FALL 2009 SUBSISTENCE FISHERY MONITORING ON THE COLVILLE RIVER

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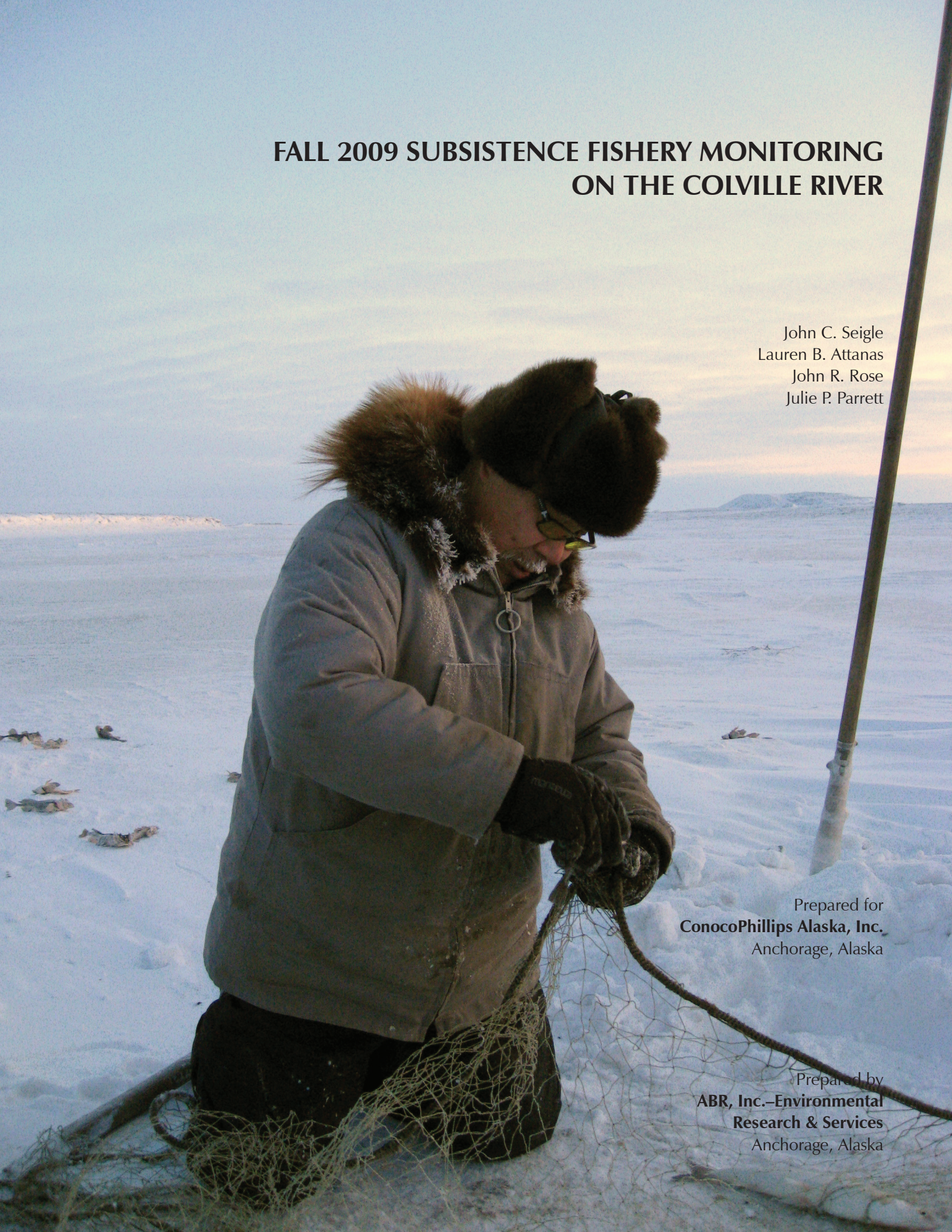

Prepared for
ConocoPhillips Alaska, Inc.
Anchorage, Alaska

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Cover:

Joeb Woods, Sr., tends to a gill net in the Upper Niġliq Channel of the Colville River near Nuiqsut in November of 2009. Joeb assisted on many research projects over the years and was a longtime friend to many at ABR. Joeb passed away in the spring 2010, and he will be missed.

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ON THE COLVILLE RIVER

FINAL REPORT

Prepared for

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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 2009 fishery monitoring team participated in a community meeting with residents of Nuiqsut on 13 October to present the results of the 2008 program. This meeting is 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 postseason meeting with the *Qaaktaq Panel* was held in late October 2010 to present the results of the 2009 program and to discuss concerns or ideas for enhancements to the monitoring program. Monitors also continued the program of daily on-ice harvest interviews, as in previous years.

Although the 2009 fishery began around 6 October, unseasonably warm weather and a great deal of overflow due to melting in the second week of October created dangerous river conditions, and most fishers waited to begin fishing until the third week of October. The fishery monitoring team observed or recorded from interviews the harvest of 11,700 fish (all species and mesh sizes combined). arctic cisco (85%) and least cisco (*Coregonus sardinella*; 9%) comprised the vast majority of the recorded harvest. Fishing effort decreased 15 % compared to 2008, and the observed catch rate for arctic cisco in the Niġliq Channel (~19 fish/adjusted net day) was slightly above the 1986–2007 average (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 2009, the Upper Niġliq area (0.0 fish/adjusted net day) saw the lowest observed harvest rate for arctic cisco caught in 7.6-cm nets, though it should be noted that just two 7.6-cm nets were deployed in this area for a total of 7 adjusted net days. Observed harvest rates were highest in the Niġliq Delta (21 fish/adjusted net day) and Nanuk areas (12 fish/adjusted net day). Based on observed catch rates and known adjusted fishing times in the Niġliq by each fisher we estimate a total harvest of nearly 23,000 arctic cisco in 2009.

As in 2008, 4, 5, and 6 years were the dominant age classes of arctic cisco harvested in 7.6-cm mesh gill nets; however, arctic cisco harvested in 2009 were larger than those harvested in 2008. It has been reported by USGS in 2009 that recent years have brought increased annual growth to arctic cisco in the Niġliq Delta which may explain why younger fish are bigger on the whole than in 2008. In general fishers appeared to be pleased with the size of the arctic cisco caught in 2009 as well as the size of their overall harvests, despite having a delayed start to the fishery. We expect harvests to increase or remain steady in the coming years due to continuing high densities of young-of-the-year arctic cisco caught in the summer at Prudhoe Bay. These fish should recruit to the fishery in 3 to 4 years.

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ACKNOWLEDGMENTS

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We depended again on the outstanding and often enthusiastic support of the residents of Nuiqsut. They made our third year in Nuiqsut very enjoyable. We thank members of the *Qaaktaq* Panel who continue to provide great support to our sampling crew throughout the year. Thanks also to the Kuukpik Subsistence Oversight Panel, Inc. (KSOPI) and Annie Gray. We thank the Nuiqsut Bed and Breakfast for excellent food and lodging and the Nanuq Corporation and its employees for endless 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 offered up their harvest data and advice again during the 2009 fall fishery.

INTRODUCTION

In 2009, 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 2009 monitoring program was a continuation of 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. 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 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). In the past, the main goals of the monitoring program have been to obtain estimates of the total fishing effort and catch and to predict future harvest.

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. 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 conducted 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 2009 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 and their dimensions and locations during the season.
- Document the subsistence fishery harvest.
- Collect length and weight for arctic cisco.
- Measure water salinity and quality in primary fishing areas.
- Compare the 2009 results with those of previous years for this program.

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 environment in 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 are flushed 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. 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 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 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 has 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 the 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 disturbance 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 MEETINGS

ABR held one meeting in Nuiqsut during the 2009 fall fishery monitoring (Appendix A). This meeting was open to all members of the public and was held on 13 October at the Community Center. The purpose of this meeting was to (1) remind residents that ABR is available for consultation or assistance on all issues related to the fall fishery, (2) present the results from the 2008 monitoring program, and (3) document concerns that the community might have over the status of the fishery. A science fair was held prior to the community meeting at the school gym and children of all ages were invited to look at fish tissue samples and to discuss the fishery monitoring work in Nuiqsut. A second meeting was held on 29 October 2010 at the KSOPI office and included members of the *Qaaktaq* Panel and monitoring program personnel. The purpose of this meeting was to (1) continue to work with active fishers to get their perspective on the state of the 2009 fall fishery and (2) act as an agent expressing the community's concerns about the fishery to the client, CPAI. Notes on the community meetings held in October 2009 and October 2010 can be found in Appendix A.

FISHERY EFFORT AND HARVEST

In the past, the majority of harvest information was collected by means of direct interviews of subsistence fishers by scientists. Starting in 2005, logbooks were distributed to the most active fishing families, to augment information collected by interviews. In 2007 and 2008, logbooks were distributed to families who had expressed interest in keeping track of their daily fishing effort and catch records and who were recommended by the *Qaaktaq* Panel. ABR did not distribute logbooks during the 2009 fishing season.

Three traditional fishing areas hosted the majority of concentrated fishing efforts within the Niġliq Channel in 2009 (Figure 2). From upstream to downstream, these are the Upper Niġliq area (adjacent to the town of Nuiqsut), the Nanuk area,

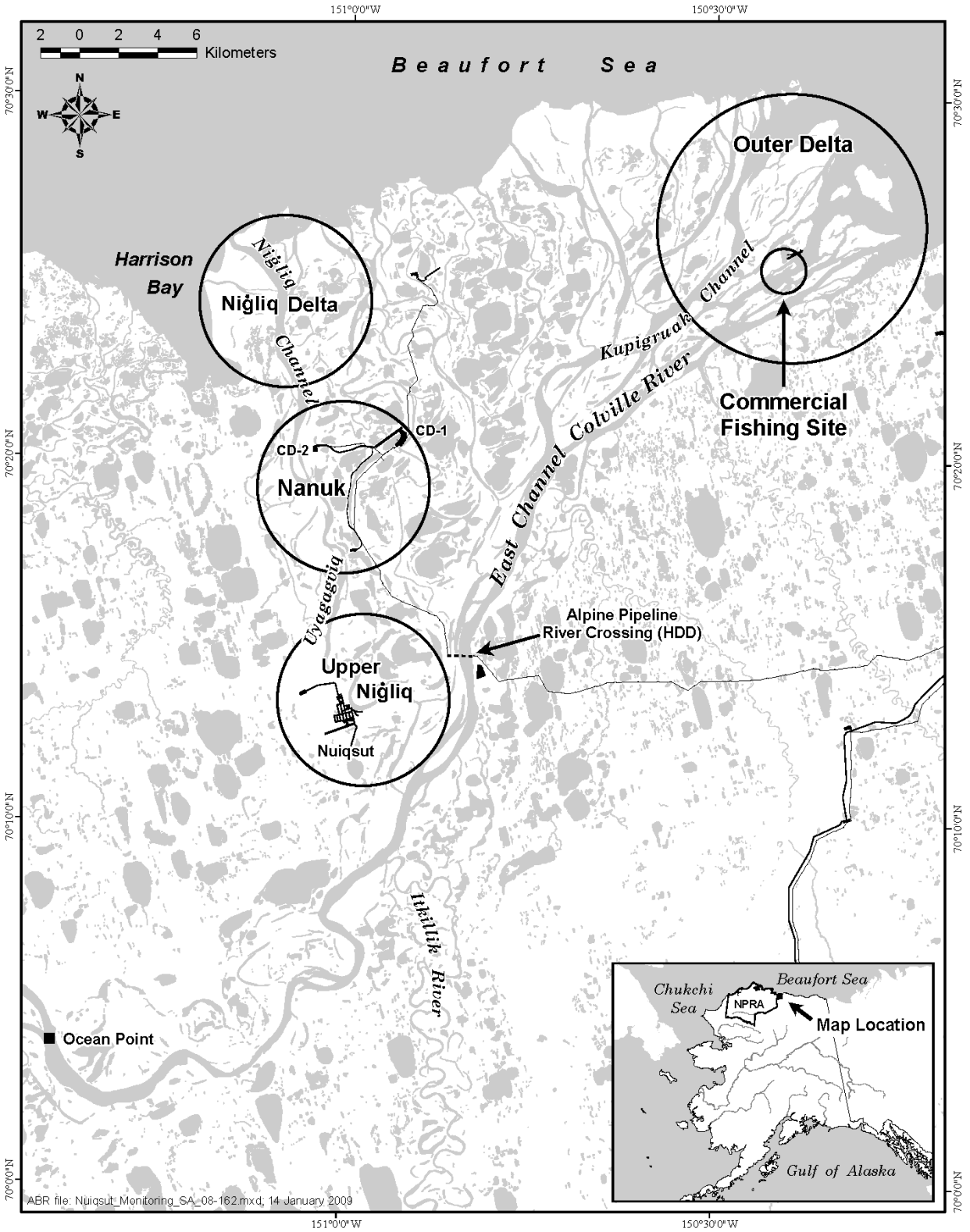

Figure 1. Three of the main subsistence fishing areas and the 1 commercial fishing area historically used for harvesting arctic cisco in the Colville Delta (after Moulton and Seeve).

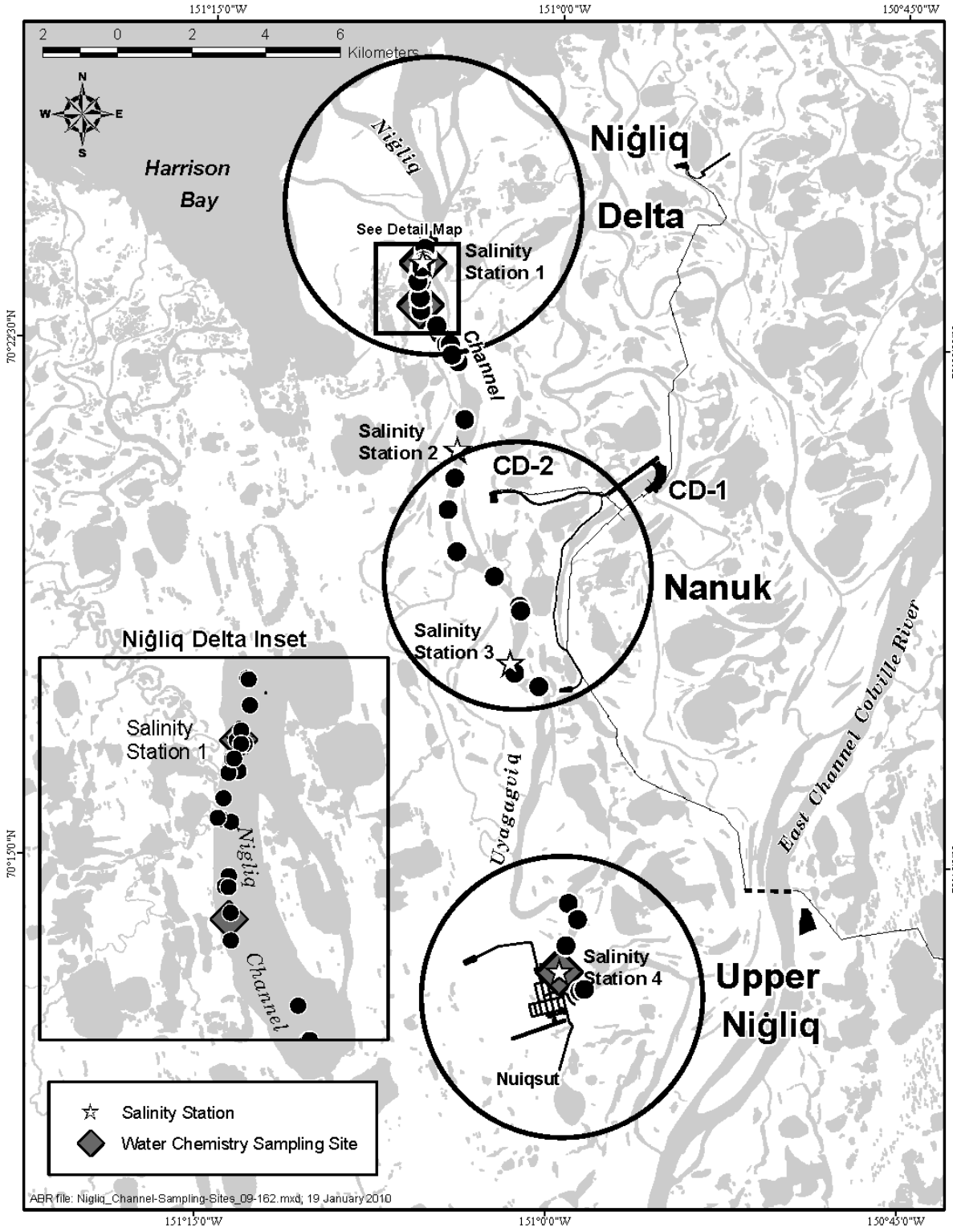

Figure 2. Salinity stations (4) and water chemistry sampling sites (3) in relation to net sites in each of the 3 main subsistence fishing areas in the Niġliq Channel of the Colville River during the fall subsistence fishery in 2009.

and the Niġliq Delta area (includes nets between the Nanuk and Niġliq Delta areas). A fourth traditionally-used area, the Uyagagviq area (between Upper Nigliq and Nanuk), was not used in 2009.

The harvest monitoring team always included 2 scientists from ABR. The third member of the team was a local resident of Nuiqsut, Jerry Pausanna. Each day the team 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.

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, or 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 nets with 7.6-cm mesh.

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 harvest assessment because these data include nets of all mesh sizes and lengths; however, these numbers 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 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. If time permitted, we measured other species harvested in a fisher's net, including least cisco.

When possible, a sub-sample of fish (~10/day) was purchased from fishers. We only purchased fish from nets of known mesh size and attempted to purchase fish caught only with 7.6-cm mesh nets. In some cases, fish from other mesh sizes were purchased, but these fish were excluded from analyses where noted. 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 coin envelopes.

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 Model 85 monitor 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. 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.

ABR collected routine water samples for analysis of water chemistry by Arctic Fox Environmental, Inc., in Prudhoe Bay, Alaska. On 3 November, samples were collected at the salinity stations in the Niġliq Delta area near Woods' Camp and in the Upper Niġliq area near Nuiqsut. These samples were tested for algal content, iron and manganese concentrations, and Total Petroleum Hydrocarbons (oil and grease by EPA Method 1664).

RESULTS

FISHERY EFFORT AND HARVEST

In 2009, the arctic cisco subsistence harvest began on approximately 6 October shortly after freeze up on the Colville River Delta, according to interviews conducted one week later (Table 1). However, a warm weather front beginning on 9 October and continuing until approximately 16 October created melting conditions and rendered river ice conditions unsafe for travel. Thus, most nets were not deployed until the after the third week of October (Table 2). Twenty-seven families deployed 58 nets during the fall fishery in 2009 (Table 2, Figure 3). This is 2 nets greater than the number of nets deployed in 2008 and is

Table 1. Estimated onset of fishing in the Colville River fall subsistence fishery, 1985–2009.

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	5 Oct
2009	6 Oct
Average	7 Oct

Table 2. Total adjusted fishing effort recorded for the fall fishery 2009, Niġliq Channel, Alaska.

Fisher Code	Fishing Area	Net	Net Code	Net Length (m)	Stretched Mesh (cm)	Start Date	End Date	Net Days	Adjusted Net Days
4	Niġliq	A	094A1	18.3	7.6	10/24	11/22	29	29.0
4	Niġliq	B	094B1	24.4	7.6	10/24	11/6	13	17.3
4	Niġliq	C	094C1	24.4	7.6	10/24	11/22	29	38.7
4	Niġliq	D	094D1	24.4	7.6	10/24	11/22	29	38.7
4	Niġliq	E	094E1	24.4	7.6	10/31	11/9	9	12.0
4	Niġliq	F	094F1	24.4	5.1	11/6	11/20	14	18.7
7	Niġliq	A	097A1	24.4	7.0	10/24	11/14	21	28.0
7	Niġliq	B	097B1	24.4	7.6	10/24	11/14	21	28.0
7	Nanuq	C	097C1	18.3	7.6	10/30	11/14	15	15.0
20	Niġliq	A	0920A1	24.4	8.9	10/28	11/9	12	16.0
20	Niġliq	B	0920B1	18.3	7.6	10/31	11/4	4	4.0
24	Niġliq	A	0924A1	24.4	7.6	10/20	11/19	30	40.0
24	Niġliq	B	0924B1	18.3	7.6	10/20	11/19	30	30.0
24	Niġliq	C	0924C1	24.4	7.6	10/20	11/4	15	20.0
25	Nanuq	A	0925A1	30.5	7.6	10/6	10/9	3	5.0
25	Nanuk	A	0925A2	30.5	7.6	10/24	11/22	29	48.3
25	Nanuk	B	0925B1	18.3	8.9	10/26	11/16	21	21.0
25	Nanuk	C	0925C1	18.3	7.6	11/1	11/22	21	21.0
27	Upper Niġliq	A	0927A1	18.3	7.6	10/25	10/31	6	6.0
27	Nanuk	B	0927B1	24.4	6.4	10/27	11/6	10	13.3
27	Nanuk	C	0927C1	18.3	7.6	10/31	11/6	6	6.0
31	Upper Niġliq	A	0931A1	24.4	7.0	11/3	11/10	7	9.3
31	Upper Niġliq	B	0931B1	18.3	7.6	11/6	11/7	1	1.0
32	Nanuk	A	0932A1	24.4	7.6	10/23	11/8	16	21.3
32	Nanuk	B	0932B1	24.4	7.0	10/23	11/5	13	17.3
33	Upper Niġliq	A	0933A1	30.5	6.4	10/26	11/2	7	11.7
33	Niġliq	B	0933B1	30.5	7.6	10/24	11/12	19	31.7
33	Niġliq	C	0933C1	24.4	8.3	10/24	11/20	27	36.0
36	Niġliq	A	0936A1	30.5	7.6	10/28	11/14	17	28.3
37	Upper Niġliq	A	0937A1	24.4	8.9	10/16	11/18	33	44.0
56	Niġliq	A	0956A1	24.4	7.6	10/20	11/17	28	37.3
56	Niġliq	B	0956B1	24.4	7.0	10/20	11/19	30	40.0
56	Niġliq	C	0956C1	18.3	7.6	10/20	11/4	15	15.0
63	Niġliq	A	0963A1	24.4	7.6	10/26	11/9	14	18.7
65	Niġliq	A	0965A1	18.3	7.6	10/26	11/10	15	15.0
66	Upper Niġliq	A	0966A1	24.4	8.9	11/6	11/23	17	22.7
66	Upper Niġliq	B	0966B1	18.3	7.0	11/8	11/13	5	5.0
69	Niġliq	A	0969A1	24.4	7.6	10/16	11/14	29	38.7

Table 2. Continued.

Fisher Code	Fishing Area	Net	Net Code	Net Length (m)	Stretched Mesh (cm)	Start Date	End Date	Net Days	Adjusted Net Days
69	Niġliq	B	0969B1	24.4	8.9	10/16	11/14	29	38.7
72	Niġliq	A	0972A1	24.4	8.9	10/28	10/29	1	1.3
72	Niġliq	B	0972B1	24.4	8.9	10/29	11/9	11	14.7
74	Niġliq	A	0974A1	30.5	6.4	10/28	11/9	12	20.0
76	Nanuk	A	0976A1	24.4	8.9	11/2	11/22	20	26.7
79	Nanuk	A	0979A1	24.4	7.6	10/28	11/10	13	17.3
79	Nanuk	B	0979B1	30.5	7.6	10/31	11/10	10	16.7
82	Niġliq	A	0982A1	24.4	7.6	10/25	10/29	4	5.3
82	Niġliq	A	0982A1	24.4	7.6	10/6	10/12	6	8.0
86	Niġliq	A	0986A1	30.5	6.4	10/20	11/5	16	26.7
86	Niġliq	B	0986B1	30.5	7.6	10/20	11/5	16	26.7
88	Nanuk	A	0988A1	24.4	7.6	11/1	11/15	14	18.7
88	Nanuk	B	0988B1	24.4	7.6	11/1	11/20	19	25.3
89	Niġliq	A	0989A1	24.4	6.4	10/29	11/4	6	8.0
93	Niġliq	A	0993A1	24.4	7.6	10/6	10/12	6	8.0
93	Niġliq	B	0993B1	24.4	7.6	10/6	10/12	6	8.0
93	Niġliq	C	0993C1	30.5	6.4	10/31	11/4	4	6.7
94	Niġliq	A	0994A1	18.3	8.9	10/16	11/10	25	25.0
94	Niġliq	B	0994B1	30.5	6.4	11/7	11/10	3	5.0
95	Niġliq	A	0995A1	24.4	7.6	11/3	11/6	3	4.0
							Total Adjusted Net Days		1,159.7

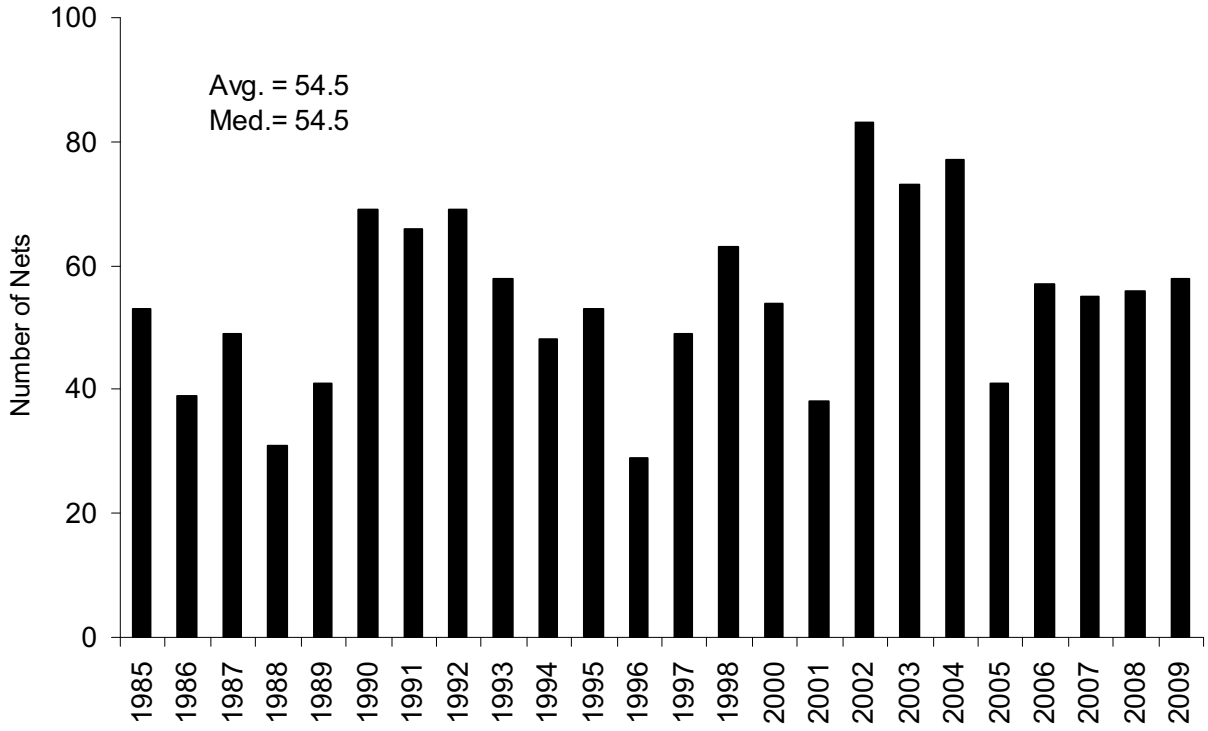

Figure 3. Number of gill nets deployed annually in the Colville River fall subsistence fishery, 1986–2009.

comparable to the average and median number deployed since 1986 (Figure 3). All 58 nets monitored in 2009 were deployed in the Niġliq Channel. ABR is unaware of any subsistence sampling having occurred in the main channel for arctic cisco in 2009.

Net deployment was inconsistent during the first 2.5 weeks of the fishing season. At least 4 nets were deployed on or about 6 October. Most nets were then pulled during the warming period during the second week of October, though at least 2 nets were lost in the river and never rediscovered. The number of nets deployed rose from 4 to 12 between 19 and 20 October and again from 14 to 23 nets between 23 and 24 October. Net deployment increased steadily during 20 October–4 November. On 4 November, the number of nets in the Niġliq Channel reached 45, which was the maximum at any one time for the season, and then decreased steadily to 1 net on 23 November (Figure 4). A rapid increase in the number of nets deployed on or after 24 October is coincident with the end of the Alaska Federation of Natives (AFN) convention in Anchorage (22–24 October).

After standardizing for net length, we calculated 1,160 adjusted net days of fishing effort in 2009 (Table 2), representing a 15% decrease in fishing effort compared to 2008. Fishing effort was highest in the Niġliq Delta area (68% of total), and effort in the Nanuk area was much lower in 2009 (24% of total) than in 2008 (Figure 5). The Upper Niġliq area accounted for just 9% of the calculated effort in the Niġliq Channel in 2009.

The most frequently deployed mesh size of nets in the Nuiqsut fall fishery has traditionally been 7.6 cm, and this trend continued in 2009. A total of 35 out of 58 nets deployed in 2009 in the Niġliq Channel were 7.6-cm mesh nets (Table 2). As previously indicated, although CPUE was calculated for all net mesh sizes, we predominately discuss results for nets with 7.6-cm mesh (standardized to 18 m length), as this is the dominant net used in the fishery. CPUE for arctic cisco in 2009 was lowest in the Upper Niġliq area (0.0 fish/adjusted net day, Table 3), though it should be noted that only two 7.6-cm mesh net were deployed in this area and fished for a total of 7 adjusted net days during which we were unable to interview these fishers to determine their

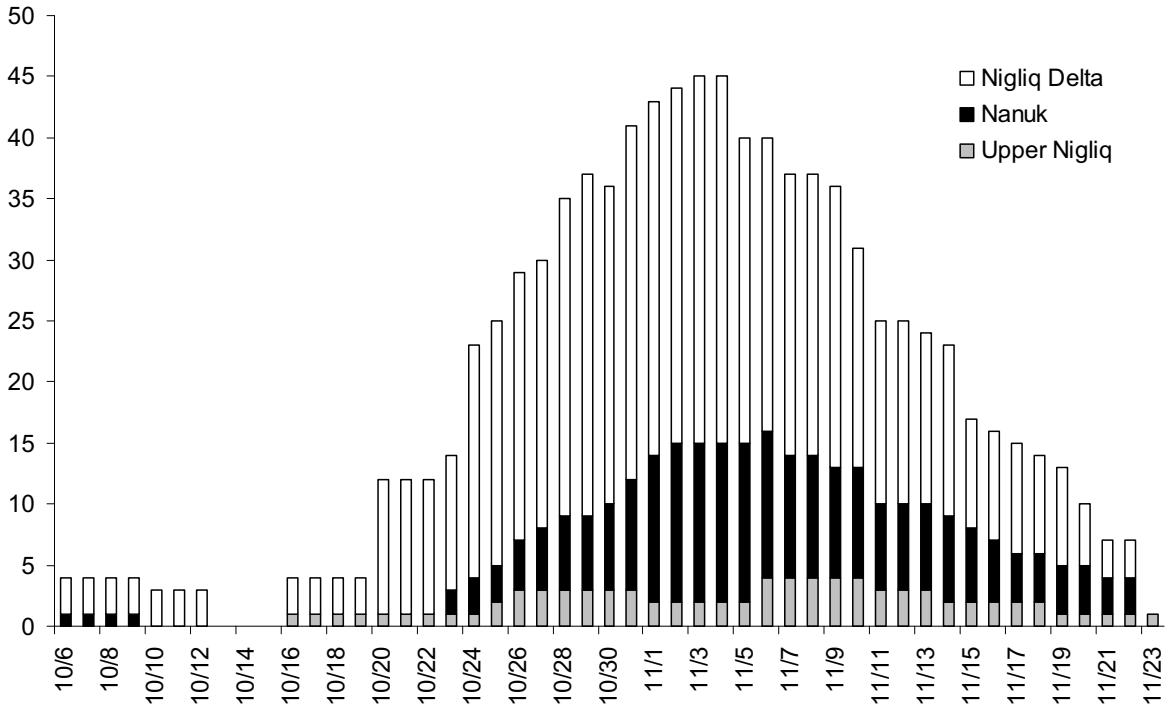

Figure 4. Number of nets fishing each day in each of 3 Niġliq Channel fishing areas, 2009.

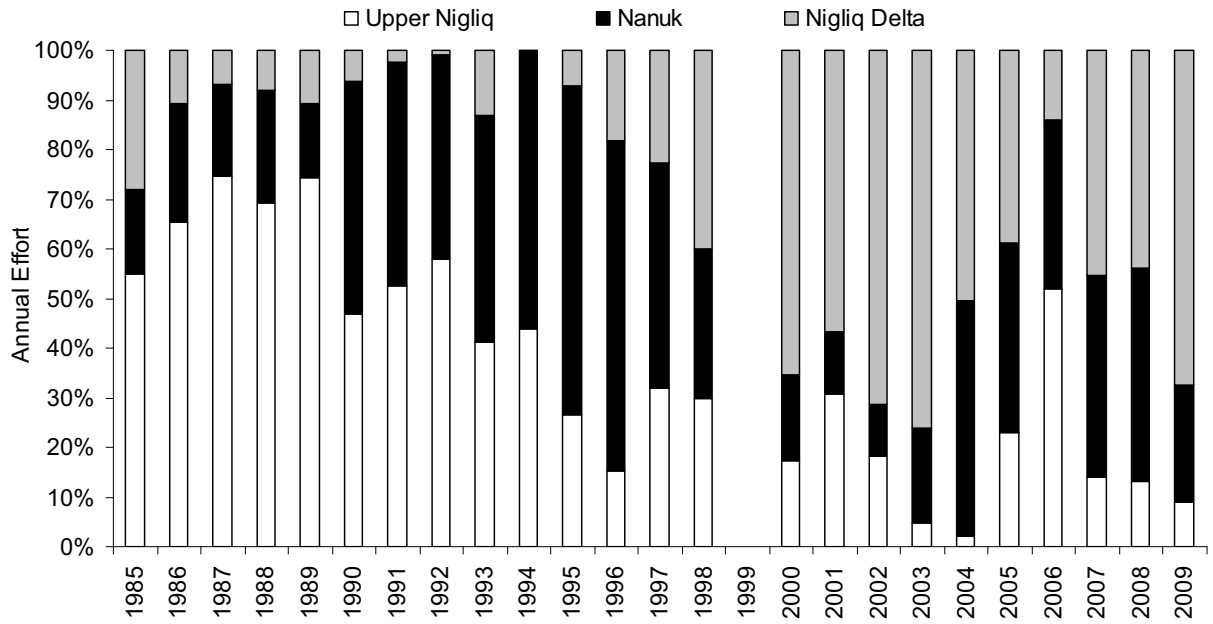

Figure 5. Percent of annual fishing effort in each of 3 Niġliq Channel fishing areas, 1985–2009. All nets are included, the Uyagagviq area is combined with the Nanuk area.

harvest. CPUE in 7.6-cm mesh nets for the Niġliq Delta area was 21.7 fish/adjusted net day, and the Nanuk area had the second highest CPUE for arctic cisco at 11.6 fish/adjusted net day. The total CPUE in 7.6-cm mesh nets for arctic cisco in the Niġliq Channel (19 fish/adjusted net day) was the highest since 2006 and slightly above the 1986–2009 average of 15 fish/adjusted net day (Table 3, Figure 6). In 2009, the daily average CPUE in 7.6-cm mesh nets peaked on 25 October at 58 fish/adjusted net day and decreased overall as the season progressed (Figure 7). Monitoring teams documented a total of 5,285 arctic cisco in 7.6-cm mesh nets (9,994 in all mesh sizes combined), similar to the long-term average of 5,108 monitored since 1986 in 7.6-cm mesh nets (Table 3).Total observed harvest in 7.6-cm nets in the Niġliq Delta was increased in 2009 over the previous year while the observed harvest was decreased in Nanuk and the Upper Nigliq areas over 2008 (Figure 8). The CPUE for each mesh size from observed harvests in the Niġliq Channel reveals that harvest results compared favorably with 7.6-cm mesh nets in most areas (Table 4). Multiplying the observed CPUE by the actual adjusted fishing time for each net we estimate a total harvest of nearly 23,000 arctic cisco in 2009 (Table 4).

In addition to arctic cisco, 7 other species of fish were recorded in the harvest in 2009 (Table 5). A total of 11,700 fish (all species and mesh sizes) were counted in interviews, with arctic cisco (85%) and least cisco (9%) comprising the vast majority of the recorded harvest (Table 5). Rainbow smelt (*Osmerus mordax*), saffron cod (*Eleginus gracilis*), Bering cisco (*Coregonus laurettae*), broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus pidschian*), and burbot (*Lota lota*) also occurred in the harvest in small numbers. The CPUE in the Niġliq Channel for least cisco in 2009 was similar in the Upper Niġliq and Nanuk areas but was noticeably lower in the Niġliq Delta. Overall, the CPUE for least cisco in 2009 was similar to the average since 1986 (Table 6).

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 2,277 arctic cisco in 2009, down from 2,341 in 2008 and 3,694 in 2007. Fish ranged in length from 204 to 417 mm (Figure 9), with the middle 50% of fish measuring

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, Alaska, 1986–2009. 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	Observed Catch	Effort	CPUE	Observed Catch	Effort	CPUE	Observed Catch	Effort	CPUE	Observed 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,b]	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	1,027	88.3	11.6	4,258	196.3	21.7	5,285	284.7	18.6
Total[c]	20,222	2,026	10.0	41,021	2,778	14.8	56,420	2,920	19.3	117,663	7,725	15.2

[a] Upper Niġliq catch and effort values include fish and net data from Uyagagviq area (Area 630)

[b] Denotes correction made in 2009 for CPUE in the Niġliq Delta and Upper Niġliq due to mislabeling of Nanuk net as Niġliq Delta net and reduction of total fish caught due to mislabel of mesh size. This resulted in a chang in the Total CPUE for Niġliq Channel from 9.8 to 10.1

[c] Denotes average CPUE 1986–2009

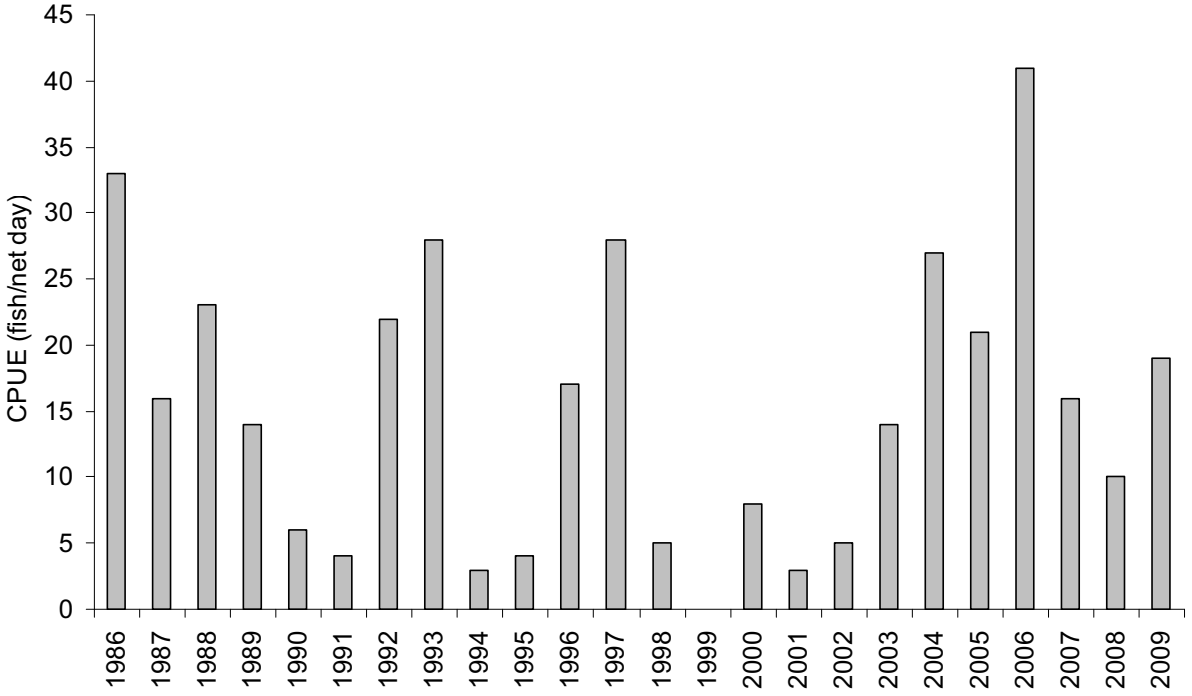

Figure 6. Catch per unit effort (CPUE) of arctic cisco in 7.6-cm gillnets, Nigliq Channel, 1986–2009. Effort is standardized to 18 m net length, as described in text.

308–333 mm, as opposed to 295–320 mm in 2008. The median fork length was 321 mm (compared to a median of 309 mm in 2008). Lengths of arctic cisco are normally distributed with a slight skew to the left. The frequency of length classes of arctic cisco captured differed among mesh sizes (Figure 10), with 7.6-cm mesh nets capturing the widest range of fish lengths among net sizes observed.

ABR also measured fork lengths of 187 least cisco (Figure 9). For least cisco, fish length also was normally distributed and ranged between 239 and 389 mm with a median of 295 mm (2008 values were between 222 and 356 mm with a median of 305 mm). The middle 50% of the measured harvest was between 279 and 310 mm (as compared to between 295 and 315 mm in 2008).

As in previous years, ABR regularly purchased a small number of fish from active fishers for additional analyses. 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 = 152). This relationship can be used as an indicator of fish health or condition of the fish. Length and weight were strongly correlated (r^2 = 0.8977) in arctic cisco in 2009 (Figure 11).

Otoliths were removed from these same fish to estimate age structure for the 2009 harvest. Over all mesh sizes combined (n = 152), arctic cisco ranged in age from 3 to 7 years (Figure 12). Age composition was 66% age 5, 18% age 4, 14% age 6, 1% age 3, and 1% age 7. Because different mesh-size nets catch 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 = 120), age composition was approximately 69% age 5, 18% age 6, 12% age 4, and 2% age 7 (Figure 12). 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 2009, the largest observed fork length of aged arctic cisco occurred in the 5-year-old class, though fish lengths in general were similar for 5 and 6 year old fish (Figure 13). Harvest of age 7

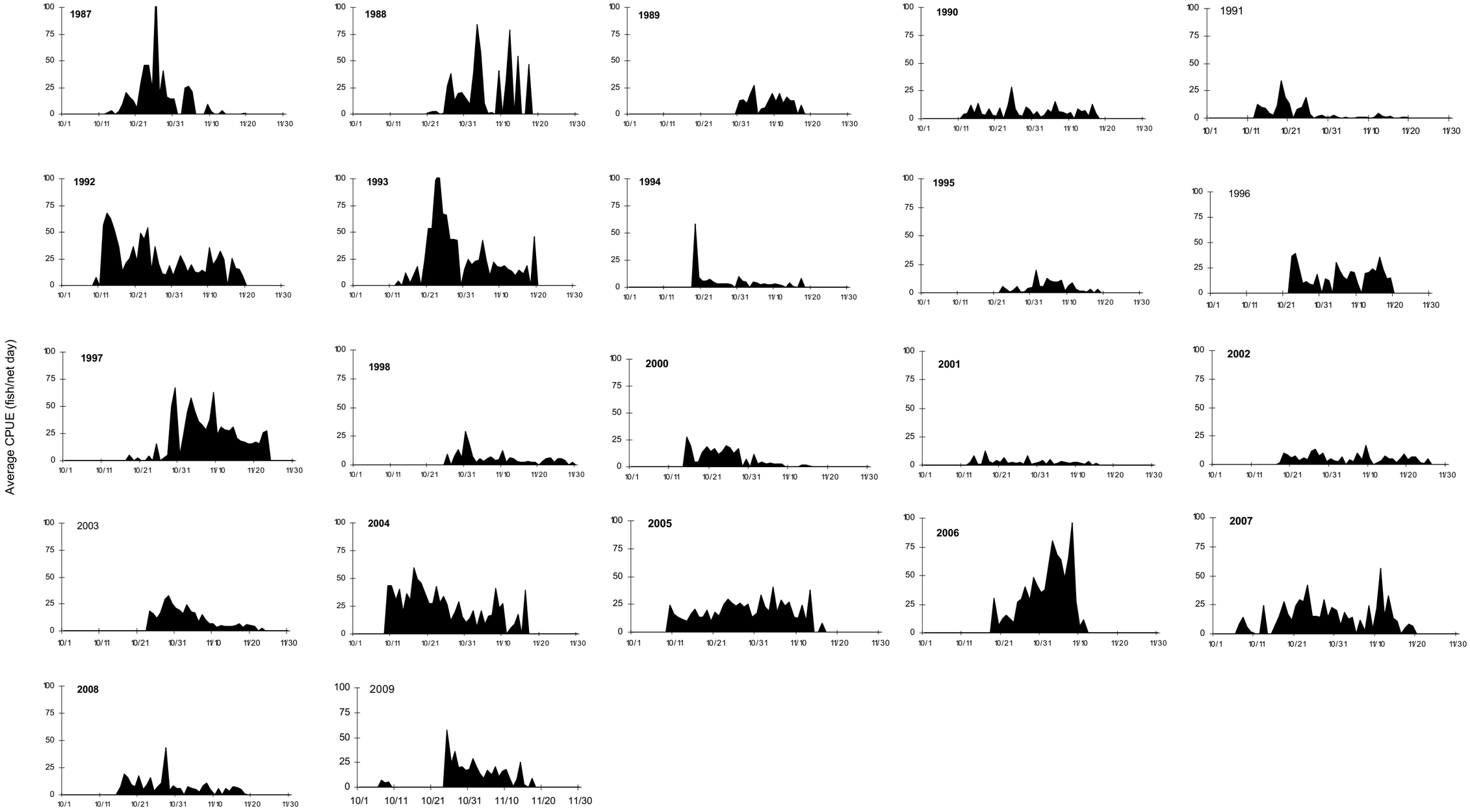

Figure 7. Average daily catch per unit effort (catch per net day) of arctic cisco in 7.6-cm gillnets, Niġliq Channel, 1987–2009. Effort is standardized to 18 m net length, as described in text.

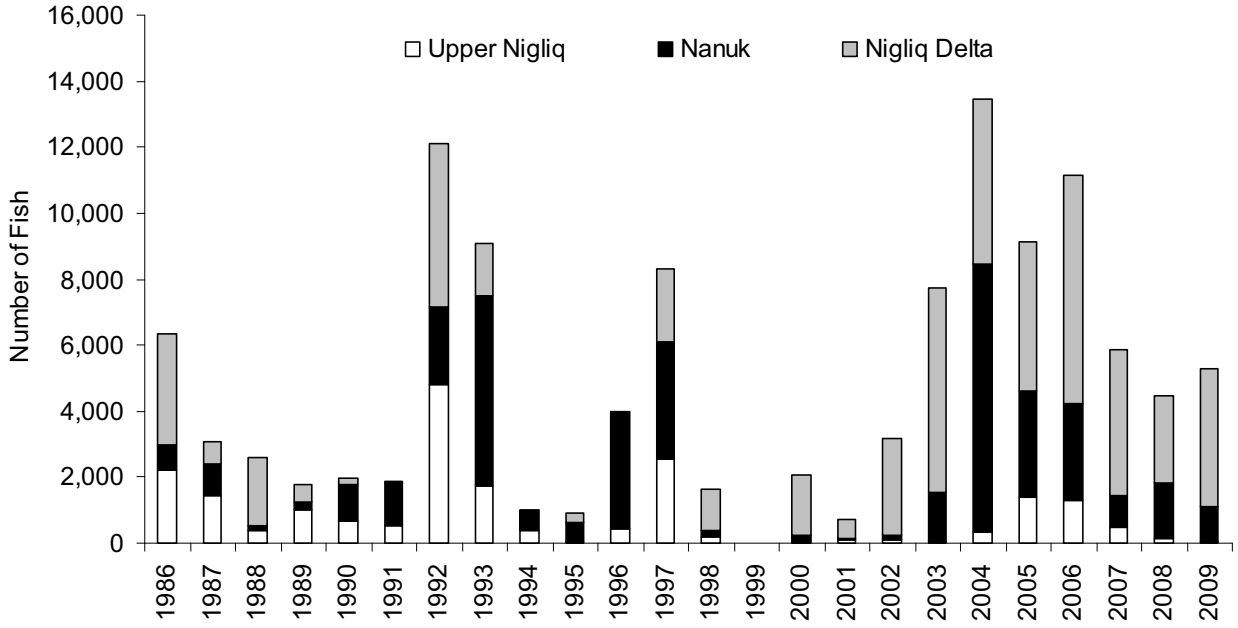

Figure 8. Number of arctic cisco harvested in 7.6-cm mesh gillnets in each of 3 Niġliq Channel fishing areas, 1986–2009. The 2005–2009 data are not directly comparable to historical data because the fishery was not monitored for the entire fishing period.

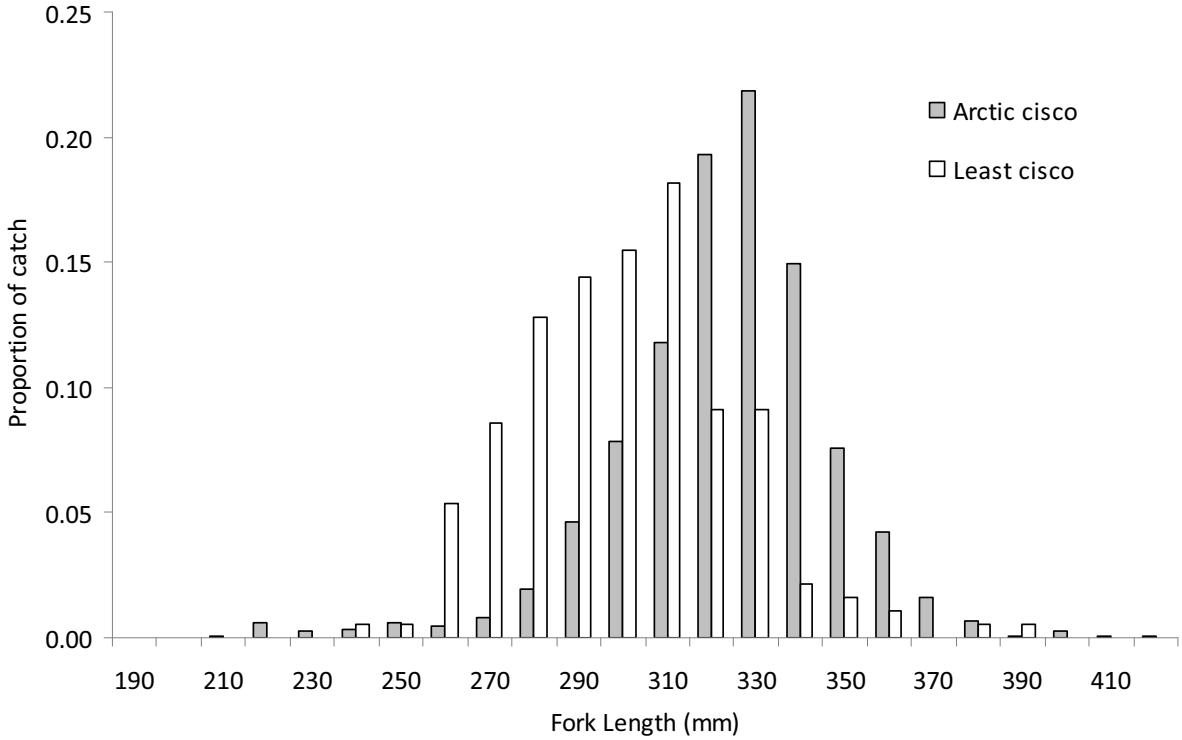

Figure 9. Length frequency (10-mm increments) of arctic and least cisco captured in all mesh sizes in the fall subsistence fishery, Niġliq Channel, 2009.

Table 4. Observed harvest and net length adjusted Catch Per Unit Effort (CPUE) in 3 major fishing areas as well as estimated total harvest numbers Niġliq Channel, Alaska, 2009.

	Upper Nigliq			Nanuk			Nigliq Delta			Total Nigliq Channel				
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)	CPUR (fish/net day)	Catch (# of fish)	Effort (net days)	CPUR (fish/net day	Actual Adjusted Net Days by Net Mesh	Estimated Harvest
5.1	--	--	--	--	--	--	146	5.3	27.4	146	5.3	27.5	18.7	515.1321
6.4	145	5.0	29.0	50	4.0	12.5	1,347	35.0	38.5	1,542	44.0	35.0	91.3	3199.65
7.0	83	3.3	24.9	87	2.7	32.6	587	20.0	29.4	757	26.0	29.1	99.7	2902.804
7.6	0	0.0	0.0	1,027	88.3	11.6	4,258	196.3	21.7	5,285	284.7	18.6	704	13068.63
8.3	28	1.3	21.0	143	4.0	35.8	304	13.0	23.4	475	18.3	26.0	36	934.4262
8.9	363	22.7	16.0	124	39.7	3.1	424	25.7	16.5	911	88.1	10.3	210	2171.51
Total														22792.16

Table 5. Species composition of the subsistence harvest from the Colville River fall fishery, expressed as a percent of the sampled catch, 1985–2009. Table includes all fish caught 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		4.3	0	0	0	0.1	0.03	0	(b)	11,700

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

Table 6. Observed catch of least cisco (number of fish), adjusted effort (net days), and catch per unit effort (CPUE; fish/net day) for each of 3 main fishing areas in the Niġliq Channel, 1986–2009. Effort data are for 7.6-cm mesh gillnets, standardized to 18-m length, as described in text.

	Upper Niġliq			Nanuk			Niġliq Delta			Total Niġliq channel		
Year	Observed Catch	Effort	CPUE	Observed Catch	Effort	CPUE	Observed Catch	Effort	CPUE	Observed 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	18.0	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	0.0	272	326.9	1.0	0	8.0	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	99.0	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	12.0	8.0	826	240.7	3.0
1996	14	36.0	0.0	195	193.3	1.0	0	0	--	209	229.3	1.0
1997	1,370	119.0	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	8.0	1.0	97	62.0	2.0	330	190.4	2.0	438	260.4	2.0
2001	129	62.0	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	104.0	4.0	1,038	455.7	2.0	1,522	571.3	3.0
2004	167	22.0	8.0	2,493	270.9	9.0	1,483	199.7	7.0	4,143	492.6	8.0
2005	405	90.0	5.0	710	140.3	5.0	700	177.0	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
Total	7,210	2,015	3.6	10,749	2,718	4.0	9,108	2,912	3.1	27,067	7,646	3.5

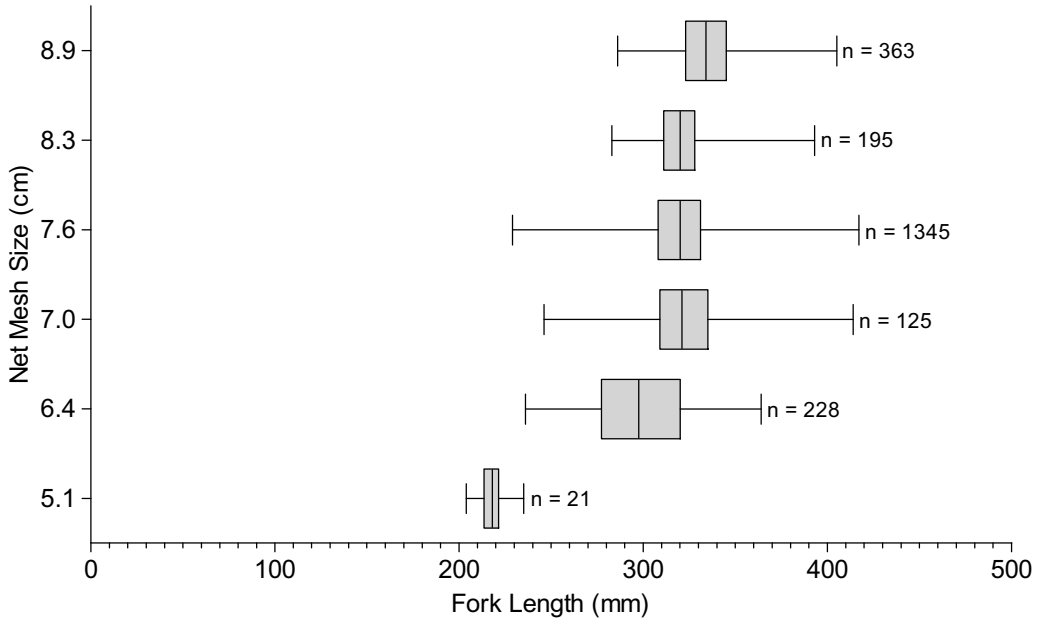

Figure 10. Cumulative length frequency of arctic cisco in the fall subsistence fishery by gillnet mesh size, Niġliq Channel, 2009.

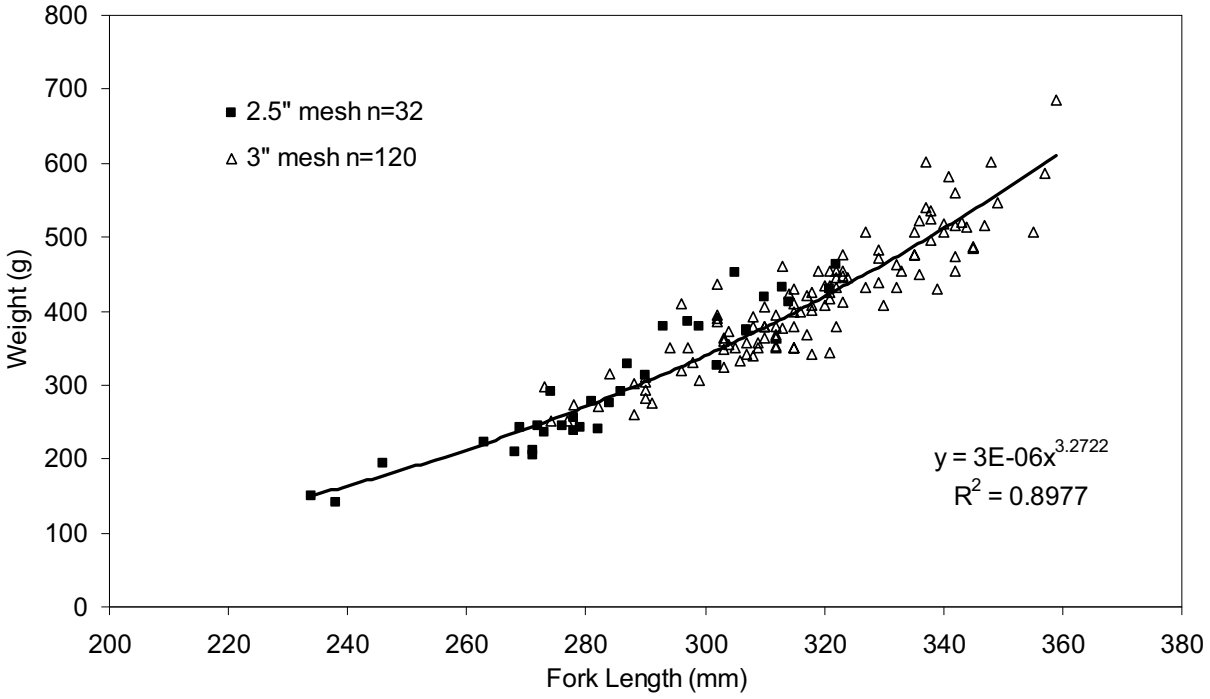

Figure 11. Relationship of weight to length in arctic cisco harvested in the fall subsistence fishery, Niġliq Channel, 2009. Trendline and equation are based on all mesh sizes combined (n = 152).

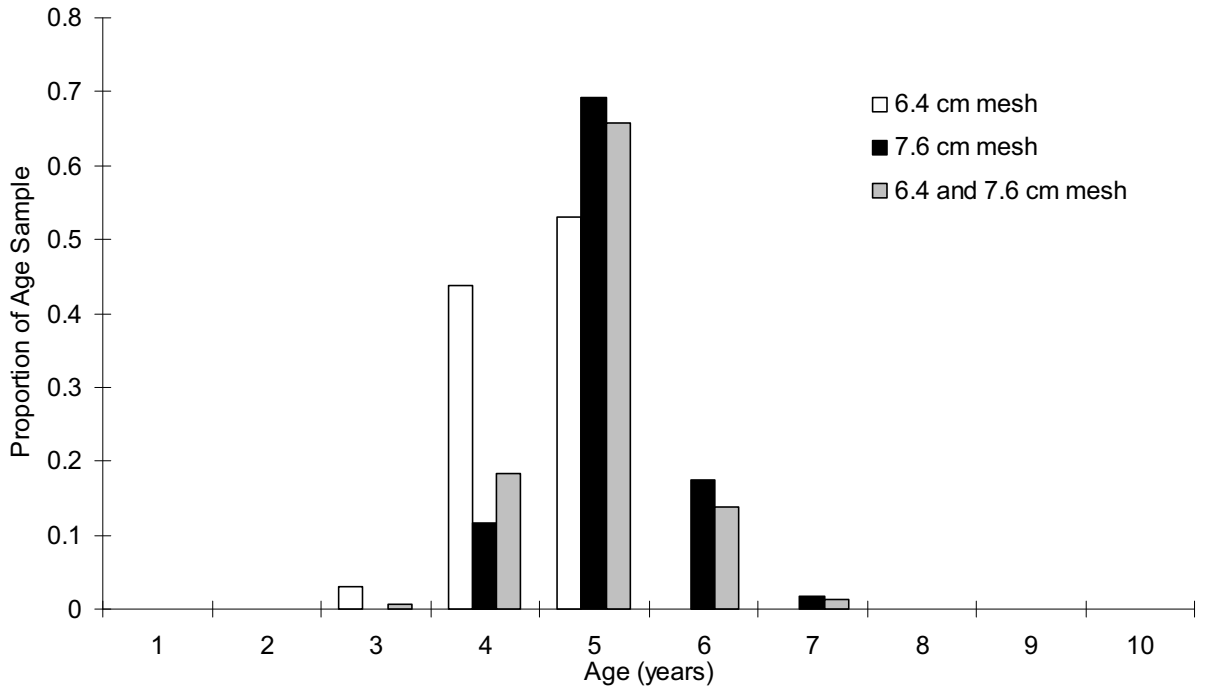

Figure 12. Age composition of arctic cisco harvested in 7.6-cm mesh nets (n = 120), 6.4-cm mesh nets (n = 32), and all both mesh sizes together (n = 152), Niġliq Channel, 2009.

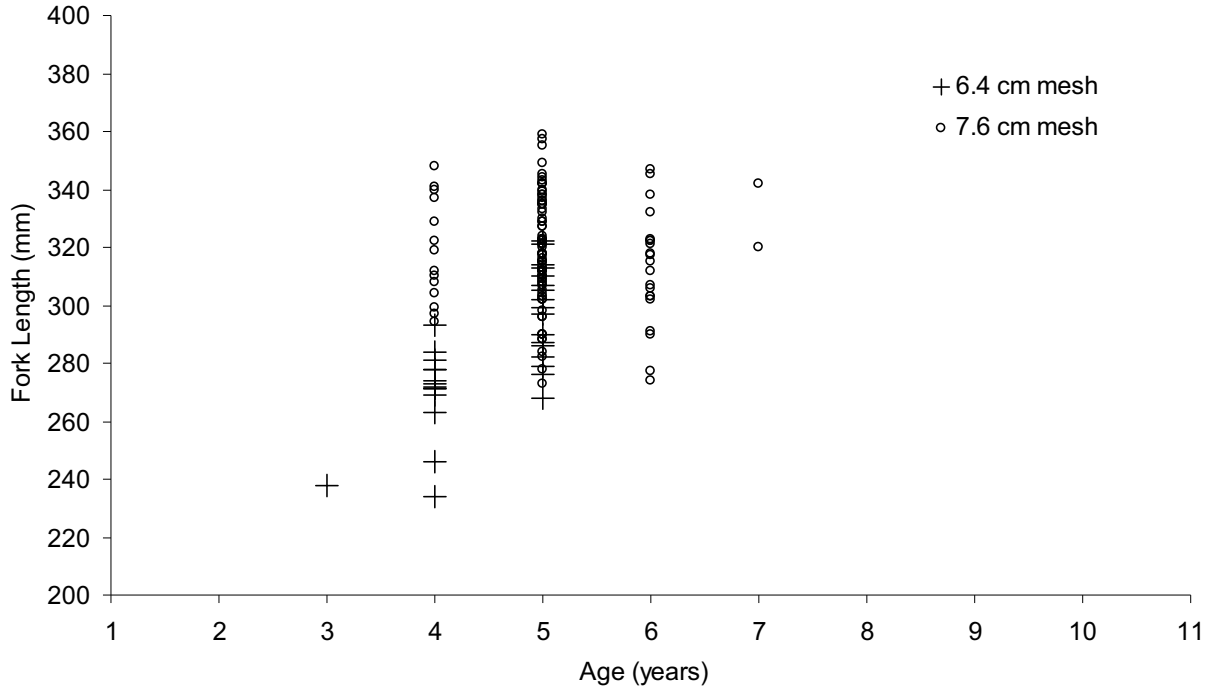

Figure 13. Age-specific length distribution of arctic cisco harvested in 7.6-cm mesh nets (n = 120) and 6.4-cm mesh nets (n = 32), Niġliq Channel, 2009.

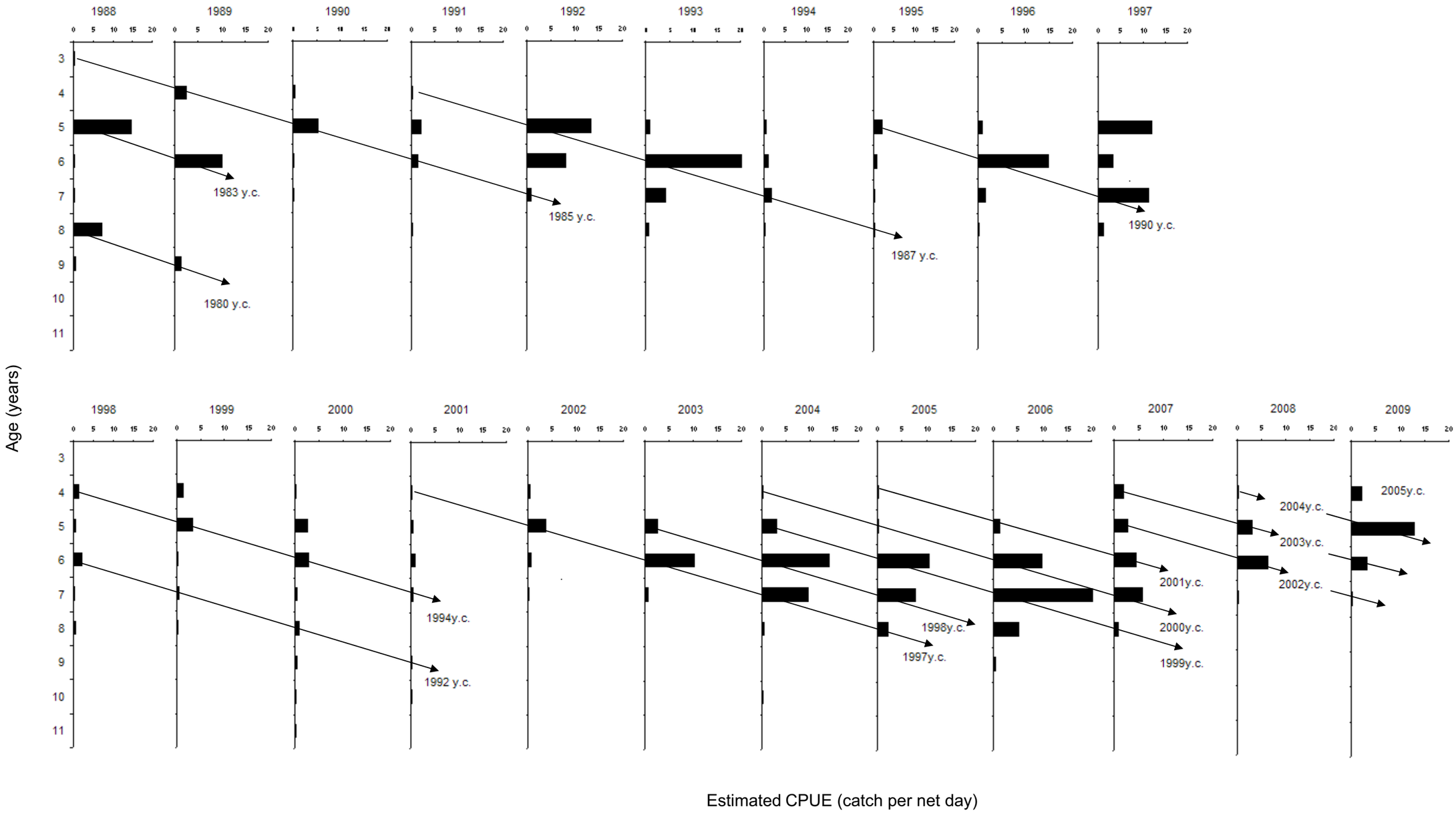

Figure 14. Catch per unit effort (catch per net day) of arctic cisco by age class in the fall subsistence fishery, Niġliq Channel, 1988–2009. Arrows demonstrate the progression of select year classes through the fishery. Only fish harvested in 7.6-cm mesh gillnets are included, and counts are standardized to 18-m net length as described in text.

and 8 fish continued to be low in 2009, as in 2008 (Seigle and Parrett 2009).

Using the age composition of the catch (in percent) and the overall CPUE of 18.6 fish/net day (Table 3), we were able to estimate the age-specific CPUE for the 2009 harvest. For 7.6-cm mesh nets, the CPUE increased from age 4 to age 5 but decreased for age 6 and age 7 arctic cisco (Figure 14). The 2000 (age 9) and 2001 (age 8) year classes appear to be minimally represented in the fishery.

Summing CPUE by age at capture for each year class across all years that the year class was represented in the fishery (Figure 15) provides an indicator of the relative contribution of each year class in the fishery. The cumulative total CPUE for the 2000 year class (absent from the 2009 aged harvest) was a relatively average year class in terms of contribution to harvest over the years. The 2004 year class appears to be a relatively healthy class and appeared in large numbers in the fishery in 2009 despite its near-absence from the fishery in 2008. For the second consecutive year, 5 and 6 year old fish dominate the fishery.

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). It should be noted that we did not begin measuring salinity until 26 October in 2009 due to the late start to the monitoring season. Salinities were high throughout the 2009 season in the Niġliq Delta and Nanuk fishing areas, which are closest to the coast (Figure 16). Salinity remained relatively steady over the course of the season for those 2 stations though there was a dip in salinity at the Nanuk station around 1 November. Salinity at 3 m depth from surface was within the appropriate range for arctic cisco at the first 3 downstream sampling stations through most of the season. 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 that at the Upper Niġliq station at that time (Figure 17; Moulton and Seavey 2004). The salt-water intrusion in 2009 did not extend as far inland as in 2008.

Because of concern among Nuiqsut residents over a red algae bloom that occurred during the 2008 fishing season, ABR biologists collected water samples at the farthest upstream and downstream stations in 2009, as a baseline in case any algal blooms occurred. On 3 November, water samples were collected and shipped for analysis to Arctic Fox Environmental, Inc., in Prudhoe Bay. Samples were tested for the presence of algae, as well as iron, manganese and petroleum hydrocarbons. No algal masses or hydrocarbons were present in water samples from 2009. Trace amounts of iron and manganese were detected but well within acceptable EPA standards (Appendix B).

DISCUSSION

The fall fishery for arctic cisco was marked by an unusual start in 2009. Freeze up and fishing began as normal in early October, but then a warm front passed through the Niġliq Channel area of the Colville River in the second week of October, causing large-scale thawing which forced early season fishers to pull their nets. As such, fishing for arctic cisco did not begin in earnest until the third week of October, which is somewhat late for this fishery (Table 1). However, following the second freeze up period and the end of the Alaska Federation of Natives (AFN) convention, the subsistence fishery took on its normal appearance with an average number of nets and fishers participating in the fishery.

Fishery monitoring was initially slated to commence on 13 October 2009 and ABR was present in the village on 12–13 October for the science fair and community meeting. However, since no nets were present in the river at this time, we moved our monitoring back to 23 October, when a second freeze-up allowed for subsistence fishing to start again. A few nets were set just prior to our return to Nuiqsut on 23 October but the bulk of nets were set after 24 October (Figure 4). ABR left Nuiqsut on 19 November when the majority of nets had been pulled or were about to be pulled. By

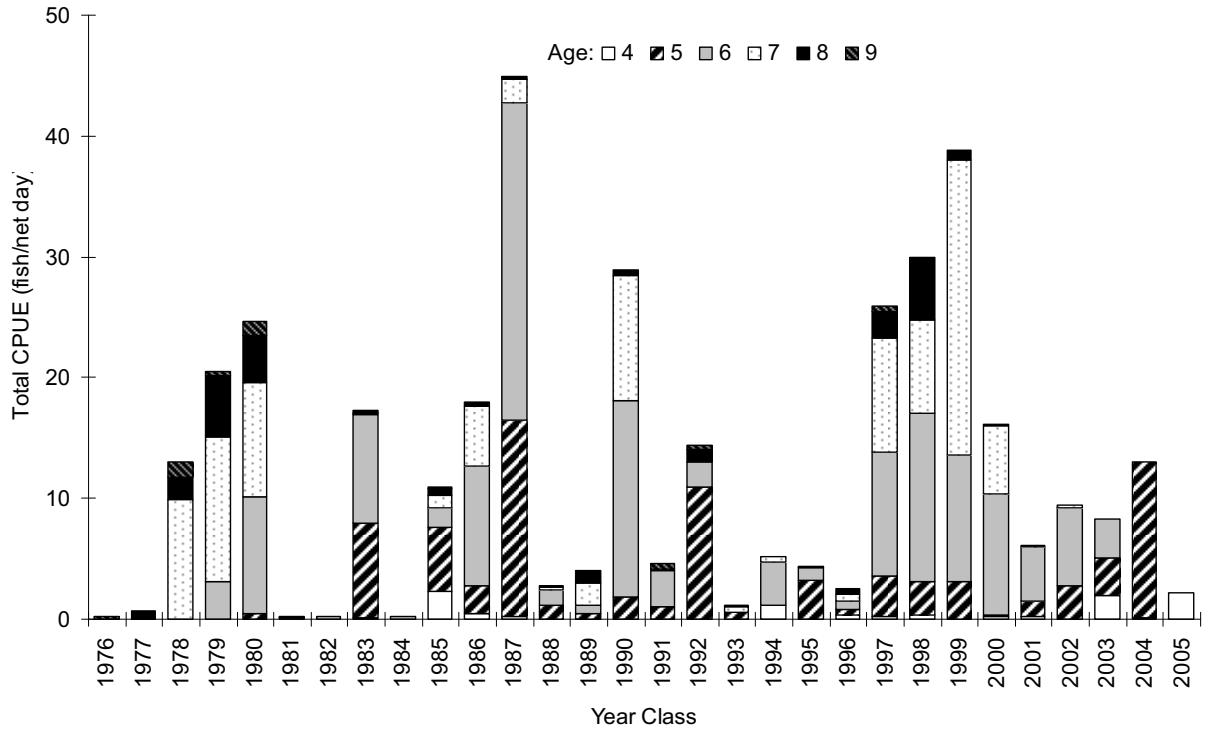

Figure 15. Cumulative catch per unit effort (catch per net day) of arctic cisco by year class (year of hatch) in the fall subsistence fishery, Niġliq Channel, year classes 1976–2004 (capture dates 1985–2009). Catch per unit effort was estimated only for fish captured in 7.6-cm mesh nets.

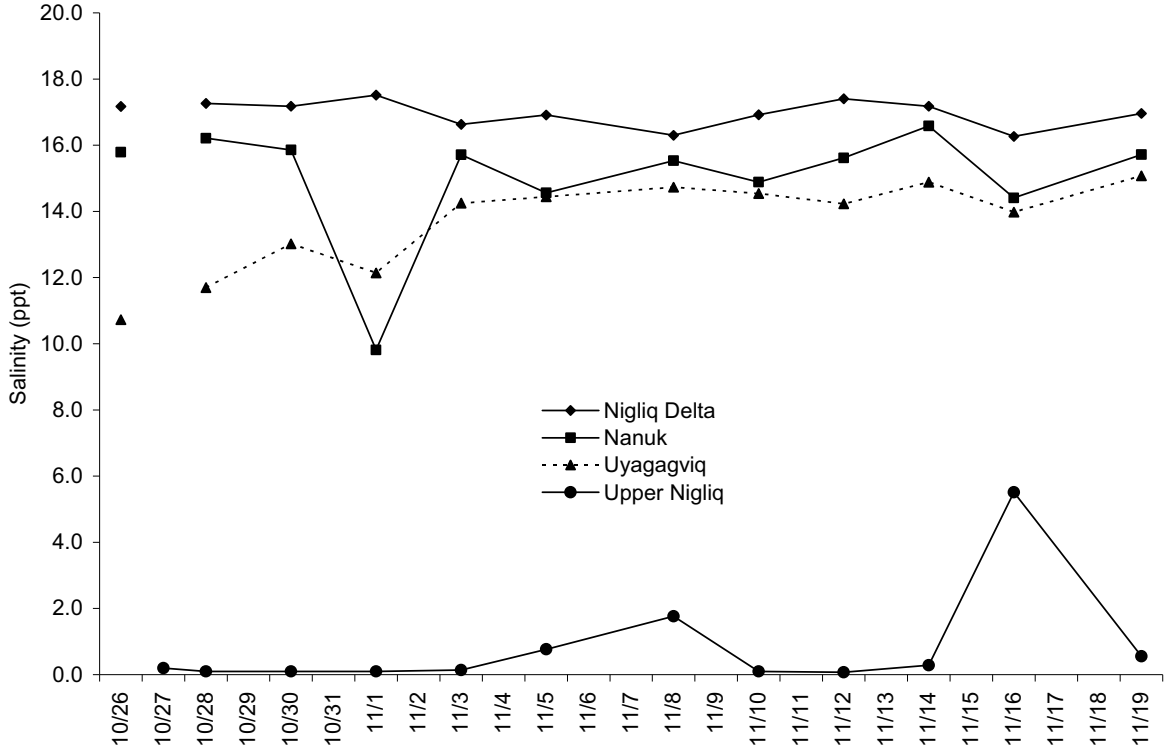

Figure 16. Water salinity (parts per thousand) at 3.0-m depth in each of 4 Niġliq Channel fishing areas, 2009.

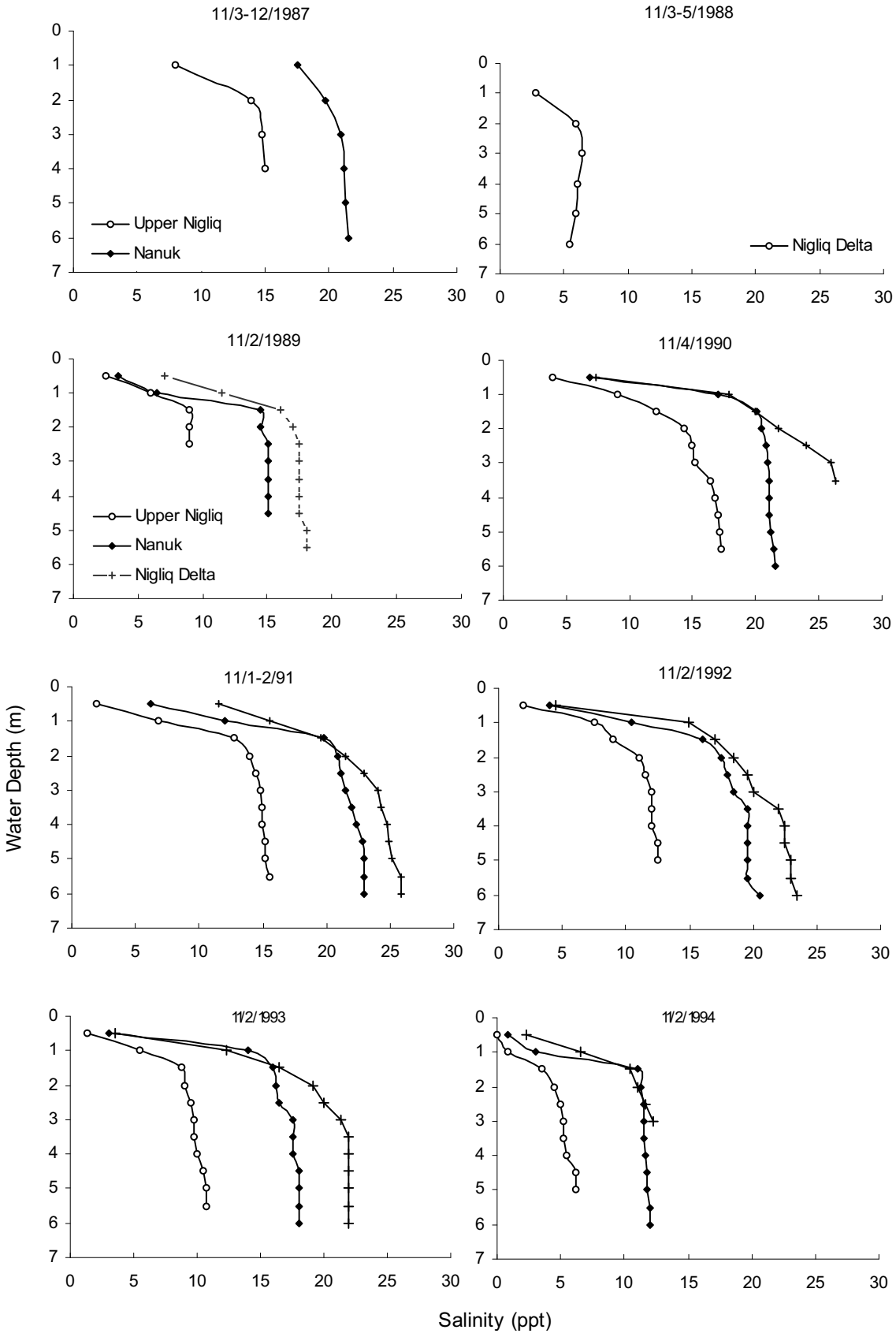

Figure 17. Water salinity depth profiles in Niġliq Channel fishing areas, early November 1987–2009.

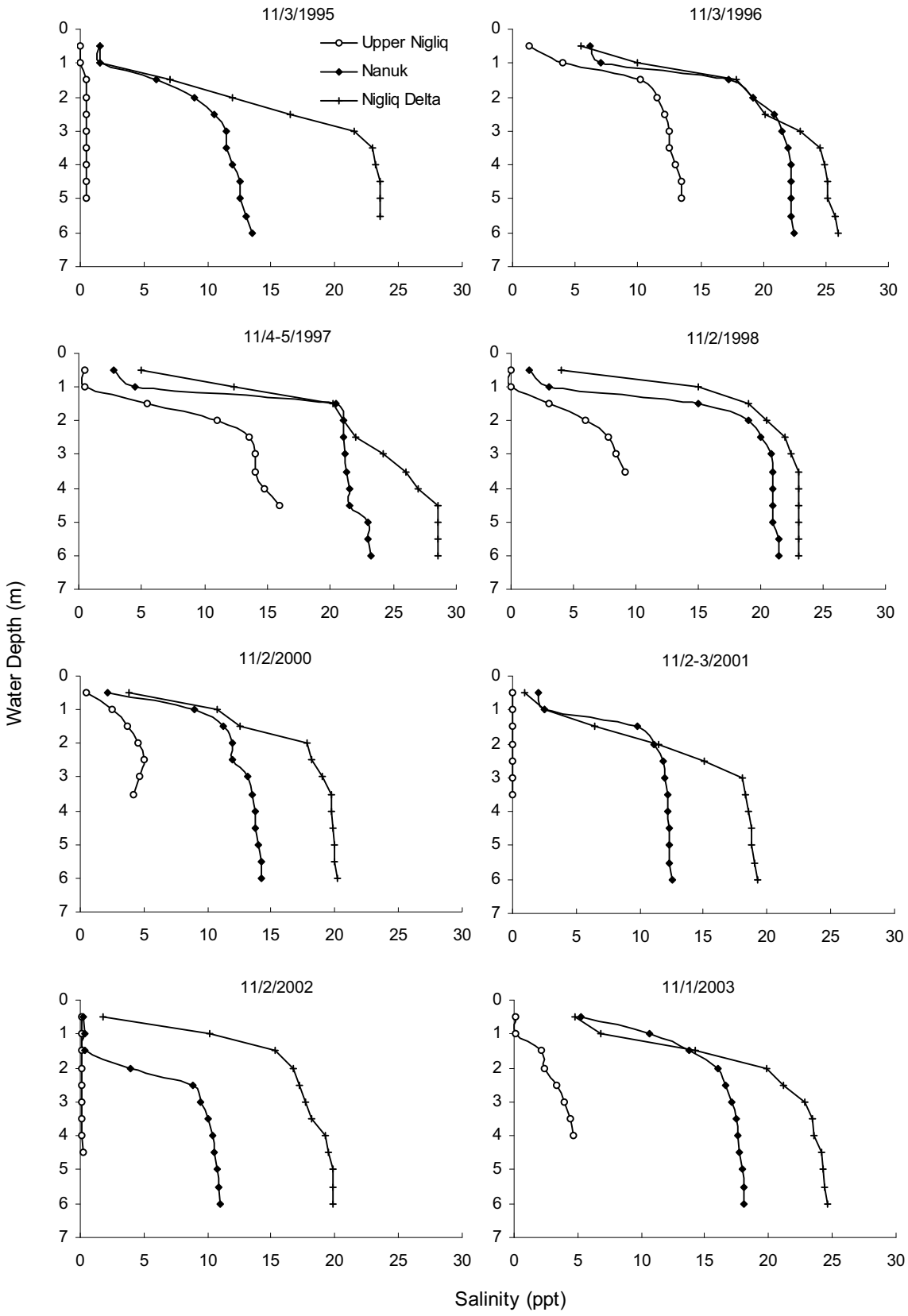

Figure 17. Continued.

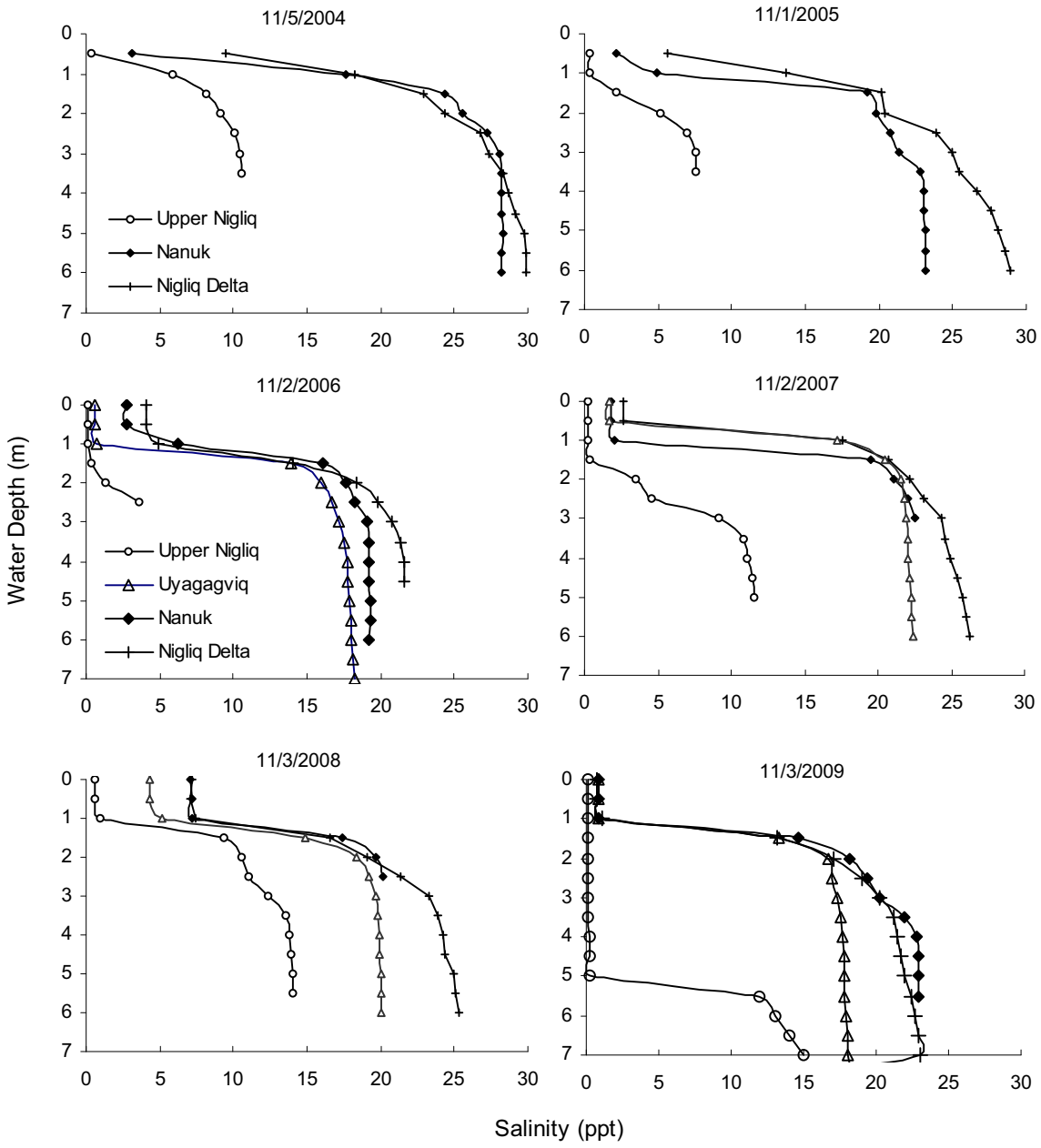

Figure 17. Continued.

this time, harvest rates had diminished significantly (Figure 7). ABR directly monitored 58 different nets over 28 days. We indirectly monitored nets until 23 November via our field assistant, Jerry Pausanna.

In 2009, most fishing effort was located in the Niġliq Delta, unlike the previous 2 years when there was near balance in fishing effort between the Niġliq Delta and the Nanuk areas (Figure 5). The shorter fishing season may be one explanation for higher fishing effort in the Niġliq Delta in 2009. After the warm spell in early October, fishers in the Niġliq Delta area reported high harvests which drew many fishers to the area; thus, relatively little fishing effort was expended upriver in 2009. The CPUE of approximately 22 fish per adjusted net day in 7.6-cm nets was a substantial improvement over 2008 for the same area (~13 fish per adjusted net day). However, fishing was also relatively strong in other areas of the river and in other mesh sizes (Table 4). In general, fishers described themselves as being content with their harvests in 2009.

In addition to an improvement in overall catch per unit of fishing effort in 2009 over 2008, the average size of arctic cisco increased. A common theme amongst fishers was that fish were "bigger than last year," and this was obvious to the fishery monitors as well. This increased size could be related to high growth of recent year classes over the last 3 years (Chris Zimmerman, USGS, personal communication). Optimal environmental conditions in recent years may also help to explain the large variability in growth within age classes (Figure 13). The 2009 harvest was dominated by age 5 (2004 year class) arctic cisco and they were similar in size to age 6 (2003 year class) fish. Furthermore, many age 4 (2005 year class) arctic cisco were as large as age 5 and age 6 fish. Age 4 fish also displayed tremendous variability in size. In 6.4-cm mesh nets, the only other mesh size evaluated for age of arctic cisco in 2009, fish were almost entirely age 4 and age 5, further verifying the strength of the 2004 year class.

It was somewhat surprising to see the 2002 (age 7) and 2003 (age 6) year classes diminished in 2009 (Figure 14). It had been expected that age 6 fish would make up a larger percentage of the harvest in 2009. The absence of these year classes could be explained by a number of factors including a behavioral shift in overwintering by older fish in the region from the Niġliq Channel to the main channel. The 2001 (age 8) and 2002 year classes appear to have largely left the Colville Delta. It is possible that the 2003 year class joined most of these fish as they re-entered the Mackenzie system in Canada as spawning adults (Gallaway et al. 1983). (Data further related to information shown in Figure 14, including CPUE by age class over time and age frequencies expressed as a percentage by year can be found in Appendix C and D).

Low harvests were previously predicted to continue until at least 2010 (Moulton et al. 2006). However, harvests were relatively strong in 2009 despite the thawing period which shortened the season, and harvests may already be on the upswing. 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, and Figure 17 *in* Seigle et al. 2008) and, based on the results of the 2009 surveys, 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 such as wind, salinity, and natural mortality of younger age classes in any given year (Moulton and Seavey 2004).

While the amount of observed fishing effort was reduced in 2009, the total observed harvest for all species increased over 2008 (Table 2). Least cisco is traditionally the second-most harvested species during the fall fishery in the Niġliq Channel, and the same was true in 2009. Harvests have been down for this species since 2007, and we have no explanation for this reduction in harvest (Table 5, Table 6). In 2009, arctic cisco made up approximately 85% of the reported harvest (excluding fourhorn sculpin) (Table 5), and this continues a long-term trend. Though we are not always able to learn the number of by-catch species caught during interviews with fishers, we feel confident that the number of least cisco was indeed lower over the past 2 harvest seasons based on harvests that we did observe. Rainbow smelt made

up a larger percentage of the harvest this year, pleasing many fishers as it is a desirable harvest species across the North Slope of Alaska.

During the 2008 harvest season there was slight dissatisfaction among fishers with their harvest as a function of the relatively low CPUE and the continued decline from the record harvests in 2006. However, the observed CPUE of 18.6 fish for the Niġliq Channel in 2009 was in the top third of recorded CPUEs since 1986. When one considers that at least a week of prime fishing was missed in mid-October, this is a respectable harvest year. The peak observed daily CPUE value of 58 fish per adjusted net day on 25 October coincides with our commencement of salinity measurements in the channel (Figure 7, Figure 16). Normally the salt wedge in the Niġliq Channel has not fully progressed upstream until our second week in Nuiqsut. It is quite possible that we missed the start of increased salinities in the channel between 9 and 23 October and thus the associated runs of arctic cisco normally associated with the movement of the salt wedge. Such increases in salinity in the Niġliq Channel normally are associated with west winds (Moulton and Field 1988, Moulton 1994). Another interesting feature of the fishery in 2009 is that salt levels remained low in the Upper Niġliq until mid-November, yet fishing for arctic cisco was relatively strong in this area of the channel (Figure 16, Table 4).

In October 2009, ABR met with the community to discuss issues related to the arctic cisco fishery (Appendix A [in prep.]). In March 2010, ABR will meet with the *Qaaktaq* Panel. [Details to be provided in the final report. It has been difficult to schedule dates; attempts in December and January were canceled. We are now attempting to meet with the *Qaaktaq* Panel in late March to discuss the fishery results from the past several years. We enjoyed great feedback from *Qaaktaq* Panel members 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. However, we have sometimes attempted to hold meetings when only a few members were available, and this is a practice we would like to avoid. We think that the monitoring program benefits from hearing the most voices and thus we are working closely with the KSOPI office in order to maximize attendance in 2010.]

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Appendix A. Summary of *Qaaktaq* Panel and community meetings.

13 October 2009 Science Fair and Community Meeting

On 13 October 2009, we participated in a science fair at the local school from 10 am until approximately 3pm. Students of all age groups attended and were invited to help in dissecting fish, to investigate various fish tissues and to observe otoliths and other fish parts under magnification with dissecting scopes. The science fair was was followed by an open community meeting in the evening. CPAI-sponsored consultants shared the results wildlife studies around Nuiqsut area, with particular importance paid to wildlife studies conducted under North Slope Borough permit # NSB04-117 in support of development associated with CD-4. ABR took that as an opportunity to conduct a preseason *Qaaktaq* meeting by presenting a summary of the 2008 harvest data. Approximately 35 residents were in attendance.

As was the case in 2008 *Qaaktaq* Panel meetings, residents expressed concern that the fish were getting smaller. We discussed how young fish dominated the catch in 2008 and that they were catching normally-sized young fish. The importance of measuring and aging fish using otoliths was explained as a way to understand how age affects the size of harvested fish. We also emphasized how age classes progress through the fishery, particularly noting that catching young fish reduces the availability of older and bigger fish in subsequent years.

There was some feedback which suggested that ABR could do a better job in reporting total harvest estimates to the community rather than relying so much on 7.6-cm mesh nets. In this report we have attempted to report observed and estimated CPUE and harvest numbers as per this suggestion.

Qaaktaq panel meeting to discuss 2009 Fall fishery on the Colville River Delta

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.

Appendix B. Lab results for algal cells, iron, manganese, oil, and grease in a water sample taken on 3 November 2009 at hydro stations 1 and 4, Niġliq Channel, Alaska.

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

61020

1109-5552

Client Name and Address: ABR, INC
P.O. Box 240268
ANCHORAGE, AK 99524

Contact Person: JOHN SEIGLE

Phone Number: 344-6777 (x206) Fax Number: 770-1443

E-mail: jseigle@abrinc.com

Project Name: NUIQSUT-COLVILLE FISHERY-FALL '09

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

Requested Turnaround Time and Special Instructions:

Account Number:

P.O. or Contract Number: 09-162

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	MICRO	FeMn TOTAL	TPH					Preservative / Remarks
STATION #1 DELTA-MICRO	3 Nov 09	1130	W	AF33997	1	X							
STATION #1 DELTA-FeMn	3 Nov 09	1130	W	AF33998	1		X						
STATION #1 DELTA-TPH	3 Nov 09	1130	W	AF33999	1			X					
STATION #4 NUIQSUT-MICRO	3 Nov 09	1300	W	~~AF33~~ AF34000	1	X							
STATION #4 NUIQSUT-FeMn	3 Nov 09	1300	W	AF34001	1		X						
STATION #4 NUIQSUT-TPH	3 Nov 09	1300	W	AF34002	1			X					

	Date:	Time:	Received By:
Relinquished By (1): John R Rose	3 Nov 09	1400	Michael Hough M.H.
Relinquished By (2):	11/3/09	1600	Michael Hough
Relinquished By (3):	Date:	Time:	Received for lab by:

TO BE COMPLETED BY LABORATORY

Location Received/ Temp on Arrival: ANC ☐ ____ °C FBK ☐ ____ °C PB ☐ 6.8 °C

80462153

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: 11/19/2009
Date Arrived: 11/3/2009
Date Sampled: 11/3/2009
Time Sampled: see below
Collected By: JRR

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

Arctic Fox Lab# AF33997-34002
Client Sample ID: see below
Location/Project: Nuiqsut-Colville Fishery Fall 09
COC#: 61020
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: Station #1 Delta-Micro
Analysis Requested: Micro
Time Sampled: 1130
Arctic Fox ID: AF33997
Test America ID: PSK0155-01

ABR Sample ID: Station #1 Delta-FeMn
Analysis Requested: Fe and Mn Total
Time Sampled: 1130
Arctic Fox ID: AF33998
Test America ID: PSK0155-02

ABR Sample ID: Station #1 Delta-TPH
Analysis Requested: TPH
Time Sampled: 1130
Arctic Fox ID: AF33999
Test America ID: PSK0155-03

ABR Sample ID: Station #4 Nuiqsut-Micro
Analysis Requested: Micro
Time Sampled: 1300
Arctic Fox ID: AF34000
Test America ID: PSK0155-04

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Analysis Requested: Fe and Mn Total
Time Sampled: 1300
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Test America ID: PSK0155-05

ABR Sample ID: Station #4 Nuiqsut-TPH
Analysis Requested: TPH
Time Sampled: 1300
Arctic Fox ID: AF34002
Test America ID: PSK0155-06

Ralph E. Allphin

Reported By: Ralph E. Allphin/Michael J. Hawley

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

ORELAP#: OR100021

November 18, 2009

Ralph Allphin
Arctic Fox Environmental, Inc.
Pouch 340043
Prudhoe Bay, AK 99734

RE: Main

Enclosed are the results of analyses for samples received by the laboratory on 11/05/09 13:45. The following list is a summary of the Work Orders contained in this report, generated on 11/18/09 18:22.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
PSK0155	Main	1109-5552/ABR, Inc

TestAmerica Portland

Vanessa Frahs, Project Manager

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:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
AF33997 Station #1 Delta -Micro	PSK0155-01	Water	11/03/09 11:30	11/05/09 13:45
AF33998 Station #1 Delta -Fe, Mn	PSK0155-02	Water	11/03/09 11:30	11/05/09 13:45
AF33999 Station #1 Delta -TPH	PSK0155-03	Water	11/03/09 11:30	11/05/09 13:45
AF34000 Station #4 Nuiqsat -Micro	PSK0155-04	Water	11/03/09 13:00	11/05/09 13:45
AF34001 Station #4 Nuiqsat -Fe, Mn	PSK0155-05	Water	11/03/09 13:00	11/05/09 13:45
AF34002 Station #4 Nuiqsat -TPH	PSK0155-06	Water	11/03/09 13:00	11/05/09 13:45

TestAmerica Portland

Vanessa Frahs, Project Manager

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BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

Analytical Case Narrative

TestAmerica - Portland, OR

PSK0155

Custom Micro Exam
Batch # 9110208 11/06/09

Analyst: S. Williams

The following samples were prepared as follows:

50 ml of the sample was centrifuged, and any sediment that formed was placed on a slide and visually examined using a compound microscope.

The following observations were recorded.

PSK0155-01
Centrifuging formed no sediment.
No microorganisms were found at 100X magnification

The rest of the sample was filtered through a 0.45-micron membrane filter, and then examined using a dissecting microscope. Nothing unusual was found.

PSK0155-04
Centrifuging formed no sediment.
No microorganisms were found at 100X magnification

The rest of the sample was filtered through a 0.45-micron membrane filter, and then examined using a dissecting microscope. Nothing unusual was found.

Steven Williams

(Analyst)

TestAmerica Portland

Vanessa Frahs, Project Manager

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Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

*** DEFAULT GENERAL METHOD ***

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PSK0155-01 (AF33997 Station #1 Delta -Micro)			**Water**				**Sampled: 11/03/09 11:30**			
See Narrative	none	ND	-----	TIC	%	1x	9110208	11/06/09 10:10	11/06/09 10:20	
PSK0155-04 (AF34000 Station #4 Nuiqsat -Micro)			**Water**				**Sampled: 11/03/09 13:00**			
See Narrative	none	ND	-----	TIC	%	1x	9110208	11/06/09 10:10	11/06/09 10:20	

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

Diesel Range Organics (C10-C25) and Residual Range Organics (C25-C36) per AK102/103

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PSK0155-03 (AF33999 Station #1 Delta -TPH)			**Water**				**Sampled: 11/03/09 11:30**			
Diesel Range Organics	AK102/103	ND	-----	0.250	mg/l	1x	9110300	11/10/09 16:20	11/11/09 01:19	
Residual Range Organics	"	ND	-----	0.500	"	"	"	"	"	
Surrogate(s): *1-Chlorooctadecane*				*102%*		*50 - 150 %*				"
Triacontane				*100%*		*50 - 150 %*				"
PSK0155-06 (AF34002 Station #4 Nuiqsat -TPH)			**Water**				**Sampled: 11/03/09 13:00**			
Diesel Range Organics	AK102/103	ND	-----	0.250	mg/l	1x	9110300	11/10/09 16:20	11/11/09 01:39	
Residual Range Organics	"	ND	-----	0.500	"	"	"	"	"	
Surrogate(s): *1-Chlorooctadecane*				*97.7%*		*50 - 150 %*				"
Triacontane				*96.5%*		*50 - 150 %*				"

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

Total Metals per EPA 6000/7000 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PSK0155-02 (AF33998 Station #1 Delta -Fe, Mn)			**Water**				**Sampled: 11/03/09 11:30**			
Iron	EPA 6020	**0.209**	-----	0.0250	mg/l	1x	9110246	11/09/09 07:54	11/09/09 22:45	
Manganese	"	**0.0515**	-----	0.00200	"	"	"	"	11/09/09 15:34	
PSK0155-05 (AF34001 Station #4 Nuiqsat -Fe, Mn)			**Water**				**Sampled: 11/03/09 13:00**			
Iron	EPA 6020	**0.312**	-----	0.0250	mg/l	1x	9110246	11/09/09 07:54	11/09/09 22:53	
Manganese	"	**0.0237**	-----	0.00200	"	"	"	"	11/09/09 15:40	

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

Diesel Range Organics (C10-C25) and Residual Range Organics (C25-C36) per AK102/103 - Laboratory Quality Control Results

TestAmerica Portland

QC Batch: 9110300 **Water Preparation Method: EPA 3510 Fuels**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9110300-BLK1)								**Extracted: 11/10/09 16:20**						
Diesel Range Organics	AK102/103	ND	---	0.250	mg/l	1x	--	--	--	--	--	--	11/11/09 00:19	
Residual Range Organics	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
Surrogate(s): 1-Chlorooctadecane		*Recovery: 99.8%*			*Limits: 50-150%*								*11/11/09 00:19*	
Triacontane		*95.4%*			*50-150%*								*"*	
LCS (9110300-BS1)								**Extracted: 11/10/09 16:20**						
Diesel Range Organics	AK102/103	2.52	---	0.250	mg/l	1x	--	2.50	101%	(75-125)	--	--	11/11/09 00:39	
Residual Range Organics	"	1.51	---	0.500	"	"	--	1.50	100%	(60-120)	--	--	"	
Surrogate(s): 1-Chlorooctadecane		*Recovery: 106%*			*Limits: 60-120%*								*11/11/09 00:39*	
Triacontane		*108%*			*50-150%*								*"*	
LCS Dup (9110300-BSD1)								**Extracted: 11/10/09 16:20**						
Diesel Range Organics	AK102/103	2.46	---	0.250	mg/l	1x	--	2.50	98.3%	(75-125)	2.39%	(20)	11/11/09 00:59	
Residual Range Organics	"	1.53	---	0.500	"	"	--	1.50	102%	(60-120)	1.33%	"	"	
Surrogate(s): 1-Chlorooctadecane		*Recovery: 105%*			*Limits: 60-120%*								*11/11/09 00:59*	
Triacontane		*106%*			*50-150%*								*"*	

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

Total Metals per EPA 6000/7000 Series Methods - Laboratory Quality Control Results

TestAmerica Portland

QC Batch: 9110246 **Water Preparation Method: EPA 200/3005**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (9110246-BLK1)								**Extracted: 11/09/09 07:54**						
Iron	EPA 6020	ND	---	0.0250	mg/l	1x	--	--	--	--	--	--	11/09/09 21:58	
Manganese	"	ND	---	0.00200	"	"	--	--	--	--	--	--	11/09/09 14:15	
LCS (9110246-BS1)								**Extracted: 11/09/09 07:54**						
Iron	EPA 6020	1.83	---	0.0250	mg/l	1x	--	2.00	91.6%	(75-125)	--	--	11/09/09 22:06	
Manganese	"	0.103	---	0.00200	"	"	--	0.100	103%	(80-120)	--	--	11/09/09 14:20	
Duplicate (9110246-DUP1)					**QC Source: PSK0149-03**			**Extracted: 11/09/09 07:54**						
Iron	EPA 6020	ND	---	0.0250	mg/l	1x	ND	--	--	--	6.98%	(20)	11/09/09 22:22	
Manganese	"	0.00513	---	0.00200	"	"	0.00522	--	--	--	1.78%	"	11/09/09 14:49	
Matrix Spike (9110246-MS1)					**QC Source: PSK0149-03**			**Extracted: 11/09/09 07:54**						
Iron	EPA 6020	1.88	---	0.0250	mg/l	1x	0.0128	2.00	93.4%	(75-125)	--	--	11/09/09 22:38	
Manganese	"	0.106	---	0.00200	"	"	0.00522	0.100	101%	"	--	--	11/09/09 15:00	
Matrix Spike (9110246-MS2)					**QC Source: PSK0194-01**			**Extracted: 11/09/09 07:54**						
Iron	EPA 6020	2.17	---	0.0250	mg/l	1x	0.414	2.00	87.7%	(75-125)	--	--	11/09/09 23:09	
Manganese	"	0.122	---	0.00200	"	"	0.0190	0.100	103%	"	--	--	11/09/09 16:03	

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1109-5552/ABR, Inc	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Ralph Allphin	11/18/09 18:22

Notes and Definitions

Report Specific Notes:

None

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.

TestAmerica Portland

Vanessa Frahs, Project Manager

TestAmerica
ANALYTICAL TESTING CORPORATION

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8244 425-420-9200 FAX 420-9210
11922 E. First Ave, Spokane, WA 99206-5302 509-924-9200 FAX 924-9290
9405 SW Nimbus Ave, Beaverton, OR 97008-7145 503-906-9200 FAX 906-9210 X
2000 W International Airport Rd Ste A-10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210

CHAIN OF CUSTODY REPORT

PSK0155
Work Order #: 61020

CLIENT:

REPORT TO: Arctic Fox Environmental, Inc.
ADDRESS: Pouch 340043
Prudhoe Bay, AK 99734
attn. Ralph E. Allphin/Michael Hawley
PHONE: (907)659 2145 FAX: (907)659-2146

INVOICE TO:
Arctic Fox Environmental, Inc.
Pouch 340043
Prudhoe Bay, AK 99734
attn. Ralph E. Allphin/arcticfox@astacalaska.com

P.O. NUMBER: 1109-5552

PROJECT NAME: ABR, inc.
PROJECT NUMBER: Nuiqsut - Colville Fishery - Fall '09
SAMPLED BY: JRR

TURNAROUND REQUEST
in Business Days *
Organic & Inorganic Analyses
(10) STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses
5 STD. | 4 | 3 | 2 | 1 | <1
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE	REQUESTED ANALYSES: Micro Exam	Fe, Mn Total Metals	TPH	MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1	AF33997	11/3/09 @1130		X			W	1	Station #1 Delta - Micro	
2	AF33998	@1130			X		W	1	Station #1 Delta Fe Mn	
3	AF33999	@1130				X	W	1	Station #1 Delta TPH	
4	AF34000	@ 1300		X			W	1	Station #4 Nuiqsut - Micro	
5	AF34001	@ 1300			X		W	1	Station #4 Nuiqsut - Fe Mn	
6	AF34002	@ 1300				X	W	1	Station #4 Nuiqsut - TPH	
7										
8										
9										
10										

RELEASED BY: Michael Hawley DATE: 11/4/09
PRINT NAME: Michael Hawley FIRM: Arctic Fox Env. TIME: 1330

RECEIVED BY: Kristin Hoffman DATE: 11/05/09
PRINT NAME: FIRM: TAP TIME: 13:45

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:

RECEIVED BY DATE:
PRINT NAME. FIRM: TIME:

ADDITIONAL REMARKS.

TEMP: 4.2

COC REV 09/2004

TestAmerica Portland

Sample Receiving Checklist

Work Order #: PSK0155 Date/Time Received: 11-5-09 @ 13:45

Client Name and Project: Arctic Fox

Time Zone:

☐EDT/EST ☐CDT/CST ☐MDT/MST ☐PDT/PST ☒AK ☐OTHER

Unpacking Checks:

Cooler #(s): 0025 _____ _____ _____ _____

Temperatures: 4.2 _____ _____ _____ _____

Digi #1 ☒ Digi #2 ☐ IR Gun ☐ (☐Plastic ☐Glass)

Temperature out of Range:

__Not enough or No Ice

__Ice Melted

__W/in 4 Hrs of collection

__Other:_____

Initials: CC

N/A	Yes	No		
☐	☒	☐	1.	If ESI client, were temp blanks received? If no, document on NOD.
☐	☒	☐	2.	Cooler Seals intact? (N/A if hand delivered) if no, document on NOD.
	☒	☐	3.	Chain of Custody present? If no, document on NOD.
	☒	☐	4.	Bottles received intact? If no, document on NOD.
	☒	☐	5.	Sample is not multiphasic? If no, document on NOD.
	☒	☒	6.	Proper Container and preservatives used? If no, document on NOD. Presvd HNO3/HCl in lab 11/5 @ 1525
☒	☒	☒	7.	pH of all samples checked and meet requirements? If no, document on NOD.
☒	☐	☐	8.	Cyanide samples checked for sulfides and meet requirements? If no, notify PM.
☒	☐	☐	9.	HF Dilution required?
	☒	☐	10.	Sufficient volume provided for all analysis? If no, document on NOD and consult PM before proceeding.
	☒	☐	11.	Did chain of custody agree with samples received? If no, document on NOD.
	☒	☐	12.	Is the "Sampled by" section of the COC completed?
☒	☐	☐	13.	Were VOA/Oil Syringe samples without headspace?
☒	☐	☐	14.	Were VOA vials preserved? ☐HCl ☐Sodium Thiosulfate ☐Ascorbic Acid
	☐	☒	15.	Did samples require preservation with sodium thiosulfate?
☒	☐	☐	16.	If yes to #14, was the residual chlorine test negative? If no, document on NOD.
☒	☐	☐	17.	Are dissolved/field filtered metals bottles sediment-free? If no, document on NOD.
☒	☐	☐	18.	Is sufficient volume provided for client requested MS/MSD or matrix duplicates? If no, document on NOD and contact PM before proceeding.
☒	☐	☐	19.	Are analyses with short holding times received in hold?
	☒	☐	20.	Was Standard Turn Around (TAT) requested?
	☒	☐	21.	Receipt date(s) < 48 hours past the collection date(s)? If no, notify PM.

TestAmerica Portland

Sample Receiving Checklist

Work Order #: PSK0155

Login Checks:

Initials:

N/A	Yes	No	
	☑	☐	22. Sufficient volume provided for all analysis? If no, document on NOD & contact PM.
☑	☐	☐	23. Sufficient volume provided for client requested MS/MSD or matrix duplicates? If no, document on NOD and contact PM.
	☑	☐	24. Did the chain of custody include "received by" and "relinquished by" signatures, dates and times?
☐	☑	☐	25. Were special log in instructions read and followed?
	☑	☐	26. Were tests logged checked against the COC?
☑	☐	☐	27. Were rush notices printed and delivered?
☑	☐	☐	28. Were short hold notices printed and delivered?
☑	☐	☐	29. Were subcontract COCs printed?
☑	☐	☐	30. Was HF dilution logged?

Labeling and Storage Checks:

Initials:

N/A	Yes	No	
☑	☐	☐	31. Were the subcontracted samples/containers put in Sx fridge?
☑	☐	☐	32. Were sample bottles and COC double checked for dissolved/filtered metals?
	☑	☐	33. Did the sample ID, Date, and Time from label match what was logged?
☑	☐	☐	34. Were Foreign sample stickers affixed to each container and containers stored in foreign fridge?
☑	☐	☐	35. Were HF stickers affixed to each container, and containers stored in Sx fridge?
☐	☑	☐	36. Was an NOD for created for noted discrepancies and placed in folder?

Document any problems or discrepancies and the actions taken to resolve them on a Notice of Discrepancy form (NOD).

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

Custody Seal

Signature: Michael Hauf

Date: 11/4/09

Cooler
#0025

Appendix C. Catch per unit effort (CPUE) by age class for arctic cisco caught in 7.6-cm mesh nets, Colville Delta, Alaska, 1986–2009[a]. Data were collected and analyzed by MJM Research in 1986–2005, by LGL in 2006, and by ABR in 2007–2009.

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
3	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
4	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	0.13	2.2
5	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	3.05	13
6	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	6.36	3.2
7	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
8	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	0.07	0
9	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
10	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
11	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Total aged	199	196	126	—[b]	150	143	154	148	139	148	150	146	151	150	143	97	144	—[b]	141	103	95	39	59	120

[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] CPUE for the 1989 and 2003 harvest seasons were estimated.

Appendix D. Age frequencies (expressed as percentages) of arctic cisco caught in 7.6-cm mesh nets, Colville Delta, Alaska, 1976–2009. 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 2007–2009.

Age class (y)	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
3	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
4	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
5	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
6	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
7	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
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
9	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
10	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
11	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
Total aged	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

[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 19984, 1985, 1989 and 2003 harvest seasons were estimated.