

UNIVERSITY OF ALASKA FAIRBANKS

College of Fisheries and Ocean Sciences

ANNUAL REPORT 2021



COLLEGE OF FISHERIES
AND OCEAN SCIENCES

University of Alaska Fairbanks

Message from the Dean

With this annual report, it is an honor and a pleasure to convey that the College of Fisheries and Ocean Sciences continues to make great strides in addressing some of the most pressing aquatic ecosystem challenges facing Alaska, the nation, and the world. And despite the continuing challenge of the pandemic, CFOS realized several key milestones over the past year.

We established the CFOS Advisory Council to facilitate greater stakeholder engagement and support. We created the CFOS Justice, Equity, Diversity, and Inclusion Committee to actively engage faculty, staff, and students in our shared vision of an equitable, diverse, and inclusive college. We are actively developing a new Master of Marine Policy degree jointly with our colleagues at the University of Alaska Southeast, which is anticipated to commence in fall 2022. We also made significant progress in improving our shoreside and cyber infrastructure in support of *Sikuliaq*, *Nanuq*, and our many seagoing research programs.

CFOS is a major contributor to aquatic ecosystem research and instruction in fisheries, marine biology, and oceanography. We train new scientists and technicians, and continue to experience strong enrollment in our undergraduate and graduate programs. We manage major research facilities, such as the Kasitsna Bay Laboratory (co-managed with NOAA), where I had the opportunity to catch some halibut near Seldovia this past summer—what a treat!

The past year also brought several new appointments. Among these, Jennifer Questel was appointed as research assistant professor



Photo by Hans Pedersen.

of Oceanography. We were honored with two new endowed faculty chairs: Andrew Seitz was appointed the first Frank and Marjorie Meek Chair in Fisheries and Ocean Sciences, and Peter Westley was appointed the first Lowell A. Wakefield Chair of Fisheries and Ocean Sciences. And, Justin Sternberg was hired as director of the Alaska Blue Economy Center.

There is much to be proud of at CFOS. The University of Alaska Board of Regents describes our college as a shining star in the university; I could not agree more. The recognition of our high-quality academic and research programs and operation of major facilities is a testament to the dedication and hard work of our faculty, staff, and students.

I invite you to learn more about the growing academic programs and innovative research being conducted by our exceptional CFOS community.

A handwritten signature in blue ink that reads "S. Bradley Moran".

S. Bradley Moran, Dean
College of Fisheries and Ocean Sciences

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R/V *Sikuliaq* navigates Beaufort Sea ice. Photo by Craig Lee.



People

Brenda Konar

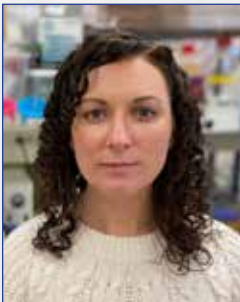


Alaska NSF EPSCoR—the Established Program to Stimulate Competitive Research—has appointed Brenda Konar to be the principal investigator and project director of its “Fire and Ice” research project.

Konar, who is a professor in the Department of Marine Biology, has served since 2018 as a co-PI of Fire and Ice, an interdisciplinary effort to study climate-driven changes to Alaska’s boreal fire regimes and its coastal ecosystems.

“I’m excited to take the reins of this important research project,” Konar said. “Fire and Ice has already started to publish some significant findings, and I look forward to helping us continue to make important discoveries and to build Alaska’s research capacity.”

Jennifer Questel



Jennifer Questel has been appointed as research assistant professor in CFOS. A CFOS alum, her research expertise focuses on the ecology of Arctic and high-latitude zooplankton communities, specifically the assessment of zooplankton biodiversity using

molecular techniques for species identification, population genetics, and population connectivity.

Questel is from Ogdensburg, New York, located along the St. Lawrence River, which the newly built R/V *Sikuliaq* sailed on its journey to Alaska. She completed her PhD in Oceanography at CFOS in 2016 and was later awarded a UAF Centennial Postdoctoral Fellowship.

“I have seen CFOS grow from a school to a college, and have experienced the immense and innovative research performed by the scientists here,” Questel said. “Seeing the influx of new researchers with a diverse range of specialties makes me excited about what is next to come.”

Jennifer Reynolds



This past year, Jennifer Reynolds was appointed interim associate dean of research. Jennifer is a geological oceanographer trained in igneous petrology and geochemistry (the composition of magmas and volcanic rocks) and use of technologies to conduct

geologic mapping on the seafloor. She has also applied geologic mapping for benthic habitat research in collaboration with fisheries biologists, and is currently studying seafloor cold seeps around Alaska with funding from the Bureau of Ocean Energy Management. Jennifer will also assume the role of interim director of the Institute of Marine Science and the Coastal Marine Institute.

Schery Umanzor



Schery Umanzor joined the Department of Marine Biology in 2020 as a research assistant professor, with support from a Chancellor’s Award to help spur Alaska’s mariculture research. In 2021, she was appointed as a tenure-track assistant professor.

Her current research includes leading a kelp nutrient extraction project funded by the US Department of Energy Advanced Research Projects Agency-Energy; developing a site assessment toolkit for kelp farming in collaboration with Alaska Sea Grant and the University of Alaska Center for Innovation, Commercialization, and Entrepreneurship (Center ICE); and working with NOAA, the Alaska Department of Fish and Game (ADFG), and farmers across Alaska to understand the genetic contribution of kelp seed stock.

Justin Sternberg



Justin Sternberg has been appointed as director of the Alaska Blue Economy Center. Sternberg is an entrepreneur with a background in clean energy and ocean industries. In his new role, he will connect research and industry with the goal of diversifying the state's economy and supporting its coastal communities.

Sternberg has worked in Alaska since 1997. While leading the Alaska development of the company Blue

Evolution, he worked with the State of Alaska to develop its seaweed mariculture permitting protocols and permitted the first commercial seaweed hatcheries and farms in the state. He also founded the Blue Pipeline Incubator and Blue Pipeline Venture Studio.

“The development of Alaska’s ocean economy represents one of the foremost opportunities in the world today. I’m proud to be a part of the incredible team at CFOS as we open this new chapter in the history of Alaska,” Sternberg said.

New Endowed Chairs

Andy Seitz | Frank and Marjorie Meek Chair in Fisheries and Ocean Sciences



Andy Seitz will serve as the university’s first Frank and Marjorie Meek Endowed Chair in Fisheries and Ocean Sciences. The Meek Chair endowment was created to support the growth of scientific knowledge about Alaska’s fisheries and help prepare the next generation of fisheries managers and scientists.

Seitz, a professor in the Department of Fisheries, is an internationally recognized expert in fish migration and behavior. His research focuses on understanding large-scale oceanic migrations of fish and their interactions with tidal and wave energy systems. Since joining CFOS in 2009, Seitz has advised numerous students who have gone on to join Alaska’s workforce in agencies

and the private sector.

“I feel fortunate to work firsthand with students while they make new discoveries and provide information for the sustainable use of our marine and freshwater resources,” said Seitz.

Peter Westley | Lowell A. Wakefield Chair of Fisheries and Ocean Sciences



Associate Professor of Fisheries Peter Westley has been selected to serve as the university’s first Lowell A. Wakefield Chair of Fisheries and Ocean Sciences. The Lowell A. Wakefield Chair supports the CFOS mission by expanding the rehabilitation, development, and improvement of fishery resources of the State of Alaska.

Westley’s research focuses on the interface of ecology and evolution, specifically the connections between fish, ecosystems, and people. He is widely known for his work on evolutionary rescue, collective movement ecology, biological invasions, and interactions between wild and hatchery-produced salmon, and for his innovative teaching.

“It is an honor to be appointed as the Wakefield Chair, and to have the opportunity to teach and conduct research at CFOS on lands and waters that have sustained and nourished people for millennia,” said Westley.

Advisory Council

CFOS has many stakeholders and supporters, and it is important that they have a platform to help guide and support the college. In this regard, the new CFOS Advisory Council was established in October 2020. The purpose of the council is to provide critical input, advice, and recommendations to the CFOS dean and UAF chancellor on matters related to academic programs, research, major facilities, and development efforts of the college.

Robert Foy



Robert (Bob) Foy is the science and research director of the Alaska Fisheries Science Center. Bob joined NOAA Fisheries in 2007 as director of the center's Kodiak Laboratory and program manager for the Shellfish Assessment Program. Bob earned a BS in

Biology from the University of Michigan and an MS in Fisheries and PhD in Oceanography from the University of Alaska Fairbanks.

Stephanie Madsen



Stephanie is the executive director of the At-Sea Processors Association. She has been involved in Alaska fisheries since arriving in Alaska more than forty years ago, and has lived in the fishery communities of Cordova, Kodiak, Unalaska/Dutch Harbor, and now

Juneau. Having served six years on the North Pacific Fishery Management Council, four of those as chair, she continues to serve the council on the Ecosystems Committee.

Molly McCammon



Molly McCammon was most recently the director of the Alaska Ocean Observing System (AOOS), the Alaska regional component of the national Integrated Ocean Observing System (IOOS) based in Anchorage. She is currently

treasurer of the IOOS Association and a member of the national Ocean Research Advisory Panel, and has served on numerous other science boards and panels. McCammon moved to Alaska in 1973 after graduating from the University of California Berkeley.

Vera Kingeekuk Metcalf



Since 2002, Vera has been the director of the Eskimo Walrus Commission (EWC) at Kawerak, Inc., working with communities in the promotion of community involvement in research, documentation of local traditional ecological knowledge, and

co-management of the Pacific walrus populations. She is a strong advocate for the subsistence lifestyles of Alaska Native peoples, and passionate about strengthening Alaska Native languages and cultures. Vera was born and raised in Savoonga (Sivungaq) on St. Lawrence Island, Alaska.

Stephanie Quinn-Davidson



Stephanie Quinn-Davidson is a fisheries scientist who has worked in salmon fisheries in Alaska for the past decade. She is currently the program director of Fisheries and Communities with the Alaska Venture Fund. Previously, Stephanie was the director of the Yukon River Inter-Tribal Fish

Commission with Tanana Chiefs Conference, and before that, she worked as a fishery biologist and fishery manager for the Alaska Department of Fish and Game. Before moving to Alaska, she was a professor in the departments of Environmental Studies and Biology at St. Olaf College in Northfield, Minnesota. Born in Wisconsin, she is an enrolled member of the Brothertown Indian Tribe of Wisconsin.

Norman Van Vactor



Norman Van Vactor is the CEO/ president of Bristol Bay Economic Development Corporation, one of six Community Development Quota organizations in Alaska. Norman has worked in the Alaska fishing industry for more than 30 years as a crewman on a fishing

vessel and in a variety of senior management positions. He has served on a variety of boards in both appointed and volunteer roles.

Doug Vincent-Lang



Doug Vincent-Lang spent his 34-year public service career at the Alaska Department of Fish and Game before accepting the position of commissioner in January 2019. In 2012 he was named director of the Division of Wildlife, and has led legislative wildlife issues at state, national, and international levels. He holds a BS in Biology/Population Dynamics from the University of Wisconsin-Green Bay and an MS in Biological Oceanography from the University of Alaska Fairbanks.

CFOS Forms New Diversity Committee

Numerous members of the CFOS community are serving on our new Justice, Equity, Diversity, and Inclusion (JEDI) Committee. Our students, staff, and faculty recognize the importance of doing this work in a careful and intentional way, so the committee is starting the year by gathering learning materials, seeking training, and deepening conversations about how to develop JEDI's vision and actions for the coming years.



Graduate student Elizabeth Mik'aq Lindley (Yup'ik) holds a sockeye salmon at a Kuskokwim River sonar site. Photo courtesy of Elizabeth Mik'aq Lindley / ADFG.



“The CFOS JEDI Committee is responsible for making recommendations to the Dean on strategies, actions, and priorities to create and maintain a diverse, equitable, and inclusive college.”

Bradley Moran

Photo by Emma Beaver.

Academics

Student enrollment in CFOS academic programs continued to be strong during the past academic year. This success reflects a concerted effort by faculty and staff to engage with students during a challenging year, including teaching courses via asynchronous delivery to facilitate distance learning.

New Programs and Curriculum Changes

CFOS developed an enrollment management plan to formalize new student recruitment and marketing strategies for both the Bachelor of Science in Fisheries and Marine Sciences and the Bachelor of Arts in Fisheries degree programs. The goal of these strategies is to increase access for students across Alaska, particularly in rural communities, as well as for students outside of the state. Asynchronous delivery of courses in undergraduate programs enables CFOS to meet this important goal; indeed, a large number of CFOS undergraduate courses are now available via asynchronous modality.

Efforts are underway to streamline the joint Bachelor of Science Program in Fisheries Science between CFOS and the University of Alaska Southeast (UAS) in Juneau. CFOS is also developing a scaffolded degree program where students can sequentially complete an

Occupational Endorsement, Certificate, and Associate of Applied Science in Fisheries Technology at UAS Sitka, and then transfer into the BS in Fisheries Science concentration at UAF.

On the graduate program front, the first cohort of nine graduate student fellows entered the new Tamamta program this fall. Funded by NSF, this graduate traineeship focuses on Indigenous knowledge in fisheries and ocean sciences. A working group developed a Master of Marine Policy (MMP) degree, a joint initiative between CFOS and UAS in Juneau. A marketing plan for the Blue MBA was developed with the College of Business and Security Management, and plans are underway to formalize the Blue concentration within the STEM MBA degree.

Professor Katrin Iken (second from left) poses with students Feyne Elmore, Amy LaBarre, Kyah Mingo, Michelle Trifari, Mary Keenan and Katie Corliss during the Marine Biology and Ecology Field Class based out of the Kasitsna Bay Laboratory. Photo by Katie Corliss.





Unloading a salmon seine at Metlakatla. Photo by Tazia Wagner.

New Master of Marine Policy Degree

The demand for science and policy expertise is ever more pressing with the increasing effects of climate change on marine ecosystems. To meet this need, and in recognition that effective marine policy requires a working knowledge of both natural and social sciences, CFOS and the UAS School of Arts and Sciences are developing a new Master of Marine Policy (MMP) degree.

The MMP program is anticipated to commence in fall 2022 and is designed to complement existing UA

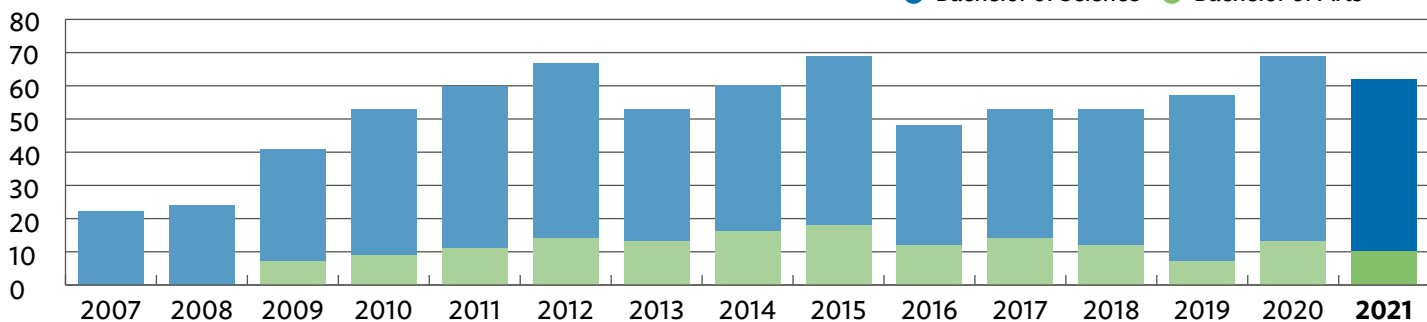
graduate programs. Foundational requirements include Marine Policy and Statistics, an internship, and courses drawn from four core areas: Living Marine Resources and their Management, Analytic Methods, Law and Policy, and Economics, Development, and Sustainability.

The wide selection of courses that fill the core requirements draw from UAF and UAS programs in Alaska Native Studies, Anthropology, Arctic and Northern Studies, Biology, Cross-Cultural Studies,

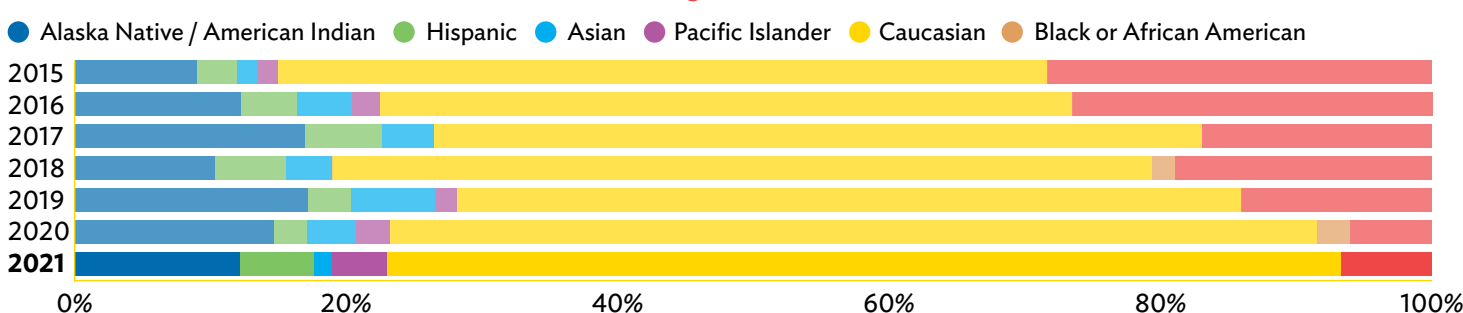
Economics, Fisheries, Geography, Marine Biology, Natural Resource Management, Political Science, Public Administration, Rural Development, and Statistics.

MMP graduates will be well-positioned to compete for marine resource management-focused positions in state and federal management agencies, tribal organizations, nongovernmental organizations, and private industry in Alaska, the nation, and across the world.

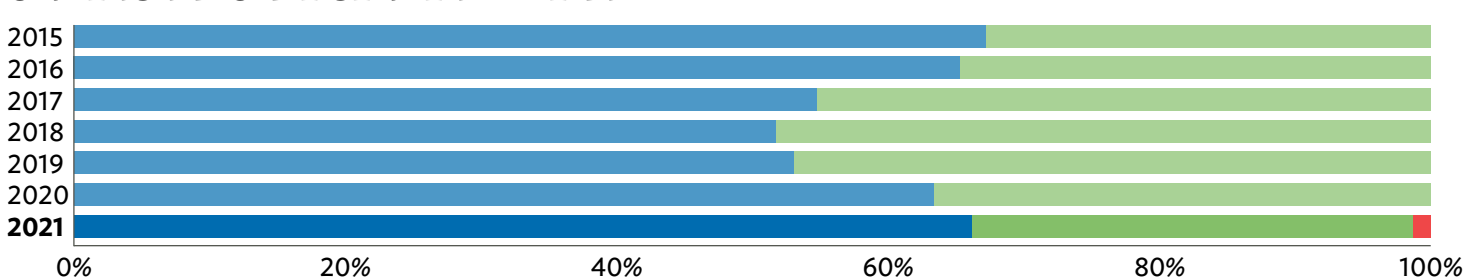
UNDERGRADUATE STUDENT ENROLLMENT BY YEAR



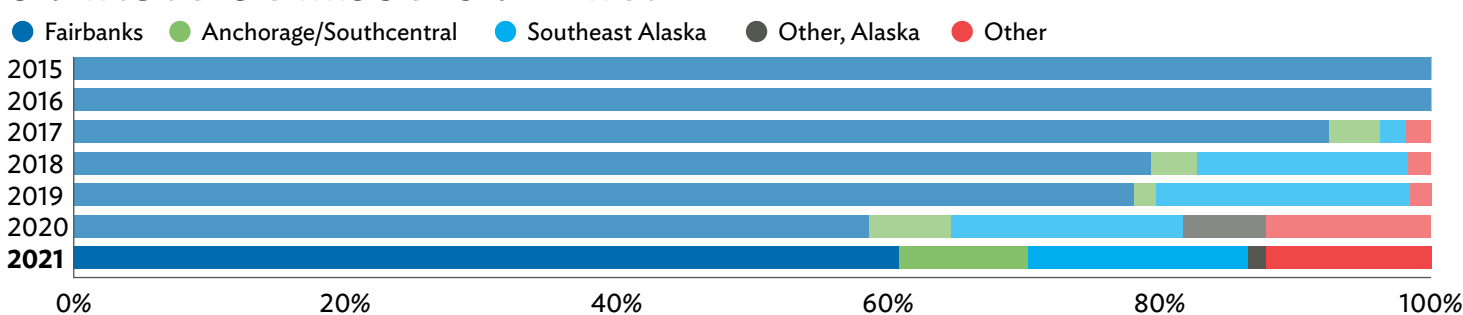
UNDERGRADUATE ETHNICITY BY YEAR



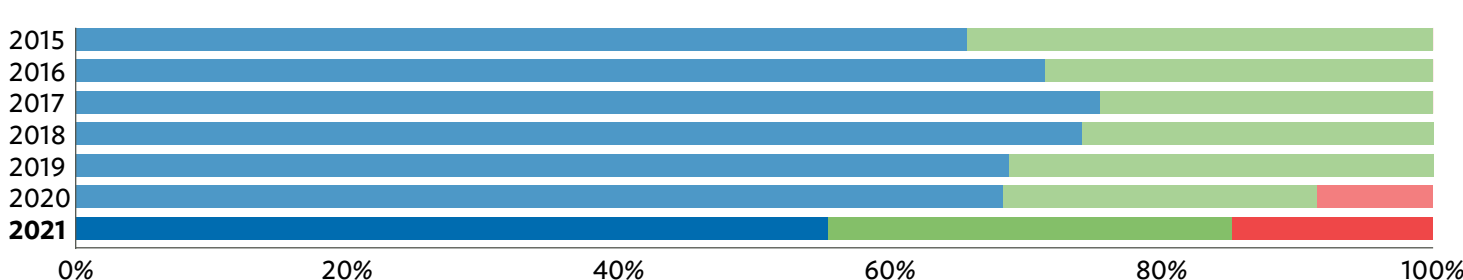
UNDERGRADUATE GENDER BY YEAR



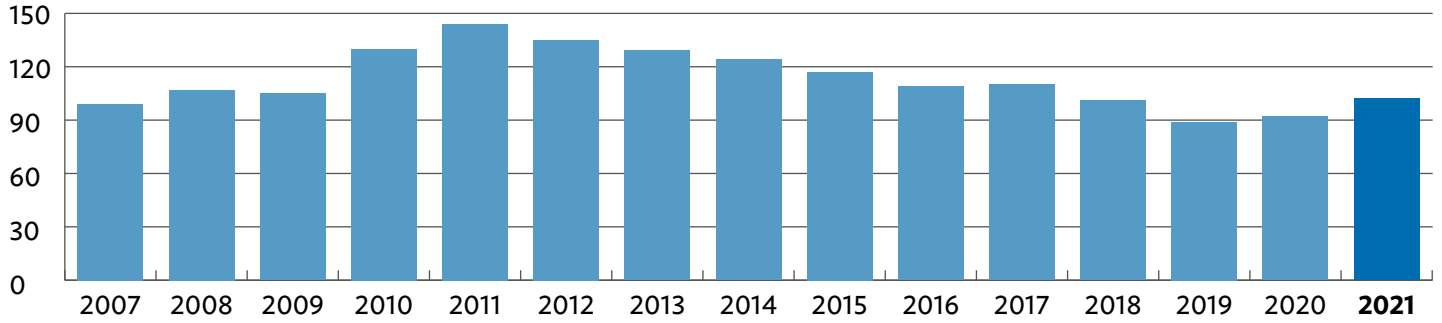
UNDERGRADUATE LOCATION BY YEAR



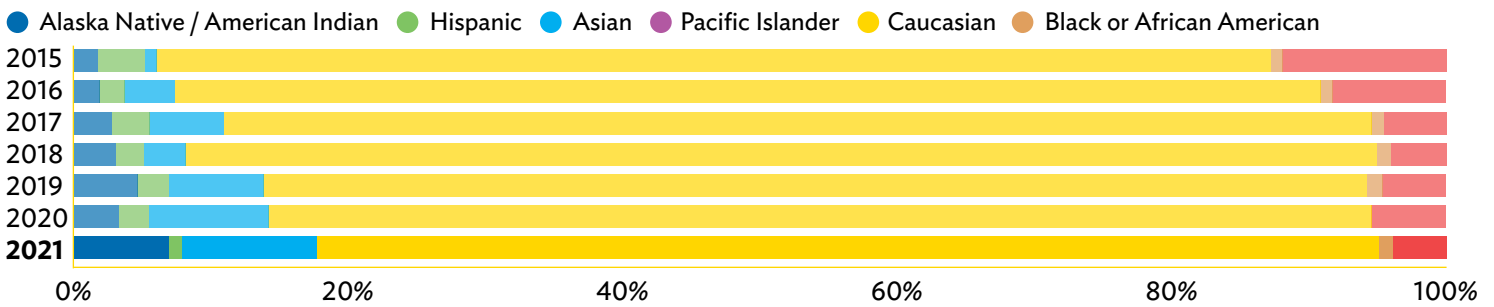
UNDERGRADUATE RESIDENTIAL STATUS BY YEAR



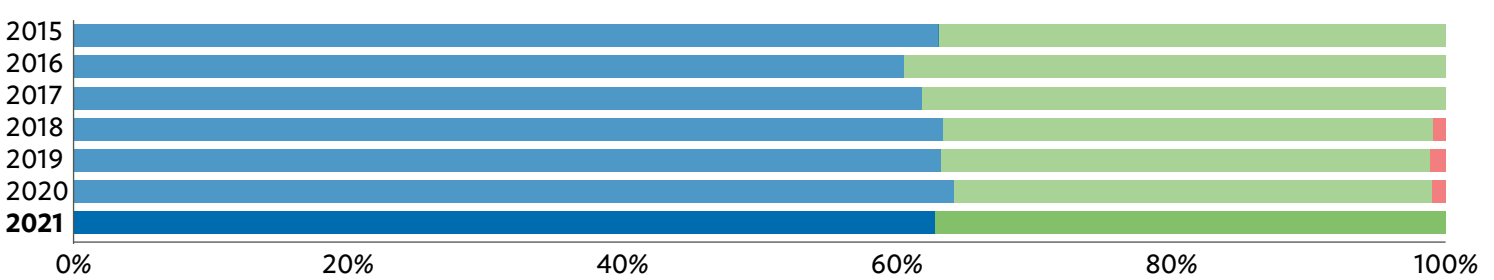
GRADUATE STUDENT ENROLLMENT BY YEAR



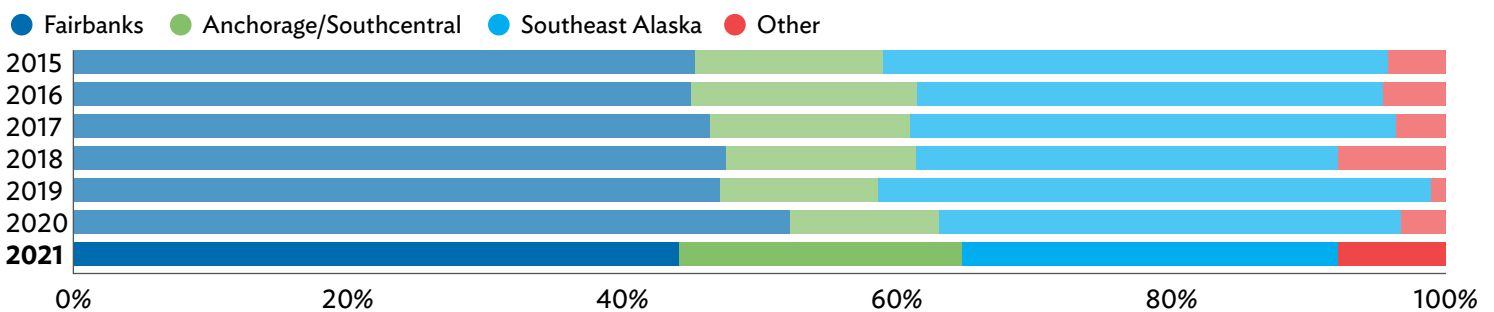
GRADUATE ETHNICITY BY YEAR



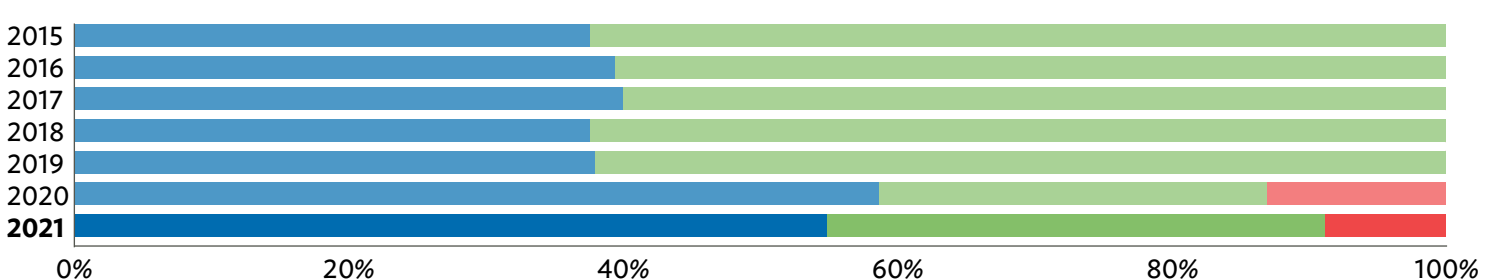
GRADUATE GENDER BY YEAR



GRADUATE LOCATION BY YEAR



GRADUATE RESIDENTIAL STATUS BY YEAR



Internships and Awards

To fulfill their internship requirement, undergraduate students Kortney Birch, Kathryn Langlois, Paul Lecheung, Bethany Matala, Kyleigh McArthur, Kyla Mingo, Nana Matsui, and Jennifer Tusten completed internships at various agencies and organizations or at UAF, working on projects involving fisheries, marine biology, or oceanography.

Undergraduate student Feyne Elmore was named a 2021 Barry Goldwater Scholar. The Barry Goldwater

Scholarship and Excellence in Education Foundation was established by Congress in 1986 to help ensure that the United States is producing highly qualified professionals in STEM fields.

A number of other CFOS undergraduate and graduate students also received awards for exemplary achievements in academics, research, leadership, and/or service. Congratulations to these and all of our students for their hard work!



Lia Domke keeps R/V Zostera off the rocks while waiting to load field gear. Photo by Jessica Whitney.

Graduate Awards

CFOS DEAN'S CHOICE AWARDS

Outstanding Graduate Student: Eric Walther

UAF UNDERGRADUATE RESEARCH AND SCHOLARLY ACTIVITY MENTOR AWARDS

Katja Berghaus, Elizabeth Figus, Carolyn Hamman

UAF INNOVATIVE TECHNOLOGY AND EQUIPMENT AWARD

Carolyn Hamman

RASMUSON FISHERIES RESEARCH CENTER FELLOWSHIP AWARDS

Shelby Bacus, Garrett Dunn, Austin Flanigan, Sonia Kumar, Kevin Siwicke, Mary Spanos, Marina Washburn

UA FOUNDATION SCHOLARSHIPS AND AWARDS

Baker Scholarship: Michelle Trifari

Dieter Family Research Scholarship: Lauren Sutton,
Sonia Kumar

Bud Fay Scholarship: Sonia Kumar

Gering Family Scholarship: Courtney Hart

Hood Memorial Scholarship: Kathleen Corliss

Northern Gulf of Alaska Research Award: Sonia Kumar,
Madeline Lee, Katja Berghaus

Clarence J. Rhode Scholarship: Laura Slater

Ken Turner Memorial Fellowship: Hannah Myers

Undergraduate Awards

CFOS DEAN'S CHOICE AWARDS

Outstanding Undergraduate Student: Brian Zhang

AL TYLER SCHOLARSHIP

Payton Russell

OUTSTANDING CFOS STUDENT ACADEMIC AWARDS

Freshman: Shelby Thompson

Sophomore: Kyleigh McArthur

Junior: Kortney Birch

Senior: Sadie Oswald

Leadership: Feyne Elmore

UAF UNDERGRADUATE RESEARCH AND SCHOLARLY ACTIVITY PROJECT AWARDS

Hanna Hellen, Emily Williamson, Feyne Elmore

UAF URSA RESEARCH AND ACTIVITY DAY DEAN'S CHOICE AWARDS

Dean's Choice: Will Samuel

Honorable Mention: Talia Davis

Kyle Gatt holds a China rockfish caught as part of lingcod and rockfish sampling in Prince William Sound. Photo by Katja Berghaus.



Research



A primary focus of CFOS research is on Alaska’s inland and coastal aquatic ecosystems, but also includes the Arctic, North Pacific, and global ocean. We are engaged in both smaller individual studies and large integrative research projects that address the structure and dynamics of marine ecosystems. As the COVID-19 pandemic continues, our faculty and students work to ensure safe and effective research practices in the field and laboratories.

Major research programs include the Alaska NSF EPSCoR Fire and Ice project; Long-term Ecological Research programs based in the Northern Gulf of Alaska and Beaufort Sea Lagoon Ecosystems; the Arctic Shelf Growth, Advection, Respiration and Deposition program; the Arctic Integrated Ecosystem Survey; and the Gulf Watch Alaska long-term monitoring program.

CFOS research continues to be strongly supported by state and federal agencies and partner organizations. For example, over the past year, the college administered new research projects supported by the Alaska Ocean Observing System, North Pacific Research Board, Pollock Conservation Cooperative Research Center, Rasmuson Fisheries Research Center, Bureau of Ocean and Energy Management, and numerous additional grants and contracts.

Mark Johnson calibrates an instrument to measure ice motion that will help predict when, where, and why Chukchi Sea ice detaches from shore. Shifting ice can be a hazard for Indigenous hunters and is an important factor in Arctic navigation. Photo by Andy Mahoney.

CFOS Active Grants as of June 30, 2021

Total active grants: **163**

Total current research funding (awarded): **\$121 million**



The skeleton of a bowhead whale is now on permanent display at the University of Alaska Museum of the North. Photo by Alice Bailey.

CFOS Contributes to Whale Exhibition

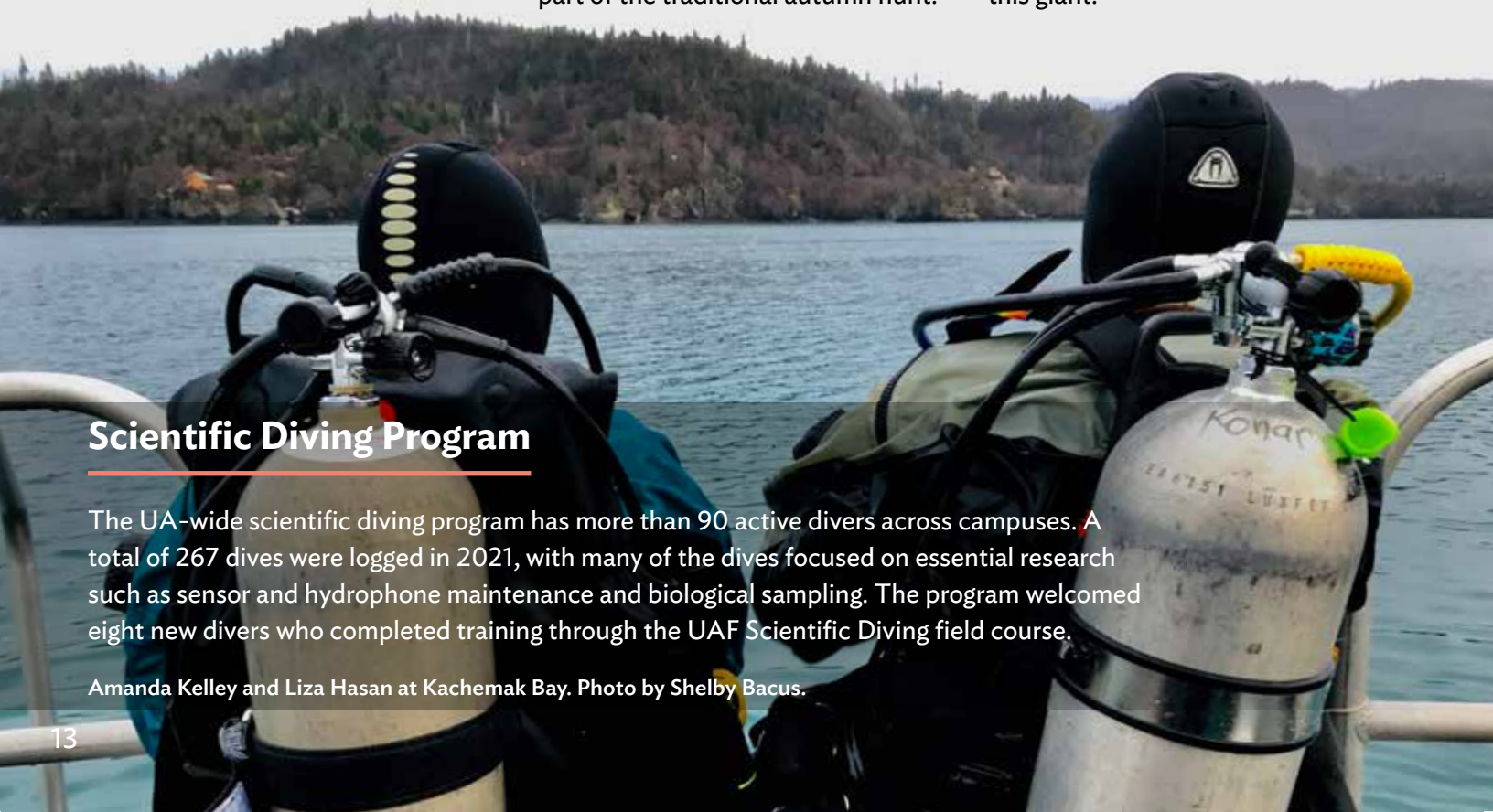
The University of Alaska Museum of the North recently unveiled a massive new addition to its mammalogy collection. A 42-foot bowhead whale skeleton now hangs from the ceiling as if it is diving into the lobby. It is the only suspended articulated bowhead whale skeleton in North America.

Lara Horstmann, who studies bowheads, advised the museum on the angle of the dive. “There is something so humbling about these massive animals,” she said. She is excited to use the whale skeleton for her marine mammal biology classes.

This bowhead was harvested by Iñupiaq whaling captains in 1963 as part of the traditional autumn hunt.

“A lot of the hunters are driving the questions about the changes that are happening to whales today,” said Horstmann.

As part of an installation accompanying the whale, visitors can view zooplankton provided by Russ Hopcroft’s lab to learn more about the tiny creatures that sustained this giant.



Scientific Diving Program

The UA-wide scientific diving program has more than 90 active divers across campuses. A total of 267 dives were logged in 2021, with many of the dives focused on essential research such as sensor and hydrophone maintenance and biological sampling. The program welcomed eight new divers who completed training through the UAF Scientific Diving field course.

Amanda Kelley and Liza Hasan at Kachemak Bay. Photo by Shelby Bacus.

Researchers Document Subduction in the Arctic

Harper Simmons, Seth Danielson, and graduate student Thilo Klenz coauthored a study that provides the first high-resolution observations of warm, northbound water sliding beneath the surface of the cold Beaufort Sea. Published in *Nature Communications*, this research adds to evidence that polar ice may be melting faster than models predict.

The scientists used R/V *Sikuliaq* and an array of scientific equipment to measure small-scale

physical processes not represented by regional and global ice and climate forecasts.

Thermal satellite imagery collected during the cruise revealed a plume of water entering the Beaufort from the Bering Sea, where it dove beneath the fresher water on the surface by a process known as subduction. Other instrument data indicated that the main core of warm water was subsurface, where it would be invisible to satellite detection. The paper also provides

high-resolution observations of small eddies that swirl around and melt ice from beneath. These pockets of warm circulating water can stay under the surface for months to years.

Much of the research was funded by the Office of Naval Research as part of the Stratified Ocean Dynamics of the Arctic project, which seeks to better understand the changing Arctic Ocean.



A view of Beaufort Sea ice during a R/V *Sikuliaq* cruise supporting Office of Naval Research's Stratified Ocean Dynamics of the Arctic project.
Photo by San Nguyen.

Fisheries Genomics Offers Insights into Environmental Change

By understanding the DNA, or genomics, of living organisms, we can learn what causes life to look and function the way it does. For example, we can understand what triggers a salmon to start migrating upstream, or how Arctic cod are able to survive in subfreezing temperatures despite being cold-blooded. Genomics can also help us learn how commercially harvested species are connected and interbreed, assess the vulnerability of populations to disease, and detect invasive species.

Genomics is one of the most quickly advancing fields of science

in terms of technology and computational capacity. Jessica Glass is currently working with a tool called environmental DNA (eDNA) metabarcoding. Similar to scanning a barcode at a grocery store, eDNA metabarcoding allows scientists to rapidly characterize biodiversity by analyzing specific sections of organisms' genomes and matching them to a database. For example, researchers can take a sample of water and sequence the DNA of whatever was shed by various organisms swimming through it.

A major concern in Alaska is how species are going to be able to cope with global warming. Glass is part of a new Coastal Marine Institute project using eDNA as a tool to assess nearshore marine communities in the Beaufort Sea to look at fine-scale patterns in detections of fishes, invertebrates, seabirds, and marine mammals throughout the summer and how specific species' detections correlate with changing environmental components such as sea ice extent and temperature.

Ecosystem Effects Linger after Gulf of Alaska Heatwave

Numerous CFOS faculty participated in the first comprehensive analysis of the lingering ecosystem effects related to the Pacific Marine Heatwave (PMH) that occurred in the Northern Gulf of Alaska from 2014 to 2016, also known as “the Blob” because of how this feature appeared on satellite temperature maps.


The PMH lasted longer than any marine heatwave globally in the last decade. Elevated temperatures extended deep into the water column and continued through all four seasons. The analysis, published in *Scientific Reports*, revealed that long- and short-term ecosystem responses occurred across all trophic levels throughout

the North Pacific during and after the heatwave.


“Biological rates in the ocean are mostly mediated by water temperature. With warmer ocean water temperatures, the rate of biological processes increases and consumes more energy. When you change the rate of biological processes, there can be a cascade of consequences,” Seth Danielson explained.

Scientists analyzed nearly 200 time series of biological data collected in intertidal zones and offshore in the Gulf of Alaska. These data revealed both positive and negative impacts on species ranging from plankton to birds to whales.

“You always have losers and winners in these scenarios. It’s not that everything just dies. Some species benefit and become more important and more abundant, while others decrease or disappear,” said Katrin Iken. For example, one of the major changes observed in the intertidal zones was a shift from being dominated by macroalgae to a system dominated by filter-feeding invertebrates—particularly barnacles and mussels. The study also questions whether the Gulf of Alaska will ever return to a pre-heatwave state. Sea stars, an important predator that eats mussels, all but disappeared in some places. “We have started to see them again, but by far not at the level or diversity as before,” Brenda Konar said.



Sea stars (*Evasterias troschelii*) are an important predator in the intertidal zones and have experienced declines likely related to the Pacific Marine Heatwave. Photo by Brenda Konar.



A sockeye salmon is tagged so that researchers can track its journey up the Copper River. Photo courtesy of the Prince William Sound Science Center.

Copper River Sockeye May Be Affected by Changes in Ocean

Copper River sockeye salmon are prized for their beautiful red flesh and delicious taste. The annual spawning migration is one of the earliest in Alaska and supports commercial, personal use, and subsistence fisheries from the flats of the Copper River Delta to the headwaters of the watershed.

The physical condition of these fish is critical, as those headed to the farthest reaches of the watershed require more energy reserves to successfully migrate and reproduce.

In recent years, populations of returning Copper River sockeye have undergone fluctuations in body size and abundance. After the run

dramatically decreased in 2018, Kristen Gorman and her colleague Pete Rand at the Prince William Sound Science Center initiated a multiyear project to better understand mechanisms driving migration success and the reproductive performance of these fish. These researchers hypothesize that the consequences of varied ocean conditions, including changes in the availability of or competition for food, may have greater impacts for the upriver stocks.

With funding from the North Pacific Research Board and the Alaska Sustainable Salmon Fund, Gorman and her team have radio-tracked returning adult sockeye to relate

migration success to the quality of these fish in terms of body size, energy content, run timing, stress, immunity, and physical exhaustion. In 2022, they will be working with ADFG and the National Park Service to relate similar metrics to genetics of specific stocks.

Ultimately, the research team believes the information generated from the series of projects will be helpful to fisheries managers who rely on escapement numbers to guide fishing regulations. By taking the quality of different stocks into consideration, managers may be able to better assess which populations are at risk of spawning failure.

New Camera Systems Image the Ocean

Seth Danielson and Katrin Iken have developed a benthic camera system that is designed to provide year-round imagery of benthic (seafloor) organisms in the Arctic. Benthic communities play important roles in energy processing, biodiversity, and as food for seals, whales, walrus, and seabirds. Most benthic studies are limited to the short summer season when ships can access the region, whereas the new tripod, camera, and light system is capable of taking unattended time-lapse imagery for 15 months. The system was test-deployed in Resurrection Bay and yielded excellent imagery. The camera will be integrated into the Chukchi Ecosystem Observatory mooring cluster and will contribute to the Arctic Marine Biodiversity Observing Network program.

In addition, Russ Hopcroft obtained a new “In situ Ichthyoplankton Imaging System – Deep Plankton Imager,” which was tested for the first time with R/V *Sikuliaq*. While being towed behind the ship, the ISIIS-DPI images large volumes of water for zooplankton, uses acoustics to look at fish communities, and measures temperature, salinity, light, oxygen, nitrate, phytoplankton biomass, and particle abundance several times per second. CFOS researchers will use the imaging system to learn how the ocean changes on very small spatial scales over large areas.



A tripod supports a new benthic camera system that will be deployed year-round in the Arctic. Photo by Seth Danielson.



The new “In situ Ichthyoplankton Imaging System – Deep Plankton Imager” sits on the deck of R/V *Sikuliaq*. Photo by Jennifer Questel.

R/V *Nanuq* Provides Essential Services

R/V *Nanuq* is a state-of-the-art, 40-foot research vessel based at the Seward Marine Center, where it is available for use by CFOS researchers, graduate students, and scientists from other organizations.

One of *Nanuq's* primary tasks is to support Gulf of Alaska Station 1 (GAK-1) mooring data collection throughout

the year. While sampling for GAK-1 this year, *Nanuq* supported 25 CTD casts and 19 Calvet net tows, and collected data from the thermosalinograph onboard system.

The vessel was used for glider recovery and as a platform for unmanned aerial systems (drones) as part of a seabird study. Water collected from *Nanuq's* onboard seawater flow-through system was used at the SMC wet lab facility for copepod growth experiments. Graduate students used *Nanuq* to collect lingcod and rockfish for stock assessments. The vessel also transported crew and spare parts to R/V *Sikuliaq* when the ship was in the vicinity of Resurrection Bay.

Casey Brown launches a drone while Greg Larsen pilots and Lillie Younkins observes seabird behavior. Photo by Amy Bishop.



Seth Danielson looks back toward R/V *Nanuq* in Resurrection Bay. Photo by Will Burt.

Mariculture Project Bolsters Growth of Industry

Mariculture is the cultivation of marine organisms in their natural environment. Finfish farming is illegal in Alaska because of the negative impacts on the environment and wild stocks. Seaweed mariculture is an entirely different story.

“Seaweed is an extractive species, meaning they extract nutrients and carbon from the water to grow,” explained Schery Umanzor. “This means that kelp farming in the ocean does not require the addition of fertilizer. Kelp actually cleans the water; for example, using up wastewater discharged from fish processing plants.”

In collaboration with Alaska Sea Grant and the Native Conservancy in Prince William Sound, Umanzor recently received support from UA Center ICE to develop a

site assessment toolkit to help farmers test locations for potential placement of their farms, ideally prior to the submission of their permit application.

A nascent industry, Alaska seaweed mariculture is currently dominated by kelp farming. So far, only three of the approximately 500 species of seaweeds found in the state are being farmed commercially, and the markets for selling it are still being developed. In addition to food, kelp biomass can be used as organic fertilizers, soil amendments, bioplastics, pharmaceuticals, nutraceuticals, medical compounds, and biofuels.

To grow kelp, fertile material is collected from the wild. At the hatchery, this material is induced to release seed, which is then placed

onto strings. Once the strings have baby plants growing on them, they are deployed at the farm site, which typically occurs in October or early November. Kelp can grow up to three meters long or more by May or June, when they are harvested. After harvesting, the mariculture equipment is removed from the ocean so that it does not interfere with commercial fishing.

Because the growing process occurs mostly during the winter months, some coastal residents involved in the commercial fishing or summer tourism industries have started to supplement their income with mariculture. “The knowledge of working in the ocean is already there, so it’s a matter of transferring the skills to seaweed farming,” said Umanzor.



Seaweed being harvested at a farm near Kodiak. Photo by Michael Stekoll.

R/V *Sikuliaq*

In its fifth year of operation, the research vessel *Sikuliaq* supported 11 science cruises led by researchers from UAF and other institutions, sailing more than 28,192 nautical miles throughout the Pacific and Arctic Oceans. UAF faculty, staff, and students were involved in 34 percent of *Sikuliaq* science days at sea.

Projects supported by *Sikuliaq* in 2021 included two CFOS-led

cruises in the NGA LTER area, a journey to the Aleutian Islands for a fisheries study, investigating how changing sea ice conditions impact mercury levels in the Arctic food web, and deployment of equipment to develop a year-round observing system for improved forecasting in the Arctic environment. The ship traveled farther north than ever before—almost 500 miles

north of Point Barrow—on a UAF-led cruise to map the Chukchi Sea Borderlands. Ship operations were conducted in accordance with a coronavirus mitigation plan that was created at the onset of the pandemic. Thanks to the diligence of the ship's personnel, science teams, and onshore staff, *Sikuliaq* successfully completed the year without a single COVID-19 case.

R/V *Sikuliaq* in the western Arctic Ocean.
Photo by Ethan Roth.



Community and Environmental Compliance

R/V *Sikuliaq*'s region of operation includes the northern Bering, Chukchi, and Beaufort Seas, where communities rely on the subsistence harvest of bowhead whales and other marine animals. Given the biological, cultural, and nutritional importance of these animals to Alaska Natives in the Arctic and subarctic, the vessel follows specific procedures to promote positive communication and mitigate conflict between research and subsistence harvest activities.

The Community and Environmental Compliance Standard Operating Procedures (CECSOP) document for R/V *Sikuliaq* ship operations was published in 2017, with guidance from the Arctic Waterways Safety Committee, an advisory body of representatives from Northern and Northwestern Alaskan coastal communities.

In 2021, CECSOP was updated based on new recommendations from the Alaska Eskimo Whaling Commission, National Science Foundation, Arctic Icebreaker Coordinating Committee, seagoing scientists, and other stakeholders.

The revised version of CECSOP includes expanded sections on communications and outreach. For example, more details have been added about presentations that researchers deliver at AEWC meetings and emails sent from the ship while it is in Arctic and subarctic waters. More maps are included, and the roles of personnel involved in R/V *Sikuliaq* research operations are clarified.



R/V *Sikuliaq* ship track from July 2020 through June 2021.

FY21 *Sikuliaq* Statistics

28,192 nm traveled • **212** paid ship days • **171** days of science (not including mob/demob days)
59 UAF/CFOS PI days • **82** days in the Arctic (as defined by the Arctic Research and Policy Act of 1984) • **20** days in the ice • **5** ice station days • **471** CTD casts • **1** XBT cast • **274** net tows
16 moorings deployed • **18** moorings recovered • **4** ROV dives • **10** gliders deployed
14 gliders recovered • **16** sediment cores collected • **10** buoys/floats deployed
4 buoys/floats recovered • **79** Iron Fish/Acrobat tows

Research Centers, Institutes, and Facilities

Seward Marine Center Celebrates a Half-Century of Marine Research

Since 1970, the Seward Marine Center (SMC) has provided consistent maritime access to the Gulf of Alaska, the Bering Sea, and the Arctic. The research and education activities supported by SMC have greatly contributed to our understanding of the marine ecosystem, especially as climate change affects our oceans.

In December 2020, CFOS scientists celebrated the birthday of a monitoring site in Resurrection Bay named Gulf of Alaska Station 1, which has been supported by UAF researchers and SMC for fifty years. GAK-1 is now the longest sustained set of temperature and salinity data in Alaska's coastal and

offshore waters, contributing to the NGA LTER area with which CFOS researchers and R/V *Sikuliaq* are heavily involved.

SMC is the homeport of two state-of-the-art research vessels, *Sikuliaq* and *Nanuq*. These vessels serve as platforms for fisheries, marine biology, and oceanographic research conducted by CFOS scientists, students, and researchers from around the world. The vessels are used on a regular basis to maintain the GAK-1 monitoring site.

SMC shoreside facilities include a mooring shop that builds and repairs anchored systems of instruments used by a growing network of ocean observatories. These moorings

log data year-round and provide valuable context for ship-based studies.

The education building is used for community events and hosts the Tsunami Bowl, part of the National Ocean Sciences Bowl. This year, eight high school teams from across Alaska competed in the first virtual Tsunami Bowl, which was a wild success.

In 2022, CFOS will offer a new Subarctic Oceanography Field School course based out of SMC. SMC staff will continue to support researchers and facilitate COVID-19 protocols that enable science cruises to embark safely.



R/V *Sikuliaq* docked at the Seward Marine Center.
Photo by Britton Anderson.

Alaska Blue Economy Center

The Alaska Blue Economy Center (ABEC) was formed in 2019 to grow Alaska's ocean economy by facilitating interactions between entrepreneurs, industry, and research related to Alaska's vast aquatic resources and ecosystems. "Alaska is a world leader in commercial fishing, seafood processing, and coastal tourism. As new technologies come online, we have an opportunity to position the state for further growth in these sectors, as well as emerging

industries including mariculture and ocean energy," said ABEC Director Justin Sternberg.

ABEC facilitates the university's role in developing a sustainable ocean economy that creates jobs, increases investment, exports innovations, and diversifies Alaska's overall economy. The center is an interdisciplinary partnership between CFOS and the UAF Alaska Center for Energy and Power, the College of Business and Security

Management, and the Alaska Center for Innovation, Commercialization, and Entrepreneurship.

"At the nexus of industry, government, and academia, ABEC is a resource to researchers and students creating valuable solutions to the toughest challenges we face, such as bycatch, ocean acidification, and plastic pollution, while preparing our graduates with the skill sets needed in tomorrow's maritime economy," said Sternberg.

Kasitsna Bay Laboratory

The Kasitsna Bay Laboratory (K-Bay) is a marine research and teaching facility located on Kachemak Bay, operated in partnership with NOAA's National Centers for Coastal Ocean Science. The laboratory supports two large programs: Gulf Watch Alaska, which conducts long-term monitoring of marine habitats in Kachemak Bay,

and the NSF EPSCoR Fire and Ice program.

The K-Bay lab was able to support essential research activities this year while operating under continued limitations due to the pandemic. Continued careful precautions allowed CFOS to offer a marine ecology field class at the lab, and several students were able to spend

the summer working on their thesis research.

The Scientific Diving program utilized K-Bay to work on basic scuba skills and focus on improving rescue and navigation skills. The program also helped collect data for short-term science projects and long-term monitoring of sea star communities.

Rasmuson Fisheries Research Center

The mission of the Rasmuson Fisheries Research Center is to promote excellence in research related to fisheries and to develop young fisheries scientists. The center continued to generously support CFOS graduate student research this year. Eight fellowships were awarded for research on a wide range of species, including crabs, Pacific sleeper sharks, Pacific halibut, Cook Inlet beluga whales, sablefish, Arctic lamprey, and razor clams.

Coastal Marine Institute

In partnership with the Bureau of Ocean Energy and Management, the Coastal Marine Institute (CMI) is administered within CFOS and supports studies focused on the development of natural resources in Alaska's coastal waters and outer continental shelf.

Projects delayed because of pandemic-related travel restrictions in 2020 were able to resume field operations in 2021. This year CMI supported four new faculty projects and two new student projects, as well as 19 ongoing projects involving research throughout Alaska.

Lena Point Fisheries Facility

The CFOS Department of Fisheries in Juneau is housed at the Lena Point Fisheries Facility, which is co-located with the NOAA Ted Stevens Marine Research Institute. Researchers at Lena Point continued to work on a number of large statewide projects such as Gulf Watch Alaska and the NSF EPSCoR Fire and Ice project.

Pollock Conservation Cooperative Research Center

The Pollock Conservation Cooperative Research Center (PCCRC) supports research projects and graduate student fellowships that focus on pollock biology and resource utilization, fisheries management and incidental catch, habitat and ecosystems, and protected species. In 2020–2021, PCCRC supported 12 research projects, five of which were successfully completed and seven that are ongoing. The PCCRC Advisory Board has approved \$300,000 to support new research projects in 2022.

Ocean Acidification Research Center

Alaska's cold waters experience the effects of ocean acidification more significantly than waters of lower latitudes. In its fourteenth year, the Ocean Acidification Research Center (OARC) continued to monitor all four of Alaska's large marine ecosystems (Gulf of Alaska, Bering Sea, Chukchi Sea, and Beaufort Sea) to ensure that global climate products include information from our region. OARC continues to serve the public and private sectors by providing access to data, training students and citizen scientists, and analyzing seawater samples.

In 2021, OARC sponsored two CFOS graduate student projects: Jacob Cohen is investigating

the relationship of increasing carbon dioxide in seawater on phytoplankton photosynthesis in the Bering Sea, and Courtney Hart is studying how changes in ocean pH may influence harmful algal blooms and shellfish toxicity.

OARC lead Natalie Monacci coauthored the new Coastal Ocean Data Analysis Product for North America, which plays an important role in promoting research efforts to understand societal vulnerabilities to OA, such as fisheries and mariculture industries. This year OARC also contributed to synthesis products that provide essential information on ocean carbon dioxide uptake to policy makers.



Seining chum salmon near Juneau. Photo by Keith Criddle.

Development

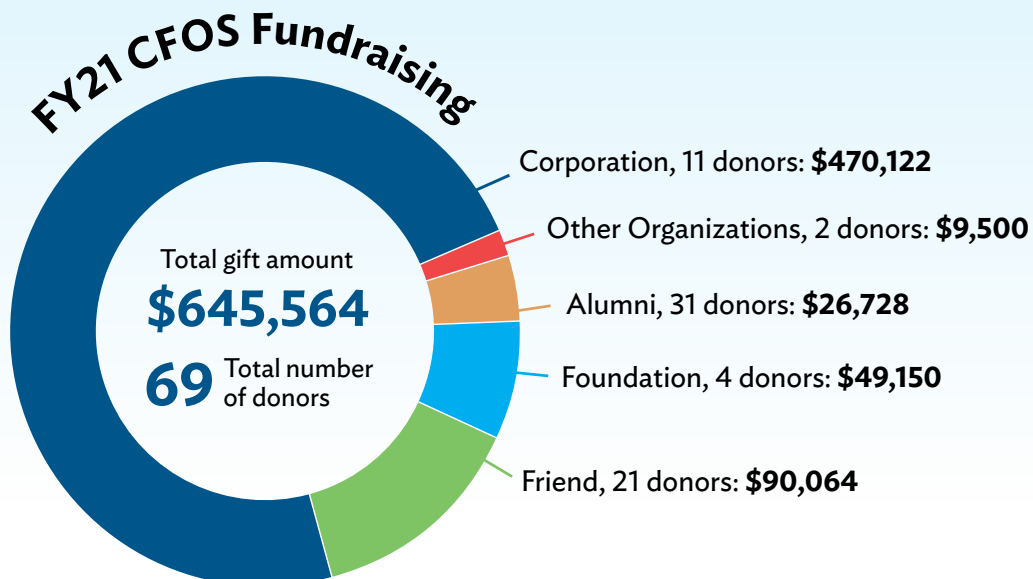
For fiscal year 2021, CFOS received \$645,564 in charitable gifts. We thank our donors for your commitment to help us fulfill our mission of teaching, research, and service. These donations provide scholarships and fellowships and increase support for student and faculty research.

We look forward to boosting opportunities for philanthropic giving to CFOS. The UA-wide “Day of Giving,” inaugurated last year and even more successful this year, is a great example of a fun and exciting event that has sparked participation from UAF alumni and friends from around the world.

Major Donors

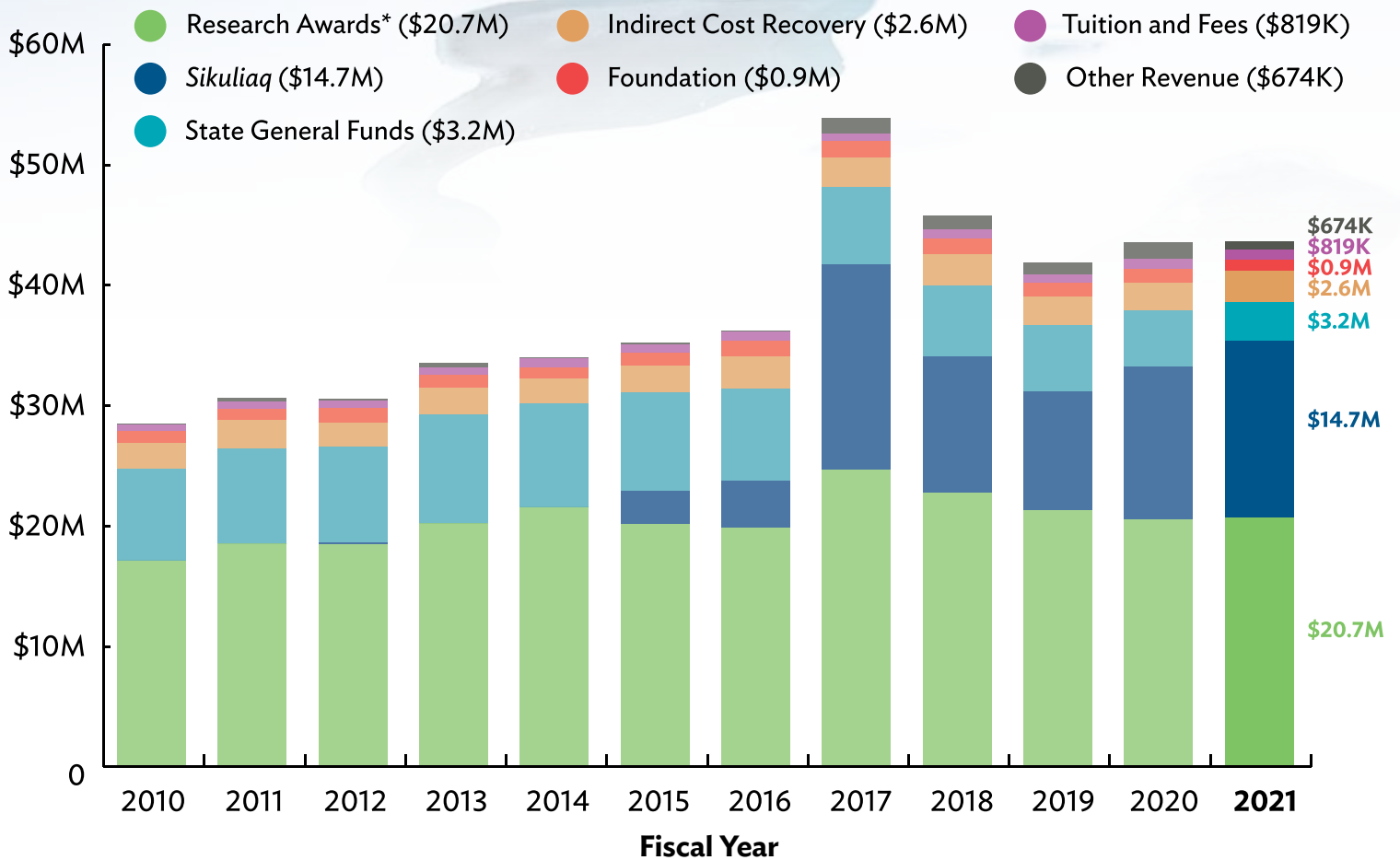
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| Anonymous | Crowley Marine Services | Ocean Beauty Seafoods |
| 57 Degrees North | E. R. Dolly Dieter | Phoenix Processors |
| Alaska Ocean Seafood | Douglas Island Pink & Chum | Prince William Sound Science Center |
| Dr. Vera Alexander | Ardella P. Follmann | Elmer and Mary Louise Rasmuson* |
| American Seafoods Company | Glacier Fish Company | Rasmuson Foundation |
| Arctic Storm | The Glosten Associates | Wendel Raymond |
| AT&T | John and Jacqueline Goering* | William S. Reeburgh |
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| Central Bering Sea Fishermen's | William F. Meek* | Usibelli Coal Mine |
| Association | Gordon and Betty Moore Foundation | Frankie Wakefield* |
| Coastal Villages Region Fund | M. J. Murdock Charitable Trust | Wards Cove Packing Company |
| Consortium for Ocean Leadership | Nelbro Packing Company | |
| Ann Cook and Gregory Thies | Northrim Bank | |

**deceased*



Budget and Finance

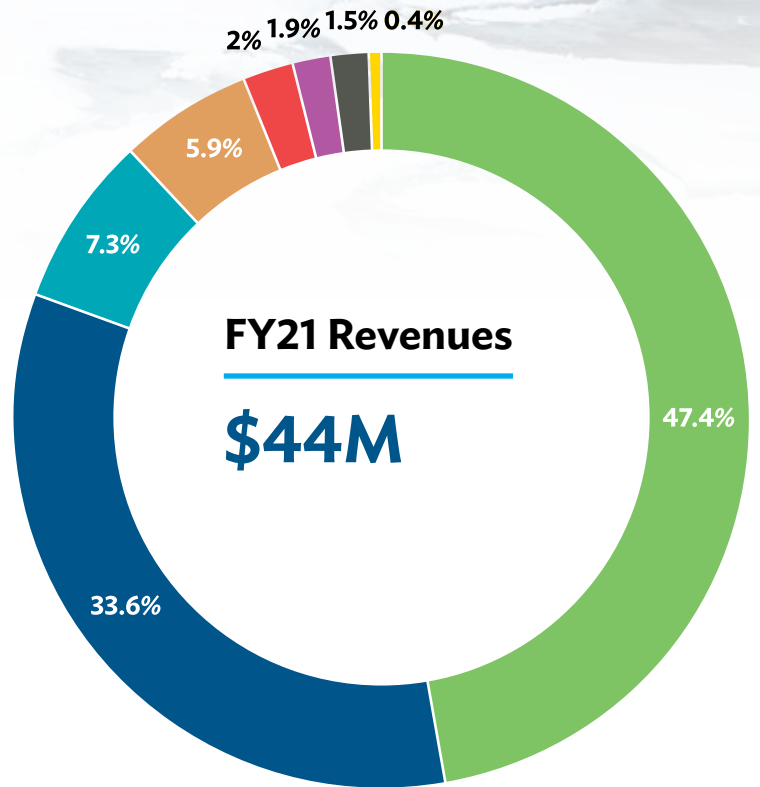
CFOS Revenue Trend



*Non-Ship Recharge and American Reinvestment and Recovery Act funding (2011–2016) excluded.



- Research Awards* (\$20.7M)
- *Sikuliaq* (\$14.7M)
- State General Funds (\$3.2M)
- Indirect Cost Recovery (\$2.6M)
- Foundation (\$0.9M)
- Tuition and Fees (\$819K)
- Other (\$674K)
- Non-Ship Recharge (\$181K)



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Pastel sky over the Chukchi Sea. Photo by Edgar Alvarado.

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