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Wildlife Studies on the Hanford Site: 1994 Highlights Report

L. L. Cadwell

April 1995

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
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Pacific Northwest Laboratory
Richland, Washington 99352

Executive Summary

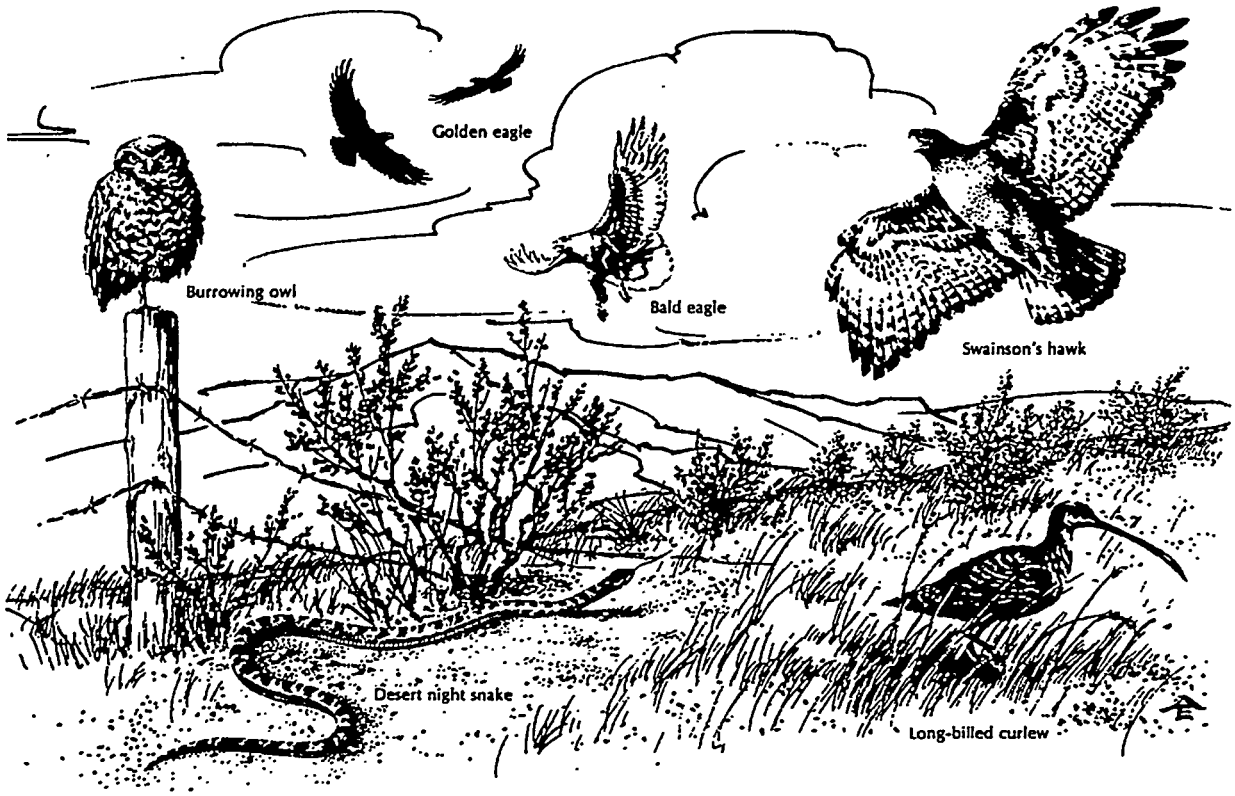
Pacific Northwest Laboratory (PNL) manages the Hanford Site's Wildlife Resources Monitoring Project for the U.S. Department of Energy (DOE). The purposes of the project are to monitor and report trends in wildlife populations; conduct surveys to identify, record, and map populations of threatened, endangered, and sensitive plant and animal species; and cooperate with Washington State and federal and private agencies to help ensure the protection afforded by law to native species and their habitats.

Often, project staff work side by side with public and private agency staff, including the Washington Department of Fish and Wildlife (WDFW), the U.S. Fish and Wildlife Service (USFWS), the Washington State Department of Natural Resources (DNR), the Washington State Department of Ecology (Ecology), and The Nature Conservancy (TNC) to collect data useful for protecting wildlife and plants and for land-use planning. Census data and results of surveys and special study topics are shared freely among cooperating agencies. Special studies are also conducted as needed to provide additional information that may be required to assess, protect, or manage wildlife resources at Hanford. This report describes highlights of wildlife studies on the Site in 1994.

Redd counts of fall chinook salmon in the Hanford Reach suggest that harvest restrictions directed at protecting Snake River salmon may have helped Columbia River stocks as well. The 1994 count (5619) was nearly double that of 1993 and about 63% of the 1989 high of approximately 9000.

A habitat map showing major vegetation and land use cover types for the Hanford Site was completed in 1993. During 1994, stochastic simulation was used to estimate shrub characteristics (height, density, and canopy cover) across the previously mapped Hanford landscape. The information provided will be available for use in determining habitat quality for sensitive wildlife species. Mapping Site locations of plant species of concern continued during 1994. Additional sensitive plant species data from surveys conducted by TNC were archived.

The 10 nesting pairs of ferruginous hawks that used the Hanford Site in 1993 represented approximately 25% of the Washington State population. Thus, it is apparent that Hanford land management decisions during environmental restoration have the potential to impact the future status of this species, currently listed as Washington State threatened.



Nesting success for the population of island-nesting Canada geese in the Hanford Reach was approximately 25% below the 1993 level. In 1994, 149 of 170 pairs nested successfully. That compares with 196 of 235 nesting pairs in 1993. The trend in recent years has been a shift in use by nesting geese from upstream islands to those nearer Richland. Nest predation by coyotes appears to have restricted nesting on upstream islands more so than on downstream islands.

Data are provided on the results of bird surveys conducted in four distinct terrestrial habitat types at Hanford. Results on the relative abundance and distribution of terrestrial game birds also are included. These survey results will provide baseline data for evaluating change in relative abundance of bird species as environmental restoration progresses on the Hanford Site. Information also is provided on the feasibility of monitoring northern oriole populations by autumn nest counts.

Mule deer studies have documented river crossings by 45% of deer marked in the 100 Areas. Some deer have moved to locations open to public hunting, including private property and the Wahluke Slope Wildlife Recreation Area. Analysis for ^{90}Sr in antler samples suggested that ^{90}Sr content was somewhat greater in 100-Area deer than in deer from the Hanford townsite and south; however, antler samples from control deer collected from the Silver Lake, Oregon, vicinity were approximately five times higher in ^{90}Sr than Hanford deer from the 100 Areas. The greater ^{90}Sr concentrations in Oregon deer were attributed to greater regional fallout ^{90}Sr associated with higher amounts of precipitation. The occurrence of abnormal antler development and atrophied testicles in some male deer is discussed, as are some possible causes for the abnormalities.

Elk count data through 1994 indicate a maximum of approximately 300 head. A study to evaluate birth control techniques and to determine the extent of associated behavioral response in Rocky Mountain elk also is described.

The wildlife resources database also is discussed. Information is included on types of historical census data available through the database. Data displays that include capabilities to create Geographic Information System (GIS) map layers also are being added to the system. We envision that as the Wildlife Resources Database continues to grow, so will its value both to DOE Site managers, planners, and interested stakeholders planning for future development and uses of the Hanford Site.

Acknowledgments

Doug Hildebrand, Dana Ward, and John B. Hall of DOE-RL, provided guidance and insight throughout the year to help ensure the Wildlife Resources Monitoring Project continued to focus on evolving biological resource issues that were both relevant and important to DOE. Lisa Fitzner and Roger McKeel, WDFW, provided technical interface with WDFW and helped provide a Washington State perspective on both wildlife monitoring needs and wildlife management objectives. Lee Rogers, PNL, provided very capable line management direction and staff availability such that project work was completed efficiently and of the highest quality. Michelle Nichols, PNL's University Programs Office, and numerous staff at Associated Western Universities, located on the Washington State University Tri-Cities campus, made technical arrangements for many students who came to learn and work on the project. The volume and quality of work completed by the project would have been greatly diminished had it not been for the long hours provided by dedicated graduate students, undergraduate students, high school teachers, and high school students who worked hand-in-hand with project staff. Rosalind Schrempf capably edited this report, and Georganne O'Connor provided creative recommendations for its structure and organization.

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Introduction

Wildlife living on the Hanford Site, as is true for public and private property elsewhere in Washington, do not belong to the U.S. Department of Energy (DOE). Rather, they belong to the state, and the Washington Department of Fish and Wildlife (WDFW) has primary responsibility for their management. Some migratory wildlife species that cross state boundaries also fall under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). The USFWS monitors and coordinates protection of both plant and animal species that have been identified as threatened or endangered on the federal level as mandated by the Endangered Species Act (ESA). Animal species similarly identified on the state level are protected by WDFW. Plants that have been identified in the state as threatened or endangered are monitored and protected by the Washington State Department of Natural Resources (DNR).

The Pacific Northwest Laboratory (PNL) Wildlife Resources Monitoring Project was initiated by DOE to track the status of wildlife populations to determine whether Hanford operations affected them. The project continues to conduct a census of wildlife populations that are highly visible, economically or aesthetically important, and rare or otherwise considered sensitive. Examples of long-term data collected and maintained through the Wildlife Resources Monitoring Project include annual goose nesting surveys conducted on islands in the Hanford Reach, wintering bald eagle surveys, and fall chinook salmon redd (nest) surveys.

Identifying and mapping habitats on the Hanford Site for threatened, endangered, and otherwise sensitive species has, in recent years, become an increasingly important function of the Wildlife Project. Our staff coordinates with both researchers and enforcement personnel at state and federal levels to help ensure the identification and protection of plants and animals as directed by Washington State codes and federal regulations.

Often, project staff work side by side with public and private agency staff, including the WDFW, DNR, the Washington State Department of Ecology (Ecology), and TNC to collect data useful for protecting wildlife and plants and for land-use planning. Census data and results of surveys and special study topics are shared freely among cooperating agencies.

This second annual report summarizes various 1994 activities conducted by the Wildlife Resources Monitoring Project. Results have been included to show trends in populations of selected wildlife species, report on the status of special studies conducted to assess the impact of Hanford Site operations on plant and wildlife, and provide information required to make informed biological management resource decisions. It should be noted that a lot of additional data beyond the summaries provide here are maintained in the project database. Project staff can provide additional data and maintain the capability to assist would-be users of those data in providing ecologically meaningful interpretations for specific Hanford Site needs. For more information on the database, contact Mary Ann Simmons (PNL Database Manager) or Larry Cadwell (PNL Project Manager).

Wildlife Monitoring Project Studies

Salmon Survey

D. R. Geist and D. D. Dauble

The objective of the salmon survey task is to survey spawning sites of fall chinook salmon (*Oncorhynchus tshawytscha*) in the Hanford Reach of the Columbia River. These surveys are typically conducted at weekly intervals from mid-October through late November. Data collected include time of initial spawning activity, peak spawning interval, and total redds observed in designated index sites. Other activities conducted in the past under this task include radiotracking of adult fall chinook salmon, identifying critical habitat, and reporting the information to fisheries management agencies.

Aerial Surveys

Six aerial surveys of fall chinook salmon spawning were conducted in October and November 1994. Redds were first observed on the October 24 survey, and active spawning continued through mid-November. In 1994, the peak redd count for fall chinook salmon in the Hanford Reach was estimated at 5,619 (Figure 1). This number is nearly twice the number of redds estimated in 1993 and reflects increased escapement of adult fall chinook salmon over McNary Dam. The larger 1994 run size was partly the result of harvest restrictions directed at protecting the Snake River stocks of fall chinook salmon that were recently listed as endangered under the Endangered Species Act. For most of the surveys, conditions were excellent (i.e., clear sky, little wind, and low flows). Low daytime discharges from Priest Rapids Dam were maintained through the November 14 survey and contributed to generally low water as far downstream as Ringold. Thus, redds were visible in the lower part of the reach during the peak spawning interval. This is the first time in several years that good peak spawning counts were obtained in this area, which increased our knowledge of redd distribution in the reach.

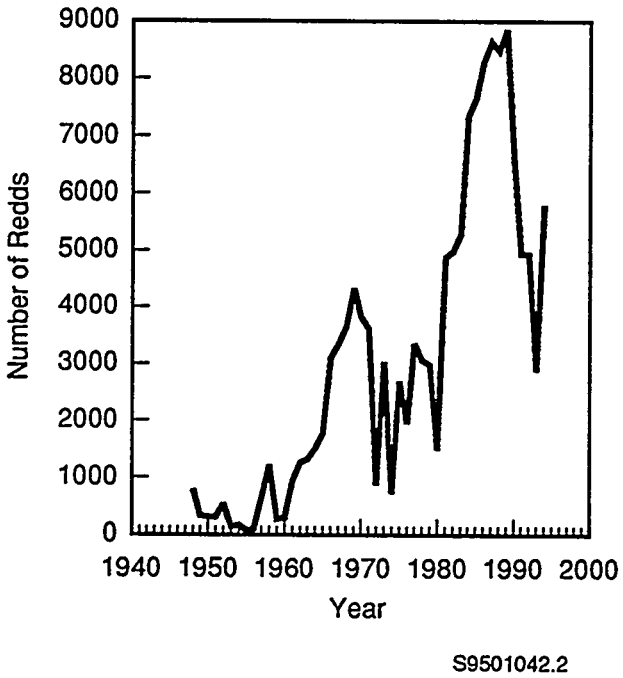

Figure 1. Fall Chinook Salmon Redd Counts in the Hanford Reach, 1948-1994

Radiotelemetry Studies

In 1994, we completed the analysis of radiotelemetry data collected in 1993. The radiotracking in 1993 was done in cooperation with the WDFW. Our results showed that fall chinook salmon apparently wandered long distances before spawning in the reach. Of the 200 fish tagged with an esophageal radiotransmitter and released at Ice Harbor Dam on the Snake River, 190 successfully left the release site. Of this number, approximately 20.5% were detected in the Hanford Reach at least once; PNL radiotrackers detected 29 fish, and WDFW detected an additional 10.

From these data collected in 1993, travel distances and rates for the average and individual fish were calculated, and a map showing the general distribution of spawning destinations was constructed. The average distance traveled after release was 321 km (range from 197 to 468 km) for males and 428 km (range from 73 to 1178 km) for females. The average rate of travel for males and females combined was 10.5 km per day (range from 0 to 60 km/d). Movement profiles were made for individual fish based on the radiotracking data.

A map was constructed of the spawning locations of the 29 fish PNL tracked (Figure 2). The majority, 62.1% (18 fish), spawned in the Hanford Reach. Of these, 55.6% (10 fish) spawned at Vernita Bar, 33.4% (6 fish) at Locke Island, and 11.2% (2 fish) in the Ringold area. Forty percent of the Hanford Reach spawners were detected at one time in the Yakima River. Of the remaining fish that did not spawn in

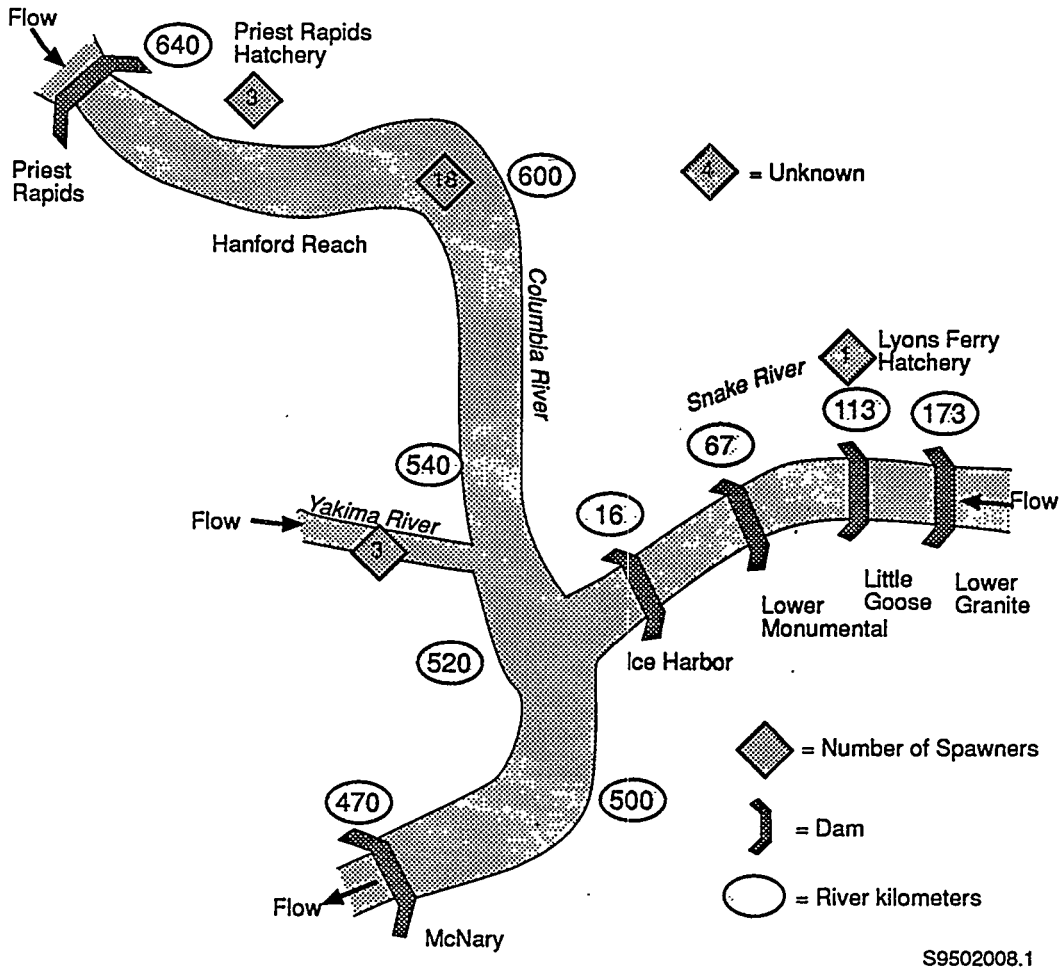

Figure 2. Spawning Locations of Fish PNL Tracked

the Hanford Reach, 3 returned to Priest Rapids Hatchery, 3 spawned in the Yakima River, and 1 returned to the Snake River to spawn. We could not determine the spawning location for 4 of the 29 fish.

Our results from the 1993 study demonstrated that radiotelemetry was useful in identifying movement and behavior of the fall chinook salmon on the Hanford Reach at a spatial scale of 1-3 km, and at weekly intervals. These coarse scales made it difficult to determine micro-habitat use of adult salmon. However, it could be determined that critical habitat does include both pre-spawning (i.e., holding) and spawning areas, because many of the study fish held for long periods (up to 21 days) in spawning locations before spawning.

In 1994, we captured, tagged with a radiotransmitter, and released 20 adult fall chinook salmon into the Hanford Reach. The objectives of the 1994 study were to determine if we could improve the accuracy and precision of our radiotracking techniques in order to reduce the spatial and temporal resolution of our results. We used a combination of Geographic Positioning Systems (GPS), electronic compasses, and multiple radio receivers to triangulate fish position. Final analysis and summary of radiotelemetry data will be completed in 1995.

Habitat Characterization

We also continued to develop a conceptual model of critical habitat for fall chinook salmon. Our approach over the last several years has been to use landform and other geomorphic descriptors of channel morphology to describe fall chinook salmon spawning habitat. The studies of Hanford Reach fall chinook salmon have demonstrated that simplistic measurements of depth, substrate, and velocity cannot explain all the variability in spawning distribution.

We completed a Geographic Information System (GIS) map of the river portion of the Hanford Reach

in 1994. This map is based on aerial photographs taken by the U.S. Army Corps of Engineers in the late 1970s. The base map will be used to compare spatial characteristics of fall chinook habitat. These data layers are being compiled based on existing information and new information, which we are collecting as part of this study and another fall chinook salmon study in the Hanford Reach.

Future Plans

In 1995 we will continue to improve on the definition of critical habitat of adult fall chinook salmon in the Hanford Reach. We will continue to conduct aerial redd surveys and will complete the analysis of the radiotelemetry data collected in 1994. Information on adult holding areas and spawning sites will be entered into the project database and will be available for analysis using GIS techniques.

Quantifying Spatial Variation of Shrub Habitat Characteristics

J. L. Downs and R. E. Rossi

Unburned shrub-steppe lands on the Columbia River plain and on the slopes of the surrounding hillsides provide important habitat for a number of plant and animal species of concern that depend on the shrub component, usually big sagebrush (*Artemisia tridentata*), for nesting, food, and protection. Reductions in available sagebrush across eastern Washington pose a serious threat to the well-being of wildlife populations that require sagebrush habitat. Vegetation associations that include big sagebrush as a dominant shrub are critical to a number of wildlife species including birds such as sage grouse (*Centrocercus urophasianus*), loggerhead shrike (*Lanius ludovicianus*), sage sparrow (*Amphispiza belli*), and sage thrasher (*Oreoscoptes montanus*). Black-tailed jackrabbits (*Lepus californicus*) and other small mammals that depend on sagebrush for food and cover provide an important food source for predators higher on the food chain such as the ferruginous hawk (*Buteo regalis*). Several of these species, including the sage sparrow, sage thrasher, loggerhead shrike, and pygmy rabbit (*Brachylagus idahoensis*), are either candidates for state listing or are already listed as sensitive, threatened, or endangered within the state.

Management of wildland shrub habitat such as that found on the Hanford Site requires an accurate inventory of shrub quantity, condition, and spatial heterogeneity. Remote sensing can provide data on a landscape scale but often cannot provide adequate resolution to describe specific vegetation and habitat characteristics. Exhaustive field sampling of vegetation supplies quantitative information, but the numbers of samples and/or transects required to adequately represent the characteristics within a large land area are often not economically feasible. In many cases, a limited number of precise field measurements is often used to extrapolate key variables for unsampled locations. The question remains as to how to extrapolate these data with a measure of confidence in the estimates and simultaneously honor any available ancillary information such as remote sensing.

We applied a relatively new geostatistical method, stochastic simulation, to estimate shrub characteristics across the landscape using detailed vegetation information previously mapped from aerial photography (Downs et al. 1993a) and field transect data. Stochastic simulation generates multiple, equally probable renditions of a shrub property instead of merely providing a single estimated value; moreover, these simulated realizations honor the data, data histograms and univariate information, the data's spatial correlation, and the ancillary information.

During spring and summer 1993, data on shrub height, cover, and density were gathered at 143 locations on the Hanford Site through cooperative efforts with the WDFW. Shrub characteristics were summarized for each of the 143 transects, and stochastic simulations were run to generate conditional probability distributions for summary statistics such as mean shrub height, cover, and density and the associated variance at unsampled locations. Results of these simulations can be presented as maps of each characteristic of interest across the landscape and are useful in identifying critical habitat areas or potential restoration areas. These maps also can aid in identifying locations for further field sampling efforts by allowing us to determine which areas have the highest variance or greatest uncertainty concerning the characteristic. The simulation results (e.g., Figure 3) provide information about both habitat structure across the landscape and the statistical reliability of the estimates. Future efforts on this task will be focused to generate maps of shrub characteristics by cover class, mean height class, and density, which will be appropriate for inclusion in the Wildlife Monitoring Project GIS.

As is usually the case with biological data, these maps represent a snapshot in time, and limitations

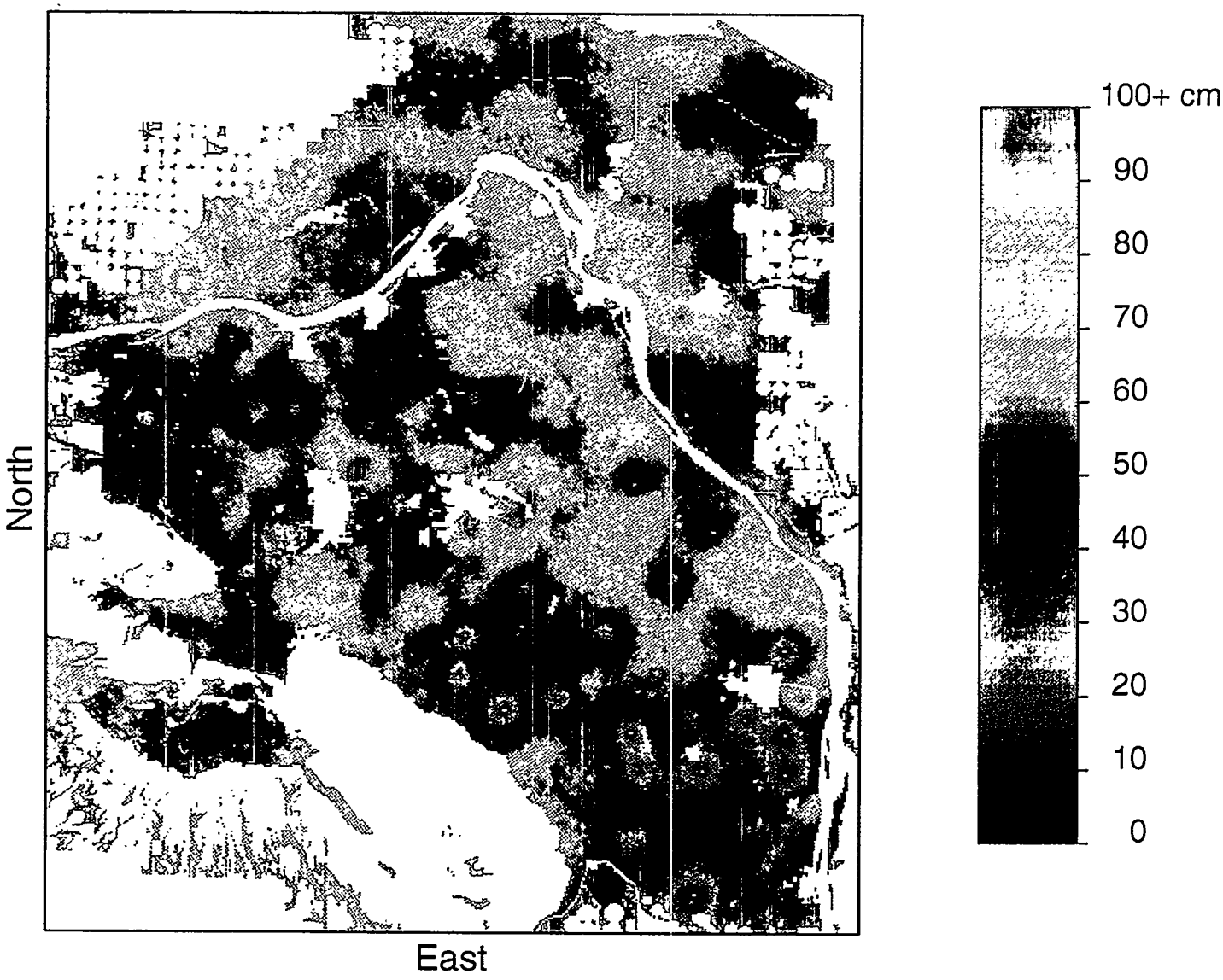

Figure 3. Average Simulated Shrub Height

exist as to their use. As areas recover from wildfire and succession and vegetative growth progresses, the shrub characteristics estimated from data collected in 1993 will change, and uncertainties concerning the estimates will be larger. However, the information from the probability simulations provides a needed starting point for assessing shrub habitat across the Hanford Site.

Plant Species of Concern

J. L. Downs, M. A. Simmons, and W. H. Rickard

During the past year, the Wildlife Resources Monitoring Project has worked in cooperation with TNC to survey plant species of concern on the Hanford Site (Table 1). Surveys by TNC focused primarily on the North Slope portion of the Hanford Site (on the north and east side of the Columbia River) and on the Fitzner/Eberhardt Arid Land Ecology (ALE) Reserve. PNL staff surveyed portions of the Columbia River plain as well as specific areas on ALE during spring and summer 1994.

A primary focus of PNL staff surveys was to ascertain the fate and distribution of populations of species of concern that had been previously reported. To that end, we worked to relocate populations that had been reported to the Washington State Natural Heritage Program and populations documented in the project database. Areas were surveyed at the appropriate time of year for the species of interest to be in flower and to maximize our chances of locating and identifying plants.

Four species are federal candidates, and intensive efforts were made to survey appropriate habitats for these species (see Table 2). One species, Columbia yellowcress (*Rorippa columbiae*), occurs at a number of locations along the shoreline of the Columbia River

(Sackschewsky et al. 1992, Sauer and Leder 1985). The Hanford Reach is believed to support the largest known population of this rare species in Washington State. It grows in river gravels and cobbles, but can survive in sandy soils and in association with other plant species. Because of its proximity to the water, this species often may be submerged when river levels rise because of regulation of river flows by the upriver dams. Additional surveys were made of rivershore and island habitat during late summer 1994. Results of these surveys and 1993 surveys are shown in Figure 4.

Another species, northern wormwood (*Artemisia campestris* var. wormskioldii), has not been found on the Hanford Site, but one of the two known populations of this species occurs upstream within 25 km of Site boundaries. This variety of northern wormwood appears quite similar to other varieties of *Artemisia campestris*, but plants are generally smaller. Cobble/gravel bars located along the Hanford Reach within Site boundaries appear to provide suitable habitat for this species. Preliminary surveys of likely habitat during spring months of 1993 and again during 1994 by both TNC and PNL staff have not identified any populations on the Site. However, the large amount of suitable habitat along the shoreline and islands of the Columbia River is difficult to survey adequately, and special emphasis should be given to ascertain the status of northern wormwood on the Hanford Site.

Columbia milkvetch (*Astragulus columbianus*) is found on Umtanum Ridge and near the Midway power substation. This species was believed to be extinct before it was relocated 15 years ago near the Hanford Site on the Army's Yakima Training Center. It is most often found on stony or sandy soils in association with sagebrush and flowers in early April. Hoover's desert parsley (*Lomatium tuberosum*), also is found on Umtanum Ridge near the Midway substation. This desert parsley prefers scree slopes as a habitat and usually blooms in March and April.

The locations of both federally and state-listed plant species of concern that were located during the 1994 surveys are shown in Figure 5. This figure represents the locations found during surveys by PNL and the majority of population locations reported by TNC staff. Two species that were reported previously (*Carex densa* and *Lindernia anagallidea*) could not be relocated during our surveys, but may still occur along the Columbia River shoreline.

The map in Figure 5 is intended for use as a guide to potentially sensitive areas, but should not be used to determine the presence or absence of plant species of concern in any particular location. Climate, growing conditions, seed distribution, and plant phenology vary from year to year, and thus, the locations and sizes of plant populations vary in response. The presence or absence of plant species of concern must be documented by onsite surveys conducted during the appropriate season of the year.

Bald Eagles, Canada Geese, and Hawks

R. Mazaika and B. Tiller

Bald Eagles

Bald eagles (*Haliaeetus leucocephalus*) are listed by the USFWS as threatened in Washington State. Historically, bald eagles have wintered along the Hanford Reach of the Columbia River. The majority of eagles occur between the Hanford townsite and the 100-K Area.

In 1994, the maximum number of eagles observed wintering on the Hanford Reach was 39-25 adults and 14 juveniles (Figure 6). Over the past 5 years, we have seen a switch in the adult/juvenile ratio, from more juveniles to fewer. This could indicate a downward trend in the wintering eagle population; however, because juveniles tend to go to the most productive food sources, this may simply imply a change in available food items.

Canada Geese

Nesting Canada geese (*Branta canadensis*) are a valued aesthetic and recreational resource of the Hanford Reach. Nesting surveys have been conducted along the Reach since 1950 in an effort to monitor changes in goose populations in response to reactor operations. Survey activities have been conducted relative to Hanford Site operations over the last 40 years, although activities of a different nature (e.g., hydroregulation of Columbia River flows) may impact nesting success.

The nesting population of Canada geese in the Hanford Reach has fluctuated during the last 40 years in response to coyote predation on upstream islands of the reach. Currently, the majority of goose nesting (i.e., 61%) occurs on downstream islands within the reach (Figure 7). In 1994, 149 of 170 (87%) pairs nested successfully. That compares with 196 of 235 (83%) nesting pairs in 1993.

The total number of nests found this year was down by 65 nests from 1993. We observed extensive coyote predation on island 12 (near Ringold), and no

Table 1. Plant Species of Concern of the Hanford Site

Common Name	Species Name	Federal Status[a]	State Status[a]
Bristly cryptantha	*Cryptantha interrupta*		M2
Canadian St. John's-wort	*Hypericum majus*		M1
Columbia milkvetch	*Astragalus columbianus*	C1	T
Columbia River mugwort	*Artemisia lindleyana*		M3
Columbia yellowcress	*Rorippa columbiae*	C2	E
Coyote tobacco	*Nicotiana attenuata*		S
Crouching milkvetch	*Astragalus succembens*		M3
Dense sedge	*Carex densa*		S
Desert dodder	*Cuscuta denticulata*		M1
Desert evening primrose	*Oenothera cespitosa Nutt.*		S
Dwarf desert primrose	*Oenothera pygmaea*		T
False pimpernel	*Lindernia dubia* var. anagallidea		S
Fuzzy beardtongue	*Penstemon eriantherus* var. whitedii		M3
Geyer's milkvetch	*Astragalus geyeri*		S
Gray cryptantha	*Cryptantha leucophaea*		S
Hoover's desert parsley	*Lomatium tuberosum*	C2	T
Medick milkvetch	*Astragalus speirocarpus*		M3
Northern wormwood	*Artemisia campestris* var. wormskioldii	C1	E
Palouse milkvetch	*Astragalus arrectus*		S
Palouse thistle	*Cirsium brevifolium*		M3
Piper's daisy	*Erigeron piperianus*		S
Robinson's onion	*Allium robinsonii*		M3
Rosy balsamroot	*Balsamorhiza rosea*		M3
Shining flatsedge	*Cyperus bipartitus* (prev. "rivularis")		S
Smooth cliffbrake	*Pellaea glabella* var. slimpex		M3
Southern mudwort	*Limosella acaulis*		S
Squill onion	*Allium scilliodes*		M3
Stalked-pod milkvetch	*Astragalus sclerocarpus*		M3
Thompson's sandwort	*Arenaria franklinii* var. thompsonii		M2

(a) See Table 2 for definitions of federal and state status.
C = candidate.
E = endangered.
M = monitor.
S = sensitive.
T = threatened.

successful nests were found there this year. In 1993, 60 nests were successfully tended on island 12. The success of geese in the downstream portion of the Reach may be attributed to a lower coyote population among downstream islands or infrequent use of downstream islands by coyotes, associated with increased use of these areas by boaters, hunters, fisherman, etc. The suitability of habitat on islands for nesting Canada geese is attributed to restricted human use of islands during the nesting season, suitable nesting substrate, and adequate forage and cover for broods (Eberhardt et al. 1989).

Table 2. Species of Special Concern in Washington—State and Federal Status[a]

Federal Status Definitions

Federal Endangered—A species in danger of extinction throughout all or a significant portion of its range.

Federal Threatened—A species likely to become endangered within the foreseeable future.

Federal Proposed—A species that is the subject of a proposed or final rule indicating the appropriateness of listing as threatened or endangered.

Federal Candidate Category 1—A species that is a candidate for listing under the Endangered Species Act. U.S. Fish and Wildlife Service has substantial evidence to support listing as a threatened or endangered species.

Federal Candidate Category 2—A species that is a candidate for listing under the Endangered Species Act. Listing is possibly appropriate but conclusive information is lacking.

Federal Candidate Category 3—A species that was once considered for listing under the Endangered Species Act that is no longer being considered.

State Status Definitions

State Endangered—Wildlife species native to the state of Washington seriously threatened with extinction throughout all or a significant part of their ranges within the state. Endangered species are legally designated in WAC 232-12-014.

State Threatened —Wildlife species native to the state of Washington likely to become endangered within the foreseeable future throughout significant portions of their ranges within the state without cooperative management or the removal of threats. Threatened species are legally designated in WAC 232-12-011.

State Sensitive—Wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their ranges within the state without cooperative management or the removal of threats. Sensitive species are legally designated in WAC 232-12-011.

State Candidate—Wildlife species that are under review by WDFW for possible listing as endangered, threatened, or sensitive. A species will be considered for State Candidate designation if sufficient evidence suggests that its status may meet criteria defined for endangered, threatened, or sensitive in WAC 232-12-297. Currently listed State Threatened or State Sensitive species may also be designated as a State Candidate species if their status is in question. State Candidate Species will be managed by the Department, as needed, to ensure the long-term survival of populations in Washington. They are listed in WDFW Policy 4802.

State Monitor—Wildlife species native to the state of Washington that:

1) were at one time classified as endangered, threatened, or sensitive
2) require habitat that has limited availability during some portion of its life cycle
3) are indicators of environmental quality
4) require further field investigations to determine population status
5) have unresolved taxonomy that may bear upon their status classification
6) may be competing with and impacting other species of concern
7) have significant popular appeal.

State Monitor species will be managed by WDFW, as needed, to prevent them from becoming endangered, threatened, or sensitive.

Species already classified in a category that provides adequate management emphasis, survey work, and data maintenance (e.g., game animals, game birds, furbearers, etc.) will not be designated as State Monitor species. Monitor species are designated in WDFW Policy 4803.

(a) Source: Washington Department of Fish and Wildlife.

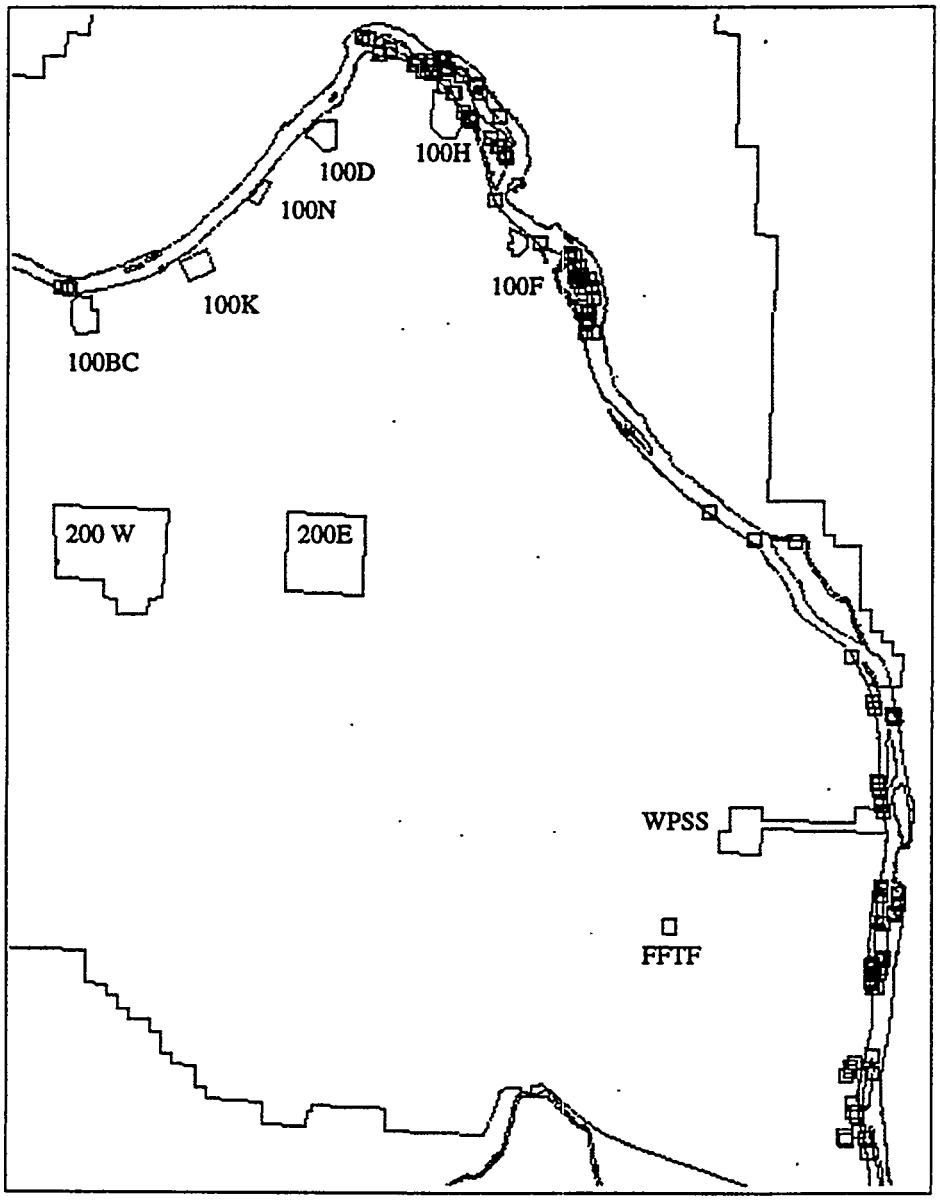

Figure 4. Locations of Columbia Yellowcress Along the Hanford Reach, 1993-1994

Hawks

The undeveloped land of the Hanford Site provides nesting and foraging habitat for Swainson's (*Buteo swainsoni*), red-tailed (*Buteo jamaicensis*), and ferruginous hawks. These species rely on natural and human-made substrates across the Site for nesting. The nesting population of ferruginous hawks, a federal Candidate 2 species, represents 25% of the nesting population in the state of Washington. Recently, the number of nesting ferruginous hawks on the Hanford Site has increased, while nesting of red-tailed and Swainson's hawks, sympatric species that occur more frequently, has decreased. The reason for the decline has not been investigated. See "Nesting Buteo Hawks" and "Ferruginous Hawks" in the section on Supporting Wildlife Studies that follows.

Bird Surveys

W. R. Rickard

Shrub-steppe Birds

The purpose of Hanford Site bird surveys is to provide a record of the relative abundance and distribution of avian species as determined by

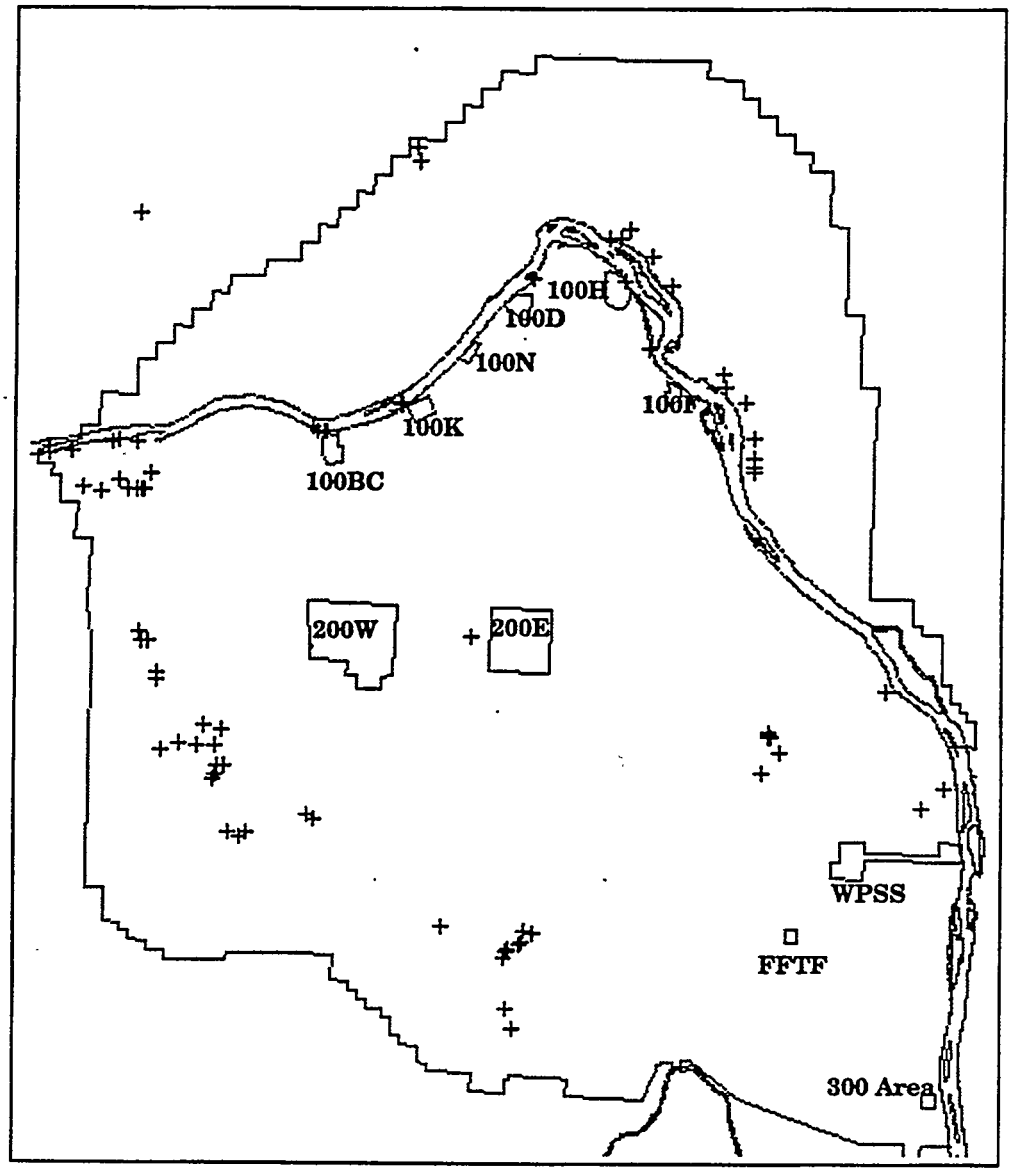

Figure 5. Locations of Plant Species of Concern on the Hanford Site

topography, vegetative cover, present and past land-use practices, and season of the year. Survey data provide the basis for detecting changes in avian populations with the passage of time and the progress of environmental cleanup.

This survey focuses on those birds that characteristically place their nests in shrub-steppe vegetative cover. Some of these birds have experienced declines in abundance as shrub-steppe habitats have become greatly diminished elsewhere in the Columbia Basin by human-induced land uses. Species showing marked population declines are the sage grouse, sage sparrow, sage thrasher, loggerhead shrike, burrowing owl (*Athene cunicularis*), and long-billed curlew (*Numenius americanus*).

Surveys were conducted by driving along established roadways on the Hanford Site west of the Columbia River (Figure 8). Four routes, "A," "B," "C," and "D," each 20 km long and marked at 0.8-km intervals, were visited in April, May, and June 1994 (Table 3). All birds seen or heard during a 3-minute stop at each marker were recorded.

The most numerous birds along the survey routes were the western meadowlark (*Sturnella neglecta*)

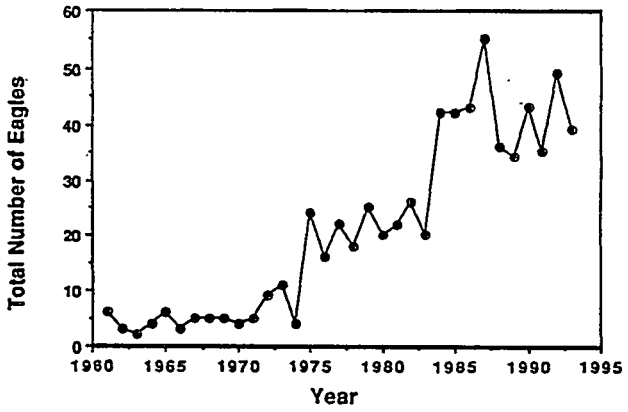

Figure 6. Bald Eagle Counts in the Hanford Reach, 1961-1994

and the horned lark (*Eremophila alpestris*) (Table 3). Meadowlarks were more or less equally distributed along the routes, but horned larks were recorded at markers at the beginning and end of survey route "B" and were absent at markers in the middle of the route (Figure 8). The mid-portion of route "B" has the largest patches of mature sagebrush remaining on the Hanford Site.

Mature sagebrush shrubs are scarce along routes "A" and "C" because of recent wildfires. They are scarce along route "D" because the land was used for irrigated agriculture between 1900 and 1944, or shrubs were removed by construction activities associated with the 100F and 100H reactors in the 1940s and 1950s.

Grasses usually dominate the vegetative cover in places lacking mature shrubs. Horned larks were most often recorded along those survey routes dominated by grasses.

Sage sparrows were recorded only from sagebrush-dominated places along route "B" showing the strong affinity of these birds for sagebrush-dominated vegetation (Table 3). Loggerhead shrikes also were most often recorded along route "B" (Table 3). Most loggerhead shrike nest on the Hanford Site in mature sagebrush or bitterbrush shrubs (*Purshia tridentata*), but nests also were found in planted trees or in broadleaf, deciduous shrubs such as mock orange (*Philadelphus lewisii*). Vesper sparrows (*Pooecetes gramineus*) were recorded only from survey route "A," where the vegetative cover is dominated by large native perennial bunchgrasses, especially bluebunch wheatgrass (*Pseudoroegnenia spicata*) (Table 3). Lark sparrows were not recorded from route "A" (Table 3). Brewer's sparrows (*Spizella breweri*) were recorded only at markers near the end of route "A" and the beginning of route "B," where small patches of mature sagebrush had escaped burning. However, Brewer's sparrows were numerous in stands of three-tip sagebrush (*Artemisia tripartita*) at higher elevations in the Rattlesnake Hills.

Long-billed curlews characteristically nest in stands of grassy vegetation, but they were not recorded from survey route "A" (Table 3). Sagebrush and bitterbrush shrubs burned along route "C" in

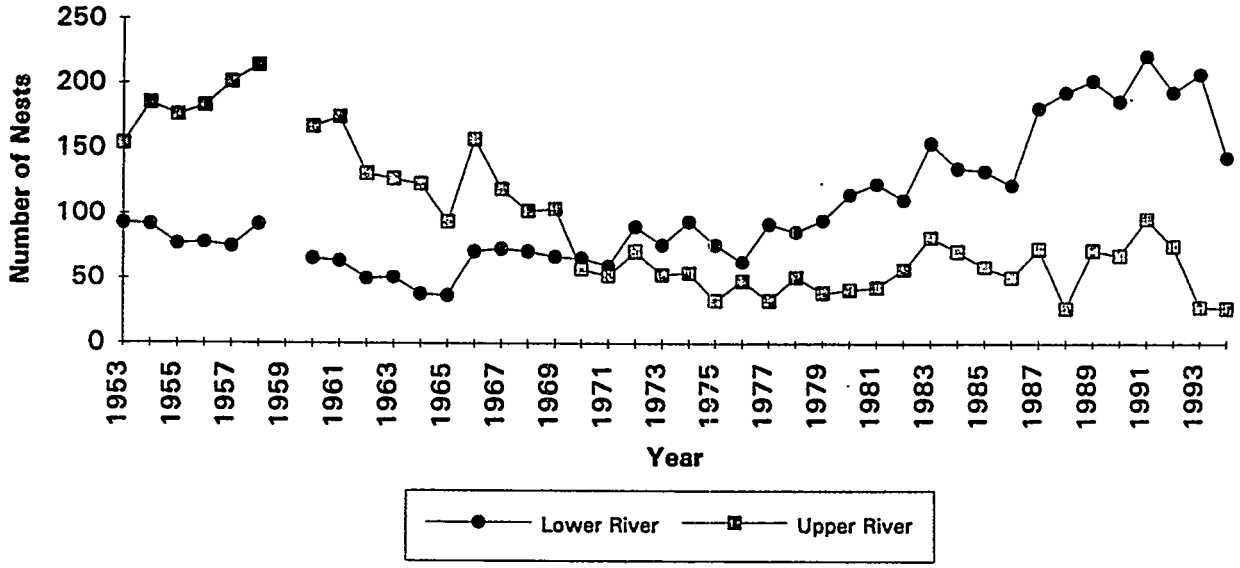

Figure 7. Canada Goose Nesting Activity

Table 3. Number of Shrub-steppe Birds Counted Along Survey Routes "A" through "D" on the Hanford Site During April, May, and June 1994

	Survey Routes											
	"A"			"B"			"C"			"D"		
Species	April	May	June	April	May	June	April	May	June	April	May	June
Meadowlark	81	76	98	106	100	101	119	104	102	89	105	76
Horned lark	101	111	148	15	22	13	62	32	66	31	50	48
Sage sparrow	0	0	0	9	8	9	0	0	0	0	0	0
Lark sparrow	0	0	0	1	5	3	0	4	6	0	0	2
Vesper sparrow	6	9	7	0	0	0	0	0	0	0	0	0
Brewer's sparrow	0	1	1	0	0	1	0	0	0	0	0	0
Loggerhead shrike	0	0	2	6	4	7	1	0	0	0	0	0
Curlew	0	0	0	0	2	0	18	6	7	0	0	4

summer 1984. Since then, the vegetative cover has been dominated by grasses, especially cheatgrass (*Bromus tectorum*) and Sandberg's bluegrass (*Poa sandbergii*). Curlews were most numerous along this route. Shrubs have been able to recolonize the burned areas, and in future years these will dominate the vegetative cover. As the vegetative cover changes from grass to shrub dominance, the distribution of long-billed curlews may also change.

Sage grouse, sage thrashers, and burrowing owls were not recorded along the road survey routes.

Relative Abundance and Distribution of Terrestrial Game Birds

Game birds associated with terrestrial habitats on the Hanford Site historically have not been harvested by hunters, but game birds have the capacity to travel offsite where they can be legally harvested during the hunting season. Game birds characteristically forage at ground level, ingesting leaves and seeds of herbaceous plants. Herbaceous plants growing in waste management zones have a potential to accumulate radionuclides from contaminated soils. Game birds that eat these plants can also become contaminated, move offsite, and be killed and eaten by people. To estimate this source as a potential food chain contaminant, game birds are routinely collected and their tissues are analyzed for radionuclides as part of the environmental surveillance sampling effort at the Hanford Site.

This report shows the abundance and distribution of game birds along road survey route "D," which passes through abandoned cultivated fields associated with the townsites of Hanford and White Bluffs and the retired 100F and 100H reactors. Game birds observed along the survey route in 1994 were the Canada goose (*Branta canadensis*), mourning dove (*Zenaida macroura*), California quail (*Callipepla californica*), and ring-necked pheasant (*Phasianus colchicus*) (Table 4).

Canada geese foraged in the abandoned fields in the vicinity of the 100F and 100H reactors, especially during autumn months, seeking the new growth of cheatgrass (*Bromus tectorum*) that had germinated following the onset of the autumnal rainy season (Table 4). The absence of hunters on the Hanford Site and the adjacent Columbia River is especially attractive to geese that seek protected foraging and resting places during the fall-winter hunting season.

Mourning doves were observed in small numbers during the spring-summer breeding season, but most doves left with the onset of autumn (Table 4). California quail and ring-necked pheasants are year-round residents. Most of the birds recorded in spring-summer were recorded by sound identifications, i.e., counts of calling males. Birds recorded in other seasons were visual sightings (Tables 5 and 6).

Quail were recorded from relatively few places along the survey route and were most numerous near the White Bluffs ferry landing (posts 42 and 43). Here, clumps of planted deciduous trees dominated the vegetative cover. Fallen tree trunks, limbs, and branches intermingled with wind-blown Russian thistle (*Salsola kali*) plants provided shelter and concealment for quail.

Ring-necked pheasants were generally more widely distributed along the survey route than quail (Table 6). The greatest concentrations of pheasants appeared to be located near the Hanford townsite at the beginning of survey route "D" (Table 6). No pheasants were recorded in the near-vicinity of the 100H reactor. A few were recorded near the 100F reactor.

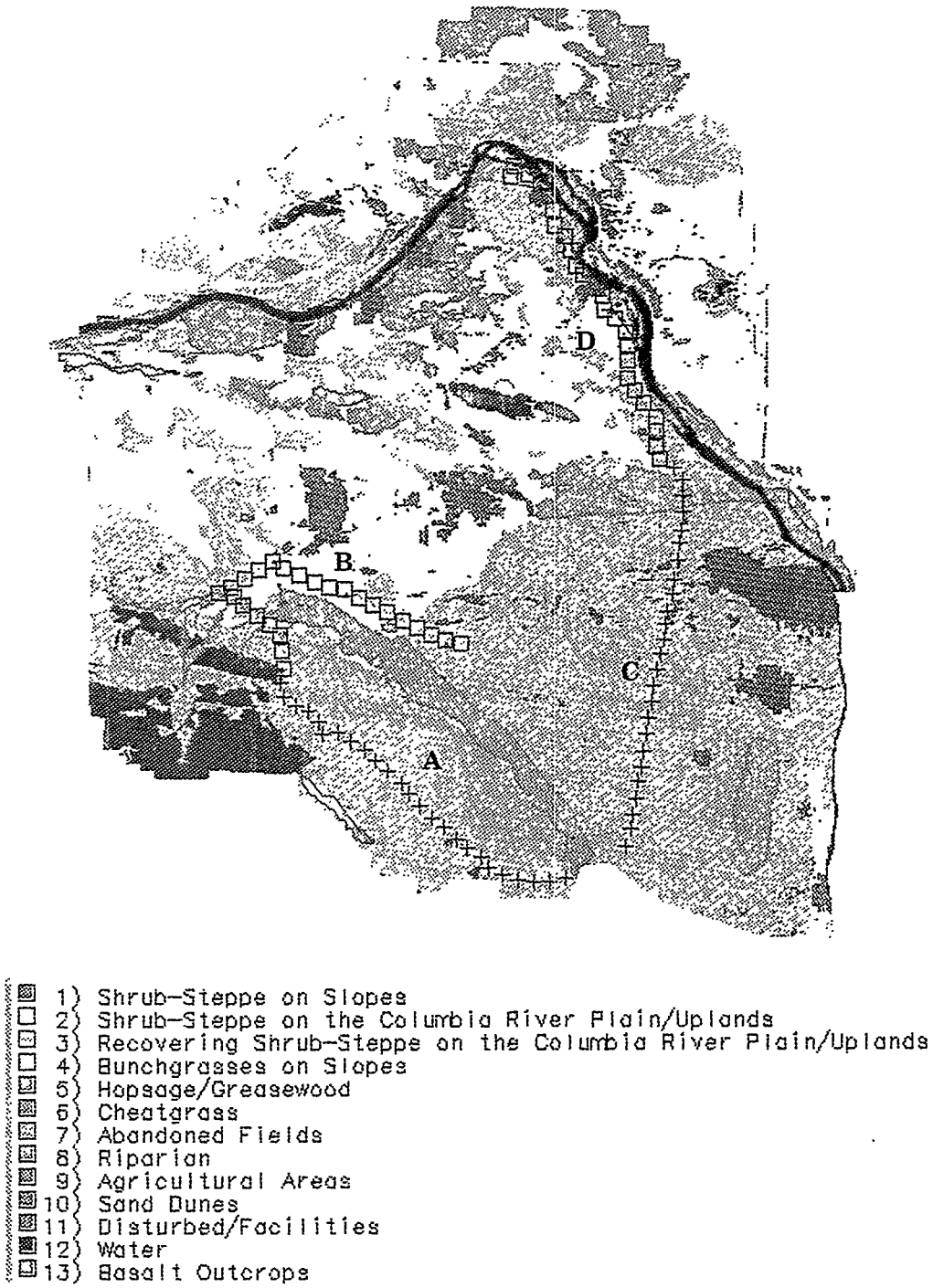

Figure 8. Bird Survey Routes "A" through "D," 1994

Table 4. Relative Abundance of Terrestrial Game Birds at Different Seasons Along Survey Route "D," 1994

Species	Winter						Spring				
	1/19	1/27	2/13	2/25	3/10	3/21	4/10	4/24	5/17	6/7	6/18
Canada goose				7	2						
Mourning dove							1		5	2	1
California quail							7	4	5	4	3
Ring-necked pheasant	1	3				7	15*	14	23	22	7

Species	Summer							Fall						
	7/10	7/23	8/7	9/4	9/15	10/2	10/9	10/26	11/2	11/12	11/21	12/3	12/9	12/19
Canada goose									35	40	780	325	316	740
Mourning dove	1	1	6		1									
California quail	11	1	39	22	15	1	58	55			28			
Ring-necked pheasant	16	4	2	1							3	1		3

* = Minimal estimate.

California quail and ring-necked pheasants were more numerous along survey route "D" than along the three other road survey routes.

Monitoring Northern Oriole Populations by Autumn Nest Counts

During the 1980s, scientists noted declines in the numbers of North American migratory songbirds. Habitat loss and degradation is partly responsible. Habitat needed for food and shelter is disappearing in the neotropics. In the United States, not enough suitable nesting habitat exists to sustain populations of some species. In some cases, populations have diminished to the point where special protection is required to sustain them. Federal agencies are required to monitor numbers of threatened and endangered species and to devise and implement management plans.

The northern oriole (*Icterus galbula*) is one of 120 species of migratory songsbirds that nest in Washington and Oregon. On the Hanford Site, northern orioles nest in deciduous trees. The nests are relatively large, 8 x 8 x 12 cm, pensile structures comprising fibrous plant materials placed at the ends of branches that are usually high above the ground. Nests are difficult to locate during the spring season when trees are in full foliage but are more conspicuous after leaves fall in autumn.

This investigation was initiated to determine the feasibility of counting oriole nests as a way to monitor year-to-year changes in nesting populations on the Hanford Site. Population changes can be expected if mortality is intensified in future years, when birds are on their neotropical wintering grounds, or if the abundance of suitable nesting trees is diminished by wildfires or by changes in land use.

The Hanford townsite was selected for monitoring because it has more trees than other places on the Site. Street trees and trees at farmhouse locations were planted in the years before 1940, when irrigation was practiced. The trees have survived for 50 years without irrigation water. For 50 years, no resident human population has occupied the site, and no farming or livestock grazing has occurred.

Clumps of trees were searched for oriole nests after leaf fall in late November 1994 by walking beneath trees. The locations of the tree groupings searched are indicated in Figure 9. The distribution of 40 nests

Table 5. Relative Abundance and Distribution of California Quail on Survey Route "D," 1994. (Marker posts 26-50 are spaced at 0.8-km intervals.)

	Marker Posts																									
Date	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total
Winter																										
19 January																	///	///	///							0
27 January																	///	///	///							0
13 February																	///	///	///							0
25 February																	///	///	///							0
10 March																///	///	///								0
21 March																										0
Spring																										
10 April					2									1		1	2	1								7
24 April																	2	2								4
17 May							1						1		1	1		1								5
7 June														1	1	1		1								4
18 June																1		2								3
Summer																										
10 July																	1	10								11
23 July																		1								1
7 August																	20	5					14			39
4 September																		1	20						1	22
15 September																		15								15
Fall																										
2 October																	1									1
9 October											6						25	15	12							58
26 October																		15	40							55
2 November																										0
12 November																										0
21 November																			28							28

/// = Not surveyed in this season to protect bald eagles at roost sites.

Table 6. Relative Abundance and Distribution of Ring-Necked Pheasants on Survey Route "D," 1994. (Marker posts 26-50 are spaced at 0.8-km intervals.)

	Marker Posts																								
Date	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total
Winter																										
19 January																	///	///	///						1	1
27 January											2						///	///	///						1	3
13 February																	///	///	///							0
25 February																	///	///	///							0
10 March																	///	///	///							0
21 March																										0
Spring																										
10 April			x	x	x	x	x	x			x	x	x	x	x	x	x		x					x		15
24 April	1	1	1	1					1	1	3					1	3	1								14
17 May	2	2	3	3	1	1	1	1	1	2	1	2	1	1				1	2							23
7 June			3	3	3	2				1		2		1		2	1	1	2						1	22
18 June			1	1	1	1						1						1	1							2
Summer																										
10 July				2	3					1	2	1	1	2	1			1	1							16
23 July			1		1		1							1												4
7 August															1				1							2
4 September												1														1
15 September																										0
Fall																										
2 October																										0
9 October																										0
26 October																										0
2 November																										0
12 November																										0
21 November																			2					1		3

/// = Not surveyed to protect bald eagles at roost sites.
x = At least one bird heard calling at each indicated post.

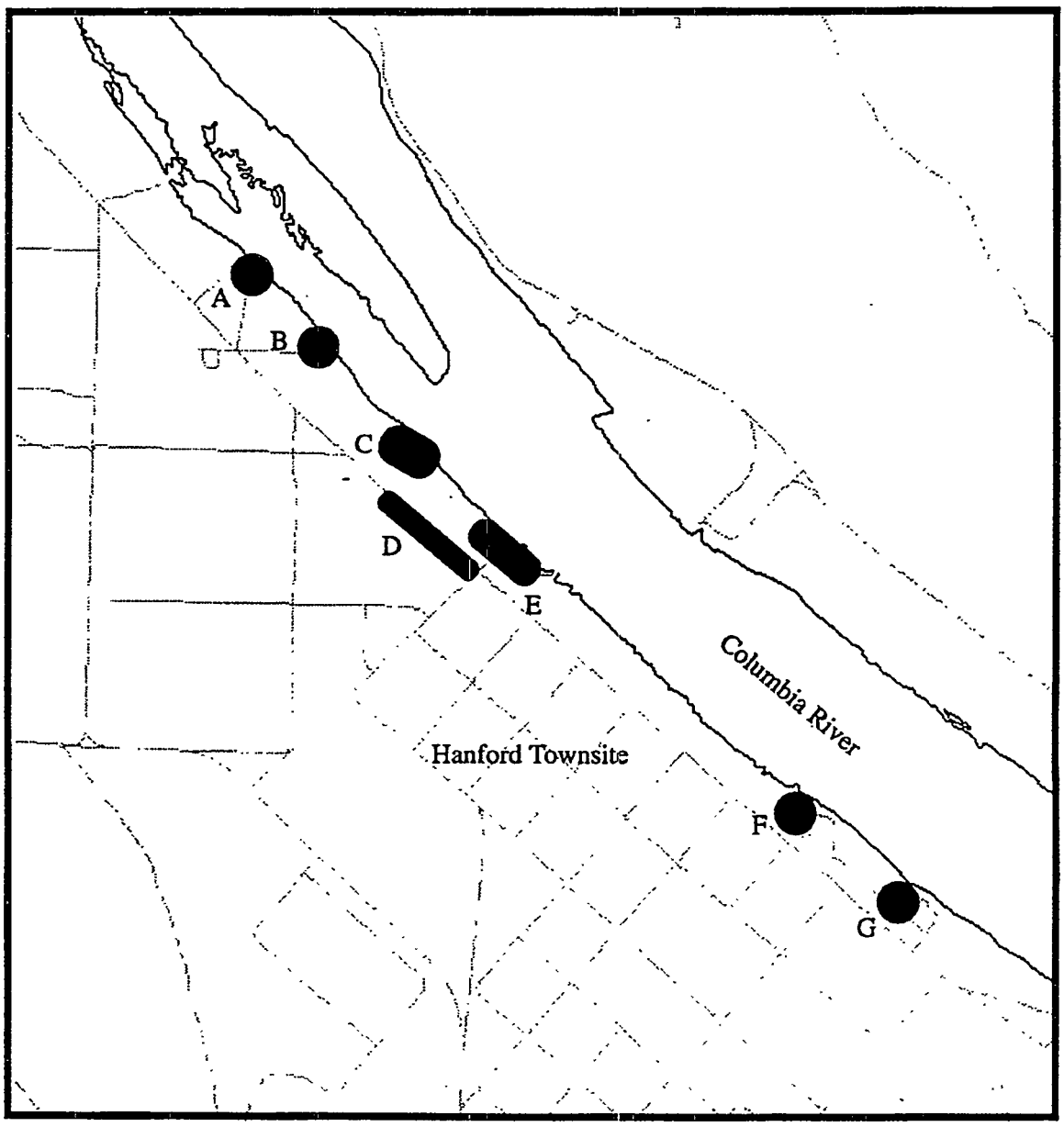

Figure 9. Map of the Abandoned Hanford Townsite Showing the Locations of Clumps of Trees Censused for Nests of Northern Oriole, 1994

located in each of seven tree groups is shown in Table 7. All trees used for nesting were planted exotics. Historically, native deciduous trees, cottonwoods and willows, were scarce and confined to the shoreline of the Columbia River. In the years before the arrival of European settlers, nesting orioles were restricted to riparian habitats. Tree plantings at the Hanford townsite expanded the nesting opportunities for northern orioles and probably increased the local oriole population.

Nest counting appears to be an efficient way to monitor breeding populations of northern orioles. These data provide a basis for judging the impacts of land-use changes at the Hanford townsite as the land is converted to other purposes for future use.

Mule Deer

B. L. Tiller

Mule deer (*Odocoilues hemionus*) are common residents 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

Table 7. Number of Nests Counted by Tree Species in Tree Groupings at the Hanford Townsite, Autumn 1994

	Tree Species					
Location	Siberian Elm	Black Locust	Silver Maple	Mulberry	Fruit Tree	Total Nests
A	-	4	3	-	-	7
B	6	-	-	-	1	7
C	5	-	-	-	-	5
D	1	1	1	-	-	3
E	1	-	-	1	-	2
F	4	-	-	-	-	4
G	11	1	-	-	-	12
Total Nests	28	6	4	1	1	40

Site for approximately 50 years, the herd has developed a number of unique population characteristics that contrast most other herds in the semiarid region of the Northwest. These characteristics include a large proportion of old animals and large-antlered males. This herd provides an opportunity for comparison to other more heavily harvested herds in this region. A study of the herd was initiated in 1991 because of its unique nature and the high degree of public interest.

Strontium-90 in Deer Antlers

Mule deer are of interest to radiation monitoring programs because they can provide useful information relating to contamination sites and subsequent cleanup efforts (Eberhardt and Cadwell 1983). Additionally, mule deer are often hunted and eaten and can contribute to the annual radiation dose received by a private citizen (Soldat et al. 1990).

The routine method for monitoring deer for radionuclide contamination on the Hanford Site is to collect samples from deer killed on the roads. Usually only two to three samples are collected each year, and often these deer are collected in areas distant from nuclear facilities. The objective of this effort is to sample a relatively large number of deer residing near 100 Area facilities in a nondestructive manner. Strontium-90 (^{90}Sr) concentrations in deer antlers have been shown to reflect ^{90}Sr levels in bone tissue because of translocation of calcium from bone to antlers during growth (Schultz 1964, Schreckhise 1974).

During deer capture events in late winter/early spring, a portion of antler from male deer was clipped off and submitted for ^{90}Sr analysis. Some of the sampled male deer were tagged with solar-powered ear radiotransmitters and released for subsequent tracking. In this way, it was possible to evaluate the animals' area of use and the corresponding ^{90}Sr results.

A total of 38 deer antler samples were analyzed for ^{90}Sr concentrations. Mule deer on the Site were partitioned into two major groups associated with the northern and southern study areas. These herds may represent combinations of smaller but distinct subgroups whose home ranges overlap; however, additional and more extensive monitoring of individual movements are necessary to make this determination. Fourteen (37%) samples came from animals captured near the 100 Area reactor sites, 14 (37%) were collected from animals captured near or south of the old Hanford townsite, and 10 (26%) were collected from a reference site near Silver Lake, Oregon. Results from these samples are summarized in Figure 10.

Although the concentrations of ^{90}Sr are very low at both locations, the data suggest that antlers collected from animals residing near the 100 Area facilities have elevated levels of ^{90}Sr compared to those collected from animals residing between the old Hanford townsite and the 300 Area. Analyses of deer movements also suggest that the animals residing within these two areas rarely intermix (see Figure 11). Concentrations of ^{90}Sr found in antlers

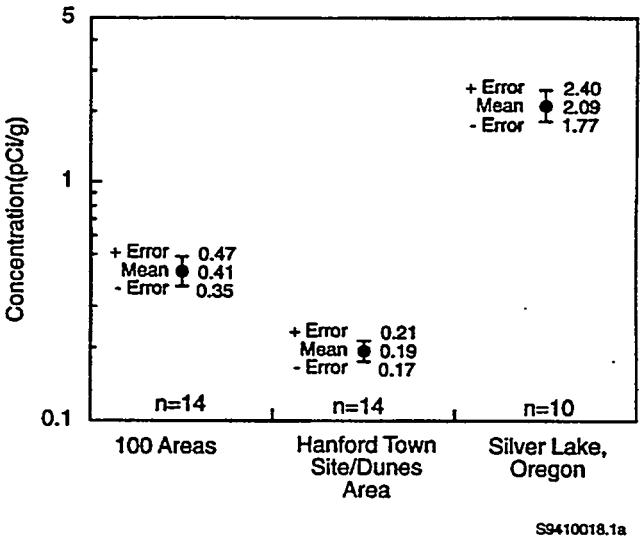

Figure 10. Mean ^{90}Sr Concentrations Detected in Mule Deer Antlers (error bars are +/- 1 S.D.)

collected near Silver Lake, Oregon, were approximately five times higher than those found in antlers from near the reactor sites (Figure 10). The elevated concentrations are likely attributed to a higher amount of fallout-derived ^{90}Sr scavenged from the atmosphere by precipitation, which is considerably greater in the mountain regions of Oregon where the deer reside during the summer months when antlers are growing. We have concluded that antlers can be useful in detecting localized levels of ^{90}Sr contamination. Full results of this study will be published as a PNL technical report during 1995.

Population Estimation

As part of the Wildlife Resources Monitoring Project we monitor population wildlife species of special concern (e.g., those classified as threatened or endangered and those that receive much public interest). Mule deer fall into this latter classification. However, we have no reliable estimates of the number of deer that reside on the Hanford Site. We do know that the 100 Areas and other areas adjacent to the Columbia River support the largest number of deer on the Site. By marking a sufficient number of deer with radiocollars and conducting aerial surveys, we plan to estimate the population of deer residing on the Hanford Site.

From 1991 to 1993, 88 mule deer from several locations south and west of the Columbia River between the 100-BC and the 300 Area were captured and fitted with ear tags and/or radiotransmitters. Fifty-four radiotransmitters were placed on animals for subsequent tracking of their movements and obtaining estimates of the population size. We plan to conduct a population estimate using a Forward Looking Infrared (FLIR) system mounted to a helicopter. This high-resolution system will allow actual counting of the number of animals within several areas throughout the Hanford Site. The population estimates planned for FY 1994 were postponed until February 1995 because emergency fire fighting assistance was needed in Montana and provided by the INEL (LITCO) helicopter services.

Offsite Movement and Harvest Potential

Based on previous tagging of fawns along the islands and radiocollaring of adult deer in the 200 Areas, we know that some Hanford Site deer move offsite and are harvested by hunters. By marking several deer with radiocollars and routinely relocating these animals, we determined the extent and frequency of deer movements to islands on the Columbia River and areas across the river, including the Wahluke Slope Wildlife Recreation Area and private property available for legal hunting. The GIS has been used to quantify the frequency and extent of offsite movements made by radiocollared deer.

A total of 1423 animal locations from 53 radio-equipped (15 bucks and 38 does) deer were used to evaluate the potential and extent of offsite movements by adult deer residing along the Hanford Reach. Frequent movements across the river or onto riverine islands were made by some deer, particularly during the breeding and fawning seasons (October-December and May-July). Twenty-four (45%) of the 53 radiocollared animals were located at least once during this study, either across the river or on the islands. For animals known to have crossed the river during our study, 125 of 954 (13%) of the relocations occurred either on the islands or across the Columbia River from the Hanford Site proper. These data suggest that adult deer are not bound by the river shores, and they will readily swim the river in search of food, cover, and breeding mates. Of the 125 relocations that occurred either on the islands or across the Columbia River from the Hanford Site, only 23 (18%) were found to be on legally huntable lands.

The extent of offsite movement by radiotagged deer generally has been small as the most frequently visited locations occur immediately adjacent to the Hanford Site along the riparian edge of the Columbia River. Figure 12 summarizes the distribution of relocations found across the Columbia River opposite the 100 Areas.

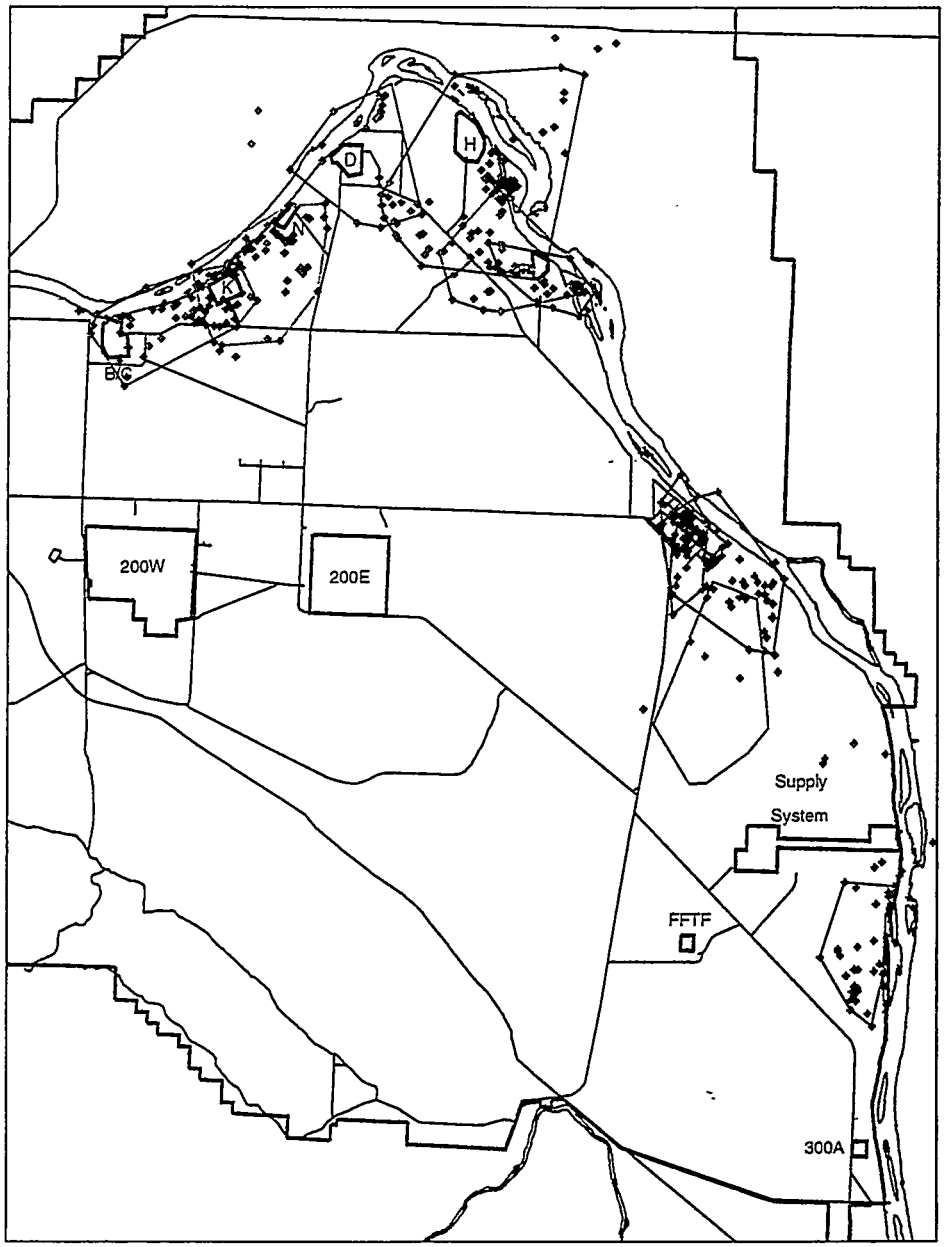

Figure 11. Home Ranges of Several Bucks and Does within the Southern and Northern Groups (data from 1991 through 1994)

Deer hunting is common on lands adjacent to the Hanford Site, and in particular, on the back side of Rattlesnake Mountain. Until now, however, little information has been available regarding the hunting pressure on riverine islands and along the shorelines of the Hanford Reach. Eberhardt et al. (1982) estimated the probability of a deer being legally or illegally harvested during any given year at 8% (range 0 to 21% at the 95% confidence interval).

In 1994, 20 male deer residing near the Columbia River were captured, radiotagged, and released for future monitoring. One animal lost its radiotransmitter within the first month after the capture event,

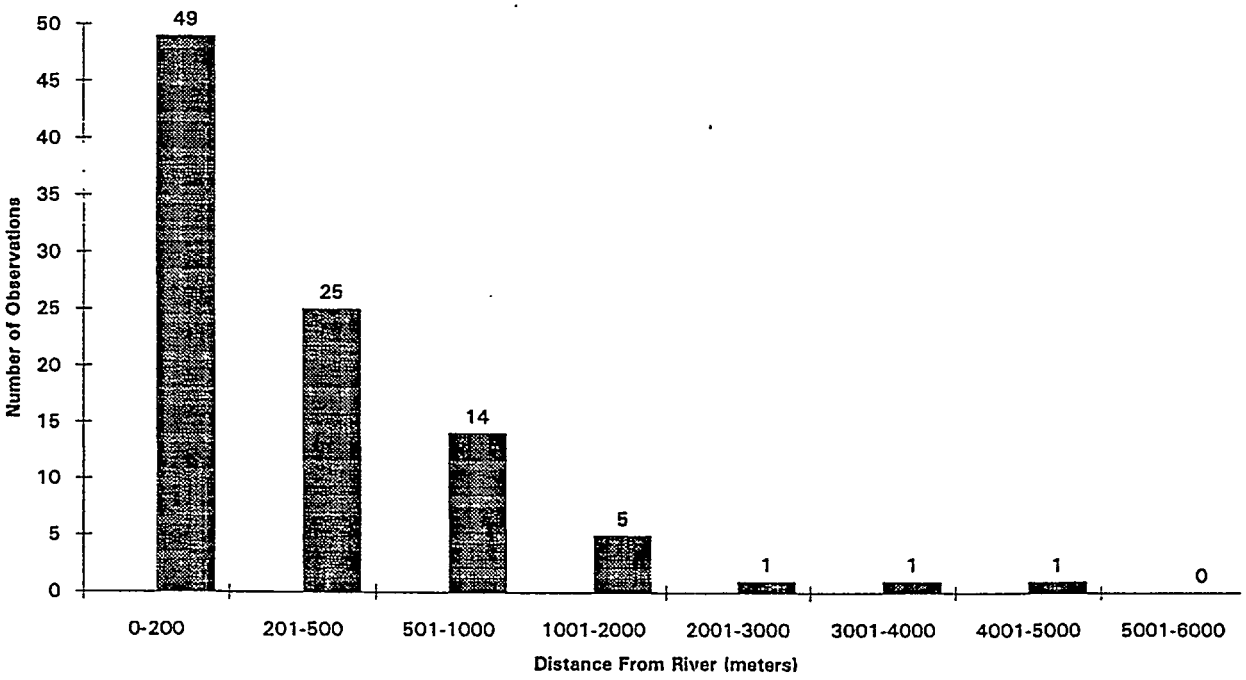

Figure 12. Extent of Deer Movements Across the Columbia River

but the remaining deer were systematically tracked by air and observed on the ground through the 1994 hunting season. During the 1994 hunting season, we found that at least three (16%) of those animals were legally harvested, and one (5%) was illegally harvested on the Saddle Mountain Wildlife Refuge near state highway 24. We lost track of three additional animals during the hunting season (September-November), and they were never found. Assuming our sample (n = 20) to be representative of deer populations along the Columbia River, the data suggest that at least 21% of the male deer residing along the Columbia River were harvested in 1994. When completed, our population estimate for Hanford Site mule deer will permit an estimate of the number of Hanford deer harvested by legal and illegal hunting.

Testicular Atrophy

Approximately 15-25% of the adult male deer residing along the Columbia River exhibit atypically shaped antlers that are velvet covered year-round. By capturing some of these animals and examining their testes, we found that they have undergone an effect known as testicular atrophy. Testicular atrophy is a condition where normally developed testes, for some unknown reason, degenerate, resulting in permanent sterility. The reproductive capacity of the Hanford Site deer herd is not currently being impeded from this anomaly as pregnancy rates for 13 females in 1993 was 100%.

In 1993, we captured five animals that exhibited this phenomenon and examined their ages. Results indicated that only the relatively old animals were being affected; however, the limited sample size (n = 5) was not conclusive evidence. In 1994, an additional 20 male deer were captured and radioequipped. Blood, hair, and fecal samples were taken, and their ages were determined. We found that only the older animals exhibit these conditions on the Hanford Site (Figure 13). It is difficult to compare the frequency of affected animals in this population to other populations because there are few populations elsewhere having a very high frequency of old animals as occurs on the Hanford Site. Data collected in most areas throughout the state at hunter check stations indicate that bucks over age five are rarely seen.

Blood results indicate that a parasitic cause for testicular atrophy in Hanford deer is not likely. Additionally, it appears that the endocrine system is functioning correctly, and therefore, reduces the likelihood that radiation damage from nuclear contaminants is involved. Although an exact agent has not been identified, it appears that some agent is directly affecting the testicles and causing the

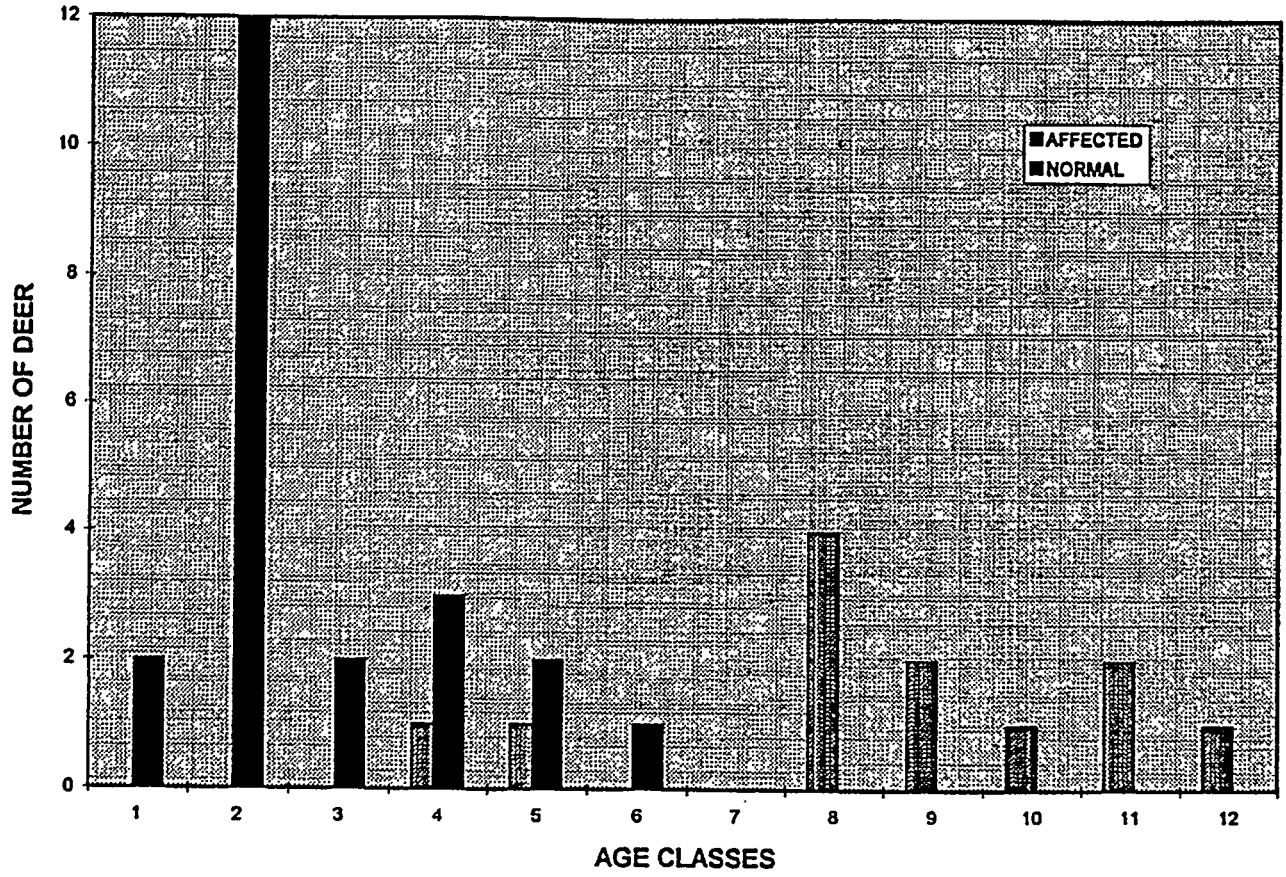

Figure 13. Age Distribution of Affected and Normal Bucks on the Hanford Site (data from 1993 and 1994)

observed testicular regression. Published literature regarding reproductive affecting agents suggests a multitude of possibilities, including plant poisons/estrogens, dietary deficiencies, heavy metals, and pesticides and fungicides.

We are currently conducting movement analysis of the normal and affected animals to examine the areas of use for the two groups. We are also observing seasonal forage patterns and collecting fecal samples to identify the diets of male deer on the Hanford Site. Additionally, some animals will be sacrificed this year to examine tissue levels of various environmental contaminants including heavy metals, pesticides, herbicides, and fungicides. A preliminary report of findings is expected to be complete during calendar year 1995.

Rocky Mountain Elk

B. L. Tiller

Population Census

Rocky Mountain elk (*Cervus elaphus nelsoni*) appeared on the Fitzner/Eberhardt Arid Lands Ecology Reserve in winter 1972. Five animals stayed and reproduced, increasing the population to 133 animals after the 1991 calving season. Relatively few animals are harvested on private lands adjoining ALE each year, and consequently, hunter harvest has not had a significant impact on the population size in the last several years. In 1993, the elk population increased to 238 animals (post-calving census) (Figure 14). A total of 14 elk (9 bulls and 5 cows) were harvested during the 1993 offsite hunting season. Census efforts for late 1994 have not yet been fully evaluated, but data indicate that the post-calving population was slightly greater than 300 animals.

A total count of elk is determined each year by conducting a series of aerial surveys during the post-calving period (August to September) and the post-hunting period (December to January). Radiotransmitters are placed on elk to aid researchers in locating the animals for the population census.

An elk capture was conducted in spring 1993 to fit additional elk with radiotransmitters to continue to conduct a census of the herd and initiate a special population study. Twenty animals were subdued by

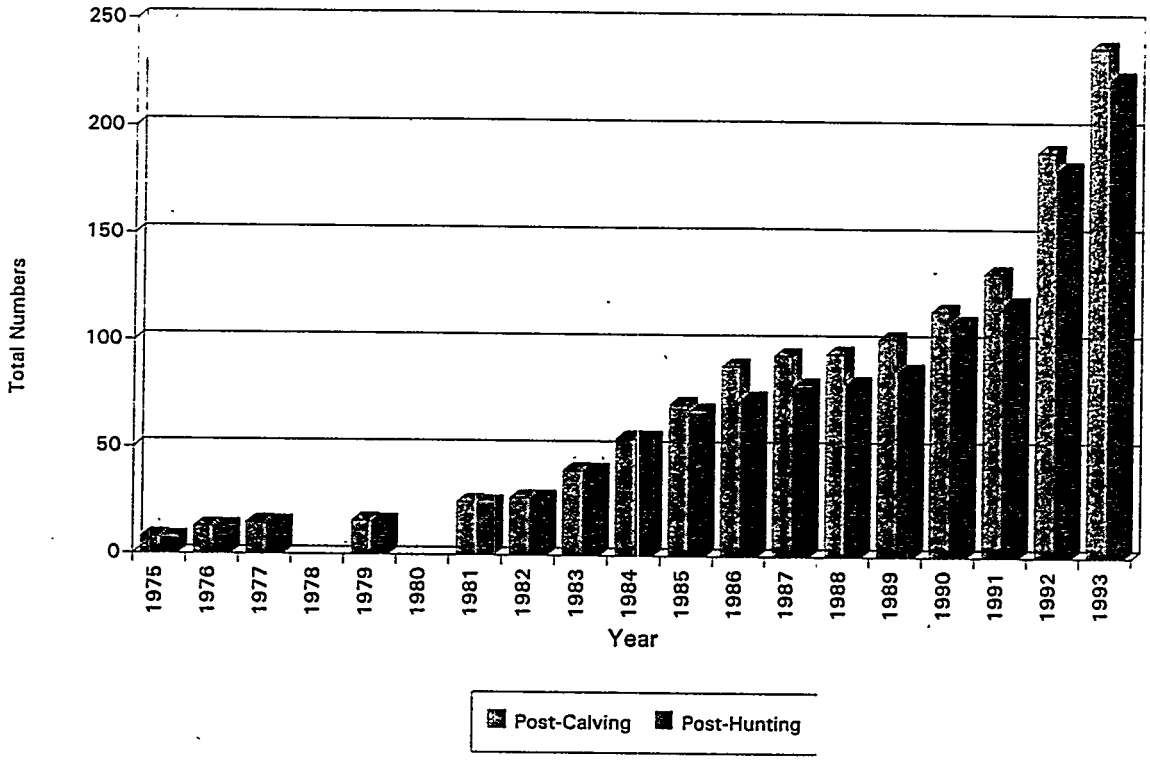

Figure 14. Elk Population (Post-Calving and Post-Hunting Census) Observed on the ALE Site

a tranquilizer dart shot from a helicopter. The anesthetized animals were then aged, measured, checked for pregnancy, fitted with radiocollars, and released. The average age of these animals was 4 years, and the oldest animal was 14 years old. All but one of the females were found to be pregnant, indicating a healthy herd and an adequate number of bulls to maintain the herd at full reproductive capability. Table 8 summarizes the sex and age breakdown of the elk population over the last 11 years.

Elk are successful on ALE and adjacent private lands because of 1) available forage without competition from domestic livestock, 2) unrestricted access to drinking water at springs located on ALE and stock tanks on private land, 3) relatively mild winters, 4) ability to accommodate extreme summer temperatures, even in the absence of shade, and 5) relatively low hunting pressure on private land coupled with total hunting restrictions on DOE land.

Table 8. Age and Sex Classification of Elk Herd (Post-Calving) on the Fitzner/Eberhardt ALE Reserve

Year	Total Number	Adult Male	Yearling Male	Adult Female	Yearling Female	Calves
1983	40	5	3	16	3	13
1984	55	7	12	20	1	15
1985	71	18	7	21	8	17
1886	89	22	8	29	9	21
1987	95	15	5	32	16	27
1988	99	12	13	38	13	23
1989	102	18	10	40	11	23
1990	115	22	12	49	11	21
1991	133	17	11	72	10	23
1992	190	30	11	93	12	44
1993	238	33	19	102	25	59

Historical Database

M. A. Simmons

Large amounts of data have been gathered on Hanford Site wildlife over the past 40-plus years through individual species studies and wildlife monitoring activities. Unfortunately, much of these data were in a format not easily accessible or understandable to any but those responsible for collecting it. Additionally, many people involved in the collection of the data are no longer at PNL. To preserve this valuable resource, a database system was developed and implemented (Cadwell 1994). This year, emphasis was placed on several areas, including updating database software to a relational database with GIS capabilities (i.e., 4th Dimension/ MapGrafix), bringing long-term monitoring studies up-to-date, and completing documentation.

Long-term monitoring on the Hanford Site includes a census of salmon spawning (1948), Canada goose nesting (1953), bald eagles (1961), breeding hawks (1975), elk (1975), and breeding bird survey (1988). In addition, this year TNC, under contract to DOE-RL, surveyed the Hanford Site for threatened and endangered species. Much of the data from those surveys have been compiled and will be entered into the database. We are also in the process of entering threatened and endangered plant species collected to support the vegetation GIS map layer completed last year (Downs et al. 1993b). Most of these new data were collected using the GPS so they can be added to the map layers of the Hanford Site. Table 9 lists the data sets in the database and the threatened and endangered species data sets that soon will be available.

This year, we received data requests from DOE-RL, Ecology, the DNR Natural Heritage Program, TNC, University of Washington, and several Hanford Site contractors. The data are being used to develop land-management plans, schedule site activities, conduct modeling and mapping of Hanford biological resources, plan mitigation strategies, develop a Hanford Site biological resources management plan, support environmental restoration activities, and support the Secretary of Energy's policy for application of ecosystem management on Hanford land.

Table 9. Threatened and Endangered Species Data Sets

Species	Collector	Dates	Database
Salmon redds	PNL	1948	yes
Canada goose nesting	PNL	1953	"
Wintering bald eagles	PNL	1961	"
Beetle trap data	PNL	1964	"
Breeding hawks	PNL	1975	"
Elk census	PNL	1975	"
Elk locations	PNL	1988	"
Breeding bird survey	PNL	1988	"
Snively gulch bird survey	PNL	1991	"
Shrike nests census	PNL	1988-89	"
Eagle roost/perch survey	PNL	1986-87	"
Vegetation map layer	PNL	1991	"
Bird survey	TNC	1994	Available in 1995
Insects of Hanford Site	TNC	1994	"
Lepidoptera survey	TNC	1994	"
Threatened and endangered plant survey	TNC	1994	"
Plant communities	TNC	1994	"
Rare plants	PNL	1994	"

PNL = Pacific Northwest Laboratory.
TNC = The Nature Conservancy.

Supporting Wildlife Studies

Supporting wildlife studies include university research that is aligned with the objectives of the Wildlife Resources Monitoring Project and is conducted with the guidance and technical support of project staff. The work also is conducted with the full cooperation of the WDFW. The supporting studies described below address practical wildlife issues whose resolution will assist DOE-RL in managing site biological resources. Faculty and graduate students from the University of Montana, Boise State University, and the University of Wisconsin, Madison, were involved in the work. Support for these studies was provided, in part, through Associated Western Universities, whose assistance is hereby gratefully acknowledged. It is our intent that the graduate students conducting these studies receive a quality educational experience while at Hanford that leads them to rewarding professional careers.

Nesting Buteo Hawks

J. J. Nugent and L. L. Cadwell

The Hanford Site provides nesting and foraging habitat for the ferruginous hawk, Swainson's hawk and red-tailed hawk. Surveys of nesting buteo hawks have been conducted on the Hanford Site since 1973. In most years, attempts were made to locate all occupied buteo nests. Figure 15 shows known nest locations from 1973 to 1994.

The ferruginous hawk is currently listed as a candidate 2 species by USFWS and as a threatened species by Washington State (see Table 2). Ferruginous hawks nesting on the Hanford Site represent 25% of the nesting population of Washington. Swainson's hawk is recognized as a candidate species and the red-tailed hawk, though common over most of North America, is a protected species in Washington. These three species have similar ecological requirements and considerable overlap in their nesting chronologies and diets, but appear to segregate along nest site and habitat dimensions.

In 1991, a study was initiated to characterize nest-site and habitat selection of ferruginous, Swainson's, and red-tailed hawks in southeastern Washington and to map areas on the Hanford Site of high nesting potential for each species. Nest site and habitat selection were evaluated on a micro- and macro-habitat scale. Micro-habitat was defined as specific features associated with the nest and nest substrate. Nests were measured from 1991 to 1993. Macro-habitat was defined as general features at the landscape level and was assessed using a GIS. Macro-habitat data were used from nests located from 1984 to 1993. Data collected before 1984 were not used because a large fire in 1984 created major changes in landscape structure across the Site.

We found that buteo hawks in southeastern Washington rely extensively on artificial substrates for nesting. Eighty-one percent of the buteo nests measured from 1991 to 1993 were in human-created situations, including planted trees, electrical transmission towers, wooden utility poles, a nest platform, and a gravel pit. These five substrates accounted for 56% of ferruginous, 98% of Swainson's, and 91% of red-tailed hawk nest substrates used. Nest substrate preference varied significantly among species (Table 10). All three species nested, to some extent, in trees and electrical transmission towers. Ferruginous hawks nested most frequently on rock outcrops and 230 Kv towers, secondarily in trees, and occasionally on 500 Kv towers. Swainson's hawks were more selective of nest substrates; most were found in trees, although a modest number nested on wooden utility poles. Swainson's hawks nested infrequently on electrical transmission towers. Red-tailed hawks were adaptable in their choices of nest substrates, most often nesting on 500 Kv towers, trees, 230 Kv towers, cliffs, and a nest platform.

Micro- and macro-habitat selection of the three species differed significantly on 17 of the 24 variables measured (Table 11). Ferruginous hawks preferred areas farthest from water with low habitat diversity. These areas contained fewer shrubs and more grasses. Ferruginous hawks selected the most sturdy substrates to support their large nests. Their nests were approximately 1.5 times the size of the other two species. Ferruginous hawks were also most sensitive to human activity, nesting on average 1.8 km from disturbances (i.e., buildings, parking lots, and gravel pits).

Swainson's hawks were least sensitive to human activity. Sixty-six percent of nests were found closer than 1 km from disturbances. Swainson's hawks favored areas of low topographic variation and low perch densities. Nests were found closer to water in

Table 10. Nest Substrates Used by Ferruginous, Swainson's, and Red-Tailed Hawks in Southeastern Washington

Nest Substrate	Ferruginous		Swainson's		Red-Tailed	
	n	%	*n*	%	*n*	%
Cliff/rock outcrop	21	58.3	0	-	3	7.0
Tree	5	13.9	37	75.5	10	23.3
230 Kv transmission tower	8	22.2	4	8.2	9	20.9
500 Kv transmission tower	2	5.6	2	4.1	20	46.5
Wooden utility pole	0	-	6	12.2	0	-
Nest platform	0	-	0	-	1	2.3
Total	36	100.0	49	100.0	43	100.0

Table 11. Micro- and Macro-Habitat Variables Measured for Ferruginous, Swainson's, and Red-Tailed Hawks in Southeastern Washington

Micro-Habitat Variables	Macro-Habitat Variables
Height of nest substrate[a]	Elevation
Height of nest above ground[a]	Slope
Relative height	Coefficient of variation of elevation[a]
Nest tree DBH[a]	Distance to water[a]
Nest branch diameter[a]	Distance to agriculture
Nest tree condition	Distance to disturbance[a]
Nest diameter[a]	Distance to primary roads
Nest height[a]	Distance to secondary roads[a]
Diameter of largest stick in nest[a]	Distance to unimproved roads[a]
Long distance exposure[a]	Length of cover type boundary edge
	Shannon Diversity Index[a]
	% of surrounding area containing perches[a]
	% of surrounding area consisting of grasses or light shrubs[a]
	% of surrounding area consisting of dense shrubs[a]

(a) Significant differences between species.

areas with more shrubs and higher habitat diversity. Swainson's hawks selected the shortest substrates and nested nearest to the ground. Their nests were built of light materials and prone to blowouts.

Red-tailed hawks preferred areas of relatively high topographic variation and high perch densities. They selected the tallest substrates and nested at heights more than twice those of ferruginous and Swainson's hawks. These substrates provided red-tailed hawks with a commanding view of their surroundings.

Efforts to map areas of high nesting potential for buteo hawks on the Hanford Site will be completed in 1995. A model that combines the Mahalanobis distance statistic, a GIS, remote sensing data, and survey data will be used to create detailed maps of habitat suitability for each of the buteo species. The information will be used to identify nesting habitat and to plan habitat-related mitigation and/or restoration.

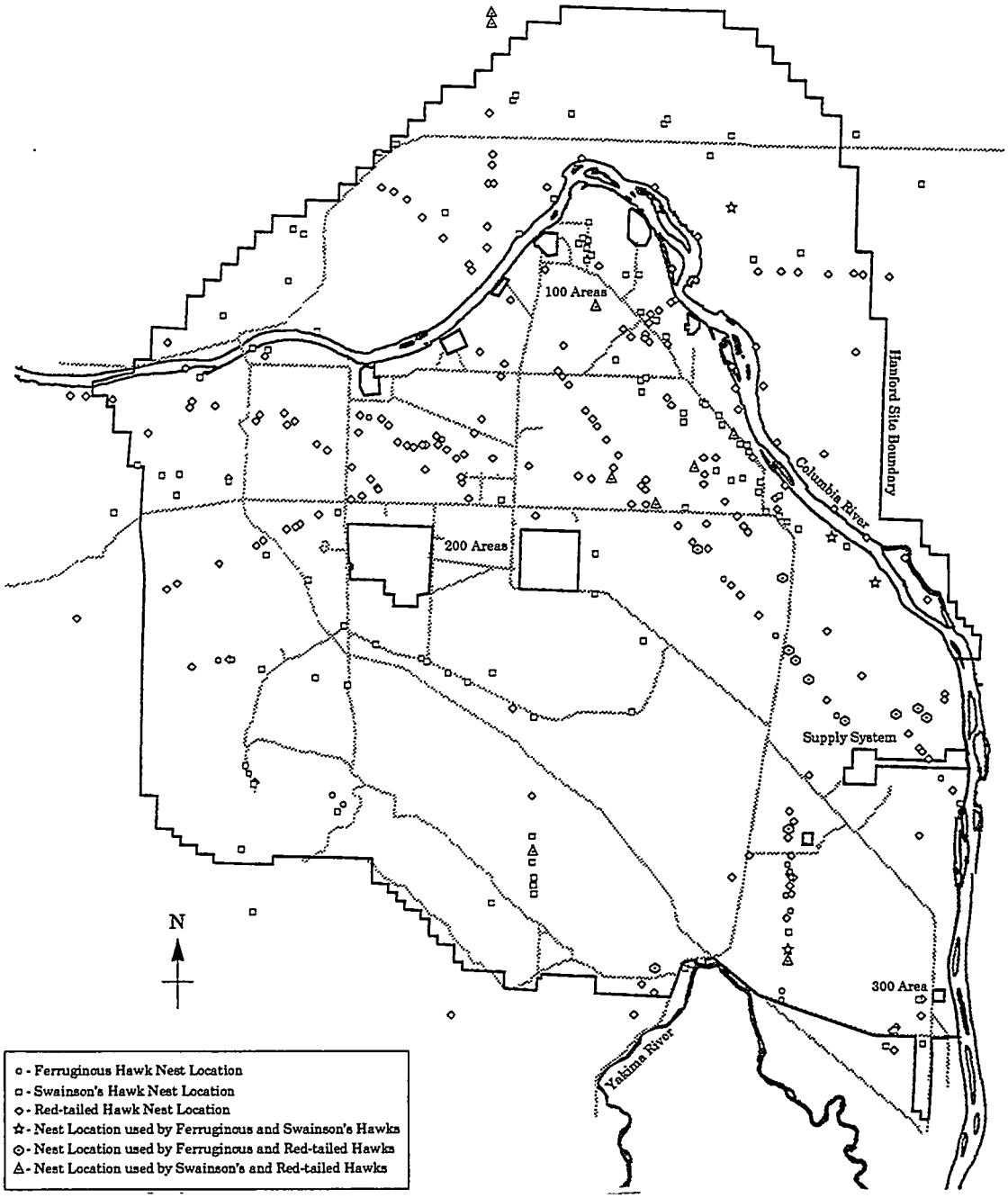

Figure 15. Buteo Hawk Nest Locations from 1973 to 1994

Ferruginous Hawks

A. W. Leary and R. Mazaika

Ferruginous hawks are the least common of the three buteo hawk species that nest on the Hanford Site. During the mid- to late 1980s and early 1990s, the number of breeding pairs of ferruginous hawks was decreasing throughout most of their range in Washington with the exception of the Hanford Site, where the number of breeding pairs has been steadily increasing since 1987. Currently, a large proportion of the state's population nests on the Hanford Site, primarily on transmission towers. The Site is unique in that no agriculture or grazing has occurred on the land for 50 years. It has not been determined whether a relationship exists between ferruginous hawk use of the Site and the current habitat condition, whether the Site affords a "refuge" for birds, or whether transmission towers on the site provide the only available nesting substrate in the area. The purpose of this study is to examine foraging of individual birds that nest in different habitats and determine the home range size of male ferruginous hawks nesting on and off the Hanford Site.

Radiotelemetry was used to study the movements and foraging activities of adult male ferruginous hawks nesting on and adjacent to the Hanford Site from May through August 1994. Males nesting both on and off the Site were tracked to compare foraging behavior, habitat use, and home range size. Males were selected because during brood rearing they do most foraging for the family. Males were tracked during all daylight hours to determine foraging areas and peak foraging times. Observations were also recorded at nest sites during all daylight hours to determine the number and size of prey delivered, times of deliveries, and the distance prey items were carried to nest sites. In addition to foraging activities, home ranges of males during the breeding/nesting season were calculated. Home ranges were similar for males nesting both on and off the Hanford Site and similar to those reported for ferruginous hawks in other states (Table 12). Males nesting both on and off the Site used agricultural fields for some of their foraging, and the majority of the foraging activity occurred during midday (1000-1400 hr) (Figure 16). Forty-nine prey deliveries were observed at four nests (two onsite and two offsite). All males were observed capturing and delivering a variety of small (mice, shrews, and voles) and medium-sized prey items (ground squirrels, pocket gophers, etc.) to the nest, but none were observed capturing or delivering

Table 12. Home Ranges for Ferruginous Hawks During 1994

Nest Location	95% Minimum Convex Polygon	95% Harmonic Mean
Webber Canyon (17)[a]	9.8 km^2	20.5 km^2
Beck Road (52)[a]	7.5 km^2	23.9 km^2
Chandler Butte (60)[a]	5.7 km^2	11.3 km^2
Route 2 (98)[b]	9.3 km^2	10.3 km^2
FFTF #1 (42)[b]	0.7 km^2	2.6 km^2
Average from this study	6.6 km^2	13.7 km^2
Average from southern Idaho reported by McAnnis 1990	6.4 km^2	13.5 km^2

(a) Nesting off the Hanford Site.
(b) Nesting on the Hanford Site.

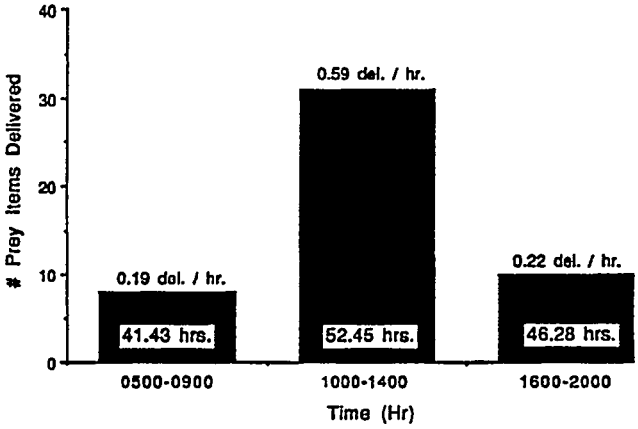

Figure 16. Number of Prey Items Delivered to Ferruginous Hawk Nests During Three Separate Observation Periods in 1994. Total hours of observation during each period indicated in bars, and prey delivery rate given at top of bars.

any large prey items such as jackrabbits (Table 13). Male use of agricultural versus shrub-steppe habitat was undetermined. Further analysis of habitat use for foraging is planned for 1995.

Elk Population Studies

R. Garrott and B. L. Tiller

Background

Populations of large herbivores such as deer and elk have the potential to grow 20-35% annually, resulting in the doubling of animal densities every 3-5 years. Such high potential growth rates can present challenges to natural resource and land management agencies because high densities of large herbivores can have significant impacts on plant communities, soil characteristics, and hydrology. Wildlife populations in proximity to agricultural and urban environments can also result in serious conflicts with society if they damage crops, transmit disease, and collide with vehicles. Traditionally, large herbivore populations have been controlled by manipulating survival rates through regulating harvest by sport hunters. Although such management effectively maintains wildlife populations at acceptable densities, many situations exist in which sport hunting is difficult or impossible to implement. Examples include lands managed by DOE and the U.S. Department of Defense (DoD) where public access is restricted or prohibited. Public lands set aside as natural sanctuaries, such as state and federal parks, also commonly support large herbivore populations that are difficult to control because the public is opposed to destroying animals within these preserves. The development of alternative nonlethal management methodologies would greatly facilitate the effective and responsible management of large herbivore populations occupying such sensitive public lands.

Recent advances in contraceptive technologies have stimulated considerable interest in the scientific community and general public as a potential tool for the nonlethal management of wildlife populations. The porcine zona pellucida vaccine (PZP), produced from pig ovaries, is a promising immunologically based contraceptive that has considerable potential as an effective wildlife management tool because it can be delivered remotely via rifle-fired darts. The

Table 13. Number of Prey Delivered by Size Category to Nests of Ferruginous Hawks in 1994

Nest Location	Group 1 (small items)	Group 2 (medium items)	Group 3 (large items)	Unknown Items
Webber Canyon (3)	10	10	0	1
Beck Road (3)	11	4	0	2
Route 2 (2)	4	4	0	0
FFTF #1 (1)	0	3	0	0
Total	25	21	0	3

( ) = Number of young in nest.

vaccine has been tested and proven effective on a wide variety of large mammals in captivity, including deer and elk; however, experiments with free-ranging populations generally have been limited to treating a small number of animals. Population-level experiments will be required to rigorously test the potential of any contraceptive technology to effectively manage and control free-ranging wildlife. The elk population occupying ALE provides an ideal situation for testing the PZP vaccine because the demography of the population is well-documented, the topography and plant communities permit animals to be readily detected and treated via helicopter, and the size of the population is optimal for providing a realistic test of the efficacy of the vaccine.

PNL biologists have developed a collaborative research program with scientists from the University of Wisconsin, Eastern Montana University, and the Starkey research facility in Oregon to develop field methodologies for administering and testing the potential of the PZP vaccine as a population management tool. There are three aspects of the research program: testing the immunological response of captive elk to various PZP vaccination protocols, experimenting on individuals using small numbers of free-ranging cow elk, and experimenting at the population level to develop and test methodologies for treating free-ranging animals and evaluate the impact of treatment on the dynamics of the elk population.

Captive animal research is being conducted at the Starkey facility where three groups of six cow elk are being maintained on varying planes of nutrition. One- and two-inoculation protocols have been administered to animals in each group. A blood sample is drawn from each animal at regular intervals for a 7-month period. All samples will be assayed for antibody response to the PZP vaccine at the end of the experiment and will provide insights into appropriate treatment protocols and estimates of the effective duration of the vaccine.

The individual-based experiment with 20 radiocollared free-ranging cow elk will be completed in the spring of 1995. The 2-year study is being conducted by a graduate student from the University of Wisconsin. (See the following section, Breeding Behavior of Elk After Treatment with Immunocontraceptive Vaccine.) Ten elk were treated with the PZP vaccine, and 10 serve as controls. The study has successfully developed methodology for delivering the vaccine to free-ranging animals via darts fired from helicopters. The darts simultaneously inoculate and mark the animal with a temporary nontoxic paint to confirm successful treatment and ensure animals are not treated repeatedly during successive flights.

During the first year of field tests, treated and control cows calved at similar rates. It was discovered that initial protocols for mixing the vaccine and adjuvant and loading darts resulted in delivery of insufficient doses of vaccine to the animals. Protocols were modified during the second year of treatment, and efficacy will be evaluated during the calving season in May 1995.

Currently, plans are being formulated to design the population-level experiment and evaluate the potential of implementing the final aspect of this research program in August 1995. This work is being conducted in cooperation with the property damage resulting from WDFW. The WDFW is experiencing significant landowner complaints resulting from reported crop damage and property damage resulting from trespass by hunters; both have been increasing in recent years as the local elk population has grown. Hanford lands serve as a refuge for a portion of that population. Thus, both adjacent private landowners and WDFW administration are seeking assistance in elk population control. This project has the potential to provide a tool that can be used by WDFW to manage population growth of that portion of the local elk herd residing on the Hanford Site while being compatible with Hanford land-use policy that excludes onsite hunting.

Breeding Behavior of Elk After Treatment with Immunocontraceptive Vaccine

T. Heilmann, B. L. Tiller and L. L. Cadwell

In August 1993, a 2-year graduate project was initiated to examine the individual behavioral effects of PZP immunocontraceptive vaccine on 20 cow elk on ALE. The study involved monitoring 10 treatment and 10 control cow elk and breeding bulls to determine what effect, if any, treatment with PZP had on breeding behavior and social structure.

Breeding behavior data were collected from September to late November on ALE and surrounding private lands. Elk groups were located using radiotelemetry. Subsequent data were recorded with an Atari Portfolio minicomputer that was programmed to serve as a time interval data logger. During the 1993 breeding season, treated cows were observed for a total of 139.6 animal observation

hours, and control cows were observed for a total of 76.99 animal observation hours. Some analyses already have been conducted, and full analysis of both years of breeding behavior data will be completed in 1995.

Paired sample t-tests were performed on the behavioral state and event data from the 1993 breeding season. Treatment cows spent significantly more time in the state of being tended by a herd bull than did control cows ($p<0.10$, df=66). In addition, herd bulls spent significantly more time directing sexual searching behavior toward treatment cows than did toward control cows ($p<0.01$, df=66). Treatment cows spent significantly more time in the state of moving than did control cows ($p<0.05$, df=66). All other paired sample t-tests did not yield significantly different results between treatment and control cows for other behavioral states and events.

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Appendix A

1994 Publications, Presentations, and Educational Activities

Appendix A

1994 Publications, Presentations, and Educational Activities

Publications and Presentations

Wildlife Studies on the Hanford Site: 1993 Highlights Report, PNL-9380. Pacific Northwest Laboratory, Richland, Washington. NTIS, Springfield, Virginia.

Persistent Sepal Yellowcress along the Mid-Columbia River, Washington, PNL-SA-23728A, Presented at the Washington Chapter, Wildlife Society Meeting, March 1-3, 1994, Wenatchee, Washington.

Predicting Nesting Habitat for Buteo spp. Hawks Using a Multivariate Model and a Geographic Information System, PNL-A-23725A, Presented at the Washington Chapter, Wildlife Society Meeting, March 1-3, 1994, Wenatchee, Washington.

The Occurrence of Gonadal Atrophy in a Wild Mule Deer Population - A Baseline Study, PNL-SA-23730A, Presented at the Washington Chapter of Wildlife Society Meeting, March 1-3, 1994, Wenatchee, Washington.

Shrubsteppe Plants of the Hanford Site: Distribution and Abundance, PNL-SA-23819A, Presented at the Annual Meeting, Northwest Science Association, March 23-26, 1994, Ellensburg, Washington.

Movement and Habitat Utilization of Adult Fall Chinook Salmon (Oncorhynchus tshawytscha) in the Hanford Reach of the Columbia River, Washington, PNL-SA-23643, Presented at the annual meeting of the American Fisheries Society in Halifax, Nova Scotia, August 23, 1994.

Status of Wildlife Resources on Hanford, PNL-SA-25361, November 14, 1994, Wenatchee, Washington.

Wildlife Issues and the Hanford Site Environmental Restoration Mission, PNL-SA-25466, Wildlife Issues of Ecosystems, Washington State Department of Fish and Wildlife, December 2, 1944, Olympia, Washington.

Educational Activities

In addition to conducting wildlife studies on the Hanford Site, PNL researchers routinely contribute to the nearby Columbia Basin communities by sharing their knowledge and expertise. For several years, Lee Rogers, manager of PNL's Terrestrial Sciences Section, has written a monthly column, "Natural History," for the *Tri-City Herald.* Each month, the column focuses on a different aspect of the area's natural history and environment, helping readers learn about and appreciate their environment and the variety of plant wildlife that they share.

In 1994, "Natural History" introduced readers to the habits and habitats of Columbia Basin's mule deer (*Odocoileus hemionus*), the rare river otter (*Lutra canadensis*), beaver (*Castor canadensis*), bobcat (*Lynx rufus*), Rocky Mountain elk (*Cervus canadensis*), and the monarch butterfly. The column also discussed how to observe wildlife in the area, how mid-Columbia rivers contribute to the natural system, the importance of topsoil and its significance as a living system, and the abundance of bird and insect life observable in the Rattlesnake Springs area of ALE.

Appendix B

Endangered, Threatened, and Candidate Species of the Hanford Site

Hanford Species of Concern

Updated 1/31/95

Category	Common Name / Latin Name	Federal Status					State Status								
		Endan.	Threat.	Cand.1	Cand.2	Cand.3C	Protec.	Endan.	Threat.	Sens.	Cand.	Monit.	Monit.1	Monit.2	Monit.3
amphib.	Woodhouse's toad (Bufo woodhousei)											X			
bird	Aleutian Canada goose (Branta canadensis leucopareia)		X					X							
bird	American peregrine falcon (Falco peregrinus)	X						X							
bird	American white pelican (Pelecanus erythrorhynchos)							X							
bird	Arctic tern (Sterna paradisaea)											X			
bird	Ash-throated flycatcher (Myiarchus cinerascens)											X			
bird	Bald eagle (Haliaeetus leucocephalus)		X						X						
bird	Barred owl (Strix varia)											X			
bird	Black tern (Chlidonias niger)				X							X			
bird	Black-crowned night heron (Nycticorax nycticorax)											X			
bird	Black-necked stilt (Himantopus mexicanus)											X			
bird	Burrowing Owl (Athene cunicularia)				X						X				
bird	Caspian tern (Sterna caspia)											X			
bird	Clark's grebe (Aechmophorus clarkii)											X			
bird	Common loon (Gavia immer)										X				
bird	Ferruginous hawk (Buteo regalis)				X				X						
bird	Flammulated owl (Otus flammeolus)										X				
bird	Forster's tern (Sterna forsteri)											X			
bird	Golden eagle (Aquila chrysaetos)										X				
bird	Grasshopper sparrow (Ammodramus savannarum)											X			
bird	Great blue heron (Ardea herodias)											X			
bird	Great egret (Casmerodius albus)											X			
bird	Gyrfalcon (Falco rusticolas)											X			
bird	Harlequin duck (Histrionicus histrionicus)			X											
bird	Horned grebe (Podiceps auritus)											X			
bird	Lewis' woodpecker (Melanerpes lewis)										X				
bird	Loggerhead shrike (Lanius ludovicianus)				X						X				
bird	Long-billed curlew (Numenius americanus)											X			
bird	Merlin (Falco columbarius)											X			
bird	Northern goshawk (Accipiter gentilis)				X						X				
bird	Olive-sided flycatcher (Contopus borealis)				X										
bird	Osprey (Pandion haliaetus)											X			
bird	Prairie falcon (Falco mexicanus)											X			
bird	Red-necked grebe (Podiceps grisegena)											X			
bird	Red-tailed hawk (Buteo jamaicensis)						X								
bird	Sage sparrow (Amphispiza belli)										X				
bird	Sage thrasher (Oreoscoptes montanus)										X				
bird	Sandhill crane (Grus canadensis)							X							

Hanford Species of Concern

Updated 1/31/95

Category	Common Name / Latin Name	Federal Status					State Status								
		Endan.	Threat.	Cand.1	Cand.2	Cand.3	Protec.	Endan.	Threat.	Sens.	Cand.	Monit.	Monit.1	Monit.2	Monit.3
bird	Snowy owl (Nyctea scandiaca)											X			
bird	Swainson's hawk (Buteo swainsoni)										X				
bird	Turkey vulture (Cathartes aura)											X			
bird	Tri-colored blackbird			X											
bird	Western bluebird (Sialia mexicana)										X				
bird	Western grebe (Aechmophorus occidentalis)											X			
bird	Western sage grouse (Centrocercus urophasianus)				X						X				
fish	Mountain sucker (Catostomus platyrhynchus)											X			
fish	Bull (Dolly Varden) trout (Salvelinus confluentus)			X											
fish	Piute sculpin (Cottus beldingi)											X			
fish	Reticulate sculpin (Cottus perplexus)											X			
fish	River lamprey (Lampetra ayresi)				X										
insect	Bonneville skipper (Ochlodes sylvanoides bonnevilla)											X			
insect	Canyon green hairstreak (Callophrys sheridanii neoperplexa)											X			
insect	Coral hairstreak (Harkenclenus titus immaculosus)											X			
insect	Juniper hairstreak (Mitoura siva)										X				
insect	Nevada skipper (Hesperia nevada)											X			
insect	Pasco pearl crescent (Phyciodes "tharos" pascoensis)											X			
insect	Purplish copper (Lycaena helloides)											X			
insect	Ruddy copper (Lycaena rubida perkinsorum)											X			
insect	Silver-bordered bog fritillary (Boloria selene atrocostalis)										X				
insect	Viceroy (Nevada) (Limenitis archippus lahontani)				X							X			
invert.	California floater (mussel) (Anodonta californiensis)				X										
invert.	Columbia pebblesnail (Fulminicola columbianus)				X						X				
invert.	Columbia tiger beetle (Cicindela columbica)										X				
invert.	Sand roller (Percopsis transmontana)											X			
invert.	Shortface lanx (Fisherola nuttalli)										X				
mammal	Fringed myotis (Myotis thysanodes)				X							X			
mammal	Long-eared myotis (Myotis evotis)											X			
mammal	Long-legged myotis (Myotis volans)				X							X			
mammal	Merriam's shrew (Sorex merriami)										X				
mammal	Northern grasshopper mouse (Onychomys leucogaster)											X			
mammal	Ord's Kangaroo rat (Dipodomys ordii)											X			
mammal	Pacific western big-eared bat (Plecotus townsendii)				X										
mammal	Pale Townsend's big-eared bat (Plecotus townsendii pallenscens)				X										
mammal	Pallid bat (Antrozus pallidus)											X			
mammal	Pygmy rabbit (Brachylagus idahoensis)				X			X							
mammal	Sagebrush vole (Lagurus curtatus)											X			

Hanford Species of Concern

Updated 1/31/95

Category	Common Name / Latin Name	Federal Status					State Status								
		Endan.	Threat.	Cand.1	Cand.2	Cand.3	Protec.	Endan.	Threat.	Sens.	Cand.	Monit.	Monit.1	Monit.2	Monit.3
mammal	Small-footed myotis (Myotis leibii)				X							X			
mammal	Washington ground squirrel (Citellus washingtoni)											X			
mammal	White-tailed jackrabbit (Lepus townsendii) State --Game														
mammal	Yuma myotis (Myotis yumanensis)				X										
reptile	Night snake (Hypsiglena torquata)											X			
reptile	Northern sagebrush lizard (Scleroporus graciosus graciosus)				X										
reptile	Striped whipsnake (Masticophis taeniatus)										X				
plant	Bristly cryptantha (Cryptantha interrupta)													X	
plant	Canadian St. John's-wort (Hypericum majus)												X		
plant	Columbia milkvetch (Astragalus columbianus)			X					X						
plant	Columbia River mugwort (Artemisia lindleyana)														X
plant	Columbia yellowcress (Rorippa columbiae)				X			X							
plant	Coyote tobacco (Nicotiana attenuata)									X					
plant	Crouching milkvetch (Astragalus succumbens)														X
plant	Dense sedge (Carex densa)									X					
plant	Desert dodder (Cuscuta denticulata)												X		
plant	Desert evening primrose (Oenothera caespitosa Nutt.)									X					
plant	Dwarf evening primrose (Oenothera pygmaea)								X						
plant	False pimpernel (Lindernia anagallidea)									X					
plant	Fuzzy beardtongue (Penstemon eriantherus)														X
plant	Geyer's milkvetch (Astragalus geyeri)									X					
plant	Gray cryptantha (Cryptantha leucophaea)									X					
plant	Hoover's desert parsley (Lomatium tuberosum)				X				X						
plant	Medick milkvetch (Astragalus speirocarpus)														X
plant	Northern wormwood (Artemisia campestris ssp. borealis var. wormskioldii)			X				X							
plant	Palouse milkvetch (Astragalus arrectus)									X					
plant	Palouse thistle (Cirsium brevifolium)														X
plant	Piper's daisy (Erigeron piperianus)									X					
plant	Robinson's onion (Allium robinsonii)														X
plant	Rosy balsamroot (Balsamorhiza rosea)														X
plant	Shining flatsedge (Cyperus rivularis)									X					
plant	Smooth cliffbrake (Pellaea glabella)														X
plant	Southern mudwort (Limosella aquatica)									X					
plant	Squill onion (Allium scilloides)														X
plant	Stalked-pod milkvetch (Astragalus sclerocarpus)														X
plant	Thompson's sandwort (Arenaria franklinii var. thompsonii)													X	

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