Era, Vickie

From: Hardy, Joan [Joan.Hardy@DOH.WA.GOV]
Sent: Tuesday, January 22, 2002 3:23 PM
To: Swecker, Sen. Dan
Subject: Fluoride and Fish

fluoride and fish.doc

Attached is a summary of a review paper on fluoridation and salmon published in 1994. I summarized the paper in February 2000 for a bill analysis by the Drinking Water Program of the Department of Health. This summary should not be considered as a "literature review"; it is the result of a quick survey of the literature to raise issues associated with fluoride and fish. Furthermore, additional information on the subject may have been published during the past two years. Please let me know if you have any questions.

The Department of Health works to protect and improve the health of people in Washington State.

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TO: **Jude VanBuren**

FROM: **Joan Hardy**

SUBJECT: **What are the adverse effects of fluoride on anadromous fish?**

"Impact of Artificial Fluoridation on Salmon Species in the Northwest USA and British Columbia, Canada"

The following is a summary of a 1994 paper by Richard G. Foulkes and Anne C. Anderson. The authors' review of the literature shows that levels below 1.5 mgF/L have both lethal and other adverse effects on salmon. Many factors influence susceptibility of fish to fluoride: temperature, water hardness, pH, chloride concentration, and the strain, age and physiological and reproductive condition of the fish.

Angelovic and others (1961) showed lethal effects on rainbow trout related to temperature. Using sodium fluoride at the same degree of hardness (estimated at 44), the 240-h LC_{50} at 7.2 degrees C was 5.9 – 7.5 mgF/L; at 12.8 degrees C, 2.6 – 6.0; and at 18.3 degrees C, 2.3 – 7.3 mgF/L. Neuhold and Sigler (1960) reported the same result for 12.8 degrees C and the same degree of hardness. Pimental and Bulkley (1983) found that the 96-LC_{50} for rainbow trout with hardness levels of 17, 49, 182, and 185 mg/L (at a constant temperature of 12 degrees C), was associated with fluoride levels of 51, 128, 140, and 193, respectively.

In British Columbia where the water in salmonid waters is usually soft, Warrington combined the above findings to calculate that the chronic threshold for rainbow trout at 12 degrees C and water hardness of 10 mg/L (calcium carbonate) is 0.2 mgF/L.

Damkaer and Dey (1989) demonstrated that high loss of both chinook and coho salmon at John Day Dam on the Columbia River in 1982-1986 was caused by the inhibition of migration by fluoride contamination from an aluminum smelter 1.6 km above the dam. The average daily discharge of fluoride in 1982 was 384 kg. This was associated with a fluoride concentration of 0.5 mg/L at the dam and a migration time of more than 150 hours and a 55% loss. In 1983, discharge was reduced to 107 kg/day, which was associated with a reduction of concentration to 0.17 mgF/L and the migration time to less than 28 hours with a loss of 11%. In 1985, fluoride discharge of 49 kg/day was accompanied by a concentration of 0.2 mgF/L and a salmonid loss of 5%. Damkaer and Dey confirmed the cause-and-effect relationship by means of a two-choice flume for fluoride gradient salmon behavior tests, which determined that the "critical level" was 0.2 mgF/L.

Other studies indicated that fluoride at levels below 1.5 mg/L have lethal and other adverse effects on fish. Delayed hatching of rainbow trout occurred at 1.5 mgF/L; brown mussels died at 1.4 mgF/L; an alga was killed by a four-hour fumigation with fluoride with a critical concentration of 0.9 mgF/L; and levels below 0.1 mgF/L were shown to be

lethal to the zooplankton *Daphnia magna*. The last two studies suggest that salmon species may be affected by fluoride induced reduction of food supply.

Documents used in a court case involving Meader's Trout farm in Pocatello, Idaho, in 1961 contain evidence of fluoride effects on salmonids . Between 1949 and 1950, trout damage and loss was related to fluoride contamination due to rain washing air-borne particles from leaves into hatchery water at levels as low as 0.5 mgF/L.

Thus, the authors of this review article argue that the "safe level" of fluoride in the fresh water habitat of salmon species is not 1.5 mg/L but 0.2 mg/L. They then ask if this concentration is exceeded by fluoridated communities on the banks of salmon waterbodies.

In fluoridated areas, drinking water obtained from surface water with an average fluoride concentration of 0.1 – 0.2 mg/L is raised to the "optimal" level of 0.7-1.2 mgF/l by the addition of sodium fluoride, hydrofluosilicic acid, or sodium silicofluoride. The authors state that fluoride enters the fresh water ecosystem in numerous ways, including surface runoff from fire-fighting, washing cars, watering gardens, and primarily during waste water treatment. The authors argue that fluoride concentration in both surface runoff and sewer effluent exceeds 0.2 mgF/L. They give calculations for several different river systems. They also point out that fluoride is either deposited in sediment locally or carried to the estuary where it may persist for 1-2 million years or may recontaminate surface waters if dredging occurs.

From information available, 0.2 mgF/L in the fresh water ecosystem in the US Pacific Northwest and British Columbia appears to be the appropriate safe level for salmon species, rather than the 1.5 mgF/L currently accepted. Among other points of discussion, the authors state that fluoridation deserves to be looked at as a component of "critical habitat" along with other factors. They also give examples of levels of fluoride entering rivers from communities along the Columbia-Snake River system, along the North Thompson, and along the Fraser River in British Columbia and suggest that these elevated fluoride levels are linked to catastrophic declines in salmonid stocks. They also point out that the decline in salmon stocks is a major economic problem for both commercial and sport fisheries. They conclude that artificial fluoridation and fluoride discharge from fluoride-producing industries should be eliminated as part of a strategy for improving the critical habitat of Northwest Pacific salmon.

Other Information on Fluoride and Salmonids

A 1983 report mentioned in the above review lists observations of salmonid migratory success at John Day Dam in the Columbia River as linked to fluoride discharges. The authors D.M. Damkaer and D.B. Dey also list results from behavior tests on salmonids that identify levels of fluoride as 0.2 mgF/L at the threshold for fluoride sensitivity for chinook and coho salmon.

Also found on the Internet were two commentaries by Dan Montgomery on related issues. The first commentary links levels of fluoride as reported by the USGS for the Willamette River to other pollutants and concludes that the reproductive fitness of salmon may be affected in some way. The second commentary examines the potential of fluoride pollution in Oregon rivers to impact salmonids. He links hydrofluoric acid waste from etching computer chips in nearby factories to high fluoride concentrations in waste water in the Tualatin River Valley, a tributary of the lower Willamette River.

Katie Mains, an employee of Washington State Department of Fish and Wildlife, stated in a personal communication that the literature indicates that fluoride levels between 0.2 and 0.5 mg/L are acceptable for salmon. She also said that the WDF&W water quality criteria for fish hatcheries are below 0.05 ppm, based on a letter written by another employee on July 11, 1989 (K. Mains, (360) 902-2503).