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Proceedings of the regional peer review of the assessment of Arctic Char in the Ulukhaktok area of the Northwest Territories

February 15–17, 2016
Winnipeg, Manitoba

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Editor: Colin Gallagher

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A Regional Advisory Process was held at the Freshwater Institute in Winnipeg to assess Arctic Char (*Salvelinus alpinus*) from the Ulukhaktok area, Northwest Territories with an emphasis on the Kuujjua River stock. The meeting was held between February 15 and 17, 2016 and included participants from Fisheries and Oceans Canada, Fisheries Joint Management Committee, the Olokhaktokmiut Hunters and Trappers Committee, University of Calgary, and an independent expert. During the meeting, multiple presentations were made on various topics relevant to the assessment; background information on the location and timing of fisheries, a review of previous studies, the methods and results from monitoring programs conducted during October/November in Tatik Lake (Kuujjua River) and during July/August along the coast, and the results of biological sampling from a Stage I (Feasibility) fishery. The results of the Ulukhaktok community survey for harvested char (all harvesting locations in the area) were presented. The reported harvest information and data from the Tatik Lake sampling program were used to develop a statistical catch-at-age population model to assess sock status and estimate reference points. In recent years, the Kuujjua River stock appears to have realized a degree of improved fitness due to changes in environmental productivity, although reasons for the decreased abundance of small-sized char along the coast over the past several decades reported by local harvesters are unclear. Meeting objectives were met and advice provided to co-management partners. Most importantly the stock status was found to be healthy and the current level of harvest appears to be sustainable. Publications from the meeting included a Science Advisory Report and multiple Research Documents.

Compte rendu de l'examen régional par les pairs de l'Évaluation du stock d'ombles chevaliers dans la région d'Ulukhaktok, dans les Territoires du Nord-Ouest

SOMMAIRE

Un processus de consultation régionale s'est déroulé à l'Institut des eaux douces, à Winnipeg afin d'évaluer l'omble chevalier (*Salvelinus alpinus*) de la région d'Ulukhaktok, dans les Territoires du Nord-Ouest, en mettant l'accent sur le stock de la rivière Kuujjua. La réunion, qui s'est tenue entre les 15 et 17 février 2016, a rassemblé des participants de Pêches et Océans Canada, du Comité mixte de gestion de la pêche, du Comité de chasseurs et de trappeurs d'Olokhaktokmiut, de l'Université de Calgary et un expert indépendant. Au cours de la réunion, plusieurs présentations ont été faites sur divers sujets pertinents pour l'évaluation; des renseignements généraux sur le lieu et la période de pêche, un examen des études antérieures, des méthodes et des résultats des programmes de surveillance menés en octobre/novembre dans le lac Tatik (rivière Kuujjua) et en juillet et août le long de la côte, et des résultats de l'échantillonnage biologique d'une pêche à la phase I (faisabilité). Les résultats du relevé de la communauté des ombles chevaliers pêchés dans la région d'Ulukhaktok (tous les sites de pêche dans la zone) ont été présentés. Les renseignements sur les prises déclarées et les données du programme d'échantillonnage du lac Tatik ont été utilisés pour élaborer un modèle statistique d'évaluation de prises selon l'âge pour évaluer l'état du stock et estimer les points de référence. Ces dernières années, le stock de la rivière Kuujjua semble avoir jouir d'un meilleur état physique en raison de changements dans la productivité de l'environnement, bien que les raisons de la diminution de l'abondance des ombles chevaliers de petite taille le long de la côte au cours des dernières décennies rapportée par les pêcheurs locaux ne soient pas claires. Les objectifs de la réunion ont été atteints et des conseils ont été fournis aux partenaires de cogestion. Plus important encore, il a été constaté que le stock était en bonne santé et le niveau de prélèvement actuel semble être durable. Les publications issues de la réunion comprennent un avis scientifique et plusieurs documents de recherche.

INTRODUCTION

The purpose of the peer-review was to assess the status of anadromous Arctic Char from the Ulukhaktok area, Northwest Territories with an emphasis on the Kuujjua River stock. Biological and catch-effort data collected from harvest-based monitoring programs in Tatik Lake (fall/ winter 1992–2015) and along the coast near Ulukhaktok (summer 1993–1997 and 2011–2015) were examined. Biological information collected from Tatik Lake in fall/ winter 1978 and 1987 and along the coast in summer 1978 was compared to data collected from the monitoring programs. All available harvest information collected from monitoring programs, community surveys (multiple sources), and commercial/ sport fisheries were also used in the assessment. Additionally, data from a Stage I (Feasibility) fishery (2010–2015) were used to inform the stock assessment and evaluate the status of the summer fishery. Research needs for char in the Ulukhaktok area were discussed. The meeting began with introductions of participants (Appendix 1), a review of the terms of reference for the meeting (Appendix 2), and a review of the agenda (Appendix 3).

DETAILED DISCUSSION

PRESENTATION 1: BACKGROUND

ARCTIC CHAR IN THE ULUKHAKTOK AREA

Presenter: Lois Harwood

Participants were given an overview of past studies, locations of important rivers/ stocks, and management milestones in regards to Arctic Char in the Ulukhaktok area. Key principle investigators in the past included Mike Papst and Lois Harwood (both with Fisheries and Oceans Canada (DFO)) who started working with the community in the early 1990s. The fieldwork for weir studies that started in 1986 was mainly conducted by John Alikamik and Paul Sparling. Others who have made important contributions include Don Dowler who did work in the community in the 1960s initially as a Fisheries Officer for the area and eventually as vice chair with Fisheries Joint Management Committee (FJMC). A review of the major water bodies/ important stocks contributing to both summer and winter fisheries for char was conducted.

Certain past projects were identified and included recording the size and timing of the harvests, biological sampling of Tatik Lake between the 1960s and 1980s, tagging studies, weir studies, the current Tatik Lake Harvest Monitoring Program (a project Mike Papst developed in its first year in 1991 and coordinated with Lois Harwood until 2009), and a genetic (unit stock) sampling program attempted in 2010. Coastal work conducted in the 1980s and 1990s was mentioned as well as the experimental fishery (500 fish quota) which is conducted near the community during the summer. Past harvest studies were mentioned such as the Inuvialuit Harvest Study conducted by the Joint Secretariat in 1988–1997 and the work conducted in the 1990s by Adrienne Paylor, a graduate student who examined community needs for char and analyzed tagging data.

There was an overview of management milestones for char in Tatik Lake which included the voluntary closure of the subsistence fishery between 1993 and 1995, and the initiation of the Ulukhaktok Char Working Group in 1995. The working group established a voluntary harvest guideline of 1,000 fish for Tatik Lake, which was administered locally using a guideline of 25 fish per household. The voluntary community-based harvest guideline currently sits as at 70 fish per household. It was clarified by a community member that although the number per household has increased there are fewer households fishing over the past few years so the overall catch in the lake has usually been at or below 1,000 fish since the voluntary guideline was implemented.

DISCUSSION

One participant from the community of Ulukhaktok stated how the Olokhaktomiut Hunters and Trappers Committee (OHTC) tries to use the knowledge of elders and experienced people to conserve fish and wildlife for future generations. Elders teach the next generation to use only what is needed in order to have something left for the future. It was stated that the land is precious and that “it’s our life, our travel, our food, and to preserve it in its natural state is getting harder and harder to do… due to global warming that is changing the land and the ocean”. The participant underscored the need to work together to preserve the land and its animals.

It was stated that the west end of Tatik Lake has an area (called Aimoakatahuk) that freezes up in the fall prior to the rest of the lake. This is where nets are initially set in the fishing season.

PRESENTATION 2: PAST STUDIES

WEIR ENUMERATION AND LIFE HISTORY/ HABITATS OF ARCTIC CHAR FROM THE KUUJJUA RIVER

Presenter: Lois Harwood

Data from weir/ t-bar tagging studies conducted in 1992 and 1993, and habitat-use and life history variation studies in 1998, 1999, and 2005 for Arctic Char from the Kuujjua River were presented. A weir was deployed on the Kuujjua River in 1992 to enumerate the upstream migration. It measured 185 m across and was operated by Paul Sparling and his community crew of Buddy Alikamik and Danny Klenkenberg. Approximately 10,000 char, consisting mainly of ‘silvers’ (either juveniles or adults that will not spawn in the current year), were enumerated between late August and early September. Current-year spawners were not observed at the weir. A total of 991 char ≥420 mm in length were t-bar tagged. It was stated that the weir enumerated only the migratory component of the population and that the number should not be interpreted as a total population estimate. Additionally, it was assumed the current-year spawners had skipped migration in the spring and had remained in freshwater. Nearly 200 tagged fish were recaptured during the fall fishery in October/ November 1992, a few months after tagging. A second tagging project was done at the mouth of the Kuujjua River in spring 1993. Char were captured during their downstream migration to the sea, including 17 that were tagged the previous August moving upstream, and an additional 487 were tagged.

In summer 1993, nearly 200 tagged char were recaptured along the coast near Ulukhaktok in the July–August subsistence fishery. Recaptures were also made in Tatik Lake in the fall of 1993. Within the first 15 months of tagging, >40% of the tags had been caught in the summer and under ice.

A correlation between the timing of ice clearance in spring in east Amundsen Gulf and the somatic condition factor of Arctic Char from the Kuujjua River was described for 1992–2009, underscoring how marine feeding conditions influence char life history parameters.

Studies on habitat use among life stages of char in Tatik Lake (Kuujjua River) were also conducted in summer and fall of 1998 and 1999. A map was shown illustrating where sampling occurred and where species/ life stages were encountered. The sampling found rearing areas for Lake Trout and Arctic Char, including tributary streams, and also collected current-year spawners and ‘silvers’. Some of the char were dead-sampled which revealed a variety of maturity stages inhabit the lake in the summer (e.g., immature, resting, maturing to spawn). The sampling crew rafted down the Kuujjua River from Tatik Lake in 1998 to find deep holes that could offer overwintering habitat. While four deep areas of the river were located, additional visits in the fall found that three of the four had frozen to the bottom.

In 2005, a weir was deployed in an important tributary river to Tatik Lake (Tributary 1) in order to enumerate char and determine if mature fish moved into this stream for spawning. The weir was in place for 35 days before it became inoperable due to sudden high-water conditions. A small number of dead-sampled fish were examined for otolith strontium concentration using laser ablation inductively coupled plasma mass spectrometry to infer seaward migratory pattern during the lifespan of each fish. Results demonstrated the presence of a current-year spawner that had never undertaken seaward migrations and none of the juvenile fish sampled (1–5 years old) had ever gone to sea. High strontium concentration in the otolith nucleus of juvenile char suggests Tributary 1 provides rearing habitat for offspring of searun females.

DISCUSSION

One of the participants from Ulukhaktok stated that lower water level in rivers may have an effect on the ability of char to move upstream. Some elders suggest fish may change which rivers they ascend if water levels are low. The lower water levels may be a result of global warming and why there is a higher incidence of scarring observed on fish in the summer.

Another participant from Ulukhaktok stated that they used to get smaller sized char “not too big and not too small” back in the 1960s and 1970s and that there was a gradual decline in their numbers up to the 2000s. Currently, they capture mainly large searun char in their nets during the summer, some of which tend to have scars. The participant stated “we don’t get those small ones/ medium-size anymore” and was unsure if the small fish had moved elsewhere.

A participant from Ulukhaktok mentioned that the smaller-sized char take longer to migrate and they are typically encountered later in the summer fishing season. It was said that they would like to know if more shipping activity would have an effect on fish given that they have seen more private ships passing through. Also, the greater presence of whales not typically observed in the area such as Beluga in 2014 and Killer Whale in 2012 was also a concern to them in regards to their interaction with Arctic Char.

Discussion was held regarding how the complex life history of Kuujjua River Arctic Char could be documented and used in decision-making. It was suggested that there was a large amount of data from the subsistence fishery and that focus should remain on the fished component of the population which required fewer assumptions for establishing parameters for management. The nature of the community fishery has not changed considerably over the years and the information provided is suitable for understanding what is fished.

PRESENTATION 3: POPULATION MONITORING

TATIK LAKE CHAR MONITORING PROGRAM (1991–2015)

Presenter: Colin Gallagher

Data from the Tatik Lake Char Monitoring Program collected during the winter fishery in 1991 and 1993–2015 as well as data from sampling conducted in 1978 and 1987 were presented. An overview of the long-term program was provided detailing where the fishing occurs on the lake, the fishing gear that was used, and what data were collected. Harvest was tabulated or graphically illustrated while catch-per-unit-effort (CPUE) data and biological information were analyzed using parametric or non-parametric statistics and evaluated for trends over time. CPUE has been stable in recent years while there has been an increase in the frequency of relatively high values since 2006. The biological data collected in recent years demonstrated the presence of a wide distribution of size (predominantly 500–750 mm)/ weight (1,000–5,000 g) consisting of a relatively high proportion of large-size fish (≥700 mm), and ages mainly distributed between 8 and 12 years with a consistent presence of relatively old fish (≥15 years) which have produced low estimates of annual mortality (~0.3).

An age comparison study carried out between the current age reader (2010–2015, using combination of whole and thin-section preparation methods) and past age reader (1970s–2012, using whole method) (both had three years of overlap) to determine if differences existed between readers;

1) using the same method (i.e., whole), and
2) using the final age assigned by the readers regardless of method.

Results indicated that for Arctic Char >11 years of age, the current age reader tended to produce older ages. Therefore, assuming the current age reader produced more accurate age estimates, the proportion of older age classes in the population may have been underestimated prior to 2010.

An examination of the data from the monitoring program indicated there were no signs of overharvest. The current stock status appeared healthy, and current level of harvest seems sustainable.

DISCUSSION

There was clarification that it was currently unknown whether Arctic Char from Red Belly Lake were part of the Tatik Lake stock. One participant from Ulukhaktok mentioned that elders have stated that char from Red Belly Lake inhabited the same watershed although it was unknown if there was movement of fish between lakes. While examining a map, locations in the southwest and eastern areas of Tatik Lake where spawning fish have been captured were identified. Additionally, the areas that freeze before the rest of the lake and where fall/winter fishing starts (near the outlet of Tatik Lake) were confirmed. Regarding the monitoring program on Tatik Lake, it was clarified that the goal of the program was never for the monitors to collect total harvest information for the lake.

There was discussion about the timing of the reported decline in the population by harvesters. The Fishing Plan stated that it was as early as 1987 although one participant mentioned that it was the town hall meeting in 1991 when it was clear that it was not a few people reporting a decline but the whole community who were communicating their concerns. It was asked whether there were declines in the coastal fishery similar to Tatik Lake during the same period. The recollection of one participant was that there was a perceived decline due to the increased prevalence of smaller fish that were ‘silvers’.

It was also reported by participants from the community that the number of people/families fishing on Tatik Lake declined between the 1980s and 1990s. Although the 25–30 char per-family voluntary harvest level of the 1990s was increased to 70 char in 2014, there were currently fewer families that made the trip to the lake and the number of char harvested has been 1,000 fish or less. During the winter in recent years more people were making use of alternative fishing areas such as Mayoklihok Lake.

Discussion about char fisheries in northern Labrador revolved around the metrics useful to infer decline in stock status. Decrease in mean weight and weight-at-age were more noticeable than any other metric for char in northern Labrador. This could have been a result of a suite of factors which include exploitation, timing of fisheries relative to migratory patterns/ timing of populations, environmental conditions, and the disappearance of capelin (i.e., diet shifts).

It was mentioned that the accuracy and confidence of ages, particularly among older age classes, was important because the presence of older ages in the fishery can be a useful indicator of stock status.

One participant from Ulukhaktok wanted to confirm that if the under-ice fishing season on Tatik Lake was opened too early and the char had yet to complete their spawning activity that this could have a negative effect on the population. In past years, in accordance with the fishing plan, the fishery voluntarily opened on October 15. However in the past two years an earlier freeze-up and greater amount of snow made the lake accessible for harvest and fishing started October 1. The participant noted that this was an oversight of the younger members of the Olokhaktomiut Hunters and Trappers Committee (OHTC) who did not consult with more experienced members who could have advised them why the fishery should not start until mid-October. Ensuing discussion easily reached consensus that fishing the spawning component of the population could negatively affect the productivity of the stock which should be afforded as much protection as possible.

One person asked about the decline in sizes/growth that were observed from 2005 to 2008. Discussion ensued regarding the effect of years of El Niño such as 1998/99, which increased the level of productivity in Amundsen Gulf resulting in faster growth for char, and years such as 2005 where there was late breakup which decreased marine productivity. A participant interpreted these patterns to be the result of enhanced environmental productivity, the effects of which were also observed in long-term monitoring of seals and in beluga whales, particularly in 2005. Another person made the point that the improvement in biological metrics observed after the voluntary closure of the Tatik Lake fishery (1993 to 1995) could have resulted because of the decrease in fishing mortality, rather than a change in environmental conditions. Someone else reiterated that diet shifts could have resulted in increased sizes/ growth, which is a manifestation of changes in marine productivity which are apparent in both the local knowledge and recent examination of char stomach contents (1970s vs 2014–2015) (see ‘Coastal Fisheries Monitoring’ below).

Mortality rates were likely overestimated because the selectivity of the gillnet gear resulted in a lack of older ages in the sample. Additionally not all components (e.g., spawners) of the population are equally vulnerable to the fishery which would also bias the distribution of ages. There was agreement that regardless of the accuracy of the mortality estimates among years, the temporal trend in mortality was an informative characteristic for evaluating stock status. A final point was made that it would be interesting to link trends in environmental productivity to a population model.

PRESENTATION 4: POPULATION MONITORING

MAYOKLIHOK LAKE

Presenter: Colin Gallagher

Results of sampling conducted in 2013 in Mayoklihok Lake, situated on a separate river system approximately 68 km northeast of Tatik Lake, using methods that were consistent with the program in Tatik Lake, were presented. The objectives included collecting catch-effort, biological and limnological data in order to characterize the char/fish species harvested in the lake and compare it to Tatik Lake to determine if life history characteristics were similar. Similar to Tatik Lake, the sizes and ages of char were mainly distributed between 500 and 700 mm, and 7 and 12 years of age, respectively. Additionally, annual mortality estimates, growth characteristics, and sex ratio were similar between lake systems.

DISCUSSION

It was reaffirmed that Mayoklihok Lake is a traditional fishing location that is not harvested as frequently as Tatik Lake, although more people have been going to the lake to harvest char in recent years. There was an interest in this sampling program to see if it could be a viable alternative fishing location and determine how productive the system was. It was also mentioned that there have been past mining exploration work conducted in the area although the exact nature of the activity was not certain. When asked about the river system that connects Mayoklihok Lake to the sea, a participant from Ulukhaktok stated that although he had never been there it was his understanding that it was a very shallow river. A participant asked if there were locations other than Mayoklihok Lake that were an alternative to Tatik Lake and was told that the Kagloryuak River and Red Belly Lake were also used. However, it was clarified that few people used the Kagloryuak River in the past few years and that Red Belly Lake was used "once in a while" and that no one fished the lake last fall (2015) because there was too much slush to travel safely and set nets. Finally, it was mentioned that there were a number of lakes with landlocked char near town that are fished in spring, summer and fall.

PRESENTATION 5: COASTAL FISHERIES MONITORING

MONITORING OF ARCTIC CHAR FROM THE ULUKHAKTOK COASTAL AREA: CATCH-EFFORT AND BIOLOGICAL INFORMATION

Presenter: Ellen Lea

Data collected during the summer from a coastal harvest monitoring program between 1993–1997 and 2011–2015, and under a commercial Stage I (Feasibility) fisheries licence (2010–2015) were presented. An overview of the monitoring program was provided detailing where the fishing occurred along the coast, the fishing gear that was used, and the data that were collected. Background information was provided regarding the Stage I licence including the size of the quota. CPUE and biological data were analyzed using parametric or non-parametric statistics and evaluated for trends over time. CPUE has been relatively stable although confidence in the values for some of the recent sampling years are limited due to low sample size. The summer subsistence and Stage I fishery near Ulukhaktok harvest a wide range of sizes (mainly 550–850 mm)/ weight (1,000–6,000 g) with ages predominantly distributed between 8 and 13 years. The distributions and mean values were stable between 2011 and 2015. Data from recent years demonstrated a considerable increase in length and weight since the 1990s. Additionally, preliminary results from a diet study comparing char stomach contents between 1978 and 2014/ 2015 indicated a shift from primarily Arctic Cod to Sand lance between these years. Results from Tatik Lake were similar to the coastal sampling, which were assumed to consist of a high proportion of char from the Kuujjua River stock. However, a higher proportion of larger sizes and older ages were observed in the coastal fishery compared to Tatik Lake.

DISCUSSION

Harvest monitoring occurred between Kidjivik and Anialik. It was mentioned that some families start their coastal fishing in Kidjivik, Nanoalok, Hikohoilak and Minto Inlet using an ATV to pull a small boat on a sled in order to set nets in open water.

When discussing the results of the diet study, the participants from Ulukhaktok stated there was less Arctic Cod and more Sand Lance encountered along the coast in recent years. When researchers familiar with the Hornaday River were asked if there has been a diet shift in char from that stock, it was stated that there was no historical diet information available to compare with recent samples. It was mentioned that the Beluga that were sampled in Ulukhaktok in 2014 consumed char and Sand Lance. Additionally, Ringed Seal in the area have also demonstrated a shift in types of prey consumed. Examples of other areas where diet shifts in char were observed were northern Labrador, seabirds in other western Arctic and Alaska locations, and char in Cambridge Bay (Nunavut).

Following a participant's statement that, based on unpublished data, Sand Lance was not as nutritious as Arctic Cod, a participant from Ulukhaktok asked whether the increased incidence of scars/open sores on char could be related to the shift in diet. Another participant replied that the scarring was likely due to interactions with predators rather than diet. Further discussion ensued where it was mentioned that there were more wolves and grizzly bears observed on the island in recent years.

Discussion was held regarding how to move the current Stage I (Feasibility) fishery to a Stage II (Exploratory) fishery. It was mentioned that the current fishery could move to a Stage II, although there would be increased data requirements under the licence. A Stage II licence, requires data to evaluate whether an annual quota can be consistently/sustainably maintained and would require harvesters to provide catch and sample data. It was stated that the data collected under the Stage I licence would be suitable for an assessment. A participant informed the group that the motivation for the community to implement this fishery was not an interest in establishing a commercial fishery and that this came about because people from other communities were contacting harvesters in Ulukhaktok and asking them to ship char for community feasts, which constituted as commercial fishing under the Inuvialuit Final Agreement. Therefore, the small-scale commercial fishery was established for the Hunters and Trappers Committee in order to legally sell fish. The motivation was never to move to a commercial fishery such as the one in Cambridge Bay because the community wants to ensure their subsistence fishery is sustainable for future generations. The question still remained about what type of licence would best suit the needs of this fishery. A participant from Ulukhaktok confirmed that the community is not seeking a higher level of commercial fishing and stated that any changes to the quota amount would have to come from the Ulukhaktok Char Working Group.

Regarding why the proportion of large-size char was greater along the coast compared to Tatik Lake, it was suggested that larger-sized individuals within a stock may travel longer distances. One person mentioned that local knowledge suggested that the summer fishery is mainly harvesting a mixture char from the Kuujjua and Kuuk rivers. It was stated that the char from the Kuuk River were known to attain larger sizes and that harvesters could visually distinguish char from the two river systems. Additionally, it was reported that char from both stocks tended to be captured in different sides of the net over the summer (i.e., coming from different directions). However, there was uncertainty regarding the origin of char that were very large in size and that some elders thought these may be too big to migrate successfully up rivers, particularly given declining water levels becoming increasingly known and observed in smaller streams flowing into the larger lakes.

PRESENTATION 6: COMMUNITY HARVEST

FISH AND MARINE MAMMAL HARVEST SURVEY RESULTS FOR ULUKHAKTOK, 2004–2015, WITH A FOCUS ON ANADROMOUS ARCTIC CHAR

Presenter: Ellen Lea

Results of various harvest surveys for fish and marine mammals in Ulukhaktok were tabulated. Data from a community survey conducted by DFO between 2004 and 2015 were emphasised, although data from a DFO harvest report (1966–1975), the Inuvialuit Harvest Survey (1988–1997), and data from the current harvest program (1999–2003) were also provided. Background on the importance of the recent DFO program, the methodology, and its objectives were described. The results confirmed that Arctic Char was the most important harvested species of fish and were predominantly captured during the summer fishery. Harvest levels were variable among years although there has been an overall decline since the 1980s with relatively few char currently taken in Prince Albert Sound. Additionally, the results demonstrated that the harvest in Tatik Lake is considerably lower than in the 1960–80s, has been stable since closure in 1990s, and has been below the harvest guideline level since 2003.

DISCUSSION

A participant from Ulukhaktok stated that there were a few lakes that were fished year-round and that more people were reporting catches from these lakes. Someone asked if it was possible to distinguish between landlocked and anadromous char. The reply was that some places had no obvious connection to the sea mainly due to the high hills which were typical of lakes situated near the community.

A question was asked whether anyone currently harvests the Naloagyok River as it is not explicitly mentioned in the fishing plan. The reply was that it was only harvested if someone was travelling in the area, which rarely occurs. It was also mentioned that the amount harvested in the Kagloryuak River had dropped over the years and that no one really harvested the Kagluk River during fall anymore because it was too far to travel by snowmobile.

A question was asked about the accuracy of reported harvest data and whether there were under- or over-reporting issues. A participant from the community replied that the harvest numbers were dependable and that there was a high degree of participation with only one or two people who did not share their harvest numbers. A follow-up comment was made that past issues with harvest data had more to do with communication lapses rather than an unwillingness to share information. It was also mentioned that there was a high degree of similarity between the number of harvested char in the DFO technical report by Adrienne Paylor and the reported catch in community surveys, thus providing added confidence in the harvest information.

One person mentioned that there was commercial harvest reported in the early 1980s in Prince Albert Sound that was not shown in the presentation. An observation was made that while the voluntary closure on Tatik Lake was in place the reported coastal harvest had increased.

PRESENTATION 7: MODELLING

POPULATION DYNAMICS AND SUBSISTENCE HARVEST OF ARCTIC CHAR FROM THE KUUJJUA RIVER, 1995–2015

Presenter: Xinhua Zhu

Participants were given an overview of a statistical-catch-at-age (SCA) model that was used to evaluate the response of Arctic Char from the Kuujjua River to the reported harvest. Using reported harvest data and information from the Tatik Lake monitoring program between 1995 and 2015, the model was used to estimate abundance and biomass, formulate reference points (e.g., maximum sustainable yield (MSY)), and determine current stock status. The data sources and methods used were described. Specifically, how outliers were identified, the distribution and interrelationships/ interactions of the various data, how growth and mortality parameters were determined and CPUE standardized. The integration of all the data and the assumptions of the age-structured model were described. A correction factor was applied to age data prior to 2012 in an attempt to standardize age information across the two age readers used in the time-series. Observed and predicted outputs were examined to evaluate the robustness of the model. Because of the unknown contribution of the Kuujjua River stock to the coastal fishery, reference points for the combined summer and winter fishery were estimated separately under three harvest scenarios where it was assumed the stock contributed 25%, 50% and 75% to the reported harvest near Ulukhaktok during the summer. Additionally, reference points among the three summer harvest scenarios were also estimated for the winter fishery in Tatik Lake.

The results of the model indicated that the current stock status was healthy (B_t/B_{MSY} and SSB_t/SSB_{MSY} were >1, and F_t/F_{MSY} was <1). A table showing reference points, MSY, and abundance (N_{MSY}), biomass (B_{MSY}), fishing mortality (F_{MSY}), and exploitation rate (U_{MSY}) at MSY for the combined summer and winter fishery and specifically for the winter fishery in Tatik Lake for char from the Kuujjua River was presented for the three summer harvest scenarios. The results demonstrated that the maximum sustainable yield estimate was within range of the current harvest.

DISCUSSION

Clarification was given regarding how outliers in the catch-effort data were identified and why these were removed. A zero inflated negative binomial model was not used to standardize catch-effort information although there was an over-dispersion of the data. Clarification was also provided that a Virtual Population Analysis was utilized to parameterize the first year in the model.

A question was asked about relying only on the two sources of information for catches without population abundance data when parameterizing the model. There was concern given that modellers typically tune their models to abundance estimates but in this case CPUE was used as a proxy for abundance. The participant wanted more detail provided in the methods section and believed this was an important issue because harvesters set their nets (i.e., CPUE data) where the fish congregate, rather than randomly, which may create hyper-stability (. another source of error).

Additional clarification was requested about where the information for the unexploited component of the stock was coming from, the maximum age used in the model (all ages >20 were combined into a single group), and why outlier CPUE data were omitted when it was known to be negatively binomially distributed. It was confirmed that the reported harvest data in 2010, 2013, and 2014 were incomplete and mentioned to the presenter that it would be prudent to treat these data differently in the model. A suggestion was made to use a five year average to estimate the harvest in 2010, 2013, and 2014.

There was discussion between two participants about possibly removing the 2015 age data from the modelling due to low sample size, which may affect model outputs. However, a point was made that the information did show the presence of older fish in the fishery which is important to document.

A participant asked how time-varying natural mortality was modelled and the answer was that a random walk technique was used. A follow-up question asked about whether a life history model was used to determine the starting value and the response was that a size-dependant model was employed. A comment was made that the starting mortality value seemed high which prompted the reply that while maximum size may have overestimated mortality, the severe conditions in the Arctic may also result in a higher mortality. Another question was asked about the truncated age distribution observed after the closure of the fishery and if this would result in a higher mortality estimate. The reply was that there was still the summer coastal fishery that took a relatively high number of fish. It was the participant’s opinion that mortality estimates may not be accurate and that this should be an important point to consider by the modeller. Someone stated ssensitivity analyses could assist in determining which parameters the SCA model is most sensitive to and focus future efforts to improve estimates of these parameters.

Someone asked why data between 1995 and 2015 were used when there was data from the monitoring program that went as far back as 1991. The answer was that the data set was truncated because of various changes in gear configurations (e.g., mesh size and net length) and the three-year closure of Tatik Lake occurred between 1993 and 1995. Due to the greater amounts of uncertainty in the data prior to 1995 and for the sake of simplicity, only information between 1995 and 2015 were used.

In response to a question about how such a precise standard error for natural mortality was estimated (four decimal places) the presenter stated that it was calculated based on a Markov chain Monte Carlo (MCMC) algorithm that generated a mean based on thousands of samples. The MCMC depended on the initial value of the model/algorithm and sample size. A participant asked whether cohort analysis was used to obtain recruitment data from the SCA model. The presenter replied that he used a Beverton-Holt model to determine the stock-recruitment relationship.

During discussion regarding the contribution of the Kuujjua River stock to the coastal fishery, a participant familiar with the results from a t-bar tagging project conducted on the Kuujjua River stated that it would be reasonable to assume that char from the stock contributed between 50 and 75% to the coastal harvest. It was noted that the largest biomass at MSY for the winter fishery in Tatik Lake was observed when the stock contributed 25% to the coastal fishery, followed by 75% and then 50% when it would seem reasonable that the 50% value would fall between 25% and 75%. The presenter acknowledged that the model and derivation of reference points for the component of the population fished during the Tatik Lake winter fishery would have to be further evaluated.

Following further exchanges that were highly specific and technical in nature, the chair suggested that the discussion continue amongst those interested during the break. The chair also asked the room to think about the implications to the assessment of the discussion just held on the modelling results and what if any improvements we could make with the time available. Could or should we adjust harvest inputs, parameterization, initial values, or assumptions about natural mortality? If we did have a recommendation in this regard could the model be re-run by tomorrow? Or do we consider the model a work in progress and if so what, if any, results would we include in the report.

One participant stated that if the harvest between 1966 and 1975 averaged at least approximately 3,000 fish per year and we don't know how we're scaling MSY then how can there be confidence in the MSY estimate. The reply from the chair was to formulate their concerns to the modeller in order to incorporate these in the edits of the working paper and re-evaluation of the model.

When the presenter was asked if there was any validation of the Bayesian model the reply was that he would need more time to do this. Following this, he was asked if a Gelman-Rubin statistic was used and whether convergence of the MCMC was assessed. The reply was that a log-negative likelihood estimate was used.

One participant had trouble understanding why the MSY results for the winter fishery on Tatik Lake were not considerably different among the 25%, 50% and 75% coastal harvest scenarios. The participant stated that this suggested the coastal fishery had no influence on the outcome of the fishery on Tatik Lake which was counterintuitive, suggesting that conducting research towards a genetic mixed-stock fishery analysis was not important. The presenter replied that he was unsure why the model produced these results and underscored his support for research on mixed stock analysis to help inform future modelling.

The modeller was asked why he used only one model for the assessment and whether he would consider other models to fit the data. For example the assessment for Arctic Char from the Hornaday River examined three models. The reply was that for the Hornaday River stock it was assumed the coastal fishery was a single stock and so it was not as complex as the Kuujjua River. It was reiterated that the SCA is a powerful model which requires more data than other models so the use of less powerful models had not been considered. However, it was emphasized that this was a first attempt and that he could try other models in the future, although most fisheries modellers would agree the SCA model is preferred. A follow-up comment was made that if there was a situation with questionable age data, such as the case with the Kuujjua River time-series, it could be possible to use a surplus production model which has been successfully used in other complex fisheries.

A statement was made that it appeared all the steps of the model were appropriately followed however it seemed that the outputs of MSY were questionable and not intuitive thereby decreasing the level of confidence in the model. It was mentioned that using different models and comparing their outputs would be beneficial. A suggestion was made to examine length-based rather than age-based models.

The chair of the meeting repeated that there appeared to be a high degree of uncertainty and reservation regarding the use of the SCA model. It was recommended that work continue on the modelling in order to improve our confidence in using the outputs for management purposes. One of the positive outcomes was that all MSY estimates were low. There was no intention to completely discard the model as there was good value in the work that was conducted. However, uncertainties had to be acknowledged and improvements made to the data inputs before the model could be adopted.

RESEARCH NEEDS

An open discussion was held regarding the research needs for Arctic Char in the Ulukhaktok area. The following ideas were provided:

1) re-age otoliths collected prior to 2010,
2) conduct an age validation study,
3) examine alternative population models,
4) monitor water levels and temperature in conjunction with the biological sampling programs,
5) incorporate local knowledge into monitoring program by improving how monitor's observations are communicated, collect local knowledge that could be useful for mixed-stock fishery analysis (e.g., morphological features, or one participant from Ulukhaktok stated that during the summer, when fishing near the Kagloryuak River, char from the Kuuk River were captured on the east side of the net while those from the Kagloryuak River were caught on the west side), collect traditional knowledge to identify which lakes have been historically harvested,
6) sample other stocks in Prince Albert Sound or other harvested lakes (e.g., Mayoklihok Lake) to better understand questions about life cycle and life history parameters,
7) re-examine harvest and tagging data collected in the 1990s that could be useful in improving the parameters of the population model,
8) sample juvenile or spawning char from all known populations for genetic-mixed-stock fishery analysis, local knowledge could be used to identify these stocks,

9) collect age data from un-harvested populations to compare age structure and mortality estimates with harvested systems,

10) increase the dead-sample size in the monitoring programs to between 250 and 300 to obtain a more representative sample (given there are 20+ age classes),

11) conduct life history studies to examine anadromy versus residency, analysis of strontium in otoliths could be used to examine migration patterns between freshwater and marine habitats, investigate freshwater and marine habitat use (e.g., dispersal and distribution), and

12) continue with monitoring programs already in place.

DEVELOPMENT OF SCIENCE ADVISORY REPORT (SAR)

The Science Advisory Report was developed collaboratively by all participants during the meeting.

NEXT STEPS

The research documents proposed as outputs of the peer-review were confirmed by the chair of the meeting. The chair thanked all participants for their input into the discussions and adjourned the peer review.

APPENDIX 1: PARTICIPANTS

Name	Affiliation
John Alikamik	Olokhaktokmiut Hunters and Trappers Committee
Burton Ayles	Fisheries Joint Management Committee
Christopher Cahill	University of Calgary (PhD candidate)
Heather Clark (Rapporteur)	Fisheries and Oceans Canada, Science
Redmond Clarke	Fisheries Joint Management Committee
Brian Dempson	Fisheries and Oceans Canada, Science
Colin Gallagher	Fisheries and Oceans Canada, Science
Les Harris	Fisheries and Oceans Canada, Science
Lois Harwood	Fisheries and Oceans Canada, Science
Kimberly Howland	Fisheries and Oceans Canada, Science
Ellen Lea	Fisheries and Oceans Canada, Fisheries Management
Joshua Oliktoak	Olokhaktokmiut Hunters and Trappers Committee
Michael Papst	Independent expert
Kate Snow	Fisheries and Oceans Canada, Fisheries Management
Ross Tallman	Fisheries and Oceans Canada, Science
Margaret Treble (Chair)	Fisheries and Oceans Canada, Science
Rick Wastle	Fisheries and Oceans Canada, Science
Xinhua Zhu	Fisheries and Oceans Canada, Science

APPENDIX 2: TERMS OF REFERENCE

Assessment of Arctic Char in the Ulukhaktok area of the Northwest Territories

Regional Peer Review – Central and Arctic Region

February 15-17, 2016
Winnipeg, MB

Chairperson: Margaret Treble

Context

Anadromous Arctic Char (*Salvelinus alpinus*) are an important subsistence resource for the residents of Ulukhaktok, NT, with the majority of the harvest occurring in the marine waters in proximity to the community during the summer. Arctic Char from Tatik Lake (Kuujjua River) are the most important stock for harvesters. The stock is harvested during the summer when feeding/ migrating along the coast in a mixed-stock fishery and during the winter (under-ice) while overwintering in Tatik Lake. A decline in the char harvests and size in Tatik Lake prompted the establishment of a harvest-based monitoring program in 1991. Two harvesters from Ulukhaktok collect harvest, catch-effort and biological data from the winter fishery (October-November). The program has occurred annually since its inception (except 1993) and the data are used to evaluate stock status and trends, including relative abundance and population demographics.

An annual summer monitoring program for char harvested on the coast near Ulukhaktok was initiated in 2011. Given the data are collected from a mixed-stock fishery, the information is used to monitor the status of the summer fishery by examining trends in annual relative abundance and biological information. In addition to subsistence harvest, a Stage I exploratory licence for char has been issued to the community for the summer coastal fishery (2006–present). This exploratory fishery is relatively small with a quota of 500 char which are all locally sold within the community or territory. Under the exploratory licence, harvesters are responsible for collecting annual harvest, catch-effort, and biological data from their catches.

The Olokhaktokmiut Hunters and Trappers Committee and Ulukhaktok Char Working Group have requested an increase in their subsistence harvest at Tatik Lake, which has a locally-set harvest guideline of 1,000 fish annually. Furthermore, the Ulukhaktok Char Working Group is currently updating their community fishing plan and have requested an updated assessment and summary of information available on char stocks in the Ulukhaktok area. As a result, Fisheries and Oceans Canada Resource Management has requested Science advice on the current stock status and sustainable harvest level of Arctic Char from Tatik Lake and an evaluation of the data collected from the summer coastal fishery.

Objectives

The objectives of this meeting are to undertake a science-based peer review of all available information relevant to providing advice on the sustainable harvest level for Arctic Char from Tatik Lake and to evaluate all available information relevant to the coastal mixed-stock fishery (including the Stage I exploratory licence). Specifically, the meeting will address the following objectives:

1) examine trends in the catch-effort and biological data collected at Tatik Lake through the harvest monitoring program, including biological information periodically collected from the subsistence fishery prior to the program;

2) examine trends in the catch-effort and biological data collected in proximity to Ulukhaktok during the summer through the coastal harvest monitoring program and

Stage I exploratory licences, including biological information periodically collected from the subsistence fishery prior to the program;

3) incorporate total harvest, catch-effort and biological time-series data from Tatik Lake into multiple population models to estimate the population abundance and sustainable harvest level, and associated risk levels, for Arctic Char from Tatik Lake;
4) determine population indicators/ reference points that can be used by co-management partners for decisions pertaining to harvest levels based on results from the modelling exercise;
5) discuss future research needs and current monitoring plans for Arctic Char in the Ulukhaktok area.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Documents

Participation

- Fisheries and Oceans Canada (DFO) (Ecosystems and Oceans Science, and Ecosystems and Fisheries Management sectors)
- Fisheries Joint Management Committee
- Academics
- Olokhaktokmiut Hunters and Trappers Committee
- Other invited experts

APPENDIX 3: AGENDA

Assessment of Arctic Char in the Ulukhaktok area, Northwest Territories RAP
February 15–17, 2016
Fisheries and Oceans Canada
Freshwater Institute (large seminar room)

February 15

13:00–13:15	Introductory remarks and review of Terms of Reference (M. Treble)
13:15–13:35	Arctic Char in the Ulukhaktok area: background (L. Harwood)
13:35–14:15	Weir enumeration and life history/ habitats of Arctic Char from the Kuujjua (L. Harwood)
14:15– 14:45	Tatik Lake Char Monitoring Program (1991–2015) (ToR #1) (C. Gallagher)
14:45–15:00	Break
15:00–15:15	Tatik Lake Char Monitoring Program (1991–2015) continued (C. Gallagher)
15:15–15:30	Mayoklihok Lake fish survey (2013) (C. Gallagher)
15:30–16:15	Coastal Harvest Monitoring Program (1993–97 and 2011–2015) (ToR #2) (E. Lea)
16:15–16:45	Stage I exploratory commercial fishery (ToR #2) (E. Lea)

February 16

9:00–9:45	Community harvest survey (E. Lea)
9:45–10:30	Surplus production/age-structured models and reference points (ToR #3 and 4) (X. Zhu)
10:30–10:45	Break
10:45–11:45	Surplus production/ age-structured models and reference points continued (X.Zhu)
11:45–13:00	Lunch
13:00–14:45	Future research needs (ToR #5) (M. Treble)
14:45–15:00	Break
15:00–16:30	Develop conclusions/ advice for the Science Advisory Report (M. Treble)

February 17

9:00	Develop conclusions/advice for the Science Advisory Report and conclude meeting (M. Treble)