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Galappaththi, EK, Ford, JD orcid.org/0000-0002-2066-3456, Bennett, EM et al. (1 more author) (2019) Climate change and community fisheries in the arctic: A case study from Pangnirtung, Canada. Journal of Environmental Management, 250. 109534. p. 109534. ISSN 0301-4797

https://doi.org/10.1016/j.jenvman.2019.109534

Appendix A. Supplementary material

Box S1: Caribou out-migration.

"…caribou hunting is no longer a major thing…that kind of really has an impact, because now we are more dependent on the food from the ocean. That has to do with the fact that we have very few caribou in this region, it *apparently has to do to some extent with climate change, …one winter, I think it was in the early 2000s, that was* really milled, and we had lot *of rain, and so the land was covered with several inches of ice. The caribou couldn't* eat, get to that food [for so long that] caribou starved during that time. Then apparently the herds also migrated to other places. But this *community was known for the name of it is 'Pangniqtuuq' which is the name for bull* caribou, it was known to have plenty of caribou*…"* –Elder/hunter/fisher (KII)

Note: Government of Canada weather data confirmed an unusual amount of rain and high monthly mean temperatures during the months of November and December in the early 2000s.

Box S2: Limitation of knowledge co-production process.

Indicators: Pangnirtung Inuit were not directly involved in the development of the Table 1 indicators. The indicators were initially developed based on an extensive review of SES resilience, development, and Indigenous literature. However, we received Inuit consent to use these indicators for the study through several key local informants and local research assistants. Interestingly, we did not observe specific activities, interests, or concerns with respect to the use of these indicators. Further, we should note that Inuit participants were well-aware of the ultimate goal of the indicators, which is to compare climate responses of Sri Lankan Coastal-Vedda and Arctic Inuit. In this paper, we present only the Arctic case study.

Translations: We had to use translators (Inuktitut-English) to talk to certain community respondents and groups. We acknowledge that certain relevant information might have been lost/obscured in translation. Many words in the Inuktitut language do not have parallel words in the English language. Therefore, the translations are often circumscribed, rather than translated. We were unable to track such missing information. Rather, we minimised the impacts to the study by using multiple translators and other methods, including participant observations.

Box S3: Glossary and acronyms.

PO (Participant observation): The goal is to advance one's understanding of a natural setting (i.e., the people, environment, and interactions within and among the system) by becoming a part of everyday interactions—observer gains firsthand knowledge by being in or around the social setting being investigated.

SSI (Semi-structured interviews): The aim is to compare participants' in-depth responses with individual diversity and flexibility. Interviews are more than 'a chat'; they are a verbal exchange of information in which one person (the interviewer) asks questions of another person (the interviewee), with the interviewee answering the questions.

FGD (Focus group discussions): The aim is to gain knowledge about a specific topic or need by interviewing a group of individuals directly affected by the particular issue or area of interest—a small group of people discussing a topic or issue defined by a researcher.

KII (Key informant interviews): Key informants are the individuals, or a group of people, who possess specific skills, knowledge, experience, and/or specialized background on the research project or project participants. They can also be someone who can effectively represent the target research sample (participants) and their activities to the researcher. KII help to get specific information related to research that difficult to access through other methods such as PO, SSI, and FGD.

DFO (Department of Fisheries and Oceans): Canadian federal government department responsible for developing and implementing fisheries policies across the country. DFO is one of the key co-management partners for the Pangnirtung Arctic char and turbot fisheries.

HTA (Hunters and Trappers Association): Community organization responsible for managing hunting, fishing, and trapping activities to ensure that the community has a good country food supply. This organization is owned and managed by Inuit of Pangnirtung. HTA is the key co-management partner from the community for the Pangnirtung Arctic char and turbot fisheries.

RWO (Regional Wildlife Organization): RWO represents multiple HTAs at the regional level. It oversees local harvesting practices and the regional management of Inuit country food.

NWMB (Nunavut Wildlife Management Board): NWMB is a territorial government institution responsible for wildlife management activities in the Nunavut settlement area. It is one of the key co-management partners for the Pangnirtung Arctic char and turbot fisheries.
GN (Government of Nunavut): This is the Government of Nunavut local office located in Pangnirtung. It focuses on economic development and the funding aspects of the fishers and community fisheries. For example, GN sponsors programs that support fishers by providing loans for upgrading their fishing gear and snowmobiles.
NTI (Nunavut Tunngavik Incorporated): This regional organization oversees negotiations for Inuit rights aimed at treaties and land claims. NTI negotiates for Inuit rights in the context of fisheries co-management.
Manifest content analysis: This is aimed at the objective, surface, or concrete content. For example, assume that the phrase 'climate change' appears many times in a text.
Latent content analysis: This is aimed at the underlining or implicit meanings, e.g., whether 'climate change' is mentioned in the text in an approving or disapproving manner.

Box S4: Inuit understanding of the definitions of characteristics of the resilience-based framework.

ᓇᐋᑦ: ᐃᓄᓐᓄᑦ ᐃᓂᒋᔭᖅ ᖃᐅᔨᓪᓚᕆᐅᓂᖏᓐᓄᑦ ᐊᑦᑐᐊᓂᖃᖅᓴᓂᓗᓪᓕᓴ. ᓇᐋᑦᑎᓄᑦ ᐊᑦᑐᐊᓂᖃᖅᖅᓴᖅ ᑐᑭᓯᔨᐅᓯᒪᓂᖏᓐᓄᑦ ᐃᓄᐃᑦ ᐊᐸᑎᓗ ᓇᐋᖅᑕᖏᓐ ᖃᐅᑕᒧᑦ (ᐃᓄᓯᕐᒥᑎᒍᑦ, ᐃᓕᖅᑯᓯᒥᑎᒍᑦ, ᖃᓄᐅᖅᓯᒥᑎᐊᖅᓂᖏᓐᓄᓐᓄᓗᓪᓕᓴ).
Place: Social and physical space that has attachment to Inuit. Attachment to place is understood as the bonding that occurs between people and their meaningful environments (livelihoods, culture, and wellbeing).

ᐃᓄᓂᖅᑎᓄᑦ: ᐃᓄᐃᑦ (ᐃᓚᒥᓄᑦ ᑲᑕᐅᖃᑎᒌᖅᓯᑦᑕᔪᓐᓇᕐᓂᑦ) ᓇᓚᒥᓂᖅ ᐃᓕᓚᓕᐅᑭᓇᖅᑐᖅ ᑕᐃᒪᓐᓇ ᐊᑐᖅᑕᐅᖅᓯᓐᓇᕐᒥ ᐃᓄᓐᓄᑦ.
Human agency: Inuit (individual or collective) capacity to act independently in making their own decisions as part of the process of the Inuit way of life.

ᑲᑐᔨᖃᑎᒌᓐᓂᖅᓄᑦ : ᑲᑐᔨᖃᑎᒌᓐᓂᖅᓄᑦ ᐊᐅᓪᓚᕆᐊᑭᑎᕐᓂᑦ (ᑲᑐᔨᖃᑎᒌᓐᓂᖅᓄᔪᓪᓕᓴᓂᑦ) ᒪᕐᕉᕐᐸᑎᑦ ᐊᒥᓕᐸᐸᑕᔪᓪᓕᓴᓂᑦ ᐱᓇᓕᐊᓚᐅᕆᔭᒧᑦ ᑎᑭᐅᑎᓇᓕᖅᑲᒥᑦ.
Collective action: Action taken together (or shared) by a group of two or more people to meet a common desired objective.

ᓕᐃᐅᕆᑦᐱᐱᓕᓇᐃᐅᕆᑦ: ᑲᑐᔨᖃᑎᒌᓐᓂᖅᓄᑦ ᐱᔨᕆᔨᓇᓕᓕᐊᖅᐸᑦᑐᑦ ᐊᖏᖃᑎᒌᓐᓂᖅᓄᑦ ᓄᓇᓕᓐᓄᑦ ᐱᓇᓕᓕᐊᖅᑕᐅᕆᒥᑦ (ᐅᑦᑐᑎᑎᓪᓗᒍ, ᐊᐅᓪᓚᕆᐊᑎᒍᑦ ᓕᓕᓐᓂᔪᓐᓇᖅᑐᑎᒍᑦ).
Institutions: Local organizations that facilitate collective action that meets local goals (for example, co-managed institutions).

ᖃᐅᔨᓴᓪᑕᐅᕆᑦ: ᖃᐅᔨᓴᖃᑎᒌᓐᓂᖅᓄᑦ ᑲᕆᓱᓇᖅᑐᑐᖅ (ᖃᐅᒥᑦᑭᔪᐅᓕᓴᕆᑦ, ᐊᑐᑦᓕᓴᓂᖅᑎᒍᑦ, ᐃᓕᓐᓂᐊᕐᑎᑎᒍᑦ ᐊᐅᓪᓚᕆᐊᑎᒍᑦ) ᑕᒪᐃᓐᓇᓐᓄᑦ ᐃᓄᐃᑦ ᐃᖃᓄᐃᓕᐊᖅᑐᓂᖅ (ᓇᐋᖅᑕᐅᓱᓪᓗᓂᓪᓕᓴᓂᑦ) ᑭᖑᓪᓕᓇᓂᖅ ᑐᓂᔭᐅᓯᓕᕆᔨᒥᑦ ᐃᓕᓐᓄᖅᑕᐅᔪᓐᓇᖅᑐᑎᒍᑦ; ᑕᑯᓴᐅᐊᖅ ᐃᓄᐃᑦ ᐃᓕᓐᓄᖅᑕᐅᔪᓐᓇᖅᑐᑎᒍᑦ ᑭᓇᐅᔨᓪᓚᕐᑎᒍᑦ.
Knowledge systems: Co-evolving cumulative body of knowledge and practice (observations, experience, lessons, skills) related to Inuit fisheries systems (or a place) and handed down through generations by cultural transmission; reflects the Inuit cultural identity.

ᐃᓕᓴᓂᖅ: ᐃᓅᖅᑎᑎᒍᑦ ᐃᓕᓴᐸᓕᐊᓂᖅ, ᐊᖏᖃᑎᒌᓐᓂᖅᓄᑦ ᑲᔪᓯᓴᓕᓂᖅ ᖃᐅᒥᑦᑭᓂᖅᓄᔪᓪᓕᓴ ᐃᓄᓐᓄᑦ ᐊᑐᖅᑕᐅᔪᓂᖅ ᐱᓇᓱᓕᓕᐊᖅᑎᓕᓐᓂᑎᒍᑦ ᐊᐅᓪᓚᕆᐊᑎᒍᑦ ᐊᐅᓪᓚᕆᐅᓱᖅᑐᑦ ᐊᖑᑎᒥᑦ.
Learning: Social learning, which itself refers to collective action and reflection that occurs among Inuit as they work to improve the management of human-environment interactions.

Co-management structure for Pangnirtung Arctic char and turbot fisheries

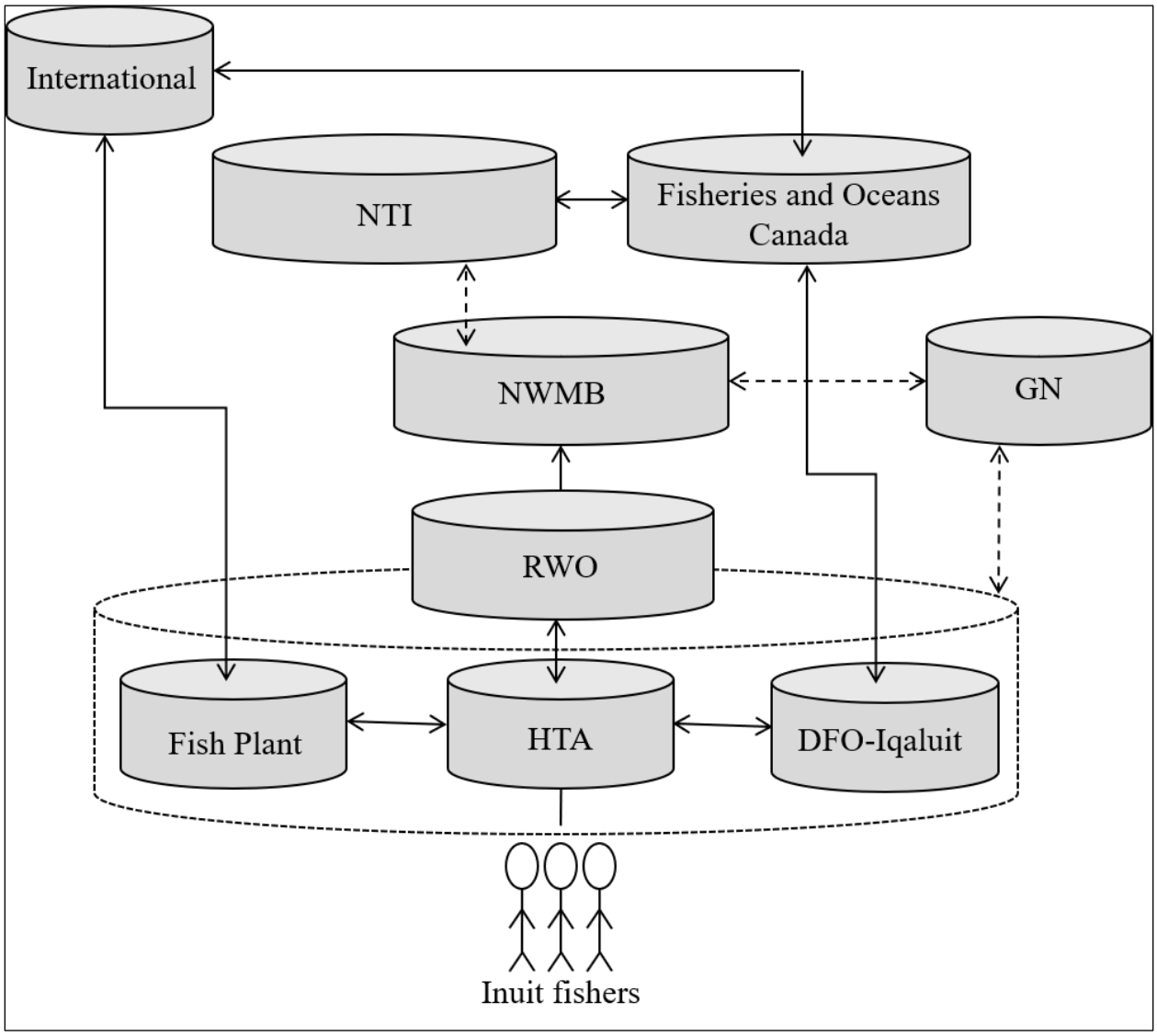

Figure S1: Co-management structure for Pangnirtung Arctic char and turbot fisheries.
Quotas are based on the fiscal year and the HTA decides when the water bodies are fished (summer versus winter). The Pangnirtung HTA has been the license holder for the exploratory char fisheries and designates a quota for its membership. Also, the Pangnirtung HTA has been the license holder for the Cumberland Sound Turbot fishery and advises the DFO on which members shall be added to the license. The HTA should advise Fish Plant and DFO about the fishers who will be fishing under issued license. As part of the fisheries co-management process, feedback about fisheries activities is transmitted to such stakeholders as the DFO, HTA and NWMB. For instance, a fisheries extension officer from the DFO visited the turbot fishing field during the season to ensure the fishery was running according to federal government quotas and other DFO regulations. Also, a local wildlife management officer from the NWMB pays regular visits to Arctic char fishing lakes to monitor and record activities. The fish plant is the community's most influential employer in terms of fishery activities. The fish plant is the main reason for the co-existence of Arctic char and turbot commercial fisheries, and purchases fish from Inuit fishers, then processes and ships the fish to local and international markets.

Table S1: Key themes of the interview guide.

Key themes	Examples of types of questions asked
Change	What kinds of changes have you experienced over the last 30 years? Have such changes affected your life? How? What are the implications of such changes? How do you respond to such changes?
Place	How long have you been living here in Pang? Do you like living here? Are you considering moving to another community or city if possible? Why you like it here (Pang)?
Human agency	How many people have jobs in your home? What are the fishing activities you do? Char or turbot or both? Why do you do both? What kind of fishing gear and tools do you use? How do you face difficult times when you don't have food or money? How did you spend last year's turbot fishing money?
Collective action/collaboration	What is your family members' involvement in fishing? Do you share country food with others? How do you do that? What kind of help do you get from other people for anything including fishing and hunting? Are you willing to share your fishing tools/gear with others?
Institutions	What is the fish plant's role in community fisheries? Who issues licences for char and turbot? How do they do that and what is the process? Who else is involved in the co-management of char and turbot fisheries? Are there any other partners? How are fishing quotas and fishing periods decided? How flexible is this process? What is your contribution to this co-management process?
Knowledge system	How did you learn your fishing and survival skills on sea-ice? From whom? How does warming affect char migration and fisheries? What are the good fishing spots and how do you track such locations? How did you learn on-ice turbot processing techniques?
Learning	How did you learn such knowledge or skills? What kinds of avenues do you have to learn about the fishing way of life? How did school education help? Why did you quit/stop school? Do you use the internet? For what purposes?
Other	Are you comfortable with discussing the above topics? Can you think of any topics that we have not included in the research but that you think would be important? After hearing about the project, would you be interested in participating in it?

Table S2: Sample profiles of SSI respondents (n=62).

Variable		Number of respondents (%)
Gender		
	Female	18 (29)
	Male	44 (71)
Age*		
	<20	1 (2)
	20-39	24 (39)
	40-59	22 (35)
	60-79	14 (23)
	80-99	1 (2)
Occupation		
	Fishing	62 (100)
	Hunting/trapping	36 (58)
	Art-related work (for example, carving, painting, crafts)	27 (44)
	Tourism-related work (for example, translating, outfitting servicers)	7 (11)

	Income support (government income assistance program)	18 (29)
	Work for other entities (for example, construction, fish plant, northern store, daycare, hamlet office)	13 (21)

*Regardless of age, Inuit possess a cumulative body of Indigenous and local knowledge, practice, and belief, evolving through the adaptive process and handed down through generations by cultural transmission.

Table S3: Framework indicators and Inuit adaptive responses.

Characteristics	Indicators/areas of adaptive responses	Responses to systems change
Place	Fishery	Two co-existing (wild capture fisheries)
	Types of fisheries	Subsistence and commercial
	No. of fish species	Two
	Food diversity (protein supply—access to edible animals throughout the year)	n=20 (high)
Human agency	Use of advanced technology	GPS, VHF radios, advanced rifles (84%)
	Livelihood diversity (# of livelihood activities involved—occupational multiplicity)	n= 6 (low)
	Access to # of assets needed for fishing activities	x= 3.8, s=1.1 (high)
	Fishing gear diversity (access to # of different fishing gear)	x= 4.0, s=0.9 (high)
	Access to loans	Via Fish Plant and Nunavut government
Collective action and collaboration	Sharing fish	Observed in subsistence fishery
	Sharing fishing gear	Observed
	Sharing of weather information	Through internet and social media
	Sharing of information related to fishing operations	Observed in commercial fishery
	Social networks	Through internet-based social media and community radio
	Level of use of collective action for problem-solving	Observed
Institutions	Fishery management approach	Adaptive co-management
	Key local institution	HTA
	Structure	Multi-level
	Way of functioning	Mostly top-down
	Adaptive nature in functionality	Flexibility observed
ILK systems	Identified knowledge areas	Arctic char, turbot, fishing techniques, fish processing, local environment knowledge
	Level of application of ILK	Some aspects of ILK identified are not used anymore
	Weakening of knowledge systems	Observed
	What bridges the weakening knowledge gap	Advanced technology
Learning	Level of diversity of learning opportunities	Relatively less diverse opportunities
	Key ways of learning (top three)	From elders/parents/extended family members (84%), learning-by-doing (13%), via internet, via school education

Table S4: Ways in which Inuit fishers respond to change.

Characteristics	Quotes from fishers

Place	*"Springtime is warmer now. We used to keep long lines, usually more than twelve hours [but] now I keep about five hours, but less turbot for me. I am ok with what we have now…" "Kids… we think children [are] owned by everyone in* the community. We raise any kid to *give them a better life" "…this [*Pangnirtung*] is where I born … I belong here [*Pangnirtung*]…"*
Human agency	*"Our elders told [us] not to go when it rainy or foggy, but we go out now whenever with GPS."*
Collective action and collaboration	*"Fish plant giving me weather information and I inform them [fishers] through* radio. If you [fishers] caught more fish, you go to radio *and ask people to pick up or give it to elders." "…of course we help each* other, like I have a broken part here, or my winch broke, they *said instead of ok … use mine."*
Institutions	*"Pang fisheries give long lines, ropes, and hooks and you can pay back later as money or fish…" "…they [hamlet and HTA] were not used to helping old days and now they do … HTA used to help with gas … but not anymore."*
ILK systems	*"We use caribou skin as* a bait *or to trick fish … learned that from elders…" "Now I leap my shack on land close to* shore, because ice can break any time unexpectedly. *I do fishing around that [pointing to a fishing spot] area."*
Learning	*"...my father was teaching about the weather. How weather is going to be bad, what are the* signs, before it gets hot or colder. Younger gen*erations, they go hunting. But they don't look* at the clouds. I want them to look at the signs.

Table S5: Key characteristics of (adaptive) co-management and methods of advancing adaptation.

Characteristics of adaptive co-management	Description	Methods of advancing adaptation
Partnerships between government and local people (or groups)	DFO, HTA, and NWMB directly co-manage Arctic char and turbot fisheries, while NTI, GN, and RWO are also partners in the decision-making process. An Inuit-owned private-entity fish plant informally has a large influence on the operation of the overall co-management process.	-Increase the range/richness of information available for effective decision-making. -Diverse stakeholder interests will improve the flexibility of the fisheries management process, to adjust to changing conditions.
Vertical and horizontal linkages for resource governance	Federal government (DFO) and provincial government (GN/NWMB) entities are connected to the community organisations (HTA) with the support of private sector industry organisations such as the fish plant.	-Improve the feedback spreading process that improves the productivity of the fisheries management system (for example, lessons from the previous fishing seasons, weather, and fish population updates).
Sharing of responsibility, authority, and power	The community organization HTA is the co-management licence holder for Arctic char and turbot fishing. For example, the HTA uses a lottery system to make decisions about issuing licences for commercial char fishing.	-Improve the sense of belongingness (or place attachments) within the fisheries management process (for example, HTA). -Actively include Inuit (as ILK holders) to improve the effectiveness of decision-making to cope with community-level changes.
Learning-by-doing	Considering the size of fish populations and migratory patterns, the fish quota will be reviewed annually based on the best available science and traditional knowledge. Community	-Allow for learning-by-doing, reassess present knowledge, and constantly co-produce new

	fishers are part of the fish population monitoring program.	knowledge for use in coping with new conditions. -Co-produce knowledge through a learning-by-doing process to increase adaptive capacity.
Adaptive management	Fisher will select commercial fishing areas (from eligible areas as licences permit) for turbot (Cumberland Sound) and Arctic char (lakes) based on the prevailing/changing weather and sea ice conditions. Inuit have certain flexibility in terms of reaching the fish quotas; for instance, turbot quotas have not been reachable in the past couple of years (except for 2018) due to weather and sea ice conditions. Flexibility is part of the co-management process.	-Maintain flexibility in the co-management process (for example, decision-making, enforcement) to allow for continuous adjustment to new conditions.

Table S6: Four place-specific attributes that shape community adaptations.

Attributes	Description
Inuit worldviews	Change has become a way of life for the Pangnirtung Inuit. Inuit accept change and try to live with it. From outpost camps to present-day life in Pangnirtung, Inuit have experienced a diverse array of shocks and stressors, but have survived. Place attachment and cultural identity are supportive aspects that allow Inuit to stay together as a community despite change. This Inuit way of thinking (worldview) supports community resilience and adaptation to change, including climate change.
Inuit-owned institutions	Inuit-owned institutions such as fish plant will redistribute fishery resources back to the community, as wages (fish processing labour), employment insurance for turbot fishers, community charity work (via a soup kitchen—community foodbank) and profits for the local Inuit board of directors. The HTA is directly involved in co-managing char and turbot commercial fisheries to support Inuit livelihoods. These institutions support adaptive strategies such as diversification and the co-management of co-existing fisheries.
Sharing and collaboration culture	Organised food sharing (the HTA has some government subsidies; when people bring seal and char, they purchase it from hunters and then the HTA makes it available to the community). Also, unorganised food sharing (going on the radio and saying, "Look, I got a seal; come on over and help yourself") minimises the uneven distribution of food (including fish) among the community. Such food sharing minimises the vulnerabilities related to food insecurity and improves social cohesion.
ILK systems	For some Inuit, the most effective way of learning is learning-by-doing and practicing with elders. Thus, apart from school education, ILK influences Inuit fishers' way of life. Inuit have access to traditional knowledge (via elders), local knowledge (via elders/locals), scientific knowledge (via the internet and government programs) and co-produced knowledge, which increases the range of data available for decision-making.