Annual Report
Merced Vernal Pools and Grassland Reserve
December 2015

2015 marked the first full year of reserve operations. A key to the success of this new reserve is to expose faculty and students to this amazing resource and to spark within them a sense of ownership and stewardship over this natural landscape. To that end, we worked diligently to bring people to the reserve, to hold informal explorations, to promote the reserve throughout campus to researchers, and to help everyone understand and appreciate the fascinating ecosystem that sits outside the back door of the campus. The agreement by faculty to serve in an official advisory capacity is helping the Reserve to function as a site for research and education. Trained student naturalists now form a corps of knowledgeable naturalists who can lead field trips and assist with classes and research. Finally, Daniel Toews, Katharine Cook, and John Cronin, all UCM undergraduates, worked as Reserve Interns in 2015. The success of our stewardship and education programs and interactions with faculty and graduate students are due in part to the energy and dedication of these three outstanding students.

The drought continued for a 4th year. The annual rainfall in our area for 2015 was only about 152 mm (6 inches), less than half of normal 330 mm (13 inches). As a result, only a small number of vernal pools filled and those that did were only partially filled or were only full for a few weeks. Nonetheless, American Kestrels had a productive breeding season, grasshopper populations seemed robust, and wintering flocks of songbirds (especially Horned Larks) were abundant. RDM levels were much higher in 2015 than in 2014, no doubt due to the rancher bringing cows on later in the season and removing them earlier than in previous years.

Highlights of 2015 were the creation of a 12-member advisory committee, chaired by Joshua Viers and with vice chair Jessica Blois; a celebration marking the 50th anniversary of UC Natural Reserve System; dedication of a Reserve interpretation sign near the Student Services Building; and many new research projects. This report summarizes accomplishments and activities for the period, July 2014 to December 2015.

Research, Monitoring and Biological Surveys

Graduate Student Studies

The campus Natural Reserve System provided a total of $7,000 to four UC Merced graduate students to conduct research in the Reserve and through the Sierra Nevada Research Station in Yosemite National Park.

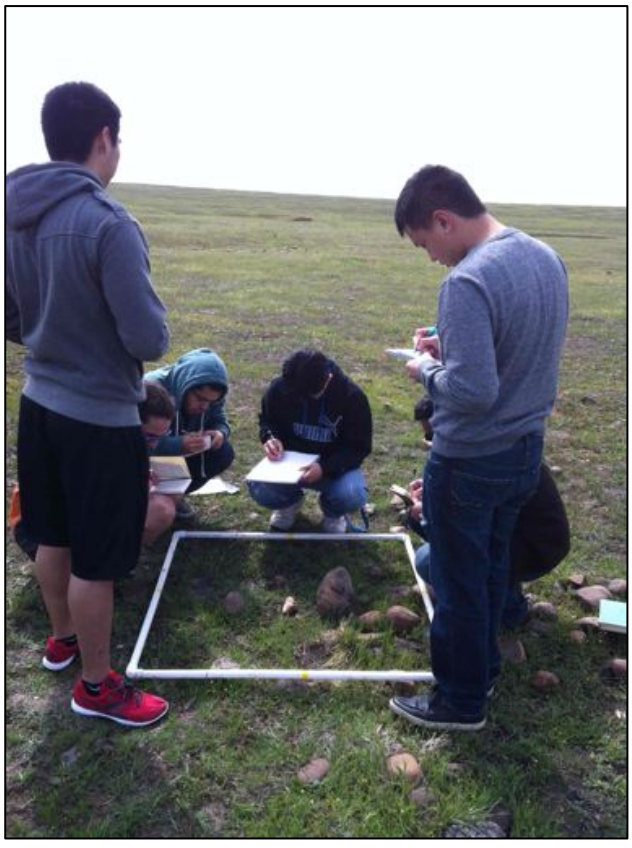
- Erin Babich, an MS student in the Sexton Lab. Her project in the Sierra and at UC Davis examines fitness and selection responses of plants to severe drought by studying low-elevation, high-elevation, and interior populations.
- Joy McDermot, an MS student in the Fogel lab, studies the diet and trophic relations of nesting American Kestrels by analyzing regurgitated pellets and kestrel body feathers using stable isotope mass spectrometry.

- Brandon Stark, a PhD student in the MESA lab under the direction of Dr. YangQuan Chen, is testing different imaging techniques on UAV (unmanned aerial vehicle) platforms.
- Eric Williams, a PhD student in the Blois lab, used his scholarship funds to summarize baseline information on the taxonomic and population genetic structure of the small mammal community within the Reserve.

Other Reserve Research Studies

Aricia Martinez, an MS graduate student at Stanislaus State, is exploring the Reserve to become familiar with the ecosystem and its vegetation communities in preparation for ecological studies of solitary bees and the plants they pollinate.

Doctoral students Brendan Smith and Brandon Stark (under the direction of YangQuan Chen) study the Reserve landscape from the air using unobtrusive aerial photography and videography employing multi-spectral and RGB cameras affixed to small unmanned aerial vehicles (UAVs). They create high resolution spatial and temporal maps. They hope to develop and validate some correlations between the surrounding wildlife and habitats through the use of this imagery and post processing methodology.



Heather Schneider and Susan Mazer (UC Santa Barbara) studied Reserve plant communities as part of Project Baseline. This project is a nationwide initiative to systematically collect, preserve, and archive seeds to be made available to future biologists for studies of evolutionary responses to anthropogenic and natural changes in the environment. They collect seeds from multiple populations of up to 84 widely dispersed plant taxa to represent phenotypic and genotypic variability across habitats and climates that roughly encompass each species' current geographic range. The seeds will be stored at the USDA National Center for Genetic Resources Preservation.

Marilyn Fogel, Liz Williams, David Araiza and lab mates completed a 3rd year of study of biogeochemical cycling and ecological relations focusing on soils, plants, and animals.

Katharine Cook and Chris Swarth completed a 6-month survey of the waterbirds that use the leakage wetland along the northeast side of Lake Yosemite. A written report is available.

Nic Kooyers (University of Virginia) and Jay Sexton study *Mimulus guttatus* (common monkeyflower) and how this species has developed photoperiod responses to adapt to local elevation gradients. This work has led to the discovery of several genes that control photoperiod differences between low and high elevation populations. A long term goal is to develop Near Isogenic Lines that isolate the photoperiod response genes.

Daniel Toews and Chris Swarth completed a 14-month study of Reserve wildlife using four automatic, remote wildlife cameras. From March 2014 to May 2015 they placed automatic Bushnell wildlife cameras at 24 locations for a total of 35 deployments. Cameras were operated in the field for over 12,600 hours. A total of 418 photographs and 274 videos were archived. Photographs of 9 mammal species, 26 bird species, and a single amphibian were collected. No San Joaquin Kit Foxes were detected. A written report is available.

Joy McDermot and Steve Simmons completed a second year of monitoring the breeding productivity of American Kestrels. They installed 20 more nest boxes, bringing the total to 30 boxes. Joy studies adult and nestling diet for her MS research, based on analysis of regurgitated pellets and stable isotopes (C and N) in feathers. Written reports for the 2014 and 2015 breeding season are available.

Niall McCarten of UC Davis initiated studies of vernal pool hydrology and physical parameters of geology, soils and weather. He is also investigating the responses of plant species to these hydrological processes. Niall took the lead in speaking with Cal Fish and Wildlife Department staff in Fresno to resolve confusion over digging holes in upland areas of the Reserve. Niall also provides field supervision for graduate student Christina Tham.

Elizabeth Green and Jay Sexton have begun studies to identify and record plant species diversity found on the reserve and to record the specific habitats and environmental conditions associated with specific plant species. Voucher specimens will be collected and preserved for research and teaching.

Jefferson Laird and Josh Viers are testing a new deployable LiDar system on the Reserve. They have held a number of overflights to test their equipment.

Jarrett Johnson (Univ. of Kentucky), Brad Shafer (UCLA) and researchers at University of New Mexico study the boundaries between population/landscape genomics and conservation biology to characterize the temporal spread of an ongoing biological invasion by the non-native Barred Tiger Salamanders. Barred Tiger Salamanders will hybridize with the native California Tiger Salamander. The resulting hybrid swarm has become a rich system for evolutionary investigations of hybridization and a testing ground for endangered species conservation genetics.

Derek Hitchcock, John Vollmar and Eric Smith (of Vollmar Natural Lands Consulting, Berkeley) are assessing the Reserve for potential wetland mitigation opportunities to

restore and enhance wetland and aquatic habitats that may have been eliminated or degraded through past land disturbances (e.g. cattle stock ponds). Any net gain in wetland habitat and function that might result will be carefully delineated and applied, through a formal permitting process, to the wetland mitigation requirements that resulted from campus permitting and development.

Chris Swarth continued his surveys of wildlife, through the placement of automatic, remote trail cameras and by regular field observations. The goal is to document the diversity of birds and mammals on the Reserve.

Jay Sexton and Daniel Toews have begun an inventory of the vascular plants on the Reserve. A new herbarium cabinet purchased by the Reserve is now in the Sexton Lab and serves as the repository for the plant specimens.

Marilyn Fogel, Chris Swarth and their students completed a 3rd season of studying biogeochemical cycling and cattle grazing. Based on work by John Cronin we also have a first order estimate of vernal pool density and distribution, and have determined how vernal pool density varies among the 10 grazing units in the Reserve. Based on this estimate, there are over 6,000 vernal pools, playa wetlands and swale wetlands in the Reserve.

John Cronin, Reserve Intern, is assessing the extent and spatial distribution of cattle in order to have a better understanding of grazing and its impact on grasslands and vernal pools.

Christina Tham, MS student with Martha Conklin, has initiated a hydrological and chemical study of the vernal pools to understand the interaction of water and soils in vernal pools at varying elevations.

Education, Field Trips and Events

UC Merced Class Field Trips

Between July 2014 and December 2015, 14 UC Merced professors and teaching assistants led students on field trips to the Reserve. Additionally, 13 graduate students lead field trips and there were 20 undergraduate student researchers. A total about 1,100 students visited the reserve. Included in this total are two Core One student groups (September 2014 and

September 2015) consisting of about 350 freshmen in each group. The Core One students visit the area near the barn where they are able to view regions where vernal pools occur in the spring.

The following professors, instructors and teaching assistants brought their students to the Reserve:

Paige Austin
Miriam Barlow
Asmeret Berhe
Elliot Campbell
Marilyn Fogel
Tom Hothem
Heather Jarrell
Monique Kolster
Kaitlin Lubetkin
Sylvain Masclin
Emily Moran
Peggy O'Day
Jason Sexton
Chris Swarth
Christina Tham

NRS 50th Anniversary

We celebrated the 50th anniversary of the UC Natural Reserve System on campus on Thursday, April 16, 2015. Ours was the first in a series of celebratory events that were held on each of the nine UC campuses that administer natural reserves. Four events marked this important day:

1. Three-hour vehicle tour of the reserve for 30 participants
2. Unveiling of the new Reserve Interpretive sign near the Ranchers Road gate
3. Lunch for all participants and guests
4. Presentations on research and new ideas by graduate students and faculty

Promotion Prior to the Event:

Flyers were posted around campus. Email invites were sent to about 120. Chris sent personal email invites to 60 individuals on April 9-10. In addition, invites were sent to the following campus email lists:

- SNRI Faculty mailing list
- SNRI Researchers mailing list
- SNRI Staff mailing list
- SNRI Student mailing list
- School of Social Sciences, Humanities and Arts-sent by Rhonda Pate
- School of Engineering-sent by D.B Quan
- School of Natural Sciences-sent by Monica Sozinho
- "Happenings" announcements (several were posted by SNRI)

Crystal Galvin and Coty Ventura in the SNRI office were very helpful with organization and communication. Students posted flyers around campus. The RSVPs were sent to the SNRI office. Sarah Butler in the campus Housing Office was very helpful in securing the Alpine Room for lunch and talks. SNRI staff handled expense reimbursements with Thembi Jackson at UCOP-NRS in Oakland.

RSVPs were received steadily up to the day before the event. We did a good job of promotion. The event captured the interest of many on campus and in the community at large.

Event Expenses

The UCOP-NRS office provided $5,000 to cover event expenses, which included: lunch for 80; rental of 4 SUVs; travel and overnight expense for guest speaker Brad Shaffer; field books with UCM NRS logos on front cover; parking permits for 4 guests and speakers. There are no campus staff shuttle vehicles back and forth to Enterprise Auto Rentals. Therefore this requires extra planning and finding student volunteers.

Reserve Tour

We rented four large SUVs from Enterprise Auto Rentals in Merced. SUVs were picked up on Wednesday afternoon and parked in Le Grand lot. Several other cars came along, too. About 30 came on the tour in five vehicles. Stopped at four locations on the route to the "Grand Canyon" of Black Rascal Creek. Three naturalist students helped with the driving and gave short talks to the group. Some notables on the tour were:

- Roger Samuelson, a former director of the NRS who also played a prominent role in the early days of selecting Merced as the location for the new university.
- Karen Merritt, an early Founder of UCM and supporter of the reserve
- Becca Fenwick, Director of the Sierra Nevada Field Stations
- Trevor Hirst, Executive Director of the Health Sciences Research Institute
- Bridget Fithian, Exec. Director of the Sierra Foothills Conservancy and a member of the reserve advisory committee
- Maynard Medefind, Yosemite Backcountry Ranger and a director of the campus Wilderness Center
- Thembi Jackson, NRS Operations Manager
- Marc Hoshovsky, Senior Conservation Biologist, California Department of Fish and Wildlife
- Robert Holland, independent consultant and vernal pool expert
- Cami Vega, SCOUT (UC Santa Cruz) and former reserve intern
- Christina Bradley, Post-doctoral Fellow in the Fogel Lab
- Elizabeth Williams, Post-doctoral Fellow in the Fogel Lab
- Erin Mutch, Director of the SPARC lab
- Zuhair Mased, Energy Chief, Facilities Management
- Steve Simmons, UC Merced Research Associate
- Lorena Anderson, Campus Assistant News Director
- Clayton Anderson, freelance photographer
- Thaddeus Miller, reporter with the Merced Sun Star
- Stephani Gimble, Service Learning Team leader (fall 2014)
- David Araiza, Laboratory Technician in the Fogel Lab
- Tapan Pathak, UCM Cooperative Extension scientist

Lunch

Catered lunch for eighty was held in the Alpine Room, located among the campus dormitories. There was plenty of food and the lunch items were good.

Presentations

Graduate students Erin Babich, Joy McDermot, Brandon Stark and Eric Williams spoke about their research which had been supported by grants of $1,500 to $2,000 from the UCM NRS.

After the graduate student presentations, Vice Chancellor for Research Sam Traina, Campus Faculty Director Martha Conklin, Reserve Director Chris Swarth and Wawona Field Station Director Becca Fenwick provided news and updates.

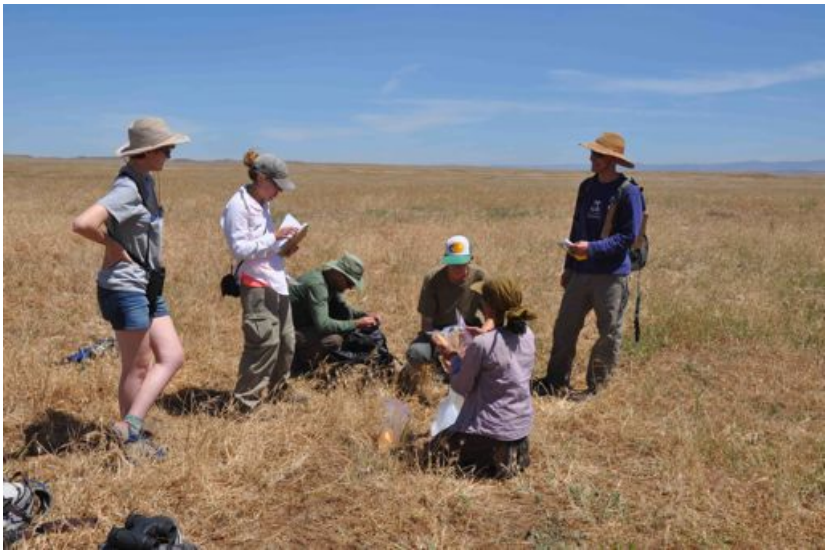
NRS Director Peggy Fiedler joined us for the afternoon to speak about the history of the NRS and of exciting plans for the future. Brad Shaffer, professor at UCLA and our keynote speaker, talked about his decades of research on the population ecology and natural history of the California Tiger Salamander. A number of Brad's long term research sites are on NRS reserves.

A panel discussion concluded the day with UC Merced professors Jessica Blois, Marilyn Fogel, Jay Sexton and Josh Viers, joined by Brad Shaffer, discussing their ideas for the future of the reserve. Highlights of this discussion are shown below:

Jay: Start a culture of science conferences at the Sierra Nevada Field Station in Wawona. On the Reserve, develop traditions and annual events that can involve students. Maximize information flow.

Josh: Archive data from studies on the Reserve. Determine how and where the data will be stored and how it will be used in the future. Hold Bioblitzes to investigate biodiversity. Use INaturalist (California Academy of Sciences application) as a way to share data with other naturalists. Continue to make regular observations on the Reserve.

Marilyn: Incorporate the NRS into the new College of Sustainability in the Anthropocene.
This would improve communications and interdisciplinary research on campus.



Jessica: Develop a sense of community around the Reserve. These are places where people can come together to discuss shared interests. Every UC Merced student should have the chance to visit the Reserve. A Reserve visit can be a transformative experiences for

students. Create a loci! Long term mammal trapping could become a campuswide project. Start studies of phenology such as the annual arrival of nesting Cliff Swallows. Begin a Facebook page.

Martha: Perhaps every UC Merced undergraduate could visit the reserve once during their time on campus. Could this become a graduation requirement?

Brad: We need to connect with neighboring ranches. Determine if UC Merced could gain permission to do work on these ranches.

Advisory Committee Formed

A Reserve Advisory Committee consisting of 12 members was formed in early 2015. The committee held two meetings in 2015: April 10 and September 25. Committee members are,

UC Faculty

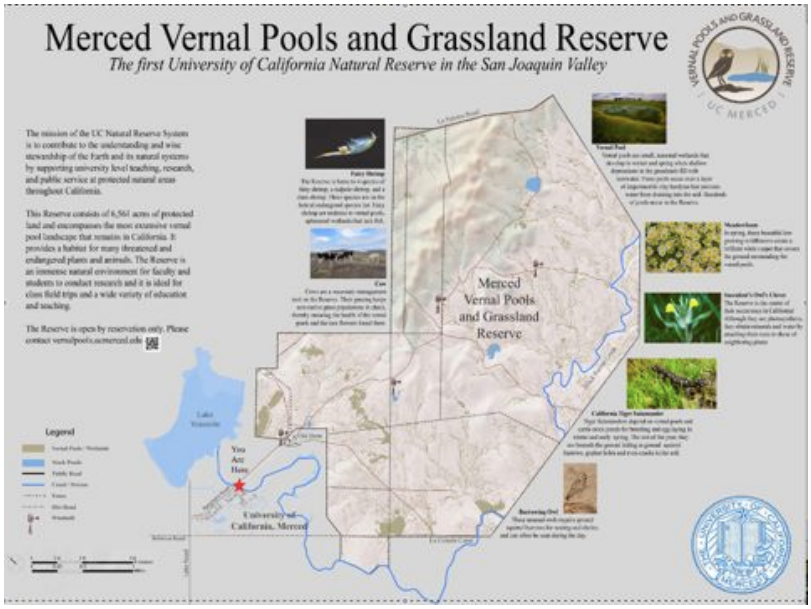
Joshua Viers, Chair (UCM School of Engineering)
Jessica Blois, Vice Chair (UCM School of Natural Sciences)
YangQuan Chen (UCM School of Engineering)
Gage Dayton (Administrative Director; UC Santa Cruz Natural Reserve System)
Teamrat Ghezzehei (UCM School of Natural Sciences)
Tom Hothem (Associate Director; UCM Merritt Writing Program)

Non-UC Faculty

Daniel Airola (President, Northwest Hydraulic Consultants, Sacramento)
Gene Barrera (Geospatial Analytics and Cartographic Services, Physical and Environmental Planning, UC Merced)
Bridget Fithian (Executive Director, Sierra Foothill Conservancy, Mariposa)
Jaymee Marty (Principal and Owner, Marty Ecological Consulting, Sacramento)
Carol Witham (Botanist, Environmental Consultant and Educator, Sacramento)
George "Van" Van Vleet (Building Services Manager, Facilities Management, UC Merced)

Reserve Interpretive Sign Unveiling

The reserve interpretive sign, a year in the design and fabrication phase, was installed two days before the unveiling on April 16. VC for Research Sam Traina presided over the unveiling. Sixty people gathered to view the new sign. Short speeches were made. On hand also, were Martha Conklin; Min Jiang (UC Merced Project Director; Design and Construction); Chris Butler (Assistant Director, Service Learning Program); Current and former Service Learning Team leaders: Daniel Toews, Stephani



Gimble, Scott Walker and Patrick Coldivar; many faculty, students and staff. Many students on the "Sign Design" team were on hand to view it for the first time. The cost of making and installing the sign was about $5,000.

Splash K-12 Program

In March 2015, Splash Sacramento, in partnership with the Reserve staff and trained naturalists, led environmental programs for about 160 Merced and Planada elementary school students. Students explored the Reserve in the vicinity of the barn area, and they participated in science education activities on campus, in the conference room in AOB. Trained undergraduate naturalists joined Splash educators to lead the science activities on campus and on the Reserve.

Mitsubishi Grant

The Mitsubishi Foundation of North America awarded Chris Swarth and Becca Fenwick a $103,000 grant to teach a California Naturalist course (in partnership with UC Cooperative Extension and the Merced County Cooperative Extension office) and our on-going training workshop for undergraduate Reserve naturalists. The grant allows us to hire an educator on campus to teach three naturalist training workshops and one California Naturalist course. At Wawona, the grant covers one-week California Naturalist courses in fall 2015 and fall 2016. The purpose of the grant is to train students to deliver environmental education programs to K-12 students in the San Joaquin Valley area.

California Naturalist Course

Chris Swarth and Karyn O'Hearn presented a California Naturalist course on campus during the spring semester. Sponsored by UC Cooperative Extension and in partnership with the Mariposa UC Cooperative Extension office and UC Davis, we had 16 student in this first-ever course. The focus was the San Joaquin Valley, the Vernal Pools Reserve, and the Sierra Foothills. Scholarships from the UC Agricultural and Natural Resources division allowed several students to participate who might not have been able to do so otherwise.

Stewardship and Other Activities

Storage Containers for Researchers

Marilyn Fogel and Josh Viers purchased two large, metal containers (also called intermodals) and placed them at the barn. They are used for storing research equipment and supplies by all those doing studies on the Reserve.

San Joaquin Kit Fox dens installed in November

A contractor installed 8 artificial kit fox dens in the Reserve in November 2015. This project was completed to meet the requirements specified in the 2002 USFWS Biological Opinion on the proposed UC Merced campus building project. Four dens are "escape" dens to allow foxes to seek shelter from coyotes. The others are "chambered" dens which provide a space for birthing and pup rearing. The dens consist of black plastic corrugated pipe, about 10 inches in diameter, buried flush or just beneath the surface of the soil. Soil was mounded over the dens. No kit foxes have been observed on the Reserve, but we have rolled out the welcome mat should one travel here.

Reserve Monitoring Report completed

The first environmental monitoring report, as required by the 2008 Management Plan, was completed by Phil Woods, Chris Swarth, Daniel Airola and Shabnam Barati. This report summarizes our activities in 2014 related to various federal and state management and monitoring requirements. The report was sent to the Environmental Protection Agency, US Fish and Wildlife Service, and the California Department of Fish and Wildlife.

RDM Survey Completes 3rd year of Monitoring

The RDM (Residual Dry Matter) survey team of Dr. Marilyn Fogel, Chris Swarth and students completed a 3rd year of measuring RDM (Residual Dry Matter) on the Reserve. RDM is a measure of grazing intensity. A baseline that we aim for is 800 lbs/acre. Mean RDM values for 2015 were about 956 lbs/acre, more than twice the amount we recorded in 2014 (430 lbs/acre). Cattle were brought onto the Reserve later than normal and were removed earlier than normal. The higher RDM levels recorded for 2015 resulted from conversations with the rancher about the drought conditions and grazing levels, and from slightly higher rain levels in fall 2014 and spring 2015.

Invasive Plants Removed

On May 10, 8 student naturalists collected 12 bags of Milk Thistle from the Black Rascal Creek cliff area. In July, we filled another 10 bags from the dried bed of Avocet Pond. Two bags of Star Thistle were collected from the Le Grand canal levee bank south of the "Willow Forest."

Windmill Restoration Project

A team of Service Learning students in the School of Engineering completed two semesters of research aimed to determine the feasibility of repairing the broken windmill at the Barn. Their research indicated that it will cost about $10,000 to repair this 12 ft. diameter windmill. Most of the cost is for labor, with the remainder for parts. Repair of the windmill to its former functionality will mean that the gasoline generator used by the rancher to pump water for the cattle water troughs at the barn will no longer be needed, reducing by a small amount the fossil fuel consumption on campus.