

ANNUAL REPORT

— A new era of exploration —



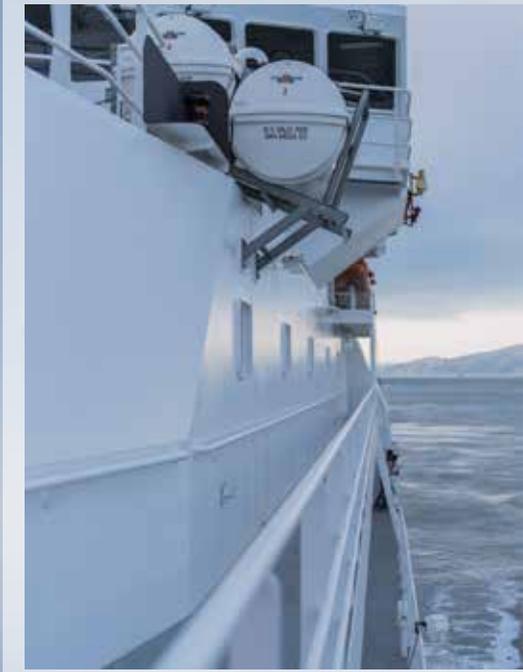
2016



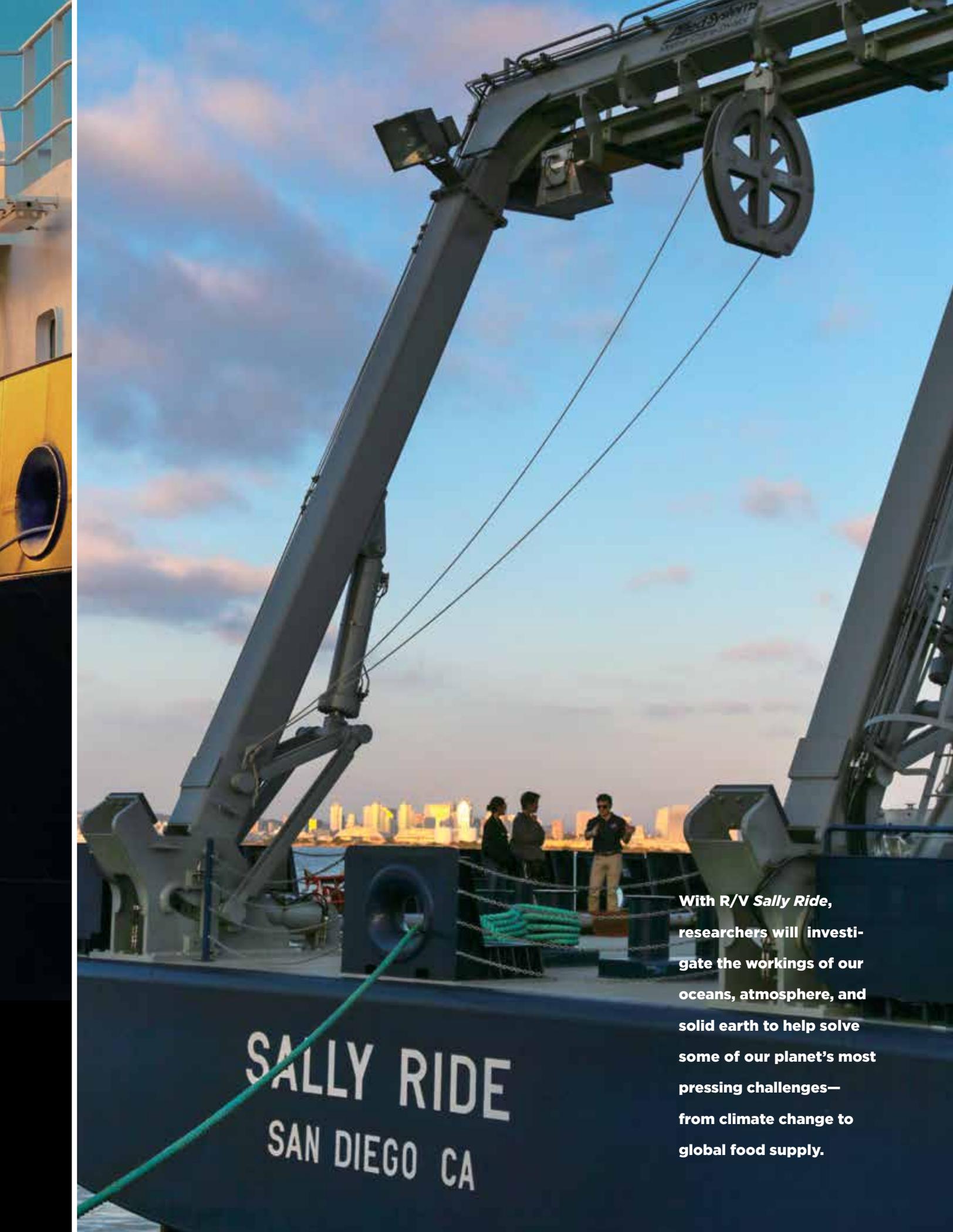


R/V SALLY RIDE

The vessel is named in honor of the late Sally Ride, the first American woman in space. After retiring from NASA, Ride became a member of UC San Diego's physics faculty. She also went on to establish Sally Ride Science, which continues to inspire generations of students to pursue careers in STEM fields.



Aboard R/V *Sally Ride*, researchers will work to achieve new breakthroughs related to global ocean resources, helping to ensure that our ocean food supply remains healthy, find new compounds that can be developed into life-saving drugs, enhance our understanding of the consequences of global warming, and deliver new insights on a wide range of hazards and threats to society, including earthquakes and tsunamis, so we can better protect our planet.



SALLY RIDE
SAN DIEGO CA

With R/V *Sally Ride*, researchers will investigate the workings of our oceans, atmosphere, and solid earth to help solve some of our planet's most pressing challenges— from climate change to global food supply.



FROM THE DIRECTOR

I've had an exciting career as a research scientist and administrator, but during the past few months I discovered that few things in life are as exhilarating as the debut of a new research vessel.

In a year filled with stellar achievements and extraordinary highlights at Scripps Institution of Oceanography at UC San Diego, the arrival of our new ship (page 10) was truly a one-of-a-kind experience. Scripps took delivery of *Sally Ride*, America's newest research vessel, on July 1 from the U.S. Navy.

As you will see in photos throughout this report, the technologically advanced vessel made its way south this summer from a Washington state shipyard to San Diego. On August 26th R/V *Sally Ride* made an inspiring whistle stop off the Ellen Browning Scripps Memorial Pier in front of a crowd of excited onlookers to mark the ship's first visit to La Jolla en route to its home port at the Scripps Nimitz Marine Facility. More than 4,000 people visited the ship during public tours at the time of its official commissioning in October. The ship began science operations in November, the latest Scripps vessel allowing researchers to solve the planet's most vexing problems through discoveries that range from climate change to human health to natural disasters.

R/V *Sally Ride*'s arrival comes at an important time in Scripps Oceanography's history. New philanthropic gifts (page 24) have allowed Scripps to address critical challenges facing our planet. Among the many important gifts in the past year, Richard and Carol Dean Hertzberg donated \$5 million to Scripps to launch the Center for Climate Change Impacts and Adaptation; Joy Frieman, wife of late Scripps Director Ed Frieman, donated \$2.5 million to endow a faculty chair and fellowships focused on climate sustainability; Scripps Director's Council Chair Stephen Strachan provided a \$1 million gift to assist the director with faculty start-up funds and seed funding; and the Donald and Elizabeth Dickinson Foundation donated funds for a new instrument for innovative research in marine drug discovery for a range of human diseases.

Scripps Oceanography's research (page 4) celebrated milestones and demonstrated real-world innovation. Scripps' four research initiatives—climate change impacts and adaptation, human health and the oceans, resilience to hazards, and innovative technology to observe the planet—

were represented by highlights ranging from the centennial of seawater measurements at Scripps Pier to crucial identification of new faults in Southern California to a breakthrough in helping the world's poor access clean energy.

Scripps' educational (page 6) program grew at a rate unmatched in the institution's history. Scripps is welcoming 11 new faculty members, including five with joint appointments in other UC San Diego departments. During the past year Scripps also forged new paths in international collaborations (page 22) and alumni relations (page 20).

Focused retreats on long-term campus planning and outreach inspired new visions that will address functionality, sustainability, and management of the campus. Steve Gallagher, recently hired assistant vice chancellor for finance and operations, is leading discussions and planning on how the Scripps campus needs to evolve in the coming years and decades to meet the demands of a growing institution (page 26). Scripps Oceanography's outreach (page 8) to the community is more vibrant than ever and our retreat allowed us to develop plans to make it more effective.

Birch Aquarium at Scripps (page 18) set out on new paths this year under the direction of new Executive Director Harry Helling. The aquarium is integrating Scripps research into compelling displays for the public. In October the aquarium launched a new R/V *Sally Ride* gallery "Expedition at Sea," which combines immersive science, art, and technology as a precursor to a major new exhibit, *The Expedition*, opening at Birch Aquarium in 2017.

Everyone on campus, as well as our alums and supporters, have contributed to making this a most exhilarating year!

Margaret Leinen
Director, Scripps Institution of Oceanography
Vice Chancellor for Marine Sciences
UC San Diego

RESEARCH highlights

Scripps Oceanography is one of the most important centers for global science and education in the world. Hundreds of research programs covering a wide range of scientific areas are underway on every continent and in every ocean.

THE OCEANS

ARE RECOGNIZED IN CLIMATE TALKS



The science community and advocates for improved study and management of the world's oceans scored a victory in Paris in December 2015 when negotiators at the 21st Conference of the Parties (COP21) climate talks made mention of the oceans in the final approved agreement from the conference.

It was the first time in the history of the talks that the importance of ocean protections had been explicitly mentioned. Observers of the negotiation process said the inclusion opens the door to more ocean-focused climate mitigation actions as countries around the world pledge to take steps to reduce their contributions to climate change. Scripps scientists and students were among those who had sought to raise the profile of the oceans through presentations and direct interactions with COP21 negotiators.

“Although two-thirds of the ocean falls outside national jurisdiction and thus doesn't have its own negotiator within the United Nations climate talks, here were unified voices reminding us that the ocean is a great and essential climate mitigator whose ecosystems we depend on for food, protection, livelihoods, and climate adaptation, and that it is vulnerable to the impacts of our CO₂ emissions,” said Scripps biological oceanographer Lisa Levin, who delivered several talks highlighting ocean stresses at COP21.

Scripps climate and atmospheric scientist Veerabhadran Ramanathan advanced the concept of limiting global warming agents besides the chief anthropogenic source of climate change, carbon dioxide. Ramanathan spearheaded University of California efforts to make the university system carbon neutral in 25 years and has studied the climate benefits of reducing emissions of refrigerants, soot and other forms of black carbon, methane, and other pollutants.



SEAFLOOR IMAGING SYSTEM CAPTURES A MICROSCOPIC VIEW OF A CORAL'S LIFE

Scripps Oceanography researchers developed an innovative underwater tool to study the minute ocean world. The Benthic Underwater Microscope, or BUM, has captured a never-before-seen microscopic view of a coral's life, including coral turf wars, a previously unknown behavior being called coral polyp “kissing,” and a unique algae settlement pattern on recently bleached corals.

The BUM is a two-part system—an underwater computer with a diver interface tethered to a microscopic imaging unit—to study marine subjects at nearly micron resolution. The instrument has a high magnification lens, a ring of focused LED lights for fast exposures, fluorescence imaging capabilities, and a flexible tunable lens, similar to the human eye, to change focus for viewing structures in 3-D.

In an effort to better understand the many ecological processes taking place on a microscopic scale in the ocean, Scripps researcher Jules Jaffe and graduate student Andrew Mullen built the seafloor system to image marine microorganisms in their natural settings without disturbing them.

In field tests, the researchers used the imaging system to view millimeter-sized coral polyps off the coast of Israel in the Red Sea, and off Maui, Hawaii. They are now preparing the instrument to take pictures of microscopic particles in water near the coral's surface to study how the flow of water over corals allows them to exchange the necessary gases to breathe.



OMINOUS CLOUD FORECASTS CONFIRMED

Computer climate models had for several years predicted that the accumulation of greenhouse gases in the atmosphere generated by human populations would cause cloud tracks to retreat toward Earth's poles and expand subtropical dry zones.

In July, a team led by Scripps climate researcher Joel Norris reported that its analysis of satellite cloud data confirmed those predictions. These cloud changes enhance absorption of solar radiation by the earth and reduce emission of thermal radiation to space. They exacerbate global warming caused by increasing greenhouse gas concentrations.

"What this paper brings to the table is the first credible demonstration that the cloud changes we expect from climate models and theory are really happening," said Norris.

The researchers reached their conclusion after reconciling inconsistent satellite records of cloud cover beginning in the 1980s and compensating for inaccuracies caused by changes in satellite orbit, the degradation of satellite-borne instruments, and other factors.



NEW TECHNOLOGY

A new technology is giving firefighters the upper hand in the battle against wildfires. The network of mountaintop cameras operated by researchers at Scripps offers a new opportunity for early detection of fire hazards in some of the most remote locations in Southern California, and within the wildland-urban interface.

The AlertSoCal system, developed in collaboration with the Scripps-based High Performance Wireless Research and Education Network (HPWREN), headed by Scripps geophysicist Frank Vernon, and the Nevada Seismological Laboratory, expands Southern California's state-of-the-art earthquake and weather monitoring system to better detect fires in real time before they spread.

AlertSoCal provides firefighters and the public with a virtual fire lookout tower equipped with real-time and on-demand time-lapse imagery up to 12 hours in the past to spot the first signs of fire ignition. The unprecedented view in these remote regions and within the wildland-urban interface can aid fire crews with critical information on fire evolution in its early stages to support safer operations, and more timely evacuations of residents from harm's way.

The web-based technology is designed to help incident command centers quickly pinpoint the initial source location of a wildfire in regions that are difficult to reach, operating in critical fire-prone regions including Toro Peak, the highest peak in the Santa Rosa Mountains located in Riverside County, and Lyons Peak in southern San Diego County.

The HPWREN network currently includes more than 64 fixed mountaintop cameras positioned in 16 remote locations across San Diego, Riverside, and Imperial counties to support public safety operations. New AlertSoCal 4K high-definition pan, tilt, and zoom cameras will augment the existing HPWREN cameras.

The online hazard alert system is also accessible to the public, who can use it to view weather conditions at these often-inaccessible locations of Southern California, and which provides an opportunity to crowd source early fire detection through public participation.



provides early fire hazard detection

EDUCATION

Scripps Oceanography students are the next generation of ocean, earth, and atmospheric science leaders. Whether they are studying ice shelves in Antarctica, manta rays in the Gulf of Mexico, science policy in Paris, or volcanoes in South America, these movers and shakers are unified in their goals of finding solutions for today's environmental challenges.



Peeking into the Underwater World of Leopard Seals

While a graduate student at Scripps, alumnus Doug Krause led research that uncovered details about the underwater foraging ecology of leopard seals through the use of cutting-edge technology, including unmanned aerial systems and Crittercams—small video cameras mounted to animals' bodies to record their movements. Krause worked with NOAA Fisheries' Antarctic Ecosystem Research Division and National Geographic Remote Imaging (Crittercam) to attach Crittercams to the backs of seven different leopard seals at Cape Shirreff, a remote NOAA field camp located in the Antarctic Peninsula, one of the top three fastest warming areas on the planet.



The resulting footage was nothing short of spectacular, riddled with surprises, drama, and a rare up-close view of life below the surface. The powerful marine mammals were caught on camera engaging in behavior such as food stealing, fighting, and food hoarding. Researchers were also surprised to discover that the leopard seals spent the majority of their time foraging for fish along the seafloor, and some seals had even developed specialized techniques for hunting and catching bottom-dwelling ice fish.

"Leopard seals are often portrayed as these large, ferocious, apex predators, and in many cases they are—but using these new approaches we've learned that their foraging is much more dynamic, and is even more adaptable than we had previously known," said Krause.



Another Stellar Year for Scripps' Academic Programs

In 2016, Scripps' educational offerings continued to expand as the department welcomed an unprecedented 11 new faculty members, including five with joint appointments across other UC San Diego departments such as Anthropology, Biological Sciences, the School of Global Policy and Strategy, and Family Medicine and Public Health. These cross-disciplinary faculty appointments will help bridge Scripps science with other fields, enabling Scripps students to remain at the forefront of efforts to understand and protect our planet.

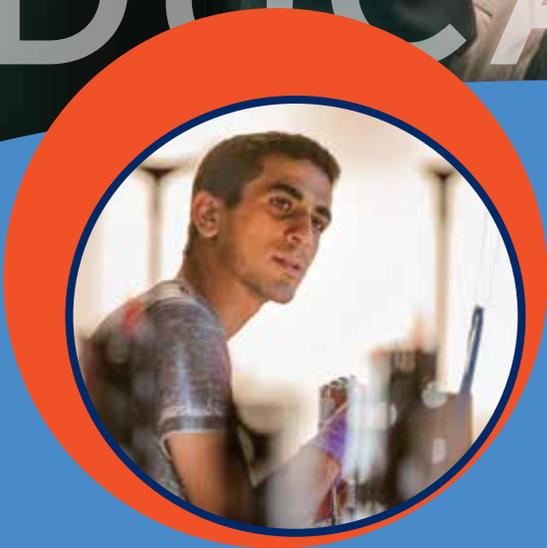
The inaugural class of students in the Master of Advanced Studies in Climate Science and Policy (MAS CSP) program graduated in summer 2016. This interdisciplinary professional degree program is designed to bridge the gap between climate change science and public policy. With one successful year under its belt, the MAS CSP program will continue to flourish and grow in the years to come. The MAS program in Marine Biodiversity and Conservation also finished a strong year with capstone presentations by students in June of 2016.

Two other student-driven research symposia were held in 2016, one for undergraduate students and the other for master's and doctoral students. Both events highlighted the depth and breadth of student research at Scripps, ranging from climate change and fisheries to seismology and medicines from the sea.

Scripps students continue to receive numerous awards and accolades for their research. Notably, graduate



EDUCATION



student Nastassia Patin was awarded the Frieman Prize for her work in characterizing the diversity of marine bacterial species, and Maitreyi Nagarkar was named “Outstanding Graduate Student” by UC San Diego’s Sustainability Office for her community outreach efforts and marine biology research.

For the sixth consecutive year, the diversity-focused Scripps Undergraduate Research Fellowship (SURF) educated students from universities across the United States, including

the U.S. Virgin Islands. The SURF program successfully builds a pipeline for underrepresented students into higher education programs, and since its inception, seven former SURF students have gone on to pursue PhDs at Scripps.

The education program continues to expose students to new opportunities. This year, thanks to fellowship support and UC Ship Funds, several Scripps students conducted research onboard a Scripps research vessel, including the new R/V *Sally Ride*. These transformative at-sea research experiences—in addition to in-the-field opportunities—are some of the many reasons why Scripps attracts the best and brightest students. In addition, the education department is working with new staff in the Scripps Director’s Office and the UC San Diego Office of Innovation and Commercialization to help students learn about opportunities to engage with the business community.

OUTREACH

Scripps made a big impact on the community in 2016 through educational outreach efforts at sea, on land, in classrooms, and even underwater. These continuously expanding programs educate students, teachers, and the public about earth and ocean science and the university's efforts to understand and protect our planet.



Classrooms Dive into Science Education with Live Underwater Broadcast

An international partnership between Scripps, the Reef Environmental Education Foundation (REEF), and the Department of the Environment in the Cayman Islands has brought marine science into classrooms in the Cayman Islands, the United Kingdom, and the United States for the past five years. Scripps assistant professor Brice Semmens, Scripps graduate students Lynn Waterhouse and Brian Stock, and others have been conducting live interactive broadcasts of dives at one of the last remaining large spawning aggregation sites for the endangered Nassau Grouper. In collaboration with REEF educator Todd Bohannon, the Scripps team has developed curriculum materials for K-12 classes, bringing conservation science and fieldwork into the classroom through expeditionary learning.



Scripps Teams Up with Sally Ride Science

Blending art with science, Scripps seismologist Debi Kilb worked with Sally Ride Science at UC San Diego to bring STEAM (science, technology, engineering, arts, and math) programs to San Diego youth. Sally Ride Science is an education company that Ride, the first American woman in space, co-founded in 2001 to ignite student enthusiasm for science. In 2015, Sally Ride Science was relaunched as a non-profit entity and its programs are now jointly coordinated by UC San Diego Extension, Scripps Oceanography, and the San Diego Supercomputer Center. The 2016 Sally Ride Science Junior Academy for Girls took place over a three-week period in July and offered students a variety of hands-on learning experiences with workshops ranging from the music of earthquakes to virtual deep-sea exploration. A total of 372 middle- and high school-age students attended the academy, and more than half of the STEAM instructors and mentors for the program are affiliated with Scripps.

Triton Summer STEM Academy Doubles Its Reach

Scripps Oceanography and UC San Diego welcomed to campus 59 rising high school seniors from underserved schools in Los Angeles, San Diego, and Oakland during the third annual Triton Summer STEM Academy (TSSA). In collaboration with other UC San Diego departments, organizers at Scripps arranged for these high-achieving students to participate in labs, workshops, and activities that highlighted the world-renowned academics and opportunities at Scripps. Since last year's program, TSSA has nearly doubled in size, a win-win for both students and the university, which hopes these bright students will become future enrollees.



Teacher Professional Development at Scripps

Scripps made a substantial contribution to preparing San Diego's K-12 science teachers for new science and engineering standards, thanks to efforts led by Cheryl Peach, director of Scripps Educational Alliances, and Emily Arnold, educational manager at Birch Aquarium. Nearly 300 teachers participated in Scripps-sponsored or -supported teacher professional development programs over the past year, establishing robust links between local science classrooms and the vast research enterprise at Scripps.



OUTREACH



Scripps Science Aboard R/V *Sproul*

This year marks the sixth that Scripps has collaborated with UC San Diego Extension on its Academic Connections pre-college program to expand Scripps outreach to diverse students. While teaching with Academic Connections in July 2016, Scripps PhD students Sean Crosby, Julia Fiedler, Bonnie Ludka, and Veronica Tamsitt organized and led a two-part cruise off Point Loma on R/V *Robert Gordon Sproul* using UC Ship Funds. A dozen high school students—most of whom had never been aboard a ship—participated in the day-long cruises where they were fully immersed in ocean science research. They assisted Scripps graduate students with data collection, got their hands muddy with sediment sampling, and looked through microscopes at plankton collected with net tows. Many students in this year's program came from the Reality Changers organization that helps low-income youth become first-generation college students.

SHIPS

Scripps operates oceanographic research vessels recognized worldwide for their outstanding capabilities. Equipped with innovative instruments, these ships are mobile laboratories and observatories serving students and researchers throughout the world.



R/V SALLY RIDE

The long-anticipated arrival of *Sally Ride* to San Diego occurred on Aug. 26, 2016, when the ship made a whistle stop visit offshore the Scripps campus in La Jolla to the cheers of hundreds of Scripps and UC San Diego colleagues. This event capped a productive year for all involved. The initial inspection of the vessel was successfully completed with high marks, which was a prerequisite for the U.S. Navy accepting the vessel. Final shipyard work was successfully completed, during which Scripps managed the installation of all the hull-mounted scientific instrumentation. This was followed by sea acceptance trials, and a series of maiden voyages that included ports of call in Newport, Ore. and San Francisco, Calif.



R/V Sally Ride will allow Scripps researchers to train the next generation of scientists.



A new era of exploration

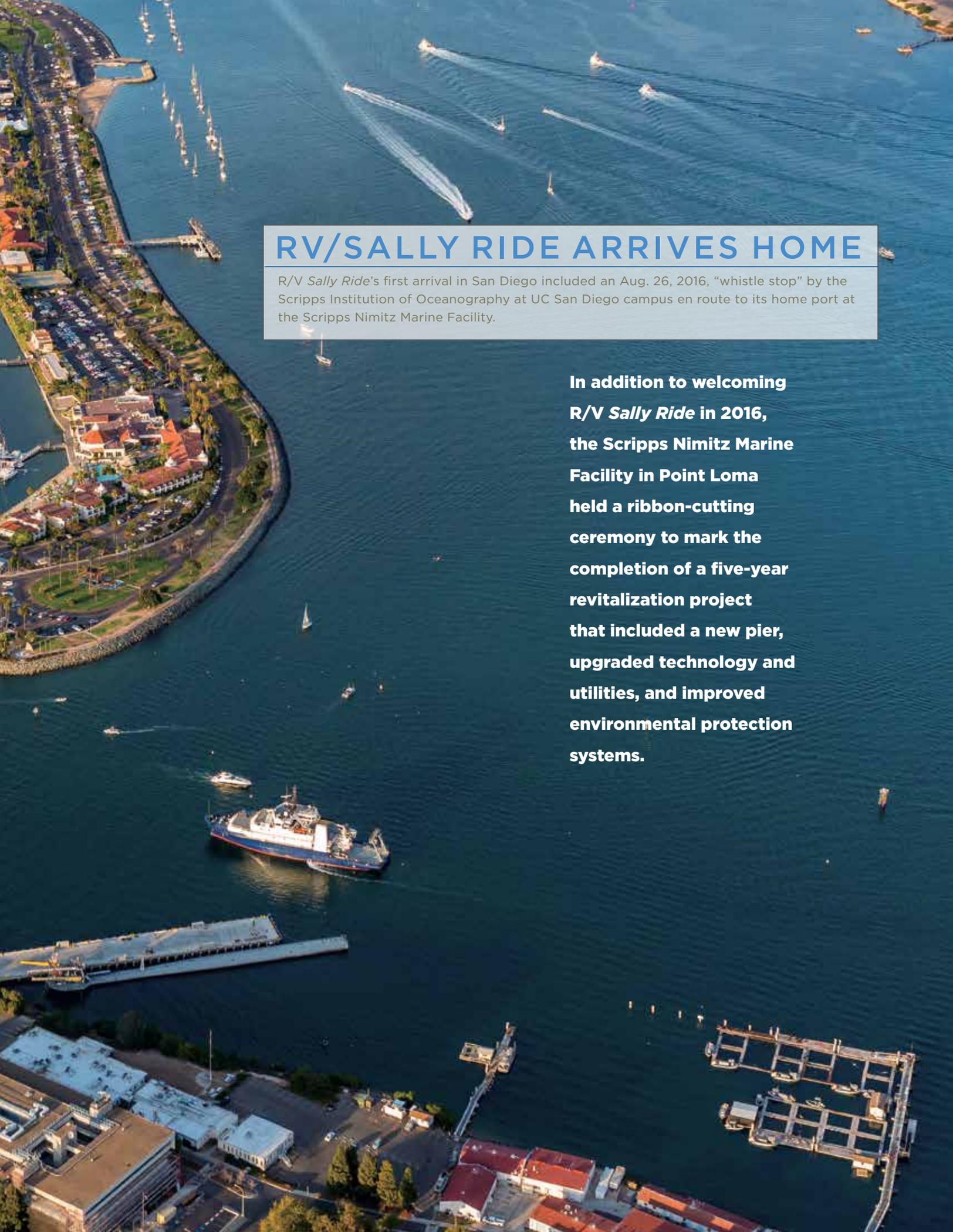
At its home port at the Nimitz Marine Facility (MarFac), R/V *Sally Ride* entered a transition to operations phase to install, integrate, test, and demonstrate the myriad science systems that are needed to productively serve Scripps's scientific mission. The ship was introduced to the scientific community on Oct. 28, 2016 with a commissioning ceremony heralding the ship's entry into University-National Oceanographic Laboratory System service. The ship's first regular science mission followed with a research cruise for the venerable CalCOFI program.

Scripps Nimitz Marine Facility had a tremendous day on April 15, when our newly revitalized wharf and pier berthing facility was officially re-opened with a ribbon-cutting ceremony—on time and under budget. Research vessels require services that are mundane and arcane, from reliable utility service to logistical support required to mobilize multimillion dollar oceanographic instrumentation. With newly completed upgrades, MarFac is uniquely capable for supporting expeditionary oceanography, and poised to continue serving as America's finest research vessel support facility for the next half-century and beyond.



R/V SALLY RIDE





RV/SALLY RIDE ARRIVES HOME

R/V *Sally Ride*'s first arrival in San Diego included an Aug. 26, 2016, "whistle stop" by the Scripps Institution of Oceanography at UC San Diego campus en route to its home port at the Scripps Nimitz Marine Facility.

In addition to welcoming R/V *Sally Ride* in 2016, the Scripps Nimitz Marine Facility in Point Loma held a ribbon-cutting ceremony to mark the completion of a five-year revitalization project that included a new pier, upgraded technology and utilities, and improved environmental protection systems.

The rest of our fleet

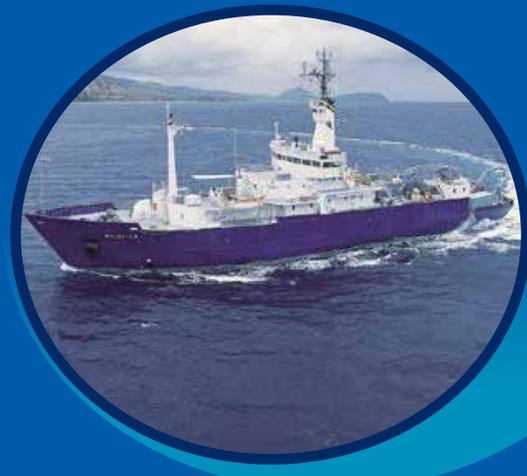
R/V ROGER REVELLE

continues to serve as a major workhorse for the U.S. academic research fleet, with more than 300 operational days per year in both 2015 and 2016. In between, we completed a 60-day regulatory drydocking, overhaul, and inspection in Keelung, Taiwan, followed by a successful sea trial to demonstrate new upgraded winches and overboard handling systems. During the past year *Roger Revelle* has successfully accomplished major projects in the Indian and Pacific Oceans supported by the National Science Foundation, Office of Naval Research (ONR), and NOAA, notably a pair of 40-plus day cruises that spanned the Indian Ocean from Antarctic ice edge to the Bay of Bengal as part of Scripps oceanographer Jim Swift's Scripps Global Ocean Repeat Hydrography program.

Scripps was awarded \$29.26 million for a midlife refit that will upgrade, refurbish, and refresh major ship systems, which will extend the service life of the vessel through the year 2041. Planning for the refit has begun, with the intent of conducting the refit work in a U.S. shipyard beginning in 2018.



R/V MELVILLE was successfully transferred to the Republic of the Philippines by the U.S. Navy, a lengthy process that was supported by Scripps Ship Operations as we continued our role as caretakers for the vessel, and trainers for the oncoming Philippine crew. Following a high-level transfer ceremony, the vessel was renamed Gregorio Velasquez, and departed San Diego on April 28, 2016 for its new home port in Manila, where this illustrious vessel will serve the citizens of the Philippines.





R/V ROBERT GORDON SPROUL

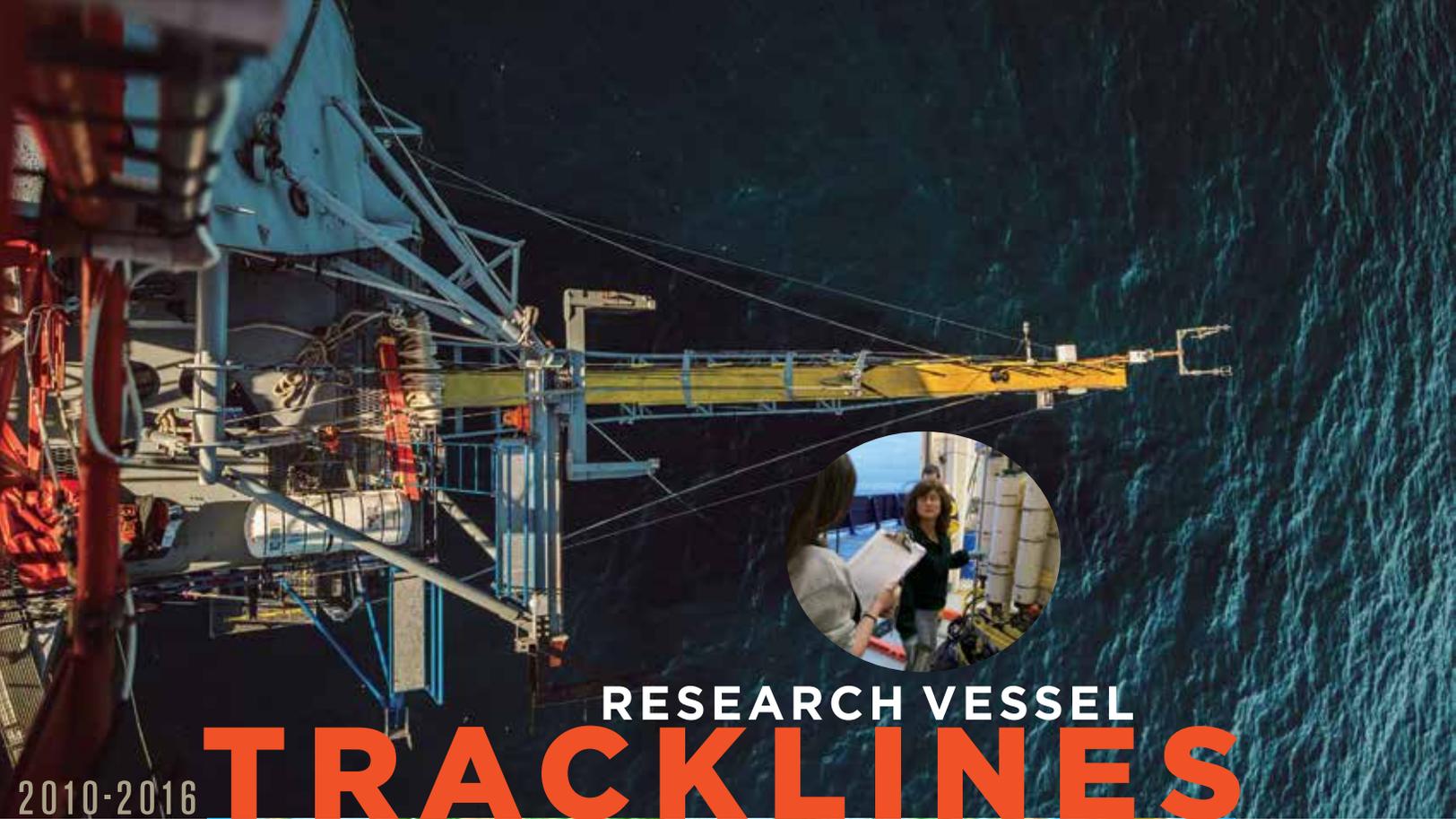
completed its 16-month pilot project to demonstrate the practicality of routine use of 100-percent renewable diesel fuel, sponsored by the U.S. Department of Transportation. This project was 100-percent successful, and we would like to continue using renewable fuel on *Sproul*. However, the cost of the fuel is 10 percent greater than fossil fuel, so in order to meet our commitment to funding agencies to provide the most economical operations of our ships, we need to find an alternate source of support to cover the marginal difference between fossil and renewable fuel—an ongoing quest.

R/V *Sproul* continues to serve its key role as Scripps's reliable coastal research vessel, available for regional and nearshore research projects that are increasingly important, including student and class cruises supported by the UC Ship Funds Program. *Sproul* is preparing to support several upcoming *FLIP* cruises, for which *Sproul* will serve as an anchor handling vessel.



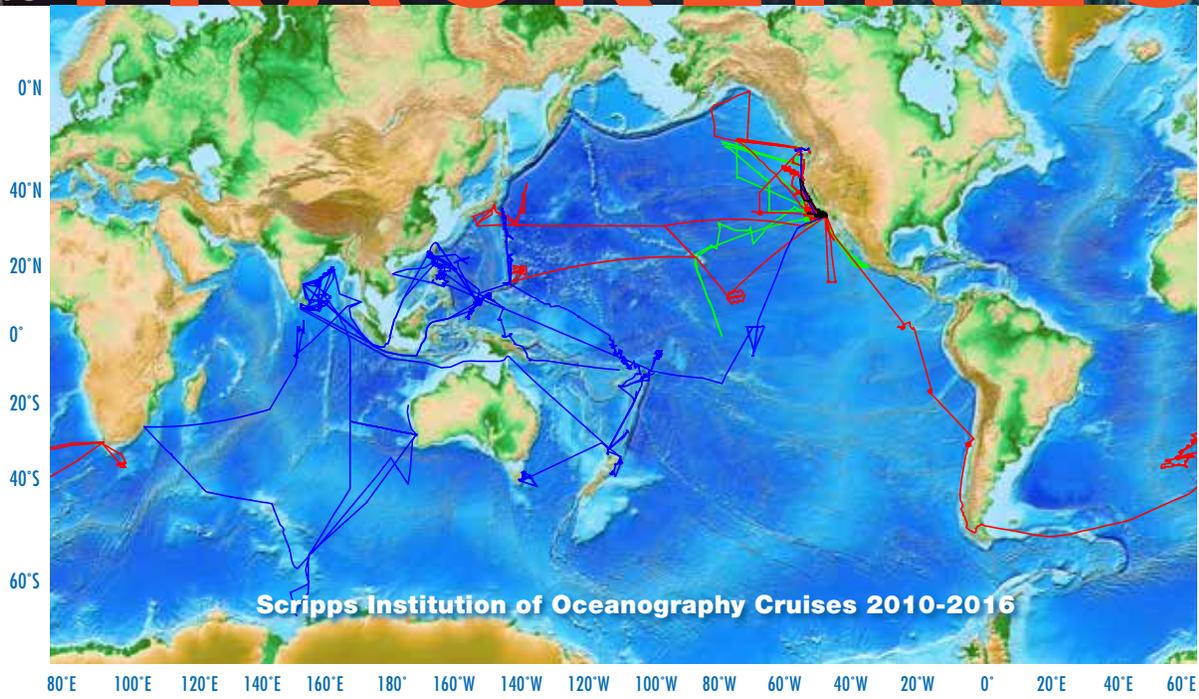
R/P FLIP With ONR funds, a new face boom for FLIP was constructed and installed, and then successfully exercised and evaluated during a test deployment in May 2016. The new face boom is stronger and easier to maintain than previous booms. Scripps Ship Operations and Marine Technical Support is planning a series of technical upgrades to the on-board science systems so that FLIP has a basic suite of sensors similar to other Scripps-operated vessels. These upgrades have been funded by ONR and will be integrated in order to support future operations.





RESEARCH VESSEL TRACKLINES

2010-2016



- **R/V Melville**
- **R/V New Horizon**
- **R/V Roger Revelle**
- **R/V Robert Gordon Sproul**

Scripps ships venture worldwide to address society’s most fundamental concerns about our planet, our environment, and life on Earth. Crewed by professional mariners and marine technicians renowned for their skill in the demanding field of scientific ship operations, our vessels serve as mobile laboratories and control centers that allow teams of scientists at sea (and through telepresence, on land) to survey, observe, and assess our planet in a way that no other platform can. For more than a century, Scripps research vessels have enabled safe, capable, and efficient scientific operations to scientists, educators, and students. Over the past five years, we have completed 304 separate research missions, carrying to sea 4,526 scientists, students, engineers, and explorers from 425 different research institutions and laboratories.



Full Moon Pier Walk

THE EXPEDITION

How do we study th



Generations of visitors have discovered the ocean world through the exhibits and educational programs at Birch Aquarium, which has been translating Scripps research for more than 100 years.

Top: Pier Walks hosted by Birch Aquarium and
Bottom: Expedition at Sea: R/V Sally Ride Gallery at Birch Aquarium.

BIRCH AQUARIUM highlights

For more than a century, Birch Aquarium has served as the public outreach arm of Scripps Institution of Oceanography. Now preparing to celebrate its 25th anniversary in its current location, the aquarium is more dedicated than ever to its mission to provide ocean science education, interpret Scripps research, and promote conservation.



BIRCH AQUARIUM HAD

473,172

public visitors

(a new record)

Supported

by a growing base of more than **7,700** members, donors, and Friends of Birch Aquarium

50,383

PRE-K-12 STUDENTS (a new record)

2 Million

reached through online programming including UCSD-TV



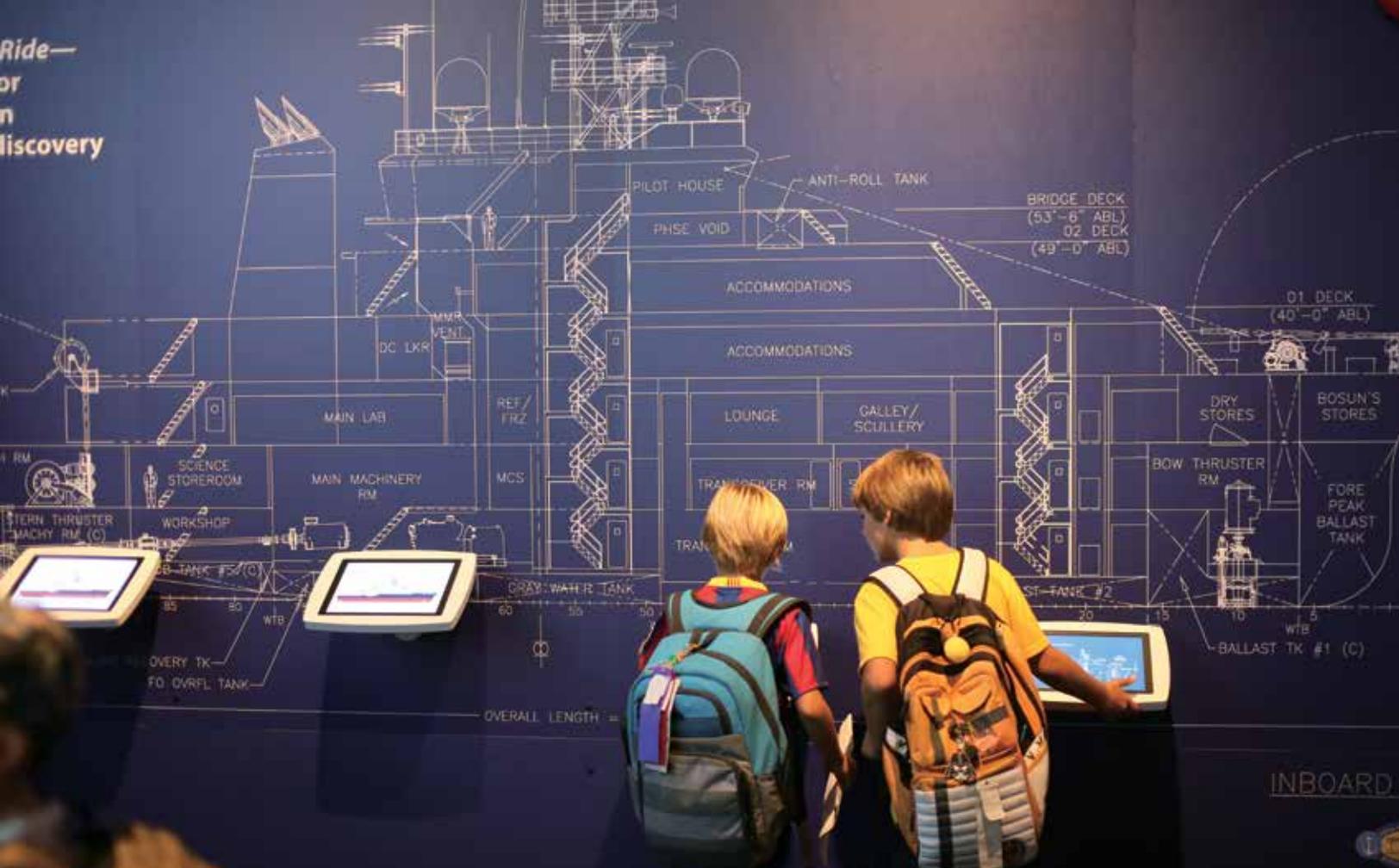
PROVIDING OCEAN SCIENCE EDUCATION

Birch Aquarium at Scripps continues to be the **largest provider of K-12 ocean science education in the county.**

Birch Aquarium provided more than **\$145,000** in scholarship and supported programs, reaching a total of **16,889 underserved students.** The Price Philanthropies Ocean Science Education Fund made tremendous impacts for local students, providing **free outreach programs to 8,454** Title One and underserved K-12 students.

SUSTAINED BY 470 VOLUNTEERS

WHO DONATE MORE THAN **30,000** HOURS EACH YEAR



A RECORD-BREAKING YEAR



INTERPRETING SCRIPPS OCEANOGRAPHY RESEARCH

More than **170 Scripps scientists** participated in Birch Aquarium outreach initiatives through innovative programs, exhibits, courses, and presentations.

PROMOTING OCEAN CONSERVATION

Representing animals from Alaska to the Tropical Pacific, Birch Aquarium's collection includes **4,274 fish and invertebrates** and **311 distinct species**.

The aquarium is distinguished for its research and leadership in husbandry for Leafy and Weedy Seadragons, sea horses, coral, and the Flamboyant Cuttlefish. Birch Aquarium hosted the 2016 international Seadragon Husbandry Symposium, attracting biologists, conservationists, and aquarists from all over the world, and highlighting Scripps' discovery of the Ruby Seadragon.

SUPPORTED BY PHILANTHROPY

Birch Aquarium is grateful to the friends and donors who support its mission of ocean conservation and outreach. As a self-sustaining organization, philanthropy is essential to fulfilling this mission.

Photo credit: Sandy Huffaker

ALUMNI

Alumni of Scripps Oceanography represent more than 2,000 academics, professionals, experts, and entrepreneurs from ages 22 to 99 years. Their accomplishments are felt widely, from education and environment to industry and innovation, and their impact spans the expanse of our planet, from deep oceans to deep space.

Alumni Connections

Scripps Director Margaret Leinen spent the past year visiting alumni across the country and around the world, gathering their stories and sharing campus news. Wherever she encountered them—from large receptions in New Orleans and San Francisco to intimate dinners in Washington, D.C., Singapore, and Japan to campus talks and visits during UC San Diego Alumni Weekend and Scripps Day—alumni expressed their enthusiasm for lifelong connections to their alma mater, current students, and each other. Alumni also expressed interest in increased communications and to hear news about fellow alumni, Scripps faculty, and the campus, as well as opportunities to help students and new alumni adapt to evolving careers. Leinen updated alumni on new hires to help meet their needs, including an alumni director and a director of corporate affiliates, business development, industry outreach, and innovation. Additionally, with campus partnerships with UC San Diego Alumni and Community Engagement, Career Services, and the Office of Innovation and Commercialization, Scripps is poised to meet alumni needs to forge new and lasting connections.

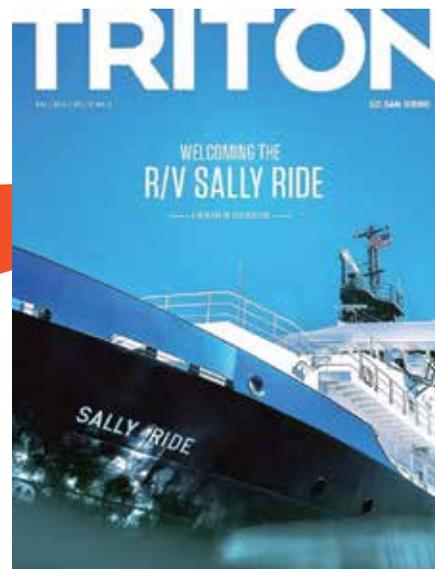
Scripps Alumni Up Close



Rear Admiral Timothy Gallaudet (MS, PhD Oceanography, '91, '01) is the Oceanographer and Navigator of the U.S. Navy, where he has been instrumental in the development of the Navy's climate change policy. Relying on scientific intelligence to oversee Navy exploration of the sea and the sky, he provides naval leadership on all issues related to oceanography, meteorology, hydrology, climate change, the Arctic, maritime domain awareness, and geospatial and celestial referencing. On June 4, Admiral Gallaudet was honored as a UC San Diego 2016 Distinguished Alumnus at the annual alumni celebration. UC San Diego stated that his selection as honoree was a celebration of "the courage, creativity, drive, and leadership of UC San Diego alumni worldwide." During his visit to San Diego, Gallaudet returned to the Scripps campus to speak with students and faculty about naval operations and strategic guidance for maintaining maritime superiority.



Above, Scripps Director Margaret Leinen with Singapore-based Scripps alumni (from left) Danwei Huang, PhD '12, assistant professor, Department of Biological Sciences, National University of Singapore; Sylvain Barbot, PhD '07, assistant professor, Asian School of the Environment, Earth Observatory of Singapore; and Federico Lauro, PhD '07, associate professor, Asian School of the Environment, Nanyang Technological University. **Below,** Scripps Director Margaret Leinen brings Scripps and UC San Diego alumni together at a dinner in Singapore.



Right: R/V Sally Ride makes historic mark on UCSD Alumni's Triton Magazine as the first full-cover (front and back) spread.



Meir was back in San Diego on October 28, joining fellow Scripps alumna and NASA astronaut Megan McArthur (PhD '02) in celebrating the R/V Sally Ride commissioning festivities.

Jessica Meir, PhD '09

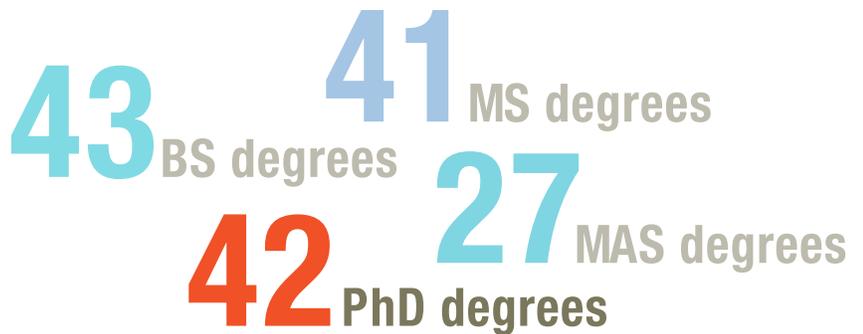
NASA astronaut Jessica Meir visited Scripps Institution of Oceanography on June 10 to deliver the alumni keynote at the annual Scripps Day commencement celebration. Speaking to the Class of 2016 and their families, Meir explained how her student experience at Scripps was a critical step in achieving her lifelong dream of being an astronaut. At Scripps, she conducted research with the Center for Marine Biotechnology and Biomedicine to study the physiology of animals in extreme environments, specifically how emperor penguins and elephant seals are capable of conducting remarkably long dives. She also spoke about her experiences as one of eight members of the 2013 astronaut candidate class, reviewing the varied and thorough training that ranged from intensive instruction in International Space Station systems and robotics to spacewalks, flight training, and water and wilderness survival methods. Having completed astronaut candidate training in July 2015, Meir is now qualified for future assignment and continues to participate in analog missions to prepare for spaceflight. Her first mission will be to the International Space Station, and she hopes to make the flight in the next five years.

2016 CLASS



Help us welcome the class of 2016, our newest alumni, who join a global community that's been changing the world for over a century. This past June, 126 new graduates received their degrees from Scripps' undergraduate and graduate programs—including the first-ever class of Climate Science and Policy Master of Advanced Studies. They represent our next-generation leaders in conservation, advocacy, education, scholarship, and research, and they're already making waves at universities, government agencies, nonprofit organizations, and business ventures around the world. We are proud to rank them among our stellar network of alumni movers and shakers and look forward to celebrating their professional accomplishments.

TOTAL NUMBER OF DEGREES IN 2016



Where are they going?

- ALL GRADUATE: 153**
- Postdoctoral – 29
 - Continuing to PhD – 34
 - Employment – 7
 - Seeking employment/unknown – 13

Gender OF GRADUATING CLASS
WOMEN-95 MEN-58

24

the number of PhDs going to postdoctoral research posts, fellowships, and scholarships

INTERNATIONAL relations

As a world-class leader in research and education, Scripps Oceanography builds and maintains connections with other top universities and organizations. Scripps leadership traveled near and far in 2016 to enhance international collaborations.



These international MOUs represent the beginning of future partnerships, cross-collaborative opportunities, and research with global implications.

Scripps forged MOUs with the University of Tasmania, Australia; the Japan Agency for Marine-Earth Science and Technology (JAMSTEC); the National University of Singapore; Hokkaido University, Japan; Institute of Oceanology, Chinese Academy of Sciences; Atmosphere and Ocean Research Institute (AORI) at the University of Tokyo, Japan; and STIM, University of SPLIT, Croatia. Scripps also renewed its MOU with CICESE (Center for Scientific Research and Higher Education at Ensenada) in Mexico.

During her visit to the National University of Singapore, Scripps Director Margaret Leinen embraced the opportunity to connect with nine Singapore-based Scripps alumni, strengthening the lifelong connections among the global Scripps network.

UC MEXUS WORKSHOP FOSTERS COLLABORATION BEYOND BORDERS

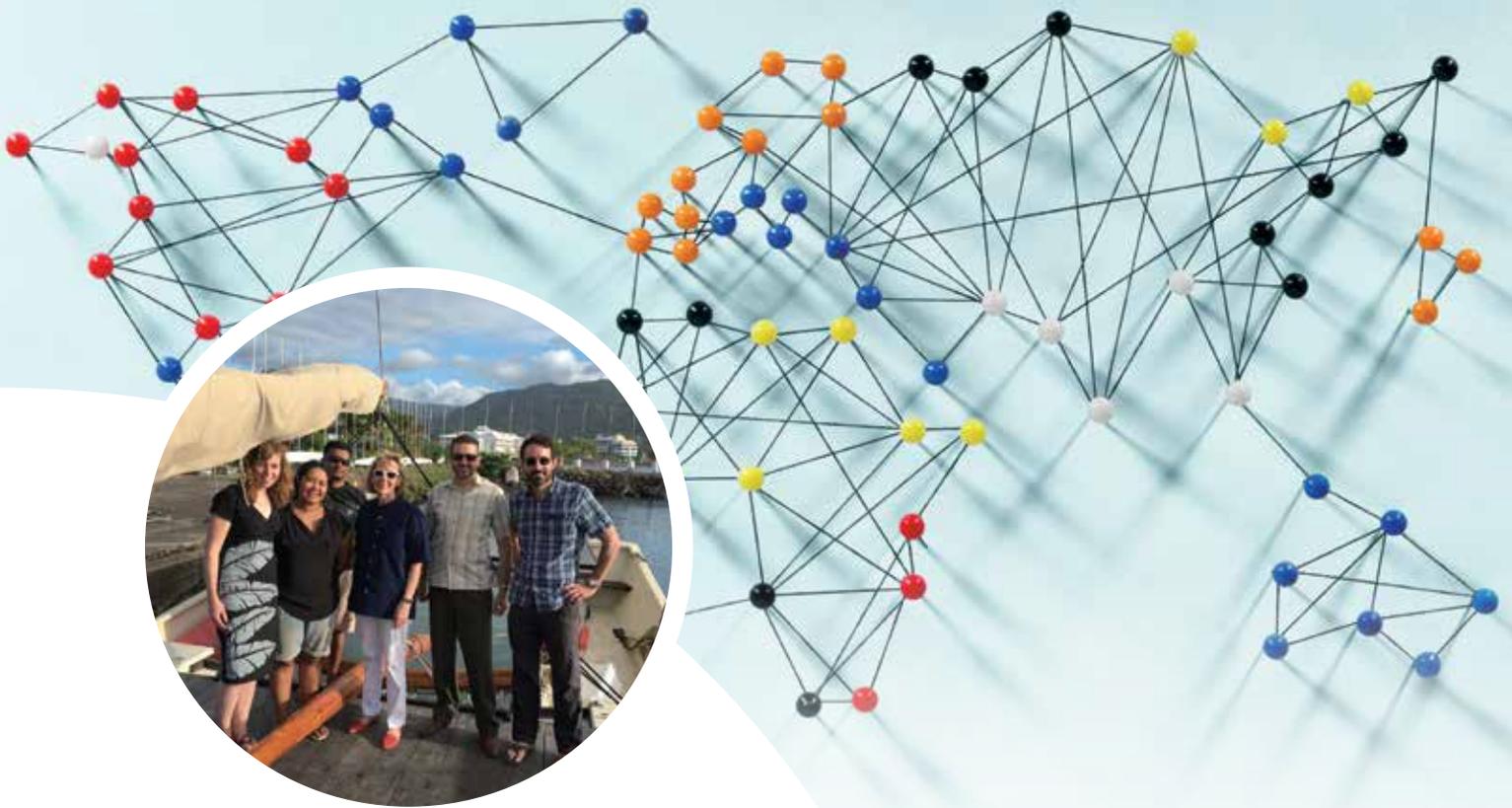
Scientists and graduate students from both sides of the U.S.-Mexico border gathered for a two-day, cross-disciplinary weather conference hosted by Scripps Oceanography.

The UC MEXUS workshop was a collaborative effort to implement new combined GPS and meteorological infrastructure in the monitoring and forecasting of North American monsoon rainfall and flash flooding in the trans-border region.



SCRIPPS FORGES INTERNATIONAL CONNECTIONS

Fueled by UC San Diego's strategic goal to understand and protect the planet, Scripps Institution of Oceanography signed memorandums of understanding, or MOUs, with eight leading universities around the world in 2016.



Participating organizations included Universidad Nacional Autónoma de México (UNAM), Universidad de Sonora, CICESE, University of Arizona, Arizona State University, the University of Washington, UNAVCO, the University Consortium for Atmospheric Research COSMIC Program Office, and the National Weather Service's office in San Diego.

The events were extremely effective in fostering group discussions about potential funding mechanisms for complementary science proposals to fund this new instrumentation work—both north and south of the border.

SCRIPPS DIRECTOR NAMED SCIENCE ENVOY BY U.S. DEPARTMENT OF STATE

Vice Chancellor Leinen was appointed the 13th U.S. Department of State Science Envoy in 2016. Her first trip as envoy was to Fiji and Samoa in July where scientists from Scripps Oceanography recently had port calls after cruises that included scientists from the region.

She spoke to government officials in both countries about new developments in conservation science and technology, as well as opportunities for collaboration with Scripps Oceanography scientists in many disciplines. Leinen also met with local leaders of non-profit ocean organizations and of the Secretariat of the Pacific Community, a partnership of 22 Pacific nations that supports education, environment, and economic development in the Pacific island nations.

She also visited and spoke at the University of the South Pacific. A highlight of her trip was the opportunity to snorkel in local Fijian marine protected areas (MPAs) and the unprotected areas adjacent to them.

“Though in place for less than 10 years, the contrast in abundance and diversity of fish species was obvious even to a paleoceanographer!” she said during a kava ceremony with the local area family stewards of the MPA.



DEVELOPMENT

Philanthropy plays a vital role in helping Scripps Oceanography address some of the most important environmental challenges we face today. We are incredibly grateful to all of our donors for supporting our world-class research initiatives, and helping us educate the next generation of scientists.

PRIVATE SUPPORT \$26,376,626

Largest annual total in the 113 year history of Scripps, a 60% increase over last year



Endowment Gifts:

\$9,627,144

18% increase over last year

48 six-figure gifts

60% increase over last year



MEMBERSHIPS

New alignment of benefits with three membership groups: EWSA, Friends of Birch, and Friends of the Collections; 75% increase in membership for the Friends of Birch

Key Events: Nierenberg Prize, Fellowship Brunch, Director's Circle, Palmyra trip

COP22: support for student delegation



To Honor Late Scripps

Highlights



- A transformational gift to fund the Center for Climate Change Impacts and Adaptation
- A 2.5 million dollar gift to fund the Edward A. Frieman Endowed Chair, and two endowed fellowships
- Over two million dollars in philanthropy to support conservation-related research
- Over a half-million dollar gift to purchase a new nuclear magnetic resonance spectrometer
- A major gift to fund a new outreach vehicle for the Birch Aquarium education program
- The creation of a new Birch Aquarium discretionary endowment fund
- A significant gift to support Scripps leadership in search and discovery of Americans missing in action since WWII
- A major gift to launch the Birch Aquarium's Expedition focused exhibits



Mrs. Joy Frieman's gift endowed two fellowships and the Edward A. Frieman Endowed Presidential Chair in Climate Sustainability in honor of Ed Frieman, her late husband, who from 1986 to 1996 served as the eighth director of Scripps Institution of Oceanography, UC San Diego, and vice chancellor of Marine Sciences.



Oceanography Director

\$2.5 Million Gift

\$5 Million Gift

TO CREATE CLIMATE CENTER

Richard and Carol Dean Hertzberg's gift has launched the Center for Climate Change Impacts and Adaptation at UC San Diego, focusing on creating solutions to address the inevitable consequences of climate change. These consequences range from sea-level rise to more extreme weather with the potential to disrupt commerce, agriculture, and the habitability of certain regions on a large scale.

CAMPUS FACILITIES

Scripps Oceanography's strategic mission to understand and protect our planet has produced global leadership and broad recognition in key areas of ocean, earth, and atmospheric science and education.



Along with a thriving campus and a history that stretches back more than a century comes the need to modernize and restore Scripps campus facilities to match the institution's growing world-class status.

Teaching facilities, research laboratories, engineering hubs, offices, and space for new programs are a few of the demands for Scripps buildings, many of which are decades old and in need of modernization.

Steve Gallagher, recently hired as Scripps assistant vice chancellor for finance and operations, is leading efforts to revitalize the Scripps campus for the immediate future, as well as the decades beyond.

Gallagher is investing in urgent campus maintenance repairs, including renovating aging facilities and infrastructure. He is also overseeing the development of a Scripps campus master plan with a broad vision that includes new buildings, improved parking and transportation, with a focus on efficient land-use, and long-term sustainability and ecosystem concerns.

Immediate actions include renovation of the Center for Coastal Studies building, which sits adjacent to the Ellen Browning Scripps Memorial Pier, and renewal of the iconic Cecil H. and Ida M. Green Institute of Geophysics and Planetary



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Physics Munk Laboratory exterior, as well as a retrofit of a former NOAA Southwest Fisheries Science Center building that will become a Scripps anchor for emerging areas such as innovative ocean technology and marine conservation, as well as home to new laboratories, offices, and a café.

Guiding both immediate and long-term projects ahead, Gallagher emphasizes the need for improved circulation flow around the Scripps campus along with an emphasis on open spaces and a sense of community and collaboration.

His goal is to carry Scripps' infrastructure into the future with facilities that match Scripps' world-class research and education.

OUR CAMPUS



FINANCE

MULTI-YEAR STATEMENT OF ACTIVITY

REVENUE			
	FY 14/15	FY 15/16	FY 15/16
	(expensed this period)		(awarded this period)
Sponsored Research	125,474,157	119,433,501	148,492,139
Federal Government	113,736,139	109,533,326	133,998,759
National Science Foundation	48,737,711	35,721,011	31,826,311
Department of the Navy	24,873,117	30,417,326	37,570,749
National Aeronautics and Space Administration	5,098,740	6,471,379	6,963,701
National Oceanic and Atmospheric Administration	23,519,239	23,478,529	42,138,010
Department of Energy	1,781,063	2,052,420	1,934,966
Other Department of Defense Agencies	4,572,523	7,227,225	7,033,392
Other Federal Departments	1,628,112	893,568	3,477,816
National Institutes of Health	3,525,633	3,271,869	3,053,814
State Government	7,429,339	5,436,964	7,720,581
Local Government	769,959	706,977	509,669
Private Contracts	3,333,397	3,748,701	6,250,631
UC Sponsored Research	205,323	7,532	12,500
University of California Support	43,433,857	43,356,222	
Benefits for UCSD FTE	7,667,043	8,098,580	
1 Core Funds (includes \$2M to cover OP tax)	35,766,814	35,257,642	
Earned Revenue	13,259,640	13,928,539	
Birch Aquarium at Scripps (BAS)	5,930,463	6,847,838	
Recharge Unit Revenues	6,150,294	5,699,357	
Intellectual Property and Royalty Income	50,987	25,095	
Other Revenue	1,127,897	1,356,250	
Private Giving	7,803,434	12,869,432	
2 Birch Aquarium at Scripps (BAS)	784,427	1,033,289	
2 Private Gifts	4,841,184	8,684,397	
3 Private Grants	2,177,823	3,151,746	
Interest Income	2,043,225	2,097,411	
Interest Earned	128,390	87,139	
Endowment Yield	1,914,835	2,010,272	
TOTAL REVENUE	192,014,313	191,685,105	
EXPENSES			
Research Programs - SEEK	(164,625,755)	(165,672,857)	
Sponsored Research	(133,058,798)	(135,865,759)	
Ships	(27,094,773)	(25,310,805)	
Oceanographic Collections	(501,563)	(447,479)	
Contract & Grant Administration	(1,183,977)	(1,208,506)	
Research Development & Planning	(697,476)	(750,353)	
Research Infrastructure & EH&S	(785,168)	(717,106)	
OP Tax on Research Expenditures	(1,304,000)	(1,372,848)	
Instruction Programs - TEACH	(10,878,814)	(11,481,638)	
Outreach - COMMUNICATE	(9,242,362)	(10,022,379)	
Birch Aquarium at Scripps	(7,019,768)	(7,722,192)	
Communications (SIO share) & Web Group	(1,028,363)	(957,068)	
Development (SIO share)	(361,922)	(303,073)	
Diversity	(71,450)	(60,615)	
Special Events (including lectures, awards, conferences)	(191,354)	(241,093)	
Conference Facilities (Forum debt service, staff, maintenance)	(569,505)	(738,338)	
Institutional Support	(5,400,711)	(6,518,380)	
SIO Administration	(2,689,603)	(2,734,670)	
IT Services	(806,572)	(1,534,893)	
4 Facilities Maintenance & Capital Improvements	(1,630,536)	(1,991,813)	
OP tax on non-core expenditures	(274,000)	(257,004)	
TOTAL EXPENSES ⁵	(190,147,642)	(193,695,254)	
Annual Balance/(Deficit) from Current Activities	1,866,672	(2,010,149)	

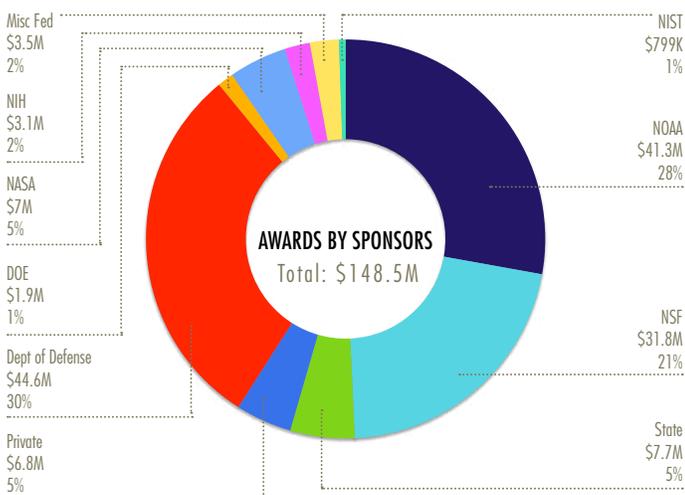
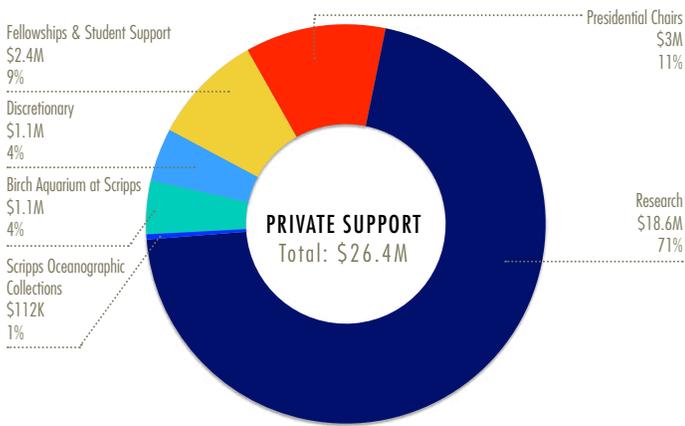
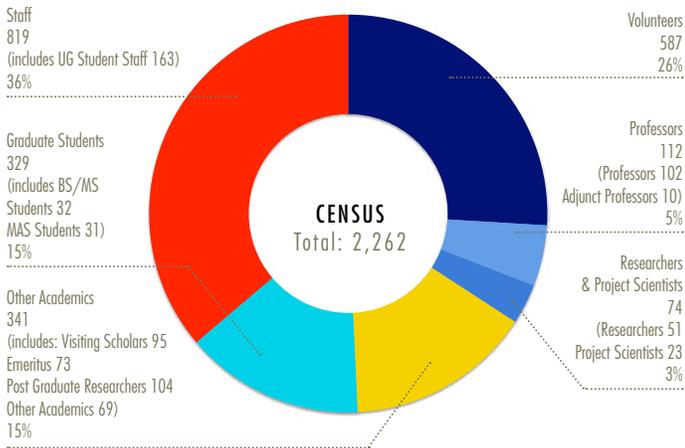
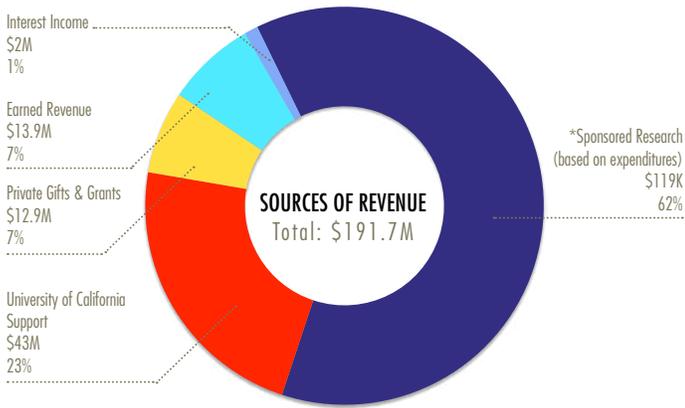
1. UCSD's budget model changed in FY 12-13. General Funds, Student Fees and Indirect Cost Returns (ICR) are now considered Core Funds. The decrease in the FY 15-16 Core Funds total is a result of transfers of funds to campus plant funds for facilities / capital improvement projects.

2. Amounts include only gifts received and available for spending in UC Regents funds in the current year. With bequests, pledges, contributions to endowments, and gifts booked with the UCSD Foundation, total SIO Development fundraising was \$26.4M in FY 15-16.

3. Private grants are typically restricted funds and considered Sponsored Research; however, UCSD counts them as Private Giving.

4. Excludes funds transferred to UCSD Facilities Design and Construction or Facilities Management and spent by those units on SIO projects. FY 15-16 total facility/capital improvement expenses paid by SIO were approximately \$7M.

5. This statement does not reflect all annual expenditures associated with operating SIO. Services provided by campus departments are captured in UCSD financial reports, e.g., utilities, custodians, payroll, central HR, general accounting, purchasing, business contracts, central IT, transportation & parking, physical planning, community relations, real estate, deferred maintenance, facilities management



EXTRAMURAL FUNDING

INTERNATIONAL GOVERNMENT

Japan Aerospace Exploration Agency
Government of New Zealand

FEDERAL

Department of Agriculture

U.S. Department of Agriculture Forest Service

Department of Commerce

National Oceanic and Atmospheric Administration
National Institute of Standards and Technology

Department of Defense

Air Force Office of Scientific Research
Department of Army Engineers
Department of Defense Strategic

Environmental Research Development

Pacific Fleet Commander
Space & Naval Warfare Systems Command

Department of Energy

DOE Office of Science
DOE National Energy Technology Laboratory

Department of Health and Human Services

National Institute of Allergy and Infectious Diseases
National Cancer Institute
National Institute of Environmental Health Sciences
National Institute of General Medicine Science
National Institute of Neurological Disorders & Stroke

Department of Interior

Bureau of Reclamation
Fish and Wildlife Service
Bureau of Safety and Environmental Enforcement
United States Geological Survey

Department of Navy

Naval Air Systems Command
Naval Facilities Engineering Command
Naval Research Laboratory
Naval Surface Warfare Center
Office of Naval Research
Space and Naval Warfare Systems Command

Department of State

National Aeronautics and Space Administration
National Science Foundation

STATE OF CALIFORNIA

Delta Stewardship Council
Department of Fish and Wildlife
Department of Parks and Recreation
Department of Water Resources
Natural Resources Agency
State Coastal Conservancy
State Lands Commission
State Water Resources Control Board
Transport Agency

CITIES AND COUNTIES

City of San Diego
County of Sonoma
Sonoma County Water Agency
Southern California Coastal Water Research Project
Southern Valley Water Authority
State and Federal Contractors Water Agency

EXTRAMURAL SUPPORT

Atlantic Petroleum Norge AS
BG Inc., CNPC
BIO-WAVES Incorporated
Centro De Investigacion Cientifica De Ensenada
CH2M Hill
Charles Stark Draper Laboratory, Inc.
Chevron Corporation
Conocophillips
Consejo Superior de Investigaciones Cientificas
Earth Networks, Inc.
Electromagnetic Geoservices SA, Seabed Logging Company
Eli Lilly & Company
Exxon Upstream Research Company
Geophysical Resources & Services PTY Ltd.
HESS Corporation
HLS Research
KMS Technologies
Los Gatos Research, Inc.
Microbio Engineering, Inc.
Neos Geosolutions
Ocean Floor Geophysics, Inc.
Pacific Northwest National Laboratories
Petroleum Geo-Services ASA
Petromarker AS
Repsol Service Company
Rock Solid Images, Inc.
Royal Dutch Shell PLC
Southern California Gas Company
SPEC, Inc.
Total E&P Research Development
Total S.A.
U.S Israel Binational Science Foundation
UNAVCO, Inc.
VERTEX Pharmaceuticals
ZONGE Engineering & Research Organization, Inc.



UC San Diego



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