

**Western Riverside County  
Multiple Species Habitat Conservation Plan (MSHCP)  
Biological Monitoring Program**

**Vernal Pool Survey Report 2010**



*Riverside Fairy Shrimp pictured*

**8 April 2011**

## TABLE OF CONTENTS

<b>INTRODUCTION</b> .....	<b>3</b>
GOALS AND OBJECTIVES .....	2
RIVERSIDE FAIRY SHRIMP .....	2
VERNAL POOL FAIRY SHRIMP .....	2
WESTERN SPADEFOOT.....	3
<b>METHODS</b> .....	<b>3</b>
PROTOCOL DEVELOPMENT .....	3
PERSONNEL AND TRAINING.....	3
SITE SELECTION .....	4
SURVEY METHODS .....	4
<b>RESULTS</b> .....	<b>6</b>
<b>DISCUSSION</b> .....	<b>11</b>
RECOMMENDATIONS FOR FUTURE SURVEYS.....	12
<b>LITERATURE CITED</b> .....	<b>13</b>

## LIST OF TABLES AND FIGURES

<b>FIGURE 1.</b> Vernal pool survey locations in 2010. ....	5
<b>FIGURE 2.</b> Fairy shrimp detections in 2010. ....	7
<b>TABLE 1.</b> Fairy shrimp survey locations and detections from 2008-2010 .....	8
<b>FIGURE 3.</b> Western spadefoot detections 2008 - 2010.....	10
<b>TABLE 2.</b> Western spadefoot survey locations and detections from 2008-2010 .....	11

## LIST OF APPENDICES

<b>APPENDIX A.</b> Western Riverside County MSHCP Biological Monitoring Program Protocol for Vernal Pool Species, January 2010.....	15
<b>APPENDIX B.</b> Environmental data from pools where Riverside fairy shrimp were detected in 2010 .....	21

## **NOTE TO READER:**

This report is an account of survey activities undertaken by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. The Biological Monitoring Program monitors the distribution and status of the 146 Covered Species within the Conservation Area to provide information to Permittees, land managers, the public, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service. Monitoring Program activities are guided by the MSHCP species objectives for each Covered Species, the information needs identified in MSHCP Section 5.3 or elsewhere in the document, and the information needs of the Permittees.

We would like to acknowledge the land managers in the MSHCP Plan Area, who in the interest of conservation and stewardship facilitate Monitoring Program activities on the lands for which they are responsible. A list of the lands where this year's data collection activities were conducted is included in Section 7.0 of the Western Riverside County Regional Conservation Authority (RCA) Annual Report to the Wildlife Agencies.

We would especially like to acknowledge the Santa Ana Watershed Association, the Center for Natural Lands Management, and the Orange County Water District for their willingness to initiate or modify their data collection to complement our survey efforts in 2010.

While we have made every effort to accurately represent our data and results, it should be recognized that our database is still under development. Any reader who would like to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data. All Monitoring Program data, including original datasheets and digital datasets are stored in the Monitoring Program office in downtown Riverside, CA.

The primary author of this report was the 2010 Herpetology Program Lead, Robert Packard. If there are any questions about the information provided in this report, please contact the Monitoring Program Administrator. If you have questions about the MSHCP, please contact the Executive Director of the RCA. For further information on the MSHCP and the RCA, go to [www.wrc-rca.org](http://www.wrc-rca.org).

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## INTRODUCTION

Vernal pools, also known as temporary wetlands, ephemeral pools, and spring ponds, are non-flowing water bodies that periodically lose all or most of their water volume and surface area during the year. The biological community is adapted to seasonal drying and typically lacks fish, thus providing a safer environment for aquatic invertebrates and amphibian reproduction (Colburn 2004).

The Western Riverside County MSHCP covers 3 fairy shrimp and 1 amphibian species that inhabit vernal pools in southern California: Riverside fairy shrimp (*Streptocephalus woottoni*), Santa Rosa Plateau fairy shrimp (*Linderiella santarosae*), vernal pool fairy shrimp (*Branchinecta lynchi*), and western spadefoot (*Spea hammondi*; spadefoot), formerly *Scaphiophus hammondi*. In 2008, Biological Monitoring Program biologists surveyed vernal pools throughout the Santa Rosa Plateau Ecological Reserve, the San Jacinto Wildlife Area, and 1 pool in Murietta on Briggs Road. During these surveys we documented the presence of vernal pool fairy shrimp and Santa Rosa Plateau fairy shrimp at the Santa Rosa Plateau. We did not detect any covered fairy shrimp species at the San Jacinto Wildlife Area or in Murietta. Surveyors heard spadefoots at the Santa Rosa Plateau and in Murietta, but MSHCP species-specific monitoring objectives require evidence of breeding for this species and no evidence was found at these locations.

We did not conduct an official vernal pool survey effort in 2009, but did survey a small number of pools reported to us by others. Biologists from Tetra Tech Inc., working at the Potrero Unit of the San Jacinto Wildlife Area (Potrero), reported pools with fairy shrimp and tadpoles, and Dustin McLain of the Riverside County Parks Regional Open Space District reported a road rut containing fairy shrimp and adult spadefoots nearby on the Shiang property in Murrieta. We surveyed 4 of the pools at Potrero in 2009. Of these, we found spadefoot tadpoles in 1 pool and adults at 3 pools, versatile fairy shrimp (*Branchinecta lindahli*), a non-covered species, in 1 pool and 1 unidentified fairy shrimp in another. We also raised versatile fairy shrimp from soil taken from 1 of the pools that had recently dried. We detected spadefoot tadpoles and versatile fairy shrimp in the pool in Murrieta. We also incidentally detected spadefoot tadpoles in some retention ponds in Wilson Valley in 2009.

We focused our 2010 survey effort on searching for vernal pools in locations within the Conservation Area not previously surveyed, assessing the suitability of these pools for Covered Species, and documenting species presence within Core Areas and other potentially suitable habitat in the MSHCP Conservation Area. We expanded on the scope of previous survey efforts to include pools that do not strictly follow the definition of vernal pools given above, due to their more permanent nature or the presence of some flowing water, in order to capture additional potential habitat for breeding spadefoot. Because the detection of Santa Rosa Plateau fairy shrimp at the Santa Rosa Plateau Ecological Reserve in 2008 satisfied the monitoring requirements for that species, we

targeted Riverside fairy shrimp, vernal pool fairy shrimp, and spadefoot during 2010 surveys. Species-specific monitoring objectives, suitable habitat, and Core Areas are described under each species section below. Our survey goals for 2010 were as follows:

**Goals and Objectives:**

1. Locate ephemeral and other pools with suitable fairy shrimp and spadefoot habitat in species-specific Core Areas and other areas that we have not surveyed in prior years.
  - a. Use historical records, anecdotal information, and satellite imagery in ArcGIS (ESRI 2006) to identify these areas.
  - b. Scout areas after significant rain events to determine if pools are present.
2. Document presence of fairy shrimp species and western spadefoot in areas where pools are found.
  - a. Survey all pools with standing water more than 3 cm deep.

**Riverside Fairy Shrimp (*Streptocephalus woottoni*)**

Riverside fairy shrimp is a federally endangered species that is restricted to deep vernal pools, vernal pool-like ephemeral ponds, livestock ponds, and other human-modified depressions (Eng et al. 1990; USFWS 1993). Riverside fairy shrimp prefer warm-water pools with low- to moderate-dissolved solids (Eriksen and Belk 1999). This species is found in southeastern Orange County, western San Diego County, and western Riverside County (Eriksen and Belk 1999). Within its range, all known occupied pools lie within annual grasslands, which are interspersed with chaparral or coastal sage scrub vegetation (Dudek & Associates 2003).

The species objectives for Riverside fairy shrimp require the conservation of 5 Core Areas: 1) Santa Rosa Plateau Ecological Reserve, 2) Murrieta, 3) Skunk Hollow, 4) Lake Elsinore, and 5) Alberhill (see Discussion section regarding Alberhill as a Core Area for Riverside fairy shrimp). Although species-specific survey objectives are not listed for Riverside fairy shrimp, the default MSHCP monitoring objective states that species presence and continued use shall be maintained at 75% of the listed Core Areas at least once every 8 years (Dudek & Associates 2003).

**Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)**

Vernal pool fairy shrimp is federally threatened and has narrow habitat requirements. This species prefers cool-water pools that have low-to-moderate dissolved solids, are unpredictable, and often short-lived (Eng et al. 1990; USFWS 1994).

The species objectives for vernal pool fairy shrimp require the conservation of 3 Core Areas: 1) Salt Creek (west Hemet portion), 2) Santa Rosa Plateau Ecological Reserve, and 3) Skunk Hollow. Survey efforts in 2010 followed general MSHCP objectives as described under Riverside fairy shrimp as species-specific survey objectives are not listed for vernal pool fairy shrimp.

### **Western Spadefoot (*Spea hammondi*) (formerly in the genus *Scaphiopus*)**

Western spadefoot is a California near-endemic (ranging from Shasta County to Baja California) and a state species of special concern (Stebbins 1985). The species breeds primarily in vernal pools or other standing water free of exotic predatory species and below 1500 m (Holland and Goodman 1998). Adults can also be found in chaparral, sage scrub, grassland, and alluvial scrub communities adjacent to breeding habitat (Holland and Goodman 1998). Western spadefoot requires pools with water temperatures between 9°C and 30°C (Brown 1966, 1967) and a hydroperiod greater than 3 weeks (Feaver 1971) to reproduce and metamorphose successfully.

The MSHCP species objectives for spadefoot require maintaining successful reproduction at 75% of conserved breeding locations as measured once every 8 years, including isolated pools, road ruts, and creeks. As listed in the MSHCP, these areas include: Santa Rosa Plateau Ecological Reserve, San Jacinto River, Salt Creek, Skunk Hollow, Hemet, Lake Skinner-Diamond Valley Lake, Lake Mathews-Estelle Mountain, San Jacinto Wildlife Area-Lake Perris, the Badlands, Potrero Valley, the Banning Bench, Sage/Vail Lake, San Jacinto Mountains, Highgrove, Murrieta, Soboba, and Anza Valley (Dudek & Associates 2003).

## **METHODS**

### **Protocol Development**

We developed our vernal pool survey protocol (Appendix A) in 2008 based on the U.S. Fish and Wildlife Service (USFWS) 10(a)(1)(A) permit guidelines for vernal pool branchiopods (USFWS 1996). The protocol focused on surveying Core Areas for covered fairy shrimp species and spadefoot.

### **Personnel and Training**

We trained crew members to identify local fairy shrimp species and other aquatic biota via field guides, taxonomic keys, and preserved specimens. Fairy shrimp identification training included a discussion of key distinguishing characteristics between species, and study of preserved specimens at the Monitoring Program office and the Natural History Museum of Los Angeles County. We also conducted mock surveys at the Santa Rosa Plateau Ecological Reserve on 1 February 2010. During this field training session we identified Santa Rosa Plateau fairy shrimp, vernal pool fairy shrimp, and most other common vernal pool invertebrates, and conducted the survey protocol as a group.

Biological Monitoring Program personnel are funded by the California Department of Fish and Game and the Regional Conservation Authority; volunteers are noted. The following individuals conducted vernal pool surveys in 2010:

- Robert Packard (Herpetology Program Lead, Biological Monitoring Program)
- Ashley Ragsdale (Biological Monitoring Program)
- Dustin McLain (Volunteer, Riverside County Parks Regional Open Space District)

- Elizabeth Dionne (Biological Monitoring Program)
- Jonathan Reinig (Biological Monitoring Program)
- Lauren Ross (Biological Monitoring Program)
- Lynn Miller (Biological Monitoring Program)
- Melody Aimar (Volunteer, Santa Ana Watershed Association)
- Rosamonde Cook (Biological Monitoring Program)
- Emma Freeman (Volunteer, The Natural History Museum of Los Angeles County)
- Kathy Omura (Volunteer, The Natural History Museum of Los Angeles County)

### **Site Selection**

Because the presence of vernal pools vary annually depending on rainfall, we searched for vernal pools at locations using historical records, a USFWS vernal pool map generated by Sally Brown, anecdotal information, and potentially appropriate locations identified using satellite imagery in ArcGIS (ESRI 2006). We conducted assessment surveys using this information between 7 December 2009 and 16 February 2010. These assessments consisted of locating any pools  $\geq 3$  cm deep, as measured 1 m from the edge of the pool, measuring the dimensions of the pool, recording location coordinates, and noting if any fairy shrimp or tadpoles were seen (Appendix A).

We searched for vernal pools in the following 13 locations using the methods outlined above: Banning Bench in San Bernardino National Forest, Lake Elsinore, Estelle Mountain Preserve, Menifee, Mystic Lake, Schleuniger Pool in Wildomar, March Stephens' Kangaroo Rat Preserve (March Preserve), Salt Creek, El Sol, San Timoteo Canyon, Bogart County Park, Rancho Bella Vista, and the Southwestern Riverside County Multi-Species Reserve (MSR). Within these areas, we found suitable vernal pools at Lake Elsinore, Mystic Lake, Estelle Mountain Preserve, Salt Creek (west Hemet portion), El Sol, and MSR (Figure 1). Vernal pools on the March Preserve were to be surveyed by another agency but lack of available trained personnel prevented those surveys from being completed. Surveys at the adjacent Skunk Hollow and Johnson Ranch properties were conducted by Center for Natural Land Management (CNLM) biologists Lee Ann Carranza and Kim Klementowski, who kindly shared their data with us. Please contact CNLM for the full report for those locations; brief results are reported below.

### **Survey Methods**

At least 2 surveyors conducted visual and dip net sampling in daylight hours around the banks of each vernal pool. Survey time per site varied from 3 min to 160 min (mean = 29 min), depending on the size of the pool and the presence and abundance of aquatic species. We recorded the following data at the beginning of each survey: date, observers, time, general weather description, ambient air temperature ( $^{\circ}\text{C}$ ), average wind speed (km/h), presence/absence of water, water temperature ( $^{\circ}\text{C}$ ), pH, dissolved oxygen (mg/L), conductivity ( $\mu\text{S}$ ), total dissolved solids (mg/L), salinity (ppm), wetted depth 1-m



from bank (cm), length and width of the pool (m), and date of the last rain event. We identified all aquatic fauna and Covered Species when possible. In addition, we searched for covered plant species around each pool when plants were present (results of these searches can be found in the *Biological Monitoring Program Rare Plant Survey Report 2010*).

We conducted all surveys between 10 February and 23 March 2010. Pools were scheduled to be surveyed at least 3 times approximately every 2 weeks, per the protocol, but many dried up before a 2<sup>nd</sup> or 3<sup>rd</sup> survey could be completed. We surveyed the El Sol pool only twice, and over a shorter time-span, because of its late discovery during the survey effort.

We collected a maximum of 3 voucher specimens per sex of every fairy shrimp species at all pools where they were detected, but only when the number taken was less than 10% of the estimated population of the pool, and when the species had not previously been collected at the pool. We collected specimens with dip nets and/or dip-cups and placed them in small plastic vials containing 100% ethanol for preservation. At least 2 Monitoring Program biologists confirmed identification of each voucher specimen before animals were euthanized. We accessioned specimens at the Natural History Museum of Los Angeles County. Detailed survey methods are provided in *Western Riverside County MSHCP Biological Monitoring Program Protocol for Vernal Pool Species January 2010* (Appendix A).

## **RESULTS**

We detected Riverside fairy shrimp at 3 locations: Lake Elsinore (1 pool), El Sol (1 pool), and the MSR (2 pools) (Table 1, Figure 2). This species was also detected in 1 pool at Johnson Ranch by CNLM biologists, although they did not find it at Skunk Hollow. Riverside fairy shrimp have historically occurred at Skunk Hollow (Eriksen and Belk 1999), and the species was detected there in 2008 by CNLM biologists. The pool at Lake Elsinore (known as the Australia Pool) had unidentified juvenile fairy shrimp (nauplii) on the first survey on 17 February 2010, tens of Riverside fairy shrimp on 2 March, and none on 15 March. We detected thousands of shrimp during both visits to the El Sol pool. We detected hundreds of fairy shrimp in the pools on the boundary between RCA property and the MSR.

The habitat and environmental conditions of pools containing Riverside fairy shrimp varied considerably (Appendix B). Many of these conditions were different than what is commonly believed to be favorable for Riverside fairy shrimp. Riverside fairy shrimp are generally found in relatively larger, deep, long-lived pools, with neutral to low pH and low total dissolved solids (TDS) (Eriksen and Belk 1999). The pools in which we detected Riverside fairy shrimp in 2010 ranged from 15 to 37 cm (mean = 24.8 cm) deep, as measured 1 m from the edge. The pH varied from 8.2 to 9.5 (mean = 8.6), and TDS ranged from 50.8 to 276 ppm (mean = 151.2). Only 1 pool dried before its final survey. The Lake Elsinore pool is shallower than most of the other pools where we detected this



species, especially the maximum depth near the center of the pool, which we estimated visually, but never measured. By contrast, the El Sol pool is a large, deep, and turbid man-made stock pond still used by cattle. The larger of the MSR pools is relatively deep and man-made; the smaller pool extends into RCA property and was possibly created when a nearby water canal was constructed, preventing water from flowing past the canal. Both of these pools are in the same intermittent streambed, the larger pool being dammed with earth.

**Table 1.** Fairy shrimp survey locations and detections from 2008-2010 (Core Areas are shaded).

Fairy Shrimp Core Areas	Visual Survey	Vernal Pool Survey	Riverside Fairy Shrimp	Santa		
				Vernal Pool Fairy Shrimp	Rosa Plateau Fairy Shrimp	Versatile Fairy Shrimp
Alberhill <sup>a</sup>	2010	No	No	No	No	2010
Lake Elsinore	2010	2010	2010	No	No	2010
Murrieta	2009	2009	No	No	No	No
Salt Creek	No	No	N/A	N/A	N/A	N/A
Santa Rosa Plateau	2008, 2010	2008	No <sup>b</sup>	2008, 2010	2008, 2010	No
Skunk Hollow	2008, 2010	2008, 2010	2008	2008, 2010	No	2010

<sup>a</sup> See Discussion section regarding Alberhill as a Core Area for Riverside fairy shrimp

<sup>b</sup> See Discussion section regarding a potential recent observation of Riverside fairy shrimp at the Santa Rosa Plateau

**Non-core Areas**

San Jacinto Wildlife Area	2008, 2010	2008	No	No	No	2008
El Sol	2010	2010	2010	No	No	No
Multi-Species Reserve	2010	2010	2010	No	No	No
Estelle Mountain	2010	2010	No	2010	No	2010
San Jacinto River	No	No	N/A	N/A	N/A	N/A
Hemet	2010	2010	No	No	No	2010
Mystic Lake	2010	2010	No	No	No	No
Menifee	2010	2010	No	No	No	No
Potrero Valley	2009	2009	No	No	No	2009
Banning Bench	2010	No	No	No	No	No

We found vernal pool fairy shrimp in 1 pool at the Estelle Mountain Preserve (a non-core area) and at 1 pool at the Santa Rosa Plateau during our field training session (Figure 2). CNLM biologists found them in 1 pool at Skunk Hollow and 1 pool at Johnson Ranch. We found this species and collected specimens at the Estelle Mountain Preserve during our assessment survey on 4 February 2010. The pool was 10 cm deep and 4 x 3 m across on that date. We did not conduct a full survey of this pool because it was dry during our first survey visit on 17 February. This pool is known to be very short-lived (*Brian Shomo, Estelle Mountain Preserve Manager, personal communication*). Michael Fugate at the University of California, Riverside verified the identity of the specimens at the Estelle Mountain Preserve.

Spadefoot tadpoles were found at 4 conserved breeding locations in 2010, and 1 in 2009 (Potrero Valley) (Table 2, Figure 3). We detected spadefoot tadpoles at a conserved breeding location in Hemet, at 4 pools in the MSR, and at El Sol (an extension of the Lake Skinner/Diamond Valley Lake Core Area). Spadefoot tadpoles were also detected by CNLM biologists at Skunk Hollow/Johnson Ranch, also part of the Lake Skinner-Diamond Valley Lake Core Area. We heard spadefoots calling at the Santa Rosa Plateau Ecological Reserve, but no evidence of breeding was detected during the 1-day training session, so this does not count towards the species objective, as evidence of breeding is required. James Gannon, a Bureau of Land Management employee, also found an adult along Bautista Creek, which is not listed as a breeding location. We did not survey for spadefoot in the following conserved breeding location in 2010: San Jacinto River, Salt Creek, Banning Bench, Badlands, Sage/Vail Lake, Anza Valley, Highgrove, or Soboba.

In addition to the target species, we detected Santa Rosa Plateau fairy shrimp during our field training session (Figure 2). We also detected versatile fairy shrimp, although not a covered species, at 5 locations in 23 pools during vernal pool surveys in 2010 (Figure 2). Almost all of the pools found with fairy shrimp contained only 1 species. The 2 exceptions were a pool at Johnson Ranch that held both Riverside and vernal pool fairy shrimp, and the pool where we held a training session at the Santa Rosa Plateau that held Santa Rosa Plateau and vernal pool fairy shrimp.



**Table 2.** Western spadefoot survey locations and detections from 2008-2010.

<b>Core Areas and Conserved Breeding Locations</b>	<b>Visual</b>	<b>Vernal Pool</b>			
	<b>Surveys</b>	<b>Surveys</b>	<b>Adults</b>	<b>Tadpoles</b>	<b>Eggs</b>
Murrieta	2008	2008	2008	No	No
Hemet	2010	2010	No	2010	No
Salt Creek	No	No	No	No	No
San Jacinto River	No	No	No	No	No
Santa Rosa Plateau	2008	2008	2008, 2010	No	No
Skunk Hollow/Johnson Ranch <sup>a</sup>	2008	2008, 2010	No	2010	No
San Jacinto Wildlife Area	2008	2008	No	No	No
El Sol	2008, 2010	2010	No	2008, 2010	No
Multi-Species Reserve	2010	2010	No	2010	2010
Estelle Mountain Preserve	2010	2010	No	No	No
Mystic Lake (SJWA)	2010	2010	No	No	No
Badlands	No	No	No	No	No
Potrero Valley	2009	2009	2009	2009	No
Banning Bench	2010	No	No	No	No
Sage/Vail Lake	No	No	No	2009	No
San Jacinto Mountains	No	No	No	No	No
Anza Valley	No	No	No	No	No
Highgrove	No	No	No	No	No
Soboba	No	No	No	No	No
<b>Additional Locations</b>					
Bautista Canyon	No	No	2009	No	No
Shiang Property, Wildomar	2009	2009	2009	2009	No
Menifee Pools	2010	2010	No	No	No
Lake Elsinore	2010	2010	No	No	No

<sup>a</sup> Surveyed by CNLM biologists.

## DISCUSSION

We focused 2010 vernal pool survey efforts on locating fairy shrimp and spadefoot in species-specific Core Areas and sites across the Conservation Area where potentially suitable habitat occurs.

Of the 5 Core Areas for Riverside fairy shrimp, we detected the species at Lake

Elsinore in 2010, and CNLM biologists detected it at Skunk Hollow in 2008. Alberhill is listed as a Riverside fairy shrimp Core Area, but the USFWS Biological Opinion for the MSHCP reports that this area has never supported a known Riverside fairy shrimp population (USFWS 2004). There are no historical records of Riverside fairy shrimp at the Santa Rosa Plateau despite this location being listed as a Core Area (Eriksen and Belk 1999; USFWS 2004). However the Monitoring Program recently received report of Riverside fairy shrimp detections at the Santa Rosa Plateau Ecological Reserve by researchers from the University of California, Davis in 2009. We are working to determine the authenticity of these records as they would be the first documented occurrences of the species at that location. We did not conduct any surveys in 2010 in the Murrieta Core Area due to the lack of suitable conserved habitat that we had not previously surveyed. We surveyed 1 area in Murrieta in 2008 (McIlhinney/Stimmel property), but no fairy shrimp were detected in this pool. The area with vernal pools around Lake Elsinore appears to be frequented by people and their pets, which may be a threat to the condition of these pools.

Vernal pool fairy shrimp were detected at 2 of their Core Areas, the Santa Rosa Plateau and Skunk Hollow, but no surveys were conducted in their only other Core Area, Salt Creek, as no vernal pools were found within conserved land in this area. Salt Creek and its immediate surrounding area has many vernal pools that are not currently included in the Conservation Area. Ideally, future land acquisition will include properties in this area that have appropriate vernal pool habitat.

The Santa Rosa Plateau is the only known location of Santa Rosa Plateau fairy shrimp and the only Core Area listed, thus the species-specific monitoring objective has been met for Santa Rosa Plateau fairy shrimp until 2018.

One of the pools on RCA property next to the MSR straddles the boundary of the existing Conservation Area and land owned by the Metropolitan Water District. Any future construction activities on the land next to the existing water canal could jeopardize the condition of the pool.

As of 2010, we have found evidence of breeding spadefoot in 6 conserved breeding locations and detected the species (tadpoles or adults) in an additional 4 areas. Additional surveys targeting conserved breeding locations will be necessary to address the species objectives for this species.

### **Recommendations for Future Surveys**

Surveys for covered fairy shrimp and western spadefoot should continue in species-specific Core Areas and non-core areas with vernal pools, given sufficient seasonal precipitation to fill pools. Priority should be given to areas where we did not detect target species in previous years or where we have not yet surveyed. Furthermore, we should continue to conduct visual surveys to document the presence of vernal pools and assess potential suitable habitat.

Many of the pools where Riverside fairy shrimp have been located are man-made stock ponds or stream impoundments. This suggests that constructing pools in Core Areas for the species to facilitate their use of these pools may be a viable option in Core Areas where they have not been detected. However, this tactic should be delayed until a more thorough spatial and temporal assessment of all potential Riverside fairy shrimp locations has been completed, especially in light of the recent apparent discovery of the species at a previously undocumented location (Santa Rosa Plateau Ecological Reserve).

Surveys for spadefoot beyond strictly vernal pool areas should also be conducted in applicable Core Areas and conserved breeding locations to determine presence and breeding activity for this species. This can be done with visual encounter surveys for egg masses and tadpoles during the breeding season, which is generally January through March (Dudek & Associates 2003). These surveys could possibly be decoupled from fairy shrimp/vernal pool surveys to better address the species objectives for spadefoot.

While Riverside fairy shrimp have not been found at the required number of Core Areas since we began surveys, we have detected the species at the MSR and El Sol, which are not listed as Core Areas. If Alberhill is removed as a listed Core Area for Riverside fairy shrimp because it has not been documented that the species ever occupied any pools at this location we recommend substituting the MSR and/or El Sol as Core Area(s). We also recommend expanding the definition of the Skunk Hollow Core Area to include all of Johnson Ranch, as both Riverside fairy shrimp and vernal pool fairy shrimp occur here outside of the Skunk Hollow pool itself.

### **Acknowledgements**

The Biological Monitoring Program would like to thank Tom Ash of the Multi-Species Reserve, Brian Shomo of the Estelle Mountain Preserve, and Karin Cleary-Rose of the U.S. Fish and Wildlife Service for productive suggestions as to where we might find vernal pools in the Plan Area. We would also like to thank the Center for Natural Land Management for sharing their data with us from Skunk Hollow and Johnson Ranch. We thank James Gannon of the Bureau of Land Management for his incidental sightings. We would also like to thank the staff at the Natural History Museum of Los Angeles County for allowing us to study specimens, and donating some 100% ethanol for the preservation of fairy shrimp specimens. Finally, we would like to thank Michael Fugate of the University of California, Riverside for his help in identification of fairy shrimp and donating training materials.

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Appendix A. Western Riverside County MSHCP Biological Monitoring Program Protocol for Vernal Pool Species, January 2010

Prepared by Robert Packard, Herpetology Program Lead

**Goals:** To identify ephemeral pools with suitable fairy shrimp and western spadefoot habitat in species-specific Core Areas. Presence of local fairy shrimp species and the spadefoot toad will be identified within Core Areas and other potentially relevant vernal pools within the Conservation Area through standard surveys, as described below.

**Timing:** January 2010 – April 2010 (dependent upon duration of pool hydration).

**Survey Locations:** The MSHCP Species Objectives lists Core Areas for the following Covered Species of fairy shrimp: Riverside fairy shrimp (*Streptocephalus woottoni*; “Riverside Fairy Shrimp”), Santa Rosa Plateau fairy shrimp (*Linderiella santarosae*; “Santa Rosa Plateau Fairy Shrimp”), Vernal Pool Fairy Shrimp (*Branchinecta lynchi*; “Vernal Pool Fairy Shrimp”).

Location	Riverside Fairy Shrimp	Santa Rosa Plateau Fairy Shrimp	Vernal Pool Fairy Shrimp
Alberhill	X		
Lake Elsinore	X		
Murrieta	X		
Salt Creek (west Hemet)			X
San Jacinto River			
Santa Rosa Plateau	X	X	X
Skunk Hollow	X		X

The MSHCP species objectives for western spadefoot require maintaining successful reproduction at 75 percent of conserved breeding locations as measured once every 8 years, including isolated pools, road ruts, and creeks. These areas include; Santa Rosa Plateau Ecological Reserve, San Jacinto River, Salt Creek, Skunk Hollow, Hemet, Lake Skinner-Diamond Valley Lake, Lake Mathews-Estelle Mountain, San Jacinto Wildlife Area-Lake Perris, the Badlands, Potrero Valley, the Banning Bench, Sage/Vail Lake, San Jacinto Mountains, Highgrove, Murrieta and Soboba, and Anza Valley. (Dudek & Associates 2003).

**Methods:** (adapted from: United States Fish and Wildlife Service. 1996. Interim survey guidelines to permittees for recovery permits under section 10(a)(1)(A) of the Endangered Species Act for the listed vernal pool branchiopods. 10 pp.).

### Vernal Pool Identification / Assessment

GIS imagery will be used to identify ponded water and potential depressions throughout the Access Area. Access Areas are the portions of the MSHCP Conservation Area where we have permission from the land owner or manager to conduct survey work for the purpose of monitoring MSHCP Covered Species. This is done by visually scanning the digital orthophoto quadrangles (DOQs) within Access Areas narrowed down to vegetation communities associated with known vernal pools. Areas marked as potential ephemeral pools are those that have the following characteristics: rounded shape, are lighter or darker in color than surrounding areas and are uniform in color and texture (likely devoid of thick vegetation). Areas that overlap the GIS lakes layer were eliminated from our list of potential vernal pools, since these are permanent, not ephemeral, water bodies.

Once potential vernal pools have been identified and sufficient rain has hydrated known vernal pools (e.g., Santa Rosa Plateau pools), reconnaissance surveys will be conducted to verify that the location is accessible and there is standing ephemeral water present. Ephemeral pools should maintain at least 3 cm of water 24 h after a rain event to be considered for fairy shrimp surveys. Assessment surveys will include the following data collection: date, surveyor names, specific pool ID and location (UTM coordinates and elevation), water depth, date of last rain event, pool surface area, presence of fairy shrimp (yes, no, maybe, or unknown) and notes regarding access and directions to the location. All surveys will be conducted by a crew of at least 2 people. Contact with the water will be avoided, but when that is not possible, 1 person will be designated the “wet surveyor” and will be the person walking into the wetter soil. Pool depth will be measured using a plastic meter stick and measured in centimeters, 1 meter from water’s edge or the center of the pool, whichever is in reach. Researchers will not wade into the pools in order to measure the depth of the pool center. If the center of the pool cannot be reached from the pool edge, then the depth of the pool will be measured 1 meter from the edge of the pool. The date of last significant rain event (minimum precipitation of 0.5 inches over 2 consecutive days) will be determined for the zip code of survey area using the following website: [www.weather.com](http://www.weather.com). Pool width and length will be measured in meters using either a tape measure or laser Rangefinder. The widest and longest sections of the pool will be measured. After completion of the survey, boots and all equipment touching the water will be disinfected per procedures listed below.

### Vernal Pool Surveys

Surveys will begin within 2 weeks after the ephemeral pools are inundated, or as soon as they are located, and will continue once every other week until either 1) the pool dries up, 2) there are 120 days of continuous inundation, or 3) all fairy shrimp species

have been identified in a given pool. If a pool dries up and becomes re-hydrated within the same season, surveys will recommence within 8 days of re-hydration with a minimum depth of 3 cm. When multiple pools are visited in one day, pools will always be visited in the order of more pristine and upstream to those that are less pristine and/or downstream in the watershed.

The following information will be collected during each visit: date, surveyor names, specific pool ID and location (UTM coordinates and elevation), digital photos (minimally north and south facing), ambient and water temperature (°C), weather conditions (Beaufort scale), pool depth and surface area, abiotic conditions (conductivity, dissolved oxygen, turbidity, salinity and total dissolved solids), and evidence of recent disturbance. Additionally, the presence of target vernal pool animal and plant species and non-target vertebrates and other invertebrates (see datasheet) will be recorded. One surveyor (henceforth called ‘observer’) will walk around the entire perimeter of the ephemeral pool, while scanning the pool edge and water for spadefoot toads (all life stages) and other aquatic biota. Additionally, the observer will sample the pool every 3-5 meters using handheld dip nets and a dip cup to record the presence fairy shrimp, other invertebrates, and amphibian larvae. Voucher specimens will be collected, as described below, when adult fairy shrimp are detected. The observer will avoid walking into the pool, by extending the nets with PVC pipe to reach as far into the pool as possible. Each scoop will be examined carefully and, if necessary, the contents placed in a small holding container filled with pool water to identify fairy shrimp and other species. Target animal and plant species will be recorded as an order of magnitude (10’s, 100’s, 1000’s) with the exception of spadefoot toads where only tadpoles will be recorded as an order of magnitude. All other life stages (adults, juvenile, egg masses and audio detections) of the spadefoot toad will be enumerated.

While the observer is surveying for aquatic biota, the second surveyor (henceforth called ‘recorder’) will be collecting weather and aquatic conditions, as well as recording any species observed by the data observer. Ambient temperature and wind speed will be collected using a handheld Kestrel weather station. Pool depth and surface area will be collected in the same format outlined in the pool assessment section above. The recorder will collect biotic parameters using either a multi-parameter Sonde (YSI 556 MPS) or single unit probes. Abiotic data will be collected at a site at the pool’s edge *only after* the observer has searched that area for aquatic biota. The recorder will also take at least two photos of the pool, using a compass for north and south facing photos. Photos will be taken from a standing position and the angle of the photo will be determined in the field in order to capture as much of the pool as possible in the photo.

All photos of pools, plants, and animals will be uploaded daily to the following location: S:\Projects\Data\_Photos\VernalPools. Vernal pool survey photos will be named with the date, photographer’s initials, and jpeg number.

Examples:

1. Vernal pool photo taken by Ashley Ragsdale on February 10, 2010, jpeg 4605: 20100210\_ABR\_4605.jpg

Once these data are collected, the recorder will walk around the pool a meter away from pool's edge and survey for target plant species. The recorder will follow the direction of the observer, so as not to disturb the aquatic biota. The area around the pool's edge and any area where the pool has receded will be searched for target plant species. Target plant species include: *Brodiaea filifolia*, *Brodiaea orcutii*, *Eryngium aritulum* var. *parishii*, *Limnanthes gracilis* var. *parishii*, *Myosurus minimus* ssp. *apus*, *Navarretia fossalis*, *Navarretia prostrata*, *Orcuttia californica* and *Trichocoronis wrightii* var. *wrightii*. If any target plant species are detected, the species (or genus when appropriate) will be recorded along with the percent of the population that is in vegetative, flower, fruit, or desiccated stage. UTM coordinates, an estimate of the population size, and photos will also be collected for each target plant species. When a covered plant species is observed in the field, the recorder will estimate what percent of the population is flowering, fruiting, vegetative, or desiccated. Plants are considered flowering when they have any flower buds and/or open flowers and a small minority, if any, flowers have developed into fruit. Plants are considered fruiting when they either have fruit or have already dispersed fruit and are still green. One sign that fruit have already dispersed are empty seeds pods. Plants are considered vegetative if they are green and are neither fruiting nor flowering. Plants are considered desiccated when they are completely devoid of any green color and all above-ground material is dead. When it is difficult to distinguish between flowering and fruiting individuals, recorder will look for worn-looking petals or other flowering parts, and investigate the plant more closely to see if the worn petals are now attached to fruit instead of a flower. Recorder will scan the area closely, before making phenological estimates, to determine if there are cryptic vegetative individuals present. The total percent across the 4 phenologies will add up to 100%. Each individual plant is counted as only one phenotypic state. For example, if an individual is both flowering and fruiting, it will count as fruiting. If an individual is fruiting, but beginning to desiccate, it will be counted as fruiting.

The recorder will make an exact count of the number of individuals, to determine population sizes of less than or equal to 50 individuals. If populations have more than 50 individuals, an estimate will be made to the nearest order of 10 (60, 70, 80 etc), or the nearest order of magnitude for estimates beyond 100 (i.e. 100s, 1000s, 10000s).

#### Fairy Shrimp Collections

Voucher specimen will be collected once for each pool for all fairy shrimp species detected. A maximum of 3 individuals of each sex for each species will be collected through the net sweeps outlined in the Vernal Pool Survey section. Fairy shrimp will be placed in small plastic vials of 100% ethanol to be fixed (Regina Wetzer, Natural History

Museum of Los Angeles County, personal communication). Specimens of the same species may be placed in the same vials, in the field. Voucher specimen will be used both as a record of species inhabiting each pool as well as to confirm species ID in the lab when identification cannot be made in the field. Confirmation of species identification will be made in the lab through microscope analysis and keying out of species by research personnel. Mike Fugate, a local fairy shrimp expert, will be consulted should any fairy shrimp ID remain unclear. Fairy shrimp will be accessioned at the Los Angeles County Museum of Natural History and vouchered in the office according to standard procedures. Once species identification has been made, the specimen will be transferred to a 2 dram glass shell vial filled with ethanol and then plugged with a cotton ball. The shell vial will then be inverted and placed inside a 2 oz or 4 oz jar, also filled with ethanol. A voucher label will be completed on 100% rag paper with a Pigma Micron (acid free) pen and placed inside the larger jar and sealed with a poly lined lid. The following information, minimally, will be included on each voucher label: species identification, date collected (day, month, year), detailed location, GPS coordinates, name of collector(s), name(s) of person(s) making identification, and preservative used. Additional notes or information may also be included on the label as necessary.

#### Field Sanitization

Contact with pool water is to be avoided when at all possible. When equipment or boots do come into contact with water or wet soil, all materials will be disinfected before moving to the next group of pools. Again, pools will be visited in a pristine and upstream to less pristine and downstream order. Before leaving each pool area and hiking back to the truck, all mud and debris will be removed from all boots and equipment, using a stiff brush and tap water, if necessary. This will be done adjacent to the pool and not while standing in the water. Water quality equipment will then be rinsed with tap water and allowed to air dry while other cleaning is taking place. If necessary, water quality equipment will be dried at the truck with a portable hair dryer. Once back at the vehicle, boots and other equipment will be soaked in a bucket containing a 10% bleach solution (1:10, one part bleach to ten parts tap water) before visiting pools of different areas or watersheds. If not going directly to another wetland, this can be done at the office. A spray bottle containing the 10% bleach solution will be used to rinse the equipment that cannot be dipped into the bleach solution. All equipment will then be rinsed in a bucket (or sprayed) with clean tap water and towels will be used to remove excess moisture. All equipment must be dry before entering the next site. All bleach solutions will be made ahead of time at the office.

#### **List of Field Equipment:**

Measuring tape (Rangefinder)  
Meter stick  
YSI 556 Sonde or single probes

Thermometer (for water temperature)  
Kestrel  
GPS (upload waypoints)  
Camera

Hand lens  
Dip nets (2)  
Extended collection cup (1)  
Plastic vials (2 per pool, minimum)  
Club soda (1 bottle)  
Petri dishes (4)  
Soft forceps  
Datasheets  
Necessary maps and directions  
Bucket & spray bottle with 10 %  
bleach solution (1:10 bleach to  
water)  
Bucket & spray bottle with tap water  
Scrub brush  
Field notebook (including species  
photos, disinfecting directions, etc.)

**Voucher Equipment:**

Microscope  
Petri dish  
Acid free pen  
Acid free paper  
70% ethanol  
Double glass vials  
Soft forceps  
Fairy shrimp field guides  
Datasheets from field collection

**Appendix B.** Environmental data from pools where Riverside Fairy Shrimp were detected in 2010.

Environmental Data	TASH06	TASH06	TASH06	TASH12	TASH12	TASH12	LKEL01	LKEL01	LKEL01	ELSO01	ELSO01
Date Surveyed	23-Feb	9-Mar	22-Mar	23-Feb	9-Mar	22-Mar	17-Feb	2-Mar	15-Mar	17-Mar	22-Mar
Last Rain Event	6-Feb	27-Feb	27-Feb	9-Feb	27-Feb	27-Feb	9-Feb	27-Feb	27-Feb	27-Feb	27-Feb
Water Clarity	Clear	Turbid	Turbid	Clear	Turbid	Clear	Clear	Clear	Clear	Turbid	Turbid
Water Temp. (°C)	15	16.50	16.20	19.70	15.10	N/A	22.70	21.80	23.80	18.60	20.65
Water Depth (cm)	19	37	23.5	13	19	2.5	3.5	8	15	19	28
Dimensions of Pool (m)	54x45	46x49	43x40	40x32	18x26	1x0.5	65x52	55x59	64x49	30x121	118x37
Conductivity (µS)	146.7	144.1	166	263	217	N/A	273	348	393	72.6	112
TDS (mg/L)	102.8	100.7	109	187	153	N/A	194	266	276	50.8	73
Salinity (ppm)	71	72	80	125	108	N/A	139	170	189	36.3	50
pH	8.4	9	N/A	8.4	9.5	N/A	8.4	N/A	8.2	8	N/A
Dissolved Oxygen (mg/L)	1.25	N/A	N/A	0.75	0.3	N/A	10.8	N/A	5.08	2.86	N/A
Disturbance	None	None	None	None	None	None	Dogs	Dogs	Dogs	Cows (app. 50)	Cows, dirt bikers
Elevation (m)	469	469	469	454	454	454	384	384	384	463	463
Riv. Fairy shrimp abundance	100s	1	None	100s	100s	None	nauplii sp.	10s	None	1000s	1000s
Spadefoot abundance	100s	100s	eggs	100s	None	10s	None	None	None	10s	None
Arroyo toad presence	None	None	Adult	Adult/tads	Adult/tads	Tadpoles	None	Tadpoles	None	None	Adult

**Appendix B cont.**

Environmental Data	TASH06	TASH06	TASH06	TASH12	TASH12	TASH12	LKEL01	LKEL01	LKEL01	ELSO01	ELSO01
Pseudacris hypochondriaca	None	None	Eggs	None	None	None	None	None	None	Tadpoles	2 hatches
Water Boatmen	None	Yes	Yes	Yes	None	None	Yes	Yes	Yes	Yes	None
Backswimmers	Yes	Yes	Yes	None	None	None	None	None	None	None	None
Cladocerans	Yes	Yes	Yes	Yes	Yes	None	Yes	Yes	Yes	Yes	Yes
Copepods	Yes	None	Yes	Yes	Yes	None	None	None	Yes	Yes	Yes
Ostracods	Yes	Yes	Yes	Yes	None	None	Yes	Yes	Yes	Yes	Yes
Mosquito larvae	None	Yes	Yes	Yes	Yes	None	Yes	Yes	None	Yes	Yes
Midge larvae	Yes	Yes	Yes	None	Yes	Yes	Yes	Yes	Yes	None	Yes
Damselfly larvae	None	Yes	Yes	None	None	None	Yes	None	None	None	None
Dysticid beetles	None	None	Yes	None	None	None	None	Yes	None	None	Yes
Hydrophilid beetles	None	None	None	None	None	None	None	None	None	None	None
Waterbirds	Yes	Yes	Yes	Yes	None	None	None	None	Yes	Yes	Yes
Other fauna	None	None	None	None	None	None	Horsehair worms	None	Rotifers	None	None
											Mayfly larvae

Notes: TASH06 and TASH12 are on RCA property next to the Multi-Species Reserve. LKEL01 is at Lake Elsinore. ELSO01 is the El Sol property.

The missing water data on 22-March at TASH12 was the result of insufficient water to use water quality equipment.

All other N/As were because the water quality equipment was not functioning properly.