



## ASSESSMENT OF THE IMPACT OF SNAGGING ON THE SYLVIA GRINNELL RIVER ARCTIC CHAR POPULATION

### Context

Over the past two years, there has been increasing concern expressed by residents of Iqaluit regarding the number of char being snagged and discarded at the falls area of the Sylvia Grinnell River (Figure 1). This area is fished heavily once char start to stage before migrating back to Sylvia Grinnell Lake in late July to late August. Char are typically netted using gillnets in the estuary, but also by snagging directly below the falls, when they are concentrated in a small pool. Large treble hooks with weights attached to the shaft of the hook are cast into the pool below the falls and dragged back to shore where any char caught on the hooks are removed. Angling gear can also be used to snag fish. Char of an undesirable size are either returned back to the river where their survival is unknown or they are discarded amongst the rocks. Snagged char are not always landed and may escape as they are being pulled to shore.

The Amarak Hunters and Trappers Association (AHTA) in Iqaluit asked Fisheries and Oceans Canada (DFO) to prepare a report about snagging below the falls, potential impacts to the fishery and recommended management measures. On September 4, 2008, Fisheries and Aquaculture Management (FAM) requested advice from Science on the issue of snagging char in the Sylvia Grinnell River to be included in the material presented to the AHTO at their upcoming meeting on October 16, 2008.

Science was specifically asked:

- 1) Would the documented discard rate of 285 snagged char, sizes ranging from 180 mm to 580 mm, every two days, over approximately a 3 week period, in addition to subsistence and sportfishing removals cause a conservation concern for the Sylvia Grinnell Arctic char population?
- 2) Which of the following management measures would have the greatest benefit in protecting the char population: ban snagging or close fishing at the falls for the month of August?

### Background

The Sylvia Grinnell River is a traditional fishing site for Inuit. There was a commercial fishery on the river from 1947 to 1951 and again from 1959 to 1966. Both commercial operations ended because of declining catch per unit effort. Following the closure of the commercial fishery in 1966, harvesting has been limited to recreational and subsistence fisheries. Wheeler (2001) summarized the historic information on the Sylvia Grinnell char stock and included some re-analysis of the data previously collected. Wheeler (2001) indicated that in 1991 char from this stock were significantly younger and smaller than they were in 1948 (on average, char from 1948 were 636 mm; those from 1991 were 341 mm). Wheeler (2001) reported that since 1958, the age and size of fish have been on an overall downward trend with little evidence of recovery.

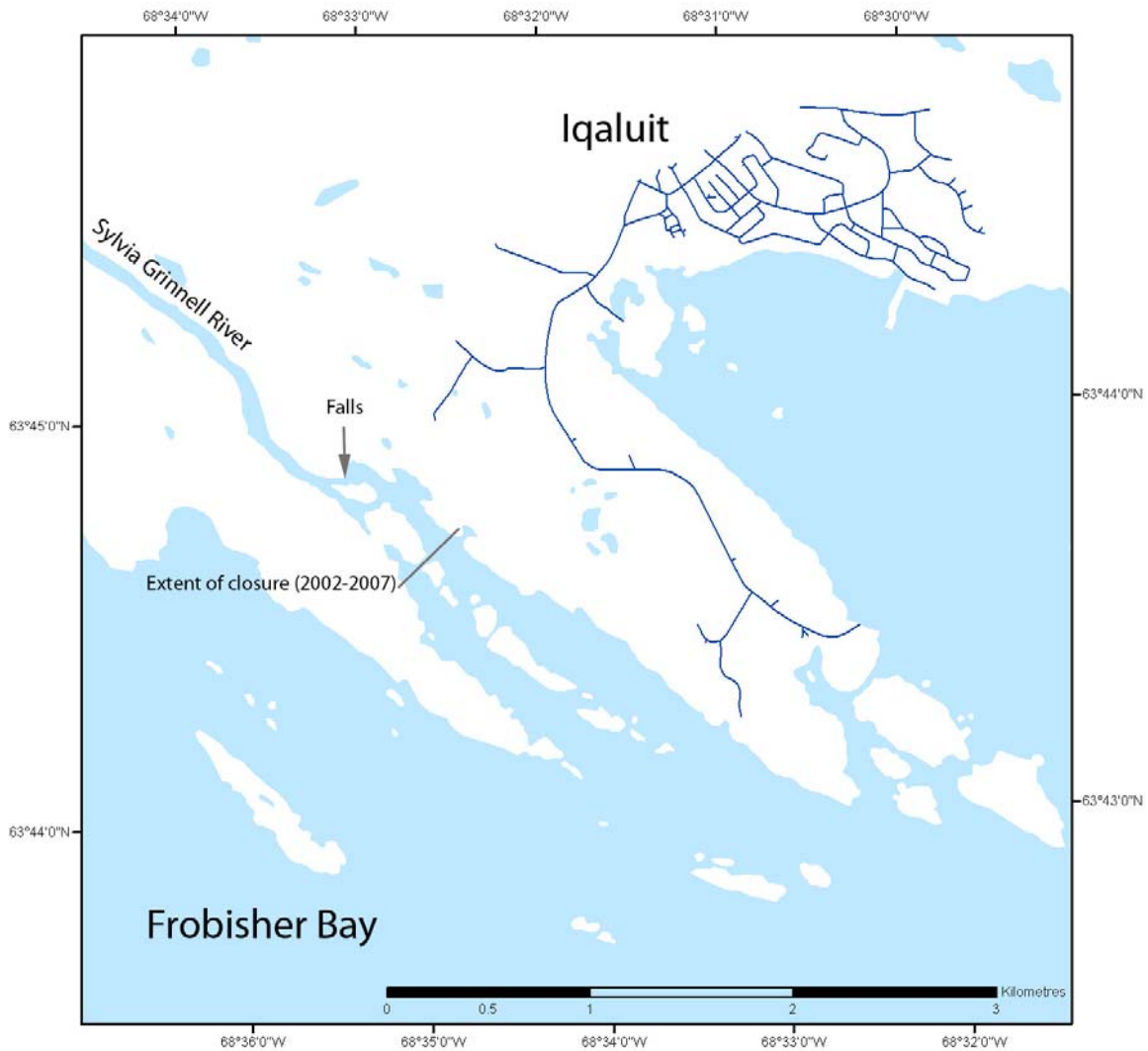


Figure 1. The Sylvia Grinnell River and the community of Iqaluit. The approximate extent of the gillnet and snagging closure (2002-2006) is marked.

Gallagher and Dick (2007) sampled Arctic char from experimental gill nets, subsistence gill nets (tidal sets) and anglers in 2002 and 2004. From their analysis, Gallagher and Dick (2007) indicated that the char stock was still below the historical highs of the 1950s based on truncated length and age frequency distributions, and decreased length and age at sexual maturity. However, the char population showed increased length at age, a slight increase in abundance (based on angling effort), decreased mortality rate and similarity between the numbers of fish caught per subsistence net in 1986, 2002 and 2004 (Gallagher and Dick 2007). Gallagher and Dick (2007) concluded that the observations indicate that the Sylvia Grinnell char population was in the very early stages of recovery.

There is an unregulated subsistence fishery that occurs in the tidal area out from the mouth of the *Sylvia Grinnell*. Angling occurs along the shore and below the falls although angling becomes less successful later in the season as the fish no longer feed and do not strike at the fishing lures. Snagging is used to catch fish as they congregate in the small pool below the falls from late July to late August. After 2001, the AHTA closed the area below the falls (Figure 1) to snagging and gillnetting but not angling, for a five year period because of concerns regarding size and number of fish in the population. Although gillnetting did stop during this period, snagging continued. The ban is no longer in place and the fishery has now reverted to the normal open state.

## Analysis and responses

### Removals by Snagging

**Would the documented discard rate of 285 snagged char, sizes ranging from 180mm to 580mm, every two days, over approximately a 3 week period, in addition to subsistence and sportfishing removals cause a conservation concern for the *Sylvia Grinnell* Arctic char population?**

In 2007 and 2008, Resource Management staff in Iqaluit documented the results of snagging activities below the falls on the *Sylvia Grinnell* River. They estimated a minimum of 285 snagged char, ranging from 180mm to 580mm, were being discarded every two days, over approximately a three week period. In addition, they sampled snagging discards that had been thrown amongst the rocks along the shoreline (Table 1). Dead fish observed in the river were also noted but were not sampled or counted. Based on the information collected in 2008, a minimum of approximately 2993 char were estimated to have been caught and discarded at the falls by snagging each year. The level of pressure from snagging is thought to be stable. Mortalities resulting from snagging were considered part of the total harvest of char from the *Sylvia Grinnell*, rather than being in addition to the fish harvested in the subsistence fishery (gillnetting, snagging and angling) and recreational fishery (angling).

*Table 1. Summary statistics from sampling of fish caught by snagging and discarded below the falls on the *Sylvia Grinnell* River in 2007 and 2008.*

Date	Number sampled	Mean Length (mm)	Standard Error	Minimum length (mm)	Maximum length (mm)
August 23, 2007	45	292.53	13.78	44	500
August 24, 2007	29	305.14	20.85	28	520
August 27, 2007	34	267.15	14.44	33	483
August 13, 2008	254	338.55	4.19	183	573
August 14, 2008	27	317.07	10.83	188	405
August 15, 2008	5	347.20	41.85	249	478
August 18, 2008	138	311.77	5.24	195	512

Gallagher and Dick (2007) sampled lengths and weights of 126 fish taken over a three day period by snagging at the falls in 2002. The proportion of fish sampled in 2002, 2007 and 2008

for each length interval was compared (Table 2). As expected, there was a higher proportion of smaller fish in the discards sampled in 2007 and 2008 when compared with the 2002 data where most of the fish would have been kept. Although they tended to be smaller, some of the discarded fish in 2007 and 2008 were over 500mm (Table 2).

*Table 2. Proportion of the snagged char sampled at the base of the Sylvia Grinnell falls, Iqaluit, Nunavut. The sample in 2002 (Gallagher and Dick 2007) included char landed and kept while those in 2007 and 2008 were all discarded.*

Length interval (mm)	Proportion (%) of sampled fish in each length classes		
	2002	2007	2008
100-149	0.0	0.0	0.0
150-199	0.0	13.3	1.7
200-249	6.3	22.9	8.7
250-299	15.1	21.0	23.1
300-349	19.0	17.1	32.5
350-399	19.0	13.3	20.3
400-449	26.2	6.7	9.2
450-499	7.1	3.8	3.1
500-549	5.6	1.9	0.9
550-599	0.8	0.0	0.5
600-649	0.8	0	0
Sample Size	127	105	424

The estimated 2993 char caught and discarded at the falls by snagging each year was apportioned into length classes based on the char sampled in 2007 and 2008. The number of fish in each age class was then used to estimate the weight of discards based on the mean weight data for each length class from the 2002 sampling program (Table 3). In addition to the weight of fish discarded along the banks of the river there is some additional unknown number of fish thrown back and which die from snagging injuries. These unknown mortalities in addition to the numbers discarded on shore would likely amount to as much as 2,000 kg of char.

In 2002, the total weight of fish removed by the tidal gill net fishery and by angling in Iqaluit was approximately 12,252 kg (Gallagher and Dick 2007). Snagging was included in this estimate. This value does not include Arctic char harvested by individuals who set short term nets from boats near the Sylvia Grinnell River although they speculate that when these were included about 15,000 kg in total are harvested from the stock (Gallagher and Dick 2007). Based on an estimate of 2,000 kg of char discarded and having died from snagging injuries, 13% of the harvest would have been wasted. In 2002, 2800 char were estimated to have been caught in the tidal gillnet fishery (Gallagher and Dick pers. comm.) in comparison to the 2993 char estimated to be discarded from snagging.

Table 3. Estimated number and weight of Arctic char landed and then discarded in 2007 and 2008 by snagging at the base of the Sylvia Grinnell falls, Iqaluit, Nunavut.

Length interval (mm)	Mean weight (kg) <sup>1</sup>	Number Snagged		Weight Snagged	
		2007	2008	2007	2008
100-149	0.037	0	0	0	0
150-199	0.035	399	49	14	2
200-249	0.107	684	261	73	28
250-299	0.273	627	692	171	189
300-349	0.414	513	974	212	403
350-399	0.617	399	607	246	374
400-449	0.920	200	275	184	253
450-499	1.233	114	92	141	113
500-549	1.636	57	28	93	46
550-599	2.143	0	14	0	30
600-649	3.060	0	0	0	0
Total		2993	2993	1134	1439

<sup>1</sup> based on 2002 data

### Current versus Historical Population Status

There are some positive signs for the population (Gallagher and Dick 2007) and local knowledge that fish are more abundant and the fish being caught are now bigger than when the population was at its lowest level. Although nowhere near the historic levels, the population may be stabilized at a lower level and may even have begun to recover. Mortality rates from 2002 (Table 4) are lower than from 1976 to 1991. Mortalities calculated from catch curves however, have to be interpreted with caution, as the assumption of population stationarity is violated. It is a serious analytical problem because catch curve analysis, unlike Virtual population analysis or cohort analysis, cannot account for the historical differences influencing the abundance of each age group. For example, the abundance of 11 year olds in the various years is a result of potentially different environmental conditions than the 12 year olds. When there is not a lot of change in the stock, catch curves provide a fairly reliable approximation of the mortality rate but when there is a lot of change, as is the case here, they may not. The change in the modal age and the age ranges are more reliable in these circumstances. From Wheeler (2001) modal ages ranged from 14 in 1948/50/51, to a low of seven in 1986. Gallagher and Dick 2007 (2007) found the modal age of the fish sampled to be 10 years in 2002 and 2004. This is evidence for a stock that is depleted but which is improving slightly.

Recent harvest statistics for the population are lacking (Table 5). Even with the long history of high harvests the population has not been decimated. The fishing has not eliminated recruitment but it has had a serious impact on the growth of the fish which no longer reach their potential. There is no information on whether there is increased fishing pressure from the gillnet fishery but the level of pressure from snagging is thought to be stable. Recreational fishing

pressure is increasing as the community of Iqaluit grows. There is always the risk that increased fishing effort could further deplete the stock.

*Table 4. Mortalities of fish from the Sylvia Grinnell River taken from Pike (1992) with 2002 data from Gallagher and Dick pers. comm.).*

Year	Age Range	Annual Mortality
1948-50	20-23	27%
1976-77	13-18	50%
1986	15-18	32%
1991	7-15	42%
2002	11-15	28%

### Benefits of Management Measures

**Which of the following management measures would have the greatest benefit in protecting the char population: ban snagging or close fishing at the falls for the month of August?**

Effort should be undertaken to ensure the continued recovery of the population. Reducing the mortality of pre-spawners is important. The population is in a depleted state in comparison to historic levels and although there is some indication that the decline has stabilized and may even have started to reverse, all measures to keep the harvest low, particularly on fish <400mm would benefit the recovery of the population.

Although snagging is sometimes used in the bay, it tends to be concentrated in the pool below the falls where the fish congregate in high densities. The practice of snagging has the potential to damage a large number of fish through injuries to fish that are not kept. It indiscriminately targets all sizes of fish including the smaller less desirable sized char. As a result, a large proportion of the catch is wasted. Removal of a large number of smaller fish could delay improvement in the stock and lead to a long term impact on recovery of the population. A snagging ban has been recommended repeatedly in various reports including in Wheeler (2001) and Gallagher and Dick (2007). However, even when a ban was in place, it was not followed.

Although there is wastage with other types of fisheries (gillnet and angling) the level is lower than for snagging. Angling and gillnetting (large mesh nets) also target a higher proportion of larger sized fish.

Fishing at the falls targets the fish when they are concentrated in time and space. In this situation they are more vulnerable to over-harvesting. With a small increase in harvest effort, mortality can be disproportionately high. When a population is in a depleted condition high risk activities could further deplete the population. Banning all fishing below the falls in August would be the most effective method to prevent this.

*Table 5. Arctic char harvest statistics for Arctic char from the Sylvia Grinnell River. Annual subsistence and recreational harvest was assumed to be 12,000 kg from 1958 to 1966.*

<i>Date</i>	<b>Method</b>	<b>Weight of Commercial Harvest (kg)</b>	<b>Weight of Non-Commercial Harvest (kg)</b>	<b>Total Weight of Harvest (kg)</b>	<b>Number of Fish Taken</b>	<b>Reference</b>
1948				22,700	7,700	Kristofferson and Sopuck 1993
1950				6,400	2167	Kristofferson and Sopuck 1993
1958		5,834		17,834	8,106	Pike 1992; Kristofferson and Sopuck 1993
1959		9,803		21,803	3,507	Pike 1992; Hunter 1963
1960		5,532		17,532	2,140	Pike 1992; Hunter 1963
1961		4,674		16,674	1,618	Pike 1992; Hunter 1963
1962		4,688		16,688	1,350	Pike 1992; Hunter 1963
1963		4,920		16,920	1,567	Pike 1992; Hunter 1965
1964		3,824		15,824	1,302	Pike 1992; Hunter 1965
1965		5,588		17,588		Pike 1992
1966		4,658		16,658		Pike 1992
1976	Snagging Angling				1920 212	Kristofferson and Sopuck 1983
1977	Snagging Net Angling		1,822 1,666 181	3,669	4,923 2,282 415	Kristofferson and Sopuck 1983
1986	Net Angling		2,055	2,055	2,142 132	Pike 1992
1991	Net	3652		3,652	5,224	Pike 1992
1997					101	Nunavut Harvest Study (Priest and Usher 2004)
1998					345	Nunavut Harvest Study (Priest and Usher 2004)
1999					197	Nunavut Harvest Study (Priest and Usher 2004)
2000					275	Nunavut Harvest Study (Priest and Usher 2004)
2001					10	Nunavut Harvest Study (Priest and Usher 2004)
2002	All Gears	15,000		15,000	~8,000+	Gallagher and Dick 2007; Gallagher and Dick pers. comm.

## Conclusions

Data on the population of Arctic char in the Sylvia Grinnell River is limited. The current population of char in the river is in a depleted state in comparison to historical populations. The decline in the population may have stabilized at a lower level and may have even begun to show some limited recovery in spite of relatively high harvest levels. There is insufficient data to conclude that the practice of snagging fish poses a “conservation concern” for the population. Snagging is indiscriminant and can catch many small, less desirable char resulting in a high percentage of discards. These small pre-spawning fish are important for the recovery of the population. Although banning snagging would reduce the fishing pressure on pre-spawners, closing the area below the falls to all fishing in August, if it was followed, would have a greater benefit for the population.

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