FALL 2017 NEWSLETTER
The Department of Integrative Biology
University of California at Berkeley

INSIGHT

GENETICS, GENOMICS, AND EVOLUTIONARY BIOLOGY

Katya Mack didn't intend to become a scientist. Originally from Chicago, she first declared an art major at the University of Michigan as an undergrad. But an elective biological anthropology class in her sophomore year sparked something. "It was right after the Neanderthal genome was sequenced and the instructors had incorporated a unit on human genetics," she recalls. "I remember feeling incredibly excited by the idea of using genomic data to understand a species' evolutionary history and how this changed our understanding of human origins." The experience inspired her to consider pursuing research, and she soon began volunteering in a molecular lab.

Seven years later, Mack is starting her fifth year as a PhD student in population geneticist Michael Nachman's lab. She uses large-scale genomic datasets to answer fundamental questions in evolutionary biology, working with house mice as a model system. In particular, she looks at how species adapt to their environments and what causes species to diverge.

One of the pleasures of Mack's work is being part of the Museum of Vertebrate Zoology (MVZ). "It's an amazing environment for graduate students," she says. "While I work on mammals, I share an office with an ornithologist and a herpetologist who, in addition to having a different taxonomic focus, are also interested in very different research questions. This has led to some lively office discussions and has encouraged me to think more broadly." She also loves that her office is located within the museum's collection. "Every time I leave, I pass mounted birds, mammal skulls, and cases full of invaluable samples. It's easy to feel inspired to do science when you're surrounded by more than 100 years of extraordinary scientific effort every day."

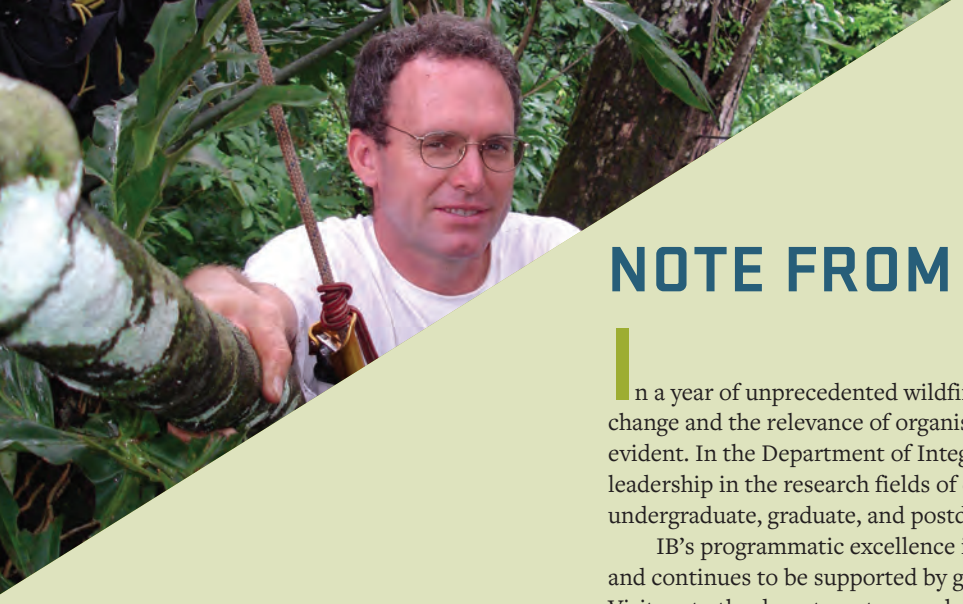
Mack is committed to the idea of mentoring and has worked with a number of Berkeley undergraduates, some of whom have since gone on to pursue graduate school or careers in science. Programs like the Undergraduate Research Apprenticeship Program (URAP) allow them to get their feet wet with active research and increase the diversity of students who enter STEM fields, she says.

Her mentoring reaches beyond UC Berkeley, as well. With the "Be A Scientist" program, she helps middle-school students work through science experiments — they propose a testable question, design an experiment, and test it over a six-week period. "It's really fun to work with them through the entire process," Mack says. "Often they'll claim they aren't interested in science — until we land on the right question."

Once she completes her PhD, Mack hopes to pursue a postdoc in the same field. For students interested in pursuing a similar path, she advises taking the time to figure out what questions excite them and then identifying those people who are interested in similar questions.

As she pursues her own scientific questions, Mack continues to enjoy the hunt for solutions. "I just love that 'aha!' moment when I solve a problem or even think about a problem in a new way," she says. "It's exciting to be in a field where I get to have those kinds of moments every week."

Katya Mack poses with Dolly, the first cloned sheep, at the National Museum of Scotland in Edinburgh.



NOTE FROM THE CHAIR

In a year of unprecedented wildfires and hurricanes, the primacy of global environmental change and the relevance of organismal biology to human concerns have become even more evident. In the Department of Integrative Biology, we continue to provide international leadership in the research fields of ecology, evolution, physiology, and behavior. Our work in undergraduate, graduate, and postdoctoral education lies at the core of these efforts.

IB's programmatic excellence is well recognized by top national educational rankings, and continues to be supported by generous gifts from graduates and other benefactors. Visitors to the department are welcome! I would be pleased to share in-person departmental news, and also to receive feedback and to pursue new mechanisms for sustaining excellence in our multifaceted academic enterprise.

Robert Dudley
Professor and Chair

FACULTY NEWS

ACCOLADES

Caroline Williams received the George A. Bartholomew Award, presented by the Division of Comparative Biology and Biochemistry in the Society of Integrative and Comparative Biology, which honors a young investigator for distinguished contributions to comparative physiology and biochemistry or to related fields of functional and integrative biology.

Britt Koskella received the 2018 Young Investigator Award, presented by the American Academy of Microbiology, which recognizes and rewards early-career scientists for research excellence and potential in microbiology and infectious disease.

NEW FACULTY PROFILE

Although José Pablo Vázquez-Medina grew up in central Mexico surrounded by land, he always loved the ocean. That youthful fascination grew into scientific study as he pursued his bachelor's and master's degrees in marine biology. Now, after a PhD at UC Merced and a postdoc at the University of Pennsylvania's Perelman School of Medicine, he's joined UC Berkeley as an assistant professor of integrative biology.

As a physiologist, Vázquez-Medina studies how vertebrates adjust to natural and anthropogenic stressors at the molecular, cellular, and organismal levels. His lab is seeking to understand the role of oxidative stress and redox signaling in physiological adaptation and human disease. "We look at marine mammals and form an approach to learn mechanisms that can be applied to human medicine," he says. "For example, how they can hold their breath for long periods of time and be so tolerant to low oxygen and low levels of blood flow. If we understand how these animals cope with extreme conditions, we can apply that to humans."

Nature has figured out all the experiments, he says, and the fun is in learning the answers. "For example, elephant seals come onto the beach to breed or molt, and they can stay there without eating for several months at a time. If we look at the phenotype, they should have a lot of complications but they don't. These animals are a prime example of fat utilization."

Within both IB and Berkeley, Vázquez-Medina is finding a rich environment for his work. "My colleagues and students are just outstanding," he says. "Our department is very broad, so I'm interacting with many different disciplines, and that opens my own perspective. It's such a diverse group, and there's lots of talking in the hallways!"

José Pablo Vázquez-Medina

RICHELLE TANNER
SEA SLUGS AND CLIMATE CHANGE

Graduate student and jazz musician Richelle Tanner

Richelle Tanner has a double passion: oceans and jazz. She earned a dual bachelor's degree in environmental studies and jazz studies from the University of Southern California, and for many years she toured and competed nationally on piano in jazz competitions. Today she's a third-year PhD student working in the labs of Jonathon Stillman and Wayne Sousa, researching marine invertebrate physiology and climate change. Is there an intersection between the two interests? "Just as deviations from a research plan can often result in more novel findings, a jazz solo with riskier note choices is often more interesting than one that is by the book," she explains.

Tanner's own research is focusing on the effects of temperature change on the physical traits, embryonic physiology, and phenology of a particular type of sea slug (*Phyllaplysia taylori*) found only on the Pacific Coast. Over the past winter, the species completely disappeared from San Francisco Bay, providing a rich opportunity to study how ecosystems shift with the loss of a major player. "Finding out how *Phyllaplysia* respond to climate change in real time is both terrifying and exhilarating," she says. "I want to push forward with molecular analyses to see if the species is really in danger of further local extirpation elsewhere."

Growing up in Seattle and spending summers in Hawaii cultivated Tanner's interest in marine creatures, especially nudibranchs and sea slugs. Her upbringing also instilled the importance of protecting the environment in the face of human-induced climate change. "From an early age, it was a sure bet you'd find me down in the tide pools poking around with my pocket-sized field guide," she remembers. "You might say that my PhD research is just a continuation of what I've loved my whole life; it's hard not to wonder about our oceans once you realize how little we know about them."

Tanner is also involved with several community science education organizations, including Bay Area Scientists in Schools (BASIS), believing that science education at multiple levels of societal impact is imperative to any scientist's career. "Without being a part of our community, we don't have the capacity to impart change," she says. She's especially excited about a growing network called the National Network for Ocean and Climate Change Interpretation, where last year she served as a science fellow in the Central CA Pilot Study Circle.

Tanner ultimately hopes to teach at a research university; before then, she expects to do a postdoc in more mechanistic physiology and the effects of climate change. Jazz will continue to be a passion, too. She still performs occasionally with local groups and writes large ensemble pieces for USC and some groups in the Bay Area. "Thinking about research in the same way that improvisation works in jazz has really helped me to create research plans with enough flexibility to allow for meandering ideas to come to fruition," she says. "Hopefully, it can result in a richer story for my research."

Tanner in an intertidal eelgrass bed researching the sea slug *Phyllaplysia taylori,* found only on the Pacific Coast.

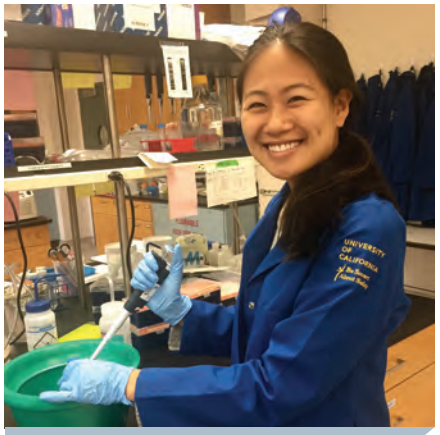
EMILY CORTEZ CHONG
EXAMINING VARIATIONS IN Y CHROMOSOMES

Fourth-year undergrad Emily Cortez Chong was drawn to the integrative biology major because of its vast scope of courses and broad range of fields and perspectives. Her own research in the lab of Doris Bachtrog, however, is laser-focused. Within the lab, projects are exploring the evolutionary history of the sex chromosomes X and Y, which can shed light on how we're affected by DNA variation. "Thinking about these genetic differences on a large scale is interesting to me because it tells a story about how DNA has evolved through time across many populations, and how these modifications can affect the organism," Cortez Chong says.

Compared to other chromosomes, the Y is very small and is often said to contain a lot of "junk" DNA that's not utilized, she explains. These regions, called heterochromatin, are tightly bound by proteins and can vary in amount across Y chromosomes.

Cortez Chong's project uses *Drosophila* fruit flies to examine variations in the Y chromosome in a strain called *Drosophila Affinis*, and she's determining whether these heterochromatic regions can correlate to something such as lifespan and aging. "Once I distinguish between flies with large Y chromosomes from those with smaller Y chromosomes, I can begin performing different tests to measure their lifespans," she says.

Beyond her Berkeley degree, Cortez Chong hopes to attend medical school and apply her integrative biology background to understand deeper biological questions and processes that affect patient health. She's grateful to her mentors, Professor Bachtrog and graduate student Alison Nguyen, for guiding her through her experiment design. "I've learned that research is a long, sometimes arduous process," she says, "which makes successful data collection and results really rewarding."



Emily Cortez Chong

To learn more about undergraduate research opportunities, visit: http://ib.berkeley.edu/undergrad/research.php or the IB Undergraduate Advising Office.

NEW UNDERGRADUATE CLASS
IB 77 INTEGRATIVE HUMAN BIOLOGY

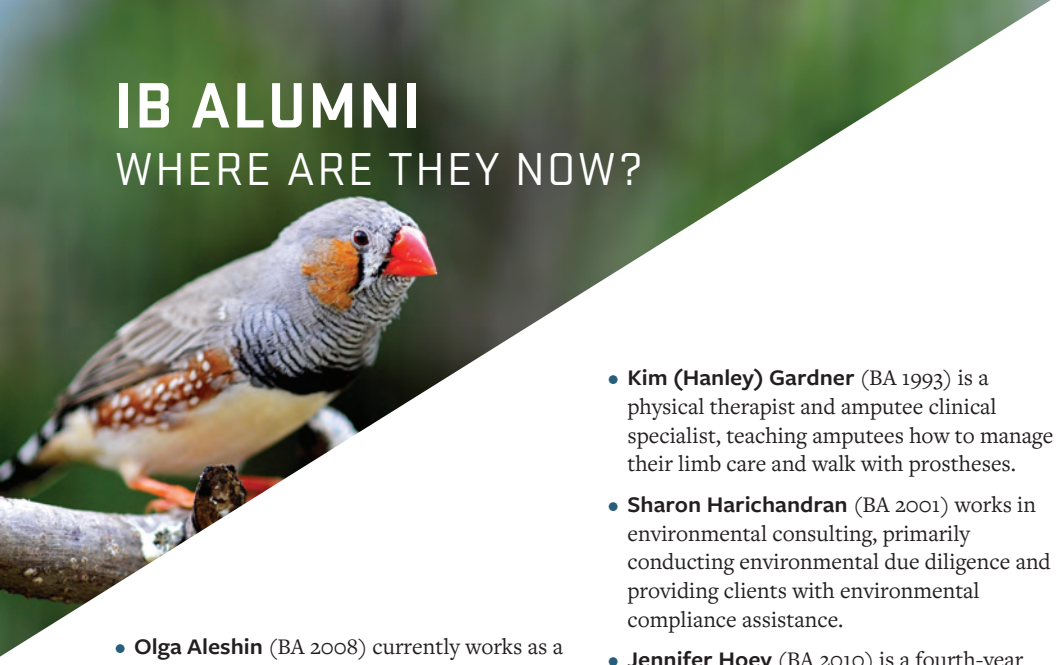
Professor Thomas Carlson holds up *Harrison's Guide to Internal Medicine*, an essential reference textbook for the health sciences. "It's more than 2,500 pages and there's not one mention of evolution," he says, "yet evolutionary theory enables us to better understand human health and disease. The IB faculty is loaded with great teachers and courses to educate our undergraduates on evolution, ecology, and organismal biology."

This is why Carlson created IB 77: Integrative Human Biology, a seminar course that is now a requirement for all newly declared IB majors — the majority of which are preparing for careers in a variety of health professions and research. Each week, a different faculty member presents how their research field contributes to our understanding of human biology and how human biology discoveries are inspired by studies on non-human organisms. The disciplines of evolution, ecology, paleontology, climate change biology, biomechanics, comparative physiology, and comparative anatomy all illuminate our understanding of human biology.

During each lecture, the faculty member also informs students about IB courses they teach, research in their lab, and which Berkeley Natural History Museum and/or research center they are affiliated with. The course enables newly declared IB students to learn about the tremendous diversity of research expertise and courses in the IB department on evolution and ecology. "Physicians will be better doctors," Carlson says, "if they understand evolution."

— Isaac H.L. Marck, graduate student

IB ALUMNI
WHERE ARE THEY NOW?



- **Olga Aleshin** (BA 2008) currently works as a registered midwife and registered nurse at the Royal Prince Alfred Hospital in Sydney, Australia.
- **John Callaway** (BS 1985) has been a professor in the Department of Environmental Science at the University of San Francisco since 1999.
- **Lynn Carpenter** (PhD 1972) has been working since 1992 on restoration ecology of tropical forests and soils on land that she bought in Costa Rica for long-term research.
- **Sheri R. Colberg** (PhD 1992) has just finished a 19-year career at Old Dominion University and retired in June as professor emerita in exercise science.
- **Blair Csuti** (PhD 1977) is retired, after serving as a research associate at the College of Forestry, Oregon State University.
- **Jovauna Currey** (BA 2007) is a third-year resident in physical medicine and rehabilitation at UC Irvine.
- **Brenda Davis** (PhD 1976) is retired in Bozeman, MT after 14+ years with Johnson & Johnson as an officer of the corporation responsible for compliance.
- **Jasmeet K. Dhaliwal** (BA 2006) is in her final year of a PhD program at Scripps Institution of Oceanography at UC San Diego.
- **Connor Dibble** (BA 2009) is a PhD student and NSF Fellow at the Bodega Marine Lab of UC Davis.
- **Daryl Domning** (PhD 1975) teaches human anatomy at the Howard University College of Medicine and has a research associateship at the Smithsonian's National Museum of Natural History.
- **Camille Giraud** (BA 2012) is a first-year medical student at Drexel University College of Medicine in Philadelphia, PA.
- **Kim (Hanley) Gardner** (BA 1993) is a physical therapist and amputee clinical specialist, teaching amputees how to manage their limb care and walk with prostheses.
- **Sharon Harichandran** (BA 2001) works in environmental consulting, primarily conducting environmental due diligence and providing clients with environmental compliance assistance.
- **Jennifer Hoey** (BA 2010) is a fourth-year PhD student at Rutgers University, studying how summer flounder, an important fishery species along the U.S. East Coast, is responding to climate change.
- **Megan Indermill** (BA 2014) is a project manager and environmental scientist for the California Environmental Protection Agency's Department of Toxic Substances Control.
- **Tobias Koehler** (BA 1999) is the director of South Shore Gardens, National Tropical Botanical Garden in Kauai, HI, overseeing its horticulture, living collections, and visitor program.
- **Armand Kuris** (PhD 1971) is a disease ecologist/parasite ecologist and has been on the faculty of UC Santa Barbara since 1975.
- **Roger Q. Landers, Jr.** (PhD 1962) retired in 1994 from a long career as an extension range specialist at Texas A&M Research and Extension Center in San Angelo, TX.
- **Emily Lindsey** (PhD 2013) just started a new job as curator at the La Brea Tar Pits, part of the Natural History Museum of Los Angeles County.
- **Sabrina Marques** (BA 2014) is currently attending medical school at the University of Coimbra in Portugal.
- **Tania Maxwell** (BA 2015) is currently enrolled in a master's program in biodiversity, ecology, and evolution at the University of Paris-Saclay, a French federal research university.
- **John McNamara** (BS 1985) is a board-certified ophthalmologist, practicing in the San Francisco/Peninsula area since 1994.
- **Meriel Melendrez** (BA 2012) owns and operates a gardening business that focuses on sustainable yard practices like drought-tolerant native plants and edible gardens in Vallejo, CA.

Three members of the Class of 2017

- **Lucia Mireles-Chavez** (BA 1992) has practiced pediatrics for 15 years and now also practices age-management and restorative medicine at Optimal Medical Group in Fresno, CA.
- **Kerianne Murphy Wilson** (BA 2010) is a PhD candidate at UC Irvine studying how developmental and adult diets of zebra finches impact resource allocation and the consequences this has for sexual selection.
- **Paul Spinka** (BA 1985) has been in private practice in gastroenterology in Redding, CA since 1996.
- **Jennifer Swillinger** (BA 1977) has been a public-school lab science teacher for 13 years as well as an independent school library resource and a teacher of music and art for 7 years.
- **Mimi Ton** (BA 2015) lives in Oakland, CA and works at the California Emerging Infections Program.
- **Peter Vallejo** (BA 1998) has been teaching secondary science in East Bay public schools for 17 years and is now supporting teachers with instructional technology integration.
- **Dirk Van Vuren** (BA 1975) has been a professor of wildlife biology at UC Davis for the last 26 years.
- **Cheryl Webbon Buettner** (BA 1986) obtained certification through AALAS as a laboratory animal technician and through ASCP as a histotechnologist. She is currently pursuing a career in teaching.
- **Mark A. Wilson** (PhD 1982) has been teaching at the College of Wooster since 1982.
- **Jordan Wolfe** (BA 2008) is a resident physician in Emergency Medicine at Brown University in Providence, RI.

POSTDOC AND STUDENT NEWS

POSTDOC AWARDS

- **Seema Sheth** (Ackerly lab) received the 2017 American Naturalist Student Paper Award from the American Society of Naturalists.
- **Adiel Klompmaker** (Finnegan lab) received a Boucot Research Grant from the Paleontological Society.
- **Ryan Bracewell** (Bachtrog lab) was awarded a NIH NRSA postdoctoral fellowship to work on "Characterizing the phenotypic and genetic basis of behavioral isolation in the Drosophila athabasca species complex."
- **Emily Landeen** (Bachtrog lab) was awarded a NIH NRSA postdoctoral fellowship to work on "Characterizing the Molecular Genetic Basis of Acquiring Dosage Compensation Across Neo-X Chromosomes."

UNDERGRADUATE AWARDS

- **Grant Schroeder** was UC Berkeley's 2017 top graduating senior and winner of the prestigious University Medal.

GRADUATE AWARDS

- Outstanding Graduate Student Instructor (OGSI) Awards: **Jenna Baughman** (Mishler lab); **Philip Georgakakos** (Power lab); **Tesla Monson** (Hlusko lab); **Benjamin Muddiman** (Looy lab); **Adam Schneider** (Baldwin lab); and **Larry Taylor** (Finnegan lab).
- The UC Berkeley Natural History Field Stations recipients of the Carol Baird Graduate Student Award for Field Research: **Kelsey Crutchfield-Peter**s (Dawson lab), **Prahlad Papper** (Ackerly lab) and **Gabriel Rossi** (Power lab).
- NSF Graduate Research Fellowships: **Kyle DeMarr** (Patel lab); **Sara Kahanamoku** (Finnegan lab); **Ashley Smiley** (Dudley lab); and **Elisa Visher** (Boots lab).
- **Tim O'Connor** (Whiteman lab), received the Philomathia Graduate Student Fellowship.
- **Rosemary Romero** (Lindberg lab) received the Bay Area Water Quality Fellowship.
- **Marianne Brasil** (Hlusko lab) received a NSF DDRIG and a Leakey Foundation Research Grant to support her dissertation research and was awarded the Pinto Summer Research Award from the Portuguese Studies Program in the Institute of International Studies at UC Berkeley.
- **Betsabe Castro Escobar** (Fine/Carlson labs) received a Botany in Action Fellowship from the Phipps Conservatory and Botanical Garden and was a Student Travel Award Recipient for the 58th Annual Meeting of the Society of Economic Botany.
- **Sara ElShafie** (Padian lab) was awarded the Charles A. and June R.P. Ross Award for Graduate Student Research from the Geological Society of America and a graduate student research grant from the Evolving Earth Foundation.

Seema Sheth, Meagan Oldfather, and Rachael Olliff Yang, all PhD students in the Ackerly lab.

IN MEMORIAM

MARIAN DIAMOND

UC Berkeley and the Department of Integrative Biology lost a pioneer scientist and a beloved colleague and teacher when Marian Cleeves Diamond died July 25 at the age of 90 at her home in Oakland. Diamond — who was renowned for walking to anatomy class carrying a floral hat box containing a preserved human brain — was one of the founders of modern neuroscience who was the first to show that the brain can change with experience and be improved with enrichment. She achieved celebrity in 1984 when she examined preserved slices of Einstein's brain, discovering that it had more support cells than the average brain.

As Professor Emerita of Integrative Biology, Dr. Diamond was best known for her work with rats, in which she showed that an enriched environment with toys and companions could change the brain's anatomy. She later proved that the brain continues to develop at any age, demonstrating the value of growth and learning throughout life. She also taught us that male and female brains are structured differently, and that stimulating the brain can even enhance our immune systems. Dr. Diamond took every opportunity to encourage both mental and physical activities that enrich the brain, and she herself continued to teach and conduct research until 2014, when she retired at the age of 87.

In a Berkeley career spanning half a century, Dr. Diamond inspired thousands of students over many generations. Globally, her ideas strengthened the efforts of physicians and educators to promote early nurturing and educational enrichment for children. We will miss her.

Marion Diamond photo: Elena Zhukova

ALEJANDRO RICO-GUEVARA
THE HIDDEN WORLD OF HUMMINGBIRDS

It was in the Amazon rainforest, on a field-work trip with a university class in his native Colombia, that Alejandro Rico-Guevara first fell in love with hummingbirds. "The jungle is full of animals, but you rarely see any. They're fearful of humans and take cover," he recalls. "So it surprised me, when we entered hummingbird territory, that the dominant male bird came up and hovered in front of each one of us, checking us out instead of fleeing."

Rico-Guevara was surprised that one of the smallest animals in the forest would be so bold. And once he began studying the species, he found that their personalities differ from those of other animals. "Time is totally different for them," he explains. "We think now that hummingbirds see humans as really big, slow, and clumsy, and they know they can outmaneuver us." He started researching their behaviors and biomechanics, even training the hummingbirds with sound and light cues. With his wife, Kristiina Hurme, a behavioral ecologist, he refined his training techniques with a feeder system. "Every time she would put in new nectar, she would whistle, and we suddenly had hummingbirds performing on command. They're like tiny, really fast dogs."

He's now using nectarivores as a study model to bridge the gap between our knowledge of ecological and co-evolutionary patterns and their underlying mechanisms. Hummingbirds are definitely more intelligent than we previously thought, he says. Proportionately, they're thought to have the largest brain of any bird and the hovering flight they've evolved is unique among vertebrates. But it's still unknown what they're capable of because we can't interact easily and the birds get confused when responding human actions are too slow. Rico-Guevara uses special miniature equipment — such as a syringe with a mask on it — to measure phenomena like breathing rates.

He was drawn to Berkeley, and specifically the lab of Robert Dudley, for its strengths in biomechanics and metabolism research. He loves having the freedom to explore questions that don't yet have an obvious immediate human application, he says, knowing that the payoff may come much later.

Rico-Guevara holds a fellowship from the Miller Institute, which provides not only funding but the chance to regularly interact with scientists from other disciplines. "I'm now collaborating with machine-learning people in the statistics department," he says. "That never would have happened otherwise."

He's also very involved with citizen science, using the iNaturalist platform to share photos of hummingbirds and flowers to study the biology behind them. "We want people to help us plot on a large scale the interactions between hummingbird and plant species. They don't have to be professional scientists to advance the science. Citizen involvement has grown exponentially in the last few years."

Although he's not officially teaching at Berkeley, Rico-Guevara is mentoring students and ultimately hopes to find a faculty position that will allow him both to teach and conduct research. "It's fantastic to get questions from undergrads," he says. "They're already so smart, and they reignite your original love of science."

Want to participate in citizen science hummingbird research? Go to: https://www.inaturalist.org/projects/hummingbirds-and-flowers

In his studies of nectarivores, Alejandro Rico-Guevara is capturing hummingbird behaviors never before identified.
Photo: Anand Varma

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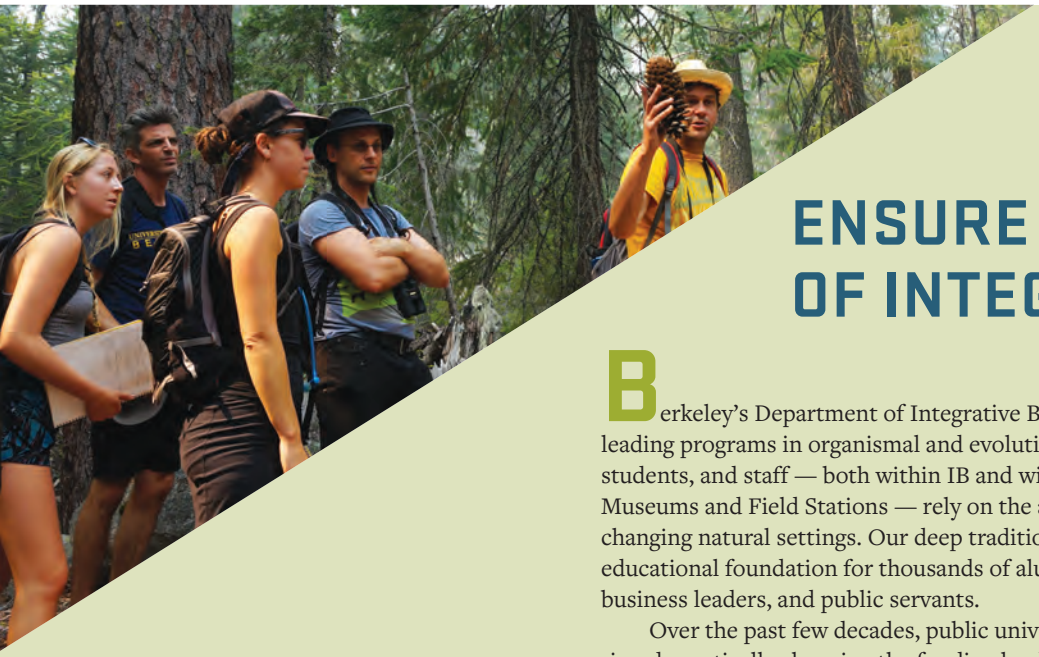

ENSURE THE FUTURE OF INTEGRATIVE BIOLOGY

Berkeley's Department of Integrative Biology (IB) is proud to offer one of the nation's leading programs in organismal and evolutionary biology. The vibrant communities of faculty, students, and staff — both within IB and with the renowned Berkeley Natural History Museums and Field Stations — rely on the ability to study organisms in their complex and changing natural settings. Our deep tradition of field research and training has built an educational foundation for thousands of alumni who have gone on to become scientists, business leaders, and public servants.

Over the past few decades, public universities have seen state support decrease as costs rise, dramatically changing the funding landscape. In order to maintain and grow the scope of our work, we need lasting resources. Private gifts enable us to recruit and retain top-ranked faculty, attract top graduate and undergraduate students, hold lectures and symposia, and continue our tradition of cutting-edge research. We invite you to join us in upholding the discovery and scholarship of IB at Berkeley.

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To discuss ways to directly help students, faculty, labs, and museums, please contact Kirsten Swan, Senior Director of Development, at (510) 643-2228 or kswan@berkeley.edu. You may also choose to donate online at: give.berkeley.edu/ib

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