Marron Valley
Vernal pool 9 looking north

3.3 B. sandiegonensis *genetic research*

A preliminary report of the *B. sandiegonensis* genetic research has been prepared by Dr. Andrew Bohonak (Appendix H). Complete results for this study will be available under separate cover in 2005.

4.0 SYNOPSIS

Within the City of San Diego, 1,369 vernal pools have been conserved by an easement, dedication in fee title, or designation as City open space (see Table 3). These represent 54% of the total known basins in the City. Of the conserved vernal pools, 861 (63%) support rare, threatened, or endangered plant species. Refer to Table 64 for specific information for each species.

Table 64 – Sensitive plant species in conserved vernal pools

Species	Number of basins	Percent of basins	Area Covered* (ft²)
E. aristulatum	686	50	94,300
M. minimus	49	4	165
N. fossalis	95	7	1,424
O. californica	51	4	2,429
P. abramsii	210	15	15,235
P. nudiscula	374	27	31,779
* Area calculations are derived from percent cover estimates.			

An additional 419 vernal pools, although not considered conserved, are located on publicly owned lands. These basins support populations of *E. aristulatum* (47 basins), *N. fossalis* (1 basins), and *P. abramsii* (131 basins).

Four hundred fifty-seven conserved vernal pools (33%) support fairy shrimp. Table 65 contains information on fairy shrimp and amphibians found in conserved vernal pools.

Table 65 – Fairy shrimp and amphibians in conserved vernal pools

	Occupied basins			
	Number	% of total	Area (ft²)	% total area
Species				
Branchinecta spp.	443	32	569,765	34
B. sandiegonensis	372	27	332,558	20
B. lindahli	20	1.5	17,441	1
S. wootonii	128	9	145,460	9
B. boreas	4	0.3	113,216	7
H. regilla	73	5	128,988	8
S. hammondii	53	4	99,336	6

These data are an important inventory of current conditions and should be compared to historic studies to detect and analyze changes in vernal pool quality, distribution, and management. Specifically, this inventory documents trends subsequent to Bauder's 1986 report. Although the general geographic extent of these studies is comparable, the scale and precision of recorded data differ significantly. The Bauder (1986) report presents data such as location, number of basins, and presence of sensitive species at the complex level. The City inventory utilized current technology to record the precise size and location of individual basins, and data such as presence and cover of sensitive species were collected at this scale.

Comparing the data from 1986 and 2003 helps to detect and understand changes in vernal pools in the City of San Diego. While the estimate for the total number of vernal pools in the City has increased due to the recent survey, it is known that an overall decrease occurred due to urbanization and, in certain cases, lack of protection. Table 66 compares the number of basins at current City-owned sites surveyed in 1979 (compilation of existing survey information by Bauder), 1986 (Bauder), and 2003 (City of San Diego).

Table 66 – Vernal pool survey results in 1979, 1986, and 2003

Number of Basins			
	1979	1986	2003
Revised Bauder ID Series			
A	8	0	0
B	50	12	66
C	212	66	153
D	154	34	123
E	30	0	0
H	218	125	573

Number of Basins			
	1979	1986	2003
Revised Bauder ID Series			
I	324	48	60
J	137	102	983
K	31	31	87
N	202	187	322
O	6	0	0
P	37	0	0
U*	—	—	63
X	35	25	35
BB	9	0	0
CC	12	0	0
DD	15	9	0
Total	**1480**	**639**	**2465**
*Numbers for City-owned sites in this complex are not available in Bauder report (1986) or field notes.			
Note: 1979 and 1986 numbers from Table 3 (Bauder, 1986); figures from 2003 include restoration/creation sites.			

Sites such as C 27 were destroyed through development while pools have been lost in the J series through border security and recreational off-road vehicle activity. Some sites, though still extant, have been degraded through many of the same factors mentioned by Bauder in 1986: edge effects, non-native invasion, pollution and hydrologic changes. These negative results have been to some degree balanced by positive trends such as targeted acquisition of vernal pool sites, large-scale restoration and creation efforts, and improved conservation planning through the MSCP. Sites such as Mesa Norte have been restored and fenced since Bauder's report, which noted damage from vehicular traffic and dumping. Additional sites, such as Del Mar Mesa, Carmel Mountain, General Dynamics, and Nobel Research Park have also been acquired and/or conserved through City mitigation requirements. Such creation, restoration, and.or conservation sites consistently show sustained or improved species presence and diversity over the past 20 years. Refer to Table 67 for information on creation, restoration, and enhancement at each site.

Table 67 – Creation, restoration, and enhancement activity by site[†]

Area	Revised Bauder ID	Site	Vernal Pool Basin Acreage				
			Total	Conserved	Created	Restored	Enhanced
Del Mar Mesa							
	H 1-15	Del Mar Mesa	5.23	5.23	0	0	0
	H 17	Shaw Texas	0.23	0	0	0	0
	H 18-23	Rhodes	0.75	0	0	0	0
	H 39	Greystone Torrey Highlands	0.68	0.68	0.68	0	0
	H 40	Li Collins	0.04	0.04	0	0	0
Carmel Mountain							
	H 38	Carmel Mountain	0.32	0.32	0	0	0

[†] Refer to page 23 for definitions of these terms.

Area	Revised Bauder ID	Site	Vernal Pool Basin Acreage				
			Total	Conserved	Created	Restored	Enhanced
Mira Mesa							
	B 5-6	Tierra Alta	0.0055	0.0055	0	0	0
	B 5-8	Lopez Ridge	0.48	0.48	0	0	0.27
	B 5-8	Sunset Pointe	0.042	0	0	0	0
	B 11	Mesa Norte	0.58	0.58	0.27	0.31	0
	C 10-16	Winterwood	0.81	0.59	0	0	0
	C 17-18	Fieldstone	0.32	0.32	0	0	0
	C 27	Mira Mesa Market Center	0.057	0.057	0	0	0.057
	C 28	Maddox	0.97	0	0	0	0
	D 5-8	Parkdale Carroll Canyon	0.021	0	0	0	0
	D 5-8	Carroll Canyon Preserve	1.19	1.19	0	0	0
	I 1	Arjons	0.73	0.73	0	0	0
Nobel Drive							
	I 6 B	Bob Baker	0.077	0	0	0	0
	I 6 C	Bob Baker 2	0.24	0	0	0	0
	I 12	Pueblo Lands	0.017	0	0	0	0
	X 5	Nobel Drive	0.085	0.085	0	0	0
	X 7	Nobel Research Park	0.098	0.098	0	0	0
Kearny Mesa							
	N 1-6	Montgomery Field	6.76	0	0	0	0
	N 7	Serra Mesa Library	0.36	0.36	0	0	0
	N 8	General Dynamics	0.4	0.4	0	0	0
	U 15	Magnatron	0.34	0	0	0	0
	U 15	Sander	0.44	0	0	0	0
	U 19	Cubic	0.45	0	0	0	0
Mission Trails Regional Park							
	Q 2	Mission Trails Regional Park	0.24	0.24	0	0	0
Urban San Diego							
	S 4	Kelton	0.022	0.022	0	0	0
Otay Lakes							
	K 3, 5, 10, 13	Otay Lakes	2.89	0	0	0	0
	R 1	Proctor Valley	0.25	0	0	0	0
Otay Mesa							
	J 2 S	Otay Mesa Road Helix	0.21	0.21	0.21	0	0
	J 2 S, J 2 W	Otay Mesa Road Pardee	0.31	0	0	0	0
	J 2 W	Otay Mesa Road Recon	0.45	0.45	0.45	0	0
	J 2 W	J 2 W	0.68	0	0	0	0
	J 2 N/W/S	Recon Cal Terraces	2.9	2.9	2.9	0	0
	J 2 W; J 31	Hidden Trails	0.13	0	0	0	0
	J 3	J 3	0.087	0.087	0	0	0
	J 4	J 4	0.09	0	0	0	0

Area	Revised Bauder ID	Site	Vernal Pool Basin Acreage				
			Total	Conserved	Created	Restored	Enhanced
	J 4-5	Robinhood Ridge	0.56	0.56	0.56	0	0
	J 11 E	J 11 E	0.63	0	0	0	0
	J 11 W	J 11 W	0.49	0	0	0	0
	J 12	J 12	0.28	0	0	0	0
	J 13 E	J 13 E	0.059	0	0	0	0
	J 13 N	J 13 N	0.28	0	0	0	0
	J 13 S	J 13 S	0.62	0	0	0	0
	J 14	J 14	0.60	0	0	0	0
	J 14	905	0.069	0.04	0	0	0
	J 14	Recon South	1.4	1.4	1.4	0	0
	J 15	Arnie's Point	0.65	0.65	0	0	0
	J 16-18	J 16-18	0.25	0.25	0	0	0
	J 16-18	Wruck Canyon	0.016	0.016	0	0	0
	J 21	J 21	0.21	0	0	0	0
	J 27	J 27	0.23	0	0	0	0
	J 28 E	J 28 E	0.16	0	0	0	0
	J 29-30	J 29-30	0.97	0	0	0	0
	J 32	West Otay A + B	0.34	0.34	0.15	0	0
	J 33	Sweetwater High School	0.065	0.065	0.065	0	0
	J 34	J 34	0.15	0	0	0	0
Marron Valley							
	MM 1	Marron Valley	0.18	0.18	0	0	0

Twenty-one new sites (766 basins) have been identified as a result of this survey (Tables 1 and 68). Ten of these sites are geographically distinct from areas mapped in the Bauder (1986) survey ("new" sites in Table 68). Six sites are contiguous to known sites in 1986 but fall outside of the complex boundaries mapped by Bauder ("contiguous" sites in Table 68). Additionally, five new sites are the result of creation efforts ("creation" sites in Table 68).

Table 68 – Complexes identified during the 2003 inventory

	Site	Revised Bauder ID	Number of Basins
New			
	Carmel Mountain	H 38	30
	General Dynamics	N 8	21
	Kelton	S 4	3
	Li Collins	H 40	2
	Maddox	C 28	82
	Marron Valley	MM 1	14
	Mission Trails Regional Park	Q 2	15
	Nobel Research Park	X 7	28
	Serra Mesa Library	N 7	25
	Wruck Canyon	J 16-18	6
Contiguous			
	905	J 14	7

	Site	Revised Bauder ID	Number of Basins
Contiguous			
	Hidden Trails	J 2 W; J 31	42
	J 2 W	J 2 W	59
	J 4	J 4	11
	J 34	J 34	14
	Tierra Alta	B 5-6	1
Creation			
	Greystone Torrey Highlands	H 39	19
	Recon Cal Terraces	J 2 N/W/S	271
	Recon South	J 14	64
	Sweetwater High School	J 33	8
	West Otay A + B	J 32	44

When comparing the datasets, it is also important to note that 43 series surveyed by Bauder were not included in the City inventory. Table 69 lists the series or complexes and why they were not relocated in 2003.

Table 69 – Previously mapped series/complexes not relocated in 2003

Bauder ID	Reason
F	Military ownership
G	Military ownership
V	Military ownership
W	Military ownership
Y	Military ownership
Z	Military ownership
AA	Military ownership
EE	Military ownership
FF	Military ownership
GA	Military ownership
GG	Military ownership
HH	Military ownership
RR	Military ownership
A 4	Military ownership
I 7	Military ownership
X 1-3	Military ownership
X 4	Military ownership
L	Outside City
M	Outside City
Q	Outside City
S	Outside City
T	Outside City
J 22	Outside City
J 23-24	Outside City
J 25	Outside City
J 26	Outside City
K 6	Outside City

Bauder ID	Reason
CC 1	Outside City
CC 5-6	Outside City
CC 7	Outside City
DD 4	Outside City
A 1	Developed
A 3	Developed
B 12-13	Developed
C 22	Developed
J 1	Developed
O 1	Developed
X 6	Developed
D 1	Gravel mining
C 23-24	Graded/inaccessible in '86
D 16	Destroyed in '86 (Bauder, 1986)
J 19	Ag/plowed in '86 (Bauder, 1986)
J 28 W	Visited—no basins located

Tables 67, 68, and 69 are indicative of the changes in vernal pool distribution within the City of San Diego. Discussion of these changes will follow the general geographic areas shown in Figure 1 and grouped in the Results. The 2003 inventory shows consistent increases in the number of vernal pools located over previous surveys.

Five hundred seventy-one vernal pools were inventoried in the Del Mar Mesa area (H series) in 2003. This is more than triple the number (125) recorded by Bauder in 1986. These numbers will remain static, within the limits of yearly rainfall variability, due to the completed conservation of vernal pools from future development in this area.

Mira Mesa includes all of series B, C, D, and I complex 1. In 1979, 154 vernal pools were located; five years later, 34 basins were surveyed. In 2003, the City inventoried 376 vernal pools in this area. The increase in this number is due in part to small restoration and creation projects such as Mesa Norte, and to the location of new sites within the area (i.e., Maddox). Several vernal pool series in this area have been lost to development since 1986 (i.e., B 12-13).

It is difficult to compare temporal changes at Nobel Drive and Montgomery Field/General Dynamics. Portions of both sites are located on military land, and several specific complexes owned by the City are not mentioned in Bauder's 1986 report (i.e., X 5). Also, several new sites were identified in this area (i.e., General Dynamics and Serra Mesa Library).

Mission Trails Regional Park, urban San Diego, and Marron Valley are made up of vernal pool groups that were not surveyed previously.

Otay Lakes showed an overall increase of 70 vernal pools from 1986 to the present. Procter Valley surveys detected one vernal pool in 1979, five in 1986, and 19 in 2003. Thirty-one vernal pools were surveyed at Otay Lakes in both 1979 and 1986, while 87 were surveyed in 2003. No restoration or creation efforts have occurred in this area.

One complex (J 1) containing two vernal pools was lost in Otay Mesa between 1986 and 2003. Although other vernal pools have been destroyed due to off-road

vehicles and grazing, J 1 is the only instance of an entire complex being lost. The recent inventory located 982 vernal pools, which is 880 more than the previous survey. A portion of this increase is due to large-scale mitigation efforts that have restored or created over 300 vernal pools in this area.

These findings form the baseline for future management decisions. The results of this survey will be utilized to prepare a management plan for all vernal pools within the City of San Diego.