University of California, Merced
**Merced Vernal Pools and Grassland Reserve**

# ANNUAL REPORT

## FY 2019-20 July 1, 2019 – June 30, 2020

**prepared by Joy Baccei**

## Table of Contents

# Part 1. Reserve Use Data - Using Unique People Roles (July 1, 2019-June 30, 2020)

| | UC Home | | UC Other | | CSU System | | CA Comm College | | Other CA College | | Out of State College | | International University | | Government | | NGO/Non-Profit | | Business Entity | | K-12 School | | Other | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs | Users | UDs |
| **UNIVERSITY- LEVEL RESEARCH** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Faculty | 7 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 22 |
| Research Scientist/Post Doc | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 |
| Research Assistant (non-student/faculty/postdoc) | 4 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 38 |
| Graduate Student | 8 | 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 69 |
| Undergraduate Student | 27 | 107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 107 |
| Professional | 6 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 10 | 11 |
| SUBTOTAL | 53 | 242 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 3 | 3 | 0 | 0 | 1 | 1 | 3 | 3 | 0 | 0 | 0 | 0 | 63 | 252 |
| **UNIVERSITY - LEVEL INSTRUCTION (CLASS)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Faculty | 7 | 17 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 18 |
| Graduate Student | 5 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 7 |
| Undergraduate Student | 687 | 759 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 704 | 776 |
| Professional | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Other | 118 | 118 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 124 | 124 |
| SUBTOTAL | 818 | 902 | 0 | 0 | 0 | 0 | 1 | 1 | 17 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 842 | 926 |
| **OTHER** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Faculty | 28 | 34 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 38 |
| Research Scientist/Post Doc | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 4 |
| Graduate Student | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 |
| Undergraduate Student | 74 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 100 |
| K-12 Instructor | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 17 | 0 | 0 | 18 | 18 |
| K-12 Student | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 112 | 112 | 0 | 0 | 118 | 118 |
| Professional | 14 | 54 | 0 | 0 | 1 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 1 | 1 | 8 | 20 | 0 | 0 | 5 | 5 | 34 | 94 |
| Other | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 16 | 0 | 0 | 3 | 3 | 6 | 20 |
| Volunteer | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 | 3 |
| SUBTOTAL | 125 | 199 | 0 | 0 | 2 | 10 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 6 | 6 | 7 | 7 | 10 | 36 | 130 | 130 | 9 | 9 | 292 | 400 |
| **HOUSING** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTALS** | **996** | **1343** | **1** | **1** | **2** | **10** | **2** | **2** | **21** | **21** | **0** | **0** | **3** | **3** | **6** | **6** | **8** | **8** | **13** | **39** | **130** | **130** | **15** | **15** | **1197** | **1578** |

# Part 2. Reserve Users' Affiliation (July 1, 2019-June 30, 2020)

| Institution Name | Location |
|---|---|
| Business Entity | |
| Creekside Science | Menlo Park, CA, California, United States |
| ECORP Consulting | Rocklin, United States |
| Habitat Restoration Sciences, Inc | Vista, United States |
| Live Oak Associates, Inc | Oakhurst, California, United States |
| LSA Associates, Inc | Point Richmond, California, United States |
| LSA Associates, Inc | Irvine, California, United States |
| Newton's Custom Tractor Work | Sanger, California, United States |
| SWCA Environmental Consultants | Half Moon Bay, California, United States |
| Vollmar Natural Lands Consulting, Inc. | Berkeley, California, United States |
| California Community College | |
| Merced Community College | Merced, California, United States |
| Sierra Community College | Rocklin, California, United States |
| California - Other University or College | |
| California Institute of Technology | Pasadena, California, United States |
| Generic California Other College or University | Various, California, United States |
| Mills College | Oakland, California, United States |
| University of San Francisco | San Francisco, California, United States |
| California State University System | |
| Generic California State University (CSU) | Various, California, United States |
| UC Merced | Merced, California, United States |
| Governmental Agency or Entity | |
| Generic Governmental Agency or Organization | Various, California, United States |
| USGS Yosemite | Oakhurst, California, United States |
| Individual or Other Entity | |
| Generic Individual or Other Entity | Various, California, United States |
| International University or College | |
| Martin Luther University Halle-Wittenberg | Halle, Germany |
| K-12 Education | |
| Ballico-Cressey School | Ballico, California, United States |
| Camp Fire Club | Madera, California, United States |
| Center for Advanced Research and Technology (CART) | Fresno, California, United States |
| Generic K-12 Education | Various, California, United States |
| Merced Girl Scouts | Merced, California, United States |
| Woodland Elementary | Mariposa, California, United States |
| Non-Governmental Organization or Non-Profit Entity | |
| Generic Non-Governmental Organization | Various, California, United States |
| Rancho Santa Ana Botanic Garden | Claremont, California, United States |
| Stanislaus Audubon Society | Modesto, California, United States |
| University of California | |
| University of California, Merced | Merced, California, United States |
| University of California, Santa Barbara | Santa Barbara, California, United States |
| U.S. - University or College Outside of California | |
| none | |

# Part 3. Use by Instructional Groups

California Community College

Merced Community College

Drone Technology 1

| | | | |
|---|---|---|---|
| *Course Number:* | CPSC 17-6055 | *Date:* | October 05, 2019 |
| *Instructor:* | Kathleen Kanemoto \| | *Faculty:* | 1 |
| | | *Undergraduate Student:* | 17 |

University of California

University of California, Merced

Carson House: Sustainable Futures

| | | | |
|---|---|---|---|
| *Course Number:* | USTU-013 | *Date:* | November 08, 2019 |
| *Instructor:* | Kinsey Brock \| Quantitative & Systems Biology | *Graduate Student:* | 1 |
| | | *Professional:* | 1 |
| | | *Faculty:* | 1 |
| | | *Undergraduate Student:* | 19 |

Carson House: Sustainable Futures

| | | | |
|---|---|---|---|
| *Course Number:* | USTU-015 | *Date:* | February 21, 2020 |
| *Instructor:* | Kinsey Brock \| Quantitative & Systems Biology | *Undergraduate Student:* | 16 |

Ecosystems of California

| | | | |
|---|---|---|---|
| *Course Number:* | ESS 50 | *Date:* | February 29, 2020 - March 14, 2020 |
| *Instructor:* | John Williams \| | *Faculty:* | 2 |
| | | *Undergraduate Student:* | 45 |

Ecosystems of California

| | | | |
|---|---|---|---|
| *Course Number:* | ESS-050 | *Date:* | November 14, 2019 - November 15, 2019 |
| *Instructor:* | Sylvain Masclin \| School of Natural Sciences | *Undergraduate Student:* | 72 |

Ecosystems of California

| | | | |
|---|---|---|---|
| *Course Number:* | ESS 50 | *Date:* | October 26, 2019 - November 17, 2019 |
| *Instructor:* | John Williams \| | *Faculty:* | 2 |
| | | *Undergraduate Student:* | 101 |
| | | *Other:* | 3 |

Enve 30 Evaluating Sustainable Living Sites

| | | | |
|---|---|---|---|
| *Course Number:* | ENVE 030 | *Date:* | September 23, 2019 |
| *Instructor:* | Lynn Sullivan \| | *Faculty:* | 1 |
| | | *Undergraduate Student:* | 30 |

Environment in Crisis

## Part 3. Use by Instructional Groups, cont'd

| | | | |
|---|---|---|---|
| *Course Number:* | ENVE 010 | *Date:* | September 26, 2019 - October 23, 2019 |
| *Instructor:* | Lynn Sullivan \| ENVE | *Faculty:* | 2 |
| | | *Undergraduate Student:* | 89 |
| | | *Graduate Student:* | 2 |
| Environmental Writing | | | |
| *Course Number:* | 114 | *Date:* | September 09, 2019 - February 22, 2020 |
| *Instructor:* | Thomas Hothem \| Writing Program, UC Merced | *Faculty:* | 2 |
| | | *Undergraduate Student:* | 40 |
| Evolution | | | |
| *Course Number:* | Bio 141 | *Date:* | October 15, 2019 - October 16, 2019 |
| *Instructor:* | Emily Moran \| School of Natural Sciences | *Graduate Student:* | 4 |
| | | *Undergraduate Student:* | 144 |
| | | *Other:* | 2 |
| Fundamentals of Ecology | | | |
| *Course Number:* | ESS 148/Bio 148 | *Date:* | March 07, 2020 - April 04, 2020 |
| *Instructor:* | John Williams \| | *Faculty:* | 2 |
| | | *Undergraduate Student:* | 90 |
| Fundamentals of Ecology | | | |
| *Course Number:* | ESS 148/Bio 148 | *Date:* | October 13, 2019 - November 03, 2019 |
| *Instructor:* | John Williams \| | *Faculty:* | 2 |
| | | *Undergraduate Student:* | 70 |
| | | *Other:* | 3 |
| Fundamentals of Soil Science | | | |
| *Course Number:* | ESS 170L | *Date:* | February 08, 2020 |
| *Instructor:* | Asmeret Berhe \| Life and Environmental Sciences | *Faculty:* | 1 |
| | | *Undergraduate Student:* | 60 |
| Insect Ecology and Evolution | | | |
| *Course Number:* | Bio/Es 159 | *Date:* | January 31, 2020 - February 28, 2020 |
| *Instructor:* | Gordon Bennett \| LES | *Faculty:* | 4 |
| | | *Undergraduate Student:* | 92 |
| Unmanned Aircraft Systems | | | |
| *Course Number:* | ME143 | *Date:* | October 05, 2019 |
| *Instructor:* | Brandon Stark \| | *Other:* | 1 |
| | | *Undergraduate Student:* | 4 |

# Part 4. Current Research Summary (Appendix provides details)

| Principal Investigator/s | Affiliation/s | Project Title |
|---|---|---|
| Robert (Doug) Stone | Rancho Santa Ana Botanic Garden | Phylogenomics & population genomics of endemic vernal pool grasses (Poaceae subtribe Orcuttiinae) |
| Rachel Meyer \| Rachel Meyer \| Dannise Ruiz | University of California, Los Angeles \| University of California, Merced \| California State University (CSU), Los Angeles \| Turlock Unified School District \| John H. Pitman High School \| Turlock High School | UC Conservation Genomics eDNA Sampling |
| Erik Bolch \| Julia Burmistrova \| Jacob Nesslage | University of California, Merced | Hyperspectral Mapping of Vernal Pools Biodiversity |
| Brandon Hendrickson | University of California, Merced | Phenological Mismatch of California Wildflowers and their Pollinators |
| Derek Hollenbeck | University of California, Merced | Vernal Pools Mapping and EVLOS Project |
| Jorge Montiel Molina | University of California, Merced | Vernal Pool Microbial Communities |
| Monique Kolster \| Brandon Stark | University of California, Merced | Drone Detection of Invasive Plant Species |
| Jason Sexton \| Molly Stephens | University of California, Merced | Genetic Investigation of Listed Vernal Pool Plants and Their Communities in Merced County |
| Brandon Stark \| Nicola Lercari \| Graham Baird | University of California, Merced | Unmanned Aerial Systems for Digital 3D Reconstructions and Digital Preservation |
| Esveidi Tinoco | University of California, Merced | Phage Hunters of University of California |
| Daniel Toews \| Jason Sexton \| Marilyn Fogel | University of California, Merced | Understanding Selective Processes In A Vernal Pool Landscape |
| Joshua Viers \| Anna Rallings | University of California, Merced | Hydrologic Monitoring and Modeling for Management and Restoration Analysis |
| Monique Kolster \| David Ardell | University of California, Merced \| California Institute of Technology \| Martin Luther University Halle-Wittenberg | Tour for the Delegation and Rector of Martin Luther University in Halle-Wittenberg, Germany |
| Rebecca Ryals | University of California, Merced \| Creekside Science | Potential collaboration: nitrogen deposition and cycling in vernal pool ecosystems |
| Jason Sexton | University of California, Merced \| No Institution Selected | Vernal Pool Phenology YLP Capstone |
| Joshua Viers \| Anna Rallings | University of California, Merced \| North Carolina State University \| University of California, Los Angeles \| Unaffiliated with any institution \| US Environmental Protection Agency \| University of South Florida \| California Department of Fish and Wildlife \| No Institution Selected \| University of San Francisco | Tours with Visiting Researchers and Prospective UCM Faculty Candidates and Graduate Students |
| Patricia Holden \| Marc Beutel \| Stephen Hart \| Samuel Traina \| Tom Harmon | University of California, Merced \| University of California, Santa Barbara | A Pilot Study of Tobacco & Cannabis Contaminants in Protected Areas (Merced Vernal Pools & Grasslands Reserve) |
| Javier Galán Díaz | University of California, Santa Cruz \| Doñana Biological Station EBD-CSIC, Sevilla, Spain | Assembly of European invasive plant species at home and abroad |
| Cassie Pinnell | Vollmar Natural Lands Consulting, Inc. \| Vollmar Consulting | Vernal Pool CRAM |

# Part 5. Publications

## 2019-2020:


Araya, Samuel, N. *Soil Structure and Land Surface Controls on Soil Hydraulic Properties and Processes: Applications of Machine Learning, Unmanned Aircraft Systems, and Observations from Long-Term Conservation Agriculture Management*. University of California, Merced, 2019, https://escholarship.org/uc/item/23d272xg.

Bolch, E. A., & Hestir, E. L. (2019, June). Using Hyperspectral UAS Imagery to Monitor Invasive Plant Phenology. In Hyperspectral Imaging and Sounding of the Environment (pp. HTu4C-3). Optical Society of America.

Bolch, E. A., Santos, M. J., Ade, C., Khanna, S., Basinger, N. T., Reader, M. O., & Hestir, E. L. (2020). Remote Detection of Invasive Alien Species. In *Remote Sensing of Plant Biodiversity* (pp. 267-307). Springer, Cham.

Fogel, Marilyn L. “My Stable Isotope Journey in Biogeochemistry, Geoecology, and Astrobiology.” *Geochemical Perspectives*, edited by Liane G. Benning, vol. 8, no. 2, Oct. 2019, pp. 240–41, https://pubs.geoscienceworld.org/perspectives/issue/8/2.

Galán Díaz, J., et al. “Plant Community Assembly in Invaded Recipient Californian Grasslands and Putative Donor Grasslands in Spain.” *Diversity*, vol. 12, no. 5, May 2020, p. 193, https://doi.org/10.3390/d12050193.

Holden, P.; Beutel, M.; Brooks, A.; Butsic, V.; Fiedler, P.; Harmon, T.; Hart, S.; Hoh, E.; Jerde, C.; Novotny, T.; Traina, S. Towards Assessing Tobacco and Cannabis Contaminants in Protected Areas (poster). SETAC Europe 30th Annual Meeting, SETAC SciCon. Dublin, Ireland. May 3-7, 2020. (Conference held virtually due to COVID-19)

Hollenbeck, Derek. “Data Quality Aware Flight Mission Design for Fugitive Methane Sniffing Using Fixed Wing SUAS.” *IEEE*, 2019. “Pitch and Roll Effects of On-Board Wind Measurements Using SUAS.” International Conference on Unmanned Aircraft Systems (ICUAS), *IEEE*, 2019.

Hollenbeck, Derek, and YangQuan Chen. “Characterization of Ground-To-Air Emissions with SUAS Using a Digital Twin Framework.” International Conference on Unmanned Aircraft Systems (ICUAS), *IEEE*, 2019.

LSA Associates, Inc. *Conceptual Landscape Restoration Plan, Merced Vernal Pools and Grassland Reserve*. UCM1901, University of California, Merced, July 2020, p. 87.

Meyer, Rachel S., et al. “The California Environmental DNA ‘CALeDNA’ Program.” *BioRxiv*, Jan. 2019, p. 503383, doi:10.1101/503383.

Montiel, J. A., et al. “Visualizing Diversity and Distribution Patterns for Microbial Communities in Vernal Pools.” *Vernal Pool Landscapes: Past Pre- Sent and Future*, edited by R.A. Schlising et al., 2020, http://sextonlab.ucmerced.edu/wp-content/uploads/2019-Montiel.pdf.

Nesslage, J., Hestir, E., and Burmistrova, J. (forthcoming December 2020). Using Sentinel-2 to Detect and Predict Biodiversity Hotspots in a Vernal Pools and Grasslands Ecosystem. American Geophysical Union Annual Symposium, San Francisco, CA.

Ruiz Ramos, D. V., et al. “T Differentiation of Vernal Pool Communities Assessed by EDNA: A Community Science Experience.” *B21E-02*, 2019, https://ui.adsabs.harvard.edu/abs/2019AGUFM.B21E..02R.


# Part 5. Publications, continued

2019-2020:

Stone, R. Douglas, and J. Travis Columbus. *Phylogenomics and Population Genomics of Endemic Vernal Pool Grasses(Poaceae Subtribe Orcuttiinae) in California and Baja California*. Rancho Santa Ana Botanic Garden, 21 Aug. 2019.

## Part 5. Publications, continued

2018 (previously un-reported):

Stephens M, D. Ruiz Ramos, D. Toews and J.P. Sexton. *Diversity above and below ground: the genetics of vernal pool plants and seed banks*. AquAlliance Annual Conference: Vernal Pool Landscapes: Past, Present, and Future (2018, Chico, CA).

Stephens M, D. Ruiz Ramos, D. Toews and J.P. Sexton. *The secret life of vernal pool soils: plant genetic diversity above and below ground*. UC Merced Vernal Pools and Grassland Symposium (2018, Merced, CA).

Toews D., Sexton J. *Local adaptation of an endemic vernal pool annual plant, Limnanthes douglasii spp. rosea (Meadowfoam)*. UC Merced Vernal Pools and Grassland Symposium (2018, Merced, CA).

Toews D., Sexton J. *Soil effects on an endemic vernal pool annual plant, Limnanthes douglasii spp. rosea (Meadowfoam).* AquAlliance Annual Conference: Vernal Pool Landscapes: Past, Present, and Future (2018, Chico, CA).

Toews D, Stephens M, Ruiz-Ramos DV, Sexton J. *Detecting annual plant diversity in vernal pool soils with environmental DNA: challenges and opportunities*. UC Genomics Conservation Consortium Workshop: Modernizing ecosystem management in California (2018, Monterey, CA).

Toews D, Stephens M, Ruiz-Ramos DV, Sexton J. *Using an eDNA approach to quantify biodiversity in California vernal pool plant communities*. Northern California Botany Symposium (2019, Chico, CA).

# Part 6. Narrative

## Summary

In the 2019-2020 fiscal year, the Merced Vernal Pools and Grassland Reserve (MVPGR) hosted a total of 1,197 users and 1,578 user-days. University-level class use (59% of total user- days) accounted for the greatest proportion of use, followed by the public use in the "other" category (25% of user- days), and research (16% of user-days). Many cancellations at the MVPGR occurred, due to restrictions set in place in response to the novel coronavirus, known as COVID-19; this resulted in limitations to Reserve use, where most public reservations were cancelled, and only visits deemed as 'essential research' were allowed to continue. The MVPGR administration benefitted from this time period by focusing on strategic planning and development efforts and facilitating essential research. This report summarizes highlights from the FY19-20 fiscal year, pre and post COVID-19 Era.

Cancellations and declined reservations due to COVID-19 impacts (both in RAMS and via email) accounted for 324 users and 330 user days, which would have accounted for 21% of the Reserve's user days in FY19-20. Of the 330 total user days cancelled, 152 user days (46%) were university-level classes (94% were from the University of California, Merced and 6% were from the University of Virginia), ~175 user days (54%) were public users, and 3 were researchers. Of the public user days cancelled, ~100 (57%) were K-12 classes and 75 (43%) were campus staff that cancelled Staff Appreciation Week trips to the Reserve. Only a few research reservations were cancelled (which were ultimately re-scheduled to a later date), and research was allowed to continue, if deemed essential based on specific University of California, Merced guidelines (e.g. time sensitive research not requiring campus building access). Permission to use the Reserve for essential research was granted by the campus Vice Chancellor of Research as well as the Natural Reserve System Faculty Director.

A total of eleven (11) researchers were granted essential research requests, which represented a total of seven (7) projects that had already been approved in RAMS. Of the 11 researchers granted approval, all were affiliated with the University of California, where 10 were affiliated with UC Merced, and one was affiliated with UC Santa Barbara. In addition, select monitoring and photography efforts were allowed to continue, where a total of six (6) users conducted monitoring, and a total of two (2) users conducted photography. In addition, the Reserve's grazing licensee was allowed to continue cattle grazing operations. All users were required to follow campus health screening guidance and also read and sign the Reserve's Notice of Policies on COVID-19 requirements prior to reservation approval, which was a part of the UC Merced NRS SOP guidance for phased re-opening given COVID-19.

## Research

Research accounted for 5% of total users and 16% of total user-days on the Reserve in FY19-20, where 63 research users contributed 252 user-days. Nineteen (19) unique research projects engaged a wide array of subject areas (see Part 4: Current Research). Almost all research projects (95%) were UC-affiliated, where the majority of projects (74%) had principal investigators from UC Merced. Seven of 19 projects (37%) were initiated during the FY19-20 fiscal year, and 12 of 19 projects had been ongoing, and were in their last year of research in 2019 or 2020. Researchers spent an average of 10 days per project. The research project with the majority of reported user days was the UC Merced Viers Lab "Hydrologic Monitoring and Modeling for Management and Restoration Analysis" project associated with restoration planning for Avocet Pond, which had a total of 31 user days for FY19-20.

Twenty (20) publications from the past two years (2018-2020) were provided by researchers or detected using Google Scholar, and were added to the UCNRS Zotero database. Of these, thirteen (14) publications were from the FY19-20 fiscal year, and six (6) were from 2018 (not previously reported).

**Highlights** on select research projects including a project summary are shown below:

**Assembly of European invasive plant species at home and abroad**
Javier Galan Diaz (University of California, Santa Cruz | Doñana Biological Station EBD-CSIC Sevilla, Spain)

*Javier Galan Diaz's vegetation sampling plot with dairy cows approaching*

This research project compared plant community assembly of invasive European annual plants in the native and invasive range, with a special focus on the traits of pool of native species these invasive species coexist with. Specifically, this study compared the community structure of grasslands in two Mediterranean regions by surveying plots in Spain and in California with similar environmental and management conditions. All species found in Spanish grasslands were native to Spain, and over half of them (74 of 139 species) are known to have colonized California. In contrast, in California, over half of the species (52 of 95 species) were exotic species, all of them native to Spain. Nineteen (19) species were found in multiple plots in both regions (i.e., shared species). The abundance of shared species in California was either similar to (13 species) or greater than (6 species) in Spain. In California, plants considered pests were more likely than non-pest species to have higher abundance. Co-occurring shared species tended to maintain their relative abundance in native and introduced communities, which indicates that pools of exotic species might assemble similarly at home and away. These findings provide interesting insights into community assembly in novel ecosystems. They also highlight an example of startling global and local floristic homogenization. This past year, one (1) journal article publication titled "Plant Community Assembly in Invaded Recipient Californian Grasslands and Putative Donor Grasslands in Spain" was published in Diversity (2020). This project has ended, with an end-date of June 30th 2019.

**Genetic Investigation of Listed Vernal Pool Plants and Their Communities in Merced County**
Jason Sexton | Molly Stephens | Daniel Toews | Dannise V. Ruiz-Ramos | Rachel Meyers |Lillie Pennington (University of California, Merced | California State Univ. (CSU), Los Angeles | University of California, LA)

This research aims to improve conservation and management of native vernal pool plant species in California through 1.) improved protocols for soil plant species identification from environmental DNA in soil samples, 2.) enhanced vernal pool plant species richness estimates, 3.) genetic marker resource development for listed species, and 4.) population genetic investigation of threatened vernal pool species. Colusa grass plants were collected in fall 2019 for the genetic marker and population genetics arm of the project. Plant vouchers for local DNA reference library preparation were collected in March and April 2020 for the environmental DNA arm of the project. In the past year, one (1) conference paper publication was associated with this project, titled "*Using an eDNA approach to quantify biodiversity in California vernal pool plant communities"* presented by Daniel Toews at the Northern California Botany Symposium in Chico, CA in 2019. The project end date is listed as December 31st, 2019.

**Hyperspectral Mapping of Vernal Pools Biodiversity**
Erik Bolch | Juilia Burmistrova | Jacob Nesslage | Erin Hestir (University of California, Merced)

This research aims to address challenges facing Conservation Biologists to effectively monitor species distribution and establish reliable baselines of regionial biodiversity facilitating early detection of species declines in California, which is recognized as a world biodiversity hotspot. This research aimed to collect and analyze samples to establish a baseline of California's biodiversity, and to store samples in an environmental DNA museum allowing future researchers to analyze change in biodiversity over time in relation to changing environmental conditions. Project goals originally included creation of a toolkit to make biodiversity monitoring easier and more effective by enhancing current methodological techniques. This past year, two publications were associated with this project, including three (3) book chapters and one (1) conference paper. The book chapter is titled "Remote Detection of Invasive Alien Species" in Remote Sensing of Plant Biodiversity (2020), and the two (2) conference papers are titled "Using Hyperspectral UAS Imagery to Monitor Invasive Plant Phenology", published in 2019 Optical Society of America conference proceedings and "*Using Sentinel-2 to Detect and Predict Biodiversity Hotspots within a Vernal Pools and Grasslands Ecosystem*" submitted to the 2020 American Geophysical Union Symposium. This project was temporarily halted because the student would be unable to complete his master's thesis on the original timeline. Additional data was needed for the project to be completed, which would have to wait until the next wet season in 2020. For his master's degree similar study was conducted in the Sacramento-San Joaquin River Delta. The original project in the Vernal Pools reserve required multiple data acquisitions during the greening/wet phase of the reserve, and only two usable acquisitions were made on March 30, 2019 and April 21, 2019. Because more data was needed and a better field protocol for species identification and location (due to the very small size of some species) this work was halted. The original project was modified and resumed by Jacob Nesslage in 2020 and has become the "Using Sentinel-2 to Detect and Predict Biodiversity in a Vernal Pools and Grasslands Ecosystem" project. Drone operations could not be conducted during Spring 2020 due to COVID restrictions and the project's focus shifted to using satellite data.

*Erik Bolch and Brandon Stark setting up drone prior to flight.*

**Phylogenomics & population genomics of endemic vernal pool grasses**
Robert (Doug) Stone | Travis Columbus (Rancho Santa Ana Botanic Garden)

This research is a phylogenomic and population genomic study of the vernal pool grasses Neostapfia, Orcuttia and Tuctoria (Poaceae subtribe Orcuttiinae) that aims to resolve their relationships with other members of the tribe Cynodonteae, and revisit the generic classification (especially of the paraphyletic group Tuctoria) and assess landscape-scale diversity of all currently recognized species. The study consisted of population-level sampling, high-throughput DNA sequencing (ddRADseq) and data analyses. Seed collections of these listed plants will provide for ex situ conservation and a safeguard against local extirpation. The study will be conducted over a period of four years (Aug. 2019 – Nov. 2022). One project proposal report publication is associated with this project, titled "*Phylogenomics and Population*

*Genomics of Endemic Vernal Pool Grasses(Poaceae Subtribe Orcuttiinae) in California and Baja California.* In 2019, researchers made a brief visit to the Reserve on 25 November 2019 to collect seeds of *Neostapfia* (endemic vernal pool grass) from the 'Southern Playa Pool'. In 2020, planned DNA work and preliminary results were to be folded into a funding proposal to NSF, but unfortunately the Garden (including the lab facility) was closed for months due to the Covid-19 outbreak. Hence, the project has been delayed until next year. This project is on-going, with a projected end-date of Novmeber 22nd, 2022.

**Tobacco & Cannabis Contaminants in Protected Areas (Pilot Study)**
Patricia Holden | Peggy Fiedler | Marc Beutel | Stephen Hart | Sam Traina | Tom Harmon | Laurie Van De WerfHorst | Michelle Gilmore (University of California, Santa Barbara | University of California, Merced, NRS)

This project is a pilot study of tobacco and Cannabis contaminants in protected areas, aiming to provide foundational results and proof of concept for future research. The project aims to 1) Synthesize all published research into original reports regarding environmental contamination by tobacco and Cannabis chemicals, including their origins, environmental transport, and fate, as well as exposures and effects on organisms delivering ecosystem services; 2) Develop a methodology to determine how, where, and to what extent protected areas may be contaminated with chemicals associated with tobacco and Cannabis; and 3) Conduct pilot field sampling and laboratory analyses to establish a research methodology using multiple reserves in the University of California Natural Reserve System, including the Merced Vernal Pools & Grassland Reserve. This past year, one (1) publication was associated with this research, including one (1) conference poster titled "Towards Assessing Tobacco and Cannabis Contaminants in Protected Areas", which was presented at the virtually held 2020 Society of Environmental Toxicology and Chemistry (SETAC) Convention in Dublin, Ireland. In winter/spring 2020, a portion of the research team along with former Reserve Director Monique Kolster conducted field reconnaissance at MVPGR and nearby areas (i.e. Lake Road and Lake Yosemite) to scout potential future sites for sampling surface water, soil, and sediment and to collect preliminary surface water samples from stock ponds and the Le Grand Canal's release valve area. Selection of sampling locations and protocol development are nearly finalized. The team plans to complete final reconnaissance, cigarette waste surveys, and water, soil, and sediment sampling on the Reserve and adjacent lands in October 2020. This research project started in August of 2019, and has a tentative end-date of January 31st, 2021.

*Stephen Hart and Monique Kolster discussing tobacco and Cannabis contaminant sampling locations.*

**UC Conservation Genomics eDNA Sampling**
Rachel Meyer | Dannise Ruiz Ramos (University of California, Los Angeles | University of California, Merced)

This research project aims to address the problems of biodiversity hotspots that have a large number of species whose existence is threatened by human activity. California's wildlife is particularly at risk because many of its resident species are endemic (only found in California) and over 70% of natural habitat has been lost due to development and land degradation. One of the main challenges facing Conservation Biologists is effective monitoring of species distribution and establishing reliable baselines of a region's biodiversity facilitating early detection of species declines. First, samples were collected and analyzed to establish a baseline of California's biodiversity. Second, samples were stored in an environmental DNA museum allowing future researchers to analyze change in biodiversity over time in relation to changing environmental conditions. Third, a toolkit was created to make biodiversity monitoring easier and more effective by enhancing current methodological techniques. This past year, two (2) publications were associated with this research, including one (1) journal article in review titled "the California environmental DNA "CALeDNA" program" is in review online at the Cold Spring Harbor Laboratory, bioRxiv pre-print server for biology, and one (1) conference paper titled "T Differentiation of Vernal Pool Communities Assessed by EDNA: A Community Science Experience", in the 2019 American Geophysical Union Symposium Abstracts. This research project has tentatively ended, based on an end-date listed as March 2019. One publication is in review, and the manuscript and accompanying data have yet to be received.

**Understanding Selective Processes In A Vernal Pool Landscape**
Daniel Toews | Jason Sexton | Marilyn Fogel (University of California, Merced)

*Meadowfoam (Limnanthes douglasii), photo: Sean Werle*

The goals of the research aim to address whether vernal pool plant species may be adapted to vernal pools occurring on specific soil types. In 2017, a common garden experiment was conducted in a greenhouse using populations (i.e., specific vernal pools) of *Limnanthes douglasii ssp. rosea*. Field-collected seeds were sown into soil from nine respective vernal pools occurring on Redding, Keyes and Corning soil types across the Merced Vernal Pools and Grassland Reserve. Results of this work indicate plant growth and performance varies widely based on the soil type from which they originated or are planted into. However, local adaptation to differences in natural conditions may not be detected in a controlled greenhouse setting and may confound experimental results (e.g. a particular genotype may be better adapted to greenhouse conditions) (Kawecki & Ebert, 2004). However, combining common garden and field transplant experiments allows for testing both underlying factors (e.g. soil type) and natural habitat conditions (e.g. abiotic and biotic interactions) that may drive local adaptation. Thus, in Spring 2019 additional *L. douglasii ssp. rosea* seeds were collected in the field and later transplanted into six vernal pools across the different soil types in winter of 2020. Plant growth and performance was monitored throughout the growing season and plants were harvested in late spring 2020. The data are currently being analyzed. In the past two years, two (2) conference paper publications were associated with this project by Daniel Toews, titled "*Soil effects on an endemic vernal pool annual plant, Limnanthes douglasii spp. rosea (Meadowfoam)'* presented at the 2018 AquAlliance Annual Conference (Chico, CA), and the *"Local adaptation of an endemic vernal pool annual plant, Limnanthes douglasii spp. rosea (Meadowfoam)"* presented at the 2018 UC Merced Vernal Pools and Grassland Symposium (Merced, CA). This project is ongoing, with an end-date of June 30th, 2020.

**Vernal Pools Mapping and EVLOS Project**
Derek Hollenbeck | YangQuan Chen (University of California, Merced)

This research is associated with the UC Merced Mechatronics Embedded System and Automation (MESA) Lab, where the research project aims to map Reserve Vernal Pools using aerial imagery on-board a small unmanned aircraft system (sUAS) in winter when the pools are likely filled with water. The sUAS is a fixed-wing platform with 2 hour endurance and is ideal for mapping this large area. The current regulations limit operations to visual line of sight (VLOS). Thus, equipment testing and data gathering is needed to satisfy the FAA waiver application process for extended VLOS (EVLOS). Further, test flights are conducted to ensure proper payload operations and map generation prior to January flight. During the 2019 Fall semester, a couple of initial communications tests for EVLOS were conducted on a fixed wing aircraft. The command and control (C2) link and safety links (ground control station) were range tested to ensure proper reliability for designing the Vernal Pools mapping mission. In both cases researchers were able to maintain the communications for over 2.5 miles from the launch point. This was included in the waiver along with strategies to map the entire Vernal Pools over 7 flights. In the past year, three (3) conference papers titled "*Data Quality Aware Flight Mission Design for Fugitive Methane Sniffing Using Fixed Wing SUAS", "Pitch and Roll Effects of On-Board Wind Measurements Using SUAS*", and "*Characterization of Ground-To-Air Emissions with SUAS Using a Digital Twin Framework*" were submitted by Derek Hollenbeck and YangQuan Chen and accepted to the 2019 International Conference on Unmanned Aircraft Systems (ICUAS). Future work focuses on further development and submission of a waiver to the FAA to conduct these EVLOS mapping flights. This project is ongoing, where the original end-date of Feb. 22nd, 2020 was extended.

*Mechatronics Embedded System and Automation (MESA)*

**Vernal Pool Microbial Communities**
Jorge Montiel Molina | Jay Sexton | Mike Beman | Carolin Frank (University of California, Merced)

This research project aims to study the central roles that fungi play in vernal pool ecosystems through interspecific relationships with other organisms. As symbionts, fungi living inside the plants -endophytes- can have a strong influence on plant stress tolerance and adaptation. Classic studies on managed ecosystems has shown that fungi living inside leaves, stems, and roots can alleviate drought stress, salinity stress, and high temperatures exposure, with the most dramatic examples coming from the wild. The purpose of this research is to elucidate the role of fungal endophytes in relation with the amphibious behavior that only vernal pools plants present, as an adaptation to the extreme fluctuations in water availability. Understanding how fungal communities are affected by temporal and spatial variables, climatic conditions, soil and biological agents, enriches our knowledge regarding function and distribution of fungal endophytes under dramatic environmental change scenarios. One book chapter publication associated with this project was written by Jorge Montiel Molina, titled "Visualizing diversity and distribution patterns for microbial communities in vernal pools" in Vernal Pool Landscapes: Past Pre- sent and Future (2020).

The master's thesis and associated manuscript for publication are currently both in preparation. Manuscripts will tentatively elaborate on trying to define microbial distribution, community assembly and biogeographical patterns, compared among several sites across the California province to determine symbiotic microbial communities within select vernal pool plants. This project is nearing completion, with an original end-date of May 2019 that has been extended.

*Jorge Montiel Molina crouching down near a vernal pool on the Reserve*

## University Instruction

University-level instruction accounted for 70% of the Reserve's users and 59% of user-days during the 2019-2020 fiscal year, where the Reserve hosted 842 university-level class users and 926 user-days of use. Ten (10) university-level classes visited the Reserve, exposing 820 undergraduate students and 5 graduate students to field studies topics. Of these classes, nine (9) were from UC Merced, and one (1) was from Merced Community College:

University of Califronia, Merced Classes:

Asmeret Berhe (LES)-ESS 170L (Fundamentals of Soil Science)
Brandon Stark (ME)-ME143 (Unmanned Aircraft Systems)
Emily Moran (SNS)-BIO 141 (Evolution)
Gordon Bennett (LES)-BIO/ES 159 (Insect Ecology & Evolution)
John (Eric) Williams (SNS)-ESS 50 (Ecosystems of California)
Kinsey Brock (SNS/QSB)-USTU-013 (Carson House-Sustainable Futures)
Lynn Sullivan (SOE)-ENVE 10, 30 (Env. In Crisis, Eval. Sustainable Living Sites)
Sylvain Masclin (SNS)- ESS 50 (Ecosystems of California)
Tom Hothem (WRI)-WRI 114 (Environmental Writing)

Merced Community College class:

Kathleen Kantemoto-CPSC 17-6055 (Drone Technology 1)

Of the 825 undergraduate and graduate students who visited the Reserve, the majority of them (808 total students or 98%) were from UC Merced. The Ecosystems of California (ESS 50) course comprised the majority of undergraduate students use, where 216 undergraduate students visited the Reserve over the course of 3 trips during the FY19-20 fiscal year. This does not take into account two trips that were cancelled in 2020 due to the COVID-19 outbreak, which would have included an additional 90 undergraduate students.

University-level class use was reduced in 2020 by approximately 152 user days, where the majority of cancellations were from UC Merced (94%) and the remainder (6%) was from the University of Virginia. This limited class visitation to five class visits in 2020, although there were 12 visits in 2019 (pre-COVID-19). In the prior fiscal year (2018-2019), the Reserve hosted a total of 1,711university-level class users who generated a total of 1,926 user-days of use.

**Highlights** on select university instruction visits including a trip summary are shown below:

### Insect Collecting Field Trips

Gordon Bennett (Insect Ecology and Evolution, BIO/ES 159, University of California, Merced)

This lab aims to teach students how to use basic insect collecting equipment (nets, aspirators, and collection vials). Students used sweep-netting techniques to collect insects in open grassy areas, where the environment was not manipulated in any other way. Students were instructed to avoid certain insects of potential conservation concern (e.g., bumble bees). Collected insects were removed from the Reserve and preserved in student research collections. Collections are being used to establish a basic insect survey of the reserve area(s).Two field trips occurred in 2020, each comprised of 24 undergraduate students, on February 21st and 28th. During these visits, quite a bit of insect collection was accomplished. However, due to COVID-19 constraints on laboratory based examination of specimens, species data are not yet available that demonstrate the collection effort. The ultimate goal of the collection effort is to create a biotic insect inventory for the reserve over the forth-coming years. This could have a number of research outcomes, where sampling is planned for every year.

### Exploring and Discovering Surrounding Sensitive Sites

Lynn Sullivan (Evaluating Sustainable Living Spaces, ENVE 030, University of California, Merced)

This course aims to impart awareness of the key environmental issues facing the Earth, an understanding of the interactions between the environment and mankind, and of the social and scientific conservation and restoration mechanisms which are needed to achieve and sustain an acceptable quality of life for all. The class trip scheduled for 30 undergraduate students on March 30th, 2020 was cancelled due to COVID-19 restrictions associated with the governor's statewide shelter in place order. However, the instructor invited the Reserve Director to meet with the class via Zoom, to share information on the NRS Reserve framework and immensity, and the importance of preservation.

### Environmental Writing Vernal Pools Hikes

Tom Hothem (Environmental Writing, WRI 114, University of California, Merced)

Field trips aimed to familiarize environmental writing students with the vernal pools & grassland habitats on the Reserve. Two field trips were conducted in FY 2019-2020, one comprised of 30 undergraduate students on September 9th, 2019, and one comprised of 10 undergraduate students on February 22nd, 2020. The goal of the field trips was to help students better engage with writing assignments in nature journaling and describing place via field journaling. During field trips, students wrote an analysis of place description, in an effort to help then become good readers of the environment. This can then be applied to writing descriptive narratives that can be distilled down to more technical and concise writing. Forthcoming, for each class, students have been invited to contribute green journalism pieces to the Reserve website, and the instructor has agreed to tailor Reserve related writing assignments to be amenable with ongoing efforts to develop a field guide.

## Public Service & Outreach

Public use accounted for 24% of the Reserve's users and 25% of user-days during the 2019-2020 fiscal year, where the Reserve hosted 292 public "other" users over 400 user-days; these included K-12 class education and public events. In 2020, approximately 100 K-12 class users and 75 UC Merced staff users (totally 175 public "other" users) were forced to cancel their planned springtime Reserve use due to the COVID-19 outbreak. Although public outreach events in 2019 were more numerous than in 2020, some public outreach highlights in 2020 included the annual wintertime Christmas Bird Count and a few K-12 winter and spring trips.

**Highlights** on these select public service events, including a trip summary are shown below:

### Christmas Bird Count (January 2nd, 2020)

Francesca Cannizzo (Campus Biologist, University of California, Merced)

*Christmas Bird Count, Merced Girl Scout Troop #67, January 22nd, 2020*

The annual Christmas Bird Count (CBC), called the Lake Yosemite-Merced CBC, was held on the Reserve and at Lake Yosemite, where the Campus Biologist (Francesca Cannizzo) led a group of twelve (12) participants, including members of the Merced Girls Scout Troop #67 (9), Stanislaus Audubon Society (1), UC Merced (1), and a local citizen (1). Participants counted all birds seen within a pre-determined 10-mile path as part of a larger 4-week period of Christmas Counts across the country. Results from this CBC are sent to the National Audubon Society and California Audubon to be used to determine patterns and distribution of bird populations in the local area, state- and nation-wide. In addition, the results are uploaded onto eBird, which is used by Cornell University in New York and countless professional and amateur birdwatchers to study distribution patterns of birds in North America to understand bird population trends.

### Center For Advanced Research and Technology (CART) Field Trip

Francesca Cannizzo (Campus Biologist, University of California, Merced)

*CART High School Group at Northwest Hill Pond, February 25th, 2020*

The Center for Advanced Research Technology (CART) high school group (Clovis, California) brought a small group of 5 students and 1 teacher to the Reserve to receive a tour of select stock ponds and conduct aquatic sampling. This event included one (1) site visit with to see the Reserve and to sample in the artificial stock ponds to learn about scientific data collection techniques related to water quality and vernal pool species sampling. Amphibians or fish caught were released back into the stock ponds, but some aquatic invertebrates were sacrificed for a UC Merced collection. The group was led by the UC Merced Campus Biologist (Francesca) and all sampling was done under her state scientific collecting permit and federal recovery permit. Students gave final presentations upon completing their research projects.

**Ballico-Cressey Elementary 2nd Grade Field Trip**
Patricia Magneson (Educator, Ballico-Cressey Elementary)

*Ballico-Cressey Elementary School 2nd Grade Field Trip group, March 5th, 2020*

Ballico-Cressey Elementary School (Ballico and Cressey, California) brought a group of thirty (30) 2nd grade students and ten (10) chaperones to the Reserve to receive a tour on the importance of the grassland and vernal pools. Participants engaged in a scavenger hunt activity that exposed them to basic vernal pool ecology concepts and terminology, and engaged them in species identification, bird watching, and use of typical scientific field equipment, such as field guides and binoculars, and use of hand lenses.

**Woodland Elementary School 8th Grade Field Trip**
Katie Pike and Erin Stacy (Educators, Woodland Elementary School, Mariposa, CA)

Woodland Elementary School (Mariposa, California) brought a group of fifty five (55) 8th graders to the Reserve to receive a tour to learn about vernal pool and grassland ecosystems. Specifically, students learned about vernal pool ecology concepts and terminology, and engaged in species identification of vernal pool plant and animals, an also engaged in bird watching, where they learned use of typical field equipment, such as field guides and binoculars, and use of hand lenses).

*Woodland Elementary School 8th Grade Field Trip, March 10th, 2020*

## Administration

New hires resulted in changes to the UC Merced NRS staff team this year, which included hiring a new Associate Director for the UC Merced NRS (Molly Stephens), who started work on February 1st of 2020, and a new Reserve Director for the MVPGR (Joy Baccei), who started work on March 1st, 2020. Both Joy and Molly are supervised by the UC Merced NRS Faculty Director (Jessica Blois). A new Reserve Director was also hired for the Yosemite Field Station (Breezy Jackson), who started work on April 1st, 2020. Both Reserve Directors (Joy and Breezy) report directly to the Associate Director of the UC Merced NRS (Molly). The MVPGR now partners with the SCICON Field Station in Tulare County, and is working to develop connections with all UC field stations, and coordinate educational resources for vernal pool and other curricula. In addition, MVPGR management related to conservation easements and environmental permits is overseen by Francesca Cannizzo (UC Merced Campus Biologist) and Phillip Woods (UC Merced Architect) from the Physical Operations, Planning, and Development (POPD) department. Both the NRS and POPD were assisted by up to three shared interns, who assisted with monitoring and outreach.

## Outreach

**Field Guide** –A working group consisting of the Reserve Director, Campus Biologist, one NRS intern, and two POPD interns was formed in late March of 2020 to collaborate on the development of a Reserve-specific field guide. The group has developed and quality checked a comprehensive species list for the Reserve, compiled and organized photographs, and has begun writing technical species description entries, and has designed various field guide sections using Adobe Illustrator. The goal of this effort is to create a Reserve field guide and associated web and mobile application content that is useful for educators, docents, researchers and visitors alike.

**Website** – An intern within the Office of Research and Economic Development (ORED) has been assigned to help with migrating and re-vamping all UCM NRS websites to a new platform, where outdated website materials will be archived, and new websites will be re-designed and improved.

**Docents**– Student docents who had previously taken the MVPGR Naturalist course assisted with various public service and outreach events, including leading K-12 groups on the Reserve.

## Stewardship

**Grazing Management** – The Reserve continued to partner with Fagundes, Fagundes, Fagundes (formerly known as Fagundes Dairy Brothers) to provide grazing vegetation management to the Reserve and adjacent campus lands via two license agreements that are set to expire in 2022. For to the 2018-2019 and 2019-2020 grazing seasons, before and throughout the grazing season, UC Merced's Campus Biologist (Francesca Cannizzo) and the Reserve Director (Monique Kolster) were in regular contact with the grazing licensee, Mike and Ralph Fagundes. Grazing coordination was done via in person meetings and via phone calls in fall and early spring to determine annual grazing plans and discuss any necessary changes to the plan based on current precipitation conditions. Additional coordination occurred via email and phone calls. After the grazing season, actual use data was compiled and residual dry matter (RDM) was monitored to determine if grazing targets were met through collaborative RDM survey work done by LSA Associates, Inc. and the Campus Biologist. The 2019 RDM survey results showed that most Reserve forage areas (management units) substantially exceeded the established objective of a mean 800 lbs/ac RDM for at least the past four consecutive seasons. Because of this, efforts were made over the course of FY19-20 to work with the grazer to reduce RDM in a more adaptive manner, where 2020 RDM survey results will hopefully reflect whether those efforts were successful.

**California Tiger Salamander Surveys-** Monitoring is required for the California tiger salamander (*Ambystoma californiense*) (CTS) per the Reserve's long-term monitoring Management Plan. Although CTS are known to breed in large vernal pool features, there is little documentation that CTS have utilized the thousands of smaller vernal pools for breeding over the last 20 years. Rather, CTS have been found breeding in artificial stockponds that were created to provide water for grazing operations and two large and naturally formed playa pools. CTS have been reported at least 14 locations. Generally, all stockponds, seasonal pools, seasonal wetlands, marshes, vernal pools, swales and surrounding grasslands may be considered habitat for CTS. To increase efficiency and feasibility, monitoring focuses on confirmed or likely breeding habitats at specific stockponds and playa pool locations on the Reserve. In 2019 and 2020, monitoring efforts occurred in spring and summer. The 2020 monitoring effort was cut short due to limited Reserve staff availability associated with the COVID-19 outbreak restrictions for Merced County.

**Vernal Pool Crustacean Surveys-** Monitoring is required for populations of large branchiopods, also referred to as fairy, tadpole, and clam shrimp, that inhabit the Reserve vernal pools and stockponds. The Campus Biologist conducted annual surveys (random transect surveys and focused surveys) to determine the status of three listed species of large branchiopods, including Conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp (*Branchinecta lynchi*), and vernal pool tadpole shrimp (*Lepidurus packardi*) (tadpole shrimp), and one unlisted species, midvalley fairy shrimp (*Branchinecta mesovallensis*), as target species for management. Two additional unlisted species, California fairy shrimp (*Linderiella occidentalis*) and California clam shrimp (*Cyzicus californicum*), are also present on the Reserve. In 2019, surveys were conducted in January and February, where a total of 60 features were found inundated with over 3 cm of water during random transect sampling, where vernal pool fairy shrimp were positively identified in 17 (28%) features. Midvalley fairy shrimp were found in one (1.6%) pool. Tadpole shrimp were found in seven (12%) features sampled. Conservancy fairy shrimp and California clam shrimp were not found in any of the random transects sampled. Tadpole shrimp were not found during targeted surveys but were found during random transect samples. A single Conservancy fairy shrimp was found in one playa pool. Midvalley fairy shrimp were found in five pools during targeted surveys. Results of the 2020 winter surveys have not yet been compiled.

**Special Status Plant Surveys** – Monitoring is required for populations of three federally threatened and state endangered plant species known to occur on the Reserve: Colusa grass (*Neostapfia colusana*), San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), and succulent owl's clover (*Castilleja campestris ssp. succulenta*). Succulent Owl's Clover was surveyed at 150 sites during the 2019 season. The SOC plants identified were in full bloom and often found among coyote thistle (*Eryngium sp.*), goldfields (*Lasthenia sp.*), bristled downingia (*Downingia bicornuta*), popcorn flower (*Plagiobothrys sp*.), meadowfoam (*Limnanthes sp*.), and woolly marbles (*Psilocarphus brevissimus*). Some of the vernal pool features surveyed were documented to have non-native grass species (i.e., *Hordium marinum, Festuca sp*.) present. Rare grasses were surveyed at 19 of 21 suitable rare grass habitats on the Reserve in 2019, where one new location of Colusa grass was identified.

**Invasive Plant Control-**

An Integrated Pest Management (IPM) Program is in place for the following target invasive plant species; milk thistle (*Silybum marianum*), yellow starthistle (*Centaurea solstitialis*), russian thistle (*Salsola tragus*), poison hemlock (*Conium maculatum*), black mustard (*Brassica nigra*), and prickly lettuce (*Lactuca serriola*). Invasive plant surveys conducted have documented that the distribution of invasive plants remains limited to a few problem areas. These problem areas are generally associated with soil disturbance associated with livestock.

The 2019 growing season management strategy focused on removal of milk thistle in heavily infested areas identified, where management techniques focused on (1) mechanical removal of individual plants and (2) grazing activities. Treatment work was done by the Greater Valley Conservation Corps (GVCC), UC Merced student volunteers and interns, the Reserve Director and the Campus Biologist

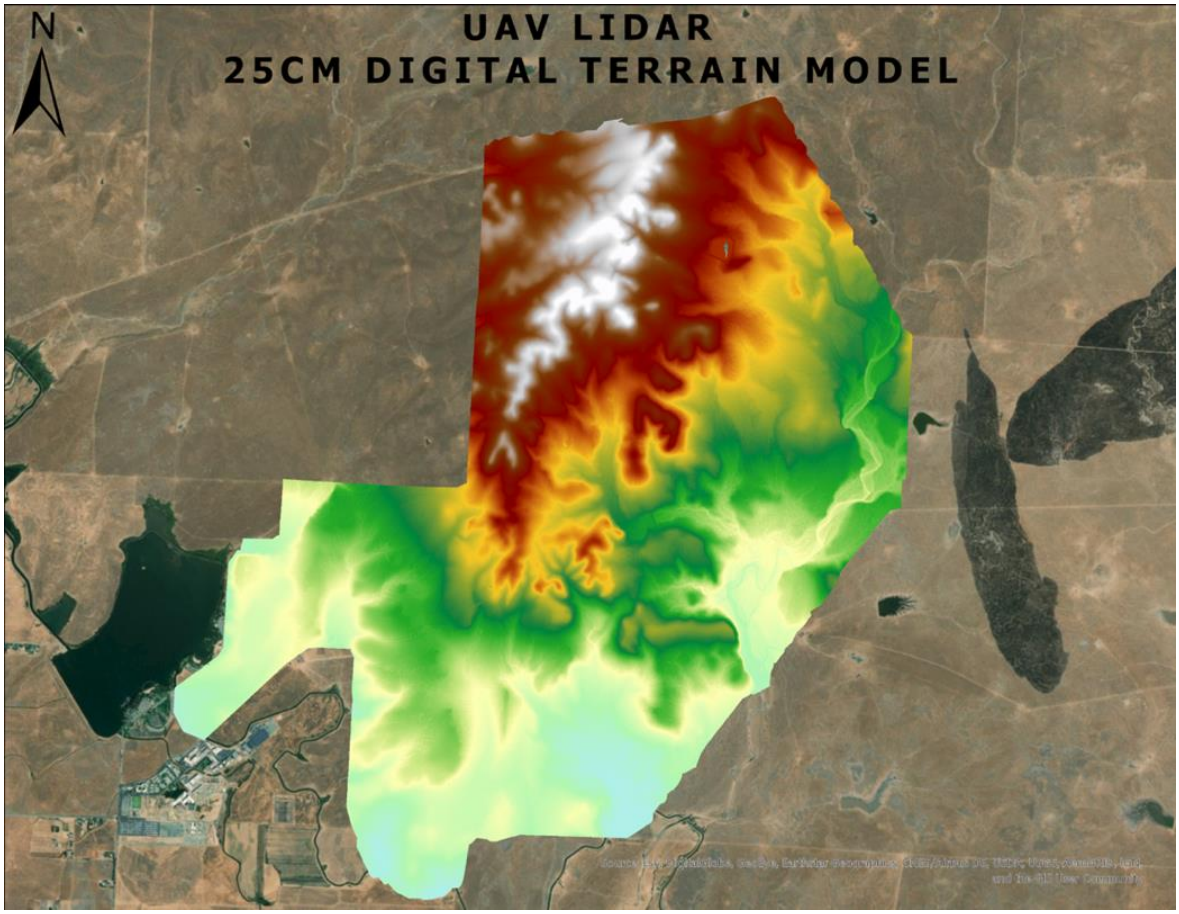
In 2020, due to limited Reserve management as a result of COVID-19 restrictions, treatment of target invasive plantwas limited to February. Both the GVCC removed milk thistle, as well as, volunteers associated with the UC Merced Natural Resources and Ecology Association student group. , The Reserve Director and Campus Biologist also visited and photographed known invasive plant populations throughout the spring. In addition, a gas powered weed trimmer was purchased by the Reserve Director for future mechanical treatment of known populations prior to senescence.

*Greater Valley Conservation Corps members, February 13th, 2020*

**Invasive Plant Drone Detection**

Brandon Stark with the UC Center of Excellence on Unmanned Aircraft Safety System (UASS) and members of Josh Viers' VICE lab collaborated on a research project to investigate if the use of drone surveys can increase the efficiency of location and removal efforts of milk thistle (*Silybum marianum*) on the Reserve, in an effort to model the plant's growth as a function of precipitation and time. Data from 2019 was used to account for environmental factors, in an effort to predict growth patterns and calculate the optimal time from for milk thistle removal. Results showed that 1) creation and analysis of highly detailed orthomosaics are useful for proper management of invasive plant species within the MVPGR, 2) that environmental factors indeed have a relationship with the growth of milk thistle, and 3) that identification and quantification of this relationship is viable for increased eradication efficiency.

**Avocet Pond Restoration** - A multi-faceted habitat improvement project for Avocet Pond and additional select stock ponds on the Reserve is being researched and planned by a working group consisting of members of Josh Viers' VICE Lab, the Campus Biologist, the Reserve Director, and LSA Associates. LSA Associates is working on preparing a Conceptual Landscape Restoration Plan to evaluate potential restoration opportunities at four stock pond locations—Avocet, Three Willows, Windmill, and Barn ponds—to enhance wetland and aquatic habitats on the Reserve that have been degraded through past land disturbances and to benefit threatened and endangered species. The VICE lab has been conducting restoration research and collecting LiDAR data on the reserve using drone technology. The LiDAR dataset was collected by the VICE Lab, where field data was collected and processed by Michael Kalua October 2019 – March 2020. Available geospatial data include high resolution .las point cloud and 25 cm resolution digital elevation model (DEM) for the full reserve boundary. Baseline data can be used for studies into geology, hydrology, ecology, as well as monitoring Reserve resources.



*UAV LiDAR Digital Terrain Model (25 cm resolution) developed by VICE Lab members*

**Camera Trap Surveys-** Annual camera trap surveys are conducted on the Reserve in the summer and fall months, in an effort to monitor San Joaquin Kit Fox (*Vulpes macrotis mutica*) (referred to as SJKF or kit fox) on the Reserve. Monitoring is conducted in accordance with the Reserve's long term monitoring Management Plan. Kit fox are likely not present on the Reserve, despite a potential suitable habitat corridor connecting areas where SJKF are present. Extensive surveys consisting of spotlights, scent dogs, camera surveys, and den searches led to seven sightings of kit fox between 1999-2002 near the Reserve. However, annual camera surveys and monitoring of artificial dens beginning in 2015 revealed no additional sightings of SJFK. Efforts to mitigate impacts caused by UC Merced and to provide suitable habitat for kit fox were constructed in 2012 and 2015, including artificial kit fox dens. Annual SJKF camera trap surveys are to be done for 10 years to monitor for presence at the artificial den sites. In 2019 and 2020, camera trap surveys were conducted by the Campus Biologist and interns, where several mammal species were identified, but no SJKF was documented in any of the photos taken.

*Bobcat captured from camera traps set-up on September 22nd, 2019*

**Feral Pig Depredation** - Feral pig hoards have been spotted on the Reserve near Black Rascal Creek during summer months, which spurred discussions for the need for monitoring and future management. Other NRS Reserves, such as the Sedgewick Reserve, which has a long-standing monitoring and depredation program. Evidence of feral pig damage has yet to be recorded, so short term efforts will prioritize documentation of pigs and magnitude of effects, prior to determining management needs and strategy.

*Feral pig hoard near Black Rascal Creek, Photo: Sean Werle, July, 2020*

## Facilities Management

**Road Maintenance** – Road maintenance needs and repair are overdue, and were evaluated by Newton's Custom Tractor Work on January 28th, 2020 to identify specific road repairs needed.

**Main Gate** – NRS and POPD staff have been working together to address and remedy the issue of main gate users consistently locking one another out. Staff have looked into a multi-user gate lock that can be fabricated locally and installed for a low cost that would prevent this problem.

## Development

**Prop. 68 Proposal for Field Station –** A working group of UC Merced NRS and POPD staff, with assistance from various campus departments, continues the planning and design effort for future MVPGR field station facilities. To-date the working group has evaluated various field station siting options, compiled cost estimates for infrastructure and operation and maintenance costs, met with key campus partners and supporters, and is working to get additional infrastructure costs and first phase project scope completed. Staff plan to submit a $1.24M Proposition 68 project proposal in early 2021. During FY2019-20, donations from the UC Merced Board of Trustees Impact Fund totaling $264,000 allowed the reserve to meet its 25% minimum campus match required to apply for the $988,000 in Proposition 68 grant funds available to each University of California Campus Natural Reserve System unit. Ongoing development efforts to raise funds for future phases of field station facilities will be critical. NRS staff are working in coordination with campus development to reach out to potential donors to realize this vision for research and community outreach at a fully functioning field station facility.

# Part 7. NRS Campus Committee Roster

Thomas Hothem, Committee Chair (Faculty), Continuing Lecturer & Founding Faculty, Merritt Writing Program, University of California, Merced

Joshua Viers, Faculty at large, Associate Dean of Research, SOE Director of Center for Information Technology Research in the Interest of Society (CITRIS) and Banatao Institute, Associate Professor of Engineering in Water Resources, University of California, Merced

YangQuan Chen, Faculty at large, Director of MESA (Mechatronics, Embedded Systems and Automation) Lab, Professor and Chair of Mechanical Engineering Graduate Program, University of California, Merced

Rebecca Ryals, Faculty at large, Assistant Professor, Life and Environmental Sciences, University of California, Merced

Jessica Blois, UCM NRS Faculty Director, Natural Reserve System, Associate Professor, School of Natural Sciences, University of California, Merced

Molly Stephens, UCM NRS Associate Director, Natural Reserve System. University of California, Merced

Francesca Cannizzo, Ad Hoc Member, UC Merced Campus Biologist, Physical and Environmental Planning, University of California, Merced

# Part 8. Use by Public

| Project Title | Institution | Role |
|---|---|---|
| University of California, Merced | | |
| Vernal Pools & Grassland Nature Hike | University of California, Merced | Professional |
| On-going Mitigation Monitoring - Campus Biologist | University of California, Merced | Professional |
| Lake Yosemite-Merced Christmas Bird Count | University of California, Merced | Professional |
| UC Merced Video Production | University of California, Merced | Professional |
| Using UAS gathered hyperspectral imagery to map and predict traits of invasive species | University of California, Merced | Graduate Student |
| Competitive Edge Summer Bridge Program Vernal Pools Visit | University of California, Merced | Graduate Student |
| Non-Native Weed Eradication Management | University of California, Merced | Professional |
| NSF-CREST Center for Cellular and Biomolecular Machines Summer Programs | University of California, Merced | Professional |
| Summer Mellon Grant Hike | University of California, Merced | Professional |
| Camp Fire Club | University of California, Merced | Faculty |
| UCM NRS Interviews | University of California, Merced | Faculty |
| Yosemite Leadership Program Star Hike | University of California, Merced | Professional |
| UC Merced Tour Guides | University of California, Merced | Undergraduate Student |
| UCM Natural Resources and Ecology Association (NREA) Weed Pull | University of California, Merced | Professional |
| Graduate Visitation Weekend Tours | University of California, Merced | Professional |
| UC Merced Research Week Tours | University of California, Merced | Faculty |
| Reserve Tour | University of California, Merced | Faculty |
| Center For Advanced Research and Technology Site Visit | University of California, Merced | Professional |
| Photos for use in Public Relations Biodiversity articles | University of California, Merced | Professional |

## Part 8. Use by Public, cont'd

| | | |
|---|---|---|
| **Business Entity** | | |
| Wetland Hydrology and Plant Community Monitoring | LSA Associates, Inc | Professional |
| Reserve photography | SWCA Environmental Consultants | Other |
| Navarretia Site Visit | ECORP Consulting | Professional |
| **California Community College** | | |
| Reserve Tour | Sierra Community College | Faculty |
| **California - Other University or College** | | |
| none | | |
| **California State University System** | | |
| none | | |
| **Governmental Agency or Entity** | | |
| none | | |
| **Individual or Other Entity** | | |
| none | | |
| **International University or College** | | |
| none | | |
| **K-12 Education** | | |
| Ballico-Cressey School Field Trip | Ballico-Cressey School | K-12 Instructor |
| Woodland Elementary School 8th Grade Field Trip | Woodland Elementary | K-12 Instructor |
| **Non-Governmental Organization or Non-Profit Entity** | | |
| none | | |
| **University of California** | | |
| **U.S. - University or College Outside of California** | | |
| none | | |

# Appendix: Part 4. Current Research Summary in Detail

**Hyperspectral Mapping of Vernal Pools Biodiversity** Application # 44911

| | |
|---|---|
| Project Dates: | 09 Mar 2020 to 31 May 2020 |
| Principal Investigators: | Erik Bolch \| Julia Burmistrova \| Jacob Nesslage |
| Other Members: | None |
| Affiliations: | University of California, Merced |

**Project Abstract**

Imaging spectroscopy will be used in conjunction with biodiversity studies to attempt biodiversity mapping using UAS technology.

**A Pilot Study of Tobacco & Cannabis Contaminants in Protected Areas (Merced Vernal Pools & Grasslands Reserve)** Application # 44491

| | |
|---|---|
| Project Dates: | 01 Aug 2019 to 31 Jan 2021 |
| Principal Investigators: | Patricia Holden \| Marc Beutel \| Stephen Hart \| Samuel Traina \| Tom Harmon |
| Other Members: | Michelle Gilmore \| Laurie Van De Werfhorst \| Monique Kolster |
| Affiliations: | University of California, Merced \| University of California, Santa Barbara |

**Sponsor**

Tobacco Related Disease Research Program (TRDRP) \| \| $531.00

**Project Abstract**

Parks and nature preserves are not only “protected areas” that can be used for recreation, but are an “ecosystem service” benefitting humankind more generally through such activities as bee pollination, maintenance of food webs, and nutrient recycling for plant growth. Parks and preserves, depending on their location, can be contaminated by pollutants that can negatively affect their “ecosystem services.” Some of these pollutants can be prevented by changing individual human behavior. This project evaluates pollutants emanating from tobacco product and Cannabis (marijuana) use and cultivation for their presence in four protected areas in California. We will develop a methodology to assess the effects of discarded cigarette butts and e-c...

(read more)

# Appendix: Part 4. Current Research Summary in Detail, cont'd

## Phenological Mismatch of California Wildflowers and their Pollinators

Application # 36412

| | |
|---|---|
| Project Dates: | 27 Nov 2017 to 31 Jul 2018 |
| Principal Investigators: | Brandon Hendrickson |
| Other Members: | None |
| Affiliations: | University of California, Merced |

**Project Abstract**

The purpose of this study is to investigate pollinator efficiency resulting from earlier and later flowering time of multiple vernal pool annuals and perennials. Pollinator efficiency will be determined by the seed set seed set is positively correlated with the number of pollen that are deposited on the stigma. Pollen on the stigma is associated with the number of pollinator visits and the number of pollen deposited per visit. The number of pollinator visitations depends upon the seasonal temperature and the number of pollen deposited per visit is dependent upon the abundance of blooming flowers, and therefore the seed set should be dependent upon the abundance of blooming flowers, temperature, and the type of pollinator. All three of...

(read more)

## Vernal Pools Mapping and EVLOS Project

Application # 43760

| | |
|---|---|
| Project Dates: | 11 Sep 2019 to 22 Feb 2020 |
| Principal Investigators: | Derek Hollenbeck |
| Other Members: | Brandon Stark \| Joshua Rivard \| Victor Ramos-Michel \| Jorge Solorio \| Jose Vega \| Alexander Coburn |
| Affiliations: | University of California, Merced |

**Project Abstract**

This project aims to map the Vernal Pools by using aerial imagery on-board a small unmanned aircraft system (sUAS) in late January early February when the pools are likely filled with water. The sUAS is a fixed-wing platform with 2 hour endurance and is ideal for mapping this large area. The current regulations limit operations to visual line of sight (VLOS). Thus, equipment testing and data gathering is needed to satisfy the FAA waiver application process for extended VLOS (EVLOS). Further, test flights will be conducted to ensure proper payload operations and map generation prior to January flight.

## Tour for the Delegation and Rector of Martin Luther University in Halle-Wittenberg, Germany

Application # 43725

| | |
|---|---|
| Project Dates: | 04 Sep 2019 to 30 Jun 2020 |
| Principal Investigators: | Monique Kolster \| David Ardell |
| Other Members: | Ivo Grosse \| Erik Redling \| Christian Tietje \| Manja Hussner |

**Tour for the Delegation and Rector of Martin Luther University in Halle-Wittenberg, Germany** — Application # 43725

| | |
|---|---|
| Affiliations: | University of California, Merced \| California Institute of Technology \| Martin Luther University Halle-Wittenberg |

**Project Abstract**

A delegation from Martin Luther University in Halle-Wittenberg, Germany, will be visiting UC Merced on September 4. They are very interested in providing funds to support exchanges of students and scholars and to support other scholarly activities between UC Merced, Caltech, NASA Ames Research Center, and MLU. They are interested in research and training exchanges for MLU students on the MVPGR to have students learn about more technical ecological research methods (e.g., remote sensing).

**UC Conservation Genomics eDNA Sampling** — Application # 35149

| | |
|---|---|
| Project Dates: | 01 Mar 2016 to 01 Mar 2019 |
| Principal Investigators: | Rachel Meyer \| Rachel Meyer \| Dannise Ruiz |
| Other Members: | Monique Kolster \| Andres Aguilar \| Jason Sexton \| Michael Dawson \| Daniel Toews \| Ryan Hollister \| Laura Hollister \| Ryan Testo \| Brian Hofsteen |
| Affiliations: | University of California, Los Angeles \| University of California, Merced \| California State University (CSU), Los Angeles \| Turlock Unified School District \| John H. Pitman High School \| Turlock High School |

**Sponsor**

University of California, President's Office Catalyst program | na | $1,750,000.00

**Project Abstract**

Conservation International names California as one of the world's biodiversity hotspots. A biodiversity hotspot is a region with a large number of species whose existence is threatened by human activity. California's wildlife is particularly at risk because many of it's resident species are endemic (only found in California) and over 70% of natural habitat has been lost due to development and land degradation. One of the main challenges facing Conservation Biologists is effective monitoring of species distribution and establishing reliable baselines of a regions biodiversity facilitating early detection of species declines. This project aims to address these problems. Firstly, the samples collected will be analyzed to establish a baseli...

(read more)

**Vernal Pool Microbial Communities** — Application # 36189

| | |
|---|---|
| Project Dates: | 05 Mar 2018 to 01 May 2019 |
| Principal Investigators: | Jorge Montiel Molina |
| Other Members: | None |

# Appendix: Part 4. Current Research Summary in Detail, cont'd

## Vernal Pool Microbial Communities

Application # 36189

**Affiliations:** University of California, Merced

**Sponsor**

UC MEXUS-CONACYT | |

**Project Abstract**

Fungi play central roles in ecosystems through interspecific relationships with other organisms. As symbionts, fungi living inside the plants -endophytes- can have a strong influence on plant stress tolerance and adaptation. Classic studies on managed ecosystems has shown that fungi living inside leaves, stems, and roots can alleviate drought stress, salinity stress, and high temperatures exposure, with the most dramatic examples coming from the wild. The purpose of this research is to elucidate the role of fungal endophytes in relation with the amphibious behaviour that only vernal pools plants present, as an adaptation to the extreme fluctuations in water availability. Understanding how this fungal communities are affected by temp...

(read more)

## Tours with Visiting Researchers and Prospective UCM Faculty Candidates and Graduate Students

Application # 34614

**Project Dates:** 18 Jan 2017 to 31 Dec 2020

**Principal Investigators:** Joshua Viers | Anna Rallings

**Other Members:** Anna Fryjoff-Hung | Erin Hestir | Laurie Huning | Anne Thebo | Steve Sheng | David Merrill | Erin Hestir | Rachel Carlson | Josue Medellin-Azuara | Selina Davila Olivera | Mark Rains | Steve Goldman | Daniel Rankin | Isaac Oshima | Andreas Anderson | Michael Kalua | Brandon Stark | William Patterson | Leanne Stepchinski | Ryan Peek

**Affiliations:** University of California, Merced | North Carolina State University | University of California, Los Angeles | Unaffiliated with any institution | US Environmental Protection Agency | University of South Florida | California Department of Fish and Wildlife | No Institution Selected | University of San Francisco

**Project Abstract**

Tours to acquaint visiting researchers and prospective UCM faculty and graduate students with the Reserve

## Vernal Pool CRAM

Application # 45024

**Project Dates:** 01 Jan 2020 to 01 Jan 2022

**Principal Investigators:** Cassie Pinnell

**Other Members:** John Vollmar | Madeline Dills

**Affiliations:** Vollmar Natural Lands Consulting, Inc. | Vollmar Consulting

# Appendix: Part 4. Current Research Summary in Detail, cont'd

**Vernal Pool CRAM** — Application # 45024

**Sponsor**

Environmental Protection Agency | #EPA WPDG 2019 CD_99T03601_0 | $291.00

**Project Abstract**

More than 150,000 acres of California's vernal pool habitats have been protected, while more than 100,000 acres have been lost, since introductions of the federal no-net-loss policy for wetlands and the California Wetlands Conservation Policy in 1988 and 1993, respectively. These figures are dated and uncertain, however. There is no ongoing, standard assessment of the status and trends in the abundance or condition of vernal pools habitats. The California Wetland Program Plan (WPP) seeks to strengthen protection for wetlands in many ways, including building capacity to track the net benefits of wetland policies and programs, using the State's Wetlands and Riparian Area Monitoring Plan (WRAMP). This project builds capacity to pro...

(read more)

**Drone Detection of Invasive Plant Species** — Application # 39783

| | |
|---|---|
| Project Dates: | 01 Dec 2017 to 31 May 2019 |
| Principal Investigators: | Monique Kolster \| Brandon Stark |
| Other Members: | Arturo Ramirez Reyes \| Judith Mendoza \| Christine Breckenridge \| Jonathan Rivas \| Nicolas Limon \| Michelle Nguyen \| Joshua Jensen \| Angelina Galvan \| Daniel Maciel Manzo \| Jiayi Wang \| Ivan Padilla \| Diego Ruiz \| Luis Valenzuela |
| Affiliations: | University of California, Merced |

**Sponsor**

University of California Office of the President, the Division of Student Affairs and the Office Undergraduate Education | | $4,000.00

University of California Office of the President, Division of Student Affairs and Office of Undergraduate Education | | $4,000.00

**Project Abstract**

This project will evaluate the effectiveness of Unmanned Aircraft Systems (UAS), or drones, on detecting and mapping non-native invasive plants on the Merced Vernal Pools and Grassland Reserve (MVPGR) and the applicability for invasive plant species and rangeland management.

**Potential collaboration: nitrogen deposition and cycling in vernal pool ecosystems** — Application # 44585

| | |
|---|---|
| Project Dates: | 29 Jan 2020 to 29 Jan 2020 |

## Potential collaboration: nitrogen deposition and cycling in vernal pool ecosystems

Application # 44585

| | |
|---|---|
| Principal Investigators: | Rebecca Ryals |
| Other Members: | Stuart Weiss |
| Affiliations: | University of California, Merced \| Creekside Science |

### Project Abstract

This request is to have access to walk along some of the designated paths in the reserve for about 1 hour. The purpose of the visit is to help us visualize potential research projects that could take place at the reserve related to nitrogen cycling.

## Genetic Investigation of Listed Vernal Pool Plants and Their Communities in Merced County

Application # 32158

| | |
|---|---|
| Project Dates: | 01 Nov 2015 to 31 Dec 2019 |
| Principal Investigators: | Jason Sexton \| Molly Stephens |
| Other Members: | Elizabeth Green \| Daniel Toews \| Erin Dickman \| Michael Spaeth \| Dannise Ruiz \| Jorge Montiel Molina \| Lauren Schiebelhut \| Michael Dawson |
| Affiliations: | University of California, Merced |

### Sponsor

USFWS/USBR- US. Fish and Wildlife Service Central Valley Project Conservation Program (CVPCP) and Central Valley Project Improvement Act Habitat Restoration Program (HRP) \| \| $389,831.00

### Project Abstract

This proposal outlines research that will improve conservation and management of native vernal pool plant species in California through improved protocols for soil plant species identification from soil samples, enhanced vernal pool plant species richness estimates, genetic marker resource development for listed species, and population genetic investigation of threatened vernal pool species. We will design and validate metabarcoding methods for detecting vernal pool plant species in soil seed banks in vernal pools of Eastern Merced County. We will compare metabarcoding detection rates with above-ground species diversity surveys and evaluate these assays for incorporation into vernal pool monitoring and restoration efforts. More broadly,...

(read more)

## Vernal Pool Phenology YLP Capstone

Application # 32651

| | |
|---|---|
| Project Dates: | 31 Jan 2016 to 30 Jun 2019 |
| Principal Investigators: | Jason Sexton |

## Vernal Pool Phenology YLP Capstone

Application # 32651

| | |
|---|---|
| Other Members: | Robert Martin \| Iris Montes \| Julia DePass \| John Cronin \| Jacob Croasdale \| Jenna Heckel \| Valeria Rivera \| Brandon Hendrickson \| Teanna Herrera \| Madeline Castro \| Jovanna Salazar \| Zara Perez-Ochoa |
| Affiliations: | University of California, Merced \| No Institution Selected |

### Project Abstract

Vernal pools are a critical component of the California Floristic Province, a global biodiversity hotspot. A group of undergraduate students as well as designated faculty and a few graduate students will establish times to visit the UC Merced Vernal Pool Grasslands Reserve (VPGR) on a weekly basis in order to monitor the diversity and phenology of native and endemic plants located around the vernal pools and grasslands. A protocol for the plant monitoring will be established. Then, will transfer above data to the public via open websites. This project will directly benefit researchers and land managers working to understanding the biology, conservation, and restoration needs of these special ecosystems and plant communities.

## Unmanned Aerial Systems for Digital 3D Reconstructions and Digital Preservation

Application # 31553

| | |
|---|---|
| Project Dates: | 20 Jul 2015 to 24 Aug 2018 |
| Principal Investigators: | Brandon Stark \| Nicola Lercari \| Graham Baird |
| Other Members: | Brendan Smith \| Stephani Gimble \| Andreas Anderson \| Jad Aboulhosn \| Tristan Yang \| Jeffrey Weekley \| Robert Mills \| Chris Samaro \| John Flynn \| Lorenzo Booth \| Luke Kostrikin \| Jacques Fracchia \| Jonathan Rivas \| Michael Kalua \| Daniel Gomez \| Hayden Namgostar |
| Affiliations: | University of California, Merced |

### Sponsor

UC Merced Natural Reserve Student Research Grant Program \| \| $1,000.00

### Project Abstract

The use of unmanned aerial systems provide a unique opportunity to collect a wide range of aerial imagery. In this project, we propose to utilize these aerial remote sensing platforms and augment their data with terrestrial lidar scans and handheld photography to generate a historical archive of the Merced Vernal Pool and Grassland reserve that will be disseminated as a searchable archive and as an immersive game environment. The UAVs, lidar and photography will provide the raw data to generate 3D models and reconstructions. Surveys of past and current researchers and their projects will provide the context and archival methods. Once combined and archived, novel methods of data fusion will be developed to create a novel immersive envi...

(read more)

# Appendix: Part 4. Current Research Summary in Detail, cont'd

**Phylogenomics & population genomics of endemic vernal pool grasses (Poaceae subtribe Orcuttiinae)** — Application # 44211

| | |
|---|---|
| Project Dates: | 26 Jul 2019 to 30 Nov 2022 |
| Principal Investigators: | Robert Stone |
| Other Members: | None |
| Affiliations: | Rancho Santa Ana Botanic Garden |

**Project Abstract**

We propose a phylogenomic and population genomic study of the vernal pool grasses Neostapfia, Orcuttia and Tuctoria (Poaceae subtribe Orcuttiinae) in order to resolve their relationships with other members of the tribe Cynodonteae, revisit the generic classification (especially of the paraphyletic group Tuctoria) and assess landscape-scale diversity of all currently recognized species. The study will consist of population-level sampling, high-throughput DNA sequencing (ddRADseq) and data analyses. In addition, seed collections of these listed plants will be made, to provide for ex situ conservation and a safeguard against local extirpation. The study will be conducted over a period of four years (Aug. 2019 – Nov. 2022).

**Tricolored Blackbird Project** — Application # 36442

| | |
|---|---|
| Project Dates: | 09 Nov 2017 to 09 Mar 2018 |
| Principal Investigators: | Chris Swarth |
| Other Members: | None |
| Affiliations: | No Institution Selected |

**Project Abstract**

To observe habitats that could be suitable for foraging by tricolored blackbirds.

**Phage Hunters of University of California** — Application # 43726

| | |
|---|---|
| Project Dates: | 03 Sep 2019 to 10 Dec 2019 |
| Principal Investigators: | Esveidi Tinoco |
| Other Members: | None |
| Affiliations: | University of California, Merced |

**Project Abstract**

# Appendix: Part 4. Current Research Summary in Detail, cont'd

**Phage Hunters of University of California** — Application # 43726

First semester, I will isolate and purify a prokaryotic virus (bacteriophage) from the environmental sample collected. Next I will characterize bacteriophages through electron microscopy and genomic restriction digestion analysis. Second semester, I will prepare bacteriophages for sequencing and archiving. Finally, I will present my findings of an isolated and characterized bacteriophage in the form of a poster presentation.

**Understanding Selective Processes In A Vernal Pool Landscape** — Application # 32153

| | |
|---|---|
| Project Dates: | 21 Oct 2015 to 30 Jun 2020 |
| Principal Investigators: | Daniel Toews \| Jason Sexton \| Marilyn Fogel |
| Other Members: | Chris Swarth |
| Affiliations: | University of California, Merced |

Sponsor

University of California Natural Reserve System | | $0.00

University of California Natural Reserve System | | $0.00

Project Abstract

Mediterranean climatic regimes, unique geomorphology and extreme hydrological cycles of vernal pools have influenced the evolution of highly specialized floral and faunal species unique to these systems. Vernal pools are characterized by their biogeographic region and vegetation classification. However, the distribution of vernal pools in California spans a wide range of soil series and geomorphic surfaces, within local scales (Smith and Verrill, 1998; Wacker and Kelly, 2004). Therefore, plant community composition and species distributions in a vernal pool landscape may be correlated with soil type, geomorphic substrate and soil age when climate and biotic factors remain constant. This study aims to characterize selective processes tha...

(read more)

**Hydrologic Monitoring and Modeling for Management and Restoration Analysis** — Application # 30140

| | |
|---|---|
| Project Dates: | 31 Dec 2014 to 31 Dec 2025 |
| Principal Investigators: | Joshua Viers \| Anna Rallings |
| Other Members: | Jefferson Laird \| Jacob Flanagan \| Brendan Smith \| Anna Fryjoff-Hung \| Lorenzo Booth \| Matt Beaman \| Jenny Ta \| Andreas Anderson \| Nicholas Magyari \| Allan Murillo \| Thomas Thayer \| Joseph Camaddo \| Alan Cai \| Luke Kostrikin \| Alexus Garcia \| Vicky Espinoza \| Erin Hestir \| Samuel Araya \| Selina Davila Olivera \| Daniel Gomez \| Jacques Fracchia \| Erik Bolch \| Michael Kalua \| Gustavo Facincani Dourado \| Francesca Cannizzo \| Jacob Nesslage |

## Hydrologic Monitoring and Modeling for Management and Restoration Analysis

Application # 30140

**Affiliations:** University of California, Merced

### Sponsor

California Department of Fish and Wildlife | P1740401 | $282,845.00

### Project Abstract

The objective of this project is to better understand the interface of topography and hydrology on the UC Merced Vernal Pools and Grassland Reserve. Using a combination of empirical data and model development, our team seeks to better understand how water moves throughout the preserve. By using a combination of modeling (e.g., HEC-RAS) and data collected in a variety of ways -- including but not limited to pressure transducers, timelapse imagery, aerial LiDAR and imagery, and RTK GPS surveys -- over a large area and long periods of time, we will develop a better understanding of potential management strategies for the preserve and evaluate the feasibility of potential hydrological restoration activities.