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Northern Perspectives

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# One "Dirty Dozen" Down, More To Go

When the Stockholm Convention on Persistent Organic Pollutants (POPs) was finally signed, those of us involved in the negotiations breathed a sigh of relief. Not because we thought the battle against toxic substances in the Arctic was over, but because we had reached a significant milestone that at times, had seemed beyond reach.

We knew the Arctic needed the kind of protection only an international treaty could provide. We knew that toxic chemicals including pesticides and dangerous residues from incinerators were collecting at alarming levels in the Arctic, brought there by winds and waters, and retained there by Arctic cold. We knew all of this thanks mainly to information from the Arctic Monitoring and Assessment Programme (AMAP), a cooperative venture by scientists from the circumpolar countries, working under the auspices of the Arctic Council.

As we focus on what lies beyond the signing of the Stockholm Convention, AMAP is continuing to make us aware of the magnitude of existing challenges, and the identity of fresh challenges to the Arctic environment.

The first challenge is that the Convention needs to be ratified by a sufficient number of countries to come into force, so that the "dirty dozen" toxic chemicals named by the treaty will be almost universally subject to measures aimed at ultimately eliminating their production and use. Canada has ratified the Convention, but our government's job does not end there. We must use whatever international leverage we have to encourage other countries to ratify swiftly. CARC is continuing its work with the International POPs Elimination Network, an international grouping of NGOs, to help persuade governments around the world that quick ratification is essential.

Adding new substances to that dirty dozen is also important. As you will read later in this journal, substances are just now being identified as potentially hazardous to the Arctic environment, and the peoples who live there. Some of those substances are POPs, such as a common chemical used to help stop fires in furniture and electrical equipment.

Another concern identified by AMAP is mercury. Recent studies have led scientists to double their estimates of how much of this toxic metal is being dumped on the Arctic every year. CARC is involved in a United Nations review of what action, if any, should be taken to control mercury. We fully endorse the calls by senior AMAP scientists for circumpolar countries such as Canada to take the lead in mobilizing international action on mercury.

Finally, we call on Canada and other circumpolar countries to ensure that the excellent work of AMAP continues. Without the continual monitoring and investigation provided by the programme, we would have little idea of the size and nature of the problem facing Arctic peoples and ecosystems, and international action might never have been taken.

*Karen Wristen, Executive Director.*

# Editorial note:

The difficulties of communicating the risk posed by Arctic contaminants were highlighted during the recent Arctic Monitoring and Assessment Programme Symposium.

There are two opposing impulses: one is to play up the risks as much as possible, with the intent of alarming governments sufficiently that they will take action. The other approach is to downplay the risks for fear of alarming people who rely on traditional foods, and who may abandon those foods if they are scared by what they hear about contaminants in their food.

Thirty years ago, it may have been possible to better separate those messages intended for different audiences. What appeared in major urban newspapers didn't necessarily make it to people eating traditional foods in Arctic villages. But we can no longer make that assumption. Today's hunter is quite capable of reading the latest headlines on a computer before sitting down to a supper of seal meat.

Ideally, what would happen now is that the hunter would already have heard of the results of the studies, communicated in a culturally appropriate fashion through an organization that knows and understands the local culture and customs. That would help to put the alarming headlines in context.

What we have done in this publication is to attempt to walk a middle ground between the two extreme approaches, neither downplaying alarming news, nor sensationalizing it. As you will read, there is a risk involved in eating food containing contaminants, a risk that is beginning to be better understood and explained. People need to know that. They also need to know that risks can be lowered by making slight alterations in their diet, and that changing their diet entirely poses its own risks.

We hope that the information in this magazine neither unduly alarms Arctic peoples, nor unduly reassures governments.


# AMAP Chief Urges Global Action on Mercury

*Northern Perspectives* editor Clive Tesar interviewed Helgi Jensson of Iceland, the chair of the Arctic Monitoring and Assessment Programme.

*What would you say are the most significant findings from this report?*

The most significant findings are about the mercury deposition and the mercury sink in the Arctic, then the second thing is about the new POPs. We're talking about for example, the brominated flame retardants. And the third thing that may be of most interest to the general public is that we now have much more knowledge about the effects on human health of these substances, especially in Greenland and in northern Canada.

*You've identified mercury deposition in the Arctic as an issue of increasing concern. What action do you expect to see flow from this?*

I expect to see and hope to see a global movement towards trying to put a lid on the emissions of mercury. I really do not believe that it will be easy to get that because the emissions are coming from coal-burning, house heating and things like that, and industrial processes, but I think it is necessary to do it on a global scale.

I just want to look a little into the future, if for example, development in Asia follows the route of the western world, emissions will increase dramatically and if the Arctic continues to be a sink, and they get to the same standard as the western world today, the Arctic becomes a source of mercury for the rest of the world. Do we really want to see this scenario in the future?

*When you talk about international action, how would that begin?*

I think it has already begun. The United Nations Environment Programme has done a global assessment on mercury and I think that at a meeting of the (UNEP) governing council in February (2003) they are going to discuss that, but I don't know what kind of decision they will make. The global community is moving, but the question is, is it moving fast enough? That's another question.

*Human health as you mentioned was another focus of this phase of study. What can you now say with certainty about the effects of Arctic pollutants on human health?*

We know that in studies from the Faeroe Islands it's shown that mercury is having an effect on child development, and we know now that in some populations in East Greenland and in Canada the concentration of POPs in the blood is high enough to cause a risk, especially to children in the womb. But I can't go into depth about that, you'd have to ask human health experts.

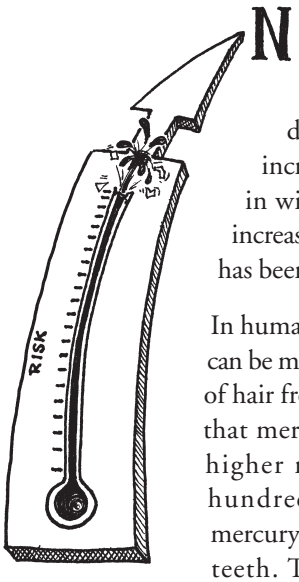
*I know this isn't up to you to determine, but do you expect to see another AMAP report four or five years from now?*

No, actually not. What I would like to see is not such a big report, but maybe a report dealing with the dietary burden of contaminants, concentrating on a much narrower theme. It's easier to produce, you don't have to gather such a lot of people. So, what I see in the future is shorter reports tackling certain special problems, not the whole of the Arctic as such.

*So this is sort of the last hurrah for big AMAP reports?*

Maybe after ten years you'd like to see a big report, but not in five or six years. Maybe it could go like this: after four years, a human health report; after six years, the POPs; after eight years, we have the mercury story, and so on, but not all together at the same time.

# Mercury Rising




Evidence suggests that the amount of mercury deposited in the Arctic is increasing, and amounts found in wildlife and humans are also increasing. Proof of those increases has been found in a variety of ways.

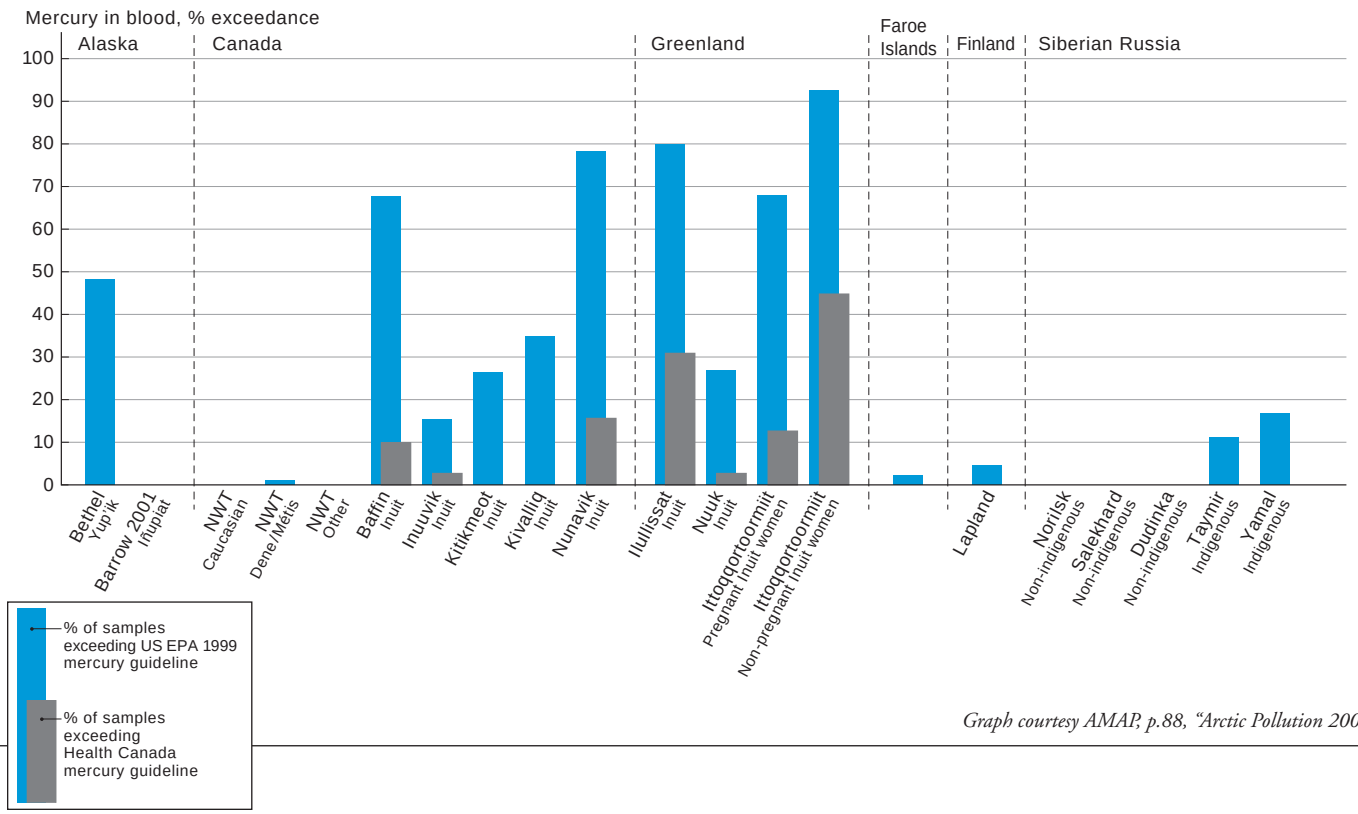
In humans, mercury concentrations can be measured in hair. Comparisons of hair from Greenlandic Inuit show that mercury levels are three times higher now than they were five hundred years ago. In animals, mercury can be measured in fur and teeth. Those measurements also indicate a sharp increase in mercury levels with increased human industrial activity.

## Origins and pathways

While the presence of mercury in the Arctic can be measured in air, water, soil, and living things, working out how the metal arrives in the Arctic, and where it originated are more complex tasks. It is known that mercury is emitted to the atmosphere by a variety of processes, particularly by coal-burning.

AMAP research shows that Asian coal-burning is likely one of the largest and fastest-growing contributors to the production of atmospheric mercury. Coal is not only burned by power stations, but also by millions of people who use it as fuel for cooking and warmth. After mercury is taken up in the atmosphere, research has shown that it can stay there for up to a year, plenty of time to be transported thousands of kilometers from where it was emitted.

Mercury levels in blood of women of reproductive age as they relate to US EPA and Canadian guidelines for increasing risk range.




*Graph courtesy AMAP, p.88, "Arctic Pollution 2002"*

New research has shown that mercury is being dumped on the Arctic in larger amounts than had previously been guessed. The latest estimates show the amount of mercury deposited in the Arctic region each year is as much as 300 tonnes.

Alexandra Steffen is a research chemist with the meteorological service of Canada. She has been part of a team measuring mercury levels in the air at Alert, a military base and weather station in the far north of Canada. Steffen says the team discovered disturbing information about mercury concentrations in Arctic air at the time when the sun returns to the area. "What we found was that come the springtime, all of a sudden mercury concentrations would drop dramatically, below or at detection levels of the instruments. At first we thought our instruments were not measuring properly, but once we figured out that was not the case, all of a sudden we had a new thing, which we call now mercury depletion events."

These "mercury depletion events" are a result of a complicated interaction that is not yet fully understood. It is thought that mercury in the air reacts with chemicals from sea salt and ultra-violet radiation from the sun. What happens then is that the mercury is deposited on the land and in the water in forms that can be absorbed by living creatures.

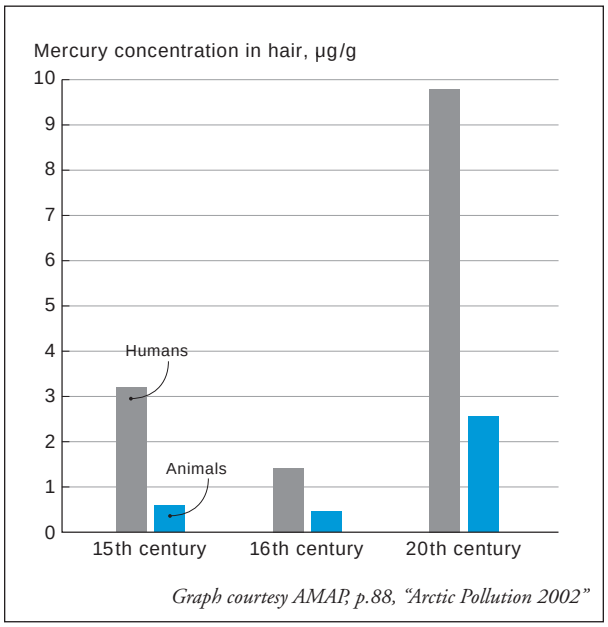
Steffen says this knowledge increases concern about the amounts of mercury being deposited in the Arctic. "Certainly this has increased what we do in our calculations for deposition, because this is a mechanism that wasn't counted in that deposition before. Certainly it adds an incredibly large pulse of mercury to the Arctic during springtime periods when they're trying to get ready for their peak summertime activity."

This timing of extra mercury deposition when northern animals and plants are on the verge of the explosion of activity in a northern spring is particularly worrisome. Michael Goodsite, a researcher with Denmark's National Environmental Research Institute says because deposition occurs when the biological system is at its most active, "Mercury may be bioaccumulated much more effectively."

## Human health effects

At present, there is no international agreement on what level of mercury in people is safe. Various countries have set levels of what they believe may be safe, and have issued dietary advice based on those levels. There is simply not yet enough evidence to be sure what effects low levels of mercury may have on people. There is evidence in laboratory studies that particularly high levels of mercury can cause brain damage, particularly in young children, or foetuses.

Mercury concentrations in hair of humans and animals from Greenland.




*Graph courtesy AMAP, p.88, "Arctic Pollution 2002"*

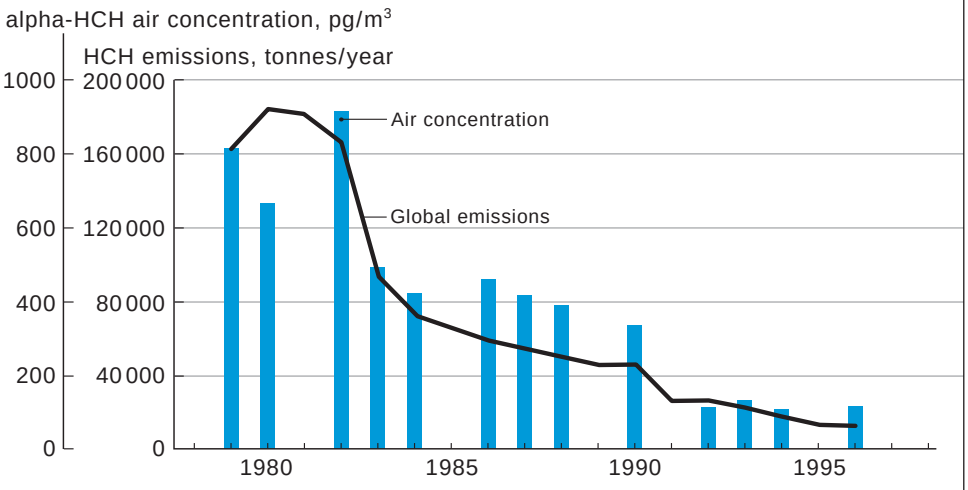
The latest AMAP report cites a study in the Faeroe Islands, where many islanders have relatively high levels of mercury from eating whale meat. The study found a link between higher levels of mercury when children were in the womb, and slight developmental delays in the children. When people were advised to eat less whale meat, mercury levels in children went down.

As with all contaminants, it is impossible to assess risks without knowing something about the diet of people, and other factors that may affect their health. Researchers acknowledge that levels of mercury in some people in Canada's eastern Arctic and Greenland are high enough to be of concern, but are unsure of what effects may be seen as a result.

# "New" threats in old packages—*the POPs situation.*

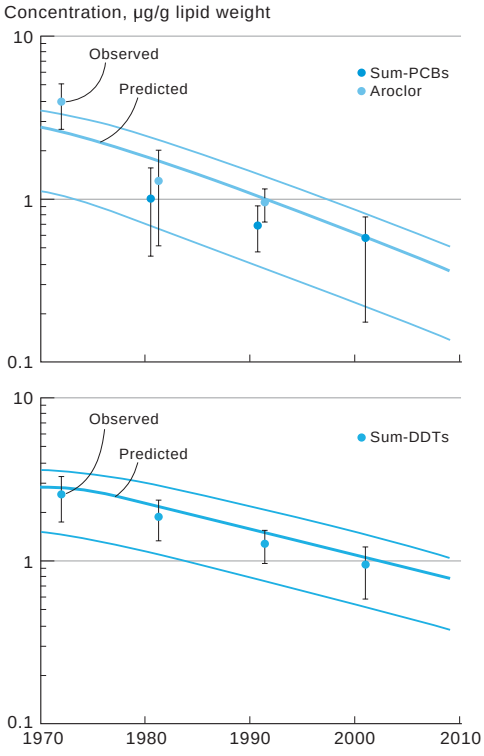
Despite the fact that the Stockholm Convention on POPs (see sidebar) has not yet been implemented, there is some good news on POPs. Levels of some chemicals already banned by most countries have been dropping, according to air measurements made at Arctic research stations. One example is a chemical called technical hexachlorocyclohexane (HCH), which was used to produce a pesticide. One part of this mixture, called alpha-HCH has been measured over several years, and shows a marked decline.

Emissions of technical HCH and concentrations of alpha-HCH in Arctic air.




*Graph courtesy AMAP, p.23, "Arctic Pollution 2002"*

Observed and predicted trends for PCBs and DDTs in ringed seal from Holman Island, Northwest Territories.




*Graph courtesy AMAP, p.25, "Arctic Pollution 2002"*

However, stopping or limiting sources of POPs does not always result in immediate drops in levels arriving in the Arctic. Some POPs can take many years to travel to the Arctic, so that levels can climb after the chemical's use has declined. For instance, between 1993 and 1998, there were increasing levels of DDT in the atmosphere measured at the far north weather station at Alert. Existing POPs in the Arctic may also take many years to decline in the environment. Some longer-lived animal species will continue to accumulate POPs in their bodies, creating potential health problems for people who rely on the animals for food.

While action on the twelve POPs identified in the Stockholm Convention is still a priority, new POPs threats are being identified. Some of the chemicals now being found in the Arctic are not particularly new. In fact, some have been in use for decades. What is new is that they are now being measured, and are now perceived as potential threats to the health of Arctic ecosystems and the peoples of the Arctic.

One group of chemicals now causing concern among Arctic environmental scientists is the polybrominated diphenyl ethers (PBDEs). These chemicals are used to prevent fabrics and equipment from burning. They are used for such things as furniture and home electronic

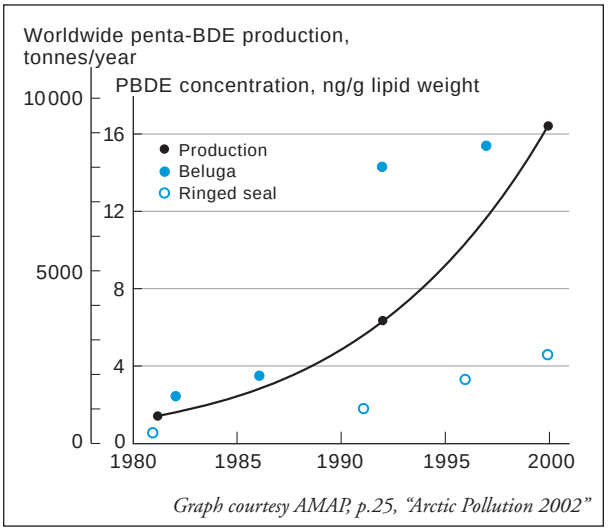
equipment. The use of PBDEs has grown substantially over the past ten years. Annual production is estimated to be more than 200,000 tonnes.

PBDEs are increasing in Arctic animals, particularly in marine mammals such as seals and whales, which are already coping with other contaminants.

The effects of PBDEs are not fully understood, but some studies have shown that they can have a negative effect on the ability of animals to fight off diseases. Although the levels of PBDEs are still lower than levels of some other Arctic pollutants they are of concern because they are rising, and they show some of the same properties as other POPs. They stay in the environment for a long time, they accumulate in the bodies of animals, and they are toxic. PBDEs are not yet covered by any international agreement.

PBDE's are not the only "new" chemicals discovered in the Arctic that are of concern to AMAP researchers. Perfluorooctane sulfonate (PFOS), short-chain chlorinated paraffins, and many more substances are on the lists of chemicals that have showed up in Arctic air and animals. Whether the levels of these chemicals are on an upward or downward trend, and whether or not they have the potential to cause serious effects in people and the environment, are largely unanswered questions at present. As Lars-Erik Liljelund, Director General of the Swedish Environmental Protection Agency said during the closing plenary of the AMAP symposium, "A very important message to our governments is to continue with monitoring, because in future, you will ask for this information to see the results of your actions."

Comparison of temporal trends of PBDEs in ringed seal and beluga in the Canadian Arctic with estimated global production of penta-BDE over the same period.




*Graph courtesy AMAP, p.25, "Arctic Pollution 2002"*

## Stopping POPs and metals—the international agreements

There are two international agreements negotiated so far to limit the production, use, or emission of pollutants that affect the Arctic:

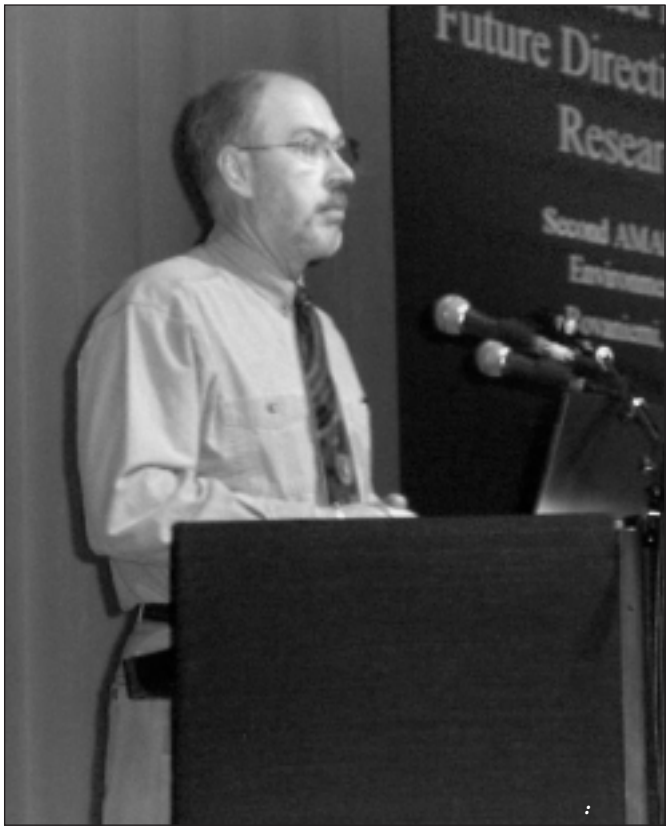
*The United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution*

This agreement entered into force in 1983, after being negotiated four years earlier. It started out of concern over the sulphur emissions that were raising acid levels in some European lakes. The name of the UNECE is misleading, as this body also includes former soviet republics in Asia, as well as Canada and the United States. The first agreement on air pollution has been enlarged by the addition of eight more "protocols" covering specific pollution concerns, such as a protocol on POPs, and a protocol on heavy metals, including mercury. Unfortunately, the protocols on POPs and heavy metals, negotiated in 1998, have still not been ratified by enough countries to come into force.

*The Stockholm Convention on Persistent Organic Pollutants*

This is a truly international treaty, signed by 151 countries. However, this treaty also has been ratified by too few countries to enter into force. It covers twelve different toxic chemicals, and has provisions to add new chemicals to the list. The treaty obliges governments to eliminate or reduce the POPs emitted to the environment, and also commits richer countries to providing technical and financial assistance to countries which can not afford to meet the provisions of the treaty. Many of the chemicals covered by the treaty had already been banned by most countries.

# The Proof of the Pudding—Pollution Impacts on Human Health




*Andy Gilman*

The question on everyone's mind when discussing pollutants is "How will this affect my health?" Researchers studying Arctic contaminants have found that question difficult to answer. *Northern Perspectives* editor Clive Tesar interviewed the co-chairs of the AMAP Human Health Committee, Andy Gilman of Canada, and Jens Hansen of Denmark.

*Are we now seeing impacts on human health from pollutants in the Arctic?*

Gilman—Yes, I think we are now seeing impacts on human health. Primarily those impacts are related to alterations in the body's immune system, that's the system that is used to fight disease. That has been reduced or lowered so our ability to fight disease is less.

And although we haven't proven it yet, I think we can expect to find slight impairments in the development of children as a result of some of the exposures that we see. That information will be arriving shortly, but we don't have it yet, that's from a study that is being conducted in northern Quebec.

Hansen—I could add that there's also a concern for the effect of pollutants on reproduction. We don't know at the moment for sure if that's true, but we're starting for instance in Greenland to look into that question.

*Which people are most at risk?*

Hansen—The traditional food is the most important source of pollutants in the Arctic. The level of pollutants in the food is related to the food web system. Those people having their food from the highest level of the food web are the highest exposed. That means the Inuit population in Greenland and in eastern Canada who have the sea mammal as priority food.

Gilman—It does depend which contaminant is being evaluated and what the human health group is doing is to try to look at all contaminants together. Certainly, for PCBs in Greenland and the eastern Canadian Arctic, they would appear to come primarily from the blubber of marine mammals. Mercury levels come more from the muscle, the meat, so mercury levels are reasonably high in parts of Greenland and parts of the eastern Canadian Arctic, and have been high in places such as the Faeroe Islands.

*Is what we're finding in certain areas partly a function of where we're looking?*

Gilman—I would say now we have pretty good coverage in human blood levels from all across the Arctic. The only portion we don't have results back from now is eastern Russia. So all the way from Alaska, right the way across Canada, Greenland, Iceland, the Scandinavian countries, the Faeroe Islands we have very good information. So I think we have good coverage, I think it's probably not a function of where we're looking so I think we have a very good idea geographically of the contaminant picture.

You had asked who was most likely to be affected by contaminants, and certainly the most at risk groups are going to be those most highly exposed groups, and also within that, the major concern would be for pregnant women because of the impact these chemicals can have on the foetus, and on children as they're growing up. So a sort of a subset of those contamination experiences, it's that part of the population that it seems critical to protect.

Hansen—There is one additional element in this question. It is true that food is the main source, but it has been shown during the latest AMAP phase that lifestyle factors such as smoking influence the amount of pollutants in the body, not because tobacco contains the pollutants, but the smoking by itself influences the way the body deals with contaminants.

*Which substances to date have been identified as the most problematic?*

Gilman—I think we have two groups, in general what are called the organochlorines, in particular the PCBs, we have found them in the highest concentrations and I think at the moment they are the highest concern. Another contaminant is mercury. In certain areas it is at a level that would give rise to concern, from a public health point of view.

One of the issues with respect to these two groups of contaminants is the direction in which we are going globally in terms of exposure. At this conference, one of the messages that has been fairly strong is that we are looking at continued emissions of mercury from various parts of the world that are going to lead more than likely to more Arctic pollution rather than less. So I think there's quite a strong imperative for us to move forward aggressively on curtailing those emissions worldwide, and that is an issue that is being addressed by the United Nations Environment Programme now.

For PCBs, I think we've learned that the emissions to the Arctic are continuing, however, they are not rising. We may be beginning to see some declines in some of the wildlife species that have been measured. We can not tell whether levels are going down in human populations yet because the monitoring of human populations is not long enough. That will be one of the priorities if the AMAP continues, to get another data point to see whether or not we're starting to see those concentrations declining in human populations.

*What action do you expect to flow from some of the data you've been seeing?*

Gilman—The key action is in getting continued support for ratification of both the United Nations Economic Commission for Europe protocol on POPs and metals, mercury is in that protocol, and also the Stockholm Convention. If there was still any doubt in anybody's mind, there ought not be after looking at the information that has been provided at this conference.

*Participants in Rovaniemi AMAP symposium.*

We simply have to move forward aggressively on stopping the use of these compounds and reducing emissions of these metals.

Hansen—I totally agree with Dr. Gilman that international action is absolutely necessary, but also local action. We have to develop strategies for advice to local populations, how to avoid the highest contaminated food, and that must be done on a local, regional basis by the health authorities, but we provide the scientific background. That's the only way to take into account local customs, cultures, and the way of life.

*What information gaps remain in terms of Arctic contaminants and public health?*

Hansen—We need to establish time trends. We have only measured for short periods and that does not say anything about the decline or stability of levels of persistent organic pollutants. For mercury, we don't have any certain indication of time trends, only for lead. There has been a significant decrease of lead in the blood concentrations in the Arctic, parallel to the reduction of lead in gasoline, so that is a story that tells us that international actions do work.

Another gap is that we need to know more about the biochemical effects at the present level of contaminants and the present mixture of contaminants, because there are interactions between different chemicals. They can potentiate the effects or they can counteract the effects so what we need to study is the actual mixture, how does that function in the human body. So we need to develop these programmes much more and have them implemented more widely in the Arctic area.

Gilman—I think we still have some sampling that needs to be done in some parts of the Arctic especially eastern Russia.

We have not yet taken a look at all at some of the newly identified contaminants, and that's an issue for us because there are publications out now indicating that polybrominated diphenyl ethers have been found accumulating very rapidly in animal tissues and in some blood samples that have been stored over time. The perfluorooctane sulfonate or PFOS is another one that has been found in wildlife, we have not looked for that in human tissues. Short-chain chlorinated paraffins are another group. Most of these chemicals appear to have similar kinds of properties to other ones that are there and we just don't know anything about those in human tissues, so that's an area that requires more work.

We probably have more work to do looking at infectious and non-infectious diseases because these chemicals can affect immune systems. Then we may be seeing more of the infectious diseases appearing in Arctic populations and we need to gather that database.

We also need to look at some of the changes in non-infectious diseases that may be occurring as a result of changes in diet, because people are fearful of consuming a diet that contains contaminants. So things like switching

> "At this point, it is impossible to evaluate the combined effects of all contaminants and other factors that influence human health in the Arctic. AMAP's Human Health Program is designed to gather information from a number of different areas to make better assessments of combined effects in the future."
>
> *AMAP, p.91, "Arctic Pollution 2002"*

diet so that obesity becomes a problem, or diabetes begins to occur, or more cardio-vascular disease begins to occur, those are things that need to be monitored.

There are a number of things that need to be done, but they're certainly not actions or bits of research that have to be filled in before we can draw the conclusion that international action must press forward to eliminate these kinds of compounds. This is refining our understanding so that the sort of advice that can be provided locally to populations is better advice. These findings are not going to have a direct impact on whether or not we do or don't take action on POPs and metals. I think that action has been taken; we need to press on with that.

*In terms of filling those information gaps to provide local advice, how soon can that be given?*

Gilman—I think that advice already has been given in some locations and has led to significant change. For instance, in the Faeroe Islands starting about five years ago the advice was for people to eat less pilot whale, and as a result mercury levels have declined dramatically. The PCB levels haven't declined because the blubber of pilot whales contains the PCB rather than the meat, and it was the reduction in the meat consumption that occurred, so PCB levels didn't drop but mercury levels did drop. So we know that interventions can be successful, however they need to be developed with local communities and local public health officials taking into account social and cultural interactions.

Hansen—Intervention is easier in some areas than in others. Dr. Gilman mentioned the Faeroe Islands. Pilot whale is only a small part of the diet there, otherwise it's a typical western diet. But in several areas of Siberia, people still depend about 100% on traditional food, and other food items are not available. In such an area, intervention is much more difficult. That's a reason strategies must be absolutely regional.

*As Arctic scientists you focus on the Arctic of course because that's your job, but how does the data compare with populations outside the Arctic? Are people in the Arctic more specifically at risk from these pollutants than people in temperate Europe or southern Canada?*

Gilman—In my opinion, because contaminant concentrations are higher in parts of the Arctic, eastern Canada, Greenland in particular, depending on the contaminant, parts of Russia, I think intuitively those people are at higher risk because they're exposed to higher levels of contaminants. Balanced against that is the fact that the quality of the diet in those regions is also extremely important. The traditional diet is a very high quality diet that is very good at preventing a number of serious diseases related to heart health and diabetes, so there are those competing influences.

Certainly, levels of these contaminants that we find in the Arctic can be found in every blood sample throughout Canada and throughout Europe, however, the levels are lower. Twenty years ago, levels of DDT in populations in the Great Lakes region were probably 10-15 times higher than they currently are in the Arctic. So the situation has changed in southern regions of Arctic countries, and the residual problem now is remaining in the Arctic because of the cold environment and the movement of chemicals northward into the Arctic.

I think the risks currently are higher in parts of the Arctic than they are in the rest of the Arctic countries if we're talking about these kinds of contaminants, the persistent organic pollutants and mercury. For airborne contaminants that are not persistent—things like particulates, sulphates, nitrous oxides, smog-related contaminants—certainly exposures are much worse in southern regions than northern regions, most of the time. So there's a real difficulty in saying 'this is the right answer' because it depends on which contaminant, which effect, which population, which part of the population, and which lifestyle they have.

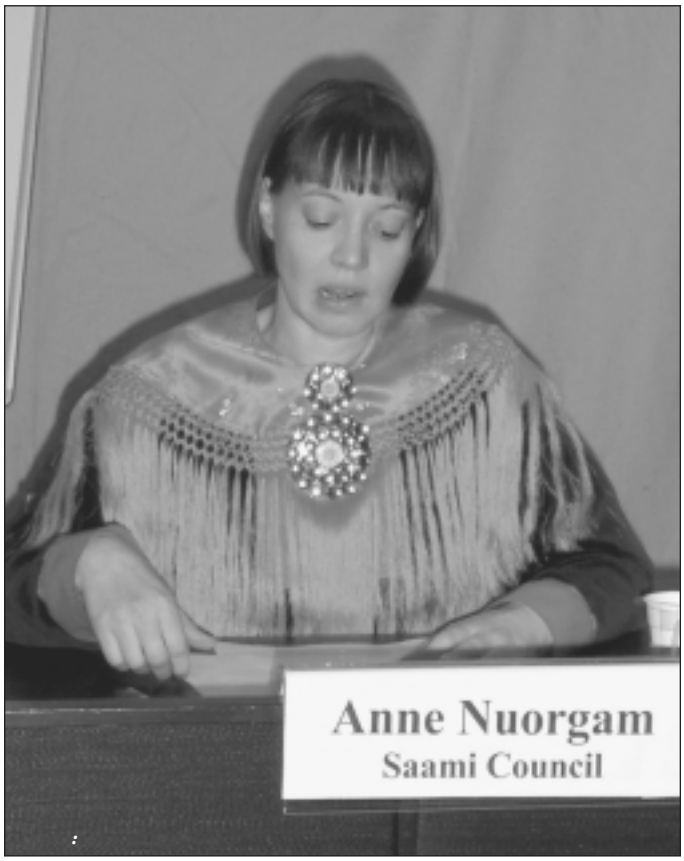
## Another perspective on Arctic health.

While most presenters at the AMAP symposium stressed risks from pollutants, Arild Vaktskjold with the University of Tromsø in Norway wanted to ensure that people put those threats in perspective. She says her studies show that, "Lifestyle factors are a larger pregnancy health problem than most environmental contaminants."

Vaktskjold says that smoking and drinking among pregnant Arctic women are more prevalent than ever. She believes that higher prices for alcohol and tobacco and information programmes warning of the risks have both failed to change the behaviour of pregnant women. Vaktskjold believes there is only one way to make a dent in the numbers of pregnant women drinking and smoking, "We need to make it socially unacceptable to smoke and drink during pregnancy."

# Setting the agenda—*Indigenous peoples and contaminant studies*

Arctic indigenous peoples are often mentioned in AMAP reports as the people most affected by contaminants in the Arctic. Given this fact, indigenous peoples' representatives who attended the meeting in Rovaniemi feel indigenous peoples are not sufficiently involved in the studies, or given enough credit for their involvement. Anne Nuorgam is President of the Saami Council, which represents Saami in Finland, Norway, and Sweden. She spoke with *Northern Perspectives* editor Clive Tesar.




*In your presentation to the AMAP Symposium, you spoke of wanting more indigenous peoples' input to the studies. What kind of input are you asking for?*

All kinds of input. Firstly, to determine what is necessary to study. For example, within the Saami people, there is already traditional knowledge of certain things, then we get all these scientists coming in and starting to study the same thing. They don't bother to ask people what they know already, and they publish the results. It's sad to say, but it's still happening. So first, they should determine what to study, what are the needs for people to know at the moment.

They also need to know how to present the studies, how to take them to the communities. It is quite worrying when you hear that the results of these studies lead to some indigenous peoples abandoning their traditional food, so they won't get all these heavy metals or POPs or whatever in their body. By abandoning the traditional food then they get the western food, and then they have the possibility of getting diabetes and other problems, that you know in Canada can be the result of eating western food.

I would like there to be a balance in the research that doesn't exist now. It's just research about the amount of pollutants, but there should be also nutritionists to tell people clearly to go for traditional foods, because it's still healthier, so after these studies there shouldn't be reactions from people who don't really know about the effects on their food.

But to go back to your question on what input we want, we should be able to control the research, what is done, where it's done and the ethics of the research.

*If you had control of the research, how would the studies change, what would your vision be?*

If indigenous peoples had more control, the basis would be already existing traditional knowledge we already have, our knowledge of how the food is, of how things are in nature, and building on that.

Also, it is important to consider how the results are used. For example in these poster exhibitions showing results from studies (exhibited during the meetings) there is some research about reindeer pastures and the shape they're in. The research results are used to determine how many reindeer you can have in certain areas, so that has a direct bearing on our livelihoods, the results of that research. People blame reindeer herders for the shape of the land, without taking into account other land uses such as tourism, forestry, and mining.

*What do you think is missing from the studies that have been done over the last four years?*

I would like to have someone to tell me what these results mean, because in some cases I hear the results, but I'm missing the information that tells me what the results mean to me and to other people. Not coming from this kind of world, I need someone to translate these results to normal language, saying "okay, pay attention to this one". As a politician I need to understand what sort of decisions may be needed as a result of this information.

And we have concerns about whether some researchers have the competence to know the results of their information. For example if there was published research on reindeer herding saying that meat has heavy loads of heavy metals, if that was published it could lower the market value of the meat. There can be results from publishing these studies that the researchers don't anticipate that have the potential to affect our lives greatly.

*Whenever the studies speak of human health, they speak of the health of indigenous peoples. What do people in your area understand of the health threats being discussed?*

I think they understand quite a lot but the question is how much they are willing to start thinking about health threats. Will they go on living as before, or will they,

because of this new knowledge change their dietary habits or something like that? It's a question of values.

*From what you've heard of what's been presented here, what action on health threats would you expect?*

For this area, nothing. Because when you look at results for Saami people, when you look at the results for heavy metals, POPs, the levels are quite low in this area, so we are lucky, very lucky. But the situation for some other Arctic indigenous peoples is not so good, and we expect governments to give them the support they need to meet their challenges.

# Double Jeopardy—
## Contaminants and Climate Change

Rob Macdonald ends his presentation with a photo of a polar bear pondering the twin challenges of POPs and climate change. The cuteness of the image masks the seriousness of the problem. Macdonald, a scientist at the Canadian Department of Fisheries and Oceans Institute of Ocean Sciences, has been examining linkages between climate change and contaminants.

One challenge is to attempt to predict how climate changes will affect the routes taken by contaminants that are transported by wind and water. Another challenge is to try to work out what amount of those contaminants will then be deposited in the Arctic, and what amount will stay in the Arctic.

For instance, it is predicted that climate change may affect currents in the Arctic Ocean. At the moment, these currents tend to sweep ice chunks containing heavily contaminated water from some Russian rivers out toward Greenland. Climate change may alter that path, so that the ice chunks migrate from the Russian coast to the Canadian Arctic islands.

Predictions that the Arctic will receive more precipitation also have implications for the deposition of toxic materials. Some pollutants that are carried by the air tend to be washed out of the air, onto the land and water, by rain and snow.

Macdonald has a long catalogue of pollution pathways and deposition mechanisms that are likely to change with a changing climate. He sums them up by saying, "The point to be made here is that there is not one step that will not change under climate change scenarios, and has not changed over the past ten years."

While changing pathways and deposition mechanisms are enough of a challenge, Macdonald sees the interaction of a variety of climate change factors as the largest threat to Arctic ecosystems. He cites the example of a recent epidemic in seals in the Baltic Sea, which he blames partly on climate change, and partly on concentrations of persistent organic pollutants in the seals.

"We have a classic example of seals getting taken out in the Baltic by a distemper-kind of a virus. Normally this population would be able to handle that, but what happened was a virus was injected into that system, and it had sufficient PCB concentrations that its immune system was compromised. You got an epidemic, and they were taken out."

Macdonald says climate change can affect the nutrition of animals. He gives the well-known example of polar bears which can not hunt effectively when sea ice is late in forming. Because some toxic chemicals are stored in fat, when the animal is hungry, the fat is absorbed, and so are the toxic chemicals. Add new diseases which have migrated with changing weather conditions, and Macdonald says you have a potent mix. "The climate change changes the disease vectors, changes the exposure cycle of individual animals, changes the total amount of exposure, and put those together and you can get effects like epidemics that depend on that conspiracy. It's not just one factor. That's what I see the risk being that we have populations in nutritional stress, and the contaminants that are still going through a decrease phase or have flattened out, or even increased and mixed with new ones are still at a sufficient level to let this population be at risk."

Some answers to what sort of climate changes might be expected in the Arctic, and the measures that should be taken to either attempt to alter or adapt to those changes, are coming in 2004. That is when the first reports of the Arctic Climate Impact Assessment (ACIA) are due to be released. The ACIA is a massive undertaking sponsored by the eight-member Arctic Council, involving the efforts of almost 300 scientists.

**"Salmon fishing is very important to me. I'm loath to quit that practice because this conference tells me the risk is too great. I know when I go back tomorrow I'll be asked, "What does it mean? That our pregnant women and nursing mothers should not eat our fish?"**

*Sally Smith, Alaska Yupik leader, speaking at the closing plenary of the AMAP symposium*

Macdonald hopes the scientists working on the ACIA and those working on contaminants issues pay attention to each others' work, and remember that all the factors that affect the Arctic need to be considered when trying to predict outcomes.

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