Integrative Biology

2022 IMPACT REPORT

L-R: Eileen Lacey; tyrone hayes

From the Integrative Biology Co-Chairs

tyrone B. hayes, Ph.D.
Eileen A. Lacey, Ph.D.

It has been an eventful year (and a half) as Co-Chairs of Integrative Biology. We took on this role as Berkeley was beginning to recover from the COVID-19 pandemic – students were returning to campus, instruction was again being offered in person, and we were all readjusting to life with more social interaction. That transition has proven to be more challenging than expected and we continue to work to rebuild the relationships and community that existed prior to the spring of 2020. It has been great to see so many members of the department back in VLSB and we will continue to promote opportunities for members of IB to interact with each other.

One of the most important changes that occurred during the past year was the appointment of tyrone as Associate Dean for Diversity, Equity, Inclusion and Belonging. Although this means that he will no longer serve as Co-Chair for IB, this is a critical opportunity for tyrone to expand the scope and impact of his efforts to improve diversity, equity, and inclusion at Berkeley. Eileen will continue as Co-Chair – in January 2023, she will be joined by new Co-Chair Professor Mike Boots.

We view these changes as a natural extension of IB's efforts to make biology accessible to all interested students and Eileen and Mike look forward to continuing to work closely with tyrone in his new role on campus.

As this calendar year draws to a close, we want to thank our many colleagues in IB – faculty, staff, postdoctoral scholars, graduate students, and undergraduates – for their hard work on behalf of our shared vision of a vibrant community of scholars dedicated to improving understanding of the natural world.

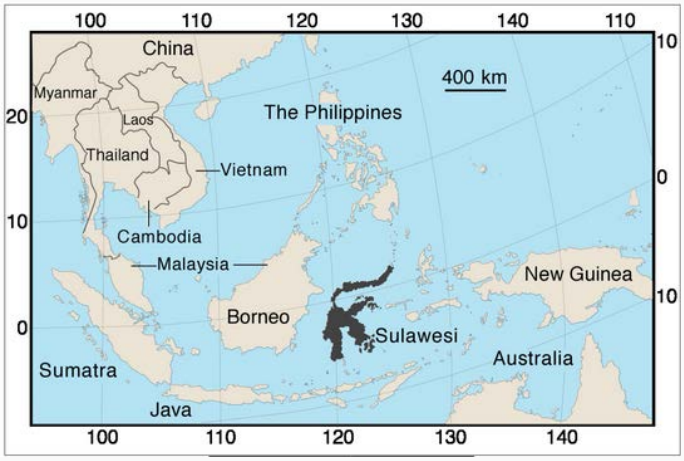
Best wishes for a fulfilling 2023.

Eileen A. Lacey, Ph.D.
tyrone B. hayes, Ph.D.
Co-Chairs, Department of Integrative Biology

Inside this report:

Tree of Life: Biodiversity and Global Change

Jim McGuire, John L. and Margaret B. Gompertz Chair in Integrative Biology



The Indonesian island of Sulawesi is huge. It is 1000 km in extent from north to south, the 11th largest island in the world, and home to 18 million people. It is also old – at least 25 million years – and has never been in contact with a continental land area such as mainland SE Asia to its west or Australia-New Guinea to its east. This long period of total isolation means that the island must have received its entire native biota by way of tens of thousands of independent oceanic overwater dispersal events. This degree of isolation is a primary driver of Sulawesi's extremely high endemism – most of the island's species are found nowhere else on Earth.

However, the island's long period of isolation only partially explains Sulawesi's remarkable biodiversity – Sulawesi also can also be divided into several primary areas of endemism, with different sectors of the island inhabited by species that are not only unique to Sulawesi but also unique to a subsection of the island. Sulawesi's macaque monkeys exemplify this pattern, with seven species each endemic to its own part of the island and with ranges that fit together like jigsaw puzzle pieces.

Attempting to explain why this regional endemism predominates has been a primary goal of Jim McGuire's research program for the past few decades. But beginning in 2016, his team took on a new challenge – asking if Sulawesi's mountainous terrain may have also contributed to the island's biodiversification. Sulawesi is a particularly mountainous island with six 3000 m summits, 25 2000 m summits, and vast areas over 1000 m in elevation. After several years of field and laboratory research, the answer to this question is clear – there are far more species on Sulawesi than we previously appreciated, many of which are elevationally stratified on Sulawesi's mountains. And many of these species are "cryptic" – morphologically similar to closely related species even though they diverged on the order of millions of years ago and often can be found co-occurring (prima facie evidence of independent species status).

This is particularly evident in Sulawesi's fanged frogs (genus *Limnonectes*), only five of which are named, but for which we have evidence indicating at least 42 species. Similarly, there are only 11 named species of *Sphenomorphus* and *Tytthoscincus* scincid lizards ("skinks") on Sulawesi, but our preliminary genetic analyses suggest that we have collected at least 70 species between them. As an example, there are two named *Tytthoscincus* species on all of Sulawesi but we found four species on a single transect on Gunung ("Mount") Galang, and this pattern repeats itself on all of the mountains that we have thus far sampled.

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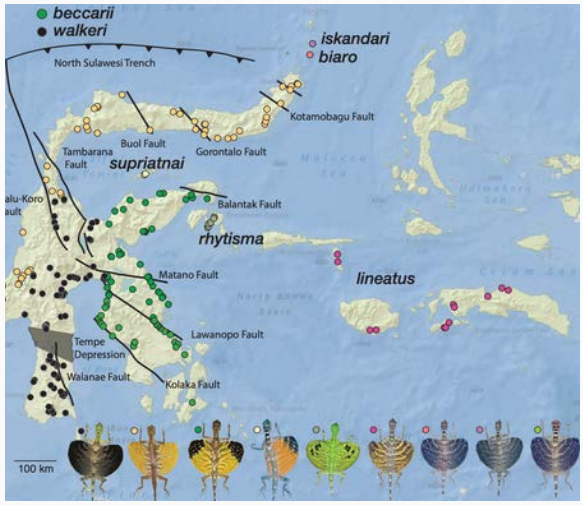


Human Connections: Origins, Health and Quality of Life

Emily Lam, Integrative Biology Ph.D. student

On a clear day looking out from my friend's window in the Sunset District of San Francisco, it's possible to catch a glimpse of the Farallon islands over the horizon. Located 28 miles off the coast, the turbulent waters that surround the islands and the characteristic jagged cliffs make coming ashore an adventure in and of itself. When the conditions are just right, a crew of volunteer skippers make the day-long patrol run to ferry vital supplies and the scientists themselves to the Southeast Farallon Island. This spring I was lucky to work on the island for a second time, and was thrilled to experience the sensation of floating once again as the safety boat, with me aboard, was hoisted into the air by a giant crane to reach the landing. It was a great feeling to be back on after a 2-year hiatus, this time with the Farallon weed in full bloom and a new crew of wildlife biologists and soon to be friends.

The California Current ecosystem relies on a careful balance of biotic and abiotic factors to sustain its diversity; therefore, it is crucial to effectively monitor sentinel species such as marine mammals and seabirds. Northern elephant seals were hunted to near extinction and have made a remarkable recovery due to marine mammal protections that were put in place. Since 1972 when elephant seals began to recolonize the islands, researchers from Point Blue Conservation Science have been collecting data on the breeding population of elephant seals at the Farallon Islands National Wildlife Refuge. During my PhD at UC Berkeley, I have partnered with Point Blue researchers to study the effects of habitat temperatures and climate change-induced habitat degradation on the physiology and behavior of Northern elephant seals that breed and migrate within the Greater Farallones National Marine Sanctuary.

> I am interested in understanding what is driving seals away from the Farallones and if they can utilize their physiological and behavioral adaptations to buffer themselves against environmental extremes that are due to fluctuations in our climate.

We know that the elephant seal population began to decline precipitously after major storms in the 1990's that washed away much of the sand from haul-out locations on the Southeast Farallon Island and West End Island. Seals rely on flipping sand onto their bodies to cool themselves when they are exposed to high temperatures and solar radiation, so the loss of sand could cause them to overheat while on land. I am interested in understanding what is driving seals away from the Farallones and if they can utilize their physiological and behavioral adaptations to buffer themselves against environmental extremes that are due to fluctuations in our climate.

The Farallon Islands are home to 5 pinniped species and a quarter of California's breeding seabirds. The rare opportunity to conduct a pinniped survey on the West End Island, which is accessible by zipline, was beyond exciting as few people have stepped foot upon this portion of the island. On this excursion I summitted Main Top and conducted surveys at Shell Beach, and I encountered Northern fur seals in the wild for the first time. Looking down at our house from the peak of Main Top, our little island home is engulfed in wildlife. The winter crew and I felt ever-so connected with the ecosystem surrounding us; however, at the same time we saw the ways in which human activities are impacting this idyllic island, despite it being remote and isolated. Increases in sea lion mortality are clear indications that pollutants, toxins and environmental change are pervasive in the lives of the animals that call the islands home.

Time slows on the island and the days and nights blend together like the pink hues of sun setting in the west. If it weren't for the active workdays and the delicious homemade meals, sleep would be a fleeting notion when the howling gusts breach 40kts and you find yourself residing in the aptly named "wind room". Even with the persistent dissonant squawking of sea birds and the wind-resistant flies buzzing around us, this island will forever be a special paradise to me.

**Biologists have been trained to safely do their research around the seals and reduce the possibility of disturbing the seals. NMFS Permit Number 21425*

Tangled Bank: Species interactions and biological communities

Annaliese Beery, Assistant Professor of Integrative Biology

> Their most recent studies show that monogamous prairie voles work hardest to gain access to a chamber holding their mate or a known same-sex companion; once in, they mostly huddle with their buddy. For females, relationships were particularly important: unfamiliar males and females were hardly worth pressing for, and never elicited a snuggle.

What makes a relationship?

For mammalian species, living in groups is an uncommon trait, and selective relationships are even more rare. Researchers in IB are studying factors that bring individuals together, focusing on vole species that prefer to hang out near the "friends" and partners they know instead of mingling gregariously.

By training voles to complete tasks to access chambers holding different social and non-social environments, IB researchers in (Assistant) Professor Beery's lab are measuring what voles are most willing to work for. Their most recent studies show that monogamous prairie voles work hardest to gain access to a chamber holding their mate or a known same-sex companion; once in, they mostly huddle with their buddy. For females, relationships were particularly important: unfamiliar males and females were hardly worth pressing for, and never elicited a snuggle. Oxytocin receptor signaling in the brain predicted both how hard voles would work for a partner, and how aggressive they were toward strangers.

A related species—the meadow vole—is not monogamous, but lives in groups during winter months. IB graduate student Kelley Power tracked microchipped voles in open habitats equipped with RFID sensors. She found that in these free-living groups, winter-like short day-lengths drive increases in group size, time in groups, and affect social network structure. But while meadow voles also love to huddle (especially with familiar buddies), they won't work for social contact, suggesting that social tolerance can be an important a driver of grouping as motivation.

Learn more!

2022 Podcast:
https://www.scientificamerican.com/podcast/episode/the-romantic-temptation-of-the-monogamous-prairie-vole/

eLife paper: Beery, A. K., Lopez, S. A., Blandino, K. L., Lee, N. S., and Bourdon, N. S. 2021. Social selectivity and social motivation in voles. eLife 10:e72684.

GB&B paper: Vahaba, D. M., Halstead, E. R., Donaldson, Z. R., Ahern, T. H., and Beery, A. K. 2022. Sex differences in the reward value of familiar mates in prairie voles. Genes, Brain and Behavior 21:e12790

Introducing FLOSS

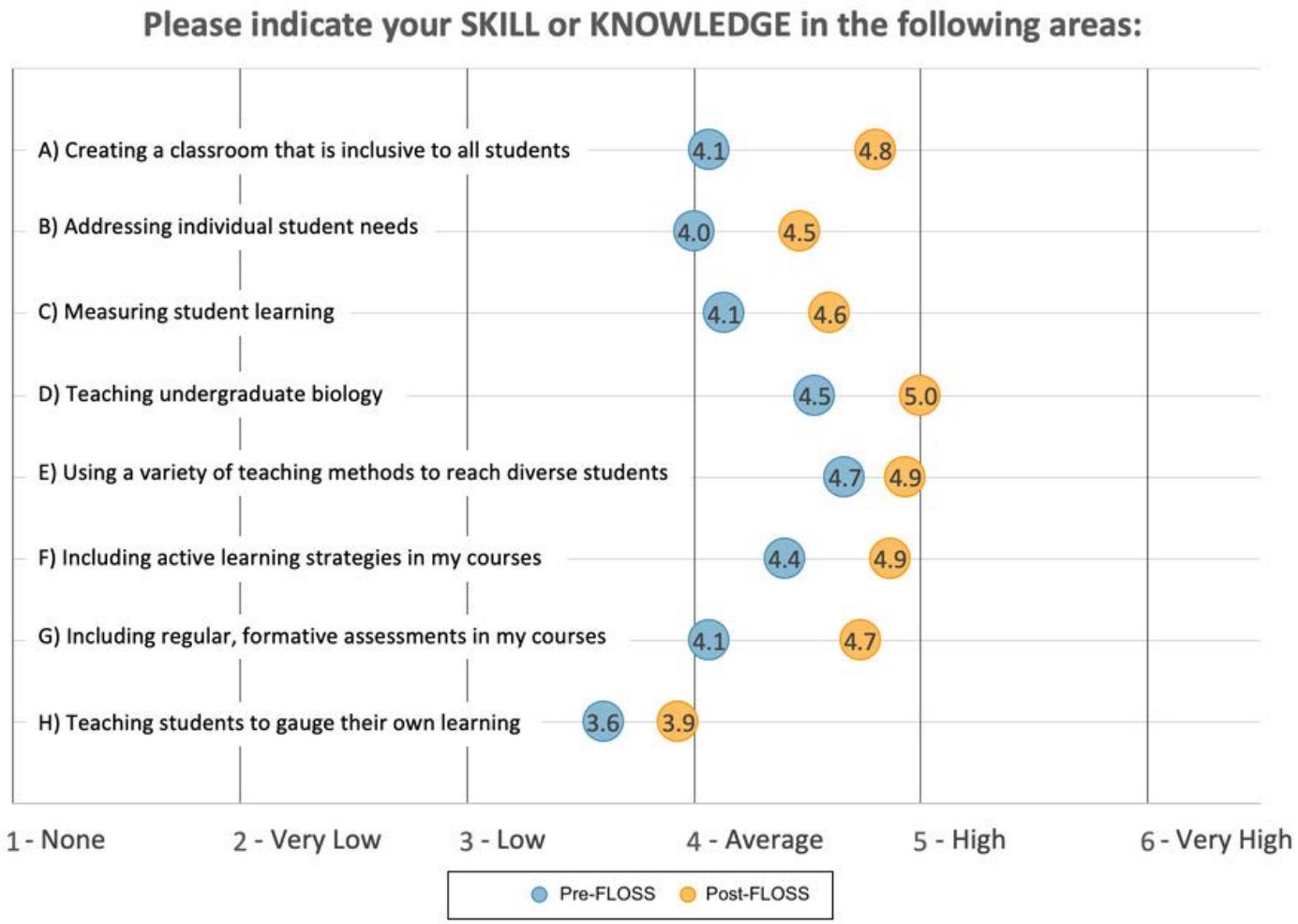
Jules Winters, Integrative Biology Instructor

University of California, Berkeley
Cal State University, East Bay
Berkeley City College

FLOSS
Faculty Learning Optimizes Student Success

Did you know that a classroom community can benefit students AND teachers? Biology Education researchers in IB created Faculty Learning Optimizes Student Success (FLOSS) - a pedagogical community of practice among UC Berkeley, CSU East Bay, and Berkeley City College - as an 8-week professional development program.

Now with 20 faculty participants in its inaugural year, preliminary results reveal how FLOSS's community of practice successfully builds faculty knowledge and skill in evidence-based teaching practices (Figure 1). As the work progresses, the inter-institutional team is looking at how this confidence, or 'teaching prowess,' translates to students' experience in the classroom. FLOSS's faculty learning community lays the foundation for building more inclusive classrooms, which will ultimately foster progress in closing equity gaps in our biology courses.



Learn more!

https://sites.google.com/berkeley.edu/floss

With gratitude

Your support of the Department of Integrative Biology has helped us advance teaching and research at Berkeley and beyond.

From all of us to you, thank you!

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