Integrative Biology

Fall 2008

Photo: P. Cowan

Photo: G. Bentley

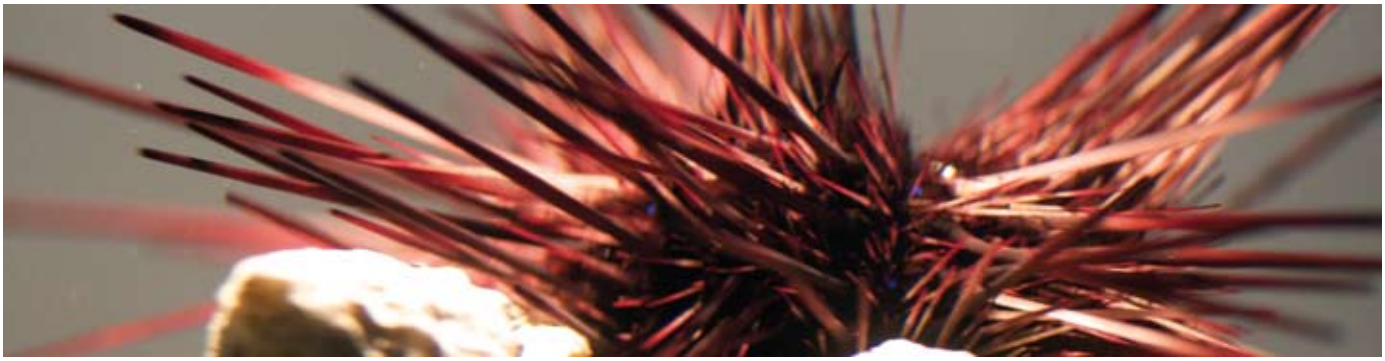

Photo: Y. Munk

Letter from the Chair

Welcome to the second Integrative Biology (IB) newsletter. There have been some exciting developments in our department since I wrote you last spring. We've hired two new faculty members, Dr. Cindy Looy and Dr. Doris Bachtrog, and added a new adjunct professor, Dr. Michael Eisen.

Dr. Looy is a paleoecologist who studies the responses of plants and plant communities to major environmental changes and their possible evolutionary consequences. Her research examines the profound temporal and spatial changes that have occurred in the earth's flora during periods of mass extinction, deglaciation, and global warming. Her work involves the detailed description, quantification, and interpretation of the distribution of plant fossils and pollen among the strata of ancient rock and sediments.

Dr. Bachtrog is an evolutionary biologist, who studies how sexual reproduction and the extent of genetic recombination affect the mode and tempo of genome evolution; in other words, how an organism's genetic information changes over evolutionary time. She uses several different approaches in her research, including molecular and computational techniques, theoretical modeling, and experimental tests. Her primary study organisms are various species of fruit fly, a classic animal model in population genetics research. Dr. Bachtrog is a founding member of the campus' newly established Center for Theoretical Evolutionary Genomics.

Dr. Eisen, a member of the Molecular & Cell Biology Department and the Lawrence Berkeley National Laboratory, has joined our faculty as an adjunct professor. His lab group employs computational and experimental genomic approaches to study how genome sequences specify organismal form and function. He too is a founding member of the Center for Theoretical Evolutionary Genomics.

Another important hire we hope to make in the very near future is that of a senior-level paleobiologist who will direct the UC Museum of Paleontology. We are currently interviewing several excellent candidates for the position. We look forward to the new research directions and courses that these superb scientists will bring to our department. Their intellectual creativity and energy will spark a variety of exciting new research collaborations within IB, and with colleagues in related departments across the Berkeley campus.

In other news since our last communication, I have been appointed chair of IB. I started as an Assistant Professor at Berkeley in 1977, fresh out of graduate school at UC Santa Barbara. My doctoral dissertation examined the responses of seashore communities to natural disturbances, with a particular focus on changes in species diversity. I was hired by the former Zoology Department as a marine ecologist. My research has since expanded to include studies of estuarine host-parasite interactions and the dynamics of mangrove forests on the Caribbean coast of Panama.

My primary goals as chair are to: (1) upgrade the IB curriculum to better meet the needs of our undergraduate majors; in particular, to give them the skills and experience to pursue the biology careers of the future, and to provide better guidance to help students establish and attain their career goals; (2) increase participation by our students in lab and field research, as a foundation for advanced postgraduate studies; (3) increase the diversity of our graduate student body and faculty; (4) increase the financial support we offer to our graduate students, through fundraising and training grants; and (5) better communicate our department's accomplishments and expertise through newsletters such as this one and an informative departmental web site.

Thank you for your continuing interest in Integrative Biology, and special thanks to those of you who have made donations in support of our program. Maintaining a connection with you creates a sense of community that is vital to our future success. The wonderful message we received from Harriet Merwin White, reprinted in this issue, beautifully captures the spirit of the relationships with alumni we hope to establish. As you can imagine, such support is a tremendous help during the lean times our public institution is currently facing. Your support will help us achieve the challenging goals I've set for Integrative Biology.

—Wayne Sousa

Alumni Letters

Greetings to the Integrative Biology Department at UCB from a former graduate of the Zoology Department on the occasion of my 50th anniversary. As my father used to say, "the hands on the clock go round and round, and tempus fugit!"

Your newsletter was quite a treat and brought forth many memories of what I consider the best time of my life. As a senior at Cal I attended a summer program on Invertebrata at Bodega Bay under the tutelage of Professors Smith and Cadet Hand. I believe it was the first year that such a program was given. There was no formal building; we stayed at a motel right on the bay. We definitely roughed it, but it was great. The most sophisticated instrument was a microscope and our most used text was "Between Pacific Tides" by Rickets & Calvin (3rd edition, 1956). Our routine was to visit various habitats each day to enumerate and identify species, mostly invertebrates but some students were interested in birds and mammals.

Another great experience that I had as a senior was to work in the Cancer Research Genetics Lab. It was my job to clean mouse mammary glands that were preserved in Methyl Salycylate. Using a stereoscope and forceps I carefully picked off all muscle fibers, hair and other debris. The best deal, however, was a standing invitation to attend all seminars. At the time the focus of the research was to show that mammary gland cancer was caused by a virus. I believe that virus particles were found in cancerous mouse mammary glands a few years after I left UC.

After graduation I received a Woodrow Wilson Fellowship to study invertebrate neurology with Professor Ernst Florey at the University of Washington. My thesis was presented at a Symposium held at the UW Friday Harbor Lab.

After receiving my Master's Degree I worked at the UW Medical School Neurology Department, and co-authored a paper on Monoamineoxidase. Then I returned to California and took a job at the Children's Hospital of the East Bay in the metabolic lab, working on models of HDL/LDL in chickens. This work also resulted in two published papers in Biochemistry.

Money, or the lack of it, forced me to take a Med Tech License. I then worked at Kaiser-Walnut Creek for 23 years, finally in management and QC. Any success that I have had in my scientific career I owe to the mentoring and classes that I took at UCB.

Please accept this small contribution with my thanks for a great education and know that I have great affection for Life Sciences at UCB.

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Sincerely,
Harriet Merwin White

PS: My daughter is now working in Environmental Studies in the Torn Lab

If you have news you'd like to share, please see Pg. 7 for information on how to contact the IB newsletter team.

Graduate Student Profile: Rebecca Calisi

Not in the Mood: Starlings, Stress and Sex

Photo: R. Calisi

Calisi in Germany studying reproductive patterns in birds under Dr. N. Perfito and Dr. M. Hau

The direct links between stress physiology and reproduction are not well understood in humans or in other vertebrates. IB graduate student Rebecca Calisi of the Bentley lab focuses her doctoral research on how stress influences sexual behavior and reproduction. Specifically, Calisi examines how different types of stress affect a particular area of the brain called the hypothalamus, which synthesizes and secretes hormones responsible for sexual behavior and reproduction. The hypothalamus can react hormonally in different ways, depending on the animal's perceived environment, social interactions, stressful situations and even season and amount of daylight. All of these environmental factors can affect reproductive function. Calisi measures what hypothalamic changes occur in response to these different environmental factors to get a better idea of how the brain might mediate reproduction.

In order to evaluate the effects that stress has on behavior and neurophysiology, Calisi is conducting experiments inside spacious, naturalistic aviaries at UC Berkeley's Field Station for the Study of Behavior, Ecology and Reproduction. Calisi uses a neuroendocrine model species, the European starling (Sturnus vulgaris). Because all animals evolved relatively recently from a common ancestor, their endocrine systems many times function in very similar ways.

Her research in part includes work with a recently discovered neuropeptide known as gonadotropin-inhibitory hormone, or GnIH. Evidence suggests GnIH can inhibit reproduction as well as influence changes in sexual behavior, quite possibly being a neurological factor responsible for "not being in the mood," and Calisi is in the midst of studies examining this topic. A recent experiment published by Calisi in the Journal of General and Comparative Endocrinology demonstrated that the number of neurons in the hypothalamus expressing GnIH in house sparrows (Passer domesticus) increased during times of stress.

These findings help to characterize the neurological pathway by which stress hinders reproduction yet continued research is needed to understand this system completely. Further analysis and findings on GnIH can lead to a better understanding of why all animals, from birds to livestock to humans, might experience certain reproductive pathologies when faced with stressors, and even how reproductive function can be recovered under such circumstances. By studying model avian systems such as the European starling, Calisi and the Bentley lab can begin to unlock the secrets of the behavioral and reproductive neurophysiology of all animals.

—Paige Richardson

Graduate Student Profile: Peter Cowan

Born in Flames: Phoenixes of the Plant World

Photo: P. Cowan

Cowan examines plant characteristics at UC's Quail Ridge near Sacramento, CA

Why would a seed wait to be engulfed in flames to cue germination? IB graduate student Peter Cowan of the Ackerly Lab examines why particular plants rely on fire to regenerate and repopulate landscapes. "The focus of my dissertation is the evolution of plant traits that allow populations to persist in fire prone ecosystems, specifically Mediterranean-type shrubland." says Cowan.

Cowan conducts his research in the chaparral, a habitat characterized by hot dry summers, cool wet winters and wildfires. To determine why fire is vital to shrubs in the chaparral, Cowan examines two separate mechanisms that plants have evolved in the face of fires: the ability to resprout from their roots below ground, as well as seed germination or release of serotiny triggered by exposure to intense heat and smoke.

These mechanisms lead to three plant life history types in fire prone landscapes. The first, known as obligate seeders are species with seeds that need fire in order to germinate, sometimes requiring chemicals in the smoke or the intense heat shock. Secondly, obligate resprouters, species with seeds incapable of surviving fire but with root systems that persist. Finally, facultative seeders, which have both roots and seeds capable of surviving fires. All of these adaptations co-occur in the chaparral. Cowan is especially interested in how these three strategies evolved over time and continue to coexist today.

In a recent project Cowan and his advisor, IB professor David Ackerly investigated how a plant's traits affect its flammability. Cowan's research entailed gathering plants at Quail Ridge, removing the dead branches from one set of plants, and leaving another set untouched. Next, Cowan burned these plants in an intermediate scale calorimeter located at the California Bureau of Home Furnishings and Thermal Insulation (BHFTI). While burning the plants, Cowan was able to measure how much heat each plant gave off in total and how quickly heat was given. Explains Cowan, "Not all plants hold onto their branches after they die, however the species we were working with chamise, Adenostoma fasciculatum, does."

With an increasing development of land near the shrublands, understanding fire characteristics of vegetation plays a major role in development. Shrublands similar to chaparral can be found in SW Australia, South Africa, Chile and the Mediterranean. Chaparral in California covers 6% of the state yet contains nearly a quarter of the plant species.

—Paige Richarson

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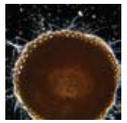

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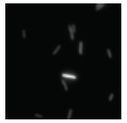

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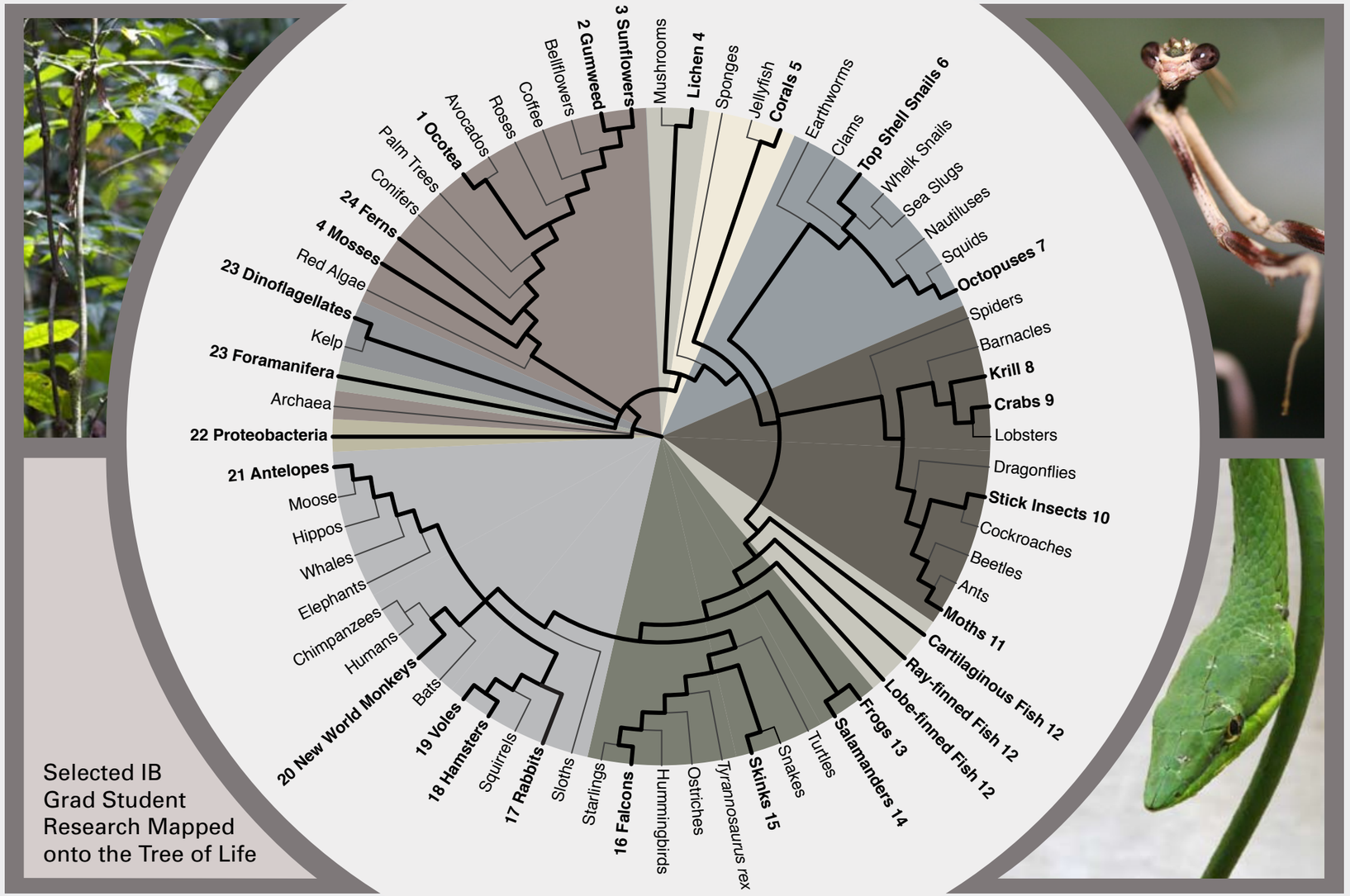

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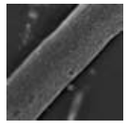

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Faculty Profile: Tony Barnosky

The Last Mass Extinction: What the Past Says About Our Future

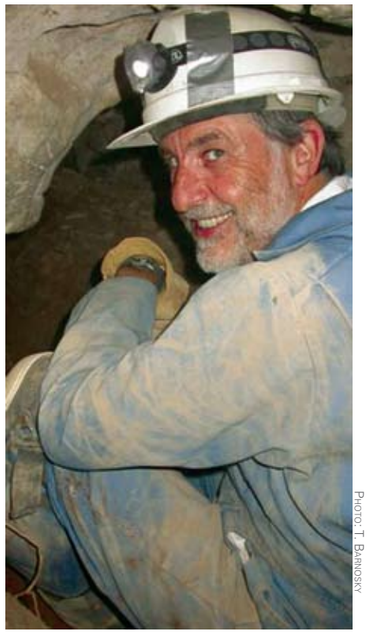


Photo: T. Barnosky

Professor Tony Barnosky excavating Pleistocene mammals from a cave

Between 15- and 10,000 years ago nearly three quarters of large mammal genera went extinct in North America. It was part of a global event known as the Quaternary Megafauna Extinction (QME), during which over 178 species of mammals with body weights exceeding 100 pounds disappeared over a period of about 40,000 years.

It's an episode in the history of life on earth that interests IB professor Tony Barnosky not only for what it can reveal about how changing climate has affected biodiversity in the past, but for what it may tell us about the future. Like today, the QME was a period when human populations were expanding rapidly at the same time the earth's climate was heating up. Understanding how these factors impacted ancient ecosystems can provide clues to how to prevent a similar kind of extinction event today.

A paleoecologist with more than 30 years of experience using fossils to understand ecosystem response to past climate change, Barnosky's latest work employs methods used by ecologists working on living systems to uncover disturbing truths. He used estimates of past human population sizes to calculate total human biomass (the combined weight of all humans on Earth) over the last 100,000 years and compared this with the biomass of all other megafauna species living across the same time.

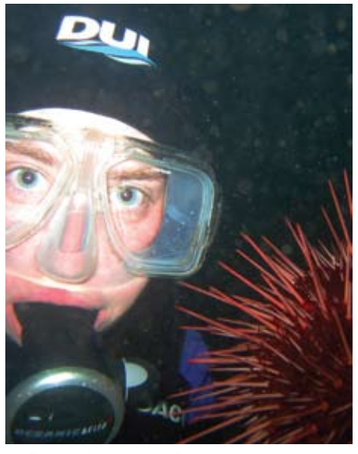
He found that as human biomass gradually increased, the combined biomass of all other megafauna decreased until a tipping point was reached in human population size and biomass of all other species crashed dramatically. "The megafaunal crash 10,000 years ago," says Barnosky, "was an inevitable outcome of growing human population sizes." Traditionally, the debate about what caused the QME has revolved around two hypotheses: overkill by humans moving into new territory, or a warming climate that changed animals' habitats. But while both of these played a role, it ultimately came down to competition for limited global resources.

You might expect that human biomass would make up the difference in the biomass lost as other species went extinct, and that overall megafaunal biomass would stay constant. But that's not what happened. Biomass returned to pre-crash levels only after some 9000 years. Then, megafauna biomass shot way above the pre-crash level. Why? As humans began to mine fossil fuels, they provided a new source of energy to supplement energy from the sun, allowing global biomass - mostly in the form of human beings - to skyrocket past pre-crash levels. It sends a warning message about our reliance on oil. "When fossil fuels are gone," says Barnosky, "either we replace that with something else, or there's another huge crash."

— Lorraine Casazza

Professor Barnosky draws on his many years of research experience to write in depth about history's lessons on the future impacts of climate change on ecology in his upcoming book *Heat Stroke: Saving Nature in the Age of Global Warming*, due out in early 2009.

URAP Profile: Julie Himes



Former Integrative Biology undergraduate and current UCLA graduate student Julie Himes dives with a red urchin in Friday Harbor, WA.

Julie Himes always knew she wanted to be a marine biologist, but it was while taking IB professor Roy Caldwell's Animal Behavior class that she decided not to wait to get hands-on experience. Thanks to UC Berkeley's Undergraduate Research Apprenticeship Program (URAP) she was able to join the Caldwell lab and learn about research in the best way possible - by doing it.

She started out helping with basic tasks. "I fed the animals, checked salinity levels, maintained aquaria," says Julie. "Pretty soon, I wanted to get involved in research, so I conducted some projects." After four semesters in URAP, the Caldwell lab was like a home away from home.

Started in 1991 to help connect undergraduates with faculty researchers, URAP is a campus wide program that gives students the opportunity to be a part of cutting edge research. Each semester professors from every department are invited to post project descriptions on the URAP website. If students see something that interests them, they can submit an application to join the project for a semester. Once professors make their selections, they sign a Learning Contract with accepted students. The contracts outline both student duties, and what they can expect to learn from the experience.

Since URAP's inception 28 IB faculty members have signed 863 learning contracts — and that number doesn't include all the IB undergraduates who sign contracts with professors in other departments. "IB students are in all kinds of different places," says Terry Strathman, director of the Office of Undergraduate Research within the College of Letters and Science. "We try to make sure they don't just look at their own department, because Berkeley is so inter-disciplinary."

For students like Julie, participating in URAP can be a great way to learn about the realities of lab and field work. "It changed my understanding of biological research," she says, "because I realized how difficult animals are to work with and how many factors need to be considered and controlled for when conducting behavioral research." That didn't deter her from going on to a PhD program at UCLA where she now studies the behavior of abalone and sea urchin sperm, but it let her know what to expect when she got there. For other URAP students, the experience may help them realize they don't enjoy research as much as they thought they would, and that's good news too. "We consider finding out that you love it, or finding out you can't stand it, those are both success stories," says Terry.

— Lorraine Casazza

My Summer Vacation: Researching Snails in Japan

This summer I was sponsored by the NSF (USA) and JSPS (Japan) as an EAPSI (East Asian Pacific Summer Institute) fellow to work with Dr. Seiji Hayashi at Nagoya University to collect buccinid gastropod (whelk) tissue samples and examine shell collections at museums throughout Japan. I'm interested in the diversity and evolution of these animals and the Japan Sea and Pacific Ocean off Japan's eastern coast are home to more whelk species than anywhere else in the world - more than 300 species!

About a dozen whelk species are commonly eaten in Japanese cuisine, so a good place for much of my "fieldwork" was at the local fish market. I found "tsubu gai" ("whelk" in Japanese) at 5 of the 6 fish markets I visited in cities including Tokyo, Osaka, Sendai, and Joetsu.

During my travels I also visited 4 Japanese castles, six Buddhist temples, and thirteen Shinto shrines. The landscape was also covered with hundreds of beverage vending machines, and thousands of loud cicadas.

One of my adventures was even in the local newspaper of the northern Honshu town of Rikuzen-Takata. While in Japan I also came to deeply appreciate the relatively cool summers of Berkeley compared to the sweltering Honshu summer, learned to love eel fillets over rice and green tea slushies with sweet red bean, and depended on 7-11 for more meals than I care to admit.

— Jann Vendetti

We'd love to hear from you! If you'd like to share feedback or tell us what you're up to — or if you know someone who would like to receive this newsletter — please send an email to **newsletter@berkeley.edu** and include your degree and graduation year.

Editors	Lorraine Casazza
	Paige Richardson
Graphic Design	Yonatan Munk

Images from the back cover (L-R):
Deep-sea squid *Galiteuthis phyllura*, collected at 1508m *(Stephanie Bush)*
Yasuni National Park, Ecuador *(Nathan Kraft)*
Giant ground sloth, La Brea Tar Pits Museum *(Emily Lindsey)*

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