MITIGATION MONITORING REPORT
FOR
SMALL LEAVED ROSE (YEAR 2)
CALIFORNIA TERRACES AND
OTAY CORPORATE CENTER

Prepared for

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Introduction

This document presents the results of the Year 2 (December 1998 to November 1999) monitoring effort for the translocation of small-leaved rose (*Rosa minutifolia*) on the California Terraces and Otay Corporate Center North and South development projects. The development project impacted the only known population of small-leaved rose in California and the United States; therefore, a translocation and management plan was designed and implemented upon approval by the California Fish and Game Department (CDFG) and U.S. Fish and Wildlife Service (USFWS). In this document, second-year growth, survivorship, and reproduction data are presented and compared with baseline data and first-year results.

The small-leaved rose (Photographs 1, 2, and 3) is a perennial plant species which was found at one location in the United States, on Otay Mesa. Here it grew as a large patch covering several hundred square feet at the edge of the mesa. Other than the specimen on Otay Mesa, the population ranges from Ensenada south to the red clay hills near Aguajitos, Baja California (Hickman 1993; Shreve and Wiggins 1964). In Baja California it grows on rocky to heavy clay soil on hillsides and valley floors. The small-leaved rose differs from other native rose species in California by having leaflets that are less than one centimeter long and having a hypanthium (the cup-shaped enlargement of the receptacle on which the calyx, corolla, and often the stamens are inserted) that is densely prickly (Hickman 1993). Small-leaved rose was originally identified on the property by Jack Reveal in 1985 (Reveal 1986). Prior to its discovery on Otay Mesa, its discovery in Baja California and its history of cultivation in the United States was summarized from correspondence and documents from 1882 to 1971 (Lenz 1982).

The reproductive biology of the small-leaved rose has not been specifically studied, but based on observations of the rose plant on Otay Mesa over the last few years, some generalizations about the reproductive biology of the plant can be inferred. Flowering observed on the rose plant is very unpredictable but appears dependent on the amount and distribution of rainfall. Seed production is tied to flower production and the availability of pollinators. Potential pollinators, such as bees, have been observed on the small-leaved rose on Otay Mesa. Seeds collected from *Rosa minutifolia* plants in Baja California, Mexico, in general, germinated slowly and in low percentages (Evans 1995).

A. Project Background

The California Terraces and Otay Corporate Center North and South project sites cover 864 acres of land on Otay Mesa located in the northwestern portion of the Otay Mesa community planning area in the city of San Diego, between Interstate 805 and Heritage Road (Figures 1 and 2). The California Terraces project (665 acres) will be

PHOTOGRAPH 1

Small-leaved Rose Patch on Otay Mesa

PHOTOGRAPH 2

Small-leaved Rose in Flower on Otay Mesa

PHOTOGRAPH 3

Close-up of Small-leaved Rose Flowers

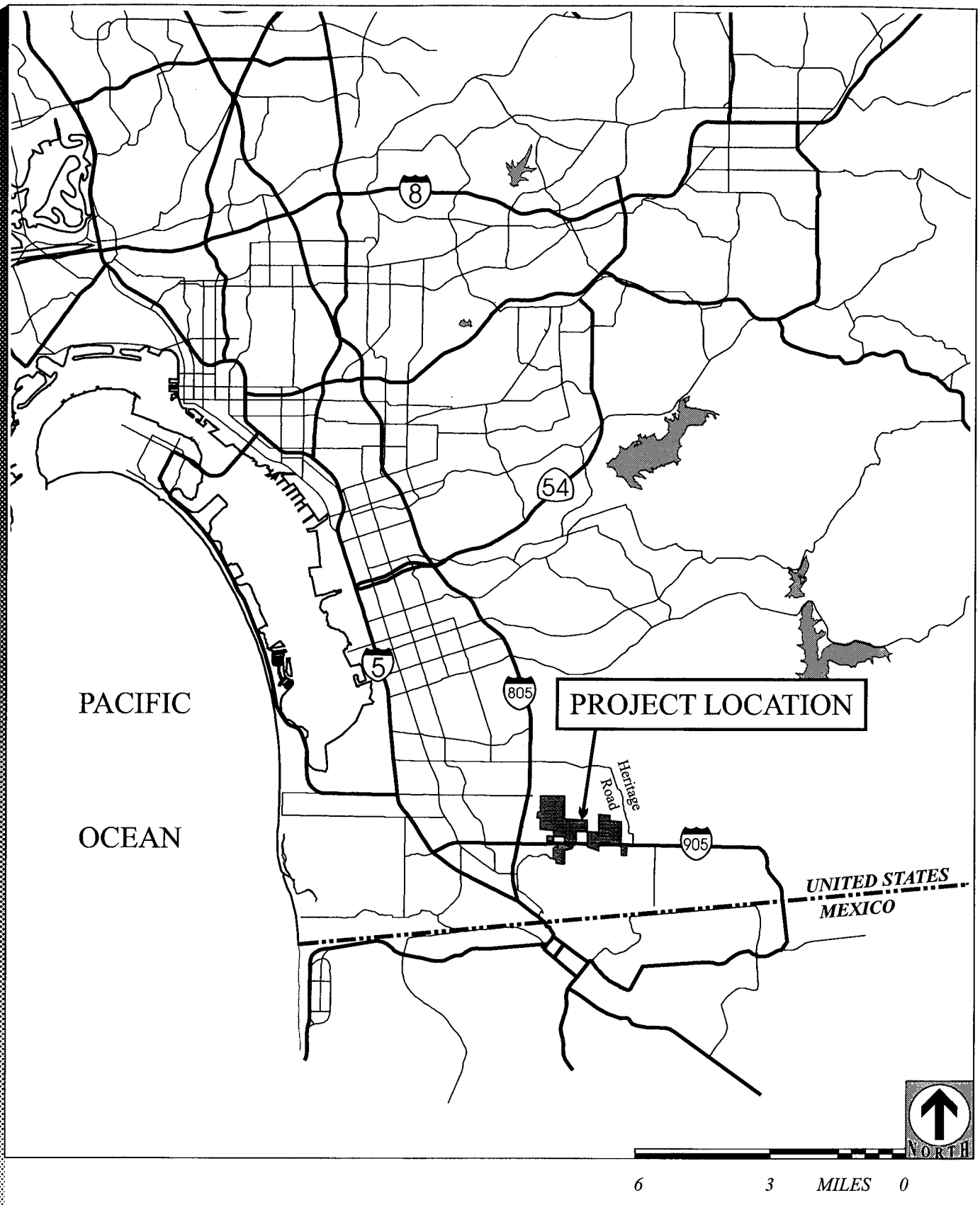

FIGURE 1

Regional Location of the Project

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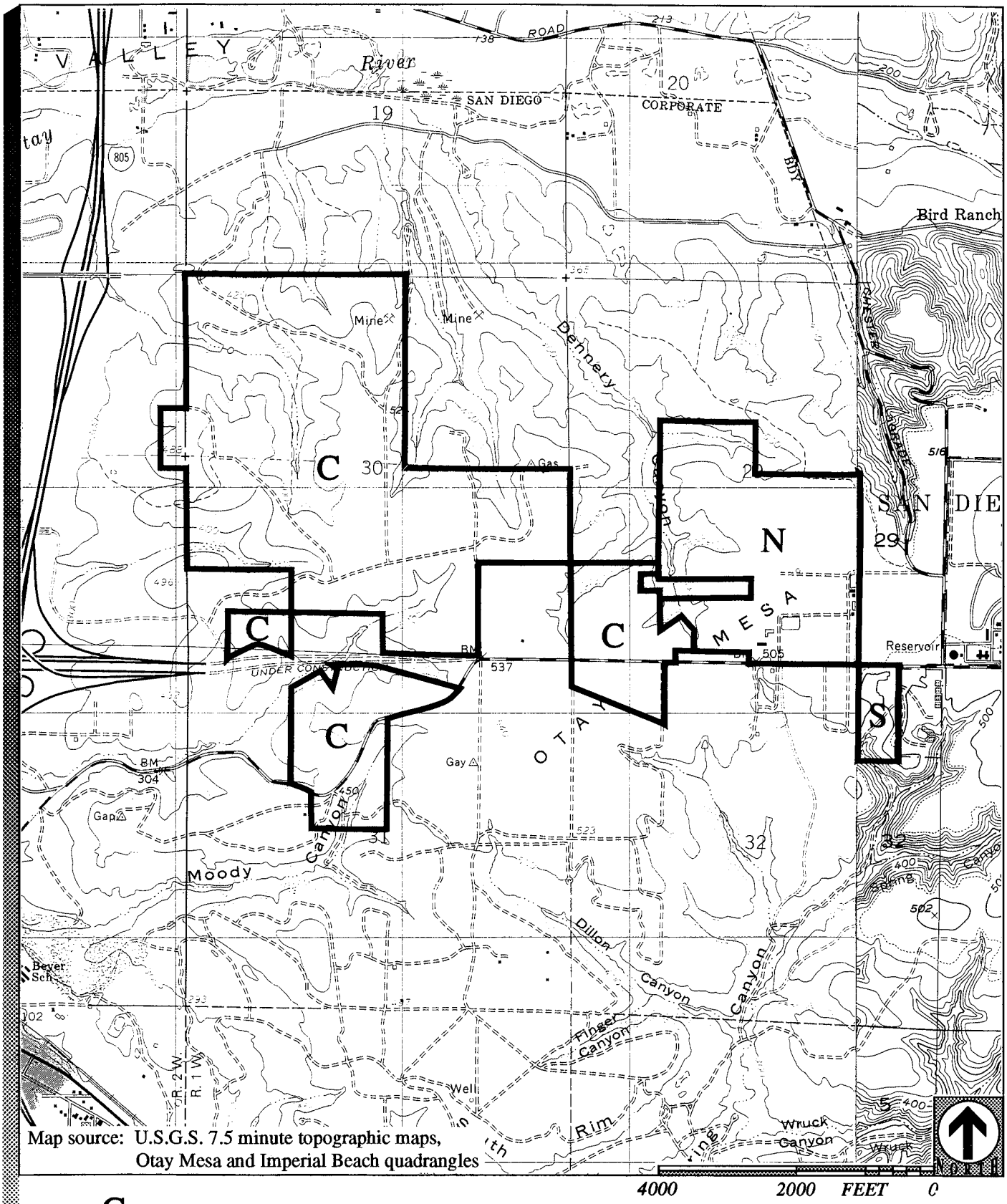

Map source: U.S.G.S. 7.5 minute topographic maps, Otay Mesa and Imperial Beach quadrangles

C California Terraces

N Otay Corporate Center North

S Otay Corporate Center South

FIGURE 2

Location of The Composite Projects on Otay Mesa

predominantly for residences and associated improvements (e.g., schools, parks, open space, habitat preserves, and commercial centers). The Otay Corporate Center North project (179 acres) is to the east of the California Terraces project, while Otay Corporate Center South project (20 acres) is to the south of Otay Corporate Center North. Both Otay Corporate Center projects will consist of industrial development, open space, and habitat preserves, including vernal pool preserves. The entire small-leaved rose patch on Otay Mesa was impacted by construction of the project.

B. Mitigation Measures and Success Criteria

Specific mitigation measures were outlined in the California Endangered Species Act (CESA) Memorandum of Understanding (CESA 2081-1996-071-5) issued by CDFG for the project. The mitigation measures included translocation trials, salvage, and propagation of the rose plants, transplantation into the vernal pool preserve, and a five-year maintenance and monitoring program. The initial translocation trial and final translocation of the donor plant is discussed in the first-year monitoring report (RECON 1999a).

Transplant success criteria over the five-year period shall include: (1) survivorship of a minimum of 100 plants, each which have shown measurable annual increase in cover over the final two years of the monitoring program, without the benefit of supplemental irrigation; and (2) flowering of 50 percent of the small-leaved rose plants during a minimum of one flowering season within the final three years of the monitoring program.

Monitoring Methods

A monitoring program has been initiated for the translocated rose individuals to track the progress of these plants. Monitoring may also provide new biological information about the small-leaved rose. Biological information will be discussed in the annual reports as it becomes available during the five-year monitoring period. The monitored rose locations are depicted in Figure 3.

Monitoring for the small-leaved rose mitigation began in January 1998 and will continue through December 2002. The five-year monitoring program is scheduled as follows:

Year 1	1998
Year 2	1999
Year 3	2000
Year 4	2001
Year 5	2002

Monitored rose locations
Vernal pool preserve boundary
Open space
Project limits

FIGURE 3

Locations of Small-leaved Rose Translocation Areas

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Six formal monitoring visits were conducted from January to April 1999 to collect qualitative and quantitative data. Informal monitoring visits were more frequent and continued through to mid-summer when the plants became inactive for the duration of the dry season.

Data on the following factors is collected during each monitoring year by the project biologist: growth, survivorship, establishment rate (i.e., recruitment of seedlings or vegetative spread), flower and seed production, presence of non-native weeds, effects of herbivores and pathogens, and environmental factors such as drought, hydrology, and disturbance. In addition, community structure and species diversity at the small-leaved rose mitigation sites shall be assessed. Techniques for conducting these assessments are given separately below.

1. Growth

Growth of the translocated small-leaved rose plants is estimated from the canopy area and relative canopy volume of each plant. The plant area and volume was measured soon after translocation to achieve baseline measurements (post-planting dimension) for the 245 plants to be monitored. Heights were measured to the tallest live branch. Relative plant area and volume is estimated by measuring the widest and narrowest diameters of the plant crown and applying an appropriate formula for calculating plant areas and volumes. Plant crown area will be estimated by multiplying the width and breadth of the canopy while plant volume will be estimated by the following formula: volume = 4/3 *pi* (width x breadth x height) (Bonham1989).

During the late spring or early summer of each year of the monitoring period, the area and relative volume of each plant will be remeasured and compared to the baseline measurements and measurements made in previous years. The difference between the baseline area and relative volume measurements and the yearly measurements will give an indication of the amount of growth the plants have undergone since planting.

2. Survivorship

Each of the transplanted roses will be monitored for survivorship. Observations on plant vigor will be recorded on each individual rose plant being monitored during site visits made in a particular monitor year.

3. Establishment Rate

Observations will be made during the monitoring period to detect any recruitment of small-leaved rose seedlings or vegetative expansion of an individual plant.

4. Flower and Seed Production

Observations of flower and fruit production will be made during the growing season. The number of buds, flowers, and fruits (i.e., hips) produced on each of the 245 translocated small-leaved rose plants will be counted. The production of hips occurs late in the growing season prior to the summer dormancy period.

5. Presence of Non-native Weeds

At each site visit, the presence of non-native weeds near the rose plants will be noted. Any non-native plant species observed within a 12-inch radius of a planting hole of a small-leaved rose will be removed.

Undesirable plants will be removed by hand pulling and with the use of hand tools. Non-native species expected to be an issue include slender wild oat (*Avena barbata*), filaree (*Erodium spp.*), black mustard (*Brassica nigra*), and foxtail chess (*Bromus madritensis* ssp. *rubens*).

6. Effects of Herbivores and Presence of Pathogens

Each of the translocated small-leaved rose will be monitored for herbivory and the presence of pathogens which could affect the survival of the plants. If excessive herbivory or pathogens are observed, the cause of the damage will be determined (e.g., insects, small mammals, etc.). Once the herbivore or pathogen is identified, appropriate control measures will be implemented.

7. Environmental Factors

The effects that environmental factors such as drought, hydrology, and disturbance have on the small-leaved rose transplants will be documented during the monitoring period as part of the routine site visits.

8. Community Structure and Species Diversity

The translocation of the donor small-leaved rose plant within upland areas of the vernal pool preserves coincided with the restoration of coastal sage and maritime succulent scrub at these same locations. Small-leaved rose is one component species of the upland restoration effort within the vernal pool preserve. Therefore, all areas where the small-leaved rose was introduced will also have other native coastal sage or maritime succulent scrub plant species introduced. The development of community structure and species diversity (i.e., abundance) shall be monitored as the various native plants become established in the upland areas of the vernal pool preserve as required in the Biological Opinion.

The development of community structure will be determined qualitatively through the assessment of vegetation layers. The establishment of a herbaceous, small shrub, and large shrub layer will comprise the structural components. The percent of native and non-native plant species in the herbaceous layer will serve as an indicator of understory development. The relative density of the component small and large shrubs becoming established will give an indication of the development and diversity of vertical structure in the habitat. Species diversity will be determined as the number or abundance of different native species establishing in uplands on the preserve.

Year 2 Monitoring Results

The results of the second-year monitoring program for the small-leaved rose on the mitigation site is discussed below. Second-year data collected for the translocated rose plants and a comparison to first- and second-year growth and reproductive data are presented.

A. Year 2 Growth Results

In April 1999, growth data on the translocated small-leaved rose plants was collected. This information is presented in Table 1. The majority of translocated rose plants have grown significantly since installation in January 1998. It appears to be indicative of this species of *Rosa* that the plant grows laterally and more dense faster than it grows in height. The average height has rebounded to its original height during the transplantation year after declining slightly in the first year of monitoring. The minimum height and maximum heights have increased. Significant growth has occurred both in canopy area and canopy volume. A series of roses shown in 1998 and 1999 are depicted in Photographs 4 through 13.

B. Year 2 Survivorship Results

At the end of the second growing season (July/August 1999), 85 percent (208 individuals) of the 245 translocated rose plants were alive.

C. Year 2 Establishment Rate Results

During the initial growing season of December 1997 to July 1998, approximately five of the translocated rose plants appeared to be spreading vegetatively. On April 30, 1999 21 rose plants were noted to have at least one stem layered (i.e., rooted) in the surrounding soil.

TABLE 1
GROWTH DATA SUMMARY FOR TRANSLOCATED SMALL-LEAVED ROSE

Growth Measurement	At Planting (baseline)*	After First Growing Season†	After Second Growing Season‡
Height (cm)			
Mean	35.67 cm	32.81 cm	35.83 cm
Minimum	7.0 cm	5.0 cm	10.0 cm
Maximum	80.0 cm	71.2 cm	77.0 cm
Canopy Area (cm^2)			
Mean	1,942.52 cm^2	2,168.38 cm^2	7,608.81 cm^2
Minimum	6.45 cm^2	2.0 cm^2	72.0 cm^2
Maximum	8,399.98 cm^2	8,580.63 cm^2	60,720.0 cm^2
Canopy Volume (cm^3)			
Mean	323,152.3 cm^3 (0.32 m^3)	335,410.8 cm^3 (0.33 m^3)	1,569,917.79 cm^3 (1.57 m^3)
Minimum	960.99 cm^3	83.78 cm^3	6,031.86 cm^3
Maximum	1,844,910.76 cm^3 (1.84 m^3)	2,087,827.08 cm^3 (2.09 m^3)	16,023,630 cm^3 (16.02 m^3)

cm = centimeter; m = meter

*Data collected January 1998
†Data collected May 1998
‡ Data collected April 1999.

PHOTOGRAPH 4

Rose Plant Number 105 in 1998

PHOTOGRAPH 5

Rose Plant Number 105 in 1999

PHOTOGRAPH 6
Rose Plant Number 161 in 1998

PHOTOGRAPH 7
Rose Plant Number 161 in 1999

PHOTOGRAPH 8

Rose Plant Number 168 in 1998

PHOTOGRAPH 9

Rose Plant Number 168 in 1999

PHOTOGRAPH 10

Rose Plant Number 175 in 1998

PHOTOGRAPH 11

Rose Plant Number 175 in 1999

PHOTOGRAPH 12

Rose Plant Number 203 in 1998

PHOTOGRAPH 13

Rose Plant Number 203 in 1999

D. Year 2 Flower and Seed Production Results

Reproduction data on the translocated small-leaved rose plants were collected over six monitoring visits in 1999, each approximately three weeks apart. The last directed flower production survey was on April 30, 1999; however, additional descriptive surveys continued into the summer. In 1999, the rose plants began entering the dormant stage in May, a few months earlier than in 1998. This is likely due to a decrease in the amount of rainfall in 1998-1999 as compared to the 1997-1998 El Niño season.

Flower, bud, and hip production increased dramatically from 1998 to 1999. This is attributed to the stabilization of the rose plants in the vernal pool preserve. Since the plants were translocated in January 1998, they may not have undergone a typical growing and flowering season in that year. As shown in Table 2, the number of flowers was highest mid-season, reaching 5,220 flowers on March 16. In comparison, the greatest number of flowers observed during one monitoring visit in Year 1 was on June 1, 1998 when a total of 1,849 were counted. As expected, the number of buds and hips increased for a few weeks after flower production peaked during Year 2. The highest number of buds in Year 1 was approximately 900 in May and June 1998. In Year 2, the number of buds observed increased significantly.

TABLE 2
1999 FLOWER AND FRUIT PRODUCTION

Survey Dates	Flowers	Buds	Hips
January 12	959	5,001	0
February 2	2,576	5,730	5
February 24	3,036	7,571	44
March 16	5,220	6,678	56
April 6	4,860	6,711	121
April 30	3,209	3,916	132

A total of 132 hips were produced by the end of April 1999, a marked increase from the 28 hips observed during the first year of monitoring (1998). However, the majority of hips did not mature before the rose plants entered the dormant phase. As stated in the MOU for the project, hips will be harvested from plants to determine seed production only if that plant contains more than four mature hips. No hips were harvested this year due to the low number of mature fruit produced. It is assumed that as the rose plants become established on-site in subsequent years, more hips will achieve maturity and hips will be available to harvest. Any seeds collected from the harvest of hips shall be stored in paper envelopes and used to study germination and for propagation of new small-leaved rose plants.

Potential pollinators were observed on the rose plants throughout the Year 2 monitoring season and a list of species (or taxonomic affiliation) observed is provided in Table 3. This information was collected during the six monitoring visits and also noted during general surveys of the vernal pool preserve. Photograph 14 shows a bumble bee visiting one of the rose plants.

TABLE 3
POTENTIAL POLLINATORS OBSERVED ON THE SMALL-LEAVED ROSE PLANTS

Common Name	Taxonomic Affiliation/Species
Bumble bee	tribe Bombini, subfamily Bombinae
Honey bee	*Apis mellifera*
Leaf hopper	family Cicadellidae
Hover fly	family Syrphidae
Argentine ant	*Iridomyrmex humilis*
Green lynx spider	*Peucetia viridans*
Aphids	*Macrosiphum rosae*
Wasp	order Hymenoptera
California ringlet	*Coenonympha california california*
Beetle	order Coleoptera
Tussock moth	*Orgyia* sp., family Lymantriidae
Crane fly	*Tipula* sp.
California ladybird beetle (adults and nymphs)	*Coccinella californica*

E. Year 2 Non-native Weed Removal Results

Maintenance crews removed non-native weed species from around the translocated rose plants during the spring of 1999 on a regular basis. The weed control efforts for the entire vernal pool preserve are continuous and intensive. At times, it was necessary to remove native plant species, such as California sagebrush (*Artemisia californica*), that had grown over the adjacent rose plants. The native plants removed from the area were transplanted to another area of the vernal pool preserve. This effort reduced the competition for resources by eliminating unwanted vegetation from around the roses. Black mustard, filaree, and annual grasses were the most common weeds encountered.

F. Year 2 Herbivory and Pathogen Results

A few desert cottontail rabbits (*Sylvilagus audubonii*) have been seen using the plants for cover; however, at this time, the health of the roses does not appear affected since no

PHOTOGRAPH 14
Bumble Bee Visiting Rose Plant

PHOTOGRAPH 15
View of Area 4 Habitat

browsing damage has occurred. No pathogens or other disease symptoms have been observed on the translocated rose plants.

G. Year 2 Environmental Factor Results

The below average rainfall during the 1998-1999 rainy season had an effect on the translocated rose plants. The growing and flowering season was shorter in Year 2 than in year 1, which was affected by El Niño rains. As in year 1, it was observed that the plants installed on the north-facing slope in Area 4 remained green longer than plants installed on flat surfaces. This is likely due to moisture differences resulting from aspect and exposure to direct sunlight and the effect these factors have on evapo-transpiration. A portion of Area 4 is shown in Photograph 15.

H. Year 2 Community Structure and Species Diversity Results

Detailed analysis of the development of coastal sage scrub and maritime succulent scrub within the vernal pool preserves where the small-leaved rose was translocated is provided in the annual technical report for the vernal pool preserve (RECON 1999b). This habitat is in its second year of development and with the introduction of salvaged mature shrubs during the implementation year of the vernal pool preserve the site is developing quickly.

Conclusions

The results of the second year of monitoring of the translocated small-leaved rose plants indicate that the mitigation measures will be met by the end of the five-year monitoring program. Currently, over 200 translocated rose plants are surviving in the preserve, well above the 100 rose plants necessary to meet the five-year success criteria. The small-leaved rose plants have grown considerably in both canopy area and volume. Although height measurements have remained relatively constant, this may be the typical growth formation. Although subsequent monitoring years may provide additional information, lateral vegetative growth appears to be the primary growth form of the small-leaved rose plant. The numbers of flowers, buds, and hips have significantly increased in Year 2 despite the low rainfall season of 1998-1999. As the number of mature hips observed on the plants increases, a seed propagation program will begin.

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