

# **Traditional Knowledge and Contaminants Project: Progress Report**

The Institute of Social and Economic Research  
University of Alaska Anchorage  
In collaboration with the  
Alaska Native Science Commission

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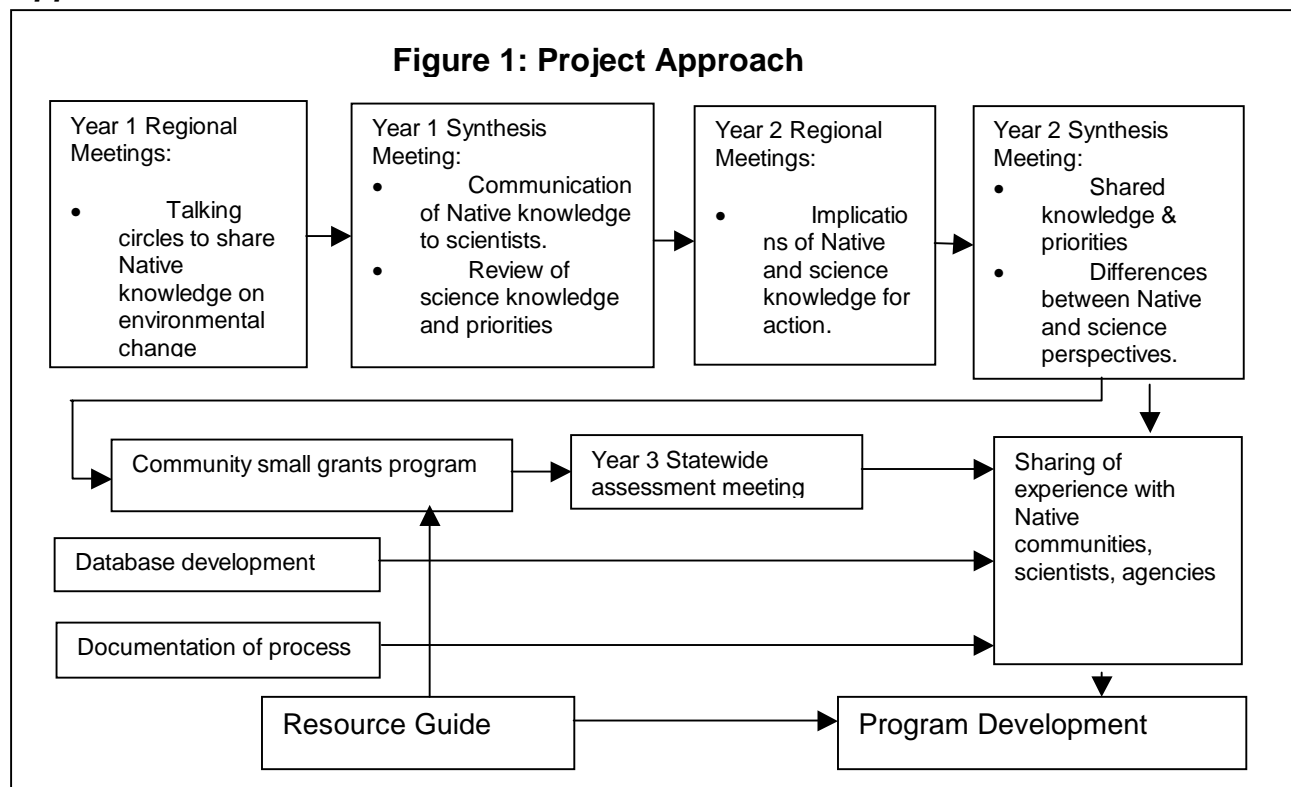
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## Traditional Knowledge and Radionuclides Project

This project is a joint effort of EPA Region 10 and the Office of Radiation and Indoor Air (ORIA). The goal of the project is to build capacity among Alaska Tribes to take effective action to clearly identify and address their concerns about radionuclides, other types of contamination, and adverse changes in the environment. The University of Alaska's Institute of Social and Economic Research and the Alaska Native Science Commission are collaborating to implement the project. We began work in the fall of 1996 under a grant from Region 10. Although the current three year grant funded by ORIA through Region 10 formally began in July 1998, an overlap between the previous grant and the current grant meant that we actually started work under the current grant in January 1999. The two grants are best seen as part of the same project. This is a status report on the entire project through July 2000. The main project website is [www.nativeknowledge.org](http://www.nativeknowledge.org).

### Approach



and to review a draft summary of science knowledge and priorities. The summaries of science knowledge and priorities are incorporated in the web-database (see "Use the Database") and summarized (see "Regional Meeting Presentation").

We are in year two of the grant. The major focus of activity this year has been the second round of regional meetings. We have completed this final round of regional meetings. The purpose of these meetings was for knowledgeable community residents to consider the bodies of Native and science knowledge, and to draw the implications of this knowledge for action. These meetings will set the groundwork for the community small grants program. See "Regional Meeting Presentation" on [www.nativeknowledge.org](http://www.nativeknowledge.org)

We will hold a second synthesis meeting with scientists and Native participants September 19-21, 2000. The purpose of this meeting is to share the traditional knowledge and research based perspectives and their implications for action. By involving both scientists and knowledgeable Native participants in this meeting, we hope that we can collectively identify points of shared knowledge and priorities and points where continuing differences in perspectives are important to respect.

The small grants program is intended to provide individual communities or small groups of communities an opportunity to begin to act on their own priorities. We anticipate providing about 10-15 grants averaging \$10,000. In preparation for the small grants program, and in anticipation of an ongoing program of research undertaken by tribes we are developing a Resource Guide for Measuring Contaminants in Native Foods. This site is under construction, and can be seen at [www.nativeknowledge.org](http://www.nativeknowledge.org) "Resource Guide" (see under "related sites").

Toward the end of Year Three, we plan to hold a statewide meeting to bring participants together to review and critique the project. We have hired a videographer who has documented all the regional meetings. He will also document the year-two synthesis meeting as well as the statewide assessment meeting.

Finally, we will continue to refine and develop a community database on contaminant measures, harvests and consumption of Native foods, nutritional value of Native foods, cultural values associated with Native harvest and consumption of Native foods, and Native knowledge about environmental change.

### ***Contaminants and Native Foods Database***

We initially focused on bringing together existing information on contaminants in Native foods and on building a network of Native villages and organizations concerned about contaminants and other environmental changes. We worked closely with people leading the Canadian Northern Contaminants Program, learning from their experience.

We decided that the most effective way to make information available to Alaska Natives and to interested government and university researchers is an interactive computer database. Three years ago many villages could not effectively access the internet. We therefore designed the database to work on individual computers. And, to avoid requiring Native villages to purchase special software, we designed the database to run on its own compiled version of Microsoft Access and Visual Basic. The database contains information on existing measures of contaminants in species of fish and animals harvested by Alaska Natives, harvest and consumption data, nutrition data, descriptions of the role of harvest and Native food consumption in communities, and examples of community initiatives taken in response to concerns about environmental change. The reader can see an overview of the Contaminants and Native Foods Database on the web at: [www.nativeknowledge.org](http://www.nativeknowledge.org)

We designed the Contaminants and Native Foods Database to store and report information by community. Appendix A contains a list of the 368 communities<sup>1</sup> in the database. Not all of these communities have Tribal governments; we include all communities in Alaska because Alaska Natives live in virtually all communities in the state.

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<sup>1</sup> The database actually includes 403 place records. We have not shown the geographic records that represent the areas outside of named settlements.

Ideally, we would like to know how much Alaska Natives consume of each type of animal, fish, and plant. We collaborated with Betsy Nobmann, formally the nutrition specialist for the Public Health Service, to compile existing information about consumption of Native foods in Alaska. Such data are only available for 11 places in Alaska: Anchorage, Bethel, Dillingham, Kake Kotzebue, Kwigillingok, Mountain Village, Pedro Bay, Pilot Point, Selawik, and Sitka. Even in these places the data are not sufficient to identify subsets of the population that may eat large quantities of tissues that tend to accumulate contaminants (e.g. livers, kidneys). There clearly is a need for research on consumption of Native foods.

Consumption of Native foods is closely, but imperfectly, related to harvest of Native foods. The relationship is imperfect because harvesters frequently share Native foods and because there are likely to be large differences in consumption rates across individuals, even those living in the same community. Harvest data are valuable, however, in identifying the species that may be consumed in large quantities by many Native people. We collaborated with the Alaska Department of Fish and Game to incorporate their Community Profiles Database in the Contaminants and Native Foods Database. Appendix B lists the 168 communities for which measured per capita annual harvest for all harvested resources are available. We thus have comprehensive harvest data for at least one year for almost half (46 percent) Alaska communities. The number of harvested resource types represented in the database exceeds 400. Forty-six species harvested in excess of 20 pounds per capita in at least one Alaska community are shown in Appendix C.

We contacted researchers and research agencies to request contaminant data sets relevant to Alaska. We decided that we would not attempt to construct contaminant data sets from scratch but rather to bring together data sets already compiled by experts in the field. The database currently includes 21,475 contaminant observations. These observations are separately organized into eight sub-databases in order to preserve the integrity of the source data.

1. Alaska Marine Mammals Database: Chlorinated Hydrocarbons, Metals and Other Elements in Tissues banked by the Alaska Marine Mammal Tissue Archival Project, Paul R. Becker, et. al., U.S. Department of Commerce, National Institute of Standards and Technology (2,760 observations)
2. National Status and Trends, Fish Liver Data: National Status and Trends Program, Benthic Surveillance Sites, Fish Liver Data, National Oceanic and Atmospheric Administration (NOAA), National Status and Trends Program (2,089 observations)
3. National Oceanic and Atmospheric Administration (NOAA) report on contaminants following the Exxon Valdez Oil Spill (14,777 observations)
4. Tanana Chiefs Conference, Northern Pike Study: Mercury and Selenium Concentrations In Fish Tissue and Surface Waters of the Northern Unit of the Innoko National Wildlife Refuge (Northern Pike), Tanana Chiefs Conference, Inc., 122 First Avenue, Suite 600, Fairbanks, Alaska 99701 (96 observations)
5. Radionuclide Sampling Results. Data on Radionuclide Sampling Results Collected in Alaska or adjacent to Alaska beginning in the 1950s, Data Collected by: Alaska Department of Environmental Conservation, Environmental Radiation Program, 610 University Ave., Fairbanks, Ak 99709 (1,110 observations)

6. Contaminants Data for Places in Alaska from Various Published Sources: Data on Various Contaminants from Various Sources, compiled by Lori Feyk, Alaska DHHS Office of Epidemiology (316 observations)
7. Contaminants Data for Various Species in Alaska from Published Sources: compiled by Jesse Ford, Oregon State University (77 observations)
8. Contaminants in Northern Canada (CINE): Arctic Food Contaminants Database, Western Northwest Territories and Yukon Region, by Contaminant (CINE) (250 observations)

These eight data sources cumulatively provide observations on 1,293 unique place-species-contaminant combinations. We list these combinations in Appendix D. In addition, we compiled bibliographies on published contaminant studies. These include 1,246 references compiled by Jesse Ford, 42 references compiled by Joar Hovda, 51 CINE references, and 46 NIST references. The twelve hundred-plus contaminant observations represent a tiny fraction of the data needed to characterize contaminant concentrations in Alaska Native foods. One has to keep in mind that there are both local and non-local potential sources of contaminants, and that the pathways and forms of accumulation of contaminants vary by contaminant. Each observation pertains to one tissue type in a single animal. Taking into account variations in contaminant loads among individuals across communities by contaminant, species, and tissue type would require a multi-year program on the scale of the Canadian Northern Contaminants Program (i.e., on the order of \$20 million over five years).

Betsy Nobmann compiled research results on the nutritional value of different Native foods. We incorporated this information in the Contaminants and Native Foods Database. We also wanted to provide some indication of the cultural value of Native foods. While there is a rich literature on cultural values in Alaska, it was not practical to undertake the task of identifying and incorporating such information from among hundreds of books and articles. We therefore decided that the most reasonable approach was to provide people unfamiliar with Alaska Native culture descriptions of annual harvest-related activities. These descriptions appear in searchable form in the Database as 2,523 html files.

Last year we asked several experts to review the Contaminants and Native Foods Database. We are currently transforming the Database to respond to their suggestions. We also decided that the rapid improvement in internet access by communities warrants moving to a web-based environment. We only have a month of database expert time in the current grant. To conserve this time, our database expert has opportunistically used other projects to develop the expertise needed to develop an interactive, searchable database as a web site. She is now in a position to make the transition and to simultaneously improve the accessibility of the database.

### ***Synthesis of Science Knowledge***

Given the vast gap between contaminant data needs and currently available data, we convened a group of 15 researchers to review the conclusions of the Canadian Northern Contaminant Program researchers. Following the workshop, we prepared a 16 page summary of findings for review by the researchers. A revised version of this summary appears as Appendix E. Major findings of the Alaska workshop include:

1. Alaska Natives have observed changes in the health of some animals and fish. They worry that these changes may be due to contaminants. We need to ask Native experts to share these observations in

order to see patterns of change (11)<sup>2</sup>.

2. The diets of Alaska Natives are more likely to include predators which may concentrate contaminants (1). Alaska Native diets are also more likely to be higher in fats. These fats may contain higher concentrations of organochlorines.
3. Slower growing plants such as lichen can result in higher contamination levels. (14)
4. Contaminants reach the Arctic through long range atmospheric transport and exposure of migrating species exposed to non-local sources of contaminants (15).
5. Local sites and the natural environment may be sources of contaminants (17).
6. We need more data to understand the processes which move contaminants through the food chain. It is possible that accelerated processes during the spring may move contaminants through the food chain more quickly (18).
7. Marine mammals including polar bear, ringed seals, beluga, and walrus probably have elevated levels of PCBs and toxaphene. There is some Alaska data to support this statement, but more is needed. We cannot assume that the trend of decreasing levels of PCBs from eastern to western Canada extends into Alaska, particularly in the Bering Sea. The higher eastern levels of PCBs may be due to a coupling of a regional cooling trend in eastern Canada with atmospheric PCBs from lower latitudes of North America (104).
8. Polar bears, ringed seals, and beluga are likely to have elevated levels of mercury, but we need data to understand how the sedimentary geology differs in different areas off Alaska's coast as compared with the Canadian Beaufort Sea (120).
9. While cadmium concentrations in beluga decrease from the eastern to western Canadian Arctic, we cannot assume that the trend extends across the Alaska Beaufort, Chukchi Seas, or into the Bering Sea and Gulf of Alaska. The mineral composition of sediments may differ from those in the western Canadian Arctic (122).
10. Geographic coverage of levels of persistent organochlorines and heavy metals in marine mammals is not good in Alaska (130). In contrast to the Canadians, we have not studied contaminant levels in most stocks or populations of beluga, ringed seals, walrus, and polar bears. (128)
11. We do not have the data necessary to conclude that an observed increase in cadmium levels in caribou kidneys from eastern to western Canada continues into Alaska. We therefore cannot say that the levels in Alaska are comparable to those in northern Quebec and Norway, which is the case in western Canada. The source of cadmium is probably natural and may be related to soil and winter forage (63,64,69).
12. Concentrations of Cesium 137 are probably 4-10 times lower than they were in the 1960s when they increased due to atmospheric testing. Levels of Cesium 134, which also increased due to atmospheric testing, are now very low (75).
13. There is some confirmation of naturally occurring potassium 40, polonium 210 and lead 210 in caribou in Alaska. Levels of lead 210 may vary within herds as they do in Canada, but we don't have data to confirm this (78-82).
14. We do not have data to know whether the trend of decreasing PCB levels in caribou from eastern to western Canada extends to Alaska (85).
15. In northern Canada, fish of primary concern due to their contribution to Native diets include: burbot, lake trout, arctic char, northern pike, and whitefish. We cannot assume that this species are of primary concern in Alaska; rather, all species consumed are of potential concern. Included also should be anadromous fish such including salmon. We also cannot assume that PCBs, toxaphene, and mercury are the primary contaminants of concern in freshwater fish (26-29).
16. We don't know how organochlorine levels vary in birds. We cannot say whether the Canadian observation of lower organochlorine levels in the western Arctic extends to Alaska (93).

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<sup>2</sup> The number in parentheses refers to the row number of the spreadsheet containing the original Canadian findings.

17. Geographic coverage of levels of persistent organochlorines and metals in seabird populations in Alaska is poor (137).
18. There is very limited information on levels of organochlorines and aromatic hydrocarbons in marine fish stocks in Alaska waters (140).
19. Military sites along Alaska's coast are likely to be local sources of PCBs and DDT contamination of the nearshore environment. While there is some Alaska data to support this conclusion, more data is needed (150).
20. At present, the temporal trend data are too limited to be able to predict future trends because they are based on two or at most three sampling times. By comparison, temporal trend data for contaminants in Lake Ontario lake trout and in various species from the Baltic and from lake Störinveid in northern Sweden are available yearly for a 15-20 year period (168).
21. There are few studies of biological effects indicators with arctic animals. There is particularly a need to study biological effects on immunosuppression in mammals at high trophic levels (216).
22. Native foods are widely consumed within communities. Marine mammals, large ungulates, and fish account for a large proportion of Native foods consumed. Consequently, potential exposure of Alaska Natives to contaminants in Native foods is widespread in Alaska (240)
23. Increases in consumption of imported foods by Alaska Natives have been associated with decreased physical activity, obesity, dental caries, anemia, lowered resistance to infection, heart disease, and diabetes (238).
24. Consumption of Native foods varies by region, income, access to urban centers, and by factors such as age and gender (246).
25. Dietary lipids are a concentrated source of energy, act as carriers of fat-soluble vitamins, and are a source of essential fatty acids (polyunsaturated fatty acids that are essential to health but cannot be synthesized by the human body). Fish and marine mammals which form a significant portion of the diet of Alaska Natives contain many n-3 polyunsaturated fatty acids which are not easily found in imported foods. Omega-3 fatty acids are found at high levels in fish and marine mammal tissues and have been associated with a decreased incidence of thrombotic and ischaemic disease (253).
26. If consumption of traditional food resources - particularly fish and wildlife- were discontinued, the mineral nutrition of most indigenous Arctic populations would be compromised to such an extent that nutritional deficiencies could occur (255).
27. In Arctic communities, a significant portion of the protein requirements are fulfilled by traditional foods such that limiting the supply of traditionally harvested meats and fish would drastically reduce protein intake (259).
28. A higher incidence of infectious diseases and ear infections among Alaska Native infants may be due to a complicated set of factors. It is unknown whether perinatal exposure to PCBs is one of these factors, nor is the extent of exposure known (271).
29. Although a major source of human exposure to cadmium is smoking, some individuals who frequently eat kidneys of caribou and marine mammals (e.g. once a week year round) may ingest significant amount of cadmium (296). However, only a small percentage of cadmium (about 5 percent) is absorbed through ingestion compared with direct absorption through smoking.
30. The greatest exposures to radionuclides occurred in the 1950s and 1960s (e.g. strontium 90). The long term effects of Strontium 90 in bone perhaps interacting with exposures to organochlorines is not known. Of all radionuclides, lead-210 and polonium-210, which are natural in origin, may make the greatest contribution to current human radiation doses in the Arctic. However, the greatest exposures to radionuclides may come from improperly used or maintained radiological equipment. Both lead-210 and polonium-210 occur in nature as airborne particles and tend to settle out on vegetation (i.e. lichens) thereby entering the terrestrial food chain (lichens-caribou-humans) (308). We should also consider polonium-210 levels in fish.
31. Of the anthropogenic radionuclides, the two main isotopes of radiocesium (cesium-137 and cesium-134) are considered to be of greatest concern in Arctic environment. Levels of radiocesium in Arctic



residents have declined from about 450 Bq-kg in 1965 to roughly 10 Bq-kg in 1990. The effects of exposures to Strontium 90 in the 1950s and 60s, however, may be important, but we don't know (312).

32. Risk determination for contaminants in Native food involves a consideration of the type and amount of food consumed and the sociocultural, nutritional, economic, and spiritual benefits associated with Native foods (315)
33. Risk management decisions must involve the community and must take all aspects into account to arrive at an option that will be the most protective and least detrimental to the community (316).
34. In Alaska Native communities, advising against Native food consumption is also to advise against hunting and fishing. To the extent that aboriginal identity and the collective sense of well-being is based on subsistence as a social system and as an activity, as well as a dietary staple, then loss of confidence in Native food undermines confidence in identity and society (321)
35. Perception of risk in the Alaska, as in many communities, differs between the public experts. A lack of straightforward and credible information about toxicity and safe levels leads to unnecessary anxiety. This anxiety in turn can disrupt Native food harvest and consumption. The goal should be to provide clear information that will minimize unnecessary anxiety and alert people to real problems where they exist (330).
36. In Arctic communities, communication is most effective when it is interpersonal and face-to-face. It should be a two-way flow of information where the opportunity for feedback is maximized (334).
37. Communication should occur from the onset of a study and should be an ongoing process through to the reporting of findings and the development of remedial options. The best studies and the best solutions to local contaminant problems are developed with and by the community (336).

We will incorporate results of this work in our Synthesis Meeting to be held in conjunction with the Arctic Division of the American Association of the Advancement of Science 1999 Arctic Science Conference to be held September 19-22 in Denali Park.

We are working with both the AMAP secretariat and with the Canadian Northern Contaminants Program to bring together plain English summaries of available knowledge about contaminants in the Arctic. In addition, we conducted a literature review to bring in articles published after the summaries were prepared. We have identified 68 such articles of which we have obtained 48 in hard copy. Over the summer of 1999 we prepared a Powerpoint summary of available knowledge to use in the September 1999 Synthesis Meeting. Our objective was to advance toward a consensus on available knowledge among researchers. We brought this consensus to communities in regional meetings held in 1999-2000. We asked community representatives for their views on the scientific consensus. We will share community views with the scientific community in the September 2000 Synthesis Meeting.

### ***Regional Meetings***

As stated above, the principal goal of the project is to build capacity among Alaska Tribes to take effective action to clearly identify and address their concerns about radionuclides and other types of contamination. The most important components of capacity to take effective action are ownership and trust. We mean by ownership that tribes take responsibility for their own lives. We mean by trust that tribes trust the world in which they live - the natural environment, the efficacy of their own actions, and the actions of others.

Traditional Knowledge and Radionuclides - "The Process"

*A healthy village is a circle whose people are safe within its fold.  
Love, understanding, kindness, culture, history, goals, truth - these*

*make the circle strong and protect the village, the family, the individual.* Harold Napoleon

The process designed for the project incorporates Native worldview and protocols. In order to capture traditional knowledge, one must use traditional methods. Traditional knowledge, taken out of context, is no longer traditional knowledge.

The process involves the primary elements of the Native worldview - a holistic view where all things are connected, the creator, earth, animals and humans, and the aspects of the physical, mental, emotional and spiritual are equally represented. This worldview serves as the basis upon which the model process has been developed.

The first step is having knowledge of the area, communities and cultures and understanding their unique protocols and circumstances. Each region of the State represents primary culture groups - Iñupiat, Yupik, Athabascan, Tlingit, Haida, Tsimpsian, Aleut, and each have their distinctive practices and protocols.

The selection of participants to the Regional Meetings is an interactive process, involving a local steering committee from the region that assists in identifying Native elders, culture bearers, hunters, youth, gatherers, resource managers and Native scientists. All regional profit and non-profit Native corporations, health corporations, tribal organizations and councils, and municipalities are notified of the Regional Meetings and of the participants representing their communities.

The Regional Meetings take place in a "Traditional Talking Circle" format, with a trained facilitator, and begin with rules of the circle and formal introductions. The Talking Circle has been used throughout history but has gained prominence as a teaching tool, a therapeutic tool, and a support group system. Traditional Talking Circles are conducted by traditional healers, elders or trained facilitators who are knowledgeable and disciplined in tradition, custom and spirituality. The facilitators may prepare for days in order to conduct the Talking Circle according to traditional beliefs.

These basic rules apply to the Talking Circle:

1. Respect for confidentiality.
2. Respect for each person in the circle.
3. Each person is given a chance to speak without interruption or comment.

There are different types of Talking Circles. For this process, we use the Traditional Talking Circle.

**Traditional Talking Circle** - The traditional facilitator begins the circle with prayer, singing, or drumming; establishing rules; and setting the tone for the circle. They may use a symbolic object (e.g., rock, feather, or prayer stick) in the circle. The circle generally begins with traditional introductions. The circle goes clockwise in respect for the cycle of life and mother earth. Each person in the circle gets a chance to share if they choose to. The circle may go around multiple times to give those who want to share more time to do so. There is normally a beginning, middle and a closure. The circle ends with a closing prayer.

The Talking Circle promotes understanding, sharing and trust. This is key to participants feeling

secure in sharing knowledge that is cultural or sacred and knowing that their information will be used in respected and appropriate ways. An important part of the process is the sharing of food and gift-giving as is the usual community practice.

To record the meeting, the scribes sit outside the circle and take remarks from participants. Each day the scribes return the comments to participants for review. General themes and actions are also reviewed by participants. Consent form are reviewed with all participants before asking for their signature. Draft report documents in their entirety are also sent to all participants before the final report is prepared.

### **Knowledge Subject Areas**

To be true to Native ways of knowing and Native ways of building consensus and to build rather than undermine trust and relationships we cannot predict what knowledge subject areas will become important to Native communities. We have a beginning set of questions that are based on prior contacts with tribes. We intend these questions to stimulate thinking in the regional meetings; however, we do not intend to structure the meetings around them. The questions are:

- What environmental changes are causing concerns about the safety of eating Native foods, and human health? What environmental conditions continue to appear healthy?
- Where and when have environmental changes been observed?
- To what extent are there apparent sources of these changes? Do radionuclides or other contaminants appear to be potential sources of changes?
- How can we support community action?
- How can we document and access traditional knowledge?

### **Goals for Documenting and Accessing Traditional Knowledge**

The most important goals influencing the design of a process for documenting and accessing traditional knowledge are that community ownership and trust are **increased** as a result. Most designs for the collection, archiving, and use of traditional knowledge are likely to **decrease** community ownership and trust. We work with community participants to design methods which preserve local control and which promote local use of information.

Additional goals for documenting and accessing traditional knowledge include:

- Relevancy
  - Observations of environmental change
  - Ideas on related changes and possible sources of change
  - Observations of changes in human health and related changes
  - Observations made over time
- Specificity
  - Species
  - Location
  - Time
  - Quantity/prevalence
- Builds a network of expertise and builds credibility of knowledge
  - Source of observations (individuals, documents)
  - Means of contacting source for additional knowledge

- Means of safeguarding local knowledge where desired

We have conducted the regional meetings. The meeting dates were:

- Northwest Arctic Regional Meeting: Nome, September 30 – October 2, 1998
- Southeast Regional Meeting: Sitka, January 28 – January 30, 1999
- Interior Regional Meeting: Fairbanks March 25 – March 27, 1999
- Yukon-Kuskokwim Regional Meeting: Bethel, August 26-28, 1999
- Prince William Sound-Alaska Peninsula Regional Meeting: February 23-25, 2000
- Southcentral Regional Meeting: Anchorage, February 28-29, 2000
- Interior-Northwest Regional Meeting: Anchorage, April 6-7, 2000
- Southeast-Northwest Arctic Regional Meeting: Anchorage, April 10-11, 2000
- Arctic Regional Meeting: Barrow, June 14-16, 2000

Appendix F reproduces the “homework assignment” that we send to meeting participants prior to the meeting. We encourage participants to talk about community concerns with other community members before coming to the regional meeting.

Appendix G contains the summary slides used to introduce the project to participants in each regional meeting. We contrast the community-based approach used in this project with the traditional science-based approach. We explain the major elements of the current grant and the purpose of the first year’s regional meetings. We also review sources of concerns about radionuclides and explain that we are broadly interested in people’s observations and concerns about environmental changes.

We record participants’ comments as close to verbatim as possible using Microsoft Access. We begin the second day by asking participants to edit printed copies of comments they made on day one. We repeat this procedure the third day. In addition, the first evening we prepare Powerpoint a summary of the major points made by participants. We use this summary interactively with participants the second day using a video projector. In this way, we work toward a consensus of points made during the meeting as a whole. Appendices H, I, and J contain the consensus summary points from the three regional meetings. Key findings to date from the regional meetings include:

#### Northwest Arctic

- There are increased numbers of fish with abnormalities. These increases appear to be associated with local sources of contaminants.
- Beavers and Bears are moving into the region and there is increased willow growth.
- There was a large die off of seabirds (cormorants, puffins, murre) in the summer of 1996.
- There is more dirty ice seen and the extent and thickness of sea ice has decreased.
- There are more years of warmer, wetter weather.
- Lakes and normally wet areas are drying up.
- Residents are concerned about Russian sources of contaminants including nuclear power plants and dumping of wastes.
- People would like to be able to test for contaminants. They want training for collection and testing.
- People are concerned about higher rates of cancer in some villages than others. There appears to be a relationship between cancer rates and local military sites.

## Southeast Alaska

- There has been a decline in herring, herring spawning areas, and a shift to earlier spawning.
- Sea otters are moving into inside waters.
- There have been declines in local shellfish, halibut, smelt, hooligan, rockfish, and sockeye.
- There is a loss in the spiritual relationship that people have with the natural environment and a loss of respect for animals.
- People are changing in how they act and think; these changes bring pollution, cancers and other illnesses. There is a need for healing.
- There is a loss of old growth forest habitat, with a decrease in availability of medicinal herbs and plants for weaving.
- Sources of contamination range from fuel tanks, asbestos, lead-based paint, pulp mills, inadequate buffers of trees along streams with resultant siltation.
- Fishing pressure on herring and halibut is high.
- Warmer ocean temperatures appear to be bringing tuna, mackerel, barracuda, sunfish, giant turtles, and white sharks to the region.
- Marine buffer zones for subsistence are needed.
- Sea otters need to be controlled.
- Tourists need to be educated about the environment and local customs.
- We need a traditional knowledge study to identify resource population levels when the system was healthy and we need large area contaminants analysis.

## Interior Alaska

- Peoples' diets are increasingly including store bought meats and vegetables, instant foods, pop, and improperly stored canned and frozen food.
- More people are dying from stomach cancer, ulcers, and other cancers. There has been a loss of traditional medicine people and an increased use of the clinic.
- There are local signs of pollution: E-Coli, discolored river and village water.
- Whitefish and salmon show increased numbers of abnormalities. There have been local die offs of Whitefish.
- Moose meat tastes different and some have water bags in their lungs.
- Muskrats have spots on their liver and lungs and are not as fat. There has been a decline in muskrats around Fort Yukon.
- There are increased numbers of beavers. Beaver recently have had spots on their liver.
- Caribou have runny bone marrow.
- The Tanana Chiefs Conference has measured high levels of PCB's and DDT's in King Salmon and high levels of mercury in fish.
- Sources of pollutants include dumps, honey buckets, military sites, mines, chemicals used in dust control, vehicle oil leaks, fire retardants, acid rain, and distant sources like sunken submarines.
- Winters have not had the usual severe cold snap with the result that lakes do not freeze to the bottom.
- Summers have been hotter and dryer with the result that lakes and wet areas are drying up.

- There is a need to return to use of traditional medicines and to use healthier practices in living.
- Youth need to be taught to be caretakers of the ecosystem.
- Gwitch'n people need to have a voice on the Arctic Council.

Following each regional meeting we edit the MS Access database of participant comments. We divide comments so that each record in the database contains a comment by a single participant about a single concern. We send this edited version of comments out to participants to review. The combined database of Native concerns now contains 857 concern records provided by 105 regional meeting participants.

The individual comments of participants reflect an experience and understanding greater than the individual participant. Participants bring to the regional meetings the collective traditional knowledge of their community and region. Here is an opening commentary by Enoch Scheidt from Kotzebue:

*My dad came from Noorvik and mom came from Noatak. I was adopted and raised mostly by my grandfather after my dad had a stroke. I lived mostly on animals and berries, both inland and on the coastline. My grandfather told me about animals everywhere we go. He said that they would change one of these days and I should worry about it.*

*I moved to Kotzebue 35 years ago and I hunt up river and on the ocean. We get to see scars a lot on fish and we think it is from the catch and release sport fisherman. This year for the first time we are noticing that our salmon have pus on them inside and outside. Are they bringing the disease in from Russia or is it here already?*

*We boat from Kotzebue to a little way from Wales - one season I went almost to Pt. Hope and back to Kivalina (about 350 miles) - just to say I did it once. When we go hunting on the ocean for 2-3 days it didn't used to be hard to find clean ice. Now it is harder and harder to find clean ice - why? Why is it getting so dirty and making it harder to hunt?*

*We used to walk way up to go caribou hunting - but nowadays most of our caribou are getting sick. We eat from the caribou and they eat the lichen, the moss. They need to study the caribou because it is our main diet inland. Is it coming in the rain to the moss?*

*Why are our people getting sick? A young kid came to my office. He had been looking for ivory across the east side of Kotzebue Sound. He found two mud sharks which still had meat. The sea gulls wouldn't eat them and you know sea gulls will eat anything.*

*Anytime someone does a study, they say they will get back to us, but they never do. It's too late for us, but our kids and grandchildren need the choice to eat Native food or not. Maybe elders are getting*

*sick from the canned food - maybe our elders are immune from the preservatives, we don't know.*

*A lot of our fisherman get sea fish with tags. They are always skinny. We know they are trying to do studies for our own good but the tags may cause a problem. It's the same with caribou collars. The necks of the collared caribou are all raw. I shot a caribou but found that it was sick so I left it. ADF&G found it and gave it to an elder. The elder didn't eat it; there were white spots on the liver, the lungs were stuck and it was green, it stunk.*

*On the berries, the cycle is a lot earlier - why? Maybe it is the rainfall. I've been hunting since I was 7 years old and never went to high school. I've got relatives all the way to Barrow. When I was 8 there was a scientist from Canada involved with Project Chariot. He hired me to take him out to take samples of moss for two and a half months. He said afterwards that your family will never get sick. A boy ate caribou and soon died. We never found out why he died.*

*Our concerns here in Kotzebue are with the White Alice site - a lot of people from Kotzebue are dying from cancer.*

*I hunt all the way to Ambler - I try to learn and I hunt both sea and inland.*

Enoch Scheidt, Kotzebue

We will be analyzing the database to present in the synthesis meeting in September. To provide the reader with a sense of the contents of the database, we provide below examples of comments from the first three regional meetings:

*We are putting together a database from 10 of our villages here. They are reporting about each village and on state lands. Where we are finding reported and proven contamination (tar, gasoline, fuel oil), we are finding deformities in the fish. The fish being reported are unhealthy when they open them up. There is definitely a relationship between reported places, waters, and fish deformities. Example - Davidson's Landing was an army fuel reserve dump (cache) during WW2. Agiapuk River and American River - we are gearing up for active remediation. That's where the reports of fish with lesions and sores are coming from.*

Guy Martin, Nome.

*We have a high rate of increase in beaver. What's happening is that because the winters are warmer, the lakes don't freeze all the way down and more of the young beaver survive. That's what is causing them to proliferate. We are having warmer winters than usual on a consecutive basis. This allows for more favorable conditions for beaver—but most important of all—is that the lakes in*

*Interior Alaska do not freeze all the way to the bottom—thus allowing a much higher percent of beaver to survive the winter.*

Paul Erhart, Tanana

*There have been a lot of changes in the sea ice currents and the weather. Solid ice has disappeared and there are no longer huge icebergs during fall and winter. The ice now comes later and goes out earlier and it is getting thinner. The current is stronger. We used to have a very low tide down at the beach and it is windier on the island. We had a bad hunting season with lots of high winds. Some years ago there was a massive amount of dead murrelets that floated on the water. I think they caught the wind currents from Japan. Our elders tell us that our earth is getting old and needs to be replaced by a new one.*

Jerry Wongittilin, Sr., Savoonga, St. Lawrence Island

*I noticed that a long time ago when I was growing up the plants and berries used to be sweet in July. Nowadays the greens and even the berries don't last long.*

Roseanna Dan-Waghiyi, Stebins

*There are a lot of things happening. The weather has gotten warmer. The taste of the plants has changed. The fur is coming off the seals like they are molting but it is not molting time. We're wondering if Chernobyl was responsible. They were wondering about Russian military dumping toxic waste and it is coming over to our side. I'm glad to be here and to understand that we aren't the only ones to experience these changes. We are isolated with one week mail service. It is really hard to get off and on our island.*

Eric Iyapana, Little Diomedea

*I was born in Deering on the south side of Kotzebue but I was raised in Shishmaref. I worked for the federal government for 31 years and just retired this April. Even though I work for the government, I make sure I go hunting every year for my family. I've seen a lot of studies on contaminants and animal behavior, and the problem I see is that we never get feedback on why this behavior is happening and what contaminants are present in them until it is too late. In the meantime, we are eating them and possibly being contaminated by something we don't know. We just have to guess at the sources of contamination because we don't know. My sister died a couple of months ago of cancer. I often wonder what caused it? Was it her Native food, the air she breathes, or the non-Native food she ate? It makes you wonder why cancer is getting more frequent, especially in our older people. I certainly hope we get some feedback on the results of these studies because everyone is getting concerned on why these things are happening.*

Delano Barr, Shishmaref



*What I'm saying is that I truly believe that we will never get action unless we do it ourselves. We have to put things together, with the help of some technical, responsible people. So the movement to gather all the information that we can is good and we should try to get a committee or statewide support to do what we're trying to do. I think that you have a pretty good group here.*

Robert Charlie, Minto

*My concern in Allakaket is water. We don't have running water at home. We have outdoor bathrooms. We have real problems with our water pollution, all over.*

Johnson Moses, Allakaket

*There are real environmental concerns about a proposal that would bring in freighters from China to get water here. It would bring in things that our environment is not ready for.*

Teri Rofkar, Sitka

*This summer we had no sockeye. The sockeye they were catching up the river in June, they had tumors, they were deformed. Some had only one eye, some had bumps.*

Elaine Abraham, Yakutat

*There is Fish Lake, and I saw dead fish there. You know when you see dead fish in a river, you know something is wrong. Like I said, the people have been mining there since I can remember. What have they been putting into that lake? Makes you wonder.*

John Starr Tanana

*They sprayed DDT in Galena area. They just sprayed everything around year after year. The military dump chemicals everywhere. Soaked the ground with PCPs. I told my little girl not to drink the water.*

Orville Huntington, Huslia

*My concern is the pollution and garbage. Everywhere I go in the summer with a boat or by snow machine in the winter, I find trash left around. The cans don't weigh hardly anything, so I haul them home. But most people don't do that. People dump oil in their machine and dump the can in the river.*

Paul Herbert, Fort Yukon

*There is a very visibly an over-population of sea otter in Southeast Alaska. Normally, the sea otter is an outer coast animal. That is where we would like to see them stay. Because of the large*

*population, the seal otter are infiltrating into the inside waters. The threat of this trend is that sea otter feed on the same things that we consider subsistence foods.*

Harold Martin, Juneau

*Unalakleet had a White Alice site and Moses Point (Elim) had a CAA station. Elim has much higher rates of cancer among people in their 40-50s. At home we don't have any of these sites.*

William Takak, Shaktoolik.

*This morning there were questions about blueberries. We analyzed our blueberries and came back with DDT. We're Indian people, we don't use pesticides. Yet we have it all over our land. I researched this and most of our pesticides come from Russia and Asia. Russians sprayed 17,528 tons of pesticides last year, and it becomes airborne and comes to us. I'd like us to face the question of whether it is safe to eat. From my perspective, the benefits far outweigh the risks.*

Paul Erhart, Tanana

*There is a real hesitancy about eating the clams now. When I was a kid, you know, we use to eat the muscles on the clam raw. As my mother and dad were cleaning it out, we ate all those little buttons. And you know, I won't let my kids eat that anymore. We use to eat it raw. But now you don't know anymore. We have a joke in my house because I have two Siamese cats and my kids say, "Gram, test it on your cat first." So, we have a generation that's scared of eating their Native foods.*

Elaine Abraham, Yakutat

*My greatest concern for the Tanana area is how can we save our elders? A lot of them have passed away from cancer. We know the cause is White Alice and all the mining that has been done in our area. The most difficult question is how are we going to make the government and the mining industry really clean up their sites? This is one of our greatest concerns.*

Gerald Nicholia, Tanana

*You don't hear birds any more. All the time we used to hunt there use to be so much noise from the geese and cranes going north. The noise just isn't there now. Go back there is the fall and you don't hear it any more. The changes we're seeing—it's not very good the changes that we're hearing.*

John Starr, Fort Yukon

*I've lived most of my life in western Alaska. I've been in groups like this in the past. The animals and berries are changing. I've noticed*

*that the silver salmon had sore-like spots on their sides. They said a few years ago when the birds were dying that there was a yellow-like substance foam in the bay. We've never seen anything like that before. When I talked to the elders at home before I came here they talked about the migration patterns of the walrus and caribou changing. Recently two families lost their reindeer to caribou because they came right down the beach near Koyuk. The caribou used to come 15-20 miles inland and now they are migrating towards our area. One family lost most of their herd this year. It seems that in my lifetime the migration of the walrus and beluga are really changing too. Take an example from the lemmings, when there are too many, they go to different areas to feed. That is the way it is with the walrus too. They are going to new places to feed. Last year thousands of them went to Norton Bay. When we opened their bellies, we found rocks in there. They migrated towards the land; maybe it was because they ran out of things to eat.*

William Takak, Shaktoolik

*Well, since you're talking about health. I work at Kawerak on subsistence. I'll talk about Brevig and in recent years there has been a lot of deaths (6?) from cancer. Being from Sishmaref, I know that people are dying from cancer and people are wondering why. It is mostly at Brevig and Teller. Since the whalers came, tobacco has been part of our lives. It gets to the point that it starts killing people. But I know a woman in Brevig who didn't smoke all her life and she died from cancer.*

Jake Olanna, Nome.

### **Status of the Budget**

As of April 14, 1999 the available balance on the current three-year, \$700,000 grant was \$551,306. Participant and meeting costs for both regional meetings completed under the current grant totaled \$36,787 compared with anticipated costs for the two meetings of \$36,120. Labor charges to date on the current grant are under anticipated charges by about \$20,000 as Kruse, Killorin, and Eberhart have had competing demands for their time on other projects. We anticipate that we will be able to make up this project time on synthesis and database tasks in June, July, and August. It has been challenging to schedule the fourth and fifth Year One regional meetings. We expect to hold meetings in Bethel and Barrow. In order to get full participation it will be necessary to schedule the regional meetings in the fall.

## Appendix A: Communities in the Contaminants and Native Foods Database

Adak Station	Chase	Ekwok
Akhiok	Chefornak	Elfin Cove
Akiachak	Chenega Bay	Elim
Akiak	Chevak	Emmonak
Akutan	Chickaloon	Ester
Alakanuk	Chicken	Evansville
Alatna	Chignik Bay	Eyak
Alcan	Chignik Lagoon	Fairbanks
Aleknagik	Chignik Lake	False Pass
Alexander Creek	Chiniak	Ferry
Allakaket	Chisana	Fort Greely
Allakaket/Alatna	Chistochina	Fort Yukon
Ambler	Chitina	Fox
Amchitka	Chuathbaluk	Fox River
Anaktuvuk Pass	Circle	Freshwater Bay
Anchor Point	Circle Hot Springs Station	Fritz Creek
Anchorage	Clam Gulch	Gakona
Anderson	Clark's Point	Galena
Angoon	Coffman Cove	Gambell
Aniak	Cohoe	Game Creek
Annette	Cold Bay	Glennallen
Anvik	Cooper Landing	Gold Creek
Arctic Village	Copper Center	Golovin
Atka	Copperville	Goodnews Bay
Atmautluak	Cordova	Grayling
Atqasuk	Council	Grouse Creek Group
Barrow	Covenant Life	Gulkana
Beaver	Craig	Gustavus
Beecher Pass	Crooked Creek	Haines
Beluga	Crown Point	Halibut Cove
Bethel	Cube Cove	Happy Valley
Bettles	Deadhorse	Harding Lake
Bettles/Evansville	Deering	Healy
Big Delta	Delta Junction	Healy Lake
Big Lake	Denali Highway	Hobart Bay
Birch Creek	Dillingham	Hollis
Brevig Mission	Diomede	Holy Cross
Buckland	Dora Bay	Homer
Butte	Dot Lake	Hoonah
Campion Station	Dry Creek	Hooper Bay
Cantwell	Eagle	Hope
Canyon Village	Eagle Village	Houston
Cape Lisburne	East Glenn Highway	Hughes
Cape Newenham	Edna Bay	Hurricane-Broad Pass
Cape Pole	Eek	Huslia
Central	Egegik	Hydaburg
Chalkyitsik	Eielson Air Force Base	Hyder

Igiugig  
Igloo  
Iliamna  
Indian Mountain  
Ivanof Bay  
Jakolof Bay  
Juneau  
Kachemak City  
Kake  
Kaktovik  
Kalifonsky  
Kaltag  
Karluk  
Kasaan  
Kasigluk  
Kasilof  
Kenai  
Kenny Lake  
Ketchikan  
Kiana  
King Cove  
King Salmon  
Kipnuk  
Kivalina  
Klawock  
Klukwan  
Knik  
Kobuk  
Kodiak City  
Kodiak Coast Guard  
Station  
Kokhanok  
Koliganek  
Kongiganak  
Kotlik  
Kotzebue  
Koyuk  
Koyukuk  
Kwethluk  
Kwigillingok  
LaBouchere Bay  
Lake Creek  
Lake Louise  
Lake Minchumina  
Larsen Bay  
Lazy Mountain  
Levelock  
Lignite  
Lime Village  
Livengood

Long Island  
Lower Kalskag  
Lower Tonsina  
Lutak  
Manley Hot Springs  
Manokotak  
Marshall (Fortuna Ledge)  
Matanuska Glacier  
McCarthy  
McCarthy Road  
McGrath  
McKinley Park Village  
Meadow Lakes  
Mekoryuk  
Mendeltna  
Mentasta  
Mentasta Pass  
Metlakatla  
Meyers Chuck  
Minto  
Montana  
Moose Creek  
Moose Pass  
Mosquito Lake  
Mountain Village  
Nabesna Road  
Naknek  
Nanwalek  
Napakiak  
Napaskiak  
Naukati Bay  
Nelson Lagoon  
Nenana  
New Stuyahok  
Newhalen  
Newtok  
Nightmute  
Nikiski  
Nikolaevsk  
Nikolai  
Nikolski  
Ninilchik  
Noatak  
Nome  
Nondalton  
Noorvik  
North Pole  
North Wrangell Mountains  
Northway  
Northway Junction

Northway Village  
Nuiqsut  
Nulato  
Nunapitchuk  
Old Harbor  
Oscarville  
Ouzinkie  
Palmer  
Parks Highway South  
Paxson  
Paxson-Sourdough  
Pedro Bay  
Pelican  
Perkinsville  
Perryville  
Petersburg  
Petersville Road  
Pilot Point  
Pilot Point/Ugashik  
Pilot Station  
Pitka's Point  
Platinum  
Pleasant Valley  
Point Baker  
Point Hope  
Point Lay  
Polk Inlet  
Port Alexander  
Port Alice  
Port Alsworth  
Port Clarence  
Port Graham  
Port Heiden  
Port Lions  
Port Protection  
Portage Creek  
Primrose  
Prudhoe Bay  
Quinhagak  
Rampart  
Red Devil  
Ridgeway  
Rowan Bay  
Ruby  
Russian Mission  
Saint George  
Saint John's Harbor  
Saint Marys (Andreafsky)  
Saint Michael  
Saint Paul

Salamatof  
Salcha  
San Juan Bay  
Sand Point  
Savoonga  
Saxman  
Scammon Bay  
Selawik  
Seldovia  
Seward  
Shageluk  
Shaktoolik  
Sheep Mountain  
Sheldon Point  
Shemya Station  
Shishmaref  
Shungnak  
Sitka  
Skagway  
Skwentna  
Slana  
Slana Homestead North  
Slana Homestead South  
Sleetmute  
Soldotna  
Solomon  
Sourdough  
South Naknek  
South Wrangell Mountains  
Sparrevohn Air Force Base  
Stebbins  
Sterling  
Stevens Village  
Stony River  
Sutton  
Takotna  
Talkeetna  
Tanacross  
Tanana  
Tatalina Station  
Tatitlek  
Tazlina  
Telida  
Teller  
Tenakee Springs  
Tetlin  
Thorne Bay  
Togiak  
Tok  
Toksook Bay

Tonsina  
Trapper Creek  
Tuluksak  
Tuntutuliak  
Tununak  
Twin Hills  
Two Rivers  
Tyonek  
Ugashik  
Unalakleet  
Unalaska  
Upper Kalskag  
Usibelli Mine  
Valdez  
Venetie  
Wainwright  
Wales  
Wasilla  
West Glenn Highway  
Whale Pass  
White Mountain  
Whitestone Logging Camp  
Whittier  
Willow  
Wiseman  
Women's Bay  
Wrangell  
Yakutat

## Appendix B: Pounds of Native Foods Harvested Per Capita By Community

(Source: Alaska Department of Fish & Game Subsistence Division)

Akhiok	322	Gulkana	153
Akutan	466	Gustavus	257
Alakanuk	725	Haines	104
Aleknagik	379	Healy	132
Allakaket/Alatna	906	Hollis	164
Anderson	139	Homer	94
Angoon	242	Hoonah	388
Atka	439	Hope	111
Barrow	289	Hughes	1492
Beaver	732	Hurricane-Broad Pass	178
Beecher Pass	532	Huslia	1082
Bettles/Evansville	260	Hydaburg	337
Brevig Mission	579	Hyder	401
Cantwell	112	Igiugig	725
Chase	209	Iliamna	848
Chenega Bay	275	Ivanof Bay	490
Chickaloon	224	Kake	159
Chignik Bay	357	Kaktovik	886
Chignik Lagoon	211	Karluk	269
Chignik Lake	442	Kasaan	186
Chisana	128	Kenai	84
Chistochina	262	Kenny Lake	136
Chitina	342	King Cove	256
Clark's Point	363	King Salmon	220
Coffman Cove	186	Kivalina	761
Cooper Landing	92	Klawock	235
Copper Center	174	Klukwan	239
Cordova	128	Kodiak City	151
Craig	185	Kodiak Coast Guard Station	
Deering	672		115
Dillingham	242	Kodiak Road	168
Dot Lake	116	Kokhanok	1013
East Glenn Highway	132	Koliganek	830
Edna Bay	517	Kotlik	503
Egegik	384	Kotzebue	593
Ekwok	797	Kwethluk	836
Elfin Cove	264	Lake Louise	179
Emmonak	612	Larsen Bay	451
False Pass	413	Levelock	884
Fort Yukon	999	Manokotak	384
Gakona	95	McCarthy Road	230
Galena	787	McGrath	182
Glennallen	99	McKinley Park Village	242
Gold Creek	174	Mentasta	125
Golovin	604	Mentasta Pass	188

Metlakatla	71		
Meyers Chuck	414		
Minto	1015		
Mountain Village	820		
Nabesna Road	250		
Naknek	188		
Nanwalek	305		
Nelson Lagoon	258		
New Stuyahok	700		
Newhalen	747		
Nikolai	787		
Nikolski	761		
Ninilchik	86		
Noatak	461		
Nondalton	1175		
Northway	278		
Nuiqsut	742		
Nunapitchuk	802		
Old Harbor	391		
Ouzinkie	218		
Parks Highway South	58		
Paxson	289		
Pedro Bay	865		
Pelican	355		
Perryville	394		
Petersburg	200		
Petersville Road	167		
Pilot Point	384		
Point Baker	344		
Point Lay	890		
Port Alexander	306		
Port Alsworth	361		
Port Graham	212		
Port Heiden	408		
Port Lions	331		
Port Protection	311		
Quinhagak	768		
Saint George	63		
Saint Paul	267		
San Juan Bay	250		
Sand Point	256		
Saxman	89		
Seldovia	184		
Sheldon Point	1393		
Shishmaref	663		
Sitka	146		
Skagway	52		
Slana	250		
Slana Homestead North			
	174		
		Slana Homestead South	
			121
		Sourdough	118
		South Naknek	297
		South Wrangell Mountains	
			139
		Stebbins	997
		Stevens Village	1139
		Talkeetna	55
		Tanacross	250
		Tanana	2157
		Tatitlek	270
		Tazlina	107
		Tenakee Springs	345
		Tetlin	214
		Thorne Bay	188
		Tok	149
		Tonsina	156
		Trapper Creek	65
		Tununak	1093
		Tyonek	260
		Ugashik	814
		Unalaska	195
		Valdez	79
		Wainwright	751
		Wales	744
		West Glenn Highway	92
		Whale Pass	186
		Whittier	80
		Wrangell	164
		Yakutat	398



**Appendix C: Species Harvested in Excess of 20 Pounds  
Per Capita by at least One Community**

Arctic Char	Harbor Seal
Bearded Seal	Hare
Beaver	Herring
Beluga	Herring Roe
Black Bear	Humpback Whitefish
Blackfish	Humpback Whitefish [Other Gear]
Bowhead	Lake Trout
Broad Whitefish	Moose
Brown Bear	Pacific Tom Cod
Burbot	Pike
Caribou	Pink Salmon
Char	Ringed Seal
Chinook Salmon	Rockfish
Chum Salmon	Round Whitefish
Cisco	Sheefish
Clams	Shrimp
Cod	Smelt
Coho Salmon	Sockeye Salmon
Deer	Spotted Seal
Dolly Varden	Steller Sea Lion
Dungeness Crab	Trout
Eulachon (hooligan, candlefish)	Walrus
Halibut	Whitefish



## Appendix D: Community-Species-Contaminant Observations

Community	Species	Contaminant	Barrow	Ringed Seal	Br
Barrow	Bearded Seal	Cs 137	Barrow	Ringed Seal	Ca
Barrow	Bearded Seal	Sr 90	Barrow	Ringed Seal	Cd
Barrow	Bowhead	Ag	Barrow	Ringed Seal	Cl
Barrow	Bowhead	Al	Barrow	Ringed Seal	Co
Barrow	Bowhead	As	Barrow	Ringed Seal	Cr
Barrow	Bowhead	Br	Barrow	Ringed Seal	Cs
Barrow	Bowhead	Ca	Barrow	Ringed Seal	Cu
Barrow	Bowhead	Cd	Barrow	Ringed Seal	Fe
Barrow	Bowhead	Cl	Barrow	Ringed Seal	Hg
Barrow	Bowhead	Co	Barrow	Ringed Seal	K
Barrow	Bowhead	Cr	Barrow	Ringed Seal	Mg
Barrow	Bowhead	Cs	Barrow	Ringed Seal	Mn
Barrow	Bowhead	Cu	Barrow	Ringed Seal	Na
Barrow	Bowhead	Fe	Barrow	Ringed Seal	Ni
Barrow	Bowhead	Hg	Barrow	Ringed Seal	Pb
Barrow	Bowhead	K	Barrow	Ringed Seal	Rb
Barrow	Bowhead	Mg	Barrow	Ringed Seal	Sb
Barrow	Bowhead	Mn	Barrow	Ringed Seal	Se
Barrow	Bowhead	Na	Barrow	Ringed Seal	V
Barrow	Bowhead	Ni	Barrow	Ringed Seal	Zn
Barrow	Bowhead	Pb	Barrow	Ringed Seal	Cis-Chlord
Barrow	Bowhead	Rb	Barrow	Ringed Seal	Dieldrin
Barrow	Bowhead	Sb	Barrow	Ringed Seal	Hcb
Barrow	Bowhead	Se	Barrow	Ringed Seal	Heptachlor Epoxide
Barrow	Bowhead	V	Barrow	Ringed Seal	Lindane (G-Hch)
Barrow	Bowhead Or	Cs 137	Barrow	Ringed Seal	P,P'-Ddd
Barrow	Black Whale		Barrow	Ringed Seal	P,P'-Dde
Barrow	Bowhead Or	Sr 90	Barrow	Ringed Seal	P,P'-Ddt
Barrow	Black Whale		Barrow	Ringed Seal	Spcb
Barrow	Bowhead Whale	S Pcb	Barrow	Ringed Seal	T-Nonachlor
Barrow	Bowhead Whale	Dieldrin	Barrow	Walrus	Cs 137
Barrow	Bowhead Whale	Hcb	Barrow	Walrus	Sr 90
Barrow	Bowhead Whale	Hch	Barrow	Whitefish	Cs 137
Barrow	Bowhead Whale	Heptachlor Epoxide	Barrow	Whitefish	Sr 90
Barrow	Bowhead Whale	S Ddt	Bering Sea	Chum Salmon	A-Hch
Barrow	Bowhead Whale	T-Nonachlor	Bering Sea	Chum Salmon	B-Hch
Barrow	King Eider	Cs 137	Bering Sea	Chum Salmon	Cis-Chlordane
Barrow	King Eider	Sr 90	Bering Sea	Chum Salmon	Cis-Nonachlor
Barrow	Ringed Seal	Ag	Bering Sea	Chum Salmon	G-Hch
Barrow	Ringed Seal	Al	Bering Sea	Chum Salmon	Oxychlordane
Barrow	Ringed Seal	As	Bering Sea	Chum Salmon	P,P'-Ddd

Bering Sea	Chum Salmon	P,P'-Dde	Cape Thompson	Northern Pelagic	Cs 137
Bering Sea	Chum Salmon	P,P'-Ddt		Cormorant	
Bering Sea	Chum Salmon	Trans-Chlordane	Cape Thompson	Northern Pelagic	Sr 90
Bering Sea	Chum Salmon	Trans-Nonachlor	Cape Thompson	Pacific (Black-Legged)	Cs 137
Bering Sea	Dall'S Porpoise	A-Hch		Kittiwake	
Bering Sea	Dall'S Porpoise	B-Hch	Cape Thompson	Pacific (Black-Legged)	Sr 90
Bering Sea	Dall'S Porpoise	Cis-Chlordane		Kittiwake	
Bering Sea	Dall'S Porpoise	Cis-Nonachlor	Cape Thompson	Pacific Herring	Cs 137
Bering Sea	Dall'S Porpoise	G-Hch	Cape Thompson	Pacific Herring	Sr 90
Bering Sea	Dall'S Porpoise	Oxychlorane	Cape Thompson	Porcupine	Cs 137
Bering Sea	Dall'S Porpoise	P,P'-Ddd	Cape Thompson	Porcupine	Sr 90
Bering Sea	Dall'S Porpoise	P,P'-Dde	Cape Thompson	Red-Throated Loon	Cs 137
Bering Sea	Dall'S Porpoise	P,P'-Ddt	Cape Thompson	Red-Throated Loon	Sr 90
Bering Sea	Dall'S Porpoise	Trans-Chlordane	Cape Thompson	Thick-Billed Murre	Cs 137
Bering Sea	Dall'S Porpoise	Trans-Nonachlor	Cape Thompson	Thick-Billed Murre	Sr 90
Bonanza Crk.	Northern Pike	Hg	Cape Thompson	Whitefish	Cs 137
Bonanza Crk.	Northern Pike	Se	Cape Thompson	Whitefish	Sr 90
Camp Crk.	Northern Pike	Hg	Cape Thompson		
Camp Crk.	Northern Pike	Se	Cape Thompson		
Cape Thompson	American Brant	Cs 137	Chena	Burbot	A-Hcb
Cape Thompson	American Brant	Sr 90	Chena	Burbot	Cis-Chlor
Cape Thompson	Arctic Loon	Cs 137	Chena	Burbot	Ddd
Cape Thompson	Arctic Loon	Sr 90	Chena	Burbot	Dde
Cape Thompson	Black Brant	Cs 137	Chena	Burbot	Ddt
Cape Thompson	Black Brant	Sr 90	Chena	Burbot	Pcb1254
Cape Thompson	Bottom Crab	Cs 137	Chena	Burbot	Pcb1260
Cape Thompson	Bottom Crab	Sr 90	Chena	Burbot	Toxaphene
Cape Thompson	Caribou	Cs 137	Chena	Burbot	Trans-Nonachl
Cape Thompson	Caribou	Sr 90	Chena	Longnose Sucker	A-Hcb
Cape Thompson	Chum Salmon	Cs 137	Chena	Longnose Sucker	Cis-Chlor
Cape Thompson	Chum Salmon	Sr 90	Chena	Longnose Sucker	Ddd
Cape Thompson	Glaucous Gull	Cs 137	Chena	Longnose Sucker	Dde
Cape Thompson	Glaucous Gull	Sr 90	Chena	Longnose Sucker	Ddt
Cape Thompson	Heir Seal	Cs 137	Chena	Longnose Sucker	Pcb1254
Cape Thompson	Heir Seal	Sr 90	Chena	Longnose Sucker	Pcb1260
Cape Thompson	Horned Puffin	Cs 137	Chena	Longnose Sucker	Toxaphene
Cape Thompson	Horned Puffin	Sr 90	Chena	Longnose Sucker	Trans-Nonachl
Cape Thompson	King Crab	Cs 137	Chena	Longnose Sucker	
Cape Thompson	King Crab	Sr 90	Chena	Longnose Sucker	
Cape Thompson	Marine Amphipod	Cs 137	Chena	Longnose Sucker	
Cape Thompson	Marine Amphipod	Sr 90	Chena	Longnose Sucker	
Cape Thompson	North Pacific (Common) Murre	Cs 137	Chilkoot River Mouth	Flathead Sole	Ag
Cape Thompson	North Pacific (Common) Murre	Sr 90	Chilkoot River Mouth	Flathead Sole	Aldrin

Chilkoot River Mouth	Flathead Sole	Alphachl	Chilkoot River Mouth	Flathead Sole	Pcb138
Chilkoot River Mouth	Flathead Sole	As	Chilkoot River Mouth	Flathead Sole	Pcb153
Chilkoot River Mouth	Flathead Sole	Cd	Chilkoot River Mouth	Flathead Sole	Pcb170
Chilkoot River Mouth	Flathead Sole	Cr	Chilkoot River Mouth	Flathead Sole	Pcb18
Chilkoot River Mouth	Flathead Sole	Cu	Chilkoot River Mouth	Flathead Sole	Pcb180
Chilkoot River Mouth	Flathead Sole	Di	Chilkoot River Mouth	Flathead Sole	Pcb187
Chilkoot River Mouth	Flathead Sole	Dieldrin	Chilkoot River Mouth	Flathead Sole	Pcb195
Chilkoot River Mouth	Flathead Sole	Fe	Chilkoot River Mouth	Flathead Sole	Pcb206
Chilkoot River Mouth	Flathead Sole	Hep	Chilkoot River Mouth	Flathead Sole	Pcb209
Chilkoot River Mouth	Flathead Sole	Heptachl	Chilkoot River Mouth	Flathead Sole	Pcb28
Chilkoot River Mouth	Flathead Sole	Heptaepo	Chilkoot River Mouth	Flathead Sole	Pcb44
Chilkoot River Mouth	Flathead Sole	Hex	Chilkoot River Mouth	Flathead Sole	Pcb52
Chilkoot River Mouth	Flathead Sole	Hexachl	Chilkoot River Mouth	Flathead Sole	Pcb66
Chilkoot River Mouth	Flathead Sole	Hg	Chilkoot River Mouth	Flathead Sole	Pcb8
Chilkoot River Mouth	Flathead Sole	Lindane	Chilkoot River Mouth	Flathead Sole	Pen
Chilkoot River Mouth	Flathead Sole	Mirex	Chilkoot River Mouth	Flathead Sole	Ppddd
Chilkoot River Mouth	Flathead Sole	Mn	Chilkoot River Mouth	Flathead Sole	Ppdde
Chilkoot River Mouth	Flathead Sole	Ni	Chilkoot River Mouth	Flathead Sole	Ppddt
Chilkoot River Mouth	Flathead Sole	Non	Chilkoot River Mouth	Flathead Sole	Se
Chilkoot River Mouth	Flathead Sole	Oct	Chilkoot River Mouth	Flathead Sole	Sn
Chilkoot River Mouth	Flathead Sole	Opddd	Chilkoot River Mouth	Flathead Sole	Tet
Chilkoot River Mouth	Flathead Sole	Opdde	Chilkoot River Mouth	Flathead Sole	Tnonchl
Chilkoot River Mouth	Flathead Sole	Opddt	Chilkoot River Mouth	Flathead Sole	Tri
Chilkoot River Mouth	Flathead Sole	Pb	Chilkoot River Mouth	Flathead Sole	Zn
Chilkoot River Mouth	Flathead Sole	Pcb101	Colville R. Drainage	Red Fox	Cs 137
Chilkoot River Mouth	Flathead Sole	Pcb105	Colville R. Drainage	Red Fox	Sr 90
Chilkoot River Mouth	Flathead Sole	Pcb11077	Cook Inlet	Beluga	Ag
Chilkoot River Mouth	Flathead Sole	Pcb118	Cook Inlet	Beluga	Al
Chilkoot River Mouth	Flathead Sole	Pcb126	Cook Inlet	Beluga	As
Chilkoot River Mouth	Flathead Sole	Pcb128	Cook Inlet	Beluga	Br
Chilkoot River Mouth	Flathead Sole	Pcb128	Cook Inlet	Beluga	Ca
			Cook Inlet	Beluga	Cd
			Cook Inlet	Beluga	Cl

Cook Inlet	Beluga	Co	Dutch Harbor	Flathead Sole	Pcb101
Cook Inlet	Beluga	Cr	Dutch Harbor	Flathead Sole	Pcb105
Cook Inlet	Beluga	Cs	Dutch Harbor	Flathead Sole	Pcb11077
Cook Inlet	Beluga	Cu	Dutch Harbor	Flathead Sole	Pcb118
Cook Inlet	Beluga	Fe	Dutch Harbor	Flathead Sole	Pcb126
Cook Inlet	Beluga	Hg	Dutch Harbor	Flathead Sole	Pcb128
Cook Inlet	Beluga	K	Dutch Harbor	Flathead Sole	Pcb138
Cook Inlet	Beluga	Mg	Dutch Harbor	Flathead Sole	Pcb153
Cook Inlet	Beluga	Mn	Dutch Harbor	Flathead Sole	Pcb170
Cook Inlet	Beluga	Na	Dutch Harbor	Flathead Sole	Pcb18
Cook Inlet	Beluga	Ni	Dutch Harbor	Flathead Sole	Pcb180
Cook Inlet	Beluga	Pb	Dutch Harbor	Flathead Sole	Pcb187
Cook Inlet	Beluga	Rb	Dutch Harbor	Flathead Sole	Pcb195
Cook Inlet	Beluga	Sb	Dutch Harbor	Flathead Sole	Pcb206
Cook Inlet	Beluga	Se	Dutch Harbor	Flathead Sole	Pcb209
Cook Inlet	Beluga	V	Dutch Harbor	Flathead Sole	Pcb28
Cook Inlet	Beluga	Zn	Dutch Harbor	Flathead Sole	Pcb44
Diomede	Pacific Walrus	Dieldrin	Dutch Harbor	Flathead Sole	Pcb52
Diomede	Pacific Walrus	Oxychlorane	Dutch Harbor	Flathead Sole	Pcb66
Dutch Harbor	Flathead Sole	Ag	Dutch Harbor	Flathead Sole	Pcb8
Dutch Harbor	Flathead Sole	Aldrin	Dutch Harbor	Flathead Sole	Pen
Dutch Harbor	Flathead Sole	Alphachl	Dutch Harbor	Flathead Sole	Ppddd
Dutch Harbor	Flathead Sole	As	Dutch Harbor	Flathead Sole	Ppdde
Dutch Harbor	Flathead Sole	Cd	Dutch Harbor	Flathead Sole	Ppddt
Dutch Harbor	Flathead Sole	Cr	Dutch Harbor	Flathead Sole	Se
Dutch Harbor	Flathead Sole	Cu	Dutch Harbor	Flathead Sole	Sn
Dutch Harbor	Flathead Sole	Di	Dutch Harbor	Flathead Sole	Tet
Dutch Harbor	Flathead Sole	Dieldrin	Dutch Harbor	Flathead Sole	Tnonchl
Dutch Harbor	Flathead Sole	Fe	Dutch Harbor	Flathead Sole	Tri
Dutch Harbor	Flathead Sole	Hep	Dutch Harbor	Flathead Sole	Zn
Dutch Harbor	Flathead Sole	Heptachl	Fairbanks	Arctic Grayling	A-Hcb
Dutch Harbor	Flathead Sole	Heptaepo	Fairbanks	Arctic Grayling	Cis-Chlor
Dutch Harbor	Flathead Sole	Hex	Fairbanks	Arctic Grayling	Ddd
Dutch Harbor	Flathead Sole	Hexachl	Fairbanks	Arctic Grayling	Dde
Dutch Harbor	Flathead Sole	Hg	Fairbanks	Arctic Grayling	Ddt
Dutch Harbor	Flathead Sole	Lindane	Fairbanks	Arctic Grayling	Pcb1254
Dutch Harbor	Flathead Sole	Mirex	Fairbanks	Arctic Grayling	Pcb1260
Dutch Harbor	Flathead Sole	Mn	Fairbanks	Arctic Grayling	Toxaphene
Dutch Harbor	Flathead Sole	Ni	Fairbanks	Arctic Grayling	Trans-Nonachl
Dutch Harbor	Flathead Sole	Non	Gambell	Pacific Walrus	Dieldrin
Dutch Harbor	Flathead Sole	Oct	Gambell	Pacific Walrus	Oxychlorane
Dutch Harbor	Flathead Sole	Opddd	Kamishak Bay	Flathead Sole	Ag
Dutch Harbor	Flathead Sole	Opdde	Kamishak Bay	Flathead Sole	Aldrin
Dutch Harbor	Flathead Sole	Opddt	Kamishak Bay	Flathead Sole	Alphachl
Dutch Harbor	Flathead Sole	Pb	Kamishak Bay	Flathead Sole	As

Kamishak Bay	Flathead Sole	Cd	Kamishak Bay	Flathead Sole	Ppddt
Kamishak Bay	Flathead Sole	Cr	Kamishak Bay	Flathead Sole	Se
Kamishak Bay	Flathead Sole	Cu	Kamishak Bay	Flathead Sole	Sn
Kamishak Bay	Flathead Sole	Di	Kamishak Bay	Flathead Sole	Tet
Kamishak Bay	Flathead Sole	Dieldrin	Kamishak Bay	Flathead Sole	Tnonchl
Kamishak Bay	Flathead Sole	Fe	Kamishak Bay	Flathead Sole	Tri
Kamishak Bay	Flathead Sole	Hep	Kamishak Bay	Flathead Sole	Zn
Kamishak Bay	Flathead Sole	Heptachl	Kenai	Dolly Varden	A-Hcb
Kamishak Bay	Flathead Sole	Heptaepo	Kenai	Dolly Varden	Cis-Chlor
Kamishak Bay	Flathead Sole	Hex	Kenai	Dolly Varden	Ddd
Kamishak Bay	Flathead Sole	Hexachl	Kenai	Dolly Varden	Dde
Kamishak Bay	Flathead Sole	Hg	Kenai	Dolly Varden	Ddt
Kamishak Bay	Flathead Sole	Lindane	Kenai	Dolly Varden	Pcb1254
Kamishak Bay	Flathead Sole	Mirex	Kenai	Dolly Varden	Pcb1260
Kamishak Bay	Flathead Sole	Mn	Kenai	Dolly Varden	Toxaphene
Kamishak Bay	Flathead Sole	Ni	Kenai	Dolly Varden	Trans-Nonachl
Kamishak Bay	Flathead Sole	Non	Kenai	Round Whitefish	A-Hcb
Kamishak Bay	Flathead Sole	Oct	Kenai	Round Whitefish	Cis-Chlor
Kamishak Bay	Flathead Sole	Opddd	Kenai	Round Whitefish	Ddd
Kamishak Bay	Flathead Sole	Opdde	Kenai	Round Whitefish	Dde
Kamishak Bay	Flathead Sole	Opddt	Kenai	Round Whitefish	Ddt
Kamishak Bay	Flathead Sole	Pb	Kenai	Round Whitefish	Pcb1254
Kamishak Bay	Flathead Sole	Pcb101	Kenai	Round Whitefish	Pcb1260
Kamishak Bay	Flathead Sole	Pcb105	Kenai	Round Whitefish	Toxaphene
Kamishak Bay	Flathead Sole	Pcb11077	Kenai	Round Whitefish	Trans-Nonachl
Kamishak Bay	Flathead Sole	Pcb118	Kisimulowk Creek	Arctic Ground Squirrel	Cs 137
Kamishak Bay	Flathead Sole	Pcb126	Kisimulowk Creek	Arctic Ground Squirrel	Sr 90
Kamishak Bay	Flathead Sole	Pcb128	Kisimulowk Creek	Muskrat	Cs 137
Kamishak Bay	Flathead Sole	Pcb138	Kisimulowk Creek	Muskrat	Sr 90
Kamishak Bay	Flathead Sole	Pcb153	Kisimulowk Creek	Northern Raven	Cs 137
Kamishak Bay	Flathead Sole	Pcb170	Kisimulowk Creek	Northern Raven	Sr 90
Kamishak Bay	Flathead Sole	Pcb18	Kobuk River	Wolf	Cs 137
Kamishak Bay	Flathead Sole	Pcb180	Kobuk River	Wolf	Sr 90
Kamishak Bay	Flathead Sole	Pcb187	Noatak River	Chum Salmon	Cs 137
Kamishak Bay	Flathead Sole	Pcb195	Noatak River	Chum Salmon	Sr 90
Kamishak Bay	Flathead Sole	Pcb206	Noatak River	Dolly Varden	Cs 137
Kamishak Bay	Flathead Sole	Pcb209	Noatak River	Dolly Varden	Sr 90
Kamishak Bay	Flathead Sole	Pcb28	Noatak River	Grayling	Cs 137
Kamishak Bay	Flathead Sole	Pcb44	Noatak River	Grayling	Sr 90
Kamishak Bay	Flathead Sole	Pcb52	Noatak River	Dolly Varden	Cs 137
Kamishak Bay	Flathead Sole	Pcb66	Noatak River	Dolly Varden	Sr 90
Kamishak Bay	Flathead Sole	Pcb8	Nome	Bearded Seal	Ag
Kamishak Bay	Flathead Sole	Pen	Nome	Bearded Seal	Al
Kamishak Bay	Flathead Sole	Ppddd	Nome	Bearded Seal	As
Kamishak Bay	Flathead Sole	Ppdde			

Nome	Bearded Seal	Br	Nome	Ringed Seal	V
Nome	Bearded Seal	Ca	Nome	Ringed Seal	Zn
Nome	Bearded Seal	Cd	Nome	Ringed Seal	Cis-Chlord
Nome	Bearded Seal	Cl	Nome	Ringed Seal	Dieldrin
Nome	Bearded Seal	Co	Nome	Ringed Seal	Hcb
Nome	Bearded Seal	Cr	Nome	Ringed Seal	Heptachlor Epoxide
Nome	Bearded Seal	Cs	Nome	Ringed Seal	Lindane (G-Hch)
Nome	Bearded Seal	Cu	Nome	Ringed Seal	P,P'-Ddd
Nome	Bearded Seal	Fe	Nome	Ringed Seal	P,P'-Dde
Nome	Bearded Seal	Hg	Nome	Ringed Seal	P,P'-Ddt
Nome	Bearded Seal	K	Nome	Ringed Seal	Spcb
Nome	Bearded Seal	Mg	Nome	Ringed Seal	T-Nonachlor
Nome	Bearded Seal	Mn	Nome	Spotted Seal	Ag
Nome	Bearded Seal	Na	Nome	Spotted Seal	Al
Nome	Bearded Seal	Ni	Nome	Spotted Seal	As
Nome	Bearded Seal	Pb	Nome	Spotted Seal	Br
Nome	Bearded Seal	Rb	Nome	Spotted Seal	Ca
Nome	Bearded Seal	Sb	Nome	Spotted Seal	Cd
Nome	Bearded Seal	Se	Nome	Spotted Seal	Cl
Nome	Bearded Seal	V	Nome	Spotted Seal	Co
Nome	Bearded Seal	Zn	Nome	Spotted Seal	Cr
Nome	Pacific Walrus	Dieldrin	Nome	Spotted Seal	Cs
Nome	Pacific Walrus	Oxychlorane	Nome	Spotted Seal	Cu
Nome	Ringed Seal	Ag	Nome	Spotted Seal	Fe
Nome	Ringed Seal	Al	Nome	Spotted Seal	Hg
Nome	Ringed Seal	As	Nome	Spotted Seal	K
Nome	Ringed Seal	Br	Nome	Spotted Seal	Mg
Nome	Ringed Seal	Ca	Nome	Spotted Seal	Mn
Nome	Ringed Seal	Cd	Nome	Spotted Seal	Na
Nome	Ringed Seal	Cl	Nome	Spotted Seal	Ni
Nome	Ringed Seal	Co	Nome	Spotted Seal	Pb
Nome	Ringed Seal	Cr	Nome	Spotted Seal	Rb
Nome	Ringed Seal	Cs	Nome	Spotted Seal	Sb
Nome	Ringed Seal	Cu	Nome	Spotted Seal	Se
Nome	Ringed Seal	Fe	Nome	Spotted Seal	V
Nome	Ringed Seal	Hg	Nome	Spotted Seal	Zn
Nome	Ringed Seal	K	North/American Crks.		Hg
Nome	Ringed Seal	Mg	North/American Crks.		Se
Nome	Ringed Seal	Mn	Ogotoruk Creek	Alaska Longspur	Cs 137
Nome	Ringed Seal	Na	Ogotoruk Creek	Alaska Longspur	Sr 90
Nome	Ringed Seal	Ni	Ogotoruk Creek	Arctic Ground Squirrel	Cs 137
Nome	Ringed Seal	Pb	Ogotoruk Creek	Arctic Ground Squirrel	Sr 90
Nome	Ringed Seal	Rb	Ogotoruk Creek	Bottom Crab	Sr 90
Nome	Ringed Seal	Sb	Ogotoruk Creek	Dolly Varden	Cs 137
Nome	Ringed Seal	Se			



Ogotoruk Creek	Dolly Varden	Sr 90	Oliktok Point	Fourhorn Sculpin Hep
Ogotoruk Creek	Ermine	Cs 137	Oliktok Point	Fourhorn Sculpin Heptachl
Ogotoruk Creek	Ermine	Sr 90	Oliktok Point	Fourhorn Sculpin Heptaepo
Ogotoruk Creek	Gray Whale	Cs 137	Oliktok Point	Fourhorn Sculpin Hex
Ogotoruk Creek	Gray Whale	Sr 90	Oliktok Point	Fourhorn Sculpin Hexachl
Ogotoruk Creek	Grizzly Bear	Cs 137	Oliktok Point	Fourhorn Sculpin Hg
Ogotoruk Creek	Grizzly Bear	Sr 90	Oliktok Point	Fourhorn Sculpin Lindane
Ogotoruk Creek	Horned Puffin	Cs 137	Oliktok Point	Fourhorn Sculpin Mirex
Ogotoruk Creek	Horned Puffin	Sr 90	Oliktok Point	Fourhorn Sculpin Mn
Ogotoruk Creek	Midges	Cs 137	Oliktok Point	Fourhorn Sculpin Ni
Ogotoruk Creek	Midges	Sr 90	Oliktok Point	Fourhorn Sculpin Non
Ogotoruk Creek	Net Plankton	Cs 137	Oliktok Point	Fourhorn Sculpin Oct
Ogotoruk Creek	Net Plankton	Sr 90	Oliktok Point	Fourhorn Sculpin Opddd
Ogotoruk Creek	Net Zooplankton	Cs 137	Oliktok Point	Fourhorn Sculpin Opdde
Ogotoruk Creek	Net Zooplankton	Sr 90	Oliktok Point	Fourhorn Sculpin Opddt
Ogotoruk Creek	North Pacific (Common) Murre	Cs 137	Oliktok Point	Fourhorn Sculpin Pb
Ogotoruk Creek	North Pacific (Common) Murre	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb101
Ogotoruk Creek	Old Squaw Duck	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb105
Ogotoruk Creek	Old Squaw Duck	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb11077
Ogotoruk Creek	Pintail Duck	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb118
Ogotoruk Creek	Pintail Duck	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb126
Ogotoruk Creek	Red-Throated Loon	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb128
Ogotoruk Creek	Red-Throated Loon	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb138
Ogotoruk Creek	Red-Throated Loon	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb153
Ogotoruk Creek	Tundra Vole	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb170
Ogotoruk Creek	Tundra Vole	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb18
Ogotoruk Creek	Wheatear	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb180
Ogotoruk Creek	Wheatear	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb187
Ogotoruk Creek	Wheatear	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb195
Ogotoruk Creek	Willow Ptarmigan	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb206
Ogotoruk Creek	Willow Ptarmigan	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb209
Ogotoruk Creek	Wolverine	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb28
Ogotoruk Creek	Wolverine	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb44
Ogotoruk Creek	Yellow Wagtail	Cs 137	Oliktok Point	Fourhorn Sculpin Pcb52
Ogotoruk Creek	Yellow Wagtail	Sr 90	Oliktok Point	Fourhorn Sculpin Pcb66
Oliktok Point	Fourhorn Sculpin Ag		Oliktok Point	Fourhorn Sculpin Pcb8
Oliktok Point	Fourhorn Sculpin Aldrin		Oliktok Point	Fourhorn Sculpin Pen
Oliktok Point	Fourhorn Sculpin Alphachl		Oliktok Point	Fourhorn Sculpin Ppddd
Oliktok Point	Fourhorn Sculpin As		Oliktok Point	Fourhorn Sculpin Ppdde
Oliktok Point	Fourhorn Sculpin Cd		Oliktok Point	Fourhorn Sculpin Ppddt
Oliktok Point	Fourhorn Sculpin Cr		Oliktok Point	Fourhorn Sculpin Se
Oliktok Point	Fourhorn Sculpin Cu		Oliktok Point	Fourhorn Sculpin Sn
Oliktok Point	Fourhorn Sculpin Di		Oliktok Point	Fourhorn Sculpin Tet
Oliktok Point	Fourhorn Sculpin Dieldrin		Oliktok Point	Fourhorn Sculpin Tnonchl
Oliktok Point	Fourhorn Sculpin Fe		Oliktok Point	Fourhorn Sculpin Tri

Oliktok Point	Fourhorn Sculpin	Zn	Point Hope	Beluga	P5Cbz
Point Hope	Bearded Seal	Cs 137	Point Hope	Beluga	Pb
Point Hope	Bearded Seal	Sr 90	Point Hope	Beluga	Pcb1
Point Hope	Beluga	1234Tcb	Point Hope	Beluga	Pcb101
Point Hope	Beluga	1245Tcb	Point Hope	Beluga	Pcb105
Point Hope	Beluga	2,4'-Ddd	Point Hope	Beluga	Pcb110
Point Hope	Beluga	2,4'-Dde	Point Hope	Beluga	Pcb114
Point Hope	Beluga	2,4'-Ddt	Point Hope	Beluga	Pcb118
Point Hope	Beluga	4,4'-Ddd	Point Hope	Beluga	Pcb128A
Point Hope	Beluga	4,4'-Dde	Point Hope	Beluga	Pcb130/176
Point Hope	Beluga	4,4'-Ddt	Point Hope	Beluga	Pcb131
Point Hope	Beluga	A-Hch	Point Hope	Beluga	Pcb132
Point Hope	Beluga	Ag	Point Hope	Beluga	Pcb134
Point Hope	Beluga	Al	Point Hope	Beluga	Pcb136
Point Hope	Beluga	As	Point Hope	Beluga	Pcb137
Point Hope	Beluga	Br	Point Hope	Beluga	Pcb138
Point Hope	Beluga	C	Point Hope	Beluga	Pcb141
Point Hope	Beluga	C1A	Point Hope	Beluga	Pcb144/135
Point Hope	Beluga	C2/U-5	Point Hope	Beluga	Pcb146
Point Hope	Beluga	C3	Point Hope	Beluga	Pcb149
Point Hope	Beluga	C5	Point Hope	Beluga	Pcb151
Point Hope	Beluga	Ca	Point Hope	Beluga	Pcb153
Point Hope	Beluga	Cd	Point Hope	Beluga	Pcb156
Point Hope	Beluga	Cis-Chlordane	Point Hope	Beluga	Pcb158
Point Hope	Beluga	Cis-Nonachlor	Point Hope	Beluga	Pcb16/32
Point Hope	Beluga	Cl	Point Hope	Beluga	Pcb17
Point Hope	Beluga	Co	Point Hope	Beluga	Pcb170
Point Hope	Beluga	Cr	Point Hope	Beluga	Pcb171
Point Hope	Beluga	Cs	Point Hope	Beluga	Pcb172/197
Point Hope	Beluga	Cu	Point Hope	Beluga	Pcb174
Point Hope	Beluga	Dieldrin	Point Hope	Beluga	Pcb175
Point Hope	Beluga	Fe	Point Hope	Beluga	Pcb177
Point Hope	Beluga	G-Hch	Point Hope	Beluga	Pcb178/129
Point Hope	Beluga	Hcbz	Point Hope	Beluga	Pcb179
Point Hope	Beluga	Heptachlor	Point Hope	Beluga	Pcb18
Point Hope	Beluga	Heptachlor-Epoxide	Point Hope	Beluga	Pcb180
Point Hope	Beluga	Hg	Point Hope	Beluga	Pcb183
Point Hope	Beluga	K	Point Hope	Beluga	Pcb185
Point Hope	Beluga	Mg	Point Hope	Beluga	Pcb187
Point Hope	Beluga	Mirex	Point Hope	Beluga	Pcb189
Point Hope	Beluga	Mn	Point Hope	Beluga	Pcb19
Point Hope	Beluga	Na	Point Hope	Beluga	Pcb191
Point Hope	Beluga	Ni	Point Hope	Beluga	Pcb193
Point Hope	Beluga	Ocstyr	Point Hope	Beluga	Pcb194
Point Hope	Beluga	Oxychlorodane	Point Hope	Beluga	Pcb195

Point Hope	Beluga	Pcb196/203	Point Hope	Beluga	S-Deca
Point Hope	Beluga	Pcb198	Point Hope	Beluga	S-Hch
Point Hope	Beluga	Pcb199	Point Hope	Beluga	S-Hepta
Point Hope	Beluga	Pcb200	Point Hope	Beluga	S-Hexa
Point Hope	Beluga	Pcb201/157	Point Hope	Beluga	S-Mon/Di
Point Hope	Beluga	Pcb205	Point Hope	Beluga	S-Nona
Point Hope	Beluga	Pcb206	Point Hope	Beluga	S-Octo
Point Hope	Beluga	Pcb207	Point Hope	Beluga	S-Pcb
Point Hope	Beluga	Pcb209	Point Hope	Beluga	S-Penta
Point Hope	Beluga	Pcb22	Point Hope	Beluga	S-Tetra
Point Hope	Beluga	Pcb24/27	Point Hope	Beluga	S-Tox
Point Hope	Beluga	Pcb25	Point Hope	Beluga	S-Toxsrf
Point Hope	Beluga	Pcb26	Point Hope	Beluga	S-Tri
Point Hope	Beluga	Pcb28	Point Hope	Beluga	Sb
Point Hope	Beluga	Pcb31	Point Hope	Beluga	Se
Point Hope	Beluga	Pcb33	Point Hope	Beluga	β-Hch
Point Hope	Beluga	Pcb4/10	Point Hope	Beluga	T.Srf-1
Point Hope	Beluga	Pcb40	Point Hope	Beluga	T.Srf-2
Point Hope	Beluga	Pcb41/71	Point Hope	Beluga	Trans-Chlordane
Point Hope	Beluga	Pcb42	Point Hope	Beluga	Trans-Nonachlor
Point Hope	Beluga	Pcb44	Point Hope	Beluga	U1
Point Hope	Beluga	Pcb45	Point Hope	Beluga	U3
Point Hope	Beluga	Pcb46	Point Hope	Beluga	V
Point Hope	Beluga	Pcb48	Point Hope	Beluga	Zn
Point Hope	Beluga	Pcb49	Point Hope	Beluga	Dieldrin
Point Hope	Beluga	Pcb52	Point Hope	Beluga Whale	S Pcb
Point Hope	Beluga	Pcb56/60	Point Hope	Beluga Whale	Cis-Chlord
Point Hope	Beluga	Pcb6	Point Hope	Beluga Whale	Dieldrin
Point Hope	Beluga	Pcb64	Point Hope	Beluga Whale	Hcb
Point Hope	Beluga	Pcb7	Point Hope	Beluga Whale	Hch
Point Hope	Beluga	Pcb70/78	Point Hope	Beluga Whale	Heptachlor
Point Hope	Beluga	Pcb74			Epoxide
Point Hope	Beluga	Pcb8/5	Point Hope	Beluga Whale	Lindane (G-Hch)
Point Hope	Beluga	Pcb83	Point Hope	Beluga Whale	Mirex
Point Hope	Beluga	Pcb84/89	Point Hope	Beluga Whale	P,P'-Ddd
Point Hope	Beluga	Pcb85	Point Hope	Beluga Whale	P,P'-Dde
Point Hope	Beluga	Pcb87	Point Hope	Beluga Whale	P,P'-Ddt
Point Hope	Beluga	Pcb91	Point Hope	Beluga Whale	S Cbz
Point Hope	Beluga	Pcb95/66	Point Hope	Beluga Whale	S Chlordane
Point Hope	Beluga	Pcb97	Point Hope	Beluga Whale	S Ddt
Point Hope	Beluga	Pcb99	Point Hope	Beluga Whale	S Toxaphene
Point Hope	Beluga	Rb	Point Hope	Beluga Whale	Spcb
Point Hope	Beluga	S-Cbz	Point Hope	Beluga Whale	T-Nonachlor
Point Hope	Beluga	S-Chlor	Point Hope	Bowhead Whale	Cs 137
Point Hope	Beluga	S-Ddt	Point Hope	Bowhead Whale	Sr 90
			Point Hope	Ringed Seal	Cs 137

Point Hope	Ringed Seal	Sr 90	Point Lay	Beluga	Pcb1
Point Lay	Beluga	1234Tcb	Point Lay	Beluga	Pcb101
Point Lay	Beluga	1245Tcb	Point Lay	Beluga	Pcb105
Point Lay	Beluga	2,4'-Ddd	Point Lay	Beluga	Pcb110
Point Lay	Beluga	2,4'-Dde	Point Lay	Beluga	Pcb114
Point Lay	Beluga	2,4'-Ddt	Point Lay	Beluga	Pcb118
Point Lay	Beluga	4,4'-Ddd	Point Lay	Beluga	Pcb128A
Point Lay	Beluga	4,4'-Dde	Point Lay	Beluga	Pcb130/176
Point Lay	Beluga	4,4'-Ddt	Point Lay	Beluga	Pcb131
Point Lay	Beluga	A-Hch	Point Lay	Beluga	Pcb132
Point Lay	Beluga	Ag	Point Lay	Beluga	Pcb134
Point Lay	Beluga	Al	Point Lay	Beluga	Pcb136
Point Lay	Beluga	As	Point Lay	Beluga	Pcb137
Point Lay	Beluga	Br	Point Lay	Beluga	Pcb138
Point Lay	Beluga	C	Point Lay	Beluga	Pcb141
Point Lay	Beluga	C1A	Point Lay	Beluga	Pcb144/135
Point Lay	Beluga	C2/U-5	Point Lay	Beluga	Pcb146
Point Lay	Beluga	C3	Point Lay	Beluga	Pcb149
Point Lay	Beluga	C5	Point Lay	Beluga	Pcb151
Point Lay	Beluga	Ca	Point Lay	Beluga	Pcb153
Point Lay	Beluga	Cd	Point Lay	Beluga	Pcb156
Point Lay	Beluga	Cis-Chlordane	Point Lay	Beluga	Pcb158
Point Lay	Beluga	Cis-Nonachlor	Point Lay	Beluga	Pcb16/32
Point Lay	Beluga	Cl	Point Lay	Beluga	Pcb17
Point Lay	Beluga	Co	Point Lay	Beluga	Pcb170
Point Lay	Beluga	Cr	Point Lay	Beluga	Pcb171
Point Lay	Beluga	Cs	Point Lay	Beluga	Pcb172/197
Point Lay	Beluga	Cu	Point Lay	Beluga	Pcb174
Point Lay	Beluga	Dieldrin	Point Lay	Beluga	Pcb175
Point Lay	Beluga	Fe	Point Lay	Beluga	Pcb177
Point Lay	Beluga	G-Hch	Point Lay	Beluga	Pcb178/129
Point Lay	Beluga	Hcbz	Point Lay	Beluga	Pcb179
Point Lay	Beluga	Heptachlor	Point Lay	Beluga	Pcb18
Point Lay	Beluga	Heptachlor-Epoxide	Point Lay	Beluga	Pcb180
Point Lay	Beluga	Hg	Point Lay	Beluga	Pcb183
Point Lay	Beluga	K	Point Lay	Beluga	Pcb185
Point Lay	Beluga	Mg	Point Lay	Beluga	Pcb187
Point Lay	Beluga	Mirex	Point Lay	Beluga	Pcb189
Point Lay	Beluga	Mn	Point Lay	Beluga	Pcb19
Point Lay	Beluga	Na	Point Lay	Beluga	Pcb191
Point Lay	Beluga	Ni	Point Lay	Beluga	Pcb193
Point Lay	Beluga	Ocstyr	Point Lay	Beluga	Pcb194
Point Lay	Beluga	Oxychlorodane	Point Lay	Beluga	Pcb195
Point Lay	Beluga	P5Czbz	Point Lay	Beluga	Pcb196/203
Point Lay	Beluga	Pb	Point Lay	Beluga	Pcb198

Point Lay	Beluga	Pcb199	Point Lay	Beluga	S-Hepta
Point Lay	Beluga	Pcb200	Point Lay	Beluga	S-Hexa
Point Lay	Beluga	Pcb201/157	Point Lay	Beluga	S-Mon/Di
Point Lay	Beluga	Pcb205	Point Lay	Beluga	S-Nona
Point Lay	Beluga	Pcb206	Point Lay	Beluga	S-Octo
Point Lay	Beluga	Pcb207	Point Lay	Beluga	S-Pcb
Point Lay	Beluga	Pcb209	Point Lay	Beluga	S-Penta
Point Lay	Beluga	Pcb22	Point Lay	Beluga	S-Tetra
Point Lay	Beluga	Pcb24/27	Point Lay	Beluga	S-Tox
Point Lay	Beluga	Pcb25	Point Lay	Beluga	S-Toxsrf
Point Lay	Beluga	Pcb26	Point Lay	Beluga	S-Tri
Point Lay	Beluga	Pcb28	Point Lay	Beluga	Sb
Point Lay	Beluga	Pcb31	Point Lay	Beluga	Se
Point Lay	Beluga	Pcb33	Point Lay	Beluga	β-Hch
Point Lay	Beluga	Pcb4/10	Point Lay	Beluga	T.Srf-1
Point Lay	Beluga	Pcb40	Point Lay	Beluga	T.Srf-2
Point Lay	Beluga	Pcb41/71	Point Lay	Beluga	Trans-Chlordane
Point Lay	Beluga	Pcb42	Point Lay	Beluga	Trans-Nonachlor
Point Lay	Beluga	Pcb44	Point Lay	Beluga	U1
Point Lay	Beluga	Pcb45	Point Lay	Beluga	U3
Point Lay	Beluga	Pcb46	Point Lay	Beluga	V
Point Lay	Beluga	Pcb48	Point Lay	Beluga	Zn
Point Lay	Beluga	Pcb49	Point Lay	Beluga Whale	S Pcb
Point Lay	Beluga	Pcb52	Point Lay	Beluga Whale	Cis-Chlord
Point Lay	Beluga	Pcb56/60	Point Lay	Beluga Whale	Dieldrin
Point Lay	Beluga	Pcb6	Point Lay	Beluga Whale	Hcb
Point Lay	Beluga	Pcb64	Point Lay	Beluga Whale	Hch
Point Lay	Beluga	Pcb7	Point Lay	Beluga Whale	Heptachlor Epoxide
Point Lay	Beluga	Pcb70/78	Point Lay	Beluga Whale	Lindane (G-Hch)
Point Lay	Beluga	Pcb74	Point Lay	Beluga Whale	P,P'-Ddd
Point Lay	Beluga	Pcb8/5	Point Lay	Beluga Whale	P,P'-Dde
Point Lay	Beluga	Pcb83	Point Lay	Beluga Whale	P,P'-Ddt
Point Lay	Beluga	Pcb84/89	Point Lay	Beluga Whale	S Ddt
Point Lay	Beluga	Pcb85	Point Lay	Beluga Whale	Spcb
Point Lay	Beluga	Pcb87	Point Lay	Beluga Whale	T-Nonachlor
Point Lay	Beluga	Pcb91	Port Moller	Flathead Sole	Ag
Point Lay	Beluga	Pcb95/66	Port Moller	Flathead Sole	Aldrin
Point Lay	Beluga	Pcb97	Port Moller	Flathead Sole	Alphachl
Point Lay	Beluga	Pcb99	Port Moller	Flathead Sole	As
Point Lay	Beluga	Rb	Port Moller	Flathead Sole	Cd
Point Lay	Beluga	S-Cbz	Port Moller	Flathead Sole	Cr
Point Lay	Beluga	S-Chlor	Port Moller	Flathead Sole	Cu
Point Lay	Beluga	S-Ddt	Port Moller	Flathead Sole	Di
Point Lay	Beluga	S-Deca	Port Moller	Flathead Sole	Dieldrin
Point Lay	Beluga	S-Hch	Port Moller	Flathead Sole	Fe

Port Moller	Flathead Sole	Hep	Port Moller	Flathead Sole	Zn
Port Moller	Flathead Sole	Heptachl	Port Valdez	Flathead Sole	Ag
Port Moller	Flathead Sole	Heptaepo	Port Valdez	Flathead Sole	Aldrin
Port Moller	Flathead Sole	Hex	Port Valdez	Flathead Sole	Alphachl
Port Moller	Flathead Sole	Hexachl	Port Valdez	Flathead Sole	As
Port Moller	Flathead Sole	Hg	Port Valdez	Flathead Sole	Cd
Port Moller	Flathead Sole	Lindane	Port Valdez	Flathead Sole	Cr
Port Moller	Flathead Sole	Mirex	Port Valdez	Flathead Sole	Cu
Port Moller	Flathead Sole	Mn	Port Valdez	Flathead Sole	Di
Port Moller	Flathead Sole	Ni	Port Valdez	Flathead Sole	Dieldrin
Port Moller	Flathead Sole	Non	Port Valdez	Flathead Sole	Fe
Port Moller	Flathead Sole	Oct	Port Valdez	Flathead Sole	Hep
Port Moller	Flathead Sole	Opddd	Port Valdez	Flathead Sole	Heptachl
Port Moller	Flathead Sole	Opdde	Port Valdez	Flathead Sole	Heptaepo
Port Moller	Flathead Sole	Opddt	Port Valdez	Flathead Sole	Hex
Port Moller	Flathead Sole	Pb	Port Valdez	Flathead Sole	Hexachl
Port Moller	Flathead Sole	Pcb101	Port Valdez	Flathead Sole	Hg
Port Moller	Flathead Sole	Pcb105	Port Valdez	Flathead Sole	Lindane
Port Moller	Flathead Sole	Pcb11077	Port Valdez	Flathead Sole	Mirex
Port Moller	Flathead Sole	Pcb118	Port Valdez	Flathead Sole	Mn
Port Moller	Flathead Sole	Pcb126	Port Valdez	Flathead Sole	Ni
Port Moller	Flathead Sole	Pcb128	Port Valdez	Flathead Sole	Non
Port Moller	Flathead Sole	Pcb138	Port Valdez	Flathead Sole	Oct
Port Moller	Flathead Sole	Pcb153	Port Valdez	Flathead Sole	Opddd
Port Moller	Flathead Sole	Pcb170	Port Valdez	Flathead Sole	Opdde
Port Moller	Flathead Sole	Pcb18	Port Valdez	Flathead Sole	Opddt
Port Moller	Flathead Sole	Pcb180	Port Valdez	Flathead Sole	Pb
Port Moller	Flathead Sole	Pcb187	Port Valdez	Flathead Sole	Pcb101
Port Moller	Flathead Sole	Pcb195	Port Valdez	Flathead Sole	Pcb105
Port Moller	Flathead Sole	Pcb206	Port Valdez	Flathead Sole	Pcb11077
Port Moller	Flathead Sole	Pcb209	Port Valdez	Flathead Sole	Pcb118
Port Moller	Flathead Sole	Pcb28	Port Valdez	Flathead Sole	Pcb126
Port Moller	Flathead Sole	Pcb44	Port Valdez	Flathead Sole	Pcb128
Port Moller	Flathead Sole	Pcb52	Port Valdez	Flathead Sole	Pcb138
Port Moller	Flathead Sole	Pcb66	Port Valdez	Flathead Sole	Pcb153
Port Moller	Flathead Sole	Pcb8	Port Valdez	Flathead Sole	Pcb170
Port Moller	Flathead Sole	Pen	Port Valdez	Flathead Sole	Pcb18
Port Moller	Flathead Sole	Ppddd	Port Valdez	Flathead Sole	Pcb180
Port Moller	Flathead Sole	Ppdde	Port Valdez	Flathead Sole	Pcb187
Port Moller	Flathead Sole	Ppddt	Port Valdez	Flathead Sole	Pcb195
Port Moller	Flathead Sole	Se	Port Valdez	Flathead Sole	Pcb206
Port Moller	Flathead Sole	Sn	Port Valdez	Flathead Sole	Pcb209
Port Moller	Flathead Sole	Tet	Port Valdez	Flathead Sole	Pcb28
Port Moller	Flathead Sole	Tnonchl	Port Valdez	Flathead Sole	Pcb44
Port Moller	Flathead Sole	Tri	Port Valdez	Flathead Sole	Pcb52

Port Valdez	Flathead Sole	Pcb66	Prudhoe Bay	Fourhorn Sculpin	Pcb153
Port Valdez	Flathead Sole	Pcb8	Prudhoe Bay	Fourhorn Sculpin	Pcb170
Port Valdez	Flathead Sole	Pen	Prudhoe Bay	Fourhorn Sculpin	Pcb18
Port Valdez	Flathead Sole	Ppddd	Prudhoe Bay	Fourhorn Sculpin	Pcb180
Port Valdez	Flathead Sole	Ppdde	Prudhoe Bay	Fourhorn Sculpin	Pcb187
Port Valdez	Flathead Sole	Ppddt	Prudhoe Bay	Fourhorn Sculpin	Pcb195
Port Valdez	Flathead Sole	Se	Prudhoe Bay	Fourhorn Sculpin	Pcb206
Port Valdez	Flathead Sole	Sn	Prudhoe Bay	Fourhorn Sculpin	Pcb209
Port Valdez	Flathead Sole	Tet	Prudhoe Bay	Fourhorn Sculpin	Pcb28
Port Valdez	Flathead Sole	Tnonchl	Prudhoe Bay	Fourhorn Sculpin	Pcb44
Port Valdez	Flathead Sole	Tri	Prudhoe Bay	Fourhorn Sculpin	Pcb52
Port Valdez	Flathead Sole	Zn	Prudhoe Bay	Fourhorn Sculpin	Pcb66
Prudhoe Bay	Fourhorn Sculpin	Ag	Prudhoe Bay	Fourhorn Sculpin	Pcb8
Prudhoe Bay	Fourhorn Sculpin	Aldrin	Prudhoe Bay	Fourhorn Sculpin	Pen
Prudhoe Bay	Fourhorn Sculpin	Alphachl	Prudhoe Bay	Fourhorn Sculpin	Ppddd
Prudhoe Bay	Fourhorn Sculpin	As	Prudhoe Bay	Fourhorn Sculpin	Ppdde
Prudhoe Bay	Fourhorn Sculpin	Cd	Prudhoe Bay	Fourhorn Sculpin	Ppddt
Prudhoe Bay	Fourhorn Sculpin	Cr	Prudhoe Bay	Fourhorn Sculpin	Se
Prudhoe Bay	Fourhorn Sculpin	Cu	Prudhoe Bay	Fourhorn Sculpin	Sn
Prudhoe Bay	Fourhorn Sculpin	Di	Prudhoe Bay	Fourhorn Sculpin	Tet
Prudhoe Bay	Fourhorn Sculpin	Dieldrin	Prudhoe Bay	Fourhorn Sculpin	Tnonchl
Prudhoe Bay	Fourhorn Sculpin	Fe	Prudhoe Bay	Fourhorn Sculpin	Tri
Prudhoe Bay	Fourhorn Sculpin	Hep	Prudhoe Bay	Fourhorn Sculpin	Zn
Prudhoe Bay	Fourhorn Sculpin	Heptachl	Red Dog Mine	Starry Flounder	Aldrin
Prudhoe Bay	Fourhorn Sculpin	Heptaepo	Red Dog Mine	Starry Flounder	Alphachl
Prudhoe Bay	Fourhorn Sculpin	Hex	Red Dog Mine	Starry Flounder	Di
Prudhoe Bay	Fourhorn Sculpin	Hexachl	Red Dog Mine	Starry Flounder	Dieldrin
Prudhoe Bay	Fourhorn Sculpin	Hg	Red Dog Mine	Starry Flounder	Hep
Prudhoe Bay	Fourhorn Sculpin	Lindane	Red Dog Mine	Starry Flounder	Heptachl
Prudhoe Bay	Fourhorn Sculpin	Mirex	Red Dog Mine	Starry Flounder	Heptaepo
Prudhoe Bay	Fourhorn Sculpin	Mn	Red Dog Mine	Starry Flounder	Hex
Prudhoe Bay	Fourhorn Sculpin	Ni	Red Dog Mine	Starry Flounder	Hexachl
Prudhoe Bay	Fourhorn Sculpin	Non	Red Dog Mine	Starry Flounder	Lindane
Prudhoe Bay	Fourhorn Sculpin	Oct	Red Dog Mine	Starry Flounder	Mirex
Prudhoe Bay	Fourhorn Sculpin	Opddd	Red Dog Mine	Starry Flounder	Non
Prudhoe Bay	Fourhorn Sculpin	Opdde	Red Dog Mine	Starry Flounder	Oct
Prudhoe Bay	Fourhorn Sculpin	Opddt	Red Dog Mine	Starry Flounder	Opddd
Prudhoe Bay	Fourhorn Sculpin	Pb	Red Dog Mine	Starry Flounder	Opdde
Prudhoe Bay	Fourhorn Sculpin	Pcb101	Red Dog Mine	Starry Flounder	Opddt
Prudhoe Bay	Fourhorn Sculpin	Pcb105	Red Dog Mine	Starry Flounder	Pcb101
Prudhoe Bay	Fourhorn Sculpin	Pcb11077	Red Dog Mine	Starry Flounder	Pcb105
Prudhoe Bay	Fourhorn Sculpin	Pcb118	Red Dog Mine	Starry Flounder	Pcb11077
Prudhoe Bay	Fourhorn Sculpin	Pcb126	Red Dog Mine	Starry Flounder	Pcb118
Prudhoe Bay	Fourhorn Sculpin	Pcb128	Red Dog Mine	Starry Flounder	Pcb126
Prudhoe Bay	Fourhorn Sculpin	Pcb138	Red Dog Mine	Starry Flounder	Pcb128

Red Dog Mine	Starry Flounder	Pcb138	Singoalik River	Whitefish	Cs 137
Red Dog Mine	Starry Flounder	Pcb153	Singoalik River	Whitefish	Sr 90
Red Dog Mine	Starry Flounder	Pcb170	Skagway River	Flathead Sole	Ag
Red Dog Mine	Starry Flounder	Pcb18	Skagway River	Flathead Sole	Aldrin
Red Dog Mine	Starry Flounder	Pcb180	Skagway River	Flathead Sole	Alphachl
Red Dog Mine	Starry Flounder	Pcb187	Skagway River	Flathead Sole	As
Red Dog Mine	Starry Flounder	Pcb195	Skagway River	Flathead Sole	Cd
Red Dog Mine	Starry Flounder	Pcb206	Skagway River	Flathead Sole	Cr
Red Dog Mine	Starry Flounder	Pcb209	Skagway River	Flathead Sole	Cu
Red Dog Mine	Starry Flounder	Pcb28	Skagway River	Flathead Sole	Di
Red Dog Mine	Starry Flounder	Pcb44	Skagway River	Flathead Sole	Dieldrin
Red Dog Mine	Starry Flounder	Pcb52	Skagway River	Flathead Sole	Fe
Red Dog Mine	Starry Flounder	Pcb66	Skagway River	Flathead Sole	Hep
Red Dog Mine	Starry Flounder	Pcb8	Skagway River	Flathead Sole	Heptachl
Red Dog Mine	Starry Flounder	Pen	Skagway River	Flathead Sole	Heptaepo
Red Dog Mine	Starry Flounder	Ppddd	Skagway River	Flathead Sole	Hex
Red Dog Mine	Starry Flounder	Ppdde	Skagway River	Flathead Sole	Hexachl
Red Dog Mine	Starry Flounder	Ppddt	Skagway River	Flathead Sole	Hg
Red Dog Mine	Starry Flounder	Tet	Skagway River	Flathead Sole	Lindane
Red Dog Mine	Starry Flounder	Tnonchl	Skagway River	Flathead Sole	Mirex
Red Dog Mine	Starry Flounder	Tri	Skagway River	Flathead Sole	Mn
Savoonga	Pacific Walrus	Dieldrin	Skagway River	Flathead Sole	Ni
Savoonga	Pacific Walrus	Oxychlorane	Skagway River	Flathead Sole	Non
Se Of Prudhoe Bay	Grayling	Dieldrin	Skagway River	Flathead Sole	Oct
Se Of Prudhoe Bay	Grayling	Hcb	Skagway River	Flathead Sole	Opddd
Se Of Prudhoe Bay	Grayling	Hept.Epoxide	Skagway River	Flathead Sole	Opdde
Se Of Prudhoe Bay	Grayling	P,P'Dde	Skagway River	Flathead Sole	Opddt
Se Of Prudhoe Bay	Grayling	S-Chlordane (Cis&Trans)	Skagway River	Flathead Sole	Pb
Se Of Prudhoe Bay	Grayling	Shch(Alpha, Gamma)	Skagway River	Flathead Sole	Pcb101
Se Of Prudhoe Bay	Grayling	Spcb*	Skagway River	Flathead Sole	Pcb105
Se Of Prudhoe Bay	Grayling	T-Nonachlor	Skagway River	Flathead Sole	Pcb11077
Se Of Prudhoe Bay	Lake Trout	Dieldrin	Skagway River	Flathead Sole	Pcb118
Se Of Prudhoe Bay	Lake Trout	Hcb	Skagway River	Flathead Sole	Pcb126
Se Of Prudhoe Bay	Lake Trout	Hept.Epoxide	Skagway River	Flathead Sole	Pcb128
Se Of Prudhoe Bay	Lake Trout	P,P'Dde	Skagway River	Flathead Sole	Pcb138
Se Of Prudhoe Bay	Lake Trout	S-Chlordane (Cis&Trans)	Skagway River	Flathead Sole	Pcb153
Se Of Prudhoe Bay	Lake Trout	Shch(Alpha, Gamma)	Skagway River	Flathead Sole	Pcb170
Se Of Prudhoe Bay	Lake Trout	Spcb*	Skagway River	Flathead Sole	Pcb18
Se Of Prudhoe Bay	Lake Trout	T-Nonachlor	Skagway River	Flathead Sole	Pcb180
Singoalik River	Dolly Varden	Cs 137	Skagway River	Flathead Sole	Pcb187
Singoalik River	Dolly Varden	Sr 90	Skagway River	Flathead Sole	Pcb195
Singoalik River	Pink Salmon	Cs 137	Skagway River	Flathead Sole	Pcb206
Singoalik River	Pink Salmon	Sr 90	Skagway River	Flathead Sole	Pcb209
Singoalik River	Pink Salmon	Cs 137	Skagway River	Flathead Sole	Pcb28
Singoalik River	Pink Salmon	Sr 90	Skagway River	Flathead Sole	Pcb44



Skagway River	Flathead Sole	Pcb52	St Paul	Fur Seal	Zn
Skagway River	Flathead Sole	Pcb66	St Paul	Northern Fur Seal	Cis-Chlord
Skagway River	Flathead Sole	Pcb8	St Paul	Northern Fur Seal	Dieldrin
Skagway River	Flathead Sole	Pen	St Paul	Northern Fur Seal	Hcb
Skagway River	Flathead Sole	Ppddd	St Paul	Northern Fur Seal	Heptachlor
Skagway River	Flathead Sole	Ppdde	St Paul	Northern Fur Seal	Epoxide
Skagway River	Flathead Sole	Ppddt	St Paul	Northern Fur Seal	Lindane (G-Hch)
Skagway River	Flathead Sole	Se	St Paul	Northern Fur Seal	P,P'-Ddd
Skagway River	Flathead Sole	Sn	St Paul	Northern Fur Seal	P,P'-Dde
Skagway River	Flathead Sole	Tet	St Paul	Northern Fur Seal	P,P'-Ddt
Skagway River	Flathead Sole	Tnonchl	St Paul	Northern Fur Seal	S-Chlordane
Skagway River	Flathead Sole	Tri	St Paul	Northern Fur Seal	S-Ddt
Skagway River	Flathead Sole	Zn	St Paul	Northern Fur Seal	Spcb
Soldotna	Rainbow Trout	A-Hcb	St Paul	Northern Fur Seal	T-Nonachlor
Soldotna	Rainbow Trout	Cis-Chlor	St Paul	Northern Fur Seal	Cs 137
Soldotna	Rainbow Trout	Ddd	St Paul	Northern Fur Seal	Sr 90
Soldotna	Rainbow Trout	Dde	St Paul	Northern Fur Seal	Dieldrin
Soldotna	Rainbow Trout	Ddt	St Paul	Northern Fur Seal	Oxychlordane
Soldotna	Rainbow Trout	Pcb1254	Utukok River	Grizzly Bear	Hg
Soldotna	Rainbow Trout	Pcb1260	Utukok River	Grizzly Bear	Se
Soldotna	Rainbow Trout	Toxaphene	Wales	Pacific Walrus	
Soldotna	Rainbow Trout	Trans-Nonachl	Wales	Pacific Walrus	
St Paul	Fur Seal	Ag	Yukon Crk.	Northern Pike	
St Paul	Fur Seal	Al	Yukon Crk.	Northern Pike	
St Paul	Fur Seal	As			
St Paul	Fur Seal	Br			
St Paul	Fur Seal	Ca			
St Paul	Fur Seal	Cd			
St Paul	Fur Seal	Cl			
St Paul	Fur Seal	Co			
St Paul	Fur Seal	Cr			
St Paul	Fur Seal	Cs			
St Paul	Fur Seal	Cu			
St Paul	Fur Seal	Fe			
St Paul	Fur Seal	Hg			
St Paul	Fur Seal	K			
St Paul	Fur Seal	Mg			
St Paul	Fur Seal	Mn			
St Paul	Fur Seal	Na			
St Paul	Fur Seal	Ni			
St Paul	Fur Seal	Pb			
St Paul	Fur Seal	Rb			
St Paul	Fur Seal	Sb			
St Paul	Fur Seal	Se			
St Paul	Fur Seal	V			

**Appendix E:  
Results of A Workshop on Uptake and Effects of  
Contaminants in Alaska Native Foods**

Funded by the Environmental Protection Agency, Region 10

Under a Grant to:

The Institute of Social and Economic Research  
University of Alaska Anchorage  
In Collaboration with  
The Alaska Native Science Commission

May 1999

The Environmental Protection Agency, Region 10, awarded a grant to the Institute of Social and Economic Research to study what is known about contaminants and subsistence foods in Alaska. The goals of the project are to help village tribal organizations, Native regional organizations, government agencies, and scientists to:

- Access existing information relevant to concerns about contaminants in subsistence foods;
- Achieve consensus on a process for setting research, monitoring, and clean-up priorities
- Communicate with each other to advance toward common goals

### ***Project Objectives***

We are addressing these three project goals by:

- ***Developing a database which contains information in seven categories:***
  1. Community concerns and priorities
  2. Harvest of subsistence foods
  3. Measured contaminants in subsistence resources
  4. Health effects of contaminants on animals and people
  5. Nutritional value of subsistence foods
  6. Cultural benefits of subsistence foods
  7. Grants and programs to address contaminant concerns
- ***Learning from the experience of the Canadian Northern Contaminants Program:***
  1. How tribal organizations are involved in setting priorities for contaminant research, obtaining samples, overseeing laboratory testing, interpreting testing results, enabling communities to decide how they will deal with the issue of whether subsistence foods are safe to eat.
  2. How scientists have interpreted the meaning of contaminant research results in Canada.
- ***Developing electronic links between village tribal organizations, Native regional organizations, government agencies, and scientists:***
  1. An interactive internet web site and internet email
  2. First Class, an electronic telecommunications system that provides email, document transfer and conferencing capabilities with villages that do not have high speed, reliable telephone connections.
- ***Collaborating with village tribal organizations to demonstrate communication linkages, provide university technical assistance to tribes, and learn about the concerns of tribes:***
  1. Collaborating with the Alaska Native Science Commission to ensure that the Alaska Native community is a full participant in contaminant research, communication and action priorities.
  2. Working with Kuigpagmiut, Inc. a consortium of four lower Yukon villages working under an EPA GAP grant (Mountain Village, Andreafsky, Pitka's Point, Marshall) to demonstrate a collaborative approach to environmental risk assessment.
  3. Working with the Council of Athabascan Tribal Governments (CATG), a consortium of 11 upper Yukon villages that is operating under several grants, including an EPA GAP grant and a NIEHS environmental justice grant. The villages include: Arctic Village, Venetie, Beaver, Birch Creek, Canyon, Chalkyitsik, Circle, Fort Yukon, Rampart, Stevens Village, and Venetie, again to demonstrate a collaborative approach.

4. Working with the Loudon Village tribal council in Galena to provide technical assistance and to incorporate six middle Yukon River villages in the FirstClass communications network (Galena, Kaltag, Nulato, Ruby, Huslia, and Koyukuk)
  5. Working with the Bristol Bay Native Association on incorporating concerns about subsistence foods in their environmental risk assessment.
  6. Contacting 226 village tribal councils as well as village health aides and village natural resource specialists to invite them to join a network
- ***Working with university, Native and government programs to develop a coordinated approach:***
    1. The Alaska Native Health Board Epidemiology program
    2. The North Slope Borough contaminants program
    3. The National Institute of Standards and Technology tissue archiving program
    4. The RuralCAP Subsistence and Natural Resources Department
    5. The Native American Fish and Wildlife Society
    6. The Alaska Department of Fish and Game
    7. The University of Alaska Fairbanks Institutes of Arctic Biology and Marine Science
    8. Greenpeace
    9. The University of Alaska Fairbanks Center for Global Change Research
    10. The Alaska Department of Environmental Conservation
    11. The University of Alaska Anchorage Telemedicine Project
    12. The US Fish and Wildlife Service
    13. The University of Alaska Environment and Natural Resources Institute
    14. The Alaska Intertribal Council
    15. Rural Systemic Initiative, AFN
    16. Americorps

### ***Purpose of this Report***

As part of the process of developing a consensus on research, monitoring, and clean-up priorities, we want to develop a summary of the state of knowledge about contaminant uptake and effects on animals and people in Alaska. This report represents a first step in producing such a summary. We intend to develop a summary of Alaska Native perspectives on contaminants and subsistence foods and a synthesis of these two important perspectives. We hope that the forthcoming synthesis will contribute to the goal of achieving a consensus on research, monitoring, and clean-up priorities for Alaska and a consensus on how to conduct such a program.

The report is the result of an unorthodox approach. On April 15<sup>th</sup> and 16<sup>th</sup> 1997 ISER and the Alaska Native Science Commission held a workshop with an invited panel of fourteen people who know about contaminant research in Alaska. We asked the panel to assess the applicability of some 200 findings made by the Canadian Arctic Environmental Strategies Northern Contaminants Program (AES/NCP).

The Canadian government initiated the NCP in 1991. Since that time the program has funded \$19.9 million in research. Participants in the program recently summarized their findings in a technical report, *Canadian Arctic Contaminants Assessment Report*<sup>3</sup>. We received permission from the lead authors of two chapters of the report (Chapter 3: Ecosystem Uptake and Chapter 4: Effects and Human Health) to use their findings as a stimulus for discussion by our Alaska panel. We should note that a subsequent report, *Highlights of the Canadian Arctic Contaminants*

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<sup>3</sup> Jensen, J., K. Adare, R. Shearer (eds). 1997. Canadian Arctic Contaminants Assessment Report. Department of Indian Affairs and Northern Development. Ottawa.

*Assessment Report: A Community Reference Manual*, is the best source of information about the findings of the Canadian program<sup>4</sup>. The people we invited and who participated (shown with an asterisk) included:

Paul Becker, National Institute of Standards and Technology\*  
 Jim Berner, MD  
 John Blake, Institute of Arctic Biology, UAF\*  
 John Booker, Institute of Circumpolar Health Studies, UAA  
 Terry Bowyer, Department of Biology and Wildlife, UAF\*  
 Michael Castellini, Institute of Marine Science  
 Patricia Cochran, Alaska Native Science Commission\*  
 Doug Dasher, Alaska Department of Environmental Conservation  
 Ted DeLaca, Office of Arctic Research, UAF\*  
 Larry Duffy, Department of Chemistry and Biochemistry, UAF\*  
 Sven Ebbesson, Institute of Marine Science, UAF  
 Grace Egland, Division of Public Health, State of Alaska\*  
 Tom Evans, US Fish and Wildlife Service, Marine Mammals Mgt.\*  
 Jim Fall, Alaska Department of Fish and Game, Subsistence Div.  
 Jesse Ford, Oregon State University\*  
 Rosyland Frazier, Institute of Social and Economic Research, UAA\*  
 Carl Hild, Rural Alaska Community Action Program\*  
 Sue Hills, Institute of Marine Science, UAF  
 Henry Huntington, Inuit Circumpolar Health Conference  
 Mary Killorin, Institute of Social and Economic Research, UAA\*  
 Kim Kloeker, US Fish and Wildlife Service  
 Jack Kruse, Institute of Social and Economic Research, UAA\*  
 Ann Lanier, MD Alaska Native Health Board\*  
 Rita Miraglia, Alaska Department of Fish and Game, Subsistence Div.  
 Lori, Division of Public Health, State of Alaska\*  
 Dan Mulcahy, US Geological Survey BRD  
 Thomas Nighswander, MD  
 Betsy Nobman, formerly of Public Health Service\*  
 Todd O'Hara, North Slope Borough  
 Scott Schliebe, US Fish and Wildlife Service  
 Joel Schmutz, US Geological Survey, BRD  
 Fran Stephan, US Environmental Protection Agency\*  
 Kimberly Trust, US Fish and Wildlife Service, WAES  
 Bob White, Institute of Arctic Biology, UAF\*

Prior to the workshop, we sent each panelist copies of the two chapters of the Canadian Northern Contaminants Program Assessment Report. At the time of the workshop, we distributed overheads and a tabular summary of the major points made in each chapter. We suggested a format for panelist assessments that used structured responses as shown in Table 1:

<b>Table 1: Response Categories Used in Assessing Status of Knowledge in Alaska Concerning Contaminant Uptake and Effects</b>	
<b>Response Category</b>	<b>Meaning of Response</b>
Finding confirmed with Alaska data	You know of Alaska data that leads you to

<sup>4</sup> Department of Indian and Northern Affairs Canada. 1997. Highlights of the Canadian Arctic Contaminants Assessment Report: A Community Reference Manual. Northern Contaminants Program. 83pp. Ottawa.

	the same conclusion.
Good bet	Given other priorities, it is worth assuming that the Canadian conclusion holds in Alaska.
Need data	The Canadian conclusion probably applies in Alaska, but we need data.
Don't know	We don't know. Another conclusion is just as likely.
Probably wrong	The Canadian conclusion probably doesn't apply in Alaska.
Screwed up	The summary presented in the workshop is not correct.
Ask someone else	This isn't my area of expertise.

The panel decided to follow the suggested format. We all recognized that our assessments of some 200 points made by the Canadian experts would exceed the time available in the workshops if we permitted ourselves to comment on each point. Such comments, however, are critically important to the development of an understanding of the Alaska situation. We provided a small amount of time for panelist comments.

We attempted to build a consensus finding for Alaska in revised wording of each point. That is, we took the panelists' responses into account in changing the wording of the Canadian findings. We used the bullet format of presentation to highlight each finding. Note that the row number on the spreadsheet in which the original Canadian finding appears is shown in parentheses.

### **Summary Points Contaminants of Concern**

Contaminants of concern in northern Canada include:

- Persistent organic pollutants, particularly organochlorines
- Heavy metals, particularly mercury and cadmium
- Radionuclides, particularly cesium 137, cesium 134, and potassium 40

More data is needed in Alaska in all three categories to conclude that each should be of concern. There is, however, some Alaska data on heavy metal contamination and persistent organic pollutants. It is probable that heavy metals are of concern in some areas (2). Other potential contaminants of concern include phthalate esters, plutonium, and brominated compounds.

***Importance of Subsistence Foods in Alaska***

- A substantial proportion, on the order of a third or more, of the meat and fish eaten by rural Alaska Natives comes from local harvests of fish and game. We do not have consumption data for most Alaska Native communities (10).
- The concept of "health" among Native people is holistic. Health is socially and culturally defined. It has spiritual dimensions. Alaska Natives have a strong traditional value of respect for the environment. They see degradation of the environment as a threat to health (227).
- Sharing of Native foods is a common practice in Alaska. Harvesting, sharing, processing, and consuming Native foods is an opportunity to practice and teach humility and spirituality (233).
- Imported sources of meat and fish are expensive and lower in protein, thiamin, riboflavin, niacin, and vitamin B12 than Native foods (257).
- If Alaska Natives were to stop eating Native foods, they would experience nutrition and

protein deficiencies. Native foods are as important to Native social well-being as they are to physical health (231,255, 259).

### ***Causes for Concern About Contaminants in Native Foods***

- Alaska Natives have observed changes in the health of some animals and fish. They worry that these changes may be due to contaminants. We need to ask Native experts to share these observations in order to see patterns of change (11).
- The diets of Alaska Natives are more likely to include predators which may concentrate contaminants (1). Alaska Native diets are also more likely to be higher in fats. These fats may contain higher concentrations of organochlorines.
- Slower growing plants such as lichen can result in higher contamination levels. (14)
- Contaminants reach the Arctic through long range atmospheric transport and exposure of migrating species exposed to non-local sources of contaminants (15).
- Local sites and the natural environment may be sources of contaminants (17).
- We need more data to understand the processes which move contaminants through the food chain. It is possible that accelerated processes during the spring may move contaminants through the food chain more quickly (18).

### ***Marine Mammals***

- Marine mammals including polar bear, ringed seals, beluga, and walrus probably have elevated levels of PCBs and toxaphene. There is some Alaska data to support this statement, but more is needed. We cannot assume that the trend of decreasing levels of PCBs from eastern to western Canada extends into Alaska, particularly in the Bering Sea. The higher eastern levels of PCBs may be due to a coupling of a regional cooling trend in eastern Canada with atmospheric PCBs from lower latitudes of North America (104).
- DDT and chlordane related contaminants may be important in polar bears and seals (104) DDT concentrations may be lower in the Bering Sea.
- We need data to confirm the Canadian finding that toxaphene predominates in the lower food web of marine organisms and does not become concentrated in polar bears to the same extent as PCBs or some chlordane components (105).
- Canadian results show a large variation in organochlorines in walrus. The presence of many different types of organochlorines in some walrus indicates that the source is not local (and hence specific types). The variation may be due to differences in diet. Walrus that eat seals may have higher levels. We need Alaska data to test this idea (111).
- It is likely that observed concentrations of PCB's in Baltic (Europe) ringed seals and in St. Lawrence estuary (Eastern Canada) beluga are 10 to 20 times higher than concentrations in Alaska ringed seal and beluga (118).
- Polar bears, ringed seals, and beluga are likely to have elevated levels of mercury, but we need data to understand how the sedimentary geology differs in different areas off Alaska's coast as compared with the Canadian Beaufort Sea (120).
- It appears that beluga eliminate mercury from their systems through molting. Canadians found that 20 percent of the total mercury and methylmercury in the skin was lost through molting (126).
- While cadmium concentrations in beluga increase from the western to eastern Canadian Arctic, we cannot assume that the trend extends across the Alaska Beaufort, Chukchi Seas, or into the Bering Sea and Gulf of Alaska. The mineral composition of sediments may differ from those in the western Canadian Arctic (122).
- We don't have the data to confirm the Canadian finding that cadmium levels in marine

mammal livers and kidneys are similar to concentrations in the livers and kidneys of caribou and moose (124). It is probably true that Cadmium concentrations are as high or higher than those of the same or similar species living in temperate waters, but again we need data (123).

- Geographic coverage of levels of persistent organochlorines and heavy metals in marine mammals is not good in Alaska (130). In contrast to the Canadians, we have not studied contaminant levels in most stocks or populations of beluga, ringed seals, walrus, and polar bears. (128)
- We have a poor understanding of how organochlorines and metals move within the marine food web (131).

### ***Caribou***

- We do not have the data necessary to conclude that an observed increase in cadmium levels in caribou kidneys from eastern to western Canada continues into Alaska. We therefore cannot say that the levels in Alaska are comparable to those in northern Quebec and Norway, which is the case in western Canada. The source of cadmium is probably natural and may be related to soil and winter forage (63,64,69).
- It is likely that cadmium levels in caribou kidneys in some Alaska herds are higher than the Canadian guideline of 30 micrograms per gram, but we don't have the data (65).
- Concentrations of Cesium 137 are probably 4-10 times lower than they were in the 1960s when they increased due to atmospheric testing. Levels of Cesium 134, which also increased due to atmospheric testing, are now very low (75).
- There is some confirmation of naturally occurring potassium 40, polonium 210 and lead 210 in caribou in Alaska. Levels of lead 210 may vary within herds as they do in Canada, but we don't have data to confirm this (78-82).
- We do not have data to know whether the trend of decreasing PCB levels in caribou from eastern to western Canada extends to Alaska (85).
- It is likely, but we need data to confirm, that PCDDs, PCDFs (polychlorinated dibenzodioxins and -furans) and nPCBs (non-ortho PCBs) are extremely low in all herds (86).
- We can't say, as the Canadians can, that TCDD toxic equivalent concentration (TEQ) levels observed in caribou are comparable to levels observed in domestic animals in Canada (87).
- Geographic coverage of contaminant measures in caribou in Alaska is incomplete (89)

### ***Freshwater Fish***

- In northern Canada, fish of primary concern due to their contribution to Native diets include: burbot, lake trout, arctic char, northern pike, and whitefish. We cannot assume that this species are of primary concern in Alaska; rather, all species consumed are of potential concern. Included also should be anadromous fish such including salmon. We also cannot assume that PCBs, toxaphene, and mercury are the primary contaminants of concern in freshwater fish (26-29).
- We don't know if mercury levels in freshwater fish are relatively high or low in Alaska. Higher mercury levels are probably the result of both natural environmental conditions and human activity. Increases in mercury concentrations in sediments in this century may indicate increased human sources (47-55). The correlation of selenium with mercury does not necessarily indicate that the source of mercury is natural.
- Toxaphene is the major organochlorine contaminant in all freshwater fish in northern Canada. We do not know if this is the case in Alaska (1). It may be true that high toxaphene levels are related to differences in food web structure (i.e. fish eating other fish that are also



predators) (31)

- Toxaphene concentrates in fish livers. Burbot with high levels of toxaphene in their livers may have concentrations in their flesh that are comparable to other fish (39).
- There is likely to be a wide variation of PCB's in freshwater fish by location and weight of the fish. In northern Canada, lakes with the highest concentrations of PCB's (e.g. Lake Labarge) have local sources of PCB's and DDT. We need data to know if this pattern is also true in Alaska (33,36).
- Canadian researchers have concluded that they can limit future measurements to non-ortho PCBs unless waste PCB oils or pentachlorophenol use is suspected. They have observed that CB126 accounts for most of the toxic equivalent concentrations in arctic fish. We cannot assume that these findings apply in Alaska (44,45).
- Polyaromatic Hydrocarbons (PAH's) are more likely to be detected in lower molecular weights (3- and 4-ring) than higher molecular weights, but we can't say that even the lower molecular weight hydrocarbons are present at low levels in all areas of Alaska (56-58).
- Geographic coverage of contaminants in freshwater fish in Alaska is poor (60).

### ***Waterfowl, Game Birds, and Small Mammals***

- We don't know how organochlorine levels vary in birds. We cannot say whether the Canadian observation of lower organochlorine levels in the western Arctic extends to Alaska (93).
- We don't know if the Canadian conclusion that there are low levels of heavy metals in birds applies in Alaska (lead not tested) (94).
- Geographic coverage of contaminants in birds in Alaska is poor (96).
- It is likely that mink production is extremely sensitive to PCB contaminants (98).
- We do not have the data to verify the Canadian observation that most organochlorine pesticides and PCB congeners are found at very low levels and that these levels decrease with increasing latitude. At these levels, the Canadians do not suspect any effect on reproduction (100).

### ***Sea Birds***

- We don't have data to confirm the Canadian observation of lower levels of organochlorines in Glaucous gulls in the western Arctic (134). Factors affecting organochlorine levels in the Bering Sea may be different, for example.
- Geographic coverage of levels of persistent organochlorines and metals in seabird populations in Alaska is poor (137).

### ***Marine Fish***

- There is very limited information on levels of organochlorines and aromatic hydrocarbons in marine fish stocks in Alaska waters (140).

### ***Local Sources of Contaminants***

- Military sites along Alaska's coast are likely to be local sources of PCBs and DDT contamination of the nearshore environment. While there is some Alaska data to support this conclusion, more data is needed (150).

### ***Temporal Trends***

- We need to confirm observed trends of declining concentrations of organochlorines in

marine mammals and sea birds from the 1970s to the 1980s and a leveling off of concentrations during the mid-1980s to the mid-1990s (153).

- It is likely that the observed decline in SDDT in peregrine falcons is greater than that in arctic sea birds, but we need data to confirm this Canadian finding (155).
- There is limited data on changes in organochlorines such as toxaphene, chlordane, and chlorobenzenes in marine biota. What Canadian data there is for the 1980s and 1990s suggests that there has been no significant decline in concentrations of these contaminants in marine mammals or sea birds. We do not have comparable temporal data for Alaska (157).
- We do not have Alaska data to confirm the Canadian finding that higher concentrations and rates of accumulation of mercury were found in ringed seals and beluga in more recent (1993-94) samples than in earlier collections (1981-83 in eastern Arctic, 1972-73 in the Western Arctic) (159). However, AMAP studies for Eastern Beaufort Sea Polar Bear support the Canadian findings.
- While it may be true that the eastern Canadian arctic finding that cadmium concentrations have showed no change over a 10 year period may apply in Alaska, we need data to confirm it (161).
- There is very limited temporal trend information on organochlorines and heavy metals in the terrestrial and freshwater environments of Alaska (164).
- At present, the temporal trend data are too limited to be able to predict future trends because they are based on two or at most three sampling times. By comparison, temporal trend data for contaminants in Lake Ontario lake trout and in various species from the Baltic and from lake Störinveid in northern Sweden are available yearly for a 15-20 year period (168).
- There is clearly a need for well-designed temporal trend studies (170).

### ***Biological Effects***

- The Canadian Northern Contaminants Program concluded that, with the possible exception of peregrine falcons, contaminant levels or biochemical indicators of effects have not been linked to effects on arctic animals at the individual or population level. The lack of research of this type in Alaska makes it impossible to conclude whether or not there have been effects of contaminants on arctic animals. Local observations of possible effects of contaminants on the environment are needed (173).
- As is usually the case with arctic animals, the lack of experimental dosage/response data continues to limit the ability to interpret concentrations observed in animals (176).
- Canadian researchers have not observed the presence of effects related to toxaphene exposure on fish and ringed seals. We need data to confirm this finding in Alaska (175).
- We lack the data to confirm the Canadian conclusion that Arctic animals have relatively high body burdens of heavy metals and radionuclides compared to similar or related species in temperate regions. We also cannot conclude that Arctic animals may be adapted to relatively high exposure because of the importance of natural sources of these contaminants (178).
- We concur with Canadian researchers that the potential effects of high doses of metals such as cadmium on caribou and beluga are not clear (180).
- It may or may not be true that the polar bear is the species with the most significant risk of exposure to PCBs and organochlorine pesticides (182).
- It is likely that Arctic animals with relatively low levels of contaminants may be vulnerable to the biological effects of these contaminants if they have to draw on lipid deposits during fasting or starvation (184).
- It is likely that organochlorine contaminant levels in arctic beluga are 10 to 20 fold lower than in St. Lawrence Estuary (Eastern Canada) beluga. In the case of St. Lawrence beluga,

there is preliminary evidence of a link to immune system dysfunction due to high PCB exposure (185).

- We lack the data to confirm the Canadian observation that concentrations of TCDD TEQs in arctic ringed seal and beluga blubber are 3 to 5 times lower than those associated with impaired immune function in harbor seals (187).
- It may be true, but we also lack data to confirm that concentrations of PCBs in blubber lipids of ringed seals are 10 to 20 fold lower than concentrations associated with poor reproductive success in captive harbor seals (188).
- It is likely true that marine mammal females and their offspring may be most vulnerable during mobilization of fats containing contaminants because this mobilization occurs at a crucial point in the growth and development of the young. Overall, the MFO enzyme data in Canada for polar bear and beluga suggest that even the relatively low levels of contaminants present in the arctic animals may have biological effects, especially during years of poor feeding (190).
- Carnivores such as polar bear may be at risk due to consumption of ringed seal tissues, but we need data to support or refute this Canadian finding (193).
- As a result of the Canadian Northern Contaminants Program, the list of priority substances monitored in northern Canada over the past five years is relatively long (including PCB congeners, isomers of HCH, numerous components of technical chlordane and DDT and 25 metals in many samples). We do not have a comparable data set for Alaska. Even in Canada, there are still a number of chemical contaminant groups for which information is quite limited or nonexistent. These groups include PCDD/Fs and non-ortho PCBs, chlorinated naphthalenes, chlorinated diphenyl ethers or their brominated analogs (all of which are cytochrome P4501A1 enzyme inducers) (196).
- As in Canada, there are no data in Alaska on toxaphene in terrestrial animals and in waterfowl and seabirds, despite that fact the likelihood that toxaphene may be a major organochlorine contaminant in arctic air, seawater, fishes and marine mammals (198).
- Current methods of quantifying toxaphene may overestimate levels in some species such as marine mammals (199).
- Current use pesticides, a diverse group of less persistent organics, have not been monitored, although recent work indicates that they are likely present in arctic air and snow and terrestrial plants (201).

### ***Gaps in Spatial and Temporal Data***

- In Alaska, there are large spatial and temporal gaps in contaminant data. In contrast, geographic coverage on most contaminants in northern Canada is good (208).
- The complete lack of data over time in Alaska is a major problem. Even where there are measures of contaminants over time, however, changes in methods make it difficult to compare recent and older data (208).
- Canadian concern with increasing levels of mercury in beluga and ringed seal may be warranted in Alaska as well. It is not clear whether the observed increase is due to human sources, which have been shown to be increasing slowly all this century in dated sediment cores, or is due to some other environment change which is mobilizing mercury (210).
- While studies show that the PCB contamination of terrestrial plants, soils and nearshore sediments and biota in Canada due to pollution from military radar facilities is localized when considered on a broad regional scale, there is a need to confirm these findings in Alaska. There is also a need to determine whether marine mammals frequenting the waters within the general area of these sites as well as terrestrial animals, such as caribou and arctic fox feeding with the impacted zones, have elevated PCB and lead contamination (212).

- It is likely true that individual and community variations in methods of preparing muktuk affect the fat content of this food. These variations should be taken into account in assessments of exposure to organochlorines (214).
- There are few studies of biological effects indicators with arctic animals. There is particularly a need to study biological effects on immunosuppression in mammals at high trophic levels (216).
- More work is needed to confirm observed correlations of non-ortho and mono-ortho PCB concentrations with CYP1A1 activity in polar bear and beluga livers. There is also a need to combine MFO measurements with other biochemical indicators of effects of PCBs such as retinol levels (218).
- Given that some of the persistent organochlorines such as o,p'-DDE, p,p'-DDE and -DDT have estrogen activity, information is needed on steroid and thyroid hormone levels in polar bears and beluga (219).
- There are likely high levels of mercury and cadmium in sea birds and marine mammals as observed in Canada. The biological implications for the animals themselves is, however, unknown. Given that the levels of cadmium, for example, are among the highest ever reported in marine mammal tissues, further efforts are needed to examine possible physiological effects (221).

### **Human Health**

- Native foods are widely consumed within communities. Marine mammals, large ungulates, and fish account for a large proportion of Native foods consumed. Consequently, potential exposure of Alaska Natives to contaminants in Native foods is widespread in Alaska (240)
- Increases in consumption of imported foods by Alaska Natives has been associated with decreased physical activity, obesity, dental caries, anemia, lowered resistance to infection, heart disease, and diabetes (238).
- Dietary survey data in Alaska is limited to 12 communities. While there are data on harvests for many Alaska Native communities, these data do not contain information on variations in consumption patterns among individuals (e.g consumption of organs, frequency of consumption, method of preparation) (241).
- Consumption of Native foods varies by season and by year. Dietary surveys which measure consumption for 2 or 3 24 hour periods may not reliably estimate consumption of Native foods (244).
- Consumption of Native foods varies by region, income, access to urban centers, and by factors such as age and gender (246).
- Dietary lipids are a concentrated source of energy, act as carriers of fat-soluble vitamins, and are a source of essential fatty acids (polyunsaturated fatty acids that are essential to health but cannot be synthesized by the human body). Fish and marine mammals which form a significant portion of the diet of Alaska Natives contain many n-3 polyunsaturated fatty acids which are not easily found in imported foods. Omega-3 fatty acids are found at high levels in fish and marine mammal tissues and have been associated with a decreased incidence of thrombotic and ischaemic disease (253).
- If consumption of traditional food resources - particularly fish and wildlife- were discontinued, the mineral nutrition of most Arctic populations would be compromised to such an extent that nutritional deficiencies could occur (255).
- Thiamin, riboflavin and niacin intake in the North are reasonably adequate due to the major contributions of these vitamins from traditional meats. Fish and game contribute substantial amounts of vitamin B12 and pantothenic acid. Total intakes of these vitamins are likely higher than in the general US population. Some reports indicate that vitamin A, calcium, and vitamin

C may be below recommended intakes (257).

- In Arctic communities, a significant portion of the protein requirements are fulfilled by traditional foods such that limiting the supply of traditionally harvested meats and fish would drastically reduce protein intake (259).
- We do not know if levels of DDT in human tissue in Alaska are, as in the Canadian Arctic, higher than that of southern Canadians and Americans (262).
- We do not know if DDE is higher in the human milk of Alaska Native groups as it is among Inuit in northern Canada (263).
- We do not know if levels of PCBs in the breast milk of at least some Alaska Native groups is higher than that of non-Natives living in southern Canada or the lower-48 states (270).
- A higher incidence of infectious diseases and ear infections among Alaska Native infants may be due to a complicated set of factors. It is unknown whether perinatal exposure to PCBs is one of these factors, nor is the extent of exposure known (271).
- Canadian Inuit show a higher exposure to dioxin-like PCBs than southern Canadians. Factoring this in increases difference in the toxic equivalent burden in the two populations. This type of comparison has not been made in Alaska (273).
- We don't know enough to conclude that there is a relationship between PCDD/PCDF/coplanar PCB exposure and immunologic and neurodevelopmental alterations associated with breast feeding (275).
- We don't have data to compare levels of chlordane in the milk of Alaska Native mothers and mothers in the lower 48 (279). Canadian Inuit mothers had chlordane levels 10 times higher than southern Canadian mothers.
- We don't have data to compare HCB levels in Alaska Native mothers' and lower 48 mothers' milk. Canadian Inuit mothers' milk has HCB levels five to nine times higher than levels seen in southern Canadian mothers' milk (283).
- Although there are Alaska Native cord blood samples to measure contaminant concentrations, they have not been analyzed (287).
- Although a major source of human exposure to cadmium is smoking, some individuals who frequently eat kidneys of caribou and marine mammals (e.g. once a week year round) may ingest significant amount of cadmium (296). However, only a small percentage of cadmium (about 5 percent) is absorbed through ingestion compared with direct absorption through smoking.
- Smoking may make the kidneys less effective in handling cadmium exposures from frequent consumption of organs, particularly among the elderly and diabetics (299) More study is needed to accept this theory.
- Methylmercury is a potent neurotoxin and the most toxic form of mercury in the environment. Human exposure in the Arctic is almost exclusively through food consumption, especially fish and marine mammals (301).
- We do not have data to confirm the Canadian findings that there is a recent decline in mercury levels in the blood of Inuit and Dene newborns in the NWT (304).
- The amount of radionuclides in the Arctic environment is generally about the same as, or lower than, levels found in the temperate zone (307).
- The greatest exposures to radionuclides occurred in the 1950s and 1960s (e.g. strontium 90). The long term effects of Strontium 90 in bone perhaps interacting with exposures to organochlorines is not known. Of all radionuclides, lead-210 and polonium-210, which are natural in origin, may make the greatest contribution to current human radiation doses in the Arctic. However, the greatest exposures to radionuclides may come from improperly used or maintained radiological equipment. Both lead-210 and polonium-210 occur in nature as airborne particles and tend to settle out on vegetation (i.e. lichens) thereby entering the

terrestrial food chain (lichens-caribou-humans) (308). We should also consider polonium-210 levels in fish.

- Residents in Arctic communities may be receiving up to 10 mSv of <sup>210</sup>Po per year through dietary sources compared with normal background doses of about 2 mSv. This has likely been occurring in the Arctic for several thousand years. The effects of exposure may be increased by smoking. (311)
- Of the anthropogenic radionuclides, the two main isotopes of radiocesium (cesium-137 and cesium-134) are considered to be of greatest concern in Arctic environment. Levels of radiocesium in Arctic residents have declined from about 450 Bq/kg in 1965 to roughly 10 Bq/kg in 1990. The effects of exposures to Strontium 90 in the 1950s and 60s, however, may be important, but we don't know (312).
- Feather moss (*Hylocomium splendens*), and lichens can be used to monitor atmospheric deposition of radionuclides and heavy metals. They can help to distinguish between atmospheric sources of these pollutants and rivers.

### **Risk Management**

- Risk determination for contaminants in Native food involves a consideration of the type and amount of food consumed and the sociocultural, nutritional, economic, and spiritual benefits associated with Native foods (315)
- Risk management decisions must involve the community and must take all aspects into account to arrive at an option that will be the most protective and least detrimental to the community (316).
- Regardless of the decision taken, some health risks associated with exposure to contaminants may remain. In the Arctic, these risks and benefits often pose a large and confusing public, moral and political dilemma (318)
- Risk management is an evolving process subject to change as new information about the situation is learned and assessed. The approach must be continually modified to suit each situation and each community and the advice monitored to ensure it is providing the best possible health outcome (319).
- In Alaska Native communities, advising against Native food consumption is also to advise against hunting and fishing. To the extent that aboriginal identity and the collective sense of well-being is based on subsistence as a social system and as an activity, as well as a dietary staple, then loss of confidence in Native food undermines confidence in identity and society (321)
- If not released with proper communication and consultation, advisories related to Native food can also result in individual estimations of risk that are often based on untested assumptions and are frequently wrong, leading to harmful and undesirable social and economic results (323)
- While Alaska Natives are unlikely to abandon their harvests of Native foods, the lack of proper communication and consultation can seriously compromise the contribution of harvests to Native well-being and the integrity of the community. Hunters may stop sharing harvests, for example, if they fear that they will make other people sick. (324)
- As such, risk management decisions must be carefully considered and must be implemented in ways that minimize the extent to which nutritional and sociocultural aspects of Aboriginal societies are compromised (326)
- Regardless of the difficulties in the processes of risk assessment and risk management and the different views on their adequacy, we must be guided by one objective. Risk assessment and management decisions are undertaken to serve public health. They must be

our "best estimate" and seen in the context on which they were created - an imperfect and ever-changing data base (327)

### ***Perceptions of Risk***

- Perception of risk in the Alaska, as in many communities, differs between the public experts. A lack of straightforward and credible information about toxicity and safe levels leads to unnecessary anxiety. This anxiety in turn can disrupt Native food harvest and consumption. The goal should be to provide clear information that will minimize unnecessary anxiety and alert people to real problems where they exist (330).
- Transfer of accurate and complete information via good communication plans may help limit the social and cultural effects resulting from the presence of contaminants in traditional food. If this does not occur, people will be forced to draw their own conclusions and will act accordingly based on their perceptions of the situation (333)
- In Arctic communities, communication is most effective when it is interpersonal and face-to-face. It should be a two-way flow of information where the opportunity for feedback is maximized (334)
- Communication should occur from the onset of a study and should be an ongoing process through to the reporting of findings and the development of remedial options. The best studies and the best solutions to local contaminant problems are developed with and by the community (336)

### ***Risk Determination Conclusions***

- There are many recognized advantages of nursing for both infants and for mothers, including improved nutrition, increased resistance to infection, protection against allergy, better parent-child relationships, and possibly a degree of protection of the mother against breast cancer. In the Arctic, alternatives to breast-feeding, such as infant formula, can be difficult to obtain (due to availability and affordability) and can pose difficulties with respect to the maintenance of hygiene in cases where the water supply is compromised (339)
- We do not have the data necessary to assess the Canadian conclusion that the organochlorines of primary health concern at this time for Alaska Natives consuming marine mammals as a major component of their diet are chlordane, toxaphene, and PCBs. In Canada, exposures in the eastern region are higher than in the western region (341)
- Canadians concluded that Dene/Metis, exposure to OCs is in general below a level of concern. However levels of chlordane and toxaphene exposure are elevated in some individuals and are a cause for concern if individual exposures are elevated on a regular basis. We lack the necessary data in Alaska to assess this conclusion with regard to Alaska Natives who do not consume marine mammals as a major component of their diet (342).
- The developing fetus and breast fed infant are likely to be more sensitive to the effects of OCs than adults and are the age group at greatest risk in the Arctic. Fetus/infant intakes of dioxins and furans, PCBs, toxaphene and HCB through human cord blood/milk are of primary concern even though the toxic effects that might occur are uncertain. In consideration of this uncertainty, the extensive knowledge of the benefits of breast-feeding are a strong rationale for Alaska Native women eating substantial quantities of marine mammals to continue to breast feed unless told otherwise by their health care provider. However, this advice should be decision of Alaska Native communities made in the context of a collaborative program of research and assessment (344)
- Risk management decisions must continue to be developed in cooperation with communities to reduce exposures and to sustain traditional ways (348)
- Current levels of lead in the Arctic do not pose a significant threat to health and, based on

declining emissions of lead globally, are not likely to pose a threat to health. When there is a potential source of lead contamination, however, cord blood and infant blood monitoring should occur to ensure local or regional lead levels are not increasing. (350).

- Cadmium intakes by non-smokers in the Alaska are likely to be low and similar to intakes reported in southern Canada (353).
- Smokers are likely to have 20 to 30 times higher mean blood levels of cadmium than non-smokers. These intake levels exceed the current WHO TDI value several-fold and are not related to consumption of Native food (355).
- We do not have adult blood mercury measurements to assess the risk of mercury exposure (25). Canadian results show that some Native populations are in the 5 percent risk range for neonatal neurological damage. Umbilical cord blood level measurements could be used to screen for exposures (357).
- It is likely that Alaska Native consumers of Native foods are exposed to an approximately seven-fold higher radiation dose than non-consumers of traditional food. More than 95% of this increased radiation dose is due to the bioaccumulation of natural radionuclides in the food chain (363)
- This increased radiation dose gives consumers of Native foods a cancer risk that is approximately 10% higher than that compared with consumers of a southern diet. In Canada, this increased risk is in fact not seen in NWT Inuit cancer statistics where Inuit have a significantly lower rate of all cancers, with the exception of lung cancer, than the Canadian population. In Alaska, there is a higher incidence of some cancers (e.g. stomach cancer), but this may be unrelated (365).



## Appendix F

### Nome Regional Meeting Participant "Homework" Assignment

Thank you for planning to come to the Nome Regional Meeting of the Traditional Knowledge and Radionuclides Project. We hope that this memo will help you to prepare for the meeting.

The principal goal of the Traditional Knowledge and Radionuclides project is to help Alaska Tribes to identify and address their concerns about radionuclides and other types of contamination. The purpose of the Nome Regional Meeting is to learn from you what environmental changes are of concern to you and why.

By environmental changes, we mean changes in the:

- Health or numbers of animals, plants, and fish
- Health of people
- Sources of radionuclides and other contaminants
- Sea ice, currents, or weather

For each of these environmental changes, we would like to learn:

- How you came to be concerned
- Why you think the change may be happening
- What you think should be done about the change

We are looking to you as an interpreter of your experience, the experience of other people you know, especially community elders and active hunters. Your "homework" assignment, then, is to talk with others and come to the Nome Regional Meeting prepared to share:

- What animals, plants, fish, sources of contaminants, and aspects of people's health are of concern.
- Why the health or numbers of these animals, plants or fish may be declining.
- Why people's health may be declining.
- Why sources of contaminants may increase.
- Who may be able to share more knowledge than you might have about a particular concern.

**Appendix G: Summary Slides Used to Introduce Regional Meeting**







## **Appendix H: Northwest Arctic Regional Meeting Concerns**







## **Appendix I: Southeast Regional Meeting Concerns**







## **Appendix J: Interior Regional Meeting Concerns**









