Exposure Investigation Protocol

Potential Contamination of Reindeer on St. Lawrence Island

Savoonga, St. Lawrence Island, AK

Cost Recovery Number–0#AK

October 29, 1999

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia

200-1e

Rationale for the Exposure Investigation

The Alaska Native community in Savoonga, St. Lawrence Island, have expressed many health concerns to ATSDR related to a formerly used defense site, NE Cape site, also located on the island. That site was used by the military for activities during and after World War II. Clean-up of the site is planned by the Army Corps of Engineers in the near future. However, past storage of materials on the site have resulted in ongoing contamination to the environment. This area has traditionally been used by the Alaska Natives for harvesting, hunting and fishing. Summer fishing villages are still located near the site. Contaminants, such as PCBs and fuel-related semi-volatiles have been detected in environmental media in the area. These persistent organic pollutants (POPs) have been detected in marine life around the Bering Sea (location of the island). Plants in the area are consumed by the native population and by the free-ranging reindeer, which are also a food supply for this population that depends on a subsistence diet. Therefore, there is likelihood for the POPs to be present in the food chain and for the natives to be exposed by consumption of the plants and the reindeer, in addition to other dietary supplies. ATSDR needs further data to evaluate this pathway. To adequately assess the food chain pathway, ATSDR is looking for sampling results on various biota; the sampling being considered during the 1999 reindeer roundup will assist our response to the heath concerns from the Savoonga community.

Objectives of the Exposure Investigation

Objective: To provide additional information to the Savoonga community on contaminants in reindeer not currently being assessed. This will be done by combining our investigation with the currently existing University of Alaska, Fairbanks Reindeer Research Program.

Background

The Reindeer Research Program

Reindeer herding represents the backbone of several village economies in northwestern Alaska, and along with hunting, fishing and gathering constitute activities that closely links the local people to the land and its natural resources. The concern recently expressed by the local people that contaminants are being introduced into the food chain and compromising their health (Alaska Native Science Commission 1998) is of utmost concern to state agencies and institutions.

Preliminary data gathered by the Reindeer Research Program suggests potential contamination of forage plants by heavy metals. Since reindeer and caribou range over the entire Seward Peninsula, their chemical signatures may serve as a powerful tool to conduct a contaminant survey of an upper trophic level over a large landscape.

The Reindeer Research Program takes an active role in developing and promoting the reindeer industry in Alaska. The program was established in 1981. Current research programs include looking at heavy metal levels in reindeer, caribou, and plants of the Seward Peninsula. The Seward Peninsula has been extensively mined for the last 100 years. The mining of cadmium- and lead-bearing ores and the widespread use of these two elements for industrial purposes have significantly increased environmental contamination over the last 50-100 years (Adriano, 1986). These elements are readily absorbed by plants that are in turn eaten by ungulates, concentrating in liver, kidney, and muscle tissue (Gamburg and Scheuhammer, 1994). In some cases health officials have recommended against their consumption (Brazil and Ferguson, 1989).

Radionuclides, which accumulate in lichens because of their absorption with nutrients from precipitation and air, are the primary source of radioactive contamination in caribou and reindeer (Forberg et al., 1992). Elevated levels of radionuclides, such as Cs^{137}, have been observed in several circumpolar caribou herds (Hanson 1982, Skogland 1987, Allaye-Chan, et al., 1988). Presently, contamination from weapons testing, accidental pollution, or illegal dumping may have found its way to the lichens of Northwestern Alaska and accumulated in reindeer and caribou tissue.

The Reindeer Research Program, during an ongoing study of the trace mineral distributions in reindeer forage plants on the Seward Peninsula, detected high levels of cadmium and lead in several species. If similar concentrations were to be found in meat, consumption of 40-60 g of meat per week would exceed the recommended intake rate (World Health Organization 1989). These preliminary findings were obtained from sampling a wide geographic area and indicate that there may be identifiable point sources of contamination. Locating these contaminated sites is essential for proper management of the reindeer herds. Reindeer herders, by moving their reindeer from contaminated sites, will minimize the accumulation of toxic metals in an important commercial and personal-use food source. If human health thresholds of radiocesium are discovered in reindeer tissues, several mitigating procedures are available to reindeer herders (Hove et al., 1988, Ahman et al., 1988, Mathieson et al., 1988).

Project Objectives of the Program:

1) Attend reindeer slaughters and village hunting expeditions on the Seward Peninsula to collect soft (kidney, liver, and muscle) and hard tissue (antlers) samples from reindeer and caribou.
2) Analyze the consumable tissue of reindeer and caribou for possible contamination by cesium and heavy metals.
3) Establish relationships between concentrations of cesium and heavy metals in consumable soft tissue to that of inert antler.
4) Present findings to the Reindeer Herders Association and village corporations.
5) Collaborate with the Reindeer Herders Association and village corporations to adopt strategies to mitigate the occurrence of contaminated meat in diets of the local people (e.g., herd relocation, chemical binders, supplemental feeding).

Reindeer Facts

Reindeer (Rangifer tarandus) are semi-domesticated caribou. Although similar, there are fundamental differences in the behavior of reindeer and their wild cousins, caribou. Reindeer have been present in Eurasia for thousands of years. It is believed they have been domesticated there for at least 7000 years, which is longer than the horse (Edwards, 1994). In Eurasia reindeer are classified as either domesticated or wild, while in North America they are called reindeer if they are of the Eurasian domesticated variety, or caribou if they are of the wild variety. This domesticated factor makes them different from caribou in that they need to be tended on the range to keep them safe from predators, and may need to be driven to a better grazing area if theirs becomes sparse. They tend to be smaller than caribou, with shorter legs, and are a lighter color. They may have a life expectancy of 10-15 years, but mortality factors including disease and predation, not to mention unpredictable weather may cause them to die prematurely.

Reindeer eat lichen in winter and spring, and grass, birch and willow leaves, mushrooms, and occasionally small mammals and eggs during the summer. They will always try to go to where the new greens are, which may be contrary to the direction the herder wants the herd to go.

The main purpose of herding reindeer is economics. Reindeer, like cattle, are a protein source. They also provide velvet antler and hides to consumers. Natives prefer to eat reindeer or caribou meat over the traditional meats of our culture such as beef, pork and chicken. Reindeer meat is high in protein (22%) and low in fat (3.5%), compared to 19.2% protein and 9.5% fat for lean beef (Swanson et al., 1990).

Weight

Seward Peninsula, Alaska

Birth-	Females- 6.64 Kg	14.61 lbs.	
	Males- 6.95 Kg	15.29 lbs	(Chetkiewicz, 1993)
Calves-	Female June Weight-	25.5 Kg	56.1 lbs.
	Male June Weight-	27.5 Kg	60.5 lbs.
	Female January Weight-	55.9 Kg	123.0 lbs.
	Male January Weight-	60.2 Kg	132.4 lbs.
Adults-	Female Average June Weight-	73.8 Kg	162.36 lbs.
	Female Average January Weight-	85.4 Kg	187.88 lbs.
	Male Average June Weight-	99.6 Kg	219.12 lbs.
	Male Average January Weight-	92.3 Kg	203.06 lbs.

Height

Captive Reindeer(Alaska)

Shoulder Height	Calves- 28.5 in.
	Yearlings- 37 in.

Adult Females- 38.5 in.
Adult Males- 43 in.

Length (Shoulder to Rump) Calves- 27.5 in.
Adult Females- 38 in.
Adult Males- 46 in.

Causes of Calf Mortality

Based on 89 calves observed April through November 1991 and 1992 on the Seward Peninsula, Alaska
(Chetkiewicz, 1993)

Survived - 51.7%
Mortality due to Predators - 24.7%
Brown Bears- 11.2%
Foxes- 5.6%
Wolverines- 1.1%
Wolves- 1.1%
Uncertain- 5.6%
Mortality due to Disease- 4.5%
Mortality due to Drowning- 2.2%
Mortality due to Unknown Cause- 16.8%

Methods

This exposure investigation will examine contamination of reindeer with PCBs, PAHs, and organochlorine pesticides. The investigation will involve analysis of serum, adipose tissue and edible meat from 5 animals which are already being sacrificed under the University of Alaska Reindeer Research Program. An additional 20 animals will have blood specimens taken for serum analysis of PCBs, PAHs, and organochlorine pesticides. Analysis will be performed using standard EPA methodology for these substances (e.g. EPA 3540, EPA 8080, EPA 8082).

The University of Alaska, Fairbanks, Reindeer Research Program is concurrently gathering information on levels of heavy metals in these same reindeer. We will not be repeating this analysis.

Agency Roles

University of Alaska, Fairbanks, Reindeer Research Program: Obtain blood and tissue samples.
U.S. Army Corps of Engineers, Vicksburg Lab: Provide analysis of specimens.
ATSDR: Interpret lab analysis and make recommendations concerning public health impact.

Reporting of Results

Results of this investigation will be provided to the communities of Savoonga and Gambel, the University of Alaska Reindeer Research Program, the U.S. Army Corps of Engineers.

Follow-Up Activities

The reindeer data in this exposure investigation, along with data from other biota and environmental media, will be evaluated by ATSDR to determine the potential for adverse health outcomes to residents of these communities.

Time Line

November, 1999: Reindeer are gathered. Animals are sampled depending on the food needs of the community. Samples are taken.
December, 1999: Analysis of tissue
January, 2000: Results are released

References

Adriano, D.C. 1986. Cadmium, In: Trace Elements in the Terrestrial Environment, pp. 106-155.

Ahman, B. 1994. Effect of bentonite and ammonium-ferric (III)-hexacyanoferrate (II) on uptake and elimination of radiocesium in reindeer In: J. of Environ. Radioactivity, vol. 31, No. 1, (1996) pp. 29-50.

Alaska Native Science Commission 1998. Traditional Knowledge and Radionuclides. University of Alaska Anchorage. 3211 Providence Drive, Anchorage, Alaska 99508.

Allaye-Chan, A.C., White, R.G., Holleman, D.F., and Russell, D.E., 1988. Seasonal concentrations of cesium-137 in rumen content, skeletal muscles, and feces of caribou from the Porcupine herd: lichen ingestion rates and implications for human consumption, In: Rangifer, 1990, special issue #3, pp 17-24.

Brazil, J., and Ferguson, S., 1989. Cadmium concentrations in Newfoundland moose, Alces 25: 52-57.

Chetkiewicz, C.B. 1993. Reindeer (Rangifer Tarandus) calf productivity and survival on the

Seward Peninsula. Unpublished M.S. Thesis. University of Alaska Fairbanks.

Edwards, E.H., 1994, IN: The Encyclopedia of the Horse, Dorling Kindersley, pub., pp. 28-30.

Forberg, S., Tjelvar, O., and Olsson, M. 1991. Radiocesium in muscle tissue of reindeer and pike from northern Sweden before and after the Chernobyl accident. A retrospective study on tissue samples from the Swedish Environmental Specimen Bank, In: Sci. of the Total Environ. 115 (1992) 179-189.

Froslie, A., Haugen, A., Holt, G., and Norheim, G. 1986. Levels of cadmium in liver and kidneys from Norwegian cervids, In: Bull. Environ. Contam. Toxicol. 37: 453-460.

Gamberg, M., and Scheuhammer, A.M. 1992. Cadmium in caribou and muskoxen from the Canadian Yukon and Northwest Territories, In: Sci. of the Total Environ. 143 (1194) 221-234.

Glooschenko, V., Downes, C., Frank, R., Braun, H.E., Addison, E.M., and Hickie, J. 1988. Cadmium levels in Ontario moose and deer in relation to soil sensitivity to acid precipitation, Sci. Total Environ., 71: 173-186.

Hanson, W.C. 1982. 137Cs concentrations in northern Alaskan Eskimos, 1962-79: effects of ecological, cultural and political factors. Health Physics 42:443-447.

Hove, K. 1993. Chemical methods for reduction of the transfer of radionuclides to farm animals in semi-natural environments, In: Sci. of the Total Environ. 137 (1993) 235-248.

Jones, K.C., and Samiullah, Y. 1985. Deer antlers as pollution monitors in the United Kingdom. Deer 6: 253-255.

Kardell, L., and Kallman, S. 1986. Ambio 15: 232-235.

Mathiesen, S.D., Nordoy, LM., and Blix, A.S. 1988. Elimination of radiocesium in contaminated adult female Norwegian reindeer, in: Rangifer, 1990, special issue #3, pp 49.

Postell, A., 1990, Where did the Reindeer Come From? Alaska Experience, the first 50 years: Alaska, Amaknak Press, 105pp.

Skogland, T. 1987. Radiocesium concentrations in wild reindeer at Dovrefjell, Norway. Rangifer 7:42-45.

Swanson, R.B., Penfield, M.P., Mitchell, D., Reimann, M.J., Loveday, H.D., 1990, Quality Assessment of Reindeer Meat, School of Ag and Land Res. Mngmt, University of Alaska Fairbanks, Circular 78, 8 pp.

Wadeson, Rhonda, 1998, Influence of the Introduction of Reindeer to the Seward Peninsula, Alaska , University of Alaska Fairbanks.

World Health Organization, 1989. Evaluation of Certain Additives and the Contaminants Mercury, Lead and Cadmium, (Technical Report Series, no. 505) WHO, Geneva.