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Abstract

The Nunavik communities have traditionally hunted beluga along the eastern Hudson Bay, Hudson Strait and Ungava Bay coasts of northern Quebec. Catch levels by these communities have been monitored over the last twenty-six years, and this report summarises available information on these statistics from 1974 to 2000. Between 1974 and 1986, an average of 243 beluga were harvested annually by the four Hudson Strait communities, whereas 124 and 83 animals were harvested by three communities in eastern Hudson Bay, and five communities in Ungava Bay, respectively. During that period, a decline in beluga harvests was observed in each region, and in several communities, although it occurred later (post 1981) in eastern Hudson Bay than in Hudson Strait and Ungava Bay (post 1978). The location of harvest, some biological samples, and the age, sex and colour composition of catches were provided by hunters for beluga harvested during 1993–2000. Beluga are harvested during summer by the communities of Kuujuaapik, Umiujaq, and Inujuaq in the south-eastern Hudson Bay, and during October by Akulivik and Puvirnituk in the north-eastern Hudson Bay. Hudson Strait communities harvest beluga in the fall and spring when animals move in and out of the Strait. Ungava Bay communities tend to follow the same pattern since the imposition, in 1986, of restrictions on beluga harvests in Ungava Bay. In recent years, Akulivik and Puvirnituk tend to harvest part, or most, of their quota from the Ivujivik area in south-western Hudson Strait, while Ungava Bay communities harvested beluga both from the Ungava Bay and the Quartaq area, in south-eastern Hudson Strait. Depending on region, grey beluga represented 46 to 51% of harvests, and females, 47 to 60% of catches during 1993–2000. The proportion of white males (23–30%) in harvests was near the percentage expected if animals were taken at random (*i.e.* 25%) during 1995–2000, even though management plans recommended that harvesting be directed towards white males. A comparison of the age frequency distributions of beluga harvested during the mid 1980s and the 1990s, indicates a recent, statistically significant change in the age composition of the harvest. During 1980–1987, the median age of beluga taken by the Nunavik communities was 14 yrs, whereas this value decreased to 9 yrs during 1993–1999. This tendency was even more pronounced for the three southernmost communities of eastern Hudson Bay and the communities from Ungava Bay, with median ages of 8.0 yrs and 8.5 yrs, respectively. The number of beluga sampled from Puvirnituk's harvest during October in south-western Hudson Strait is small ($n = 13$) but indicates 50% of the harvest is young, aged ≤ 7.5 yrs.

Résumé

Les collectivités du Nunavik pratiquent une chasse traditionnelle du béluga le long des côtes de l'est de la baie d'Hudson, du détroit d'Hudson et de la baie d'Ungava, dans le Nord du Québec. Les niveaux de captures faites par ces collectivités sont surveillés depuis vingt-six ans; le présent rapport résume ces données pour la période allant de 1974 à 2000. De 1974 à 1986, les quatre collectivités du détroit d'Hudson capturaient en moyenne 243 bélugas par année, tandis que trois collectivités de l'est de la baie d'Hudson et cinq collectivités de la baie d'Ungava en capturaient respectivement 124 et 83 par année. Au cours de cette période, les prises ont baissé dans chaque région, et pour plusieurs collectivités; ce déclin s'est produit plus tard (après 1981) dans l'est de la baie d'Hudson que dans le détroit d'Hudson et la baie d'Ungava Bay (après 1978). Les chasseurs ont fourni des renseignements sur le lieu de capture, l'âge, le sexe et la couleur des prises faites de 1993 à 2000, ainsi que quelques échantillons biologiques prélevés sur ces prises. Les collectivités de Kuujjuaraapik, d'Umiujaq et d'Inujjuaq, situées sur la côte sud-est de la baie d'Hudson, chassent le béluga durant l'été, tandis que les villages d'Akulivik et de Puvirnituq, dans le nord-est de la baie d'Hudson, le chassent en octobre. Les collectivités du détroit d'Hudson pratiquent leur chasse au printemps et à l'automne, lorsque les bélugas entrent dans le détroit et en sortent, comme les collectivités de la baie d'Ungava ont tendance à faire depuis qu'on a restreint les prises de bélugas dans la baie d'Ungava en 1986. Depuis quelques années, les chasseurs d'Akulivik et de Puvirnituq capturent une partie, sinon la plupart, de leur quota dans la région d'Ivujivik, dans le sud-ouest du détroit d'Hudson, tandis que les collectivités de la baie d'Ungava chassent le béluga tant dans la baie d'Ungava que dans la région de Quartaq, dans le sud-est du détroit d'Hudson. De 1993 à 2000, les bélugas gris représentaient de 46 à 51 % des prises, et les femelles, de 47 à 60 % des prises, selon la région. La proportion de mâles blancs capturés de 1995 à 2000 (de 23 à 30 %) s'approchait du pourcentage de la population qu'ils constituent, soit 25 %, même si les plans de gestion recommandaient que la chasse se concentre sur les mâles blancs. La comparaison de la répartition des âges des bélugas capturés au cours des années 1980 et des années 1990 indique un changement récent statistiquement significatif de la composition par âge des prises. En effet, l'âge médian des bélugas capturés par les collectivités du Nunavik de 1980 à 1987 était de 14 ans, alors que cette valeur a baissé à 9 ans pour la période allant de 1993 à 1999. Cette tendance était plus marquée pour les captures faites par les trois collectivités les plus méridionales de l'est de la baie d'Hudson et par les villages de la baie d'Ungava, l'âge médian ayant chuté à 8,0 ans et à 8,5 ans, respectivement. Le petit échantillon (n = 13) de bélugas capturés par les chasseurs de Puvirnituq en octobre dans le sud-ouest du détroit d'Hudson indique que la moitié des prises sont jeunes, ne dépassant pas 7,5 ans

Introduction

The beluga, *Delphinapterus leucas*, has a circumpolar distribution. In northern Quebec (Nunavik), large concentrations of these animals are observed in Hudson Strait during the winter (Finley et al. 1982; Richard et al. 1990). Beluga disperse during the summer, and are observed along both coasts of Hudson Bay, as well as in James Bay and Ungava Bay. Genetic studies (Brennin et al. 1997; Brown Gladden et al. 1997) indicate at least two separate stocks: a western Hudson Bay stock of $\approx 23,000$ individuals, and an eastern Hudson Bay stock of $\approx 1,000$ individuals (these estimates are uncorrected for animals missed because they were underwater during census; Smith and Hammill 1986; Richard et al. 1990; Kingsley 2000). Approximately 3,000 beluga enter James Bay during summer, but their relationship to other beluga is unknown. Numbers of beluga entering Ungava Bay during this period are now too few to be estimated using standard techniques (Smith and Hammill 1986; Kingsley 2000). In 1993, an estimated minimum of 20 individuals was present in Ungava Bay during summer, with an imprecise upper 90% confidence limit of 150 individuals (Kingsley 2000).

Beluga hunting is an important traditional activity for Nunavik communities. During the eighteenth, nineteenth, and early twentieth centuries, commercial whaling at various sites along the Nunavik coasts increased hunting pressure on northern Quebec beluga stocks (Reeves and Mitchell 1987a; 1987b). Hunting has reduced eastern Hudson Bay and Ungava Bay beluga numbers below historic levels, leading to their classification as ‘threatened’ and ‘endangered’ stocks, respectively, by the Committee on the Status of Endangered Wildlife in Canada (Reeves and Mitchell 1989; Richard 1993).

Native people from the Nunavik still harvest beluga along the northern Quebec coasts. Catch levels have been monitored since 1974. Beginning in 1986, management plans were adopted by the Department of Fisheries and Oceans (DFO), in cooperation with Anguvigaq Wildlife Management Inc, and are re-examined on a regular basis (Table 1). Management plans prescribed different conservation measures, including quotas for each community, and the creation of permanent sanctuaries in southern Ungava Bay (1986) at the Whale, Mucalic, Tuctuc and Tunulic rivers, and seasonal closures at the Nastapoka (1991) and Little Whale (1996) rivers in eastern Hudson Bay. To reduce the effects of the harvest on the dynamics of the population, hunters agreed, in compliance with the *Beluga Protection Regulations*, and later, the *Marine Mammal Regulations* of the *Fisheries Act*, to avoid killing of mature females accompanied by calves. The management plan from 1996–2000 recommended further that any hunt be directed towards adult males (Fisheries and Oceans Canada 1996).

This paper summarises and qualifies the information on beluga catch levels by Nunavik communities between 1974 and present (*i.e.* before and after management plans were implemented) and includes yearly, seasonal and spatial distribution of the kills, age, colour and sex composition of the harvests.

Methods

Harvest data have been collected systematically in each community since 1974, although the degree of participation and quality of the information vary between communities and years. During 1974–1980, catch levels were compiled by the Native Harvesting Research Committee, which was created under the James Bay and Northern Quebec Agreement (Native Harvesting Research Committee 1976; 1979; 1982a; 1982b). Harvest level data from 1974 and 1975 were obtained *a posteriori* through questionnaires to hunters, whereas those from 1976 to 1980 were obtained through weekly reports by individual hunters. Considering the interest of community hunters to continue participating in the monitoring program, the Department of Fisheries and Oceans approached Anguvigaq Wildlife Management Inc. and the Makivik Corporation in 1984 to fill the gap in data between 1980 and 1985 (Brooke and Kemp 1986). It is unclear how harvest levels were obtained during the 1980–1984 period, but in 1985, harvest levels were monitored on a daily basis using booklets distributed to individual hunters (Brooke and Kemp 1986). Beginning in 1986, community agents, and depending on years, personnel from Anguvigaq, Makivik, or Kativik Regional Government, assisted in the monitoring of beluga harvests through weekly and annual reports (Brooke 1992; 1995; 1996; 1997; 1998; Olpinski 1993; Portnoff 1994; Richard 1993; R. Fibich, Coordinator, Northern Quebec Affairs for years 1998–2000). Monthly harvests

were available from annual summary reports in yr. 1985 and yrs 1991 to 1997, from a compilation of community agent weekly reports in 1998–2000 (transmitted to R. Fibich), and from figures presented in Finley et al. (1982) between 1976 and 1979. Information on harvest period was used to examine inter-annual and seasonal variation in harvesting activity by the different communities.

Beginning in 1993, hunters were solicited by the Makivik Corporation to participate in a sampling program that aimed at documenting the composition and seasonal and spatial distribution of harvests. Hunters were provided with data sheets and sampling kits, and were asked to indicate the sex, colour of each animal, as well as the location and date of harvesting. Hunters also collected teeth for age determination, and other samples for genetic studies (de March et al. 2001). The proportion of harvested beluga that were sampled under this program was generally less than 50%, and varied between communities and years.

Age was determined, assuming the deposition of two growth layer groups (GLGs) per year (Goren et al. 1987; Brodie et al. 1990). The age, sex and colour of beluga harvested between 1993–1999 were compared with those of beluga taken in the same area during 1980–1987, using information provided by hunters (1993–1999) and published information (1980, 1983–1987: Doidge 1990). Tooth wear might bias age downward in older animals, and was noted for each tooth, except for tooth from yrs 1993, 1995 and 1997. The reader involved in the age determination during the 1980s double-checked some of the ages obtained for the 1990s to insure consistency of results.

The communities from the Nunavik territory were divided into three distinct zones: the eastern Hudson Bay, Hudson Strait, and Ungava Bay regions, which comprised respectively 5, 4 and 5 communities (Figure 1). Harvest statistics are presented separately for the pre-quota period (1974–1985), and periods when quotas were in effect, but which preceded (1986–1995) or followed (1996–2000) the recommendation of a hunt directed towards males. Between 1974 and 1985, an estimate of yearly harvests by each community was obtained by correcting catch levels provided by participating hunters in a community for those who were unwilling to participate in the program (Native Harvesting Research Committee 1976; 1982a; 1982b). For years 1986 to present, this correction does not appear to have been maintained, and reported harvests are meant to represent total harvests. In years when a community did not participate in the program, harvest levels were estimated using median catch levels for the period characterised by similar management measures. For example, harvest levels for Ivujivik in yrs 1974 to 1980 were estimated as the median catch levels over the 1981–1985 period, *i.e.* 69 beluga. Only in the case of Puvirnituq in yrs 1974–1985 were such estimates not applicable, Puvirnituq having failed to provide harvest data during the entire period when no quota was established.

Results

Annual beluga harvests, and harvest trends

Annual beluga harvests vary greatly between regions and communities (Table 2; Appendix 1). Regardless of time periods or quota levels, the largest harvests occurred in the Hudson Strait communities, while the lowest catches consistently came from those of Ungava Bay. Before the introduction of quotas, an average of 243 beluga were harvested annually by the four Hudson Strait communities, while these figures were 124 and 83 animals for three eastern Hudson Bay and five Ungava Bay communities, respectively. Although the annual regional harvest was less in eastern Hudson Bay than Hudson Strait during this period, the eastern Hudson Bay community of Inujjuaq harvested the largest number of beluga annually, with an average of 71 beluga/yr, and regularly took more than 100 beluga/yr prior to 1981. Puvirnituq, a community also located in the north-eastern part of Hudson Bay, might also have taken large numbers of beluga during the pre-quota period, but their harvest statistics prior to the introduction of quotas are not available. This community represented the eastern Hudson Bay community harvesting the largest number of beluga after quotas were introduced. The next largest annual harvests came from three of the four communities of Hudson Strait: Ivujivik, Salluit and Kangirsujuaq, with averages of 62–70 beluga/yr, and occasional harvests in excess of 100 individuals. Ungava Bay communities harvested an average of 5–33 beluga/yr during the pre-quota period, which resulted in regional annual harvests >100 individuals during the 1970s.

When examining temporal trends in harvest levels prior to quota introduction, one notices a decline in total harvests in the late 1970s (Figure 2). This reduction in beluga harvests was observed in each region (Figure 3), and in several communities (Figure 4), although it occurred later in eastern Hudson Bay (1981) than in Hudson Strait or Ungava Bay (1978). Once quotas were introduced, the annual take decreased in each region, and became less variable between years (Table 2; Figure 3). Annual harvests in recent years (1996–2000) stabilised at 125, 106, and 54 beluga for the Hudson Strait, eastern Hudson Bay, and Ungava Bay, but often exceeded the annual quotas of 100, 90, and 50 beluga, respectively, for these regions.

Seasonal distribution and location of harvests

Beluga are successfully harvested principally between June and November (Figure 5; see Appendix 2 for detailed monthly harvests). However, the period and location where most of the animals are taken vary depending on regions, communities and years.

Before the introduction of management plans, catch levels peaked in July in the participating communities from eastern Hudson Bay (Kuujjuaraapik, Inujjuaq and Akulivik; Figure 5). However, once quotas and other restrictions on harvesting were introduced, a shift in harvesting dates was observed in some communities. July continued to be the most successful period for beluga hunting in the three southernmost villages of eastern Hudson Bay (Kuujjuaraapik, Inujjuaq, and the new village of Umiujaq, opened in 1985). A shift or a second peak in harvest was observed during October–November in the two northernmost communities of eastern Hudson Bay (Akulivik and Puvirnituk). A clearer pattern emerges when monthly distributions of harvests are examined separately for the years when different regulations prevailed. Following the recommendation that, during 1992 to 1994, Akulivik and Puvirnituk hunt in Hudson Strait, a clear shift towards an October hunt was observed in Akulivik (Figure 6a). However, a large proportion of the harvest remained in the vicinity of the community at that time. During the same period, Puvirnituk maintained a summer beluga harvest along the eastern Hudson Bay coast, but also harvested about 45% of their animals from the Ivujivik area in Hudson Strait (Figure 6b). The restriction on beluga harvesting in Hudson Bay was maintained in 1995–2000 for Puvirnituk, but relaxed for Akulivik hunters. During that period, most beluga taken by either community were harvested during October–November (Figure 6). The location of harvesting was mainly the Ivujivik area for Puvirnituk, with only a few animals taken at the Nastapoka River, while harvest locations during 1995–2000 are generally unknown for Akulivik.

The creation of sanctuaries prohibiting beluga harvesting during July at the Nastapoka (1991) and Little Whale (1996) rivers, in eastern Hudson Bay, did not result in major reductions in harvesting during July by the communities neighbouring these rivers (Umiujaq and Kuujjuaraapik; Figure 7). While Kuujjuaraapik hunters provided no information on the location of their harvests during July, information obtained from Umiujaq hunters, and *in situ* observations by the DFO research team indicate that Umiujaq respected, at least in some years (1993, 1995, 1996 and 1999), the July closure of the Nastapoka River, and harvested beluga in other areas. Inujjuaq hunters, who also harvested most of their animals at the Nastapoka River, shifted their peak harvest period towards August, but still took appreciable numbers of beluga during July (Figure 5). Although their July takes were also obtained elsewhere than the Nastapoka River in some years, reports from the Umiujaq community agent indicate that Inujjuaq hunters harvested beluga at the Nastapoka River at least in 1996 during its closure.

Prior to the establishment of quotas, harvesting by the Hudson Strait communities occurred primarily during June–July and October–November, with a majority of the animals taken during the spring (except for Quartaq), and only a few catches reported in August and September (Figure 5). Following the introduction of seasonal quotas in 1996, the hunting patterns of the four Hudson Strait communities changed according to the management plan (*i.e.* 7 beluga during summer (July 15 – September 14), and either, larger quotas in the spring than fall (Salluit and Kangirsujaq), or even quotas during the spring and fall (Ivujivik and Quartaq)). Each community tended to harvest beluga in the vicinity of their community. An eastward trend in the timing of harvests was observed along Hudson Strait, with most of the animals being taken in October in Ivujivik and Salluit, and both during October and November in Kangirsujaq and Quartaq (Figure 5).

A harvesting pattern similar to that observed in Hudson Strait appeared in Ungava Bay following restrictions in the number of beluga to be harvested within the Bay (Figure 5). Instead of being hunted mostly in July and August as previously, beluga were then harvested mostly during June–July and October–November, with few animals taken during August and September. Although this pattern is consistent in the three communities located close to the Hudson Strait, the August hunt continued to be appreciable in the two communities located in southern Ungava Bay (Kuujjuaq and Kangirsualujjuaq). Each community harvested some animals outside the Bay, in the Quartaq region, and all five communities did take some beluga during August (see Appendix 2). According to the management plan, all of the beluga should have been taken outside Ungava Bay during that period. However, it is not possible to determine whether beluga harvested during August were taken inside or outside the Bay, due to the absence of information on the location of these kills.

Age and sex composition of harvests

Beluga of known sex harvested during 1993–2000 totals 306 whales, which have a catch composition of 51%, 47% and 60% of females in eastern Hudson Bay, Hudson Strait and Ungava Bay, respectively (Table 3). White females represented 51% of the females taken in eastern Hudson Bay, and 46% and 39% of those taken in Hudson Strait and Ungava Bay, respectively. Grey beluga represented 46–51% of the known-colour harvests depending on the region. Beginning in 1995, management plans recommended that harvesting be directed towards white males. However, the proportion of white males taken during this period was 23–30% depending on regions and thus, was near the percentage expected if animals were taken at random (*i.e.* 25%) (Table 3). No trend in the proportion of males or females was observed in the catch over the years in any regions (Figure 8).

The high takes of grey beluga by the Nunavik communities were reflected in the age structure of the harvest. A comparison of the age frequency distributions of beluga harvested during the mid-1980s and the 1990s, indicates a recent, statistically significant change in the age composition of the harvest, using either both worn and unworn teeth (Kolmogorov-Smirnov two-sample test: $D_{195,199} = 0.30$; $P < 0.0001$; Figure 9a) or unworn teeth only ($D_{113,87} = 0.21$; $P = 0.025$; Figure 9b). During 1980–1987, the median age of harvested beluga was 13 yrs. The beluga examined during this period were harvested mainly in eastern Hudson Bay (69%), with 27% and 4% of the animals coming from the Hudson Strait and Ungava Bay. By 1993–1999, the median age had dropped to 9 yrs. Animals during that period were taken mainly from Hudson Strait (49%) and Eastern Hudson Bay (35%), and to a lesser extent Ungava Bay (16%). The overall decrease in the age of harvested beluga is also indicated by a decline in the proportion of beluga with worn teeth, from 42% in 1980–1987 to 21% in 1993–1999. Using only beluga harvested in the Eastern Hudson Bay area provided similar results, with harvests being significantly different in age composition between the 1980s and 1990s (using worn and unworn teeth: $D_{132,69} = 0.36$; $P < 0.0001$), and including younger beluga in recently years (median = 8 yrs; $n = 69$) as compared to the 1980s (median = 13 yrs; $n = 132$) (Figure 10a). This trend became insignificant when using unworn teeth only ($D_{69,29} = 0.25$; $P < 0.10$), a result that might be related to a decrease in power of the statistical test due to low sample sizes.

This reduction in the age of harvested beluga is also pronounced in Ungava Bay, with a median age of 8.5 yrs for beluga taken from this region (Figure 11c). In contrast, the median age of the beluga harvested by the Hudson Strait communities is higher than the regional median, with a value of 10.0 yrs (Figure 11b). The beluga harvested by Puvirnituq, which is located in north-eastern Hudson Bay, were the youngest, with a median age of 7.5 yrs (Figure 12). However, this result should be interpreted with caution given the small number of aged animals available from this community ($n = 13$). The harvests from 1993 contain a larger proportion of older animals than those from 1994–1999. However, no clear trend in the age composition of harvests is discernible over the 1993–1999 period, either when examining the Nunavik harvest as a whole (Figure 13), or the eastern Hudson Bay and Hudson Strait/Ungava Bay harvests, separately (Figure 14).

Recent harvests are also characterised by an absence of older animals. In the 1980–87 harvest, the oldest animal was 34, whereas during 1993–1999, the maximum age has declined to 18 in eastern Hudson Bay and 21 in Hudson Strait. A slightly different pattern is observed in Ungava Bay, which includes a large proportion of younger animals, and several older beluga, of which many were taken during the summer in southern Ungava Bay.

Discussion

In this study, the methodology of data collection changed on four occasions: self-monitoring by individual hunters, *post-hoc* questionnaires, weekly reports by community agents and data sheets filled on a daily basis by hunters. Also, harvest levels were corrected for non-participating hunters prior to 1981, while they were assumed to represent total catches after 1985. It is unclear whether non-participating hunters were taken into account between 1981 and 1985 (Brooke and Kemp 1986), when a decline in beluga harvests was observed among the Hudson Strait and Ungava Bay communities. One might not exclude the possibility that the 1981 decline in beluga harvests could be an artefact of the change in methodology, *i.e.* not accounting for non-participating hunters. However, the decline occurred 3 years earlier along eastern Hudson Bay, which indicates that the trend may be real.

The interpretation of trends in beluga harvests is difficult due to a lack of data or partial reporting of catches by some communities. No data on harvests are available from Ivujivik and Puvirnituk hunters prior to 1981 and 1987. There were years of low or no reports between 1986 and 1995 from Ivujivik. Location of kills in August and July are not reported in Ungava bay and south-eastern Hudson Bay. There was a reported harvest of 7 beluga by Umiujaq hunters for 2000 according to community agent reports while, based on discussions with local hunters, 19 beluga were taken that year by this community. Appreciable unexplained discrepancies were observed between monthly reports and total harvests in yrs 1993 to 1996, but the unavailability of the weekly reports prevents any further examination of these results. Similar discrepancies were observed in reports from the 1970s, but the latter were probably related to the correction of total harvests, and not monthly harvest reports, for hunters unwilling to participate in the program.

In spite of the problems with the data, this study provides evidence that beluga harvested now in Nunavik are considerably younger than those landed during the mid-1980s. The difference in the estimated age distributions between the 1980s sample and the 1990s sample is unlikely an artefact of differences in the interpretation of growth layer groups in the teeth between the two periods. The person involved in teeth reading during the mid-1980s also double-checked some of the teeth from the 1990s to ensure comparability of ages between the two periods. In addition, the decline in the proportion of worn to unworn teeth from 44% in the 1980s to 21% in the 1990s is consistent with the interpretation that the more recent harvests comprise younger beluga.

The apparent difference in the estimated age distributions between the two periods might have arisen from changes in the availability of older beluga. This could have happened through a change in hunting practices, a change in the inshore/offshore distribution of adults, or a depletion of the population. During the mid-1980s, harvesting effort in estuaries such as the Nastapoka River or Little Whale River was spread out over July and August. By the 1990s, most hunting was concentrated in the first few days of August, when the season opened. The types of vessels and engines that are used to hunt beluga have also changed since the 1980s (Doidge 2001), hunters are now younger, and there are more less-experienced hunters than during the 1980s. During these short-term hunts, a large proportion of the animals present in an estuary may be killed all at once. Selectivity is then probably low, and these two factors might result in a larger proportion of younger animals being killed. The quicker return to estuaries of females with calves after a disturbance (Caron and Smith 1990) may also increase their vulnerability to hunters. The overall seasonal distribution of harvests has changed little between the 1980s and 1990s and thus, has unlikely affected the composition of catches. However, the extent to which different areas are used for hunting, *e.g.* estuaries vs more open water, may have changed compared to the 1980s. The extent of changes in hunting practices over time, and how they might have affected the age structure of the harvests are generally uncertain, and need to be investigated further.

Disturbance in estuaries has increased since the 1980s (Doidge 2001), and might have caused older, less naïve, white beluga to stay offshore. The proportion of white to grey beluga in herds observed in the Nastapoka estuary increased during the 1990s (58% in 1993 and 63% in 2000: Doidge 2001) compared to the 1983—1984 period (54%: Caron and Smith 1990, in Doidge 2001) and thus, does not support the hypothesis of a recent, greater avoidance of estuaries by white beluga. A similar increase in the proportion of white beluga in the harvests from 40% in the 1980s (D.W. Doidge, unpublished data) to 51% in the 1990s (51%: Table 3) also tends to dismiss this hypothesis, if one assumes hunters were not

selective towards a colour or sex class. The residency time, movement patterns, and motivations in frequenting estuaries are poorly understood in northern Quebec beluga. A study conducted at the Nastapoka Estuary during the mid-1980s indicates that white females at that time, were four times more abundant than white males in this estuary (Caron and Smith 1990). These observations and the quicker return of females with calves to estuaries after a disturbance (Caron and Smith 1990) suggest that adult females with calves may be more addicted to estuaries than white males. No information on the relative abundance of white males and females is available for the 1990s. However, during both the 1980s and the 1990s, the Nunavik hunters killed white males and females in approximately equal numbers (Table 3; D.W. Doidge, Unpublished data). If one assumes selectivity - if it existed - remained constant over time, these observations would indicate that the relative availability of sex classes of white beluga were similar in both periods.

The recent change observed in the age distribution of harvests could be an evidence of stock depletion. A study conducted in 2000, and which indicated longer duration-of-absence of beluga from the Nastapoka Estuary following a disturbance than during the 1980s, tend to support this hypothesis (Doidge 2001). The first beluga that enter an estuary following a disturbance were shown not to be the same as those that were disturbed (Caron and Smith 1990). As a population decline, the probability of a herd entering an estuary soon after a disturbance also declines, which might result in longer duration-of-absence of beluga from estuaries (Doidge 2001).

The similarity of the median age of beluga between Puvirnituk, which harvests beluga in the Digges Island area in October, and the three southernmost communities from eastern Hudson Bay suggests that Puvirnituk might be taking most of their harvests from the eastern Hudson Bay stock. A harvest constituted principally of eastern Hudson Bay beluga would be expected for Puvirnituk, if beluga followed coastlines of eastern Hudson Bay during their northward, fall migration to the Hudson Strait. If this is the case, then one might question the origin of beluga taken during the fall hunts by the Hudson Strait communities, and particularly those located in the western part of the Strait, namely Ivujivik and Salluit. A recent study examined mitochondrial DNA haplotypes of beluga harvested by Puvirnituk that particular year (1999), and by the Hudson Strait communities during the spring. This study indicates that a large proportion of the beluga harvested by Puvirnituk and the Hudson Strait communities are not closely related to eastern Hudson Bay beluga (de March et al. 2001). Several lines of evidence support the hypothesis that the Hudson Strait is an important wintering area for both western Hudson Bay and eastern Hudson Bay beluga, and possibly south-eastern Baffin Island beluga. These include observations by local hunters and scientists of large numbers of beluga in Hudson Strait during the fall and spring, a northward migration of animals in the fall, seasonal changes in abundance of beluga along the coasts of Hudson Bay and southern Baffin Island, and an eastward trend in the harvest period (Figure 5: this study), and in the appearance of large numbers of beluga along the Hudson Strait communities (Sergeant 1973; Finley et al. 1982; Richard and Orr 1986; Brooke 1995: report from the community agent of Akulivik).

Management efforts to limit harvests to maintain population levels were first undertaken in 1986. The introduction of quotas had the effect of stabilising the total harvests, although regional or community quotas are regularly exceeded, and communities such as Akulivik, Aupaluk and Tasiujaq now reportedly take more animals than when quotas were non-existent. The 1996 management plan specifically recommends that white male beluga be preferentially harvested, and that individuals with the highest reproductive values, *i.e.* reproductively active females and grey animals, be protected. About half of the harvest by any of the regions is grey in colour, and half of the white animals are females, indicating that these management measures have been ineffective. The large proportion of grey animals in the harvests might reflect a reduced availability of white animals, whereas the large proportion of white females might reflect the inability of hunters to distinguish between white males and females.

The management plans also created seasonal or permanent sanctuaries in three river estuaries known to be frequented by beluga, or have imposed restrictions to areas where animals should be taken (*e.g.* Puvirnituk, Ungava Bay communities). Although annual reports of community agents indicate that hunters are well aware of area closures, the general absence of information on the location of harvests during periods of area closure prevents any analysis of compliance with these regulations. Nevertheless, the available information indicate that some Ungava Bay hunters harvest a portion of their quota outside the Bay, in the Quartaq area, while Puvirnituk, and recently, Akulivik, take most of their harvest from the

Hudson Strait. The latter management measure was intended to reduce the harvesting pressure on the eastern Hudson Bay stock and protect animals in southern Ungava from exploitation. In the light of the information obtained from genetic mtDNA studies, it appears that this management measure might have been effective.

In summary, this study indicates that beluga that are now harvested in northern Quebec are younger than those landed in the 1980s. Although these results could indicate population depletion, several other factors might have resulted in a change in the age distribution of harvest since the 1980s, and require further investigation. A comparison of age distributions between the 1980s and 1990s of a group of beluga, clearly identifiable, e.g. white males, would help determine whether the observed change in the age distribution results from population depletion or from some other factors. The examination of the location of each kill reported during the two periods could help identify changes in hunting practices.

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Table 1. Beluga management plans for the Nunavik region. Sources: Fisheries and Oceans Canada 1986; 1987; 1990; 1993a; 1993b; 1996; Olpinski 1993; Portnoff 1994. Additional management measures are presented in the different source reports.

Region	Community	1986	1987–1989	1990–1991	1992–1994	1995–2000
Eastern Hudson Bay	Kuujuaraapik	9	10	10	15	18
	Umiujaq	15	10	10	15	18
	Inujjuaq		10	10	15	18
	Puvirnituq	9	10	10	15 (all in H. Strait)	18
	Akulivik	9	10	10	15 (all in H. Strait)	18
	Other agreements			Sanctuary at the Nastapoka River in July	Sanctuary at the Nastapoka River in July	Sanctuary at the Little Whale and Nastapoka rivers in July
	Hudson Strait (H. Strait)	Ivujivik	25	30	30	30
	Salluit	25	30	30	30	25
	Kangirsujuaq	25	29	29	29	25
	Quartaq	25	29	29	29	25
	Other agreements					
Ungava Bay (UN)	Kangirsuk	8 (3 outside UN)	10 (5 outside UN)	10 (all outside UN)	10 (all outside UN in Aug)	10 (all outside UN in Aug)
	Aupaluk	8 (3 outside UN)	10 (5 outside UN)	10 (all outside UN)	10 (all outside UN in Aug)	10 (all outside UN in Aug)
	Tasiujuaq	8 (3 outside UN)	10 (5 outside UN)	10 (all outside UN)	10 (all outside UN in Aug)	10 (all outside UN in Aug)
	Kuujuuaq	8 (3 outside UN)	18 (13 outside UN)	10 (all outside UN)	10 (all outside UN in Aug)	10 (all outside UN in Aug)
	Kangirsualujjuaq	8 (3 outside UN)	10 (5 outside UN)	10 (all outside UN)	10 (all outside UN in Aug)	10 (all outside UN in Aug)
	Killiniq	8 (all outside UN)	10 (all outside UN)	10 (all outside UN)	10 (all outside UN in Aug)	10 (all outside UN in Aug)
	Other agreements	Mucalic River sanctuary	Mucalic River sanctuary	Mucalic River sanctuary	Mucalic River sanctuary	Mucalic River sanctuary

* Comprises the Whale, Mucalic, Tuctuc and Tunulic rivers

Table 2. Mean (\pm SD) annual harvests of beluga by the different Nunavik regions and communities during the period preceding (1974–1985) and following (1986–1995 and 1996–2000) the introduction of management plans.

Region	Community	1974–1985		1986–1995		1996–2000	
		Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD	Range
Eastern Hudson Bay	Kuujjuaraapik	46.2 \pm 12.2	24–75	11.3 \pm 3.9	0–22	12.4 \pm 2.3	8–15
	Umiujaq	N/A	N/A	16.6 \pm 4.9	3–24	19.8 \pm 1.7	18–24
	Inujjuaq	71.3 \pm 38.9	18–144	15.1 \pm 3.7	7–20	23.0 \pm 4.8	18–35
	Puvirnituq	-	-	27.9 \pm 8.7	16–50	32.6 \pm 3.7	27–38
	Akulivik	7.0 \pm 4.7	1–28	15.2 \pm 3.2	9–20	18.0 \pm 4.0	12–24
	Regional total	124 \pm 45	61–220	86.1 \pm 20.3	55–124	106.0 \pm 2.2	103–109
Hudson Strait	Ivujivik	70.0 \pm 9.3	35–126	31.8 \pm 19.5	2–118	34.6 \pm 5.3	22–44
	Salluit	61.9 \pm 27.6	22–159	30.0 \pm 11.2	16–53	38.6 \pm 9.1	28–54
	Kangirsujuaq	69.0 \pm 44.8	14–174	28.2 \pm 3.5	22–39	25.0 \pm 1.2	22–27
	Quartaq	42.3 \pm 13.7	25–85	25.6 \pm 6.2	15–35	27.2 \pm 3.4	23–32
	Regional total	243.0 \pm 76.4	121–438	116 \pm 37	71–234	125 \pm 10.6	114–152
Ungava Bay	Kangirsuk	22.6 \pm 19.6	3–79	9.2 \pm 2.0	3–12	15.2 \pm 2.2	12–19
	Aupaluk	4.6 \pm 4.6	0–31	3.8 \pm 2.2	0–9	8.2 \pm 1.9	4–13
	Tasiujuaq	7.5 \pm 4.6	0–23	7.5 \pm 3.9	2–14	14.2 \pm 3.8	6–21
	Kuujjuaq	32.9 \pm 18.2	2–102	6.6 \pm 3.2	2–12	8.6 \pm 2.3	5–13
	Kangirsualujjuaq	15.2 \pm 8.2	3–37	3.2 \pm 2.8	0–11	7.4 \pm 2.1	3–11
	Regional total	82.8 \pm 43.7	19–178	30.3 \pm 9.6	9–48	53.6 \pm 7.5	44–68
Overall total	450 \pm 177	162–735	232.0 \pm 62.6	162–368	285 \pm 13.0	267–302	

Table 3. Number of beluga of known colour and sex that were harvested during 1993–2000 in different regions of the Nunavik. Number of beluga harvested under the 1996–2000 management plan (i.e. 1995–2000) are presented in parentheses.

Sex	Colour	Sector			Total
		Eastern Hudson Bay	Hudson Strait	Ungava Bay	
Female	Dark Grey	3 (2)	6 (3)	4 (1)	13 (6)
	Grey	32 (26)	24 (21)	13 (10)	69 (57)
	White	36 (31)	26 (21)	11 (10)	73 (62)
	Unknown	3 (3)			3 (3)
Total		74 (62)	56 (45)	28 (21)	158 (128)
Male	Dark Grey	6 (6)	5 (5)	1 (1)	12 (12)
	Grey	24 (21)	24 (18)	4 (4)	52 (43)
	White	39 (34)	34 (20)	14 (11)	87 (65)
	Unknown				
Total		69 (61)	63 (43)	19 (16)	151 (120)
Unknown	Dark Grey	2 (2)			2 (2)
	Grey	3 (3)	4 (4)	1 (1)	8 (8)
	White	7 (5)		1 (0)	8 (5)
Total		12 (10)	4 (4)	2 (1)	18 (15)
Total		155 (133)	123 (92)	49 (38)	327 (263)

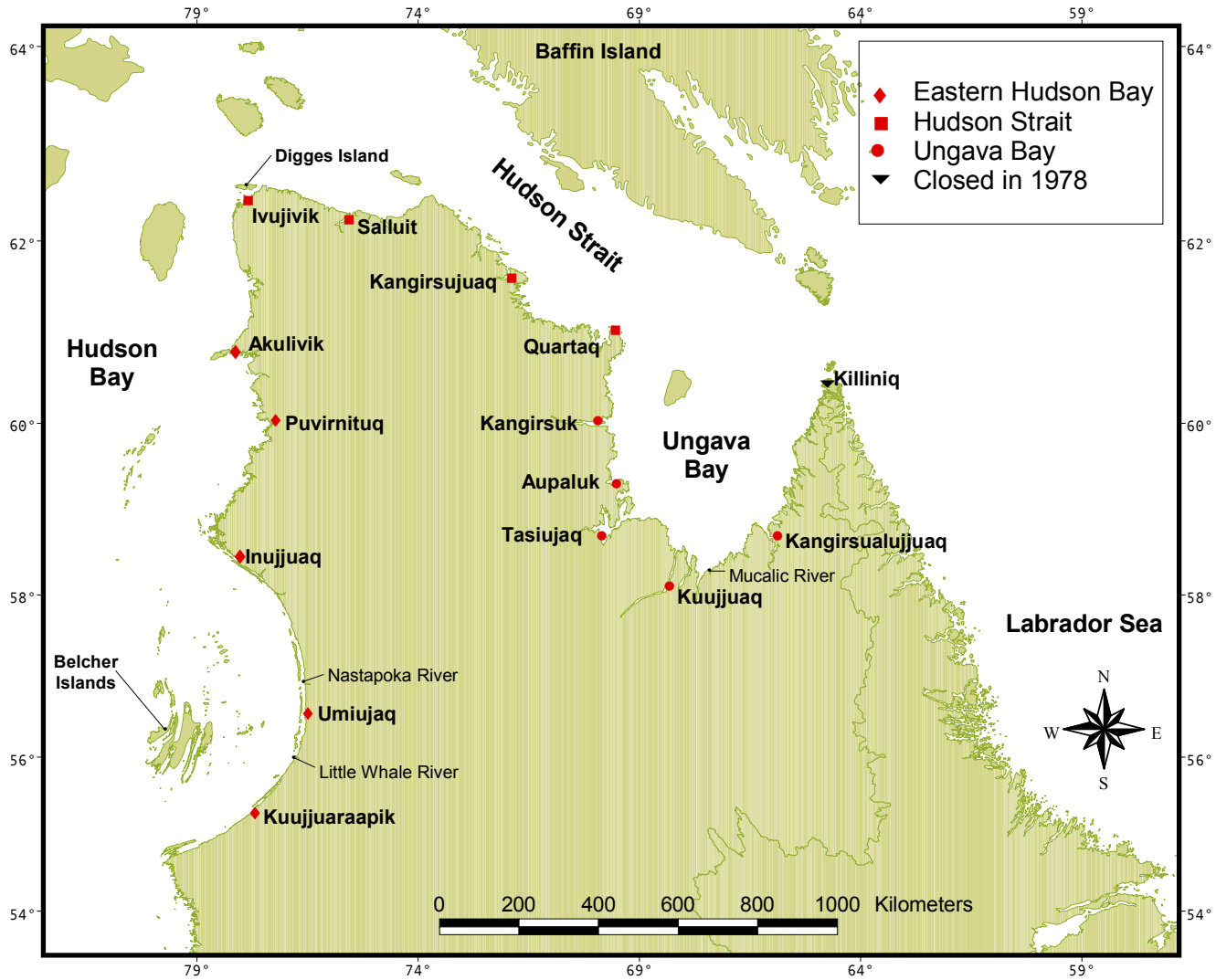


Figure 1. Communities of the Nunavik, Northern Quebec.

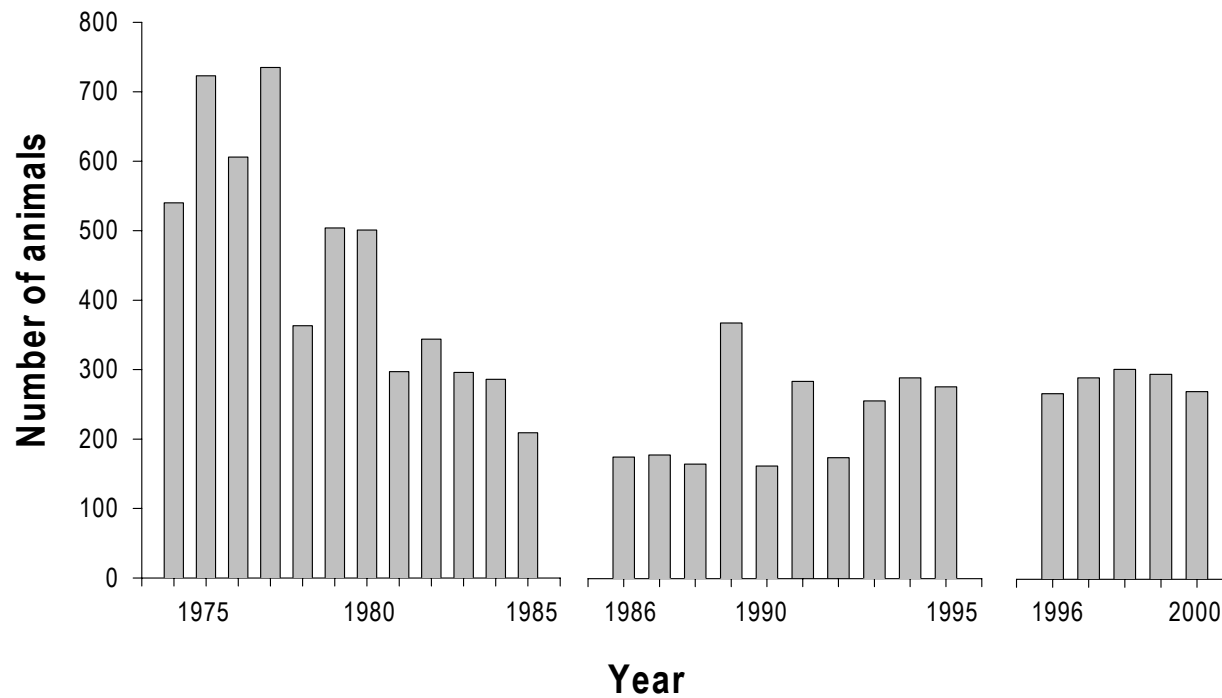


Figure 2. Total number of beluga harvested by the Nunavik communities between 1974 and 2000. Data were compiled by the Native Harvesting Research Committee (1974–1980: used ‘Estimate total harvest’ from Native Harvesting Research Committee 1976; 1979; 1982a; 1982b), by Anguvigaq Wildlife Management Inc. and the Department of Fisheries and Oceans (1981–1985: Brooke and Kemp 1986), the Department of Fisheries and Oceans, and depending on years, Anguvigaq, Makivik or Kativik Regional Government (1986–1990: Richard 1993), and community agents and the Department of Fisheries and Oceans (1991–2000: Brooke 1992; 1995; 1996; 1997; 1998; Olpinski (1993); Portnoff (1994) for years 1991–1997, and R. Fibich, Coordinator, Northern Quebec Affairs for years 1998–2000).

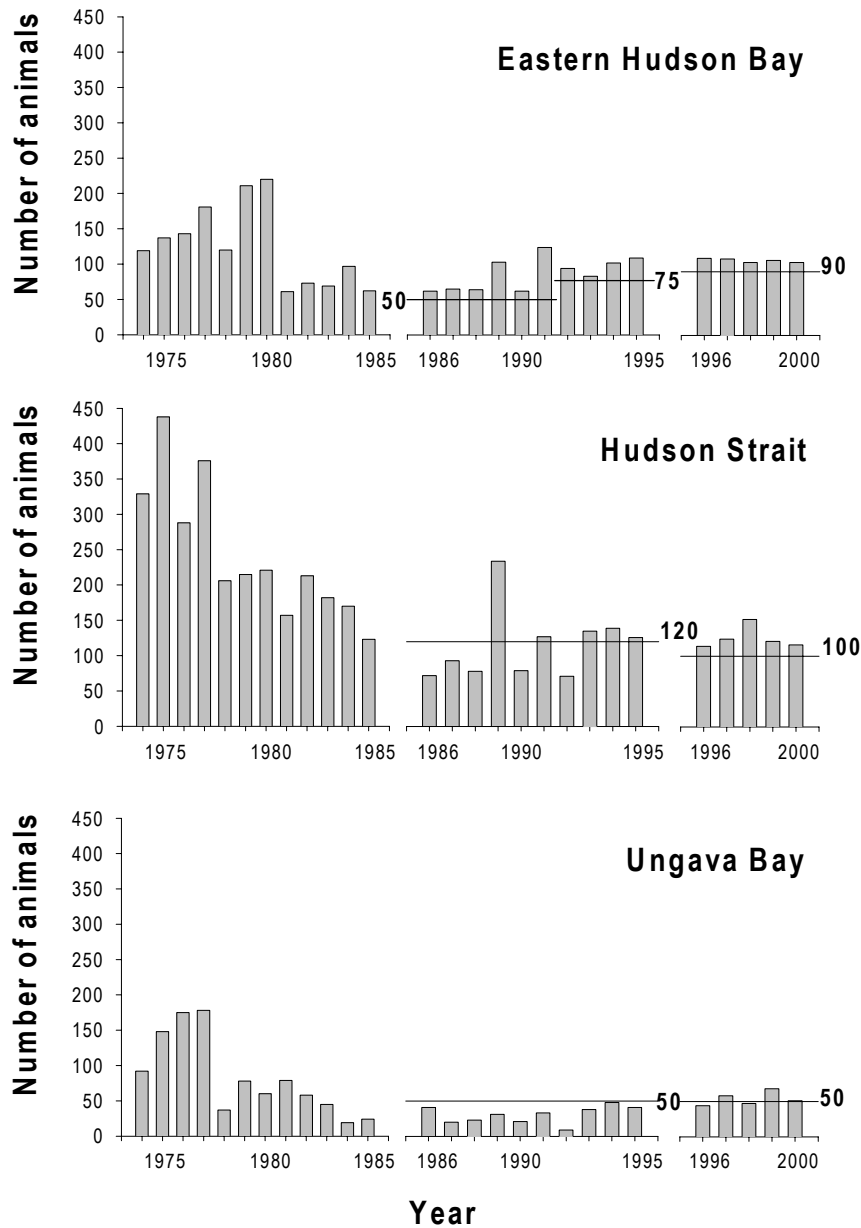


Figure 3. Total harvests of beluga by the communities of the eastern Hudson Bay, Hudson Strait, and Ungava Bay communities of the Nunavik during 1974-2000. The curve represents quotas prescribed by the management plans (Fisheries and Oceans Canada 1986; 1988; 1990; 1993a; 1993b; Olpinski 1993; Portnoff 1994; Brook 1995; 1996; 1996). The median catch level over a management period was used for communities and years where catch levels were missing.

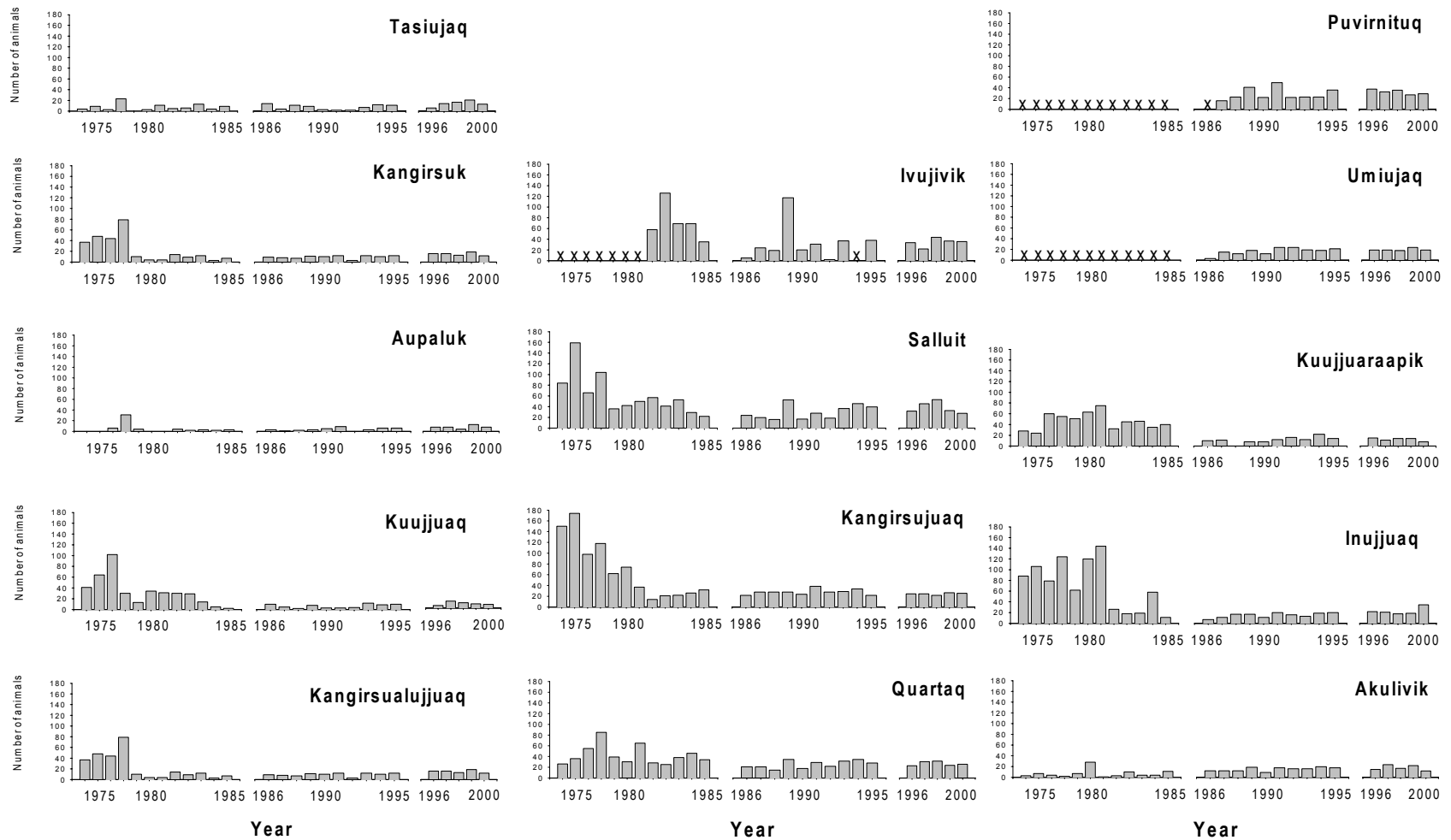


Figure 4. Number of beluga harvested by the different communities of the Nunavik, for periods preceding (1974–1985), and following quota introduction (1986–1995, 1996–2000). An 'x' indicates that no harvest data was available from a community.

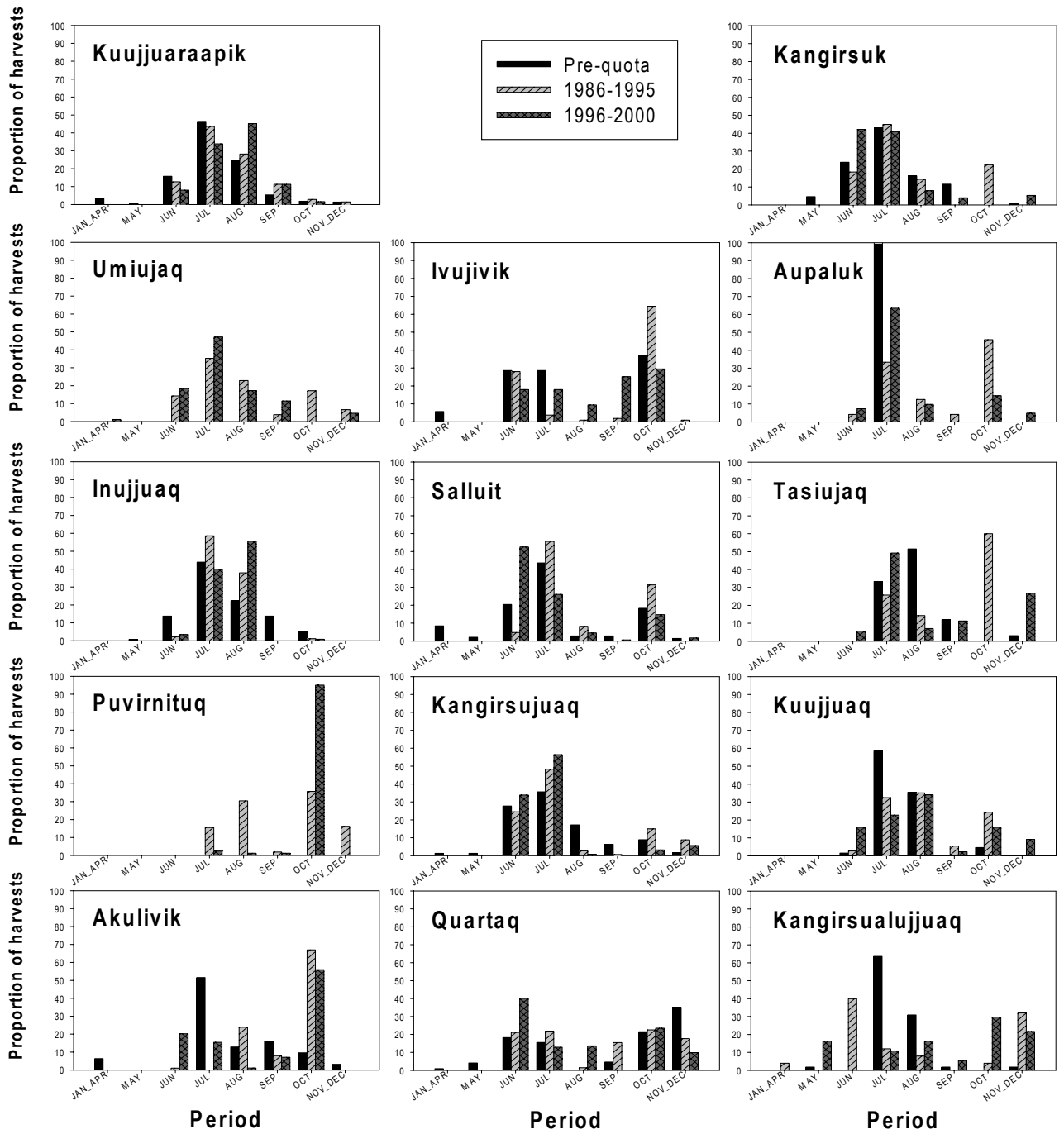


Figure 5. Monthly distribution of beluga harvests for each Nunavik community between 1974 and 2000. Umiujaq was created in 1985, whereas Puvirnituk did not participate in the program prior to 1987.

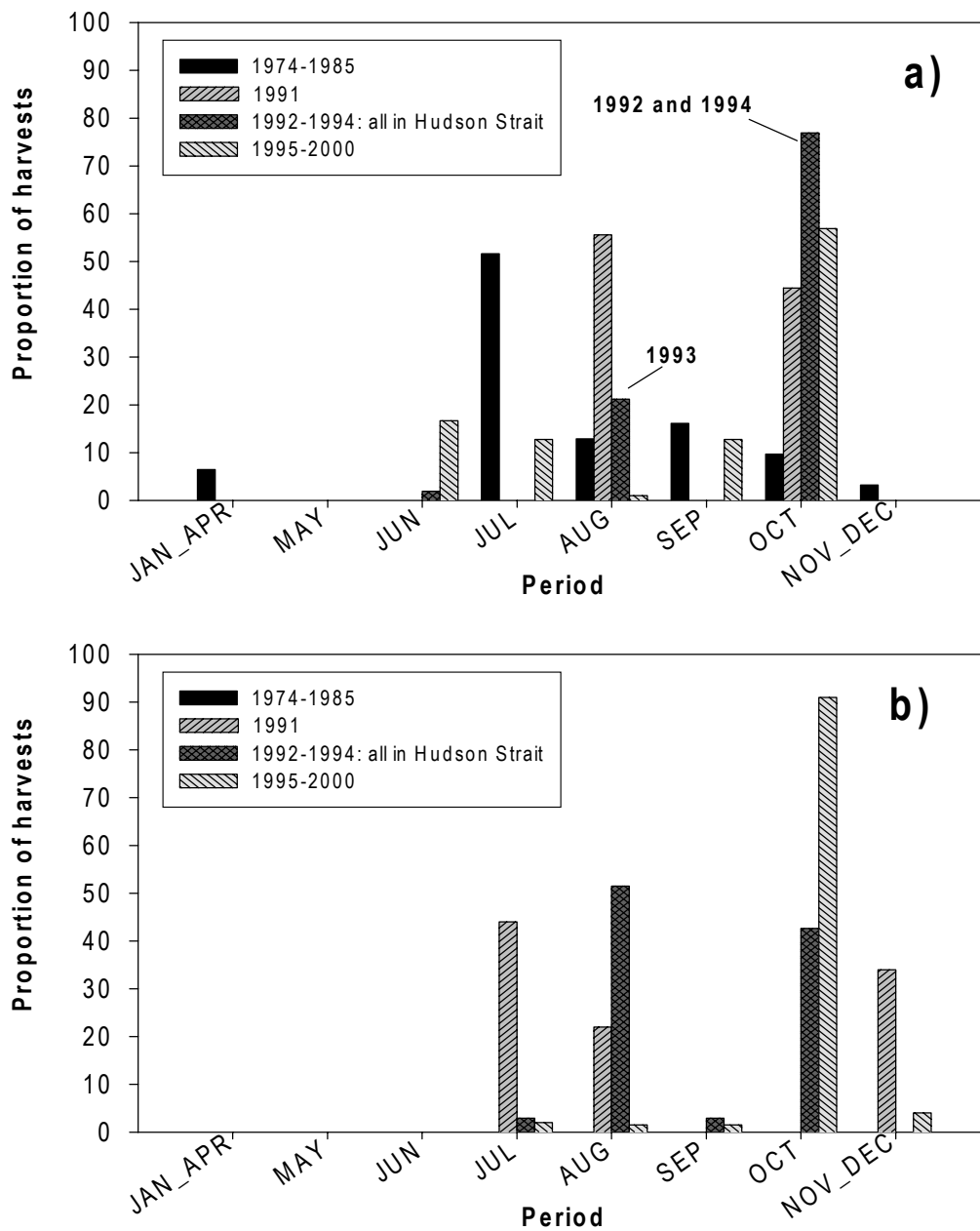


Figure 6. Monthly distribution of beluga harvests taken by a) Akulivik and b) Puvirnituk between 1974 and 2000.

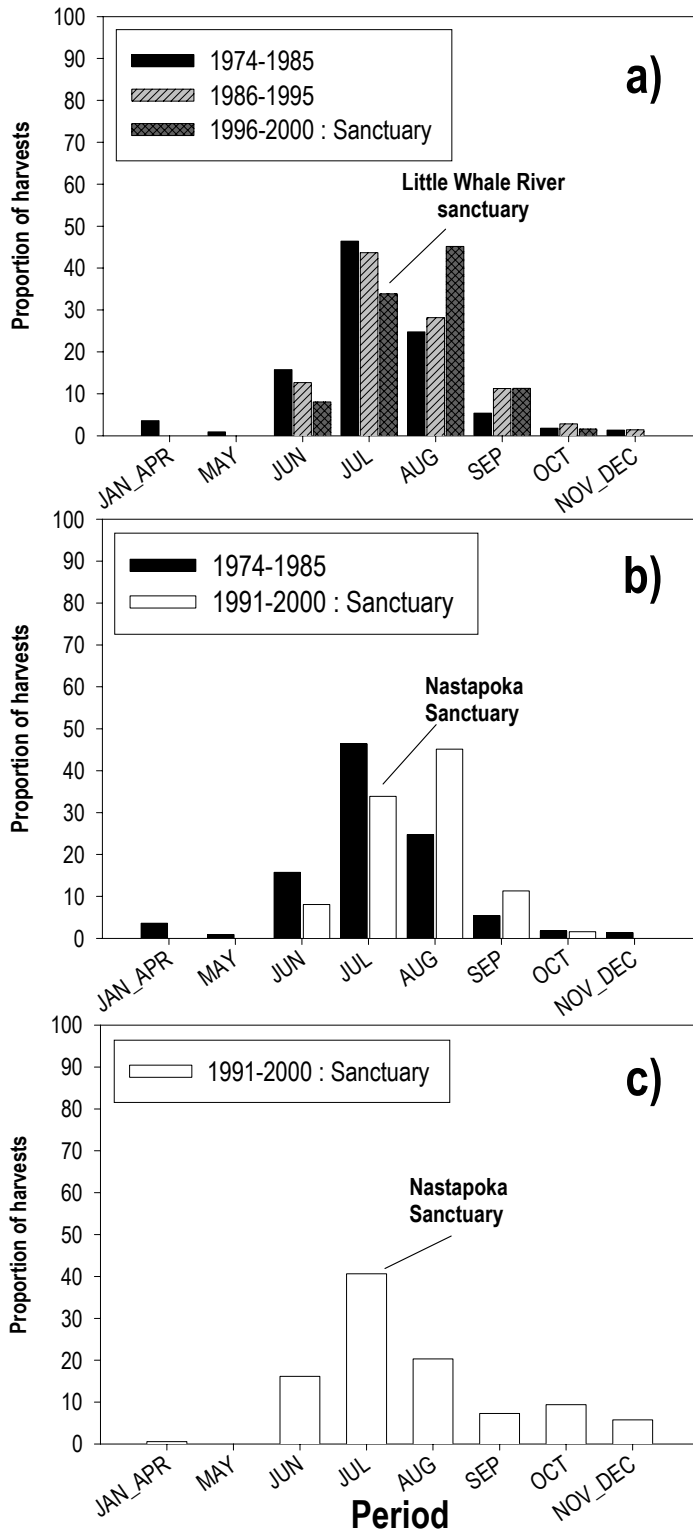


Figure 7. Monthly distribution of beluga harvests taken by a) Kuujuaaraapik, and b) Inujjuaq between 1974 and 2000, and by c) Umiujaq between 1991 and 2000.

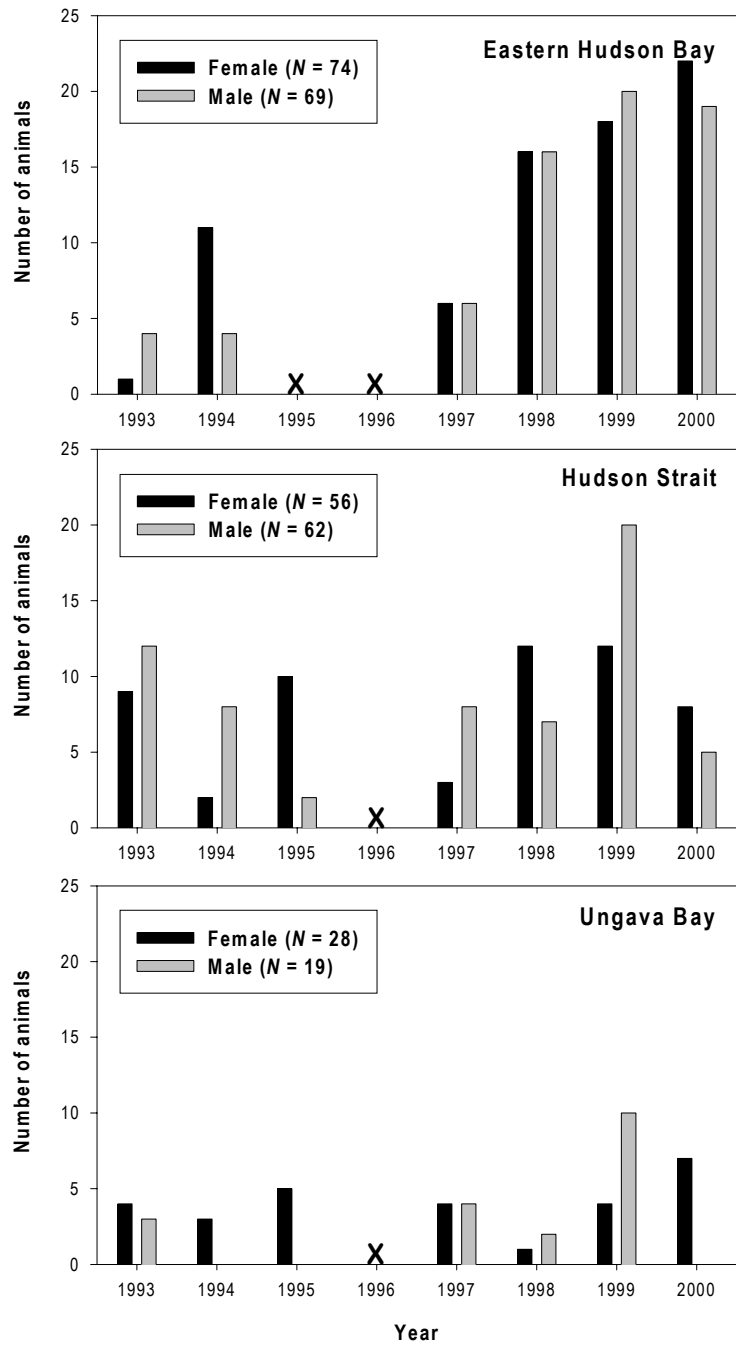


Figure 8. Proportion of male and female beluga taken by communities from eastern Hudson Bay, Hudson Strait, and Ungava Bay, 1993–2000. An 'x' indicates a lack of data.

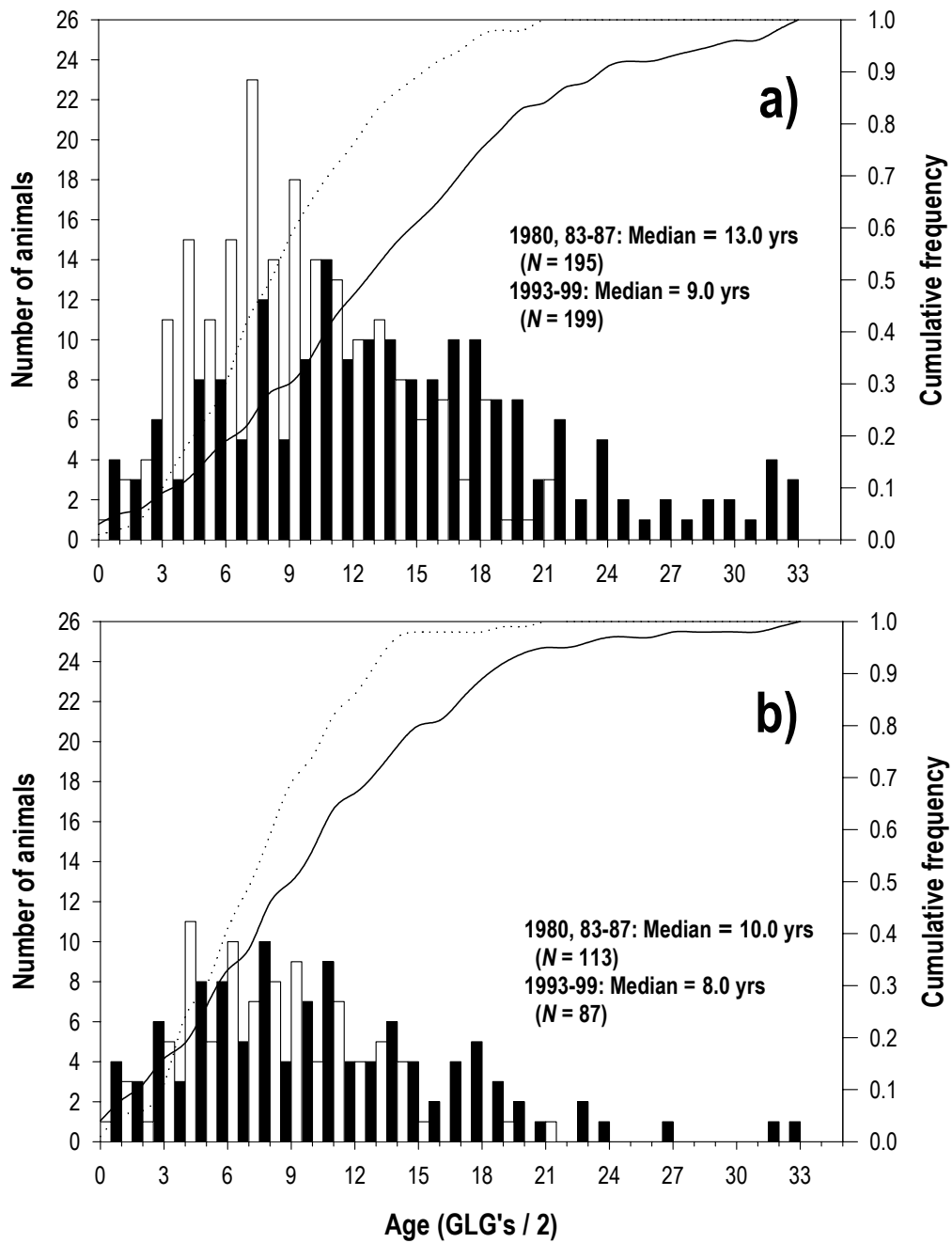


Figure 9. Age of beluga harvested in northern Quebec during 1980, 1983–1987 (black bars and plain curve; Doidge 1990) and 1993–1999 (clear bars and dotted curve), presented as age frequencies (bars) and cumulative frequencies (curves), and using worn and unworn teeth (a) or unworn teeth only (b).

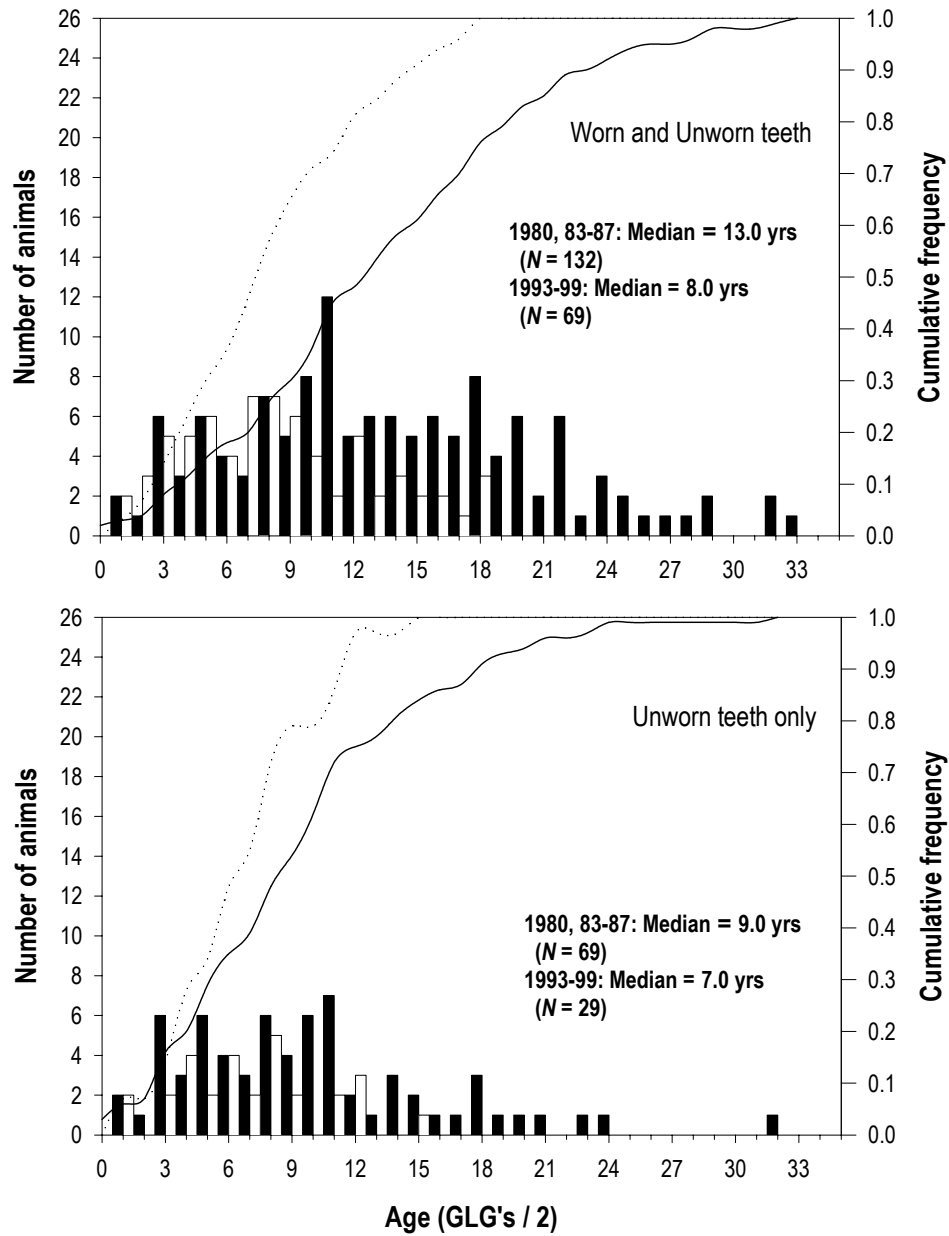


Figure 10. Age of beluga harvested in Eastern Hudson Bay during 1980, 1983–1987 (black bars and plain curve; Doidge 1990) and 1993–1999 (clear bars and dotted curve), presented as age frequencies (bars) and cumulative frequencies (curves), and using worn and unworn teeth (a) or unworn teeth only (b).

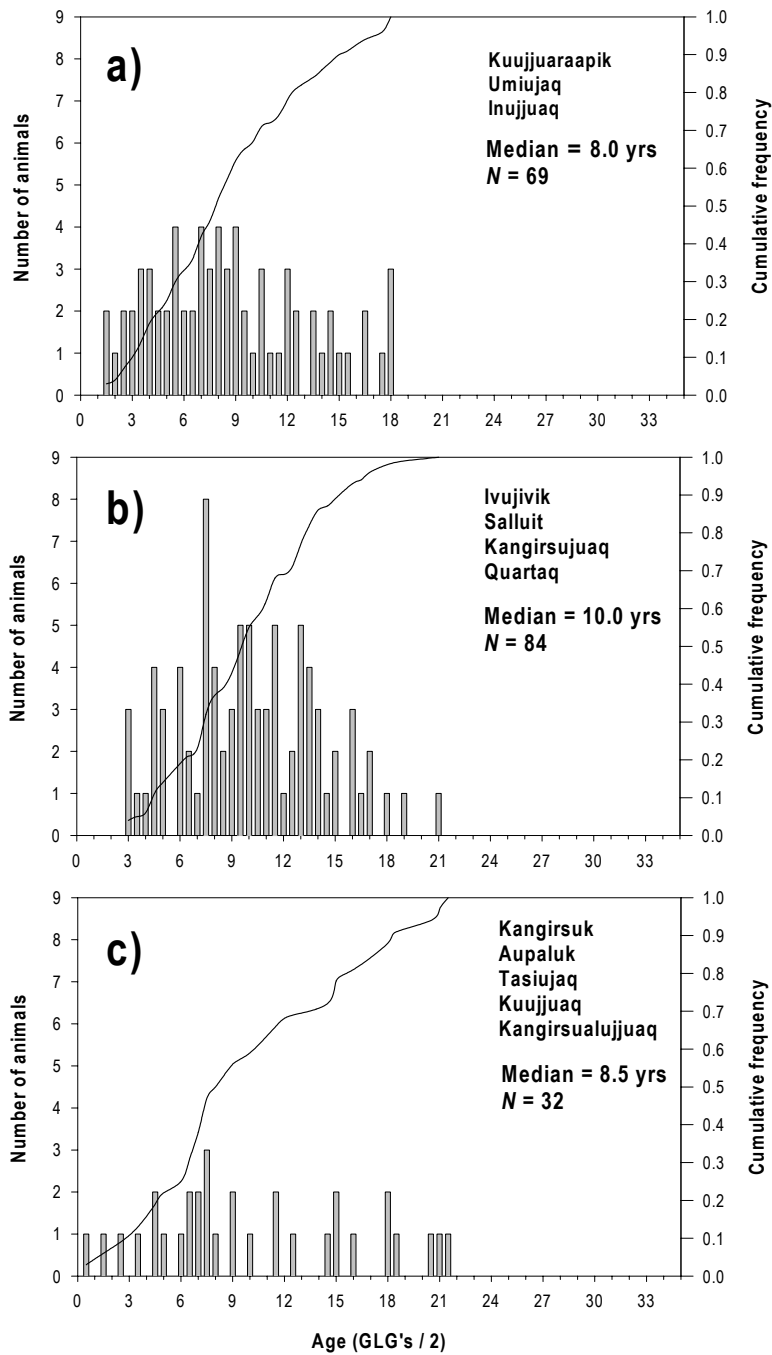


Figure 11. Age of beluga harvested by a) eastern Hudson Bay, b) Hudson Strait, and c) Ungava Bay communities, during 1993–1999, presented as age frequencies (bars) and cumulative frequencies (curves).

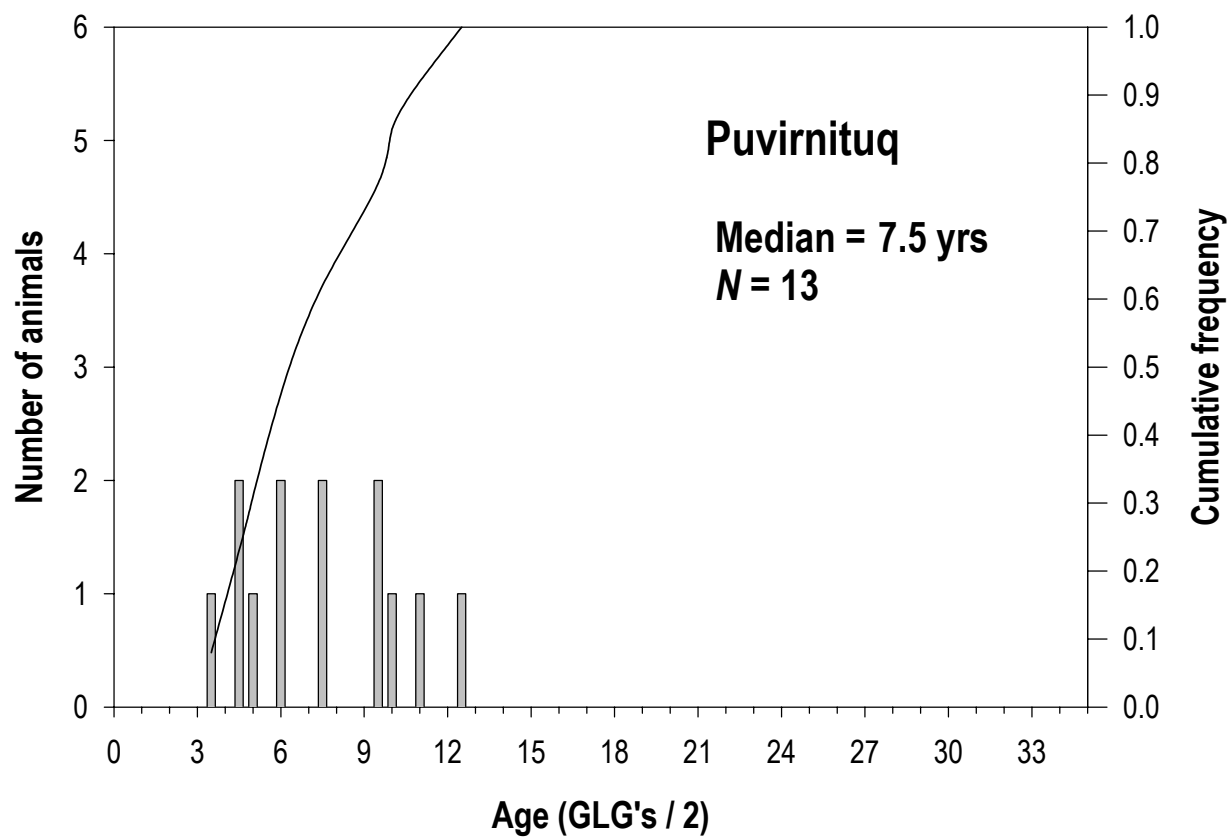


Figure 12. Age of beluga harvested by Puvirnituk in 1999, presented as age frequencies (bars) and cumulative frequencies (curves).

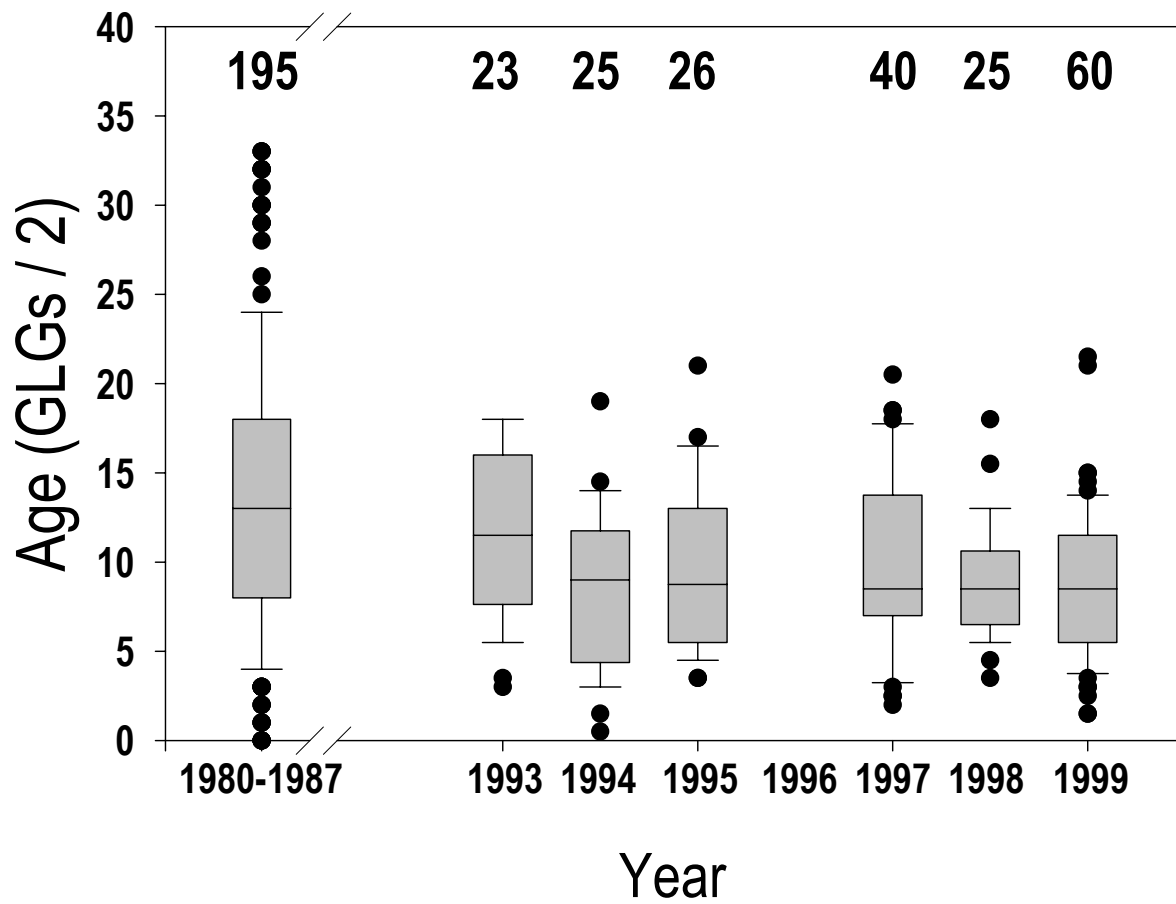


Figure 13. Age distribution of beluga harvested during 1993—1999 in the Nunavik. Horizontal lines in grey boxes represent median ages. The bottom and top edges of a box are located at the sample 25th and 75th percentiles, whereas the vertical lines extend to the sample 10th and 90th percentiles. Each value located within the first and last 10th percentiles is indicated by a dot. Numbers on the graph indicate the sample size for each year.

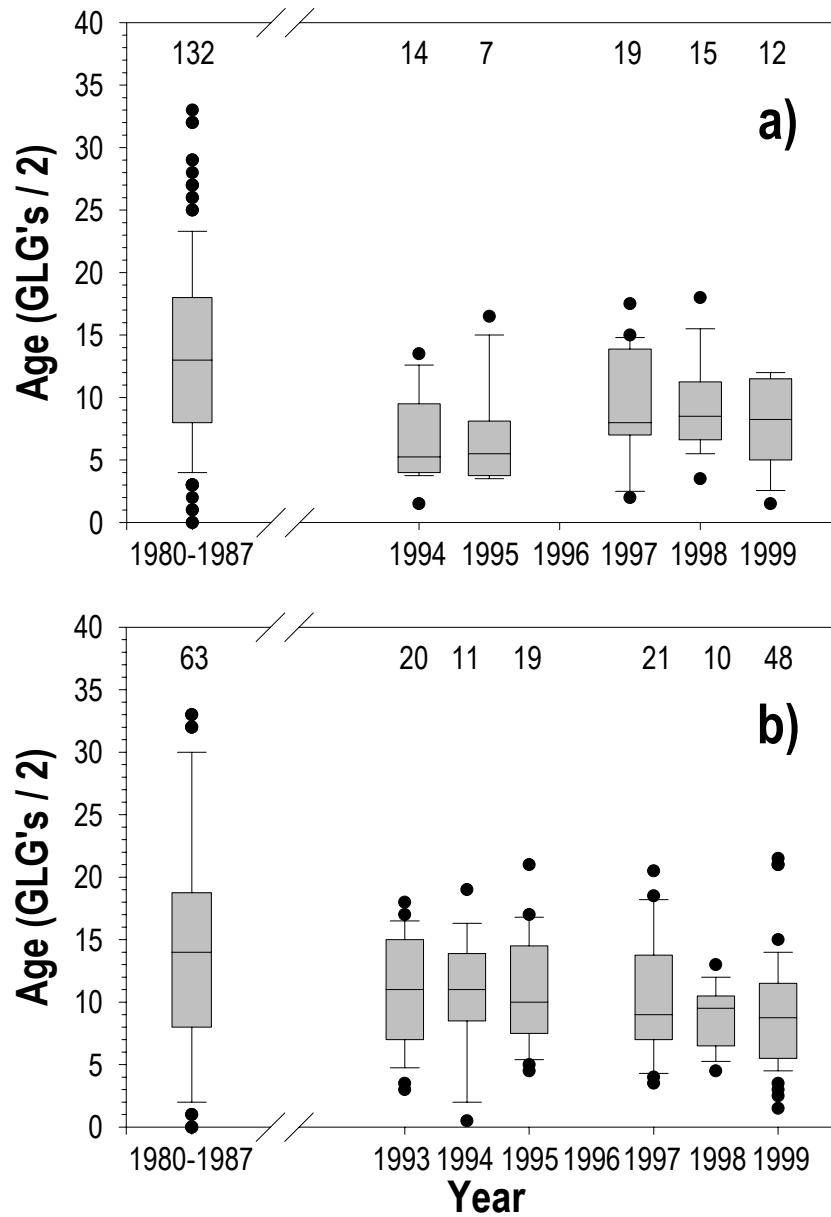


Figure 14. Age distribution of beluga harvested during 1993—1999 in a) eastern Hudson Bay and b) in Hudson Strait and Ungava Bay. Horizontal lines in grey boxes represent median ages. The bottom and top edges of a box are located at the sample 25th and 75th percentiles, whereas the vertical lines extend to the sample 10th and 90th percentiles. Each value located within the first and last 10th percentiles is indicated by a dot. Numbers on the graph indicate the sample size for each year.

Appendix 1. Summary of beluga catches by the Nunavik communities, 1974–2000. Data were compiled by the Native Harvesting Research Committee (1974–1980: used 'Estimate total harvest' from Native Harvesting Research Committee 1976; 1979; 1982a; 1982b), by Anguvigaq Wildlife Management Inc. and the Department of Fisheries and Oceans (1981–1985: Brooke and Kemp 1986), community agents and depending on years, personnel from Anguvigaq, Makivik or Kativik Regional Government (1986–1990: Richard 1993), and community agents and the Department of Fisheries and Oceans (1991–2000: Brooke 1992; 1995; 1996; 1997; 1998; Olpinski 1993; Portnoff 1994 for years 1991–1997, and R. Fibich, Coordinator, Northern Quebec Affairs for years 1998–2000). Reports from 1991 to 2000 include animals that were struck but lost, but it is unclear whether these animals were accounted for in reports earlier than 1991.

Region	Community	1974	1975 ⁱ	1976	1977 ⁱ	1978	1979 ⁱ	1980 ⁱ	1981	1982	1983 ⁱ	1984 ⁱ	1985 ⁱ	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Eastern	Kuujuaaraapik	28	24	60	55	51	63	75	32	45	46	35	40 ^a	10	11	0	8	8	12	16	12	22	14	15	11	14	14	8
Hudson	Umiujaq	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A ^b	3	15	12	18	12	24	24	19	18	21	19	19	18	24	19 ^j
Bay	Inujuaq	88	106	79	124	62	120	144	26	18	19	58	11	7	11	17	17	11	20	16	13	19	20	22	21	18	19	35
	Puvurnituk	-	-	-	-	-	-	-	-	-	-	-	-	-	16	23	41	22	50	22 ^g	23	23	36	38	33	36	27	29
	Akulivik	3	7	4	2	7	28	1	3	10	4	4	11	12	12	12	19	9	18	16	16	20	18	15	24	17	22	12
Hudson	Ivujivik	-	-	-	-	-	-	-	58	126	69	69	35	5	24	19	118	20 ^h	31	2 ^g	37	-	38	34 ^j	22	44	37	36
Strait	Salluit	84	159	66	104	36	42	50	57	41	53	29	22	24	20	16	53	17	28	19	37	46	40	32	46	54	33	28
	Kangirsujuaq	150	174	98	118	62	74	37	14	21	22	26	32	22	28	28	28	24	39	28	29	34	22	25	25	22	27	26
	Quartaq	26	36	55	85	39	30	65	28	25	38	46	34 ^k	21	21	15	35	18	29	22	32	35	28	23	31	32	24	26
Ungava	Kangirsuk	37 ^f	48 ^f	44	79	10	4	4	14	9	12	3	7	9	8	7	11	10	12	3	12	10	10 ^d	16	16	13	19	12
Bay	Aupaluk	N/A ^f	N/A ^f	6	31	4	0 ^e	0 ^e	4	2	3	2	3	3	1	2	3	5	9	0	3	6	6	8	8	4	13	8
	Tasiujaq	4	9	3	23	0 ^e	3	11	5	6	13	4	9	14	4	11	9	3	2	2	7	12	11	6	14	17	21	13
	Kuujuaq	41	64	102	30	13	34	31	30	29	14	5	2	10	5	2	8	3	3	4	12	9	10	5	13	10	8	7
	Kangirsualijuaq	10	27	20	15	10	37	14	26	12	3	5	3	5	2	1	0	0	7	0	4	11	2	9	7	3	7	11
	Killiniq ^c	0	15	9	16	-	-	-	-	-	-	-	8	1	0	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	540	723	606	735	363	504	501	297	344	296	286	207	175	178	165	368	162	284	174	256	289	276	267	290	302	295	258

^a Includes Umiujaq

^b Community established in 1985

^c killiniq closed in 1978, but some families resided there sporadically

^d From Tables 3 and 4; erroneous reporting in Table 1 (Brooke 1996) carried over in following reports (Brooke 1997; 1998; R. Fibich, DFO, Laurentian Region, pers. comm. for years 1998–2000)

^e inferred from non-zero rate of participation for the community (63–95%) because catch levels for the community is absent from the detailed harvest statistics (Native Harvesting Research Committee 1976; 1982a; 1982b); zero value for the community is erroneously reported as missing data in all subsequent reports (1981–2000)

^f Includes Aupaluk ('Aupaluk not distinguished from Kangirsuk in 1974 and 1975', Native Harvesting Research Committee 1979)

^g Unconfirmed harvest level

^h R. Fibich, Department of Fisheries and Oceans, Northern Quebec Affairs, Laurentian region, pers. comm.

ⁱ Corrected for hunters unwilling to participate in the program

^j Harvest is an estimate

^k Monthly harvests sum up to 34 beluga, and not 32 as reported in total harvests (Brooke and Kemp 1986: p. 18)

^l Umiujaq community agent, pers. comm. to M.O. Hammill, Department of Fisheries and Oceans, Laurentian Region

Appendix 2. Monthly harvests by Nunavik communities, 1976–2000. Sources are Finley et al. (1982) for 1976–1979, Brooke and Kemp (1986) for yr. 1985, annual summary reports for 1991–1997 (Brooke 1992; 1995; 1996; 1997; 1998; Olpinski 1993; Portnoff 1994) and R. Fibich for yrs. 1998–2000 (Fisheries and Oceans Canada, Northern Quebec Affairs, Laurentian region, pers. comm.).

Community	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kuujjuaraapik	1976					2	14	18	16	5			
Kuujjuaraapik	1977						7	17	14	5		3	
Kuujjuaraapik	1978						10	20	10	2			
Kuujjuaraapik	1979							28	7		4		
Kuujjuaraapik	1985	1	7				4	20	8				
Kuujjuaraapik	1990												
Kuujjuaraapik	1991						6	2	4				
Kuujjuaraapik	1992						0	5	5	5	0	1	0
Kuujjuaraapik	1993						0	9	0	1	0	0	0
Kuujjuaraapik	1994						1	7	7	2	2		
Kuujjuaraapik	1995						2	8	4				
Kuujjuaraapik	1996							6	3	5	1		
Kuujjuaraapik	1997							4	5	2			
Kuujjuaraapik	1998						1	6	7	0	0	0	
Kuujjuaraapik	1999						4	1	9	0	0	0	
Kuujjuaraapik	2000						0	4	4	0	0	0	
Umiujaq	1990												
Umiujaq	1991						4	12	1	1		6	
Umiujaq	1992						0	9	10	2	2	1	0
Umiujaq	1993						6	9	3	0	0	0	0
Umiujaq	1994						5	7	4	1	1		
Umiujaq	1995								6		15		
Umiujaq	1996				1		2	10	6				
Umiujaq	1997						2	5	4	8			
Umiujaq	1998						6	9	2	1	0	0	
Umiujaq	1999						6	11	2	1	0	4	
Umiujaq	2000						0	6	1	0	0	0	
Inujjuaq	1977					2	11	32	11	22	10		
Inujjuaq	1978							23	22	2			
Inujjuaq	1979						23	48	16	10	3		
Inujjuaq	1985							5	6				
Inujjuaq	1990												
Inujjuaq	1991							12	8				
Inujjuaq	1992						0	7	9	0	0	0	0
Inujjuaq	1993						1	11	1	0	0	0	0
Inujjuaq	1994							3	15		1		
Inujjuaq	1995						1	18					
Inujjuaq	1996						2	2	18				
Inujjuaq	1997							3	18				
Inujjuaq	1998							9	8	0	1	0	
Inujjuaq	1999						2	0	17	0	0	0	
Inujjuaq	2000						0	32	3	0	0	0	
Puvirnituaq	1990												
Puvirnituaq	1991							22	11			17	

Appendix 2. (continued)

Community	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Puvirnitug	1992						0	0	15	0	7	0	0
Puvirnitug	1993						0	2	7	1	13	0	0
Puvirnitug	1994								13	1	9		
Puvirnitug	1995								1	1	26	8	
Puvirnitug	1996							3	2		33		
Puvirnitug	1997									2	31		
Puvirnitug	1998							0	0	0	36	0	
Puvirnitug	1999						0	0	0	0	27	0	
Puvirnitug	2000						0	1	0	0	28	0	
Akulivik	1976									3			
Akulivik	1977								1		1		
Akulivik	1978		2							2	2		
Akulivik	1979							5	3			1	
Akulivik	1985							11					
Akulivik	1990												
Akulivik	1991								10		8		
Akulivik	1992						0	0	0	0	16	0	0
Akulivik	1993						1	0	10	0	1	0	0
Akulivik	1994								1		19		
Akulivik	1995									7	11		
Akulivik	1996							1		6	2		
Akulivik	1997							4			20		
Akulivik	1998						15	0	0	0	2	0	
Akulivik	1999						2	4	1	0	15	0	
Akulivik	2000						0	4	0	0	8	0	
Ivujivik	1985				2		10	10			13		
Ivujivik	1990												
Ivujivik	1991						19		1		10	1	
Ivujivik	1992						0	2	0	0		0	0
Ivujivik	1993						11	2	0	2	22	0	0
Ivujivik	1994												
Ivujivik	1995										37		
Ivujivik	1996												
Ivujivik	1997							9	13				
Ivujivik	1998						0	0	0	35	9	0	
Ivujivik	1999						21	16	0	0	0	0	
Ivujivik	2000						4	0	0	0	32	0	
Salluit	1976					3	10	22	3		3		
Salluit	1977		2		2		12	18		4	7		2
Salluit	1978	3	3	2				8					
Salluit	1979						4	7	1		4		
Salluit	1985						3	7			12		
Salluit	1990												
Salluit	1991							23			5		
Salluit	1992						0	3	13	0	3	0	0
Salluit	1993						8	29	0	0	0	0	0
Salluit	1994							3	1		42		

Appendix 2. (Continued)

Community	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salluit	1995							36			3		
Salluit	1996						6	7	3				
Salluit	1997						25	16	5				
Salluit	1998						50	3	0	1	0	0	
Salluit	1999						5	17	0	0	8	3	
Salluit	2000						7	3	0	0	18	0	
Kangirsujuaq	1976	2	2				20	32	16	7	9		
Kangirsujuaq	1977						35	43	13	5	7	1	
Kangirsujuaq	1978					3	13	17	10	3	1		
Kangirsujuaq	1979					1	6	10	1	4	8	2	
Kangirsujuaq	1985						10	6	12		2	2	
Kangirsujuaq	1990												
Kangirsujuaq	1991						14	15		1		9	
Kangirsujuaq	1992						0	15	3	0	8	2	0
Kangirsujuaq	1993						16	4	0	0	2	2	0
Kangirsujuaq	1994						6	17	1		10		
Kangirsujuaq	1995							20			2		
Kangirsujuaq	1996						10	14					
Kangirsujuaq	1997							25					
Kangirsujuaq	1998						18	4	0	0	0	0	
Kangirsujuaq	1999						6	20	1	0	0	0	
Kangirsujuaq	2000						8	7	0	0	4	7	
Quartaq	1976				2		5	6		2	1	40	
Quartaq	1977					9	26	8		6	11	23	
Quartaq	1978						5	8			1	3	2
Quartaq	1979						4			2	12	9	
Quartaq	1985							12			22		
Quartaq	1990												
Quartaq	1991						12	16	1				
Quartaq	1992						0	0	0	9	11	2	0
Quartaq	1993						0	0	0	13	8	23	0
Quartaq	1994						18		1				
Quartaq	1995							15			13		
Quartaq	1996						4				5	10	
Quartaq	1997							13	18				
Quartaq	1998						18	1	0	0	13	0	
Quartaq	1999						13	3	0	0	5	3	
Quartaq	2000						18	0	0	0	8	0	
Kangirsuk	1976					6	3	23	9	2		1	
Kangirsuk	1977						26	24	8	9			
Kangirsuk	1978						1	3	3	1			
Kangirsuk	1979							4					
Kangirsuk	1985						1	2	1	3			
Kangirsuk	1990												
Kangirsuk	1991						1	5	6				
Kangirsuk	1992						0	0	0	0	3	0	0
Kangirsuk	1993						5	7	0	0	2	0	0

Appendix 2. (Continued)

Community	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kangirsuk	1994							6	1		3		
Kangirsuk	1995						3	4			3		
Kangirsuk	1996						5	6		3		2	
Kangirsuk	1997						7	8	1				
Kangirsuk	1998						6	6	1	0	0	0	
Kangirsuk	1999						9	7	2	0	0	1	
Kangirsuk	2000						5	4	2	0	0	1	
Aupaluk	1985							3					
Aupaluk	1990												
Aupaluk	1991								1	1	7		
Aupaluk	1992						0	0	0	0	0	0	0
Aupaluk	1993						0	1	2	0	0	0	0
Aupaluk	1994						1	5					
Aupaluk	1995							2			4		
Aupaluk	1996							6	2				
Aupaluk	1997							1	2		4	1	
Aupaluk	1998						0	4	0	0	0	0	
Aupaluk	1999						3	10	0	0	0	0	
Aupaluk	2000						0	5	0	0	2	1	
Tasiujaq	1976												
Tasiujaq	1977							7	11	3			
Tasiujaq	1978												
Tasiujaq	1979								1	1		1	
Tasiujaq	1985							4	5				
Tasiujaq	1990												
Tasiujaq	1991								2				
Tasiujaq	1992						0	1	1	0	0	0	0
Tasiujaq	1993						0	0	2	0	4	0	0
Tasiujaq	1994							6			8		
Tasiujaq	1995							2			9		
Tasiujaq	1996							2	2			2	
Tasiujaq	1997							3	3			8	
Tasiujaq	1998						2	11	0	4	0	0	
Tasiujaq	1999						2	15	0	4	0	0	
Tasiujaq	2000						0	4	0	0	0	9	
Kuujuaq	1976												
Kuujuaq	1977							9	15		1		
Kuujuaq	1978						1	7	2		1		
Kuujuaq	1979							21	5		1		
Kuujuaq	1985							1	1				
Kuujuaq	1990												
Kuujuaq	1991							1	2				
Kuujuaq	1992						1	0	0	2	1	0	0
Kuujuaq	1993						0	0	11	0	1	0	0
Kuujuaq	1994							7			1		
Kuujuaq	1995							4			6		
Kuujuaq	1996										2	4	

Appendix 2. (Continued)

Community	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kuujjuaq	1997							4	9				
Kuujjuaq	1998						5	2	3	0	0	0	
Kuujjuaq	1999						1	3	2	1	1	0	
Kuujjuaq	2000						1	1	1	0	4	0	
Kangirsualujjuaq	1976					1		7				1	
Kangirsualujjuaq	1977							6	1	1			
Kangirsualujjuaq	1978							4	4				
Kangirsualujjuaq	1979							15	12				
Kangirsualujjuaq	1985							3					
Kangirsualujjuaq	1990												
Kangirsualujjuaq	1991			1					1			4	1
Kangirsualujjuaq	1992						0	0	0	0	0	0	0
Kangirsualujjuaq	1993						0	1	0	0	1	2	0
Kangirsualujjuaq	1994						10		1			1	
Kangirsualujjuaq	1995							2					
Kangirsualujjuaq	1996					6			1	1		1	
Kangirsualujjuaq	1997							3	3	1			
Kangirsualujjuaq	1998						0	0	2	0	1	0	
Kangirsualujjuaq	1999						0	0	0	0	0	7	
Kangirsualujjuaq	2000						0	1	0	0	10	0	