11.0 Conclusions

The goals of this study were to determine:

1) if fish were contaminated with toxic chemicals,

2) the difference in chemical concentrations among fish species and study sites, and

3) the potential human health risk due to consumption of fish from the Columbia River Basin.

The results of the study showed that all species of fish had some levels of toxic chemicals in their tissues and in the eggs of chinook and coho salmon and steelhead. The concentration of organic chemicals in the egg samples was lower than expected, given the high lipid content of the egg samples. The fish tissue chemical concentrations were quite variable within fish (duplicate fillets), across tissue type (whole body and fillet), across species, and study sites. However, the chemical residues exhibited some trends in distribution. The concentrations of organic chemicals in the salmonids (chinook and coho salmon, rainbow and steelhead trout) were lower than any other species. The concentrations of organic chemicals in three fish species (white sturgeon, mountain whitefish, largescale sucker) were higher than any other species. Pacific lamprey had higher organic chemical concentrations than anadromous species but lower than resident species. The concentrations of metals were variable with maximum levels of different metals occurring in a variety of species. The distribution across stations was variable although fish collected from the Hanford Reach of the Columbia River and the Yakima River tended to have higher concentrations of organic chemicals than other study sites.

The concentrations of toxic chemicals found in fish from the Columbia River Basin may be a risk to the health of people who eat them depending on:

1) the toxicity of the chemicals,

2) the concentration of chemicals in the fish,

3) fish ingestion rates

4) fish species, and tissue type

The chemicals which contributed the most to the hazard indices and cancer risks were the persistent bioaccumulative chemicals (PCB, DDE, chlorinated dioxins and furans) as well as some naturally occurring metals (arsenic, mercury). Some pollutants persist in the food chain largely due to past practices in the United States and global dispersion from outside North America. Although some of these chemicals are no longer allowed to be used in the United States, a survey of the literature indicates that these chemical residues continue to accumulate in a

variety of foods including fish. Human activities can alter the distribution of the naturally occurring metals (e.g. mining, fuel combustion) and thus increase the likelihood of exposure to toxic levels of these chemicals through inhalation or ingestion of food and water.

Many of the chemical residues in fish identified in this study were not unlike levels found in fish from other studies in comparable aquatic environments in North America. The results of this study, therefore, have implications not only for tribal members but also the general public.

While contaminants remain in fish, it is useful for people to consider ways to still derive beneficial effects of eating fish, while at the same time reducing exposure to these chemicals. Fish are a good source of protein, low in saturated fats, and contain oils which may prevent coronary heart disease. Risks can be reduced by decreasing the amount of fish consumed, by preparing and cooking fish to reduce contaminant levels, or by selecting fish species which tend to have lower concentrations of contaminants.

Reducing dietary exposure through cooking or by eating a variety of fish will decrease the consumer's exposure, but not eliminate these chemicals from the environment. Reduction of many of the man-made chemicals from the environment will take decades to centuries. Regulatory limits for new waste streams and clean up of existing sources of chemical wastes can help to reduce exposure. The exposure to naturally occurring chemicals can be reduced through better management of our natural resources. The results of this study confirm the need for regulatory agencies to continue to pursue rigorous controls on environmental pollutants and to remove those pollutants which have been dispersed into our ecosystems.

There are many uncertainties in this risk assessment which could result in alternate estimates of risk. These uncertainties include our limited knowledge of the mechanisms which cause disease, the variability of contaminants in fish, changes in fish tissue concentrations over time, ingestion rates, and the effects of food preparation. The uncertainties in our estimates may increase or decrease the risk estimates reported in this study.

The chemicals which were estimated to contribute the most to potential health effects (PCB, DDE, chlorinated dioxins and furans, arsenic, mercury) are the chemicals for which regulatory strategies need to be defined to eliminate or reduce these chemicals in our environment.

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