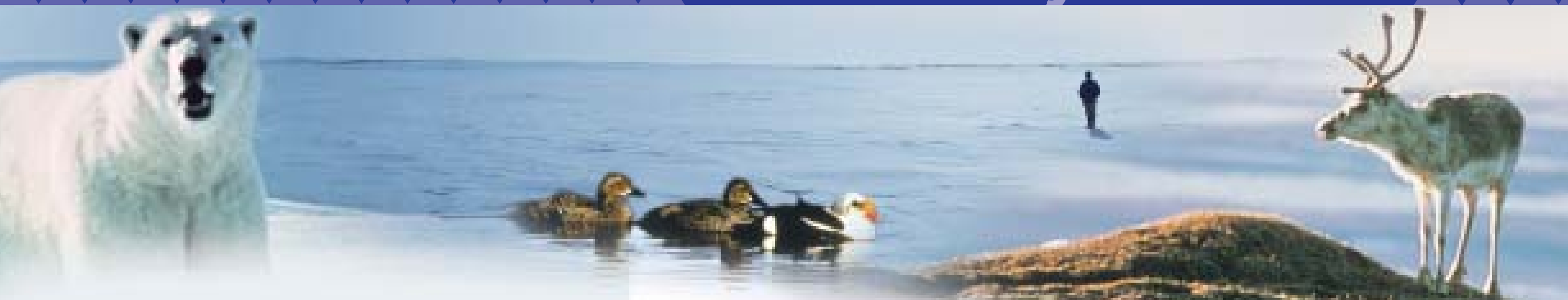

Northern Contaminants Program

The Northern Contaminants Program (NCP) was established in 1991 in response to concerns about human exposure to elevated levels of contaminants in the fish and wildlife species important for the traditional/country food diets of northern Aboriginal peoples. Early studies indicated that a wide spectrum of substances – persistent organic pollutants, heavy metals, and radionuclides – many of which had no Arctic or Canadian sources, were nevertheless reaching unexpectedly high levels in the Arctic ecosystem.

The first phase of the NCP (NCP–I) (1991-1996) focussed on gathering the data required to determine the levels, geographic extent, and sources of contaminants in the northern atmosphere, environment and its people, and the probable duration of the problem. Results from NCP-I were published in 1997 in the first *Canadian Arctic Contaminants Assessment Report* (CACAR).

During its second phase, which ran from 1998–2003, the NCP focussed on:

- impacts and risks to human health that may result from current levels of contaminants in key Arctic food species
- temporal trends of contaminants of concern in important indicator Arctic species and air
- improved education and communications activities involving northern communities
- efforts to control contaminant production, use and disposal at the international level

NCP–II addressed these issues under a number of subprograms: human health; monitoring the health of Arctic peoples and ecosystems and the effectiveness of international controls; education and communications; and international policy. The results of the research and related activities conducted during NCP–II are summarized in the *Canadian Arctic Contaminants Assessment Report II* (CACAR II) series of reports, which was released in March 2003. CACAR II is a comprehensive assessment of the last five years of research and related activities on northern contaminants funded under the NCP.

Five fact sheets have been developed, one for each of the CACAR II reports. These fact sheets provide a snapshot of many of the significant NCP research results described in each report.

Canadian Arctic Contaminants Assessment Report II

Contaminant Levels, Trends and Effects in the Biological Environment

The CACAR II technical report *Contaminant Levels, Trends and Effects in the Biological Environment* presents the results of research on the three areas of study identified at the start of NCP-II as priorities for the Arctic biological environment:

- temporal trends of contaminants in biota
- monitoring and spatial surveys of contaminants in wildlife
- effects of contaminants on wildlife health

After five years of research in these priority areas, significant and useful progress in our understanding of contaminants in the Arctic biological environment has been made. There have also been some unexpected discoveries. This fact sheet describes some of the key research outcomes.

Temporal trends of legacy persistent organic pollutants (POPs) and mercury

Along with metals such as mercury, cadmium and selenium, a large number of "legacy" (no longer in use) persistent organic pollutants (POPs) – including PCBs, DDT, chlordanes, dieldrin, hexachlorocyclohexanes (HCHs), toxaphene and chlorobenzenes (CBz) – were measured in biota in most NCP–II studies. Some of the data sets are now very large since some species have been sampled over a 30-year period, e.g. ringed seals.

Persistent organic pollutants (POPs)

Most "legacy" POPs significantly declined in Canadian Arctic biota from the 1970s to the 1990s. Significant declines in ΣPCB and ΣDDT concentrations have been observed in all ringed seal

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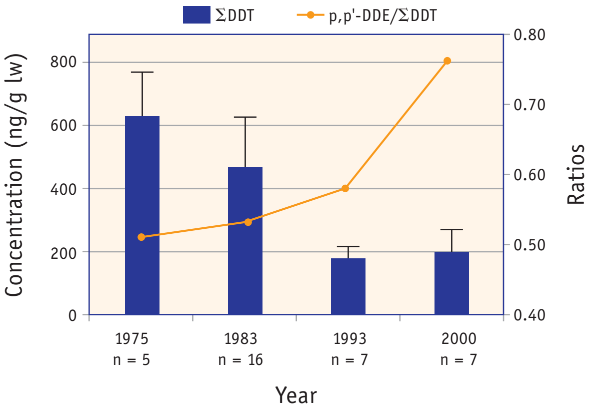

Figure 1: Trends in concentrations and proportions of major DDT components in blubber of female ringed seals from Ikpiarjuk (Arctic Bay).

populations and in seabird eggs in Lancaster Sound. Recent measures of DDT mixtures, as indicated by p,p′-DDE/ΣDDT, indicate weathered or old sources (Figure 1).

Concentrations of coplanar PCBs and chlorinated dioxins/furans (PCDD/Fs) have changed little in Holman Island ringed seals over 20 years. In seabirds in Lancaster Sound, however, levels of PCDD/Fs and coplanar PCBs are generally decreasing, although PCDFs increased in northern fulmars from 1975–1993. ΣHCH levels have remained relatively constant in most species though the levels of the toxic β-HCH isomer and its proportion of ΣHCH have increased in seabird eggs and in ringed seal blubber.

The rate of decline of PCBs and DDT-related compounds in biota has now slowed or stopped in many species, e.g., polar bears from western Hudson Bay. The rate of decline of POPs also varies among species. Beluga and polar bears are experiencing the slowest declines and the ringed seals and seabirds the most rapid.

Mercury

There is solid evidence that mercury has increased in Canadian Arctic animals from pre-industrial times to the present. For example, mercury has increased 10–17-fold in beluga (as measured in teeth) in the Mackenzie Bay area since about 1450–2000 AD (Figure 2). Mercury has increased four-fold in beluga from the Beaufort Sea over the past ten years and

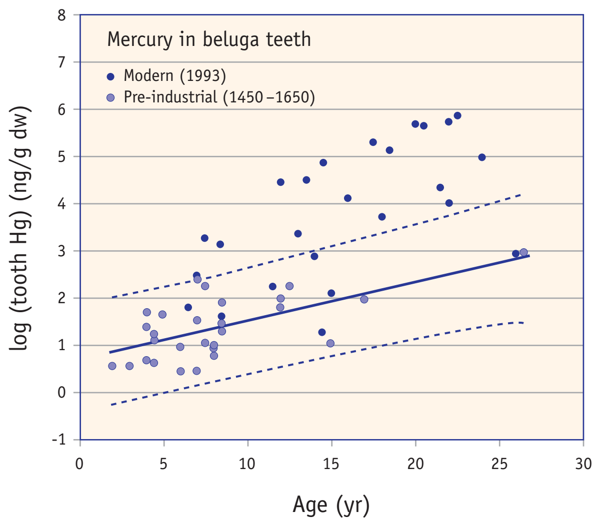

Figure 2: Mercury in modern and pre-industrial teeth of Beaufort Sea beluga whales from the Mackenzie River delta.

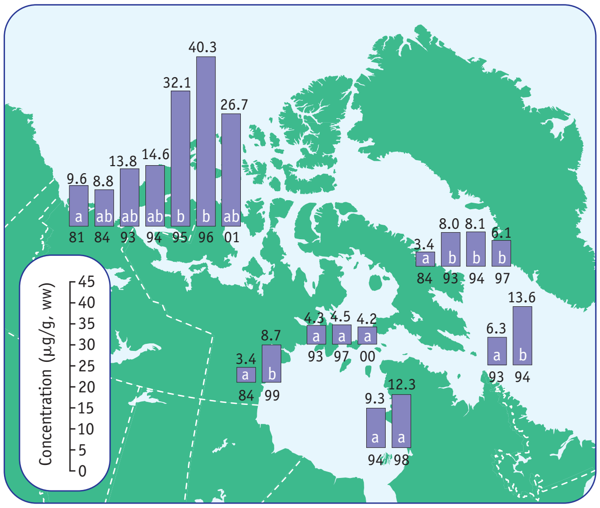

Figure 3: Temporal and spatial trends of total mercury in beluga whale liver.

2.5-fold in western Hudson Bay beluga but not significantly at any other location (Figure 3). It has been suggested that higher temperatures in the Mackenzie River region have liberated mercury, leading to the increases in mercury concentrations observed in the Beaufort Sea beluga.

Mercury has also increased about three-fold in the livers of ringed seals from Pond Inlet over 1976–2000. On the other hand, no significant increases in mercury in the livers of ringed seals from Holman in the western Canadian Arctic were seen over a 30-year period (1972–2001) although a doubling was observed between 1993–2001.

In contrast to the relatively sudden rise in mercury in Beaufort Sea beluga over the past ten years, a slow but steady increase in mercury has been observed in Lancaster Sound seabird eggs over the past 30 years.

In Great Slave Lake, mercury increased significantly in lake trout over a 22-year period (1979–2001) but declined in walleye, northern pike and burbot over approximately the same period. Mercury temporal trends are thus very specific to species and region for reasons that are as yet not well understood.

Spatial patterns of mercury and POPs in biota

The coverage of contaminant data for freshwater and anadromous (sea-run) fish has improved considerably and includes POPs and mercury data for a number of fish species in most regions of the Canadian Arctic. For many lakes, concentrations of mercury in freshwater fish exceed guideline levels for subsistence (0.2 µg/g) and/or commercial sale (0.5 µg/g) but these data follow no obvious geographic pattern (Figure 4). A number of studies have found that food web length, and the age and size of the fish are important variables but a definitive explanation for the high and variable levels among lakes remains elusive.

Mercury in ringed seal livers shows no significant geographic patterns although levels are higher at Arviat than at other locations. In beluga, concentrations of mercury are 2–10 times higher in Mackenzie Bay/ Beaufort Sea animals than at other locations. Regional differences were also found between beluga in Mackenzie Bay and beluga at Paulatuk despite all being from the same southern Beaufort Sea stock. Differences in diet may account for these regional differences since a subgroup of the animals is believed to return to the same feeding grounds each year. Levels of cadmium in the livers and kidneys of ringed seals and beluga continue to show large differences between western and eastern Canadian Arctic populations. These differences are thought to be natural and best explained by differences in geology.

Lake-to-lake variability of POPs in freshwater fish is less than what is seen for mercury but in some lakes higher levels have been found in lake trout and burbot. In some lakes, food web length accounts for the differences, but in other lakes glacial melt may be influencing POPs levels.

Spatial coverage of POPs in ringed seals, beluga and seabirds remains a strength of the Arctic contaminant data set for Canada. Concentrations of PCBs, DDT and chlordane-related compounds, as well as toxaphene in marine biota, are slightly elevated in eastern compared to the western Canadian Arctic, consistent with circumpolar trends (Figure 5). HCH concentrations tend to be higher in western Arctic biota since this pesticide is transported to western Canada from Asia where it is still used. POPs in Arctic fox and marine invertebrates show similar geographic patterns.

With the exception of HCHs, levels of POPs in ringed seals, polar bears, seabirds, and freshwater fish are lower in the Canadian Arctic compared with the same or similar species from eastern Greenland and the European and Russian Arctic.

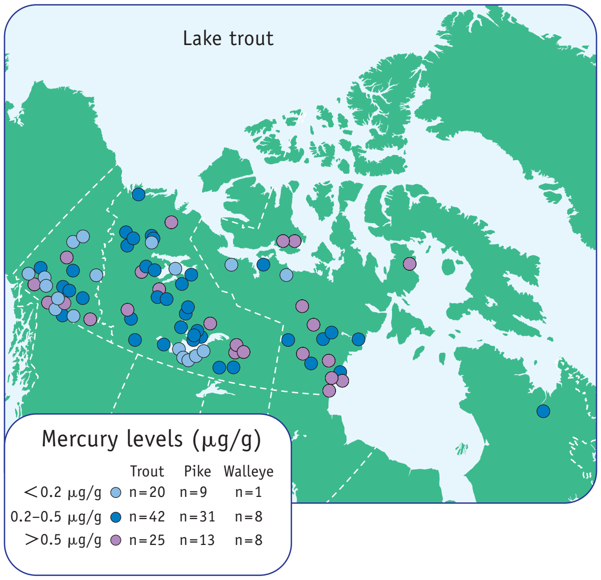

Figure 4: Mercury concentrations in lake trout show no discernable geographic pattern.

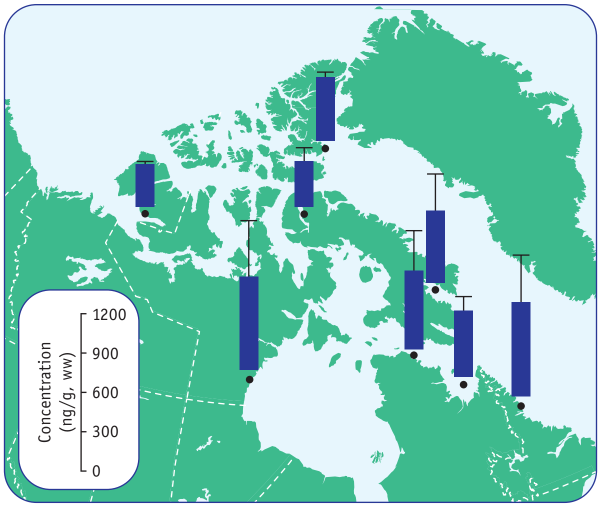

Figure 5: Concentrations of ΣPCBs in female ringed seal blubber.

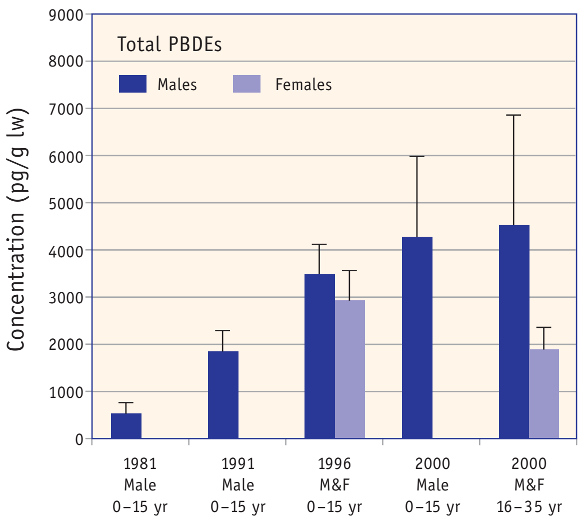

Figure 6: Increasing concentrations of Br_2-Br_7 PBDE congeners in ringed seal blubber from Holman.

New chemicals

The number of new chemicals known to exist in Arctic biota has increased significantly and several new chemicals have been found since 1978. Polybrominated diphenyl ethers (PBDEs) have been measured at very low levels in both freshwater and marine organisms, while short-chain chlorinated paraffins (SCCPs) and chlorinated naphthalenes (PCNs) have been detected in beluga and ringed seals. Although concentrations of many of these new chemicals are lower than legacy POPs (PCBs, DDT, etc.) there is concern because levels of current use substances like PBDEs are increasing (Figure 6).

Perfluorooctane sulfonate (PFOS), which is widely used as a stain repellent, has been found unexpectedly in some Canadian Arctic biota, sometimes at significant levels. Compared to other POPs, PFOS has been detected at relatively high levels in polar bear livers.

Effects of contaminants on wildlife health

Information and data on the biological effects of contaminants in Canadian Arctic biota remain an important knowledge gap. Although current levels of contaminants in Canadian Arctic biota are generally below threshold levels of effects, there is still cause for concern.

Black guillemot nestlings that had been exposed to PCBs as a result of local contamination at Saglek showed dose-related effects on liver biomarkers. These effects were observed at relatively low levels of PCB exposure. There is potential for concern elsewhere in the Arctic since higher trophic level birds such as glaucous gulls often have higher exposure levels.

A study at Southhampton Island found evidence for a relationship between sea duck health and metal exposure. At Lancaster Sound in a general assessment of risks to Arctic seabirds, toxic equivalent (TEQ) concentrations in the livers of northern fulmars, black-legged kittiwakes and thick-billed murres exceeded the no-observed-effects-levels and lowest-observed-effects-levels (NOELs and LOELs, respectively) established for certain fish-eating birds (Figure 7).

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Polar bears, more than any other wildlife species, are at risk from contaminants. The immune systems of polar bears from the Canadian Arctic and Svalbard (Norway) are being compromised by PCBs and potentially by other POPs. PCBs are also associated with reduced levels of thyroid hormone and a suppressed immune response. The influence of these altered systems on the health of polar bear populations is unknown, but some evidence suggests contaminant exposure may be related to reduced survival rates in polar bear cubs.

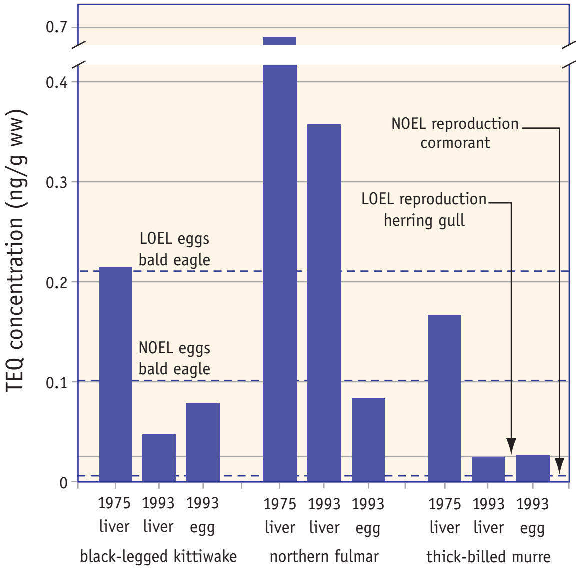

Figure 7: Toxic equivalent (TEQ) concentrations in the livers of seabirds compared to threshold effects levels.

For more information on *Contaminant Levels, Trends and Effects in the Biological Environment* please consult the CACAR II series of reports, available from the Northern Contaminants Program Secretariat:

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