FALL 2010 SUBSISTENCE FISHERY MONITORING ON THE COLVILLE RIVER

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FINAL REPORT

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EXECUTIVE SUMMARY

The Colville River fall harvest of arctic cisco (*Coregonus autumnalis*), or *qaaktaq* in Iñupiaq, is one of the most important subsistence events annually for residents of Nuiqsut. Increasing oil and gas development in the 1970s along the northern Arctic Coastal Plain and, in particular, the construction of offshore causeways near Prudhoe Bay, led to concerns that the migrations and feeding behavior of arctic cisco would be negatively affected. As a result, monitoring of harvest on the Colville River has been conducted since the mid-1980s.

The 2010 fishery monitoring team participated in a community meeting with the *Qaaktaq Panel* in Nuiqsut on 29 October to present the results of the 2009 program and field questions and comments of fishers for the 2010 season. This meeting was part of an ongoing attempt by fishery monitors to engage stakeholders (including Nuiqsut residents, subsistence fishers, the North Slope Borough [NSB] and ConocoPhillips Alaska, Inc. [CPAI]) in discussions on the present and future of the Colville River fall fishery monitoring program. A post-season meeting with the *Qaaktaq Panel* will be held in early spring 2011 to present the results of the 2010 program and to discuss concerns and ideas for enhancement of the monitoring program. Monitors also continued the program of daily on-ice harvest interviews, as in previous years.

In 2010, the arctic cisco subsistence harvest began on approximately 5 October shortly after freeze up on the Colville River Delta. Traditionally, there are 3 areas of the Niġliq Channel that are the most heavily fished (Upper Niġliq, Nanuk, and the Niġliq Delta). For the first time since 2005, there was fishing effort in the main channel of the Colville Delta as well. The fishery monitoring team visually observed a harvest of 18,505 fish (all species, mesh sizes and areas) with arctic cisco (61%) and least cisco (*Coregonus sardinella*; 34%) comprising the vast majority of the recorded harvest. The proportion of arctic cisco caught in 2010 was the lowest since 2002, whereas the proportion of least cisco caught was the highest since 1998. Fishing effort increased 101% compared to 2009, although the observed catch rate for arctic cisco in the Niġliq Channel (6.8 fish/adjusted net day) was the lowest since 2002 and well below the 1986–2009 average of 15 fish/adjusted net day. The observed catch rate for least cisco was consistent with the average since 1986. Of the 3 main fishing areas on the Niġliq Channel used in 2010 season, the Upper Niġliq area (2.6 fish/adjusted net day) saw the lowest observed harvest rate for arctic cisco caught in 7.6-cm nets. Observed harvest rates were highest in the Niġliq Delta (9.7 fish/adjusted net day) and Nanuk areas (2.8 fish/adjusted net day), although these values are significantly lower than 2009. The CPUE in 7.6-cm net in the main channel was 8.6. Based on observed catch rates and known adjusted fishing times in the Niġliq by each fisher we estimate a total harvest of nearly 24,000 arctic cisco in 2010, with the main channel fishery contributing an estimated 3,000 to the total.

In 2010, age 5 (2005 year class), age 6 (2004 year class) and age 7 (2003 year class) fish were the dominant age classes of arctic cisco harvested in 7.6-cm mesh gill nets; however, arctic cisco harvested in 2010 were smaller than in 2009. The 2004 year class (6-year-old fish) still appears to be the most prevalent year class in the fishery and was the most harvested year class for a second consecutive year. This is the strongest year class since 1999 and could still contribute cumulatively to the CPUE of that year class, as they will likely remain in the fishery for at least 1 more year.

During the 2010 harvest season there was a general sense of dissatisfaction among many fishers concerning harvests of arctic cisco. This stemmed from low CPUE following a year (2009) in which CPUE was larger than the long-term average since 1986. There was also some concern over the size of fish caught on average in 2010. However, we note that 2009 CPUE levels were unexpected and that predictions are for harvests to remain low until 2011 (without factoring in environmental factors). The substantial increases in fishers, overall number of nets and fishing effort made the Niġliq Delta a competitive fishing

location. The low harvests and crowding in the Niġliq Delta, combined with a delay in the higher salinities that are associated with upstream movement of arctic cisco, may have contributed to the prolonged fishing period in 2010 (~30 nets still active on 18 November) and the re-establishment of substantial fishing effort in the main channel of the Colville River.

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ACKNOWLEDGMENTS

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We depend every year on the outstanding and welcoming support of the residents of Nuiqsut. They made our fourth year in Nuiqsut a very enjoyable one. We thank members of the *Qaaktaq* Panel who continue to provide invaluable support to our sampling crew throughout the year. Thanks also to the Kuukpik Subsistence Oversight Panel, Inc. (KSOPI) and Annie Gray. We thank the Kuukpik Hotel for the comfortable accommodations and good food and the Nanuq Corporation and its employees for entertainment and insights as they prepared for the ice road season. We thank Larry Moulton for continued support over the years. Thanks also to Arctic Fox Environmental, Inc., for their speedy analysis of water samples during the field season. As always, we are indebted to all the fishermen and women who graciously offered their harvest data and advice and insights during the 2010 fall fishery.

INTRODUCTION

In 2010, ABR worked with key fishery stakeholders in Nuiqsut, Alaska, to monitor the Colville River subsistence fishery, which is conducted each fall after freeze-up in the Niġliq Channel of the Colville River. The 2010 monitoring program was a continuation of long term studies that have taken place annually since 1985 (no data were collected in 1999). Monitoring has been conducted by several contractors over that time period (MJM Research [1985–2005], LGL Alaska Research Associates [2006]), and ABR [2007–present]) on behalf of ConocoPhillips Alaska, Inc., (CPAI) and its predecessors (see Daigneault and Reiser 2007 and Moulton et al. 2006). The monitoring program focuses on arctic cisco (*Coregonus autumnalis*; *qaaktaq*, in Iñupiaq), which are a staple in the diet of Nuiqsut residents. However, the program also attempts to quantify harvest of other subsistence harvest species captured in the Qaaktaq fishery. The primary impetus for the monitoring program is concern that oil and gas exploration and development in the nearshore marine environment and, more recently, on the Colville River Delta (henceforth the Colville Delta) could adversely affect these anadromous or amphidromous fish. Furthermore, in recent years this monitoring program has continued as mandated under stipulations defined by the CD-4 development permit issued by the North Slope Borough (NSB04-117, 2004). The main goals of the monitoring program have been to obtain estimates of the total fishing effort and catch, to predict future harvest and, more recently, to monitor other environmental issues associated with the fishery.

Prior to implementing a new monitoring program in 2007, CPAI hosted several community meetings seeking (1) to reaffirm support for the monitoring program among the primary stakeholders (i.e., the Nuiqsut fishers, the Kuukpik Subsistence Oversight Panel, Inc. [KSOPI], the North Slope Borough [NSB] Department of Wildlife Management, and CPAI), and (2) to gain consensus on how the monitoring program should be implemented and managed. This process was successful, and subsequently the monitoring program has been working closely with fishers and other stakeholders to keep all parties abreast of developments in the fishery. As an integral part of the monitoring program, ABR has conducted numerous meetings with community members and a *Qaaktaq Panel* (composed of expert participants in the fishery) before, during, and after the fishing season, and has offered assistance to fishers on the ice whenever seeking interviews. The objectives of the monitoring program in 2010 were to:

- Continue working with key stakeholders as per agreements made in 2007 (Seigle et al. 2008, Appendix 1).
- Monitor the harvest of arctic cisco throughout the fishing effort, using interviews of participants.
- Record the number of nets fishing at any given time and their dimensions and locations during the season.
- Document the subsistence fishery harvest.
- Collect age, length and weight information for a subsample of arctic cisco harvested.
- Measure water salinity and quality (i.e., testing for metals and petroleum-based organic compounds) in primary fishing areas.
- Compare the 2010 results with those of previous years for this program and other historical data.
- Increase participation in the *Qaaktaq Panel* meetings.

BACKGROUND

Very little was known of the basic life history characteristics of arctic cisco until fish monitoring studies were initiated by the oil industry in the nearshore environments of the Prudhoe Bay region in the early 1980s (Gallaway et al. 1983). These studies discovered that all arctic cisco in Alaska originate in the Mackenzie River system in Canada. Young-of-the-year drift down river into the Beaufort Sea in early summer, and prevailing easterly winds and ocean currents transport these young fish passively along the Beaufort Sea coast to the west. The number of young-of-the-year arctic cisco (i.e., recruitment strength) in Alaska and the Colville River region is correlated with the consistency and strength of easterly winds in the

Beaufort Sea region during summer (Fechhelm and Fissell 1988). This wind- and ocean current-driven recruitment process largely determines the age structure of arctic cisco in Alaska (Gallaway and Fechhelm 2000), and the number of young-of-the-year arctic cisco at Prudhoe Bay (the site with the longest records on abundance of young-of-the-year arctic cisco) is highly correlated with harvest rates for the Colville River fishery 5–7 years later (ABR et al. 2007).

Young arctic cisco in Alaskan Beaufort Sea waters spend their summers feeding in deltas and nearshore brackish waters before returning to deep pools of the Colville River for over-wintering (Craig 1984, Moulton et al. 1986). After achieving maturity (females age 7–8, males age 6–7), arctic cisco migrate during summer to their source rivers within the Mackenzie River system for fall spawning. These adult fish do not return to rearing streams in Alaska but rather stay in the Mackenzie River region where they continue to spawn well into their teen-aged years (Craig and Halderson 1981, Gallaway et al. 1983, Bond and Erickson 1985, Bickham et al. 1989, Moulton 1989, Bond and Erickson 1997).

The arctic cisco fishery on the Colville Delta is an under-ice fishery that yielded an average of 8,743 kg (19,200 lbs) of arctic cisco annually between 1985 and 2003 (Moulton and Seavey 2004). The subsistence fishery is conducted almost exclusively on the Niġliq Channel of the Colville River (Figure 1). Until recently, a commercial arctic cisco fishery operated by the Helmericks family also was active on the main channel of the Colville River. In 1993, the year with the highest combined harvest from these 2 fisheries, ~78,254 fish (31,340 kg) were taken on the Colville Delta (Moulton and Seavey 2004). In contrast, only 5,859 fish (2,799 kg) were harvested in 2001, which was the lowest harvest on record. This substantial annual variability in harvest rates, coupled with increased development by the oil and gas industry within the range of arctic cisco, have raised concerns among subsistence users and other stakeholders about the population status of arctic cisco in Alaska. In 2003, the Minerals Management Service (MMS) convened a workshop in Nuiqsut to review the issue of variability in annual harvest of arctic cisco, from perspectives of both the subsistence community and scientists researching this species (MBC Applied Environmental Sciences 2004). Following the workshop, MMS commissioned a study to review and synthesize all available information from scientific studies and from subsistence users to assess the status of the arctic cisco population in Alaska and to evaluate the effects of anthropogenic disturbances on the fish (ABR et al. 2007). This study relied heavily on data collected since 1985 on the subsistence fishery in Nuiqsut (i.e., this long-term monitoring program).

METHODS

STAKEHOLDER MEETING

ABR held 1 meeting in Nuiqsut during the 2010 fall fishery monitoring (Appendix A). The *Qaaktaq Panel*, composed of expert fishers involved in the subsistence harvest, met on 29 October 2010 at the KSOPI office in Nuiqsut. Turnout for previous *Qaaktaq Panel* meetings has been low since 2007, so an additional number of fishers were invited to attend. Attendees included: Roger Ahnupkana (new invitee representing Marjorie Ahnupkana), Eli Nukapigak, Lydia Sovalik, Dwayne Hopson, Sr., Sam Kunaknana (new invitee), Billy Oyagak, Gordon Brown (new invitee), Thomas Nukapigak (new invitee) and 3 ABR scientists (John Seigle, Joel Gottschalk, Alyson McHugh) and KSOPI representative Annie Gray. The purpose of this meeting was to (1) summarize the 2009 fishing season and report results comparing 2009 harvest information to historical records, (2) continue to work with active fishers to get their perspective on the state of the 2010 fall fishery, and (3) act as an agent expressing the community's concerns about the fishery to the client. A second meeting will be held in late winter/early spring 2011 at the KSOPI office (date to be determined following the submittal of this draft report to CPAI) and will include members of the *Qaaktaq Panel* and monitoring program personnel. Notes on the community meetings held in October 2010 and can be found in Appendix A.

FISHERY EFFORT AND HARVEST

Three traditional fishing areas hosted the majority of concentrated fishing efforts in the Niġliq Channel in 2010 (Figure 2). From upstream

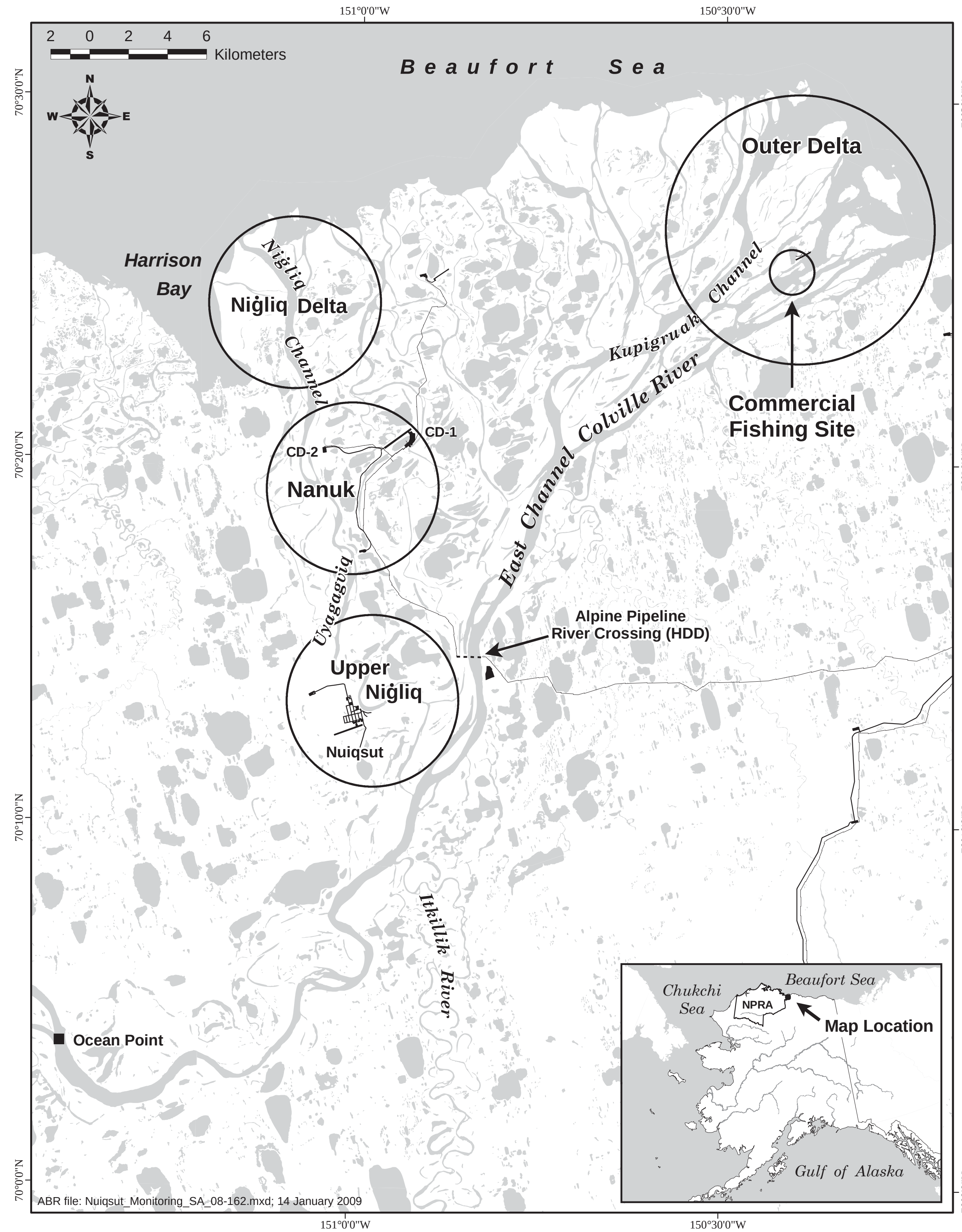


Figure 1. Three of the main subsistence fishing areas in the Niġliq Channel and the commercial/subsistence fishing area in the main channel historically used for harvesting arctic cisco in the Colville Delta (after Moulton and Seavey 2004).

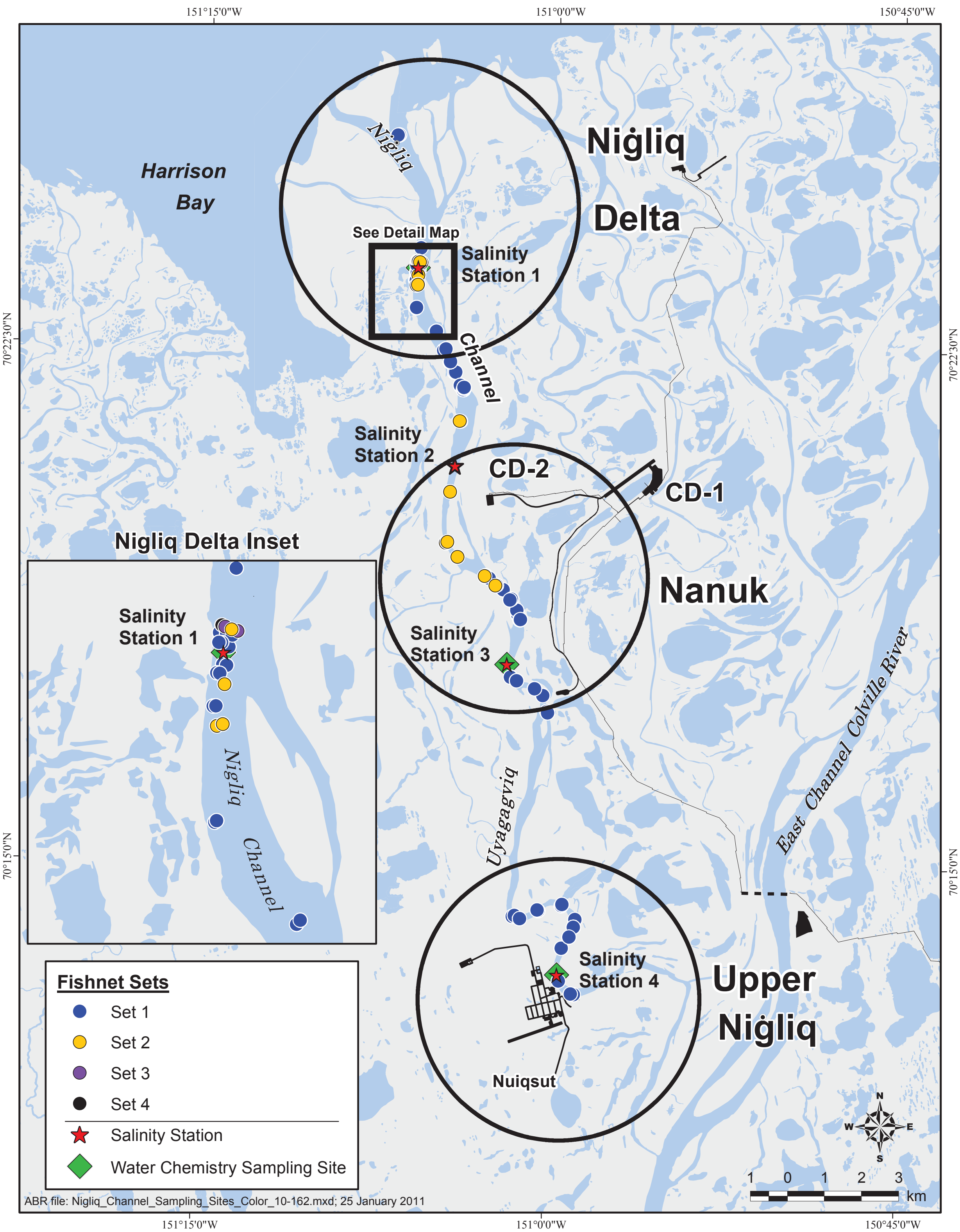


Figure 2. Salinity stations (4), and water chemistry sampling sites (3), and net sites in each of the 3 main subsistence fishing areas in the Niġliq Channel of the Colville River, 2010.

to downstream, these were the Upper Niġliq area (adjacent to the town of Nuiqsut), the Nanuk area, and the Niġliq Delta area (includes nets between the Nanuk and Niġliq Delta areas). A fourth traditionally-used area, the Uyagagviq area (see Figure 2), was not used in 2010. A late season fishing effort also occurred in the main channel of the Colville River for the first time since ABR began monitoring the fishery in 2007.

The harvest monitoring team always included 2 scientists from ABR. The third and fourth members of the team were local residents of Nuiqsut, Jerry Pausanna and Richard Tukle. Each day, ABR fishery monitors traveled by snow machine to the more intensively fished areas of the Colville River to conduct interviews for harvest assessment. When a member of the monitoring team observed a fisher on their way to or from a harvest, permission was asked to assist in the harvest or to conduct an interview and assess the recently completed harvest. During interviews, we recorded net length and mesh size and start and end times for that particular fishing effort. If a fisher expressed desire to work alone or to not participate in an interview, we respected those wishes and moved on to another net.

As in years past, fishers used a variety of net lengths and mesh sizes depending on individual preferences. For this reason, in calculating fishing effort (i.e., net days), net length and effort were adjusted to a standardized 18-m (60 ft) net length and full day set durations. For example, if an 80 ft net was used during a 24-hour period, fishing effort (or standardized hours of fishing) was calculated as 80 ft/60 ft × 1 day = 1.3 days of adjusted effort. We calculated catch per unit effort (CPUE) using these adjusted estimates of effort. In this report, CPUE is expressed as catch per net day. Because nets of different mesh sizes capture different sizes of fish at different rates, we specify when data presentations are broken down by mesh size, when they include all mesh sizes, or when they are limited to the most frequently used mesh of 7.6 cm (3 inches). CPUE was calculated only for all mesh sizes but is most commonly reported for nets with 7.6-cm mesh as this has historically been the most fished mesh size in the fishery.

In the event that we did not actually witness a harvest, we conducted interviews with fishers the next time we met (usually within 24–48 hours). The following questions were asked:

- How long was your net in the water?
- What were your net dimensions?
- How many *qaaktaq* did you harvest?
- How many fish of other species did you harvest?
- How often are you checking your nets?
- Do other people check your nets?
- Where is your net and has it been moved recently?

Information from these post-harvest interviews was included in the overall “observed” harvest assessment even if it was unclear which nets fish had been captured in (i.e., the fisher knew how many fish he/she caught in a day but could not say how many fish were caught in individual nets of varying mesh sizes and net lengths). Reported harvest numbers from these interviews were used in CPUE analysis only if the fisher also knew the number of days each net fished and the number of fish caught in nets of each mesh size.

LENGTH, WEIGHT, AND AGE OF CATCH

After removing fish from each net, we counted all of them and measured a sub-sample (fork length to the nearest mm). The catch from each net was counted separately. The standard routine for sub-sampling from each net’s catch was to lay out all fish of each species side-by-side on the ice in no particular order. Depending on the number of fish in the harvest and the amount of time available for the interview, every second, third, or fourth fish was measured. We counted and measured arctic cisco first, and other species, including least cisco (*Coregonus sardinella*), as time permitted.

The total number of fish measured on a given day varied depending on several factors, including a fisher’s availability, the total number of fish caught in the net, and the number of fishers in the area. When several fishers were harvesting simultaneously in the same area, monitors attempted to obtain a sub-sample of measurements from every fisher. When possible, ABR paid a participation fee to various fishers who were willing to donate a sub-sample of fish (~10/day at $10/fish). We only accepted donated fish from nets of known mesh size and we were primarily interested in fish caught with 7.6-cm mesh nets. The fish were kept frozen and transported to Anchorage where we measured fork length (mm) and weight (using a top loading electronic scale), and removed otoliths for ageing at a later date. Otoliths were cleaned with tap water and stored in 96-well pipette trays.

The break-and-burn technique was used to prepare otoliths for ageing (Chilton and Beamish 1982). Otoliths were broken in half along the transverse axis using a sharp scalpel or by pressing the otolith between a fingernail and forefinger. The broken edge of each otolith was held over an open flame for several seconds until it acquired an amber color. The otolith half was then placed broken-edge up in putty and the surface was brushed with mineral oil to emphasize the growth rings under magnification. The sample was examined under reflected light on a dissecting scope with 10× to 40× magnification. Alternating bands of dark and light correspond to winter and summer growth, respectively, and together represent one year's growth. Following methodologies used in previous years, the central core region of the otolith, composed of a dark and light region, was recognized as the first summer and winter growth of an age-0 fish. All annuli outside this region were then counted to determine the age of the fish.

SALINITY MEASUREMENTS AND WATER QUALITY

Water salinity was measured every other day at 4 salinity sampling stations that corresponded to areas of intense fishing (Figure 2). At these stations, a plug of ice was removed and the sampling probe from a YSI Professional Plus meter was lowered into the water. Salinity was measured in parts per thousand (ppt) and was recorded at the surface and at 0.5-m increments of depth until the probe reached the river bottom. At the end of each sampling event, a small piece of insulation was used to cover the hole in the ice. In this way, the sampling hole was only partially frozen upon return 48 hours later.

On 3 dates, 21 October, 7 November and 18 November, ABR collected water samples for 4 analyses conducted by Arctic Fox Environmental, Inc., in Prudhoe Bay, Alaska. Samples were collected at the salinity stations in the Niġliq Delta area near Woods' Camp, in the Nanuk fishing area and in the Upper Niġliq area closest Nuiqsut. Water samples were collected in pre-rinsed glass and polypropylene bottles provided by Arctic Fox. Analyses included total metals (mercury, arsenic, barium, cadmium, chromium, lead, selenium and silver, method EPA747OA, EPA 6020), total nitrogen (NO_3 + NO_2) (EPA 353.2), diesel range organics and heavy oil (EPA1664), and algal fragment enumeration (algal fragments/100 ml of H_20) (See Appendix B and C).

RESULTS

FISHERY EFFORT AND HARVEST

In 2010, the arctic cisco subsistence harvest began on approximately 5 October shortly after freeze up on the Colville River Delta, according to interviews conducted 1 week later (Table 1). Thirty households deployed 75 nets during the fall fishery in 2010 (Table 2, Figure 3). This is 17 nets more than were deployed in 2009 and well above the average and median number deployed since 1986 (Avg. = 55.36, Med = 55) and the highest number deployed since 2004. Eighty-five sets of 66 unique nets occurred in the Niġliq Channel. Main channel fishing began on 23 October and ceased on 19 November. Sixteen unique sets occurred in the main channel using 9 unique nets. The main channel sets were the first monitored by ABR in 4 years (since 2007).

At least 6 nets were deployed in the Niġliq Channel on or about 5 October and numbers rose consistently during the first two and a half weeks of the fishing season. The number of nets deployed rose from 6 to 20 between 5 and 13 October and again from 20 to 42 nets between 14 and 20 October (Figure 4). Net deployment reached a virtual plateau of approximately 50 nets between 23 October and 13 November with a maximum of 55 nets active on 7 November in the Niġliq Channel. Fishing effort steadily declined beginning on 14 November. At the time of ABR's departure from Nuiqsut on 19 November, 30 nets were still

Table 1. Estimated onset of fishing in the Colville River fall subsistence fishery, 1985–2010.

Year	Start Date
1985	2 Oct
1986	3 Oct
1987	8 Oct
1988	14 Oct
1989	22 Oct
1990	6 Oct
1991	12 Oct
1992	26 Sep
1993	3 Oct
1994	3 Oct
1995	16 Oct
1996	28 Sep
1997	13 Oct
1998	28 Sep
1999	
2000	3 Oct
2001	6 Oct
2002	14 Oct
2003	16 Oct
2004	9 Oct
2005	7 Oct
2006	14 Oct
2007	4 Oct
2008	4 Oct
2009	6 Oct
2010	5 Oct
Average	7 Oct

actively fishing the Niġliq Channel (Figure 4), although the frequency that these nets were checked for harvest had severely declined. Most of these nets were still "active" on 25 November (personal communication, Jerry Pausanna), but appeared to be infrequently checked. After standardizing for net length, we calculated 2,336 adjusted net days of fishing effort in 2010 in the Niġliq Channel and the main channel of the Colville Delta (Table 2), representing a 101% increase in fishing effort compared to 2009 and a 76% increase from 2008. In the Niġliq Channel only (2,044 adjusted net days), fishing effort was highest in the Niġliq Delta area at 40% of total, followed by the Nanuk area at 29% of total and the Upper Niġliq (Figure 5) at 19% of total. The main channel (~293 adjusted net days effort) accounted for an additional 13% of total fishing effort.

The most frequently deployed mesh size of nets in the Nuiqsut fall fishery has traditionally been 7.6-cm and this trend continued in 2010. A total of 43 out of 75 nets deployed in 2010 in the Niġliq Channel were 7.6-cm mesh nets (Table 2). In the Niġliq Channel, a total of 2,227 arctic cisco were documented during harvest assessments by the monitoring teams in 7.6-cm mesh nets. This number is 56% lower than the long-term Niġliq Channel average of 5,116 arctic cisco harvested between 1986 and 2009 in 7.6-cm mesh nets (Table 3). The total observed harvest increased in the Upper Niġliq and decreased in the Nanuk and Niġliq Delta areas compared to 2009 (Table 3). An additional harvest of 483 arctic cisco was documented for 7.6-cm nets in the main channel.

For the purposes of this report CPUE (expressed as catch per adjusted net day) in the Niġliq Channel was reported for nets of 7.6-cm mesh (standardized to 18-m length) unless otherwise noted, as this is the dominant net used in the fishery. The 2010 CPUE by 7.6-cm mesh nets for arctic cisco in Niġliq Channel was highest in the Niġliq Delta (9.7 fish/adjusted net day, Table 3) followed by the Nanuk area (2.8 fish/adjusted net day), and the Upper Niġliq area (2.6 fish/adjusted net day). CPUE in 7.6-cm nets in the main channel was 8.6. The total CPUE in 7.6-cm mesh nets for arctic cisco in the Niġliq Channel (6.8 fish/adjusted net day) was the lowest since 2002 and well below the 1986–2009 average of 15 fish/adjusted net day (Table 3, Figure 6). In 2010, the daily average CPUE in 7.6-cm mesh nets peaked on 4 November at 16.5. The peak fishing period was between 29 October to 6 November, with an average CPUE of 12.6 fish/adjusted net day (Figure 7).

A total of 6,544 arctic cisco were reported by the monitoring team (ABR direct observations and indirect fisher-aided reporting) in all mesh sizes combined for the Niġliq Channel (Table 4). The net length adjusted CPUE for each individual mesh size from observed harvests in the Niġliq Channel reveals that harvest results varied widely from 61

Table 2. Total adjusted fishing effort recorded for the fall fishery, Niġliq and main channels, Colville River, 2010.

Fisher Code	Fishing Area	Net	Net Code	Net Length (m)	Start Date	End Date	Stretched Mesh (cm)	Net Days	Adjusted Net Days
4	Nigliq	A	104A1	18.3	10/16/2010	11/25/2010	7.6	40	40.0
4	Nigliq	B	104B1	18.3	10/16/2010	11/25/2010	7.0	40	40.0
4	Nigliq	C	104C1	18.3	10/16/2010	11/25/2010	7.6	40	40.0
4	Nigliq	D	104D1	24.4	10/16/2010	11/25/2010	7.6	40	53.3
4	Nigliq	E	1040	24.4	10/16/2010	11/19/2010	8.9	34	45.3
4	Nigliq	F	104F1	24.4	10/20/2010	10/27/2010	7.0	7	9.3
4	Nigliq	G	104G1	18.3	10/20/2010	10/30/2010	5.1	10	10.0
4	Nigliq	H	104H1	18.3	10/20/2010	10/27/2010	7.6	7	7.0
4	Nigliq	H	104H2	24.4	10/27/2010	11/19/2010	7.6	23	30.7
7	Nigliq	A	107A1	18.3	10/5/2010	10/17/2010	7.0	12	12.0
7	Nanuq	A	107A2	24.4	10/17/2010	11/10/2010	7.0	24	32.0
7	Nigliq	B	107B1	18.3	10/5/2010	10/17/2010	7.6	12	12.0
7	Nanuq	B	107B2	18.3	10/17/2010	11/10/2010	7.6	24	24.0
7	Nigliq	C	107C1	30.5	10/5/2010	10/29/2010	7.6	24	40.0
7	Nigliq	D	107D1	24.4	10/5/2010	11/10/2010	7.6	36	48.0
17	Nanuq	A	1017A1	18.3	10/15/2010	11/25/2010	7.6	41	41.0
24	Upper Nigliq	A	1024A1	18.3	10/14/2010	10/17/2010	7.6	3	3.0
24	Nigliq	A	1024A2	18.3	10/17/2010	11/15/2010	7.6	29	29.0
24	Upper Nigliq	B	1024A1	80.0	10/14/2010	10/17/2010	7.6	3	13.1
24	Nigliq	B	1024B2	24.4	10/17/2010	11/25/2010	7.6	39	52.0
24	Nigliq	C	1024C1	18.3	11/6/2010	11/25/2010	7.6	19	19.0
25	Nanuq	A	1025A1	24.4	10/14/2010	10/29/2010	7.6	15	20.0
25	Nanuq	B	1025B1	24.4	10/14/2010	11/10/2010	8.9	27	36.0
25	Nanuq	C	1025C1	18.3	10/16/2010	11/13/2010	7.6	28	28.0
25	Nanuq	D	1025D1	18.3	10/17/2010	11/13/2010	8.9	27	27.0
25	Nanuq	E	1025F1	18.3	10/29/2010	11/25/2010	7.6	27	27.0
25	Nanuq	F	1025F1	18.3	10/31/2010	11/25/2010	8.9	25	25.0
25	Nigliq	G	1025G1	30.5	11/6/2010	11/25/2010	7.6	19	31.7
30	Upper Nigliq	A	1030A1	18.3	11/8/2010	11/25/2010	7.6	17	17.0
30	Nanuq	B	1030B1	18.3	11/9/2010	11/25/2010	7.6	16	16.0
31	Upper Nigliq	A	1031A1	18.3	10/29/2010	11/14/2010	7.0	16	16.0
31	Upper Nigliq	B	1031B1	24.4	11/6/2010	11/16/2010	7.0	10	13.3
32	Nanuq	A	1032A1	24.4	10/13/2010	11/25/2010	8.9	43	57.3
32	Nanuq	B	1032B1	18.3	10/13/2010	11/25/2010	7.6	43	43.0
33	Nigliq	A	1033A1	24.4	11/2/2010	11/25/2010	7.6	23	30.7

Table 2. Continued.

Fisher Code	Fishing Area	Net	Net Code	Net Length (m)	Start Date	End Date	Stretched Mesh (cm)	Net Days	Adjusted Net Days
33	Nigliq	B	1033B1	24.4	11/2/2010	11/8/2010	7.0	6	8.0
33	Nigliq	C	1033C1	30.5	11/2/2010	11/8/2010	6.4	6	10.0
33	Nigliq	D	1033D2	24.4	11/14/2010	11/25/2010	7.6	11	14.7
54	Nanuq	A	1054A1	18.3	10/24/2010	11/2/2010	7.0	9	9.0
54	Nanuq	B	1054B1	18.3	10/18/2010	10/27/2010	8.9	9	9.0
54	Nanuq	B	1054B2	18.3	10/27/2010	11/2/2010	8.9	6	6.0
55	Nigliq	A	1055A1	18.3	11/2/2010	11/7/2010	8.9	5	5.0
55	Nigliq	A	1055A2	18.3	11/7/2010	11/10/2010	8.9	3	3.0
55	Nigliq	A	1055A3	18.3	11/10/2010	11/16/2010	8.9	6	6.0
55	Nigliq	B	1055B1	24.4	11/1/2010	11/18/2010	7.0	17	22.7
56	Nigliq	A	1056A1	24.4	10/31/2010	11/15/2010	7.0	15	20.0
56	Nigliq	B	1056B1	24.4	10/31/2010	11/25/2010	7.6	25	33.3
65	Nanuq	A	1065A1	18.3	11/12/2010	11/25/2010	7.6	13	13.0
66	Upper Nigliq	A	1066A1	24.4	10/11/2010	11/25/2010	8.9	45	60.0
66	Upper Nigliq	B	1066B1	24.4	10/11/2010	11/25/2010	8.9	45	60.0
66	Upper Nigliq	C	1066C1	18.3	10/23/2010	11/25/2010	7.6	33	33.0
70	Nigliq	A	1070A1	18.3	10/15/2010	10/21/2010	7.6	6	6.0
70	Main	A	1070A2	30.5	10/23/2010	10/28/2010	7.6	5	8.3
70	Main	B	1070B1	30.5	10/23/2010	10/28/2010	6.4	5	8.3
72	Main	A	1072A1	18.3	10/28/2010	11/18/2010	7.6	21	21.0
74	Main	A	1074A1	30.5	10/28/2010	11/2/2010	6.4	5	8.3
76	Nanuq	A	1076A1	24.4	10/24/2010	10/29/2010	8.9	5	6.7
76	Nigliq	A	1076A2	24.4	10/29/2010	11/5/2010	8.9	7	9.3
76	Nigliq	A	1076A3	24.4	11/7/2010	11/13/2010	8.9	6	8.0
78	Nanuq	A	1078A1	18.3	10/25/2010	10/30/2010	7.6	5	5.0
78	Nigliq	A	1078A2	18.3	10/30/2010	11/25/2010	7.6	26	26.0
78	Nigliq	A	1078A3	18.3	11/7/2010	11/13/2010	7.6	6	6.0
79	Nanuq	A	1079A1	24.4	10/16/2010	11/1/2010	7.6	16	21.3
79	Nanuq	B	1079B1	30.5	10/17/2010	10/22/2010	7.6	5	8.3
79	Nanuq	B	1079B2	30.5	10/22/2010	11/1/2010	7.6	10	16.7
81	Upper Nigliq	A	1081A1	18.3	11/5/2010	11/25/2010	7.6	20	20.0
82	Nigliq	A	1082A1	18.3	10/15/2010	10/22/2010	7.6	7	7.0
82	Main	A	1082A2	18.3	10/23/2010	11/13/2010	8.9	21	21.0
82	Nigliq	B	1082B1	18.3	10/15/2010	10/21/2010	7.6	6	6.0
82	Main	B	1082B2	24.4	10/23/2010	11/13/2010	7.6	21	28.0
84	Nanuq	A	1084A1	24.4	10/13/2010	11/5/2010	7.6	23	30.7
86	Upper Nigliq	A	1086A1	30.5	10/21/2010	10/23/2010	7.6	2	3.3

Table 2. Continued.

Fisher Code	Fishing Area	Net	Net Code	Net Length (m)	Start Date	End Date	Stretched Mesh (cm)	Net Days	Adjusted Net Days
86	Main	A	1086A2	30.5	10/23/2010	10/31/2010	7.6	8	13.3
86	Upper Nigliq	B	1086B1	30.5	10/21/2010	10/23/2010	6.4	2	3.3
86	Main	A	1086A2	30.5	10/23/2010	10/31/2010	7.6	8	13.3
86	Main	B	1086B2	30.5	10/23/2010	10/31/2010	6.4	8	13.3
88	Upper Nigliq	A	1088A1	24.4	10/9/2010	10/16/2010	7.0	7	9.3
88	Nanuq	A	1088A2	24.4	10/19/2010	11/25/2010	7.0	37	49.3
88	Upper Nigliq	B	1088B1	24.4	10/9/2010	10/16/2010	8.9	7	9.3
88	Nanuq	B	1088B2	24.4	10/19/2010	11/25/2010	8.9	37	49.3
88	Upper Nigliq	C	1088C1	24.4	10/9/2010	11/8/2010	7.6	30	40.0
88	Upper Nigliq	D	1088D1	24.4	10/9/2010	11/8/2010	7.6	30	40.0
93	Upper Nigliq	A	1093A1	30.5	10/7/2010	11/25/2010	6.4	49	81.7
93	Nanuq	B	1093B1	24.4	11/10/2010	11/17/2010	8.3	7	9.3
94	Nigliq	A	1094A1	18.3	10/6/2010	10/27/2010	8.3	21	21.0
94	Nigliq	B	1094B1	30.5	10/6/2010	10/27/2010	6.4	21	35.0
95	Nigliq	A	1095A1	18.3	10/17/2010	11/6/2010	6.4	20	20.0
96	Nigliq	A	1096A1	18.3	10/5/2010	11/7/2010	7.6	33	33.0
96	Nigliq	B	1096B1	30.5	10/5/2010	11/7/2010	6.4	33	55.0
96	Nigliq	C	1096C1	40.0	10/27/2010	11/7/2010	8.9	11	24.0
97	Nigliq	A	1097A1	24.4	11/8/2010	11/25/2010	8.9	17	22.7
97	Nigliq	B	1097B1	24.4	11/9/2010	11/25/2010	7.6	16	21.3
97	Nigliq	C	1097C1	18.3	11/11/2010	11/25/2010	7.6	14	14.0
98	Main	A	1098A3	30.5	11/7/2010	11/18/2010	7.6	11	18.3
98	Main	B	1098B3	30.5	11/7/2010	11/18/2010	7.6	11	18.3
99	Main	A	1099A1	30.5	11/9/2010	11/12/2010	6.4	3	5.0
99	Main	B	1099B1	30.5	11/12/2010	11/18/2010	7.6	6	10.0
Total									2,336.3

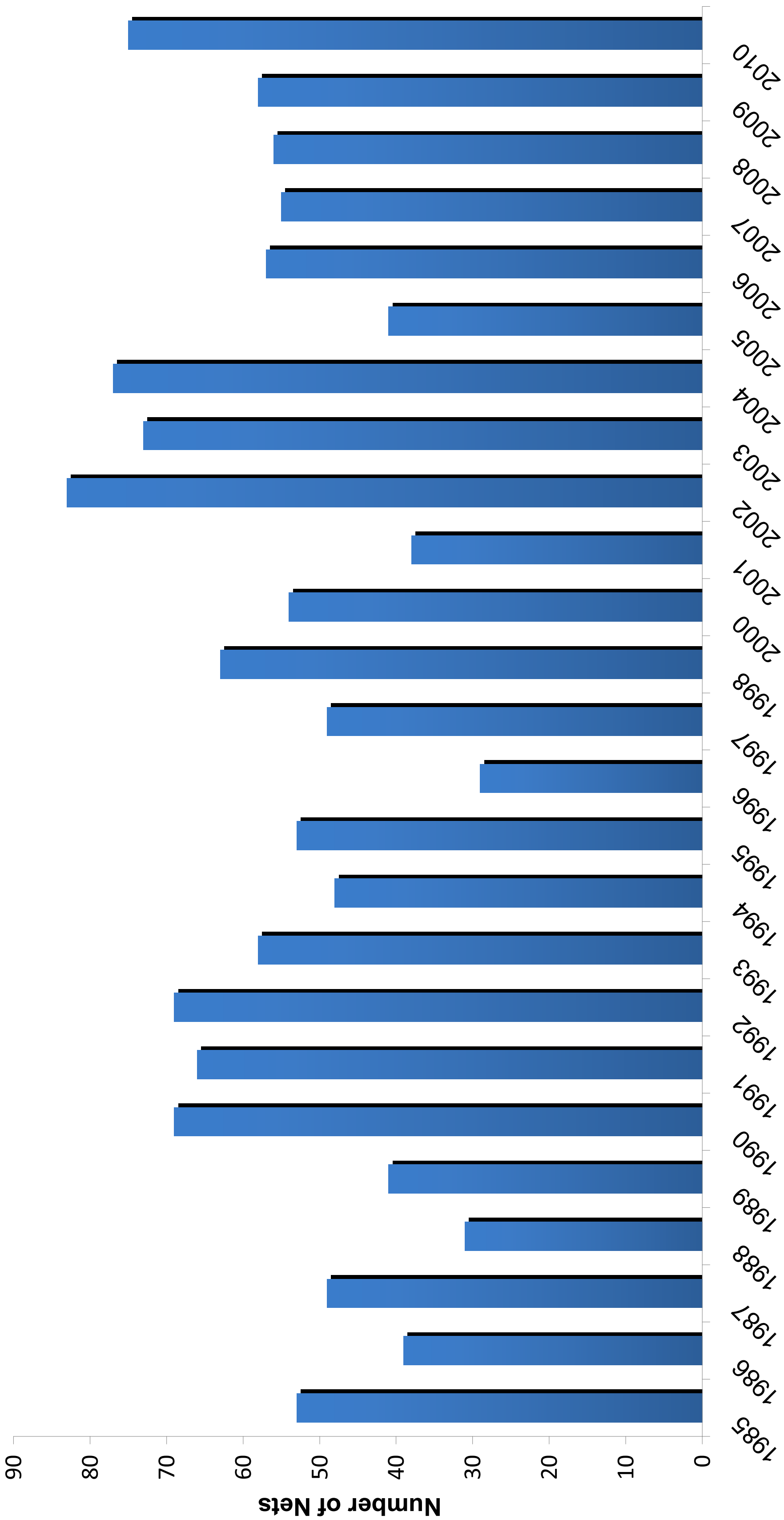


Figure 3. Number of gill nets deployed annually in the fall subsistence fishery, Colville River, 1986–2010.

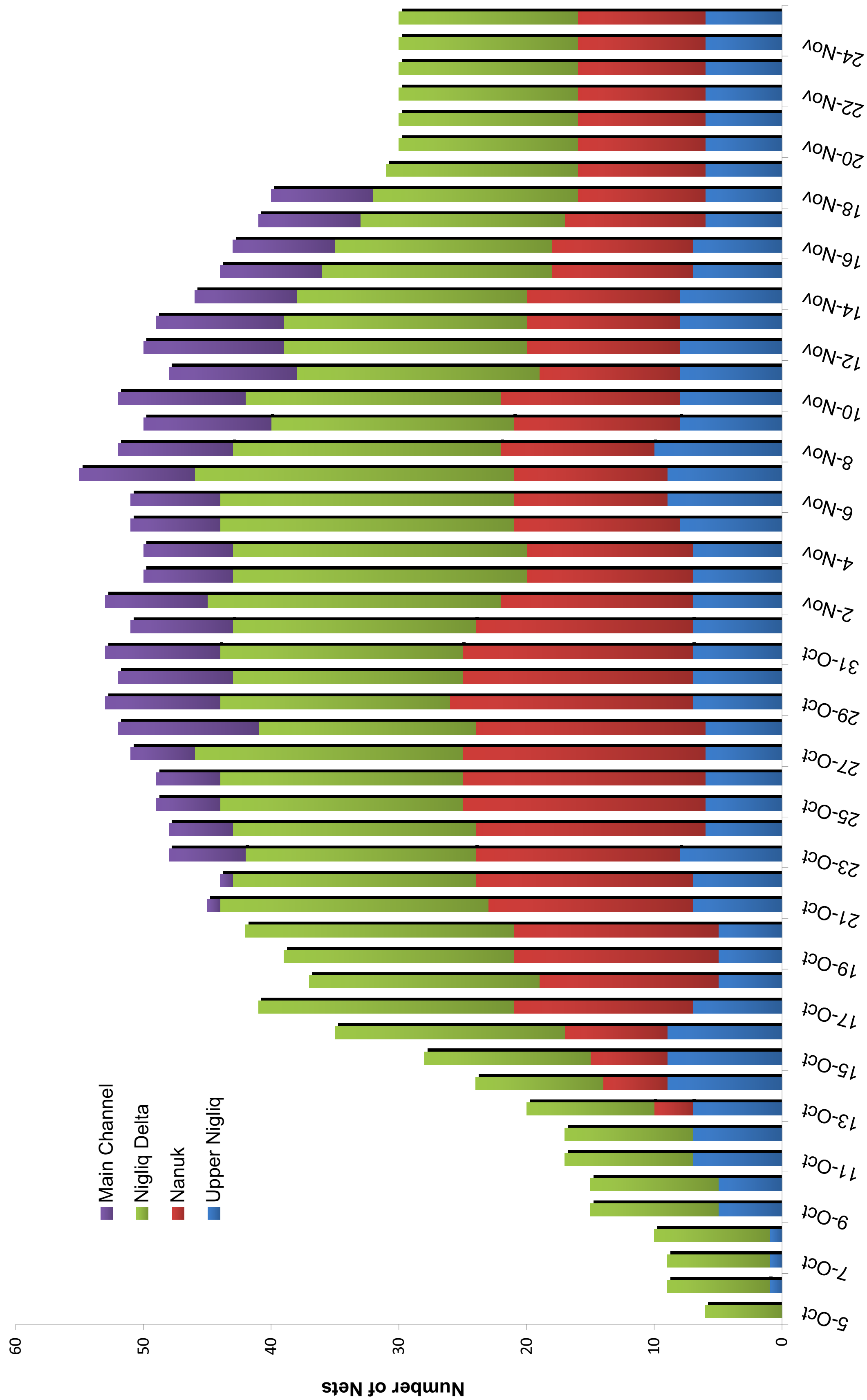


Figure 4. Number of nets fishing each day in each of 3 Nigliq Channel fishing areas and in the main channel, Colville River, 2010.

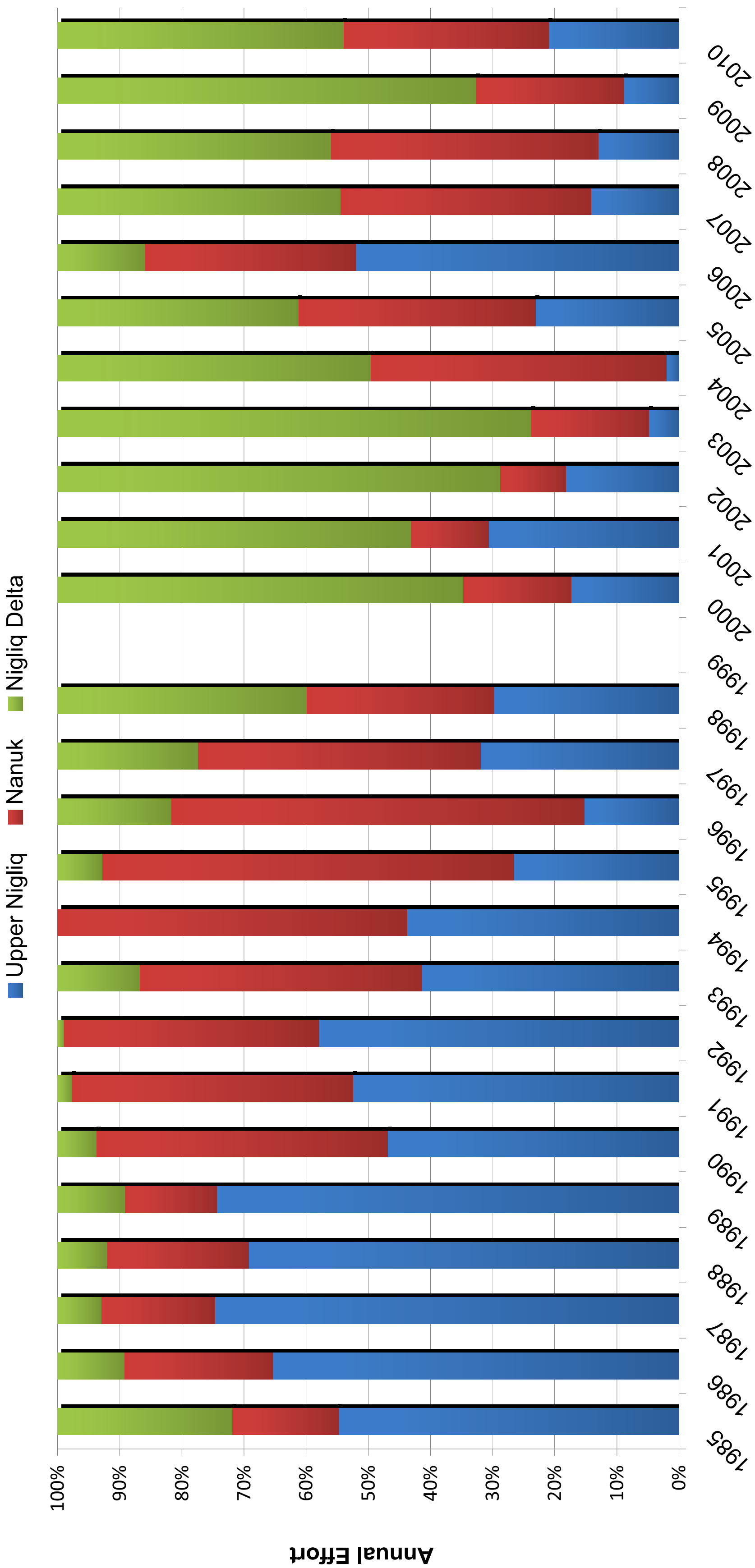


Figure 5. Percent of annual fishing effort in each of 3 Nigliq Channel fishing areas, Colville River, 1985–2010. All nets are included, and the Uyagagviq area is combined with the Nanuk area.

Table 3. Observed catch of arctic cisco (number of fish), effort (net days), and catch per unit effort (CPUE; fish/net day) for each fishing area in the Niġliq Channel, Colville River, 1986–2010. Catch and effort data are for 7.6-cm mesh gillnets, standardized to 18-m length.

	Upper Niġliq			Nanuk			Niġliq Delta			Total Niġliq Channel		
Year	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1986	2,218	115.7	19.2	752	25.1	29.9	3,379	51.3	65.8	6,349	192.2	33.0
1987	1,451	131.7	11.0	948	32.6	29.1	661	31.3	21.1	3,060	195.7	15.6
1988	366	56.9	6.4	146	18.0	8.1	2,078	37.3	55.7	2,590	112.3	23.1
1989	993	90.8	10.9	258	14.3	18.0	535	21.7	24.7	1,786	126.8	14.1
1990	650	147.1	4.4	1,114	148.5	7.5	202	27.6	7.3	1,966	323.1	6.1
1991	522	143.0	3.7	1,327	326.9	4.1	16	8.0	2.0	1,865	477.9	3.9
1992[a]	4,825	316.2	15.3	2,322	130.4	17.8	4,956	96.2	51.5	12,103	542.8	22.3
1993[a]	1,709	106.2	16.1	5,783	158.3	36.5	1,568	57.7	27.2	9,060	322.2	28.1
1994	366	99.0	3.7	642	190.2	3.4	0	0.0	--	1,008	289.2	3.5
1995[a]	56	50.3	1.1	568	178.3	3.2	267	12.0	22.3	891	240.7	3.7
1996	413	36.0	11.5	3,591	193.3	18.6	0	0.0	--	4,004	229.3	17.5
1997	2,539	119.0	21.3	3,586	128.8	27.8	2,207	53.3	41.4	8,332	301.2	27.7
1998	189	92.3	2.0	218	83.7	2.6	1,214	155.3	7.8	1,621	331.3	4.9
1999						No Data						
2000	8	8.0	1.0	217	62.0	3.5	1,826	190.4	9.6	2,051	260.4	7.9
2001	92	62.0	1.5	36	22.7	1.6	611	208.8	2.9	739	293.4	2.5
2002	103	115.7	0.9	137	36.7	3.7	2,925	460.9	6.3	3,165	613.2	5.2
2003	62	11.7	5.3	1,495	104.0	14.4	6,187	455.7	13.6	7,744	571.3	13.6
2004	338	22.0	15.4	8,102	270.9	29.9	5,021	199.7	25.1	13,461	492.6	27.3
2005	1,387	90.0	15.4	3,222	169.5	19.0	4,512	177.0	25.5	9,121	436.5	20.9
2006[a]	1,281	105.0	12.0	2,930	83.3	35.0	6,913	81.3	85.0	11,124	269.7	41.0
2007[a]	498	63.0	7.9	935	109.2	8.6	4,422	200.2	22.1	5,855	372.5	15.7
2008[a]	156	44.0	3.5	1,665	203.3	8.2	2,662	198.3	13.4	4,483	445.6	10.1
2009[a]	0	0.0	0.0	1,027	88.3	11.6	4,258	196.3	21.7	5,285	284.6	18.6
2010[a]	91	34.7	2.6	270	98.0	2.8	1,866	193.0	9.7	2,227	326	6.8
Total[b]	20,313	2,060	9.9	41,291	2,876	14.4	58,286	3,113	18.7	119,890	8,051	14.9

[a] Upper Niġliq catch and effort values include fish and net data from the Uyagagviq area (Area 630).
[b] Denotes average CPUE from 1986–2010.

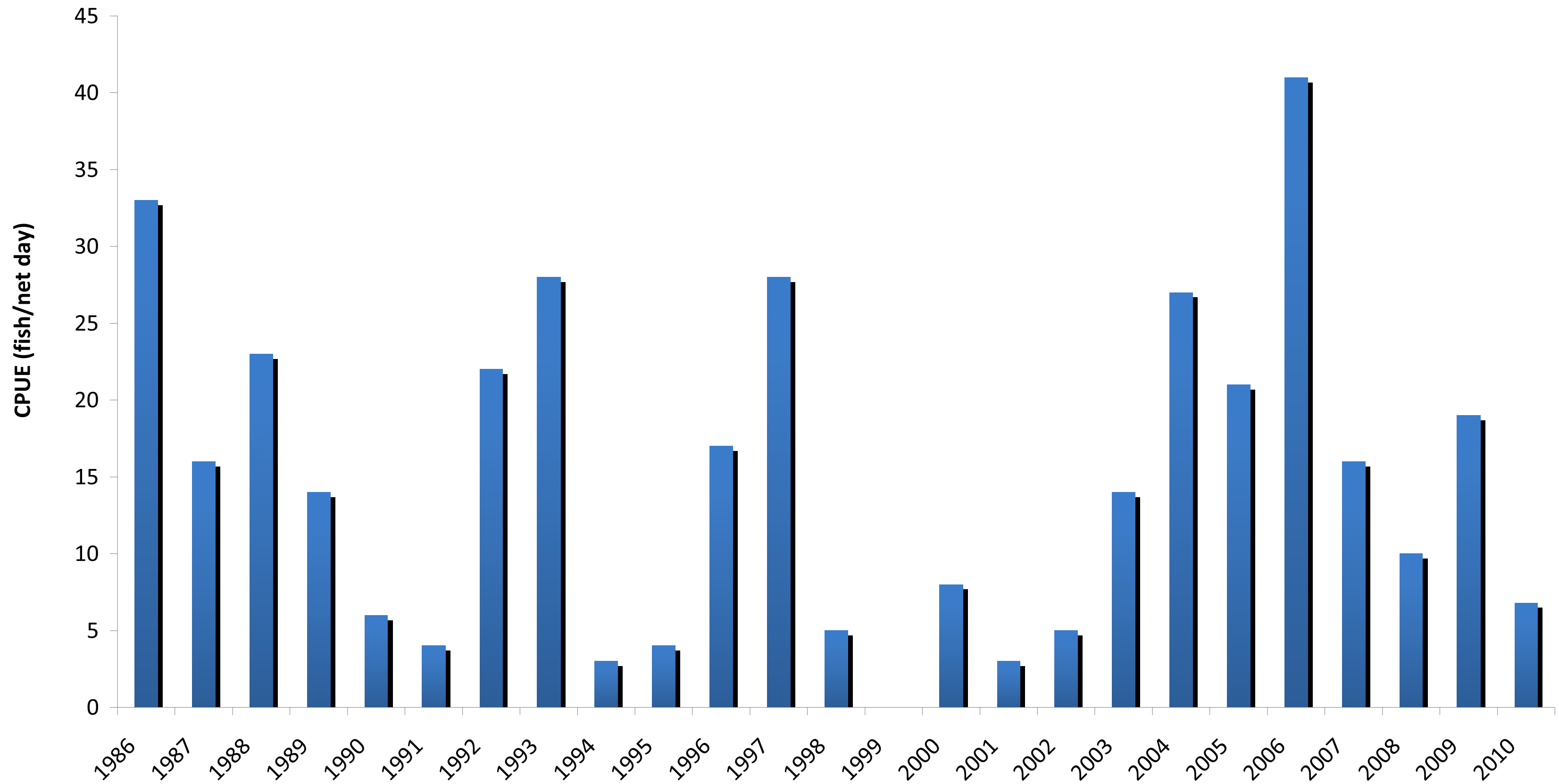


Figure 6. Catch per unit effort (CPUE) of arctic cisco in 7.6-cm gillnets, Niġliq Channel, Colville River, 1986–2010. Effort is standardized to 18-m net length, as described in text.

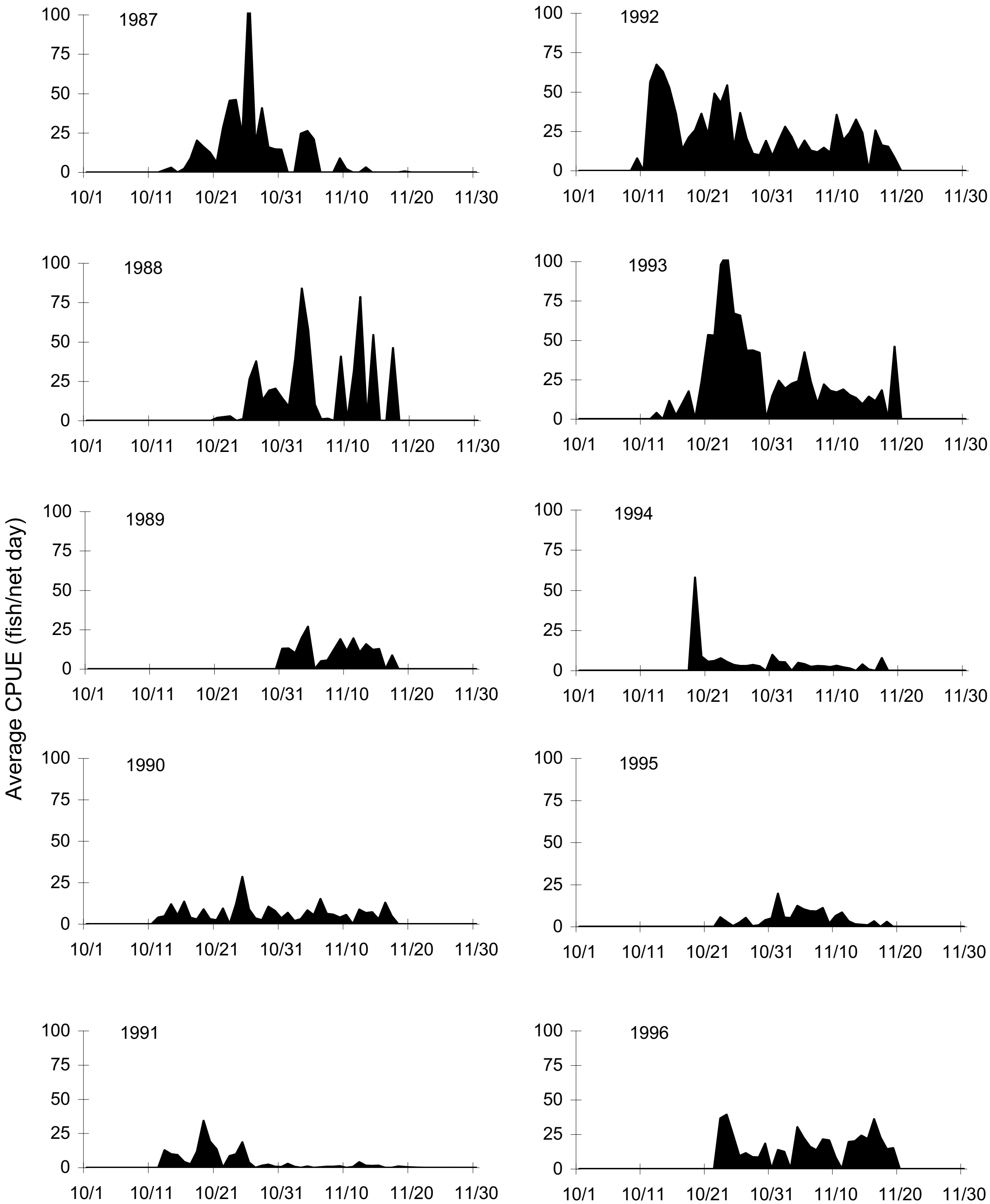


Figure 7a. Average daily catch per unit effort (catch per net day) of arctic cisco in 7.6-cm gillnets, Niġliq Channel, Colville River, 1987–1996. Effort is standardized to 18-m net length, as described in text.

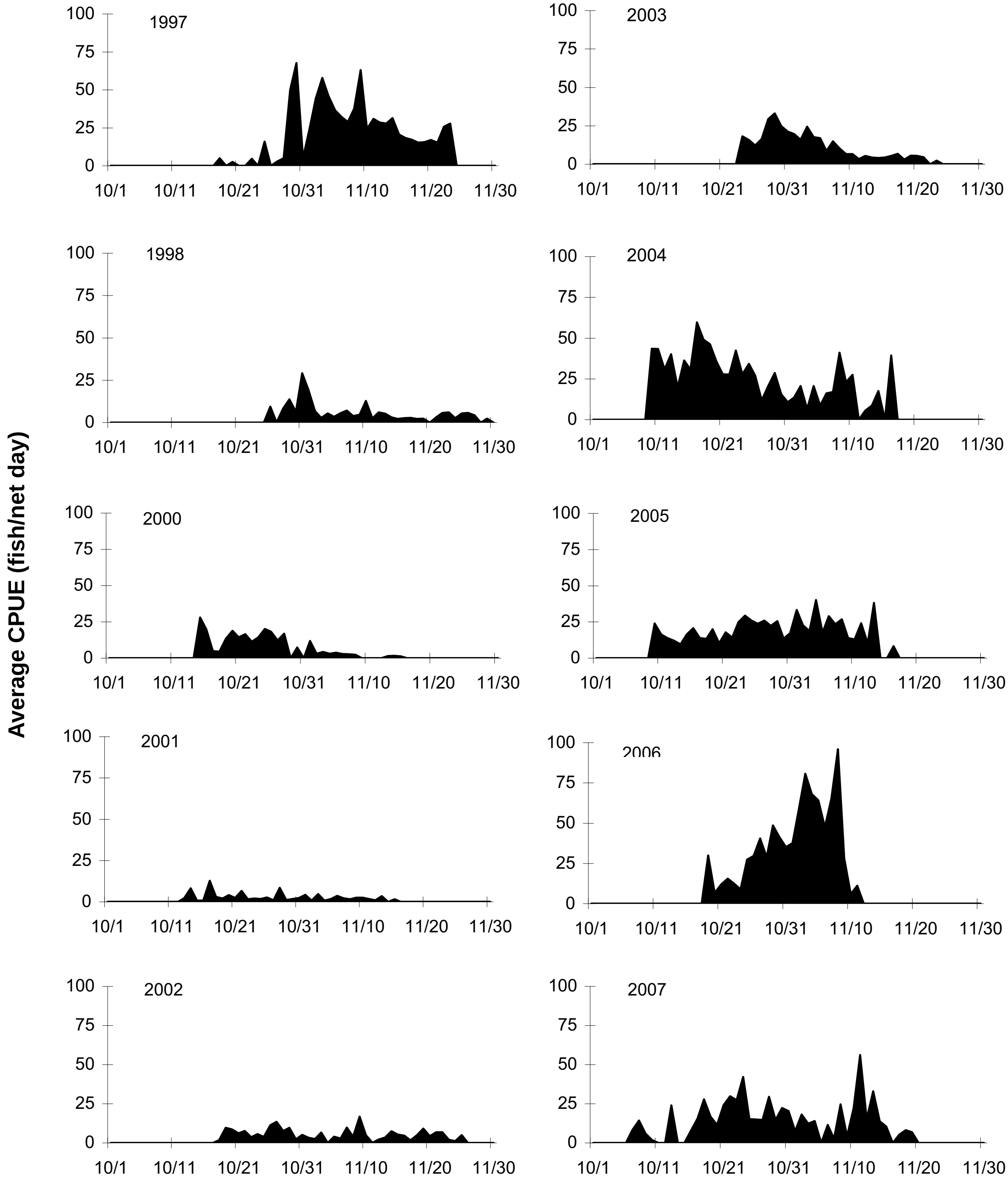


Figure 7b. Average daily catch per unit effort (catch per net day) of arctic cisco in 7.6-cm gillnets, Niġliq Channel, Colville River, 1997–1998 and 2000–2007. Effort is standardized to 18-m net length, as described in text.

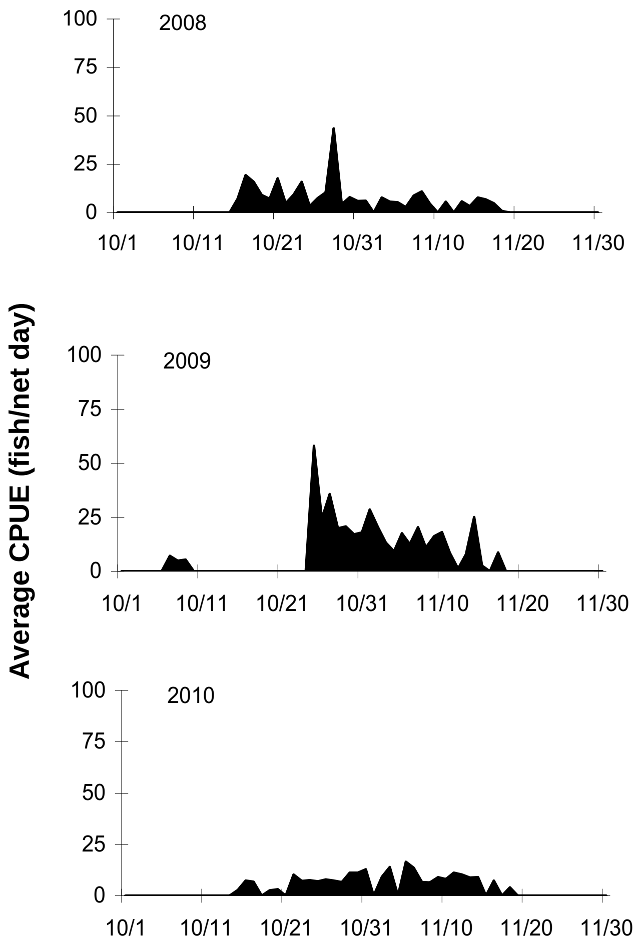


Figure 7c. Average daily catch per unit effort (catch per net day) of arctic cisco in 7.6-cm gillnets, Niġliq Channel, Colville River, 2008–2010. Effort is standardized to 18-m net length, as described in text.

fish/day in 5.4-cm mesh nets to 2.6 fish/day in 8.9-cm mesh nets (Table 4). Observed net length adjusted CPUE multiplied by observed adjusted fishing time for each mesh size class (from Table 2) yields a total harvest estimate of 20,754 arctic cisco from the Niġliq Channel and 3,083 from the main channel of the Colville River for an estimated harvest of nearly 24,000 arctic cisco in 2010 (Table 4, Figure 8).

In addition to arctic cisco, 7 other species of fish were recorded in the harvest in 2010 for all fishing areas (Table 5). A total of 18,505 fish (all species and mesh sizes) were counted in interviews, with arctic cisco (60.7%) and least cisco (34.4%) comprising the vast majority of the recorded harvest (Table 5). The proportion of least cisco in the observed harvest (34.4%) was the highest since 1998. Rainbow smelt (*Osmerus mordax*), saffron cod (*Eleginus gracilis*), Bering cisco (*Coregonus laurettae*), broad whitefish (*C. nasus*), and humpback whitefish (*C. pidschian*) also occurred in the harvest in small numbers. The CPUE in the Niġliq Channel for least cisco in 2010 was slightly lower (1.9 fish/day) than in 2009 (2.2 fish/day). CPUE increased in an upstream direction with the highest CPUE (4.0 fish/ adjusted net day) occurring in the Upper Niġliq fishing location. CPUE for least cisco in 2010 in the Niġliq Channel was lower than the long term average between 1986–2009 (3.5 fish/ day) (Table 6). Catch rates for least cisco in the main channel (1.9 fish/day) were significantly higher than those of the Niġliq Channel (39.7 fish/day).

LENGTH, WEIGHT, AND AGE OF CATCH

A sub-sample of fish were measured daily at net sites to determine the size classes present in the fishery. ABR measured fork lengths of 1,547 arctic cisco in 2010, compared to 2,277 arctic cisco in 2009 and 2,341 in 2008. Fish ranged in length from 195 to 450 mm (Figure 9), with the middle 50% of fish measuring between 280 and 331 mm. By comparison, the middle 50% of fish measured between 308 and 333 mm in 2009. The median fork length was 296 mm (compared to a median of 321 mm in 2008). The length distribution of arctic cisco appears bimodal in distribution with a skew to the left. The frequency of length classes of arctic cisco captured differed among mesh sizes (Figure 10), with 7.6-cm mesh size nets capturing the widest distribution of lengths in the fishery. There is a general stair-step increase in fish lengths captured in nets of increasing mesh size.

ABR also measured fork lengths of 613 least cisco (Figure 9). The length distribution for least cisco also was normally distributed and ranged between 204 and 403 mm with a median of 322 mm (2009 values were between 239 and 389 mm with a median of 305 mm). The middle 50% of the measured harvest was between 304 and 343 mm (by comparison with 279 and 310 mm in 2009).

Table 4. Observed harvest of arctic cisco (number of fish), effort (net days), and catch per unit effort (CPUE; fish/net day) by mesh size, standardized to 18-m length, for each fishing area in the Niġliq Channel and main channel, Colville River, 1986–2010. Estimate of total harvest is calculated based on calculated effort and estimated CPUE for each river section.

	Upper Niġliq			Nanuk			Niġliq Delta			Total Niġliq Channel			Main Channel			Total							
Mesh Size (cm)	Observed Catch (# of fish)	Effort (net days)	CPUE (fish/net day)	Catch (# of fish)	Effort (net days)	CPUE (fish/net day)	Catch (# of fish)	Effort (net days)	CPUE (fish/net day)	Catch (# of fish)	Effort (net days)	CPUE (fish/net day)	Catch (# of fish)	Effort (net days)	CPUE (fish/net day)	Catch (# of fish)	Effort (net days)	CPUE (fish/net day)	Niġliq Actual Adjusted Net Days	Estimated Nigliq Channel Harvest	Main Actual Adjusted Net Days	Estimated Main Channel Harvest	Estimated Harvest
5.1	--	--	--	--	--	--	630	10.3	61.0	630	10.3	61.0	--	--	--	630	10.3	61.0	10	609.87	--	--	
6.4	145	11.7	12.4	--	--	--	2,570	51.7	49.7	2,715	63.3	42.9	542	20	27.1	3,257	83.3	39.1	206.7	8,859.97	26.7	723.57	
7.0	54	12.7	4.3	51	10.7	4.8	499	42.7	11.7	604	66.0	9.2	--	--	--	604	66.0	9.2	213.3	1,951.72	--	--	
7.6	91	34.7	2.6	270	98.0	2.8	1,866	193.0	9.7	2,227	325.7	6.8	488	57	8.6	2,715	382.7	7.1	1,143.3	7,818.13	209.7	1,795.03	
8.3	--	--	--	--	--	--	47	4.0	11.8	47	4.0	11.8	--	--	--	47	4.0	11.8	30.3	356.03	--	--	
8.9	13	16.0	0.8	103	64.0	1.6	205	42.0	4.9	321	122.0	2.6	141	14	10.07	462	136.0	3.4	440.3	1,158.49	56	563.92	
Total																				20,754.21		3,082.52	23,836.73

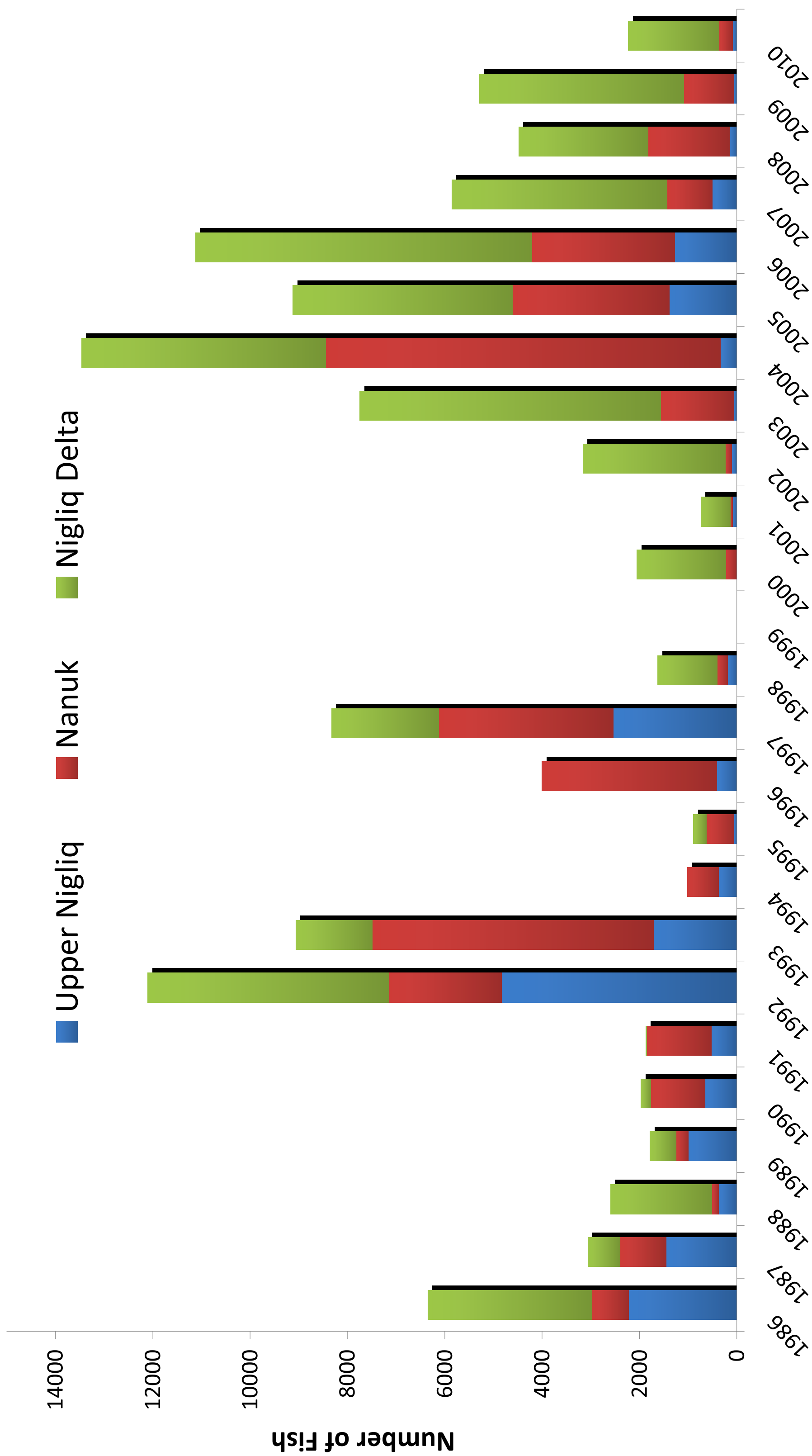


Figure 8. The number of arctic cisco harvested in 7.6-cm mesh gill nets in each of 3 Nigliq Channel fishing areas, Colville River, 1986–2010. Data from 2005–2010 are not directly comparable to older data because the fishery was not monitored for the entire season.

Table 5. Species composition of the subsistence harvest from the Colville River fall fishery, expressed as a percent of the sampled catch, 1985–2010. Table includes all fish caught in every net, regardless of mesh size.

Year	Arctic cisco	Bering cisco	Least cisco	Broad whitefish	Humpback whitefish	Arctic grayling	Rainbow smelt	Round whitefish	Dolly Varden char	Northern pike	Saffron cod	Burbot	Arctic flounder	Fourhorn sculpin	Total Observed
1985	69.5	(a)	14.8	15.1	0.5	0	0.2	0	0	0	0	0	0	(b)	2,705
1986	95.9	(a)	3.8	0.3	0.03	0	0.03	0.01	0	0	0	0	0	(b)	8,952
1987	71.8	(a)	18.7	5.5	3.8	0	0.01	0	0.03	0	0.03	0.06	0	(b)	6,826
1988	90.6	(a)	8.3	0.6	0.5	0	0	0	0	0	0	0.1	0	(b)	2,948
1989	66.2	(a)	23.7	7	3.1	0	0.03	0	0	0	0.03	0.03	0	(b)	2,946
1990	39.6	21.8	30.2	5.3	2.9	0	0.2	0	0.1	0	0.03	0.01	0	(b)	7,911
1991	62.8	1.2	30	1	3.8	0	1	0.03	0	0	0.04	0.09	0	(b)	7,576
1992	89.2	0.1	6	0.2	0.1	0	0	0	0	0	0	0	0	4.4	24,305
1993	85.4	0.02	11.1	0.3	0.4	0	0.04	0	0	0	0.01	0	0	2.7	17,155
1994	39.6	0.1	44.6	2.2	13.2	0	0.3	0	0	0	0	0	0	(b)	3,792
1995	34.7	0.2	35	7.6	22.3	0	0.2	0	0	0	0	0.1	0	(b)	7,155
1996	81.9	0	4.8	0.1	0.4	0	0.1	0	0	0	0.02	0.02	0.02	12.5	5,730
1997	74.8	0	22.9	1.3	0.9	0	0	0	0	0	0	0	0	(b)	19,758
1998	39.6	0	50.8	0.4	8.9	0	0	0.2	0	0	0	0	0	(b)	6,481
2000	79.4	0.1	14	0.2	6	0	0.3	0	0	0	0.03	0	0	(b)	3,871
2001	35.6	0.1	29.6	5.5	27.8	0	0.1	0	0	0	0	1.3	0	(b)	3,515
2002	49.8	0.1	30.6	1.6	17.5	0	0.2	0	0	0	0.1	0.2	0	(b)	8,445
2003	66.3	0.2	22.3	0.2	9.4	0	0.9	0	0	0	0.6	0.1	0	(b)	16,654
2004	74.7	0.06	24.2	0.03	0.85	0	0.08	0	0	0	0.04	0.03	0	(b)	20,705
2005	81.3	0	14.8	0.2	3.5	0	0.15	0	0	0	0.01	0	0	(b)	13,957
2006	86.6	0	12	0.4	0.9	0	0	0	0	0.1	0	0	0	(b)	17,344
2007	71.7	0	22.3	0.4	5.5	0	0	0	0	0	0.1	0	0	(b)	14,686
2008	84.1	0.2	14.7	0	0.1	0	0.7	0	0	0	0.1	0.01	0	(b)	9,199
2009	85.4	0.2	9.2	0.2	0.5	0	4.3	0	0	0	0.1	0.03	0	(b)	11,700
2010	60.7	0	34.4	0.4	3.0	0	1.3	0	0	0	0.2	0	0	(b)	18,505

(a) = included with arctic cisco prior to 1990
(b) = always present but not counted

Table 6. Observed catch of least cisco (number of fish), effort (net days), and catch per unit effort (CPUE; fish/net day) for each fishing area in the Niġliq Channel, Colville River, 1986–2010. Catch and effort data are for 7.6-cm mesh gillnets, standardized to 18-m length.

	Upper Nigliq			Nanuk			Nigliq Delta			Total Nigliq Channel		
Year	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1986	146	115.7	1.0	16	25.1	1.0	24	51.3	0.0	186	192.2	1.0
1987	730	131.7	6.0	63	32.6	2.0	12	31.3	0.0	805	195.7	4.0
1988	93	56.9	2.0	12	18	1.0	105	37.3	3.0	210	112.3	2.0
1989	332	90.8	4.0	16	14.3	1.0	10	21.7	0.0	358	126.8	3.0
1990	711	147.1	5.0	416	148.5	3.0	179	27.6	6.0	1,306	323.1	4.0
1991	50	143	0.0	272	326.9	1.0	0	8	0.0	322	477.9	1.0
1992	261	316.2	1.0	88	130.4	1.0	151	96.2	2.0	500	542.8	1.0
1993	181	106.2	2.0	498	158.3	3.0	96	57.7	2.0	775	322.2	2.0
1994	330	99	3.0	711	190.2	4.0	0	0	--	1,041	289.2	4.0
1995	238	50.3	5.0	494	178.3	3.0	94	12	8.0	826	240.7	3.0
1996	14	36	0.0	195	193.3	1.0	0	0	--	209	229.3	1.0
1997	1,370	119	12.0	1,575	128.8	12.0	203	53.3	4.0	3,148	301.2	10.0
1998	544	92.3	6.0	577	83.7	7.0	935	155.3	6.0	2,056	331.3	6.0
1999						No Data						
2000	11	8	1.0	97	62	2.0	330	190.4	2.0	438	260.4	2.0
2001	129	62	2.0	222	22.7	10.0	491	208.8	2.0	842	293.4	3.0
2002	176	115.7	2.0	165	36.7	5.0	1,033	460.9	2.0	1,374	613.2	2.0
2003	25	11.7	2.0	459	104	4.0	1,038	455.7	2.0	1,522	571.3	3.0
2004	167	22	8.0	2,493	270.9	9.0	1,483	199.7	7.0	4,143	492.6	8.0
2005	405	90	5.0	710	140.3	5.0	700	177	4.0	1,815	407.3	4.0
2006	274	92.7	3.0	261	67.3	4.0	414	65.0	6.0	949	225.0	4.0
2007	939	63.0	15.0	559	109.4	5.0	1085	188.7	6.0	2583	361.2	7.0
2008	78	44.0	1.8	529	188.0	2.8	460	233.2	2.0	1067	465.2	2.3
2009	6	1.7	3.6	321	88.3	3.6	265	181.3	1.5	592	271.3	2.2
2010	139	34.7	4.0	235	92	2.6	225	193.3	1.2	599	320	1.9
Totals	7,349	2,050	3.6	10,984	2,810	3.9	9,333	3,106	3.0	27,666	7,966	3.5

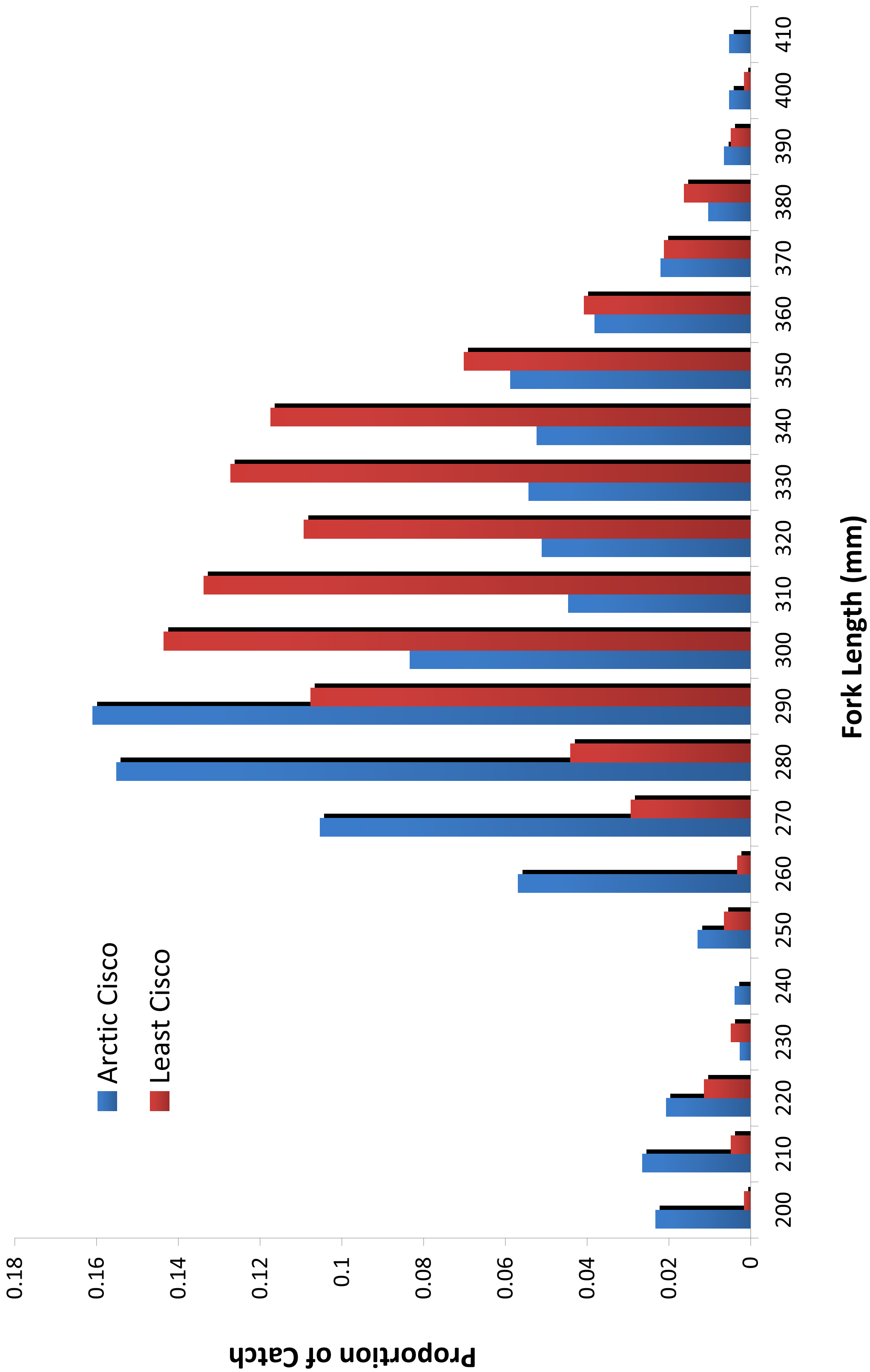


Figure 9. Length frequency (10-mm increments) of arctic and least cisco captured in all mesh sizes in the fall subsistence fishery, Nigliq Channel, Colville River, 2010.

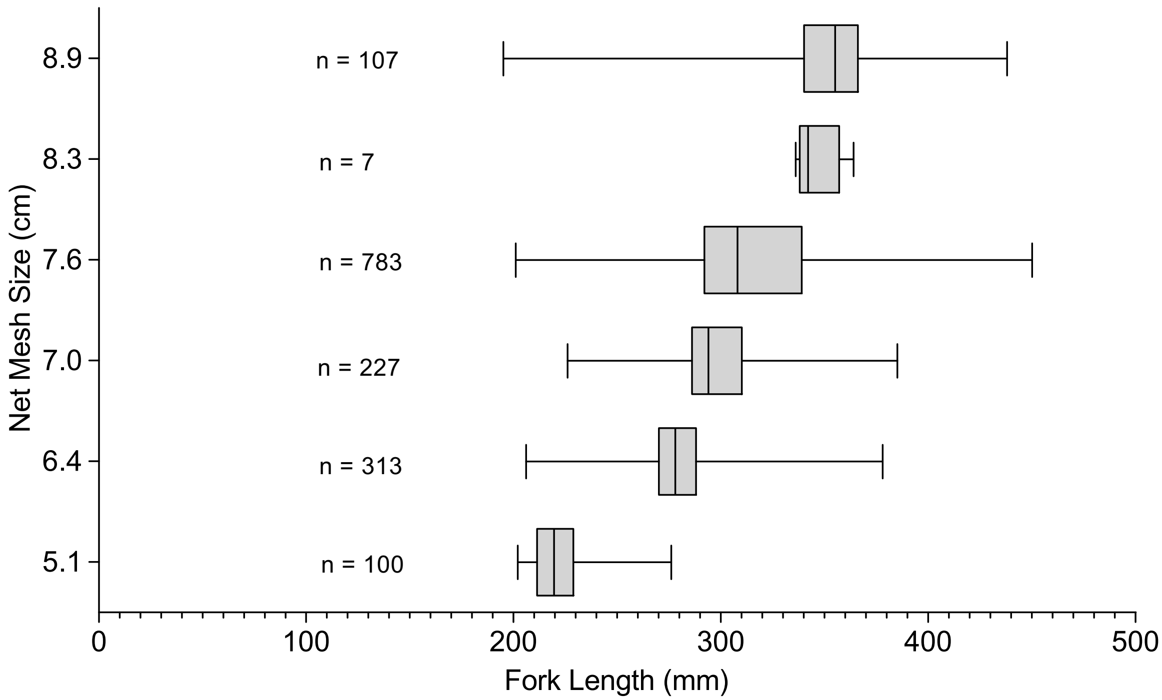


Figure 10. Cumulative length frequency of arctic cisco in the fall subsistence fishery by gillnet mesh size, Niġliq Channel and main channel, Colville River, 2010.

As in previous years, ABR paid for fisher participation to obtain fish for ageing. These fish were frozen and shipped to Anchorage where ABR measured fork length (mm) and weight (g) for an analysis of the relationship between the 2 variables (n = 169). This relationship can be used as an indicator of fish health or condition of the fish. Length and weight were strongly correlated (r^2 = 0.9281, n = 169 following removal of 5 extreme outliers) in arctic cisco in 2010 (Figure 11). These results are similar to 2008 and 2009 which showed correlations of 0.9058 and 0.8977, respectively (Figure 12).

Otoliths were removed from these same fish to estimate age structure for the 2010 harvest. Over all mesh sizes combined (n = 163), arctic cisco ranged in age from 4 to 9 years (Figure 13). Age composition was 42% age 6, 29% age 5, 22% age 7, 3% age 8, 4% age 4, and <1% age 9. Because different mesh-size nets catch different age classes (i.e., sizes of fish) differentially, we also examined harvest separately for 7.6-cm mesh nets, the size most commonly used in the fishery. In 7.6-cm mesh nets (n = 141), age composition was approximately 47% age 6, 25% age 7, 23% age 5, 3% age 8, 1% age 4, and < 1% age 9 (Figure 13). Harvest of age 7 fish made up a higher proportion of the overall observed harvest than 2009 age 6 fish, which represent the same year class (Seigle and Parrett 2009). Arctic cisco generally recruit to the fishery at age 4, when they typically reach lengths sufficient for capture in 6.4-cm and 7.6-cm mesh nets. The fish continue to grow in subsequent years and are caught in higher proportions in these and larger nets. In 2010, the largest observed fork length of aged arctic cisco was in the 9-year-old class, although fish lengths in general were highest in 6- and 7-year-old fish (Figure 14).

Using the age composition of the catch (as percentage of catch) and the overall CPUE of 6.8 fish/net day in the Niġliq Channel (Table 3), we were able to estimate the age-specific CPUE for the 2010 harvest. For 7.6-cm mesh nets, the CPUE increased from age 5 to age 6 before dropping off in age 7 and age 8 arctic cisco (Figure 15). These represent the 2002–2005 year classes. There is still

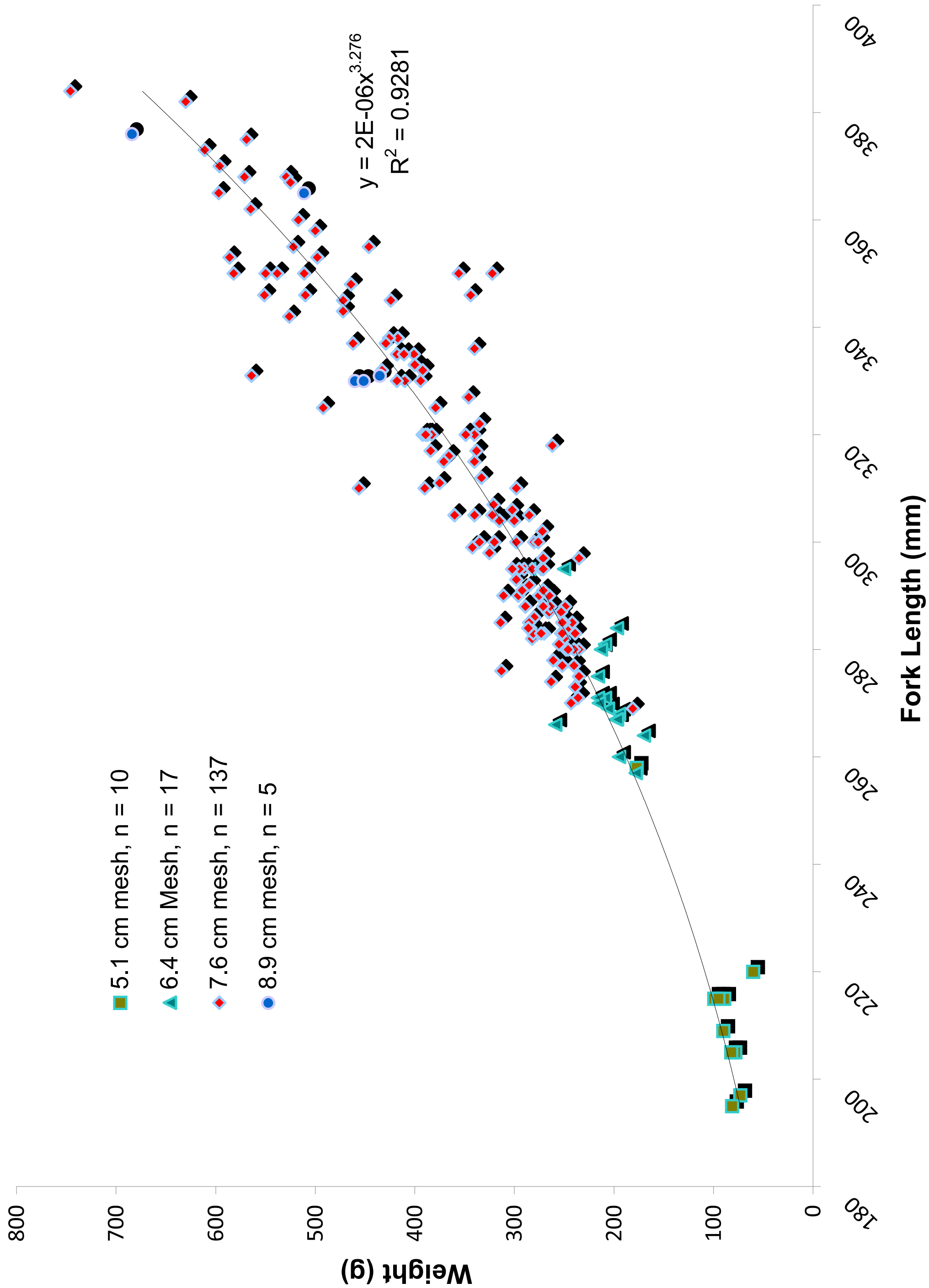


Figure 11. Length-weight relationship of arctic cisco captured in the Nigliq Channel, Colville River, 2010. Includes fish captured in all mesh sizes and all nets (n = 169).

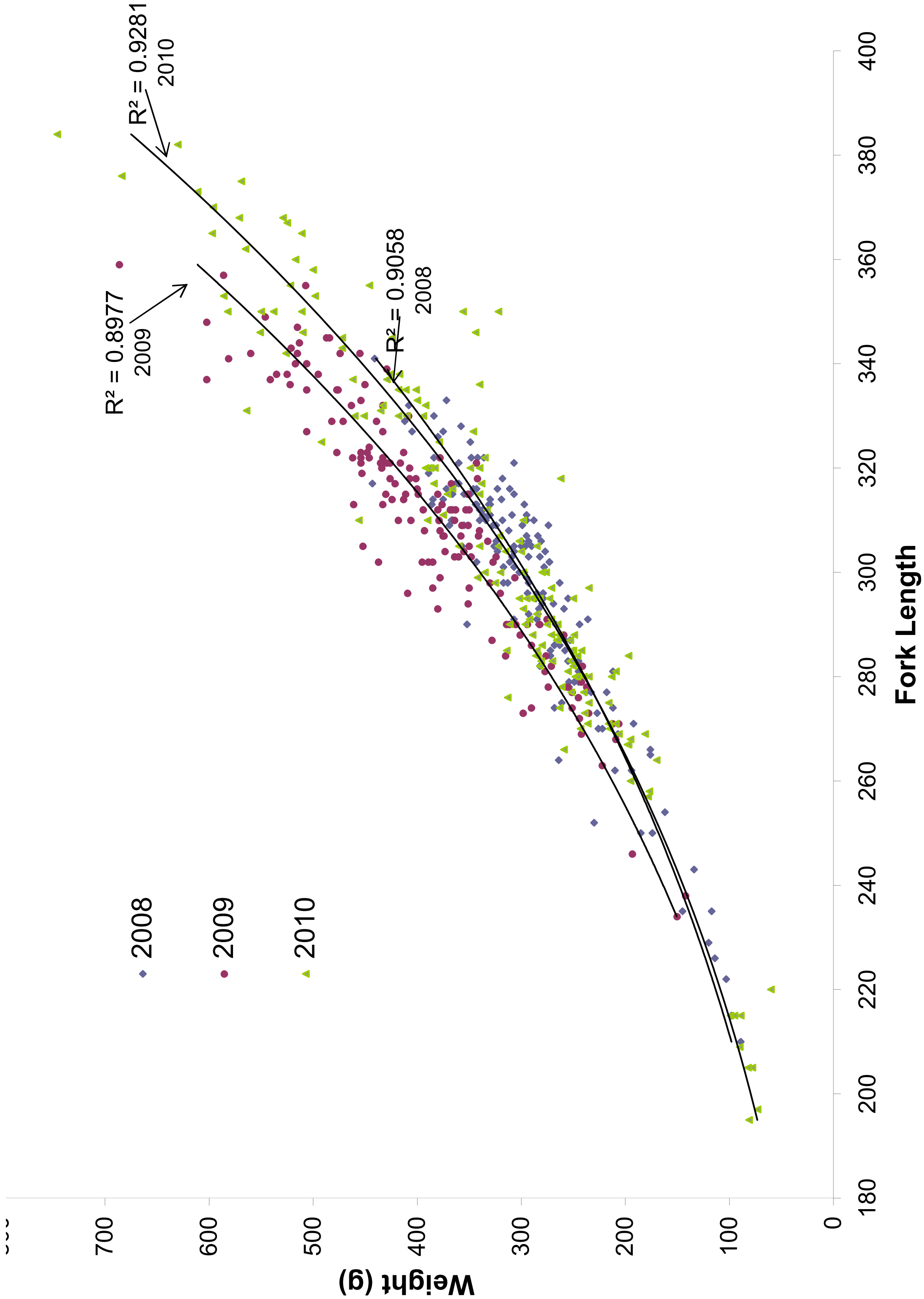


Figure 12. Three-year record of the length-weight relationship of arctic cisco captured in the Niġliq Channel, Colville River, 2008–2010. Includes fish captured in all mesh sizes and all nets for each year.

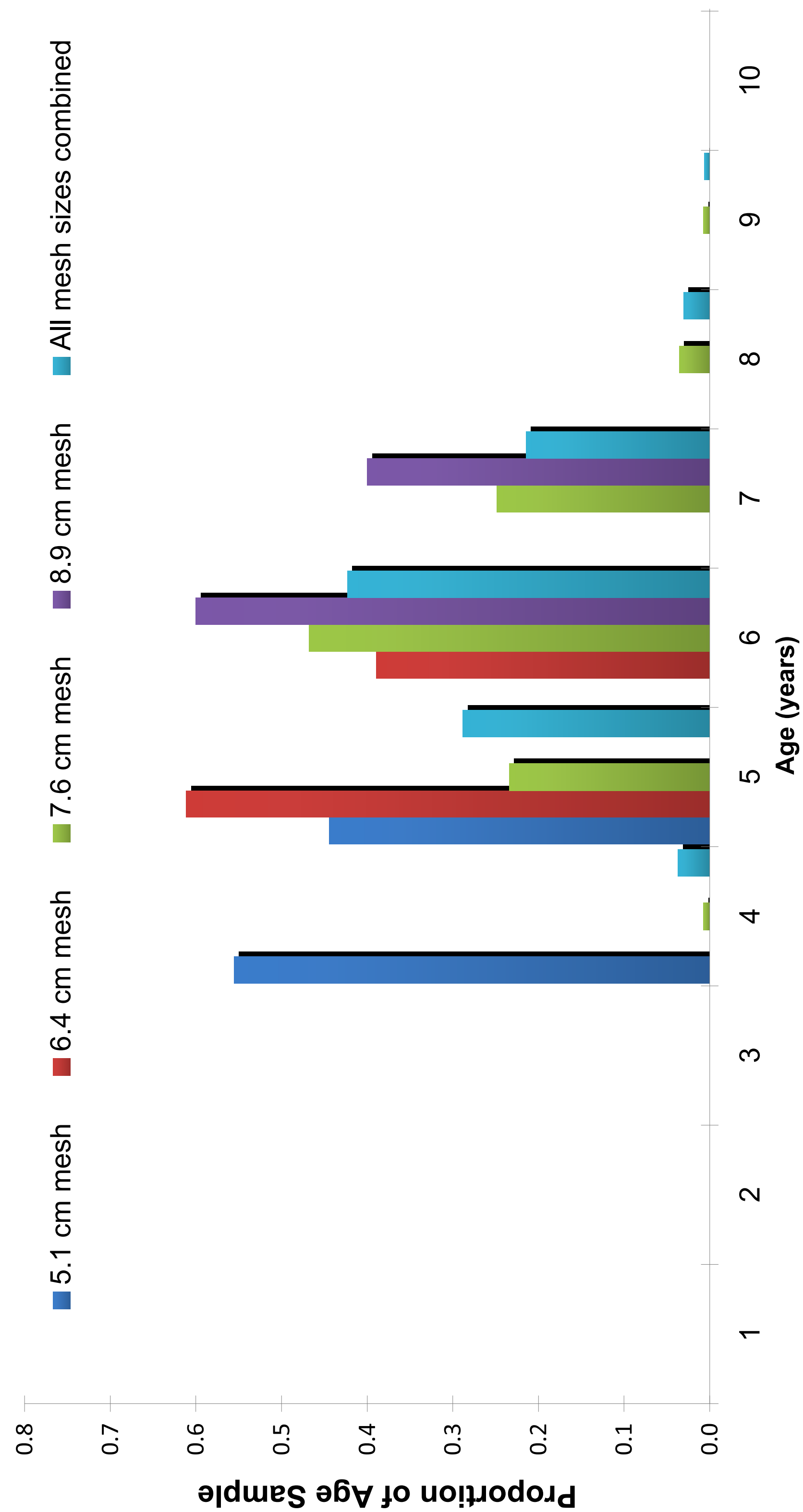


Figure 13. Age composition of arctic cisco harvested in 5.1-cm mesh nets (n = 9), 6.4-cm mesh nets (n = 18), 7.6-cm mesh nets (n = 131), 8.9-cm mesh nets (n = 5), and all mesh sizes together (n = 163), Nigliq Channel, Colville River, 2010.

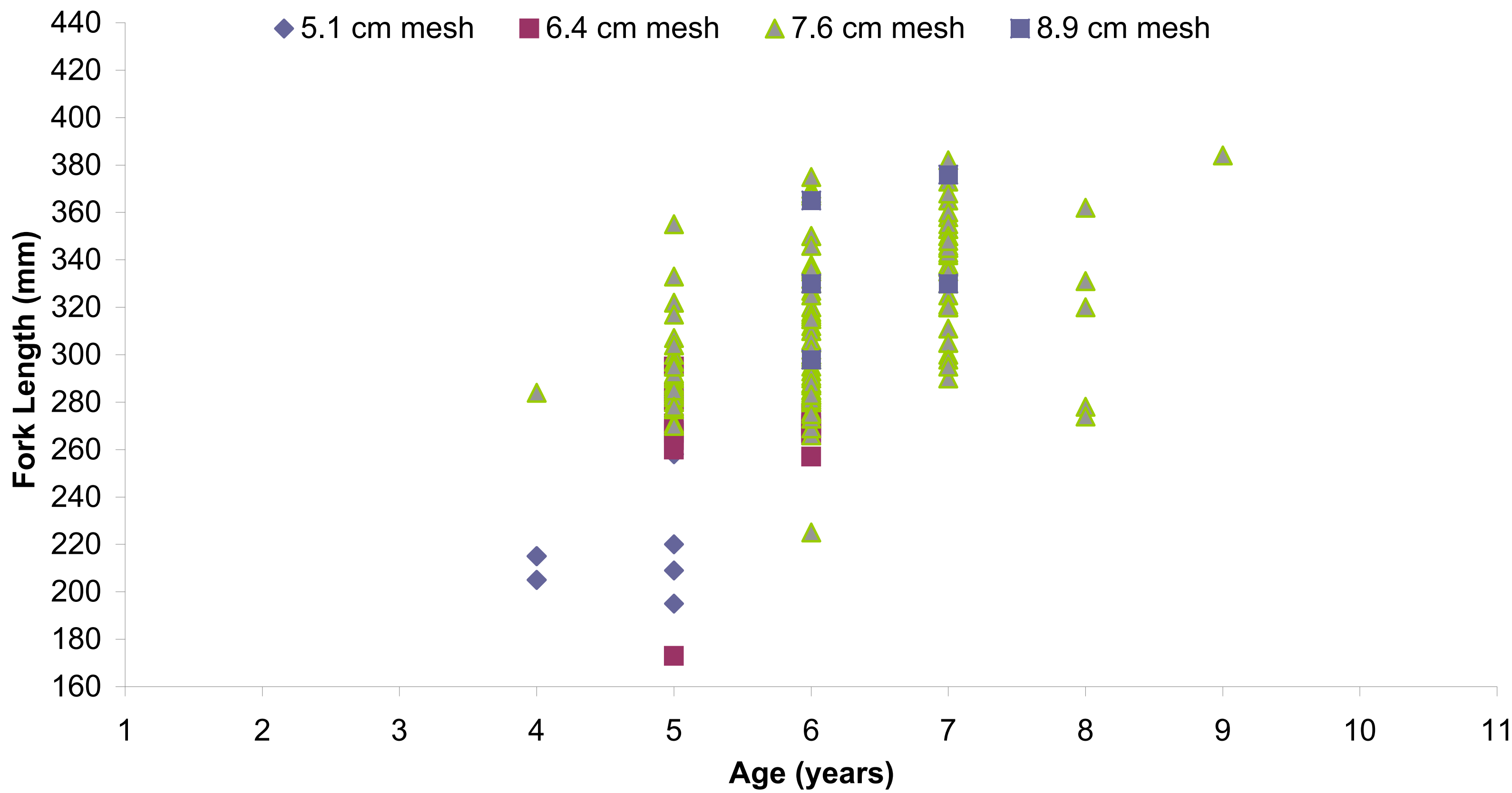


Figure 14. Age-specific length distribution of arctic cisco harvested in the fall subsistence fishery, Niġliq Channel, Colville River, 2010.

minimal representation of the 2001 year class, and the 2006 year class appears for the first time in the fishery (Figure 15). Summing CPUE by age at capture for each year class across all years that the year class was represented in the fishery (Figure 16) provides an indicator of the relative contribution of each year class in the fishery. The cumulative total CPUE for the 2001 year class appears to have topped out at near 10 fish/net day cumulatively by age class. The 2004 year class (6-year-old fish) still appears to be strong in the fishery and was the most harvested year class in the fishery for a second consecutive year (Figures 14 and 15). This is the strongest year class since 1999 and could still contribute cumulatively to the CPUE of that year class, as they will likely remain in the fishery for at least 1 more year.

SALINITY MEASUREMENTS AND WATER QUALITY

Arctic cisco are commonly associated with salinities in the range of 15 to 25 ppt (parts per thousand). West winds in the Colville Delta raise water levels on the Niġliq Channel and bring saline waters upstream, attracting greater numbers of arctic cisco farther up the channel (Moulton and Seavey 2004). We began sampling for salinity on 15 October. Salinities increased steadily throughout the 2010 season at all stations of the Niġliq Channel. Highest salinities were found closest to the delta and lowest salinities were found upstream, as expected (Figure 17). There were 2 dips in salinity at the upstream Uyagagviq station on 27 October and 31 October. Salinity at the downstream Niġliq Delta station increased on both dates, while the Nanuk station in the middle remained steady. Salinity at 3-m depth from surface was within the appropriate range for arctic cisco at the first 2 downstream sampling stations starting around 31 October and the Uyagagviq station reached the 15 ppt threshold on 8 November. Salinities were <15 ppt throughout the fishing season at the farthest upstream station in the Upper Niġliq area, as is common over the years. Salinity usually reaches 15 ppt at the 3-m depth by early November at the 3 downstream sampling stations, but often is less than 15 ppt at 3-m depth at the Upper Niġliq station at that time (Figure 18; Moulton and Seavey 2004). The extent of salt-water intrusion in 2010 was farther upstream than in 2009.

ABR biologists collected water samples at the upper most and the 2 downstream stations in 2010 for analysis metals, total nitrogen, diesel and heavy range organics, and enumeration of algal fragments (Figure 2). On 21 October, 7 November, and 18 November, water samples were collected and shipped for analysis to Arctic Fox Environmental, Inc., in Prudhoe Bay, AK. Total nitrogen readings were highest at the farthest upstream station (water chemistry station 4) in the Upper Niġliq area (Figure 2) and trace amounts of barium were detected at all locations and dates throughout the season, with the highest values occurring at the Niġliq Delta location (water chemistry station 1), closest to the coastline (Figure 2). Trace levels of selenium and arsenic were observed on 7 November. All metals detected throughout the season were well below acceptable EPA standards for drinking water (USEPA 2011). Diesel range and heavy oil organics were not detected during the season. The number of algal fragments in water samples was negligible. Laboratory reports and a summary of water chemistry results are included in Appendices B and C.

DISCUSSION

In 2010, the start of the fall fishery for arctic cisco on approximately 5 October was close to the average historic commencement date (Table 1). The fishery was uninterrupted by unusual warm weather events, as occurred in 2009. Following the commencement of fishing, the number of nets deployed increased rapidly to beyond 50 nets and this high level of fishing effort continued for 3 weeks between 23 October and 13 November (Figure 4). ABR discontinued on-the-ground harvest monitoring after 18 November, consistent with the historical date at which fishing efforts begin to substantially decrease. In 2010, 30 nets were still active in the Niġliq Channel on the date of ABR's demobilization, a significant increase from past years. However, the actual tending of these 30 nets had decreased significantly to the point where many fishers were going 3 days to 1 week without checking their nets (personal communication, Jerry Pausanna). Indeed, by this

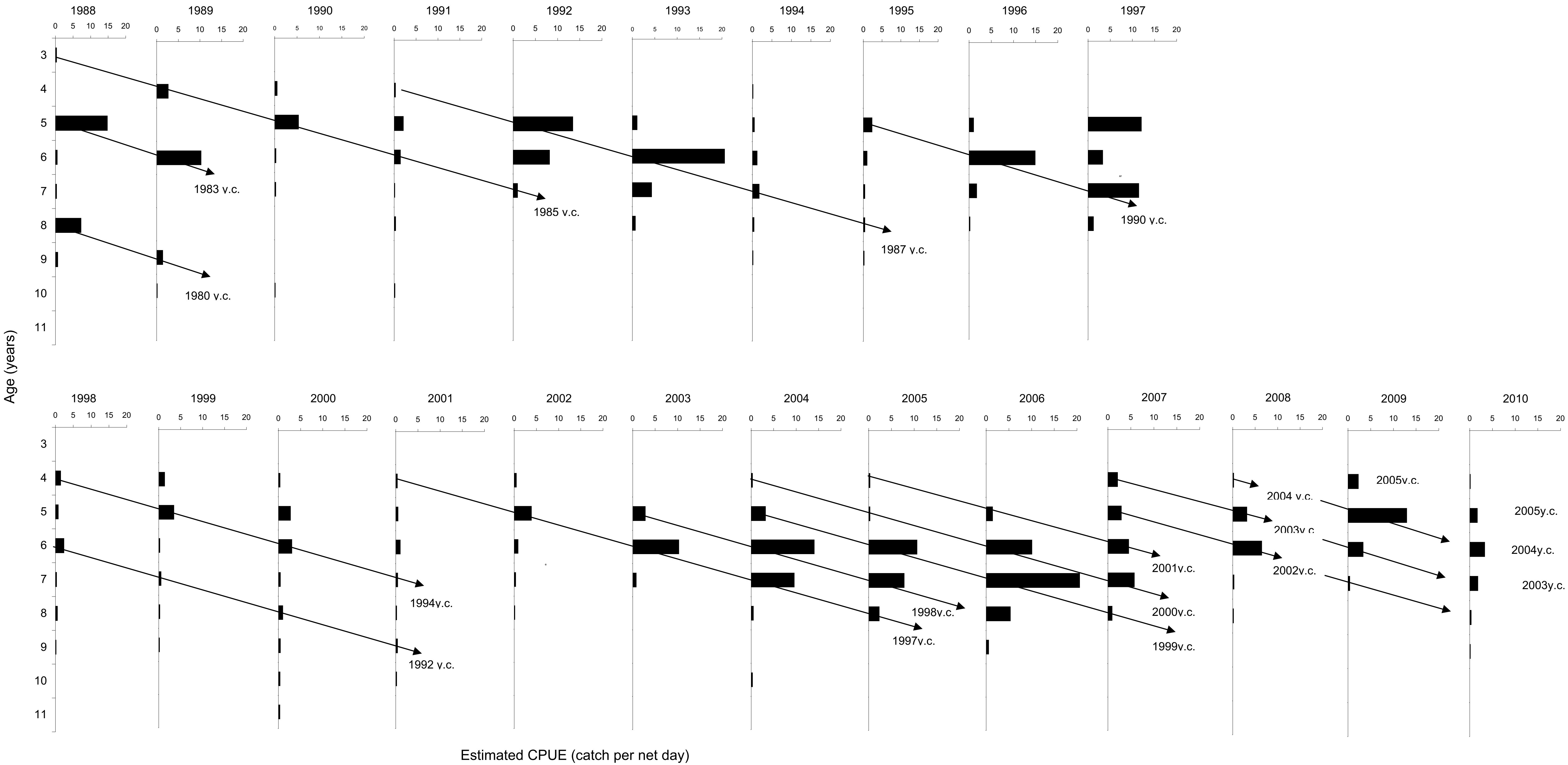


Figure 15. Catch per unit effort (CPUE) of arctic cisco by age class in the fall subsistence fishery, Niġliq channel, 1988–2010. Arrows represent relative change in year class strength over time. Numbers following arrows represent a given year class. Only fish harvested in 7.6 cm mesh gillnets are included and counts are standardized to 18 m net length, as described in text.

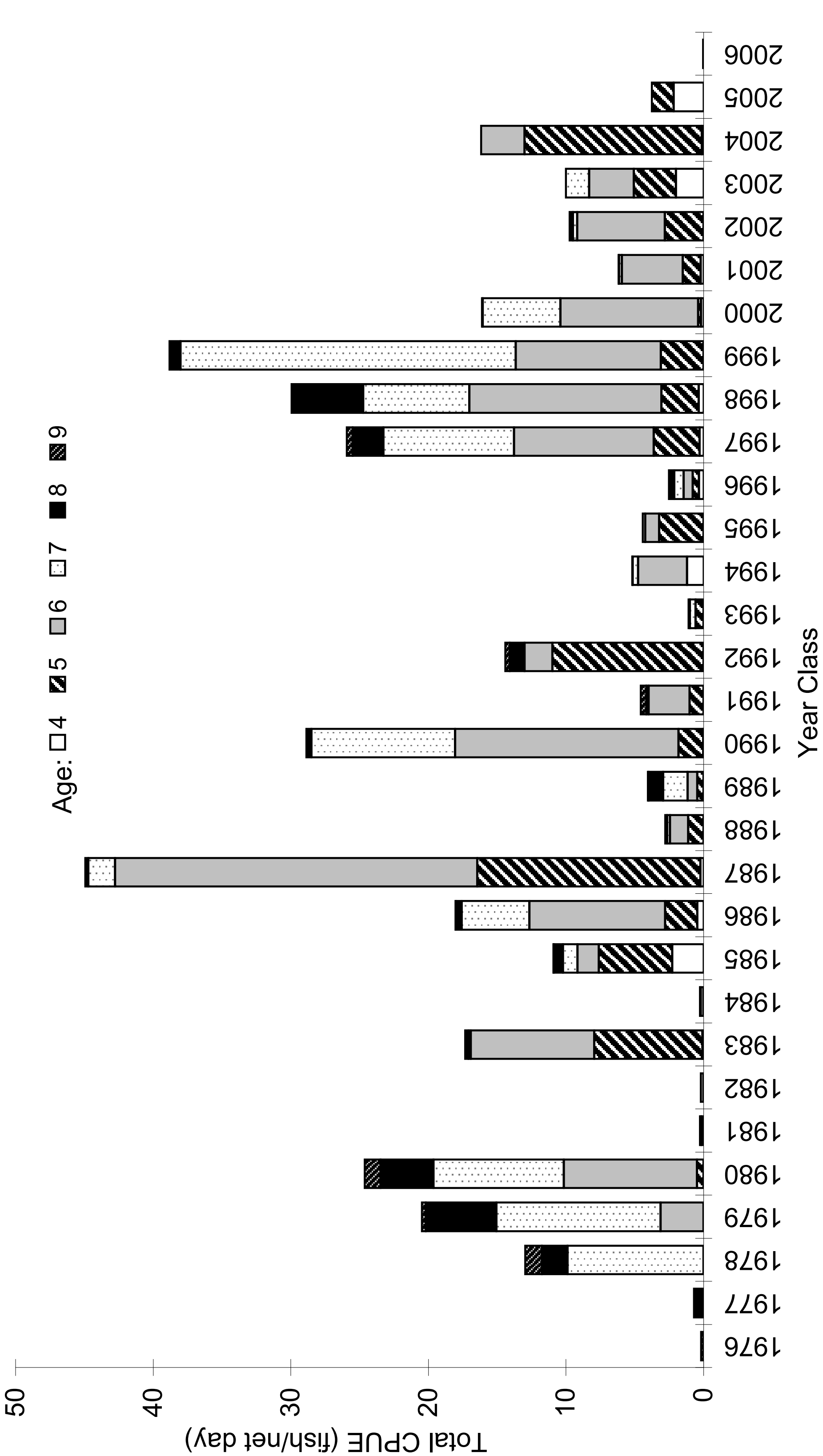


Figure 16. Cumulative catch per unit effort (catch per net day) of arctic cisco by year class (year of hatch) in the fall subsistence fishery, Nigliq Channel, Colville River, 1976–2006 (capture dates 1985–2010). Catch per unit effort was estimated only for fish captured in 7.6-cm mesh nets.

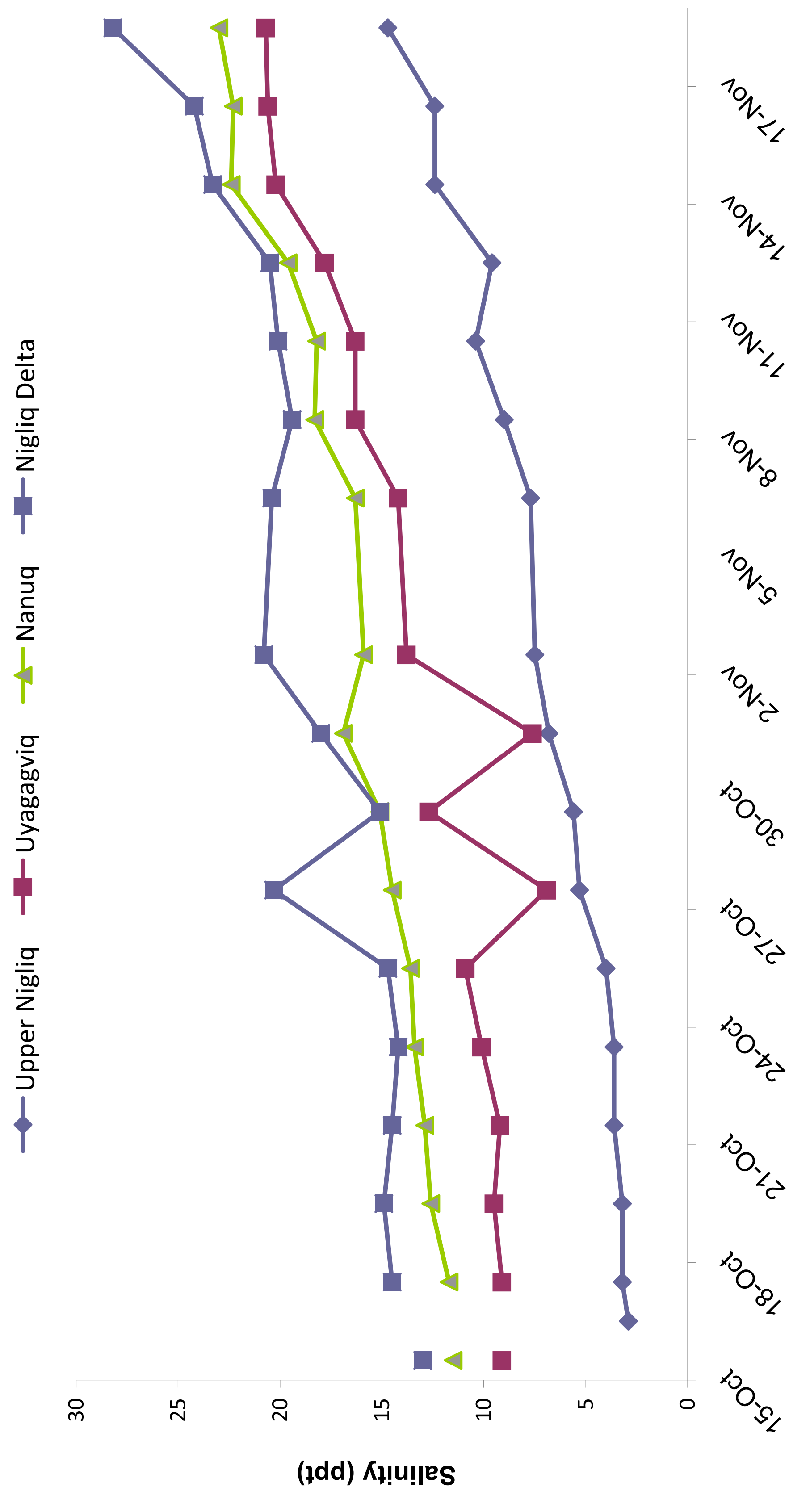


Figure 17. Water salinity (parts per thousand) at 3.0-m depth in each of 4 Nigliq Channel fishing areas, Colville River, 2010.

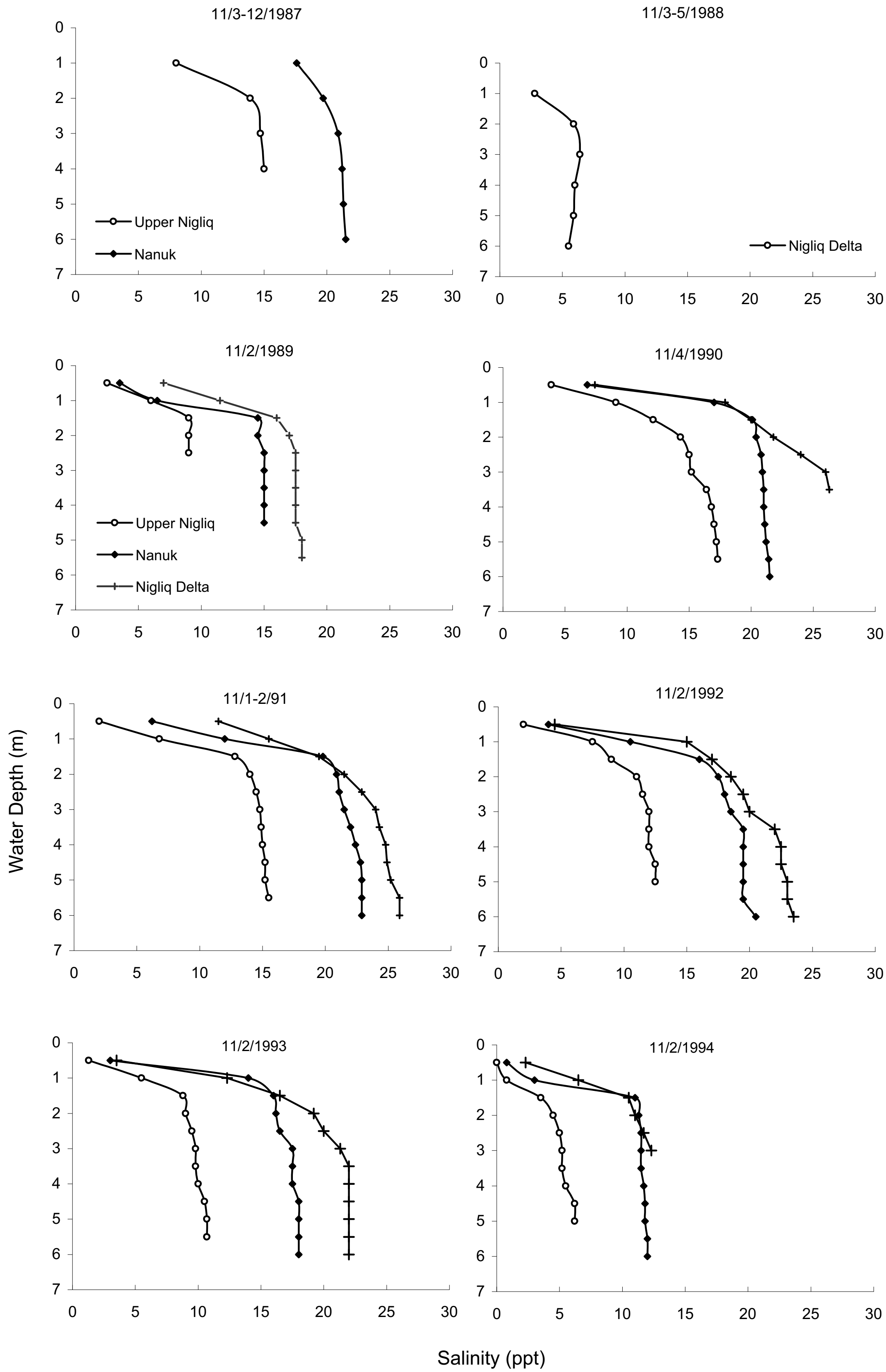


Figure 18a. Water salinity depth profiles in Niġliq Channel fishing areas, early November 1987–1994.

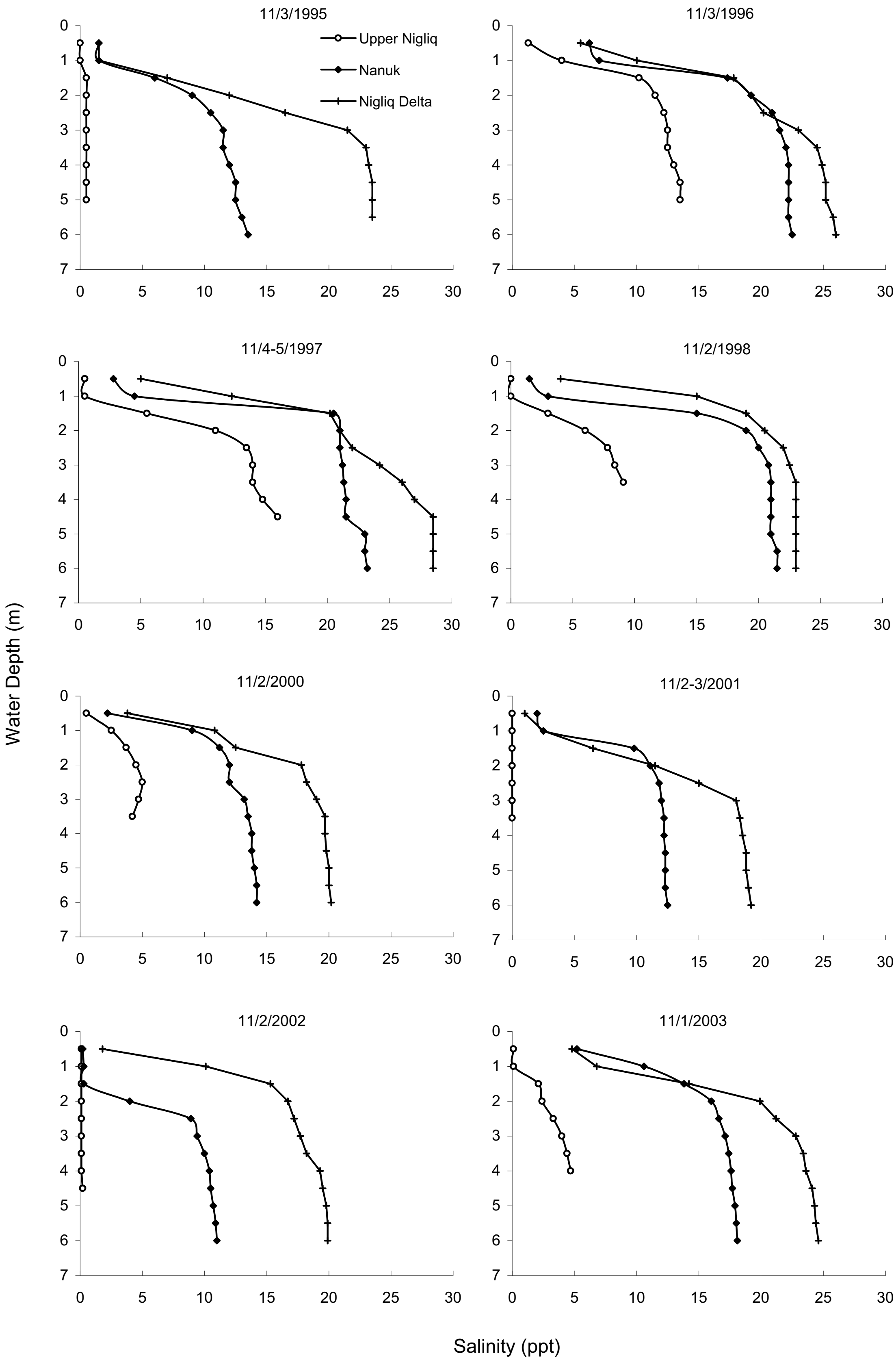


Figure 18b. Water salinity depth profiles in Niġliq Channel fishing areas, early November 1995–1998 and 2000–2003.

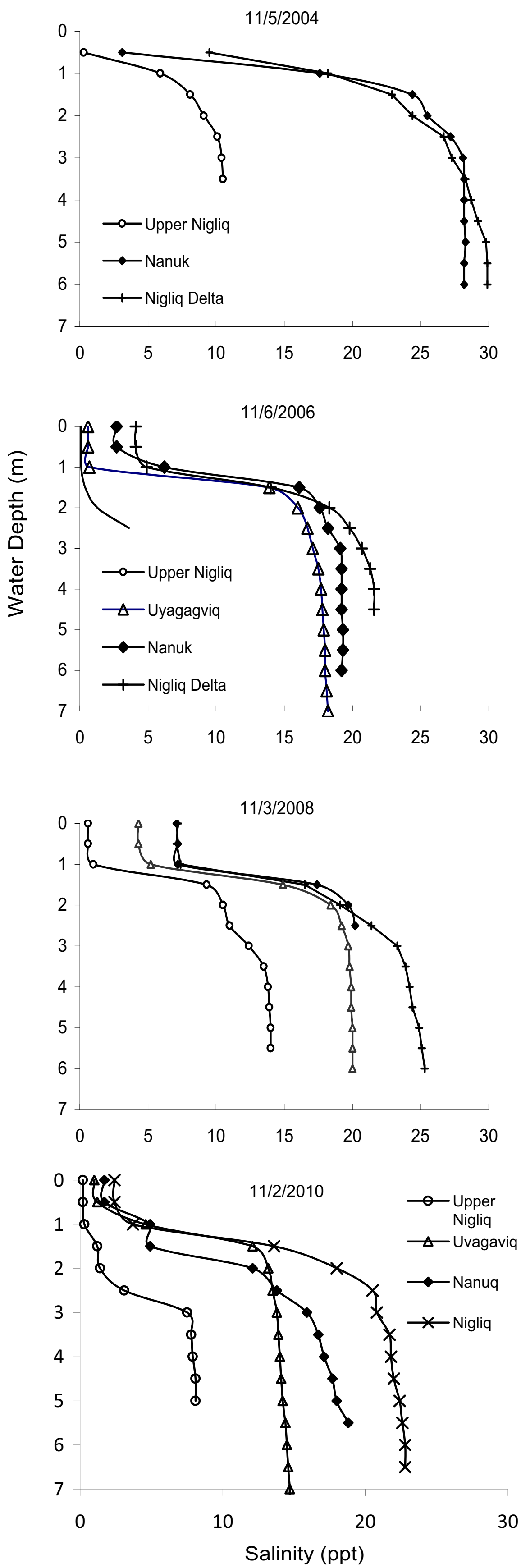


Figure 18c. Water salinity depth profiles in Niġliq Channel fishing areas, early November 2004–2010.

time harvest rates had begun to diminish (Figure 7). During the 2010 season, ABR observed 75 different nets belonging to 30 families with 101 distinct sets over 34 days. We indirectly monitored nets until 25 November via our field assistant, Jerry Pausanna.

In 2010, most Niġliq Channel fishing effort was located in the Niġliq Delta, a common occurrence in the last decade. However, while relative effort in the Niġliq Delta area was similar to 2005 and 2007–2008, the relative effort in the Upper Niġliq area constituted its largest percentage since 2006 (Figure 5). A contributing factor may be that fishers tending nets in the Upper Niġliq also maintain full-time day jobs which hinder their ability check nets regularly at longer distances from Nuiqsut. For the first time since ABR began fall fishery monitoring on the Colville River in 2007 there was substantial fishing effort (13% of total Colville River adjusted net days) in the main channel (Figure 1) of the Colville River (Figure 4, Table 4). Fishers who moved nets to, or initially deployed nets in the main channel, expressed frustration with numbers of fish being caught in the Niġliq Channel and with the general congestion (high number of nets) in the Niġliq Delta. Those who did fish the main channel had moderate success harvesting arctic cisco (Table 4).

The increased fishing effort in the Niġliq Delta and the establishment of nets in the main channel may be attributed to the slow upstream movement of the salinity wedge in 2010 due in part to the lack of west winds. This may have contributed to the belated upstream migration of arctic cisco and hence, poor harvests in the early part of the 2010 season in the Upper Niġliq and Nanuk fishing locations. Salinity levels in Nanuk did not reach optimal levels (15–25 ppt) until after 1 November and the Upper Niġliq did not reach this level during ABR's monitoring season. In contrast, the Niġliq Delta had optimal salinity levels for arctic cisco over the course of nearly the entire season. This is not entirely uncommon, but Upper Niġliq salinity levels were still below 10 ppt in the second week of November, which is a somewhat rare occurrence. Around 29 October, fishers in the outer delta began reporting excellent harvest days (concurrent with the period of increased salinity in the delta). Such increases in salinity in the Niġliq Channel normally are associated with west winds, a wind direction that was rarely observed during our stay and was a point of concern for many fishers (Moulton and Field 1988, Moulton 1994). This information undoubtedly contributed to the deployment of more nets in the Niġliq Delta.

While the outer Niġliq Delta was perceived by fishers to be the best harvest area of the 3 major Niġliq Channel harvest areas in 2010, the CPUE of 9.7 fish per adjusted net day in 7.6-cm nets was a substantial decrease from 2009 for the same area (~22 fish per adjusted net day) and was the worst for the area in 8 years. Fishing was even weaker in other areas of the river, where the CPUE for 7.6-cm nets in the Nanuk and Upper Niġliq locations was less than 3 fish per adjusted net day. Total CPUE for these nets in the Niġliq Channel was the lowest in 8 years (Table 4). However, smaller mesh nets (i.e., 5.1- and 6.4-cm mesh) performed significantly better than 7.6-cm mesh nets (Table 4), because smaller nets inherently catch smaller-sized fish. The 6.4-cm nets differ from 7.6-cm mesh nets mainly in catching fewer arctic cisco at the larger end of their growth scale. The higher CPUE in smaller mesh nets in the Niġliq and main channels suggests that arctic cisco are slightly smaller on the whole and thus more susceptible to harvest in smaller mesh nets. Indeed, arctic cisco appear to be slightly smaller in 2010 than in 2009 and similar to 2008 which was noted by all to be a year in which fish were smaller (Figures 9 and 12, Table 4). Unlike 2008, fishers in 2010 described themselves as being content with the size of fish in their harvests but were concerned about the number of fish caught.

One explanation for decreased size of fish is not simply that they are smaller, but rather that younger year classes are being selected for by the use of smaller nets. Fish age distribution continues to be dominated by largely 5, 6, and 7 years of age (Figure 15). In subsequent years, the use of smaller net meshes might leave fewer "older" fish in the fishery each year (ages 6, 7, and 8). However, there is clearly large variability in size at age for arctic cisco. While there is some evidence for increased growth in younger age classes in recent years which is suggestive of changing environmental conditions and improved summer feeding opportunities in marine waters (von Biela et al. 2010), we continue to see a wide range of sizes in all age classes, including younger fish (Figure 14). Age 6 (2004 year class) arctic cisco were similar in size to age 5 (2005 year class). In 5.1-cm mesh nets, fish were exclusively age 4 and age 5 fish, while 6.4-cm nets exclusively captured age 5 and 6 fish. Nets with 8.9-cm mesh captured almost entirely age 6 and 7 fish. We did observe a small number of 8- and 9-year-old fish (2002 and 2001 age classes), but it is likely that based on the life history of arctic cisco and the history of the fishery that this year class has mostly reached sexual maturity and the remainder of the year class will leave the Colville River in the summer of 2011 for spawning grounds in the McKenzie River. Even though a number of smaller nets were fishing, we saw fewer 4-year-olds (2006 year class) than expected. The absence of any given year class could be explained by a number of factors including a behavioral shift in overwintering by fish in the region from the Niġliq Channel to the main channel. It will be interesting to see if 5-year-old fish from the 2006 year class suddenly appear in the fishery in 2011 or if age 7 fish from the 2004 year class dominate the fishery in 2011. We are entering a period (2011 and 2012) when harvests are expected to increase (Moulton et al. 2006). Data used in Figure 15 are presented in Appendix D (CPUE by age class over time) and Appendix E (age frequencies expressed as a percentage by year).

The amount of observed fishing effort doubled from 2009 to 2010, and the total observed harvest for all species increased (Tables 2 and 5). We were able to record 423 individual harvest events in 2010 (an increase from 244 in 2009). This allowed ABR biologists to better estimate this year's harvest. Harvest in 2010 was indeed low despite the relative success experienced by some fishers and expectations of good fishing on the heels of increased harvests in 2009 (Seigle et al. 2010). Still, this was not entirely unexpected as diminished harvests were previously predicted to continue until at least 2010 (Moulton et al. 2006). Looking ahead, high densities of young-of-the-year arctic cisco continue to be captured during summer fyke net surveys near Prudhoe Bay over the last several years (Craig Reiser, LGL, personal communication 2009 and 2010, and Figure 17 *in* Seigle et al. 2008), and we are optimistic that Colville River harvests will continue to increase in the next few years due to large numbers of recruiting juveniles into the fishery from Canada. However, harvest forecasts cannot account for other important and unpredictable variables affecting the fishery such as wind, salinity, and natural mortality of younger age classes in any given year (Moulton and Seavey 2004). The correlation between fyke net CPUE in Prudhoe Bay and subsistence harvests in the Niġliq Channel is associated with considerable error (Moulton et al. 2010).

Least cisco is traditionally the second-most harvested species during the fall fishery in the Niġliq Channel, and this trend held true in 2010. Observed harvests had been down for this species since 2007. Numbers increased significantly in 2010 as did the species specific proportion of least cisco caught compared to historical harvests. The percentage of arctic cisco caught in 2010 (~61%, excluding four-horn sculpin) was the lowest since 2002, whereas the percentage of least cisco (~34%) was the highest since 1998. Least cisco generally reside in waters with salinity <15 ppt. These conditions existed for the majority of the season in the upper two thirds of the Niġliq Channel throughout the season, possibly accounting for the increased numbers of least cisco observed in 2010. Significant numbers of least cisco were taken by fishers in the main channel of the Colville River, with 2 instances of over 200 fish being harvested from a single net within a 24-hour set. The overall increases in fishing effort, particularly in the main channel, may also be contributing factors to the higher numbers of least cisco harvested in 2010. Though we are not always able to ascertain the number of by-catch species caught during interviews with fishers, we feel confident that the number of least cisco was significantly higher based on harvests that we did observe. Other desirable species such as rainbow smelt decreased from 2009 harvest figures.

During the 2010 harvest season, there was dissatisfaction among fishers with their harvest as a function of CPUE and continued a general tendency towards decline from the record harvests in 2006 (the exception being 2009). The observed CPUE of 6.8 fish for the Niġliq Channel in 2010 was in the bottom quarter of CPUEs since 1986 and the lowest since 2002. Despite the low harvest levels there were still 75 nets deployed during the season and fishing continued later in the season than normally observed. This extended fishing season may have been a reaction to low CPUE and fishers attempting to meet some form of self-imposed harvest quotas. Peak observed daily CPUE values of 17 fish per adjusted net day on 5 November occurred during a period of increased salinity levels moving upstream (Figure 7, Figure 17). However, CPUE did not continue to increase with salinity when levels again rose later in the season. One of ABR's continuing objectives in 2010 Colville River fall subsistence fishery surveys was increasing the participation in the *Qaaktaq Panel* meetings. ABR invited several active Nuiqsut fishers to be involved in the forum along with past participants. In October 2010, ABR met with the community to discuss issues related to the arctic cisco fishery (Appendix A). We will attempt to meet with the *Qaaktaq Panel* in either late February or March of 2011 to discuss the fishery results from the 2010 season and to hear their concerns for the fishery moving forward. We enjoyed great feedback from *Qaaktaq Panel* members and most fishers on the ice throughout the season, and it is clear that this is a part of the program that they look forward to, as many fishers asked about it. In the past, participation at scheduled meetings by *Qaaktaq Panel* members has been limited for a variety of reasons. We were encouraged by increased participation in October and received a number of valuable insights from subsistence fishers past and present.

LITERATURE CITED

ABR, Inc.—Environmental Research & Services (ABR, Inc.); Sigma Plus, Statistical Consulting Services; Stephen R. Braund & Associates; and Kuukpik Subsistence Oversight Panel, Inc. 2007. Variation in abundance of arctic cisco in the Colville River: Analysis of existing data and local knowledge. Volumes I and II. Report for the U.S. Department of the Interior, Minerals Management Service Alaska OCS Region, Anchorage, AK. Technical Report No. MMS 2007-042.

Bickham, J.W., S.M. Carr, B.G. Hanks, D.W. Burton, and B.J. Gallaway. 1989. Genetic analysis of population variation in the arctic cisco (*Coregonus autumnalis*) using electrophoretic, flow cytometric, and mitochondrial DNA restriction analysis. Biological Papers of the University of Alaska 24: 112–122.

Bond, W.A., and R.N. Erickson. 1985. Life history studies of anadromous coregonid fishes in two freshwater lake systems on the Tuktoyaktuk Peninsula, Northwest Territories. Canadian Technical Report of Fisheries and Aquatic Sciences 1336: 1–61.

Bond, W.A., and R.N. Erickson. 1997. Coastal migrations of arctic cisco in the Eastern Beaufort Sea. Pages 155–164 *in* J. Reynolds, editor. Fish ecology in Arctic North America. American Fisheries Society Symposium 19, Bethesda, Maryland.

Chilton, D.E., and R.J. Beamish. 1982. Age determination methods for fishes studied by the Groundfish Program at the Pacific Biological Station. Canadian Special Publication of Fisheries and Aquatic Sciences 60. 102 pp.

Craig, P.C. 1984. Fish use of coastal waters of the Alaskan Beaufort Sea: A review. Transactions of the American Fisheries Society 113: 265–282.

Craig, P.C., and L. Halderson. 1981. Beaufort Sea barrier island-lagoon ecological process studies: Final report, Simpson Lagoon. Part 4. Fish. Pages 384–678 *in* Environmental Assessment of the Alaskan Continental Shelf. OCS Final Reports of Principal Investigators, MMS/NOAA, OCSEAP, Anchorage, AK. Vol. 7.

Daigneault, M.J., and C. Reiser. 2007. Colville River fall fishery monitoring, 2006. Report by LGL Alaska Research Associates, Inc. for ConocoPhilips Alaska, Inc., Anchorage, AK. 42 pp.

Fechhelm, R.G., and D.B. Fissel. 1988. Wind-aided recruitment of Canadian arctic cisco (*Coregonus autumnalis*) into Alaskan waters. Canadian Journal of Fisheries and Aquatic Sciences 47: 2,164–2,171.

Gallaway, B.J., and R.G. Fechhelm. 2000. Anadromous and amphidromous fishes. *In* The natural history of an arctic oil field. Joe C. Truett and Stephen R. Johnson eds. Academic Press, New York, NY. 422 pp.

Gallaway, B.J., W.G. Griffiths, P.C. Craig, W.J. Gazey, and J.W. Helmericks. 1983. An assessment of the Colville River Delta stock of arctic cisco (*Coregonus autumnalis*)—Migrants from Canada? Biological Papers of the University of Alaska 21: 4–23.

MBC Applied Environmental Sciences. 2004. Proceedings of a workshop on the variability of arctic cisco (*qaaktaq*) in the Colville River, November 18–20, Nuiqsut, AK. OCS Study, MMS 2004-033. USDOI, MMS, Alaska OCS Region, Anchorage, AK. 60 pp. + appendices.

Moulton, L.L. 1989. Recruitment of arctic cisco (*Coregonus autumnalis*) into the Colville Delta, Alaska, in 1985. Biological Papers of the University of Alaska 24: 107–111.

Moulton, L.L. 1994. The 1993 Endicott Development Fish Monitoring Program. Vol. II: The 1993 Colville River Fishery. Report by MJM Research, Bainbridge Island, WA, for BP Exploration (Alaska) Inc. and North Slope Borough. 60 pp. + appendices.

Moulton, L.L., and L.J. Field. 1988. Assessment of the Colville River fall fishery 1985–1987. Report by Environmental Sciences and Engineering, Inc., Anchorage, AK, for ARCO Alaska, Inc., North Slope Borough, and the City of Nuiqsut. 42 pp.

Moulton, L.L., L.J. Field, and S. Brotherton. 1986. Assessment of the Colville River fishery in 1985. Colville River Fish Study, Ch. 3. Report by Entrix, Inc., Anchorage, AK, for ARCO Alaska, Inc., the North Slope Borough, and the City of Nuiqsut. 86 pp.

Moulton, L.L., and B.T. Seavey. 2004. Harvest estimate and associated information for the 2003 Colville River fall fishery. Report by MJM Research, Bainbridge Island, WA, for ConocoPhillips Alaska, Inc., Anchorage, AK 79 pp.

Moulton, L.L., B.T. Seavey, and J. Pausanna. 2006. Harvest rates for the 2005 Colville River fall fishery. Report by MJM Research, Bainbridge Island, WA, for ConocoPhillips Alaska, Inc., Anchorage, AK.

Moulton, L.L., B.T. Seavey, and J. Pausanna. 2010. History of an under-ice subsistence fishery for arctic cisco and least cisco in the Colville River, Alaska. Arctic 63: 381–390.

Seigle, J.C., S.M. Murphy, and S.R. Braund. 2008. Fall 2007 fishery monitoring on the Colville River. Report by ABR, Inc.—Environmental Research & Services, Anchorage, AK, for ConocoPhillips Alaska, Inc., Anchorage, AK. 33 pp.

Seigle, J.C., and J.P. Parrett. 2009. Fall 2008 subsistence fishery monitoring on the Colville River. Report by ABR, Inc.—Environmental Research & Services, Anchorage, AK, for ConocoPhillips Alaska, Inc., Anchorage, AK. 46 pp.

Seigle, J.C., L.B. Attanas, J.R. Rose, and J.P. Parrett. 2010. Fall 2009 subsistence fishery monitoring on the Colville River. Report by ABR, Inc.—Environmental Research & Services, Anchorage, AK, for ConocoPhillips Alaska, Inc., Anchorage, AK. 61 pp.

USEPA. 2011. Current drinking water regulations. http://water.epa.gov/lawsregs/rulesregs/sdwa/currentregulations.cfm

Von Biela, V.R., C.E. Zimmerman, and L.L Moulton. 2010. Long-term increases in young-of-the-year growth rates of arctic cisco *Coregonus autumnalis* and environmental influences. Journal of Fish Biology 78: 39–56.

Appendix A. Qaaktaq panel meetings to discuss the 2009 and 2010 fall fishery on the Colville River Delta.

June 29, 2011, Meeting

The *Qaaktaq* Panel, composed of expert fishers involved in the Colville River subsistence harvest near Nuiqsut, met on June 29, 2011, at the KSOPI office in Nuiqsut. The purpose of this meeting was to (1) summarize the 2010 fishing season and report results comparing 2010 harvest information to historical records, (2) continue to work with active fishers to get their perspective on the upcoming 2011 fall fishery, and (3) collect comments from the panel highlighting their concerns about the fishery to relay to CPAI. A handout summarizing the 2010 fishery was provided to attendees and served as a meeting outline (see pages 43–50). John Seigle of ABR presented 2010 harvest data to the panel during which there was as open discussion covering a broad array of topics.

Attendees of this meeting were: the *Qaaktaq* Panel of Nuiqsut residents and fishers, Lydia Sovalik, Dwayne Hopson, Sr., Sam Kunaknana, Frank Oyagak, Jr., Dora Leavitt, Robert Lampe, Edward Nukapigak, and Jonah Nukapigak; ABR scientist, John Seigle; and KSOPI representative, Eunice Brower.

There was general agreement that 2010 had not been a particularly good *Qaaktaq* fishing season following a slightly above average 2009 harvest season. No panel member expressed serious concerns about the overall harvest numbers for *Qaaktaq;* however, it was agreed that the effort necessary to reach individual harvest goals had increased in a more competitive fishery. There was a brief discussion of increased harvest effort (number of nets) in the delta. John Seigle reminded the panel that 2010 had long been predicted to be a low harvest year and that 2009 had been a pleasant surprise in terms of better than expected harvests. The consensus among *panel* members was that we had indeed expected lower harvests and 2011 will be interesting as it has been predicted to be a year of increasing harvest levels.

John Seigle also expressed that CPAI has heard the panel's concerns regarding a need for more water, sediment, and fish tissue sampling for contaminant monitoring in the Niġliq channel. ABR is developing plans in conjunction with CPAI to increase this monitoring effort in 2011. Additionally, the panel had previously expressed interest in seeing ABR use their own nets to help in surveying the fishery and this topic was discussed. The panel agreed with John's thoughts on donating fish to the community if ABR and CPAI decided that using ABR nets was a useful effort towards augmenting monitoring. Fish tagging was also discussed and panel members did not express any discomfort over the potential use of floy tags, particularly if a bounty system for tag returns was implemented.

One topic of discussion that focused the attention of the panel for much of the meeting was the recent news over the acquisition of nearby oil/gas leases by the Spanish company, Repsol. According to the panel, representatives from Repsol conducted an "unannounced" meeting in Nuiqsut and outlined their intent to begin drilling/exploration work and ice pad/road development just offshore from Woods Camp in the Beaufort Sea on the west side of the Colville delta, with development extending to the east beyond the delta and inland a few miles. The representatives provided maps and plans for their work which included a winter ice road and/or pipeline that, according to panel members, could potentially negatively affect fish movement in the delta region. This new information along with knowledge of development plans for leases in the eastern NPRA has panel members concerned over fish stocks.

The panel expressed that they would like to see more monitoring and research focusing on the Niġliq channel fishery as well as the Fish Creek area.

There was some housekeeping discussion regarding the membership on the panel and it was decided that John Seigle would work with Eunice Brower to update the member list and streamline communication between ABR, KSOPI and the *Qaaktaq* Panel. This was a very well attended and enthusiastically received meeting and the panel expressed excitement over meeting again in the fall of 2011.

October 29, 2010 Meeting

The *Qaaktaq* Panel, composed of expert fishers involved in the Colville River subsistence harvest near Nuiqsut, met on October 29, 2010, at the KSOPI office in Nuiqsut. Several previous attempts had been made to hold this meeting over the course of 2010 but numerous scheduling factors led to postponement until late in 2010. In the past we have had some difficulty in getting good attendance so we added a few names to the Qaaktaq Panel based on our experience in the field working with a number of fishers.

Attendees at this meeting were: Roger Ahnupkana, Eli Nukapigak, Lydia Sovalik, Dwayne Hopson, Sr., Sam Kunaknana, Patrick Easterday, Billy Oyagak, Gordon Brown, Thomas Nukapigak and three ABR scientists (John Seigle, Joel Gottschalk, Alyson McHugh) and KSOPI representative Annie Gray. The purpose of this meeting was to (1) summarize the 2009 fishing season and report results comparing 2009 harvest information to historical records (2) continue to work with active fishers to get their perspective on the state of the 2010 fall fishery and (3) act as an agent expressing the community's concerns about the fishery to the client.

John Seigle of ABR presented 2009 harvest data to the panel. Compared to 2008, *qaaktaq* catch rates (average number of fish caught per adjusted net day) were higher in 2009. The total adjusted catch rate for *qaaktaq* in the Nigliq channel (19 fish/day) was the highest since 2006 and slightly higher than the 1986-2009 average of 15 fish/day. Everyone was in agreement that it had been a better fishing season.even the 2009 fishing season began with sub-par ice conditions. The consensus among *Qaaktaq* Panel members was that the fishing season was a success and most voiced satisfaction with both harvest numbers and size of fish caught.

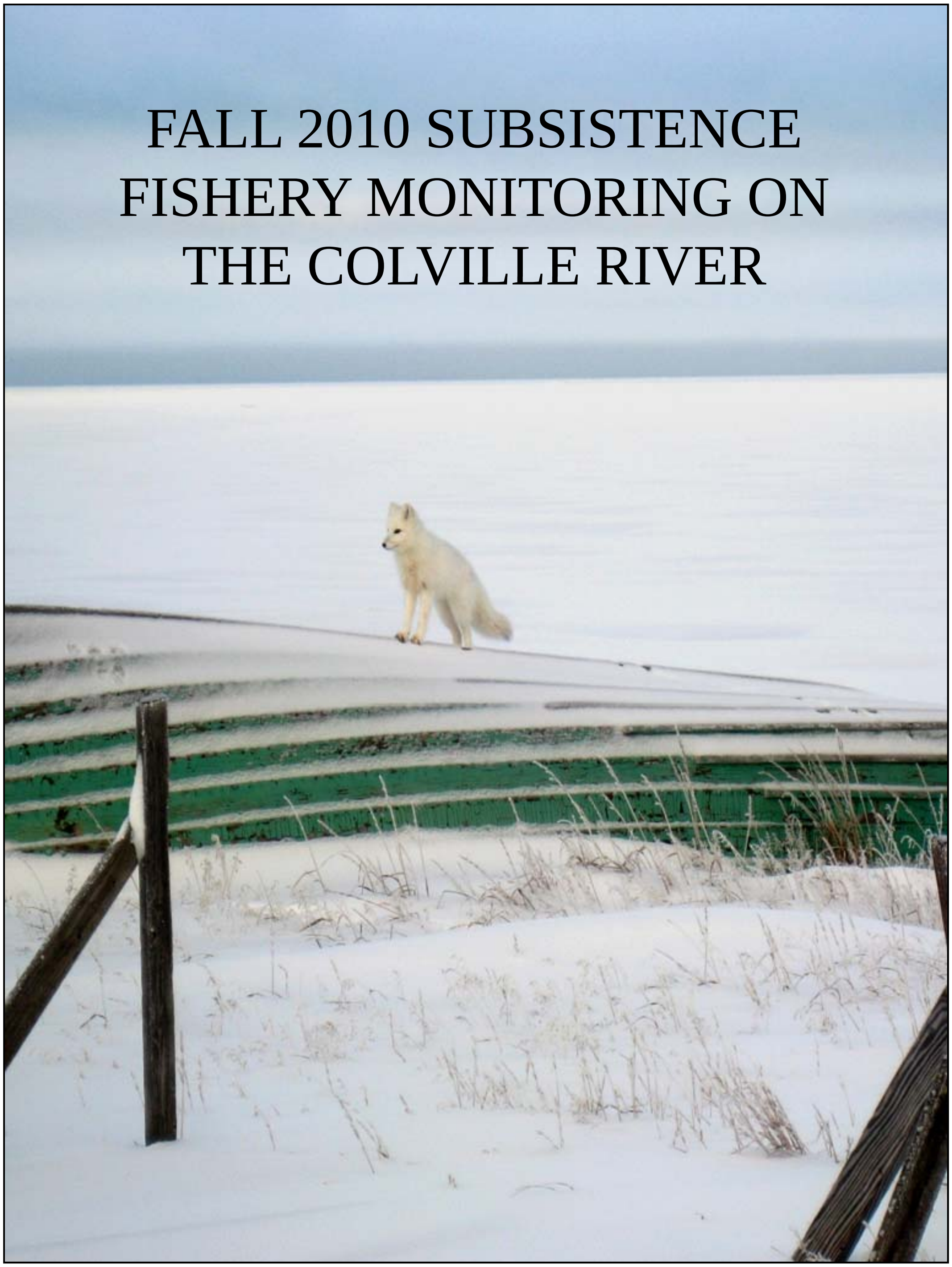
At the date of the meeting, approximately 40 nets were deployed in the Nigliq channel for the 2010 fishery, with most effort focused on Nigliq Delta area. There was also significant fishing effort on the main channel of the Colville River, a change from 2009. Active fishers reported that the early part of the 2010 season had been 'slow', although the fish caught had been of good size. Members suggested that the lack of consistent west winds or a slush dam at the mouth of the river may be slowing the salinity wedge associated with the winter migration of *qaaktaq* up river (In days after the meeting, harvest numbers increased notably for fishers in the Nigliq Delta, while fishing in the Upper Nigliq remained slow and the fish caught were dominated by *iqalusaaq*).

Panel members voiced several concerns for the fishery and offered suggestions for expanded monitoring. Reccurring questions were (1) how is continued seismic exploration on land and in near shore environments effecting fish behavior (migration and harvest)? (2) Are injection products associated with Alpine sites CD2 and CD4 leaching into river water and adversely affecting the fishery? The consensus of the panel was that they would like to go beyond harvest and predictive harvest information and expand sampling methodology. Attendees suggested and were receptive to using a variety of tracking techniques including tagging, radio telemetry and acoustics. The expansion of water quality parameters, including benthic sediment sampling and resident fish tissue sampling (four-horned sculpin) was also discussed. Panel members agreed that the deployment of nets (catch donated) by ABR scientists during the fall fishery would bolster monitoring efforts and strengthen harvest estimates.

It was agreed that more community participation is critical for this study and that one suggestion for getting folks to come to community meetings on the subject was to augment raffles to include items such as buoys, gill nets, ice skimmers, burlap sacks and other items associated with the fishing effort.

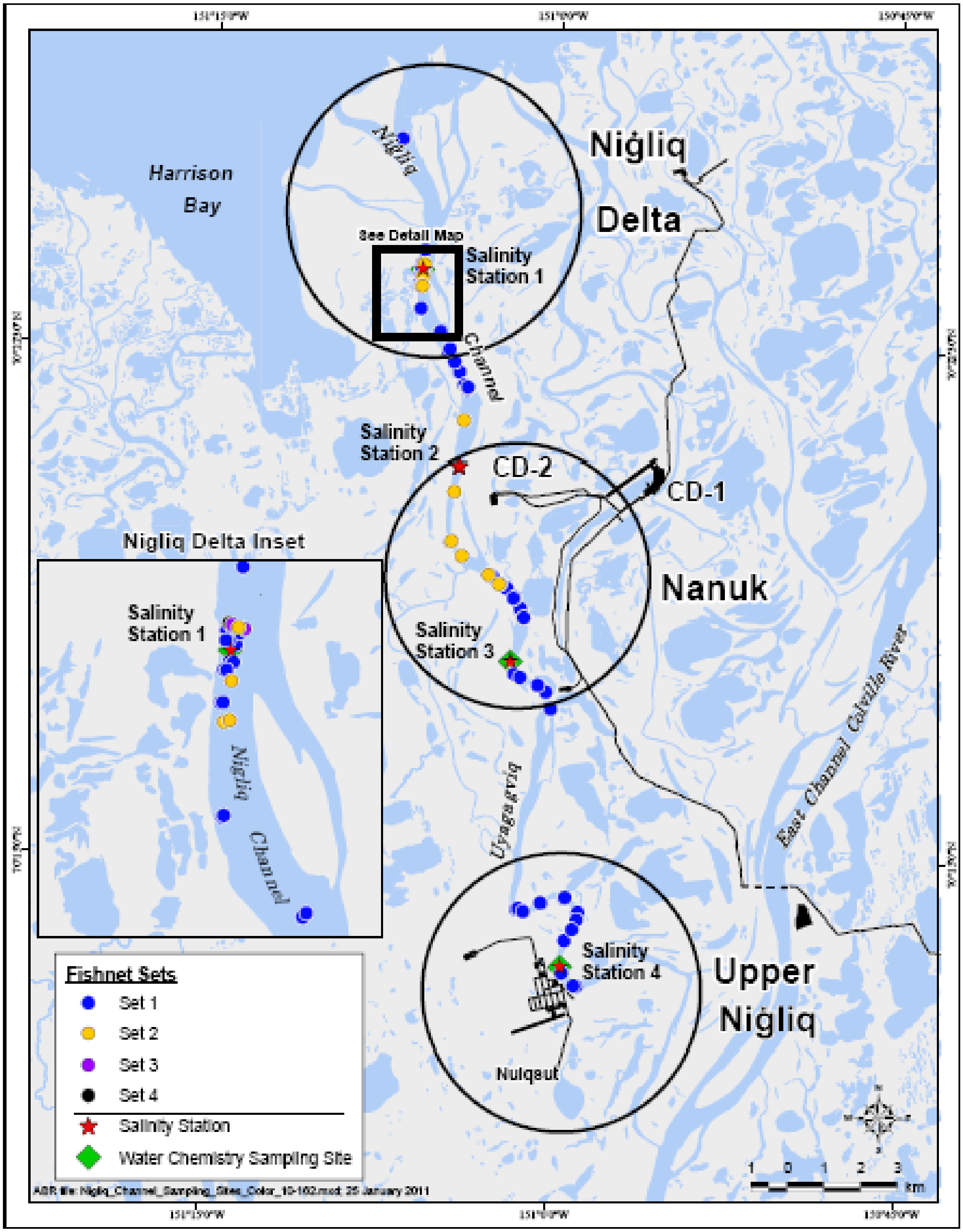
(Handout to Fishers on June 29, 2011, Qaaktaq Panel Meeting)

FALL 2010 SUBSISTENCE FISHERY MONITORING ON THE COLVILLE RIVER



ConocoPhillips

ABR inc.



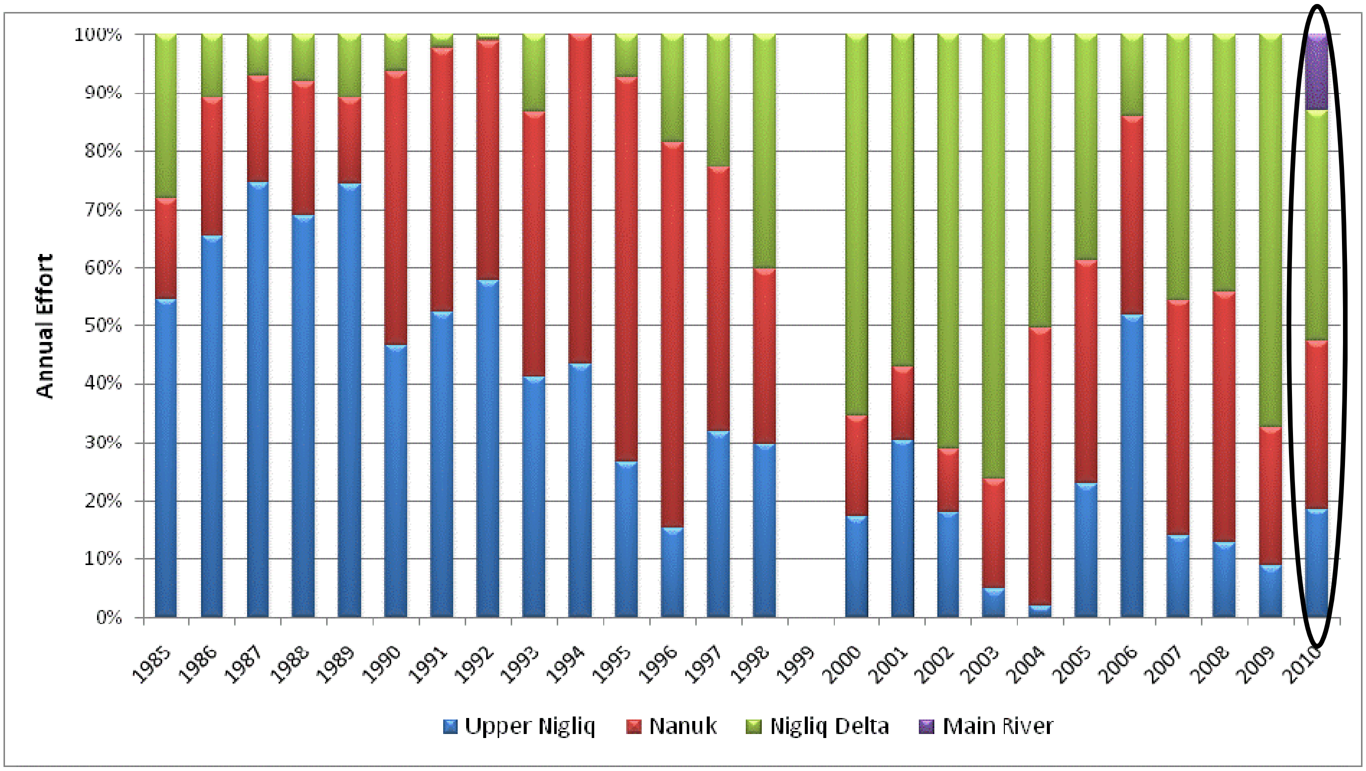
151°15'0"W
151°0'0"W
150°45'0"W
Harrison
Bay
Nigliq
Niġliq
Delta
See Detail Map
Salinity
Station 1
Channel
Salinity
Station 2
CD-2
CD-1
Nigliq Delta Inset
Salinity
Station 1
Nigliq
Channel
Nanuk
Salinity
Station 3
Uyagagviq
East Channel Colville River
Salinity
Station 4
Upper
Niġliq
Nuiqsut
Fishnet Sets
Set 1
Set 2
Set 3
Set 4
Salinity Station
Water Chemistry Sampling Site
1 0 1 2 3
km
ABR file: Nigliq_Channel_Sampling_Sites_Color_10-182.mxd; 25 January 2011

Fishing Effort

- Fishing began on approximately 5 October, shortly after freeze-up on the Colville River Delta
- Thirty households deployed 75 nets during the fall fishery in 2010
- 17 more nets than 2009
  * above the average deployed since 1986 (55.4)

Fishing Effort by location

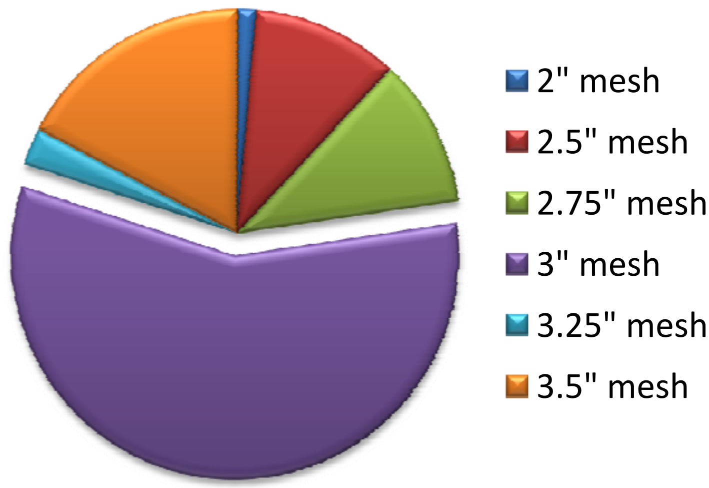
- Niġliq Delta 40%
- Nanuk 29%
- Upper Niġliq 19%
- Main channel 13%:
  first major observation of fishing by ABR since 2007
- 2,336 hours in 2010 compared to 1,160 hours in 2009 (increase of 101%)



Nets and Catch

- 3-inch nets continue to catch the widest variety of fish and continue to be the most efficient

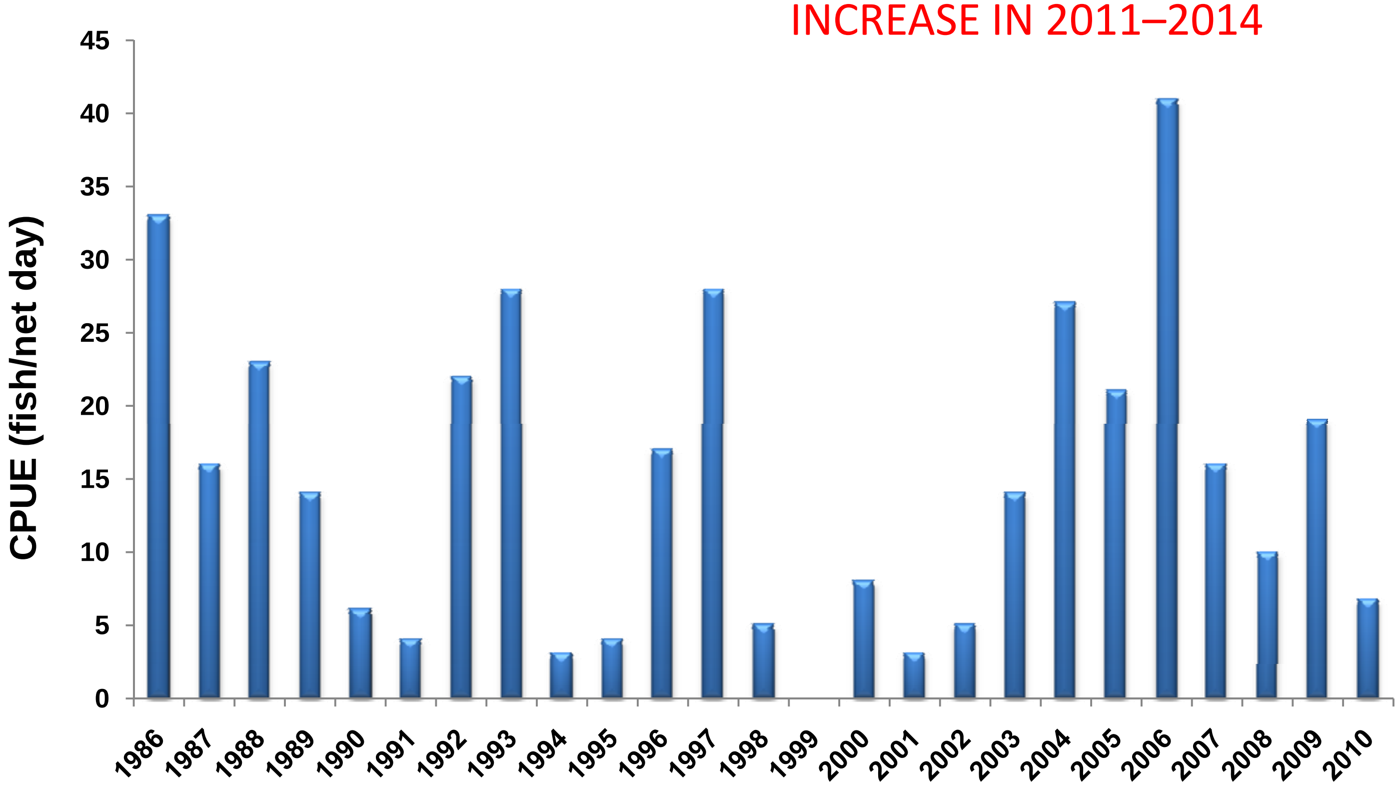
- A total of 43 out of 75 nets were 3-inch mesh nets



Catch per unit effort (CPUE)

- Observed catch rate for qaaktaq in the Niġliq channel was 6.8 fish/adjusted net day

- Lowest since 2002 and below the 24 year average of 15 fish/adjusted net day
- HARVESTS PREDICTED TO INCREASE IN 2011–2014



2010 Colville Fisheries Monitoring, ABR, Inc.

Harvest

- The fishery monitoring team visually observed a harvest of 18,505 fish (all species, mesh sizes and areas)
- A total of 2,227 arctic cisco were recorded by the monitoring team from 3” nets

Harvest estimate

- 20,754 qaaktaq from the Niġliq Channel; 3,083 from the main channel
- Estimated total harvest of nearly 24,000 qaaktaq in 2010.
- Similar to years past but more effort was needed

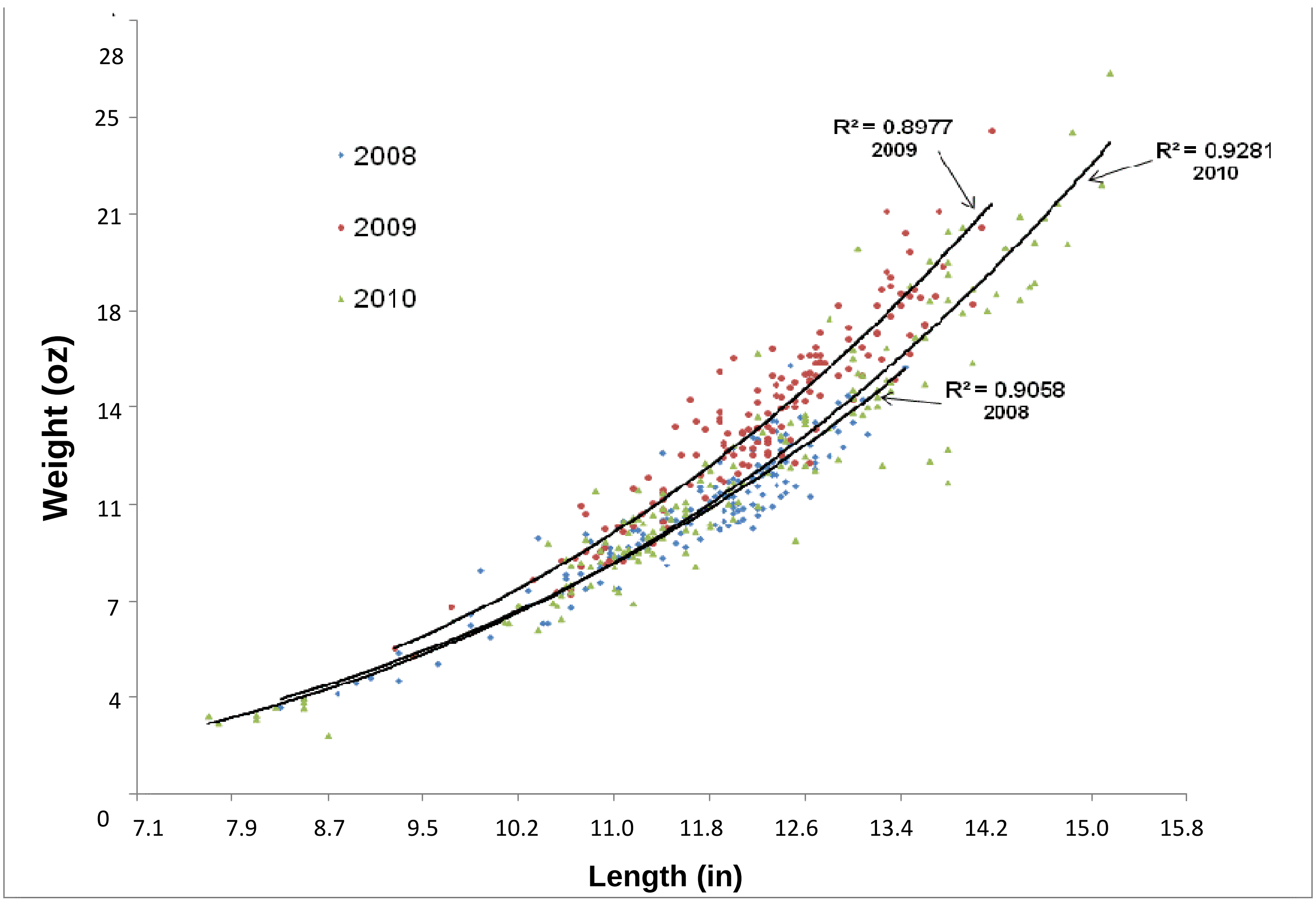
	Upper Niġliq	Nanuk	Niġliq Delta	Total Niġliq Channel		
Mesh Size (in)	CPUE	CPUE	CPUE	CPUE	Adjusted Net Days	Estimated Niġliq Channel Harvest
2.0	--	--	61.0	61.0	10.0	609.9
2.5	12.4	--	49.7	42.9	206.7	8860.0
2.75	4.3	4.8	11.7	9.2	213.3	1951.7
3.0	**2.6**	**2.8**	**9.7**	**6.8**	**1143.3**	**7818.1**
3.25	--	--	11.8	11.8	30.3	356.0
3.5	0.8	1.6	4.9	2.6	440.3	1158.5
						23,836.70

Size of Catch

- ABR measured 1,547 qaaktaq in 2010
- Fish ranged in length from 7.7 to 17.7 inches
- The middle 50% of fish measured between 11.0 and 13.0 inches
- The middle 50% of fish measured in 2009 measured between 12.1 and 13.1 inches in 2009

Age of catch

- 42% age 6
- 29% age 5
- 22% age 7
- 3% age 8
- 4% age 4
- <1% age 9



2010 Colville Fisheries Monitoring, ABR, Inc.

October 2010 Panel Meeting Summary

Panel Concerns:

- How is continued seismic exploration on land and in near-shore environments affecting fish behavior (migration and harvest)?
- Are injection products associated with Alpine sites CD2 and CD4 leaching into river water and adversely affecting the fishery?

Attendees suggested using a variety of fish tracking and water quality tests including:

- Tagging, radio telemetry, and acoustics
- Benthic sediment and resident fish tissue sampling
- Deployment of nets by ABR scientists to bolster monitoring efforts (catch donated)

Appendix B. Lab results for algal cells, iron, and manganese in a water sample taken at Gordon Matumeak's net, Niġliq Channel, Colville River, October and November 2010.

Arctic Fox Environmental, Inc.
Pouch 340043 / Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146
arcticfox@astacalaska.com / www.arcticfoxenv.com

Analytical Services Order and Chain of Custody Form

62388

1010-6294

Client Name and Address: ABR, INC. P.O. Box 80410 Fairbanks, AK 99708

Contact Person: John Seigle

Phone Number: 907 344-6777 Fax Number:

E-mail: jseigle@ABRINC.COM

Project Name: Arctic Cisco Catch Monitoring

Data Deliverables: Level I ☐ Level II ☐ Level III ☐ EDD/Format:

Requested Turnaround Time and Special Instructions:

Account Number:

P.O. or Contract Number:

Authorization Number:

Sampled By: John R. Rose

PWS Number:

Send Results to ADEC: ☐ YES ☒ No

Preservative: HCl, HNO3

Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID	Number of Containers	TPH	Total Metals	Algae	NO3/NO2				Remarks
Hydro 1-01	21 OCT 10	1200	L	AF38337	4	X	X	X	X				
Hydro 3-01	21 OCT 10	1245	L	AF38338	4	X	X	X	X				
Hydro 4-01	21 OCT 10	1430	L	AF38339	4	X	X	X	X				

Relinquished By	Date	Time	Received By
(1): John R. Rose	22 OCT 10	11	Received By:
(2):	10/23/10	1515	Received By: R. [signature]
(3):	Date:	Time:	Received for lab by:

TO BE COMPLETED BY LABORATORY

Location Received/ Temp on Arrival: ANC ☐ ____ °C FBK ☐ ____ °C PB 6.1 °C

05122

Chain of Custody Seal ☐ INTACT ☐ BROKEN ☐ ABSENT

Shipping Bill Number:

Arctic Fox Environmental, Inc.
Pouch 340043 - Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146 / arcticfox@astacalaska.com

ABR Inc.
PO BOX 240268
Anchorage, Alaska 99524

Report Date: 11/11/2010
Date Arrived: 10/22/2010
Date Sampled: 10/21/2010
Time Sampled: see below
Collected By: JRR

Attn: John Seifle
Phone: (907) 344-6777 ext 206
Fax: (907) 770-1443
Email: jseifle@abrinc.com

Arctic Fox Lab# AF38337-38339
Client Sample ID: see below
Location/Project: Arctic Cisco Catch Monitoring
COC#: 62388
Sample Matrix: Liquid

Comments: Attached are the results for analysis of your samples.
These samples were analyzed by Test America in Beaverton, OR.
Tracking information is as follows:

ABR Sample ID: Station Hydro 1-01
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate, Nitrite
Time Sampled: 1200
Arctic Fox ID: AF38337
Test America ID: PTJ0879-01

ABR Sample ID: Station Hydro 3-01
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate, Nitrite
Time Sampled: 1245
Arctic Fox ID: AF38338
Test America ID: PTJ0879-02

ABR Sample ID: Station Hydro 4-01
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate, Nitrite
Time Sampled: 1430
Arctic Fox ID: AF38339
Test America ID: PTJ0879-03

Michael Hawley

Reported By: Ralph E. Allphin/Michael J. Hawley
Arctic Fox Environmental, Inc.

BioLogic Resources, LLC

10260 SW Nimbus Ave., Suite M11
Portland, OR 97223
Phone 503.670.1312
Fax 503.670.7262

For: TestAmerica - Portland
9405 SW Nimbus Ave.
Beaverton, OR 97008
Attn: Vanessa Frahs

Received: 10.27.10
Tested: 10.27.10
Completed: 11.10.10

Lab #	Sample	Microscopic Examination Algae
TA267	PTJ0879-01 10.21.10 12:00	8 algal fragments observed 100 ml sample filtered through 0.45µm filter; 50 fields examined
TA268	PTJ0879-02 10.21.10 12:45	6 algal fragments observed 100 ml sample filtered through 0.45µm filter; 50 fields examined
TA269	PTJ0879-03 10.21.10 14:30	5 algal fragments observed 100 ml sample filtered through 0.45µm filter; 50 fields examined

Kim W. Hutchinson
Microbiologist/Principal

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1010-6294/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/11/10 15:38

Diesel and Heavy Range Hydrocarbons per NWTPH-Dx Method

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTJ0879-01 (AF38337 Hydro 1-01)			**Water**			**Sampled: 10/21/10 12:00**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0952	mg/l	1x	10J0962	10/28/10 19:59	10/29/10 10:07	
Residual Range/Heavy Oil Organics	"	ND	-----	0.476	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*77.3%*		*50 - 150 %*	*"*			*"*
PTJ0879-02 (AF38338 Hydro 3-01)			**Water**			**Sampled: 10/21/10 12:45**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0952	mg/l	1x	10J0962	10/28/10 19:59	10/29/10 10:27	
Residual Range/Heavy Oil Organics	"	ND	-----	0.476	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*76.8%*		*50 - 150 %*	*"*			*"*
PTJ0879-03 (AF38339 Hydro 4-01)			**Water**			**Sampled: 10/21/10 14:30**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0952	mg/l	1x	10J0962	10/28/10 19:59	10/29/10 10:46	
Residual Range/Heavy Oil Organics	"	ND	-----	0.476	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*76.0%*		*50 - 150 %*	*"*			*"*

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1010-6294/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/11/10 15:38

Total Metals per EPA 6000/7000 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTJ0879-01 (AF38337 Hydro 1-01)			**Water**			**Sampled: 10/21/10 12:00**				
Arsenic	EPA 6020	ND	-----	0.00100	mg/l	1x	10J0983	10/29/10 10:20	11/03/10 23:07	
Barium	"	**0.103**	-----	0.00100	"	"	"	"	"	
Cadmium	"	ND	-----	0.00100	"	"	"	"	"	
Chromium	"	ND	-----	0.00200	"	"	"	"	"	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	ND	-----	0.00100	"	"	"	"	"	
Silver	"	ND	-----	0.00100	"	"	"	"	"	
PTJ0879-02 (AF38338 Hydro 3-01)			**Water**			**Sampled: 10/21/10 12:45**				
Arsenic	EPA 6020	ND	-----	0.00100	mg/l	1x	10J0983	10/29/10 10:20	11/03/10 23:10	
Barium	"	**0.0898**	-----	0.00100	"	"	"	"	"	
Cadmium	"	ND	-----	0.00100	"	"	"	"	"	
Chromium	"	ND	-----	0.00200	"	"	"	"	"	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	ND	-----	0.00100	"	"	"	"	"	
Silver	"	ND	-----	0.00100	"	"	"	"	"	
PTJ0879-03 (AF38339 Hydro 4-01)			**Water**			**Sampled: 10/21/10 14:30**				
Arsenic	EPA 6020	ND	-----	0.00100	mg/l	1x	10J0983	10/29/10 10:20	11/03/10 23:18	
Barium	"	**0.0867**	-----	0.00100	"	"	"	"	"	
Cadmium	"	ND	-----	0.00100	"	"	"	"	"	
Chromium	"	ND	-----	0.00200	"	"	"	"	"	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	ND	-----	0.00100	"	"	"	"	"	
Silver	"	ND	-----	0.00100	"	"	"	"	"	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1010-6294/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/11/10 15:38

Total Mercury per EPA Method 7470A

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTJ0879-01 (AF38337 Hydro 1-01)			**Water**			**Sampled: 10/21/10 12:00**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0114	11/03/10 14:05	11/03/10 16:01	
PTJ0879-02 (AF38338 Hydro 3-01)			**Water**			**Sampled: 10/21/10 12:45**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0114	11/03/10 14:05	11/03/10 16:03	
PTJ0879-03 (AF38339 Hydro 4-01)			**Water**			**Sampled: 10/21/10 14:30**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0114	11/03/10 14:05	11/03/10 16:13	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1010-6294/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/11/10 15:38

Conventional Chemistry Parameters per APHA/EPA Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTJ0879-01 (AF38337 Hydro 1-01)			**Water**			**Sampled: 10/21/10 12:00**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0573**	-----	0.0300	mg/l	1x	10J0956	10/28/10 15:12	10/28/10 16:32	
PTJ0879-02 (AF38338 Hydro 3-01)			**Water**			**Sampled: 10/21/10 12:45**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0888**	-----	0.0300	mg/l	1x	10J0956	10/28/10 15:12	10/28/10 16:32	
PTJ0879-03 (AF38339 Hydro 4-01)			**Water**			**Sampled: 10/21/10 14:30**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0870**	-----	0.0300	mg/l	1x	10J0956	10/28/10 15:12	10/28/10 16:32	

TestAmerica Portland

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Vanessa Frahs, Project Manager

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Arctic Fox Environmental, Inc.
Pouch 340043 / Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146
arcticfox@astacalaska.com / www.arcticfoxenv.com

Analytical Services Order and Chain of Custody Form

62362

1110-6330

Client Name and Address: ABR, INC. P.O. Box 80410 FAIRBANKS, AK 99708	Account Number:
	P.O. or Contract Number:
Contact Person: John SEIGLE	Authorization Number:
Phone Number: (907) 344-6777 Fax Number:	Sampled By: J.S.
E-mail: JSEIGLE@ABRINC.COM	PWS Number:
Project Name: 10-162 ARCTIC CISCO MONITORING	
Data Deliverables: Level I ☐ Level II ☐ Level III ☐ EDD/Format:	Send Results to ADEC: ☐ YES ☒ No
Requested Turnaround Time and Special Instructions:	

Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID	Number of Containers	HYDROCARBONS	METALS	NITRATES	ALGAE				Remarks
HYDRO 1-2 (3 bottles)	6 Nov 10		W	AF38504	3	NO	✓	✓	✓				
Hydro 3-2	6 Nov 10		W	AF38505	4	✓	✓	✓	✓				
Hydro 4-2	6 Nov 10		W	AF38506	4	✓	✓	✓	✓				

Preservative ←

Relinquished By	Date	Time	Received By
Relinquished By (1): John R Rose	Date: 7 Nov 10	Time: 11:45	Received By:
Relinquished By (2):	Date: 11/7/10	Time: 1530	Received By: [signature]
Relinquished By (3):	Date:	Time:	Received for lab by:

TO BE COMPLETED BY LABORATORY

Location Received/ Temp on Arrival: ANC ☐ ____ °C FBK ☐ ____ °C PB ☐ 2.9 °C

80462153

Chain of Custody Seal ☐ INTACT ☐ BROKEN ☐ ABSENT

Shipping Bill Number:

Page ____ of ____

Arctic Fox Environmental, Inc.
Pouch 340043 - Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146 / arcticfox@astacalaska.com

ABR Inc.
PO BOX 240268
Anchorage, Alaska 99524

Report Date: 11/26/2010
Date Arrived: 11/7/2010
Date Sampled: 11/6/2010
Time Sampled: not documented
Collected By: JS

Attn: John Seigle
Phone: (907) 344-6777 ext 206
Fax: (907) 770-1443
Email: jseigle@abrinc.com

Arctic Fox Lab# AF38504-38506
Client Sample ID: see below
Location/Project: 10-162 Arctic Cisco Monitoring
COC#: 62362
Sample Matrix: Water

Comments: Attached are the results for analysis of your samples.
These samples were analyzed by Test America in Beaverton, OR.
Tracking information is as follows:

ABR Sample ID: Hydro 1-2 (3 bottles)
Analysis Requested: Total Metals, Micro Exam, Nitrate
Arctic Fox ID: AF38504
Test America ID: PTK0368-01

ABR Sample ID: Hydro 3-2
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate
Arctic Fox ID: AF38505
Test America ID: PTK0368-02

ABR Sample ID: Hydro 4-2
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate
Arctic Fox ID: AF38506
Test America ID: PTK0368-03

Ralph E. Allphin

Reported By: Ralph E. Allphin/Michael J. Hawley
Arctic Fox Environmental, Inc.

TestAmerica
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PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6330/10-162 Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/23/10 16:49

Diesel and Heavy Range Hydrocarbons per NWTPH-Dx Method

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0368-02 (AF38505 Hydro 3-2)			**Water**			**Sampled: 11/06/10 00:00**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0971	mg/l	1x	10K0525	11/16/10 09:30	11/16/10 12:02	
Residual Range/Heavy Oil Organics	"	ND	-----	0.485	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*87.0%*		*50 - 150 %*	*"*			*"*
PTK0368-03 (AF38506 Hydro 4-2)			**Water**			**Sampled: 11/06/10 00:00**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0971	mg/l	1x	10K0525	11/16/10 09:30	11/16/10 12:20	
Residual Range/Heavy Oil Organics	"	ND	-----	0.485	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*83.7%*		*50 - 150 %*	*"*			*"*

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6330/10-162 Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/23/10 16:49

Total Metals per EPA 6000/7000 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0368-01 (AF38504 Hydro 1-2)			**Water**			**Sampled: 11/06/10 00:00**				
Arsenic	EPA 6020	**0.00190**	-----	0.00100	mg/l	1x	10K0439	11/12/10 10:01	11/13/10 13:08	
Barium	"	**0.120**	-----	0.00100	"	"	"	"	"	
Cadmium	"	ND	-----	0.00100	"	"	"	"	"	
Chromium	"	ND	-----	0.00200	"	"	"	"	"	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.00879**	-----	0.00100	"	"	"	"	"	
Silver	"	ND	-----	0.00100	"	"	"	"	"	
PTK0368-02 (AF38505 Hydro 3-2)			**Water**			**Sampled: 11/06/10 00:00**				
Arsenic	EPA 6020	**0.00184**	-----	0.00100	mg/l	1x	10K0439	11/12/10 10:01	11/13/10 13:13	
Barium	"	**0.126**	-----	0.00100	"	"	"	"	"	
Cadmium	"	ND	-----	0.00100	"	"	"	"	"	
Chromium	"	ND	-----	0.00200	"	"	"	"	"	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	**0.00741**	-----	0.00100	"	"	"	"	"	
Silver	"	ND	-----	0.00100	"	"	"	"	"	
PTK0368-03 (AF38506 Hydro 4-2)			**Water**			**Sampled: 11/06/10 00:00**				
Arsenic	EPA 6020	ND	-----	0.00100	mg/l	1x	10K0439	11/12/10 10:01	11/13/10 13:19	
Barium	"	**0.116**	-----	0.00100	"	"	"	"	"	
Cadmium	"	ND	-----	0.00100	"	"	"	"	"	
Chromium	"	ND	-----	0.00200	"	"	"	"	"	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Selenium	"	ND	-----	0.00100	"	"	"	"	"	
Silver	"	ND	-----	0.00100	"	"	"	"	"	

TestAmerica Portland

Vanessa Fras

Vanessa Frahs, Project Manager

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PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6330/10-162 Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/23/10 16:49

Total Mercury per EPA Method 7470A

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0368-01 (AF38504 Hydro 1-2)			**Water**			**Sampled: 11/06/10 00:00**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0594	11/17/10 13:49	11/17/10 16:29	
PTK0368-02 (AF38505 Hydro 3-2)			**Water**			**Sampled: 11/06/10 00:00**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0594	11/17/10 13:49	11/17/10 16:32	
PTK0368-03 (AF38506 Hydro 4-2)			**Water**			**Sampled: 11/06/10 00:00**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0594	11/17/10 13:49	11/17/10 16:34	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6330/10-162 Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/23/10 16:49

Conventional Chemistry Parameters per APHA/EPA Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0368-01 (AF38504 Hydro 1-2)			**Water**			**Sampled: 11/06/10 00:00**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0752**	-----	0.0300	mg/l	1x	10K0375	11/10/10 15:36	11/10/10 19:02	
PTK0368-02 (AF38505 Hydro 3-2)			**Water**			**Sampled: 11/06/10 00:00**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0661**	-----	0.0300	mg/l	1x	10K0375	11/10/10 15:36	11/10/10 19:02	
PTK0368-03 (AF38506 Hydro 4-2)			**Water**			**Sampled: 11/06/10 00:00**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0905**	-----	0.0300	mg/l	1x	10K0375	11/10/10 15:36	11/10/10 19:02	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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BioLogic Resources, LLC
10260 SW Nimbus Ave., Suite M11
Portland, OR 97223
Phone 503.670.1312
Fax 503.670.7262

For: TestAmerica - Portland
9405 SW Nimbus Ave.
Beaverton, OR 97008
Attn: Vanessa Frahs

Received: 11.11.10
Tested: 11.22.10
Completed: 11.23.10

Lab #	Sample	Microscopic Examination Algae
TA274	PTK0368-01 11.06.10	6 algal fragments observed 100 ml sample filtered through 0.45μm filter; 50 fields examined
TA275	PTK0368-02 11.06.10	31 algal fragments observed 100 ml sample filtered through 0.45μm filter; 50 fields examined
TA276	PTK0368-03 11.06.10	5 algal fragments observed 100 ml sample filtered through 0.45μm filter; 50 fields examined

Kim W. Hutchinson
Microbiologist/Principal

Arctic Fox Environmental, Inc.

Pouch 340043 / Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146
arcticfox@astacalaska.com / www.arcticfoxenv.com

Analytical Services Order and Chain of Custody Form

62394

~~1110-6345~~ 1110-6345

Client Name and Address: ABR, Inc. Environmental Research and Services, P.O. Box 240268 Anchorage, AK 99524

Contact Person: John Seigle

Phone Number: 907 344-6777 Fax Number: 907 770-1443

E-mail: jseigle@ABRinc.com

Project Name:

Data Deliverables: Level I ☐ Level II ☐ Level III ☐ EDD/Format:

Requested Turnaround Time and Special Instructions:

Account Number:

P.O. or Contract Number: 10-162

Authorization Number:

Sampled By: JRR

PWS Number:

Send Results to ADEC: ☐ YES ☒ No

Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID	Number of Containers	HCL – 1 L Glass bottle – TPH	HNO_3 – 500 mL poly bottle – Total metals	None – 125 mL bottle – NO_3^- NO_2	None – 250 mL bottle – Algae				Remarks
HYDRO 1-4	18 Nov 10	1550-1700	L	AF38579	4	X	X	X	X				
HYDRO 3-4	18 Nov 10	↓	L	AF38580	4	X	X	X	X				
HYDRO 4-4	18 Nov 10	↓	L	AF38581	4	X	X	X	X				

Preservative ←

Relinquished By	Date	Time	Received By
(1): John R. Rose	19 Nov 10		
(2):	11/19/10	1615	R. [illegible]
(3):			Received for lab by:

TO BE COMPLETED BY LABORATORY

Location Received/Temp on Arrival: ANC ☐ ____°C FBK ☐ ____°C PB ☐ ____°C

Chain of Custody Seal: ☐ INTACT ☐ BROKEN ☐ ABSENT

Shipping Bill Number: ____________

Page ____ of ____

Arctic Fox Environmental, Inc.
Pouch 340043 - Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146 / arcticfox@astacalaska.com

ABR Inc. environmental Research & Services
PO BOX 24068
Anchorage, Alaska 99524

Report Date: 12/8/2010
Date Arrived: 11/19/2010
Date Sampled: 11/18/2010
Time Sampled: 1530-1750
Collected By: JRR

Attn: John Seigle
Phone: (907) 344-6777 ext 206
Fax: (907) 770-1443
Email: jseigle@abrinc.com

Arctic Fox Lab# AF38579-38581
Client Sample ID: see below
Location/Project:
COC#: 62394
Sample Matrix: Liquid

Comments: Attached are the results for analysis of your samples.
These samples were analyzed by Test America in Beaverton, OR.
Tracking information is as follows:

ABR Sample ID: Hydro 1-4
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate, Nitrite
Arctic Fox ID: AF38579
Test America ID: PTK0819-01

ABR Sample ID: Hydro 3-4
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate, Nitrite
Arctic Fox ID: AF38580
Test America ID: PTK0819-02

ABR Sample ID: Hydro 4-4
Analysis Requested: TPH, Total Metals, Micro Exam, Nitrate, Nitrite
Arctic Fox ID: AF38581
Test America ID: PTK0819-03

Ralph E. Allphin

Reported By: Ralph E. Allphin/Michael J. Hawley
Arctic Fox Environmental, Inc.

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THE LEADER IN ENVIRONMENTAL TESTING

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6345/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	12/08/10 16:03

Diesel and Heavy Range Hydrocarbons per NWTPH-Dx Method

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0819-01 (AF38579 Hydro 1-4)			**Water**			**Sampled: 11/18/10 15:30**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0980	mg/l	1x	10K0761	11/23/10 10:15	11/23/10 23:06	
Residual Range/Heavy Oil Organics	"	ND	-----	0.490	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*81.7%*		*50 - 150 %*	*"*			*"*
PTK0819-02 (AF38580 Hydro 3-4)			**Water**			**Sampled: 11/18/10 15:30**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0980	mg/l	1x	10K0761	11/23/10 10:15	11/23/10 23:25	
Residual Range/Heavy Oil Organics	"	ND	-----	0.490	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*89.4%*		*50 - 150 %*	*"*			*"*
PTK0819-03 (AF38581 Hydro 4-4)			**Water**			**Sampled: 11/18/10 15:30**				
Diesel Range Organics	NWTPH-Dx	ND	-----	0.0980	mg/l	1x	10K0761	11/23/10 10:15	11/23/10 23:44	
Residual Range/Heavy Oil Organics	"	ND	-----	0.490	"	"	"	"	"	
Surrogate(s): 1-Chlorooctadecane				*95.2%*		*50 - 150 %*	*"*			*"*

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6345/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	12/08/10 16:03

Total Metals per EPA 6000/7000 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0819-01 (AF38579 Hydro 1-4)			**Water**			**Sampled: 11/18/10 15:30**				
Arsenic	EPA 6020	ND	-----	0.00500	mg/l	5x	10K0900	11/30/10 16:27	12/01/10 00:04	**RL1**
Barium	"	**0.147**	-----	0.00500	"	"	"	"	"	
Cadmium	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Chromium	"	ND	-----	0.0100	"	"	"	"	"	**RL1**
Lead	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Selenium	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Silver	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
PTK0819-02 (AF38580 Hydro 3-4)			**Water**			**Sampled: 11/18/10 15:30**				
Arsenic	EPA 6020	ND	-----	0.00500	mg/l	5x	10K0900	11/30/10 16:27	12/01/10 00:07	**RL1**
Barium	"	**0.164**	-----	0.00500	"	"	"	"	"	
Cadmium	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Chromium	"	ND	-----	0.0100	"	"	"	"	"	**RL1**
Lead	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Selenium	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Silver	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
PTK0819-03 (AF38581 Hydro 4-4)			**Water**			**Sampled: 11/18/10 15:30**				
Arsenic	EPA 6020	ND	-----	0.00500	mg/l	5x	10K0900	11/30/10 16:27	12/01/10 00:19	**RL1**
Barium	"	**0.222**	-----	0.00500	"	"	"	"	"	
Cadmium	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Chromium	"	ND	-----	0.0100	"	"	"	"	"	**RL1**
Lead	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Selenium	"	ND	-----	0.00500	"	"	"	"	"	**RL1**
Silver	"	ND	-----	0.00500	"	"	"	"	"	**RL1**

TestAmerica Portland

Vanessa Fras

Vanessa Frahs, Project Manager

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PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6345/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	12/08/10 16:03

Total Mercury per EPA Method 7470A

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0819-01 (AF38579 Hydro 1-4)			**Water**			**Sampled: 11/18/10 15:30**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0848	11/29/10 10:18	11/29/10 14:46	
PTK0819-02 (AF38580 Hydro 3-4)			**Water**			**Sampled: 11/18/10 15:30**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0848	11/29/10 10:18	11/29/10 14:48	
PTK0819-03 (AF38581 Hydro 4-4)			**Water**			**Sampled: 11/18/10 15:30**				
Mercury	EPA 7470A	ND	-----	0.000200	mg/l	1x	10K0848	11/29/10 10:18	11/29/10 14:51	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1110-6345/Arctic Cisco Catch Monitoring	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	12/08/10 16:03

Conventional Chemistry Parameters per APHA/EPA Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PTK0819-01 (AF38579 Hydro 1-4)			**Water**			**Sampled: 11/18/10 15:30**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0699**	-----	0.0300	mg/l	1x	10K0757	11/23/10 08:55	11/23/10 11:32	
PTK0819-02 (AF38580 Hydro 3-4)			**Water**			**Sampled: 11/18/10 15:30**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.0559**	-----	0.0300	mg/l	1x	10K0757	11/23/10 08:55	11/23/10 11:32	
PTK0819-03 (AF38581 Hydro 4-4)			**Water**			**Sampled: 11/18/10 15:30**				
Nitrate/Nitrite-Nitrogen	EPA 353.2	**0.104**	-----	0.0300	mg/l	1x	10K0757	11/23/10 08:55	11/23/10 11:32	

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Vanessa Fras

Vanessa Frahs, Project Manager

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Notes and Definitions

Report Specific Notes:

- R4 - Due to the low levels of analyte in the sample, the duplicate RPD calculation does not provide useful information.
- RL1 - Reporting limit raised due to sample matrix effects.

Laboratory Reporting Conventions:

- DET - Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.
- ND - Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).
- NR/NA - Not Reported / Not Available
- dry - Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.
- wet - Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.
- RPD - RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).
- MRL - METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.
- MDL* - METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.
- Dil - Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.
- Reporting Limits - Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.
- Electronic Signature - Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

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For: TestAmerica - Portland
9405 SW Nimbus Ave.
Beaverton, OR 97008
Attn: Vanessa Frahs

Received: 11.23.10
Tested: 11.23.10
Completed: 11.23.10

Lab #	Sample	Microscopic Examination Algae
TA281	PTK0819-01 11.18.10	7 algal fragments observed 100 ml sample filtered through 0.45µm filter; 50 fields examined
TA282	PTK0819-02 11.18.10	15 algal fragments observed 100 ml sample filtered through 0.45µm filter; 50 fields examined
TA283	PTK0819-03 11.18.10	8 algal fragments observed 100 ml sample filtered through 0.45µm filter; 50 fields examined

Kim W. Hutchinson
Microbiologist/Principal

Appendix C. A summary of water chemistry results from 3 sampling locations on 3 dates during the subsistence harvest of arctic cisco in the Niġliq Channel, Colville River, 2010. ND = below detectable limits.

	10/21/2011			11/7/2011			11/18/2011		
	Water Chemistry Station 1	Water Chemistry Station 3	Water Chemistry Station 4	Water Chemistry Station 1	Water Chemistry Station 3	Water Chemistry Station 4	Water Chemistry Station 1	Water Chemistry Station 2	Water Chemistry Station 4
Arsenic(mg/l)	ND	ND	ND	0.0019	0.00184	0.116	ND	ND	ND
Barium (mg/l)	0.103	0.0898	0.0867	0.12	0.126	0.116	0.147	0.164	0.222
Cadmium (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium (mg/l)	ND	ND	ND	0.00879	0.00741	ND	ND	ND	ND
Silver (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diesel Range Organic (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Residual/Heavy Oil Organics (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate/Nitrite ans Total Nitrogen	0.0888	0.0888	0.087	0.0752	0.0661	0.0905	0.0699	0.0559	0.104
Algal Fragment/100ml H_20	8	6	5	6	31	5	7	15	8

Appendix D. Catch per unit effort (CPUE) by age class for arctic cisco caught in 7.6-cm mesh nets, Colville Delta, Alaska, 1986–2010.[a] Data were collected and analyzed by MJM Research in 1986–2005, by LGL in 2006, and by ABR in 2007–2010.

Age Class (y)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.1	0.0	2.6	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.3	0.3	0.4	0.0	0.2	0.2	0.0	2.0	0.1	2.2	1.6
6	0.0	0.0	14.6	0.0	5.2	2.0	13.3	0.9	0.4	2.2	0.9	11.9	0.6	3.4	2.6	0.4	3.8	2.7	3.1	0.2	1.3	2.8	3.0	12.8	3.2
7	13.6	0.2	0.4	10.1	0.2	1.3	8.1	22.4	1.1	0.9	14.8	3.2	2.2	0.1	2.9	0.9	0.8	10.2	14.0	10.5	10.0	4.4	6.4	3.2	1.7
8	16.8	9.2	0.2	0.0	0.2	0.1	0.9	4.2	1.6	0.3	1.6	11.4	0.2	0.4	0.3	0.4	0.2	0.7	9.5	7.7	24.3	5.6	0.2	0.3	0.2
9	2.6	5.0	7.1	0.0	0.0	0.2	0.0	0.6	0.3	0.3	0.1	1.1	0.4	0.1	0.9	0.1	0.0	0.0	0.4	2.2	5.2	0.8	0.1	0.0	0.0
10	0.0	1.2	0.5	1.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.3	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
N =	199	196	126	—[b]	150	143	154	148	139	148	150	146	151	150	143	97	144	—[b]	141	103	95	39	59	120	141

[a] 1989 age distributions estimated by comparing length frequencies of Arctic cisco caught in gill nets to fish caught in fyke nets.
[b] Catch per unit effort (CPUE) for the 1989 and 2003 harvest seasons were estimated.

Appendix E. Age frequencies (expressed as percentages) of arctic cisco caught in 7.6-cm mesh nets, Colville Delta, Alaska, 1976–2010.[a] Data were collected and analyzed by the North Slope Borough in 1976–1978, by MJM Research in 1985–2005, by LGL in 2006, and by ABR in 2007–2010.

1976	1977	1978	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.5	10.7	0.0	0.0	0.0	0.5	0.0	18.3	7.3	4.9	0.0	0.0	0.7	0.0	0.0	0.0	27.2	23.3	3.5	10.3	7.6	0.0	0.7	1.0	0.0	12.8	1.4	11.7	0.7
3.2	57.7	10.2	10.2	3.3	0.0	0.0	63.5	0.0	86.0	51.0	59.7	3.4	10.8	59.5	5.3	43.2	13.2	62.0	33.6	16.5	72.9	20.0	11.3	1.0	3.2	17.9	31.1	69.2	23.4
54.8	15.4	74.0	77.2	21.5	41.2	1.0	1.6	72.0	3.3	33.6	36.4	79.7	31.7	23.6	84.7	11.6	45.7	2.7	37.1	37.1	14.6	75.0	51.1	50.5	24.2	28.2	64.9	17.5	46.8
6.4	23.6	0.9	9.1	68.2	50.8	59.0	0.8	0.0	2.7	1.4	3.9	14.9	46.8	7.4	9.3	41.1	4.0	8.0	4.2	14.4	4.2	5.0	34.8	36.9	58.9	35.9	2.0	1.7	24.8
29.0	1.6	2.8	0.0	4.8	8.0	32.0	31.0	0.0	0.0	5.6	0.0	2.0	9.4	7.4	0.7	4.1	8.6	2.7	11.2	4.1	0.7	0.0	1.4	10.7	12.6	5.1	0.7	0.0	3.5
6.4	0.5	0.0	0.0	1.3	0.0	7.6	2.4	9.3	0.0	0.0	0.0	0.0	0.7	2.0	0.0	0.0	1.3	1.3	4.2	12.4	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.7
0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	5.2	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	182	215	—[b]	—[b]	199	196	126	—[b]	150	143	154	148	139	148	150	146	151	150	143	97	144	—[b]	141	103	95	39	59	120	141

[a] 1984, 1985 and 1989 age distributions estimated by comparing length frequencies of Arctic cisco caught in gill nets to fish caught in fyke nets.
[b] Catch per unit effort (CPUE) for the 1984, 1985, 1989 and 2003 harvest seasons were estimated.