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Dolly Varden (*Salvelinus malma malma*) fisheries in the Inuvialuit Settlement Region and the Gwich'in Settlement Area 2009–2014: harvest, monitoring and communications in an adaptive co-management setting

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Dolly Varden are an important cultural and subsistence food source for residents of the Inuvialuit Settlement Region (ISR; primarily Aklavik, NT), and the Gwich'in Settlement Area (GSA; Aklavik and Fort McPherson, NT). Subsistence fishing for Dolly Varden generally occurs along the Canadian Beaufort Sea Coast, in the Mackenzie River Delta and its tributaries, and upriver at spawning and overwintering areas. Dolly Varden are co-managed under the Inuvialuit Final Agreement and Gwich'in Comprehensive Land Claim Agreement through community-based working groups and an overarching Steering Committee established under the Dolly Varden Integrated Fisheries Management Plan. The working groups include representatives from community resource management and co-management boards along with territorial and federal governments. The West Side Working Group (WSWG) and Rat River Working Group (RRWG) have made recommendations on the management, monitoring, and research of Dolly Varden populations, including decisions on harvest levels. The process associated with these harvest decisions and methods for the collection of harvest data between 2009 and 2014 are described and harvest data are summarized by area and/or stock, where possible. From 2009 to 2014, the total Dolly Varden harvest from all coastal and inland locations within the ISR and GSA ranged between 654 and 1,086 fish. Estimated harvest rates for the Big Fish, Babbage, and Rat River populations were less than 7% of population abundance estimates. Regular review of harvest data and results from research and monitoring programs, along with traditional and local knowledge by the WSWG and RRWG will continue to support the successful adaptive co-management of Dolly Varden populations.

INTRODUCTION

Dolly Varden (*Salvelinus malma malma*), known locally as iqaluqpik (Inuvialuktun), dhik'ii (Gwich'in), char, trout, or river trout, is an important traditional food and cultural resource for Gwich'in and Inuvialuit communities, particularly for Ft. McPherson and Aklavik (Byers 1993, Papik et al. 2003, Benson 2010, Byers et al. 2019). While anadromous, stream resident, and isolated resident life histories of this species can be found in the Inuvialuit Settlement Region (ISR) and Gwich'in Settlement Area (GSA) (Sawatzky and Reist 2014), current subsistence fisheries in these land claim areas target the anadromous form. Anadromous populations of northern Dolly Varden inhabit certain river systems west of the Mackenzie Delta in the Northwest Territories, Yukon North Slope, and Alaska, draining into the Beaufort and Bering seas (Taylor and May-McNally 2015). Canadian populations are highly philopatric (Harris et al. 2015) and found in river systems with headwaters in both the ISR (Big Fish River, Babbage River, Firth River watershed including Joe Creek, and Fish Creek (near Komakuk beach)) and GSA (Rat and Vittrekwa rivers) (Figure 1). These river systems are characterized by perennial groundwater flows that provide temperatures ideal for Dolly Varden spawning, rearing and overwintering (Mochnacz et al. 2010), with these areas known locally to the communities as the 'fish holes' given that open water can persist throughout the winter.

Documentation of Inuvialuit and Gwich'in fisheries for anadromous Dolly Varden has relied on sharing of traditional knowledge by harvesters (see Byers 1993, Papik et al. 2003, Benson 2010, and Byers et al. 2019). The locations of fisheries change over the course of a year and are situated in areas used by Dolly Varden during their seasonal migration. Subsistence harvesting for anadromous Dolly Varden occurs during three seasons: in coastal locations during summer ocean feeding, in the Mackenzie River Delta and its tributaries, or other coastal-draining river systems on their upstream (return) migration in late summer, and in fall at spawning and overwintering 'fish hole' areas.

Community concerns that Dolly Varden populations in the Rat and Big Fish Rivers had declined led to the creation of the Rat River Working Group (RRWG) in 1995 and the West Side Working Group (WSWG) in 2001 (focused on populations in the ISR; see Ayles et al. 2018 for further background information). These two working groups were established under co-management structures set out in the Inuvialuit Final Agreement (IFA) (Indian and Northern Affairs Canada 2005) and the Gwich'in Comprehensive Land Claim Agreement (GCLCA) (Indian and Northern Affairs Canada 1992), with decisions being made to reflect community interests, priorities and knowledge. While the composition of these working groups has evolved slightly over time, they generally include representatives from community resource management and co-management boards established under each land claim, along with territorial and federal governments. These working groups have taken the lead in developing fishing plans, monitoring programs, research projects, and communication of management decisions.

In November 2010 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Western Arctic populations of northern Dolly Varden as a 'Species of Special Concern' due to limited habitat and susceptibility to environmental changes or overharvest (COSEWIC 2010). Northern Dolly Varden were subsequently listed as a Species of Special Concern under the *Species at Risk Act* (SARA) in May 2017.

The working groups and associated fishing plans were expanded following the co-development of the Dolly Varden Integrated Fisheries Management Plan (IFMP), signed by the Department of Fisheries and Oceans Canada (DFO), Fisheries Joint Management Committee (FJMC), Gwich'in Renewable Resources Board (GRRB) and Parks Canada Agency (PCA) in 2010 and updated in 2019 (DFO 2010, DFO et al. 2019). The IFMP clearly defined the co-management of

Dolly Varden in the ISR and GSA and established a Steering Committee of senior representatives from DFO, GRRB, FJMC and PCA who were responsible for overseeing the implementation of the IFMP, through the WSWG and RRWG. The IFMP and its associated working groups are governed by the IFA, the GCLCA, and the principles of adaptive co-management. Adaptive co-management is a process that allows stakeholders to jointly manage a resource in an adaptive fashion as decisions are clearly documented, evaluated, and then modified based on what was learned (Ayles et al. 2007). Dolly Varden management also follows ecosystem-based management principles, recognizing the importance of other species, environmental factors, and relationships amongst all of these in the overall management of a species (DFO 2007, Howland et al. 2012). The first iteration of the IFMP in 2010 identified a number of priorities for enhanced Dolly Varden harvest monitoring, which led to the development of more comprehensive monitoring programs which are described below.

Monitoring and documenting the harvest is an essential component of the adaptive co-management process for Dolly Varden. Harvest information allows co-managers to estimate total harvest levels and rates, and assess their impact on populations. Furthermore, the data allows for evaluating the effectiveness of management measures, documenting when, where, and how people are fishing, and providing an opportunity to learn more about biological characteristics of populations while documenting local observations and changes. Additionally, the ongoing collection of Dolly Varden harvest data is important for documenting the significance of this species to Inuvialuit and Gwich'in diets and cultures.

We compile harvest data collected through collaborative community and scientific approaches and to provide information for fisheries co-management decision making, specifically by:

1. describing Dolly Varden fisheries and management in the ISR and GSA during 2009–2014, including how harvest decisions, monitoring programs, reports, and communications were developed in an adaptive co-management setting under the Dolly Varden Integrated Fisheries Management Plan;
2. summarizing Dolly Varden harvest for 2009 to 2014; and,
3. summarizing harvest rates for the Rat River, Big Fish River, and Babbage River Dolly Varden populations.

FISHERIES DESCRIPTION, MANAGEMENT, MONITORING, AND COMMUNICATIONS

Subsistence fisheries for anadromous Dolly Varden have occurred at a number of coastal and inland fishing sites for generations (Papik et al. 2003, Benson 2010). Many these traditional fishing sites are still fished today (Figure 1), particularly from coastal and delta fishing camps; however, the 'fish holes' have not been fished in recent years, for the following reasons: (1) to protect the species in their important habitat; (2) these sites are more difficult to access due to distance and mountainous terrain; and/or (3) because regulations stipulate their closure for conservation reasons (in the case of Rat River's Fish Creek and the Big Fish River and all of its tributaries; Justice Canada 2017). Gillnets were used in coastal and delta fishing locations while seine or gillnets (used like a seine) were used in the 'fish holes'. Dolly Varden were caught in targeted fisheries using 4 and 4 ½ inch gillnets and were also caught in nets used to target other species, for example 5 ½ inch nets used in the delta to target whitefish (*Coregonus* spp.) and Inconnu (*Stenodus leucichthys*), and 3 ½ inch nets used in coastal fisheries targeting several species, including Arctic cisco (*Coregonus autumnalis*; locally referred to as "herring").

A limited sport fishery occurs within Ivvavik National Park and Herschel Island Qikiqtaruk Territorial Park (Figure 1). The daily catch and possession limit for Dolly Varden in the Yukon

(including coastal waters) are 5 and 10, respectively. However, Parks Canada regulations stipulate a daily catch and possession limit of 1 Dolly Varden. Dolly Varden sport fishing in the Northwest Territories is 'catch and release' only with a possession limit of zero (Justice Canada 2017).

While commercial fisheries targeting Dolly Varden were attempted in the 1960s, these ventures were short-lived due to over-fishing (Corkum and McCart 1981). Commercial fisheries have not been attempted since for conservation reasons and to prioritize the important subsistence fisheries.

FISHERIES LOCATIONS

Coastal

There are several Dolly Varden subsistence fishing locations along the coast west of the Mackenzie Delta, including the mouth of Running River, Shingle Point, Sabine Point, King Point, Ptarmigan Bay, and Herschel Island Qikiqtaruk Territorial Park (Figure 1). While additional locations were used in the past (Papik et al. 2003), these are the most consistently used at present. The Beaufort Sea coastal fisheries are known to be of mixed-stock origin, with variability in the stock composition over time and space, and contributions from both Alaskan and Canadian stocks (Krueger 1999, Gallagher et al. 2018, 2020a), including the Firth, Babbage, Big Fish, Rat, and Vittrekwa river drainages.

Mackenzie Delta

Gwich'in and Inuvialuit harvesters have fished for Dolly Varden in the Mackenzie Delta for generations, including outside of Aklavik in Peel Channel and Husky Channel towards the mouth of the Rat River (Figure 1) (Benson 2010). These fishing areas encompass part of the upstream migration route for Rat River Dolly Varden, as well as Vittrekwa River Dolly Varden that continue their migration up the Peel River past Fort McPherson.

Rat River

The lower reaches of the Rat River, including Destruction City and the mouth of the Rat River, are important fishing areas for harvesters from Aklavik and Ft. McPherson (Figure 1) (Benson 2010). The last harvest from the 'fish hole', a traditional Gwich'in harvesting site on Fish Creek (a tributary to the Rat River), occurred in the 1970s (Benson 2010). With support from the GRRB and communities, DFO closed Fish Creek to fishing in 2009 (Justice Canada 2017).

Big Fish River

The Big Fish River is an important subsistence harvesting area for Inuvialuit from Aklavik, NT (Figure 1) (Papik et al. 2003). The 'fish hole' on Little Fish Creek (a tributary to the Big Fish River) was an important early winter fishing area that could be reached by dog team or snowmobile within a day from Aklavik. A few families began fishing in the lower reaches of the Big Fish River and downstream of its mouth in the Mackenzie Delta in the 1960s (Byers 1993). Following community concerns that the population had declined, the 'fish holes' were closed voluntarily in the early 1980s (Sandstrom and Harwood 2002, Stephenson 2003). The population declines were attributed to overharvesting along with changes in the 'fish hole' habitat. Seismic activity in the area is thought to have contributed to reduced groundwater flows which affected water levels in this important habitat (Stephenson 2003). The entire Big Fish River and its tributaries (including the Little Fish Creek 'fish hole' area) were legally closed to fishing in 1987 and gillnetting restrictions during August were implemented in Mackenzie Delta

Area VI (including the river mouth) to protect the population on its upstream migration (Justice Canada 2017). Since 1987 there have been occasional harvests at the mouth of the Big Fish River or at the ‘fish holes’ under the authority of a licence to fish for scientific or educational purposes.

Babbage River

The Babbage River, including its mouth and Fish Hole Creek tributary were important traditional harvesting areas for Inuvialuit from Aklavik (Figure 1; Papik et al. 2003). Harvesting on the Babbage River has been limited in recent years, though the population comprises a high proportion of the coastal harvest, particularly at Shingle Point (Gallagher et al. 2018).

Firth River

Traditional harvesting areas have been identified in the Firth River watershed (including Joe Creek), and Fish Creek (at Komakuk Beach) (Figure 1) (Papik et al. 2003). However, most of the current harvest comes from subsistence and recreational fishing that occurs on the Firth River, at the Sheep Creek (Imniarvik) base camp, or during rafting trips down the Firth River that typically begin at Margaret Lake and end on the coast. Visitors to Ivvavik National Park are allowed to fish recreationally if they possess a valid National Park Fishing Permit and follow relevant regulations, including being limited to a lure with a single barbless hook and a daily catch and possession limit of one Dolly Varden. Certain areas of the park are closed to sport fishing including the Firth River and Joe Creek ‘fish holes’, the Firth River aufeis area, upstream of Babbage Falls, Trout Lake, Roland Lake, and two unnamed lakes. Inuvialuit beneficiaries can fish for subsistence purposes in the park without a permit and they are not required to follow the aforementioned regulations.

Other locations

Anadromous Dolly Varden are occasionally harvested in the Peel River near Fort McPherson and as far upstream as Trail River (Benson, 2010). These fish are presumed to be Vittrekwa River Dolly Varden. Given limited harvest information and its probable small size ($n \leq 500$ anadromous adults; GRRB unpublished data) the Vittrekwa River Dolly Varden population is not discussed in this report.

While coastal communities in the Alaskan Beaufort Sea may catch Dolly Varden from Canadian populations while feeding in the Beaufort Sea during summer, harvests west of the Alaska-Yukon border (e.g., from Kaktovik; Pedersen and Linn 2005) are not reported here.

FISHERIES MANAGEMENT

The Dolly Varden IFMP stipulates that the RRWG and WSWG are responsible for conducting an annual evaluation of management measures, harvest information, monitoring programs, communications, research, local observations and traditional ecological knowledge, and community concerns. Based on this evaluation, the working groups make recommendations for the upcoming fishing season, including stock- and/or area-specific harvest levels. The working groups are also responsible for consulting with affected communities before sending their recommendations to the Steering Committee, who provide final approval and guidance on behalf of all co-management partners. The RRWG and WSWG function similarly but have slightly different processes. There is significant overlap in membership between the two working groups and even if a representative is not officially a member under the Terms of Reference, they have been welcomed to bring their knowledge, experience, and suggestions to the discussion.

Rat River Working Group

Membership on the RRWG includes a chair selected by the GRRB and representatives from the GRRB, FJMC, DFO, Aklavik Hunters and Trappers Committee (AHTC; Aklavik Inuvialuit), Ehdiiat Renewable Resource Council (ERRC; Aklavik Gwich'in), and Tetlit Gwich'in Renewable Resource Council (TGRRC; Fort McPherson Gwich'in) (Figure 2). Observers include the WSWG chair, the Nihtat Renewable Resource Council (NRRC; Inuvik Gwich'in), and the Gwichya Gwich'in Renewable Resource Council (GGRRC; Tsiigehtchic Gwich'in). Advisors to the RRWG include the harvest monitors, DFO Science, and other experts (scientific and/or local) as required.

Every year, the RRWG recommends a voluntary harvest level based on consensus amongst members, which is then brought forward to each members organizations for their support. Following the adoption of the IFMP in 2010, these harvest decisions were also sent to the IFMP Steering Committee for their final approval. The RRWG makes recommendations for the allocation of the annual harvest level among communities, harvest monitoring stations, and supported scientific collections. The AHTC, ERRC, and TGRRC are responsible for reaching consensus on the sub-allocation of the communities' portion of the harvest level among their respective HTCs and RRCs. As defined in the IFA and GCLCA, the HTC and RRCs have the responsibility for allocating harvest amongst their membership as required.

West Side Working Group

Membership on the WSWG includes a chair and representatives from FJMC, DFO, PCA, AHTC, Yukon Territorial Parks (YTP), and Aklavik Elders Committee (AEC) (Figure 2). Observers include the RRWG Chair, GRRB, ERRC, and TGRRC. Advisors to the WSWG have included harvest monitors, DFO Science, and other experts (scientific and/or local) as required.

Harvest decisions, management measures, support for research programs, and other working group activities are voted on as formal motions with a defined quorum level, though consensus has generally been the goal. Beginning in 2012, the FJMC has been leading the WSWG in the development of a traffic-light approach assessing scientific and traditional knowledge indicators to support harvest decisions at the spring meetings. The WSWG used to have a fall meeting as a preliminary review of the year's harvest monitoring and research programs; however, these were discontinued after November 2014.

In March 2012, the WSWG reviewed all available Indigenous and scientific knowledge along with the conclusions from the Canadian Science Advisory Secretariat (CSAS) Regional Advisory Process on Big Fish River Dolly Varden (DFO 2013, Gallagher et al. 2013), and recommended a harvest of 150 Big Fish River Dolly Varden from inland locations (within the delta and 'fish hole' area). Based on genetic mixed-stock fishery analyses (Gallagher et al. 2013) it was estimated that approximately 25 Big Fish River Dolly Varden were harvested on the coast annually. A total annual harvest of 175 fish represented less than 5% of the 2010 population abundance estimate (Gallagher et al. 2013) and therefore a request for a Big Fish River Dolly Varden subsistence fishery was submitted to DFO by the AHTC, with recommendations from the FJMC, the WSWG, and the Steering Committee. DFO then issued Variation Orders annually from 2012 to 2014 under Schedule VII of the *Northwest Territories Fishery Regulations* to lift the closure in Mackenzie Delta Area VI, allowing subsistence harvesters to fish with gillnets during August below the mouth of the Big Fish River. However, the mainstem Big Fish River and all of its tributaries remained closed to fishing for conservation reasons (Justice Canada 2017).

In 2014 AHTC requested a fall harvest at the Big Fish River 'fish holes', and prepared a harvest and sampling plan that was submitted to DFO jointly by the AHTC and FJMC (see following sections for description). Using an Aboriginal Communal Fishing Licence (ACFL), DFO was able

to authorize a subsistence and cultural harvest, with conditions pertaining to the fishing method (seine net), harvest number (up to 140 Dolly Varden and 300 Arctic Grayling (*Thymallus arcticus*)), the area that could be fished ('fish holes' of the Little Fish Creek), and sampling requirements, which had been discussed and agreed upon by all parties.

FISHERIES MONITORING

Coastal Monitoring

The coastal harvest monitoring programs are described in detail in Gallagher et al. (2013, 2018). The focus here is in the collection of harvest data from Shingle Point, Ptarmigan Bay and Herschel Island.

Various forms of monitoring have occurred intermittently at Shingle Point since the 1980s; harvest reported voluntarily to the AHTC, harvest information and biological samples collected on site by fishery monitors hired from the AHTC, and/or using personal fishing diaries to record harvest numbers that are submitted to the AHTC at the end of the fishing season. Since 2011 a comprehensive fishery monitoring program using monitors hired by the AHTC have recorded harvest and catch-effort data, and collected biological samples from fisheries at Shingle Point and adjacent areas (including mouth of Running River, Sabine Point, and King Point) during the majority of the coastal fishing season (July-early August).

A fishery sampling program was initiated in 2011 at Ptarmigan Bay to gain a better understanding of coastal harvests. A local harvester from Aklavik was tasked with recording harvest, catch-effort data, and biological information and collecting fin clip samples for genetic mixed-stock fishery analyses.

Herschel Island Qikiqtaruk Territorial Park is an important fish harvesting location (Friesen 2012, Harwood et al. 2012), and its Park Rangers have been recording observations and harvest records for a wide range of species for decades. In 2011, DFO initiated a comprehensive fishery monitoring program in partnership with the Park Rangers, which included recording catch-effort and biological information, and collecting tissue samples for genetic mixed-stock fishery analyses.

Rat River Fishery Monitoring

Between 2009 and 2014 DFO Fisheries Management hired a community monitor through each of the AHTC, ERRC and TGRRC to interview subsistence harvesters during the summer fishing season (July-September) in the vicinity of Aklavik and Ft. McPherson, with the dates selected by each board to cover the majority of the Rat River Dolly Varden run. These monitors were responsible for contacting local harvesters twice a week, in person, by phone, or over the radio to record the number and locations of Dolly Varden harvested. Harvest data were sent to DFO and GRRB on a weekly basis. Information collected from these surveys was used by co-management partners to monitor the harvest level. Dolly Varden harvested in the Peel River further upstream of the mouth of the Rat River were assumed to be from the Vittrekwa River population.

The Rat River Harvest Monitoring Program has collected harvest, catch-effort, and biological data annually since 1995 (Harwood 2001, Harwood et al. 2009, Roux et al. 2012, Gallagher et al. 2020a). Three monitoring locations have consistently been used since the program's inception: Big Eddy in the Husky Channel of the Mackenzie Delta, the mouth of the Rat River, and Destruction City, which is a traditional camp on the lower reaches of the Rat River (Figure 1). The program has evolved over time, but the primary goals have been to involve harvesters in Dolly Varden catch monitoring and collection of biological samples (annual sample size set by

RRWG). The monitors are tasked with maintaining a log of weather and water conditions (e.g., level, colour, debris, temperature) and recording information from their harvest: gillnet set location, net length, mesh size and soak time, and number of fish caught by species. Additionally, the monitors collect biological information and samples from a subset of Dolly Varden. Monitors also record harvest data from individuals fishing nearby and report these numbers to the RRCs and DFO.

Big Fish River Fishery Monitoring

A local fisheries monitor was hired through the AHTC in 2012 and 2013 to collect harvest and biological data from Dolly Varden harvested at the mouth of the Big Fish River in Little Moose Channel (Figure 1; Table 1). The monitor was tasked with recording information on weather and water conditions, gillnet set location, length, mesh size and soak time, and number of fish captured by species. The monitor was also expected to sample each Dolly Varden caught for fork length, round weight and gonad weight, determine sex and maturity, collect otoliths for ageing and a fin clip for genetic analyses, and preserve other tissue samples for archiving.

Beginning in 2014 community members harvesting Dolly Varden at the mouth of the Big Fish River during summer were requested to report their numbers to the AHTC upon their return home, while harvest monitoring efforts shifted to the Big Fish River 'fish holes'. A fall fishery and sampling plan was developed through discussions at the WSWG and among DFO, AHTC and FJMC. This plan was reviewed and approved by the IFMP Steering Committee and licensed using an ACFL. The same seine net used by Sandstrom et al. (2009) and Gallagher et al. (2013) was deployed by community members for the harvest. All fish caught in the seine were measured for fork length, with sex/maturity identified, tag numbers recorded if present, and any injuries from predators noted. Following the harvest, a predetermined number of fish were further sampled for biological information according to a plan developed to balance community needs with the benefits that biological information provides to fisheries monitoring objectives.

Firth River Fishery Monitoring

Parks Canada issues fishing permits and uses a survey to collect information from Ivvavik National Park visitors and staff members for both subsistence harvesting (Inuvialuit beneficiaries) and sport fishing (for non-beneficiaries with a permit). Information collected includes the number of fish caught and retained by species, level of effort, locations fished, and any other observations. Parks staff periodically received training on how to collect biological samples from Dolly Varden which have been sent to DFO.

COMMUNICATIONS

Pre-season Communications

The RRWG hold their annual communications meetings in June in Aklavik and Ft. McPherson, NT (Figure 2). The purpose of these meetings are to communicate the harvest level and other management decisions for the upcoming fishing season, provide an overview of research and harvest monitoring programs, and discuss community concerns, observations and direction. Furthermore, direction is provided on who to report harvests to (community monitors, Rat River harvest monitors, or through the RRCs/HTC). These public meetings are advertised through posters and local radio announcements, and often included door prizes to encourage participation. Fisheries management decisions are shared with community members through a combination of handouts, posters, social media, community radio, and word of mouth.

The WSWG invite community members to attend a public dinner and meeting each spring, where they have an opportunity to raise concerns, share observations and provide direction concerning Dolly Varden fisheries management and monitoring (Figure 2). These public meetings are advertised through posters and local radio announcements, and often included door prizes to encourage participation. Recommendations for harvest allocation are presented along with information on research and monitoring programs. Prior to the start of the fishing season the AHTC communicates management decisions and programs to the greater membership through community radio, social media, posters, and word of mouth.

In-season Communications

The RRWG has tried various in-season communication strategies, including the use of community radio, word of mouth, posters, brochures, social media and brochures. A Rat River Dolly Varden communications plan was formally developed in 2013–2014 that summarized roles and responsibilities for in-season harvest reporting (Appendix 1). This communications plan defined roles, responsibilities and timelines for harvesters, harvest monitors, RRC/HTC coordinators, and co-management partners, and identified one lead person responsible for compiling and distributing harvest data from all involved parties on a weekly basis. Methods used to communicate harvest data, when available, included camp radios, face to face interactions, satellite phone, telephone, community radio broadcasts, posters, and social media.

The WSWG developed a communications plan for the 2012 and 2013 summer fisheries at the mouth of the Big Fish River to ensure harvest didn't exceed the 150 Dolly Varden allocated for this area. The harvest monitor and AHTC had responsibilities for communications among themselves, with harvesters, and DFO to keep everyone informed when: 1) the Dolly Varden had started their upstream migration, 2) 75% of the harvest level had been reached, and 3) when 100% of the harvest level had been reached (Appendix 2). Methods used to communicate harvest included, camp radios, face to face discussions, satellite phones, telephones, community radio broadcasts, posters, and social media. In 2014 and a communications plan was not necessary given that the harvest was planned to take place at the 'fish holes' in fall with predetermined harvesters and dates. Harvesters who chose to fish at the mouth of the Big Fish River during the summer of 2014 were asked to report their Dolly Varden harvest to the AHTC, who was responsible for communicating harvest to community members and DFO.

HARVEST AND HARVEST RATES, 2009 TO 2014

Data from harvest surveys and monitoring programs were sources of information used to compile harvest statistics for this report. DFO compiles harvest data which are reviewed and verified annually by the RRWG and WSWG.

A genetic mixed-stock fishery analyses was conducted during 2011–2014 using samples collected from coastal locations and the Rat River Monitoring Program. These analyses assessed the contribution of Dolly Varden stocks from the Babbage River (Gallagher et al. 2018), Rat River (Gallagher et al. 2020a), and Big Fish River (Gallagher et al. 2013; and this report) to mixed fisheries along the coast and portions of the Rat River. Detailed background, methodologies, and discussion can be found in Gallagher et al. (2013, 2018, 2020a). In this report, where genetic mixed-stock analyses is available, the annual harvest numbers reflect the respective contributions from each assigned stock as noted in the tables. The harvest rate was calculated by dividing the estimated total number of Dolly Varden harvested from the Rat, Big Fish and Babbage River stocks by the population abundance estimate from the most recent year available given the one year time lag between tag deployment and recapture (Gallagher et al. 2018; 2020a). We used this value as our best estimate of the component of the population

susceptible to the fishery at the time of the harvest, along with our best estimates of harvest for those same years, acknowledging variability and uncertainty around all values used in these calculations. For years when population abundance estimates were not available, our best available estimate of harvest rate was to use the population abundance from the most recent year under the assumption that the population size had not changed drastically between years.

COASTAL FISHERIES

Dolly Varden harvested at Herschel Island during 2009–2014 ranged from 80 to 256 fish (mean 154) (Table 1). The net was set in different locations depending on catches but generally always within Pauline Cove in the vicinity of the base camp (R. Gordon, Qikiqtaruk-Herschel Island Park, pers. comm.). Annual harvest at Ptarmigan Bay ranged from 1 to 93 Dolly Varden (Table 1). The ability to travel to, and successfully harvest Dolly Varden, at Ptarmigan Bay was largely dependent on weather conditions; for that reason harvesting did not occur at this location in 2009 and 2010 (D.C. Gordon, Community of Aklavik, pers. comm.). Dolly Varden harvested at Shingle Point ranged from 115 to 412 fish (mean 281) (Table 1). The participation rate for local harvesters at Shingle Point during 2011–2014 was generally high (J. McLeod, Community of Aklavik, pers. comm.). Community harvesters made day trips to King and Sabine points between 2011 and 2014 and reported Dolly Varden harvests of 16 to 66 fish to the monitors at Shingle Point (Table 1). It is unknown if harvesting occurred at these locations in 2009 and 2010, and if so these numbers may have been included in the total harvest for Shingle Point. The 2009–2014 average of all Dolly Varden harvested at Shingle Point, King Point and Sabine Point combined was 305 fish.

RAT RIVER FISHERY

The voluntary harvest level of Dolly Varden from the Rat River stock, including all community harvesters, the Rat River Harvest Monitoring Program, and scientific research varied between 300 and 1225 fish, during 2009–2014 (Table 2). Further allocations of this harvest level among communities and the Rat River Monitoring sites are presented in Tables 3 and 4, respectively.

The total reported harvest from all known locations for 2009 to 2014 ranged from 261 to 387 fish (Table 2). The contribution of the Rat River population to coastal harvests was not assessed in 2009 and 2010 so harvest was underestimated for those years. With the exception of 2011, the reported harvest was consistently lower than the harvest level recommended by the RRWG. Genetic mixed-stock fishery analysis estimates of Rat River Dolly Varden harvested at coastal locations during 2011–2014 ranged from 21 to 42 fish (Table 2; Gallagher et al. 2020a). Harvest reported in annual community-based surveys varied between 69 and 199 Dolly Varden during 2009–2014. Harvests reported by the Rat River Monitoring program for 2011 to 2014 have been adjusted based on the genetic mixed-stock fishery analyses and as a result the values for 2012 to 2014 presented in Table 2 differ slightly from the total harvest compiled from each of the monitoring locations presented in Table 4. The allocation and reported harvest for communities and land claim groups is described in Table 3. Given that the AHTC allocation encompassed harvesting at the coast the portion of the coastal harvest allocated to the Rat River population generated by the genetic mixed-stock fishery analyses are also presented in Table 3. The average annual harvest rate for 2009–2014 ranged between 2.9% and 5.3% (Table 2) (Gallagher et al. 2020b).

BIG FISH RIVER FISHERY

The Big Fish River Dolly Varden harvest level for inland locations during 2012–2014 was 150 fish (Table 5). This allocation was not intended to include any harvest of this stock in the coastal fishery. In 2012 and 2013 harvest at the mouth of the Big Fish River was much lower, 61 and 29

fish, respectively. The lower catches were attributed to a reduction in community participants, poor water conditions, and the timing of the migration relative to the dates of the program.

In 2014 the entire allocation was taken at the 'fish hole' during November (n = 140) with a small number of spawning fish (< 400 mm in size) collected for research purposes in September (n = 10). Although community members had the option to harvest at the mouth of the Big Fish River during summer 2014, the AHTC did not receive any reports that fishing occurred.

The estimated contribution of the Big Fish River stock to harvests from coastal locations and Rat River Monitoring Program sites as assessed through a genetic mixed-stock fishery analysis, for samples collected during 2011–2014 suggested a high degree of inter-annual variability (Table 6). Big Fish River stock contributions at Shingle Point ranged from 2.1–34.4% (mean 15.0%) and from 1.9–13.8% (mean 6.8%) at King/Sabine Point. There were negligible contributions further west along the coast at Ptarmigan Bay (1.4% in 2011 only) and Herschel Island ($\leq 0.2\%$ for all years) (Table 6). Combining the mixed-stock analyses contributions and reported harvest at Shingle Point and King/Sabine Point produced harvest estimates of 9–40 fish (mean 28) and 0–2 fish (mean 1), respectively. Results also suggested the presence of fish from the Big Fish River stock at harvest monitoring locations at the mouth and lower reaches of the Rat River, although at a negligible rate (contribution estimates $\leq 2.2\%$; 1 or zero fish harvested at each of these sites annually) (Table 6).

Accounting for harvest at all known locations during 2011–2014, the total estimated annual harvest from the Big Fish River population ranged between 29 and 190 annually (Table 7). Total harvest was underestimated in 2009 and 2010 because contributions to the coastal harvest were not assessed in those years. However, given there was no directed harvest on the stock the total harvest is presumed to be lower than in other years. The 2010 population abundance estimates for fish ≥ 310 mm and ≥ 365 mm from Gallagher et al. (2013) were used to estimate harvest rate for 2011–2014 which varied between 0.5–3.3% and 0.7–4.4%, respectively. The highest rate occurred in 2014 when a community harvest occurred at the 'fish holes'.

BABBAGE RIVER FISHERY

To date the WSWG has not identified the need to allocate a harvest level for the Babbage River Dolly Varden population given that harvests have been small relative to population size. However, its contributions to coastal harvests continue to be monitored. While there was no fishery on the Babbage River between 2009 and 2014, there were 9 fish caught in 2014 for scientific research and there have been harvests from coastal locations along the Canadian Beaufort Sea (Gallagher et al. 2018). Genetic mixed-stock fishery analyses of harvest from coastal locations during 2011–2014 indicated that fish from the Babbage River stock were harvested primarily at Shingle Point, with estimates ranging from 30–89% (mean 64%) (Gallagher et al. 2018). Total harvest ranged from 77 to 437 fish but was underestimated for 2009 and 2010, given that contributions to the coastal harvest were not assessed in those years (Table 8). Using the most recent population abundance estimates for fish ≥ 310 mm and ≥ 365 mm from Gallagher et al. (2018), estimated harvest rates for 2011–2014 varied between 0.7–5.5% and 0.7–6.9%, respectively (Table 8).

FIRTH RIVER FISHERY

To date the WSWG has not identified the need to establish harvest levels for Dolly Varden populations within Ivvavik National Park, given that harvests have been relatively small. The total reported harvest by permit holders and Inuvialuit beneficiaries from the Firth River did not exceed 50 fish annually between 2009 and 2014, although some records were not available (Table 9). The proportion of permit holders that reported catching Dolly Varden during 2010–

2012 ranged from 32–57%. In 2014, 20 Dolly Varden were sampled by Parks Canada staff for research purposes. Dolly Varden from populations within Ivvavik National Park are also known to contribute to catches from locations along the Canadian and Alaskan Beaufort Sea coasts (Krueger 1999), however, these contributions have not been formally assessed for the years presented in this paper. Harvest rates have not been calculated for Dolly Varden populations within the Firth River watershed.

ALL LOCATIONS

Dolly Varden harvest from all coastal and inland locations within the ISR and GSA during 2009–2014 ranged between 654 and 1086 fish, with an average of 848 fish per year. Estimated annual harvest rates for the Big Fish River, Babbage River, and Rat River populations were less than 7% of the most recent population abundance estimates.

HARVEST INFORMATION AND THE CO-MANAGEMENT OF DOLLY VARDEN

A number of factors determine Dolly Varden harvest, including, but not limited to, fish migration timing, weather and water conditions, population sizes, location and timing of fishing, number of active harvesters, dependence on local foods, and fuel and equipment costs. Traditional and local knowledge is essential to understanding and interpreting the factors affecting harvest. For these reasons the RRWG and WSWG communicate harvest results and discuss fisheries management issues on an annual basis with community harvesters to get their input towards future decision-making.

The harvest survey and monitoring programs outlined above have relied on the participation of harvesters from Aklavik, Ft. McPherson, and the surrounding area, as well as the commitment of harvesters who have worked seasonally as monitors for years, in some cases, decades. All of the information collected by these programs has been from harvesters who have voluntarily reported their catches. The information collected through these programs underscore the value associated with training local monitors to lead the long-term collection of harvest and biological data through community-based programs (Bell and Harwood 2012). While there have been occasional concerns raised that one or two individuals were not accurately reporting their harvest, thereby underestimating the total, the working groups have commented that participation rates were high. Most harvesters recognize the importance of collecting harvest information. The working groups also concluded that the number of fish harvested but not reported would likely be small and would not affect management decisions.

For fishing areas where the working groups had established a harvest level, it was important to have a strong in-season communications plan to avoid surpassing it. This was especially valuable for coastal and delta Dolly Varden fisheries, given that fishing can occur in remote locations, over a large geographical area, and over a timespan of several weeks. Furthermore, pre-season communications were important to notify harvesters about the allocations and reasons behind them, to familiarize them with monitoring and survey programs so that they would be more comfortable participating, and to seek feedback to ensure that both management decisions and monitoring programs would be well received.

Through the process of adaptive co-management (Ayles et al. 2007) the RRWG and WSWG build on their past successes and challenges, continuously adjusting to ensure that management decisions and monitoring programs are applying the best available scientific and traditional knowledge. This is demonstrated through modifications over the years to harvest levels, monitoring programs, communication plans, research programs, and management measures. The RRWG and WSWG meetings have provided a forum to evaluate the effectiveness of management measures and monitoring programs with all partners, including

the communities' subsistence harvesters. Complementary to these annual assessments at the working group level, periodic DFO peer-reviewed stock assessments through the Canadian Science Advisory Secretariat (CSAS) process have also supported the working group decisions (Big Fish (DFO 2013); Babbage (DFO 2017a); and Rat Rivers (DFO 2017b)).

In addition to the harvest survey and monitoring programs, population abundance estimates generated from fall mark-recapture research programs and genetic mixed-stock fishery analyses continue to remain a priority, so that population abundance and stock contributions to the coastal fisheries can be monitored and harvest levels adjusted accordingly.

Results of the genetic mixed-stock fishery suggested a different harvest composition than that based on tag returns alone (Stephenson 2003). Furthermore, the analyses revealed the potential for significant inter-annual variability, reinforcing the value of continuing these analyses on an annual basis. Although the results of these analyses are only available through a retrospective lens, they still provide the working groups with information that can be used to guide future decisions and allow for a better assessment of total harvest for each stock.

CONCLUSIONS

Dolly Varden harvests in the ISR and GSA were collected using community-based harvest surveys and monitoring programs that have been designed and adapted over time to help both community harvesters and co-managers in their decision-making. Dolly Varden harvest from all coastal and inland locations within the ISR and GSA during 2009–2014 ranged between 654 and 1,086 fish. Estimated annual harvest rates for the Big Fish River, Babbage River, and Rat River populations between 2009 and 2014 were less than 7% of the most recent population abundance estimates.

Dolly Varden populations have been effectively managed and monitored by the RRWG, WSWG, and DFO, based on sustainable harvesting principles which are core to Inuvialuit and Gwich'in cultures. Leadership and participation from community harvesters, strong working relationships, and tailored research and monitoring programs all contribute to adaptive co-management of these Dolly Varden fisheries. The allocation of harvest levels by the working groups has been one of the tools used to successfully manage these fisheries. Annual review of harvest data, along with assessment of scientific, traditional and local knowledge indicators by the RRWG and WSWG will continue to support the sustainable management of Dolly Varden populations.

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TABLES AND FIGURES

Table 1. Dolly Varden harvested at coastal subsistence fishing locations along the Canadian Beaufort Sea, 2009–2014.

Location	2009	2010	2011	2012	2013	2014
Herschel Island	80	256	129	118	189	151
Ptarmigan Bay	6	-	93	1	12	0
King Pt./Sabine Point	-	-	43	66	19	16
Shingle Point	307	252	193	412	115	404
Total	393	508	458	597	335	571

- Unreported harvest and/or not known to have been fished.

Table 2. Number of Dolly Varden harvested from the Rat River stock (coastal and inland locations), harvest level, population abundance estimates from harvest monitoring and seining programs (see Gallagher et al. 2020b) and harvest rates, 2009–2014. Annual harvest rates were estimated based on population estimates derived from each program, as well as the average of these two estimates.

Year	Beaufort Sea Coast ^a	Community Harvest Surveys	Rat River Harvest Monitors	Research	Total Harvest	Harvest Level	Population Abundance 1 ^b	Population Abundance 2 ^c	Harvest Rate 1 ^b (%)	Harvest Rate 2 ^c (%)	Average Harvest Rate (%)
2014	42	167	178 ^a	0	387	420	†	†	2.6	3.2	2.9
2013	33	113	172 ^a	0	318	420	14,891	11,919	2.1	2.7	2.4
2012	21	195	146 ^a	0	362	375	-	-	3.9	6.2	5.1
2011	24	199	147 ^a	9	379	300	-	-	4.1	6.5	5.3
2010	-	59	220	0	279 [‡]	600	9,310	5,820	3.0	4.8	3.9
2009	-	69	192	0	261 [‡]	1225	6,625	5,792	3.9	4.5	4.2

^a Based on genetic mixed-stock fishery analyses of samples collected from the coast and the Rat River Harvest Monitoring Program (Table 6; Gallagher et al. 2020a, so values for 2012-14 differ slightly from those presented in Table 4; stock contributions to the coastal harvest were undetermined in 2009 and 2010.

^b population abundance (harvest monitoring estimated) and corresponding harvest rate calculated by dividing the total harvest by the population abundance (Gallagher et al. 2020a).

^c population abundance (seine estimated) and corresponding harvest rate calculated by dividing the total harvest by the population abundance (Gallagher et al. 2020b).

[‡] Underestimated due to lack of information from coastal genetic mixed-stock analyses.

- Not assessed in this year.

† Not available at the time of the review.

Table 3. Rat River Dolly Varden harvest level (allocation) for each community (A), harvest from subsistence fishing locations in the Mackenzie River Delta and Rat River based on community surveys (H), and contribution to the coastal harvest (CH), 2009–2014. The harvest allocation for Inuvialuit from Aklavik encompassed both the harvest in the delta (H) and the Rat River stocks' contribution to the coastal harvest (CH).

Year	Ft. McPherson Gwich'in		Aklavik Gwich'in		Aklavik Inuvialuit			Total	
	A	H	A	H	A	H	CH*	A	H
2014	80	96	80	15	80	56	42	240	209
2013	80	0	80	41	80	72	33	240	146
2012	75	112	75	38	75	45	21	225	216
2011	50	43	50	69	50	87	24	150	223
2010	175	0	100	46	100	13	-	375	89 [#]
2009	400	41	300	0	300	28	-	1000	112 [#]

* Based on coastal harvest and genetic mixed-stock fishery analyses (Gallagher et al. 2020a); stock contributions to the coastal harvest were undetermined in 2009 and 2010.

[#] Underestimated due to lack of information from coastal genetic mix-stock analyses.

- Not assessed in this year.

Table 4. Rat River Dolly Varden harvest level (allocation) (A), and reported harvest (H), for Rat River Harvest Monitoring Program sites 2009–2014: Big Eddy (John Carmichael), Mouth of Rat River (Billy Wilson), and Destruction City (Selwyn Kay) and the total numbers for all three locations.

Year	Big Eddy		Mouth of Rat River		Destruction City		Total	
	A	H	A	H	A	H	A	H
2014	60	60	60	60	60	60	180	180
2013	60	60	60	60	60	60	180	180
2012	50	50	50	50	50	50	150	150
2011	47	47	47	50	47	50	141	147
2010	75	75	75	70	75	75	225	220
2009	75	46	75	71	75	75	225	192

Table 5. Big Fish River Dolly Varden harvest level, reported harvest by location and date, and total harvest, 2012-2014. These numbers do not include harvest from the coastal harvesting sites.

Year	Harvest Level	Total Harvest	Reported Harvest	Location	Harvest Dates	Notes
2014	150	150	0	Mouth of Big Fish River, in Little Moose Channel	NA	Voluntary Reporting to Aklavik Hunters and Trappers Committee
-	-	-	10	Fish Holes, Little Fish Creek	September	Scientific harvest of small anadromous spawners as approved by WSWG
-	-	-	140	Fish Holes, Little Fish Creek	November 8	Community harvest under an Aboriginal Communal Fishing Licence
2013	150	61	61	Mouth of Big Fish River, in Little Moose Channel	August 4–11	Harvest Monitoring Program July 19–August 11
2012	150	29	29	Mouth of Big Fish River, in Little Moose Channel	August 8–19	Harvest Monitoring Program August 8–19

Table 6. Dolly Varden harvest information (location, year, dates, number of fish) for subsistence fishing locations along the Canadian Beaufort Sea coast (2011–2014) and in the Mackenzie Delta and Rat River (2012–2014). Percent contribution (\pm 95% C.I.) and number of fish harvested (\pm 95% C.I.) from the Big Fish River stock based on a genetic mixed-stock fishery analysis (Bayesian mixture methods) is also provided. Table adapted from Gallagher et al. (2020a).

a) Beaufort Sea cost

Locations	Year	Dates of harvest and sampling	Total number of Dolly Varden harvested	% contribution to harvest from Big Fish River stock	Number of Big Fish River stock harvested
Herschel Island	2014	Jun. 21–Aug. 11	151	0.1 (0–0.9)	0 (0–1)
	2013	Jun. 29–Aug. 29	189	0.1 (0–0.9)	0 (0–1)
	2012	Jul. 15–Aug. 19	118	0.1 (0–1.2)	0 (0–1)
	2011	Jun. 13–Aug. 4	129	0.2 (0–1.3)	0 (0–2)
Ptarmigan Bay	2014	-	-	-	-
	2013	Early Jul.	12	*	*
	2012	Early Jul.	1	*	*
	2011	Jul. 1–4	93	1.4 (0–1.3)	0 (0–1)
King Pt./ Sabine Pt.	2014	Jul. 18 & Aug. 1	16	13.8 (2.2–35.2)	2 (0–6)
	2013	Aug. 2 & 3	19	6.5 (0–21.4)	1 (0–4)
	2012	Jul. 20–23	66	1.9 (0–1.7)	0 (0–1)
	2011	Jul. 22–23 & Aug. 2	43	4.9 (0.2–16.3)	2 (0–7)
Shingle Point	2014	Jul. 17–Aug. 8	404	9.4 (6.5–12.4)	38 (26–50)
	2013	Jul. 30–Aug. 14	115	34.4 (26.0–43.2)	40 (30–50)
	2012	Jul. 16–Aug. 9	412	2.1 (0.8–4.4)	9 (3–18)
	2011	Jul. 22–Aug. 9	193	14.2 (9.4–19.9)	27 (18–38)

b) Mackenzie Delta/ Rat River

Locations	Year	Dates of harvest and sampling	Total number of Dolly Varden harvested	% contribution to harvest from Big Fish River stock	Number of Big Fish River stock harvested
Big Eddy (Mackenzie Delta)	2014	Jul. 30–Aug. 28	60	0.2 (0–1.7)	0 (0–1)
	2013	Jul. 24–Aug. 31	60	0.2 (0–1.7)	0 (0–1)
	2012	Jul. 29–Sep. 1	50	0.3 (0–2.8)	0 (0–1)
Mouth of Rat River	2014	Aug. 7–Sep. 8	60	0.1 (0–1.4)	0 (0.1–1)
	2013	Aug. 5–Sep. 6	60	1.9 (0–6.1)	1 (0–4)
	2012	Aug. 9–Sep. 2	50	0.3 (0–2.4)	0 (0.1–1)
Destruction City (Rat River)	2014	Aug. 6–Sep. 10	60	0.2 (0–1.5)	0 (0–0.9)
	2013	Aug. 11–Sep. 12	60	1.8 (0.1–6.1)	1 (0–4)
	2012	Aug. 6–Sep. 7	50	2.2 (0.1–7.5)	1 (0–4)

- no fishing occurred at Ptarmigan Bay in 2014

* no genetic samples collected; assumed that contribution of Big Fish River stock was negligible

Table 7. Big Fish River Dolly Varden harvest estimates from coastal and inland locations, 2009–2014. The harvest rate based on 2010 population abundance estimates for ≥ 310 mm and ≥ 365 mm fish is also provided (Gallagher et al. 2013). Dead-sampled fish from fishery-independent research (at the spawning and overwintering location in Little Fish River) is reported under research.

Year	Beaufort Sea Coast*	Mouth of Big Fish River	Fish Holes	Research	Other locations*	Total Harvest	Population size ≥ 310 mm	Population size ≥ 365 mm	Harvest Rate ≥ 310 mm (%)	Harvest Rate ≥ 365 mm (%)
2014	40	0	140	10	0	190	†	†	3.3	4.4
2013	41	61	0	0	2	102	†	†	1.8	2.3
2012	9	29	0	0	1	38	†	†	0.7	0.9
2011	29	0	0	0	-	29	†	†	0.5	0.7
2010	-	0	0	0	-	0 [‡]	5,794	4,341	-	-
2009	-	0	0	0	-	0 [‡]	4,441	3,855	-	-

* Based on genetic mixed-stock fishery analyses using samples collected from the coast and the Rat River Harvest Monitoring Program (Table 6); stock contributions to the coastal harvest were undetermined in 2009 and 2010.

[‡] Underestimated due to lack of information from coastal genetic mixed-stock analyses.

† Not available at the time of the review.

- Not assessed in this year.

Table 8. Babbage River Dolly Varden harvest estimates from coastal and inland locations, 2009–2014. The harvest rate was calculated by dividing harvest by the population estimate for each year from Gallagher et al. (2018), except in 2014 where a population estimate was not available and the 2013 estimate was used. Dead-sampled fish from fishery-independent research conducted at the spawning and overwintering location in Fish Hole Creek is reported under Research.

Year	Beaufort Sea Coast*	Research	Total Harvest	Population size ≥ 310 mm	Population size ≥ 365 mm	Harvest Rate ≥ 310 mm (%)	Harvest Rate ≥ 365 mm (%)
2014	284	9	294	†	†	2.8	2.8
2013	77	0	77	10,659	10,356	0.7	0.7
2012	437	0	437	7,950	6,363	5.5	6.9
2011	82	0	82	7,407	5,861	1.1	1.4
2010	-	0	0 [‡]	8,427	6,553	-	-
2009	-	0	0 [‡]	-	-	-	-

* Based on genetic mixed-stock fishery analyses of samples collected from the coast (Gallagher et al. 2018); stock contributions to the coastal harvest were not determined in 2009 and 2010.

[‡] Underestimated due to lack of information from coastal genetic mix-stock analyses.

† Not available at the time of the assessment.

- Not assessed in this year.

Table 9. Dolly Varden harvested from the Firth River in Ivvavik National Park during 2009–2014, reported by permit holders, beneficiaries, and Parks Canada staff (biological samples). Harvest reporting rate is also calculated based on number of permits issued.

Year	Permit Holders	Beneficiaries	Parks Canada Staff	Total Harvest	% Reporting rate (number reported of permits issued)
2014	-	-	20	≥ 20	-
2013	6	4	0	10	-
2012	22	7	0	29	57 (25 of 44)
2011	11	8	0	19	32 (12 of 38)
2010	33	14	0	47	34 (19 of 56)
2009	-	-	0	-	-

- Records unavailable

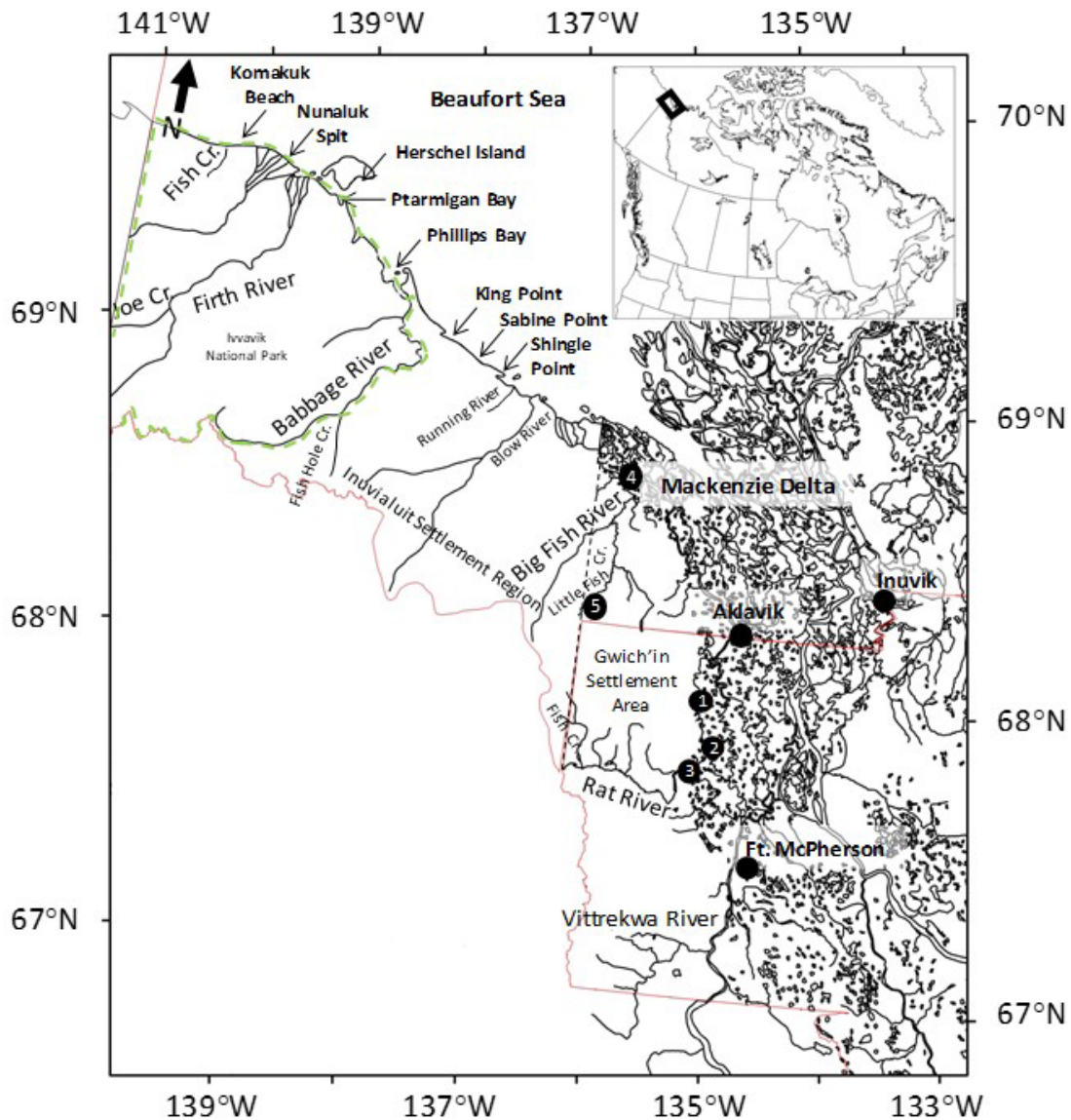
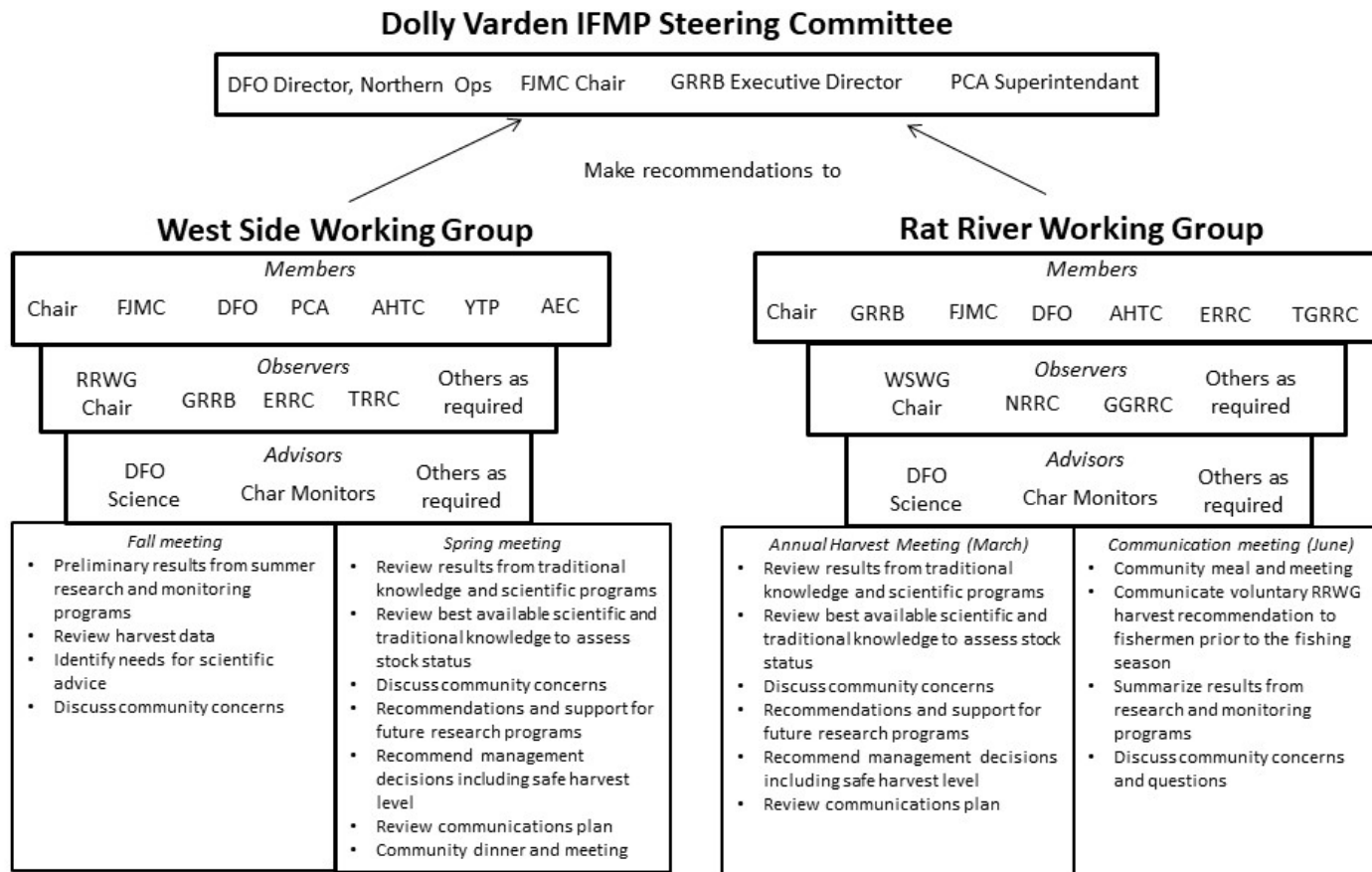


Figure 1. Location of rivers and creeks* in the Inuvialuit Settlement Region and Gwich'in Settlement Area (red lines delineate borders) known to support anadromous Dolly Varden populations and locations along the Beaufort Sea coast where harvesting of Dolly Varden occur. Inuvik National Park is highlighted with the dashed green line. Locations where harvest monitors have collected fisheries information during the upstream migration of Dolly Varden (end of July-September) in the Mackenzie Delta (Husky Channel) are at (1) Big Eddy, (2) the mouth of the Rat River, (3) Destruction city and (4) the mouth of the Big Fish River and during fall (October-November) at (5) the Big Fish River 'Fish Holes'. Map adapted from Gallagher et al. (2020a). *Joe Cr., Firth R., Babbage R., Big Fish R./ Little Fish Cr., Rat R./ Fish Cr., and Vittrekwa R.



ACRONYMS:
 DFO- Department of Fisheries and Oceans; GRRB- Gwich'in Renewable Resources Board; FJMC- Fisheries Joint Management Committee; PCA- Parks Canada Agency;
 YTP- Yukon Territorial Parks; AEC- Aklaviik Elders Committee; AHTC- Aklaviik Hunters and Trappers Committee; ERRC- Ehditiat Renewable Resource Council;
 TGRRC- Tetlit Gwich'in Renewable Resource Council; GGRRC- Gwich'ya Gwich'in Renewable Resource Council; NRRC- Nihtat Renewable Resource Council

Figure 2. Dolly Varden co-management system with roles and responsibilities described for the West Side and Rat River Working Groups . The system includes an Integrated Fisheries Management Plan Steering Committee, that receives recommendations from the two regional working groups.

APPENDIX 1. 2014 RAT RIVER DOLLY VARDEN COMMUNICATIONS PLAN

1. Shingle Point Monitors

The Shingle Point Dolly Varden Monitors are responsible for collecting Dolly Varden harvest numbers in the Shingle Point area. They are responsible for communicating these numbers to the AHTC and DFO (Ellen) by Sat Phone or other device every Tuesday on the same schedule as the “2014 Char Fishing In-Season Reporting Table” (for harvest Monday–Sunday of the previous week). They are also responsible for communicating total harvest numbers back to the harvesters as they receive updates from the AHTC.

2. Rat River Community Char Interviewers (Monitors- one from AHTC, ERRC and TGRRC)

The Harvest Interviewers will conduct verbal interviews with Dolly Varden community harvesters twice a week (Aklavik- July 28, 2013 to September 14; Ft McPherson August 4–September 21) using data forms provided by Fisheries and Oceans Inuvik (“Community Monitor Reporting Page”). The information is to be collected on Monday and Friday of each week and then submitted to the HTC/RRCs on the same day as the interviews.

They are also responsible for communicating total harvest numbers back to the harvesters as they receive updates from the AHTC, ERRC and TGRRC.

3. Rat River Char Monitors (John Carmichael, Billy Wilson and Selwyn Kay)

Monitors are responsible for collecting their own harvest information and biological samples as a part of the Rat River Monitoring Program. While John, Billy and Selwyn can record harvest information from other harvesters in their books, other harvesters are strongly encouraged to report their harvest numbers back through the Community Char Interviewers/Monitors in Fort McPherson or Aklavik, as this is how we will be keeping track of in-season harvest numbers.

4. Aklavik HTC

The AHTC is responsible for collecting harvest data from the Community Char Interviewer and the Shingle Point Dolly Varden Monitors on Monday and Friday of each week, compiling this information into the same reporting spreadsheet for both the Shingle Point and Aklavik HTC areas (“2014 Char Fishing In-Season Reporting Table”). The AHTC is then responsible for sending the total Shingle Point and AHTC numbers every Tuesday to Kris Maier (KMaier@grrb.nt.ca) and Ellen Lea (Ellen.Lea@dfo-mpo.gc.ca). The AHTC is also responsible for sending a copy of the completed “Community Monitor Reporting Page” to DFO Inuvik each week.

The AHTC is also responsible for communicating total harvest numbers back to the monitors and community fishers.

5. Ehdiitat and Tetlit RRCs

The ERRC and TGRRC are responsible for collecting harvest data from the Community Char Interviewer on Monday and Friday of each week, compiling this information into the same reporting spreadsheet (“2014 Char Fishing In-Season Reporting Table”). The RRCs are then responsible for sending the total harvest numbers every Tuesday by email to Kris Maier (KMaier@grrb.nt.ca) and Ellen Lea (Ellen.Lea@dfo-mpo.gc.ca). The ERRC and TGRRC are also responsible for sending a copy of the completed “Community Monitor Reporting Page” to DFO Inuvik each week.

The ERRC and TGRRC are also responsible for communicating total harvest numbers back to the monitors and community fishers.

6. K. Maier (GRRB Fisheries Biologist) and E. Lea (DFO Fisheries Biologist)

K. Maier will be the primary person compiling the harvest data from the AHTC, ERRC and TGRRC. Ellen Lea will help as a back-up if Kris is away. Kris will send out weekly reports based on reported harvest to the AHTC, ERRC, TGRRC, DFO Inuvik (E. Lea), and FJMC (K. Hynes).

7. Community harvesters

If you are a **Gwich'in participant fishing at/near Ft McPherson**, the Rat River or Husky Channel:

- Report your harvest to the Ft McPherson RRC community harvest monitor
or
- Report your harvest to the Ft McPherson RRC coordinator (Georgina Vaneltsi-Neyando).

If you are a Gwich'in participant fishing at/near Aklavik, the Peel Channel or Husky Channel:

- Report your harvest to the Aklavik RRC community harvest monitor
or
- Report your harvest to the Aklavik RRC coordinator (Corinne Dillon)

If you are an Inuvialuit participant fishing at/near Aklavik, the Peel Channel or Husky Channel:

- Report your harvest to the Aklavik HTC community harvest monitor
or
- Report your harvest to the Aklavik HTC coordinator (Michelle Gruben).

If you are an Inuvialuit participant fishing at/near Shingle Point or along the coast:

- Report your harvest to the Aklavik HTC Shingle Point harvest monitors
or
- Report your harvest to the Aklavik HTC community harvest monitor
or
- Report your harvest to the Aklavik HTC coordinator (Michelle Gruben).

APPENDIX 2. 2013 BIG FISH RIVER DOLLY VARDEN COMMUNICATIONS PLAN

2013 Big Fish Harvest Communication Diagram

Communication 1 Fish Run Started

Who	How	When
Monitor to HTC	Camp radios/ satellite phone	As soon as run starts
HTC to community/pre-determined harvesters	Phone, radio, facebook	Same day as receiving news of run starting from monitor

ACTION: Harvesters proceed to harvesting location(s).

Communication 2 75% of the limit has been reached (112/150)

Who	How	When
Monitor to harvesters	Camp radios, site visits	As soon as 75% limit is reached
Monitor to HTC	Camp radios, satellite phone	As soon as 75% limit is reached
HTC to harvester list	Radio, facebook, phone	Same day as receiving news from monitor

ACTION: Harvesters/monitor/HTC determine how remainder of harvest limit will be caught; determined by monitor to ensure even distribution of char between harvesters. Communication through marine radio and satellite phone.

Communication 3 100% of the limit has been reached

Who	How	When
Monitor to harvesters	Camp radios, site visits	As soon as limit is reached
Monitor to HTC	Camp radios, satellite phone	As soon as limit is reached
HTC to harvester list	Radio, facebook, phone list	Same day as receiving news from monitor.

ACTION: Harvest ceases.