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Central and Arctic Region
Canadian Science Advisory Secretariat
Science Advisory Report 2010/060

STOCK ASSESSMENT OF ARCTIC CHAR, *Salvelinus alpinus*, FROM THE ISUITUQ RIVER SYSTEM, NUNAVUT

Typical Cumberland Sound Arctic Char Photo by J.S. Moore

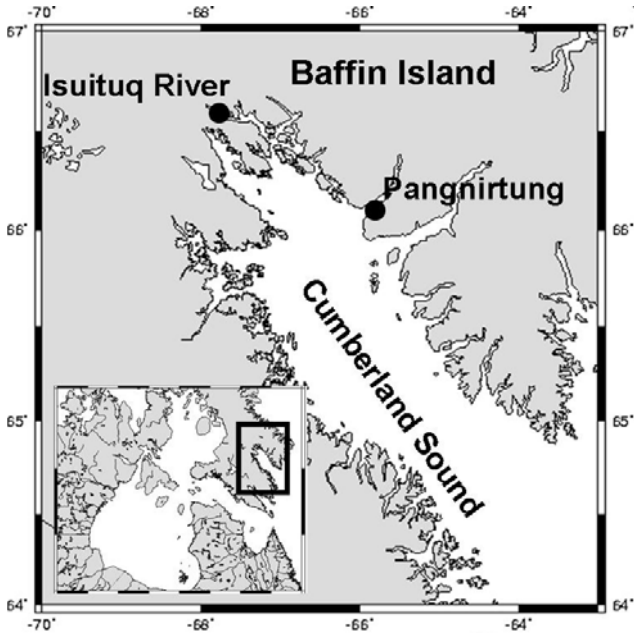

Figure 1. Cumberland Sound showing the location of the Isuituq River system and the community of Pangnirtung (primary resource users of the Isuituq system).

Context :

Anadromous Arctic Char, Salvelinus alpinus, inhabit a number of river systems that drain into Cumberland Sound, NU. They spawn, overwinter and rear in the freshwater habitats of these systems and typically spend the summers feeding in the marine waters of Cumberland Sound. The Isuituq River system at the head of Clearwater Fiord is one such system that has long provided Arctic Char for both subsistence and exploratory fisheries of the area, in particular for residents of Pangnirtung.

Since 1997, Isuituq Arctic Char have been harvested under an exploratory licence (1997-2009) by local fishers. The exploratory fishery is meant to provide information to determine whether a stock can sustain a particular level of harvest. Fisheries and Oceans Canada has been collecting fishery independent biological and catch and effort data (to compliment that collected from exploratory fisheries) from 2002-2006 and 2008 to assess the potential of the stock to support a commercial fishery.

A Regional Advisory Process meeting was held in Pangnirtung, March 24-25, 2010 to assess the status of the Isuituq system Arctic Char stock, to provide advice on the sustainability of the fishery and to peer review the research document generated from this assessment. Participants from DFO Science and Fisheries and Aquaculture Management, the Pangnirtung Hunters and Trappers Association (HTA), municipal and territorial governments, the Pangnirtung fish plant, the Universities of British Columbia and Manitoba and local fishers attended the meeting. Discussion generated from these meetings is also included in this report.

SUMMARY

- Anadromous Arctic Char are common in many river systems of Cumberland Sound, NT. It is presently unknown if individual Cumberland Sound river systems represent genetically discrete stocks or if there is a high degree of migration (gene flow) between systems.
- The Isuituq River is one such Cumberland Sound system that is inhabited by anadromous Arctic Char and these fish are an important local resource for residents of Pangnirtung, Nunavut.
- The fishery for Isuituq Arctic Char is primarily an open-water gill-net fishery, at the mouth of the river in nearshore areas of Clearwater Fiord. It is likely that this fishery is harvesting Arctic Char from several distinct stocks. There currently is an exploratory quota of 2500kg for the area.
- An assessment of length, weight, age and catch and effort data was conducted to assess the resilience of Isuituq Arctic Char to the current levels of harvest.
- The lack of negative trends in length, weight, age and catch and effort data indicate that the current harvest level is likely sustainable.
- There is a low to moderate risks of over-harvest Arctic Char in this system if the current rates of harvest continue.
- Age data should be interpreted cautiously given age reading discrepancies and in regards to a future assessment, the re-ageing of this benchmark data should be considered.
- Initiatives to resolve the genetic population structure of Arctic Char in this system should be pursued. This will also include determining how many other putative stocks are being harvested and to what extent (i.e., mixed-stock fishery analysis).

INTRODUCTION

Background and Rationale for the Assessment

Arctic Char have been, and continue to be, an important resource for Nunavummiut. In the Cumberland Sound area of Nunavut, residents of Pangnirtung regularly harvest Arctic Char for subsistence purposes. The long-term sustainability of fisheries on some waterbodies in the area is of interest to the community and Fisheries and Oceans Canada (DFO). Before a fishery is licenced as a commercial operation, the sustainability of the harvest on the stock must be evaluated (DFO 2010). This is typically done by operating a fishery under an exploratory licence for five or more consecutive years. The specific objective of the exploratory fishery stage is to determine whether the harvested stock or population can sustain a commercial viable operation by collecting and analysing biological and catch and effort data. Essentially the resilience of a stock to sustained fishing pressure is assessed and if resilience to the level of harvest is demonstrated, the stock may be considered for designation as a commercial waterbody.

The Isuituq River system in Cumberland Sound is one such waterbody that is presently being assessed for the feasibility of a sustainable fishery (Figs. 1, 2). As with most of the waterbodies in Cumberland Sound, this river has a long history of subsistence fishing and, since 1997, it has also been fished under an exploratory licence (with an annual quota of 2500 kg) at its confluence with Clearwater Fiord (waterbody code PG080). Periodically, exploratory licences were issued for other waterbodies in this and nearby systems (e.g., PG086, PG092, Fig. 2). Most Cumberland Sound fisheries, especially during the open-water season, have the potential

to harvest a mixture of Arctic Char stocks from proximate systems (i.e., they are mixed-stock fisheries).

DFO's Fisheries and Aquaculture Management (FAM) sector has requested assessments of the current status of the Arctic Char stocks from the Cumberland Sound area. In the Isuituq River system, particularly at Clearwater Fiord, DFO has been collecting biological and catch and effort data as part of a research-oriented (fisheries independent) fishing effort program since 2002. As such, this waterbody is one of few in the Cumberland Sound region that has sufficient data necessary for stock assessment analyses and thus is a prime candidate for FAMs request. These fishery independent data form the foundation of the current assessment.

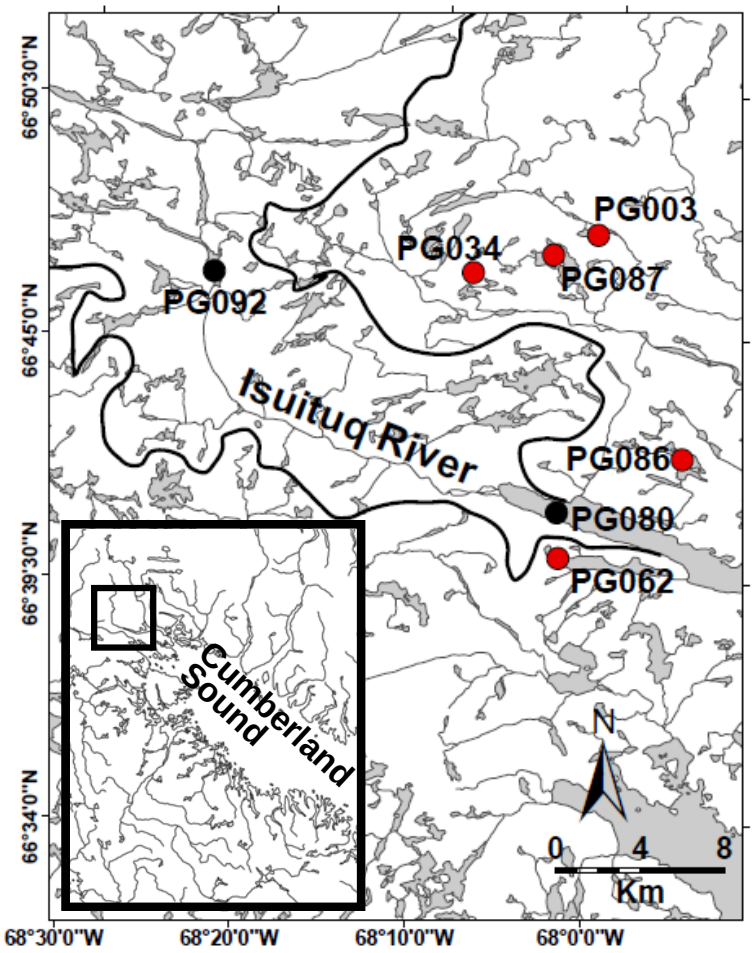

Figure 2. The Isuituq River system in Cumberland Sound. Also shown are several of the waterbodies in the area where fishing has occurred. These waterbodies likely contribute fish to the mixed-stock harvest at Isuituq. Black circles represent fisheries in the Isuituq system and red circles show fisheries in other nearby systems including the Ranger River system to the east. PG003 = Ijaruvung Lake and PG080 = Isuituq. The rest are unnamed waterbodies.

Biology of the Species

Arctic Char have a circumpolar distribution and are the most northerly distributed freshwater fish species (Scott and Crossman 1998). Several Arctic Char life histories exist, the most common are lake-resident (freshwater) small form and anadromous (sea-run) large form. This assessment will focus on the latter in the Isuituq system, although resident forms are also known from this system.

In general, anadromous Arctic Char spend the first several years of their lives in the freshwater lakes where they were hatched. Typically around 5-6 years of age they undergo a process called smoltification after which they migrate downstream annually to the productive marine habitats of Cumberland Sound shortly after ice-off. Typically, the adults spend the summer in marine habitats feeding in the vicinity of their natal rivers. The migration from estuarine habitats back into freshwater where they spawn and overwinter occurs in July and August. Some anadromous Arctic Char do not migrate to the estuary in the open-water season in the year in which they spawn although Harris and Tallman (2010) provide evidence that at least some current year spawners do undertake this spring migration. There is also some evidence that immature fish can tolerate some levels of elevated salinity as they have also been captured in marine habitats (Harris and Tallman 2010).

Spawning in Isuituq Arctic Char begins in September at water temperatures between 0.5-4.0^{o}C (Moore 1975). Given that the majority of the Isuituq River likely freezes to the bottom over the winter, spawning takes place over gravel or rocky shoals in the headwater lakes (Harris and Tallman 2010). Specific spawning locations in the Isuituq system, however, have yet to be identified. Fish maturing as young as eight years of age have been found in the Isuituq system (Harris and Tallman 2010).

The Fishery

The Isuituq system has a long history of harvest. Accurate information on total harvest is essential for assessing the status of the stock and for implementing a sustainable harvest rate that is economically viable. Additionally, in a fishery where several populations are potentially being exploited (i.e., a mixed-stock fishery), an accurate description of what populations are being harvested and to what extent is essential. This is likely the case for the Isuituq River fishery, although this possibility has yet to be tested quantitatively. For example, it is possible that Arctic Char from the Ranger River system to the East and other nearby systems are potentially being harvested at Clearwater Fiord. Future genetic research initiatives will likely be able to resolve some of the current unknowns regarding the harvest of mixed-stocks.

Fishing under exploratory licences has been occurring in the Isuituq system since 1997 (Table 1). The fishery is a summer open-water (July-August) gillnet fishery that typically use nylon or monofilament gillnets with mesh sizes of 139.7 mm (5.5”). Nets are usually set at the mouth of the Isuituq River at Clearwater Fiord (PG080) although other waterbodies (PG086 and PG092, Fig. 2) in the Isuituq system have occasionally been fished under exploratory licences (Harris and Tallman 2010). Only data from PG080 is being considered in this assessment.

Winter fishing in this area for Arctic Char is negligible. As Isuituq is far from Pangnirtung, it is not considered one of the primary subsistence fishing areas. It is however fished opportunistically when residents are in the area hunting for caribou or belugas.

The quota for the fishery has remained at 2500 kg since 1997. Harvest data (Table 1) from this fishery ranged from 2298.45 kg (1997) to 3378.91 kg (1998) and has averaged 2679.28 kg of Arctic Char per year since 1997. Using an average char weight of 2537.3 grams (average weight of char caught using 139.7 mm nets for all years combined in this assessment) this corresponds to a harvest of 906 and 1332 fish for 1997 and 1998 respectively.

Limited subsistence harvest data (1996 – 2000) are available from Isuituq (Priest and Usher 2004, Table 1) from the Nunavut Wildlife Harvest Study. Subsistence harvest is extremely variable among years and ranged from 157 char in 1996 to 1255 char in 2000 (Table 1). Using

an average char weight of 2537.3 g (described above) an estimated 3184.0 kg of char were harvested in the Isuituq subsistence fishery in 2000. These data however, must be interpreted with caution as the information presented in the Nunavut Harvest Study may include exploratory or commercial harvest (Harris and Tallman 2010). Contrary to what is reported in the harvest study, subsistence harvest at Isuiutq is considered by Pangnirtung residents to be quite consistent and low.

Sport fishing for Arctic Char at Isuituq is considered low.

Table 1. Harvest information for Arctic Char from the Isuituq River system (PG080) from 1997 to 2009. Harvest under exploratory licence is reported in kg round weight while subsistence harvest from the Nunavut Wildlife Harvest Study (Priest and Usher 2004) reports the number of fish harvested.

Year	DFO Research		Exploratory Harvest (PG080)	Subsistence Harvest	
	# Fish	Round Wt (kg)	Round Wt (kg)	# Fish	Estimated Round Wt (kg)
1996				157	398.36
1997			2298.45	1180	2994.01
1998			3378.91	290	735.82
1999			3159.48	950	2410.44
2000			2328.61	1255	3184.31
2001					
2002	199	459.08	2589.54		
2003	222	404.52	2738.93		
2004	189	495.78	2491.36		
2005	213	462.43	2458.51		
2006	195	412.96	2446.25		
2007			2958.41		
2008	186	549.34	2690.04		
2009			2612.88		
Average	**200.67**	**464.02**	**2679.28**	**766.40**	**1944.59**
Totals	**1204**	**2784.11**	**32151.37**	**3832**	**9723**

ASSESSMENT

Six years of fishery independent survey data were collected in the Isuituq system from 2002-2006 and 2008 (Table 1) and provide the basis of this assessment. Multi-mesh (38.1 mm (1.5-inch), 50.8 mm (2.0-inch), 63.5 mm (2.5-inch), 76.2 mm (3.0-inch), 88.9 mm (3.5-inch) and 101.6 mm (4.0-inch)) gill nets were used to collect fish. Additionally, research nets of fishery

mesh size (139.7 mm, (5.5-inch)) were used to collect information on sizes and ages of Arctic Char likely to be harvested in the fisheries of the area.

Catch-per-unit Effort and Abundance

There are no population estimates for the Isuituq stock. In the absence of abundance data, however, catch-per-unit-effort (CPUE) can be used as an index of relative stock size if the same fishing gear and methods are consistent among years. Assuming natural mortality is constant, changes in CPUE may be attributed to fishing induced changes in abundance (if certain assumptions are met). For example, a consistent decrease in CPUE over several consecutive years might indicate that the overall stock size is declining.

In DFO research surveys, catch and effort data were recorded for 2002-2006 but not 2008 (Harris and Tallman 2010). Overall, trends in CPUE (calculated as the number of fish landed per 9.29 m^2 (100 ft^2) per 24 hours of fishing) were quite similar between gill net types, but CPUE was highly variable among years within each (Harris and Tallman 2010). With the exception of 2003, where catch rates were abnormally high, CPUE appears to be relatively constant across sampling years, especially towards the end of the assessment. The high CPUE in 2003 is difficult to explain given the gear type, methods, location and time of fishing (end of July – beginning of August) were relatively consistent across years. Additionally, environmental variables (e.g., water temperature and weather) were also relatively consistent across years (Harris and Tallman 2010).

Overall, there was no trend in the stock index from 2002 to 2008 and there was no difference in CPUE between gear types (Harris and Tallman 2010). Significant yearly differences were found within each gear type (Harris and Tallman 2010) but could not be explained.

Sex Ratio and Maturity

Over the duration of the research program, the sex ratio remained relatively constant and no statistical differences were found across all years (Harris and Tallman 2010). In every sampling year, males were more abundant than females (Table 2) and the male to female sex ratio averaged 1.33 and varied from 1.15 (2008) to 1.71 (2002; Table 2). The stability of the sex ratio in this assessment may be evidence of the stock stability of Isuituq Arctic Char (Harris and Tallman 2010).

The frequency of the maturity stages of Isuituq Arctic Char sampled from the DFO research fishery was also highly variable across year. Considering mature fish only, for example, the percentage ranged from 2.56% (2006) to 92.44% (2008, Table 2). On average, resting fish were most prevalent in catches (51.7%) followed by mature (28.3%) and immature fish (20.0%). It is hypothesized that current year spawners usually do not migrate to Cumberland Sound which may explain the high frequency of resting (i.e., non-spawning adults) fish in comparison to mature (i.e., current year spawners) fish.

Length (L_{50}) and age (A_{50}) at 50% maturity was used as a reproductive potential index. Calculated only for 139.7 mm mesh nets (sexes combined) L_{50} ranged from 427 mm in 2003 to 515 mm in 2002 (Fig. 3) and A_{50} varied between 8.2 in 2005 and 11.6 in 2003 (Fig. 4). Both of these indices of maturity appear to be quite stable, especially in the latter years of the assessment. The consistency of maturity indices provided here, albeit over a small time series, offer evidence for the stability of this stock and its ability to endure the current harvest levels.

Overall, the mean age at first maturity was 8.3 for males and 8.7 for females (Table 2). These means were relatively close although age at first maturity was quite variable between years and between sexes and no trend was apparent across years or within sexes. Importantly, there was no indication that age at maturity was decreasing over the duration of the assessment, especially during the last four years of the study which would be expected for moderate to heavily exploited fish populations as a compensatory response to harvest.

Table 2. Sex and maturity information for Isuituq River system Arctic Char caught in research fisheries, 2002-2006, 2008.

	Sex	Maturity			Age at First Maturity	
Year	**M:F**	**% Immature**	**% Mature**	**% Resting**	**Male**	**Female**
2002	1.73	31.2	6.5	62.3	8	12
2003	1.17	23.2	7.1	69.7	10	10
2004	1.33	11.6	49.7	38.6	8	8
2005	1.19	24.1	11.3	64.6	8	7
2006	1.44	26.2	2.6	71.3	8	7
2008	1.15	4.1	92.4	3.5	8	8
Average	**1.33**	**20.0**	**28.3**	**51.7**	**8.3**	**8.7**

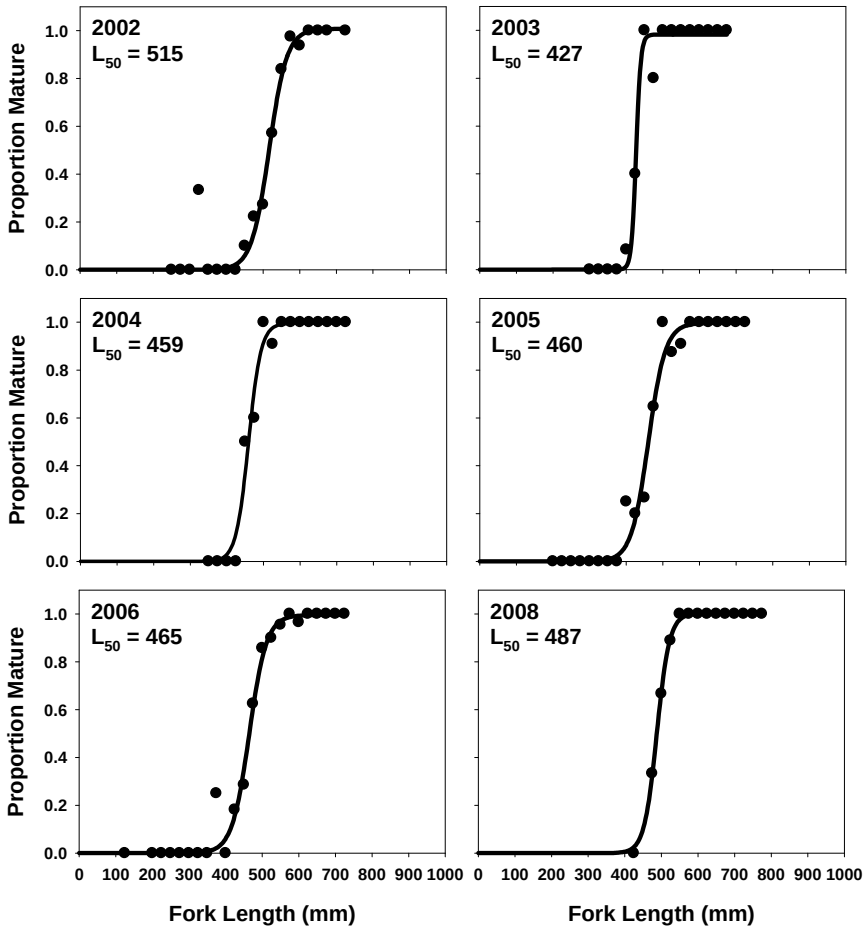

Figure 3. Length at %50 maturity (L_{50}) for Arctic Char (sexes combined) captured in the Isuituq River system, NU, using fishery mesh size (139.7 mm mesh) gill nets, 2002-2008.

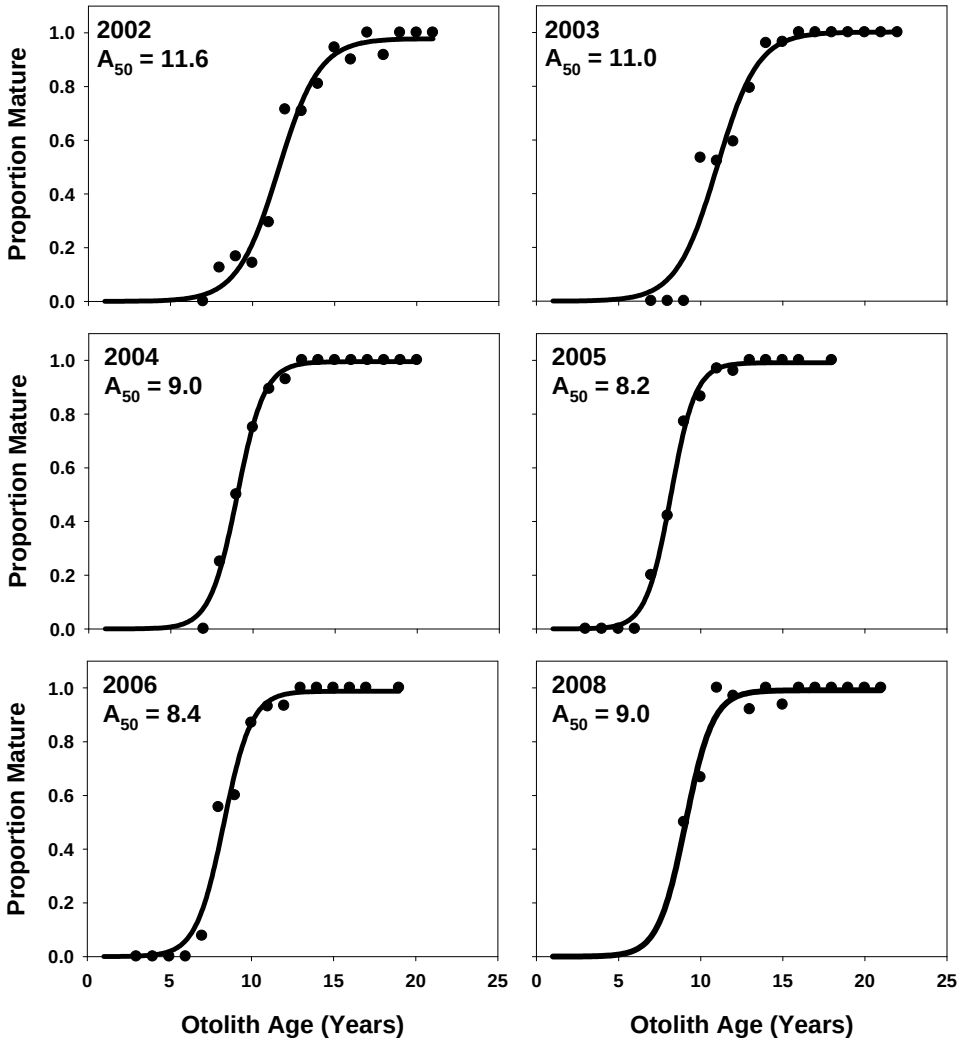

Figure 4. Age at %50 maturity (A50) for Arctic Char (sexes combined) captured in the Isuituq River system, NU, using fishery mesh size (139.7 mm mesh) gill nets, 2002-2008.

Stock Trends in Biological Characteristics

Given the current abundance of Isuituq Arctic Char is currently not known, the status of this stock is inferred from trends in biological characteristics obtained from DFO research surveys in the area. Trend analyses of round weight, fork length and age, are used to assess the response of Isuituq Arctic Char to fishing.

Weight

Individual Arctic Char weight ranged from 29.5 g (2006) to 5298 g (2008) and was variable among years and between sexes and net type within years (Table 3a). Across all years, Arctic Char sampled from DFO research fisheries averaged 2533.1 g for males and 2049.7 g for females. Males were statistically heavier than females in each sampling year (Harris and Tallman 2010) with the exception of 2005. Additionally, within each year, there were significant

differences in the weight of fish captured with multi-mesh and fishery (139.7 mm) mesh size with the latter capturing heavier fish on average (Fig. 5a).

Mean round weight was relatively stable over the assessment period (Table 3a, Fig. 5a) although there was annual variation. No trends were evident and in fact, mean round weight was higher in the final year of the assessment compared to data from 2002. Long-term declines in mean weight can be a response to heavy harvest but given that this index does not appear to be declining in the current assessment, the fishery seems to be stable given the current harvest levels.

Length

Individual fork length ranges from 145 mm (2006) to 758 mm (2002), but mean fork length was also quite variable depending on the year, sex and gear type employed (Table 3b). Males were significantly longer than females within each year (Harris and Tallman 2010) with the exception of 2005. Additionally, each year there were statistical differences in the length of fish captured with multi-mesh and 139.7 mm gill nets with the latter capturing larger fish on average (Fig. 5b). As with the weight data, no clear trend in mean fork length across sampling years was resolved. Importantly, no negative trends indicative of overharvest (e.g., consistent decline in mean length) were found.

The length-frequency distributions were unimodal with modal lengths relatively stable across years (Fig. 6) ranging between 550-650 mm. There is considerable variability in the shapes of the length distributions from year to year and the distributions were typically skewed towards the larger sizes (Fig 6). As such, there was weak representation of the smaller size classes throughout all years of the study and thus, in some years, the distributions appear to be truncated. This was caused due to the higher proportion of fish that were captured using the 139.7 mm mesh nets therefore over-representing the number of larger sized fish captured in each year. This raises concerns regarding future sampling protocols with respect to sample mesh sizes. To truly obtain an accurate representation of the population (in terms of length, weight and age), it is recommended that multi-mesh nets (that include a 139.7 mm panel) be used solely for future research surveys. This should greatly reduce misinterpretation of the data.

Condition

Given the overall stability in weight and length data, it is not surpirising that relative condition factor (K) appears relatively constant across years (Fig. 5d). For both 139.7 mm mesh size nets and and multi-mesh nets, condition remained relatively stable (Fig. 5d) varying from from 1.14 in 2002 to 1.24 in 2005 (data not shown). Although some temporal variation is apparent, condition factor did not vary annually as much as mean weight, length or age (Fig. 5d).

Condition factor is often used as an index of fish health and in fisheries where high harvest rates have adversly affected population structure significant changes in mean condition often accompany increases in harvest. This was not the case for Isuituq Arctic Char.

Age

Arctic Char ranged in age from 3 years (2005 and 2006) to 22 years (2003) and overall averaged 10.2 (2005) to 14.0 (2008, Table 3c). Age varied between sampling year, sexes and gear type employed. There was no trend in age data over the assessment period. Given the annual variation, and the uncertainty surrounding estimates of age for some years (Harris and

Tallman 2010), age data were of limited use to assess the impact of harvesting on the stock. As such, length, weight and condition data may provide more reliable indicators of stock health and resilience to the current levels of harvest.

The shapes of the age distributions and the range of ages differed among years and appear to be skewed towards older ages in all years; a result of the size selectivity of the 139.7 mm mesh size nets. Age-frequency distributions were unimodal with modal lengths relatively stable across sampling years (Fig. 7) and no trend in modal age, or the age-frequency distributions were evident.

Truncations in age distributions, through the removal of older age classes, are often associated with fishing and harvest but were not obvious in this assessment. Older (> 18 years of age) fish were captured in all years.

Population growth rates are shown in Fig. 8 as plots of mean fork length on age. Qualitatively, growth rates appear to be relatively similar among years. Overall, these data suggest growth rate of Arctic Char has remained relatively stable in this system.

Mortality

Full recruitment of Arctic Char to the fishery (139.7 mm mesh net size) varied among years and ranged from 10 (2005) to 15 (2003) years of age (Fig. 9). Mortality was highly variable among years and ranged from moderately low (0.27 in 2002) to relatively high (0.68 in 2004; Fig. 9). These are the first mortality estimates for this system, therefore comparisons with historic values are not available. It does appear, however, that annual survival is relatively high in this system. Even though overall mortality appears to be variable, given the stability of length, weight and age data it appears Isuituq Char population can sustain current mortalities rates. If the fishery were having a detrimental effect on the Isuituq Char population, we would expect mortality rates to increase with time. Indeed, this was not the case and trends showing consistent increases in mortality were not found.

Table 3. Mean weight (A), mean length (B) and mean age (C) of Arctic Char from the Isuituq River, NU. Means, ranges, %95 confidence intervals (C.I.) and sample sizes (N) are shown for males (M) and females (F) and for 139.7 mm and multi-mesh gill nets).

A	Weight (g)							
Year	**M**	**F**	**139.7**	**Multi**	**All**	**Range**	**95% C.I.**	**N**
2002	2536	1912	2520	1309	**2307**	**300 - 4700**	**2186 - 2428**	**199**
2003	1980	1629	1925	1562	**1822**	**400 - 4450**	**1714 - 1930**	**219**
2004	2895	2261	2844	1298	**2623**	**546 - 4763**	**2487 - 2758**	**189**
2005	2270	2076	2350	1497	**2181**	**100 - 4427**	**2052 - 2309**	**212**
2006	2327	1817	2419	787	**2118**	**29.5 - 4113**	**1978 - 2258**	**194**
2008	3403	2694	3169	1868	**2598**	**54.5 - 5298**	**2461 - 2735**	**184**
B	Length (mm)							
Year	**M**	**F**	**139.7**	**Multi**	**All**	**Range**	**95% C.I.**	**N**
2002	598	545	598	486	**579**	**300 - 758**	**566 - 591**	**199**
2003	539	509	535	504	**526**	**305 - 700**	**515 - 537**	**219**
2004	611	564	610	476	**591**	**364 - 739**	**580 - 602**	**189**
2005	552	536	561	480	**545**	**203 - 733**	**531 - 558**	**212**
2006	553	507	572	369	**534**	**145 - 735**	**518 - 550**	**194**
2008	654	610	633	515	**616**	**189 - 751**	**605 - 628**	**185**
C	Age (otolith years)							
Year	**M**	**F**	**139.7**	**Multi**	**All**	**Range**	**95% C.I.**	**N**
2002	13.6	13.3	14.0	11.0	**13.5**	**7 - 21**	**13.0 - 13.9**	**183**
2003	14.1	13.5	13.8	13.7	**13.8**	**7 - 22**	**13.4 - 14.2**	**214**
2004	12.8	11.9	12.9	9.8	**12.4**	**7 - 20**	**12.1 - 12.8**	**179**
2005	10.1	10.2	10.5	9.0	**10.2**	**3 - 18**	**9.9 - 10.5**	**206**
2006	10.7	10.5	11.4	7.1	**10.6**	**3 - 18**	**10.2 - 11.0**	**194**
2008	13.8	14.2	14.2	12.5	**14.0**	**9 - 21**	**13.7 - 14.4**	**176**

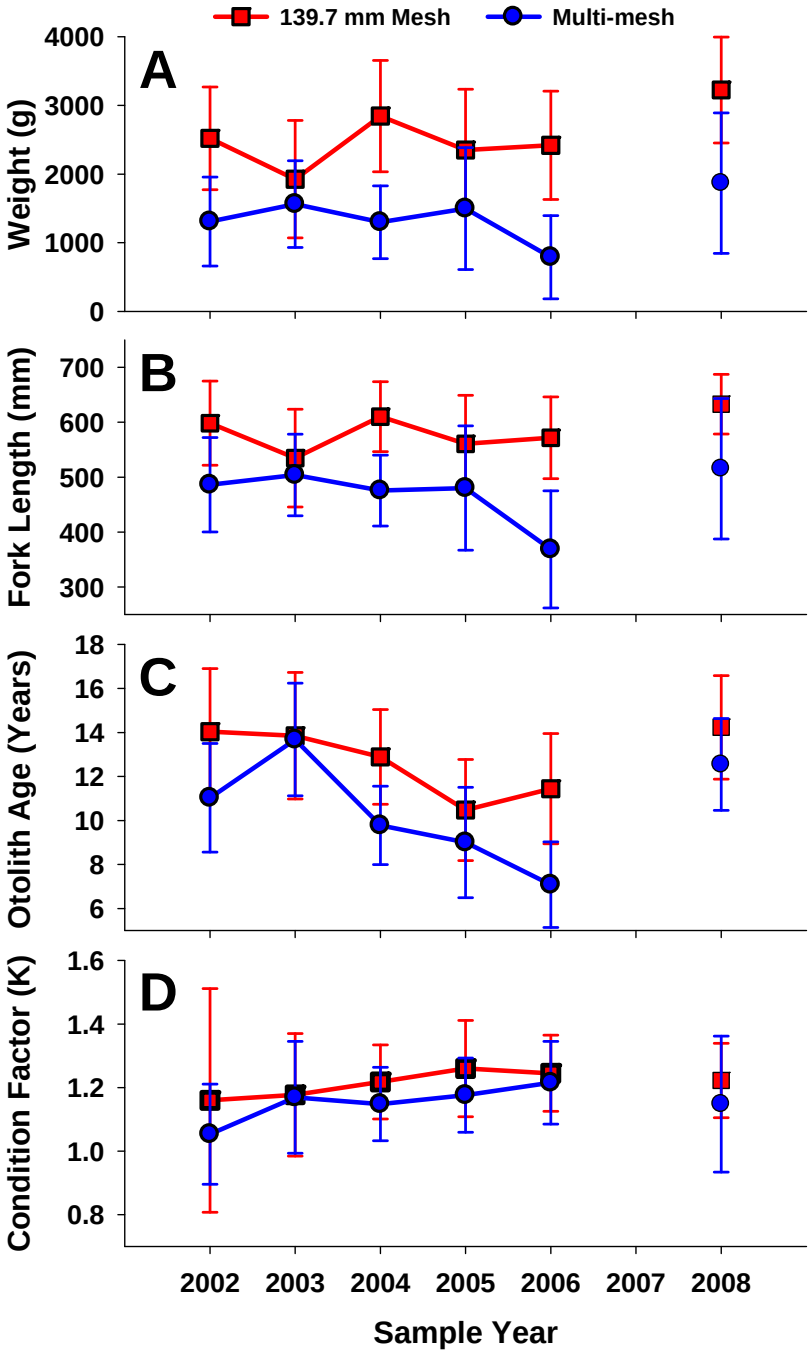

Figure 5. (A)Mean weight (g), (B) fork length (mm), (C) age and (D) condition (K) or Isuituq River, NU, Arctic Char shown by net type and year.

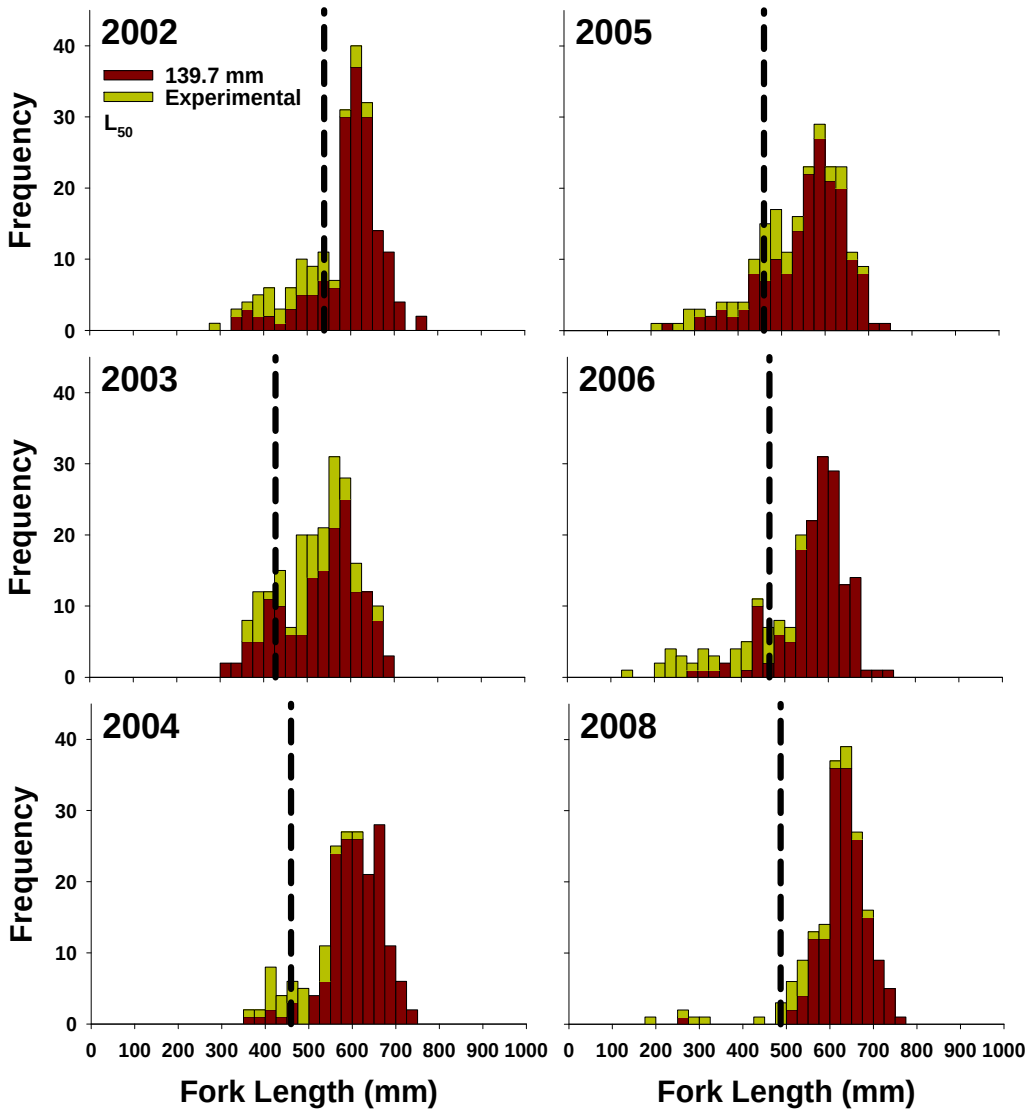

Figure 6. Fork length frequency distributions of Arctic Char captured by research survey gill-netting (using fishery size (139.7 mm) and multi-mesh gill nets) at the mouth of the Isuituq River, NU. Length at 50% maturity (L_{50}) is also shown.

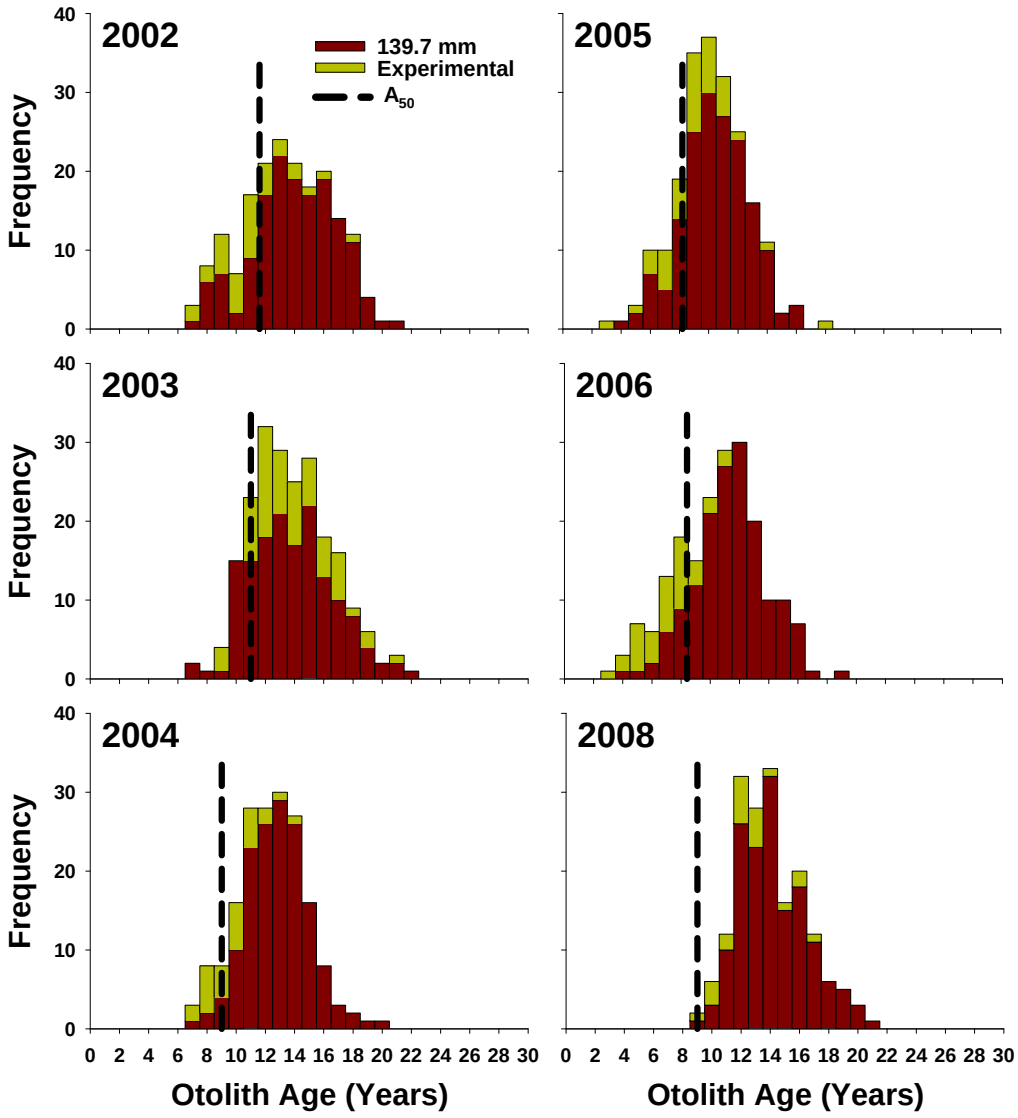

Figure 7. Age frequency distributions of Arctic Char captured by research survey gill-netting (using fishery (139.7 mm) and multi-mesh gill nets) at the mouth of the Isuituq River, NU. Age at 50% maturity (A_{50}) is also shown.

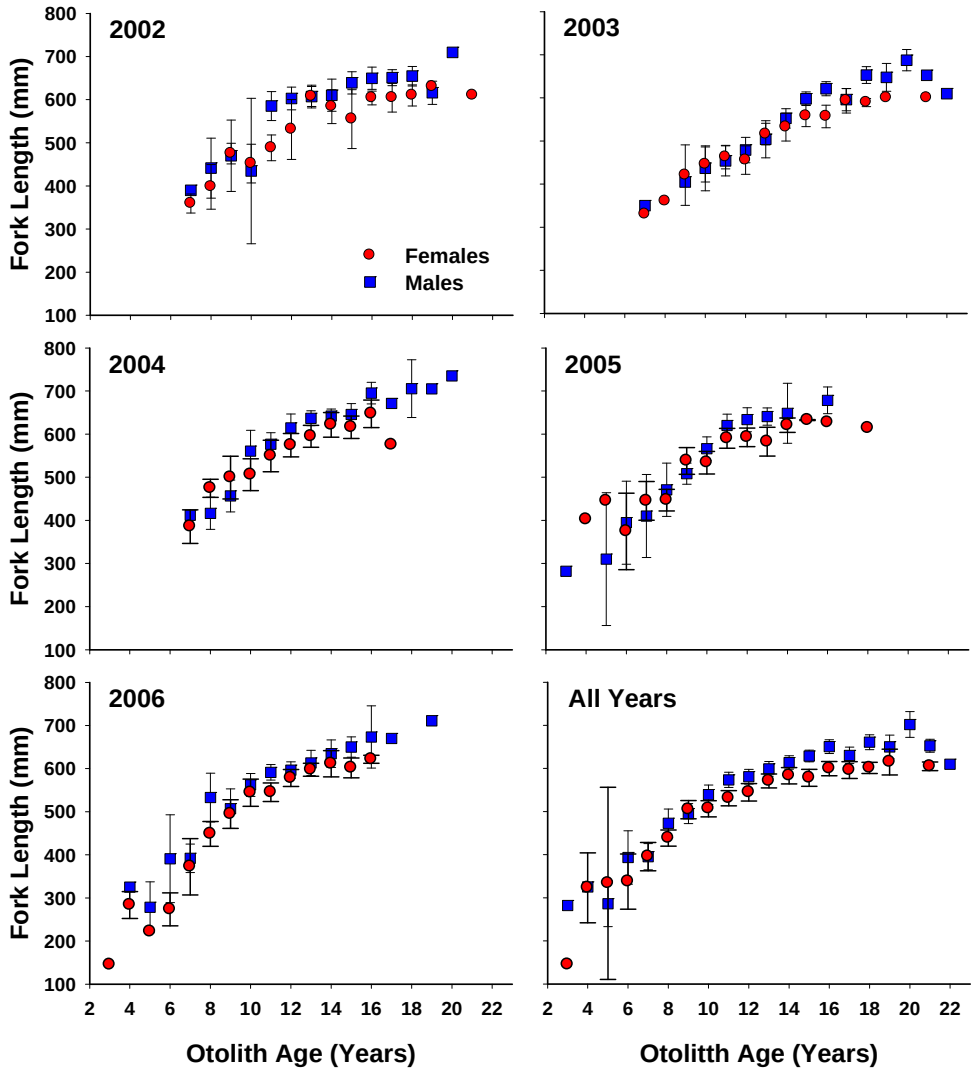

Figure 8. Mean length at age (± 2 standard deviations) of male and female Arctic Char from the Isuituq River, NU, 2002-2008.

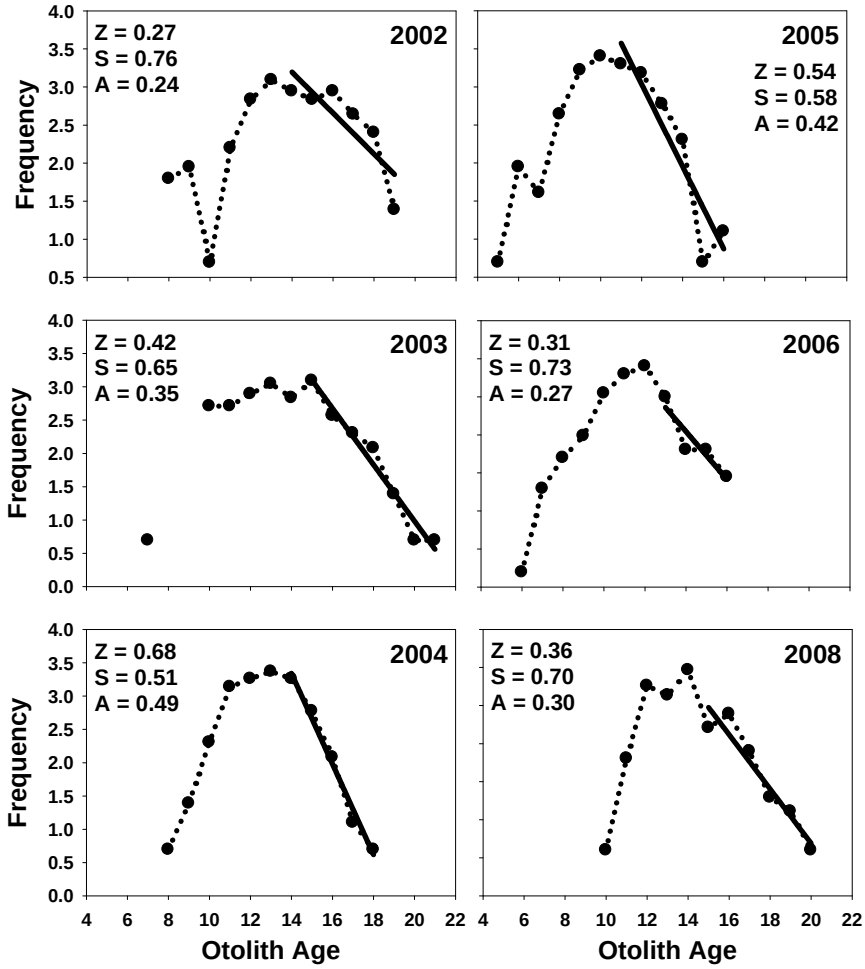

Figure 9. Age frequency catch curves for Arctic Char collected in the Isuituq River, NU, 2002-2008. Instantaneous mortality (Z), survival (S) and annual mortality (A) have been calculated where appropriate. LN = natural log.

Sources of Uncertainty

Direct estimates of abundance are critical for fisheries stock assessments and the establishment of quotas, but in most Arctic systems, such data are rarely available. This is also the case for Isuituq Arctic Char. Attempts to estimate abundance directly using, for example, weirs counts and/or mark-recapture methods, should be initiated. These methods have worked on Salmonines in other northern systems and such data could be valuable for future Isuituq Arctic Char assessments.

Unfortunately, for this assessment, there are no effort data available from subsistence and exploratory fisheries and therefore estimates of CPUE could not be calculated for these fisheries. In the future, data used to calculate CPUE should be collected from these fisheries to assist evaluations of this stock.

In this assessment, ages were determined by one reader for the first five years of the assessment (2002-2006) and by a second for 2008. Errors in ageing can greatly affect the estimation on population parameters and as such consistent ageing is required for reliable

fisheries stock assessments and subsequent interpretations. It is therefore recommended that all years be re-aged if further assessments of Isuituq River Arctic Char are required.

Anadromous char that spawn and overwinter in the Isuituq system are assumed to be a discrete stock, however, this assumption has yet to be tested. Initiatives to resolve the genetic population structure of Arctic Char in this system should be pursued. This will also include determining how many other stocks are being are harvested and to what extent (i.e., mixed-stock fishery analysis). Such work is currently being started by DFO and will provide a great deal of information vital to, not only Isuituq system fisheries, but Cumberland Sound Arctic Char fisheries as a whole.

ADDITIONAL STAKEHOLDER PERSPECTIVES

Pangnirtung residents have indicated that there are many other fishing areas in Cumberland Sound that are more important for subsistence and commercial fisheries. Isuituq is far from the community and many closer systems offer opportunities to catch larger char of better condition. Most subsistence fishing in the Isuituq system occurs opportunistically while local harvesters are in the area for other purposes (e.g., harvesting caribou or belugas). Therefore current subsistence harvest at Isuituq is likely quite low. Given the distance of the Isuituq system from Pangnirtung, residents have expressed that more proximate systems to the community are more important for commercial purposes.

Local fishermen have no concerns with the overall health of the Isuituq Arctic Char population include population sizes. Lately however, Pangnirtung residents have noticed that the flesh of Arctic Char around Isuituq appears to be noticeably more white. Community members have suggested that perhaps the increased abundance of capelin (*Mallotus mallotus*) that is now in the area, could explain the change in flesh color. From a marketing perspective, white-flesh char are less desirable than char with noticeably more orange or red flesh.

Pangnirtung Fisheries Ltd., the local fish processing plant, has been purchasing Arctic Char at Isuituq harvested under licences since 1997. Prior to 2007, the fish plant would only purchase fish weighing more than 1.81 kgs (4 lbs, Harris and Tallman 2010). Currently the plant will purchase fish between 2 – 4 lbs, but at a reduced price. This selective high grading of fish likely means that biological data collected at the plant does not represent the true exploratory harvest at Isuituq. Of note, Pangnirtung Fisheries Ltd. is more interested in the commercial potential of other Arctic Char producing waterbodies in Cumberland Sound, especially those closer to Pangnirtung.

Sport fishing at Isuituq is negligible and also occurs opportunistically while residents of Pangnirtung are in the area for other purposes. At one time a fishing lodge operated at Isuituq, but this has not been in operation since the late 1980's.

CONCLUSIONS AND ADVICE

There is no indication that Isuituq Arctic Char have been adversely impacted by recent harvests in the Isuituq system. The biological characteristics of this population have not been altered drastically as a result of fisheries in this system. This is supported by several analyses. With the exception of 2003, catch-per-unit-effort data remained relatively stable across all assessment years. The relative stability observed in mean weight, length, age and condition all provide

evidence that Isuituq River Arctic Char are presently not being over-harvested. The lack of negative trends in mean weight, length, age and condition indicate Isuituq Char are being harvested at or below their optimal sustainable rate of harvest. The high catches of mature fish, also indicates sufficient numbers of Arctic Char in this system are reaching reproductive age and likely recruitment overfishing is not a concern.

With no abundance data available, harvest rates cannot be determined. For the effective management of this fishery, attempts to estimate population size should be initiated.

In the absence of abundance data a sustainable level of harvest cannot be calculated. The thorough collection of CPUE data by fish harvesters participating in the exploratory fishery would assist in inferring changes in abundance. Given the consistency of the majority of data presented in this assessment, the current harvest level appears to pose a low to moderate risk to the sustainability of Isuituq Arctic Char. If the harvest remains at the current levels, this fishery could be moved from the exploratory status to a commercial status at the current harvest levels.

The stock may be able to support higher harvest but this should follow small increases in quota followed by careful monitoring of the fishery. Ideally, a balance between harvest rate and stability of the fishery would be determined as the fishery evolves. The time series of biological data included in this assessment was relatively short and the collection of subsequent data after several more years of harvest would be valuable for reassessments of the fishery. Current assessment data do, however, provide a benchmark for future assessments of Arctic Char from the Isuituq River system.

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ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2010. Stock Assessment of Arctic Char, *Salvelinus alpinus*, from the Isuituq System, Nunavut. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/060.