FINAL REPORT

FALL 2008 SUBSISTENCE FISHERY MONITORING ON THE COLVILLE RIVER

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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.

In 2007, stakeholders (including the residents of Nuiqsut, subsistence fishers, the North Slope Borough [NSB] and ConocoPhillips Alaska, Inc. [CPAI]) discussed the future of the Colville River fall fishery monitoring program. These discussions resulted in decisions to continue monitoring and to further define the responsibilities of all stakeholders. A *Qaaktaq* Panel, consisting of subsistence fishers, was created to provide future guidance to the monitoring team on issues affecting Nuiqsut stakeholders. The 2008 fishery monitoring team held 3 meetings, one with the local community and 2 with the *Qaaktaq* Panel, to present the results of the 2007 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. Logbooks also were distributed to a small number of fishers, to account for daily harvest events that the monitoring program may have missed.

Although the 2008 fishery began around 5 October, early snowfall and warm weather created slushy river conditions and most fishers waited to begin fishing until the second or third week of October. By the end of the season in 2008, the harvest of 9,199 fish (all species and mesh sizes combined) was documented by the interview process. Arctic cisco (84%) and least cisco (*Coregonus sardinella*; ~15%) comprised the vast majority of the recorded harvest. Although fishing effort increased 7% over 2007, the catch rate for Arctic cisco in the Niġliq channel (10 fish/adjusted net day) was the lowest since 2002 and slightly below the 1986–2007 average (15 fish/adjusted net day). The catch rate for least cisco was slightly lower than the average since 1986.

Of the 3 main harvest areas used in 2008, harvest rates for Arctic cisco were greatest in the Niġliq Delta area (13 fish/adjusted net day) and were lower in the 2 upstream harvest areas. Salinity was within the appropriate range for Arctic cisco (i.e., 15–25 ppt) in the Niġliq Delta and Nanuk areas through most of the season, whereas in the Upper Niġliq area, salinity only began approaching this range in early November.

Arctic cisco harvested in 2008 were smaller than those harvested in 2007 due to the prevalence of young age classes in the 2008 fishery. Age classes 5 and 6 were the dominant age classes harvested in 7.6-cm mesh gill nets. Harvest of age classes 7 and 8 was reduced from the previous 2 years.

The high percentages of 5- and 6-year-old Arctic cisco in the 2008 harvest suggests that the 2009 harvest will be moderate compared to historical harvest levels, but could diminish further as the 2000 and 2001 year classes leave the fishery. The 2007 fyke net surveys in Prudhoe Bay recorded an all-time high catch per unit effort (CPUE) for young-of-the-year Arctic cisco, which indicates that 2011 could mark the beginning of an upturn in harvest rates in the Colville River.

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INTRODUCTION

In 2008, 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 2008 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 delta could adversely affect these anadromous fish. 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 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 the 2008 program continued the same process, by which the monitoring program works closely with fishers and other stakeholders and keeps all parties abreast of developments in the fishery. As an integral part of the monitoring program, ABR has 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 2008 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 log-books and 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 in primary fishing areas.
- Compare the 2008 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 numbers 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 3 meetings in Nuiqsut during the 2008 fall fishery monitoring (Appendix 1). The first meeting was held on 17 October at the KSOPI office and included members of the *Qaaktaq* Panel (Seigle et al. 2008) 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 2008 fall fishery and (2) act as an agent expressing the community's concerns about the fishery to the client, CPAI. The second meeting was open to all members of the public and held on 18 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 2007 monitoring program, and (3) document concerns that the community might have over the status of the fishery. The third meeting was held on 19 November at the KSOPI office, again with the *Qaaktaq* Panel and monitoring program personnel. Notes on these 3 meetings can be found in Appendix 1.

FISHERY EFFORT AND HARVEST

In the past, the majority of harvest information was collected by means of direct interviews of subsistence fishers by scientists. To augment information collected by interviews, logbooks were distributed to the most active fishing families, starting in 2005. 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. Logbooks were again distributed to a select group of fishers in 2008 and included many of the most intensive fishers from previous years. Fishers were asked to record net location, harvest date, set duration, net length, net mesh size, and harvest numbers for Arctic cisco and other species.

Three traditional fishing areas hosted the majority of concentrated fishing efforts within the Niġliq channel in 2008 (Figure 2). From upstream to downstream these are the Upper Niġliq area (adjacent to the town of Nuiqsut), the Nanuk area, and the Niġliq Delta area (includes nets between

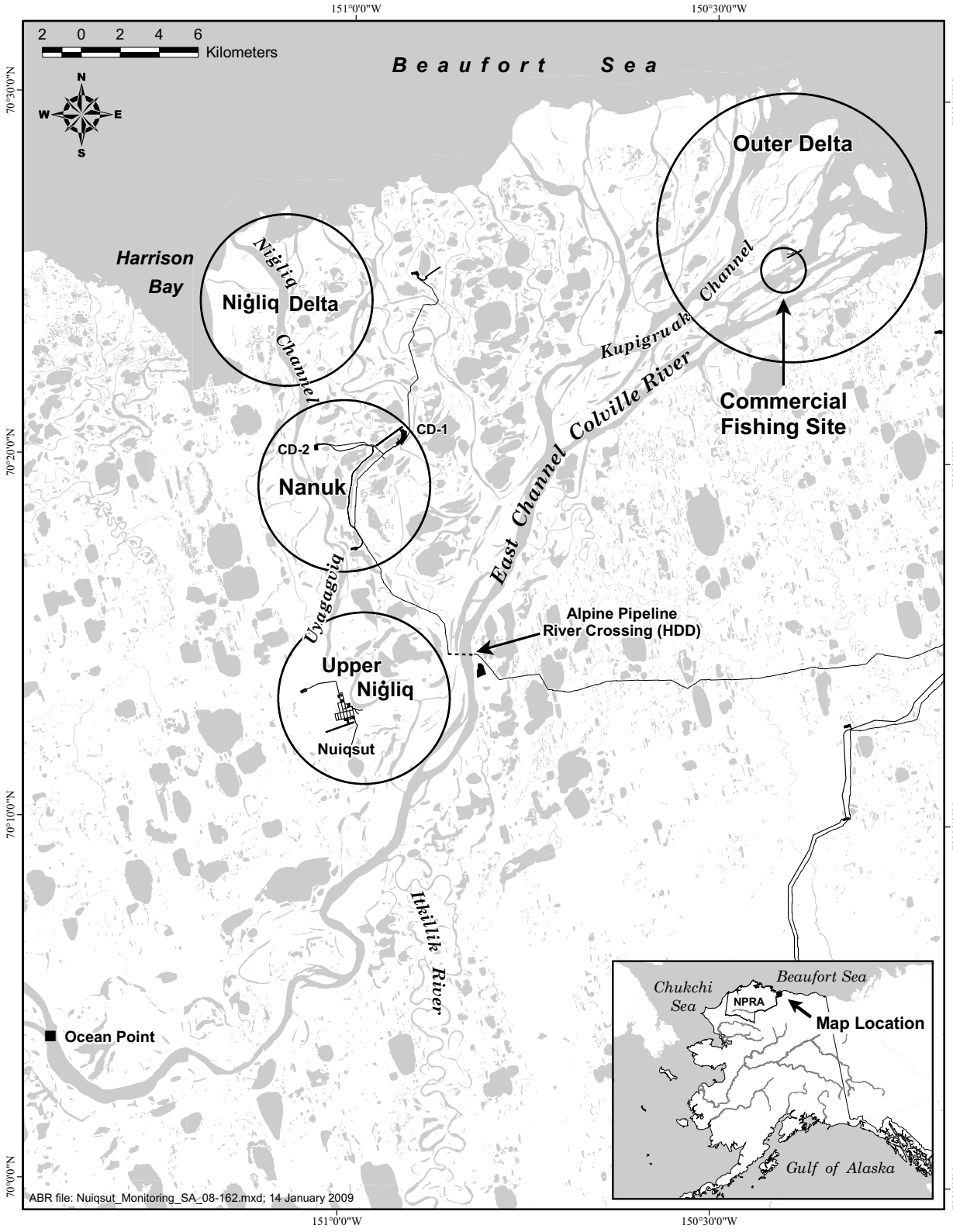

Figure 1. Three of the main subsistence fishing areas and the 1 commercial fishing area historically used for harvesting Arctic cisco in the Colville delta (after Moulton and Seevey 2004).

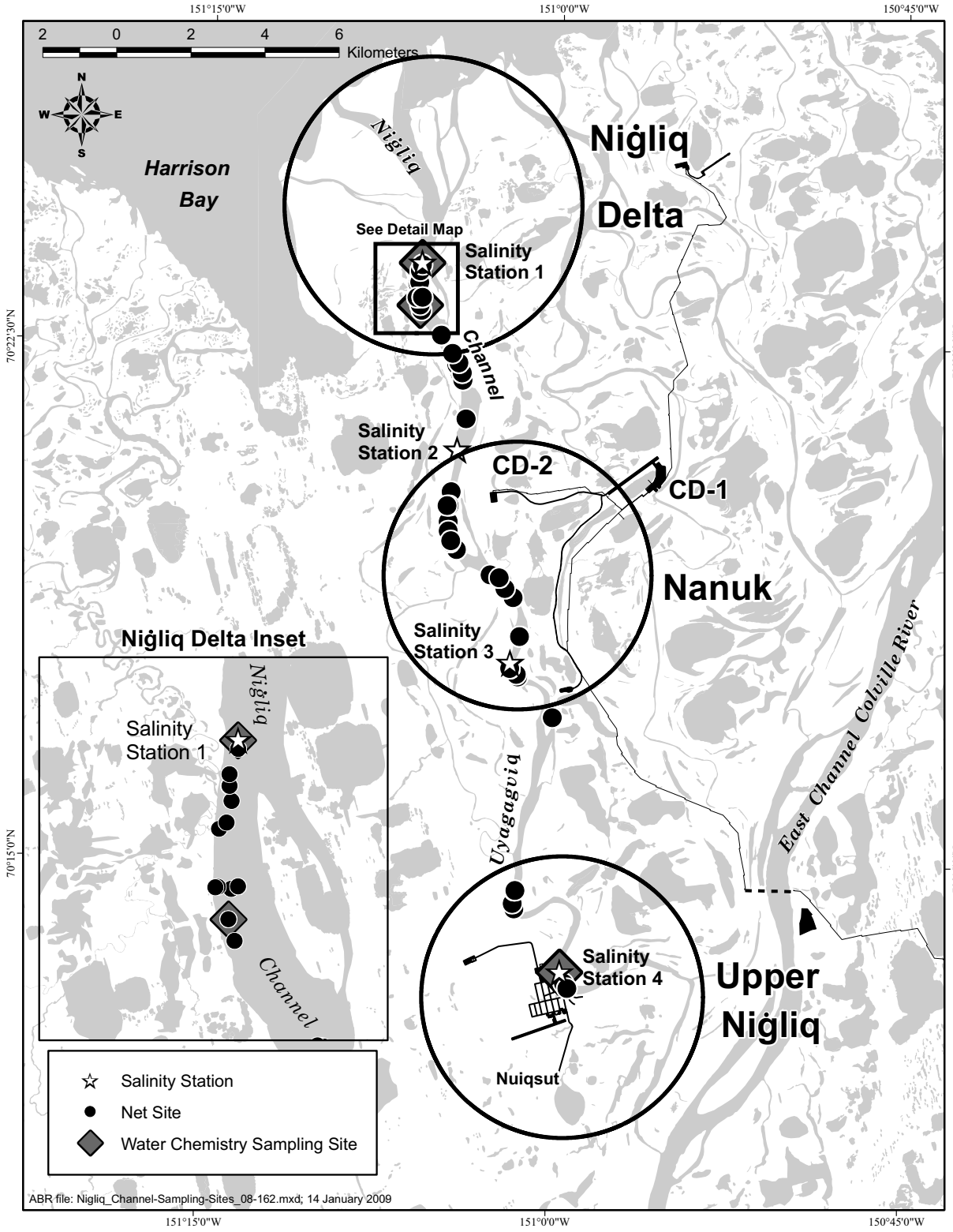

Figure 2. Salinity stations (4) and water chemistry sampling sites (3) in relation to net sites in each of the 3 main subsistence fishing areas in the Niġliq channel of the Colville River during the fall subsistence fishery in 2008.

the Nanuk and Niġliq Delta areas). A fourth traditionally-used area, the Uyagagviq area (see Figure 2), only contained 1 net in 2008 and results from that area are combined with those from the Nanuk area.

The harvest monitoring team always included 2 scientists from ABR. A 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 were 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, they were counted and a sub-sample was measured (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 either 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 bring out 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.

Due to an unusual red algae bloom that occurred near the end of October in 2008, ABR collected samples for analysis of water chemistry by Arctic Fox Environmental Inc., in Prudhoe Bay, Alaska. The first sample was collected at a fisher's net in the Niġliq Delta on 22 October and was analyzed for algal content, and for iron and manganese concentrations. Two more samples were collected on 18 November, 1 in the Upper Niġliq area near Nuiqsut and the other in the Niġliq Delta area near Woods' Camp, and 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 2008, the Arctic cisco subsistence harvest began on approximately 5 October, according to interviews conducted approximately 10 days later (Table 1). However, an early snow fall associated with warm weather and cloud cover made river ice conditions unsafe for travel and most nets were not deployed until the second and third weeks of October (Table 2). Twenty-nine families deployed 57 nets during the fall fishery in 2008 (Table 2, Figure 3). This is 2 nets greater than the number of nets deployed in 2007 and is comparable to the

Table 1. Estimated onset of the fall subsistence fishery in the Colville River, 1985–2008.

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
Average	7 Oct

Table 2. Total adjusted fishing effort recorded for the 2008 fall fishery on the Niġliq channel. All fishers are included along with all mesh sizes, net lengths, and fishing areas. Net days were standardized to 18-m net length in order to adjust for effort.

Fisher Code	Fishing Area	Net	Net Code	Net Length (m)	Stretched Mesh (cm)	Start Date	End Date	Net Days	Adjusted Net Days
1	Nanuk	A	0801A1	24.4	6.4	10/9/2008	10/17/2008	8	10.7
1	Nanuk	A	0801A2	24.4	6.4	10/17/2008	10/21/2008	4	5.3
4	Nigliq Delta	A	0804A1	30.5	6.4	10/12/2008	10/17/2008	5	8.3
4	Nigliq Delta	B	0804B1	18.3	7.6	10/12/2008	11/1/2008	20	20.0
4	Nigliq Delta	C	0804C1	18.3	7.6	10/12/2008	11/8/2008	27	27.0
4	Nigliq Delta	D	0804D1	18.3	7.6	10/12/2008	10/24/2008	12	12.0
4	Nigliq Delta	E	0804E1	24.4	8.9	10/12/2008	10/30/2008	18	24.0
4	Nigliq Delta	F	0804F1	18.3	7.6	10/12/2008	10/30/2008	18	18.0
4	Nigliq Delta	G	0804G1	30.5	7.6	10/17/2008	11/8/2008	22	36.7
4	Nigliq Delta	H	0804H1	24.4	5.1	10/28/2008	11/1/2008	4	5.3
4	Nigliq Delta	H	0804H2	24.4	5.1	11/1/2008	11/8/2008	7	9.3
7	Nanuk	A	0807A1	24.4	7.6	10/5/2008	11/6/2008	32	42.7
7	Nanuk	B	0807B1	24.4	7.0	10/17/2008	11/6/2008	20	26.7
24	Nanuk	B	0824B1	24.4	7.6	10/14/2008	10/31/2008	17	22.7
24	Nanuk	A	0824A1	18.3	7.6	10/18/2008	10/31/2008	13	13.0
25	Nanuk	A	0825A1	30.5	7.6	10/13/2008	11/7/2008	25	41.7
25	Nanuk	B	0825B1	30.5	7.6	11/4/2008	11/11/2008	7	11.7
25	Nigliq Delta	B	0825B2	30.5	7.6	10/14/2008	11/4/2008	21	35.0
27	Nanuk	A	0827A1	21.3	7.6	10/18/2008	10/20/2008	2	2.3
27	Nanuk	B	0827B1	18.3	8.9	10/23/2008	11/13/2008	21	21.0
27	Nanuk	D	0827D1	24.4	6.4	10/20/2008	10/23/2008	3	4.0
27	Nanuk	C	0827C1	24.4	6.4	11/13/2008	11/20/2008	7	9.3
30	Nanuk	A	0830A1	30.5	7.6	10/23/2008	11/20/2008	28	46.7
30	Nanuk	B	0830B1	30.5	7.6	10/8/2008	10/25/2008	17	28.3
31	Nanuk	A	0831A1	24.4	7.6	10/15/2008	10/18/2008	3	4.0
32	Nanuk	A	0832A1	24.4	7.6	10/5/2008	11/9/2008	35	46.7
32	Nanuk	B	0832B1	24.4	7.6	10/5/2008	11/9/2008	35	46.7
33	Nanuk	A	0833A1	30.5	7.6	10/29/2008	11/5/2008	7	11.7
33	Nanuk	B	0833B1	18.3	7.6	10/30/2008	11/11/2008	12	12.0
33	Nanuk	C	0833C1	30.5	7.0	10/30/2008	11/11/2008	12	20.0
37	Nigliq Delta	A	0837A1	30.5	6.4	10/13/2008	10/18/2008	5	8.3
41	Nigliq Delta	A	0841A1	24.4	7.6	11/13/2008	11/20/2008	7	9.3
42	Upper Nigliq	A	0842A1	24.4	7.6	10/13/2008	11/20/2008	38	50.7
54	Nigliq Delta	A	0854A1	24.4	7.6	10/18/2008	11/13/2008	26	34.7
54	Nigliq Delta	B	0854B1	18.3	8.9	10/18/2008	11/20/2008	33	33.0
56	Nigliq Delta	A	0856A1	18.3	7.6	10/19/2008	10/21/2008	2	2.0
56	Nigliq Delta	A	0856A2	18.3	7.6	10/21/2008	10/22/2008	1	1.0
56	Nigliq Delta	B	0856B1	24.4	7.6	10/20/2008	11/3/2008	14	18.7
56	Nigliq Delta	C	0856C1	18.3	10.2	10/22/2008	10/23/2008	1	1.0
56	Nigliq Delta	A	0856A3	18.3	7.6	10/23/2008	11/3/2008	11	11.0
63	Nigliq Delta	A	0863A1	24.4	7.6	10/24/2008	11/20/2008	27	36.0
64	Upper Nigliq	A	0864A1	24.4	7.6	10/13/2008	11/13/2008	31	41.3
65	Nigliq Delta	A	0865A1	12.2	7.6	10/16/2008	10/30/2008	14	9.3

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
65	Nigliq Delta	B	0865B1	18.3	7.6	10/16/2008	10/30/2008	14	14.0
65	Nigliq Delta	C	0865C1	18.3	8.9	10/24/2008	10/30/2008	6	6.0
65	Nigliq Delta	C	0865C2	18.3	8.9	10/30/2008	11/19/2008	20	20.0
65	Nigliq Delta	B	0865B2	18.3	7.6	10/31/2008	11/19/2008	19	19.0
66	Nanuk	A	0866A1	15.2	6.4	10/29/2008	11/20/2008	22	18.3
69	Upper Nigliq	A	0869A1	24.4	7.6	10/5/2008	10/25/2008	20	26.7
70	Nigliq Delta	A	0870A1	30.5	7.6	10/12/2008	10/20/2008	8	13.3
72	Nigliq Delta	A	0872A1	24.4	7.6	10/10/2008	10/28/2008	18	24.0
72	Nigliq Delta	B	0872B1	30.5	8.9	10/8/2008	10/20/2008	12	20.0
72	Nigliq Delta	C	0872C1	24.4	7.6	10/8/2008	10/20/2008	12	16.0
72	Nigliq Delta	A	0872A1	24.4	7.6	10/29/2008	11/20/2008	22	29.3
79	Nanuk	A	0879A1	24.4	7.6	10/16/2008	10/31/2008	15	20.0
79	Nanuk	B	0879B1	30.5	7.6	10/31/2008	11/9/2008	9	15.0
79	Nanuk	A	0879A2	24.4	7.6	10/31/2008	11/21/2008	21	28.0
81	Upper Nigliq	A	0881A1	24.4	7.6	10/8/2008	10/25/2008	17	22.7
82	Nigliq Delta	A	0882A1	24.4	7.6	10/19/2008	11/20/2008	32	42.7
88	Upper Nigliq	A	0888A1	21.3	7.6	10/29/2008	11/20/2008	22	25.7
88	Upper Nigliq	B	0888B1	24.4	7.6	10/29/2008	11/20/2008	22	29.3
89	Nigliq Delta	A	0889A1	18.3	7.0	10/12/2008	10/30/2008	18	18.0
93	Nanuk	A	0893A1	24.4	8.9	10/8/2008	10/28/2008	20	26.7
93	Nigliq Delta	A	0893A2	24.4	8.9	10/28/2008	10/29/2008	1	1.3
93	Nigliq Delta	B	0893B1	24.4	7.6	10/29/2008	11/20/2008	22	29.3
99	Nigliq Delta	A	0899A1	24.4	7.6	10/24/2008	11/3/2008	10	13.3
							Total adjusted Net Days		1,357.7

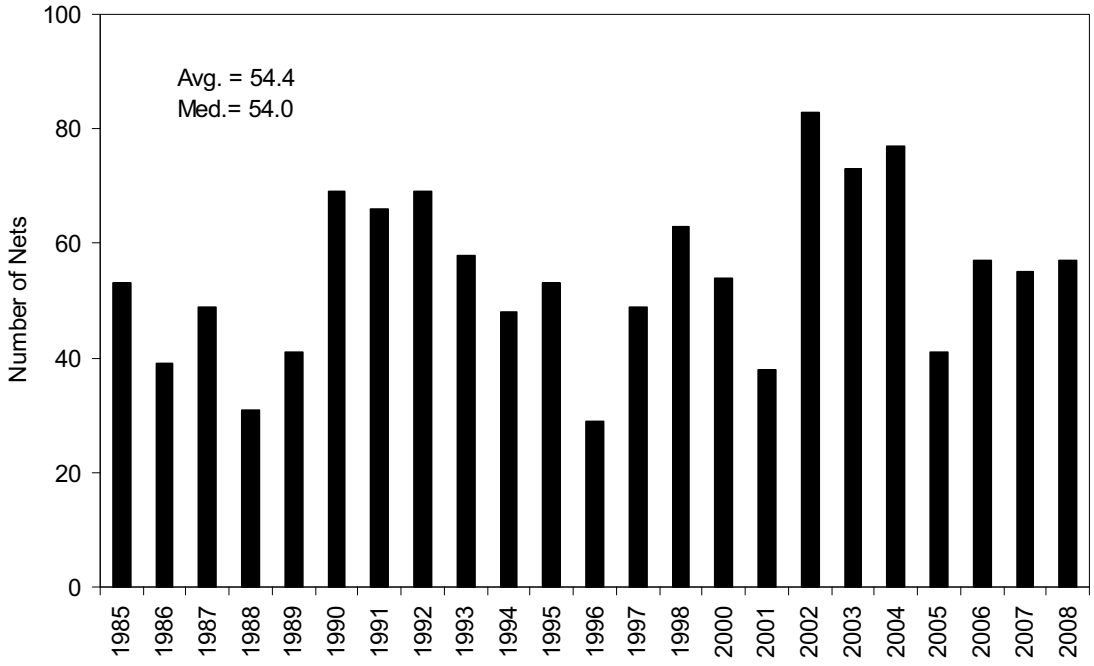

Figure 3. Number of gill nets deployed annually in the Colville River fall subsistence fishery, 1986–2008.

average and median number deployed since 1986 (Figure 3). All 57 nets monitored in 2008 were deployed in the Niġliq channel. Following the monitoring effort in 2008, we were informed of an additional net that was deployed for 2 days near Helmericks' camp on the Kupigruak channel but we were unable to obtain data for this net. It was reported that the high cost of fuel prevented further fishing in this channel in 2008.

The number of nets deployed increased steadily during 5–20 October. The number of nets reached 36 on 20 October, then dropped to 31 nets on 26 October, and then increased again to 38 nets on 30 October, which was the maximum for the season (Figure 4). This period of fluctuation between 20 and 30 October is coincident with the Alaska Federation of Natives (AFN) Conference in Anchorage (19–26 October) and a simultaneous fuel shortage in Nuiqsut, which limited some deployment of nets. Increased fuel costs in late October 2008 led to many fishers pulling their nets early, with a steep decline to 14 nets by 12 November.

After standardizing for net length, we calculated 1,358 adjusted net days of fishing effort in 2008 (Table 2), representing a 7% increase in fishing effort over 2007. Fishing effort was similar in the Niġliq Delta (46% of total) and Nanuk areas (39% of total) (Figure 5). The Upper Niġliq area accounted for just 14% of the calculated effort in 2008.

The most frequently deployed mesh size of nets in the Nuiqsut fall fishery has traditionally been 7.6 cm, and 2008 was no exception. CPUE (expressed as catch per net day) in the Niġliq channel was computed only for nets of 7.6-cm mesh (standardized to 18 m length). CPUE for Arctic cisco in 2008 was highest in the Niġliq Delta area (13.3 fish/adjusted net day, Table 3). CPUE for the Nanuk area was 6.8 fish/adjusted net day and the Upper Niġliq had the lowest CPUE for Arctic cisco at only 3.5 fish/adjusted net day. The total CPUE for Arctic cisco in the Niġliq channel (~10 fish/adjusted net day) was the lowest since 2002 and slightly below the 1986–2007 average of 15 fish/adjusted net day (Table 3, Figure 6). The

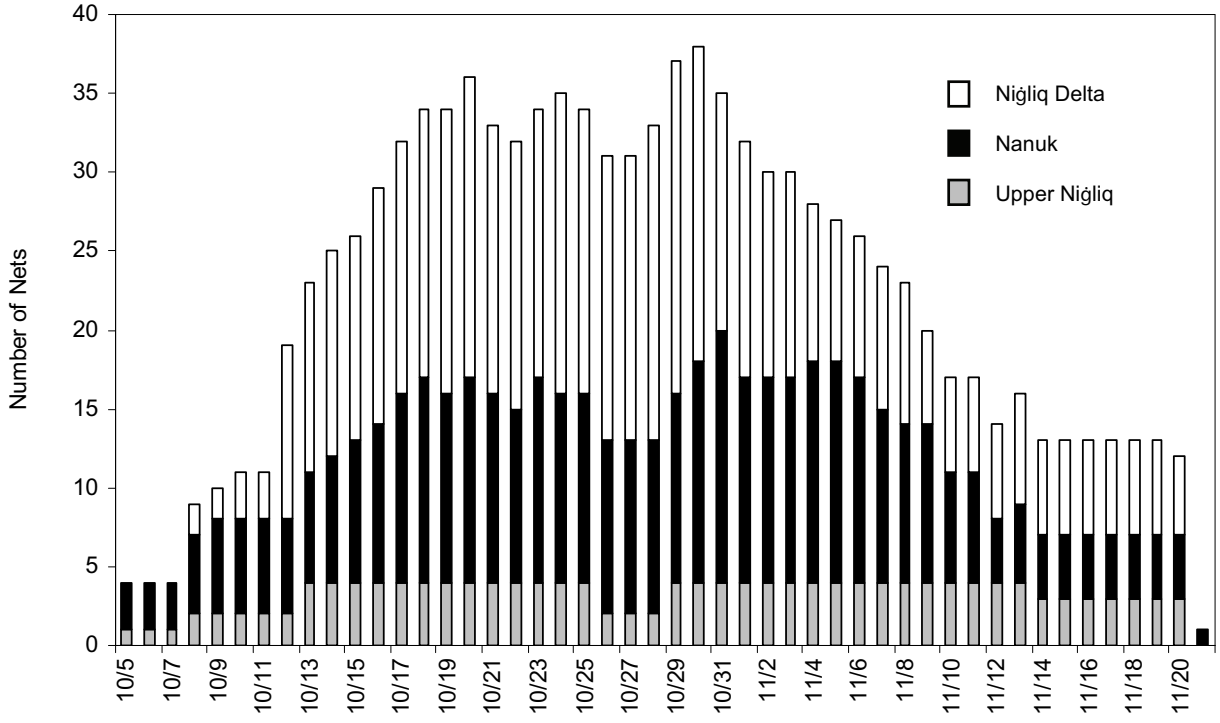

Figure 4. Number of nets fishing each day in each of 3 Niġliq channel fishing areas, 2008.

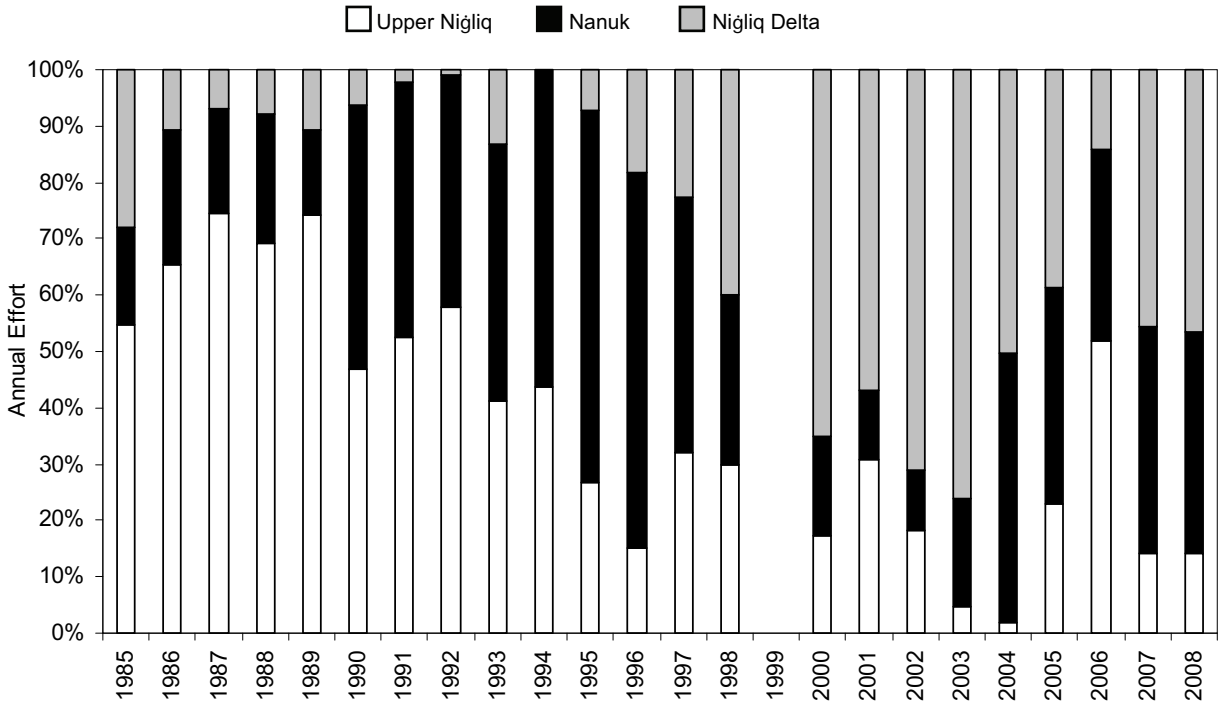

Figure 5. Percent of annual fishing effort in each of 3 Niġliq channel fishing areas, 1985–2008. All nets are included, the Uyagagviq area is combined with the Nanuk area.

daily average CPUE in 7.6-cm mesh nets exceeded 10 fish/day only 7 times in 2008 and exceeded 20 fish/day only once (~33 fish on 20 October) (Figure 7).

Similarly, the observed harvest of Arctic cisco in the Niġliq channel in 7.6-cm nets was the lowest since 2002 (Table 3, Figure 8). A total of 4,545 Arctic cisco were observed being harvested from 7.6-cm nets, which is slightly below the long-term average of 5,111 cisco. The total observed harvest decreased in both the Upper Niġliq and Niġliq Delta areas compared to 2007 but increased in the Nanuk area.

In addition to Arctic cisco, 6 other species of fish were recorded in the harvest in 2008 (Table 4). A total of 9,199 fish (all species and mesh sizes) were counted in interviews, with Arctic cisco (84%) and least cisco (~15%) comprising the vast majority of the recorded harvest in 2008 (Table 4). Rainbow smelt (*Osmerus mordax*), saphron cod (*Eleginus gracilis*), Bering cisco (*Coregonus laurettae*), humpback whitefish (*Coregonus oidschian*), and burbot (*Lota lota*) also occurred in the harvest in small numbers. The CPUE in the Niġliq channel for least cisco in 2008 was similar in all 3 major fishing areas but overall was slightly lower than the long term average since 1986 (Table 5).

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 2,341 Arctic cisco in 2008, down from 3,694 in 2007. Fish ranged in length from 210 to 410 mm (Figure 9), with 50% of fish measuring between 295 and 320 mm (median = 309 mm). The length distribution of Arctic cisco appears normally distributed. As expected, the frequency of length classes differed among mesh sizes (Figure 10), with smaller mesh sizes capturing greater numbers of small fish. We also measured fork lengths on 772 least cisco (Figure 9). The length distribution for least cisco also was normally distributed and ranged between 222 and 356 mm (median = 305 mm). Lengths between 295 and 315 mm

Table 3. Arctic cisco catch, effort, and CPUE for each fishing area in the Niġliq channel, 1986–2008. 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 (# 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)
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	1,287	188.0	6.8	3,102	233.2	13.3	4,545	465.2	9.8
Total[b]	20,222	2,026	10.0	39,616	2,675	14.8	52,602	2,759	19.1	112,440	7,459	15.1

[a] Upper Niġliq catch and effort values include fish and net data from the Uyagagviq area (Area 630).
[b] Denotes average CPUE form 1986–2008.

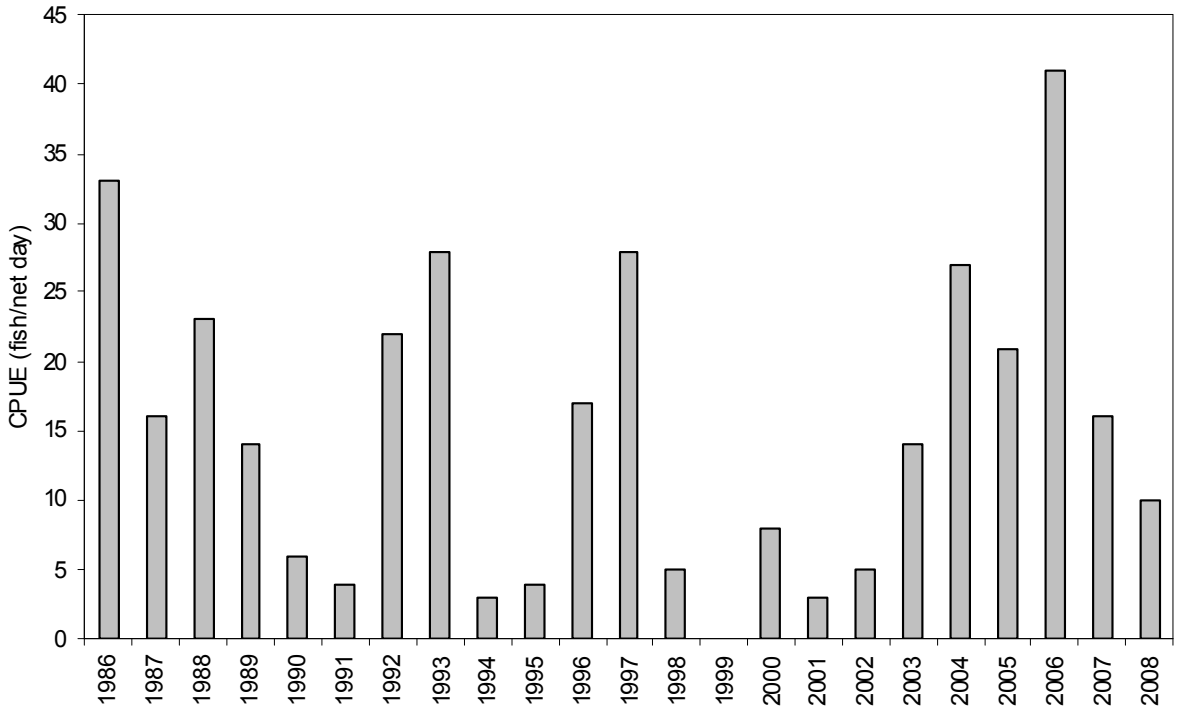

Figure 6. Catch per unit effort (CPUE) of Arctic cisco in 7.6-cm gillnets, Niġliq channel, 1986–2008. Effort is standardized to 18 m net length, as described in text.

represented 50% of the measured harvest, and this length distribution overlapped closely with that recorded for Arctic cisco in 2008.

As in 2007, 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 = 188). This relationship can be used as an indicator of fish health or condition of the fish. Length and weight were strongly correlated (r^2 = 0.78) in Arctic cisco in 2008 (Figure 11).

Otoliths were removed from these same fish to estimate age structure for the 2008 harvest. Over all mesh sizes combined (n = 172), Arctic cisco ranged in age from 4 to 8 years (Figure 12). Age composition was 58% age 6, 33% age 5, 7% age 4, and 2% total for ages 7–8. 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 = 148), age composition was 65% age 6, 31% age 5, and 3% for ages 4, 7, and 8 combined (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 2008, the fishery was dominated by fish 5 to 6 years old. Maximum fish lengths occurred in the age 6 class, and the 2008 harvest included few of the larger fish normally found in the age 7 and age 8 classes (Figure 13). Harvest of age 7 and 8 fish was lower in 2008 than it was in previous 2 years (Daigneault and Reiser 2007, Seigle et al. 2008).

Using the age composition of the catch (in percent) and the overall CPUE of 9.8 fish/net day (Table 3), we were able to estimate the age-specific CPUE for the 2008 harvest. As expected for 7.6-cm mesh nets, the CPUE increased from age 4 to age 6 (Figure 14). The 1999 year class (age 9

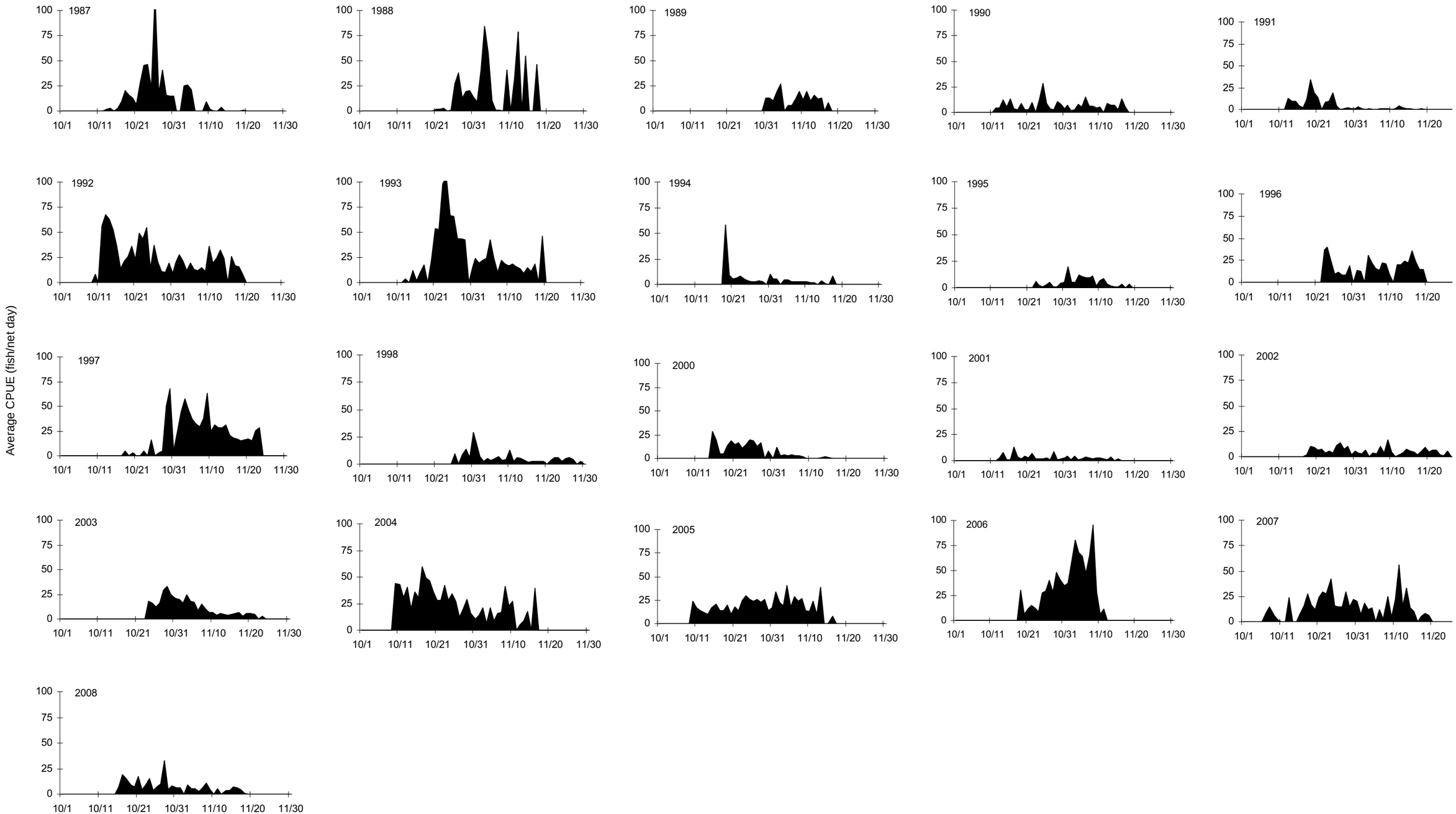

Figure 7. Average daily catch per unit effort (catch per net day) of Arctic cisco in 7.6-cm gillnets, Niġliq channel, 1987–2008. Effort is standardized to 18-m net length, as described in text.

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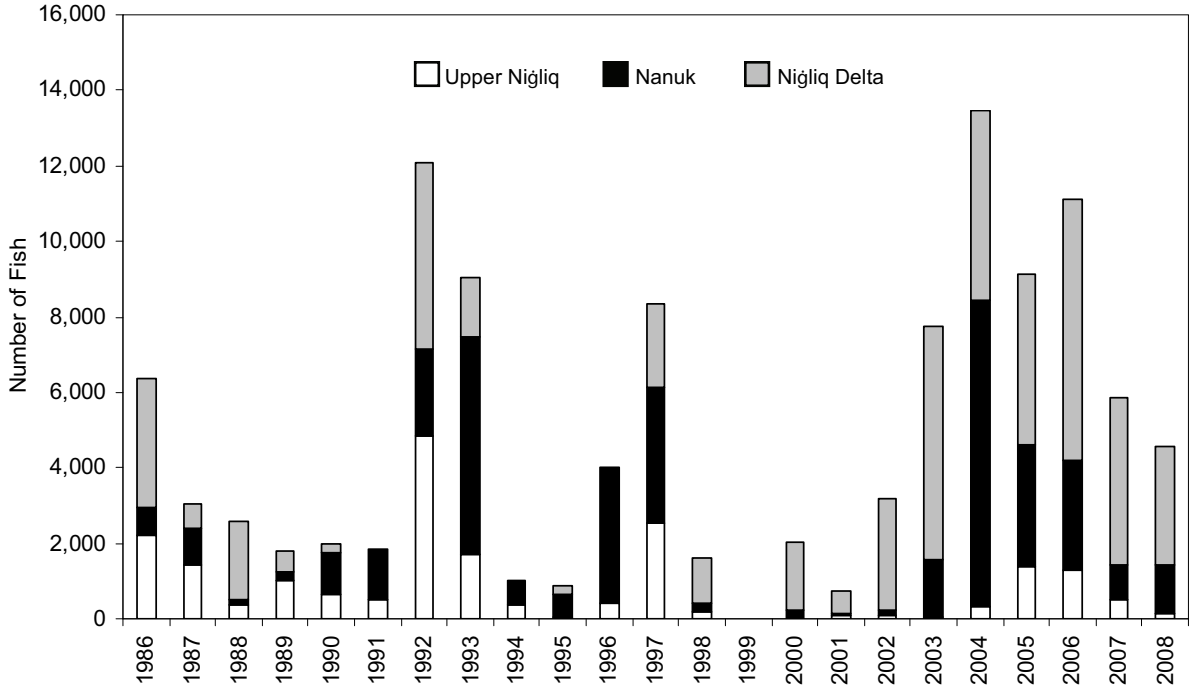

Figure 8. Number of Arctic cisco harvested in 7.6-cm mesh gillnets in each of 3 Niġliq channel fishing areas, 1986–2008. The 2005–2008 data are not directly comparable to historical data because the fishery was not monitored for the entire fishing period.

fish, hatched in 1999) disappeared from the fishery entirely in 2008, as expected (Seigle et al. 2008), and the 2000 year class (age 8) also was nearly absent.

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 1999 year class (absent from the 2008 harvest) was one of the highest in 22 years of surveying, which accounts for the strong harvests in recent years. The CPUE for the 2000 year class (nearly absent in 2008) is near the long-term average observed over the course of monitoring. Although some fish from the 2002 and 2003 year classes may still be captured in future years, these 6- and 5-year-old fish, which dominated the 2008 fishery, appear to represent relatively small cohorts, somewhat below the long-term average for the fishery, although at least 9 previous cohorts were even smaller.

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). Salinities were high throughout the 2008 season in the Niġliq Delta fishing area, which is closest to the coast (Figure 16). In general, salinity increased slightly over the season at all stations and decreased with distance from the coast. However, all 3 of the more inland sampling sites exhibited 2 periods of very low salinities during the 2008 fishing season. All 3 upstream stations exhibited low salinity on 19 October. This freshwater intrusion was short-lived, however, as all 3 stations exhibited higher salinities at the next sampling on 22 October. Low salinities occurred again on 13 November and remained low through 15 November, rising again on 16 November. There

Table 4. Species composition of the subsistence harvest from the Colville River fall fishery, expressed as a percent of the sampled catch, 1985–2008. 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
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	7.0	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	1.0	3.8	0	1.0	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	35.0	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	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	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

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

Table 5. Observed catch of least cisco (number of fish), adjusted effort (net days), and catch per unit effort (CPUE) for each of 3 main fishing areas in the Niġliq channel, 1986–2008. 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 (# 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)
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
	0	0	--	0	0	--	0	0	--	0	0	--
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	274.0	92.7	3.0	261	67.3	4.0	414.0	65.0	6.0	949.0	225.0	4.0
2007	939.0	63.0	15.0	559	109.4	5.0	1085.0	188.7	6.0	2583.0	361.2	7.0
2008	78.0	44.0	1.8	529	188.0	2.8	460.0	233.2	2.0	1067.0	465.2	2.3
Total	7,204	2,013	3.6	10,428	2,630	4.0	8,843	2,731	3.2	26,475	7,374	3.6

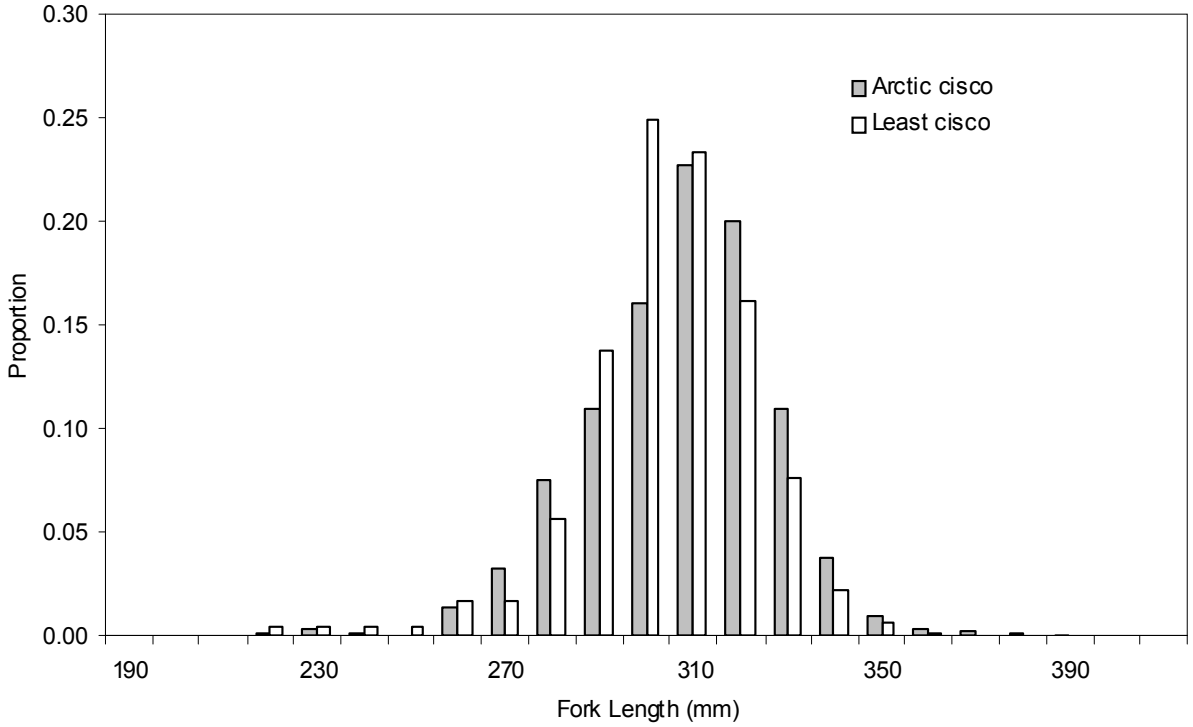

Figure 9. Length frequency (10 mm increments) of Arctic and least cisco captured in all mesh sizes in the fall subsistence fishery, Niġliq channel, 2008.

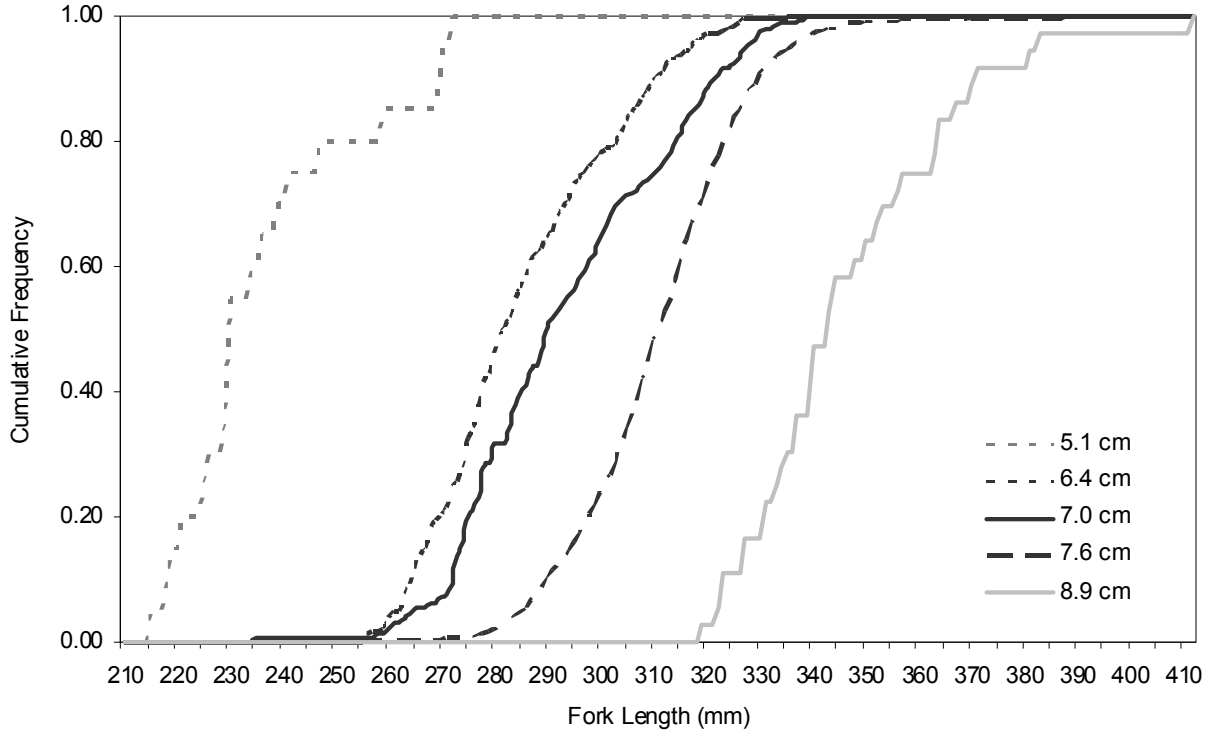

Figure 10. Cumulative length frequency of Arctic cisco in the fall subsistence fishery by gillnet mesh size, Niġliq channel, 2008.

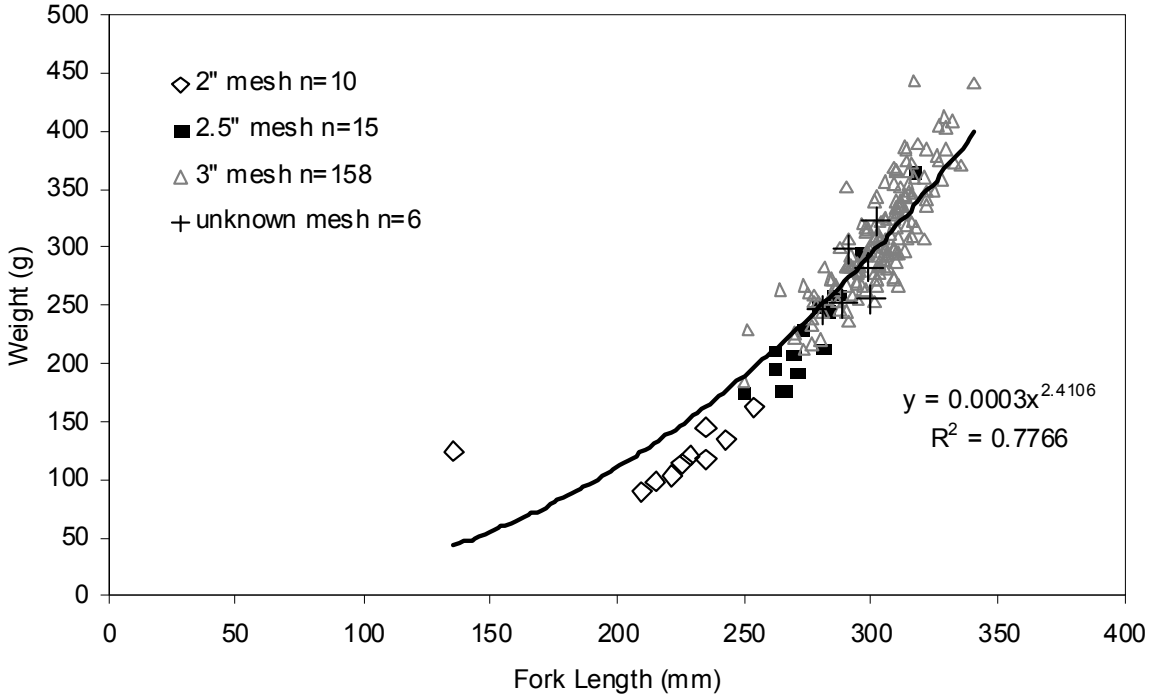

Figure 11. Relationship of weight to length in Arctic cisco harvested in the fall subsistence fishery, Niġliq channel, 2008. Trendline and equation are based on all mesh sizes combined.

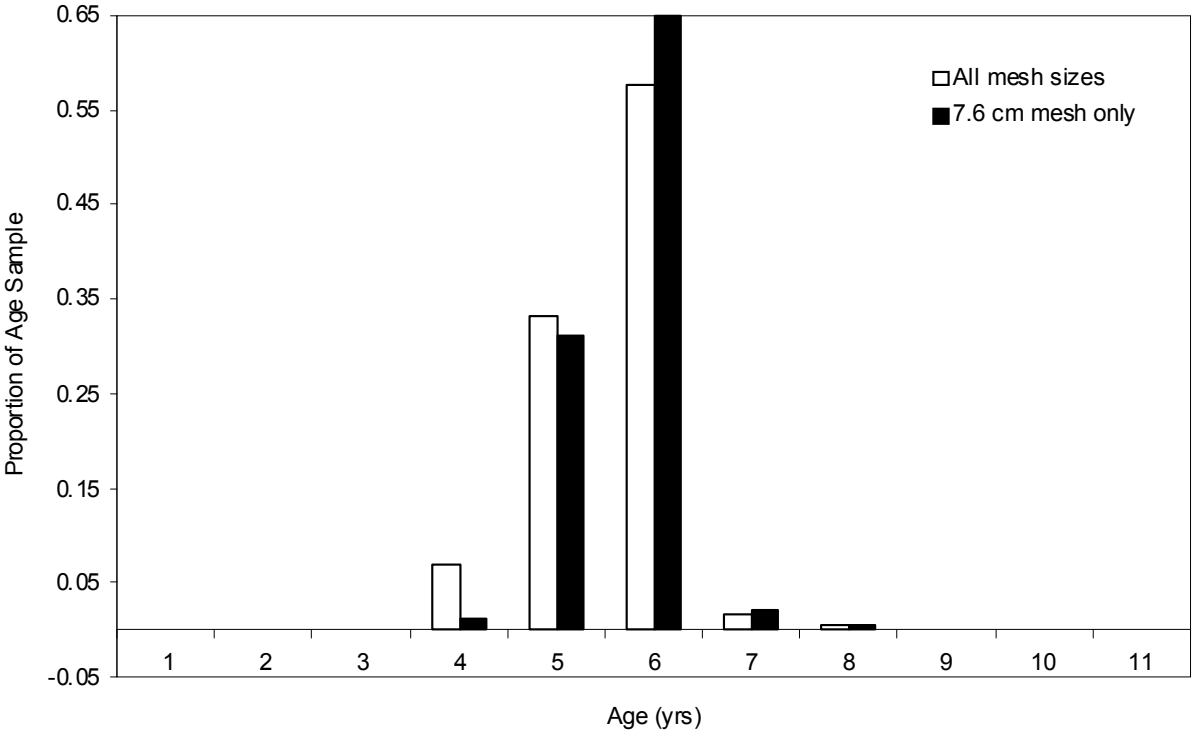

Figure 12. Age composition of Arctic cisco harvested with 7.6-cm mesh nets (n = 148) and in all mesh sizes combined (n = 172), Niġliq channel, 2008.

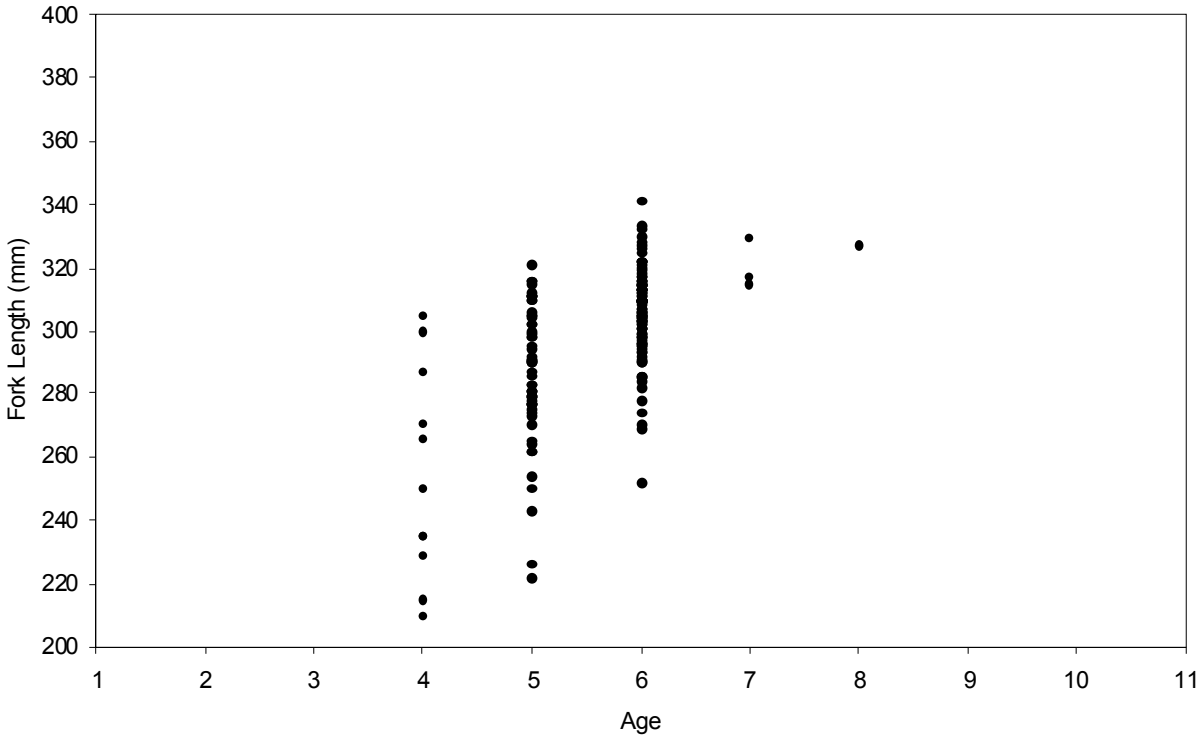

Figure 13. Age-specific length distribution of Arctic cisco harvested in the fall subsistence fishery, Niġliq channel, 2008. All mesh sizes (n = 172) are combined.

was a slight increase in salinity on 29 October that may explain the high average CPUE for Arctic cisco that day. Salinity at 3 m depth was within the appropriate range for Arctic cisco at the first 3 downstream sampling stations through most of the season. In contrast, salinities were <15 ppt throughout the fishing season at the farthest upstream station, in the Upper Niġliq area, where where both CPUE and total harvest levels were the lowest in 2008. 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 17; Moulton and Seavey 2004). When comparing years, the salt-water intrusion in 2008 appears to be farther inland and into more shallow waters at the Upper Niġliq site than in most years since approximately 1997.

ABR biologists and Nuiqsut fishers witnessed what appeared to be a red algae bloom around 20–22 October in the Niġliq channel. Residents expressed considerable concern over the origins of the reddish color caused by the algae, resulting in correspondence between residents, ABR, and the North Slope Borough Department of Wildlife Management (Appendix 2). The bloom was readily observed below and on top of the ice from the delta upstream to the Nanuk area. On 22 October, ABR biologists collected a water sample in the Niġliq Delta area and shipped it for analysis to Arctic Fox Environmental, Inc., in Prudhoe Bay. Results verified high densities of various unidentified red algae (Appendix 3). This sample also was tested for iron and manganese, both of which were detected at low concentrations. Two additional samples were collected on 18 November from the Upper Niġliq and Niġliq Delta areas. Analyses of these samples indicated that the volumes of red algae were significantly reduced (Appendix 4). These samples also were tested for iron, manganese, and petroleum hydrocarbons, all of which were undetected. Photos of algae found in a water sample near Woods' Camp can be found in Appendix 5. The causes of this algal bloom remain unknown.

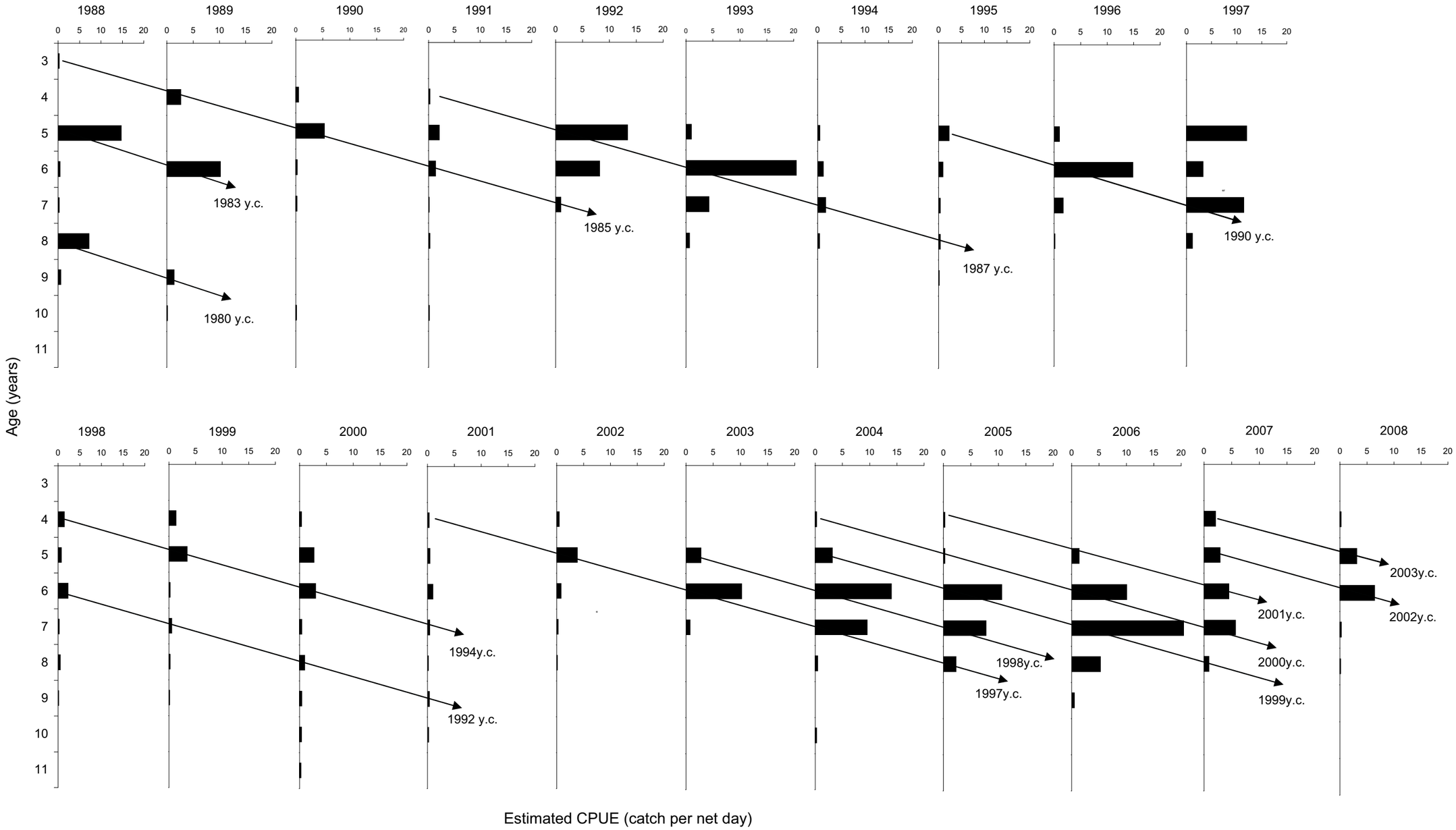

Figure 14. Catch per unit effort (CPUE) of Arctic cisco by age class in the fall subsistence fishery, Niġliq channel, 1988–2008. Arrows demonstrate the progression of select year classes through the fishery. Only fish harvested in 7.6-cm mesh gillnets are included and counts are standardized to 18-m net length, as described in text.

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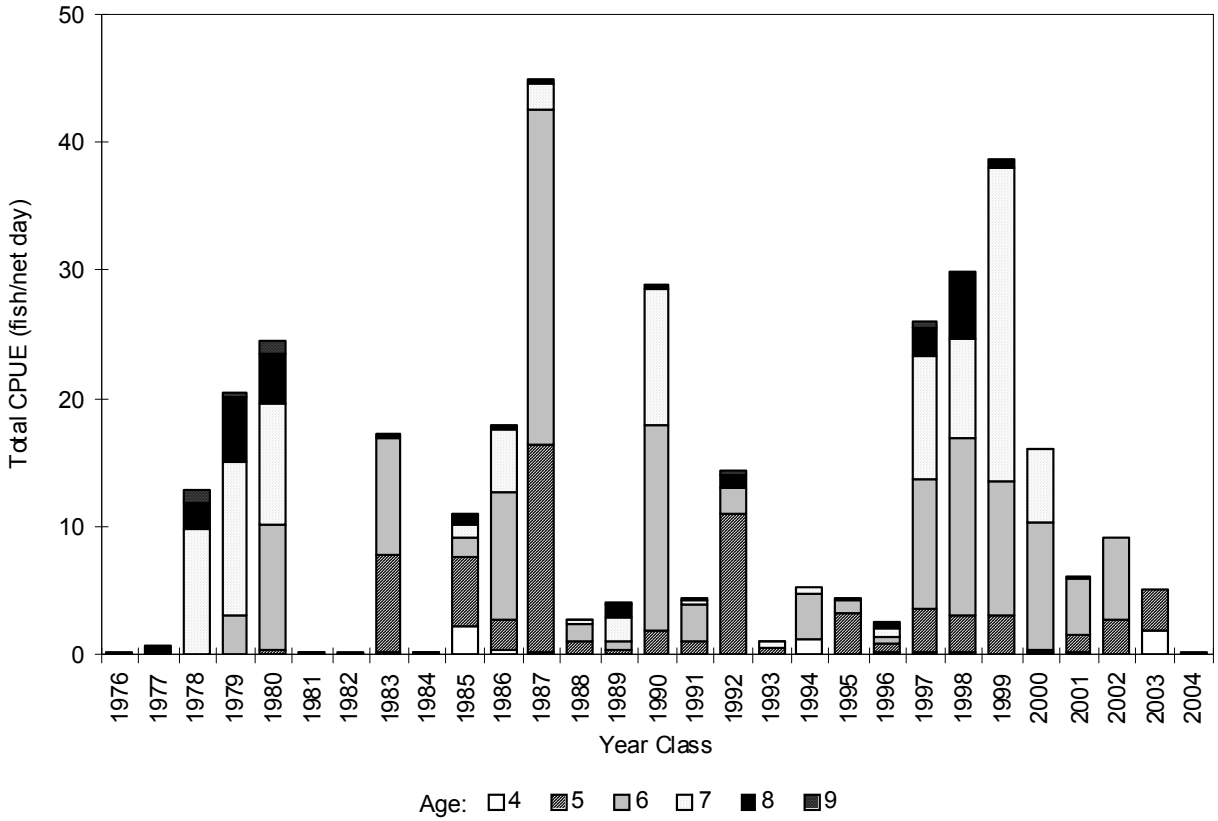

Figure 15. Cumulative catch per unit effort (catch per net day) of Arctic cisco by year class (year of hatch) in the fall subsistence fishery, Niġliq channel, year classes 1976–2004 (capture dates 1985–2008). Catch per unit effort was estimated only for fish captured in 7.6-cm mesh nets.

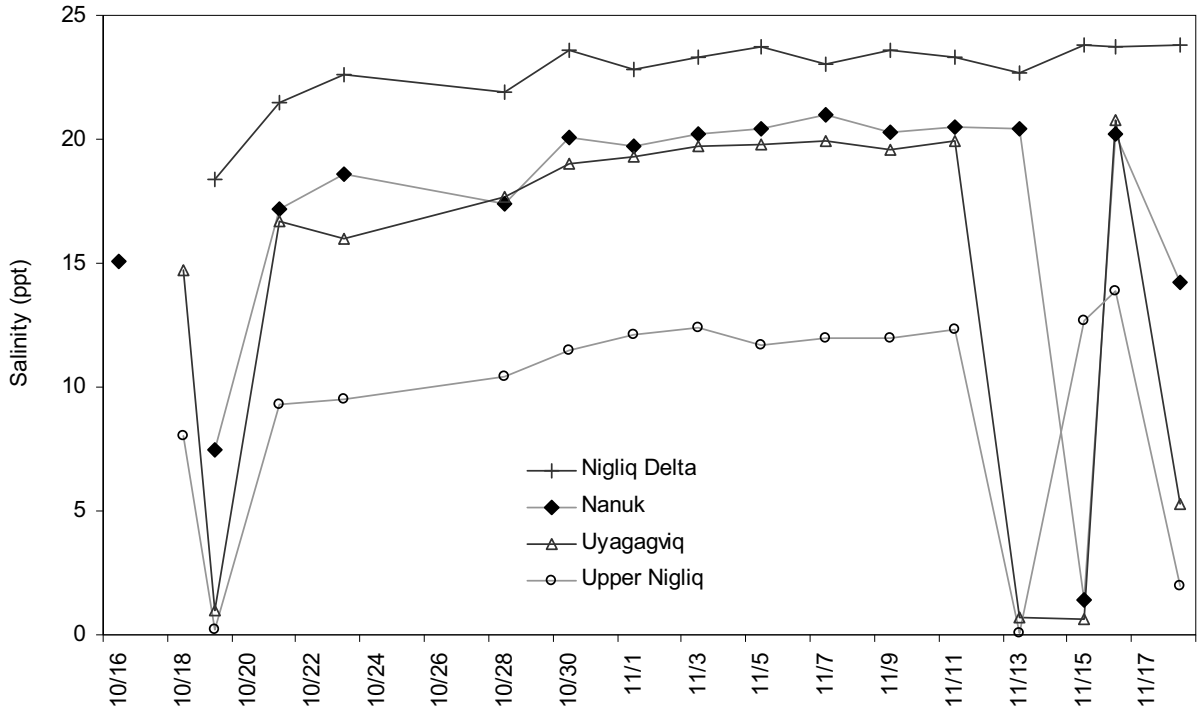

Figure 16. Water salinity (parts per thousand) at 3.0-m depth in each of 4 Niġliq channel fishing areas, 2008. (At the Nanuk area, water depth was 2.0–2.6 m and measurements were taken at the bottom.)

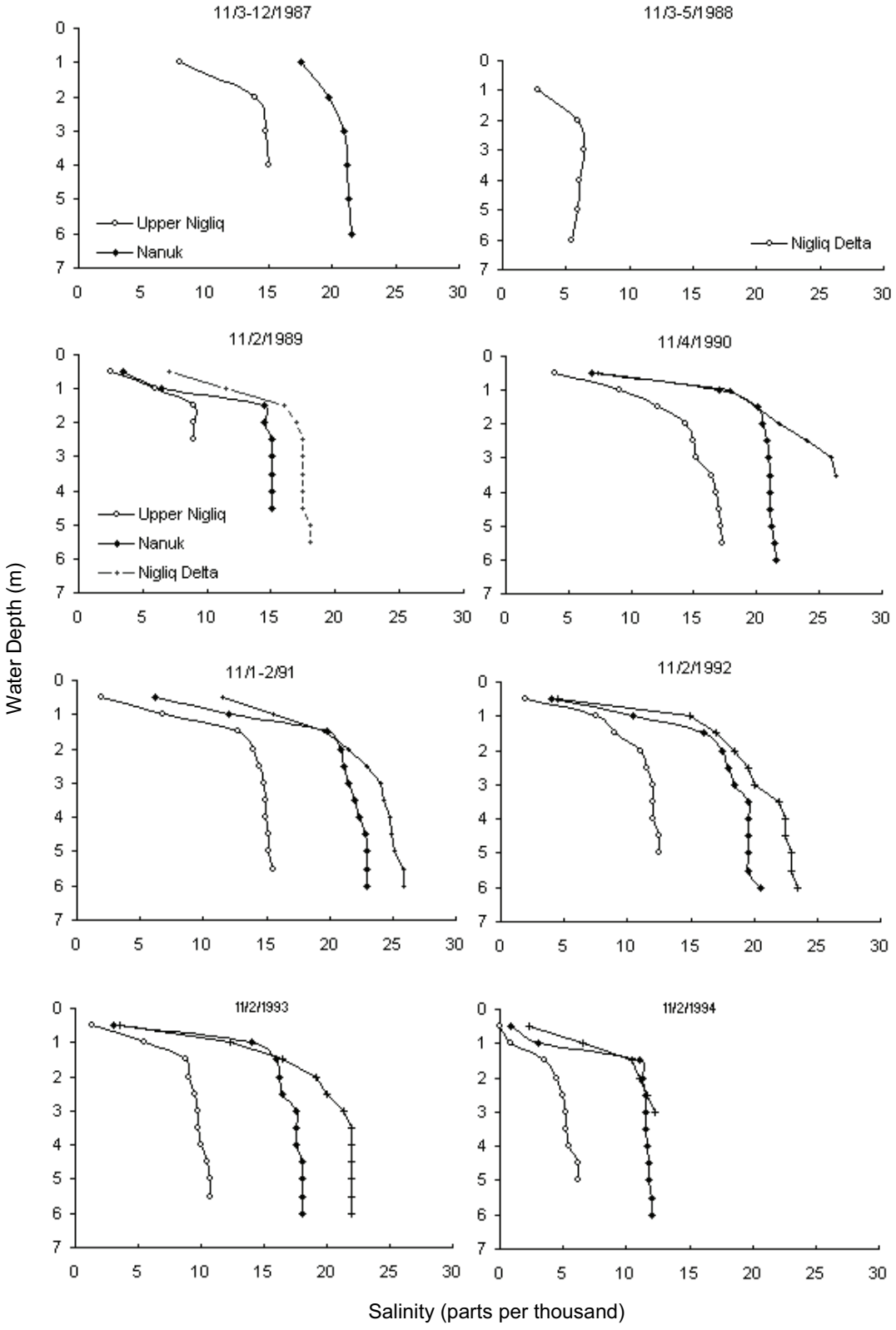

Figure 17. Water salinity depth profiles in Niġliq channel fishing areas, early November 1987–2008.

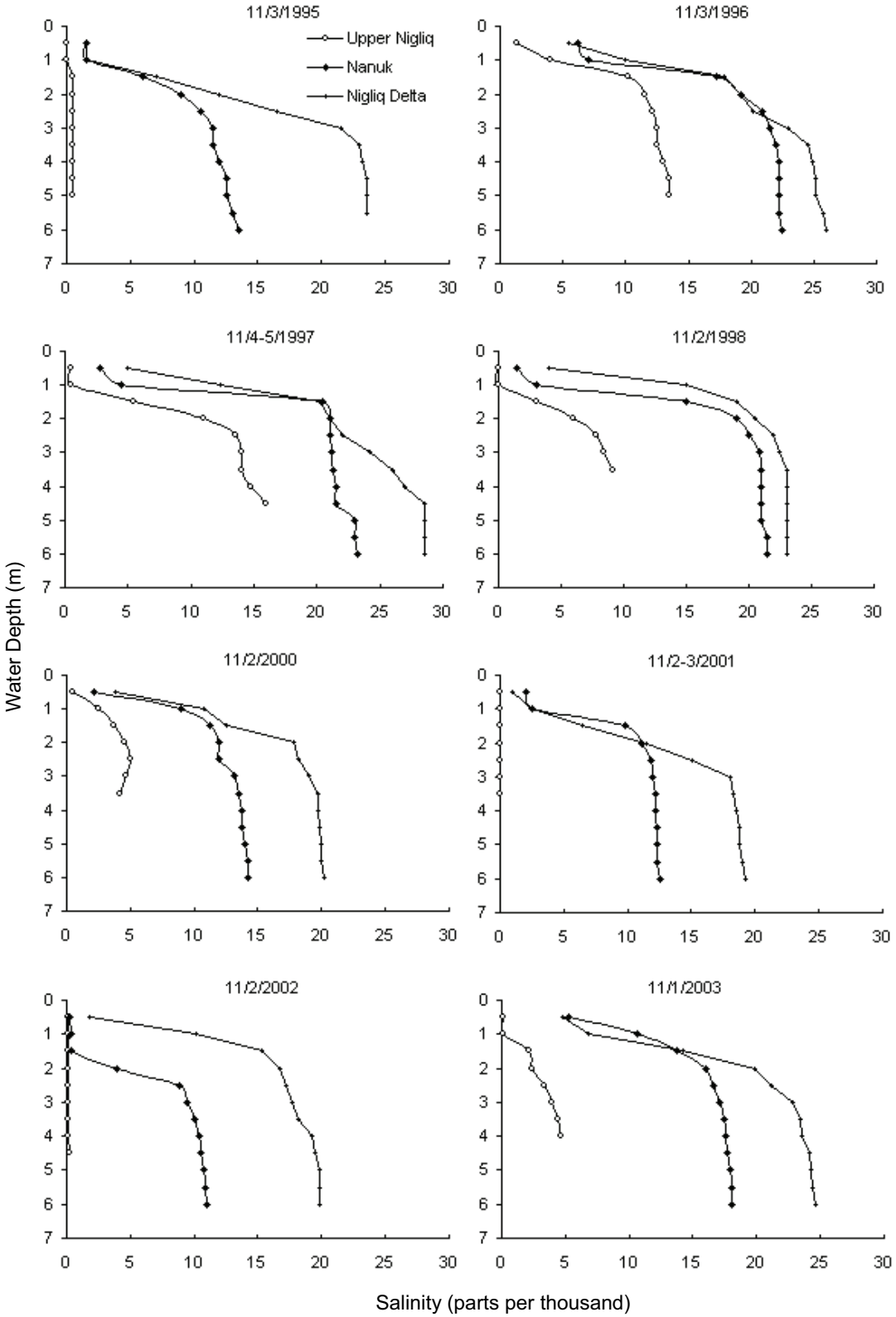

Figure 17. Continued.

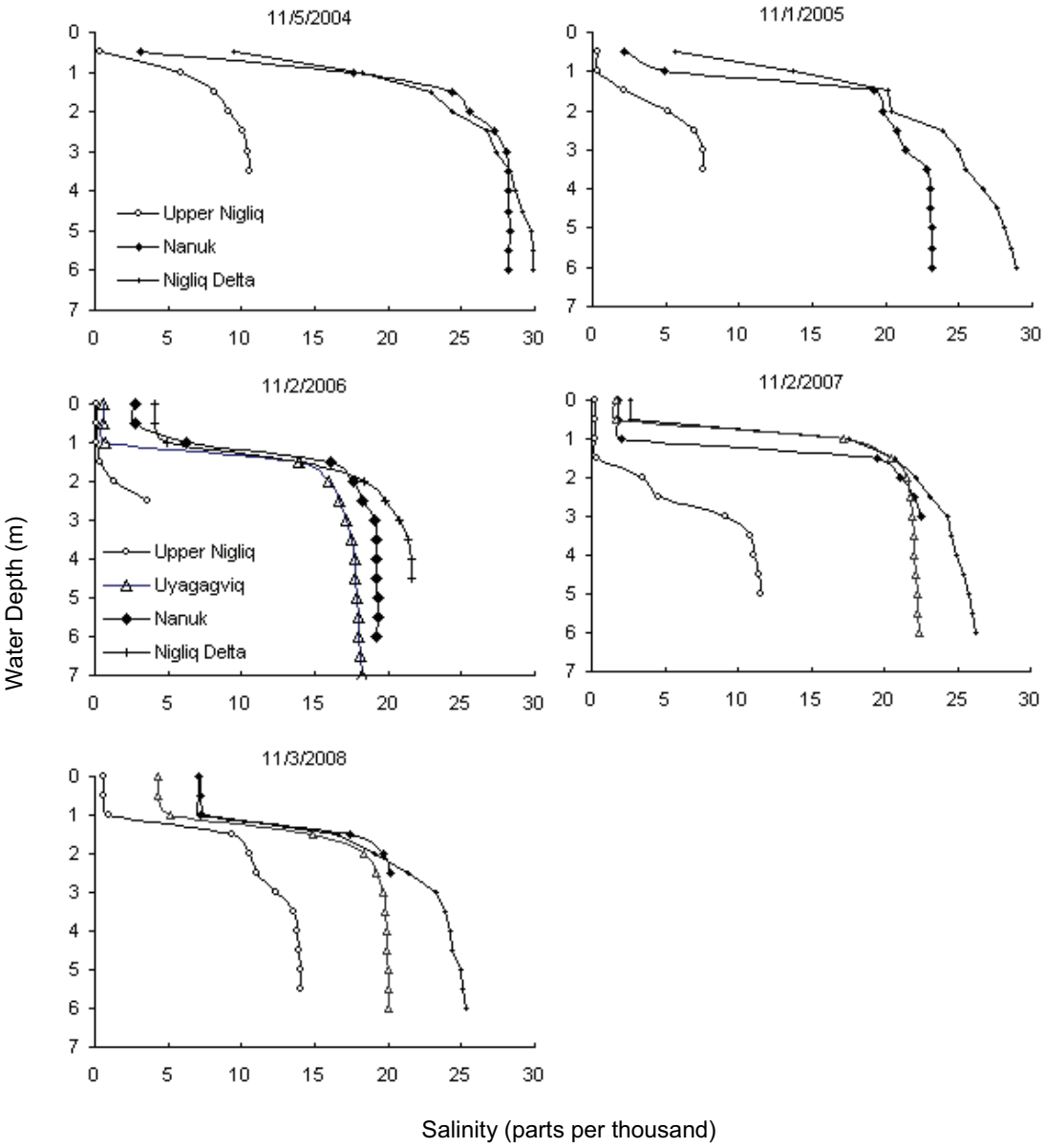

Figure 17. Continued.

DISCUSSION

Freeze up on the Colville River occurred slightly later in fall 2008 than it did in 2007, and conditions on the ice were slushy well into the third week of October. Fishery monitoring commenced on 14 October 2008, slightly before the mean start date of 17 October for Nuiqsut fishers. A few fishers did set nets before our arrival in Nuiqsut, so a small amount of the early season Arctic cisco fishery went unmonitored. ABR monitored 57 different nets over 37 days. Although we conducted fewer on-ice interviews in 2008 (275) than in 2007 (>350), this was mostly because fishers reduced net checking to every other day or every 3 days during the last week of monitoring. Regardless, we feel that we obtained a good representation of fishing effort and harvest in 2008.

Arctic cisco caught in 2008 were mostly within a small size range. The 2008 harvest was dominated by the 2002 and 2003 year classes (Figure 14), which largely explains this low variability in size. The 2000 and 2001 year classes were, for the most part, absent from the 2008 fishery. The 1999 year class was completely absent, apparently having exited the Colville River delta and re-entered the Mackenzie system in Canada as spawning adults, as would be predicted (Gallaway et al. 1983). The near absence of the 2000 and 2001 year classes similarly suggests that these cohorts have either matured and migrated back to the Mackenzie or otherwise been depleted, and will remain absent from the Colville subsistence fishery.

In past reports on the fall subsistence fishery, CPUE has been estimated for the most commonly used mesh size (7.6 cm), which is popular because it catches a wide range of sizes and ages for Arctic cisco. Nets of 7.6-cm mesh size made up 40 of the 57 nets monitored in 2008 (Table 2) and, therefore, continued to provide a good measure for CPUE comparison among years. An evaluation of the ages of fish caught in other mesh sizes confirmed that the 2002 and 2003 age classes were indeed the dominant year classes present in the Colville River fishery in 2008 (Figure 12).

Many fishers commented during interviews that fish were smaller in 2008 than they were in previous years. In fact, fish caught in 2008 were not only smaller, but they also were younger. The 2007 harvest was dominated by the 2000 and 2001 year classes which, as previously mentioned, have exited the Colville fishery. Along with 2002 and 2003 year classes, the 2004 year class made its first appearance in the fishery in 2008 (Figures 14 and 15), thereby shifting the catch to predominantly 4-, 5-, and 6-year-old fish and away from older, larger fish. We anticipate that the 2009 harvest will be comprised of larger fish by comparison with 2008, because all 3 of these year classes should still be present in the fishery in large numbers after 1 more year of summer feeding along the Beaufort Sea coast.

Daily CPUE has dropped in the Niġliq channel since 2006 (Figure 7), although the total number of fishers participating in the fishery remained fairly constant (Figure 3). While, interviewed fishers appeared to be accustomed to the ebb and flow of daily harvests by year (based on oral communication) they were, in general, slightly disappointed with 2008 harvest levels. Despite increased fishing effort (adjusted net days) in 2008, the total harvest of Arctic cisco in 7.6-cm mesh nets decreased by more than 20% between 2007 and 2008 (Table 3).

A decrease in harvest in 2008 was previously predicted (Moulton et al. 2006), and the harvest likely will remain low for at least 2 more years—a fact that we communicated to fishers during community meetings. Arctic cisco harvests are predicted to remain below average in the next 2 years based on low numbers of young-of-the-year captured during summer fyke net surveys near Prudhoe Bay in the first part of this decade (see Figure 17 *in* Seigle et al. 2008). We did, however, document moderate numbers of smaller Arctic cisco that were caught in nets with mesh sizes smaller than 7.6 cm in 2008 (Figure 10). These smaller fish represent the 2002 and 2003 age classes (Figure 12–14) that are expected to dominate in harvests over the next 2 years, prior to an expected boost in harvest beginning in 2011.

The anticipated boost in harvest in 2011 is predicted because of particularly high numbers of young-of-the-year Arctic cisco that were recorded in Prudhoe Bay in 2007 (see Figure 17 *in* Seigle et al. 2008). Of course 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).

The slight dissatisfaction of fishers with their harvest in 2008 was a function of the moderately low CPUE and the continued decline from the record harvests in 2006, although CPUE in 2008 actually ranked tenth over 22 years of monitoring. CPUE in the Niġliq Delta area, which is usually the highest of the traditionally fished areas in the Niġliq channel, averaged only 13 fish/adjusted net day in 2008. CPUE in the Niġliq Delta area was 85 fish/day in 2006 and 22 fish/day in 2007 (Table 3). CPUE levels in the Nanuk and Upper Niġliq areas also were low at approximately 7 and 4 fish/adjusted net day, respectively. However, the harvest in the Nanuk area was only slightly lower than 2007.

Harvest effort continues to be focused mainly in the Nanuk and Niġliq Delta areas. Fishers appear to balance the number of fish they expect to catch with the distance they would have to travel each day to fish. Gas prices doubled during the harvest season in 2008 from over $3/gallon to over $6/gallon. The effect on fishers was to limit their activity on the river in general. Our records suggest that, particularly toward the end of the season, fishers were checking their nets less frequently than usual, and this probably was due to high gas prices coupled with relatively low harvest rates.

A pulse of increased harvest occurred on 29 October (Figure 7) in the Niġliq channel. This peak in CPUE was perhaps associated with the increase in salinity that moved upstream starting 28 October (Figure 16). Such increases in salinity in the Niġliq channel normally are associated with west winds (Moulton and Field 1988, Moulton 1994), although we have not yet verified this with weather records.

In 2008, ABR continued the practice of pre- and post-season meetings with the *Qaaktaq* Panel, which was established in 2007. The public meeting held in October 18 in the Community Center in Nuiqsut was attended by 11 individuals and was received with positive interest. Most attendees were not among the group of most expert subsistence fishers, but all did participate in the fishery on some level. Of particular interest at the public meeting was the presentation of a review of the life history of Arctic cisco. The life history review appeared to be illuminating with respect to the community's perception of how fish recruit to the fishery. The *Qaaktaq* Panel meetings were attended by only a small percentage of those on the panel (See Appendix 1 for attendee list). Members of the panel continued to express concerns about the impact of exploration and offshore drilling on future Arctic cisco stocks. We also discussed with fishers the concept that fishing also can influence future harvests.

Of particular interest to fishers during the post-season *Qaaktaq* Panel meeting was the red algae bloom that occurred in late October 2008. Fishers in the Niġliq Delta and Nanuk areas reported pinkish or red water rising onto the ice through their fishing holes during an approximately 3-day period (21–23 October). Fishers reported never having witnessed such an event and feared the presence of contaminants in the water from drilling operations. We presented water quality data to verify that the discoloration was related to an algal bloom. We explained that algae are always naturally present in the Colville River, although not in such high concentrations. We do not, however, have an explanation for the occurrence of this bloom (See Appendices 2–5). We did note that a slush dam appeared to clog the mouth of the delta prior to the bloom and that the bloom appeared when higher salinity waters pushed upstream after the breaking of that slush dam. We speculate that this algal bloom occurred offshore or in the outer delta and was pushed upstream with the subsequent intrusion of higher salinity waters from offshore. It is notable that the bloom was not associated with the death or injury of fish, as all fish caught during this time were alive and displayed healthy gills.

In 2005, logbooks were introduced to certain fishers in the Arctic cisco fishery. In 2008, logbooks were again distributed but none were returned to the monitoring program. In 2009, we hope to simplify the logbooks and repackage them as guidebooks to fish species in the hopes that people will be more inspired to keep long-term notes on their harvests. We do not, however, expect that logbooks will ever replace the more intensive monitoring effort, although they may enhance documentation of the harvest season. We look forward to improving the logbook process in future harvest seasons.

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Appendix 1. Summary of *Qaaktaq* Panel and community meetings.

INTRODUCTION

Communication between monitors and fishers and among all stakeholders is a key component of the Monitoring and Stakeholder Engagement Plan. As part of this plan, the monitoring team held pre- and post-season meetings with the *Qaaktaq* Panel and a community meeting. The purpose of the meetings was to present the results of the 2007 fishery and provide an open forum for the community to discuss concerns or ideas for enhancements to the monitoring program.

PRE-SEASON *QAAKTAQ* PANAL MEETING

A pre-season meeting with the *Qaaktaq* Panel was held on 17 October and was attended by 3 panel members. A presentation was given that included an overview of the life history of Arctic cisco and a summary of 2007 harvest data. Some members expressed concern over the potential for offshore drilling near Kaktovik and how that development might affect the Arctic cisco fishery near Nuiqsut. The panel also thought the fish harvested so far during the 2008 season were smaller than normal and that the fish were varying in size more since oil development. The monitoring team reviewed the concept of age classes and how the age of the fish relates to its size. No questions were asked that would require action or a change of action in the monitoring program.

Attendees:

·John Seigle (fishery monitor and meeting facilitator)

·Julie Parrett (fishery monitor)

·Billy Oyagak

·Lydia Sovalik

·Joeb Woods

COMMUNITY MEETING

A community meeting was held on 18 October and was attended by 11 community members. The presentation was similar to that given at the *Qaaktaq* Panel meeting, including an overview of the life history of Arctic cisco and a summary of 2007 harvest data. Attendees expressed concern that harvested fish were getting smaller, a concern also of the *Qaaktaq* Panel. Most discussion involved illustrating how age classes progress through the fishery and how the age of the fish relates to the size of fish. Environmental factors, specifically the prevalence of easterly winds that influence age class structure and the number of fish available for harvest, also were discussed. The importance of measuring and aging fish using otoliths was emphasized as a way to understand how age relates to size of harvested fish. No questions were asked that would require action or a change of action in the monitoring program; however, future presentations should re-emphasize the life history of Arctic cisco and the concept of age class structure.

Attendees:

·John Seigle (fishery monitor and meeting facilitator)

·Julie Parrett (fishery monitor)

·Dora Ahkiviana

·Clarence Ahnupkana (door prize winner of 20 gallons of gas)

·Wendy Brower (door prize winner of 10 gallons of gas)

·Vince Corazza

·Joe Ericklook

·Stephen Manuel

·Robert Nukapigak (door prize winner of 20 gallons of gas)

·Heather Smith

·Lydia Sovalik

·James Taalak

·Dorcas Tukle

POST-SEASON *QAAKTAQ* PANEL MEETING

The post-season meeting with the *Qaaktaq* Panel was held 19 November 2008 and was attended by 5 panel members. A brief overview of the 2008 fishery was given and included the total number of fish counted and changes in salinity during the season. Graphics of how the number of fish harvested varies with salinity also were presented. The idea that fishing and removing fish from the population affects the fishery to some degree was introduced. As forecast, fewer fish were caught during the 2008 fishery compared to 2007, but harvests are predicted to increase by 2011.

Panel members expressed concerns about the algal bloom, the size of harvested fish, and offshore oil exploration. The monitoring team collected water samples at Gordon Matumeak's net and salinity stations 1 and 4 (see Figure 2), and sent the samples to Arctic Fox Incorporated and the North Slope Borough for testing (see Appendix 2). The cause of the bloom is unknown.

Members repeated the same concern expressed during the first panel meeting and community meeting, in that fish were getting smaller. The monitoring team re-emphasized that fish may not be getting smaller, but rather fishers may be catching young fish and young fish are smaller, but normally-sized for their age. The latter was confirmed according to the 2008 data; fishers caught more fish in the 6-year age class and few of the larger fish normally found in the 7- and 8-year age classes.

No questions were asked that would require action or a change of action in the monitoring program; however, future presentations should re-emphasize the life history of Arctic cisco and the concept of age class structure. Discussions should also include the concept that harvesting fish also affects the fishery.

Attendees:

·John Seigle (fishery monitor and meeting facilitator)

·John Rose (fishery monitor)

·Clarence Ahnupkana (on behalf of Marjorie Ahnupkana)

·Bernice Kaigelak

·Robert Lampe

·Gordon Matumeak

·Joeb Woods

Appendix 2. E-mail from John Seigle, ABR, to Cyd Hanns, North Slope Borough Department of Wildlife Management, regarding the algal bloom in the Niġliq channel during late October 2008.

The following e-mail was sent by John Seigle in reference to a message sent by Gordon Matumeak on 31 October 2008:

On or about the 22nd of October we began to see slightly discolored water seeping up through ice holes when we helped folks pull nets in the Nigliq Delta. Most of this discoloration was occurring in the Woods Camp area and in the lower portion of Nanuk.

My initial thought as a biologist was that we were looking at an algal bloom. I was surprised to learn that none of the fishers we talked to that day had ever seen such discolored water. I probably should have worried more than I did but having seen this kind of thing in other parts of the world, I simply decided to tell folks that I would collect a sample and then send it off for processing. I had no ability to magnify the samples in the field so I returned to camp and collected a sample from Gordon Matumeak's net site the next day.

Gordon is correct in stating that I told him that I believed this to be a natural occurrence rather than a spill of some sort. There was no odor, nor was there any oily sheen to the water. In collecting the water I could see that the sample was clearly "pinkish" in nature. It appeared to have some large algal masses in it, but not large enough to decipher clearly with the naked eye. I sent this water sample to Arctic Fox Incorporated in Prudhoe Bay last Friday. We had asked them to look at a couple of metals and biota. By yesterday I still had heard no news of this so I called. It will take awhile on the metals but I don't think that's what we were seeing. Here is the news on the biota analysis from Arctic Fox:

> "The following samples were prepared as follows:
>
> After centrifugation of the sample, the pellet was placed on a slide and mounted onto a compound microscope for examination.
>
> In addition to the large amounts of green algae on the slide, there was also a moderate amount of another single-celled algae (often forming clumps), but red in color. The cells probably belong to some species of Rhodophyta, or might possibly be a dinoflagellate species. The organism is giving the water just above the centrifuged pellet a pink to red tint in the centrifuge tube. Further identification of the organism was difficult due to the age and degradation of the sample.
>
> Steven Williams (Analyst)"

To me this confirms my initial belief that we were seeing algae. I looked at a lot of fish between the 15th and the 24th of October and I didn't see anything that concerned me in terms of physical appearance. There were no flared gills and there were no dead fish in the nets. However, catch is much reduced in the delta as of the 24th. As we were seeing a lot of slush in the water, we assumed that this was because of a blockage at the mouth keeping fish out (which by the way is a normal event according to fishers). Fish harvest was still quite high in the upper portion of Nigliq Delta and in Nanuq as well. Both of these areas fished well despite also having pinkish water.

It is possible that due to a bloom event of algae that oxygen became depleted in the lower delta and so fish might have moved up stream. I have directed our team to look at oxygen levels in the water when we do our normal salinity measurements at four stations along the channel from Nuiqsut to the Delta. I still feel that slush was a greater hindrance on harvest in the delta than whatever was coloring the water. There was no shortage of four-horned sculpin in any areas.

At any rate, this discoloration appears to be a biological event and not a direct human impact such as a spill or mud event. Still, residents say they have never seen this before and so we have to be able to assure them that something is both unusual and natural and that we are looking into the cause. I can understand Gordon's concern when it comes to having lived in a place his whole life without ever seeing such an event. I did not mean to diminish this episode by telling him that I thought the event was a natural event. My intent was to inform him that he was not looking at a diesel spill. I will personally call Gordon today to let him know of these early results on the water sample which I gathered at his net.

I would like to apologize for not bringing this to your attention sooner. I left the field last Friday and participated in the American Fisheries Society meetings in Anchorage until yesterday. I did stay in touch with our field crew in Nuiqsut however, and they said that the color had disappeared from the water as of Monday. I have asked our field technicians to collect more water and to keep an eye out for any further discoloration. I have also collected fish samples and we will continue to do so throughout the season. We would be happy to send samples over to Barrow for further testing.

I would also like to point out that CPAI is aware of this event and has been in communication with me over the last two days. Obviously they want to work with everyone to make sure we get to the bottom of this.

I would like to put together a flyer for the residents of the area that would inform them on the biology of these algal masses. Having a test of fish tissues would help in giving comfort to the community when it comes to eating the fish.

We will be happy to cooperate with the Borough in any way we can. Please feel free to call me at home or on my cell phone.

Sincerely, John Seigle

ABR, Inc. - Environmental Research & Services

907-344-6777

Appendix 3. Lab results for algal cells, iron, and manganese in a water sample taken at Gordon Matumeak's net, Niġliq channel, Alaska, 20 October 2008.

ARCTIC FOX ENVIRONMENTAL, INC.

Pouch 340043
Prudhoe Bay, AK 99734
(907) 659-2145 phone (907) 659-2146 fax

Analytical Services Order and Chain of Custody Form

PB-54473

Client Name and Address: ABR PO Box 80410 Fairbanks, AK 99708	Account Number:
Contact Person: John Seigle	P.O. or Contract Number:
Phone Number: 907-240-8352 ~~Fax Number:~~	Authorization Number:
E-mail: jseigle@abrinc.com	Sampled By: JCS
Project Name: Lower Niglig Channel of Colville River	PWS Number:
Data Deliverables: Level I ❑ Level II ❑ Level III ❑ EDD/Format:	Send Results to ADEC: ❑ YES ❑ NO
Requested Turnaround Time and Special Instructions:	

Anc. # 344-6777
Cell # 240-8352

Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID	Number of Containers	Micro Exam	Total Manganese + Iron						Remarks
Colville near Woods Camp	10/20/08	1205	Water	AF27050	1	X	X						

Preservative & Lot Number

Relinquished By (1):	Date: 10/24/08	Time: 0930	Received By:
Relinquished By (2):	Date:	Time:	Received By:
Relinquished By (3):	Date:	Time:	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: _____

ARCTIC FOX ENVIRONMENTAL, INC.
Pouch 340043
Prudhoe Bay, AK 99734
Phone: (907) 659-2145 Fax: (907) 659-2146
E-mail: arcticfox@astacalaska.com

ABR
PO Box 80410
Fairbanks, AK 99708

Report Date: 11/10/2008
Date Arrived: 10/24/2008
Date Sampled: 10/20/2008
Time Sampled: 12:00 PM
Sampled By: JCS

Attn: John Siegle
Phone: (907) 240-8352
Fax:
Email: jseigle@abrinc.com

AF Lab #: AF27050
Client Sample ID: Colville near Woods Camp
Location/Project: Lower Niqliq Channel of Colville River
COC#: 54473
Sample Matrix: Water

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

ABR Sample ID: Colville near Woods Camp
Analysis Requested: Micro Exam, Total Iron and Manganese
Arctic Fox ID: AF27050
Test America ID: PRJ0884-01

Reported By: Jerry Pollen / Ralph E. Allphin / Jeff Shannon
Prudhoe Bay Laboratory

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:	1008-4590/Lower Niglig Channel of	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Jerry Pollen/Ralph Allphin	11/10/08 12:36

Analytical Case Narrative

TestAmerica - Portland, OR

PRJ0884

Custom Micro Exam
Batch # 8101047 10/27/08

Analyst: S. Williams

Source:
PRJ0884-01 (sample taken from Lower Niglig channel of Colville).

The following samples were prepared as follows:

After centrifugation of the sample, the pellet was placed on a slide and mounted onto a compound microscope for examination.

In addition to the large amounts of green algae on the slide, there was also a moderate amount of another single-celled algae (often forming clumps), but red in color. The cells probably belong to some species of Rhodophyta, or might possibly be a dinoflagellate species. The organism is giving the water just above the centrifuged pellet a pink to red tint in the centrifuge tube. Further identification of the organism was difficult due to the age and degradation of the sample.

Steven Williams

(Analyst)

TestAmerica Portland

Vanessa Frahs, Project Manager

TestAmerica
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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1008-4590/Lower Niglig Channel of	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Jerry Pollen/Ralph Allphin	11/10/08 12:36

Total Metals per EPA 200 Series Methods

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PRJ0884-01 (AF27050 (Colville Near Woods Camp))		**Water**					**Sampled: 10/20/08 12:00**			
Iron	EPA 200.8	**0.0250**	-----	0.0250	mg/l	1x	8110021	11/03/08 10:22	11/06/08 14:22	
Manganese	"	**0.144**	-----	0.00200	"	"	"	"	11/05/08 19:37	

TestAmerica Portland

Vanessa Frahs, Project Manager

Appendix 4. Lab results for algal cells, iron, manganese, oil, and grease in a water sample taken at hydro station 1 and 4, Niġliq channel, Alaska, 18 November 2008.

ARCTIC FOX ENVIRONMENTAL, INC.

Pouch 340043
Prudhoe Bay, AK 99734
(907) 659-2145 phone (907) 659-2146 fax

Analytical Services Order and Chain of Custody Form

PB-54534

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

Contact Person: JOHN SEIGLE

Phone Number: 907-338-8005 Fax Number:

E-mail: jseigle@abrinc.com

Project Name: NUIQSUT ARCTIC CISCO MONITORING

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

Account Number:

P.O. or Contract Number:

Authorization Number:

Sampled By: JCS

PWS Number:

Send Results to ADEC: ❑ YES ❑ NO

Requested Turnaround Time and Special Instructions: AS SOON AS POSSIBLE

Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID	Number of Containers	Requested Analysis: Total Fe, Mn	Requested Analysis: Micro exam	Requested Analysis: TPH (HCl)	Preservative & Lot Number / Remarks
Hydro 1 - Total Fe, Mn	11/18/08	1300	W	AF28203		✓			
Hydro 1 - Micro	11/18/08	1300	W				✓		
~~Hydro 1 - TPH~~	~~11/18/08~~	~~1300~~	W					✓	
Hydro 4 - Total Fe, Mn	11/18/08	1655	W	AF28204		✓			
Hydro 4 - Micro	11/18/08	1655	W				✓		
~~Hydro 4 - TPH~~	~~11/18/08~~	~~1655~~							
Hydro 4 - TPH	11/18/08	1655	W					✓	

→ 11/27/08 Cyd sent TPH sample to replace broken one (Hydro-1-TPH)

Relinquished By (1):	Date:	Time:	Received By:
JOHN SEIGLE	11/19/08	1200	
Relinquished By (2):	Date:	Time:	Received By:
	11/20/08	1545	R. Allphin
Relinquished By (3):	Date:	Time:	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: _____

ARCTIC FOX ENVIRONMENTAL, INC.
Pouch 340043
Prudhoe Bay, AK 99734
Phone: (907) 659-2145 Fax: (907) 659-2146
E-mail: arcticfox@astacalaska.com

ABR
PO Box 240268
Anchorage, AK 99524

Report Date: 12/5/2008
Date Arrived: 11/20/2008
Date Sampled: 11/18/2008
Time Sampled: See Below
Sampled By: JCS

Attn: John Seigle
Phone: (907) 388-8005
Fax:
Email: jseigle@abrinc.com

AF Lab #: AF28203-28204
Client Sample ID: See Below
Location/Project: Nuiqsut Arctic Cisco Monitoring
COC#: 54534
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
Analysis Requested: Micro Exam, Total Iron and Manganese and TPH
Time Sampled: 1:00 PM
Arctic Fox ID: AF28203
Test America ID: PRK0901-01

ABR Sample ID: Hydro 4
Analysis Requested: Micro Exam, Total Iron and Manganese and TPH
Time Sampled: 4:55 PM
Arctic Fox ID: AF28204
Test America ID: PRK0901-02

Reported By: Jerry Pollen / Ralph E. Allphin / Jeff Shannon
Prudhoe Bay Laboratory

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:	1108-4665/Nuiqsut Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Jerry Pollen/Ralph Allphin	12/03/08 08:57

Analytical Case Narrative

TestAmerica - Portland, OR

PRK0901

Custom Micro Exam
Batch # 8110907 11/25/08

Analyst: S. Williams

The following samples were prepared as follows:

Both samples were free of any suspended or settleable solids that could be seen by the naked eye. Each container was shaken, then poured into a 50 ml centrifuge tube. The samples were centrifuged, and any pellet that was formed at the bottom of the tube would be pipetted onto a slide and examined using a compound microscope.

PRK0901-01
No pellet was formed. A couple of drops were taken from the bottom of the centrifuge tube anyway, and examined. Except for a couple of possible algal cells, nothing was found using a compound microscope.

PRK0901-02
No pellet was formed. A couple of drops were taken from the bottom of the centrifuge tube anyway, and examined. Nothing was found using a compound microscope.

Steven Williams

TestAmerica Portland

Vanessa Frahs, Project Manager

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1108-4665/Nuiqsut Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Jerry Pollen/Ralph Allphin	12/03/08 08:57

Oil and Grease Analysis per EPA Method 1664

TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PRK0901-01 (AF28203 HYDRO 1)			**Water**				**Sampled: 11/18/08 13:00**			
Oil & Grease	EPA 1664	ND	-----	4.76	mg/l	1x	8120002	12/01/08 14:45	12/02/08 06:27	
PRK0901-02 (AF28204 HYDRO 4)			**Water**				**Sampled: 11/18/08 16:55**			
Oil & Grease	EPA 1664	ND	-----	4.76	mg/l	1x	8120002	12/01/08 14:45	12/02/08 06:27	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager

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Arctic Fox Environmental, Inc.	Project Name:	**Main**	
Pouch 340043	Project Number:	1108-4665/Nuiqsut Arctic Cisco	Report Created:
Prudhoe Bay, AK 99734	Project Manager:	Jerry Pollen/Ralph Allphin	12/03/08 08:57

Total Metals per EPA 200 Series Methods

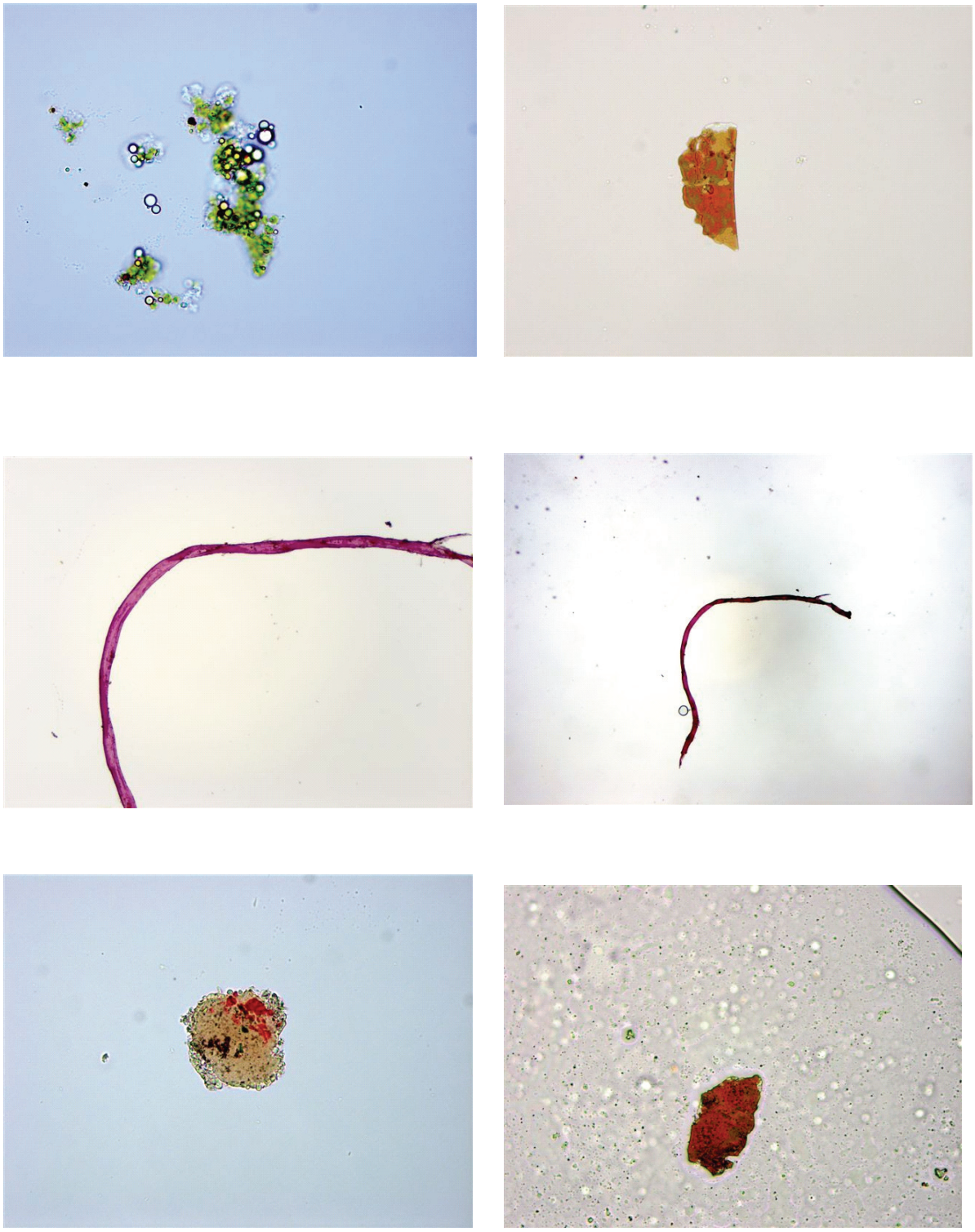
TestAmerica Portland

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PRK0901-01 (AF28203 HYDRO 1)			**Water**				**Sampled: 11/18/08 13:00**			
Iron	EPA 200.7	ND	-----	0.100	mg/l	1x	8110942	11/26/08 09:34	12/01/08 17:37	
Manganese	"	**0.185**	-----	0.0500	"	"	"	"	"	
PRK0901-02 (AF28204 HYDRO 4)			**Water**				**Sampled: 11/18/08 16:55**			
Iron	EPA 200.7	ND	-----	0.100	mg/l	1x	8110942	11/26/08 09:34	12/01/08 17:44	
Manganese	"	ND	-----	0.0500	"	"	"	"	"	

TestAmerica Portland

Vanessa Frahs

Vanessa Frahs, Project Manager



Appendix 5. Photos of algae found in a water sample from salinity station 4 in the Niġliq Delta near Woods' Camp. Photos courtesy of Cyd Hanns, North Slope Borough Department of Wildlife Management.