Towards a New Ocean Science

Engaging with Culture to Promote Sustainable Development

United Nations Educational, Scientific and Cultural Organization

Canadian Commission for UNESCO

Acknowledgements

We acknowledge that the research presented through case studies in this report benefited from inclusion of Indigenous communities and more often on their traditional territories. We cannot guarantee that the original research was always undertaken with their consent, and we hope our recommendations lead to greater inclusion of Indigenous groups in marine research in the future.

Foreword **1**

About the Authors **3**

Introduction **5**

Science to promote sustainability 6

Engaging culture in ocean science 7

Canada as an exemplar 8

Canadian case studies **9**

Eelgrass in Eeyou Istchee 10

Arctic resilience in the face of climate change 12

Whales in busy waterways 14

Marginalized by fisheries management 16

Cod collapse and cultural calamity 18

An ecosystem of community-engaged research 20

Conclusion: Toward a new ocean science **22**

Recommendations 23

References **24**

Foreword

Sustainable development has always been about promoting equitable outcomes for people. The most famous definition may be from the Brundtland Commission in 1987: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This focus on intergenerational equity has no doubt contributed to the focus of sustainability as *maintainability* of resources and living standards. Sustainability-based research has been dominated by technical assessments of resource maintainability into the future. Failure of people, from communities to nations, to act on the recommendations of these assessments often leads to frustrated calls to "listen to the science", as well as demands for cultural changes to get people to conform to sustainability recommendations.

One reason that sustainability recommendations are constantly ignored is because they often call for limits or curtails that are not desirable to people and are often blind to cultural and societal values and potentials. In short, much sustainability-based research neglects the agency of people and proposes wide-ranging interventions, which end up ignored. Perhaps a science that requires entirely different kinds of people from those who actually exist to act on its recommendations is a science of limited relevance. What is needed is a science that can not only assess the *maintainability* of resources, but also do so according to the *desirability* of the people affected by practice. As evidenced by the lack of action on recommendations by sustainability research that only addresses maintainability, failing to address desirability often means maintainability is not achievable. Accounting for both aspects of sustainability requires a close working relationship between scientists studying sustainability and the people affected by development, in ways that challenge traditional models of science as removed from social and cultural influences.

A current definition of sustainable development, as thematically emphasized in the UN Sustainable Development Goals, is "no one will be left behind" – emphasizing equity not just for future generations but also for those currently facing injustices from past and current events. If science is to contribute to this framing of sustainable development, it needs to consider ways to promote and maintain the values of those people historically marginalized.

The UN Decade of Ocean Science for Sustainable Development is an international initiative to promote sustainable development through ocean science. Through this report, we hope to showcase the kinds of science that have had positive and negative consequences for sustainable development, through case studies highlighting engagement with Canadian coastal communities. The case studies outline people's needs and desires and how working with them can make science actionable. The case studies also explore situations where people were not engaged and where science has had counterproductive effects.

Our goal is to inspire and challenge science institutions, science funders, governments, and intergovernmental organizations to promote culturally – and societally – engaged science in order to balance aspects of sustainable development, maintainability, and desirability.

- GERALD SINGH, SCIENCES SECTORAL CHAIR,
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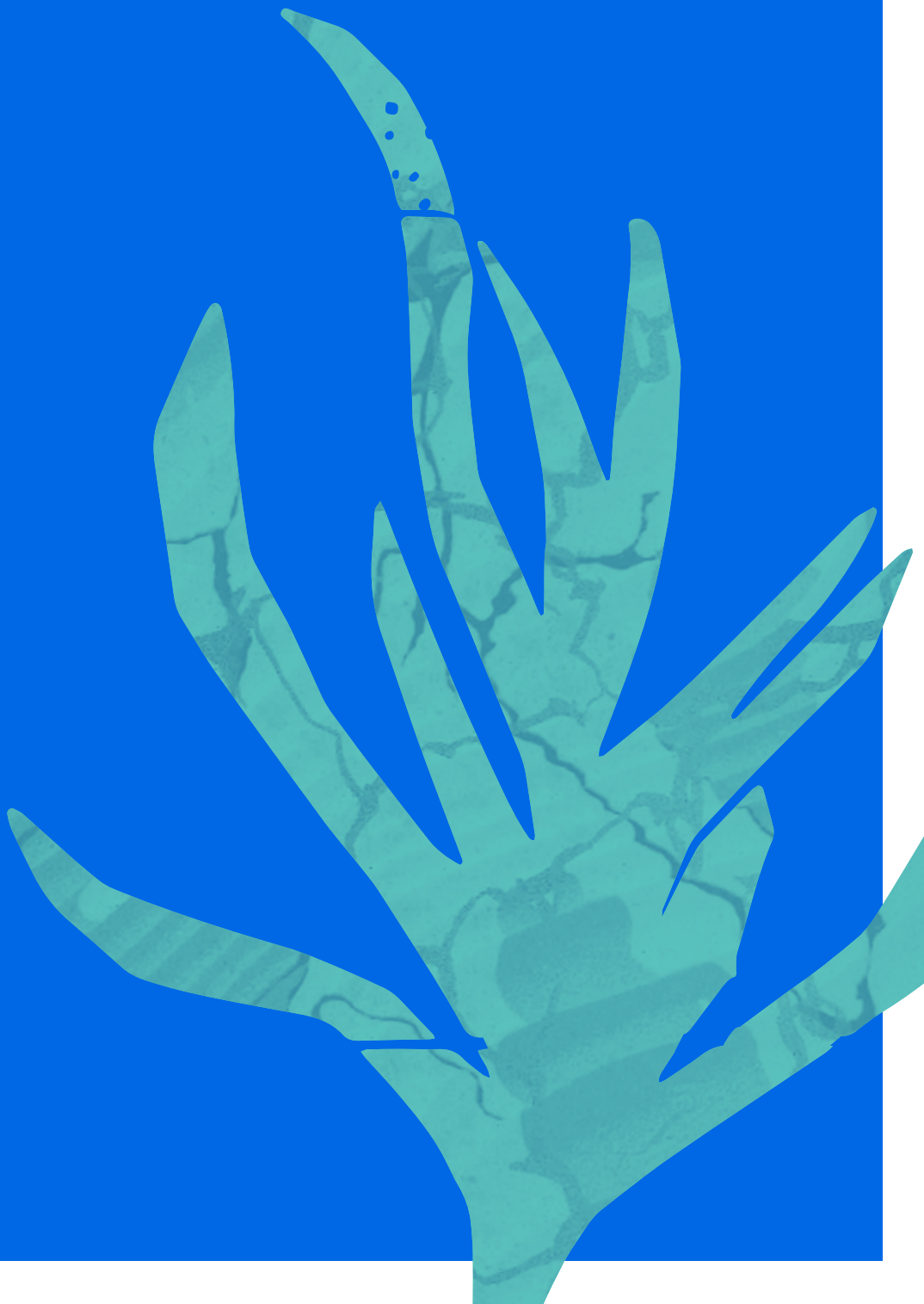
Introduction



Science to promote sustainability

Science has a fundamental role in assembling knowledge and developing solutions to deliver the United Nations Sustainable Development Goals (SDGs)[1,2]. Since the launch of the SDGs through *The 2030 Agenda for Sustainable Development*, promoting or informing sustainability has increasingly become an objective of science (Fig 1). Yet, the dominant ways we approach science, as specialized fields of study and independent research projects, limits the potential for the transformation we need to address society's biggest challenges[3].

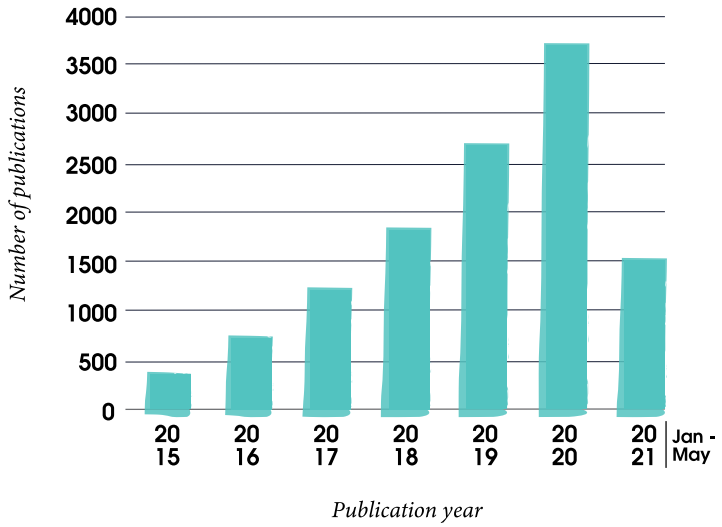


Fig 1. Increasing trend in publications on "sustainable development goal(s)" or "SDG(s)" in Web of Science since adoption of the 2030 Agenda for Sustainable Development. Data as of May 28, 2021.

Sustainability science remains dominated by the natural sciences, often neglecting the social and human dimensions of sustainability[4]. This science has led to frequent calls for changes to human behaviour, norms, aspirations, and technologies – essentially, changes to culture, to solve largely environmental issues[5]. For many years, the dominant narrative was that culture served as a receptor of sustainability initiatives. Instead, culture

must be viewed as an enabler of sustainable development[6]. For science to inform sustainability, it must be unified and mutually beneficial, where researchers, practitioners, decision-makers, funders, and communities work together. To deliver the ambitious vision set by the SDGs, science itself must be transformed, and doing this will require the support of academic and research institutions, funding agencies, and governments.

UNESCO recognizes four dimensions of sustainable development – society, environment, culture, and economy – that are interwoven[7]. Sustainability considers a future where these dimensions are balanced in the pursuit of an improved quality of life. The 2030 Agenda follows three principles that can enable the transformations required for achieving the SDGs: (1) a human rights-based approach, (2) leave no one behind, and (3) gender equality and women's empowerment[8,9]. The Agenda acknowledges "the natural and cultural diversity of the world" and recognizes "that all cultures and civilizations can contribute to, and are crucial enablers of, sustainable development"[10]. As science increasingly seeks to identify and develop sustainability solutions, we argue that science must also leave no one behind. We suggest that grounding science in culture is a potential pathway to successful sustainability initiatives, that are themselves sustainable, by being desirable and relevant to the communities they serve.

Engaging culture in ocean science

A sustainable ocean depends on actions to ensure equity and justice for ocean rights holders and stakeholders; inclusive and holistic governance that is co-designed; and interdisciplinary science that is fit-for-purpose[11]. With this in mind, ocean science must be diverse, decolonized, and connected to the local communities affected by management decisions to fully serve sustainability for those "left behind"[12]. When ocean science engages components of culture, it may inform more equitable solutions. Reducing the inequities that stem from how we choose to do ocean science and how we manage the ocean can improve sustainability outcomes[13].

UNESCO defines culture as the set of distinctive spiritual, material, intellectual, and emotional features of society or a social group that goes beyond art and literature to include lifestyles, ways of living together, value systems, traditions, and beliefs[14]. This broad definition can be used

to identify cases where culture is embedded in science and better able to generate successful sustainable ocean initiatives, rather than the traditional scientific model where components of culture must change as a result of such initiatives.

Canada as an exemplar

Canada is home to the world's longest coastline of any one country, with diverse geographies and vibrant ecosystems spreading across the ocean in Pacific, Arctic, and Atlantic regions. Along this coast, Indigenous Peoples and coastal communities, their livelihoods, well-being, and cultures, are intimately tied to the ocean. With these unique features, Canada serves as a special case study to understand the role of culture in coastal sustainability.

As Canada develops its Blue Economy Strategy, promising ocean protection, production, and prosperity[15], an approach to science that appropriately reflects the importance of the ocean to Indigenous and non-Indigenous cultures in Canada is not just ideal, but necessary to support long-term sustainability. If the blue economy is to promote the "sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health"[15], coastal communities must be a central part of our sustainability solutions.

With momentum building from the UN Decade of Ocean Science for Sustainable Development (2021-2030), and as Canada aims to set priorities for the Decade, we are at an important crossroads where science could be transformed to co-design and co-deliver sustainability solutions with and for the communities depending on our coasts and ocean[16]. At a time when Canada's ocean policy and science must come together[17], we visit every Canadian coast to explore what is gained when culture is at the centre of ocean science, and what is lost when it is at the periphery.

Canadian case studies

Eelgrass in Eeyou Istchee

The Coastal Habitat Comprehensive Research Project

LOCATION Sub-arctic – Eeyou Istchee/Eastern James Bay

CONTEXT Cree Land Users in Eeyou Istchee, along the Eastern James Bay, have witnessed declines in Shkaapaashkw (eelgrass) since the 1990s. At the same time, Nisk (Canada geese), a traditional food species in Cree culture, were changing – geese no longer came to the same areas where the Cree had traditionally hunted them. Concerns about these changes led to the Coastal Habitat Comprehensive Research Project in 2016, supported by the non-governmental organisation (NGO) Niskamoon Inc.

This project weaves together Cree traditional knowledge and scientific research to build a holistic understanding of the coastal ecology in Eeyou Istchee, especially the relationship between Shkaapaashkw and Nisk. Underpinning this research are considerations related to food security, culture, and well-being for coastal communities.

Local Cree people and non-Indigenous researchers work together to collect water, in rivers and along the coast, and eelgrass samples and install scientific water sensors, all while exchanging local knowledge of Shkaapaashkw, environment, traditional hunting techniques, and scientific ways of studying coastal ecosystems.

RELEVANT FACTS

A major decline in eelgrass occurred between 1998 and 1999. At five out of six permanent sampling stations, eelgrass leaf biomass declined by more than 90% compared to biomass levels observed in 1995[18].

Eelgrass beds provide food for culturally important geese and shelter for many animals, like fish, mussels, and other migratory birds. When the conditions are right, eelgrass can thrive and support both the ecosystem and coastal communities. However, shifts in eelgrass bed dynamics can lead to whole ecosystem changes.

LINK TO SUSTAINABILITY

The Coastal Habitat Comprehensive Research Project was initiated by the Cree Nations of Chisasibi, Wemimdji, Eastmain, and Waskaganish, building a sustainable foundation for collaborations between the Eeyou Istchee Cree people, Niskamoon, HydroQuebec, and academic researchers.

The research is revealing a dynamic and complex ecosystem where species are evolving and competing, including Shkaapaashkw and Nisk[19], influenced by local environmental drivers and climate-driven processes. These changes deepen long-lasting challenges, and/or create new ones, for the Cree and their traditional lifestyle and subsistence economies.

By centering culture in science, this project is delivering sustainability outcomes, like better understanding of eelgrass bed dynamics and food availability, supporting ecosystem management, traditional harvest, and well-being within coastal communities. Because the project has been co-designed, partnering with communities from inception to solutions, culture is central to the research.

Co-design ensures that the community is engaged throughout the project, making sustainability outcomes more feasible as community members are committed to the project and a part of solutions. Outreach activities were carried out in schools and during Chisasibi Pow-wow to engage the youth.

Arctic resilience in the face of climate change

Sea-Ice Monitoring And Real Time Information for Coastal Environments (SmartICE)

LOCATION

Arctic – Inuit Nunangat
(4 Inuit settlement regions in the Canadian Arctic)

CONTEXT

Trends over recent decades indicate that sea ice in the Canadian Arctic is becoming thinner, forming later, and breaking up earlier than before[20,21]. Under a changing climate, warm days mid-winter are becoming more frequent, turning sea ice to slush, making conditions for sea-ice users more dangerous.

To empower Inuit communities to adapt to these increasingly unpredictable ice conditions, SmartICE was co-designed to integrate Inuit knowledge of ice safety and travel with advanced data acquisition from remote monitoring technology.

SmartICE generates near real-time information on sea-ice conditions. Using stationary sensors and satellites (the SmartBUOY) and a mobile sensor pulled behind a snowmobile along community trails (SmartQAMUTIK), SmartICE measures snow and ice thickness. This scientific data is shared through SIKU, a mobile app and web platform made by and for Inuit.

SIKU, the Inuktitut word for "sea ice" or "Inuit knowledge of sea ice", was released in 2019 by the Arctic Eider Society and provides tools and services for ice safety, language preservation, and weather.

RELEVANT FACTS

In 2010, an extremely warm winter led to fickle sea ice in Nunatsiavut (located in Labrador). That winter, 75% of sea ice users indicated they could not predict the ice conditions and one in twelve people reported falling through the ice.

As a social enterprise, SmartICE has hired 68 operators across 17 communities in Northern Canada. Hiring Inuit operators ensures that community members have confidence in SmartICE data.

In Nunavut, between 2019 and 2020, SmartICE was active in 13 communities, involved more than 50 Elders and community members in community management, and saw 140 Inuktitut sea-ice terms documented by Elders and youth.

LINK TO SUSTAINABILITY

The scientific data collected by SmartICE gives insight into local ice conditions and improves safety for sea-ice users. In doing this, SmartICE supports food security, traditional practices, and community health.

SmartICE provides culturally relevant training programs, harnessing the potential of young Inuit to embrace science, technology, and traditional knowledge as a pathway to sustainable employment, economic development, and well-being.

The pilot programs of SmartICE in Nain, St. John's, and Pond Inlet have enabled the technology and processes required to expand as a social enterprise, while preparing SmartICE for commercial markets to ensure its long-term sustainability.

Whales in busy waterways

Enhancing Cetacean Habitat and Observation (ECHO) for sustainable shipping

LOCATION

Pacific – Vancouver

CONTEXT

Marine mammals are exposed to several threats where they coexist with human activities. In the southern coast of British Columbia, this can mean noisy waters, a risk of collision with ships, and polluted air[22].

As commercial activity was increasing in the Port of Vancouver, the ECHO program launched in 2014 to reduce the effects of shipping on at-risk whales in the region. The ECHO program promotes initiatives to reduce underwater noise, while also providing educational outreach and training sessions across the public and private sectors.

Envisioning the world's most sustainable port, this program is led by the Vancouver Fraser Port Authority and involves more than 100 partners from industry, Indigenous communities, research and technology, environmental groups, provincial and federal government, and more[23].

RELEVANT FACTS

The Southern Resident Killer Whale is listed as an endangered species in Canada and the United States. Fewer than 80 individuals remain (76 individuals as of 2017[24]).

Killer whales use sound to communicate, find food, and avoid danger. When the environment is too noisy, whales have a harder time sending and receiving information and communications.

Between July and October 2020, 91% of vessels navigating Haro Strait and Boundary pass participated in a voluntary slowdown area and a 50% reduction in sound intensity[25].

LINK TO SUSTAINABILITY

The ECHO program brings together partners and participants to take action toward a common goal. Unlike traditional conservation measures in the shipping industry, often imposed on the industry, this program is built by a culture of care within the industry, collaborating within and across the diverse community of partners.

Vessel operators have a central role in protecting at-risk whales from shipping-related threats. The ECHO program recognizes this role, secures the participation of thousands of vessels in voluntary initiatives to slow down or avoid important whale habitats[22], and encourages ways of living together with nature.

By leveraging shared values in conservation, especially for an iconic and culturally important species like the Southern Resident Killer Whale[24], this program fosters sustainable shipping practices along the southern coast of British Columbia.

Marginalized by fisheries management

Individual Transferable Quota (ITQ) System and the halibut fishery

LOCATION

Pacific – British Columbia coast, North Pacific/Gulf of Alaska

CONTEXT

With advancements in fishing technology, a 'race to fish' was occurring off the coast of British Columbia for the valuable Pacific halibut[26]. In 1991, the fishery was transitioned to an Individual Transferable Quota (ITQ) system – an approach intended to improve economic viability and conservation outcomes[27].

ITQs are built on economic models and continue to rely on scientific models to establish total allowable catch. Under ITQ management, licensed individuals are given a predetermined share of the catch. The Pacific halibut fishery was among the first ITQ fisheries in Canada and is commonly heralded as a successful example of ITQ fisheries management[28].

However, this system has allowed for private investors to acquire ITQs, and to then lease the quota back to fishers on the water, creating issues and inequities that threaten the sustainability of the fishery[28]. The system is divorced from local fishers, their livelihoods, and fishing as a cultural activity.

RELEVANT FACTS

In 1980, fishers took 65 days to catch 5.7 million pounds of halibut. By 1990, fishers took only six days to catch 8.5 million pounds of fish[26].

In the first year of the ITQ system, owner-operators caught 90% of the halibut. But by 2016, there were equity concerns as owner-operators accounted for only 45% of the halibut catch and owned only 15% of the quota[28].

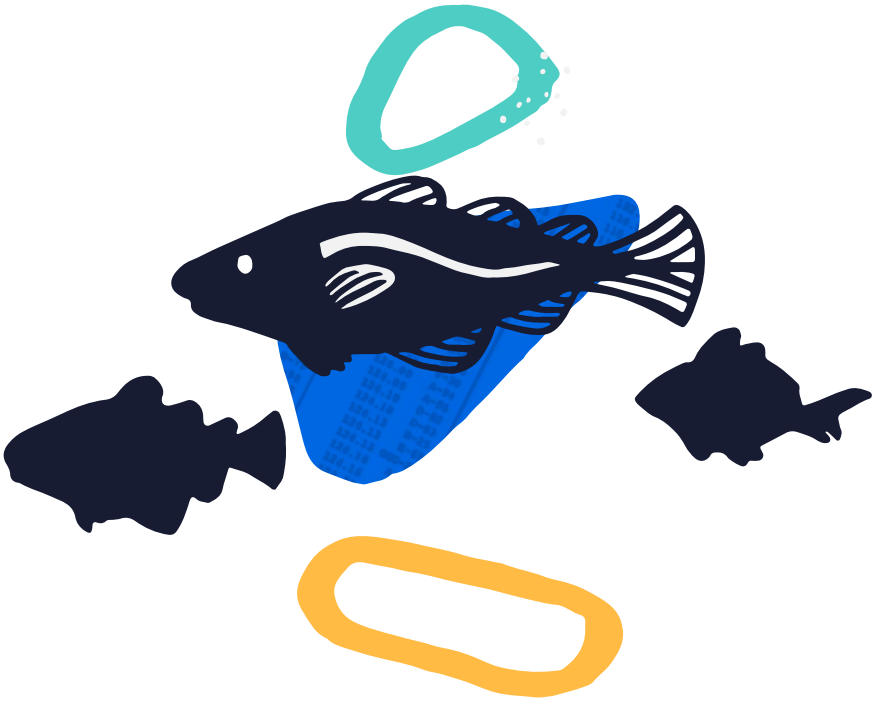
Up to 435 Canadian vessels are licensed to commercially fish for Pacific halibut. As of 2018, 76 of these were First Nation communal licenses[28].

LINK TO SUSTAINABILITY

This British Columbian fishery has been certified sustainable by the Marine Stewardship Council since 2009. This fishery is part of a wider management program across national boundaries and makes use of sustainable gear, including longlines that cause minimal damage to the ocean floor and large hooks that limit the capture of smaller fish.

Ecologically, this is a sustainable fishery. The ITQ system has resulted in less overage in total catch; however, there is consolidation in the fishery, with fewer boats and higher revenues that exacerbate equity concerns.

Would things be different if a cultural lens had been used when ITQs were implemented? Could this lens have kept the sustainability gains but prevented the issues of consolidation? Is this fishery truly sustainable if the fishers on the water are not equitably receiving benefits?



Cod collapse and cultural calamity

Fisheries science divorced from local knowledge

LOCATION Atlantic – Newfoundland & Labrador

CONTEXT Dating back to the 1400s, historic records tell tales of plentiful cod off the shores of Newfoundland. In the 1960s, however, stocks were falling and by 1992, the spawning biomass of Northern cod had dropped by 93%[29]. In July of 1992, a two-year moratorium was announced that has more-or-less persisted to this day, as large-scale commercial fishing is still prohibited.

The Newfoundland cod collapse is known around the world, perhaps as one of the most famous fisheries management failures[30]. Even as some fishers and scientists warned of declining catch, overfishing persisted under pressure to set high total allowable catch for socio-economic reasons[31].

Fisheries science was at the centre of the cod collapse, as cod were viewed as statistical populations that could be maximized each year[30]. Observations of fish and lived experiences with cod in the water by local fish harvesters were generally considered less important, resulting in catastrophic consequences[30].

RELEVANT FACTS

In 1975, Newfoundland was home to 15,000 fishers and 110 fish plants. Just five years later, 35,000 fishers landed their catch at 175 processing plants[32].

The cod moratorium resulted in the largest mass layoff in Canadian history as 12% of Newfoundland and Labrador's workforce was put out of work[33].

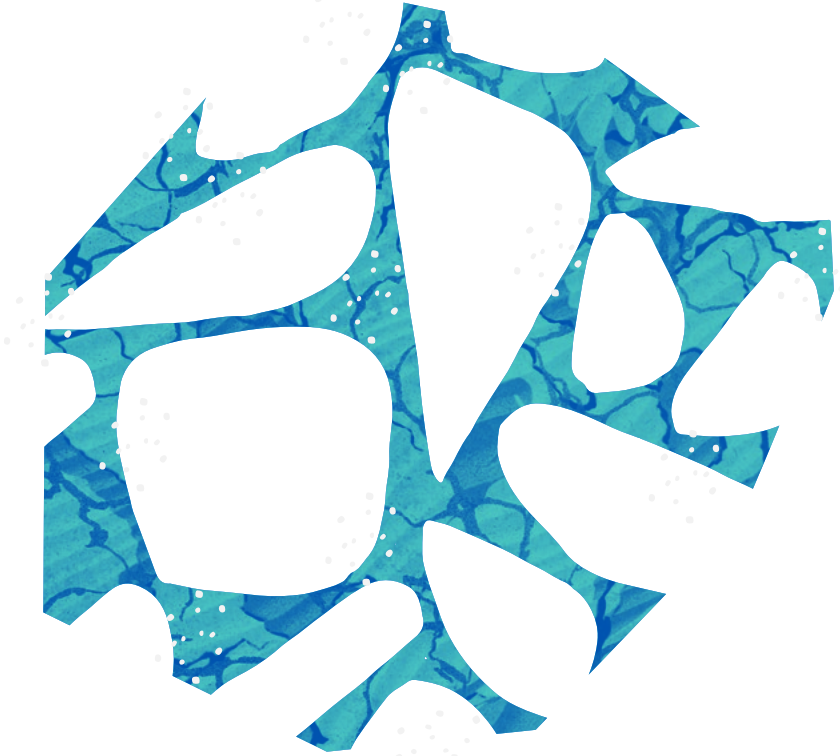
A small, inshore commercial cod fishery, the "stewardship fishery", has been active since 2006 in hopes that the stock will rebuild, to build a better understanding of the stock through data collection, and to include fishers in stock assessments[34].

LINK TO SUSTAINABILITY

For many, the cod moratorium marked the end of a way of life[35]. Despite being managed by highly-qualified scientists and managers, the cod stock collapsed. Their knowledge was privileged over the knowledge of those who depended on and faced the consequences of fisheries decisions. While common sustainability discourse holds that experiencing collapse is a great teacher and generates radical changes in management, it is not clear this has occurred.

The "Rebuilding plan for Atlantic Cod – NAFO Divisions 2J3KL", a non-legally binding plan released in late 2020, has been criticized for failing to take a precautionary approach and relying on questionable scientific models and views that discounts others[36].

Overfishing remains a threat to this iconic Canadian species[37]. What might have happened had culture – local knowledge and values, ways of living, traditions – been central to fisheries science and management of Northern cod prior to its collapse?



An ecosystem of community-engaged research

Building relationships for Sustainable Nunatsiavut Futures

LOCATION

Atlantic – Nunatsiavut, Labrador

CONTEXT

Community-engaged research invites communities into the research process with a voice and role beyond simply serving as study participants[38]. This type of research makes upfront investments of time, energy, and capacity in order to build meaningful and lasting relationships with members of a community.

The Sustainable Nunatsiavut Futures initiative of the Oceans Frontiers Institute is the most recent collaboration in an ecosystem of research, where efforts to build relationships, trust, and co-design research have paved the way for new and truly community-led research. The project looks at changing environmental conditions in Nunatsiavut and the impacts of changes on local communities who rely on ocean resources[39].

Using community-engaged research and western scientific methods, Sustainable Nunatsiavut Futures looks to co-produce knowledge and build capacity for ocean research. But getting to this stage is a long and winding road, and the outputs of such research do not always fit the traditional research model. Instead, trust itself can be an important and powerful outcome of the research process.

QUICK FACTS

Nunatsiavut is the first Inuit region in Canada to achieve self-government, having authority over health, education, culture and language, justice, community, and research related to its people[40].

The Nunatsiavut Government Research Advisory Committee (NGRAC) reviews all research by non-beneficiaries of the Labrador Inuit Land Claims Agreement[41].

Sustainable Nunatsiavut Futures has engaged 50 project members, including academic and non-academic partners, from 18 organizations[42].

LINK TO SUSTAINABILITY

Because this research prioritizes meaningful engagement with Inuit, the types of questions and analyses that Sustainable Nunatsiavut Futures can explore are richer, more thoughtful, and more relevant to the diverse communities who co-develop research.

When trust comes first in community-engaged research, initiatives like long-term monitoring become possible as research can identify the infrastructure, institutions, and supports needed to build capacity and fulfill self-determined community interests in science.

This case demonstrates that community-engaged research not only leads to positive sustainability outcomes, like sustainable fisheries, but also towards the co-design of a sustainable research program that benefits scientists, the region of Nunatsiavut, and its people.

Conclusion

Toward a new ocean science

Culture, the diverse and distinctive features of a social group (including lifestyles, ways of living together, value systems, traditions, and beliefs[6]), is at the core of a sustainable ocean. The case studies we present here demonstrate the ways in which components of culture can enable or, when omitted, hinder, science and solutions to sustainability issues. When principles of respect, reciprocity, and working together – that is, with the communities affected by and affecting sustainability solutions – are upheld by science, science can support the co-design of feasible, appropriate, and socially acceptable solutions that are themselves sustainable. However, these case studies also describe an emerging type of ocean science that may not be readily supported by traditional systems. An ocean science that is grounded in culture necessitates a transformation to existing scientific systems, a transformation that fosters co-design, partnerships, and community leadership.

We have listed a set of recommendations that emerged through our exploration of these cases studies and experience with ocean science in Canada. We believe these recommendations should be enacted to transform ocean science in Canada to deliver on sustainable development.

Recommendations

1. Early partnerships: true co-design must front-end community partnerships, investing time and resources in developing strong relationships before any research begins

2. Continual assessment: sustainable co-design research must be continually and adapted as needed in a cyclic manner, requiring human and financial support

3. Science infrastructure: the scientific system, including funding and metrics of excellence, must support relationship building and non-traditional outputs of research

4. Community-led: supports for science, including access to human, financial, and technological resources, must be available to communities who seek to lead research

5. Two-way training: as communities are trained to conduct science, scientists must be trained to participate in co-design that values other cultures and beliefs

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