JOINT INSTITUTE FOR THE STUDY OF THE ATMOSPHERE AND OCEAN
UNIVERSITY OF WASHINGTON

JISAO

2020 JISAO Magazine

UNIVERSITY of WASHINGTON

ON THE COVER
Nothern fur seals resting on a remote island in the Bering Sea. Since the 1950s, the Alaskan population has declined to just over a half million, with pup production reaching a 100-year low in 2018 at St. Paul Island, the largest of the breeding islands. *Photo: Jeremy Sterling NMFS/MMPA Permit #14327*
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FROM THE DIRECTOR

What a difference a year can make! JISAO becomes CICOES, a pandemic that, among other things, stopped most of us going to the office and caused an economic meltdown, and too many events that catalyzed international recognition and scrutiny of systemic racism. I hope that all of you are well and are adapting to our new normal.

This will be the last edition of the JISAO magazine but we will be continuing this publication under our new title, "CICOES Magazine."

And that brings me to our biggest news in 2020, the acceptance of our proposal to create a new Cooperative Institute.

At the end of every five years, the existing Cooperative Institute applies for renewal, and after a 10 year cycle each Cooperative Institute has to compete to host a new Cooperative Institute. The new Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES) is comprised of three partner Universities: University of Washington, University of Alaska Fairbanks (UAF), and the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University (OSU CEOAS). My goal is to create a fully integrated Cooperative Institute

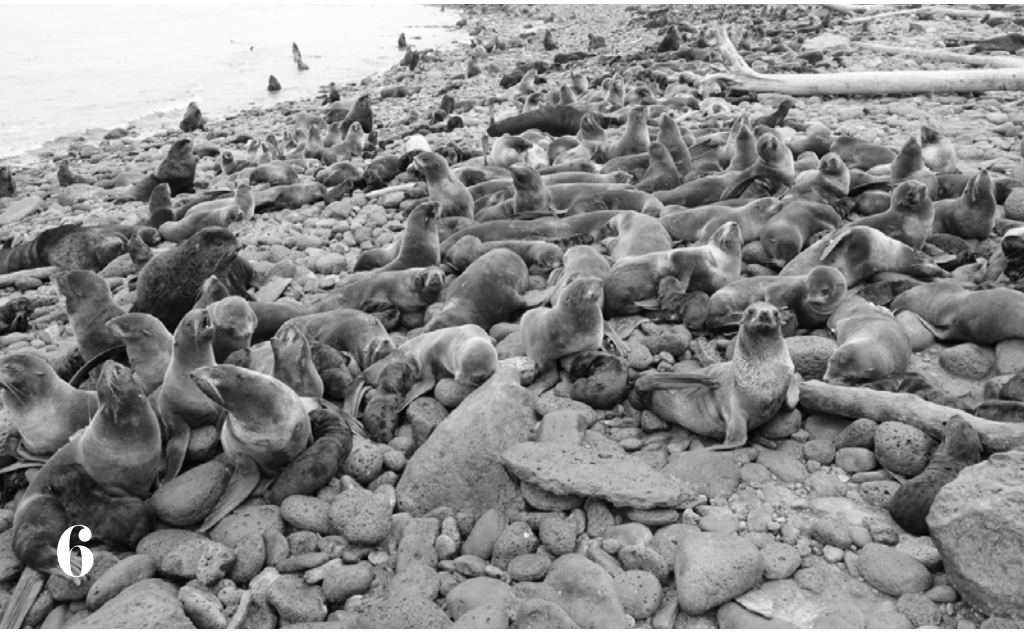
that conducts world class research, education, and public engagement throughout the Pacific Northwest and the world. We now have a venue to formalize research collaborations that have naturally formed through joint interests among left-coast scientists over the last two decades and to expand collaborations among institutions and with our NOAA partners: the Pacific Marine Environmental Laboratory (PMEL), the Alaska Fisheries Science Center (AFSC), and the Northwest Fisheries Science Center (NWFSC).

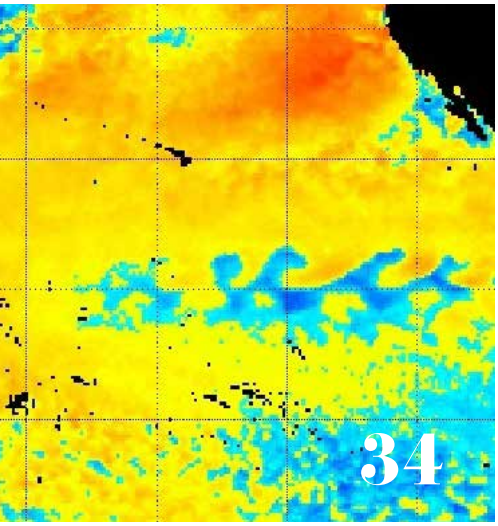
The current challenge is to make CICOES operational across all of the partner universities. I am working with our intrepid admin team and the new Deputy Directors at UAF – Uma Bhatt and OSU CEOAS – Roberta Marinelli to examine ways to expand our current initiatives to our partners in an effort to catalyze research collaborations across partner universities, grow summer internship opportunities, provide laboratory exchange visits for graduate students and research scientists, and to enhance the postdoctoral program. We also need to introduce research ideas from new members of the CICOES community to potential NOAA collaborators at PMEL, AFSC, and NWFSC. Not all details have been finalized and I'm sure that there will be cross institutional administrative hurdles, but my intent is to evolve CICOES to the model integrated consortium within the Cooperative Institute system.

We are excited about the prospects for CICOES. I hope that you remain an active member in our community.

John Horne
JISAO Executive Director

2020 JISAO Magazine





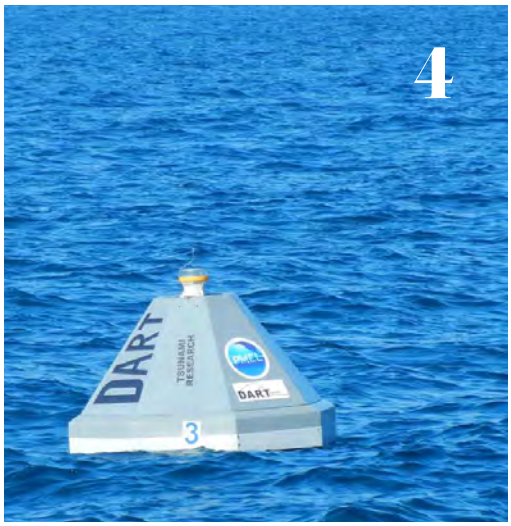


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Photo: Paul Wade, NMFS MMPA/ESA Permit #20465

Could COVID-19 be helping Alaska's beluga whales get some 'ME TIME'?

By Freya Paterson

When you try to imagine what a happy, calm beluga whale looks like, what images do you conjure up? A smiling white blob, reclining on a chaise lounge with a shrimp cocktail? A zen-like cetacean emerging from a meditation workshop session with a rolled-up mat under its flipper?

For Manuel Castellote, a researcher at the Joint Institute for the Atmosphere and Ocean (JISAO), the image is less absurd but more exciting. He pictures a beluga "with a large social group, with calves, in an environment where they don't have trouble finding food and the only threats they face are natural predation."

For many of the beluga whales living in our oceans, this kind of existence is rare and hard to come by. Fortuitously, while the COVID-19 pandemic brings the world to a grinding halt, our planet's more sensitive wildlife, including beluga whales, are being given a welcome reprieve from the anthropogenic (i.e. human-caused) stressors that usually pose a threat to their existence.

Research by Castellote and colleagues at JISAO and NOAA identifies various human-caused noises — such as those produced by ships, jet engines and mechanical drilling — as one of the leading threats to the well-being of beluga whales. Castellote, a behavioral ecologist, has been using acoustic techniques to study beluga whales and other cetaceans for more than 20 years. He and his colleagues use recording devices to monitor and measure the noise surrounding beluga habitats in Alaska's Cook Inlet, along with the sounds the whales make. Listening to audio samples collected by Castellote in which the gentle sounds of whale song are drowned out by passing ship engines and mining activities, it's easy to see how the well-being of these creatures is challenged when they live alongside large or industrialized communities of humans.

On the upside, the unprecedented reduction in air travel and boat traffic in Alaska's Cook Inlet area due to COVID-19 and travel restrictions in place since March 2020, is expected to result in quieter, calmer waters for these sonar-sensitive creatures. By comparing acoustic information with concurrent analysis of tissue samples (analyzed for signs of beluga stress indicators, such as hormones, proteins and elements), Castellote and fellow researchers will be able to see what happens when Alaska's belugas are given some peace and quiet.

> "We're interested to see if, during these quiet times, belugas might be spending less energy and effort finding and catching prey."

"Belugas chase fish blind, purely using biosonar, like bats," explains Castellote. "We're interested to see if, during these quiet times, belugas might be spending less energy and effort finding and catching prey, or returning to areas they've previously abandoned due to the noise and traffic."

Similar research conducted by UW researchers, including Castellote following the events of September 11th, 2001 showed that quieter waters in Canada's Bay of Fundy (due to reduced ship traffic) were linked to decreased levels of stress-related hormones found in fecal samples from North Atlantic right whales. This was the first evidence that exposure to low-frequency ship noise may be associated with chronic stress in whales and has implications for other sonar-sensitive creatures living in heavy ship traffic areas, including belugas.

Although the travel restrictions also prevent Castellote and his fellow researchers from traveling to Cook Inlet to observe the acoustic changes in real-time, they are crossing their fingers and toes that the various recording moorings deployed back in September 2019 will continue to capture any audible changes in the popular beluga habitats. "Are the noise levels really down with the reduced traffic?" asks Castellote. "Will the belugas change their foraging habits? Will they need to work as hard to catch fish?"

With just 279 belugas estimated to remain in Cook Inlet in 2018, the outcomes of this research may help inform conservation and sustainable development in key beluga habitats. Whatever it looks like, the idea of a happy, calm beluga whale is a very comforting one indeed.

Photo: NOAA

A "PERFECT" TSUNAMI

WHEN AN EARTHQUAKE PROMPTS TSUNAMI EVACUATIONS, BUT NO BIG WAVE, SCIENTISTS SEE AN OPPORTUNITY.

By Yong Wei

When people think of tsunamis they often think of killer waves – a factual and life-saving connection.

The world remembers destructive tsunamis spawned by powerful earthquakes as if they happened yesterday. The 2004 Boxing Day tsunami in the Indian Ocean, the 2010 tsunami in Chile, and the 2011 East Japan event are the most recent examples. Altogether, these tsunamis claimed more than 250,000 lives and caused trillions of dollars in damages.

To enhance tsunami warning and forecasting capabilities, scientists drill deep to learn not only from the devastating tsunamis, but the unobtrusive ones as well.

Known to scientists as a "perfect" tsunami, these events, spawned by powerful earthquakes, pose little tsunami impact to coastal communities but are highly valuable in advancing our knowledge of future events in the same rupture area. They help us "debug" the current forecast system.

The Mw 7.8 earthquake/tsunami on July 22, 2020, was such a "perfect" event – a fault rupture offshore of Alaska Peninsula that led to less than one foot of tsunami yielding no damages along the coastlines nearby.

The earthquake occurred at 06:12:44 UTC according to the U.S. Geological Survey report. The epicenter at 55.068°N 158.554°W, was only 60 miles south of Perryville, a small borough of around 100 inhabitants, and more than 500 miles southwest of Anchorage (Figure 1a). A tsunami warning was issued for some parts of the Alaska Peninsula, the Aleutian Islands, and south Alaska. Residents of those areas, a stretch of more than 500 miles along the coast, were warned to head for higher ground and leave the designated danger zones.

IT WAS APPROACHING MIDNIGHT in Seattle when the strong quake nucleated off the coast of Alaska. A handful of CICOES/PMEL tsunami researchers monitored the wave fluctuation following the earthquake via the live data stream transmitted from DART (Deep-ocean Assessment and Reporting of Tsunamis), a global network of more than 60 PMEL-patented deep-water devices specifically designed to record tsunami water level with a bottom pressure recorder anchored to a nearby surface buoy (Figure 1b).

In less than one and a half hours, the tsunami waves peaked at five DART stations offshore spanning ~1,000 miles along the Aleutians and Alaskan Trenches. Somewhat surprisingly all heights appeared to be less than 1 cm,

meaning a consequential, far-reaching tsunami would not be expected. The tide station at Sand Point harbor (Figure 1b), 80 miles northwest of the epicenter, registered up to 25 cm tsunami waves. As a result, the National Tsunami Warning Center canceled the warning about two hours later, after the threat had passed.

Indeed, this was a seemingly "perfect" tsunami producing a handful of data allowing us to unfold what we know and what we have missed.

SO WHAT DO WE KNOW?

First of all, the NCTR/CICOES real-time modeling valuation tuned from the DART measurements predicted small waves in the near field. These predictions were further confirmed by a rapid model computation using the USGS's finite-fault solution obtained from seismic data.

However, this solution predicted some misfits – larger wave amplitudes and earlier arrival – at all five DART buoys. Utilizing the new Graphic Processor Unit (GPU) model computation capability, NCTR/CICOES scientists later carried out a quick finite-fault tsunami source, driven by the USGS W-Phase solution, that offered a more reconcilable interpretation between tsunami (DART) and seismic observations (Figure 1b and 1c).

THEY HELP US "DEBUG" THE CURRENT FORECAST SYSTEM.

Here's what we know about the tsunami so far:

1. Large, shallow slips up to 4.3 m ruptured only a small portion (~600 km2) dipping at 20° along the subducting Pacific plate underneath the North American Plate. The energy released from the small rupture area was probably dissipated quickly when propagating away from the source.
2. There were possibly high-slip ruptures in the deeper part of the Pacific Plate that contributed major energy to the seismicity but generated much smaller, longer tsunami waves.
3. Multiple uninhabited islands blocked the tsunami energy from direct impact on coastal communities in the Alaska Peninsula.
4. There are concerns whether this powerful earthquake has ruptured into the Shumagin Gap (Figure 1a), an area that has been considered immune from large earthquakes due to constant release of fault pressure.

"It kind of opens the door on what types of earthquakes could occur in that region," and "what kind of tsunamis we should plan for," said Michael West, the state seismologist at the Alaska Earthquake Center in an interview with Anchorage Daily News.

WHAT HAVE WE MISSED?

Murphy's law found its way to play a role in what should have been an opportunity to test the latest DART 4th generation (4G) model. The 4G technique has an exceptional ability to separate tsunami waveforms from the background seismic noise with its high-frequency (1 Hz) sampling rate (reporting at every 15 sec).

The DART 46403, located less than 200 miles south of the epicenter (Figure 1c), is equipped with this technology, however, the 4G capabilities were not engaged during this event. Instead it performed as a 2nd generation buoy with the tsunami signals entirely overwhelmed by the seismic noises due to its proximity to the epicenter. A study of the later model revealed the tsunami wave might have peaked at 2 cm about 20 minutes after the earthquake on DART 46403 (Figure 1c).

From this perspective, this "perfect" tsunami worked as a debugger of the buoy network and enabled an important correction to the forecasting system, making it better prepared for a future event.

Someday, when the next big one hits, all of us will surely benefit from these little perfect tsunamis spawned by powerful quakes.

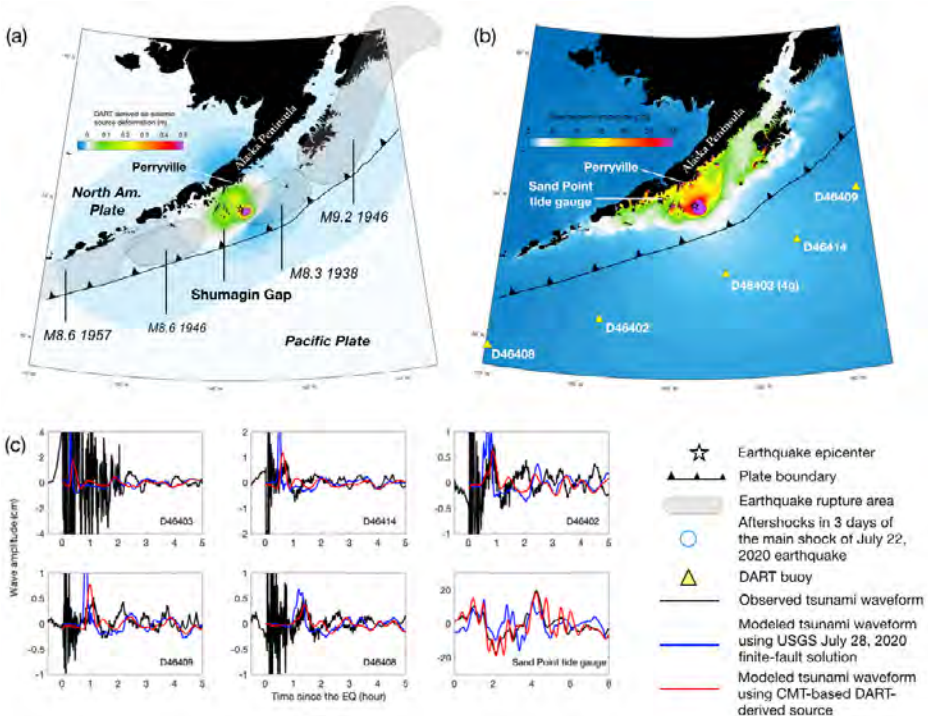
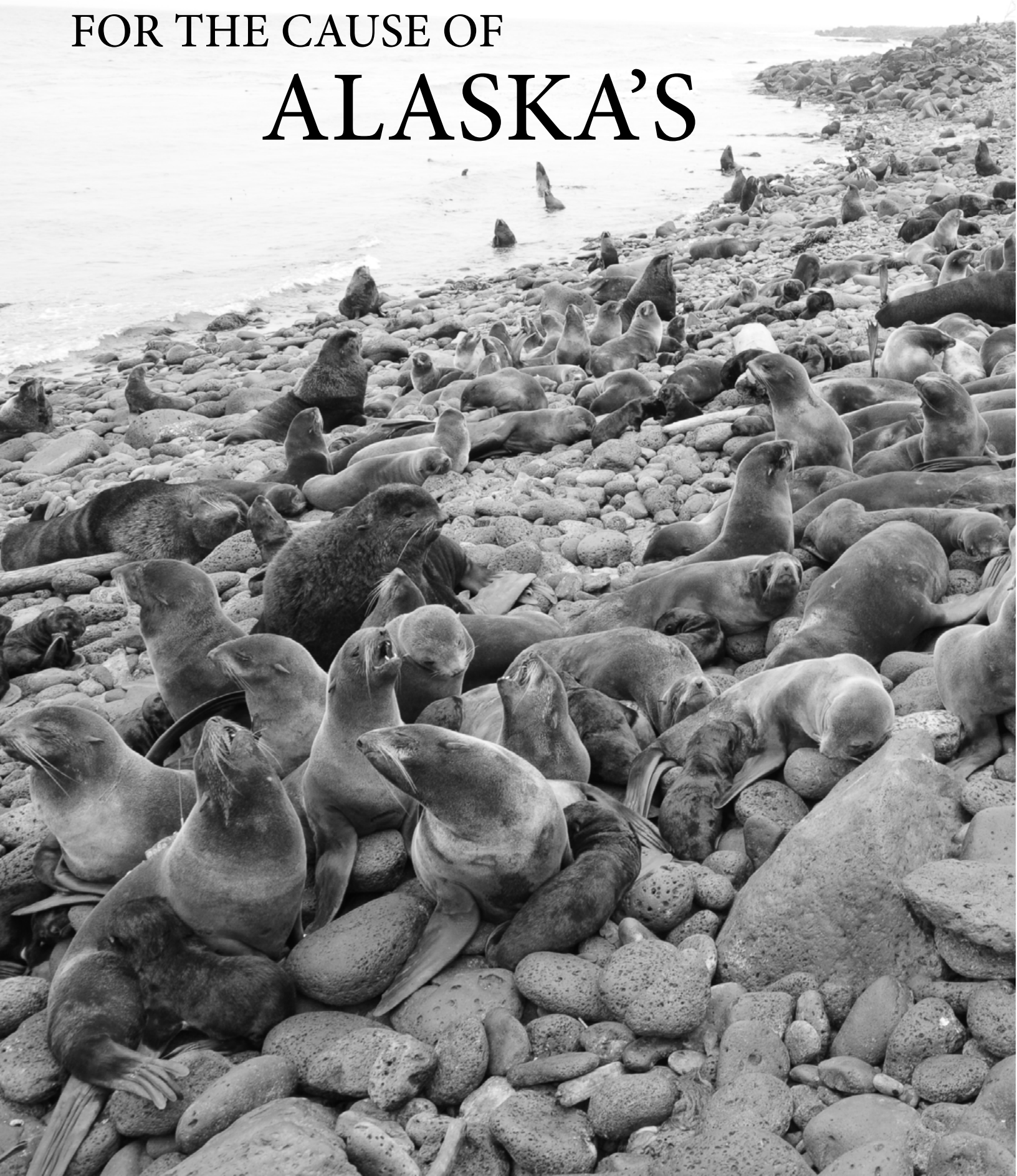


Figure 1. Summary of the July 22, 2020 Mw 7.8 Alaska Peninsula earthquake and tsunami. (a) co-seismic deformation computed from the CMT-based DART-derived tsunami source of the earthquake; (b) max tsunami wave amplitude computed using the CMT-based DART-derived tsunami source of the earthquake; (c) model results vs observations at five nearby DART buoys and the tide gauge at Sand Point.

SEARCHING
FOR THE CAUSE OF
ALASKA'S



SHRINKING
FUR SEAL POPULATION

By Elizabeth McHuron

Finding enough food to survive and reproduce is a universal challenge faced by all living creatures and one that has big impacts on population dynamics. For marine mammals, this issue has come to the forefront in recent decades as many populations face a rapidly changing environment that is increasingly altered by human activities.

The impetus for much of my current work at JISAO is the ongoing population decline of northern fur seals in Alaska that began in the late 1990s. Northern fur seals from Alaska are seasonal residents in Washington waters, but few people likely have had the pleasure of spotting them in the wild. In contrast to their sea lion cousins, fur seals prefer to spend their time in the open ocean, resting at sea instead of on land for most of the year. When they do come to shore, it is primarily on several remote islands in the Bering Sea, Alaska. There, females give birth to pups, males establish and defend territories, and juveniles practice their social skills.

Northern fur seals in the U.S. are no strangers to population declines. Commercial hunting reduced their population from 3 to 4 million down to several hundred thousand around the turn of the twentieth century. Through early conservation efforts, led in large part by the naturalist Henry W. Elliot, the Fur Seal Treaty of 1911— the first international wildlife conservation effort — helped fur seals recover to a population size of about 1.8 million in the 1950s. Since that time, the Alaskan population has declined to just over a half million animals, with pup production — an indicator of population size — reaching a 100-year low in 2018 at St. Paul Island, the largest of the breeding islands. Populations at other islands in Alaska have stabilized or are increasing, but this has not been sufficient to reverse the overall decline.

While the cause of the current decline remains unknown, there are indications that fur seal mothers may be struggling to get enough food to ensure their pups are heavy enough to survive their first few months at sea. In addition to facing the consequences of a rapidly warming Bering Sea, they also have to compete with fisheries for food. Walleye pollock, one of the primary prey of fur seals in Alaska, is also the target species for the largest U.S. fishery by volume. These potential interactions have long raised

questions about if and how the fishery might impact fur seals, and conversely, how fur seals might impact pollock populations and the fishery. These questions have taken on new importance given the continued decline and predictions that warming seas will adversely affect the survival of young pollock.

My JISAO and NOAA colleagues and I are drawing on existing fur seal research and a variety of energetic modeling approaches to address these issues, answering questions like "what are the energy requirements of fur seals in the Bering Sea?," "how much pollock are fur seals consuming?," and "how will climate change affect reproductive success?" We have also partnered with the Seattle Aquarium, and three others across North America (Vancouver, Mystic, and New England) with fur seals cared for by humans to fill in some of the missing pieces, primarily as it relates to adult males and weaned pups. These two groups have the potential to have big impacts on prey communities, albeit for different reasons, yet we know very little about how much food they consume.

THIS IS RELEVANT NOT ONLY TO FUR SEAL CONSERVATION GOALS, BUT ALSO THE ALASKA NATIVE COMMUNITIES FOR WHOM FUR SEALS ARE A CULTURALLY IMPORTANT RESOURCE.

While much of this work addresses basic, scientific questions, the end results have important applications to fur seal management. Not only will they provide a better understanding of the cause of the population decline, but they will also help to predict what might be in store for fur seals in the future. This is relevant not only to fur seal conservation goals, but also the Alaska Native communities for whom fur seals are a culturally important resource. Perhaps the most critical application of this work is in incorporating fur seals into ecosystem-based fisheries management of pollock, a task we are undertaking now. Worldwide, very few marine mammals are formally incorporated into fisheries management decisions, and the fur seal-pollock system represents an opportunity to highlight how this can be successfully accomplished.

Photos: Jeremy Sterling
NMFS/MMPA Permit #14327

THE FOLLOWING SUMMARIES ARE AN EXAMPLE OF THE BROAD RANGE OF SCIENTIFIC RESEARCH, PROJECTS, AND COLLABORATIONS BEING CONDUCTED AT JISAO/CICOES OVER THE PAST YEAR.

CHRIS ANDERSON

Management strategy evaluation is a tool that stock assessors use to evaluate the effects of allowing different levels of harvest from a fish stock.

My work identifies areas where economic considerations—behavioral or distributional—affect outcomes considered in management. I am collaborating with economists at AFSC to understand how the portion of sustainable catch that is allocated to different fleets and gear groups affects the productivity, fleet and shoreside processing benefits from the Pacific cod stock.

Allocating total allowable catches to individual fleets affects the short term distribution of benefits among gear groups, but has two indirect effects. First, different fleets land, process and market fish in different markets and communities, which leads to different regional economic impacts. Second, different fleets catch Pacific cod at different points in their life histories, and thus who catches how much affects the overall biological productivity of the stock.

We have recently seen a dramatic drop in the cod stock, which is likely environmentally driven, so increasing the resilience of these diverse fleets requires understanding the linked biological and economic system.

NICK BOND

Looking for a hot time in the Gulf of Alaska?

The waters of the Gulf of Alaska in the vicinity of Kodiak Island became considerably warmer than normal in 2019. An interesting wrinkle here is that the temperature anomalies were especially prominent in the layer between 100 and 250 meters, which happens to be where adult Pacific cod congregate. The unusual conditions there were accompanied by a reduction in cod populations to the extent that a commercially important fishery was closed (see headline below).

Additionally, I have been working with colleagues at NOAA to describe and understand the mechanisms responsible for this marine heat wave, and how past fluctuations in sub-surface temperatures may be related to boom and bust cycles in cod populations during the 20th century.

TREVOR BRANCH

Fisheries management relies heavily on stock assessments (computer models that explain existing data and forecast future trends in fish numbers) to figure out how many fish there are, and how many can be safely caught. However, it takes immense computing power and time to correctly estimate the uncertainty in the most sophisticated Bayesian stock assessments.

New methods have now been applied to fisheries models by Cole Monnahan et al. that can speed up these Bayesian models by a factor of 50 to 50,000 times so that they can run in minutes to hours instead of days to months.

These methods are already being used to assess Pacific hake, the largest fishery on the U.S. West Coast, allowing multiple alternative models to be run each year instead of a single base case, and have the promise to transform the field of fisheries stock assessment.

DAVE BUTTERFIELD

My research examines how the oceans interact chemically with the solid earth and how that affects marine ecosystems. Submarine volcanoes, hydrothermal vents and coastal methane seeps are my primary focus.

I work with a team of geochemists, geologists, biologists, and microbiologists to understand how geological processes create energy for chemosynthetic ecosystems and what role those ecosystems play in the oceans.

Recently I have worked on how magmatic CO_2 escapes from an active submarine volcano through hydrothermal vents and studied the sources and distribution of dissolved methane in Puget Sound to evaluate the air-sea methane flux.

BRENDAN CARTER

I use a diverse array of physical and chemical ocean measurements to figure out how much of the carbon in the ocean is there because of human emissions. I then use that information with forward, inverse, and data-assimilating models to make inferences about how much the ocean can buffer future human CO_2 emissions, the chemical and (increasingly) biological consequences of this marine CO_2 uptake, and what we can do to best monitor our rapidly changing planet.

As part of the PMEL Carbon Group, I, and the brilliant people I am privileged to work with, directly monitor the changing ocean chemistry on research vessels and using uncrewed ocean vehicles.

I also participate in global efforts to make the measurements made through these efforts more easily and widely available, useful, and understandable to the research community and the community at large.

BONNIE CHANG

Broadly, I am interested in the way nutrients are cycled in the modern ocean.

Specific projects I am working on include: (1) a new global reconstruction of marine nitrous oxide emissions using machine-learning algorithms, (2) examination of nitrous oxide cycling, transport, and efflux from the eastern tropical Pacific oxygen deficient zones using concentration and natural abundance stable isotope data, (3) assessing over-winter/under-ice nutrient supply via advection versus in situ recycling in the Chukchi Sea, and (4) examining the effect of ocean acidification on nitrification in Hood Canal/Puget Sound.

WEI CHENG

My primary research interest is to understand the ocean's role on regional and global climate and on time scales from seasonal to multidecadal.

To highlight one project from the past year, I am a member of an interdisciplinary team working on the Alaska Climate Integrated Modeling Project. Through the ACLIM effort, scientists model climate change impacts on the marine environment and ecosystems in the Bering Sea, Alaska, and address how such changes might cascade up the marine food web and eventually affect fisheries management strategies and fishing practices.

Within the ACLIM framework, I work on Bering Sea dynamical downscaling using CMIP5/CMIP6 forcing and investigate ocean changes in the downscaled simulations.

The team has recently published a paper entitled "Ecosystem-Based Fisheries Management Forestalls Climate-Driven Collapse."

ANDY CHIODI

My research addresses questions about air-sea interaction, climate variability and the interface between weather variability and wildland fire and smoke management.

My recent projects span studies of the tropical Pacific, where I have analyzed the ability of the moored-buoy component of our tropical Pacific observing system to accurately measure near surface wind variability key to driving El Nino and La Nina events. I co-managed a mission in the Alasan Arctic using saildrones to explore and observe the seasonal ice zone and thereby identify high-priority targets for improving our weather and climate forecast models.

I am also working on studies of weather and climate over the U.S. intended to reduce weather impediments to prescribed burning, which is a critical land management tool for restoring and maintaining healthy fire-adapted ecosystems and reducing hazardous levels of fuels in our forests and rangeland.

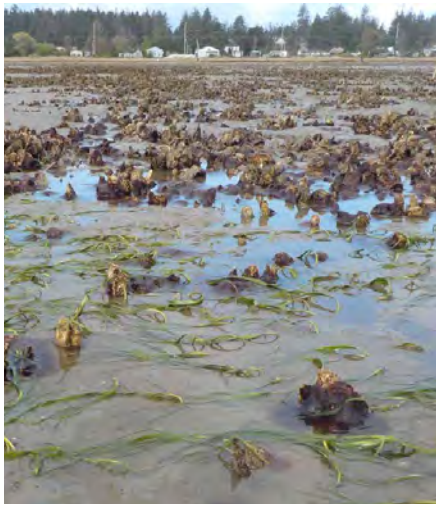
JEFF CORDELL

Jason Toft and I are collaborating with the Northwest Fishery Center's Ecosystem Analysis Program to compare ecological functions provided by shellfish aquaculture with natural habitats (eelgrass and mudflat).

NOAA is addressing fish and UW is studying invertebrate ecology, to ask (1) how do communities differ among eelgrass, shellfish aquaculture, and mudflats, and (2) how do the differences affect feeding by fish and other food web functions?

The first product of this work is a recently submitted data synthesis paper titled "Small Invertebrates in Bivalve-Cultivated and Unmodified Habitats of Nearshore Ecosystems."

Our continuing work will include conducting targeted field research to further understand aquaculture and eelgrass habitats.



SARAH DOHERTY

I've been working with a team of colleagues in UW Atmospheric Sciences as the Program Manager for the Marine Cloud Brightening (MCB) project, which is investigating the feasibility and impacts of spraying sea salt into clouds to brighten them, with the goal of offsetting climate warming (i.e. for climate intervention).

The research requires understanding how adding aerosols to low marine clouds affects their reflectivity, how long the clouds last, whether they precipitate and other responses.

In this sense, the work is "dual-purpose" in that many of the process-level uncertainties we will be addressing regarding how clouds respond to the addition of aerosols are the same sources of uncertainty in how inadvertent emissions of particulate pollution (aerosols) have been altering clouds and contributing to climate change over the industrial era.

AL HERMAN

I collaborate with physical oceanographers and biologists on regional models of circulation, plankton and fish dynamics in the Bering Sea and Gulf of Alaska as a member of the Ecosystems and Fisheries-Oceanography Coordinated Investigations (EcoFOCI) program at PMEL.

Additional projects center on the Northeast Pacific and Pacific Northwest. This "regional downscaling" work includes generating and evaluating multi-year "hindcasts" of past through present conditions, as well as seasonal forecasts and multi-decadal projections through the end of the 21st century.

A central goal of this work is to inform fisheries managers of past and possible future ocean conditions, which can help guide management strategies.

Three of the programs supporting this work are the NOAA Alaska Climate Integrated Modeling (ACLIM) program, JISAO's Seasonal Coastal Ocean Prediction of the Ecosystem (JSCOPE), and the NOAA Modeling and Prediction Program (MAPP).

I enjoy developing low-cost immersive stereo (3D) visualization techniques, and using them to share these modeling results with colleagues and the public.

JOHN HORNE

Over the last year I have continued development of autonomous acoustic sampling systems that measure biomass density, analyze data in near-real-time, and then transmit data products to satellites or cellular networks.

I am working on projects to characterize fish layers in Gulf of Mexico canyons and in the Gulf of Alaska to characterize salmon distribution and their prey using underwater gliders, to estimate mortality of migrating fish in the Tonle Sap River, Cambodia from a surface platform, and in collaboration with CICOES postdoc Angelee Annasawmy, to characterize krill distributions and predation events from acoustic moorings in the Antarctic.

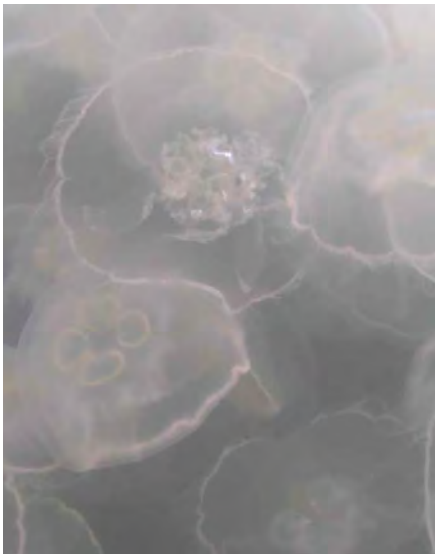
JULIE KEISTER

One of my current research studies aims to quantify the impact of the moon jellyfish Aurelia labiata on zooplankton populations that are critical prey for many commercially and ecologically important fish.

Aurelia medusae can form huge, dense aggregations in summertime in estuaries including Puget Sound, feeding heavily on copepods and other abundant crustacean zooplankton.

In collaboration with NOAA NWFSC scientists, my lab is conducting Aurelia predation experiments to measure the rate at which medusae deplete prey and collect measurements of nutrients, chlorophyll, phytoplankton composition, and zooplankton abundance in regions of varying medusae abundance in the field.

These lab and field data will parameterize an Atlantis model of Puget Sound to explore the future effects of climate change and to better understand the role Aurelia play in competition with larval and juvenile fish for prey.



PARKER MacCREADY

My research is focused on coastal and estuarine physics and how it shapes water quality and ecosystems.

I run a daily ocean forecast model, LiveOcean that simulates circulation and biogeochemistry in the coastal waters of the Pacific Northwest, and the inland waters of the Salish Sea, including Puget Sound. The model is used for the prediction of harmful algal bloom events as part of a NOAA MERHAB project. It also provides information on ocean acidification used by shellfish growers.

RYAN McCABE

I am a physical oceanographer focusing on processes that occur in coastal regions, with particular interests in issues relevant to ecosystems.

I use a combination of both observations and models in my research. Two large endeavors that I am currently involved in include: (1) a field-based Pacific Arctic ecosystem project aimed at better understanding the processes that structure the ecosystem; and (2) a U.S. West Coast harmful algal bloom project aimed at providing risk forecasts for coastal shellfish managers.

I also participate in projects aimed at developing and improving realistic models of the coastal ocean. I collaborate closely with researchers at UW Oceanography, at NOAA PMEL, and at NOAA NWFSC.

CALVIN MORDY

My research is focused on nutrient dynamics in the global ocean and in ecosystems in Alaskan waters.

I collaborate with NOAA's EcoFOCI program to measure nutrients during extensive field campaigns in the Chukchi and western Beaufort Seas in the Arctic, Bering Sea, and Gulf of Alaska. The goal is to understand how climate and other physical forcing influence nutrient supply to the ecosystems in these regions.

I am also a co-PI of the GO-SHIP repeat hydrographic program, and the Innovative Technology for Arctic Exploration program where we work with scientists and engineers to develop, test, and deploy innovative platforms and sensors in the Arctic.

IVONNE ORTIZ

I work on ecosystem approaches to fisheries management in Alaskan waters.

The goal is to inform policy makers, managers, and stakeholders of how the ecosystem responds to fisheries, climate, and different management strategies.

Two of my current projects include: (1) Benchmarks for Ecosystem Assessment which aims to develop practical indicators for ecosystem structure and function, along with guidelines for their application, and (2) Quantifying Relationships of Northern Fur Seals, pollock, and climate change in Alaska, which looks at fur seals, prey, fisheries and climate.

I collaborate closely with the Resource Ecology and Ecosystem Modeling group at the Alaska Fisheries Science Center, as well as other AFSC groups and Divisions

ANDRE PUNT

My research relates to supporting the provision of management advice for fish and invertebrate stocks by improving methods of stock assessment and for evaluating management systems.

The research conducted by my lab is applied to fisheries off the U.S. West Coast and Alaska, with projects that include evaluating the performance of alternative management approaches for Alaskan fisheries under changing climate conditions, developing ways to include the impact of changing ocean pH on long-term management advice for Alaskan crab stocks, creating a new method for combining the results of acoustic and trawl survey for Alaska groundfish, and improving the basis for quantifying scientific uncertainty in assessments of West Coast groundfish.

YOLANDE SERRA

My projects primarily involve the study of weather systems in the Tropics, including their initiating factors, time and space variability, and association with topography.

I also examine operational model skill at predicting short-term weather events, most recently working towards more probabilistic forecasting methods and products.

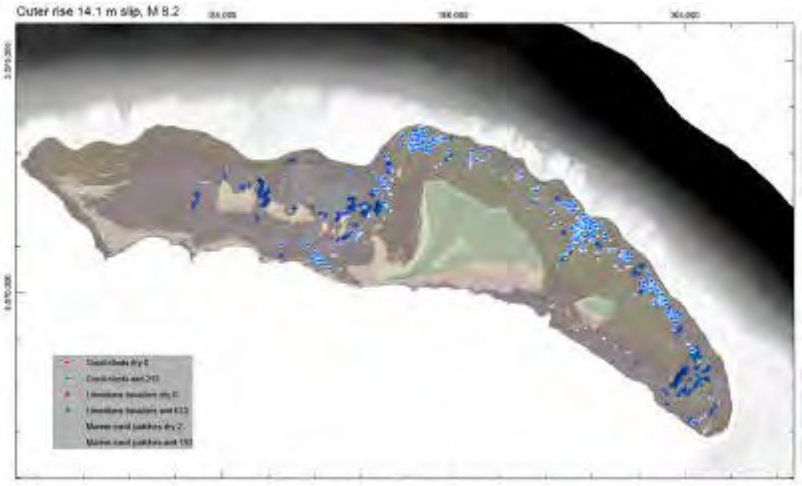
The goal of this research is to advance our process-level understanding of the organization of tropical convection in order to improve the representation of precipitation and tropical modes of variability in numerical models. Additional goals are to improve the usefulness of precipitation information from models for societal applications.

MUYIN WANG

My research focuses on understanding the Arctic climate system: what and why the changes happened and what the future would be.

My current projects include investigating the potential linkages between changing Arctic conditions and mid-latitude weather events, projections of the Arctic system using coupled climate models, and seasonal forecasts of September sea-ice minimums. The changing Arctic climate, especially the reduction of sea ice cover, plays a role in modulating the atmospheric circulations patterns, which in turn impact the downstream weather extreme events.

I also collaborate with fishery scientists to study the impact of climate change on components of the ecosystem (including fisheries).



Tsunami inundation on the island of Anegada, British Virgin Island caused by a magnitude 8.2 outer-rise normal-fault earthquake in the Puerto Rico Trench. The geological overwash evidence (the color-coated symbols) indicated such a devastating flooding event may have occurred on the island of Anegada during the medieval time.

YONG WEI

During the past reporting period, one of my principal research activities focuses on developing high-resolution probabilistic tsunami design zone maps for the Island of Oahu, Hawaii in a collaborative effort with colleagues at the University of Hawaii for the State of Hawaii Office of Planning project sponsored by NOAA Coastal Zone Management.

As a co-PI, I continued to collaborate with two other PIs at Scripps Institute of Oceanography and Stanford University to investigate the impact of tsunami-induced infra-gravity waves on the Ross Ice Shelf of the Antarctic.

I am also a PI of the USGS Earthquake Hazards Program (EHP) grant to evaluate outer-rise earthquake hazards from the Puerto Rico Trench by calibrating coastal inundation models with geological evidence (above).

GRAHAM YOUNG

Our research is focused on understanding mechanisms underlying observations of rapid fitness loss in hatchery-reared steelhead. I collaborate with scientists in the NOAA Fisheries' Genetics and Evolution program to examine how hatchery rearing influences genetic and epigenetic patterns in steelhead from the Methow River in Washington State. While genetic change in response to novel environments (such as hatcheries) is considered to be a slow process requiring multiple generations, epigenetic changes can be rapid, long-lasting, and in some cases be passed from parent to offspring.

The research is the first to show that hatchery rearing is associated with long-lasting epigenetic changes in steelhead.

ALEX ZERBINI

My research focuses on population assessment methods for cetaceans. I collaborate with NOAA's Marine Mammal Laboratory to design, implement and conduct data analysis for abundance estimation surveys. These estimates are used to assess whether anthropogenic induced mortality (e.g., bycatch in fishing operations) threaten cetacean populations.

I also develop and deploy satellite transmitters on large cetaceans in collaboration with engineers and instrument manufacturers. These transmitters are used worldwide to track movements of individual whales to understand population structure, migrations, and habitat use.

I also have the privilege to serve as the Vice-Chair of the Scientific Committee of the International Whaling Commission, which is an intergovernmental organization whose purpose is the conservation of cetaceans and the management of whaling.

DONGXAIO ZHANG

I led a NOAA Saildrone field campaign as part of the U.S. Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign (ATOMIC) and European EUREC4A (Elucidating the role of clouds-circulation coupling in climate) field observation in the western tropical Atlantic.

The 40-day intensive observation (January-February, 2020) of ATOMIC and EUREC4A involved four research vessels, four aircraft, and a fleet of Autonomous Underwater Vehicles (AUV) and Uncrewed Surface Vehicles (USVs). During the intensive observation period (IOP), the USV saildrones (photo below) were closely coordinated with the participating research vessels, aircraft, and other autonomous observing platforms.

After the IOP, the two NOAA funded saildrones continued their observations until July 2020, with a total distance traveled of more than 23,000 nautical miles in the western tropical Atlantic.

BEHIND THE SCENES: CREATING A RESEARCH INSTITUTE

HOW TO BAKE A CICOES:

Prepare ingredients ahead of time. Preheat oven to Hot. Then take one UW JISAO, add two universities and a handful of freshly picked research themes, stir in over 200 scientists from Corvallis to Fairbanks, bake at high pressure for sixty days…. and voilà, a delicious new CICOES.

By Tom Van Pelt

THAT'S THE SHORT version. The full story of how we moved from JISAO to CICOES is a bit more complicated. Now that the dust has settled and we're getting comfortable with our new institute, a new name, new logo, and new partners, it's a story worth a brief look back.

NOAA's Cooperative Institutes (CIs) facilitate collaborative research among academic and federal scientists, in support of NOAA goals. But CIs are not set up as permanent institutes — instead they are intentionally dynamic with five-year funding cycles that can be renewed once. Every ten years, the NOAA CI office defines a new or updated set of research priorities, and a competition is held to create the new CI. Existing CIs and any interested groups must prepare competitive proposals.

Around September 2019, JISAO Director John Horne began to organize preparation to respond to the expected CI invitation for proposals, formally called a "Notice of Funding Opportunity" (NOFO). At that time, we didn't have any concrete information on exactly when the NOFO would be announced or what it would contain, but Horne was busy reading the tea leaves of prior proposal timing and reaching out to directors at other CIs for insights.

We did know that we'd only have a short 60-day window between announcement of the NOFO and the deadline for submission of a full proposal. Our first preparatory step was to establish a work group including JISAO PIs tapped to be 'theme leads' to build momentum for rapid response and, crucially, for out-of-the-box thinking to look beyond our usual horizons.

A proposal for a new JISAO couldn't just be iterative. It would need to describe the ongoing strength and capability of JISAO with its four-decade track record, and at the same time articulate a clear and innovative vision for response to the priorities listed in the NOFO, with the small complication that we wouldn't know what those priorities would be until the day of the NOFO announcement!

After initial meetings of the work group, built around a hypothetical set of 'best guess' priority themes, we received our version of an October surprise: on Halloween, the NOFO hit the streets, entitled "Competition for a Cooperative Institute for the Pacific Northwest and Polar Regions". Polar Regions? A quick scan of the NOFO revealed nine research themes defined as priorities, shaping the structure of the proposal. Five of the themes had reasonable overlap with the draft themes we'd been gaming out in our preparatory meetings, but four themes were unexpected: aquaculture science, human dimensions, data science, and polar studies.

Across its 42-year history, JISAO was always a University of Washington CI, but now that the NOFO's scientific breadth was coming into focus, Horne and team were wrestling with a major decision. Should JISAO's proposal for the next ten years continue the single-institution approach, or should we invite partner institutions to form a consortium?

After much discussion among JISAO leadership, College of the Enviroment leaders, potential consortium partners, and colleagues in other CI consortia, we committed to proposing a consortium CI, with the University of Alaska Fairbanks and Oregon State University joining the team. Horne envisioned a nested structure, with the proposed CI consisting of a Seattle-based 'Research Institute' that would continue to include CI staff at NOAA labs including PMEL, AFSC, and NWFSC, plus a 'Regional Consortium' to encompass affiliated faculty and staff at UAF and OSU.

Now it was action stations and all-hands-on-deck time. Horne led a realignment of the work group to match the nine science themes, and UAF and OSU colleagues were invited in. With some collaborative self-identification of motivated scientists, and plenty of shepherding in the form of suggested outlines and structuring, the work group dove into building out the proposed research to take the new CI five to ten years into the future.

We settled on a three-level structure, forming the science narrative around the nine themes at the top level, then describing three to five broad research 'programs' within each theme, and finally showcasing a number of more focused and actionable 'program elements' within each program. This phase was a real challenge — we needed to minimize overlap and balance effort to meet NOAA priorities and vision, while taking care to develop the proposal independent of NOAA colleagues.

During the initial preparation phase, a small team consisting of myself, Horne, and Nick Bond began meeting for weekly strategy sessions, and we kept that going through the whole November and December period. Those sessions helped us track how the thinking and writing was going in each group and helped steer the overall structure of the proposal. Having a team of three 'sous chefs' wound up being very useful, as we were able to pool our contacts with different groups of folks doing different parts of the writing. Personally, I enjoyed the challenge of facilitating connection and communication and helping navigate the sometimes-bumpy pathway of building the proposal. And it was a great immersion in the diversity and depth of JISAO and partner university research capabilities.

One key aspect was engagement of the excellent network of prior and current JISAO partners around the scientific community. Outreach to other academic departments combined with input from many of the scientists within JISAO and the proposed Regional Consortium partners at UAF and OSU ensured full coverage of the nine research themes —not only science but also societal relevance.

At the same time, the core JISAO admin staff together with College of the Environment leaders and consortium colleagues launched parallel tracks to tackle the administrative and fiscal requirements laid out in the NOFO. We also undertook a big effort to catalog and describe the extremely deep and broad set of research assets that the new

Cooperative Institute for
CLIMATE, OCEAN & ECOSYSTEM STUDIES

We worked with representatives from the UW College Of the Environment and UW Marketing and Communications to create a logo that represents both our partnership and our broad range of research themes. The new logo (above) was designed by Alanya Cannon, the UW Director of Brand Management.

CI would encompass, with an infrastructure footprint spanning southern Oregon to the Arctic.

BY LATE NOVEMBER, the eruption of scientific vision and planning was starting to be distilled into shape. Horne had installed a moon-launch-style countdown clock in Wallace Hall, with glowing red numbers illustrating how quickly the short 60-day preparation window was flying by. Right through Thanksgiving and into December, a blizzard of in-person meetings BC (Before Covid) plus myriad email and phone call discussions resulted in all the proposal contributions coalescing by mid-December, guided by the strictly page-limited outline that Horne and the lead team built early in the process.

The core writing squad then enjoyed a less-festive-than-usual Christmas and New Year, striving make the January 3rd submission deadline. A final scramble of editing, integrating, crosschecking, navigation of internal reviews, and sign-offs across departments at UW, OSU, and UAF, culminated in the successful submission of the proposal package with a few hours to spare. Phew!

In recognition of the major expansion in scope as a consortium, a new name introduced our proposal: CICOES – the Cooperative Institute for Climate, Ocean, and Ecosystem Studies. After a few months of suspense, the proposal was accepted and CICOES officially started July 1, 2020.

The scientific reach of JISAO over its 40+ years was always broad and visionary. The structure of our 'new and renewed' three-university CICOES spans a vast stretch of North Pacific coastline, from Port Orford to Utqiaġvik, and its scientific reach stretches from pole to pole, from the deep ocean through the atmosphere. The sky and the ocean horizon are literally the limits for continuing our ongoing research and bringing to fruition some of the ambitious new collaborations and programs that emerged from the hot oven of the proposal process.

A CRUISE ON THE CUSP

AS THE NOVEL CORONAVIRUS WAS BEGINNING TO SPREAD IN THE UNITED STATES, THREE JISAO RESEARCHERS DEPARTED FOR A CRUCIAL RESEARCH CRUISE IN SOUTH AFRICA

By Jed Thompson

In early March 2020, three JISAO researchers departed for South Africa expecting to board NOAA's *R/V Ronald Brown* for a 45-day cruise to collect water column samples along the coast of Africa beginning in Cape Town and heading north to Cape Verde.

The COVID-19 outbreak outside of China was just beginning so there was reason to expect the cruise to proceed as planned. The scientists and crew – 47 people in total – were already in port and prepared to launch the project. The virus was certainly concerning but the scientists were optimistic that the cruise, after a decade of planning, would depart on schedule.

The optimism didn't last long.

•••

JISAO's Bonnie Chang, Andrew Collins, and Emily Norton flew to Cape Town roughly a week before the cruise's scheduled departure date of March 19. Meanwhile, back in Seattle, a stay-at-home order would be issued by the governor on March 23. "We kind of skipped out right before the door closed," Bonnie said.

The researchers had a few days to play tourist in Cape Town but businesses around the city were already beginning to close. Emily hiked to the top of Table Mountain where the gondola was shut down and restaurants along the normally busy waterfront were nearly empty.

"I went out to dinner and the concierge at our hotel recommended a place but told us we wouldn't be able to get drinks because they stop serving at 6:00," Andrew said. "I was like that's funny, good joke, but it was true."

RAPIDLY CHANGING PLANS

The group received daily emails of optimism from NOAA saying the cruise was still on, but NSF had already canceled their university-operated fleet so, to many people, the writing was on the wall. Bonnie was concerned but hoping they could squeeze out of port before it was too late just like they had done in Seattle. "I thought we're already here so let's be on our way before anyone notices what's happening."

Emily felt the same way. "We were going to be quarantined on the ship anyway," she said, "so I hoped somehow they'd just let us do our thing."

However, by the time departure day arrived news had trickled down that the NOAA fleet had been called home and the cruise was cancelled.

The disappointing news was made worse by the fact that the border to South Africa had been closed and, at that point,

Bonnie, right, with Leah Chomiak (UMiami) preparing to deploy a drifter on which emily drew a mahi mahi and a blufin tuna. *Photo: Emily Norton*

"THAT WAS A SCARY PERIOD FOR ME...WE DIDN'T KNOW HOW WE WERE GOING TO GET HOME."

there was no plan for how they would get home. "That was a scary period for me," Emily said. "We still didn't know if we were going to be able to ride the boat back to the U.S. We didn't know how we were going to get home."

Fortunately, the researchers soon learned they could leave with the ship, however, six hours before departure they still didn't know where it would take them. There was a whiteboard with a cruise plan showing the departure time as 2:00 PM and a question mark as the destination.

Eventually a plan became clear. The ship would spend the next week within a three-day transit radius of Cape Town and then, once they knew that no one onboard was sick, would steam its way across the Atlantic to Norfolk, Virginia.

At this point the goals of the trip had changed dramatically. "They're just moving the ship, just driving it back as fast as they could," Bonnie explained. "We did science but they certainly didn't intend for us to do science."

The journey would take three weeks and they knew the boat would never stop for them to take samples but it was an intrepid group of researchers determined to make the most of the situation. "We made up new questions on the fly," Bonnie said. "Like, okay, now we'll turn into an air/sea surface team."

They decided to use the ship's flow-through seawater system to collect samples around the clock. "Every two hours we'd all convene in the same lab and draw water samples," Andrew said about their improvised routine. "We took samples for pretty much every measurement group along the entire track the whole way. That's the data set we came back with."

"And it's not nothing," Bonnie added, "it's absolutely something. We took the whole suite of samples every two hours, 24 hours a day."

The silver lining in terms of science, Andrew pointed out, is that they were able to fill a key gap in the BGC Argo Float data. "There's a nice plot that shows gaps around the world before and after the cruise (opposite page), so we were able to help that project."

FREQUENT UPDATES

The *R/V Ronald Brown* has one of the best internet setups in NOAA's fleet so COVID updates were easy to obtain. They had access to internet and satellite TV with three news networks available (perhaps surprisingly, Fox was the most watched station) and there was also a satellite phone so everyone could stay in touch with their families.

Emily remembers talking to her sister back home. Those conversations were nerve wracking because her sister's husband is a doctor in the intensive care unit at a hospital in Boston. "He was seeing a lot of very sick COVID-19 patients so it was scary to think that he, and perhaps my sister, could be exposed to the virus."

Daily emails told them official counts of the total number of COVID cases and total deaths in the U.S. The emails also included updates about implementation of stay at home orders, PPE shortages, and emergency response activities. These official – and stark – notifications, Emily said, were daily gut-wrenching reminders of how bad things were and how fast they were deteriorating back home.

The outbreak was a cloud hanging over the entire trip, it was impossible not to think about it, but they couldn't dwell on the negative. "We were actually living a regular existence and enjoying each other's company" Bonnie said. "I had a good time. I'd rather be on the ship than

locked up in my apartment."

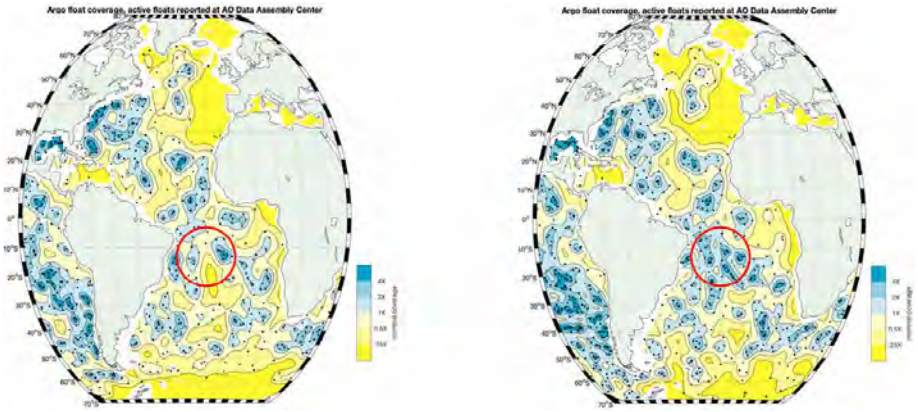
Emily remembered an all-hands meeting the week before they arrived in Norfolk where the captain pointed out that all 47 people on board were gathered in one room together which was an anomaly worldwide. "We're all looking around thinking, yeah, we're not going to have this for potentially many months once we get home."

There were a lot of mixed feeling onboard the boat. At first there was some anxiety from not knowing if anyone was infected and people were also worried about their families. "I was quite worried about my parents," Andrew said, "but once I got home, put eyes on the place, and saw they're doing things right, I started to think why did we come back here?"

Emily had a similar experience. "When we were on the boat and hearing about the apocalypse happening it felt very scary, just totally out of control," She said. "Now we're back home and all we do is stay inside all day."

There were also some questions about what kind of PPE would be available for everyone once they docked in Norfolk. Eventually the ship's crew assembled little care packages for everyone with hand sanitizer, gloves, and some spare rags to make into masks. When they reached shore, Andrew, Bonnie, and Emily received a package from PMEL with N-95 masks and other supplies to help them get home safely. They were especially appreciative of the elaborate, hand-sewn masks made by a colleague's family member. Everyone agreed it was extremely thoughtful and it eased one worry they all had about returning to the new world.

"We were very fortunate to be surrounded by a team of good-natured, positive people," Emily wrote in an email. "Despite the extenuating circumstances, everyone stayed positive and worked diligently to carry out the mission du jour. These incredible people were the highlight of my trip."



Change in Argo Coverage: Argo deployments from the Ron Brown were very helpful to address persistent voids in the Argo Atlantic coverage in the center of the South Atlantic at about 15°S, 15°W. These maps compare coverage from November 2019 to Apri 2020 showing changes as a result of the recent *Ron Brown* activity.

IVONNE ORTIZ

DR. IVONNE ORTIZ DISCUSSES THE PATH THAT LED TO HER NEW ROLE AS CICOES ASSOCIATE DIRECTOR AND THE COMMUNITY THAT SUPPORTED HER.

By Abby Zorn

IVONNE ORTIZ HAS ALWAYS valued interdisciplinary collaboration. She has made connections across disciplines, institutions, and countries throughout her education and professional milestones, and she brings this spirit of interdisciplinary collaboration to her new role as associate director at CICOES.

As associate director she will manage the relationship between the CICOES administration, CICOES employees, and NOAA collaborators at the Alaska Fisheries Sciences Center (AFSC) and, in particular, the Marine Mammal Lab.

Ivonne's career journey has prepared her well for this position. Born and raised in Mexico City, Ivonne discovered her love for marine life while accompanying her parents on trips to remote areas. "We went to Cancún when we were little before Cancún was Cancún," she said of these early travels. Ivonne enjoyed experiencing nature and wildlife firsthand, which included a chance to swim with sea turtles at an early age. These interests led her to pursue biology in her studies and marine ecosystems as her career.

As a biology major in undergrad, Ivonne took as many marine-related classes as she could. She continued to visit remote places like the Revillagigedo Islands, which are off-limits to tourists and only accessible through the Mexican Navy unless you are an advanced scuba diver. Ivonne took time off in the middle of undergrad to work as a translator and host at events, but ultimately returned to finish her degree.

When asked about how she made her way to the University of Washington, Ivonne credited a workshop organized by the National Fisheries Institute of Mexico. The workshop was supposed to be in English, but Ivonne remembers that

Ivonne Ortiz on board the *Ocean Explorer*, summer 2003 during an Atka mackerel tagging cruise in the Aleutian Islands.

soon "it was pretty obvious that it was not going to be possible to hold an advanced modeling mathematical course in English, and so they asked me to translate."

Translating allowed her to get to know the workshop leads, Drs. Ray Hilborn (SAFS) and Carl Walters (UBC, Emeritus). Ray and Carl encouraged Ivonne to apply to UW's School of Aquatic and Fishery Sciences (SAFS). She accepted a spot at SAFS without much investigation about the area. "I thought I'd just do a Master's, three years and come back, and that's it. I didn't even check the Seattle weather."

Three years turned into over twenty years of living in Seattle, though Ivonne admits that the decision to stay at SAFS for a PhD was initially a fortunate mistake. After her Master's, she inquired about a job studying ecosystem dynamics in the Aleutian Islands with Dr. Kerim Aydin (AFSC, NOAA). Kerim explained that the job was actually a PhD, and after some resistance to an additional degree, Ivonne decided to go for it.

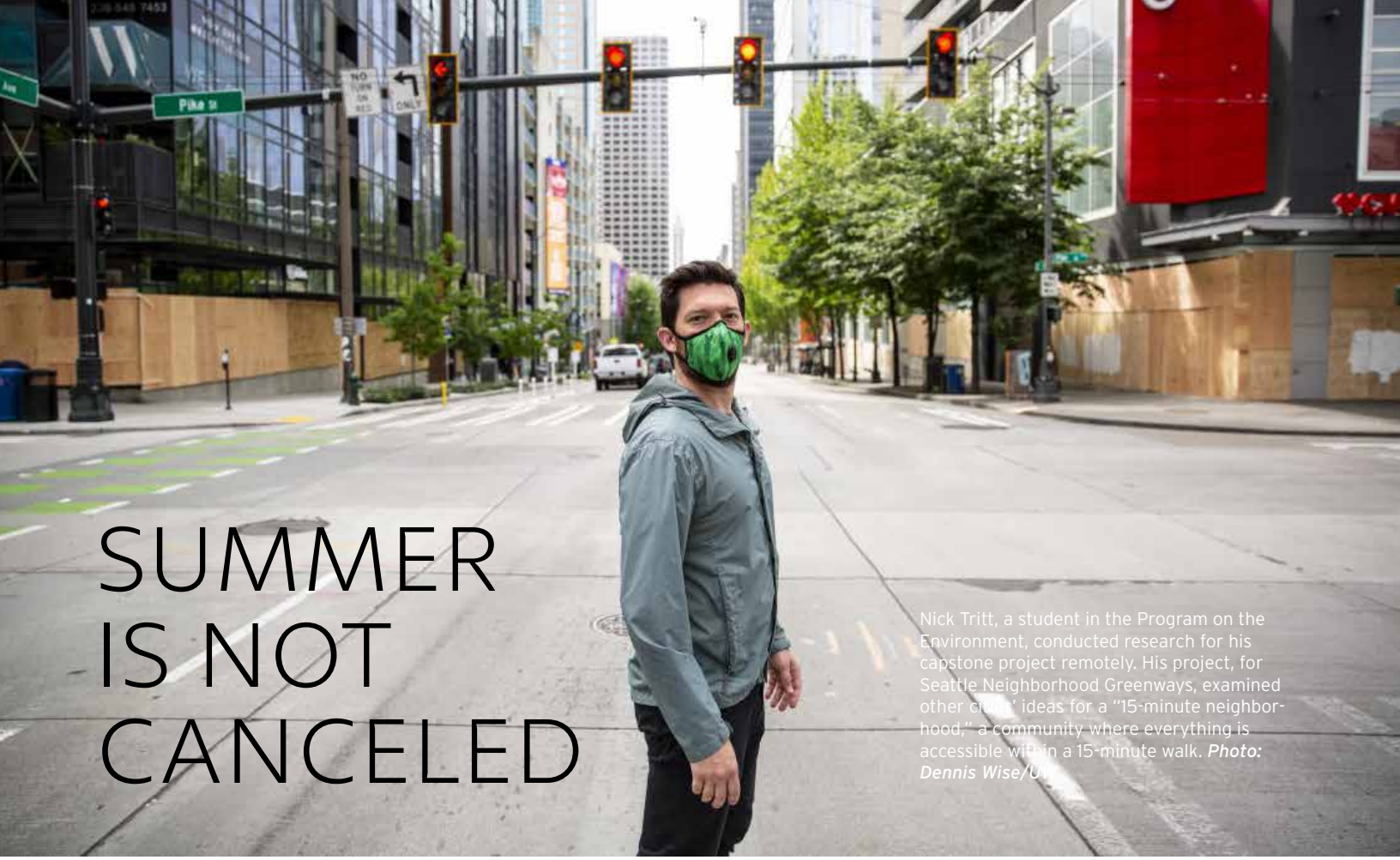
Throughout her time at SAFS she was able to work on policy projects and continue her field work adventures such as research cruises to the Aleutian Islands and a salmon-coded wire tagging job where she tagged 1,000 fish per day.

After completing her PhD, she joined the Bering Sea Integrated Ecosystem Research Project as a postdoc with Aydin and Dr. André Punt, which she calls "one of the best decisions I've ever made. That project was truly amazing." Through this project she met JISAO scientists such as Drs. Nick Bond and Al Hermann, so when Ivonne saw the opportunity to become a JISAO PI, it was an easy walk across the parking lot to Wallace Hall for the transfer.

"IT'S REALLY NICE TO HELP PEOPLE CHART THEIR CAREERS THE WAY OTHER PEOPLE HELPED ME."

AS ASSOCIATE DIRECTOR at CICOES, Ivonne is excited to return to her marine mammal roots. Marine mammals were part of her masters and doctoral theses, and she has worked with many of her new marine mammal colleagues before on previous or ongoing projects. Ivonne is looking forward to getting to know CICOES employees in the Marine Mammal Lab and being a resource for career guidance. "It's really nice to help people chart their careers the way other people helped me," Ivonne said. "The idea is to give them enough tools and information so if they don't want to take a certain route, it's not because they are not qualified or because they didn't know, but because they are making a conscious choice that they didn't want to follow that path."

Ivonne also looks forward to opportunities that come with the new cooperative institute and being able to provide input into how it develops. She sees UW's new partnership with University of Alaska Fairbanks and Oregon State University as "a nice opportunity to move into a more interdisciplinary area." She thinks CICOES "is in a particularly good position to really bring that sense of community because it offers opportunities for funding, and it can offer introductions and can enhance the knowledge network across different organizations and funding agencies." She says that "networking and putting interested parties in contact helps the interdisciplinary agenda," which has been a cornerstone of her journey.



SUMMER IS NOT CANCELED

Nick Tritt, a student in the Program on the Environment, conducted research for his capstone project remotely. His project, for Seattle Neighborhood Greenways, examined other cities' ideas for a "15-minute neighborhood," a community where everything is accessible within a 15-minute walk. ***Photo: Dennis Wise/UW***

UW REINVENTS SUMMER RESEARCH, INTERNSHIPS DURING COVID-19

By Kim Eckart, Reprinted from UW News

Headed into her final year of law school, Mary Ruffin had planned to spend the summer at a private law firm where she had secured an internship – a near rite of passage among law students to future employment.

But the internship, like so many summer jobs for college students in so many industries, was put on hold, the victim of the COVID-19 economy that has left millions out of work nationwide.

Yet Ruffin was undeterred, and she started reaching out to fellow students, faculty, alumni, and attorneys to see what might be available – any kind of legal research or project to keep her skills sharp and her resume competitive.

In the meantime, faculty and administrators with the University of Washington School of Law were working with local law firms to find solutions for the dozens of students in need of the professional development experience that defines the summers between years of law school and often leads to a full-time job. Together, they came up with the COVID-19 Clearinghouse, a collection of short-term, remote, pro bono projects for private firms and nonprofits that mainly address legal questions specific to life during the pandemic. And through the Clearinghouse, Ruffin received her first assignment for a client: researching employment laws for essential workers and their families.

"A lot of students go into law school because law can have a profound impact on people's lives," Ruffin said. "This seemed like a really good use of our time, when things are constantly changing, and it's good for students to get involved and feel like we're part of a community."

The COVID-19 Clearinghouse is just one of the ways that faculty and staff across the UW have revamped summer research internships and worked with outside partners and employers to involve students in a remote working environment, even for jobs that would normally be out in the field.

BRINGING THE OUTSIDE IN

Transforming what are usually outdoor or in-the-lab tasks has required creativity. Just ask almost anyone in the College of the Environment.

The Joint Institute for the Study of the Atmosphere and Ocean's nine-week research internship program accepts about a dozen undergraduates from around the country. Students are paired with a project that's meant to match their interests, either on the UW campus with a faculty member, or at the National Oceanic and Atmospheric Administration offices in Seattle. The cohort is housed in UW residence halls, participates in regular activities and goes on the occasional field trip.

Not this year. All 10 interns will work remotely, some on projects that were reconfigured to be online, and a

few who agreed to take a remote project that was completely different from what program administrator Jed Thompson would have offered, pre-pandemic.

Gone, for example, is any assignment involving the always-popular "ship time." But time on the computer provides valuable skills, too, useful for oceanography and so many other science fields.

Both Julie Keister and Randie Bundy, faculty in the School of Oceanography, have converted internships that would otherwise have been out on the water or inside in the lab. Instead of examining zooplankton for Keister or using mass spectrometers to measure metals in water for Bundy, the interns will analyze data from previously obtained samples, learning new computer programs and other means of identification and measurement.

Elsewhere in the College of the Environment, Washington Sea Grant's science communication fellow would normally spend much of their time bringing safety and water-quality messages directly to the people – literally, surveying boaters, promoting education at festivals and sharing materials at docks and marinas. But until lockdown restrictions loosen significantly, assistant director for communications MaryAnn Wagner said, the fellowship is steering toward writing and social media: from press releases about marine debris disposal and pump-out stations, to tweets of recipes and sea-life trivia.

ADAPTING ALONGSIDE EMPLOYERS

Many internships and practicum experiences rely on other partners and agencies. And as the reality of the pandemic and remote working arrangements became clear, UW faculty and staff started contacting their usual job sites to determine what, if anything, could be modified.

The Program on the Environment requires its environmental studies majors to complete a year-long capstone project that includes a winter or summer field component, pairing students with outside organizations such as the Environmental Protection Agency and King County, said Sean McDonald, a senior lecturer and the program's capstone instructor. But ahead of the summer, some of the smaller nonprofit partners tightened their budgets, leaving some job sites unavailable.

"A huge selling point is that we embed students in these organizations, and largely, all that has disappeared," McDonald said.

About one-third of students decided to postpone to a later quarter, while the remaining 21 students are pressing on with a summer assignment, albeit a remote one. The program's job fair proceeded via Zoom, with students "meeting" prospective employers in breakout rooms.

In the School of Public Health's dietetic program, graduate students are training to become registered dietitians, primarily destined for hospitals, clinics and public health settings. Students complete seven rotations, including at least one stint in a health care facility, and one stint in a concentration area such as public policy, school nutrition or public health practice.

But during the pandemic, the placements in health care settings are in flux, and program director Anne Lund has been working on ways to provide students the experiences they need to graduate this summer. For some students, this meant completing a second public health rotation and delaying the start of clinical work. An entire cohort of dietitian students, nationwide, is in the same boat, she said.

"Our dietetic program has taken an individualized approach to meet students' educational and career goals," Lund said. "We're doing everything we can but there are still gaps in their experiences due to the pandemic. It's a system-level problem, and the system needs to recognize that and respond with post-credentialing training opportunities."

PARTNERING AROUND THE PANDEMIC

The quest to secure employment after law school begins early: The summer between the first and second years is the "resume-building" internship that leads to the more career-focused second summer, when a successful experience at a firm or organization often ensures a job there after graduation.

Establishing the COVID-19 Clearinghouse was a collective effort, led by UW Law administrators and faculty, in consultation with alumni, retired attorneys, the Washington State Bar Association and several local firms, primarily Foster Garvey in Seattle. The pandemic had begun to generate many legal questions, and with the disappearance of so many paid jobs for law students, was there a way to address some of these issues, provide pro bono legal services to communities in need, and give students some of the experiences and skills practice they might get in a summer internship?

"There is a confluence of community need and student need," said

> "ALL IN ALL, I HAD AN AMAZING TIME! I AM GRATEFUL THAT JISAO WAS ABLE TO SWITCH TO A REMOTE FORMAT AND STILL CREATE A VERY MEANINGFUL INTERNSHIP."
>
> *MARK YAMANE, JISAO RESEARCH INTERN*

professor Christine Cimini, UW Law's associate dean for experiential education, who collaboratively oversees the Clearinghouse with Haiyun Damon-Feng, co-chair of Foster Garvey's pro bono committee. "We're trying to take an otherwise challenging experience for students and turn it into a learning experience that builds their skills and enhances their future job prospects."

The Clearinghouse matches students with supervising pro bono attorneys to tackle COVID-19 research projects that qualified legal service providers don't have the capacity to undertake. The matching is coordinated through a series of Google surveys: one for legal service providers to submit questions and projects they want students to address; another for attorneys who want to volunteer their time to student teams; a third for students to indicate their areas of interest. To date, 66 UW law students have volunteered their time and skills.

The law schools at Seattle University and Gonzaga University joined the effort, and now there are 14 active projects involving dozens of students, many from the UW.

Mary Ruffin's assignment with Foster Garvey is one of the projects that have concluded. Under the supervision of attorney Mikaela Louie, a UW Law alum, Ruffin and students Ysabel Mullarky and Dailey Koga tackled the employment rights of essential workers who live with people at high risk of the COVID-19 infection. The final product was a memo for the client, the Northwest Justice Project, to use in counseling people in need of legal advice.

As society adjusts to the new normal of the pandemic, these opportunities for community engagement can continue, said Damon-Feng, who was key to facilitating the Clearinghouse and creating a list of project needs.

"Moving forward, when students may not be getting the employment experiences they need, we hope that we can get them experiences and skills training through the Clearinghouse," Damon-Feng said. "The Clearinghouse is also helping to meet increased need from the nonprofit and legal services community. And from the law firm side, we want to contribute to these efforts and get more people involved in this work."

> My internship took place during the global pandemic of COVID–19. I had the unique opportunity to be a part of a remote research project, the first of its kind in JISAO/CICOES history. Remote research is not easy, but through the guidance and ingenuity of my advisors, I was able to conduct independent research that by the end of nine weeks, culminated into clear results that I presented as a virtual poster in a novel format, an online poster hall and presentation symposium. This summer I studied the effects of low oxygen levels, hypoxia, on the behaviour of a species of zooplankton: Calanus pacificus, a ma–rine copepod. I was advised by Julie Keister and Danny Grunbaum; UW graduate student Amy Wyeth and zooplankton ecologist Deana Crouser were also integral to my success this summer.
>
> *Dina Zawadzki, JISAO Research Intern from Montery Peninsula College*

UW Law faculty have developed a summer course, too: "Lawyering in the Time of COVID-19," designed to provide students with a substantive overview of big-picture issues, as well as skill development. The course will be taught in modules related to legal issues central to the pandemic, such as immigration and detention, unemployment, criminal justice and detention, and small-business issues. The second half of the course will pair students with local practitioners to work on a project or case in their area of expertise. Whether through opportunities with the Clearinghouse, or in the classroom, faculty say, students have a chance to learn about the law as it relates to an unprecedented event.

It's not the summer experience that students expected, said Elana Matt, the law school's interim assistant dean for student and career services. But a can-do attitude can help.

"Students gain key legal skills through a variety of experiences, and students should remember to stay focused on continuing to learn, even if their summers don't look how they hoped. Remember — this is just one small time in your very long career," she said.

BEHIND THE SCENES: STORAGE IN THE ERA OF BIG DATA

By Mariona Claret

THE DIGITAL CLOUD has become a necessary tool for scientific researchers, especially now as we're working from home during an ongoing pandemic. Many of us are using incredibly large amounts of data, so where does this data physically sit? Likely not on our home computers.

A high-speed internet connection is crucial to teleworking, of course, but so is high-end technology for data storage. Think about how much storage is needed if each Gmail user across the world – around 1.5 billion people – stores a single 1 MB file in their Gmail drive. That amounts to 1,500 TB of storage! At the beginning of my career as an ocean modeler I would run simulations on my desktop computer and store its output on a conventional hard drive but output from state-of-the-art climate models will no longer fit.

Climate models can simulate complex CO_2-driven warming in the ocean and atmosphere to provide an understanding of current climate changes and future climate projections. These intricate models include tens of tracers saved monthly or yearly for a few hundred years, spanning the industrial era and beyond. Just saving ocean temperature output from a high-resolution (1/10° globally) NOAA-GFDL climate model requires about 27 TB of space while the latest hard drives can only hold around 20 TB.

As hard drives are reaching their storage capacity and flash memory is too expensive for upscale storage, an old friend is being revived, the magnetic tape. Yes, the same tape you remember from music cassettes in the '80s!

AS HARD DRIVES ARE REACHING THEIR STORAGE CAPACITY AND FLASH MEMORY IS TOO EXPENSIVE FOR UPSCALE STORAGE, AN OLD FRIEND IS BEING REVIVED...

Magnetic tape is cheaper than hard drives, lasts longer, and it's safer in terms of malware as it is off-line. However, its sequential access memory slows input/output operations compared to random-access hard drives. As a result, big data storage in the cloud or in high-performance computers (HPCs) often combines hard drives with magnetic tape. Hard drives are great for analyses, as data needs to be readily accessible, while tape is used for backup and digital archiving.

But how do these two storage devices talk to each other? This is when the bridge-building tape robot comes into action. I'm talking about a robot that moves hundreds of cartridge tapes to and from a tape driver and loads data from those tapes into a hard disk or vice versa (pictured above). For instance, if you request data online archived in a NOAA Climatic Data Center, a robot will locate the cartridge containing the requested data and the robot's arm will grab the cartridge and place it into a reader to be downloaded. A similar process occurs when reading large model output archived in HPCs, such as UW's Hyak server or NSF's Cheyenne. So imagine a dark storage room with thousands of tapes clustered in big rectangular blocks and robots on rails relentlessly moving tapes across slots.

MY FASCINATION WITH data storage goes beyond tape robots. Consider the challenge of migrating data into large storage rooms. In climate modeling, for example, this challenge is overcome by saving large model output in the same computer system where it is analyzed. In high-performance cloud computing, data migration adds an additional layer of complication. Transferring hundreds or thousands of files over the internet can take weeks, months, or even years. The way Amazon Web Services (AWS) handles this issue is with a devise called the Snowball. This is a sizeable box storage container that is shipped to you for uploading your data directly from your machine, and when it's done you ship it back to AWS and your data will be put in a server farm containing thousands of computers connected to the cloud.

For those researchers/institutions with too much data for the Snowball, there is the much larger SnowMobile, literally a data center inside of a semi-trailer truck that will come to your office door to collect your data.

Now, as you connect to the world from the comforts of home, I invite you to imagine the technological actions happening behind the scenes to keep scientific discoveries happening during a global pandemic.

THE JISAO POSTDOC PROGRAM:

When you do what you love...

By Fred Averick

RACHEL WHITE, a former JISAO postdoc, credits her mom for helping inspire her to become a scientist. Rachel's mom was a physical oceanographer who took time away from her career to raise Rachel and her brother. "She went back to research part-time once we were both in primary school," Rachel recalls, "including going on oceanography cruises. It was obvious she found her research really engaging and interesting, which made me want to have a job I really loved too".

Rachel earned her undergraduate degree at Cambridge University and, after receiving her doctorate from Imperial College London, she left the UK—crossing the pond all the way to Seattle—upon being awarded a JISAO Postdoctoral Fellowship in 2014.

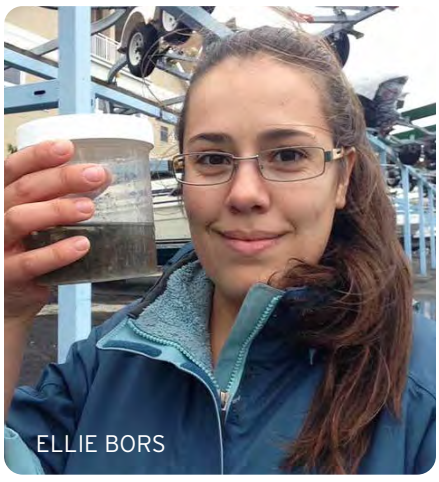
The JISAO Postdoctoral Fellowship Program has been a key component of the institute since its founding in 1977. Funded by NOAA, under what's known as the JISAO "Task I" (money awarded to JISAO to run the institute), the program currently awards three individuals per year with a two-year postdoctoral fellowship to focus on any of JISAO's primary research themes.

"The JISAO program gave me the flexibility to follow my own research path, which was great fun and hugely rewarding, and I think really helped my academic career as well," Rachel says. She also appreciated being based at UW in Seattle, where she got to work with scientists across a wide range of fields in earth sciences, from atmospheric sciences to chemical oceanography, as well as enjoy time outdoors in the Pacific Northwest.

Now an assistant professor at the University of British Columbia, Rachel's research focuses on understanding "more about large-scale circulation in the atmosphere, on what circulation patterns help create heatwaves, whether we can get useful predictions of these months ahead, and how these circulation patterns might change with human-caused climate change."

"I will always be grateful for JISAO and the people there," Rachel adds. "For the opportunities this fellowship gave me, and the doors that it opened."

RACHEL WHITE



ELLIE BORS

Above: Ellie Bors enjoying enjoying some leisure time in Sommarøya, Norway. She was a 2018-2019 Fulbright Arctic Initiative Scholar and did a research exchange to Norway in the Spring of 2019.

CURRENT POSTDOC ELLIE BORS had a somewhat different path to JISAO. She grew up right here in Seattle and remembers spending a lot of time as a kid finding tiny crabs under rocks and building holes and dams in the sand, or "complex coastal infrastructure construction projects" you might say.

In the summer before her senior year of high school, Ellie attended a program in Woods Hole, MA that consisted of 10 days on land and 10 days on a tall ship at sea. It was there that a guest speaker from the Woods Hole

"We propose our own research projects, which means we work on exactly what we find interesting and important."

Oceanographic Institute (WHOI) spoke about hydrothermal vents and her mind was blown. "That's how my love affair with ocean science really started," Ellie recalls.

She earned two Bachelor degrees – in Biology and Cello Performance – from Oberlin College and Conservatory of Music, and her Ph.D. in Biological Oceanography from the joint program at WHOI and MIT.

Why did she apply to be a JISAO postdoc? "JISAO offers a fantastic opportunity to collaborate on research that spans academic and government organizations," says Ellie. "As postdocs, we propose our own research projects, which means we work on exactly what we find interesting and important. That's a real privilege. And the program includes a livable employment package, which is hard to find as a postdoc."

Ellie is now collaborating with Lorenz Hauser, at the School of Aquatic and Fisheries Sciences here at UW, and Ingrid Spies at NOAA's Alaska Fisheries Science Center. Her research uses genomic techniques to describe the population genetic consequences of climate-driven distributional shifts for pollock in the Bering Sea.

Ellie still tries to keep up with the cello and search tide pools for tiny crabs in her spare time.

Rachel, jokingly, says she has forgotten the meaning of spare time. She recently saw a meme saying, Do what you love and you will ~~never work a day in your life~~ kinda work all the time! "This feels rather true," she says, "even when I'm hiking or snowshoeing I'm often thinking about my work. But I love that feeling."

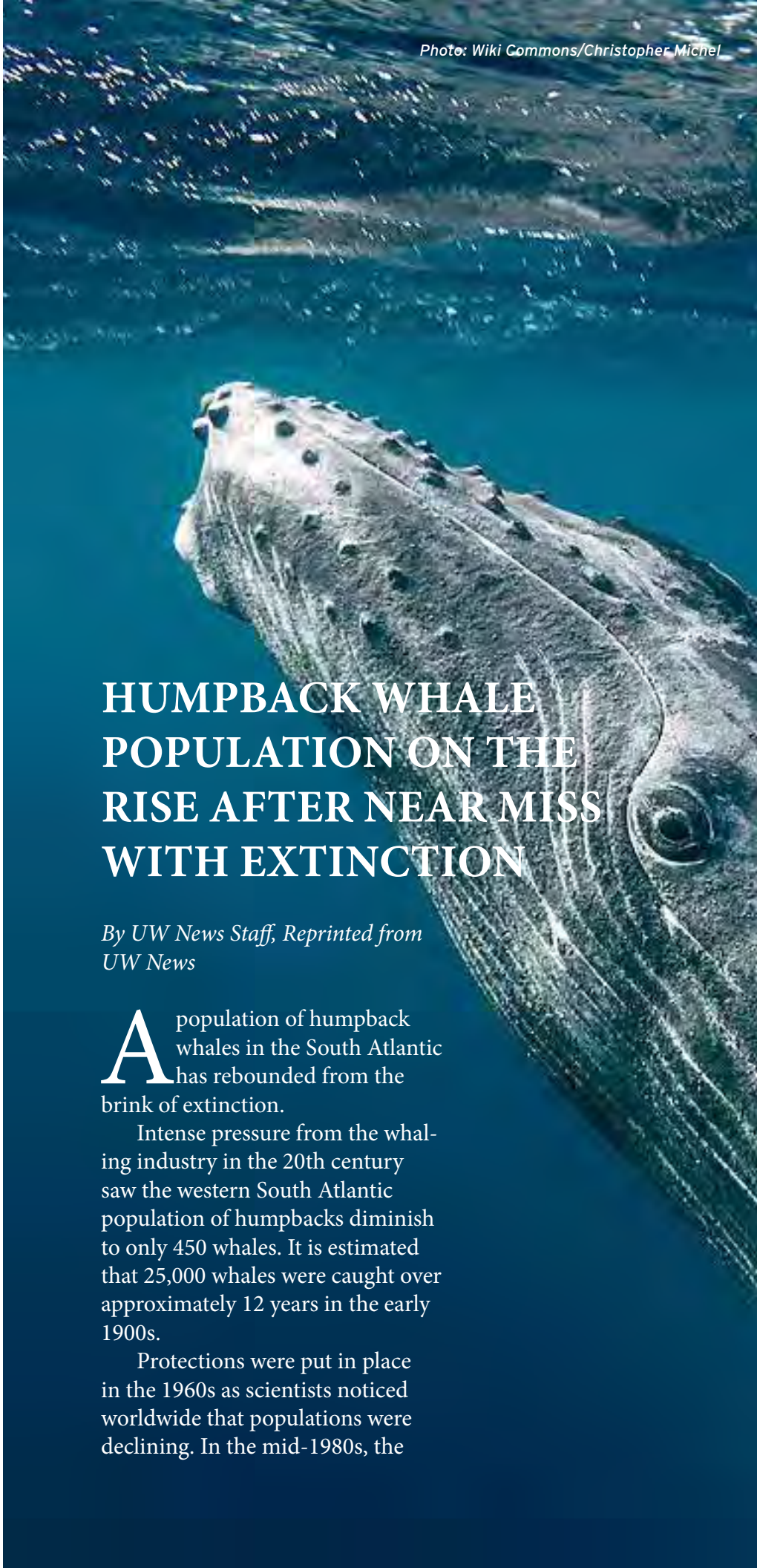


Photo: Wiki Commons/Christopher Michel

HUMPBACK WHALE POPULATION ON THE RISE AFTER NEAR MISS WITH EXTINCTION

By UW News Staff, Reprinted from UW News

A population of humpback whales in the South Atlantic has rebounded from the brink of extinction.

Intense pressure from the whaling industry in the 20th century saw the western South Atlantic population of humpbacks diminish to only 450 whales. It is estimated that 25,000 whales were caught over approximately 12 years in the early 1900s.

Protections were put in place in the 1960s as scientists noticed worldwide that populations were declining. In the mid-1980s, the

International Whaling Commission issued a moratorium on all commercial whaling, offering further safeguards for the struggling population.

A new study co-authored by Grant Adams, John Best, and André Punt from the University of Washington's School of Aquatic and Fishery Sciences shows the western South Atlantic humpback (*Megaptera novaeangliae*) population has grown to 25,000. Researchers believe this new estimate is now close to pre-whaling numbers.

The findings were published October 16 in the journal Royal Society Open Science.

"We were surprised to learn that the population was recovering more quickly than past studies had suggested," said Best, a UW doctoral student.

The study follows a previous assessment conducted by the International Whaling Commission between 2006 and 2015. Those findings indicated the population had only recovered to about 30% of its pre-exploitation numbers. Since that assessment was completed, new data has come to light, providing more accurate information on catches — including struck-and-lost rates — and genetics and life-history.

A population of humpback whales in the South Atlantic has rebounded from near extinction, a new study shows. *Photo: iStock.com/Martin Hristov*

"Accounting for pre-modern whaling and struck-and-lost rates where whales were shot or harpooned but escaped and later died, made us realize the population was more productive than we previously believed," said Adams, a UW doctoral student who helped construct the new model.

> RESEARCHERS BELIEVE THIS NEW ESTIMATE IS NOW CLOSE TO PRE-WHALING NUMBERS.

By incorporating detailed records from the whaling industry at the outset of commercial exploitation, researchers have a good idea of the size of the original population. Current population estimates are made from a combination of air- and ship-based surveys, along with advanced modeling techniques.

The model built for this study provides scientists with a more comprehensive look at the recovery and current status of the humpback population. The authors anticipate it can be used to determine population recovery in other species in more detail as well.

"We believe that transparency in science is important," said Adams. "The software we wrote for this project is available to the public and anyone can reproduce our findings."

Lead author Alex Zerbini of the UW's Joint Institute for the Study of the Atmosphere and Ocean stressed the importance of incorporating complete and accurate information when conducting these assessments, and providing population assessments without biases. These findings come as good news, he said, providing an example of how an endangered species can come back from near extinction.

"Wildlife populations can recover from exploitation if proper management is applied," said Zerbini, who completed this work at the NOAA Alaska Fisheries Science Center's Marine Mammal Laboratory.

The study also looks at how the revival of South Atlantic humpbacks may have ecosystem-wide impacts. Whales compete with other predators, like penguins and seals, for krill as their primary food source. Krill populations may further be impacted by warming waters due to climate change, compressing their range closer to the poles.

"Long-term monitoring of populations is needed to understand how environmental changes affect animal populations," said Zerbini.

And Now, Please Welcome Our New Additions

The following researchers joined the JISAO staff between October 2019 and September 2020.

ANGELEE ANNASAWMY

I work with CICOES director Dr. John Horne, Dr. Christian Reiss from NOAA and Dr. Gavin Macaulay from the Institute of Marine Research on the krill distribution patterns, aggregation structures, and predator-prey interactions in Bransfield Strait, Antarctica.

The Antarctic krill, *Euphausia superba*, is a major component of the Southern Ocean's ecosystem, and is one of the main resources exploited by commercial fishing vessels in the area. The absence of updated high-resolution krill distribution data constitutes a major obstacle in determining the status of local krill stock and its response to fishing pressure and melting sea ice.

My postdoctoral research project is multi-faceted with ecological, technological, scientific/economic, and fishery/management perspectives. The spatio-temporal variability in krill vertical distribution and aggregation structures are being investigated with respect to the changing environmental conditions at Nelson vs. Deception Islands in Antarctica. An analysis method will also be developed to compare the performance of the Simrad WBAT echosounder vs. the new-generation Nortek Signature 100 profiler mounted on moorings.

ELLIE BORS

I am collaborating with Dr. Lorenz Hauser (UW School of Aquatic and Fisheries Science) and Dr. Ingrid Spies (NOAA Alaska Fisheries Science Center) on a project that aims to describe the population genetic consequences of climate-driven distributional shifts for fish in the Bering Sea.

Focusing on Walleye pollock, which is the most valuable groundfish species in Alaska, I am using new genomic techniques to describe the spawning stock structure in the region, determine if genetic structure varies between warm and cool periods, and identify which fish stocks are moving into the Northern Bering Sea in response to recent anomalously warm temperatures.

YUVAL BOSS

I collaborate with MML's Polar Ecosystems Program at NOAA, largely supporting the aerial survey effort. My role is to develop machine learning/computer vision models for real time detection and classification of Arctic and sub-Arctic pinniped populations.

Outside of developing models, I've been working on designing methods for making the machine-learning process more reproducible and transparent which becomes much more challenging with all of the variability that often comes with aerial survey datasets.

CASEY CLARK

My research focuses on the use of biogeochemical tools to investigate Arctic marine mammal ecology and physiology.

As a JISAO/CICOES postdoc, I am working to establish new techniques for studying important life history events, such as

weaning and attainment of sexual maturity, by measuring concentrations of trace elements in teeth. Like the rings of a tree, seasonal growth layers in the teeth allow me to link changes in trace element (e.g., iron, zinc, or strontium) concentrations to a specific year, or even a specific season within an animal's life.

The ability to estimate demographic parameters, such as the average age at sexual maturity, is important for assessing animal population status, and a primary goal of this research is to improve the ability of wildlife managers to conserve and manage Arctic marine mammal populations.

TARA CLEMENTE

I recently joined PMEL and CICOES as the new field operations manager for the Global Tropical Moored Buoy Array (GTMBA) Program. I received my M.Sc. degree in Biological Oceanography under the guidance of Dr. David M. Karl from the University of Hawai'i at Manoa.

Prior to arriving at PMEL I was working as the HOT - SCOPE program operations manager for the Hawaii Ocean Time series (HOT) and the Simons Collaboration on Ocean Processes and Ecology (SCOPE), two collaborative oceanographic field programs investigating the temporal and spatial variability of the hydrography, chemistry, and biology of the North Pacific Subtropical Gyre.

To date I have participated on over ninety, research cruises with the HOT program and dozens of other research cruises between Hawaii, Alaska, California, American Samoa, Rapa Nui and Antarctica, totaling 1,500+ days at sea. I've led, planned, and organized oceanographic research data collection and have served as chief scientist on numerous oceanographic expeditions.

In my new role I hope to draw upon all my previous experiences to manage, coordinate, and support the project personnel, field operations, and research objectives of GTMBA Program in collaboration with our partners in the Atlantic, Pacific, and Indian Oceans.

Outside of studying, researching, and teaching about the sea, I love to spend my time sailing, kayaking, hiking in the mountains, and exploring the world's infinite wonders.

ZACK GOLD

I work with Dr. Kim Parsons at the NOAA Northwest Fisheries Science Center and Professor Ryan Kelly at UW to develop novel environmental DNA (eDNA) methods for elucidating population genetics of harbor porpoises and southern resident killer whales.

eDNA approaches provide a non-invasive genomic sampling method relying on the collection and sequencing of sea water around the target marine species. These novel conservation genomics tools will provide powerful methods to help inform the successful management of these economically and culturally important species.

LARAMIE JENSEN

I work with Dr. Rebecca Woodgate (APL, Oceanography), Dr. Ryan McCabe (CICOES), and Dr. Randie Bundy (Oceanography) to apply chemical tracers to physical processes in the Arctic Ocean.

Recent measurements of trace metals and their biogeochemical cycling across the Arctic Ocean can be used to help constrain water mass provenance and circulation. Additionally, concurrent measurements of trace metals and water transport can yield information on trace metal fluxes from the continental shelves to the Arctic basin.

My current work at CICOES focuses on better merging trace metal analyses with ongoing biological and physical measurements being made in rapidly changing areas of the Arctic Ocean. This work will involve historical data as well as future fieldwork and other opportunistic sampling efforts.

SEAN MCALLISTER

I work in the Genetics and Genomics group at NOAA-PMEL, researching species composition, diversity, and connectivity of microbial, fish, and invertebrate communities in chemosynthetic hydrothermal environments, a.k.a. the dark biosphere.

Hydrothermal plumes and methane seeps are habitats with a high flux of reduced chemicals that can be used by chemoautotrophic bacteria and archaea to produce energy for growth, supporting a broader biological community.

Understanding the links between these communities and the hydrothermal environment is key to understanding their impacts on coastal fisheries and the blue economy. I use eDNA metabarcoding, RADSeq of selected taxa, metagenomics, and bioinformatics to address these interests.

NOEL PELLAND

I am a physical oceanographer collaborating with researchers in NOAA's Marine Mammal Laboratory to incorporate information about physical climate and habitat into life history studies of Alaska pinniped species. I am also working with Pacific Marine Environmental Laboratory scientists on an observational study of upper-ocean processes in the Bering Sea.

Overall, my research seeks to better understand the physical environment of one of our nation's most important ma-

rine ecosystems and how it impacts protected species.

JACK REEVES EYRE

I am researching how the ocean and atmosphere exchange heat, water, and momentum, and how the atmosphere responds to sharp sea surface temperature gradients (on the scale of a few miles).

The oceans act as the major heat reservoir in the climate system, and ocean currents move huge amounts of heat energy around the globe. Research over the last few decades has greatly increased our knowledge of global patterns of fluxes (ocean heat uptake and loss). Less is known about how fluxes vary at smaller scales. I hope my research will advance understanding of this problem, and thereby help global climate monitoring and prediction.

I am collaborating with CICOES and NOAA PMEL scientists and making use of autonomous, wind- and solar-powered surface vehicles, along with weather/climate models.

SKYLA WALCOTT

I am a Pinniped Research Scientist II with the Marine Mammal Lab (MML) at NOAA, working with both the Alaska Ecosystem and Polar Ecosystem Programs. I have a BSc in Marine Biology from UC Santa Cruz, and a MSc in Biology from UA Anchorage.

My research career has focused on the critical life history stages for pinnipeds, including reproduction and molt, during which they are often hauled out of the water.

My research with the MML will be centered on assessing haul out behavior of Steller sea lions using remote camera images, as well as analyzing aerial images of hauled out Arctic seals. We hope to use these tools as a way to assess spatial and temporal population dynamics in a changing climate.

HONGJIE WANG

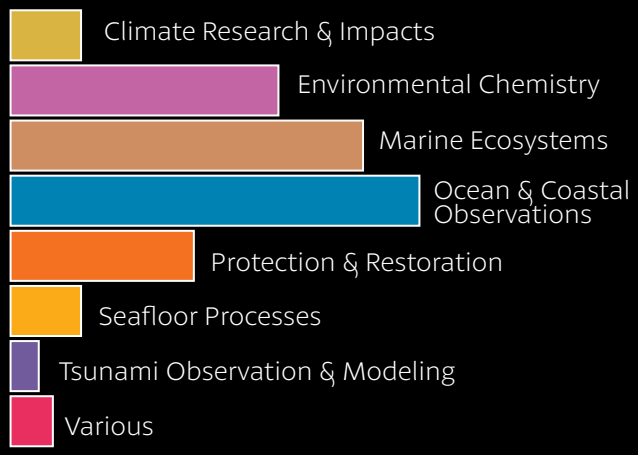
I am working with Dr. Jessica Cross and Dr. Darren Pilcher to study ocean acidification in the eastern Bering Sea and Chukchi Sea.

The Bering and Chukchi Seas are likely to be heavily affected by ocean acidification because of their naturally high carbon dioxide concentrations. So far, our knowledge of OA is highly reliant on field data collection by research ships and autonomous mooring platforms, but both methods have limited spatial or temporal coverage.

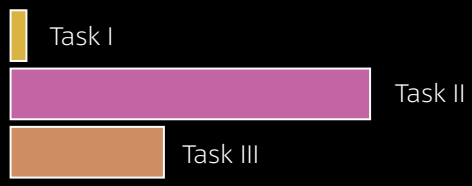
I am working on one high-resolution spatiotemporal pCO_2 dataset collected by an Autonomous Surface Vehicle CO_2 system. This new dataset will help elucidate carbon system dynamics and provide important insight into future ocean acidification in the high-latitude coastal areas.

2020 Financial Tidbits

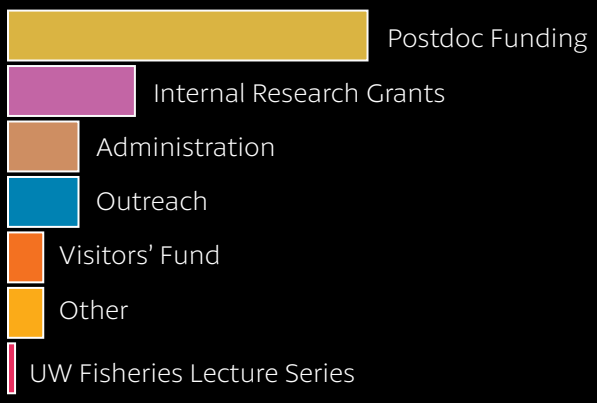
JISAO has seven research themes; the following chart shows the portion of grant funds received last year per theme:

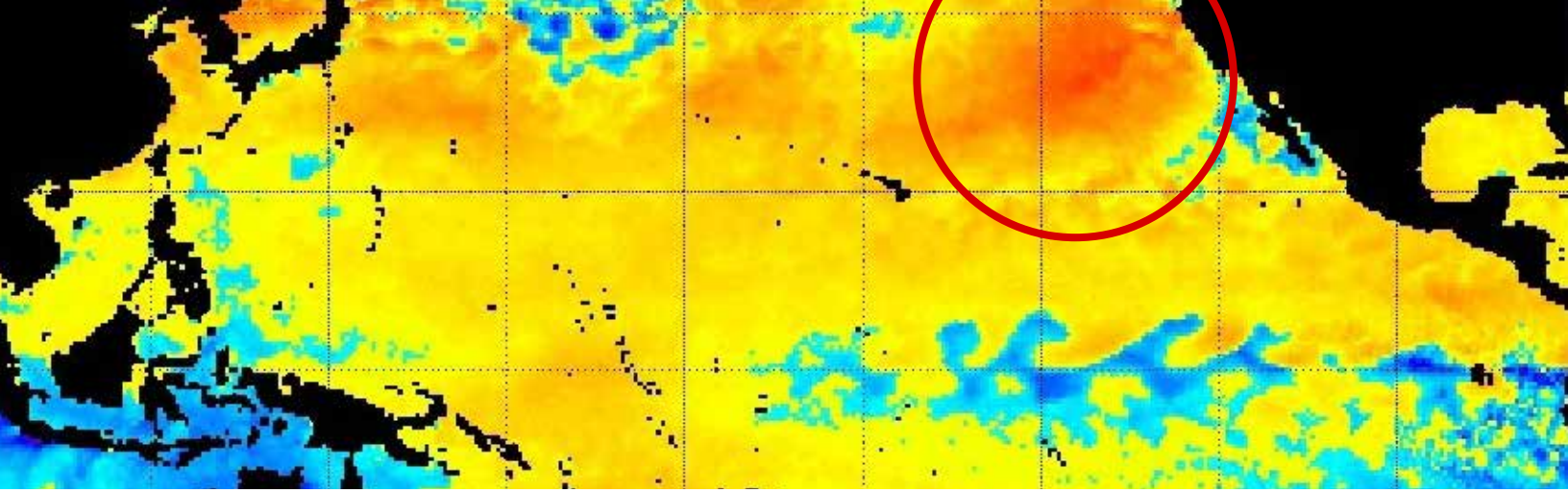


The JISAO cooperative agreement is divided into three tasks: Task I, which supports the core of JISAO's administration, education and outreach; Task II, which supports research (generally NOAA led) taking place at NOAA facilities; and Task III, which supports research (generally university led) taking place on UW campus. For last year, the funding for the three tasks breaks down as follows:



As mentioned, Task I supports JISAO's administration, education and outreach. The following is a more specific breakdown of how those funds were spent:





A NEW BLOB ALONG OUR COAST? SEE WHAT NICK BOND HAS TO SAY ABOUT IT

Reprinted from UW College of the Environment

In the fall of 2014, Nick Bond—research scientist at JISAO and Washington State's Climatologist—dubbed a patch of unusually warm water off the North American coast 'The Blob.' The warmer temperatures went on to wreak havoc in marine environments over the following year. Now, another slug of warm water has appeared, this time stretching all the way to Hawaii. We sat down with Bond to talk about this new Blob—which is an anomaly in the ocean more commonly referred to as a marine heat wave—and what we might expect.

We're seeing a new Blob form along our coast. How does it compare to the one in 2014?

At its maximum right now, well off the coast of Oregon, it's about three degrees Celsius (five degrees Fahrenheit) above normal. It's very warm in the Gulf of Alaska, and the Chukchi Sea is really hot. The present event is at least as big as it was in 2014—it doesn't extend as far down into Southern and Baja, California like the last one, but it does extend a little bit further out to the southwest. For most of its geographic extent, it looks like the layer of warm water is relatively shallow, roughly 20-30 meters deep, whereas with the Blob of 2014-16 was more like 100 or more meters deeper.

We know that the last one had profound impacts on the marine ecosystem. Can you talk about those impacts?

We noticed the warmer water in the summer of 2014, but it really started manifesting in real noticeable impacts later in 2014 as that warm water moved into the coastal region. One of the first real effects we saw was a massive die off of seabirds along the Washington-Oregon coast, Cassin's auklets—they were emaciated. The auklets target krill and large zooplankton that depend on cold water. Then in 2015, all sorts of things happened—higher mortality of marine mammals, from sea lions down in California to fin whales in the Gulf of Alaska.

Nick Bond, WA State Climatologist

There were also harmful algal blooms that got a lot of attention. Soon there were a lot of unusual sightings of warm water species, including things like ocean sunfish that were up in the Gulf of Alaska. So there were all sorts of disruptions to the marine environment.

What about now? Are we seeing these same disruptions to marine organisms?

It's a little early—we don't really know how this one is going to play out.

How long can we expect this current Blob to stick around?

The seasonal weather predictions are suggesting that as the storms start rolling through the north Pacific, the warm water temperatures will get damped down. In most cases, as storm systems go by there's an increase of winds that draws more heat out of the ocean. Moreover, the winds and associated waves with those storms cause more mixing of the upper ocean, bringing up cooler water from below which cools the surface layers. We think for this year it'll stay on the warm side, but not as warm as it was with this past event.

Why are we seeing this happen, and is this something that we can expect more of?

The climate community is looking into that. The easy answer is that it is random variability in the atmosphere and ocean.

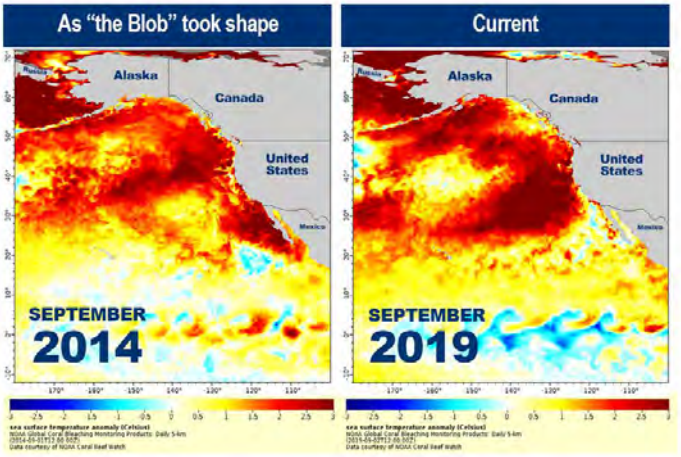
It's not like we've gone into a different sort of climate regime where the weather patterns have really shifted or anything like that. But we also know that the oceans are warming; there's a baseline upward trend in temperatures. So that means when we get these perturbations, they're happening on top of what's already an elevated baseline. I think the important point is that with climate change, at least so far, it's just making it that much worse.

What can we learn about the future from these events?

From the ecosystem point of view, we can use these events to a certain extent as a dress rehearsal for the kind of changes we're anticipating with global warming. In very rough terms, the climate models as a group are showing that the temperatures in these warm events are going to be what the normal temperatures are in the middle of the century. We're certainly going to have warm and cool events in the future, so with that baseline warming it means that when you have those warm events in the future, they're going to be out there in uncharted territory. And then it'll take a cool event in the future to create something like what we see as normal conditions today.

One more question: if you had to rename The Blob, what would you name it?

Yeah, well, you know, I have some regrets about coming up with that four-letter word, you know, digging deep into my vocabulary, of course. Yeah, boy. I think the term 'marine heat wave' is better. Maybe it doesn't roll off the tongue quite the same way, but I'm comfortable with that. And I think that's better than just saying 'event'. You know, you hear the word 'event' and you think, "What do you mean, like Elton John is coming to town or something?"



Sea surface temperature anomaly maps show temperatures above normal in orange and red. *Image: NOAA Coral Reef Watch, which corrects effectively for cloud cover.*

publications

JISAO RESEARCHERS AUTHORED THE FOLLOWING PUBLICATIONS BETWEEN SEPTEMBER 2019 AND SEPTEMBER 2020.

Anderson, N. D., et al. (2020), Challenges of Measuring Abyssal Temperature and Salinity at the Kuroshio Extension Observatory, Journal of Atmospheric and Oceanic Technology, doi:10.1175/jtech-d-19-0153.1.

Bates, T., P. Quinn, D. Coffman, J. Johnson, L. Upchurch, et al. (2020), Variability in Marine Plankton Ecosystems Are Not Observed in Freshly Emitted Sea Spray Aerosol Over the North Atlantic Ocean, Geophysical Research Letters, 47(1), e2019GL085938, doi:10.1029/2019gl085938.

Baumberger, T., MD Lilley, ET Baker, RW Embley, JA Resing, et al. (2020), Dissolved Gas and Metal Composition of Hydrothermal Plumes From a 2008 Submarine Eruption on the Northeast Lau Spreading Center, Front Mar Sci, doi:10.3389/fmars.2020.00171.

Bednaršek, N., et al. (2020), Exoskeleton dissolution with mechanoreceptor damage in larval Dungeness crab related to severity of present-day ocean acidification vertical gradients, Science of The Total Environment, 716, 136610, doi:10.1016/j.scitotenv.2020.136610.

Best, J., and A. Punt (2020), Parameterizations for Bayesian state-space surplus production models, Fisheries Research, 222, 105411, doi:10.1016/j.fishres.2019.105411.

Bonnel, J., A. Thode, D. Wright, and R. Chapman (2020), Nonlinear time-warping made simple: A step-by-step tutorial on underwater acoustic modal separation with a single hydrophone, The Journal of the Acoustical Society of America, 147(3), 1897-1926, doi:10.1121/10.0000937.

Burton, E. J., and R. N. Lea (2019), Annotated checklist of fishes from Monterey Bay National Marine Sanctuary with notes on extralimital species, Zookeys, 887, 1-119, doi:10.3897/zookeys.887.38024.

Buser, T. J., D. L. Finnegan, A. P. Summers, and M. A. Kolmann (2019), Have Niche, Will Travel. New Means of Linking Diet and Ecomorphology Reveals Niche Conservatism in Freshwater Cottoid Fishes, Integrative Organismal Biology, 1(1), doi:10.1093/iob/obz023.

Campbell, M. A., T. J. Buser, M. E. Alfaro, and J. A. López (2020), Addressing incomplete lineage sorting and paralogy in the inference of uncertain salmonid phylogenetic relationships, PeerJ, 8, e9389, doi:10.7717/peerj.9389.

Cao, J., J. T. Thorson, A. E. Punt, and C. Szuwalski (2020), A novel spatiotemporal stock assessment framework to better address fine-scale species distributions: Development and simulation testing, Fish and Fisheries, 21(2), 350-367, doi:10.1111/faf.12433.

Capotondi, A., Jacox, M., Bowler, C., Kavanaugh, M., et al. (2019), Observational Needs Supporting Marine Ecosystems Modeling and Forecasting: From the Global Ocean to Regional and Coastal Systems, Front Mar Sci, doi:10.3389/fmars.2019.00623.

Castellote, M., R. J. Small, M. O. Lammers, J. Jenniges, et al. (2020), Seasonal distribution and foraging occurrence of Cook Inlet

beluga whales based on passive acoustic monitoring, Endangered Species Research, 41, 225-243, doi:10.3354/esr01023.

Chiodi, A. (2019), Diagnosing and Predicting ENSO SSTA Development from Moored-Buoy and Scatterometer Winds, Journal of Climate, 32(24), 8755-8770, doi:10.1175/jcli-d-19-0183.1.

Chiodi, A. M., and D. E. Harrison (2020), Tropical Pacific Surface Wind Energy Spectra and Coherence: Basinwide Observations and Their Observing System Implications, Journal of Climate, 33(16), 7141-7154, doi:10.1175/jcli-d-19-0836.1.

Chong, L., T. K. Mildenberger, M. B. Rudd, M. H. Taylor, et al. (2020), Performance evaluation of data-limited, length-based stock assessment methods, ICES Journal of Marine Science, 77(1), 97-108, doi:10.1093/icesjms/fsz212.

Chu, S. N., A. J. Sutton, S. R. Alin, N. Lawrence-Slavas, et al. (2020), Field evaluation of a low-powered, profiling pCO2 system in coastal Washington, Limnology and Oceanography: Methods, 18(6), 280-296, doi:10.1002/lom3.10354.

Clague, D., J. Martin, J. Paduan, D. Butterfield, et al. (2020), Hydrothermal chimney distribution on the Endeavour Segment, Juan de Fuca Ridge, Geochemistry, Geophysics, Geosystems, e2020GC008917, doi:10.1029/2020GC008917.

Clarke, J. T., A.A. Brower, M.C. Ferguson, and A.L. Willoughby (2019), Distribution and Relative Abundance of Marine Mammals in the Eastern Chukchi and Western Beaufort Seas, Annual Report, OCS Study BOEM 2019-021, Marine Mammal Laboratory, AFSC.

Clem, K. R., R. L. Fogt, J. Turner, B. R. Lintner, et al. (2020), Record warming at the South Pole during the past three decades, Nature Climate Change, doi:10.1038/s41558-020-0815-z.

Comiso, J. C., D. K. Hall, and I. Rigor (2019), 5 - Ice Surface Temperatures in the Arctic Region, in Taking the Temperature of the Earth, edited by G. C. Hulley and D. Ghent, pp. 151-184, Elsevier, doi:10.1016/B978-0-12-814458-9.00005-8.

Crawford, L., et al. (2020), Tube-like structures within the ovarian follicle of Hydrolagus colliei indicates the early origins of follicle cell processes, Journal of Fish Biology, n/a(n/a), doi:10.1111/jfb.14423.

Danielson, S. L., et al. (2020), Manifestation and consequences of warming and altered heat fluxes over the Bering and Chukchi Sea continental shelves, Deep Sea Research Part II: Topical Studies in Oceanography, 177, 104781, doi:10.1016/j.dsr2.2020.104781.

De Robertis, A., N. Lawrence-Slavas, R. Jenkins, I. Wangen, C. Mordy, et al. (2019), Long-term measurements of fish backscatter from Saildrone unmanned surface vehicles and comparison with observations from a noise-reduced research vessel, ICES Journal of Marine Science, 76(7), 12, doi:10.1093/icesjms/fsz124.

Echols, R., and S. C. Riser (2020), The Impact of Barrier Layers on Arabian Sea Surface Temperature Variability, Geophysical Research Letters, 47(3), e2019GL085290, doi:10.1029/2019gl085290.

Fiorenza, E. A., et al. (2020), Fluid preservation causes minimal reduction of parasite detectability in fish specimens: A new approach for reconstructing parasite communities of the past?, Ecology and Evolution, n/a(n/a), doi:10.1002/ece3.6379.

Freitag, H., M. McPhaden, and K. Connell (2019), Global Tropical Moored Buoy Array Wind Direction Accuracy Revisited, NOAA Technical Memorandum OAR PMEL-150, doi: 10.25923/bn0n-3g25.

German, C. R., J A Resing, G Xu, I A Yeo, et al. (2020), Hydrothermal Activity and Seismicity at Teahitia Seamount: Reactivation of the Society Islands Hotspot?, Front Mar Sci, doi:10.3389/fmars.2020.00073.

Ghedotti, M. J., W. L. Smith, and M. P. Davis (2019), The first evidence of intrinsic epidermal bioluminescence within ray-finned fishes in the linebelly swallower Pseudoscopelus sagamianus (Chiasmodontidae), Journal of Fish Biology, 95(6), 1540-1543, doi:10.1111/jfb.14179.

Goldstein, E. D., J. L. Pirtle, J. T. Duffy-Anderson, W. T. Stockhausen, M. Zimmermann, M. T. Wilson, and C. W. Mordy (2020), Eddy retention and seafloor terrain facilitate cross-shelf transport and delivery of fish larvae to suitable nursery habitats, Limnology and Oceanography, n/a(n/a), doi:10.1002/lno.11553.

Grandy, J. J., B. Onat, V. Tunnicliffe, D. A. Butterfield, and J. Pawliszyn (2020), Unique Solid Phase Microextraction Sampler Reveals Distinctive Biogeochemical Profiles among Various Deep-Sea Hydrothermal Vents, Scientific Reports, 10(1), 1360, doi:10.1038/s41598-020-58418-4.

Grüss, A., et al. (2020), Estimating synchronous changes in condition and density in eastern Bering Sea fishes, Marine Ecology Progress Series, 635, 169-185, doi:10.3354/meps13213.

Harvey, C. J., et al. (2019), Ecosystem Status Report of the California Current for 2019: A Summary of Ecosystem Indicators Compiled by the California Current Integrated Ecosystem Assessment Team (CCIEA), U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-149, doi:10.25923/p0ed-ke21.

He, H., et al. (2020), Facilitating International Collaboration on Climate Change Research, Bull. Amer. Meteor. Soc., 101(5), E650–E654, doi:10.1175/BAMS-D-19-0320.1.

Hilborn, R., et al. (2020), Effective fisheries management instrumental in improving fish stock status, Proceedings of the National Academy of Sciences, 117(4), 2218-2224, doi:10.1073/pnas.1909726116.

Hollowed, A. B., et al. (2020), Integrated Modeling to Evaluate Climate Change Impacts on Coupled Social-Ecological Systems in Alaska, Frontiers in Marine Science, 6(775), doi:10.3389/fmars.2019.00775.

Hoy, M. S., and C. O. Ostberg (2019), Development of two quantitative PCR assays for detection of several Cottus species from environmental DNA in Pacific coast watersheds of North America, Conservation Genetics Resources, doi:10.1007/s12686-019-01118-7.

Huie, J. M., C. E. Thacker, and L. Tornabene (2020), Co-evolution of cleaning and feeding morphology in western Atlantic and eastern Pacific gobies, Evolution, 74(2), 419-433, doi:10.1111/evo.13904.

Jacobson, E. K., et al. (2020), Assessing cetacean populations using integrated population models: an example with Cook Inlet beluga whales, Ecological Applications, 30(5), e02114, doi:10.1002/eap.2114.

Jacox, M. G., et al. (2020), Seasonal-to-interannual prediction of North American coastal marine ecosystems: Forecast methods, mechanisms of predictability, and priority developments, Progress in Oceanography, 183, 102307, doi:10.1016/j.pocean.2020.102307.

Jiang, L.-Q., B. Carter, R. Feely, S. Lauvset, and A. Olsen (2019), Surface ocean pH and buffer capacity: past, present and future, Scientific Reports, 9, 18624, doi:10.1038/s41598-019-55039-4.

Kapur, M., et al. (2019), Oceanographic features delineate growth zonation in Northeast Pacific sablefish, Fisheries Research, 222, 105414, doi:10.1016/j.fishres.2019.105414.

Karp, M. A., et al. (2019), Accounting for shifting distributions and changing productivity in the development of scientific advice for fishery management, ICES Journal of Marine Science, 76(5), 1305-1315, doi:10.1093/icesjms/fsz048.

Kastelle, C., et al. (2020), Age validation of four rockfishes (genera Sebastes and Sebastolobus) with bomb-produced radiocarbon, Marine and Freshwater Research, -, doi:10.1071/MF19280.

Kearney, K., A. Hermann, W. Cheng, I. Ortiz, and K. Aydin (2019), A coupled pelagic-benthic-sympagic biogeochemical model for the Bering Sea: documentation and validation of the BESTNPZ model (v2019.08.23) within a high-resolution regional ocean model, Geosci. Model Dev., 13(2), 597-650, doi:10.5194/gmd-2019-239.

Kenchington, T. J., et al. (2020), Pelagic anglerfishes (Lophiiformes: Ceratioidei) of The Gully Marine Protected Area, Marine Biology Research, 1-15, doi:10.1080/17451000.2020.1771598.

Kerns, B. W., and S. S. Chen (2020), A 20-Year Climatology of Madden-Julian Oscillation Convection: Large-Scale Precipitation Tracking From TRMM-GPM Rainfall, Journal of Geophysical Research: Atmospheres, 125(7), e2019JD032142, doi:10.1029/2019jd032142.

Ko, Y. H., and P. D. Quay (2020), Origin and Accumulation of an Anthropogenic CO2 and 13C Suess Effect in the Arctic Ocean, Global Biogeochemical Cycles, 34(2), e2019GB006423, doi:10.1029/2019gb006423.

Kolmann, M. A., et al. (2020), Habitat transitions alter the adaptive landscape and shape phenotypic evolution in needlefishes (Belonidae), Ecology and Evolution, 10(8), 3769-3783, doi:10.1002/ece3.6172.

Kruppert, S., et al. (2020), Ontogeny and potential function of poacher armor (Actinopterygii: Agonidae), Journal of Morphology, n/a(n/a), doi:10.1002/jmor.21223.

Kuhn, C. E., et al. (2019), Test of unmanned surface vehicles to conduct remote focal follow studies of a marine predator, Marine Ecology Progress Series, 635, 1-7, doi:10.3354/meps13224.

Kuriyama, P. T., et al. (2019), Catch shares drive fleet consolidation and increased targeting but not spatial effort concentration nor changes in location choice in a multispecies trawl fishery, Canadian Journal of Fisheries and Aquatic Sciences, 76(12), 2377-2389,

doi:10.1139/cjfas-2019-0005.

Lauvset, S. K., B. R. Carter, F. F. Perez, L.-Q. Jiang, et al. (2020), Processes driving global interior ocean pH distribution, Global Biogeochemical Cycles, 34(1), e2019GB006229, doi:10.1029/2019gb006229.

Li, S., M. Wang, W. Huang, S. Xu, B. Wang, and Y. Bai (2020), Using a skillful statistical model to predict September sea ice covering Arctic shipping routes, Acta Oceanologica Sinica, 39(5), 11-25, doi:10.1007/s13131-020-1595-z.

Litzow, M. A., M. E. Hunsicker, N. A. Bond, B. J. Burke, et al. (2020), The changing physical and ecological meanings of North Pacific Ocean climate indices, Proceedings of the National Academy of Sciences, 117(14), 7665-7671, doi:10.1073/pnas.1921266117.

Litzow, M. A., M. J. Malick, N. A. Bond, C. J. Cunningham, et al. (2020), Quantifying a Novel Climate Through Changes in PDO-Climate and PDO-Salmon Relationships, Geophysical Research Letters, 47(16), e2020GL087972, doi:10.1029/2020gl087972.

Logerwell, E. A., M. Busby, K. L. Mier, H. Tabisola, and J. Duffy-Anderson (2020), The effect of oceanographic variability on the distribution of larval fishes of the northern Bering and Chukchi seas, Deep Sea Research Part II: Topical Studies in Oceanography, 104784, doi:https://doi.org/10.1016/j.dsr2.2020.104784.

Lomas, M., L. Eisner, J. Cosden Gann, S. E. Baer, C. W. Mordy, and P. J. Stabeno (2020), Time-series of direct primary production and phytoplankton biomass in the southeastern Bering Sea: Responses to cold and warm stanzas, Marine Ecology Progress Series, doi:10.3354/meps13317.

Ma, Q., et al. (2020), Interannual Variability of Lower Equatorial Intermediate Current Response to ENSO in the Western Pacific, Geophysical Research Letters, 47(16), e2020GL089311, doi:10.1029/2020gl089311.

Matić-Skoko, S., et al. (2020), Fish and Sclerochronology Research in the Mediterranean: Challenges and Opportunities for Reconstructing Environmental Changes, Frontiers in Marine Science, 7(195), doi:10.3389/fmars.2020.00195.

Matsuzaki, K., et al. (2020), A new species of Careproctus (Cottoidei: Liparidae) from the Sea of Okhotsk and a redescription of the blacktip snailfish Careproctus zachirus, Ichthyological Research, 67(3), 399-407, doi:10.1007/s10228-020-00734-w.

McAllister, S. M., S. W. Polson, D. A. Butterfield, B. T. Glazer, et al. (2020), Validating the Cyc2 Neutrophilic Iron Oxidation Pathway Using Meta-omics of Zetaproteobacteria Iron Mats at Marine Hydrothermal Vents, mSystems, 5(1), e00553-00519, doi:10.1128/mSystems.00553-19.

McGowan, D., et al. (2019), Spatial and temporal dynamics of Pacific capelin (Mallotus catervarius) in the Gulf of Alaska: implications for ecosystem-based fisheries management, Marine Ecology Progress Series, doi:10.3354/meps13211.

Meinig, C., et al. (2019), Public private partnerships to advance regional ocean observing capabilities: A Saildrone and NOAA-PMEL case study and future considerations to expand to global scale observing, Front Mar Sci, 6 (Oceanobs19: An Ocean of Opportunity), doi:10.3389/fmars.2019.00448.

Meléndez, M., et al. (2020), Seasonal Variations of Carbonate Chemistry at Two Western Atlantic Coral Reefs, Journal of Geophysical Research: Oceans, 125(8), e2020JC016108, doi:10.1029/2020jc016108.

Miller, D. J. (2020, 1976), Miller and Lea's Guide to the Coastal Marine Fishes of California, edited by M. Love and J. Passarelli, UCANR Publications, Davis, CA.

Mordy, C. W., S. Bell, E. D. Cokelet, C. Ladd, et al. (2020), Seasonal and interannual variability of nitrate in the eastern Chukchi Sea: Transport and winter replenishment, Deep Sea Research Part II: Topical Studies in Oceanography, 104807, doi:10.1016/j.dsr2.2020.104807.

Muto, M. M., et al. (2019), Alaska Marine Mammal Stock Assessments, 2018 (NOAA Technical Memorandum NMFS-AFSC-393), 390, doi:10.25923/15rp-p193.

Nazarkin, M. V., and T. W. Pietsch (2020), A fossil dreamer of the genus Oneirodes (Lophiiformes: Ceratioidei) from the Miocene of Sakhalin Island, Russia, Geological Magazine, 1-5, doi:10.1017/S0016756820000588.

Norton, E., Siedlecki, S.A., Kaplan, I.C., Hermann, A.J., et al. (2020), The Importance of Environmental Exposure History in Forecasting Dungeness Crab Megalopae, Occurrence Using J-SCOPE, a High-Resolution Model for the US Pacific Northwest, Front Mar Sci, 7, doi:10.3389/fmars.2020.00102.

Okazaki, T., et al. (2020), Genetic population structure and demographic history of a pelagic lumpsucker, Aptocyclus ventricosus, Environmental Biology of Fishes, 103(3), 283-289, doi:10.1007/s10641-020-00955-y.

Oladi, M., R. Saberi-Pirooz, F. Ahmadzadeh, and A. Ghazilou (2019), Further Documentation of the Indian Frogfish, Antennarius indicus (Teleostei: Lophiiformes), from the ROPME Sea Area; a Molecular and Morphological Approach, Thalassas: An International Journal of Marine Sciences, 35(2), 503-509, doi:10.1007/s41208-019-00147-1.

Olsen, A., Lange, N., Key, R. M., Tanhua, T., Álvarez, M., Becker, S., and Wanninkhof, R. (2019), GLODAPv2.2019 - An update of GLODAPv2, Earth System Science Data, 11(3), doi:10.5194/essd-11-1437-2019.

Orlova, S. Y., et al. (2019), Evolutionary history told by mitochondrial markers of large teleost deep-sea predators of family Anoplopomatidae Jordan & Gilbert 1883, endemic to the North Pacific, Journal of the Marine Biological Association of the United Kingdom, 99(7), 1683-1691, doi:10.1017/S0025315419000572.

Orr, J. (2019), Snailfishes, in Miller and Lea's Guide to the Coastal Marine Fishes of California, 2nd Ed., edited by M. Love and J. Passarelli, Davis: UC Agriculture and Natural Resources Publication 3556, San Pedro, CA.

Overland, J., et al. (2019), The urgency of Arctic change, Polar Science, 21, 6-13, doi:10.1016/j.polar.2018.11.008.

Peng, G., Jessica L. Matthews, Muyin Wang, et al. (2020), What Do Global Climate Models Tell Us About Future Arctic Sea Ice Coverage Changes?, Climate, 8(1), 15, doi:10.3390/cli8010015.

Peterson, P. K., et al. (2019), Snowpack measurements suggest role for multi-year sea ice regions in Arctic atmospheric bromine and chlorine chemistry, Elementa (Washington, D.C.), 7(1), doi:10.1525/elementa.352.

Pietsch, T. (2019), Families Antennariidae, Diceratiidae, and Oneirodidae, in Field Identification Guide to the Living Marine Resources of Myanmar, edited by P. Psomadakis, H. Thein, B. Russell and M. Tun, pp. 233-234, FAO and MOALI, Rome.

Pietsch, T., and R. J. Arnold (2020), Frogfishes: Biodiversity, Zoogeography, and Behavioral Ecology, John Hopkins University Press.

Pietsch, T., and J. Orr (2019), Fishes of the Salish Sea: Puget Sound and the Straits of Georgia and Juan de Fuca, 1048 pp., University of Washington Press, Seattle.

Post, E., et al. (2019), The polar regions in a 2°C warmer world, Science Advances, 5(12), eaaw9883, doi:10.1126/sciadv.aaw9883.

Privitera-Johnson, K. M., and A. E. Punt (2019), Leveraging scientific uncertainty in fisheries management for estimating among-assessment variation in overfishing limits, ICES Journal of Marine Science, 77(2), 515-526, doi:10.1093/icesjms/fsz237.

Privitera-Johnson, K. M., and A. E. Punt (2020), A review of approaches to quantifying uncertainty in fisheries stock assessments, Fisheries Research, 226, 105503, doi:10.1016/j.fishres.2020.105503.

Prokofiev, A., and T. Pietsch (2019), First Record of the Ceratioid Anglerfish Species Gigantactis microdontis (Teleostei: Lophiiformes: Gigantactinidae) in the Western Pacific Ocean, Zootaxa, 4664, 441-444, doi:10.11646/zootaxa.4664.3.11.

Punt, A. E., and J. M. Cope (2019), Extending integrated stock assessment models to use non-depensatory three-parameter stock-recruitment relationships, Fisheries Research, 217, 46-57, doi:10.1016/j.fishres.2017.07.007.

Punt, A. E., M. G. Dalton, and R. J. Foy (2020), Multispecies yield and profit when exploitation rates vary spatially including the impact on mortality of ocean acidification on North Pacific crab stocks, Fisheries Research, 225, 105481, doi:10.1016/j.fishres.2019.105481.

Punt, A. E., et al. (2020), When are model-based stock assessments rejected for use in management and what happens then?, Fisheries Research, 224, 105465, doi:10.1016/j.fishres.2019.105465.

Quinn, P. K., et al. (2019), Seasonal Variations in Western North Atlantic Remote Marine Aerosol Properties, Journal of Geophysical Research: Atmospheres, 124(24), 14240-14261, doi:10.1029/2019jd031740.

Randall, J., M. Busby, A. Spear, and K. Mier (2019), Spatial and temporal variation of late summer ichthyoplankton assemblage structure in the eastern Chukchi Sea: 2010–2015, Polar Biology, doi:10.1007/s00300-019-02555-8.

Ray, S., S. A. Siedlecki, M. A. Alexander, N. A. Bond, and A. J. Hermann (2020), Drivers of Subsurface Temperature Variability in the Northern California Current, Journal of Geophysical Research: Oceans, 125(8), e2020JC016227, doi:10.1029/2020jc016227.

Reum, J. C. P., et al. (2020), Ensemble Projections of Future Climate Change Impacts on the Eastern Bering Sea Food Web Using a Multispecies Size Spectrum Model, Frontiers in Marine Science, 7(124), doi:10.3389/fmars.2020.00124.

Saliba, G., et al. (2019), Factors driving the seasonal and hourly variability of sea-spray aerosol number in the North Atlantic, Proceedings of the National Academy of Sciences, 116(41), 20309-20314, doi:10.1073/pnas.1907574116.

Schmeisser, L., N. A. Bond, S. A. Siedlecki, and T. P. Ackerman (2019), The Role of Clouds and Surface Heat Fluxes in the Maintenance of the 2013–2016 Northeast Pacific Marine Heatwave, Journal of Geophysical Research: Atmospheres, 124(20), 10772-10783, doi:10.1029/2019jd030780.

Shelden, K., C. Boyd, C. Sims, V. Gill, and B. Mahoney (2019), Chapter 1: Field report for the June 2018 Cook Inlet beluga aerial abundance and distribution survey, in Aerial surveys, distribution, abundance, and trend of belugas (Delphinapterus leucas) in Cook Inlet, Alaska, June 2018, AFSC Processed Report 2019-09, edited by K. Shelden and P. Wade, p. 93.

Snyder, M. R., et al. (2020), Detecting aquatic invasive species in bait and pond stores with targeted environmental (e)DNA high-throughput sequencing metabarcode assays: Angler, retailer, and manager implications, Biological Conservation, 245, 108430, doi:10.1016/j.biocon.2020.108430.

Song, S., et al. (2020), An important biogeochemical link between organic and inorganic carbon cycling: Effects of organic alkalinity on carbonate chemistry in coastal waters influenced by intertidal salt marshes, Geochimica et Cosmochimica Acta, 275, 123-139, doi:10.1016/j.gca.2020.02.013.

Sonnerup, R. E., B. X. Chang, M. J. Warner, and C. W. Mordy (2019), Timescales of ventilation and consumption of oxygen and fixed nitrogen in the eastern tropical South Pacific oxygen deficient zone from transient tracers, Deep Sea Research Part I: Oceanographic Research Papers, 151, 103080, doi:10.1016/j.dsr.2019.103080.

Stabeno, P. J., and R. M. McCabe (2020), Vertical structure and temporal variability of currents over the Chukchi Sea continental slope, Deep Sea Research Part II: Topical Studies in Oceanography, 104805, doi:10.1016/j.dsr2.2020.104805.

Trembath-Reichert, E., D. A. Butterfield, and J. A. Huber (2019), Active subseafloor microbial communities from Mariana back-arc venting fluids share metabolic strategies across different thermal niches and taxa, The ISME Journal, 13(9), 2264-2279, doi:10.1038/s41396-019-0431-y.

Trochta, J. T., T. A. Branch, A. O. Shelton, and D. E. Hay (2020), The highs and lows of herring: A meta-analysis of patterns and factors in herring collapse and recovery, Fish and Fisheries, 21(3), 639-662, doi:10.1111/faf.12452.

Voskoboinikova, O. S., et al. (2020), Relationships and Evolution of Lumpsuckers of the Family Cyclopteridae (Cottoidei), Journal of Ichthyology, 60(2), 154-181, doi:10.1134/S0032945220020204.

Wade, P., C Boyd, KEW Shelden, and CL Sims (2019), Chapter 2: Group Size Estimates and Revised Abundance Estimates and Trend for the Cook Inlet Beluga Population, in Aerial surveys, distribution, abundance, and trend of belugas (Delphinapterus leucas) in Cook Inlet, Alaska, June 2018, AFSC Processed Report 2019-09, edited by K. Shelden and P. Wade, p. 93.

Walker, S. L., E T Baker, J E Lupton, J A Resing (2019), Patterns of fine ash dispersal related to volcanic activity at West Mata volcano, NE Lau basin, Front Mar Sci, 6, doi:10.3389/fmars.2019.00593.

Weijer, W., W. Cheng, O. A. Garuba, A. Hu, and B. T. Nadiga (2020), CMIP6 Models Predict Significant 21st Century Decline of the Atlantic Meridional Overturning Circulation, Geophysical Research Letters, 47(12), e2019GL086075, doi:10.1029/2019gl086075.

Whitehouse, G. A., and K. Y. Aydin (2020), Assessing the sensitivity of three Alaska marine food webs to perturbations: an example of Ecosim simulations using Rpath, Ecol Model, 429, 109074, doi:10.1016/j.ecolmodel.2020.109074.

Whiting, A., M. Castellote, R. J. Small, K. J. Frost, and R. Suydam (2020), Unexpected mid-winter presence of harbor porpoises (Phocoena phocoena) in Kotzebue Sound, Alaska, Marine Mammal Science, 36(1), 354-358, doi:10.1111/mms.12641.

Yang, S., et al. (2020), Global reconstruction reduces the uncertainty of oceanic nitrous oxide emissions and reveals a vigorous seasonal cycle, Proceedings of the National Academy of Sciences, 117(22), 11954-11960, doi:10.1073/pnas.1921914117.

Zanowski, H., and G. C. Johnson (2019), Semiannual Variations in 1,000-dbar Equatorial Indian Ocean Velocity and Isotherm Displacements from Argo Data, Journal of Geophysical Research: Oceans, 124(12), 9507-9516, doi:10.1029/2019jc015342.

Zanowski, H., G. C. Johnson, and J. M. Lyman (2019), Equatorial Pacific 1,000-dbar Velocity and Isotherm Displacements From Argo Data: Beyond the Mean and Seasonal Cycle, Journal of Geophysical Research: Oceans, 124(11), 7873-7882, doi:10.1029/2019jc015032.

Zhong, M., M. Castellote, R. Dodhia, J. L. Ferres, M. Keogh, and A. Brewer (2020), Beluga whale acoustic signal classification using deep learning neural network models, The Journal of the Acoustical Society of America, 147(3), 1834-1841, doi:10.1121/10.0000921.

...loop Hartford. Commanded by Comd[r] Rich[d] Wainwright.

...orce.	Weather.	Temperature. Air.	Temperature. Water.	Barometer.
	bc			
3.	"			
"	"			
"	"			
"	"			
4.	c			
"	"	80		29.98
"	bc			
"	"	82		29.98
"	"			
"	"	81		29.98
"	"			
4.	bc			
3	"	79		
"	"			
"	"			
2	"			
"	"			
"	"			
"	"			
0	"			
1.	"			
2	"	80		29.92

REMARKS on this 17th day of July 1862

From Midnight to 4. A.M.

E. C. Haselline.

From 4 to 8. A.M.

At daylight the Peniola, dropped down and anchored astern of the Oneida.

Jno. L. Watson

From 8 to Meridian.

"At 9. assist. Surgeon, Gibson, returned to the ship." "The Mortar Schooners on the other side fired occasionally." "At 9.30 inspected crew at quarters." "At 9.45 made signal to the Richmond, to send a boat on board."

Henry J. Baker

From Merid[n] to 4. P.M.

"At 1.30" "Mr. Draper, Actg Master, left the ship to go North, on account of sickness." "The following men, were sent from this ship, to the hospital at Pilot-Town, by gunboat Pinola, Viz-" "Nathaniel Wright. (O.S.) Wm. B. Parlton. (O.S.)

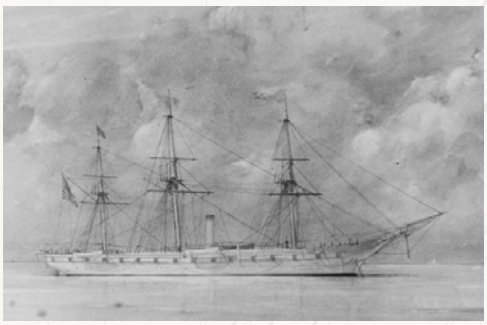
LOG OF UNITED ST...

H.	Knots.	Fathoms.	Courses
A. M.			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Distance per Log
Latitude, D. R.
Longitude, D. R.
Latitude observed
Longitude
Current
Variation

P. M.	
1	
2	
10	
11	

"At 2.30 came to anchor, in 10 fath[s] water with 15 fathoms chain to starboard [illegible]



Some creative log keeping in a digitized 1862 log book from the *USS Hartford*. The Old Weather program, led by JISAO's Kevin Wood, uses images like these to collect climate and sea ice data from the 19th and 20th century. Volunteers transcribe the historic ice and weather observations and create data sets that are freely available to help scientists better understand changes in the global environment.

Photo: Logbook images are produced by the collaborative Seas of Knowledge project at the National Archives, supported by a Digitizing Hidden Collections grant from the Council on Library and Information Resources. The grant program is made possible by funding from The Andrew W. Mellon Foundation. Learn more at archivesfoundation.org/digitalweather and oldweather.org.

ATES Steam Sloop of War HARTFORD. Commanded by Com.dr Richd Wainwright.

Wind.		Weather.	Temperature.		Barometer.	Remarks on this 15th day of July 1862
Direction.	Force.		Air.	Water.		
S.E by E.	2.	bc.				From Midnight to 4 A.M.
"	"	bc	76		29.94	As per Columns. Henry J. Blake
"	"	"				
"	"	"	76		29.94	From 4 to 8 A.M.
S.S.W.	3.	"				
"	"	"	78		29.96	At 6 Gunboats Wissahickon and Winona, got
"	2.	"				underweigh and proceeded down the river.
"	"	"	79		30.00	At 7 A.M. U.S.S. Kensington came
"	"	"				alongside.
"	"	"	82		30.	THE RAM IN SIGHT. OFF VICKSBURG.
"	"	"				D S Murphy
"	"	"	83		30.	From 8 A.M. to Noon.
						At 8.30 AM, watch on deck, commenced to provision ship. Received on board 102 Bbls Bread, 50 Bbls Pork & 27 Bbls Beef from the U.S. Store Ship Kensington. Strs Burton, Sbervide and Sauck Hill went down the river. Mortars above Vicksburg throwing shell at the Rebel Ram.
S by W.	1.	bc				The Brooklyn fired a shot at a battery abreast
"	"	"	83		30.	of her.
"	"	"				
"	"	"	84		30.	
"	"	"				From Meridian to 4 P.M.
Calm.	0.	bc	83		"	Engaged in taking in provisions. At 1 P.M. the
"	"	"				Brooklyn got underway and dropped down the river.
"	"	b	84		30.00	Received the following stores in the Paymasters
"	"	"				department 3 Bbls Beef. 480 lbs.
"	"	"	84		"	Beef. 21 Bbls Bread. 227 lbs Tea. 684. Pickles.

2020
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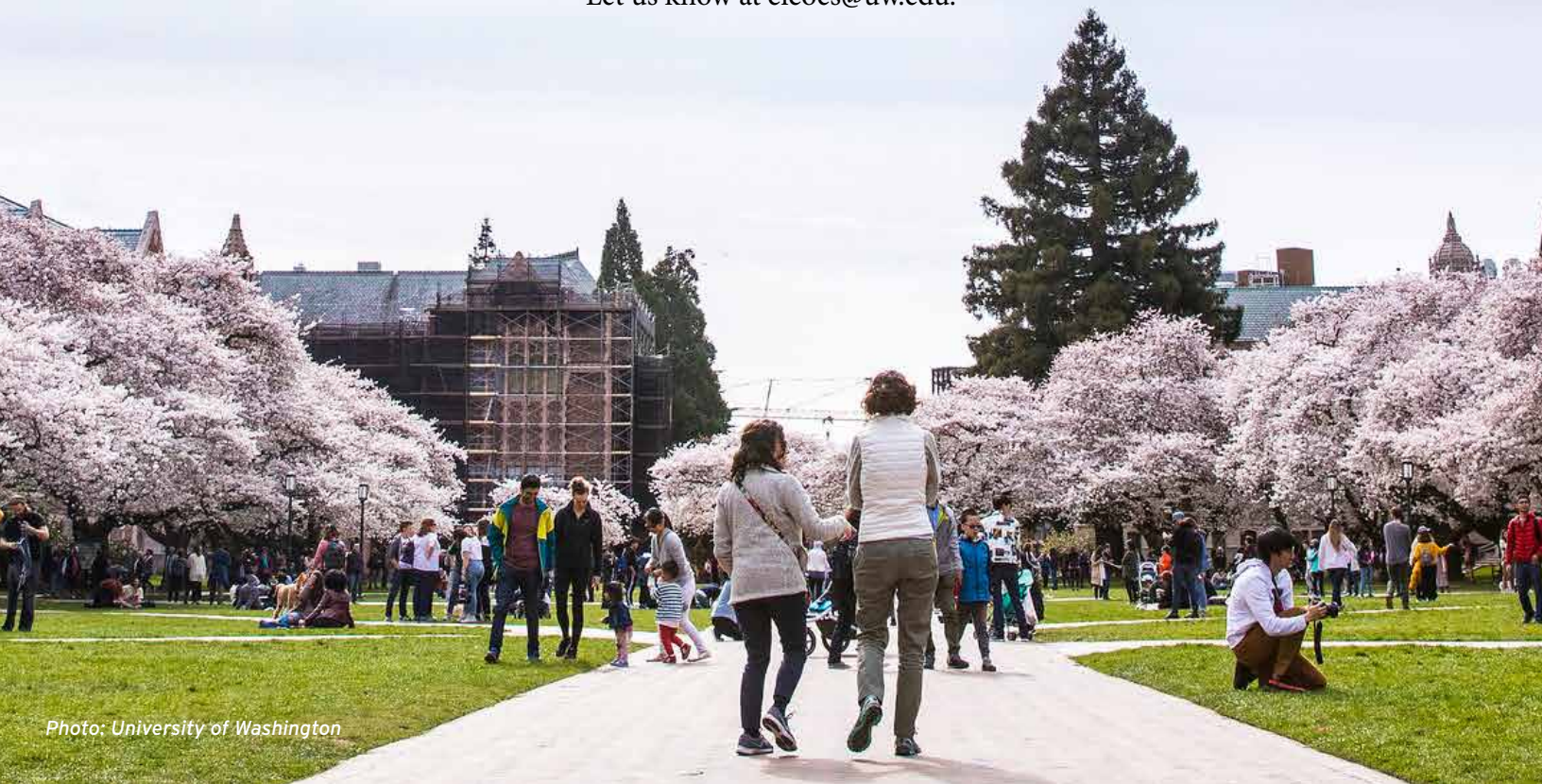

Photo: University of Washington

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