



Yukon North Slope
Wildlife Conservation and Management
Plan
2021

Companion Report 9:
Dolly Varden / Iqaluqqig



Publication Information

- Cover photo: Dolly Varden at Tapqaaq, Yukon North Slope. © Michelle Gruben, 2016.
- Copyright: 2021 Wildlife Management Advisory Council (North Slope)
- Citation: Wildlife Management Advisory Council (North Slope). (2021). *Yukon North Slope Wildlife Conservation and Management Plan – Companion Report*. Whitehorse, Yukon: Wildlife Management Advisory Council (North Slope).
- Available from: Wildlife Management Advisory Council (North Slope)
P.O. Box 31539
Whitehorse, Yukon,
Y1A 6K8, Canada
- Download link: <https://wmacns.ca/what-we-do/conservation-plan/companion>

Acknowledgements

Many individuals and organizations have contributed to the preparation of the *Yukon North Slope Wildlife Conservation and Management Plan – Companion Report*. Much of the western science and traditional knowledge research that is the evidentiary basis for this plan reaches back several decades.

Critical reviews by Environment Yukon, Parks Canada, the Canadian Wildlife Service, Fisheries and Oceans Canada have been helpful in addressing a wide-range of terrestrial, aquatic and marine conditions that inform the conservation requirements of the Yukon North Slope.

The principal writers of the Companion Report are Kim Heinemeyer and Joan Eamer. Kim is a conservation biologist with Round River Conservation Studies. She was ably supported by Julia O’Keefe, Maggie Triska, and Will Tyson. Joan is a former Council member, science writer, and environmental consultant. They were assisted with strong support from Mike Sutor – Environment Yukon biologist, Dave Tavares – Parks Canada science advisor, Craig Machtans – Environment and Climate Change Canada manager, and Tyler Kuhn – Environment Yukon biologist. Allison Thompson and Kaitlin Wilson – Council biologists, and Lindsay Staples – past chair – participated in all stages of report design, drafting and editing. Kirsten Madsen provided invaluable editing support.

The Aklavik Hunters and Trappers Committee assisted with and contributed to a substantial body of traditional knowledge of the wildlife and habitat, and traditional use mapping, of the Yukon North Slope that informs the report.

Jennifer Smith, Council chair, Council members and alternates, Tyler Kuhn, Matt Clarke, Craig Machtans, Billy Storr, Evelyn Storr, Colleen Arnison, and Michelle Gruben, and Council staff Allison Thompson and Kaitlin Wilson reviewed the final draft of the report.

Companion Report to the Yukon North Slope Wildlife Conservation and Management Plan Number 9: Dolly Varden/ Iqaluqqig

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About the Companion Report

This report is a companion document to the *Yukon North Slope Wildlife Conservation and Management Plan* (WMAAC (NS), 2022). The *Yukon North Slope Wildlife Conservation and Management Plan* (the Plan) is grounded in traditional knowledge and Western science. It addresses traditional use and wildlife conservation and management issues affecting the Yukon North Slope. Strategies in the Plan align with actions underway or planned by a range of agencies and organizations with jurisdiction on the Yukon North Slope.

This companion report summarizes the information that was used to support the objectives and strategies in the Plan, and provides references for the studies used in its development. The companion report draws from authoritative works, reports that synthesize knowledge and issues, and presentations of recent research findings. Sources include traditional knowledge and traditional use, scientific reports and journal articles, and management and conservation reports.

Companion Report Table of Contents

Selected Topics

1. Traditional Use
2. Climate Change Effects
3. Contaminants
4. Aullaviat/Aunguniarvik

Featured Species and Species Groups

- | | |
|-----------------|---------------------|
| 5. Caribou | 10. Broad Whitefish |
| 6. Moose | 11. Geese |
| 7. Grizzly Bear | 12. Furbearers |
| 8. Polar Bear | 13. Dall's Sheep |
| 9. Dolly Varden | 14. Muskox |

Each chapter is available for download at <https://wmacns.ca/what-we-do/conservation-plan/companion>.

There are fourteen companion reports, addressing four selected topics of key interest as well as ten wildlife species featured in the Plan. The featured species were selected by participants at a workshop held in Aklavik. The wildlife species in the companion reports:

- Have high cultural or economic value or are important as food for Inuvialuit;
- Have similar habitat needs to other wildlife species, so that conserving their habitat is key to conserving habitat for other species; and/or
- Are important for healthy ecosystems, including species that are main food items for top predators.

The Plan identifies key conservation requirements on the Yukon North Slope for each featured wildlife species. The Plan's objectives and strategies are designed to meet these conservation requirements. This companion report summarizes the information that guides the objectives, strategies and conservation requirements in the *Yukon North Slope Wildlife Conservation and Management Plan*.

Companion Report: Dolly Varden / Iqaluqpig

This companion report provides information on the conservation requirements for Dolly Varden (which are locally known as 'Char') as identified in the *Yukon North Slope Wildlife Conservation and Management Plan*. It summarizes the information that guides the objectives, strategies and conservation requirements in the Plan. It includes information on traditional use, population status and trends, important habitat types and locations, threats to Dolly Varden, programs and measures for conservation and management, and selected studies and research relevant to the Yukon North Slope.

Conservation requirements for Dolly Varden on the Yukon North Slope

1. Minimize disturbance to spring-fed spawning and overwintering sites and ensure access to these spots by Dolly Varden is not impaired by human activity.
2. Conservation of productive summer feeding conditions along the coast.
3. Track hydrological and fish passage changes to key spawning and overwintering rivers associated with new or increased beaver infrastructure. Rivers on the Yukon North Slope are likely to become more favourable for beaver habitat over time, with increased shrubification.

From the *Yukon North Slope Wildlife Conservation and Management Plan* (WMA (NS), 2022)

The *Integrated Fisheries Management Plan (IFMP) for Dolly Varden* (DFO et al., 2019) informs the conservation requirements above, and is referenced throughout this report. The IFMP's development and implementation is an adaptive co-management process between the Government of Canada, Inuvialuit, and Gwich'in organizations and groups. It identifies objectives, strategies and measures for managing the fisheries and fish habitats, and for sustaining and rebuilding Dolly Varden populations.

IFMP conservation measures of particular relevance to the *Yukon North Slope Wildlife Conservation and Management Plan* are listed in Table 9- 1.

Table 9- 1. Selected conservation measures from the Integrated Fisheries Management Plan for Dolly Varden, 2019 update

Conservation measure	Priority
Apply the precautionary and ecosystem-based approaches	High
Develop management regimes for the Firth and Babbage rivers	Medium
Manage Coastal Fisheries to ensure no stock is over- harvested	High
Protect habitats	High
Monitor harvests	High
Research and monitoring measures: monitor harvests; conduct periodic stock assessments; collect coastal and Mackenzie Delta (mixed-stock fisheries) samples for genetic analyses; undertake life-cycle studies; Identify, assess, and monitor critical, sensitive, and limiting habitats; gain better understanding of Dolly Varden ecosystem interactions; and gather local observations on environmental conditions and climate change.	High

(DFO et al., 2019, Table 4)

Dolly Varden on the Yukon North Slope

(General references for this section: Brewster, Neumann, Ostertag, & Loseto, 2016; COSEWIC, 2010; DFO, FJMC, GRRB, & Parks Canada, 2019)

The Inuvialuktun name *Iqaluqpig* can also refer to Arctic char (*Salvelinus alpinus*). Dolly Varden on the Yukon North Slope are also commonly called “Dolly Varden”, “Arctic char”, or “char”. In this report, “Dolly Varden” or “char” refers to the northern form of Dolly Varden (*Salvelinus malma malma*), known in Canada as Western Arctic Dolly Varden.

Dolly Varden (*Iqaluqpig*) are related to Arctic char, trout, and salmon. After rearing in freshwater, most Dolly Varden 3 to 5 years of age begin to migrate between feeding habitats in the sea in summer and spawning and overwintering areas in the upper reaches of river systems. These are known as searun, or anadromous, Dolly Varden. Young Dolly Varden remain in small mountain streams in the summer, feeding on insects, shellfish, and fish eggs. Searun Dolly Varden eat other fish and eat invertebrates when feeding in the ocean (McCart, 1980).

Two types of Dolly Varden stay in rivers and streams all their lives:

- 1) Stream-resident – mainly male fish that live alongside searun fish in headwater streams but do not migrate to the sea;
- 2) Isolated Dolly Varden that live their entire lives upstream of impassable waterfalls on the Babbage and Big Fish rivers.

Freshwater winter habitat is crucial to all Dolly Varden as they are not able to overwinter in the sea. Dolly Varden spend the winter in headwater areas of watersheds, in reaches of rivers and streams under the aufeis. They usually also spawn in these spring-fed areas, or fish holes. In winter, groundwater from the springs can freeze into thick sheets of ice (aufeis) below the fish

holes. The aufeis melts slowly over the summer, helping to maintain good water conditions for the fish.

Dolly Varden are important as a food source for Aklavik Inuvialuit (Aklavik HTC, Aklavik Community Corporation, WMAC (NWT), FJMC, & Joint Secretariat, 2016). Harvest locations are in rivers, most commonly the Big Fish River (fish hole and river mouth), the Mackenzie Delta around Aklavik, and in coastal areas of the Beaufort Sea (Lea, Gruben, Gallagher & Costa, 2020).

Dolly Varden are also an important component of Yukon North Slope marine food chains. They eat bottom-dwelling marine invertebrates and Arctic cisco (locally known as herring). Dolly Varden, in turn, are eaten by beluga whales, seals, larger fish, and birds.

Traditional Use

Dolly Varden are fished for by the Inuvialuit and Gwich'in peoples of Aklavik and the Fort McPherson Gwich'in (DFO (Department of Fisheries and Oceans Canada) et al., 2019). The major fisheries are on the Mackenzie Delta, and the Rat and Big Fish rivers, which are close to the two towns, and along the Yukon coast. Big Fish River and Rat River fisheries have declined since the 1970s due to fish stock reductions, but harvest has resumed at levels considered sustainable (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

An historical perspective on fishing for Dolly Varden

Before 1930 there were many traditional fishing locations (Byers et al., 2019; Papik et al., 2003). Inuvialuit fishing was concentrated along the western Beaufort Sea coast between the Alaska border and the Mackenzie Delta, and at the Big Fish River overwintering area (the fish holes). Inuvialuit began fishing the lower reaches of the Big Fish River in the 1960s. Gwich'in fished primarily in the Mackenzie Delta and Peel River drainage, and Vuntut Gwich'in from the Yukon fished Yukon North Slope rivers, especially the Firth and Babbage. The direct and indirect effects of socioeconomic change over the last century have resulted in a shift in Inuvialuit fisheries, with more remote locations being fished less frequently.

Traditional fishing methods included baleen, sinew and willow gill and sweep nets used in deeper waters, and rock, driftwood and willow traps and spears used in shallow streams and river beds. Now, more efficient cotton and nylon gill nets are used, and the mesh size has changed from 76-127 mm (3.0-5.5 inches) to 102-114 mm (4.0-4.5 inches), and to 89 mm (3.5 inch) at Shingle Point. An 89 mm (3.5 inch) mesh had been popular as it caught smaller, tastier fish. Voluntary gear restrictions and

The Dolly Varden harvest is identified in traditional use studies (Brewster, Neumann, et al., 2016; Papik, Marschke, & Ayles, 2003; WMAC (NS) & Aklavik HTC, 2018b) and in the Aklavik Inuvialuit Community Conservation Plan (Aklavik HTC et al., 2016) as an important component of the traditional Inuvialuit way of life. A 1991 dietary survey demonstrated the importance of these fish in the diet of Aklavik Inuvialuit (Wein & Freeman, 1992). On average, Dolly Varden (locally

known as char) had been served 31 times over the previous year in the 36 households surveyed, and char and dry fish were among the top ten preferred foods.

Inuvialuit and Gwich'in Dolly Varden harvest levels declined in the 1980s and have not returned to previous levels, although there is a lot of year-to-year variation. The decline may be a result of fewer fish, combined with other factors, such as higher gas prices (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

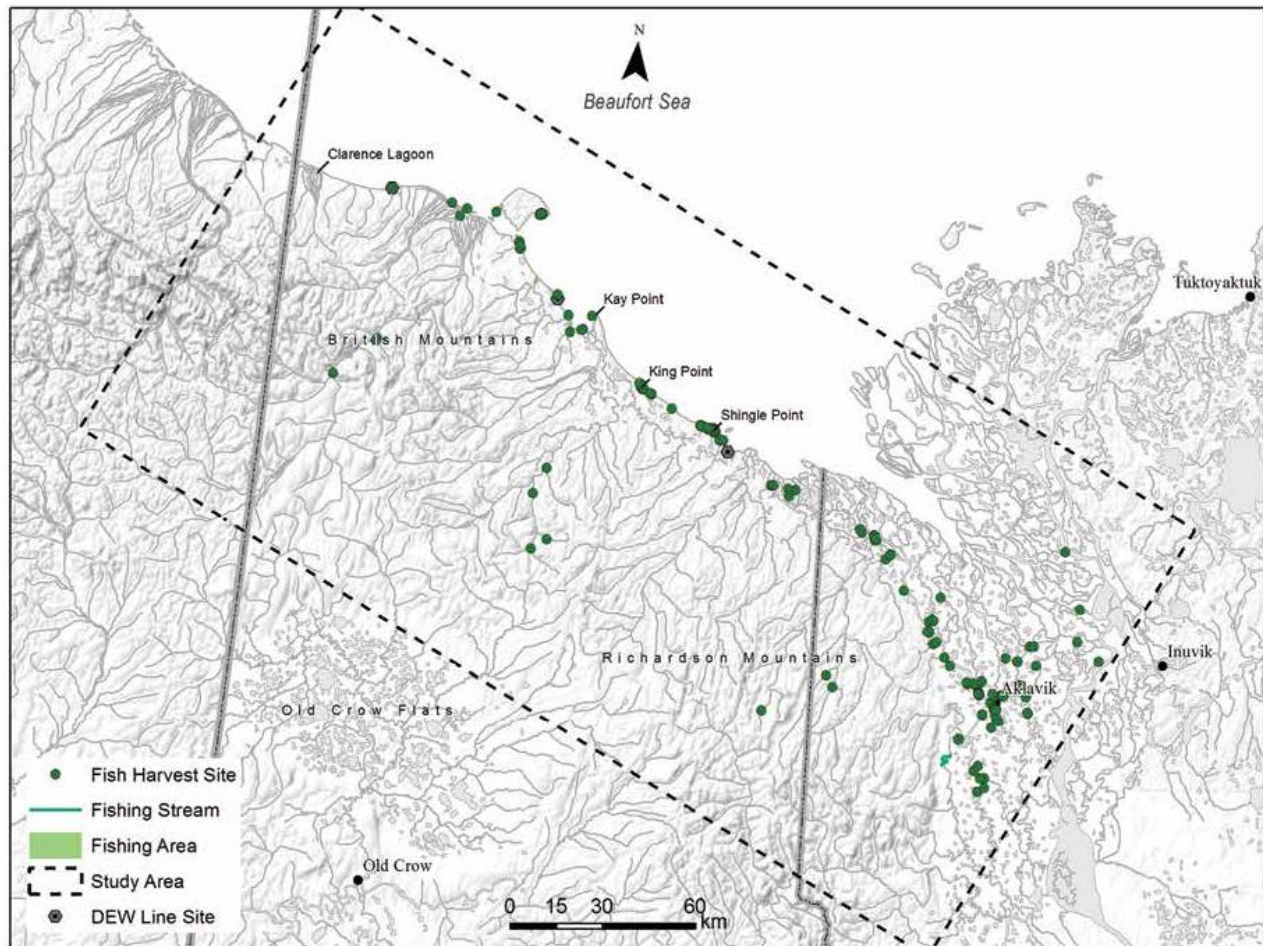
Annual harvests of Dolly Varden by Aklavik Inuvialuit vary according to coastal fishing conditions and Big Fish River closures and catch guidelines. When the Big Fish River was closed to fishing, Aklavik Inuvialuit were able to catch Dolly Varden in Aklavik, south of Aklavik, and through the coastal fishery. In recent years, a limited harvest has occurred in the Big Fish River as an alternative to the coastal fishery and to revitalize use of traditional fishing locations (Lea, Gruben, Gallagher & Costa, 2020). Since the mid-1980s the annual Aklavik Inuvialuit reported harvest has varied from over 2,500 to fewer than 50 char (DFO (Department of Fisheries and Oceans Canada) et al., 2019, Table A1-1).

[The Big Fish River has] traditionally been where everybody fished for char. People are trying to maintain their ties to the land, to where we've been before, and we like to continue to see tradition stay because our membership in Aklavik is pretty traditional. We like to keep things going if we can. So, I think that's good because it lets our young people know: this is where my dad fished, my grandpa fished, and that's important to us. —Billy Storr (Lea, Gruben, Gallagher & Costa, 2020)

The Yukon North Slope Inuvialuit Traditional Use Study (WMAC (NS) & Aklavik HTC, 2018b) provides documentation of past and current fishing locations on the Yukon North Slope (Map 9-1). This observation by an older interviewee shows the relationship between Dolly Varden (referred to as char, below) and sea ice and how ice conditions affect the success of fishing on the coast:

They go as far as Fish Hole for getting char, and down [to] Shingle Point to get char. When ice used to come in close [to shore], we would go down farther, King Point, in that area, where the ice get close. Seem to get more char when the ice is close to the land.... We don't use very long net. We just use short net and string it out. But when there's no ice, it's different fishing. At Shingle Point we're just lucky because it's where it [the ice] comes when it [char] runs. (WMAC (NS) & Aklavik HTC, 2018b, p. 81)

Map 9- 1. Fish harvest locations identified in the Inuvialuit traditional use interviews



The fishing locations are for all species of fish. The interviewers asked Inuvialuit land users to identify fishing areas and harvest sites used within living memory. Source: WMAC (NS) and Aklavik HTC (2018b), Map 11.

Climate change effects on sea ice, wave and erosion patterns have impacted Inuvialuit fishing on the Yukon North Slope. Fishing locations have changed because of changes to the bays and deltas. Gravel has built up at King Point, closing off the harbour. King Point is still used for fishing on day trips from Shingle Point (Byers, Reist, & Sawatzky, 2019). Phillips Bay and the Firth River delta are shallower now than they were decades ago and less suitable as harbours (Papik et al., 2003). Sea ice is often not as close to the coast as it was historically, which also impacts the ability to safely boat and fish along the coast (WMAC (NS) and Aklavik HTC, 2018b).

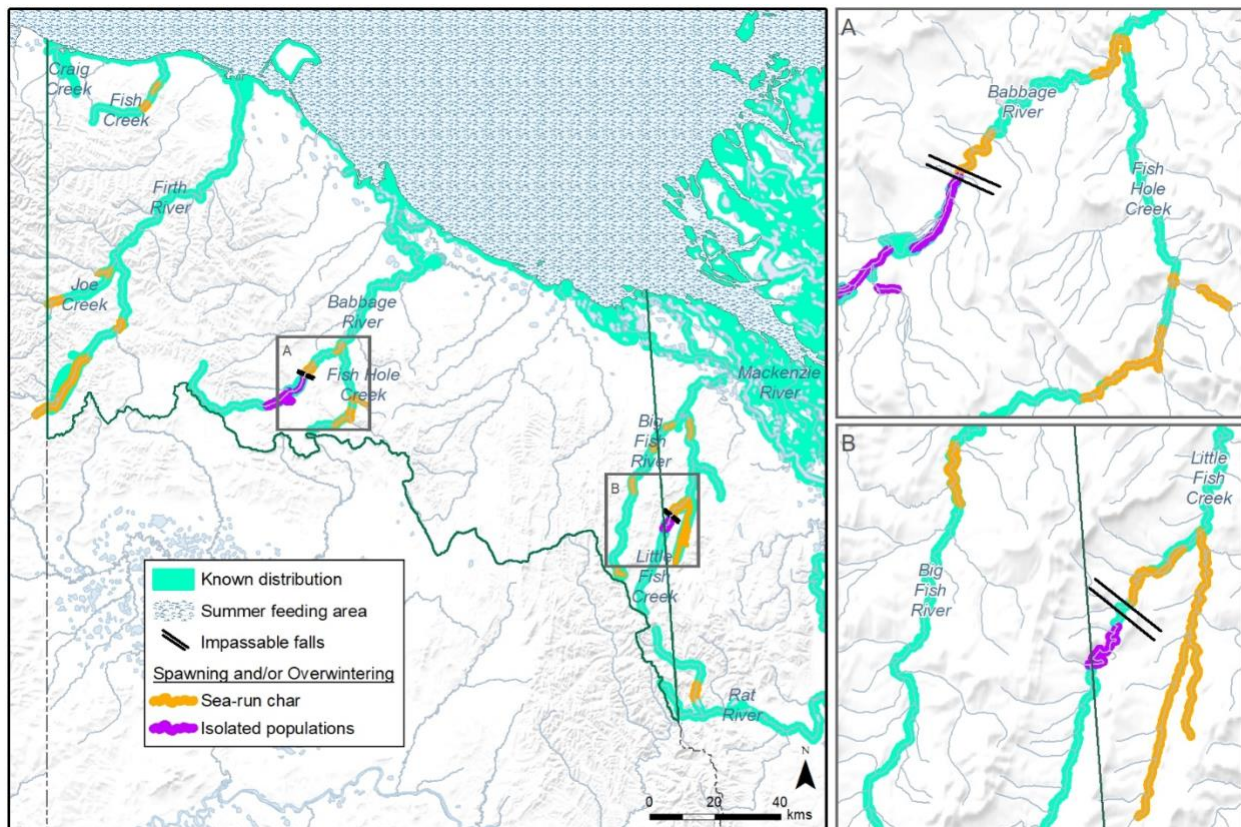
Habitat for Dolly Varden

Yukon North Slope Habitat

Yukon North Slope habitat includes the coastal marine area, where Dolly Varden feed during the summer period, estuaries and river reaches that provide migration corridors, and overwintering, spawning, and fish rearing areas at the headwaters of rivers and creeks (Map 9- 2).

Overwintering areas, often also used for spawning, are limited to a few distinct locations. Recent research has emphasized the importance of the Beaufort Sea for Dolly Varden and suggests that Dolly Varden are widely distributed in the offshore Beaufort Sea and may use marine waters throughout their range (Courtney et al., 2018).

Map 9- 2. Dolly Varden habitat: known distribution, overwintering and spawning locations, and summer marine feeding zone, based on surveys and Inuvialuit traditional knowledge



This map is from the Plan (WMAC (NS), 2022, Appendix 1). It is based on surveys and Inuvialuit traditional knowledge (Dave Tavares, personal communication, April 2019; Ellen Lea, personal communication, March 2019; WMAC NS and Aklavik HTC, 2018b). Note that the distribution in Craig Creek (based on data from Fisheries and Oceans Canada [DFO]) is not spawning or overwintering.

Habitat with year-round groundwater discharge is a limiting factor of Dolly Varden abundance (Loewen et al., 2015). The proportion of habitat within each watershed that is associated with

groundwater discharge in winter is small—for example, it is less than 5% of the Babbage River system downstream of the falls (Mochnacz, Schroeder, Sawatzky, & Reist, 2010).

The total known winter habitat for Western Arctic Dolly Varden in Canada is only 0.63 km², of which 47% is within the Yukon North Slope (Table 9- 2). A further 0.35 km² has been identified as potential Dolly Varden winter habitat. This is almost entirely (98%) within the Yukon North Slope. The largest blocks of both known and potential winter habitat are in the Firth River watershed.

Table 9- 2. Estimates of known and potential winter habitat for Western Arctic Dolly Varden on the Yukon North Slope and over the entire Canadian range

		Firth River	Joe Creek	Babbage River	Total for Yukon North Slope	Entire Canadian range	Percent of all Canadian habitat that is within the Yukon North Slope
Winter habitat (km ²)	Known	0.190	0.022	0.084	0.296	0.632	47%
	Potential	0.330	0.009	0.002	0.341	0.350	98%

The totals for the entire Canadian range include the Big Fish, Little Fish, Rat, Gayna, Vittrekwa, and Blackstone rivers, in addition to the rivers listed. Although headwater reaches of Little Fish Creek, Big Fish River, and the Rat River are within the Yukon North Slope, the main Dolly Varden overwintering areas are in the NWT, just downstream of the territorial boundary (Data from Mochnacz et al., 2010, Table 3).

Firth River and Joe Creek Char Habitat

The headwaters of the Firth River and Joe Creek are in Alaska, in the Arctic National Wildlife Refuge. Fish holes on both streams are in the Yukon, close to the border with Alaska and high up in the watershed. Groundwater discharge and summer temperatures are important in maintaining habitat in these mountain streams. The thick aufeis downstream of the fish holes rarely melts completely—meltwater from the aufeis maintains water levels in the summer.

The Firth River and Joe Creek fish holes are designated as Zone 1 Special Preservation areas of Ivvavik National Park, the highest level of protection afforded through the national park zoning system (Parks Canada, 2018a).

Babbage River Char Habitat

The upper reaches of the Babbage River and its tributaries are shallow. Flow is maintained by groundwater upwelling. The lower reaches freeze to the river bottom. Fish holes are along a 1.5 km section on Wood Creek and Fish Hole Creek (Canoe River), on the east side of the Babbage and thus not within Ivvavik National Park. There is also an isolated Dolly Varden population in the mainstem of the Babbage River, upstream of the falls and within Ivvavik National Park.

Char Habitat in Other Yukon North Slope Rivers

In addition to the habitat for the larger populations described above, Fish Creek (in the Komakuk Beach area, within Ivvavik National Park) supports Dolly Varden. There is known to be a wealth of traditional knowledge of Dolly Varden in this area; research about Dolly Varden in this area began in 2016 (Gallagher and Lea, personal communication, 2019).

Habitat Extending Beyond the Yukon North Slope

Dolly Varden originating in the Big Fish River and Rat River are caught in the Inuvialuit coastal fishery. Both of these rivers have headwater streams within the Yukon North Slope. For both rivers, the majority of overwintering and spawning habitat for searun Dolly Varden is downstream in the NWT.

Big Fish River Char Habitat

Big Fish River and its tributary Little Fish Creek cross the Yukon/Northwest Territories boundary. The headwaters are in Yukon North Slope, but much of the key habitat, including the overwintering habitat, is in the NWT. The main fishing areas historically used by Aklavik Inuvialuit are in the NWT (Fish Hole Creek close to the Yukon boundary, and at the mouth of the Big Fish River).

Waterfalls upstream of Fish Hole are a barrier to fish movement. There is an isolated population of Dolly Varden upstream of the falls and within the Yukon North Slope planning area.

Aklavik fish harvesters identified deterioration in the spawning and overwintering areas of the Big Fish Rivers as a likely cause of the decline in char abundance since the 1960s and 1970s. The water at Fish Hole is less salty and the water level has dropped (Papik et al., 2003). Earthquake activity in the 1970s probably changed groundwater flows (Stephenson, 2003). At the mouth of the Big Fish River, another harvest location, harvesters note that water levels seem lower than in the past, with more exposed gravel beds (Papik et al., 2003). Protection of the Big Fish/Little Fish watershed was identified by the Aklavik Hunters and Trappers Committee (HTC) as a priority for the Plan.

Rat River Char Habitat

Most of the Rat River drainage is southeast of the Inuvialuit Settlement Region (ISR). The headwaters of Fish Creek, a tributary of Rat River, are in the Yukon. An overwintering area for searun and juvenile Dolly Varden has been identified on upper Fish Creek, within the Yukon North Slope. The known overwintering and spawning habitat for Rat River Dolly Varden is downstream on Fish Creek, in the Gwich'in Settlement Area (GSA) in the NWT.

Dolly Varden Populations

Species Conservation Status

Western Arctic Dolly Varden were assessed as Special Concern in 2010, and then listed legally as Special Concern in 2017. Western Arctic Dolly Varden populations are ranked as Critically Imperiled in the Yukon and are on the Yukon Conservation Data Centre animal track list (Yukon CDC, 2019).

Table 9- 3. Dolly Varden, Western Arctic populations: conservation status

Status assigned by	Applies to	Status	References
Species at Risk Act (SARA)	Canada	Special Concern; listed on Schedule 1 since 2017	(Canada, n.d.)
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)	Canada	Special Concern; last assessed 2010	(Canada, n.d.)
Yukon	Yukon	S3S4: Vulnerable/apparently secure*	(Yukon, 2020)

*Following the ranking system developed by NatureServe, an international network of conservation data centres (NatureServe, n.d.). G=Global; N=National; S=Subnational

Dolly Varden Fisheries, Populations, and Management

Fisheries

The main Dolly Varden fisheries within this area are the Inuvialuit fishery along the Yukon North Slope coast, and Inuvialuit and Gwich'in fisheries on Big Fish River (at Fish Hole and at the river mouth) and Rat River respectively, and the Mackenzie Delta (which is outside the Yukon North Slope).

Recreational fishing is allowed throughout the Yukon North Slope, either with a Yukon fishing license and subject to Yukon fishing regulations, or, in Ivavik National Park, through the Park's permitting system. There were two short-lived commercial fisheries of char on the Yukon North Slope, one in the early 1960s at Shingle Point, and a second in the mid-1960s at Pauline Cove and Ptarmigan Bay (Steigenberger, Elson, Bruce, & Yole, 1975). There is currently no commercial quota for Dolly Varden within the ISR or the GSA (E. Lea, DFO, personal communication, 2020).

Management

Collaborative management is integrated across the ISR and GSA with Inuvialuit and Gwich'in participation, including the Aklavik HTC and the Fisheries Joint Management Committee (FJMC). Management planning and decision making are guided by working groups for the Rat and Big

Fish populations and an Integrated Fisheries Management Plan (IFMP) for all Dolly Varden populations within the ISR and the GSA.

The Integrated Fisheries Management Plan for Dolly Varden of the ISR and the Gwich'in Settlement Area for 2011 to 2015 (DFO, 2010a) encouraged monitoring programs, recommended preferred fishing gear and methods, and listed locations closed to fishing. The plan recommended following voluntary quotas set by the Rat River Working Group and the West Side Working Group. An updated plan was released in 2019 (DFO (Department of Fisheries and Oceans Canada) et al., 2019). It includes: updated stock assessments; updates on knowledge about Dolly Varden; updates on knowledge about threats and limiting factors; and management objectives, strategies, and measures. For information on the history and status of Dolly Varden populations and their management in the ISR and GSA, see the Integrated Fisheries Management Plan (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

Mixed-Stock Coastal Fishery

The main Yukon North Slope Inuvialuit fishery for Dolly Varden is the coastal fishery at Tapqaq (Shingle Point) and Qikiqtaruk (Herschel Island). Dolly Varden are also caught at other locations along the coast: Komakuk Beach, Nunaluk Spit, Ptarmigan Bay, Phillips Bay (e.g., Niakolik Point), King Point, Sabine Point, and near the mouth of Running River (C. P. Gallagher et al., 2013). The fishery at Shingle Point is mainly for Arctic cisco (called herring, **Qaaqtaq**, *Coregonus autumnalis*) and inconnu (called coney, **Sirrgarq**, *Stenodus leucichthys*), though Dolly Varden and broad whitefish (**Aanaarlirq**, *Coregonus nasus*) are also caught (Brewster, Neumann, et al., 2016). Fisheries further west, including Qikiqtaruk, use larger mesh gill nets and have a greater focus on Dolly Varden (DFO, 2017a). Harvest takes place from July to early September (most commonly July to mid-August) (C. P. Gallagher et al., 2013).

Genetic studies show that fish caught in coastal waters are from populations that overwinter and spawn in several river systems: Firth River system, Babbage, Big Fish, Rat, and Vittrekwa rivers, as well as Alaskan rivers. The population composition of the fish caught varies from year to year. Dolly Varden originating in the Babbage River made up the majority of the Shingle Point harvest in a study from 2011 to 2014 (C. P. Gallagher, Howland, Bajno, Sandstrom, & Reist, 2018). The harvest at Qikiqtaruk has a higher contribution from the Firth River system and Alaskan rivers than the Tapqaq harvest. Comprehensive annual harvest monitoring and collection of biological data about the fish harvested began in 2011 for the coastal fishery (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

Firth River and Joe Creek Char Populations

Firth River and Joe Creek may support genetically distinct populations (see Harris et al., 2015). The Firth River system populations are harvested by mixed-stock coastal fisheries on the Alaskan and Yukon North Slopes. The main freshwater fishery is recreational fishing on the Firth River by Park visitors on river trips. Ivavik National Park issues fishing permits with a catch and possession limit of one Dolly Varden per day. Recreational fishing is closed in areas used for

spawning and overwintering in the upper reaches of Joe Creek and the Firth River (Parks Canada, 2018b).

Babbage River Population

Results from monitoring the harvest and assessing the status of this population suggest that Babbage River Dolly Varden are harvested sustainably at several locations along the Yukon North Slope coast and the population is stable (DFO (Department of Fisheries and Oceans Canada) et al., 2019; DFO, 2017a). The highest proportions of Babbage River stock in harvests is at King/Sabine and Shingle points; few are caught at Herschel Island (DFO, 2017a).

Recreational fishing is closed over the range of the isolated Dolly Varden population above the falls on the Babbage River (Parks Canada, 2018b).

Big Fish River Population

Stock assessments and Inuvialuit knowledge show a decline in Big Fish Dolly Varden abundance since the 1970s and 1980s (Stephenson, 2003). Inuvialuit also observe a decline in Arctic grayling in this river system.

The most recent formal assessment of Big Fish river Dolly Varden (DFO, 2013a) concluded that there are no immediate concerns for this population at the current harvest rate. Big Fish Dolly Varden are caught at Fish Hole and at the mouth of the river, although there have been harvest closures on the Big Fish River since 1987. Harvest at safe levels has been permitted under variation orders and Aboriginal Communal Fishing Licences since 2012 (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

Western scientific and traditional knowledge was used by the West Side Working Group to establish a safe harvest level and design a monitoring program at the mouth of the Big Fish River, beginning in 2012 (Lea, Gruben, Gallagher & Costa, 2020).

This commitment to the sustainable management and monitoring of Dolly Varden by the Aklavik Hunters and Trappers Committee and the community has led a community harvest at the fish holes each fall since 2014, and provided the opportunity for harvesters to fish and report back on their total catch (Lea, Gruben, Gallagher & Costa, 2020).

Decline of Big Fish Dolly Varden

Aklavik harvesters observed that the numbers and size of the fish at Fish Hole declined from the 1970s to 1980s and agreed to a fishing closure for 5 years in 1987. Limited re-openings of the Big Fish for Dolly Varden in the 1990s showed that the population was still at a low level. Earthquake activity near Fish Hole in the 1970s may have changed groundwater flows and led to habitat loss. Combined harvest in the river, at the river mouth, and in the coastal fishery may have been too high to maintain the previous population abundance.

(Stephenson, 2003)

As Inuvialuit, we're taught not to over-harvest. I think that's why Akłarvik HTC kept pushing to get it open at the Big Fish River fish hole. And today, I'm proud to say that our community members could look forward to fishing there on their own — Michelle Gruben (Lea, Gruben, Gallagher & Costa, 2020)

Genetic studies indicate that Big Fish Dolly Varden are also caught in the coastal fishery at Shingle and King points (C. P. Gallagher et al., 2013).

Rat River Population

Although all but the highest reaches of headwater streams of the Rat River are outside of the Yukon North Slope, the population is of interest to Inuvialuit fishers because char originating in this river are caught in the Yukon coastal fishery and in the Mackenzie Delta. Several sources of information indicate that this population is stable (DFO, 2017b).

Rat River fishing was reopened in 2009 when the voluntary closure ended. A safe fishing level was established and it is reviewed annually through the Rat River Working Group (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

Transboundary Considerations

The northern form of Dolly Varden spawn in rivers in Alaska, Yukon, and NWT. In Canada, the range includes the western part of the ISR and the GSA.

There is no management plan or formal arrangement that encompasses the full range of the northern form of Dolly Varden. Dolly Varden from Alaskan and Canadian rivers migrate both east and west along the coast during their summer feeding period. A 1999 study found that Firth and Babbage Dolly Varden made up as much as 25% of harvest at some locations in Alaska and that 65% of the catch in at Phillips Bay was from Alaskan populations (reported in C. P. Gallagher, Roux, Howland, & Tallman, 2012). A study that attached radio tags to Dolly Varden in the Canning River (Alaska) located a small number of these tagged fish overwintering in the Firth River (Brown, Courtney, & Seitz, 2018).

The Integrated Fisheries Management Plan (DFO (Department of Fisheries and Oceans Canada) et al., 2019; DFO, 2010b, 2010a) brings together jurisdictions and interests within Canada, including Inuvialuit and Gwich'in, Yukon and Northwest Territories, and Parks. The plan is for the ISR and GSA. It does not cover Dolly Varden ranges that are in the Sahtu Settlement Area and the Yukon south of the Yukon North Slope (DFO (Department of Fisheries and Oceans Canada) et al., 2019). The plan, however, includes a strategy to promote cooperation with the Sahtu, Yukon, and Alaska.

Observations, Concerns, and Threats

Overview of Identified Threats

Main threats to Dolly Varden identified in the Integrated Fisheries Management Plan and the COSEWIC species assessment (COSEWIC, 2010; DFO (Department of Fisheries and Oceans Canada) et al., 2019; DFO, 2010a) fall into three categories:

- Threats from climate change (high concern);
- Threat of stock depletion from over-fishing at fish holes (high concern) and in the coastal fishery (medium concern);
- Threats from human activities related to resource extraction (mainly rated as medium concern and not currently an issue in streams in the ISR and GSA; threat of impacts from possible hydrocarbon exploration and development is rated as a high concern for coastal locations).

Levels of concern in the above list are from the Integrated Fisheries Management Plan (DFO (Department of Fisheries and Oceans Canada) et al., 2019, Table 3). In the IFMP, natural habitat change is also identified as a threat of high concern. Habitat changes listed are slumping and erosion, water flow and groundwater level changes, and changes in river salinity. The major area of concern for groundwater and salinity changes is the Big Fish River. These natural changes may increase in rate and/or magnitude with climate change.

Contaminants and Dolly Varden

Research on contaminants in Dolly Varden has been mainly on mercury levels because mercury has been found at high levels in some Arctic char populations in the Eastern Arctic. Studies on Rat, Vittrekwa, and Babbage river Dolly Varden indicate that mercury levels are low in Dolly Varden (Evans, Muir, Keating, & Wang, 2015; Tran, Reist, & Power, 2016). However, mercury uptake by fish is influenced by water temperatures and other factors affected by climate change, such as the fish's position in the food web. In addition, warming temperatures may increase the amount of mercury in marine feeding areas. A study comparing mercury in Rat River and Firth River Dolly Varden collected in the 1980s with char collected in the 2010s from the same rivers concluded that mercury levels have increased slightly in Rat River char, but not in Firth River char (Tran, Reist, Gallagher, & Power, 2019). The study also concluded that there are local variations in how mercury is accumulated by char and that it is important to continue to monitor mercury levels and to gain a better understanding of mercury uptake.

Impacts of Climate Change

Aklavik Inuvialuit land users identified climate change impacts on habitat as a threat to Dolly Varden through the study documenting traditional knowledge about Yukon North Slope wildlife and habitat (WMAC (NS) & Aklavik HTC, 2018a). Participants described climate-change related impacts that they had observed:

- Erosion along riverbanks and coastlines, which was observed to deposit sediment in rivers, making them shallower and less clear;
- Change in the timing of migration, largely referring to Dolly Varden moving through summer fishing locations earlier in the year;
- Observations of salmon moving into the region, attributed to warmer temperatures;
- Decrease in summer sea ice, impacting marine habitat; and
- Less snowpack, leading to lower water levels in spawning areas.

Observations from people interviewed:

...you know, we've never had salmon in the area before, and now they're starting to... pop up in places where we're getting the Arctic char.

...the erosion on the hills...make the creek shallow... Probably harder [for Dolly Varden char] to get up to where they're supposed to spawn.

Probably about ten years [ago] was a really thick ice... And it was really good fishing... you could see the char coming, you could see their little ripples... along the edge of the water... That's what the normal used to be back then. (WMAC (NS) & Aklavik HTC, 2018a, p. 42)

Participants in a traditional knowledge study conducted on the Yukon North Slope reported a change in the timing of arrival of Dolly Varden to the Shingle Point area (Brewster, Neumann, et al., 2016). Most people observed an earlier arrival. People interviewed attributed the change to increased sea water temperatures, commenting that Dolly Varden prefer cool water.

Main threats to Dolly Varden from climate change were identified in the COSEWIC assessment (COSEWIC, 2010) and the IFMP (DFO (Department of Fisheries and Oceans Canada) et al., 2019):

1. Less groundwater and surface water in the fish holes and small headwater reaches that are crucial habitat for Dolly Varden, due to hotter summers and less rain (as is currently occurring);
2. Damage to habitat in fish holes from permafrost thawing and slumping;
3. Competition from Pacific salmon if they become more common and widespread;
4. Change to coastal habitat, including decreased salinity and shoreline erosion;
5. Changes in virus or parasites related to changes in habitat. Salmon could also introduce new parasites or diseases.

A multi-party ArcticNet integrated regional impact study (IRIS) of the Canadian Western and Central Arctic (Stern & Gaden, 2015) noted the following key finding about impacts of climate change:

Permafrost thaw and lake expansion are expected to continue as temperatures in the Arctic increase. Lake growth has the potential to transport large sediment loads to freshwater and coastal habitats, degrading quality of habitat (e.g. lower oxygen levels in fall and winter resulting from increased organic matter decomposition) which is particularly problematic for Dolly Varden... (Stern & Gaden, 2015, p. 16)

The study highlights Dolly Varden as being particularly vulnerable to climate change because they have a limited distribution, they are dependent on small sections of headwater habitats fed by groundwater, and they grow slowly and mature late. The capacity of Dolly Varden to adapt to a changing environment is an important consideration. Tracking changes in conditions and responses of the fish will aid in setting management priorities (Stern & Gaden, 2015).

There is some evidence that Dolly Varden are responding to changing marine conditions. Dolly Varden captured in Beaufort and Chukchi sea studies in Alaska since 1969 showed an increase in maximum fish length over the 50-year period (Courtney, DeSanto, & Seitz, 2019).

Impacts on Dolly Varden from Human Activities

In Rivers and Streams

Activities such as road building, seismic testing, gravel extraction, water removal, or modifications of river channels can cause damage to key wintering, spawning, and rearing areas for Dolly Varden in streams, or disruption of migratory pathways in rivers (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

Human activities in streams beyond the Yukon North Slope (for the Big Fish, Rat, and Vittrekwa rivers) could affect the availability of Dolly Varden to the Inuvialuit coastal fishery. Adults of these char populations spend the summer in Yukon North Slope marine waters.

In the Beaufort Sea

Dolly Varden are considered one of the key species to protect in the event of an oil spill in the Beaufort Sea, because of their importance to the Inuvialuit traditional fishery. The Beaufort Regional Environmental Assessment produced a vulnerability profile for Dolly Varden and other key marine wildlife species (BREA, 2015, 2016). The vulnerability profiles assembled biological data, including seasonal distribution maps to assess vulnerability to potential spills and accidents from marine oil and gas exploration and development. Disruption of Dolly Varden movement and impacts on the quality of marine ecosystems for feeding in the Beaufort Sea could result from offshore infrastructure, reduction in benthic invertebrates from disturbance to the ocean floor, or damage from oil spills.

The IFMP (DFO et al., 2019) also identifies shipping as a potential threat to Dolly Varden in the Beaufort Sea. Shipping activity may interfere with Dolly Varden migration and feeding. Satellite-tagged Dolly Varden have been shown to occupy waters up to 150 kilometres offshore (Gallagher, unpublished data), which increases concern for the impact of marine development on their populations.

Links to Plans and Programs

This section lists plans and programs that link to the objectives and strategies of the *Yukon North Slope Wildlife Conservation and Management Plan*. These plans and programs informed the development of the Yukon North Slope Plan and are an integral part of its implementation.

Fisheries Management

- **Integrated Fisheries Management Plan (DFO (Department of Fisheries and Oceans Canada) et al., 2019)**

Full title: *Integrated Fisheries Management Plan for Dolly Varden (*Salvelinus malma malma*) of the Gwich'in Settlement Area and Inuvialuit Settlement Region, Northwest Territories and Yukon North Slope. Volume 1: The Plan–2019 Update.*

This plan, an update of the first IFMP for Dolly Varden (DFO, 2010a) provides the species conservation actions required of a SARA species management plan for Dolly Varden within the ISR and the GSA.

[The Integrated Fisheries Management Plan] identifies objectives, strategies and measures for managing the fisheries and fish habitats, and for sustaining and rebuilding Dolly Varden populations. This IFMP will be used by fishers, communities, Gwich'in, Inuvialuit, Government of Canada and other stakeholders in managing day-to-day and longer-term activities, and is intended to achieve the long-term conservation, sustainable use and rebuilding of Dolly Varden populations in the GSA and ISR.

Extract from the plan (DFO (Department of Fisheries and Oceans Canada) et al., 2019, p. 7)

IFMP objectives (DFO (Department of Fisheries and Oceans Canada) et al., 2019, pp. 23-24):

1. To maintain healthy stocks of Dolly Varden throughout the GSA and ISR;
2. To preserve and protect Dolly Varden habitats in all rivers in the GSA and ISR and along the Beaufort Sea coast to ensure that Dolly Varden stocks continue to thrive;
3. To manage the Dolly Varden fisheries using adaptive management processes with full community participation;
4. To ensure the maintenance of Dolly Varden in the GSA and ISR to provide subsistence food and to support traditional Gwich'in and Inuvialuit culture;
5. To manage, to the extent possible, the Dolly Varden fisheries in a manner consistent with Gwich'in and Inuvialuit cultural practices.

- **West Side Working Group**

Established in 2001 to advise on Dolly Varden fisheries management west of the Mackenzie River to the Alaskan border. Membership: Aklavik HTC, FJMC, DFO, Aklavik Elders, Parks Canada, and Herschel Island–Qikiqtaruk Territorial Park. The West Side Working Group was instrumental in development of the IFMP and will continue to advise on its implementation (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

Habitat Conservation

➤ [Aklavik Inuvialuit Community Conservation Plan \(Aklavik HTC et al., 2016\)](#)

The Aklavik conservation plan's sections on Dolly Varden are mainly concerned with the Big Fish population. The plan notes that when the coastal fishery for Dolly Varden is unsuccessful, the mouth of the Big Fish River and the Fish Hole are alternative locations for Aklavik to harvest this important food.

Special Designated Lands include:

- Fish Hole and Big Fish River. Importance to Aklavik: historically important for harvesting Dolly Varden; overwintering and spawning habitat on Cache Creek (also known as Little Fish River).
- Firth and Babbage River watersheds. Importance to Aklavik: both rivers support stocks of Dolly Varden; overwintering and spawning for the Babbage watershed is in Fish Hole Creek (eastern tributary of the Babbage, also known as Canoe River); fish hole at the top of the Babbage River (inside Ivavik National Park) is a traditional fishing area.

Plan priorities include:

- Responding to the community's great concern over change in char abundance and water quality at Fish Hole (Big Fish River), and the strong interest in winter habitat research
- Improving knowledge about biology and movement of Dolly Varden (a high research priority)

Conservation measures for Dolly Varden include:

- Identify and protect important habitats from disruptive land uses.
- "Ensure harvest is sustainable" and "Do not take more than needed"

➤ [Ivvavik National Park of Canada Management Plan \(Parks Canada, 2018a\)](#)

Zone 1 Special Preservation areas designated in the park include the Firth River fish holes and Joe Creek fish holes.

➤ [Beaufort Sea Conservation and Management](#)

Beaufort Sea ecosystems are the main foraging areas for searun Dolly Varden. Plans and programs for integrated management of Beaufort Sea ecosystems include:

Beaufort Sea Partnership (BSP, 2020)

This partnership provides a forum for information sharing and discussion of mutual interests and responsibilities for Beaufort Sea conservation and management, guided by an integrated ocean management plan (BSP, 2009).

Tarium Niryutait Marine Protected Areas Management Plan (DFO, 2013b) and Monitoring Plan (DFO & FJMC, 2013)

The management plan recognizes the importance of these protected areas for fish, including Dolly Varden. The monitoring plan includes fish surveys and fish sampling to assess status and trends of fish populations, fish health, and marine food webs.

Research and Monitoring Programs

Dolly Varden populations in the Big Fish and Rat rivers have been monitored and assessed since declines were observed in the 1970s. Inuvialuit and Gwich'in traditional knowledge has informed estimates of trends and understanding of habitat needs and changes. Population assessments on the major searun populations, traditional knowledge documentation, harvest monitoring, and research on Dolly Varden genetics and ecology have taken place in response to the assessment of Dolly Varden as Special Concern in 2010 by the Committee on the Status of Endangered Wildlife in Canada, and through the development and implementation of the 2010 Integrated Fisheries Management Plan. Due to community concerns about declines in some Dolly Varden populations, working groups were established to support local decision-making through an adaptive co-management approach. Fishing plans were created to reflect community priorities and knowledge. Representation from harvesters, co-management organizations, and territorial and federal governments on working groups led to the co-development of the comprehensive management plan. This work is ongoing, guided by the recently updated management plan (Lea, Gruben, Gallagher & Costa, 2020).

Inuvialuit have also worked closely with Gwich'in leadership on Dolly Varden populations originating in the Gwich'in Settlement Area, as part of the Rat River Working Group. Since 2009, Akłarvingmiut and biologists have conducted annual tagging (mark-recapture study) at the 'fish hole' in the Big Fish and Babbage Rivers (Lea, Gruben, Gallagher & Costa, 2020).

As part of the implementation of the IFMP, Yukon North Slope Dolly Varden research and monitoring has been expanded to provide updated information on all Yukon North Slope searun populations. Currently, data are collected annually on the Firth River, Joe Creek, Fish Creek (Komakuk Beach), Babbage River, and Big Fish River (Map 9- 3). Inuvialuit Park Rangers at Qikiqtaruk (Herschel Island) Territorial Park have also been working with DFO since 2011 to collect biological samples and catch information from Dolly Varden harvests (Gallagher et al., 2013).

Map 9- 3. Yukon North Slope 2018 harvest monitoring and fish tagging locations for Dolly Varden



Figure provided by C. Gallagher

Annual harvest monitoring in the ISR from 2016-2019 was led by the Inuvialuit Game Council and the Inuvialuit Regional Corporation. This program included Dolly Varden harvest monitoring (Inuvialuit Harvest Study, 2003). Inuvialuit harvest study annual monitoring is part of a larger, comprehensive, co-management monitoring program for Dolly Varden. This program is managed adaptively to help community harvesters and co-managers make informed decisions (Lea, Gallagher, Maier, & Ayles, 2021).

Selected Studies and Research Relevant to the Yukon North Slope

This section is an annotated listing of selected reports, scientific papers, and other resources that provide support to the *Yukon North Slope Wildlife Conservation and Management Plan* and highlight issues and research directions that will be important to consider during its implementation.

Traditional Knowledge Studies

- *Yukon North Slope Inuvialuit Traditional Use Study* (WMAC (NS) & Aklavik HTC, 2018b) and *Inuvialuit Traditional Knowledge of Wildlife Habitat, Yukon North Slope* (WMAC (NS) & Aklavik HTC, 2018a)

These two studies were undertaken by the WMAC (NS) and the Aklavik HTC to document traditional use patterns and knowledge about wildlife habitat on the Yukon North Slope. Both studies were based on interviews with Aklavik Inuvialuit land users. Maps were used in the interviews and all geographically referenced data were digitized and displayed on maps.

The results were used in developing the Plan and are described and referenced throughout this chapter.

- *Compilation and Synopsis of Literature on the Traditional Knowledge of Aboriginal Peoples in the NWT Concerning Dolly Varden* (Byers et al., 2019)

This report synthesizes documented Inuvialuit and Gwich'in traditional knowledge about Dolly Varden in the NWT and Yukon North Slope. The purpose is to prepare for further COSEWIC assessments of this species. In addition to information on Dolly Varden, the report summarizes traditional knowledge on changes to coastal landscapes and weather that may be affecting Dolly Varden migration and feeding.

- *Traditional Ecological Knowledge (TEK) at Shingle Point, YT: Observations on changes in the environment and fish populations* (Brewster, Neumann, et al., 2016)

In 2015 a traditional ecological knowledge survey was conducted at Shingle Point at the request of the FJMC and Aklavik HTC. This study complemented the fish and marine monitoring program in place since 2010. The 15 participants included elders and younger participants.

Assessments and Syntheses of Survey Results

- *Volume 2 (Appendices) to the 2010 Dolly Varden Integrated Fisheries Management Plan* (DFO, 2010b)

Reviews of research, stock assessments, habitat mapping, and monitoring are in Volume 2 of the 2010 plan. The 2019 plan notes that several sections of this supplementary volume will be updated (DFO (Department of Fisheries and Oceans Canada) et al., 2019).

- *COSEWIC Assessment and Status Report on the Dolly Varden *Salvelinus malma malma* Western Arctic Populations in Canada* (COSEWIC, 2010)

The COSEWIC report summarizes available information on population status and trends and on threats to Dolly Varden. The report presents the rationale for the designation of Dolly Varden as a species of Special Concern.

- *Assessment of Northern Dolly Varden Habitat in Canada* (Mochnacz et al., 2010)

Habitat is described for known populations. This DFO report is based on literature review and field surveys from 2008 and 2009.

- *Synthesis of biological and harvest information* (C. P. Gallagher et al., 2012)

This DFO report presents summaries of available information for each Dolly Varden population, pointing out gaps in knowledge. It includes harvest data for river and coastal fisheries.

➤ *Beaufort Regional Environmental Assessment (BREA, 2016)*

BREA was a four-year research program (2012-2015) focused on research to inform decision-makers on offshore oil and gas development in the Beaufort Sea. The assessment included a project to develop vulnerability profiles for key marine species, including Dolly Varden.

➤ *Population (stock) assessments*

- Big Fish River population assessment, 2009 to 2011 (DFO, 2013a), supported by a DFO research document (C. P. Gallagher et al., 2013). Abundance estimates are based on mark and recapture studies at the Little Fish River fish hole. The reports also cover biological characteristics, harvest reporting and management (including studies to identify Big Fish Dolly Varden in the coastal fishery), and population trends.
- Babbage River population assessment, 2010-2014 (DFO, 2017a). This assessment reviews studies undertaken to implement the 2010 Integrated Fisheries Management Plan, including monitoring at Shingle Point and Herschel Island, and provides updated estimates of Babbage River char population size and characteristics. It is supported by a DFO research document (C. P. Gallagher et al., 2018).
- Rat River population assessment, 2009-2014 (DFO, 2017b; Colin P Gallagher, Bajno, Reist, & Howland, 2020). Although this river is mainly outside of the Yukon North Slope, Rat River Dolly Varden are caught in the coastal fishery, mainly at Shingle Point.

Research

➤ *New insights into the biology of anadromous Dolly Varden, Canning River, Arctic National Wildlife Refuge, Alaska (Brown et al., 2018)*

This 2-year study used radio tags to study movements of Dolly Varden in the Canning River, Alaska, and nearby rivers. The Firth River, including Joe Creek, was included in the surveys.

Some findings:

- Almost 40% of the fish that had been tagged in the Canning River migrated to other rivers for overwintering– but not for spawning. Dolly Varden rarely return to a different drainage for spawning. Some fish tagged in the Canning River were recorded during winter in the Firth River and Joe Creek.
- Migration to sea was over a brief period in the first half of June, but fish returned to rivers over an extended period of about 3 months.
- Spawning fish migrated to spring-fed upstream reaches and remained there in the winter, while non-spawners overwintered in spring-fed reaches of the river mainstem.

➤ *Life-history characteristics and landscape attributes as drivers of genetic variation, gene flow, and fine-scale population structure in northern Dolly Varden in Canada (Harris et al., 2015)*

This study investigated landscape and life-history variables driving variation in genetic diversity and population structure. The study concluded that searun and isolated

populations are genetically distinct, but resident forms of Dolly Varden (the fish that remain in rivers their entire lives) are genetically the same as searun populations in the same rivers.

➤ *Assessing conservation risks to Dolly Varden populations* (Harris et al., 2017)

This study looked at genetic make-up and abundance of populations of Western Arctic Dolly Varden. The authors concluded that the various populations of Dolly Varden likely have a common origin and diverged in the past, and there is limited gene flow at present (meaning that they remain true to their spawning areas). The management implication is that it is most effective to manage fisheries on a river-by-river basis.

➤ *Characterizing the diet and habitat niches of coastal fish populations in the Beaufort Sea Tarium Niryutait Marine Protected Area* (Brewster, Giraldo, et al., 2016)

This study is based on analyses of carbon isotopes (different forms of carbon that can be related to the sources of food) in fish caught at Shingle Point from 2011 to 2013. The study concluded that, although searun char spend their early years and their winters as adults in rivers, the majority of the food eaten over their lifetimes is from the sea.

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