QASIGIYAT LAKE ARCTIC CHAR ASSESSMENT

Male Arctic Char from Qasigiyat Lake in spawning condition. Photo by J. S. Moore.

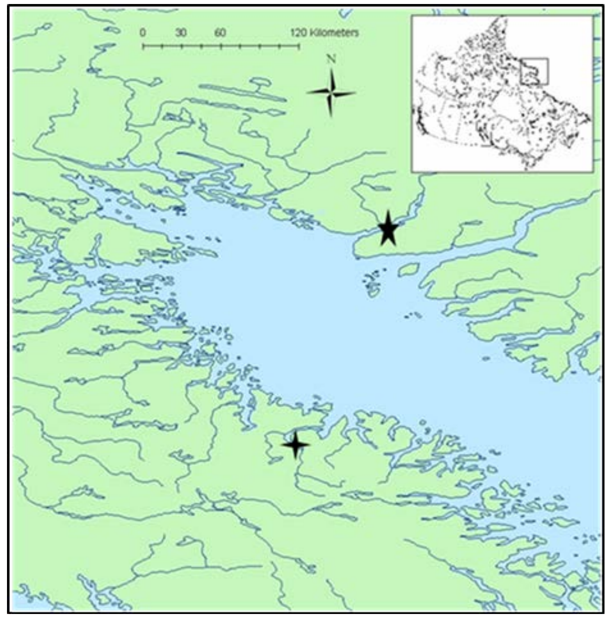

Figure 1. Map of Cumberland Sound with the community of Pangnirtung ★ and Qasigiyat Lake ✦ marked.

Context:

*Arctic Char (*Salvelinus alpinus *(Linneaus)) are widely distributed throughout the Arctic and are an important commercial and subsistence resource for Inuit. Arctic Char found in Qasigiyat Lake, are an important resource for the community of Pangnirtung, Nunavut. They have been harvested under a stage II exploratory licence since 1989. The initial quota for Qasigiyat Lake was established based on test fishery data collected in 1982 and 1984.*

Fisheries and Oceans Canada (DFO) Resource Managers requested an updated summary of information collected from Cumberland Sound Arctic Char stocks. A Regional Advisory Process was held to evaluate the status of the Qasigiyat Lake (Ptarmigan Fiord) Arctic Char stock and recommend a long-term plan for this fishery.

SUMMARY

- Qasigiyat Lake Arctic Char have been harvested under a stage II exploratory licence since 1989.
- Historically, fishing occurred in the winter months on Qasigiyat Lake. More recently, fishing has occurred in the summer months in Ptarmigan Fiord.
- The results of the assessment indicate that current harvest levels appear to be sustainable.

- Additional research is recommended for this system including fishery-dependent sampling.

INTRODUCTION

To assess the status of the Qasigiyat Lake Arctic Char stock a Regional Advisory Process meeting was held in Iqaluit, Nunavut, January 10-11, 2011. Participants included Pangnirtung Hunters and Trappers Organization (HTO), Pangnirtung fishers, Government of Nunavut Fisheries and Sealing, Pangnirtung Fisheries Ltd, Fisheries and Oceans Canada (DFO) - Resource Management, and Science programs, and the Universities of Manitoba and British Columbia.

Species Biology

Two life history forms of Arctic Char – anadromous and resident are found in Qasigiyat Lake. They differ in their migration behaviour, growth patterns, and age and size at first maturity. Anadromous Arctic Char migrate between fresh water and salt water while residents remain in freshwater environments but may access saltwater environments (Loewen et al. 2009). The resident life history form matures at an earlier age and smaller size compared to the anadromous life history form. Anadromous individuals are targeted by the fishery due to their higher commercial value. However, both life forms may be affected by harvest in their environment. The current assessment is focused on anadromous Arctic Char, any individuals identified as resident have been removed from maturity related analysis.

The movements of Qasigiyat Lake anadromous Arctic Char have not been directly monitored. However, it is assumed they follow the same pattern as other Arctic Char populations in Cumberland Sound. Anadromous Arctic Char migrate from freshwater to saltwater habitats for the purpose of feeding during spring break-up and ice-out, annually around May and June (Moore 1975). Beginning in late summer, end of July and August, they migrate back into freshwater habitats to spawn and/or over-winter. Tidal cycles are pronounced in Cumberland Sound compared to other regions of Nunavut. Pangnirtung fishermen reported the importance of tidal cycles on the timing and movement of Arctic Char into the Qasigiyat Lake system. Spawning has been observed in other Cumberland Sound systems as early as September (Moore 1975) however, there is no specific information on spawning time for Qasigiyat Lake Arctic Char. The frequency of spawning, as in other Arctic Char populations, is likely variable and depends largely on the condition of the fish.

In Cumberland Sound, anadromous Arctic Char feed primarily in the marine environment on amphipods, other aquatic invertebrates (Moore and Moore 1974), and larval fish (T. Loewen, DFO pers. comm., S. Keenainnaq, Pangnirtung, NU pers. comm.). The importance of fish in the diet of Arctic Char may have shifted in recent years with the occurrence of fish species not historically important in this area (e.g., Capelin).

Habitat

Qasigiyat Lake over-wintering habitats have not been well documented. Information from the test fishery and Pangnirtung fishers indicates that fish congregate in open ice areas on the lake, most likely to access waters with high oxygen concentrations.

Locations of Qasigiyat Lake spawning habitat are unknown however it is believed that rearing takes place in adjoining small ponds along the periphery of the lake (Martin and Tallman 2013).

Traditional Knowledge indicates that habitats upstream of the first lake (Figure 2 upper lake) may be important for the success of Arctic Char. The importance of the upper lake to the Qasigiyat Lake Arctic Char stock has not been studied.

Compared to other systems within Cumberland Sound, surface waters in Qasigiyat Lake (presumably the fjord area where fishing takes place in the summer) have a lower salinity (i.e., were described as being “almost good for tea” by one fisherman) (S. Keenainnaq, Pangnirtung, NU pers. comm.). It is known that in general rivers are important as migratory corridors for Arctic Char, but that these corridors may not always be accessible. Fishers of Pangnirtung state there is an absence of seasonal, physical barriers to Arctic Char movement in this system, explaining that access to overwintering habitat/areas is never a problem for Arctic Char in Qasigiyat Lake.

The Cumberland Sound region is mountainous with estuarine flats at the mouths of rivers which are an important area for Arctic Char feeding, as is the case for the Qasigiyat Lake area.

Fishery

Data Sources

Three sources of data were used for the Qasigiyat Lake Arctic Char assessment: test fisheries data (1982, 1984); fishery-independent data (2003, 2004, 2006, 2007, 2009, 2010; and fishery-dependent data (1990 to 2011).

Test fishery data have been included in the assessment as a historical reference (Table 1). The test fishery data from Qasigiyat Lake were collected by Resource Development Officers from Pangnirtung (McGowan 1985).

Fishery-independent data were collected by DFO Science (Central and Arctic Region) (Table 2).

Fishery-dependent data were compiled from the Fisheries Management and Harvest Information System (FMHIS) and include total weight harvested annually under the exploratory licences (Table 1). It should be noted that the fishery-dependent data does not necessarily represent the actual catch by fishers, for more information see Martin and Tallman (2013).

Harvest Information

On average, the residents of Pangnirtung harvest 35,000 Arctic Char annually for subsistence purposes from various waterbodies in the Cumberland Sound area (Priest and Usher 2004). Priest and Usher (2004), reported no subsistence harvest from Qasigiyat Lake. Currently, Pangnirtung fishers harvest less than 150 kg (330 lb) annually from Qasigiyat Lake. Due to the lack of recorded information, subsistence harvest has not been included in this assessment.

Test fishery data were collected during the winter in 1982 and 1984, so sampling was limited to the lake (freshwater environment) (McGowan 1985). In 1982, a provisional quota was set at 454 kg (998.8 lb), this quota was surpassed within 24 hours with the capture of 528 fish weighing 908 kg (1997.6 lb). In 1984, the quota was increased to 1,000 kg (2,200 lb). This quota was reached in 24 hours with the capture of 395 fish weighing 1088 kg (2,393.6 lb) (McGowan 1985) (Table 1).

Unlike the test fishery data which were collected in March, the fishery-independent data were collected between August and September with sampling occurring some years in the lower lake and some years in the inter-tidal zone at the mouth of the river (Martin and Tallman 2013). The number of fish captured varied from 129 (114 kg, 250.8 lb) in 2004 to 211 (255 kg, 495 lb) in 2010. Average harvest from fishery-independent data was 158.2 kg (348 lb) (standard deviation

63.63 kg) for the 2003-2010 period. The catch rates varied between the three gear types (38.1 mm nets, multi-mesh nets, 139.7 mm nets) (Table 2).

Historically this waterbody was a winter fishery, but since the 1997/1998 licence year it has developed into a summer fishery (Table 1). According to Pangnirtung fishers this is due to lack of safe ice conditions for winter travel across Cumberland Sound. The current quota for the Qasigiyat Lake waterbody is 1,500 kg (3,300 lb). Since 2004/2005 when the quota was increased from 1,000 kg to 1,500 kg, all reported harvest has been below the quota. When the quota was 1,000 kg (2,200 lb) fishers harvested over the quota in 7 out of 16 years (Table 1).

In total, Arctic Char harvested from Qasigiyat Lake from all recorded sources (Test Fisheries Data, Independent Fisheries Data and Fishery Dependent Data), totals 25,781 kg (56,717.9 lb) round weight, since 1982 (Table 3, Martin and Tallman 2013).

ASSESSMENT

Stock Delineation

The Qasigiyat Lake Arctic Char population is assumed to be a discrete stock based on observations from Pangnirtung fishers, genetic analysis (J. -S. Moore, unpubl. data, University of British Columbia, 2329 West Mall Vancouver, BC V6T 1Z4) and the physical characteristics of the freshwater systems around Cumberland Sound. There are a limited number of suitable habitats for Arctic Char around the area of Qasigiyat Lake further supporting stock discreteness.

Stock Size

There have been no direct estimates of stock size of Qasigiyat Lake Arctic Char either by weir counts or mark-recapture studies.

For this analysis CPUE was used as an index of abundance.

Stock Trends

Catch-Per-Unit-Effort (CPUE)

There is no trend in the CPUE data (Figure 3). No trend indicates that there has been no change in the catch rates and thus, no change in the abundance of Arctic Char in Qasigiyat Lake. The small variability in CPUE from year to year is most likely attributed to the timing of sampling in correspondence with the return migration of the fish to the lake. There is high variability in CPUE between gear types. The CPUE between gear types varied more in some years (2003, 2006, 2010) compared to other years (2004, 2007, 2009). The highest CPUE was recorded in 2010 when 2+ fish were captured for every hour of soak time.

Biological Results (Length-Frequency Distribution)

Arctic Char caught between 2003 and 2010 in the fishery-independent sampling ranged in fork length from 75 mm to 700 mm (Figure 4). The length frequency shows that throughout the recent fishing period the stock continues to have the same range in fork length with many large fish. It should be noted that the length-frequency distributions were strongly influence by net selectivity (Martin and Tallman 2013).

Biological Results (Age-Frequency Distribution)

The range of ages for Qasigiyat Lake Arctic Char remains consistent from year-to-year indicating that there is no change in the age structure of this stock (Figure 5). Arctic Char caught between 2003 and 2009 in the fishery-independent sampling ranged in age from 3 to 19 years. From the age-frequency distributions, individuals born in 1995 appear to be a strong year class; they are seen as age class 8 in 2003, age class 11 in 2006 age class 9 in 2007 and age class 11 in 2009 (Martin and Tallman 2013).

Biological Results (Trend Analysis)

For the trend analysis fishery-independent data and test fishery data have been included, thus allowing limited and cautious comparison. It should be noted that samples from the test fishery data were collected in the winter in the lake, and samples collected for the fishery-independent data were collected in summer and fall (Table 1, Table 2).

Mean fork length (mm) for fish captured in 139.7 mm nets is consistent over time ranging from 529.6 mm in 2007 to 646 mm in 1984 (Figure 6-A). Similarly, the mean fork length of fish captured in the 38.1 mm nets did not vary between 2004 and 2006. In contrast, there is a lot of variability between the mean fork length of fish captured in the multi mesh nets across the years. The overall mean fork length shows no trend or a slight increasing trend over time, indicative of a sustainable fishery and perhaps an improving stock.

Mean age from the test fishery are higher than the recent fishing period (2003-2009) (Figure 6-B). The change in average age from the 1980's to recent period is likely due to increased growth that could be a result of a fishing-up-effect, changing environmental conditions or both. It is noted that the mean age from recent sampling is high and stable and therefore indicative of a sustainable fishery.

Mean round weight (g) of fish captured in 139.7 mm nets appears to be stable, with 2007 being an exception (Figure 6-C). In 2007, there was a decrease in the mean weight of fish captured in the 139.7 mm nets followed by an increase in 2009 and 2010. The multi-mesh nets show a trend of increasing mean round weight from 2003 to 2010. Overall the mean round weight appears to be increasing over time, indicative of a sustainable fishery and perhaps improving stock.

The mean condition factor (K) for this stock shows variability with no trend (Figure 6-D). The 139.7 mm nets have a condition factor of 1.0 in 1982 and a condition factor of 1.35 in 2010. It should be noted that the change in condition factor from the 1980s to more recent sampling is most likely a seasonal effect (Martin and Tallman 2013). This indicates no changes in the stock structure of the Qasigiyat Lake Arctic Char stock.

Sources of Uncertainty

Fishery-dependent data catch-per-unit-effort (CPUE) and biological samples are currently not available for this stock.

The fisheries-independent data provides a data set with a fair amount of consistency in its collection (e.g., sampled in the same season, caught similar sample sizes, collected the same information, used experimental and 139.7 mm nets for all sampling). However, it should be noted that mesh size, date of collection and location of sampling varied in some years (Table 2) (Martin and Tallman 2013).

Important habitats have not been studied in this system. In particular, there is limited information on the specific location of over-wintering habitat within the lake, migratory corridors, spawning sites and juvenile rearing areas.

Catch-per-unit-effort data has been used as an index of abundance. However, there are no other independent sources of abundance by which this assumption can be fully evaluated for this stock.

Recommendations

The recommendations for the long-term plan are as follows:

1) a) Continued assessment of this stock requires that CPUE and biological samples are collected for fish harvested under the exploratory licence (fishery-dependent data), according to DFO protocols (DFO 2010, VanGerwen-Toyne and Tallman 2011).

   b) Scientific sampling data (i.e., fishery-independent data) are collected to provide an independent comparison to Arctic Char caught by the fishery (i.e., fishery-dependent data). It is imperative that this sampling continues within Cumberland Sound collaboratively between the local HTO of Pangnirtung and DFO.

   c) It is recommended that sampling be as consistent as possible; same methods, same sampling equipment, same location and same time of year.
2) The possibility and usefulness to adjust the timing of sampling to specific environmental cues (such as neap tides) should be examined, as this determines Arctic Char movements in Cumberland Sound systems, according to local harvesters.
3) Pangnirtung fishers note that the upper lake may be important for the persistence of this stock, by providing critical habitat to different life stages. It is recommended that baseline information (fishery-independent data) from the upper lake be collected.
4) Traditional Knowledge from experienced fishers and elders in the community is available but needs to be written down. Local fishermen have a wealth of information and we recommend that this information be collected, documented and incorporated into all fishery plans, including science sampling plans.
5) A collaborative approach between the Pangnirtung HTO, Pangnirtung fishers and DFO to develop long term research plans should be undertaken for the Cumberland Sound area, with emphasis on stocks the community considers to be high priority.

CONCLUSIONS AND ADVICE

Sustainable harvest

Current average annual harvest (1074.2 kg, 2363.3 lbs, Table 1) from all sources (fishery-dependent data, fishery-independent data and test fishery data) appears to be sustainable; however the rate of harvest is not known due to a lack of population size information.

Studies of harvest rates on other Nunavut Arctic Char populations recommend harvest levels of 5% or less of the population, which is considered precautionary (DFO 2005, DFO 2009).

Outlook

All biological parameters indicate that this stock is healthy and current harvest is sustainable.

Based on their long experience of fishing in Cumberland Sound and the present assessment, Pangnirtung fishers and elders believe that this stock can sustain a higher harvest level in the range of 1750 kg (3850 lbs). The fishers and elders of Pangnirtung noted that DFO Science removed up to 250 kg annually as fisheries-independent data samples. They concluded from this assessment that the Qasigiyat Lake Arctic Char stock can withstand a harvest removal of 1750 kg (3850 lbs), and they request that the Qasigiyat Lake quota be amended to reflect this total.

OTHER CONSIDERATIONS

Climate change and its impact on Arctic Char stocks and fisheries are of concern to the residents of Pangnirtung (DFO 2005). Based on Inuit Qaujimajatuqangit weather patterns, and in particular winds, are changing and are resulting in considerable changes in the sea ice conditions in the Cumberland Sound area (DFO 2005). The effects of climate change on fish and fish habitat in this area are not well understood.

As resource development is likely to increase in this area in the future, there is a need to collect baseline water quality, contaminant and fish health data. This information is needed prior to the initiation of exploratory or resource development activities.

SOURCES OF INFORMATION

This Science Advisory Report is from the January 10-11, 2011 Qasigiyat Arctic Char assessment. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

DFO. 1999. Hornaday River Arctic Charr. DFO Science Stock Status Report D5-68 (1999).

DFO. 2005. Stock Assessment Report on Kipisa Arctic Char. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/028.

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Loewen, T. N., Gillis, D., and Tallman, R.F. 2009. Ecological niches specialization inferred from morphological variation and otolith strontium of Arctic charr *Salvelinus alpinus* L. found within open lake systems of southern Baffin Island, Nunavut, Canada. J. Fish Biol. 75: 1473 – 1495.

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McGowan, D. K. 1985. Data from the Test Fisheries Conducted in the Baffin and Central Arctic Regions, Northwest Territories, 1980-1984. Can. Data Rep. Fish. Aquat. Sci. No. 531

Moore, J. W. 1975. Distribution, movements and mortality of anadromous arctic char, *Salvelinus alpinus* L. in the Cumberland Sound area, of Baffin Island. J. Fish Biol. 7: 339-348.

Moore, J.W., and I.A. Moore 1974. Food and growth of arctic char, *Salvelinus alpinu*s (L.) in the Cumberland Sound area of Baffin Island. J. Fish Biol. 6: 79-92.

Priest, H., and Usher, P.J. 2004. Nunavut Wildlife Harvest Study. Report prepared for the Nunavut Wildlife Management Board, Iqaluit, Nunavut, Canada.

VanGerwen-Toyne, M., and Tallman, R. F. 2010. Exploratory Fishery Protocol – Nunavut and Northwest Territories anadromous Arctic Charr. DFO Can. Sci. Advis. Sec. Res.Doc. 2010/077. vi + 32 p.

Table 1. Summary of Qasigiyat Lake Arctic Char test fishery data and fishery- dependent data. All harvests were captured under an exploratory licence. Fisheries Management and Harvest Information System (FMHIS) is a DFO database. Harvest in presented by calendar year for 1982 and 1984 and licence year (April 1 – March 31) for all others. A conversion factor of 1.1 was used to convert dressed weight to round weight data from the summer months (7 and 8).

Year	**Harvest Month**	**Quota**		**Harvest by weight**		**Source**	**Fishery-independent data**	
		kg	**lb**	**kg**	**lb**		number	weight (kg)
1982	3	454	998.8	908	1997.6	McGowan 1985		
1984	3	1000	2200	1088	2393.6	McGowan 1985		
1989/1990	1, 3	1000	2200	2027.6	4460.7	FMHIS		
1990/1991	3	1000	2200	680	1496	FMHIS		
1991/1992	2, 3	1000	2200	1791.9	3942.2	FMHIS		
1992/1993	1, 3	1000	2200	900.2	1980.4	FMHIS		
1993/1994	1, 3, 7	1000	2200	2370.1	5214.2	FMHIS		
1994/1995	1, 3	1000	2200	1094.1	2407	FMHIS		
1995/1996	1, 2	1000	2200	795.5	1750	FMHIS		
1996/1997	5	1000	2200	915	2013	FMHIS		
1997/1998	8	1000	2200	501.5	1103.3	FMHIS		
1998/1999	8	1000	2200	927.4	2040.2	FMHIS		
1999/2000		1000	2200	0	0	FMHIS		
2000/2001	8	1000	2200	858.2	1888	FMHIS		
2001/2002	7, 8	1000	2200	1616.6	3556.5	FMHIS		
2002/2003	8	1000	2200	1492	3282.4	FMHIS		
2003/2004	8	1000	2200	668.5	1470.7	FMHIS	204	114
2004/2005	8	1500	3300	916.5	2016.3	FMHIS	129	73
2005/2006	8	1500	3300	1067.6	2348.7	FMHIS		
2006/2007	7	1500	3300	1100	2420	FMHIS	184	172
2007/2008	7, 8	1500	3300	1299.3	2858.5	FMHIS	181	142
2008/2009		1500	3300	0	0	FMHIS		
2009/2010	7, 8	1500	3300	1510	3322	FMHIS	192	193
2010/2011	7, 8	1500	3300	1253	2756.6	FMHIS	211	255
Average per Year				1074.2	2363.3			
Total				25,781	56,717.9		1098	949

Table 2. Summary of fishery-independent data. Note that exp. refers to experimental nets.

Sampling Year	Start Date	End Date	Number of fish captured		Experimental (exp.) net mesh sizes (mm)	Number of nets set		Total soak time (hours)	Total number of fish captured	Location fished
			139.7mm nets	exp. nets		139.7	exp. nets			
2003	September 5	September 8	48	156	38.1 – 101.6	1	4	443.7	204	Lake
2004	September 7	September 8	57	72	38.1	2	2	116.3	129	Lake
2006	August 20	August 21	140	44	38.1	4	2	156.8	184	Lake
2007	August 1	August 4	121	60	38.1 – 101.6	7	3	558.1	181	Inter-tidal zone
2009	August 20	August 23	72	120	38.1 – 101.6	4	4	295.7	192	Inter-tidal zone/Lake
2010	September 4	September 5	64	147	38.1 - 101.6	1	2	57.4	211	Lake

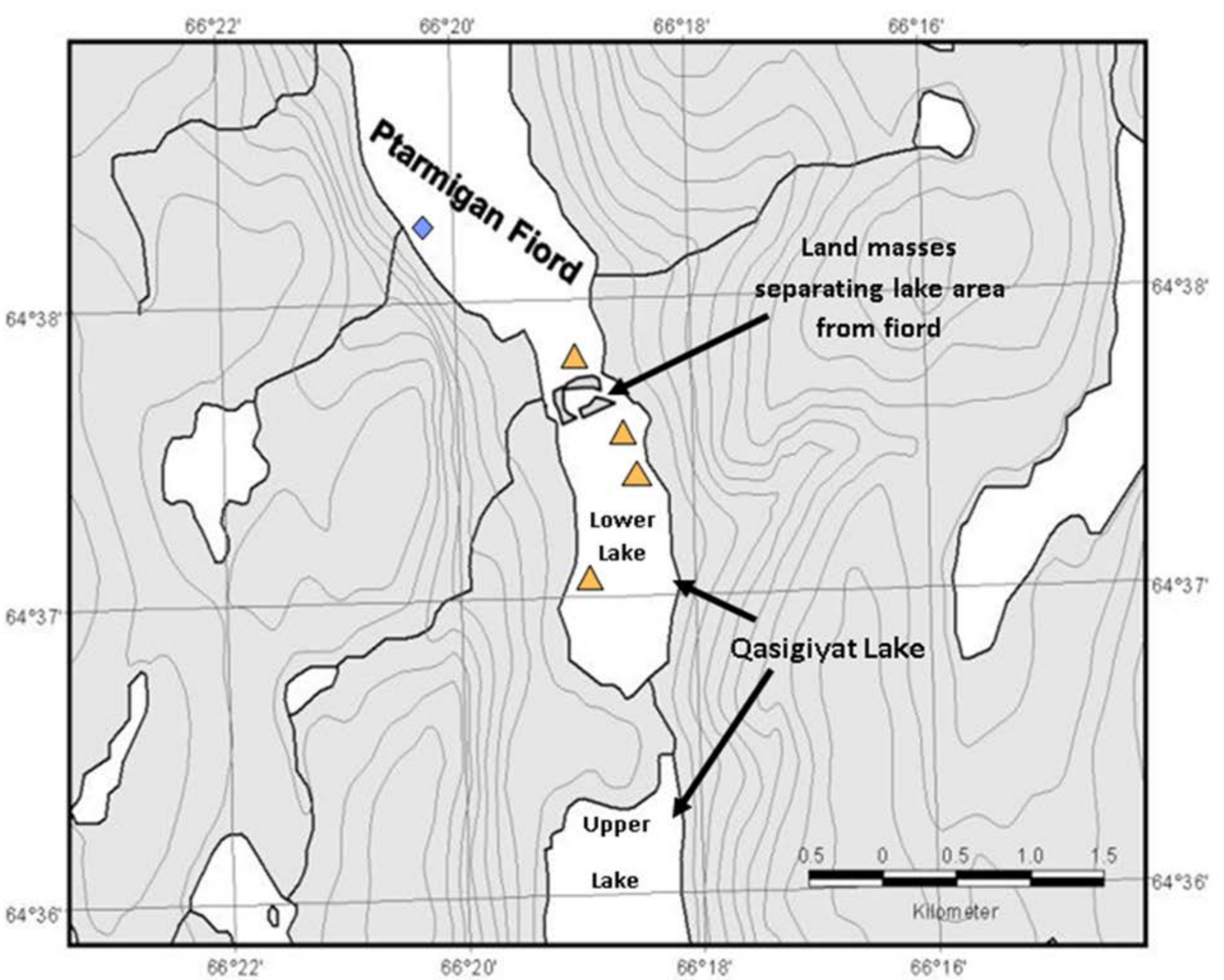

Figure 2. Map of Qasigiyat Lake, with common fishing locations noted. Fishery-independent data were generally collected in the areas marked by ▲. The fishing location commonly used by local fishermen is marked with ♦. Map from Loewen et al. (2009), detailed fishing locations in Martin and Tallman (2013).

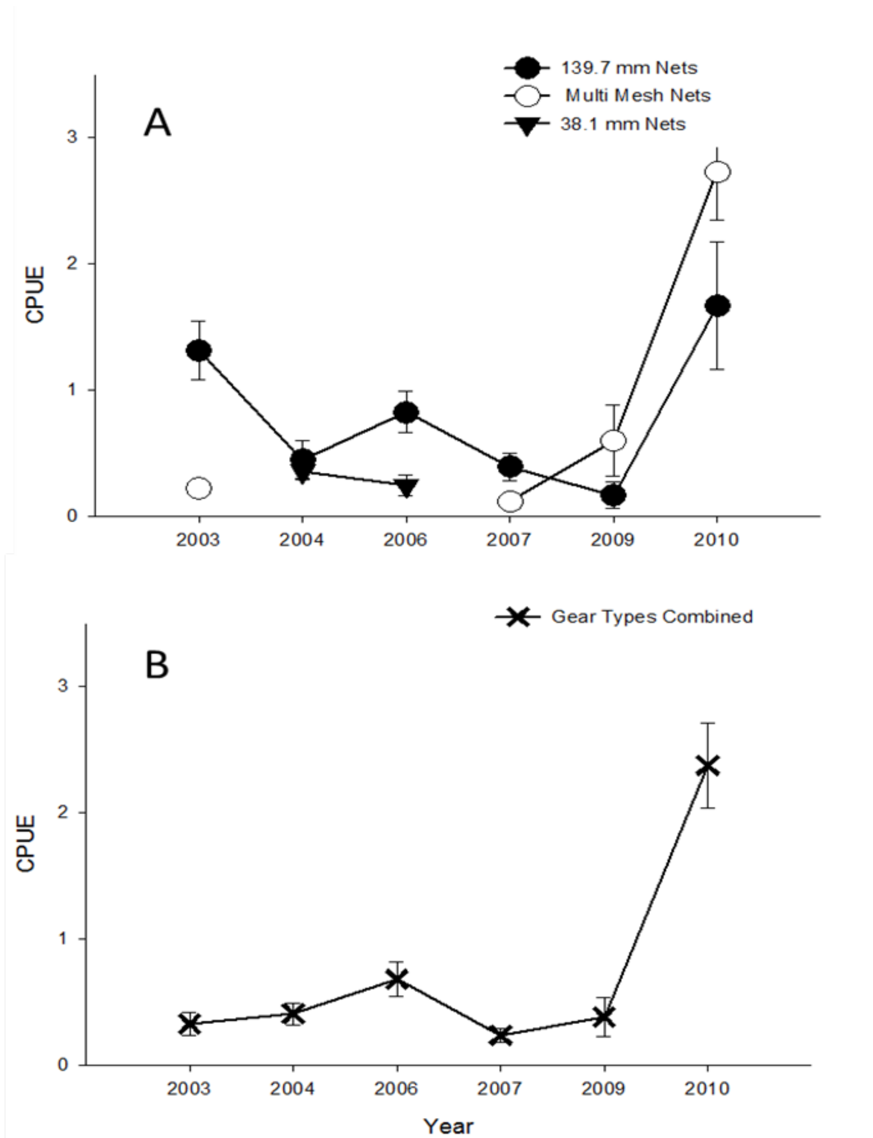

Figure 3. Mean catch-per-unit-effort (CPUE, number of fish/100m net/hour) by year, gear type (139.7 mm nets, multi-mesh nets and small nets) separate (A), and gear type combined (B), data from the fishery-independent data. Standard error bars included.

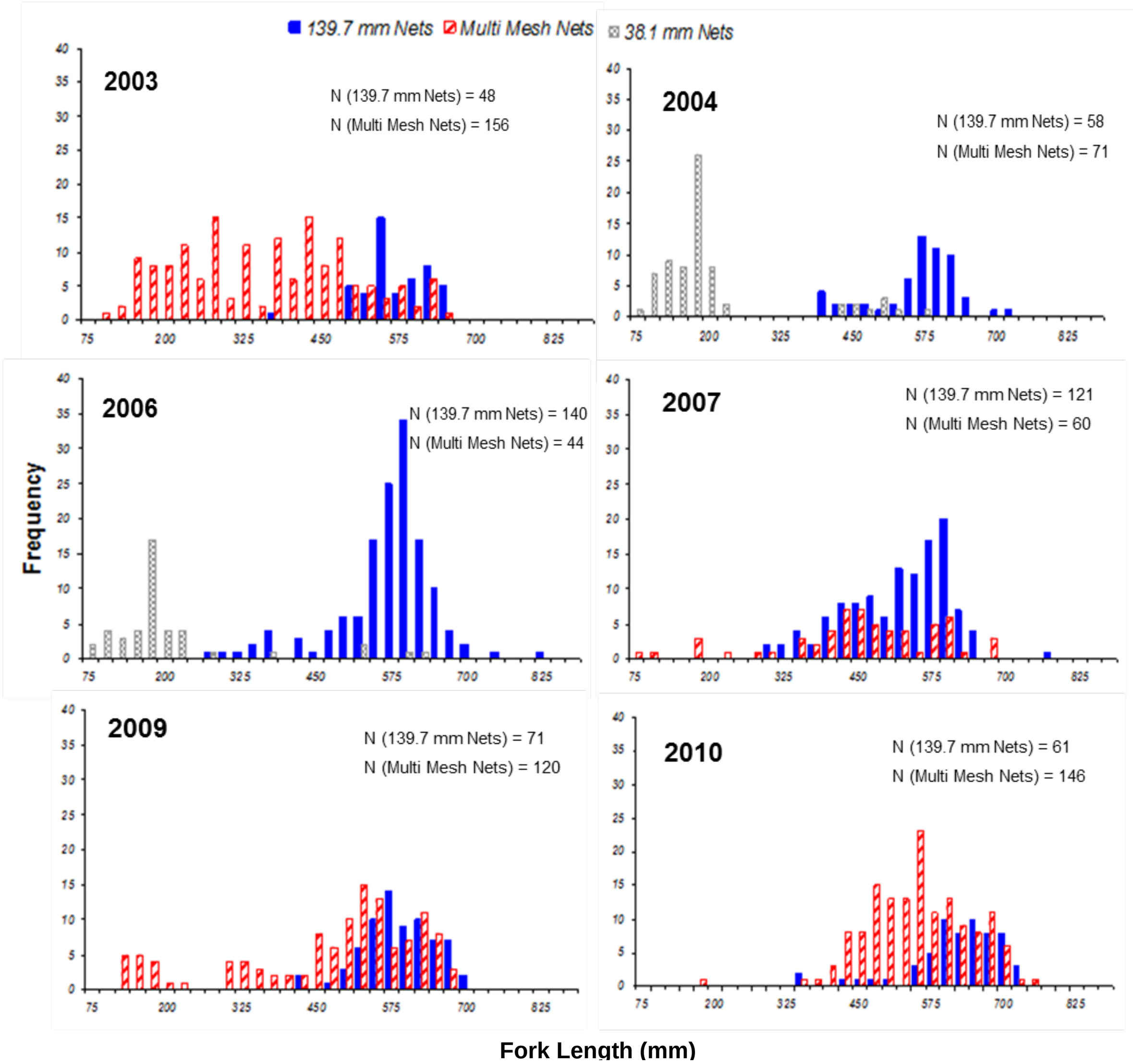

Figure 4. Length-frequency distributions of Arctic Char from fishery-independent data by net type. N=sample size.

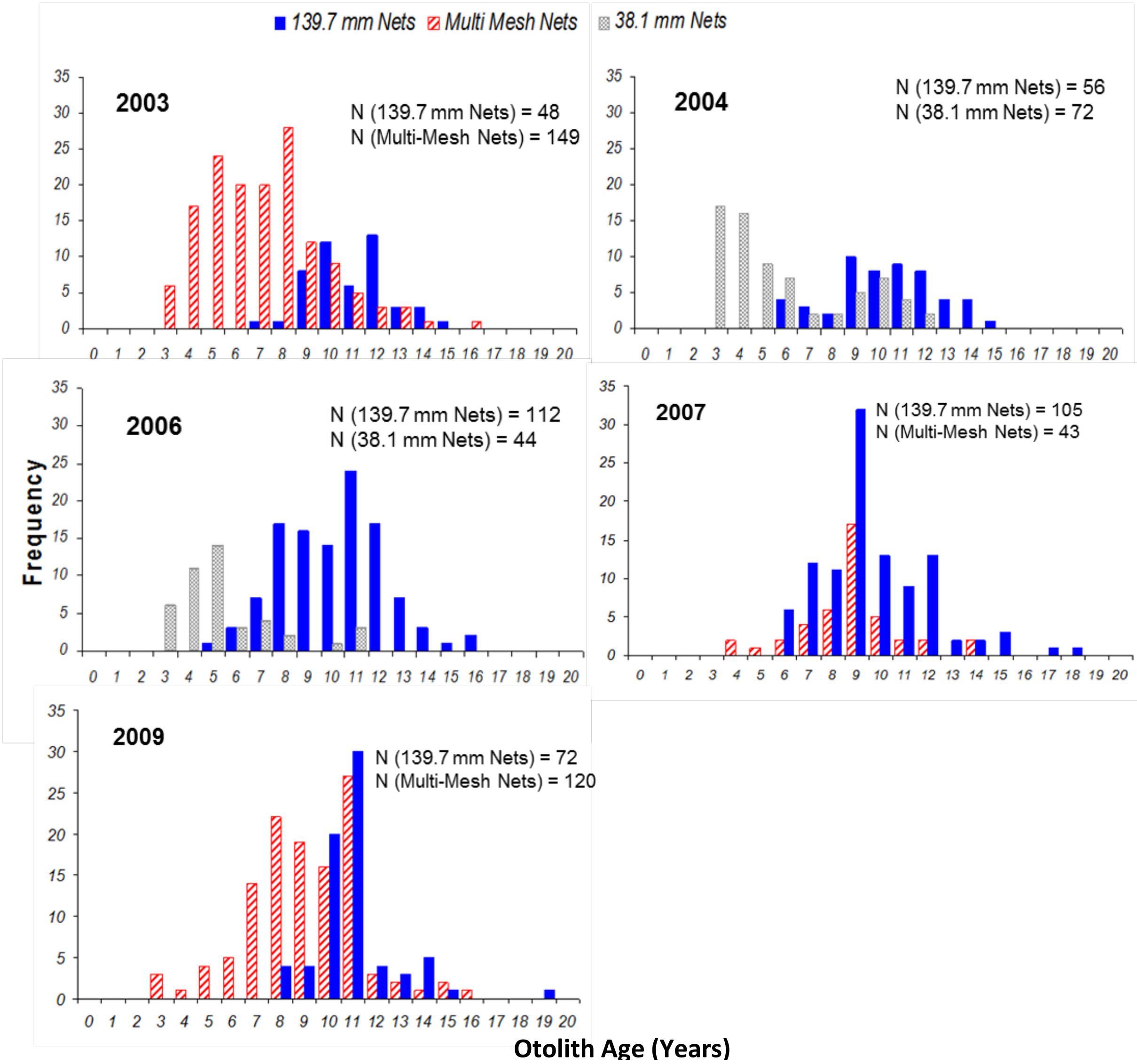

Figure 5. Age-frequency distributions of Arctic Char from fishery-independent data by net type. n=sample size.

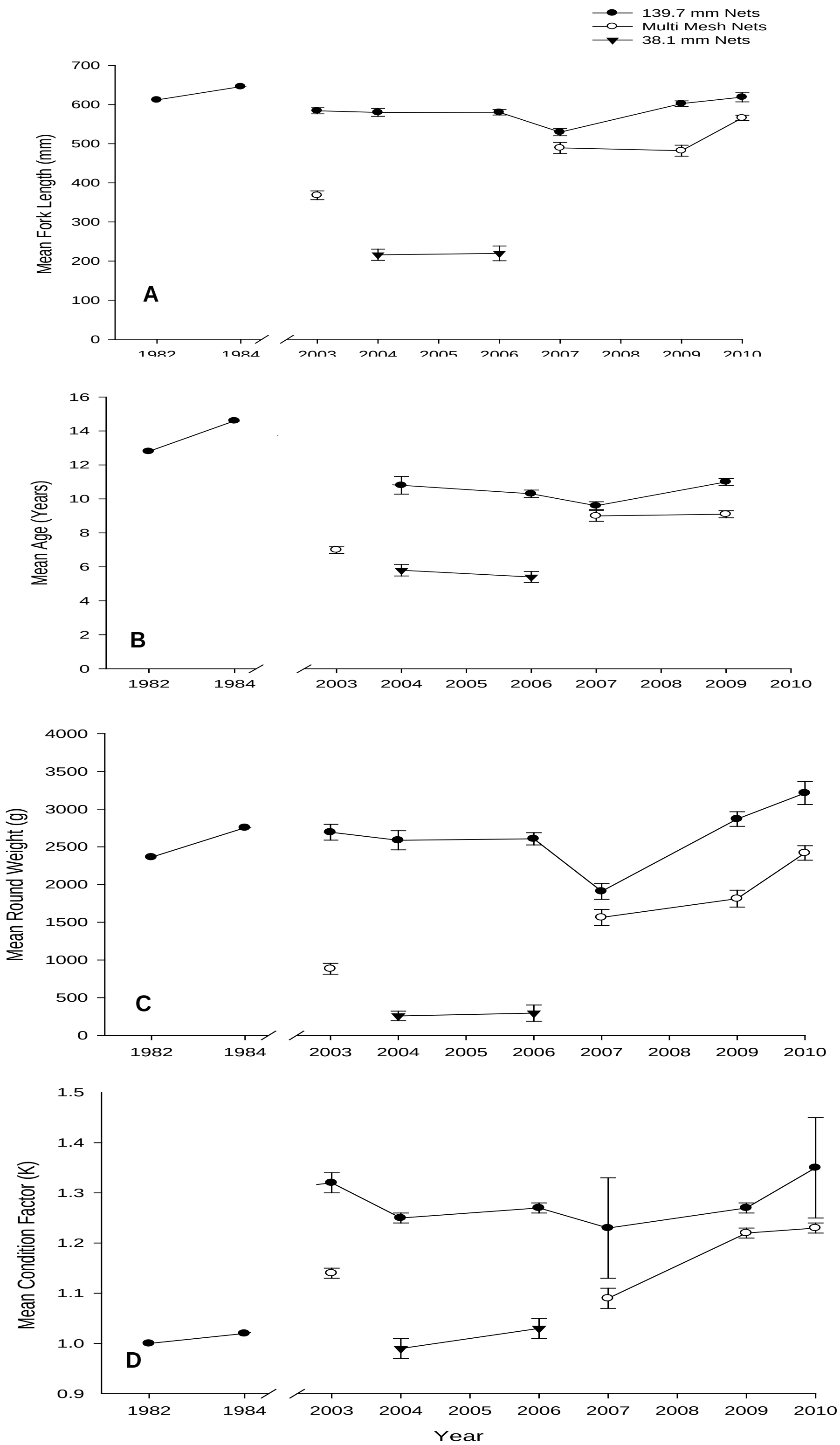

Figure 6. Trend analysis - plot of the means (fork length (mm) (A), age year (B), round weight (g)(C), condition factor K (D)) from both test fishery data (1982 and 1984) (McGowan 1985) and fishery-independent data (for the remaining years). Standard error bars of the mean included.

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