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Information in support of an Exploratory Fishery Protocol - Nunavut and Northwest Territories Anadromous Arctic Charr

Information appuyant le protocole pour la pêche exploratoire à l'omble chevalier anadrome du Nunavut et des Territoires du Nord-Ouest

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TABLE OF CONTENTS

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ABSTRACT

A data collection protocol for assessing anadromous Arctic Charr, *Salvelinus alpinus* (Linnaeus), exploratory fisheries in Nunavut and the Northwest Territories was established in 1973 and last reviewed in 2003. In light of the New Emerging Fisheries Policy and the increasing interest in the development of commercial fisheries, especially in Nunavut, this protocol again required review.

The 2009 protocol set a provisional quota for five years and requested that the licence holder record catch-per-unit-effort (CPUE) and harvest data each year. Biological data from a sub-sample of the Charr caught was also requested from the licence holder, but only in years one and five under an exploratory licence. Guidance was also provided regarding selection of fish used for biological processing and treatment of bycatch species.

A review of the 2009 protocol led to the following recommendations:

- All provisional quotas should be fished fully for a minimum of five years.
- Biological, CPUE, and total harvest data should be collected every year for a minimum of five years before stocks are assessed and recommendations are made about the biological viability of a commercial fishery.
- Biological sampling should include individual fork length, round weight, sex, and sagittal otoliths for a minimum of 200 anadromous Arctic Charr.
- Fish selected for biological processing should be done so in a stratified manner (e.g. every third fish) throughout the duration of the fishery.
- Bycatch species should be identified, counted, and released. Fish that are unlikely to survive after release should be sampled for biological data (fork length, round weight, sex, and ageing structure, as appropriate).

RÉSUMÉ

Un protocole de collecte de données pour évaluer la pêche exploratoire à l'omble chevalier anadrome, *Salvelinus alpinus* (Linnaeus), au Nunavut et dans les Territoires du Nord-Ouest a été établi en 1973 et a été examiné pour la dernière fois en 2003. À la lumière de la Politique sur les nouvelles pêches et de l'intérêt croissant pour l'exploitation des pêches commerciales, principalement au Nunavut, ce protocole rendait nécessaire un nouvel examen.

Le protocole de 2009 établit un quota provisoire pour cinq ans et demande aux détenteurs de permis de consigner les prises par unité d'effort (PUE) et les données sur la récolte chaque année. On a également demandé aux détenteurs de permis de fournir les données biologiques d'un sous-échantillon de l'omble chevalier, mais seulement pour la première et la cinquième année en vertu d'un permis exploratoire. On a également fourni de l'orientation concernant le choix du poisson utilisé pour l'échantillonnage biologique et le traitement des individus d'espèces non ciblées.

Un examen du protocole de 2009 a mené aux recommandations suivantes :

- L'ensemble des quotas provisoires doivent être atteints pendant au moins cinq ans.
- Les données biologiques, sur les prises par unité d'effort (PUE) ainsi que sur les prélèvements totaux doivent être recueillies chaque année dans les cinq ans précédant l'évaluation des stocks et la formulation de recommandations au sujet de la durabilité biologique d'une pêche commerciale.
- L'échantillonnage biologique doit permettre la cueillette de données sur la longueur à la fourche, le poids brut, le sexe et les otolithes sagittaux d'au moins 200 ombles chevaliers anadromes.
- Le choix des spécimens pour l'échantillonnage biologique doit être fait de façon stratifiée (c.-à.-d. chaque troisième poisson) pendant toute la durée de la pêche.
- Les individus d'espèces non ciblées qui sont capturés accidentellement doivent être identifiés, dénombrés et remis à l'eau. Les individus qui pourraient ne pas survivre à la remise à l'eau doivent être sacrifiés pour un échantillonnage biologique (longueur à la fourche, poids brut, sexe et structures de détermination de l'âge, s'il y a lieu).

INTRODUCTION

LIFE HISTORY TYPES OF ARCTIC CHARR

Arctic Charr, *Salvelinus alpinus* (Linnaeus), found in Nunavut and the Northwest Territories occur in various life history types including; landlocked, resident, and migratory (Babaluk *et al*. 2002, Grainger 1953, Loewen *et al.* 2009, Reist *et al.* 1995). Landlocked Charr do not have access to the sea due to the impassable barriers. Resident fish have access to the sea, but remain in freshwater throughout their lives (Loewen *et al.* 2009). Migratory (anadromous) Arctic Charr spawn and overwinter in freshwater but feed in the marine environment (Grainger 1953). Differences among these life history types require that the protocol for data collection for each will differ in order to produce an optimal assessment of the stock. This document focuses on the anadromous Arctic Charr.

BIOLOGY OF ANADROMOUS ARCTIC CHARR

Mature anadromous Arctic Charr spawn in the fall in freshwater on gravel beds (Grainger 1953). Though iteroparous, spawning does not normally occur annually (Dutil 1986). Egg development occurs throughout the winter and young fish emerge in the spring (Hunter 1976). Juvenile Charr remain in freshwater to feed usually until the age of four or five (Johnson 1980). Thereafter, immature Charr undergo annual migrations in the late spring or early summer to feed in the sea, returning to freshwater in the fall (Johnson 1980). Sexual maturation does not generally occur until at least eight years of age, but varies depending on location (Dempson and Green 1985). Mature Charr then continue the cycle of migrating to the sea to feed and returning to freshwater to overwinter (Grainger 1953). However, mature fish may forgo the migration to the marine environment to feed in the year of spawning (Dutil 1986, Kristofferson 2002).

HISTORY OF CHARR FISHING LICENCES

Commercial fishing for Arctic Charr has been documented since the late 1940s in what was the Northwest Territories (now Northwest Territories and Nunavut; Grainger 1953). In 1973, a test fishery program was established by the Fishery Management Division, Department of the Environment (now Fisheries and Oceans Canada (DFO), Central and Arctic Region), in cooperation with the Wildlife Service, Government of the Northwest Territories (GNWT), to facilitate the development of new commercial fisheries (Kristofferson and McGowan 1981, McGowan 1985). The test fishery program was designed to determine commercial feasibility, establish initial quotas, identify any potential problems a commercial fishery may encounter, and collect biological data. A provisional quota was set based on estimates of productivity per hectare (Allen Kristofferson, *pers comm.*) and fishers were asked to fish the full quota. It was assumed that gill nets would be used and if not, an explanation was requested. Most of the test fisheries were performed during winter by setting gill nets under the ice of target stocks within the overwintering lake. The biological sampling protocol in the test fishery program required a minimum of 100 fish be sampled annually for fork length, weight, sex, sexual maturity (if time permitted), stomach contents (if time permitted) and age structures (scales or otoliths). All other fish were to be identified, counted, and also sampled if possible. Catch and effort data was collected daily. GNWT staff performed, or directly supervised, the test fisheries and data analyses were performed by the DFO staff. Test fisheries ran for two to three years, under permits applied for annually, until sufficient data were collected for assessment. Upon completion, if it was determined that the waterbody could sustain a commercial fishery, it was submitted for inclusion under Schedule V of the Northwest Territories Fishery Regulations as a commercial waterbody.

In the mid-1980s, the test fishery program for each waterbody ran for at least five years before sufficient data was collected for assessment (McGowan 1989). Rather than annual sampling of biological data, sampling from the first and/or second year and the fifth year of the test fishery were required to assess the effects of exploitation. In addition, total annual harvest (commercial, sport, domestic) were to be reported for the waterbody.

The Exploratory Fishery licence replaced the test fishery program in 1990 to standardize the program with DFO Quebec Region (McGowan *et al.* 1993). The goals of the program continued to be testing and developing new commercial fisheries in the Northwest Territories, but included the following revisions:

1) Fisheries in fresh and marine waters were examined.
2) Fishing occurred under an Exploratory Licence, issued annually.
3) Licences were issued to local associations and individuals within the communities.
4) Biological samples were not requested every year but when requested, they were collected by the licencee or person approved by the licencee.
5) The five-year sampling protocol was formalized and included specific instructions on the data to be collected in each of the five years.

As in the past, a provisional quota was set and fishers were asked to catch the full quota. However, in the formalized five-year approach it was requested that the sampling of 100 fish occur in years one and five, and that catch, effort, and total harvest data be collected in all five years. In this revision, total harvest referred to the total harvest collected under the licence, not the total annual harvest including commercial, sport, and domestic, as in the past. The data and age structures continued to be submitted to and analyzed by DFO staff.

The sampling manual for Experimental (Exploratory) Fisheries (Appendix 1) provided details to assist licence holders with biological sampling, and collecting catch and effort data.

In 2003, DFO Science suggested that biological sampling of 200 fish would provide improved data for assessment. This was suggested, though not enforced, on licences. Further, it was recommended that biological data be collected in each of the five years, that data be collected throughout the duration of the annual fishery, and that to provide a random sample, every third fish be sampled (Appendix 2).

In 2009, DFO did not issue any Stage II Exploratory licences in the Northwest Territories, but did issue ten in Nunavut. For these licences, the biological sampling of 200 Arctic Charr for fork length, round weight, and sex, with a sub-sample of 100 for ageing structure was required in years one and five of exploratory status, and strongly recommended in interim years (Appendix 3).

DFO POLICY

Interest in developing additional commercial fisheries for anadromous Arctic Charr continues, although primarily in Nunavut. DFO is developing a Sustainable Fisheries Framework to form the basis for decision-making in Canadian fisheries. The framework incorporates existing and new policies for fisheries management, conservation and sustainable use, governance, and economics. The New Emerging Fisheries Policy was developed in 1996 to lay out the requirements that must be met and the procedures that have to be followed before a new fishery can be initiated. The policy requires that a scientific basis be established where responses to new fishing pressures can be assessed. The objective is to achieve sustainable use of fisheries resources while conserving the fish stocks. It is meant to apply to all new fisheries undertaken in marine or freshwater areas where DFO manages the fishery.

As a general rule, new fisheries involve three stages (from http://www.dfo-mpo.gc.ca/fm-gp/policies-politiques/efp-pnp-eng.htm#2):

i. STAGE I (Feasibility): The objective of this stage is to determine if harvestable quantities of the species/stock known to be present in a particular fishing area exist, if the species/stock can be captured by a particular gear type, identify multi-species and habitat impacts, if markets exist, and the best approach for proceeding further, e.g. to Stage II.

ii. STAGE II (Exploratory): The commercial and stock assessment stage is reached if and as soon as feasibility has been demonstrated. The objective of this stage is to determine whether a species/stock can sustain a commercially viable operation and to collect biological data in order to build a preliminary database on stock abundance and distribution.

iii. STAGE III (Commercial): The commercial fishery stage is reached once it has been determined that a species/stock can sustain (commercially and biologically) a commercial fishing operation. A formal Integrated Fisheries Management Plan is introduced.

The three stages are often not distinct and in some cases stages I and II may be combined. This is likely appropriate for anadromous Arctic Charr where there is already sufficient information available to proceed directly to stage II.

This review focuses on the 2009 Stage II Exploratory Fishery licence conditions (Appendix 3) to determine if the information requested will be sufficient to provide an assessment of the impact of the harvest level on the fish stock and thereby determine if the level of harvest is sustainable over the long-term.

ASSESSMENT

DETERMINING EFFECTS OF EXPLOITATION ON A STOCK

One avenue for the assessment of a stock is to determine what the sustainable removal level may be. Studies of anadromous Arctic Charr stocks in Nunavut and the Northwest Territories have shown that harvests of 11% or more were found to be excessive and resulted in population decline (DFO 1999, Johnson 1980, Kristofferson *et al.* 1984). With a lack of quantitative studies on the lower limit of the safe removal levels, a precautionary approach has been adopted and a removal level of 5% of the stock size has been recommended for other Charr stocks in northern Canada (Cosens *et al.* 1995, DFO 2005, DFO 2009). While this estimate is available, its application requires knowledge of the stock size and the total removal of fish from all sources.

An estimate of stock size is rarely available for anadromous Arctic Charr stocks in Northwest Territories and Nunavut. There are various avenues to determining stock size of Arctic Charr, including absolute counts with a weir or estimated counts using mark-recapture experiments.

These types of studies are complicated in both experimental design and logistics, as well as financially expensive. Further, to determine an estimate of stock size one would ideally know the total number removed from the stock by harvesting, including the exploratory licence, domestic, sport, and subsistence. This information is not collected in the current Stage II Exploratory Fishery licence, nor is it realistic to ask the licencee to collect it.

If an estimate of stock size is not feasible, then an exploratory fishery approach (e.g., setting a provisional quota and fishing to that level over a certain number of years) becomes a test to see whether the level of harvest has any measurable impact on the population and whether it is acceptable and doesn't negatively affect the long-term sustainability of the fishery. This should include all harvest regardless of what the fish are used for (e.g., subsistence, sale, barter, dog food). This again, is one of the drawbacks to the current approach since only harvest for the exploratory fishery is recorded. No information on the total harvest from the system is provided and whether it is consistent among years. This affects interpretation of any data collected from the population.

Initially in an exploratory fishery, a conservative provisional quota is recommended and fishers are asked to fish to the full quota for each of five years. It is important to make every effort to fish the full quota because the intensity of effort required to reach the quota could be used to infer the relative abundance of the stock and evaluate the feasibility of a commercial fishery. For example, if the full quota is reached for a particular location but requires a large amount of effort, it could indicate that the population abundance is low at that particular place and time, suggesting that a commercial fishery may not be viable. Conversely, if the full quota is reached with little effort over successive years, this would suggest that fish are abundant at that place and time, and that a commercial fishery may be viable. However, if consistent effort to fish the full quota is not applied, the relative abundance of the stock, and its response to the exploratory fishery, may be misinterpreted (e.g., stock abundance may be high but interpreted as low or variable if effort is minimal or unevenly applied among years).

Maintaining effort to consistently fish the full quota throughout the exploratory stage is also important to properly assess any changes that may have occurred in the biological characteristics of the stock. Licencees are asked to provide length, weight, and otoliths of a sub-sample of the catch each year, along with catch-effort data. Based on the samples and data provided, the population characteristics are monitored for changes which may result from the harvest. Dramatic changes in the age structure of the population, such as a drastic reduction in the number of age classes, may suggest that harvest is too high and that quotas may have to be adjusted.

Therefore, failing to invest effort towards achieving the entire provisional quota for the duration of exploratory status prevents proper assessment of the stock (relative abundance and biological characteristics) and reduces the ability to evaluate the potential for a commercially viable fishery.

CATCH-PER-UNIT-EFFORT

Catch-per-unit-effort (CPUE) can be defined as "The catch of fish, in numbers or weight, taken by a defined unit of fishing effort" (Ricker 1975). Theoretically, CPUE would decrease proportionally to a decrease in stock size.

While CPUE will have a relationship to stock size, direct prediction of population abundance from a simple relationship can rarely be achieved and thus CPUE is considered an index of stock size. Many assumptions must be considered when using CPUE as an index of stock size in a stock assessment analysis. One assumption is that the stock is homogenous (Ricker 1975). A homogenous stock is one in which all fish are equally vulnerable to capture; which is rarely, if ever, plausible in the natural environment.

Another assumption is that all fish in the population are equally susceptible to the gear (Ricker 1975). In a size selective fishery, the index of stock size refers only to the proportion of the population susceptible to the gear, not the entire population. The same rationale applies to the differing life stages of the population; generally only the larger, mature fish are captured in the 139.7 mm (5.5 inch) mesh nets used by commercial fishers and thus the index of stock size does not reflect the smaller/younger portion of the population. For example, Arctic Charr in the Silvia Grinnell River system migrate to the sea for the first time when they are approximately 15 to 20 cm (five to eight years) (Hunter 1976) and would not be susceptible to a 139.7 mm (5.5 inch) mesh gill net. Therefore, that portion of the stock is not represented in the CPUE based stock size.

Another consideration for the use of CPUE is the consistency of fishing effort and gear involved (Ricker 1975). If this takes the simple form of fishing more often with the same gear or fishing with more gear of the same type, the data can be standardized before analysis is performed. However, analyses would become more difficult if the inconsistency resulted in something more subtle and harder to track, such as an increased efficiency of the harvesters using the same equipment and effort as they learn more about the stock itself (e.g., areas of congregation).

An additional influence on the reliability of CPUE is the activity of the fish at the time of capture. Anadromous Arctic Charr are often, but not always, caught during their migration into the overwintering lake after a summer of feeding in the sea (Read and Roberge 1991). When populations are aggregated in time and space, CPUE may not decrease noticeably until the population has been dramatically reduced in size (Mackinson *et al.* 1997) and make it appear as though the population is stable through a period of decline. Therefore, CPUE data obtained during a period of migration should be interpreted cautiously.

The numerous assumptions of using CPUE as an index of abundance are unlikely to be met; however, actions can be taken to minimize departures from such assumptions (for example, consistency in timing of the sampling and sampling gear used).

A sample of the CPUE record sheets for Arctic Charr provided to Nunavut fishers in 2009 with a Stage II Exploratory Licence can be found in Appendix 4. The information requested is acceptable for assessment purposes.

While the collection of CPUE is relatively easy and inexpensive, the issues associated with only using it to estimate relative stock size and infer stock status and sustainability is not recommended. Rather, utilizing CPUE in combination with a suite of biological characteristics that are known to change with harvesting pressure provides an improved basis of information for studying stock dynamics and impacts of exploitation.

BIOLOGICAL DATA

The status of an Arctic Charr stock may be assessed in numerous ways using biological data, such as through the monitoring of age or length frequency distributions, population growth (length-at-age), or mortality rate. The basic information required for these assessments include fork length, round weight, sex, and sagittal otoliths for age determination. The biological data requested for Arctic Charr from fishers in Nunavut and Northwest Territories with a Stage II Exploratory licence include all of the above, and is therefore sufficient for assessment purposes. However, the number of those samples collected requires revision.

Number of samples of biological data to collect

The protocol on the 2009 licences stated that 200 fish be sampled for fork length, round weight, and sex, but only 100 otoliths were required. Age determination for 100 fish is not sufficient to characterize population age structure.

This is demonstrated using age-frequency data collected from Arctic Charr (n= 200) in 2007 at Kingnait Fiord, Nunavut using 139.7 mm (5.5 inch) mesh gill nets. A sub-sample of 100 ages was randomly drawn, with replacement (Manly 1997), from the dataset and the age-frequency distribution was graphed. After repeating the random sub-sampling 1000 times, the mean deviation (± 1.96 SE) of the re-sampled ages was determined for each age class. Results of the simulations show that the amount of variation in the common age classes is high when 100 ages are used (Figure 1) which could result in a less accurate assessment of the stock.

However, due to the nature of re-sampling simulations in general, some variation is expected. To determine if the amount of variation would be lower if more ages were included, we repeated the re-sampling exercise, but with n=200 ages drawn, with replacement from the Charr dataset. Results of the simulations revealed that variation did decrease when more ages were included in each sample (Figure 2). Therefore, age determination for 100 fish is not sufficient to characterize population age structure and could result in less accurate assessment of the stock.

Accurate representation of the age classes is critical because they have an influence on the statistics for calculating two parameters that are used in assessing a stock: mortality and growth.

Total instantaneous mortality rate

Total instantaneous mortality rate (Z) is the total mortality (natural and fishing mortality combined) on a stock and can be described mathematically as the number of fish at time t+1 minus the number of fish at time t (Ricker 1975).

$$Z = -(\ln N_{t+1} - \ln N_t)$$

Z can be estimated by first plotting the natural logarithm of the frequency of each age class (Ricker 1975). Z is then estimated as the negative slope of the regression from the age of full recruitment to the gear is reached (the modal age + 1), and on (Ricker 1975).

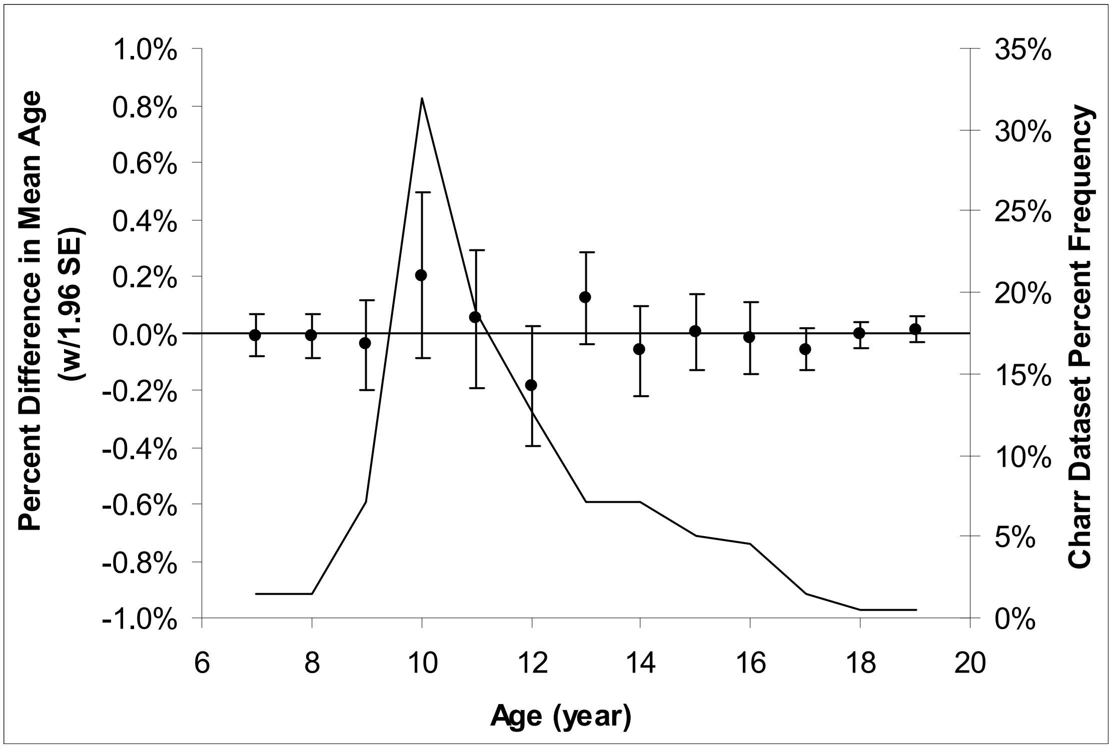

Figure 1. Percent deviation in mean age (+/- 1.96 SE) between the Charr dataset and the re-sampled (n=100 each trial, 1000 trials) ages from the Charr dataset (left axis); the percent frequency distribution for the Charr dataset (n=200) is shown for comparison (right axis). The horizontal line marks the 0.0% difference.

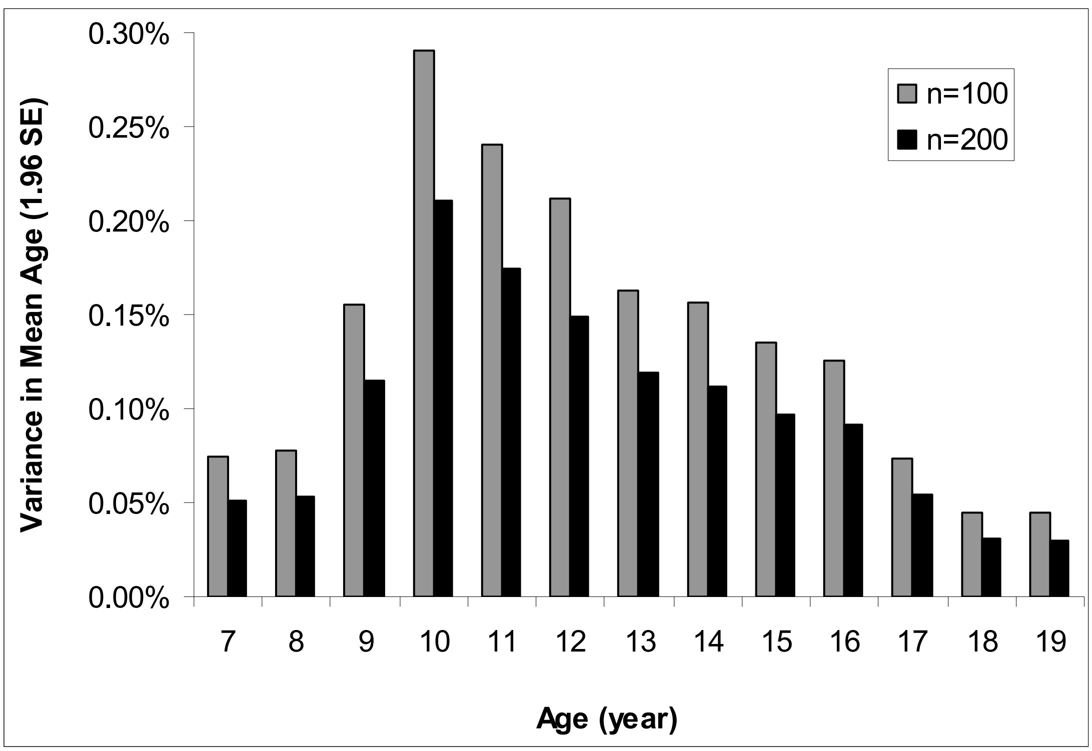

Figure 2. Comparison of the variance (1.96 SE) in the mean age between trials consisting of n=100 re-sampled ages and n=200 re-sampled ages (1000 trials each) from the Charr dataset.

To illustrate the impact of using 100 versus 200 (and 300) ages on the sample variance for estimated Z, we ran a second re-sampling experiment. A sub-sample of n=100, 200, and 300 ages were drawn from the Charr dataset (n=200, described above), with replacement and Z was calculated. This was repeated 1000 times and the variance (1.96 SE) of the re-sampled trials were calculated. Results show that when the size of the sample is increased from 100 to 200 ages, the amount of variation in the resulting estimates of Z decrease (Figure 3). Further, when the size of the sample is again increased from 200 to 300, the improvement in reduced variation is minimal.

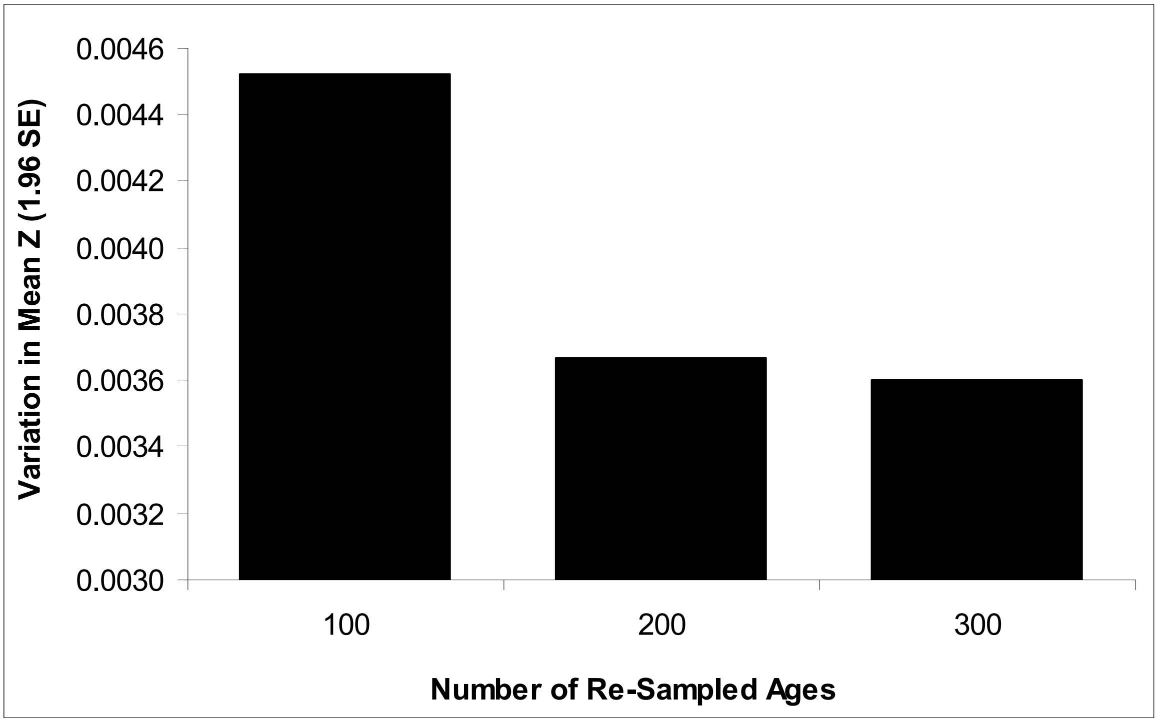

Figure 3. Comparison of variation (1.96 SE) in mean total instantaneous mortality (Z) between re-sampled datasets including n=100, 200, and 300 ages (1000 re-sampling trials for each sample size).

Growth

The monitoring of growth parameters, such as those in the von Bertalanffy growth equation (Figure 4), is also useful in the assessment of fish stocks, and its precision relies upon accurate representation of all age classes in a stock.

The von Bertalanffy parameters include:

$L(t)$ - estimated length at time t

L_∞ - largest sized fish observed in the sample/population

t_0 - theoretical length at age 0

K - body growth coefficient

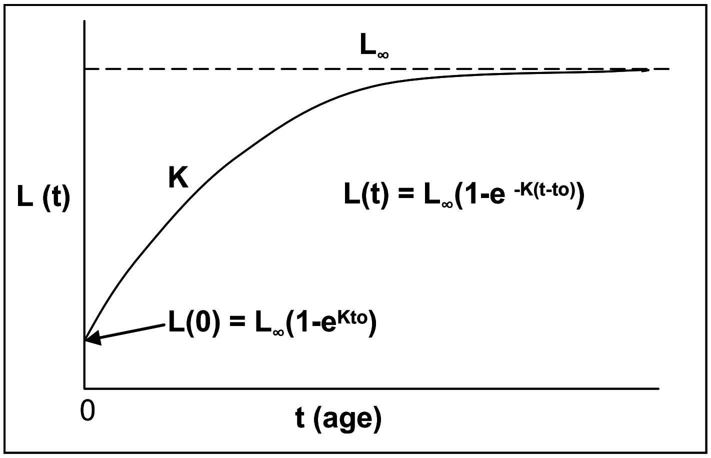

Figure 4. Graphical representation of the von Bertalanffy growth equation (modified from Sparre and Venema 1998).

For example, to determine the minimum sample size required to accurately estimate growth, Brouwer and Griffiths (2005) drew subsets of observations from a large collection (n=618) of *Argyrozona argyrozona* and fitted the von Bertalanffy growth model to the resulting datasets. They then estimated the upper and lower confidence intervals for each parameter using parametric bootstraps of the maximum likelihood estimate.

Variation in the confidence intervals produced were observed until a sample size of approximately 200 fish was reached, after which the confidence intervals stabilized (Figure 5). Brouwer and Griffiths (2005) generalized that at least 10 fish per 2-cm size class were required to produce accurate estimates of growth.

The fish used in Brouwer and Griffiths (2005) are slow-growing, attain approximately 25 years of age, and included 20 2-cm size classes. These characteristics are equivalent to those of Arctic Charr in Nunavut and Northwest Territories and therefore, these results provide additional support for the rationale to collect otoliths from 200 Arctic Charr (10 fish x 20 size classes = 200 fishes).

<u>Duration of biological data collection</u>

Arctic Charr have been known to migrate in specific groups, such as sex or size classes (Dempson and Green 1985, DFO 2001). Collecting a predetermined number of fish in a short time period may result in an unrepresentative sample of the population that is susceptible to harvest. Sampling throughout the duration of a fish run would ensure the representation of the entire harvestable population. Spatial and temporal sampling consistency should be maintained throughout the exploratory period. Where deviations occur an explanation should be provided.

To ensure an unbiased sample is collected, fish selected for biological processing should be done so in a stratified manner. For example, sampling every third fish that is landed was recommended in the Stage II Exploratory Fishery licence issued in Nunavut and Northwest Territories in 2009.

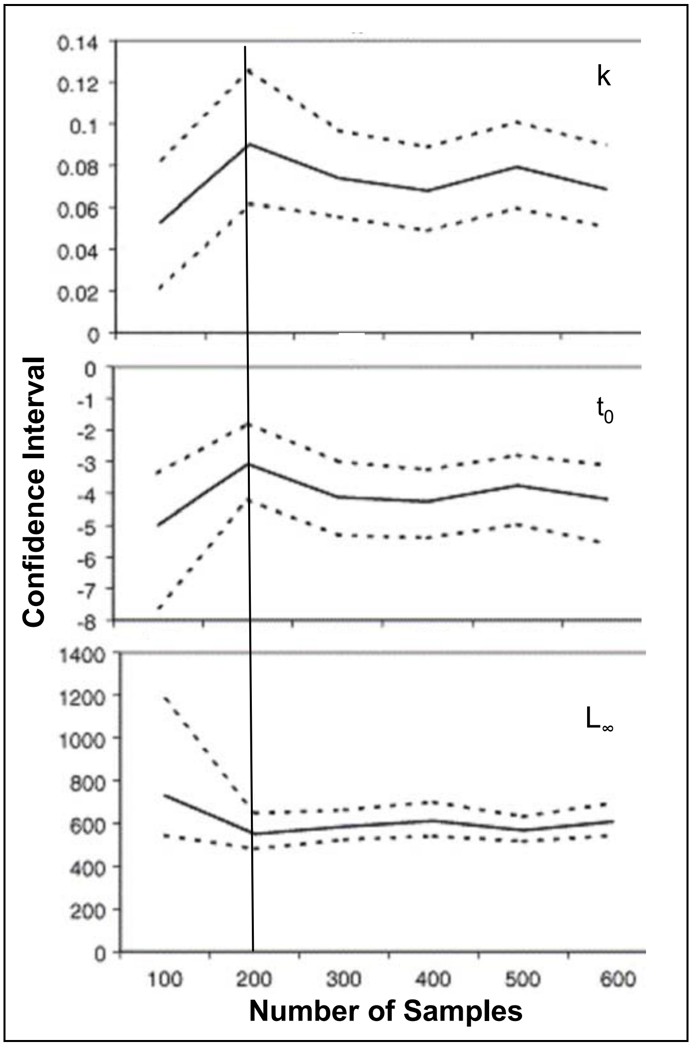

Figure 5. Confidence intervals produced at various sample sizes for the von Bertalanffy growth parameters (after Brouwer and Griffiths 2005).

Frequency of biological data collection

Assessment of an exploratory fishery becomes difficult if the full quota is not reached annually over some set length of time. If the quota is not reached, an explanation should be provided. The 2009 Stage II Exploratory licence requires biological data to be collected in the first and fifth year of the fishery. While a comparison between two years may provide some insight into population dynamics, it is likely to be optimal only if all factors influencing the population remain constant. This is rarely the case. For example, anadromous Arctic Charr do not migrate to the sea every year, only in years it is not spawning (Dutil 1986, Hunter 1976). If fishing only occurs in one year, the data will not include that portion of the population who did not migrate that particular year. Data collected annually over a minimum five-year period would encompass variation from many sources and may provide a more accurate representation of the population. However, if the data are not collected consistently, the portion of data collected would have to be reviewed to determine if there is enough information for assessment. It is possible that even if data are collected for five years, it may still not be sufficient for proper assessment to determine if the stock could sustain a commercial fishery and may require additional years of data collection. Generally, the more variation that exists in the population, the more data that is required to make an assessment.

BYCATCH SPECIES

When fishing with gill nets, there is the potential to catch non-target (bycatch) species. If bycatch species suffer mortality it may negatively impact a population that is not being monitored. Therefore, any bycatch caught should be identified, counted, recorded in the CPUE record sheets, and released. If a bycatch species is not likely to survive release, it should be sampled for biological characteristics.

DISCUSSION

Since commercial fishing of Arctic Charr began, DFO has initiated and revised programs and licences to ensure proper information is requested to assess potential impacts of harvest. In 2009, fishers were issued a Stage II Exploratory Fishery Licence which included a five-year sampling protocol for biological data collection. The Fisheries and Aquaculture Management sector of DFO Central and Arctic region, requested that DFO Science review and revise the 2009 five-year sampling protocol to ensure it reflects current needs.

The majority of the 2009 five-year sampling protocol remains sufficient for assessment of anadromous Arctic Charr in Nunavut and Northwest Territories. Important features of the protocol include: fully fishing all provisional quotas for a minimum of five years; collecting CPUE and total harvest data every year for five years before stocks are assessed and recommendations are made about the biological viability as a commercial fishery; sampling Charr for biological information should be done in a stratified manner throughout the duration of the fishery; identifying, counting, and releasing bycatch species; and sampling bycatch that are unlikely to survive release.

However, revisions to the protocol were required for the quantity of biological samples collected. The 2009 protocol required sampling of 200 Arctic Charr for fork length, round weight, and sex, with a sub-sample of 100 for ageing structures. Age information for 100 Arctic Charr is not sufficient to characterize population age structure. Results from our analyses suggest that a sample of 200 provides a more accurate representation and greater confidence in age related metrics such as growth and mortality.

An alternative approach to determining age structure of a stock is to perform stratified sub-sampling for determining age distributions (Ketchen 1949). In this general approach, now referred to as age-length keys, a sub-sample (10 to 15 fish per size class) of fish is aged and an age frequency distribution is estimated based on the percentage of ages found per size class. More advanced approaches have developed since Ketchen (1949) that analyze age-length keys via computer program to do the calculations and reduce the number of assumptions that must be met; resulting in increased confidence in results with less manual effort (Isermann and Knight 2005). For Charr in Nunavut and the Northwest Territories, this type of approach would still require 200 fish be measured for fork length and 200 otoliths to be collected, but only a random sub-sample of the 200 otoliths (max of 10 or 15 per size class) would be required to proceed to the age-determination stage, thus saving time and money. This approach could be investigated more thoroughly in the future.

Revisions to the protocol were also required for the frequency of biological samples collected. In order to account for inter-annual variation of biological characteristics, samples should be collected every year for a minimum of five years before stocks are assessed and harvest recommendations are made, instead of sampling in year one and five only.

Commercial fishing for anadromous Arctic Charr in Nunavut and Northwest Territories is performed using 139.7 mm (5.5 inch) mesh gill nets. As a result, assessments are made with biological data that is only collected from the portion of the stock that is susceptible to the gear type. Using age information from commercial gill nets will likely demonstrate higher Z values than experimental multiple mesh gill nets because the 139.7 mm mesh gill nets will likely capture a greater abundance of older age classes than the experimental gill net, and will have a steeper descending limb of the catch curve. The larger mesh will be selective for the larger sized Charr in an age class, thus faster growing Charr are more susceptible to the fishery and the parameters will model for production of faster growing fish. Further, the faster growing fish will likely be removed from the system as the fishery proceeds and thus shifts in Z should be carefully interpreted. Unfortunately, the sampling protocol cannot resolve this issue unless fishery independent surveys are conducted.

Another consideration for an assessment using data from the exploratory fishery is that some Arctic Charr stocks have been shown to mix in the overwintering areas (Kristofferson 2002). Exploratory licences are fished both during the upstream migration to overwintering areas, and in the overwintering lake itself (before and/or after ice freeze-up). There is also the possibility of catching non-anadromous life history forms of Charr in a lake, such as a resident form; although, resident Charr are generally smaller than anadromous Charr (Loewen *et al.* 2010) and not likely to be caught in 139.7 mm mesh nets. However, due to the possibility of catching multiple anadromous stocks or other life history forms, results should be interpreted cautiously. Future genetic stock delineation is required to clarify this.

Assessing the biological sustainability of anadromous Arctic Charr exploratory fisheries in Nunavut and Northwest Territories is complicated due the biology of the fish. However, if assumptions and limitations are properly addressed, the recommendations for the data collection protocol presented in this document should be sufficient to assess the biological feasibility of commercial fisheries for anadromous Arctic Charr stocks.

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APPENDIX 1. Sampling Manual

FISHERIES AND OCEANS CANADA

CENTRAL AND ARCTIC REGION

NORTHWEST TERRITORIES AND NUNAVUT

EXPERIMENTAL FISHERY PROGRAM

FISH SAMPLING METHODS

Updated 13 December, 2001

DATA COLLECTION FOR EXPERIMENTAL FISHERIES.

The examination of an Experimental Fishery depends on how well information is collected. Extra care should be taken when collecting and recording the information. All samples and data should be sent to:

Carol Read,
Fisheries and Oceans Canada,
Freshwater Institute,
501 University Crescent,
Winnipeg, MB
R3T 2N6

LIST OF EQUIPMENT NEEDED:

Sample Envelopes
Pencil to Record Data
Measuring Board
Filet Knife
Round Ended Knife to extract otoliths
Tweezers to extract otoliths
Weigh Scale
Scrub brush to clean equipment
Data sheets
CPU (Catch per unit effort) forms/booklets

NOTE: IT IS IMPORTANT TO CATCH THE ENTIRE QUOTA, IF POSSIBLE.

FISH SAMPLING

For each of 100 fish from each fishing site take:

1. FORK LENGTH
2. ROUND WEIGHT
3. SEX
4. OTOLITHS

If fish other than the target species are caught, record the type and the number captured and include this information with the Catch and Effort data.

CATCH AND EFFORT

It is important that Catch and Effort information is collected along with the fish sampling data. Catch and Effort is a measure of the effort spent to catch fish. It gives a sign of the abundance or scarcity of fish in a lake or river. Catch and Effort is most valuable as a comparison over a number of years at the same fishing site and as a comparison to other fishing sites in the area.

To measure Catch and Effort we need to know:

- The number, length and mesh of nets set
- How long the nets were in the water
- How many fish were caught

Catch and Effort booklets have been designed to assist in getting these answers from fishermen. The following example shows the inside cover and a data page from a Catch and Effort booklet.

Always indicate time (circling am or pm) and date (day and month in both places as asked for on the page.

Use a new page for each time the net is checked even if no fish are caught; filling in the page completely.

The booklet was designed for collecting data on Arctic char, so if only Arctic char are present then just the number caught should be written on the last line. If other species are being caught then the number of fish of each species must be recorded.
Example: record Arctic char – 12, Lake trout – 3, round whitefish – 5 at the bottom of the page.

ᑖᓇ ᐅᖃᓕᒫᒐᒃᓴᖅ ᐃᑲᔪᕈᑎᐅᓂᐊᖅᐳᖅ ᐃᖃᓗᒃᑎᐅᓇᓱᐊᖃᑦᑐᓐᓂᒃ ᑕᒪᑯᓇᓂ ᑰᓂ, ᑕᕆᐅᒥ ᐊᒻᒪᓘᓐᓃᑦ ᑕᓯᕐᓂ.
This booklet will help record the effort spent to catch fish at river, sea or lake.

ᐃᖃᓗᒃᑯᐱᑦ ᐃᖃᓗᒃᓯᐅᑐᖃᕈᓐᓂᑦ ᖃᐅᔨᒪᓇᖅᓂᐊᖅᐳᖅ ᑕᒪᓂ ᐃᓗᐊᓂ ᐃᖃᓗᐃᑦ ᐃᑭᑦᑐᑦ
If you catch fish with much effort, it will indicate that there are few fish in that area.

ᐃᖃᓗᒃᑯᐱᑦ ᐊᒥᓱᐊᓗᒃᓂᒃ ᒥᑭᔪᒥᒃ ᐃᖃᓗᒃᓯᐅᕈᓐᓂᑦ. ᑕᒪᓇ ᐃᖃᓗᒃᓯᐅᖅᑕᐃᑦ ᐊᒥᓱᓂᒃ ᐃᖃᓗᖃᖅᐳᖅ
If you catch many fish with little effort, it will indicate that there are many fish in that area.

ᑖᓇ ᐅᖃᓕᒫᒐᒃᓴᖅ ᐊᑐᖅᓂᐊᖅᐳᖅ ᐃᑲᔫᖅᑐᒥᒃ ᖃᐅᔨᓇᓱᐊᕐᓗᓂ ᐅᑭᐅᓂᒃ ᐊᑐᖅᑐᓐᓂᒃ ᐊᒥᓱᓂᒃᑯᓐᓂᑦ ᐊᑕᐅᓯᕐᒥ ᐃᖃᓗᒃᓯᐅᖅᑕᐅᔪᒥ ᐊᒻᒪᓗ ᐊᓯᖏᓂ ᐃᖃᓗᒃᓯᐅᖅᑕᐅᒐᖅᑐᑦ ᐃᓗᐊᓂ.
This booklet is valuable as a comparision over a number of years at the same fishing site and to other fishing sites in the area.

ᑕᒃᑯᐊ ᒪᒃᑎᒃᑕᐅᑎᑦ ᐃᓕᓴᕆᔭᒃᑎᑦ ᑰᒧᑦ, ᑕᕆᐅᒧᓂᑦ ᐊᒻᒪᓗᓂᑦ ᑕᓯᕐᒧᑦ ᑕᒃᑯᐊᖑᔪᑦ ᐃᓱᓇᖅᑕᕐᓗᑎᑦ
When you set your nets at a river, sea or lake complete the following:

ᓱᑯᑎᐊᓂ ᓄᓗᐊᖃᖅᑭᑦ :
Location of net: ____________________

ᖃᑦᑎᐅᕐ / ᑕᑭᓂᖓ ᓄᓗᐊᑉ (ᓄᓗᐊᑦ) :
Number / length of net(s): ____________________

ᓄᓗᐊᑉ ᐱᑦ ᐳᑐᖏ ᐊᖏᓂᖓ :
Mesh size of net: ____________________

ᐅᓪᓗᖓ ᐊᒻᒪᓗ ᖃᖓ ᖃᐅᔨᓴᕐᓂᖅᑭᑦ ᓄᓗᐊᑎᑦ :
Date and time net(s) set or last checked:

ᑕᖅᑭᖅ	ᐅᓪᓗᖓ	ᖃᖓ (ᐅᓪᓛᒃᑯᑦ ᐅᓐᓄᓴᒃᑯᑦ)
month	day	time (am or pm)
______	______	__________

ᐅᓪᓗᖓ ᐊᒻᒪᓗ ᖃᖓ ᐃᖃᓗᐃᔭᐃᕕᒥᓂᑦ :
Date and time fish removed from net:

ᑕᖅᑭᖅ	ᐅᓪᓗᖓ	ᖃᖓ (ᐅᓪᓛᒃᑯᑦ ᐅᓐᓄᓴᒃᑯᑦ)
month	day	time (am or pm)
______	______	__________

ᖃᑦᑎᐅᕐ ᐃᖃᓗᒃᑕᑎᑦ :
Number of fish caught ____________________

SAMPLE ENVELOPE

Label each envelope with all the following information:

Sample No. – start at 1 to 100 for each fishing site

Date – write out the month, day and year (do not use numbers for the month) April 15/2001

Area – the nearest community

Location – the river or lake where the fish were caught

Species – type of fish (A.C. for Arctic char)

Fork Length – from the measuring board (to the nearest 0.1 cm)

Round Weight – from the scale (to the nearest 50 g)

Sex – female = F,   male = M

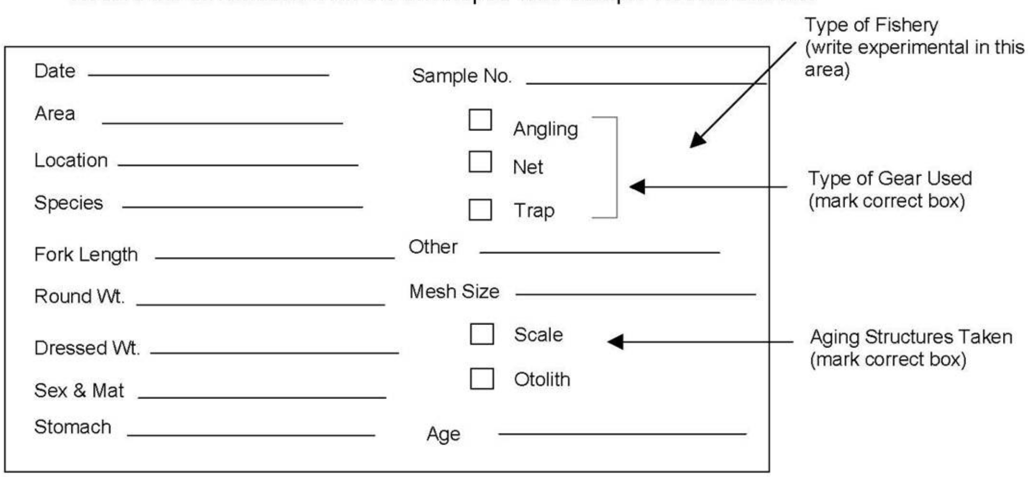
Type of Fishery – Experimental

Type of Gear – mark appropriate box

Mesh Size – stretch mesh size of net

Aging Structure Taken – mark appropriate box or add name of structure

Record the information from the envelopes onto Sample Record Sheets.

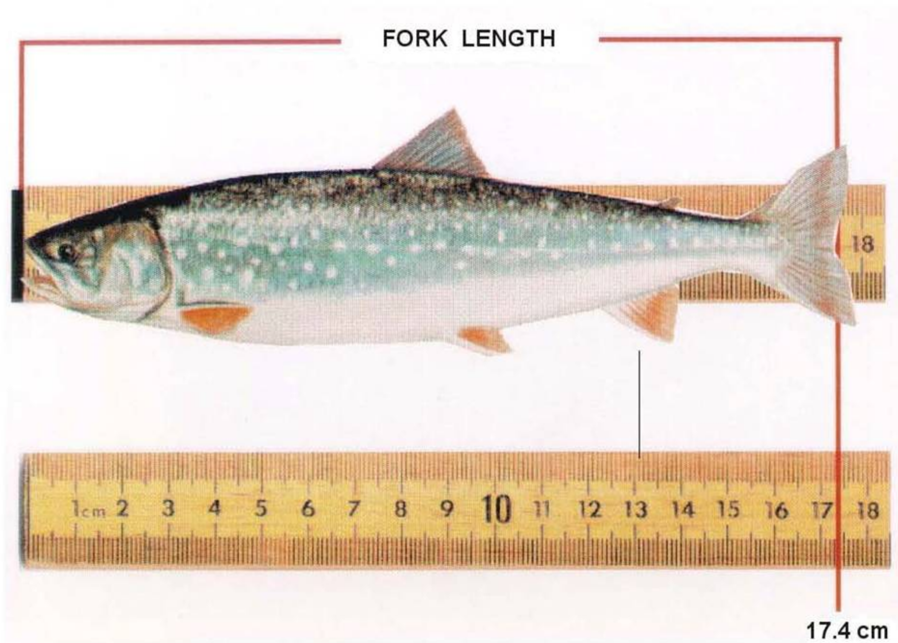


FORK LENGTH

FORK LENGTH is the distance from the tip of the snout (or jaw) to the fork in the tail.

To measure FORK LENGTH:

1. Place the fish onto the measuring board on its right side so the snout or jaw is against the end of the board.
2. Put the cutting edge of your knife on the board at the fork of the tail and then remove the fish from the board, keeping your knife in place on the board.
3. Record onto the envelope the FORK LENGTH marked by your knife. Record the fork length to the nearest millimetre.



ROUND WEIGHT

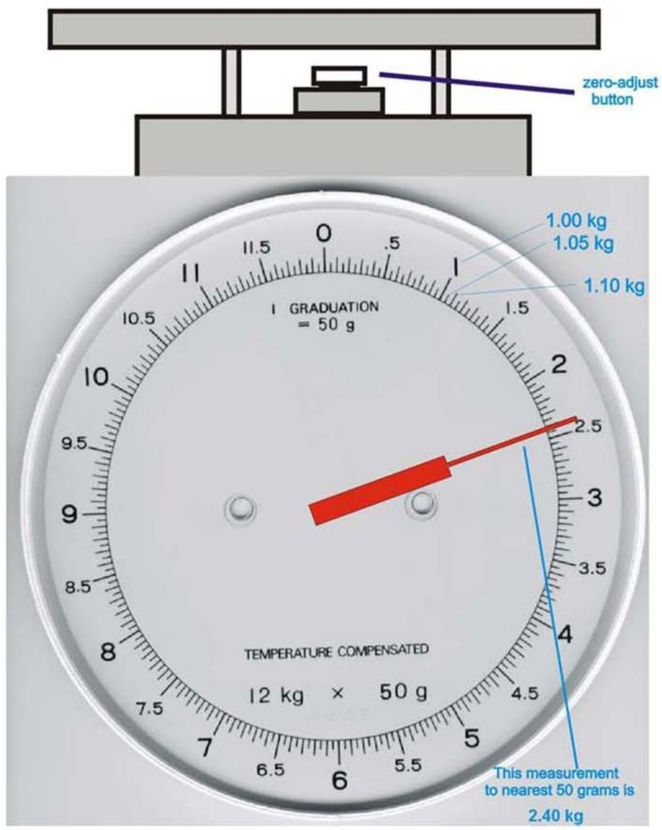
ROUND WEIGHT is the weight of the whole fish (with guts and gills)

To measure ROUND WEIGHT:

1. Put the pan on the top of the scale.
2. Turn the zero-adjust button until the scale reads "0".
3. Put the fish in the pan on top of the scale/
4. Read the weight to the nearest 50 grams (g) as shown in the following diagrams.
5. Record this weight onto the sample envelope.

Keep the pan free of water and slime by rinsing it off regularly.

Check regularly that the scale is still on "0" when the pan is empty.



ENLARGEMENT OF SCALE DIAL

Enlargement of part of the scale dial shows what the weight should be recorded as when the needle points to or closest to one of the divisions indicated by the lines.

SEX

Mark the sex of each fish on the sample envelope. Mark 'F' for female and 'M' for male.

AGEING STRUCTURE TO BE COLLECTED FROM EACH FISH SAMPLED:

OTOLITHS

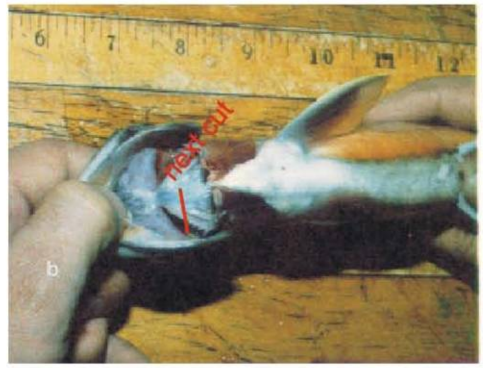
Otoliths are two small bones that lie on either side of the brain. The surface of the otolith is ground to expose rings that are viewed under a microscope. These rings are counted to determine the age of the fish.

Pictures and text on the next page explain how to remove the otoliths from the fish. Each otolith is encased in a sac filled with fluid. It is important to clean the 'jelly' from the otoliths before putting them in the envelope. This can be done by rubbing the otolith between your fingers or between your finger and the top of your other hand.

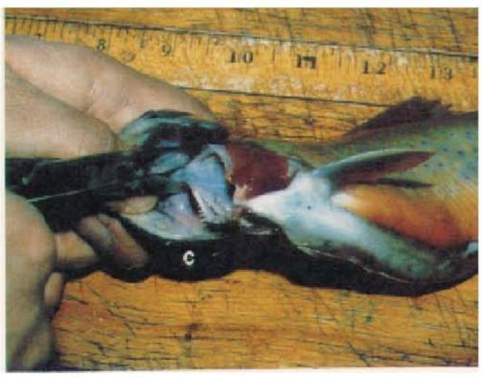
Put both cleaned otoliths into the envelope marked with the information (location, fork length, round weight, etc.) for the fish you removed the otoliths from. Do not seal the envelope, simply fold the flap shut.

REMOVAL OF OTOLITHS

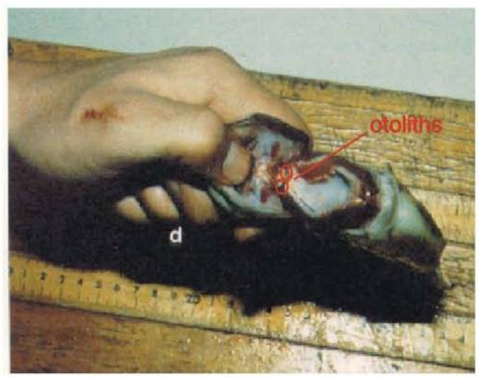
a) cut through the floor of the mouth and the gills.



b) roof of mouth exposed with the next cut location indicated. (Between 1st and 2nd gill rakers)



c) using a blunt ended knife (not as illustrated) at position indicated in (b), using downward motion twist back and forth to separate the vertebra ¾ the way thru.



d) to expose the otoliths hold the head of the fish and "break" the backbone downward where the cut was made.

e) with forceps remove both otoliths.

Clean the fluid and "jelly" off of the otoliths and put both otoliths in the labelled envelope.

From: W.C. MACKAY et al. Fish Ageing Methods for Alberta.

SAMPLE RECORD SHEET

Fill in the Sample Record Sheets from the envelopes that were filled out for each fish sampled. All the information written on the envelope should be transferred to the Sample Record Sheet being careful to copy it correctly.

SAMPLE RECORD SHEET

DATE

DAY	MONTH	YEAR

FISH AND MARINE MAMMAL MANAGEMENT DIVISION

LAKE/STREAM/LODGE	
SPECIES	AREA
MESH SIZE/GEAR	

NUMBER	SAMPLE NUMBER	FORK LENGTH (mm)	ROUND WEIGHT (g)	DRESSED WEIGHT (g)	AGE	MAT / SEX			REMARKS
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

RECORDER

APPENDIX 2. Procedure for Exploratory Licence Application

Exploratory Fishery Program in Nunavut

What is the purpose of an Exploratory Fishery?

The exploratory fishery program was established in 1973 by the Fishery Management Division, Department of the Environment, in cooperation with the Wildlife Service, Government of the Northwest Territories, to facilitate the development of new commercial fisheries in the Northwest Territories and what is now Nunavut.

A commercial fishery is listed in Schedule V of the Northwest Territories Fishery Regulations. The water body is opened upon annual request through a Variation Order for a specified time and quota.

What is the procedure to apply for an exploratory fishery?

1) Make sure there is no conflict with domestic or sport fisheries on the waterbody being considered by asking the HTO.
2) Include a letter from the HTO approving/supporting the request.
3) Obtain an Experimental Fishery Request Form from the Wildlife Officer or Fisheries and Oceans Canada

NOTE: Requests naming government employees, as the Project Authority will not be processed. Please provide an individual's name for Project Authority.

Complete Request Form, include a map identifying the fishing location and forward to:

Fisheries and Oceans Canada
Attention: Licence Coordinator
P.O. Box 358
Iqaluit, NT
XOA OHO
(867) 979-8000

Approval Process

All requests are reviewed for completeness at the Area office. A request is then sent to DFO Science for review and recommendations.

The project authority usually requests a quota and DFO determines the potential risk to the stock and provides an assessment to DFO Fisheries Management (FM). FM will then recommend to the Nunavut Wildlife Management Board (NWMB) that the request be rejected or accepted. If the application is recommended to be accepted, a provisional quota and license conditions will be recommended. The Board (NWMB) can approve, reject or alter the recommendations which then will go to DFO's Minister to accept.

NOTE: DFO's review process will likely only take a few weeks. However, since the Board is required to make a decision, the request may be delayed until the next regular Board meeting (held quarterly). Any requests should be made as soon as possible prior to the fishing season.

General procedures for an exploratory fishery

If an exploratory licence is issued for a waterbody, a provisional quota will be assigned and the following general procedure will be required:

First Year:

1. **Fish Sampling Data**. Sample a minimum of 100 (200 fish would provide a much better basis for assessing the stock and may be requested when a waterbody is known to have been fished previously) fish for fork length, round weight, sex, ageing structures (otoliths). Collect data throughout the duration of the fishery. To provide unbiased sampling every third fish should be sampled.

2. Report **Total Harvest** when fishery is completed.

3. Collect **Catch and Effort** data throughout the duration of the fishery. Catch and effort data gives a measure of the "state" of the fish population at the time fishing begins. It gives a sign of the abundance or scarcity of fish in a lake or river. Catch and Effort is most valuable as a comparison over a number of years at the same fishing site and as a comparison to other fishing sites in the area.
To measure Catch and Effort you must know:

- The number, length and mesh of nets set (mesh size may be limited by licence conditions)
- How long the nets were in the water and how long they are in the water
- How many fish were caught
- The geographical position of the nets in latitude and longitude

If non-target species are caught in the fishery the number of each species must be recorded.

Second, **Third** and **Fourth** year of the Fishery

Apply for a licence renewal for each year.

1. Report **Total harvest** each year when fishery is completed.
2. Collect **Catch and Effort Data** throughout the duration of the Fishery
3. It is strongly recommended that additional biological samples also be collected during these intermediate years (minimum of 100 for lengths and ages)

Fifth Year of Fishery
Apply for a licence renewal

1. **Fish Sampling Data**. Sample a minimum of 100 (200 fish would provide a much better basis for assessing the stock) fish for: Fork length, Round Weight, Sex, Aging structures (Otoliths). These should not be the first 100 fish caught or the largest fish caught but should be fish caught throughout the duration of the fishery. To provide unbiased sampling every third fish should be sampled.
2. Report **Total Harvest** when fishery is completed.
3. Collect **Catch and Effort Data** throughout the duration of the fishery.

Five years of data on a fishery can be used to compare the biological status of the fish stock at the end of the fifth year to the first year. Including data in-between provides a much stronger tool to assess the status of the stock. This gives some idea if the fishery has had an impact on the stock, for example, it may have resulted in a change to the average size of the fish caught. Catch and effort data can also be used to assess the impact of the fishery. At this time the effects of the current harvest on the population can be assessed and recommendations can be made as to the sustainability of the fishery at the current harvest level. The quota issued should be considered a provisional quota and recommendations may be made over the five years to adjust the quota if it is warranted.

If the biological data collected indicate that the stock can support a commercial fishery then the waterbody will be added to the list of waterbodies opened by Variation Order once the NWMB has approved a commercial quota.

The assessment of an Exploratory Fishery depends on how completely the information is collected. Extra care should be taken when collecting and recording the information.

<u>List of equipment needed*</u>

*Sample envelopes
Pencil to record data
*Measuring board
Filet knife
Tweezers to extract otoliths
*Weigh scale
*Data sheets
*CPU (Catch per unit effort) booklets
GPS (Global positioning system) or map to mark location and find latitude and longitude

* DFO can supply this material to the HTO.

If any instruction (see Fish Sampling Method manual) or information is needed, please contact the DFO Iqaluit office:

P.O. Box 358
Iqaluit, Nunavut
X0A-0H0
Phone (867) 879-8000
Fax: (867) 979-8039

All samples and data should be sent to:

Kathleen Martin
Fisheries and Oceans Canada
Freshwater Institute,
501 University Crescent,
Winnipeg, MB
R3T 2N6

APPENDIX 3. 2009 Exploratory Fishery Licence

Fisheries and Oceans Canada   Pêches et Océans Canada

Emerging Fisheries - Stage II Exploratory Licence

X2-09/10-1000-NU

Pursuant to Section 7 of the Fisheries Act, the Minister of Fisheries and Oceans hereby authorizes the individual(s) listed below to fish for experimental purposes, subject to the conditions specified.

Project Authority: First Name Last Name   Company Name
Address 1 Address 2
City Name, NU, CAN Postal Code

Other Personnel: Additional Personnel Here

Objectives: Objectives Here

CONDITIONS

Authority To Fish: Each person fishing under this licence granted to the project authority shall be in possession of a copy of this licence.

Authorized Waters, Species, Gear and Limitation of Harvest:

Water Body Comments Here

Water Body: UNNAMED LAKE (72-38N, 89-30W)

Species: All Species (excludes marine mammals)   Gear: See Conditions

Total Weight Sampled (Kg)	Weight Live Sampled (Kg)	Weight Dead Sampled (Kg)	Total Number Sampled	Number Live Sampled	Number Dead Sampled	Number Tows/Sets	Hours per	Minutes per
999.00	999.00	999.00	999	999	999	999 / 999	23	59

Fishing Period: April 01, 2009 to March 31, 2010

Exploratory Fisheries:

Conditions Here

Any exploratory fishery should follow the five year approach, although each licence is issued on a yearly basis and must be renewed in subsequent years.

It is important to attempt to catch the full quota. This provides a better estimate of the abundance of fish in the waterbody.

A minimum of five years of data are generally required to make any predictions about the viability of a fishery for a given stock. Catch and effort data are a valuable source of information to assess the affects of a fishery on a stock and should be collected in conjunction with biological data/fish sampling data. The request will be reviewed using the subsequent data provided by the applicant. The quota issued should be considered a provisional quota and recommendations may be made over the five years to adjust the quota if it is warranted.

Incidental species encountered and total weight landed for each species must be reported.

If during the course of netting in a particular waterbody, fish are either too few or in some way not suitable for sale (poor condition, heavy parasite load, etc.) then this information should be reported.

All samples should be sent to:
Advisory Contact - Licensing
Fisheries and Oceans Canada

Central and Arctic Region
Box 358
Iqaluit, NU X0A 0H0
(867) 979-8005

Région du Centre et de l'Arctique
Box 358
Iqaluit, NU X0A 0H0
(867) 979-8005

Freshwater Institute
501 University Crescent
Winnipeg, MB R3T 2N6
Phone: (204) 983-5131 Fax: (204) 984-2403
Email: XCA-fishstocks@dfo-mpo.gc.ca

Data and samples must be collected, according to the year of fishery, as follows:

First Year of Fishery

a) Sample a minimum of 200 fish for fork length, round weight, sex, ageing structures (100 otoliths). Collect data throughout the duration of the fishery. To provide unbiased sampling every third fish should be sampled.

b) Report total harvest when fishery is completed.

c) Collect catch and effort data throughout the duration of the fishery. Catch and effort data provide a first estimate of relative abundance of the fish population. Catch and effort data are the number of nets used; the length of time the nets are in the water and how many fish are caught from each. Each time the nets are placed in the water record the following: Location (water body name, latitude and longitude), date set (e.g. 4 August, 2003, spell the month), time set (AM or PM), number and length of nets (e.g. 2 - 50 yds), mesh size (e.g. 5 1/2"). Each time the nets are checked record the following: data/time, number of fish caught. If other fish are caught, record kind and number. GPS readings should be taken over the nets to accurately identify fishing location.

This information provides a measure of the 'state' of the fish population at the time fishing begins. A provisional quota may be adjusted after biological inforamtion has been analyzed or the fishery may be found unsuitable for a commercial harvest.

Fish sampled for biological data can still be sold or used by the fishers.

Second, Third and Fourth Year of Fishery

Apply for a licence renewal for each year.

Report total harvest when fishery completes.

Collect Catch and Effort Data throughout the duration of the fishery.

It is strongly recommended that additional biological samples also be collected during these intermediate years (minimum of 200 for lengths and 100 Otoliths).

Fifth Year of Fishery

Apply for a licence renewal.

Sample a minimum of 200 fish for: Fork length, Round Weight, Sex, Aging structures (100 otiliths). These should not be the first 200 fish caught or the largest fish caught but should be fish caught throughout the duration of the fishery. To provide unbiased sampling every third fish should be sampled.

Report total harvest at end of fishery.

Collect Catch and Effort Data throughout the duration of the fishery.

Five years of data on a fishery can be used to compare the biological status of the fish stock at the end of the fifth year to the first year. Including data between the first and last provides a much stronger tool to assess the status of the stock. This gives some idea if the fishery has had an impact on the stock, for example, it may have resulted in a change to the average size of the fish caught.

Catch and effort data can also be used to assess the impact of the fishery. At this time the effects of the current harvest on the population can be assessed and recommendations can be made as to the sustainability of the fishery at the current harvest level.

Notification of Commencement:

Prior to the commencement of fishing the Project Authority will contact:

Fishery Officer
Fisheries and Oceans Canada
Box 358
Iqaluit, NU X0A 0H0
Phone: (867) 979-8005 Fax: (867) 979-8039

Notification of Harvest:

Within 30 days of the completion of this fishery the Project Authority must complete and return information on the amount of total harvest from each water body identifed on this licence, to:

Fisheries Management Biologist
Fisheries and Oceans Canada
Box 358
Iqaluit, NU X0A 0H0
Phone: (867) 979-8002 Fax: (867) 979-8039

Area Director
Central and Arctic Region
Fisheries and Oceans Canada

Date

For the Minister of Fisheries and Oceans.

Pursuant to Section 7 of the Fisheries Act

APPENDIX 4. CPUE Record Sheet

Net Information Sheet

FISHER NAME / ᐃᖃᓗᒐᓱᐊᖅᑐᖅ ᐊᑎᖓ: ______________________

LOCATION / ᓇᒦᓐᓂᖓ: ______________________

MESH SIZE / ᓄᓗᐊᑦ ᐳᑎᖏᑦ ᐊᖏᓂᖏᑦ: ______________________

NET LENGTH / ᓄᓗᐊᑦ ᑕᑭᓂᖓ: ______________________

NET HEIGHT / ᓄᓗᐊᑦ ᐳᖅᑐᓂᖏᑦ:

Date net in / ᐅᓪᓗᖓ ᓄᓗᔾᔨᖅᑕᐅᔪᑦ	Time net in / ᓯᕿᓐᖑᔭᖅ ᖃᑦᑎᒨᖅᑎᓪᓗᒍ ᓄᓗᔾᔨᖅᑕᐅᔪᑦ	Date net lift / ᐅᓪᓗᖓ ᓄᓗᐊᑦ ᐊᒧᔭᐅᔪᑦ	Time net lift / ᖃᑦᑎᒨᖅᑎᓪᓗᒍ ᐊᒧᔭᐅᔪᑦ	Species / ᐃᖃᓗᒃ ᐊᑎᖓ (ᐃᖃᓗᐃᑦ)	# Fish / # ᐃᖃᓗᐃᑦ
	am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		
	am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		
	am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		
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	am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		
	am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		
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	am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		am/pm / ᐅᓪᓛᒃᑯᑦ/ᐅᓐᓄᒃᑯᑦ		