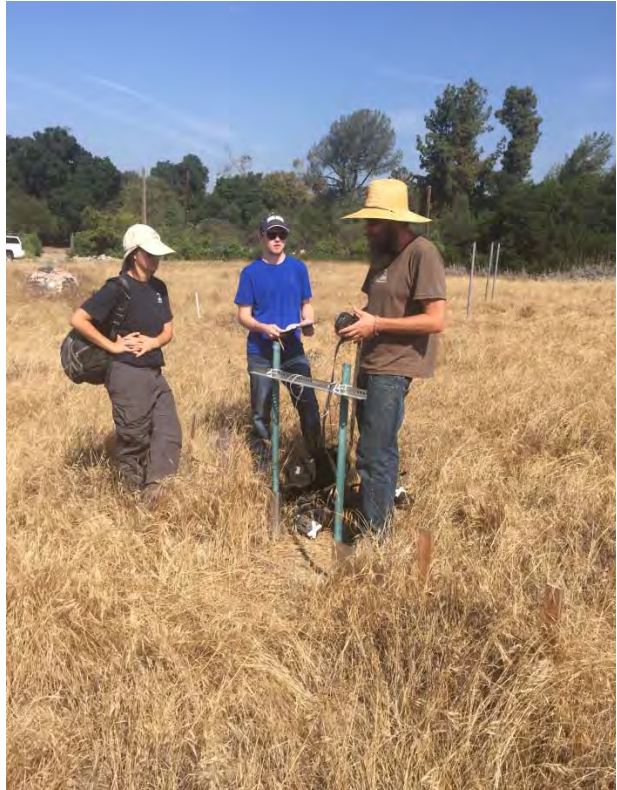


Robert J. Bernard Field Station 2015-16 Annual Report



Activities at Bernard Field Station during the 2015-2016 academic year. Upper Left: Students Mary-Clare Bosco (Pomona) and Lauren Hartz (Scripps) examining plant succession following a fire. Upper Right: Students Tali Caspi (Scripps) and John Litle (Pomona) with the BFS Director Wallace Meyer using motion sensor cameras to assess the vertebrate community. Lower Left: Professor Paul Stapp (Cal State Fullerton) introducing community members to the vertebrates at the BFS during the BFS's Earth Day Events. Lower Right: Student Tessa Finley (Pomona) collecting nectar from Royal Penstemon flowers to measure the sugar concentration and determine how rewarding they are for bees to visit.

Executive Summary

This annual report summarizes uses of the Robert J. Bernard Field Station (BFS) during the 2015-16 academic year and highlights the critical role the BFS plays at the Claremont Colleges and in communities throughout Southern California.

- **Use statistics.** Our second complete year of use monitoring recorded 5,811 user days, indicating that on average >15 people use the BFS each day of the year. User day statistics, however, underestimate actual use.
- **Course use, Claremont Colleges.** During the 2015-16 academic year, 29 Claremont Colleges courses used the BFS, providing 855 opportunities for students to have hands-on educational experiences.
- **Research, Claremont Colleges.** Twenty-eight Claremont Colleges research projects were conducted at the BFS, including at least 5 senior thesis projects. Claremont College faculty and students published four articles based on research conducted at the BFS this year.
- **Educational opportunities for local K-12 students.** In recent years, the Leadership in Environmental Education Partnership (LEEP), run through Pitzer College since 1996, has provided the primary link between the BFS and local K-12 students. This year >150 fifth and sixth grade students came to the BFS each week during the spring semester to learn about Southern California ecology. The BFS is examining expanding educational opportunities for K-12 students.
- **Engaging the greater Claremont community.** This year we held our third annual BFS Earth Day Event with over 100 people from the community taking part in various tours and activities that highlighted local biodiversity and the diverse research conducted at the BFS. Community members also participated in the BFS volunteer program and are increasingly using the BFS for a myriad of experiences.
- **Research and academic use by institutions outside the Claremont Colleges.** This year we hosted four classes from Cal Poly Pomona, CSU Fullerton, and Pasadena City College (2) as well as eight research projects from UC Riverside (3), Arizona State University, Cal Poly Pomona, UC Davis, CSU Fullerton, and York University (Toronto). We also hosted two workshops focused on monitoring biodiversity in endangered sage scrub habitats and data management techniques with attendees from multiple institutions throughout southern California.
- **Publications.** Research from the BFS resulted in the publication of six peer-reviewed journal articles this academic year.

Use of the BFS

In total, we recorded **5,811 user days** at the BFS during the 2015-16 academic year. This is a conservative estimate that does not include use associated with our active volunteer program, the director's use, the LEEP program open house, or the 2016 BFS Earth Day Events. User day statistics also underestimate actual use since people must sign in to be counted, and omissions were unfortunately common this year. Below are some pictures highlighting different uses of the BFS:



Additional activities at Bernard Field Station during the 2015-2016 academic year. Top: Student Charlotte Startin (Scripps College) sets up a hummingbird feeder where hummingbird activity will be monitored with an automatic camera. Her thesis investigated whether artificial light near feeders impacted the feeding schedules. Lower Left: A California ground squirrel visits an artificial seed tray set out by Dr. Stapp's Mammalogy students (Cal State Fullerton) to study foraging behavior of rodents at BFS. Lower Right: Retired CGU Professor Dean McHenry cuts cattails in pHake Lake.

Course Use by the Claremont Colleges

Twenty-nine courses from throughout the Claremont Colleges used the BFS this year, providing **855 opportunities** for students to have hands-on educational experiences in the sciences and the arts. In addition, the BFS was used for Claremont College programs such as the Scripps Academy and Pomona's POSSE program. Courses included:

Harvey Mudd College

- BIOL 052: Introduction to Biology
- SOSC 180: Tropical Forests: Policy and Practice
- BIOL 110: Experimental Ecology
- HM CL 57.1: Field Ecology of Lizards
- BIOL 108: Ecology and Environmental Biology
- Core Lab: Environmental Analysis

Pomona College

- BIOL 121: Insect Ecology
- Workshop: Introduction to Designing Inquiry Based Experiences
- EA 173: Ecology of Inland Waters
- BIOL 41E: Ecological and Evolutionary Biology
- BIOL 180: Microbial Ecology
- BIOL 130: Invasion Biology

Pitzer College

- EA 10: Introduction to Environmental Biology
- FYS: Making Space and Unsettling Settlers
- EA 82(2 semesters): GIS Application in Environmental Science
- Art 120: Introduction to Black and White Photography
- MS 82: Introduction to Video Art
- EA 146: Theory and Practice of Environmental Education

Keck Science (Pitzer, Scripps and Claremont-McKenna Colleges)

- BIOL 067: Conservation Biology & Management
- BIOL 154L: Animal Behavior Lab
- EA 030L (two semesters): Science and the Environment
- BIOL 168: Microbiology
- ASTR 066: Astronomy
- BIOL 139: Applied Ecology & Conservation
- BIOL 156: Genomics and Bioinformatics
- BIOL 044L: Introductory Biology
- AISS: Accelerated Integrated Science Sequence

Research

Research Use by the Claremont Colleges

Claremont Colleges faculty and students conducted **28 research projects** at the BFS this academic year; five were senior thesis projects.

Use by Non-Claremont Institutions

The BFS also attracted significant use from institutions outside the Claremont Colleges. The BFS provides a secure place to conduct research on biodiversity and ecosystems that may not be available at the home institution and can also serve as a useful site for inclusion in studies that examine gradients (e.g., nitrogen or temperature) over a large geographic area. Research and academic use by institutions outside the Claremont Colleges has, in fact, been expanding. This year, we supported researchers from California Polytechnic University Pomona, California State University Fullerton, University of California at Riverside (3 projects), University of California at Davis, York University (Toronto) and Arizona State University. Faculty and staff from multiple southern California institutions also participated in two BFS-hosted workshops focused on effectively monitoring biodiversity in endangered sage scrub habitats and data management of the collected data (see below).

Publications

Faculty and student research at the BFS from this and previous years has resulted in the publication of five senior theses and six peer-reviewed manuscripts this academic year:

Senior Theses:

Adams, Tessa (2016) Effects of fire on ant assemblages in California sage scrub. Bachelor of Arts, Pomona College, Biology. Advisor: Wallace Meyer

Sartorius, Andrea (2016) The effects of type-conversion and fire on sage scrub vertebrate assemblages. Bachelor of Arts, Pomona College. Advisors: Nina Karnovsky & Wallace Meyer

Cowen, Madeline (2016) Offspring dispersal and territory acquisition of Western Scrub-Jays (*Aphelocoma californica californica*) at the Bernard Field Station. Advisor: Rachel Levin.

Startin, Charlotte (2016) The effects of light pollution on the foraging behavior of *Caltpte anna* and *Selasphorus sasin*. Advisor: Elise Ferree.

Farooq, Ana (2016) Effects of light and noise pollution on bird vocalizations. Advisor: Elise Ferree.

Peer-Reviewed Publications:

Hollowell, A. C., J. U. Regus, D. Turissini, K. A. Gano-Cohen, R. Bantay, A. Bernardo, D. Moore, J. Pham, and J. L. Sachs. 2016. Metapopulation dominance and genomic island acquisition of *Bradyrhizobium* with superior catabolic capabilities. *Proceedings of the Royal Society B: Biological Sciences* **283**: 20160496.

Wheeler, M. M., M. M. Dipman, T. A. Adams, A. V. Ruina, C. R. Robins, and W. M. Meyer III. 2016. Carbon and nitrogen storage in California sage scrub and non-native grassland habitats. *Journal of Arid Environments* **129**: 119-125.

Thomson, D. M., R. Cruz-de Hoyos, K. Cummings, and E. L. Schultz. 2016. Why are native annual abundances low in invaded grasslands? Testing the effects of competition and seed limitation. *Plant Ecology* **217**: 431-442.

Hollowell, A. C., J. U. Regus, K. A. Gano, R. Bantay, D. Centeno, J. Pham, J.Y. Lyu, D. Moore, A. Bernardo, G. Lopez, A. Patil, S. Patil, Y. Lii, and J. L. Sachs. 2016. Epidemic spread of symbiotic and non-symbiotic *Bradyrhizobium* genotypes across California. *Microbial Ecology* **71**: 700-710.

Wu, G. C., and J. C. Wright. 2015. Exceptional thermal tolerance and water resistance in the mite *Paratarsotomus macropalpis* (Erythracaridae) challenge prevailing explanations of physiological limits. *Journal of Insect Physiology* **82**: 1-7.

Staubus, W. J., E. S. Boyd, T. A. Adams, D. M. Spear, M. M. Dipman, and W. M. Meyer III. 2015. Ant communities in native sage scrub, non-native grassland, and suburban habitats in Los Angeles County, USA: conservation implications. *Journal of Insect Conservation* **19**: 669-680.

K-12 Programs

The BFS has two K-12 programs:

The **Leadership in Environmental Education Partnership (LEEP)**, through Pitzer College, has provided the primary link between the BFS and K-12 students. This flagship program is run through a Pitzer College class offered most years titled, *“Theory and Practice in Environmental Education”*. This course teaches college students (16 this year) environmental/ecological pedagogy and curriculum development. The college students then use what they have learned to teach Claremont Unified elementary school children (>150 this academic year) from diverse backgrounds (> 70% of the students qualify for the free or reduced lunch program) about environmental concerns in our community.



K-12 activities at Bernard Field Station during the 2015-2016 academic year. Left: College student instructors, K-12 students, and family members visiting the BFS during the LEEP open house; Right: Activities in pHake Lake during the LEEP open house.

This year marked the second year of a **new K-12 program at the BFS**. This goal of this program is to provide an additional link between the BFS and Claremont elementary students, complementing efforts of the LEEP program. The educational objective is to provide students a more accurate sense of place (i.e., understand that the California Sage Scrub ecosystem is extremely diverse, unique and in critical need of conservation) and develop a community with a stronger commitment to environmental stewardship. With support from the Henry David Thoreau Foundation, we planned to expand this program to provide access to all fourth graders in the Claremont Unified School District during the 2015-16 academic year. While twelve college students were trained in inquiry-based learning in preparation for the second year of implementation, student schedules and interested teachers schedules did not match.

This year the BFS also provided opportunities for non-traditional K-12 programs. The BFS is occasionally used by a local home school group whose curriculum is focused on environmental stewardship. In addition, the BFS provided a tour and activities for students from the Leroy Haynes School, which is dedicated to educating students with special needs relating to emotional development, autism, Asperger’s Disorder, learning disabilities, neglect, and abandonment.

2016 BFS Earth Day Events

This year, the BFS held its third annual BFS Earth Day events, which provides the primary opportunity for the greater Claremont Community to participate in various tours and learn about the research being conducted at the BFS. We had a great time this year with >100 attendees.



BFS Earth Day Events. Top: Poster announcement of the event. Lower Left: Professor Steve Adolph (Harvey Mudd College) introducing the native lizards living at the BFS. Lower Right: Professor Catherine McFadden (Harvey Mudd College) leading a tour of the bird fauna.

Bio-Monitoring Program

The BFS is currently leading a multi-institutional effort with National Science Foundation support to set up long-term bio-monitoring programs in California sage scrub fragments throughout southern California. This year marked our third year of the planning process and the second year of bio-monitoring implementation at the BFS and four other participating institutions. Bio-monitoring efforts have been designed to assess changes in diversity and phenology of four distinct taxonomic groups: plants, invertebrates, birds, and mammals. Protocols were developed based on two criteria: (1) that they collect data in a way that can reveal changes in the biota at both the patch and regional levels; and (2) that they are practical (i.e., they could be implemented with the resources at most institutions).

This year's efforts were focused on the management of the data collected. Currently institutions are working on assembling the primary and meta-data. By the end of September data should be publically available. To provide a hub for this program, we are currently developing a website for the bio-monitoring program which will provide links to protocols, data sheets, links to the data, and a description of how various people/institutions can get involved. We have recently named our program: PRISSM: Partnership of Regional Institutions for Sage Scrub Monitoring. Please be on the lookout for our website (www.prissm.org) in October.



Bio-monitoring efforts at the BFS during the 2015-16 academic year. Left: Student Tali Caspi from Scripps College setting up motion sensor cameras to monitor vertebrates at the BFS. Right: Students from Pomona's BIOL 41E: Ecological and Evolutionary Biology course taking site measurements while continuing pitfall trap sampling that is being used to assess changes in arthropod communities at the BFS. Arthropod sampling has been conducted every spring since 2013.

Volunteer Program

Our volunteer program continued in 2015-2016, with 12 workdays held on first and third Saturdays during the academic year. Seventy-five volunteers participated in the program, including 50 college and high school students (from Harvey Mudd, Pomona, Claremont McKenna, Scripps, Pitzer, Mt. San Antonio, and Citrus Colleges, University of California Riverside, and Claremont High School), 10 faculty and staff members, 7 children, and 8 community members. An average of 12 volunteers participated in each workday for a total of 290 volunteer hours.

Most of this year's work was directed toward removing nuisance/invasive plants, including cattails, invasive thistles, non-native mustards, and horehound. Volunteers also cleared overgrown trails and picked up trash along Foothill Blvd.



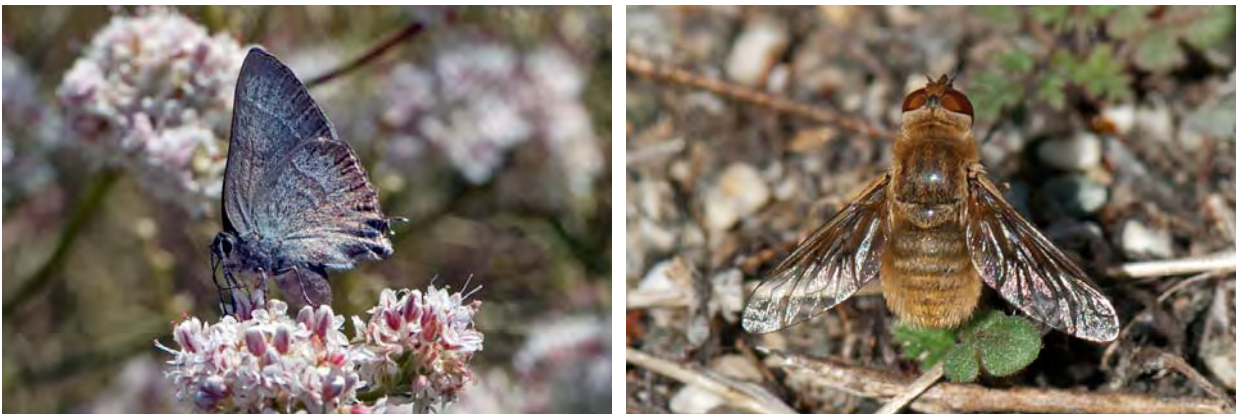
Volunteers at the BFS during the 2015-16 academic year. Upper Left: Student volunteers Cami Wendlandt (UC Riverside) and Vanessa Ruiz (Citrus College) collect cut cattails. Upper Right: Volunteers remove horehound from a fire road. Lower Left: Community member Lucy Nagler cuts cattails in pHake Lake. Lower Right: Citrus College student Emil Sunaj declares victory over his pile of horehound.

BFS Web Resources

Over the past year, we have continued to improve the BFS web resources, which provide useful information to Claremont College students and faculty as well as outside researchers and the general public. Among our main web resources are the constantly updated lists of flora and fauna at the BFS, with links to many photographs of the species taken at the BFS.

Most notably, through cooperation with the Rancho Santa Ana Botanic Garden, we were able to post the first-ever list of non-vascular plants (mosses and liverworts) found at the BFS (<http://bfs.claremont.edu/biota/plants/bryophytes.html>). This preliminary list was generated by an RSABG introductory level bryophytes class taught by Dr. Paul S. Wilson, California State University, Northridge. In the future we hope to engage Dr. Wilson in creating a more extensive, vouchered bryophyte list.

This year, through a combination of regular surveys and findings from research projects, we added 15 new plant, one new mammal, one new bird, and 12 new invertebrate taxa to the BFS species list. The extensiveness of our invertebrate list is fairly unique, and it was recently cited as one of the few all-taxa invertebrate surveys in Southern California in the *Biodiversity Data Journal* by Feisler and Drake (2016).



Some new additions to the BFS species lists. Left: *Satyrium tetra* (Mountain Mahogany Hairstreak). Right: *Paravilla edititoides* (a bee fly).

BFS Director Achievements

Publications

Research from BFS (* highlights undergraduate mentees)

Wheeler*, M. M., M. M. Dipman*, T. A. Adams*, A. V. Runia, C. R. Robins, and **W. M. Meyer III**. 2016. Carbon and nitrogen storage in California sage scrub and non-native grasslands. *Journal of Arid Ecosystems* **129**: 119-125.

Staubus*, W. J., E. S. Boyd*, T. A. Adams*, D. M. Spear*, M. M. Dipman* and **W. M. Meyer III**. 2015. Ant communities in native sage scrub, non-native grassland, and suburban habitats in Los Angeles County, USA: conservation implications. *Journal of Insect Conservation* **19**: 669-680.

Spear*, D. M., E. S. Boyd*, T. A. Adams*, M. M. Dipman*, J.W. Staubus* and **W. M. Meyer III**. *In Review*. The effects of development, type conversion, and fire on low-elevation California spider assemblages. *Invertebrate Biology*.

Research outside BFS

Curry, P.A., N.W. Yeung, K.A. Hayes, **W.M. Meyer III**, A.D. Taylor and R.H. Cowie. 2016. Rapid range expansion of a predator and its impact on endemic Hawaiian land snails. *Biological Invasions* **18**: 1769-1780.

Meyer, W. M. III, J. Eble, K. Franklin, R. B. McManus*, S. L. Brantley, J. Henkel*, P. E. Marek, W. E. Hall, C. A. Olson, R. McInroy*, E. M. Bernal-Loaiza*, R. C. Brusca and W. Moore. 2015. Ground-dwelling arthropod communities of a sky island mountain range in southeastern Arizona, USA: obtaining a baseline for assessing the effects of climate change. *PLoS ONE* **10(9)**: e0135210.

Presentations

Meyer, W. M., III. Invited Oral Presentation. Preserving biodiversity and ecosystem function in low elevation Southern California habitats. Cal-Poly Pomona Biology Department Seminar Series, May 2016.

Meyer, W. M., III. Invited Oral Presentation. Reflections on development, deforestation and dams in SE Asia. Globalization and Sovereignty Conference, Pitzer College, March 2016.

Meyer, W. M., III. Invited Oral Presentation. Sweat the small stuff: conservation of invertebrate biodiversity and ecosystem function. Humboldt State Biology Department Seminar Series, October 2015.

- I also advised seven students who presented an oral presentation and two posters at the West Coast Biological Sciences Undergraduate Research Conference.

BFS Director Achievements (continued)

Bio-monitoring

I hosted three workshops focused on implementing bio-monitoring programs in the endangered California sage scrub ecosystem and developing an appropriate data management approach for this multi-institutional effort. Currently, we are working on making data from the first two years of implementation publically available and developing a website for the program.

Research

Through generous grants from the Henry David Thoreau Foundation and the Schenk Fund along with research funds from the BFS and Pomona College, I was able to hire and support 26 student researchers on nine research projects. This does not include the three senior thesis students I oversaw this past academic year.

Grants

Administered

Henry David Thoreau Foundation, Grant for Student Research – 2014 (\$31,000)

National Science Foundation, Field Station Planning Grant (DEB, FSML) – 2013 (\$23, 897)

Schenk Fund, Grant for Research on Plants – (\$4,000)

K-12 Programs

I taught the Pitzer College class titled, “*Theory and Practice in Environmental Education*” and oversaw the LEEP program this year while Professor Faulstich was on sabbatical. This course taught 16 college students environmental/ecological pedagogy and curriculum development. These students then taught >150 fifth and sixth graders from the Claremont Unified School District once a week for the entire spring semester.

I hired and trained twelve student education interns in inquiry based scientific instruction to implement environmental curriculum for fourth graders in the Claremont Unified School District. While education interns were not able to implement the environmental curriculum, they did assist in a variety of different tours and activities at the BFS.

Community Outreach

In addition to overseeing the LEEP program this year, I organized and oversaw the 2016 BFS Earth Day Events, gave tours to various community groups, and helped provide opportunities for a local homeschool group. I also worked with local teachers to aid in curriculum development and trained 12 students in an effort to expand K-12 program. I am especially interested in incorporating high school students into research at the BFS if they are passionate about ecological research. I am open to additional community programs, but none are planned for 2016-17.