

# Vernal Pool Critical Habitat and Recovery: A Tale of Two Plans

BARBARA VLAMIS

AquAlliance, P.O. Box 4024, Chico, CA 95927  
barbarav@aqualliance.net

**ABSTRACT.** The Endangered Species Act requires the designation of critical habitat soon after a species is listed. In the late 1980's the issue of critical habitat became politically charged and since that time critical habitat has been designated almost exclusively through litigation. This situation applies to the fifteen species dependent on the vernal pool landscapes covered in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*. The effort that led to the critical habitat designation and the recovery plan took many years and multiple legal challenges. Since the 2004 vernal pool critical habitat designation, protecting the habitat has been challenging and continues to be driven by grassroots advocacy. This paper also addresses additional measures to preserve critical habitat for the fifteen species and the implications for their recovery.

**CITATION.** Vlamis, V. 2011. Vernal pool critical habitat and recovery: A tale of two plans. Pages 157-1166 in D. G. Alexander and R. A. Schlising (Editors), *Research and Recovery in Vernal Pool Landscapes*. Studies from the Herbarium, Number 16. California State University, Chico, CA.

## INTRODUCTION

The author's interest in vernal pools began in 1991 in the region including Butte County. Within two years, it became clear that advocating for local protection was an effort in futility. As a result, I expanded the scope of the effort by speaking at conferences and workshops around the state and seeking allies outside the region. This led to a pivotal collaboration with Neil Levine, an attorney working for the Environmental Defense Center (EDC) in Santa Barbara. The Federal Endangered Species Act of 1973 (ESA) was the law used to pursue protection for vernal pool landscapes in California and Southern Oregon. This paper provides a summary of the author's involvement with this process.

The ESA provides for both the designation of critical habitat and development of recovery plans for listed species, and for public involvement, including the ability to petition to list species, to file public comments, and to

sue the Department of Interior (Levine, 2007). Table 1 provides a list of California vernal pool species listed by the Department of Interior under the ESA. A subset of these species (Table 1) was used in the designation of critical habitat and the development of the *Recovery Plan for Vernal Pool Ecosystems in California and Southern Oregon* (U.S. Fish and Wildlife Service, 2005). Some species in this table were not used in the development of the *Recovery Plan* (e.g., California tiger salamander, Searcy and Shaffer, 2011). Other species in the table were used in the *Recovery Plan for Southern California Vernal Pool Ecosystems* (U.S. Fish and Wildlife Service, 1998) and are not considered in this paper (although, see Bauder, 2011, on San Diego mesa mint).

A general summary of background federal activity involving the ESA, followed by a summary of the legal activity resulting in the implementation of the *Recovery Plan* are presented in Table 2.

## Research and Recovery in Vernal Pool Landscapes

TABLE 1. California vernal pool species protected by the Federal Endangered Species Act. Only the species in bold were used in the designation of critical habitat and the development of the *Recovery Plan for Vernal Pool Ecosystems in California and Southern Oregon*. See Table 2 for a chronological review of federal activity.

Date	Action	Species from California Vernal Pools
1978	Endangered Species Listing	San Diego mesa mint, <b>Solano grass</b>
1980	Threatened Species Listing	<b>Delta green ground beetle</b>
1986	Endangered Species Listing	<b>Loch Lomond button-celery</b>
1993	Endangered Species Listing	Riverside fairy shrimp, California Orcutt grass, Otay mesa mint, San Diego button-celery
1994	Endangered Species Listing	<b>Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp</b>
1994	Threatened Species Listing	<b>Vernal pool fairy shrimp</b>
1997	Endangered Species Listing	San Diego fairy shrimp, <b>Contra Costa goldfields, few-flowered navarretia</b> , fleshy owl's clover, <b>Greene's tuctoria, hairy Orcutt grass, Lake County stonecrop</b> , many-flowered navarretia, <b>Sacramento Orcutt grass</b>
1997	Threatened Species Listing	<b>Colusa grass, Hoover's spurge, San Joaquin Valley Orcutt grass, slender Orcutt grass</b>
2000	Endangered Species Listing	Santa Barbara County, California tiger salamander
2002	Endangered Species Listing	Sonoma County, California tiger salamander
2004	Threatened Species Listing	Central California, California tiger salamander

### LISTING OF NORTHERN CALIFORNIA VERNAL POOL SPECIES

Roxanne Bittman petitioned the U.S. Fish and Wildlife Service (Service) to list the Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and California linderiella as endangered species in a letter dated November 19, 1990 (Federal Register, 1992). Dee Warencia petitioned the Service to list the vernal pool tadpole shrimp as an endangered species in a letter dated April 28, 1991 (Federal Register, 1992). On September 18, 1994 the Conservancy fairy shrimp, longhorn fairy shrimp, and vernal pool tadpole shrimp were listed as endangered species, with the vernal pool fairy shrimp listed as a threatened species, and the listing of California linderiella was rejected (Federal Register, 1994).

### RESPONSE TO LISTING

On April 17, 1995, the Building Industry As-

sociation (BIA) filed a complaint in federal court for the District of Columbia which opined that the Service relied on "questionable scientific data" to support the listing. The Building Industry Association attorneys illustrated their client's ignorance of the vernal pool habitat by stating, "If you disturb mud puddles on your private property without first proving that no fairy shrimp are impacted, you could be subject to civil and criminal penalties. It's a ridiculous situation."

### LEGAL SUPPORT OF LISTING

Neil Levine from the EDC contacted me soon after the BIA filed their lawsuit. At that time, I was the Executive Director for Butte Environmental Council (BEC) and had developed a reputation as an advocate for vernal pools. Mr. Levine wondered if BEC would consider joining his organization, as interveners supporting the listing of vernal pool crustaceans. The EDC provided his expertise and covered

## Vlamis: Vernal Pool Critical Habitat and Recovery

TABLE 2. Key points in the development of the *Recovery Plan for Vernal Pool Ecosystems in California and Southern Oregon*, including a summary of federal activity that provides background for the conservation of vernal pool landscapes. Refer to Table 1 for a listing of the California and Oregon vernal pool species protected by the Endangered Species Act. See text for additional information.

<b>Date</b>	<b>Action</b>	<b>Additional Details</b>
<b>1973</b>	Endangered Species Act; initial listing of selected animals	No vernal pool animals listed
<b>1977</b>	First plant species listed as endangered	No vernal pool plants listed
<b>1978</b>	Formalized Federal Agency consultation with U.S. Fish and Wildlife Service (Service)	
<b>1978</b>	First vernal pool plants listed	
<b>1982</b>	Federal action allowed destruction of listed wildlife when permit holder implements a species Habitat Conservation Plan (HCP).	
<b>1994</b>	Four California and Oregon vernal pool crustaceans listed	
<b>1995</b>	The U.S. Supreme Court upheld the Service's regulation defining "harm" to include destroying or modifying habitat for an endangered or threatened species.	
<b>1995</b>	The Building Industry Association (BIA) filed a complaint in the U.S. District Court for the District of Columbia.	The complaint stated that the Interior Department relied on "questionable data" when listing the four vernal pool crustaceans in 1994 (Table 1).
<b>1997</b>	Federal District Judge Paul Friedman ruled in support of the listing of the four crustaceans.	The judge also ruled favorably for the BIA's claim that the government failed to designate critical habitat for the species.
<b>2000</b>	The Department of Interior was sued by Barbara Vlamis of Butte Environmental Council and Neil Levine of Environmental Defense Center to develop critical habitat for four crustaceans.	An agreement for a time extension for the Service added 11 vernal pool plants to the critical habitat mapping, and mandated the completion of a recovery plan.
<b>2001</b>	The District of Columbia Court of Appeals upheld Judge Friedman's ruling in support of the listing of the four crustaceans.	
<b>2002</b>	The U.S. Supreme Court upheld the appeals court ruling, thereby affirmed the protection of the four federally listed fresh water crustaceans under the Endangered Species Act.	
<b>2003</b>	The first Vernal Pool Critical Habitat (VPCH) Rule was completed.	The Department of Interior appointee Julie MacDonald altered the biological mapping for political purposes, and removed one million acres and six counties on economic grounds, leaving 740,000 acres in the VPCH Rule (see text).
<b>2004</b>	The VPCH Rule was appealed by BEC.	The California Native Plant Society and Defenders of Wildlife joined the appeal.
<b>2005</b>	The <i>Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon</i> was completed.	

TABLE 2, continued on next page

## Research and Recovery in Vernal Pool Landscapes

TABLE 2, continued

Date	Action	Additional Details
2005	Plaintiffs won the challenge of the VPCH Rule in Sacramento’s Federal District Court, and the Service created a second VPCH Rule.	Critical habitat acreage was added to the five counties previously excluded; however, other counties lost acreage. The Second VPCH Rule left 858,842 acres in 36 counties, including Jackson County in Oregon.
2005	Plaintiffs appealed the second VPCH Rule.	The San Joaquin Raptor and Wildlife Rescue Center, vernalpools.org and the Sierra Foothills Audubon Society joined the plaintiffs.
2006	The Sacramento District Court ruled for the plaintiffs, finding that the Service failed to look at whether its decision to eliminate critical habitat designations for vernal pool grasslands affected the future recovery of the vernal pool species in Butte, Fresno, Madera, Merced, Monterey, Placer, Sacramento, Shasta, Solano, Stanislaus and Tehama Counties.	The Service’s response in 2007 satisfied the court; however, it did not expand the acreage in the third VPCH Rule.

his costs, and BEC gladly accepted his offer to intervene and split additional expenses. On April 15, 1996, Mr. Levine and an attorney the groups hired from Harmon, Curran, Gallagher, and Spielberg in Washington DC represented us at the district court’s hearing. Judge Paul Friedman heard the arguments from both sides of the case for 2.5 hours. A decision was issued July 29, 1997, that rejected the BIA request to delist the crustaceans, but supported their petition requiring the Service to designate critical habitat for the four vernal pool crustacean species. The BIA’s appeal of the ruling was rejected by the District of Columbia Court of Appeals on May 8, 2001. The U.S. Supreme Court upheld the appeals court ruling, on January 14, 2002, thereby affirming the protection of the four federally listed fresh water crustaceans under the Endangered Species Act.

### CRITICAL HABITAT FOR LISTED VERNAL POOL SPECIES

After the BIA requested that the Service designate critical habitat for the crustaceans, Mr. Levine and I began conversing about both the

conservation benefits and the legal importance of the vernal pool critical habitat designations. These discussions resulted in an April 12, 2000 lawsuit filed by the EDC and BEC seeking critical habitat for the four crustaceans. In February 2001, the District Court for the eastern district of California ordered the Service to complete a final critical habitat designation for four species of listed vernal pool crustaceans by August 9, 2001.

Relatively quickly, it became clear that the Service was unable to meet the court-ordered deadline. As a result, we negotiated an extension that gave the Service until August 15, 2002 to complete the final rule. This negotiated agreement added eleven vernal pool plants to the critical habitat designation. The Service was unable to meet the 2002 deadline and requested another eleven months to finish the critical habitat mapping.

Our negotiated agreement with the Service requested a court order to

- impose new deadlines for the proposed (draft) and final critical habitat rules,

## Vlamis: Vernal Pool Critical Habitat and Recovery

- require the submission of a work plan with details of the administrative process and milestone dates for progressing to the final designation,
- require the submission of monthly status reports to the Court and Plaintiff demonstrating compliance with the work plan and progress toward the final deadline, and
- enjoin the Defendants from authorizing all projects with impacts to the fifteen vernal pool taxa (four endangered crustacean species and eleven plants added through negotiation) and their habitat through Sections 7 and 10 of the ESA (incidental take permits and habitat conservation plans) until the critical habitat designation was completed.

The Service accepted all the conditions except the moratorium on permits and habitat conservation plans. In an attempt to gain more protection for the habitat and listed species during the second extension, this agreement also stipulated the development of a vernal pool species recovery plan due December 15, 2005. The agreement also stipulated that the Service would fund two vernal pool research projects that would analyze grazing impacts and study the genetics of Butte County meadowfoam (Sloop, 2011), and review a petition for the listing of the mid-valley fairy shrimp. (This request made by the Center for Biological Diversity and Vernalpools.org in August, 2001 was considered not warranted in January 2004).

### FEDERAL RESPONSE TO CRITICAL HABITAT SUIT

The Final Rule on the critical habitat designation was released on August 6, 2003, almost two years to the day from the district court's initial deadline. Tragically, this Vernal Pool Critical Habitat (VPCH) Rule was dramatically altered in Washington, DC by a Bush polit-

ical Appointee, Julie MacDonald, aide to the Service's Assistant Secretary Craig Manson. The VPCH Rule eliminated almost 1 million acres, leaving only 740,000 acres of critical vernal pool habitat (Tables 3 and 4). The entire counties of Butte, Madera, Merced, Sacramento and Solano were completely excluded based on an improper economic analysis, and Riverside County was removed because of a pending habitat conservation plan.

The economic "costs" used by MacDonald to eliminate the five counties have proven illusory as documented in *Endangered Species and Wetlands Report*, May 2004 (Endangered Species and Wetlands Report, 2004). After obtaining documents in the case, the *Endangered Species and Wetlands Report* found that Julie McDonald made two fatal computational errors: 1) She added costs that are separate actions together by simply listing a species as threatened or endangered years ago to the costs of establishing critical habitat in the present, severely skewing the results, 2) She used taxable sales as an indicator of economic activity in each county. For example, McDonald underestimated Butte County's taxable sales by 1,000 times. "She assumed such sales totaled just \$2 million per year. But Butte County has more sales than that in a single day" (Endangered Species and Wetlands Report, 2004). She also failed to consider any economic benefits from listing the species.

### CHALLENGES TO THE 2003 FEDERAL RESPONSE TO THE CRITICAL HABITAT SUIT

While dealing with the legal and political critical habitat dance, it occurred to me that I was rather isolated and that other groups and people must be working on similar habitat and species issues around California. As a result, I organized a meeting in Sacramento with numerous people and groups in January, 2002. From that meeting, the California Endangered

## Research and Recovery in Vernal Pool Landscapes

TABLE 3. Acres of vernal pool habitat in California counties proposed by the Service in 2002 and 2003, and the 2005 acreage reinstated by court order.

County	2002 Proposed Acreage	2003 Rule Acreage	2005 Rule Acreage
Butte	58,849	0	24,247
Madera	95,802	0	48,359
Merced	194,335	0	147,638
Sacramento	68,820	0	37,098
Solano	67,961	0	13,415

Species and Habitat Alliance was formed. Relationships grew and mutual issues and interests became more apparent, so when it was time to challenge the VPCH Rule two new partners, the California Native Plant Society and Defenders of Wildlife, joined BEC on January 15, 2004 (EDC was not a plaintiff in this case). We sought to have the five removed counties reinstated, and to add back acres to other counties, in the VPCH Plan, because of deficient economic justification.

On Oct. 28, 2004, the District Court in Sacramento ordered the Service to review the non-economic lands excluded (state reserves, federal military lands, refuges, areas with habitat conservation plans, and one tribal land) and to complete a new economic analysis for the five counties by July 31, 2005. Unfortunately, the Service hired David Sunding, an economist from the University of California, Berkeley, who worked previously for the California Home Builders Association during the public comment period for the 2003 VPCH Rule. Once again, the Sunding analysis only looked at the costs of designating critical habitat and not at the benefits. Since this one-sided approach was repeated by Sunding, the report came to a similar economic conclusions as the McDonald analysis. These problems were articulated by Frank Casey with Defenders of Wildlife, and by Barney Hope from California State University, Chico.

The 2005 VPCH Rule included some lands in the counties previously excluded, albeit noth-

ing close to what was proposed by Service scientists before ruling that was influenced by MacDonald (Table 3). A prime example of the justifications used to limit acreage in counties is found in the presentation for Butte County. The Sunding economic analysis estimated that the proposed VPCH would cost \$152 million over 20 years in Butte County. This total translates into \$13 million per year at the 7 percent discount rate used in the analysis. While this may seem like a significant number, the Sunding analysis fails to mention that this is a microscopic 0.17% of the annual economic output of the county, which is \$7.36 billion (IMPLAN, 2001).

The court order allowed the Service to re-evaluate the counties included in the 2003 Rule—another bite at the apple for the political appointees. As plaintiffs, we were not surprised to find that the 2005 Rule removed significant and valuable acreage from some of the included counties with the greatest development pressure (Table 4). The manipulation of science and attempts to circumvent the law were and will remain a hallmark of George W. Bush's presidency and administration.

### CHALLENGES TO THE 2005 FEDERAL RESPONSE TO THE CRITICAL HABITAT SUIT

Undeterred by the political gamesmanship, BEC, CNPS, and Defenders of Wildlife prepared to challenge the 2005 VPCH Rule and were joined by the San Joaquin Raptor/Wildlife Rescue Center, Vernalpools.org,

## Vlamis: Vernal Pool Critical Habitat and Recovery

TABLE 4. Acres of vernal pool habitat in California counties with high development pressure, proposed by the Service in 2002 and 2003, and the acreage reinstated by court order in 2005.

County	2002 Proposed Acreage	2003 Rule Acreage	2005 Rule Acreage
Fresno	32,218	32,228	19,200
Placer	58,849	32,134	2,580
San Luis Obispo	64,171	64,378	48,134
Stanislaus	132,708	128,035	67,462
Tehama	130,752	130,691	102,837

and the Sierra Foothills Audubon Society. The lawsuit was filed December 13, 2005 and challenged the

- entire economic analysis,
- exclusion of state and federal lands,
- exclusion of lands overlapping with habitat conservation plans,
- exclusion of 23 census tracts for economic reasons,
- failure to disclose the locations of the exclusions, and
- Service's engagement in unlawful pattern, practice, and policy by refusing to comply with mandatory ESA duties when designating critical habitat for threatened and endangered species.

These patterns, practices, and policies were to include, but not be limited to

- disregarding multiple court orders invalidating its "adverse modification" regulation at 50 C.F.R. § 402.02, the Code of Federal Regulation dealing with adverse modification of critical habitat,
- ignoring the conservation, or recovery, mandate of critical habitat under the ESA, and
- considering only the economic costs of critical habitat designations, while failing to consider, either quantitatively or qualitatively, the economic benefits of critical habitat designations.

On November 2, 2006, Federal District Court Judge William B. Shubb issued a major ruling overturning the Service's decision to omit 900,000 acres from the 2005 Final Rule in Butte, Fresno, Madera, Merced, Monterey, Placer, Sacramento, Shasta, Solano, Stanislaus, and Tehama Counties. He found that the Service failed to look at whether its decision to eliminate critical habitat designations for vernal pool grasslands in the eleven counties had an impact on the future recovery of the vernal pool species. Judge Shubb also rejected the building industry attempt to overturn the designation of more than 800,000 acres that the Service designated as critical habitat in the 2005 Rule. Ironically, the court did agree with the builders that the Service failed to adequately explain why it excluded the University of California, Merced, and a Highway 99 project in Tehama County from critical habitat—both of which were last-minute exclusions that had been directed by MacDonald.

### THIRD VERNAL POOL CRITICAL HABITAT RULE BY THE FISH AND WILDLIFE SERVICE

To comply with Judge Shubb's ruling, the Service released a *third* Vernal Pool Critical Habitat Rule on May 31, 2007. The Rule still covered the fifteen endangered and threatened vernal pool plants and animals that live in landscapes of California and southern Oregon. The 2007 Rule maintains the same acreage found in the 2005 Rule: 858,846 acres, with the exclusion of almost 900,000 acres that

## Research and Recovery in Vernal Pool Landscapes

were proposed in the original 2002 Draft Rule (Tables 3 and 4). In the 2007 Rule, the Service changed from an economic justification contending, however illogically, that the federally threatened and endangered species will somehow manage to recover even with less suitable habitat available to them.

The 2007 Rule also retained the flawed economic analysis from 2005 that overestimated the potential costs of critical habitat designation. It also underestimated or completely disregarded the potential benefits of designation, such as providing educational, research, and recreational opportunities, infrastructure support services, ranching, tourism, and economy of scale by covering all fifteen species in one rule.

In addition, the 2007 Rule continued exclusions in many areas by assuming adequate management and oversight of national monuments, national wildlife refuges, tribal land, state lands, and lands overlapping with habitat conservation plans. The crucial ESA language, “Do not jeopardize,” is also noticeably absent in the 2007 VPCH Rule, while it was included in the 1994 critical habitat rule for delta smelt. This illustrates the fact that the Service has veered away from stronger enforcement language and action, which requires either a political or judicial remedy.

Designating critical habitat for federally listed species is important for these species because it clearly identifies the areas essential for their recovery, a requirement of the Endangered Species Act. Habitat maps are essential to provide information for statewide and local conservation planning efforts. If recovery is to occur, the remaining range of the fifteen vernal pool species must not only be protected, it must be expanded.

The initial listing of endangered species was caused by a habitat loss that has continued to

date. Without a change in Service policy, habitat is still being destroyed by direct and indirect impacts from development, infrastructure, and agriculture, as well as uncontrolled illegal activity. Despite the lack of improvement in the 2007 Rule, the conservation groups decided to stop pursuing changes to the Rule and began to focus on defending the habitat in individual cases and implementing the *Recovery Plan for Vernal Pool Ecosystems in California and Southern Oregon*.

### RECOVERY PLAN FOR VERNAL POOL ECOSYSTEMS IN CALIFORNIA AND SOUTHERN OREGON

The Service finished the *Recovery Plan for Vernal Pool Ecosystems in California and Southern Oregon* on December 15, 2005, the date ordered by the court. That was due in no small part to the management support by Betty Warne in the Service’s Sacramento Field Office. The Recovery Plan was released to the public in March 2006, and was celebrated with great fun and fanfare during the vernal pool conference held in Chico. A substantive improvement in the Recovery Plan was the inclusion of a majority of the acreage removed from the critical habitat designation, and it contains valuable analysis of each species. Regrettably, recovery plans are implemented voluntarily.

The Recovery Plan acknowledges this fact stating, “Recovery plans, on the other hand are voluntary guidance documents, not regulatory documents, that broadly address conservation needs of the species by identifying research, habitat protection and restoration, and management, and all other actions that must be taken to bring a species to a state in which it may be delisted or down-listed. Recovery planning documents are necessarily expansive, identifying as many options and strategies that may contribute to recovery as possible. None of the actions or maps associated with this re-



## Vlamis: Vernal Pool Critical Habitat and Recovery

covery plan carry any regulatory authority.” This represents a type of government supervision that is liked most by people and businesses concerned only with profits resulting in a biological and long-term economic cost to society and the earth.

While voluntary efforts and collaboration can lead to positive results, they should move in tandem with regulatory oversight. The public’s pursuit of enforcement is also essential as illustrated with the many lawsuits that were necessary to implement existing laws that require critical habitat designations and recovery plans. Easing regulations and failures to enforce the law has recently led us to the worst economic collapse in this country since the Great Depression. Is it any wonder that the smallest among us, and some with funny names, are destroyed with impunity due to political pressure on government agencies?

An example of important vernal pool landscape preservation that benefited from the Recovery Plan was Stoneridge Ranch (800 acres in northeast Chico, visited on the fieldtrip phase of the 2006 vernal pool conference). The Ranch also has a conservation easement on another 3,885 acres. This ranch preserve was established with joint efforts including support by Cay Goode from the Service and Jenny Marr from the California Department of Fish and Game. The preserve contains a healthy population of *Limnanthes floccosa* ssp. *californica* (Butte County meadowfoam).

Having lost over 90% of vernal pool habitat from the historic range (Holland and Hollander, 2007; Wright, 2002), we must save the remnant islands that still shine like beacons each spring to the birds, bees, and amphibians who need a chance to survive and, maybe one day, thrive.

## LITERATURE CITED

- BAUDER, E. T. 2011. Science and vernal pool conservation: research questions, methodologies and applications based on a case study of *Pogogyne abramsii* in San Diego County, California. Pages 5-23 in D. G. Alexander and R. A. Schlising (Editors), Research and Recovery in Vernal Pool Landscapes. Studies from the Herbarium, Number 16. California State University, Chico, CA.
- ENDANGERED SPECIES AND WETLANDS REPORT. 2004. Poplar Publishing 9(9).
- FEDERAL REGISTER. 1992. Proposed Rules. Federal Register 57:19856-19863.
- FEDERAL REGISTER. 1994. Determination of Endangered Species. Federal Register 59:48136-48153.
- HOLLAND, R. F. and A. D. HOLLANDER. 2007. Hogwallow biogeography before Gracias. Pages 29-50 in R. A. Schlising and D. G. Alexander (Editors), Vernal Pool Landscapes. Studies from the Herbarium, Number 14. California State University, Chico, CA.
- LEVINE, N. 2007. Endangered species act and grassroots activism. Pages 153-155 in R. A. Schlising and D. G. Alexander (Editors), Vernal Pool Landscapes. Studies from the Herbarium, Number 14. California State University, Chico, CA.
- IMPLAN. 2001. Professional Version v.2.0.1024, 1997-2004, a product of MIG, Inc.
- SEARCY, C. and H. B. SHAFFER. 2011. Determining the migration distance of a vagile vernal pool specialist: how much land is required for the conservation of California tiger salamander? Pages 73-87 in D. G. Alexander and R. A. Schlising (Editors), Research and Recovery in Vernal Pool Landscapes. Studies from the Herbarium, Number 16. California State University, Chico, CA.
- SLOOP, C. M. 2011. The population and genetic status of the endangered vernal pool annual *Limnanthes floccosa* Howell ssp. *californica* Arroyo: Implications for species recovery. Pages 25-37 in D. G. Alexander and R. A. Schlising (Editors), Research and Recovery in Vernal Pool Landscapes. Studies from the Herbarium, Number 16. California State University, Chico, CA.

## Research and Recovery in Vernal Pool Landscapes

U.S. FISH and WILDLIFE SERVICE. 1998. Vernal Pools of Southern California. Recovery Plan. Portland, OR.

U.S. FISH and WILDLIFE SERVICE. 2005. Recovery Plan for Vernal Pool Ecosystems of Cali-

fornia and Southern Oregon. Portland, OR.

WRIGHT, S. 2002. Protecting our disappearing vernal pools. Dateline. University of California, Davis, CA.