7.2 Ecosystem Monitoring (Plants and Wildlife)

L. L. Cadwell, D. D. Dauble, J. L. Downs, M. A. Simmons, and B. L. Tiller

The Hanford Site is a relatively large, undisturbed area of shrub-steppe that contains a rich, natural diversity of plant and animal species adapted to the region's semiarid environment. Terrestrial vegetation on the site consists of ten major plant communities: 1) sagebrush/bluebunch wheatgrass, 2) sagebrush/cheatgrass or sagebrush/Sandberg's bluegrass, 3) sagebrush-bitterbrush/cheatgrass, 4) grease wood/cheatgrass-saltgrass, 5) winterfat/Sandberg's bluegrass, 6) thyme buckwheat/Sandberg's bluegrass, 7) cheatgrass-tumble mustard, 8) willow or riparian, 9) spiny hopsage, and 10) sand dunes (PNNL-6415, Rev. 12). Over 600 species of plants have been identified on the site and recent work by The Nature Conservancy of Washington has further delineated thirty distinct plant community types (Nature Conservancy 1999) from within those ten major communities.

There are two types of natural aquatic habitats on the Hanford Site. One is the Columbia River and associated wetlands, and the second is upland aquatic sites. The upland sites include small spring streams and seeps located mainly on the Fitzner/Eberhardt Arid Lands Ecology Reserve on Rattlesnake Mountain (e.g., Rattlesnake Springs, Dry Creek, Snively Springs) and West Lake. West Lake is a small, natural pond near the 200 Areas; the level of the pond has been affected by operational aqueous discharges to the soil column in the 200 Areas.

More than 1,000 species of insects (Soll and Soper 1996), 3 species of reptiles and amphibians (PNNL-6415, Rev. 12), 44 species of fish (Gray and Dauble 1977; PNNL-6415, Rev. 12), 214 species of birds (Soll and Soper 1996), and 39 species of mammals (PNNL-6415, Rev. 12) have been found on the Hanford Site. Deer and elk are the major large mammals, coyotes are plentiful, and the Great Basin pocket mouse is the most abundant mammal. Waterfowl are numerous on the Columbia River, and the bald eagle is a regular winter visitor along the river. Salmon and steelhead are the fish species of most interest to sport fishermen and are commonly consumed by local Native American tribes.

Although no Hanford Site plant species have been identified from the federal list of threatened and endangered species (50 CFR 17.12), biodiversity inventory work conducted in collaboration with The Nature Conservancy of Washington identified more than 100 populations of 31 different rare plant taxa (Hall 1998). The U.S. Fish and Wildlife Service lists the bald eagle as threatened (50 CFR 17.11). The bald eagle is a common winter resident and has initiated nesting on the site but has never successfully produced offspring. Several species of mammals, birds, molluscs, reptiles, and invertebrates occurring on the site are candidates for formal listing under the *Endangered Species Act*. Appendix F lists special-status species that could occur on the site.

7.2.1 Chinook Salmon

Chinook salmon are an important resource in the Pacific Northwest; they are caught commercially and for recreation. Salmon are also of cultural importance to Native American tribes. Today, the most important natural spawning area in the mainstem Columbia River for the fall chinook salmon is

found in the free-flowing Hanford Reach. In the early years of the Hanford Site, there were few spawning nests (redds) in the Hanford Reach (Figure 7.2.1). Between 1943 and 1971, a number of dams were constructed on the Columbia River, their reservoirs eliminating most mainstem spawning areas, resulting 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 increases.

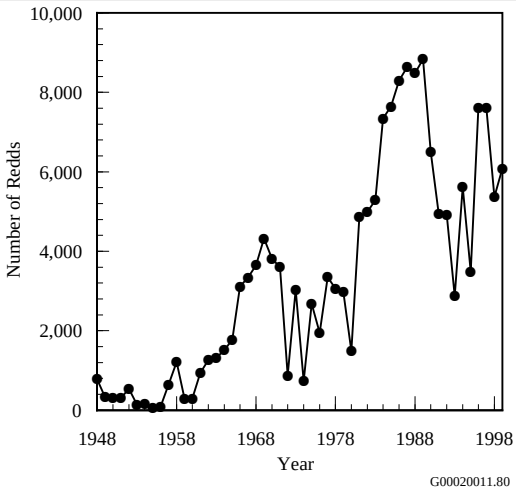

Figure 7.2.1. Chinook Salmon Spawning Redds in the Hanford Reach, 1948 Through 1999

The number of fall chinook salmon redds counted in the Hanford Reach by aerial surveys increased during the 1960s, 1970s, and 1980s until reaching a high in 1989 of nearly 9,000 (see Figure 7.2.1). In the early 1990s, redd counts declined to approximately one-third of the 1989 peak, but they appear to have rebounded in recent years. In 1999, ~6,068 redds were observed, an increase of 700 from 1998 and ~80% of the 1996 and 1997 totals. It should be noted that aerial surveys do not yield absolute redd counts because visibility varies, depending on water depth and other factors, and because the number of redds in high-density locations cannot be counted accurately. However, redd survey data generally agree with adult numbers obtained by counting migrating adult fish at fish ladders on the Columbia River.

7.2.2 Bald Eagle

The bald eagle is listed as a federally threatened species (50 CFR 17.11) and also a Washington State threatened species (Washington State Department of Wildlife 1994); however, the bald eagle is currently under review for removal from federal listing. Protection for bald eagles on the Hanford Site is guided by the management plan contained in DOE/RL-94-150 and coordinated with representatives of the U.S. Fish and Wildlife Service.

Historically, bald eagles have wintered along the Hanford Reach of the Columbia River. The wintering eagles originate from various places, including interior Alaska, British Columbia, Northwest Territories, Saskatchewan, and possibly Manitoba. However, when monitoring began in the early 1960s, numbers were low (Figure 7.2.2). Following passage

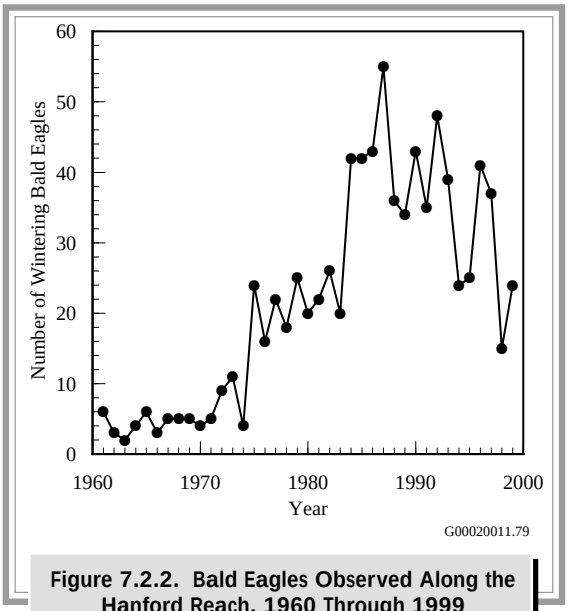

Figure 7.2.2. Bald Eagles Observed Along the Hanford Reach, 1960 Through 1999

of the *Endangered Species Act*, the number of wintering bald eagles generally has increased. Primary reasons for this increase are 1) reduced persecution in Alaska, 2) protection of bald eagles at nesting locations, and 3) nationwide elimination of dichlorodiphenyltrichloroethane (DDT) as an agricultural pesticide in 1972.

The number of nesting eagles was estimated at ~25,000 in the lower 48 states when the bird was adopted as our national symbol in 1782. From fewer than 450 nesting pairs in the early 1960s, there are now more than 4,000 nesting pairs in the lower 48 states. When eagles were federally listed as endangered, recovery goals included at least 800 nesting pairs collectively in California, Idaho, Montana, Oregon, Utah, and Washington (i.e., the Pacific states). In 1997, the wildlife experts estimated more than 1,200 nesting pairs in the Pacific states region. Only two pairs of nesting eagles are known to occur in southeastern Washington.

A maximum count of 24 eagles (14 adults and 10 juveniles) were observed along the Hanford Reach in 1999. Only four full surveys were successfully completed due to adverse weather and equipment delays. However, all four surveys were conducted during December and January when maximum counts typically occur. This maximum count is similar to those seen in the late 1970s and early 1980s and indicates that the low count in 1998 likely reflected changes in food availability near the birds nesting territories and hence winter migration patterns.

Changes in the number of eagles on the Hanford Site generally have corresponded to changes in the number of returning fall chinook salmon, a major fall and winter food source for eagles (compare Figures 7.2.1 and 7.2.2 to see similarity in the patterns of salmon redd counts and bald eagle counts). In 1999, one eagle pair defended an historic nest site through mid-August. This extended nesting attempt by an eagle pair, one of which was just reaching adulthood, suggests the birds were born and raised near this area. A more serious nesting attempt may be made by these birds in 2000 if disturbances, such as recreational fishing activities, do not cause them to abandon the nest site. The pair arrived in November 1999, and a nest site protection buffer of 0.8 kilometer (0.5 mile) was initiated for all Hanford activities.

7.2.3 Hawks

The undeveloped land of the semiarid areas of the Hanford Site provides nest sites and food for three species of migratory buteo hawks: Swainson's, red-tailed, and ferruginous. Under natural conditions, these hawks nest in trees, on cliffs, or on the ground. Power-line towers and poles also can serve as nest sites. These structures are used extensively by nesting hawks on the site because of the relative scarcity of trees and cliffs. The ferruginous hawk is a Washington State threatened species (Washington State Department of Wildlife 1994) as well as a U.S. Fish and Wildlife Service candidate species for listing as threatened or endangered (50 CFR 17.11). Approximately one quarter of the state's ferruginous hawk nesting territories are located on the site.

Since 1995, the number of ferruginous hawks nesting on the Hanford Site has ranged from 7 to 12. There were eight active nests in 1999 and seven were successful. The site continues to provide hawk nesting habitats that are administratively protected from public intrusion. An evaluation of selected aspects of ferruginous hawk ecology on the site and adjacent lands was completed in 1996 (Leary 1996). That work suggested that ferruginous hawks nest on the site because of suitable, disturbance-free habitat, and the proximity of agricultural fields available for foraging.

Ten ferruginous hawks nesting in southcentral Washington State were captured in 1999 and tagged with satellite telemetry transmitters. Seven of the

ten birds (four females and three males) occupied nest sites located on the Hanford Site. The transmitters send signals to satellites that relay location information back to ground stations. From there, biologists retrieve the information daily via computer, within 2 to 6 hours of signal reception, to track the hawks movements. The 2-year study lead by Washington State Department of Fish and Wildlife, in cooperation with Pacific Northwest National Laboratory, was initiated to learn more about the bird's migration patterns and help recover their declining populations nationwide.

The four radio-equipped female hawks that nested on the Hanford Site left and traveled to southwestern Montana. As of August 1999, the male birds captured on or near the Hanford Site were widely dispersed. One male settled near Edmonton, Alberta; another near Provo, Utah; and another in southwest Montana.

7.2.4 Rocky Mountain Elk

Rocky Mountain elk did not inhabit the Hanford Site when it was established in 1943. Elk were first observed on the Fitzner/Eberhardt Arid Lands Ecology Reserve in the winter of 1972. A few animals stayed and reproduced. Since that time, the herd has grown and now occupies portions of the Hanford Site, the United States Army's Yakima Training Center, and private land along Rattlesnake Ridge. Herd size was estimated from census data at 838 animals prior to the 1999 hunting season (Figure 7.2.3). The 1999 harvest was ~101 animals. The larger number of elk harvested in 1999 (~11% of the population) may be related to a new hunting strategy that established three separate hunting seasons prior to the opening of deer season. In addition, a dry fall may have resulted in more elk using irrigated private lands adjacent to the Hanford Site during the hunting season. The increased harvest, as well as plans for moving some of the elk off the site in 2000, should help to alleviate damage to both the natural plant community on the Hanford Site and crops on adjacent private lands in future years.

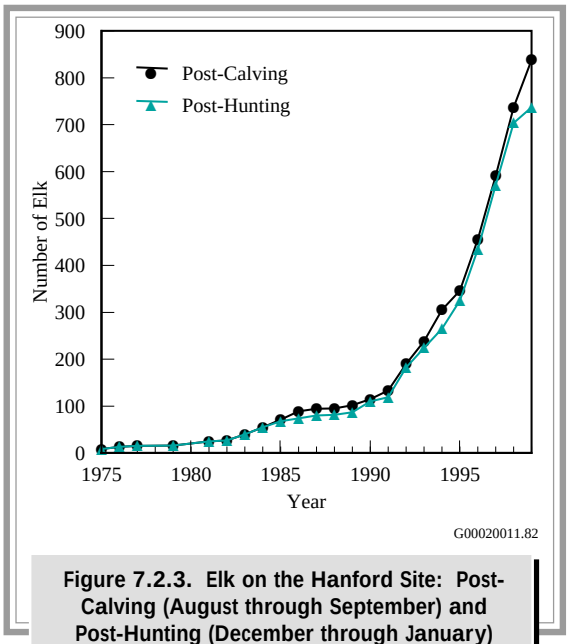

Figure 7.2.3. Elk on the Hanford Site: Post-Calving (August through September) and Post-Hunting (December through January) Periods, 1975 Through 1999

7.2.5 Mule Deer

Epidemiological data and microscopic examinations of mule deer *(Odocoileus hemionus)* residing on the Hanford Site in the early 1990s revealed that nearly one quarter of the male deer (bucks) had undergone some level of testicular atrophy (degeneration of the testicles after maturity). A special study was initiated in 1992 to better describe the occurrences on a spatial scale and to examine possible influences of contaminates from the Hanford Site. The results of this study (Tiller et al. 1997, PNNL-11518) provide a comprehensive discussion of possible causes of testicular atrophy and the likelihood of

their influence on the atypical condition in this deer herd. No single factor was identified as the primary cause; however, analyses of affected animal movement patterns revealed no spatial correlations with Hanford Site contamination plumes. In addition, contaminate levels found within the study animals were well below levels that have been shown to cause testicular atrophy in experimental cases. Elevated liver enzyme activations caused from man-made contaminates were also not detected in normal or affected animals.

Dating back to as early as 1916, testicular atrophy has been documented in other deer populations throughout the United States, including Arizona, California, Texas, Colorado, and Ohio. Tiller et al. (1997) described a positive relationship between the frequency of this anomaly and the age class distribution within the population. The 1-year-old bucks essentially were normal, intermediate lesions were detected in one 3-year-old buck, and severely degenerative/atrophic testes occurred in the 5- to 12-year-old bucks. Hunting is not allowed on Hanford Site property and, therefore, provides deer with a unique opportunity for high survival rates in the older (5+ years) age classes, magnifying the frequency of this condition in the Hanford Site deer and making it difficult to compare with other mule deer populations.

PNNL-11518 also describes the reproductive status of the Hanford Site mule deer herd. Examination of several females captured in early spring (January-March) indicated all animals were pregnant. This suggests that although a portion of the males were infertile, enough fertile males were present to maintain reproductive capacity of the herd.

Systematic roadside observations have been conducted during the post-hunting (December-January) periods since 1993. The surveys were conducted primarily to monitor trends in age and sex ratios of mule deer and to examine trends in the relative abundance of deer on the Hanford Site. The precharted route was ~40 kilometers (25 miles) long and was traveled by vehicle at an average speed of 16 kilometers per hour (10 miles per hour). The number of deer observed along the route were recorded. Deer observations were classified as bucks, does, fawns, or unknown. Bucks were further classified as affected or normal during the post-hunting surveys based on antler morphometry (velvet-covered antlers indicate atrophic testes).

Figure 7.2.4 illustrates the observed frequency of bucks (number of affected males per 100 males) that exhibited signs of testicular atrophy (velvet-covered antlers) during the post-hunting roadside surveys. In 1993, Tiller et al. (1997) and PNNL-11518 estimated 15% of the males observed during deer capture events and radio-tracking efforts exhibited velvet-covered antlers and atrophic (shrunken) testicles. In 1994, systematic survey results suggested 22% of all bucks exhibited velvet-covered antlers, a direct indicator of testicular dysfunction. The percentage of males considered affected declined during the years 1995 through 1997; however, results in 1998 and 1999 indicated the frequency of the anomaly was back up to near the levels reported in 1993.

This change is likely attributed to an increase in the proportion of older age class males (greater than 5 years of age) alive in the resident deer herd. This is in part due to the fact that ten affected males were removed from the population in the fall of 1995 for histological and chemical analyses. Continued monitoring will help determine if this is indeed the only responsible mechanism for the observed change.

Monitoring the total number of deer observed per survey per year may provide a useful index for changes in the total deer population over time. In addition, fawn recruitment (number of fawns surviving the first year after birth) is helpful to support the observed population trends. PNNL-11518 estimated that 330 deer reside along the riverine regions of the Hanford Site (Benton County side only). This estimate was conducted in 1995.

Figure 7.2.5 illustrates trends in fawn ratios seen per survey from 1993 through 1999. The numbers of

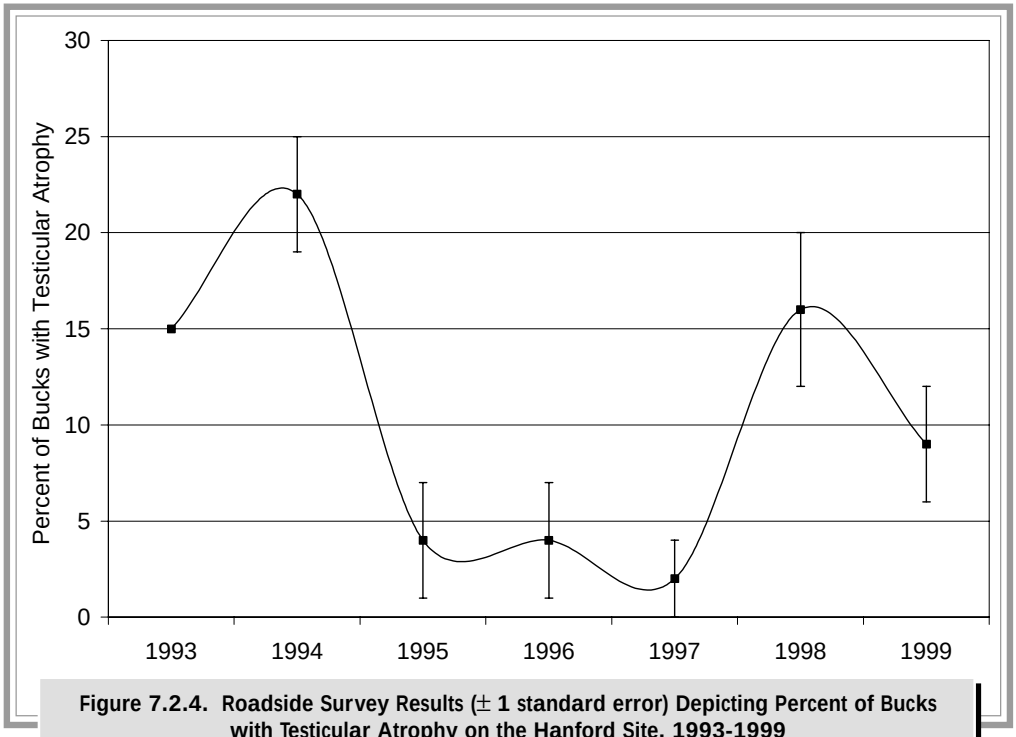

Figure 7.2.4. Roadside Survey Results (± 1 standard error) Depicting Percent of Bucks with Testicular Atrophy on the Hanford Site, 1993-1999

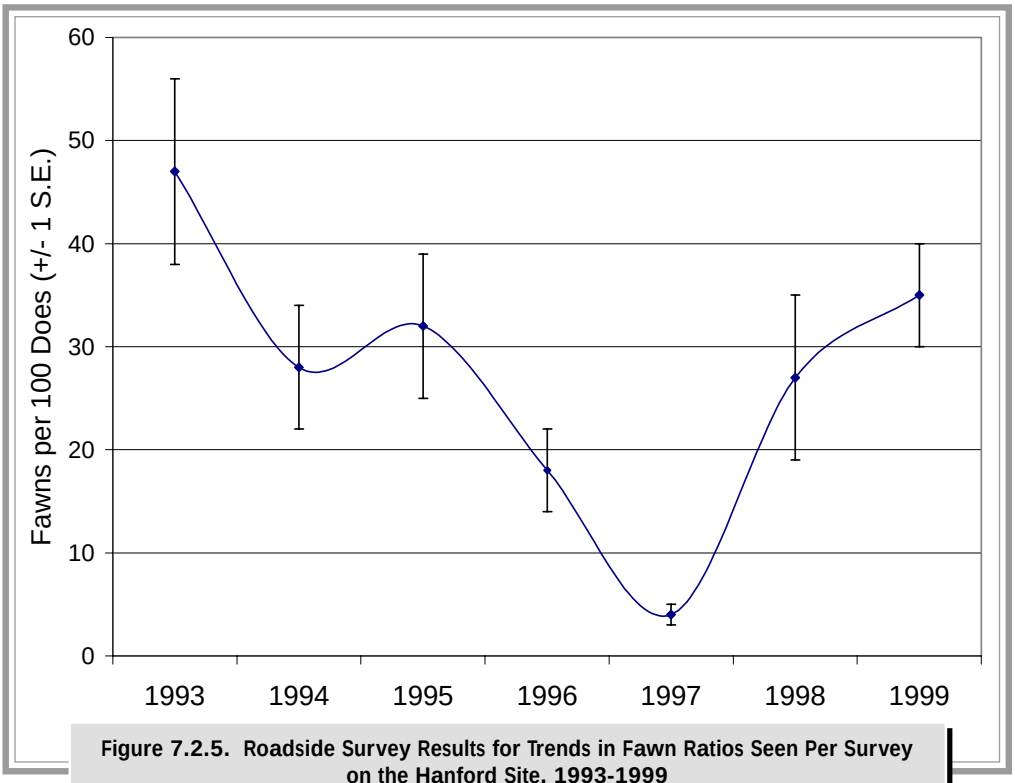

Figure 7.2.5. Roadside Survey Results for Trends in Fawn Ratios Seen Per Survey on the Hanford Site, 1993-1999

fawns (standardized to 100 does) declined from 1993 hitting a low of 4 fawns per 100 does in 1997 but has rebounded to 35 fawns per 100 does in 1999.

Roadside surveys are a simple and inexpensive index to monitor for changes in the frequency of testicular atrophy and sex and age composition of the deer along the Hanford riverine corridor. The number of fertile males in this deer herd is such that reproductive capacity has not been impaired. The frequency of affected males along the riverine areas of the Hanford Site was dramatically reduced subsequent to the special investigation and now appears to have increased to near the frequency originally observed in 1993 and 1994 (15 to 20% of all males).

Observed trends in the fawn recruitment rates suggest patterns of cycling. Pregnancy rates determined in 1993 (PNNL-11518) were at or near 100% of all deer sampled. The pregnancy rate was sampled in the early stages of gestation and, therefore, does not reflect subsequent birth rates or survival rates of the fawns. The loss of over 70% of the in-utero fawns (35 fawns per 100 does surviving past year 1) may be the result of increased neonatal mortality (i.e., fetal resorbtion or abortion) or increased post-natal mortalities (increased predation, old-aged adults) or a combination of all of these factors. Results from the post-hunting surveys in 1999 indicate the number of fawns per 100 does rebounded to the levels seen in the early 1990s and are similar to other deer populations in shrub-steppe ecosystems.

It is unknown whether the observed cycles are the result of natural processes or man-induced change. Continued roadside surveys to monitor the frequency of testicular atrophy and age and sex classes will document the demographical trends of mule deer on the Hanford Site. This data will be necessary to determine the persistence of testicular atrophy in the Hanford mule deer population.

7.2.6 Canada Geese

Nesting Canada geese are valuable recreational and aesthetic resources along the Snake and Columbia Rivers in eastern Washington. Goose nesting surveys began in the 1950s to monitor changes in response to reactor operations (Figure 7.2.6). The gradual decline in the late 1960s and early 1970s is attributed to persistent coyote predation, mostly on the Columbia River islands upstream from the Old Hanford Townsite. Since the 1970s, the majority of nesting geese have shifted from the upstream islands to the downstream islands near Richland, which in recent years have been relatively free from coyote predation. Since 1995, nesting surveys have been conducted every two years.

In 1999, nest positions were identified using a Global Positioning System and eggs were marked with the respective nest number, using a permanent, nontoxic marker. All nests were monitored until the fate of each nest (i.e., eggs hatched, destroyed by predators, flooded, abandoned) was documented. In 1999, there were 241 nests surveyed, with 193 (80%) that successfully hatched at least one egg. The fate

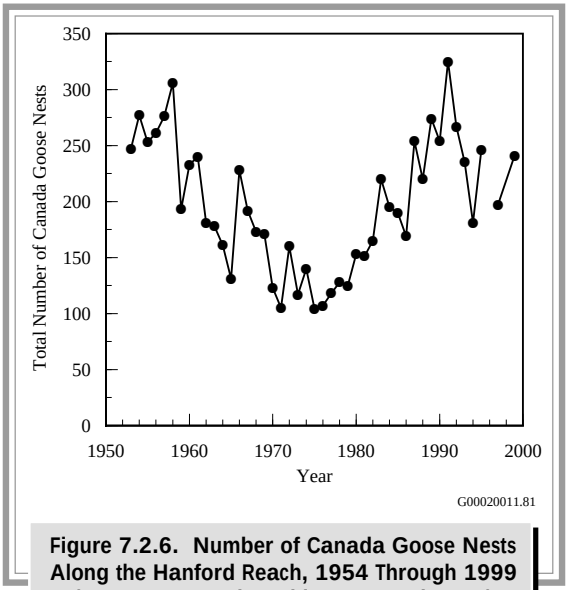

Figure 7.2.6. Number of Canada Goose Nests Along the Hanford Reach, 1954 Through 1999 (no surveys conducted in 1996 and 1998)

of the remaining nests was affected equally by predation, flooding, abandonment, or other unidentified disturbances. By marking the eggs, the reuse of several nest sites during the year by other nesting geese was documented. Had the eggs not been marked (as in all previous years), it is likely that only a single nesting event would have been recorded at each of these nest sites. Canada goose populations have been successful on the Hanford Reach because the islands are restricted from human uses during the nesting period and because shoreline habitats provide adequate food and cover for successful brood rearing (Eberhardt et al. 1989).

7.2.7 Plant Biodiversity Inventories

The Hanford Site contains biologically diverse shrub-steppe plant communities that have been protected from disturbance, except for fire, over the past 55 years. This protection from disturbance has allowed plant species to thrive at Hanford that have been displaced by agriculture and development in other parts of the Columbia Basin. Surveys and mapping efforts conducted by The Nature Conservancy of Washington and the Pacific Northwest National Laboratory Ecosystem Monitoring Project document the occurrence and extent of rare plant populations and plant community types on the Hanford Site (Nature Conservancy). Populations of rare plants include taxa listed by Washington State as endangered, threatened, or sensitive and the locations of species that are listed as review group 1 (i.e., taxa in need of additional field work before status can be determined) (Washington Natural Heritage Program 1997). The data provide information that is critical to site planning processes and land-use policy development.

Figure 7.2.7 shows the known locations of more than 100 rare plant populations of 31 different taxa. Five of these 31 taxa (including the two new species, *Eriogonum codium* and *Lesquerella tuplashensis* [Umtanum buckwheat and White Bluffs bladderpod]) have been designated as species of concern in the Columbia River Basin Ecoregion by the U.S. Fish and Wildlife Service. 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. These include areas that could support populations of rare annual forbs found in adjacent habitat.

During 1999, a small population of *Nicotiana attenuata* (Torr.) (coyote tobacco) was discovered on the Fitzner/Eberhardt Arid Lands Ecology Reserve. This state-sensitive species had not been documented in Benton County for more than 100 years, and, although historically documented in Franklin County, has not been located in recent years. Surveys in 1999 also indicated significant increases in the numbers of *Erigeron piperianus* (Piper's daisy) a species of concern occurring in the 200 Areas. Populations of another species of concern in the Columbia River Basin Ecoregion, *Rorippa columbiae* (persistent sepal yellowcress), still appear to be in decline as a result of the high river flow levels over the past 4 years. *Rorippa columbiae* is a rhizomatous perennial found in moist soils along the Columbia River within the Hanford Site. This species is often inundated by river flows, but little is known concerning long-term survival under continuous inundation. Surveys in 1999 showed low numbers of stems at the 100-F cobble beach on the Hanford Reach (Table 7.2.1) and no stems have been observed in flower for the past 2 years.

Maps showing the extent and distribution of vegetation cover types found on the Hanford Site have been updated to include recent work delineating the plant communities in central Hanford (Salstrom and Easterly 1997, Nature Conservancy 1999). These were merged with existing map data for the Fitzner/Eberhardt Arid Lands Ecology Reserve, the Wahluke Wildlife Recreation Unit, and the Saddle Mountain Unit. Data included in this representation of vegetation on the site have been developed over several years by staff of the Ecosystem

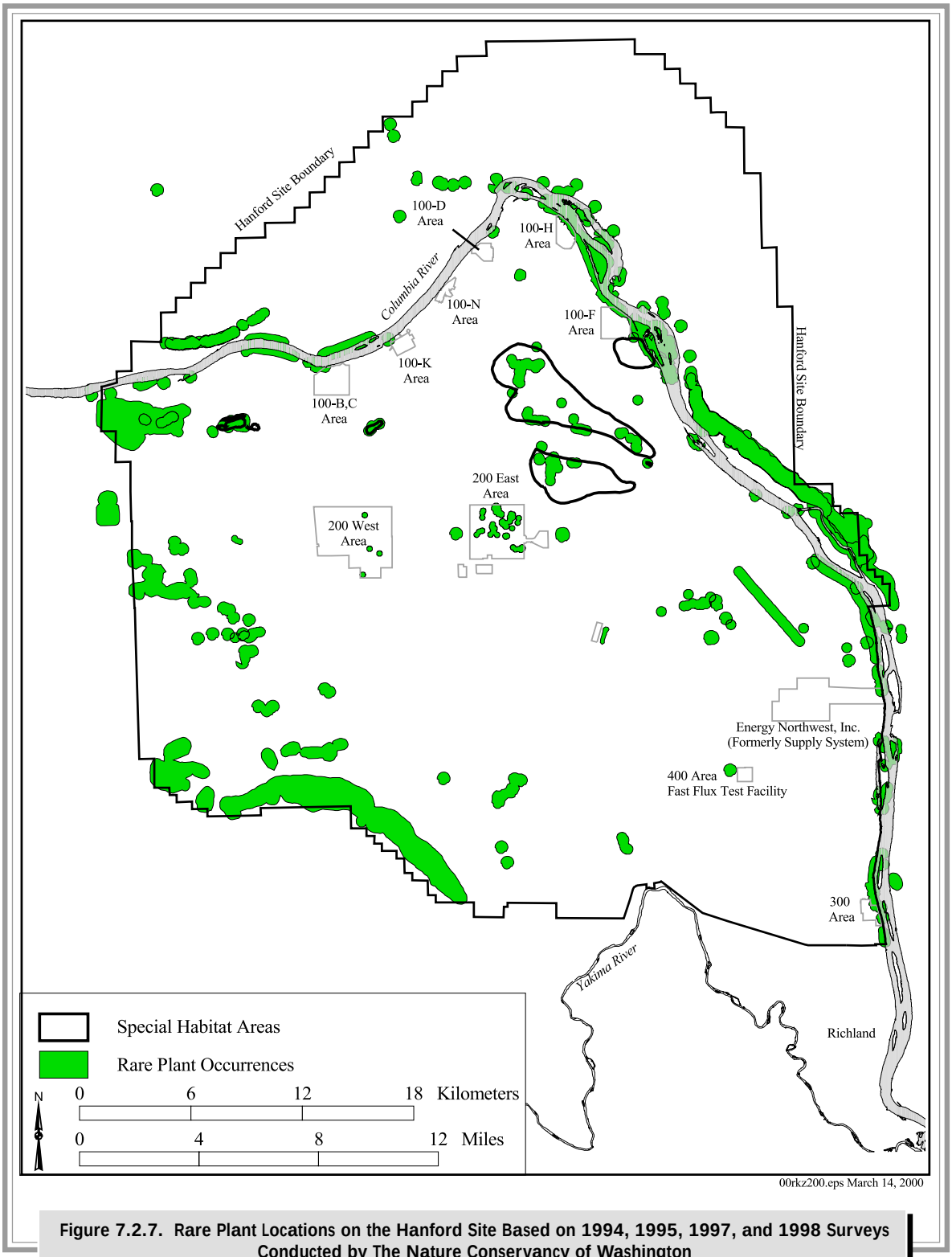

Figure 7.2.7. Rare Plant Locations on the Hanford Site Based on 1994, 1995, 1997, and 1998 Surveys Conducted by The Nature Conservancy of Washington

Table 7.2.1. Numbers of *Rorippa columbiae* Stems Counted Along the Hanford Reach of the Columbia River, 1994, 1998, and 1999

Survey Location	1994 Counts	1998 Counts	1999 Counts
100-F beach	>15,000	70	94
Locke Island	>10,000	117	Not surveyed[a]
Island 18[b]	>10,000	0	Not surveyed

(a) High water levels prevented access to populations.
(b) Located in the Columbia River at the 300 Area.

Monitoring Program and contractors for The Nature Conservancy of Washington. These maps are documented in the draft of the Hanford Site Biological Resource Management Plan and can be viewed on the Ecosystem Monitoring Project web page (www.pnl.gov/ecology/ecosystem/).

7.2.8 Sagebrush Die-Off

Big sagebrush (*Artemisia tridentata* subspecies *wyomingensis*) is the most common shrub component of shrub-steppe vegetation on the Hanford Site. Sagebrush stands represent an important resource for sagebrush-obligate wildlife species such as black-tailed jackrabbits, sage sparrows, sage thrashers, and loggerhead shrikes. Since 1993, site biologists have documented areas of sagebrush die-off in stands near the 100-D Area, the cause of which is not known. Shrub die-offs are not uncommon in the intermountain west and such episodes have been reported from British Columbia, Idaho, Nevada, Utah, and Wyoming (Dobrowolski and Ewing 1990). Die-off of shrubs has been attributed to severe rootlet mortality, root rot, soil salinity and anaerobiosis, and vascular shoot wilt induced by fungal pathogens (Nelson et al. 1989, Weber et al. 1989).

The extent of the die-off on the Hanford Site was mapped and survey data were collected in 1996 and 1997 to establish a baseline for monitoring future expansion of the die-off (PNNL-11700). The resulting report indicated that a total area of 1,776 hectares (4,388 acres) showed evidence of sagebrush decline, with a central portion of 280 hectares (692 acres) where shrub death was estimated to be ~80% or greater. Observations of shrub vigor (percent canopy defoliation) show continuing declines in shrub health in the die-off areas and along the boundary of the die-off areas.

Surveys from 1997, 1998, and 1999 of shrubs within the die-off areas indicate that sagebrush plants are continuing to decline. Shrubs along transects were classified by amount of live canopy in the following manner: dead, less than 50% live canopy, 50 to 90% live canopy, and more than 90% live canopy. These measurements indicated that although few shrubs actually died along each measured transect, 10% to 35% of shrubs measured declined by at least one category.

During 1999, four of the original six monitoring transects (three in the die-off area and one in a control area) were surveyed to evaluate possible re-establishment of sagebrush seedlings. No seedlings from the 1999 growing season were found on the transects in the die-off area or on the control transect. The absence of seedlings in any one year does not necessarily indicate decline or a change in community dynamics. Germination and seedling establishment are dependent on climatic conditions, particularly precipitation, during the early winter

and spring growing season. However, no young sagebrush (shrubs less than 30 centimeters [12 inches] tall) were found within 50 meters (164 feet) of transects in the die-off area. In the area surrounding a control transect outside the die-off, shrubs in different age classes were observed. Although not abundant, young shrubs were found within 50 meters (164 feet) of the existing transect. These observations may indicate a need to further investigate the community dynamics and recruitment of sagebrush seedlings in both the die-off areas and sagebrush stands growing in similar soils.

7.2.9 Other Important Biological Resources

A number of biological resources have been measured in several distinct community types on site. The resources include vegetation, cryptogamic crusts (mosses and lichens), reptiles, invertebrates, birds, and mammals. Figure 7.2.8 depicts trends in abundance of two bird species within big sagebrush/bunchgrass communities on the Hanford Site. The sage sparrow and loggerhead shrike are known as sagebrush-dependant species, especially during nesting and brood rearing. Populations of these two species have declined substantially over the past decade within their historical ranges. Results collected from the baseline monitoring on the Hanford Site from 1996 through 1999 suggest consistency in absolute and relative numbers for shrikes and sage sparrows within the big sagebrush/bunchgrass communities there.

Figure 7.2.9 depicts the composition and abundance of small mammals within active and inactive (unstable and stable) sand dunes, and big sagebrush/bunchgrass communities (pre- and post-fire) on the Hanford Site. Active sand dunes contained a small mammal species known as the western harvest mouse, which was not found in the inactive dunes. All four communities contained large populations of deer

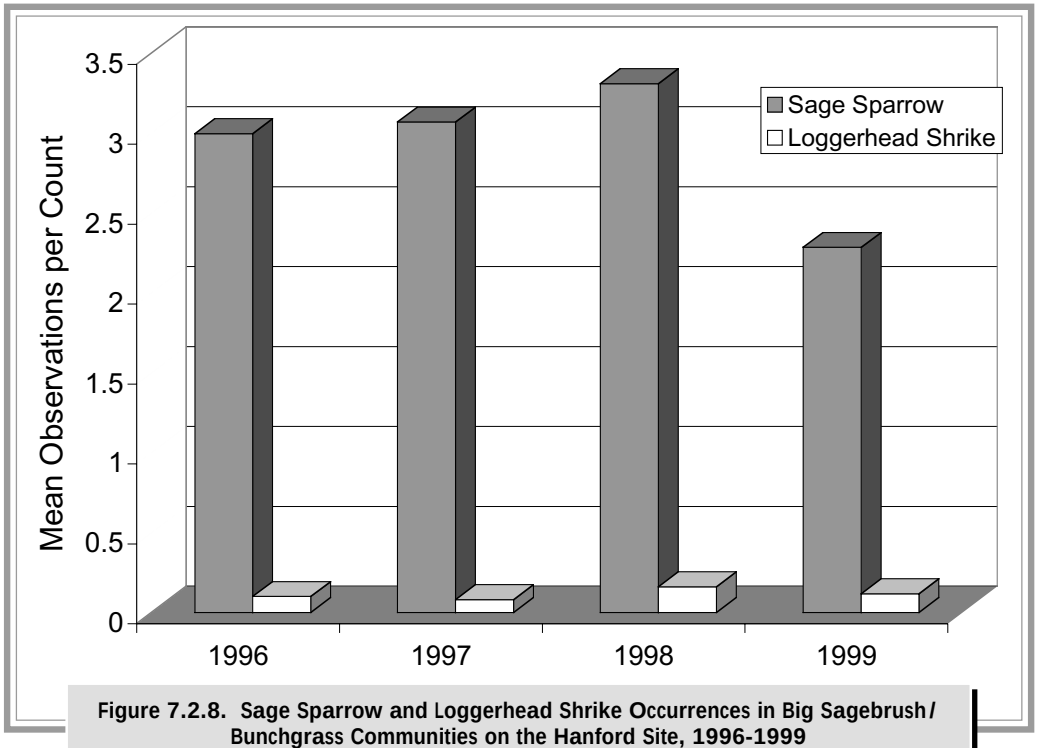

Figure 7.2.8. Sage Sparrow and Loggerhead Shrike Occurrences in Big Sagebrush/ Bunchgrass Communities on the Hanford Site, 1996-1999

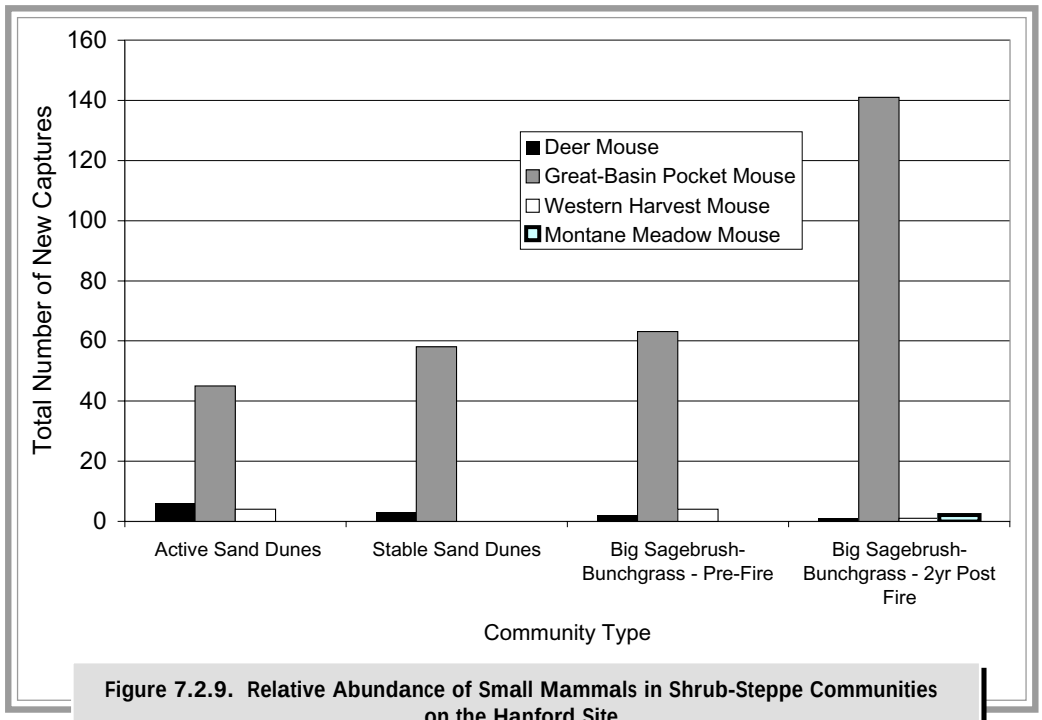

Figure 7.2.9. Relative Abundance of Small Mammals in Shrub-Steppe Communities on the Hanford Site

mice and Great-Basin pocket mice as well as other species unique to their communities.

For the first time in over two decades, several confirmed sightings of sage grouse were made on the Fitzner/Eberhardt Arid Lands Ecology Reserve in 1999. This is significant because the Washington State western sage grouse (*Centtocercus urophaqsianus phaios)* population has been in decline for many years and the species was recently listed by the Washington State Department of Fish and Wildlife as threatened. Should a sizable population of sage grouse become established on the reserve, the potential for these birds to escape total eradication in Washington State would be increased.