

## 7.2 Ecosystem Monitoring (Plants and Wildlife)

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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. 9). Nearly 600 species of plants have been identified on the Hanford Site (WHC-EP-0054). Recent work by The Nature Conservancy of Washington has further delineated 36 distinct plant community types (Soll and Soper 1996) from within those 10 major communities.

There are two types of natural aquatic habitats on the Hanford Site: one is the Columbia River and the other is provided by the small spring streams and seeps located mainly on the Fitzner/Eberhardt Arid Lands Ecology Reserve on Rattlesnake Mountain. These include Rattlesnake Springs, Dry Creek, and Snively Springs. West Lake is a small, natural pond near the 200 Areas.

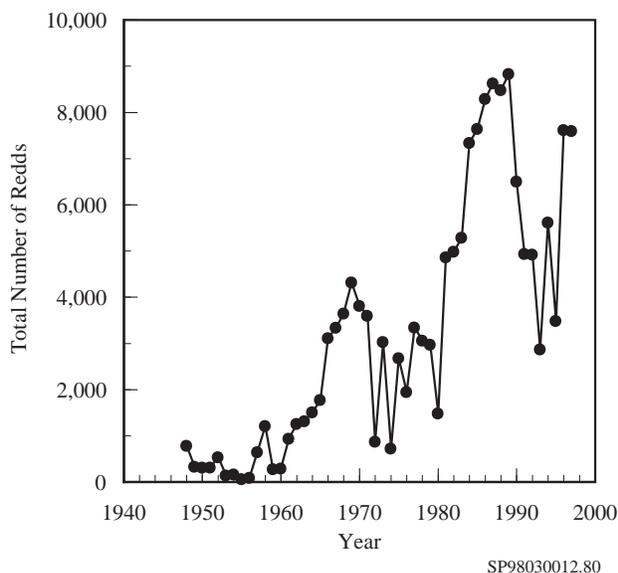
More than 1,000 species of insects (Soll and Soper 1996), 12 species of reptiles and amphibians (PNNL-6415, Rev. 9), 44 species of fish (Gray and Dauble 1977; PNNL-6415, Rev. 9), 214 species of birds (Soll and Soper 1996), and 39 species of mammals (PNNL-6415, Rev. 9) have been found on the Hanford Site. 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 (Title 50, Code of Federal Regulations, Part 17, Section 12 [50 CFR 17.12]), recent biodiversity inventory work conducted by The Nature Conservancy of Washington identified 82 populations of 17 rare plant taxa. In addition, The Nature Conservancy of Washington described 53 occurrences of 9 priority plant communities (Soll and Soper 1996). The U.S. Fish and Wildlife Service lists the peregrine falcon as endangered and the bald eagle and Aleutian Canada goose as threatened (50 CFR 17.11). The peregrine falcon and Aleutian Canada goose are migrants through the Hanford Site, and the bald eagle is a common winter resident and has initiated nesting on the Hanford Site but never nested successfully. Several plant species, mammals, birds, molluscs, reptiles, and invertebrates occurring on the Hanford Site currently are candidates for formal listing under the Endangered Species Act. Appendix F lists special-status species that could occur on the Hanford Site.

### 7.2.1 Chinook Salmon

Chinook salmon are an important resource in the Pacific Northwest. Salmon are caught commercially and for recreation. The commercial and recreational catch is managed carefully to sustain the resource. 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. The reservoirs created behind the dams eliminated most mainstem spawning areas and increased salmon spawning in the Hanford Reach. Fisheries management strategies aimed at maintaining spawning populations in the mainstem Columbia River also have contributed to the observed increases. The number of fall Chinook salmon redds counted in the Hanford Reach increased through the decades of the 1960s, 1970s, and 1980s until reaching a

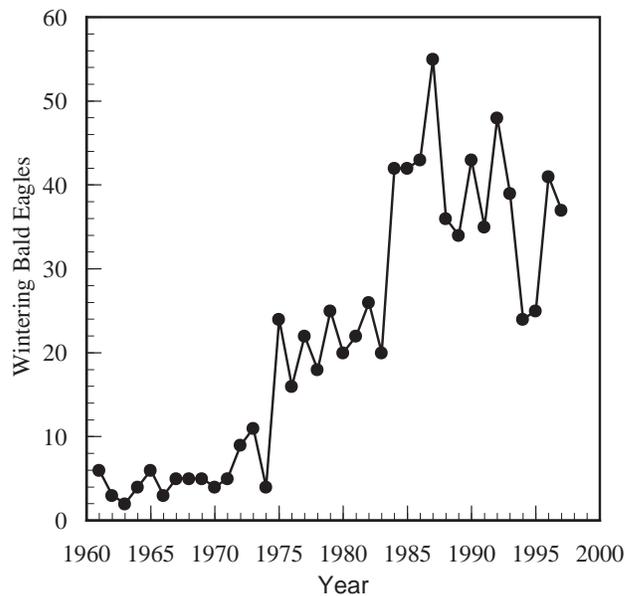


**Figure 7.2.1.** Chinook Salmon Spawning Redds in the Hanford Reach, 1948 Through 1997

high in 1989 of nearly 9,000 (see Figure 7.2.1). In the early 1990s, redd counts declined to approximately one-third the 1989 peak, but they appear to have rebounded in recent years. In 1997, approximately 7,600 redds were observed, which represents no change from the 1996 count. It should be noted that aerial surveys do not yield absolute counts of redds because visibility varies, depending on water depth and other factors, and because the number of redds in high-density locations cannot be counted accurately. It has been noted, however, that redd survey data generally track adult escapement figures 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). Historically, bald eagles have wintered along the Hanford Reach of the Columbia River. However, when monitoring began in the early 1960s, numbers were low (Figure 7.2.2). Following the passage of the Endangered Species Act in 1973, the number of wintering bald eagles increased. Possible reasons for the observed increase are 1) reduced persecution in Alaska, 2) protection of bald eagles at nesting locations off the Hanford Site, and 3) the nationwide elimination of dichlorodiphenyltrichloroethane (DDT) as an agricultural pesticide in 1972.



**Figure 7.2.2.** Bald Eagles Observed Along the Hanford Reach, Fall and Winter Months, 1961 Through 1997

A single maximum count of 37 bald eagles was documented on the Hanford Reach in the winter of 1997. This number is similar to the 1996 count (41) and up from 25 birds observed in 1995. Changes in the number of eagles on the Hanford Site generally correspond 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). Thus, it appears that the number of bald eagles occupying the Hanford Reach in any given year may be directly related to the local abundance of food.

Protection for bald eagles is guided by the *Bald Eagle Site Management Plan for the Hanford Site, South-Central Washington* (DOE/RL-94-150) and coordinated with representatives of the U.S. Fish and Wildlife Service.

Several nest building attempts by bald eagles have been observed at the Hanford Site in recent years. The presence of two bald eagle pairs attending nest sites along the Hanford Reach triggered the closure of several roads and portions of the Hanford Site shoreline in 1997. Nest tending activities and territorial displays were documented as early as mid-November. However, the birds eventually left the area without successfully nesting.

The Hanford Reach is expected to continue providing wintering bald eagle habitat as long as critical resources

such as food, perches, and relative freedom from human activities are maintained.

### 7.2.3 Hawks

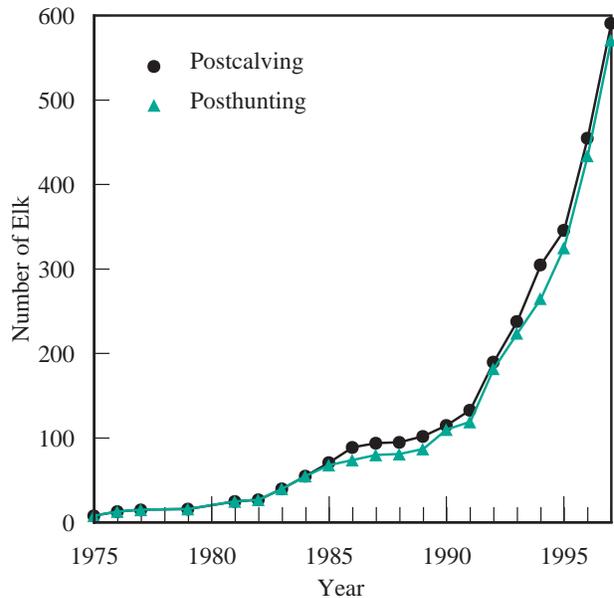
The undeveloped land of the semiarid areas of the Hanford Site provides nest sites and food for three species of migratory buteo hawks: Swainson’s, red-tailed, and ferruginous. Under natural conditions, these hawks nest in trees, on cliffs, or on the ground. Power-line towers and poles also can serve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

In recent years, the number of ferruginous hawks nesting on the Hanford Site has remained stable (12 active nests in 1997). 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 Hanford Site and adjacent lands was completed in 1996 (Leary 1996). That work suggested that ferruginous hawks nesting on the Hanford Site were attracted to the area because of suitable, disturbance-free nesting habitat, but that much of the foraging for prey species occurred on adjacent privately owned agricultural fields. Male ferruginous hawks were observed to travel up to 15 km (9.3 mi) from their Hanford Site nests to hunt, making several trips each day to deliver prey to their mates and offspring. These results showed that medium-sized mammals such as northern pocket gophers, which can be serious agricultural pests, are the primary prey of ferruginous hawks. It is likely that the success and relative abundance of ferruginous hawks nesting at the Hanford Site depend on both site lands for quality nesting habitat and adjacent private agricultural lands for suitable foraging habitat.

### 7.2.4 Rocky Mountain Elk

Rocky Mountain elk did not inhabit the Hanford Site when it was established in 1943. Elk appeared 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 591 animals prior to the 1997 hunting season (Figure 7.2.3). Although accurate counts of elk harvest on adjacent private lands are not available, the harvest appears to be small, with less than 5% of the herd being harvested and the majority of the harvest consisting of bulls. The 1997 harvest consisted of 16 adult bulls, 1 spike (yearling male), and 3 cows. Thus, growth of the herd is largely unconstrained, and increasing damage to natural plant communities on the Hanford Site and to crops on adjacent private land is likely. Several observations were made in 1996 and 1997 of elk having crossed to the north side of State Highway 240, making future sitings of elk near the 100 and 200 Areas probable. As the herd continues to grow, there are two safety-related concerns that will increase. The first is the potential for an increase in automobile-elk collisions on local highways, and the second is the possibility that elk will range into the recently enlarged radiation protection zone (BC Cribs) immediately south of the 200-East Area.



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**Figure 7.2.3.** Elk on the Hanford Site Counted by Aerial Surveillance During Postcalving (August through September) and Posthunting Periods (December through January), 1975 Through 1997

## 7.2.5 Mule Deer

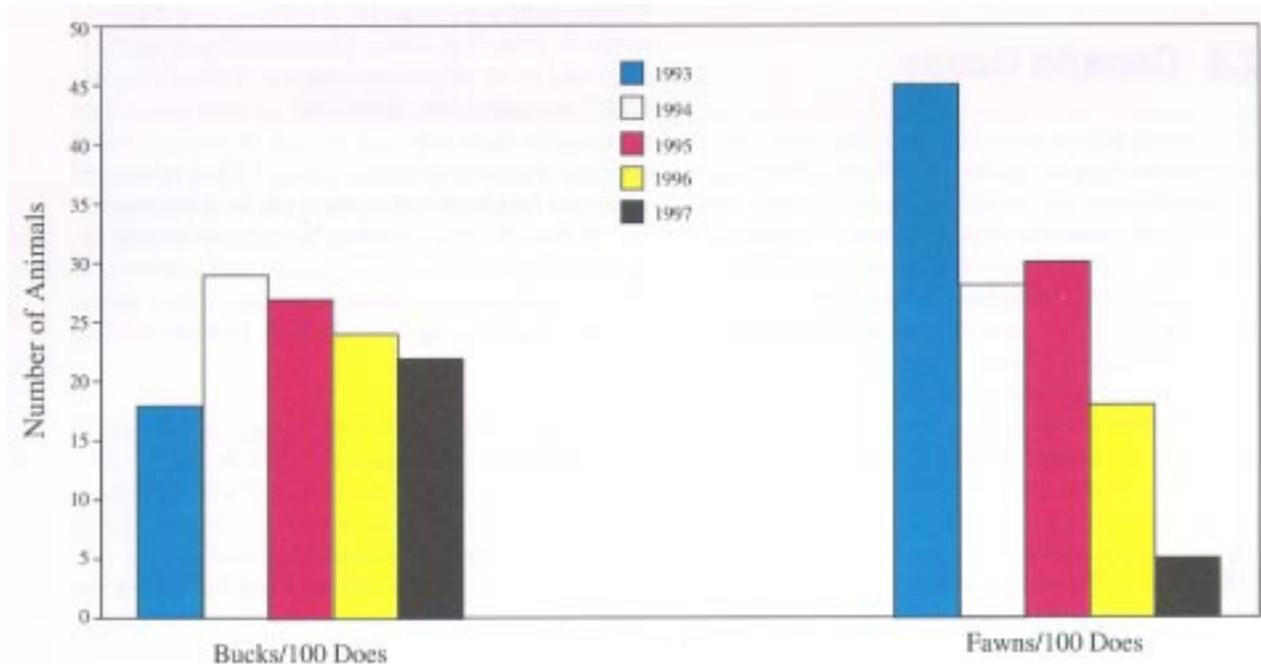
Mule deer are a common resident of the Hanford Site and are important because of the recreational (offsite hunting) and aesthetic values they provide. Because mule deer have been protected from hunting on the Hanford Site for approximately 50 years, the herd has developed a number of unique population characteristics different from most other herds in the semiarid region of the northwest. These characteristics include a large proportion of old-age animals (older than 5 years) and large-antlered males.

Because mule deer are often hunted and eaten, they potentially can contribute to the radiation dose received by members of the public that consume game animals (PNL-7539, MacLellan et al. 1993). On the Hanford Site, deer are also of interest to environmental monitoring programs because they can provide useful information that can be used in contaminant cleanup efforts (Eberhardt and Cadwell 1983, PNL-10711, PNNL-11518).

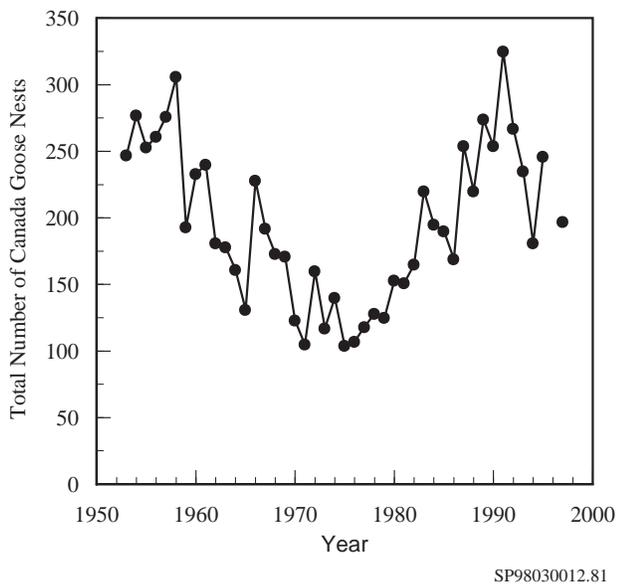
The deer population onsite was estimated in 1996 by marking deer and counting the ratio of marked to unmarked animals along the south and west shorelines of the Columbia

River. In addition, relative deer densities were determined for the remainder of the Hanford Site by comparing the frequency of fecal pellet groups found within each region. Approximately 330 deer were estimated to reside along the Hanford Reach south of the Columbia River. The total Hanford Site mule deer population for the land area south of the Columbia River, including the central portion of the Hanford Site and the Fitzner/Eberhardt Arid Lands Ecology Reserve was estimated at 650.

Age and sex classes of deer that reside along the Columbia River of the Hanford Site have been monitored yearly since 1993. Roadside surveys have been conducted on an established route that is nearly 48 km (30 mi) long. The route is driven several times during the postfawning season (July-September) and the posthunting season (December-February) to get an estimate of the ratio of antlered deer (bucks) to antlerless deer (females) and the ratio of fawns to antlerless deer. The buck-to-doe ratios seen in this region have remained relatively stable since 1993. This ratio (22 antlered per 100 antlerless in 1997) is high compared to other more heavily hunted populations in the semiarid northwest. Fawn-to-doe ratios have begun to demonstrate a significant downward trend (Figure 7.2.4).



**Figure 7.2.4.** Age and Sex Ratios of Mule Deer Along the Hanford Reach, 1993 Through 1997



**Figure 7.2.5.** Number of Canada Goose Nests and Successful Nests Along the Hanford Reach, 1954 Through 1997 (no survey conducted in 1996)

Typically, 30 to 40 fawns per 100 does are observed throughout the semiarid regions of the northwest. The cause of the decline in fawn recruitment on the Hanford Site is currently unknown.

## 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 7.2.5). The gradual decline observed 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. Nesting success was relatively low (61%) in 1995 as a result of predation and the increase in river flows during the nesting season. Surveys were conducted in 1997 to record the maximum number of nesting pairs found on each island and to determine nesting success for those nests. The results appear similar to past nesting seasons; 197 pairs were identified and 177 (90%) of those were considered successful hatches. Canada goose populations are successful on the Hanford Reach because the

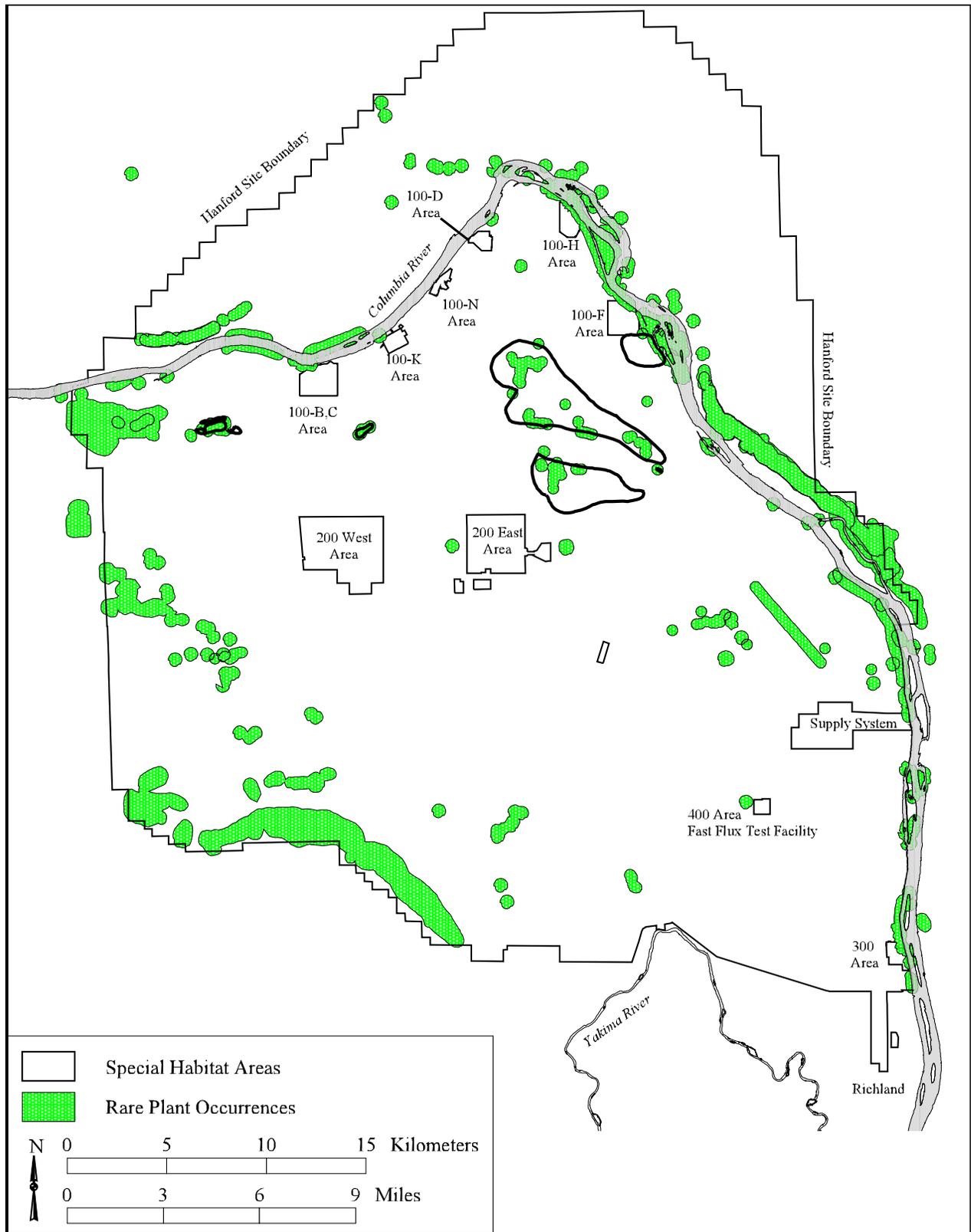
islands are restricted from human uses during the nesting period and because shoreline habitats provide adequate food and cover for successful brood rearing (Eberhardt et al. 1989).

## 7.2.7 Plant Biodiversity Inventories on the Hanford Site

Over the past years, The Nature Conservancy of Washington has conducted intensive surveys and mapping efforts to document the occurrence and extent of rare plant populations and plant community types on the Hanford Site (Soll and Soper 1996, Hall 1998). These data, along with existing data from the ecosystem monitoring project, provide information that supports the U.S. Department of Energy's (DOE's) land-use planning process, provides information on which to base responsible biological resource stewardship and management actions, and provides a technical basis for mitigation action planning associated with DOE's site cleanup mission.

Surveys for rare plants on the site were conducted through the growing seasons of 1994, 1995, and portions of 1997. Figure 7.2.6 delineates the known locations of more than 100 rare plant populations of 30 different taxa (Caplow and Beck 1996, Hall 1998). These populations include taxa listed by the Washington Natural Heritage Program (1977) as endangered, threatened, or sensitive within Washington State and the locations of populations of taxa that are listed as review group 1 (taxa in need of additional field work before status can be determined). Five of these 30 taxa, including the two new-to-science species, *Eriogonum codium* and *Lesquerella tuplashensis*, 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 potentially support populations of rare annual species found in adjacent habitats. The inventory accomplished by The Nature Conservancy of Washington over the past several years documents a remarkable number of rare plant populations across the site. The degree of protection from disturbance afforded to the Hanford Site over the past 50 years has resulted in an "island of biodiversity" for plant resources



**Figure 7.2.6.** Rare Plant Locations on the Hanford Site Based on 1994, 1995, and 1997 Survey Conducted by The Nature Conservancy of Washington

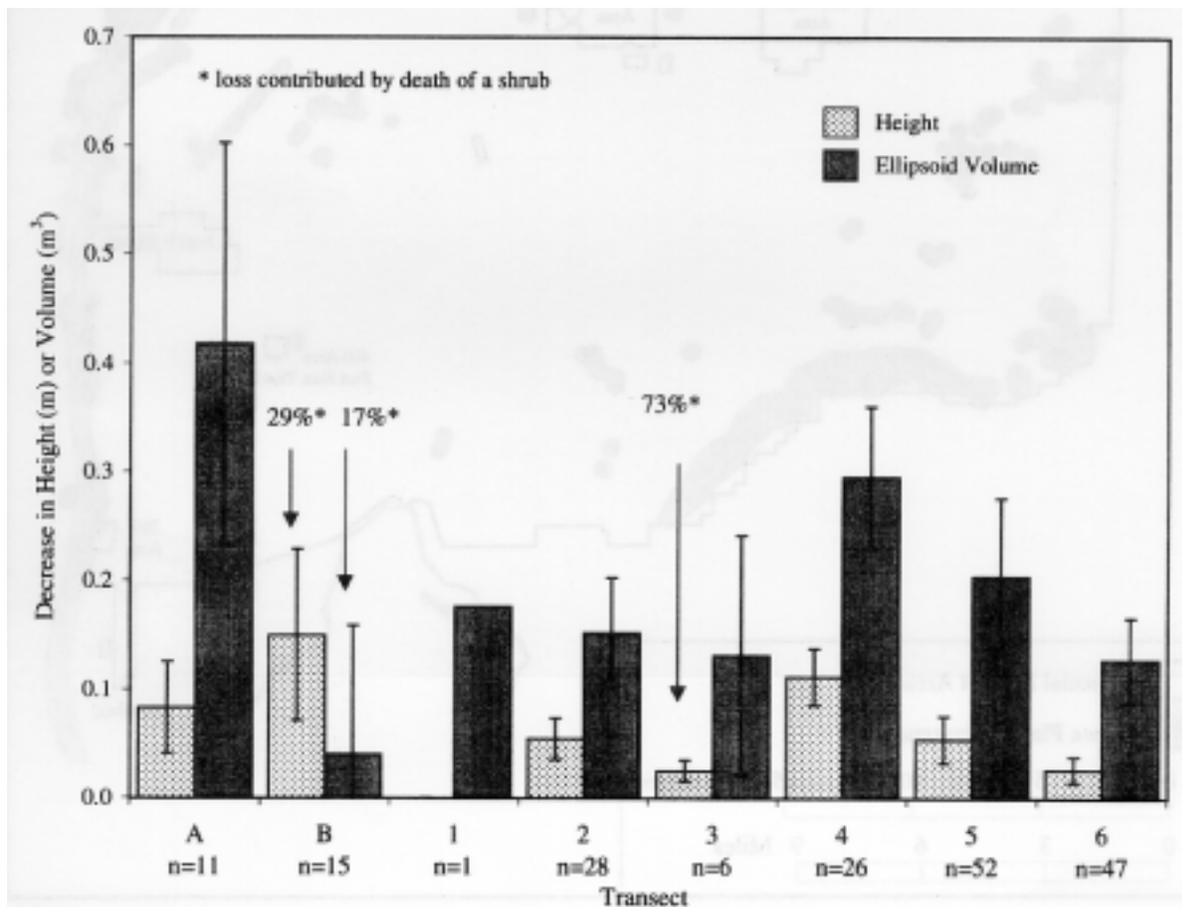
(Caplow and Beck 1998). Some of the preliminary summary information on the site's rare plants was included in Appendix D of the *Draft, Hanford Site Biological Resources Management Plan* (DOE/RL-96-32). The draft plan currently serves as a guidance document for Hanford Site biological resources management, pending tribal input and comment and Hanford stakeholder review.

### 7.2.8 Sagebrush Die-Off

Big sagebrush (*Artemisia tridentata* subspecies *wyomingensis*) is the most common shrub component of shrub-steppe vegetation associations 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 the sagebrush die-off on the site is not known.

Shrub die-offs are not uncommon in the intermountain west and such episodes have been reported from Nevada, Wyoming, Utah, Idaho, and British Columbia (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). That report indicated that a total area of 1,776 ha (4,388 acres) showed evidence of sagebrush decline, with a central portion of 280 ha (692 acres) where shrub death was estimated to be approximately 80% or greater. Surveys in late 1997 and early 1998 of shrubs along transects established in late 1996 within the die-off areas indicate that sagebrush plants are continuing to decline. Shrub height and canopy volume decreased (Figure 7.2.7) and observations of shrub vigor (percent canopy defoliation) also indicate continuing declines in



**Figure 7.2.7.** Average Decrease in Shrub Height and Volume Along Each Transect (bars are ±1 standard error of the mean)

shrub health in the die-off areas. No efforts have been made to compare the current extent of the die-off area with the area previously mapped in early 1997. Determining an exact boundary between healthy shrub stands and declining shrub stands is difficult because these boundaries are transitional with no clear edge.

Information was gathered regarding seedling recruitment and seedling growth in areas of shrub decline to understand whether and how sagebrush may reinvade the die-off areas. To examine how sagebrush seed germination and growth might be affected in die-off areas onsite, healthy seeds collected distant from the die-off areas were allowed to germinate in soils from areas inside and outside the die-off regions and growth of seedlings was

measured over a 6-week period. No differences in germination rates were observed; however, 43 days after the seeds had been planted, seedling height and number of leaves were significantly less in die-off soils. No sagebrush seedling mortality was observed. The causes of reduced growth of seedlings in die-off soils are unknown, but might result from differences in soil nutrient and organic content where leaf fall and litter from healthy shrubs are reduced. These seedlings have been planted into the central die-off area and in a control plot away from the central die-off area. Sagebrush planted at the two sites will be monitored over the next year to determine seedling growth and vigor within and away from the die-off area.