Stanford | Jasper Ridge Biological Preserve

SCHOOL OF HUMANITIES & SCIENCES

Donate

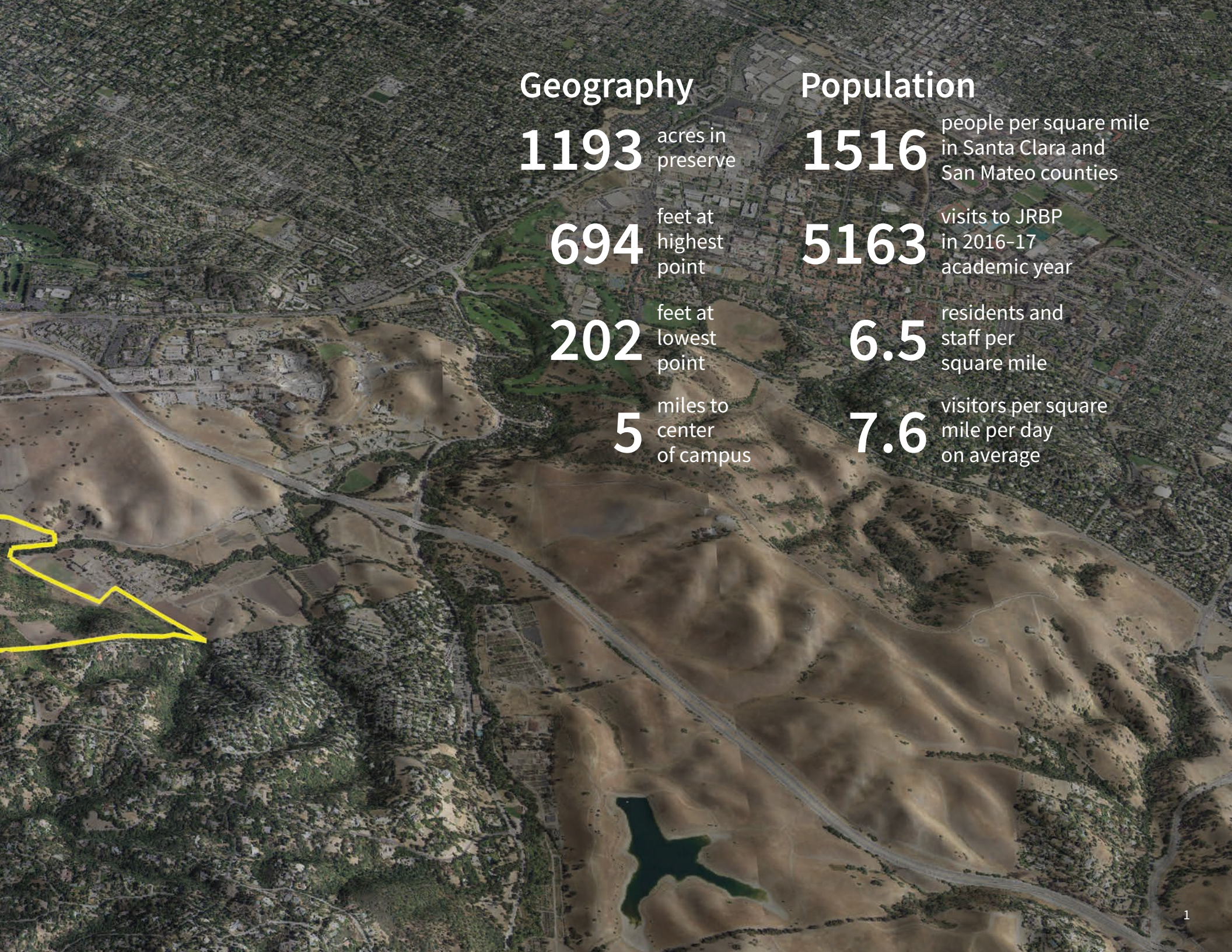
Annual Report 2016–17

CONTENTS

Contributing to the understanding of Earth's natural systems through research, education, and protection of the preserve's resources

Cover Art: *The Jasper Ridge Tree of Life, produced exclusively for JRBP by Jennifer Berlinger, Fairhope Graphics. The full tree is available as a 24˝x 36˝ poster for purchase at jrbp.stanford.edu*

photo credits on back cover



Geography

1193 acres in preserve

694 feet at highest point

202 feet at lowest point

5 miles to center of campus

Population

1516 people per square mile in Santa Clara and San Mateo counties

5163 visits to JRBP in 2016–17 academic year

6.5 residents and staff per square mile

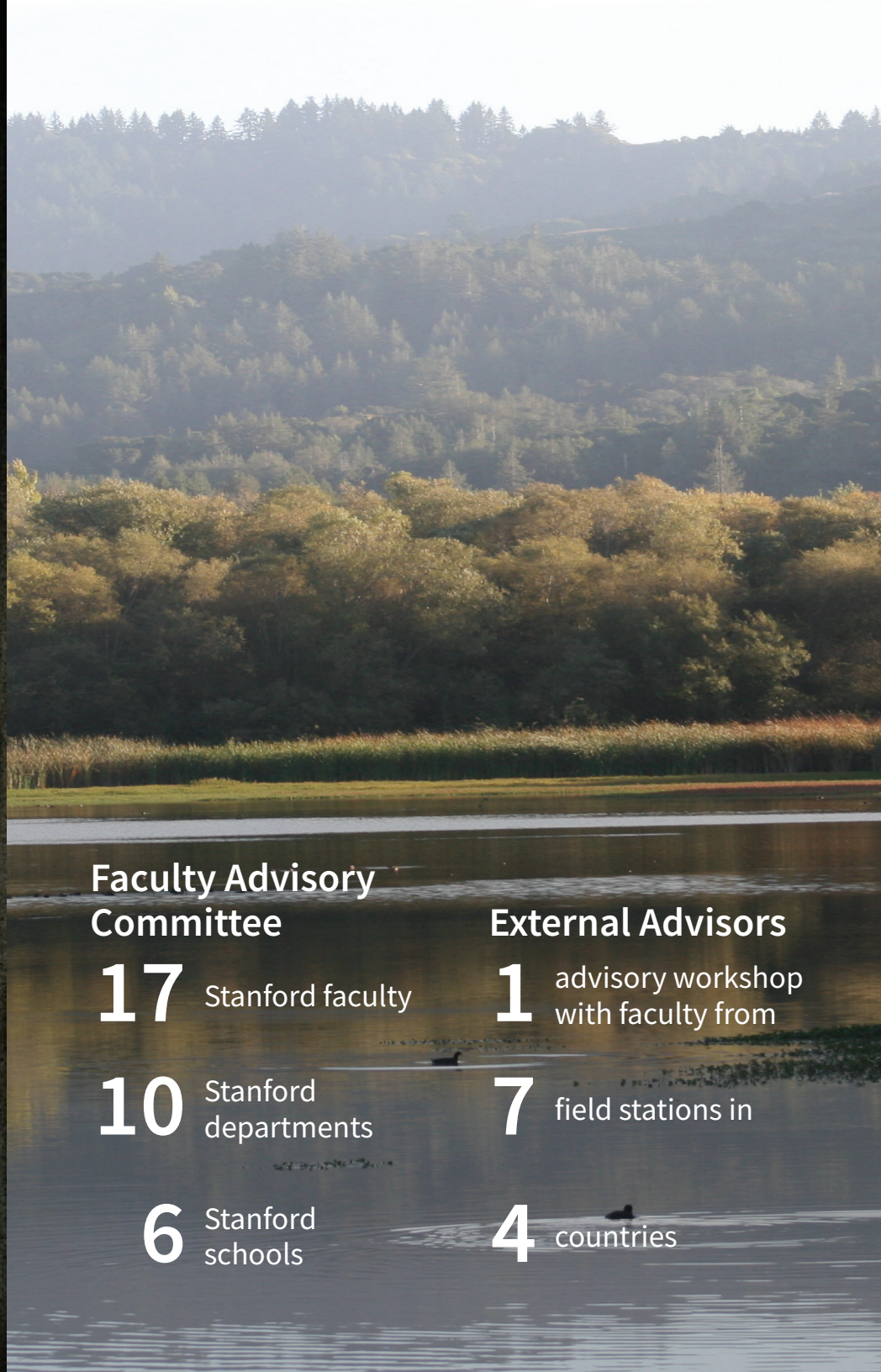
7.6 visitors per square mile per day on average

DIRECTOR REPORTS

Faculty Director

Elizabeth A. Hadly

Jasper Ridge Biological Preserve is going global. After a year of strategic planning, we have even more reasons for excitement about the preserve. We have broadened our Faculty Advisory Committee to include faculty from 6 of Stanford's 7 schools; we renewed our already enthusiastic Community Advisory Council with the addition of NGO representatives, writers, thought-leaders, and neighbors; and we formed a new working group of national and international scholars with field station experience to help us leverage JRBP's many strengths for a global reach. Conversations with our stakeholders have enlightened us about the extraordinary sense of place that is JRBP—its geography and biodiversity, its legacy of research and education, its ties to Stanford, and the affection that it engenders in our community. Our strategic planning process has also clarified some key issues ahead. First, we are committed to maintaining JRBP's value to the university as a place prized for its research and teaching. Second, we are renewing and re-envisioning our conservation mandate. We are reflecting on what "preserve" means given our inability to return to any previous baseline because of accelerating rates of species invasions, climate change, the ever-present threat of wildfire, and increased human impact (including our own needs of infrastructure repair, issues surrounding Searsville Dam, and visitor usage). And finally, we are anxious to see JRBP make a difference in the world by using it as a "laboratory" to design, develop, and deploy field research innovation, what we call "Out of the Box and Into the Cloud". Stay tuned for opportunities to re-connect and to help JRBP wrestle with some of these issues. And as ever, thank you for your interest and for your continued engagement with us.



Faculty Advisory Committee

17 Stanford faculty

10 Stanford departments

6 Stanford schools

External Advisors

1 advisory workshop with faculty from

7 field stations in

4 countries

Community Coordinating Council

25 community members including

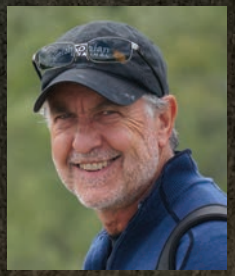
13 from private & public organizations outside Stanford

10 from administrative units at Stanford

Above: *Stanford President Marc Tessier-Lavigne (right) and Director of Water Resources Tom Zigterman discuss JRBP's role in the university water system.*

12 visits by Stanford leadership

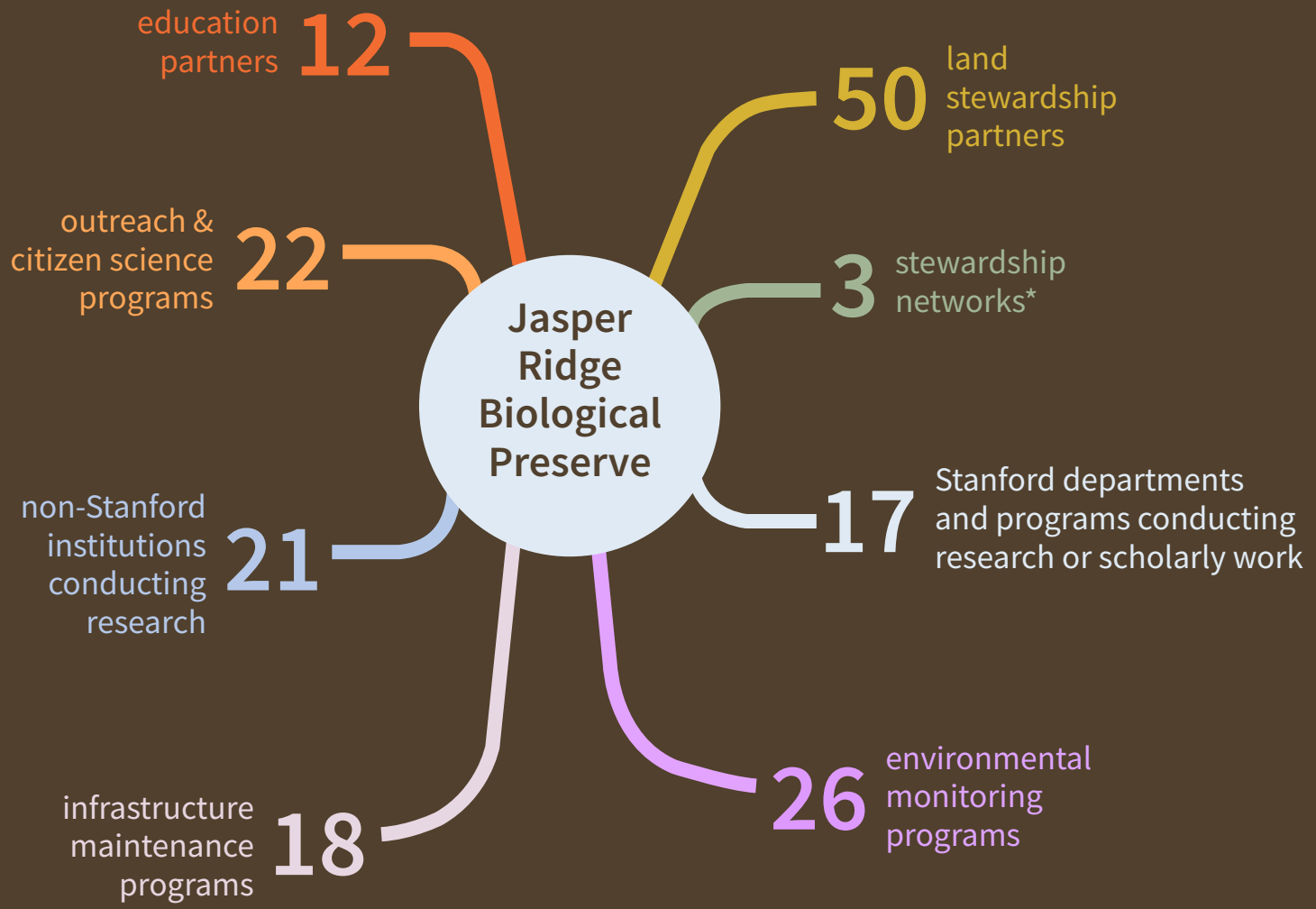
Executive Director
Anthony D. Barnosky



The Mongolian ger (photo, pg 7) next to the Leslie Shao-ming Sun Field Station is the real deal, shipped over from Ulaanbaatar last June. When you go inside you'll smell the rich animal odor of the felt insulation and ropes, all hand-made from the hair of nomads' sheep, goats, horses, yaks, and camels. You may feel like you are in the past, but you'll be standing in the present. Some 900,000 people in Ulaanbaatar live in these off-grid structures, a result of nomads taking on a new way of life. This exemplifies how the world is rapidly transitioning into a future that needs more cooperation and innovation to deal with problems associated with increasing numbers of humans, climate change, and declining biodiversity. For Liz and me, walking by the ger each day reminds us that JRBP has a huge role to play in contributing solutions. Already, the ger is being used by students from Stanford's Design School, partnering with the NGO GerHub in Mongolia, to prototype new heating solutions. Going forward we envision more local, regional, and international partnerships. Other additions this year include a new bridge to enhance fish passage at the low-flow crossing, renovation of the Road C bridge to support fire trucks, new trail registers to provide critical usage data, and the beginnings of vegetation restoration outside the Sun Field Station. And the Annual Report itself follows a different style from past years. We pulled together numbers to encapsulate the present state of JRBP's many activities. The impressive counts leave me with an overwhelming sense of gratitude for our incredible staff and community, whose engagement has built JRBP into the amazing facility it already is and promises even more as we move into the future.

WHO WE SERVE

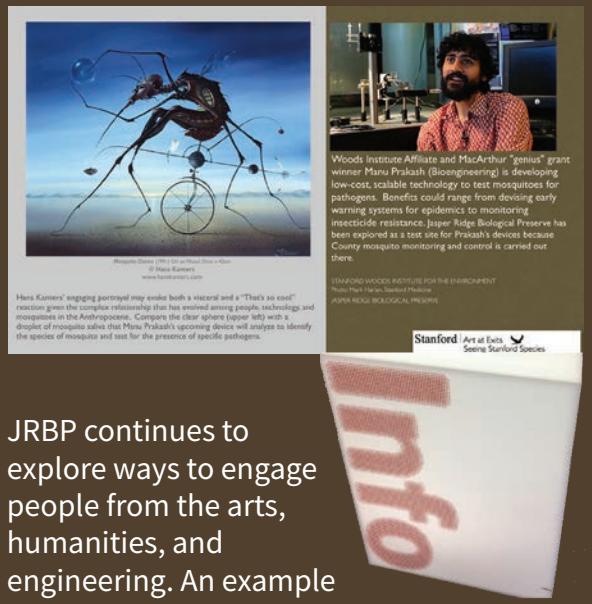
Embedded in the founding of Stanford University are the goals of "promoting the public welfare by exercising an influence in behalf of humanity and civilization" and "qualifying its students for personal success, and direct usefulness in life." Over the years, JRBP has grown to help fulfill those goals through interactions with its many partners. Besides being Stanford's premier outdoor terrestrial laboratory for education and research, the preserve serves as a hub for programs that involve not only a broad spectrum of the rest of the university, but also other colleges and K-12 schools, the surrounding community, and the world at large. These partnerships promise to become ever more important in the coming years, as a doorway through which the next generation of global leaders can engage with a variety of real-world environmental and social problems and solutions.



*UNESCO MAB Golden Gate Biosphere
Santa Cruz Mountains Land Stewardship Network
Organization of Biological Field Stations

Minimum counts over the past five years.

Reaching Out Across Campus



JRBP continues to explore ways to engage people from the arts, humanities, and engineering. An example is this year's collaboration with Darryl Wheye, with whom we produced an exhibit at the north door of the Jerry Yang and Akiko Yamazaki Environment and Energy Building (Y2E2). This is the first digital installation in Darryl's and Don Kennedy's "Art-at-Exits: Seeing Stanford Species" series, which now graces ten Stanford buildings. The Y2E2 exhibit integrates science done at JRBP with art to highlight societally relevant messages.

The panel above, one of seven in the exhibit, features Hans Kanters's "Mosquito Dance" next to Stanford Bioengineering professor Manu Prakash, who used JRBP to test devices designed to identify mosquito species by acoustics of their buzzing as well as testing them for pathogens.

INFRASTRUCTURE

Sun Field Station

2024 square feet of labs

1425 square feet for teaching

1 herbarium

0 net CO_2 emissions annually

Energy Production[1]

41200 kWh in academic year 2016–17

123 PV panels

[1]includes Sun Field Station and ranger residence

25000 gallons of water in underground cistern

Thanks to Cary Tronson

It takes a lot of behind-the-scenes work and equipment to keep the Sun Field Station and JRBP's nearly 1200 acres of outdoor research and teaching space in top shape. For the past 15 years that task has fallen to Operations Manager extraordinaire Cary Tronson, who retired in September. Cary oversaw construction of the Sun Field Station and ever since has done a first-rate job of making sure that researchers, students, staff, and visitors all have what they need to accomplish their goals. It's with heartfelt thanks and great admiration that we bid Cary a fond farewell!

2 residences on-site

1 Mongolian ger

4 building awards

1 dam and reservoir

3.5 miles of water pipe

41 culverts

4.7 miles of fences

2 tractors

9 essential tractor attachments

5 gates

6 passenger vehicles and trucks

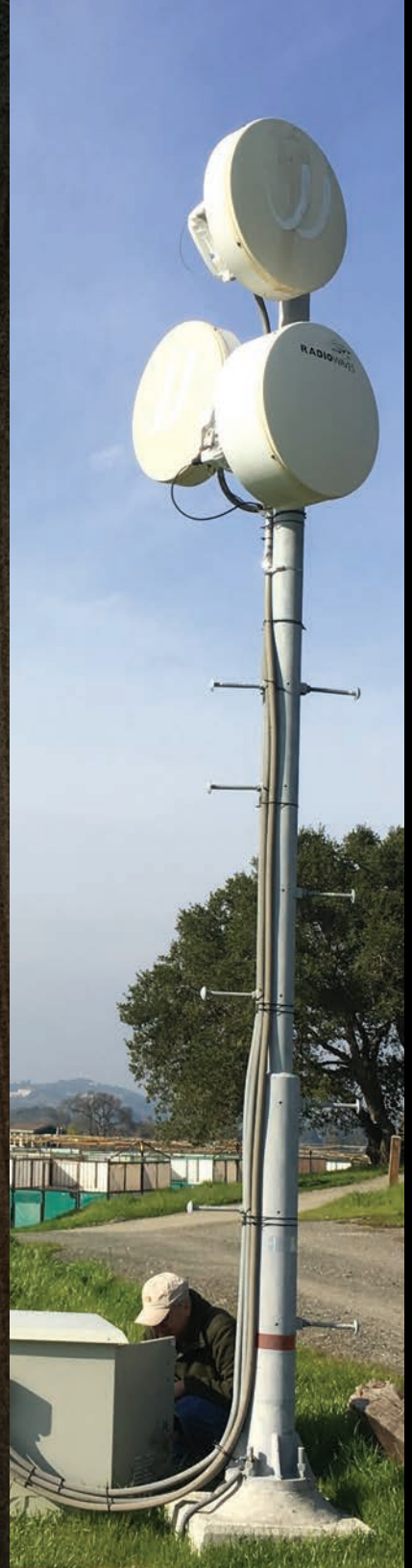
4 electric field vehicles

15 bridges

6 vehicle trailers

1 biodiesel field vehicle

TECHNOLOGY



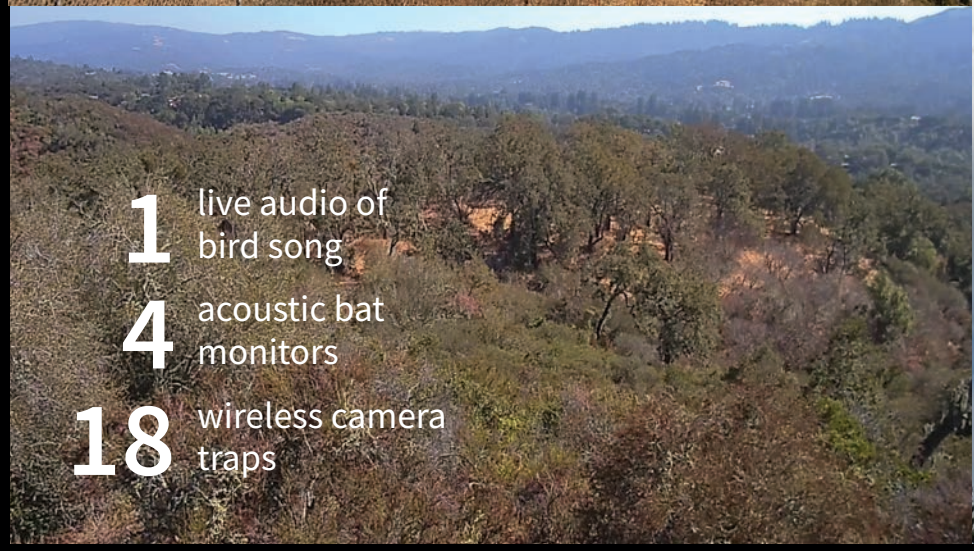
We live in a new era of cloud-based data collection and analysis, where networked systems offer new opportunities for research and teaching.

JRBP's state-of-the-art network and other technology already is helping us lead the way, including: automated processing of photos from our wireless wildlife cameras; serving of high-resolution live video and audio for real-time viewing and listening; remotely controlled gate access; monitoring of geophysical and climate data in real time; and innovating for teaching and outreach—such as graduate student Emily Dittmar's employing a live video chat from her field site with school children in Michigan.

We are continuing to innovate. New additions this year include two live video fire-lookout cameras (top and middle right), installed to help mitigate the risks of catastrophic wildfire, and a new drone (opposite page) for research on how invasive species utilize microhabitats. On tap for replacement is the wireless link with the Stanford campus (left), which will be upgraded to a fiber-optics link that will provide even better connection to the world.

2 live video fire lookouts

1 phenocam station



1 live audio of bird song

4 acoustic bat monitors

18 wireless camera traps

Imagery

180000
analyzed camera trap photos

183000
total camera trap photos

Mapping

280
GIS base layers

4 drones

1 GB per second top Internet transmission speed

The installation five years ago of a high-bandwidth, Gigabit-speed network link, a preserve-wide outdoor wireless mesh network, and subsequent improvements have fully integrated JRBP into Stanford's cyber-infrastructure. The network now allows multiple VLANs for data, management, and other functions, including a wireless VLAN for the Stanford-managed Wi-Fi infrastructure and Voice Over Internet Protocol (VOIP) telephones. High bandwidth connectivity enables users to leverage cloud computing resources both on campus and around the world.

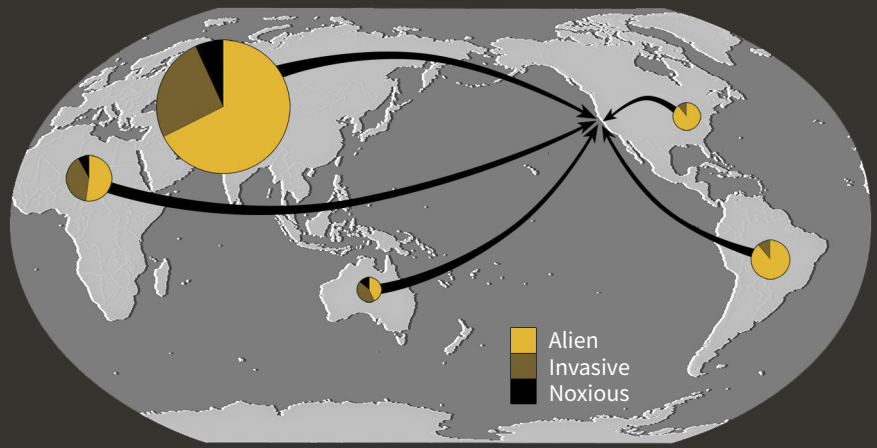
Out of the Box and Into the Cloud

The National Science Foundation has awarded JRBP a 1-year planning grant to design and install "pop-up" equipment that can be feasibly replicated at low cost in remote locations. The pop-up facilities will be environmentally friendly, making use of re-purposed and local materials, and self-sufficient for energy, water purification, and waste treatment. Their "out-of-the-box" design will be adaptable for use in strikingly different geographic and cultural settings. The concept is to provide a diverse variety of field stations with the capacity to employ cutting-edge and emerging technology in order to acquire and send data to the cloud for collaborative analyses with those who may live on opposite sides of the world. Such networking capacity is a prerequisite to attacking research questions, on both a local and global scale, that are not easily explored in isolation, using techniques such as genomic analyses, automation of labor-intensive camera-trapping, drones, remote sensing and mapping, and collaborative analyses that cross cultural boundaries.

Plants

JRBP includes examples of nearly every natural plant community found in west-central California. This diversity is due to multiple factors, including high geologic and topographic diversity, JRBP's position in the watershed, and, of course, a long history of protection. As a consequence, the diversity of vascular plants—more than 800 species and subspecies of ferns, gymnosperms, and flowering plants—is more than ten percent of California's total. Represented are 110 plant families, or more than sixty percent of California's total. The high plant diversity supports a rich trophic structure entailing coevolutionary interactions with herbivores, frugivores, pollinators, parasites, and pathogens. However, a third of JRBP's vascular flora is non-native, a higher proportion than the state as a whole, putting JRBP on the front line in terms of protecting native biodiversity.

JRBP's 268 non-native plants



The area of each pie on this map indicates the relative number of non-natives from each continent, and the slices indicate percentages of alien, invasive, and noxious species. The three terms reflect the relative degrees of aggressiveness, potential harm to native habitats, and difficulty of eradication.

Vertebrate Animals

Most of JRBP's ~283 known vertebrate species have yet to be studied in detail. We lack such basic information as how many deer browse within our boundaries, whether the large predators are resident or migrants, and how the density of our 24 terrestrial small-mammal species varies from one year to the next. Some new studies are underway to gather such baseline information, and long-term monitoring has produced rich datasets that await analysis—for example, nearly two decades of bird surveys by dedicated volunteers, and gigabytes of acoustic data from up to 16 bat species.

Native	Non-native	
33	4	mammals
12	1	amphibians
19	1	reptiles
6	12	fish

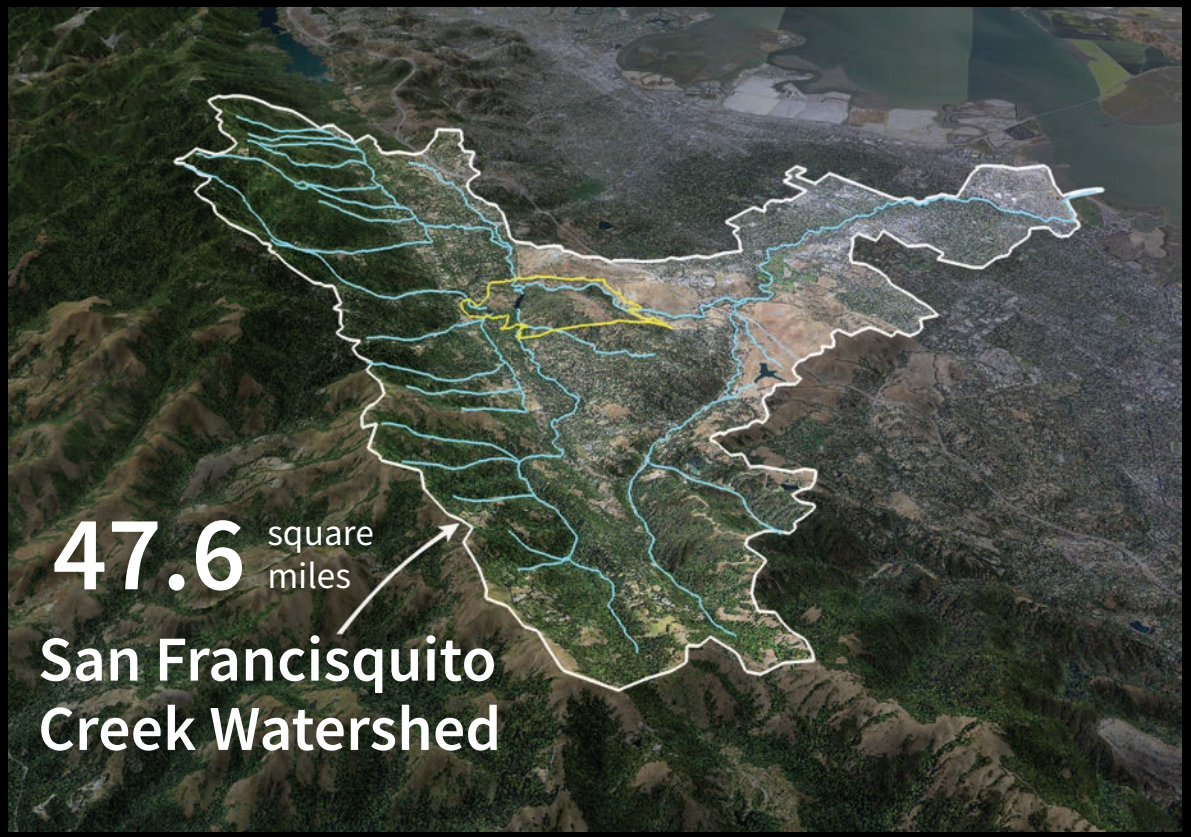
195 bird species observed

Invertebrate Animals

Valuable work on invertebrates includes more than two decades of work that has identified 30 ant species and impacts of Argentine ant invasion, classic studies on checkerspot butterflies, and incidence of the Lyme disease bacterium in ticks. But the surface has barely been scratched when it comes to understanding our invertebrate fauna—we are nowhere near to even knowing all the species in JRBP.

Above: *A dusky-footed woodrat (*Neotoma fuscipes annectens*), common at JRBP but a California subspecies which is of Special Concern, makes a rare daytime appearance.*

WATER AND WEATHER



Climate

Mean annual temperature[1]

57.7°F (14.3°C)

28 days above 90°F (32.2°C)[2]

Mean annual precipitation[1]

25.4 in (646 mm)

[1]1975 – 2017
[2]July 2016 – June 2017

Water in JRBP

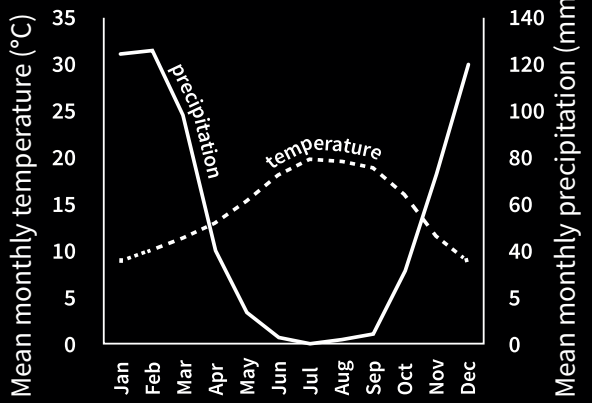
4.1 miles of creeks & streams

23.5 acres of open water

21.3 acres of marsh

JRBP has a Mediterranean-type climate, characterized by warm, dry summers and cool, wet winters. Annual rainfall has varied more than five-fold since 1975, leading to interannual variation in annual plant communities, the acorn crop of oaks, and gains in ant invasion success, as well as other phenomena observed by JRBP researchers. The impacts of rainfall variation are amplified by JRBP's position as a funnel within the San Francisquito watershed. Fed by numerous tributaries in the Santa Cruz Mountains, four major creeks flow into Searsville Reservoir, whose outflow is joined by a fifth creek to form San Francisquito Creek. Roughly a quarter of JRBP—lake, creeks, marsh, swamp, riparian communities—is directly influenced by the water flowing into and through it.

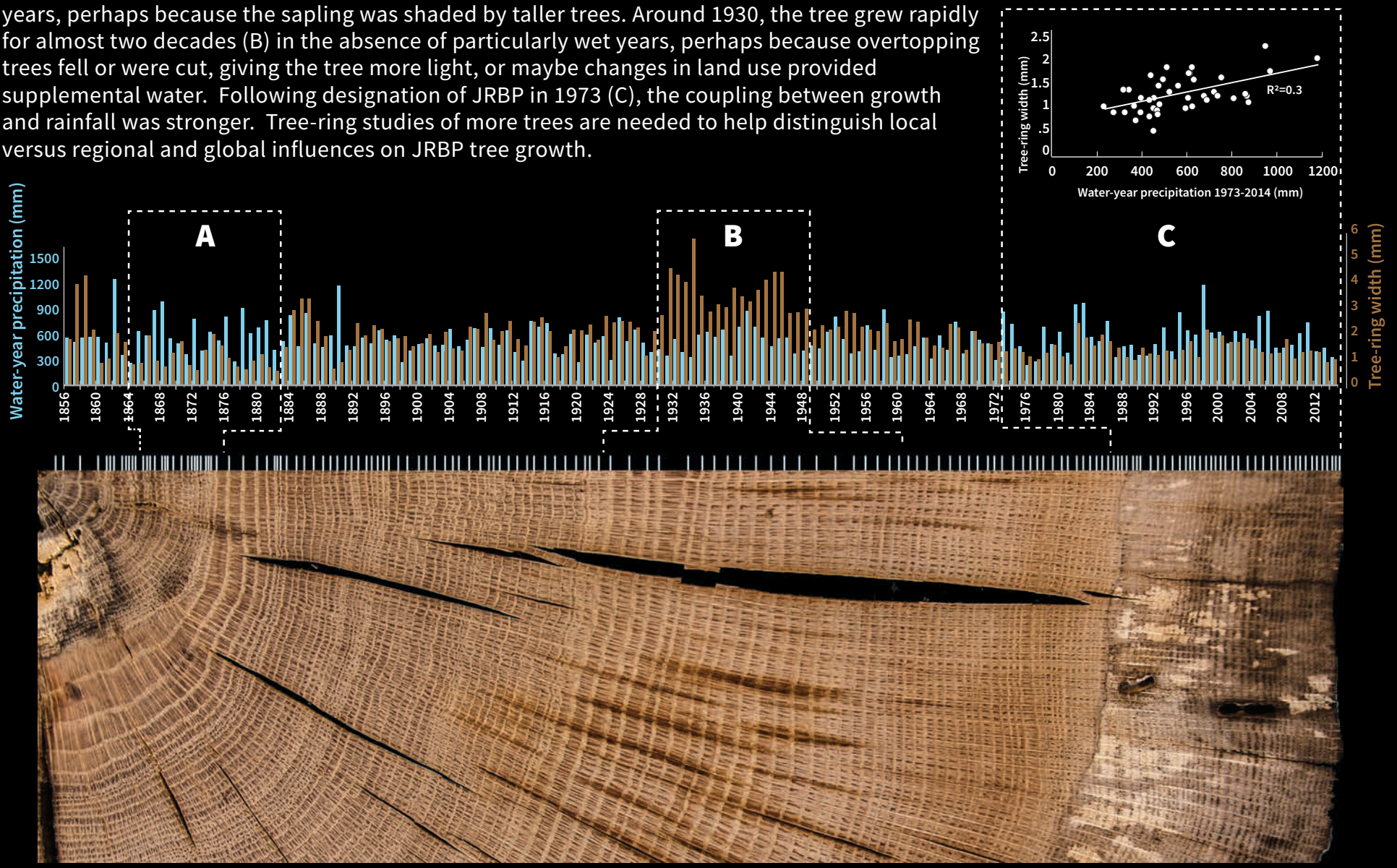
Monthly means[1]



Changing Conditions

160 years of oak growth

Tree rings provide information about how climate changes over decades. Some recent treefalls at JRBP provide an opportunity to examine links between tree-ring width and annual rainfall. Cross-sections of oaks were cut by Professor Chris Field and intern John Fleming. The one pictured below is from the west end of Trail 1 and records years from the Gold Rush to the present, indicated by 160 white tick marks along the top edge of the cross-section. The timeline of annual precipitation in San Francisco (blue bars), a good proxy for JRBP rainfall, is paired with annual tree ring growth (brown bars). In the tree's second decade (phase A), its growth was persistently slow despite wet years, perhaps because the sapling was shaded by taller trees. Around 1930, the tree grew rapidly for almost two decades (B) in the absence of particularly wet years, perhaps because overtopping trees fell or were cut, giving the tree more light, or maybe changes in land use provided supplemental water. Following designation of JRBP in 1973 (C), the coupling between growth and rainfall was stronger. Tree-ring studies of more trees are needed to help distinguish local versus regional and global influences on JRBP tree growth.



Researchers[1]

Stanford

9 faculty

12 postdocs

11 grad students

8 undergrads[3]

12 departments represented

6 schools represented

Non-Stanford

38 researchers

8 countries represented

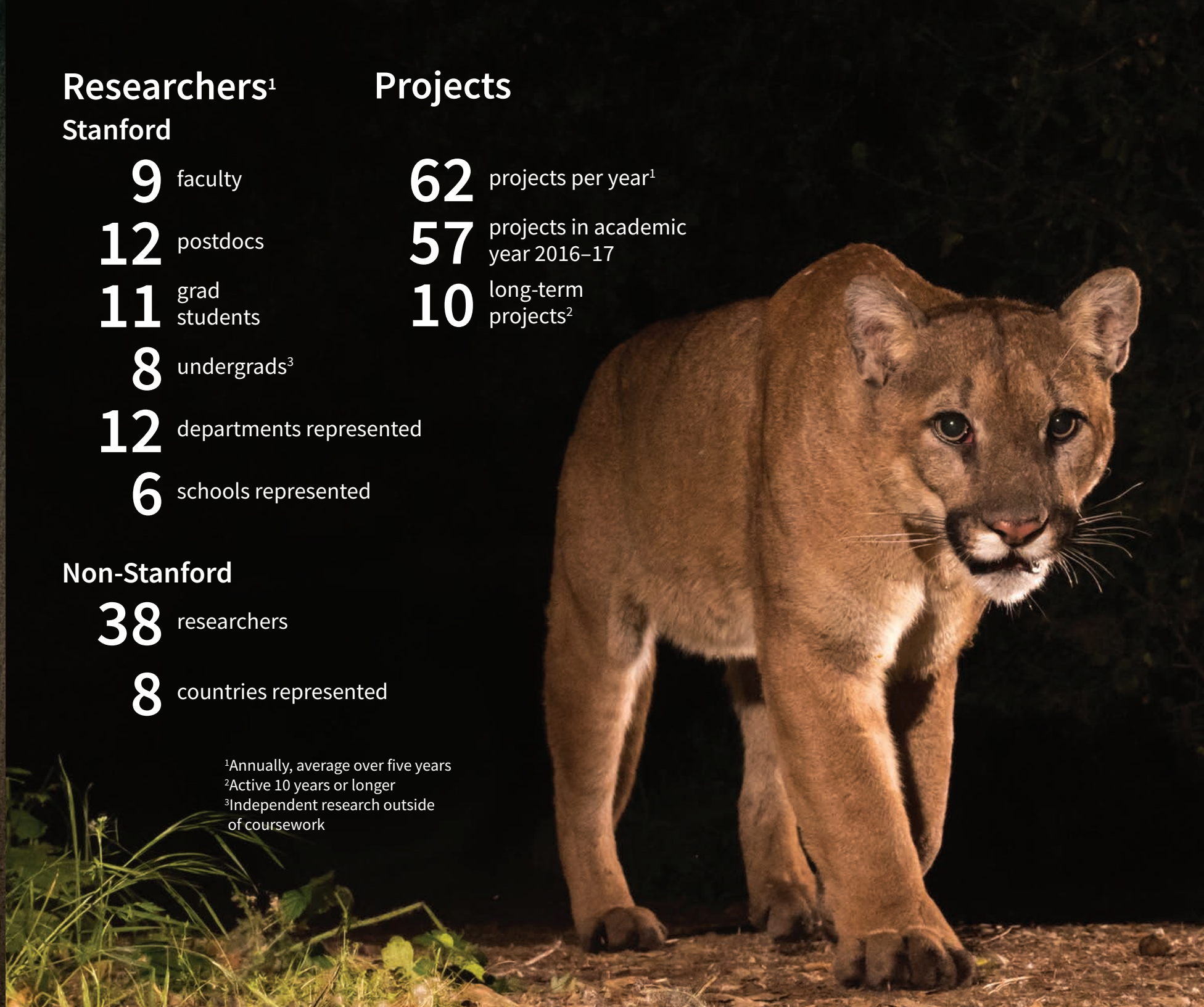
Projects

62 projects per year[1]

57 projects in academic year 2016–17

10 long-term projects[2]

[1]Annually, average over five years
[2]Active 10 years or longer
[3]Independent research outside of coursework



Left: *Undergraduates* ***Syler Peralta-Ramos ’20*** *and* ***David Rosenzweig ’20*** *experimented with using a motion-triggered HDSLR camera to get high quality images of mountain lions.*

Right: *Several studies this year examined phenomena that take place where people rarely look—at the soil surface and below. Clockwise from top left of the panel, the photos show:*

Sadie Cwikiel ’19 *measuring* CO_2 *flux of soil as part of her Stanford Earth Summer Undergraduate Research study of microbial respiration in soils during extreme drought and subsequent wetting.*

Thief ants *(*Solenopsis molesta*) form nests near those of other ants and steal from them. They are one of 19 ant species tracked by the long-term survey of Argentine ant invasion.*

A ceramic doll’s face *assembled from fragments unearthed by archaeologists studying the trash pit of the Searsville dam-keepers and their families, whose lives at the turn of the 20th century are explored in an archaeology thesis by* ***David Daly****.*

Camera-trap images, scats, and environmental DNA are providing data for doctoral student ***Jordana Meyer*** *and postdoc* ***Kevin Leempoel*** *to ground-truth new methods of censusing wildlife, techniques useful at JRBP and around the world.*

Undergraduate ***Ricky Cordova ’18*** *collecting lichens from fallen limbs in a hunt for new species of tardigrades, a new model system in developmental and evolutionary biology.*

Slender salamanders (Batrachoseps attenuatus*), studied by undergraduate* ***David Tattoni ’20*** *to evaluate the abundance and habitat distribution of* Batrachochytrium dendrobatidis*, a fungus that causes a devastating disease in amphibians.*

PUBLICATIONS

Andresen LC, Müller C, de Dato G, Dukes JS, Emmett BA, Estiarte M, Jentsch A, et al. 2016. Chapter nine–Shifting impacts of climate change: long-term patterns of plant response to elevated CO_2, drought, and warming across ecosystems. *Advances in Ecological Research* 55:437–473. http://dx.doi.org/10.1016/bs.aecr.2016.07.001.

Asner GP, Brodrick PG, Anderson CB, Vaughn N, Knapp, Martin RE. 2016. Progressive forest canopy water loss during the 2012–2015 California drought. *Proceedings of the National Academy of Sciences* 113:E249–255.

Barbosa JM, Sebastián-González E, Asner GP, Knapp DE, Anderson C, Martin RE, et al. 2016. Hemiparasite–host plant interactions in a fragmented landscape assessed via imaging spectroscopy and LiDAR. *Ecological Applications* 26:55–66.

Barnosky AD, Hadly EA, Gonzalez P, Head J, Polly PD, Lawing AM, Eronen JT et al. 2017. Merging paleobiology with conservation biology to guide the future of terrestrial ecosystems. *Science* 355(6325):eaah4787.

Daly DB. 2016. Archaeology of the Dam-keeper's House. MA thesis, Department of Anthropology, San Francisco State University.

Dittmar EL. 2017. Local Adaptation and Fitness Trade-offs. PhD dissertation, Michigan State University.

Dittmar EL, Schemske DW. The edaphic environment mediates flowering-time differentiation between adjacent populations of Leptosiphon parviflorus. *Journal of Heredity. doi.org/10.1093/jhered/esx090*

Foxcroft LC, Pyšek P, Richardson DM, Genovesi P, MacFadyen S. 2017. Plant invasion science in protected areas: progress and priorities. *Biological Invasions* 19:1353–1378. 10.1007/s10530-016-1367-z.

Funk JL, Wolf AA. 2016. Testing the trait-based community framework: do functional traits predict competitive outcomes? *Ecology.* doi: 10.1002/ecy.1484

Gallardo-Romero NF, Drew CP, Weiss SL, Metcalfe MG, Nakazawa YJ, Smith SK, Emerson GL, et al. 2012. The pox in the North American backyard: Volepox virus pathogenesis in California mice *(Peromyscus californicus)*. *PLOS ONE* 7(8):e43881. doi:10.1371/journal.pone.0043881.

Gharehaghaji M, Minor ES, Ashley MV, Abraham ST, Koenig WD. 2017. Effects of landscape features on gene flow of valley oaks *(Quercus lobata)*. *Plant Ecology* 218:487–499.

Harrison JG, Forister ML, Parchman TL, Koch GW. 2016. Vertical stratification of the foliar fungal community in the world's tallest trees. *American Journal of Botany* 103:2087-2095. doi:10.3732/ajb.1600277.

Hufkens K, Keenan TF, Flanagan LB, Scott RL, Bernacchi CJ, Joo E, Brunsell NA, et al. 2016. Productivity of North American grasslands is increased under future climate scenarios despite rising aridity. *Nature Climate Change*. doi: 10.1038/NCLIMATE2942.

Klimley AP, Wyman MT, Kavet R. 2017. Chinook salmon and green sturgeon migrate through San Francisco Estuary despite large distortions in the local magnetic field produced by bridges. *PLOS ONE* 12(6): e0169031. https://doi.org/10.1371/journal.pone.0169031.

Publications

31 total publications

5 by Stanford researchers only

23 different journals

15 by non-Stanford researchers only

11 by Stanford plus outside researchers

Koenig WD, Knops JMH, Carmen WJ, Pesendorfer MB. 2017. Testing the terminal investment hypothesis in California oaks. *The American Naturalist* 189:564-569. doi: 10.1086/691161.

Koenig WD, Knops JMH, Pesendorfer MB, Zaya DN, Ashley MV. 2017. Drivers of synchrony of acorn production in the valley oak *(Quercus lobata)* at two spatial scales. *Ecology*. doi:10.1002/ecy.2010

Le Roux X, Bouskill NJ, Niboyet A, Barthes L, Dijkstra P, Field CB, et al. 2016. Predicting the responses of soil nitrite-oxidizers to multi-factorial global change: a trait-based approach. *Frontiers in Microbiology* 7:628.

Mukundarajan H, Hol FJH, Castillo EA, Newby C, Prakash M. 2017. Using mobile phones as acoustic sensors for high-throughput surveillance of mosquito ecology. *bioRxiv* doi: https://doi.org/10.1101/120519.

Nieto NC, Salkeld DJ. 2016. Epidemiology and genetic diversity of *Anaplasma phagocytophilum* in the San Francisco Bay Area, California. *The American Journal of Tropical Medicine and Hygiene* 15:0707. doi 10.4269/ajtmh.15-0707.

Perea R, López-Sánchez A, Dirzo R. 2017. Differential tree recruitment in California oak savannas: Are evergreen oaks replacing deciduous oaks? *Forest Ecology and Management 399:1–8.*

Paz-Kagan T, Asner GP. 2017. Drivers of woody canopy water content responses to drought in a Mediterranean-type ecosystem. *Ecological Applications* 27: 2220–2233. doi:10.1002/eap.1603.

Perkins ML, Frank HK, Pauly JM, Hadly EA. 2017. Frequency shifting reduces but does not eliminate interference between echolocating bats: a theoretical analysis. *Journal of the Acoustical Society of America* 142:2133. doi.org/10.1121/1.5006928.

Porter SS, Chang PL, Conow CA, Dunham JP, Friesen ML. 2016. Association mapping reveals novel serpentine adaptation gene clusters in a population of symbiotic *Mesorhizobium*. *International Society for Microbial Ecology Journal.* Doi:10.1038/ismej.2016.88.

Romero-Olivares AL, Allison SD, Treseder KK. 2017. Soil microbes and their response to experimental warming over time: a meta-analysis of field studies. *Soil Biology and Biochemistry* 107:32–40.

Siebecker MG, Chaney RL, Sparks DL. 2017. Nickel speciation in several serpentine (ultramafic) topsoils via bulk synchrotron-based techniques. *Geoderma* 298:35-45. doi: http://dx.doi.org/110.1016/j.geoderma.2017.03.008.

Skowronek S, Asner GP, Feilhauer H. 2016. Performance of one-class classifiers for invasive species mapping using airborne imaging spectroscopy. *Ecological Informatics.* http://dx.doi.org/10.1016/j.ecoinf.2016.11.005

Steffen W, Leinfelder R, Zalasiewicz J, Waters CN, Williams M, Summerhayes C, Barnosky AD et al. 2016. Stratigraphic and earth system approaches to defining the Anthropocene. *Earth's Future.* doi: 10.1002/2016EF000379

Strong AL, Johnson TP, Chiariello NR, Field CB. 2017. Experimental fire increases soil CO_2 efflux in a grassland long-term, multi-factor, global change experiment. *Global Change Biology* 23:1975–1987. doi:10.1111/gcb.13525.

Vannette RL, Fukami T. 2016. Nectar microbes can reduce secondary metabolites in nectar and alter effects on nectar consumption by pollinators. *Ecology* 97:1410–1419.

Vittori G. 2016. A meditation on stillness: Ann Carlson's Picture Jasper Ridge. *The Drama Review* 60:83–102.

Zhu K, Chiariello NR, Tobeck T, Fukami T, Field CB. 2016. Nonlinear, interacting responses to climate limit grassland production under global change. *Proceedings of the National Academy of Sciences* 113:10589–10594. doi:10.1073/pnas.1606734113.

Authors

194 total authors

29 Stanford authors

12 Stanford departments and programs

165 non-Stanford authors

7 average number of co-authors per paper

EDUCATION

David Tattoni '20 *holding a gopher snake (*Pituophis catenifer*) with teaching assistant* ***Brendan Palmieri BS'15 MS'16*** *looking on during class field work.*

Formal and informal education, meetings and workshops

>5100 total visitors[1]

2 flagship courses

Bio/Esys 105 A/B is a two-quarter class that prepares students to join the JRBP education program. Students learn how to do field research and are trained to communicate science. They put their skills to work by joining the JRBP educational program, where they lead teaching tours and assist with classes.

Bio 46/47 teaches students how biological research is conducted through hands-on projects that focus on nectar microbes at JRBP. The students' work includes assessing background literature, generating testable hypotheses, collecting and analyzing field- and lab-based data, and writing up and presenting results.

Within Stanford[1]

~2500 students from

22 courses

25 departments & programs

5 schools

31 meetings, retreats or tours for Stanford groups

[1]Annually, average over five years

Left: Jessica Eggers '19 *and* ***Jack Owicki*** *working together to identify insects during the 2017 Bio/Esys 105 terrestrial invertebrate class.*

Below: *Incoming freshmen participating in the Stanford Native Immersion Program (SNIP) visited JRBP along with* ***Denni Woodward*** *(Mescalero Apache), Assistant Dean of Student Affairs & Associate Director, Native American Cultural Center (at the right end of the middle row) and* ***Greg Graves '85*** *(Delaware of Western Oklahoma), Assistant Dean for Student Affairs and Associate Director, Native American Cultural Center (back row, third from left).*

Non-Stanford educational use[1]

970 K-12 students

9 high-schools and middle-schools

260 college and university students

10 colleges and universities

800 visitors on educational tours

350 participants in collaborative education events

Invasive Species

Beginning habitat restoration around Sun Field Station and attacking invasive species were among this year's hands-on conservation activities. Crews from the American Conservation Experience (ACE) made good progress on removing Slender False Brome from the wetland and French Broom from the Sand Hill Road fence line. JRBP staff and volunteers pulled truckloads of *Dittrichia* (stinkwort). Some newly arriving invasive plants, such as Virginia Creeper and Bulbous Bluegrass, have been detected early enough to keep them at "near-zero" status.

21 power poles were made avian-safe by PG&E

1 replacement creek-crossing designed for fish-migration safety

340 hours removing invasive species by ACE crews

4 invasive plant species brought down to "near-zero" populations

Monitoring

A cornerstone of JRBP's conservation mission is longterm monitoring, which includes botanical surveys and collections, high-coverage camera-trap recording of mammals, monthly bird surveys, semi-annual ant surveys, and, periodically, other biotic surveys. Volunteers sustain all of these monitoring efforts, contributing much to the biodiversity knowledge of the preserve.

Mining Historical Records

Volunteers have been working hard to make historical information more accessible and useful for conservation efforts. Zoe Chandik and Sara Timby have now transcribed a fifth of naturalist Herb Dengler's handwritten Jasper Ridge field notebooks. Fred Hansson is indexing and annotating myriad maps and boundary surveys, and has unearthed the oldest map yet (1908) that applies the name Jasper Ridge to the area.

Anticipating Threats

Some looming threats to JRBP are driven by global changes: anthropogenic climate change, wildfires, increasing urbanization, invasive species. Other threats derive from our local setting: our relatively small size, issues involving Searsville Dam and Reservoir, and aging infrastructure. Dealing with these threats over the next few years will require developing new programs with local, regional, and international partners. At the same time, our hands-on research, education, and volunteer programs continue to be especially relevant, for instance, monitoring and developing new methodologies for understanding patterns of animal movement, trophic cascades, the abundance and spread of pathogens, the distribution and impacts of pollutants in the environment, and an educational program that highlights local and global stewardship.

Special Conservation Status

20 animal taxa

10 plant taxa

Reducing Fire Risk

The danger of catastrophic wildfire and the duration of the fire season are on the increase. As a result, vegetation management to reduce fire risk is being given high priority. We also installed two fire-lookout cameras to give early warning should fire break out in more remote parts of the preserve or in the surrounding community (see pg 8).

0.33 mile of fence line cleared of ladder fuels by the California Department of Forestry and Fire Protection (CAL FIRE)

1 acre near the Sun Field Station prepared for fire-safe restoration

0.25 acre of Coast live oak thinned to a fire-safe density and distance from the Sun Station

CONGRATULATIONS

This year JRBP awarded research funds to four investigators. Made possible by endowments set up by our generous donors, these awards allow Stanford faculty and students to embark on innovative research that otherwise would not be possible.

Charli Nicole Davis Biology, PhD Student

Philippe Cohen Graduate Research Fellowship

"My work focused on developing methods to assess the populations of large predators in human-dominated landscapes. My co-workers and I extracted DNA from scat and used camera-trap surveys to explore the population dynamics of bobcats (*Lynx rufus*) in JRBP. Scat samples identified 5 individuals in the preserve during the dry season, and 13 in the wet season. Camera traps also picked up fewer bobcats in the dry compared to the wet season (3 versus 4, respectively), and suggested a decrease in the bobcat population since earlier camera-trapping studies in 2011. Our genetic approach combined with traditional camera-trapping improves upon traditional mark-recapture techniques, likely providing a more reliable method for monitoring low-density wildlife populations."

Sergio Redondo Biology, PhD Student

Mellon Grant

"Past mining for gold and mercury as well as other anthropogenic activities (e.g., coal burning) in California have led to excessive release of mercury into the environment, without a clear understanding of the long-term consequences. My project aims to characterize the movement and impact of mercury in terrestrial ecosystems, as we know very little about mercury dynamics in these systems. I'm sampling soil, lichen, earthworms, and bats at JRBP and across the Bay Area to assess the persistence and fate of this toxicant in the terrestrial environment. I am using a mercury analyzer to quantify levels of the toxicant and stable isotope analyses to define Hg sources and trophic structure in this system. I will also be taking a genomic approach to gauge how mercury affects bat health. This project will provide new insights into mercury dynamics and terrestrial food webs at JRBP and beyond."

Glade Dlott Biology, PhD Student

Mellon Grant

"Soil fungi and prokaryotes co-exist in all soils, but most of their ecological niches and interactions remain poorly understood. Their vastly diverse communities often appear functionally redundant, with many organisms seeming to play similar roles. We are exploring this apparent redundancy and inter- and cross-taxon interactions, by studying DNA-based communities of 180 individual soil aggregates taken from the roots of 36 Coast Live Oaks (*Quercus agrifolia*) growing in sandstone, chert, or serpentinite-derived soils. The unprecedented high resolution of these communities will allow us to characterize interactions between microbes, and for the first time, quantify the underlying spatial heterogeneity of bacterial and fungal communities in soil. "

Kabir Peay PhD, Assistant Professor, Biology

Donald Kennedy Award

"Although microbial organisms make up the vast majority of taxonomic and genetic diversity on Earth and control key ecosystem processes, for most ecosystems we have only limited understanding of microbial diversity patterns and the processes that generate them. Therefore, at JRBP we are sequencing microbial genomes from soils and using the information to map microbial diversity across the landscape, in an effort to set microbial organisms in context with better-documented ecosystem features such as plant communities and geological formations. We are also generating a public dataset that will facilitate future research on microbes and their interactions with plants, animals, and the environment at JRBP."

Left: Sergio Redondo *preparing mist nets for capturing bats to be sampled for mercury.*

Right: Charli Davis *(in red shirt) and her crew surveying for bobcat scat.*

Below Left: Kabir Peay *(in red cap) and* ***Glade Dlott*** *collecting soil samples to assess microbial diversity and redundancy.*

FINANCES

Total Expenses[1]

$1,114,389

99,100
Operations & Maintenance

51,777
Administration

28,901
Education & Outreach

59,777
Research[2]

10,298
Land Management

864,536
Salaries & Benefits

Total Revenues[1]

$1,150,710

900,418
Endowments[2]

140,115
University H&S

22,361
General Income

87,816
Gifts & Grants

[1]Only funds controlled by JRBP in direct support of maintaining the preserve for users. Most users fund their work from non-JRBP sources.

[2]Includes $37,403 (expenses) and $54,571 (revenues) administered by Biology but restricted for JRBP use.

Staff

ELIZABETH HADLY Faculty Director
ANTHONY BARNOSKY Executive Director
NONA CHIARIELLO Staff Scientist
BROOKE FABRICANT Resident Ranger
STEVEN GOMEZ Operations Assistant
TREVOR HÉBERT Academic Technology Specialist
SIRI HUNTOON Administrative Associate
CARY TRONSON Operations Manager
JEFF VANCE Special Projects Technician
CINDY WILBER Education Coordinator

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NONA CHIARIELLO JRBP Staff Scientist (ex-officio)

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TOM ZIGTERMAN Stanford University Water Resources & Civil Infrastructure

ELIZABETH HADLY JRBP Faculty Director, Biology
ANTHONY BARNOSKY JRBP Executive Director
NONA CHIARIELLO JRBP Staff Scientist (ex-officio)

JASPER RIDGE BIOLOGICAL PRESERVE
Stanford University
Stanford, CA 94305-5020
http://jrbp.stanford.edu

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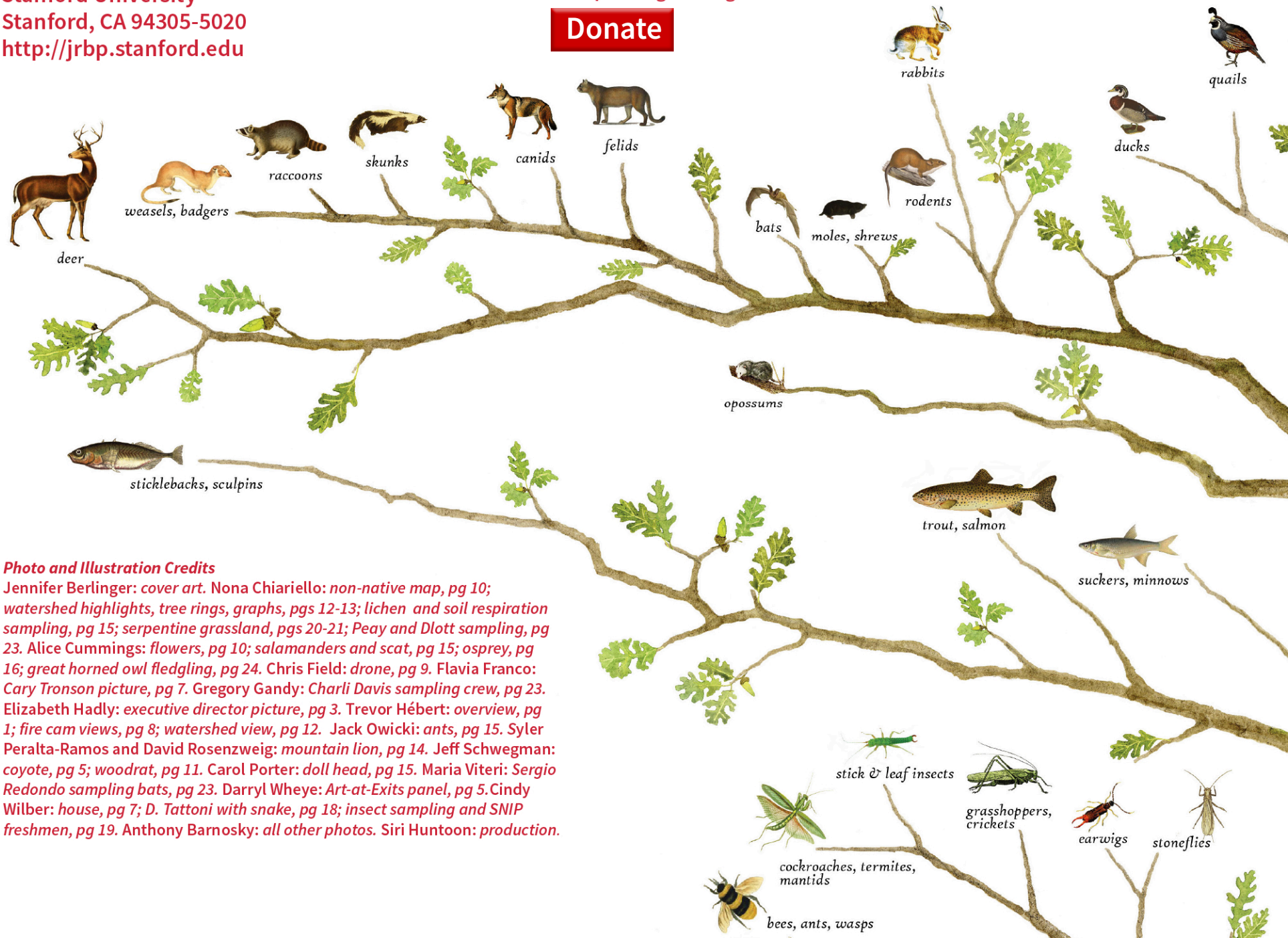

Photo and Illustration Credits

Jennifer Berlinger: *cover art.* Nona Chiariello: *non-native map, pg 10; watershed highlights, tree rings, graphs, pgs 12-13; lichen and soil respiration sampling, pg 15; serpentine grassland, pgs 20-21; Peay and Dlott sampling, pg 23.* Alice Cummings: *flowers, pg 10; salamanders and scat, pg 15; osprey, pg 16; great horned owl fledgling, pg 24.* Chris Field: *drone, pg 9.* Flavia Franco: *Cary Tronson picture, pg 7.* Gregory Gandy: *Charli Davis sampling crew, pg 23.* Elizabeth Hadly: *executive director picture, pg 3.* Trevor Hébert: *overview, pg 1; fire cam views, pg 8; watershed view, pg 12.* Jack Owicki: *ants, pg 15.* Syler Peralta-Ramos and David Rosenzweig: *mountain lion, pg 14.* Jeff Schwegman: *coyote, pg 5; woodrat, pg 11.* Carol Porter: *doll head, pg 15.* Maria Viteri: *Sergio Redondo sampling bats, pg 23.* Darryl Wheye: *Art-at-Exits panel, pg 5.* Cindy Wilber: *house, pg 7; D. Tattoni with snake, pg 18; insect sampling and SNIP freshmen, pg 19.* Anthony Barnosky: *all other photos.* Siri Huntoon: *production.*