Northern Alaska Subsistence Food Research
Contaminant and Nutrient Ecology in Coastal Marine Mammals and Fish

A report compiled by the North Slope Borough Department of Wildlife Management
2006
Funded by the Coastal Impact Assistance Program
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This report is prepared for subsistence wildlife users to aid them in making informed decisions on the relative benefits and risks associated with consumption of commonly consumed wildlife subsistence foods with regard to the contaminants discussed in this report.

For a number of years, scientists of the North Slope Borough Department of Wildlife Management, along with visiting scientists and graduate students, have collected tissues from various subsistence species from Alaska’s North Slope through the cooperation of Alaskan Native hunters.

Many locally caught marine mammals, terrestrial mammals and marine and freshwater fish were tested for organochlorines (like PCBs and DDT), heavy metals (mercury, lead), and radionuclides (radioactive particles).

Results of these studies show that most contaminant levels in northern Alaska animals are low, in comparison to the rest of the Arctic. The levels of these contaminants are considered to be below levels of health concern for people. This is all good news, documenting that traditional foods are healthy.

Subsistence foods are good for you.
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<th>Project Goals</th>
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Contaminants are produced and released all over the world. On the North Slope, there are many local sources. Military sites, industrial development, and landfills are all local sources of contaminants. In addition, contaminants can be carried around the world in air and water. Contaminants found on the North Slope may have been released in the lower 48, in Asia, or in Europe.

Once they are in the air and water, they can travel thousands of miles. Some contaminants tend to concentrate in the Arctic. They are carried here in the air, and settle where it is cold. They may be taken up in plants or animals. Once they are in the food web, they are hard to get rid of.

The North Slope is fortunate that major contaminant transport pathways tend to lead elsewhere, which is not the case in other Arctic regions.

The eastern Canadian Arctic and West Greenland, for example, have higher levels of many contaminants. These contaminants come from the eastern United States and Europe, carried by air and water to that part of the Arctic. The North Slope receives some pollution from Asia, but levels are still relatively low.
Contaminants cause concern because they can be harmful. The many different types of contaminants can cause many different effects in animals and people. The same contaminant can also cause different effects depending on how much is present and how the person or animal is exposed to it.

Organochlorines can disrupt bodily functions. When present, some can cause cancer. Others may affect the ability to reproduce or damage nerves and the brain. At high levels, organochlorines can produce major effects, including death. This kind of *acute exposure* is rare, usually from an industrial accident. On the North Slope, exposures would be more likely to be *chronic*, meaning that they would occur in small amounts over a long time.

Consumers of subsistence-harvested foods from the North Slope are fortunate that the scientific analyses have shown *very low* levels of organochlorines to be present in many of the subsistence foods that they eat, at levels that are below levels of public health concern.
Heavy metals also disrupt bodily functions. Mercury can hurt the brain and nerves. Cadmium can harm kidneys and liver. Lead has the potential to cause nerve and brain damage, also. As with organochlorines, exposures can be acute or chronic. On the North Slope, the main concern is about chronic exposures.

Contaminants do not always produce effects. Sometimes, the concentrations are low enough that no harm is caused. Some elements such as zinc are necessary for the body in small amounts, but can become harmful in higher doses. It is important to study the concentrations of contaminants, not just whether they are present. Everyone in the world has been exposed to some types of contaminants, but most exposures are too low to have any effect.
How nutritious are our subsistence-harvested foods?

For Iñupiat, *niqipiaq* has always been a source of physical, mental, social, and cultural health. Many people say they simply feel better when they can eat traditional foods. Sharing brings people together, which also feels good, and is a key part of the Iñupiat value system.

Analyzing nutrients in various traditional foods confirms that they are healthy. In fact, many are better for you than even the healthiest food at the store. One way of showing how nutritious foods are is to see how much of the recommended daily allowance (RDA) of nutrients they provide. The RDA is the percentage shown on food labels. As this study shows, our *niqipiaq* is an excellent source of many nutrients.
We evaluated the raw (i.e., uncooked) nutritional value of many bowhead whale-based subsistence foods. Based on a person eating 100 grams (3 ounces) of *niqipiaq*, we determined what percent of the recommended daily allowance (RDA) is met (e.g., 50%, means that this 100 g portion of food provides half of the specific nutrient required for a day).
Blubber is rarely eaten alone and is a very good source of polyunsaturated fatty acids (PUFAs –see next page) (189%) and many elements. It also offers 8% of needed vitamin A, 10% protein and little carbohydrate (<4%). Maktak is considered the outer skin and a small amount of underlying blubber.

As for most tissues studied, epidermis ("skin") represents a good source for protein (42%), dietary fiber (21%), vitamin E (12%), and many elements, but is a poor source of carbohydrates (<5%) and sugars, vitamin C, and beta carotene.

Skeletal muscle (meat) provides approximately 45% of needed protein and ≥ 10% for some of the Vitamin B compounds and many elements. It is a poor (<5%) source of fat, PUFAs, dietary fiber, and carbohydrate.
Polyunsaturated fatty acids (PUFA) are part of the family of dietary fats. Like all fats, they provide energy for the body, are components in cell membranes, and help to transport many fat-soluble vitamins to their destination in the body. There are two types of PUFA: omega-3 and omega-6. Some fatty acids are essential for healthy growth and body maintenance. These fatty acids cannot be made within our bodies and must be obtained through dietary sources. PUFAs are involved in immune system health and the regulation of blood clotting and inflammatory processes.

Many important essential fatty acids (omega-3 class) are present in bowhead whale tissues. These are known to be important in prevention of heart disease, diabetes and many other diseases and are essential for neonatal development. These data indicate that important nutrients are provided by bowhead whale tissues (raw) to human consumers.

PUFAs and Healthy Hearts
The roles of different types of fat in the diet has been closely linked to cardiovascular (heart) health. Past studies emphasized saturated fat as the primary culprit in many types of heart disease. As a result, diets low in fat (especially saturated) were recommended for heart health. More recent studies are finding that PUFAs are strongly protective against heart disease. To cut these types of fats out of the diet would raise the risk for cardiovascular disease. Doctors and researchers now believe that the type of fat that you eat is as or more important for heart health than the amount of fat you eat. Recent research on PUFAs confirms this concept.
Kidney is a good source of fat (11%) and protein (28%) but not carbohydrate (2%). Kidney provides nearly 16% of the needed PUFAs and is an excellent source of many elements (Cr, Cu, Fe, Na, Mo, P, and Zn).

Heart is a good source of protein (40%) and many elements (Cu, Fe, Na, K, Zn, and P).

Tongue is a good source of fat (82%), PUFAs (161%), protein (27%), calories (30%), vitamin A (16%), and some elements (Cr, Cu, Na, and Fe).

Intestinal tissue is a good source of protein (37%) and many elements (Cu, Na, K, Fe, P and Zn).
Almost everything we eat has contaminants present in it. However, their levels vary by the type of food, where it comes from and often the amount of fat it has in it.

Bowhead whale does have contaminants present, but they have been shown to be present in **VERY LOW** levels in comparison to both store bought foods and other subsistence foods.

Bowhead whale is a healthy subsistence food high in omega fatty acids and is highly recommended for continued consumption!

**Where do we LOOK for contaminants in bowhead whales?**

**FOOD (Zooplankton)  
FAT/MAKTAK  
KIDNEYS  
MEAT  
LIVER**
The most remarkable observation is that these whales are much less contaminated than many other cetaceans with respect to metals (i.e., mercury and lead), radionuclides, and organochlorine contaminants (i.e. PCB, DDT).

Organochlorine levels measured were highest in blubber and maktak (because these tissues contain fat which is associated with organochlorine contaminants). However, these levels are still over 10 times lower than those found in northern right whales, a species that feeds in ways similar to the bowhead whale.

As compared with terrestrial arctic wildlife, like caribou, the levels of Cs–137 (a radionuclide) are 100 to a 1,000 times lower in bowhead whale tissues.

<table>
<thead>
<tr>
<th>Organochlorine contaminant class</th>
<th>Blubber</th>
<th>Maktak</th>
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<tbody>
<tr>
<td>HCB</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sumCHL</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sumDDT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sumHCH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sumPCB</td>
<td>0</td>
<td>0</td>
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Blubber has a higher organochlorine concentration than maktak because of the higher amount of fat (lipid) present. Organochlorines are “lipophilic”, which means that they like to concentrate in fat.
Essential and non-essential elements analyzed in bowhead whale tissues were generally low and of no concern. Of the 12 elements studied (arsenic, cadmium, cobalt, copper, lead, magnesium, manganese, mercury, molybdenum, selenium, silver, and zinc) in the bowhead whale, the element of possible minor concern from a subsistence perspective is cadmium in the kidney. However, because people usually do not eat very much kidney, it is unlikely to pose a significant health risk. Most of the cadmium present in the bowhead whale and other arctic animals is thought to be from natural sources rather than from human-caused pollution. Other arctic species have elevated cadmium levels and this has probably always been the case.
Beluga Whale Research

**Organochlorine contaminants in the maktaaq of beluga whales from Alaska**

- HCB
- sumCHL
- sumDDT
- sumHCH
- sumPCB

N=5
48% lipid content

Blubber has a higher organochlorine concentration than maktaaq because of the higher amount of fat (lipid) present. Organochlorines are “lipophilic”, which means that they like to concentrate in fat.

**Organochlorine contaminants in the blubber of beluga whales from Alaska**

- HCB
- sumCHL
- sumDDT
- sumHCH
- sumPCB

N=20
85% lipid content

Blubber has a higher organochlorine concentration than maktaaq because of the higher amount of fat (lipid) present. Organochlorines are “lipophilic”, which means that they like to concentrate in fat.

When compared with store-bought food, there was little difference found in organochlorine (OC) concentrations in beluga whale tissues, with the exception of blubber and maktaaq (which contains blubber). There was no store-bought food that could compare to blubber/maktaaq, so this comparison could not be made.

We emphasize that switching from non-blubber tissues to store-bought food will not eliminate organochlorine exposure. This switch is likely to result in the consumption of less healthy, nutrient-poor products and the elimination of important, healthy, socio-cultural practices.

*Adapted from Hoekstra et al., 2005*
We realize how important these species are to many villages. Future DWM research plans include additional studies on the nutrients and contaminants present in seal and walrus.

Though contaminants are present in seal blubber, when considering the risks associated with contaminant exposure relative to the known benefits of eating subsistence foods, as well as the risks associated with eating poor replacement foods (store-bought food), the consumption of these subsistence foods should be maintained and encouraged.

*adapted from O’Hara et al., 2005
All fish above had their fillets analyzed with the exception of the burbot, which had only the liver analyzed. The burbot livers are much higher in fat (lipid) than the fillets from the other fish, and likewise are higher in organochlorine contaminants, though these levels are much lower than those seen in the blubber of marine mammals found higher in the food chain. In many cases, the subsistence fish analyzed had lower concentrations of organochlorines than the store-bought foods that were examined. It is also important to note that these samples were analyzed raw. Previous studies have noted a reduction of total PCBs and other organochlorines in fish due to cooking.

*adapted from O'Hara et al., 2005
Currently, there is a caribou health assessment in progress that will evaluate both the health of the animals and some of the nutrients present in their tissues. Data are still preliminary, but will be made available to the public when the project is completed. The NSB-DWM is actively pursuing additional funding for studies that will investigate the nutritive value of this subsistence food to consumers living in northern Alaska. Through this work we hope to document contaminant levels, as well as basic human nutritional parameters.

Assisting the DWM with the collection of these data will aid us immeasurably in getting this research completed and providing the answers our communities need with respect to this food resource. This includes providing samples from hunter-collected carcasses, as well as providing us with information on what parts of the animal you eat, how you prepare it, the amount you consume and how often you eat it.
What can we do locally?

The presence of contaminants in *niqipiaq* forces people to make choices. While contaminants are found in subsistence foods, those same foods are highly nutritious. They are culturally important, too. It is also important to remember that foods from the store also have contaminants. The goal of the Department of Wildlife Management’s studies is to provide people with the information to make informed choices.

Our analyses show that contaminant levels in animals and fish used for subsistence on the North Slope are low as compared to levels found in similar species from other arctic regions. This is good news. Eating subsistence–harvested foods is healthy for individuals. Sharing foods is healthy for communities. The Alaska Department of Health and Social Services, which has studied contaminants and human health for many years, has come to the same conclusion:

*Subsistence foods are good for you.*
Nonetheless, we will continue to gather more information and carry out more studies. Contaminant levels change over time, and we have not yet looked at all animals or all contaminants on the North Slope. Continue to support our studies:

- If you see animals that appear unhealthy, please contact the North Slope Borough Department of Wildlife Management at (907)852-0350.
- If you have concerns about specific areas or animals, tell us.
- If you would like more information to help you make your choices, let us know.

While we may not be able to answer all your questions, your information and concerns can help us design new studies to meet the needs of our communities.
Contaminant levels are relatively low on the North Slope, but this may change over time. New chemicals are being developed. Industrial activity is increasing, on the North Slope and especially in Asia. Climate change may increase transport of contaminants to the Arctic.

National and global actions have helped combat some contaminants. DDT, PCBs, and other organochlorines have been banned in many countries, to protect human health as well as the environment. In fact, Arctic peoples have played a role in these efforts. Canadian Inuit pushed hard to ban many organochlorines, lobbying the Canadian government as well as the United Nations. The result was an international treaty banning 12 chemicals, signed in Stockholm, Sweden, in 2001. More chemicals may be added to this list over time.
Many countries have taken action against heavy metal pollution, as well. The United Nations Environment Programme is recommending global action on mercury. North Slope residents can help in several ways. We can call on our congressional delegation to push for vigorous action by the United States. We can use organizations such as the Inuit Circumpolar Conference to work internationally to reduce mercury and other metals in our environment. And we can continue to let the world know that we do not appreciate seeing their pollution end up in our food.

Congressional contacts:
Senator Ted Stevens (R – AK)
http://stevens.senate.gov/
Senator Lisa Murkowski (R – AK)
http://murkowski.senate.gov/
Representative Don Young (R – AK At Large) 202–225–5765 202–225–0425
http://donyoung.house.gov/

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F: (907) 274–3861
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Results of these studies show that for the most part, contamination of northern Alaskan animals is low in comparison to the rest of the Arctic. Currently, the levels of these contaminants are recognized as being below levels of concern. This is all good news and we have local, documented proof that these traditional subsistence foods are healthy.

We believe that there is a need to continue to monitor the levels of these contaminants in our arctic species over time to see if the levels are increasing, decreasing, or staying the same.

In 2004 the DWM concentrated on an assessment of exposure based on what we know about concentrations of contaminants and nutrients in the tissues of the bowhead whale. Papers were presented at the International Whaling Commission (IWC) meeting. These data continue to confirm our recognition of these traditional foods as healthy and full of essential nutrients. We are currently conducting research on petroleum hydrocarbons (contaminants that are both naturally present in the environment and industry-generated) in several subsistence species.
The Inupiat have long considered *niqipiaq* essential to their well being, they crave it when they have been away from it – and now, between the local assessment studies and a growing body of worldwide studies, the nutrient value is being documented in scientific literature.

**Subsistence foods are good for you.**

Other key information needed for improved scientific review and assessment of risk factors is related to the documentation of how much traditional food people actually eat in a week. Assisting researchers in gathering information on this topic will help detail the differences between subsistence and commercial foods in your diet.
Where can we get more information?

**NSB–Department of Wildlife Management**: PO Box 69 Barrow, AK 99723 (907)852–0350 web: [http://www.north-slope.org](http://www.north-slope.org)

**State Epidemiology/Public Health**: State of Alaska, Department of Health & Social Services, Division of Public Health, Section of Epidemiology, PO Box 240249, Anchorage, Alaska 99524–0249 Phone: (907) 269–8000 web: [http://www.epi.hss.state.ak.us/](http://www.epi.hss.state.ak.us/)

**Environmental Protection Agency (EPA)**: web: [http://www.epa.gov/](http://www.epa.gov/)

**Arctic Monitoring and Assessment Programme (AMAP)**: web: [http://www.amap.no/](http://www.amap.no/)

**Literature Cited/Additional Publications (* all available through the DWM)**


**Definitions**

**Bioaccumulation**: The increase in contaminant concentrations in an animal's body over time as the animal ages. Bioaccumulation affects animals higher in the food chain through contaminant build-up over time. Older animals are likely to have a higher concentration of certain contaminants in their tissues because they have been consuming and storing these contaminants longer than younger animals have.

**Biomagnification**: The increase in the concentration of a contaminant as you move higher up in the food chain. The higher you are on the food chain the more contaminants you are likely to have stored in your body. When a species occupying a lower level of the food chain (i.e., a fish) is eaten by a species at a higher level (i.e., a seal), its fat is digested and contaminants may move to the fat of the consumer. This is how contaminants accumulate, or biomagnify, in the fat stores of consumers high in the food chain (i.e., seals and polar bears).

**Acute exposure**: Exposure to a contaminant takes place over a short period of time, so that a large amount is delivered quickly.

**Chronic exposure**: Exposure to a contaminant takes place over a long period of time, with smaller amounts of the contaminant delivered more slowly.

**Contaminant**: An impurity or substance that should not be present in the material being analyzed. Though not all contaminants are toxicants, the word “contaminant” in common usage generally implies that a toxic substance is present.

**Heavy metals**: Naturally occurring elements such as mercury, cadmium, and lead. In some areas, metal concentrations can be high because local rocks are rich in
these elements, but human activity can release metals into the environment, adding to the natural levels already present. Coal burning, metal refining, and waste disposal are all sources of heavy metals. Once in the environment, heavy metals are almost impossible to get rid of because they do not decompose.

**Hydrocarbons**: Petroleum and natural gas are made of hydrocarbons. Oil development on the North Slope is a cause of concern for hydrocarbon pollution. Studies are now underway to examine levels of hydrocarbons on the North Slope.

**Organochlorines**: These contaminants are typically man-made chemicals. Some are used as pesticides, such as DDT. Others have industrial uses, such as PCBs. Some have no uses but are by-products in the making of other things, such as dioxins. They are considered POPs.

**Persistent organic pollutants (POPs)**: A class of chemicals that persist in the environment, they are capable of long-range transport, bioaccumulate in human and animal tissue, and have significant impacts on human health and the environment. They include such substances as dioxins, PCBs, DDT, brominated flame-retardants or tributyltin (TBT). POPs released into the environment can travel through air and water to regions far distant from their original source.

**Radionuclides**: These are atoms that can split, releasing radiation. Nuclear weapons and power plants are sources of radionuclides, however, some also occur naturally in the earth. Their levels on the North Slope are low.

**Recommended Daily Allowance (RDA)**: The level of essential nutrients required to adequately meet the known nutrient needs of practically all healthy persons, according to the Food and Nutrition Board of the National Academy of Sciences.
Acknowledgements

We are very grateful to the communities on the North Slope, the hunters in particular, for the support and cooperation we receive in conducting these studies. The DWM began its now internationally recognized intensive study of contaminants in 1995 due to a growing local resident concern about the effects of environmental contamination on their traditions subsistence foods and wildlife resources. We hope that this booklet is helpful in guiding subsistence consumer choices and encourage public input with respect to future research directions.

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