Director’s message

Calling this an Annual Report is a misnomer. However, in common parlance, a Quadrennial Report just does not ‘sing’ the way that Annual Report does. And so this is an Annual Report for the first four years of the Institute for the Oceans and Fisheries.

It does make sense. It has taken at least that many years for us to get our feet fully beneath us. When we were created on July 1, 2015, the Institute, while it evolved from the storied Fisheries Centre, had a new, broader mandate that spanned the natural and social sciences. We now include aquatic ecology, economics, zoology, anthropology, sociology, oceanography, marine geochemistry, microbiology, resource management, and international maritime law in our purview, and are charged with the mission of leading the way to healthy and sustainable marine and freshwater systems through excellent research, inspirational education, and innovative societal engagement. Lofty, and inspiring, goals.

Looking through the Report you will note that, while we are still finding our way, we are slowly but surely building an Institute that is more than the sum of its parts. We are still organized in research units, but note that in so many cases, those units work with each other to produce the excellent research we have always been famous for. The Sea Around Us works with the Fisheries Economics Research Unit and Changing Oceans Research Unit for numerous studies, while the Marine Zooplankton and Micronekton Laboratory works with the Pelagic Ecosystems Lab, which in turn liaises with Marine Mammal Research Unit and the Statistical Ecology Research Group, and so on. We pride ourselves on our interdisciplinary nature at the macro level, and can also celebrate our interconnectiveness at the micro.

We look forward to sharing our next milestones with you.

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

This initiative catalogues and presents fisheries and related data at spatial scales that are relevant to ecology and policy. The *Sea Around Us* website catalogues fisheries and ecosystem data according to Exclusive Economic Zones, Large Marine Ecosystems, High Seas areas, and other ecologically meaningful special areas.

*Principal Investigator: Dr. Daniel Pauly*

### Highlights

**Closing the high seas to fishing**
In 2015, with contributions from the Fisheries Economics Research Unit, the *Sea Around Us* entered this debate, which was already taking place in international fora, with the paper, “Winners and losers in a world where the high seas is closed to fishing” (Scientific Reports). This paper had a major impact; demonstrating that the high seas generate 5 to 8 percent of the world's marine catch, and that only a handful of subsidized fleets can fish there. This is effectively an oligopoly for accessing the different species of valuable tuna found in the area.

The *Sea Around Us* research showed that more people could benefit from such resources if the high seas were closed to fishing because a giant marine reserve would be created and it would enable overfished tuna stocks to rebuild. Such a recovery would generate a spillover effect that would allow for more tuna and other highly migratory fish presently caught in the high seas to be caught in the EEZs of various countries.

Thus closing the high seas could be catch-neutral in terms of global fish catches while inequality in the distribution of fisheries benefits among the world’s maritime countries could be reduced by 50%.

**Sub-Antarctic Islands catch reconstruction**
In 2015, the *Sea Around Us* published, in a Fisheries Centre Research Reports, a compilation of catch reconstructions for the often-neglected sub-Antarctic islands. *Sea Around Us* had previously published four similar compendia for islands, covering both tropical and temperate islands in all ocean basins, and ranging from the largest, such as Greenland, to the smallest such as Pitcairn Island or Nauru, however a research group had never presented the fisheries catches of all island territories of the world. The *Sea Around Us* was the first to do it.

This may lead to advances in ‘nesology,’ the multifaceted disciplines devoted to the study of island economies and culture, but which suffered from the inability to access reliable fishery catch time series from countries' overseas territories, such as the Galápagos, and also from culturally or economically important islands such as Crete, Sardinia, Sicily, or the Baleares in the Mediterranean.

**Global catch reconstruction**
In 2016, the *Sea Around Us* had two major publications; the paper “Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining” in *Nature Communications* and the book, *Global Atlas of Marine Fisheries*.

The Atlas presented the methods and results of the 273 catch reconstructions that the *Sea Around Us* team, assisted by over 300 researchers from all continents, carried out to cover the Exclusive Economic Zones of all maritime countries, or their overseas territories for the years 1950 to 2010. The *Nature Communications* article presented a synthesis of these 273 reconstructions.

This synthesis demonstrated that global marine fisheries catches are 50% higher than what the Food and Agriculture Organization of the United Nations (FAO) reports on behalf of member countries, and that have been...
**Mission:** To assess the impact of fisheries on the marine ecosystems of the world and offer mitigating solutions to a range of stakeholders such as researchers, students, NGOs, advocacy groups, fishers, fisheries managers, government bodies, and intergovernmental organizations.

**Vision:** To be the provider of the most accurate, updated, complete and used global fisheries database, as a support system for research devoted to the sustainable management of fisheries resources across the world.

Declining at a rate of 1.2 million tonnes of catch per year since the mid-1990s.

The stark difference between reported and reconstructed catches could be explained by the fact that the data reported by FAO are ‘landings’ and not ‘catches,’ because they explicitly omit discarded catches and bycatch. Also, they cover small-scale fisheries very cursorily, often ignoring artisanal and especially subsistence and recreational fisheries. Additionally, they do not attempt to include illegally caught fish, thus masking issues associated with Illegal, Unreported and Unregulated (IUU) fisheries. The Sea Around Us database, on the other hand, covered all those sectors, as the catch reconstruction methodology that was developed corrects for the omissions in the FAO database.

The data behind these catch reconstructions are available on the Sea Around Us website (www.seaaroundus.org) and are corrected and updated regularly. Individual catch reconstructions are also submitted to scientific journals and over 100 of them have already been published in the peer-reviewed literature.

The results from both the Nature Communications paper and the Atlas drew a lot of attention from the media, with over 100 stories published in various outlets (i.e. The Washington Post, The Guardian, The Huffington Post, BBC, and CBC).
Documenting the *Sea Around Us* work

The international dimension of the *Sea Around Us* catch reconstruction work was captured in an award-winning documentary produced by Ms. Alison Barrat for the Khaled Bin Sultan Living Oceans Foundation. The film is titled *An Ocean Mystery: The Missing Catch*. This documentary premiered at the Smithsonian National Museum of Natural History and on Smithsonian Channel on Earth Day 2017. It is now available online and has gathered a dozen awards and thousands of views.

**GOLT paper creates some buzz**

In August 2017, Dr. Daniel Pauly and Dr. William Cheung (a former *Sea Around Us* postdoc, now professor in the Institute for the Oceans and Fisheries), published the paper “Sound physiological knowledge and principles in modeling shrinking fishes under climate change” in *Global Change Biology*. It explained how higher temperatures, by elevating the oxygen requirements of fish, force them to remain smaller, as is already occurring in various species.

This obvious inference was based on the fact that fish gills, as a two-dimensional surface, cannot grow as fast as their bodies, i.e., the 3-dimensional volumes that gills supply with oxygen. Hence, the larger fish get, the less oxygen they obtain per unit weight. It is thus no surprise that they must remain smaller when exposed to higher temperatures.

The article, which was based on Dr. Pauly’s Gill-Oxygen-Limitation Theory (GOLT), also attracted a lot of attention from researchers, NGOs and media because of the growing worries about the implication of ocean warming and deoxygenation, and similar processes in freshwater bodies. The piece was among UBC’s Top 5 Stories of 2017.

**Assessing the world’s fish stocks**

In 2018, with the support of Oceana, and based on the *Sea Around Us* reconstructed catch time series, Dr. M.L. ‘Deng’ Palomares led the *Sea Around Us* team on a project aimed at performing over 2,000 stock assessments, essentially covering the most important exploited marine fish and invertebrate species in the world.

The group used the CMSY method developed by long-time collaborator, Dr. Rainer Froese, and colleagues. This method requires only catch time series as input, along with easy-to-obtain ancillary quantitative information, which makes it ideal for determining trends in fish biomass in data-poor areas and inform fisheries managers in charge of establishing catch quotas.

This work allowed the *Sea Around Us* team to present, for every ‘Marine Ecoregion’ and thus every EEZ of the world, stock assessments of major species occurring and exploited therein.

**Sea Around Us Down Under**

In June 2017, Dr. Dirk Zeller, who had been *Sea Around Us*’ project manager since 1999, became a professor of Marine Conservation at the University of Western Australia (UWA) and launched the *Sea Around Us* – Indian Ocean, the project’s first external ‘branch.’

*Sea Around Us* activities at UWA have brought attention to the Indian Ocean, an area often neglected in global studies but crucial when dealing with food security, as countries along the Indian Ocean Rim are home to one-third of the world’s population.

Dr. Zeller’s appointment helped solidify the *Sea Around Us*’ partnership with UWA and its Marine Futures Lab led by Prof. Jessica Meeuwig, as well as with the Minderoo Foundation, one of the unit’s new partners.

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**Partners and Donors**

Bloomberg Philanthropies  
Changing Ocean Research Unit  
Conservation International  
David and Lucile Packard Foundation  
FishBase and SeaLifeBase  
Fisheries Economics Research Unit  
Global Greengrants Fund  
Marisla Foundation  
Mava Foundation  
Minderoo Foundation  
Nereus Program  
Oak Foundation  
Oceana  
Paul G. Allen Family Foundation  
Paul M. Angell Family Foundation  
Pew Charitable Trusts  
Rockefeller Foundation  
United Nations  
University of Western Australia  
Vulcan Inc.  
Walk Free Foundation
Collaborative papers on fisheries expansion and slavery at sea

“Far from home: distance patterns of global fishing fleets,” was published in Science Advances, and marked the first collaborative research article between the Sea Around Us at UBC, the Sea Around Us - Indian Ocean, the Marine Futures Lab at UWA, and the Minderoo Foundation.

The authors mapped the growth and spread of industrial fisheries using Sea Around Us data and found that heavily-subsidized industrial fishing fleets have doubled the distance they travel to fishing grounds since 1950 but catch only a third of what they did 65 years ago per kilometre travelled.

The article received coverage by important media outlets which, together, have a potential audience reach of 30 million people.

The same groups, together with the Walk Free Foundation/Minderoo Foundation, published “Modern slavery and the race to fish” in Nature Communications. This garnered massive media coverage and received a score of 320 in Altmetric, meaning it was in the 96th percentile of the nearly 3,000 articles in the journal. By combining fisheries data from the Sea Around Us with country-level data on modern slavery from the Walk Free Foundation, the researchers found that countries whose fleets rely heavily on government subsidies, fish far away from home ports, and fail to comprehensively report their actual catch, tend to fish beyond sustainable limits and are at higher risk of labour abuses. In a vicious cycle, such labour abuses become ‘hidden subsidies’ that allow those distant-water fishing fleets to remain profitable and continue their unscrupulous operations.

Fisheries catch by gear

An intense effort led by Tim Cashion, resulted in the world’s fisheries catch disaggregated by major industrial fishing gears. This disaggregation, published in the journal Fisheries Research and available on the Sea Around Us website, can be viewed at country level, as well as for Large Marine Ecosystems and other geographies, and thus enables comparative assessments of the ecosystem impact of fishing, particularly by bottom trawlers.

This work is being complemented with the construction of a global database on fishing effort, as expressed by the cumulative power of the engines in the fishing fleets of maritime countries, ranging from small coastal to large offshore vessels. This database is expected to be made public in 2020.
Project Seahorse

Project Seahorse is an interdisciplinary and international organisation committed to conservation and sustainable use of the world’s coastal marine ecosystems. It engages in connected research and management at scales ranging from community initiatives to international accords. Collaborating with stakeholders and partners, Project Seahorse use seahorses to focus its efforts in finding marine conservation solutions.

Principal Investigator: Dr. Amanda Vincent

Highlights

Saving seahorses & securing the shallow seas
Threatened by non-selective gear and other bad fishing practices, as well as habitat degradation, seahorses are flagship species for a wide range of marine conservation issues. Through biological and social research, management and policy change, field conservation, and citizen science, Project Seahorse is dedicated to ensuring that seahorse populations and their habitats are healthy and well-managed.

- Researchers published a monograph on seahorse taxonomy that now serves as the global reference for policy and management (2016).
- Project Seahorse obtained the first film footage of seahorse birth in the wild, with 2.39 million views on YouTube (2016).
- Dr. Amanda Vincent was one of six finalists for world’s pre-eminent Indianapolis Prize in animal conservation (2016).
- The project completed the first global conservation assessments (www.IUCNredlist.org) for all 323 species of syngnathid fishes (2017).
- Project Seahorse co-hosted the 3rd global SyngBio meeting for researchers and managers engaged with the Syngnathid family of fishes: seahorses, pipefishes, pipehorses, and seadragons (2017).
- As Chair of the global expert group on syngnathid fishes, Dr. Vincent established the group’s first strategic plan (www.iucn-seahorse.org) (2017).
- Four toolkits on seahorse conservation in China, Portugal, Florida (USA), and South Africa, respectively, were created (2017-2018).
- iSeahorse, Project Seahorse’s citizen science programme for seahorses (www.iSeahorse.org), reached >400 sightings and 12 trends monitoring team globally (2018).

Seahorses (and many other organisms) are incidentally caught in multiple artisanal as well as commercial fisheries throughout their range - and this is the major threat facing them. Even though small numbers are caught per unit of effort, the number of individuals taken is substantial. © Sarah Foster/Project Seahorse

Making trade & fisheries sustainable
Project Seahorse team members track the global seahorse trade through a combination of field work and data analysis. In the 1990’s they uncovered the vast geographical and economic scope of this trade. About 15-20 million seahorses are traded, live and dead, around the world each year. They are used in traditional medicine, for display in aquariums, and as curios. Working with the United Nations’ global agreement, the Convention on International Trade in Endangered Species (CITES), they continue to make notable contributions to trade regulation. Throughout 2015-2018, Project Seahorse:

- Provided practical policy advice on seahorses for 182 nations, as key advisors to the United Nations Convention on International Trade in Endangered Species;
- Hosted inter-governmental events on (i) connections between illegal wildlife trade and illegal fishing and (ii) implementation of global export controls on marine fishes (2016);
- Discovered that 95% of seahorse imports to Hong Kong SAR – a major global centre for wildlife trade - reportedly came from countries that had ended exports (2017);

Impacts

- Catalysed creation of Project Seahorse’s 35th no-take marine protected area in the Philippines (2016).
- Provided the technical and policy input that prompted the near global closure of legal exports of seahorses, with new suspensions of trade from Guinea, Senegal, and Thailand (2016).
- Created breakthroughs in seahorse and marine conservation in China, with gains in professional training, citizen science, spatial planning, advancement of protected areas, and outreach (2017).
- Supported development of one new marine protected area in each of Argentina, Bahamas, and China (2017-2018).
AWARDS and HONOURS

Amanda Vincent was awarded the Le Cren Medal (Fisheries Society of the British Isles) for outstanding work in conservation, education and outreach (2018).

Amanda Vincent was one of six finalists for world’s pre-eminent Indianapolis Prize in animal conservation (2016).

Amanda Vincent and Xiong Zhang visiting the CITES Authority in Beijing, December 2018. © Amanda Vincent/Project Seahorse

Partnerships and Collaborators

Guylian Belgium Chocolates
Langar Foundation
Zoological Society of London
Center for Marine Sciences, University of Algarve, Portugal
Chandrakasem Rajabhat University, Thailand
Fisheries NSW, Australia
Hirosaki University, Japan
Knysna Basin Project, South Africa
NatureServe, USA
Oceanario de Lisboa, Portugal
Peau-Bleue, France
Research Centre in Biodiversity and Genetic Resources (CIBIO), University of Porto, Portugal
Save Our Seahorses Malaysia
South China Sea Institute of Oceanology, Chinese Academy of Sciences, China
State University of Paraíba (UEPB), Brazil
The National Scientific and Technical Research Council of Argentina (CONICET)
University of Tampa, USA
Vivekananda College, Manonmaniam Sundaranar University, India

Training conservationists & building capacity

Under greater pressure than ever before, the world’s oceans need more champions and more optimists. Project Seahorse is training the next generation of scientists, conservationists, and advocates to stand up for the oceans. To date Project Seahorse has trained 175+ professional conservationists (and ~80 volunteers) around the world, with backgrounds ranging from the biological sciences to law to the arts. It also mentors and supports many other colleagues.

• Dr. Vincent is co-investigator on new NSERC CREATE grant ($1.56 million) for Training Our Future Ocean Leaders programme (2016)
• Dr. Vincent was appointed as Chair of the Marine Conservation Committee for the global union of conservation agencies and organizations (IUCN) (2017)
• Dr. Vincent spent a year travelling to support marine conservation projects around the world, providing collegiate contributions in Argentina, Bahamas, China, France, India, and South Africa (2017-2018).

PhD candidate, Tanvi Vaidyanathan, standing by baskets of bycatch destined for chicken feed in Mandapam north, India. ©Amanda Vincent/Project Seahorse
Staff and Researchers

Prof. Amanda Vincent, Professor and Director, Project Seahorse
Dr. Sarah Foster, Research Associate
Dr. Lindsay Aylesworth, PhD student and Research Associate
Dr. Sara Lourie, Research Associate
Dr. Lucy Woodall, Research Associate
Dr. Tse-Lyn Loh, Postdoctoral Fellow
Dr. Xiong Zhang, PhD student, then Postdoctoral Fellow
Lily Stanton, Syngnathid Research Biologist
Regina Bestbier, Research Biologist and Communications Coordinator
Riley Pollom, Syngnathid Research Biologist
Scott Finestone, Operations Manager
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Ting-Chun Kuo, PhD student
Jennifer Selgrath, PhD student
Tanvi Vaidyanathan, PhD student
Iwao Fujii, MSc student
Clayton Manning, MSc student
Allison Stocks, MSc student
Emilie Stump, MSc student

Partners and Donors

Aquarium du Quebec, Canada
Disney Worldwide Conservation Fund
Greensboro Science Center, USA
Guylian Belgian Chocolates
Herbert W. Hoover Foundation, USA
Indianapolis Zoo, USA
International Conservation Fund of Canada (ICFC)
International Union for the Conservation of Nature
Laguntza Foundation
Langar Foundation, Canada
Mohamed Bin Zayed Species Conservation Fund
Munich Zoo, Germany
NSERC CREATE program
Ocean Park Conservation Foundation Hong Kong
Paul G. Allen Family Foundation, USA
People’s Trust for Endangered Species, UK
Point Defiance Zoo and Aquarium, USA
Save Our Species
Synchronicity Earth, UK
Taiwan Forestry Bureau, COA
Whitley Fund for Nature

A Great seahorse (Hippocampus kelloggi) in black coral, Oman. It is traded both live for the aquarium trade as well as dried, for use in traditional medicine. It is classified as Vulnerable on the IUCN Red List for Threatened Species. © John van Lent/Guylian Seahorses of the World

Measuring dried seahorses in Vietnam. Although CITES has suspended exports of seahorses from Vietnam, they still make up a significant portion of the seahorse stock in the markets of Hong Kong – the world’s largest importer of dried seahorses. Photo by Allison Stocks/Project Seahorse
Bayesian stock assessments
Dr. McAllister undertook research on developing Bayesian stock assessment methodologies, and implementations of those, in collaborations with agency scientists in Europe, New Zealand, the US, and Canada on numerous fisheries stock assessments and have led the way to the more common implementation of Bayesian stock assessment methodologies in fisheries stock assessments. Since 2015, he has led the development of stock assessment methodologies for fisheries for several different stocks on the Pacific and Atlantic coasts of Canada. Dr. McAllister was the lead analyst in developing and applying Bayesian stock assessment methods for DFO assessments of Fraser River Eulachon, and outside waters yelloweye rockfish on the Pacific coast, and for Acadian and deepwater Atlantic redfish on the Atlantic coast.

Atlantic redfish fishery
Dr. McAllister’s collaborative research with the federal Department of Fisheries and Oceans Canada (DFO), and Canadian fishing industry organizations on the Canadian Atlantic redfish fishery led to the mending of a long-standing, and previously adversarial, relationship between DFO and fishing industry groups on the stock assessment and management of the Canadian Atlantic redfish fishery. Atlantic redfish stock assessments carried out between 2010 and 2016 had been highly contested by industry groups with those groups bringing in their own consultants to contest the DFO assessments of Atlantic redfish. Management recommendations to keep quotas low had been contested by industry, which successfully had lobbied the Minister of Fisheries to keep the catch quota much higher. In early 2017, Dr. McAllister undertook a new collaborative assessment and management approach to the redfish fishery called “management strategy evaluation.” The UBC team led the development of new assessment and simulation evaluation models in collaboration with DFO, industry groups, Oceana, and SFU academics. They developed and applied new modeling software to evaluate a large variety of different candidate management methodologies for the fishery. This time industry partners agreed not to bring in its own stock assessment consultants and strongly supported the new management process and fishery management models developed by McAllister’s UBC team.

In May 2018, DFO and fishing industry groups selected a small subset of the numerous management options that the UBC team had evaluated as desirable for the future management of the Canadian Atlantic redfish fishery. The management procedures considered had been found to perform acceptably in terms of specific conservation and fishery economic objectives under a large variety of plausible hypotheses about redfish stock dynamics. DFO is currently preparing to implement one of these management procedures to set catch limits for the Canadian Atlantic redfish fishery. The potential economic
In addition to his work with ECODIGM, Dr. McAllister successfully led the IOF’s proposal for two graduate programs, a Masters and PhD in Oceans and Fisheries, with final approval given from the BC Minister of Advanced Education, Skills and Training in December 2018. The two programs opened for admission of new graduate students in September, 2019. There was a total of 20 graduate students registered in the program on its official start date in September 2019, most coming from transfers into the program from existing programs but with eight new applicants accepted directly into the program.

value of landings from this fishery within the next decade is forecasted to run at about $20-40 million per year.

In addition, a 1.5 year management strategy evaluation that Dr. McAllister led from 2016-2018 to evaluate candidate management procedures for the Gulf of St. Lawrence and Laurentian Channel Atlantic redfish fishery passed peer review in April 2018. DFO considers the results as setting a new fishery management policy for this fishery. A journal article based on this collaboration was published in the Canadian Journal of Fisheries and Aquatic Sciences in October 2019.

Pinniped abundance
PhD students supervised by Dr. McAllister investigated the potential impacts of the several-fold increase in pinniped abundance on the Atlantic and Pacific coasts of Canada. This research resulted in the publication of high quality journal articles that provide some of the most scientifically rigorous evaluations yet of the hypothesis that predation by pinnipeds has markedly increased natural mortality rates and reduced productivity and sustainable fishery yields of important commercial fish stocks on Canada’s Pacific and Atlantic coasts. PhD student Ben Nelson was first author of the paper “Effects of harbour seal predation and hatchery releases on Chinook salmon productivity in the Pacific Northwest”, published in the Canadian Journal of Fisheries and Aquatic Sciences in 2018. The paper documented research that found that there was a significant and strong negative correlation between local harbour seal abundance and Chinook salmon productivity in 14 of 20 stocks investigated. In contrast no significant negative correlations between Chinook salmon productivity and salmon hatchery releases in all twenty stocks was found. The analysis predicted that, on average, that the maximum sustainable yield for Chinook salmon stocks has declined by 74 percent in association with the observed 10-fold increase in harbour seal abundance in the Salish Sea since 1970.

PhD student Rachel Neuenhoff was first author of the paper “Continued decline of a collapsed population of Atlantic cod (Gadus morhua) due to predation-driven Allee effects” published in the Canadian Journal of Fisheries and Aquatic Sciences, in 2019. The research documented in this paper showed a very strong predator driven Allee effect in the southern Gulf of St. Lawrence cod population, i.e., over the past two decades that the average stock productivity was negative at low cod stock abundances, i.e., below 200,000 tons. This is despite there being a moratorium on the fishery for this stock and bycatch being held at a very low level over the past three decades since the fishery closed. Applying field observations of gray seal predation on overwintering mature cod from this stock, the analyses showed that marked increases in predation from gray seals since the 1980s could explain the very large observed increases in cod natural mortality rates and the continued decline in abundance of this cod stock since the 1990s.

Harbour seal - © Skeeze/Pixabay
Onward and upward - training the next generation of experts

Many of the PhD students and post-doctoral researchers trained and supervised by Dr. McAllister have been successful in applying for research and analyst positions within agencies responsible for natural resource management. These include Fisheries and Oceans Canada, the Pacific Salmon Commission, the International Commission for the Conservation of Atlantic Tunas (ICCAT), the UK Game and Wildlife Conservation Trust, and the US Corps of Army Engineers. Dr. Robin Forrest (postdoc, 2008-9), was hired as a research scientist with DFO in 2010, and in 2016 became a section head of a new Quantitative Assessment Methods Section at the Pacific Biological Station.

Dr. Nathan Taylor (postdoc, 2007-2010), was hired as a biologist by DFO in 2010 and in 2015 became Acting section head of the Marine Ecosystems and Aquaculture Division. In 2018 he was hired as bycatch coordinator at ICCAT in Madrid. Dr. Divya Varkey (postdoc, 2011-2017), was hired as a research scientist at the DFO St. Johns Laboratory in 2017. Drs. Catarina and Shannon Obradovich (supervisor for PhDs) were hired into stock assessment analyst positions with DFO in 2018. Sarah Hawkshaw (current PhD student), was hired as a stock assessment analyst by the DFO Institute of Ocean Science in 2017. Dr. Tom Carruthers (PhD supervisor at Imperial College London, and research associate 2010-2015), was hired as an Assistant Professor at UBC in 2017.

Partnerships

Fisheries and Oceans Canada (DFO) Redfish scientists, Mont Joli, Quebec
Fisheries and Oceans Canada (DFO) Pelagic Fisheries Scientists, Pacific Biological Station, Nanaimo, BC
Fisheries and Oceans Canada (DFO) Stock Assessment Research Scientists, St. Johns, Newfoundland.
The Canadian Wildlife Service, Pacific Region, Delta, BC.
BC Ministry of the Environment, Applied Freshwater Ecology Unit, UBC, Vancouver Campus.
Game and Wildlife Conservation Trust, Fordingbridge, UK.

Fisheries Modeling and stock Assessment Unit, Yokohama National Fisheries Research Institute, Yokohama, Japan.
Fisheries Modeling and Stock Assessment Unit, Sekai National Fisheries Research Institute, Nagasaki, Japan.
Fisheries Modeling and Stock assessment unit, National Institute of Water and Atmospheric Sciences, Wellington, New Zealand.
US Army Corps of Engineers, Oregon.
Finnish Game and Fisheries Research Institute, Finland.
Carruthers Lab

Dr. Tom Carruthers joined IOF as an Assistant Professor in 2017. In that time his lab has established a research network and tools for eco-certification (MSC) and status determination (UN FAO) for the majority of the world’s fisheries. Through their developments in Management Strategy Evaluation and state-of-the-art population assessment, the small team is arguably one of the most advanced applied fishery modelling units in the world.

Highlights

**Online decision making tool**
In partnership with the Marine Stewardship Council and the UN Food and Agricultural Organization, the Carruthers Lab published the Method Evaluation and Risk Assessment (MERA) online tool to support decision making in all fisheries. MERA is the culmination of more than 15 person-years of software development (DLMtool, MSEtool) and is the first theoretically rigorous tool to inform fishery managers on research gaps, most cost-effective data collection protocols, the best resource assessment type. MERA also provides state-of-the-art stock status determination for fisheries in the full spectrum of data-poor to data-rich. MERA is in beta testing but will go ‘live’ in early 2020 for use in fishery improvement projects, seafood certification (MSC) and status determination (FAO).

Beta version: [http://142.103.48.20:3838/MERA_2/](http://142.103.48.20:3838/MERA_2/)

**Fishery system models**
The Lab published an online repository of complete fishery system models that have supported and will continue to support peer reviewed publications on fishery management solutions.


**BC recreational trout fishery**

**Partners and Donors**
The Marine Stewardship Council
The UN Food and Agricultural Administration
NSERC Discovery grant
Department of Fisheries and Oceans
Collaborative Research Projects
Natural Resources Defense Fund

**Mission:** To bring strategic, transparent and accountable decision making to fisheries management.

Trout catch - © Skeeze/Pixabay

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**Staff and Researchers**

**Dr. Tom Carruthers**
(Principal Investigator, Assistant Professor)

**Dr. Adrian Hordyk**
(Postdoctoral fellow)

**Dr. Quang Huynh**
(Postdoctoral fellow)
Policy for Restoration of Ecosystems and Fisheries (PERF)

Highlights

Pacific Herring
There is a pressing need to understand the pivotal role of low-trophic level or forage fish in social-ecological systems. In British Columbia, Pacific herring feed marine mammals, seabirds and fish, and compete with zooplanktivores, such that any changes to herring biomass ripple through the entire food web. Moreover, herring supply both commercial and First Nations fisheries. Improved ecological science of herring requires ecosystem-based analysis and integration of this fishery’s strong ecological and human impacts. PERF partnered with the Council of Haida Nation and Heiltsuk First Nation, for whom herring are embedded in traditional culture, to undertake innovative ecosystem-based initiatives to advance forage fish science, perform ecosystem modelling of herring management scenarios with participatory research, and explore the integration of traditional values and ethics with scientific principles.

One activity that informed these values was a serigraph series, produced by Haida artist April White, called “Herring People”. These serigraphs highlight the importance of Pacific herring’s role in BC marine ecosystems, aboriginal communities, and commercial fisheries. The full series is on display at the Institute for the Oceans and Fisheries.

PERF also hosted an International Research Roundtable in 2016 that focused on the ethical challenges of herring food webs and value chains. Herring food webs connect diverse ecological species (e.g., euphausiids, copepods, finfish, whales, seals, and seabirds) with different functions within marine ecosystems. The Roundtable’s goal was to develop policy recommendations for herring management and governance and compose a synthesis paper that addresses the ethical dilemmas that ensue from herring’s provisioning role for both humans and ecosystems.

Mission: To foster analysis supporting in policy that can lead to the restoration of ecosystems and their fisheries.

Staff and Researchers

Principal Investigator
Dr. Tony Pitcher

Research Associate
Dr Mimi Elizabeth Lam

Postdoctoral fellows
Dr Rajeev Kumar
Dr Wade Smith

Graduate students
Sahir Advani, PhD student
Jamie Slogan, PhD student
Szymon Surma, PhD student
Nicolas Talloni, PhD student
Jeffrey Scott, MSc student

Partners and Donors
NSERC
Peter Wall Institute
MITACS
Council of the Haida Nation
Skipper Otto Seafood

Herring People - Humpback whale - © April White 2016
Global Ocean Modelling

Focusing on the development of a spatial model of the global ocean to support informed policy and management decisions, Global Ocean Modelling participates in the development of the Ecopath with Ecosim approach and software.

Principal Investigator: Dr. Villy Christensen

ECOPATH
The unit serves as a central hub for the Ecopath Research and Development Consortium for which Principal Investigator, Dr. Villy Christensen, serves as Executive Board Chair.

The Consortium has the following members,
1. Centre for Environment, Fisheries and Aquaculture Science, Lowestoft Laboratory (UK);
2. Centro Interdisciplinario de Ciencias Marinas Instituto Politécnico Nacional (Mexico);
3. Ecology Department, The Scottish Association for Marine Science (UK);
4. Ecopath International Initiative research association (Spain);
5. ESSA Technologies (Canada);
6. Estonian Marine Institute, University of Tartu (Estonia);
7. Faculty of Biosciences, Fisheries and Economy, The Arctic University of Norway (Norway);
8. FishBase Information and Research Group (Philippines);
9. Fisheries and Aquatic Sciences Center, Agrocampus ouest, institute for life, food and horticultural sciences and landscaping (France);
10. Fisheries Service of the National Oceanic and Atmospheric Association (USA);
11. Institute for Research and Development (France);
12. Instituto Nazionale di Oceanografia e di Geofisica Sperimentale (Italy);
13. Institute of Marine Sciences, Middle East Technical University (Turkey);
14. Institute of Marine Science, Spanish National Research Council (Spain);
15. Iranian national institute for oceanography and atmospheric science (Iran);
16. Joint Research Centre, Ispra (Italy);
17. Kinneret Limnological Laboratory, Migdal (Israel);
18. Centre de Recherches Insulaires et Observatoire de l'Environnement, University of Perpignan (France);
19. Louisiana State University (USA);
20. M-expertise marine (Canada);
21. Marine Research Institute, Klaipédà University (Lithuania);
22. Texas A&M University Corpus Christi (USA);
23. The Potomac Environmental Research and Education Center, George Mason University (USA);
24. Universidade de Santiago de Compostela (Spain);
25. Universidade de São Paulo (Brazil);
26. Universidade Federal do Rio Grande do Norte (Brazil);
27. University of Cape Town (South Africa); and
28. University of South Florida (USA).

Staff and researchers:
Principal Investigator
Villy Christensen, PhD

Postdoctoral fellows
Vijay Kumar, PhD

Graduate students
Abdulrahman Ben-Hasan, PhD candidate
Abdulrahman Ben-Hasan, MSc (2017)

Danielle Edwards, PhD candidate
Patricia Woodruff, PhD candidate

Santiago de la Puente, PhD student & Ocean Leaders Fellow
Santiago de la Puente, MSc (2017)

Greig Oldford, PhD student & Ocean Leaders Fellow

Carolina Lang, MSc student & Ocean Leaders Fellow

Key collaborators
Joe Buszowski, consultant
Marta Coll, PhD
Jeroen Steenbeek, MSc
Carl Walters, PhD

Vision: Advancing ecosystem-based fisheries management in the global ocean.

Mission: Develop research that supports policy making, including through the Ecopath with Ecosim approach and software (www.ecopath.org)
Marine Zooplankton and Micronekton Laboratory

Through active field data collection and modelling, the Marine Zooplankton and Micronekton Laboratory focuses on understanding marine ecosystems’ structure and function, physical-biological interactions, biogeochemical coupling, active carbon transport, and ecosystem responses to climate change. The research spans species ecology from plankton to fish to food webs covering water column processes in the world ocean from the North Pacific to the Southern Ocean.

Principal Investigator: Dr. Evgeny Pakhomov

Highlights

Antarctic Krill
Dr. Pakhomov undertook trophic ecophysiology, life cycles, and demography research on Antarctic (Euphausia superba) and Antarctic neritic (Euphausia crystallorophias) krill. Fundamental advances were made in the fields of the large-scale distribution, stock assessment, long-term variation, demography (growth, mortality, longevity, reproduction, recruitment), daily rations, contribution of autotrophic and heterotrophic food sources to the diet, individual and population grazing impacts of two key stone euphausiid species (larval stages and adults) within the coastal and open ocean high Antarctic ecosystems.

Dr. Pakhomov was part of the team that created and published the unique data base (KRILLBASE) with the unprecedented temporal (1926 till present) and spatial retrospective analysis of length frequency data sets of Antarctic krill in the Southern Ocean.

Eddy Pump and Under Sea Ice habitat projects
Research here focused on understanding the contribution of metazoan zooplankton to the carbon sequestration in the Southern Ocean. The main emphasis given to pelagic tunicates. In particular, the ecology of the Antarctic pelagic tunicate was re-evaluated with regard to their horizontal distribution that identified their southward shift during the past century. This was one of the first elemental and ecophysiological studies, helping to re-evaluate tunicate functional importance in the Antarctic pelagic ecosystem.

Plankton and the biological pump
This research covered poorly studied groups of zooplankton and nekton in the pelagic and demersal food webs. Main achievements included:

- mapping macroplankton and micronekton distribution;
- studying community dynamics on meso- and macro-scales as well as in relation to major frontal systems;
- producing daily ration estimates for major carnivorous zooplankton and micronekton species and groups, including mesopelagic fish, arrow worms, jellyfish, euphausiids, ctenophores;
- understanding the importance of each group in the regional and...
seasonal carbon transfer from surface layers to the deep ocean;
• completing a comprehensive analysis of demersal fish community structure and feeding ecology in the Indian sector of the Southern Ocean.

**Marine-terrestrial interactions in sub-Antarctic island systems**
Dr. Pakhomov's research contributed to the development and understanding of the ‘life-support system’ of the sub-Antarctic Prince Edward Island ecosystem, which is ultimately dependant on allochthonous food supply and culminated in creation of the detailed PEI ecosystem model.

**Forage fish science**
Pakhomov's undertook research to advance the understanding the ecosystem role of Pacific herring in coupled social-ecological systems. This study, undertaken with the PERF research unit, focused on collaborative solutions for Haida herring fisheries.

**The missing link**
The Micronekton lab undertook a marine ecosystem assessment to evaluate how zooplankton rates constrain fisheries and phytoplankton biomass.

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**Partnerships**

NIWA (New Zealand)
British Antarctic Survey (UK)
Alfred Wegener Institute (Germany)
University of South Wales (Australia)

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**Staff and researchers**

**MSc students**
Yago Doson Coll
Yulia Egorova
Lian Kwong
Natalie Mahara
Samantha James
Vanessa Fladmark

**PhD students**
Joanne Breckenridge
Yulia Egorova
Lian Kwong
Yulia Kuzmenko
Florian Lüskow

**Technicians**
Vanessa Fladmark
Marina Espinasse

**Postdoctoral Fellows**
Boris Espinasse
Natasha Henscke

**Research Associates**
Brian Hunt
Mimi Lam

**Visiting Scientist**
Dr. Yongqiang Shi
Pelagic Ecosystems Laboratory
Principal Investigator: Dr. Brian Hunt

Highlights

Canada C3 expedition
Dr. Hunt was the chief scientist on two legs of the Canada 150 anniversary C3 expedition (Sep-Oct 2017). While on board, Dr. Hunt managed the integrated data collection for ocean and terrestrial systems in British Columbia. In addition, he was the lead communicator of C3 science to BC coastal communities.

Kril life history
Dr. Hunt co-authored a new formulation of krill life history in the pack ice zone that revises understandings of how krill will respond to warming oceans and sea-ice decline.

Hakai Coastal Initiative Marine Food Webs Working Group
The Hakai Coastal Initiative's Marine Food Webs Working Group is a collaborative research unit that aims to understand how marine food webs operate, with a particular focus on British Columbia’s coastal ocean. The group hired two dedicated postdoctoral fellows to assist with the research, which has a strong focus on understanding connections between the planktonic organisms that form the base of the food web, including the connections between viruses, bacteria, microbial phytoplankton, protozoa, zooplankton, and fish. This research initiative is poised to significantly advance our understanding of how marine food webs operate, and how they will respond to changing ocean conditions.

Jellyfish and drones
Dr. Hunt and his team worked on mapping marine resources using aerial drones to map jellyfish blooms along the Pacific coast. The story and video about this innovative use of aerial tools received extensive international media coverage.

DEWEX program
Dr. Hunt completed three pivotal contributions to the DEWEX program (DEep Water formation Experiment) resolving the response of plankton communities to deep-water formation in the west Mediterranean Sea.

Salish Sea’s Southern Resident Killer Whale population
With the Marine Mammal Research Unit, the Pelagic Ecosystems Lab successfully applied to the Department of Fisheries and Oceans Canada for the project “Impacts of marine ecosystem variability on the Southern Resident Killer Whale population in the Salish Sea.” This $1.1million research grant will be used to examine how changes in the food web in areas of the Southern Resident Killer Whale affect the abundance and quality of Chinook salmon.

Coastal Rainforest Margin Network
The lab led Workshop 2 of the Coastal Rainforest Margin Network: Marine-terrestrial interactions in the Pacific Temperate Coastal Rainforest domain.
Partnerships

**British Columbia**

**Hakai Institute**: Dr. Hunt partnered with the Hakai Institute through three Hakai Coastal Initiative working groups:

1. Food Webs;
2. Ocean productivity; and
3. Riverine Coastal Domain.

He is the Principal Investigator of the Hakai Institute Juvenile Salmon Program and collaborates in their Ocean Observing Program. Dr. Hunt also partnered with Hakai Institute on two Mitacs grants.

**Pacific Salmon Foundation**: Dr. Hunt is a member of the Salish Sea Marine Survival Project Synthesis Committee, and partners with PSF on a Mitacs grant.

**Department of Fisheries and Oceans (DFO)**: Dr. Hunt works in partnership with numerous DFO researchers on projects in BC:

- Dr. Ian Perry (IOS/PBS) - Plankton Food Webs;
- Dr. Ian Forster (WVL) - Plankton food webs and salmon ecology;
- Dr. Chrys Neville (PBS) - Plankton food webs and salmon ecology; and
- Dr. Jennifer Boldt (PBS) - Forage fish ecology.

**Wuikinuxv First Nation**: The Lab monitored sockeye salmon health in Rivers Inlet.

**K’omoks Nation**: The Lab has developed a partnership with the K’omoks Nation on a field program measuring microplastics baselines in Baynes Sound.

**Association of Denman Island Marine Stewards**: Developed a partnership on a field program measuring microplastics baselines in Baynes Sound.

**Canada**

Dr. Hunt was the chief scientist on two legs of the Canada 150 anniversary C3 expedition. This research voyage was undertaken in partnership with multiple organizations in planning and implementation, including:

- Students on Ice Foundation;
- Canadian Museum (Ottawa); and
- Department of Fisheries and Oceans (Halifax).

**International**

**Coastal Rainforest Margins Network**: Dr Hunt is a Steering committee member of the National Science Foundation Research Coordination Network, in partnership with researchers from the Alaska Rainforest Center, University of Alaska, and University of Washington.

**International Year of the Salmon**: In partnership with the North Pacific Anadromous Fish Commission and researchers from its member countries (USA, Russia, Japan, Korea).

**Transient memories**: Deep-sea coral record of upwelling around the Maldives, in partnership with researchers from the University of Western Australia, University of Queensland, University of Rhode Island, and Nanyang Technological University.

**MOBYDICK** (Marine Ecosystem Biodiversity and Dynamics of Carbon around Kerguelen: an integrated View) In partnership with the French National Research Agency and researchers at the University of Aix Marseille.

**Synthesis Group**: Thresholds of Ocean Acidification Impacts on Calcifying Pteropods and Interactions With Warming. In partnership with the Southern California Coastal Water Research Project.

**DEWEX** (DEep Water formation Experiment). Partnership with 62 international scientists primarily from French laboratories (LOMIC, CEFREM, LEGOS, MIO, LOV, LOG, LOCEAN, LA, DTINSU, CNRM-GAME, IMAGE, LSCE-IPSL, CEREGE) researching the biological response of deep-water formation in the west Mediterranean Sea.

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**Staff and researchers**

**Postdoctoral Fellows**
- David Costalago
- Hayley Dosser
- Boris Espinasse
- Jessica Garzke
- Fernanda Giannini Colo
- Caterina Rodriguez Giner
- Jacqueline Maud
- Wade Smith

**Graduate Students**
- Vanessa Fladmark, MSc student
- Caroline Graham, MSc student
- Samantha James, MSc student
- Yuliya Kuzmenko, PhD student
- Jessica Schaub, MSc student
- Thomas Smith, MSc student

**Technician**
- Lauren Portner, Research Technician
Highlights

Arctic Research
Four research projects focused on arctic ecosystems were undertaken. As part of a longer-term collaboration with Mark Mallory (Acadia University) on arctic seabirds, the group started a study to understand the migratory patterns of Arctic terns and to identify key areas for their conservation. The second project focused on methods to understand the foraging ecology of arctic mammals, specifically it aimed to understand the relationships between the foraging behaviour of polar bears and narwhals, how the behaviour of each species responded to environmental factors, and how this information could be linked to individual fitness and the risks associated with environmental change. The third project focused on the relationship between ringed seals and polar bears, and how it is influenced by changing sea ice regimes. It also involved developing models and collaborating with local communities to incorporate local priorities into wildlife management, and to identify critical habitat. The fourth project focused on understanding the habitat use of three ice seal species (ringed seals, bearded seals, and spotted seal) in Alaska, with its primary goal to integrate movement data with traditional knowledge.

Integrating Traditional Knowledge and Western Scientific Data
Through work, funded, amongst others, by the North Pacific Research Board Core Program and the Marine Mammal Commission, the group worked to integrate Bayesian statistical methods with local and aboriginal traditional knowledge into fully formed models.

Collaboration on State-Space Models
The group organized an international workshop on new developments in state-space models at Casa Matemática Oaxaca, Mexico. Dr. Auger-Méthé led the writing of extensive review on state space models with practical advice for ecologists on methods to fit and assess them. This effort is also tied to the group’s work on stock assessment modelling with Dr. Andrew Edwards (DFO) and as a member of the Canadian Statistical Sciences Institute working group.

Mission: The Statistical Ecology Research Group works to support improved conservation and management of aquatic ecosystems by filling gaps in knowledge of the behaviour, population dynamics, movement, and space-use of aquatic animals and developing tools that will help predict how they will be affected by rising human pressures.

Southern Resident Killer Whale Research
The group developed a new statistical method to integrate multiple data sources to infer the spatial distribution of southern resident killer whales (with Drs. Ruth Joy and Dominic Tollit, SMRU consulting) for DFO (Dr. Sheila Thornton) who will use it in management of the population. It helped Dr. Andrew Trites and his team (Scott Hinch, Brian Hunt, Nancy Heckman, and others) secured funding (NSERC & DFO-Whale Science for tomorrow). Their work focused on understanding the movement behaviour of both species.

Partnerships
Fisheries and Oceans Canada (DFO)
Environment and Climate Change Canada (ECCC)
South Atlantic Environmental Research Institute (SAERI)
SMRU Consulting
Canadian Statistical Sciences Institute
Natural Sciences and Engineering Research Council of Canada (NSERC)
Canada Research Chair Program (CRC)
Canadian Foundation for Innovation (CFI)
North Pacific Research Board (NPRB)
Marine Mammal Commission (MMC)
Fish & Wildlife Compensation Program
Kenneth M Molson Foundation
Falkland Island Gentoo Penguin Project
The group's first field-based project since starting at UBC, involved two field seasons in the Falkland Islands. Data collection and sample processing is now complete, with analysis and manuscript preparation in progress. This work was heavily featured in the media (Global News, Vancouver Sun, etc.).

Partners and Donors

- Fisheries and Oceans Canada
- Molson Foundation
- BC Knowledge Development Fund
- NSERC - Canada Research Chairs Program
- NSERC - Discovery Grant Program
- NSERC - Northern Supplement
- NSERC - Research Tools and Instruments Grants Program
- NSERC & Fisheries and Oceans Canada - Whale Science for Tomorrow
- Fish & Wildlife Compensation Program
- Canada Foundation for Innovation - John R. Evans Leaders Fund
- North Pacific Research Board - Core program
- UBC - Grants for Catalyzing Clusters
- British Ecological Society - Special Interest Group Annual Funding
- Canadian Statistical Sciences Institute - Collaborative Research Team
- Canadian Institute of Ecology & Evolution - Thematic Program (Working Groups)
- Banff International Research Station & Casa Matemática Oaxaca

Impacts

- The group's research and projects focused on building collaborations with local communities in order to integrate their knowledge and priorities into ecological inference and management decisions.
- Through contracts and collaborative research projects with government scientists and decision makers the group is collecting data and developing tools that will directly inform management decisions. This will have direct impacts at the local and national level.
- The group's involvement with the COSEWIC Marine Mammal Specialist Subcommittee helps assess the status of at risk wildlife species and provide advice to the Minister of Environment and Climate Change Canada.

Staff and researchers

- Marie Auger-Méthé, Assistant Professor
- Rowenna Gryba, PhD student
- Katie Florko, PhD student
- Joe Watson, PhD student
- Ron Togunov, PhD student
- Joanna Wong, MSc student
- Sarah Dier-McComb, MSc student
Coast-to-Coast Research

MMRU has undertaken marine mammal research in the Pacific, Arctic, and Atlantic Oceans and is internationally recognized for its productivity, novel research approaches, development of new technologies, and ability to solve difficult ecological problems. Its research-intensive and interdisciplinary approach has established UBC as a world leader in marine mammal research.

Collaborative & unbiased research

MMRU has a reputation for working with all stakeholders (fisheries, NGO’s, ecotourism, industry, First Nations, and government) to undertake collaborative research and provide unbiased, independent insight and advice.

Unique in Canada

MMRU is the only university-based group of researchers in Canada specialized in teaching and training graduate students to undertake marine mammal research. UBC is the only Canadian university with a dedicated marine mammal research program.

Highlights

BC Marine Mammal Symposium

In 2016, MMRU live-streamed the BC Marine Mammal Symposium to over 2,000 viewers from over 50 countries, who were able to ask questions of the presenters in real time. It made BC research accessible to the public and allowed people to understand its importance. MMRU has continued to live-stream the symposium every year since and has attracted an audience far larger than could ever have been accommodated in a single room at UBC.

Open Water Research Station

In 2017, the MMRU’s Open Water Research Station celebrated its 10 year anniversary. This floating laboratory is at the centre of a ground-breaking scientific collaboration that has significantly advanced understanding of how nutritionally stressed Steller sea lions forage in the wild. Through a long-term partnership with the Vancouver Aquarium, the station has a small cohort of trained Steller sea lions who are able to access open ocean, without any physical restraints or barriers. The program is staffed with full-time animal care professionals who are primarily concerned with the health and welfare of the animals, allowing the scientific teams to stay focused on experimental design and analysis, and to make the best use of their time with the animals.

In 2017, some of the sea lions moved to the Vancouver Aquarium’s new Steller’s Bay exhibit, which was designed to highlight the research conducted at the Open Water station.

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In 2017, some of the sea lions moved to the Vancouver Aquarium’s new Steller’s Bay exhibit, which was designed to highlight the research conducted at the Open Water station.

Principal Investigator: Dr. Andrew Trites
Awards and Honours

In June 2018, Dr. Trites was awarded the Timothy R. Parsons Medal, by Fisheries and Oceans Canada, for distinguished contributions towards ocean science.

Dr. Trites was given the UBC Faculty of Science’s 2018 Alumni Builder Award for his leadership, passion, advocacy, and long-standing dedication to the multidisciplinary facets of environmental education, conservation, and ocean sciences.

Dr. David Rosen received the Honorary Life Member Award from the Comparative Nutrition Society in 2018.

Staff and Researchers

Faculty
Andrew Trites (Professor)
David Rosen (Assistant Professor)

Staff
Pamela Rosenbaum (Administrator)
Mei Sato (Research Associate)
Renee LaRoi (Web Designer)

Research Assistants
Rebecca Barrick
Brianna Cairns
Cody Carlyle
Johanna Fee
Alessandra Gentile
Rob Marshall
Brandon Russell
Rhea Storlund

Partners and Donors

Alaska SeaLife Center
Department of Fisheries and Oceans
Hakai Institute
Kintama Research
Mazuri
MITACS
NOAA
North Coast Brewing
NCE MEOPAR
NPRB
NSERC ReNewZoo
Ocean Foundation
Ocean Wise
Pacific Salmon Foundation
Port of Vancouver
Vancouver Aquarium
Vancouver Foundation
Fisheries Economics Research Unit (FERU)

FERU strives for interdisciplinary solutions to global, national, and local marine and freshwater management issues. It focuses on economic and policy analysis and mobilize researchers, students, and practitioners to advance resource management for the benefit of current and future generations, while maintaining ‘healthy’ ecosystems.

Principal Investigator: Dr. Rashid Sumaila

Highlights

OceanCanada Partnership
A major project of FERU is the OceanCanada Partnership, a 7-year SSHRC-funded research partnership that is comprised of 22 formal research partners, including universities from coast to coast, community organizations, and Fisheries and Oceans Canada. OceanCanada supports sixty-two highly qualified students and postdoctoral fellows from various universities. The partnership held six public outreach sessions on issues for oceans and fisheries through its speaker series from 2015 to 2018. Members of the OceanCanada partnership produced over 300 project-related publications and close to 400 project-related presentations and were mentioned in 349 media stories during that same time period.

Turn the high seas into a Fish Bank for the world by banning fishing
About 58 percent of the ocean is legally defined as high seas, i.e., areas beyond national waters, also called Exclusive Economic Zones (EEZs). FERU and collaborators have been making contributions to the literature on high seas marine protected areas since the mid-2000s (Marine Ecology Progress Series, 2007). Recent contributions by FERU, in collaboration with the SAU, have spurred the debate on how best to manage the high seas. In a series of papers starting in 2007, the unit argued that by turning the high seas into a fish bank for the world we would improve marine biodiversity, increase economic benefits and promote a fairer distribution of these benefits to all maritime countries (e.g., Scientific Reports 2015; and Science Advances 2018). This call to action to protect the high seas is beginning to have an impact - the first substantial high seas marine protected area was declared in 2017 and the UN is currently working on a new framework for managing the high seas.

Economics of climate change impacts marine biodiversity
Climate change is driving shifts in the distribution of fish stocks towards areas with cooler environments, generally in higher latitude or deeper waters. In particular, distribution shifts in fish stocks that straddle between national jurisdictions or Exclusive Economic Zones are challenging transboundary fisheries management. FERU, in collaboration with CORU, has been at the forefront of global research on how climate change is likely to affect people and marine ecosystems. For example, using an ensemble of climate-marine ecosystem and economic models, they explored the effects of implementing the Agreement on fish, fishers and seafood consumers worldwide. They find that implementing the Agreement could protect millions of tonnes in annual worldwide catch of top revenue generating fish species, as well as billions of dollars annually of fishers’ revenues, seafood workers’ income, and household seafood expenditure. Further, 75% of maritime countries would benefit while ~ 90% of protected catch occurs within developing country waters. Thus, implementing the Paris Agreement could prove to be crucial for the future of the world’s ocean ecosystems and economies.

Economic valuation and intergenerational discounting
To support large-scale valuation work by researchers worldwide, FERU embarked on building global fisheries related socio-economic databases such as ex-vessel fish prices, fisheries subsidies; global cost of fishing; and fisheries jobs databases (e.g., Frontiers in Marine Science 2017; Marine Policy 2016). These databases are now part of the global ocean and fisheries data infrastructure, used to conduct scholarly work worldwide. FERU also pioneered the study of what is denoted ‘intergenerational discounting’ in a series of papers (e.g., J. Environmental Economics and Management, 2015).

**Global fisheries subsidies and sustainability**
FERU’s contributions to the fisheries subsidies debate started in the early 2000s and continues unabated. They embarked on a big effort to develop a transparent source of fisheries data and analyses on the scope, types, impacts and amounts of fisheries subsidies worldwide (e.g., *Marine Policy* 2016). A key goal was to support the work of the World Trade Organization, which had just been mandated by the world to reach an agreement among nations to ‘discipline’ harmful subsidies. FERU, in collaboration with SAU, created a ‘living’ global fisheries subsidies database, which is currently considered the most comprehensive in the world. The database formed the basis for deriving findings such as approximately 86% of the total subsidies to the fishing sector goes to large scale industrial fisheries (*Marine Policy* 2017); this large imbalance makes small scale fisheries, which are important for the food security of coastal communities, less viable (*Ecological Economics* 2016); and demonstrated that buyback subsidies, i.e., subsidies used to buy out fishing vessels in an overfished fisheries, if anticipated by fishers, will generally have a negative effect on economic performance and resource conservation. FERU’s work has made UBC the place to go for scientific information and insights on fisheries subsidies by high level institutions such as the Canadian Parliament, the EU, the African, Caribbean and Pacific (ACP) countries, the WTO, the World Bank, and the United Nations.
Managing shared and transboundary fish stocks

Shared fisheries involve fish that are caught in the marine waters of more than one country, or in the high seas. FERU analysis shows that these fisheries are the source of over 50% of the global catch (Mar Ecol Prog Ser 2015). FERU continues to explore the optimal management of shared fish stock fisheries such as those for cod and capelin and tuna stocks when different fishing gears are used to target different age groups of the stock. These articles provided insights on how best to set catch quotas for different interacting species and fishing sectors in order to optimize benefits while ensuring the long term sustainability of these important fish stocks (Game Theory and Fisheries: Essays on the Tragedy of Free for All Fishing, Routledge, 2013). FERU also explores how climate change is likely to affect both the economics and management of shared fish stocks (e.g., Science, 2015).

Student awards

Two FERU students received SSHRC Doctoral scholarships: Sarah Harper (2014-2017) and Tim Cashion (2017-2021). Harper also won the 2018 Biodiversity Research Integrative Training and Education and IOF Student Society Travel Award.

Partners and Donors

ADM Foundation Hong Kong  
ARCTIConnexion  
Belmont Forum  
Blue Water Foundation  
Canadian Rivers Institute  
Canadian Parks and Wilderness Society  
Carleton University  
Council of the Haida Nation  
Dalhousie University  
Duke University  
Ecotrust Canada  
Fisheries and Oceans Canada  
Friends of Port Mouton Bay  
First Nations Fishery Council  
International Centre for Trade and Sustainable Development  
Living Oceans Society  
Mackenzie Fujisawa LLP  
McMaster University  
Memorial University of Newfoundland  
Ocean Wise Conservation Association  
Oceana Canada  
Pew Charitable Trusts  
Port Metro Vancouver  
Rhodes University  
Saint Mary’s University  
Simon Fraser University  
T. Buck Suzuki Environmental Foundation  
United Nations University Institute for Water, Environment and Health  
University of British Columbia  
University of Cape Town  
University of Guelph  
University of Manitoba  
University of Victoria  
University of Waterloo  
University of Winnipeg  
World Wildlife Fund Canada & Hong Kong  
World Bank  
Vancity
Changing Oceans Research Unit (CORU)

Studying the effects of global climate and ocean changes on marine ecosystems, biodiversity, and fisheries, CORU’s researchers integrate multidisciplinary datasets and information across scales and domains and facilitate democratization of knowledge through innovative partnerships, capacity building and outreach initiatives. The unit applies and develops scenarios and models to understand the dynamics of changing oceans and ecosystems.

**Highlights**

**Multidisciplinary datasets**
CORU has created and updated several global datasets of different variables during the reported period. These tasks include:

- Updating the *Sea Around Us* mariculture production database;
- Creating the Farm gate price database;
- Working on the preliminary mariculture farm location database; and
- Compiling and developing databases of climate change projection data including the change in maximum catch potential of marine species, change in fisheries revenues under climate change, projected change in species distribution of marine species, etc.

**Capacity building**
CORU students and researchers always strive to learn and acquire new knowledge on their research topics and in areas that are relevant to our studies. They have participated in various training courses and workshops. Also, our researchers are heavily involved in teaching and instructing science-related training program and lectures. Here are some examples:

- IMBeR ClimEco6 Summer School - Interdisciplinary approaches for sustainable oceans, August 2018. Gadjah Mada University, Yogyakarta, Indonesia
- IMBeR ClimEco5 Summer School - Towards more resilient oceans: Predicting and projecting future changes in the ocean and their impacts on human societies. August 2016 at Praia Mar Hotel, Natal, Brazil
- Spatial Data and Analysis Workshop, Fall 2016. The Biodiversity Research Centre and the Institute for the Oceans and Fisheries
- Dr. William Cheung taught a 5-day summer course on scenarios and models for biodiversity and ecosystem services organized by the University of Zurich, Lugano, Switzerland on 11-14 June 2018
- Drs. Cheung, Lam, and Reygondeau, taught about “Global sustainability: ecosystem service and indigenous governance” in a special program for Nitobe College students in the UBC (September 2018)

**Vision:** To predict future oceans under climate change.

**Mission:** To improve understanding of the past, current and future responses of marine ecosystems and fisheries to global changes. We also explore and inform policy-relevant solutions at local and global scales to improve human well-being and the sustainable use of ocean resources.

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The state and future of fishing in the East and South China Seas under climate change at the Ocean Asia East China Sea Expert Consultation Workshop, August 20-21, 2018, Ocean University of China, Qingdao, China

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Principal Investigator: Dr. William Cheung
• PhD student Muhammed Oyinlola, presented “Global estimation of areas with suitable environmental conditions for mariculture species.” at the 2018 APEC Training Workshop on Eco-aquaculture and Utilization of Fishery Waste Asia-Pacific Economic Cooperation Name of Workshop, Xiamen, China
• Dr. Cheung taught an ecology field course for a joint Germany-Columbia graduate program, Santa Marta, Columbia, 29 Feb – 3 March 2016.

Outreach initiatives
The CORU team carried out a range of outreach activities within and outside UBC, with the indigenous community, students and researchers of other institutes, local and global community to make their ideas and works accessible to all and promote public awareness of global change on marine ecosystem and all the ecosystem services provided by the ocean. These activities include organizing workshops, participating in workshops and conferences, publication on newsletter and online articles.

Here are some selected outreach activities:
• Dr. Colette Wabnitz, along with Robert Blasiak (Stockholm Resilience Centre) co-hosted a workshop for academics, policy makers, and practitioners on Ocean finance in Stockholm, Sweden in December 2018
• A public discussion forum on the future of seafood production from Marine aquaculture under global change was organized by CORU and held in December 2018 at the UBC
• Dr. Cheung and postdoctoral fellow Dr. Oa Li Chen were the convenors of Session 12: Scenarios and models to explore the future of marine coupled human-natural systems under climate change in the 4th International Symposium on the effects of climate change on the world’s oceans (ECCWO) held from 4 June to 8 June in Washington D.C., United States

Innovative partnerships
CORU collaborates with a wide range of organizations and institutes on different projects.

Social Media
CORU set up social media accounts on Twitter (@coru_ubc) and Facebook (@changingoceanresearchunit) to share information about their work and latest activities with the academic community and the public.

2018
Juliano Palacios-Abrantes won SESYNC Graduate Pursuit Award.

2017
Dr. William Cheung:
• was indicted as Member of the Royal Society of Canada College of New Scholars, Artists and Scientists
• won the 2017 Ehor Boyanowsky Academic of the Year Award
• won The Prix d’Excellence Award from the International Council for the Exploitation of the Seas
• won Peter Wall Institute for Advanced Studies Wall Scholar Award

The future of high seas governance under climate change workshop
Impacts

The outcomes of CORU studies have been highlighted and adopted in different levels of discussions and reports on climate change and fisheries relevant policies including intergovernmental discussions.

- The CORU results on projecting the impact of climate change on fisheries were included in the Fifth Assessment (AR5) report by Intergovernmental Panel on Climate Change (IPCC)
- Dr. William Cheung is the Coordinating Lead Author of the AR6 Special Report of IPCC
- Dr. William Cheung was the Lead Author of the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) global assessment report
- Research outputs from the CORU members have been published in many high impact factor journals
- The work and research outputs from the CORU team have been reported on by the media, including both local and global news outlets such as Newsweek, Huffington Post, Vancouver Sun, Global News, National Geographic, etc.
- CORU researchers serve as members of the editorial board of different journals including Fish and Fisheries, Fisheries Oceanography, Frontiers in Marine Sciences and Marine Policy.
- Dr. Cheung serves as scientific advisor on a number of international and local organizations including BioDiscovery, IUCN, and WWF Canada. Dr. Juan José Alava is an expert member of the Southern Resident Killer Whale Technical Working Group (TGW) on Contaminants.

Tla’amin food and fish systems

A two half-day workshop was held in early December 2018 with members of the Tla’amin Nation. The aim was to integrate different expertise and knowledge to collectively develop a conceptual model of the key dynamics in the Tla’amin food and fish system. Twenty-one participants—a mix of fisheries, health, culture, resource management professionals, and knowledge holders—came together with CORU research team members Patricia Angkiriwang, Sachiko Ouchi, William Cheung, Tiff-Annie Kenny, to co-develop a shared multi-disciplinary complex system for understanding of the factors and dynamics relating fisheries, environmental change, food security, culture and well-being. Outputs from this workshop will be used as the basis for Patricia Angkiriwang’s Master’s project as she explores ways to make an develop a semi-qualitative model for Tla’amin Nation to further discuss the future of fisheries, food and policy planning in a changing climate.

A walk along the beach to reflect on a day of rich discussion about the complexity of issues affecting seafood availability and access for the Tla’amin Nation people.
Partnerships

At UBC

CORU joined with Sea Around Us and Fisheries Economic Research Unit to form the UBC Global Fisheries Cluster, bringing together UBC researchers who share the vision of focusing on global, interdisciplinary, and integrated fisheries research.

Researchers within this cluster work closely together on a wide range of different projects related to global fisheries, ecology, human society, and economics, and the effects of each on the others and these projects include reconstruction of the global catch database, updating estimate of global fisheries subsidies and climate change impact studies, etc.

Worldwide

Nippon Foundation-UBC Nereus Program is a global partnership of 17 leading institutes working to advance our comprehensive understanding of the global human-ocean system across the natural and social sciences. UBC was the leading institute of the partnership program and Dr. William Cheung was the Director (Science) of this program.

Atmospheric and Oceanic Sciences Program, Princeton University
School of Environmental Sciences, University of East Anglia
School of International Development, University of East Anglia
Centre for Environment, Fisheries, Aquaculture Sciences (CEFAS)
East China Sea Fisheries Research Institute, China
World Bank
International Institute for Environment and Development (IIED)
Intergovernmental Panel on Climate Change (IPCC)
Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES)
World Wild Fund (WWF)
Southern Resident Killer Whale Technical Working Group (TGW) on Contaminants
Stockholm Resilience Centre
International Institute for Environment and Development (IIED), London, UK
Environmental Resources Management (ESM), Hong Kong
ESSA, Vancouver, Canada
University of Bern, Switzerland
Marine Science Institute, University of California, Santa Barbara (UCSB), United States
Environmental Defense Fund
Abu Dhabi Environmental Agency
University of Bergen, Norway

Shared socioeconomic pathways for mariculture was held in December 2018.


**Publications**

**Peer-reviewed journal articles**


Alava, J.J., Cisneros-Montemayor, A.M., Sumaila, R., Cheung, WW.L. 2018. Projected amplification of food web bioaccumulation of MeHg and PCBs under climate change in the Northeastern Pacific. Scientific Reports 8:13460


Teh LSL, Cheung WWL, Sumaila UR (2017) Socio-economic analysis of Hong Kong fisheries. Report to WWF Hong Kong, Hong Kong.


Teh LSL, Hotte N, Sumaila UR. 2017. Having it all: can fisheries buybacks achieve capacity, economic, ecological, and social objectives? Maritime Studies. 16(1).


Teh LSL, Cheung WWL, Sumaila UR (2017) Socio-economic analysis of Hong Kong fisheries. Report to WWF Hong Kong, Hong Kong.


Teh LSL, Hotte N, Sumaila UR. 2017. Having it all: can fisheries buybacks achieve capacity, economic, ecological, and social objectives? Maritime Studies. 16(1).


Teh, L.C.L. and D. Pauly. 2018. Who brings in the fish? The relative contribution of small-scale and industrial fisheries to food security in Southeast Asia. Frontiers in Marine Science


Publications

Book chapters, Reports, Working Papers, Conference proceedings, etc.


**Publications**

**Books**

The Red Sea Ecosystem and Fisheries (2016). Eds. Dawit Tesfamichael and Daniel Pauly, Springer Netherlands

