Effects of contaminants on Arctic humans and biota

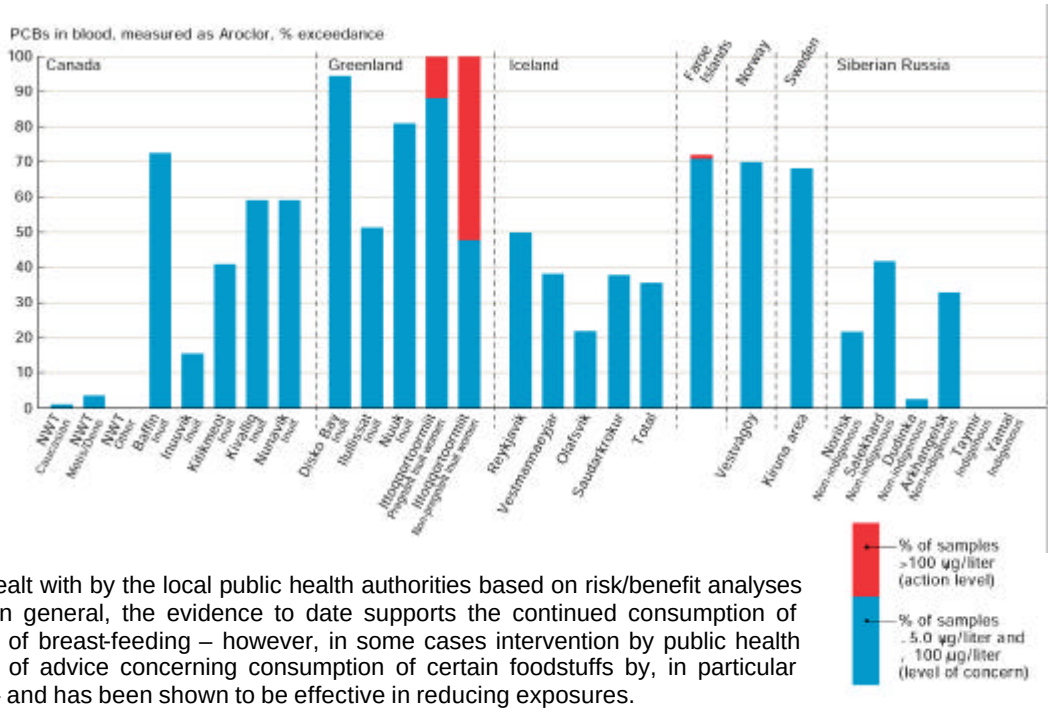
Over the past 10 years, the Arctic Monitoring Programme (AMAP) has conducted two major assessments of the pollution status of the Arctic, documenting the sources, levels and trends, and effects of a wide range of contaminants, including persistent organic pollutants (POPs), heavy metals, radionuclides, acidifying substances, and petroleum hydrocarbons. The main conclusions of these assessments are that: *"In comparison with most other areas of the world, the Arctic remains a clean environment. However, for some pollutants, combinations of different factors give rise to concern in certain ecosystems and for some human populations. These circumstances sometimes occur on a local scale, but in some cases may be regional or circumpolar in extent."*

What does it mean that a polar bear has 30 µg/g PCB in their fat, or that Inuit in Greenland have blood mercury levels of 50 µg/L? To answer this question it is necessary to place information on levels in an appropriate context.

Contaminants such as persistent organic pollutants, or metals including, mercury, cadmium and organotin, are known to have a range of effects on biota – neurotoxic effects; effects on liver enzymes; effects on the immune, thyroid and vitamin A systems; some are carcinogenic. Of particular concern are contaminants that can have reproductive effects, including those that can mimic the activity of natural hormones. Some contaminants can pass the placental barrier, and have the potential to affect the development of the fetus or young.

EFFECTS in BIOTA: For some animals it is possible to compare levels found in wildlife with effects thresholds derived from laboratory studies, or with environmental levels that are believed to have been implicated in effects seen in the wild – such as declines in bird populations. This process is not simple. For many Arctic biota, relevant laboratory studies do not exist and comparisons should be made with caution because of problems with extrapolating data across species. For some contaminants, environmental quality guidelines have also been developed. A further complicating factor is that, unlike the situation in most laboratory studies, animals in the wild are exposed to a suite of many different contaminants.

Such comparisons have revealed that levels, of PCBs and dioxins in particular, are high enough to affect the health of individual animals in species including polar bears, northern fur seals, and glaucous gulls, and to raise concern about immune and reproductive effects in these and other species including Arctic fox, killer whales and several seabirds. Despite bans, organic pesticides such as DDT persist in the environment and are still a concern for the reproductive health of birds of prey. New POPs (such as PFOS and PBDEs) are being found at elevated levels in Arctic biota, and very little is known about their potential effects.

Knowledge about the combined effects of multiple contaminant exposures is also very sparse and other factors such as temperature change, exposure to UV radiation, food availability, etc. can also play a role. However, such comparisons do provide useful information on the species that appear to be most at risk from effects of environmental contaminant exposure.

EFFECTS in HUMANS: Humans represent another case – some knowledge of contaminant effects is based on accidents – but most concern in the Arctic is about long-term chronic exposure to low levels of contaminants rather than acute exposure. Epidemiological studies are necessary to resolve the influence of contaminants from other factors such as smoking, nutritional status, and also genetic factors that can also give additional exposures or influence health response to contaminant exposures. Such studies are particularly rare in the Arctic – where populations are low – however some recent studies have linked PCB and mercury exposure in Arctic populations to immunological and neuro-developmental effects. Of particular concern are possible effects due to pre-natal or early childhood exposure – periods of intense development and increased vulnerability. Within the Arctic, in particular amongst indigenous populations that receive high contaminant exposure due to their traditional diets, there are significant exceedances of international and national guideline values for exposure to, e.g. PCB (as shown in the figure) and mercury. Whether these exposures constitute a health concern is a policy decision issue which should be dealt with by the local public health authorities based on risk/benefit analyses for the populations concerned. In general, the evidence to date supports the continued consumption of traditional food, and the practice of breast-feeding – however, in some cases intervention by public health authorities and the development of advice concerning consumption of certain foodstuffs by, in particular vulnerable groups, is warranted – and has been shown to be effective in reducing exposures.