7.2 Ecosystem Monitoring and Compliance

The Hanford Site is a relatively undisturbed area of shrub-steppe (a drought-resistant, shrub and grassland ecosystem) that contains a rich diversity of plant and animal species adapted to the region's semi-arid environment. The Ecological Monitoring and Compliance Project provides data and information to fulfill the U.S. Department of Energy (DOE) Richland Operations Office's needs to achieve compliance with natural resource-related legal and regulatory requirements for the biological resources found on Hanford. Under this project, surveys and monitoring of resources and key biota are conducted to assess the abundance, vigor or condition, and distribution of populations and species on the Hanford Site. Data collection and analysis are integrated with environmental monitoring of biotic and abiotic media under the Surface and Environmental Surveillance Project and analytical results are used to characterize any potential risk or impact to the biota. Ecological monitoring and ecological compliance support multiple objectives for completion of Hanford's waste management and environmental restoration mission through the following activities:

- Assuring Hanford Site operational compliance with laws and regulations including the *Endangered Species Act of 1973*, the *Bald and Golden Eagle Protection Act*, and the *Migratory Bird Treaty Act*.
- Providing data for environmental impact and ecological risk assessments.
- Providing maps and information useful for biological resource impact mitigation during facility expansion.
- Supporting Hanford Site land-use planning and stewardship.

These activities are intended to help protect the natural resources within the DOE-operated portions of the Hanford Site including the DOE-managed portion of the Hanford Reach National Monument and provide information useful to the Hanford natural resource stakeholders and the public on the status of some of Hanford's most highly valued biological resources.

This section provides current inventory, monitoring and survey information for species and communities found on the Hanford Site and presents this information in context with historical data and trend information. Ecological compliance activities and efforts related to inventory and management of threatened and endangered species are also included in this section.

7.2.1 Chinook Salmon

R. P. Mueller

Chinook salmon (*Oncorhynchus tshawytscha*) are an important resource in the Pacific Northwest; they are caught commercially and for recreation. Salmon are also of cultural importance to Native Americans. Today, the most important natural spawning area in the mainstem Columbia River for fall Chinook salmon is the free-flowing Hanford Reach (Dauble and Watson 1997). In the early years of the Hanford Site, only a few spawning nests (redds) were found in the Hanford Reach. Between 1943 and 1973, a number of dams were constructed on the Columbia River and the formation of reservoirs behind these dams eliminated most mainstem spawning areas. These changes resulted in increased numbers of salmon spawning in the Hanford Reach. Fisheries management strategies aimed at maintaining spawning populations in the mainstem Columbia River also have contributed to the increased number of redds found in the Hanford Reach.

The number of fall Chinook salmon redds estimated in the Hanford Reach by aerial surveys increased during the 1960s, 1970s, and 1980s until reaching a high in 1989 of nearly 8,800 (Figure 7.2.1). In the early 1990s, redd estimates

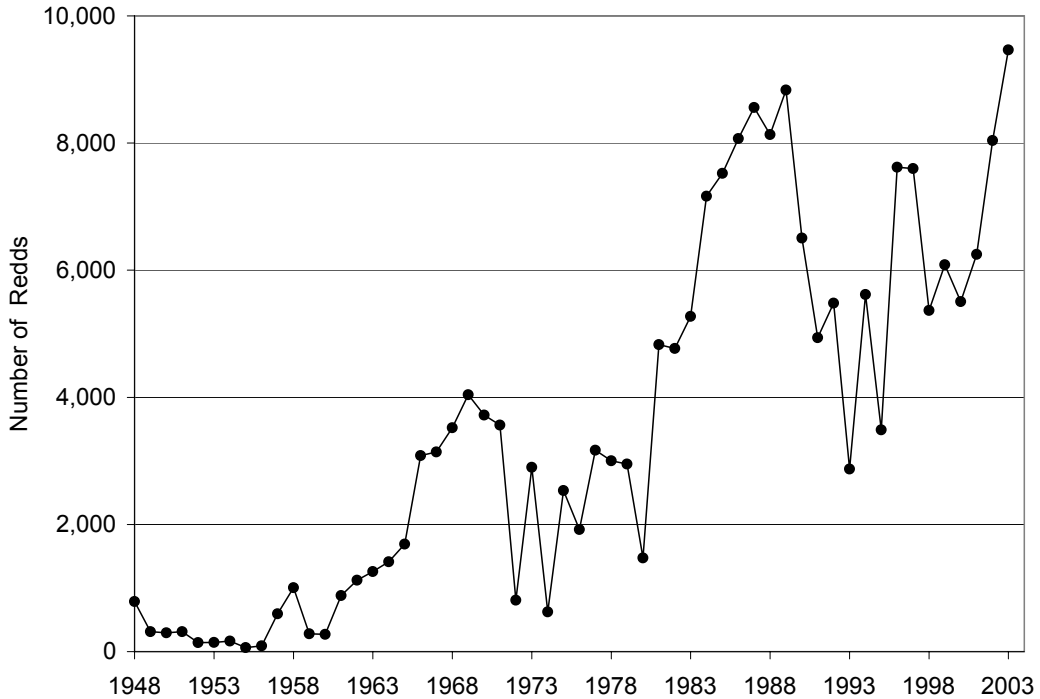

Figure 7.2.1. Number of Salmon Redds in the Hanford Reach of the Columbia River

declined to approximately one-third of the 1989 peak. The number of redds peaked again in 1996 and 1997 and then declined before rising again in 2001.

During 2003, approximately 9,400 redds were observed, an increase of over 1,400 from 2002 and surpassing the peak of approximately 8,800 seen in 1989. The primary spawning areas in the Hanford Reach in 2003 were similar to areas used in previous years (Figure 7.2.2). The general locations of the spawning areas have not changed significantly over the past few years. The majority of redds occur near Locke Island (Areas 4 and 5), Vernita Bar (Area 10), and the areas upstream (Areas 6 and 7) and downstream (Areas 2 and 3) of Locke Island. Aerial surveys do not yield absolute redd counts because environmental conditions such as water depth, water turbidity, and sun angle vary. In addition, the number of redds in high-density locations cannot be counted with absolute accuracy while flying. However, redd survey data are highly correlated with adult salmon escapement estimates obtained by state and federal agencies within the Columbia River Basin.

7.2.2 Mule Deer

B. L. Tiller and K. D. Hand

The health of resident mule deer (*Odocoileus hemionus*) on Hanford has been routinely monitored to assess onsite environmental quality. In 1993, Tiller et al. (1997) estimated that 15% of resident male mule deer were affected with testicular atrophy, a condition which also results in misshapen antlers and male sterility. Studies revealed no clear link between this condition and contaminants present at Hanford (Tiller et al. 1997). However, since 1994, trends in the population characteristics of the mule deer population have been monitored using roadside surveys during the months November 2003 through January 2004. Population characteristics include number of fawns per 100 does that survive until the fall and male sterility. The survey areas include both upland and riparian environments that occur between the 300 Area to the south and the 100-B/C Area to the north. According to Tiller and Poston (2000), two sub-populations of deer inhabit the roadside survey region, the north region deer (100 Areas) and the south region deer (Hanford town site to the 300 Areas). After the hunting

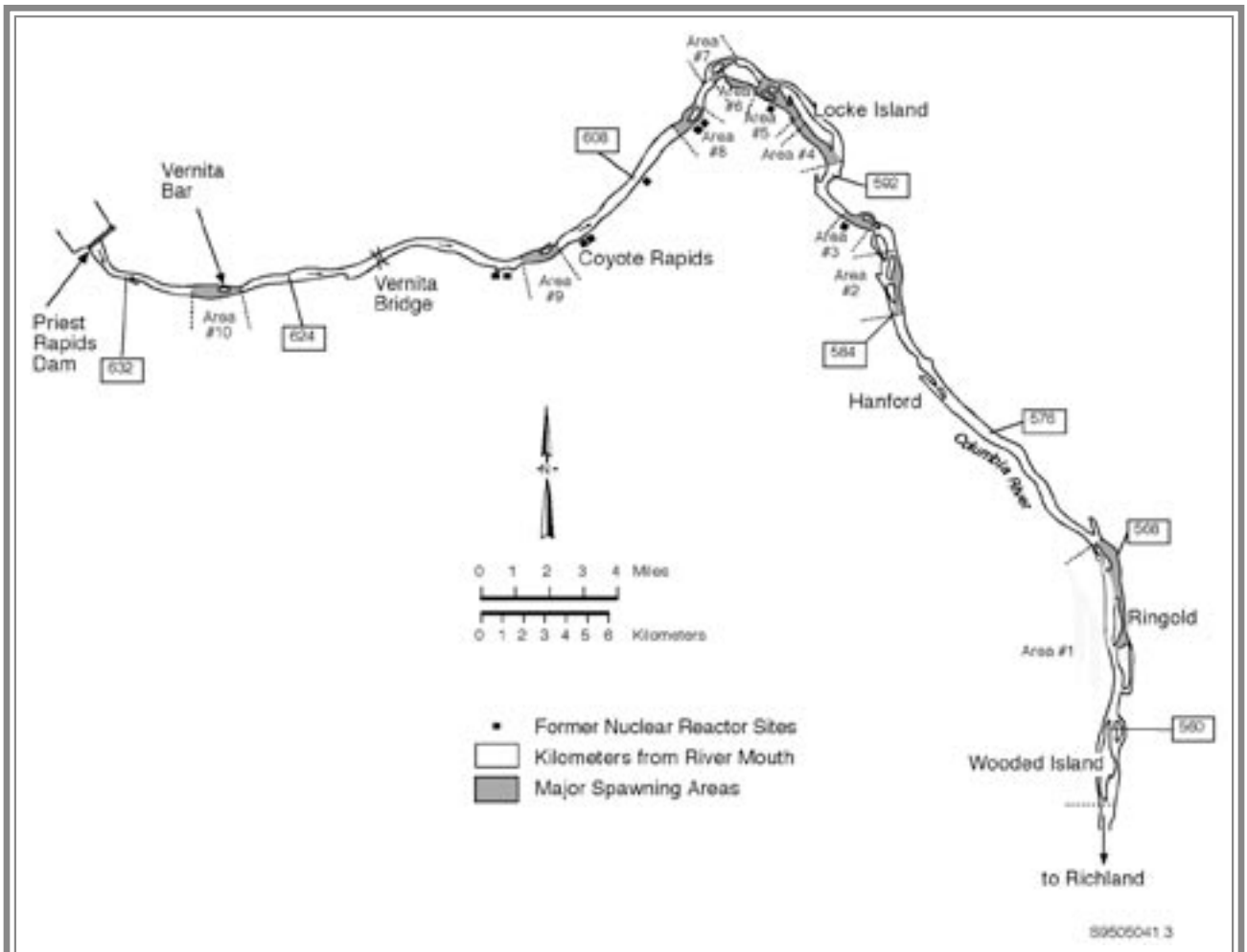

Figure 7.2.2. Major Fall Chinook Spawning Areas in the Hanford Reach of the Columbia River

season of 2003, five complete surveys were conducted during November and December 2003 and January 2004; 244 deer were observed noting sex and age. In addition, for male deer, the presence or absence of velvet covered antlers was noted as an indication of their reproductive condition (fertile or sterile).

The data indicate that spatial trends in fawn survival were generally consistent between herds from the north and south regions; however, there appears to be a cyclic pattern over the 9-year survey period (Figure 7.2.3). Survival estimates in 1994 ranged between 20 and 40 fawns born per 100 adult female deer, and then steadily declined to less than 10 fawns per 100 does during 1997. From 1997 through 2000, fawn survival estimates steadily increased before decreasing in 2001. Deer surveys were not conducted during 2002. During 2003, mean fawn to doe survival rate estimates ranged from 47 to 55 fawns per 100 does in herds inhabiting the north and south Hanford Site regions, respectively (Figure 7.2.3). The survival results in 2003 from the deer population in the north region were the second highest in the 10 years of surveys, while estimates for the herd in the south region exceeded the highest documented survival rates.

The long-term trends of male deer with signs of testicular atrophy have also cycled since surveys began in 1994 (Figure 7.2.4). Estimates of the frequency of testicular atrophy in antlered deer (bucks) ranged from 3% to 7% between 1994 and 1997. The frequency of infertile bucks increased substantially during 1998, reaching levels in both the north and south regions similar to those seen during 1992 and 1993 by Tiller et al. (1997). Since 1998, there has been a steady decline in the frequency of this condition in male deer from both regions on the Hanford Site (Figure 7.2.4). During 2003, no bucks were seen with signs of testicular

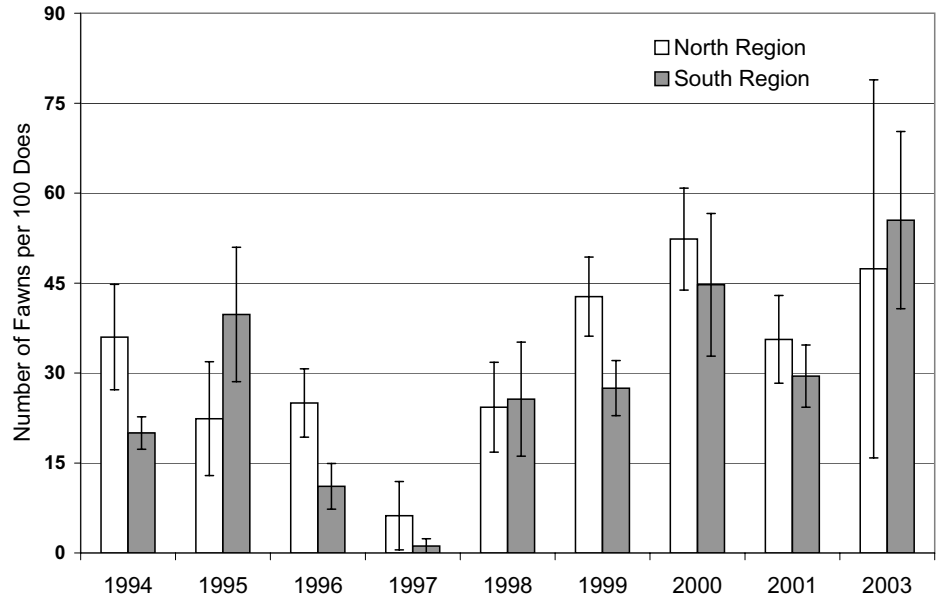

Figure 7.2.3. Mule Deer Survival Estimates on the Hanford Site from 1994 through 2003 (mean ±1 standard error)

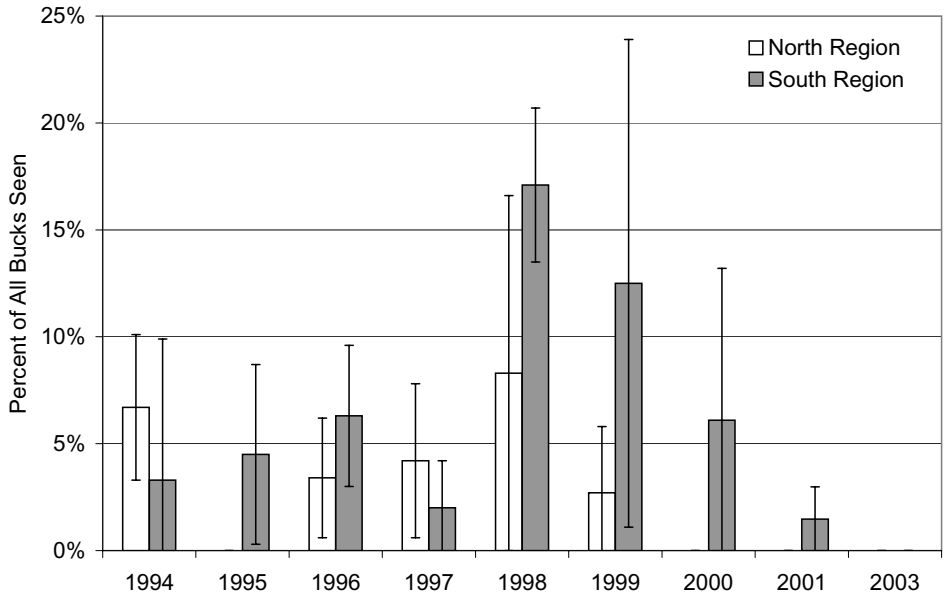

Figure 7.2.4. Percent of Male Mule Deer on the Hanford Site from 1994 through 2003 Showing Signs of Testicular Atrophy (mean ±1 standard error)

atrophy in either the north or south deer herds. Continued roadside surveys to monitor trends of the frequency of testicular atrophy and corresponding demographic and physiological trends of mule deer on the Hanford Site will allow continued evaluation of the health of the deer population.

7.2.3 Breeding Bird Roadside Surveys

W. H. Rickard, M. A. Simmons, S. DeBoer

The shrub-steppe habitat at one time covered approximately 255,000 square kilometers (98,000 square miles) in western North America (Knick et al. 2003). Much of this land has been transformed as a result of agriculture, grazing, and urbanization. Along with the decrease in habitat, the bird species that depend on this habitat have also declined. A large remnant of shrub-steppe habitat currently exists on the Hanford Site and, for the past 16 years, roadside surveys have been used to monitor bird populations on the site. Four survey routes have been monitored that represent distinct vegetation cover types on the Hanford Site (Figure 7.2.5) to determine which species use the site and to evaluate trends in the abundance of shrub-steppe birds. Of particular interest is the status of breeding birds on the site.

Trends were evaluated for the entire avian community as well as for the two most abundant species: Western meadowlarks (*Sturnella neglecta*) and horned larks (*Eremophila alpestris*). A log-linear regression model was used to evaluate the trend in the number of bird species observed during April, May, and June of each year between 1988 and 2003. The analyses revealed a decline in the number of species counted along each of the four transects (Figure 7.2.6). Meadowlarks, one of the most commonly occurring birds in shrub-steppe declined significantly along all four survey routes (Figure 7.2.7), whereas the number of horned larks (another common species) declined significantly on only one route (route A) (Figure 7.2.8). Recent wildfires on the site have eliminated large portions of the shrub habitat and could account for some of the decline. However, meadowlarks and horned larks are often associated with grassland habitats (Knick et al. 2003).

The trends seen at Hanford appear to mirror regional trends and appear to be associated with an overall decline and fragmentation of shrub-steppe habitat (Knick et al. 2003). For example, a general decline in meadowlarks has been noted across much of their range (USGS North American Breeding Bird Survey 1996-2001). Thus, while the Hanford Site continues to act as a refugium (Gray and Rickard 1989), the site cannot compensate for the large-scale habitat changes occurring throughout the Columbia Basin and the west. Results from these monitoring surveys are used for mitigation and land-use planning on the site.

7.2.4 Vegetation Survey and Monitoring

J. L. Downs, K. D. Hand, M. R. Sackschewsky, and R. E. Durham

The Hanford Site contains biologically diverse shrub-steppe plant communities that have been protected from most disturbances, except for fire, for more than 55 years. This protection has allowed plant species and communities that have been displaced by agriculture and development in other parts of the Columbia Basin to thrive at Hanford. Surveys and mapping efforts have documented the occurrence and extent of rare plant populations and plant community types on the Hanford Site (Soll et al. 1999). Plant populations monitored on the site include taxa listed by Washington State as endangered, threatened, or sensitive (Appendix G), and those species listed as review group 1 (i.e., taxa in need of additional field work before status can be determined) (Washington Natural Heritage Program 1997). Data are collected for plant populations and plant communities on the Hanford Site to develop baseline information and to monitor any changes resulting from Hanford operations. The data provide information that is used for site planning processes and land-use policy development.

More than 100 plant populations of 47 different taxa listed by the Washington Natural Heritage program as endangered, threatened, sensitive, review, or watch list are found at the Hanford Site <http://www.pnl.gov/ecomon/Veg/Habitat.html; PNNL-13688>. The U.S. Fish and Wildlife Service has designated 5 of these 47 taxa (including the two species,

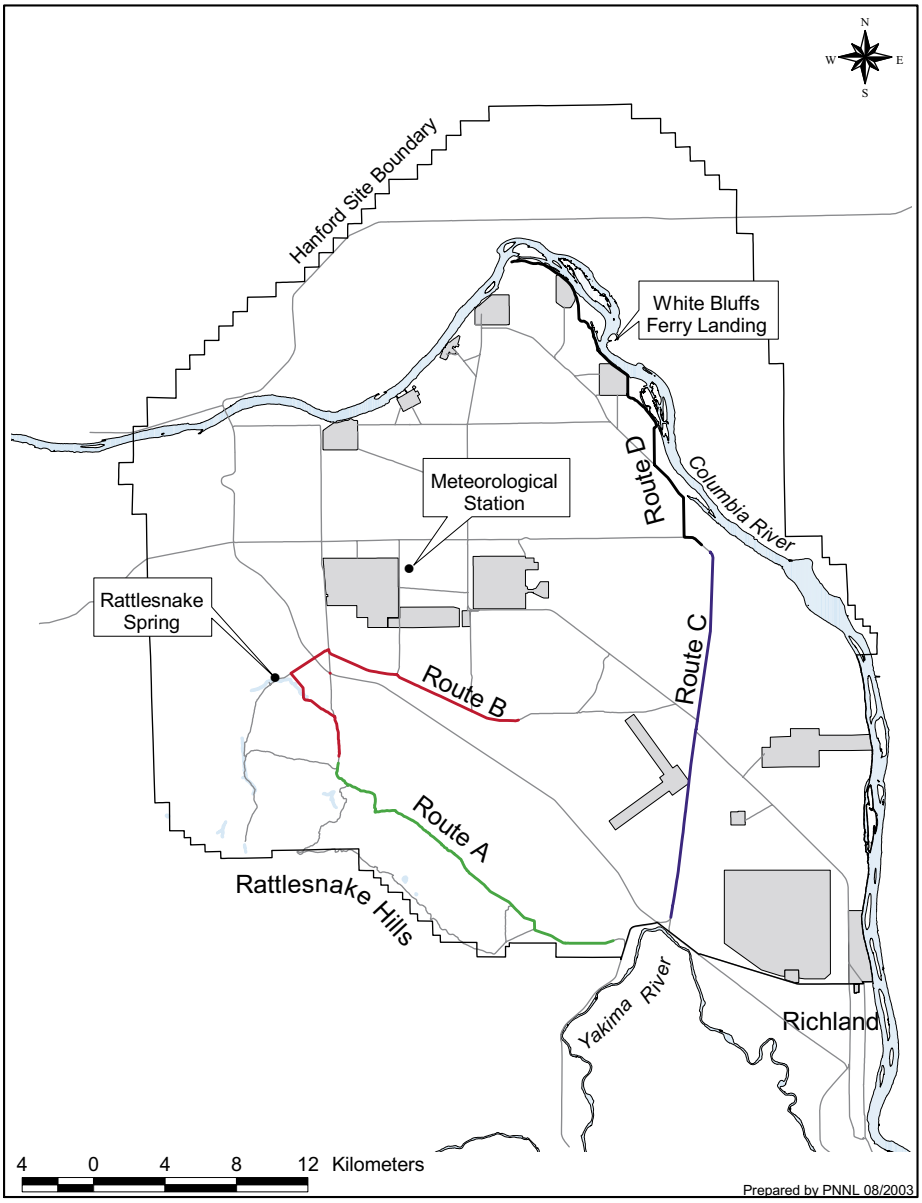

Figure 7.2.5. Roadside Bird Survey Routes on the Hanford Site. Each route passes through a different habitat — route A: bluebunch/wheatgrass community; route B: sagebrush/cheatgrass community; route C: bitterbrush/ cheatgrass community; and route D: old agricultural fields.

Umtanum buckwheat [*Eriogonum codium*] and White Bluffs bladderpod [*Lesquerella tuplashensis*]) as species of concern in the Columbia River Basin ecoregion <http://www.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html>. These two species are proposed as candidates for federal listing. In addition to the rare plant populations, several areas on the Hanford Site are designated as special habitat types with regard to potential occurrence of plant species of concern listed by Washington State. These are areas that potentially support populations of rare annual forbs that have been documented in adjacent habitat.

In 2003, areas where rare annual forbs had been previously documented were resurveyed several times in April and May. No rare forbs were seen during these surveys. During 2004, these locations will be surveyed again as will adjacent habitat to the extent feasible. Occurrences of rare annual

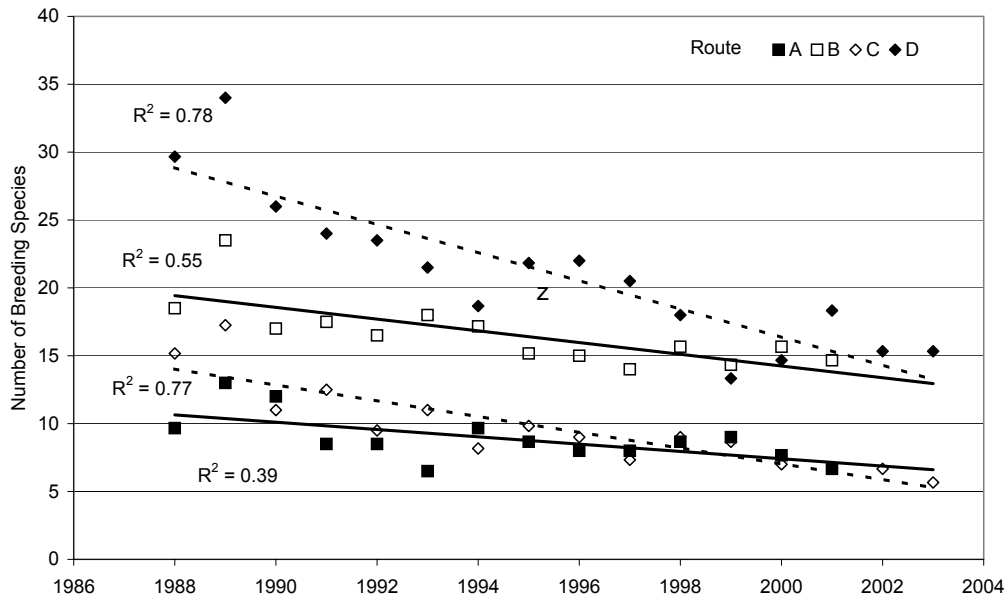

Figure 7.2.6. Species Richness During the Breeding Season Along Four Roadside Routes on the Hanford Site, 1988 through 2003. R^2 refers to the fit of a linear regression through the data. Routes are shown in Figure 7.2.4.

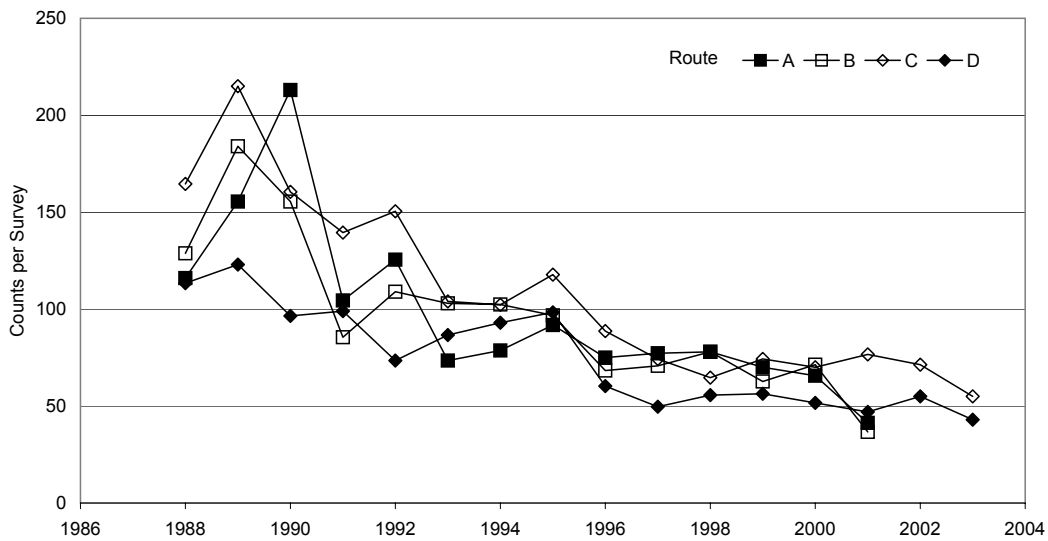

Figure 7.2.7. Abundance of Western Meadowlarks Along Four Roadside Survey Routes on the Hanford Site, 1988 through 2003. Routes are shown in Figure 7.2.4.

plant species can be episodic and variable in location depending on weather conditions and environmental factors that influence seed dispersal.

Rare plant surveys were also conducted along the Columbia River in riparian habitats adjacent to the 100-B/C Area during the summer and early fall months of 2003. These surveys identified several known species including populations of Columbia or persistent sepal yellowcress (*Rorippa columbiae*), toothcup (*Rotala ramosior*), false pimpernel (*Lindernia dubia*), shining flatsedge (*Cyperus rivularis*), and small-flowered hemicarpha (*Lipocarpha aristulata*). Monitoring transects established to examine condition and status of persistent sepal yellowcress along

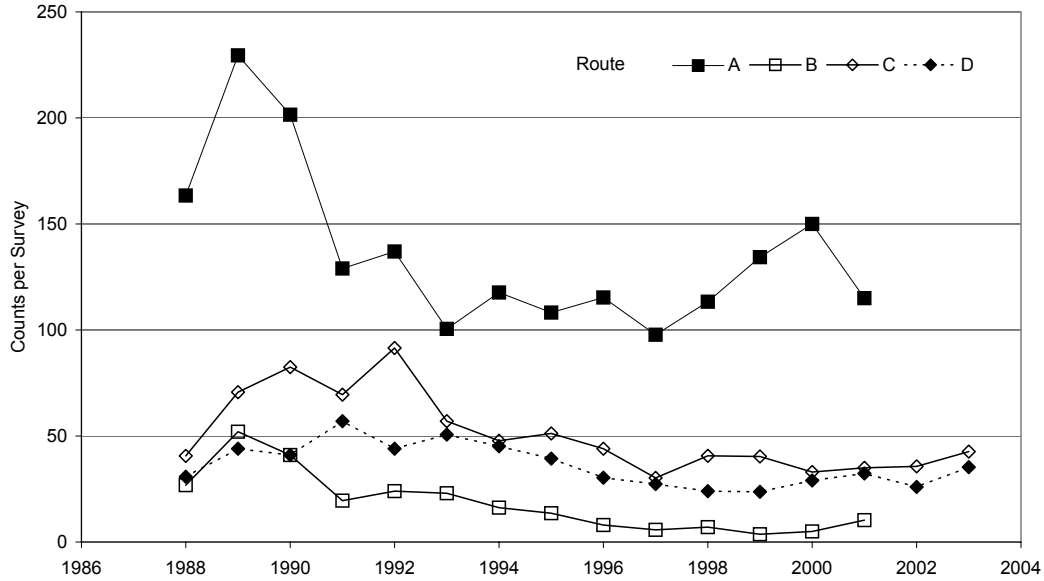

Figure 7.2.8. Abundance of Horned Larks Along Four Roadside Survey Routes on the Hanford Site, 1988 through 2003. Routes are shown in Figure 7.2.4.

the shoreline near 100-F Area and on several islands of the Hanford Reach were not surveyed during 2003 due to high river flows.

In addition to rare plant surveys along the Columbia River shoreline, Ecological Monitoring and Compliance Project personnel, in collaboration with Characterization of Systems tasks under the Groundwater Remediation Program, mapped and described riparian habitats found along the Hanford shoreline of the Columbia River. Vegetation cover types were also mapped on the persistently emergent islands in the Hanford Reach. The mapped vegetation cover types have been classed into landcover/vegetation types (Table 7.2.1; Figure 7.2.9). Each vegetation cover type description includes both the dominant vegetation and other commonly occurring species. In some cases, plant functional types and growth forms related to substrate or geomorphology are used to describe the vegetation association rather than dominant species (e.g., forbs – cobble). The mapped area includes the southern and western shores of the Hanford Reach as well as portions of the Franklin and Grant County and most of the islands that occur within the Hanford Reach.

7.2.5 Ecological Sampling and Impact Evaluations

B. L. Tiller

During 2002 and 2003, sampling of invertebrates, fish, mammals, and birds were initiated as part of an integrated monitoring effort supported by the Ecological Monitoring and Compliance Project and the Surface and Environmental Surveillance Project. Results can be used to describe levels of contaminants in organisms and corresponding measures of biological health. The data also can be used to assist with ecological risk assessments and decisions associated with legacy contamination and cleanup activities and help validate existing cleanup standards at DOE waste sites or develop new standards that reduce costs and simplify cleanup decisions.

Several sets of measurements of biological conditions were obtained in 2003 for organisms inhabiting the near-shore areas of the Columbia River (water less than 2 meters [6.6 feet] deep at low-water levels) near the 100-B/C, 100-K, 100-N, 100-D, 100 H, 100-F Areas, Hanford town site, and 300 Area. Organisms such as Asiatic clams (*Corbicula fluminea*) and crayfish (*Pacificastus leniusculus*) may be exposed to legacy contaminants in these areas.

Table 7.2.1. Current Mapped Extent of Riparian Vegetation Cover Types (hectares) Along the Hanford Shoreline of the Columbia River

Vegetation Cover Type	Cover Type Description	Hectares (acres)	Percent of Mapped Area[a]
Low shrub-forb-cobble association	Vegetation band on unconsolidated cobble adjacent to the "low water mark" with low rhizomatous subshrubs common dogbane (*Apocynum caninum*) and western goldenrod (*Solidago occidentalis*) and scattered herbs	503.15 (1,243)	18.45
Exotic weed	Introduced weedy species such as knapweeds (*Centaurea diffusa* and *Acroptilon repens*), Russian thistle (*Salsola tragus*), and cheatgrass (*Bromus tectorum*)	403.57 (997)	14.80
Wormwood/perennial grass	Perennial *Artemisia* subshrub species including Pacific sagebrush or field sagewort (*Artemisia campestris*), Columbia River wormwood or mugwort (*Artemisia lindleyana*) and prairie or white sagebrush (*Artemisia ludoviciana*)	388.66 (960)	14.26
Cobble	Little to no vegetation	312.77 (773)	11.47
Upland shrub-steppe	Upland areas including Snow buckwheat (*Eriogonum niveum*)/bunchgrass, sagebrush (*Artemisia tridentate*)/ bunchgrass, rabbitbrush (*Chrysothamnus viscidiflorous* or *Ericameria nauseosa*)/bunchgrass, rabbitbrush/cheatgrass, and Antelope bitterbrush (*Purshia tridentate*)/bunchgrass	254.95 (630)	9.35
Riparian wheatgrass association	*Agropyron dasystachyum*/*Agropyron riparium* changed to *Elymus lanceolatus*. Riparian wheatgrass is the dominant species intermixed with other grasses and forbs	177.26 (438)	6.50
Sand dropseed grass association	A subset of the wormwood/perennial grass category where the wormwood component is sparse or missing	128.31 (317)	4.71
Willow	Coyote (*Salix exigue*) patches and small groves scattered along shore with occasional peach leaf willow (*Salix amygdaloides*)	90.85 (224)	3.33
Wormwood/riparian wheatgrass	Perennial *Artemisia* subshrub species with Riparian Wheatgrass as the dominant understory grass	84.60 (209)	3.10
Wild rye association	Great Basin wild rye (*Leymus cinereus*), a large perennial bunchgrass	77.60 (192)	2.85
Reed canary grass	Stands of reed canary grass (*Phalaris arundinaceae*)	73.52 (182)	2.70
Tree association	Clumps or small stands of both native and non-native tree species	44.79 (111)	1.64

Table 7.2.1. (contd)

Vegetation Cover Type	Cover Type Description	Hectares (acres)	Percent of Mapped Area[a]
Wormwood/forb	Low-lying areas, at or below the daily high water mark, with cobble/silty soil. The plant community is comprised of *Artemisia campestris*, *A. lindleyana*, or *A. ludoviciana*, with an understory of *Heterotheca villosa*, *Aster hesperius*, *Coreopsis atkinsoniana*, *Helenium autumnale*, *Bidens frondosa*, and other riparian forbs.	30.65 (76)	1.12
Non-persistent emergent and emergent wetlands	Wetland areas of backwater and sloughs characterized by cattails (*Typha latifolia*), rushes (*Juncus species* and *Scirpus maritimus*), and sedges (*Cyperus* species, *Eleocharis* species, and *Carex* species)	27.46 (68)	1.01
Riparian mosaic	Patchy mosaic of riparian wheatgrass association, forb-cobble, willow, non-persistent emergent wetland, reed canary grass, wormwood/riparian wheatgrass, and exotic weed	26.91 (66)	0.99
Horsetail association	Horsetails (*Equisetum* species) as the dominant cover occurring in topographic lows along the shoreline with silt embedded cobble or some siltation present.	12.77 (31)	0.47
Open sand	Open sand beaches occur in small stretches	9.24 (23)	0.34
Juniper	Characterized by widely spaced junipers (*Juniperus scopularum*) at the transition between riparian and upland cover types	5.80 (14)	0.21
Riparian shrub	Small patches of dense chokecherry (*Prunus virginiana*), currant (*Ribes* sp.), and/or Wood's rose (*Rosa woodsii*). Clematis (*Clematis ligustifolia*) and various forbs or grasses may be present.	3.95 (10)	0.15
Bare Silt	No vegetation	3.11 (8)	0.11
Rock/Road/Outflow	No vegetation	2.30 (6)	0.08

(a) Mapping includes all of the Benton County shoreline from the Verni
in the Hanford Reach.

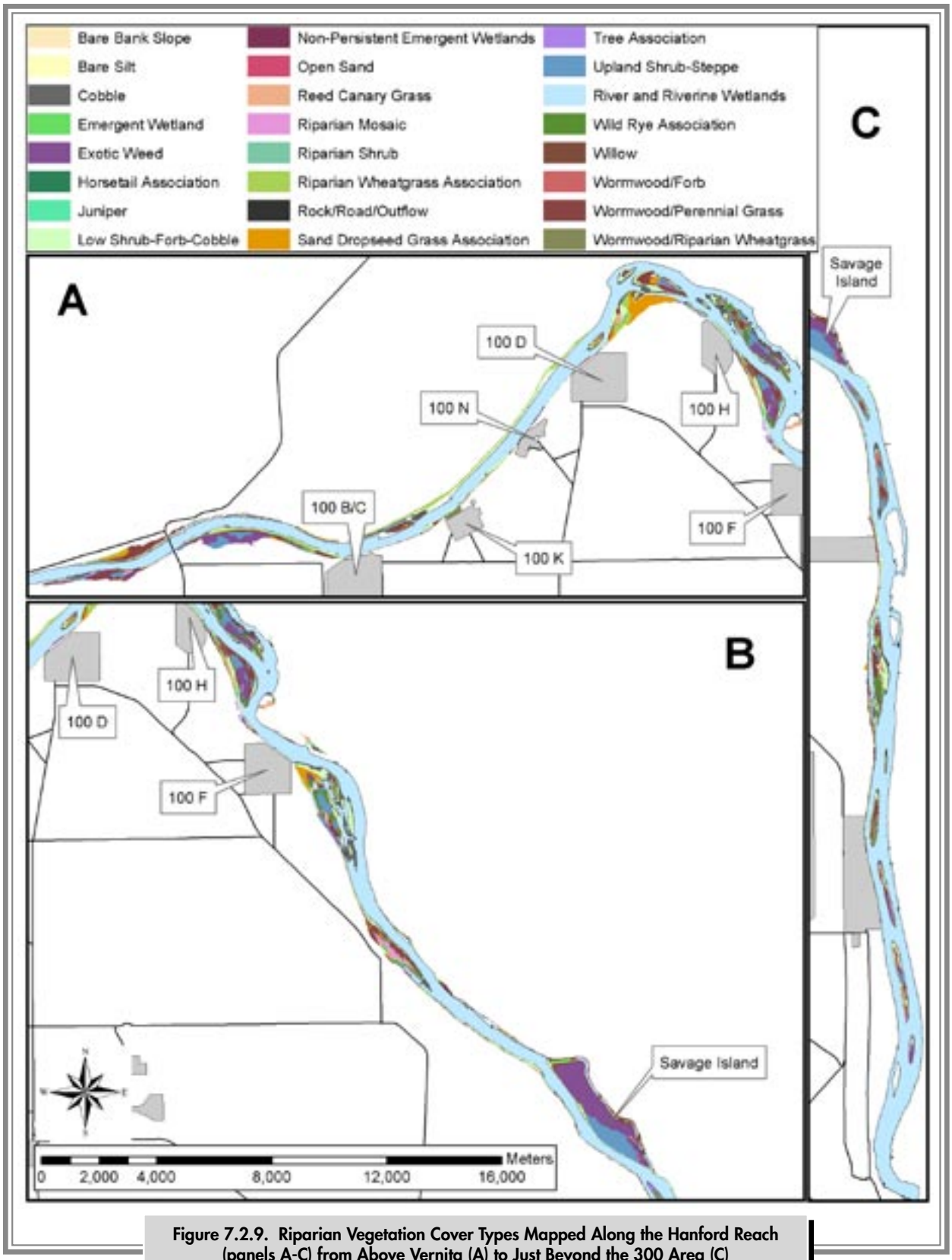

Figure 7.2.9. Riparian Vegetation Cover Types Mapped Along the Hanford Reach (panels A-C) from Above Vernita (A) to Just Beyond the 300 Area (C)

Reference areas located upstream of the Hanford Site operations were also identified and sampled. Information and results obtained from sampling the shoreline area near Hanford Site facilities in subsequent years will be compared with data from the reference locations.

Biological measurements obtained from near-shore indicator species included (1) histological inspection of target organs (radiological and chemical), (2) body condition, (3) relative abundances, and (4) demographic structures. Results for radiological tissue residue levels in clams are discussed in Section 4.5 of this report. Analyses for other species and biological components were still under development when this report was prepared.

7.2.6 Ecological Compliance

M. R. Sackschewsky

DOE policies require that all projects having the potential to adversely affect biological resources have an ecological compliance review performed prior to initiation of the project. This review determines if the project will comply with the *Endangered Species Act of 1973* and the *Migratory Bird Treaty Act*. It also re-examines whether other significant resources such as Washington State listed species of concern, wetlands, and native shrub-steppe habitats are adequately considered during the project planning process. Where effects are identified, mitigation action is prescribed. Mitigation actions can include avoidance, minimization, rectification, or compensation.

Because many projects occur during periods of the year when plants are not growing and are difficult to identify or evaluate, each of the operational areas (200-East and 200-West Areas, all of the 100 Areas, and the 300 Area) are surveyed each spring. All habitat areas within these areas are surveyed and each building is inspected for the nests of migratory birds. These baseline visual surveys provide information about habitat types, and species inventories and abundance, which can be used throughout the rest of the year to assess potential impacts. These data are also used to support ecological inventory and data requirements for ecological risk evaluations. Examples of the baseline survey maps are available at http://www.pnl.gov/ecomon/Compliance/comp.html.

A total of 149 ecological compliance reviews were performed during 2003 in support of general Hanford Site activities. An additional 34 reviews were performed in support of environmental restoration activities. The total number of reviews prepared during 2003 (183) was comparable to the number of reviews performed during the previous 2 years (Table 7.2.2).

7.2.6.1 Bald Eagles

B. L. Tiller

Bald eagles (*Haliaeetus leucocephalus*) have wintered along the Hanford Reach for many years. In accordance with DOE's Bald Eagle Site Management Plan (DOE/RL-94-150), limited-access road closures within 800 meters (875 yards) (or within 400 meters [437 yards] out of line of sight) of major perching and roost sites have been in force from November 15 through March 15 since 1994. While these dates generally encompass the arrival and departure times of wintering bald eagles, nest-tending activities and

Table 7.2.2. Ecological Reviews Performed on the Hanford Site, 1997 through 2003

Calendar Year	100 Areas	200 Areas	300 Area	Other[a]	Total
1997	8	79	44	33	164
1998	42	91	28	47	208
1999	36	72	36	52	196
2000	36	52	27	47	161
2001	26	64	27	52	169
2002	36	68	26	55	185
2003	36	69	29	49	183
Totals	220	495	217	335	1,266

(a) Includes the 400, 600, 700, Richland North, and former 1100 Areas.

territorial displays in the late 1990s have been observed as early as October with nest occupancy continuing to as late as August. However, all nesting attempts documented along the Hanford Reach have so far been unsuccessful.

During 2003, a pair of adult eagles returned during November to occupy the historical nest site in the vicinity of the former White Bluffs town site. This was the only site occupied by the eagle pair during 2003. Visual surveys revealed the eagles discontinued occupancy of the nest sometime during February or March 2003.

Primary causes of eagle nest abandonment may include (1) adverse weather, (2) food availability, (3) human activity near the nest, and (4) avian predator interactions (hazing and harassment by magpies and ravens). The causes of eagle nest abandonment along the Hanford Reach have not been determined. Food resources do not appear to be limiting as a pair of eagles stayed through August in 1999 (PNNL-13230); thus, some other factor is likely responsible for nest desertion on the Hanford Site. A large buoy was placed in the Columbia River near the nesting site to help minimize all boating activities. During 2001 and 2002, traffic monitors (counts of vehicle passes) were placed at the entrance to the nesting area access road, an area within 400 meters (437 yards) from the major use site for the nesting eagle pair. Vehicle counts were low between November and January and increased dramatically during late February and early March (PNNL-14295).

7.2.6.2 Steelhead

M. R. Sackschewsky

In February 2003, two to three steelhead (*Oncorhynchus mykiss*) redds were discovered near the Columbia River shoreline adjacent to the north end of the 300 Area. Steelhead at this location are considered part of the upper Columbia River Evolutionarily Significant Unit, listed as endangered under the *Endangered Species Act of 1973*.

To address the presence of spawning steelhead near the 300 Area, the DOE prepared a biological evaluation of the potential impact of site characterization and cleanup efforts on steelhead in the Hanford Reach and came to a conclusion that the ongoing characterization and cleanup project activities may affect, but are not likely to adversely affect, upper Columbia River steelhead. This biological evaluation was sent to the National Oceanographic and Atmosphere Administration Fisheries in December 2003. The National Oceanographic and Atmosphere Administration Fisheries concurred with the DOE conclusions in January 2004. The DOE committed to increase monitoring efforts for steelhead redds in the Hanford Reach during 2004 and to limit activities in the vicinity of any redds that are discovered. The results of early monitoring during February 2004 indicated that steelhead had not returned to the redd site at the 300 Area nor were redds observed elsewhere in the Hanford Reach.

7.2.6.3 Sage Sparrow Habitat Suitability Index

M. R. Sackschewsky, C. A. Duberstein, M. A. Simmons, and J. M. Becker

The big sagebrush (*Artemisia tridentata*) communities found on the Hanford Site provide habitat for several sagebrush-obligate species including the sage sparrow (*Amphispiza belli*). The presence of mature big sagebrush (greater than 0.5 meter [1.6 feet] in height with woody branching structure) was one of several factors used to classify land areas into management levels for land use and resource management (DOE/RL-96-32). As part of the *Hanford Site Biological Resource Management Plan*, a preliminary habitat suitability index for breeding sage sparrows was applied to delineate critical habitat areas for sagebrush obligate breeding birds on the Hanford Site based on estimates of big sagebrush canopy cover and grass cover.

Monitoring and analysis efforts in 2003 attempted to better quantify relationships between the presence of breeding and nesting sage sparrows and habitat characteristics. These relationships and ultimately a modified habitat suitability index will be used to support resource management and mitigation planning efforts. Surveys were conducted between March and June 2003. Twenty-four sparrows were detected during 34 surveys. Of those detected, 15 sage sparrow territories were mapped on 10 different transects. An additional six sites were established on transects determined not to have sage sparrows. The monitoring effort in 2003 measured general vegetation characteristics of both the overstory and understory on a total of seventy-nine 10- by 10-meter (32.8- by 32.8-foot) plots (at least three per territory).

Preliminary analysis found all occupied territories contained big sagebrush. Other shrub species occurring in some of the occupied territories included bitterbrush (*Purshia tridentata*) and spiny hopsage (*Grayia spinosa*). Although these shrub mixtures were also present in some of the unoccupied areas, canopy cover was generally lower. Evaluation of the measured vegetation characteristics indicated that, in occupied territories, on average, there was more shrub and bare ground cover, and less annual grass and annual forb cover than unoccupied territories (Figure 7.2.10). However, variability in these habitat components was large, and the statistical analysis (i.e., discriminant function analysis) did not yield an ecologically meaningful distinction between occupied and unoccupied territories. Some of the variability appears to be associated with territory size. Of the 15 territories, 11 were less than 1 hectare (2.5 acres) in size, while 4 were greater than 1.5 hectares (3.7 acres). When habitat characteristics were examined for these two groups, the habitats associated with large territories had fewer shrubs than habitats associated with smaller sage sparrow territories (Figure 7.2.11). While these results are preliminary, it appears that territory size and habitat characteristics, primarily those related to shrubs, are related at a territory scale, and that birds may defend larger territories where shrubs are sparse.

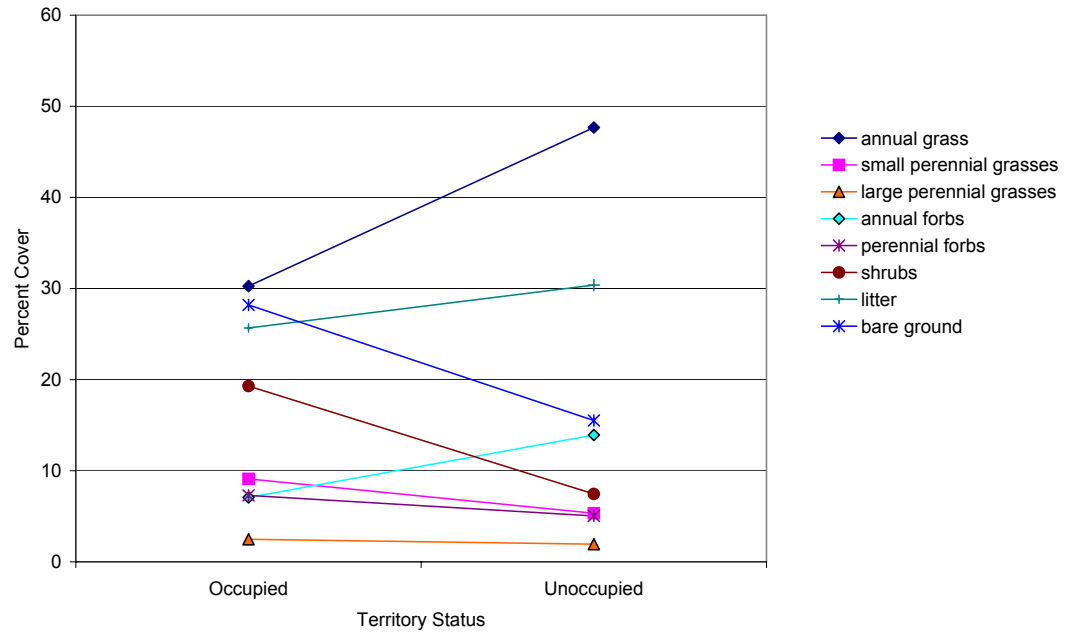

Figure 7.2.10. Average Vegetation Cover for Occupied Versus Unoccupied Sage Sparrow Territories on the Hanford Site in 2003

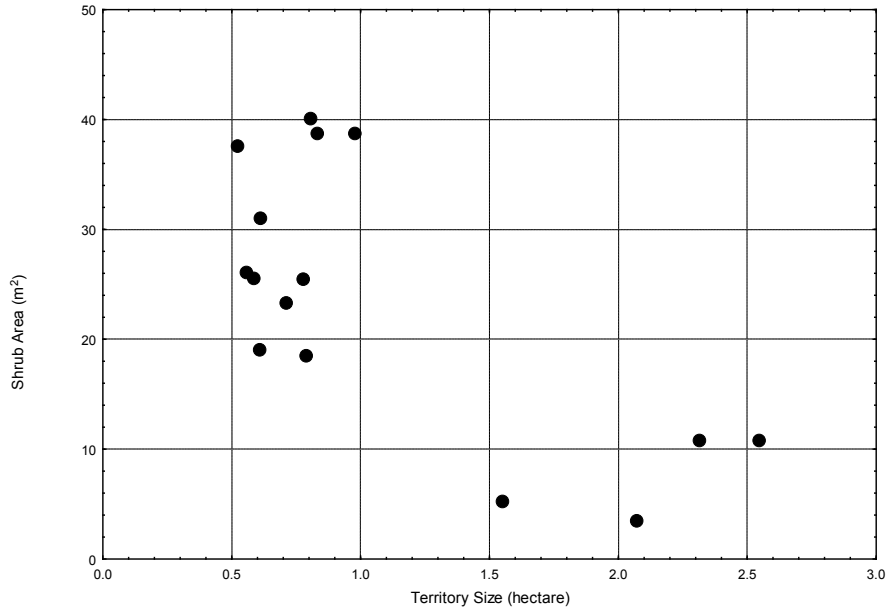

Figure 7.2.11. Total Shrub Area (m^2) for Occupied Sage Sparrow Territories on the Hanford Site in 2003. Shrub area is the sum of sagebrush, bitterbrush, and spiny hopsage.