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Fostering fisheries futures: the promise of localized stewardship education in Nunatsiavut

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Nunatsiavut is a self-governing Inuit territory in northern coastal Labrador, where cultural knowledge and social values are incorporated into co-managed subsistence and commercial fisheries. Snow crab (*Chionoecetes opilio*), known as Putjotik in Inuttitut (the Nunatsiavut dialect of Inuktitut), is a co-managed fishery through the Torngat Joint Fisheries Board (TJFB) and plays a crucial role in sustaining the community of Makkovik. Arctic Char (IKaluk) is also harvested in co-managed subsistence and commercial fisheries, and is a staple in local economies and culture. In 2022, the TJFB partnered with Inuit educators to foster youth stewardship in a project called Paigitsiaguk. The Paigitsiaguk project bridges Inuit and scientific knowledge to nurture cultural values and environmental stewardship through providing place and land-based resources to educators. The project team created a comprehensive database of curriculum outcomes required by the Newfoundland and Labrador school system, and then designed culturally relevant learning activities that presented Inuit knowledge with science and social studies for students in Nunatsiavut. These resources include learning activities that are organized into education kits: one of which is centered on Putjotik and another on IKaluk. The Putjotik kit has 23 activities tailored to meet grade-specific learning outcomes, while the IKaluk kit provides 12 place-based learning activities appropriate for multiple grade levels. By providing localized and culturally relevant education resources to teachers that revolve around stewarding local fish species and their ecosystems, youth are connecting to their communities and to the coastal environment. Educational resources and learning activities reflect Inuit and scientific knowledge systems, and position teachers as facilitators to encourage students to learn from the land and Elders, knowledge holders, fishers, scientists, and managers. This paper reflects the promising futures that this work can contribute to; from facilitating intergenerational knowledge transmission from knowledge holders to youth, to encouraging self-determined stewardship activities that encourage care for the ocean and its fisheries.

KEYWORDS

co-management research, Nunatsiavut, small-scale fisheries, stewardship, Indigenous education, place-based education, intergenerational knowledge transfer

1 Introduction

Inuit livelihoods in Nunatsiavut have long been tied to the ocean (Brice-Bennett, 1977; Hanrahan, 2012). The connection between the ocean and local livelihoods continues to this day considering the substantial impact of commercial and subsistence fisheries on the social, cultural, and economic wellbeing of coastal communities (Snook et al., 2018). Commercial fisheries are a way of life in Nunatsiavut (Snook et al., 2022) and the fisheries provide essential employment and spin-off benefits to communities.

Nunatsiavut is a self-governing Inuit territory in northern Labrador that was created in 2005 after decades of advocacy and negotiation by the Labrador Inuit Association (White, 2023). The Labrador Inuit Land Claims Agreement (LILCA) (Figure 1) created new institutions such as the Nunatsiavut Government (NG) and the Torngat Joint Fisheries Board (TJFB). The TJFB is a co-management Board responsible for making recommendations regarding commercial fisheries in Nunatsiavut. However, despite the land claims agreement, there have been multiple fisheries injustices that have hampered the equitable development of and access to fisheries in the region (Hoover et al., 2024). Yet, commercial fisheries continue despite the odds and constant social struggle (Snook et al., 2022).

The TJFB makes management recommendations to the Minister of the Department of Fisheries and Oceans Canada (DFO) on various commercial fisheries and conservation issues. Since co-management was implemented, the TJFB has successfully

increased the active participation and representation of Nunatsiavut beneficiaries' interests. It has also built the scientific knowledge base of species in local waters. (Cadman et al., 2022). This article focuses on two commercial species currently fished in Labrador: snow crab and arctic char.

The most economically valuable fishery in the region is snow crab (*Chionoecetes opilio*), known as Putjotik in Inuktitut. Snow crab is a relatively new fishery on the Labrador coast; however, it has grown into one of the most important due to its high economic value. The snow crab fishery has also been the steadiest commercial fishery in Nunatsiavut since the 1990s (Boutet, 2016) and has seasonally employed approximately 120 people in fish processing in the community of Makkovik (population 350). However, the fishery is now in decline due to a variety of factors including rising ocean temperatures, increased predation, and fishing (Mullowney et al., 2014), causing present employment to drop to approximately 30–60 people per season. Youth in Makkovik are particularly familiar with snow crab, as some high school students are employed during the summer and crab is available for purchase (Figure 2). Crab is a high value species, and while it is not a staple in the local diets, its presence contributes to food security.

Atlantic salmon (*Kavisilik* in Inuktitut) and arctic char (*IKaluk* in Inuktitut) are both longstanding fisheries in Nunatsiavut. For thousands of years, fishing these species has been an integral part of Labrador Inuit food, culture, and economy. The Atlantic Salmon commercial fishery thrived along the Labrador coast from the 1770s through to the 1900s until its decline and closure in 1998 (Rose, 2007). Today Atlantic Salmon continue to be accessible for subsistence, but the commercial fishery is a distant past. Arctic char (*IKaluk*) shares salmon's anadromous lifestyle but is unique because it is currently fished for both subsistence throughout Nunatsiavut, and commercially in the community of Nain where there is a processing facility. Combined, these two species are integral to local livelihoods, food security, and culture (Figure 2). Furthermore, Nunatsiavut-based fishers incorporate their knowledge and social values into both subsistence and commercial fisheries through a constitutionally protected co-management process. This article will focus on char due to its commercial fishery.

Due to longstanding relationships with the marine environment and fisheries in Nunatsiavut, there is a wealth of local knowledge held by Elders, commercial and subsistence fishers, processing workers, scientists, and recreational users. Significant efforts have been made by the TJFB to ensure local knowledge of fishers is captured in management recommendations and monitoring activities. The TJFB is committed to continuing and enhancing the long history of marine and environmental stewardship Inuit in Labrador have practiced for centuries. While the methods and technologies of fishing and stewardship have changed, the values of taking care of wildlife and fisheries populations for the benefit of community health and wellbeing have remained the same.

Local knowledge is typically defined as a “cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment” (Berkes, 2018, p. 8). As well as being used to understand and adapt to changing environmental circumstances, local knowledge can be used to

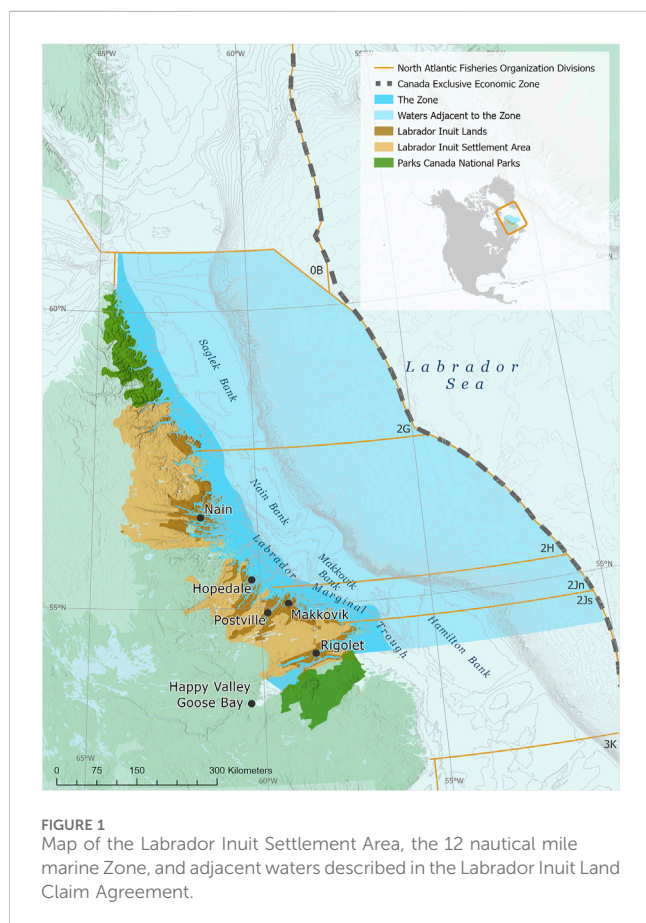




FIGURE 2
Fishery photos from Makkovik (July 2023): (A) bucket of salmon and char from the subsistence gillnet fishery; (B) processed snow crab purchased from the commercial processing facility; (C) salmon and char filets cooling in the ocean.

foster just and sustainable futures (Lam et al., 2020). For example, the TJFB brings together fishers annually to discuss management measures, current scientific observations, and to collect fishers' understandings of the current state of fisheries to make well-rounded recommendations to the DFO. Furthermore, fisheries stakeholders in Nunatsiavut recently collaborated on a planning process that allowed participants to use both scientific and local knowledge to envision an ideal Inuit-led future of sustainable fisheries in the region (Cadman et al., 2023a).

Local knowledge is often passed on through practice and engaging in the physical activity of fishing, but in today's society young people spend a substantial part of their lives and formative years in the public school system. The K-12 education system in Nunatsiavut is administered by the Government of Newfoundland and Labrador and is typically classroom based. Furthermore, the curriculum was developed in St. Johns—the capital of Newfoundland and Labrador—which is more than 1,000 km away from the administrative capital of Nunatsiavut. There is also cultural distance between the mandated provincial curriculum and the desires of what community members would like to see in reflected schools.

1.1 The problem

Before co-management began in the region, fisheries were controlled with minimal input from local fish harvesters. This led to keystone species like Atlantic Cod vanishing and commercial fisheries in an Indigenous area that are only partially sustainable. It has been very difficult for fishers to succeed and create viable fishing businesses. Additionally, fish processing plants are often run based on social values and carry on producing fish products when strictly profit-focused processors would stop operating. For example, fish processing plants run by the TFPC have been subsidized by offshore shrimp royalties in order to keep local fish processing jobs available and other commercial fisheries such as char operating (Foley et al.,

2017). The way fisheries have been mismanaged without considering local communities has caused socio-economic problems and put the continuation of local small-scale fisheries at risk (Snook, 2023a).

Another key challenge is that new generations of young people are hesitant to see a future in fishing (Power et al., 2014). As described, fishing and fish processing provides significant seasonal employment and food security to people living on the coast. There are few options for seasonal work in communities and without local resource industries such as fishing, limited employment options may force people out of town. Many people have also been attracted to the higher paying careers in the mining industry (Pike, 2023). It is integral that fisheries in Nunatsiavut are managed sustainably and remain profitable to support the continuous economic, environmental, physical, and social wellbeing of people living in Labrador's coastal communities. At present, there are very few successful fish harvesting enterprises to act as role models. Moreover, youth in Nunatsiavut are educated in a provincially administered school system that does not regularly reflect local culture or ecology (Anderson and Lane, 2020) or address sustainable community development and stewardship from a culturally informed lens (Snow and Obed, 2022). The Nunatsiavut Government has jurisdiction over the K-12 education system through the 2005 land claim agreement but they currently choose to leave the administration of the schools to the provincial government. Students receive cultural education through some specific classes such as Inuttitut language classes, Inosivut, Labrador Society and Culture, and Ilusivut. However, all other subjects have been developed from, and continue to reflect, Western worldview and values.

1.2 An intersectoral opportunity

The Torngat Joint Fisheries Board (TJFB) believes in the importance of stewardship and education. Through a strategic

planning process, the TJFB started to identify new and creative opportunities for sustaining commercial fisheries in the region. Beginning in 2022, the TJFB partnered with Inuit educators to promote youth stewardship through intergenerational, land-based, and classroom learning. The project, called Paigitsiaguk, which translates into English as “to take care of it”, has the goal of nurturing Inuit values and bringing awareness to stewardship activities. The Paigitsiaguk project team is creating stewardship education kits aligned with provincial curriculum on locally and culturally important species for use by local teachers and schools. Two of the five kits currently in development are based on stewardship of commercial marine species: char and snow crab.

There have been efforts globally to incorporate Indigenous and local knowledge in classrooms (Da Silva et al., 2024). The implications of an education that is grounded in Indigenous and local knowledge, culture, and place are wide reaching. For example, land- and place-based education can positively impact the physical, mental, and emotional wellbeing of students (Luig et al., 2011; Stelkia et al., 2021). Place-based education also increases student engagement (Powers, 2004), students' cultural identity and community connection (Redvers, 2016; Smith, 2002), and capacity and passion for environmental stewardship (Redvers, 2016; Gruenewald, 2008; Powers, 2004). There are also cultural benefits associated with place-based learning including intergenerational ecological knowledge transfer of skills, relationships, and values (Obed, 2017; Lines and Jardine, 2019) and cultural and language resurgence (Snow and Obed, 2022; Corntassel and Hardbarger, 2019). Land-based education and pedagogies can also support relationship building and sustainable, Indigenous-led futures (Bang et al., 2013). While this paper focuses on the current preliminary state of an initiative to provide resources to localize education and include Indigenous and local knowledge in learning resources in Nunatsiavut, the Torngat Secretariat has acquired funding over a 3-year period to research the experiences of youth who have participated in land-based educational programming in Nunatsiavut. Some broader indicators of success that could be seen at a community level include youth pursuing post-secondary education related to the marine industry, seeking funding to acquire vessels or gear to pursue fishing full or part-time, or leaving the mining sector to invest in fishing as alternate employment.

Supporting the teaching and learning of marine stewardship values and concepts within the K-12 school system provides opportunities for youth to envision commercial fisheries as viable career opportunities and to gain the knowledge, education, and skills needed to be successful in this industry. While the TJFB does have a broad mandate, it could not implement or participate in a project like this without the collaboration and expertise of people within the education sector such as the Indigenous educator leading the project and the Nunatsiavut Government's department of Education and Economic Development. The Nunatsiavut Government's Education Department endorses the Paigitsiaguk project, and the goal of prioritizing Inuit cultural values in learning.

2 Methodological approach

This project is distinctly a co-management-led research study that is being led by a co-management board with collaborating partners to address stewardship and education priorities that are for,

and with, Inuit in the Nunatsiavut region (Snook, 2023b). The work is underpinned by the concept of Health in All Policies (Leppo et al., 2013) that promotes wellbeing across all sectors of society. Although fish and wildlife co-management boards may not be directly engaged in determining health policies, the work of this project recognizes the intersection of public education, fisheries management, environmental health, stewardship, and youth wellbeing.

The project is also based on a decolonizing approach to teaching and learning (Smith, 2021) as it centers Inuit knowledge, values, and pedagogies in K-12 schooling. It also advances education as a component of Inuit self-determination. The outputs from this work align with the Nunatsiavut Governments' vision of Inuit-led education and more extensive cultural and language programming (Nunatsiavut Government, 2024). It also builds on other education initiatives in the region, such as the rejuvenation of Inuttitit and aims to advance Inuit self-determined education through collaborative and participatory program development (Moore, 2019; Tulloch et al., 2023).

The Paigitsiaguk project team includes professional educators, the majority of whom are also co-authors of this paper. Their extensive teaching experience and education have ensured that the kits are practical and beneficial for current teachers in classrooms and their connections to the broader education network have also been invaluable. An Elder and respected translator on the project team has played a key role by integrating Inuttitit (the Nunatsiavut dialect of Inuktitut) language resources into the kits, contributing significantly to supporting language revitalization efforts in the Nunatsiavut education system. The first author is a recent graduate from the Master's in Marine Management program at Dalhousie University and joined the Paigitsiaguk project as part of an internship. The academic co-leads for this project consist of an associate professor with expertise in Indigenous pedagogy and the Executive Director of the Torngat Wildlife Plants and Fisheries Secretariat connects this project to the field of co-management, policy implementation, and public health.

Led by a fisheries co-management board and a subject matter expert team, these kits reflect the values and priorities of Nunatsiavut communities as well as the goals of the Secretariat's Stewardship and Education Strategy. The project also reflects a transdisciplinary collaboration for environmental stewardship. Action needs to be taken today to collaborate with youth to ensure they have the knowledge and skills necessary to address the current and future climate and environmental changes that are especially affecting the north and its fisheries. The TJFB's work on stewardship education furthers the vision of what sustainable fisheries management looks like by investing in youth learning. The Putjotik and IKaluk kits offer learning activities that connect students to multiple elements of commercial fisheries; from ecological communities to industrial facilities, to people in the marine space that all culminate in facilitating intergenerational knowledge transfer in coastal communities.

2.1 Methods

The first step necessary for the success of this project was to create a database of curriculum requirements that learning activities

could be based on. This task was critical to creating learning activities that teachers could use to meet their mandatory curriculum outcomes, thereby making it more likely teachers would take advantage of the resources. The database was created by a local Inuk education expert and author on this paper, Ola Andersen. Ola analyzed the relevant learning outcomes from the provincial curriculum online database that could be infused with Inuit content and stewardship concepts. The database contains all relevant curriculum outcomes from science and social studies courses, is approximately 70 pages long, and spans from grades K-12.

Inuit knowledge of ecosystems, culture, and identity go hand in hand. Western scientific knowledge found in the NL curriculum was a natural fit for blending outcomes in science courses with Inuit knowledge about species such as polar bears, caribou, salmon and char, and crab. Social studies was chosen as the identity of Inuit cultural practices could be connected to the specific outcomes identified in the NL Social studies documents. Connecting stewardship and conservation of local species through Inuit-led practices based in community engagement with Elders, knowledge holders, and science experts provided opportunities to integrate science and social studies curriculum outcomes in the same learning activities.

Specific curriculum outcomes in NL Science and Social studies K-12 curriculum were analyzed and identified to fit together with the study of Inuit culture, identity, and environmental sustainability in Nunatsiavut. This analysis included Graduated Curriculum Outcomes (GCO) as well as specific learning outcomes for all K-12 Science and Social studies courses. Learning activities were then designed around species that are familiar to students in the 5 Inuit communities of Nunatsiavut to meet these curriculum requirements. For example, to meet GCO 1: "Science, Technology, Society, and the Environment: Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology", teachers could choose to create lessons around any number of technologies and their relationships to science and society (ex. Forestry, transportation methods, housing technologies, etc.). However, in order to connect students to their local environments and culture, the Paigitsiaguk project kits use examples and learning activities students are familiar with. For example, learning activities based on different fishing and processing methods for char or how peoples' techniques and technologies for understanding snow crab in the Labrador Sea have changed over time.

2.1.1 The Putjotik (snow crab) kit

The foundation of the Putjotik kit is the database of social studies and science curriculum outcomes. Learning activities were created to meet specific curriculum outcomes through exploring the snow crab fishery. Additionally, the kit was created with the pillars of land- and place-based learning and culturally relevant content in mind through the guidance of professional educators on the Paigitsiaguk project. The majority of learning activities were designed to be customizable to any community in Nunatsiavut, however there are a few that are designed specifically for students in Makkovik who have access to the commercial fish processing facility and the public docks where snow crab is landed for processing. The

creation of the Putjotik kit was made possible through on the ground experience in Makkovik and through the collaboration, advice, vision, research, and resources of the educators involved in the Paigitsiaguk project.

2.1.2 The IKaluk (char) kit

Conceptualization of the IKaluk kit took a more land-based, practical approach since most communities in Nunatsiavut have easy access to char, and students, Elders, and facilitators of learning activities can actively fish these. The arctic char and salmon kit stands out from the other kits in that it offers all-grade lessons that are place-based, meaning they are tailored to local communities and their specific needs. These lessons are designed to be community-driven, engaging students in activities that directly connect them with their surroundings. This community-focused approach empowers the youth to develop a deep appreciation for sustainable fishing practices while fostering a strong connection to their environment and heritage.

3 Results

As a result of the Paigitsiaguk project, the project team has developed Inuit-centric teaching and learning resources that may be used within the K-12 school system. These resources and learning activities are organized into education kits; one focusing on snow crab (Putjotik kit) and the other on char (IKaluk kit). The IKaluk kit contains twelve place-based learning and engagement activities that can be used at any grade (K-12) due to the kits' flexible community-based design. The kit is designed to meet a broad variety of provincial curriculum outcomes associated with the interactions between technologies, the environment, and society, problem solving, working collaboratively, and using knowledge to benefit the self, society, and the world around them. Activities in the IKaluk kit are focused on connecting students with their communities' existing and historical fishing practices and ensuring youth have the skills and knowledge needed to continue sustainable livelihoods from local anadromous fish species that are a staple in local diets. The Putjotik kit contains twenty-three learning activities grouped in grade levels K-2, 3-6, and then upper years separately. Over half of the learning activities are land- and community-based and bring students to fishing docks, local museums, and nearby coastline and intertidal ecosystems to explore their learning. The other half are classroom based; many including remote or in person guest speakers from the snow crab industry. Both kits span western science and Inuit knowledge systems, social studies and science curriculum outcomes, and classroom and land-based learning.

The kits come with digital and physical components (Figure 3) to complete the learning activities. Physical components are held in boxes and include scientific monitoring equipment, tools for exploring the outdoors, books in English and Inuktitut, posters, and fabric-art models for both species to display their structures and lifecycles (Figure 4). Digital components of the kits include PowerPoint presentations (Figure 5), online video resources, Inuktitut language resources (Figure 6), and each lesson plan and learning activity (Table 1) description is also available digitally.

The education kits, which will be circulated amongst the five schools in Nunatsiavut, provide place-based and culturally relevant

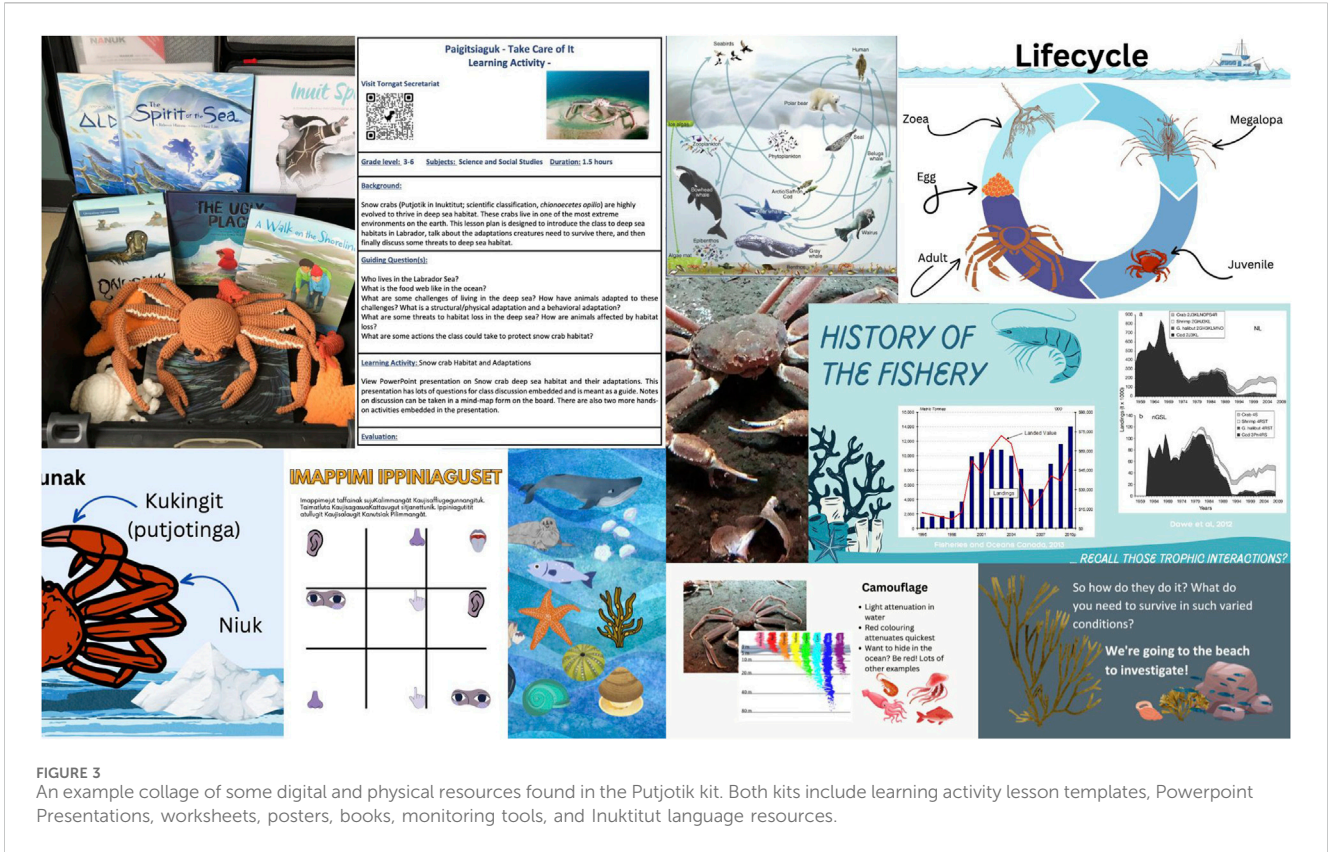


FIGURE 3
An example collage of some digital and physical resources found in the Putjotik kit. Both kits include learning activity lesson templates, Powerpoint Presentations, worksheets, posters, books, monitoring tools, and Inuktitut language resources.

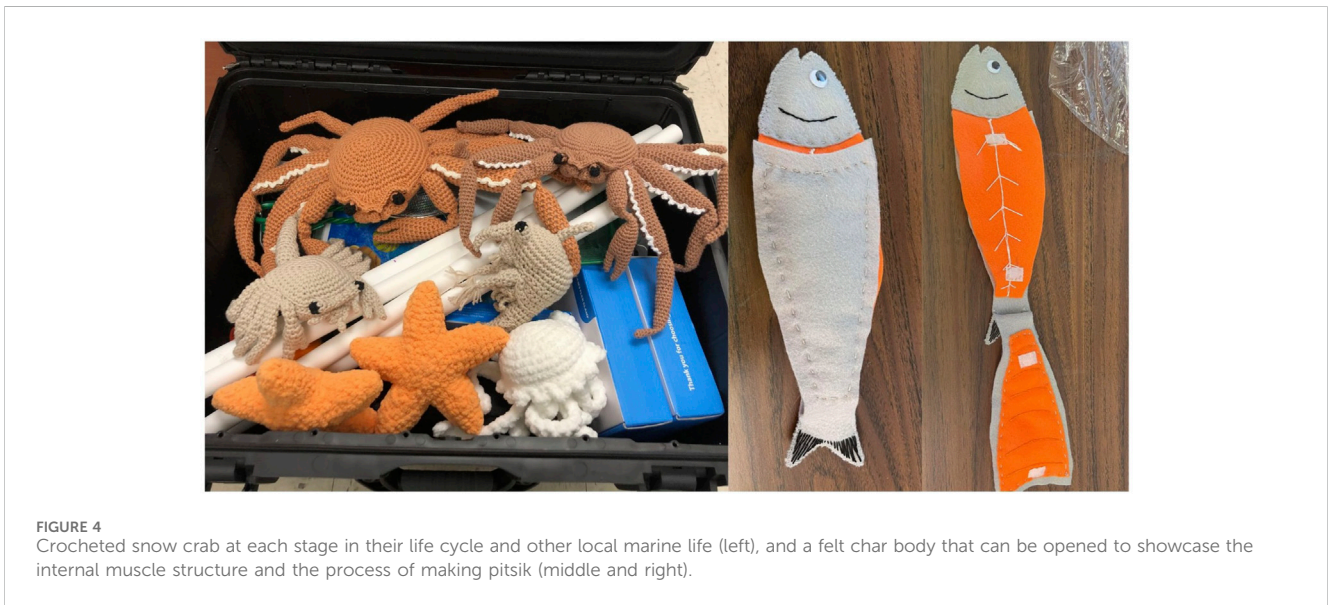


FIGURE 4
Crocheted snow crab at each stage in their life cycle and other local marine life (left), and a felt char body that can be opened to showcase the internal muscle structure and the process of making pitsik (middle and right).

teaching and learning resources for use in K-12 classrooms. The learning activities and resources reflect local fisheries, culture, ecology, and economies, and are aligned to meet provincial science and social studies curriculum outcomes. By offering resources to teachers that are directly compatible with provincially mandated curriculum, these kits are practical creations. The kits are currently undergoing an interactive review process for their development through being reviewed by teachers in

each community and Nunatsiavut Government senior leaders in the Department of Education and Economic Development.

4 Discussion

The Paigitsiaguk project aims to cultivate youth passion for marine species at every level; from recreational, to subsistence, to

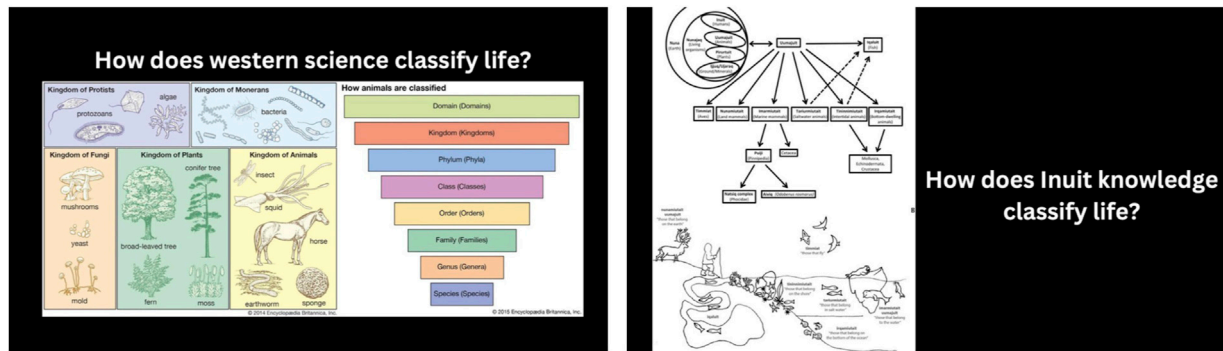


FIGURE 5

Example Powerpoint slides for an in-class learning activity titled “Marine Diversity, Classification, and Evolution” for grades 3–6. This Powerpoint explores how marine life is classified in both western science and Inuit knowledge systems, and how marine species have evolved over time using the snow crab as an example.

Char/Salmon Place-based Engagement Activities

Vocabularies

IKaluk, iKalok, iKaluik - char singular, dual and plural
kavisilik - salmon

Oganniatik - fisher person

Nuluak - nets

AKumigok - speedboat

Kuatsevik - freezer

Katjusak - fish hook

Isigitsiak - smoked fish

Isigitsiagutik - smoke house

Paungait - berries

Kijuk - wood

kiatsautik - wood stove

Names of places to fish in their communities

Kok - River

Imappik - ocean

Ingiulik - rough sea

SilakKik - beautiful weather

Silaluk - raining

FIGURE 6

An example from the IKaluk kit of Inuktitut language vocabulary resources to be used in conjunction with learning activities.

commercial harvest. Commercial fishing can be a difficult industry to connect youth to due to the offshore working environments and the industrial nature of fish processing. However, in the small coastal communities of Nain and Makkovik, commercial docks and processing facilities are a short walk away from the schools and are fixtures in the communities. The TJFB is also involved with monitoring and research, making collaborative management decisions, and has an extensive network of fisher and science expertise and other fisheries management bodies such as the NG and DFO. Within this network, there is remarkable access and opportunity for youth to experience and learn about different

aspects of commercial fisheries due to their physical proximity and community network access.

4.1 Connecting youth to a culture of fishing

In Nunatsiavut, fishing and harvesting ocean resources is a longstanding practice and has allowed harvesters to continue their relationship with the sea to this day. Commercial fishing in the abundant and cold Labrador Sea has been taking place on the coast for over 500 years and has become a way of life (Snook et al., 2022). Through their harvesting activities, fishers engage in cultural practices such as intergenerational knowledge transfer, observation of the fisheries and ecosystems over time, harvesting approaches, and stewardship of the local fish stocks (Cadman et al., 2023b). In this context, education activities built around marine species like snow crab and arctic char are entrenched in local culture and livelihoods. Connecting education materials to the culture of fishing in both the Putjotik and IKaluk kits allow students to showcase their pre-existing knowledge and connection to the sea and explore furthering and deepening their understanding through place-based experiential learning.

The vision for a culturally relevant formal education in Nunatsiavut is one that fosters Inuit values and culture by facilitating bridges between students, the land, and their communities (Moore et al., 2016). In this case, by focusing on a culture of stewardship the kits connect students with knowledge holders and users of the local marine space. Connecting youth with culturally familiar subject matter is important so students “have a base on which to build . . . meaningful learning that is easier to assess, is more relevant, and is reflective of the students’ own journeys” (Anderson and Lane, 2020, p. 368). Culturally relevant materials, content, and assessment are integral for students to be fully engaged in, connected to, and represented in school (Anderson and Lane, 2020; Moore et al., 2016). Both the IKaluk and Putjotik kits draw from local ecosystems, histories, projects, and imagery that is well-known to students in Nunatsiavut. For example, an activity in the Putjotik kit for grade 9 titled “Snow Crab History” is meant specifically for students from Makkovik. In the activity, students can create audio-visual resources that document the snow crab

TABLE 1 The titles and number of learning activities in the Putjotik and IKaluk kits. A detailed description of each activity is available in [Supplementary Appendix 1](#).

Grade level	Titles of learning activities	Activity type*
Primary – Grades K-6 (Putjotik kit)	“Introduction”, “Ocean Zones”, “Snow Crab Lifecycle”, “Getting to know the Ocean”, “Boating in Nunatsiavut”, “Intro to Snow Crab Fishing”, “Navigating to the Beach”, “Beach Day”, “Nunatsiavut’s Fishing History”, “Snow Crab Habitat and Adaptations”, “Economy, Stewardship, and Sustainable Development”, “Exploring the Sea Ice”, “Marine Diversity and Evolution”, “Ghost Gear”, “Marine Monitoring” (15)	Classroom-based: 9 Community-based: 8 Land-based: 3 *Some learning activities contain multiple activity types
Secondary – Grades 7–12 (Putjotik kit)	“Marine Ecosystem Interactions”, “Marine Environmental Action”, Water Systems and Abiotic Factors”, “Ocean Basin Exploration”, “Ocean Currents and Waves”, “Snow Crab History”, “Economies”, “Quality of Life” (8)	Classroom-based: 7 Community-based: 4 Land-based: 3
All Grades - Graduated Curriculum Outcomes (IKaluk kit)	“Smokehouse STEM Challenge”, “Smoked Fish Process”, “Build a Smokehouse”, “Passion Project”, “Issuing Salmon licences”, “Fishing Nets”, “Arctic Char Lifecycle”, “Making Pitsik”, “Connections between Rivers and Fish”, “Kakavik Tool”, “Salmon Life Cycle Wheel”, “Salmon, Char, and Trout Recipes” (12)	Classroom-based: 8 Community-based: 10 Land-based: 4

processing facility. In this way, students can share their knowledge, skills, and experience with the fishery with other students in Nunatsiavut and can meaningfully contribute to the kit through an assessment activity. This learning activity also takes students into their community to interact with the fishing industry, which could inspire action and participation in youth.

A culturally relevant education should be grounded in familiar content. Therefore, learning activities have also been designed to be adaptable to specific spaces. In the IKaluk kit, a suggested activity, “Salmon, Char, and Trout Recipes”, outlines a day where students visit an Elder to make a fish dish. Students are provided with conversational Inuktitut phrases relevant to cooking different types of fish - including char - that they can also practice while completing the activity and interacting with the Elder. Teachers can further facilitate students gathering recipes from home and documenting them as an assignment. Cooking fish is likely a familiar experience for students, and by incorporating Inuktitut, learning about family recipes, and visiting Elders, the tradition and continued importance of fishing for food security, culture, and wellbeing can be illustrated.

In an associated activity, the IKaluk kit also guides students to explore past and present fishing technologies in their communities. Youth can learn to create a kakivak (a traditional Inuit spear used for fishing) with the guidance of teachers or community members in an activity called “Kakivak tool”. Furthermore, students explore their present fishing rights by speaking with their community Conservation Officer and completing harvest forms as a part of a classroom activity titled “Issuing Salmon license tags”. These learning activities provide opportunities for youth to investigate the culture of fishing and see how people have adapted and changed over time by connecting with current fishers, Elders, and rivers. By connecting youth with past and current fishing practices, as well as a Conservation Officer and the licensing program, school activities can become pathways for students to participate in harvesting activities, and by doing so contributing to the protection of Indigenous knowledge systems and harvesting rights.

The Putjotik kit also takes advantage of the rich fishing history in each community by outlining learning activities like one titled

“Nunatsiavut’s Fishing History” that take youth to local museums and connect with their families’ fishing culture. Youth are prompted to visit a community-based museum to locate an ocean-related technology artifact that sparks their interest (ex. a boat/kayak, hook, net, anchor, trap, weir, engine, etc.) and to take photos of it and any information the museum has on it. Alternatively, students can bring an artifact from home. As optional project-based homework, youth can ask their relatives or friends of family about stories they have about any ocean-related fishery (crab, cod, scallop, shrimp, etc.) and how the fishery has changed in their lifetime. Talking with relatives about their fishing experiences can spark interest in youth to continue and improve fishing in the region. These activities can help meet curriculum requirements for multiple social studies and science units from grades 3–6 on the topics of local habitats, community development, peoples impacts on natural resources, and how local environments influence past and present societies.

Community-based learning is an excellent opportunity for youth to interact with multiple different career paths that are directly and indirectly associated with commercial fishing. Students might not be aware of the kinds of careers available in fishing such as deckhands, observers, plant workers, conservation specialists, quality control workers, scientists, managers, and fish harvesters who are multi-dimensional in the sense that they are usually business owners as well. Given the number of guest speakers and community outings in both kits, youth can meet and ask questions about a variety of positions associated with local fisheries. Exposing youth to a wide variety of career paths is beneficial for the local economy, the wellbeing and success of youth, and the continuation of sustainable co-managed fisheries in the region.

4.2 Connecting youth to an environment of fishing

Nunatsiavut-based scholars have identified land-based learning as critical for Inuit education (Moore et al., 2016; Obed, 2017; Snow

and Obed, 2022), as well as an excellent way to engage youth in active, hands-on learning. Renewing a culture of land-based learning in the formal education system is an essential step forward in addressing educational inequities among Inuit youth and building social capacity and sustainable practices (Obed, 2017). Land-based learning immerses youth in the environment. It is a medium that enhances environmental knowledge and skills; knowledge and skills that are also essential for the fishing industry.

Environmental knowledge is necessary for success in marine industries such as fishing. Fishers at all levels are in direct relationship with the marine environment. They are knowledge holders and can act as stewards of local waters. The actions of fishers have direct impacts on local habitats and species and are therefore ideally situated as collaborators for environmental protection and stewardship of marine resources. To connect youth to the fishers, fishing technologies, and stewardship, a learning activity in the Putjotik kit introduces the concept and implications of ghost gear. Students are invited to view local video content on how ghost gear impacts the ocean and may invite a guest speaker from the Secretariat or a fisher who has participated in a local ghost gear retrieval project. Through community-based learning such as this, students can expand their knowledge of the local fishing industry and explore what stewardship looks like at multiple levels.

In the IKaluk kit, land-based activities associated with fisheries are foundational. Activities such as building a smokehouse for fish and learning to make and mend gillnets with an expert net maker in the community are examples of place and land-based activities that connect youth with fisheries. There is also an activity that facilitates students exploring how to make pitsik (a dried fish snack) by connecting with knowledgeable community members. All these activities invite Elders and fishers to pass their environmental knowledge onto the next-generation. Activities such as these can be done at multiple grade levels to satisfy curriculum requirements for learning about the relationships between science, technology, and the environment, as well as problem solving, communicating scientific ideas, and working collaboratively.

These kits can also facilitate land-based practical skill acquisition for marine livelihoods. In the Putjotik kit, an activity for grades 3–6 titled “Exploring the Sea Ice” guides students to observe their local weather patterns in relation to the freeze and thaw cycles of sea ice over multiple weeks. The learning activity also suggests an Elder or knowledgeable resident is invited to share their experience of weather patterns and sea ice conditions with students. The activity opens with a student-centered discussion of youth relationships with the land (in this case specifically the ocean and sea ice). Being able to read the skies for incoming weather is an important skill for all fishers. This skill is one that can be practically and meaningfully acquired through observation of the land, preferably with a knowledge holder (i.e., Elder or fisher) who has experience with and can interpret local weather patterns. This learning activity meets curriculum requirements for learning about local weather required for grade 3 and 5 science. From this example it is clear there is ample opportunity for community- and place-based learning through collaboration with local fishing industries to meet educational outcomes, connect youth with the land and with commercial fishing, and to encourage intergenerational knowledge transfer.

4.3 Connecting youth to Fisher knowledge and livelihoods

Educational resources and learning activities in both the Putjotik and IKaluk kits reflect Inuit, local, and scientific knowledge systems, and position teachers as facilitators of the learning process whereby students gain knowledge directly from the land, Elders, knowledge holders, fishers, and scientists. Throughout the Putjotik and IKaluk kits, students are invited to speak to fisheries managers, scientists and technicians, subsistence harvesters, commercial fishers, and a variety of careers related to the production of different fish products. These industry professionals are primarily locally based, so youth are exposed to a variety of career options that would allow them to gain employment in their region. By creating learning activities and providing resources for students to meet the provincial curriculum requirements that are based in marine environmental stewardship and land-based learning, youth can be exposed to and potentially inspired to take part in the fishing industry. Moreover, in order for the upcoming generation to fully appreciate and be prepared for the challenges associated with changing climates and fisheries, they need to be connected to their communities, the coastal environment, and its users.

In the Putjotik kit, six learning activities from grades K-8 involve bringing Elders or local knowledge holders either into the classroom or out on the land with the class. Another six request a guest speaker from the fishery industry (ex. a fisher, someone involved in scientific monitoring, or someone involved in fisheries governance) to be involved as a key part of the lesson. In this way, local and traditional knowledge about the land, sea, and fishing in Nunatsiavut can be upheld and transmitted through classroom learning, while also meeting curriculum requirements. Furthermore, between grades 3 to 8 there are four learning activities in the kit that involve bringing students out on the land to collect scientific information or test hypotheses using tools provided (ex. viewing buckets, quadrants, water clarity disc, go-pro, etc.). Taken together, these activities provide space for students to cultivate relationships with their local marine environment, to connect with knowledge holders, gather their own information on their local lands and waters, and to participate in integrational knowledge transfer necessary for the continuation of successful fisheries and marine travel.

There is ample opportunity for intergenerational knowledge transfer to transpire through the IKaluk and Putjotik learning activities as youth are connected directly with knowledge holders. Indigenous knowledge is culturally specific, locally embedded, rooted in the worldview of the region, contained within Inuit, and transferred through generations (Bell, 2013). In this case, Inuit knowledge is attached to the geography, ecology, and people of Nunatsiavut. Inuit ways of life, values, and knowledge have been passed through generations of Elders and knowledge keepers through experience and observation on the land and in community, storytelling, and direct teaching (Karetak et al., 2017). Language is also an essential component of how Indigenous knowledge is passed on. Battiste and Henderson (2000) explain how intergenerational knowledge is updated and renegotiated: “in each generation, individuals make observations, compare their experiences by what they have been told by their teachers, conduct experiments to test the reliability of their knowledge, and exchange their findings with others” (p. 45). Knowledge

obtained from longstanding, ongoing relationships with the land has provided Indigenous Peoples with specific knowledge of their territories to allow management and adaptation to change throughout long periods of time (Berkes, 2018; Turner and Berkes, 2006). Consequently, localized, Inuit harvester knowledge can be the basis for excellent monitoring and management of land and sea resources unto itself (Thompson et al., 2019).

In the IKaluk kit, students can explore their local rivers that salmon and char run in through community maps and invite an Elder to the classroom to share their experiences with fish migration in a land-based activity titled “Connections between Rivers and Fish”. This activity can be done at multiple grade levels and allows youth to explore their own lands and waters with a knowledgeable guide who can explain their experience with fish migration over time. The topics that might arise during a river day could be how things have changed or remained the same including fishing technologies and strategies, conservation and stewardship measures, processing fish, the condition and abundance of the population, the river and ecosystem, weather and temperature, and seasonal timing. All this information is integral for the proper stewardship of species at recreational, subsistence, and commercial levels and can be transmitted through generations by enlisting the help of the education system as a facilitator for ecological knowledge transfer between Elders and youth.

Land-based education is also a tool with which to recenter education from an Inuit lens, and a middle ground for knowledge systems to come together (Snow and Obed, 2022; Anderson and Lane, 2020; Moore et al., 2016; Obed, 2017). There have been successes in integrating traditional ecological knowledge and science to better understand wildlife and fisheries (Gagnon and Berteaux, 2009; Fernandez-Gimenez, Huntington and Frost, 2006). The TJFB specifically holds annual meetings between managers, scientists, and fishers to gather feedback and share experiences of the season to develop recommendations informed by both knowledge systems. With this experience, the kits are informed by multiple ways of knowing and led by an organization that has ample experience walking with one foot in each world. For example, in the Putjotik kit, multiple knowledge systems are presented side by side in a powerpoint presentation on the classification of living things (Figure 5) that uses snow crabs as an example of marine evolution. The lesson is titled “Marine Diversity, Classification, and Evolution” and is aimed at curriculum outcomes from grades 3–6 in both science and social studies. The Linnaean and Inuit knowledge systems are presented with class time to discuss the similarities and differences in how people have made sense of the world. As discussed, both kits also provide activities that bring in guest speakers with a diversity of backgrounds and experiences that are built on both local and Inuit knowledge and scientific understandings of the world and often a blending of both at the same time.

4.4 Connecting youth to a future of fishing

The TJFB is committed to renewing a culture of stewardship at all levels, including commercial fisheries. To secure a future of local fisheries that are ecologically, socially, and economically sustainable, youth must be involved early and often. The Putjotik and IKaluk kits

are a part of bridging the gap between generations of knowledge holders, past and future technologies, knowledge systems, and ensuring the culture of sustainable commercial fishing continues and is enhanced.

Beneficiaries in Nunatsiavut have constitutionally protected rights to harvest marine species. Given the continued social, cultural, and economic importance of marine species to the area (Felt et al., 2012), it is integral that residents receive marine stewardship education that is tailored to place. Communities that are connected to and dependent on coastal resources are also more likely to support long-term sustainable practices (Bennett et al., 2018). The formal education system is an ideal place to facilitate marine stewardship education considering attendance policies and the value of providing place- and land-based resources to youth. By facilitating marine stewardship education that fosters a connection to place, it is more likely that sustainable practices will continue and be enhanced in the future.

The processing of snow crabs on Inuit lands, which began in 1997 in the coastal community of Makkovik, has become a significant source of seasonal wages which is crucial for the financial security of the community. To ensure the long-term sustainability of the fishery, it is essential to educate community members and students about the importance of stewardship of the crab species. Learning activities offered in the Putjotik kit provide students with a comprehensive understanding of snow crab processing, its economic significance, and the importance of sustainable practices to preserve this valuable resource for future generations. Furthermore, in the Putjotik kit there are three learning activities (“Navigating to the Beach”, “Snow Crab Habitat”, on in “Marine Environmental Action”) that include imagining different futures in students’ communities whether it be in environmental conditions, infrastructure, projects, or industries. These activities all have the potential to equip students with the curiosity and skills to become involved with local planning and stewardship activities. Providing opportunities for students to reflect on their visions for the future can help promote Inuit-led sustainable development.

Alternatively, Char has been caught on the Labrador coast for many generations. Char is currently fished commercially and processed in a Nain facility. The subsistence and recreational fisheries are also staples in the region and integral to local diets and economies. This means there are multiple levels of stewardship actions necessary, from scientific monitoring of the commercial fishery, to fishing practices that ensure recreational and subsistence fisheries continue sustainably. The IKaluk kit connects youth with Elders, fishers, and local culture, technologies, and ecologies to allow students to explore stewardship over time and what it means to them in the present day.

Western fisheries science conventionally focuses on quantitative statistical models that render fish to commodities and governance schemes that depend on hierarchical, centralized power relations (Jacquet and Pauley, 2022; Silver et al., 2022). However, co-management institutions such as the TJFB disrupt this process, creating space to incorporate fisher voices and support localized decision making. Co-management institutions such as the TJFB are excellent conduits for collaboration across local and scientific knowledge systems in marine spaces (Snook et al., 2018; Thornton and Scheer, 2012). In this case, the Secretariat has collaborated with the public education system to bring multiple

knowledge systems and perspectives into classrooms where the next-generation of marine users and stewards spend their days.

5 Conclusion

This paper highlights the promising future of this work in fostering intergenerational knowledge transfer and encouraging a self-determined approach to ocean and fisheries stewardship in Nunatsiavut. Reflecting on the project's inaugural year, the team notes progress in:

- Inspiring and supporting place-based teaching and stewardship education through an Inuit lens;
- Promoting youth learning about IKaluk and Putjotik and their ocean habitat;
- Bridging the fisheries knowledge between Elders/knowledge holders and youth.

In the Putjotik and IKaluk kits, students explore intricate connections between local ecosystems, cultural heritage, and marine industries. The kits are designed to support teachers in providing culturally relevant, localized education aligned with provincial curriculum that connect youth to place. Through hands-on experiences and interactions with local experts, students can expand their knowledge and develop a profound appreciation for their marine and river habitats and their role in preservation.

The Paigitsiaguk project team acknowledges the preliminary state of project implementation and looks forward to further research in the impact of this work by obtaining ongoing feedback from communities, students, and teachers. Furthermore, the team hopes to develop additional resources and adaptations based on feedback to ensure the kits remain relevant as community needs and knowledge evolve. There are opportunities to investigate the potential for sharing education kits with other Indigenous communities or regions with similar cultural contexts or to bring northern-developed educational resources to southern audiences. Other co-management entities can look to this example to initiate collaborative projects between educators, local experts, and researchers to develop educational resources that bridge diverse knowledge systems and facilitate place-based stewardship activities. These research directions and recommendations aim to build upon the success of the Paigitsiaguk project, ensuring that stewardship education continues to serve the needs of communities.

The Paigitsiaguk project is an investment in interdisciplinary education, skills acquisition, and Inuit stewardship, contributing to self-determination in Nunatsiavut's fisheries and education. The Torngat Joint Fisheries Board's commitment to sustainable fisheries extends to youth programming, ensuring the next-generation is involved in and connected to creating socially and environmentally just and sustainable fisheries.

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Data availability statement

The original contributions presented in the study are included in the article/[supplementary material](#), further inquiries can be directed to the corresponding author.

Author contributions

QL: Visualization, Writing–original draft, Writing–review and editing. OA: Conceptualization, Methodology, Visualization, Writing–original draft, Writing–review and editing. SM: Conceptualization, Supervision, Writing–original draft, Writing–review and editing. CP: Conceptualization, Supervision, Writing–review and editing. JS: Conceptualization, Funding acquisition, Methodology, Supervision, Writing–original draft, Writing–review and editing, Project administration.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary Material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenvs.2024.1409358/full#supplementary-material>

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