4.5 Fish and Wildlife Surveillance

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Contaminants in fish and wildlife that inhabit the Columbia River and Hanford Site are monitored for several reasons. Wildlife have access to areas of the site containing radioactive or chemical contamination, and aquatic organisms (fish, bivalves, etc.) can be exposed to contamination entering the river along the shoreline. Fish and some wildlife species exposed to Hanford contaminants might be harvested for food and may potentially contribute to offsite public exposure. In addition, detection of contaminants in wildlife may indicate that wildlife are entering contaminated areas (e.g., burrowing in waste burial grounds) or that materials are moving out of contaminated areas (e.g., through blowing dust or food-chain transport). Consequently, fish and wildlife samples are collected at selected locations annually (Figure 4.5.1). More detailed rationale for the selection of specific species sampled in 2001 can be found in DOE/RL-91-50.

Routine background sampling is conducted approximately every 5 years at locations believed to be unaffected by Hanford releases. Additional background data also may be collected during special studies.

As a result of changing operations on the Hanford Site, the frequency of fish and wildlife sampling was modified significantly in 1995. Species that had been collected annually were placed on a rotating schedule so that surveillance of all key species would be accomplished over a 3-year period. Factors supporting these changes included the elimination of many onsite radiological sources and a decrease in environmental concentrations of radionuclides of interest. Additionally, several radionuclides that were monitored in the past had not been detected in recent wildlife samples because they were no longer present in the environment in sufficient amounts to accumulate in wildlife or they did not accumulate in fish or wildlife tissues of interest.

For each species of fish or wildlife, radionuclides are selected for analysis based on the potential for the contaminant to be found at the sampling site and to accumulate in the organism (Table 4.5.1). At the Hanford Site, strontium-90 and cesium-137 have been historically the most frequently measured radionuclides in fish and wildlife.

Strontium-90 is chemically similar to calcium; consequently, it accumulates in hard tissues rich in calcium such as bone, antlers, and eggshells. Strontium-90 has a biological half-life in hard tissue of 14 to 600 days (PNL-9394). Hard-tissue concentrations may profile an organism's lifetime exposure to strontium-90. However, strontium-90 generally does not contribute much to human dose because it does not accumulate in edible portions of fish and wildlife. Spring water in the 100-N and 100-H Areas are the primary sources of strontium-90 from Hanford to the Columbia River; however, the current contribution relative to historical fallout from atmospheric weapons testing is small (less than 2%) (PNL-8817).

Cesium-137 is particularly important because it is chemically similar to potassium and is found in the muscle tissues of fish and wildlife. Having a relatively short biological half-life (less than 200 days in muscle; less than 20 days in the gastrointestinal tract [PNL-9394]), cesium-137 is an indicator of more recent exposure to radioactive materials and is also a major constituent of historical worldwide fallout.

Fish and wildlife samples were analyzed by gamma spectrometry to detect a number of gamma emitters (see Appendix F). However, gamma spectrometry results for most radionuclides are not discussed here because levels were too low to measure or measured concentrations were considered artifacts of low-background counts. Low-background counts occur at random intervals during sample counting and can produce occasional spurious false-positive results.

For many radionuclides, concentrations are below levels that can be detected by the analytical laboratory. When this occurs for an entire group of samples, two

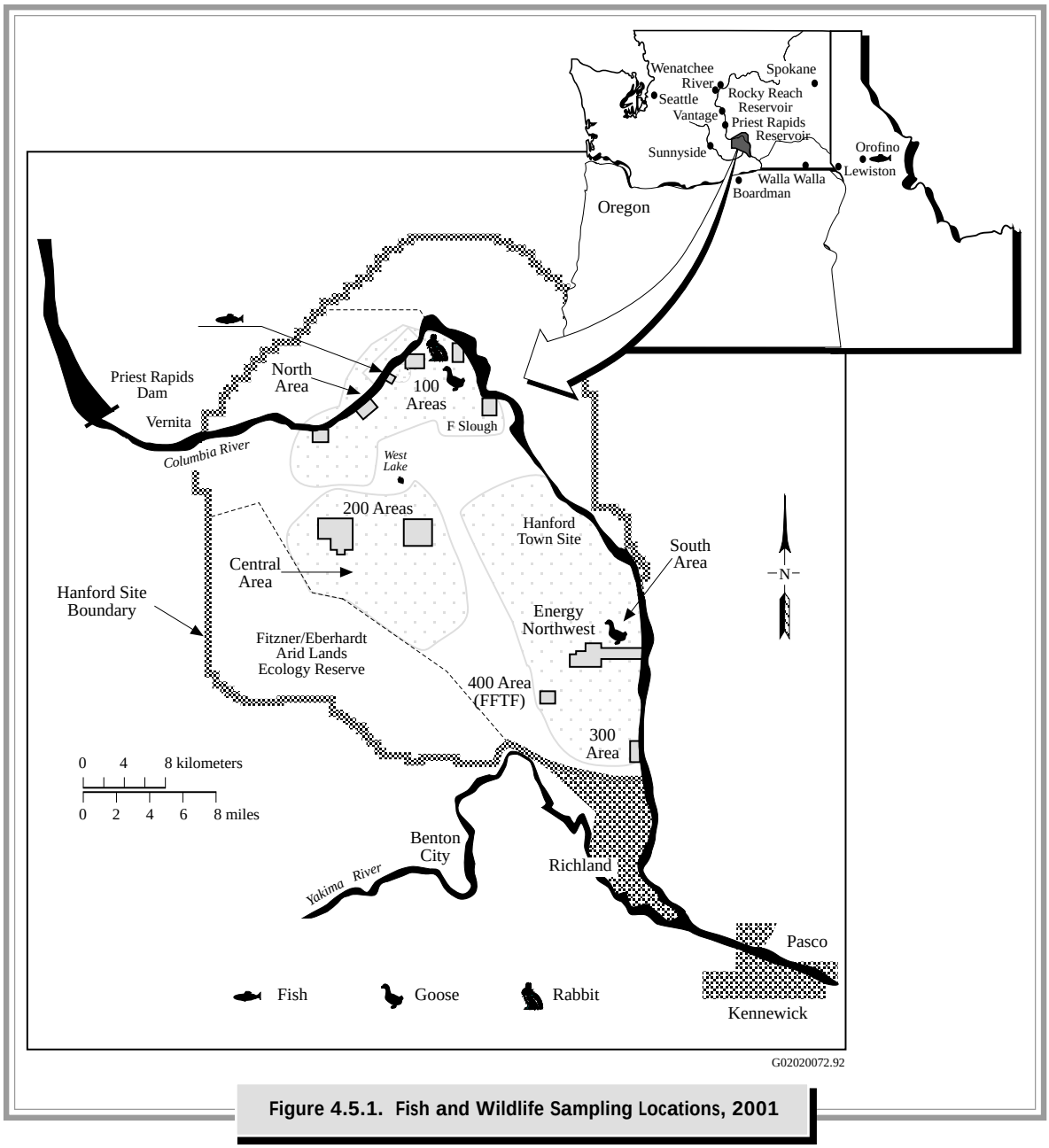

Figure 4.5.1. Fish and Wildlife Sampling Locations, 2001

times the total propagated analytical uncertainty is used as an estimate of the nominal detection level for that analyte and particular medium. Results and propagated uncertainties for all results may be found in PNNL-13910, APP. 1.

Wet-weight analytical detection levels for cesium-137 in muscle and strontium-90 in bone/carcass tissues were ~0.04 pCi/g (~0.0015 Bq/g) and 0.01 pCi/g (0.0037 Bq/g), respectively.

4.5.1 Fish Samples and Analytes of Interest

The amounts of radiological contamination measured in fish samples are well below levels that are known to cause adverse biological effects and contribute only a small proportion of the radiation dose to the maximally exposed individual (see Section 5.0). However, monitoring fish and other organisms for uptake and exposure to radionuclides at both nearby and distant locations continues to be important to track the extent and long-term

trends of contamination in the Columbia River environment. In 2001, five whitefish were collected from the Columbia River near the 100-N Area, and two whitefish were obtained from a reference site near Orofino, Idaho (see Figure 4.5.1). Whitefish analyzed in 2001 from the reference site were collected by sportsmen fishing the Clearwater River in the fall of 1999 and donated to Pacific Northwest National Laboratory. Fillets and the eviscerated remains (carcass) of fish were analyzed for a variety radiological contaminants and results from the nearby and distant locations were compared and are discussed below. All analytical data for 2001 samples are given in PNNL-13910, APP. 1.

Table 4.5.1. Locations, Species, and Contaminants Sampled for Fish and Wildlife, 2001

Biota	No. of Offsite Locations	No. of Onsite Locations	No. of Analyses	
			Gamma	Strontium-90
Fish (whitefish)	1[a]	1[b]	7	7
Canada goose	1[c]	2[d]	11	11
Rabbits	0	1	4	4

(a) Background samples collected from the Clearwater River near Orofino, Idaho.
(b) Samples collected from 100-N to 100-D Areas and the 300 Areas.
(c) Samples collected at Vantage, Washington.
(d) Samples collected from 100-D to 100-H Areas.

In 2001, fillet (muscle) samples were analyzed with gamma spectrometry for cesium-137 and other gamma-emitting radionuclides (PNNL-13910, APP. 1). Cesium-137 results were below the analytical detection limit (0.04 pCi/g [0.0015 Bq/g] wet weight) in all seven whitefish fillet samples collected in 2001. These results are consistent with results from whitefish fillet samples (n=12) analyzed and reported from 1995 through 2000 (PNNL-13487) and support results reported throughout the 1990s that indicate a gradual decline in cesium-137 levels in whitefish.

Strontium-90 was only found in the two whitefish carcass samples analyzed in 2001 and both were from the reference site (collected in 1999) (Figure 4.5.2). Levels of strontium-90 in carcass tissues collected from the 100-N to 100-D Areas in 2001 were consistent with levels observed in samples collected over the preceding 5 years. Strontium-90 concentrations in carcass tissue would need to exceed 600 pCi/g (22.2 Bq/g) wet weight to be near the current DOE dose limit of 1.0 rad/day (0.01 Gy/day) for aquatic organisms (see Section 5.0). The hypothetical dose associated with the consumption of Hanford Reach fish is discussed in Section 5.0.

4.5.2 Wildlife Sampling

Monitoring various biota for uptake and exposure to radionuclides both near and distant from Hanford Site operations continues so that long-term trends of contamination in the ecosystem can be tracked. Wildlife sampled and analyzed in 2001 for radioactive constituents included cottontail rabbits and Canada geese. Wildlife samples were analyzed for gamma emitters and strontium-90.

4.5.2.1 Goose Samples and Analytes of Interest

Ten goose samples were collected from the Hanford Reach and one was collected from the reference location near Vantage, Washington, in the early fall of 2001 (see Figure 4.5.1). Radionuclide levels found in these samples were compared to levels in samples collected onsite in 1995, 1997, and 1999.

Cesium-137 was not detected (<0.02 pCi/g) in any goose muscle samples collected from the Hanford Site. The concentration in the sample obtained from the reference site in 2001 was reported to be 0.15 ± 0.02 pCi/g (0.056 ± 0.00074 Bq/g) wet weight. The number of results reported at or below the analytical detection limit in 2001 was similar to the number reported for 28 goose samples collected from the Hanford Reach between 1995 and 2000. The 2001 levels were consistent with levels reported for other waterfowl collected on the Hanford Site (PNL-10174) and suggest that resident geese do not accumulate measurable amounts of cesium along the Hanford Reach of the Columbia River.

Strontium-90 concentrations found in goose bones were similar between the two areas sampled on the Hanford Site in 2001 (see Figure 4.5.1) and the reference

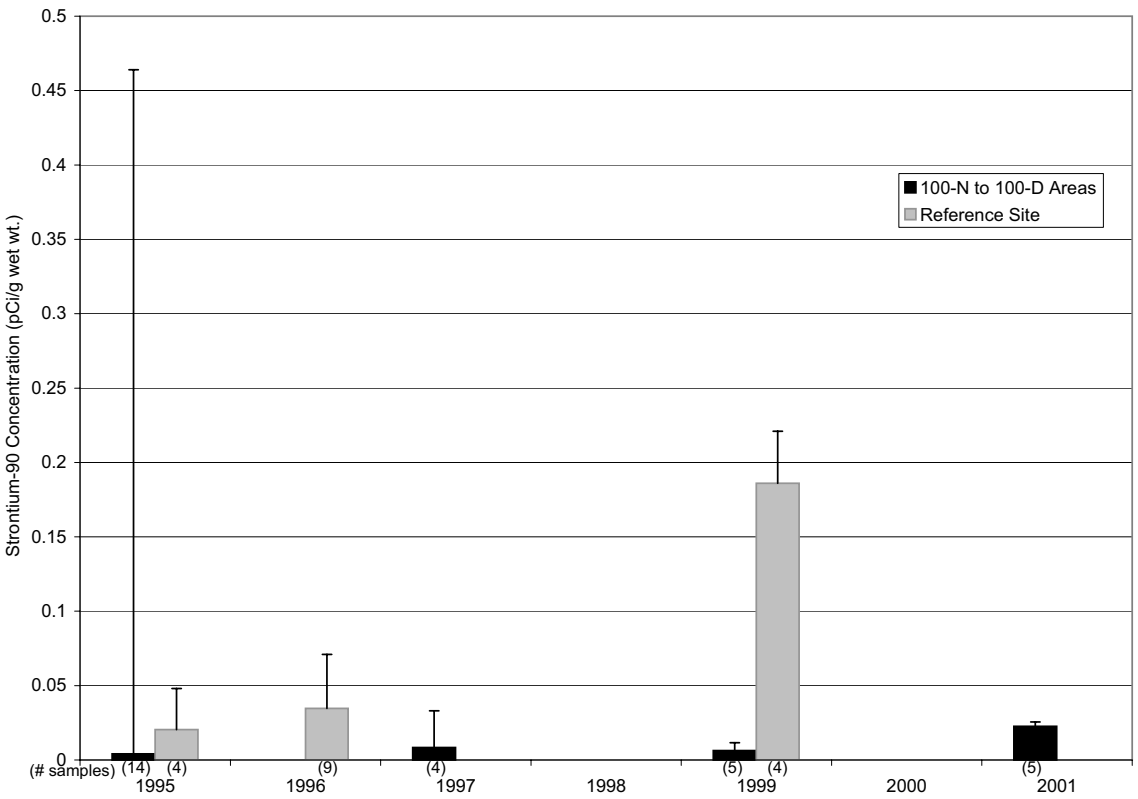

Figure 4.5.2. Median and Maximum Strontium-90 Concentrations (pCi/g wet wt.) in Whitefish Carcasses, 2001 Compared to Four Previous Years. Reference Areas: 1995 - Wenatchee River in Washington; 1996 - Columbia River in the pool behind Rocky Reach Dam in Washington; 1999 - Clearwater River in Idaho. Multiply pCi/g by 0.037 to convert to Bq/g.

site (Figure 4.5.3). Median and maximum results reported from Hanford goose samples in 2001 were higher than any reported from 1995 through 2000 (n=28), but were similar to results from reference (background) samples obtained in 1995 (n=10), 1999 (n=3), and 2001 (n=1). While the apparent increase in strontium-90 concentrations in Hanford Site goose samples obtained in 2001 is noteworthy, the strontium-90 concentration in bone would need to exceed 60 pCi/g (2.2 Bq/g) wet weight to be near the current DOE dose limit of 0.1 rad/day (0.0008 Gy/day) for terrestrial organisms (see Section 5.0).

4.5.2.2 Rabbit Samples and Analytes of Interest

Rabbits are good indicators of regional radioactive contamination because they have relatively small home ranges, occupy burrows, and can enter fenced-restricted areas. However, due to the cyclic-patterns of the populations over time, sampling rabbits can be very difficult when numbers are low. In 2000, jackrabbits were listed as a sensitive species of concern in Washington State. As a result, rabbit sampling in the Central Plateau was not conducted.

In 2001, muscle and bone samples of cottontail rabbits were collected from near the 100-N Area. Reference samples of rabbits were collected near Boardman, Oregon (see Section 5.4.1), in 1990 (n=10).

Muscle. Cesium-137 concentrations in muscle samples from four rabbits collected on the Hanford Site in 2001 were all below the analytical detection limit (0.02 pCi/g [0.00074 Bq/g] wet weight). These results are similar to those seen from a reference location sampled in 1990 and do not indicate elevated exposures from Hanford-derived sources.

Bone. Strontium-90 concentrations in the bones of four rabbits on the site were all above the analytical detection limit in 2001 (Figure 4.5.4). Three of the four sample results were reported near the analytical detection limit of 0.04 pCi/g (0.0015 Bq/g); one sample was reported to be 9.0 pCi/g (0.33 Bq/g). Results from animals collected on the Hanford Site suggest onsite

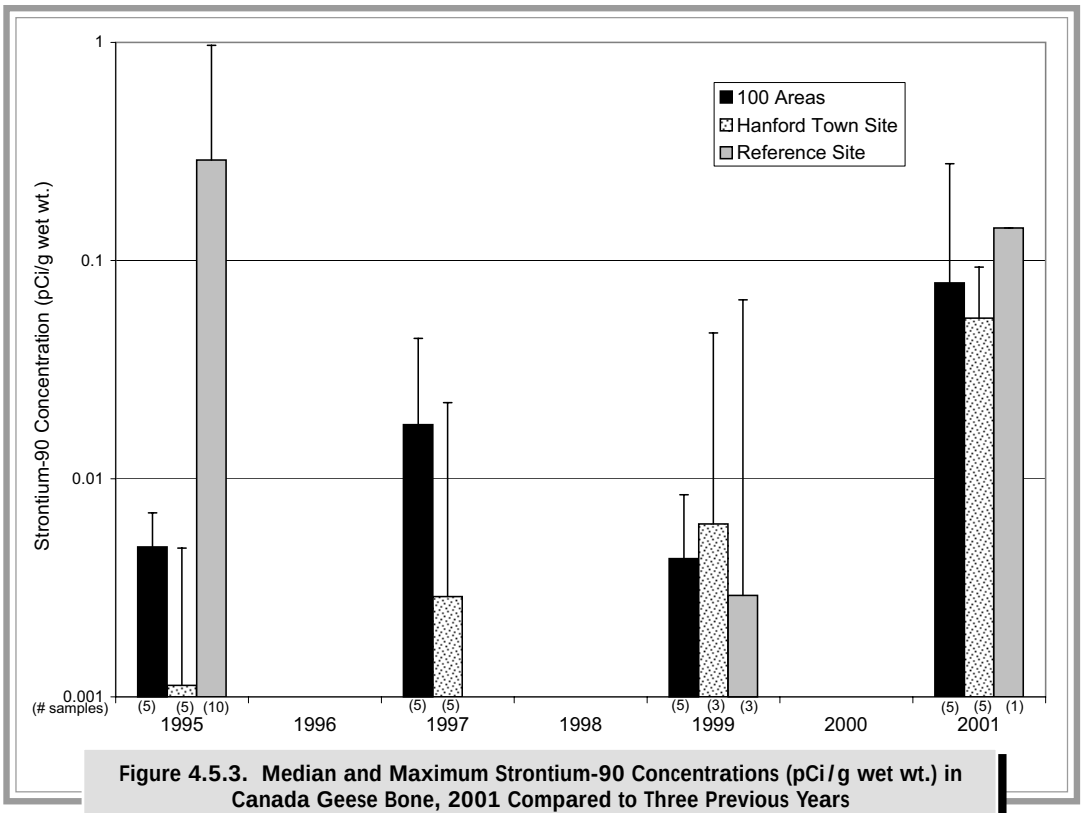

Figure 4.5.3. Median and Maximum Strontium-90 Concentrations (pCi/g wet wt.) in Canada Geese Bone, 2001 Compared to Three Previous Years

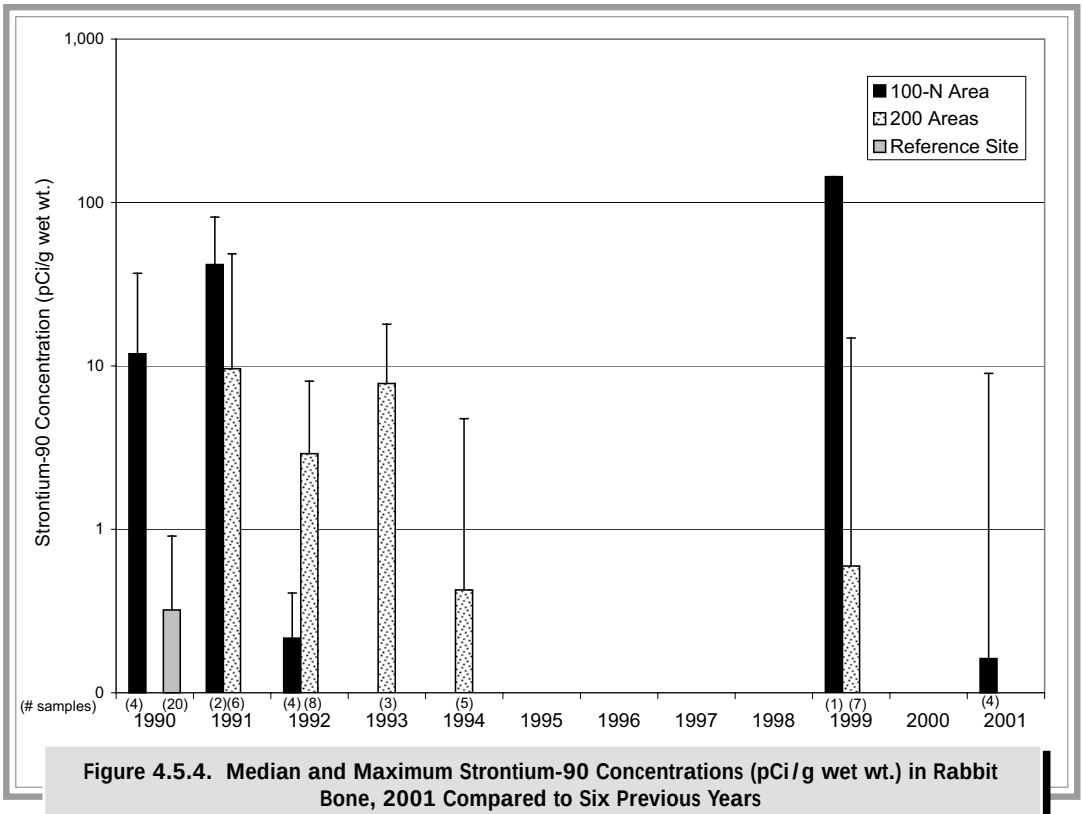

Figure 4.5.4. Median and Maximum Strontium-90 Concentrations (pCi/g wet wt.) in Rabbit Bone, 2001 Compared to Six Previous Years

exposure to low levels of strontium-90 around the 100-N and 200 Areas. Although low sample sizes are available to interpret the long-term trends, major changes in strontium-90 within rabbit bone tissues are not apparent over the past decade. Strontium-90 concentrations in bone tissues would need to exceed 60 pCi/g (2.2 Bq/g) wet wt. to be near the current DOE dose limit of 0.1 rad/day (0.0008 Gy/day) for terrestrial organisms (see Section 5.0).