SUMMER 2019

CALIFORNIA STATE UNIVERSITY FULLERTON™

TraNSMission

News from the College of Natural Sciences & Mathematics

WHERE SCIENCE MEETS THE SEA

Biology Professor **Misty Paig-Tran**, unlocking the secret to manta ray filters.

Seeking to protect, preserve, and shore up the habitats of marine species along the Southern California coast, Cal State Fullerton students are involved in many research projects under the sea and in the rocky intertidal zone.

SEARCHING FOR THE SECRET TO BETTER FILTRATION SYSTEMS

Combing the sea for tiny zooplankton and using its gill rakers to filter food, the manta ray may hold answers to devising faster, more effective filtration systems.

At least, that is what biology graduate student Raj Divi and his faculty research adviser Misty Paig-Tran believe. Their latest research, published in *Science Advances,* found that the manta ray's filter works in an unexpected way, allowing it to filter large volumes of particles from the water quickly, without clogging.

"Manta rays have what we have termed a 'ricochet filter,'" explains Paig-Tran, assistant professor of biological science. "Particles enter the mouth, then ricochet off the filter surface and back toward the esophagus, while water takes a different path and exits out the gill slits. It is very sophisticated and cool – and important from an engineering perspective."

MESSAGE FROM THE DEAN:

The Power of Mathematics & Science

As mathematicians and scientists, we are in constant awe of the natural world. We seek to figure out how it works, advance our knowledge, and make new discoveries. Often, it is like putting together a puzzle – but one with missing pieces that we must find.

That is a big part of the reason Cal State Fullerton focuses on hands-on learning and developing close working relationships between our students and faculty. Starting with our required freshman course that teaches students to "Think Like Einstein," we foster students' analytical and critical thinking skills, setting them up for success in their majors. Through the federally funded Project RAISE and other college and campus resources, we offer support, guidance, and opportunities to help low-income, transfer, and first-generation students excel in STEM education and go on to successful careers.

We strive to go above and beyond for our students, creating opportunities to conduct truly original research at the undergraduate level – something that is uncommon at most universities, but is in our DNA. And we are seeing the results every day, from important research on critical marine ecosystems to new discoveries that help us understand our universe and push the limits of what we know.

We are also preparing for a $40 million renovation of the second floor of McCarthy Hall, creating a modern facility for scientific education, research, and discovery. And with added support from our incredible network of alumni, donors, industry partners, and community members, we can create an even bigger impact, as we continue to inspire our students to unravel the mysteries of the natural world.

Marie Johnson, Ph.D.
Dean, College of Natural Sciences & Mathematics

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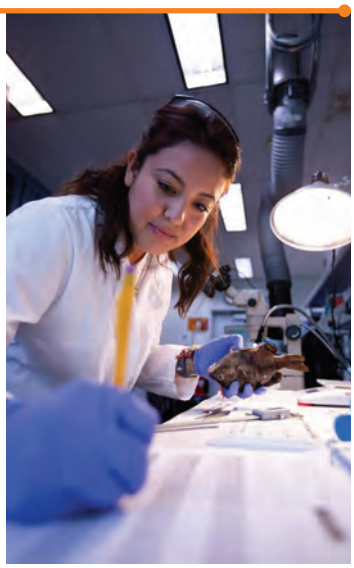
UNDERSTANDING UNUSUAL REPRODUCTIVE HABITS



Surfperches, which live near shore on the California coast, have a somewhat unusual reproductive physiology. Males use an external structure to deliver sperm into the female reproductive tract, fertilizing the eggs internally before they are released into the water.

Biology graduate student Evelyn Bond, recipient of a prestigious National Science Foundation Graduate Research Fellowship, hopes to contribute to our scientific understanding by studying their anatomy and physiology, which is relatively unknown.

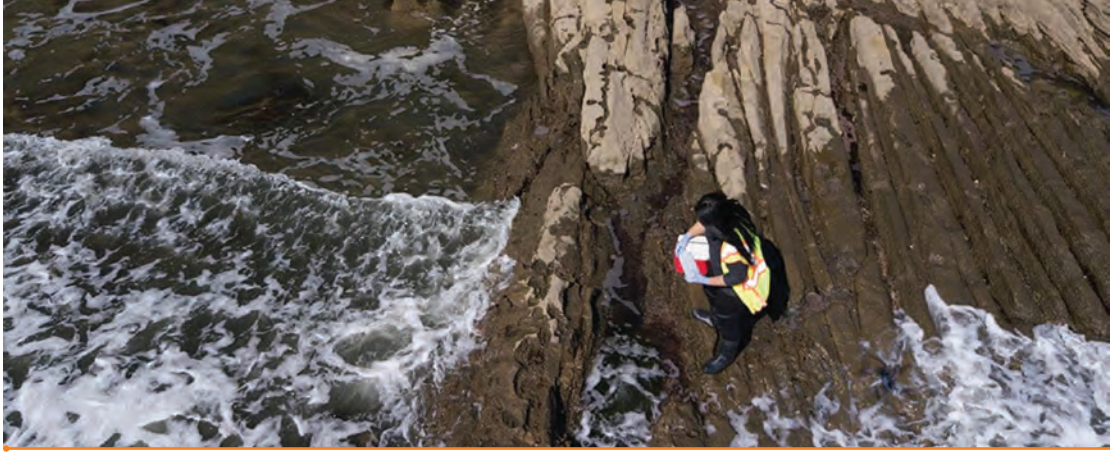
Bond credits her success in large part to her mentor, Kristy Forsgren, associate professor of biological science, who oversees her research.

"My confidence as a Mexican-American woman in the field of science has significantly grown," she says. "Dr. Forsgren has provided me with guidance and support, and she motivated me to reach higher than I could ever have imagined."

MAPPING GENETIC DIFFERENCES IN PIPEFISH POPULATIONS

Biological science major Brian Bartter often dives up to 40 feet into the waters near Redondo Beach to catch pencil-thin pipefish. Bartter and his faculty mentor, Ryan Walter, have developed molecular genetic markers using DNA fingerprinting techniques. This has helped them assess paternity and determine the levels of genetic similarity among pipefish groups.

Ultimately, their work may uncover local and regional genetic structures in different pipefish species. "Our goal is to refine our current understanding of the morphological differences among species and their corresponding genetic signatures," says Bartter.



SAVING THE OLYMPIA OYSTER

Overharvesting, pollution, disease, climate change, and habit destruction have contributed to significant declines of native oyster species in Southern California over the last 200 years. Biology graduate student Victoria Wood and scores of other students, under the guidance of faculty mentor Danielle Zacherl, associate professor of biological science, work on restoring the Olympia oyster's habitat.

Using natural structures such as rocks and vegetation to increase shoreline resiliency and buffer erosion caused by climate change, including rising sea levels, Wood is hoping to improve shoreline stabilization and resiliency, and reduce erosion as part of a living shoreline initiative.

"Oysters provide the ecosystem service of filtering phytoplankton out of the water column that might cause algal blooms, which threaten both human health and the health of organisms in the ocean," says Wood.

STUDYING BIODIVERSITY IN TIDEPOOL ECOSYSTEMS

In rocky intertidal regions, rocks collect pools of seawater in their crevices as the water recedes for the low tide, forming homes and temporary shelters for many marine organisms.

"Many of these organisms can only be found in these regions and are susceptible to negative human impacts, which is what makes tidepool conservation so important," says biological science major Shannon Chou.

Chou, a scholar in the Southern California Ecosystems Research Program, is studying tidepools along the Orange County coastline, where these living marine organisms leave genetic material known as environmental DNA (eDNA). Under the mentorship of Ryan Walter, professor of biological science, and Jennifer Burnaford, associate professor of biological science, Chou's research focuses on whether the use of eDNA analysis is a plausible alternative to more intrusive methods of surveying species composition and diversity in tidepools.

INVESTIGATING THE IMPACTS OF RISING SEA LEVELS

Biology graduate student Ariel Heyman is studying a fleshy brown seaweed that lives high up in the rocky intertidal zone. The seaweed is often out of the water for up to 15 hours a day during low tides. Its habitat is threatened due to climate change and sea level rise, which could prove disastrous for the intertidal ecosystem and food chain.

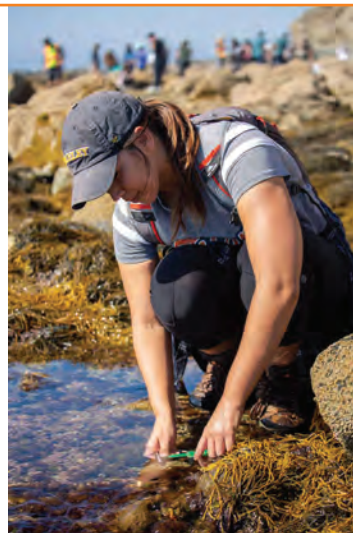
Under the mentorship of Burnaford, Heyman is transplanting the seaweed closer to the ocean to simulate rising sea levels at sites in Newport Beach, so the seaweed is only out of the water about four hours a day. "If the seaweed cannot handle this change to its habitat, it will affect many other creatures as well," says Heyman. "This research will give us an idea of whether our local rocky intertidal ecosystems have a chance of surviving climate change."

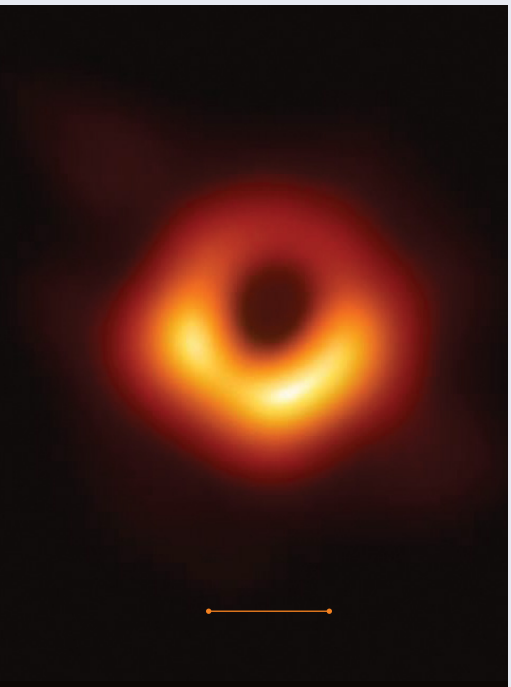
MONITORING AGGRESSIVE SEA ANEMONES

Alexis Barrera, a biology graduate student working with Burnaford, is studying a species of intertidal sea anemone that can split itself in half, creating large groups of densely packed, genetically identical clones. The anemones use their tentacles as weapons, displaying aggressive behavior toward any anemones that do not have identical genetics.

Barrera, recipient of a 2018 Graduate Student Research Fellowship from the California State University Council on Ocean Affairs, Science & Technology, is investigating the relationship between environmental conditions and the sea anemone's behavior.

"The sea anemone is an important species in the intertidal zone," says Barrera. "Changes in their population and borders can impact many other species."





Capturing the First-Ever Image of a Black Hole

In a major breakthrough, scientists recently captured an image of the silhouette surrounding the black hole at the center of a galaxy known as M87. Using a technique called very-long-baseline interferometry (VLBI), they focused hundreds of telescopes all over the world on the supermassive black hole, and were able to get a high enough resolution to make the black hole stand out against the light emitted by the stars in the galaxy surrounding it.

GROUNDBREAKING RESEARCH IN GRAVITATIONAL WAVES

When the Gravitational Wave Physics and Astronomy Center (GWPAC) was established at Cal State Fullerton in 2012, no one on Earth had ever measured a gravitational wave passing. Now, scientists have measured gravitational waves from distant collisions of black holes and neutron stars. Our GWPAC researchers made significant contributions to this groundbreaking discovery, and they are using gravitational waves to help advance our understanding of the universe.

"Any time two masses move around each other, they send out gravitational waves that stretch and compress the objects they come in contact with by imperceptibly small amounts," explains Geoffrey Lovelace, associate professor of physics. "Discovering these waves and how to measure them has opened up whole new areas of research. It has been like finding an entirely new sense you didn't know you had."

Gravitational waves have allowed Lovelace and other researchers at GWPAC to study black holes and neutron stars crashing into each other at nearly the speed of light. Students in the program are taught how to work with big data sets, filter out the background noise, and use high-performance lasers and supercomputers.

"When you take a course in physics or astronomy, you're learning what we already know," says Lovelace. "When you do research, you're learning things we don't know. The students coming through GWPAC are getting a firsthand experience in how new knowledge is discovered."

This kind of cutting-edge research can be incredibly exciting for the students and for Lovelace himself. In some cases, it even leads them to change career trajectories.

"We've had a couple older students come to us with business backgrounds, and after participating in the program, decide to pursue Ph.D.s in the sciences," says Lovelace. "Other students are using what they've learned to push the boundaries in fields like aerospace and optics."

One student in particular, Adrian Avila-Alvarez, is working to advance techniques in laser eye surgery. Others are working on lenses so we can see farther into the universe, developing new technology for NASA, working for leading aerospace companies, and more.

"The students coming through GWPAC are getting a firsthand experience in how new knowledge is discovered."

Geoffrey Lovelace
Associate professor of physics

Ashley Le-Pham (BS '16) works for the National Science Foundation, where she helps review grant proposals for scientific research.

Ashley Le-Pham (BS '16):

SHAPING THE FUTURE OF RESEARCH WITH NSF

With a dream job at the National Science Foundation, Cal State Fullerton alumna Ashley Le-Pham (BS '16) is helping to shape the future of scientific discovery.

Armed with a degree in biochemistry, Le-Pham joined NSF's Directorate of Biological Sciences as a science assistant and is now midway through her two-year term. She works alongside program managers and scientific experts in the field as they fund cutting-edge research. NSF, which provides about 25% of all federal funding for scientific research, receives about 40,000 grant proposals each year. While only 11,000 are funded, a team of NSF staff members and panelists – Le-Pham included – must review each and every one of them.

"The grant process is extensive," Le-Pham explains. Administrative staff review each proposal for compliance. Next, each is categorized and sent to several panelists, who spend two to four days in a review, discussing proposals in terms of intellectual merit and broader impact beyond the scientific community. Part of Le-Pham's job is to make sure everything discussed by the panel is included in a summary that will become the basis for final selection. At the end of the process, NSF's Division of Grants and Awards funds recipients of the 11,000 selected proposals.

"I may not see the results from the panels I've read immediately," Le-Pham muses, "But knowing how the process works, it's amazing to think I might be helping to fund the next big thing." She cites the first photo of the gravitational wave and black hole. "NSF has been funding it for years – and in the end, it paid off."

Le-Pham ultimately plans to pursue a career in medicine. She looks back on her academic training at Cal State Fullerton, grateful for the research skills she learned. "My classes helped me read and understand scientific literature." She also cherishes her network of professors who have encouraged her career pursuits saying, "I'd never have known about this job if it weren't for a CSUF professor."

> *"It's amazing to think that I might be helping to fund the next big thing."*
>
> **Ashley Le-Pham** (BS '16)

To date, over 200 Nobel laureates are NSF-supported scientists. Le-Pham says, "I don't think people realize how far-reaching NSF is. They've had a hand in Google, the development of the cellphone, and the internet. I spent my childhood watching Bill Nye and *The Magic School Bus*. It's all been funded through this agency... and I work here." •

FACULTY FOCUS

Jocelyn Read, professor of astrophysics and co-leader of the Extreme Matter team at the Laser Interferometer Gravitational-Wave Observatory, was featured in *Scientific American*, where she helped explain neutron stars and how they fit into theories of matter and gravity.

Framroze Virjee's appointment as president of CSUF was made permanent in March by the California State University Board of Trustees. He is the sixth permanent president of CSUF, succeeding Mildred García, who is now president of the American Association of State Colleges and Universities. "Joining, learning from, and succeeding with this incredible Titan family has been the greatest honor of my life, not to mention the most fun I have ever had," says Virjee.

Matthew E. Kirby, professor of paleoclimatology, recently found evidence of major flooding 4,800 years ago in the Lake Elsinore area of Riverside County. His findings were published in the Geological Society of America's special papers, and may be used to help understand flood risks and improve flood management and planning.

Math Cuajungco, professor of biological science, was honored with the 2019 Faculty Research Award from the California State University Program for Education and Research in Biotechnology for his research on Mucolipidosis type IV, a rare genetic disease that causes children to have speech, blindness, and mobility issues.

Darren R. Sandquist, professor of biological science, has been leading efforts to reestablish habitat for the Santa Ana River woolly star, an endangered flowering plant that is vital to the local ecosystem. He and his team recently collaborated on a paper published in the journal *Ecosphere*, detailing soil treatments that emulate the flood conditions the woolly star needs to survive.

The Department of Mathematics and friends gathered in May to celebrate the establishment of the Dr. Gerald Gannon Scholarship. Named for Professor Emeritus Dr. Gerald Gannon and established through the generosity of many donors, this endowment will provide an annual scholarship to students in the Masters of Mathematics – Teaching Option program.

STUDENT, ALUMNI & COLLEGE NEWS

Lucy Odom

Isabel Serrano

Lucy Odom, **Isabel Serrano**, and **Bogdan Suceavă** published a paper on the work of seventh-century scholar Isidore of Seville, which was included in *The Best Writing on Mathematics 2018* by Princeton University Press. Odom received her bachelor's degree in mathematics in 2013, and Serrano received her bachelor's degree in applied mathematics in 2018. Suceavă is a professor of mathematics at CSUF.

Stan Hillman, who received his bachelor's (1970) and master's (1972) degrees in biology from CSUF and is now professor and chair of biology at Portland State University, was named the 2018 August Krogh Distinguished Lecturer by the American Physiological Society. Through the Hillman and McClanahan Scholarship in Plant or Animal Physiological Ecology that he established with his master's thesis advisor, Lon McClanahan, professor emeritus of biological science, Hillman has also been supporting graduate students in physiology at CSUF for many years.

"The rigor of the curriculum and the laboratory experiences at CSUF set me up to succeed in doing research, which opened up opportunities I did not know existed," says Hillman. "It was an unforgettable experience I carried throughout my career, and I am proud to help give the next generation of exceptional students a similar opportunity."

Geology alumna **Kylie Caesar** (MS '16) worked with her faculty research advisor, **Sean J. Loyd,** to lead a collaborative study focused on mineral formation by a community of unique microbes living in the U.S. Gulf Coast subsurface. The study, published in the journal *Nature Research*, found that the microbes destroyed vast quantities of methane in the subsurface of the Gulf of Mexico region.

Sean J. Loyd

Kylie Caesar

Omar Muneeb (BS '16; MS '18) has won several awards for his master's thesis on developing fuel cells powered by vitamin C, including the Giles T. Brown Outstanding Thesis Award. He has presented his research at national conferences and been published in numerous peer-reviewed journals, and his work has led to a dramatic expansion of the research lab of Chemistry Professor John Haan, who served as Muneeb's thesis advisor.

Members of the CSUF **Division of University Advancement** won several awards at the recent Council for Advancement and Support of Education District VII Conference for their fundraising, awareness, and alumni engagement efforts.

Earlier this year, **Wawanesa Insurance** made a generous donation to establish the Wawanesa Scholarship in Actuarial Science. Leo Morales from Wawanesa Insurance is seen here presenting a check to Nicole Bailey, director of development, and Jeffrey Jolley, professor of finance.

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READY TO TAKE ON THE WORLD

Congratulations from all of us at the college. As you travel the road ahead, know that you're now part of a distinguished family of alumni. We're all rooting for you and can't wait to see what impact you'll have in your field.