HARVEST ESTIMATE AND ASSOCIATED INFORMATION FOR THE 2003 COLVILLE RIVER FALL FISHERY

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EXECUTIVE SUMMARY

Moulton, L.L and B.T. Seavey. Harvest estimate and associated information for the 2004 Colville River fall fishery.

The objectives of the 2003 study were to continue obtaining estimates of the total effort and catch for the fall gill net fishery in the Colville River delta, which targets qaaqtaq (Arctic cisco), including harvests of both the village of Nuiqsut and the commercial fishery. Similar to previous years, a daily count was made of the nets fishing from mid October to late November.

The fishery began around October 16, which is considered slightly late. The 2003 fishery was characterized by moderate catches of qaaqtaq (Arctic cisco) through the season. While the 2003 catch rate in the Nigliq Channel was up substantially from 2001 and 2002, it was near the 10-year average. Catches in 2001 and 2002 had been the lowest seen for both the Nuiqsut and commercial fishery, thus th e2003 catches provided some relief from the recent trend of low abundance. The catch of iqalussaq (least cisco), the primary by-catch species, was near the average for the period of record (1985-2003).

The catch rate of qaaktaq (Arctic cisco) in 2004 should be similar to that seen in 2003. This prediction is based on the abundance of fish between 260-300 mm in the Prudhoe Bay region during summer 2003. The 2003 harvest was supported almost completely by larger fish of the 1997 year class. Catches in fyke nets from summer studies in Prudhoe Bay indicate there continues to be a substantial pool of fish that will be available for harvest by fall 2004. Fish caught in 2004 should be larger than those in 2003 because of growth in the 1997 and 1998 year classes.that will comprise the catch.

Catch rates of qaaktaq (Arctic cisco) in 2005 will likely again decline to a low level as the 1997 and 1998 year classes mature and leave the area.

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INTRODUCTION

For nearly 30 years, there were concerns that causeways built in the coastal region of the Alaskan Beaufort Sea to support coastal developments were causing changes in the summer feeding habitat of anadromous fishes in the region (Furniss 1975; USACE 1980, 1984). A variety of studies have been conducted in the coastal region since the mid-1970's to gain basic biological, distribution and habitat utilization information needed to address these concerns (Furniss 1975; Bendock 1979; Craig and Haldorson 1981; Griffiths and Gallaway 1982; Critchlow 1983; Griffiths et al. 1983; Woodward-Clyde Consultants 1983; Moulton and Fawcett 1984; Envirosphere 1987, LGL 1990, 1992, 1993, 1995).

The anadromous fishes that are the subject of these studies provide an important food resource for the Inupiat communities of the Alaskan Arctic Coastal Plain and have been fished for many generations. The qaaqtaq (Arctic cisco, *Coregonus autumnalis*), in particular, is a highly prized food resource. This species is harvested near Kaktovik in late summer and in the Colville River delta after ice forms during fall. In addition to subsistence harvests, there is a commercial fishery that has operated in the Colville River delta since the early 1950's. Prior to 1985, there was little information on the subsistence harvests of anadromous fishes, although detailed information existed on the commercial fishery (Craig and Haldorson 1981; Gallaway et al. 1983; Moulton et al. 1986a; Craig 1987).

The concerns expressed over possible effects of causeways to the anadromous fishes of the region, especially Arctic cisco, raised concerns among local people that their traditional fishery resource would, in turn, be affected. The local government for Alaska's Arctic Coastal Plain region, the

North Slope Borough, requested that information be collected to assess the fisheries in the Colville River, which were considered to be most at risk. The study reported here was begun in 1985 in response to that request. The initial year of investigation included a study of fish use of the Colville River delta region and evaluation of both summer and fall fisheries (Fawcett et al. 1986; Moulton et al. 1986b). Following years (1986 to 2003) focused on the fall fishery for Arctic cisco and iqalussaq (least cisco, *C. sardinella*).

Arctic cisco targeted by the fall fishery are derived from spawning stocks in the Mackenzie River, with young-of-the year fish recruiting into the Colville region during August or September, as described by Gallaway et al. (1983). The recruitment of age 0 Arctic cisco into the Colville River region is aided by westerly currents generated by the predominantly easterly winds in the Beaufort Sea region. Strength of recruitment has been correlated to the percentage of easterly winds from June to September (Fechhelm and Fissel 1988). Arctic cisco return to the Mackenzie River at maturity to spawn, thus are only available to the fishery for two or three years prior to maturity. Anadromous least cisco being harvested spawn and winter entirely in the Colville Delta and lower river.

This study of the 2003 fishery constitutes the eighteenth year that the fishery in the delta was subjected to a harvest estimate. Results from 1985 to 2002 are reported in Moulton and Field (1988), previous editions of the Endicott Monitoring Program Annual Report Series and Moulton (2001, 2003). Additional information on the fall gill net fishery in the Colville River was developed by George and Nageak (1986) and George and Kovalsky (1986).

In previous years, information on the commercial fishery was provided by the fisherman operating that fishery. In 2003, however, he decided not to participate in the fishery assessment, thus the assessment for 2003 is only on the Nuiqsut fishery conducted in the Nigliq Channel. The objectives of the 2003 survey were to 1) continue to obtain estimates of effort and catch for the fall fishery in the Nigliq channel of the Colville River, which targets Arctic cisco, 2) evaluate the harvest predictions made prior to the fishing season, and 3) evaluate methods to predict catches in future years.

METHODS

The study area includes the Colville River from the Itkillik River downstream to Harrison Bay (Figure 1). The 2003 study was restricted to three areas of concentrated fishing effort in the Nigliq Channel: 1) the Upper Nigliq Channel near Nuiqsut, 2) the Nanuk area of the Nigliq Channel, and 3) the Nigliq Delta (Figure 2).

The assessment and monitoring of the fall under-ice fishery based in Nuiqsut began on 15 October and continued through the third week in November. Fishing began on October 16, which was a later than normal start date for this fishery (Table 1).

Salinity measurements were taken every other day with a YSI 30 salinity/conductivity/temperature meter at standard locations in three monitoring areas on the Nigliq Channel (Figure 2). Salinity was measured from a vertical profile of the water column at 0.5 m increments.

During the main fishing season, village catches were sampled daily for species composition, number of fish caught, and fork length to the nearest mm. Fish were examined for tags, fin clips, and dye marks applied by other fish studies in the region. Whenever catch data were collected, set duration, net length, net depth (e.g. the width of the net) and mesh size data were also recorded so that catch-per-unit-effort (CPUE) could be calculated for the net set. Effort was calculated in net-days by using the start and end dates for each net. Effort data were adjusted for the various net lengths and set durations by standardizing net length to 18 m and set duration to 24 h.

The nets in the village fishery are of variable length with 18 and 24-m nets being the most common. In 2003, net depth was measured on nets used in the Nigliq Channel. Seventy-one of the 73 nets were 1.8 m deep, with the remainder being 1.2 m. In 1993 and 1994, estimates of the total catch were made both with and without a correction for net depth. The 1993 estimate containing the correction for net depth was 4.4% greater than the estimate based solely on net length and set duration, while in 1994 the correction resulted in an error 3% less than the uncorrected estimate. A correction for net depth was not made in 2003 because virtually all the nets were 1.8 m deep.

Within the main sampling areas, catch rates (CPUE) were estimated by obtaining catch and effort data by mesh size in each fishing area during the season. For each mesh size in each fishing area, the total observed catch was divided by the total observed effort to provide the CPUE estimate. The catch rates for each mesh size by area were then multiplied by the total effort estimated for each mesh size/area combination, and the estimated catches were summed to provide the estimates of total catch.

In the village fishery, 76-mm (3 inch) mesh nets were the preferred gear. Catch rate indices used for comparisons among areas and years and evaluation of changes in length distributions were based on 76-mm (3 inch) mesh. For the 2003 report, some of the abundance indices were re-calculated in a consistent manner to ensure comparability of the data. As a result, some of the numbers changed between this report and previous versions. The changes were mostly minor and did not affect trends or statistical results.

In previous years, otoliths were obtained from Arctic cisco and least cisco caught in 76-mm (3 inch) mesh in the commercial fishery to estimate the age distribution of the harvest. Otoliths were not obtained during 2003, thus there was no age group analysis for this year. Otoliths from previous years were read using the break-and-burn technique. The otolith is broken across the transverse axis, held over a flame until the edge begins to discolor, and placed in isopropyl alcohol to be viewed with a dissecting microscope at 30 power. Annuli appear as narrow dark rings between the wider, lighter annual growth bands.

Information obtained from annual measurements of length frequency, length/weight relationships and estimated catches by mesh size was used to estimate the annual harvested biomass for Arctic cisco and least cisco from 1985 to 2003. Length/weight relationships and length frequency data were used to estimate the mean weight of a harvested fish by mesh size for each year, then the total estimated harvest for that mesh size was multiplied by the mean weight. A composite length frequency was generated for mesh sizes in which length frequencies were not determined on an annual basis.

Information from the commercial fishery was not obtained in 2003, but records of the previous data are included in the report for comparative purposes. Records of catch and effort have been maintained for the Colville Delta commercial fishery since 1967 (summarized in Gallaway et al. 1983, 1989). Effort data are recorded as the beginning and end date of each net set. Catch data are recorded as the catch by species for each net whenever the nets are checked. Usually the nets are checked daily or every other day, although longer sets are sometimes made. From 1967 to 1986, the fishery records were maintained by Mr. Jim Helmericks. In 1987, a second fishery operation was initiated by Mr. Harmon (Bud) Helmericks. Data from 1987 to 1991 contain estimates of the effort and catch for both operations. Since 1992, the fishery has reverted to a single operation. The data are converted to catch rates (CPUE) by dividing the total season harvest by the total effort expended.

Prior to 1981, the total effort expended by the commercial fisheries averaged 908 net-days (standard deviation = 295) and was never less than 500 net-days. Between 1982 and 1990, the effort averaged 475 net-days (standard deviation = 186). There is a significant inverse correlation between catch rate and effort ($r = -0.545$, 45 df, $a=0.01$). The relationship is statistically identical for Arctic cisco and least cisco catch rates. Because of this correlation between effort and catch rate, the data were adjusted to remove the linearity from the relationship. Use of the unadjusted data would provide inflated estimates of catch rates in years when effort is low. The adjustment consisted of calculating a correction factor for each observed effort based on the correlations through 1990. The correction factor was calculated as follows:

$$CF_i = CPUE_{Ei} - CPUE_m$$

where CF_i = correction factor for effort estimate i

$CPUE_{Ei}$ = linear estimate of catch rate associated with effort i

$CPUE_m$ = estimated catch rate associated with the mean of the observed effort

The correction factor was then subtracted from the observed catch rates to provide an adjusted catch rate (Table 2). The adjusted catch rates were used for all subsequent analyses. The trend of the revised CPUE estimates is similar to that of the observed CPUE. The primary effects of the

adjustment are a slight increase in CPUE in the early years of the data set and a decrease in the post-1980 period for years in which effort was low, which was the desired effect of the adjustment.

RESULTS

Distribution of Fishing Effort

Village Fishery. The total estimated effort by Nuiqsut villagers in the Nigliq Channel fall fishery was 1,656 net-days, about 8% below the average for the 1993-2002 period (Figure 4). From 1985 to 2003 the number of Nuiqsut fishing groups (a family or group of families fishing cooperatively) participating in the under-ice fishery ranged between 21 and 35, using 29 to 83 separate nets. In 2003, 31 fishing groups using 73 nets were identified. The trend in the number of nets being used is not statistically significant, however effort measured in net-days has been increasing significantly over the period of record (Figure 4). Effort in 2003 was highest in the Nigliq Delta area, followed by the Upper Nigliq area (Figure 5).

Effort has gradually shifted downstream in the Nigliq Channel during the eighteen years of monitoring (Figure 5). From 1985 to 1989, between 65 to 74% of the effort within the channel was expended in the Upper Nigliq area. In 1993, effort in the Nanuk area exceeded that of the Upper Nigliq area for the first time, and in 2003 over 76% of the Nigliq Channel effort was in the Nigliq Delta area. Since 1998, the Nigliq Delta has had the highest effort of the three Nigliq Channel areas.

Salinity is monitored in conjunction with the fishery because Arctic cisco are commonly associated with salinities in the range of 15 to 25‰ (parts per thousand). During east winds, the water level in the river drops, and the channels become fresh. When the wind reverses to the west, water levels rise and saline water moves into the delta, which brings in Arctic cisco, and displaces least cisco, piquktuuq (humpback whitefish, *Coregonus pidschian*) and aanaakliq (broad whitefish, *C. nasus*). From 1985 to 1993, with the exception of 1988, salinity in the Nigliq Channel near the village reached 10 to 15‰ by the beginning of November (Figure 6). In contrast, during 1997 and 1998 the salinity exceeded 20‰ in both the Nanuk and Nigliq Delta areas through the fishing season. In 2003, salinity in the Nigliq Channel was moderate to high compared to previous years, with the Upper Nigliq increasing to near 10‰ by the end of the season (Figure 7). In the Nanuk region, salinity rose from 13‰ at the onset of fishing to near 20‰ by late November. Salinity in the Nigliq

Delta was 18‰ at the onset of fishing, and gradually increased to over 22‰ by the end of monitoring. This salinity distribution is considered ideal for Arctic cisco fishing.

Commercial Fishery. The commercial fishery has operated at a low level of effort since 1993 (Figure 4). There has been a declining trend in effort, and effort in 2003, while not quantified, was reported to be low (J. Helmericks, personal communication, 2003).

Catch Composition

Arctic cisco, the target species, comprised over 66% of the total observed catch in the Nigliq Channel in 2003 (Table 3). Least cisco also accounted for 22% of the observed catch, with humpback whitefish third most abundant at 9%. In 2003, tiipuq (Bering cisco, *C. laurettae*) abundance remained low. In 1990, the species was more numerous than in the past and an effort was made to quantify their contribution to the 1990 harvest. Since 1991, their occurrence in the harvest has remained low. Siquilaraaq (round whitefish, *Prosopium cylindraceum*) occur in high abundance within the lower Colville River and delta (Fawcett et al. 1986), but rarely appear in the harvest. Their small size and narrow body allow them to pass through the meshes used in the fishery. More uugaq (saffron cod, *Eleginus gracilis*) were caught in the fishery than in previous years, with 109 observed in the catch monitoring. While high salinity in the main fishing areas may have allowed this marine fish to enter the delta, previous years with similar salinities did not produce a similar high catch.

Comparative Catch Rates

Village Catch Rates. Overall, the Arctic cisco catch rates in the Nigliq Channel were slightly above average for the period 1985-2003, although they were over 2.5 times higher than the low catch rates observed in 2002, and over 5 times greater than the historically low rate observed in 2001 (Table 4). While there is considerable variation on a daily basis, catches tend to remain high through the season when Arctic cisco are abundant, and remain low when they are scarce (Figure 8). Least cisco mean catch rates in Nigliq Channel areas were lower than the previous ten-year average, but were

not unusual (Table 5).

Commercial Catch Rates. The effort-adjusted catch rate for Arctic cisco (see Methods) in the commercial fishery was not estimated in 2003, but the historical rates are included for comparison to recent village harvest rates (Table 2). The mean annual catch rate for Arctic cisco and least cisco has been recorded for one of the commercial fisheries since 1967 (Figure 9). Values are reported in fish/day/46 m net to maintain continuity with previous reports on this fishery.

Estimated Total Catch

The total estimated catch of Arctic cisco in the Nigliq Channel (23,369 fish, 9,986 kg) was the fifth highest for the Nigliq Channel (Figure 10, Appendix Table 2). The least cisco total catch was also the fifth highest for the Nigliq Channel, about 47% above the recent 10-year average (Figure 10, Appendix Table 3). Humpback whitefish continued to be a significant portion of the catches (Table 6). Broad whitefish harvest remained at low levels.

Size and Age of Harvested Fish

A comparison of the length frequencies of Arctic cisco captured in 76-mm (3 inch) mesh gill nets to those captured in fyke nets has been used in past reports to evaluate the effect of strong and weak year-classes on the fishery, for both catch rate and size of harvested fish (Figure 11). The movement of dominant year classes through the fishery has a profound effect on the size of fish harvested, even when mesh size was held constant. For example, the length frequency of Arctic cisco from fyke nets in the coastal region during the late summer of 1995 (after 14 August) indicated that there was a group of fish, primarily from the 1990 recruitment (LGL Alaska 1992), that was just becoming large enough to be caught by 76-mm (3 inch) mesh gill nets in 1995 (Figure 11). In 1996 and 1997, virtually all members of this group were of sufficient size to be harvested. The length frequencies for 2003 indicate that there was a large group of fish slightly too small to be caught by the 76 mm mesh gill nets. This group will grow to harvestable size by fall, 2004 and will likely comprise most of the harvest at that time.

The mean length of least cisco caught in the 76-mm (3 inch) mesh nets in 2003 was similar to that observed in recent years (Table 8, Figure 12). Least cisco have shown a decreasing trend in mean size during the period of study.

Information from the fyke nets fished in Prudhoe Bay during the summer is used to obtain information on the relative strength of Arctic cisco year classes when they recruit into the region as young-of-the-year (YOY) (Figure 13). Abundant year classes in the mid-1980's produced high catches in the early 1990's, while the abundant 1990 and 1992 year classes produced high catches in 1997-1998 (Figure 10). The absence of a dominant year class from 1993 to 1996 resulted in the recent period of low catches. Based on the YOY, and subsequent year indices, the 1997 recruitment appears to be strong and is providing some relief from the recent years (2000-2002) of low catch.

Ages of Arctic cisco taken in the fishery were estimated from 1984 to 2002 (Figure 14). The age data were used to partition the catch rate in the commercial fishery by year class to evaluate the relative year class strength (Figure 15). The cumulative catch rate for a year class can be used as an index to year class productivity. The analysis demonstrates why 1986 had such a high catch rate; i.e., two abundant year classes (1979 and 1980) had reached a harvestable size in the same year. In subsequent years, the abundance of these year classes decreased and they were replaced by later year classes. The 1987 year class, which dominated the fishery from 1992 to 1994, was essential gone by 1996. The cumulative harvest of this year class has surpassed any other single year class in abundance. The 1990 year class contributed the second highest cumulative harvest, and was responsible for the high catch rates in 1996 and 1997. Subsequent year classes have been much less abundant, which is responsible for the low catch rates in recent years.

Least cisco are only sampled every other year for age structure because of their slow growth rate and the relative stability of the population. The distribution of ages in least cisco has not shown a change in year class dominance, which is consistent with the hypothesis that the least cisco captured in the fishery were from a relatively stable Colville River population. There was, however, a continuing upward shift in the mean age of the harvested fish since 1978. In 1978, the mean age was 9.6 years;

while in 1995, the mean age was 12.5 years. In subsequent years, the mean age has remained over 11 years. This upward shift in age, combined with smaller size (see above), may reflect reduced mortality in the population. As previously presented, there has been a substantial reduction in the commercial fishing effort since 1980. This reduction in effort may account for much of the reduced mortality that has allowed the mean age of harvested fish to increase.

Information from Returned Tagged Fish

Tag returns continue to dwindle, since tags have not been released in great numbers since 1993. During 2003, 1 tag was recovered from the Nuiqsut fishery. The return was from a large Arctic cisco that had been released in 1993. The fish had probably returned to the Colville region after spawning in the Mackenzie River.

Predictability in Arctic cisco Harvest Rates

The mean catch rate of large Arctic cisco in Prudhoe Bay fyke nets one year prior to entering the fishery is regressed against the catch in 76-mm (3 inch) mesh gill nets used in the commercial fishery in the following year to evaluate the suitability of this size group as a predictor of catch. The best predictor of gill net catch rate is the fyke net catch rate of 260-300 mm Arctic cisco during the summer prior to entering the fishery. After an additional summer of growth, this group typically grows into the 300-340 mm size range that is highly vulnerable to 76-mm (3 inch) mesh gill nets. The correlation between fyke net catches of 260-300 mm Arctic cisco and the next year's catch of 300-340 mm fish is statistically significant ($p=0.02$) (Table 9, Figure 17).

The harvest rate for 300-340 mm Arctic cisco was predicted for 1994 through 2002 using the relationship between commercial gill net catches and fyke net catches the prior year. The comparison of the predictions to actual harvest rates is as follows:

Year	Predicted	Actual	Percent Error
1994	15.3	15.0	-2%
1995	35.6	32.2	-30%
1996	59.1	130.0	+98%
1997	55.4	50.1	-10%
1998	66.6	20.1	-68%
1999	56.1	26.7	-52%
2002	52.5	12.7	-76%

Lack of fyke net sampling in Prudhoe Bay during 1999 and 2000 precluded making predictions for 2000 and 2001.

The actual CPUE from 1997 to 2002 was less than predicted, and it is clear there is often substantial deviation between the predicted and actual CPUE's. Much of this deviation can be explained for a given year after close examination of the details for a given year. Examples of known reasons for the high deviation include annual differences in salinity distribution and changes in timing of the fishery. For 2002, there is some evidence that summer 2001 was a poor growth year and most fish of the 1997 year class did not reach harvestable size by age 5 (see, for example, Figure 11).

The village catch rate for Arctic cisco in the Nigliq Channel is correlated with the commercial catch rate observed in the Outer Delta, indicating that Arctic cisco abundance fluctuates similarly throughout the lower delta within a given year ($p = 0.001$, Table 9, Figure 18). Catch rates of least cisco between the two areas show no relationship ($p=0.62$).

The predicted catch rate in the commercial fishery for 2003 was 111 fish/day/45 m gill net, which would be equivalent to 17.5 fish/day using the 18-m standard gill net index for the Nigliq Channel. The actual catch rate in the commercial fishery was not obtained, but the actual Nigliq Channel catch rate was 14.4 fish/day/18m, or 17% lower than predicted. Using the relationships described above for abundance of 260-300mm Arctic cisco in Prudhoe Bay fyke nets and the gill net catch rates, the

2004 predicted catch rate in Nigliq Channel is 16.4 fish/day/18m, or similar to that seen in 2003. This prediction assumes that the salinity distribution in the fishing areas will be suitable for Arctic cisco, as happened in 2003.

DISCUSSION

The 2003 fishery was characterized by moderate abundance of Arctic cisco caused by recruitment of the 1997 year class into the fishery. Early catch rates in the Nigliq Delta area were high when periodic west winds brought high salinity water into the area, inducing fish to move upstream. Catches then decreased through the season. Studies from previous years have established that Arctic cisco move into the Colville River channels as salinity increases after ice formation (Moulton and Field 1988; Moulton 1994). For years in which salinity does not increase, such as 1988 and 1999, catches of Arctic cisco are lower than expected. In 2003, salinity was high in the Nigliq Delta and Nanuk areas through the season, and increased steadily through the fishing season in the Upper Nigliq area, thus the main group of Arctic cisco moved into the Nigliq Channel early in the season and was available for harvest. Bering cisco, which had been unusually abundant and a dominant portion of the catch in 1990, remained essentially absent in 2003. Humpback whitefish again formed a significant portion of the harvest in 2003.

In the past, knowledge of Arctic cisco juvenile recruitment into the region as a whole and information on growth rates prior to recruitment into the fishery has allowed some prediction of impending increases or decreases in the Arctic cisco catch rate (Figure 18). Unpredictable variables, such as the distribution of saline water in the delta, and possible variations in natural mortality, growth and maturation rates, make accurate predictions of catch rates unlikely. In 2003, the fishery did not respond as expected, with catch rates remaining lower than predicted. The 1990 year class has fully matured and left the region. The 1997 year class, which was expected to support the 2003 harvest, apparently did not grow as expected and a lower proportion of the fish than normal reached harvestable size. Catches should improve substantially in 2003 when the 1997 year class fully recruits into the fishery and larger members of the 1998 year class begin to enter the fishery.

PREDICTIONS FOR 2004

Based on the catch rates of 260-300 mm Arctic cisco in Prudhoe Bay during 2003, it is likely that 2004 gill net catch rates will be similar to those observed in 2003. The 2003 harvest was supported almost completely by larger fish from the 1997 year class. In 2004, the remaining fish from this year class will have grown large enough to be harvested by the gill nets used in the Colville Delta fishery (see Figure 11). The 2004 harvest will be supplemented with fish from the 1998 year class, which appears to be of moderate abundance. Catches will likely decrease in 2005, when both the 1997 and 1998 year classes will be maturing and leaving the Colville region.

If the catches of 260-300 mm Arctic cisco from fyke nets in the Prudhoe Bay region in 2003 are used as predictors of abundance, then the catches in the Colville Delta commercial fishery (76-mm [3 inch] mesh) will be around 67 fish per day per 46 m of net (or 27 fish per day per 18 m of net) for fish in the range of 300-340 mm, which will likely form 80-90% of the harvest. In the Nigliq Channel, catches may approach 17 fish per day per 18 m of net. Most of the remaining 10 to 20 % will be larger fish from the 1998 year class. As is usually the case, variability in this estimate could result from salinity distribution, competing fishers, or reduced growth rates during the summer of 2003.

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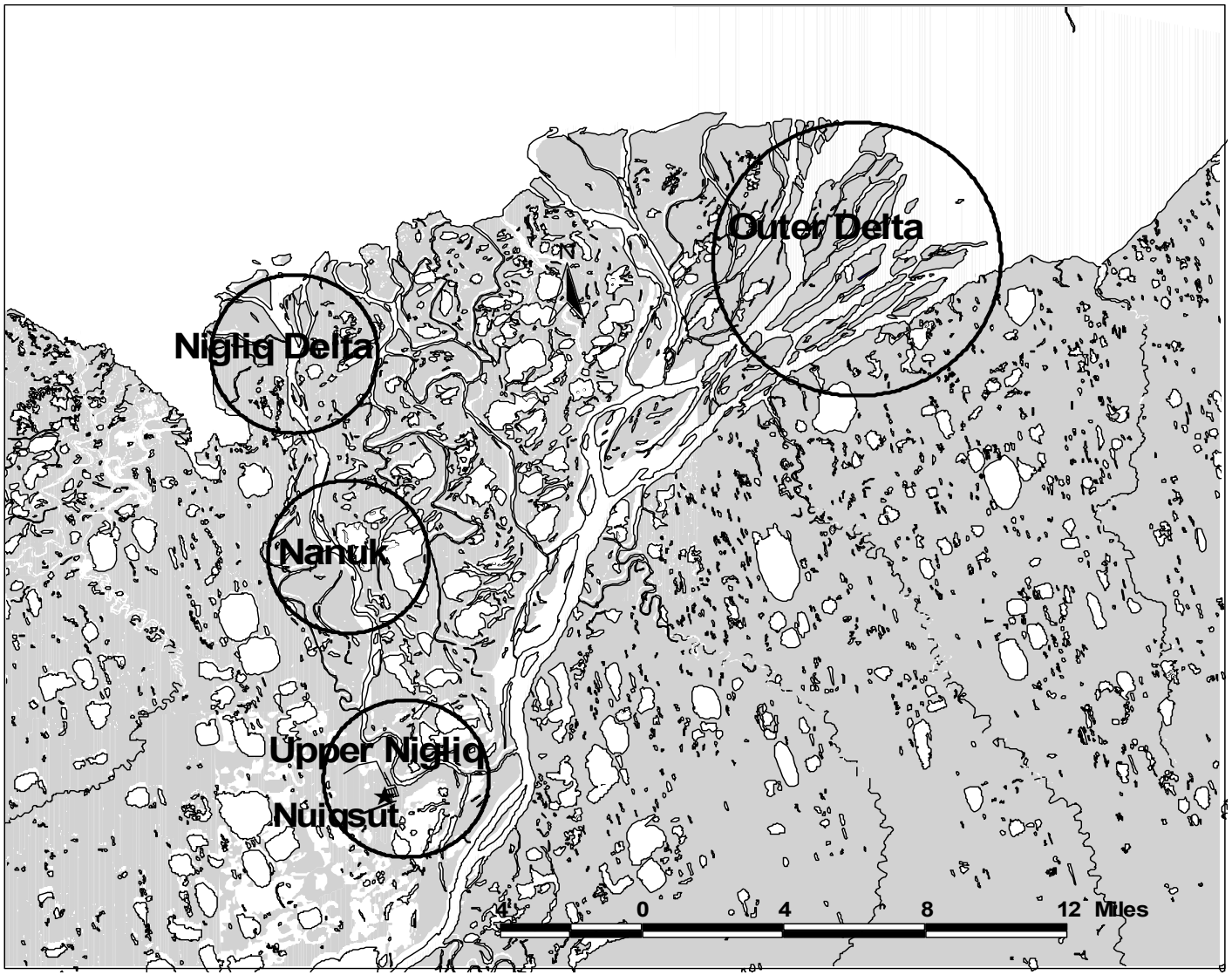


Figure 1. Colville Delta region showing locations of major fishing areas.

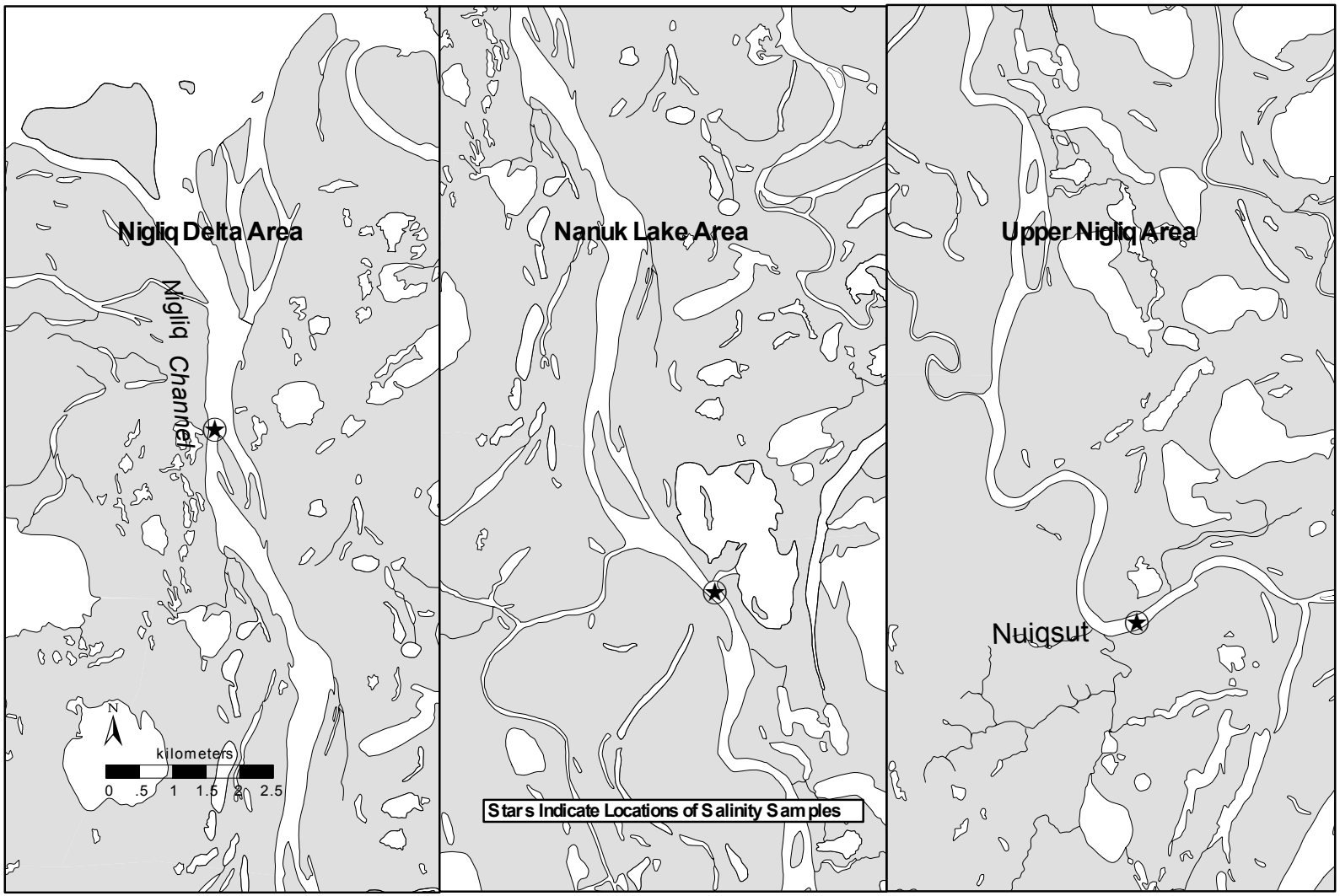


Figure 2. Major fishing areas on the Nigliq Channel with location of salinity monitoring stations.

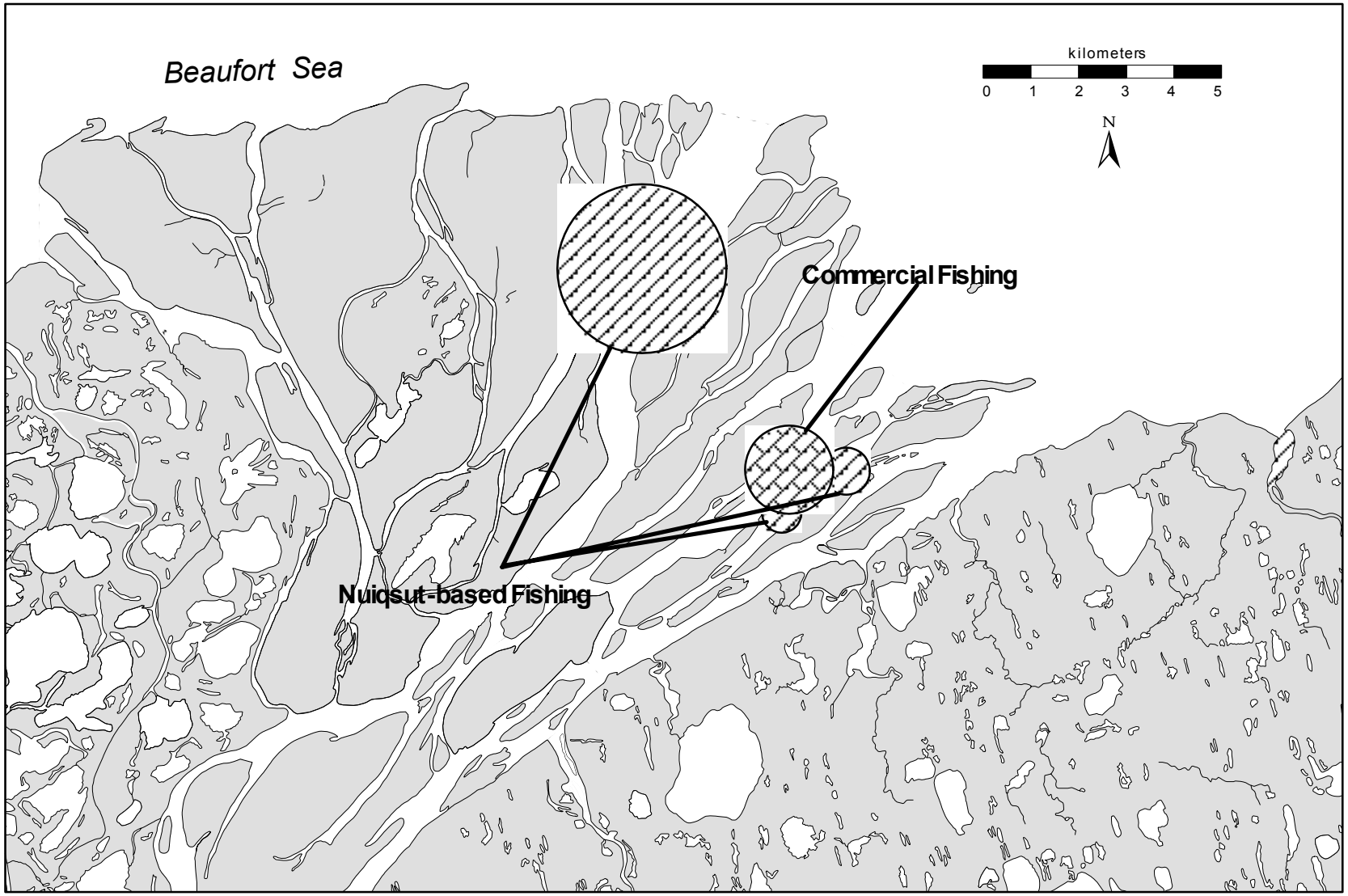
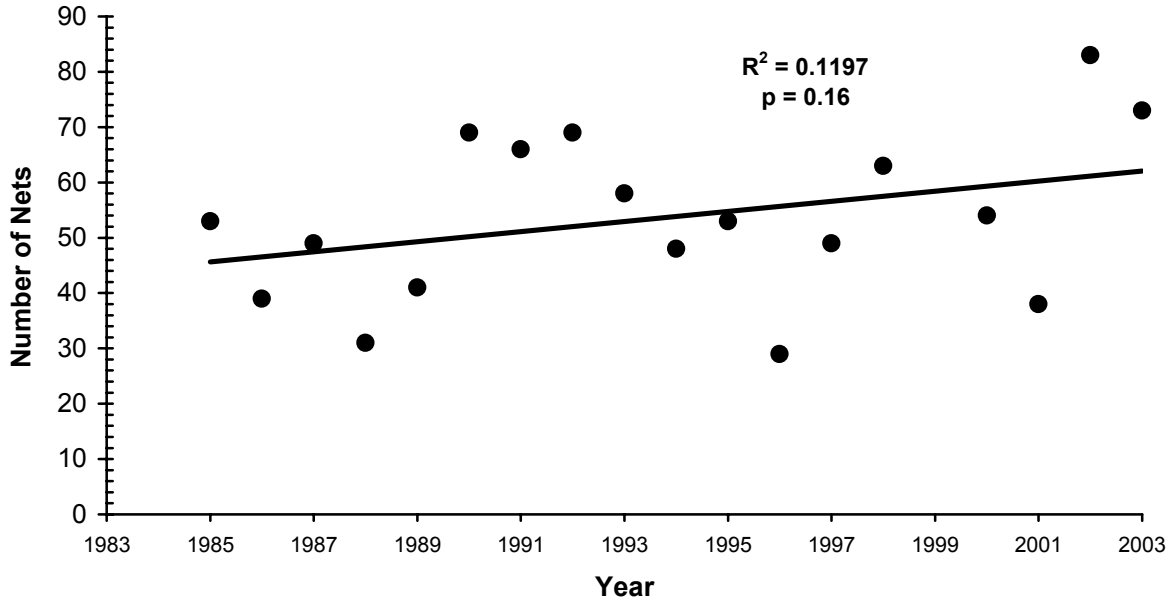
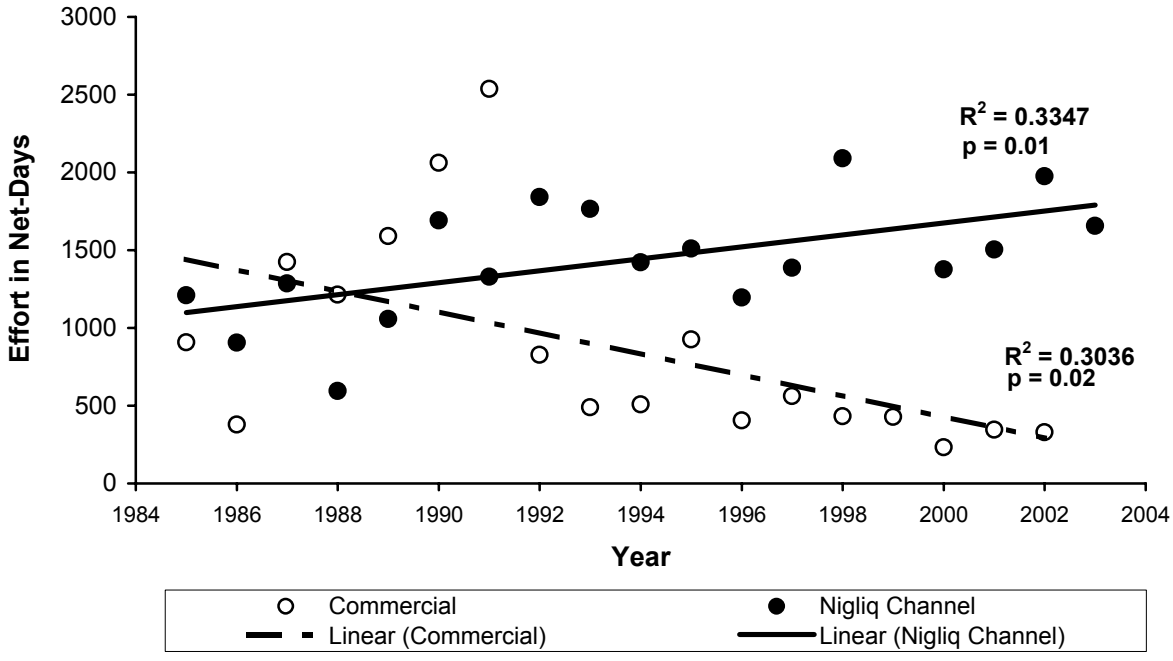


Figure 3. Fishing areas on the lower Colville River and Outer Delta region.



a. Number of Nets



b. Estimated Fishing Effort

Figure 4. Trends in fishing effort in the Colville Delta fall Fishery, 1985-2003 by number of nets and effort in net-days (1 net-day = 24 hrs fishing per 18 m of net, all meshes combined).

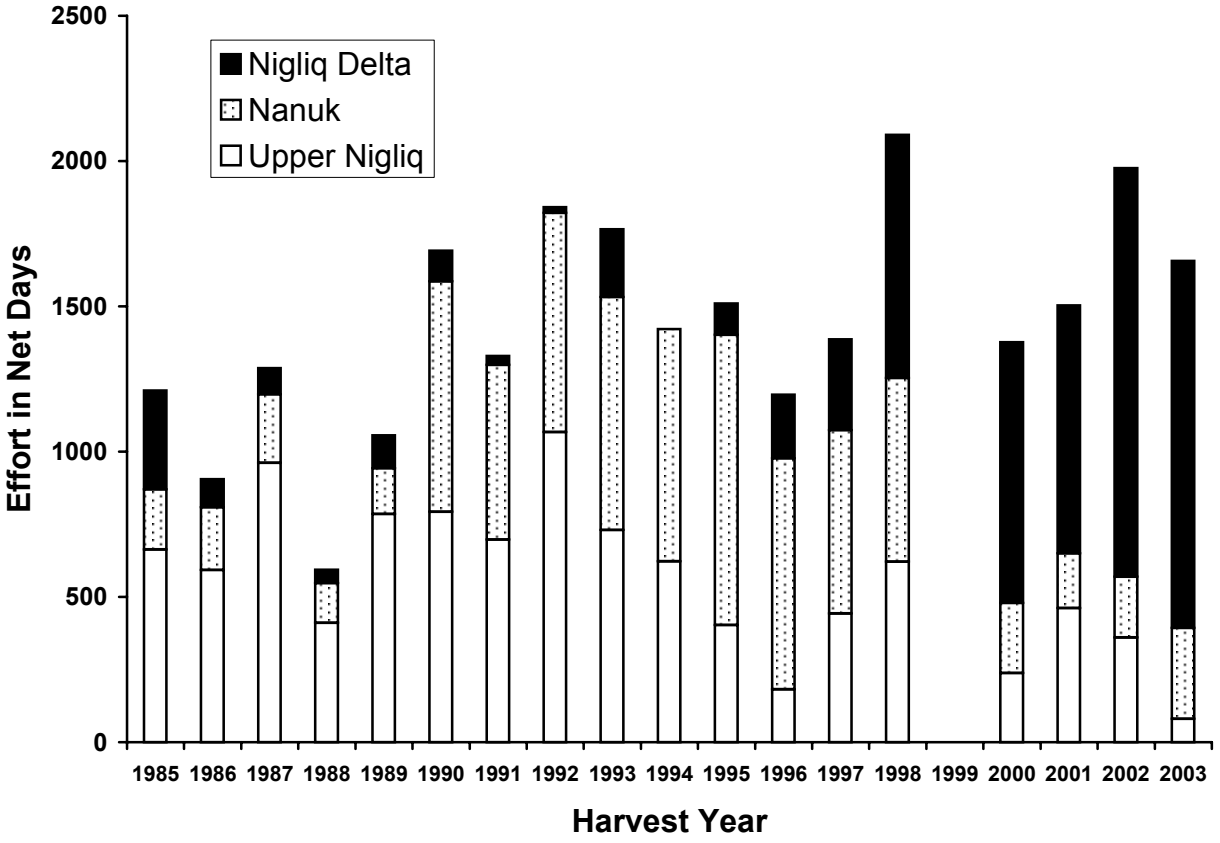


Figure 5. Distribution of fishing effort in the Nigliq Channel by fishing area, all meshes combined, 1986 to 2003.

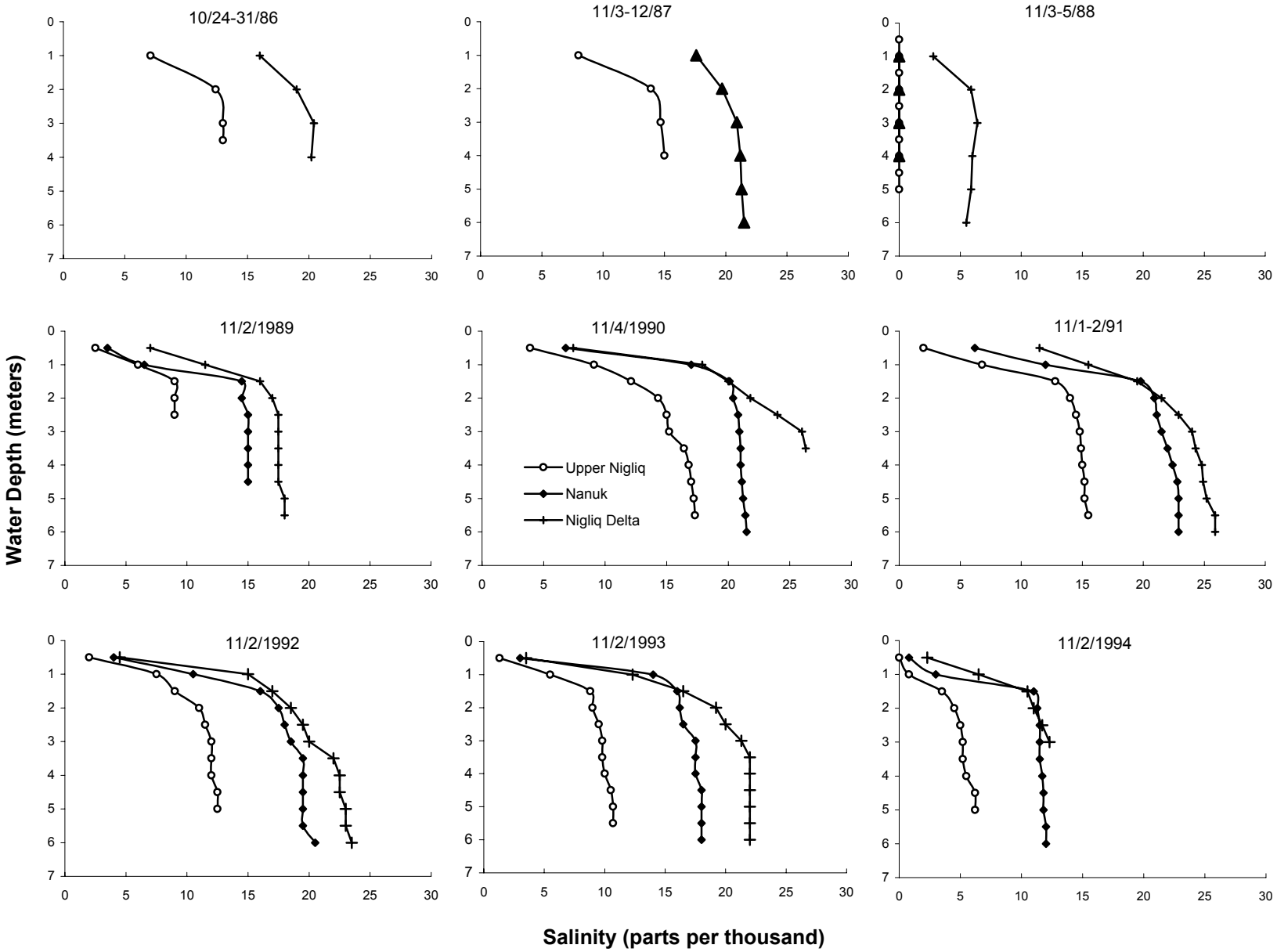
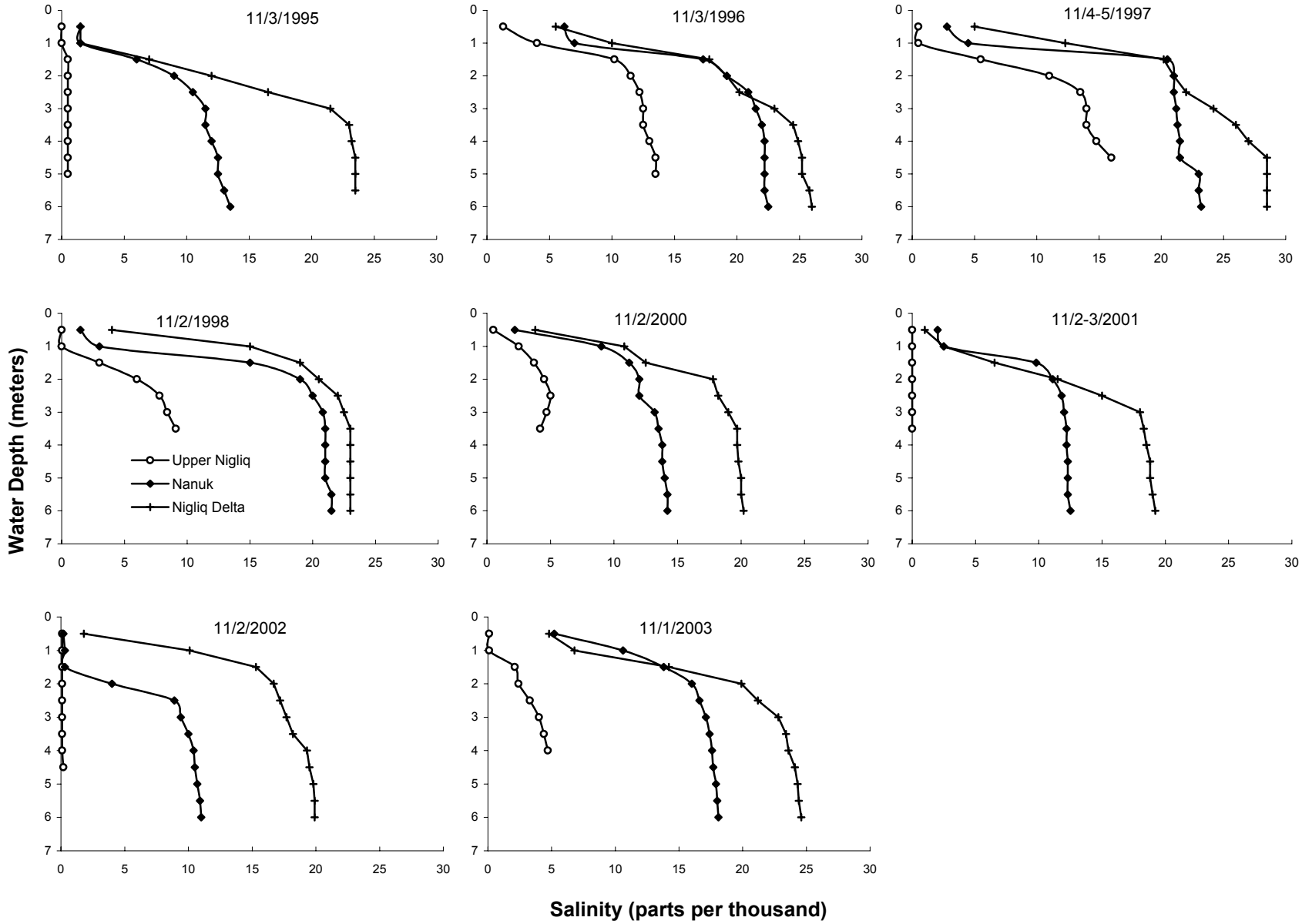


Figure 6. Salinity distribution in the Nigliq Channel, Colville Delta, during the fall gill net fishery, 1986-2003.



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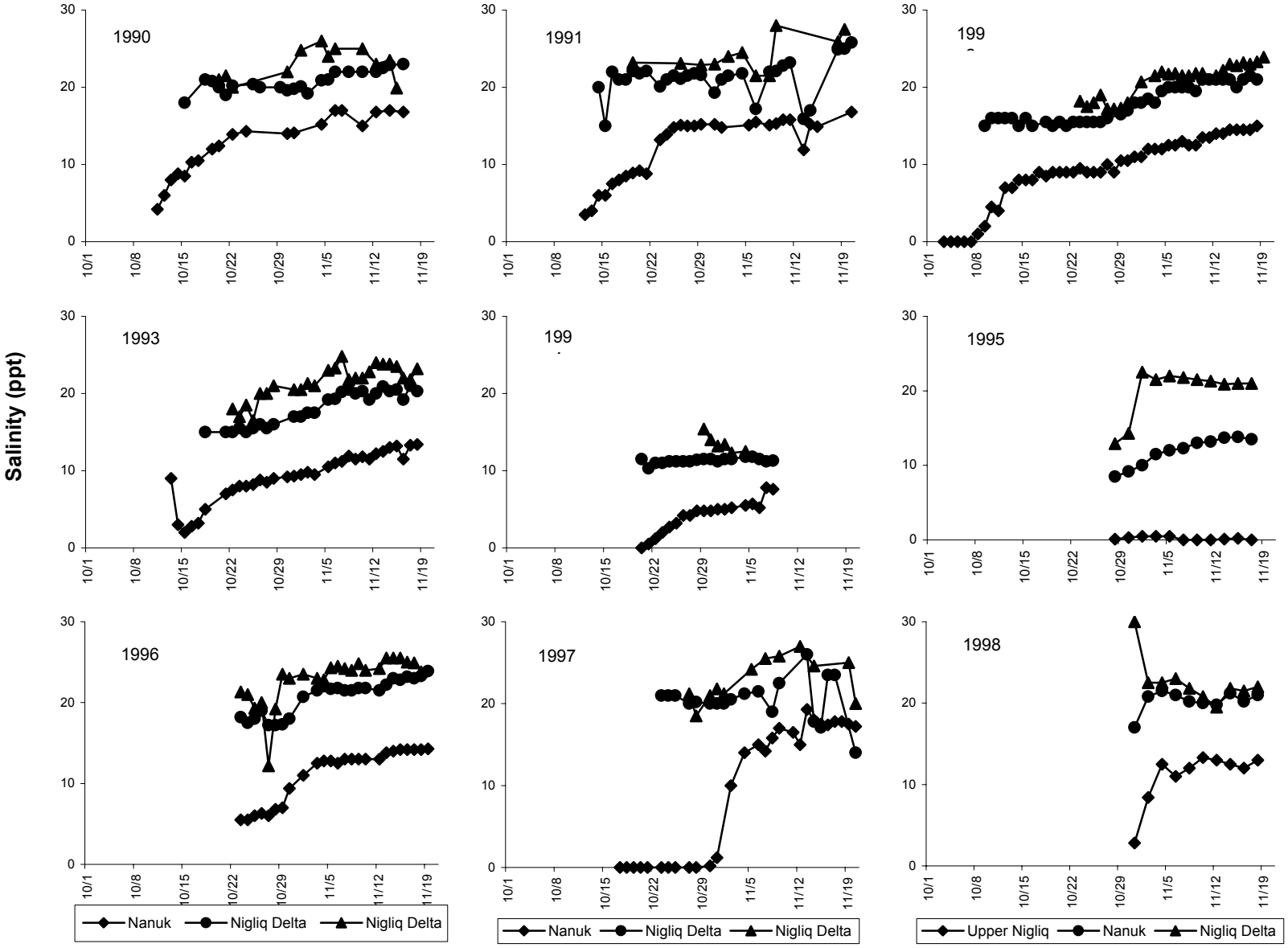
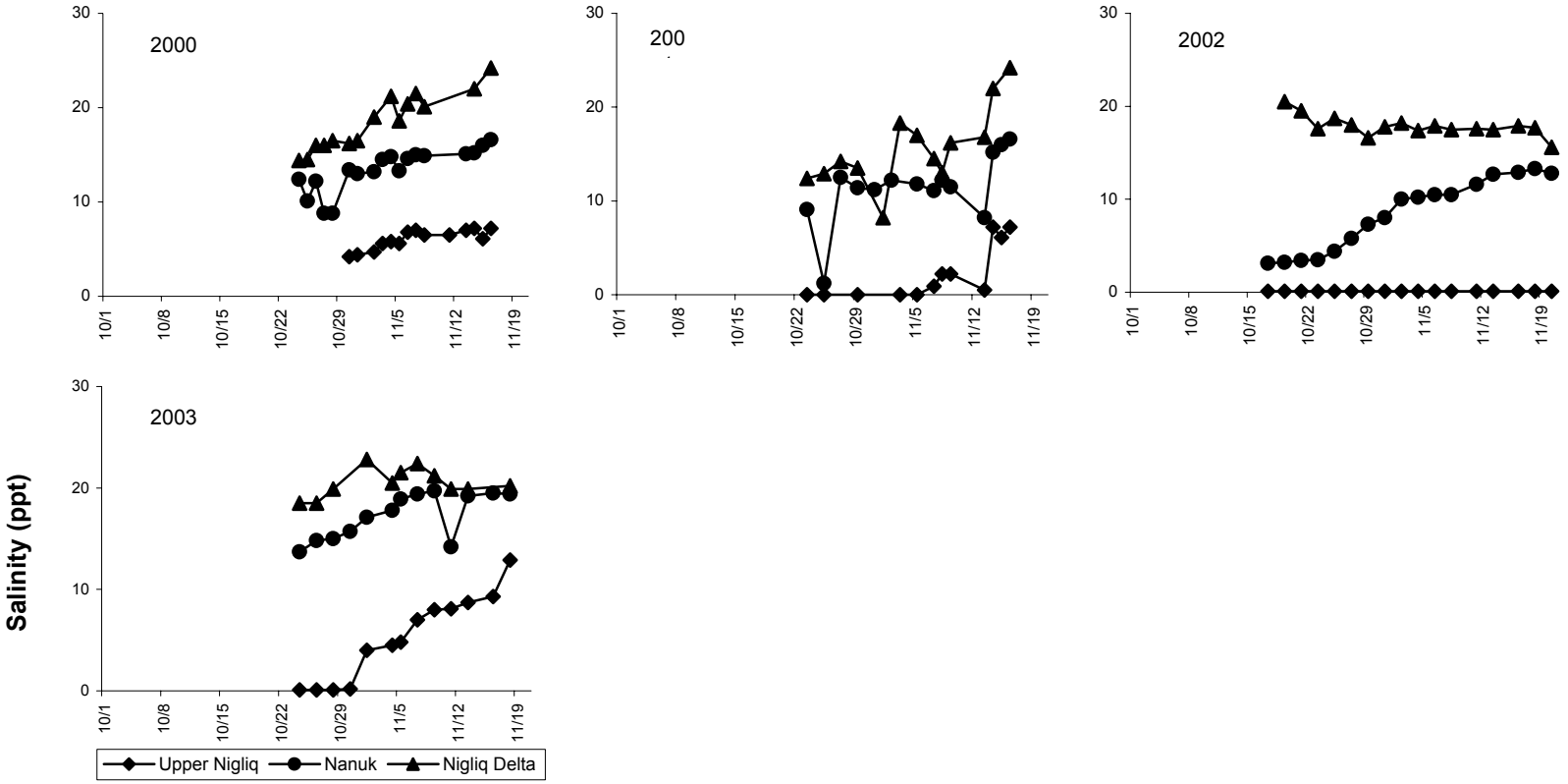


Figure 7. Salinities (in parts per thousand) measured at 3 m below the ice surface at Nigliq Channel fishing areas, 1990-2003.



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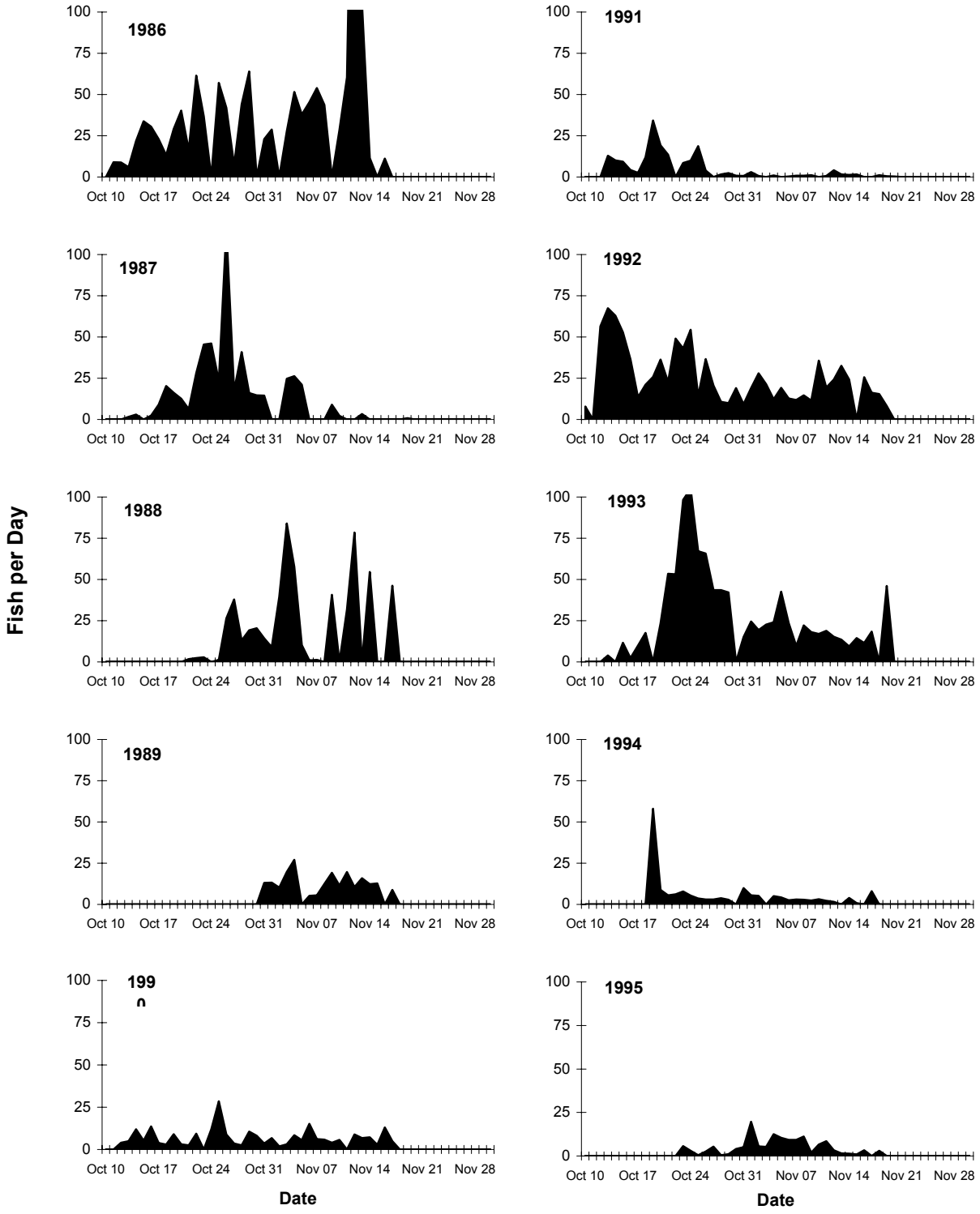
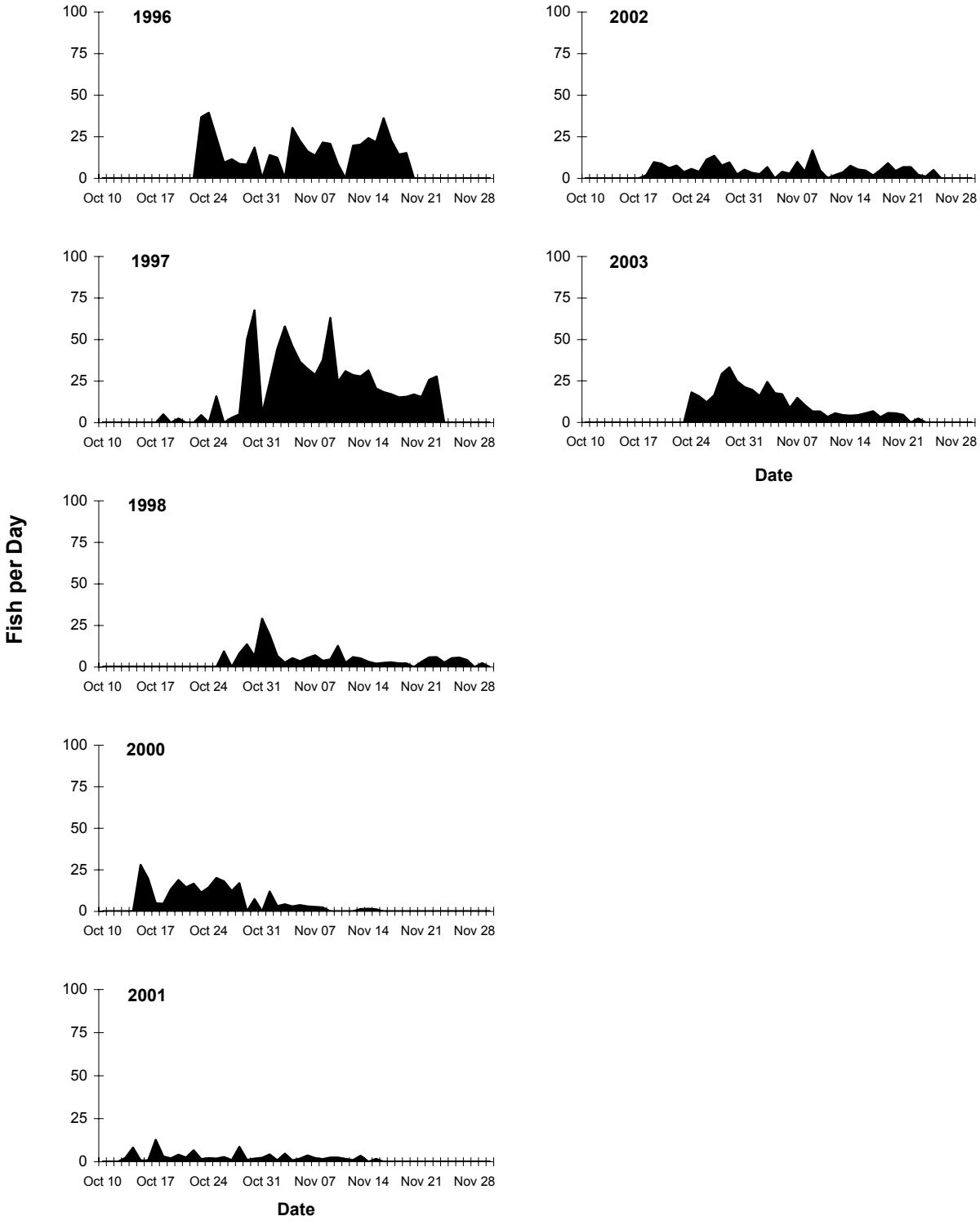


Figure 8. Mean daily catch rate of Arctic cisco in 76-mm (3 inch) mesh in the Nigliq Channel, 1986-2003.



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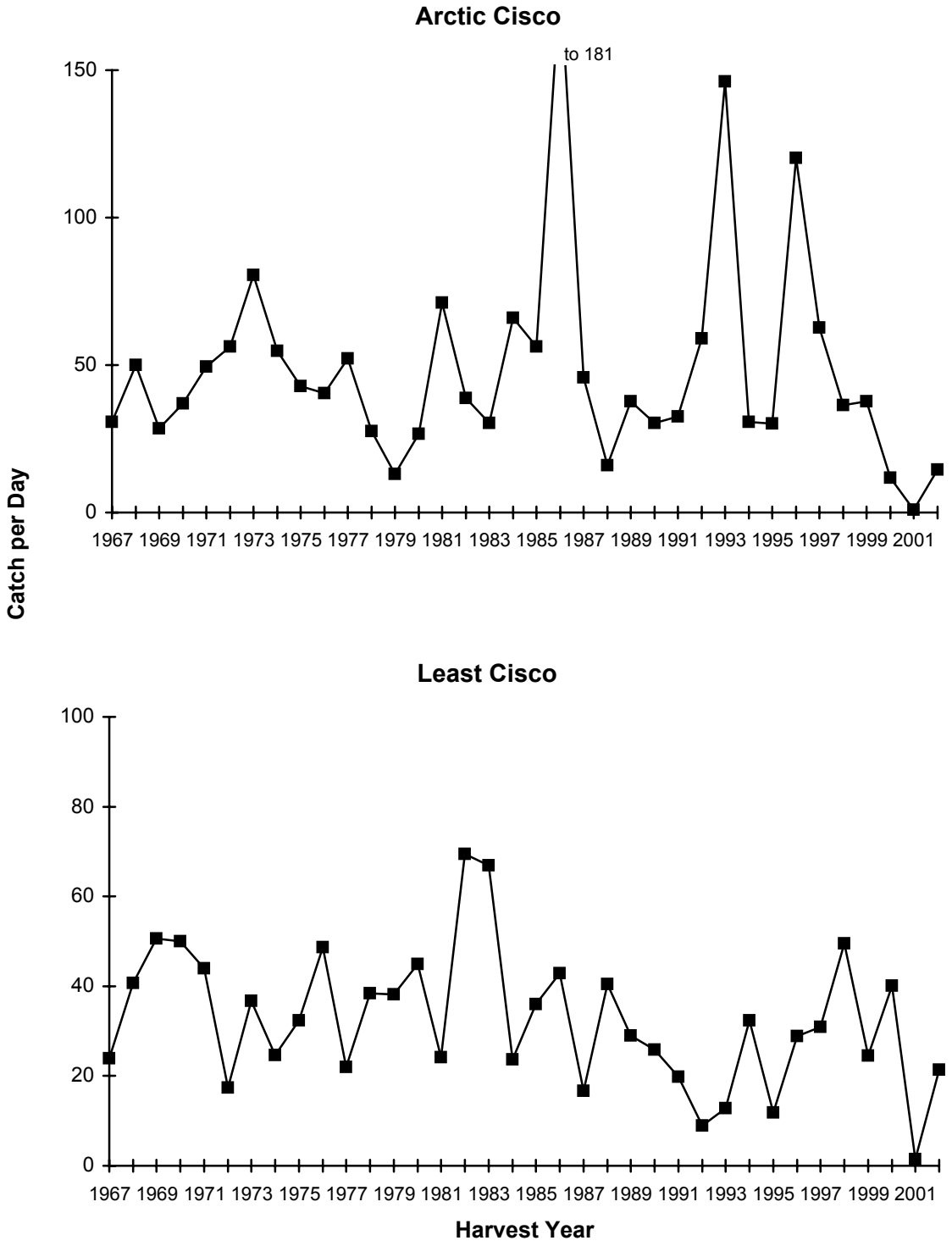
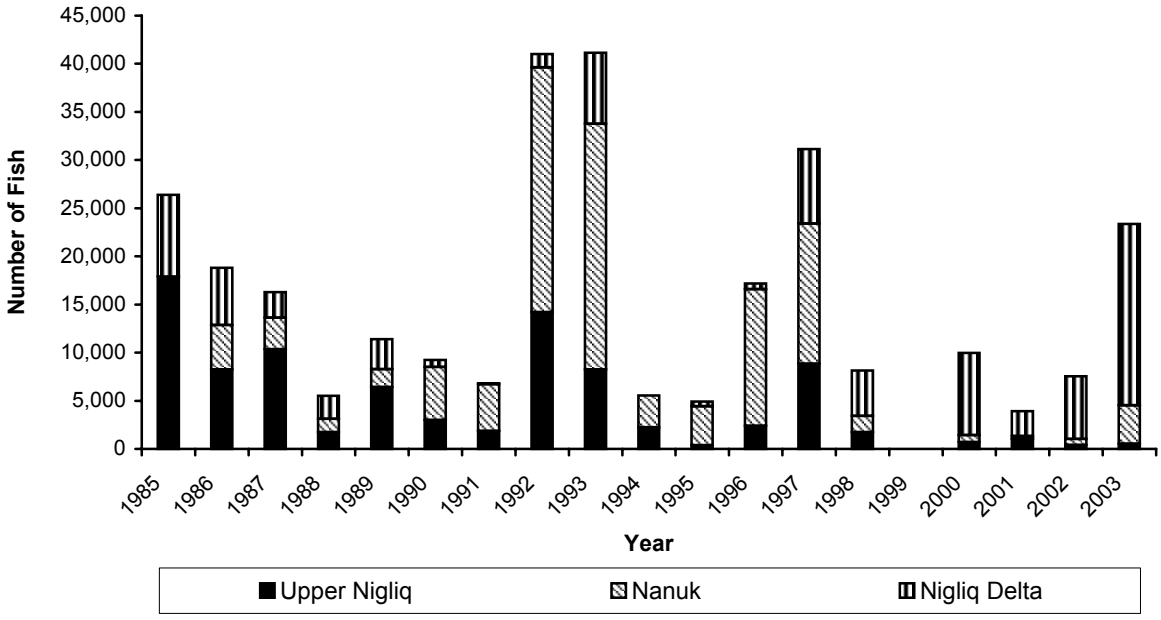
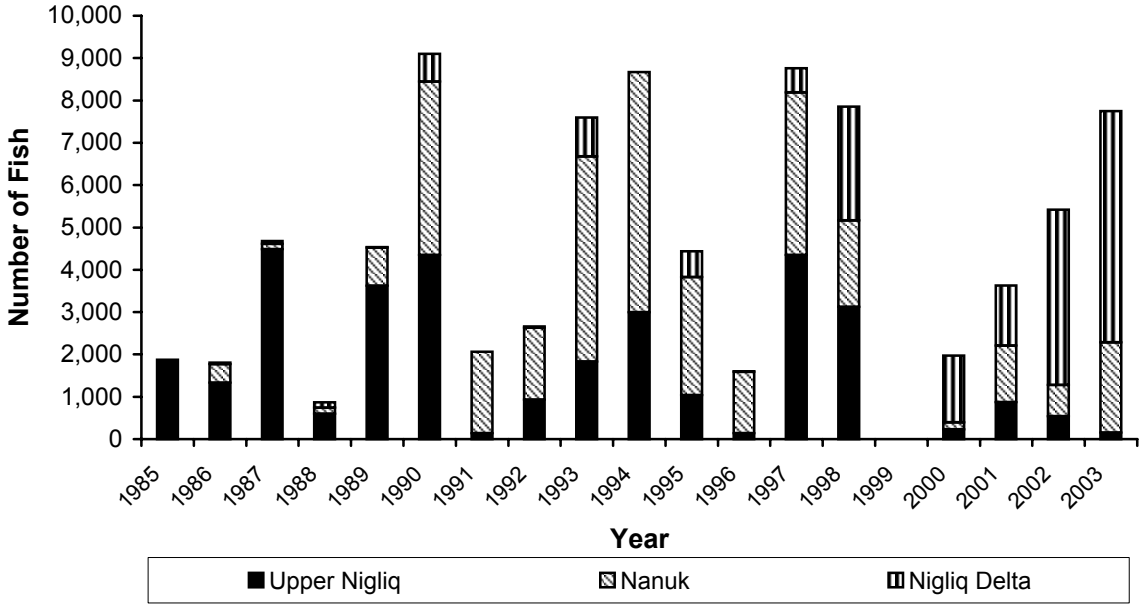


Figure 9. Catch rates of arctic cisco and least cisco in the Colville River delta commercial fishery, 1967-2002 (using catch rates ajusted for varying effort - see text).



a. Arctic Cisco



b. Least Cisco

Figure 10. Catch of arctic cisco and least cisco by harvest area in the Nigliq Channel, 1985 to 2003.

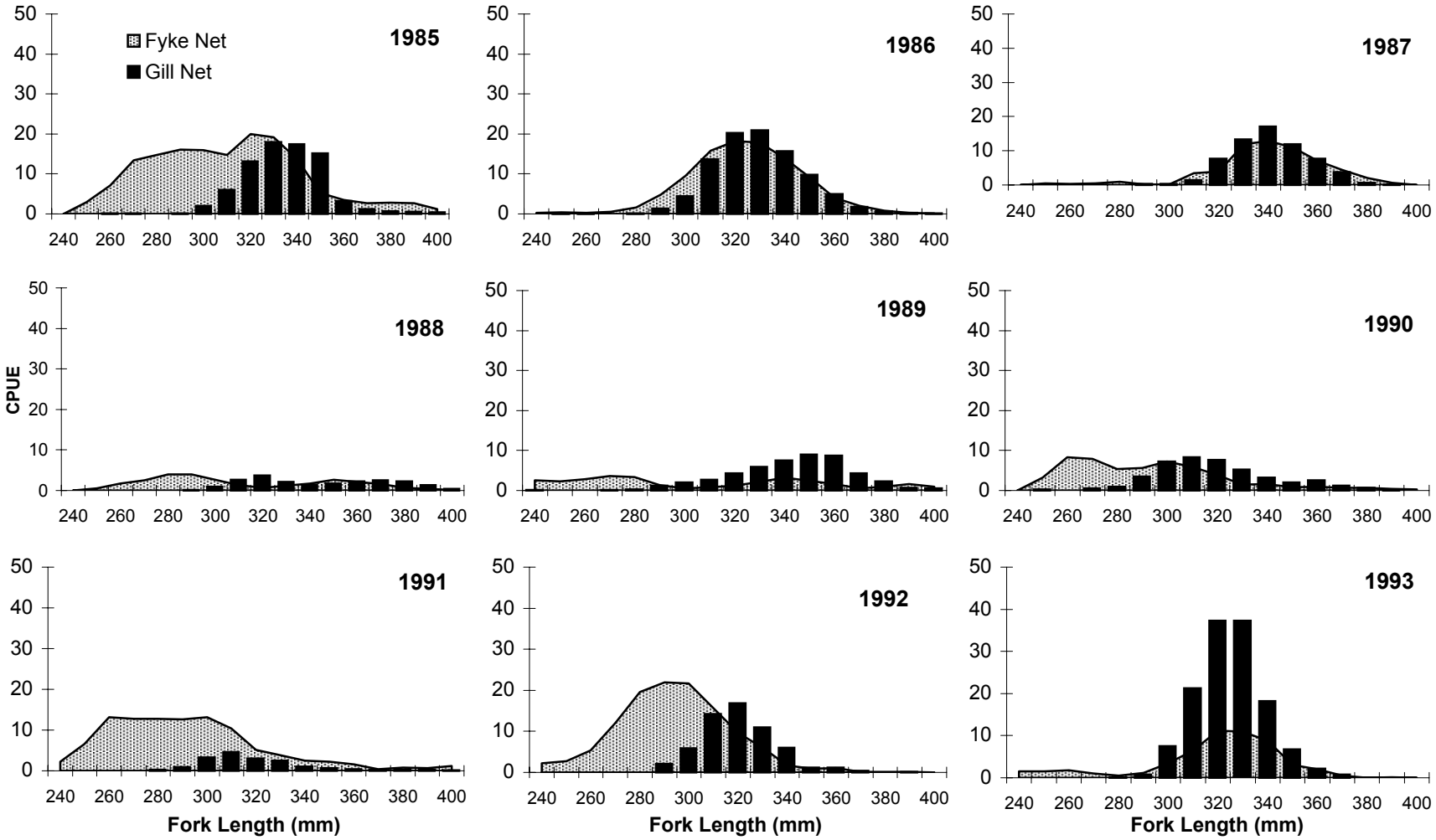
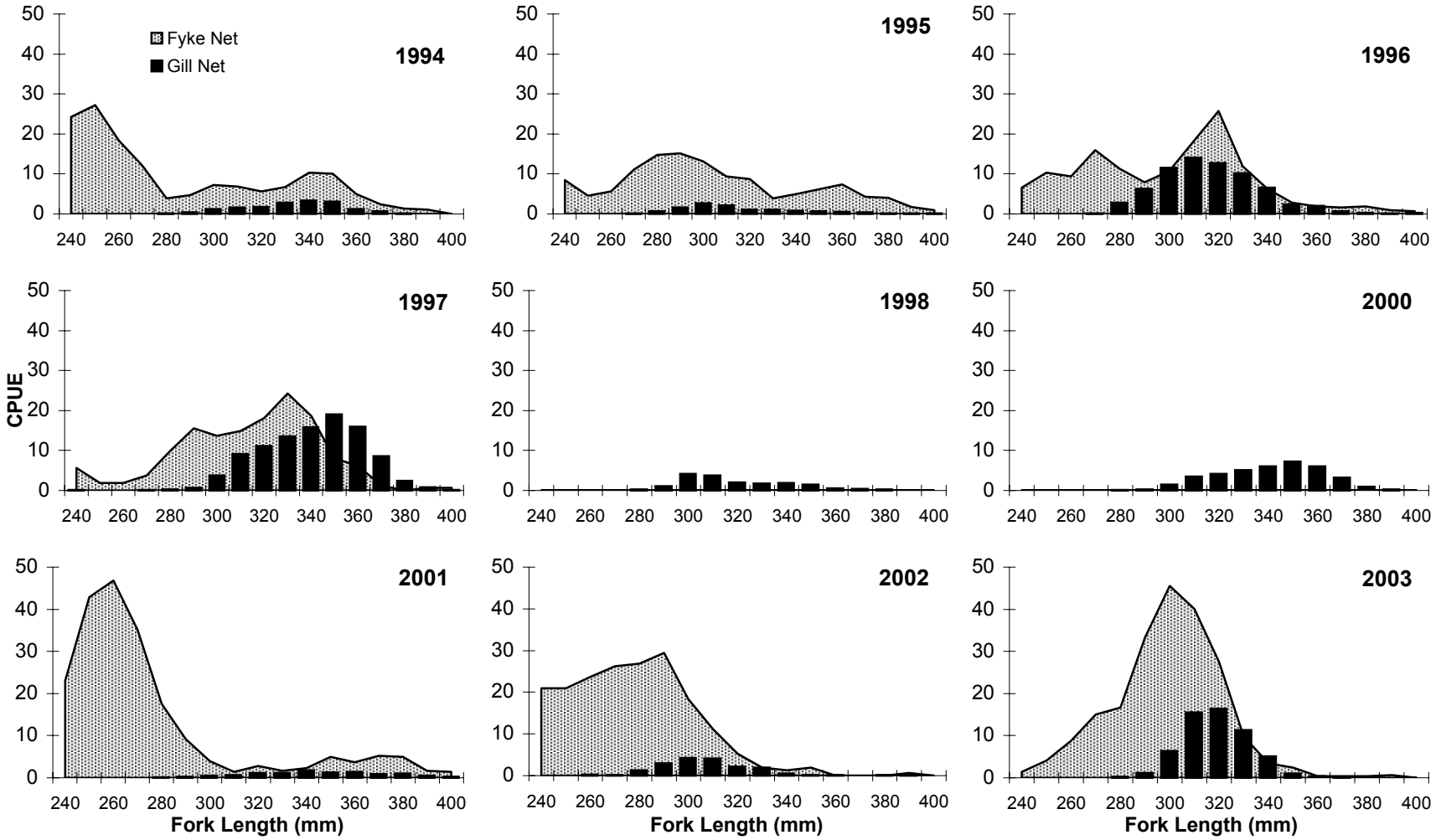


Figure 11. Length frequencies of Arctic cisco caught in fyke nets near Prudhoe Bay compared to those caught by 76-mm (3 inch) gill nets in the Nigliq Channel fishery, 1985-2003 (fyke net length frequencies for fish caught after August 14, i.e. after summe growth period). (Length frequencies scaled by CPUE to reflect annual changes in Arctic cisco abundance, Prudhoe Bay fyke nets not fished from 1998-2000)



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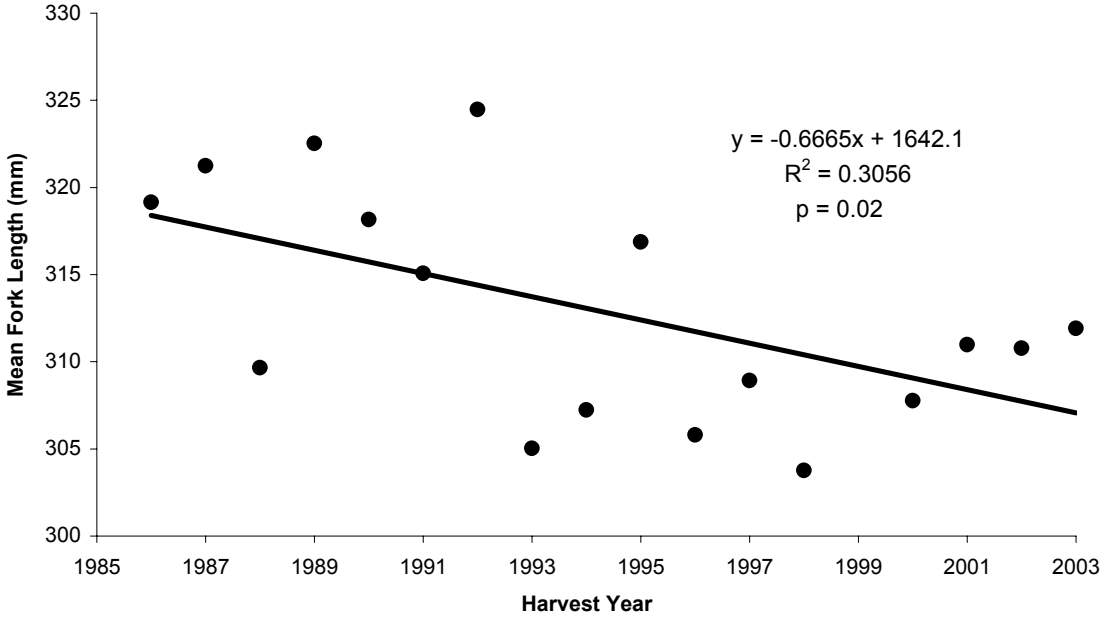

Figure 12. Trend in mean length for least cisco caught in 76-mm (3 inch) mesh in the Nuiqsut fall fishery, 1986-2003.

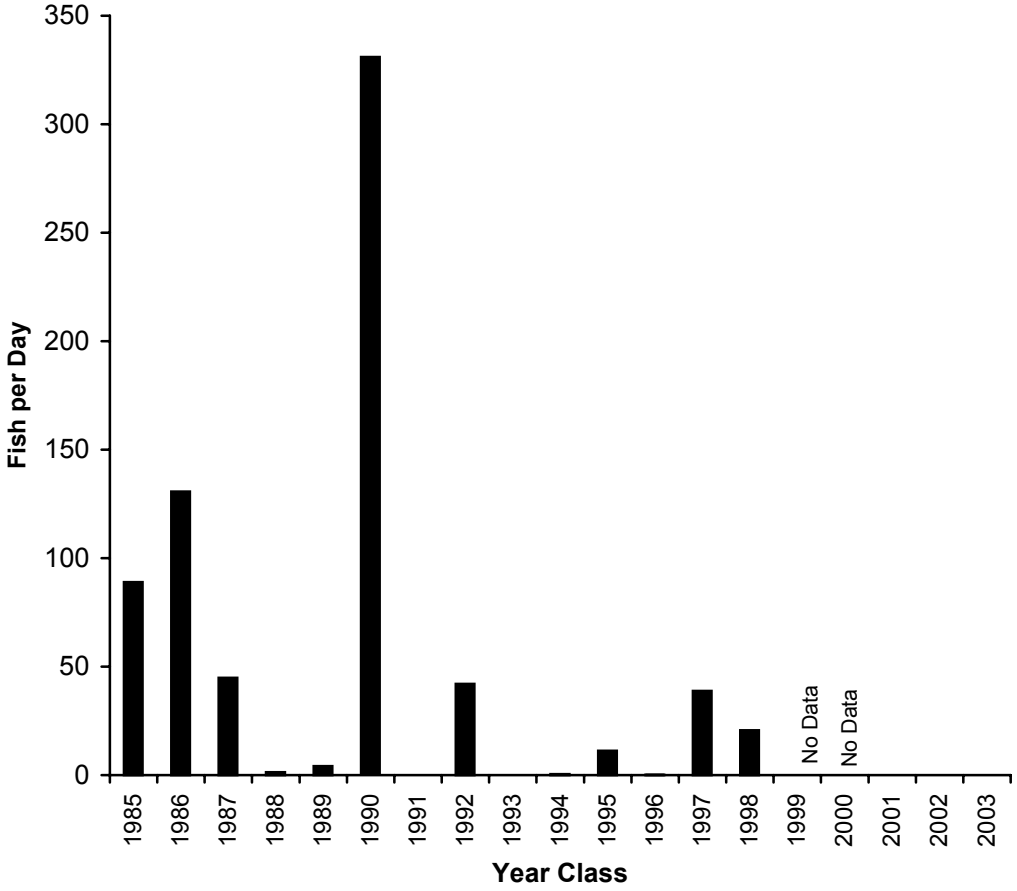

Figure 13. Catch rates of young-of-the-year (YOY) arctic cisco by year class ir Prudhoe Bay fyke nets, 1985-2002.

(source: LGL Alaska Research Associates 2000, B. Fechhelm, pers. comm. 2003, 2004).

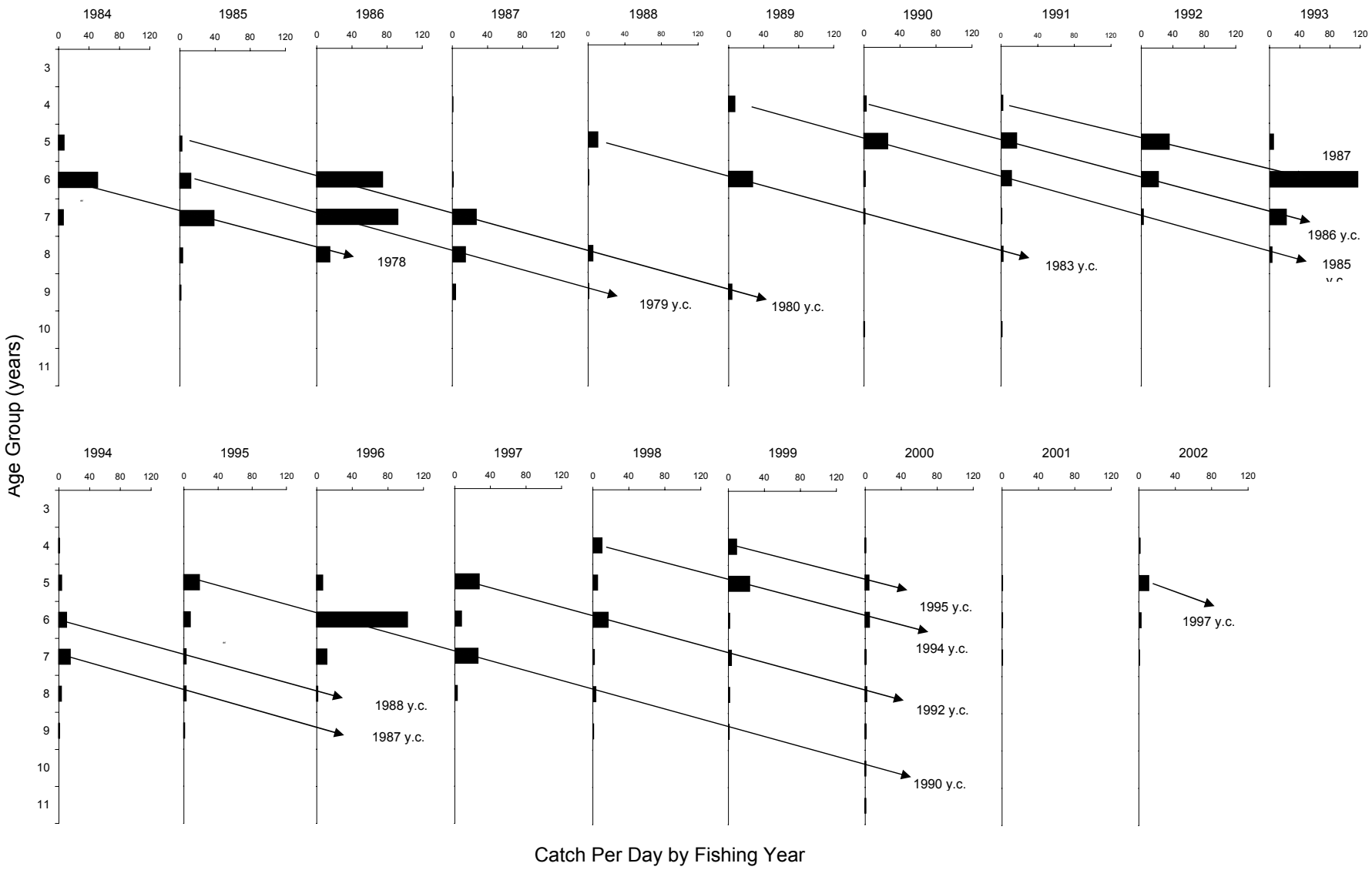

Figure 14. Age distribution of Arctic cisco caught in the Colville River commercial fishery, 1984 - 2002, scaled to CPUE (from fish caught in 76-mm mesh nets, arrows indicate progression of year classes through the fishery).

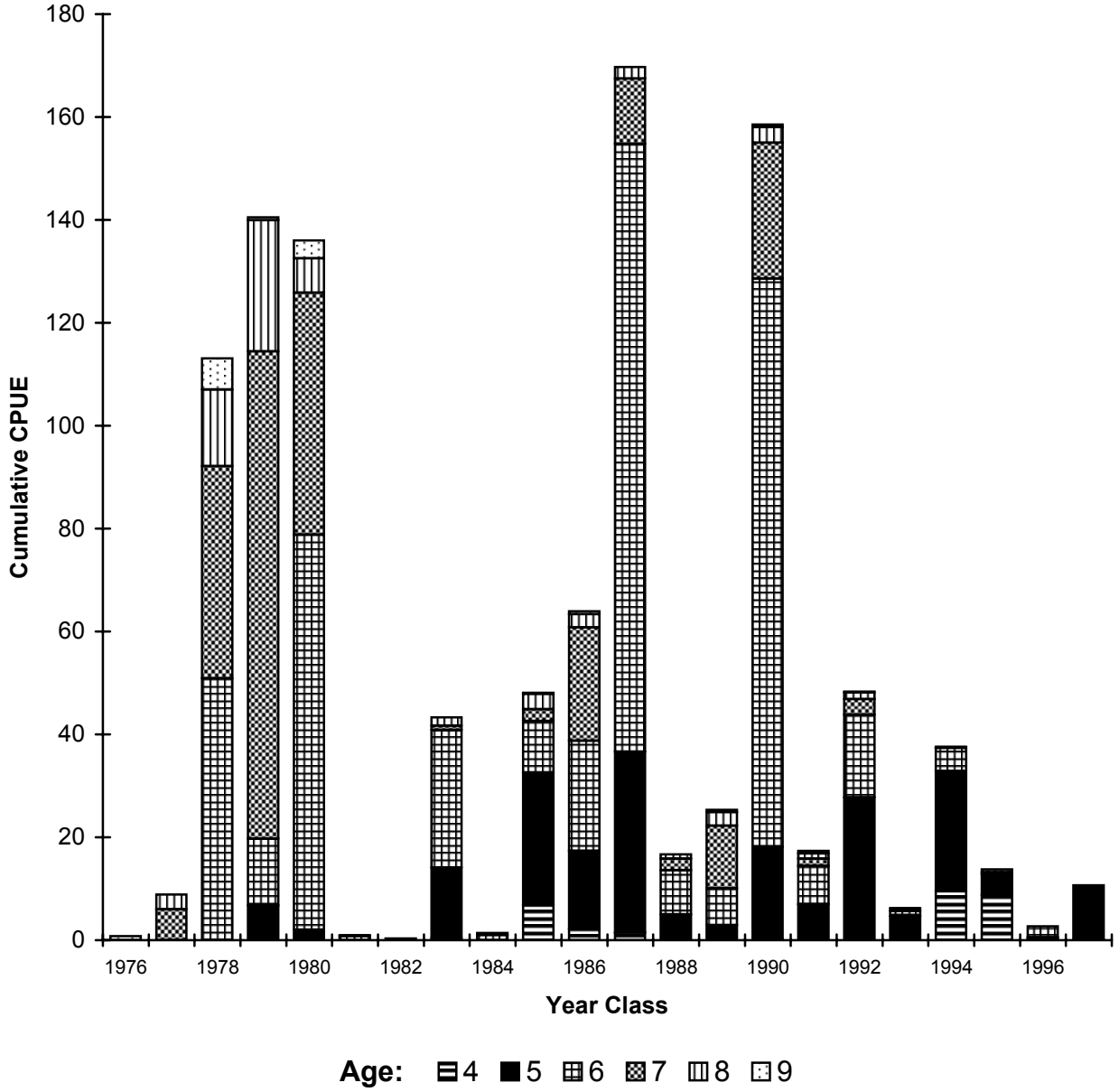

Figure 15. Cumulative harvest for each year class of Arctic cisco, expressed as cumulative catch rate for harvest years 1984 to 2002.

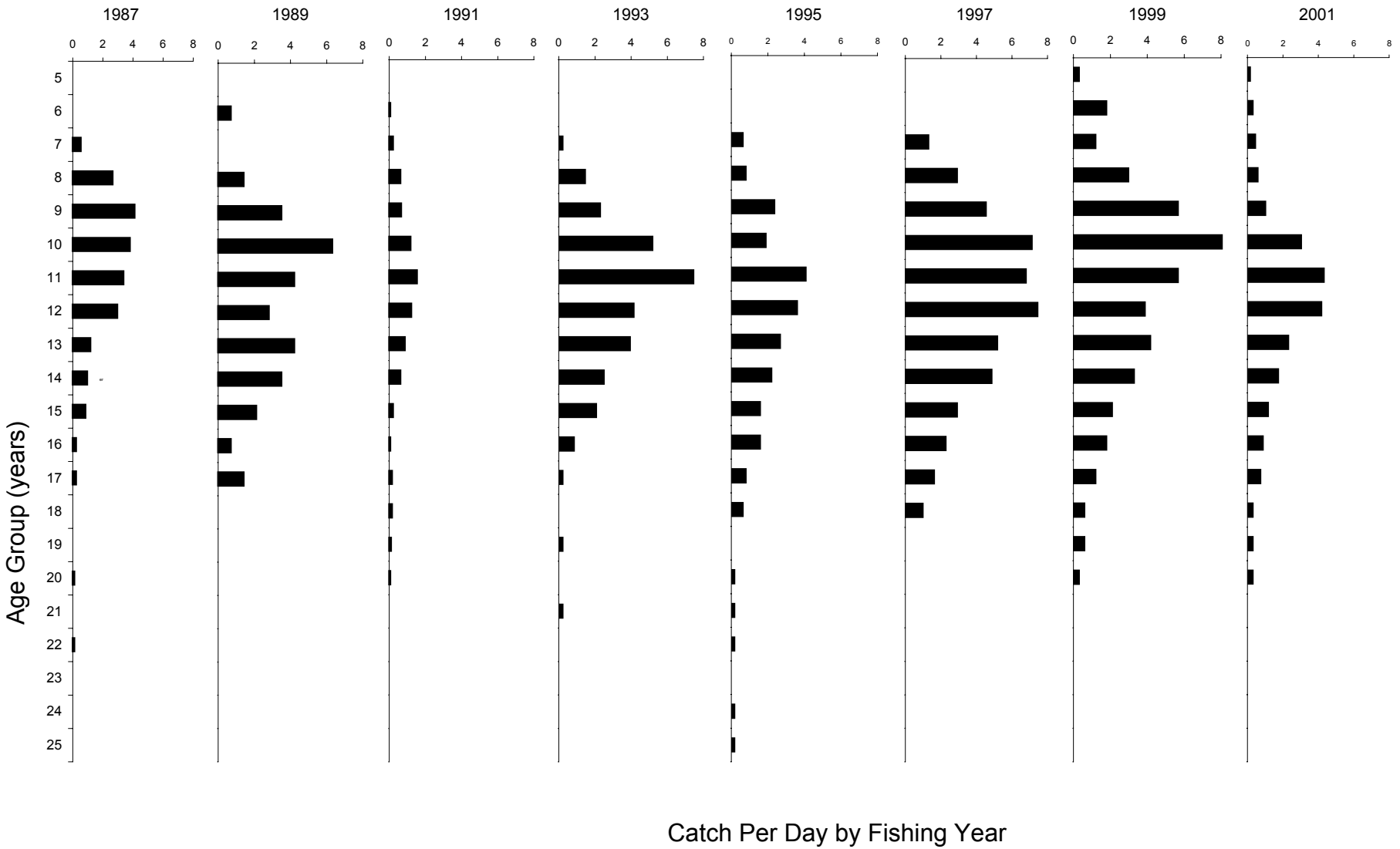

Figure 16. Age distribution of least cisco caught in the Colville River commercial fishery, 1987 - 2001, scaled to CPUE (from fish caught in 76-mm mesh nets, arrows indicate progression of year classes through the fishery).

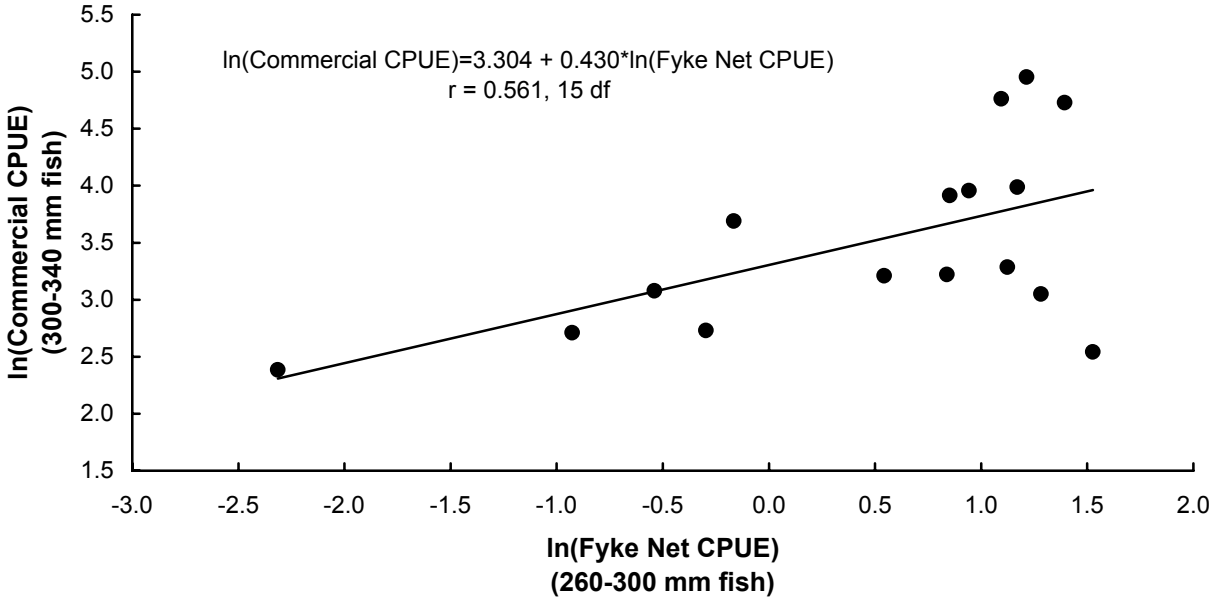

Figure 17. Relationship between commercial catch rate of 300-340 mm Arctic cisco in 76-mm (3 inch) mesh and fyke net catch rate for 260-300 mm fish the prior year.

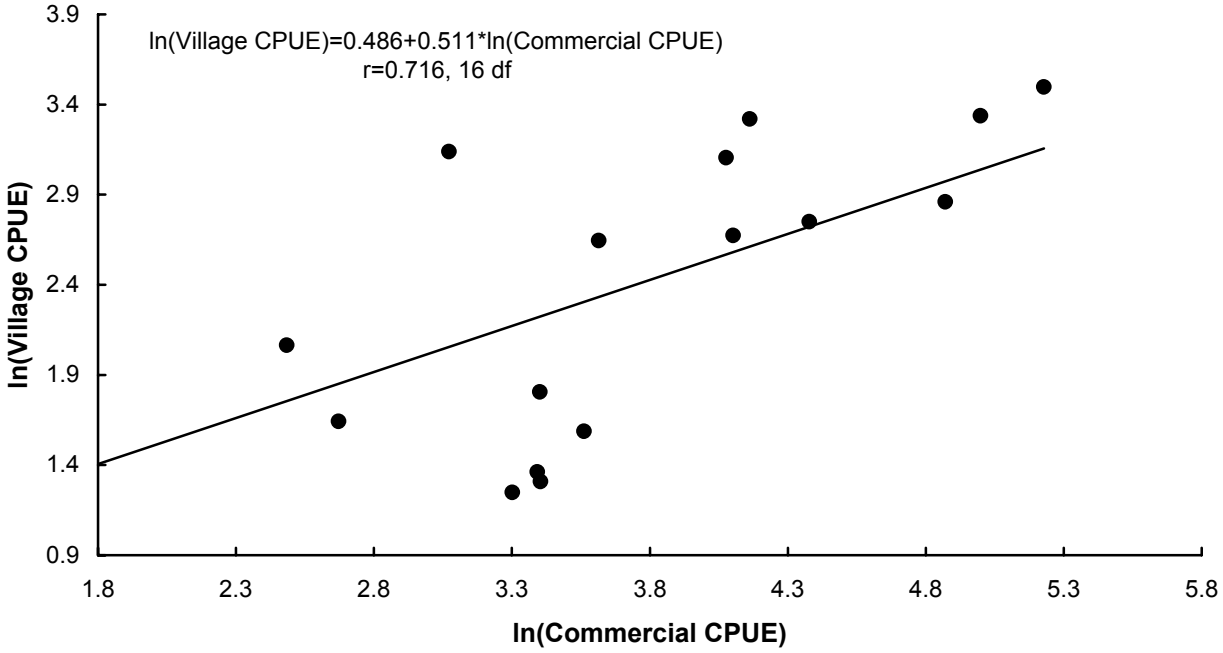

Figure 18. Relationship between village and commercial catch rates of arctic cisco in 76-mm (3 inch) mesh, 1985-2002.

Table 1. Estimated onset of fishing effort in the Nuiqsut fall fishery, 1985-2003.

Year	Onset of Fishing
1985	Oct 2
1986	Oct 3
1987	Oct 8
1988	Oct 14
1989	Oct 22
1990	Oct 6
1991	Oct 12
1992	Sep 26
1993	Oct 3
1994	Oct 3
1995	Oct 16
1996	Sep 28
1997	Oct 13
1998	Sep 28
1999	--
2000	Oct 3
2001	Oct 6
2002	Oct 14
2003	Oct 16

Average start date for 1985-2003 = October 7.

Table 2. Observed and effort-adjusted CPUE values for the Colville Delta commercial fishery, 1967 - 2002 (CPUE = fish/day/46 m net).

		Arctic Cisco			Least Cisco		
Year	Total Effort	Total Harvest	Actual CPUE	Adjusted CPUE[a]	Total Harvest	Actual CPUE	Adjusted CPUE[a]
1967	774	21,904	28.3	30.8	15,982	20.6	24.0
1968	1,427	41,948	29.4	50.0	19,086	13.4	40.7
1969	699	19,593	28.0	28.5	35,001	50.1	50.6
1970	562	22,685	40.4	37.0	30,650	54.5	50.0
1971	1,422	41,312	29.1	49.5	23,887	16.8	44.0
1972	646	37,101	57.4	56.4	12,183	18.9	17.5
1973	993	71,575	72.1	80.7	25,191	25.4	36.7
1974	947	44,937	47.5	54.8	14,122	14.9	24.6
1975	759	30,953	40.8	42.9	22,476	29.6	32.4
1976	996	31,659	31.8	40.5	37,046	37.2	48.7
1977	576	31,796	55.2	52.2	14,961	26.0	22.0
1978	1,077	18,058	16.8	27.7	25,761	23.9	38.4
1979	620	9,268	14.9	13.2	25,097	40.5	38.1
1980	1,209	14,753	12.2	26.8	30,982	25.6	45.0
1981	501	38,176	76.2	71.2	15,504	30.9	24.2
1982	328	15,975	48.7	38.9	27,085	82.6	69.5
1983	520	18,162	34.9	30.4	37,909	72.9	66.9
1984	371	27,686	74.6	66.0	13,076	35.2	23.7
1985	363	23,678	65.2	56.4	17,383	47.9	36.1
1986	151	29,595	196.0	181.3	9,444	62.5	42.9
1987	570	27,948	48.3	45.9	11,930	20.9	16.7
1988	485	10,470	21.6	16.0	23,196	47.8	40.5
1989	636	24,802	39.0	37.6	19,595	30.8	29.0
1990	825	21,772	25.6	30.3	17,064	20.7	25.9
1991	1,015	23,731	23.4	32.5	7,743	7.6	19.8
1992	331	22,754	68.7	59.0	7,284	22.0	9.0
1993	196	31,310	159.7	146.3	6,037	30.8	12.8
1994	203	8,958	44.1	30.8	10,176	50.1	32.4
1995	368	14,311	38.9	30.1	8,633	23.5	11.8
1996	162	21,817	134.7	120.2	7,796	48.1	28.9
1997	225	16,990	75.5	62.8	10,754	47.8	30.9
1998	173	8,752	50.6	36.4	11,822	68.3	49.5
1999	171	8,872	51.9	37.6	7,430	43.5	24.5
2000	93	2,619	28.2	11.7	5,758	61.9	40.1
2001	138	1,924	13.9	1.0	2,976	21.6	1.4
2002	132	3,935	29.8	14.5	5,503	41.7	21.3
1992-2001 Mean:	206	13,831	66.6	53.6	7,867	41.8	24.1

[a] The relationship used to adjust the CPUE for effort is based on the correlation between CPUE and effort during the period 1967-1990.

Table 3. Catch contribution by species as observed during fisherman interviews in the Nigliq Channel, by percent of sampled cat 1985-2003 (does not include commercial fishery).

Species	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	200
Arctic cisco	69.5	95.9	71.8	90.6	66.2	39.6	62.8	89.2	85.4	39.6	34.7	81.9	74.8	39.6	79.4	35.
Bering Cisco	(a)	(a)	(a)	(a)	(a)	21.8	1.2	0.1	0.02	0.1	0.2	0.0	0.0	0.0	0.1	0.
Least cisco	14.8	3.8	18.7	8.3	23.7	30.2	30.0	6.0	11.1	44.6	35.0	4.8	22.9	50.8	14.0	29.
Broad whitefish	15.1	0.3	5.5	0.6	7.0	5.3	1.0	0.2	0.3	2.2	7.6	0.1	1.3	0.4	0.2	5.
Humpback whitefish	0.5	0.03	3.8	0.5	3.1	2.9	3.8	0.1	0.4	13.2	22.3	0.4	0.9	8.9	6.0	27.
Arctic grayling	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.
Rainbow smelt	0.2	0.03	0.01	0.0	0.03	0.2	1.0	0.0	0.04	0.3	0.2	0.1	0.0	0.0	0.3	0.
Round whitefish	0.0	0.01	0.0	0.0	0.0	0.0	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.
Dolly Varden char	0.0	0.0	0.03	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
Northern Pike	0.0	0.0	0.00	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.
Saffron cod	0.0	0.0	0.03	0.0	0.03	0.03	0.04	0.0	0.01	0.0	0.0	0.02	0.0	0.0	0.03	0.
Burbot	0.0	0.0	0.06	0.1	0.03	0.01	0.09	0.0	0.0	0.0	0.1	0.02	0.0	0.0	0.0	1.
Arctic flounder	0.0	0.0	0.00	0.0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.
Fourhorn sculpin	(b)	(b)	(b)	(b)	(b)	(b)	(b)	4.4	2.7	(b)	(b)	12.5	(b)	(b)	(b)	(b
Total Observed:	2,705	8,952	6,826	2,948	2,946	7,911	7,576	24,305	17,155	3,792	7,155	5,730	19,758	6,481	3,871	3,51

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

Table 4. Mean catch rate of arctic cisco in 76-mm (3 inch) mesh gill nets in the Nuiqsut fall fishery, 1985-2003 (in fish per day per 18 m of net).

(see Appendix Table A-12 for supporting data on the Nigliq Channel)

Year	Upper Nigliq	Nanuk	Nigliq Delta	Nigliq Channel Average	Outer Colville Delta Main Channel	Outer Colville Delta East Channel
1985	--	--	--	14.5	76.1	--
1986	19.2	29.9	65.8	33.0	62.0	--
1987	11.0	29.1	21.1	15.6	47.6	--
1988	6.4	8.1	55.7	23.1	19.3	--
1989	10.9	18.0	24.7	14.1	--	--
1990	4.4	7.5	7.3	6.1	--	--
1991	3.7	4.1	2.0	3.9	--	--
1992	15.3	17.8	51.5	22.3	54.1	--
1993	16.1	36.5	27.2	28.1	207.1	--
1994	3.7	3.4	--	3.5	35.5	--
1995	1.1	3.2	22.3	3.7	21.4	7.6
1996	11.5	18.6	--	17.5	28.6	45.8
1997	21.3	27.8	41.4	27.7	--	--
1998	2.0	2.6	7.8	4.9	--	--
1999	--	--	--	--	--	--
2000	1.0	3.5	9.6	7.9	--	--
2001	1.5	1.6	2.9	2.5	--	--
2002	0.9	3.7	6.3	5.2	--	--
2003	5.3	14.4	13.6	13.6	--	--
1993-2002						
Mean	6.6	11.2	16.8	11.2	73.2	26.7
Standard Deviation	7.7	13.1	14.0	10.5	89.5	27.0

-- = not available

Table 5. Mean catch rate of least cisco in 76-mm (3 inch) mesh gill nets in the Nuiqsut fall fishery, 1985-2003 (in fish per day per 18 m of net).

(see Appendix Table A-13 for supporting data on the Nigliq Channel)

Year	Upper Nigliq	Nanuk	Nigliq Delta	Nigliq Channel Average	Outer Colville Delta Main Channel
1985	--	--	--	2.7	47.4
1986	1.3	0.6	0.5	1.0	18.3
1987	5.5	1.9	0.4	4.1	15.4
1988	1.6	0.7	2.8	1.9	57.9
1989	3.7	1.1	0.5	2.8	--
1990	4.8	2.8	6.5	4.0	--
1991	0.3	0.8	0.0	0.7	--
1992	0.8	0.7	1.6	0.9	8.1
1993	1.7	3.1	1.7	2.4	--
1994	3.3	3.7	--	3.6	--
1995	4.7	2.8	7.8	3.4	--
1996	0.4	1.0	--	0.9	--
1997	11.5	12.2	3.8	10.5	--
1998	5.9	6.9	6.0	6.2	--
1999	--	--	--	--	--
2000	1.4	1.6	1.7	1.7	--
2001	2.1	9.8	2.4	2.9	--
2002	1.5	4.5	2.2	2.2	--
2003	2.1	4.4	2.3	2.7	--
1993-2002					
Mean	3.6	5.1	3.7	3.8	
Standard Deviation	3.4	3.8	2.4	2.9	

-- = not available

Table 6. Estimated harvest during the Colville Delta fall fisheries by species, in number of fish, 1967-2003.

	Arctic Cisco		Least Cisco		Humpback Whitefish		Broad Whitefish	
Year	Commercial Harvest[a]	Village Harvest[b]	Commercial Harvest	Village Harvest	Commercial Harvest	Village Harvest	Commercial Harvest	Village Harvest
1967	21,904		15,982		356			
1968	41,948		19,086		172			
1969	19,593		35,001		3,136			
1970	22,685		30,650		345			
1971	41,312		23,887		183			
1972	37,101		12,183		1,481			
1973	71,575		25,191		5,733			
1974	44,937		14,122		4,802			
1975	30,953		22,476		1,946			
1976	31,659		37,046		1,793			
1977	31,796		14,961		1,366			
1978	18,058		25,761		2,758			
1979	9,268		25,097		1,102			
1980	14,753		30,982		4,232			
1981	38,176		15,504		469			
1982	15,975		27,085					
1983	18,162		37,909					
1984	27,686		13,076					
1985	23,678	46,681	17,383	15,814				1,148
1986	29,595	33,523	9,444	6,805		79		229
1987	27,948	20,847	11,930	6,114	1,880	957		1,239
1988	10,470	6,098	23,196	2,320	6,945	70		58
1989	24,802	12,892	19,595	6,035	5,804	421	69	1,306
1990	21,772	11,224	17,064	9,100	4,581	200	2	416
1991	23,731	8,269	7,743	3,193	1,658	634	11	206
1992	22,754	45,401	7,284	2,659	5,209	30	208	130
1993	31,310	46,944	6,037	7,599	5,339	1,057	19	534
1994	8,958	10,956	10,176	8,669	8,827	2,736	8	936
1995	14,311	8,573	8,633	8,573	10,860	6,395	186	1,514
1996	21,817	41,205	7,796	15,854	6,425	6,105	258	326
1997	16,990	33,274	10,754	10,002	1,721	365	13	486
1998	8,752	13,559	11,822	19,323	5,279	4,681	13	91
1999	8,872	--	7,430	--	6,875	--	436	--
2000	2,619	9,956	5,758	1,973	3,706	1,062	4	3
2001	1,924	3,935	2,976	3,630	6,184	2,576	--	979
2002	3,935	7,533	5,503	5,422	4,185	2,765	--	268
2003	--	23,369	--	7,748	--	3,685	--	176

[a]Commercial harvest numbers provided by J. Helmericks, 1996-2002

[b] 2000-2003 village harvest represents only the Nigliq Channel harves

Table 7. Estimated numbers and biomass of harvested Arctic cisco and least cisco by year for village and commercial fisheries in the Colville Delta, 1985-2003 (Bering cisco included for 1990).

	Village Harvest						Commercial Harvest					
	Arctic Cisco		Least Cisco		Bering Cisco		Arctic Cisco		Least Cisco			Harvested
	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass	Total	Biomass
Year	(in fish)	(kg)	(in fish)	(kg)	(in fish)	(kg)	(in fish)	(kg)	(in fish)	(kg)	Catch	(kg)
1985	46,681	19,478	15,814	5,298	trace		23,678	10,146	17,596	6,021	103,769	40,942
1986	33,522	14,414	6,804	2,176	trace		29,456	12,640	9,000	2,959	78,782	32,189
1987	20,926	9,800	6,178	2,020	trace		27,494	12,945	11,939	4,117	66,537	28,882
1988	6,098	2,951	2,321	793	trace		10,480	5,264	23,040	8,121	41,939	17,129
1989	12,892	6,497	6,036	1,844	trace		24,802	12,697	19,640	7,006	63,370	28,043
1990	11,224	4,407	9,100	2,584	8,652	5,474	21,105	8,634	17,049	5,513	67,130	26,613
1991	8,269	2,852	3,193	754	trace		23,698	8,695	7,744	1,838	42,904	14,139
1992	45,402	15,700	2,658	777	trace		22,754	8,391	7,284	2,513	78,098	27,380
1993	46,944	18,615	7,599	2,093	trace		31,310	12,725	6,037	1,795	91,890	35,229
1994	10,956	4,502	8,669	2,455	trace		8,958	4,037	10,176	3,153	38,758	14,147
1995	8,574	3,463	8,573	2,487	trace		14,311	5,353	8,633	2,658	40,091	13,961
1996	41,205	15,387	15,854	4,645	trace		21,817	8,124	7,796	2,375	86,672	30,531
1997	33,274	14,487	10,002	2,979	trace		16,990	7,186	10,754	3,228	71,020	27,880
1998	13,559	5,435	19,323	5,487	trace		8,752	3,501	11,822	3,443	53,455	17,866
2000	9,956	4,851	1,973	641	trace		2,619	1,218	5,758	1,873	20,306	8,583
2001	3,935	1,886	3,630	1,089	trace		1,924	913	2,976	925	12,465	4,813
2002	7,533	2,669	5,422	1,555	trace		3,935	1,424	5,503	1,710	22,393	7,358
2003	23,369	9,986	7,748	2,327	trace		--	--	--	--	--	--

Table 8. Mean fork length of least cisco caught in 76-mm (3 inch) mesh gill nets during the Nuiqsut fall fishery, 1986-2003.

Year	Mean Length (mm)	Standard Deviation	Number of Fish
1986	319.1	18.6	148
1987	321.3	18.7	52
1988	309.7	22.4	137
1989	322.5	25.5	238
1990	318.2	21.7	267
1991	315.1	25.2	294
1992	324.5	25.4	145
1993	305.0	15.2	157
1994	307.2	17.3	218
1995	316.9	22.2	236
1996	305.8	15.0	123
1997	308.9	23.9	173
1998	303.8	19.0	513
1999	--	--	--
2000	307.8	20.6	129
2001	311.0	19.4	515
2002	310.8	21.2	688
2003	311.9	19.1	588

Table 9. Data used to predict Arctic cisco harvest rates in the Colville Delta fall fishery.

Harvest Year	year-1 Prudhoe Bay Fyke Net CPUE (260-300 mm)	Commercial CPUE (300-340 mm) (45-m of net)	Commercial Proportion 300-340 mm	Adjusted Commercial 3 inch Mesh CPUE (45-m of net)	Nigliq Channel 3 inch Mesh CPUE (18-m of net)
1985	2.57	52.2	0.864	60.5	14.5
1986	3.37	141.7	0.760	186.5	33.0
1987	0.85	40.0	0.502	79.7	15.6
1988	0.10	10.8	0.502	21.6	23.1
1989	0.74	15.3	0.413	37.1	14.1
1990	0.58	21.7	0.724	30.0	6.1
1991	1.72	24.8	0.832	29.7	3.9
1992	3.22	54.0	0.916	58.9	22.3
1993	4.03	113.1	0.763	148.1	28.1
1994	0.40	15.0	0.553	27.2	3.5
1995	2.31	25.1	0.833	30.1	3.7
1996	2.99	117.0	0.896	130.5	17.5
1997	2.35	50.1	0.780	64.3	27.7
1998	3.61	21.1	0.600	35.2	4.9
1999	3.08	26.7	0.710	37.6	--
2000	--	5.1	0.423	12.0	7.9
2001	--	0.3	0.322	1.0	2.5
2002	4.60	12.7	0.877	14.5	5.2
2003	10.71	--	--	--	13.6
2004	8.03				
Mean:			0.682		

Relationship between Prudhoe Bay fyke nets and commercial fishery 300-340 mm CPUE:

ln(Commercial CPUE)=3.304 + 0.430*ln(Fyke Net CPUE)

r = 0.561, 15 df

Relationship between Commercial fishery 76-mm mesh CPUE and Nigliq Channel CPUE:

ln(Nigliq CPUE)=0.4862+0.511*ln(Commercial CPUE)

r=0.716, 16 df

DATA APPENDIX

LIST OF APPENDIX TABLES

Appendix Table 1. Total estimated fishing effort by in the Colville River fall fishery, 1985-2003 (in net-days per 18-m of gill net).

	Village Effort							
Year	Upper Nigliq	Nanuk	Nigliq Delta	Outer Delta	Main River	**Total Village**	**Commercial**	**Total**
1985	663	207	340	543		1,753	908	2,661
1986	592	216	97	365		1,270	378	1,648
1987	961	236	90	89		1,376	1,424	2,800
1988	411	136	47	37		631	1,213	1,844
1989	786	157	114	98		1,155	1,590	2,745
1990	793	793	106	142		1,834	2,063	3,897
1991	697	601	31	28	108	1,465	2,538	4,003
1992	1,067	755	19	39		1,880	828	2,707
1993	730	802	233	28		1,793	490	2,283
1994	622	800	0	152		1,574	508	2,082
1995	403	1,000	108	443	198	2,151	925	3,076
1996	182	795	219	622		1,818	405	2,223
1997	443	631	313	59		1,446	563	2,008
1998	621	632	836	435		2,525	433	2,958
1999	--	--	--	--		--	428	428
2000	238	240	898	--		1,377	233	1,609
2001	461	189	854	--		1,503	345	1,848
2002	360	209	1,407	--		1,976	330	2,306
2003	80	313	1,263	--		1,656	NR	--
1993-2002								
Mean:	451	589	541			1,796	466	2,082
StDev:	182	302	473			375	187	737

NR = not reported

Appendix Table 2. Total estimated catch of arctic cisco in the Colville Delta fall fishery, 1985-2003. (in numbers of fish).

	Nigliq Channel				Outer Colville Delta			Total	Total	
Year	Upper Nigliq	Nanuk	Nigliq Delta	Nigliq Channel Total	Main Channel	East Channel	Main River	Village Catch	Commercial Catch	Total Harves
1985	17,878	NA	8,500	26,378	12,397	7,906	--	46,681	23,678	70,3
1986	8,239	4,636	5,924	18,799	14,724	0	--	33,523	29,456	62,9
1987	10,331	3,310	2,635	16,276	4,571	0	--	20,847	27,494	48,3
1988	1,736	1,401	2,374	5,511	587	0	--	6,098	10,480	16,5
1989	6,403	1,866	3,123	11,392	1,500	0	--	12,892	24,802	37,6
1990	2,979	5,538	706	9,224	2,000	0	--	11,224	21,105	32,3
1991	1,866	4,853	91	6,810	1,025	0	434	8,269	23,731	32,0
1992	14,182	25,444	1,375	41,001	4,400	0	--	45,401	22,754	68,1
1993	8,243	25,525	7,375	41,144	5,800	0	--	46,944	31,310	78,2
1994	2,230	3,326	0	5,556	5,400	0	--	10,956	8,958	19,9
1995	379	4,037	489	4,905	1,400	1,853	415	8,573	14,311	22,8
1996	2,404	14,170	598	17,172	13,571	10,462	0	41,205	21,817	63,0
1997	8,834	14,554	7,743	31,130	2,144	0	0	33,274	16,990	50,2
1998	1,730	1,697	4,721	8,148	--	--	--	8,148	8,752	16,9
1999	--	--	--	--	--	--	--	--	8,872	
2000	688	735	8,533	9,956	--	--	--	9,956	2,619	12,5
2001	1,044	279	2,612	3,935	--	--	--	3,935	1,924	5,8
2002	384	641	6,508	7,533	--	--	--	7,533	3,935	11,4
2003	543	3,975	18,852	23,369	--	--	--	23,369	--	

Appendix Table 3. Total estimated catch of least cisco in the Colville Delta fall fishery, 1985-200
(in numbers of fish)

	Nigliq Channel				Outer Colville Delta					
Year	Upper Nigliq	Nanuk	Nigliq Delta	Nigliq Channel Total	Main Channel	East Channel	Main River	Total Village Catch	Total Commercial Catch	Total Harvest
1985	1,871	NA	0	1,871	8,698	5,245	--	15,814	33,410	49,224
1986	1,329	440	38	1,807	4,998	0	--	6,805	15,805	22,610
1987	4,483	124	74	4,681	1,433	0	--	6,114	18,053	24,167
1988	600	143	123	866	1,454	0	--	2,320	25,360	27,680
1989	3,621	898	16	4,535	1,500	0	--	6,035	25,630	31,665
1990	4,348	4,098	654	9,100	--	0	--	9,100	26,149	35,249
1991	136	1,929	0	2,065	--	0	1,128	3,193	10,931	14,124
1992	927	1,706	26	2,659	--	0	--	2,659	9,943	12,601
1993	1,832	4,839	928	7,599	--	0	--	7,599	13,636	21,234
1994	2,990	5,679	0	8,669	--	0	--	8,669	18,845	27,514
1995	1,039	2,782	615	4,436	--	3,731	406	8,573	17,206	25,779
1996	136	1,450	15	1,601	7,982	6,271	0	15,854	23,650	39,504
1997	4,344	3,845	572	8,761	1,241	0	0	10,002	10,754	20,756
1998	3,120	2,042	2,691	7,853	--	--	--	7,853	11,822	19,675
1999	--	--	--	--	--	--	--	--	7,430	--
2000	225	168	1,580	1,973	--	--	--	1,973	5,758	7,731
2001	871	1,337	1,421	3,630	--	--	--	3,630	2,976	6,606
2002	538	741	4,143	5,422	--	--	--	5,422	5,503	10,925
2003	152	2,134	5,462	7,748	--	--	--	7,748	--	--

Appendix Table 4. Fishing effort in the Nigliq Channel by fisher, 2003.

Fisher Code	Net	Fishing Area	Net Length (m)	Net Depth (m)	Mesh (mm)	Start Date	End Date
1	A	650	30	1.8	64	10/21/2003	11/14/2003
1	B	650	24	1.8	76	10/25/2003	11/14/2003
4	A	670	24	1.8	64	10/19/2003	11/7/2003
4	B	670	24	1.8	64	10/19/2003	10/26/2003
4	C	670	30	1.8	76	10/20/2003	11/8/2003
4	D	670	24	1.8	76	10/20/2003	11/7/2003
4	E	670	24	1.8	64	11/7/2003	11/16/2003
4	F	670	24	1.8	76	11/8/2003	11/14/2003
7	A	670	24	1.2	70	11/1/2003	11/7/2003
7	B	670	24	1.8	76	11/1/2003	11/7/2003
7	C	650	30	1.8	76	11/3/2003	11/17/2003
7	D	650	24	1.2	70	11/3/2003	11/12/2003
15	A	650	18	1.8	89	10/25/2003	11/16/2003
15	B	650	18	1.8	76	10/26/2003	11/4/2003
24	A	650	18	1.8	76	10/21/2003	11/7/2003
24	B	650	18	1.8	76	10/21/2003	11/22/2003
25	A	670	30	1.8	76	10/17/2003	11/1/2003
25	B	670	24	1.8	89	11/3/2003	11/11/2003
25	C	670	9	1.8	76	11/5/2003	11/11/2003
25	D	650	30	1.8	76	11/21/2003	11/24/2003
25	E	610	30	1.8	76	11/22/2003	11/24/2003
30	A	670	24	1.8	76	10/19/2003	11/8/2003
30	B	610	24	1.8	76	11/23/2003	11/24/2003
31	A	610	18	1.8	76	11/10/2003	11/16/2003
32	A	670	24	1.8	76	10/23/2003	11/8/2003
32	B	670	30	1.8	89	10/23/2003	11/13/2003
33	A	670	24	1.8	76	10/19/2003	11/24/2003
33	B	670	18	1.8	89	10/20/2003	10/28/2003
33	C	670	24	1.8	76	10/28/2003	11/24/2003
37	A	670	30	1.8	76	10/16/2003	11/5/2003
41	A	670	24	1.8	76	11/3/2003	11/24/2003
41	B	670	24	1.8	76	11/2/2003	11/24/2003
42	A	670	30	1.8	64	10/23/2003	11/24/2003
42	B	670	30	1.8	76	10/26/2003	11/24/2003
48	A	650	24	1.8	89	10/23/2003	11/21/2003
48	B	650	18	1.8	76	10/23/2003	11/21/2003
48	C	670	18	1.8	76	10/23/2003	11/24/2003
51	A	670	18	1.8	89	10/23/2003	11/10/2003
51	B	670	24	1.8	76	10/23/2003	11/19/2003
51	C	670	24	1.8	64	10/24/2003	11/19/2003

Appendix Table 4. Fishing effort in the Nigliq Channel by fisher, 2003.

Fisher Code	Net	Fishing Area	Net Length (m)	Net Depth (m)	Mesh (mm)	Start Date	End Date
54	A	670	24	1.8	89	10/21/2003	11/18/2003
54	B	670	18	1.8	89	10/22/2003	10/26/2003
54	C	670	24	1.8	76	10/16/2003	11/18/2003
56	A	670	24	1.8	76	10/18/2003	11/8/2003
56	B	670	24	1.8	76	10/29/2003	11/8/2003
57	A	670	24	1.8	76	11/1/2003	11/15/2003
57	B	670	24	1.8	76	11/8/2003	11/18/2003
61	A	670	24	1.8	76	10/18/2003	11/15/2003
61	B	670	24	1.8	76	10/28/2003	11/24/2003
63	A	670	30	1.8	76	10/19/2003	11/24/2003
64	A	670	30	1.8	76	10/26/2003	11/15/2003
64	B	650	30	1.8	76	11/17/2003	11/24/2003
65	A	650	24	1.8	127	11/5/2003	11/6/2003
65	B	650	18	1.8	76	11/5/2003	11/24/2003
66	A	610	24	1.8	89	10/19/2003	10/27/2003
66	B	650	30	1.8	76	10/26/2003	10/30/2003
66	C	670	24	1.8	76	10/29/2003	11/11/2003
66	D	670	30	1.8	76	10/30/2003	11/11/2003
69	A	670	30	1.8	76	10/19/2003	11/6/2003
69	B	670	24	1.8	89	10/20/2003	10/29/2003
72	A	670	24	1.8	76	10/18/2003	11/16/2003
72	B	670	24	1.8	70	11/1/2003	11/16/2003
72	C	670	30	1.8	89	11/6/2003	11/18/2003
72	D	670	24	1.8	76	11/21/2003	11/24/2003
73	A	670	24	1.8	70	11/1/2003	11/12/2003
73	B	670	24	1.8	76	11/1/2003	11/12/2003
76	A	670	24	1.8	76	11/15/2003	11/24/2003
78	A	610	30	1.8	76	10/26/2003	11/12/2003
85	A	650	24	1.8	76	10/21/2003	11/5/2003
85	B	610	24	1.8	76	11/7/2003	11/24/2003
86	A	670	30	1.8	76	10/18/2003	11/1/2003
86	B	670	30	1.8	76	10/25/2003	11/24/2003
87	A	670	24	1.8	51	11/12/2003	11/24/2003

Fisher Code: numerical code used to identify individual fishers, used constantly across years.
Area: 610 = Upper Nigliq; 650 = Nanuk; 670 = Nigliq Delta; 100 = Outer Delta
Start = Date net was set at a location
End = Date net was removed from a location

Appendix Table 5. Estimated effort by Nigliq Channel fishermen by mesh size and fishing area, 2003.

Estimated Effort in Net-Days by 10-day Interval

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29	Mesh Total	Area Total
Upper Nigliq										
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	76	0.0	0.0	0.0	6.7	27.3	24.3	11.3	69.7	
	89	0.0	0.0	1.3	9.3	0.0	0.0	0.0	10.7	80.3
Nanuk										
	64	0.0	0.0	0.0	16.7	16.7	8.3	0.0	41.7	
	70	0.0	0.0	0.0	0.0	8.0	4.0	0.0	12.0	
	76	0.0	0.0	0.0	56.7	65.7	53.3	23.3	199.0	
	89	0.0	0.0	0.0	14.3	23.3	20.3	2.7	60.7	313.3
Nigliq Delta										
	51	0.0	0.0	0.0	0.0	0.0	9.3	6.7	16.0	
	64	0.0	0.0	2.7	42.3	43.3	39.3	8.3	136.0	
	70	0.0	0.0	0.0	0.0	32.0	13.3	0.0	45.3	
	76	0.0	0.0	34.3	248.7	353.3	222.3	70.0	928.7	
	89	0.0	0.0	0.0	54.7	51.3	30.7	0.0	136.7	1262.7

Estimated Nigliq Total: 1,656.3

Appendix Table 6. Estimated catch of arctic cisco in the Nigliq Channel, 2003.

Estimated Arctic Cisco CPUE by 10-day Interval (numbers in bold are estimates)

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29
Upper Nigliq								
	64							
	76				4.5	13.5	4.5	3.0
	89			**0.0**	0.0			
Nanuk								
	64				18.0	15.4	4.5	
	70					19.0	3.3	
	76				21.2	19.4	5.3	**5.3**
	89				21.0	1.2	0.1	**0.1**
Nigliq Delta								
	51						21.5	13.9
	64			**45.0**	45.0	31.4	7.1	**7.1**
	70					8.7	6.8	
	76			**26.6**	26.6	14.4	3.9	5.3
	89				7.2	4.1	0.2	

Estimated Arctic Cisco Harvest by 10-day Interval

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29	Mesh Total	Area Total
Upper Nigliq										
	64	0	0	0	0	0	0	0	0	
	76	0	0	0	30	369	110	34	543	
	89	0	0	**0**	0	0	0	0	0	543
Nanuk										
	64	0	0	0	300	257	38	0	594	
	70	0	0	0	0	152	13	0	165	
	76	0	0	0	1,201	1,275	283	**124**	2,883	
	89	0	0	0	301	28	3	**0**	333	3,975
Nigliq Delta										
	51	0	0	0	0	0	200	93	293	
	64	0	0	**120**	1,905	1,362	279	**59**	3,726	
	70	0	0	0	0	278	90	0	368	
	76	0	0	**914**	6,617	5,092	865	371	13,859	
	89	0	0	0	392	210	6	0	607	18,852

Estimated Nigliq Channel Harvest: 23,369

Appendix Table 7. Estimated catch of least cisco in the Nigliq Channel fishery, 2003.

Estimated Least Cisco CPUE by 10-day Interval (numbers in bold are estimates)

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29
Upper Nigliq								
	64							
	76				3.0	3.0	2.1	0.0
	89			**0.0**	0.0			
Nanuk								
	64				30.2	16.7	4.8	
	70					9.1	4.3	
	76				6.5	4.7	3.9	**3.9**
	89				17.0	0.3	0.0	**0.0**
Nigliq Delta								
	51						13.1	15.0
	64			**37.4**	37.4	11.5	9.9	**9.9**
	70					1.0	3.3	
	76			**4.5**	4.5	2.0	1.0	1.6
	89				2.5	0.9	0.1	

Estimated Least Cisco Harvest by 10-day Interval

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29	Mesh Total	Area Total
Upper Nigliq										
	64	0	0	0	0	0	0	0	0	
	76	0	0	0	20	82	50	0	152	
	89	0	0	**0**	0	0	0	0	0	152
Nanuk										
	64	0	0	0	503	278	40	0	822	
	70	0	0	0	0	73	17	0	90	
	76	0	0	0	371	305	206	**90**	972	
	89	0	0	0	244	6	0	**0**	250	2,134
Nigliq Delta										
	51	0	0	0	0	0	122	100	222	
	64	0	0	**100**	1,585	499	388	**82**	2,654	
	70	0	0	0	0	33	43	0	76	
	76	0	0	**155**	1,119	709	232	110	2,324	
	89	0	0	0	136	47	4	0	187	5,462

Estimated Nigliq Channel Harvest: 7,748

Appendix Table 8. Estimated catch of broad whitefish in the Nigliq Channel fishery, 2003.

Estimated Broad Whitefish CPUE by 10-day Interval (numbers in bold are estimates)

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29
Upper Nigliq								
	64							
	76				0.0	0.0	0.0	0.0
	89			**12.0**	12.0			
Nanuk								
	64				2.0	0.0	0.0	
	70					0.0	0.0	
	76				0.1	0.0	0.0	**0.0**
	89				0.0	0.0	0.0	**0.0**
Nigliq Delta								
	51						0.0	0.0
	64			**0.0**	0.0	0.0	0.0	**0.0**
	70						0.0	0.0
	76			**0.0**	0.0	0.0	0.0	0.0
	89				0.0	0.0	0.0	

Estimated Broad Whitefish Harvest by 10-day Interval

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29	Mesh Total	Area Total
Upper Nigliq										
	64	0	0	0	0	0	0	0	0	
	76	0	0	0	0	0	0	0	0	
	89	0	0	**16**	112	0	0	0	128	128
Nanuk										
	64	0	0	0	33	0	0	0	33	
	70	0	0	0	0	0	0	0	0	
	76	0	0	0	8	1	0	**0**	10	
	89	0	0	0	0	0	0	**0**	0	43
Nigliq Delta										
	51	0	0	0	0	0	0	0	0	
	64	0	0	**0**	2	0	0	**0**	2	
	70	0	0	0	0	0	0	0	0	
	76	0	0	**0**	2	0	0	0	3	
	89	0	0	0	0	0	0	0	0	4

Estimated Nigliq Channel Harvest: 176

Appendix Table 9. Estimated catch of humpback whitefish in the Nigliq Channel fishery, 2003.

Estimated Humpback Whitefish CPUE by 10-day Interval (numbers in bold are estimates)

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29
Upper Nigliq								
	64							
	76				3.3	6.0	1.9	0.6
	89			**31.5**	31.5			
Nanuk								
	64				3.6	1.6	0.0	
	70					0.6	1.0	
	76				4.6	4.5	0.6	**0.6**
	89				7.0	9.6	0.0	**0.0**
Nigliq Delta								
	51						0.0	0.0
	64			**2.8**	2.8	0.2	0.6	**0.6**
	70					0.1	0.3	
	76			**4.4**	4.4	0.3	0.1	0.6
	89				7.8	1.1	0.1	

Estimated Humpback Whitefish Harvest by 10-day Interval

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29	Mesh Total	Area Total
Upper Nigliq										
	64	0	0	0	0	0	0	0	0	
	76	0	0	0	22	164	46	7	238	
	89	0	0	**42**	294	0	0	0	336	574
Nanuk										
	64	0	0	0	60	27	0	0	87	
	70	0	0	0	0	5	4	0	9	
	76	0	0	0	262	298	33	**14**	608	
	89	0	0	0	100	223	0	**0**	324	1,027
Nigliq Delta										
	51	0	0	0	0	0	0	0	0	
	64	0	0	**7**	119	10	22	**5**	164	
	70	0	0	0	0	2	3	0	5	
	76	0	0	**152**	1,098	122	17	43	1,432	
	89	0	0	0	424	54	4	0	482	2,083

Estimated Nigliq Channel Harvest: 3,685

Appendix Table 10. Estimated catch of Bering cisco in the Nigliq Channel fishery, 2003.

Estimated Bering Cisco CPUE by 10-day Interval (numbers in bold are estimates)

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29
Upper Nigliq								
	64							
	76				0.0	0.0	0.0	0.0
	89			**0.0**	0.0			
Nanuk								
	64				0.4	0.0	0.0	
	70					0.0	0.0	
	76				0.4	0.4	0.0	**0.0**
	89				0.0	0.2	0.0	**0.0**
Nigliq Delta								
	51						0.0	0.0
	64			**0.0**	0.0	0.0	0.0	**0.0**
	70					0.0	0.0	
	76			**0.0**	0.0	0.0	0.0	0.0
	89				0.0	0.0	0.0	

Estimated Bering Cisco Harvest by 10-day Interval

Area	Mesh (mm)	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-30	Oct 31-Nov 9	Nov 10-19	Nov 20-29	Mesh Total	Area Total
Upper Nigliq										
	64	0	0	0	0	0	0	0	0	
	76	0	0	0	0	0	0	0	0	
	89	0	0	**0**	0	0	0	0	0	0
Nanuk										
	64	0	0	0	7	0	0	0	7	
	70	0	0	0	0	0	0	0	0	
	76	0	0	0	22	27	2	**1**	52	
	89	0	0	0	0	4	0	**0**	4	63
Nigliq Delta										
	51	0	0	0	0	0	0	0	0	
	64	0	0	**0**	0	0	0	**0**	0	
	70	0	0	0	0	0	0	0	0	
	76	0	0	**1**	7	6	0	0	14	
	89	0	0	0	1	0	0	0	1	15

Estimated Nigliq Channel Harvest: 78

Appendix Table 11. Length frequency by mesh size for arctic cisco and least cisco, 2003 Colville Delta fall fishery.

ARCTIC CISCO

Fork Length (mm)	Mesh (mm)				
	51	64	70	76	89
200					
210		1			
220				1	
230	1				
240	9	1			
250	9	4			
260	27	7			
270	26	28	1	1	
280	16	68	2	10	2
290	9	92	7	40	3
300	4	108	22	225	14
310	2	64	23	546	30
320	4	52	29	578	48
330		25	9	400	48
340		8	5	178	35
350		1		35	18
360				15	8
370				3	6
380					3
390		1	1	1	
400				1	1
410					
420					
430					
440					
450					
Total:	107	460	99	2,034	216

LEAST CISCO

Fork Length (mm)	Mesh (mm)				
	51	64	70	76	89
200			1		
210					
220					
230	1			1	
240	2	1		2	1
250	6	7	1	4	2
260	15	25		5	
270	17	57	1	8	2
280	13	75	3	25	5
290	7	67	15	76	5
300	1	50	23	127	24
310	3	27	10	161	10
320		11	9	94	10
330		4	1	49	5
340		3		18	1
350		1		9	
360		1		4	
370		1		1	1
380				2	
390				2	
400					
410					
420					
430					
440					
450					
Total:	65	330	64	588	66

Appendix Table A-12. Calculation of Arctic cisco catch rate in 76-mm mesh in the Nigliq Channel, 1986-2003.

Harvest Year	Upper Nigliq			Nanuk			Nigliq Delta			Nigliq Channel Total		
	Observed Catch (no. of Fish)	Observed Effort (net-days)	CPUE (fish per net Day)	Observed Catch (No. of Fish)	Observed Effort (Net-days)	CPUE (Fish per Net Day)	Observed Catch (No. of Fish)	Observed Effort (Net-days)	CPUE (Fish per Net Day)	Observed Catch (No. of Fish)	Observed Effort (Net-days)	CPUE (Fish per 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	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	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	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	0	0.0	--	0	0.0	--	0	0.0	--	0	0.0	--
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

Appendix Table A-13. Calculation of least cisco catch rate in 76-mm mesh in the Nigliq Channel, 1986-2003.

Harvest Year	Upper Nigliq			Nanuk			Nigliq Delta			Nigliq Channel Total		
	Observed Catch (No. of Fish)	Observed Effort (Net-days	CPUE (Fish per Net Day)	Observed Catch (No. of Fish)	Observed Effort (Net-days	CPUE (Fish per Net Day)	Observed Catch (No. of Fish)	Observed Effort (Net-days	CPUE (Fish per Net Day)	Observed Catch (No. of Fish)	Observed Effort (Net-days	CPUE (Fish per Net Day)
1986	146	115.7	1.3	16	25.1	0.6	24	51.3	0.5	186	192.2	1.0
1987	730	131.7	5.5	63	32.6	1.9	12	31.3	0.4	805	195.7	4.1
1988	93	56.9	1.6	12	18.0	0.7	105	37.3	2.8	210	112.3	1.9
1989	332	90.8	3.7	16	14.3	1.1	10	21.7	0.5	358	126.8	2.8
1990	711	147.1	4.8	416	148.5	2.8	179	27.6	6.5	1,306	323.1	4.0
1991	50	143.0	0.3	272	326.9	0.8	0	8.0	0.0	322	477.9	0.7
1992	261	316.2	0.8	88	130.4	0.7	151	96.2	1.6	500	542.8	0.9
1993	181	106.2	1.7	498	158.3	3.1	96	57.7	1.7	775	322.2	2.4
1994	330	99.0	3.3	711	190.2	3.7	0	0.0	--	1,041	289.2	3.6
1995	238	50.3	4.7	494	178.3	2.8	94	12.0	7.8	826	240.7	3.4
1996	14	36.0	0.4	195	193.3	1.0	0	0.0	--	209	229.3	0.9
1997	1,370	119.0	11.5	1,575	128.8	12.2	203	53.3	3.8	3,148	301.2	10.5
1998	544	92.3	5.9	577	83.7	6.9	935	155.3	6.0	2,056	331.3	6.2
1999	0	0.0	--	0	0.0	--	0	0.0	--	0	0.0	--
2000	11	8.0	1.4	97	62.0	1.6	330	190.4	1.7	438	260.4	1.7
2001	129	62.0	2.1	222	22.7	9.8	491	208.8	2.4	842	293.4	2.9
2002	176	115.7	1.5	165	36.7	4.5	1,033	460.9	2.2	1,374	613.2	2.2
2003	25	11.7	2.1	459	104.0	4.4	1,038	455.7	2.3	1,522	571.3	2.7

Appendix Table 14. Age frequencies of arctic cisco caught in 76 mm mesh, 1976-2002.

	Percent																				
Age (Years)	1976	1977	1978	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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
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	28.7	24.5	3.5	10.3	7.6
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	14.0	65.0	33.6	16.5	72.9
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	48.3	2.8	37.1	37.1	14.6
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	4.2	8.4	4.2	14.4	4.2
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	9.1	2.8	11.2	4.1	0.7
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	1.4	1.4	4.2	12.4	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
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
N =	31	182	215	est.	est.	199	196	126	est.	150	143	154	148	139	148	150	146	151	150	143	97	144

1984, 1985 and 1989 age distributions estimated by comparing length frequencies of
Arctic cisco caught in gill nets to fish caught in fyke nets

Appendix Table 15. Age frequencies of least cisco caught in 76 mm mesh, 1976-2002.

Age (Years)	Percent																				
	1976	1977	1978	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
5			0.0				0.0		0.0		0.0		0.0		0.0		0.0		0.7		0.7	
6			7.4				0.0		2.3		0.7		0.0		0.0		0.0		4.1		1.3	
7			14.8				2.5		0.0		2.7		0.7		2.7		2.7		2.7		2.0	
8			28.4				12.6		4.5		8.0		4.7		3.3		6.1		6.8		2.7	
9			8.6				19.6		11.4		8.7		7.4		10.0		9.5		13.0		4.7	
10			7.4				18.1		20.5		15.3		16.8		8.0		14.9		18.5		14.0	
11			7.4				16.1		13.6		20.0		24.2		17.3		14.2		13.0		20.0	
12			11.1				14.1		9.1		16.0		13.4		15.3		15.5		8.9		19.3	
13			4.9				5.5		13.6		11.3		12.8		11.3		10.8		9.6		10.7	
14			4.9				4.5		11.4		8.0		8.1		9.3		10.1		7.5		8.0	
15			0.0				4.0		6.8		2.7		6.7		6.7		6.1		4.8		5.3	
16			2.5				1.0		2.3		0.7		2.7		6.7		4.7		4.1		4.0	
17			1.2				1.0		4.5		2.0		0.7		3.3		3.4		2.7		3.3	
18			1.2				0.0		0.0		2.0		0.0		2.7		2.0		1.4		1.3	
19			0.0				0.0		0.0		1.3		0.7		0.0		0.0		1.4		1.3	
20			0.0				0.5		0.0		0.7		0.0		0.7		0.0		0.7		1.3	
21			0.0				0.0		0.0		0.0		0.7		0.7		0.0		0.0		0.0	
22			0.0				0.5		0.0		0.0		0.0		0.7		0.0		0.0		0.0	
N =			81				199		44		150		149		150		148		146		150	

Appendix Table 16. Calculation of harvested biomass for arctic cisco in the Colville Delta fall fishery, 1985-2003.

Arctic Cisco

Estimated Mean Weight by Mesh Size

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)
51	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230
64	381	0.284	381	0.306	381	0.297	381	0.313	381	0.289	381	0.287	381	0.279	525	0.253	979	0.298
70	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354
76	629	0.425	1,428	0.429	830	0.471	773	0.484	1,601	0.518	470	0.393	1,327	0.365	1,596	0.369	1,965	0.403
83	883	0.465	883	0.475	883	0.472	883	0.515	883	0.514	883	0.475	883	0.431	233	0.454	920	0.469
89	1,162	0.516	346	0.462	122	0.539	63	0.653	212	0.539	223	0.555	211	0.556	325	0.477	870	0.469

Estimated Nigliq Catch

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
51		0		0		0		0		0	36	8	178	41	0	0	0	0
64	5,465	1,553	1,058	323	581	172	61	19	839	243	2,143	616	2,912	812	11,050	2,794	6,861	2,044
70		0		0	801	284	263	93		0		0		0	1,921	680	1,877	665
76	14,940	6,353	14,990	6,424	10,502	4,941	5,066	2,453	6,092	3,157	5,542	2,176	3,401	1,242	25,440	9,381	24,612	9,913
83	1,812	843	1,928	916	2,448	1,156	43	22	3,349	1,721	145	69	283	122	582	265	1,080	507
89	4,161	2,147	822	380	1,945	1,048	57	37	1,112	599	1,358	753	470	261	1,948	929	5,844	2,743
95															61	29	869	408
102							5	3										
114							16	10										
Total:	26,378	10,897	18,798	8,044	16,277	7,601	5,511	2,639	11,392	5,720	9,224	3,622	7,244	2,478	41,002	14,077	41,144	16,279

Estimated Outer Delta Catch

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
64	682	194		0		0		0		0		0		0		0		0
70		0		0		0		0		0		0		0		0		0
76	19,148	8,143	13,102	5,615	4,487	2,111	420	203	1,500	777	2,000	785	1,025	374	4,400	1,623	5,800	2,336
83		0	390	185		0		0		0		0		0		0		0
89	473	244	1,232	569	162	87	167	109		0		0		0		0		0
Total:	20,303	8,581	14,724	6,370	4,649	2,199	587	312	1,500	777	2,000	785	1,025	374	4,400	1,623	5,800	2,336

Estimated Commercial Catch

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
76	22,831	9,709	28,988	12,423	22,527	10,600	5,056	2,449	18,825	9,754	16,884	6,629	23,046	8,414	22,754	8,391	29,589	11,917
83		0		0	4,967	2,345	5,277	2,719	5,977	3,071	4,221	2,004	652	281	0	0	1,721	807
89	847	437	468	216		0	147	96		0		0		0	0	0	0	0
Total:	23,678	10,146	29,456	12,640	27,494	12,945	10,480	5,264	24,802	12,826	21,105	8,634	23,698	8,695	22,754	8,391	31,310	12,725

Appendix Table 16. continued.

Arctic Cisco

Estimated Mean Weight by Mesh Size

Mesh	1994		1995		1996		1997		1998		2000		2001		2002		2003	
(mm)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)
51	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230	116	0.230
64	125	0.219	1,185	0.295	1,273	0.307	1,273	0.296	1,310	0.296	1,310	0.296	1,629	0.296	264	0.258	460	0.310
70	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354	786	0.354
76	520	0.444	824	0.374	1,539	0.371	788	0.420	423	0.380	1,041	0.464	412	0.477	1,836	0.362	2,033	0.375
83	2,036	0.477	389	0.491	83	0.400	259	0.460	2,767	0.460	142	0.521	2,978	0.463	2,978	0.463	2,978	0.463
89	166	0.547	289	0.513	296	0.451	875	0.468	299	0.501	278	0.541	278	0.541	306	0.448	216	0.411

Estimated Nigliq Catch

Mesh	1994		1995		1996		1997		1998		2000		2001		2002		2003	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
51	0	0	0	0		0		0		0		0		0		0	293	67
64	1,665	364	307	91	1,770	544	435	129	146	43	12	4	375	111	1,332	343	4,320	1,341
70	258	91	134	47		0		0		0		0		0		0	533	189
76	3,242	1,438	2,257	844	13,376	4,961	18,381	7,717	5,531	2,103	6,756	3,137	2,087	996	5,263	1,904		0
83	15	7	850	417	512	205	2,211	1,017	151	69	737	384	223	103	66	31	17,284	8,003
89	375	205	1,357	696	1,514	683	10,103	4,724	2,320	1,163	2,451	1,327	1,250	677	872	390	939	386
95		0		0		0		0		0		0		0		0		0
102																		
114																		
Total:	5,556	2,106	4,905	2,096	17,172	6,393	31,130	13,587	8,148	3,378	9,956	4,851	3,935	1,886	7,533	2,669	23,369	9,986

Estimated Outer Delta Catch

Mesh	1994		1995		1996		1997		1998		2000		2001		2002		2003	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
64		0	90	27	2,267	697		0		0		0		0		0		0
70		0	232	82		0		0		0		0		0		0		0
76	5,400	2,396	3,287	1,230	18,963	7,033	2,144	900	5,411	2,057		0		0		0		0
83		0	55	27		0		0		0		0		0		0		0
89		0	4	2	2,803	1,265		0		0		0		0		0		0
Total:	5,400	2,396	3,669	1,368	24,033	8,994	2,144	900	5,411	2,057	0	0	0	0	0	0	0	0

Estimated Commercial Catch

Mesh	1994		1995		1996		1997		1998		2000		2001		2002		2003	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
76	7,054	3,129	14,311	5,353	20,740	7,692	15,686	6,586	6,579	2,501	2,591	1,203	1,566	747	3,935	1,424	3,935	1,477
83	1,904	908	0	0	1,077	431	1,304	600	2,173	1,000	28	15	358	166		0		0
89	0	0	0	0		0		0		0		0		0		0		0
Total:	8,958	4,037	14,311	5,353	21,817	8,124	16,990	7,186	8,752	3,501	2,619	1,218	1,924	913	3,935	1,424	3,935	1,477

Appendix Table 17. Calculation of harvested biomass for least cisco in the Colville Delta fall fishery, 1985-2003.

Least Cisco

Estimated mean weight by mesh size

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)	Samp. Size	Ave Wgt (kg)
51	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200
64	572	0.251	572	0.263	572	0.248	572	0.263	572	0.255	572	0.250	572	0.237	697	0.247	778	0.246
70	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290
76	449	0.342	370	0.329	400	0.344	285	0.346	388	0.355	267	0.317	292	0.236	124	0.345	311	0.297
83	36	0.397	36	0.382	36	0.393	36	0.412	36	0.406	36	0.366	36	0.385	39	0.386	62	0.345
89	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329

Estimated Nigliq Catch

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
51		0		0		0		0		0	545	109	172	34	0	0	0	0
64	492	123	951	250	1,090	270	46	12	3,086	786	3,633	909	2,261	536	1,381	341	3,739	921
70		0		0	355	103	33	10		0		0		0	65	19	274	80
76	1,271	434	746	245	2,695	926	715	247	1,247	443	4,696	1,491	726	171	1,078	372	2,745	814
83	27	11	59	23	456	179	48	20	190	77	15	6	24	9	4	2	82	28
89	81	27	50	16	149	49	8	3	13	4	211	70	11	4	127	42	754	248
95															3	1	4	1
102							1											
114							16											
Total:	1,871	595	1,806	535	4,745	1,527	867	291	4,536	1,310	9,100	2,584	3,193	754	2,658	777	7,599	2,093

Estimated Outer Delta Catch

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
64	692	173	32	8		0		0		0		0		0		0		0
76	13,175	4,504	4,924	1,619	1,417	487	1,392	481	1,500	533		0		0		0		0
83		0	12	5		0		0		0		0		0		0		0
89	76	25	31	10	16	5	62	20		0		0		0		0		0
Total:	13,943	4,702	4,998	1,642	1,433	492	1,454	502	1,500	533	0	0	0	0	0	0	0	0

Estimated Commercial Catch

Mesh	1985		1986		1987		1988		1989		1990		1991		1992		1993	
(mm)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
76	17,495	5,981	8,988	2,955	11,636	3,998	20,678	7,148	19,126	6,798	14,944	4,744	7,666	1,808	7,284	2,513	5,939	1,761
83		0		0	303	119	1,904	784	514	209	2,105	770	78	30	0	0	98	34
89	101	40	12	5		0	458	189		0		0		0	0	0	0	0
Total:	17,596	6,021	9,000	2,959	11,939	4,117	23,040	8,121	19,640	7,006	17,049	5,513	7,744	1,838	7,284	2,513	6,037	1,795

Appendix Table 17. (continued)

Least Cisco

Estimated mean weight by mesh size

Mesh (mm)	1994 Samp. Size	1994 Ave Wgt (kg)	1995 Samp. Size	1995 Ave Wgt (kg)	1996 Samp. Size	1996 Ave Wgt (kg)	1997 Samp. Size	1997 Ave Wgt (kg)	1998 Samp. Size	1998 Ave Wgt (kg)	2000 Samp. Size	2000 Ave Wgt (kg)	2001 Samp. Size	2001 Ave Wgt (kg)	2002 Samp. Size	2002 Ave Wgt (kg)	2003 Samp. Size	2003 Ave Wgt (kg)
51	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200	140	0.200
64	778	0.253	833	0.236	886	0.235	886	0.242	310	0.234	1,221	0.239	1,634	0.243	330	0.259	330	0.259
70	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290	106	0.290
76	218	0.306	234	0.308	123	0.302	173	0.300	514	0.288	328	0.325	515	0.310	681	0.311	587	0.310
83	62	0.371	92	0.335	92	0.367	133	0.336	133	0.336	133	0.336	147	0.345	147	0.345	147	0.345
89	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329	430	0.329

Estimated Nigliq Catch

Mesh (mm)	1994 No.	1994 (kg)	1995 No.	1995 (kg)	1996 No.	1996 (kg)	1997 No.	1997 (kg)	1998 No.	1998 (kg)	2000 No.	2000 (kg)	2001 No.	2001 (kg)	2002 No.	2002 (kg)	2003 No.	2003 (kg)
51		0		0		0		0		0		0		0		0	222	44
64	3,714	939	1,476	348	600	141	971	235	1,956	457	16	4	670	163	2,619	679	3,476	900
70	442	128	380	110		0		0		0		0		0		0	166	48
76	4,200	1,284	2,196	676	890	269	6,623	1,985	5,229	1,506	1,690	550	2,689	833	2,549	792		0
83	12	4	102	34	15	6	335	112	124	42	51	17	235	81	20	7	3,448	1,190
89	301	99	283	93	96	32	833	274	545	179	215	71	36	12	234	77	436	144
95		0		0		0		0		0		0		0		0		0
102																		
114																		
Total:	8,669	2,455	4,437	1,262	1,601	447	8,761	2,607	7,853	2,184	1,973	641	3,630	1,089	5,422	1,555	7,748	2,327

Estimated Outer Delta Catch

Mesh (mm)	1994 No.	1994 (kg)	1995 No.	1995 (kg)	1996 No.	1996 (kg)	1997 No.	1997 (kg)	1998 No.	1998 (kg)	2000 No.	2000 (kg)	2001 No.	2001 (kg)	2002 No.	2002 (kg)	2003 No.	2003 (kg)
64		0	708	167	1,552	365		0		0		0		0		0		0
76		0	3,333	1,026	12,700	3,833	1,241	372	11,470	3,303		0		0		0		0
83		0	95	32		0		0		0		0		0		0		0
89		0	1	0		0		0		0		0		0		0		0
Total:	0	0	4,137	1,225	14,253	4,198	1,241	372	11,470	3,303	0	0	0	0	0	0	0	0

Estimated Commercial Catch

Mesh (mm)	1994 No.	1994 (kg)	1995 No.	1995 (kg)	1996 No.	1996 (kg)	1997 No.	1997 (kg)	1998 No.	1998 (kg)	2000 No.	2000 (kg)	2001 No.	2001 (kg)	2002 No.	2002 (kg)	2003 No.	2003 (kg)
76	9,549	2,920	8,633	2,658	7,451	2,249	10,644	2,580	11,010	3,170	5,693	1,851	2,823	875	5,503	1,710	5,503	1,704
83	627	233	0	0	345	127	110	33	812	273	65	22	153	53		0		0
89	0	0	0	0		0		0		0		0		0		0		0
Total:	10,176	3,153	8,633	2,658	7,796	2,375	10,754	2,613	11,822	3,443	5,758	1,873	2,976	927	5,503	1,710	5,503	1,704

Appendix Table 18. Catch rate of arctic cisco in the commercial fishery by year-class, 1984-2002 (outlined boxes indicate year-class CPUE at age-5, based on CPUE corrected for effect of variable effort, 76-mm mesh).

	Fishing Year																			Year
Year Class	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Class Total
1974	0.0																			0.0
1975	0.0	0.0																		0.0
1976	0.0	0.8	0.0																	0.8
1977	6.0	2.9	0.0	0.0																8.9
1978	50.9	41.2	14.9	6.1	0.0															113.1
1979	6.7	13.0	94.7	25.5	0.5	0.1														140.6
1980		2.0	76.8	47.0	6.7	3.5	0.2													136.2
1981			0.0	0.8	0.2	0.0	0.0	0.6												1.6
1982				0.0	0.3	0.0	0.0	0.0												0.3
1983				0.4	13.7	26.7	0.8	1.7												43.3
1984						0.0	1.0	0.4												1.4
1985					0.2	6.8	25.8	10.0	2.3	3.0	0.2									48.3
1986							2.2	15.2	21.4	22.0	2.5	0.6								64.0
1987								1.5	35.2	118.1	12.7	2.2								169.7
1988										5.0	8.6	2.2	0.9							16.7
1989											2.9	7.1	12.2	2.6	0.5	0.0	0.3			25.7
1990											0.2	17.9	110.5	26.4	3.0	0.5	0.4			159.0
1991													7.0	7.5	1.4	1.0	0.5	0.1		17.4
1992														27.7	16.1	3.0	1.3	0.1		48.3
1993															4.7	1.0	0.5	0.0		6.2
1994															9.6	23.3	4.4	0.1	0.1	37.6
1995																8.8	4.0	0.4	0.6	13.8
1996																	0.4	0.2	2.1	2.7
1997																		0.1	10.6	10.7
1998																			1.1	1.1
Total CPUE	65.9	60.5	186.5	79.7	21.6	37.1	30.0	29.7	58.9	148.1	27.2	30.1	130.5	64.3	35.2	37.6	12.0	1.0	14.5	

boxes indicate CPUE at age-5

Appendix Table 19. Mean weight and CPUE by mesh size in the Nigliq Channel fishery, 1986-2003.

Arctic Cisco

Mean Weight (kg) by Mesh Size

Mesh (mm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003
51	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230
64	0.306	0.297	0.313	0.289	0.287	0.279	0.253	0.298	0.219	0.295	0.307	0.296	0.296	0.296	0.296	0.258	0.310
70	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354
76	0.429	0.471	0.484	0.518	0.393	0.365	0.369	0.403	0.444	0.374	0.371	0.420	0.380	0.464	0.477	0.362	0.375
83	0.475	0.472	0.515	0.514	0.475	0.431	0.454	0.469	0.477	0.491	0.400	0.460	0.460	0.521	0.463	0.463	0.463
89	0.462	0.539	0.653	0.539	0.555	0.556	0.477	0.469	0.547	0.513	0.451	0.468	0.501	0.541	0.541	0.448	0.411
95	0.462	0.539	0.653	0.539	0.555	0.556	0.477	0.469	0.547	0.513	0.513	0.513	0.513	0.513	0.513	0.513	0.513

Mean CPUE by Mesh Size

Mesh (mm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003
51					5.7	44.5											18.3
64	15.4	9.9	3.7	5.3	22.4	26.6	44.5	33.3	6.7	4.6	27.2	12.9	2.2	1.0	4.0	7.5	24.3
70		26.7	6.4				15.4	10.7	2.3	4.0							8.1
76	23.5	16.1	12.4	12.5	11.0	4.4	24.7	33.0	4.2	3.0	17.5	25.4	4.4	9.6	2.7	4.6	14.4
83	14.7	8.4	1.5	3.0	5.6	3.7	14.9	15.6	0.6	5.3	3.1	17.5	10.2	6.7	1.6	0.8	
89	10.3	11.4	0.8	4.5	8.2	1.2	4.7	11.6	1.7	2.9	2.2	20.1	3.0	4.4	2.5	1.6	4.5
95							3.1	19.3									

Least Cisco

Mean Weight (kg) by Mesh Size

Mesh (mm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003
51	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
64	0.263	0.248	0.263	0.255	0.250	0.237	0.247	0.246	0.253	0.236	0.235	0.242	0.234	0.239	0.243	0.259	0.259
70	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290
76	0.329	0.344	0.346	0.355	0.317	0.236	0.345	0.297	0.306	0.308	0.302	0.300	0.288	0.325	0.310	0.311	0.310
83	0.382	0.393	0.412	0.406	0.366	0.385	0.386	0.345	0.371	0.335	0.367	0.336	0.336	0.336	0.345	0.345	0.345
89	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329
95	0.382	0.393	0.412	0.406	0.366	0.385	0.386	0.345	0.371	0.335	0.335	0.335	0.335	0.336	0.336	0.336	0.336

Mean CPUE by Mesh Size

Mesh (mm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003
51					46.6	43.0											13.9
64	13.8	18.7	2.8	19.5	33.5	13.9	5.5	18.1	15.0	22.1	11.5	28.8	30.1	1.3	7.1	14.8	19.6
70		11.8	1.4				0.5	1.6	3.9	11.4							1.7
76	1.2	4.1	1.7	2.8	4.7	0.7	1.1	3.7	5.4	2.9	1.1	9.2	4.2	2.4	3.5	2.2	2.9
83	0.5	1.6	1.7	0.9	0.3	0.3	0.1	1.2	0.5	0.6	0.6	2.6	8.4	0.5	1.7	0.2	
89	0.6	0.9	0.1	0.1	0.4	0.0	0.4	1.5	1.4	0.6	0.6	1.7	0.7	0.4	0.1	0.4	2.1
95							0.2	0.1									

Appendix Table 20. Salinity profiles from the Nigliq Channel, Colville Delta, 2003.

RK = River Kilometer, as measured from the mouth of Nigliq Channel
Depth in meters from upper surface of ice, salinity in ppt

Upper Nigliq (RK 29)

Depth (m)	Oct 24	Oct 26	Oct 28	Oct 30	Nov 1	Nov 4	Nov 5	Nov 7	Nov 9	Nov 11	Nov 13	Nov 16	Nov 18	Nov 21	Nov 23
	Salinity (ppt)														
0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.7	0.5	0.4	0.3	0.4	0.5
1.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.5	0.8	0.5	5.7	0.8	0.4	0.9
1.5	0.1	0.1	0.1	0.1	2.1	1.9	0.2	1.7	1.8	5.1	4.9	8.2	8.9	7.7	8.3
2.0	0.1	0.1	0.1	0.1	2.4	3.8	3.8	4.4	4.6	7.0	7.9	8.6	10.8	8.5	9.0
2.5	0.1	0.1	0.1	0.2	3.3	4.1	4.5	5.3	7.1	7.6	8.4	9.0	12.9	9.2	9.5
3.0	0.1	0.1	0.1	0.2	4.0	4.5	4.8	7.0	8.0	8.1	8.7	9.3	12.9	9.6	9.7
3.5	0.1	0.1	0.1	0.4	4.4	4.8	5.6	7.4	8.3	8.7	9.1	9.5	13.0	9.6	9.8
4.0	0.1	0.1	0.1	0.7	4.7	4.8	5.6	8.0	10.8	9.0	9.1	9.7	14.7	9.7	10.0

Nanuq Lake (RK 15)

Depth (m)	Oct 24	Oct 26	Oct 28	Oct 30	Nov 1	Nov 4	Nov 5	Nov 7	Nov 9	Nov 11	Nov 13	Nov 16	Nov 18	Nov 21	Nov 23
	Salinity (ppt)														
0.5	0.2	0.6	2.0	3.6	5.2	2.5	3.3	5.6	5.2	5.8	7.9	5.9	5.9	5.4	6.1
1.0	0.2	0.8	3.8	3.7	10.6	5.0	3.4	8.1	10.5	5.8	8.1	6.8	9.1	5.5	7.0
1.5	0.3	1.9	7.9	13.0	13.8	15.1	13.9	13.6	18.7	10.9	11.6	17.1	16.9	8.0	8.9
2.0	11.2	14.3	13.1	13.9	16.0	17.2	17.5	17.2	19.5	13.2	18.4	19.0	18.4	19.1	19.3
2.5	13.5	14.6	14.5	15.3	16.6	17.6	18.5	19.3	19.6	13.7	18.8	19.4	19.1	19.3	19.3
3.0	13.7	14.8	15.0	15.7	17.1	17.8	18.9	19.4	19.7	14.2	19.2	19.5	19.4	19.5	19.5
3.5	13.9	15.0	15.2	15.8	17.4	18.0	19.1	19.5	19.8	14.4	19.6	19.6	19.8	19.5	19.6
4.0	14.1	15.1	15.2	16.4	17.6	18.4	19.1	19.8	19.8	14.7	19.7	19.7	19.6	19.6	19.6
4.5	14.4	15.3	15.3	16.4	17.7	18.5	19.2	20.0	20.1	14.8	19.7	19.9	19.8	19.8	19.6
5.0	14.4	15.4	15.5	16.5	17.9	18.7	19.3	20.4	20.2	15.1	19.8	19.9	19.9	19.8	20.0
5.5	14.8	15.6	15.5	16.6	18.0	18.8	19.5	20.5	20.2	15.8	20.0	20.0	19.9	20.0	20.2
6.0	14.9	15.7	15.5	16.8	18.1	19.0	19.7	20.5	20.2	16.1	20.1	20.1	20.0	20.0	20.7
6.5	15.0	15.7	15.5	16.8	18.6	19.1	19.8	20.5	20.1	16.4	20.1	20.2	20.0	20.1	20.9
7.0	15.0	15.8	15.5	16.8	18.6	19.2	19.8	20.6	19.9	16.4	20.1	20.2	20.1	20.1	20.9

Appendix Table 20. Salinity profiles from the Nigliq Channel, Colville Delta, 2003 (continued).

Nigliq Delta (RK 6)

Depth	Salinity (ppt)												
(m)	Oct 24	Oct 26	Oct 28	Nov 1	Nov 4	Nov 5	Nov 7	Nov 9	Nov 11	Nov 13	Nov 18	Nov 21	Nov 23
0.5	0.6	0.7	2.8	4.8	4.9	5.5	6.5	7.8	7.8	8.0	8.7	9.6	9.1
1.0	0.6	0.7	3.8	6.8	9.1	5.9	7.5	18.3	8.0	11.1	9.0	16.3	12.9
1.5	11.3	10.2	12.2	14.2	15.5	16.8	10.4	19.9	18.4	18.4	9.2	19.3	13.4
2.0	13.9	14.6	16.5	19.9	18.3	19.4	19.7	20.5	19.4	18.8	17.7	20.6	19.8
2.5	11.5	17.6	19.6	21.2	20.1	20.5	21.2	20.9	19.7	19.7	19.2	20.7	21.3
3.0	18.5	18.5	19.9	22.8	20.5	21.5	22.4	21.2	19.9	19.9	20.2	21.6	22.0
3.5	19.2	19.3	20.1	23.4	23.8	23.2	22.8	21.7	20.3	21.0	20.5	22.0	22.9
4.0	19.7		20.6	23.6	24.1	24.4	23.1	22.0	20.8	21.4	20.5	22.5	23.3
4.5	20.9		21.3	24.1		24.5	23.3	22.9	20.8	22.0	20.8	23.0	23.5
5.0	21.8		21.7	24.3		24.6	23.3	23.7	21.4	22.5	20.9	23.2	23.8
5.5	22.3		21.9	24.4			24.3	22.6	21.3	22.4	21.1	23.2	24.1
6.0	22.5		22.2	24.6			24.3	22.4	21.1	22.8	21.1	23.2	24.1
6.5	22.5		22.3	24.7			24.3	22.4	20.8	22.8	21.1	23.2	24.1

Appendix Table 21. Cumulative length frequencies of Arctic cisco and least cisco by mesh size, Nuiqsut fishery, 1986-2003. (data used to evaluate mesh selectivity)

Arctic Cisco - Village Catch

Fork Length (mm)	Village Mesh Sizes in inches					
	2.00	2.50	2.75	3.00	3.25	3.50
200	0	0	0	2	0	0
210	1	3	0	0	0	1
220	0	1	1	4	1	0
230	1	2	0	5	0	0
240	9	3	0	3	0	0
250	11	51	0	10	0	1
260	31	125	0	6	0	1
270	28	229	9	30	1	3
280	16	320	22	215	3	7
290	9	386	62	749	5	38
300	4	365	160	2,227	33	100
310	2	241	224	3,532	136	193
320	4	159	157	3,303	301	369
330	0	80	84	2,726	469	731
340	0	38	44	1,848	542	1,064
350	0	19	11	1,132	345	1,027
360	0	7	5	644	242	797
370	0	3	3	355	160	454
380	0	3	3	173	72	280
390	0	4	1	93	27	117
400	0	0	0	40	13	68
410	0	0	0	14	2	35
420	0	0	0	2	6	15
430	0	0	0	1	1	2
440	0	0	0	1	1	4
450	0	0	0	1	1	0
Total:	116	2,039	786	17,116	2,361	5,307

Least Cisco - Village Catch

Village Mesh Sizes in mm					
2.00	2.50	2.75	3.00	3.25	3.50
1	1	1	6	0	2
4	1	1	3	0	1
14	3	0	2	0	0
12	10	0	6	0	3
14	33	0	11	0	8
15	120	1	15	2	15
27	237	0	36	1	18
19	380	3	90	1	25
16	379	9	312	9	21
13	295	20	722	11	34
2	203	30	975	18	47
3	121	21	976	19	42
0	61	11	639	17	51
0	34	6	406	26	30
0	12	1	195	11	35
0	5	0	100	11	23
0	4	2	65	10	31
0	1	0	28	5	19
0	1	0	21	3	12
0	1	0	13	3	8
0	0	0	0	0	4
0	0	0	0	0	2
0	0	0	0	0	2
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
140	1,902	106	4,621	147	433

Mesh Size in:	inches	mm
	2.00	51
	2.50	64
	2.75	70
	3.00	76
	3.25	83
	3.50	89

Appendix Table 22. Cumulative length frequencies of Arctic cisco by mesh size, commercial fishery, 1985-2002. (data used to evaluate mesh selectivity)

Arctic cisco - Commercial Catch

Fork Length (mm)	Commercial 76-mm Mesh 1985	1986	1987	1988	1989	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
220	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
250	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
280	2	0	0	0	0	0	0	0	3	1	0	0	0	0	0	2	0	8
290	7	1	0	2	4	7	16	0	0	25	5	8	1	1	0	4	8	89
300	36	8	0	18	22	16	45	0	12	77	23	19	19	10	5	13	28	351
310	92	39	5	50	35	60	109	17	28	106	50	36	41	37	4	16	52	777
320	103	51	22	69	24	54	129	56	39	68	91	57	30	62	23	26	77	981
330	112	49	61	38	35	54	84	91	40	52	47	41	46	60	51	23	47	931
340	67	43	88	26	49	24	46	65	47	30	13	42	44	44	65	37	18	748
350	21	27	93	31	79	8	9	55	58	12	8	28	51	23	56	43	4	606
360	13	19	49	41	66	9	9	10	50	13	2	15	31	18	62	46	4	457
370	7	8	20	47	35	3	3	5	21	8	3	4	24	18	34	49	5	294
380	3	4	10	43	24	3	0	1	1	4	6	0	8	11	30	38	6	192
390	5	1	1	24	8	2	1	0	0	4	2	0	4	8	12	18	2	92
400	1	0	1	7	12	5	0	0	0	0	0	0	1	6	8	26	2	69
410	0	0	0	0	5	2	0	0	1	0	0	0	0	1	0	13	0	22
420	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	3	0	6
430	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	2
440	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
450	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total:	471	250	350	396	400	250	451	300	300	400	250	250	300	300	351	357	253	5,629