in the pool on the date indicated.
No = no standing water was present in the pool on the date indicated.

Table 45. Presence of Surface Water in Travis pools for the 2001/2002 Rainy Season.

Date	1/17/02	2/22/02	3/4/02	3/8/02	3/21/02	4/2/02	4/8/02	4/19/02	5/22/02	6/5/02
Pool										
A1	Yes	Yes	Yes	Yes	No	No	No	No	No	No
A2	Yes	Yes	No	No	No	No	No	No	No	No
A3	Yes	Yes	Yes	No	No	No	No	No	No	No
A4	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
A5	Yes	Yes	Yes	No	No	No	No	No	No	No
B1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
B2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
B3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
B4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
B5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
C1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
C2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
C3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
C4	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
C5	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
SP1	Yes	Yes	No	No	No	No	No	No	No	No
SP2	Yes	Yes	No	No	No	No	No	No	No	No
TR1	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
TR2	Yes	Yes	No	No	No	No	No	No	No	No
TR3	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
TR4	Yes	Yes	No	No	No	No	No	No	No	No
TR5	Yes	Yes	Yes	Yes	No	No	No	No	No	No
TR14	Yes	Yes	No	No	No	No	No	No	No	No
TR15	Yes	Yes	No	No	No	No	No	No	No	No
TR16	Yes	Yes	Yes	Yes	No	No	No	No	No	No
TR17	Yes	Yes	Yes	Yes	No	No	No	No	No	No

The winter of 2000/2001 was dry and the periods of inundation tended to be shorter than those of any of the previous years. TR17 however contained surface water longer than it did in 1993/1994 when it was dry by March 18. Most of the artificial vernal pools contained surface water longer than did the smaller natural pools SP1, SP2, TR14 and TR15. A3 and A5 the artificial pools that dried out most quickly held water for about as long as the natural pools TR16 and TR17. The other artificial pools contained surface water longer than any natural pool in the immediate vicinity. The artificial vernal pools generally contained surface water longer than TR17 during the Sonoma State study (Northen, Holve-Hensill and Eakins, 1998).

On 01/17/2002 all of the pools held surface water. By 04/19/2002, none of the natural or artificial pools held any surface water. Some of the artificial pools contained surface water through 4/08/02, but were dry by 04/19/02. In 2002 many of the artificial pools held surface water for a longer period than the natural pools. The smaller natural pools SP1, SP2, TR14 and TR15 contained no surface water by 02/22/02. The larger natural pools TR17 and TR16 contained surface water through 03/8/02, but were dry by 03/21/02.

The winter of 2001/2002 was dry and the periods of inundation tended to be shorter than 1993/1994, 1994/1995 and 1995/1996. However, the winter of 2001/2002 was wetter and had longer periods of inundation than 2000/2001. In 2000/2001 some of the natural and artificial pools contained surface water from March until Mid-April. While in 2001/2002, some of the natural and artificial pools contained surface water from January until Mid-April.

During the observations it became clear that pools constructed in close proximity to one another with the same design do not necessarily have the same inundation period. Pools A3 and A5 were dry by 3/29/01, while pools B1, B3, B5, C1, C2 and C3 still contained surface water on 4/10/01. In 2001/2002, Pool A3 and A5 were dry by 3/08/02. Pools B1, B2, B3, B5, C1, C2, and C3 were still holding surface water on 4/08/02. A3 also had a shorter inundation period than most of the other artificial pools in 1993/1994, 1994/1995 and 1995/1996. A5 had a shorter inundation period than most of the other artificial pools in 1994/1995 and 1995/1996.

Table 46. Monthly Rainfall for Fairfield CA.

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Year												
93/94	0.59	2.65	2.39	2.71	4.31	0.14	1.19	1.26	0.00	0.00	0.00	0.02
94/95	0.28	5.30	4.49	12.47	0.14	9.21	0.88	1.21	1.83	0.00	0.00	0.00
95/96	0.0	0.08	10.02	8.65	8.34	2.32	2.18	3.03	0.0	0.00	0.00	0.00
96/97	1.61	3.58	11.67	11.07	0.28	0.52	0.20	0.47	0.27	0.00	0.41	0.00
97/98	0.81	6.73	2.30	8.95	14.71	2.35	2.30	3.29	0.00	0.00	0.00	0.34
98/99	0.71	4.29	1.57	2.11	6.97	2.85	1.73	0.03	0.00	0.00	0.00	0.04
99/00	0.56	2.91	0.52	5.98	11.25	2.87	1.29	0.98	0.17	0.00	0.00	0.08
00/01	2.54	1.16	1.13	3.36	6.35	1.37	0.62	0.00	0.08	0.00	0.00	0.00
01/02	0.33	3.78	7.34	2.30	1.16	1.77	0.8	1.6	0.00	0.00	0.00	0.00
Local Mean	1.25	2.88	3.79	5.11	3.96	3.12	1.33	0.51	0.18	0.02	0.07	0.28

Hydrology Conclusions

1. The 2000/2001 rainy season was drier than the average season. Inundation periods for the artificial pools were shorter than the inundation periods for previously measured years.

2. The 2001/2002 rainy season produced more rainfall than the 2000/2001 season. Inundation periods in the 2001/2002 artificial pools were generally longer than 2000/2001.

3. The artificial pools generally had longer inundation periods during the 2000/2001 and 2001/2002 seasons than the nearby natural pools.

4. The inundation periods for the artificial pools exhibit significant variability limiting the use of parametric statistics for comparisons among pools.

5. The design of the artificial pools is probably a major factor in the type of vegetative community that will ultimately develop in those pools. Plant species associated with longer inundation periods are likely to be benefited by the design of the artificial pools at Travis AFB.

Hydrology Discussion

The artificial vernal pools were designed to provide statistically oriented data to evaluate four inoculation treatments for vernal pool plants and invertebrates. The small rectangular design with a sloping plane from ground level to 80 cm in depth may in itself be a significant determinant of the type of plant community that can ultimately become established in each individual pool. De Weese observed that the lack of microhabitat variation along with increased inundation time due to increased depth may ultimately develop habitat that favors the dominance of species such as *Eleocharis macrostachya*, whose abundance is correlated with longer inundation periods (De Weese, 1998). In both years of the study most artificial pools at Travis were inundated for a longer period of time than the natural pools.

The rainy season 2000/2001 was drier than normal. The composition of vegetation in the pools this year may, at least in part, be a reflection of the low rainfall. The increased number of species in the pools during the second year may reflect the longer inundation periods.

SOIL

Soil Methods

For the present study we visited the natural and artificial pools at Travis AFB on June 26, 2002. On the visit we collected soil samples using a small trowel. The soil samples were taken a few inches deep to reflect the soil surface composition of the pools. Electronic images were taken to document the collection of the soil samples.

Soil Results

Tables 47-50 summarize the soil data derived from our soil sample. Table 47-48 summarizes the soil data showing structural form, mottles, and color. Table 49-50 summarizes the soil data indicating texture of soil.

The surface soil in source pool TR5 had a higher percentage of coarse sand and a smaller percentage of fine sand than the pools of the A series. The other texture categories are roughly similar.

Table 47. Soil samples taken from source pool TR5 and its corresponding artificial pools A1-A5, showing structural form, mottles and color.

Source/Artificial Pool	Structural Form	Mottles	Color
TR5	angular blocky	yes	10YR 3/2
A1	angular blocky	yes	5YR 5/8
A2	angular blocky	yes	5YR 5/6
A3	angular blocky	yes	7.5YR 5/8
A4	angular blocky	yes	7.5YR 5/4
A5	angular blocky	yes	10YR 5/4

Table 48. Soil samples taken from source pools TR1-TR4 and its corresponding artificial pools C1-C5, showing structural form, mottles and color.

Source/Artificial Pool	Structural Form	Mottles	Color
TR1	angular blocky	yes	2.5Y 4/2
TR2	angular blocky	yes	2.5Y 5/4
TR3	angular blocky	yes	2.5Y 5/2
TR4	angular blocky	yes	2.5Y 5/2
C1	angular blocky	yes	7.5YR 6/8
C2	angular blocky	yes	7.5YR 5/8
C3	angular blocky	yes	7.5YR 5/8
C4	angular blocky	yes	10YR 4/4
C5	angular blocky	yes	10YR 4/4

Table 49. Soil samples taken from source pool TR5 and A1-A5, indicating texture of soil.

Pool	Total Weight	Course Sand 0.590 mm	% of Course Sand	Medium Sand 0.355 mm	% of Medium Sand	Fine Sand 0.150 mm	% of Fine Sand	Very Fine Sand 0.053 mm	% of Very Fine Sand	Silt 0.043 mm	% of Silt
TR5	27.63g	8.39g	30.40%	4.00g	14.50%	7.96g	28.80%	5.44g	19.70%	0.54g	1.95%
A1	20.16g	0g	0	2.31g	11.50%	8.49g	42.10%	4.48g	22.20%	0.173g	0.86%
A2	22.84g	1.68g	7.40%	3.77g	16.50%	7.54g	33.00%	8.13g	35.60%	0.471g	2.06%
A3	25.81g	2.05g	7.90%	4.70g	18.20%	10.06g	39.00%	7.53g	29.20%	0.385g	1.50%
A4	29.67g	1.70g	5.70%	3.67g	12.40%	13.76g	46.40%	8.98g	30.30%	0.384g	1.29%
A5	23.31g	2.96g	12.70%	3.06g	13.10%	10.35g	44.40%	5.01g	21.50%	0.446g	1.91%

Table 50. Soil samples taken from source pool TR1-TR4 and C1-C5, indicating texture of soil.

Pool	Total Weight (g)	Course Sand 0.590 mm	% of Course Sand	Medium Sand 0.355 mm	% of Medium Sand	Fine Sand 0.150 mm	% of Fine Sand	Very Fine Sand 0.053 mm	% of Very Fine Sand	Silt 0.043 mm	% of Silt
TR1	33.79g	14.17g	41.90%	5.14g	15.20%	8.35g	24.70%	4.61g	13.60%	0.267g	0.79%
TR2	25.02g	2.78g	11.10%	2.63g	10.50%	7.26g	29.00%	10.02g	40.00%	0.575g	2.30%
TR3	23.75g	4.10g	17.30%	3.13g	13.20%	7.38g	31.10%	7.38g	31.10%	0.450g	1.89%
TR4	24.01g	5.04g	21.00%	2.98g	12.40%	7.88g	32.80%	6.82g	28.40%	0.25g	1.04%
C1	18.58g	2.12g	11.40%	4.51g	24.30%	9.19g	49.50%	2.20g	11.80%	0.08g	0.43%
C2	9.59g	1.28g	13.40%	2.23g	23.30%	3.64g	38.00%	2.02g	21.10%	0.108g	1.13%
C3	11.55g	0.63g	5.40%	3.68g	31.90%	5.01g	43.40%	1.72g	14.90%	0.11g	0.95%
C4	13.12g	1.72g	13.10%	2.60g	19.80%	4.30g	32.80%	3.34g	25.50%	0.26g	1.98%
C5	26.08g	4.29g	16.40%	3.46g	13.30%	8.26g	31.70%	8.38g	32.10%	0.58g	2.22%

The source pools TR1, TR2, TR3, and TR4 varied somewhat in texture particularly in the percentage of course sand and very fine sand. The texture of the soils in the C series also varied somewhat.

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Appendix A-

Raw Data & Constancy Tables

Tables A – Raw Tables

A1. Species present in each zone of the listed artificial pools on 04/26/01.

A2. Species present in each zone of the listed artificial pools on 05/03/01.

A3. Species present in each zone of the listed artificial pools on 06/08/01.

A4. Species present in TR16 on each date listed.

A5. Species present in SP1 on each date listed.

A6. Species present in SP2 on each date listed.

A7. Species present in each zone of the listed artificial pools on 04/19/02.

A8. Species present in each zone of the listed artificial pools on 05/01/02.

A9. Species present in each zone of the listed artificial pools on 06/05/02.

A10. Species present in each plot of the listed natural pools on 04/19/02.

A11. Species present in each plot of the listed natural pools on 05/01/02.

A12. Species present in each plot of the listed natural pools on 06/05/02.

Tables B – Constancy Tables

B1. Most common species present in the artificial pools on 04/26/01.

B2. Most common species present in the artificial pools on 05/03/01.

B3. Most common species present in the artificial pools on 06/08/01.

B4. Most common species present in the artificial pools on 04/19/02.

B5. Most common species present in the artificial pools on 05/01/02.

B6. Most common species present in the artificial pools on 06/05/02.

B7. Most common species present in the natural pools on 04/19/02.

B8. Most common species present in the natural pools on 05/01/02.

B9. Most common species present in the natural pools on 06/05/02.

Tables A

Table A1. Raw Data Table indicating species present in each zone of the artificial pools on 04/26/01.

Raw Data 042601	Shallow Zone															Middle Zone														Deep Zone													
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Erodium botrys	+		1				1						1		2			+																										
Eryngium aristulatum	2	+		1	1					2						2	1		1					1	2		1				1		1	1	1				1	+		2			
Psilocarphus brevissimus	2	1	2	1		2	4	3	2	1	3	4	2			2	3	3		2	1	2	3	1	1	3	4	5		2	1	3	3				2	2			2		2	1	
Anagalis arvensis		1																												1															
Downingia concolor		+		1	r	r	1	+			1	r	1				+			1								r	1	1															
Lupinus bicolor		+													2																														
Lasthenia glaberrima				3		+	+		3	5					2	r	1		5	3	1	3		4	5				3			2		1	3		2			1					
Convolvulus arvensis						+	+											r		1												1			+										
Plagiobothrys stipitatus								+	2		1				+				1	1	5	1	2	2	2	4	2	1	3	2	4	3		5	3	5	3	3	5	5	5	4	4	5	5
Hemizonia fitchii													2																																
Lasthenia macrantha ssp. bakeri																																													
Eremocarpus setigerus																																													
Centaurium muehlenbergii																																													
Xanthium strumarium																																													
Asclepias asperula																																													
Cyperus eragrostis																																													
Rumex crispus																																													
Eleocharis macrostachya																																													
Grasses																																													
Hordeum murinum	2	3	2	2	3	3	2	3			2	1			3	2	1	1		1								1		2		2	1				1								
Taeniatherum caput-medusae																																													
Polypogon monspeliensis																																													
Lolium multiflorum																																													
Other																																													
algae/algal matting																					2													2		2		2		2					
bare soil	2	3	3	2	3	2	1	3	2	1	2	3	3		1	2	3	3	1	2		2	2	2	1	2	2	2	1	1	2	1	3		2	1	2		2		2	2	3	1	1

Table A2. Raw Data Table indicating species present in each zone of the artificial pools on 05/03/01.

Raw Data 050301	Shallow Zone															Middle Zone														Deep Zone													
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Erodium botrys		+												1	1																														
Eryngium aristulatum	2	2	1	1	1		1		2	2		1				2	1	2	2			1		1	2		2				1	2	1	2	2		+		2	1		2			
Psilocarphus brevissimus	2	2	2	2		4	3	3	3	3	4	4	4			2	3	3	1	2	2	3	2	2	2	4	4	3	1	3	1	3	2			1	2		2		2	1	1	1	
Anagalis arvensis		1												1																															
Downingia concolor	+	+		1	1	1	+	1		r		+	+	1	1		+		1	1			1						1	2	r			1	r											
Lupinus bicolor																																													
Lasthenia glaberrima	+	1		2		1	+		1	1		+			1	+	+		3	2	1	1		2	4				1			1		2	2			+	1	+					
Convolvulus arvensis			+					+										+	1	+								+			1	1	1												
Plagiobothrys stipitatus						2		+	+		+				1				+	1	4	+	2	1	1	2	+	1	1	+		+		r	r	3	+	3	2	4	3	3	4	2	4
Hemizonia fitchii													+															2																	
Eremocarpus setigerus																																													
Centaurium muehlenbergii																																													
Xanthium strumarium																																													
Asclepias asperula																																													
Lasthenia macrantha ssp. bakeri																																													
Cyperus eragrostis																																													
Rumex crispus																																													
Eleocharis macrostachya																																													
Grasses																																													
Hordeum murinum	2	2	3	3	4		3		2	2	1	1		4	4	2	2	1				1	1						4	2	1	2	+		2		2					2			3	2
Taeniatherum caput-medusae																																													
Polypogon monospeliensis																																													
Lolium multiflorum		1							1									1																											
Other																																													
algae/algal matting																					2															3		3							
bare soil	3	1	3	2	2	2	3	2	3	1	3	2	2	1	2	3	3	3	3	3	1	2	3	2	1	3	3	3	+	+	4	2	4	3	2		4		2	3	3	3	2	1

Table A3. Raw Data Table indicating species present in each zone of the artificial pools on 06/08/01.

Raw Data 060801	Shallow Zone															Middle Zone														Deep Zone													
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Erodium botrys																																													
Eryngium aristulatum	3	3	1	2	1	+	+		2	3						3	2	1	2	1		1		2	3		1		2		2	2	1	2	3	1	1		2	2		1			
Psilocarphus brevissimus	2	2	2	1		3	3	3	2	1	3	2	1			1	2	2	1	1	3	2	2	2	1	3	2	2			1	1	1			2	+		1		2	2	2	1	
Anagalis arvensis																																													
Downingia concolor																																													
Lasthenia macrantha ssp. bakeri																																													
Lupinus bicolor																																													
Lasthenia glaberrima																																													
Convolvulus arvensis	1		1			1	1				1							1	1	1				1		1						1	+	1	+	1							2		
Plagiobothrys stipitatus																																													
Hemizonia fitchii			1			2	2	2	2	1	2	2	2		1			2			2	2	2	1	1	2	2	2	2	1			1			1	2	+	1	1	2	2	2		
Eremocarpus setigerus					+	1	1	2	1	1	2			2						1	1	1	2	1	1	1			2					r	+	1	2	2	+	2	2			2	1
Centaurium muehlenbergii												1																																	
Xanthium strumarium																				1															1										
Asclepias asperula											r																																		
Cyperus eragrostis																															r														
Rumex crispus										r																																			
Eleocharis macrostachya																			1															1											
Grasses																																													
Hordeum murinum	2	2	3	2	2	3	2	4	2	2	2	1	2	3	3	2	1	2	2	2	1	3	2	1	2		1	2	2	2	1	1	+		2	+	1	2		1	+	1	1	1	2
Taeniatherum caput-medusae	2	2	2	2	1	+	1	1	+	1	1	2	1	1	1	1	1	+	+			+	1	1	1		2	1	1	1	1	1	2	+	+	1	+	1	1	1	1	2	+	1	1
Polypogon monospeliensis						1				1				2											1				+											1	1			2	
Lolium multiflorum	2	2	2	1	3	+	+	+	+	1	+	1	1	1	1	1	2	+	2	1	1	+	1	+	1	2	+	1	+	+	1	2	1	1	1	1	+	1	1			+	1	1	+
Other																																													
algae/algal matting																																													
bare soil	2	2	2	1	+	2	2	2	3	2	2	1	2	2	2	3	2	3	1	2	3	2	2	3	2	3	2	2	2	2	4	2	4	2	2	4	3	2	3	3	3	3	3	3	2

Table A4. Raw Data Table indicating species present in TR16 on each date.

Raw Data Table	TR16		
List of Species	4/26/2001	5/3/2001	6/8/2001
Lasthenia macrantha ssp. bakeri	2	2	
Eryngium aristulatum	2	2	2
Psilocarphus brevissimus	2	2	2
Downingia concolor	2		
Lasthenia glaberrima	2		
Hemizonia fitchii			1
Eremocarpus setigerus			3
Asclepias asperula			r
Convolvulus arvensis	1		
Plagiobothrys stipitatus			
Lupinus bicolor			
Anagalis arvensis			
Centaurium muehlenbergii			
Xanthium strumarium			
Erodium botrys			
Cyperus eragrostis			
Rumex crispus			1
Eleocharis macrostachya			
Grasses			
Hordeum murinum	1	1	1
Taeniatherum caput-medusae			
Polypogon monospeliensis			
Lolium multiflorum			
Other			
bare soil	1	1	1
algae/algal matting			

Table A5. Raw Data Table indicating species present in SP1 on each date.

Raw Data Table	Small Pool 1 (SP1)		
List of Species	4/26/2001	5/3/2001	6/8/2001
Lasthenia macrantha ssp. bakeri	1		
Eryngium aristulatum	2	4	3
Psilocarphus brevissimus	2	1	1
Downingia concolor			
Lasthenia glaberrima			
Hemizonia fitchii			
Eremocarpus setigerus			
Asclepias asperula			
Convolvulus arvensis			
Plagiobothrys stipitatus			
Lupinus bicolor			
Anagalis arvensis			
Centaurium muehlenbergii			
Xanthium strumarium			
Erodium botrys			
Cyperus eragrostis			
Rumex crispus			
Eleocharis macrostachya			
Grasses			
Hordeum murinum	1	1	2
Taeniatherum caput-medusae			
Polypogon monospeliensis			
Lolium multiflorum	1	1	2
Other			
bare soil	2	2	2
algae/algal matting			

Table A5. Raw Data Table indicating species present in SP2 on each date.

Raw Data Table	Small Pool 2 (SP2)		
List of Species	4/26/2001	5/3/2001	6/8/2001
Lasthenia macrantha ssp. bakeri			
Eryngium aristulatum	2	3	2
Psilocarphus brevissimus			
Downingia concolor			
Lasthenia glaberrima	3	1	
Hemizonia fitchii			2
Eremocarpus setigerus			2
Asclepias asperula			
Convolvulus arvensis			
Plagiobothrys stipitatus	3	1	
Lupinus bicolor			
Anagalis arvensis			
Centaurium muehlenbergii			
Xanthium strumarium			
Erodium botrys			
Cyperus eragrostis			
Rumex crispus			
Eleocharis macrostachya			
Grasses			
Hordeum murinum	1	1	2
Taeniatherum caput-medusae			
Polypogon monospeliensis			
Lolium multiflorum			
Other			
bare soil	1	2	2
algae/algal matting			

Table A7. Raw Data Table indicating species present in each zone of the artificial pools on 04/19/02.

Table 1.1 "Raw Data" 041902	Shallow Zone															Middle Zone														Deep Zone													
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Eryngium aristulatum	2	2		2	2	1	1		2	2		1				2	2		2	2		1		2	2		2				2	2	2	3	2							3			
Psilocarphus brevissimus	2	3	3			3	2	3	3	2	2	4	3	2	2	3	2	2	3		3	2	2		2	2	3	3	2	3	3	3	2	2		2	2	2			2	2	3	2	3
Anagalis arvensis			r																																										
Downingia concolor	1	2	2	3	1	2	1	3	2	1	1	2	2	2	2	1	2	2	2	2	2	2	2			2		2	2	2	1	2	1	2	2	2	2	2			2	2	2	2	
Lupinus bicolor		r																																											
Lasthenia fremontii																				3																									
Lasthenia glaberrima		2		3	2	3	2		3	3				4		1	3		3		3	2		2	3				2			3			4									3	
Convolvulus arvensis																																													
Plagiobothrys stipitatus	1	1	1	2		3	2	3	3	2	2	2		2	2	2	2	2	3	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2			2	2	3	3	3
Hemizonia fitchii																																													
Brodiaea elegans																																													
Eremocarpus setigerus																																													
Centaurium muehlenbergii																																													
Epilobium pygmaeum																																													
Lythrum hyssopifolium																																													
Xanthium strumarium																																													
Navarretia squarrosa																																													
Navarretia intertexta																																													
Cotula coronopifolia				r																																									
Cyperus eragrostis																																													
Rumex crispus			t																											r															
Eleocharis macrostachya	2			1				t								2	3		2	2			2			3					2	2		2	1										
Grasses																																													
Hordeum murinum	2	2	2	2	4	2	3				2				3			2																											
Pleuropogon californicus										3				2						2	1				2					2															
Polypogon monspeliensis																																													
Lolium multiflorum																																													
Other																																													
bare soil	2	3	3	2	1	1	2	2	2		3	2	3		1	2	3	3	2	1	2	2		3	1	2	2	3		2	2	2	3	2	2	2	2	5	4	4	3	2	3	3	2

Table A8. Raw Data Table indicating species present in each zone of the artificial pools on 05/01/02.

Raw Data 050102	Shallow Zone															Middle Zone														Deep Zone													
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Eryngium aristulatum		2		2	2		1		1	2	1	2		1		2	2	2	2	2		1		2	2		2		1		2	2	1	3	2		2		2	2		3		1	
Psilocarphus brevissimus	2	3	3			3	2	3	3	2	2	4	2	2	1	3	2	2	2		3	3	2	1	2	3	3	2	1	3	3	3	2	2		2	3	2	1	3	2	2	2	2	3
Anagalis arvensis																																													
Downingia concolor	1	2	2	3	1	2	1	3	2	1	1	2		2	1	1	2	2	2	2	2	2	2			2	1	3	2	3	2	2	1	2	2	2	2	2	1	2	2	2	2	2	3
Lupinus bicolor		r																																											
Lasthenia fremontii																																													
Lasthenia glaberrima				3	2	3	1		2	3				1		1	3		3	3	3			3	3							3			4		1		1						
Convolvulus arvensis																																t	t												
Plagiobothrys stipitatus	1	1	1	2		3	2	3	2	2	2	2	2		t	2	2	2	3	2	3	3	2	3	3	3	3	3	4	2	3	3	3	3	3	3	3	2	1		2	2	2	2	3
Hemizonia fitchii			3															3															3												
Brodiaea elegans																																													
Eremocarpus setigerus																																													
Centaurium muehlenbergii																																													
Epilobium pygmaeum																																													
Lythrum hyssopifolium																																													
Xanthium strumarium																																													
Navarretia squarrosa																																													
Navarretia intertexta													3																																
Cotula coronopifolia				r																																									
Cyperus eragrostis																																													
Rumex crispus			t								1																			r															
Eleocharis macrostachya	t	2		1				t								2	2		2	1			2			3					2	2		2	1		t				2				
Grasses																																													
Hordeum murinum	2	2	2	2	4	2	3				2				3			2											t				1												
Pleuropogon californicus										3				3						2	1				2															2					
Polypogon monspeliensis																																													
Lolium multiflorum					2																																								
Other																																													
bare soil	2	2	3	2	1	2	2	2	2		2	2	2	1	2	2	3	3	2	2	2	2	2	3	1	2	2	2	2	2	2	2	3	2	2	3	3	3	3	3	3	2	3	3	2

Table A9. Raw Data Table indicating species present in each zone of the artificial pools on 06/05/02.

Raw Data 060502	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Eryngium aristulatum	3	3		2	2		2			3						3	3	1	2	2		2		3	3		3				3	3	2	3	3		2		3	3		4		2	
Psilocarphus brevissimus	2	2	2			2		2	2		1		2	t		2	2	1	1	1	2	2	2		1		2	2	t	3	1	2	2	2	1	2	2	1		2	1		2	1	3
Anagalis arvensis																																													
Downingia concolor																																													
Lupinus bicolor																																													
Lasthenia fremontii																																													
Lasthenia glaberrima																																													
Convolvulus arvensis		1		r			t		t				t	t		t	t	t	t				t						1	t	t	t	t		t							t	t	1
Plagiobothrys stipitatus																												2						1	1	1	2		2	1				
Hemizonia fitchii			3			3	3	3	2		3	2	3	3	3			4			3	3	1	2	2	2	3	3	3	1			3			2	2		2	2	3	2	3		
Brodiaea elegans												t																																	
Eremocarpus setigerus						1	2	2	2		2	2		2						2	2	3	3		2	2			3	3				2		2	3	3	2	2	2			3	3
Centaurium muehlenbergii												t			2																														
Epilobium pygmaeum								2			2	2		2							2		3	2	2	3	3	3	2								2	3		2			2	
Lythrum hyssopifolium											2										1					2																		
Xanthium strumarium																																			1									
Navarretia squarrosa								1																																				
Navarretia intertexta													4																															
Cotula coronopifolia																																													
Cyperus eragrostis											1															1				1														
Rumex crispus			t			t				t	1				t										t																			
Eleocharis macrostachya				2												2	3		3	1			3		2	3					2	3		2							2				
Grasses																																													
Hordeum murinum	3	2	2	2	3	3	3		3		3	3		3	3			2										t					2												
Pleuropogon californicus										3											2																							
Polypogon monspeliensis																																													
Lolium multiflorum					2																																								
Other																																													
bare soil	1	1	3	2	2	t	t	1	2	2	2	1	1	1	1	2	2	2	3	3	2	1	2	3	2	2	2	3	1	2	3	2	3	2	2	3	3	3	2	2	2	2	3	3	2

Table A10. Raw Data Table indicating species present in each plot of the natural pools on 04/19/02.

Raw Data 041902	Plot 1						Plot 2					Plot 3				
List of Species	SP2	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Eryngium aristulatum	1					2										3
Psilocarphus brevissimus	2			2	4						t				1	
Anagalis arvensis																
Downingia concolor	2	2	3		3	3	2	2	2	2		2	3		1	
Lupinus bicolor																
Lasthenia fremontii																
Lasthenia glaberrima		4		4		3	4	2	4	t	4	2		3		3
Convolvulus arvensis		t	t	t				t	t		r		t			
Plagiobothrys stipitatus	3	3		2		2	2	1	1	2	1	2	2	1	4	3
Hemizonia fitchii																
Brodiaea elegans																
Eremocarpus setigerus																
Centaurium muehlenbergii																
Epilobium pygmaeum																
Lythrum hyssopifolium																
Xanthium strumarium																
Navarretia squarrosa																
Navarretia intertexta																
Cotula coronopifolia	r					t						t	t	t		
Cyperus eragrostis		1					t									
Rumex crispus	r						t									
Eleocharis macrostachya											2					
Grasses																
Hordeum murinum			2													
Pleuropogon californicus			3					3		2		2	2		1	1
Polypogon monspeliensis																
Lolium multiflorum	2															t
Other																
bare soil	2	1	2	2	1	r	r	1	1	r		1	1	3	t	t

Table A11. Raw Data Table indicating species present in each plot of the natural pools on 05/01/02.

Raw Data 050102	Plot 1						Plot 2					Plot 3				
List of Species	SP2	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Eryngium aristulatum	2					2					1				t	
Psilocarphus brevissimus	2			2	3										1	
Anagalis arvensis																
Downingia concolor	2	2	3	2	2	4	2	2	2		2	2	4	2		
Lupinus bicolor																
Lasthenia fremontii																
Lasthenia glaberrima		4		4			4	1	4	1	4	2		3		3
Convolvulus arvensis		t	t	t	t			t	t				t		t	t
Plagiobothrys stipitatus	3	3		2		2	2	1	1	2		2	1	2	2	3
Hemizonia fitchii																
Brodiaea elegans																
Eremocarpus setigerus																
Centaurium muehlenbergii																
Epilobium pygmaeum																
Lythrum hyssopifolium								2								
Xanthium strumarium																
Navarretia squarrosa																
Navarretia intertexta								1								
Cotula coronopifolia	r											t	t			
Cyperus eragrostis							1									
Rumex crispus	r					t	t									
Eleocharis macrostachya						2					1					
Grasses																
Hordeum murinum		2	2	2	2		2	2					2	2		
Pleuropogon californicus			3					3		1		2	2		2	2
Polypogon monspeliensis																
Lolium multiflorum																
Other																
bare soil	2	1	2	2	2		r	1	1	t	t	2	1	3	1	t

Table A12. Raw Data Table indicating species present in each plot of the natural pools on 06/05/02.

Raw Data 060502	Plot 1						Plot 2					Plot 3				
List of Species	SP2	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Eryngium aristulatum	3					2										3
Psilocarphus brevissimus				1	3										1	
Anagalis arvensis																
Downingia concolor																
Lupinus bicolor																
Lasthenia fremontii																
Lasthenia glaberrima																
Convolvulus arvensis	t	t	t	1	t	1	t	t	2	1	t		t	t	t	t
Plagiobothrys stipitatus				1					1					1		
Hemizonia fitchii			3		3		2			2		3	3		3	
Brodiaea elegans																t
Eremocarpus setigerus	2	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3
Centaurium muehlenbergii																
Epilobium pygmaeum	1			2	2					2				2		
Lythrum hyssopifolium	2	2						2		1						
Xanthium strumarium						2					1					2
Navarretia squarrosa																
Navarretia intertexta								2								
Cotula coronopifolia																
Cyperus eragrostis																
Rumex crispus	r		1	1		2	t	t			1			t		
Eleocharis macrostachya						3					2					1
Grasses																
Hordeum murinum		3	2				2	2		2		2		2	2	
Pleuropogon californicus			2							1		2			1	
Polypogon monspeliensis																
Lolium multiflorum						2										
Other																
bare soil	2	2	1	2	1		2		2	t	t	2	1	2	2	1

Tables B

Table B1. Constancy Table indicating the most common species present on 04/26/01.

Table 1.2 "Constancy" 042601	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Psilocarphus brevissimus	2	1	2	1		2	4	3	2	1	3	4	2			2	3	3		2	1	2	3	1	1	3	4	5		2	1	3	3				2	2			2		2	1	
Spergularia arvensis								+	2		1				+				1	1	5	1	2	2	2	4	2	1	3	2	4	3		5	3	5	3	3	5	5	5	4	4	5	5
Lasthenia glaberrima				3		+	+		3	5					2	r	1		5	3	1	3		4	5				3			2		1	3		2			1					
Eryngium aristulatum	2	+		1	1					2						2	1		1					1	2		1				1		1	1	1				1	+		2			
Downingia concolor		+		1	r	r	1	+			1	r	1				+			1								r	1	1															
Convolvulus arvensis						+	+											r		1											1				+										
Erodium botrys	+		1				1						1		2			+																											
Anagalis arvensis		1																												1															
Lupinus bicolor		+													2																														
Hemizonia fitchii													2																																
Lasthenia macrantha ssp. bakeri																																													
Centaurium muehlenbergii																																													
Xanthium strumarium																																													
Asclepias asperula																																													
Cyperus eragrostis																																													
Rumex crispus																																													
Eleocharis macrostachya																																													
Grasses																																													
Hordeum murinum	2	3	2	2	3	3	2	3			2	1			3	2	1	1		1								1		2		2	1				1							
Taeniatherum caput-medusae																																													
Polypogon monspeliensis																																													
Lolium multiflorum																																													
Other																																													
bare soil	2	3	3	2	3	2	1	3	2	1	2	3	3		1	2	3	3	1	2		2	2	2	1	2	2	2	1	1	2	1	3		2	1	2		2		2	2	3	1	1
algae/algal matting																					2													2		2		2		2					

Table B2. Constancy Table indicating the most common species present on 05/03/01.

Constancy 050301	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Psilocarphus brevissimus	2	2	2	2		4	3	3	3	3	4	4	4			2	3	3	1	2	2	3	2	2	2	4	4	3	1	3	1	3	2			1	2		2		2	1	1	1	
Plagiobothrys stipitatus						2		+	+		+				1				+	1	4	+	2	1	1	2	+	1	1	+		+		r	r	3	+	3	2	4	3	3	4	2	4
Eryngium aristulatum	2	2	1	1	1		1		2	2		1				2	1	2	2			1		1	2		2				1	2	1	2	2		+		2	1		2			
Lasthenia glaberrima	+	1		2		1	+		1	1		+			1	+	+		3	2	1	1		2	4				1			1		2	2			+	1	+					
Downingia concolor	+	+		1	1	1	+	1		r		+	+	1	1		+		1	1			1						1	2	r			1	r										
Convolvulus arvensis			+					+										+	1	+								+			1	1	1												
Erodium botrys		+												1	1																														
Anagalis arvensis		1												1																															
Hemizonia fitchii													+															2																	
Eremocarpus setigerus																																													
Lasthenia macrantha ssp. bakeri																																													
Lupinus bicolor																																													
Centaurium muehlenbergii																																													
Xanthium strumarium																																													
Asclepias asperula																																													
Cyperus eragrostis																																													
Rumex crispus																																													
Eleocharis macrostachya																																													
Grasses																																													
Hordeum murinum	2	2	3	3	4		3		2	2	1	1		4	4	2	2	1				1	1						4	2	1	2	+		2		2					2			3	2
Lolium multiflorum		1							1									1																											
Taeniatherum caput-medusae																																													
Polypogon monospeliensis																																													
Other																																													
bare soil	3	1	3	2	2	2	3	2	3	1	3	2	2	1	2	3	3	3	3	3	1	2	3	2	1	3	3	3	+	+	4	2	4	3	2		4		2	3	3	3	3	2	1

Table B3. Constancy Table indicating the most common species present on 06/08/01.

Constancy 060801	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Psilocarphus brevissimus	2	2	2	1		3	3	3	2	1	3	2	1			1	2	2	1	1	3	2	2	2	1	3	2	2			1	1	1			2	+		1		2	2	2	1	
Hemizonia fitchii			1			2	2	2	2	1	2	2	2		1			2			2	2	2	1	1	2	2	2	2	1			1			1	2	+	1	1	2	2	2		
Eryngium aristulatum	3	3	1	2	1	+	+		2	3						3	2	1	2	1		1		2	3		1		2		2	2	1	2	3	1	1		2	2		1			
Eremocarpus setigerus					+	1	1	2	1	1	2			2						1	1	1	2	1	1	1			2					r	+	1	2	2	+	2	2			2	1
Convolvulus arvensis	1		1			1	1				1							1	1	1				1		1						1	+	1	+	1							2		
Xanthium strumarium																				1															1										
Cyperus eragrostis																															r														
Asclepias asperula											r																																		
Eleocharis macrostachya																			1															1											
Centaurium muehlenbergii												1																																	
Rumex crispus										r																																			
Anagalis arvensis																																													
Lasthenia glaberrima																																													
Downingia concolor																																													
Erodium botrys																																													
Lasthenia macrantha ssp. bakeri																																													
Lupinus bicolor																																													
Plagiobothrys stipitatus																																													
Grasses																																													
Lolium multiflorum	2	2	2	1	3	+	+	+	+	1	+	1	1	1	1	1	2	+	2	1	1	+	1	+	1	2	+	1	+	+	1	2	1	1	1	1	+	1	1			+	1	1	+
Hordeum murinum	2	2	3	2	2	3	2	4	2	2	2	1	2	3	3	2	1	2	2	2	1	3	2	1	2		1	2	2	2	1	1	+		2	+	1	2		1	+	1	1	1	2
Taeniatherum caput-medusae	2	2	2	2	1	+	1	1	+	1	1	2	1	1	1	1	1	+	+			+	1	1	1		2	1	1	1	1	1	2	+	+	1	+	1	1	1	1	1	2	+	1	1
Polypogon monospeliensis						1				1				2											1				+											1	1			2	
Other																																													
bare soil	2	2	2	1	+	2	2	2	3	2	2	1	2	2	2	3	2	3	1	2	3	2	2	3	2	3	2	2	2	2	4	2	4	2	2	4	3	2	3	3	3	3	3	3	2
algae/algal matting																																													

Table B4. Constancy Table indicating the most common species present on 04/19/02.

Constancy 041902	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Plagiobothrys stipitatus	1	1	1	2		3	2	3	3	2	2	2		2	2	2	2	2	3	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3	2	2	2			2	2	3	3	3
Downingia concolor	1	2	2	3	1	2	1	3	2	1	1	2	2	2	2	1	2	2	2	2	2	2	2			2		2	2	2	1	2	1	2	2	2	2	2			2	2	2	2	
Psilocarphus brevissimus	2	3	3			3	2	3	3	2	2	4	3	2	2	3	2	2	3		3	2	2		2	2	3	3	2	3	3	3	2	2		2	2	2			2	2	3	2	3
Eryngium aristulatum	2	2		2	2	1	1		2	2		1				2	2		2	2		1		2	2		2				2	2	2	3	2							3			
Lasthenia glaberrima		2		3	2	3	2		3	3				4		1	3		3		3	2		2	3				2			3		4										3	
Eleocharis macrostachya	2			1				t								2	3		2	2			2			3					2	2		2	1										
Anagalis arvensis			r																																										
Lupinus bicolor		r																																											
Lasthenia fremontii																				3																									
Cotula coronopifolia				r																																									
Rumex crispus			t																											r															
Convolvulus arvensis																																													
Hemizonia fitchii																																													
Brodiaea elegans																																													
Eremocarpus setigerus																																													
Centaurium muehlenbergii																																													
Epilobium pygmaeum																																													
Lythrum hyssopifolium																																													
Xanthium strumarium																																													
Navarretia squarrosa																																													
Navarretia intertexta																																													
Cyperus eragrostis																																													
Grasses																																													
Hordeum murinum	2	2	2	2	4	2	3				2				3			2																											
Pleuropogon californicus										3				2						2	1				2					2															
Polypogon monspeliensis																																													
Lolium multiflorum																																													
Other																																													
bare soil	2	3	3	2	1	1	2	2	2		3	2	3		1	2	3	3	2	1	2	2		3	1	2	2	3		2	2	2	3	2	2	2	2	5	4	4	3	2	3	3	2

Table B5. Constancy Table indicating the most common species present on 05/01/02.

Constancy 050102	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Plagiobothrys stipitatus	1	1	1	2		3	2	3	2	2	2	2	2		t	2	2	2	3	2	3	3	2	3	3	3	3	3	4	2	3	3	3	3	3	3	3	2	1		2	2	2	2	3
Downingia concolor	1	2	2	3	1	2	1	3	2	1	1	2		2	1	1	2	2	2	2	2	2	2			2	1	3	2	3	2	2	1	2	2	2	2	2	1	2	2	2	2	2	3
Psilocarphus brevissimus	2	3	3			3	2	3	3	2	2	4	2	2	1	3	2	2	2		3	3	2	1	2	3	3	2	1	3	3	3	2	2		2	3	2	1	3	2	2	2	2	3
Eryngium aristulatum		2		2	2		1		1	2	1	2		1		2	2	2	2	2		1		2	2		2		1		2	2	1	3	2		2		2	2		3		1	
Lasthenia glaberrima				3	2	3	1		2	3				1		1	3		3	3	3			3	3							3			4		1		1						
Eleocharis macrostachya	t	2		1				t								2	2		2	1			2			3					2	2		2	1		t				2				
Hemizonia fitchii			3															3															3												
Rumex crispus			t								1																			r															
Convolvulus arvensis																																t	t												
Lupinus bicolor		r																																											
Navarretia intertexta													3																																
Cotula coronopifolia				r																																									
Lasthenia fremontii																																													
Anagalis arvensis																																													
Brodiaea elegans																																													
Eremocarpus setigerus																																													
Centaurium muehlenbergii																																													
Epilobium pygmaeum																																													
Lythrum hyssopifolium																																													
Xanthium strumarium																																													
Navarretia squarrosa																																													
Cyperus eragrostis																																													
Grasses																																													
Hordeum murinum	2	2	2	2	4	2	3				2				3			2											t				1											
Pleuropogon californicus										3				3						2	1				2														2					
Lolium multiflorum					2																																								
Polypogon monspeliensis																																													
Other																																													
bare soil	2	2	3	2	1	2	2	2	2		2	2	2	1	2	2	3	3	2	2	2	2	2	3	1	2	2	2	2	2	2	2	3	2	2	3	3	3	3	3	3	2	3	3	2

Table B6. Constancy Table indicating the most common species present on 06/05/02.

Constancy 060502	Shallow Zone															Middle Zone														Deep Zone														
List of Species	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Psilocarphus brevissimus	2	2	2			2		2	2		1		2	t		2	2	1	1	1	2	2	2		1		2	2	t	3	1	2	2	2	1	2	2	1		2	1		2	1	3
Hemizonia fitchii			3			3	3	3	2		3	2	3	3	3			4			3	3	1	2	2	2	3	3	3	1			3			2	2		2	2	3	2	3		
Eryngium aristulatum	3	3		2	2		2			3						3	3	1	2	2		2		3	3		3				3	3	2	3	3		2		3	3		4		2	
Eremocarpus setigerus						1	2	2	2		2	2		2						2	2	3	3		2	2			3	3					2		2	3	3	2	2	2			3	3
Convolvulus arvensis		1		r			t		t				t	t		t	t	t	t				t							1	t	t	t	t		t								t	t	1
Epilobium pygmaeum								2			2	2		2							2		3	2	2	3	3	3	2								2	3		2				2	
Eleocharis macrostachya				2												2	3		3	1			3		2	3					2	3		2								2			
Plagiobothrys stipitatus																													2						1	1	1	2		2	1				
Rumex crispus			t			t				t	1				t										t																				
Cyperus eragrostis											1															1					1														
Lythrum hyssopifolium											2										1					2																			
Centaurium muehlenbergii												t			2																														
Brodiaea elegans												t																																	
Navarretia squarrosa								1																																					
Navarretia intertexta													4																																
Xanthium strumarium																																			1										
Anagalis arvensis																																													
Downingia concolor																																													
Lupinus bicolor																																													
Lasthenia fremontii																																													
Lasthenia glaberrima																																													
Cotula coronopifolia																																													
Grasses																																													
Hordeum murinum	3	2	2	2	3	3	3		3		3	3		3	3			2										t					2											
Pleuropogon californicus										3											2																								
Lolium multiflorum					2																																								
Polypogon monspeliensis																																													
Other																																													
bare soil	1	1	3	2	2	t	t	1	2	2	2	1	1	1	1	2	2	2	3	3	2	1	2	3	2	2	2	3	1	2	3	2	3	2	2	3	3	3	2	2	2	2	3	3	2

Table B7. Constancy Table indicating species present in each plot of the natural pools on 04/19/02.

Constancy 041902	Plot 1						Plot 2					Plot 3				
List of Species	SP2	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Plagiobothrys stipitatus	3	3		2		2	2	1	1	2	1	2	2	1	4	3
Downingia concolor	2	2	3		3	3	2	2	2	2		2	3		1	
Lasthenia glaberrima		4		4		3	4	2	4	t	4	2		3		3
Convolvulus arvensis		t	t	t				t	t		r		t			
Psilocarphus brevissimus	2			2	4						t				1	
Cotula coronopifolia	r					t						t	t	t		
Eryngium aristulatum	1					2										3
Cyperus eragrostis		1					t									
Rumex crispus	r						t									
Eleocharis macrostachya											2					
Anagalis arvensis																
Lupinus bicolor																
Lasthenia fremontii																
Hemizonia fitchii																
Brodiaea elegans																
Eremocarpus setigerus																
Centaurium muehlenbergii																
Epilobium pygmaeum																
Lythrum hyssopifolium																
Xanthium strumarium																
Navarretia squarrosa																
Navarretia intertexta																
Grasses																
Pleuropogon californicus			3					3		2		2	2		1	1
Lolium multiflorum	2															t
Hordeum murinum			2													
Polypogon monspeliensis																
Other																
bare soil	2	1	2	2	1	r	r	1	1	r		1	1	3	t	t

Table B8. Constancy Table indicating species present in each plot of the natural pools on 05/01/02.

Constancy 050102	Plot 1						Plot 2					Plot 3				
List of Species	SP2	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Plagiobothrys stipitatus	3	3		2		2	2	1	1	2		2	1	2	2	3
Downingia concolor	2	2	3	2	2	4	2	2	2		2	2	4	2		
Lasthenia glaberrima		4		4			4	1	4	1	4	2		3		3
Convolvulus arvensis		t	t	t	t			t	t				t		t	t
Eryngium aristulatum	2					2					1				t	
Psilocarphus brevissimus	2			2	3										1	
Cotula coronopifolia	r											t	t			
Rumex crispus	r					t	t									
Eleocharis macrostachya						2					1					
Lythrum hyssopifolium								2								
Navarretia intertexta								1								
Cyperus eragrostis							1									
Lupinus bicolor																
Anagalis arvensis																
Hemizonia fitchii																
Brodiaea elegans																
Eremocarpus setigerus																
Centaurium muehlenbergii																
Epilobium pygmaeum																
Lasthenia fremontii																
Xanthium strumarium																
Navarretia squarrosa																
Grasses																
Hordeum murinum		2	2	2	2		2	2					2	2		
Pleuropogon californicus			3					3		1		2	2		2	2
Polypogon monspeliensis																
Lolium multiflorum																
Other																
bare soil	2	1	2	2	2		r	1	1	t	t	2	1	3	1	t

Table B9. Constancy Table indicating species present in each plot of the natural pools on 06/05/02.

Constancy 060502	Plot 1						Plot 2					Plot 3				
List of Species	SP2	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Eremocarpus setigerus	2	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3
Convolvulus arvensis	t	t	t	1	t	1	t	t	2	1	t		t	t	t	t
Rumex crispus	r		1	1		2	t	t			1			t		
Hemizonia fitchii			3		3		2			2		3	3		3	
Epilobium pygmaeum	1			2	2					2				2		
Lythrum hyssopifolium	2	2						2		1						
Xanthium strumarium						2					1					2
Eryngium aristulatum	3					2										3
Psilocarphus brevissimus				1	3										1	
Plagiobothrys stipitatus				1					1					1		
Eleocharis macrostachya						3					2					1
Brodiaea elegans																t
Navarretia intertexta								2								
Anagalis arvensis																
Downingia concolor																
Lupinus bicolor																
Lasthenia fremontii																
Lasthenia glaberrima																
Centaurium muehlenbergii																
Navarretia squarrosa																
Cotula coronopifolia																
Cyperus eragrostis																
Grasses																
Hordeum murinum		3	2				2	2		2		2		2	2	
Pleuropogon californicus			2							1		2			1	
Lolium multiflorum						2										
Polypogon monspeliensis																
Other																
bare soil	2	2	1	2	1		2		2	t	t	2	1	2	2	1