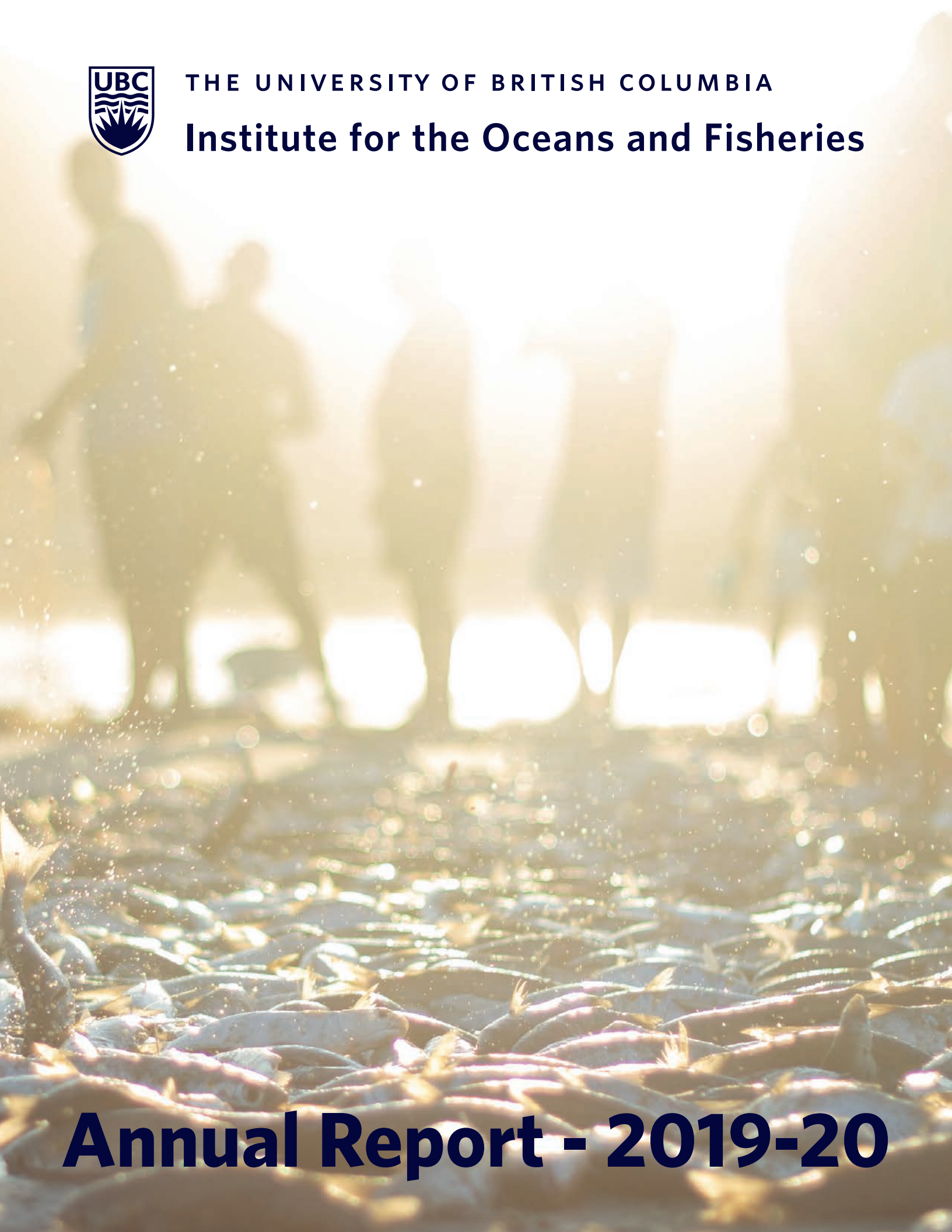
THE UNIVERSITY OF BRITISH COLUMBIA

Institute for the Oceans and Fisheries



Annual Report - 2019-20

Director's message

Once again this is not an Annual Report, but a bi-annual one. For the Institute for the Oceans and Fisheries, much like for the entire world, 2019 was somewhat truncated as the global pandemic had our researchers working from home, cancelling fieldwork, and reorganizing their lives – both research life and other - to adapt to the new situation. 2020 was similarly affected, and as such it made sense to roll the two years in to one Report.

Still, once we did that, we were somewhat surprised to see how much we had accomplished in this period! Whether isolating at home or undertaking public health responsible fieldwork, the IOF community continued to shine. We persisted in undertaking interdisciplinary research on the ocean environment and contributing to a transformative global shift toward sustainable coastal ecosystems, oceans and fisheries. Our research spanned the ocean and freshwater ecosystems from infinitesimal viruses to bowhead whales, as well as having major policy and decision-making impacts at the local, national and international levels. We continued to build not only on our research areas, but on developing strong foundations, programs and processes for our Institute. Community members were recognized for their excellent research efforts, and, sadly, we also lost some of our guiding lights. Through it all we endured, learned, and steered our path forward.

We look forward to sharing our milestones, and outlining our research, collaborative engagement, and outreach. Enjoy!

Dr. Evgeny Pakhomov
Professor and Director, Institute for the Oceans and Fisheries
The University of British Columbia

All creatures, great and small

IOF researchers look at freshwater and ocean species from viruses to cetaceans.

Viruses in salmon

Curtis Suttle (Professor), with Gideon Mordecai (PhD student), Scott Hinch (Professor, UBC Forestry), and other researchers from the Pacific Salmon Foundation and Fisheries and Oceans Canada, led a large multi-investigator project that used genomics to detect for viruses in salmon. This led to the publication of several high impact papers, including one, with Mordecai as lead author, that described several previously unknown viruses circulating in wild and farmed salmon populations.

©Kristi-Miller-Saunders/ DFO

Of the three new viruses, one, an arenavirus, was found in farmed, hatchery, and wild chinook and sockeye salmon. A nidovirus was found in farmed, hatchery, and wild chinook, while a reovirus was found only in farmed salmon.

The team looked at farmed fish first because it is difficult to find diseased fish in the wild. On fish farms, diseases are much more obvious as fish are found dead or dying with abnormalities on their bodies; in the wild, salmon displaying any deficits in performance are usually eaten. Still, the team was able to find the viruses in wild salmon, which they had collected and tested in the lab, by using molecular analyses to see if their immune responses were triggered by a virus. One new virus, detected more commonly in salmon hatcheries, infected more than 15% of all hatchery Chinook tested. Another new virus was detected in 20% of Chinook from fish farms, but was only found in adult or sub-adult salmon. In general, the new viruses were more commonly found in cultured fish populations than in wild populations.

Although the scientists found that the viruses were infecting the salmon's cells, they did not proved that the viruses cause diseases. Linking the new viruses to diseases is the next step for further research.

Over the past 30 years, steady declines in Chinook and sockeye salmon populations have been of great concern to Indigenous communities, commercial and recreational fishers, and the general public. While much of the focus has been on the impact of piscine orthoreovirus (PRV), the new findings highlight how little is known about other viruses endemic to salmon populations. The scientists were also unsure if the viruses are being passed between farmed and wild fish. They tested chinook and sockeye salmon from different locations as a first step to understanding possible transmission. Genomic sequencing will be used to see whether viruses found in different populations are the same.

Viruses galore!

Suttle, along with Chris Harley (Professor) and others, looked at the population genetics of oysters, their microbiomes and ocean acidification to understand the causes of large local and world-wide die-offs in bivalves. Another project had Brian Hunt and Suttle working on an examination of the role viruses play in regulating crustacean zooplankton populations and looking at the microbiomes of zooplankton and sea lice. Preliminary metagenomic sequencing results have revealed a large number of previously unknown viruses, as well as in a wide range of Arthropods.

Krill like it cold

Warming climates have Antarctic krill moving further south to colder regions. That was the conclusion of research from the creation of the unique data base, KRILLBASE, a research project, in which Evgeny Pakhomov (Professor and Director) participated.

A keystone species, krill are the most heavily tapped fishing prey in the world. These tiny pelagic, shrimp-like crustaceans are crucial to predators like whales, seals and birds, and also play an important role in the cycle of critical elements such as carbon, nitrogen and iron by returning these elements to the environment.

Pakhomov's research determined that the krill population's circumantarctic distribution had changed and that they were more concentrated around the colder, southern Antarctic ice shelves. The total population density was also on a decline, which, he warned, could affect the Southern Ocean's pelagic ecosystem structure, and alter biogeochemical cycling in the region.

In addition to his work on Antarctic krill, Pakhomov also contributed significant advancements that aid our understanding of the biology, ecophysiology and ecological role of key organisms in the Southern Ocean including tunicates and other non-gelatinous species.

Krill ©KoiQuestion /Flickr

Taking on the world -

The Project Seahorse team, led by Amanda Vincent (Professor), undertook a variety of initiatives, with the clear aim of saving syngnathid fishes (seahorses, pipefishes, and seadragons) internationally.

Weedy seadragon (*Phycodurus eques*). Photo by Gaetano Gargiulo / Guylian Seahorses of the World

Kyle Gillespie (PhD candidate) led research in the Central Philippines, diving on remote coral reefs to analyse the effects of marine reserves on invertebrates - key prey for the dainty seahorse. In those shallow, protected seas, Gillespie found that marine reserves could increase the abundance of invertebrates important to local fisheries by 1.5 to 2.3 times, and with nearby areas seeing spillover benefits.

Research by Ting-Chun Kuo (PhD candidate), found that many nations with bans on the trade of seahorse products apparently continued to export dried seahorses, thus failed to meet their obligations under The United Nations Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and failed to enforce the trade bans. The researchers found that 95% of dried seahorses in Hong Kong's large market were reported as being imported from source countries that had export bans in place, including Thailand, the Philippines, Indonesia, India, Malaysia, and Viet Nam.

Xiong Zhang (PhD graduate and postdoctoral fellow), developed a novel way to identify which marine species are threatened and what is threatening them, even if these species lack data. "By

Dried seahorses for sale in Hong Kong. © T. Stiem/Project Seahorse

to save seahorses

quantifying and mapping the combined human pressures on individual species – using existing, if scarce, data, modeling techniques and expert knowledge – we can address this challenge," Zhang explained. Using this estimation of cumulative human impact (CHI) approach, the researchers looked specifically at seahorses, mapping the human impact of 12 human-created stressors onto 42 seahorse species to predict which data-poor seahorses might be threatened, what is threatening them and which areas are under the greatest threat. The researchers found that five of 17 seahorse species with unknown conservation statuses were potentially under threat. China, Southeast Asia and Europe were identified as major threat epicentres for seahorses, having the highest level of combined human pressures for populations of 33 seahorse species. While seahorses are threatened by a variety of human activities, the researchers identified non-selective bottom fishing, as well as ocean and nutrient pollution, as putting more severe pressures on global seahorse populations. Species-level CHI modelling could help estimate conservation status for thousands of Data Deficient species on the IUCN Red List.

In addition to their other publications, Project Seahorse released two Fisheries Center Research Reports (FCRR), one each in 2019 and 2020, respectively. The first looked at the catch and trade of seahorses in the Philippines post-CITES, concluding that the Philippines was not fully implementing CITES regulations. None of the seahorse catch was being monitored or regulated to any extent to assess sustainability, and exports of dried seahorses were occurring illegally without CITES permits. The second, reviewed the catch and trade of seahorses in India prior to the country implementing a national ban on exploitation of seahorses in 2001. India was the first country to implement such a ban even before seahorses were listed under CITES. The analyses could aid policy makers when evaluating the use of a ban as a management tool for seahorses and contribute to helping improve the management of seahorses in India.

In 2019, the International Union for Conservation of Nature (IUCN)'s Species Survival Commission (SSC) Seahorse, Pipefish and Seadragon Specialist Group, chaired by Dr. Amanda Vincent, won a Citation of Excellence in recognition of their "outstanding contribution in delivering the Species Strategic Plan."

Project Seahorse led the IUCN's SSC Seahorse, Pipefish and Seadragon Specialist Group in crafting a formal Motion (Motion 111) that would guide the IUCN to promote vital conservation action for seahorses, pipefishes and seadragons. Adopting this Motion would not only benefit syngnathids, but also many other forms of marine life by improving fisheries sustainability, protecting areas where syngnathids are found, enhancing management of entire watersheds, and taking precautionary approaches to aquaculture. This motion was adopted by electronic vote in November 2020.

Pacific seahorse (*Hippocampus ingens*), Galapagos Islands. Photo by Joshua Feingold / Guylian Seahorses of the World

Jellyfish diets

It has always been suggested that jellyfish have voracious appetites, and aren't considered the most selective eaters, and that they had a"take what comes" feeding strategy, feeding on whatever gets stuck to their tentacles. Jessica Schaub (MSc student) wanted to know about what and how jellyfish eat.

She collected moon jelly (*Aurelia aurelia*) near Quadra Island to undertake molecular gut content analysis of their stomachs, and then worked with moon jelly and Japanese sea nettle from Vancouver Aquarium to learn more. What was discovered was that jellyfish diets could look quite different than expected, and that some jellyfish occupy a completely different position in the food web.

The study tested how much the concentrations of two biomarkers, isotopes and fatty acids, changed, and how quickly they were absorbed when jellyfish digested their prey and incorporated prey signatures into their bodies.

We discovered that after feeding them two crustaceans, krill and artemia, but they didn't really incorporate the krill, Schaub noted. They didn't appear to like feeding on a single diet and preferred the live artemia over the dead, frozen krill.

Schaub also found that the jellyfish appeared to "elongate" fatty acids. This means that jellyfish may be able to create their own essential omega-3 and omega-6 fatty acids, which are important for healthy body function. The phenomenon has been described in a few other organisms, such as corals and sea sponges, but never in jellyfish. Overall, these findings are a step towards better understanding the role that these understudied creatures play in marine ecosystems.

Measuring jellyfish ©Jessica Schaub

Sharks and rays not counted

Shark and ray species commonly caught in the Mediterranean and Black seas are not being reported in official statistics, according to *Sea Around Us* research. The research revealed that 97% of the sharks and rays caught and brought to market from those seas are not reported by species. Madeline Cashion (MSc graduate) stated that between 53% and 71% of sharks and rays found in the Mediterranean and Black Seas face an elevated risk of extinction because countries were not keeping track of the different species of sharks and rays that they are bringing to port.


Small great white shark ©NOAA

Another *Sea Around Us* study showed that recreational fishers were increasingly targeting sharks and rays. The study found that recreational catches of these fishes had increased over the last six decades around the world, and now accounted for 5-6% of the total catches taken for leisure or pleasure. The rise in recreational purposes was particularly troubling because many species are already threatened by the commercial fishing industry and by illegal fishers. Further, Daniel Pauly (University Killam Professor) noted that even if sharks and rays are thrown back into the ocean, a practice many recreational fishers practice called 'catch-and-release,' not all individuals survive.

Finally, as sharks are slow when it comes to growing and maturing, they produce only a small number of young in their lifetimes. If many individuals are caught before they have been able to reproduce sufficiently, their population numbers will dwindle.

Walruses rest, but swimming is a chore

David Rosen (Assistant Professor) studied two juvenile walruses, sent to the Vancouver Aquarium from Quebec. Rosen measured the resting metabolic rate (the rate at which an animal burns calories when not moving) and underwater swimming metabolism of the two walruses.

Days were spent coaxing the walruses to swim and then rest inside a chamber that measured the animals' oxygen consumption. One surprising discovery: the young walruses had resting metabolic rates closer to those seen in adult marine mammals – an indication that walruses expend less energy when resting than researchers might expect.

However, the study also revealed something grim: resting metabolic rate doesn't take up too much energy. However, that is vastly overshadowed by how much energy they expend on swimming. While walruses typically stay near their food sources, with climate change the ice that they rest on when they reach these food sources is melting, requiring them to swim greater distances to eat.

The two visiting walruses, Balzak and Lakina ©David Rosen

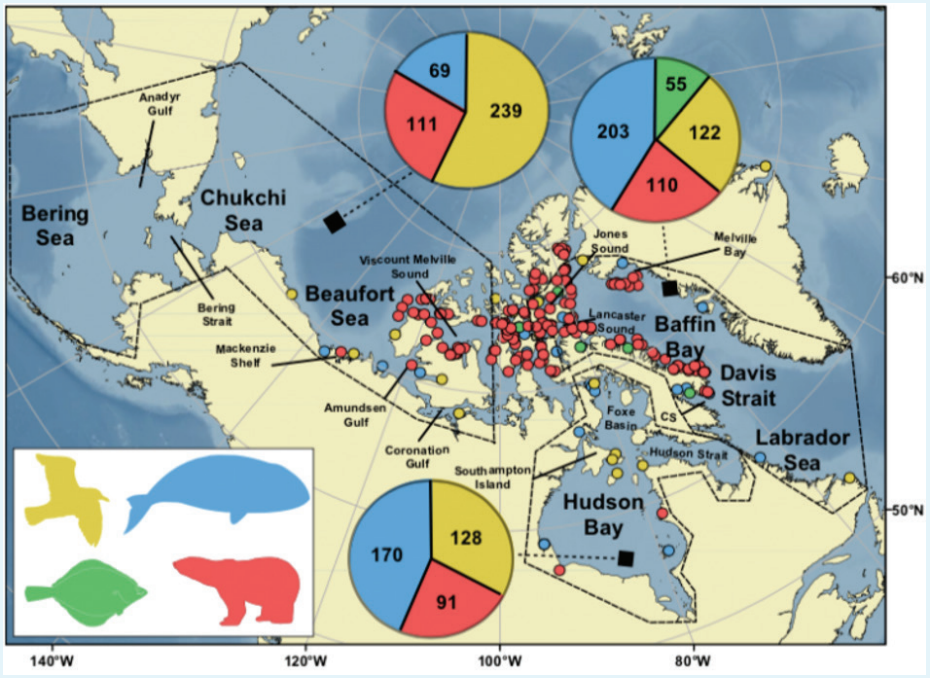
Protecting the Arctic for top predators

With increasingly more pressure from resource development and climate change, protecting the Arctic and its wildlife is more important than ever. However, which parts of the Arctic should be prioritised for protection?

A group of international researchers, including Marie Auger-Méthé (Assistant Professor), and Ron Togunov (PhD student), collaborated to map out key locations in the Arctic where top predators converged, called "hotspots." Since these hotspots are areas with high levels of biodiversity where various species come together, they are crucial for conservation; protecting them means protecting multiple species. The study mostly took place in Canadian Arctic marine waters, but also in parts of the United States, Greenland, and Russia.

To find these hotspots, the researchers looked at existing animal tracking data across four highly mobile species groups, which were cetaceans and pinnipeds, polar bears, seabirds, and fishes. The data informed the researchers about where these predators were located at different times of the year and where they converged, giving insight into which areas should be protected.

Given the various threats endangering the Arctic, the researchers felt that it is important that policy-makers prioritise protection for the most important conservation areas.



The coloured dots show where species were captured and tagged, while the numbers in the pie chart show how many individual animals were tagged in each species group. The species groups are shown in the bottom left (yellow for birds, green for fishes, blue for cetaceans and pinnipeds, and red for polar bears).

For the birds

Saving Galápagos seabirds

Galápagos birds are facing considerable threats from human-induced activities like climate change, pollution and resource use. Juan José Alava, (Research Associate) and his team assessed the environmental threats and anthropogenic impacts affecting 20 endangered bird species. Seven were seabirds and aquatic birds, including the flightless cormorant, Galápagos penguin, and the Galápagos albatross. The latter two species are endemic to the Galápagos.

Climate change is a major threat to these seabirds. Increased frequency and intensity of El Niño events and heat waves, coupled

Galápagos penguin ©Derek Keats

with changes like higher sea surface temperature, sea level rise and a reduction in upwelling in the waters of the Galápagos will result in population declines, prey and habitat decline and possible extinction.

The researchers proposed that conservationists adopt a 50/500 rule for Galápagos birds, which suggests short-term and long-term minimum population sizes of 50 and 500, respectively, so that species can exist in the future with viable population sizes. Better fisheries management and a switch from longline fisheries – which hurt the survival of some Galápagos albatross populations – to less harmful fishing methods would also be beneficial.

Losing these bird species would not only affect the health of Galápagos ecosystems, but also negatively impact people and the local eco-tourism activities that are reliant on wildlife.

Tern-ing migration

The Arctic tern holds the world record for the longest annual migration, travelling from the Arctic to the Antarctic — up to a 90,000-kilometre roundtrip.

Joanna Wong (MSc student) is researching the Arctic tern's migration strategies to understand how they adapt to the environment around them. With her guidance of her supervisor, Marie Auger-Méthé (Assistant Professor) she is studying the animal movement of this migratory bird species. Migratory species are vital to ecosystems, she notes, as they serve important such as dispersing nutrients through their excrement, and are both prey for other animals, and important predators in various ecosystems. Migratory animals play a role in every environment they pass through.

Arctic tern ©Mark Mallory

Given the long distance and geopolitical span of the Arctic tern's migration, their conservation is particularly challenging, Wong notes, which is why she is so focused on identifying primary routes and key staging sites — where birds stop and rest and feed along the way. Understanding these migration routes can ensure that specific conservation efforts can be prioritized.

Marbled murrelet abundance

In 2019-2020, Murdoch MacAllister (Associate Professor) collaborated with ornithologists with the Canadian Wildlife Service to develop improved statistical methods to estimate trends in abundance of the threatened Marbled murrelet in different coastal regions of B.C. They also investigated correlations between Marbled murrelet abundance, coastal sea surface temperatures and Pacific herring abundance.

Marbled murrelet ©Kim Nelson and Dan Cushing

Bowhead whales feed in Nunavut year-round

Bowhead whales live year-round in Arctic and sub-Arctic waters and are split into different geographic populations. Wintering, it was thought, occured in areas with less ice such as Hudson Strait.

An individual bowhead whale resting near the surface in Cumberland Sound, Nunavut. Image captured by unmanned aerial system (VDOS Global LLC) with support from World Wildlife Fund Canada.

However, research undertaken by Sarah Fortune (postdoctoral fellow) with the Marine Mammal Research Unit, shows that at least one of these areas - Cumberland Sound (Nunavut, Canada)- is an important year-round feeding ground for bowhead whales.

Fortune and her team from Fisheries and Oceans Canada, Woods Hole Oceanographic Institution, and UBC tracked 25 bowheads with satellite-linked time-depth telemetry tags to determine movements and dive behaviors. They also collected zooplankton samples in Cumberland Sound to determine prey species and biomass.


Sarah Fortune undertaking fieldwork in Cumberland Sound
©Cory Matthews

Prey sampling data suggested that the bowheads in Cumberland Sound were eating energy-rich Arctic copepods such as *Calanus glacialis* during summer. Dive depths were substantially shallower during spring and summer compared to fall and winter, and appear to correspond with seasonal changes in the vertical distribution of the copepods that suspend development and overwinter at depth during fall and winter.

The researchers also found that bowhead dive depths changed with time of day—providing evidence that their prey are migrating each day up and down the water column. Zooplankton avoid predation from visual predators by staying away from the sunlight surface waters during daylight, and move to the surface waters to eat phytoplankton at night.

One of the big surprises of Fortune's research was that bowhead whales resided in Cumberland Sound during all four seasons. Some were only there for a few weeks, some for several months, with one animal remaining all year.

Satellite telemetry locations also showed movement patterns indicative of feeding, suggesting that Cumberland Sound is a year-round feeding area.

How sustainable is tuna?

A new global database of tuna catches created by *Sea Around Us* researchers, shows that our current tuna fishing habits are not sustainable. They found that global tuna catches have increased over 1,000% in the past six decades, fueled by a massive expansion of industrial fisheries.

The findings indicate that these fisheries — which have been catching nearly six million tonnes of tuna annually in recent years — are operating substantially over capacity. Fisheries have exploited populations of tuna and other large fish species and spread out so no new fishing grounds remain to be explored.

The researchers created the database by assembling and standardizing all of the different public data sets created by tuna regional fisheries management organizations (RFMOs). By combining the data sets they were able to create a complete picture of the evolution and current state of this fishery that mobilizes billions of dollars worldwide, feeds millions and affects areas that are shared by all countrie

They found that skipjack and yellowfin are the most commonly caught species of tuna, with combined catches of four million tonnes per year in recent years. Meanwhile, catches of the sushi-favourite bluefin tuna have declined heavily since the mid-20th century, with the species now considered critically endangered.

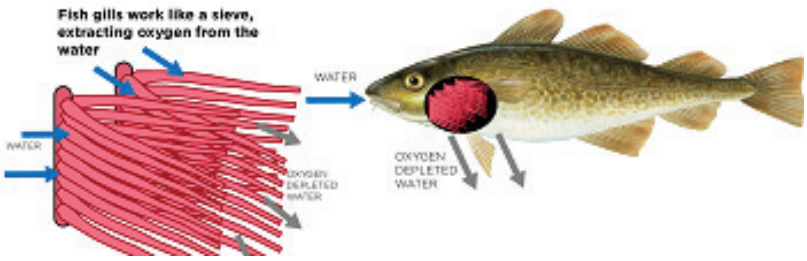
Tuna for sale at the Tsukiji Fish Market in Tokyo. Credit: Wikimedia Commons

Solid GOLT

The Gill-Oxygen Limitation Theory, known as GOLT, explains – among many other things - the biological reasons that force fish, particularly larger or older ones, to move poleward when the waters in their habitats heat-up due to climate change.

The *Sea Around Us*' Daniel Pauly explained that warming waters have less oxygen and, therefore, fish have difficulties breathing in such environments. Such warming, low oxygen waters also increase fish's oxygen demands because their metabolism speeds up.

This is how it works: fish's gills extract oxygen from the water to sustain the animal's body functions. As fish grow into adulthood their demand for oxygen increases because their body mass becomes larger. However, the surface area of the gills does not grow at the same pace as the rest of the body because it is two-dimensional, while the rest of the body is three-dimensional. The larger the fish, the smaller its surface area relative to the volume of its body.



Female fish are bigger than males

In over 80% of fish species, the females grow bigger than the males. This long-established fact is difficult to explain with the conventional view of fish spawning being a drain on the 'energy' available for growth. If this view were correct, females, which are defined by their larger reproductive effort, would always remain smaller than males.

Pauly stated that females growing larger than males can be readily explained by the Gill-Oxygen Limitation Theory (GOLT). He said that 90% of the oxygen fish get from their gills is used for various activities and only the rest for growth. Thus, by remaining a bit calmer than the males, females can outgrow them.

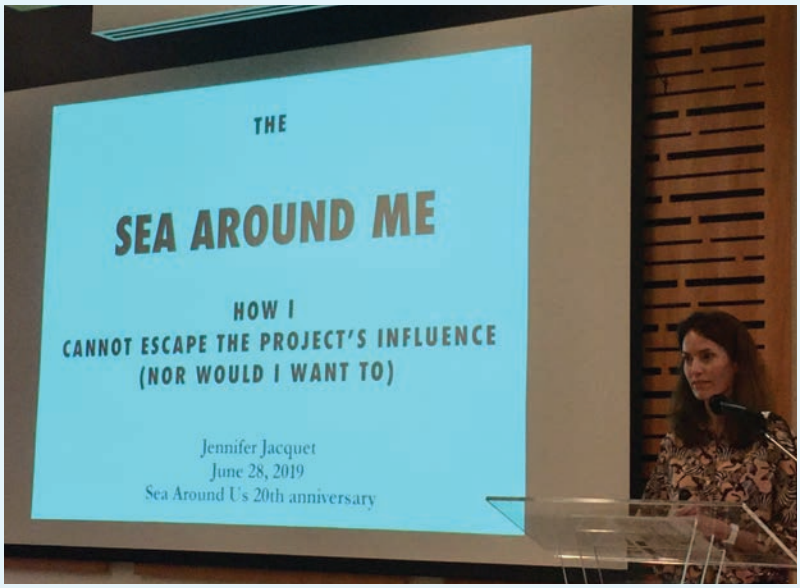
Sea Around Us' 20th Anniversary Symposium

On June 28, 2019, the *Sea Around Us* hosted a daylong symposium to celebrate its 20th anniversary.

Gail Murphy, UBC VP Research; Meigan Aronson, UBC Dean of Science, and Evgeny Pakhomov, Director of the IOF, welcomed some 70 attendees to the symposium and congratulated the *Sea Around Us* for its two decades of fisheries research serving civil society.

The university authorities were followed by the keynote speaker, Jessica Meeuwig, who is the Director and Research Leader of the Marine Futures Lab at the University of Western Australia (UWA) and whose talk focused on impact of the *Sea Around Us* on ocean research in the past two decades.

Renewed scientists and long-time *Sea Around Us* collaborators such as Rainer Froese, co-developer of FishBase; John Tanzer, WWF's Ocean Lead; Dirk Zeller, director of the *Sea Around Us* – Indian Ocean at UWA; Philippe Cury, from the French Research Institute for Development; Imani Fairweather-Morrison, from the Oak Foundation; and many others joined the celebration both in-person and remotely and highlighted how their scientific work has greatly benefitted from the fisheries catch data reconstructed and made freely available by the *Sea Around Us*.



Above: Jennifer Jacquet
Below: John Tanzer, Jessica Meeuwig, and Daniel Pauly

Popular seafood species in sharp decline

In the first study of its kind, researchers from the *Sea Around Us*, the GEOMAR Helmholtz Centre for Ocean Research Kiel, and the University of Western Australia assessed the biomass of more than 1,300 fish and invertebrate populations. They discovered global declines, some severe, of many popularly consumed species.

Of the populations analyzed in the study, 82% are below the level that can produce maximum sustainable yields because they are being or have been caught at a rate that takes out more than is regrown. This also means that fishers are catching less and less fish and invertebrates over time, even if they fish longer and harder.

In fact, more than 8% of the populations studied or about 87 populations are currently in the 'very bad' category, with biomass levels less than 20% of the level that might maximize sustainable fisheries catches.

These findings were obtained by the CMSY and BSMY methods to the reconstructed catch data of the *Sea Around Us* for the 1950-2014 period.

Daniel Pauly takes the top spot as the most cited fisheries scientists in PLoS Biology study

For second year in a row, the Sea Around Us Principal Investigator, Dr. Daniel Pauly, was among the top 0.01% of the world's scientists based on the impact of his publications.

This, according to a study published in PLoS Biology, which was updated in 2020, whose authors created a publicly available database of the world's 100,000 top scientists. The database provides standardized information on citations, h-index, co-authorship adjusted impact, and information on impact in papers according to different author positions (single, first, last author).

In the case of fisheries, 590 authors were assessed. Among them, Dr. Pauly is the most cited one.

Fishy podcast

To celebrate the 30th anniversary of FishBase and 15th anniversary of SeaLifeBase, the Sea Around Us team launched the FishBase and SeaLifeBase Anniversary Podcast in 2020.

Given the interconnection that exists between the databases since their inception, three IOF – Sea Around Us members were featured in the podcast, namely, Daniel Pauly, Maria 'Deng' Palomares and Nicolas Bailly.

Available at https://bit.ly/fbslbpodcast2

Salmon - the iconic species

Salmon's top predator?

Zachary Sherker - MSc student, in the Marine Mammal Research Unit - is researching why many juvenile salmon don't survive the initial journey from the rivers where they were born to the ocean. He was investigating potential freshwater and estuarian predators, like river otters, mink, raccoons, and eventually identified Pacific great blue herons as major predators.

Zachary Sherker looking for PIT tags from the scat of Pacific great blue herons under their rookery in Stanley Park. ©Rhea Storlund

He had been searching for small tags called passive integrated transponders, or PIT tags, which are implanted near the stomachs or in the body cavity of both hatchery and wild juvenile salmon. Each tag is uniquely numbered, they can be used to track the movement of different salmon individuals, which would give researchers insight into their migration and survival.

When a predator eats a tagged fish, the tag will ultimately end up in the predator's scat. Sherker wasn't finding many salmon tags until he started scanning heron scat and found over 1,000 tags in different heron rookeries around B.C., primarily in the Cowichan River, the Capilano River, and the Big Qualicum River. This accounted for around 1 to 3% of all the salmon tags that are released annually!

Developing stock assessment

Sarah Hawkshaw (PhD student), who is also a Fisheries and Oceans Canada quantitative biologist, worked with Murdoch MacAllister (Associate Professor) to develop new stock assessment methods to estimate harvest rates and abundance of individual Chinook salmon stocks at much higher spatial-temporal resolutions than is currently done in practice.

The analysis will contribute to the development of improved methodologies to evaluate management controls for the fishery on the BC coast.

Dam salmon

Murdoch MacAllister received funding from the US Army Corps of Engineers to evaluate options for the passage of juvenile and adult salmon around dams.

The aim of this was to restore populations of Chinook salmon and winter steelhead populations in the upper reaches of the Willamette River system, Oregon. Winter steelhead and spring Chinook salmon populations in Willamette River tributaries have been listed under the US Endangered Species Act as threatened and endangered, respectively.

A major contributing factor to the depleted conservation status of these salmon populations was the building of high head dams in Willamette River tributaries in the 1950s. The research team will be developing and applying computer models for evaluating the effectiveness of alternative passage options for the endangered and threatened salmon and the prospects for population recovery.

Chinook salmon: Image by PublicDomainImages/Pixabay

Salmon Expo 2019

IOF's Pelagic Ecosystems Lab researchers participated in the Salmon Science Expo at the Gulf of Georgia Cannery.

This was a community event, held in November 2019, and gave visitors of all ages an opportunity to investigate and appreciate wild salmon by exploring interactive displays, examining specimens, conducting experiments, and learning about research projects.

Researchers Vanessa Fladmark (MSc student), Samantha James (PhD student), Jacob Lerner (PhD student), and Thomas Smith (MSc student), also set up a microscope to show juvenile salmon diets.

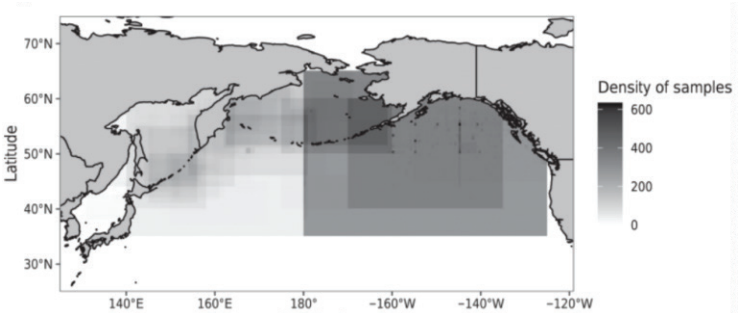
Salmon diet database

Scientists investigating North Pacific salmon have a new tool at their disposal in the form of an open-access salmon diet database, thanks to the work of Caroline Graham (MSc student/graduate), Brian Hunt (Assistant Professor) and Evgeny Pakhomov.

Developed as part of Project Salmon Resilience, a larger undertaking that aims to explore the impacts of fisheries and climate change on salmon populations, this database fills gaps in scientists' understanding of the late marine phase of the salmon life cycle, which is challenging to study at a large scale because of the long distances salmon swim from shore when they leave rivers and streams and enter the ocean.

The diet database gives a window into the lives of salmon as they travel thousands of kilometres and experience different ecosystems and conditions, said Graham. It helps us see what conditions these fish face in the open ocean, what food is available for them, and how does this relates to environmental variability and salmon returns..

The creators of the database hope that researchers collecting diet data on salmon in the North Pacific will add their findings to it so that researchers studying Pacific salmon and North Pacific ecosystems more generally can use it in their work.



Samantha James talks with visitors to the Salmon Science Expo. ©Brian Hunt

International and national impact

The Institute has a major impact in policymaking at the provincial, national and international level.

The IOF was pleased when, for the first time, the then Minister of Fisheries, Oceans and the Canadian Coast Guard, the Hon. Jonathan Wilkinson (North Vancouver) stopped by. He held a discussion forum session with UBC Dean of Science, Dr. Meigan Aronson, and a tour of our facilities. When the federal cabinet was shuffled in late 2019, the Hon. Bernadette Jordan (South Shore-St. Margarets) stepped in as Minister. However, with the pandemic occuring in early 2020, there was not an opportunity for an in-person visit. She did, however, meet with several Canadian marine experts - including Amanda Vincent - virtually.

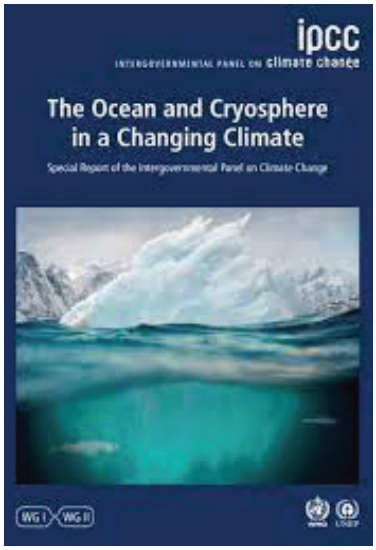
In 2019, then Minister of Fisheries, Oceans and the Canadian Coast Guard, the Hon. Jonathan Wilkinson (North Vancouver) stopped by for a discussion with UBC Dean of Science Dr. Meigan Aronson (above), and IOF Director Dr. Evgeny Pakhomov (below).

Brian Hunt was part of a team to complete the first tier outputs from the British Columbia Coastal Ocean Biogeochemical Regionalization Project. He also worked closely with BC sport fishers, Fisheries and Oceans Canada, and the Pacific Salmon Commission to gain coast wide coverage of Chinook salmon samples for trophic ecology research. Hunt is a member of the Salish Sea Marine Survival Project Synthesis Committee and its Lower Trophic Level Working Group. He is also a Steering Committee member for the US National Science Foundations' Coastal Rainforest Margins Research Network. One of Hunt's postdoctoral fellows, Kyra St. Pierre, was a contributor to the Arctic Monitoring and Assessment Program (working group of Arctic Council)'s report on mercury in the Arctic.

In 2019, Murdoch MacAllister was appointed as the Commercial Fishery Sector Representative in a Canadian Technical Working Group, tasked with developing updated management benchmarks and conservation targets for commercial and aboriginal sockeye salmon fisheries in Northern BC and Southern Alaska. The technical working group and associated stakeholder guiding group for the evaluation management consultation include Fisheries, Oceans and the Canadian Coast Guard (DFO) scientists, managers, and representatives from commercial fishing organizations and eleven First Nations groups.

In 2019, Andrew Trites became a member of DFO Southern Resident Killer Whale Prey Availability Technical Working Group. This is in addition to his work on Marine Mammal Species Specialist Group of Committee on the Status of Endangered Wildlife In Canada (COSEWIC), and the Pacific Salmon Foundation's Scientific Advisory Panel for the Strait of Georgia Coho and Chinook Program. He is also Canada's delegate to the PICES Advisory Panel on Marine Birds and Mammals.

Image by Wolfgang Lucht/Pixabay



On the international scene, Professor William Cheung was the coordinating lead author on the Intergovernmental Panel on Climate Change (IPCC) Special Report on the Ocean and Cryosphere in the Changing Climate. The report was completed and approved by the IPCC plenary in September 2019. He was also one of the lead authors for the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment, which was published in the summer of 2019.

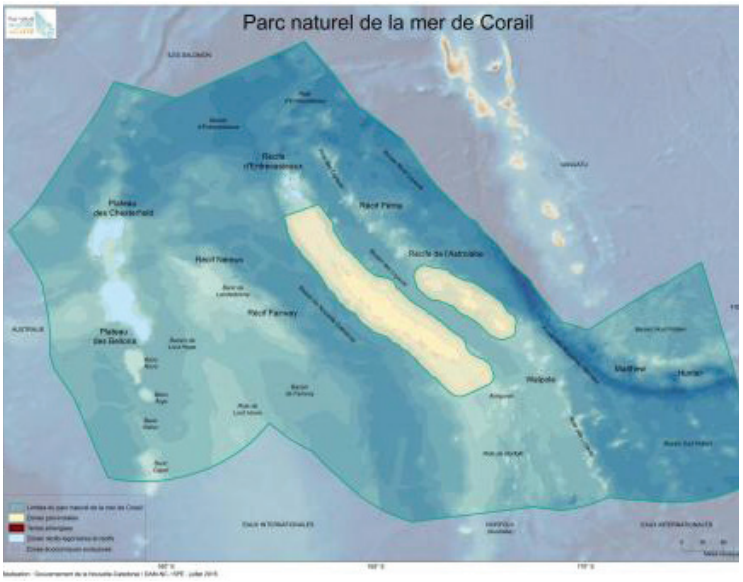
Villy Christensen worked in close cooperation with international colleagues to develop an integral part of a comparative modelling initiative (Fisheries and Marine Ecosystem Model Intercomparison Project, Fish-MIP), which will supply vetted model results for the future assessments of the UNEP Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. As part of the Fish-MIP activities and model development, Christensen hosted Marta Coll and Jeroen Steenbeek during August through December 2020, to work on the EcoOcean model. This model is included in Fish-MIP and will be used for IPBES and IPCC scenario evaluations.

Amanda Vincent's impact on the world stage has been immense. As Founding Chair of International Union for the Conservation of Nature (IUCN) SSC Seahorse, Pipefish and Seadragon Specialist Group she is globally responsible for generating and supporting action for conservation of 324 species of fish, including appointing, co-ordinating and supporting 37 taxon experts working in 19 countries on six continents. Both Vincent, and her Project Seahorse team have provided the IUCN with input on marine species conservation in the development of the Global Biodiversity Targets post-2020 through many processes and stages. In November 2020, the IUCN voted to approve a Resolution 95, that Vincent and Project Seahorse drafted, which called for collective support for Conservation of seahorses, pipefishes and seadragons (family Syngnathidae). Resolution 95 now guides approximately 1450 member conservation organizations globally, including 225 government agencies.

Image by dadriaen/Pixabay

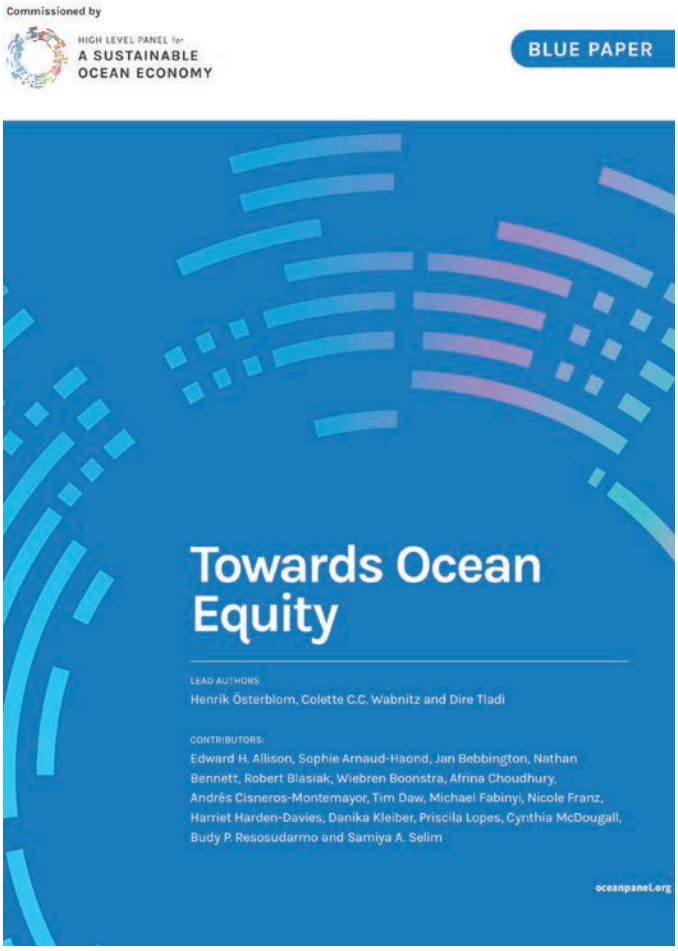
Daniel Pauly has spent his life working with governments, multi-governmental organizations, and non-governmental organizations. And he continues to do so. A member of New Caledonia's Parc National de la Mer de Corail, Scientific Committee, he is working to develop the nation's newest marine park to preserve the ecological integrity of the marine environment, while still allowing for responsible and sustainable economic development. He is also a member of Hong Kong's Swire Trust Marine Advisory Panel. Both he and Rashid Sumaila also serve as Board Members of OCEANA.

Rashid Sumaila's Fisheries Economics Research



Unit (FERU) worked closely with Pauly and the *Sea Around Us* team to build large-scale national and global socio-economic databases, such as ex-vessel fish prices; fishing subsidies; cost of fishing; and fishing jobs. These databases are now used by many country ambassadors and negotiators at the World Trade Organization. Sumaila and his FERU team also worked with the First Nations Fisheries Council of British Columbia (FNFC) to develop a valuation approach that attempts to capture the 'whole value' of culturally iconic fish such as a sockeye salmon. The toolkit they developed will help First Nations coastal communities conduct their own economic research and analyses to better reflect the full range of values and benefits that they associate with their fisheries. In addition he gave virtual presentations to the United States International Trade Commission, Indonesia Ocean Justice Initiative, and Our Fish Symposium, among others.

Research Associate, Colette Wabnitz, was a contributing author to the 'International dimensions' chapter of the national issues volume of NRCan's knowledge assessment of climate change impacts and adaptation in Canada; a contributing author to the "Risk to the integrity of low-lying coastal socio-ecological systems" chapter of the IPCC's 6th Assessment Report; a contributing author to the Blue Climate Initiative Mineral and Genetic Resources Working Group; and a working group member of the Deep Ocean Stewardship Initiative Biodiversity Beyond National Jurisdiction. She was engaged with the High Level Panel for a Sustainable Ocean Panel, as co-lead author of their Blue Paper: Towards Ocean Equity in 2019. Andres Cisneros-Montemayor, another IOF Research Associate also contributed to this report.



Research Associate, Nathan Bennett, was named as the Chair of IUCN's People and the Ocean Specialist Group. This group will promote the voices, visions, rights, and livelihood needs of coastal peoples and island nations into policies and practices related to the conservation and management of the oceans.

Hitting the High Seas

International Gulf of Alaska Expedition - 2019

Many Pacific salmon populations are in decline in the face of increasing pressure from human impacts. The life history of salmon straddles freshwater and ocean. Specifically, the scientific community believe that one-third of all Pacific salmon spend the winter in the Gulf of Alaska. Pacific salmon from Canada, Japan, Korea, Russia, and the United States are believed to mix together in the Gulf of Alaska, and any impacts to salmon here, could impact salmon around the Pacific Rim. However, with limited surveys being taken in the Gulf of Alaska, there was little or no data to help researchers understand if impacts to salmon in Alaska were a factor in the declining salmon returns.

IOF faculty members, Evgeny Pakhomov - who also served as the Expedition's Chief Scientist - and Brian Hunt were part of a international expedition team to survey the abundance and condition of salmon in the Gulf of Alaska in winter. The expedition chartered a research vessel, and with a team of 21 researchers from Canada, the United States, Russia, Japan, and Korea left for a month-long voyage in the Gulf of Alaska – the first winter-at-sea international research collaboration, surveying the abundance and condition of salmon.

Pakhomov's on-board research was focused on zooplankton (creatures from 0.2 to 2 cm in size) and micronekton (creatures from 2 to 20 cm in size). These play critical roles in the pelagic ecosystems because they link microscopic plants with larger fish, including salmon. Pakhomov was interested in learning which foods the salmon consume.

Hunt explored the structure and function of pelagic marine ecosystems, and their response to climate forcing and anthropogenic impacts. During the Expedition, Hunt collected samples for comprehensive biogeochemical analysis of salmon food webs in the Northeast Pacific, from plankton to the salmon. The resulting data will be used to parameterize salmon food web linkages, validating a recently developed North Pacific Isoscape model, as well as validating biogeochemical proxies of salmon feeding ecology and health that can be measured in fish on the spawning ground to reveal oceanic life history experience.

Right: Brian Hunt
Left: Expedition team
Photos: ©Chrys Neville

The Honorable Jonathan Wilkinson, federal minister of Fisheries, Oceans and the Canadian Coast Guard, as well as the BC Minister of Agriculture, the Honorable Lana Popham (middle right in photo), send off the Gulf of Alaska Expedition team.

Evgeny Pakhomov ©Chrys Neville

Gulf of Alaska Expedition - 2020

Building off the success of the 2019 expedition, a second research voyage, with 12 scientists from Canada, Russia, and the United States, set out on March 11, 2020. The goal was to study the winter ecology of salmon and to identify mechanisms and environmental factors that could determine the annual abundance and condition of Pacific salmonids in the Gulf of Alaska.

Once again, two IOF researchers were present on the vessel; Jacob Lerner (PhD student), who investigated stock-specific Chinook salmon marine trophic ecology off the BC Coast utilizing bulk/compound specific stable isotope analysis, with the aim of connecting these analyses with regional food web dynamics and climate change; and IOF alumni and Research Technician, Natalie Mahara, who went to collect oceanographic data in the North Pacific to add to the understanding of the physical characteristics and lower trophic level dynamics in the open ocean.

Natalie Mahara and Jacob Lerner checking samples on the Gulf of Alaska 2020 expedition. ©Svetlana Esenkulova

Salmon and the Pacific food web

Jacob Lerner (PhD student) boarded the commercial salmon troller, *Carte Blanche*, to investigate how fat content changes between stocks of Chinook and across regions of the coast. For three weeks in October 2019, he measured the fat content of Chinook caught in Juan de Fuca and Johnstone Strait, two regions frequented by both Northern and Southern resident killer whales, laying the groundwork for research into Chinook salmon trophic ecology and their value as prey.

Lerner then hopped aboard the *SeaCrest*, a commercial trawler, with other members of the Pelagic Ecosystems Lab, Alicia Andersen, Anna McLaskey, Lauren Portner and PI Brian Hunt. Combining oceanography and fisheries surveys in a survey, they were assessing the productivity of coastal food-webs around Vancouver Island, and particularly how they support healthy Chinook salmon.

Aboard the SeaCrest (Photo: Brian Hunt)

Summer food web sampling

The connections between the animals that form the base of marine food webs are still largely unknown. To improve understanding of how the plankton and microbes that support the majority of marine life would respond to climate change, The Hakai Coastal Initiative Marine Food Webs Working Group - led by Brian Hunt, Assistant Professor and Director of the UBC Pelagic Ecosystems Lab; Dr Colleen Kellogg of the Hakai Institute; and Dr. Vera Tai of Western University - took their team of postdoctoral fellows, students, volunteers, and a technician to the Hakai Institute's field station on Quadra Island to collect data on the day and night behaviour of bacteria, protists, zooplankton, and parasites in the Strait of Georgia.

The team used Hakai Institute boats and equipment to collect plankton during day and night.

IOF postdoc Jackie Maud is using DNA analysis to better understand zooplankton diets, information that will help understand how these organisms, that the rest of the food web depends on for food, will respond to changing climate, including extreme events like heat waves.

Sorting the catch

The HCI food webs field team: (l to r) Jessica Schaub (MSc student), Dr. Caterina Giner (postdoctoral fellow), Rosie Savage (volunteer), Dr. Vera Tai (Western University), Dr. Brian Hunt (IOF), Dr. Jackie Maud (postdoctoral fellow), Lauren Portner (research technician), Dr. Anna McLaskey (postdoctoral fellow), Dr. Colleen Kellogg (Hakai Institute). (Photo: Brian Hunt)

Orca-strating a better understanding of BC's killer whales

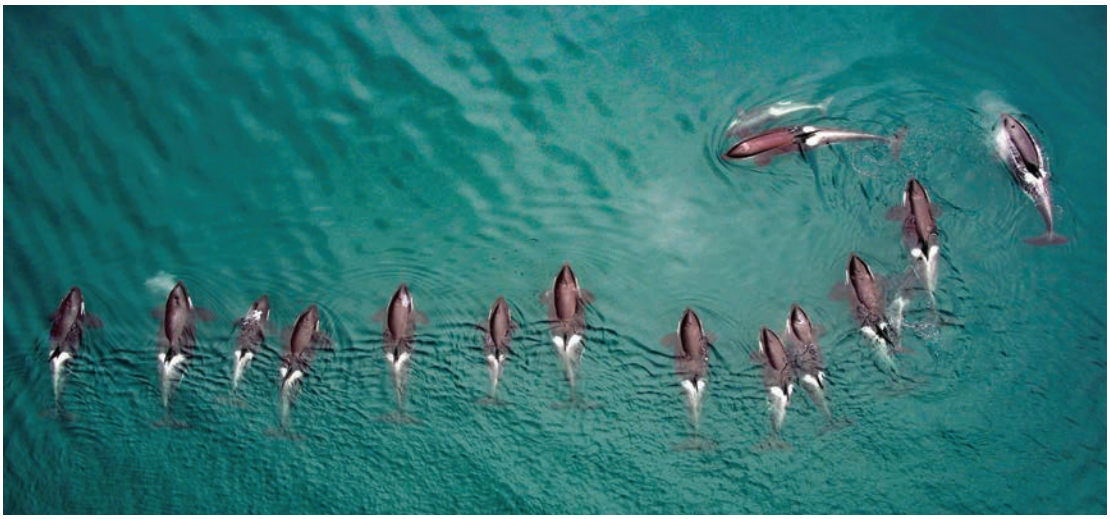
In the summer of 2019, a team of researchers from the IOF's Marine Mammal Research Unit (MMRU), led by Andrew Trites (Professor), together with the Hakai Institute, set out to determine how fish-eating killer whales (resident killer whales) find their food and whether there is a shortage of Chinook salmon available to these whales in the Salish Sea.

The *Gikumi* collecting hydroacoustic data off of Saturna Island.

Using drones, the researchers recorded the killer whales, viewing their behaviours in a natural settting without disturbing the animals. They also attached GPS, depth and speed recording tags, cameras and hydrophones to gather information from individual whales. They also used hydroacoustics to gather information about the number of fish available for predation, as well as environmental information on ocean salinity and temperature in the local waters.

Trites also led a two-week voyage in 2020 to study the feeding behaviours of northern resident killer whales. This research used hydroacoustics to assess prey abundance and included placing suction-cup camera tags onto whales to record what they see and hear, as well as their three-dimensional movements, diving depths and feeding behaviours.

Some initial findings that were shared include that the whales use a series of calls, clicks, and whistles, many of which are unique to each pod, to communicate. Whales also use echolocation to hunt for prey, often working in coordinated hunts, and sharing the fish caught amongst the hunting party.



Photos from 2019 trip (top and centre) and 2020 trip (bottom) ©Marine Mammal Research Unit

Indigenous knowledge

Fisheries provide a significant source of food for, and are of economic, social, and cultural importance to, many Aboriginal peoples in Canada and around the world. The IOF proposed revitalizing the Aboriginal Fisheries Research Unit (AFRU), which had ceased operating when its Aboriginal fisheries research leader left UBC in December 2015. The plan as to strengthen and broaden its vision and having it contextualized within UBC's Strategic Plan. An extensive guidance and consultation process was undertaken; something that had been absent when the unit was originally created.

The revitalized AFRU would boost the IOF's and UBC's commitments to promoting Aboriginal fisheries education, fostering Aboriginal leadership and development, and building Aboriginal student and community engagement. It would combine traditional ecological knowledge and modern science to support more effective ecosystem and aquatic resource management.

In early 2019, a comprehensive hiring search and interview process was undertaken. At the completion of this process, it was announced that Andrea Reid, a member of the Nisga'a Nation had accepted the position of Assistant Professor, Indigenous Fisheries, a position which would begin in January 2021.

Dr. Andrea Reid

In preparation for this, Dianne Newell (Professor Emeritus), who had been instrumental in the revitalization process, joined the unit as a Senior Advisor and continued the work of building the unit, making interim administration arrangements, including a potential name change, and laying groundwork for funding a potential second faculty hire.

In March 2019, the Ocean Leaders unit also held an interactive workshop on titled "Working with Indigenous Communities" led by Dr. Sm'hayetsk (Teresa) Ryan (UBC Forestry).

Dr. Sm'hayetsk (Teresa) Ryan talks to IOF participants

Graduate Program

After years of development, the IOF welcomed its first cohort of MSc and PhD students in September 2019. Twenty students, most coming from transfers from existing programs, were registered in the graduate program. Eight new applicants applied directly to the program.

IOF's graduate program focuses on training marine and freshwater scientists to undertake basic and applied research that will help foster healthy marine and freshwater ecosystems and sustainable resource use. Students gain interdisciplinary expertise by acquiring in-depth training in fisheries science, aquatic ecology, environmental physiology, natural resource economics, marine governance, and climate change. Students also develop the research capacity and knowledge translation skills necessary for rewarding careers in academia, industry, government, NGOs, and consulting .

The Graduate Committee worked tirelessly to develop the admission procedures, policies, guidelines, and administrative documents for the new program, and to manage the admission process, and the financial support policy for students. Murdoch McAllister and Marie Auger-Méthé were named as graduate advisors. They built processes and materials, such as the student handbook. Brett van Poorten (Honorary faculty member) took on the role of graduate liaison, working directly with students as they identified issues and hurdles.

The program's first graduate was Travis Tai, who completed his PhD under the supervision of William Cheung. He was followed closely by Tim Cashion, also a PhD student, supervised by Daniel Pauly. The COVID-19 pandemic brought with it a number of challenges for the IOF's graduate program. Classes were rapidly moved online, and planned fieldwork, exams, defenses, and other requirements were put on hold. This put many academic plans in flux, and several students who had planned to graduate were forced to defer to later dates. Despite this, IOF students were able to graduate at online ceremonies held in June and November 2020.

In 2020, the program's second cohort was made up of ten students, eight joining in September, with two more slated to begin in January 2021. As the pandemic persisted, classes, workshops, and seminars continued to be offered online, and strict special arrangements were made to enable students to take lab courses and undertake field research.

IOF Graduate Student Society

The IOF's Student Society was very active in 2019 and 2020. They invited students to give reports on their research, both as a way of informing other students, and as a practice session for those who were approaching their defense dates. These rebranded 'Fish N Chips' sessions proved very popular and quickly moved from once a month events to weekly events.

Above: IOF students celebrate Chinese New Year. ©IOF Student Society
Below: Heading to the Climate Change march

The Society also spear-headed a number of events in 2019 including group dinners, such as the one for Chinese New Years, as well as the Whistler Ski trip, a snowshoeing get-away, and other sporting events. In conjunction with Shoreline Cleanup, they held a beach clean-up on Wreck Beach, followed by a BBQ. They also participated in the Climate Change march in September 2019.

In December 2019 the Society held a Holiday Art Auction, where the proceeds were shared by

Whistler ski trip ©IOF Rebecca Schjins

the IOF artist and Sea Smart, a charity that delivers a diverse and innovative range of ocean-oriented educational programs to youth, and which was, incidentally, created by an IOF alumnus.

One of the most important issues the Society took on was equity, diversity, and inclusion (EDI). The Society worked with the IOF administrative team to create resources that provide information about EDI policies, initiatives, and support across UBC. For IOF students they developed two documents: *The Expectations and Resources for Creating a Respectful Climate*, and an *Introduction to Indigenous Relations at UBC*. The latter is a valuable resource for everyone at IOF, but especially those who are new to BC and/or Canada, and those who are unfamiliar with the University's efforts for reconciliation (including territorial acknowledgments), and why they are so important and necessary. A Women and Gender Minority group was also formed. This group met, both in-person and online, as a closed discussion group, to talk freely and confidentially about their experiences in science.

While unable to get together in-person get-togethers during the pandemic, the Society worked to ensure that students' mental health was addressed. While the Society initially reported that there are challenges to working from home for most students, they also developed several surveys to investigate what the issues where and how they changed as the pandemic continued. Working closely with IOF faculty and staff, the Society worked ensure students were supported, checked on regularly, and provided with mental health resources as needed.

Some of the items on offer at the Holiday Art Auction to support Sea Smart.

All other IOF Student Society activities moved online, including the Fish N Chips sessions, Deep Sea Data Squad workshops, and an IOF Trivia Night.

IOF Student Society Travel Awards

2019

Juliano Palacios-Abrantes (PhD, Supervisor: William Cheung0
Patricia Woodruff (PhD, Supervisor: Villy Christensen)

2020

Thomas Smith (MSc, Supervisor: Brian Hunt)
Joanna Wong (MSc, Supervisor: Marie Auger-Méthé)
Yulia Egorova (PhD, Supervisor: Evgeny Pakhomov)

Seminars, workshops and lectures

The IOF offers multiple seminars and workshops through the year. These draw a diverse audience, leading to thought-provoking discussions and a sharing of new ideas and perspectives. Speakers from within the IOF, UBC, and from around the globe are invited to present on a wide range of topics related to freshwater systems, the oceans, fisheries, and the global environment. Subject matters discussed span the natural and social sciences, including aquatic ecology, economics, zoology, anthropology, sociology, oceanography, marine geochemistry, microbiology, resource management, and international maritime law.

For the academic year 2019-20, IOF's weekly seminars featured researchers from UBC, Simon Fraser University, and Fisheries and Oceans Canada. A special Panel Discussion "Fish you didn't know you eat" allowed UBC Journalism's Global Reporting Program to give an overview of the award-winning project they undertook on the fishmeal industry. Two IOF MSc students, Caroline Graham and Thomas Smith, participated in this project, undertaking fieldwork in China and West Africa respectively.

Larkin Lecture

The Larkin Lecture is IOF's pre-eminent lecture, featuring a leading oceans or fisheries researcher. Created in honour of Dr. Peter Larkin, a distinguished fisheries biologist and emeritus professor who was known for his expertise in conservation, resource management and environmental impact assessment, these free lectures offer cutting edge research to the IOF community and the interested public.

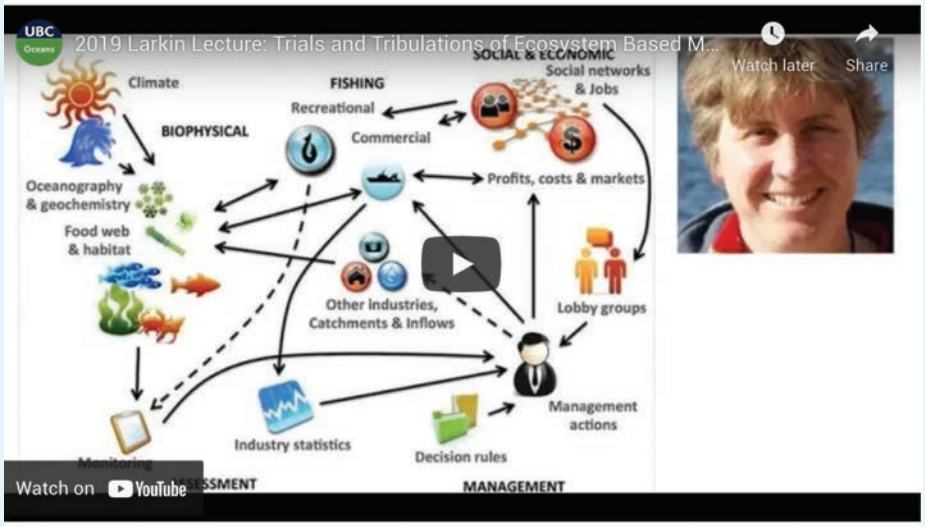
Peter Larkin, ©University of British Columbia Archives

In addition to the lecture, there is a reception with the invited speaker, as well as a student-organized panel discussion. A manuscript of the lecture is also submitted for publication in the academic journal *Fish and Fisheries.*

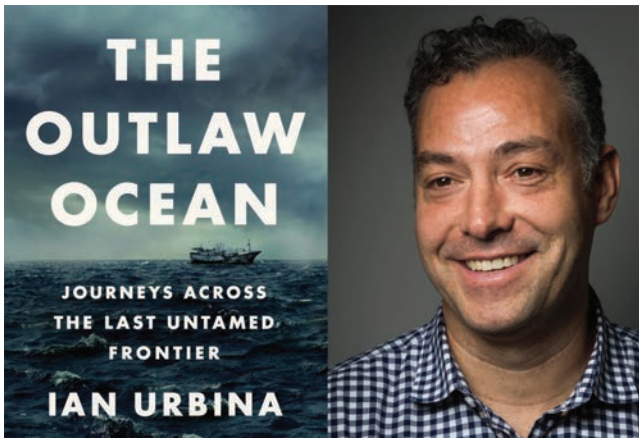
In 2019, the invited speaker was Dr. Beth Fulton, Senior Principal Research Scientist from Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO)'s Oceans and Atmosphere division.

Fulton's presentation was titled: "Trials and Tribulations of Ecosystem Based Management," and looked at the concept of ecosystem based management and whether it is enough to shoehorn ecosystem considerations into institutional, governance and regulatory structures that are built around management targeted at individual species.

The Lecture was recorded and is available for viewing on the IOF's website or on its YouTube channel.



The Lecture series was put on hold in 2020 due to the pandemic.



Pulitzer Prize winning journalist Ian Urbina also spoke about his recent book *The Outlaw Ocean*, which provides an in-depth look at the global state of human trafficking at sea.

UBC alumnus, Dr. Jennifer Sunday, visited from McGill University to discuss "the ecological mechanics of range shifts in a warming world."

Another UBC alumnus, Dr. Jennifer Jaquet, (New York University) also stopped by to meet with the IOF community and to discuss her research on high seas fisheries and how it relates to the current negotiations at the United Nations regarding a legally binding instrument for the conservation and sustainable use of the high seas.

Academic year 2020-21 was when the weekly seminars went online. IOF was able to invited speakers from all over the globe and our viewers were just as international in nature. Presenters came from the Stockholm Resilience Centre in Sweden, Dalhousie University in Halifax, NOAA in Hawai'i, Oceana Europe in Ireland, and Ocean Unite in the United Kingdom.

IOF held a special screening of SEA OF SHADOWS, a National Geographic documentary that looked at poaching activities by Mexican drug cartels and Chinese traffickers as they seek out the rare totoaba fish in the Sea of Cortez, and how their methods threaten to destroy marine life in the region, including the most elusive and endangered whale species on Earth; the vaquita porpoise. The presentation was followed by a panel discussion with the Consul General for México in Vancouver, Dr Anna Hall from the Porpoise Conservation Society, and UBC marine mammal experts.

Building strong foundations

While a unit that researches fisheries biology and ocean systems has been present at UBC, in one form or other, for more that 60 years, the Institute for the Oceans and Fisheries itself was created on July 1, 2015.

Becoming a research unit in the Faculty of Science, with a graduate program, required the IOF to develop a wide variety of new administrative processes and practices. The IOF's core admin team worked on centralizing and streamlining financial and human resources procedures, as well as developing relationships with various UBC central administration groups. Neil Maclean, IOF's Manager of HR and Operations was also involved with UBC's move from its legacy systems to Workday, a modern technology platform managing the university's HR and Financial business processes.

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The IOF continued efforts to bring our community together as one team occurred. Monthly lab presentations gave students and faculty an opportunity to learn about what other units within IOF were working on, while lunch-time seminars series allowed for increased transparency and greater understanding of day by day IOF activities.

Running by committee

The formation of a Graduate Committee, responsible for all internal mechanisms needed to mange graduate students, including admission selections, funding and awards, course management, comprehensive exams, thesis & dissertation presentations, and all matters related to administering degree granting programs was a demanding job. The Committee, chaired by Dr. Villy Christensen, managed this Herculean task with aplomb and has contninued to attract first rate students to IOF.

Another vital task was to strike an Equity, Diversity and Wellness (EDW) Committee. Student, staff and faculty had indicated, via several anonymous surveys, that there existed some ongoing tensions betwen students, staff and faculty supervisors. This was the opposite to the communitie's desire for IOF to be seen as a welcoming and inclusive workplace. Meetings were held with faculty and everyone indicated a willingness to be involved in a process that would aspire to improve the workplace environment in the IOF. The EDW Committee worked closely with their IOF Student Society's counterpart committee, and included representatives from the UBC Equity and Inclusion Office. Regular IOF-wide EDI sessions have been put in place, a confidential Women and Gender Minorities working group developed, equity issues were highlighted in the development of IOF's Strategic Plan, and other measures were put in place. Also, two EDI seminars and a Wellbeing Consultation session were well attended by the IOF community. More recent IOF-wide surveys have shown that there has been some improvement, however this will continue to be an important area as IOF continued to evolve.

Strategic Planning

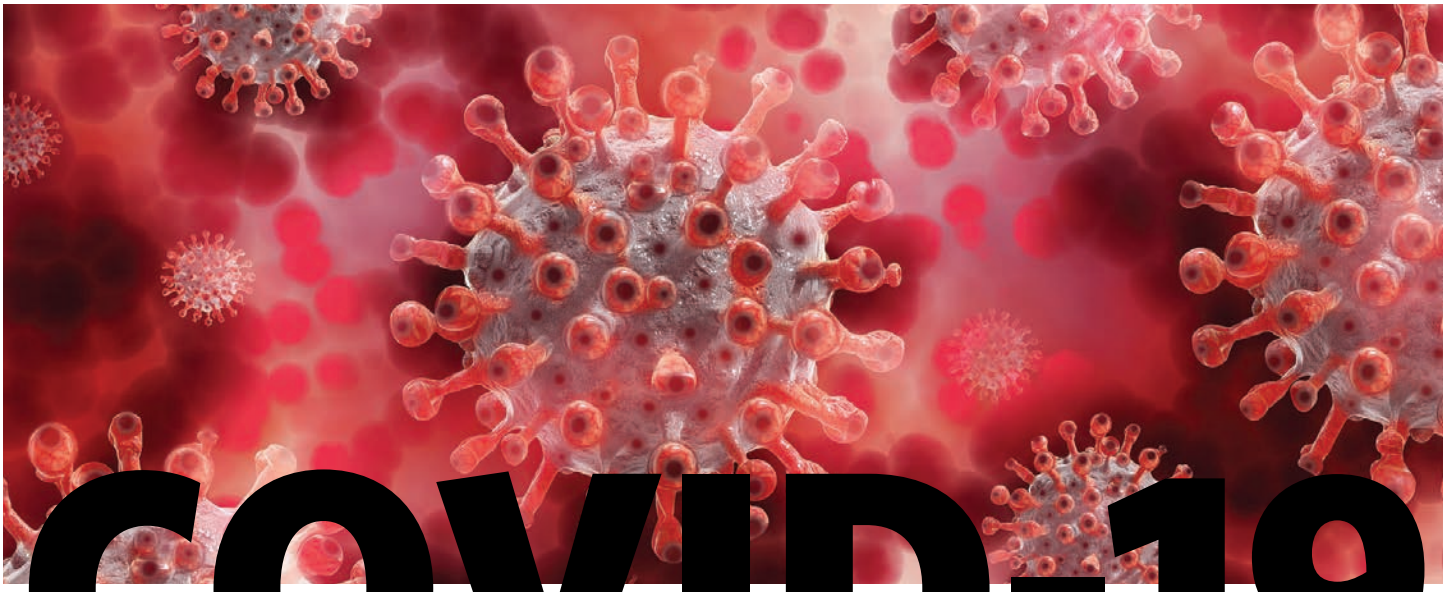
The IOF had invested in the creation of a fully-representative Strategic Planning Committee, undertaken two retreats where the Institute's vision and mission were evaluated, and a SWOT analysis that focused the committee on the preparation of the draft Strategic Plan. However, in early 2020 some staffing issues occured which had the Committee taking a short break. With the onset of the pandemic, and the increased availability of members, the Committee was able to focus on the preparation of a draft Strategic Plan.

The draft plan was presented to the IOF faculty committee, Research Associates, Postdoctoral Fellows, IOF Student Society, and staff representatives, with some components of it being widely discussed. Several important components of the draft were revised based on those recommendations and the planning is continuing to evolve. Discussion about the lack of a Strategic Plan was raised during the IOF's External Evaluation, and an external facilitator was engaged to assist in the facilitation of the strategic plan, particularly focused on its implementation milestones and targets.

The current target date for finishing this process is May-June 2021.

IOF faculty participate in a Strategic retreat session.

The Sustainability Committee began looking at social and environmental sustainability values, working to make IOF a better space. One are being looked at is improving our current sustainability policies by reducing our carbon impact. The pandemic, unfortunately, was helpful in this area.



COVID-19

As with most of the world, the COVID-19 pandemic took its toll on the IOF. In March 2020, UBC requested that all students, faculty, researchers, and staff please head home and work from there for what was to be a two-week period.

Two weeks turned into over eighteen months, with many still working from home well into 2021.

This world-wide situation resulted in several changes for the Institute. First, the IOF moved - quickly - to online offerings. While the final two IOF seminars of the 2020 academic year were cancelled, other classes, workshops, meetings, and exams, were migrated online.

The ability to use on-site labs was curtailed, and all fieldwork was also cancelled and postponed. This impacted several of our researchers who were about to undertake fieldwork required for them to complete their degrees. It also impacted a few researchers who had left on a research voyage just before the isolation period and were out at sea during its initial days!

As the isolation period extended, and while travel had been restricted, many students and researchers chose to return home to be with their families. Institute staff and faculty worked to remain connected with all researchers and students - and each other - no matter where they were located, with regular check-ins, lab meetings, workshops, and social games and events to keep spirits up. Mental health support became an important issue as IOF community members were working from their homes - some of which were less than ideal for long-term stays. Many were also juggling family responsibilities, with young children home from school, yet with work demands still omnipresent. And, more than anything, there were many concerns about financial support during this period. Federal, provincial and municipals governments stepped in with a variety of programs, including rent freezes, and other support. Both UBC and the Alma Mater Society of UBC also provided some financial assistance, and the IOF did what it could to support its students. This included regular newsletters highlighting new funding, university policy changes, government resource changes, pandemic regulations, mental health resources, and more.

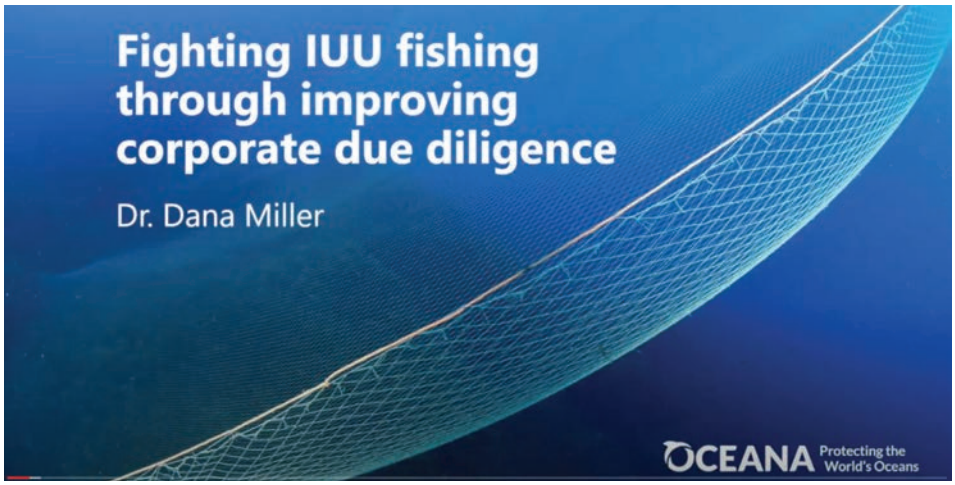
As time went on and we all adapted to the 'new normal' things became a little more settled. Zoom meetings now contained the obligatory 'introduction to one another's pets', "you're on mute" became a familiar refrain, and the IOF community displayed their avant-garde mask choices. Recipes, memes, and interesting websites were shared, and many noticed that the number of meetings and contingent workloads seemed to increase despite being at home.

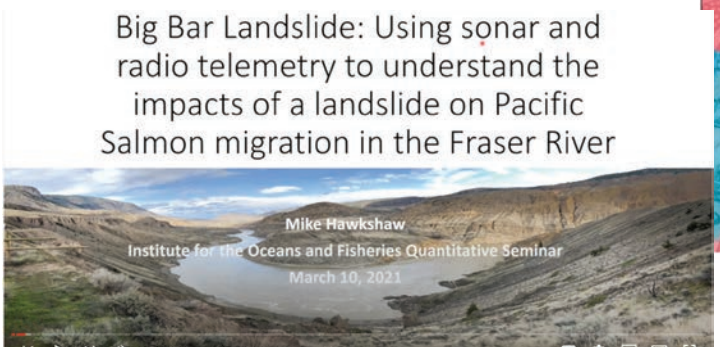
Special plans were put in place to allow some to return to campus for work or use of on-site labs, with stringent safety protocols in place. Summer courses had already moved on-line, and all departments were told to start preparing for the possibility that Fall (and possibly Winter) term courses would also need to be offered online. This proved to be the case.

One incidental benefit of the situation is that, with IOF seminars being offered online, we could attract presenters from all over the world. UBC presenters were invited and presented from their home offices, while the IOF was also able to offer presenters from across Canada, Europe, the United States, and Africa. As the sessions were given online, we also attracted audience members from around the globe - expanding the IOF's reach.

It also gave the IOF an opportunity to re-introduce regular quantitative research and modelling seminars. Hosted by Murdoch MacAllister (Associate Professor), Villy Christensen (Professor) and Dr. Carl Walters (Professor Emeritus) these provided in-depth seminars to a specialized audience.

These seminars are available on the IOF's YouTube channel and its website.





Awards, Honours and Recognition

IOF faculty, students, researchers, and staff continue to draw accolades at UBC, across Canada, and internationally.

Amanda Vincent has pipefish named after her

A newly discovered species of pipefish, found in *Patagonia, Argentina*, was named after Amanda Vincent in honour of her work on syngnathids (pipefishes and seahorses), according to the Journal of Fish Biology. Diego C. Luzzatto, the Argentinian biologist, who, along with his wife and fellow scientist María L. Estalles, first found and described the pipefish, said naming it after Vincent was "the obvious answer because of her huge work on syngnathids and their conservation."

Leptonotus vincentae (common name: Patagonian pipefish) was discovered in Argentina's San Antonio Bay, a marine protected area regulated by the provincial government and Protected landscape–seascape by the IUCN. This genus of pipefishes, Leptonotus, is distinguished by the fact that males brood eggs on their tail. Males and females differ in other ways, too; when courting, females develop bright stripes on their deep, flattened bodies.

Pipefish photos: ©Diego Luzzatto

Faculty honours

2019

Dr. Marie Auger-Méthé was named Canada Research Chair in Statistical Ecology (Tier II).

Dr. Nathan Bennett, Research Associate with the OceanCanada project was named as Chair of the IUCN's People and the Ocean Specialist Group

Dr. William Cheung won a Killam Faculty Research Fellowship (UBC), and was named to RSC's College of New Scholars, Artists and Scientists.

Dr. Daniel Pauly won the BBVA Foundation Frontiers of Knowledge Award in Ecology and Conservation Biology, along with marine biologists Carlos Duarte and Terence Hughes.

Dr. Gabriel Reygondeau, Research Associate with the Changing Oceans Research Unit, was named as 'The Marine Guy' for the Half Earth Project, based at Yale University.

Dr. Rashid Sumaila was awarded UBC's President's Award for Public Education through Media, won the Murray A. Newman Research Award (from Ocean Wise/Vancouver Aquarium), was made Canada Research Chair in Interdisciplinary Ocean and Fisheries Economics (Tier I), and was inducted as a Fellow in the Royal Society of Canada.

Dr. Curtis Suttle received a Wall Scholar Award from the Peter Wall Institute for Advanced Studies (UBC).

Dr. Colette Wabnitz, Research Associate, Changing Oceans Research Unit, was a Guest Editor for a special Ocean Finance issue of Marine Policy.

Professor Emeritus Dr. Carl Walters was appointed to the Order of British Columbia.

Dr. Amanda Vincent was awarded the Le Cren Medal from the Fisheries Society of the British Isles.

2020

Dr. Villy Christensen won the American Fisheries Society's Award of Excellence.

Dr. William Cheung won a E.W.R. Steacie Fellowship.

Dr. Daniel Pauly, Dr. Andrew Trites, and staff member Eden Fellner join UBC's Quarter Century club.

Dr. Maria "Deng" Palomares won the "Excellence in Service" award from UBC's Faculty of Science, for her contributions to UBC Science's mission.

Dr. Rashid Sumaila was named Distinguished International Professor by the National University of Malaysia

Dr. Amanda Vincent won the Indianapolis Prize and was inducted as a Fellow in the Royal Society of Canada.

Pamela Rosenbaum wins President's Service Award for Excellence

Pamela Rosenbaum, Manager of the Marine Mammal Research Unit (MMRU) was awarded a 2019 President's Service Award for Excellence.

The President's Service Awards for Excellence acknowledges staff who have made outstanding contributions to UBC, and who excel in their personal achievements.

With more than 35 years of experience at UBC, Rosenbaum is a trusted professional advisor, generous in sharing her knowledge and guidance with faculty, administrators, and students. She cares deeply about improving the student experience at UBC and student success after graduation.

Within and outside UBC, Pamela serves as a role model by demonstrating community involvement and active citizenship. She actively encourages and demonstrates community involvement by volunteering alongside students in various activities with the BC Marine Mammal Symposium, Northwest Student Society for Marine Mammalogy, and the Peter Larkin Lecture series.

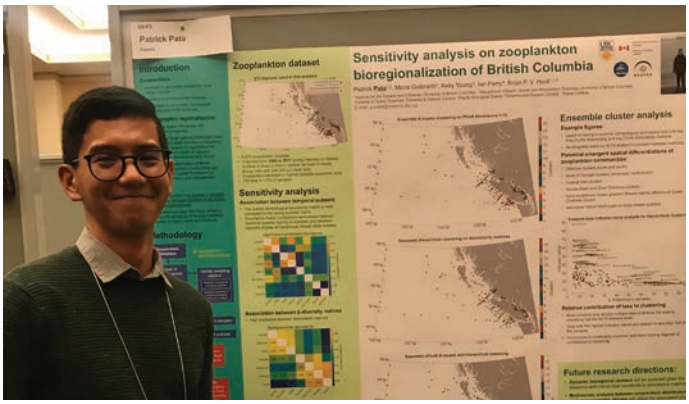
Honouring our graduate students

2019

PhD student Yuliya Kuzmenko won the inaugural Lawrence Hassel Graduate Field Research Award and used it to collect 100 adult sockeye otoliths during the spawning period on Adams lake, to assess early marine growth and link it to the environmental conditions in the Strait of Georgia and answer the question: how early marine growth influence survival and contributes to returns.

MSc student Caroline Graham's COSMOS Travel Award allowed her to liaise with potential project collaborators in the United States as she created an open-access database for salmon stomach contents in the marine environment.

PhD student, Patrick Pata won best poster in the Monitor category at the PICES (North Pacific Marine Science Organization) 2019 Science



Conference for his poster was entitled: "Sensitivity analysis on zooplankton bioregionalization of British Columbia."

Katie Florko, PhD student, used her Cecil and Kathleen Morrow Scholarship to travel to Churchill, Manitoba to participate in collection of data from monitoring studies (telemetry and body condition) and subsistence harvest (fitness) of polar bears and ringed seals to gain insights on concurrent habitat use, condition, and fitness under variable sea ice regimes.

2020

Alicia Anderson, MSc student, used her Lawrence Hassel Graduate Field Research Award to support her sustainability field research.

Natalie Benoit and Thomas Smith, both MSc students, will use the monies they received from the Brian Jessop Graduate Award to further their research on freshwater and diadromous fisheries.

Roshni Mangar (MSc student) received the COSMOS International Graduate Travel Award to undertake research or field work in her region or country of origin - in this case, Mauritius.

MSc student Karly McMullen received the Cecil and Kathleen Morrow Scholarship. This scholarship is awarded for best academic proposal for research travel work using techniques developed at the IOF.

UBC #WomeninScience campaign

February 11th, 2020 was International Day of Women and Girls in Science, and as part of the festivities, UBC ran a campaign that highlighted female leaders in science at UBC.

IOF selected MSc student Vanessa Fladmark to be part of the campaign, while the *Sea Around Us* initiative was represented by Dr. Maria "Deng" Palomares, research associate and the intiative's Program Manager.

Sarah Harper wins inaugural Sumaila-Volvo Prize

In 2019, Sarah Harper won the inaugural Sumaila-Volvo Graduate Prize in Environmental Sustainability.

This prize was made available through an endowment established by Dr. Rashid Sumaila, upon being named the 2017 Volvo Environment Prize laureate.

Harper, who had just defended her RES doctoral dissertation at the time, focuses her research on the contributions by women in fisheries economies globally.

Sumaila-Volvo Prize goes to IOF student for 2nd time

In 2020, PhD student Katie Florko won the Sumaila-Volvo Graduate Prize in Environmental Sustainability, which she used to continue her research on Arctic marine mammal (polar bears and ringed seals) space-use, predator-prey dynamics, and fitness under climate change.

This is the 2nd year running that an IOF student has won this award.

In Memoriam

C.S. "Buzz" Holling passed away on August 16, 2019. He was the first director of the Institute of Animal Resource Ecology (now Institute for the Oceans and Fisheries).

Recognized as one of the world's leading ecologists, he made major contributions to the theory of predation, the concept of ecological resilience, the concept of panarchy, and adaptive management.

Photo © Sandra Buckingham

Arthur (Art) Tautz passed away on September 13, 2020. It was Art who linked UBC's then Institute of Animal Resource Ecology and Fisheries Centre (now the IOF) with the Province's Ministry of Environment. After securing this collaboration, Tautz served as Manager of the Fisheries Research Branch, based at UBC where, like many he was 'temporarily' located in 'the Huts' for about 25 years, prior to moving to new offices in the AERL Building. He was also appointed as an as an Adjunct Professor at UBC, a position he continued to hold after his retirement.

Ronald (Bud) Sparrow passed away on September 14, 2020. A remarkable hero in the fisheries arena, Sparrow, a member of the Musqueam Band, stood at the forefront of aboriginal rights cases in Canada, challenging aboriginal fishing rights in the Regina v. Sparrow 1990 (SCC) case. The first Indigenous fishing rights case in British Columbia to succeed in the area of fisheries alone, and he opened the way for the ultimate recognition of the aboriginal right to use its catch for commercial purposes.

IOF students featured in UBC promotion

In 2020, UBC rolled out a media campaign, promoting the university as a premier institution, and attracting new students. Among the research stories told were two from IOF: A look at the work MSc student Joanna Wong is doing on the migration patterns of the Arctic tern; and Jessica Schaub's (MSc student) research on jellyfish blooms. Together these creatures may hold the key to helping us understand how climate change — and the human actions that cause it — are affecting the ocean.

This campaign was broadcast across British Columbia, in Ontario, and various markets around the globe.

IOF Community

Faculty

Marie Auger-Méthé, Assistant Professor and Canada Research Chair (Tier II, Statistical Ecology). Institute for the Oceans and Fisheries & UBC Department of Statistics

William Cheung, Professor and Canada Research Chair (Tier II, Ocean Sustainability and Global Change). Institute for the Oceans and Fisheries

Tom Carruthers, Assistant Professor. Institute for the Oceans and Fisheries

Kai Chan, Professor. Institute for the Oceans and Fisheries and UBC Institute for Resources, Environment and Sustainability

Villy Christensen, Professor. Institute for the Oceans and Fisheries

Simon Donner, Professor. Institute for the Oceans and Fisheries and UBC Department of Geography

Christopher Harley, Professor. Institute for the Oceans and Fisheries and UBC Department of Zoology

Brian Hunt, Assistant Professor and UBC Hakai Professor in Oceanography. Institute for the Oceans and Fisheries

Murdoch McAllister, Associate Professor. Institute for the Oceans and Fisheries

Charles Menzies, Professor. Institute for the Oceans and Fisheries and UBC Department of Anthropology

Dianne Newell, Professor Emerita, Institute for the Oceans and Fisheries and UBC Department of History

Evgeny Pakhomov, Director, Institute for the Oceans and Fisheries. Professor. Institute for the Oceans and Fisheries and UBC Department of Earth, Ocean and Atmospheric Sciences

Daniel Pauly, University Killam Professor. Institute for the Oceans and Fisheries and and UBC Department of Zoology

Tony Pitcher, Professor. Institute for the Oceans and Fisheries

David Rosen, Assistant Professor. Institute for the Oceans and Fisheries

Rashid Sumaila, Professor. Institute for the Oceans and Fisheries

Curtis Suttle, Professor. Institute for the Oceans and Fisheries and UBC Department of Earth, Ocean and Atmospheric Sciences

Andrew Trites, Professor. Institute for the Oceans and Fisheries and UBC Department of Zoology

Amanda Vincent, Professor. Institute for the Oceans and Fisheries

Carl Walters, Professor Emeritus, Institute for the Oceans and Fisheries and UBC Department of Zoology

Research Faculty

Juan Jose Alava, Research Associate, Changing Oceans Research Unit

Nathan Bennett, Research Associate, OceanCanada Partnership

Lucas Brotz, Honorary Research Associate, Sea Around Us

Andrés Cisneros-Montemayor, Research Associate, Nippon Foundation - UBC Nereus Program

Vicky Lam, Research Associate, Nippon Foundation - UBC Nereus Program

Maria Lourdes (Deng) Palomores, Research Associate, Sea Around Us

Gabriel Reygondeau, Research Associate, Changing Oceans Research Unit

Mei Sato, Research Associate, Marine Mammal Research Unit

Wilf Swartz, Research Associate, Nippon Foundation - UBC Nereus Program

Louise Teh, Research Associate, Fisheries Economics Research Uxanit

Lydia Teh, Research Associate, Changing Ocean Research Unit

Colette Wabnitz, Research Associate, Nippon Foundation - UBC Nereus Program

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Joey Bernhardt, Changing Oceans Research Unit

Oa Li Chen, Nippon Foundation - UBC Nereus Program

Tayler Clarke, Changing Oceans Research Unit

Fernando Colo Gianni, Pelagic Ecosystems Lab

David Costalago, Pelagic Ecosystems Lab

Hayley Dosser, Pelagic Ecosystems Lab

Jill Dwyer, Ocean Leaders
Boris Espinasse, Pelagic Ecosystems Lab
Andrea Frommel, Pelagic Ecosystems Lab
Jessica Garzke, Pelagic Ecosystems Lab
Alyssa Gehman, Harley Lab
Adrian Hordyk, Quantitative Modelling Group
Quang Huynh, Quantitative Modelling Group
Ibrahim Issifu, Fisheries Economics Research Unit
Myriam Khalfallah, Sea Around Us
Vijay Kumar, Global Modelling Lab
Anna Laskey, Pelagic Ecosystems Lab
Miling Li, Changing Oceans Research Unit
Roberto Licandeao, ECODIGM
Ravi Maharaj, Changing Oceans Research Unit
Christian Marchese, Pelagic Ecosystems Lab
Andrew Margolin, Pelagic Ecosystems Lab
Harmony Martell, Ocean Leaders
Jacqueline Maud, Hakai Coastal Initiative and Pelagic Ecosystems Lab
Anna McLaskey, Pelagic Ecosystems Lab
Sean Naman, Applied Freshwater Fisheries Research Unit
Muhammed Oyinlola, Changing Oceans Research Unit
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Caterina Rodriguez Giner, Pelagic Ecosystems Lab
Daniel Skerritt, Fisheries Economics Research Unit
Gerald Singh, Nippon Foundation - UBC Nereus Program
Wade Smith, Pelagic Ecosystems Lab
Kyra St. Pierre, Pelagic Ecosystems Lab
Szymon Surma, Fellow; Policy and Ecosystem Restoration in Fisheries
Travis Tai, Fisheries Economic Research Unit
Raul Villanueva, Fisheries Economics Research Unit
Xiong Zhang, Ocean Leaders

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Sahir Advani
Selina Agbayani
Alicia Andersen
Patricia Angkiriwang
Adepa Anyang
Alexis Bahl
Fiona Beaty
Abdul BenHasan
Natalie Benoit
Matias Bofarull Oddo
Virginie Bornarel
Joanne Breckenridge
Graham Brownlee
Salome Buglass
Cameron Bullen
Sara Cannon
Tim Cashion
Rachel Chudnow
Tayler Clarke
Fanny Couture
Allison Cutting
Santiago de la Puente
Sarah Dier-McComb
Hubert du Pontavice
Danielle Edwards
Meaghan Efford
Yulia Egorova
Vanessa Fladmark
Katie Florko
Sarah Fortune
Stephanie Foucault
Kyle Gillespie
Pedro Gonzalez Espinosa
Caroline Graham
Aaron Greenberg
Rowenna Gryba
Sarah Harper
Mike Hawkshaw
Sarah Hawkshaw
Vania Henriquez
Amelia Hesketh
Adam Hicks
Sam James
Hanbyeol Jang
Isaac Jonas
Charity Justrabo
Jess Kennedy
Myriam Khalfallah
Hong Sik Kim
Cassandra Konecny
Yuliya Kuzmenko
Lian Kwong
Carolina Lang Abarzua
Jacob Lerner
Xinru Li
Roberto Licandeo
Rachael Louton
Florian Lueskow
Ravi Maharaj
Roshni Mangar
Josh McInnes
Karly McMullen
Annie Mejaes
Barbara Ann Mejaes
Maxwell Miner
Oliver Murray
Kate Mussett
Benjamin Nelson
Rachel Neuenhoff
Greig Oldford
Haley Oleynik
Polina Orlov
Muhammed Oyinlola
Juliano Palacios Abrantes
Patrick Pata
Ana Pozas Franco
Aaron Purdy
Samantha Ramirez
Veronica Relano-Ecija
Taryn Marie Scarff

Jessica Schaub
Rebecca Schijns
Zack Sherker
Thomas Smith
Kristen Sora
Ambre Soszynski
Kasey Stirling
Rhea Storlund
Heather Summers
Szymon Surma
Travis Tai
Nicolas Talloni-Alvarez
Ron Togunov
Alejandra Urcelay
Tanvi Vaidyanathan
Allison Witter
Joanna Wong
Patricia Woodruff
Seth (Christopher) Wynes
Xueying Yin
Xiong Zhang
Katie Zinn

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Scott Finestone, Manager, Finance & Facilities, Institute for the Oceans and Fisheries

Katherine Came, Communications Manager, Institute for the Oceans and Fisheries

Eden Fellner, Graduate/Admin Coordinator, Institute for the Oceans and Fisheries

Rebecca Smith, Finance Clerk, Institute for the Oceans and Fisheries

Riley Tjosvold, Communications Assistant, Institute for the Oceans and Fisheries

Pamela Rosenbaum, Manager, Marine Mammal Research Unit

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Anne Marie Goodfellow, Program Manager, OceanCanada

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Jessika Woroniak, Research Assistant, Sea Around Us

Audrey Zhu, Research Assistant, Sea Around Us

Publications

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