

Down on the farm

TALKING GENES | MONUMENTAL DISPUTES | MORAY AMORE

UC SANTA CRUZ

The spirit of **inquiry**@UC Santa Cruz

Welcome to the 8th edition of *inquiry@UC Santa Cruz*, the latest volume of our annual magazine highlighting the wide range of outstanding

research performed across the university's five academic divisions. As in previous issues, the stories we offer here were crafted by alumni of our world-renowned Science Communication Master's Program (see **INQUIRINGminds**, p. 51).

Their writing this year invites you to: dive into the lives of outwardly fierce—but actually quite shy—moray eels; peer over the shoulders of genomic sleuths using cutting-edge technology to answer difficult questions about the ancient—and

recent—past; stand with fearless women filmmakers whose award-winning work aims to challenge—and change—the world; fly with researchers piloting drones to help monitor and mitigate the negative impacts of climate change; and dig into innovations like the mud battery, a fuel cell powered by the millions of microbes in the dirt beneath our feet.

In our cover story, “Down on the farm” (p. 14), we take you on a tour of the bountiful campus farm and garden, the heart of the UCSC Center for Agroecology, where faculty and students are tackling the tough issues of agricultural sustainability and food security. Quite uniquely among academic institutions, the farm supplies much of the fresh produce offered by the university's food services, including the ingredients “Sally,” the Cowell Coffee Shop's salad-making robot, chops to help make kale a regular part of the UCSC undergraduate diet.

All this and more—including a sampling of the latest books authored by our faculty (**PEN&INQ**, p. 50)—awaits you in these pages. Want to dig deeper? Access this issue and past issues of *inquiry@UC Santa Cruz*—enhanced with hyperlinks, additional artwork, and references for “**Further Inquiry**”—online at inquiry.ucsc.edu.

We hope you enjoy reading these stories as much as we enjoy bringing them to you.



John MacMillan

Vice Chancellor for Research
and Professor of Chemistry and
Biochemistry

Credit: Carolyn Lagattuta

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About the cover: What is now the UCSC Center for Agroecology began in the late 1960s as a hand-cultivated organic garden carved out of rocky soil and thick brush by Englishman and expert gardener Alan Chadwick and his eager student apprentices. The farm and garden complex has since expanded to 32 acres of fields, orchards, greenhouses, cabins, and, most recently, an aquaculture facility, all on the same gently sloping campus hill overlooking the Monterey Bay. Credit: Carolyn Lagattuta, with permission.

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BRIEF inquiries

MUSIC

Compose yourself



Professor Emeritus of Music David Evan Jones conducts a group of musicians playing one of his compositions for Korean instruments, including a daegeum (second from left), a long bamboo flute, and gayageums (middle and right), 12-stringed zithers that Jones said produce “the most beautiful sound in the world.” Credit: Courtesy of David Evan Jones, with permission.

Professor Emeritus David Evan Jones first discovered traditional Korean music in 1996, at the first of now six UC Santa Cruz Pacific Rim Music Festivals, the last held in 2017. Organized by Professor **Hi Kyung Kim**, Jones’s Music Department colleague and fellow music theorist and composer, the festivals bring to campus musicians from Japan, Taiwan, Australia, and Korea, among other countries, to share and perform new music. It was there, Jones said, that he began to form lasting friendships with

a community of Korean musicians, leading to the professional premiere of his chamber opera, *Bardos*, in downtown Seoul.

That first trip to Korea in 2004, Jones said, sparked his interest in composing music for traditional Korean instruments, including the daegeum, a long bamboo flute, and the gayageum, a 12-stringed zither. “I have technical and theoretical curiosities about the ways music can be and is put together in different cultures,” said Jones, who also creates music compositions

using computers and unconventional sources such as audio from news broadcasts.

Writing music for Korean instruments required multiple attempts to get right, Jones said. Ultimately, though, he said he was very pleased with the 2017 performances in New York, Santa Cruz, Berkeley, and Seoul of his *Dreams of Falling* for a full Korean orchestra. His favorite instrument? The gayageum. “It makes the most beautiful sound in the world,” Jones said.

—Annie Melchor

ELECTRICAL AND COMPUTER ENGINEERING

Reimagining imaging

Cancer and plant growth might seem quite different subjects, but the research of Assistant Professor **Shiva Abbaszadeh**

has common roots. In her Radiological Instrumentation Laboratory, Abbaszadeh and her students work to develop tools for imaging and sensing low levels of radiation, with potential applications ranging from health care to sustainable energy. "There is no similar facility in a

research university for the type of detector we are fabricating," said Abbaszadeh. "Maybe one or two companies and one or two national labs do similar work."

Much of the lab's efforts focus on improving conventional medical imaging technologies like positron emission

tomography (PET) and computed tomography (CT). Abbaszadeh's \$2.3 million in National Institutes of Health grants support the development of highly accurate, low-radiation systems customized specifically for medical imaging of the brain and lymph nodes in the head and neck.

OCEAN SCIENCES

Helping kelp

In 2014, kelp, an iconic feature of coastal California, started dying—and kept dying. Per a UC Santa Cruz-led study published in 2021, the once lush forests of this bulb-topped, giant algae off the California coast had, by 2019, receded by more than 95%. Taking their place? A barren sea floor crawling with spiny sea urchins.

Historical records indicate that kelp abundance cycles

with environmental conditions, typically declining as coastal waters warm. But the latest die-off appears poised for persistence. An atypically dogged warm-water mass lasting from 2014 to 2016 (nicknamed "The Blob") likely initiated the kelp decline. But then, a strong El Niño followed. The unusually extended warming exacerbated disease-related die-offs of the sea stars that eat urchins. Not surprisingly, the numbers of purple

sea urchins—the voracious primary predators of kelp—exploded. How long this possibly climate change-related ecological upset will last is unclear. "I think the kelp will return," said Professor **Peter Raimondi**, who co-leads the coastal ecosystem-focused Raimondi-Carr Lab with Professor **Mark Carr**. "The more important question is will such die-offs become more common."

In a step towards potentially helping kelp to recover, Raimondi's genetics-based research has identified kelp subpopulations adapted to thrive at different water temperatures. If coastal policy called for human intervention, Raimondi said, "You could theoretically restore kelp populations from a "seed bank" with stock adapted to current or expected temperature ranges."

—Bethany Augliere



Left: Sea otters, like this one caught snoozing in the Monterey Bay, today have fewer spots to park themselves due to recent, atypically massive declines in the kelp forests that usually blanket a good deal of Northern California coastal waters. The origins and extent of this ecological upset, as well as potential interventions to address it, are a focus of research for the Raimondi-Carr Lab. Credit: Pixabay (CC0). Right: With the die-off of the sea stars that kept them in check, populations of purple sea urchins have exploded, contributing to massive declines in kelp forests along the California coast and replacing them with "urchin barrens" like the one seen here. Credit: Katie Davis/UC Santa Barbara (public domain).

BRIEF inquiries

An additional 2021 Department of Energy grant provides nearly \$2 million over three years to develop—with academic collaborators including **Weixin Cheng**, professor and chair of environmental studies—a low-cost, combined PET/CT-based system for imaging plant-soil interactions. The newly funded research aims to track the movement of carbon between soil and roots, heretofore possible only by disturbing the experiments. “This technology will help us

answer questions we couldn’t answer before because we didn’t have tools to investigate them,” said Abbaszadeh.

—Erin Malsbury

Assistant Professor of Electrical and Computer Engineering Shiva Abbaszadeh reads at least one journal paper a day to stay versed on potential applications for the complex imaging instruments she and her laboratory team develop. Credit: Christopher C. Lee, courtesy of Shiva Abbaszadeh.



COMPUTATIONAL MEDIA

Playing for real



Kate Ringland can spend hours each day on Twitter “posting tons of nonsense” while engaging with accounts dedicated to the popular Korean boy band BTS. But for Assistant Professor Ringland, a long-time member of ARMY, the official—40 million-strong—fandom of BTS, scrolling through the memes isn’t just for fun. She’s making observations, taking notes, and asking questions, all part of her

research to explain and characterize how playful online communities like ARMY enable acts of care and promote social activism.

Contrary to the craziness some might imagine happening in a stereotypical fandom of rabid teen girls, real mental health support occurs in ARMY, Ringland said. With outcomes like those achieved in, for example, a depression support group, online interactions amongst

ARMY members have the potential to provide substantial benefit. On Ringland’s Twitter account where she shares content for disabled ARMY members, as many as half a million people have viewed her posts. “That kind of reach is unheard of in other support settings,” she said.

By studying the ways play-based online communities support marginalized individuals, especially

BTS, a popular, seven-member Korean boy band, sold out their largest ever concert, attended by some 90,000 fans at the Rose Bowl in Pasadena, part of the bands’ 2019 “Love Yourself” tour, in 10 minutes. Seen here is the “Purple Ocean” of fans during the tour’s concert in Bangkok, Thailand. Per band folklore, purple became significant in 2016 when, on a stage bathed in purple light, band member “V” exclaimed to fans that he “purpled them,” interpreted to mean “I will love and care for you for a long time.” Credit: Chris Belison (CC BY 3.0).

people with disabilities, Ringland hopes to better understand what it means to be social. “There are really positive, important caring activities happening in these online spaces,” Ringland said. “We shouldn’t disregard them.”

—Emily Harwitz

Eat your medicine

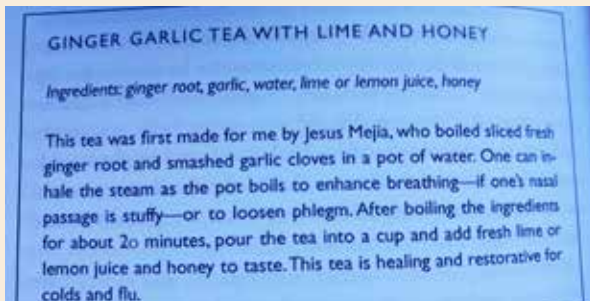
When Professor **Nancy N. Chen** feels a cold coming on, she prepares a pot of fresh garlic, ginger, honey, and lemon tea. Making sure to inhale the steam from the smashed—not chopped—garlic, she drinks the brew all day. For Chen, a medical anthropologist, food stands at the frontline of healing and she “eats her medicine.”

How food, medicine, and culture intersect animates Chen’s research. The notion that food can heal is not new—“These

concepts have been around for centuries,” Chen said. Building on this knowledge, Chen partnered with **Kellee Matsushita-Tseng**, assistant manager of the UCSC farm garden, to mentor and support students in the Global and Community Health Wellbeing Fellows program while they tend the Center for Agroecology’s newly revitalized Community Herb Garden. The work, Chen said, aims to reconnect BIPOC students to their ancestral heritages



In their roles as Global and Community Health Wellbeing Fellows, undergraduate students tend to the Community Herb Garden in April 2022. With the attention of the Fellows, mentored by Anthropology Professor Nancy N. Chen and Assistant Farm Garden Manager Kellee Matsushita-Tseng, this long-neglected patch of the Center for Agroecology’s campus farm is receiving a much-needed makeover. Credit: Kellee Matsushita-Tseng, with permission.



Recipe for ginger garlic tea. Credit: Courtesy of Nancy N. Chen, with permission.

via food and herbal cultivation, as well as through “active engagement” with the soil, each other, and local communities.

Chen’s scholarship facilitates her role, since 2018, as the Division of Social Sciences’ associate dean for

health, wellbeing, and society. The pandemic has highlighted the importance of good health, said Chen. “My hope is that people become more mindful about the health benefits of eating for long-term wellbeing.”

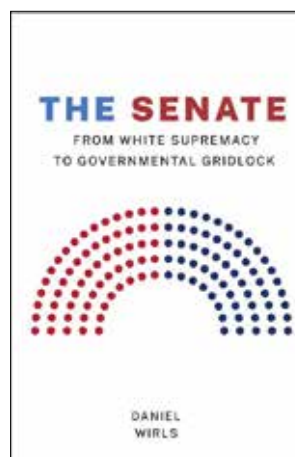
—Bethany Augliere

POLITICS

Senatorial stalemate

Rather than addressing what most Americans recognize as critical issues, including voting rights and climate change, today’s United States Senate serves as a place where legislation—as some have put it—“goes to die.”

How this sad state-of-affairs arose—and what



In his latest book, *The Senate: From White Supremacy to Governmental Gridlock*, Professor of Politics Daniel Wirls exposes the current dysfunction in what many used to call “the world’s greatest deliberative body,” and how it is undermining effective democratic government and maintaining white supremacy in America. Credits: Courtesy of Daniel Wirls, with permission; University of Virginia Press (public domain).

BRIEF inquiries

reforms might correct the problem—is the subject of Professor **Daniel Wirls's** latest book, *The Senate: From White Supremacy to Governmental Gridlock* (University of Virginia Press, 2021). In the book, Wirls discusses, among other matters, how the two Senate features of equal representation and the filibuster, the first fundamental and the second adopted, have effectively stalled lawmaking, maintained

white supremacy, and become institutional barriers to democracy. “If we were to start over again, the Senate would have neither,” said Wirls.

The problem arose as urban populations exploded in the 19th and 20th centuries, exacerbating the rural-urban divide. Equal representation meant Senate seats increasingly stacked in favor of less diverse rural areas, resulting

in disproportionately reduced sway for the greater numbers of voters living in more diverse urban areas. “We’re sending a Senate to Washington that not at all accurately represents the American population,” said Wirls. “Senators elected by a very small minority of the American population can stop anything the majority of voters might want to do.”

—Katie Brown

MOLECULAR, CELL AND DEVELOPMENTAL BIOLOGY

Bon voyage

When Professor **Yi Zuo** gives her research subjects “non-hallucinogenic” psychedelic drugs, she actually does not know they don’t hallucinate. “You can’t ask them,” she said, “because they are mice.” This actually important question aside, her

ECOLOGY AND EVOLUTIONARY BIOLOGY

Happy places

Though growing scattered across Asia and Africa, spiral gingers (plant family Costaceae) really found their happy place some three million years ago when they took root in Central and South America. It got especially happy for one group of these corkscrew-stemmed plants. Over the millennia, the genus *Costus* evolved into a whopping 59 neotropical species,

sprouting all the way from sea level to the great heights of cloud forests.

A latecomer to this plant party, Professor **Kathleen Kay** began studying *Costus* two decades ago while earning her doctorate in plant biology from Michigan State University. She zeroed in on neotropical *Costus* specifically for its unique diversity, perfect for studying how closely related

plants become separate, distinct species. “I try to figure out why they stop mating with their close relatives,” said Kay.

More generally, Kay’s research blends field and greenhouse studies with genomics to understand how flowering plants diversify through adaptations and speciation. In a study published in 2020, for example, while Kay and collaborators confirmed a correlation

between *Costus* species richness and mountainous terrain, they also showed how *Costus* speciation occurred by similar mechanisms regardless of elevation. Beyond its basic science value, her lab’s work could have a more immediate impact. “Understanding how things adapt has important implications for climate change,” said Kay. “Everything’s getting hotter.”

—Katie Brown



Taking a break from her fieldwork, Professor of Ecology and Evolutionary Biology Kathleen Kay kneels behind a flower of *Costus montanus*, one of the highly biodiverse *Costus* species she studies in the lush neotropical forests of Central and South America. Her research seeks to better understand the forces that drive speciation in these and other flowering plants. Insets: Both the stems and the flowers of plant species in the spiral ginger family Costaceae grow in corkscrew shapes. Credit, all: Courtesy of Kathleen Kay, with permission.



The brain's neurons, like the ones shown here, make connections to each other, called synapses, which appear or disappear, and strengthen or weaken, in response to external stimuli. This process, called synaptic plasticity, and its role in, for instance, learning and memory, is the subject of the basic science research conducted in the laboratory of Yi Zuo, professor of molecular, cell and developmental biology. Credit: Yi Zuo, with permission.

lab's basic science work supports the growing excitement about the potential clinical use of psychedelic drugs to treat medical conditions like intractable depression and post-traumatic stress disorder.

Zuo and her team study how connections between neurons—synapses—constantly change, through a process called synaptic plasticity. “Synaptic plasticity means making or losing, strengthening or weakening synapses,” said Zuo. “By changing these connections,

you're basically changing the network of how neurons communicate.”

In their experiments, Zuo's team explores how external stimuli like stress, disease (e.g., Alzheimer's), or drugs can physically alter networks of synapses in the brains of their living research animals. They then look for correlates of these brain alterations in the mice's behavior. In dual papers published in 2021, for example, they reported in one how chronic stress physically rewires neuronal connections, making it harder for the

HISTORY

All that jazz

What do jazz improvisation, African American activist and intellectual W. E. B. Du Bois, and the San Francisco International Airport (SFO) have in common? They are all subjects of books written by historian **Eric Porter**. Professor Porter describes his research interests as cultural and intellectual history, ethnic studies, music studies, and urban studies—in his own words, “kind of eclectic.”

His latest project, a soon-to-be-published book, *A People's History of SFO* (UC Press, 2023), provides a recent history of the Bay Area, where Porter grew up, by focusing on how the airport was developed and how it became a public stage for activism. The book contains more than history, though, touching on



SFO has long provided a go-to stage for protest for people upset over a range of issues, from the more mundane, like noise pollution from jets, to the more attention-grabbing, like labor rights and discriminatory immigration policies. Through this lens, Professor of History Eric Porter sees the airport as a catalyst for social change. “It's a focus in part because people are unhappy with things that happen at the airport,” he said, “but it's also a very public place where you can get seen and heard.” Credit: Peter Giordano (CC BY-NC-ND 4.0).

“race, class, gender, sexuality, colonialism, and imperialism,” Porter said, all foundational elements of each

subject he chooses as his next research muse. “Airports,” he said, “are really interesting places where lots of different

people and networks come together.”

With music, jazz enthusiast Porter's interest centers on how a city's culture influences the music people make, and vice versa. As “a way of expressing ideas, feelings, and experience,” music reveals a lot about how people relate to each other and their communities. In all his work, Porter said he seeks to understand how urban development shapes people and their communities. “Sometimes it's representing people who have been marginalized,” he said. “And sometimes it's complicating familiar narratives and celebrating radical thinking.”

—Emily Harwitz

LITERATURE

Shakespeare asks



Professor of Literature Sean Keilen, shown here giving a lecture at a “Slugs and Steins” event in downtown Santa Cruz, returns to Shakespeare’s play *Hamlet* most often in teaching and discussions. “*Hamlet* is just such a vastly interesting play,” he said, “able to absorb attention and questions from so many different directions.” Credit: Courtesy of Sean Keilen.

Sean Keilen’s lifelong fascination with Shakespeare began early, as an eight-year-old intrigued by a small-town production of *Macbeth*. Now, as a professor, Keilen channels Shakespeare to examine modern life and connect with both academic and non-academic communities.

Shakespeare remains relevant after 400 years because his work captures human nature, said Keilen, who directs the Shakespeare Workshop, a research center at The Humanities Institute that has hosted public performances, lectures, and discussions since 2013. During the pandemic, in collaboration with longtime partner local theater company Santa Cruz Shakespeare, the workshop organized live virtual productions and conversations in a series called Undiscovered

Shakespeare.

Shakespeare’s plays hold up a mirror to modern life, providing a powerful vehicle for self-examination, Keilen said. A play that questions monarchy as an institution, for example, can spark conversations about the fragility of our current political system.

“No one I work with—students, actors, people in the community—comes to Shakespeare for answers,” said Keilen. “They come for questions we’re not asking because we’re so focused on our own moment and place and culture.”

“Shakespeare is alien enough to allow us to look at ourselves differently and ask new questions of ourselves,” said Keilen. “But he’s connected to us enough that we understand what he’s talking about and why it has purchase for us.”

—Erin Malsbury

mice to learn. In the second, they reported the reversal of stress-induced brain changes with just one dose of a non-hallucinogenic psychedelic drug. But no hallucinations? The mice aren’t talking.

—Annie Melchor

ELECTRICAL AND COMPUTER ENGINEERING

Biopower plants

We all know about power generation from the sun and the wind, but it’s probably a surprise to learn that



Assistant Professor of Electrical and Computer Engineering Colleen Josephson and her collaborators have deployed 12 of their first prototype “mud batteries,” or MFCs (one held here by Josephson), four at one field site in California and eight at two sites near Chicago. “Our oldest two cells were deployed in July 2021,” Josephson said, “and we’re still collecting data.” Don’t expect a widely available product soon, she said—“A lot depends on the economics.” Credit: Courtesy of Colleen Josephson.

electricity can also come from the dirt beneath our feet. The dirt itself, however, is not the source—it’s the so-called exoelectrogens, mostly bacteria, that inhabit healthy soil all over the world. As they break down and metabolize—i.e., “eat”—complex molecules like sugars, these miniscule organisms release a steady trickle of electrons.

Commensurate with their microbial size, the electron output of a single bacterium is quite small. But their immense numbers and density in the soil can collectively produce enough of a spark for Assistant Professor **Colleen Josephson** and her collaborators to attempt to harness it. Josephson’s work aims to create what she calls “a mud battery,” more technically known as a microbial fuel cell (MFC). If she succeeds, MFCs will power soil moisture sensor networks on farms, potentially saving a lot of increasingly valuable water.

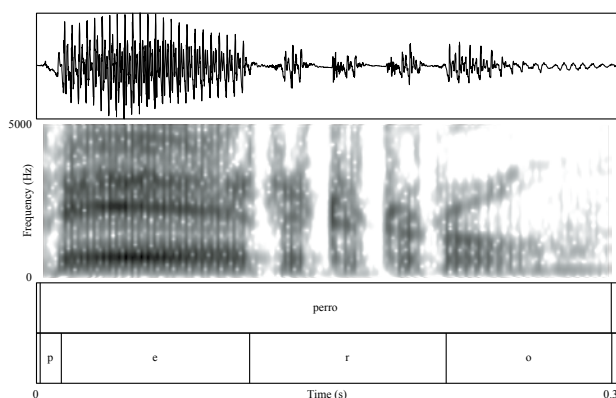
About 70% of all the potable water we use today goes to agriculture, said Josephson, noting that the sensor networks she envisions could improve the sustainability of farming by saving up to half of this water. And with another expected two billion people added to the world’s population over the next 30 years, “it’s going to be critical,” she said, “to use water more efficiently.”

—Bethany Augliere

LINGUISTICS

Doublespeak

The mental gymnastics of speaking another language requires using a new sound system while suppressing the dominant one of your first language. How people achieve this feat—and its linguistic, social, and cognitive consequences—centers the research of **Mark Amengual**, associate professor of applied linguistics and director of Spanish studies. “I’ve



plosive consonant, such as the “p” in “pan” or the “t” in “time,” and the beginning of the following vowel. Different languages, including Spanish and English, have distinct timing patterns. “We can measure really fine-grained differences between individuals,” said Amengual, “and we can compare to what degree the two sound systems are interacting in their speech.” Credit: Courtesy of Mark Amengual, with permission.

In the UCSC Bilingualism Research Lab, Associate Professor Mark Amengual performs acoustic analyses, like this one (top panel) for the pronunciation of the trilled “r” in the Spanish word “perro” (“dog” in English), as study participants produce target experimental words in a soundproof booth. The second panel shows the recording’s voice onset time (VOT), a measurement of the duration (usually milliseconds) between the release of a

EARTH AND PLANETARY SCIENCES

Geological faults



At the 2018 American Geophysical Union conference, Assistant Professor of Earth and Planetary Sciences Tamara Pico stands in front of the Great Falls of the Potomac River and describes how the changing weight of ice sheets alter the landscapes around them. She compares the process to placing a rock on bread dough. As the weight compresses one spot, the rest of the dough—the Earth’s crust—puffs up around it. Pico uses physical signs of these changes to model where glaciers once existed. Credit: Courtesy of Tamara Pico, with permission.

Perusing the library stacks, **Tamara Pico**, then a Harvard University Ph.D. student, discovered an old book by Nathaniel Shaler in which the eminent 19th-century Harvard geologist argues that certain climates or landscape features produced superior humans in Europe compared to other parts of the world. “No one in my department had any idea,” said Pico.

The discovery prompted Pico, now a UC Santa Cruz assistant professor, to dig into the history of geology to better understand how bias influenced scholarship in the field, whose practitioners were—and largely still are—white and male. The work birthed GeoContext, a collaborative website project that provides historical background to topics covered in undergraduate geology

courses. Its teaching modules connect, for example, oceanography with the slave trade, and volcanology with colonialism. Pico hopes teaching this history will help address geology’s diversity issues. “Having a sense of that history helps because bits of that are still here with us,” she said.

In her primary research, Pico models changes in glaciers by measuring how the land that surrounds them moves in response to the weight of the ice. Her interest in geology’s history is a separate endeavor, but she considers it important to think about how it applies to all her work. “I try to put myself in a social context,” she said. “Why is this work valued in my field? Why do I value it? What is the consequence of my doing this?”

—Erin Malsbury

BRIEF inquiries

always been intrigued by how seamlessly bilinguals switch between languages,” said Amengual, himself multilingual, speaking English, Spanish, and Catalan.

In the UCSC Bilingualism Research Laboratory he directs, Amengual analyzes the acoustic profiles of multilingual

speech collected under controlled experimental conditions. In one study, for example, Amengual compared two groups of Latino Spanish-English bilinguals—one speaking Spanish at home and not English until starting school and the other exposed to both languages from birth—with a third group of bilinguals who grew

up English-speaking and then acquired Spanish by studying it in college. It turns out the degree of exposure to each language in the formative, early years of life has a persistent effect, influencing adult speech acoustics in a quantifiable way.

To get a fuller picture of “what bilingualism

is all about,” Amengual also studies speech perception among Indigenous bilingual populations in Mexico who speak Spanish and an endangered language, Hñáñho. “Perception and production,” said Amengual, “are two sides of the same coin.”

—Elizabeth Devitt

THEATER ARTS

Inclusive dancing



A still from former Associate Professor of Theater Arts Gerald Casel's latest ensemble piece, *Not About Race Dance*, which he describes on his website as “a collaborative, choreographic response to the unacknowledged racial politics in U.S. postmodern dance.” In this photograph of two of the ensemble's five BIPOC members, which includes Casel, undergraduate **Audrey Johnson** dances in front of a live video backdrop of Styles Alexander. “I make dances that celebrate and affirm folks who have been historically excluded,” said Casel. Credit: Robbie Sweeny, with permission, courtesy of Gerald Casel.

On September 20, 2018, some 50 Bay Area dance artists, choreographers, educators, funders, and administrators gathered in Oakland for a “long-table discussion.” On the table? A social justice issue still unacknowledged by most in dance—racial

inequity. The Oakland public forum, the first of many around the country, kick-started *Dancing Around Race*, a community engagement project sponsored by Hope Mohr Dance, a dance organization dedicated to “creating and supporting

embodied art and social change.”

At the center of the conversations stood their lead organizer, **Gerald Casel**, a person whose lived experience gives him firsthand knowledge of dance's racialized issues and

the skills and drive to do something about it. Casel wears many hats: queer, Filipinx immigrant, first-gen college graduate, highly accomplished dance artist, award-winning performance maker, cultural and community activist. Casel, formerly an associate professor of theater arts, recently left UCSC to become chair of the Dance Department at Rutgers University.

Insights from *Dancing Around Race* now extend into workshops Casel is piloting, as well as teaching modules for higher education and K–12 performing arts curricula, all directed at facilitating candid discussions in brave spaces. “It's the system that's racist, not necessarily the people,” Casel said. “There's a lot of potentially problematic issues around appropriation, tokenism, and cultural mismatch—we want to unpack all that and talk about it rather than pretend it doesn't exist.”

—Katie Brown

Sea rescue

Like the birds that still frequent its shores, people once flocked to the Salton Sea. Just hours from Los Angeles, the desiccated lakebed refilled in 1905 with spillover from Colorado River irrigation canals. But since its 1950s heyday as a popular tourist destination, the irrigation runoff that kept the lake filled has diminished, shrinking it dramatically. Wind-laden agrochemical dust off the exposed lakebed contributes to asthma rates in surrounding communities, and rising salinity has killed fish and jeopardizes migrating and nesting birds. Tourist destination no more, the Salton Sea now poses a considerable public health and environmental challenge.

Enter **Brent Haddad**, director and founder of the Center for Integrated Water Research. Professor Haddad heads a team of faculty,



Bushes line the former shoreline of the Salton Sea, far from its receding surface that since 2000 has dropped more than 10 feet. The drying of the lake poses considerable public health, environmental, and economic challenges. Proposals for “water importation” to refill the lake—sourcing water from the Pacific Ocean or perhaps Mexico’s Sea of Cortez—are being evaluated by a team of UCSC researchers led by Professor of Environmental Studies Brent Haddad. Credit: USGS (public domain).

graduate students, outside consultants, and an Independent Review Panel charged with identifying—as part of the state-managed Salton Sea Management Program—a long-term plan for restoring the Salton Sea ecosystem and its languishing surrounding

communities. In addition to evaluating proposals for “water importation” to refill the lake, the team’s remit includes considering the area’s economic future. “The region is of immense interest in part because of its potentially massive lithium resources,”

Haddad said.

“We don’t have any templates for what we’re doing,” Haddad said. The hope, he said, is that other regions with evaporating lakes around the world can use their Salton Sea restoration process and plans as a model.

—Emily Harwitz



The ruins of the Salton Sea Yacht Club offer a stark reminder that the Salton Sea was once a thriving tourist destination in the 1950s. Credit: Wikimedia Commons (CC BY 3.0).



Down on the farm

Growing sustainable food systems...and students



► An idyllic scene unfolds on a gently sloping hill overlooking the serene blue water of Monterey Bay: not just the Bay...redwoods, weathered wooden fences, straw-hatted workers, the occasional wandering cat; a sprawl of thousands of the sweetest, juiciest, most flavorful organic strawberries you might ever put in your mouth; acres of lush green fields packed with a bountiful assortment of potatoes, lettuce, broccoli, corn, cauliflower, squash, and more, growing in tightly spaced rows; behind the fields, dozens of fruit trees—peaches, nectarines, lemons, plums, and numerous varieties of apples.

Left: “The farm is really a beloved space on campus,” said Professor of Environmental Studies and Director of the Center for Agroecology Stacy Philpott. In addition to serving students, the farm is open for the public to enjoy during daylight hours (and when allowed by the pandemic) and hosts events such as the Harvest Festival and the Strawberry and Justice Festival, the latter a free community event focused on food and social justice education. Additionally, the farm’s Life Lab program hosts around 3,500 local schoolchildren every year who visit the farm to learn things like where food comes from and how to choose and prepare delicious and nutritious meals. Below left: The Center for Agroecology’s farm and gardens not only provide students with fresh, healthy foods, but give them the opportunity to learn about how that food gets to their plates. Credit, both: Carolyn Lagattuta, with permission.

This agricultural cornucopia anchors a large organic farm and garden complex at the southern end of the UC Santa Cruz campus. Growing from an idea planted more than a half century ago, the UCSC farm and gardens became the first agricultural research center in the UC system to not only embrace sustainable agriculture and commercial organic production methods, but also to strongly acknowledge the social issues compelling their adoption. Today, this flagship of the Division of Social Sciences’ Center for Agroecology continues to serve as a state-of-the-art research facility focused on addressing food insecurity and sustainability. Its mission applies regionally, globally, and—uniquely—quite locally...on campus.

Fertile ground

UCSC’s bustling organic farm began as a smallish garden. Two professors, **Donald Nicholl** and **Paul Lee**, hatched the idea of a student garden in the mid-1960s. As bulldozers ripped up the old Cowell Ranch to build the new UCSC college campus and the Vietnam war raged amidst widespread protests, Nicholl and Lee imagined a student garden that would have a positive impact on the campus community by connecting students to the natural world.

In a serendipitous series of events, the Countess Freya von Moltke of Bavaria graced the new campus with a visit in 1966 and heard about the garden proposal. She then convinced **Alan Chadwick**, whom she had met years earlier in South Africa, to come to Santa Cruz. An Englishman and former Shakespearean actor in his mid-50s, Chadwick was also—importantly—an expert gardener.

Arriving at UCSC in 1967, Chadwick set to work transforming a rocky, brush-filled slope on the east side of campus into a lush garden. As Nicholl and Lee envisioned, students flocked to this haven. Here, Chadwick taught them how to cultivate and grow fruit trees, vegetables, and flowers. A few dropped out of classes to have more time to help and learn full-time from Chadwick, whose gardening philosophy followed what he called the “biodynamic/French intensive” method. This form of organic farming uses hand tools only and eclectically follows traditional Chinese,

Greek, Roman, and French horticulture practices.

As the popularity of the garden grew, so did its footprint. In 1971, the campus planning committee committed another 14 acres near the main entrance to campus, expanding the garden into a full-fledged farm where Chadwick’s techniques could be tested on a larger scale. Continuing to expand since then, the farm’s fields now fill most of the 32-acre complex. And Chadwick’s legacy of organic farming lives on, in both the entire farm and the still hand-cultivated Alan Chadwick Garden.

For more than five decades now, research at the farm has helped farmers—in California, and, increasingly, worldwide—adopt more environment-friendly and economically viable practices, including organic techniques to manage crop disease and control pests. All the work aims to increase food security through the development and promotion of sustainable food production.

Farm life

“I’m catching my breath,” said **Stacy Philpott**, professor of environmental studies and director of the Center for Agroecology. After a short uphill walk, she paused for a moment near the top of the dirt path that leads up into the farm from the back of the 150-year-old, restored Cowell Ranch Hay Barn. Looking downhill toward the barn, the panoramic view of the Monterey Bay sparkling beneath the bright blue, cloudless sky causes her to pause a bit longer.

Large rectangular fields stretch out from both sides of the narrow path, some lined with organized rows



Master gardener—and former professional Shakespearean actor—Alan Chadwick tends to the red poppies cultivated in the organic garden he created on the fledgling UCSC campus in the late 1960s. Many consider Chadwick the originator of California’s now flourishing farm-to-table movement. Credit: Courtesy Special Collections, UC Santa Cruz.

Down on the farm

of ankle- to waist-high leafy plants and others full of fertile, loose soil ready to plant. A hundred yards away, a student wearing a wide-brimmed straw hat kneels between rows of dirt mounds. That five-acre field, Philpott explains, is typically dedicated to research, where scientists study different farming practices, testing new methods of irrigation, soil management, or pest control. “Last year in the strawberries,” she said, “we had some engineers trying out new soil nitrate sensors to monitor the movement of nitrogen, a very important nutrient for crops.”



Researchers at the center's new aquaculture facility are examining ways to make aquaculture more sustainable, such as by creating a microalgae-based fish food that's free of fish products and using nutrient-rich water from the fish tanks to water crops. Credit: Carolyn Lagattuta, with permission.

In 2011, Philpott eagerly applied for and accepted a job opening for an agroecologist with the Environmental Studies Department and the center. She admired the farm and its legacy and reputation for operating with a holistic view of agriculture—one, she said, that considers ecological and economic sustainability along with social justice and equity in the food system. “At UCSC, we have the reputation for thinking about transformation, and doing things differently than at the big ‘ag’ schools,” she said. In one recent example of this ethos in play, fishery experts **Anne Kapuscinski** and **Pallab Sarker**, both professors in environmental studies, designed and built an innovative facility right on the farm to study sustainable systems that closely integrate aquaculture with agriculture.

Budding farmers

As a leader in the agroecology field, the UCSC farm hosts budding farmers, urban growers, and gardening enthusiasts from both within and outside the campus

community, all hoping to take away kernels of farming and gardening knowledge that will hone their green thumbs. In addition to regularly scheduled online and in-person workshops on topics like beekeeping, gopher-proofing, and pruning, among many others, the farm offers an immersive Apprenticeship Program for early-career farmers. Philpott said she is excited about the relaunch (after a planned and pandemic-induced two-year hiatus) of this longstanding, legacy program inspired by Chadwick and his early acolytes. Much like back then, apprentices spend their days getting their hands dirty as they practice organic farming techniques and learn about soil cultivation, plant physiology, and discuss the political and social contexts in which food is produced and delivered. The program enrolls “a whole array of different people, young and old,” said Philpott. “We have folks working in environmental education and urban agriculture, some wanting to start their own organic farms, several veterans, and some just wanting to improve food security in their communities.”

Though clearly a valuable resource for gardeners and farmers outside the campus community, the farm delivers its greatest impact as a classroom for UCSC students. In addition to offering a new (2020–21) agroecology major with around 40 students already enrolled, the center also employs around 50 students and supports 150 student interns every year, providing work ranging from cultivating the fields to leading educational programs for visiting children. Students also get hired to run the campus's food pantries, with many first becoming acquainted with the campus farm as its customers, reaping the benefits of having a bountiful organic farm right on campus. Spread out across campus, the food outlets intentionally put students within easy reach of the healthy, sustainably produced food the farm supplies.

Farm-to-student

Upbeat music fills the sunlit space as the server behind the counter tops off a mug of coffee with a shot of organic macadamia milk. The mug could be from someone's personal collection. With no cashier stand in sight, the atmosphere of the café, known as the Cowell Coffee Shop: For the Peoples, channels the relaxed vibe of hanging out in your friend's kitchen. The “nontransactional” (i.e., free) café is the product of a collaboration between the Center for Agroecology and the campus's Colleges, Housing and Educational Services (CHES).

The café “builds upon the idea of a gift,” said **Tim Galarneau** (B.A., '05), a center education



At the campus's twice weekly Produce Pop-Ups, students can get free or low-cost food, and learn how to cook it by picking up complimentary recipe cards made by fellow students employed by the Center for Agroecology. "We want to help people use the ingredients they get," said Francis Ge, coordinator for UCSC's Basic Needs program. Back row: **Andrew Yniguez, Michelle Ross, Kirra McColl, and Francis Ge**; front row: **Wai Shan Chan and Victoria Mederos**. Credit: Courtesy of Wai Shan Chan, with permission.

Popping up produce

No, this isn't a just-for-fun college scavenger hunt: Where on the UCSC campus might a student find a freshly picked delicata squash? At a Produce Pop-Up, a farmstand offering low-cost organic veggies and fruit from the campus farm as well as local growers. The stands set up twice a week when classes are in session, at Quarry Plaza on Wednesdays, Porter Quad on Fridays.

"Our goal is to spread access to our food around campus," said **Francis Ge**, Basic Needs coordinator at the UCSC Center for Agroecology. The program operates the Pop-Ups as an important resource for the entire campus community, Ge said, "like a library or gym." Each week, Ge and her team of student coordinators and interns gather seasonal produce from the farm and round that out with wholesale purchases from the local farmer's market. Some Pop-Up produce is free; the rest sells for half the cost, or less, of its supermarket prices.

For students without the wheels to forage off-campus, especially if they are receiving monthly electronic benefits from the government-funded CalFresh assistance program, the Pop-Ups are a lifesaver. "There's nowhere on campus to use those benefits," said Ge, "except a Produce Pop-Up."

and research specialist and co-chair of the Basic Needs Committee of the Basic Needs Initiative, a UC-systemwide program that provides resources to help students meet their basic needs, including food security, affordable housing, and mental health resources. "This isn't a socialist, Marxist revolution, as some may intimate" said Galarneau. "It's recognizing that the usual structures for supporting students have limits, and we can do better—we're simply trying to ensure that all students have access to what they need to be successful."

After graduating from high school in upstate New York, Galarneau moved across the country to work on his uncle's horse ranch in Santa Ynez, CA, while also taking classes at Santa Barbara City College. "And then I heard about this jewel in the UC system," Galarneau said. Knowing of Galarneau's interest in working outdoors and connecting society and the environment, his college adviser encouraged Galarneau to check out the agroecology program at UCSC.

Once at UCSC, Galarneau quickly found purpose in advocating for UCSC to become a "self-operated" school in terms of its food sourcing. At that time, in the early 2000s, the third-party company contracted for all UCSC's food services paid little attention to where the food it offered came from or how it was produced. In this setup, Galarneau saw an opportunity and gathered support for a system in which students could become more connected to their food. How? By terminating the 32-year-old food service contract and working to link the campus's "jewel," its farm, to its dining halls. "That was the first direct food relationship for the farm," Galarneau said.



The center's popular Apprenticeship Program enrolls a wide variety of people who are interested in organic and sustainable farming. During the entire 10-week program, participants live in rustic wood and canvas platform tents tucked against the trees in the far northwest corner of the farm, backdropped by the ocean. Credit: Carolyn Lagattuta, with permission.

Down on the farm

More than food

For a while, that relationship operated at a low level, with farm produce part of the mix of food supplied to the dining halls, Galarneau said. But it eventually became clear that much more was needed. In 2014, Galarneau and his Basic Needs Committee co-chair UC Berkeley-based Ruben Canedo surveyed UC students about their access to food. The results showed that, rather than an essential, basic need, many students considered the campus dining halls an unaffordable amenity and that lack of food was adversely affecting their mental health and well-being. This was the first evidence that supplying the dining halls wasn't enough—the food wasn't getting to the students who really needed it.

Additional research found that, because of other basic expenses, especially housing, students were often skipping meals or felt like they couldn't afford more than one meal a day. In 2017, a study funded by the UC Office of the President as part of the university's Global Food Initiative reported that

44% of all UC undergraduates and 23% of graduate students experience food insecurity. And, in 2018, a UCSC-focused study concurred, estimating that food insecurity affected 48% of undergraduate students and 31% of graduate students.

This is a problem that the university can't ignore, said **Heather Bullock**, professor of psychology and director of the Blum Center on Poverty, Social Enterprise, and Participatory Governance, part of the Division of Social Sciences' Institute for Social Transformation. "For students who are food insecure, it's absolutely a struggle to focus on their coursework," said Bullock, who also serves as associate dean of the Division of Social Sciences. "Just trying to meet basic needs, it's constant wear and tear."

Further Blum Center research has identified several factors that contribute to students' food insecurity, including stigma, discrimination, difficulty accessing government-funded food assistance programs (aka CalFresh), high food costs, family responsibilities, cultural exclusion, and unawareness

Robotic salads

Against the back wall of the Cowell Coffee Shop stands one of the most advanced pieces of dining technology in the world: a salad-making robot. The Chowbotics vending machine whirls precisely programmed paddles around to assemble

colorful, delicious bowls of fresh greens and chopped produce, each served exactly as ordered by its button-pushing customers.

"As fast as we stock it, it sells out," said **Brooks Schmitt**, the Cowell Coffee Shop food supervisor. "You wouldn't believe how excited people get about kale when it's coming out of a robot."

As the popularity of the Cowell Coffee Shop grew, Schmitt began looking for more efficient, food-safe ways to serve customers fresh, nutritious meals. When he learned about Chowbotics, "I thought this is a great solution and also a great way to get students

excited about salad," he said.

Since its installation in the 2021 fall quarter, the salad robot has become a hit, serving 30 to 40 bowls a day. "Almost every single ingredient is grown on the campus farm," Schmitt said. He hopes to place more of the robots around campus and sees them as a way to provide a healthy food option for students, especially during times when accessing fresh food becomes more difficult, like during finals or between quarters. "It's a really powerful piece of technology," he said. "What we're doing in the agroecology department is absolutely cutting edge."



Student **Ashley Ramirez** orders a custom salad from "Sally" the Chowbotics machine. UCSC was the first UC campus to install any kind of automated food robot. "When we went through the steps to get the unit approved, some inspectors were a little surprised because they said cutting-edge tech like this usually rolls out on other UC campuses, like UCLA or Berkeley," said Cowell Coffee House food supervisor Brooks Schmitt. But Schmitt and the Basic Needs team knew the Chowbotics unit would be a hit at UCSC, a research campus with a productive organic farm and programs aimed at connecting students to their food. Credit: Hunter Esquivel, with permission.



The center offers programs for undergraduates from any campus major who are interested in working on the farm. “They participate in everything, from weeding, harvesting, planting, growing seedlings in the greenhouse, to delivering produce to our various campus outlets and selling it there,” said Professor Stacy Philpott. Credit: Carolyn Lagattuta, with permission.

of campus resources. The problem has important consequences, leading to poor dietary habits, reduced food intake, and contributing to health problems including stress, hypertension, diabetes, and depression. In addition to its health impacts, food insecurity also trashes performance, with as many as eight of ten college students identified as food insecure reporting negative academic outcomes.

To respond to this now-well-documented problem, UCSC Basic Needs has partnered with other campus groups, including the Dean of Students Office and CHES, to better meet the food security needs of students. They’ve opened the campus food pantries and filled them with fresh seasonal food from the UCSC farm and other local sources, all available for free or much lower than supermarket prices. The Cowell Coffee Shop also operates as a “farm-to-plate” café, Galarneau said, where students can easily—and mostly for free—obtain pre-made foods, produce, coffee, and more, all sourced locally and sustainably.

Growing changemakers

“Happy Tuesday!” Galarneau greets a student intern walking into the café. She has day-old bagels to drop off, she tells him. She’s come from The Bagelry, a local bagel shop in downtown Santa Cruz. “You’ve developed quite a following with those bagels,” Galarneau said. “Everyone loves them.”

The café serves students as a refuge where they can get nourishment, including really good day-old bagels, “without worrying about what’s in their wallet and without the stigma that comes with accepting food without paying for it,” Galarneau said. In

addition, the café acts as an information hub, where students can find resources to help them meet their basic needs, like how to enroll in CalFresh, or attend rent and lease workshops. “One of the most beautiful things about our basic needs work is that it’s gotten rid of the silos and created relationships across divisions,” Galarneau said. “Having staff and students connected cohesively and working together is a very powerful force of change.”

While students clearly value the access to free and low-cost food, our society teaches us that nothing is free, Galarneau said. Providing this level of support isn’t a charity handout, he said, but a critical component of achieving UC’s educational mission, a concept the Basic Needs team has worked hard to get university leaders and state legislators to understand and accept. “And it’s all actually backed by science and research,” Galarneau said.

Indeed, the most recent Blum Center research shows that, simply by providing services to make sure they are well-nourished and feel supported, UCSC Basic Needs is helping students complete their degrees on time and with higher GPAs. In addition, student participation in the program through jobs and internships, or just using its resources, encourages them to think about how they can be agents for positive change—just as Nicholl and Lee hoped they would learn through a smallish garden first planted in the late 1960s. The UCSC farm and garden has become an amazing living laboratory and teaching facility, Galarneau said. “But we’re doing so much more than growing food,” he said. “We’re really growing changemakers.”



Documenting reality

Female filmmakers
aspire to move the
field—and the world

Behind a banner for the ecosexual movement they co-founded, Professor of Art Elizabeth “Beth” Stephens (second from right), and her wife, UCSC staff member Annie Sprinkle (far left), march in the 2015 San Francisco Pride Parade. The couple’s latest documentary film, *Water Makes Us Wet*, follows Beth, Annie, and their dog Butch as they travel around the United States to explore the history and politics of water through an ecosexual lens. The film captures the protagonists meeting with water experts and activists, investigating Nestle’s shady water-bottling business, hobnobbing with elephant seals, and even plunging a toilet. Credit: Seth Temple Andrews, courtesy of Elizabeth Stephens.

► Besides banana slugs, UC Santa Cruz sports a healthy population of another amazing creature. Amidst the towering redwoods on UCSC’s verdant campus, there also roams a thriving colony of world-class women filmmakers. This unusual cluster of still unfortunately rare—but notably spectacular—individuals includes many who have achieved broad acclaim with their groundbreaking documentary films addressing a broad range of topics,

from long-forgotten history to environmental injustice. While men still dominate the world of documentary filmmaking (and all filmmaking), you wouldn't know it by looking at the makeup of the collective UCSC visual arts departments.

A diverse group of women from all walks of life now account for more than 65% of the Arts Division's faculty, according to Dean of the Arts **Celine Parreñas Shimizu**. And many of these women are engaged in practicing, teaching, and shaping the evolving tenets of documentary filmmaking. "All of these filmmakers, who are so renowned in their fields, define their service to the university, not in terms of their fame, but in the way they are training the next generation of filmmakers," said Shimizu, herself a documentary filmmaker.

Among these women are **Irene Lusztig**, **Jennifer Maytorena Taylor**, and **Elizabeth Stephens**.

As stand-out filmmakers, artists, and educators, Lusztig, Maytorena Taylor, and Stephens are shaping important discussions about our society, said Robb Moss, professor of visual and environmental studies at Harvard University. "Each has affixed themselves to the big, sprawling, complicated issues of our day," said Moss, who is also a documentary filmmaker. "They've all done extraordinary work researching, exploring, and trying to make sense of the things that are most fascinating and sometimes troubling about our society."

Although their backgrounds and work differ substantially, all three women share a strong commitment to ethical and inclusive filmmaking. We spoke with each about how they became documentary filmmakers, their work, and their efforts to change the field for the better.

Archival passion

A filmmaker and visual artist with a passion for archival research, Professor of Film and Digital Media Lusztig finds stories in long-forgotten historical archives and breathes new life into them using experimental documentary techniques. Much of her work focuses on the history of women and perceptions of women's bodies, including her latest film *Yours in Sisterhood*. The film, which premiered in 2018, explores the past, present, and future of feminism inspired, as described on the film's website, "by the breadth and complexity of letters sent in the 1970s to the editor of *Ms.*, America's first mainstream feminist magazine." Lusztig, who joined the UCSC faculty in 2008, currently serves as the director of the Center for Documentary Arts and Research (CDAR).

How did you get into filmmaking? I went to college wanting to be a painter and took a film course by accident. But as soon as I was in the class, I understood right away it was bringing together many different things I was excited about. I knew I was a visual thinker and wanted to make visual work, but I also love to research. It just felt like a way to explore the world that could bring all the things I was excited about together. I graduated in the mid-'90s and then immediately started working on *Reconstruction* (2001), my first feature-length film.

The film was about my family, a wonderful place for young filmmakers to start. In 1959, my mom's mom participated in a bank robbery in Bucharest, Romania. The interesting thing is that, after she was arrested and convicted, she "starred" in a bizarre propaganda film about the bank heist produced by the Romanian state. To make the film, she, her husband, and the other men involved were basically forced to re-enact an "official" version of what happened. And I was able to find that film with my grandmother in it, performing as herself. I think my way of investigating the world came out of the experience of making that film. I still encourage my students to make films about stuff that's close to them.



Professor of Film and Digital Media Irene Lusztig stands surrounded by vintage issues of *Ms.*, the first mainstream American feminist magazine. To make her award-winning, most recent documentary *Yours in Sisterhood* (2018), Lusztig asked hundreds of strangers in communities across the U.S. to read aloud and respond to selected letters-to-the-editor published in *Ms.* in the 1970s. Lusztig shot the film in the aftermath of the 2016 election, a time when many feared for the future of American women's rights. Credit: r.r. jones, courtesy of Irene Lusztig.

Documenting reality

How do you approach filmmaking? I allow myself a very long research process—it can take years before I start filming. This is different from how much of the film industry operates. I'm really interested in history and people's engagement with history. Questions about memory and history shape all my work.



Posters for Lusztig's breakthrough feature documentary *Reconstruction*, about her grandmother's involvement in a bank heist in Romania, and the bizarre propaganda film the government forced her to star in that re-enacted the crime, and her most recent film, *Yours in Sisterhood*. Credits: Both, courtesy of Irene Lusztig.

San Francisco Bay Area (*Home Front*, 2001) to Puerto Rican American Muslim hip-hop culture (*New Muslim Cool*, 2009). Born in Los Angeles and fluent in Spanish and Portuguese, Maytorena Taylor's mixed heritage includes Mexican, Sicilian, and Irish/English. She credits her diverse background with driving her to seek out the stories of those with similarly complex identities.

How did you get into filmmaking? I originally wanted to be a dancer, but I badly injured both knees and had to stop dancing. Eventually, I got interested in the way mass media was serving as a platform for social change and social movements, in the different ways that movies, TV, and pop music were enabling essential

How are you influencing the filmmaking scene at UCSC?

The film industry still has a long way to go in terms of really representing the full breadth of different lived experiences. But our students are telling stories that represent all those perspectives. We have a lot of first-gen students, a lot of Hispanic students, a lot of students from immigrant families—basically, a lot of students with quite diverse life experiences. Those of us who get to work with these students are nurturing new voices that will start telling new kinds of stories and representing new kinds of perspectives. Much of the work I do is thinking about how to support these students and give them the tools, confidence, and critical thinking skills they need to go out in the world and create new kinds of films.

conversations about social issues through fun and accessible formats. So, I started making short videos and films back in the 1990s when you would record things on videotape. My first feature documentary, *Paulina*, was a collaborative effort with filmmaker

Associate Professor Jennifer Maytorena Taylor shooting her most recent film, *For the Love of Rutland*, in the small town of Rutland, Vermont, where she spent part of her childhood. The film explores how the once-prosperous town, now gripped by drug addiction and poverty, responds when its mayor invites 100 Syrian refugees to move there. The critically acclaimed film premiered in May 2020 at North America's largest documentary film festival, Toronto's Hot Docs Canadian International Documentary Festival, and is available for streaming on PBS and the World Channel. Credit: Jim Sabatano, courtesy of Jennifer Maytorena Taylor.



People-centered

The films of Associate Professor Jennifer Maytorena Taylor center around people, communities, and cultures that have been overlooked by mainstream society. Prior to coming to UCSC in 2012, she worked at the San Francisco-based public media station KQED where she produced award-winning documentaries on topics ranging from gentrification in two diverse working-class communities in the

Vicky Funari. It first premiered in Havana in December 1997 and then in the U.S. at Sundance in January. Set in Mexico, it was a Spanish-language film, with English subtitles, which told the life story of Paulina, a maid originally from Veracruz. Much of it revolved around sexual abuse and assault. We—unusually and experimental at the time, but now more accepted—included Paulina in the editing process, to ensure that her image as a resilient, creative woman, a survivor, was reflected in the final film. It was a labor of love

that so often characterizes independent documentary films, and it made me decide I wanted to work in documentary filmmaking full time.

How do you approach filmmaking? I strongly believe in stories that are very, very specific—paradoxically, the more specific the story, the more potentially universal it will be. And that’s why my production company is called Specific Pictures. I’m really interested in how big structural issues get expressed through day-to-day life, and through encounters that may seem insignificant, but when you put them in a film, they can become significant. I’m also interested in communities, people, and places, which have been mischaracterized or simply ignored by mass media and bringing others into awareness of those communities, but through perspectives that resonate with the folks inside them. Everyone, me included, goes into places with fixed ideas, assumptions, presuppositions, and hypotheses. My job is to test those and be willing to be proven wrong. It’s also crucial that as you make media of any kind, whether it’s a documentary, book, or a written piece, you do so by engaging the community it’s about. You don’t just helicopter

I consistently bring new lessons learned through my own work in the evolving field of documentary film, and my extensive relationships with organizations like Sundance Institute, back into the classroom. There’s a growing awareness that mass media culture has done a generally terrible job of representing communities that have been systematically pushed out. A whole cultural change needs to take place in representational media, and we see ourselves as the vanguard of that.

Nature lovers

Filmmaker, performance artist, author, and activist, Professor of Art Beth Stephens is a self-described “fiercely devoted lover of the Earth.” This devotion is amply evident in all her work, whatever form

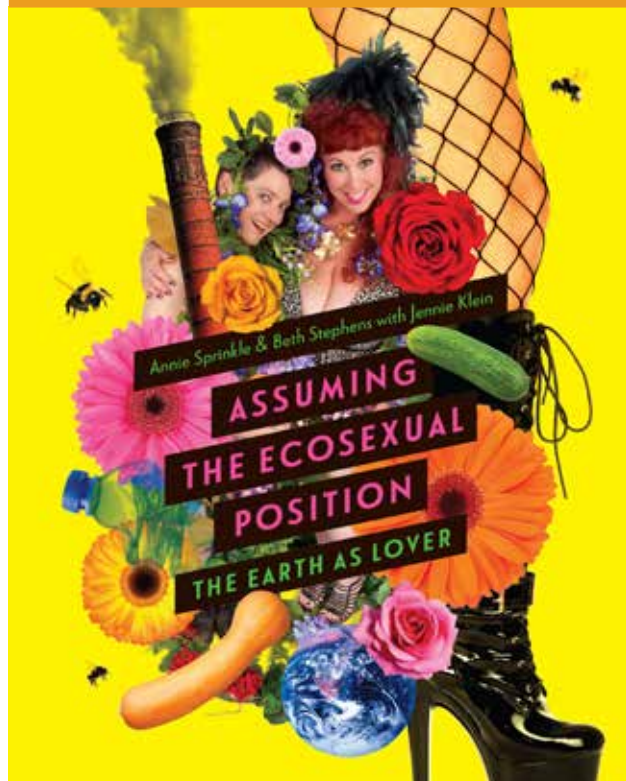
Coauthored by Beth Stephens and her partner, UCSC staff member Annie Sprinkle, their 2021 book *Assuming the Ecosexual Position* chronicles the ecosexual movement they co-founded as well as the story of how the two artists, activists, and filmmakers became lovers and collaborators to take a stand for the Earth and against homophobia and xenophobia. Credit: University of Minnesota Press (public domain).



Above, left to right: Posters for three of Jennifer Maytorena Taylor’s many feature documentaries, *New Muslim Cool* (2009), *Daisy & Max* (2015), and her latest, *For the Love of Rutland* (2020). Credits: Erick Hernandez; Marissa Kitazawa; Lani Rodriguez. All courtesy of Jennifer Maytorena Taylor.

in, make it, and leave. The world is now catching up with us—this mode of filmmaking is now being recognized on a more mainstream level.

How are you influencing the documentary filmmaking scene at UCSC? By incorporating my ongoing active practice as a documentary filmmaker, making work for national outlets like PBS, into my teaching and role as director of the Social Documentation M.F.A. program.



it takes, which has included films, sculptures, writings, and live performances. In all of it, she tells stories about her love of nature, typically through a

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queer lens. In 2008, Stephens and her wife, UCSC staff member **Annie Sprinkle** held a ceremony in the Santa Cruz Mountains in which they married the Earth, kicking off what has since become known as the “ecosexuality” movement. She and Sprinkle subsequently coauthored the book *Assuming the Ecosexual Position: The Earth as Lover* (University of Minnesota Press, 2021), which explores the origins of the movement as well as their partnership. Stephens joined the UCSC faculty in 1993 and is the

How do you approach filmmaking? My partner and I created ecosexuality, a conceptual art movement based on loving the Earth and shifting the metaphor from ‘Earth as Mother’ to ‘Earth as Lover.’ The way I go about making a film is wrapped up in ecosexuality. With Annie, I’ve made a film about the Earth and another about water (*Water Makes Us Wet*, 2017). Our next one is about fire. I’m an untrained filmmaker, and my approach is really one of curiosity. I don’t sit down and write a script. Ideas come and then we pursue them and see where they go.

How are you influencing the documentary filmmaking scene at UCSC?

When I started teaching here, I never imagined that Annie and I would be the movers and shakers of the ecosexual

executive director and co-founder of the university’s E.A.R.T.H. Lab (E.A.R.T.H = Environmental Art, Research, Theory, and Happenings); Sprinkle, her co-founder, serves as the lab’s director of research.

How did you get into filmmaking? I grew up in West Virginia and I realized on a trip home that the mountains there were being destroyed in a heartbreaking way. I started investigating and learned about this horrific form of coal mining called mountaintop removal. I thought, wow, everybody needs to know about this because it’s awful. I thought a film would be one of the better ways to broadcast this environmental disaster, so I made *Goodbye Gauley Mountain* (2015) with Annie Sprinkle, my partner. It’s probably the first queer environmental documentary ever made.

Stephens and Sprinkle photographed on location near the Salton Sea during their tour across California while filming *Water Makes Us Wet*, now available to stream on Kanopy. The film uses a combination of curiosity, humor, sensuality, and concern to explore the pleasures and politics of water from an ecosexual perspective. Credit: Courtesy of Elizabeth Stephens and Annie Sprinkle.




movement. Most universities wouldn’t allow me to do that, and I probably would have been fired. I really love teaching and I find my students very inspiring. My goal is to help them learn how to be creative, so that they can engage in life in a creative improvisational way, especially in the face of climate change. Thinking creatively and being able to improvise are especially useful tools because the standard ways of how we’ve been facing the future might not serve us so well anymore.



Creature features

By Elizabeth Devitt

A fish—a long, skinny one—out of water



With their slimy skin, snake-like bodies, and fearsome faces, there is little charismatic about moray eels. In the wild, morays like this chestnut moray eel (*Enchelycore carychroa*) lurk in hidden places, feeding on sleeping fish and many other sea creatures—a lifestyle that makes them difficult to study. The research of Professor of Ecology and Evolutionary Biology Rita Mehta meets this challenge, advancing knowledge of the role morays play as top predators in marine ecosystems. Credit: Kris-Mikael Krister (CC BY 2.0).

► Under the glare of bright lights, the pattern-stamped skin of a snowflake moray eel shines as it serpentine around a saltwater tank. Video cameras are rolling, ready to capture the moment the eel hauls itself out of the water, slithers up a sandy ramp, and snatches a bit of squid on dry “land.” Once the eel makes its move, it takes less than a minute to document an evolutionary adaptation millions of years in the making: unlike any other fish, some moray eels don’t need water to get a meal.

Catching that feeding behavior on camera took more than six years, seven eels, and an ever-changing roster of ardent student assistants under the direction of **Rita Mehta**. A professor of ecology and evolutionary biology, Mehta studies the diversity of form and function in animals with an elongated body plan, especially eels. “The way an animal is shaped has a really large effect on what

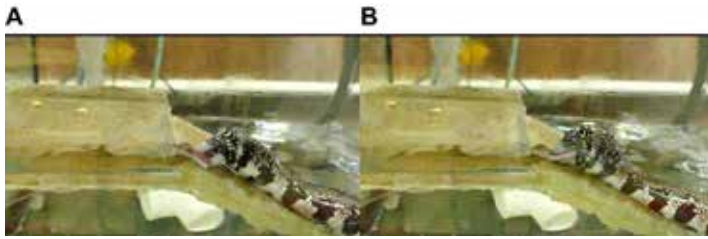
they can eat, how they behave, and the types of environments they can take advantage of,” said Mehta. “Morays are fascinating because their adaptations are so extreme.”

Double take

Morays manage to take prey without the benefit of water because their second set of jaws function like something straight out of a sci-fi movie (think *Alien*). Positioned behind a “first” jaw already full of sharp, backward-pointing teeth, the second “pharyngeal jaw” lunges forward into the mouth and drags food down the throat. Although the anatomy of this double-jaw system was described decades ago, Mehta was the first to video the moray’s double jaws in action, as a postdoc in Professor of Evolution and Ecology Peter Wainwright’s “fish lab” at UC Davis. Morays turn out to be an extreme example of evolutionary adaption—and, therefore, particularly interesting to functional morphologists like Mehta and Wainwright because unusual behaviors are often linked with extreme adaptations.

The Wainwright Lab’s research focuses on the feeding mechanisms of fish. “We look at the ways evolution

Creature features

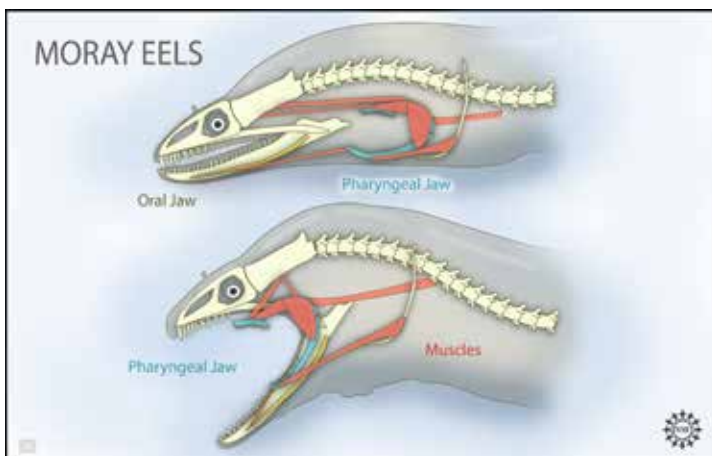


These stills from a video taken in the lab of Professor Rita Mehta show a snowflake moray eel (*Echidna nebulosa*) eating squid “on land.” The extreme adaptations of moray eels that eat hard-shelled prey enable some species to expand their menu options by uniquely capturing prey on land without the use of water. Credit: Rita Mehta and Kyle Donohoe (CC BY 4.0).

tweaks fish anatomy to produce all this ecological diversity,” said Wainwright, a biologist who specializes in reef fish. He likened the research process to taking apart bicycles: “What is it about the build of a mountain bike that makes it better for jumping up and down hills than a road bike with its goofy handlebars?”

Although pharyngeal jaws are common in bony fishes, most fish are suction feeders and use their mouths to generate a wave of water to suck in prey. Even the mudskipper, a fish long known to take prey on land, carries water in its mouth to use that technique on terra firma. And, in most bony fishes, the second set of jaws tucks within the oral cavity. But the drastically modified two-jaw system of morays allows them to eat big prey that are quite hard to swallow—particularly without water.

To see how the mechanism worked from inside, Mehta teamed up with Rachel Pollard, a veterinary radiologist at UC Davis who specialized in swallowing disorders of animals. “It was a creative process,” said Pollard, now retired, as she recalled how an



Pharyngeal jaws are common among bony fishes, but in morays this second set of jaws sits behind the oral cavity and moves all the way into the mouth to pull large prey into the esophagus. Credit: Zina Deretsky/NSF, after Rita Mehta/UC Davis (public domain).

enthusiastic technician, Candi Stafford, carried out their painstaking plan. They had to be fast enough to take x-rays while the hopefully hungry eels ate dead goldfish into which the researchers had injected radiodense iodine. “Remarkably, it worked,” Pollard said, although not exactly as planned. It turned out the injected dye was hard to see, but they could watch the pharyngeal jaws in action by tracking the swallowed fish by their bones and the air in their swim bladders.

Body building

But there is more to morays than their monstrous mouths. These eels belong to the Muraenidae family, in the larger order of Anguilliformes, which includes more than 800 eel species found worldwide. Although eels all have similar stretched-out physiques, the 200-plus species of morays display amazing diversity in the way they’re put together—from the number of vertebrae in their spine to the shape of their skull.

Mehta’s research showed how the long body plan of morays evolved differently than in other eels. The three ways to extend a fish spine are: by adding more vertebrae at the front (pre-caudal) part of the spine, adding more at the tail (caudal) end, or making each vertebra longer. Working with long-time collaborator Andrea Ward, professor of biology at Adelphi University in New York, Mehta surveyed vertebral patterns in 54 different eel taxa. When they compared the vertebral patterns among three major eel families, those from the moray group added more vertebrae in the caudal region—a longer tail—while the other two major eel groups added equal numbers of vertebrae in both spinal regions.

Vertebral patterns affect how an eel moves and correlate with some behavioral differences among eels. For example, Mehta observed that the extra caudal vertebrae gave morays enough length to tie an overhand knot with its body, and then use it as an anchor to help capture prey, or to slip it up their body to entrap prey.

Eels’ meals

The fact that morays can ingest large prey, in one mouthful, puts them among the top predators in their environments. Yet little was known about the moray diet or how the eels impacted their ecosystems, said Mehta. Key predators affect the abundance and distribution of their prey, which, in turn, influences the rest of the food chain. So one of the first steps to figure out the moray’s role was to find out what they ate.

To learn more about their menu, Mehta searched scientific databases for reports on moray prey. She visited museums where, along with her students, they extracted and catalogued the stomach contents of preserved eel specimens. And in the field, Mehta trapped morays in Caribbean and California waters. Using a technique learned during her graduate studies on snakes, she anesthetized the eels and then massaged their stomach contents upward to extract the prey from their mouths, a method that allows her to study the eels without causing them harm. Along with the dietary data, she recorded a broad set of measurements including skull size, jaw length, and number of teeth.



The diversity of elongated body plans in eels allows them to develop different feeding behaviors. Morays have more vertebrae in the tail (caudal) region of their spines, which allows some of them to “knot,” like this *Gymnothorax pictus* moray using the behavior to provide more leverage as it wrestles down its dinner, a large Sally Lightfoot crab (*Percnon planissimum*). Credit: Kevin Lafferty/USGS (Public domain).

These investigations showed that morays eat a diverse diet of small fish, octopus, shrimp, and hard-shelled prey such as mollusks and crabs. More intriguing to Mehta, was that different species showed distinct preferences for fish (piscivory) or hard-shelled prey (durophagy). What made a moray want fish, she wondered, rather than crab? While morphological differences between skulls and teeth showed that piscivores had sharper teeth and longer skulls, Mehta found other skull changes were also important. For instance, durophagous eels had skulls that supported the attachment of thicker cheek muscles, the better to bite harder.

The eels’ dietary choices also correlated with differences in their organ systems. In a series of

dissections, **Samantha Gartner**, a former UCSC undergraduate now studying fish morphology at the University of Chicago, compared organ placement and size among nine species of moray eels. Among the differences she found, the hard-shelled prey eaters had smaller hearts, possibly because they don’t have to swim so much to catch their prey. Mehta also expected to find smaller stomachs in durophagous eels, because they digest fragments of food instead of whole fish. But this wasn’t the case—at the microscopic level, Mehta saw that hard-shell-eating eels had thicker stomach walls, perhaps to protect them from the shards of shells. “There’s so much incredible diversity out there,” said Mehta. “We’ve only just begun to tap into diet and morphology.”

More questions

California has only one species of moray, the aptly named California moray. *Gymnothorax mordax* lives in kelp forests and rocky shorelines near Santa Catalina Island, southwest of Los Angeles (and elsewhere down the Pacific coast and around some Pacific islands). But morays are not part of a commercial fishery, so the eels had received little scientific attention. In fact, no one thought many morays were in the area until Mehta began studying them in 2010. With then-graduate student **Benjamin Higgins** (Ph.D. ’18; now chief scientist with Kokua Services, a cannabis cultivation company in Olympia, WA), Mehta trapped, examined, and tagged 462 morays within



Learning the diet of top predators like morays provides insights on their ecological impact. To identify a moray’s menu, Mehta and her students trap and anesthetize eels at field sites, then massage prey up from their stomachs to their mouths. When Mehta travels internationally she always carries a bottle of clove oil—a useful anesthetic agent for eels. Credit: B. A. Higgins, C. J. Law, R. S. Mehta (CC BY 4.0).

Creature features

an area called Two Harbors in just a few weeks. Not only did their survey find more morays than expected, but throughout the years that Mehta and her team have returned to their field sites, they've repeatedly trapped many eels in the same location. The tendency to stay in one area, called site fidelity, suggested the eels' feeding preferences might be playing a big role in the local ecosystem.

In 2015, Mehta and Higgins expanded their Two Harbors study to the Blue Cavern Onshore State Marine Conservation Area on the leeward side of Santa Catalina Island, a "no take" marine protected area (MPA) where fish cannot be removed for any reason. Here, joined by UCSC doctoral student **Katherine Dale** and undergraduate researchers, they trapped and measured the weight, size, age, and body condition of 1,736 eels over the next three years. Their results showed that more eels lived inside the MPA—and larger and older ones—than those found outside. Morays outside the MPA ate a greater variety of prey, while eels inside had a higher rate of cannibalism. Those results generated more questions: What did it mean for the commercially important kelp bass to live with a bigger, older eel population? Did the morays prefer different sizes of kelp bass? Did preferences change with prey abundance? As Mehta and her students have continued studying these morays, their findings are providing insights that could help improve MPA management.

Although Mehta has specialized in morays, her work in the eel realm extends more broadly. In one large study, she and Ward analyzed how various types of eels move in the water and across different substrates and inclines. "We're trying to understand how these animals use their bodies to propel themselves on land," said Ward, whose

work focuses on American eels, an endangered fish that migrates between saltwater and freshwater. Learning how eels maneuver most efficiently could help boost their declining populations—by informing the design of more eel-friendly passages across the dams that interrupt their migration routes to inland freshwater habitats.

Moray amore

Mehta's lab research, museum work, comparative studies, and field ecology, all aim to pull together the ecology of morays, said Elizabeth Dumont, an evolutionary biologist who studies form and function in bats. Dumont, UC Merced dean of the School of Natural Sciences, has been a collegial mentor for Mehta since they met at an engineering workshop more than a decade ago. "You pick away on the ecology, you pick away on the evolution, and then at some point you finally have enough to start seeing the picture of how it all fits," Dumont said. "Then you can start asking the bigger evolutionary questions, like why are there so many long, skinny fishes?" With the biodiversity crisis worsening

across the globe, these questions matter, Dumont said. "If we don't understand how things evolved and got here, we can't make good predictions about the future."

In pursuit of answers to the myriad questions that continue

to arise as she learns more about her outwardly fierce but truly quite shy research subjects, Mehta is undeniably committed to morays. "Everything about them is a surprise," she said. And it's clear to her that once acquainted with these captivating creatures, other people soon feel the same. "When undergraduates visit my lab and see what I'm working on," Mehta said, "they quickly become fascinated."



Mehta does hard fieldwork, said Elizabeth Dumont, UC Merced bat expert and dean of natural sciences: "You know, she dives in cold, shark-infested waters to study these eels. I go to the jungle to study tiny animals that fly really fast in the dark. I mean, we don't set ourselves up for easy stuff." Shown here are one of Mehta's Santa Catalina Island field sites and Mehta with a moray just anesthetized with clove oil. Credit, both: courtesy of Rita Mehta, with permission.

On the spectrum



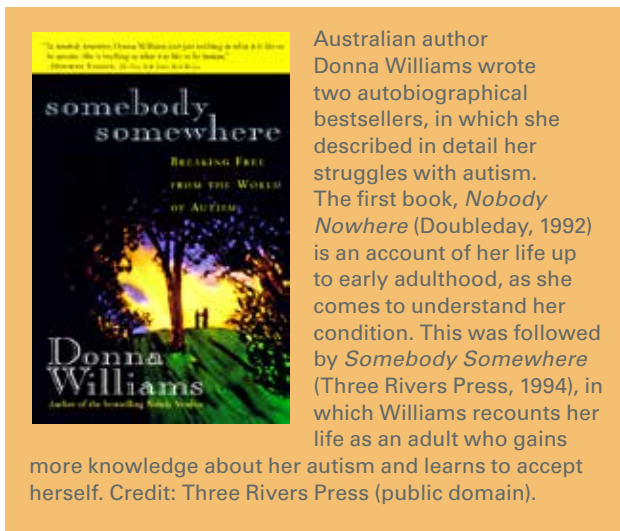
Seeing people with autism as different, not deficient

The Liverpool, UK-based ADHD Foundation organizes the Neurodiversity Umbrella Project. Thousands of colorful umbrellas are hung over schools, public places, and business buildings in cities across the UK. The aim is to celebrate the gifts, talents, and strengths of neurodivergent people who have been diagnosed with conditions such as autism, ADHD, dyslexia, and Tourette syndrome. The project aims to change perceptions of neurodivergent people by accepting and celebrating differences. Credit: Printkick Ltd. (CC BY 2.0).

► People diagnosed with conditions listed in the *Diagnostic and Statistical Manual of Mental Disorders (DSM)* are deemed, by the manual, to have certain deficits. For a diagnosis of autism spectrum disorder, for example, this “bible” of psychiatry states that a child must show, in addition to other behavioral tendencies, “persistent deficits in each of three areas of social communication and interaction.” Such pathology-based diagnoses promote a “deficit view” of mental disorders, a narrow perspective subject to increasing challenge.

One such challenge comes from Associate Professor of Philosophy **Janette Dinishak**, whose introduction to autism fostered a different view. While conducting her Ph.D. research at the University of Toronto, Dinishak was invited by her adviser, philosopher Ian Hacking, to work on a project analyzing the autobiographies of autistic people. In addition to reading these works, Dinishak exchanged emails with, among others, Tito Mukhopadhyay, an Indian-born nonspeaking autistic poet, and Donna Williams, an Australian woman with autism who wrote two bestsellers, *Nobody Nowhere* and *Somebody Somewhere*. From this research, Dinishak gained insights into the experiences of autistic people that she wouldn't have had otherwise.

On the spectrum



Dinishak eventually took these insights to UC Santa Cruz, joining the faculty in 2011. At UCSC, she met and began a now decade-long collaboration with Professor of Developmental Psychology **Nameera Akhtar**. The collaboration has included others, such as Vikram Jaswal, professor of psychology at the University of Virginia in Charlottesville. Their common interest? Critiquing the deficit view of autism, assessing its impact on autism research, and unveiling its potential toll on autistic people and their families.

The researchers recently completed a qualitative study, published in *PLOS ONE*. “We tried to understand how some moms come to experience a sense of connection with their autistic kids. What kinds of behaviors, perspectives, and approaches in the relationship led them to feel connection with kids who traditionally—and wrongly in my view—are assumed not to be all that interested in connecting with other people,” said Jaswal. Of Dinishak, Jaswal said: the qualities she “brings to bear on challenging the deficit view of autism include her fierce intellect and her willingness to practice intellectual humility, her careful and rigorous interrogation of entrenched and novel ideas, and her genuine interest in reducing the stigma associated with autism.”

We spoke with Dinishak about her research and its implications for autistic people.

How has the deficit view shaped your work?

As a philosopher, I got interested in trying to be clear on what it is to have a deficit view of some phenomenon. It's a dominant, popular, and scientific viewpoint that when you are trying to understand autistic behaviors and other features of autism,

you are associating those features with some kind of absence of what so-called normal people have. Then, there's the additional step of evaluating it negatively and saying, you lack something you should have. I find both aspects of the deficit view of autism problematic.

Has the deficit view impacted the scientific research on autism? On the one hand, there's

research on autism? On the one hand, there's some appreciation of the heterogeneity of autism. The *DSM* changed its category for autism by using the term autism spectrum disorder. But no matter where you're placed on the so-called spectrum, the common denominator is having challenges in social interaction. I'm putting it quite neutrally. Usually, it's cast as deficits in social and emotional reciprocity. So autistic people's behaviors—such as lack of eye contact, or rocking back and forth, turning, or walking away during conversation—are taken to be indicative of deficits in social and communication skills. Autistic people are being attributed deficits to explain what's going wrong in interactions with non-autistic people.

Another deficit view is the lack of empathy portrayal, saying that autistic people lack empathy. It's sometimes related to the mind-blindness theory of autism, which says typical or normal people have a theory of mind, which allows them to predict and explain other people's behaviors. They attribute mental states like beliefs, desires, and intentions to others to figure out what other people are going to do, and to explain things that they've already done. So, if an autistic person lacks a theory of mind or has a deficit of it, then the idea is that they're not able to use those same kinds of behavioral cues, as a way of making inferences about mental states of other people, but also themselves.

Why is the deficit view a cause for concern?

Think about this phrase that one encounters in the *DSM*: deficits in social and emotional reciprocity. Well, what is reciprocity? That's something that occurs between people. So, there's something conceptually strange about thinking about that lack of reciprocity as a problem with a particular person and saying, 'Oh, there's something wrong with the autistic person,' but not paying attention to how non-autistic people are contributing to the difficulty in the reciprocal interaction.

Tell us about your study with mothers and autistic children. It was an in-depth interview

autistic children. It was an in-depth interview study of just 13 mothers of nonspeaking autistic children. I don't want to say anything that would be interpreted as a generalization for all mothers of

nonspeaking autistic children, let alone fathers or other caregivers. But these mothers have developed a perspective or a way of regarding their child and their relationship with their child that allows them to be open to moments of connection to their children and interpreting their children's behavior in ways that help them feel connected.

Can you give an example? Just by being exposed to an alternative to the deficit point of view, such as the neurodiversity perspective on autism, and then bringing that alternative perspective to atypical interactions, like just sitting next to their child, not making eye contact, or talking to each other, just being in physical contact, shoulder to shoulder, and appreciating how that itself could be a moment of connection.

Sometimes the typical interactions do happen. Then, the parents appreciate those, even if they are rarer than if the child wasn't autistic. But they were open to recognizing and appreciating atypical forms of social behavior as social. That fueled their feeling of connection with their child because they could interpret those behaviors as bids for social connection. It's extremely powerful just to appreciate the enormous amount of reflection, self-understanding, and the humility of their journey in trying to understand their children.

Did anyone talk about how the deficit view had an impact on them? There was one mother who had felt connected to her child prior to diagnosis

and had a really strong bond with her child. And then later on, her child got a diagnosis, and that diagnosis changed retrospectively how she viewed her experience with her child in a negative way. It made her look back and say, 'Well, I guess, all those times that I thought we were connected, we weren't, because you have autism and because autism means that you can't connect.' The diagnosis was a deeply negative experience for her. It was like losing meaning in how she understood her relationship with her child prior to diagnosis, because of the deficit view. Finding a way back to reinterpreting her past experience with her child in a positive light was an important part of her journey.

Did the mothers have any advice for parents whose children just got diagnosed with autism?

The advice that they gave is, first of all, to recognize that if you've met one autistic person, you've met one autistic person. You must get to know your child in their particularity. Another recommendation was to get connected to advocacy communities that are friendly to alternatives to the deficit-view pathology paradigms, like those that promote neurodiversity. These communities believe that autism, like some other human differences, is a positive variation in some of its manifestations. If you take that perspective, then you are open to strengths or neutral differences that your autistic child may have, not just focused on challenges.

There is no one right way to be. The neurodiversity movement advocates that differences between people considered "normal" (neurotypicals) and those diagnosed with conditions such as autism (neurodivergents) are just that: differences. Neurodivergents interact with and experience the world differently and possess a unique set of strengths and skills. Credit: MissLunaRose12 (CC BY-SA 4.0).





Beyond the end

Imagining better futures in the wake of dystopia

► During the often fierce 2016 protests in the vast North Dakota landscape of the Standing Rock Indian Reservation, hundreds of mirror shields glinted in the sun like dappled water. Their purpose? To help the “water protectors” who gripped them side-by-side stand firm in their conviction: the planned Dakota Access Pipeline that would carry oil from western North Dakota to southern Illinois endangered the region’s water and the ancient burial grounds of the Standing Rock Sioux Tribe and other Native American cultural sites. By reflecting their images back at them, the mirrors reminded the riot gear–garbed police of their humanity, said artist and shield designer Cannupa Hanska Luger.

Having grown up on the reservation, Luger had an intimate understanding of the threats posed by the pipeline. Remembering mirrors similarly used by Ukrainian protesters in 2014, he designed long wooden shields covered in unbreakable reflective coatings. After building dozens of the shields with students at the Institute of American Indian Arts, he released a video instructing others how to make them. The video provided an important way for anyone to join the protest, Luger said, prompting supporters to build and send more than a thousand mirrors to the front lines.

According to **T. J. Demos**, UC Santa Cruz professor of art history and visual culture, Luger, with his *Mirror Shield Project*, belongs to an emerging group of artists who employ experimental and unconventional practices to address historically complex and interlinked social and environmental crises. Luger is one of many artists featured in the Demos-directed *Beyond the End of the World*, a two-year project designed, per the UCSC project’s website, to

confront urgent global threats and cultivate “radical futures of social justice and ecological flourishing.”

Demos explored the project’s theme in his similarly titled book, *Beyond the World’s End* (Duke University Press, 2020). The inventive artist activists Demos has identified, together with leading thinkers and visionary writers, are all addressing socio-ecological crises with “models of aesthetic practice where life is being reinvented in ways that not only critically identify the manifold problems that threaten existence as we know it,” writes Demos, “they also offer diverse approaches to a hopeful futurity beyond the catastrophe of racial and colonial capitalism.”

Artists in Mexico tapped traditional kite-making practices and cultural traditions to create an innovative way of engaging and organizing people both to fight anti-immigration policies as well as to envision more humane ways to manage climate change and climate refugees. Their work was displayed at the Santa Cruz Museum of Art & History as part of the *Beyond the End of the World* project’s first of three exhibitions. *BordersBordados: A Rasquache Time Machine*, digital video still, 2020. Credit: The Rasquache Collective, courtesy of the artists.



Radical imaginaries

The project’s conception and expansion grew out of past research and political concerns of Demos, who also created and directs the UCSC Center for Creative Ecologies; it additionally resonated with a growing array of international intellectual and creative practices. Starting in 2018, with support from The Humanities Institute, a \$225,000 grant from the Andrew W. Mellon Foundation, and more than 20 collaborators, Demos led the planning and development of a range of thematically related research topics and activities

Top: Artist and activist Cannupa Hanska Luger designed mirror shields to support protesters during front-line actions in 2016 against the multibillion interstate Dakota Access Pipeline project. To engage the global community in helping to protect his tribal lands and culture, Luger created a call to action in an instructional video for how to build the shields out of low-cost materials. He estimates that people around the country made and sent more than 1,000 mirror shields to the Oceti Sakowin Camp near Standing Rock, ND. Credit: Cannupa Hanska Luger, courtesy of the artist and the Garth Greenan Gallery, New York.

culminating in both his book and the project's Sawyer Seminar series, film series, and art exhibitions. The latter three series of events during 2020 and 2021 provided forums for international thinkers and cultural practitioners to consider both current challenges and what life might look like in the near and distant future.

According to Demos, the new and radical "imaginaries" that spring from this type of creativity are multifaceted social worlds envisioned and created through the grassroots efforts of art activists who are fighting against wide-ranging and intersecting injustices, including economic inequality, political disenfranchisement, racial and colonial violence, and environmental destruction. By employing and modeling new aesthetic and political forms, Demos said, the artists associated with the project are, in many ways, playing a vital role in challenging ongoing oppression. Fostering this movement are three significant transformations Demos cites having observed in recent art practice: a willingness to step away from art as a commodity presented in rarefied gallery environments; a growing body of work in justice-based art focused on socio-environmental issues; and an increasing use of art within social-justice movements.

The work of Dutch visual artist Jonas Staal, for example, embodies this socio-political and movement-based aesthetic, interweaving art, propaganda, and collective organizing in engaged ways to galvanize people around a common postcapitalist vision that could help improve their social circumstances and environment. "To change the world," Staal said, "we must first imagine the world differently. Radical imagination educates and mobilizes the struggle, and the struggle transforms the radical imagination into a new construction of reality."

Flying high

Another example? A twist to high-flying kites crafted in a Mesoamerican tradition by artists from the Rasquache program in Mexico. The installation *BordersBordados: A Rasquache Time Machine*, part of the first Beyond-related exhibition at the Santa Cruz Museum of Art & History, encouraged viewers to consider emancipatory horizons beyond the present dystopia of violent, militarized border-zones that prevent passage to migrants seeking refuge from intolerable political and environmental conditions. To build their colorful kites that a viewer might imagine seeing flown above the U.S.–Mexico border wall, the artists used traditional needlework methods to combine re-engineered items associated with callous anti-immigration actions, including mylar blankets from border detention centers and tiki torches carried by

white supremacists at hate rallies. "Imagine yourself in a future world," said the artists in their online guide for creating the kites. "And speculate how our communities can survive and support one another." The kites, they said, can "glide without resistance across borders and carry messages of hope."

A third example, one of many described by Demos in his book, showcases a three-panel video installation created by British artist and filmmaker John Akomfrah. In *Vertigo Sea* (2015), Akomfrah reveals a shared conflict zone amongst seemingly unrelated histories, geographies, and inhabitants of the ocean by mixing lush imagery of vibrant marine life with images depicting century-spanning, violent human practices, including trans-Atlantic slave shipping, harpoon whaling, nuclear arms testing, and dangerous migrant crossings. Haunting music and background sounds accompany this montage of disparate images, all displayed without narration.

British artist and filmmaker John Akomfrah created a montage of disparate elements in his video installation *Vertigo Sea*, covering centuries of the oceans' tumultuous history with humans. Together with moving sound

and no narrator, the film juxtaposed images of stunning beauty with violent actions such as whaling, nuclear testing, and the trans-Atlantic slave trade. *Vertigo Sea*, 2015, video still, three-channel HD color video installation, 7.1 sound, 48 minutes 30 seconds. Credit: John Akomfrah © Smoking Dogs Films. Courtesy Smoking Dogs Films and Lisson Gallery.



According to Demos, work like *Vertigo Sea* connects environmental scholarship, such as Blue Humanities research, to social justice and antiracist inquiry, such as Black Atlantic studies—areas seldom brought together in a complex dialog. The resulting artwork intertwines social and non-anthropocentric histories, providing a visually poignant and emotionally powerful impetus for creating a better future. "We are entering the endgame, the terminal point of democracy, of liberalism, of capitalism, of a cool planet, of the Anthropocene, of the world as we know it," writes Demos. "Perhaps what *Vertigo Sea* offers is, ultimately, optimism, if not without its cruelties. Where past injustices have failed to utterly destroy their aftermath, we can maintain hope, despite all, of a different time to come."



Disputed memories

Why do they hide the bad things?

► On June 10, 2020, **Martin Rizzo-Martinez** (Ph.D. '16) was less than two weeks into his new job as park historian for the Santa Cruz County Parks when history marched right up to his doorstep. Protesters against the murder of George Floyd swept up from downtown to the Santa Cruz Mission Plaza, toppled a mission bell marker, and spray-painted the mission walls and a memorial plaque with the word “genocide.”

On the day after the protest, Rizzo-Martinez said, “I was out there scrubbing the walls with my colleagues.” (The Parks Department owns the site of the mission adobe and was responsible for the cleanup.) But Rizzo-Martinez, who has documented the appalling loss of life by Native Americans during the Spanish mission period, most notably with his recently published book *We Are Not Animals* (University of Nebraska Press, 2022), would be the last person to disagree with the protesters.

In an earlier era, the Parks Department might have bemoaned the vandalism. But this was 2020. Instead of criticizing, they listened. Rizzo-Martinez and his Parks Department colleagues looked for ways to “rethink how the story has been told.” Their response, designed in consultation with local Native American groups, produced a remarkable virtual exhibit on the history of the mission bells (See https://www.parks.ca.gov/?page_id=30583). “I understand that when you remove a marker, people are afraid of erasing history,” Rizzo-Martinez said. “So, the exhibit we built includes six different perspectives of what the bells have meant to different communities over time.”

The George Floyd murder prompted a reckoning for the entire United States over its history of violence against people of color. While a great deal of attention has focused on Confederate memorials in the Southeast, California has its own set of

Top: This painting of the original Santa Cruz Mission includes a bell tower destroyed in an 1840 earthquake; another earthquake in 1857 destroyed the rest of the original mission. Credit: Leon Trousset, 1876 (public domain).

problematic memorials: more than 500 mission bell replicas that line the state's highways. For Indigenous people, they are a reminder of a brutal period. At Mission Santa Cruz alone, 2,078 of the 2,289 Native Americans who were baptized were also buried there, an appalling death rate of 90% over a 40-year period. Half the children died before age one and three-quarters died before age five. Eyewitness accounts testify to abusive treatment of the natives by the padres. These facts are not taught in schools, and they are not widely known by the public. Rizzo-Martinez and faculty and students at UC Santa Cruz are trying to change that.



More than 500 mission bell replicas mark the route of El Camino Real; most, like this one, were sponsored by women's clubs, with the first one installed in Los Angeles in 1906. The markers romanticize a very traumatic period for Native Americans; the actual mission bells regulated the hours of work, prayer, and sleep of the mission internees. The name "El Camino Real" (royal road) itself conceals the fact that the route was a Native American footpath long before the first Spanish settlers trod upon it. Credit: ramalama_22 (CC BY 2.0).

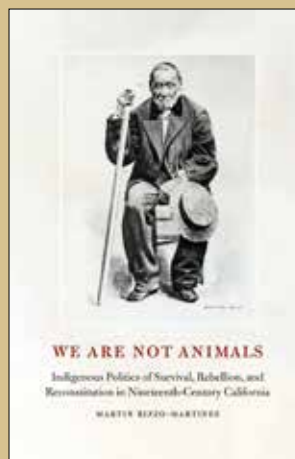
A fuller story

In 2018, UCSC joined three other University of California campuses and several Native American tribes to launch a project called Critical Mission Studies, which aims to tell a fuller story of the Spanish mission era. UCSC has had a long partnership with the Amah Mutsun Tribal Band, the Indigenous descendants of several original tribes often forcibly taken to Mission Santa Cruz and Mission San Juan Bautista. "Our goal is to have the true history of the missions told," said Valentin Lopez, chairman of the Amah Mutsun. "Whenever I would talk about the history of the missions, people could not believe it. The Critical Mission Studies project is allowing tribes and individuals to

tell the story. It was just natural for us to work with UCSC on this effort. We're grateful and feel we are accomplishing our goals."

The project was conceived by UCLA Art History Professor Charlene Villaseñor Black, UC Riverside History Professor Jennifer Scheper Hughes, UCSC History Professor **Amy Lonetree**, and UC San Diego Ethnic Studies Associate Professor Ross Frank, who jointly applied for a grant as part of the Multicampus Research Programs and Initiatives (MRPI). One of only 16 grants funded out of 179 applications, their proposal received slightly over \$1 million. But it is not the size of the grant that makes it unique. "It really became special when Native Americans were brought in as co-supervisors," said Rizzo-Martinez. The four co-principal investigators share all decision making with four representatives of California Native tribes, including Lopez and **Yve Chavez**, UCSC assistant professor of art history and a member of the Southern California Tongva tribe. "We listen to the community and do not come in with our idea of what they should care about," said Lonetree, who handed over her co-principal investigator duties to Anthropology Professor **Renya Ramirez** after the grant was funded.

The grant funds a diverse set of projects. In one, Amah Mutsun Ph.D. students Alexii Sigona (UC Berkeley) and **Carolyn Rodriguez** (B.A. '18, now at UCLA) conducted oral history interviews with 11 members of the Amah Mutsun; clips from these interviews are being made available as a resource to elementary school teachers. In another, Rizzo-Martinez is working on *Walk for the Ancestors*, a film documenting a 780-mile walking journey that Caroline Ward Holland, a woman from the



The title of Santa Cruz County Parks historian Martin Rizzo-Martinez's book is a quote from an oral history and refers to the way that many California Natives felt they were treated by the missionaries. Credit: University of Nebraska Press (public domain).

Disputed memories



Generations of fourth-graders in California schools have learned about the missions by building models of them, promoting a sanitized view of the state's history in which Native American faces and voices are neither seen nor heard. Credit: David Lofink (CC BY 2.0).

Los Angeles-based Tataviam Tribe, took with her teenaged son, Kagen, in 2015 to visit and hold ceremonies with local tribe members at each of the 21 Spanish missions. The grant also funded a one-day conference in August 2021, held at Mission Santa Cruz. Called "Telling and Teaching the Truth of the California Missions," the gathering included a ceremony to celebrate the removal of the mission bell the following day. Ramirez described it as a "catharsis" for the Amah Mutsun and others. "I was surprised about how emotional it was, to be at that site giving a talk," said Lonetree. "I've heard the history recounted before, but there is something powerful and very poignant about hearing it in the space where it happened."

Popsicle-stick missions

Other related activities at UCSC focus on an important group that urgently needs to hear the Native side of mission history: California's children. **Judith Scott**, professor of education, wrote and self-published a children's book, called *When the Mission Bells Rang* (2022; free PDF available at <https://whenthemissionbellsrang.weebly.com/#/>). The child-friendly fantasy features animals that join together to foil the padres' attempts to ring the bells. The story incorporates Indigenous folklore and uses Amah Mutsun names for the animals; it also includes aspects of recorded

history, such as an earthquake in 1840 that destroyed the mission's bell tower. "It's a great way to get kids engaged, and to start creating curiosity," Scott said.

For more than 50 years, as part of their required, standard curriculum, all California public school students have learned about the Spanish missions in the fourth grade, traditionally including the activity of building models of the missions out of popsicle sticks and other materials. But their

textbooks typically portray the Native Americans as docile converts to Christianity, a representation that is offensive to those who know better.

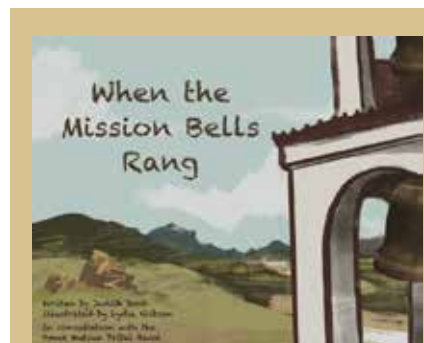
Unfortunately, textbook publishers have done little to change this narrative. But in focus groups she collaboratively conducted as part of the grant, **Daisy Martin**, director of the Education Department's History & Civics Project, said she consistently heard pleas from teachers: "We want Native voices, where

can we find them?" The Critical Missions Project will provide those teachers with teaching plans and classroom resources, such as the previously mentioned clips from the Amah Mutsun oral histories.

Meanwhile, the California Department of Education is finally working on a long overdue statewide curriculum on Native American history, expected to be completed in 2025.

Some of the materials

produced by Martin, Scott, and their colleagues could become part of the new curriculum. However, "One of the difficulties in trying to teach a generic history is that there are no generic tribes," said



As recounted in Professor of Education Judith Scott's self-published fable written for the Critical Missions Project, the mission bells changed the soundscape of Central California—and not for the better. Credit: Courtesy of Judith Scott and Lydia Gibson.

Scott. To address this issue, educators in other counties will have to reach out to their local tribes to hear their stories, a process that the Critical Missions Project hopes to facilitate by providing a roadmap and helping them make the connections.

Barbara Novelli, a fourth-grade teacher at Bay View School in Santa Cruz, has field-tested Scott's book and other materials. Kids at that age are very attuned to fairness and injustice, she said, and they notice how their textbooks duck the issue. Novelli recalled one child asking, "I've read about Mission Santa Cruz before. Why did they hide the bad things from us?"

Facing the bad things

The reality is that adults often find it more difficult to face the "bad things" than children. In Santa Cruz, Lopez worked for two years to get the removal of Santa Cruz's last mission bell onto the city council's agenda, finally achieving a unanimous 5-0 vote to

remove the bell. In Gilroy, however, the opposite happened when its council considered a proposal to erect a new bell marker in honor of the city's 150th anniversary. "I believe 40 letters were sent to them, some very powerful, from university professors and local citizens," Lopez said. "It was obvious at the hearing that the council members hadn't even read the letters." Lopez was allotted one minute to speak, not enough time to convince someone that what they have been taught for their entire life is wrong. "They have no doubt they are correct," Lopez said. "And they are unwilling to even contemplate anything else." The council voted 4 to 3 in favor of the new mission bell.

"The educational process is going to take a very long time," said Lopez. "We know it could take generations, so it's important to get started as soon as we possibly can, to work diligently and persistently, and never give up on getting the truth told."

Erasing the silence

One question that people who want to take down a monument always confront is: "Aren't you erasing history?" Associate Professor of History **Catherine Jones** turns the question around: "What does this monument silence?" The Confederate monuments silenced Black people, who were invisible in those monuments, and they also silenced white dissenters. "They denied the fact that there were many people in the South who opposed slavery and fought fiercely to end it," Jones said. Similarly, the mission bells silenced the experience of California Indians, still struggling to be heard after 150 years.

Both kinds of monuments also had mercenary objectives. In Richmond, Virginia, the sponsors of the Confederate statues on Monument Avenue built them as part of a plan to market the area as a desirable white neighborhood. In California, sponsors of the mission bells placed them to encourage tourism to the cities that grew up around the 21 former missions. But these bells are as fake as the mission bells in Taco Bell advertisements. Though such memorials convey some historical meaning, it is typically not the one intended. "Monuments tell us more about the time when they were built," said Daisy Martin, "than the events they are supposed to memorialize."



George Floyd protesters defaced the pedestal of the Robert E. Lee Monument in Richmond, VA, photographed here in July 2020; city authorities removed the statue in September 2021. Credit: Mk17b (CC BY-SA 4.0).

Seeing the forest

The latest research buzz: drones

► Perched awkwardly in a stand of shrubby manzanita on a cool December day, **Jon Detka** swiveled a 20-foot swimming pool sweep in the air, a Bluetooth-equipped GoPro camera strapped to its tip. Steadying the long pole over the coastal brush, the UC Santa Cruz Ph.D. student in environmental studies snapped overhead photos of the woody plant he studies to measure the effects of the ongoing drought at UCSC's Ford Ord Natural Reserve.

Up and coming

Detka is but one of the many researchers at UCSC, other UC campuses, and around the world who have had "lightbulb" moments grasping the promise of drones as transformative tools for research. Drones—also called uncrewed—or unmanned—aerial vehicles or UAVs—have potential applications in nearly every field of study, including performing surveys and collecting data for analyses of coastal and terrestrial ecosystems, animal populations, and remote archaeological sites; managing agriculture; creating bird's eye cinematography; and, importantly, serving as a platform to drive the development of new technology, like remote sensing.

With the emerging new normal of California's climate-change-fueled, supercharged drought and wildfire seasons, drones offer an unparalleled tool to facilitate field research aimed at assessing and informing measures to mitigate the resulting environmental effects. In addition, UC faculty and Monterey business leaders and entrepreneurs have also landed upon drones and drone-based technology as an up-and-coming, important economic opportunity for the Monterey Bay region. Predicted to grow to \$90 billion by 2030, the global drone industry will demand skills in a workforce UC plans to foster, seeing the prospects as especially attractive for students with backgrounds traditionally underrepresented in scientific and engineering careers.



CIDER director Becca Fenwick shot this drone photograph in UCSC's Landels Hill Big Creek Reserve in Big Sur while surveying fire damage in late 2020, looking for burn scars and new growth. Through CIDER, UCSC researchers have access to 11 drones, ranging from research-grade fixed-wing and quadcopter models to smaller quadcopters ideal for photography and videography. Credit: Becca Fenwick, with permission.

While waving his pool sweep over the brush, Detka also tried to avoid the chaparral's dense, sharp, pointy branches, the poison oak, and the questing arms of Lyme disease-carrying ticks. Then, in the middle of these tricky maneuvers, Detka spied a group of interesting folks who had "come out to scout the Reserve for a drone camp event." Seeing their drones nimbly buzzing about and hovering, the thought flitted into his mind: "Maybe I don't have to walk through all this."

Lift off

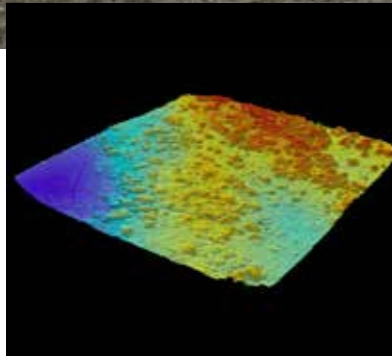
With apologies in advance for the following alphabet soup, the drone-sporting people spotted by Detka that day belonged to the UC Drone Camp, a five-day training program that, according to its website, "covers everything you need to know to use drones for mapping and field data collection." Run in its initial five years by a threesome of partners, including UCSC, UC Agriculture and Natural Resources (UCANR), and California State University, Monterey Bay, the Drone Camp, as of 2022, is now managed jointly by



UCANR and a brand-new UCSC-based program called CITRIS Initiative for Drone Education and Research, or CIDER. CIDER, in turn, sprung from a mind meld of the UC Natural Reserve System's Environmental and Information Technology Group and UC's Center for Information Technology Research in the Interest of Society, also known as "CITRIS and the Banatao Institute." The high-profile CITRIS center, according to its website, aims to "leverage the research strengths of the University of California campuses at Berkeley, Davis, Merced, and Santa Cruz, and operate within the greater ecosystem of the University and the innovative and entrepreneurial spirit of Silicon Valley." **J. J. Garcia-Luna-Aceves**, distinguished professor and chair of computer science and engineering, leads the UCSC arm of CITRIS.

Unique to the UCSC campus, CIDER officially launched in late 2021, with 20 undergraduate students accepted into its first Pilot-in-Training Mentorships in winter quarter 2022. The nine-week course of extramural instruction trains each student in the use of drone technology, including how to fly them, do photogrammetry and use software to create maps, and analyze imagery in Geographic Information System (GIS). In addition to providing a \$600 stipend, the mentorship also helps students earn the Federal Aviation Administration license needed to fly drones and covers the cost of the test. Once licensed, the students become eligible for volunteer and paid opportunities with CIDER to fly drones and process drone-derived data in support of campus research and commercial contracts.

"Drones are incredibly cool and useful for all sorts of things," said CIDER director and five-year drone aficionado **Becca Fenwick**. "There is a massive need to train students," said Fenwick, who co-founded CIDER with Garcia-Luna-Aceves, CITRIS Executive Director **Michael Matkin**, and **Justin Cummings**, CIDER associate director (and current Santa Cruz city councilmember).



Top: While surveying fire damage in late 2020, Becca Fenwick, director of a new UC Santa Cruz drone-focused program, took this aerial photograph in Big Sur with a drone flying over UCSC's Big Creek Reserve. Credit: Becca Fenwick, with permission. Above: The July 2021 photograph on the right shows Ph.D. student Jon Detka flying a drone to collect multispectral images of coastal manzanita for his research at UCSC's Fort Ord Natural Reserve. The technology helps Detka identify and assess the stands of manzanita he studies for his research on the effects of long-term drought. The resulting images—like the one on the left—show the change in elevation across the landscape, with the highest elevation in red and the lowest areas in blue. Credits: Erin Detka, with permission; Jon Detka, with permission.

More than photos

The drone that replaced Detka's GoPro-topped pool sweep does much more than take photographs. Detka created a computer model that uses artificial intelligence (AI) and drone images to locate and collect data on the specific plants he studies amongst the dense coastal shrubbery. "Just like Facebook uses AI algorithms to recognize friends' faces, I've trained a computer model to recognize plants," Detka said. "The drone sees things we can't, like in the near infrared spectrum, which is really important for plant identification," he said. "I can actually use the drone to identify shrub species and classify the health of plants in the landscape."

Drones have indeed provided better and safer ways to conduct research, said Detka's faculty adviser **Gregory Gilbert**, professor of environmental studies. "The data we collect characterizes the distribution and health of plants," said Gilbert. "Sometimes this means traversing impenetrable scrublands, or the tops of tree canopies. We have ways to access these areas without drones, but they can be destructive and dangerous."

Seeing the forest



Ph.D. student Wendy Bragg and fellow researchers used drones to monitor the impact of the 2020 wildfires on her thesis animal, the endangered black abalone—like the one held by Bragg here—in coastal Big Sur, prompting a successful effort to rescue about 200 of the large marine snails. Credit: Kenan Chan, with permission.

Another budding drone researcher, **Wendy Bragg**, doctoral student in ecology and evolutionary biology, has also taken advantage of the accessibility drones provide. Following the extensive wildfires of fall 2020,

heavy spring rains sent debris flowing down the Santa Lucia Mountains onto the beach and intertidal zone. In emergency mode, Bragg used a drone to quickly survey changes that might threaten the endangered black abalones she studies in difficult-to-access areas on the Big Sur coastline. “We went out right after the debris flows to see how things looked,” Bragg said.

When the drone footage identified areas with abalone likely buried in sediment, Bragg mobilized colleagues from MARiNe (Multi-Agency Rocky Intertidal Network, a consortium of organizations that monitor rocky intertidal ecosystems along the entire Pacific coast of North America) to help her unearth about 200 black abalones and escort them to UCSC’s Raimondi-Carr Lab to recover. Later that summer, she released her rescue abalone back into the wild in different—and hopefully safer—coastal sites.

Other UCSC researchers have used CIDER drones to study wildfire recovery in the forests of UCSC’s Big Creek Natural Reserve in Big Sur, Fenwick said, and the effects of drought on the campus’s Younger Lagoon Reserve, among other locations. She envisions the program eventually working with other large landowners, including the state, to study forest-scale wildfire patterns or survey widespread damage following an earthquake, as well as working with the agricultural industry.

Taking flight

The student pilots-in-training face a steep learning curve, Fenwick said, especially with the expensive drones equipped with the technology CITRIS/CIDER offers. And the Baskin School of Engineering connection to the program promises even further advances in drone capabilities. For example, **Steve McGuire**, assistant professor of electrical and computer engineering, is working with Gilbert and Detka on a new project to fly drones over

the UCSC organic farm and Alan Chadwick Garden. The researchers plan to use “hyperspectral imagery” to try to predict and monitor the development of disease in crop plants.

In addition to surveying large fields much faster than humans on the ground, the drone data allows computer models—like the one used by Detka in his thesis research—to recognize changes in plants that indicate they might be sick or water-stressed. The sensing technology the team uses detects “a long-wave infrared that provides textual information about how the plants are absorbing the sunshine,” McGuire said. “This is taking pictures beyond the visual spectrum you can see with the human eye.”

Programs like CITRIS and CIDER are helping to put the Central Coast on the map as an emerging hub for drone development, said Josh Metz, co-founder with serial entrepreneur Chris Bley of the Monterey Bay business organization Drone, Automation & Robotics Technologies (DART). In its membership, DART includes industry, government, academic, and other drone operators, and researchers and developers working to advance the field. Metz, Bley, and other DART leaders host regional events, including a three-day symposium scheduled for November 2022, with the objective of bringing together individuals with diverse backgrounds but a shared interest in drones.

With its proximity to Silicon Valley and innovative research institutions; “wide open spaces” needed to fly; motivated public and private groups “focused on expanding economic opportunities”; and a growing number of companies setting up shop, the Monterey Bay is fast becoming a notable hub for drone research, Metz said. “Our hope is that with continued focus, coordination, and investment, the Monterey Bay region will become one of a growing number of national hotspots for drone-related innovation and economic development.”



This set of drone photographs shot between February 2021 and February 2022 in the UCSC Younger Lagoon Reserve captures and documents the water’s ebbs and flows. It also shows seasonal and drought-related changes in vegetation. Such aerial images, taken by CIDER staff, provide unprecedented—and not otherwise available—data for research. Credit: Becca Fenwick, with permission.

In the heart

Preserving and sharing Watsonville's rich Filipino heritage

► Juanita Sulay Wilson's connection to the agricultural valley surrounding Watsonville lies deep in her sensory memory. "I love that feel of that valley and the beauty of it," she said. "The richness of the soil is such that beautiful dark brown you don't see everywhere. Between that, and then the ocean smell, you come over the hill and you go, 'I'm home.'"

Sulay Wilson's father, Mamerto "Max" Sulay, farmed the fertile Watsonville soil she describes. He was one of the tens of thousands of "manong," the first generation of Filipinos who immigrated to the United States in the 1920s and 1930s to work as agricultural laborers. Her family's story is among the dozens of oral histories now collected for "Watsonville is in the Heart" (WIITH), a jointly UC Santa Cruz- and community-driven "public history initiative" to preserve and share the rich heritage of the manong in the Pajaro Valley.

"We met this phenomenal group of community members who took it upon themselves to document their history. And we're helping them do that," said Associate Professor of Sociology **Steve McKay**, co-principal investigator of WIITH with Assistant Professor of History **Kathleen Cruz Gutierrez**. The two manage WIITH in partnership with Watsonville-born-and-raised community organizer—and manong

descendant—Dioscoro "Roy" Recio, Jr.

In addition to the project leads, the WIITH team consists of UCSC graduate and undergraduate students, as well as community research assistants. Their work includes recording oral histories from children of the manong, like Sulay Wilson, who are now in their 60s, 70s, and 80s, as well as scanning photographs and documents. These, along with transcripts of the oral histories, reside in a digital archive hosted on the Humanities Division server, with the actual recordings stored in the McHenry Library's Special Collections and Archives.

Elder brothers

"Manong," derived from the Spanish "hermano," means "elder brother" in Ilokano, a language spoken in the northern Philippines from where many of these mostly male workers emigrated in the early 20th century. Traveling on a seasonal migration, the

Above: On their weekend days off, manong agricultural workers often gathered for picnics to barbeque, socialize, and unwind from their grueling labor in the fields. During oral history interviews for "Watsonville is in the Heart," a "community-driven public history initiative to preserve and uplift stories of Filipino migration and labor in the city of Watsonville and greater Pajaro Valley," manong descendants shared fond childhood memories of going to such picnics and being doted on by many bachelor "uncles" in the community who became family by association. Kneeling on the far left in this 1930s photograph is Mamerto "Max" Sulay, father of Juanita Sulay Wilson. Credit: Juanita Sulay Wilson, with permission.

In the heart



Clemente Florendo, Sr., of the manong generation sits on a tractor at his strawberry farm in Corralitos, California. After arriving in the United States from the Philippines as young men in the 1920s and '30s to work as farm laborers, many manong continued to work in agriculture for the rest of their lives, some picking crops until the age of 70 or 80. Florendo's daughter Mary Florendo Perry contributed this 1950s photograph to the WIITH digital archive. Credit: Mary Florendo Perry, with permission.



Three Filipino manong pose during their leisure time in this early 1930s snapshot from the personal album of Marcel Bosque (pictured on the left). Donning fashionable suits when they frequented dance halls or posed for photographs to send home helped the manong infuse some Hollywood glamor into their lives, in contrast to the difficult working conditions and discrimination they were subject to in the United States. At taxi dance halls, well-dressed manong would pay ten cents to dance with women who were usually white. Outcry against this racial mixing contributed to the tensions that sparked the deadly 1930 Watsonville anti-Filipino race riot. Bosque's daughter Sharon Bosque-Wiebe Hoffmann contributed this photo to the WIITH digital archive. Credit: Sharon Bosque-Wiebe Hoffmann, with permission.

manong might have harvested sugarcane and pineapples in Hawai'i, picked lettuce, string beans, and strawberries in the Pajaro Valley, and canned salmon in Alaska. Eventually, however, some manong settled in Watsonville, forming tight community groups because of their shared heritage, but also because they were largely unwelcome in white areas and businesses.

Like many immigrant groups newly arrived in the United States, the manong were not just unwelcome, but actively subject to race-related violence. In January 1930, a deadly race riot targeting the manong rocked the city of Watsonville. For five days, mobs of hundreds of white men and boys terrorized and assaulted the Filipino community. During the turmoil, a shooting at a farmworker bunkhouse on the John Murphy ranch killed 22-year-old Fermin Tobera. The riot was "a pretty seminal moment in California history," said McKay. "But the event is thinly documented, and never from the point of view of the Filipinos."

Three Filipino manong pose during their leisure time in this early 1930s snapshot from the personal album of Marcel Bosque (pictured on the left). Donning fashionable suits when they frequented dance halls or posed for photographs to send home helped the manong infuse some Hollywood glamor into their lives, in contrast to the difficult working conditions and discrimination they were subject to in the United States. At taxi dance halls, well-dressed manong would pay ten cents to dance with women who were usually white. Outcry against this racial mixing contributed to the tensions that

By interviewing the living descendants of the manong about the riot and other events, the WIITH collaborators hope to better understand the Filipino immigrant experience by documenting the details of the farmworkers' lives. The oral history narrators are "a graying population with a very unique perspective on immigrant life in the early 20th century," said Gutierrez. There is a sense of urgency, she said, to capture these stories that can add depth and texture to the limited—and much biased—formal historical record of the time.

Community roots

Recio, whose father Dioscoro "Coro" Respino Recio, Sr., was a manong, planted the seeds of WIITH. After his parents died, Recio felt compelled to honor them in some way. "I wanted to make sure their stories and sacrifices were represented in a dignified manner," he said, "and I found like-minded people who felt the same way."

In 2019, Recio asked other Filipino Watsonville families to share their family photographs and history to produce a 2020 calendar. This undertaking—named The Tobera Project to honor the murdered Fermin Tobera—has since created a new calendar each year. "We're building community with the common goal of sharing our humanity, culture, and experiences," Recio said.

While Recio and his fellow manong descendants had ideas, passion, and momentum for their community project, they lacked a way to house the collected history and make it widely accessible. When McKay attended an exhibit Recio organized at Watsonville's Freedom Branch Library, the two recognized the potential for a partnership, and joined forces with faculty and students at UCSC to create WIITH. The collaboration leverages the university's resources to access archiving software, raise funds, and organize and promote events. Perhaps most importantly, the university provides a digital repository for the community's history. "That's one of the biggest things we can give—making sure there's a home in perpetuity for these stories," said Gutierrez.

Taking cues from Recio's calendar work, the WIITH team organized an "archive drive" in Watsonville for Filipino community members to bring their family photographs and documents to be scanned on the spot for the archive. Led by the digital archive's co-directors **Meleia Simon-Reynolds** (Ph.D. candidate, history) and **Christina Ayson Plank** (Ph.D. candidate, history of art and visual culture), the team has digitized more than 600

photos and documents and recorded oral history interviews with about 30 families. Ayson Plank also created an online exhibit that documents sites of manong labor and leisure in the region, and Simon-Reynolds is developing a K–12 educational curriculum associated with the archive. All this builds towards a Santa Cruz Museum of Art & History exhibit scheduled to open in 2024 that Ayson Plank will curate.

After learning about the project, Filipino and non-Filipino groups in other cities interested in pursuing similar efforts have contacted the team. “It’s exciting that this work can serve as a model for doing public history and scholarship,” said McKay. By making local history accessible, he said, WIITH helps fulfill the university’s mission as a public institution to benefit the broader community.

Seeing connections

The project has also highlighted important connections between the past and present, McKay said, with the 1930 Watsonville riot foreshadowing the spike in anti-Asian rhetoric and targeted attacks against Asian Americans during the COVID-19 pandemic. “Understanding the past helps put our present in context,” he said. “What happened in 1930s Watsonville around the race riot teaches us a lot about racism today.”

Rick Baldoz, former associate professor of sociology and comparative American studies at Oberlin (now

at Brown University), made the connection in a *Washington Post* op-ed, pointing out that “anti-Asian sentiment is deeply rooted in American

history.” The Watsonville riot is just one well-known example of a wave of anti-Filipino violence that occurred during that period, as Baldoz details in *The Third Asiatic Invasion: Empire and Migration in Filipino America 1898–1946* (NYU Press, 2011). “Despite all the hostility, these immigrant pioneers really fought to carve out a space for themselves in an American society that wasn’t very welcoming,” said Baldoz, who has consulted with WIITH. The project, he said, “is really attentive to the important role of ordinary people in California’s development and growth as an economic powerhouse.”

Both WIITH team members and the project’s Filipino American participants described the experience of hearing and sharing the community’s stories as moving and meaningful. Beyond recounting discrimination and struggle, the oral histories and photographs paint compelling portraits of family life, festive community gatherings, and the resilience of a generation striving to sow the seeds of opportunity for their children. “It’s important to remember who came before us and the sacrifices they made, what they had to go through,” said Sulay Wilson. “I was always

told, ‘Never forget where you come from.’ And I really try hard to remember that.”



In this photograph, Eva Alminiana Monroe, daughter of manong Amando Ocampo and Rosario “Nena” Nieva Alminiana, discusses her mother’s photo album and other artifacts with WIITH team members. The project has helped reinforce among Filipino-heritage community members that their family stories are a part of American history worth preserving and sharing. Credit: Christina Ayson Plank and Meleia Simon-Reynolds/WIITH, with permission.



Three manong pose in front of a car in this 1940s photo from the personal photo album of John Madio Millares (on the left). Cars and fashionable suits featured prominently in photographs like this that many manong sent to the Philippines to project an air of success in a land of opportunity. In reality, the men faced many hardships in the United States, including loneliness, as immigration restrictions and anti-miscegenation laws made it difficult for them to marry and have families of their own. Many remained lifelong bachelors. Joan Ellen Rodriguez contributed this photo to the WIITH digital archive. Credit: Joan Ellen Rodriguez, with permission.

If genes

A detailed painting of a mammoth and a herd of horses in a snowy, mountainous landscape. The mammoth, with its large tusks and shaggy brown fur, is in the foreground on the right, facing left. Behind it, a herd of four horses is running towards the left. The ground is covered in patches of snow and dry grass. In the background, there are snow-capped mountains and several tall, thin evergreen trees. The sky is a pale blue with soft clouds.

Genomic sleuthing
paints pictures of both
past and present

► More than a million years ago, snow and ice buried a mammoth's decaying body in Siberia. Over time, most of the "Krestovka mammoth" vanished; first its soft tissues and later even its bones became food for bacteria and bugs. Some teeth remained, however, and a Russian paleontologist unearthed a few in 1970. For decades, they sat in museum collections as curiosities, too old to carbon date. Scientists presumed any lingering organic material long gone.

Woolly mammoths like the ones depicted here once roamed the icy northern plains of Eurasia and North America. However, the last one died more than 4,000 years ago, making it nearly impossible to use conventional genetics-based methods to trace the evolution and natural history of these elephant ancestors. Today, rapidly advancing technology and genetic techniques developed by UC Santa Cruz scientists and others have made peering into the past—of mammoths and all other creatures, including humans—a much more feasible research proposition. Credit: Mauricio Antón (CC BY 2.5).

could talk



However, in research published in February 2021 in the scientific journal *Nature*, an international team of scientists including **Beth Shapiro**, professor of ecology and evolutionary biology, turned to modern genomics to reveal more about this ancient mammoth and its relatives. Drilling a minuscule amount of material—about a pinch of salt’s worth—out of one molar, the team was able to isolate tattered bits of DNA from the sample. Their sequencing of this and other mammoth DNA showed that the Krestovka specimen represented a previously unknown genetic lineage of mammoths, upending previous hypotheses about mammoth evolution. Based on its sequenced genes and how much they varied from those of more modern mammoths, the team estimated that the animal lived about 1.2 million years ago. Before this effort, no one had ever sequenced genes more than a million years old.

Until recently, such a genomic dive into the deep past was considered impossible. But gene sequencing continues to get better, faster, and cheaper, allowing scientists, like Shapiro and others at UCSC, to develop new ways to piece together and analyze genes from even the most fragmented DNA specimens. The advances are letting researchers solve long-standing mysteries about evolution, migration, and diversity—in both animals and humans. They’re also a boon for understanding and diagnosing genetic diseases and helping criminal investigators solve cold cases. “Even a single genome can tell us all kinds of things about the broader population it belongs to,” said Shapiro. “It really can paint a picture of the past.”

If genes could talk

Dog-chewed

When people swab the inside of their cheeks with test kits like those from 23andMe and ancestry.com, they collect—among other things—strands of genetic material, each containing hundreds of millions of relatively intact nucleotide base pairs, the building blocks of DNA. Sequencing such DNA samples is straightforward. But immediately after an organism dies, the natural world around them starts breaking down their components, including their DNA. Further muddling the genomic picture, microbes and other decaying plants and animals seep into the heap, adding their DNA remnants.

If sequencing DNA from a living person is like putting together a thousand-piece puzzle per the picture on the box cover, then sequencing ancient DNA is like solving such a puzzle after your dog chews up each puzzle piece, someone mixes those pieces with dog-chewed pieces from several other puzzles, and you lose the box. “To sequence ancient genomes, we need to take dirty, crumbled up DNA and transform it into molecules that can be sequenced,” said Shapiro.

Shapiro and her husband **Richard Edward Green**, associate professor of biomedical engineering, now routinely perform this difficult task in the UCSC Paleogenomics Laboratory they run together. The



DNA from mammoth teeth, like the one shown here in the Palatinate Museum of Natural History in Germany, let scientists at the UCSC Paleogenomics Lab and their collaborators discover how two different lineages of mammoths interbred to create an entirely new species of mammoth more than 420,000 years ago. Credit: BlueBreezeWiki (CC BY-SA 3.0).



Researchers in the UCSC Paleogenomics Lab analyzed DNA from 38 bison hide moccasins, like this one, worn more than 800 years ago by cave dwellers in what is now Utah. They discovered that nearly all of the moccasins, which were well preserved in dry caves for centuries, came from the hides of female bison. The researchers hypothesized that the Indigenous people of the American plains may have purposefully targeted female bison for moccasin manufacture. Credit: Daderot (public domain).

work involves tedious washing, isolating, and handling to get rid of contaminants, gene amplification to make millions of copies of tiny bits of DNA, and powerful computer programs that assemble the short sequences into more complete gene readouts. “We need specialized facilities where we don’t touch our samples,” said Shapiro. “We don’t even breathe on them—if our DNA gets into this ancient DNA confetti, it makes our experiments much harder.”

Assessing admixing

Work at the Paleogenomics Laboratory in the last few years has sequenced not only the genomes of mammoths but also those of ancient bears, dogs, bison, horses, and Neanderthals. A key question tying many of the projects together is what genetically defines a species. “As humans, we have this proclivity to put things into boxes—a polar bear is a polar bear, and a brown bear is a brown bear,” said Shapiro. But this view is too simple. “Speciation typically doesn’t happen overnight.”

In the genomes of nearly all the ancient animals Shapiro and

others have studied, the results indicate that those from different lineages often interbred even after beginning to separate into distinct species, a phenomenon called admixing. The result? Brown bears have snippets of polar bear DNA, bison have cattle in their genomes, and modern humans share

a surprisingly large amount of DNA with Neanderthals.

Cataloguing these genetic admixtures can help scientists understand how ancient populations arose and declined. But it also can prove valuable in conservation efforts to help save struggling species from extinction. In some cases, preventing admixing might be critical to ensuring the survival of a rare species—if two species interbreed too frequently, the unique traits of one may completely fade away. More often, though, endangered populations suffer from interbreeding between close relatives, which can harm a population by increasing the prevalence—and impact—of detrimental genes.

To make at-risk species healthier and more likely to survive long term, conservationists sometimes encourage the breeding of isolated populations with closely related animals from the outside. Scientists successfully boosted Florida's dwindling panther population in the 1990s, for instance, by cross-breeding the Florida animals with Texas cougars. Having genetic information on each species helps conservationists choose which populations—or even individual animals—to breed with each other, which can be



By comparing the genomes of ten pumas from sites across North and South America, Beth Shapiro, Ed Green, and their colleagues at the UCSC Paleogenomics Laboratory assembled a puma family tree. North American pumas, they calculated, diverged from their South American relatives more than 100 thousand years ago. The results also showed that Florida panthers, like the one seen here, remain inbred even after cross-breeding efforts in the 1990s. Credit: U.S. Army Corp of Engineers (CC BY 2.0).



By sequencing ancient DNA from these bones of horses that lived in North America during the last Ice Age, scientists at the UCSC Paleogenomics Lab shed new light on how different horse populations diverged—and then later crossed paths again. Eurasian and North American horses, they discovered, crossed the Bering Land Bridge repeatedly over the course of hundreds of thousands of years. Understanding how, when, and where these populations evolved has implications for managing today's wild horse populations. Credit: Alisa Vershinina/Paleogenomics Lab, with permission.

critical to the success of such efforts. "The past is a completed evolutionary experiment," said Shapiro. "But when we try to devise strategies to protect species, we're making a lot of guesses. By looking into the past, we can better understand what has already worked."

Seeing differences

The genomic science advances enabling scientists to study ancient DNA and help endangered animals also have vast promise to improve human health, said

Benedict Paten, associate professor of biomolecular engineering and associate director of the UCSC Genomics Institute. Some of that promise is clearcut. For example, as reported in February 2022 in the *New England Journal of Medicine*, Paten and collaborators showed that rapid sequencing of the entire genomes of critically ill patients uncovered genetic variations that impacted the treatment of five of the dozen subjects enrolled in the study. But other implications

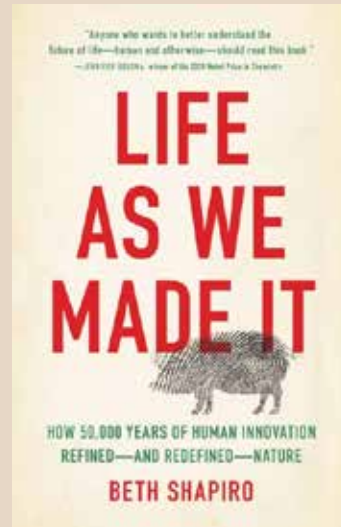
are less straightforward. Understanding human genetic evolution, Paten said, can shed light on how today's diversity arose and how it impacts human

If genes could talk

Coming to terms

In the past several decades, gene-editing technologies—most recently and notably the 2020 Nobel Prize–winning CRISPR (shorthand for Clustered Regularly Interspaced Short Palindromic Repeats)—have become mainstream laboratory tools, used by scientists to re-engineer the genomes of animals, plants, and even human patients. For some people, the idea of purposefully altering an organism’s genome sounds like spooky science fiction or a recipe for disaster. For Professor Beth Shapiro, however, it sounds like what humans have already done for 50,000 years. “Humans have been changing other species as long as we’ve existed,” she said, “in all sorts of both accidental and very purposeful ways.”

This history, Shapiro said, is typically not appreciated by people wary of new genetic technologies. In her recently published *Life as We Made it*, she details the long history of how humans have shaped nature and continue to do so. She also seeks to counteract misinformation



about the capabilities of genomic engineering. “If we want a future that is both biodiverse and filled with people,” she said, “we must come to terms with these biotechnologies.”

Published in October 2021, Shapiro’s *Life as We Made It* (Basic Books) has been well-received:

in March 2022, it was announced as a nonfiction finalist for the California Book Award. Writing the book, Shapiro said, was a welcome distraction from the pandemic. Credit: Basic Books (public domain).

health, which could help address the increasingly acknowledged—yet quite elusive—problem of systemic racial bias in medicine.

Paten chairs the Genome Alignment and Annotation Committee of the Vertebrate Genomes Project, a group of more than 150 scientists, each with their own funding, aiming to collaboratively sequence at least one genome from 66,000 vertebrate species, including mammals, birds, reptiles, amphibians, and fish. Like Shapiro and Green, Paten is not only interested in the stand-alone genomes of single species, but how these genomes compare and have evolved and diverged over time. “On their own, genomes can be incredibly interesting but they’re also snapshots in time in a long evolutionary history,” Paten said. Comparing the genomes of different species can reveal new genes and proteins that could lead to the discovery and development of a broad range of innovative items, from medicines to adhesives or even electronics, said Paten. “Every species contains unique genes that can be powerful in terms of understanding biology and giving us new tools.”

In addition, understanding how and why one gene has evolved to vary between species while another has remained stubbornly stagnant can tell Paten and other researchers much about the importance—and flexibility—of that gene. Paten gauges this flexibility

by comparing variation between modern species, while Shapiro and researchers in the Paleogenomics Lab often try to assess the same thing by analyzing the genomes of ancient species. In July 2021, for instance, the journal *Science Advances* published Shapiro and Green’s research comparing modern human and Neanderthal genomes to see which parts of the modern human genome were never—in any individuals—derived from Neanderthal ancestry. Less than 7% of the modern human genome, they discovered, is unique and never of Neanderthal origin. “Some traits move between species and become advantageous, but others don’t, because they can’t. They’re not compatible,” said Shapiro, adding that knowledge of a gene’s natural variation could eventually prove helpful to bioengineers attempting to repair or improve its function.

Pushing envelopes

If genomes could talk, each human’s would sound different. Diversity in ancestry, race, disease risk, metabolism, and a plethora of other features, from personality to appearance, are all captured in our DNA. But for the past nearly 20 years since the milestone completion of the Human Genome Project in 2003, researchers have used a single reference genome—based almost entirely on the genome of

a single individual from Buffalo, New York—as the template for all other human genomes. “That’s a problem,” said **Karen Miga**, Paten’s colleague, and an assistant professor of biomedical engineering. “The reference genome gives us only one snapshot of a human genome when we all know that our genomes differ, sometimes in very large ways.”

When researchers analyze a person’s genome, they use that reference genome as a point of comparison. Places where an individual’s genes vary greatly from the reference may indicate causes of disease, for instance. But for some populations, the current reference genome may not be a fair place to start—it may not capture the norm at all.

Like Shapiro, Green, and Paten, Miga is pushing the envelope on how to obtain the most detailed information from genomes and capture the differences between them. Miga co-chaired the Telomere-to-Telomere Consortium, an effort—just recently completed and reported in six papers published in the March 31 issue of *Science*—to fill in the gaps that remained in the original reference genome. She also co-chairs working groups within the broader Human Pangenome Project, which aims to create a more

global reference genome that better represents human genomic diversity. In all this work, Miga uses multiple new technologies, including nanopore sequencing, that let researchers piece together much larger chunks of the genome at a time—akin to completing a puzzle with a hundred pieces instead of one with a thousand pieces. This makes it easier to figure out the many repetitive stretches of DNA within people’s genomes—a challenge that’s a bit like assembling a large blue sky of a puzzle.

The rapidly improving technology, Miga said, doesn’t just benefit the Pangenome Project, but gene sequencing for all other purposes. This broad applicability rings true for all the researchers. The same breakthroughs that allow them to determine how horses or wolves evolved can also help them better diagnose patients with rare diseases, identify criminals, and engineer improved food crops. “A lot of basic research has a very long tail,” said Paten. “Genomics often asks some fairly technical questions about how we can assemble the whole genome and all its variations, but the progress we make on those questions serves us well in many, many other areas.”

CSI: Santa Cruz

In 1980, an off-duty police officer and his brother discovered the body of a murder victim on the side of the road in Henderson, Nevada. She became known as “Arroyo Grande Jane Doe,” and for decades investigators had no leads on who she was or how she was killed. Then, in 2019, a clip of her hair made its way to Astrea Forensics, a Santa Cruz–based startup headed by chief executive officer (CEO) **Kelly Harkins Kincaid**, a former postdoc of Ed Green’s in the Paleogenomics Laboratory.

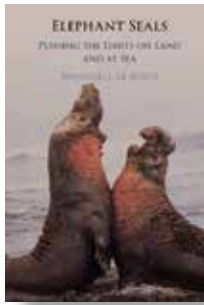
In May 2017, after he first applied his expertise in assembling DNA to determine the identity of an unknown body, Green started receiving dozens of phone calls from law enforcement agencies requesting help in analyzing crime scene DNA. It turns out the same techniques that can piece together degraded DNA from ancient bones also make powerful tools for reassembling the minuscule amounts of DNA present in hair, skin, or semen samples from years-old crime scenes. Prompted by this interest, Green and Harkins Kincaid founded Astrea, with Arroyo Grande Jane Doe’s murder the first crime addressed by



Two brothers discovered the body of 17-year-old Tammy Corrine Terrell in Henderson, Nevada in 1980, but investigators couldn’t identify her until December 2021, after Santa Cruz–based startup Astrea Forensics sequenced DNA from a strand of her hair. Despite the identification, her murder remains unsolved. Credit: Henderson Police Department (CC BY-SA 4.0).

the company. In late 2021, the Henderson Police Department announced that, thanks in part to the Astrea sequencing, they’d finally put a name to the victim: Tammy Corrine Terrell.

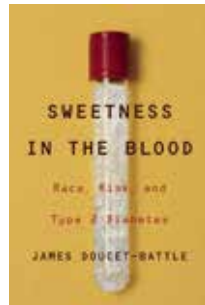
“I realized that I really liked thinking about what these technologies could be applied to other than ancient DNA,” said Harkins Kincaid, who also wears the founding CEO hat of Claret Bioscience, which employs some of the same Paleogenomics Lab techniques to help process degraded DNA in blood sampled for medical testing.



Extreme Nature

Elephant seals alternate between months of feeding at sea, where they can dive a mile deep, and fasting on land while breeding or lactating. During breeding season, adult males—three to 10 times the size of females—fight ferociously to maintain their harems of hundreds of females.

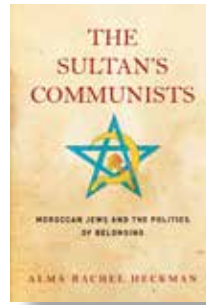
Just 21 miles from campus, Año Nuevo State Park provided an opportune setting for **Burney Le Boeuf**, elephant seal expert and professor emeritus of ecology and evolutionary biology, to lead one of the most extensive, long-term studies of any mammal. In ***Elephant Seals: Pushing the Limits on Land and at Sea*** (Cambridge University Press, 2021), Le Boeuf summarizes results he and colleagues have reported over five decades in hundreds of scientific papers. The book highlights the incredible uniqueness of both the animals and the ability to study this biological phenomenon “right here in our backyard,” said Le Boeuf.



Racialized Medicine

Although Type 2 diabetes disproportionately affects Black Americans, Associate Professor of Sociology **James Doucet-Battle** argues against linking race with the risk of developing the insidious metabolic disease. Rather, “Diabetes risk should be equated with environmental risk in that it’s contingent upon the environments we inhabit, in which we nourish ourselves, move our bodies, and relate to one another.”

Contesting a biological role for race in disease is the central theme of Doucet-Battle’s ***Sweetness in the Blood: Race, Risk, and Type 2 Diabetes*** (University of Minnesota Press, 2021), which reviews decades of racialized diabetes research and development, including, for example, one Silicon Valley company’s efforts to boost profitability by altering its algorithm for predicting diabetic risk. The book also explores the hesitancy of many Blacks to participate in biomedical research and considers how sharp drops in the cost of genomic sequencing have increased access to the technology and reinvigorated conversations about the race-disease connection.



Jewish Radicals

In 2009, on a Fulbright scholarship in Morocco, **Alma Heckman** met a former communist activist while volunteering at the Jewish Museum in Casablanca. “I had never heard about Moroccan Jewish communists before,” said Heckman, associate professor of history and Jewish studies, who holds the Neufeld-Levin Chair in Holocaust Studies.

Following Moroccan independence from France and Spain in 1956, most Jews left the country, part of a broader migration of Jews away from North Africa in the 1950s and 1960s. Since then, Jews who chose to remain in the region and participate in anti-colonial movements have received little attention, said Heckman.

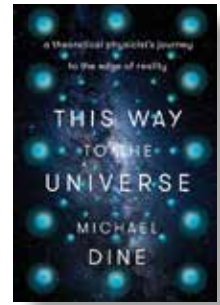
In ***The Sultan's Communists: Moroccan Jews and the Politics of Belonging*** (Stanford University Press, 2021), Heckman tells the previously untold story of Jewish involvement in the Moroccan national liberation movement and presents a modern history of Jews in North Africa, documenting their continuing presence and influence in the region.



Joy and Pleasure

Associate Professor of Critical Race and Ethnic Studies **Xavier Livermon** spent his early 20s in South Africa, coming of age during the heyday of *kwaito*—a type of electronic dance music that emerged post-apartheid. In portrayals at odds with his lived experience, the mainstream media at the time maligned *kwaito*, said Livermon, much as it also disparaged American hip-hop in the 1980s.

Livermon’s ***Kwaito Bodies: Remastering Space and Subjectivity in Post-Apartheid South Africa*** (Duke University Press, 2020) advances a more positive view of *kwaito*, supported by interviews with musicians and fans, analyses of recordings and performances, and accounts of visits to nightclubs and parties. The book provides a Black queer and feminist perspective, said Livermon, in contrast to the heteronormative, masculine one typical of the genre. “I wanted to represent the joy and pleasure and possibilities that could come out of a culture that Black youth had created for themselves.”



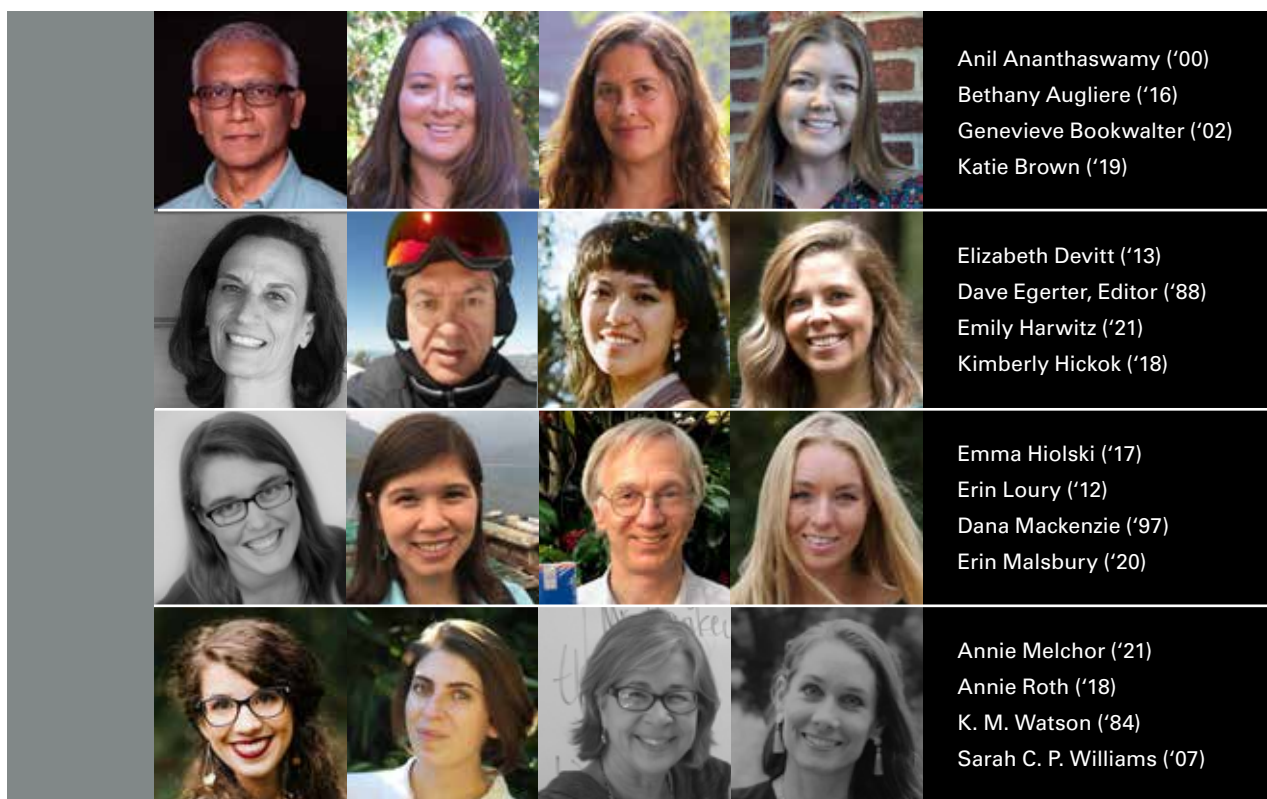
Universal Understanding

Distinguished Professor of Physics **Michael Dine** views the discovery of the Higgs boson particle in 2012 as a “watershed moment” that ushered in a notably productive decade for the field. “We now have an exquisite understanding of nature on very small scales and very large scales,” he said. “At the same time, many questions and puzzles remain.”

Dine, a leading theoretical physicist, distills this concept in ***This Way to the Universe: A Theoretical Physicist's Journey to the Edge of Reality*** (Penguin Random House/Dutton, 2022). The book surveys cutting-edge research in particle physics, cosmology, and astrophysics, guiding readers through physicists’ current comprehension of the Big Bang, dark matter and dark energy, the Higgs boson, string theory, and more.

Beyond imparting a deeper appreciation for how much we know about the universe, Dine hopes his book provides readers with the confidence to understand and contemplate the big questions that remain, like the identity of dark matter.

INQUIRINGminds



**Names are listed left to right.*

In our cover story, “Down on the farm,” Science Communication Master’s Program (“SciCom”) alum **Kim Hickok** ('18) reports on how UC Santa Cruz faculty, staff, and students are using ecology and sustainability research to advance equity on campus and beyond. Other stories written by SciCom alums for this issue, edited by **Dave Egerter** ('88), cover scholarship that highlights women filmmakers, imagines more tolerant civilizations, revises societal views toward people living with autism, disputes the racial impetus underlying historical monuments, and celebrates a vibrant immigrant community in nearby Watsonville.

The equity thread also runs through other work by students and alums of the highly respected SciCom Program. Last year (2021), for example, **Nicholas St. Fleur** ('14), won the coveted Evert Clark/Seth Payne Award for young science journalists, given by the Council for the Advancement of Science Writing, for his work at STAT, a leading site for health news. Judges praised St. Fleur’s stories for covering “fresh ground, particularly on topics around race, medicine, and research.” Science reporter **Rodrigo Pérez Ortega** ('19) covered how scientists in Latin America

and the U.S. have exposed sexual harassment in academia, while Ortega’s classmate, **Helen Santoro** ('19), explored how COVID-19 has exacerbated health care disparities, including for transgender people.

SciCom students, led by director **Erika Check Hayden**, also focused on inclusivity in science. The 167 stories published by the class of '22 included pieces on the disproportionate impact of wildfire smoke on racial and ethnic minorities and how COVID-19 more heavily affected schools in predominantly Latino school districts.

Private supporters have joined national foundations to help underwrite the program’s efforts to diversify science journalism. **Barbara Masters** ('84) and her husband, Marc Weiss, established a new Science Communication Fund for Diversity, Equity, and Inclusion. Other key sponsors include David and Dana Lousy, parents of **Erin Lousy** ('12); Ellen Chu ('71); **Ari Remmel** ('20); and former SciCom director **Rob Irion** ('88), who anchored a matching campaign for alumni donors to support an incoming student.

We hope you enjoy reading this year’s inquiry@UC Santa Cruz.

Learn more: news.ucsc.edu



Matthew Alejandro
Human biology major

UC Santa Cruz is proud to be a founding member of the newly formed Alliance of Hispanic Serving Research Universities.

The HSRU Alliance aims to achieve two key goals by 2030: double the number of Hispanic doctoral students enrolled at Alliance universities, and increase by 20 percent the Hispanic professoriate in Alliance universities.

