5.0 The 2000 "24 Command" Hanford Site Wildfire

L. L. Cadwell and T. M. Poston

In early summer 2000, a large wildfire extensively burned federal, state, and private lands on and around the Hanford Site. The wildfire originated near the western boundary of the Hanford Site on State Route 24, ~2 miles west of the junction of State Routes 24 and 240 (Figure 5.1). Dry vegetation was ignited by a vehicle accident that occurred about 1:30 p.m. on June 27, 2000. Throughout the afternoon of June 27 and much of June 28, 2000, light winds pushed the fire mostly south from the point of ignition onto private grazing lands and through the western portion of the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit of the Hanford Reach National Monument (see Figure 1.2). During this time the fire crossed State Route 240, prompting the U.S. Department of Energy (DOE) to declare an alert-level emergency as it approached the 200-West Area. An alert-level emergency activates the Hanford Emergency Operations Center and implements certain emergency responses, protective actions, and authorities. Winds increased out of the northwest in the early evening of June 28, 2000, and rapidly pushed the fire southeast across most of the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit. By late evening on June 28, the fire had moved to the outskirts of Benton City, Washington, where several homes and other structures were burned (see Figure 5.1). On June 29, 2000, the wind changed direction and the fire spread north and east across the Hanford Site toward a non-radiological landfill, the 300 Area, the BC Cribs radiological control area, and the 200-East Area. By June 30, 2000, only a relatively small area of land southwest of the 200-East Area continued to burn. The wildfire was declared out at 4:00 p.m. on July 1, 2000.

Approximately 66,400 hectares (164,000 acres) were burned including ~8,100 hectares (20,000 acres) of private land and 58,300 hectares (144,000 acres) of DOE and U.S. Fish and Wildlife Services managed lands. None of the Hanford Site's operational facilities burned, but the fire approached the boundaries of the 200-East and the 200-West Areas. The fire, formally designated the "24 Command Fire" based on its point of origin on State Route 24, will be referred to as the 2000 Hanford wildfire in the remainder of this chapter.

The following sections describe fire related environmental monitoring activities sponsored by DOE's Richland Operations Office and conducted by Hanford Site contractor personnel. Additionally, monitoring activities undertaken by other federal and state agencies are discussed. DOE has published a detailed report on the fire (DOE/RL-2000-63), which is available on the DOE website at http://www.hanford.gov/docs/rl-2000-63/index.html. The U.S. Fish and Wildlife Service, managers of the Hanford Reach National Monument, which includes the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit, in concert with other federal agencies, documented the wildfire's impact on monument resources and investigated possible wildlife habitat rehabilitation activities (U.S. Department of the Interior 2000). The Washington State Department of Health investigated potential radiological releases from the fire and reported their sample analysis results on their website at http://www.doh.wa.gov/ehp/rp/default.htm. The U.S. Environmental Protection Agency (EPA), at the request of the Washington State Department of Health, collected high-volume air particulate samples in local communities from June 30 through July 3, 2000. The results of EPA sample analysis were

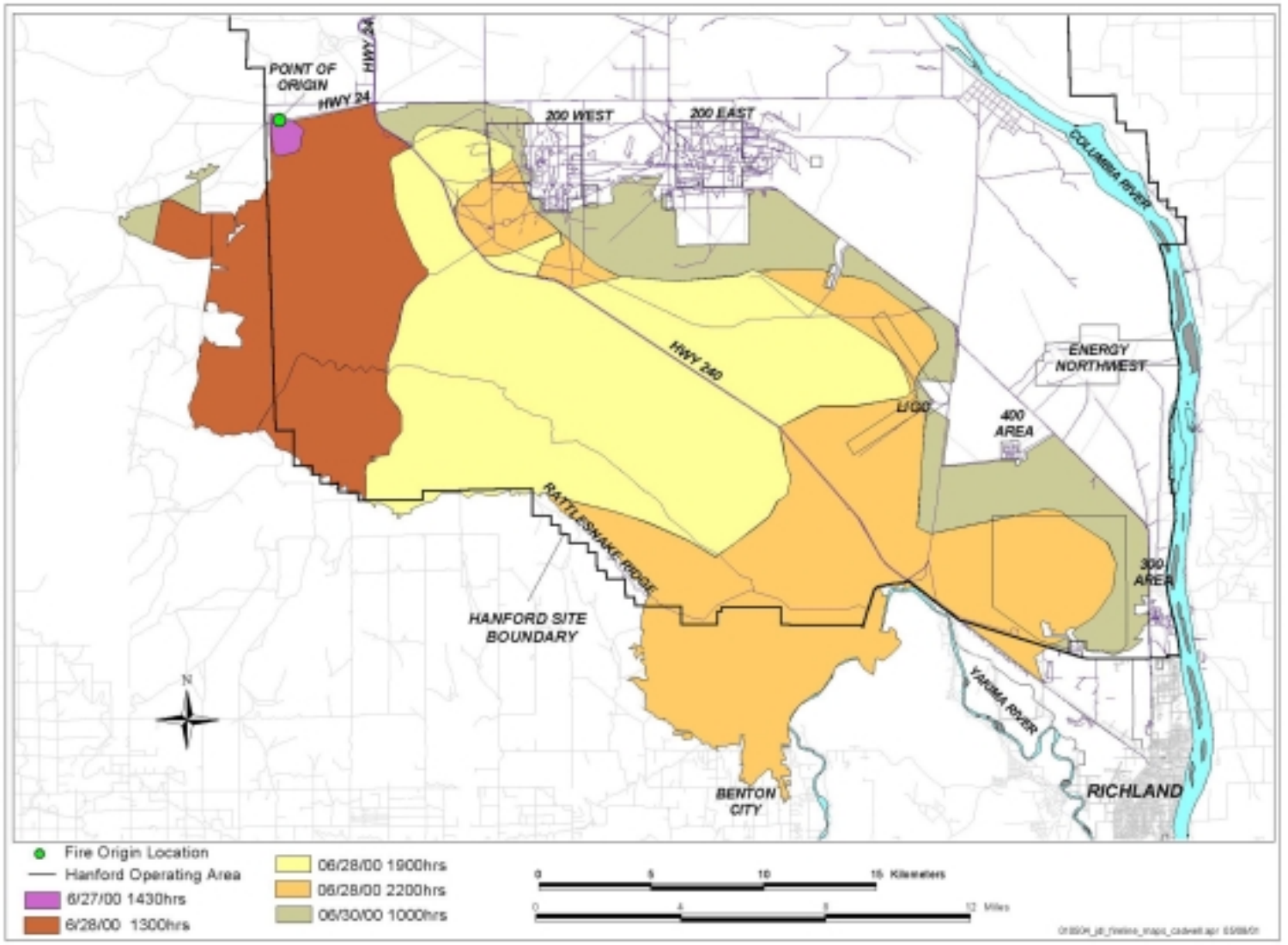


Figure 5.1. Progression of the 2000 Hanford Site Wildfire, June 27 through June 30, 2000

reported on the Washington State Department of Health website at http://www.doh.wa.gov/ehp/rp/epa_data.htm.

The rest of this chapter summarizes air monitoring efforts during and after the fire including post-fire radionuclide monitoring of farm products, soil, ash, and natural vegetation on and around the Hanford Site; brief assessments of the impact to biological and cultural resources; and post-fire soil stabilization and revegetation efforts. Some sampling was conducted at a fire near Mabton, Washington (formally designated the Mule Dry Fire), in late August 2000, to compare monitoring results with those obtained from the 2000 Hanford wildfire. Mabton is a small community located ~32 kilometers (20 miles) southwest of the Hanford Site.

5.1 Air Monitoring

DOE personnel, agency officials, and contractor staff that convened at the Hanford Site emergency center in the late afternoon of June 28, 2000, recognized the potential for airborne suspension of Hanford contaminants if the fire reached waste disposal areas in and near the 200 Areas. This concern became the reason DOE deployed crews to collect environmental samples that evening. The Washington State Department of Health also notified selected staff to report to the emergency center for deployment. Surface Environmental Surveillance Project staff consulted with staff from the Near-Facility Environmental Monitoring Program and personnel from DynCorp, another Hanford Site contractor, to determine where DOE samples should be collected. Hanford meteorology personnel manned the Hanford Meteorology Station near the 200-West Area to monitor changes in weather patterns and were present also at the emergency center throughout the evening. Wind predictions were updated at 15-minute intervals.

During the fire, DynCorp staff collected air samples along fire lines. Washington State Department of Health crews collected samples of airborne dust, smoke, and ash at locations on and off the site. EPA deployed crews to collect air particulate samples in communities at numerous locations around the Hanford Site from the evening of June 30 through July 3, 2000. The Surface Environmental Surveillance Project and Near-Field Environmental Monitoring Program already had continuous air particulate samplers operating on and around the site for their existing programs. Additional onsite air sampling was conducted by personnel from a DOE contractor and the Washington State Department of Health during months following the fire when strong winds suspended dust and ash into the air.

5.1.1 Near-Facility Air Monitoring

C. J. Perkins

Routine monitoring for radioactive particles in air near Hanford Site facilities in 2000 used a network of continuously operating air samplers at 85 locations (see Section 3.2, Table 3.2.2). Filter samples were usually collected biweekly; however, during the fire, the routine sampling schedule was modified (shortened) and samples were collected early so that they could be analyzed immediately. All air filter samples were screened for gross alpha and gross beta activity. They were then grouped (composited) into three sampling periods covering eight geographical onsite locations (Figure 5.2) and analyzed for specific radionuclides. The geographic composite groups and individual sampling locations are listed in Appendix B, Table B.11.

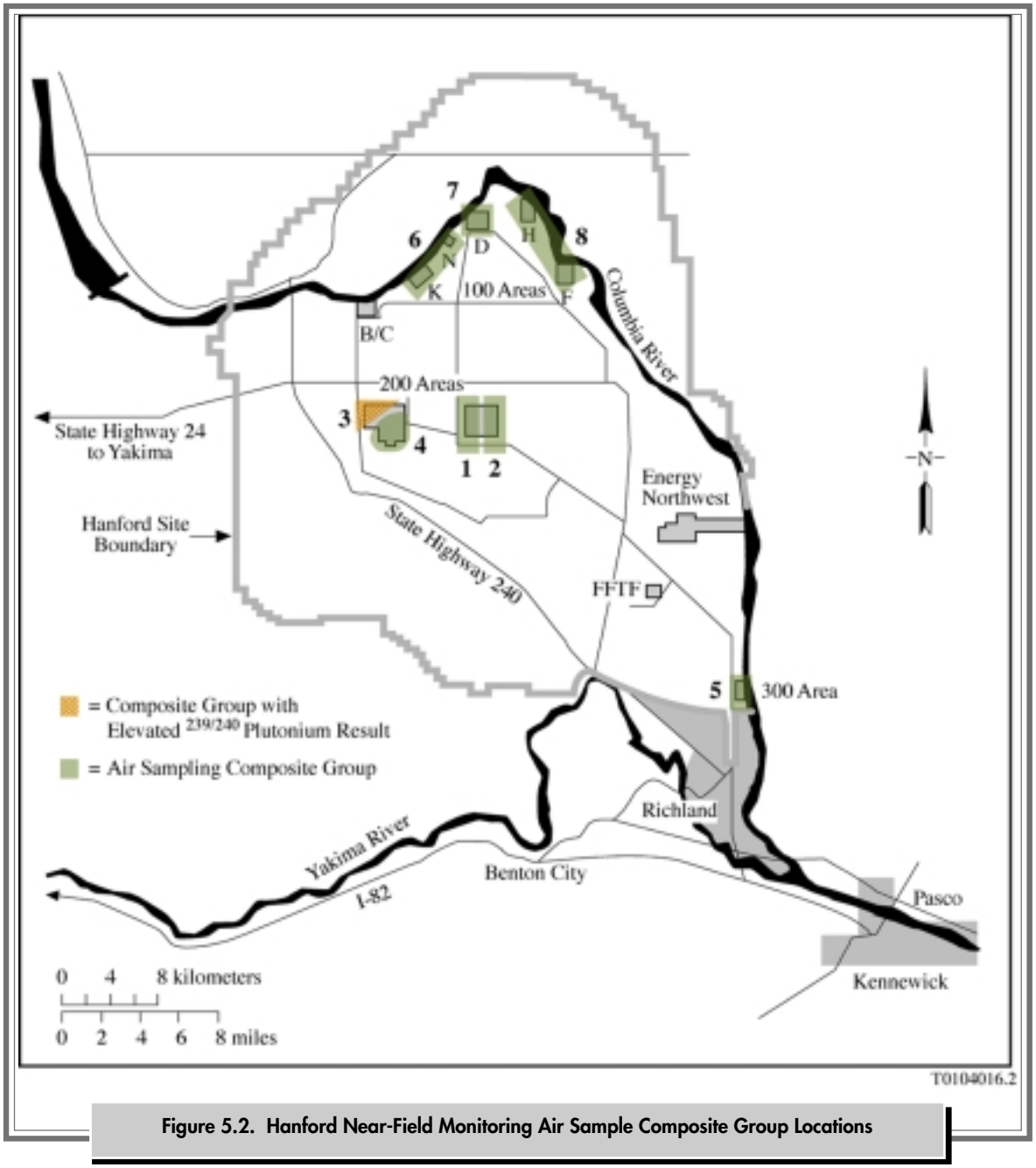


Figure 5.2. Hanford Near-Field Monitoring Air Sample Composite Group Locations

The three sampling periods included:

- June 26 through June 30, 2000. Sampling during the fire ended when the fire was under control and workers were allowed to return to the site
- June 30 through July 10, 2000, immediately following the fire. There were several windstorms during this period that created locally dense levels of airborne dust and ash in the 200 Areas
- July 10 through July 24, 2000.

5.1.1.1 Near-Facility Air Monitoring Results

Radionuclide concentrations in near-facility air samples were compared to the DOE derived concentration guides (see Appendix D, Table D.5). Derived concentration guides are concentrations of radionuclides in air that if continuously inhaled at an annual average rate, would result in an effective dose equivalent of 100 mrem/yr. Results for strontium-90, uranium isotopes, and plutonium-239/240 in samples representing the eight geographic composite groups are shown in Table 5.1 and compared to concentrations from their respective operational areas measured during the time period 1995 through 1999. A complete listing of near-facility air sampling results for 2000 is in PNNL-13487, APP. 2. Analytical results from fire related samples are summarized below.

Gross Alpha and Gross Beta Analyses. Gross alpha concentrations measured in the 200 Areas appeared to be elevated only for samples collected while the fire was burning. Ash and smoke may have contained elevated levels of natural uranium and its short-lived decay progeny that could have increased gross alpha results. The increase in gross alpha, which is common to all range fires where vegetation is burned, was exacerbated when samples were held for just 4 to 5 days prior to analysis to allow the natural activity of uranium progeny to decay away. Routinely collected samples are held for at least 7 days prior to analysis to allow this decay to occur. Gross alpha and gross beta concentrations measured after the fire in the 200 Areas, and for all three sampling periods in the 100 and 300 Areas, were consistent with mean (±2 standard error of the mean) historical levels of 0.0011 ± 0.00004 (alpha) and 0.015 ± 0.0005 (beta) pCi/m^3 (Table 5.2).

Specific Radionuclide Analyses. Samples were analyzed for strontium-90, uranium-234, uranium-235, uranium-238, plutonium-239/240, and gamma-emitting radionuclides (e.g., cesium-137). During the first sampling period (June 26 through 30, 2000), the concentrations of strontium-90 at several locations exceeded the maximum concentration observed over the 5-year period, 1995 through 1999 (see Table 5.1). The maximum strontium-90 value detected during the first sampling period was 0.0029 pCi/m^3 in the 200 Areas and was 3,000 times lower than the DOE derived concentration guide (9 pCi/m^3). Maximum uranium concentrations were detected during the third sampling period (July 10 through 24, 2000) around the 300 Area, but concentrations did not exceed maximum values reported over the preceding 5 years for the same location and were about 100 times lower than the DOE derived concentration guide (0.1 pCi/m^3). The maximum concentration of plutonium-239/240 (0.0016 pCi/m^3) was measured in a sample collected during the second sampling period (June 30 through July 10, 2000) in the 200-West Area. This concentration was greater than the maximum result reported for the site within the past 5 years, but about 12 times lower than the DOE derived concentration guide for plutonium-239/240 (0.02 pCi/m^3). For all three sampling periods, manmade gamma-emitting radionuclides and plutonium-238 concentrations were consistently either below analytical detection limits or at background levels.

5.1.2 Sitewide and Offsite Air Monitoring

B. M. Gillespie

Surface Environmental Surveillance Program staff prepared a special collection and analysis plan for fire-related air particulate samples using existing air particulate sampling stations. The special collection and analysis plan called for the early collection of selected samples at some locations through June 28, 2000, and the collection of an extra sample at several locations during the fire. The plan focused on locations around the Hanford Site perimeter and at nearby communities. Priority handling and analysis of samples at the laboratory

Table 5.1. Summary of Near-Facility Air Sampling Results from the June 2000 Hanford Site Wildfire Compared to Previous Years

Isotope	Composite Group	Location	Sample Period 1[a] Result (pCi/m³)[b]	Sample Period 2[a] Result (pCi/m³)[b]	Sample Period 3[a] Result (pCi/m³)[b]	1995-1999 Average (pCi/m³)[c]	1995-1999 Maximum (pCi/m³)[d]
Strontium-90	1	200-East	0.0018 ± 0.00063	0.00086 ± 0.00026	0.00025 ± 0.00015	0.00038 ± 0.00021	0.0098 ± 0.0012
	2		0.0015 ± 0.0006	0.00056 ± 0.00022	0.0001 ± 0.0001		
	3	200-West	**0.0029 ± 0.00072**	0.00041 ± 0.00025	0.00015 ± 0.00014	0.00031 ± 0.00005	0.0015 ± 0.0003
	4		0.0014 ± 0.00057	0.0007 ± 0.00024	0.00011 ± 0.00013		
	5	300 Area	0.00085 ± 0.00034	0.0013 ± 0.00052	-0.000068 ± 0.00024	0.00029 ± 0.000095	0.00043 ± 0.00031
	6	100-N/100-K	0.0019 ± 0.00061	0.00036 ± 0.0002	0.0002 ± 0.00011	0.0003 ± 0.000068	0.0016 ± 0.00026
	7	100-D	0.0019 ± 0.00076	0.00077 ± 0.00031	0.00043 ± 0.00017	0.00046 ± 0.00018	0.0015 ± 0.00045
	8	100-H/100-F	0.0013 ± 0.0006	0.00083 ± 0.00021	0.000054 ± 0.00012	0.0004 ± 0.00016	0.00089 ± 0.00059
Uranium-234	1	200-East	0.000037 ± 0.000023	0.000051 ± 0.00002	0.000036 ± 0.000014	0.000019 ± 0.0000018	0.000086 ± 0.000048
	2		0.000048 ± 0.000024	0.000034 ± 0.000014	0.000024 ± 0.00001		
	3	200-West	0.00004 ± 0.000031	0.000027 ± 0.000015	0.000026 ± 0.000011	0.000021 ± 0.000003	0.00024 ± 0.000038
	4		0.000064 ± 0.000032	0.000045 ± 0.000018	0.000024 ± 0.000011		
	5	300 Area	0.000055 ± 0.000024	0.000059 ± 0.000028	**0.0002 ± 0.000056**	0.000054 ± 0.00002	0.0001 ± 0.000037
	6	100-N/100-K	0.000036 ± 0.000026	0.000021 ± 0.000011	0.000016 ± 0.0000072	0.000024 ± 0.0000045	0.00012 ± 0.000029
	7	100-D	0.000067 ± 0.000036	0.00003 ± 0.000015	0.000038 ± 0.000014	0.000023 ± 0.0000031	0.000041 ± 0.000018
	8	100-H/100-F	0.000014 ± 0.000017	0.000026 ± 0.000012	0.000026 ± 0.000011	0.000026 ± 0.0000049	0.000052 ± 0.000033
Uranium-235	1	200-East	0.000014 ± 0.000014	0.0000044 ± 0.0000053	0.0000083 ± 0.0000067	0.000012 ± 0.0000019	0.000053 ± 0.000028
	2		0.000006 ± 0.000015	0.0000012 ± 0.000012	0.0000061 ± 0.0000059		
	3	200-West	0.000026 ± 0.000022	0.00001 ± 0.0000096	0.00001 ± 0.0000069	0.000011 ± 0.0000014	0.000052 ± 0.000014
	4		0.000014 ± 0.000017	0.000015 ± 0.0000099	0.0000071 ± 0.0000055		
	5	300 Area	0.0000083 ± 0.000016	0.000015 ± 0.000021	0.000016 ± 0.000014	0.000025 ± 0.000012	0.0001 ± 0.000037
	6	100-N/100-K	0.000024 ± 0.000019	0.0000054 ± 0.0000081	0.0000045 ± 0.0000038	0.000014 ± 0.0000047	0.0001 ± 0.000026
	7	100-D	**0.000028 ± 0.000024**	0.0000062 ± 0.0000062	0.0000083 ± 0.0000065	0.000014 ± 0.0000035	0.000034 ± 0.000024
	8	100-H/100-F	0.000022 ± 0.000018	0.0000048 ± 0.0000058	0.000011 ± 0.0000064	0.000012 ± 0.0000047	0.000026 ± 0.000016

Table 5.1. (contd)

Isotope	Composite Group	Location	Sample Period 1[a] Result (pCi/m³)[b]	Sample Period 2[a] Result (pCi/m³)[b]	Sample Period 3[a] Result (pCi/m³)[b]	1995-1999 Average (pCi/m³)[c]	1995-1999 Maximum (pCi/m³)[d]
Uranium-238	1	200-East	0.000025 ± 0.000018	0.000016 ± 0.00001	0.000022 ± 0.00001	0.000015 ± 0.0000017	0.0001 ± 0.000058
	2		0.00004 ± 0.000024	0.000019 ± 0.000011	0.000016 ± 0.0000077		
	3	200-West	0.000036 ± 0.000025	0.00003 ± 0.000016	0.000034 ± 0.000014	0.000016 ± 0.000003	0.00026 ± 0.000042
	4		0.000035 ± 0.000024	0.000029 ± 0.000015	0.000029 ± 0.000012		
	5	300 Area	0.000028 ± 0.000017	0.000026 ± 0.000019	**0.00015 ± 0.000047**	0.000039 ± 0.000011	0.00011 ± 0.000052
	6	100-N/100-K	0.000022 ± 0.000021	0.000023 ± 0.000011	0.000011 ± 0.0000058	0.000018 ± 0.0000038	0.000083 ± 0.000022
	7	100-D	0.000021 ± 0.000023	0.000024 ± 0.000012	0.000022 ± 0.00001	0.000019 ± 0.0000041	0.000058 ± 0.000031
	8	100-H/100-F	0.000017 ± 0.000015	0.000015 ± 0.0000093	0.000017 ± 0.0000078	0.000026 ± 0.00001	0.000089 ± 0.00005
Plutonium-239/240	1	200-East	0.000024 ± 0.00002	0.000024 ± 0.000017	0.000011 ± 0.0000076	0.00001 ± 0.0000029	0.000064 ± 0.000024
	2		0.0001 ± 0.000044	0.0000095 ± 0.0000074	0.0000048 ± 0.0000044		
	3	200-West	0.000057 ± 0.000044	**0.0016 ± 0.0003**	0.000028 ± 0.000015	0.000018 ± 0.0000037	0.00013 ± 0.000042
	4		0.000039 ± 0.000028	0.000013 ± 0.0000095	0.000023 ± 0.000011		
	5	300 Area	0.000096 ± 0.000035	0.0000054 ± 0.0000076	0.000041 ± 0.000023	0.0000086 ± 0.0000052	0.000012 ± 0.0000068
	6	100-N/100-K	0.000018 ± 0.000016	0.0000036 ± 0.0000043	0.0000074 ± 0.0000056	0.00002 ± 0.0000064	0.00001 ± 0.000035
	7	100-D	0.000044 ± 0.000048	0.0000032 ± 0.000009	0.00001 ± 0.0000088	0.000019 ± 0.0000092	0.000061 ± 0.000027
	8	100-H/100-F	-0.0000092 ± 0.000013	-0.0000046 ± 0.0000074	0.000018 ± 0.0000099	0.000017 ± 0.0000088	0.000042 ± 0.000031

(a) First sample period = June 26-30, 2000; second sample period = June 30 - July 10, 2000; third sample period = July 10-24, 2000.
(b) ± counting error. Bold results indicate maximum values.
(c) ±2 standard error of the mean.
(d) ± counting error.

Table 5.2. Near-Facility Air Monitoring Program Gross Alpha and Beta Results for Air Samples Collected in the 200 Areas during the 2000 Hanford Site Wildfire, and during the Period 1995 through 1999

2000 Hanford Site Wildfire

	Gross Alpha, pCi/m³		Gross Beta, pCi/m³	
Sampling Period	**Mean[a]**	**Maximum[b]**	**Mean[a]**	**Maximum[b]**
June 26 - 30, 2000	0.0043 ± 0.00059	0.0095 ± 0.0031	0.02 ± 0.0013	0.029 ± 0.0055
June 30 - July 10, 2000	0.0013 ± 0.0002	0.0023 ± 0.00097	0.0079 ± 0.00071	0.013 ± 0.0019
July 10 - 24, 2000	0.0011 ± 0.00013	0.002 ± 0.00076	0.011 ± 0.00088	0.016 ± 0.0016

1995 through 1999

	Gross Alpha, pCi/m³		Gross Beta, pCi/m³	
Sampling Period	**Mean[a]**	**Maximum[b]**	**Mean[a]**	**Maximum[b]**
January 1995 - December 1999	0.0011 ± 0.000035	0.049 ± 0.014	0.015 + 0.00048	0.49 ± 0.04

(a) ±2 standard error of the mean.
(b) ±2 sigma total propagated analytical error.

were requested for some samples collected during and shortly after the wildfire. The modified sampling schedule is listed in Appendix B, Table B.12.

During and after the fire, the analytical laboratory was directed to provide priority turnaround times for samples from specific locations for a quick evaluation of public exposure to radioactive materials released during the fire. Selected samples were individually analyzed for gamma emitters prior to compositing. These results were then compared to results from samples collected and analyzed by other agencies. All samples were analyzed according to contract and laboratory procedures so that results could be compared to historical results.

5.1.2.1 Sitewide and Offsite Air Monitoring Results

There appeared to be no increase in gross alpha or gross beta concentrations in samples collected on the site, at the site perimeter, or at distant sampling locations during the fire (Figures 5.3 and 5.4; also see Section 4.1, Figures 4.1.2 and 4.1.3). The results for samples analyzed for gamma-emitting radionuclides prior to compositing were all below minimum detectable levels. After compositing, gamma results were also below minimum detectable levels (see Section 4.1.2 for discussion of sample results below the minimum detectable level). Strontium-90 concentrations were all within the normal annual range of concentrations recorded for the past 5 years (see Figure 4.1.5). Plutonium levels appeared elevated in five surveillance samples (Table 5.3), however, only the Prosser Barricade and 100 Area samples exceeded the maximum value detected over the preceding 5 years for each specific location. Two slightly elevated uranium-238 concentrations were also seen following the fire (see Table 5.3). The highest was seen at Byers Landing, an offsite station located across the Columbia River from the 300 Area. For all seven samples, the observed concentrations were below DOE derived concentration guides for plutonium-239/240 (0.02 pCi/m³) and uranium-238 (0.1 pCi/m³).

No other radionuclide concentrations were above levels observed in routine samples collected during the past 5 years (see Section 4.1.2 for a comparison of 2000 data with data from previous years).

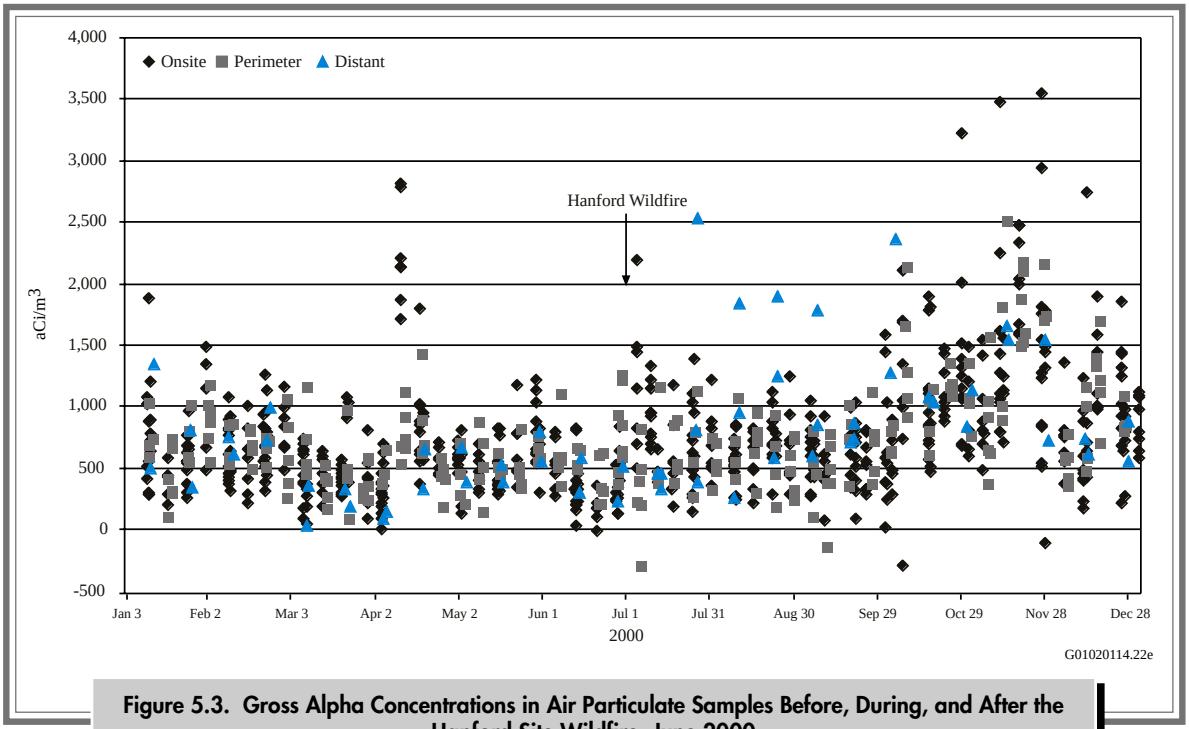


Figure 5.3. Gross Alpha Concentrations in Air Particulate Samples Before, During, and After the Hanford Site Wildfire, June 2000

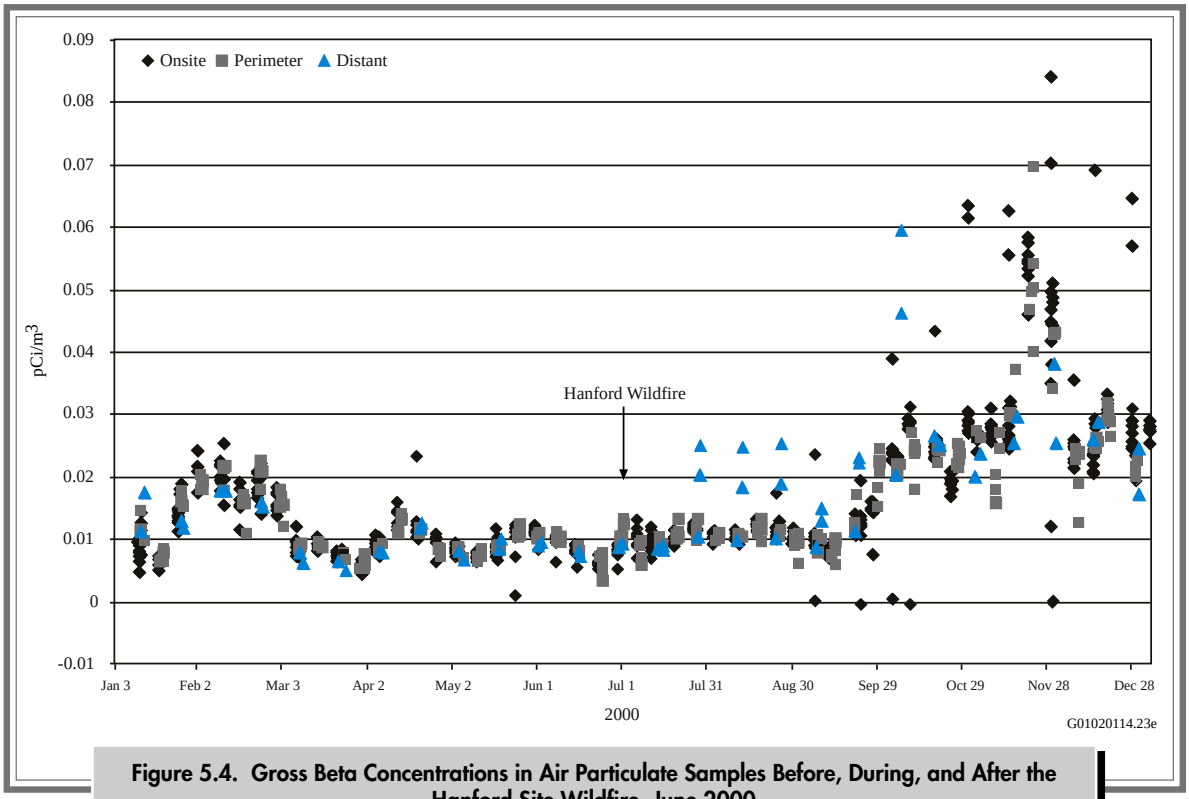


Figure 5.4. Gross Beta Concentrations in Air Particulate Samples Before, During, and After the Hanford Site Wildfire, June 2000

Table 5.3. Elevated Concentrations of Plutonium-239/240 and Uranium-238 Observed in Surveillance Air Samples Collected after the 2000 Hanford Site Wildfire Compared to Maximum and Annual Mean Values from 1995 through 1999

	Following 2000 Hanford Site Fire		1995-1999	
Sample Site (Number)[a]	Collection Date (2000)	Sample Result[b]	Maximum[b]	Mean[c]
		Plutonium-239/240, pCi/m^3		
200-West (14)	July 5	0.000004 ± 0.000003	0.000009 ± 0.000002	0.000003 ± 0.000005
200-West (14)	September 26	0.000006 ± 0.000004	0.000009 ± 0.000002	0.000003 ± 0.000005
200-West Southeast Composite (11, 12, 13)	September 26	0.000003 ± 0.000002	0.000003 ± 0.000001	0.000001 ± 0.000002
100 Areas Composite (1, 2, 3)	October 3	0.000006 ± 0.000002	0.000005 ± 0.000002	0.000002 ± 0.000003
Prosser Barricade (31)	October 6	0.000004 ± 0.000002	0.0000005 ± 0.0000009	0.0000001 ± 0.0000004
		Uranium-238, pCi/m^3		
Byers Landing (28)	September 29	0.00014 ± 0.000003	0.00006 ± 0.00002	0.00004 ± 0.00002
300 Area Trench (18)	October 5	0.00008 ± 0.000002	0.00005 ± 0.00001	0.00003 ± 0.00002

(a) See Figure 4.1.1 for sample site locations.
(b) Value ±2 sigma total propagated analytical error.
(c) Value ±2 standard deviation of the mean for each location.

Comparisons with the Mabton Wildfire. Particulate air samples were collected for DOE on August 25 through 31, 2000, at locations downwind of a wildfire burning near Mabton, Washington, in the southeastern portion of the state (formally designated the Mule Dry Fire based on its point of origin). This fire occurred in an area generally upwind of the Hanford Site. Samples were collected to compare analytical data with data from samples collected on or near the Hanford Site during and after the June wildfire to see if comparable concentrations of strontium-90, plutonium isotopes, and uranium isotopes would be found. A portable high-volume air sampling system was used to filter ~28.3 m^3 (1,000 ft^3) of air over 1-hour sampling periods. The intent was to collect as much particulate matter on the filters as possible so that the detection of radionuclides would be enhanced. Eight filter samples were collected and analyzed for strontium-90, uranium-234, uranium-235, plutonium-238, and plutonium-239/240.

Mabton Fire Monitoring Results. None of the stronium-90, plutonium-238, or plutonium-239/240 results were above minimum detectable levels (about 0.000532 pCi/m^3, 0.000021 pCi/m^3, and 0.000024 pCi /m^3, respectively). Concentrations of uranium-234, uranium-235, and uranium-238 were similar to concentrations obtained during routine air surveillance at the Hanford Site and vicinity (see PNNL-13487, APP.1.). No firm conclusions could be drawn after comparing the Mabton plutonium-239/240 and strontium-90 results to the June wildfire results because all concentrations from the Mabton fire were below minimum detectable levels.

5.1.3 EPA Air Monitoring

T. M. Poston

EPA collected 61 air samples from 23 locations in communities surrounding the Hanford Site. Samples were collected during the latter stages of

and after the fire from June 30 through July 3, 2000. The high-volume air particulate samples were each collected for periods of about 24 hours and analyzed for cesium-137 and other gamma-emitting radionuclides, strontium-90, uranium-234, uranium-235, uranium-238, plutonium-238, and plutonium-239/240.

5.1.3.1 EPA Air Monitoring Results

Neither gamma emitters (cesium-137) nor strontium-90 were detected in any sample. Uranium-238 was detected in nearly all samples and was determined to represent background concentrations of natural uranium (http://www.doh.wa.gov/ehp/rp/epa_data.htm).

Plutonium-239/240 was detected in six samples collected from 10:00 p.m. June 30 through 8:00 a.m. July 3, 2000. Five of these samples were collected in the Tri-City area (Figure 5.5). Concentrations of plutonium-239/240 in the Tri-City samples ranged from 0.00014 to 0.00042 pCi/m^3 (Table 5.4). The analytical error associated with the measurements ranged from ~9 to 13%. Relatively strong winds (usually greater than 7.2 meters per second [16 miles per hour]) blew across the Hanford Site during three separate periods when EPA was collecting these air samples. The northwesterly winds blew for ~30 to 39% of the times the air samplers were operating and carried suspended dust and ash from burned areas towards the Tri-Cities. The sixth sample was collected in Sunnyside, Washington, and had a plutonium-239/240 concentration of 0.000065 (±60%) pCi/m^3. The relatively high analytical error associated with this analysis suggests that the value was very close to the limits of detection. All other plutonium concentrations collected in the remaining 55 samples were below detection (<0.00005 pCi/m^3).

It is reasonable to conclude that the elevated plutonium concentrations in air samples detected in the Tri-City area were attributable to suspended ash and/or dust carried from the 200 Areas by high winds. Onsite monitoring by Hanford Site contractor personnel also measured elevated levels of plutonium-239/240 on air filters (see Sections 5.1.1.1 and 5.1.2.1). All measured plutonium-239/240 concentrations in samples collected at onsite and offsite locations during and after the fire were well below regulatory limits (e.g., DOE derived concentration guide = 0.02 pCi/m^3). Dose estimates associated with the elevated plutonium levels in the Tri-City area samples are discussed in Section 6.0.

5.2 Special Garden Vegetable and Milk Sampling

B. L. Tiller

Special samples of vegetables (produce) and milk were collected in August 2000 from the gardens of private citizens in the Tri-Cities area (see Figure 5.5). Samples were collected to monitor the radioactive dust and ash deposited from the Hanford wildfire. Five cabbage and four tomato samples were analyzed for plutonium-238 and plutonium-239/240. Twelve milk samples routinely collected each quarter but not usually analyzed for plutonium were analyzed for plutonium-238 and plutonium-239/240. Two samples of goat milk collected from nearby downwind areas also were analyzed for plutonium. Plutonium-238 and plutonium-239/240 concentrations in all produce and milk samples were at or below their analytical detection limits (~0.00003 pCi/g wet weight for milk, or 0.1 pCi/L for produce).

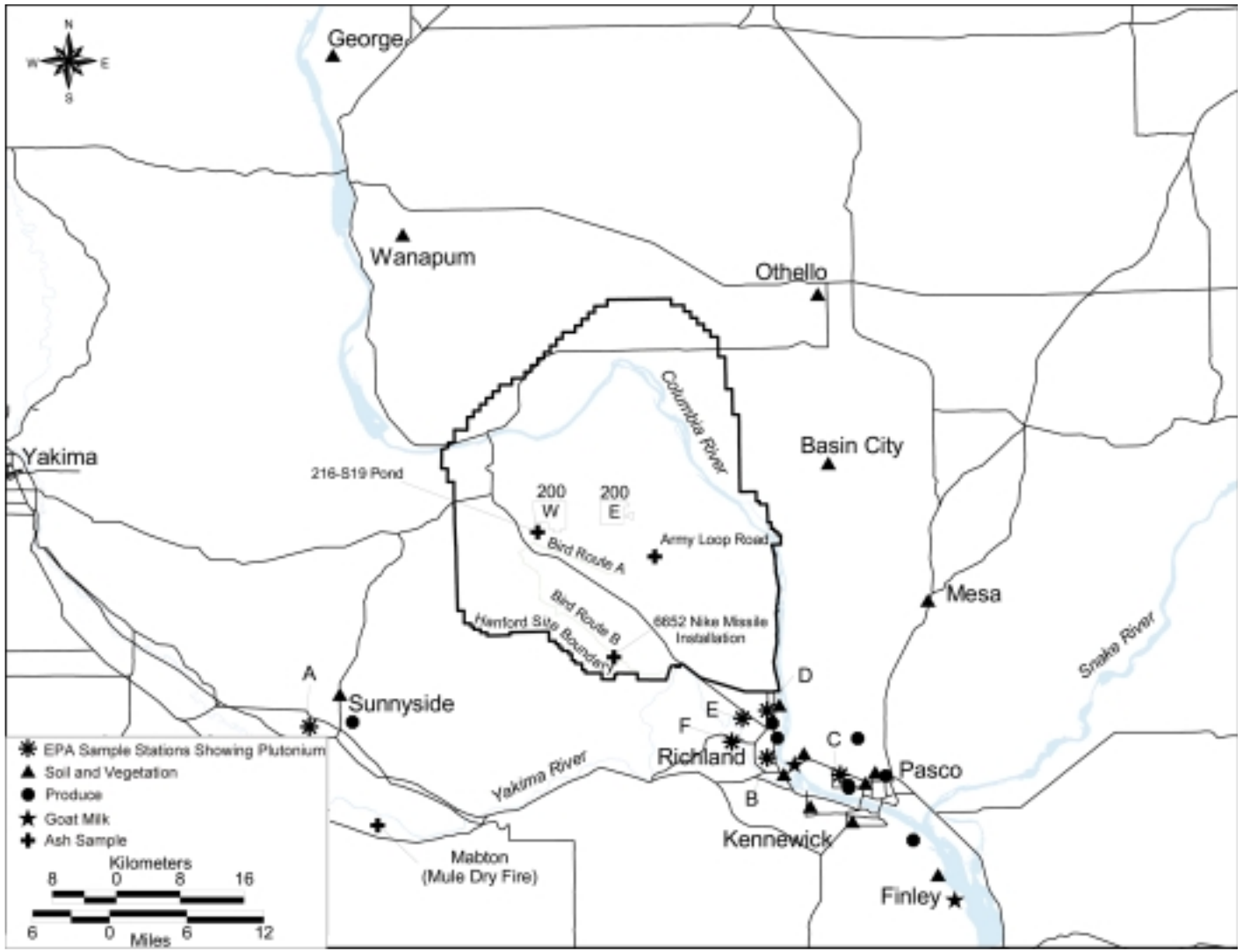


Figure 5.5. Special Air (EPA), Ash, Soil, Vegetation, Milk, and Garden Vegetable Sampling Locations for Post-Fire Collections near the Hanford Site, August 2000

Table 5.4. Comparison of Plutonium-239/240 Concentrations Measured by the U.S. Environmental Protection Agency around the Hanford Site with the Percentage of the Time Northwesterly Winds Crossed the Site

Sample Designation	Location[a]	Date (2000)	Concentration, pCi/m^3[b]	Analytical Error, %	Percentage of Sample Time with Winds >7.2 m/sec (16 mph)[c]
Sunnyside Fire Station	A	July 2-3	0.000065 ± 0.000041	63	NA[d]
Richland #6, Swift Blvd.	B	July 1-2	0.00036 ± 0.000045	13	31
Pasco #8, Road 48	C	July 1-2	0.00042 ± 0.000045	10	39
Richland, Crestview Rd.	D	June 30-July 1	0.00014 ± 0.000012	9	30
Richland, Preswick St.	E	June 30-July 1	0.00023 ± 0.000028	12	30
West Richland, Van Geisen Ave.	F	July 1-2	0.00026 ± 0.000027	10	30

(a) Refer to Figure 5.5 for locations.
(b) Value ±2 total propagated analytical error.
(c) Northwesterly winds blowing across the Hanford Site to the southeast.
(d) Not applicable; Sunnyside is upwind of the Hanford Site.

5.3 Special Soil and Vegetation Sampling

B. L. Tiller

Surface soil and perennial vegetation samples have been collected routinely on and around the Hanford Site for more than 50 years. Routine sampling of surface soil and vegetation was last conducted in 1998 (see PNNL-12088, Section 4.6). Special soil samples collected offsite in August 2000 (see Figure 5.5) in response to the 2000 Hanford wildfire consisted of five plugs of soil, each 2.54 centimeters (1 inch) deep and 10.2 centimeters (4 inches) in diameter, collected within 10 meters (33 feet) of one another and then combined into one bulk sample for analysis (PNL-MA-580). Additional samples consisting of five cores taken from only the top 1 centimeter of surface soil were also collected at each location. Perennial vegetation samples (see Figure 5.5) consisted of the current year's growth of leaves and stems collected from sagebrush and rabbit brush using standard procedures (PNL-MA-580).

5.3.1 Soil Sampling Results

The concentrations of plutonium-239/240 measured in soil are shown in Table 5.5. Concentrations of plutonium-239/240 in soil immediately southeast of the Hanford Site (i.e., Kennewick, Pasco, and Richland) appeared to be marginally elevated compared with samples from locations north and east of the site. Median post-fire concentrations of plutonium-239/240 were lower in all samples from offsite locations than in samples collected around the 200 Areas. Additionally, all plutonium-239/240 concentrations in samples collected offsite following the fire were lower than historic offsite plutonium-239/240 concentrations. All concentrations were well within the range of measurements at offsite locations for the years 1983 through 1998 as noted in Table 5.5. Concentrations of plutonium-239/240 were lower in samples of top 1 centimeter of soil compared to standard surface soil samples. If significant amounts of

Table 5.5. Concentrations of Plutonium-239/240 (pCi/g dry wt.) in Soil from Surveillance Sites Located on and around the Hanford Site, 1983 through 1998, and in Special Samples Collected in August 2000

Location	Mean[a]	Median	Maximum[b]	Minimum[b]	Number of Samples
			1983-1998		
100 Areas	0.013 ± 0.014	0.013	0.030 ± 0.004	0.0008 ± 0.008	42
200 Areas	0.086 ± 0.37	0.013	0.83 ± 0.027	0.0003 ± 0.0004	78
300 Area	0.014 ± 0.014	0.014	0.025 ± 0.004	0.0004 ± 0.0002	21
600 Area	0.010 ± 0.016	0.007	0.034 ± 0.004	0.0007 ± 0.0003	66
Offsite	0.010 ± 0.015	0.008	0.033 ± 0.004	0.00003 ± 0.00017	165
			2000 Special Soil Samples		
Sunnyside	NA[c]	NA	0.0055 ± 0.0011	NA	1
North/East of the Hanford Site	0.004 ± 0.005	0.004	0.0077 ± 0.0017	0.0023 ± 0.0006	5
Tri-City Vicinity	0.007 ± 0.014	0.005	0.018 ± 0.003	0.0002 ± 0.0002	8

(a) ±2 standard deviation.
(b) ±2 total propagated analytical error.
(c) NA = Not applicable.

plutonium-239/240 had been deposited onto the soil from the Hanford wildfire, concentrations of plutonium would have likely been higher in the top 1 centimeter samples.

5.3.2. Vegetation Sampling Results

Fourteen samples of perennial vegetation were collected in August 2000 (see Figure 5.5), and concentrations of plutonium-238/240 in all but one were at or below the level of detection (0.0004 pCi/g dry weight). A sample of gray rabbitbrush collected at the Yakima River delta near Richland had 0.0009 ± 0.0003 pCi/g dry weight of plutonium-239/240. The results overall were consistent with results from past measurements of plutonium-239/240 in vegetation.

5.4 Ash Samples

T. M. Poston

Samples of residual ash (burned natural vegetation) were collected by Surface Environmental Surveillance Project staff from the Mabton wildfire at the same time air samples were collected (see Section 5.1.2.1). Ash samples were collected at the Mabton wildfire to compare with similar samples collected near the 200 Areas by Government Accountability Project personnel and DOE following the 2000 Hanford wildfire. The two 200 Areas samples were collected near Army Loop Road to the southeast of the 200-East Area (see Figure 4.1.1), and close to the retired 216-S19 pond located to the south of the 200-West Area (see Figure 5.5).

A comparison of analytical results from Mabton wildfire samples and results from samples collected in the 200 Areas in July 2000 shows that the ash samples from the 200 Areas were higher in plutonium-238 and plutonium-239/240 (Figure 5.6). Plutonium concentrations were consistent with the historical pattern of contamination measured in vegetation samples collected from the 200 Areas back to 1983 (PNL-10728).

5.5 Biological and Cultural Resource Impacts of the Hanford Wildfire

This section describes some preliminary reviews and assessments of impacts to Hanford Site biological and cultural resources from the Hanford wildfire. A multi-agency report prepared by the U.S. Department of the Interior addresses some of the same issues in more detail (U.S. Department of the Interior 2000).

5.5.1 Habitat Loss

J. L. Downs

The June 2000 Hanford Wildfire has altered the composition of the shrub-steppe habitat in the burned area. The burn intensity of the wildfire was considered to be low, meaning that the soil and

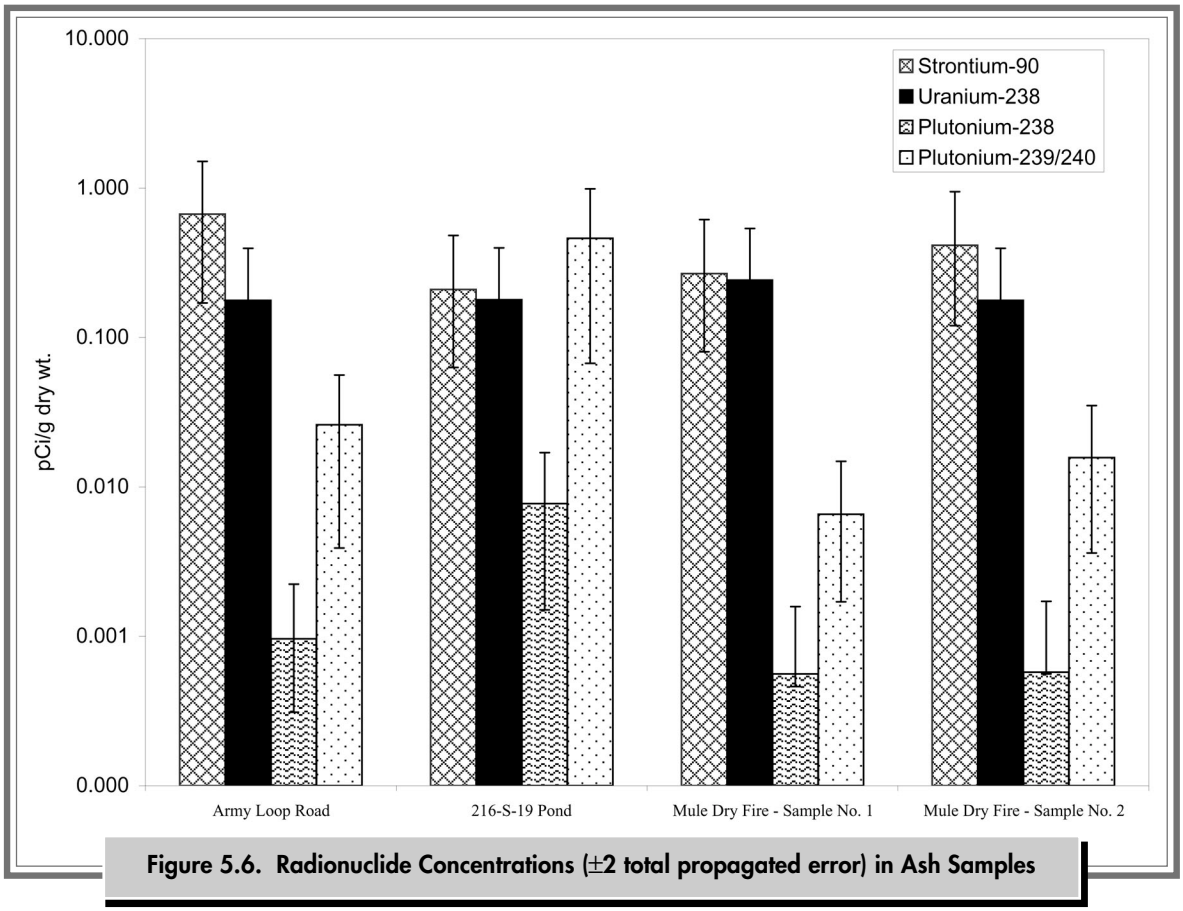


Figure 5.6. Radionuclide Concentrations (±2 total propagated error) in Ash Samples

buried seeds remained intact and the below ground portions of most perennial plants were unharmed and are expected to re-sprout as conditions permit. About 28,700 hectares (71,000 acres) of shrub habitat dominated by big sagebrush and ~13,300 hectares (32,800 acres) of grassland habitat dominated by native grasses were burned in the fire. Most of the vegetation is expected to recover within 1 to 3 years to a configuration resembling the pre-fire conditions, except for sagebrush. The re-establishment of big sagebrush stands is likely to take at least 5 to 10 years, and it potentially could be decades before sagebrush is once again an important feature of the landscape.

5.5.2 Hanford Elk

B. L. Tiller

Elk are mobile animals capable of escaping most wildfires when there is an escape route. Post-fire surveys of adult elk on the Hanford Site suggested very low mortality of adult elk as a result of the June wildfire. However, the wildfire occurred in the middle of the calving season and may play a role in reducing the number of calves that survive to adulthood in the summer of 2001. The long-term impact of the wildfire on the Hanford elk herd is still uncertain.

The wildfire resulted in a temporary relocation of the Hanford elk herd. Figure 5.7 shows post-calving period (July through August) animal locations grouped by decade (1980s and 1990s) and for 2000. Since the 1980s, elk have increased their use of private and Washington State Department of Fish and Wildlife land along the southern boundary of the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit. Data collected after the June 2000 fire indicated that Hanford elk spent a considerable portion of their time foraging on private lands south of the burn area.

5.5.3 Bird Responses to the Fire

W. H. Rickard

Bird use of the shrub-steppe habitat on the Hanford Site has been monitored monthly for the past 12 years. Road surveys were used to cover relatively large areas in a short period of time. Two routes, A and B, were within the area covered by the Hanford wildfire (see Figure 5.5). Birds were identified and counted during 3-minute stops at 0.8-kilometer (0.5-mile) intervals along the survey routes. Surveys were conducted monthly from October 1998 through October 2000. During that time, the vegetation along route A consisted primarily of stands of bluebunch wheatgrass. This area had previously burned and most of the sagebrush had been killed. Along route B, the vegetation consisted of large patches of sagebrush with an understory of cheatgrass. Nearly all vegetation was burned along both routes during the 2000 Hanford wildfire.

The total number of species along both routes decreased after the fire (July 2000) compared to July 1999 (Figure 5.8). The abundance of birds is shown in Figure 5.9. There was a substantial decline in the abundance of birds within the burned-off sagebrush habitat, but the total number of birds counted in the burned-off bunchgrass habitat (Route A) was actually greater in July 2000 following the fire than it was the previous year (July 1999). Species of birds dependent on large sagebrush for habitat will be most severely affected by the fire.

5.5.4 Cultural Resources

D. W. Harvey and L. L. Hale

The Hanford Cultural Resources Laboratory assessed the impact of the June 2000 Hanford

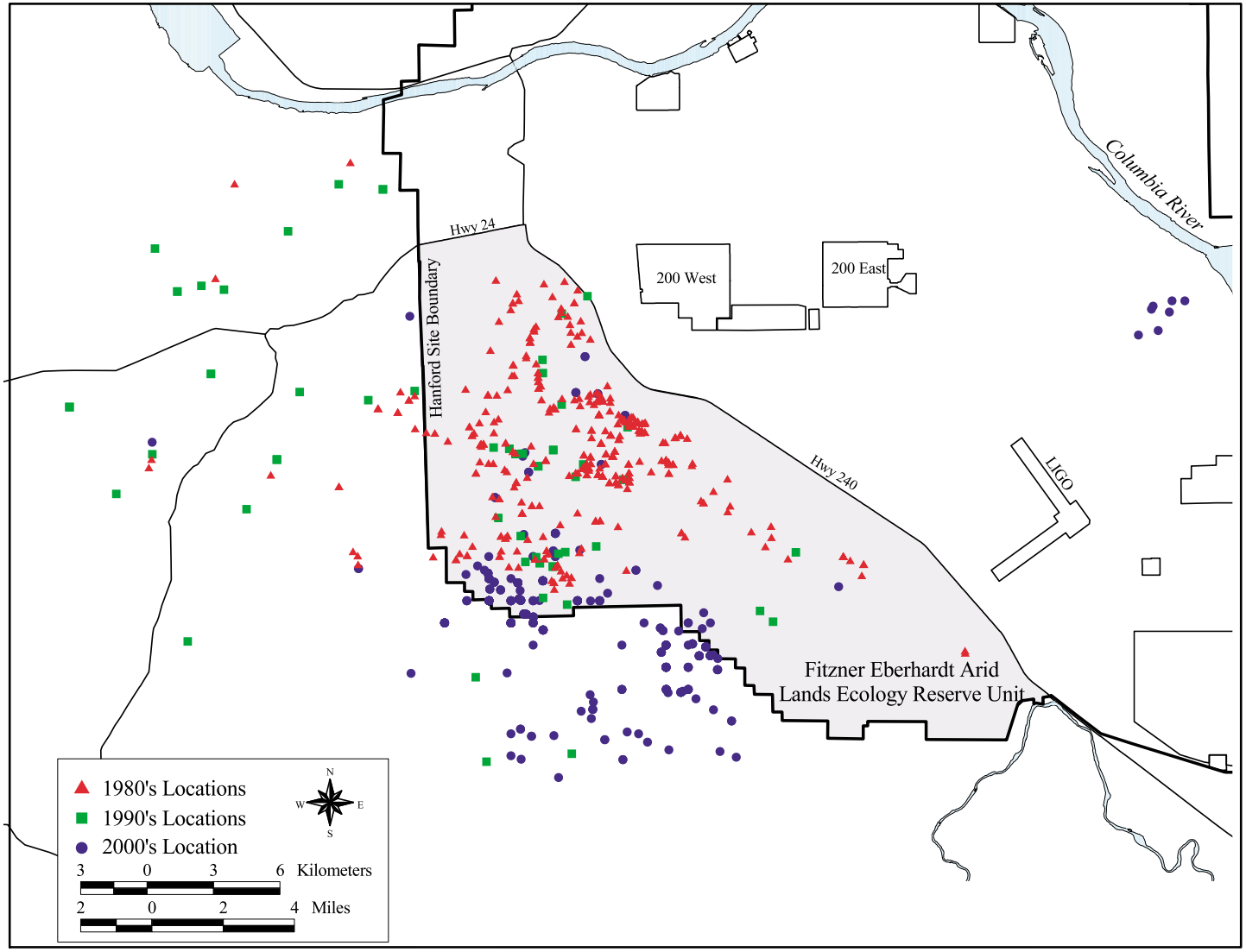
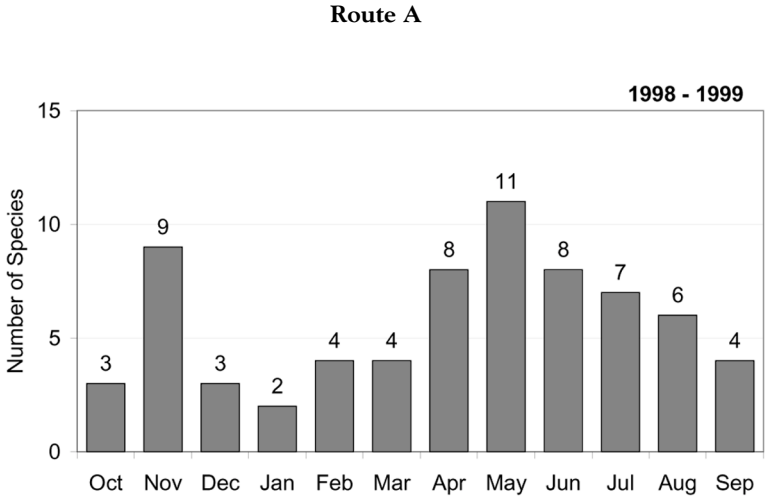
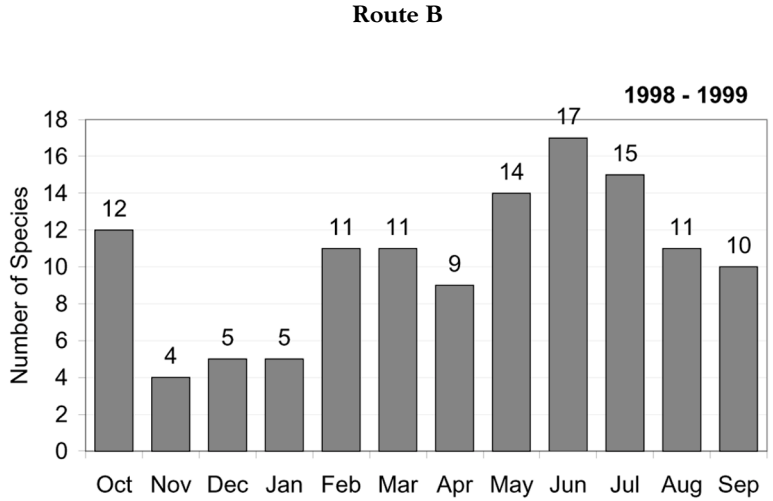
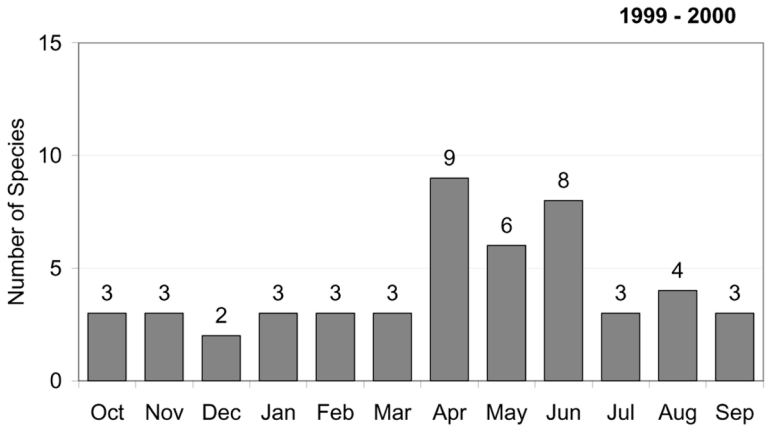


Figure 5.7. Post-Fire (July-August) 2000 Elk Locations Compared with July-August Locations for the 1980s and 1990s







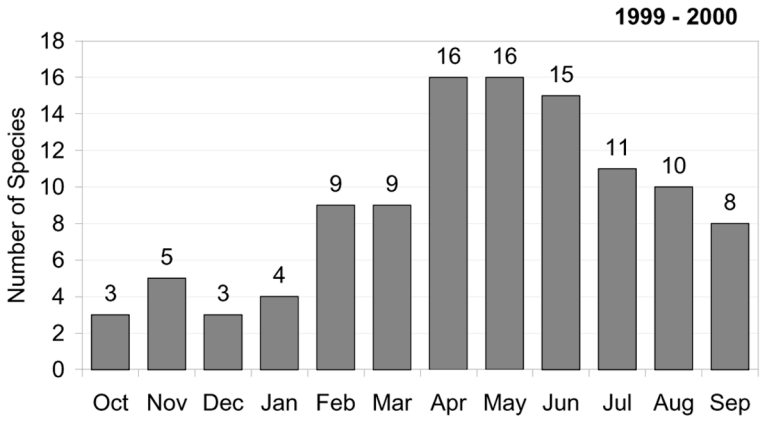


Figure 5.8. Total Number of Bird Species Counted during Roadside Surveys in 1998-1999 and 1999-2000 along Two Routes on the Hanford Site

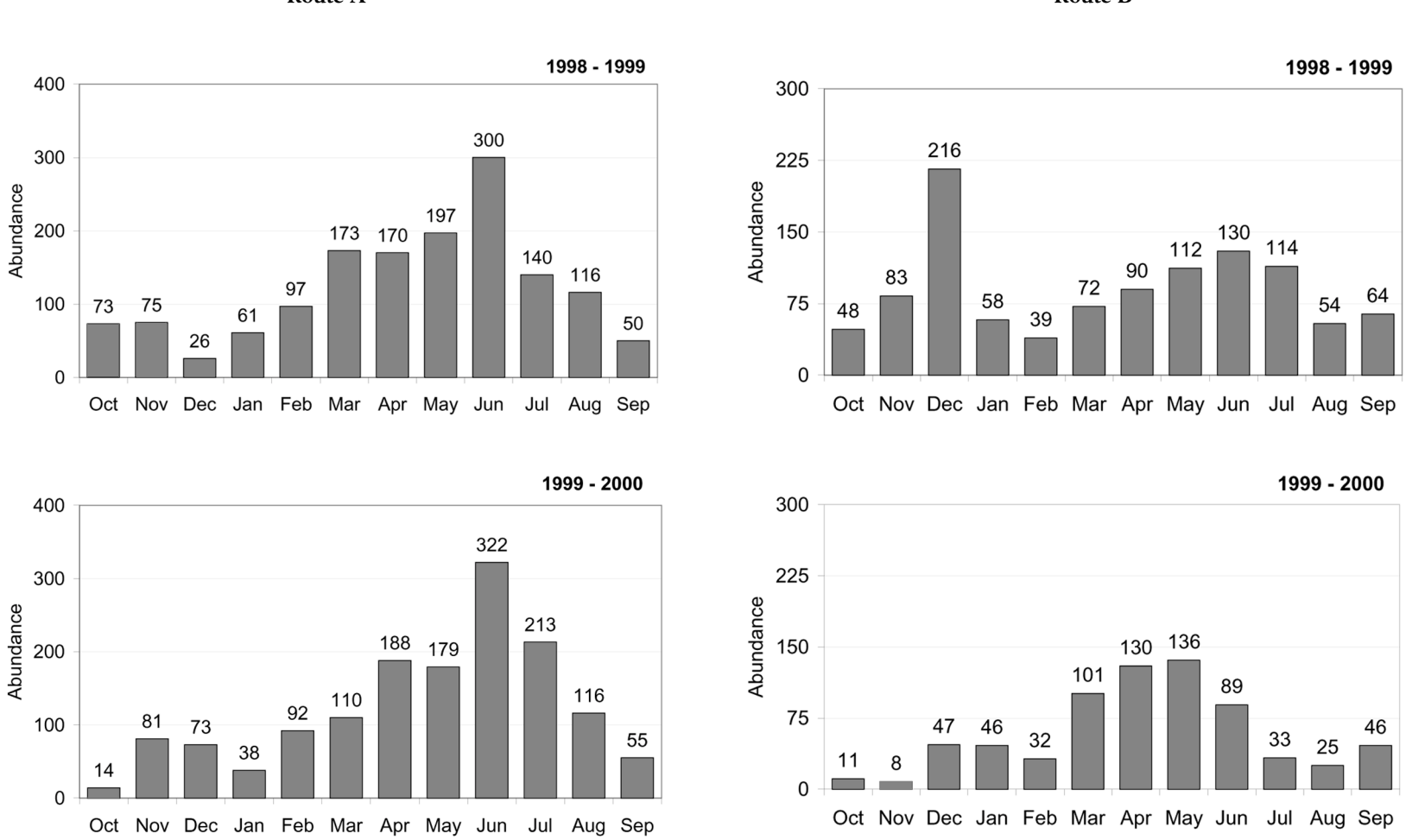


Figure 5.9. Number of Birds Counted during Roadside Surveys in 1998-1999 and 1999-2000 along Two Routes on the Hanford Site

wildfire on cultural resources in the fall of 2000. Members of the Confederated Tribes of the Umatilla Indian Reservation, the Wanapum People, and the Nez Perce Tribe assisted. All previously known archaeological sites, Traditional Cultural Properties, and cold-war era military properties within the burned area on the Hanford Site were located and assessed. If unrecorded sites were located during the course of the assessment, they were noted.

Survey results showed that effects of the wildfire on cultural resources resulted from subsequent soil erosion in some areas. The area along the White Bluffs Road, which was covered over by windblown sand, was the most greatly affected. Other items noted included recreational impacts from dirt bikes near the ethnographic village of Wanawish (Horn Rapids). Several motorcycle tracks were noted in the village area.

The effects of fire suppression activities included vehicle tracks and ruts near cold-war era military properties on site. Bulldozer tracks were noted along the western edge of 200-West Area, along the western edge of Highway 4 South, west of the 200-East Area, and near the former 6652 Nike Missile launch installation (see Figure 5.5). In a few limited areas, most notably on the hill east of the 200-East Area, the fire exposed several building foundations, pads, and sidewalks previously covered by thick vegetation.

The fire consumed all or part of two historic structures at the former 6652 Nike Missile Launch Installation. A 40-foot wooden crow's nest and observation post and the roof of a concrete block guard shack building were destroyed. Most of the wooden light poles, utility poles, and fence posts at the missile installation were also destroyed.

An assessment of the impact to previously known archaeological sites and Traditional Cultural Properties resulted in the discovery of five newly identified archaeological sites and two newly identified finds (e.g., a sheep herders implement and a projectile point). The sites had formerly been obscured by vegetation.

5.6 Soil Stabilization and Revegetation of Burned Areas

A. R. Johnson

A severe windstorm occurred on July 1, 2000, resulting in extensive movement of ash (remains of burned vegetation) and surface soil in areas on the site burned by the Hanford 2000 wildfire and no longer protected by vegetative cover. It was immediately apparent that operations in the 200-West Area were being affected by blowing dust and ash because a vast expanse of native shrub-steppe vegetation west and upwind of 200-West Area had been completely consumed by the fire. A satellite image taken on July 2, 2000, revealed wind erosion of land surfaces previously stabilized by native plants. Within a few weeks following the fire, soil stabilization and re-vegetation efforts were started in selected burned areas to protect workers and facilities from blowing dust. Work progressed throughout the fourth quarter of 2000 to stabilize nearly 400 hectares (1,000 acres) on the west (upwind) side of the 200-West Area. A combination of methods was used that included re-seeding, transplanting shrubs, incorporating hay into the soil, and applying commercial soil fixatives.

5.7 References

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