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January 1989

Prepared for the U.S. Army
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Pacific Northwest Laboratory
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ECOLOGICAL BASELINE STUDY OF THE YAKIMA FIRING CENTER PROPOSED LAND ACQUISITION: A STATUS REPORT

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SUMMARY

This report provides baseline environmental information for the property identified for possible expansion of the Yakima Firing Center. Field census data were gathered on the site from October 1987 through August 1988. Results from this work provide general descriptions of the animals and major plant communities present. A vegetation map derived from a combination of on-site surveillance and remotely sensed imagery is provided as part of this report.

Through August 1988, 27 wildlife species of special interest (protected, sensitive, furbearer, game animal, etc.), and waterfowl, were observed on the proposed expansion area. Bird censuses revealed 13 raptorial species (including four of special interest: bald eagle, golden eagle, osprey, and prairie falcon); five upland game bird species (sage grouse, California quail, chukar, gray partridge, and ring-necked pheasant); common loons (a species proposed for state listing as threatened); and five other species of special interest (sage thrasher, loggerhead shrike, mourning dove, sage sparrow, and long-billed curlew). Estimates of waterfowl abundance are included for the Priest Rapids Pool of the Columbia River.

Six small mammal species were captured during this study; one, the sagebrush vole, is a species of special interest. Two large animal species, mule deer and elk, were noted on the site. Five species of furbearing animals were observed (coyote, beaver, raccoon, mink, and striped skunk). Four species of reptiles and one amphibian were noted.

Fisheries surveys were conducted to document the presence of gamefish, and sensitive-classified fish and aquatic invertebrates. Rainbow trout were the only fish collected within the boundaries of the proposed northern expansion area. Because of beaver dams, other natural barriers, and low stream flow in Johnson Creek, it is unlikely that anadromous fish will enter and spawn within the proposed expansion area. The nearest chinook salmon spawning area occurred about 4 miles upstream of the proposed Columbia River crossing area. Juvenile fall chinook salmon were abundant along both Columbia River shorelines of the proposed crossing area from late April through mid-June. Young bass were also present along both shorelines, with no evidence of spawning activity. No sensitive aquatic invertebrate species were found in the proposed river crossing area.

ACKNOWLEDGMENTS

We would like to thank G. A. Sargeant [Pacific Northwest Laboratory (PNL)], R. W. Hanf, Sr. (PNL), D. Boyd (Colorado State University), and J. Blatt (Central Washington State University) for their field assistance. In addition, we thank E. Anderson of Ft. Lewis and the Yakima Firing Center, who contributed to field data collection and observations; S. A. Eisner of the University of Montana, who contributed the 1986-87 field data on bald eagle and waterfowl sightings; G. M. Petrie, L. G. McWethy, C. S. Kimball, and G. E. Wukelic of PNL for image processing and analysis, and Mastrogiuseppe and Gill, Environmental Consultants from Pullman, Washington, who conducted a survey in the proposed expansion area for the Columbia milkvetch.

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INTRODUCTION

The U.S. Army is considering expanding the Yakima Firing Center (YFC) training facility (Figure 1). The expansion area would involve about 63,000 acres of rangeland. Most of the expansion area lies north of the present YFC (e.g., the northern expansion area), but a narrow right of way along the eastern boundary and a river crossing area are also included.

Although substantial information is available on the taxonomic and geographic status of the important plant and animal species of Washington, there is a paucity of information specific to the planned acquisition area. This study is intended to provide baseline information on the plants and wildlife inhabiting the area. Specific studies included 1) the distribution of vegetation types, 2) the distribution of sensitive plant species, 3) the distribution of key wildlife (game animals, protected and sensitive species, waterfowl, and game fish), and 4) game fish spawning and/or rearing areas near the Columbia River crossing site.

This report is based on information gained from studies conducted from October 1, 1987, through August 31, 1988.

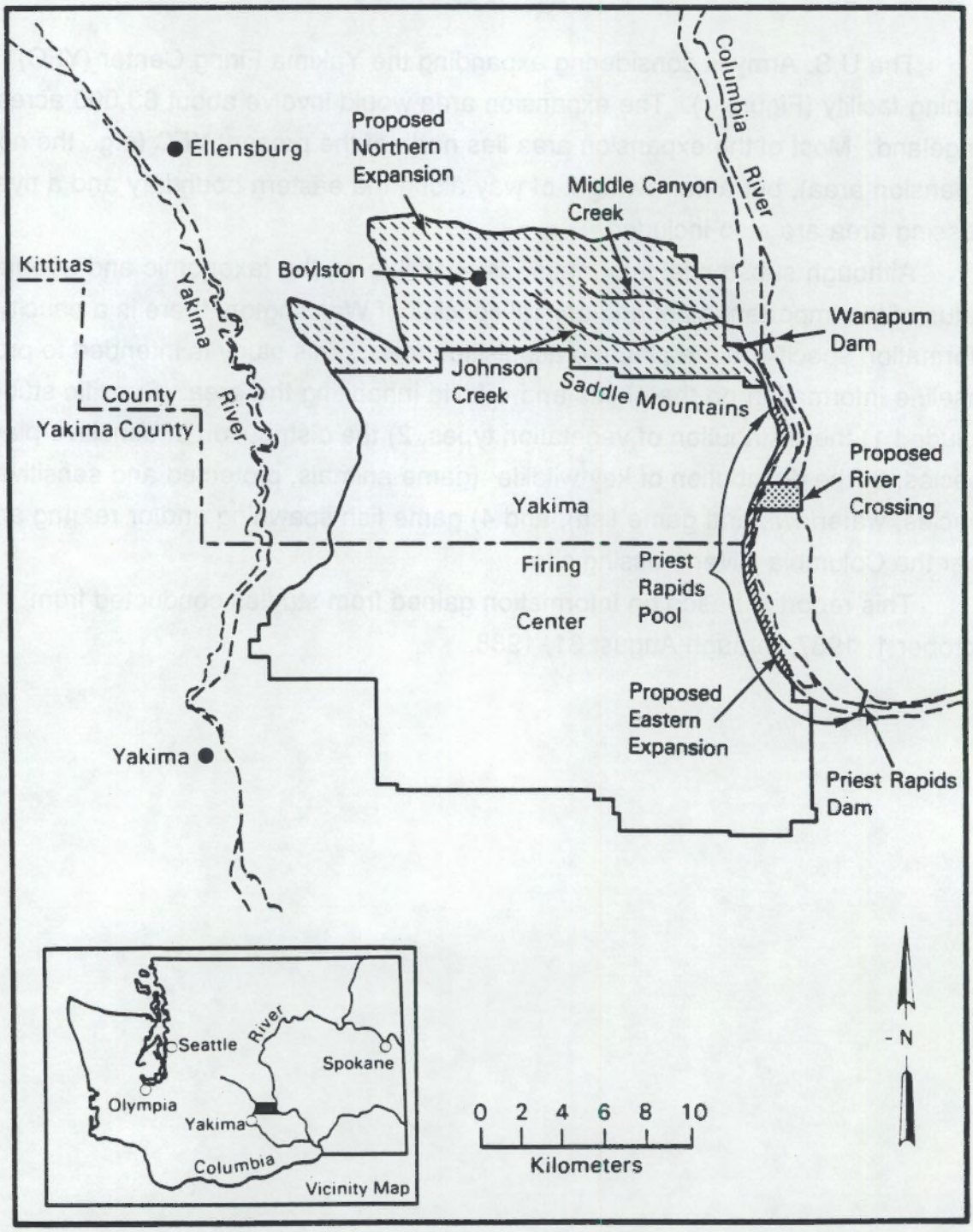


FIGURE 1. Proposed Expansion Area of the Yakima Firing Center

VEGETATION SURVEYS

PURPOSE

The purpose of the vegetation survey is to provide a preliminary estimate of the distribution and extent of the major vegetation types on the proposed expansion area. The survey is not intended to characterize the vegetation types by species composition, biomass, density, or percent coverage of vegetation. The information presented here serves as a basis for further vegetation studies to be conducted in FY 1989 and for wildlife habitat characterization. In addition, searches were made for the presence of protected plant species.

VEGETATION MAPPING

Landsat and aircraft imagery was used to locate areas of homogeneous vegetation. Field reconnaissance using fixed-wing aircraft and vehicles was used to identify the major vegetation types located from the imagery. Large areas of homogeneous vegetation were designated as reference areas and recorded on topographic maps. These reference areas were used to classify Landsat imagery of the entire expansion area to produce a preliminary map of the major vegetation types.

Methods

Several data sources were used to produce the preliminary classification. These included:

1. Landsat 5 Thematic Mapper Multispectral Scenes from May 8, 1986, and October 22, 1986.
2. Topographic Maps:

Name	Sheet	Series	Edition	DMA Stock#
Badger Pocket	1977 IV	V 791	4-DMATC	V791X 19774
Boylston	1977 I	V 791	4-DMATC	V791X 19771
Beverly	2077 IV	V 791	4-DMATC	V791X 20774
Yakima Firing Center	Special Map	V7915	4-DMA-FCSM	V7915YAKFIRCEN

3. Video Tape:
   - 8 mm, digital format taken from a fixed-wing aircraft on October 21,1987
   - VHS taken from an Army helicopter overflight in October 1986.

4. Large format color infrared photography taken by EG&G, Inc., during the first week of May 1987 at an altitude of 10,000 ft.

5. Ground surveys of the proposed acquisition areas conducted on the following dates to establish ground reference sites (areas of known vegetation used in supervised classification of the Landsat data):
   - October 28, 1987
   - November 4, 1987
   - November 19, 1987.

Supervised classification of the Landsat TM scene of October 22, 1986, was conducted to determine the relative distribution of the major vegetation types on the proposed acquisition area. The ground reference areas were used to train the Landsat data using the software "TRAIN" developed at PNL. The trained data were classified with the I^2S 600 software. The following training classes were used:

1. "Stiff Sage" - Stiff sagebrush(a) is the dominant plant species, Sandberg's bluegrass is the dominant grass. Rock buckwheat is common. Vegetation cover is sparse and the soil is rocky. This vegetation type is found primarily on the broad, exposed ridges.

2. "Cheatgrass" - Cheatgrass areas are found primarily at disturbed sites. Vegetation in this class is predominantly cheatgrass, but other annual weeds, such as tumblemustard and prickly lettuce, are also found. The vegetation canopy cover is typically 100%. Soil types vary.

3. "Rock" - Rock outcrops and talus slopes are included in this class.

(a) See Appendix A, Table A.2, for a listing of scientific names of species mentioned in this report.

4. "Big Sage" - This class is found on upland and canyon bottom soils, which are usually silty. The dominant species are big sagebrush and bluebunch wheatgrass, with Sandberg's bluegrass in association.

5. "Ridge" - This class is found on ridge crests along the slopes of the Saddle Mountains. Because of the steep slopes, shaded and sunny areas are prominent and produce spectral differences on the Landsat imagery. For this reason, two subclasses were produced during the classification: "Ridge Sunny" and "Ridge Shaded." These classes were combined in the preliminary map. The vegetation consists of many species; the dominants include stiff sagebrush, buckwheat, and Sandberg's bluegrass. The soils are rocky with large areas of exposed basalt.

6. "Sagebrush - Bluegrass" - This class is found on silty soils in upland areas. These areas are grazed. The dominant plant species are big sagebrush and Sandberg's bluegrass. Bluebunch wheatgrass is often found growing within the canopies of big sagebrush where it is protected from grazing. Bare ground is prominent.

7. "Sage Bottom" - This class is found along stream bottoms in Johnson and Middle Canyons. Big sagebrush is the dominant plant. Willows and wild roses are found near surface water. Cottonwood and aspen trees are at higher elevations.

8. "Sage - Stiff Sage" - This class, intermediate between "Big Sage" and "Stiff Sage," is found in transition areas between the two. Big sagebrush and stiff sagebrush are approximately equal in abundance. Bluebunch wheatgrass and Sandberg's bluegrass are also abundant. Saddles of ridges commonly have this type of vegetation.

9. "Agricultural Land" - This class included orchards and field crops. Riparian areas in the canyon bottoms were included here.

10. "Water" - Primarily the Columbia River.

11. "Lawn" - Areas surrounding residential areas east of the Columbia River and west of the proposed expansion area.

12. "Sand/Bare Soil" - Primarily dune areas.

Preliminary Results

The above data were used to delineate the relative distribution of major vegetation types within the proposed acquisition area. The vegetation distribution data are presented in map form (Figure 2), but the map was not validated with respect to actual species composition and cover. The distribution data will, however, be useful in identifying the primary habitats for bird and mammal species under consideration for this project.

The supervised classification produced seven readily discernable land cover classes (Table 1). Several of the training classes were not distinguishable spectrally, and consequently, the resulting land cover classes were reduced from the training set. The following training classes were combined to form the landcover classes given in the table:

- "Sand/Bare Soil" and "Stiff Sage" into "Stiff Sage"
- "Sage Bottom," "Ridge Shaded," and "Big Sage" into "Big Sage"
- "Sagebrush-Bluegrass" and "Ridge Sunny" into "Sandberg's Bluegrass"
- "Agricultural Land" and "Lawn" into "Riparian"

Qualitative evaluation of the preliminary vegetation map was conducted in the spring of 1988. Map units were compared with actual vegetation at selected sites in the acquisition area. These comparisons indicated that the map classes were generally representative of the vegetation, and that these units correspond well with the map units on the YFC proper. Accuracy of the map units was variable. To increase accuracy, the Landsat data will be reclassified with topographic data included during FY 1989.

ENDANGERED SPECIES SURVEY

Columbia milkvetch is currently being considered for listing as a protected species under the Federal Endangered Species Act. Most of the known populations of this species occur within the boundaries of the present YFC. The purpose of this

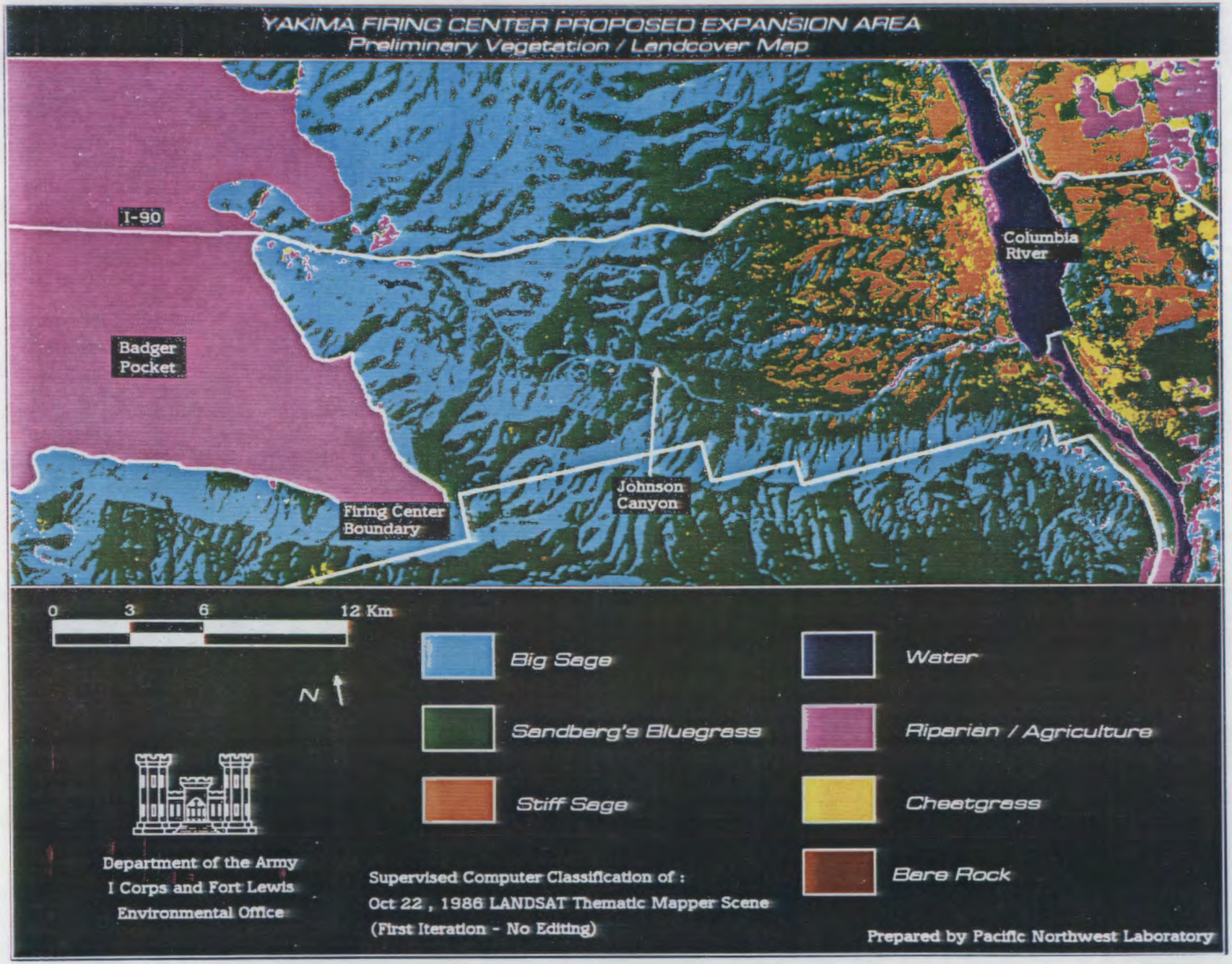


FIGURE 2. Vegetation Distribution on the Proposed Expansion Area

TABLE 1. Land Cover Classes of the Proposed Expansion Area. Landsat TM data from October 22, 1986, were trained from ground-truth information and subjected to supervised classification.

Land cover class	Description	Coverage[(a)]
1. Water	Columbia River	N/A
2. Cheatgrass	Abandoned farm land and disturbed areas	<1%
3. Big Sage	Uplands and canyon bottoms dominated by big sagebrush; bluebunch wheatgrass also common; generally silty, deep soils.	27%
4. Stiff Sage	Uplands with thin rocky soils; stiff sagebrush and rock buckwheat are the dominant shrubs; Sandberg's bluegrass common; much bare soil.	5%
5. Riparian	Moist canyon bottoms; willows, wild roses, cottonwoods, rhizomatous grasses common.	<1%
6. Sandberg's Bluegrass	This broad classification was found on upland areas and consisted of areas with sparse vegetation; grasses were primarily Sandberg's bluegrass, but bluebunch wheatgrass was present in some areas; shrubs were primarily small-statured big sagebrush, but stiff sagebrush and rock buckwheat were common; soils were generally thin.	67%
7. Rock	These areas included rock outcrops and talus composed primarily of basalt.	<1%

1(a) Coverage refers to the percent of land in the proposed expansion area covered by the respective land cover classes. These values were calculated from pixel counts from the classified Landsat image.

survey was to determine if Columbia milkvetch occurs within the proposed northern expansion area.

Methods

This study was conducted by Mastrogiuseppe and Gill, Environmental Consultants from Pullman, Washington. Mastrogiuseppe and Gill have been involved in studies of this species for several years. A search was conducted for Columbia milkvetch on April 14-15, 1988, a time of peak flowering for the species. Two hours of helicopter time were used to relocate and check the phenologic stage of known populations and to search portions of the northern expansion area for previously unknown populations. The remainder of the survey was conducted by vehicle, where possible, and on foot.

Results

Two previously unknown populations of Columbia milkvetch were found within the proposed northern expansion area: one between the north and middle forks of Middle Canyon Creek and the other near the southern boundary of Ginkgo State Park, just south of Ryegrass Mountain. Columbia milkvetch was not found in the river crossing area. This finding extends the known range of this species by about two miles. It is likely that this species occurs in other areas within the proposed northern expansion that were not surveyed because of limited helicopter time or limited road access.

WILDLIFE SURVEYS

The objective of the wildlife task was to determine, through field surveys, the wildlife species present on the proposed expansion areas of the YFC. Emphasis during these surveys was placed on species of special interest to state and federal agencies. These species include: 1) all wildlife likely to occur in the region that were classified as threatened or endangered by the U.S. Fish and Wildlife Service and the Washington Department of Wildlife, 2) game species, and 3) many nongame species listed as "special animal species" by the Washington Department of Wildlife (Appendix A, Table A.1). "Special animal species" are species for which little information exists for the state population and that may be rare enough to become classified as threatened or endangered. Although emphasis during the field surveys was placed on determining the presence or absence of wildlife species, information on abundance was collected whenever possible.

RAPTORS

The objectives of the raptor studies were to 1) document the species of raptors utilizing the proposed expansion areas, 2) identify nest site locations, and 3) document the winter use of the Priest Rapids Pool by bald eagles.

Methods

Wintering raptors on the proposed northern expansion area were surveyed from vehicles. Raptors observed were identified as to species and their locations recorded.

Raptor nest sites were searched for primarily by walking through likely habitat, although a fixed-wing airplane and vehicles were also used. These surveys were conducted between April and August 1988. Most species of raptors begin nesting in March and April and can be expected to occupy nesting territories through July or August. Great horned owls, however, begin nesting in February or March. The April surveys encompassed the nestling and fledgling stages of this species.

Surveys of wintering bald eagles were conducted along with waterfowl surveys from a Cessna 172 flown at approximately 30 to 70 m above the Priest Rapids Pool. These surveys were begun in October 1987 and were conducted periodically through March 1988. In addition to the the 1987-88 survey results, data on wintering bald eagle populations on the Priest Rapids Pool for 1986-87 were obtained from S.A.

Eisner (University of Montana, Missoula) and summarized. The age (adult or juvenile) of each eagle observed and its location were recorded.

Chi-square analyses were used to determine whether bald eagles disproportionately used the proposed crossing area relative to the remainder of the pool. The expected number of bald eagles for the crossing and noncrossing areas was estimated by multiplying the total number of bald eagles observed on the pool by the proportional length of the pool for both areas.

Results

Thirteen species of raptors were observed, 11 of these on the northern expansion area (Appendix A, Table A.3). Red-tailed hawks and American kestrels were the most frequently sighted species. Two raptor species of special interest (golden eagle and prairie falcon) were observed on the proposed northern expansion area; two others (bald eagle and osprey) were seen on the proposed river crossing

Three species of territorial raptors were observed on the proposed northern. expansion area (Appendix A, Table A.3) during the nesting season: red-tailed hawks, American kestrels, and great horned owls. Common ravens used habitats and nest sites that could have supported raptors and, thus, may have competed for some of the limited nest site locations. Therefore, raven nests are also documented, as these sites may be used by nesting raptors in future years.

During the 1988 nesting season, territorial great horned owls (two pairs and three single birds) were found on the proposed northern expansion area (Figure 3). They were found mostly on basalt cliffs along Johnson Creek and Middle Canyon and in excavated basalt cliffs along the abandoned railroad bed. One suspected great horned owl nest was found with eggs in March. Five nesting pairs each of red-tailed hawks and kestrels were also found (Figure 3). Red-tailed hawks nested in transmission towers (N = 1) basalt cliffs (3) and in trees (1). Kestrels nested in cottonwood trees (3) and on basalt cliffs (2) along Johnson Creek and Middle Canyon. Ravens nested on basalt cliffs (3), transmission towers (3), and an abandoned railroad trestle (1) (Figure 3).

The summer raptor population on the proposed northern expansion area appears to be both less diverse and less abundant than the population on the nearby Hanford Site (Fitzner et al. 1981). Some raptor species (Swainson's hawk,

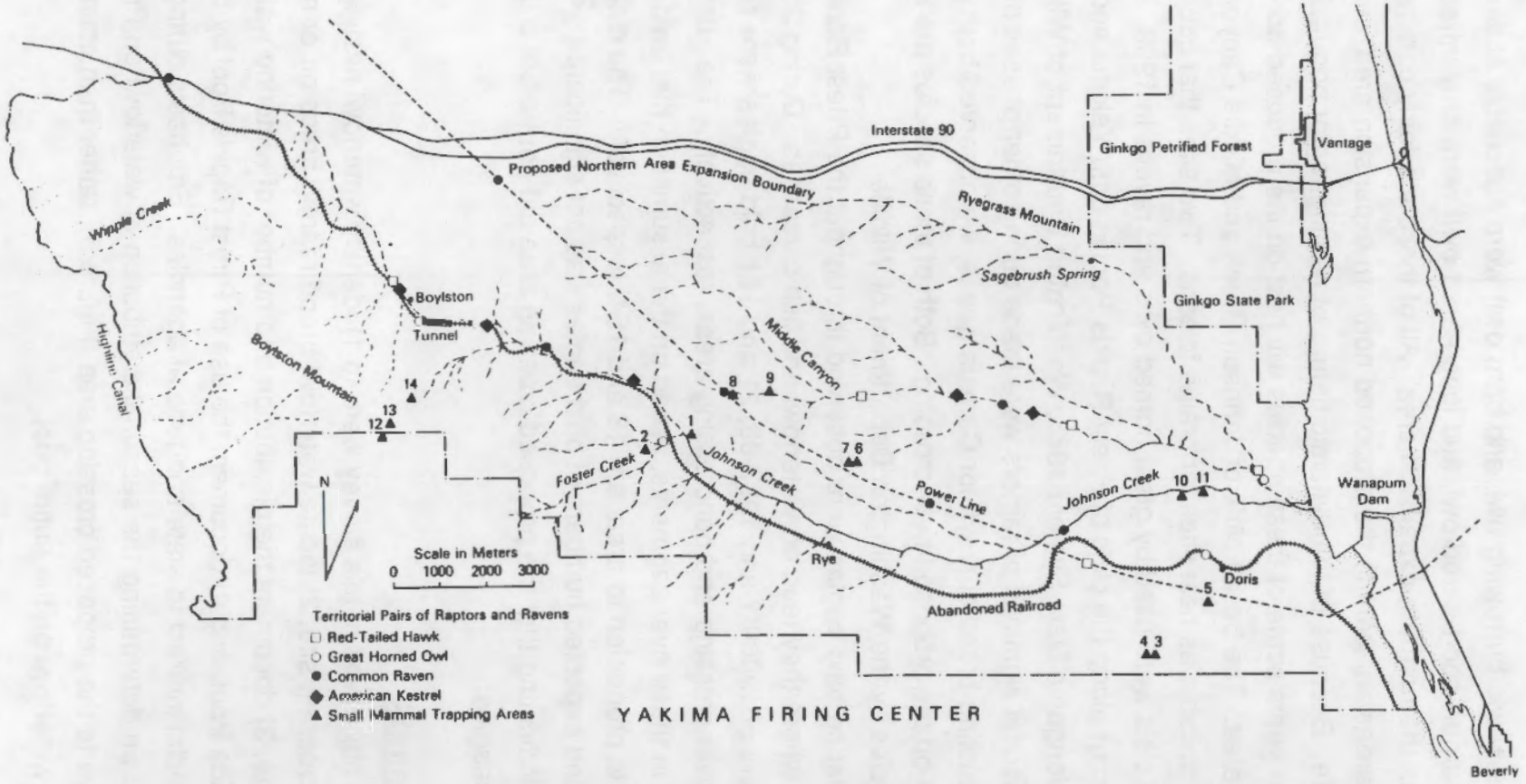


FIGURE 3. Proposed Northern Expansion Area, Including Location of Territorial Pairs of Raptors and Small Mammal Trapping Locations

Ferruginous hawk, burrowing owl, and barn owl) were noticeably absent; others (northern harrier, short-eared owl, and long-eared owl) were only infrequently observed on the northern expansion area. All of these are fairly common nesting species in areas adjacent to the proposed northern expansion area, such as the Hanford Site. Because of the dynamic nature of nesting raptor populations, it is likely that in other years some of these species will nest on the proposed northern expansion area. The basalt cliffs of Johnson Creek and Middle Canyon appear to be particularly suitable as nest sites for prairie falcons. Two sites that could serve as falcon nest cliffs were used by great horned owls and ravens in 1988. Prairie falcons regularly occur along the cliffs of Priest Rapids Pool in both Yakima and Kittitas counties (Nongame Data System 1988, Washington Department of Wildlife, Olympia).

Additional sightings of raptors were made during other phases of this study. While conducting brood surveys for Canada geese, we observed both prairie falcons and osprey on the proposed river crossing. Both of these species are listed as special animal species by the Washington Department of Wildlife.

Wintering bald eagles were observed throughout the Priest Rapids Pool area (Figure 4), where they feed on waterfowl and fish carcasses. During 35 aerial surveys in the winters of 1986-87 and 1987-88, 21 and 151 bald eagles were seen in the proposed river crossing and noncrossing areas, respectively. The numbers expected to be seen in these river segments, based on the assumption that bald eagles were distributed in proportion to area, are 18 and 154, respectively. The difference between observed and expected numbers of bald eagles was not significant ($\chi^2 = 0.56$, $P = 0.45$), indicating that the proposed crossing area did not harbor a disproportionate number of eagles.

AQUATIC BIRDS

The objectives of this survey were to 1) identify waterfowl nesting areas on the proposed crossing site, 2) locate waterfowl brood rearing areas on or near the crossing site, 3) document the distribution and number of wintering waterfowl on the Priest Rapids Pool, and 4) document the use of Priest Rapids Pool by other aquatic birds of special interest to state and federal agencies. Emphasis during these surveys was placed on determining the seasonal distribution of waterfowl on Priest Rapids Pool relative to the proposed crossing area (Figure 5), rather than estimating the exact number of waterfowl on the entire pool.

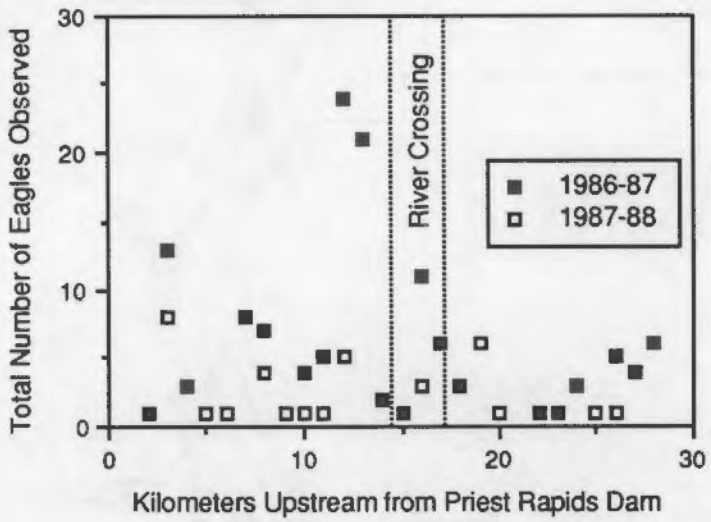


FIGURE 4. Distribution of Bald Eagles During the Winters of 1986-87 and 1987-88 on the Priest Rapids Pool of the Columbia River

Methods

Information on the distribution and relative number of nesting waterfowl, primarily Great Basin Canada geese, on the Priest Rapids Pool was obtained from a survey conducted by the Washington Department of Wildlife (Lisa Fitzner, personal communication). All islands, which are the primary nesting sites for waterfowl on the pool, were systematically searched by several people walking through all areas of potential nesting habitat.

Data on the distribution and relative numbers of waterfowl reared on the pool were obtained from two surveys conducted from a boat during the prefledging period of geese (May-June) and two surveys conducted from aircraft shortly after fledging (early July). All surveys were conducted during early morning hours. Additional information on waterfowl and other aquatic bird species using the northern portion of the Priest Rapids Wildlife Recreation Area (WRA), which is partially included in the proposed crossing area (Figure 5), was obtained during early morning surveys conducted on foot.

The distribution and number of wintering waterfowl on the Priest Rapids Pool were estimated from a Cessna 172 flown at elevations of approximately 30 to 70 m. During the winter of 1986-87, flights were made at approximately 1-week intervals

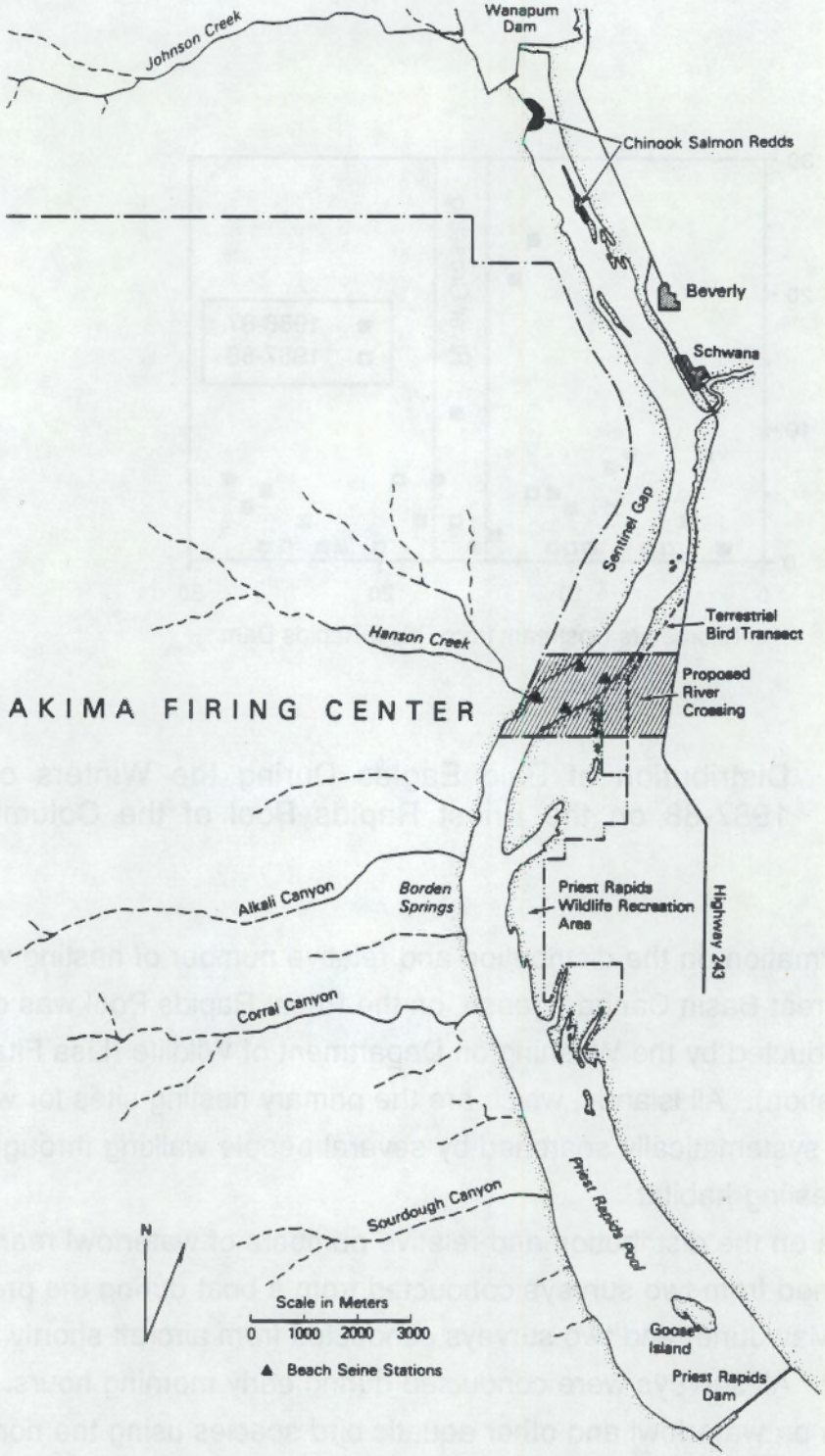


FIGURE 5. Priest Rapids Pool of the Columbia River and the Proposed River Crossing Site. Location of Columbia River sampling stations within the proposed river crossing site, fall chinook salmon spawning locations, and drainage systems along the eastern expansion area of the Yakima Firing Center are also shown (see section on Fisheries Surveys, page 29).

from mid-December through mid-March. Approximately two to three flights were made each month from October 1987 to March 1988. Waterfowl observed during the winter of 1986-87 were classified as coots, ducks, or geese. In 1987-88 waterfowl were identified to species. During both years the number of waterfowl in each 1-km section of the pool was recorded; however, in 1987-88 waterfowl in the east and west sides of the pool were recorded separately.

Areas in which wintering waterfowl concentrated were identified, and chi-square analyses were used to determine whether the proposed crossing area had a disproportionate number of waterfowl on it relative to the remainder of the pool. The expected numbers of waterfowl for the crossing and noncrossing areas were estimated by multiplying the total number of waterfowl on the pool by the proportional length of the pool for each of the two areas (crossing and noncrossing areas).

Results

One hundred and sixty-two goose nests were found on the the Priest Rapids Pool, 125 (77%) of these were located on Goose Island, just upstream from Priest Rapids Dam (Figure 5). No goose nests were found in the proposed river crossing area. Undoubtedly, this was due to the lack of islands in this region, which are essential to geese for nesting (Hanson and Eberhardt 1971).

Only one observation was made of Canada goose broods in the proposed river crossing during and immediately after the brood rearing season (Appendix A, Table A.4). Areas most intensively used on the Priest Rapids Pool by goose broods included the southern portion of the Priest Rapids Wildlife Recreation Area (WRA) and the islands upstream from Sentinel Gap (Figure 5).

Several species of waterfowl were observed using the northern portion of the Priest Rapids WRA, part of which extends into the river crossing area. During two ground and one aerial survey, two broods of redheads and one brood of American coots were observed on the WRA within the river crossing area. Three other species of special interest (Forster's tern, Caspian tern, and great blue heron) were observed in the portion of the WRA within the proposed crossing area.

Wintering waterfowl were not evenly distributed over the approximately 28 km of the Priest Rapids Pool (Figure 6 and Appendix B). Large concentrations of ducks occurred on Goose Island, just upstream from Priest Rapids Dam (Figure 5). The number of waterfowl on the proposed crossing area was comparatively low during both 1986-87 and 1987-88 (Figure 6). In all cases, the numbers of waterfowl on the

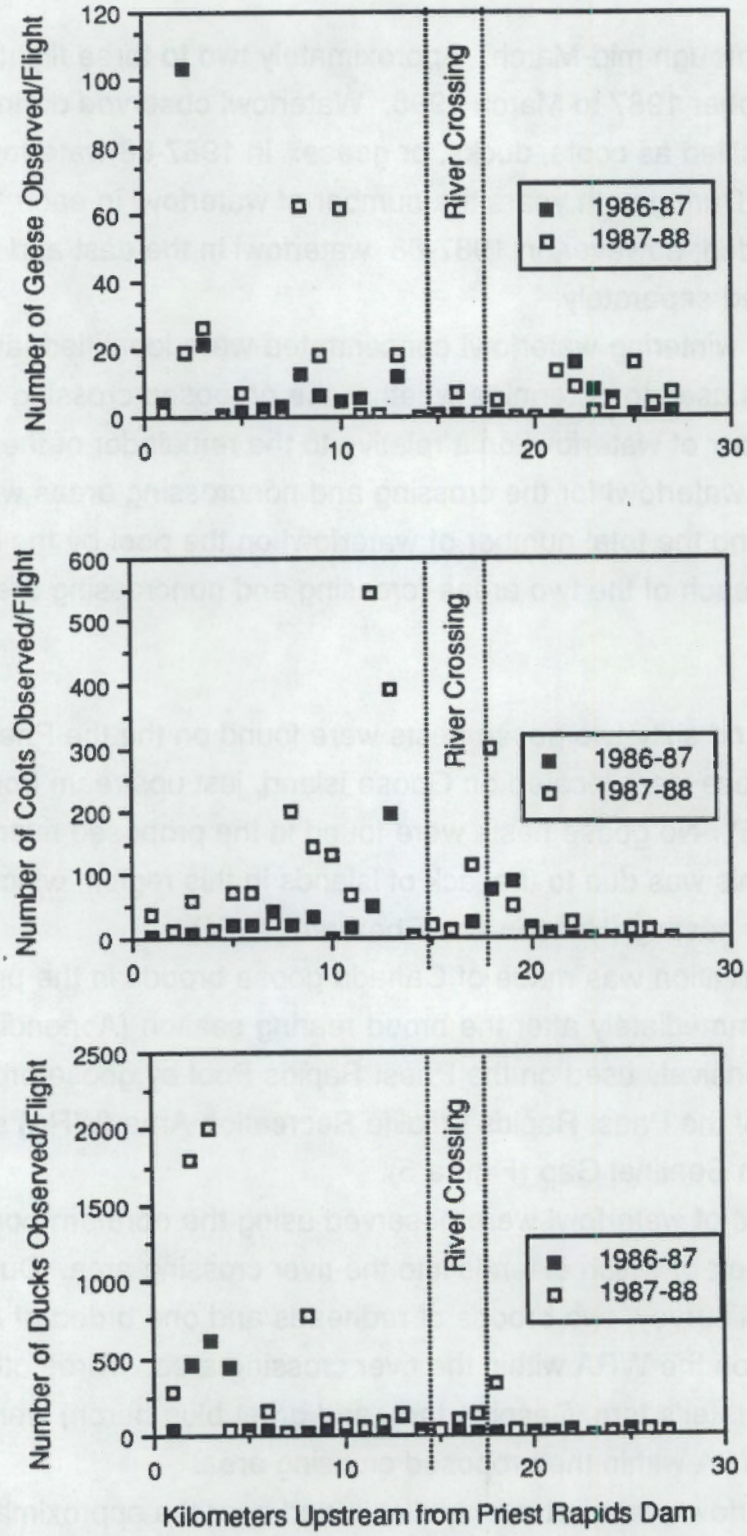


FIGURE 6. Distribution of Waterfowl on the Priest Rapids Pool of the Columbia River for the Winters of 1986-87 and 1987-88

proposed crossing area were less than expected (Appendix A, Table A.5), based on the assumption of equal distribution of birds along the entire pool. The number of waterfowl on the pool appeared to be higher during the winter of 1987-88 than in 1986-87 (Figure 6). Seasonally, the numbers of waterfowl generally decreased during both winters on the proposed crossing area (Figure 7) and during the winter of 1986-87 in the non-crossing area. However, from December through March in 1987-88 the number of wintering waterfowl increased on the non-crossing area.

One other aquatic bird species of special interest (common loon) was observed throughout the Priest Rapids Pool, including the proposed northern crossing (Figure 8). However, loon use of the crossing was low compared to the rest of the pool.

Mallards were observed several times throughout the year on Johnson Creek in the proposed northern expansion area. Only one brood was observed on Johnson Creek, outside of the proposed expansion area.

UPLAND GAME BIRDS

The objectives of this survey were to identify the number and locations of sage grouse leks on the proposed northern expansion area and document the species of upland game birds that use the proposed expansion area.

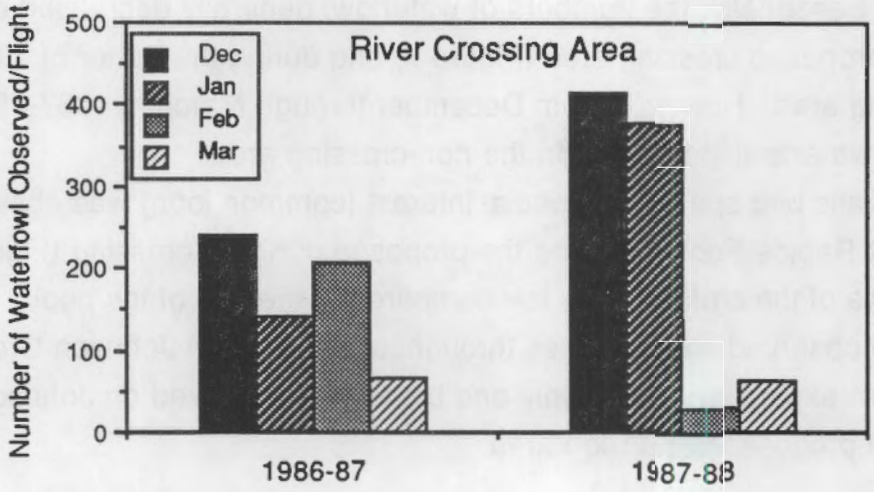
Methods

Sage grouse leks were systematically searched for from vehicles, on foot, and from aircraft. A Cessna 172, flying 30-50 m above the ground, and an army helicopter, flying at similar elevations, were employed. Surveys were conducted during early morning hours (times of peak activity on leks) on days of little or no wind.

All species of game birds were routinely recorded during other phases of our studies. Location, date, time, and species were recorded whenever a game bird was observed.

Results

No sage grouse leks were observed on the proposed northern expansion area. However, three sage grouse (one pair and one single) were observed during a helicopter survey of the proposed expansion area in early March. Seven other surveys conducted in February and March (sage grouse breeding season), three from fixed-wing aircraft and four from the ground, did not yield any sightings of sage grouse. A flock of approximately 15 sage grouse was observed near Boylston (Figure 3) on



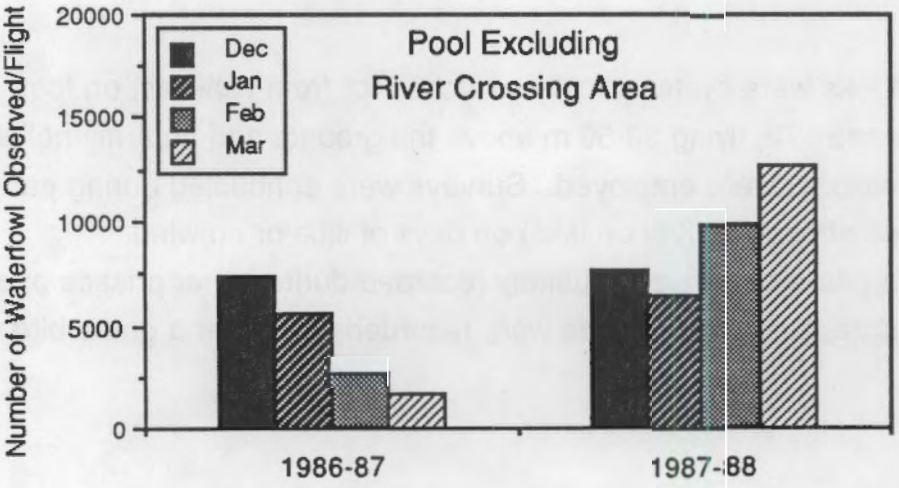


FIGURE 7. Seasonal Distribution of Waterfowl or the Priest Rapids Pool of the Columbia River for the Winters of 1986-87 and 1987-88

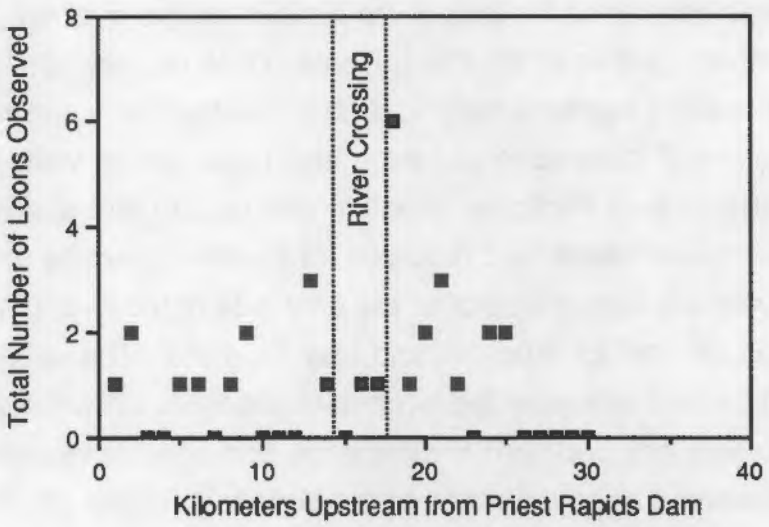


FIGURE 8. Distribution of Common Loons on the Priest Rapids Pool of the Columbia River

two occasions in November 1987. Considering the size of the proposed northern expansion and extrinsic factors that may affect the occupancy of a lek on a given day, it is possible that our surveys may have failed to detect small leks.

Other upland game birds observed on the proposed northern expansion area included California quail, chukar, and gray partridge. California quail were observed primarily in riparian habitats and adjacent sagebrush-dominated areas. Chukars were frequently seen and heard calling near the basalt cliffs along both Johnson Creek and Middle Canyon. Gray partridge were observed on the western end of the proposed northern expansion area and were associated with sagebrush-dominated areas. No ring-necked pheasants were observed on the proposed northern expansion area; however six males were heard crowing within the proposed river crossing area in May.

OTHER TERRESTRIAL BIRDS

The objectives of this survey were to identify long-billed curlew nesting sites and to document the presence or absence of other terrestrial bird species of special interest.

Methods

A special survey was conducted for long-billed curlews on the river crossing area and the adjacent northern portion of the Priest Rapids WRA on May 17, 1988. This area was driven and walked systematically and all birds observed were recorded.

Locations and numbers of birds observed were also noted during visits to the proposed northern expansion area. Particular attention was paid to bird species of special interest. Bird observations were also recorded for the river crossing area. This was accomplished by driving a 2.7-km transect on the east side of the river (Figure 5) during early morning hours on April 21, April 26, and May 17, 1988. The observer stopped 17 times (each 0.16 km) and recorded every bird observed or heard during a 3-minute period. The transect included both shrub-steppe and riparian vegetation types. These surveys provided a good indication of the birds that nest in or utilize habitats within the terrestrial environment of the proposed river crossing.

Results

Three pair of long-billed curlews, a species of special interest (Appendix A, Table A.1), were observed using the northern portion of the Priest Rapids WRA. The curlews were territorial, defending areas dominated by cheatgrass and bluegrass with surrounding areas of sagebrush. These birds were probably nesting because this type of habitat is typically used for nesting by this species (Allen 1980). All curlew pairs were observed more than 1 km south of the proposed river crossing.

Sixty species of birds were observed on the proposed northern expansion area (exclusive of the river crossing area) between October 1987 and August 1988 (Appendix A, Table A.6). A crude index to the relative abundance, seasonal use, and habitat associations for each species is presented in Table A.6 (Appendix A). Four of these species (sage thrasher, loggerhead shrike, mourning dove, and sage sparrow), not mentioned in previous sections of this report, are listed as species of special interest. Sage thrashers and sage sparrows were very common breeding birds on the site and could be found in most sagebrush-dominated habitats during the spring and summer.

Twenty-seven species of birds were observed on the transect route in the proposed river crossing area (Appendix A, Table A.6). The most numerous terrestrial birds observed on the transect route were meadowlarks, magpies, killdeer, and horned larks. One of the 27 species, the sage sparrow, not mentioned in previous sections of this report, is listed as a species of special interest.

LARGE ANIMALS

The objective of this survey was to document the seasonal presence and distribution of mule deer and elk on the proposed northern expansion area.

Methods

Ground surveys were conducted from October 1987 to August 1988. One helicopter survey (3/9/88) and three fixed-wing aerial surveys (1/22/88, 2/24/88, 3/15/88) were conducted for elk and deer on the proposed northern expansion area. The aerial surveys were flown from 30 to 50 m above the ground during early morning hours.

Results

Based on tracks and observations, mule deer were present year-round throughout the proposed northern expansion area. Subjectively, densities of deer on the area appear to be low in comparison to similar habitats on the nearby Hanford Site. Deer were only observed on eight of 38 extensive visits to the proposed northern expansion area between October 1987 and August 1988. The largest herd of deer observed was five individuals in November 1987.

Depending on the severity of the weather, variable numbers of elk, which migrate from nearby mountainous areas, overwinter on the proposed northern expansion area. During this study, the largest herd of elk observed on the proposed northern expansion area was 29 animals (21 adult females and 8 calves) in February 1988. However, the winter of 1987-88 was relatively mild. A resident herd of nonmigratory elk is also present year-round on the proposed northern expansion area. Elk calves were observed in the area during both early November 1987 (before elk had migrated down from the mountains) and August 1988 (one month post-calving). Therefore, the calves were probably born on or in the immediate vicinity of the proposed northern expansion area.

FURBEARING ANIMALS

The objective of this survey was to document the presence of furbearing mammals on the proposed expansion areas.

Methods

Records were made of all furbearing mammals and their tracks observed during all phases of this study. Waterways (streams and the Columbia River) were searched for beaver lodges, bank dens, and cuttings.

Results

Five species of furbearers were observed during the course of our studies. Four species were observed on the proposed northern expansion area: coyotes, beaver, raccoon, and mink. Coyotes were frequently observed and their tracks were often noted along dirt roads. Two adult beaver and eight beaver ponds were located along a 1- to 2-km segment of Johnson Creek, 4.5 km upstream of the mouth. Three beaver lodges and two bank dens were also observed. These lodges and dens were present throughout the winter of 1987 and summer of 1988. A single raccoon was observed along Johnson Creek on July 6, 1988. Mink tracks were observed near the mouth of Johnson Creek on March 31, 1988.

A striped skunk was the only furbearer observed on the proposed river crossing area. On May 19, 1988, a single animal was observed walking along the Kittitas County shoreline of the Columbia River.

SMALL MAMMALS

The objective of the small mammal studies was to document the presence or absence of state or federally protected small mammal species and/or species of special interest on the proposed northern expansion area. Field surveys for mice began in October and continued through December 1987. Field surveys for bats occurred during October 1987, but were then discontinued until August 1988. Hare and rabbit surveys occurred from October 1987 through August 1988.

Methods

Species composition and distribution of small mammals on the proposed northern expansion area were evaluated using pitfall and live traps. The traps were placed along 14 assessment lines, each of which consisted of 20 trapping stations located at 10-m intervals. At each station, two Sherman live traps were placed, for a total of 40 live traps/assessment line. In addition, pitfall traps, consisting of 2.5-L cans buried flush with ground level, were placed at 10 of the trapping stations. Live traps were baited with a mixture of rolled oats, peanut butter, bacon grease, and bird seed.

Traps were run for two consecutive nights with no prebaiting and checked daily. All captured animals were released, except for three mice retained as voucher specimens.

Bats were searched for by examining culverts, tunnels, and deserted buildings. Mist netting and observations were conducted over creeks and near basalt cliffs where bats were previously seen or where they were suspected to be feeding. Mist nets of 6- or 12-m length with 30- to 36-mm mesh were used to trap bats.

Hares and rabbits were recorded as they were observed during all phases of the study. Location, date, and time of each sighting were recorded.

Results

Fourteen small-mammal assessment trap lines (Figure 3) were run for a total of 1,260 trap-nights (live traps and pitfalls). Assessment lines were located in most of the major habitat types on the proposed northern expansion area (Appendix A, Table A.7). Two hundred and fifty-one small mammals were captured (Appendix A, Table A.8) for an overall trapping success of 0.20 captures/trap-night. The capture rate and species composition were comparable to those reported for similar habitat types (Rickard 1960, O'Farrell 1975).

Only one species of special interest to state and federal agencies, the sagebrush vole, was captured. This species was captured in most of the habitats sampled on the proposed expansion area (Appendix A, Tables A.7 and A.8). Capture frequency, a crude index of abundance, for this species on the proposed expansion area was comparable to that reported elsewhere (Mullican and Keller 1986).

No bats were found during searches of culverts, tunnels, and deserted buildings. Nor were any bats captured during mist netting along Johnson and Foster Creeks in October 1987, presumably because of the late date. In August 1988 mist nets were set along Johnson Creek, Middle Canyon, in basalt cuts along the abandoned railroad bed, and in the railroad tunnel (Figure 3). Only three California myotis bats were captured. This species is not considered a sensitive species by state or federal authorities.

Nuttall's cottontails and white-tailed jackrabbits were the only rabbits/hares observed on the proposed northern expansion area. Nuttall's cottontails were observed during June, August, and September, 1988, and jackrabbits were observed in August and September, 1988. Both species were seen on the railroad bed between Doris and Rye (Figure 3). Neither species is considered sensitive at the state or

federal level, but they are game animals and are hunted. Black-tailed jackrabbits also probably occur on the site, but none have been observed to date.

Porcupines and yellow-bellied marmots were also observed on the proposed northern expansion area. Neither of these species was very abundant, nor are they classified as sensitive wildlife species.

REPTILES AND AMPHIBIANS

Four species of reptiles and one amphibian were observed on the proposed northern expansion area. Side-blotched lizards and desert short-horned lizards were the only lizards observed, both in the Johnson Creek drainage near Doris (Figure 3). Gopher snakes and western rattlesnakes, were also seen in the Johnson Creek drainage. The only amphibians observed were the Pacific treefrogs, which were common wherever pools of water or streams occurred. Treefrog tadpoles were also observed in the beaver ponds in Johnson Creek.

Gopher snakes and Pacific treefrogs were the only reptiles or amphibians observed on the proposed river crossing.

None of the reptiles or amphibians observed during this study are species of special interest.

SUMMARY OF WILDLIFE SURVEYS

From October 1987 though August 1988, in addition to waterfowl, 27 wildlife species of special interest were observed on the proposed expansion areas (Table 2). These species included one federally classified as threatened (bald eagle) and one proposed by the state as threatened (common loon). Both of these species were common in the proposed river crossing. No endangered species were observed during this study.

TABLE 2. Summary of Wildlife Species of Special Interest Observed on the Proposed Expansion Area of the Yakima Firing Center from October 1987 Through August 1988

Species	Status[a]	Observed Location[b]	Date Observed[c] O	N	D	J	F	M	A	M	J	J	A
Birds													
Bald eagle	FT	RC			*	*	*	*					
Golden eagle	PS	NE	*	*		*	*	*	*				*
Osprey	PM	NE								*			
Prairie falcon	PM	NE	*				*						
		RC									*		
Caspian tern	PM	RC										*	
Forster's tern	PM	RC								*			
Great blue heron	PM	RC								*			
Common loon	PT	RC				*	*	*	*	*	*	*	
Sage thrasher	PS	NE							*				
Sage sparrow	PS	RC											
		NE											
Loggerhead shrike	PS	NE	*	*	*				*				*
Waterfowl	Game	NE											
		RC	*	*	*	*		*	*	*	*	*	*
Sage grouse	PS, Game	NE		*				*					
California quail	Game	NE	*	*					*				*
Chukar	Game	NE	*						*		*		*
Gray partridge	Game	NE			*								
Ring-necked pheasant	Game	RC								*			
Mourning dove	Game	RC								*			
		NE											*
Mammals													
Sagebrush vole	PM	NE	*	*	*								
Mule deer	Game	NE	*	*		*	*	*					*
Rocky Mt. elk	Game	NE	*	*		*							*
Nuttall's cottontail	Game	NE									*		*
White-tailed jackrabbit	Game	NE											*
Beaver	Furbearer	NE	*	*									*
Coyote	Furbearer	NE	*				*	*			*		*
Raccoon	Furbearer	NE										*	
Skunk	Furbearer	RC								*			
Mink	Furbearer	NE						*					

(a) FT = federally threatened species; PM = state proposed monitor species; PS = state proposed sensitive species; PT = state proposed threatened species; Game = state game species.
(b) RC = river crossing; NE = northern expansion area
(c) Date of observation only reflects species presence, not seasonal occurrence or abundance.

FISHERIES SURVEYS

NORTHERN EXPANSION AREA STUDIES

Surveys were conducted from late October 1987 through August 1988 of streams located in the proposed northern expansion area to determine the distribution of anadramous salmonids (i.e., chinook salmon and steelhead trout), resident rainbow trout, and other gamefish or sensitive fish species. Initial objectives were to determine the species composition and relative abundance of fall/winter fish populations in the Johnson Creek drainage and in Middle Canyon (Figure 9). Later studies included surveys of streams on the west slope and examined the relationship between habitat features and spring/summer distribution of rainbow trout in Johnson Creek. The principal method used for fish collections was a backpack electroshocker (Smith-Root, Type VII Electrofisher). Sections of the stream were also blocked with a seine, and rocks were dislodged upstream of the net to sample fish that might reside in the substrate.

Distribution of Fish in Johnson Creek

In November 1987, we surveyed Johnson Creek from the headwaters near Boylston to its confluence with the Columbia River above Wanapum Dam (Figure 9). Only intermittent surface flows were observed in the upper portion of the drainage, including Foster Creek. However, stream flows were nearly continuous from Foster Creek downstream. Water temperatures in areas of flowing water remained constant at 11°C during November.

Resident rainbow trout were the only fish species collected within the proposed northern expansion areas in November 1988. No fish were collected above a 2- to 3-m fall, located about 2 km below the mouth of Foster Creek. Rainbow trout were abundant from this barrier falls downstream to the mouth of Johnson Creek. Fish collected within the proposed expansion areas in November 1987 (n = 99) ranged from 6 to 27 cm fork length (FL); about 36% were >15 cm (Figure 10).

Additional surveys were conducted in lower Johnson Creek on private land to characterize fish populations that might migrate into the proposed expansion area. We collected prickly sculpin, three-spine stickleback, largescale sucker, and redside shiner near the confluence of Johnson Creek and the Columbia River. Rainbow trout from 6 to 17 cm FL (n = 39) were collected in lower Johnson Creek (Figure 10). Although local residents reported seeing adult salmon in the creek in past years, we

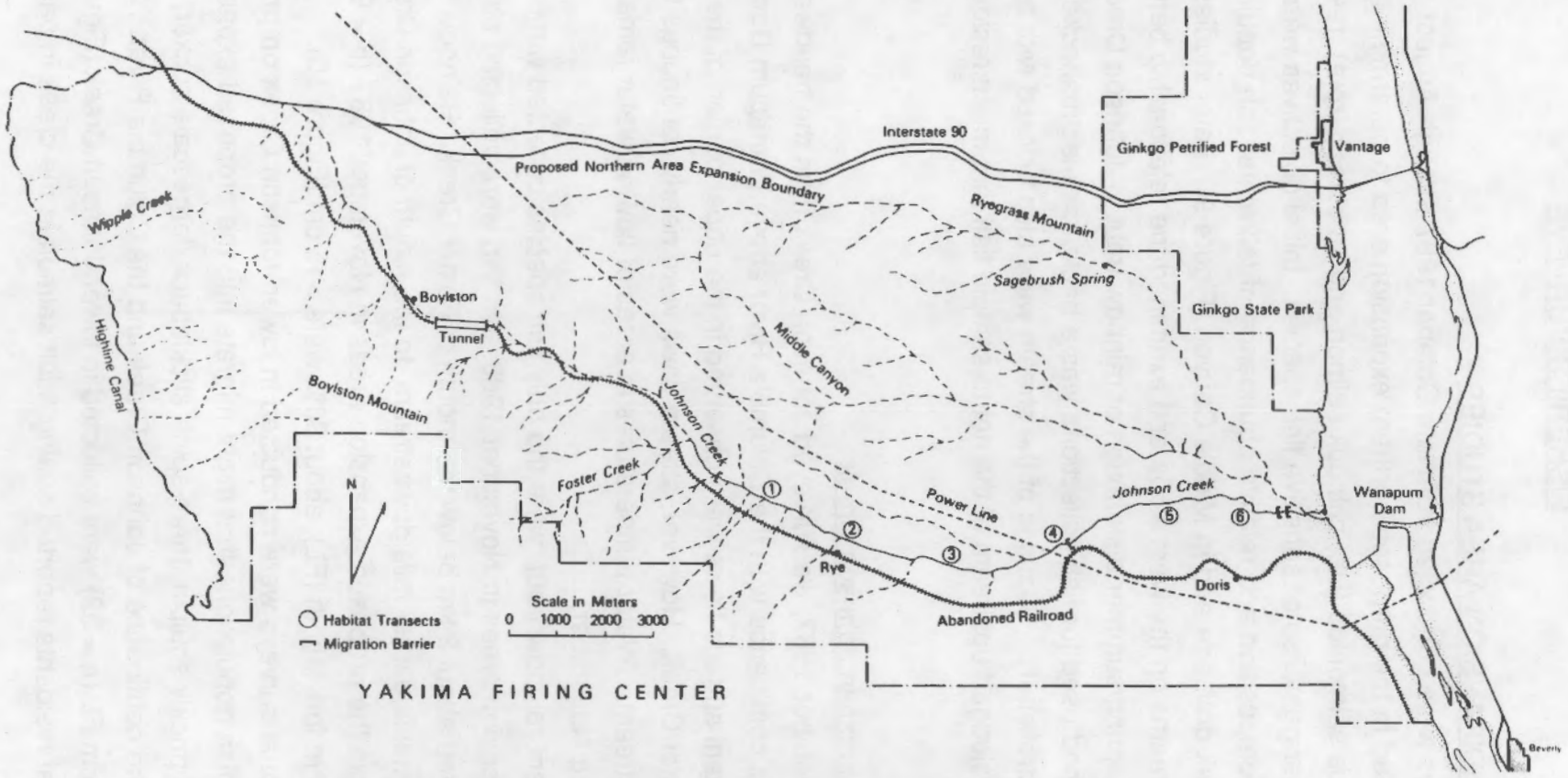


FIGURE 9. Johnson Creek and Middle Canyon Drainages Showing the Location of Habitat Zone Stations. Areas of intermittent flow are indicated by a dashed line.

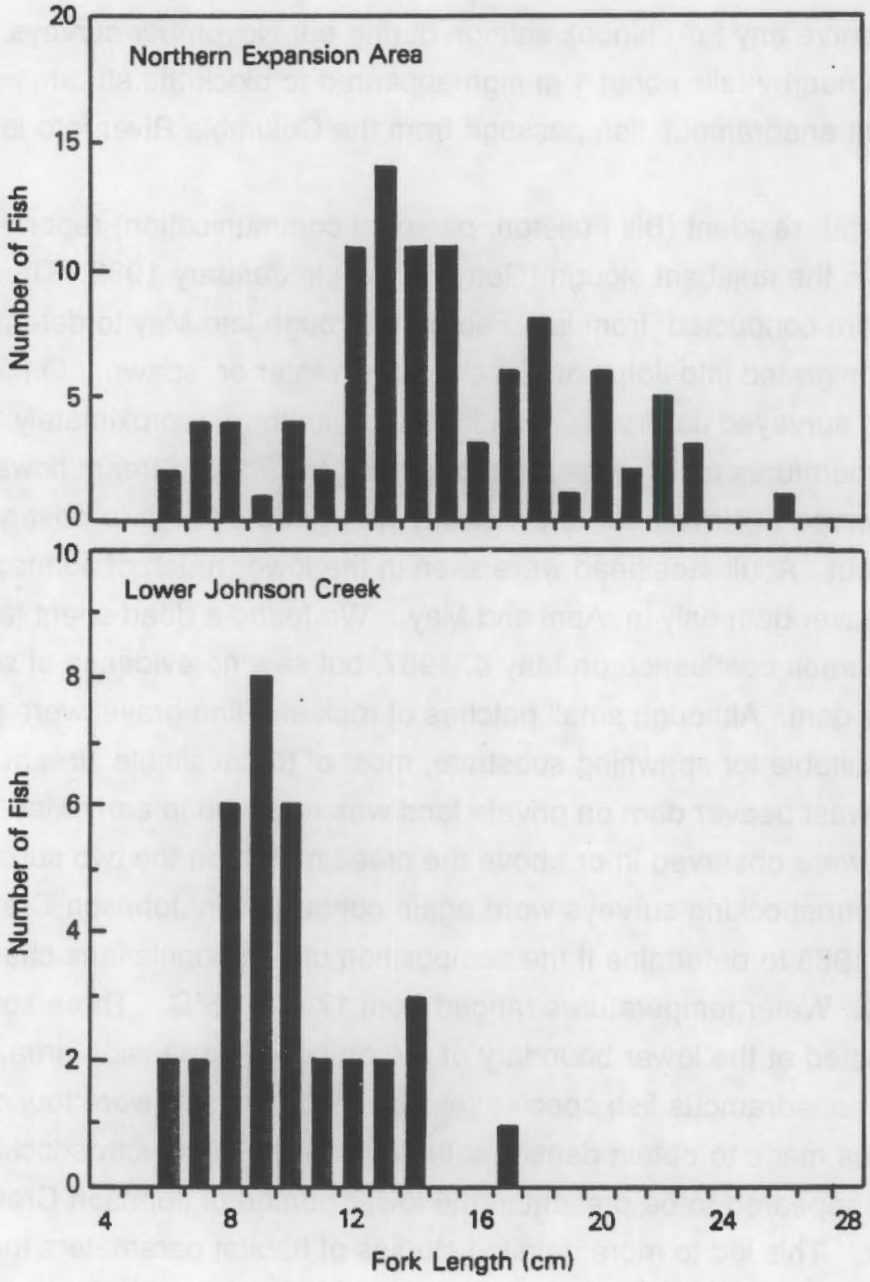


FIGURE 10. Length Frequency of Rainbow Trout Collected from Johnson Creek by Electroshocking in November 1987

did not observe any fall chinook salmon during our November surveys. Both a beaver dam and a nearby falls about 1 m high appeared to block the stream near its mouth and prevent anadramous fish passage from the Columbia River into lower Johnson Creek .

A local resident (Bill Fulleton, personal communication) reported catching steelhead in the adjacent slough (Getty's Cove) in January 1988. Therefore, visual surveys were conducted from late February through late May to determine if adult steelhead migrated into Johnson Creek to overwinter or spawn. On five occasions, two people surveyed Johnson Creek from the mouth to approximately 1 km upstream. Water temperatures at this time ranged from 11 to 17°C. Stream flows were similar to those observed in November and visibility was good enough to observe juvenile rainbow trout. Adult steelhead were seen in the lower reach of Johnson Creek below the first beaver dam only in April and May. We found a dead spent female steelhead below the creek confluence on May 4, 1987, but saw no evidence of spawning below the beaver dam. Although small patches of rock and fine gravel were present that could be suitable for spawning substrate, most of the available stream bed was silted in. The lowest beaver dam on private land was removed in early May, but no steelhead were observed in or above the creek mouth on the two subsequent surveys.

Electroshocking surveys were again conducted in Johnson Creek during May and June 1988 to determine if the composition of fish populations changed seasonally. Water temperatures ranged from 17 to 21.5°C. Three-spine stickleback were collected at the lower boundary of the proposed expansion area, but no other resident or anadramous fish species (except rainbow trout) were found. Although no attempt was made to obtain density estimates during the electroshocking surveys, fewer fish appeared to be present in the lower portion of Johnson Creek than in November. This led to more detailed studies of habitat parameters that might influence rainbow trout movement and distribution in Johnson Creek (see below).

Habitat Associations of Rainbow Trout in Johnson Creek

Studies were initiated in June 1988 to characterize certain habitat features in Johnson Creek and to assess the relationship between these features and rainbow trout populations. Stream habitat throughout the Johnson Creek drainage is variable and substrate ranges from bedrock, to mud/silt over cobble, to areas with gravel and boulders. The riparian community and streambed characteristics also change as the stream flows from its origin near Boylston to the Columbia River. For example, the

riparian vegetation near Rye is characterized by overhanging willows and deep gullies, while the lower reach has a shallower, less enclosed streambed that is sometimes choked with cress.

Methods

We subjectively defined six general habitat types in Johnson Creek (Table 3). Each type contained characteristic features of the drainage and fish. The study area extended from about 1.2 km above Rye to about 1.5 km above the mouth of Johnson Creek (Figure 9). A permanent 100-m transect was established within each habitat type and preliminary estimates of fish densities and habitat features were obtained in July and August 1988.

Fish populations were estimated by blocking off the downstream end of each transect and by electroshocking from the upper end of the transect to the net. All collected fish were measured and released in the transect. Fish were collected on July 6 and August 11, 1988. These data were combined to obtain an average value for density and size of fish in each transect.

Habitat measures included temperature, depth, flow, substrate composition, instream vegetation, stream gradient, cover, pool/riffle ratios, maximum pool depth,

TABLE 3. General Description of Stream Habitats Where Study Transects Were Established in the Johnson Creek Drainage, July to August 1988

Station	Description
1	scattered sage/willow; open channel over bedrock and silt; discontinuous flow, a few large pools
2	dense willow overstory; deep, enclosed channel over cobble and silt; continuous flow, uniform pool/riffle habitat
3	scattered willows and Russian olive; deep, open channel over cobble and silt; continuous flow with mainly riffle habitat
4	scattered willows; shallow, open channel over boulders and cobble; continuous flow with mainly riffle habitat.
5	scattered willows; beaver ponds; large pools with silt bottoms
6	scattered willows; shallow, open channel over gravel and cobble; narrow stream bed, choked with cress.

pool area, and pool class (Hamilton and Bergersen 1984). Velocity measurements were obtained using a water current meter (Marsh McBimey Model 201) and averaged to estimate flows. Substrate was classified according to Platts (1979).

Results

Habitat measurements from representative transects in the six habitat types on Johnson Creek are summarized in Table 4. Daytime stream temperatures generally were greatest downstream from Rye in locations where stream cover was reduced. The pool/riffle ratios were variable and ranged from 7/6, in the transect containing beaver ponds, to 1/10 in the middle reach with the highest stream gradient. The composition of fine sediment in the channel was greatest in the upper reaches (transects 1 and 2) and in the lower reach where flows were reduced by beaver dams (transect 5). These same areas also had larger average pool areas than the other three study sites.

We collected an average of 7.5, 12.5, and 7.5 fish/100 m in transects 1, 2, and 5, respectively (Table 4). Rainbow trout were either absent or sparse in the other three transects during the July and August surveys. The largest fish were collected at transect 1 in a single large bedrock pool. All transects with sizable fish populations were characterized by abundant or large pools and a high percentage of instream cover.

The distribution and abundance of Johnson Creek trout populations are likely determined by a combination of physical variables, including seasonal flows, temperatures, and cover. That suitable conditions currently exist for reproduction is shown by the range of sizes present in both the upper and lower portions of the creek. Temperature and pool depth appear to be the most significant variables regulating trout distribution in the summer. Maximum temperatures in the lower reach were near the lethal limit of rainbow trout. However, reduced stream flows may have restricted fish from moving to upstream locations where permanent seep/springs and the willow overstory maintained water temperatures near 15°C.

Although cattle grazed throughout most of Johnson Creek in the summer, the shallow stream banks in the lower reach were more accessible to cattle than the deep gullies near Rye. Cattle activity was observed to markedly increase stream bank erosion and the sediment load in portions of Johnson Creek. Cattle may also affect fish distribution through removal of the riparian overstory.

TABLE 4. Summary of Habitat Variables and Relationship to Rainbow Trout Production in Johnson Creek During 1988 Summer Flows. Pool classification is defined as: quality of class 1 > class 2 > class 3 (Hickman and Raleigh 1982), with number in each class defined.

	Habitat Zone Transect Number					
Parameter	1	2	3	4	5	6
Temperature range (°C)	15.0-18.3	14.4-15.0	18.3-20.0	16.2-25.0	20.0-23.3	17.3-20.6
Flow (m/sec)	0.01	0.01	0.02	0.02	0.025	0.03
Pool/riffle ratio	3/5	1/2	1/10	1/25	7/6	1/9
Average depth (cm)	24	20	23	23	62	24
Gradient (percent)	2.0	2.0	3.8	3.0	2.8	2.9
Channel composition (percent)						
fine sediment	71	42	31	7	99	23
gravel	8	3	25	25	<1	52
rubble	<1	55	29	68	<1	21
boulder	<1	<1	15	<1	<1	4
bedrock	21	<1	<1	<1	<1	<1
Instream cover (percent)						
none	26	10	55	55	61	39
light	5	22	3	1	<1	<1
medium	11	<1	19	5	39	10
heavy	58	68	23	39	<1	51
Average pool area (m^2)	5.3	4.2	1.1	0.9	70.9	2.0
Pool classification						
class 1	1	0	0	0	5	0
class 2	2	1	2	0	1	0
class 3	6	11	3	2	0	3
Average number of fish	7.5	12.5	1.0	1.0	7.5	0
Average length (FL, cm)	19.5	11.5	11.2	9.0	13.9	-

Middle Canyon

In November 1987, we collected nine rainbow trout (range 16-26 cm FL) in a series of pools located about 2 km up the Middle Canyon drainage. Flows were discontinuous from about 4 km up the canyon to its confluence with the Columbia River. The low flows and limited stream cover probably restricted the distribution of fish in upper portion of the Middle Canyon drainage. Some of the rainbow trout were in poor condition (i.e., thin), possibly because of the low flow conditions. One female (17 cm FL) contained ripening eggs, suggesting that spawning occurs in this drainage.

We returned to Middle Canyon in late July 1988 and did not collect any fish. However, sampling efforts in areas of standing water were not effective because of the dense riparian growth. Stream flows were estimated at about 50% of those in November 1987. The water temperature was 22.8°C.

West Slope

Preliminary surveys of surface waters that drain into the Yakima River watershed (i.e., the western side of Boylston Mountain) were initiated in June 1988. No surface water was found in the Wipple Creek drainage above the privately owned irrigated land. However, there was evidence of past runoff (excavated, but dry, cattle ponds). Flows on the western slope appear related to snowmelt and rainfall runoff, rather than originating from a permanent spring. Fish populations do not presently exist in the upper portion of this drainage system.

A single stock pond was also found near the head of a seep spring that disappeared under the abandoned railroad bed near Boylston. Flows were then discontinuous as the creek flowed from Boylston northwest to State Highway 24. These springs and a downstream stock pond were electroshocked in July 1988, but no fish were seen. Temperatures of standing water ranged from 14.5-16.2°C and aquatic invertebrates were abundant. Most of the stream bed was silted in and pools were <10 cm deep.

Summary

The composition and distribution of the current fish community in Johnson Creek are apparently affected by beaver dams and other barriers to migration. Because of the barriers and uniform low water flow, it is unlikely that anadramous fish will enter and spawn in Johnson Creek above private land. However, adult steelhead may be attracted to warm water temperatures near the mouth of Johnson Creek in the

winter. Therefore, steelhead could enter the lower reach (above the former beaver dam barrier) during extended periods of increased flow.

Initial habitat surveys indicated that the greatest numbers of rainbow trout occur in the summer where cover and pools are abundant and water temperatures are coolest. These areas are located mainly in the upper portion of Johnson Creek and where beaver dams occur. Damage to the riparian community from cattle is extensive in lower sections of the stream and may affect trout populations.

COLUMBIA RIVER CROSSING SITE

The overall objective of studies at the proposed Columbia River crossing site was to document the presence and relative abundance of important aquatic species. These species included anadramous fish, other game fish, and state or federally classified fish and aquatic invertebrates.

Columbia River Fisheries

These studies evaluated the use of the river crossing site by anadramous and other important fish species. Emphasis was placed on determining the use of river shoreline areas by fish during sensitive life stages, i.e., spawning and rearing.

Fall chinook salmon - Low elevation aerial surveys were conducted on October 31, November 7, and November 15, 1987, to determine if fall chinook salmon spawned near the proposed river crossing site. These times were selected to coincide with peak spawning activity of fall chinook salmon in the Hanford Reach of the Columbia River (Watson 1976). The nearest that salmon spawned to the crossing site was just below Wanapum Dam (Figure 5), approximately 4 miles upstream of the crossing [River Miles (RM) 413-414]. Peak spawning occurred on November 11, 1987, when 408 redds were observed. About 95% of the redds occurred along the west shoreline, 0.5 to 1.5 km below the dam. The proposed crossing site (RM 409) is still within the influence of the Priest Rapids Pool and appeared unsuitable for spawning.

Surveys were initiated in spring 1988 to define the period of outmigration and rearing for 0-age fall chinook salmon originating from upriver stocks. Seining was conducted at 2- to 3-week intervals from March 21 to June 28, 1988. Four permanent sample stations were established to characterize 0-age chinook salmon populations along the Columbia River shoreline (Figure 5). Duplicate seine hauls of approximately 50 m^2 of shoreline were made at each station using a 9.1- x 1.2-m (30- x 4-ft) net with

a 3-mm (1/8-in) mesh. Catch per unit effort (C/UE) is given as number of fish per seine haul.

Juvenile fall chinook salmon were collected from mid-April through mid-June 1988 (Table 5). Near-shore temperatures ranged from 13.9 to 21.1°C during that interval. Peak C/UE occurred on May 5; fish averaged 45 mm FL. No 0-age fall chinook salmon were collected along the shorelines during the last seining effort on June 28, 1988. Previous studies indicate that most naturally spawned fall chinook salmon in the Hanford Reach move offshore and migrate downstream towards the estuary by late June (Page, Dauble, and Neitzel 1982; Dauble, Page, and Hanf 1984).

TABLE 5. Beach Seine Catch Per Unit Effort (C/UE) and Average Size for 0-Age Fall Chinook Salmon Collected in the Columbia River Near the Proposed Northern River Crossing Site. Four seine nets were used for each site and date.

Date	Location	C/UE	Fork Length (mm)
3-31-88	East shore	0	-
4-19-88	East shore	22.2	41 ± 2 (17) [a]
	West shore	6.2	
5-5-88	East shore	54.8	45 ± 7 (19)
	West shore	41.5	
5-17-88	East shore	16.5	47 ± 9 (17)
	West shore	35.8	
6-2-88	East shore	7.5	51 ± 8 (20)
	West shore	16.5	
6-15-88	East shore	0.3	55 ± 12 (9)
	West shore	2.8	
6-28-88	East shore	0	-
	West shore	0	

[a] mean ± S.D. (sample size for measurements)

Other important fish species - Surveys were conducted from May to August 1988 to determine if bass spawn and rear in the vicinity of the proposed river crossing. On three occasions, we shocked approximately 1 km of each shoreline with a boat-mounted electroshocker unit (Smith-Root Type VI Electrofisher) to document areas of adult bass abundance. Surveys were conducted during daytime hours on June 9, June 30, and August 9, 1988. The boat was driven downstream in a zig-zag pattern, and electroshocking was conducted at depths ranging from 1 to 3 m. All shocked fish were netted, identified, and released.

Smallmouth bass ranging from 26.5 to 31.0 cm FL (n = 4) were collected on June 30 and August 9 near the outlet of the irrigation return stream on the eastern shoreline study area. Two juvenile smallmouth bass (12.5 and 13.0 cm FL) were collected from a small shoreline embayment along the upper west shoreline in late June. The principal species collected during boat electroshocking surveys was largescale sucker. Other common species included redside shiner, northern squawfish, chiselmouth, mountain whitefish, and carp.

There was no evidence of bass spawning along either Columbia River shoreline. Suitable habitat for spawning appeared to be present along the middle portion of the eastern shoreline (i.e., a mixture of cobble, boulders, and gravel patches). There were several dead trees along the shoreline and extensive offshore beds of curled-leaf pondweed, which could provide cover for both adult and juvenile bass. In contrast, the western shoreline had faster current and greater shoreline slope. As a result, pondweed was present only in small scattered patches. The substrate on the western shoreline appeared unsuitable for bass spawning, consisting mainly of packed cobble on the upper end and sand/silt off the mouth of Hanson Creek.

The shoreline was also surveyed for bass fry and juveniles. Previous studies in the Hanford Reach (Page, Dauble, and Neitzel 1982) had shown that bass fry remained near the shore in shallow water following emergence from nests. The shoreline surveys were conducted using polarized glasses or with a backpack electroshocker at monthly intervals from May through August. Both smallmouth bass and largemouth bass juveniles were collected by backpack electroshocker during the final survey on August 5, 1988. Near-shore water temperatures ranged from 20 to 22.2°C. Young-of-the-year bass were collected within 50 m of the irrigation return creek on the eastern shoreline. The largemouth bass ranged from 57-60 mm FL (n = 3) and the smallmouth bass from 50-68 mm FL (n = 8). Two largemouth bass (47 and

75 mm FL) were also collected from the upper end of the west shoreline during this survey.

Two species of sculpins (Family Cottidae) known to occur in the Hanford Reach of the Columbia River (Gray and Dauble 1977) are listed as species of special concern in the state of Washington (Johnson 1987). These are the Paiute sculpin and the reticulate sculpin. We conducted electroshocking surveys near the permanent beach seine stations to survey for these fish species. Near-shore areas < 1m depth were shocked with a backpack electroshocker on both sides of the river for about 200 m in May, July, and August 1988. Stunned fish were netted, identified, and released near the capture site.

The only sculpin collected during three separate surveys along both river shorelines was the prickly sculpin. Prickley sculpin were most abundant during the first survey on May 17, 1988. We collected 112 prickly sculpins ranging from 3 to 15 cm total length on that date; many adults were in spawning coloration. Average C/UE ranged from 1.9 to 11.8 sculpins/100 timer units on the east shoreline and from 0.2 to 4.7 sculpins/100 timer units on the west shoreline surveys.

Columbia River Invertebrates

We placed rock baskets along both Columbia River shorelines in early March 1988 to provide substrate for the great Columbia River spire snail and the giant Columbia River limpet. Both of these species are federal candidates for listing as threatened and endangered species. The historical range of the spire snail and limpet may have included the proposed northern crossing site since they have been collected at several locations in the Hanford Reach of Columbia River from 1969-1982 (Coutant and Becker 1970; Wolf 1976; Beak Consultants, Inc. 1980; Page, Dauble, and Neitzel 1982). The cylindrical sample baskets were constructed of nickel-chrome plated wire and were about 17 cm in diameter by 26 cm long. The baskets were left in the river until July 1988. To collect the samples, the baskets were placed in cloth bags and carried to the surface by scuba divers. Grab samples were also taken at two locations along each shoreline in July. Divers collected rocks from a 2- to 3-m depth and placed them into cloth bags to prevent organisms from being washed off during transport to the surface. Each basket sampler represented about 3.0 L volume and the grab samples averaged about 7.5 L volume of rocks. After collection, the rocks were scrubbed with a nylon brush to remove all organisms. Samples were then screened through a 0.8-mm sieve and preserved in 60% isopropyl alcohol. Preserved

specimens were sorted to separate gastropods from other aquatic organisms and counted.

No limpets or snails were found in any of the benthos samples taken from the proposed crossing site. A few specimens of the Asiatic clam were collected from rocks sampled along the east shoreline. Samples from the west shoreline site contained insect larvae, but no gastropods.

Summary

Juvenile fall chinook salmon are abundant along both shorelines from April through mid-June. This indicates that the reservoir environment is favorable habitat for this species during outmigration from upriver spawning areas. Priest Rapids reservoir could become an important rearing area for juvenile fall chinook salmon if spawning populations continue to increase in the mainstream Columbia River above Priest Rapids Dam.

Although no spawning areas were identified for bass, the presence of young-of-the-year bass suggests that some spawning occurs in the vicinity of the crossing site. However, shoreline areas containing bass appear to be mainly limited to the eastern portion of the proposed river crossing site.

EASTERN EXPANSION AREA

The objective of these studies was to examine the use of the lower reaches of tributary creeks that originate in the YFC by anadramous fish species. These creeks enter the Columbia River above Priest Rapids Dam on the western shoreline (Figure 5). Hanson Creek is within the boundary of the northern river crossing site; the other creeks enter the Columbia River at downstream locations.

Stream Surveys

Four drainages were studied: Hanson Creek, Alkali Creek, Corral Canyon Creek, and Sourdough Creek (Figure 5). These drainages contained the most surface water in the eastern expansion area and three of them contained fish populations during surveys conducted April through August 1988. A summary of the characteristics of these three drainages is presented in Table 6.

Chinook salmon fry were seen in Hanson Creek when it was first surveyed on April 19. Water temperatures were 17.2°C, or about 4°C warmer than the Columbia River. An electroshocking survey was conducted from the mouth of the creek to a

TABLE 6. Comparison of Features for Eastern Expansion Area Creeks that Contained Fish. Flows were measured on June 28, 1988. Temperature ranges are for May and June.

Drainage	Flow (m^3/sec)	Temperature(°C)	Stream channel
Hanson Creek	0.05	15.0 - 19.4	cobble, gravel
Alkali Creek	0.04	18.8 - 21.1	bedrock, cobble
Corral Canyon Creek	0.003	13.3 - 19.4	cobble, silt

point about 1 km upstream. The C/UE of fry decreased from 52 chinook fry/100 timer units at 50 m from the stream mouth, to 17 fish/100 units at 100 m upstream, to 3 fish/ 100 units just inside the present YFC boundary. Chinook salmon fry were visible in Hanson Creek until June 28, 1988 when most fry also left nearshore beach seine stations. However, three 0-age chinook fry (78-91 mm FL) were collected by electroshocking in the lower reach of Hanson Creek on August 5, 1988. Water temperatures in the creek were 19.4°C, or similar to nearshore temperatures in the Columbia River.

Chinook salmon fry were also observed in Alkali Creek on May 5, 1988, when water temperatures were 18.8°C. We electroshocked the creek on May 17 and found that chinook fry were abundant up to a stair-step bedrock falls about 100 m upstream from the confluence with the Columbia River. No chinook fry were found above the falls. We collected rainbow trout up to 20 cm FL ($n = 3$) in the lower 600 m of Alkali Creek. Brook trout were abundant upstream of the bedrock fall. Most ranged from 10-17 cm FL, but several fry from 4-5 cm FL were also collected. Chinook fry were observed in the lower creek as late as June 15, but no additional electroshocking surveys were conducted.

Corral Canyon Creek was much smaller than Hanson and Alkali creeks. Surface water was only visible for about 200 m above its confluence with the Priest Rapids Pool. The stream channel above this area, although wetted, was narrow and had no permanent flow. We found an estimated 200-300 chinook salmon fry present in the creek during our first survey on June 2, 1988. However, flows were not continuous to the river at that time, preventing fish movement back to the river. Less than 30 chinook fry remained in Corral Creek by mid-June as the reduced flows stranded fish and exposed them to predation.

A survey of Sourdough Creek on June 15 indicated no surface flows within 100 m of the Columbia River. Above this, a trickle flow was evident in isolated patches of riparian growth. There was no evidence of fish in this drainage.

Summary

Juvenile chinook salmon utilized the lower reaches of creeks that originate in the YFC for rearing in 1988. However, there was no evidence of anadramous fish spawning in these creeks. Rather, the 0-age chinook salmon probably enter the creeks from the Columbia River. This may be because the creeks provide more cover and warmer temperatures than the adjacent river shorelines in the springtime. Access by adult anadramous fish is likely limited because the streams all have narrow or undefined channels at the mouth and depths are too shallow to allow upstream migration. Most of the 0-age chinook moved out of the creeks at the same time Columbia River fish outmigrated from the Priest Rapids Pool. However, some fish became stranded because of low seasonal flows, while others remained through the summer.

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APPENDIX A

WILDLIFE TABLES

APPENDIX A

WILDLIFE TABLES

TABLE A.1. Wildlife Species That Received Special Emphasis During Field Surveys on the Proposed Expansion Area to the Yakima Firing Center

Species	Status[a]
Birds	
Bald eagle	Threatened (state and federal)
Golden eagle	Special animal species - PS(a)
Osprey	Special animal species - PM
Peregrine falcon	Endangered (state and federal)
Prairie falcon	Special animal species - PM
Gyrfalcon	Special animal species - PM
Swainson's hawk	Special animal species - PS
Ferruginous hawk	Threatened (state)
Northern goshawk	Special animal species - PS
Burrowing owl	Special animal species - PS
American white pelican	Endangered (state)
Sandhill crane	Endangered (state)
Common loon	Special animal species - PT
Long-billed curlew	Special animal species - PM
Loggerhead shrike	Special animal species - PS
Sage thrasher	Special animal species - PS
Sage sparrow	Special animal species - PS
Purple martin	Special animal species - PS
Western bluebird	Special animal species - PS
Ducks and geese	Game species
Sage grouse	Game species
Mourning dove	Game species
Other upland game birds	Game species
Mammals	
Pygmy rabbit	Threatened (state)
Yuma myotis	Special animal species - PM
Long-eared myotis	Special animal species - PM
Western pipistrelle	Special animal species - PM
Pallid bat	Special animal species - PM
Townsend's big-eared bat	Special animal species - PT
Sagebrush vole	Special animal species - PM
Merriam's shrew	Special animal species - PS
Rocky Mountain elk	Game species
Mule deer	Game species
Furbearers	Game species

TABLE A.1. (contd)

Species	Status[a]
Fish	
Rainbow trout	Game Species
Chinook salmon	Game species
Smallmouth bass	Game species
Largemouth bass	Game species
Paiute sculpin	Special animal species - PM
Reticulate sculpin	Special animal species - PM
Invertebrates	
Great Columbia River spire snail	Special animal species - PT
Giant Columbia River limpet	Special animal species - PT

(a) PM = proposed monitor species; PS = proposed sensitive species; PT = proposed threatened species.

TABLE A.2. Common and Scientific Names of Mammals, Birds, Reptiles, and Amphibians

Common Name	Scientific Name[a]
Vegetation	
Cottonwood	Populus spp.
Aspen	Populus tremuloides
Willow	Salix spp.
Wild rose	Rosa spp.
Big sagebrush	Artemisia tridentata
Stiff sagebrush	Artemisia rigida
Rock buckwheat	Eriogonum sphaerocephalum
Tumblemustard	Sisymbrium altissimum
Prickly lettuce	Lactuca sp.
Cress	Rorippa nasturtium - aquatica
Curled-leaf pondweed	Potomagetan crispus
Columbia milkvetch	Astragalus columbianus
Sandberg's bluegrass	Poa sandbergii
Cheatgrass	Bromus tectorum
Bluebunch wheatgrass	Agropyron spicatum
Mammals	
Rocky Mountain elk	Cervus elaphus
Mule deer	Odocoileus hemionus
Coyote	Canis latrans
Raccoon	Procyon lotor
Beaver	Castor canadensis
Mink	Mustela vison
Striped skunk	Mephitis mephitis
Yellow-bellied marmot	Marmota flaviventris
Porcupine	Erethizon dorsatum
White-tailed jackrabbit	Lepus townsendii
Black-tailed jackrabbit	Lepus californicus
Nuttall's cottontail	Sylvilagus nuttallii
Pygmy rabbit	Sylvilagus idahoensis
Least chipmunk	Eutamias minimus
Great Basin pocket mouse	Perognathus parvus
Deer mouse	Peromyscus maniculatus
Sagebrush vole	Lemmiscus curtatus
Montane vole	Microtus montanus
Long-tailed vole	Microtus longicaudus
Merriam's shrew	Sorex merriami
California myotis	Myotis californicus
Yuma myotis	Myotis yumanensis
Long-eared myotis	Myotis evotis
Western pipistrelle	Pipistrellus hesperus
Pallid bat	Antrozous pallidus
Townsend's big-eared bat	Plecotus townsendii

TABLE A.2. (contd)

Common Name	Scientific Name[a]
Birds	
Common loon	Gavia immer
American white pelican	Pelecanus erythrorhynchos
Western grebe	Aechmophorus occidentalis
Canada goose	Branta canadensis
Gadwall	Anas strepera
American widgeon	Mareca americana
Cinnamon teal	Anas cyanoptera
Green-winged teal	Anas carolinensis
Wood duck	Aix sponsa
Redhead	Aythya americana
Lesser scaup	Aythya affinis
Greater scaup	Aythya marila
Bufflehead	Bucephala albeola
Common merganser	Mergus merganser
Mallard	Anas platyrhynchos
Sharp-shinned hawk	Accipiter striatus
Northern harrier	Circus cyaneus
Northern goshawk	Accipter gentilis
Rough-legged hawk	Buteo lagopus
Red-tailed hawk	Buteo jamaicensis
Swainson's hawk	Buteo swansoni
Ferruginous hawk	Buteo regalis
Golden eagle	Aquila chrysaetos
Bald eagle	Haliaeetus leucocephalus
Osprey	Pandion haliaetus
Prairie falcon	Falco mexicanus
Gyrfalcon	Falco rusticolus
American kestrel	Falco sparverius
Sage grouse	Centrocerus urophasianus
California quail	Callipepla californica
Chukar	Alectoris chukar
Gray partridge	Perdix perdix
Ring-necked pheasant	Phasianus colchicus
Great blue heron	Ardea herodias
Black-crowned night heron	Nycticorax nycticorax
American coot	Fulica americana
Sandhill crane	Grus canadensis
Killdeer	Charadrius vociferus
Long-billed curlew	Numenius americanus
Spotted sandpiper	Actitis macularia
Common snipe	Gallinago gallinago
Ring-billed gull	Larus delawarensis
Forster's tern	Sterna forsteri

TABLE A.2. (contd)

Common Name	Scientific Name[a]
Caspian tern	Hydroprogne caspia
Rock dove	Columba livia
Mourning dove	Zenaida macroura
Great horned owl	Bubo virginianus
Long-eared owl	Asio otus
Short-eared owl	Asio flammeus
Burrowing owl	Athene cunicularia
Common barn owl	Tyto alba
Saw-whet owl	Aegolius acadicus
Common poor-will	Phalaenoptilus nuttallii
Common nighthawk	Chordeiles minor
Rufous hummingbird	Selasphorus rufus
Belted kingfisher	Megaceryle alcyon
Common flicker	Colaptes auratus
Western kingbird	Tyrannus verticalis
Say's phoebe	Sayornis saya
Horned lark	Eremophila alpestris
Purple martin	Progne subis
Barn swallow	Hirundo rustica
Cliff swallow	Hirundo pyrrhonota
Violet green swallow	Tachycineta thalassina
Rough-winged swallow	Stelgidopteryx serripennis
Black-billed magpie	Pica pica
Common raven	Corvus corax
Common crow	Corvus brachyrhynchos
Red-breasted nuthatch	Sitta canadensis
Bewick's wren	Thryomanes bewickii
Rock wren	Salpinctes obsoletus
Sage thrasher	Oreoscoptes montanus
American robin	Turdus migratorius
Varied thrush	Ixoreus naevius
Mountain bluebird	Sialia currucoides
Western bluebird	Sialia mexicana
Ruby-crowned kinglet	Regulus calendula
Golden-crowned kinglet	Regulus satrapa
Loggerhead shrike	Lanius ludovicianus
European starling	Sturnus vulgaris
Yellow-rumped warbler	Dendroica coronata
Wilson's warbler	Wilsonia pusilla
House sparrow	Passer domesticus
Western meadowlark	Sturnella neglecta
Yellow-headed blackbird	Xanthocephalus xanthocephalus
Red-winged blackbird	Agelaius phoeniceus

TABLE A.2. (contd)

Common Name	Scientific Name[a]
Brewer's blackbird	Euphagus cyanocephalus
Brown-headed cowbird	Molothrus ater
Northern oriole	Icterus galbula
Black-headed grosbeak	Pheucticus melanocephalus
Lazuli bunting	Passerina amoena
House finch	Carpodacus mexicanus
American goldfinch	Spinus tristis
Rufous-sided towhee	Pipilo erythrophthalmus
Sage sparrow	Amphispiza belli
Lark sparrow	Chondestes grammacus
Dark-eyed junco	Junco hyemalis
Brewer's sparrow	Spizella breweri
White-crowned sparrow	Zonotrichia leucophrys
Golden-crowned sparrow	Zonotrichia atricapilla
Song sparrow	Melospiza melodia
Reptiles and Amphibians	
Side-blotched lizard	Uta stansburiana
Desert short-horned lizard	Phrynosoma douglassii
Gopher snake	Pituophis melanoleucus
Western rattlesnake	Crotalus viridis
Pacific treefrog	Hyla regilla
Fish	
Rainbow trout (steelhead)	Salmo gairdneri
Chinook salmon	Oncorhynchus tschawytscha
Brook trout	Salvelinus fontinalis
Smallmouth bass	Micropterus dolomeiu
Largemouth bass	Micropterus salmoides
Northern squawfish	Ptychocheilus oregonensis
Chiselmouth	Acrocheilus alutaceus
Mountain white fish	Prosopium williamsoni
Carp	Cyprinus carpio
Three-spine stickleback	Gasterosteus aculeatus
Largescale sucker	Catostomus machrocheilus
Redside shiner	Richardsonius balteatus
Paiute sculpin	Cottus beldingi
Reticulate sculpin	Cottus perplexus
Prickley sculpin	Cottus asper

TABLE A.2. (contd)

Common Name	Scientific Name[a]
Invertebrates	
Great Columbia River spire snail	Lythoglyphus columbianus
Giant Columbia River limpet	Fisherola nuttalli
Asiatic clam	Corbicula sp.

(a) Vegetation names follow Hitchcock and Cronquist (1973); mammal names follow Jones, Carter, and Genoways (1979); bird names follow American Ornithologist's Union (1983); reptile and amphibian names follow Stebbins (1954); fish names follow Robins et al. 1980.

TABLE A.3. Sightings of Raptors on the Proposed Northern Expansion Area to the Yakima Firing Center from October 1987 Through August 1988

Species Observed	Number Observed										
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Great horned owl	1					1	6[a]				1
Long-eared owl	1	1									
Short-eared owl				1							1
Saw-whet owl											1
Sharp-shinned hawk	1	1									
Red-tailed hawk	9	3				1	10[b]	1	1		
Rough-legged hawk		2	1								
Golden eagle	1	1		1	1	1	1				1
American kestrel	6	8	2				6[b]		2		2
Prairie falcon	2				1						
Northern harrier	1	2									

(a) Territorial pairs present and presumed nesting.
(b) Observed nesting.

TABLE A.4. Number and Distribution of Canada Geese Observed on Priest Rapids Pool During and After the Brood Rearing Season (May - June) 1988

River Segment[a]	5/19&25/88[b] Ad.	5/19&25/88[b] Juv.	6/13/88[b] Ad.	6/13/88[b] Juv.	7/26/88[b] Ad./Juv.[c]	7/29/88[b] Ad./Juv.[c]
0-1						
1-2	2	2				
2-3						5
3-4						
4-5					55	8
5-6					45	8
6-7					15	
7-8						
8-9	69	178	27	85		85
9-10						
10-11						
11-12						
12-13					120	
13-14						
14-15[d]						
15-16[d]			4	23		
16-17[d]						
17-18					15	
18-19						
19-20						
20-21						
21-22						
22-23						
23-24	4	8				
24-25	8	15	17	19		
25-26					60	47
26-27			15	30		
27-28	9	3	6	12		
Total	92	206	69	169	310	153

(a) 0-1, 1-2, etc. refer to number of kilometers above Priest Rapids Dam.
(b) Date surveys conducted.
(c) Could not distinguish adults from juveniles.
(d) Approximate location of proposed river crossing.

TABLE A.5. Distribution of Wintering Waterfowl on the Priest Rapids Pool of the Columbia River During the Winters of 1986-87 and 1987-88 Relative to the Proposed Crossing Site. Data are presented as number observed/census flight.

	Location on Pool			
	Crossing	Noncrossing	χ^2	P
1986-87				
Observed ducks	76	2114		
Expected ducks	235	1955	120	<0.001
Observed geese	2	215		
Expected geese	23	194	21	<0.001
Observed coots	56	621		
Expected coots	73	604	4	0.04
1987-88				
Observed ducks	281	5972		
Expected ducks	670	5583	253	<0.001
Observed geese	8	275		
Expected geese	30	253	18	<0.001
Observed coots	148	2188		
Expected coots	250	2086	46	<0.001

TABLE A.6. Birds Observed on the Proposed Expansion Area of the Yakima Firing Center from October 1987 Through August 1988

Species	Location Observed[a]	Relative Abund.[b]	Seasonal Use	Habitat Associations
Common loon	RC	C	Sp, Su, F, W	River
Cinnamon teal	RC	C	Sp, Su, F	Ponds
Mallard	RC, NE	C	Sp, Su, F	Ponds, riparian
Sharp-shinned hawk	NE	UC	Sp	Riparian
Northern harrier	NE	UC	Sp, Su, F	All
Rough-legged hawk	NE	C	W	All
Red-tailed hawk	NE	VC	Sp, Su, F, W	All
Bald eagle	RC	C	F, W	Riparian
Golden eagle	NE	UC	Sp, Su, F, W	All
Osprey	RC	UC	Sp, Su	Riparian
Prairie falcon	NE	UC	Sp, Su, F, W	All
American kestrel	NE	VC	Sp, Su, F, W	All
Sage grouse	NE	UC	W	
California quail	NE	VC	Sp, Su, F, W	Riparian
Chukar	NE	VC	Sp, Su, F, W	All
Ring-necked pheasant	RC	C	Sp, Su, F, W	All
Great blue heron	RC	C	Sp, Su, F, W	River, ponds
Gray partridge	NE	C	Sp, Su, F, W	All
Killdeer	NE, RC	C	Sp, Su, F	Riparian
Common snipe	NE	UC	Sp	Riparian
Ring-billed gull	RC	VC	Sp, Su, F, W	River, ponds
Forster's tern	RC	C	Sp, Su, F	River, ponds
Caspian tern	RC	UC	Sp, Su, F	River, ponds
Rock dove	NE, RC	C	Sp, Su, F, W	Basalt cliffs
Mourning dove	NE, RC	C	Sp, Su, F	Riparian
Great horned owl	NE	C	Sp, Su, F, W	All
Long-eared owl	NE	UC	Sp, Su, F	Riparian
Short-eared owl	NE	UC	Sp, Su, F	Sage
Saw-whet owl	NE	UC	Sp, Su, F	Riparian
Common poor-will	NE	VC	Sp, Su, F	Riparian, sage
Common nighthawk	NE	VC	Su, F	Riparian, sage
Rufous hummingbird	NE	UC	Su	Riparian
Common flicker	NE	VC	Sp, Su, F	Riparian
Western kingbird	NE	C	Sp, Su, F	All
Say's phoebe	NE	C	Sp, Su, F	Riparian cliffs
Horned lark	NE, RC	C	Sp, Su, F	Sage-grass
Barn swallow	NE	C	Sp, Su, F	Riparian
Cliff swallow	NE, RC	C	Sp, Su, F	Riparian cliffs
Violet-green swallow	NE	UC	Sp, Su, F	Riparian cliffs
Rough-winged swallow	NE	UC	Sp, Su, F	Riparian cliffs
Black-billed magpie	NE, RC	C	Sp, Su, F, W	All

TABLE A.6. - (Contd)

Species	Location Observed[a]	Relative Abund.[b]	Seasonal Use	Habitat Associations
Common crow	RC	C	Sp, Su, F	Riparian
Common raven	NE	C	Sp, Su, F, W	All
Red-breasted nuthatch	NE	UC	Su, F, W	Riparian
Bewick's wren	NE	UC	Sp, Su, F	Riparian
Rock wren	NE	VC	Sp, Su, F	Basalt Outcrops
Sage thrasher	NE	VC	Sp, Su	Sage-grass
American robin	NE, RC	VC	Sp, Su, F, W	All
Varied thrush	NE	C	Sp, F	Riparian
Mountain bluebird	NE	UC	Sp, F	Sage-grass
Ruby-crowned kinglet	NE	C	Sp, F	Riparian
Golden-crowned kinglet	NE	C	Sp, F	Riparian
Loggerhead shrike	NE	C	Sp, S, F, W	All
European starling	NE, RC	UC	Sp, S, F, W	All
Yellow-rumped warbler	NE, RC	C	Sp, F	Riparian
Wilson's warbler	NE	UC	Sp, F	Riparian
Western meadowlark	NE, RC	VC	Sp, Su, F, W	All
Red-winged blackbird	NE, RC	C	Sp, Su, F	Riparian
Brewer's blackbird	NE, RC	C	Sp, Su, F	Riparian
Brown-headed cowbird	NE	UC	Sp, Su, F	Riparian
Northern oriole	RC	C	Sp, Su, F	Riparian
Black-headed grosbeak	RC	VC	Sp, Su, F	Riparian
Lazuli bunting	NE	C	Sp, Su, F	Riparian
House finch	NE	UC	Sp, Su, F	Riparian
American goldfinch	NE, RC	UC	Sp, Su, F	Riparian
Rufous-sided towhee	NE	C	Sp, Su, F	Riparian
Sage sparrow	NE, RC	VC	Sp, Su, F	Sage-grass
Dark-eyed junco	NE	C	F, W	Riparian
Brewer's sparrow	NE	C	Sp, Su, F	Sage-grass
Golden-crowned sparrow	NE	UC	Sp, F	Riparian
White-crowned sparrow	NE, RC	VC	Sp, F, W	All
Song sparrow	NE, RC	VC	Sp, Su, F	Riparian

(a) RC = proposed river crossing, NE = proposed northern expansion area.
(b) C = common, usually observed in its preferred habitats, UC = uncommon, not often observed - seen only on a few occasions. VC = very common, observed frequently in its preferred habitats.

TABLE A.7. Habitat Training Classes Trapped for Small Mammals During October-December 1987 on the Proposed Northern Expansion Area to the Yakima Firing Center

Line No.	Dates Trapped	Habitat Type	Descriptive Comments
1	10/28-10/30	Sage Bottom	Riparian sage
2	10/28-10/30	Sage Bottom	Hillside seep area
3	11/3-11/5	Sage-Stiff Sage	Steep slope
4	11/3-11/5	Stiff Sage	Ridge top
5	11/3-11/5	Sagebrush-Bluegrass	Flats
6	11/11-11/13	Stiff Sage	Ridge top
7	11/11-11/13	Big Sage	Bottom of small draw
8	11/11-11/13	Big Sage	Bottom of draw
9	11/11-11/13	Stiff Sage	Heavily grazed ridge top
10	11/16-11/18	Sage Bottom	Riparian
11	11/16-11/18	Disturbed	Disturbed farmstead
12	12/8-12/10	Sagebrush-Bluegrass	Ridge top, little sage
13	12/8-12/10	Big Sage	Steep hillside
14	12/8-12/10	Big Sage	Bottom of draw

TABLE A.8. Summary of Small Mammal Trapping Results for October-December 1987 on the Proposed Northern Expansion Area to the Yakima Firing Center

Species	Total Number Captured on Trap-Line Number														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Deer mouse	29	37	6	13	3	7	5	13	9	16	26	2	1	11	178
Sagebrush vole	2		3			4	2	4	6			4	2		27
Long-tailed vole		2						1					1		4
Montane vole		2													2
Great Basin pocket mouse	6	2	4		1	2	3								18
Least chipmunk	11	5					6								22
															251

APPENDIX B

NUMBERS OF WATERFOWL OBSERVED ON THE PRIEST RAPIDS POOL OF THE COLUMBIA RIVER DURING THE WINTERS OF 1986-87 AND 1987-88

APPENDIX B

NUMBERS OF WATERFOWL OBSERVED ON THE PRIEST RAPIDS POOL OF THE COLUMBIA RIVER DURING THE WINTERS OF 1986-87 AND 1987-88

TABLE B.1. Ducks Observed in 1986-87[a]

River Segment (km)	Number of Ducks, 1986-87[b] Dec	Jan	Feb	Mar
0-1	300	245	9	53
1-2	0	4435	1800	1540
2-3	200	6250	1260	1100
3-4	3160	4280	75	60
4-5	510	70	0	35
5-6	542	140	0	25
6-7	13	335	2	83
7-8	105	160	32	60
8-9	118	175	65	42
9-10	46	40	45	82
10-11	20	120	30	45
11-12	180	225	0	20
12-13	745	487	790	150
13-14	17	24	285	340
14-15	45	410	62	60
15-16	196	97	150	26
16-17	173	40	14	20
17-18	155	70	10	185
18-19	14	30	5	50
19-20	10	110	40	0
20-21	5	110	150	0
21-22	30	220	414	25
22-23	5	60	30	6
23-24	40	152	0	2
24-25	149	293	20	0
25-26	97	208	34	18
26-27	110	99	24	4
27-28	30	10	20	2

(a) All data for 1986-87 were obtained by S. A. Eisner, University of Montana, Missoula.

(b) Cumulative totals or three flights in December, five in January, four in February, and five in March.

TABLE B.2. Ducks Observed in 1987-88

River Segment (km)	Number of Ducks, 1987-88[a]			
	Dec	Jan	Feb	Mar
0-1	0	0	280	2000
1-2	4363	902	4100	5010
2-3	2985	2120	6100	4856
3-4	4	18	180	20
4-5	2	20	40	0
5-6	6	1235	50	0
6-7	66	53	10	0
7-8	754	1735	3700	0
8-9	173	60	185	400
9-10	152	146	225	3
10-11	151	50	102	62
11-12	476	136	40	0
12-13	221	108	782	2
13-14	4	0	0	0
14-15	27	60	61	64
15-16	191	64	592	0
16-17	622	566	4	0
17-18	2230	498	0	0
18-19	218	0	36	0
19-20	1	53	10	0
20-21	1	0	0	0
21-22	2	2	6	7
22-23	14	0	24	0
23-24	4	43	85	12
24-25	12	4	0	2
25-26	231	2	59	2
26-27	83	0	38	10

(a) Cumulative totals for three flights in December, two in January, two in February, and one in March.

TABLE B.3. Geese Observed in 1986-87[a]

River Segment (km)	Number of Geese, 1986-87			
	Dec	Jan	Feb	Mar
0-1	0	50	15	0
1-2	0	40	953	765
2-3	0	20	102	250
3-4	0	2	12	0
4-5	0	30	0	0
5-6	0	40	0	0
6-7	0	50	0	0
7-8	0	175	20	20
8-9	0	25	32	48
9-10	7	0	35	35
10-11	0	100	0	0
11-12	0	0	20	0
12-13	0	30	75	100
13-14	0	0	0	0
14-15	0	7	2	0
15-16	0	15	0	0
16-17	0	0	0	4
17-18	0	0	0	0
18-19	0	0	0	0
19-20	5	0	0	0
20-21	0	0	0	0
21-22	270	0	2	0
22-23	0	90	31	12
23-24	11	50	9	25
24-25	0	0	15	0
25-26	0	25	10	13
26-27	0	0	27	0

(a) Cumulative totals for 3 flights in December, five in January, four in February, and five in March.

TABLE B.4. Geese Observed in 1987-88

River Segment (km)	Number of Geese, 1987-88[a]			
	Dec	Jan	Feb	Mar
0-1	0	0	12	0
1-2	70	0	50	33
2-3	70	20	73	46
3-4	0	1	0	0
4-5	0	0	57	0
5-6	0	0	0	0
6-7	0	0	0	0
7-8	501	0	0	0
8-9	0	85	60	0
9-10	400	0	90	0
10-11	3	0	0	0
11-12	5	0	0	0
12-13	0	0	150	0
13-14	0	0	0	0
14-15	0	0	0	0
15-16	30	25	0	0
16-17	8	0	0	0
17-18	14	25	0	0
18-19	0	0	0	0
19-20	0	0	0	0
20-21	81	0	27	0
21-22	70	0	0	0
22-23	14	0	0	0
23-24	20	0	4	6
24-25	96	0	20	12
25-26	30	1	0	0
26-27	20	0	21	14

(a) Cumulative totals for three flights in December, two in January, two in February, and one in March.

TABLE B.5. Coots Observed in 1986-87

River Segment (km)	Number of Coots, 1986-87[a]			
	Dec	Jan	Feb	Mar
0-1	0	50	0	0
1-2	0	0	50	0
2-3	0	20	100	50
3-4	0	135	20	0
4-5	0	305	40	0
5-6	0	330	15	17
6-7	135	180	380	0
7-8	65	200	95	0
8-9	100	70	366	20
9-10	0	0	0	0
10-11	20	130	110	0
11-12	163	185	550	6
12-13	850	1090	1300	90
13-14	16	0	0	70
14-15	60	130	182	0
15-16	0	10	100	50
16-17	0	0	320	105
17-18	0	60	300	925
18-19	0	200	700	600
19-20	0	0	250	20
20-21	0	5	150	0
21-22	0	0	0	0
22-23	0	10	0	0
23-24	0	0	10	0
24-25	0	0	0	0
25-26	0	0	0	0
26-27	0	0	0	0
27-28	0	0	0	0

(a) Cumulative totals for three flights in December, five in January, four in February, and five in March.

TABLE B.6. Coots Observed in 1987-88

River Segment (km)	Number of Coots, 1987-88[a]			
	Dec	Jan	Feb	Mar
0-1	300	2	0	0
1-2	45	60	0	0
2-3	300	150	20	0
3-4	0	45	30	20
4-5	65	40	480	0
5-6	30	195	260	0
6-7	50	150	20	0
7-8	300	280	10	0
8-9	306	526	240	100
9-10	860	150	50	0
10-11	315	60	160	0
11-12	3700	575	75	0
12-13	740	1650	740	0
13-14	6	0	0	0
14-15	60	20	80	0
15-16	54	65	0	0
16-17	250	654	0	0
17-18	1100	1300	0	0
18-19	0	0	400	0
19-20	0	0	65	0
20-21	0	0	10	0
21-22	0	0	60	150
22-23	0	0	0	0
23-24	0	0	0	0
24-25	100	10	1	0
25-26	100	0	0	0
26-27	0	0	0	0

(a) Cumulative totals for three flights in December, two in January, two in February, and one in March.

TABLE B.7. Total Waterfowl Observed in 1986-87[a]

River Segment (km)	Total Waterfowl, 1986-87[b] Dec	Jan	Feb	Mar
0-1	300	345	24	53
1-2	3000	6045	2838	2305
2-3	10500	9240	1422	1400
3-4	3160	4465	107	60
4-5	510	540	40	35
5-6	542	550	15	42
6-7	148	565	382	83
7-8	170	1205	147	80
8-9	258	470	463	110
9-10	53	40	80	87
10-11	40	470	140	45
11-12	433	420	570	26
12-13	2195	1867	2165	340
13-14	33	24	285	410
14-15	355	547	246	60
15-16	196	122	250	76
16-17	173	40	334	129
17-18	155	130	310	1110
18-19	14	230	705	650
19-20	15	110	290	20
20-21	5	115	300	0
21-22	300	220	416	25
22-23	5	160	61	18
23-24	51	202	19	27
24-25	149	294	35	0
25-26	97	243	44	31
26-27	110	99	51	4
27-28	30	10	23	2

(a) Total may exceed the sum of coots, ducks, and geese because of unidentified waterfowl.

(b) Cumulative totals for three flights in December, five in January, four in February, and five in March.

TABLE B.8. Total Number of Waterfowl Observed in 1987-88

River Segment (km)	Total Number of Waterfowl, 1987-88[a]			
	Dec	Jan	Feb	Mar
0-1	300	2	292	2000
1-2	4478	962	4150	5043
2-3	3355	2290	6193	4902
3-4	4	64	210	40
4-5	67	60	577	0
5-6	136	1430	310	0
6-7	116	203	30	0
7-8	2555	2015	3710	0
8-9	479	671	485	500
9-10	1412	296	365	3
10-11	469	110	262	62
11-12	4181	711	115	0
12-13	961	1758	1672	2
13-14	10	0	0	0
14-15	87	80	141	64
15-16	275	154	592	0
16-17	880	1220	4	0
17-18	3344	1823	0	0
18-19	218	0	436	0
19-20	1	53	75	0
20-21	82	0	37	0
21-22	72	2	66	157
22-23	28	0	24	0
23-24	24	43	89	18
24-25	208	14	21	14
25-26	361	3	59	2
26-27	103	0	59	24

(a) Cumulative total for three flights in December, two in January, two in February, and one in March.

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