

**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**  
**2011 – 2015**  
**VOLUME 2: APPENDICES**



Photo Credit: Colin Gallagher-DFO, Big Fish River 2009

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## INTRODUCTION

This Integrated Fisheries Management Plan (IFMP) is for Dolly Varden (*Salvelinus malma malma*) of the Gwich'in Settlement Area (GSA) and the Inuvialuit Settlement Region (ISR) in Canada's Western Arctic (see Fig. 1, Volume 1). An IFMP serves as a guide for the conservation, sustainable use and recovery of fish species or stocks, and identifies measures to prevent harm to the species or stocks. The IFMP for Dolly Varden contains objectives, strategies and measures for managing these stocks and helping in their rebuilding. The IFMP will be used by the fishermen, communities, Gwich'in, Inuvialuit, Government of Canada and other stakeholders in managing day-to-day and longer-term activities and should achieve long-term conservation and sustainable use of Dolly Varden in the GSA and ISR

The IFMP was developed and will be implemented by the Government of Canada, Gwich'in and Inuvialuit partners through an adaptive co-management process that advances community-based management. Groups involved in the preparation of the IFMP were Fisheries and Oceans Canada (DFO), the Fisheries Joint Management Committee (FJMC), the Gwich'in Renewable Resources Board (GRRB), the Aklavik Hunters and Trappers Committee (HTC), the Ehdiiitat Renewable Resources Council (RRC), the Gwichya RRC, the Nihtat RRC, the Teetl'it RRC, elders of Aklavik and Teetl'it Zheh, Parks Canada Agency, the Rat River Working Group, and the West Side Working Group.

The IFMP is in two volumes. Volume 1 contains the Plan. This volume, Volume 2, contains the appendices to the Plan:

Appendix A: Abbreviations and Glossary

Appendix B: Integrated Fisheries Management Plans

Appendix C: Jurisdictional Context

Appendix D: Co-Management in the GSA and ISR

Appendix E: Habitat and Ecosystems

Appendix F: Management History

Appendix G: Harvest Levels

Appendix H: Stock Status

Appendix I: General DFO, Gwich'in, Inuvialuit and PCA Objectives

Appendix J: Objectives, Strategies and Measures for the Management of Dolly Varden

Appendix K: Research and Monitoring Plan

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Appendix M: Selected Sources of Information

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## APPENDIX A: ABBREVIATIONS AND GLOSSARY

This Appendix contains a list of abbreviations and acronyms and a glossary of many of the terms used in the Dolly Varden IFMP.

### Abbreviations and Acronyms

BSP	Beaufort Sea Partnership
CEAA	Canadian Environmental Assessment Act
COSEWIC*	Committee on the Status of Endangered Wildlife in Canada
CPUE*	Catch per Unit Effort
DEW	Distant Early Warning
DIDSON*	Dual-Frequency Identification Sonar
DFO*	Department of Fisheries and Oceans
DV	Dolly Varden
EC	Environment Canada
EIRB	Environmental Impact Review Board
EISC	Environmental Impact Screening Committee
ENR	Environment and Natural Resources
FJMC*	Fisheries Joint Management Committee
GCLCA*	Gwich'in Comprehensive Land Claim Agreement
GLWB	Gwich'in Land and Water Board
GNWT	Government of the Northwest Territories
GRRB*	Gwich'in Renewable Resources Board
GSA*	Gwich'in Settlement Area
GSCI	Gwich'in Social and Cultural Institute
GTC	Gwich'in Tribal Council
HTC*	Hunters and Trappers Committee
IFA*	Inuvialuit Final Agreement
IFMP*	Integrated Fisheries Management Plan
IGC	Inuvialuit Game Council
IOMP	Integrated Ocean Management Plan
IPNV	Infectious Pancreatic Necrosis Virus
ISR*	Inuvialuit Settlement Region
LOMA*	Large Ocean Management Area
MPA	Marine Protected Area
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	Mackenzie Valley Resource Management Act
PCA	Parks Canada Agency
RRC*	Renewable Resources Committee
RRWG*	Rat River Working Group
SARA*	Species at Risk Act
TAC	Total Allowable Catch
TEK	Traditional Ecological Knowledge (TK)
WSWG*	West Side Working Group

YESAA Yukon Environmental and Socio-economic Assessment Act

\*denotes glossary term.

## **Glossary**

### *Anadromous*

Anadromy refers to a life history mode in a species of fish which is hatched and resides in a freshwater ecosystem for a short period of time, matures in the ocean and returns to freshwater to spawn. Various modes of anadromy exist; that followed by northern Dolly Varden is one of seasonal anadromy where fish use the sea during summer but return each year to overwinter in fresh water.

### *Carrying Capacity*

With respect to fisheries, carrying capacity indicates the number of fish and diversity of fish species that the aquatic environment is capable of supporting for an indefinite amount of time.

### *Co-Management*

Adaptive co-management is a process that permits stakeholders to share management responsibility and to learn from their actions through multi-level feedback. It includes a shared common focus, a high degree of interaction, multiple levels of shared responsibility, some autonomy at different levels, generation and sharing of knowledge at all levels, flexible learning, and recognition of uncertainty.

### *Committee on the Status of Endangered Wildlife in Canada (COSEWIC)*

COSEWIC is a committee of experts that assesses and designates which wildlife species are in some danger of disappearing from Canada. COSEWIC was created in 1977 as a result of a decision made at the Conference of Federal-Provincial-Territorial Wildlife Directors held in 1976 in Fredericton, New Brunswick. It arose from the need for a single, official, scientifically sound, national classification of wildlife species at risk. COSEWIC is an advisory body to the Species at Risk Act (SARA), thus ensuring that wildlife species will continue to be assessed using the best available scientific and Aboriginal Traditional Knowledge. Under SARA, the government of Canada will take COSEWIC's designations into consideration when establishing the legal list of wildlife species at risk.

### *Catch per Unit Effort (CPUE)*

The amount of fish caught for a given fishing effort. E.g.: number of fish caught per hour per meter of gill net.

### *Department of Fisheries and Oceans (DFO)*

Fisheries and Oceans Canada (DFO) delivers programs and services that support sustainable use and development of Canada's waterways and aquatic resources. On

behalf of the Government of Canada, DFO is responsible for developing and implementing policies and programs in support of Canada's scientific, ecological, social and economic interests in oceans and fresh waters. Working agreements under the GCLCA, IFA and with the GRRB, FJMC and GNWT help to define the mandate of DFO with respect to Dolly Varden char.

#### *DIDSON Camera*

This "Acoustic Camera" gives near-video quality images for inspection and identification of objects underwater. It is a surrogate for optical systems in turbid water. Dual-frequency Identification Sonar transmits pulses of sound then listens for echoes returning from objects in the "field of view" of the sonar. Objects of different sizes, shapes, ranges, and positions return echoes of different strengths or intensities, from different directions and coming back at different times. DIDSON collects these echoes and maps them to form an image. DIDSON works in waterways with rocky, uneven beds where other acoustic measurement products have been ineffective. DIDSON is generally placed in the water near the bank and pings perpendicular to the flow. Fish are imaged and optionally counted and sized as they pass through the sonar's field of view.

#### *Fisheries Joint Management Committee (FJMC)*

Established by the IFA of 1984, the FJMC is the co-management board responsible for fish and marine mammals in the ISR. The FJMC has five members, two appointed by the Government of Canada, two appointed by the Inuvialuit, and a Chair selected by the members.

#### *Gwich'in Comprehensive Land Claim Agreement (GCLCA)*

Signed on April 22, 1992, the Gwich'in Comprehensive Land Claim Agreement is a modern treaty between the public governments of the Northwest Territories and Canada and the aboriginal population of the area customarily occupied by the Gwich'in. Its major provisions include: Gwich'in title to over 22,000 square kilometres of land in the Northwest Territories and over 1,500 square kilometres of land in the Yukon; Gwich'in wildlife harvesting rights and rights of first refusal for a variety of commercial wildlife activities; establishment of institutions of public government to manage wildlife and to regulate land, water and the involvement, with Gwich'in representation guaranteed, on these public institutions; transfer of monies to the Gwich'in Tribal Council.

#### *Gwich'in Renewable Resources Board (GRRB)*

Established by the 1992 Gwich'in Comprehensive Land Claim Agreement (GCLCA) between Canada and the Gwich'in, the GRRB is a public co-management board with responsibilities for fish, wildlife, and forest management in the Gwich'in Settlement Area in the Northwest Territories. This includes the area south of the ISR in the Mackenzie Delta and Mackenzie Valley and parts of the Richardson and northern Mackenzie mountains.

#### *Gwich'in Settlement Area (GSA)*

The Gwich'in Settlement Area (GSA) of the Canadian Western Arctic is comprised of land from the Yukon and Northwest Territories. The Gwich'in Settlement Area (GSA) is

a portion of the Mackenzie Valley in the Northwest Territories and includes the communities of Inuvik, Fort McPherson, Aklavik and Tsiigehtchic. The Agreement covers approximately 56,935 km<sup>2</sup>.

*Hunters and Trappers Committee (HTC)*

The IFA of 1984 established local Hunters and Trappers Committees in each community in the ISR (Aklavik, Inuvik, Holman, Paulatuk, Sachs Harbour and Tuktoyaktuk). HTCs are co-management partners primarily working with DFO, the FJMC and the IGC to manage natural resources in the ISR. HTCs have the power to distribute allocations within its membership. In Aklavik, the HTC and RRC work together to distribute allocations.

*Inuvialuit Final Agreement (IFA)*

The IFA is the 1984 comprehensive land claim agreement between Canada and the Committee for Original Peoples' Entitlement, representing the Inuvialuit of the western Canadian Arctic. The agreement established the Inuvialuit Settlement Region and a co-management system for all matters relating to the management of living resources in the region, including their habitats. The basic goals of the Agreement are to preserve Inuvialuit cultural identity and values within a changing northern society and enable the Inuvialuit to be equal and meaningful participants in the northern and national economy and society; and protect and preserve the arctic wildlife, environment, and biological productivity.

*Inuvialuit Settlement Region (ISR)*

The area of the Northwest Territories and Yukon Territory negotiated in the Inuvialuit Final Agreement as defined in Annex A-1 of the Inuvialuit Final Agreement 1984.

*Large Ocean Management Area (LOMA)*

Large ocean management areas (LOMAs) are marine regions established by DFO for planning purposes. They form the planning basis for implementation of integrated-management plans. LOMAs are typically hundreds of square kilometres in size. Their boundaries are determined using a combination of ecological and administrative considerations.

*Perennial*

Perennial is a term used to define something that is present year-round. With respect to this document, perennial refers to stream-flow and rivers that flow continuously year round.

*Precautionary Approach*

The precautionary approach was defined in the 1992 United Nations Conference on Environment and Development: "In order to protect the environment, the Precautionary Approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." This IFMP uses the Precautionary Approach to identify three stock status

zones (healthy, cautious, critical) according to Upper Stock and Limit reference points, set a removal rate at which fish may be harvested within each stock status zone and adjust the removal rate based on pre-agreed decision rules, in accordance with fish stock status variations. At current, with respect to Dolly Varden, a safe harvest limit of 5% when a stock is healthy is considered to be a low risk option.

#### *Rat River Charr Fishing Plan*

The Rat River Charr Fishing Plan was first implemented in 1996 as a result of indications that the Rat River Charr stock was in decline. The goals of the plan are to maintain a healthy stock of char in the Rat River system, to maintain and manage the Rat River Dolly Varden char fishery for the continued use and enjoyment by the residents of Aklavik and Fort McPherson and to encourage co-operation among all users to ensure sound management of the Rat River Charr stock.

#### *Rat River Working Group (RRWG)*

The Rat River Working Group consists of the Char Monitors, the Ehdiitat RRC, Aklavik HTC, Teetlit RRC and staff from GRRB, FJMC and DFO. Observers to this group include the Gwichya RRC, Nihtat RRC and the Chair of the West Side Working Group. The RRWG invites other individuals and groups concerned with Dolly Varden. The Rat River Working Group is an advisory body with respect to Rat River Dolly Varden and functions to provide recommendations on Rat River Dolly Varden management including allocations to the co-management bodies responsible for fishery management (GRRB, DFO and FJMC).

#### *Renewable Resources Council (RRC)*

When the GCLCA was signed in 1992, it established a Renewable Resource Council in each Gwich'in community (Aklavik, Fort McPherson, Inuvik and Tsiigehtchic). The purpose of the RRC is to promote local involvement in conservation, harvesting studies, research and management in the community. RRCs are valuable co-management partners and work with DFO, the GRRB and all other resource management groups on all resource issues in the GSA. The RRC has the power to distribute allocations within its membership. In Aklavik, the RRC and HTC work together to distribute allocations.

#### *Smoltification*

Smoltification refers to a process in anadromous fishes when fish migrate to salt water and undergo physiological changes to allow them to survive in a salt environment. In Dolly Varden, this stage typically first occurs between 2 and 4 years of age and then annually. A smolt is the fish during the life stage at which this process occurs.

#### *Species at Risk Act (SARA)*

The purposes of the *Species at Risk Act* are to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk. The *SARA* is a result of the implementation of the Canadian Biodiversity Strategy, which is in response to the United



Nations Convention on Biological Diversity. The *Act* provides federal legislation to prevent wildlife species from becoming extinct and to provide for their recovery.

#### *Sustainable Fisheries Framework*

The Sustainable Fisheries Framework forms the basis for decision-making in Canadian fisheries. It incorporates existing policies for fisheries management conservation and sustainable use, governance, and economics with new and evolving policies using a phased-in approach. It also includes tools to monitor and assess results of conservation and sustainable use in order to identify areas that may need improvement. The primary goal of the Sustainable Fisheries Framework is to ensure that Canada's fisheries are environmentally sustainable, while supporting economic prosperity. This means maintaining a balance between healthy fish stocks and marine environments, while allowing for prosperous fisheries; a balance known as 'sustainable development.'

#### *Traditional Ecological Knowledge (TEK/TK)*

TEK or TK is a cumulative body of knowledge, practice, and belief evolving from adaptive processes and handed down through generations by cultural transmission. TEK is knowledge about the relationships between the biotic and abiotic parts of the land (including humans), learned extensive interaction with the land. TEK is also values, beliefs and practices which are passed from one generation to another by oral means or through learned experience, observation and spiritual teachings, and pertains to identity, culture and heritage. This body of knowledge reflects many millennia of living on the land. It is a system of classification, a set of empirical observations about the local environment and a system of self-management that governs the use of resources and defines the relationship of living beings with one another and with their environment.

#### *West Side Working Group (WSWG)*

The purpose of the West Side Working Group (WSWG) is to coordinate the development of fisheries management plan(s) for the rivers and streams in the Inuvialuit Settlement Region (ISR) west of the Mackenzie Delta to the Canada/Alaska border. Membership of the WSWG is formal; members are named to the WSWG by the Aklavik HTC, the FJMC, DFO and Parks Canada). Representatives from other agencies (GRRB, Yukon Territorial Government, Environment Canada, Department of Indian and Northern Affairs) will be invited to participate and contribute to the meetings of the WSWG as needed.

## **APPENDIX B: INTEGRATED FISHERIES MANAGEMENT PLANS**

IFMPs provide a planning framework for the conservation and sustainable use of fishery resources as well as a process by which a fishery will be managed for a period of time. They were initiated to ensure greater integration of functional and technical expertise, integrate decision-making within areas subject to land claims agreements, identify performance outputs, and allow for enhanced input from resource users and industry within a given fishery.

IFMPs assist with: the identification of issues, objectives and management measures designed to ensure an orderly, economically viable, socially/culturally beneficial and sustainable fishery; the communication of basic information on a fishery and its management within and between co-management partners to outside parties; and the reporting and assessing of the achievement of management objectives. They should include criteria for changing management measures.

An IFMP usually contains more information on a fishery and its management than a fishing plan (e.g. the Rat River Charr Fishing Plan), such as additional information and actions related to habitat protection, research and monitoring, compliance, communication and education, but does not summarize all information. This IFMP emphasizes elements of the national process that are of greatest relevance in the GSA and ISR and includes additional elements that may not be considered important nationally but are important in these areas.

This IFMP builds on the work of the Rat River Working Group and the West Side Working Group. The Rat River Working Group has developed the Rat River Charr Fishing Plan for managing Rat River Dolly Varden in the GSA. The West Side Working Group has been developing plans for the management of Dolly Varden stocks in the ISR. Gwich'in and Inuvialuit organizations have been involved with developing and implementing fishing plans and other IFMPs and with other planning initiatives such as Community Conservation Plans, Land Use Plans and Oceans Management Plans that contain pertinent information for the management of Dolly Varden. This IFMP will be relevant and used for the integrated management of the Dolly Varden fish stocks and fisheries of the GSA and ISR, will meet the national DFO needs, and may contribute to meeting any potential requirements of the *SARA*.

## **APPENDIX C: JURISDICTIONAL CONTEXT**

This section describes the basic responsibilities of the major groups with legislated responsibilities for the management of Dolly Varden in the GSA and ISR.

DFO, the FJMC, the GRRB, HTC's and RRCs, and the Parks Canada Agency all have responsibilities for managing Dolly Varden stocks in the GSA and ISR. All groups work closely together to fulfil their specific responsibilities. The partners fulfil their responsibilities within the context of the two land claims agreements, *Fisheries Act*, *Oceans Act*, *Canada National Parks Act*, and *SARA*.

DFO has the ultimate responsibility for the conservation and sustainable use of fish stocks. The FJMC and the GRRB are legislated public institutions, and are the main instruments of fishery management in the ISR and GSA respectively; their fishery management responsibilities are outlined in the respective land claims agreements. The Parks Canada Agency is responsible for managing Dolly Varden stocks in Ivvavik National Park on the Yukon North Slope.

### **Gwich'in Renewable Resources Board (GRRB)**

The full text of the GRRB's responsibilities related to fish and fisheries is in the Gwich'in Comprehensive Land Claim Agreement (GCLCA). The GRRB must act in the public interest. In summary, its responsibilities include:

- establishing policies and proposing regulations for harvesting;
- calculating Gwich'in Minimum Needs Levels;
- determining Total Allowable Harvest Levels;
- approving plans for the management and protection of fisheries, endangered species and fish habitat;
- approving the designation of conservation areas and endangered species;
- establishing rules and procedures for consultation;
- reviewing matters related to fisheries management referred to it by government;
- providing advice to government on fisheries and fish habitat;
- participating in harvesting studies, data collection and the evaluation of research;
- involving the RRCs and Gwich'in harvesters in research and harvesting studies conducted in the GSA by government or the GRRB; and
- consulting regularly with the RRCs.

The GRRB has completed its "GRRB Rules and Procedures for Consultation" that is followed in the development of all management plans.

### **Fisheries Joint Management Committee (FJMC)**

The full text of the FJMC's responsibilities is in the Inuvialuit Final Agreement (IFA). The FJMC must act in the public interest. In summary, its responsibilities include:

- reviewing information on the state of fishing in waters on lands in the ISR;
- identifying areas of waters and lands where fishing has or may take place;
- determining current harvest levels;
- developing and maintaining a public registration system for fishing in waters on lands in the ISR;
- restricting and regulating the public right to enter 7(1)(b) lands for fishing where required for conservation or interference with Inuvialuit activities, and denying entry to persons who abuse the right;
- allocating subsistence quotas among communities;
- determining the role of HTCs in regulating the subsistence harvest and collecting harvest statistics;
- making recommendations to the Minister of Fisheries and Oceans on subsistence quotas for fish, harvestable quotas for marine mammals, Inuvialuit commercial fishing, allocation of preferential fishing licences, regulations for sport and commercial fishing in waters on 7(1)(a) and 7(1)(b) lands, and identifying waters where such fishing may be prohibited; and
- advising the Minister of Fisheries and Oceans on regulations, research policies and administration of fisheries in the ISR, and on any new international agreements being developed that might apply to Inuvialuit fisheries.

### **Fisheries and Oceans Canada (DFO)**

The federal government has constitutional authority for sea coast and inland fisheries. Legislatively, it exercises this authority through the *Fisheries Act*. The *Act* provides DFO with powers, authorities, duties and functions for the conservation and protection of fish and fish habitat (as defined in the *Fisheries Act*) essential to sustaining commercial, recreational and Aboriginal fisheries. The *Fisheries Act* contains provisions that can be applied to regulate flow needs for fish, fish passage, killing of fish by means other than fishing, the pollution of fish-bearing waters, and harmful alteration, disruption or destruction of fish habitat. Section 36 of the *Act* is the key pollution prevention provision that prohibits the deposit of deleterious substances into waters frequented by fish unless authorized by regulation or by federal laws. The administration of section 36 has been assigned to the Minister of Environment, except in cases of sedimentation.

Hence, DFO is the ultimate management authority for Dolly Varden. In the GSA and ISR, DFO works in partnership with the legislated GRRB and FJMC to manage and protect fishery resources. DFO is required to consult with the boards on fishery management topics.

Through development and implementation of the Sustainable Fisheries Framework, DFO is incorporating precautionary and ecosystem-based approaches into fishery management decisions. Application of the Framework should ensure the continued health and productivity of Canada's fisheries and fish stocks while protecting biodiversity and fish habitats. The Framework comprises four main elements: conservation and sustainable use policies; economic policies; governance policies and principles; and planning and monitoring tools.

DFO's activities include: issuing a variety of fishery licences, including Commercial Licences and Licences to Fish for Scientific Purposes; protecting fish habitat under the provisions of the *Fisheries Act*; conducting research on fish, fish habitat and aquatic ecosystems; being the lead federal agency for the fish and marine mammal aspects of *SARA* and for the *Oceans Act*; and enforcing the *Fisheries Act*.

Initiatives in the Beaufort Sea under the *Oceans Act* include Tarium Niriyutait Marine Protected Areas and the Integrated Ocean Management Plan for the Beaufort Sea. These initiatives contain provisions that can be used to advance management of Dolly Varden in marine waters.

### **Hunters and Trappers Committees (HTCs) and Renewable Resource Councils (RRCs)**

HTCs and RRCs have specific fishery-related responsibilities assigned to them under the IFA and GCLCA respectively. The full texts of these responsibilities are in the agreements. In summary, their responsibilities include:

- allocating harvests among communities (HTCs and RRCs);
- managing the local exercise of Gwich'in harvesting rights (RRCs);
- advising the GRRB and FJMC on harvesting (HTCs and RRCs);
- participating in the collection of harvesting data (HTCs and RRCs);
- implementing Rat River Working Group decisions (RRCs);
- reporting back to the Rat River Working Group on harvest allocations (RRCs);
- setting by-laws on acceptable fishing gear and methods (HTCs), or recommending such measures to the GRRB (RRCs);
- reviewing and approving project proposals (HTCs and RRCs);
- participating in the development of fishing plans (HTCs and RRCs);
- participating in wildlife research and harvest studies (RRCs); and
- encouraging and promoting involvement in conservation, research, monitoring, management, enforcement and use of fishery resources (HTCs).

**Parks Canada Agency**

*“On behalf of the people of Canada, we protect and preserve nationally significant examples of Canada’s natural and cultural heritage, and foster public understanding, appreciation and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations.”*

Parks Canada Agency is the federal agency responsible for protecting and managing the resources within Ivvavik National Park, encompassing 9,750 km<sup>2</sup> on the Yukon North Slope. The Park includes the Firth and Babbage rivers which support Dolly Varden stocks. Following the principles of the IFA, Parks Canada Agency supports the continuing traditional use of the North Slope and recognizes Inuvialuit rights to harvest fish and game within the Park. Parks Canada Agency has the legislated responsibility to carry out the objectives of the Park’s management plan. These objectives include: monitoring and maintaining the ecological integrity of the aquatic ecosystems within the Park, including the Firth and Babbage river systems; regulating sport fishing within the Park; and working with the West Side Working Group to implement fisheries research and monitoring priorities.

## **APPENDIX D: CO-MANAGEMENT IN THE GSA AND ISR**

Fishery, fish habitat and oceans management in both the GSA and ISR are conducted through adaptive co-management processes. The processes are similar in both areas, but the details may differ.

Adaptive co-management is a process that permits stakeholders to share management responsibility and to learn from their actions through multi-level feedback. It includes a shared common focus, a high degree of interaction, multiple levels of shared responsibility, some autonomy at different levels, generation and sharing of knowledge at all levels, flexible learning, and recognition of uncertainty. Development of IFMPs through adaptive co-management in the GSA and ISR usually involves establishing a working group (e.g. the Rat River Working Group and the West Side Working Group for Dolly Varden), assembling background information, establishing conservation requirements (e.g. harvest limits as required) and setting management objectives and strategies through consensus, developing an operational plan, implementing the plan and reviewing the results. A steering committee may be established to provide direction to a working group.

### **Fishery Management**

Co-management is a legislatively supported partnership that delineates shared management responsibilities between Gwich'in participants and Inuvialuit beneficiaries of the respective land claims agreement and the responsible government agency, which is DFO for fisheries. The FJMC and the GRRB are the legislated public institutions (co-management boards) with mandates to manage fish in partnership with DFO. They have a mix of decision-making, operational and advisory responsibilities which are assigned in the IFA and GCLCA (see Appendix C). They are the foci of fishery management in the ISR and GSA respectively, working with their stakeholders. The FJMC and GRRB work together to manage transboundary stocks and issues. Pertinent decisions or recommendations of the FJMC and GRRB are forwarded to the Minister of Fisheries and Oceans who may implement, vary, or reject them, providing a written response as required. DFO provides information and advice, and implements decisions as appropriate. The intent is that DFO, the FJMC and the GRRB should fully exchange information on their policies, programs and research. Details are provided in the GCLCA and the IFA.

Specific decision-making and approval processes for IFMPs and Fishing Plans follow the cycle of adaptive fisheries co-management. This model has been applied to the Rat River Dolly Varden, resulting in the Rat River Charr Fishing Plan, and is being applied to West Side Dolly Varden. The GRRB follows its consultation policy with timelines in the development and approval of management plans.

The process usually begins with a specific conservation issue identified by one or more fishermen at the local HTC or RRC. The concern is then formalized by the GRRB or

FJMC in partnership with the HTC or RRC and DFO, and involving other appropriate community groups or government agencies. Usually a working group, composed of appointees from FJMC/GRRB, DFO, HTC/RRC and other relevant parties, is struck to coordinate the assessment of concerns and possible actions. For Dolly Varden management, the GRRB led the establishment of the Rat River Working Group with Aklavik HTC, DFO, Ehdiiat RRC, FJMC, GRRB and Teetl'it RRC membership, and with Gwichya RRC, Nihtat RRC as observers, as well as, more recently, the chair of the West Side Working Group. The FJMC later led the establishment of the West Side Working Group with Aklavik HTC and Elders Committee, DFO, FJMC and Parks Canada Agency membership, and with the Ehdiiat RRC, GRRB and the chair of the Rat River Working Group as observers. The working group annually conducts an assessment of the issues, evaluates pertinent scientific, traditional and local information and knowledge, revisits community concerns, management objectives and possible management options, and arrives at proposed management actions by consensus to address the initial concern(s). The working group consults with affected communities on any recommendations from their annual assessment.

These management actions and recommendations are presented in a community-based Fishing Plan, or possibly in a more formal IFMP. The draft plan is reviewed formally by all relevant stakeholders during all stages of development. The final version of the Fishing Plan or IFMP is ratified by the FJMC/GRRB, DFO and the appropriate HTC(s)/RRC(s).

Each signatory's organization supports the implementation of the Fishing Plan or IFMP by implementing the fishery management actions appropriate to its mandate and responsibilities. For instance, the FJMC and GRRB might establish research priorities consistent with local and regional concerns, determine harvest levels and fund research projects, DFO might change regulations and conduct research projects, and the HTC(s) and RRC(s) might adjust allocations of fish amongst harvesters and monitor harvests.

One important step is the annual allocation of harvests among communities and among harvesters. The Rat River Working Group and the West Side Working Group jointly recommend the allocation of harvests between the GSA and the ISR, and communicate and consult on decisions, management programs and research results to all groups in a timely fashion and in plain language. The GRRB and FJMC set the overall allocations. The Aklavik HTC, the Ehdiiat RRC and the Teetl'it RRC, in consultation with the working group(s), divide the allocations among the communities, and each HTC or RRC is responsible for the allocation among its members. The HTC and RRCs implement these decisions, and work with harvest monitors hired with funds from DFO to collect harvest data and report to the relevant Working Group. It is noteworthy that this process enabled the Rat River Working Group to implement voluntary closures successfully for three consecutive years with community compliance. If closure is not voluntary, the GRRB must conduct a public hearing to determine to address local concerns (e.g. to set a Total Allowable Harvest and Gwich'in Needs Level).



The working group then conducts an annual review of fisheries management programs and information that support the implementation of the IFMP or Fishing Plan. The review involves the presentation and sharing of new information and the evaluation of harvest monitoring results and approaches, research projects results and other items identified by working group members or the communities. The working group reports the results of its review to all stakeholders, often in a newsletter and/or in public meetings.

Every three to five years the working group conducts a thorough review of the completed Fishing Plan or IFMP, and proposes changes to the Plan and/or management actions based on any new information. The adaptive co-management process returns to the “consensus decision on actions to take” stage and the cycle repeats.

The Minister of Fisheries and Oceans can, for conservation or any other valid reason (e.g. safety), modify access, allocations and sharing agreements as outlined in the IFMP in accordance with the powers granted pursuant to the *Fisheries Act*.

### **Habitat Management**

All development activities that may affect Dolly Varden or their habitats, directly or indirectly, must go through a co-management environmental review process conducted by co-management bodies and meet the respective environmental assessment requirement as described below.

In the ISR, the Environmental Impact Screening Committee (EISC) and the Environmental Impact Review Board (EIRB) are the co-management organizations with the mandate for assessing potential environmental impacts of proposed developments. DFO, the FJMC and the appropriate HTC(s) provide information and advice on pertinent projects. If the EISC determines that a proposed development has the potential for significant negative environmental impacts, it would be referred to the EIRB, or other body as deemed appropriate, for public review. Licences and permits are issued by the appropriate regulatory authority after the completion of the environmental review process. *CEAA* requirements are separate from those of the EISC and EIRB. For the Yukon North Slope, the *CEAA* requirements are replaced by those of the *Yukon Environmental and Socio-economic Assessment Act*.

In the GSA, the Gwich'in Land and Water Board, the Mackenzie Valley Land and Water Board and the Mackenzie Valley Environmental Impact Review Board, under the *Mackenzie Valley Resource Management Act*, are responsible for assessing potential environmental and socio-economic impacts of proposed developments. The GRRB, DFO and the appropriate RRCs and other bodies provide information and advice on pertinent projects in the GSA. The requirements of the *Mackenzie Valley Resource Management Act* replace the requirements of *CEAA*.

Dolly Varden habitats are protected through the requirements of the *Fisheries Act* and other legislation.

The Parks Canada Agency zoning system gives special protection to two areas of critical Dolly Varden habitat within Ivvavik National Park. The Joe Creek and Firth River fish holes are designated as “Zone 1: Special Preservation” due to their high ecological value. These zones are areas where public use may be controlled to protect fragile resources, and to which no motorized access (including air access) is permitted.

Areas important for Dolly Varden that should be protected are identified in the Aklavik Community Conservation Plan and the Gwich’in Land Use Plan (currently undergoing its 5-year review). These areas include Big Fish River, the Husky Channel – Rat River system, the Vittrekwa River and the Mackenzie Bay/Shallow Bay area east of Shingle Point. These plans are consulted when projects are reviewed. Also, the Gwich’in Social and Cultural Institute is working with Gwich’in communities to nominate Big Eddy on the Husky Channel as a national or territorial historic site.

### **Oceans Management**

Under Section 31 of the *Oceans Act*, the Minister of Fisheries and Oceans shall lead and facilitate the development and implementation of plans for the integrated management of all activities or measures in or affecting estuaries, coastal waters and marine waters that form part of Canada or in which Canada has sovereign rights under international law. Under section 35(1) of the *Oceans Act* the Minister can establish Marine Protected Areas (MPAs) to conserve and protect one or more of the following:

- 1) commercial and non-commercial fishery resources, including marine mammals and their habitats;
- 2) endangered or threatened marine species and their habitats;
- 3) unique habitats;
- 4) marine areas of high biodiversity or biological productivity; and
- 5) any other marine resource or habitat as is necessary to fulfil the mandate of the Minister of Fisheries and Oceans (ss. 35(1)).

The *Oceans Act* creates a holistic approach to oceans management and provides a mechanism for balancing the many competing ocean interests. Six goals and purposes of the *Act* are: (1) to reduce fragmentation in Canadian oceans management; (2) to bring national legislation in line with the Law of the Sea Convention; (3) to create a national oceans strategy based on sustainable development, integrated management and the precautionary approach; (4) to provide conservation based on an ecosystem approach; (5) to support economic diversification and wealth generation from Canada’s oceans; and (6) to create integrated management plans for Canada’s oceans.

DFO’s Oceans program facilitates the conservation and sustainable use of Canada’s oceans through the development and implementation of objectives-based integrated

oceans management plans and the establishment of MPAs. Integrated Ocean Management Plans (IOMPs) take into account ecological and social/cultural/economic factors. Marine conservation tools, including MPAs, support the sustainable management of the oceans resource by providing options to secure critical aspects of the ecosystem from harm.

An IOMP has been prepared by DFO and its partners for the Beaufort Sea Large Oceans Management Area (LOMA). This has been a multi-year planning process involving aboriginal organizations, federal and territorial government departments, commercial interests and non-governmental organizations among others. The IOMP provides a comprehensive set of objectives and strategies for collaborative governance and integrated management, sustainable human use, and a healthy ecosystem. The IOMP identifies Herschel Island/Yukon North Slope and Shallow Bay as Ecologically and Biologically Significant Areas, and includes strategies and actions to help protect priority areas.

IOMP Working Groups are leading the development of work plans, which detail how the IOMP objectives will be achieved and what resources are required. The IOMP will be implemented through the existing mandates and responsibilities of signatory departments. IFMPs, such as the Dolly Varden IFMP, are critical components of achieving the broad strategic objectives of the IOMP. The IOMP will undergo a full review every five years.

DFO also led the designation of the first ever Arctic Marine Protected Area called Tarium Niryuait in the Beaufort Sea Mackenzie Delta. This MPA will contribute to the conservation and protection of important fish stocks in the area, such as Dolly Varden.

These initiatives involve many Gwich'in and Inuvialuit groups, communities, federal and territorial agencies and other stakeholders that have marine responsibilities or interests through a Regional Coordination Committee, the Beaufort Sea Partnership and several Working Groups.

### **International Initiatives**

The Gwich'in and Inuvialuit participate in international initiatives to help protect the Arctic environment. Through the Gwich'in Council International and the Inuit Circumpolar Conference, they participate on the Arctic Council and its initiatives such as climate change and the Arctic Council's Working Group on Protection of the Arctic Marine Environment. DFO also is involved in many Arctic circumpolar initiatives.

## APPENDIX E: HABITAT AND ECOSYSTEMS

### Habitat Assessment

The most significant ecological control of northern Dolly Varden populations is the onset and long annual period of cold temperatures and ice covered habitats in northern rivers. Fish have adopted life history strategies to survive in these extreme environments. Though specific habitat use may vary between river basins and among life history stages, common habitats are identified and discussed. These are particularly important for survival and in some cases critical (i.e., if disrupted or lost, would have serious implications for the survival of existing populations of that taxon for all northern populations).

### Groundwater

During winter, which can span 8-9 months, populations are confined to upstream reaches of freshwater streams that do not completely freeze primarily because of discharging groundwater. All reaches of the river outside of such perennially fed locations regularly freeze to the bottom rendering them useless as fish habitat. Fields of thick ice (*aufeis*) build up downstream of the open water because flow can no longer follow the channel and freezes in layers on top of the ice. These *aufeis* fields contribute significantly to base flow during the summer months thus aid in maintaining habitat during open water periods as well. Habitats associated with discharging groundwater sources are used for spawning, rearing, and overwintering; however, these areas comprise a small proportion (10-20%) of each stream and are limiting to the populations. These areas should be accurately delineated so they can be protected as they are critical to the long-term sustainability of the populations.

Fish also spawn in areas associated with perennial springs, presumably to exploit this high quality habitat. Spawning habitat, which often corresponds with winter habitat, is also considered to be critical and limiting in most systems. However, unlike winter habitat, which is typically finite with respect to availability, fish have access to other areas in the fall which have suitable substrate for spawning. There is no evidence to suggest that Dolly Varden spawn in areas without perennial springs. Furthermore, if spawning habitat associated with groundwater is lost, it is unclear if populations would spawn in other areas with lower quality habitat. If they did so, egg mortality during winter likely would be increased. Further work is required to document spawning and rearing habitat.

There are three types of groundwater that are common in northern rivers: 1) active layer groundwater, which originates in shallow sediments that freeze and thaw each year; 2) supra-permafrost perennial springs that originate deeper than active layer groundwater, but are not geo-thermally heated (range = 0.5-4.0°C); and 3) sub-permafrost perennial springs, which originate from much deeper in the earth's crust, are warm (range = 8.0-

16°C), and usually have high total dissolved solid concentrations. Perennial groundwater is the only water source in northern rivers during the winter and can account for up to 80% of the base flow during the open water season.

### Small streams

Small streams are used by Dolly Varden for spawning, rearing, and overwintering, thus are critical for survival. Adults often use the same locations for overwintering and spawning, therefore, the availability and quality of rearing habitat associated with these areas influences juvenile recruitment. It is suspected but poorly documented that young Dolly Varden (e.g., ages 1-4 years) disperse in summer away from the overwintering/spawning sites and occupy areas throughout the river systems. Prior to freeze-up of such habitats these individuals then presumably return to spring-fed areas to overwinter. Summer habitat use in the river systems requires substantive work to understand both dispersal patterns and feeding ecology. Research demonstrates that the growth rates of other species similar to Dolly Varden are sensitive to juvenile survival rates, which implies that rearing habitat is critical for long-term survival. Anadromous Dolly Varden have been shown to preferentially occupy slower flowing habitat (e.g., pools) rather than fast habitat (e.g., riffles) in small streams, which helps decrease energetic expenditure before and after spawning and during winter. It is not clear if habitats used during the open water season (i.e., spring, summer, and fall) are limiting given that other areas are available for fish to use during this period. The availability of habitat during the open water season is far greater than the winter period.

### Coastal areas

Access to critical habitats is vital for migrating anadromous (sea-run) adults and pre-adults as they move between feeding areas in productive near shore marine coastal habitats and spawning, rearing, and winter habitats in freshwater streams. Prior to smoltification, large juveniles and first-year smolts move into river deltas and estuarine habitats to access more productive feeding environments. Corridors, which are typically larger rivers (e.g., Rat and Big Fish rivers), are important for current-year spawners as they provide a route to productive coastal waters where Dolly Varden can grow sufficiently (i.e., accumulate energy stores) to make the long migration back to their natal freshwater rivers and spawn successfully. Highly productive feeding areas are also important but they are not considered critical because if these areas were disrupted or lost fish could feed in freshwater rivers downstream of spawning and winter habitat, however, the productivity of such areas would result in lower population sizes and likely lower growth of individual fish.

## **Ecosystem Relationships**

Components of the ecosystem will affect Dolly Varden populations differently; however, they all operate cumulatively to limit the carrying capacity of populations.

### Exploitation

Our understanding of exploitation rates of Dolly Varden populations is poor due to unknown levels of harvest and unit stock composition of harvested fish along the Beaufort Sea coast.

### Habitat Stressors

Any factor that could reduce water levels in freshwater streams has the potential to negatively impact northern populations. Winter habitat, which is typically limited to several small isolated headwater reaches of freshwater streams, is most sensitive to water fluctuations. A substantial reduction in discharge could significantly decrease the carrying capacity of winter habitat and result in severe winter kill. A decrease in discharge could also de-water downstream reaches and isolate these important habitats, preventing successful upstream migrations by anadromous fish in the fall.

Human activities which could directly disturb or destroy spawning or winter habitat also represent a serious threat to populations as these could compromise recruitment and lead to direct mortality during winter. Similarly, activities that disrupt migratory pathways thus alter access between key summering and wintering habitats represent threats to the populations.

### Climate Change

Recent climate change projections indicate that precipitation could decrease and annual air temperatures may increase in the north ultimately leading to an overall decrease in water levels. If this occurs, available habitat will decrease creating lower carrying capacity of critical habitats (e.g., fall and winter) or isolation of these key upstream areas. An increase in air temperature could also degrade existing permafrost and promote slumping and infilling of spawning habitat. Other potential indirect effects of climate change upon habitats of Dolly Varden include permafrost degradation and slumping of sediments into water bodies, and, shifts in nutrient inputs into the rivers thus affecting ecosystem productivity and Dolly Varden early life history.

Climate change could also affect the evolution, transmission dynamics, and epidemic dynamics of viruses and parasites. This possibility is particularly noteworthy in relation to northern Dolly Varden given the historical presence of infectious pancreatic necrosis virus (IPNV) in Dolly Varden from the Rat River. Furthermore, results from the Pacific

salmon sampling program suggest a potential shift in salmonid species' ranges resulting from climate change. We anticipate that if salmon colonize northern streams they would provide another transmission mechanism for the introduction of new emerging viral diseases into Arctic ecosystems.

### Competition

Dolly Varden co-occur with other species at various life stages. The most notable species found with Dolly Varden in spawning and overwinter streams is Arctic Grayling. Although large numbers are observed, it is not clear how the two species interact with one another. However, if both species are present in these streams during winter, which is confirmed in some systems, competition for available habitat and food sources could limit the overwinter survival rates of and carrying capacity for both species. This could be especially critical in years where water levels are low and winter habitat availability is diminished.

Pacific salmon might continue to expand their ranges affecting northern Dolly Varden in Canada. Many of these salmon species use similar riverine habitats for spawning (e.g., Coho Salmon) and if their numbers increase they may compete successfully with Dolly Varden for limiting stream habitat (e.g., gravel size for reproductive activities). The ability of northern form Dolly Varden to effectively compete with other fish species is not well understood.

### Predation

Dolly Varden are vulnerable to predation because they predictably congregate in confined areas at critical periods during the year (e.g., spawning, overwintering). Piscivorous fishes, including larger sized Dolly Varden, may be key predators on smaller juveniles and eggs. Other predators include mammals (e.g., otters, bears, wolves) and birds (e.g., eagles). The influence of predators on population size is unknown; similarly the dynamics of many of the predator populations, thus whether they are undergoing demographic shifts, are unknown.

### Parasites and Infectious Diseases

Parasites and viruses regulate populations through natural mortality as a consequence of natural selection. But both factors are a positive stabilizing force in wild fish ecology and are essential for ecosystem integrity. However, if the incidence of parasitism or disease increases it could affect recruitment and result in dwindling populations, especially if the incidence is higher than normal over successive years. IPNV was detected in Dolly Varden from the Rat River dating back to 1984. Further research should be conducted to determine if this disease is currently present in this system as well as others, and what the consequences of it are in terms of population dynamics of Dolly Varden.

**Integration/Modeling**

The interrelationships among the biological characteristics of Dolly Varden (e.g., life-history, growth rate, and fecundity), habitat, and their interactions with other species will determine the abundance of Dolly Varden within individual populations. Factors influencing populations can be divided into two categories: density-dependant (i.e., factors that influence the population differently as its size increases or decreases) and density-independent (i.e., factors that influence population regardless of its size). A visual model of some of these interrelationships and a qualitative ranking of their importance on Dolly Varden abundance provides an indication where limits to population growth are thought to occur (Figure E-1).

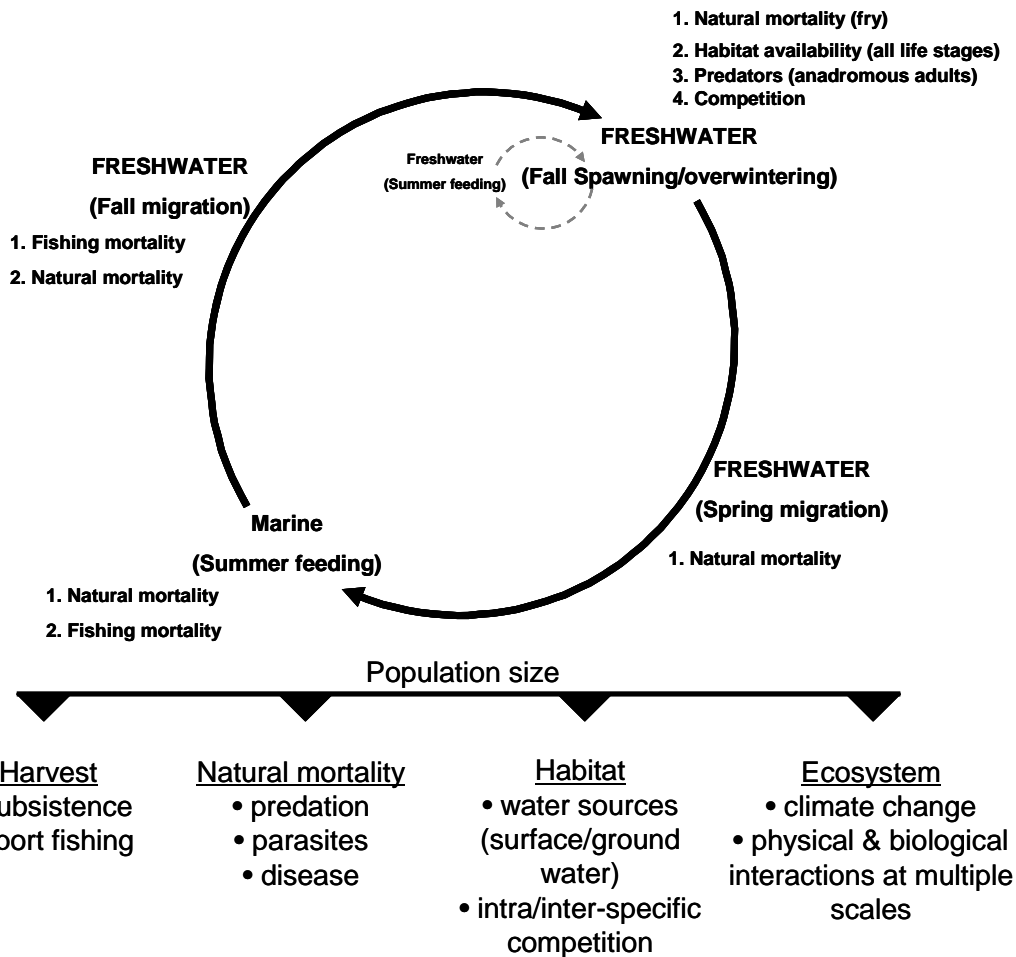


Figure E-1. Model illustrating important factors affecting the population size of freshwater juvenile (either stream-resident or juveniles that have not smolted; dashed line) and anadromous (solid line) Dolly Varden in freshwater and marine habitats. Examples of the factors affecting population size are also described.



In freshwater (spawning/overwintering areas), natural mortality among fry and constraints imposed by habitat availability (influenced by water levels) among adults are likely most limiting, followed by natural predation and competition. In the Beaufort Sea, mortality (natural predation and fishing) is presumed to be the most significant impact on adult abundance. The interrelationships are likely to be significantly affected by climate change that will probably affect habitats occupied by Dolly Varden and inter/intra-specific interactions.

Fishing activity is the only source of Dolly Varden mortality that can be controlled. Unit-stock composition of fisheries occurring in Alaska, Yukon coast (e.g., Shingle Point) and Aklavik Channel varies with the proximity to the source rivers, therefore fisheries may differentially target individual stocks.

Understanding the ecological influences that determine the abundance of Dolly Varden underscores the importance of both habitat and population assessments.

## **APPENDIX F: MANAGEMENT HISTORY**

Gwich'in and Inuvialuit traditional management of Dolly Varden stocks involve a great deal of respect for the fish. In past times, people only took what fish they needed, and if Dolly Varden became scarce in an area, they stopped fishing in that area and moved somewhere else. This was a style of rotational fishing and it was effective at spreading pressure out so that one fish stock was not fished too hard. True 'management' of Dolly Varden populations was not relevant or understood. There was always fish to catch. Some elders think that because people can now sell Dolly Varden, it has led to a decrease in respect for the fish and people just want to use the charr to make money. Instead of just fishing for what the family needs, they may try to catch many more fish to sell. Some elders also think that with the new nets people have it is easier to catch Dolly Varden than in the past. Some have said that before people had cotton and nylon nets, charr were much harder to catch.

Recent management of Dolly Varden stocks is through adaptive co-management. For example, the Rat River Working Group was established in 1995 to develop a fishing plan for the Rat River stock. This Group continues to meet annually to review the status of the Rat river population and make recommendations for how it should be managed. The recommendations are presented to the communities of Aklavik and Tetlit Zeh as well as the Nihtat and Gwichya RRC. The Group requests written support from the Aklavik RRC, Aklavik HTC and Tetlit RRC before requesting the GRRB to implement the recommendations. The emphasis is on voluntary measures. The RRWG communicates the decisions to the communities. The West Side Working Group works in a similar fashion.

### **Chronology: 1960-2010**

- 1960 A commercial fishery operated a Shingle Point, and closed after two years.
- 1965 A commercial fishery operated for two years out of Pauline Cove and Ptarmigan Bay.
- 1970s An unsuccessful commercial fishery operated on the Big Fish River.
- 1984 Inuvialuit Final Agreement signed establishing the Fisheries Joint Management Committee as the main instrument of fishery management in the Inuvialuit Settlement Region, and creating a new system of fishery management.
- 1984 IFA established Ivvavik National Park, giving permanent protection to the Babbage River and the Firth River and Joe Creek Dolly Varden habitat on the Yukon North Slope. Ivvavik managed by Parks Canada Agency under the *Canada National Parks Act* and the provisions of the Inuvialuit Final Agreement.

- 1987 Big Fish River closed year-round to all fishing under the Northwest Territories Fishery Regulations, and the mouth of the Big Fish River and some adjacent channels closed to gill nets in August.
- 1992 Gwich'in Comprehensive Land Claim Agreement signed establishing the Gwich'in Renewable Resources Board as the main instrument of wildlife and fishery management in the Gwich'in Settlement Area, and creating a new system of fishery management.
- 1995 The Rat River Working Group established as a result of a workshop held in Aklavik
- 1996 First version of the Rat River Charr Fishing Plan endorsed. Versions endorsed annually until 2001.
- 1997 As first proposed in 1987, charr stocks west of Mackenzie River confirmed to be Dolly Varden, not Arctic Charr, as first proposed in 1989.
- 2001 DFO Research Advisory Process review of Rat River Dolly Varden stock.
- 2001 Sixth edition of the Rat River Charr Fishing Plan endorsed for three years.
- 2001 The West Wide Working Group was established.
- 2002 DFO Research Advisory Process review of Firth, Babbage and Big Fish Dolly Varden stocks.
- 2003 Consultation and amendment process began to reduce Ivvavik National Park Sport Fishing Regulations from a daily catch and possession limit of 6 Dolly Varden to 3, and to close sport fishing at the Firth River Fish hole and other sensitive areas within the Park.
- 2004 Seventh edition of the Rat River Charr Fishing Plan endorsed. Declines observed in the Rat River population.
- 2005 Rat River Dolly Varden declines confirmed with mark-recapture results.
- 2006 Voluntary closure implemented for the entire migratory route of the Rat River Dolly Varden from August 1 to September 15. Char Monitors permitted 40 Dolly Varden each (total 120).
- 2007 Voluntary closure continued for the entire migratory route of the Rat River Dolly Varden from August 7 to September 15. Char Monitors permitted 40 Dolly Varden each (total 120).

- 2008 DFO Research Advisory Process review of Rat River Dolly Varden stock.
- 2008 Voluntary closure continued for migratory route of the Rat River Dolly Varden from August 7 to September 15. Char Monitors permitted 40 Dolly Varden each (total 120).
- 2008 DFO Pre-COSEWIC Research Advisory Process review of Dolly Varden stocks.
- 2009 Increase in Rat River Dolly Varden confirmed. Voluntary allocation of 1225 Dolly Varden granted (including 225 for the Char Monitoring Program). The Rat River fish hole on Fish Creek (Ne'edilee) closed to all fishing under the Northwest Territories Fishery Regulations.
- 2010 Voluntary allocation of 600 Rat River Dolly Varden granted (including 225 for the Char Monitoring Program).
- 2010 Ivvavik National Park Sport Fishing Regulations consultation and amendment process (begun in 2003) revised to consider reducing the daily catch and possession limit to 1 Dolly Varden and also to close sport fishing at the Joe Creek Fish Hole area.
- 2010 Consultations held on a recommended IFMP in all user communities in the GSA and ISR. Drafting a new edition of the Rat River Charr Fishing Plan and fishing plans for other stocks and fisheries began.

## **APPENDIX G: HARVEST LEVELS**

The following tables summarize available information on annual harvests from the traditional Dolly Varden fisheries in the GSA and ISR. The information comes from the Department of Fisheries and Oceans, the Gwich'in Harvest Study and the Inuvialuit Harvest Study.

Harvest level information is presented for the Gwich'in and Inuvialuit harvests in Table G-1, and for the Big Fish River, Rat River and coastal traditional fisheries in Table G-2. Information on harvests from commercial and sport fisheries and from scientific collections is summarized in Section 3.1 of volume 1 of the Dolly Varden IFMP.

### **Gwich'in and Inuvialuit Harvests**

Table G-1 summarizes available information for overall Gwich'in and Inuvialuit harvests of Dolly Varden. The information comes from DFO harvest monitoring programs, the Gwich'in Harvest Study that was conducted from 1995 to 2004, and the Inuvialuit Harvest Study that was conducted from 1988 to 1997. Harvest information from some fisheries is not available for all years.

The Gwich'in Harvest Study recorded the estimated total Dolly Varden harvest for all Gwich'in communities from the Rat River fishery and accounts for over and under harvest reporting. Gwich'in harvest numbers from DFO incorporate 50% of the harvest from Shingle Point. The Inuvialuit Harvest Study recorded the estimated Dolly Varden harvest for Aklavik, plus 50% of the harvest from Shingle Point.

Table G-1. Gwich'in and Inuvialuit Dolly Varden harvests.

<u>Year</u>	<u>Gwich'in Harvest</u>	<u>Inuvialuit Harvest</u>
1972	6,500	9,000-13,000
1973	2,600	4,050
1975	2,100	
1980	1,545	94
1984		343
1985		989
1986	1,100	1,875
1987	3,125	203
1988	1,681	735*
1989	1,999	1,164*
1990	1,051	768*
1991	376	352*
1992	1,034	759*
1993	1,409	1,301*
1994	2,155	2,759*
1995	1,524*	548*
1996	2,920*	2,457*
1997	3,393*	1,079*
1998	3,760*	386
1999	1,911*	321
2000	1,453*	39
2001	1,781*	1-25
2002	6,35*	1-25
2003	1,492*	
2004	772*	
2005	658	
2006	124	64
2007	120	166
2008	119	56
2009	95	

\* Harvest levels being reviewed to ensure no double counting of DFO information, the Gwich'in Harvest Study and the Inuvialuit Harvest Study.

**Big Fish River, Rat River and Coastal Fisheries**

Table G-2 presents harvest level information for the Big Fish River, Rat River and the coastal traditional fisheries. Information on harvest guidelines for the Big Fish River and Rat River also is presented.

Dolly Varden caught in the Herschel Island fishery are attributed to the Firth River and Babbage River stocks. Dolly Varden caught in the Shingle Point fishery are attributed 50% to the Big Fish River stock and 50% to the Rat River stock. The harvests in Table G-2 for the Big Fish River fishery and the Rat River fishery do not include fish caught at Shingle Point.

Table G-2. Dolly Varden harvests from the Big Fish River, Rat River and coastal fisheries.

	<u>Big Fish River Fishery</u>		<u>Rat River Fishery</u>		<u>Coastal Fisheries</u>		
	Harvest	Harvest Guideline	Harvest	Harvest Guideline	Herschel Island	Shingle Point	Others (King Point, Phillips Bay)
1971					200		
1972	8,000 – 12,000		6,500		1,000		
1973	3,850		2,600		200		
1975			2,100				
1980	94		1,545				
1984	343						
1985	989						
1986	1,875		1,100				
1987	0	Voluntary Closure	3,125		73	259	
1988	0	Voluntary Closure	1,681			147	50 (King Point)
1989	0	Voluntary Closure	1,999		25	30	75*
1990	0	Voluntary Closure	1,051			214	5 (Phillips Bay)
1991	0	Voluntary Closure	376		30	7	
1992	24	700	1,034		20	17	24 (King Point)
1993	40	200	1,409		19	119	
1994	36-74	200	2,155		130	33	36 (King Point) 16 (Phillips Bay)
1995	40-93	200	1,492		48	63	
1996	18	200	2,517		560	805	
1997	99	150	3,331	1,500	130	123	
1998	77	150	3,319	2,000	233	541	35*
1999	96	200	1,761	2,000		250	
2000	39	400	1,485	2,000			15 (King Point)
2001	1-25	Closure	1,781	2,000			
2002	1-25	Closure	1,180	2,000			
2003	0	Closure	1,083	2,000			
2004	0	Closure	363	600			
2005	0	Closure	554	600			
2006	0	Closure	132	Voluntary Closure**		127	
2007	0	Closure	146	Voluntary Closure**	113	106	
2008	0	Closure	120	Voluntary Closure**	41	29	
2009		Closure	95	1,250			
2010		Closure		600			

\*includes some from Shingle Point \*\*120 Dolly Varden allocated for fishery monitors



## APPENDIX H: STOCK STATUS

This Appendix summarizes information on the status of Dolly Varden stocks of the Firth, Babbage, Big Fish, Rat and Vittrekwa rivers. Information on other stocks in the GSA and ISR is insufficient to include in this Appendix. More details can be found in the syntheses by Roux et al. (in prep.) on Rat River Dolly Varden, Gallagher et al. (in prep.) on big fish river Dolly Varden, and Roux et al. (in prep.) comparing Dolly Varden populations (see references in Appendix M).

### Firth River

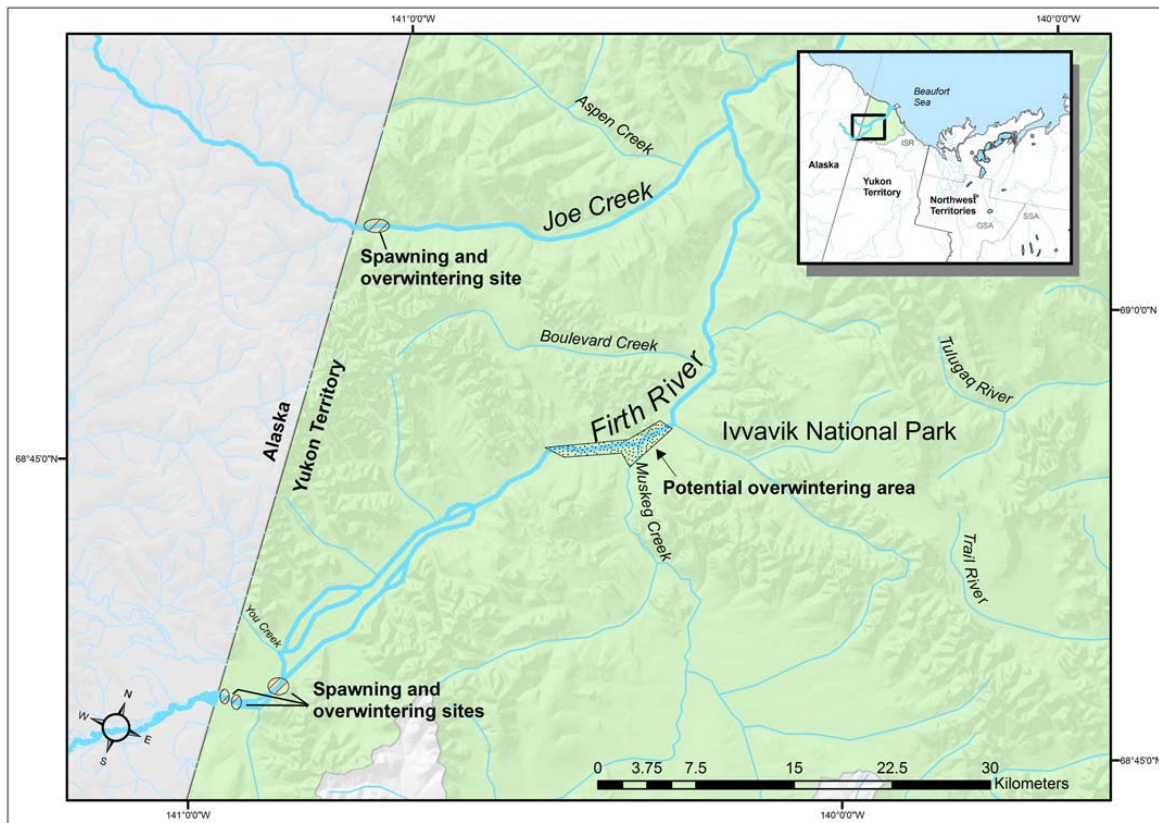


Figure H-1. Upper Firth River system with the spawning and overwintering area indicated. Additional sites may exist in Alaska (see Bryan 1973) (Sawatzky and Reist, in prep.).

The Firth River system originates in the Davidson Mountains in Alaska and flows northeast through Ivvavik National Park to the Beaufort Sea. The headwaters of both the Firth and Joe Creek (a major tributary) originate within Alaska's Arctic National Wildlife Refuge. The spawning areas (fish holes), where underground springs provide freshwater through the year, on the Firth River and Joe Creek (near the Alaska-Yukon border) are prime wintering, spawning and feeding area for anadromous Dolly Varden. *Aufeis* is a distinct feature of the Firth River system. *Aufeis* is formed when water from underground springs run over river ice and then freezes. These extensive ice sheets can become two to

five metres thick and they rarely melt completely during summer. *Aufeis* helps maintain water levels throughout the summer by contributing run-off to the Firth system.

A reliable estimate of population size does not exist for the Firth River stock. Glova and McCart (1974) reported an abundance estimate of 32,000 (no range provided) for anadromous Dolly Varden from the Firth River, not including Joe Creek, in 1972. A video survey in 1989 provided an abundance ranging 8,250-10,700 large anadromous fish (Kristofferson et al. 1991). The result was considered a minimum estimate as only the upper section of the river was surveyed and only visible fish could be counted.

Dolly Varden from the Firth River were larger and older than those from Joe Creek and other rivers, and males had a higher mean length and length-at-age than females.

Anadromous Firth River Dolly Varden likely are harvested along the Beaufort Sea coast as well as in the river system.

### **Babbage River**

The Babbage River forms the eastern boundary of Ivvavik National Park, and flows north from the British Mountains to Phillips Bay on the Beaufort Sea Coast. The upper main channel of the Babbage is shallow with a mixed gravel and rock streambed. Summer flow in the main channel depends upon snowmelt, precipitation, and groundwater upwellings. The entire lower Babbage River is frozen over during winter and in most places the ice is grounded to the river bed. Important spawning, rearing and overwintering habitat for Dolly Varden occurs in the Canoe River, a tributary of the Babbage that falls outside the boundaries of the National Park. Freshwater thermal springs in both Wood Creek and Fish Hole Creek maintain a 1.5 km section of unfrozen water in Canoe River known as the Fish Hole. This open water habitat is considered critical for both overwintering and spawning of char. The anadromous Dolly Varden population in the Babbage River system is a distinct genetic stock. There is also an isolated resident population of Dolly Varden that lives in the spring-fed area upstream of the falls in the mainstem of the Babbage River.

A population size (with 95% confidence intervals) estimate of Dolly Varden from Babbage River was conducted once in 1991. A Bailey's Triple Mark Recapture Procedure, adjusted for tag loss, produced an estimate of 13,639 (10,615-16,663) for fish >150 mm (Sandstrom 1997). In 1990, Dolly Varden were collected using a conduit weir during the fall migration and tagged. Recaptures were made in 1991 and 1992 during the fall using the weir.

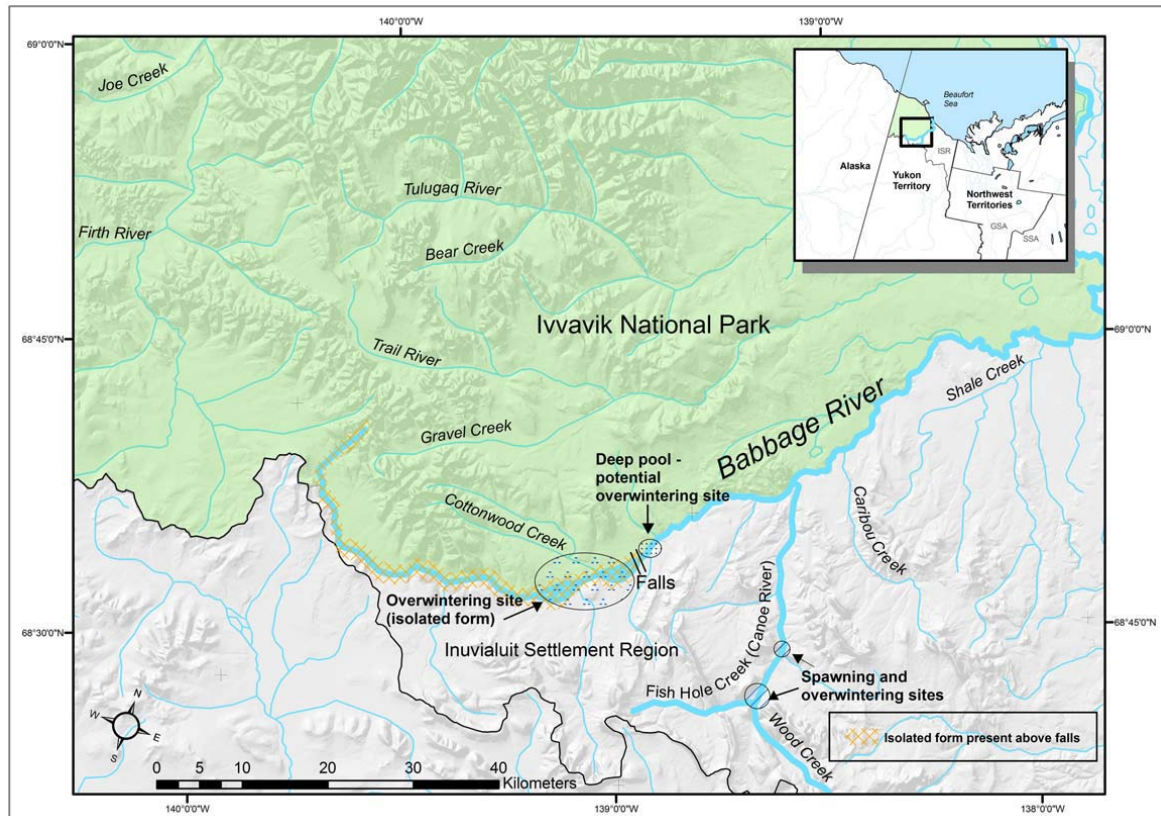


Figure H-2. Upper Babbage River system with the spawning and overwintering area indicated. (Sawatzky and Reist, in prep.).

Males had a higher mean length and length-at-age than females.

The anadromous population likely sustains fishing mortality along the Beaufort Sea coast.

### **Big Fish River**

Inconsistent sampling methods and locations among study years and small sample sizes hinder assessment of trends in the Big Fish River Dolly Varden. However, population estimates suggest a decline in Big Fish River Dolly Varden from the 1970s to the mid-1980s with no recovery through the 1990s.

Multiple population abundance estimates for Dolly Varden from the Big Fish have been estimated using mark-recaptures studies. Thirteen population estimates have been generated for seven years between 1972 and 1998 and the results suggest that the number of Dolly Varden from the Big Fish River dramatically declined during this time. Multiple population estimates were produced in 1972 (n= 2), 1984 (n= 2), 1987 (n= 2), 1988 (n= 3) and 1991 (n= 2), while single estimates were made in 1994 and 1998. In certain years,

multiple estimates within a single year were possible by recaptures made at both the mouth of the river and the overwintering site (using a seine, gill net or visual observation). In 1987-1989, Dolly Varden were intercepted using a weir (situated below the spawning/overwintering area) and recaptured the following year with the weir or at the overwintering area. Dolly Varden captured using a weir in 1991 were recaptured by both enumerating tagged fish by visual observation and by seining in the same year. The estimate in 1998 was based on capturing fish at the overwinter site by seining again in the same year.

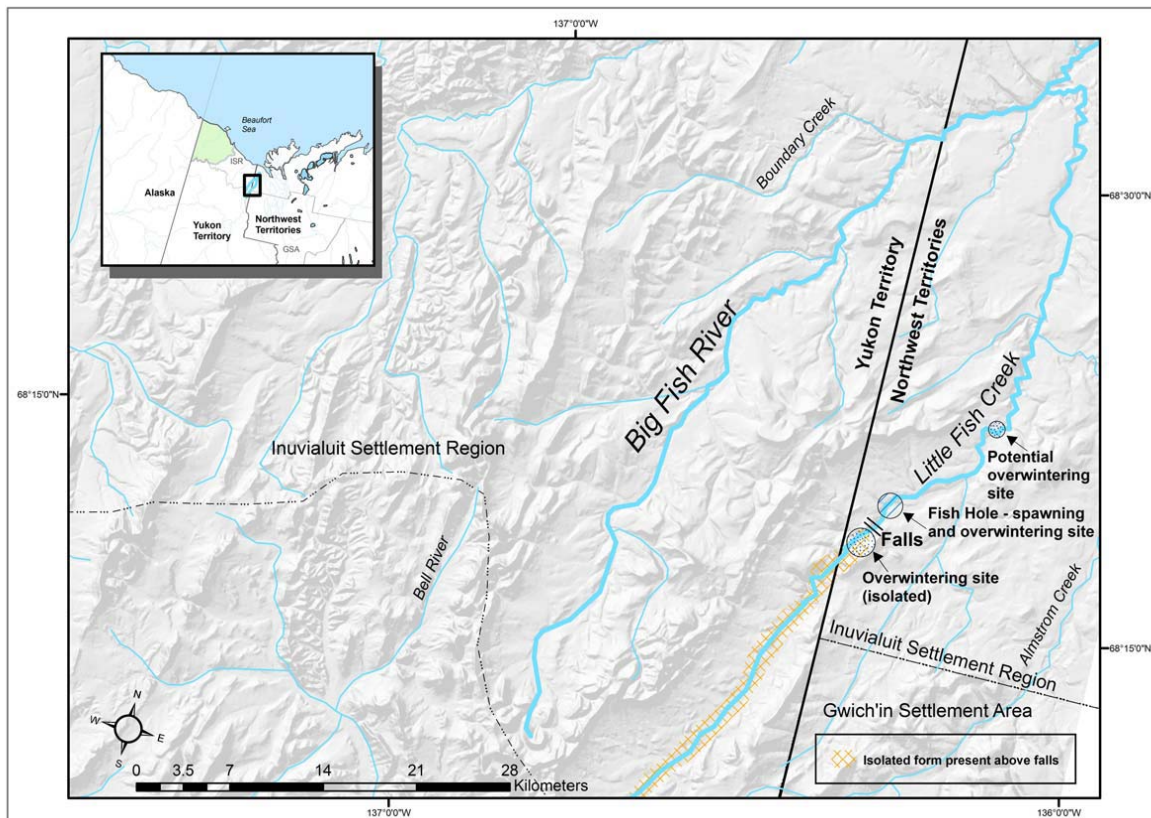


Figure H-3. Upper Big Fish River system with the spawning and overwintering area indicated. (Sawatzky and Reist, in prep.).

The estimate in 1972 was between 20,700 (15,800-27,600) and 13,500 (11,300-16,000) Dolly Varden, and was between 9,300 (6,300-14,300) and 4,600 (3,100-7,100) in 1984. Values from both years are highly variable and overlap slightly. Even with no fishing activity at the mouth of the Big Fish River or at the Fish Hole between 1987 and 1992, the population size decreased. The estimates in 1991 were between 2,232 (1,716-2,748) and 2,840 (2,014-3,666) while values between 1993 [4,477 (2,305-6,649)] and 1998 [4,026 (2,988-5,563)] were similar. The studies did not estimate the number of fish of similar sizes among study years. The estimates in 1972 and 1984 were for Dolly Varden  $\geq 150$  mm and  $\geq 350$  mm, respectively, while studies in the 1990s estimated the number of fish ranging from  $\geq 320$  mm to  $\geq 400$  mm in length.

Some biological parameters also may have changed over time. Before 1991 male Dolly Varden were typically larger than females, but males captured in the 1990s were often smaller than females. The number of male spawners decreased over time. Fewer 8+ age classes were observed in the late 1990s.

The stock now may have reached a stable population size at a lower level, and that habitat change may limit the size of the stock.

The anadromous population likely sustains fishing mortality along the Beaufort Sea coast.

### **Rat River**

Population abundance of Dolly Varden from the Rat River has been estimated seven times between 1989 and 2007. Single estimates were generated in 1989, 1995, 1997, 2001, 2004, while two were made in 2007. The Rat River is the only population that has been periodically studied for population size using consistent methodology over the past ten years. Abundance estimates from 1995 to 2008 were based on tagging Dolly Varden that were collected by seining at the overwintering area and recapturing fish the following year by harvesters who set their gill nets at Big Eddy and other locations in channels of the Mackenzie River, the mouth of the Rat River and in the Rat River at Destruction City.

Rat River Dolly Varden population appeared stable from 1989 to 1997, and declined since 1997 with some recovery since 2004. The first estimate in 1989 indicated a population size of 11,191 (8,532-15,020). Population size decreased to 9,036 (6,931-11,141) in 1995. Results from 1997 were similar to 1995 with an estimated abundance of 10,411 (6,558-14,264). A decline in the population became evident with the 2001 estimate which was equal to 7,953 (4,547-11,359) while a further decline in the Rat River was observed in 2004 with 2,912 (1,934-3,890) Dolly Varden. Due to the concerns of the population size, a voluntary closure of the fishery was established for three years although three harvest monitors were allowed to harvest a total of 120 Dolly Varden per year to collect biological information and harvest statistics. In 2007, the population estimate based on the tag returns from the harvest monitors was 14,897 (6,026-23,568); however the confidence intervals are very high, due to the low recaptures, compared to previous years. The reason for the low tag returns was due to the decreased fishing effort by the monitors who were only allowed to harvest a small number of fish. A second estimate for 2007 was generated based on recapturing fish at the overwintering site. The population size was estimated to be 9,120 (4,430-13,810) Dolly Varden, and the size intervals of tagged fish is mainly >300 mm; this information is awaiting peer review.

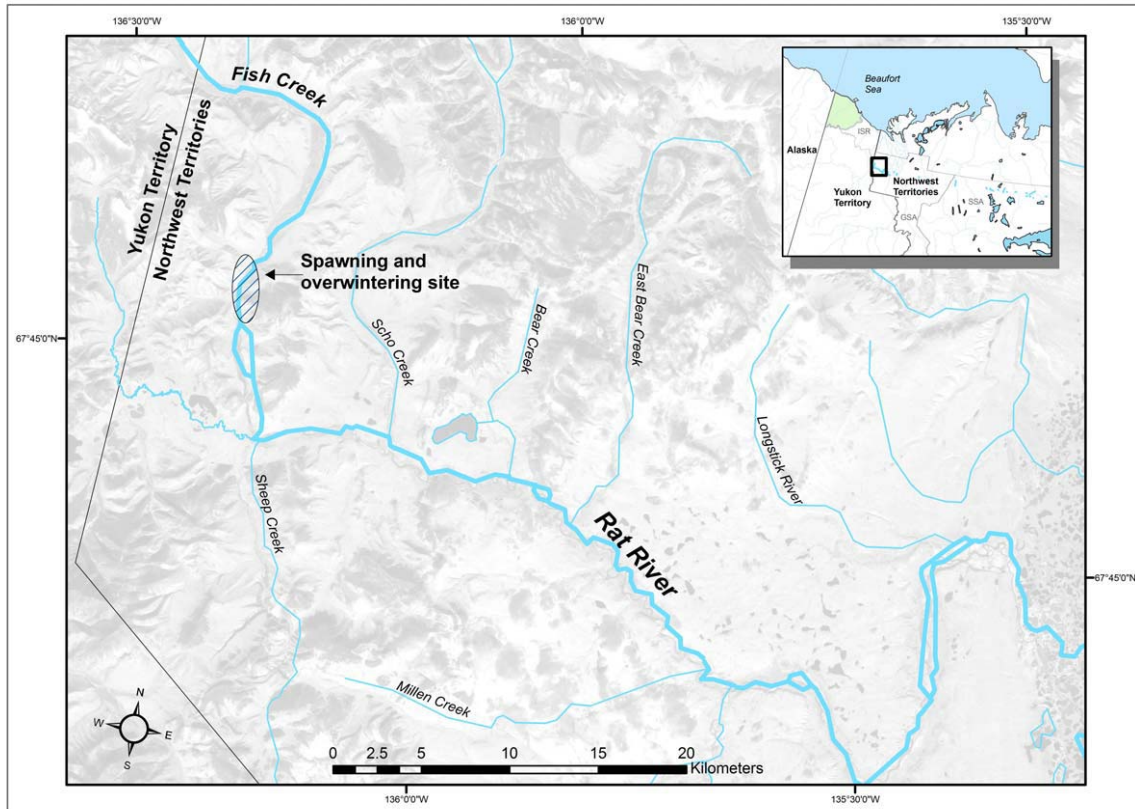


Figure H-4. Upper Rat River system with the spawning and overwintering area indicated (Sawatzky and Reist, in prep.).

Changes in some biological parameters have been observed during the periods of decline and recovery. More smaller Dolly Varden were caught during the period of decline; during the period of recovery female Dolly Varden remained smaller but males returned to pre-decline sizes. The proportion of younger (3-4) age classes increased and of older (6+) age classes decreased during the recovery.

The Rat River Dolly Varden stock appears to have responded positively to reductions in harvests since 2004, but the reproductive potential of the stock may be reduced as reflected in its eroded size and age structure and the weak occurrence of spawning Dolly Varden, especially males.

The anadromous population likely sustains fishing mortality on the coast and during its migration through the Mackenzie Delta as well as in the Rat River.

### **Vittrekwa River**

No formal stock assessment has occurred on the Vittrekwa River Dolly Varden population. GRRB research conducted in 2006 and 2007 suggests a moderate population of stream-resident male Dolly Varden, and a small run of anadromous Dolly Varden. The number of anadromous fish returning to the Vittrekwa each year is estimated to number in the low hundreds at most. This estimate is based on a visual spawning survey that took place on the Vittrekwa, during which no more than 165 mature fish were observed.

The anadromous population likely sustains fishing mortality on the coast and during its run through the Mackenzie Delta and up the Peel River. The number of Vittrekwa Dolly Varden that may be caught in these mixed stock fisheries is unknown.

The anadromous Dolly Varden population of the Vittrekwa River exhibits a sex ratio which is significantly skewed in favour of males. This is the opposite of sex ratios exhibited in the Rat River and other Dolly Varden populations. There may be environmental or other factors which contribute to an increase in male Dolly Varden in the Vittrekwa River. The higher proportion of males in the population and the very low amount of suitable spawning habitat are limiting factors to population size. The abundant population of stream resident male Dolly Varden is probably the cause for this, as it has been shown in other anadromous fish species that the prevalence (and spawning success) of precocious males will skew the population's sex ratio in favour of males.

## **APPENDIX I: GENERAL DFO, GWICH'IN, INUVIALUIT AND PCA OBJECTIVES**

The following relevant objectives of DFO, the Gwich'in, the Inuvialuit and Parks Canada Agency are explicitly or implicitly reflected in this Dolly Varden IFMP.

### **Fisheries and Oceans Canada**

DFO's objectives for the management of fish stocks are to protect and conserve fishery resources to ensure stable and sustainable fishing. Conservation is the first priority, followed by aboriginal food, social and ceremonial use. Any remaining harvestable surplus would then become available for other uses such as commercial and recreational fishing.

DFO also has the objective to achieve a net gain of productive capacity for fishery resources. This is achieved through fish habitat conservation, restoration and development, and the application of the habitat provisions of the *Fisheries Act*.

In addition, the Tarium Niryutait Marine Protected Areas and the Integrated Ocean Management Plan (IOMP) for the Beaufort Sea have objectives and processes relevant for the management of Dolly Varden along the coast. These include maintaining ecosystem integrity, and protecting and conserving representative marine areas and special species. The IOMP provides a comprehensive set of objectives and strategies for collaborative governance and integrated management, sustainable human use, and a healthy ecosystem. A number of the objectives have a direct link to the IFMP including:

- a governance objective to promote effective planning and decision making;
- a social, cultural, economic objective to promote a vibrant local subsistence economy by assessing and managing for a safe and accessible supply of marine resources and culturally important species;
- a traditional and local knowledge objective is to use TK and LK in resource management, monitoring and identification of sensitive species and areas; and
- an ecosystem objective to maintain ecosystem integrity and protect and conserve representative marine areas and special species.

### **Gwich'in**

The GCLCA contains the following specific goals relevant to fishery management (N.B. under the GCLCA, wildlife includes fish):

- to protect for the future the right of the Gwich'in to gather, hunt, trap and fish throughout the settlement area at all seasons of the year;
- to conserve and protect wildlife and wildlife habitat and to apply conservation principles and practices through planning and management;



- to provide the Gwich'in with certain exclusive, preferential and other harvesting rights and economic opportunities related to wildlife;
- to respect the harvesting and wildlife management customs and practices of the Gwich'in and provide for their ongoing needs for wildlife;
- to involve the Gwich'in in a direct and meaningful manner in the planning and management of wildlife and wildlife habitat;
- to integrate planning and management of wildlife and wildlife habitat with the planning and management of all types of land and water use in order to protect wildlife and wildlife habitat;
- to ensure that traditional harvesting by other aboriginal peoples who have harvested in the settlement area can be accommodated in this agreement; and
- to deal fairly and equitably with persons who hunt, trap, fish or conduct commercial wildlife activities in the settlement area and who are not participants.

In addition, showing respect to fish, including Dolly Varden, is a key traditional component of Gwich'in culture.

### **Inuvialuit**

The IFA also contains specific goals relevant to fishery management. They are:

- to preserve Inuvialuit cultural identity and values within a changing northern society;
- to enable Inuvialuit to be equal and meaningful participants in the northern and national economy and society;
- to protect and preserve the Arctic wildlife, environment and biological productivity;
- to establish an integrated wildlife and management regime;
- to ensure the effective integration of the Inuvialuit into all bodies, functions and decisions pertaining to wildlife management and land management in the ISR;
- to employ the relevant knowledge and experience of both the Inuvialuit and the scientific communities in order to achieve conservation; and
- to provide the Inuvialuit with certain harvesting rights subject to laws of general application respecting public safety and conservation.

In addition, showing respect to fish, including Dolly Varden, is a key traditional component of Inuvialuit culture.

**Parks Canada Agency**

The primary management objective of Parks Canada Agency is to protect and present the fish, wildlife, environment and biological productivity of Ivvavik National Park. Relevant to fishery management, Parks Canada has the following goals:

- to monitor and maintain the ecological integrity of the aquatic ecosystems;
- to support the sustainable traditional harvest of fish;
- to support sustainable recreational fishing opportunities consistent with the *Canada National Parks Act* and regulations in cooperation with the FJMC; and
- to work within the West Side Working Group to implement fisheries research and monitoring priorities for the region.

**APPENDIX J: OBJECTIVES, STRATEGIES AND MEASURES FOR THE MANAGEMENT OF DOLLY VARDEN**

Table 1 lists the strategies and identified measures for the management of Dolly Varden in the GSA and ISR arranged under the appropriate long-term objective. They are consistent with the general objectives (see Appendix I) and attempt to address the issues (see Section 5). Leads are identified for implementation measures as appropriate.

The management measures were developed during consultations on the development of the Dolly Varden IFMP especially by the Rat River Working Group and the West Side Working Group. Many of the management measures are voluntary.

Table J-1. Objectives, management strategies and management measures for Dolly Varden in the GSA and ISR.

<b>Management Strategies</b>	<b>Management Measures (Lead)</b>
<i>Stock Conservation Objective</i> To maintain healthy stocks of Dolly Varden throughout the GSA and ISR	
Conduct stock assessments of all known anadromous Dolly Varden populations	<ul style="list-style-type: none"> <li>• Focus resources on developing and implementing a comprehensive stock assessment plan for anadromous Dolly Varden in the GSA and ISR (Working Groups and DFO)                             <ul style="list-style-type: none"> <li>○ Complete the current stock assessment plan (DFO)</li> <li>○ Plan a regular cycle for repeating stock assessments with emphasis on harvested stocks (Working Groups and DFO)</li> <li>○ Conduct research to understand the structure of mixed stock fisheries (DFO)</li> <li>○ Conduct research on stock movement between Canada and Alaska (DFO)</li> <li>○ Investigate and use appropriate new technologies for estimating stock abundance (e.g. DIDSON) (DFO)</li> <li>○ Integrate stock assessment and ecological integrity monitoring of Firth River system (DFO and Parks Canada Agency)</li> </ul> </li> </ul>
Identify other harvestable Dolly Varden stocks in the GSA and ISR	<ul style="list-style-type: none"> <li>• Include potentially harvestable stocks in the stock assessment plan (Working Groups and DFO)                             <ul style="list-style-type: none"> <li>○ Prioritize other stocks including Babbage, Vitrekwa and non-anadromous stocks</li> </ul> </li> </ul>
Ensure the harvesting of Dolly Varden is sustainable in the long term	<ul style="list-style-type: none"> <li>• Take a precautionary approach in making management decisions (Working Groups, DFO, FJMC, GRRB and Parks Canada Agency)</li> <li>• Develop Reference Points and Total Allowable Catch estimates for harvested Dolly Varden stocks (DFO)</li> <li>• Determine Safe Harvest Levels/Total Allowable Harvests for all stocks and the coastal and Delta fisheries (Working Groups, FJMC, GRRB, DFO)                             <ul style="list-style-type: none"> <li>○ Maintain Dolly Varden harvests at 5% or less of stock levels until specific Reference Points and Total Allowable Catch estimates are developed</li> <li>○ Introduce more stringent harvest levels if conservation concerns exist</li> <li>○ Introduce other voluntary closures if necessary</li> <li>○ Enable stock levels to recover or increase</li> </ul> </li> <li>• Establish harvest strategies for healthy, cautious and critical zones for all Dolly Varden stocks (Working Groups)</li> <li>• Continue current stock-specific conservation measures until changes are required (Working Groups):                             <ul style="list-style-type: none"> <li>○ The Big Fish River is closed to fishing</li> <li>○ The Rat River Fish Hole is closed to fishing</li> <li>○ The Rat River harvest level is 600 Dolly Varden for 2010, and is to be reviewed annually</li> </ul> </li> <li>• Do not open any commercial fisheries (DFO, FJMC and GRRB)</li> <li>• Improve sport fishing management (DFO and Parks Canada Agency)                             <ul style="list-style-type: none"> <li>○ Maintain NWT daily catch limit and possession limit for sport fishing at zero (DFO)</li> <li>○ Review and modify if necessary Yukon sport fishing requirements (DFO)</li> <li>○ Continue to regulate sport fishing within Ivvavik National Park (Parks Canada Agency)</li> </ul> </li> <li>• Document management history in the GSA and ISR (DFO, FJMC and GRRB)</li> </ul>

	<ul style="list-style-type: none"> <li>• Identify to GNWT the need for research on and control of predators (Working Groups)</li> <li>• Educate youth on the importance of Dolly Varden and research (Working Groups, HTC and RRCs)</li> </ul>
<p><b>Ecosystem Objective</b></p> <p>To preserve and protect Dolly Varden habitats in all rivers in the GSA and ISR and along the Beaufort Sea coast to ensure that the stocks continue to thrive</p>	
<p>Identify and assess critical habitats</p>	<ul style="list-style-type: none"> <li>• Develop and implement a comprehensive winter and summer habitat assessment plan for Dolly Varden including photographic and other surveys and water quality and quantity studies (Working Groups, DFO, RRCs and Harvesters)             <ul style="list-style-type: none"> <li>◦ Identify carrying capacity for each river (DFO)</li> <li>◦ Continue Rat River monitoring studies and survey its length (DFO, GRRB, RRCs, harvesters)</li> <li>◦ Monitor Firth and Babbage fish holes (Working Groups, DFO and Parks Canada Agency)</li> <li>◦ Monitor benthic invertebrates (DFO, Parks Canada Agency)</li> <li>◦ Measure water quality and quantity in the Firth, Rat and other rivers (DFO and Parks Canada Agency)</li> <li>◦ Involve the youth (Working Groups)</li> </ul> </li> <li>• Investigate possible restoration of slumps at fish holes (DFO and Working Groups)</li> <li>• Partner with ArcticNet, Water Survey of Canada and others as possible (DFO and Working Groups)</li> </ul>
<p>Protect Dolly Varden and its habitats from adverse effects of development</p>	<ul style="list-style-type: none"> <li>• Provide information on and protection requirements for Dolly Varden and its habitats to review and regulatory agencies (DFO, FJMC and GRRB)             <ul style="list-style-type: none"> <li>◦ Ensure spawning and overwintering areas are fully protected and riparian habitats are not damaged</li> <li>◦ Highlight current national, regional and local protection requirements</li> <li>◦ Provide the Dolly Varden IFMP to developers, regulators and Beaufort Sea managers</li> </ul> </li> <li>• Continue to protect critical Dolly Varden habitat in Ivvavik National Park (Parks Canada Agency)             <ul style="list-style-type: none"> <li>◦ Give special protection to the Joe Creek and Firth River fish holes</li> </ul> </li> <li>• Protect Dolly Varden from fuel spills, ballast water and drill cuttings (DFO, FJMC and GRRB)</li> <li>• Improve understanding of effects of seismic activity on Dolly Varden (DFO)</li> <li>• Conduct patrols and inspections of developments that may affect Dolly Varden (DFO)</li> <li>• Protect Dolly Varden marine habitats through <i>Oceans Act</i> initiatives and the <i>Fisheries Act</i> (DFO and FJMC)             <ul style="list-style-type: none"> <li>◦ Participate in relevant Beaufort Sea Integrated Ocean Management Plan initiatives including identification of Ecologically and Biologically Significant Areas</li> </ul> </li> <li>• Monitor selected Dolly Varden habitats (DFO, Parks Canada Agency, HTC, RRCs and Harvesters)</li> <li>• Monitor possible effects of climate change on Dolly Varden and its habitats (DFO, Parks Canada Agency, HTC, RRCs and Harvesters)             <ul style="list-style-type: none"> <li>◦ Develop studies to investigate climate change and adaptation measures (DFO)</li> </ul> </li> <li>• Conduct contaminant, disease and parasite surveillance and studies (DFO, HTC, RRC and Harvesters)</li> <li>• Monitor invasive species (DFO, HTC, RRC and Harvesters)</li> </ul>
<p><b>Stewardship Objective</b></p> <p>To manage the Dolly Varden fisheries using adaptive management processes with full community participation</p>	
<p>Manage the Dolly Varden fisheries in the GSA and ISR through the Rat River Working Group and the West Side Working Group</p>	<ul style="list-style-type: none"> <li>• Review harvest, research and other new information annually and recommend revised conservation, other measures and studies as appropriate (Working Groups, HTC, RRCs and Harvesters)             <ul style="list-style-type: none"> <li>◦ Engage communities as much as possible through education, consultation, communication and media</li> <li>◦ Hold joint meetings</li> </ul> </li> <li>• Establish voluntary annual harvest levels (Working Groups, HTC, RRCs and Harvesters)</li> <li>• Fish in accordance to the requirements of the NWT Fishery Regulations (Harvesters)</li> <li>• Apply Rat River management measures to all other fisheries:             <ul style="list-style-type: none"> <li>◦ use 4" or 4.5" mesh nets</li> <li>◦ use nets no more than 30 meshes deep</li> <li>◦ use no more than three nets per household</li> <li>◦ use nets no more than 25 yards long</li> <li>◦ check nets twice per day (Harvesters)</li> </ul> </li> </ul>
<p>Monitor coastal and inland fisheries</p>	<ul style="list-style-type: none"> <li>• Develop and conduct plans for harvest studies and monitoring of all coastal and inland fisheries (Working Groups, DFO, HTC, RRCs and Harvesters)             <ul style="list-style-type: none"> <li>◦ Continue harvest studies</li> <li>◦ Encourage community reports on fish run information, TK, ice and habitat conditions</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>• Provide information on harvests to monitors and others as requested (Harvesters)</li> <li>• Report habitat changes and incidents of predation to Working Groups (Harvesters)</li> <li>• Return all Dolly Varden tags with accurate information (Harvesters)</li> <li>• Introduce a comprehensive harvest monitoring program (DFO, FJMC, GRRB and Parks Canada Agency)             <ul style="list-style-type: none"> <li>◦ Continue Rat River, Shingle Point and Ivavik National Park monitoring programs (Working Groups and Parks Canada Agency)</li> <li>◦ Monitor other fisheries, including Herschel Island Territorial Park (Working Groups)</li> </ul> </li> <li>• Monitor parasites in Dolly Varden flesh (Fishermen)             <ul style="list-style-type: none"> <li>◦ Inform harvesters about monitoring parasites and fish health (DFO)</li> </ul> </li> </ul>
<p>Involve the harvesters and communities in decision-making and information exchanges</p>	<ul style="list-style-type: none"> <li>• Meet each year with the harvesters and communities (Working Groups)             <ul style="list-style-type: none"> <li>◦ Include harvesters in decision-making processes on harvesting and allocation</li> <li>◦ Ensure annual recommendations are communicated effectively</li> </ul> </li> <li>• Develop a Dolly Varden communication plan and educational program (Working Groups, HTC and RRCs)</li> <li>• Increase information sharing with communities (Working Groups, DFO, FJMC, GRRB, Parks Canada Agency)             <ul style="list-style-type: none"> <li>◦ Ensure timely reporting from researchers with plain language information</li> <li>◦ Use existing media e.g. community newsletters</li> <li>◦ Use radio and internet to communicate important issues</li> <li>◦ Synergise efforts with ongoing investigations e.g. Arctic Borderlands</li> </ul> </li> <li>• Engage additional community members             <ul style="list-style-type: none"> <li>◦ Develop youth outreach programs</li> </ul> </li> </ul>
<p>Ensure compliance with requirements for the conservation and sustainable use of Dolly Varden</p>	<ul style="list-style-type: none"> <li>• Promote compliance through education (Working Groups, HTC and RRCs)             <ul style="list-style-type: none"> <li>◦ Encourage communication between harvesters and monitors</li> </ul> </li> <li>• Comply voluntarily with management measures (Harvesters)</li> <li>• Conduct fishery patrols within their respective jurisdictions (DFO – see Appendix L)             <ul style="list-style-type: none"> <li>◦ Increase C&amp;P presence (DFO)</li> </ul> </li> <li>• Conduct prevention activities for Ivavik National Park as required (Parks Canada Agency – see Appendix L)</li> </ul>
<p><b><i>Socio-Economic Objectives</i></b></p> <p>To ensure the maintenance of Dolly Varden in rivers, streams and other waters of the GSA and ISR, primarily for the purpose of subsistence food and as a mechanism for the support of traditional Gwich'in and Inuvialuit culture</p> <p>To manage, to the extent possible, the Dolly Varden fisheries in a manner consistent with Gwich'in and Inuvialuit cultural practices</p>	
<p>Ensure the subsistence food fishery is the first priority for sustainable use</p>	<ul style="list-style-type: none"> <li>• Continue to ensure sustainable traditional food fisheries have priority over other uses of Dolly Varden (DFO, Working Groups, RRCs, HTC and Parks Canada Agency)             <ul style="list-style-type: none"> <li>◦ Do not open any commercial fisheries (DFO, FJMC and GRRB)</li> <li>◦ Amend sport fishing regulations as required (DFO and Parks Canada Agency)</li> </ul> </li> </ul>
<p>Ensure effective allocation of the harvestable fish</p>	<ul style="list-style-type: none"> <li>• Allocate harvests between the GSA and ISR as necessary (Working Groups and Communities)             <ul style="list-style-type: none"> <li>◦ Involve all stakeholders</li> <li>◦ Respect GLCA and IFA process requirements</li> </ul> </li> <li>• Divide allocations amongst their own membership (RRCs and HTC)             <ul style="list-style-type: none"> <li>◦ Include elders and others in the distribution of Dolly Varden</li> </ul> </li> </ul>
<p>Promote traditional practices in implementing Dolly Varden management decisions</p>	<ul style="list-style-type: none"> <li>• Include elders and youth at meetings (Working Groups, RRCs and HTC)</li> <li>• Encourage traditional values (RRCs and HTC)             <ul style="list-style-type: none"> <li>◦ Educate youth about traditional values</li> </ul> </li> <li>• Include traditional management measures in annual operational plans (Working Groups)</li> <li>• Show respect to Dolly Varden (Harvesters)             <ul style="list-style-type: none"> <li>◦ Give priority in fishing site selection to fishermen remaining at the fishery throughout the season (RRCs and HTC)</li> <li>◦ Harvest only what is needed for their own subsistence purposes (Harvesters)</li> <li>◦ Kill quickly and humanely (Harvesters)</li> <li>◦ Handle fish cleanly (Harvesters)</li> <li>◦ Store and process Dolly Varden to minimize wastage (Harvesters)</li> </ul> </li> </ul>

## **APPENDIX K: RESEARCH AND MONITORING PLAN**

### **Introduction**

The development of fishery research and monitoring plans and proposals in the GSA and ISR must involve the HTC's, RRCs and harvesters as well as DFO, GRRB, FJMC, and, in Ivvavik National Park, Parks Canada Agency (see Appendix C). These groups were involved in developing the research and monitoring proposals identified in Appendix J, and it is these proposals that are the basis for the Research and Monitoring Plan.

There are three priorities of the Research and Monitoring Plan for Dolly Varden in the ISR and GSA:

- stock assessments, with priority on rivers without current stock assessment data;
- Harvest monitoring; and
- habitat assessments and monitoring habitat change.

This plan is broken down into a list of short-term research and monitoring goals and then long-term research and monitoring goals. Under each of the short-term and long-term goals, existing research or monitoring projects that are addressing those goals are listed. The lead organization is listed along with partners for each existing project.

### **Short-term Research and Monitoring Priorities for Dolly Varden (3-5 years)**

#### **Stock Identification and Composition of Mixed Stock Fishery**

Genetic studies to identify unit-stocks and establish genetic baseline stock structure is critical for management of mixed stock fisheries. Samples collected from the coastal fisheries will be used to assess the composition of contributing Dolly Varden populations. Existing projects include:

- *Unit stock analysis* (Lead: J. Reist and R. Bajno, DFO. Partners: GRRB). The genetic method of nuclear microsatellite analysis will examine variation within and between Canadian Dolly Varden systems and will be employed to identify unit-stocks and establish understanding of genetic baseline stock structure.
- *Sub-structuring of Dolly Varden in the Rat River* (K. Howland and C. Gallagher, DFO. Partners: GRRB). There may be both summer and fall spawning populations of Dolly Varden in the Rat River. Confirmation of population structuring and an understanding of the behaviour (migration timing, spawning/overwintering habitat) of sub-populations is important in determining the reliability of existing and future population trend information. A project to confirm the presence of adult fish on the Rat River spawning grounds in summer and to verify anadromous behaviour began in 2010.

- *Otolith micro-chemical analyses to aid in stock discrimination of Dolly Varden* (Lead: T. Loewen, J. Babaluk, J. Reist, DFO and N. Halden, U. Manitoba. Partners: GRRB) The objective is to examine of geochemical signals in the otolith during early life history (pre-smolt for anadromous individuals) as well as examine similar geochemical signals in the aqueous environment (rearing and over-wintering tributaries). Archived sagittal otoliths collected from Dolly Varden of various Yukon North Slope and Northwest Territories tributaries will be used for geochemical analyses.

### Stock Assessment

Stock assessments will be high priority over the next 3-5 years on the Babbage, Firth and Vittrekwa rivers.

*Stock assessment* (Lead: K. Howland, DFO. Partners: GRRB, FJMC). Over the next 1-3 years a comprehensive program will be developed to assess Dolly Varden populations throughout the western Arctic. The focus is to collect updated population abundance and demographic information for stocks which are currently data deficient (Big Fish, Babbage and Firth rivers). Research in 2010-11 is focused mainly on the Big Fish River with some work in the Babbage. Dual Frequency Identification Sonar (DIDSON) enumeration and mark-recapture studies will be conducted on the Babbage and Firth Rivers in 2011-12. Additional research will be initiated on other stocks including the Vittrekwa and Rat over the next 2-3 years. Research on each system will involve:

- reconnaissance flights to evaluate feasibility of estimating Dolly Varden abundance using DIDSON and/or mark-recapture methods;
- complete enumeration of the upstream migration of Dolly Varden using DIDSON;
- live sampling for biological data and tagging for mark-recapture population estimate of Dolly Varden simultaneous with use of DIDSON to allow for comparison of methods using abundance estimates derived in the same year;
- where possible, multi-year (2 consecutive years) mark-recapture studies will be conducted to estimate survival and address key assumptions associated with single year mark-recapture studies.

### Habitat Assessment

Future studies on habitat include the collection of similar data for other rivers along the Yukon North Slope to improve our understanding of habitat use for Dolly Varden. Documentation of baseline habitat reference conditions will continue which can be used to monitor change over time, and develop a two-dimensional river models to predict habitat availability based on different scenarios of water levels. Existing projects include:

- *Assessment of critical habitat* (Lead: N. Mochnacz and J. Reist, DFO. Partners: GRRB). The objective is to improve our overall understanding of habitat associations for northern form Dolly Varden found in rivers of the Inuvialuit, Gwich'in, and Sahtu Settlement regions. This project will: 1) examine habitat availability (quantity/quality) and use, 2) determine baseline habitat reference conditions which can be used to monitor change over time, and 3) develop a two-dimensional river model to predict habitat availability based on different water levels.
- *Freshwater ecological integrity monitoring in Ivvavik National Park* (Lead: Parks Canada. Partners: FJMC, Water Survey of Canada, Environment Canada). The following projects are conducted on an annual basis as part of the Freshwater Ecological Integrity monitoring program for Ivvavik National Park: 1) Water quality testing in the Firth River; 2) Peak flow, monthly discharge and water level are monitored the gauging station on the Firth river; 3) Benthic Invertebrates community is monitored as indicators of aquatic health, and 4) Integrated Dolly Varden monitoring: a pilot project in 2010 to monitor critical physical characteristics, water, habitat condition of rearing and overwintering fish habitat. Juvenile abundance and reproductive effort (redd counts) will also be monitored to provide comprehensive information on Dolly Varden for long-term monitoring.
- *Habitat use and relative abundance of Dolly Varden from the Vittrekwa River* (Lead: C. Gallagher, DFO). The project will examine spawning sites, habitat use, and population characteristics of Dolly Varden from the Vittrekwa River during the fall. This is of interest to the Gwich'in.
- *Habitat monitoring of Dolly Varden rivers using photography* (Lead: A. Joynt, DFO). The objective of this project is to create a photographic record of several rivers inhabited by Dolly Varden, namely the Big Fish, Rat, and Vittrekwa rivers, to 1) provide a baseline for comparison between historical, and future records and 2) provide a starting point for a habitat study of the Northern form of Dolly Varden.

### Aging

Research will be undertaken on aging methods and to verify that the relative ages obtained represent accurate absolute ages (or at least a known and consistent bias). Existing projects include:

- *Effectiveness of non-lethal ageing methods* (Lead: K. Howland, DFO). Given the current concerns with population status, particularly in the Rat River, there is a need for examination of the feasibility of using non-lethal aging structures such as fin clips for future aging of Dolly Varden charr. DFO will determine whether fins rays can be used instead of otoliths to determine age. This would help reduce the number of Dolly Varden sacrificed for scientific investigation.



### Identification of Other Stocks

Declines in some Dolly Varden stocks have increased interest in identifying unknown or suspected Dolly Varden populations. Possible distinct stocks include the Fish River (near the Alaska border) where groundwater springs may indicate the presence of spawning or overwintering habitat. Confirmation that the Malcolm River contains a distinct and viable stock is also required. Inland populations of Dolly Varden may also be present in rivers west of the Peel River. Adequate sampling to verify or negate these possibilities needs to be conducted. Existing project:

- *Identification of additional inland populations* (Lead: N. Mochnac and J. Reist, DFO). A survey of suitable habitats in inland locations (e.g. mountainous rivers flowing into the east side of the Peel River, mountainous rivers flowing into the west side of the lower Mackenzie River, and rivers in upstream areas of the Peel Basin) thought likely to sustain isolated-resident populations of Dolly Varden.

### Monitoring of Coastal and Inland Fisheries

Harvest and biological data from coastal and inland fisheries will continue to be recorded for monitoring purposes.

- Monitoring coastal fisheries (Lead: DFO and FJMC). The only present significant ongoing fishery for Dolly Varden in Canada is that conducted coastally at Shingle Point. This fishery likely captures mixed-stocks comprised from Rat, Big Fish, and Babbage rivers, with small contributions from Vittrekwa and perhaps Firth rivers. Composition likely varies inter-annually depending upon local weather, stock abundance, and related conditions. The mixed stock fishery is an identified concern. Monitoring for tag returns will be especially important in 2011 given that tags will be applied to the Rat, Big Fish and Babbage rivers simultaneously in the fall of 2010, thus providing an opportunity to examine the contributions of each of these stocks to the coastal fishery.
- Monitoring inland fisheries (Lead: GRRB). The upstream migration of Dolly Varden into the lower Rat River has been monitored for 15 years and data/samples relevant to key projects have been obtained. These include biological data, catch data, genetic tissues, ageing structures, etc. Continued monitoring of this fishery provides information on changes in biological parameters that are used to make adjustments to the Fishing Plan.
- Sport-fishing surveys in Ivvavik National Park (Lead: Parks Canada). All visitors who purchase sport-fishing surveys are required to report their catch, fishing locations and fishing effort.

**Long-term Research and Monitoring Goals for Dolly Varden (5-10 years)**

Long-term research on Dolly Varden will revolve around priorities established by the GRRB in consultation with the RRCs, the FJMC with the HTC's, DFO and Parks Canada. Research and monitoring priorities and gaps in knowledge have been identified by these organizations, including the NWT Board Forum (2009), a GRRB gap analysis (Weagle 2009) and the FJMC's annual meeting. The short-term priorities of harvest data collection, habitat monitoring and stock assessment are also projects that aim to be carried out over the long-term. Regular assessments (3-5 year rotation for each stock) of abundance and biological characteristics are required to evaluate trends in relation to harvest levels and the environment. Other long-term goals, not addressed in the short-term, may include the following:

- documentation of aquatic habitat and ecosystem interactions among aquatic resources;
- influence of climate change;
- assessment of cumulative effects of development on aquatic resources;
- contaminant, disease and parasite levels in Dolly Varden;
- alternatives to population estimation techniques using new technologies;
- role of resident males in maintaining recruitment;
- population sub-structure of Dolly Varden populations;
- monitoring predator populations.

## **APPENDIX L: COMPLIANCE PLAN**

### **Fisheries and Oceans Canada**

DFO Conservation & Protection activities are designed to ensure compliance with legislation and the IFMP. A number of strategies will be used to ensure compliance including proactive communications with fish harvesters to ensure that they remain aware of the management plan and related regulations. As well Fishery Officers will conduct patrols, monitoring and surveillance throughout the year, with an increased presence during sensitive times (migration/over wintering)

Fishery Officers will respond to and investigate complaints and reports of illegal activity. Where there is evidence of non-compliance, enforcement action will be taken; this may include warnings or prosecutions.

The local RRC or HTC will communicate to its members the importance of compliance. Emphasis will be on voluntary management actions. Fishery Officers will assist with communicating the RRWG and WSWG recommendations during voluntary closures. HTCs have the power to create bylaws (IFA Section 14.(76)(f)) which could be used to help implement compliance plans.

Education is, of course, an important activity in achieving compliance.

### **Parks Canada Agency – Prevention Plan**

In accordance with Parks Canada Agency's prevention guidelines, a series of proactive and reactive measures will be used to prevent incidents and mitigate impacts of contraventions to the National Park Fishing regulations, or local Western Arctic Field Unit Superintendent orders with regards to fishing in Ivvavik National Park. Proactive strategies include: (1) education and information about fishing regulations and resource conservation through positive and effective communication to visitors and staff; and (2) dissuasive measures to improve prevention, including regular park operations along the Firth River and the coastal area of Ivvavik, and other monitoring activities. Reactive strategies are corrective measures including friendly reminders or formal notices used to resolve situations before there are serious law enforcement interventions.

A law enforcement officer (park warden) would be available to respond to or investigate major complaints or serious resource conservation incidents, as needed. Should illegal activities occur within the Park, the law enforcement officer's investigation could result in prosecutions.

**APPENDIX M: SELECTED SOURCES OF INFORMATION**

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