

## **Introduction**

The quality of human life is enriched by a willingness to understand and preserve natural ecosystems. The continued existence of natural ecosystems depends on individuals that value the natural world and are willing to influence local and federal land-use managers that control development or preservation of these landscapes. Unfortunately, most California vernal pool landscapes have been irreplaceably converted to development. The remaining vernal pool landscapes are vulnerable because they are often adjacent to and within areas of extensive human land use, and the general public often poorly appreciates them. This book is dedicated to the better understanding and recovery of the remaining California vernal pool landscapes.

### **Plants and Animals in Vernal Pool Landscapes**

California vernal pool landscapes are the product of the interaction of plants and animals with the Mediterranean climate (dry summers alternating with cool wet winters) and a relatively level topography that includes a water-resistant layer. The water-resistant layers that cause pools to fill with rainwater are found in isolated older soils that have developed a hardpan (duripan), or where impermeable geologic formations occur near flat land surfaces.

Not only do vernal pool landscapes show strikingly different dry summer and wet winter conditions throughout the year, they also display topographic diversity with different size pool and interpool areas. These conditions have persisted long enough to support the evolution of species that grow and reproduce only during specific seasons in small parts of the landscape.

Plants and animals that complete reproduction in vernal pool landscapes often share unique biological characteristics that include activity only during limited times each year, and the production of resistant stages that survive inhospitable times. The survival of resistant stages for more than one year increases the potential for dispersal and genetic diversity. This occurs when resistant stages with different genetic information hatch or germinate and mix. Examples that cause genetic mixing include production in years with different climate patterns and dispersal from different microhabitats.

The chronologically and spatially narrow window of opportunity for growth selects for rapid activation and maturation. This potentially results in large populations and communities dominated by a few species. However, the high variability of rainfall and temperate between different years also impacts population success, resulting in some organisms successfully growing and reproducing only during years with specific climatic patterns and interactions between plants and animals. As a result, the species diversity observed in one pool in any one year, is less than the total potential species diversity in that pool over many years.

### **Loss of California Vernal Pool Landscapes**

Vernal pool landscapes were, and are, replaced and fragmented by human development. Examples include urban, industrial, and orchard development (deep soil ripping and the provision of water in summer continues to threaten vernal pool landscapes). Many of the remaining landscapes persist as part of seasonal grazing operations.

### **Organization of the Book**

This book and its companion volume, *Vernal Pool Landscapes*, published in 2007 by Schlising and Alexander, are the products of two vernal pool conferences in Chico—held in 2006 and 2010. Both confer-

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ences involved presentations the first day in the Big Room of the Sierra Nevada Brewing Company, followed the next day by a fieldtrip visiting local vernal pool landscapes. The Vernal Pool Lands Committee, chaired by Barbara Vlamis, convened both conferences, with the 2010 conference sponsored by the newly-formed advocacy group, AquAlliance. Specialists who presented talks in the conferences were invited to submit expanded manuscripts from their presentations for the books. These papers were subjected to peer review.

We are pleased with the quality and diversity of manuscripts completed for both publications. Although some of the specialists chose not to submit articles, summaries of most of the ideas presented during oral presentations were included in the books. The first volume the editors benefitted from a recording of presentations. The recordings were used to develop papers for the presenters that did not submit manuscripts. Unfortunately the 2010 conference was not recorded. As a result, we used talk abstracts and PowerPoint presentations from the conference, with editorial comments, to expand or explain important ideas.

The sequence of articles in this book is different from the sequence of talks at the 2010 conference in Chico. The initial article by Ellen Bauder, who gave the dinner address at the conference, contains a section on research methodologies that is a logical introduction to research articles on vernal pool plants and animals. Although the next three sections are titled plant, animal, and geography/soils, most articles contain interactive ecosystem topics and are directed toward issues that support recovery and management of vernal pool landscapes. Several management issues are covered in the fourth section. The final section is actually a time-line. The first paper looks back at the history of conflicts involving vernal pool litigation for preservation. The final paper considers actions that will result from *The Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*.

### Peer Review Support for the Book

The following individuals provided critically important peer-review comments that the editors directed to the authors. These individuals (including some that helped authors before the manuscripts were submitted) provided information that improved the quality of this volume: Kathy Alexander, Pelayo Alvarez, Deborah Ayres, Sheila Barry, Ellen Bauder, Barb Castro, Sharon Collinge, George Cox, John Dittes, Tag Engstrom, Erin Gottschalk-Fischer, Kay Goude, Samantha Hillaire, Colleen Hatfield, Shelly Kim, Rich Lis, Jenny Marr, Rob Preston, Nishi Rajakaruna, Kristina Schierenbeck, Joe Silveira, Pete Trenham, Barbara Vlamis, and John Vollmer.

### Production of the Book

*Research and Recovery in Vernal Pool Landscapes* is the 16<sup>th</sup> publication in the series Studies from the Herbarium, Department of Biological Sciences, California State University, Chico. It was completely edited and published on the campus at California State University, Chico. We appreciate the support provided by the Department during our editing the current volume. Barbara Castro provided exceptional proofreading support. We thank Chris Ficken, Academic Technologies, for providing a distinctive cover design. We also thank Dale Wymore and her staff at University Printing for producing the book.

Special thanks also go to the effort of Lawrence Janeway, Herbarium Curator and longtime coordinator of the Studies from the Herbarium.

The book editors accept responsibility for any potential editorial errors.

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## Vernal Pool Plants

These papers on vernal pool plants represent diverse approaches considering research and recovery of vernal pool landscapes throughout California. Each of these papers illustrates the importance of combining specific local studies with a broad statewide approach.

Ellen Bauder skillfully presents detailed research methodologies, giving suggestions about goals, hypotheses and levels of inference as well as considering the importance of spatial and temporal variability. These discussions consider field observation, field experimentation and controlled experiments that isolate specific functions. They are supported with numerous examples from her long-time research in San Diego County on *Pogogyne abramsii* (San Diego mesa mint), one of the first California vernal pool organisms considered endangered by the U.S. Fish and Wildlife Service.

Christina Sloop considers the population and genetic status of *Limnanthes floccosa* subspecies *californica* (Butte County Meadowfoam), providing information essential for restoration and recovery of this species whose native populations are restricted to the Chico area. This work contains a regional scale genetic consideration of 21 different populations. It also includes comments on this species' reproductive ecology and population abundance. It establishes the need to regulate seed movement, and documents past seed movement by individuals conducting "conservation activities" that resulted in populations with genetic characteristics that do not follow natural population patterns. Some support for this research came from the U. S. Fish and Wildlife service as a result of litigation discussed in the final section of this book.

Nancy Emory, Lorena Torres-Martinez, Elizabeth Forrestel, Bruce Baldwin and David Ackerly present a far-reaching paper considering the niche dynamics of *Lasthenia* in California. This paper considers both genetic markers and environmental controls to describe *Lasthenia* species and subspecies. This information illustrates movement by two generalist *Lasthenia* species into vernal pool habitats; a group of specialist *Lasthenia* species now primarily restricted to vernal pool habitats; and an apparent reverse movement out of these habitats by two *Lasthenia* species. The niche discussion illustrates species that have local distributions controlled by both physical and biological factors, and provides examples of niche dimensions that exemplify both the fundamental and realized niche. The authors also consider potential responses of these vernal pool species to climate change.

Joan Leong presents a transition between research on plants and animals in this volume because she considers pollinators of the rare *Blennosperma bakeri*, a vernal pool plant on the Santa Rosa Plain in Sonoma County. This paper illustrates the biological complexity resulting from some forms of vernal pool restoration. It documents a shift from bee-dominated to fly-dominated pollination observed when comparing natural and created vernal pools. Follow-up studies on pollination ecology and the presence of the specialist bee in natural and created pools could be most instructive.

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