Annual Report

Merced Vernal Pools and Grassland Reserve
July 1, 2013 – June 30, 2014

Prepared by Chris Swarth, Reserve Director

Introduction and Background

A broad expanse of rolling grasslands and treeless hills rises gently to the east of the UC Merced campus. For thousands of years, these lands were the domain of large herds of grazing ungulates - bison, antelope, and tule elk. Grizzly bears, mountain lions, wolves and coyotes patrolled the landscape. Native Americans also traversed these grassy slopes en route from the oak woodlands to the rich river bottomlands of the Central Valley to the west. When the Spaniards arrived they brought cattle. The grasslands were very well suited for grazing. Within a few decades cattle ranching had spread across the entire state. Just as quickly the native perennial grasses gave way to competitive European annual grasses - a transformation that is nearly complete throughout the west. Cattle grazing remains the primary use of these lands today; soil characteristics and low rainfall combine to make other forms of agriculture uneconomical.

The rains that come in winter and spring fill thousands of small vernal pools here, catalyzing a biological rebirth as dormant invertebrates hatch, grow and reproduce, and colorful, small wildflowers bloom in circles around the pools. For a brief period vernal pools are a scene of hectic life and unique beauty. Cattle can be seen grazing when the grass and low forbs are lush, but by May the cattle are moved off the Reserve as the vegetation dies back. The appearance of this landscape changes markedly through the year, from bright green in winter and spring to golden brown in summer and fall. In the wet season the hills are bright green and inviting and vernal pools are full; by the dry season, which can begin in April, the pools are empty again and the hills become bone dry.

The decision to build the campus in eastern Merced County required the removal of about 55 acres of vernal pools. Over 90% of California's vernal pools have been lost to suburban development, agriculture and to other similar causes. The university received an Army Corps of Engineers Section 404 permit in order to allow contractors to grade and remove the pools prior to construction. As a permit condition, federal and state agencies required the university to perform environmental mitigation to make up for the loss of vernal pools. The university fulfilled part of their mitigation obligation by

purchasing 6,500 acres adjacent to campus from the Virginia Smith Trust. This acquisition was made possible by a gift from the David and Lucille Packard Foundation in 2001. The university dedicated these lands to a campus reserve, ensuring that the vernal pools and the many rare and endemic plants and animals found here would remain protected forever. Also in 2001, the William and Flora Hewlett Foundation provided a pivotal grant of $2 million to the university to be dedicated to the operation and management of these campus natural lands.

In January 2014, the protected UC Merced lands were designated by the UC Regents into the UC Natural Reserve System (NRS). A dedication ceremony to mark this event was held on the new Reserve on April 10, 2014, presided over by Chancellor Dorothy Leland.

The mission of the NRS is to contribute to the scientific understanding and wise management of the Earth and its natural systems by supporting university-level teaching, research, and public service. The 39 reserves in the NRS are used by faculty, graduate students, undergraduates, and other researchers to study natural systems and communities, and to investigate the ecological processes within these rich, diverse environments. This network of permanently-protected reserves spans the length and breadth of California. The Merced Vernal Pools and Grassland Reserve is the first UC natural reserve located in the San Joaquin Valley.

Reserve operations are managed by a Reserve Director under the oversight of a campus NRS Faculty Director and with the guidance of an advisory committee composed of faculty and natural resource specialists. The Vice Chancellor of Research and Vice Chancellor of Business and Administrative Services are ultimately responsible for the Reserve and between them balance the academic and educational use of the lands with the environmental mitigation and regulatory obligations imposed under the campus' environmental permits.

This annual report is presented in three sections, which coincide with the three-part mission of the UC Natural Reserve System: Research, Teaching, and Public Outreach.

RESEARCH

Research is the cornerstone of a UC Natural Reserve. To further this goal, we've spoken with many professors and graduate students to make them aware of the new Reserve. We've also purchased sampling gear, reference books and a four-wheel drive off-road Gator. Professors Viers and Fogel purchased two storage containers to safely store equipment and supplies for faculty and students. The storage containers are located near the barn adjacent to the Reserve. In the first year following designation several professors and five graduate students have begun to investigate reserve ecosystems and processes. Brief summaries of these projects follow:

Ecosystem Food Web Study Using Stable Isotopes

Dr. Marilyn Fogel, Chris Swarth and their students are carrying out an ecosystem-wide study of soil, water, plants and animals using stable isotope mass spectrometry. The objective is to understand sources of nutrients (for example, in situ sources of N or deposition via the atmosphere) and locations in the reserve where these nutrients are taken up. Of key interest as a potential source are agricultural activities in the San Joaquin Valley. Crop fertilizers and cattle play prominent roles in these biogeochemical cycles. Rainwater and groundwater are analyzed for nitrogen concentrations.

Undergraduate students in several different classes have collected samples for lab analysis. Results of these studies were delivered at Ecological Society of America and American Geophysical Union conferences.

Grazing Assessment

Dairy cattle graze on the Reserve as a management technique to help control the spread of annual grasses into the vernal pools. Grazing limits grass growth near the pools, thereby lowering the rate of evapotranspiration which can cause pools to dry prematurely. Annual assessment of grazing is required to monitor potential negative environmental impacts of grazing. Residual dry matter (RDM) refers to the standing dry grass at the end of the grazing season and this is measured (clipped and weighed) by Marilyn Fogel, Chris Swarth and students. RDM provides an estimate of the forage that remains at the end of the grazing season and is an indicator of annual grazing intensity. Too little RDM can lead to soil erosion and poor plant growth in future seasons. Almost 400 RDM samples from 130 locations spanning the length and breadth of the Reserve have been collected. Grass growth is related to annual precipitation; three gages have been placed across the Reserve to collect rain.

American Kestrel Nesting Productivity Study

UC Merced students worked with SNRI Research Associate Steve Simmons to erect ten nesting boxes for American Kestrels and to monitor nests to determine the number of young produced. Six pairs of kestrels used the boxes and a total of 15 chicks successfully fledged. Three adult females had been banded by Simmons in 2012 and 2013 on the adjacent Flying M Ranch. This wildlife conservation project provided hands-on science training for students. The results of this initial study were published in the December 2014 issue of the Bulletin of Central Valley Birds. Graduate student Joy McDermott has begun a study of kestrel diet under the direction of Dr. Marilyn Fogel, making good use of the nest boxes.

Wildlife and Bird Surveys

Over 60 species of birds have been identified on the Reserve, based on 80 surveys conducted over 18 months. Thirteen species were documented as breeding. Common diurnal raptors include Golden Eagles, Red-tailed Hawks, Ferruginous Hawks, Swainson's Hawks, American Kestrels and Prairie Falcons. Long-billed Curlews and Short-eared Owls are found here in winter. We've observed coyotes on 35 trips, Burrowing Owls on 30 trips and Golden Eagles on 22 trips through the reserve. Several pairs of Burrowing Owls nest in ground squirrel burrows and American Kestrels began nesting in 2014 in wooden nest boxes erected by students. A graduate student and several undergraduates are studying wetland birds and kestrel diet. To survey for the endangered San Joaquin Kit Fox, we deployed four automatic wildlife cameras and we've collected hundreds of hours of video and still photos. With California Audubon and the US Fish and Wildlife Service, we're examining the feasibility of restoring nesting habitat for Tricolored Blackbirds at Lake Yosemite.

TEACHING

The close proximity of the Reserve to campus makes it easy to hold field trips. More than 1,200 undergraduates visited the Reserve last year to learn about natural history, ecology and environmental science. Fourteen faculty have brought classes to the reserve, focusing on such topics on ecology, botany, soils, geology, microbial evolution, and writing.

To provide more educational opportunities on the reserve, undergraduates have been trained to become reserve naturalists. The students participate in a Reserve Naturalist Training certificate program where they learn to lead field trips and to assist professors with class visits. Over three semesters, 28 students have completed the program. A grant from the Mitsubishi Corporation will allow us to expand this program in 2015 and 2016.

Students in a School of Engineering Service Learning Team, with Martha Conklin as the instructor, created an informative brochure, a Facebook page, and a campus outreach program. The major accomplishment of the team, comprising almost 30 students over two semesters, was the design of an permanent interpretive sign that will be mounted near the Student Services Building in April 2015. The sign includes a map, and information about the plants and animals found on the reserve, and will inform the entire campus about the reserve and its possibilities for scientific exploration and education. The students were involved in all aspects of sign design – from effective graphics to determining the structural requirements of the design.

Two interns have brought high energy and great ideas to the Reserve. Maria "Cami" Vega, a senior Cognitive Science major, worked winter - summer 2014 to develop field guides, monitor bird and mammals, lead field trips, and to expand our web site. Cami received a campus award for her work as Reserve intern; she now works for UC Santa Cruz and is applying for graduate school. In fall 2014, Daniel Toews, an Earth System Science major, came on board to lead field trips, carry out plant biomass studies, help with building projects, and to deploy cameras for kit fox surveys. Daniel has been accepted as a graduate student in the UC Merced School of Natural Sciences.

Field trips for campus administrators and officials were held to familiarize them with the new reserve:

- September 19, 2013: Jane Lawrence, Vice-Chancellor and Vice-Provost Elizabeth Whitt
- November 6, 2013. Graeme Mitchell, Vice-Chancellor, Zuhair Mased, Energy and Sustainability Chief, and UCM Facilities Management staff
- January 13, 2014. Safety tour for UCM police officers Josie Haywood and Kevin Warkentin
- February 27, 2014. Chancellor Dorothy Leland and Kim Garner, Chief of Protocol and Executive Assistant to the Chancellor
- March 3, 2014. Vice-Chancellor Kyle Hoffman, Jim Brumm, International Crane Foundation and Armando Quintero, UC Merced Development
- April 25, 2014. Dante Nolo, UCOP Director of Resource Development and Susie Quinn, UCOP Director of Development Policy
- October 1, 2014. Laurie Herbrand, Registrar of Students and UCM staff
- November 7, 2014. Susan Carter, Director of Research Development Services and participants in the UC Systemwide Joint Meeting for Research Development Officers, Extramural Funds Directors, Contract & Grant Officers

PUBLIC Outreach

The proximity of the Reserve to Merced and the San Joaquin Valley makes it especially amenable to introducing the public to this outstanding natural area. Local newspapers including the Sacramento Bee and ABC News featured Reserve events over the last 18 months. The campus Public Information Office and CITRIS have made three videos for our web site.

Reserve interns pose at the new Reserve sign at our entrance gate. From left, Daniel Toews, Katharine Cook, Bobby Nakamoto, Cami Vega, Brandon Tran and David Aratza. Nov. 2014

Tours and presentations were made to over a dozen community and governmental organizations. These interactions result in important public outreach and they serve to develop productive professional relationships with other natural resource specialists.

The Reserve has a great potential for exposing K-12 students to ecology and ecosystem science. We partnered with *Sacramento Splash*, a vernal pool educational organization, to host six Merced County elementary schools for Reserve field trips. All teachers participated in training sessions to prepare their students before the visits. Over 180 fifth grade students participated in hands-on science learning about vernal pools and Reserve ecosystems.

Faculty Feedback on the new Reserve

The Reserve is a tremendous asset for education and research for UC Merced faculty and graduate students. Feedback and reflections from two faculty who use the Reserve are provided below.

Professor Jessica Blois:

1. **How is the Reserve an asset for your research and educational goals?**

Having access to the Reserve, and also the location of the Reserve adjacent to campus, is very beneficial for both my research and teaching. In terms of teaching, it becomes a living laboratory. I'm able to easily take students to the reserve and they get to explore the natural world that's right in their backyard. Because of the biodiversity, uses, and conservation issues associated with the reserve (endangered species, grazing, Mima mounds, etc.), it's an easy way to show students how biodiversity intersects with human influences.

In terms of research, I'm able to set up a local project that helps advance knowledge of local biodiversity. It also serves as a project through which I can train my grad students in research tools.

2. What are important natural attributes of the reserve, from your perspective?

I think the landscape itself is important- the vernal pools and grasslands show both what the Valley would have looked like in the past, as well as how much it has changed (e.g. conversion from native perennial grasses to annual invasive grassland). I also like that it's a grassland and is very open and exposed- it's a nice contrast to the Sierra forests.

3. What is your vision of the reserve in the next 5 years?

Reserve Director Chris Swarth has done a great job at establishing the educational aspects of the reserve in the short two years that he's been here, and integrating the reserve into campus life a bit more deeply. I would like to see this upper trajectory continue with respect to education. We've also started establishing a culture of research on the Reserve, and in the next five years, I would like to see research use expand and become well established. As part of this, I would like to see the plans for a field station become more concrete.

Professor Jason Sexton:

1. How is the Reserve an asset for your research or educational goals?

The reserve is an unparalleled asset for studying natural populations, literally right out the door of my lab. I am very excited to conduct short-term and long-term experiments, sampling, and monitoring at the Vernal Pools Grasslands Reserve. Additionally, this reserve allows remarkable

opportunities to show students, first-hand, the unique flora and fauna and to sample and measure biodiversity and ecosystem properties.

2. What are important natural attributes of the reserve, from your perspective?
I appreciate the scale, heterogeneity, and diversity of the reserve. I believe this natural heterogeneity (e.g., soils, pools sizes, habits differences, topography) allows for a great amount of natural variation within a respectable tract of land, but one that is also easily accessed by foot and by vehicle. I am very excited to explore this reserve over the years. Specifically, I appreciate the topographical and physiognomic gradients, from hills and uplands, to vernal pools, to deeply cut ravines and arroyos.

3. What is your vision of the reserve in the next 5 years?
I would like to see the reserve eventually become a hub for vernal pools research and education, within California and internationally. Within five years I think it will be reasonable to inventory the great majority of macro-diversity on the reserve. I believe it would also be possible to inventory the varying habitats and to have important geospatial databases (e.g. remotely sensed topography, vegetation, soils, hydrology, etc.) established and available for users. Myriad long-term research projects can spring from these initial efforts. I think infrastructure planning (e.g, sensor arrays, facilities, housing) is also possible within five years. I think great care and sensitivity needs to be taken before adding any structures within the reserve. These habitats encompassed within the reserve will become rarer and rarer over time and we need to carefully consider limits on footprint expansion through development.

Acknowledgments

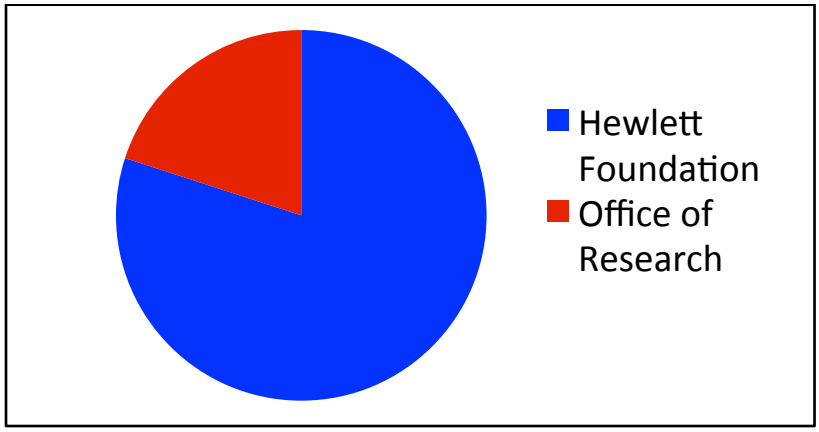
Roger Samuelson and Karen Merritt proposed the idea for a UC Merced reserve in 2001. When Sam Traina became the Founding Director of SNRI he was charged with ensuring that the protected vernal pools/grassland complex on the campus became part of the UC Natural Reserve System. Many UC Merced faculty and staff have provided critical guidance and support. We thank Andy Aguilar, Lorena Anderson, Roger Bales, Gene Barrera, Jason Baumsteiger, Becca Fenwick, Marilyn Fogel, Teamrat Ghezzehei, David Hosley, Tom Hothem, Amy Lorenzo, Maynard Medefind, Steve Shackelton, Tibor Toth, Van Van Vleet, Josh Viers, and Phil Woods. At the NRS at UCOP, we thank Peggy Fiedler, Violet Nakayama, Chen Yin Noah, Kathleen Wong, Erin Marnocha, and Michael Kisgen for unflagging support and advice.

Appendix 1. List of the classes and other educational Reserve field trips: Fall 2013 to Fall 2014.

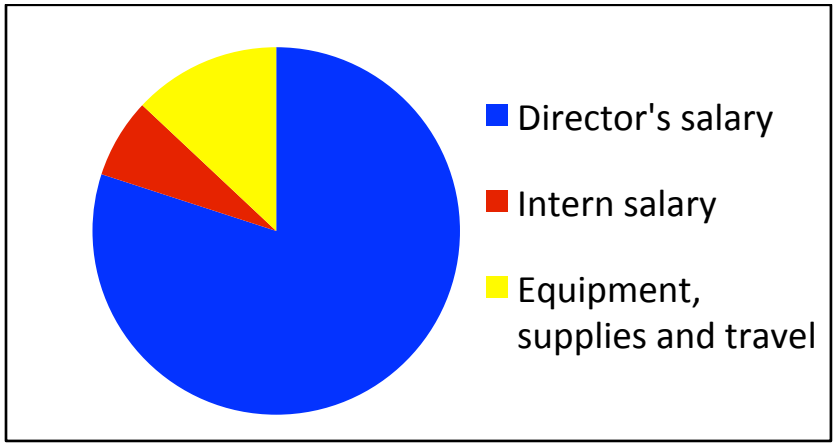
Course or Group	Professor or Leader	Semester	No. Students	User Days	Organization
Core 1 Presentation and Field Trip	C. Swarth	Fall 2013	350	350	UC Merced
Campus Hike	C. Swarth	Fall 2013	10	10	UC Merced
Campus Hike	C. Swarth	Fall 2013	10	10	UC Merced
Biology Today (BIO-05)	C. Gilbert	Spring 2014	26	26	UC Merced
Biology Today (BIO-05)	C. Gilbert	Spring 2014	22	22	UC Merced
Campus Hike	M. Vega	Spring 2014	17	17	UC Merced
Campus Hike	C. Swarth	Spring 2014	21	21	UC Merced
Campus Hike	C. Swarth	Spring 2014	10	10	UC Merced
Campus Hike	C. Swarth	Spring 2014	10	10	UC Merced
Conservation Biology (BIO-149)	J. Sexton; C. Swarth	Spring 2014	20	20	UC Merced
Conservation Biology Field Course (BIO-149F)	C. Swarth	Spring 2014	10	10	UC Merced
Core 1 Presentation and Field Trip	M. Fogel & C. Swarth	Spring 2014	351	351	UC Merced
Engineering Service Learning Team	C. Swarth	Spring 2014	10	10	UC Merced
Environmental Writing	E. Habecker; C. Swarth	Spring 2014	25	25	UC Merced
Field Biology (EEB-124B)	E. McCartney-Melstad	Spring 2014	12	24	UC Merced
Field Ecology	B. Shaffer	Spring 2014	10	20	UC Los Angeles
Fundamentals of Ecology (BIO-148)	M. Fogel; C. Swarth	Spring 2014	41	41	UC Merced
K-12; Splash/UCM Program	K. Kellerman; C. Swarth	Spring 2014	63	63	Chenoweth Elementary
K-12; Splash/UCM Program	J. Cardaso; C. Swarth	Spring 2014	62	62	Planada Elementary
K-12; Splash/UCM Program	A. Shaw; C. Swarth	Spring 2014	60	60	Margret-Sheehy Elementary
K-12; Splash/UCM Program	B. Hughes; C. Swarth	Spring 2014	45	45	Sierra Foothills Charter School
K-12; Wild Link Club (High School)	C. Valdovinos	Spring 2014	14	14	Turlock High School
K-12; Yosemite Leadership Program	R. Maltos	Spring 2014	36	36	Joe-Stephanie Elementary
Microbial Evolution (BIO-124)	M. Barlow; C. Swarth	Spring 2014	46	276	UC Merced
Research	C. Swarth	Spring 2014	28	28	UC Merced
Research/Survey	C. Swarth	Spring 2014	3	3	Yosemite Area Audubon Society
Stable Isotope Ecology (ESS-192/ESS-292)	M. Fogel	Spring 2014	21	21	UC Merced
Stable Isotope Ecology (ESS-192/ESS-292)	M. Fogel	Spring 2014	11	11	UC Merced
Yosemite Audubon Society	C. Swarth & L. McKenzie	Spring 2014	26	26	Yosemite Area Audubon Society
Campus Hike	C. Swarth; C. Vega	Summer 2014	8	8	UC Merced

Research Scoping Field trip	M. Fogel	Summer 2014	4	32	UC Merced
Campus Hike	C. Swarth	Fall 2014	8	8	UC Merced
Campus Hike	D. Toews; C. Swarth	Fall 2014	12	12	UC Merced
Campus Hike	D. Toews	Fall 2014	8	8	UC Merced
Campus Hike	D. Toews	Fall 2014	5	5	UC Merced
Core 1 Presentation and Field Trip	M. Fogel; C. Swarth	Fall 2014	350	350	UC Merced
Engineering Service Learning Team	C. Swarth	Fall 2014	5	5	UC Merced
Fund. of Atmospheric Modeling (ES-291)	E. Campbell; C. Swarth	Fall 2014	7	7	UC Merced
Fundamentals of Geology (ESS-20)	P. O'Day; C. Swarth	Fall 2014	37	111	UC Merced
Microbial Evolution (BIO-124)	M. Barlow; C. Swarth	Fall 2014	123	123	UC Merced
Research Scoping Field trip	M. Gabet	Fall 2014	3	3	San Jose State Univ.
Research Scoping Field trip	N. McCarten	Fall 2014	3	3	UC Davis

Appendix 2. Budget Summary. Reserve operations are supported by funds from the Hewlett Foundation and the UCM Office of Research and Economic Development. In 2014, the annual budget was about $100,000.



Sources of Reserve Income, 2014.



Reserve Expenses, 2014.