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STATE OF ALASKA

FRANK H. MURKOWSKI, GOVERNOR 52

DEPARTMENT OF HEALTH & SOCIAL SERVICES

DIVISION OF PUBLIC HEALTH
SECTION OF EPIDEMIOLOGY

3601 C STREET, SUITE 540
P.O. BOX 240249
ANCHORGE, ALASKA 99524-0249

INFECTIOUS DISEASES
AIDS/STD
TUBERCULOSIS (907) 269-8000
IMMUNIZATION (907) 562-7802
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Epidemiology Investigation of Polychlorinated Biphenyl (PCB) Exposures in Unalakleet

Interim Report – November 3, 2003

Prepared By: Lori A. Verbrugge, Ph.D., Joe McLaughlin, MD, MPH, and Scott Arnold, Ph.D.

Background

The North River Radio Relay Station (RRS) was constructed as part of the United States Air Force (USAF) Distant Early Warning system of the 1950's. The site is located 8 miles east of the village of Unalakleet, which is about 150 miles southeast of Nome. The 216-acre site was operational from 1957 to 1978 and is currently accessible via a gravel road from Unalakleet.

In 1995, the North River RRS buildings, storage tanks, and antennas were demolished and removed by U.S. Army Corps of Engineers contractors. Petroleum products, polychlorinated biphenyls (PCBs), and organic solvents were found in soil on the site in the early 1980s, and a number of soil removal activities have occurred since 1982.

A Unalakleet resident who owns a cabin near the former North River RRS noticed that there was an area of land devoid of vegetative growth after RRS structures were removed. On July 9, 2003, she wrote a letter to the USAF, asking that the site be tested for contaminants. The suspected area was investigated and determined to be a historic PCB spill site, approximately 10' by 20' in area, in the middle of an access road leading to the resident's cabin. PCB concentrations detected in soil exceeded 40,000 parts per million (ppm) at the source area, or hot spot, while concentrations detected in soil collected along the access road ranged from 1.6 ppm to 233 ppm. Eight dust wipe samples were collected from the interior of the cabin following standard USEPA procedures, and PCBs were not detected there (detection limit = 0.015 ppm). PCB concentrations detected in soil samples (n = 4) collected adjacent to the cabin ranged from below the detection limit (detection limit = 0.055 ppm) to 3.9 ppm. The Alaska Department of Environmental Conservation (ADEC) default clean-up value for PCBs in soil is 1 ppm.

On September 26, 2003 the USAF completed the excavation and removal of 31,530 pounds of PCB-contaminated soil from the spill site. Following removal of the contaminated soil, the former spill site was covered with a heavy industrial liner and crushed rock, and contaminated vegetation was removed. Isolated pockets of PCB contamination remain, which have been enclosed with a 6-foot chain link fence. Interested parties, including community leaders, ADEC and USAF staff, are working on a collaborative agreement for the preferred clean-up options for the remaining PCB contaminated areas. The USAF is currently planning the remaining actions, which are scheduled to begin next June.

The discovery of elevated PCB levels in soil near Unalakleet led to concerns regarding the possible exposure to PCBs among area residents and the public health implications of such exposures. The State of Alaska Section of Epidemiology (DHSS Division of Public Health) responded to these concerns by conducting an exposure investigation that is detailed in this report.

Epidemiology Investigation

A nurse epidemiologist (Sue Anne Jenkerson) and a medical epidemiologist (Dr. Joe McLaughlin) visited Unalakleet on October 1, 2003 to visit the spill site and conduct the exposure investigation.

Upon arriving in Unalakleet, Epidemiology staff was provided with a list of people who were considered by Unalakleet clinic staff to be at the highest potential risk for exposure to the spill site, such as residents with a cabin near the site or persons that regularly perform subsistence harvesting near the site. These individuals were invited to participate in the investigation, and those who were interested reported to the local health clinic. A blood sample was obtained from each participant, which was centrifuged to separate the serum for PCB analysis.

A total of 26 people participated in the exposure investigation by providing a blood sample. Participants ranged in age from 18 – 81 years, with a median age of 41 years.

Serum specimens were shipped frozen on dry ice to the Centers for Disease Control and Prevention (CDC) analytical laboratory. The CDC laboratory analyzed 36 individual PCB congeners using state-of-the-art methodology. Results for each of the 36 congeners were summed to derive a "total PCB" value. CDC provided test results in both a wet-weight concentration and a lipid-adjusted concentration. Lipid-adjustment makes it unnecessary to fast before the PCB test; otherwise the consumption of food could influence the amount of PCBs measured in the blood.

Results

Small amounts of PCBs were detected in each of the 26 serum samples collected; the median value of total PCBs on a whole-weight basis was 1.3 parts per billion (ppb), and the highest total PCB level was 7.7 ppb. The median lipid-adjusted total PCB level was 214 ppb, and the highest lipid-adjusted total PCB level was 1,066 ppb (Table 1). PCB

levels were strongly associated with age, and were higher among older persons (Figure 1).

We compared our findings with those of several other recent PCB exposure investigations in Alaska. In 1999, we conducted a similar PCB exposure investigation among 166 people from 5 Aleutian and Pribilof Island villages [1] who relied heavily on traditional foods, including marine mammals. (PCBs are known to bioaccumulate in aquatic food chains, and people can be exposed to PCBs by consuming fatty tissues from marine mammals.) PCB results from the Aleutian/Pribilof assessment are directly comparable to the Unalakleet results, because samples were collected in the same way, and the same CDC laboratory performed the chemical analyses. PCB exposure levels in Unalakleet were lower than those in the Aleutian and Pribilof Island residents (Table 1, Figure 2).

Others have measured PCB exposure levels in the Norton Sound region. For example, PCB exposure levels were recently measured among residents of St. Lawrence Island [2]. Comparisons between that study and the Unalakleet investigation must be made with caution, because of the differences in research and laboratory methodologies used. When PCB results for the two studies are plotted by age, it appears that the Unalakleet residents had lower PCB levels than the St. Lawrence villagers tested (Figure 3).

We also compared our results to findings of a recent analysis of PCB exposures of Alaska Native women [3]. That exposure analysis measured PCBs in stored blood serum samples collected and banked in the mid-1980s from 131 women whose mean age at the time serum was collected was 57 years. The arithmetic mean level of total serum PCBs was higher among Alaska Native women than among Unalakleet participants (7.56 ppb versus 2.2 ppb, respectively, or 1153 ppb versus 304 ppb on a lipid-adjusted basis).

Discussion

The PCB levels detected in Unalakleet participants are very low, and are below any levels that would be expected to cause ill health effects. PCB levels in tested Unalakleet residents are similar to those of people in other parts of Alaska and in other parts of the United States. All people are exposed to small amounts of PCBs through the foods they eat, and the PCB levels detected in Unalakleet participants are similar to these global background exposures.

No additional medical exams or treatments are needed or recommended for any of the participants with regard to PCB exposure. We realize, however, that even in the absence of any demonstrated adverse health effects associated with exposure to such low levels of PCBs, individuals and communities may still have concerns about their exposures.

One question always asked by anybody who gets a blood test is, "How do my results compare to the norm?" Norms for many medical tests are expressed as a reference range. Unfortunately, due to the complexities of PCB testing, formal reference range data are not available for these chemicals. However, many studies are published that give PCB exposure levels throughout the world, and we can make comparisons to those levels. The

PCB levels detected in Unalakleet residents are lower than those found in people from many industrialized countries.

PCBs have become distributed throughout the global environment, and everyone is exposed to them in small amounts. PCBs do not break down (or break down very slowly) in the environment, so temperature, time, light, and bacteria don't change them much. PCBs also do not break down when eaten by people or animals; instead they remain in the body. Furthermore, PCBs do not dissolve in water but are fat soluble, meaning they are attracted to and collect in the fat of humans and animals. Most people are exposed to PCBs through the food they eat – especially fatty animal products. Very tiny amounts of PCBs are present in many of the store-bought foods we commonly eat. They are also present in all of the world's food chains (on land, in the sea, and in freshwater). PCB concentrations in the Arctic are usually highest in the fat of marine mammals.

We found that PCB levels were lower in Unalakleet participants than in several other populations tested in Alaska. This may indicate that Unalakleet participants might eat fewer traditional foods that contain PCBs, such as marine mammal blubber. A dietary survey would be needed to determine whether dietary differences among tested communities actually explain these results.

PCB levels among Unalakleet participants were strongly associated with age. This is a very common result that has also been observed in other Alaskan studies. PCBs tend to bioaccumulate in people as they age, since they are very slow to break down or be eliminated from the body. Among Unalakleet participants, it is fortunate that PCB levels are particularly low in young women, since the developing fetus is most sensitive to the potential harmful effects of PCBs.

Our exposure investigation is not able to determine the source of the PCBs that were detected in serum of Unalakleet participants. It is not possible to determine whether any of the measured PCBs came from the site. These low PCB exposures could be explained by trace global background contamination of the food supply, as they are similar to background exposure levels in humans throughout the northern hemisphere. In order to protect against future PCB exposures, it is still important to clean up the former North River RRS site. As the State's regulatory authority, the ADEC should continue to direct and guide clean-up activities at the site, including risk assessments, clean-up decisions, and remediation activities, with the continued collaboration of the Unalakleet community and the Norton Sound Health Corporation.

Conclusions and Recommendations

- This investigation documents that tested Unalakleet residents have been exposed to small quantities of PCBs. The PCB levels detected in participant's serum were below levels associated with ill effects, and do not warrant any individual seeking further medical examinations, tests, or treatment.

- Restrictions in the subsistence diet of Unalakleet residents are not justified or recommended. The known benefits of fish and marine mammal consumption far outweigh the controversial potential adverse health effects from contaminants at the concentrations found in those foods. Unalakleet residents should continue to consume traditional foods, which are nutritious and provide many health and cultural benefits.

- The Alaska Division of Public Health supports the clean-up of military contamination at the former North River RRS as an important priority. As the State's regulatory authority, the ADEC should continue to direct and guide clean-up activities at the site, including risk assessments, clean-up decisions, and remediation activities, with the continued collaboration of Unalakleet community and the Norton Sound Health Corporation.

References

1. Alaska Division of Public Health. Assessment of Exposure to Persistent Organic Pollutants (POPs) in 5 Aleutian and Pribilof Islands. Epidemiology Bulletin 2001;5.

2. Alaska Community Action on Toxics (ACAT). Contaminants in Wildlife and People of St. Lawrence Island, Alaska: A Report to the Communities of Savoonga and Gambell. 2002.

3. Rubin CH, Lanier A, Socha M, et al. Exposure to persistent organochlorines among Alaska Native women. International Journal of Circumpolar Health 2001;60:157-69.

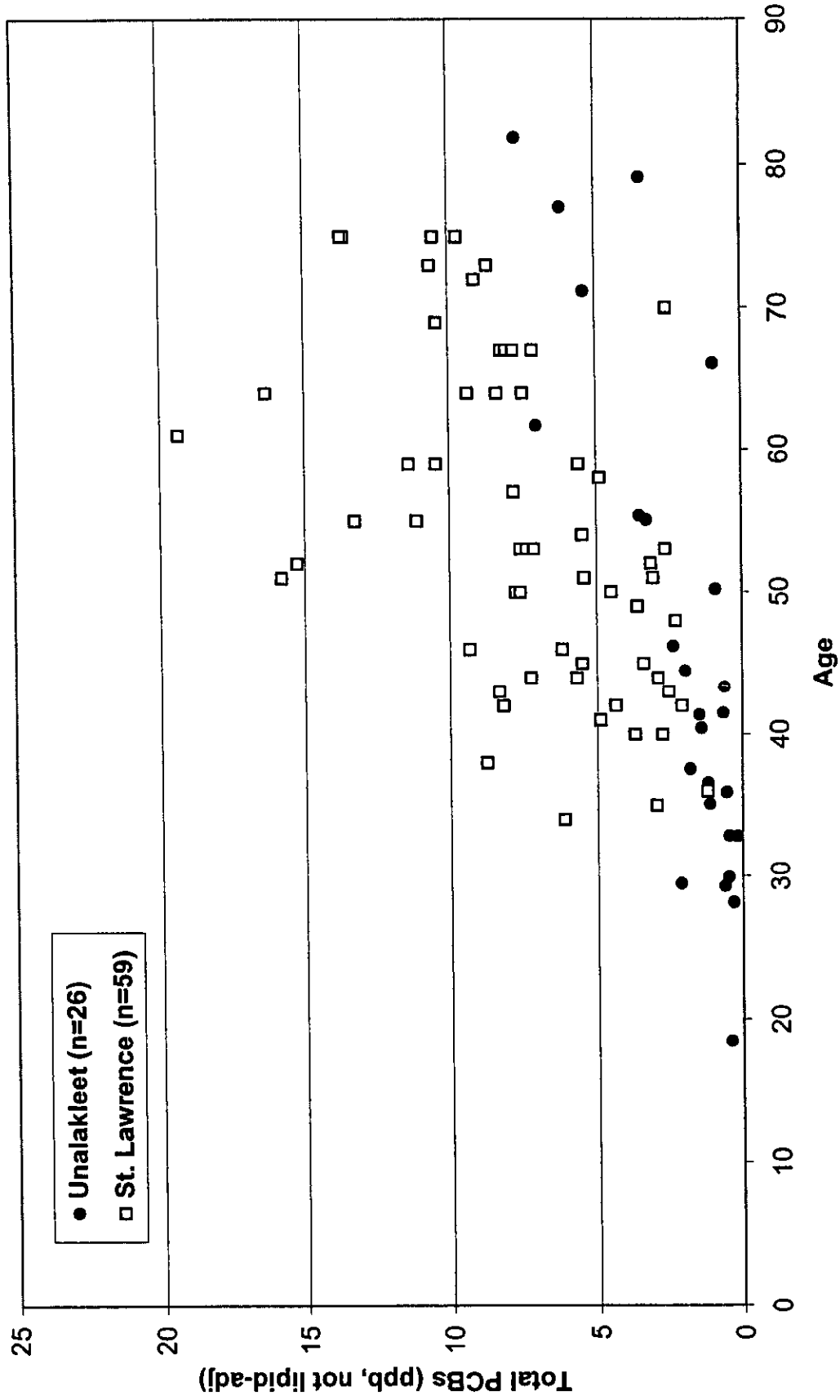

Figure 3. Total PCBs in serum from villagers at Unalakleet and St. Lawrence Island by Age

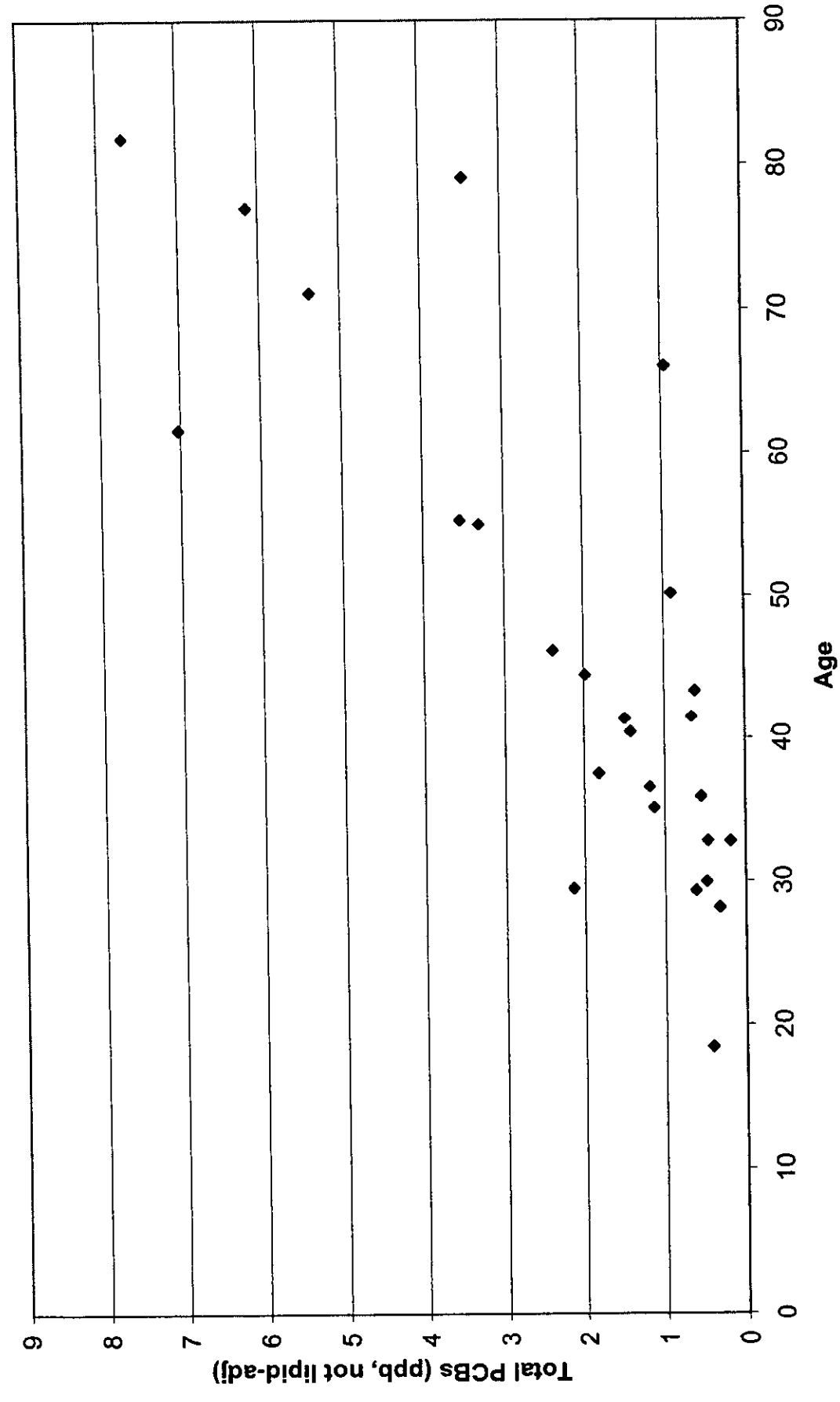

Figure 1. Total PCBs in serum from Unalakleet villagers

Figure 2. Total PCBs in serum from villagers in the Aleutian and Pribilof Islands and Unalakleet by Age

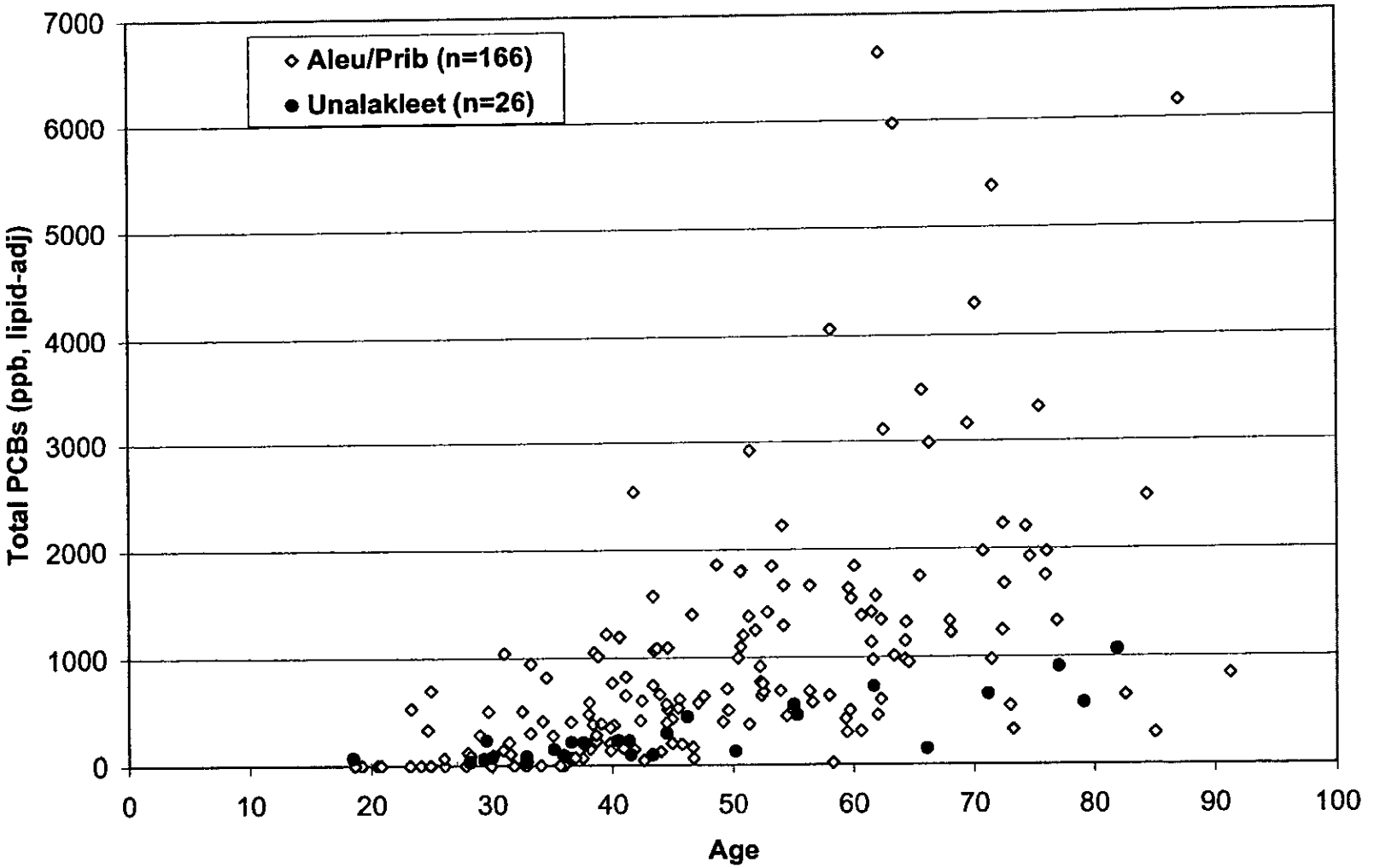

Table 1: Summary statistics of Total PCBs in Serum, Aleutian/Pribilof Islands and Unalakleet

A. Not Lipid Adjusted (ppb)

VILLAGE/REGION	Number Tested	Arithmetic Mean	Standard Deviation	PCB (ppb) Median Level	Lowest Level	Highest Level
Aleutian/Pribilof Islands	166	7.7	8.9	4.8	n.d.	53.7
Unalakleet	**26**	**2.2**	**2.2**	**1.3**	**0.19**	**7.7**

B. Lipid Adjusted (ppb)

VILLAGE/REGION	Number Tested	Arithmetic Mean	Standard Deviation	PCB (ppb) Median Level	Lowest Level	Highest Level
Aleutian/Pribilof Islands	166	994	1158	643	n.d.	6643
Unalakleet	**26**	**304**	**285**	**214**	**34.9**	**1066**

Frequently asked questions about polychlorinated biphenyls

Adapted from material from the
National Center for Environmental Health,
Centers for Disease Control and Prevention

What are polychlorinated biphenyls (PCBs)?
PCBs are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. Many commercial PCB mixtures are known in the United States by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they do not burn easily and are good insulators. The manufacture of PCBs was stopped in the United States in 1977 because of evidence they build up in the environment and can cause health problems. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

How do PCBs enter the environment?
PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs. PCBs still can be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.

What happens to polychlorinated biphenyls (PCBs) when they enter the environment?
PCBs do not easily break down in the environment, so they may remain there for a long time. PCBs can travel long distances in the air to areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also attach strongly to soil. Small organisms and fish take up PCBs in water. Other animals take up PCBs when they eat these aquatic animals. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How can people be exposed to PCBs?
- Breathing air that contains PCBs.
- Eating food or drinking water that contains PCBs.
- Breathing dust or consuming soil that contains PCBs.

In Alaska, people are most commonly exposed to PCBs by eating fish and marine mammals.

Can exposure to PCBs make people sick?
Sometimes, following exposures to high levels, such as occupational exposures or industrial accidents. In people exposed to large amounts of PCBs, the most common health problems are skin conditions such as acne and other rashes. Some exposed workers had changes in blood and urine that may indicate liver damage. In most people, PCB exposure probably will not cause skin and liver problems. Only a few studies of workers have associated PCBs with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Lab rats that ate food with high levels of PCBs for 2 years developed liver cancer.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage, and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health problems, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland problems. Other effects of PCBs in animals include changes in the immune system, changes in behavior, and reproduction problems. PCBs are not known to cause birth defects.