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APPENDIX D

TECHNICAL REPORT

Avian Use of Proposed KENETECH and CARES Wind Farm Sites in Klickitat County, Washington

Prepared for:

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January 31, 1995

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Executive Summary

Executive Summary

PURPOSE AND OVERVIEW OF AVIAN STUDIES

The Columbia Hills area above (north of) the Columbia River in Klickitat County, in southcentral Washington, is being considered for development of two wind power generation projects that could include the eventual placement of up to 436 wind turbines. The KENETECH Windpower Washington Windplant™ Number 1 project would include placing up to 345 KENETECH 33M-VS turbines, capable of producing up to 115 megawatts (MW), in 39 rows (strings) on a 5,110-hectare (12,630-acre) site. The Conservation and Renewable Energy Systems (CARES) Columbia Wind Farm # 1 project would include placing 91 Flowind AWT-26 turbines, capable of generating 25 MW, in 11 rows on a 395-hectare (975-acre) site.

Klickitat County and the Bonneville Power Administration (BPA) are the lead agencies making decision for the two proposed projects through National Environmental Policy Act (NEPA) and State Environmental Policy Act (NEPA) environmental impact statements. In addition, BPA is consulting with the U.S. Fish and Wildlife Service (USFWS) to ensure project compliance with the Endangered Species Act.

During scoping for these proposed developments, concerns were raised regarding the potential for avian mortality associated with wind farm development. Collision with wind turbine blade, towers, guy wires, and transmission lines, and electrocution from power lines have been identified as sources of avian mortality, particularly raptors, at existing wind farm facilities.

To address these concerns, an avian study was conducted at the site in accordance with an avian study plan and protocol developed, with input from a national avian task force, state agencies (Washington Department of Fish and Wildlife [WDFW]), and federal agencies (USFWS). The study included four elements: (1) a winter raptor and waterfowl study, (2) spring migration and fall migration studies, (3) a summer resident study, and (4) a raptor breeding study. The study involved extensive field studies conducted by biologists experienced in identifying raptors and other birds.

AFFECTED ENVIRONMENT

Special-Status Birds

Consultations were held with the USFWS and WDFW to identify federal and state special-status species existing or potentially existing on and in the vicinity of the KENETECH and CARES project sites. The consultations were supplemented by a literature review and identification of habitat types on the project sites. From these sources, 22 special-status bird species were identified as potentially being present on or in the vicinity of the sites being proposed for wind turbine development. These species are discussed in the following sections.

Eight Special-Status Species Determined to be Significant Elements of the Affected Environment

Of the 22 special-status species evaluated as part of the avian studies, 8 were determined to be present in sufficient numbers or to have sufficient protection to be evaluated in detail:

- peregrine falcon (federal and state endangered),
- bald eagle (federal and state threatened),
- golden eagle (state candidate),
- Swainson's hawk (state candidate),
- prairie falcon (state monitor),
- turkey vulture (state monitor),
- Lewis' woodpecker (state candidate), and
- western bluebird (state candidate).

Fourteen Species Determined Not to be Significant Elements of the Affected Environment

Of the 22 special-status species that could potentially use or fly over the two project sites, 14 were determined to be present in such low numbers (in relation to their numbers in commonly known use areas off the project sites) that they were not considered to be of special concern on the two proposed project sites. Seven of these 14 species (i.e., osprey, long-billed curlew, loggerhead shrike, sandhill crane, northern goshawk, ferruginous hawk, and ash-throated flycatcher) were infrequently observed on the project sites. The number of these species observed was sufficiently low to conclude that the projects would not pose a significant risk to their local or regional distribution.

The merlin, a special-status species, was not originally suspected to be present on the project sites based upon agency consultations and literature and habitat review. However, one merlin was observed to be near the project sites during the field studies. This single observation was not sufficient to conclude that merlins would be at risk at the local or regional level as a result of the two projects.

The other six of the 14 species (i.e., western sage grouse, gray flycatcher, burrowing owl, grasshopper sparrow, bank swallow, and sage sparrow) were not observed on the project sites during the field studies. Although these species may be present in small numbers or occasionally pass through the site as a part of their natural movements, because there were no observations of them it was determined that the project sites were not important for the local or regional abundance or distribution of these species.

Other Raptors

Other raptors observed in or near the project sites (in order of frequency observed) included American kestrel, red-tailed hawk, northern harrier, sharp-shinned hawk, and Cooper's hawk.

Waterfowl

Waterfowl are abundant within the Columbia River and associated tributaries south of the project sites. One project concern was that waterfowl may cross areas proposed for turbine development on their way to and from feeding areas. However, field studies resulted in relatively few observations at either of the project sites (48 sightings during five observations).

Other Birds

Oak-woodlands at the sites provide habitat for a wide variety of song-birds, including dark-eyed junco, northern oriole, rufous-sided towhee, and Townsend's warbler. Common birds in more open areas include black-billed magpie, common raven, northern flicker, Brewer's black bird, Townsend's solitaire, and barn swallow.

ENVIRONMENTAL CONSEQUENCES

Five potential impacts on raptors and other birds were evaluated as part of this study: (1) loss of habitat, (2) disturbance to foraging and breeding behavior, (3) electrocution, (4) collision with overhead power lines, and (5) collision with wind turbines. Of these five potential impacts, collision with wind turbines developed as part of the two projects was determined to have the most potential for significant impacts on raptors and other birds.

Environmental Consequences of the KENETECH Project

Habitat Loss

Habitat loss would be limited in extent because the KENETECH project would be distributed at relatively low density across a wide area. Approximately 155 hectares (382 acres) of habitat would be removed or disturbed during project construction, which involves less than 3% of the 5,110-hectare (12,630-acre) project site. In addition, approximately 76% of this disturbance would occur within cultivated land or degraded rangeland, two habitat types that are very common in Klickitat County and the region.

Disturbance

Disturbance to foraging and breeding behavior of raptors and other birds would result from project-related human activity during construction, but post-construction activities would be relatively minor and would not significantly alter avian use. Most raptors would avoid active construction sites, but would continue to use other areas. Construction would occur near four red-tailed hawk nest sites and near one Swainson's hawk (a special-status species) nest site and could reduce productivity at some of these sites. Because raptors have been shown to become accustomed to the presence of wind turbines and associated facilities following wind farm construction, raptors and other birds are expected to continue to use lands on the project site after construction.

Electrocution

The applicant proposes raptor-protection measures on overhead power lines and poles, thereby minimizing the potential for electrocution.

Collision with Overhead Powerlines

Project features would not include guy wires, thereby eliminating the potential of collision with those wires. Overhead power lines would pose a risk to waterfowl, raptors, and other birds. However, because similar power lines are common in the vicinity of the project, collisions are not expected to significantly increase as a result of the project.

Collision with Wind Turbines

Collision with wind turbines was determined to have the most potential for significant impacts on raptors and other birds. Based on the avian mortality experienced at California wind farms, development of wind turbines at the KENETECH site would result in avian mortality. Although conditions at California wind farms differ in many ways from the proposed KENETECH project, these projects can provide a general indication about the expected magnitude of mortality. Based on the range of mortality estimates for wind farms in California (1.7 to 5.8 raptors per 100 turbines per year), mortality resulting from the KENETECH project could range from 6 to 20 raptors a year (KENETECH Windpower 1994).

Because of differences in behavior and abundance, different bird species would experience different levels of mortality in terms of intensity (i.e., actual number of bird mortalities) and in terms of context (i.e., number of bird mortalities relative to local and regional populations).

Formal Consultation Under Endangered Species Act. Section 7 of the Endangered Species Act, 16 U.S.C. § 1536 and Section 402.14 of the Joint Regulations on Endangered Species, 50 CFR Part 402, require formal consultation between BPA and USFWS if BPA determines that an action may affect a listed species or its critical habitat. This technical report was prepared both to support BPA's and Klickitat County's joint NEPA/SEPA environmental impact statements for the KENETECH and CARES projects and to serve as a biological assessment under the Joint Regulations on Endangered Species. Because this report concludes that peregrine falcons and bald eagles are present in the project area, and may be affected by the projects, BPA should initiate formal consultation with USFWS, using this report as its biological assessment.

Threatened and Endangered Species. Because peregrine falcon, an endangered species, and bald eagle, a threatened species, were found to use areas of the KENETECH site proposed for wind turbines, the project could result in mortality for these species. BPA is conducting formal consultation with the USFWS under Section 7 of the Endangered Species Act. This is discussed in more detail below in the Unresolved Issues section of this Executive Summary.

Peregrine falcon were observed on the KENETECH project site, and one pair of peregrine falcons likely includes the site within its home range. The pair was observed to frequent the Rock Creek area, located approximately 8 kilometers (5 miles) from the eastern edge of the KENETECH site. Peregrine falcons are known to travel widely and often fly up to 10 miles from their nesting areas. The KENETECH site is located on the eastern edge of the peregrine falcon's current range in the Columbia River Gorge. There are up to seven pairs in the gorge area (not including the pair found near Rock Creek). Thus, although the likelihood of collision is relatively low based on the relatively few individuals in the area, the potential for mortality remains and a peregrine mortality could measurably reduce the Columbia River Gorge peregrine population. However, the population would likely remain viable.

Bald eagles were observed to fly within areas proposed for wind turbines. Bald eagles traveling at dawn and dusk to and from night roosting areas were observed crossing the eastern portion of the site. Turbine strings that bald eagles could approach on their way to and from these night roosts would include strings Z, Y, AA, BB, and CC. While construction activity at strings Z and Y may cause bald eagles to abandon a nearby roost site and therefore reduce their long-term vulnerability to collision, bald eagles would likely continue to cross the ridge to Luna Gulch. Luna Gulch is north of the KENETECH site, where between 2 and 4 bald eagles were determined to roost during winter field studies.

Although bald eagles do not typically dive or fly erratically in pursuit of prey, a behavior believed to contribute to collisions, they were observed flying at altitudes that would put them at risk of colliding with wind turbines and some mortality could occur. Between 3 and 10 bald eagles were estimated to use the KENETECH/CARES project sites over the 1993-1994 winter. This number may increase to as many as 20 in some years.

When viewed from a regional perspective, impacts on wintering bald eagles would be localized and would not likely affect overall populations in eastern Washington. Klickitat County has only a small percentage of bald eagle winter populations in Washington. In addition, the species has greatly recovered from previously low population levels, and the regional population is stable or increasing. Therefore, within a regional context, the project's effects on bald eagles would not pose a significant decline in regional breeding or wintering populations.

Other Special-Status Species. Special-status species that would be most vulnerable to collision with turbines due to behavior and abundance factors include golden eagle, Swainson's hawk, and western bluebird. Golden eagle and Swainson's hawks would have low overall mortality levels, but high levels relative to local populations. Collision mortality could affect the low local breeding populations of these species. However, mortality would not be sufficient to affect regional distribution or abundance of these species because their regional populations are substantial enough to sustain local losses without significant effects on the overall population. Western bluebirds would have low overall mortality levels and low levels relative to local and regional populations. The potential impacts on local and regional populations of these species are summarized in Section 5 of this report.

Other Raptors (Not Special-Status). Some raptors are common on the project site and display behaviors that make them vulnerable to collisions with wind turbines. Overall mortality on the project site would be the greatest for these species, but would be low in relation to the size of local and regional populations. Raptors in this category include red-tailed hawk, American kestrel, and rough-legged hawk. In the case of red-tailed hawk and American kestrel, which are year-around residents, local breeding populations would be reduced, but these reductions would not affect the regional distribution or abundance because the species are so common. In the case of the rough-legged hawk, which only winters on the project site, local wintering populations could be reduced. However, losses on breeding populations would be more disperse because these birds migrate from many different breeding areas. As with the red-tailed hawk and American kestrel, mortality of rough-legged hawks would not be at a level that would significantly affect regional distribution or abundance.

Environmental Consequences of the CARES Project

Habitat Loss

Approximately 42 hectares (95 acres) of habitat would be removed or disturbed during project construction, which involves about 9.7% of the 395-hectare (975-acre) project site.

Disturbance

Disturbance to foraging and breeding behavior of raptors and other birds would result from project-related human activity during construction, but post-construction activities would be relatively minor and would not significantly alter avian use. Most raptors would avoid active construction sites, but would continue to use other areas. Because raptors have been shown to become accustomed to the presence of wind turbines and associated facilities following wind farm construction, raptors and other birds are expected to continue to use lands on the project site after construction.

Electrocution

The applicant proposes raptor-protection measures on overhead power lines and poles, thereby minimizing the potential for electrocution.

Collision with Overhead Powerlines and Guy Wires

Project features would include overhead power lines and guy wires. These overhead power lines and guy wires would pose a risk to waterfowl, raptors, and other birds. Although similar power lines are common in the vicinity of the project and they are not expected to significantly increase power line collisions, the guy wires add an additional level of risk.

Collision with Wind Turbines

Collision with wind turbines was determined to have the most potential for significant impacts on raptors and other birds. Based on the avian mortality experienced at California wind farms, development of wind turbines at the CARES site would result in avian mortality. Although conditions at California wind farms differ in many ways from the proposed CARES project, these projects can provide a general indication about the expected magnitude of mortality. Based on the range of mortality estimates for wind farms in California (1.7 to 5.8 raptors per 100 turbines per year), mortality resulting from the CARES project could range from 2 to 6 raptors a year (KENETECH Windpower 1994).

Because of differences in behavior and abundance, different bird species would experience different levels of mortality in terms of intensity (i.e., actual number of bird mortalities) and in terms of context (i.e., number of bird mortalities relative to local and regional populations).

Formal Consultation Under Endangered Species Act. Section 7 of the Endangered Species Act, 16 U.S.C. § 1536 and Section 402.14 of the Joint Regulations on Endangered Species, 50 CFR Part 402, require formal consultation between BPA and USFWS if BPA determines that an action may affect a listed species or its critical habitat. This technical report was prepared both to support BPA's and Klickitat County's joint NEPA/SEPA environmental impact statements for the KENETECH and CARES projects and to serve as a biological assessment under the Joint Regulations on Endangered Species. Because this report concludes that peregrine falcons and bald eagles are present in the project area, and may be affected by the projects, BPA should initiate formal consultation with USFWS, using this report as its biological assessment.

Threatened and Endangered Species. Peregrine falcons, an endangered species, and bald eagles, a threatened species, could use areas of the CARES site proposed for wind turbines and the project could result in mortality for this species. BPA is conducting formal consultation with the USFWS under Section 7 of the Endangered Species Act. This is discussed in more detail below in the Unresolved Issues section of this Executive Summary.

Peregrine falcon were not observed on the CARES project site and the Rock Creek pair were located 19.3 kilometers (12 miles) away, too far away to regularly use the project site. Peregrine falcons are known to travel widely and often fly up to 10 miles from their nesting areas. The CARES site is located on the eastern edge of the peregrine falcon's current range in the Columbia River Gorge and up to seven pairs are known to exist in the gorge (not including the pair found near Rock Creek). Thus, although the likelihood of collision is relatively low based on the relatively few individuals in the area, the potential for mortality remains and a peregrine mortality could measurably reduce the Columbia River Gorge peregrine population. However, the population would likely remain viable.

While bald eagles were not observed to fly within areas proposed for wind turbines, they are assumed to occasionally fly over the project site. Bald eagles traveling at dawn and dusk to and from night roosting areas located over 7 miles northeast of the project site. Between 3 and 10 bald eagles were estimated to use the KENETECH/CARES project sites over the 1993-1994 winter. This number may increase to as many as 20 in some years.

When viewed from a regional perspective, impacts on wintering bald eagles would be localized and would not likely affect overall populations in eastern Washington. Klickitat County has only a small percentage of bald eagle winter populations in Washington. In addition, the species has greatly recovered from previously low population levels, and the regional population is stable or increasing. Therefore, within a regional context, the project's effects on bald eagles would not pose a significant decline in regional breeding or wintering populations.

Other Special-Status Species. Special-status species that would be most vulnerable to collision with turbines due to behavior and abundance factors include golden eagle, Swainson's hawk, and western bluebird. Golden eagle and Swainson's hawks would have low overall mortality levels, but high levels relative to local populations. Collision mortality could affect the low local breeding populations of these species. However, mortality would not be sufficient to affect regional distribution or abundance of these species because their regional populations are substantial enough to sustain local losses without significant effects on the overall population. Western bluebirds would have low overall mortality levels and low levels relative to local and regional populations. The potential impacts on local and regional populations of these species are summarized in Section 5 of this report.

Other Raptors (Not Special-Status). Some raptors are common on the project site and display behaviors that make them vulnerable to collisions with wind turbines. Overall mortality on the project site would be the greatest for these species, but would be low in relation to the size of local and regional populations. Raptors in this category include red-tailed hawk, American kestrel, and rough-legged hawk. In the case of red-tailed hawk and American kestrel, which are year-around residents, local breeding populations would be reduced, but these reductions would not affect the regional distribution or abundance because the species are so common. In the case of the rough-legged hawk, which only winters on the project site, local wintering populations could be reduced. However, losses on breeding populations would be more disperse because these birds migrate from many different breeding areas. As with the red-tailed hawk and American kestrel, mortality of rough-legged hawks would not be at a level that would significantly affect regional distribution or abundance.

Section 1. Introduction

Section 1. Introduction

An area in the Columbia Hills above the Columbia River in Klickitat County, Washington (Figure 1-1), is being considered for development of two wind power generation projects that could include the eventual placement of up to 436 wind turbines. The two projects include the 5,110-hectare (12,630-acre) KENETECH Washington Windplant™ Number 1 project, and the 395-hectare (975-acre) CARES Columbia Wind Farm #1 project.

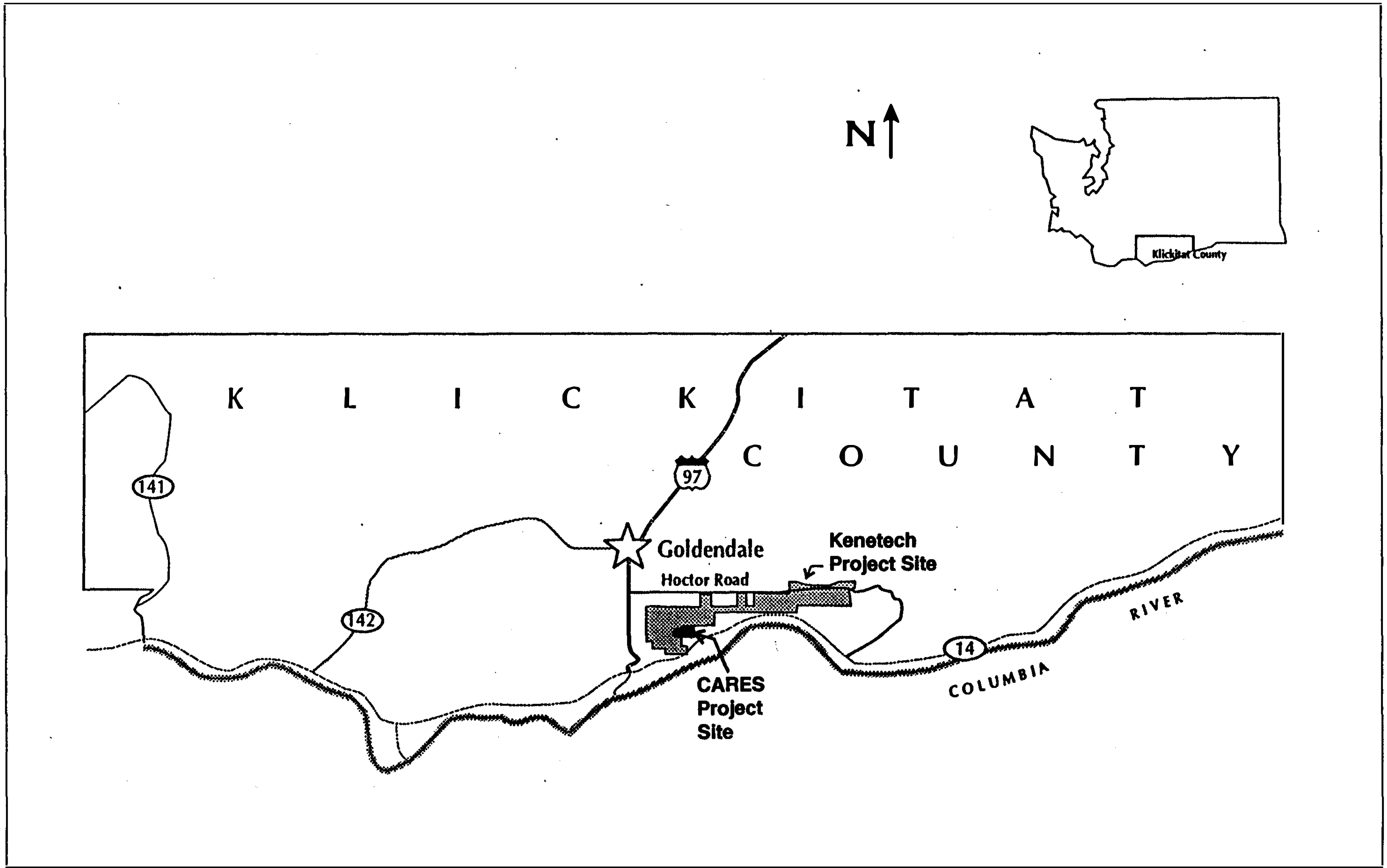
During the environmental impact statement (EIS) scoping process for these proposed developments, concerns were raised regarding the potential for avian mortality associated with wind farm development. Collision with wind turbines, guy wires, and transmission lines, and electrocution on power poles have been identified as sources of avian mortality, particularly raptors, at existing wind power facilities (Winkelman 1985, McCrary et al. 1986, CEC 1989, BioSystems Analysis 1992).

1.1 PURPOSE OF THE STUDY

Klickitat County and the Bonneville Power Administration (BPA) are the lead agencies who will be issuing joint environmental impact statements for each of the two projects pursuant to the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA). The potential for birds to collide with turbine structures has been identified as a concern of the public, state agencies, and federal agencies. The greatest concern is for raptors, which may be more vulnerable to collisions than other birds (BioSystems Analysis 1992).

This report serves as a technical reference to the draft environmental impact statement (DEIS), and support for BPA's biological assessment and Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS). Section 7 of the Endangered Species Act requires federal agencies, including BPA, to consult with the USFWS on actions leading to activities that may affect listed threatened and endangered species. As a biological assessment, this report assesses whether or not the proposed projects are likely to adversely affect a listed threatened or endangered species.

To address these concerns, BPA and Klickitat County retained Jones & Stokes Associates and R.W. Beck to conduct avian field studies in compliance with a study plan and protocol developed with input from state (WDFW and ODFW) and federal (USFWS) agencies and nationally recognized experts on raptors (Strickland pers. comm. 1994 and Nelson pers. comm. 1994). The intent of the studies was to provide the information needed to make informed decisions about potential impacts to avian resources from the proposed projects and to comply with the consultation requirements of the Endangered Species Act.



Jones & Stokes Associates, Inc.

Figure 1-1
Location Map

The avian study methods were designed to meet the following goals: (1) estimate impacts; (2) provide information for decisions under NEPA, SEPA, and the Endangered Species Act; (3) help identify alterations or refinements to project configurations that would reduce impacts on birds; and (4) provide a framework for ongoing monitoring studies of avian use and impacts should development of the projects be approved.

As the first step toward meeting the above goals, the following key questions (objectives) were developed to provide guidance in conducting the avian studies. The answers to these questions, coupled with existing information on impacts from other wind farm developments, were used to estimate impacts and identify potential mitigation measures.

General Use

- What species of birds are present or potentially present within areas of potential turbine locations during winter, breeding, summer, and spring and fall migration periods?
- How do these birds use the site (e.g., where do they occur and what habitats do they use)?
- Does use of the area by specific species groups differ: (1) within specific portions of the project area, or (2) during certain seasons?
- Are any species more likely to fly at critical altitudes (i.e., between 7.5 and 58 meters [25 and 190 feet] where they are vulnerable to injury from turbines) (1) within specific portions of the study area, or (2) during certain seasons?

Migration

- To what degree do specific species of birds migrate through the area relative to other known migration corridors in the western United States?
- Do migrating birds move through the study area in predictable patterns (e.g., at a specific altitude or using particular topographic features)?

Threatened and Endangered Species

- Do bald eagles or peregrine falcons forage, breed, rest, or travel near areas considered for wind turbine placement?

1.2 SITE LOCATION

The KENETECH Windpower Washington Windplant™ Number 1 and CARES Columbia Wind Farm #1 sites are located in the Columbia Hills area of Klickitat County, in southcentral Washington, 9.6 kilometers (6 miles) southeast of Goldendale and east of U.S. Highway 97 (Figure 1-1). Specifically, the project sites are located south of Hoctor Road and north of State Route (SR) 14 and the Columbia River. The CARES project site is bordered on the north and west by the KENETECH project site.

1.3 PROJECT DESCRIPTION AND SITE DEVELOPMENT

1.3.1 KENETECH Windpower Washington Windplant™ Number 1 Project

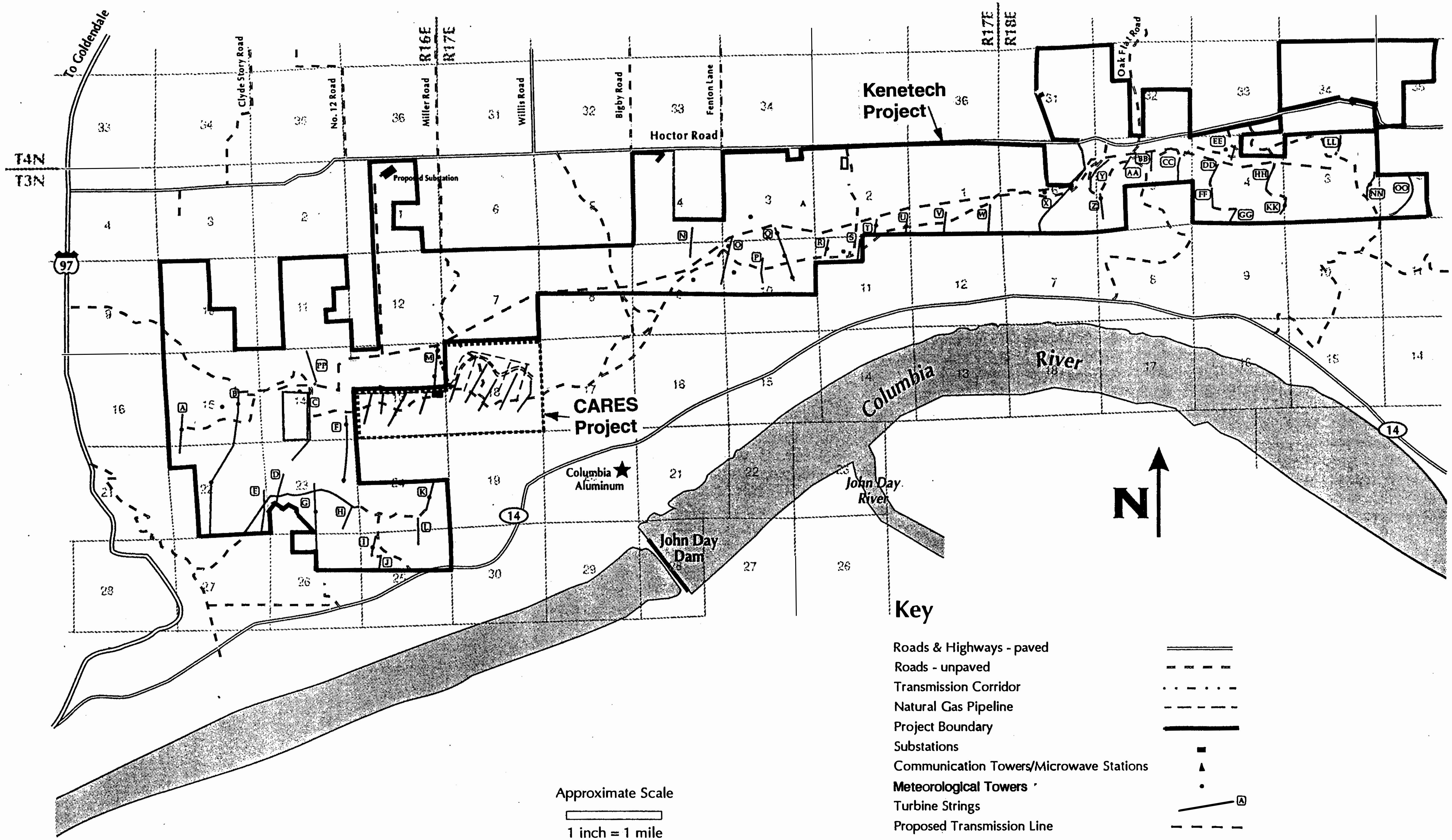
The Washington Windplant™ Number 1 project is proposed by KENETECH Windpower, Inc. KENETECH would construct, own, and operate the facility. KENETECH has requested that BPA transmit electrical power from the proposed project over its transmission system to utilities purchasing the project's output.

The KENETECH project includes the installation of approximately 345 wind turbines arranged in 39 distinct rows, or turbine strings. Turbines will have three-bladed rotors ranging from 33 to 39 meters (108 to 128 feet) in diameter, or 16.5 to 18 meters (54 to 64 feet) in radius. The rotors are attached to a horizontal-axis generator, mounted at the top of a modified tubular steel tower, and operate upwind of the towers. The towers measure 24 to 36.6 meters (80 to 120 feet) tall, resulting in the blade rotating sweep reaching from about 7.5 to 55 meters (25 to 187 feet) above the ground. The first phase of the proposed project would produce 50 megawatts (MW) and the total project, if built, would produce 115 MW.

Development within each turbine string would include turbines/rotors, tower structures and foundation pads, controls, small transformers, underground collection and communication lines, and an access road. Turbine strings would range in length from approximately 213 to 2,316 meters (700 to 7,600 feet) (Figure 1-2). Construction of turbine strings and new secondary access roads would temporarily disturb about 98 hectares (243 acres) (assuming a 100-foot-wide construction corridor) and would permanently occupy 33 hectares (82 acres). Following construction, new primary access roads would occupy 24 hectares (58 acres) and upgraded access roads would occupy 7 hectares (18 acres).

Each turbine string would interconnect to a new 34.5 kilovolt (kV) transmission line, 24.7 kilometers (15.3 miles) long. The line would generally run east-west across the central portion of the site. Construction of the transmission line would temporarily disturb about

Figure 1-2
Proposed Site Development of the
Kenetech and Cares Projects



Jones & Stokes Associates, Inc.

17 hectares (42 acres). The transmission line would permanently occupy about 14 hectares (34 acres). The transmission line would connect to a new substation located onsite, where power voltage would be increased to 230-kV prior to interconnection with the BPA Midway-Big Eddy transmission line. The project substation would occupy less than 0.5 hectare (less than 1 acre). Overhead powerlines would be constructed to meet standard raptor protection standards.

Project site development would also entail installing meteorological towers and developing an onsite maintenance facility. Temporary laydown areas, disturbing 4 hectares (10 acres), for construction equipment and materials would also be required.

The total amount of land that would be disturbed during construction is about 155 hectares (383 acres). After restoration of temporarily disturbed areas, project features would permanently occupy about 79 hectares (193 acres). Less than 3 acres would be impervious surface.

1.3.2 CARES Columbia Wind Farm #1 Project

The Columbia Wind Farm #1 project is proposed by Conservation and Renewable Energy System (CARES) and FloWind, Inc. CARES is a consortium of eight Washington state public utility districts, and FloWind is a wind energy developer. CARES would be the project owner and utility sponsor. As a contractor to CARES, FloWind would assist in project development and initial project operations. BPA would purchase up to 25 MW of electricity generated by the project and would provide the financial guarantee for bond financing.

The CARES project would be composed of 91 AWT-26 wind turbines generating 25 MW of electricity at any one time (an annual average of 7 MW). The CARES project site is 395 hectares (975 acres) located in the Columbia Hills, north of the Columbia River about 10.5 kilometers (6.5 miles) south of Goldendale in Klickitat County. The site is currently used as rangeland, with a radio facility located at the apex of Juniper Point.

The CARES project AWT-26 wind turbines are each rated at 275 kilowatts and generally operate in winds between 21 and 89 kilometers per hour (13 and 55 miles per hour). The turbines would be arranged in 11 rows (i.e., turbine strings) in a general southwest to northeast configuration. The turbines have two-bladed rotors that are 26.2 meters (86 feet) in diameter, or 13.1 meters (43 feet) in radius. The rotors are attached to a horizontal-axis generator, mounted at the top of a tubular tower, and operate downwind of the towers. The tubular towers measure approximately 43 meters (140 feet) tall and 0.9 meter (3 feet) in diameter, resulting in the blade rotating sweep reaching from about 30 to 56 meters (98 to 184 feet) above the ground. The tubular towers are designed to be anchored with guy wires.

The project would also include associated power collection and transmission lines, transformers, electrical substation, operations building, and access roads. The power collection and transmission system would consist of approximately 3,962 meters (13,000 feet) of underground trench, 5.6 kilometers (3.5 miles) of overhead 24-kV line, and 4 kilometers (2.5 miles) of overhead 115-kV line. About 4 miles of lateral roads would be built to access each of the turbine strings. An estimated 20 hectares (50 acres) of land would be temporarily disturbed during construction of the turbine strings and new secondary/lateral roads and 5.4 hectares (13 acres) would be disturbed permanently during operation. Approximately 2.4 kilometers (1.5 miles) of the 115-kV line would extend offsite to connect with an existing Klickitat County Public Utility District #1 transmission line, which then connects to BPA's Goldendale substation. The construction of the 24-kV and 115-kV transmission lines would temporarily disturb 4 hectares (10 acres) and permanently disturb 3.1 hectares (8 acres). All overhead transmission lines would be built to meet or exceed appropriate raptor protection standards.

Each turbine string would be served by an access road, and the existing jeep trail would be made into an engineered main access road. The main access road would be comprised of 8 kilometers (5 miles) of upgraded existing road. The upgraded main access road would temporarily disturb 11 hectares (28 acres) of land during construction and permanently disturb 10 hectares (25 acres) of land during operation.

Additional project features include the electrical substation, maintenance building, and construction staging area. Construction of the electrical substation would temporarily and permanently disturb 0.5 hectare (1 acre) of land. The maintenance building would temporarily and permanently disturb 0.4 hectare (1 acre). The construction staging area would temporarily disturb 2 hectares (5 acres).

The total amount of land that would be disturbed during construction is about 42 hectares (95 acres). After restoration of temporarily disturbed areas, project features would permanently occupy about 19.4 hectares (48 acres).

1.4 CONSULTATION UNDER THE ENDANGERED SPECIES ACT

Telephone communications and meetings have been held with representatives of the USFWS and the Washington Department of Fish and Wildlife (WDFW) to obtain input on the field studies to be conducted and regarding compliance with Section 7 of the Endangered Species Act. Initial input was received from the USFWS on February 15, 1994 (Bush pers. comm.) and from the WDFW on February 1 and 11, 1994 (Anderson pers. comm.). Based upon USFWS and WDFW agency input and scoping comments, a detailed avian study plan and protocol was prepared by Jones & Stokes Associates in March and April. Follow-up meetings were then held with the USFWS on March 10, 1994, and the WDFW on March 8, 1994 to discuss the avian study plan and protocol. The plan and protocol was followed during the surveys conducted from April through October 1994. Meetings were held again with the USFWS on December 14, 1994, and with the WDFW on November 28 to update them on the status of the field studies and the preliminary results of the data analysis. This technical report will be submitted by BPA to the USFWS as a biological assessment. Additional winter raptor field studies are being conducted in December 1994, and the information will be transmitted to the USFWS as an addendum letter. Under Section 7 of the Endangered Species Act, the USFWS is responsible for issuing a biological opinion within 90 days if a request for formal consultation is made.

1.5 OVERVIEW OF AVIAN MORTALITY AT WIND FARMS

Human-made structures, including transmission towers, buildings, and utility lines, have been identified as a source of avian mortality for decades (Coues 1876, Aronoff 1949, Alsop and Wallace 1969, Avery et al. 1980). Migrating birds, in particular, appear to be the most vulnerable to collision with tall structures at night and during inclement weather (Aronoff 1949, Cochran and Graber 1958, Weir 1977).

During the 1970s and early 1980s, research focused on waterfowl collisions with transmission lines and electrocution of raptors on electrical utility poles (Krapu 1974, James and Haak 1979, Benson 1980). The level of waterfowl and raptor mortality has been successfully reduced by siting transmission line corridors to avoid crossing important waterfowl travel corridors (Beaulaurier 1981), installing raptor protection devices on utility poles, and providing adequate spacing between conductors (Olendorff et al. 1981).

Wind energy exploration and development for utility-scale power generation began during the 1970s. Single wind turbines or small groups of turbines were constructed in various locations, particularly along the Pacific Coast, to assess the potential and feasibility of generating and marketing wind-produced electrical energy. During the 1970s and 1980s, large multi-turbine facilities, or wind farms, were constructed in areas identified as wind resource areas (WRAs) in California.

The potential for avian mortality at wind farms was suggested relatively early in the development of wind energy technology (Rogers et al. 1977). During the 1980s, several projects were initiated to study the potential for collision with wind turbine generators at one or several turbines (Byrne 1983, Karlsson 1983, Moller and Poulsen 1984).

Most of the recent work on avian mortality at wind farms has occurred at WRAs in California. Systematic data collection began in 1985 at the San Gorgonio WRA in Southern California (McCrary et al. 1985). In 1989, a staff report by the California Energy Commission (CEC) concluded that rows of large wind turbine generators and unprotected utility poles are a mortality hazard to breeding and wintering raptors in certain WRAs (CEC 1989). This conclusion was reached by compiling and analyzing existing data from wind farm operators, resource agencies, and others. The report also concluded that further study was necessary to assess the extent of the problem and to investigate solutions.

As a result, the CEC funded a study to investigate raptor mortality in the Altamont WRA in Central California (BioSystems Analysis 1992). Howell and Noone (1992) also conducted postconstruction monitoring studies at a KENETECH (formerly U.S. Windpower) facility in the Solano WRA. Both of these studies, as well as an independent multi-year study begun by KENETECH in 1989 in the Altamont WRA, have provided data on actual collision mortality, mortality potential, and limited information on cause of mortality as it relates to bird behavior.

Additional proposed wind resource development in the Solano WRA has also resulted in several preconstruction monitoring studies of waterfowl and raptor use of proposed wind farm development sites (BioSystems Analysis 1987a, 1987b; Jones & Stokes Associates 1987; Howell and DiDonato 1988; Howell and Noone 1993). These studies have provided data on avian abundance, habitat use, and movements in the proposed wind farm sites.

A more detailed discussion of these studies and findings is provided in Section 5.2.

Section 2. Environmental Setting

Section 2. Environmental Setting

2.1 OVERVIEW

The project sites are located along the Columbia Gorge region of south-central Washington. The primary feature defining the area is a steep ridge, 21 kilometers (13 miles) long, that rises abruptly 900 vertical meters (2,800 feet) above (north of) the Columbia River. The ridge consists of a mostly continuous, southeast-facing steep slope composed primarily of grassland with occasional basalt outcroppings and cliffs. Grassland habitat in the Columbia Hills ranges from areas which have been heavily grazed and are dominated by non-active invasive weeds, such as cheatgrass (rangeland), to areas which are relatively undisturbed and contain predominantly native grasses and shrubs (shrub-steppe habitat). This slope separates the Columbia River to the south from the Goldendale Plateau to the north. The Goldendale Plateau begins at the top of the ridge and slopes gently downward to the north, toward Goldendale. The eastern and western ends of the ridge transition into more rounded loess hills (loess consists of silt-loam soils).

2.1.1 Overview of Study Area

Two study areas were defined to conduct the field studies and impact analysis. The first one is the greater study area, comprised of a 10-mile radius surrounding the project sites and the focus of the nesting/breeding survey. The second study area includes the project sites (Figure 2-1) and lands within approximately 1 kilometer (0.6 mile) of potential wind turbine and collection line locations. This 1-kilometer distance was established to focus on avian use near potential turbine and collection line locations, the area in which birds would be at risk of collisions with project structures. The project sites consist of five areas containing similar topography, vegetation, land use, and other habitat features (Figure 2-2). These areas are called study units in this report (see Section 3, Study Methods, for more explanation on how field studies were conducted in these study units).

The five study units are defined as follows:

1. **Western hills.** This unit includes the steep, rounded hills located on the western quarter of the primary study area. The primary unit contains primarily grassland and some riparian habitat.

2. **Eastern hills.** This unit includes the steep, rounded hills located on the eastern quarter of the primary study area. The unit contains mostly grassland interspersed with a few parcels of cropland and some woodland.

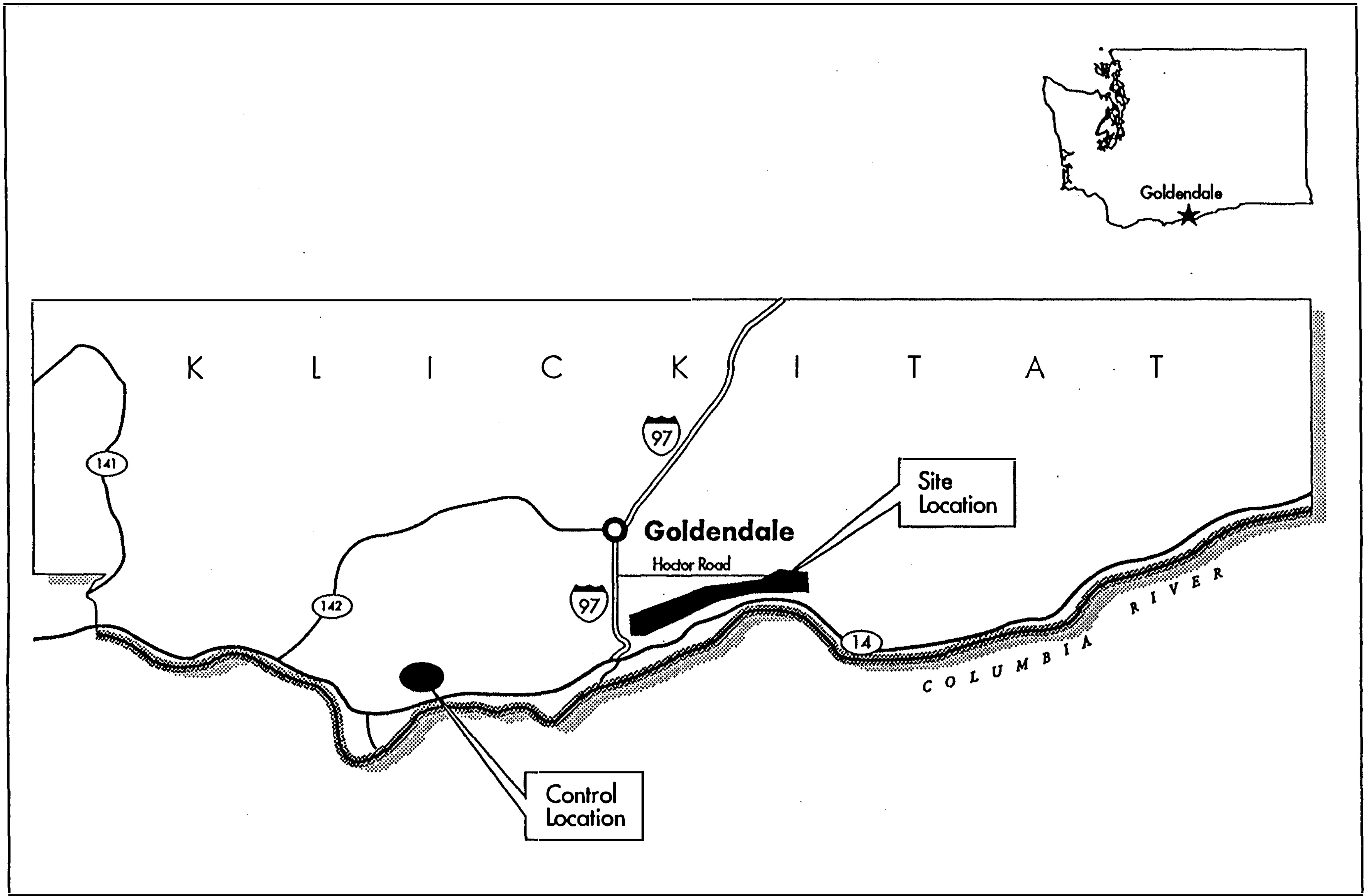


Figure 2-1. Vicinity Map

3. **Ridge top.** This unit includes lands within 0.5 kilometer (0.3 mile) north of the ridge line, where the ridge face peaks and begins to gently slope downward to the north. The unit contains grassland along rolling topography connecting the various points (e.g., Juniper and Clauson) along the ridge top. These points are separated by shallow gaps (also known as saddles).

4. **Ridge face.** This unit includes the face of the ridge that dominates the study area. The ridge is composed of the steep, south-facing slopes and cliffs situated on the southern edge of the study area (between the western hills and eastern hills study units). This study unit begins approximately 1 kilometer (0.6 mile) west of Juniper Point and continues about 13 kilometers (8 miles) east. The ridge is paralleled by State Route (SR) 14 and the Columbia River to the south. About 0.5 kilometer (0.3 mile) of gently sloping hills separates the road from the ridge face, which rises from the valley floor approximately 900 meters (2,800 feet) over about 1 kilometer (0.6 mile) horizontal distance. The unit contains mostly grazed grassland intermixed with patches of juniper and a few patches of pine and oak/pine woodland.

5. **Northern plateau.** This unit includes lands beginning 0.5 kilometer (0.3 mile) north of the ridge line and continuing north to the northern limit of the study area. The unit contains grassland and oak/pine woodland in the southern portion and agricultural lands (mostly pasture) and some juniper woodland in the northern portion.

2.2 BUILT ENVIRONMENT

The project sites and vicinity have been altered by human developments and activities. Two major developments in the area include the John Day Dam and the nearby Columbia Aluminum Plant. The John Day Dam has raised water levels and contributed to human activity in the area, and the industrial Columbia Aluminum Plant adds to the overall development in the area. A railroad line also runs along the Columbia River. Electrical transmission lines traverse the sites and surrounding area, the largest being the BPA Midway-Big Eddy 230-kV line.

Agricultural practices have shaped the sites' vegetation communities. Arable lands have been converted to nonirrigated cropland or pastures, and much of the nonarable land has been heavily grazed.

The transportation network includes highways on both sides of the Columbia River and on the western edge of the study area, and paved and unpaved roads traversing most of the area. Single-family, ranch, and farm homes are dispersed throughout the more level portions of the landscape. Most residences are present along the northern portion of the study area (along Hoctor Road).

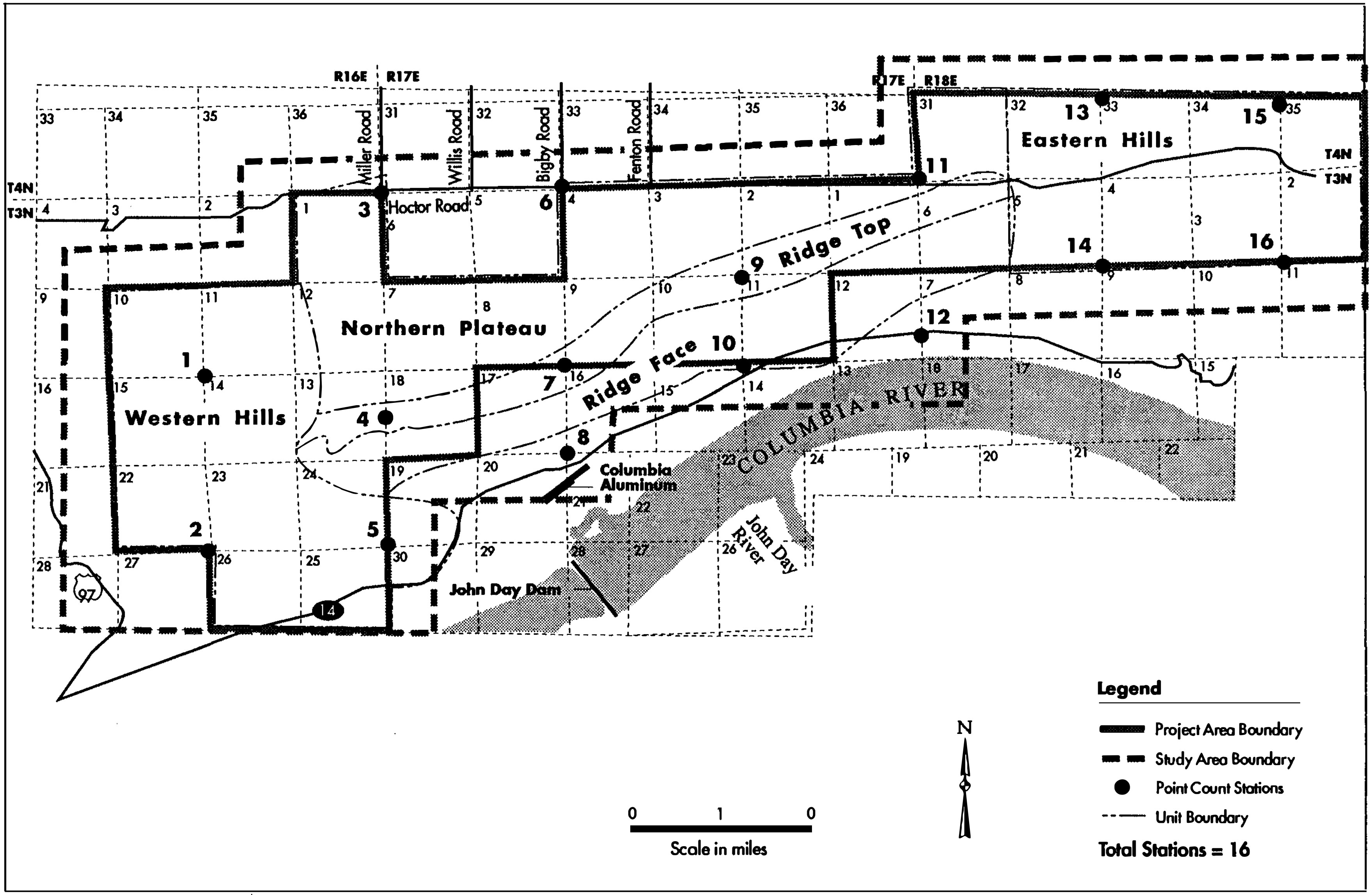


Figure 2-2. Fixed Point Stations and Units - Spring and Fall Seasons

2.2.1 KENETECH Site

A number of existing utility corridors traverse portions of the KENETECH site. Two BPA high-voltage transmission lines are partially located on project lands: the 230-kV Midway-Big Eddy line crosses the northwestern corner of the KENETECH site, and the 500-kV Hanford-John Day line passes through the far eastern portion of the KENETECH site. A 115-kV Klickitat County PUD transmission line crosses the western portion of the KENETECH site enroute from John Day Dam to Goldendale. A natural-gas pipeline runs east-west just south of Hoctor Road and passes through the northern portion of the KENETECH site. Numerous smaller distribution lines are present throughout the KENETECH site, including those along Hoctor Road and other areas.

2.2.2 CARES Site

At the CARES site, several communication towers and microwave stations are present at the peak of Juniper Point. An unpaved road traverses the site from Hoctor Road to the communication tower area. There is another jeep trail that runs east-west through the site. A natural-gas pipeline, the same one also traversing the KENETECH site, runs north-south through the western portion of the site. The site apparently has been grazed less intensively than other areas, and several native plant communities are present (see Jones & Stokes Associates 1994).

2.3 VEGETATION COMMUNITIES

General topography and vegetation in the vicinity include basalt terraces, mixed grassland, and patches of cottonwoods along the river; a mix of grassland, juniper patches, talus, and basalt outcrops along the steep ridge face; grassland mixed with juniper patches along the ridge top; oak/pine woodlands within shallow draws north of the ridge; and relatively flat cropland and pasture situated to the north. Some grain and forage cropland is present in the eastern portion of the study area. Much of the area is extensively grazed. Table 2-1 summarizes the major plant communities identified in the study area, and Figure 2-3 illustrates their distribution.

2.3.1 KENETECH Site

The KENETECH project site contains the more rounded hills present on the eastern and western thirds of the study area. These hills are predominantly grasslands that have been heavily grazed and contain a mix of mostly non-native annual grasses (predominantly cheatgrass) and some native grass species. Gray rabbitbrush occurs in a patchy distribution.

Table 2-1. Summary of Vegetative Communities Classified on the KENETECH and CARES Project Sites, Klickitat County, Washington

Vegetative Community	General Description	General Location	Dominant Plants	Approximate Percentage of Kenetech Site	Approximate Percentage of CARES Site
Oak and oak-pine stands	Patches of oak and mixed oak and pine	Draws located north of ridgeline	Oregon white oak, Oregon white oak-ponderosa pine, western juniper, Idaho fescue, and Douglas-fir	11	<1
Cultivated or recently cultivated land	Currently cultivated and recently abandoned farmland, including Conservation Reserve Program (CRP) areas	Northern portion of study area	Wheatgrass	18	0
Rangeland	Degraded grasslands and improved pasture	Eastern and western loess hills along and below ridgeline	Cheatgrass and gray rabbitbrush	>62	16
Juniper woodland	Open areas of grassland interspersed with 3-6 meter junipers	Central portion of study area along and south of ridgeline	Western juniper, bluebunch wheatgrass, cheatgrass, and other weedy grasses and forbs	1	0
Native shrub-steppe communities	Grasslands or shrub-steppe composed of mostly native species	Scattered patches along ridge top	Bluebunch wheatgrass, Idaho fescue, Douglas buckwheat, Sandberg's bluegrass, northern buckwheat, thyme-leaved buckwheat, stiff sagebrush, bottlebrush squirreltail, gray rabbitbrush, western yarrow, wild buckwheats, and desert-parsley	5	49
Wetlands	Very degraded excavated stockponds heavily used by livestock; many are entirely devoid of vegetation	Isolated ponds north of ridgeline	Willows, common cattail, western serviceberry, and chokecherry	<1	0
Riparian	Many are eroded and low in vegetation cover because of heavy livestock use	Mostly in valley bottom in southwestern portion of study area	Oregon white oak and black cottonwood	<1	0
Mixed rangeland	Basalt outcrops and native shrub-steppe communities	Steep slopes and cliffs located north of the ridge line	Western juniper, mixed grasses	1	34

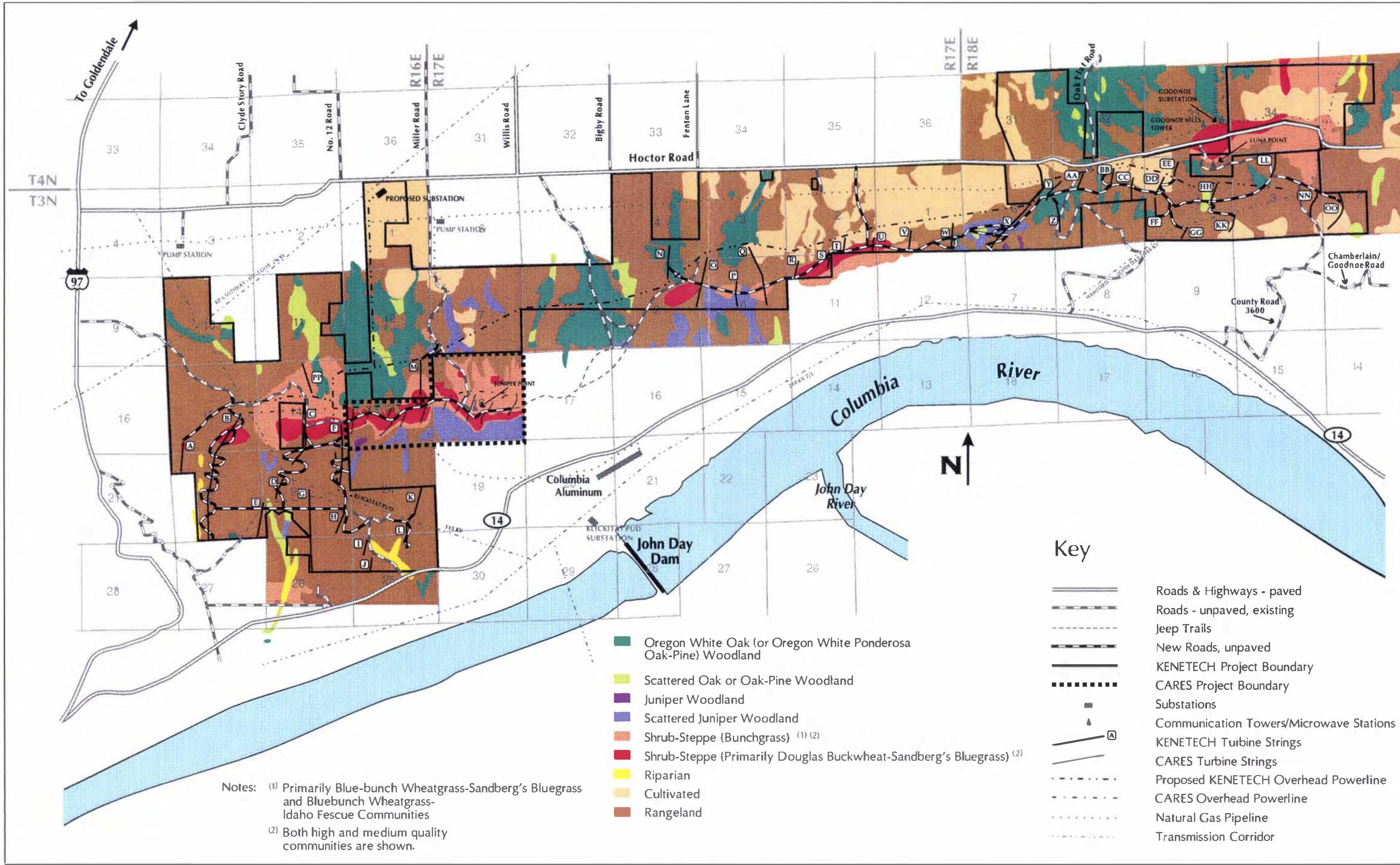


Figure 2-3 — Plant Communities/Habitat Map

Three areas situated in draws north of the ridge line contain the majority of oak and oak/pine woodlands. One area is located about 1 kilometer (0.6 mile) northwest of Juniper Point (just north of the CARES site), one is located about 2 kilometers (1.2 miles) northeast of Juniper Point, and one is located in the northeast portion of the study area. Smaller patches of oak and pine woodlands are also present south of the ridge line in steep canyons.

The most northern portion of the KENETECH site is predominantly agricultural lands. Nonirrigated cropland and pasture are common along Hoctor Road, which runs east-west and generally forms the northern limits of the site. Croplands are also present in the central portion of the site.

2.3.2 CARES Site

The CARES project site is located approximately one-third of the way from the western edge of the study area. It contains Juniper Point, which is a prominent feature of the ridge. Juniper Point drops off steeply to a formation of basalt cliffs and outcrops interspersed with steep slopes containing mixed grasses and junipers. Extensive talus formations are present at the base of this slope. The area west of Juniper Point (which is where most turbine strings would be located) contains a mix of native grasslands and, at the northernmost edges, developed pasture and oak woodlands.

2.4 GENERAL CLIMATIC CONDITIONS

The Columbia Hills area is located in the Central Basin climatic region, which is known for low precipitation and generally cold winters and hot summers. Typical January temperatures are a low of -7°C (20°F) and a high of 2°C (36°F). Typical July temperatures are a low of 13°C (56°F) and a high of 29°C (84°F). Snow is relatively common during the winter months; however, accumulations are usually slight. Winds are predominantly from the west at Goodnoe Hills and the west-northwest at Juniper Point and range from a few kilometers per hour to over 50 kilometers per hour (30 miles per hour).

Winds typically blow eastward up the Columbia Gorge and parallel to the ridge face that defines the study area. The ridge creates complexities in the wind flow over the area, and winds are occasionally deflected by the ridge. This deflection can form downdrafts flowing down the ridge and updrafts flowing up the ridge and over the top of the ridge.

2.5 EXISTING KNOWLEDGE OF AVIAN RESOURCES

This section provides the background information necessary to understand the field results presented later in this report. This section does not discuss the results of surveys that were conducted as part of this study. Rather, it includes general information on the types of species present in the area, their habitat associations and behavior, and the status of species in terms of regulations and other considerations.

The information provided here has been gathered from several sources, including state biologists and information contained in the Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species Database (which lists known locations of species and habitats that are a management priority of the WDFW).

This section also summarizes avian habitat associations and behavior patterns from the scientific literature (e.g., Heintzelman 1986, Johnsgard 1990, Alerstam 1990, Kerlinger 1989, Reynolds et al. 1992, and numerous scientific articles in journals such as Raptor Research, Condor, Northwestern Naturalist, Journal of Field Ornithology, and Journal of Wildlife Management).

2.5.1 Special-Status Species

Some of the species that occur in the study areas are considered special-status species. These are species that are afforded some level of regulatory protection or advisory management by state or federal resource agencies because of declining population levels.

Federally Listed Species

For these projects, the Endangered Species Act (16 USC 1531 et seq.; PL 97-304) is administered by BPA (the "action agency") and the U.S. Fish and Wildlife Service (USFWS, the "consulted agency"). The USFWS lists certain wildlife species under three different categories. Threatened and endangered species ("T&E") are protected from harm through various sections of the Endangered Species Act (ESA), including the Section 7 consultation process described below. Endangered species are considered in danger of extinction throughout all or a significant portion of its range. Threatened species are considered likely to become endangered within the foreseeable future without active management. Candidate species are listed as an advance notice to federal agencies of species which may be proposed and listed in the future as T&E (except for Category 3 which are no longer being considered for listing).

Section 7 of the ESA requires federal agencies, including the BPA, to consult with the USFWS on actions leading to activities that may affect listed T&E species. In this case, the BPA is obligated to provide the USFWS with the best available scientific and commercial information regarding the potential impacts of the CARES and KENETECH projects on the listed T&E species using the project areas and their critical habitat, if any. This report has been prepared to support the BPA's "biological assessment" of whether or not the CARES and KENETECH projects are likely to adversely affect a listed T&E species. Should the biological assessment conclude that bald eagles and peregrine falcons may be adversely affected by collision with wind turbines in the project areas, formal consultation with the USFWS is required.

In formal consultations, the USFWS reviews the biological assessment and issues a biological opinion whether or not the projects would jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If the biological opinion concludes that the species would be jeopardized by the projects, USFWS shall suggest reasonable and prudent alternatives that BPA can take to avoid jeopardy. If the biological opinion indicates that the species will not be jeopardized, or if USFWS offers reasonable and prudent alternatives to avoid jeopardy, the USFWS could issue an "incidental take statement" that details the reasonable and prudent measures necessary to minimize take, which are typically minor alterations to a project.

Peregrine falcons, an endangered species, and bald eagles, a threatened species, are present in the Columbia Gorge region of Oregon and Washington. These species are discussed in greater detail below.

Federal Candidate Species

There are three categories of candidate species: Category 1 is those for which the USFWS has substantial evidence to support listing; Category 2 is those for which conclusive evidence is lacking; and Category 3 is those which are no longer being considered for listing.

Species that are listed or candidates for listing as federally threatened or endangered are listed in Table 2-2 along with their status, distribution, and habitat associations.

State-Listed or State Species of Concern

Several species that potentially occur within the study area are on lists prepared by Oregon or Washington wildlife agencies. These lists are generally intended to define management priorities and to provide an early warning system that may prevent some species from becoming threatened, endangered, or extinct in the two states. Table 2-3 presents the state-listed species that potentially occur in the study area.

At the state level in Washington, state-listed animal species are not specifically protected by regulations, but may be protected in appropriate cases under SEPA. The Washington state list is advisory only and is intended to help focus conservation efforts on those species most in need of special consideration.

Table 2-2. Species Listed under the Endangered Species Act, Including Candidates for Listing, KENETECH and CARES Project Sites and Vicinity, Klickitat County, Washington

Species	Federal Status[a]	Regional Distribution	Potential for Using Study Area	Habitat Association[b]
Peregrine falcon (*Falco peregrinus*)	E	Throughout Washington and Oregon, although most occur in the Columbia Gorge and coastal regions of Oregon and Washington	Occasional travel and foraging, possible nesting	Cliffs, large concentrations of flocking birds, especially waterfowl or rock dove
Bald eagle (*Haliaeetus leucocephalus*)	T	Associated with major river systems of Washington and Oregon	Foraging on slopes, roosting in pine forest types	Water, ponderosa pine forest, rangeland
Black tern (*chlidonias niger*)	C2	British Columbia to Central California	Potential rare migrant	Marshes and shallow ponds
Western sage grouse (*Centrocercus urophasianus phaios*)	C2	Sagebrush areas of eastern Washington and Oregon	Possible along river and in riparian draws	Sagebrush
Northern goshawk (*Accipiter gentilis*)	C2	Forested areas of Washington and Oregon	Possible migrant	Mature forest types
Long-billed curlew (*Numenius americanus*)	C2	Columbia Basin region of Oregon and Washington	Potential breeding and migrant	Annual grasslands
Ferruginous hawk (*Buteo regalis*)	C3	Southeastern Columbia Basin, not known to breed in Klickitat County	Potential migrant	Arid grasslands with level or rolling terrain (avoid high elevations)

[a] Status explanations:

E = listed as endangered under the federal Endangered Species Act.

T = listed as threatened under the federal Endangered Species Act.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate, but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

C3 = no longer a candidate for federal listing. Category 3 species have been dropped from the candidate list because they are extinct (C3a), taxonomically invalid or do not meet the USFWS definition of a "species" (C3b), or are too widespread or are not threatened at this time (C3c).

-- = not listed.

[b] Source: Rodrick and Milner 1991, Marshall et al. 1992, Frederick pers. comm.

Table 2-3. State-Listed Species (with No Status under the Endangered Species Act), Kenetech and CARES Project Sites and Vicinity, Klickitat County, Washington

Species	Oregon Status	Washington Status	Habitat Association[a]	Suitable Habitat at Kenetech Site?	Suitable Habitat at CARES Site?
Lewis' woodpecker (*Melanerpes lewis*)	Critical	Candidate	Oak and pine woodlands	Yes	Yes
Swainson's hawk (*Buteo swainsoni*)	Vulnerable	Candidate	Open areas, agricultural lands	Yes	Marginal
Western bluebird (*Stalia mexicana*)	Vulnerable	Candidate	Clearings, old farms, fields, pastures, burned areas with snags	Yes	Yes
Bank swallow (*Riparia riparia*)	Undetermined	--	Open ground or water; nests near water in recently cut banks	Yes	Yes
Grasshopper sparrow (*Ammodramus savannarum*)	Undetermined	Monitor	Grasslands with or without shrubs	Yes	Yes
Burrowing owl (*Speotyto cunicularia*)	Critical	Candidate	Sagebrush steppe, grasslands, pastures, and roadsides where vegetation is sparse and terrain level	Yes	Yes
Golden eagle (*Aquila chrysaetos*)	--	Candidate	Areas isolated from human disturbance in open grassland; nests on cliffs or in large trees	Yes	Yes
Prairie falcon (*Falco mexicanus*)	--	Monitor	Arid lands and open grasslands	Yes	Yes
Sandhill crane (*Grus canadensis*)	--	Endangered	Extensive open areas providing good visibility, including grain fields, meadows, large marshes, and shallow ponds; nests in large shallow-water marshes	Marginal	Marginal
Gray flycatcher (*Empidonax wrightii*)	--	Monitor	Dry coniferous forests	Yes	Marginal
Ash-throated flycatcher (*Myiarchus cinerasens*)	--	Monitor	Open grassland and riparian	Yes	Possible

Table 2-3. Continued

Species	Oregon Status	Washington Status	Habitat Association[a]	Suitable Habitat at Kenetech Site?	Suitable Habitat at CARES Site?
Loggerhead shrike (*Lanius ludovicianus*)	--	Monitor	Shrubland for nesting, open areas for foraging	Possible	Possible
Turkey vulture	--	Monitor	Open, usually arid areas, nests on cliffs	Yes	Yes
Osprey (*Pandion haliaetus*)	--	Monitor	Closely associated with fish-bearing waters, nests in large trees	Possible	No
Merriam's turkey	--	Priority (game status)	Ponderosa pine and white oak	Yes	Yes
Sage sparrow	--	Monitor	Sagebrush steppe	Yes	No

-- = not listed.

[a] Sources: Rodrick and Milner 1991, Marshall et al. 1992, Dames & Moore 1993, Carey pers. comm., ODFW 1993, WDFW 1993.

In Oregon, the state's Endangered Species Rules (OAR 635-100-105) apply to actions taken by agencies of Oregon or any action taken on state owned lands. It does not apply to the two projects involved in this study. As in Washington, state-listed species in Oregon carry no regulatory requirements but are intended to advise landowners and others of the declining populations of those species.

2.5.2 General Avian Communities

Raptors

Raptors are a primary focus of this study because they have been found to be more susceptible to collisions with wind turbines than are other types of birds (BioSystems Analysis 1992). This susceptibility is due primarily to their flight and foraging behaviors. Both the KENETECH and CARES sites provide habitat for several species of raptor. Table 2-4 lists those raptors known or believed to be present in the study area, based on consultations with ODFW and WDFW, on preliminary studies conducted at the project site (Dames & Moore 1993) and on range and habitat information provided in the literature.

Waterfowl

The Columbia River and associated tributaries south of the study area provide the most suitable waterfowl habitat in the vicinity. Waterfowl breed along the river, and about 6,000 ducks and geese winter near the mouth of the John Day River (Annear in Dames & Moore 1993). While waterfowl use is most concentrated along the Columbia River, waterfowl have been reported to feed in croplands similar to those in the north plateau study unit (Dames & Moore 1993). This behavior is most likely to occur during nonbreeding periods, especially during the fall and winter. In late fall, large flocks of Canada geese and various species of ducks fly through the Columbia River corridor. Their movements are mostly restricted to the river itself, but waterfowl can move great distances relatively easily and are likely to take advantage of foraging opportunities located away from the river. The Klickitat County Long Range Resources Plan identifies the waterfowl are abundant along the Columbia River and that they often forage in croplands located north of the river in Klickitat County.

Other Common Birds

Several species of birds occur in the study area. Some species of medium- to large-sized birds are common throughout the study area, including common raven, black-billed magpie, western meadowlark, and northern flicker. In general, the north plateau study unit contains habitat for species associated with agricultural lands, including Brewer's blackbird, horned lark, killdeer, swallows, and European starling. Many of these birds are habitat generalists and use habitats in the other study units as well.

Table 2-4. Raptor Species Known or Likely to Be Present in the Study Area

Species	Breeding	Winter	Fall	Spring	Summer	General Habitat	Comments
Bald eagle		X				Water, ponderosa pine forest, rangeland	Known to winter within the study area
Pegergine falcon		X	X	X	X	Cliffs, large concentrations of flocking birds, especially waterfowl or rock dove	Known to be present in general area, but mostly west of study area
Golden eagle	X	X	X	X		Steep-sloped open areas	Known to breed within the study area
Red-tailed hawk	X	X	X	X	X	Open areas	Most common in areas containing perches
Northern harrier	X	X	X	X	X	Croplands and grasslands	
Rough-legged hawk		X				Croplands and grasslands	Common in winter
Swainson's hawk	X				X	Croplands and grasslands	
American kestrel	X	X	X	X	X	Common in many habitat types	Prefers areas containing perches, especially areas with utility lines close to ground
Merlin		X				Variable, typically grassland and forest edges	Uncommon in area
Prairie falcon	X	X	X	X	X	Cliffs, cropland and grasslands	
Turkey vulture	X		X	X	X	Steep open areas	Known to breed at Maryhill Park located west of the project area
Sharp-shinned hawk	X	X	X	X	X	Oak/pine woodlands, riparian thickets, and open areas	
Cooper's hawk	X	X	X	X	X	Oak/pine woodlands	
Ferruginous hawk		X				Level open areas with basalt outcrops	Not typically found in the area
Great horned owl	X	X	X	X	X	Common in many habitat types	
Western screech owl	X	X	X	X	X	Oak/pine woodlands	
Short-eared owl	X	X	X	X	X	Grasslands and cliffs	

Sources: Palmer 1988, Johnsgard 1990, Wahl and Paulson 1991, Ennor 1991, and WDFW Priority Habitats and Species Database.

The eastern and western hills study units contain habitat for several species of sparrows, including savannah, grasshopper, and vesper sparrow. The ridge top study unit contains habitat for a variety of song birds associated with open grassland and juniper savannah, including Townsend's solitaire, American robin, and several types of sparrows and other passerines. The ridge face study unit contains habitat suitable for nesting cliff swallows as well as canyon wrens and chukar. California quail are common south of the ridge face along the Columbia River.

2.5.3 Species Listed Under the Federal Endangered Species Act

The following sections describe what was generally known about threatened and endangered species prior to the initiation of the field studies conducted for the proposed projects. See Section 4, Affected Environment, for the results of field studies.

Peregrine Falcon

Current Status. Peregrine falcons are state and federally listed as endangered in Oregon and Washington. The species' global decline is attributed mostly to the use of DDT and other pesticides. Since the banning of these chemicals in the United States, peregrine falcon numbers in Washington have increased, in part due to active reintroduction programs.

Recovery Goals. The USFWS has developed a recovery plan for the Pacific population of peregrine falcons (USFWS 1982). The plan identified specific minimum numbers of breeding pairs within 21 Peregrine Falcon Management Units located within Washington, Oregon, California, and Nevada. For the species to be delisted, each management unit must maintain the minimum number of pairs and average 1.5 young fledged per pair each year. The study area is located within the Columbia Gorge Peregrine Falcon Management Unit, which has a goal of maintaining a minimum of 3 breeding pairs. As of 1993, up to 7 pairs were known to be present in the Management Unit but the breeding situation has been unstable and changes from year to year (McAllister pers. comm.).

Regional Numbers. Peregrine falcons have never been abundant in Washington or Oregon (Garbrielson and Jewett 1970), with historical numbers estimated to be 16 pairs for Washington and 30 pairs for Oregon (Platt and Enderson 1989). Populations declined further as a result of egg-shell thinning caused by DDT and other chemicals (USFWS 1992). In Oregon, the 1992 count was established at 26 nesting pairs, with 15 successfully fledging young (ODFW 1993). Oregon nesting areas are located primarily on the Pacific Coast, Siskiyou Mountains, Cascade Mountains, and Columbia River Gorge.

Naturally established nest areas in Washington have been documented in the outer Pacific Coast, the San Juan Islands, and the Columbia River Gorge. A much publicized pair nested in Seattle in 1994. Reintroduction programs in Washington have included the release of young birds in the Columbia River Gorge in Skamania County, located immediately west of Klickitat County. According to the WDFW nongame database, young were placed within an active prairie falcon nest in the middle reaches of Rock Creek Canyon, located 5.6 kilometers (3.5 miles) east of the study area. Young have also been released in Lewis, Spokane, Asotin, and Yakima Counties (Rodrick and Milner 1991).

Washington is also used by wintering peregrine falcons originating from Alaska and Canada. Peregrine falcons are known to use the larger estuaries and bays that support large populations of wintering waterfowl, including Skagit Flats, Grays Harbor, and Willapa Bay (USFWS 1982, Wahl and Paulson 1991). Peregrine falcons have also been observed overwintering in urban habitats within the Puget Sound region. Over about the past 4 years, peregrines have been observed for extended winter periods in Seattle, Tacoma, and Olympia.

Site Numbers. Peregrine falcons are known to nest within the Columbia River Gorge in the general vicinity of the study area, but no nests have been reported within the greater study area. A pair has nested for the past 9 years at Horsethief Lake State Park, which is located about 25 kilometers (15 miles) west of the primary study area. Another nest site is known to exist about 38 kilometers (23 miles) west of the primary study area, near Lyle, Washington (Dames & Moore 1993).

Seasonal Timing. According to Call (1978), peregrine falcons usually begin egg laying from around the third week in March to the first week in May, with hatching occurring any time from late April to mid-May. Young usually leave the nest in June.

During migration, peregrine falcons have been reported to move through the eastern Washington area from late November through January (Ennor 1991). Documented wintering areas have been located in saltwater areas of western Washington, including the Samish Flats, Grays Harbor, and Sequim areas.

Food Stocks. Peregrine falcons feed almost exclusively on birds, which are usually taken in the air. A variety of small birds are taken, but peregrines are most noted for taking flocking birds when available, including waterfowl, rock dove, mourning dove, and shorebirds. During the nonbreeding season, peregrine falcons typically follow the movements of shorebirds and waterfowl.

Habitat, Including Nesting and Foraging Areas. In general, peregrine falcons are found in areas with cliffs or other tall features (including large trees and human-made structures) and near abundant sources of prey. Such features provide a good vantage point from which to locate and dive on prey.

Peregrines typically nest on steep cliffs or other areas where they can avoid predators such as fox and coyote. Ratcliffe (1993) reported that peregrines "favor the highest and steepest cliffs available". Basalt cliff formations along the Columbia River Gorge are one of the primary features making the area suitable for peregrine falcon breeding.

Because of peregrines' close affinity for cliffs, the southern portion of the CARES site provides the most typical habitat, although cliffs in this area are not the highest and steepest available. Higher (i,e., more suitable) and more abundant cliff habitat is present across the river from the study area, just east of the John Day River.

Other portions of the CARES site and most of the KENETECH site contain steep, grassy slopes, rather than cliffs. Nevertheless, because cliffs are nearby in several places along the Columbia River and because peregrine falcons are typically wide ranging, virtually all portions of the primary study area can be used by peregrine falcons, even if only as part of their travel routes to more appropriate foraging areas. Peregrine falcons may forage on flocking birds as they travel between more regularly used foraging areas.

Foraging and Perching Areas. During winter, peregrine falcons typically follow migrant and wintering waterfowl. Both the estuarine and urban habitats share two important features: (1) they support concentrations of prey birds (e.g., waterfowl or pigeons), and (2) they contain perch and roost habitat in the form of cliffs or tall buildings and bridges. These features are present in all known regular locations of wintering or breeding peregrine falcons in Washington.

Management Recommendations for Peregrine Falcons. Most management recommendations focus on nest sites. The WDFW is drafting planning guidelines for peregrine falcons, but none are currently available to the public. General buffer distances reported in the literature range from 0.8 to 4.8 kilometers (0.5 to 3 miles) around nest sites (Ellis 1992). Other management approaches to protect peregrine falcons include pesticide restrictions and protection of wetland foraging areas.

Bald Eagle

Current Status. Bald eagles are federally listed as threatened in Washington. Bald eagle populations initially declined to threatened levels because of pesticide poisoning. Organochlorine pesticides, particularly DDT, severely affected bald eagle reproduction from 1947 to the early 1970s by thinning eggshells.

Since the banning of DDT in the United States and Canada, bald eagle numbers have improved, and numbers are near the recovery goals set by the USFWS (USFWS 1986). The bald eagle was recently downlisted to threatened status in many states in which it had previously been classified as endangered. Habitat loss is currently the primary threat to bald eagle populations in the Pacific recovery area (USFWS 1986). Other threats include electrocution from power lines, accidental poisoning, and illegal shooting.

Regional Numbers. Most bald eagles that winter in Washington are associated with western Washington river systems. However, bald eagles do winter in eastern Washington. Midwinter bald eagle surveys have regularly identified over 300 individual bald eagles in eastern Washington each year since 1982 (WDW 1988). These eagles are most common along major rivers, lakes, and reservoirs.

The upper and middle reaches of the Columbia River (which are north of the project sites) support the greatest number of wintering bald eagles in eastern Washington (Fielder and Starkey 1987). The greatest densities occur just above Grand Coulee Dam at Banks and FDR Lakes. Most of these middle and upper reaches of the Columbia River and their shoreline are mapped by WDFW as priority habitat for wintering bald eagles.

Klickitat County supports relatively few bald eagles. In 1990, when the most recent statewide survey of wintering bald eagles was conducted, about 1.2% of the total count was found in Klickitat County (35 out of a total of 2,983) (WDFW 1990). This amounts to about 5% of the total count for eastern Washington counties (35 out of 642).

Site Numbers. While bald eagles regularly winter within and near the project sites, bald eagles are not known to concentrate in large numbers (greater than 10) near the project sites. No specific surveys are known to have been conducted to identify winter roosts in the area, and the database contains no records of communal roosts or other important bald eagle habitats.

Bald eagle numbers are known to fluctuate annually. Annual maximum counts in Klickitat County ranged from a low of 9 individuals to a high of 35 (WDFW 1989, 1990). A severe winter during the 1992-1993 season caused unusually high bald eagle numbers throughout eastern Washington. During another winter in 1985, the numbers of wintering bald eagles in Klickitat County increased 47% over the previous year (from 19 to 28 individuals).

Seasonal Timing. Bald eagle use near the project sites is limited to nonbreeding individuals from fall (end of October) through early spring (end of March) (Frederick pers. comm.). Most of the bald eagles wintering in eastern Washington are migrants from Canada and Alaska. In general, wintering numbers peak in January (Stalmaster 1987), but timing and use are greatly influenced by local food availability. Ichisaka et al. (1989) reported bald eagle numbers peaking in late February and early March along the White Salmon River drainage in western Klickitat County, an area with a very different environment than the project sites.

Food Stocks. Wintering bald eagles in eastern Washington feed mainly on waterfowl, upland birds, and deer and livestock carrion, although fish are taken when available (Fielder 1982, Ichisaka et al. 1989, Fielder and Starkey 1987).

Ichisaka et al. (1989) reported that bald eagles in western Klickitat County feed mostly on deer and livestock carrion, with bald eagles regularly foraging at livestock disposal sites where dead dairy stock were left in the open to decompose.

Potential food stocks present in the study area include chukar, carrion, and waterfowl. Fielder (1982) reported that chukar were second only to coots (a type of waterfowl) as a food source for bald eagles wintering in the upper Columbia River. Chukar are relatively common at the CARES site and throughout the KENETECH site, except for agricultural lands in the northern section. Carrion present include winter-killed deer and cattle, as well as cattle afterbirth during the calving season in February and March. Mallards and other waterfowl are also taken regularly by bald eagles. The Columbia River near the confluence with the John Day River supports numbers of up to 6,000 wintering waterfowl, and waterfowl are probably taken by bald eagles using this area. The relative availability of food stocks varies between years and seasons.

Foraging and Perching Areas. Wintering bald eagles are known to take an overall strategy of minimizing energy expenditures while obtaining an adequate daily meal (Stalmaster 1987). To accomplish this, most individuals fly from night roosts to locations that provide foraging opportunities. Foraging areas are typically within a few kilometers of night roosts (Stalmaster 1981). Perch sites are usually located in tall trees on the edge of stands, contain strong lateral branches, and are closely associated with water. Eagles also perch on cliffs and on sand and gravel bars.

Wintering bald eagles can spend over 90% of their daylight hours in such perches, and much of this activity can be classified as loafing rather than hunting (Watson et al. 1991). Individuals may loaf for hours until a foraging opportunity arises.

Prior to the site studies conducted for this EIS, little information was available regarding primary foraging areas in the study area or vicinity. However, based on behavior reported at other areas along the Columbia River, bald eagles focus their activities along the Columbia River but make frequent flights along the adjacent slopes. The results of field studies are presented in Section 4, Affected Environment.

Night Roost Areas. Bald eagles typically spend the night and occasional periods of severe weather in regularly used roosting areas and often roost in groups. In northwestern Washington, the four primary characteristics of winter roosts or potential roosts are: clear visual access to surrounding terrain, a favorable microclimate (a relatively small area that provides shelter from wind, rain, and cold temperatures), stout perches high above the ground, and isolation from excessive human disturbance (Hansen et al. 1980). The favorable microclimate may become more important in inclement weather, and bald eagles may use different roost sites depending on weather conditions. Winter roost sites are often associated with foraging areas, although bald eagles will travel many miles between foraging areas and roosting areas. No winter communal roosts were reported in the study area prior to the initiation of field studies (see Section 4, Affected Environment).

Management Recommendations for Bald Eagles. Several guidelines have been developed by WDFW and the USFWS regarding the management of bald eagle foraging, perching, and roosting habitat. Retention of known and potential perch and roost trees and designation of activity restriction zones in primary foraging areas are common management strategies.

Communal winter roosts and nest sites are protected under the Washington State Bald Eagle Protection Rules (WAC 232-12-292). Because bald eagles are only present during winter in the vicinity of the study area, only communal roost site rules may be applicable to the proposed projects. The WDFW defines a communal bald eagle roost as all roost trees used by three or more eagles on consecutive nights (Rodrick and Milner 1991). The Pacific States Bald Eagle Recovery Plan recommends temporary disturbance buffers (e.g., timing restrictions for construction) within 400 meters (1,300 feet) of roost sites (USFWS 1986).

Other recommendations include the preservation of perch trees within 60 meters (200 feet) of feeding waters (USFWS 1982); trees greater than 30.5 centimeters (12 inches) in diameter within 30 meters (100 feet) of shorelines (Steenhof 1978); and vegetation containing suitable perch trees within 50 meters (165 feet) of shorelines where eagles are known to perch (Stalmaster and Newman 1979). At a primary foraging area in Kitsap County, the WDW (Kessler 1990) required that perch trees, snags, and snag-top trees within 90 meters (300 feet) of the shoreline be retained along with one-third of the stand in this zone.

Activity buffers are often proposed near primary perch areas. Steenhof (1978) recommends the maintenance of dense vegetative buffers within 30 meters (100 feet) of shorelines and other use areas. Stalmaster and Newman (1978) recommend the maintenance of 75- to 90-meter (250- to 300-foot) vegetative screening zones where disturbances are common. The USFWS (1982, 1986) recommends that no buildings be constructed within 400 meters (1,300 feet) of key feeding waters.

Based on a study of eagles in the Columbia River Estuary, McGarigal et al. (1991) suggested that restrictions on activities (such as operating heavy machinery) within 400 meters (1,300 feet) of high-use foraging areas from sunrise to 10 a.m. during nesting and post-fledging periods would be effective in preventing disturbance to foraging eagles. Stalmaster (1980) recommended that, if vegetation is preserved within 50 meters (160 feet) of feeding waters, human activity (especially in the morning) should be restricted within 75 to 100 meters (240 to 330 feet) of feeding areas. Steenhof (1978) recommended restrictions on recreational activities within 150 meters (500 feet) of favored perches or the shoreline.

2.6 RAPTOR PREY BASE AND FORAGING BEHAVIOR

2.6.1 Relevance of Prey Base and Foraging Behavior to the Existence and Behavior of Raptors

The relationship between predator and prey has been a much studied topic of population biology (Robinson and Bolen 1989). It involves a complex relationship of many factors, including prey base, habitat, and behavior. This section discuses the types of prey present and their habitat associations. In addition, this section describes the types of foraging behavior employed by raptors in the study area. This behavior is a factor to be evaluated in the environmental consequences section (Section 5) of this study because of its potential relationship to raptor mortality.

For this study, prey base is defined as the types and relative importance of prey species for particular raptor species. Prey base is of interest to this study because it affects two factors that may contribute to raptor vulnerability to collisions with wind turbines:

- **Raptor Densities and Location.** Raptors may be more concentrated where prey is more available than in areas where prey is less available.

- **Foraging Behavior.** The type of prey exploited can determine the type of foraging behavior.

Because most raptor species can exploit several types of prey, the types on which they concentrate are often a function of what types of prey are available. This may change between areas, seasons, habitats, and years.

2.6.2 Types of Prey Typically Hunted by Raptors

Except for the very large and the very small, almost all animals can become food for raptors, including other raptors. However, some prey items are of particular importance to specific raptor species. This section examines specific categories of prey, the habitat in which they occur, and the raptors that specialize in hunting them.

Prey Categories

To more effectively describe the raptor prey base in the study area, prey species have been classified into general categories that correlate with raptor prey selection. These categories are defined by size and type of prey, as well as by the hunting technique required to capture them. In general, prey size is closely related to the size of raptor, with smaller raptor species preying on smaller prey, and larger species preying on larger prey.

Table 2-5 presents the most common species of prey within the study area as well as their habitat associations, based on the literature (Maser et al. 1984, Nussbaum et al. 1983) and field observations conducted for this study. Prey are presented within the categories used for this study. Table 2-6 presents the types of prey most commonly taken by each raptor species that is present in the study area.

Prey Abundance and Prey Availability. When examining the relationship between raptors, habitat, and prey species, it is important to note the distinction between prey abundance and prey availability. Prey abundance is simply the number of individuals of each prey species present in a given area or habitat, while availability is the number of individuals accessible to raptors as prey.

For example, small-rodent populations within the study area may be abundant within the oak woodland habitat, but this population is relatively unexploited by most raptors

Table 2-5. Common Raptor Prey Species and their General Habitat Associations

Prey Type	Habitat Association: Oak and Oak/Pine Woodlands	Juniper Woodland and Shrub-Steppe	Riparian	Cultivated	Rangeland	Rock and/or Talus Slopes	Water	Comments
Small Mammals								
Deer mouse	C	C	C	C	C	C		Common in all habitats
Vole (*Mycrotus* sp.)	C	C	C	LC	LC	LC		
Shrew (*Sorex* sp.)	C	C	C	LC	LC	LC		
Great basin pocket mouse		C			C			
Medium-Sized Mammals								
Nuttall's cottontail	LC	LC	LC			C		Common in rocky areas and shrubby thickets
California ground squirrel	LC	LC	LC	C	C			
Least chipmunk	LC	LC	LC			LC		
Northern pocket gopher	C	C	C	C	C	C		Common in all habitats
Bushy tailed woodrat	C	C	C		C	LC		
Large Mammals								
White-tailed jackrabbit		C				LC		
Black-tailed jackrabbit		C				LC		
Yellow bellied marmot						C		
Skunk	C	C	C	C	C	C		Common in all habitats

Table 2-5. Continued

Prey Type	Habitat Association: Oak and Oak/Pine Woodlands	Juniper Woodland and Shrub-Steppe	Riparian	Cultivated	Rangeland	Rock and/or Talus Slopes	Water	Comments
Small Birds	C	C	C	C	C	C		
European starling	LC	LC	LC	C	LC	C		
Horned lark		LC		C	C			Very common in winter
White-crowned sparrow	C	C	C	LC	LC			
House finch	LC	LC	C	LC	C			
Medium-Sized Birds	C	C	C	C	C	C		
Western meadowlark		C	C	C	C	LC		Very common species
Rock dove						C		
Upland Game Birds	C	C	C	C	C	C		
Chukar		C	C		C	LC		
California quail	C	LC	C		LC			
Gray partridge		LC	LC	C	LC			
Ring-necked pheasant	LC	LC	C	C	LC			
Waterfowl	C	C	C	C	C	C	C	
Puddle ducks				LC			C	
Diving ducks							C	
Coots								

Table 2-5. Continued

Prey Type	Habitat Association: Oak and Oak/Pine Woodlands	Juniper Woodland and Shrub-Steppe	Riparian	Cultivated	Rangeland	Rock and/or Talus Slopes	Water	Comments
Snakes/Lizards	C	C	C	C	C	C		
Southern alligator lizard	C		LC					
Sagebrush lizard	LC	C						
Western fence lizard	LC	C	C		LC	C		
Western skink	LC	LC	C			LC		
Gopher snake	LC	C	LC	LC	C	LC		Most common in semi-arid bushy areas adjacent to farms
Racer	LC	C	C	LC	C	LC		Associated with forest edges
Garter snake (*Thamnophis* sp.)	C	C	C	LC	C	C		Common
Western rattlesnake	LC	LC	LC		LC	C		

C = Common in this habitat.
LC = Less common in this habitat.

Source: Maser et al, 1984, Nussbaum et al 1983.

Table 2-6. Primary Types of Prey for Raptors Present in the Study Area

Raptor Species	Prey: Waterfowl	Upland Game Birds	Small Birds	Medium-Sized Birds	Carrion	Snakes and Lizards	Medium-Sized Mammals	Small Mammals	Insects	Comments
Peregrine falcon	1		2	1						
Bald eagle	2	1		3	2		2	3		
Golden eagle		2			3	3	1	2		
Red-tailed hawk	3	3			3	2	2	1		
Rough-legged hawk					3		3	1		
Northern harrier			2			3	3	1		May shift from small mammals to young passerine birds during the breeding season (Johnsgard 1990)
Swainson's hawk						3	3	1	2	Ground squirrels (spring) and grasshoppers (summer) are the most frequent prey
Merlin			2			2		1		
American kestrel			2					1	2	Starling, horned larks, deer mice, and various insects are the typical prey
Prairie falcon			2	2			1			Ground squirrels may be more important during breeding; flocks of small- and medium-sized birds may be more important during winter
Turkey vulture					1					
Sharp-shinned hawk	2	1						2		
Cooper's hawk	2	1						2		
Ferruginous hawk							1	2		
Great-horned owl							1	2		
Western screech owl						2		1		

1 = Primary prey species. 2 = Secondary prey species. 3 = Occasional prey species.

Source: Johnsgard 1990, Palmer 1988.

because it is protected by the dense oak canopy. Another example was documented by Bechard (1982), who found that Swainson's hawks foraged in cropland more than in grassland even though prey was more abundant in the grassland. He concluded that the prey was more available in the cropland because it was more visible. An even more extreme example is that of hibernating mammals, such as ground squirrels, that can be abundant but totally unavailable to raptors during winter.

As demonstrated by these examples, the relationship between predator and prey depends not only on the abundance of the prey, but also on the prey's availability, which is a function of several factors, including habitat structure, season, and the type of raptor hunting the prey. Because of these complications, typical foraging behavior, discussed below, is more applicable to the potential raptor mortality associated with wind farms than is prey abundance.

Raptor Foraging Behavior

The foraging behavior of raptors is well documented in the literature. Johnsgard (1990) and Palmer (1988) provide a recent summary of hundreds of studies on foraging behavior. In addition, the field surveys conducted as part of this study provided specific information about raptor foraging behavior within the study area.

Based on the literature and on field observations conducted for this study, foraging behavior has been classified into the following categories:

- **aerial pursuit**, where the raptor chases down flying prey;
- **soar and dive**, where the raptor soars or glides at altitudes greater than 20 meters (66 feet) in search of prey and then dives to capture prey;
- **kiting and hovering**, where the raptor uses wind or flapping to remain stationary over an area being searched for prey;
- **perch and wait**, where the raptor hunts from a stationary perch and then dives to capture prey;
- **flapping close to ground**, where the raptor flies low to the ground in search of prey; and
- **gliding close to ground**, where the raptor uses updrafts to glide near the ground in search of prey.

In addition to these flight behaviors, several raptors (e.g., bald eagles and golden eagles) are involved in pirating prey from other predators (Johnsgard 1990). This usually involves aerial pursuit.

Most raptors use a variety of techniques, but many use one or two methods much more frequently than others. Table 2-7 lists the raptors present in the study area and the most common foraging behavior employed.

Table 2-7. Foraging Behavior of Raptors Present within the Study Area

Raptor Species	Aerial Pursuit	Soar and Search	Perching	Flapping Close to Ground	Contouring Close to Ground	Comments From the Literature
	Foraging Behavior					
Bald eagle	3	3	1	2	2	
Peregrine falcon	1	2	2	3	--	
Golden eagle		2	3	3	1	Often fly low to ground or make low and fast final approach on prey (Johnsgard 1990)
Red-tailed hawk	3	2	1	3	2	
Northern harrier	2	3	3	1	2	
Rough-legged hawk		2	1	2	3	
Swainson's hawk	--	1	2	2	--	Rarely observed to fly low at high speed (Palmer 1993)
Merlin	2	2	1			
American kestrel	2	--	1	--	--	
Prairie falcon	3	3	3	1	2	
Turkey vulture	--	1	--	--	--	
Sharp-shinned hawk	2	--	1	2	--	Hunt mostly within woodlands
Cooper's hawk	2	--	1	2	--	Hunt mostly within woodlands
Ferruginous hawk	--	2	2	1	--	
Northern goshawk	2	--	1	--	--	
Great horned owl	--	--	1	2	--	
Western screech owl	--	--	1	--	--	

1 = Primary foraging method.
2 = Secondary foraging method.
3 = Occasional foraging method.
-- = Rarely used foraging method.

Sources: Johnsgard 1990, Palmer 1988, field observations conducted for this study.

Section 3. Study Methods

Section 3. Study Methods

This section describes the methods that were used to conduct the winter raptor and waterfowl study, the spring through fall fixed point observation and transect studies, and the spring breeding study. The winter raptor and waterfowl study (December 1993 through February 1994) and the first week of the spring migration study (March 24-27) were conducted using a study methodology, variables, and forms originally developed by Dames & Moore (1994). The results of the data collected during this period are reported separately from the other studies because of differences in the study protocol used and the data collected.

Telephone communications and meetings have been held with representatives of the U.S. Fish and Wildlife Service (USFWS) and the Washington Department of Fish and Wildlife (WDFW) to obtain input on the field studies to be conducted and regarding compliance with Section 7 of the Endangered Species Act. Initial input was received from the USFWS on February 15, 1994 (Bush pers. comm. 1994) and from the WDFW on February 1 and 11, 1994 (Anderson pers. comm. 1994). Based upon USFWS and WDFW agency input and scoping comments, a detailed avian study plan and protocol was prepared by Jones & Stokes Associates in March and April 1994. Follow-up meetings were then held with the USFWS on March 10, 1994, and the WDFW on March 8, 1994 to discuss the avian study plan and protocol. The plan and protocol was followed during the surveys conducted from April through October 1994. Meetings were again held with the USFWS on December 14, 1994, and with the WDFW on November 28, 1994, to update them on the status of the field studies and the preliminary results of the data analysis.

Each of the methods used during these periods is described in detail in this section. The section begins with a discussion of the general features (e.g., species of concern, seasons, and study areas) of the studies that were conducted. Detailed descriptions are then provided of the methods used to conduct: (1) the winter raptor and waterfowl study, (2) the spring migration, summer resident, and fall migration studies, and (3) the raptor breeding study. Finally, the statistical methods used to analyze the field data collected during the spring through fall studies are described.

3.1 SPECIES OF PRIMARY CONCERN EVALUATED

The avian studies were designed to focus upon species or species groups that were of greatest concern to federal and state agencies and the public. Studies were designed to evaluate impacts to species or groups of species that:

1. were known to be present and were recognized as vulnerable to disturbance by the WDFW (through correspondence and a meeting on March 8, 1994);

2. were contained in a list provided by the USFWS, and discussed at a meeting on March 10, 1994, and other correspondence of listed and proposed endangered and threatened species and candidate species which might occur within or near the study area (Appendix A); and

3. were identified by the public during the public EIS scoping process in February 1994.

Together with these sources, WDFW files (WDFW 1994), interviews with knowledgeable individuals (Dames & Moore 1994), and field reconnaissances were used to develop a list of species of primary concern upon which field studies were focused. Species on this list were grouped as follows based on similar behavior, appearance, and ecology:

- bald eagle,
- golden eagle,
- large falcons (peregrine and prairie falcon),
- turkey vulture,
- accipiters (northern goshawk, Cooper's hawk, and sharp-shinned hawk),
- small falcons (American kestrel and merlin),
- buteos (red-tailed, rough-legged, ferruginous, and Swainson's hawks),
- burrowing owl,
- long-billed curlew,
- loggerhead shrike,
- black tern,
- western sage grouse,
- waterfowl, and
- migrating passerines (i.e., song birds, with special emphasis on western and mountain blue birds).

Species determined to be ubiquitous within the study area were not recorded during fixed point station and other observations. Ubiquitous species initially included western meadowlark, black-billed magpie, horned lark, and vesper sparrow. Additional species were subsequently determined to be ubiquitous because they were present at relatively high and uniform levels throughout the study area. This determination was made by the avian study team leader following review of field data forms on an ongoing basis.

3.2 SEASONS EVALUATED

To identify seasonal patterns of avian use, studies were conducted over a 1-year period. These studies occurred during the four seasonal periods as follows:

- **Winter Raptor and Waterfowl.** This period generally occurs from mid-November through February. Surveys were conducted in two phases: (1) over 12 days between December 1, 1993, and January 12, 1994, by Dames & Moore, and (2) during January 27-29 and February 8-12, 1994, by Jones & Stokes Associates. Subsequently, a survey was conducted over 4 days during December 8-16, 1994.

- **Spring Avian Migration.** This period generally occurs from the last 2 weeks in March through the first 2 weeks of May. Out of this overall period, surveys were conducted on the following days: March 24-27, April 12-18, April 23-28, and May 5-8. Migration was identified as a project issue in agency and public scoping comments. The study periods were determined based on migration behavior published in the literature (Wahl and Paulson 1991, Hoffman 1992, Jewett 1953, Heintzelman 1986).

- **Raptor Breeding.** This period overlaps with the spring migration period and generally occurs from the beginning of April through the end of June. During a March 8, 1994, meeting, the WDFW identified the breeding raptor population level as a key indicator of the significance of the area to raptors and the potential for impacts. Specific survey dates within this overall period included May 11-16, May 18-20, and June 7-9. Specific survey times were developed based on published breeding dates (Call 1978) and on recommendations provided by the WDFW at the March 8, 1994, meeting.

- **Summer Resident Avian Use.** This period generally occurs in middle to late August. While summer was not expected to be a key use period, surveys were conducted during the summer to provide a greater level of detail about resident raptor use, including dispersal of juveniles and postbreeding movements of adults. Survey dates included August 24-27.

- **Fall Avian Migration.** This period generally occurs from the beginning of September through the first week of November, based on seasonal occurrence tables presented in Wahl and Paulson (1991). As previously mentioned, spring and fall migrations have been identified as a project issue by the USFWS and the WDFW. Specific dates when surveys were conducted included September 7-10, September 21-24, September 28-October 1, October 5-8, October 12-15 (a replicate added later in the study), and October 19-26.

Specific survey dates were selected so that a survey would be made each week during the peak part of each seasonal period, and every other week during the remainder (i.e., nonpeak) of the season. This method of conducting surveys concentrated data collection during peak periods, when significant avian activities were likely to occur, while still providing surveying throughout the rest of the seasonal period. It was understood in developing the avian study plan that the above survey dates and total days of effort could change based upon unforeseen weather conditions or other contingencies. A total of 85 person-days were spent conducting field observations over the four seasons.

3.3 STUDY AREAS EVALUATED

Two study areas were established for the avian studies: the project sites and a greater study area that includes breeding raptor study areas. Investigations within the project sites provided information regarding raptor movements near potential locations of turbines and power collection lines and towers. Investigations within the greater study area for breeding raptors provided information regarding breeding population levels. The greater breeding raptor study area was expanded to include searches for breeding golden eagles and peregrine falcons that might nest outside of the project sites but potentially travel within the project sites. Each of these study areas is described in greater detail in the following sections.

3.3.1 Primary Study Area

The primary study area included lands within approximately 1 kilometer (0.6 mile) of the project area boundary (Figure 3-1). This 1-kilometer distance was established to focus on avian use near potential turbine and collection line locations, the area in which birds would be at risk of collisions with project structures.

3.3.2 Greater Breeding Raptor Study Area

The greater study area includes two breeding raptor subareas: one for golden eagle, bald eagle, and peregrine falcon, and another for all other raptor species. The first breeding raptor subarea for golden eagle, bald eagle, and peregrine falcon nest sites included lands along the Columbia River and associated tributaries within 16 kilometers (10 miles) of potential turbine locations. This distance is the maximum home range diameter for these species as reported by Call (1978) and is the study distance recommended by the WDFW during the March 8, 1994, meeting.

Other raptor species were surveyed in the second breeding raptor subarea during the nesting season, within 3 kilometers (1.9 miles) of the project area boundary. This distance covers the typical home range of nesting hawks, as described in the literature (Call 1978, Johnsgard 1990).

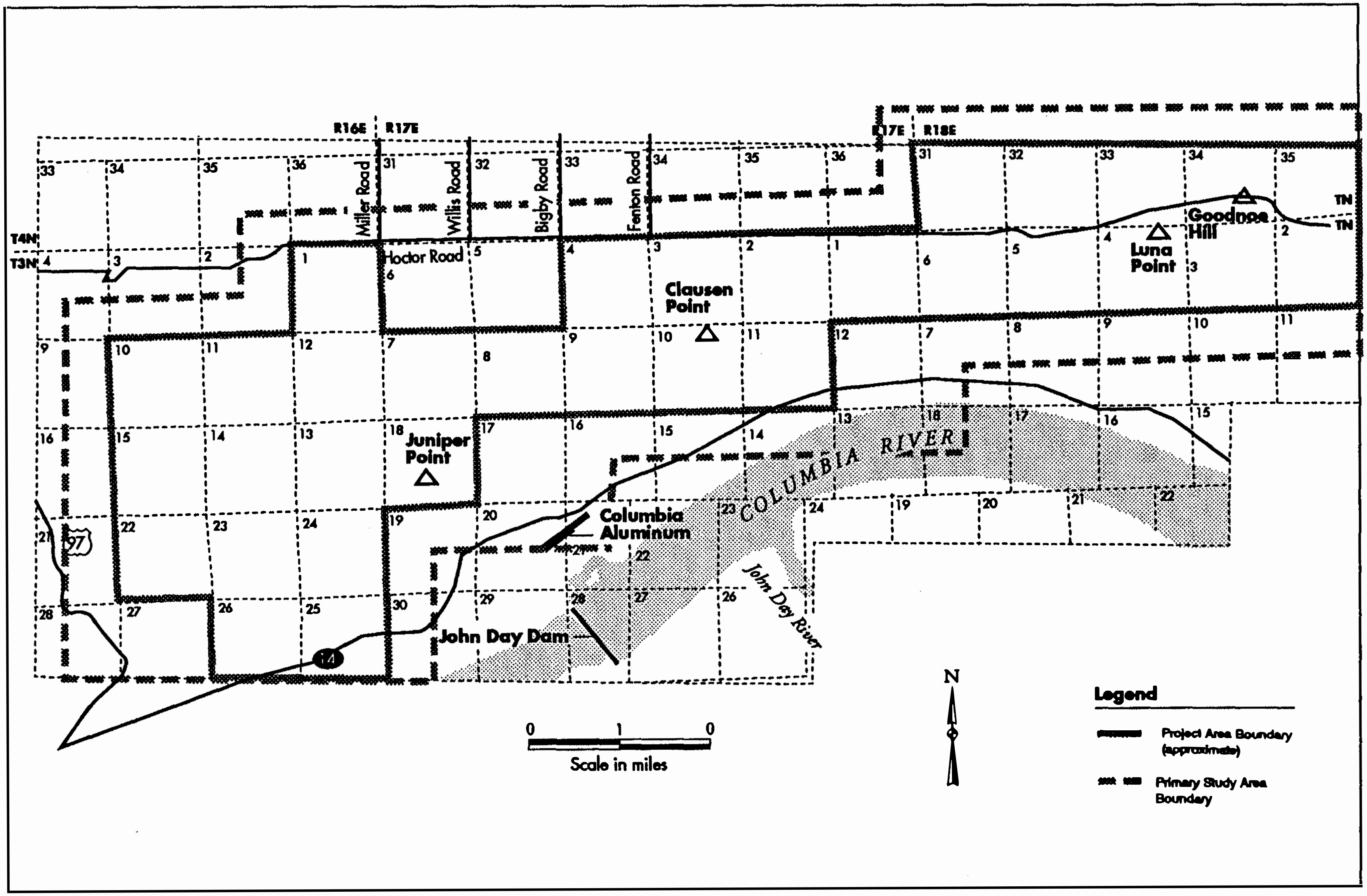


Figure 3-1. Primary Study Area

3.4 WINTER RAPTOR STUDY METHODOLOGY

3.4.1 Dames & Moore Study

A Dames & Moore biologist conducted a winter raptor survey during 12 days from December 1, 1993, through January 12, 1994. The survey involved conducting observations along roads and walking transects throughout the study area. However, because of dense fog throughout most of December, the biologist was only able to conduct surveys in good weather during 4 days at the end of December. He walked the entire site once during that period.

All observations were recorded on photocopies of 1:24,000 U.S. Geological Survey maps and on standard field forms. Information recorded included species observed, age class and sex (if known), flight patterns (i.e., soaring, flapping, and foraging), flight direction, flight altitude, perch site characteristics, interactions with other birds, habitat (i.e., open grassland, oak woodland, and steep cliffs), time of observation, and specific location of observation (i.e., township, range, and section, or other spacial reference). The data were used to develop the winter raptor study, conducted by the Jones & Stokes Associates avian study team, as described in the following section.

3.4.2 Jones & Stokes Associates Winter Raptor and Waterfowl Study

Jones & Stokes Associates completed the winter raptor and waterfowl study using three methods: (1) bald eagle winter roost observations, (2) bald eagle daytime loafing and foraging observations, and (3) fixed point station observations. The winter survey was conducted by two experienced surveyors working independently during January 27-29, 1994, and with a single observer during February 8-12, 1994. Field days began about one-half hour before sunrise and continued until about one-half hour after sunset (approximately 10 hours duration). An additional 4 days of observations were made during December 8-16, 1994, to supplement previously collected information.

Wintering Bald Eagle

The objective of the wintering bald eagle survey was to provide sufficient information to make well documented conclusions as part of the consultation process under Section 7 of the Endangered Species Act. Specifically, the study identified two elements:

- the approximate number of bald eagles that wintered within 2 kilometers (1.2 miles) of the project sites, and

- movement and activities (especially roosting and travel patterns) within the study area.

Bald Eagle Winter Roosts. Techniques for conducting the bald eagle winter roosts study followed Keister (1981) and Ichisaka et al. (1989) and included:

1. Identifying potential roost sites within the primary study area from aerial photographs, habitat maps, and anecdotal reports or previous studies.

2. Conducting ground searches of known and potential sites for presence of "whitewash" (i.e., droppings) or eagle-cast pellets, which are indicative of regular roost sites.

3. Locating eagles situated along the Columbia River in late afternoon and attempting to follow their movements as night approached.

4. Surveying suspected roost sites. Surveys were conducted 90 minutes before sunset to 30 minutes after sunset, or 30 minutes before sunrise to 90 minutes after sunrise.

Bald Eagle Daytime Loafing and Foraging. Because bald eagles are closely associated with nearby water (Stalmaster 1987), wintering bald eagle day use was expected to be highest along the Columbia River. To sample such use, a road transect was established from the intersection of Chamberlin-Goodnoe Road and SR 16, west to John Day Dam Road, and continuing west along the river to Maryhill. This route allowed observation of the shoreline and adjacent trees and rock outcrops. This transect was conducted three times.

Fixed Point Observation Station Surveys. Fixed point observation station surveys were conducted to cover the primary study area and adjacent lands along the Columbia River. In the first winter sampling period, a grid of 31 fixed point observation stations was established at regular intervals throughout the entire primary study area (Figure 3-2). Stations were placed no more than 4 kilometers (2.5 miles) apart and at locations providing prominent viewpoints. Stations were established along Hoctor Road, the ridge top, U.S. Route 97, SR 16, and Chamberlin-Goodnoe Road.

Observations were taken over a 20-minute period from each station using the unlimited radius approach (Blondel et al. 1981), with all raptor detections being recorded. Each station was sampled twice: once between January 27 and 29, 1994, and again between February 8 and 12. Variables for which data were collected were the same as described in the following sections for the spring and fall migration survey periods.

During a second winter sampling period, four additional days of field observations were made of raptor and waterfowl use of the project sites to supplement the winter data collected during December 1993 and January-February 1994. Surveys were conducted on December 8-9 and 15-16, 1994. Because all study units and fixed point observation stations

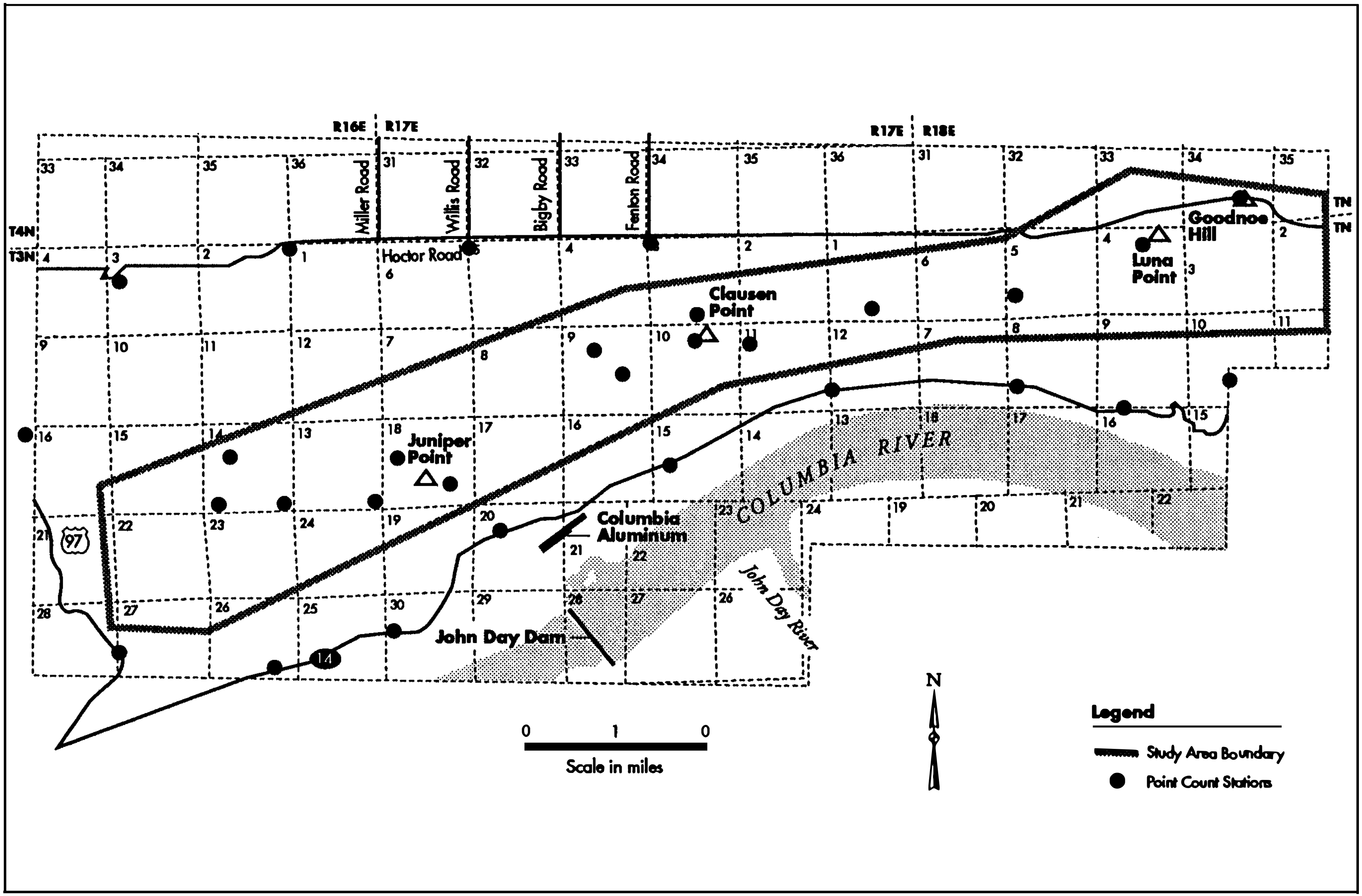


Figure 3-2. Point Count Stations - Winter Study

that were used during the Spring-Fall avian studies could not be surveyed during these two 2-day periods, a more limited study methodology was used. Three study units (i.e., ridge top, northern plateau, and eastern hills) were selected for further study based upon the level of avian use and potential for impacts that was identified during the Spring-Fall raptor studies. Within these three study units, stations 4, 7, and 9 in the ridge top unit; stations 8, 10, and 12 in the ridge face unit and station 14 in the eastern hills unit were selected for observation. Each of these stations were to be surveyed for a 20-minute period, three times a day, as was done for the Spring-Fall studies. Four stations were to be surveyed on one day and the remaining three stations were to be observed on the second day. This method was repeated during the second 2-day survey period.

In the event that poor weather obscured viewing or adverse road conditions prohibited access to stations, alternative stations were selected as contingencies. Alternative stations selected for observation included station 6 of the northern plateau study unit and stations 13 and 15 of the eastern hills unit. These stations were determined to have a potential for high avian use, but to a lesser extent than the first set of study units. During the course of conducting the four days of fixed point station observations, inclement weather conditions (e.g., snow and fog) and wet road conditions required use of the alternative stations for conducting observations. The unimproved dirt road leading to the ridge top study unit (stations 4, 7, and 9) was extremely slippery and hazardous to negotiate. Thus, observations were made from stations 6, 13, and 15 instead.

Additional observations were also made near the two known bald eagle night roost sites located in sections 5 and 16 of Township 3 North, Range 18 East. Observations began 45 minutes prior to sunset and commenced until visibility was obscured too severely by darkness.

Waterfowl Surveys

Waterfowl surveys were conducted to determine (1) the relative use of waterfowl along the Columbia River, and (2) the amount of waterfowl use occurring across the study area. During the first winter sampling period, fixed point observation stations were also used to survey for waterfowl crossing or using the study area. Road transects for waterfowl counts were conducted simultaneously with the bald eagle winter day roost survey previously described. The road transects followed the Columbia River along the entire shoreline adjacent to the study area.

During the second survey period (December 8-16, 1994), a waterfowl count was made each day, for a total of four counts, along the Columbia River to the south of the project sites and near Rock Creek to the southeast of the project sites. Each count was conducted over a 2-hour period.

3.5 SPRING MIGRATION, SUMMER RESIDENT, AND FALL MIGRATION FIXED POINT OBSERVATION STUDY METHODOLOGY

The following sections describe the processes and reasons for selecting study areas, observation stations, observation zones, time periods, and field methods to be implemented for the spring migration, summer resident, and fall migration studies, as originally described in the avian study plan. Two techniques, fixed point and transect observations, were used to survey the primary study area for the spring migration, summer resident, and fall migration periods. The fixed point survey methods are described below, while the transect survey method is described in Section 3.6.

Fixed point surveys are an established method for surveying birds (Blondel et al. 1981, Cooperrider et al. 1986, Bibby et al. 1993). Fixed point surveys involve a surveyor taking observations from a fixed point (i.e., observation station) over a fixed period of time. This method was selected for conducting the avian studies because it provided standardized data that could be compared between stations, habitat types, and seasons. The use of fixed point station observations also allowed statistical evaluation of data collected over the study period and will allow future statistical comparisons of data collected during subsequent, ongoing site monitoring. For the spring through fall surveys, fixed radius fixed point surveys were conducted.

Fixed point observation surveys were used to determine two key elements of avian use for the impact analysis:

- patterns of use by resident raptors (e.g., travel routes, flight altitude, foraging locations, and intensity of use), and
- migratory use, routes, and flight patterns for raptors, waterfowl, and passerines.

The following sections describe in detail how the fixed point observation studies were conducted.

3.5.1 Division of Primary Study Area into Units

KENETECH Windpower and CARES have obtained lease options or easements on whole or portions of 32 sections in which wind turbines potentially could be sited (Figure 3-2). These 32 sections compose the overall project area boundary (see Figure 3-3). (It should be noted that the actual KENETECH and CARES sites cover a smaller area than defined by the "project area boundary" since only portions of some of the 32 sections are included in the sites.) The primary study area extended approximately 1 km (0.6 mile) beyond the project area boundary and was the basis for obtaining a sample of locations for

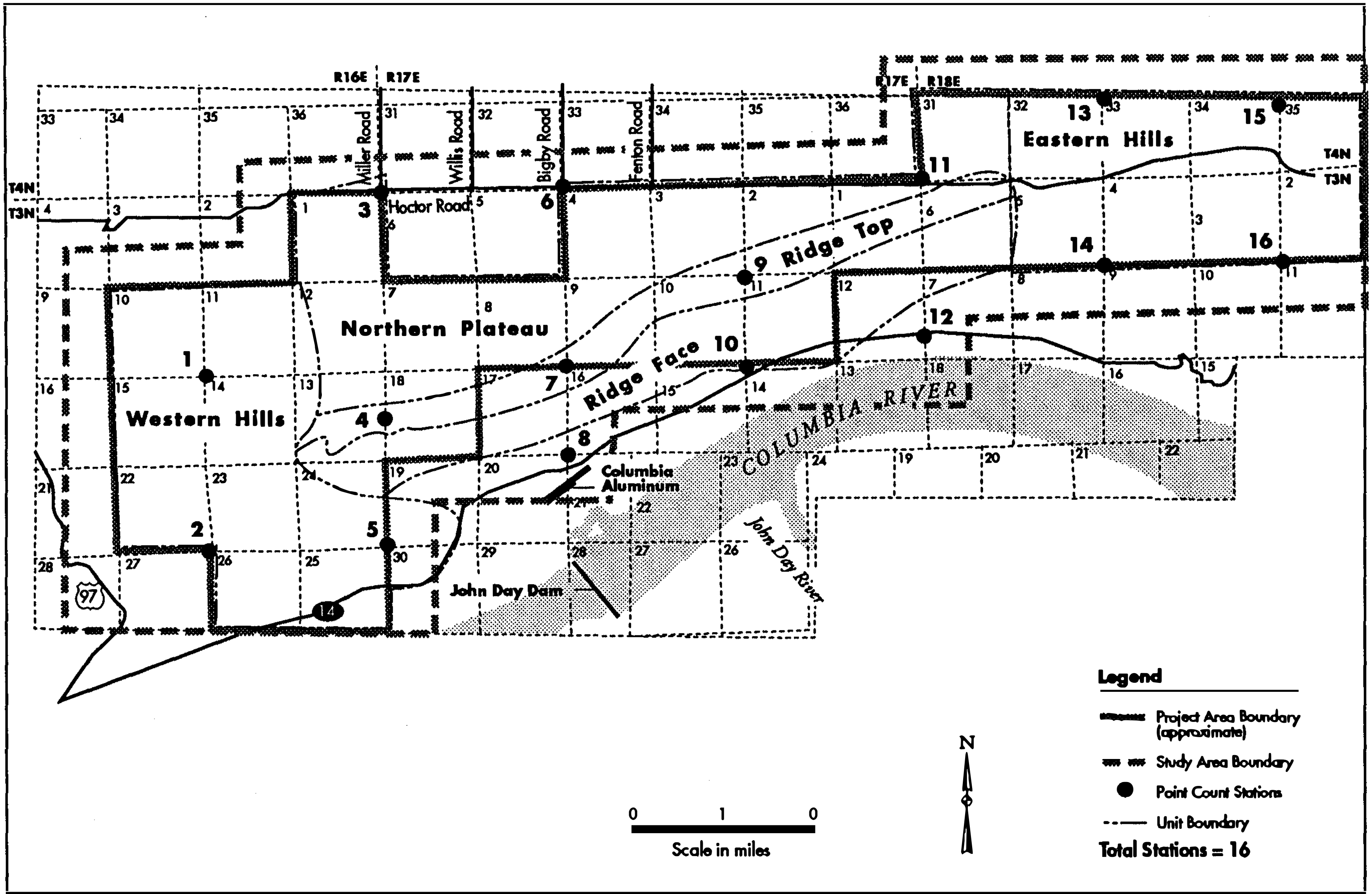


Figure 3-3. Fixed Point Stations and Units - Spring and Fall Seasons

conducting the avian surveys. Investigations within the primary study area provided information regarding raptor movements near potential turbine locations.

To distribute observations evenly throughout the primary study area, the area was divided into five units, each containing three or four fixed point observation stations and transects connecting the stations (Figure 3-3). The eastern hills unit was divided into two subunits for surveying purposes because the number of stations and distance between them did not allow complete surveying in a 1-day period. In addition to distributing the survey effort, the division of the primary study area into five units allowed comparisons between specific portions of the study area.

Each study unit was defined based upon topography, vegetation, and overall similarity of features. The five study units were defined as follows:

1. **Western hills.** This unit included the steep, rounded hills located on the western quarter of the primary study area. The primary unit contains grassland and some riparian habitat.

2. **Eastern hills.** This unit included the steep, rounded hills located on the eastern quarter of the primary study area. The unit contains mostly grassland interspersed with a few parcels of cropland and some woodland. The unit was divided into two subunits for surveying purposes because the number of stations and distances between them required surveying over 2 days.

3. **Ridge top.** This unit included lands within 0.5 kilometer (0.3 mile) north of the ridge line, where the ridge face peaks and begins to gently slope downward to the north. The unit contains grassland along rolling topography connecting the various points (e.g., Juniper and Clauson) along the ridge top. These points are separated by shallow gaps (also known as saddles).

4. **Ridge face.** This unit included the ridge that dominates the study area. The ridge is composed of the steep, south-facing slopes and cliffs situated on the southern edge of the study area (between the western hills and eastern hills study units). This study unit begins approximately 1 kilometer (0.6 mile) west of Juniper Point and continues about 13 kilometers (8 miles) east. The ridge is paralleled by SR 14 and the Columbia River to the south. About 0.5 kilometer (0.3 mile) of gently sloping hills separates the road from the ridge face, which rises from the valley floor approximately 900 meters (2,800 feet) over about 1 kilometer (0.6 mile) horizontal distance.

5. **Northern plateau.** This unit includes lands beginning 0.5 kilometer (0.3 mile) north of the ridge line and continuing north to the northern limit of the study area. The unit contains grassland and oak/pine woodland in the southern portion and agricultural lands (mostly pasture) and some juniper woodland in the northern portion.

3.5.2 Selection of Fixed Point Observation Stations

Fixed point observation stations were selected using a systematic sampling procedure. The locations of these stations resulted in comprehensive coverage of all sections of land within the primary study area. Using whole sections, even if as little as one-eighth of the section was a potential site for wind turbines, increased the size of the study area and ensured that a broader range of avian use was recorded. In addition, placing most of the stations along the perimeter of the project sites ensured that potential avian activities occurring outside of the project-leased sections were recorded (thus surveying areas outside of the project sites).

The observation zone for conducting the avian studies was established at a 1-kilometer (0.6-mile) radius (see Section 3.5.3). Incidental observations (i.e., those outside of the observation zone) were obtainable from within a 1.6-kilometer (1-mile) radius. Thus, observation stations were selected to be no more than a 1.6-kilometer (1-mile) observation radius, or 3.2 kilometers (2 miles), apart. However, in some instances, observation stations were sited closer than this if topography and land features (e.g., trees and structures) obstructed views and resulted in the viewing distance being less than 3.2 kilometers (2 miles) between stations.

Section corners were selected as the initial sites for observation stations to facilitate surveyors' easy and consistent location of the stations while in the field. Stations were selected by beginning with a section line surrounded by project lands on which turbines might be sited, within the most northwestern part of the KENETECH project site. Thus, the first observation station was sited at Township 3 North, Range 16 East, and at the intersection of Sections 10, 11, 14, and 15 (Figure 3-3). A second station was selected 3.2 kilometers (2 miles) south (station 2) and a third station was selected by moving two sections to the east and proceeding to the top of the project sites. This pattern continued until the southeast corner of the KENETECH and CARES was reached and 16 observation stations had been selected. This process resulted in fairly evenly spaced observation stations in a checkerboard pattern across both sites.

After the initial evaluation during onsite visits of the 16 fixed point observation stations, the following criteria were established to adjust station locations to ensure that observations could be made within the established 1-kilometer (0.6-mile) observation zone and to facilitate access to the station locations:

1. A 270° field of view was established as the minimum horizontal viewing distance threshold. A station with less than a 270° field of view was relocated to a new site within a 1-kilometer (0.6-mile) radius of the originally assigned station location or where the minimum field of view could be achieved. Examples of this change are station locations that fall within relatively deep draws or channels.

2. Stations that met or exceeded the 270° view but provided an unsafe viewing platform for the surveyor were moved to any cardinal direction. An example would be a station located on a relatively steep slope. If a road, trail, or other level surface occurred within 0.5 kilometer (0.3 mile) of stations with steep gradients, the stations were moved to enhance the safety of the surveyor's working environment.

3. Stations located in close proximity to developed sites, such as a residence or other human development, were moved to any cardinal direction within 0.5 kilometer (0.3 mile) of the originally assigned station location. The station locations were modified to avoid reducing the ability of the surveyor to detect raptors or reduce the field of view to less than 270°.

The following adjustments to the systematic sampling procedure for siting stations were made using the above criteria:

1. Station 4, as originally selected, provided less than a 200° view of the study area because it was located in a moderately deep draw. Therefore, it was moved about 1 kilometer (0.6 mile) south from the corner connecting Sections 12, 7, 13, and 18.

2. Station 5, as originally established, had less than a 180° viewing area and was moved slightly west of the section line corner.

3. Station 8 was sited slightly more than 1.6 kilometers (1 mile) south of station 7 on a turnout on the north side of SR 14. This was done because placing the station at the intersection of Sections 20, 21, 28, and 29 of Township 4N, Range 17E would have resulted in it being sited south of the Columbia Aluminum Plant and along the bank of the Columbia River. This would have presented an access problem to surveyors trying to reach this point, as well as obstructing views of avian activities. In addition, placing the station at this site facilitated viewing near the top of the ridge and from below, thus avoiding a significant "blind" area where avian activities were likely to occur but that otherwise would not have been viewed with the systematically selected observation station.

4. Station 9 was also located 1.6 kilometers (1 mile) south of where it would have been systematically placed to similarly facilitate viewing at the rim of the ridge and avoid a major "blind" area near a potentially important avian use area.

5. Station 10 was originally located about 137 meters (150 yards) north of SR 14 but was moved to a pullout on the south side of SR 14 to improve the safety for the surveyor.

6. Station 12 was sited slightly north of where it would have been systematically placed because the corner of the section was on the bank of or in the Columbia River, and the station could be more easily surveyed from SR 14.

In addition to stations placed within the primary study area, three control area observation stations were placed approximately 16 kilometers (10 miles) west of the primary study area (Figures 2-1 and 3-4). This control area was selected for ongoing monitoring studies of avian use and mortality should development of the projects be approved. Surveys in this control study unit provided baseline data on raptor population use (e.g., an abundance index) in the general area and will provide some index as to changes in raptor populations due to changes in prey abundance, weather, or some other variable not related to the wind generation projects.

Control stations were located 3.2 kilometers (2 miles) or at a 1-kilometer (0.6-mile) viewing radius apart. Control stations were sited in habitat similar to those found in the primary study area.

3.5.3 Survey Radius

The range of detectability of raptors is recognized as an inherent variable in field observation (Fuller and Mosher 1986). For example, a bald eagle can be seen from several kilometers, while an American kestrel is difficult to see from over just 1 kilometer (0.6 mile). Because of this, an observer can search a much greater area from a single point for bald eagles than he/she can for American kestrels.

To account for this difference, the distance over which fixed point surveys were recorded at an observation station was limited to a radius of 1 kilometer (0.6 mile). Field surveyors determined whether observations were within or outside of the 1-kilometer (0.6-mile) radius by locating the bird's position on a U.S. Geological Survey topographic map. The position was relatively easy to pinpoint on the map by using a combination of compass bearings and topographic features. The distinct topography of the site allowed for direct pinpointing of raptor locations. Each raptor observation was recorded, but observations had to be within the 1-kilometer (0.6-mile) radius to be counted as within the sample plot. Avian activity observed beyond that radius was recorded as outside of the fixed point radius on the field data forms.

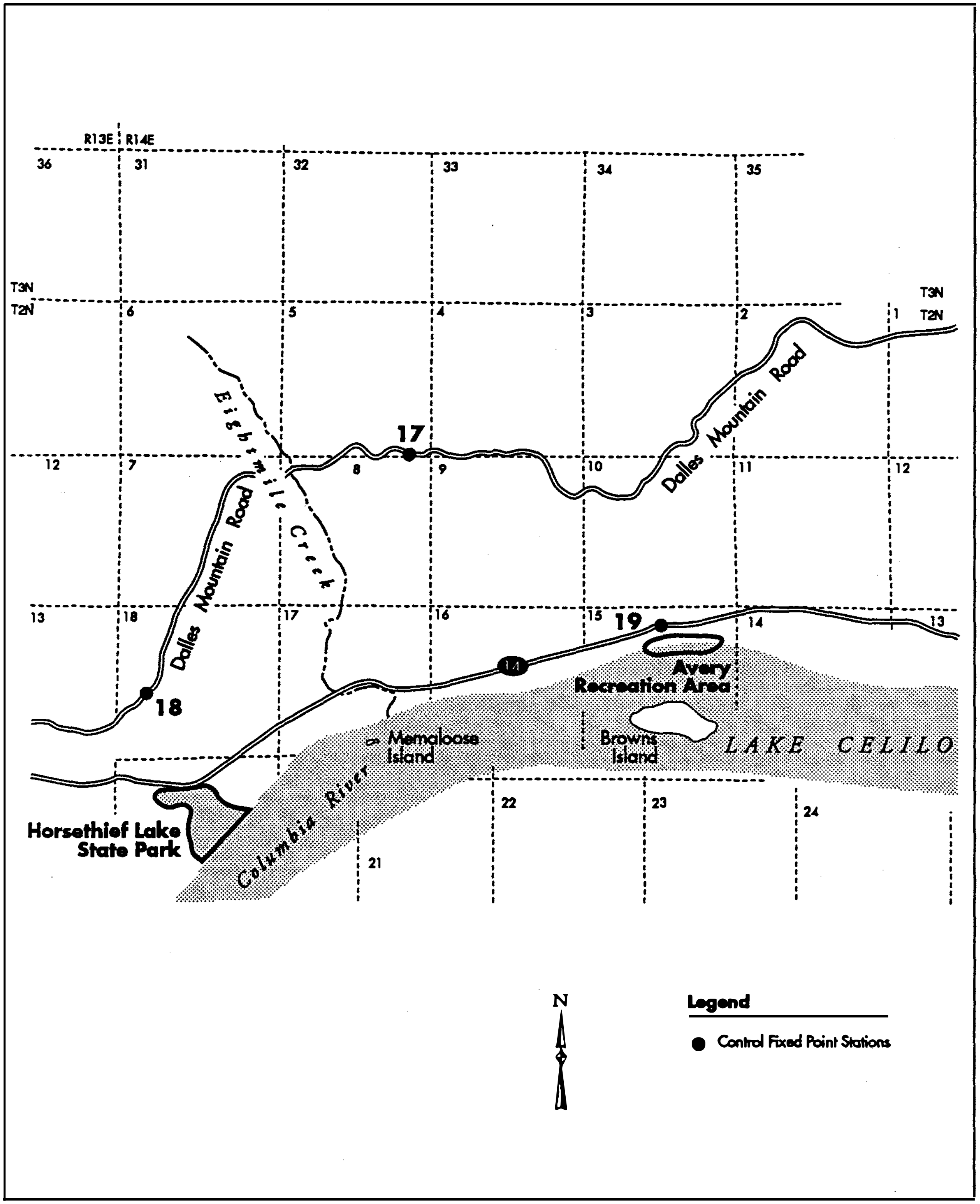


Figure 3-4. Control Fixed Point Stations - Spring and Fall Seasons

3.5.4 Seasonal Timing and Replicate Selection

To distribute observations evenly throughout each season, several survey replicates were conducted throughout each seasonal study period. A replicate was defined as one complete survey of all fixed point stations in the primary study area, three samples per day each, during a planned 4-day period. Several survey replicates were conducted during each study season to ensure that information was gained over the full duration of each season.

Replicates were conducted approximately every other week during the beginning and ending periods of the spring and fall migration seasons. During the peak of each migration season, replicates were conducted every week. The exact timing of surveys depended on weather and on the intensity of avian migration activities observed. The avian study plan (Jones & Stokes Associates, Inc., 1994) allowed flexibility to avoid inclement weather and to increase efforts during peak migration periods.

3.5.5 Surveying Throughout Each Replicate and Day

Surveyors conducted observations over the course of a day within each study unit (2 days in the eastern hills unit) during each survey replicate. It typically took two surveyors 3 days to complete one replicate of the fixed point stations on the primary study area and 1 additional day for one surveyor to observe the control area. Weather conditions or logistics in deploying surveyors sometimes required the survey period to be extended over several additional days.

A schedule was established by the avian team leader, prior to entrance into the field, to ensure that stations were fairly evenly surveyed at different times within periods. For example, station 1 was the first station surveyed in the morning, afternoon, and evening periods. This would be followed, in each time period, by station 4 and then station 7. The second week that the unit was surveyed, the surveyor began with station 4, followed by station 7, and then station 1. The third week that the unit was surveyed, the surveyor began with station 7 followed by station 1 and then station 4. On the fourth week of observation in the unit, the surveyor started the process over again.

Observations for each replicate, at each fixed point station, were distributed evenly throughout the day. Field surveyors sampled each station for 20 minutes, roughly once during the morning (sunrise to 10 a.m.), once during midday (10:01 a.m. to 2 p.m.), and once during the afternoon (2:01 p.m. to 6 p.m.). Transects were also surveyed while traveling between stations during each of these time periods (see Section 3.6).

3.5.6 Adverse Weather Considerations

Fixed point or transect surveys were not conducted when fog, rain, or other weather conditions seriously inhibited visibility, the ability to observe, or surveyors' ability to access the fixed point stations. The decision to cancel fixed point surveys due to weather was based on the professional discretion of the field leader, and typically involved a telecommunicated approval by the project manager prior to cancellation. As a general rule, station observations were not conducted when visibility was less than 1 kilometer (0.6 mile).

3.5.7 Topographic Mapping

Raptor observations were marked on topographic maps. A separate map was made, at a scale of 1:1,200, to cover the 1-kilometer (0.6-mile) radius of each fixed point observation station. Each observation was identified using the time of first detection. The location of the siting within the 1-kilometer radius and the direction of travel were shown. Topographic maps had reference numbers to key them to observation forms.

3.6 SPRING MIGRATION, SUMMER RESIDENT, AND FALL MIGRATION VARIABLE TRANSECT SURVEY STUDY METHODOLOGY

Because field surveyors spent about the same amount of time traveling between fixed point observation stations as they spent actually conducting the observations, additional transect observations significantly augmented fixed point survey data. Field surveyors were often moving between fixed point observation stations along regular routes. These stations were distributed evenly throughout each study unit, so additional observations could be collected at essentially equal effort throughout each study unit.

Because surveyors had to adhere to planned timing of fixed point observation stations, they were not able to complete all data collection and field data forms for each observed raptor during variable transect surveys. When time was limited, surveyors did not record weather information (e.g., wind speed, wind direction, and temperature) and other data. While almost all wildlife species were noted during fixed point station observations, only those species identified as special focus species were recorded during transect surveys. Similarly, field surveyors otherwise would have been significantly detained while taking notes about ravens and common song birds and could not meet the timing requirements of the fixed point surveys.

3.7 DATA RECORDING COMMON TO ALL FIXED POINT AND TRANSECT STUDIES

3.7.1 Prefield Training

Three experienced field surveyors were selected for this study. A training session was conducted with the surveyors to describe the purpose of the studies as part of the environmental review process, various characteristics of wind turbines, the physical characteristics of the study area, and the methodology described above. Training focused on ensuring that field data were recorded consistently between observers. The variables and data codes provided in Appendix B were reviewed in great detail with the surveyors. Hypothetical bird observation scenarios were presented to them so that they could practice completing the forms and using the field data codes.

3.7.2 Field Data Forms

Raptor sightings were recorded on a standard field data form that included space for all variables being studied (described in Appendix B). Appendix C contains a copy of the standard blank field data form used while conducting the surveys.

3.7.3 Quality Control

Quality control measures were implemented at several stages throughout the study process. Each surveyor checked field data forms for completeness, accuracy, and legibility at the end of each survey period or at the end of each day. The avian team leader or project manager then reviewed the forms to ensure that they were completed and legible, discussed the observations made that week with each surveyor, and noted any other valuable information that required immediate attention because of its significance to birds or its potential effect on the studies being conducted.

The data were keypunched into an electronic file and compared to the field data forms to ensure that no keypunching errors occurred. If the keypunch operator was uncertain about a code or saw a possible irregularity in the data, he/she was instructed to inform the avian team leader or project manager to resolve the issue prior to completion of keypunching. The project manager then randomly selected more than a 5% sample of field data forms and checked the appropriate entry in the electronic files to verify that data were entered accurately. Finally, once these steps were taken, the data analyst prepared univariate and bivariate summaries of the data. Incorrect codes or unusual results were checked against the original field data forms and the errors or irregularities were corrected.

3.8 BREEDING RAPTOR SURVEY IN THE GREATER STUDY AREA

Investigations within the greater study area for breeding raptors provided information regarding breeding raptor population levels. The greater study area included searches for breeding golden eagles, bald eagles, and peregrine falcons that might nest outside of the project sites but potentially travel within it. The major objective of this survey element was to identify golden eagle, bald eagle, and peregrine falcon nests within 16 kilometers (10 miles) of potential wind turbine sites. This distance was selected because it is the maximum diameter of foraging ranges for nesting individuals of these species. The intent of this survey was to provide information suitable to meet the requirements for biological assessments for BPA under Section 7 of the Endangered Species Act.

3.8.1 Habitat Analysis

Prior to conducting the breeding raptor surveys, habitat for target raptor species was evaluated for suitability. The vegetation map, prepared as part of the botany investigations, and aerial photographs of the project sites and vicinity were examined and used to identify habitats potentially suitable for nesting for each target raptor species. The avian team developed a nesting habitat suitability map that was used to focus subsequent field efforts to search for raptor nest sites, as described in the following sections.

3.8.2 Raptor Nest Surveys

Bald Eagles, Golden Eagles, and Peregrine Falcons

Nest surveys for these species were conducted using a combination of ground and helicopter surveys. Prior to conducting helicopter surveys, field surveyors searched cliffs for vertical white-wash streaking (i.e., stains caused by excrement), which is an indication of falcon nest sites (Call 1978). Cliff faces and draws were searched on both sides of the Columbia River within 16 kilometers (10 miles) of potential wind turbine locations.

Two helicopter flights were conducted, one in mid-May, when females were sitting on nests, and another in early June, when young had hatched yet were still white and visible. Attempts were made to conduct the helicopter surveys in cooperation with the WDFW. Potential falcon nesting sites identified during helicopter surveys were subsequently revisited from the ground, if later determined by the avian team leader to be necessary.

Other Raptors

Nest sites for prairie falcon, Cooper's hawk, sharp-shinned hawk, red-tailed hawk, ferruginous hawk, and Swainson's hawk were surveyed during the nesting season within 3 kilometers (1.9 miles) of potential turbine locations as recommended by the WDFW during the March 8, 1994, meeting. Three general habitat categories were established for conducting these raptor nesting observations: (1) cliffs and basalt outcrops, (2) sparsely located trees, and (3) oak/pine woodlands. Each of these habitats possessed inherent features that required different survey techniques.

Cliffs and basalt outcrops were surveyed using direct observations from below (along SR 14) and from above (along the rim of the ridge). Field surveyors systematically searched the face of the ridge using spotting scopes, binoculars, and the unaided eye to locate nesting hawks. Because of habitat associations, red-tailed and ferruginous hawks were the target of these studies. Cliff and basalt outcrops were also simultaneously surveyed for golden eagle, prairie falcon, and peregrine falcon. Helicopter surveys for peregrine falcon and golden eagle were also used to detect buteo hawk nest sites.

Trees that were either singly located or in small interspersed groups throughout the greater study area were visually searched for stick nests. They were first examined at about a 0.25-kilometer (0.16-mile) distance using binoculars and a spotting scope. When hawks or stick nests were detected, the tree(s) were examined more closely until the presence or absence of a nest site was determined.

Oak/pine woodlands (i.e., more concentrated and larger woodland areas) were surveyed using two methods: (1) stationary observations to detect birds entering or leaving nest sites, and (2) walkthrough transects to directly locate stick nests. Each stand of oak/pine was surveyed as a separate unit.

The observations from fixed viewpoints (not from one of the 16 established observation stations) for the breeding raptor survey were different in intent and approach than those conducted for general raptor use. Rather than establishing a systematic grid of observation stations, observation sites were selected based solely on the field of view they provided the surveyor. Sites containing potential nesting habitat were surveyed at least once for approximately one-half hour in the midmorning (approximately between 9 a.m. and 11 a.m.), when breeding males were likely to be taking prey to their nests. Once suspected nest sites were located using this method, field surveyors entered the woodland stand and searched directly for the nest site. Both red-tailed and Swainson's hawks typically call loudly when people approach a nest site, and such behavior was used to locate nest sites.

The second method to survey oak/pine woodlands involved walking transects through each oak/pine grove within the greater study area. The woodlands are situated in shallow draws on the northern portion of the greater study area. The woodlands are generally elliptically shaped, with the long axis north to south. The transects were placed along the north-south edges of each oak/pine woodland. Edges are the areas most likely to be used by nesting red-tailed and Swainson's hawks. While walking transects, field surveyors also played recorded calls of sharp-shinned, Cooper's, northern harrier, Swainson's, and red-tailed hawks at about every 0.5 kilometer (0.3 mile) to attempt to elicit responses from nesting hawks. The calls were played in the order just described, starting with the smaller sharp-shinned hawk and ending with the larger and more aggressive red-tailed hawk. Calls were played over about a 5- to 10-minute period. The surveyors were particularly careful to ensure that they were not hearing calls of mimic bird species (e.g., Stellar's jay.)

3.9 FIELDWORK IMPLEMENTATION

Weather conditions and unforeseen logistic problems in scheduling field surveyors' time resulted in some minor variations from the field study method originally outlined in the avian study plan. The study plan recognized that these variations might occur as a natural part of conducting fieldwork.

Only one field surveyor could be mobilized during the replicates originally planned for April 12-14 and April 21-23 because of a short notice to proceed with the fieldwork under the newly developed avian study plan. Thus, one person was deployed and conducted the survey during the April 12-18 and April 23-28 periods of the spring migration study. Similarly, for the breeding study, one surveyor conducted ground fieldwork during the prescribed period of May 11-13 and a second surveyor conducted his surveying during the May 14-16 period. These variations resulted in the same level of effort being expended over a longer period of time.

Stations 17, 18, and 19 (the control stations) were not sampled until April 23 because they were not selected until that time. Therefore, data for the control stations and area are not available for the period prior to that date. However, these stations were sampled during each replicate period thereafter.

On September 29, while conducting the fall migration study, surveying was terminated at station 4 (the ridge top area) because of poor weather and road conditions. No information was recorded for that station for the entire day or for that replicate.

During the fall migration study, concerns arose that the primary migration period for raptors might be occurring slightly later than predicted because of an unusually warm early fall. Therefore, one replicate was added to the fall migration study to ensure that a prolonged, concentrated sample of the peak migration period occurred. This additional replicate occurred during October 12-15. Through independent contacts with other biologists and through the fieldwork, it was later confirmed that the peak fall raptor migratory period was not missed.

On October 21, access could not be obtained to station 4 in the ridge top area because an additional lock had been placed on the gate on the Tower Hill area. Subsequent attempts to contact the local landowner to obtain a key and gain access were not fruitful.

On October 26, stations 1, 2, and 5 (in the western hills area) could not be surveyed during the third visit of the day because of poor weather and road conditions. However, those stations were sampled during the first and second visits of the day.

Finally, one of the field surveyors had a family emergency during the planned October 19-21 replicate. This resulted in one surveyor conducting his observations during the prescribed period and the second surveyor conducting his observations during October 23-26.

The missing samples presented no problems for the analyses because, as described below in Section 3.10.3, data from all samples within each season were pooled by time of day, and there were not missing pooled samples. Pooling would have produced biased samples if the missing data deviated substantially from other data collected in the same season, but there was no evidence of any such deviation.

3.10 STATISTICAL METHODS

3.10.1 Statistical Analysis Objectives

The statistical analyses primarily addressed two central questions:

1. Are there statistically significant differences among study units (areas), seasons (i.e., spring, summer, or fall), or times of day (i.e., dawn, midday, and dusk) in the degree of use by the major avian species present?

2. What environmental factors significantly affect the probability of the major avian species entering the critical altitude?

Two statistical analysis methods were principally used for this study: repeated measures analysis of variance (ANOVA) and logistic regression. Repeated measures ANOVA was used to test for differences among study units, seasons, and times of day in degree of use of the major bird species (i.e., differences in frequency or duration of species' presence). Repeated measures ANOVA is analogous to a three-way ANOVA where study unit, season, and time of day are the factors. However, it would not be legitimate to use a simple ANOVA for this test because the samples were obtained by repeated sampling of the same stations, and samples from the same station are likely to be correlated. A repeated measures ANOVA appropriately accounts for this correlation.

Logistic regression was used to examine how several environmental factors affected the probability of entering the critical altitude. Logistic regression is similar to linear regression except that different assumptions are made regarding how the independent variables affect the response variable. The assumptions of logistic regression are more appropriate than those of linear regression when the outcome of the response variable is binomial (i.e., observed bird either entered or did not enter the critical altitude).

More detailed information regarding the statistical analysis procedures used for this study is given below.

3.10.2 Measurement and Experimental Units

The basic measurement units of the study were the recorded observations. Only observations within the 1-kilometer survey radius at the fixed point stations were included in the statistical analyses. No statistical analyses were conducted for bird species with fewer than 15 observations because the sample size would have been too small to obtain statistically valid results.

A systematic sampling design rather than a random design was used to locate observation stations. The statistical methods used to analyze the data assume a random design, so the computed probability levels may be slightly different. To account for this uncertainty, results were reported as not significant if the reported probability (p) was greater than 0.1, as significant if $p < 0.01$, and as marginally significant if $p > 0.01$ and $p < 0.1$. Statistical significance refers to the probability of detecting a difference in the values of variables when no difference exists. For instance, a probability of 0.1 indicates that there is one chance in 10 of finding a difference when none exists.

For analyses addressing the probability of birds entering the critical altitude, an observation was treated as the basic experimental unit. An observation was a record of whether the bird or birds observed entered the critical altitude. The proportion of observations of a species in which the bird entered the critical altitude was the estimated response function.

The analyses addressing the question of differences in degree of use among study units, seasons, and time of day included two sizes of experimental units: (1) station was the large experimental unit, and (2) a station visit (visit within station) was the small experimental unit. Studies with two or more sizes of experimental units have a split-plot or repeated-measures design (Milliken and Johnson 1992).

Observations were not suitable experimental units for the degree of use analyses because observations regarding a species were made only when the species was present. Because the length of a station visit was constant, the number or duration of observations per visit was an appropriate measure of use. Total number of individuals of a species observed during a visit was not used for statistical analyses because birds tend to associate with one another, and therefore the presence of one bird increases the likelihood of additional birds being present. However, the means of the numbers of sightings (individuals) made at each station and season were computed and are presented graphically in Section 4.

3.10.3 Statistical Analysis Methods for Comparing Degree of Use Among Study Units, Seasons, and Time of Day

Test Procedure

The same set of stations was sampled during each survey visit in this study. Studies in which fixed stations are repeatedly sampled violate assumptions of the simple analysis of variance (ANOVA) procedures. The appropriate method for analyzing data from such designs is a repeated-measures ANOVA procedure (Milliken and Johnson 1992). Repeated-measures ANOVA (SAS 1992) was used in this study to test for differences in the mean number of observations per visit and the mean total duration of observations per visit among the study units, seasons, and times of day.

Test Assumptions, Pooling Data, and Transformations

The number and duration of observations per visit data were highly skewed (i.e., not normally distributed) with a large proportion of zeros in the data (i.e., many visits with no observations of the species). In addition, the variances of the groups (e.g., study units, seasons, and times of day) being compared were heteroscedastic (i.e., had unequal variances). These conditions violate assumptions of the ANOVA test.

To reduce the proportion of zeros and otherwise improve the distribution of the data and reduce differences in variances, the data from all surveys within a season were pooled by time of day and the pooled data were log-transformed. Pooling was also required because, as noted above, a few sampling visits were missed. The repeated measures ANOVA procedure requires that the matrix of subjects (i.e., stations) and times be complete. By pooling the data within seasons, missing data were eliminated. Pooling and log transformation greatly increased the normality of the distribution and reduced differences among variances, but the data remained significantly nonnormal and, for many species, were still heteroscedastic. Therefore, results indicating probabilities close to the significance level should be regarded skeptically. Test results were reported as significant, marginally significant, or not significant as described in Section 3.10.2.

Another assumption of the repeated-measures ANOVA is that the data meet sphericity conditions (a measure of independence). For most of the analyses the sphericity condition was met (i.e., the test for sphericity was not significant [$p < 0.05$]). For cases where the test was significant, probability values with the Huynh-Feldt adjustment were reported.

Analysis Variables

Study unit, season, and time of day were the independent variables in the repeated-measures analysis. Number and duration of observations per visit (see Section 4 for definition of observation) were the response variables. The repeated-measures ANOVA was applied to the data after pooling the survey data for each season. Pooling produced means for each time of day within each season, resulting in nine repeated measures for each station. However, time of day and season were treated as two separate repeated-measures factors, with time of day nested within season, so that their effects could be distinguished. Stations were the grouping factor and served as replicates in the analysis to compare study units.

Individual Comparisons of Means

If results of the repeated-measures ANOVA indicated significant or marginally significant differences among study units, Tukey's multiple comparison test (SAS 1992) was carried out to determine significant differences. Two orthogonal contrasts (SAS 1992) were also made to test the following hypotheses:

H_o: The mean use by the species of the control study unit is equal to its combined mean use of the other study units.

H_o: The combined mean use by the species of the study units in which wind turbines are planned (western hills, ridge top, and eastern hills) is equal to its combined mean use of the other study units in the primary study area (ridge face and northern plateau).

Mean use in these hypotheses refers to mean number of observations per visit and mean duration of observations per visit.

3.10.4 Statistical Analysis Methods Used to Test for Effects of Environmental Factors on Probability of Entering the Critical Altitude

Analysis Variables

The environmental factors tested for their potential effects on the probability of a species entering the critical habitat were season, study unit, ground wind direction, wind speed, air temperature, and percent cloud cover. Season, study unit, and ground wind direction are nominal or class variables, while wind speed, temperature, and cloud cover are continuous variables. The response variable, the presence or absence of a bird at the critical altitude, is a dichotomous (binary) variable.

Test Procedures

Effects of the continuous explanatory variables on the probability of a bird entering the critical altitude were estimated using stepwise logistic regression (SAS 1992). Probability thresholds to enter and to keep variables in the model were set at 0.15.

Logistic regression provides an equation for estimating the probability of an outcome. For dichotomous variables, the equation estimates the logit of the probability (p) of one of the outcomes (SAS 1992), where logit(p) = log(p/(1-p)). Thus, for significant regressions, the probability, p, of a bird entering the critical altitude was estimated from the regression results as follows:

$$p = e^{\text{logit}(p)} / (1 + e^{\text{logit}(p)}).$$

The sample sizes were too small to use logistic regression with nominal independent variables (SAS 1992). Therefore, exact tests (SAS 1992) were used to test association of the nominal variables with the probability of a bird entering the critical altitude. Exact tests, which are extensions of Fisher's exact test (Sokal and Rohlf 1981) to larger contingency tables, are especially suited for analyzing sparse data. The exact tests were carried out separately for each of the nominal variables because of the small sample sizes.

Section 4. Affected Environment

Section 4. Affected Environment

4.1 WINTER RAPTOR AND WATERFOWL STUDY

4.1.1 Raptors

Winter raptor populations are generally more variable than breeding populations because of the inherent variability of prey species availability during winter (Newton 1979). Populations are also known to fluctuate widely over the course of a single winter. However, while raptor densities may shift, general patterns of habitat associations remain fairly stable. Because of this, this section focuses primarily on the species that were present in the study area and the habitats or areas they frequented.

Peregrine Falcon. No peregrine falcons were observed during the winter studies. Therefore, few results regarding peregrine falcon winter use can be discussed here, other than that peregrine use within the study area is low. While peregrines are believed to occasionally travel and forage throughout the study area year-round, winter use is expected to be concentrated near waterfowl located along the Columbia River south of the study area.

Bald Eagle. Bald eagles winter along the Columbia River and associated drainages near the study area. During winter surveys, bald eagles were observed to use all study units within the study area. Use was concentrated along the river and ridge face, and one regular travel route was found to exist between the river and roosting areas north of the ridge. General patterns of behavior and use were identified and are described in the following sections. However, based on the inherent variability of bald eagle wintering behavior, as well as the variability of observed behavior, bald eagles can be expected to occur throughout the study area to varying degrees.

Site Numbers and Seasonal Timing. Klickitat County supports relatively few bald eagles. In 1990, when the most recent statewide survey of wintering bald eagles was conducted, about 1.2% of the total count was found in Klickitat County (35 out of a total of 2,983) (WDFW 1990). This amounts to about 5% of the total count for eastern Washington counties (35 out of 642). Bald eagle use was observed to vary over the winter from about three individuals during low use periods to about 10 individuals during higher use periods. In general, use was low during December but increased through the end of January. During December 1993, a single bald eagle was observed regularly within the study area (although the presence of fog may have resulted in artificially low observations). During early January 1994, approximately three bald eagles were estimated to be using lands within or near the study area. By the end of January 1994, up to 10 bald eagles were estimated to be present in the study area. In mid-February 1994, 10 bald eagles were estimated to be present. This pattern corresponds with that reported by Ichisaka et al. (1989), with bald eagle numbers being greatest from early January to mid-March. Numbers of eagles found in the second winter study (conducted in December 1994) were similar to those found in the first.

Because of seasonal and yearly variation, it is necessary to apply some estimation of maximum bald eagle abundance in the project area. As reported earlier, wintering bald eagle numbers fluctuate annually, depending on both the severity of the winter and on the availability of food. During 1987 and again in 1989, bald eagle numbers in Klickitat County doubled over 1986 and 1988 respectfully (WDFW 1989). The winter survey was conducted during a relatively mild winter, and bald eagle numbers reported statewide were generally average. Assuming peak use is roughly double average use, the maximum bald eagle abundance in the study area is estimated to be at 20 during peak use years (including use along the north shore of the Columbia River), or twice the maximum number found at the site during the 1994 winter survey.

Overview of Behavior. Bald eagles observed in the study area were engaged in three primary activities: (1) day roosting, (2) roaming/foraging, and (3) roosting or traveling to and from night roost sites. Most daytime observations were of birds perched along the river or flying along the ridge face and the Columbia River.

Day Roosting. No regular day roosts were located on the Kenetech and CARES project sites in the study area. However, regularly used day roosts were present at three points along the Columbia River (Figure 4-1). Bald eagles used these areas throughout the day. Weather characteristics were relatively uniform, and no correlations between weather and day roosting behaviors were detected.

Roaming/Foraging. Bald eagles also moved along the Columbia River and the ridge face in apparently casual or arbitrary fashion. This behavior, described in this report as "roaming", could be considered a combination of foraging behavior and travel behavior. During such roaming flights, bald eagles regularly glided and soared on updrafts along the ridge face. They would often travel in a criss-cross pattern, occasionally stopping to perch on the ground at various places. In some instances, this perching may have been to investigate possible food sources.

During these roaming flights, bald eagles would sometimes cross the ridge top; however, daytime use of areas north of the ridge was less than that observed along the ridge face and along the Columbia River. On one occasion, bald eagles were observed flying within 50 meters of the ground along agricultural lands north of the study area. During this same day, three bald eagles were observed soaring at approximately 300 meters above the ground and 2 kilometers north of the northwest corner of the study area. These soaring birds were observed for over 10 minutes until the observers lost sight of them.

Bald eagles also crossed the Columbia River, doing so in less than 1 minute with apparently little effort. Based on several such observations, it appeared that the river

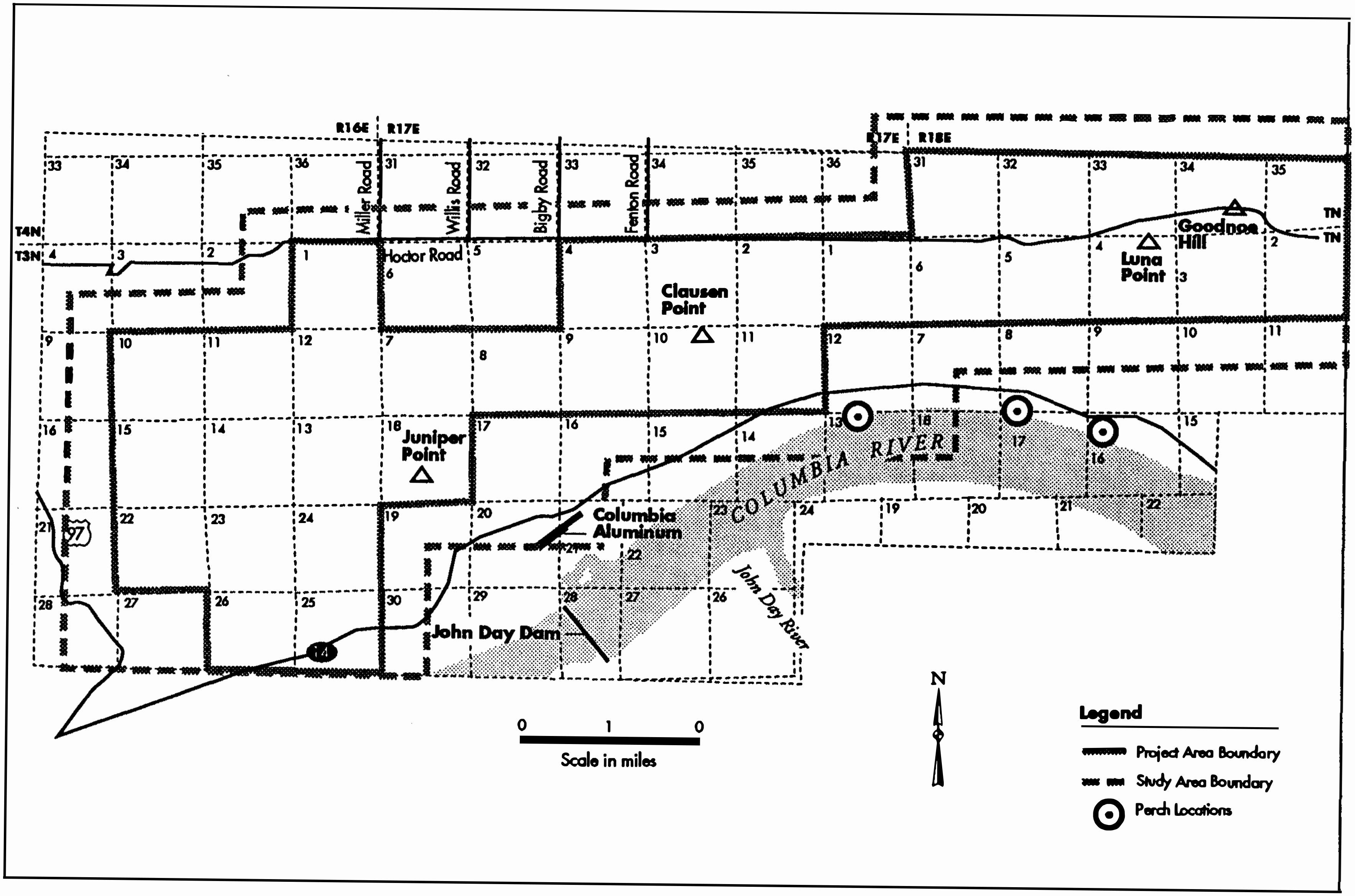


Figure 4-1. Bald Eagle Day-Time Perch Locations

formed no barrier to movement and that, therefore, bald eagles present on the Oregon side of the river also used the Washington side.

Night Roosting and Roost Flights. Winter night roosts are areas used by bald eagles during the night and occasionally during periods of bad weather. Three winter night roosting areas were identified during the winter surveys (Figure 4-2).

Winter surveys also identified flight paths and general behavior of bald eagles to and from their winter night roosts. In general, bald eagles using night roost sites located away from the Columbia River left the sites at or near dawn and returned at or near sunset. The one night roost site located near the river was also used as a day roost, and travel routes to it were observed along the river.

Bald eagles began their movements toward night roosts about 2 hours before sunset. During late afternoon, bald eagles were observed to fly more frequently than at other times of the day. During such late afternoon flights, bald eagles slowly worked their way up the ridge face of the study area and eventually crossed over the ridge. One specific route was used by two adult bald eagles on two consecutive nights in early January and again in late January.

Food Stocks. Bald eagles were not observed foraging during the winter survey. However, food sources are likely to be those described in Section 2. Based on the distribution of bald eagle observations, it appeared that bald eagles foraged mostly near the Columbia River where food stocks included sick or wounded waterfowl, fish, or carrion. The second most used area included the ridge face and associated rangelands where food stocks included chukar, deer and cattle carrion, and food stolen from kills made by other raptors (known as pirated food). As previously discussed, bald eagles were observed foraging north of the ridge where food stocks included small mammals, deer and cattle carrion, and pirated food.

Because bald eagles are highly opportunistic in their foraging behavior, their foraging areas and behavior are likely to shift with the availability of food stocks. For example, in years of high winter mortality of deer and cattle, bald eagles are much more likely to use the rangelands along the river, ridge face, ridge top, and eastern and western hills. In years when waterfowl are abundant, eagles may shift their foraging to the Columbia River.

Golden Eagle. Golden eagles were seen to frequent the ridge top and ridge face during winter studies. Based on field observations, activity appeared to be greatest near the historic nest site located just south of the central portion of the KENETECH site and about 3 kilometers (1.8 miles) east of the CARES site (Township 3 North, Range 17 East, Section 16). Golden eagles were observed to primarily use the middle to upper portions of the ridge face study unit and to cross the ridge top at several locations. Crossing altitudes were generally below 30 meters (98 feet) but still within the critical altitude range defined for this study. Golden eagles were also occasionally observed flying in the western hills study unit. Only a few observations were made within the eastern hills and north plateau areas.

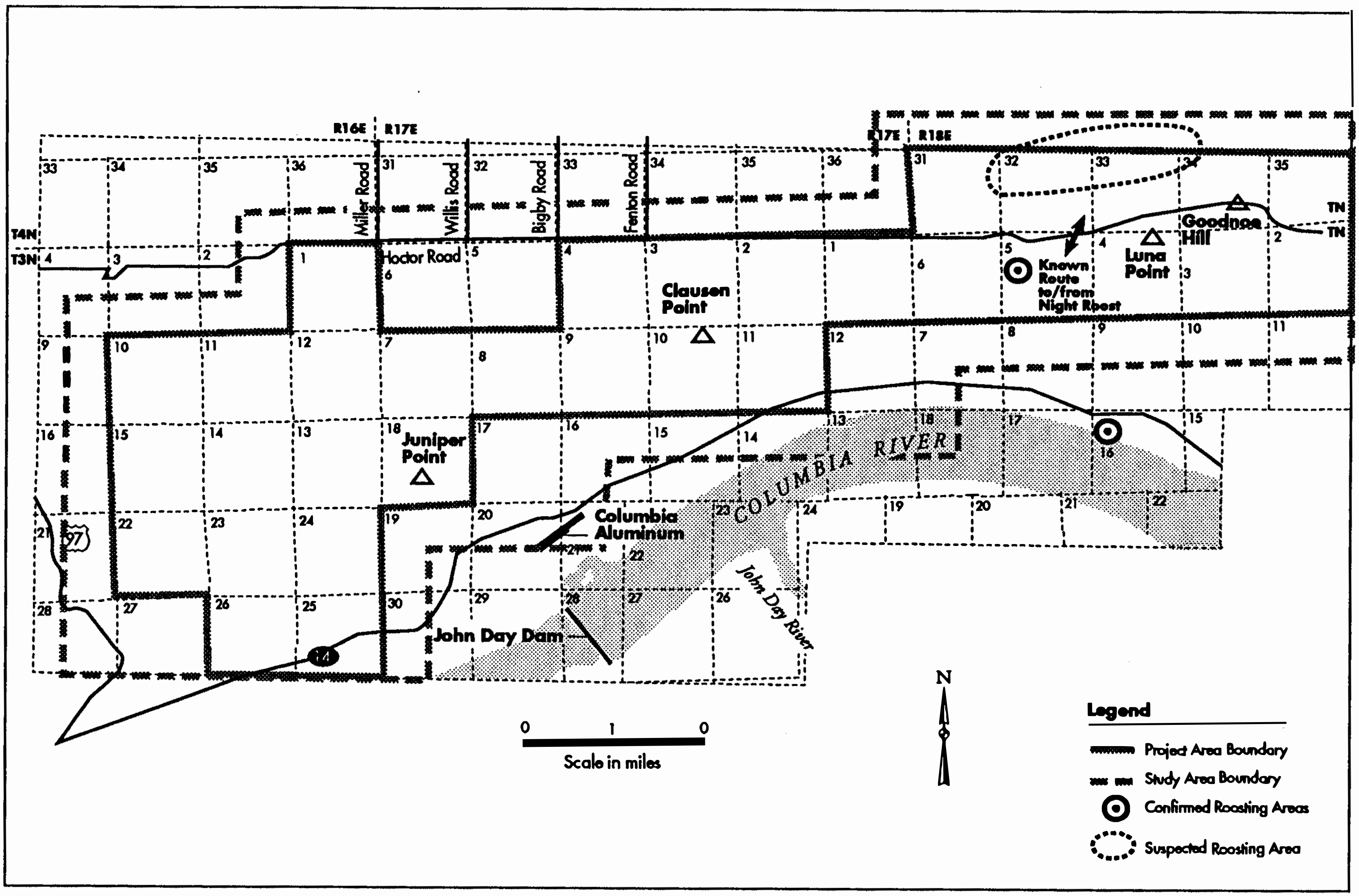


Figure 4-2. Bald Eagle Night Roosts

Based on observations made over consecutive days and on results of subsequent surveys (i.e., breeding and spring and fall migration surveys), the number of golden eagles using the area was estimated to be approximately four juveniles and three adults.

The flying behavior of golden eagles was similar to that observed during other periods of the year. Golden eagles were observed to fly mostly in two distinct patterns: (1) flying parallel to the contour of the ridge face at altitudes below 20 meters (66 feet), a flight pattern known as contouring, and (2) soaring and circling at altitudes generally above 20 meters (66 feet). Contouring was apparently not connected to wind direction, although birds flying against the wind would obviously move considerably slower than those flying with the wind. While soaring was observed throughout the ridge face unit, it was observed more frequently near the ridge top. Golden eagles were also observed to perch on the ground and on rock ledges.

Ferruginous Hawk. A single ferruginous hawk was observed in the ridge top study unit during the winter survey. Of the other five candidate species that were evaluated as part of this study, only the loggerhead shrike and western sage grouse are known to generally remain in the region during winter, although these were not observed during winter surveys.

Prairie Falcon. Prairie falcons were observed or expected to occur within all study units during winter. Several observations were made along Hoctor Road in the north plateau study unit and along SR 14 within and south of the ridge face unit. Behavior observed included perching on utility poles and flying close to the ground. Based on field observations and habitat associations, prairie falcons are most likely to forage in areas containing sparse ground cover in the ridge top unit and in croplands in the north plateau study unit. These are areas where horned larks, primary winter prey for prairie falcons, are most common.

Other Raptors. Other raptor species observed during the winter survey included rough-legged hawk, red-tailed hawk, American kestrel, and northern harrier. Most raptors present in the area are year-round residents. Besides those raptor species already mentioned, turkey vultures are the only raptor species that leave the study area during the winter.

In addition to resident raptors, rough-legged hawks migrate to the area during the winter and become one of the most common winter species. They are similar to red-tailed hawks in appearance and habit. Most observations of rough-legged hawks were within the north plateau study unit. They were regularly observed perching on utility poles and flying over croplands and pastures. Typical behavior included hovering at altitudes between 10 and 25 meters (33 and 82 feet). Rough-legged hawks were also observed or assumed present (based on habitat) in the other study units. The southernmost portion of the western hills study unit was particularly suitable for this species.

Rough-legged hawks are believed to increase the overall raptor population during winter. Rough-legged hawks have been reported to occupy areas vacated by other raptors that have migrated farther south (Palmer 1988), but observations made in the winter and in subsequent seasons suggested that the overall raptor population increased during winter when the rough-legged hawks appeared. Swainson's hawks are the only hawk to completely migrate from the area, and the breeding study found that only two pairs breed within the study area. Some red-tailed hawks that breed in the area may also migrate, but use was observed to be relatively the same during winter as was observed in other seasons. The number of rough-legged hawks observed to use the study area is believed to be greater than the number of breeding hawks that migrate south or otherwise leave the study area during the winter.

Red-tailed hawks were the most frequently observed hawk species during winter. Use was somewhat centered around the oak/pine woodlands, although these hawks were observed throughout the study area. They were commonly observed perching along Hoctor Road and to perch, soar, or glide throughout the study area.

Other raptors were observed in habitats similar to these reported to be typical in the literature. Northern harriers were observed near CRP and other croplands in the north plateau study unit. American kestrels were frequently observed perched on power lines along roads and were found to be common south of the study area and SR 14. They were also seen flying along the ridge face and ridge top study units.

Sharp-shinned hawks are presumed to be most closely associated with the oak/pine woodlands, although none were observed within this habitat, presumably because of the limited visibility allowed by the woodlands. The species is also likely to forage in more open areas as well. Cooper's hawks also were not observed during the winter study, but they are assumed to be present in small numbers. Great horned owls were not observed but are expected to be present in all study units.

Lewis' Woodpeckers. While Lewis' woodpeckers are migratory, they were observed during the winter months. They were observed most frequently near the oak woodlands in the north plateau area, but they were also observed within the north plateau area flying across croplands and pasture, away from woodland areas.

4.1.2 Waterfowl

Many species of waterfowl winter along the Columbia River and its tributaries. The area around the mouth of the John Day River, south of the central portion of the study area, is a known concentration area for waterfowl during winter and has been mapped as such by the WDFW. The wintering population of ducks and geese has been estimated to be about 6,000 in the vicinity of the John Day Dam (Annear in Dames & Moore 1993). Canada geese are especially abundant in the area.

During the first and second winter study periods, road counts along the Columbia River in the area immediately south of the study area found no concentrations greater than

200 birds. Most observations were of small groups of 10 to 50 individuals. Canada geese were the most frequently observed species, and flocks averaging 20 to 50 individuals were seen to fly up and down the Columbia River corridor. American coots were the second most commonly observed species along the river. Other species observed include redhead, common goldeneye, Barrow's goldeneye, ring-necked duck, hooded merganser, bufflehead, mallard, and scaup.

The Rock Creek area was identified as a concentration point for wintering waterfowl during the first winter survey period. This area is located about 8.0 kilometers (5 miles) east of the KENETECH project site and 19.3 kilometers (12 miles) east of the CARES site. American coot and mallard were the most numerous species in this area. Other species observed included wigeon, Canada geese, bufflehead, northern pintail, gadwall, and northern shoveler. An important observation related to this waterfowl concentration area was that a pair of peregrine falcons were detected in this area during subsequent surveys. Peregrine falcons are known to be attracted to concentrations of waterfowl, although no peregrine falcons were observed in this area during the winter survey.

Waterfowl have been reported to fly from the Columbia River to forage in croplands, and a primary concern of this study was that waterfowl were crossing the ridge in the study area to feed in the north plateau study unit and other areas to the north. However, no regular movements were observed during the first or second winter survey period and no foraging was noted in the north plateau study unit. Only three flocks of geese were observed to fly over the ridge during the first winter study and none were observed during the second. The three flocks observed during the first winter study were seen crossing the western hills study unit, approximately 1.6 kilometers (1 mile) west of Juniper Point. Two of these observations were in the western portion of the CARES site and the third was approximately 0.8 kilometer (0.5 mile) west of the westernmost portion of the CARES site.

Waterfowl counts during the second winter survey period (December 8-16, 1994) included detections of Canada geese, common goldeneye, Barrow's goldeneye, ring-necked duck, bufflehead, hooded merganser, redhead, and mallard. During the first 2-day observation period, more than 1,300 waterfowl were counted on the Columbia River and Rock Creek. During the second 2-day observation period, more than 1,700 waterfowl were observed. Waterfowl were not detected within the project site boundaries during the 2-week survey period. These few observations indicate that only minor movements occur through the study area during winter. However, such movements may vary from year to year, and it is assumed that potentially greater numbers of waterfowl cross the project site during some years.

4.1.3 Common Winter Passerines

Horned larks were the most frequently observed passerine during the winter survey. They were seen in all habitats, but most frequently along fence lines, in tilled fields, and in the open rocky areas along the ridge top. Another common species was European starling, with flocks of up to 100 individuals observed. They occur in all study units but seemed to prefer the ridge face and the north plateau, where elevated perching areas were present.

Other species of passerines were observed in small flocks throughout the study area, but they were most frequently seen along roads and fence lines, shrubby areas, and other areas containing cover. Species commonly observed included American robin, house finch, dark-eyed junco, American goldfinch, western meadowlark, Brewer's blackbird, and white-crowned sparrow.

4.1.4 Other Common Winter Birds

Ravens, American crows, black-billed magpie, and northern flicker were found to be very common winter birds within the study area and occurred in all study units. Killdeer were common in the north plateau study unit. Gray partridge are assumed present in the north plateau, but none were observed. Chukar were relatively common along the ridge top and ridge face study units. Rock doves were observed in small flocks along the ridge face, and mourning doves were observed in the north plateau study unit. Gulls, including ring-billed and California, were observed along the river but not within the study area. Bonapart's gulls have been reported to winter along the river (Dames & Moore 1993), but none were observed.

4.2 SPRING THROUGH FALL STUDY

The following describes what species of birds were observed within the study area during the spring through fall study, their relative abundances, and their likelihood of occurrence in the study area by study unit and by season. Also, an analysis is presented of the flight behavior, the likelihood of each species flying within the critical altitude, and the factors that influence occurrence within the critical altitude.

4.2.1 Species Abundance and Distribution

A list of all species observed in the survey radius (1 kilometer or 0.6 mile) area along with the total number of sightings the total number of observations, and the total duration of observations is presented in Table 4-1. For this analysis, primary species refers to those species that occurred in the project area in sufficient frequency to be included in the statistical analyses. The following discussions use the following terms to describe the results of the surveys and statistical analyses. Visit refers to one 20-minute fixed point observation. Observations refers to the number of times a bird or birds were seen in the survey radius. For instance, one or more birds flying into the survey radius simultaneously count as one observation. Sightings refers to the number of birds that were seen within the survey radius.

Table 4-1. Total Numbers of Individuals, Observation, and Duration of Observations within the Survey Radius of the Fixed Stations

Species	Total Number of Sighted	Total Number of Observations[1]	Total Duration of Observations (minutes)
Golden eagle	37	32	90.1
Peregrine falcon	2	2	7.0
Prairie falcon	17	17	67.4
American kestrel	125	110	214.1
Turkey vulture	59	37	124.8
Northern goshawk	1	1	4.0
Cooper's hawk	5	5	11.8
Sharp-shinned hawk	32	28	38.5
Red-tailed hawk	186	160	727.6
Rough-legged hawk	1	1	0.8
Ferruginous hawk	3	3	6.0
Swainson's hawk	18	17	60.3
Long-billed curlew	1	1	0.2
Loggerhead shrike	3	3	14.0
Waterfowl	48	5	21.3
Western bluebird	101	16	16.5
Other passerines	6,443	317	4.3
Unidentified raptor	2	2	0.1
Unidentified hawk, eagle, or vulture	5	1	--
Unidentified hawk	12	12	19.1
Unidentified accipiter	9	8	6.5
Unidentified large falcon	6	5	2.3
Unidentified small falcon	2	1	0.2
Northern harrier	45	42	54.2
Osprey	1	1	5.0

[1] The number of birds sighted is sometimes greater than the number of observations because more than one bird was seen and recorded at one time (i.e., a pair) during an observation.

For instance, if two birds were seen at the same time, it would represent two sightings but one observation. Duration refers to the total minutes of observation.

Raptors

Raptors were the most frequently observed group of birds in the study area, and were observed a greater amount of time overall within the survey radius.

Fourteen raptor species were observed in the study area during surveys. The relative abundance of raptors in the study area is expressed using three separate indices: (1) the mean number of sightings (individuals) per visit (Figure 4-3), (2) the mean number of observations per visit (Figure 4-4), and (3) the mean duration of observation per visit (Figure 4-5). The mean number of raptor observations per 20 minute visit was 1.21 (+/- 0.75 SD, N = 568). Figure 4-5 illustrates the seasonal changes in the index of relative abundance. In descending order of abundance, red-tailed hawk, American kestrel, turkey vulture, Swainson's hawk, and prairie falcon were the five most common raptor species within the survey radius area during the spring through fall seasons. Red-tailed hawks and American kestrels use of the primary study area were two to three times greater than all other raptor species.

Passerines and Other Birds

Passerines made up the majority of sightings, but were observed a very small amount of time within the survey radius. A moderate number of western blue bird observations were made, and they tended to remain within the survey radius longer relative to other passerines. Very few sightings were made of long-billed curlew and loggerhead shrike, making up a negligible percentage of the data.

Western Bluebird. Western bluebirds were observed during the fall migratory period and were abundant during the breeding season. The spring survey occurred after the typical blue bird migration period (generally in early March) and thus few were observed.

Loggerhead Shrike. Only three sightings of loggerhead shrikes were made during surveys, indicating that only a few individuals moved through the area during migration. Two of these sightings were in the Eastern Hills study unit.

Sandhill Cranes. One observation of a flock of 50 sandhill cranes was made within the survey radius area during spring through fall surveys. During the spring, outside of the survey radius area, this single flock was observed initially flying over the Columbia River in a north/northeasterly direction. They were south of station 14, located in the Eastern Hills study unit on the KENETECH project site. They flew east and entered the southeastern edge of the KENETECH site boundary, and continued east flying at over 91.4 meters (300 feet) above ground level. Because only one flock was observed, it suggests that the site is part of a wide migratory front for sandhill cranes, and not a concentrated migratory area.

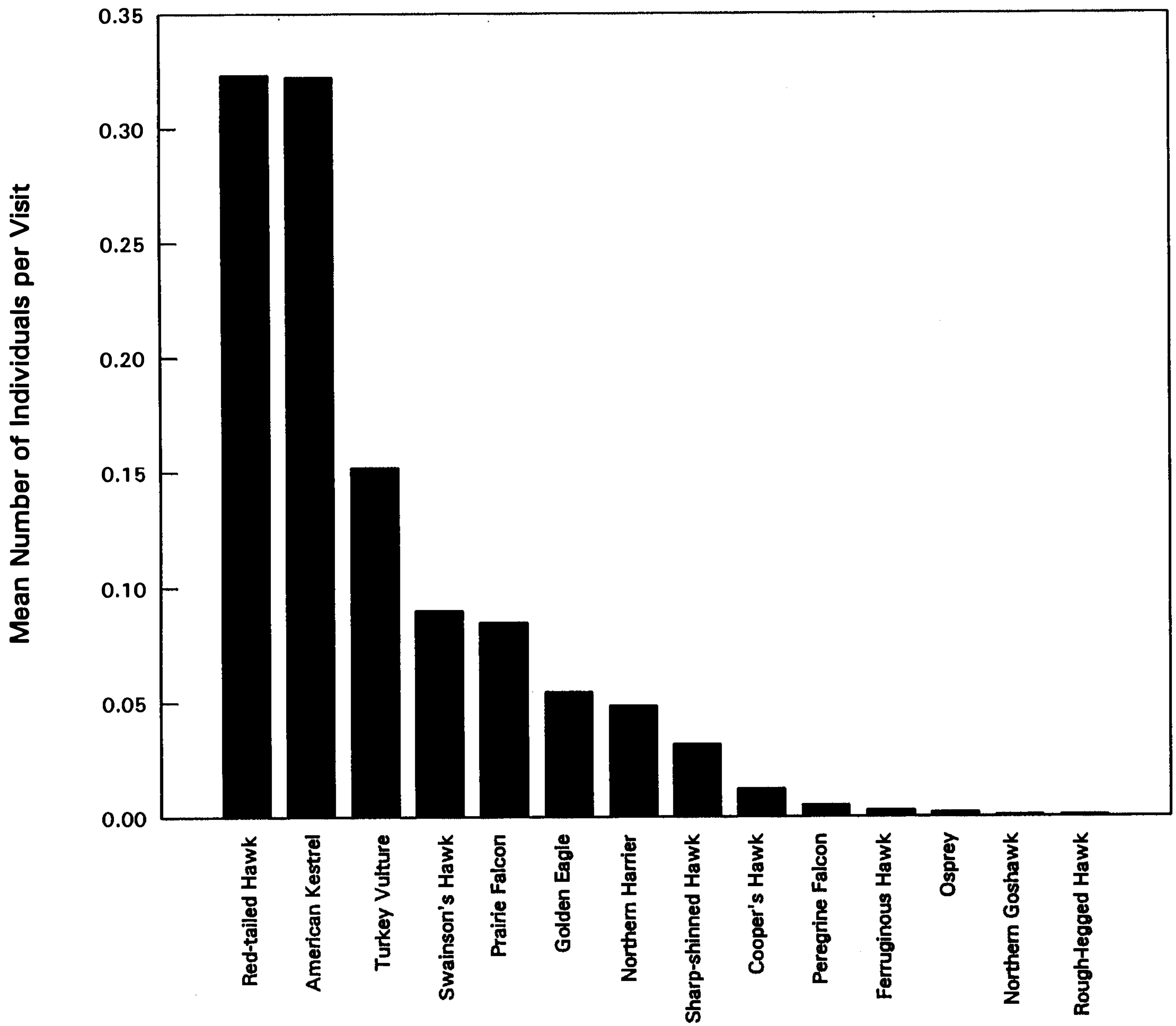


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Figure 4-3
Mean Number of Individuals by Species

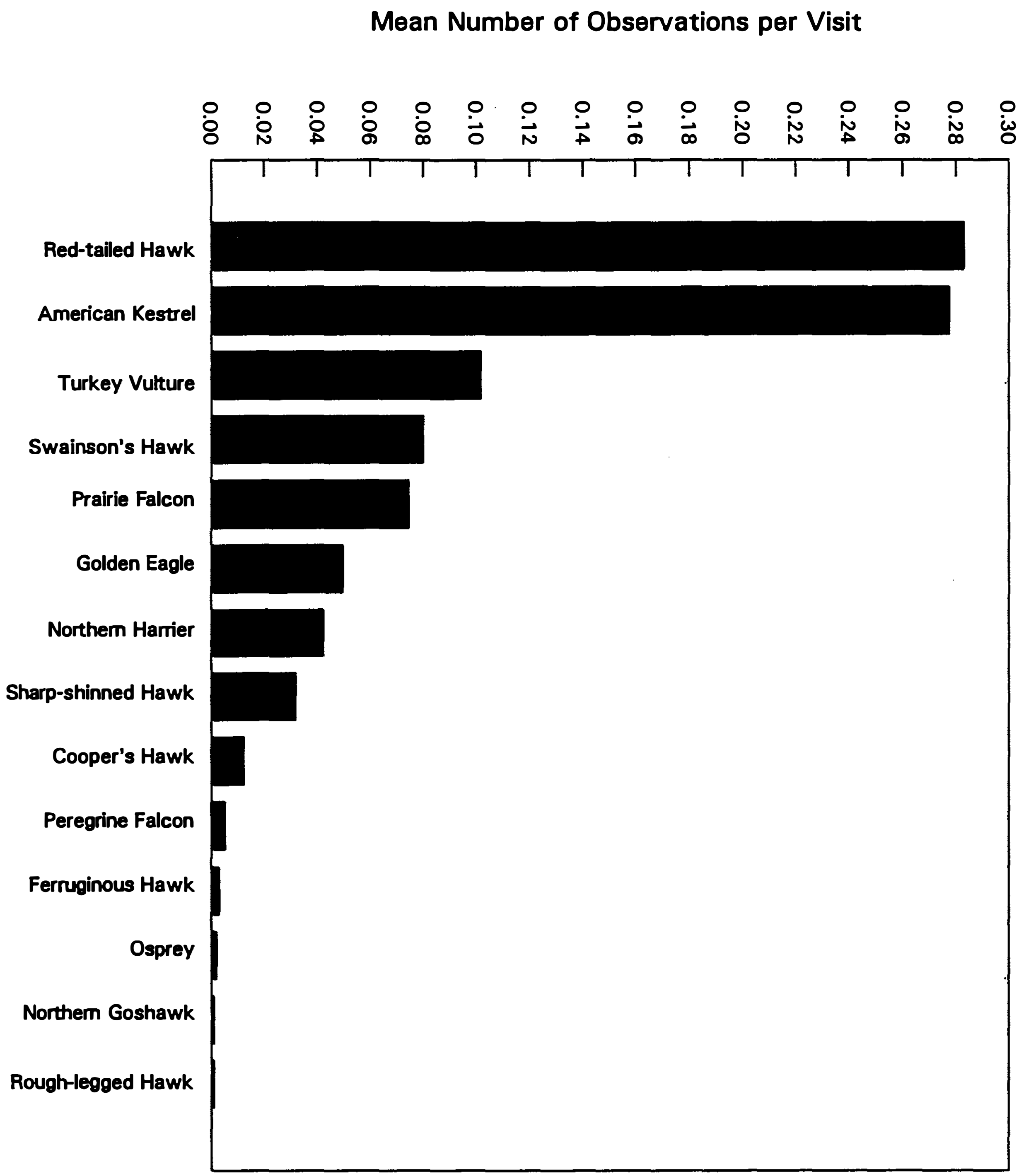

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Figure 4-4
Mean Number of Observations by Species

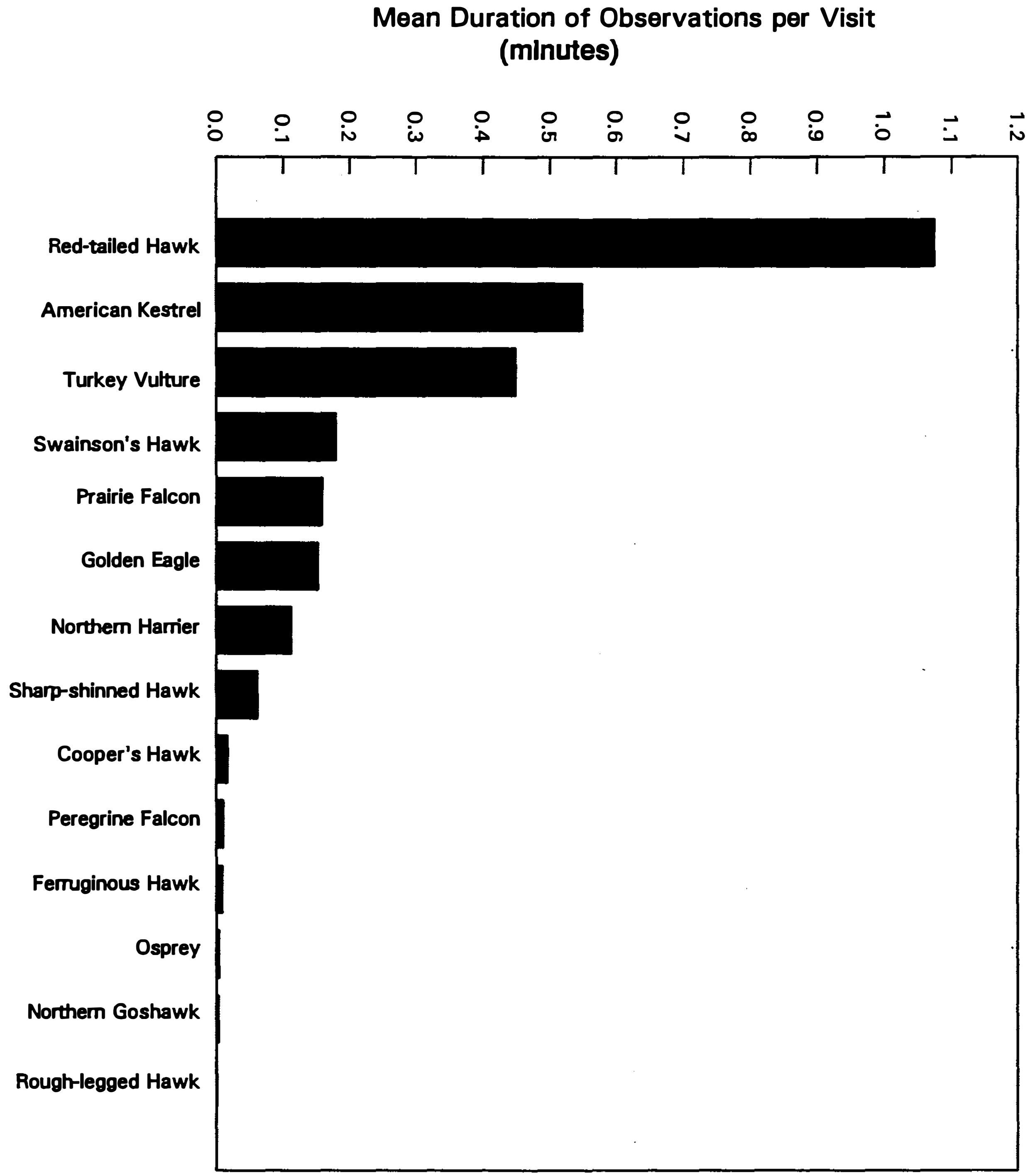

Figure 4-5
Mean Duration of Observations by Species

A wide migratory front means that birds migrate over a wide area, rather than through a narrow migratory corridor, such as a mountain pass.

Long-Billed Curlews. Two sightings of long-billed curlews were made in the project area (including one incidental observation), one of these in the Eastern Hills study unit at station 16 on the KENETECH site and another in the Western Hills study unit. This suggests that the project site is not an important migratory flyway for curlews and the area receives only occasional use.

Waterfowl

The occurrences of waterfowl made up only a small proportion of the sightings, observations, and total duration within the survey radius. Observations of waterfowl in the study area suggested that the area does not receive abundant waterfowl use and that the area is not an important migratory waterfowl corridor. Waterfowl are known to use the Columbia River and small waterbodies in the vicinity of the greater project area. Agricultural fields also probably receive some waterfowl foraging use. Only five observations of waterfowl (48 sightings) were made during surveys of the area, however, and only one of these was a flock that crossed over the Columbia Ridge.

4.2.2 Seasonal and Site Variation

Effects of the Distribution of Sampling Effort on Results

Total number of station visits varied considerably among seasons. However, for the repeated measures analyses of the effects of study unit, season, and time of day on degree of use, as well as for graphs and tables showing seasonal differences in results, the data from individual surveys were pooled by season. This pooling masked the differences in sampling effort between seasons (see Section 3.10.3 for a description of how data were pooled).

Bird Species Included in Statistical Analyses

As noted in Section 3.10, only bird species observed at least 15 times were included in the statistical analyses. Species observed at least 15 times were golden eagle, prairie falcon, American kestrel, turkey vulture, sharp-shinned hawk, red-tailed hawk, Swainson's hawk, western blue bird, and northern harrier (Table 4-1). There were 317 observations for the category, "other passerines", but no statistical analyses were conducted for this category because the group was considered to be too diverse to draw meaningful conclusions from results of statistical analyses. However, compilations of results for this and the other multi-species categories listed in Table 4-1 are presented in tables.

Presentation of Results

The statistical results are presented separately for the two groups of analyses conducted: repeated measures ANOVAs to test for the effects of study unit, season, and time of day on degree of use; and logistic regressions and exact tests to investigate the relationship of environmental variables and the probability of entering the critical altitude. Results within each of these groups are listed by species. Mean number of observations and mean duration of observations by season and study unit were used in the statistical analyses. The mean number of sightings of each species by season and study unit were not analyzed but are provided in Appendix D.

ANOVA tables are given for the repeated measures results. For ANOVA results with significant or marginally significant study unit effects, results of the multiple comparison tests and orthogonal contrasts are included in the tables. Only multiple comparisons and contrasts with significant results are listed. For multiple comparisons, means of the study units are listed in order of mean value (i.e., highest mean to lowest mean) and means that are not significantly different from one another are superscripted with the same letter. Because there were significant interactions between study unit and season for many of the analyses, the multiple comparison and contrast tests were carried out separately for each season. To provide consistency, the multiple comparisons and contrasts were made separately for each season even when interaction of study unit and season was not significant. To simplify reference to each study unit throughout the analysis, study units were given the following numerical assignments: (1) western hills, (2) eastern hill, (3) ridge top, (4) ridge face, (5) northern plateau, and (6) control area.

Logistic regression equations are provided only when one or more of the independent variables was significant or marginally significant. For the nominal variables, tables showing percentages of observations with birds entering the critical altitude are given for each class of the variables and probability levels are reported for significant and marginally significant results. Logistic regression and exact test results are reported for each season.

The reported probability levels are superscripted with a double asterisk when the result was considered significant ($p \leq 0.01$), with a single asterisk when the result was considered marginally significant ($0.01 < p \leq 0.10$), and with no asterisk when the result was considered not significant ($p > 0.10$). All unreported results for the species analyzed were not statistically significant.

Results of Repeated Measures ANOVA to Test Effects of Study Unit, Season, and Time of Day on Mean Number and Duration of Observations per Visit

The results for mean number of observations and mean duration of observations for all raptor species combined are presented for each study unit and season in Figures 4-6 and 4-7. These data are analyzed by species in the following sections.

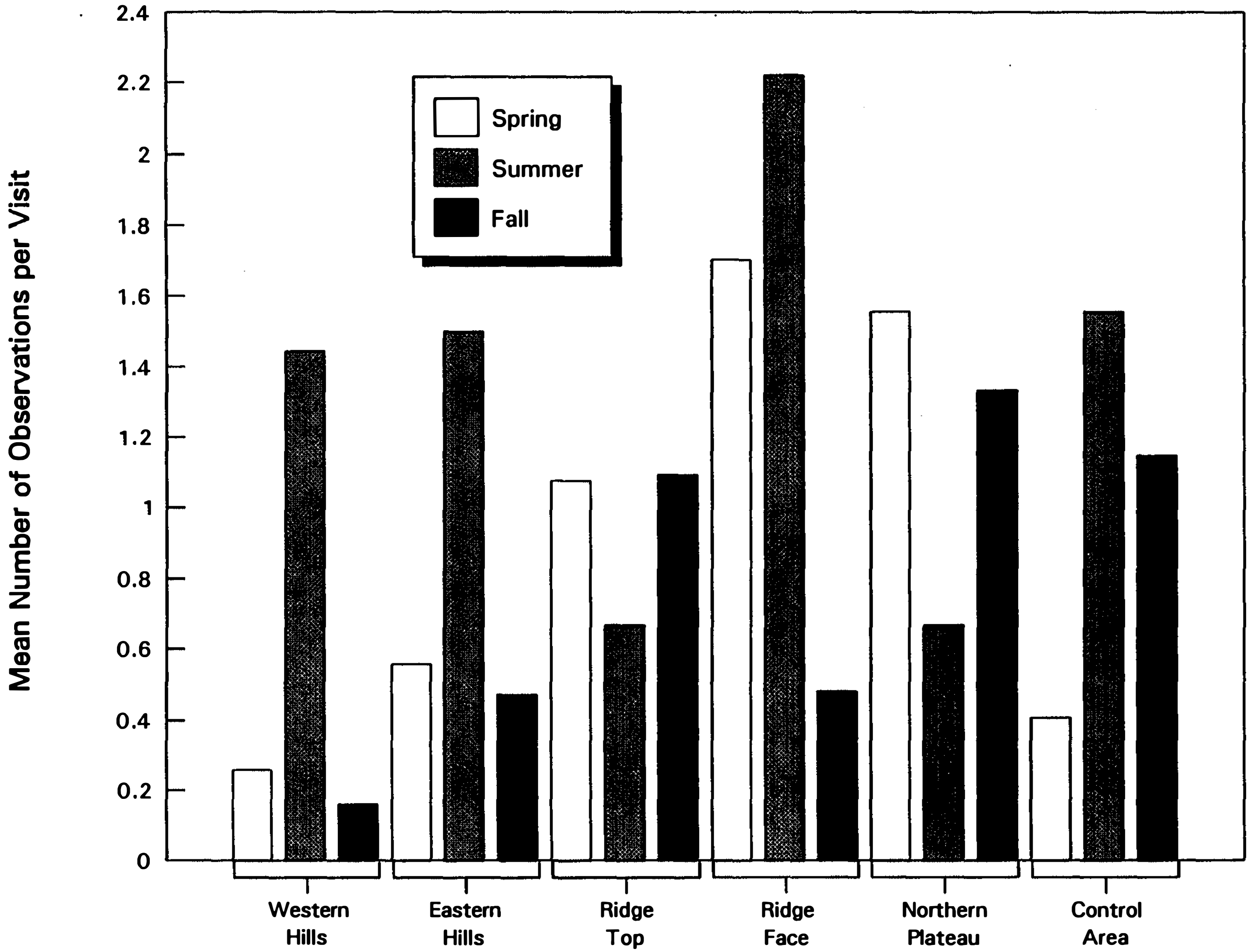

Figure 4-6
Mean Number of Observations of Raptors by Study Unit and Season

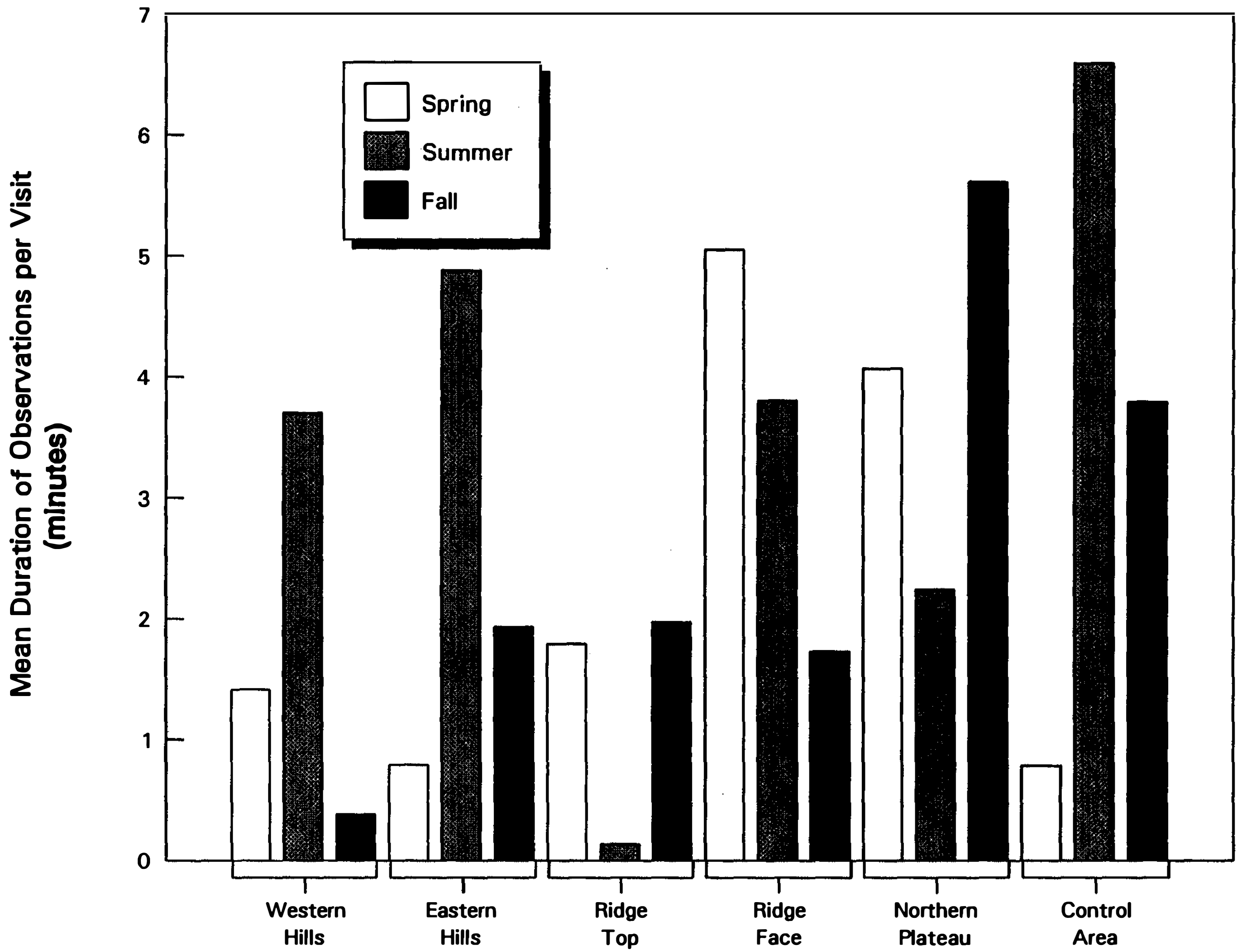

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Figure 4-7
Mean Duration of Observations of Raptors by Study Unit and Season

Removal of Time of Day Effects. Time of day was a marginally significant factor (p=0.0160) for mean number of observations of turkey vultures. Mean number of observations for early, midday, and late were 0.026, 0.112, and 0.059, respectively. Time of day was not significant for mean duration of observations of turkey vultures and it was not significant for mean number or mean duration of observations of all other species. It was concluded that time of day had little or not effect on the degree of use patterns, so this factor was dropped from the analyses. A reduced model was analyzed in which time of day results were pooled and seasons was the only repeated measures factor.

Golden Eagle. ANOVA tables for mean number and mean duration of observations of golden eagles are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study unit	5	0.0138	8.85	0.0008^{**}
Error	13	0.0016		
Season	2	0.0052	4.04	0.0296^{*}
Study Unit x Season	10	0.0048	3.79	0.0030^{**}
Error (Season)	26	0.0013		

Multiple Comparison Results

Spring	4^{a}	6^{ab}	5^{ab}	3^{ab}	2^{b}	1^{b}
Summer	4^{a}	6^{b}	2^{b}	5^{b}	3^{b}	1^{b}

Contrasts

Spring	Turbine sites lower than others $(p=0.0008)^{**}$
Summer	Turbine sites lower than others $(p=0.0039)^{**}$

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0396	9.44	0.0006**
Error	13	0.0042		
Season	2	0.0147	1.72	0.1993
Study Unit x Season	10	0.0052	0.61	0.7934
Error (Season)	26	0.0085		

Multiple Comparison Results

Spring	4[a]	5[ab]	3[ab]	6[b]	2[b]	1[b]
Summer	4[a]	6[ab]	2[ab]	5[b]	3[b]	1[b]

Contrasts

Spring	Turbine sites lower than others (p=0.0056)**
Summer	Turbine sites lower than others (p=0.0277)*

Both mean number and mean duration of observations per visit of golden eagles were significantly different among study units. There was a marginally significant difference among seasons in mean number of observations, but mean duration of observations was not significantly different. The interaction of study unit and season was also significant for mean number of observations, indicating that the variation among study units in the number of observations was not consistent among seasons.

Multiple comparison tests of mean number of observations and of mean duration of observations and Figures 4-8 and 4-9 indicated that study unit 4, the ridge face, was generally used more by golden eagles than other areas. However, this study unit was significantly greater than all other study units only for mean number of observations in summer.

The contrasts results indicated that, during spring and summer, the study units in the primary study area in which siting of turbines is planned (study units 1, 2, and 3, western hills, eastern hills, and ridge top) had significantly lower combined mean numbers and

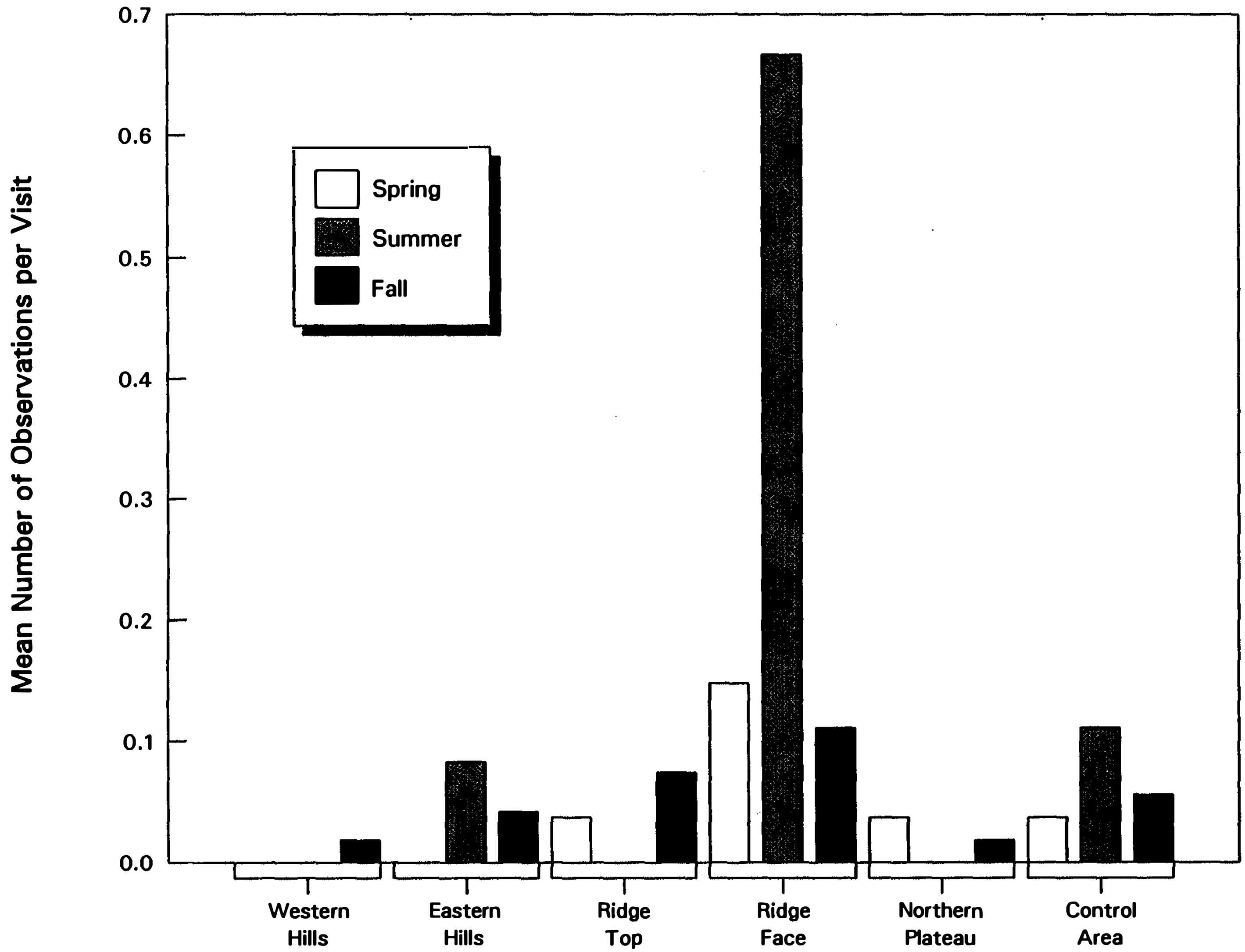

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Figure 4-8
Mean Number of Observations of Golden Eagles by Study Unit and Season

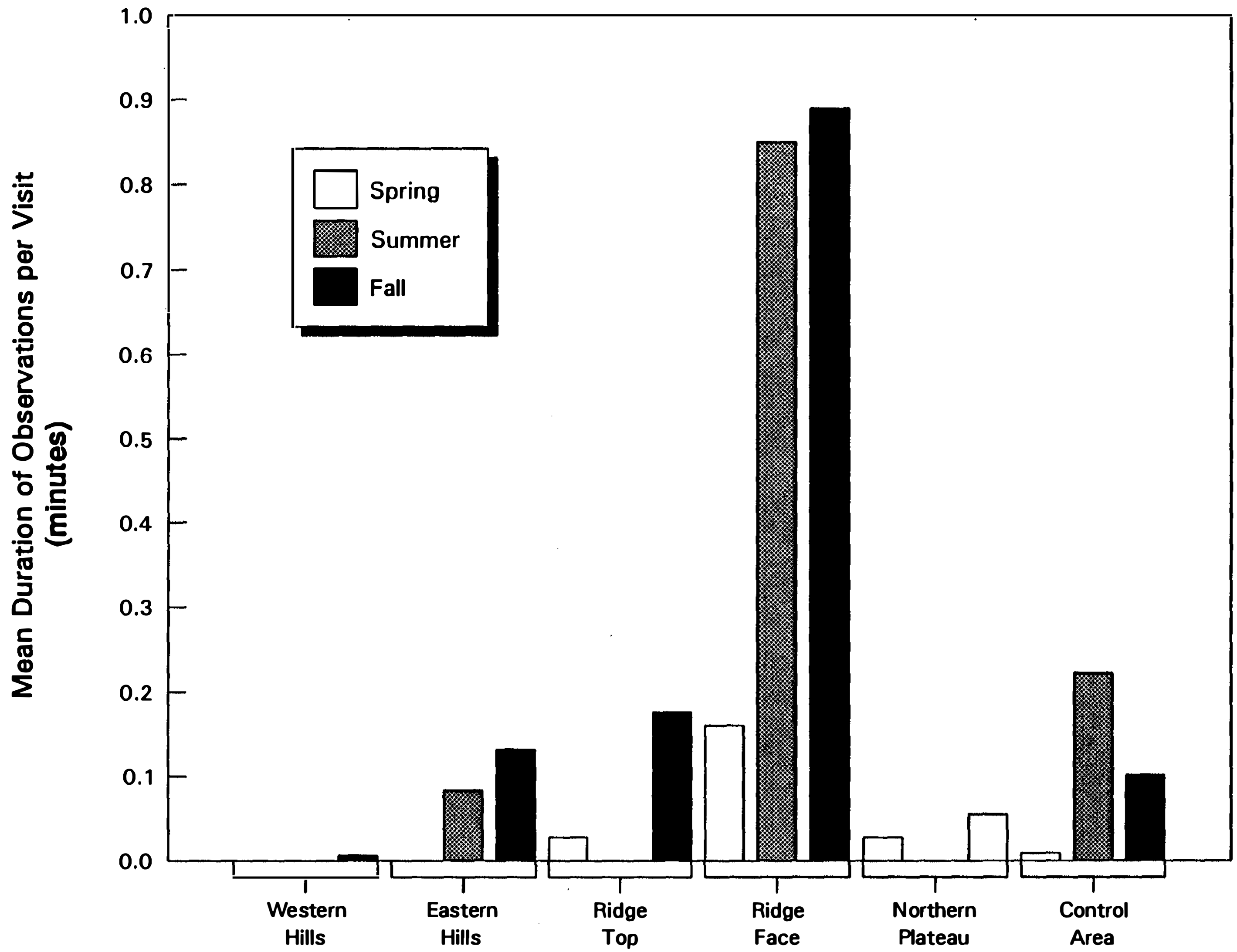

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Figure 4-9
Mean Duration of Observations of Golden Eagles by Study Unit and Season

combined mean durations of observations than the study units in which no or few turbines are planned (study units 4 and 5, ridge face and northern plateau). This difference resulted from the much greater use by the golden eagles of study unit 4 than other study units. The combined mean number and combined mean duration of observations of study units in the primary study area (study units 1-5) were not significantly different from the means of the control study unit (study unit 6).

Peregrine Falcon. Insufficient data were gathered on peregrine falcons to conduct statistical analyses. Mean number of observations and mean duration of observations by study unit and season are presented in Figures 4-10 and 4-11.

Prairie Falcon. ANOVA tables for mean number and mean duration of observations of prairie falcons are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0008	0.54	0.7444
Error	13	0.0015		
Season	2	0.0000	0.04	0.9572
Study Unit x Season	10	0.0010	1.43	0.2238
Error (Season)	26	0.0007		

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0124	0.80	0.5671
Error	13	0.0155		
Season	2	0.0070	0.49	0.6197
Study Unit x Season	10	0.0152	1.05	0.4310
Error (Season)	26	0.0144		

Both mean number and the mean duration of observations per visit of prairie falcons were not significantly different among study units and among seasons. Few prairie falcons

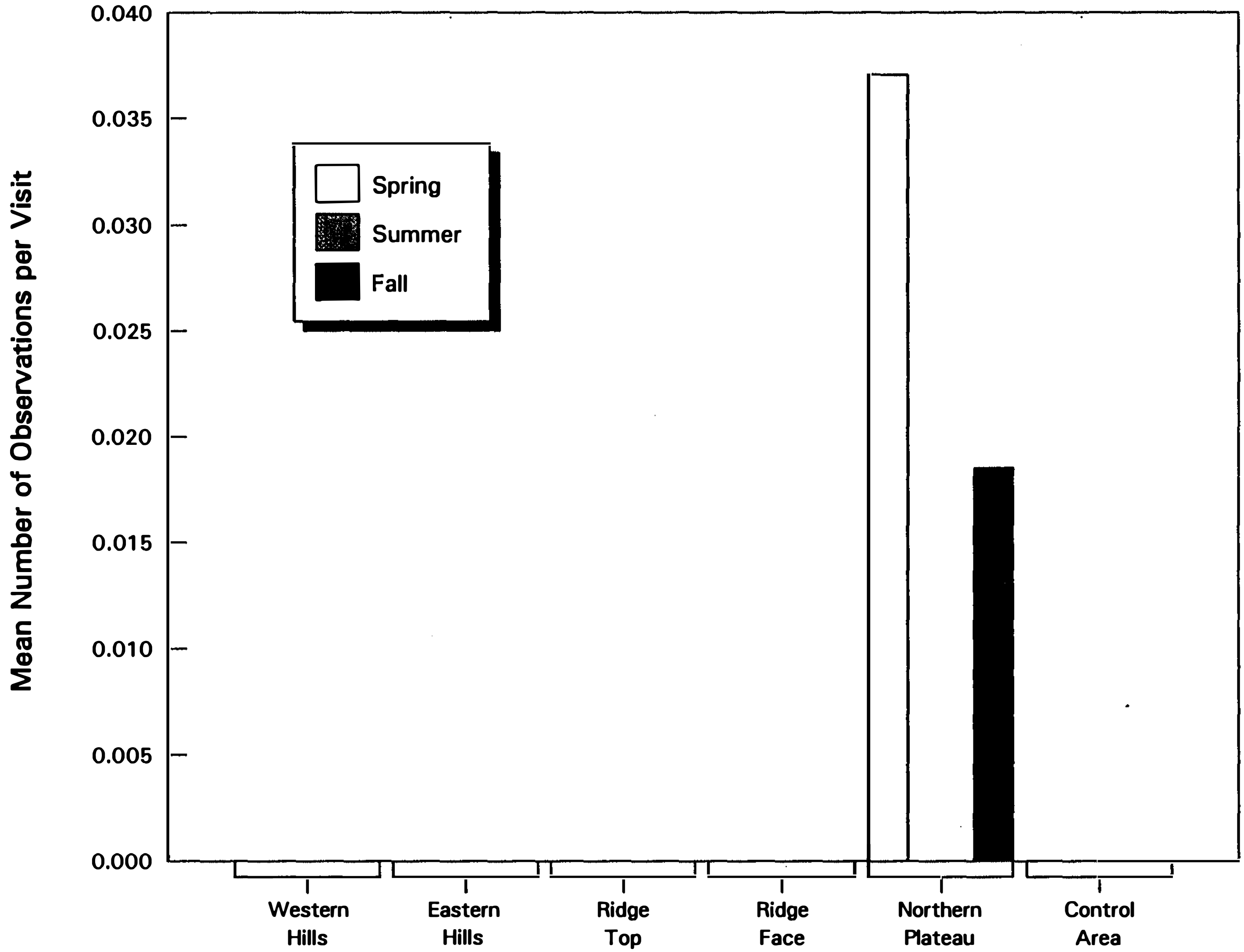

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Figure 4-10
Mean Number of Observations of Peregrine Falcons by Study Unit and Season

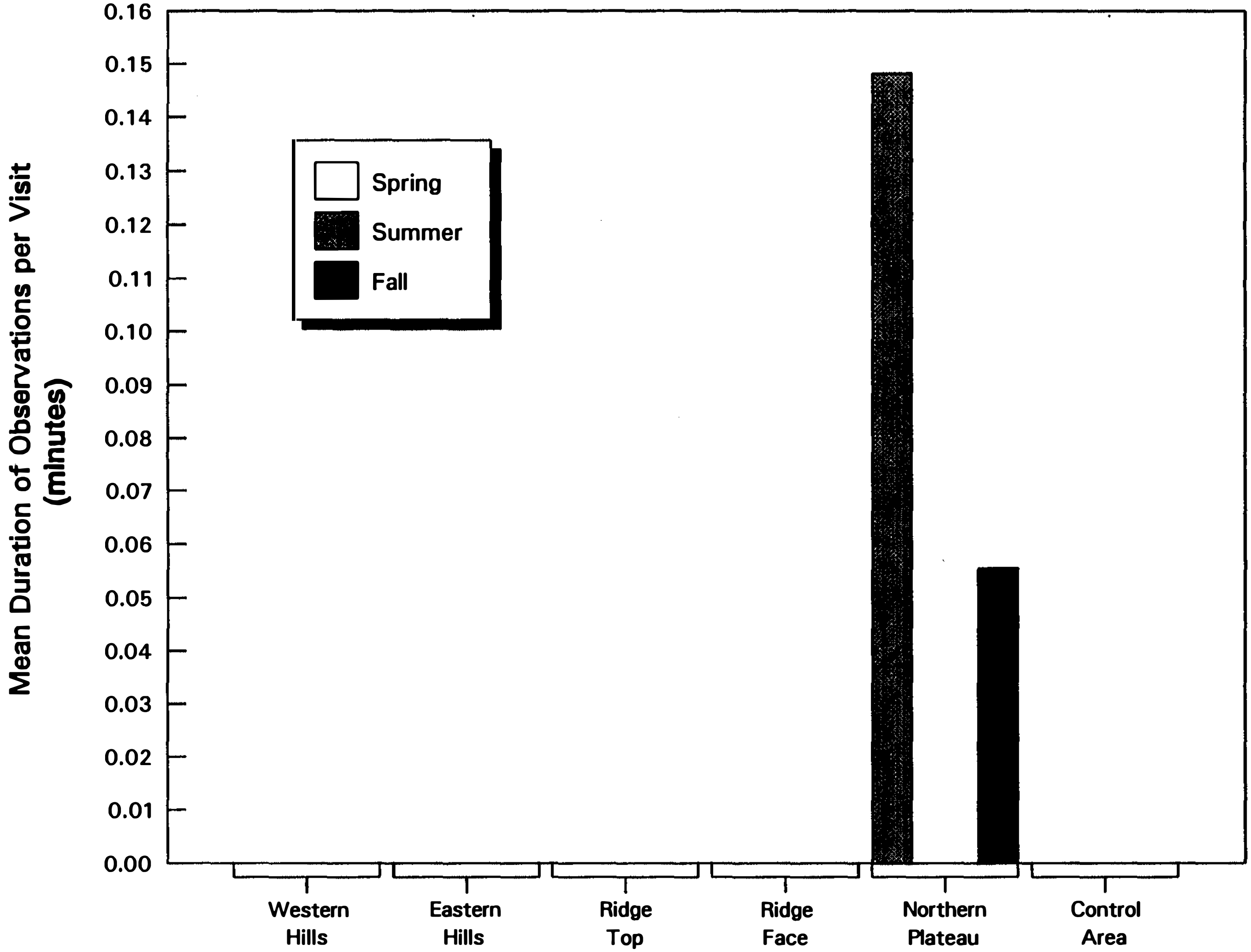

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Figure 4-11

Mean Duration of Observations of Peregrine Falcons by Study Unit and Season

were observed during the study (Table 4-1), so differences in use patterns may be difficult to detect statistically. Figures 4-12 and 4-13 show no consistent differences in spatial and temporal patterns of use.

American Kestrel. ANOVA tables for mean number and mean duration of observations of American kestrel are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0089	0.80	0.5666
Error	13	0.0111		
Season	2	0.0484	5.02	0.0179*
Study Unit x Season	10	0.0088	0.91	0.5299
Error (Season)	26	0.0096		

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0290	1.04	0.4369
Error	13	0.0280		
Season	2	0.0473	1.06	0.3558
Study Unit x Season	10	0.0585	1.31	0.2845
Error (Season)	26	0.0447		

Both mean number and the mean duration of observations per visit of American kestrel were not significantly different among study units (Figures 4-14 and 4-15). Mean number of observations was marginally significantly different among seasons. Mean number of observations in most study units was greatest in summer and least in fall (Figure 4-14).

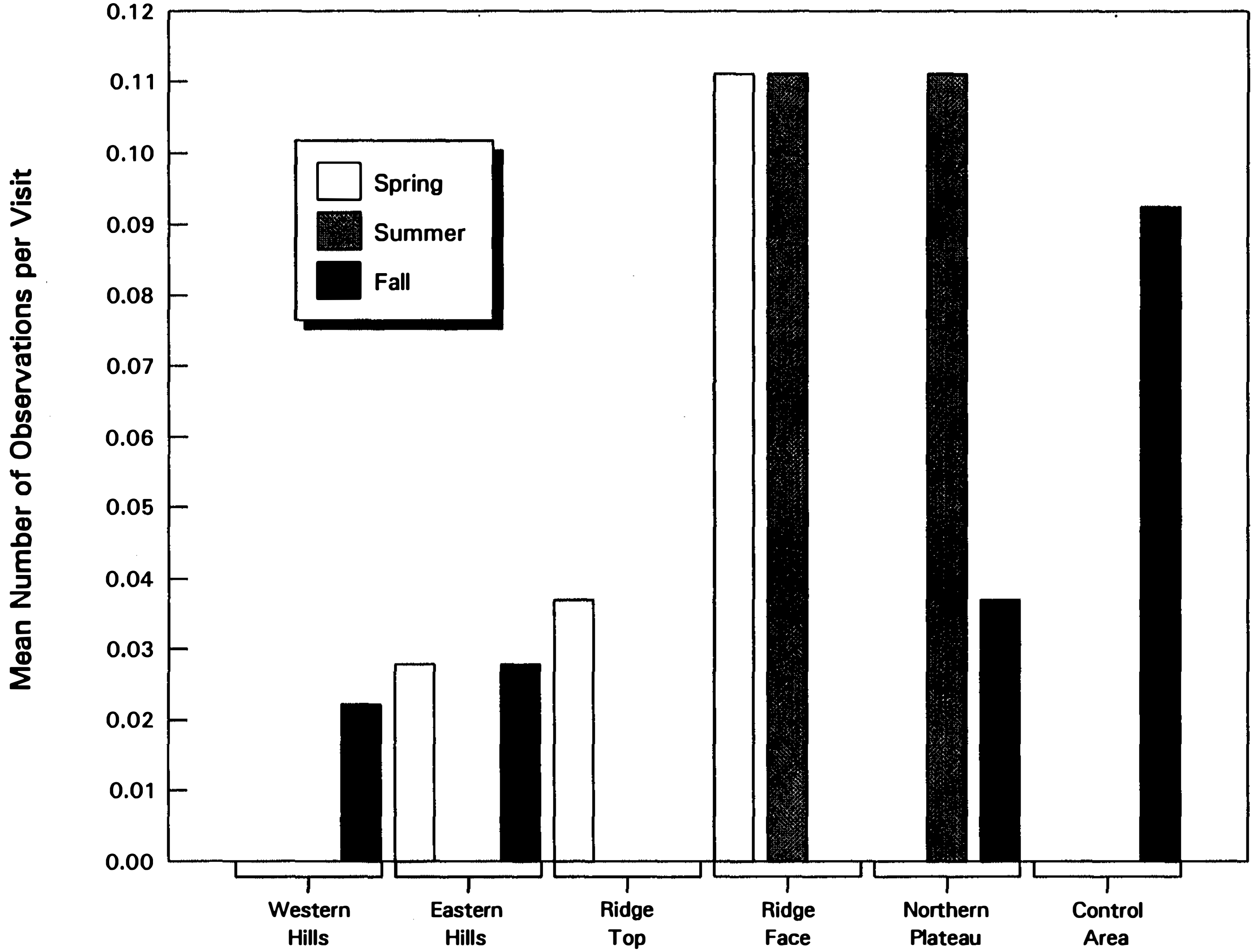

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Figure 4-12
Mean Number of Observations of Prairie Falcons by Study Unit and Season

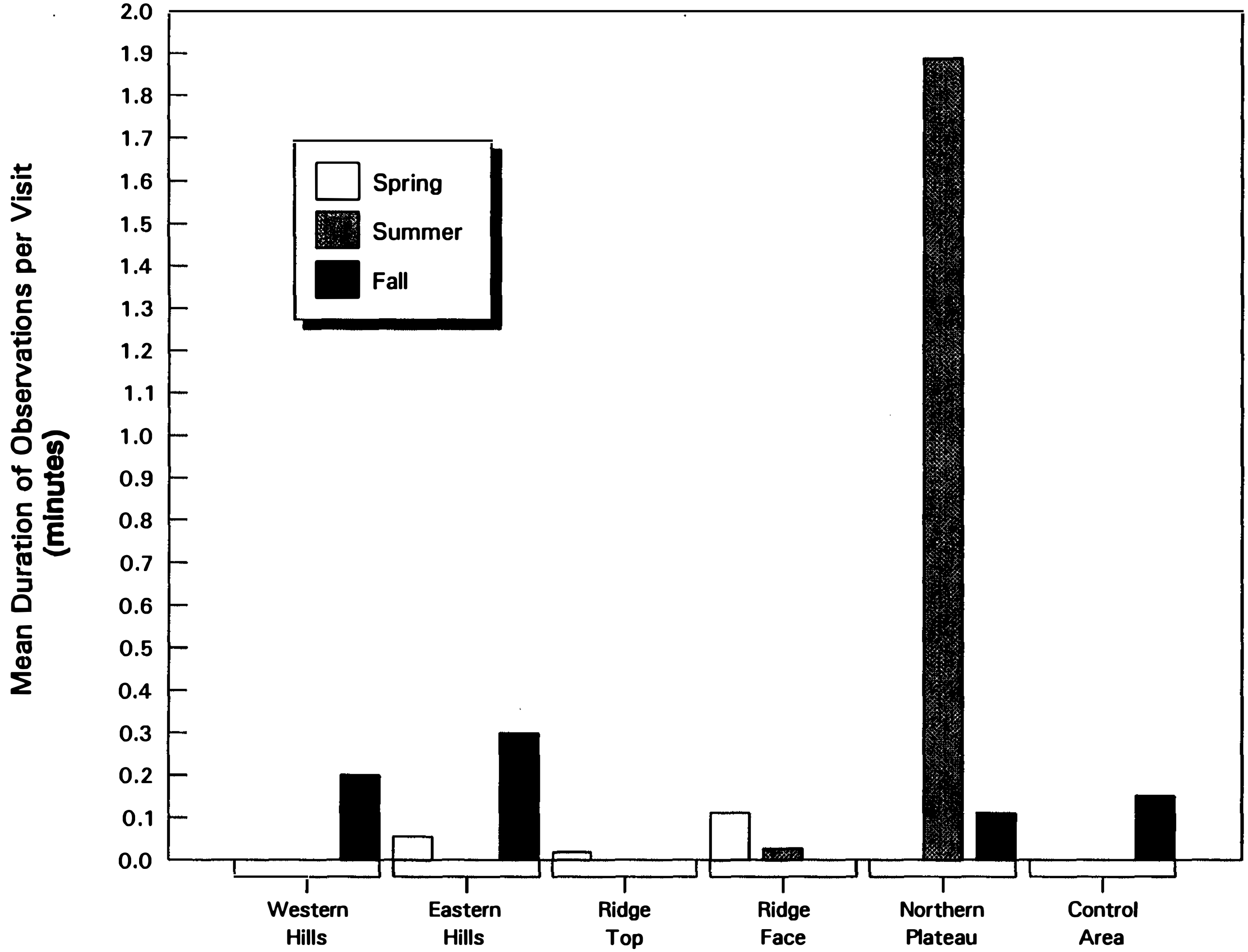

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Figure 4-13
Mean Duration of Observations of Prairie Falcons by Study Unit and Season

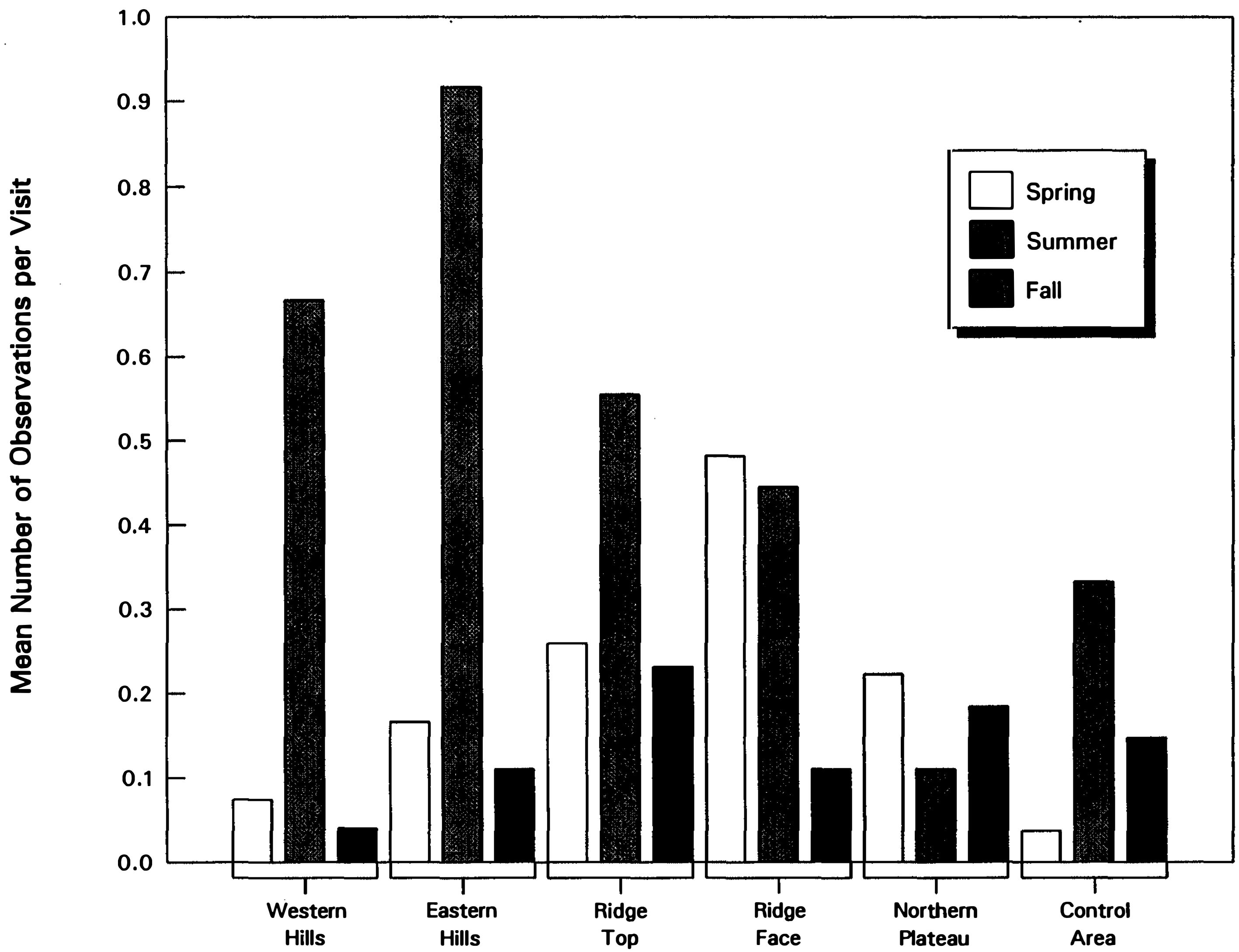

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Figure 4-14
Mean Number of Observations of American Kestrels by Study Unit and Season

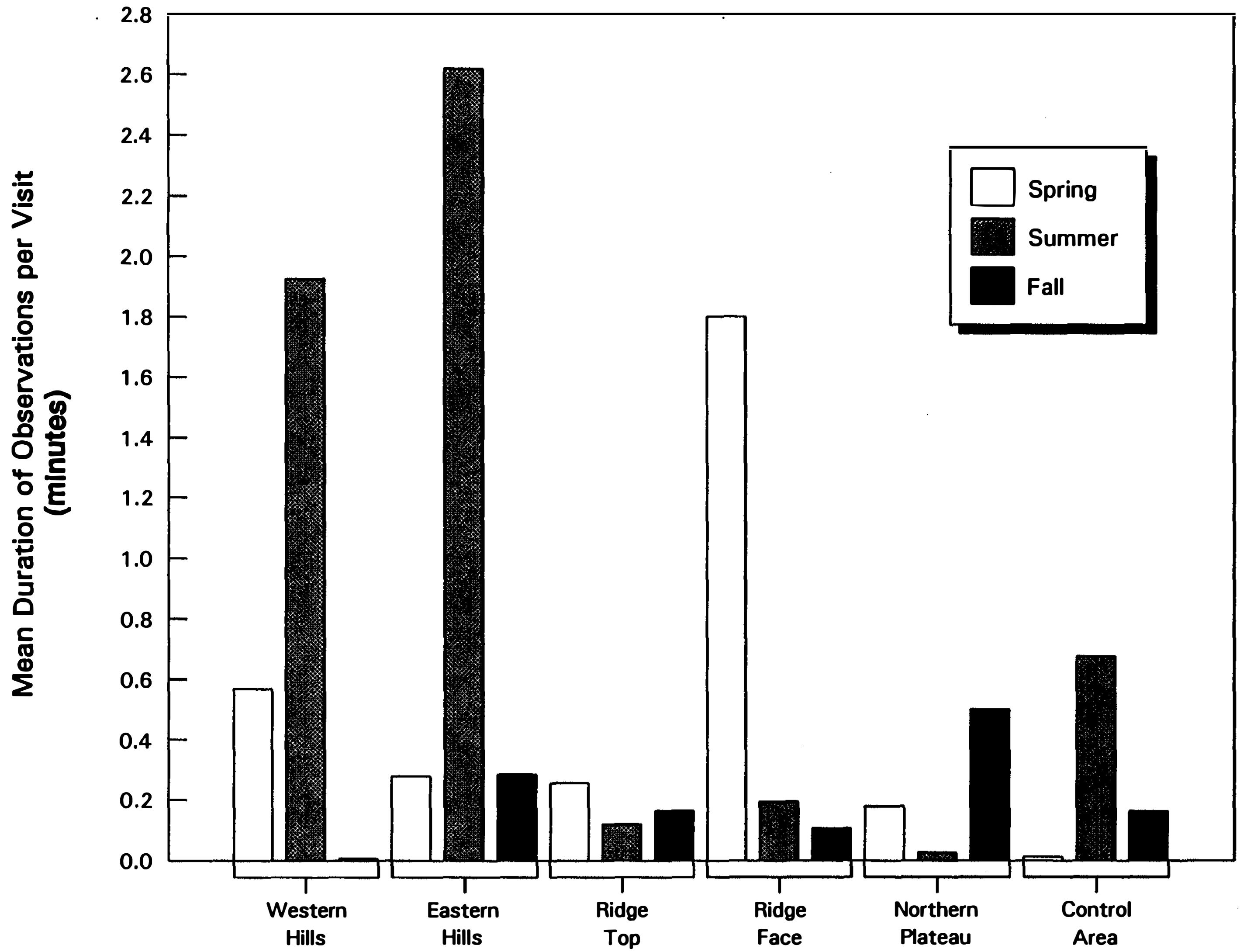

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Figure 4-15
Mean Duration of Observations of American Kestrels by Study Unit and Season

Turkey Vulture. ANOVA tables for mean number and mean duration of observations of turkey vultures are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0153	3.01	0.0507*
Error	13	0.0051		
Season	2	0.0074	4.22	0.0300*
Study Unit x Season	10	0.0083	4.73	0.0011**
Error (Season)	26	0.0013		

Multiple Comparison Results

Spring	4[a]	3[ab]	6[ab]	5[b]	2[b]	1[b]

Contrasts

Spring	Turbine sites lower than others (p=0.0140)*
	Control sites higher than others (p=0.0229)*
Summer	Turbine sites lower than others (p=0.0590)*

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0977	2.49	0.0858*
Error	13	0.0392		
Season	2	0.0818	5.67	0.0095**
Study Unit x Season	10	0.0783	5.42	0.0003**
Error (Season)	26	0.0144		

Multiple Comparison Results

Spring	4^a	3^{ab}	6^{ab}	5^{ab}	2^b	1^{ab}
Summer	6^a	4^{ab}	5^b	3^b	2^b	1^b

Contrasts

Spring	Turbine sites lower than others (p=0.0353)*
Summer	Control sites higher than others (p=0.0020)**

Both the mean number and the mean duration of observations per visit of turkey vultures were marginally significantly different among study units. There was a marginally significant difference among seasons in mean number of observations and a significant difference among seasons in mean duration of observations. The interaction of study unit and season was also significant for mean number and mean duration of observations, indicating that the variation among study units was not consistent among season.

Multiple comparison tests of mean number and mean duration of observations indicated that, during spring, study unit 4 (ridge face) was used by turkey vultures significantly more than study units 1, 2, and 5 (western hills, eastern hills, and northern plateau) (Figures 4-16 and 4-17). During summer, mean duration of observations was significantly greater in study unit 6 (control area) than in study units 5, 3, 2, or 1 (Figure 4-17).

The mean number of observations for study unit 4 (ridge face) during summer was much higher than those of the other study units, and the difference was greater than that

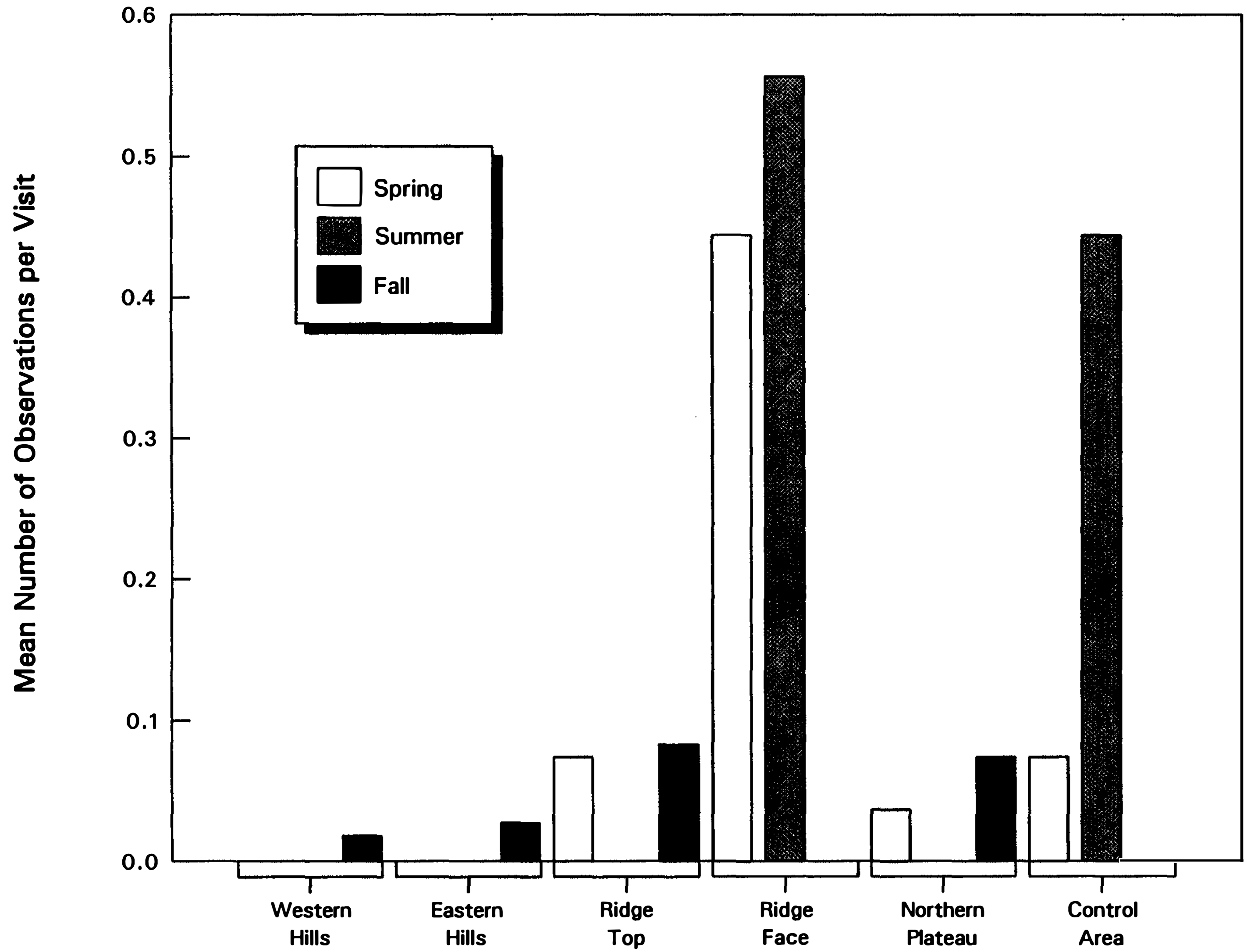

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Figure 4-16
Mean Number of Observations of Turkey Vultures by Study Unit and Season

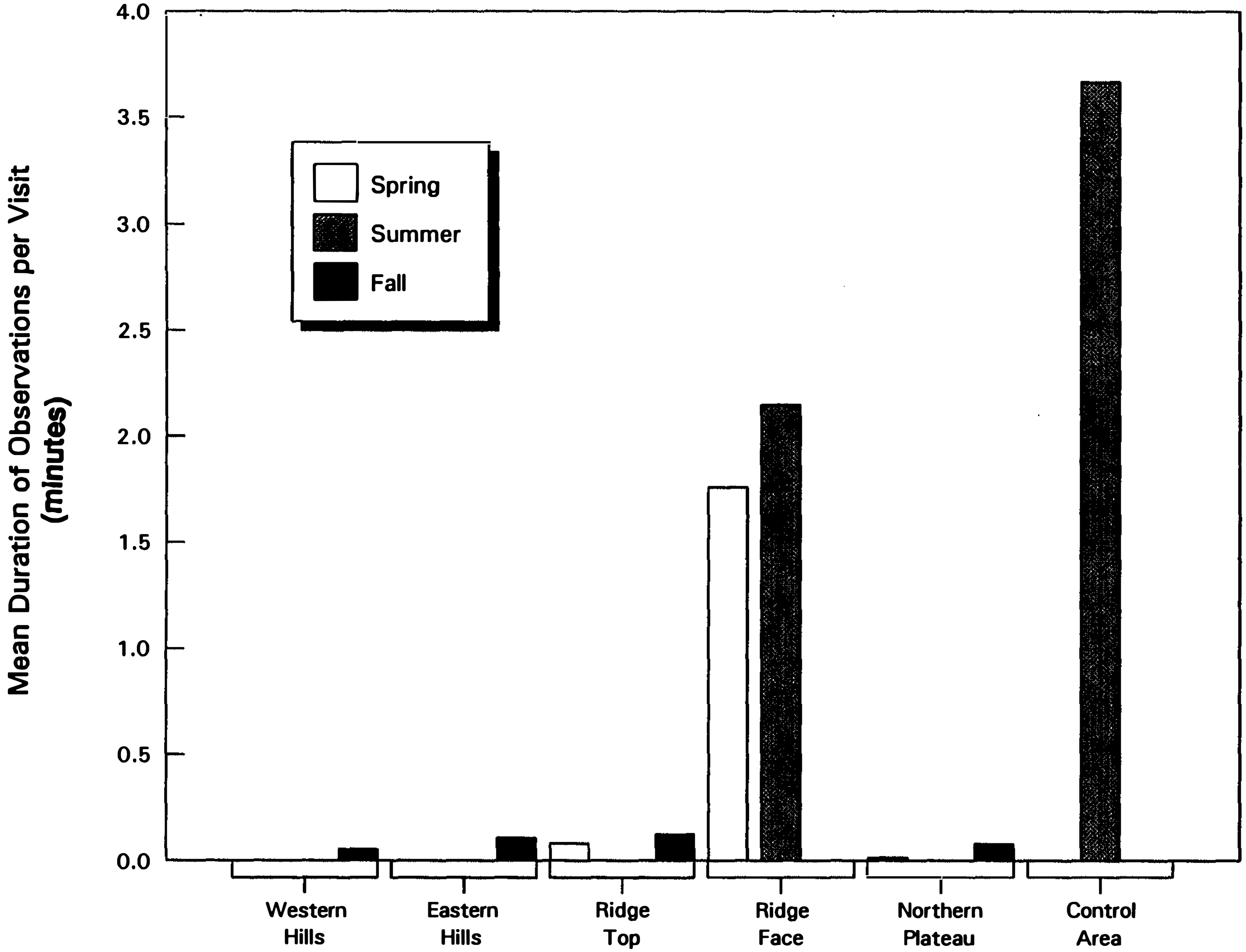

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Figure 4-17
Mean Duration of Observations of Turkey Vultures by Study Unit and Season

found during the spring (Figure 4-16). Nonetheless, the multiple comparison test found significant differences for the spring but not for the summer. The reason for this difference is that the variance of the summer mean was greater than that of the spring mean. Several cases of high variances were found for means during summer. Extreme variances in the summer data are expected because, as noted earlier, fewer samples were pooled to obtain the summer data than were pooled for the spring or fall data.

The contrasts results indicated that, during spring and summer, the study units in the primary study area in which siting of turbines is planned (study units 1, 2, and 3) had marginally significantly lower combined mean numbers of observations than the study units in which no or few turbines are planned (study units 4 and 5) and, during spring only, had a marginally significantly lower combined mean duration of observations. Mean number of observations in study unit 6, the control area, was marginally significantly higher than the combined mean for the other study units during spring, while mean duration of observations in the control area was significantly higher during summer.

Cooper's Hawk. Insufficient data were gathered on Cooper's hawks to conduct statistical analyses. Mean number of observations and mean duration of observations are presented in Figures 4-18 and 4-19.

Sharp-Shinned Hawk. ANOVA tables for mean number and mean duration of observations of sharp-shinned hawks are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0016	1.58	0.2339
Error	13	0.0010		
Season	2	0.0023	3.00	0.0675*
Study Unit x Season	10	0.0012	1.58	0.1694
Error (Season)	26	0.0008		

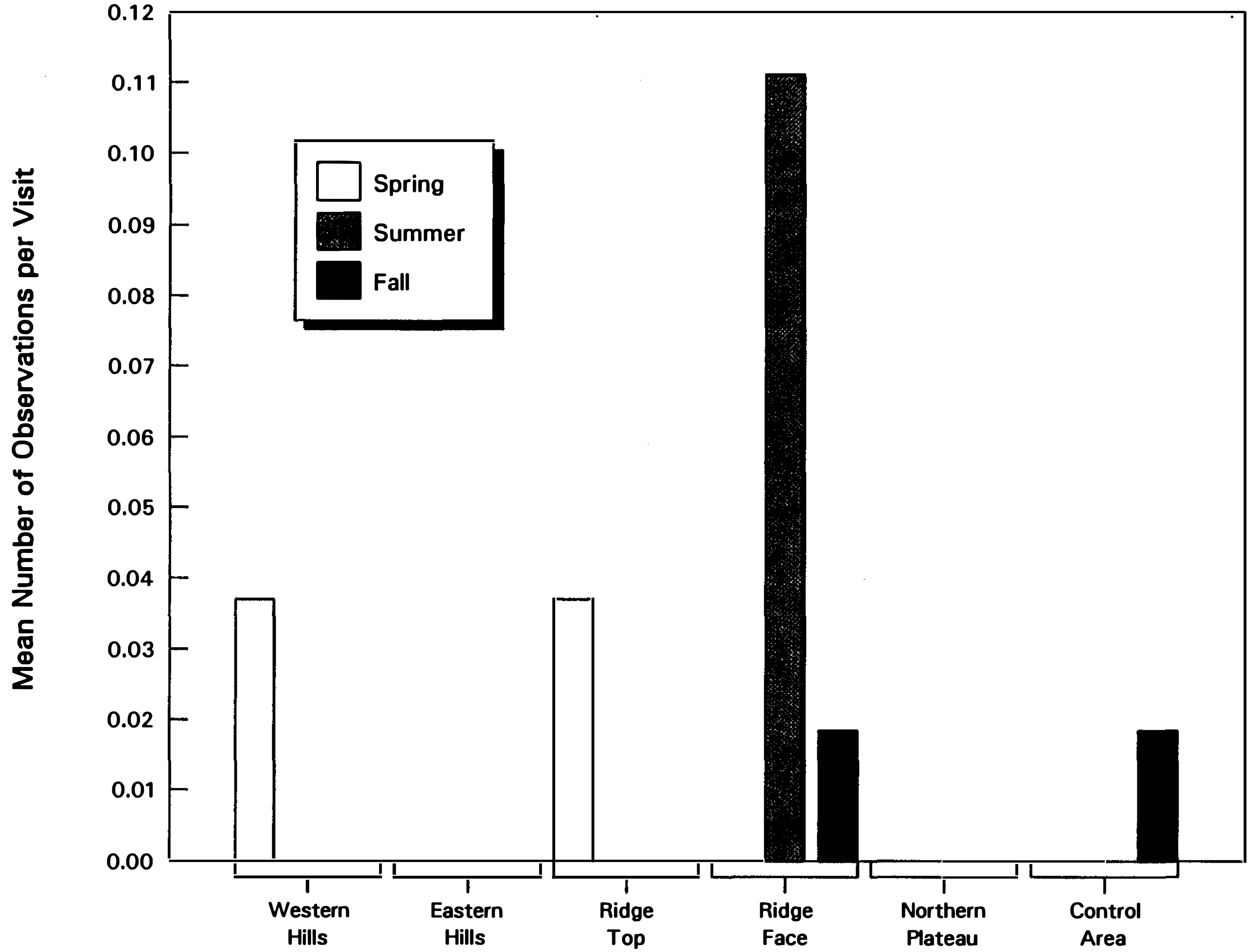

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Figure 4-18
Mean Number of Observations of Cooper's Hawk by Study Unit and Season

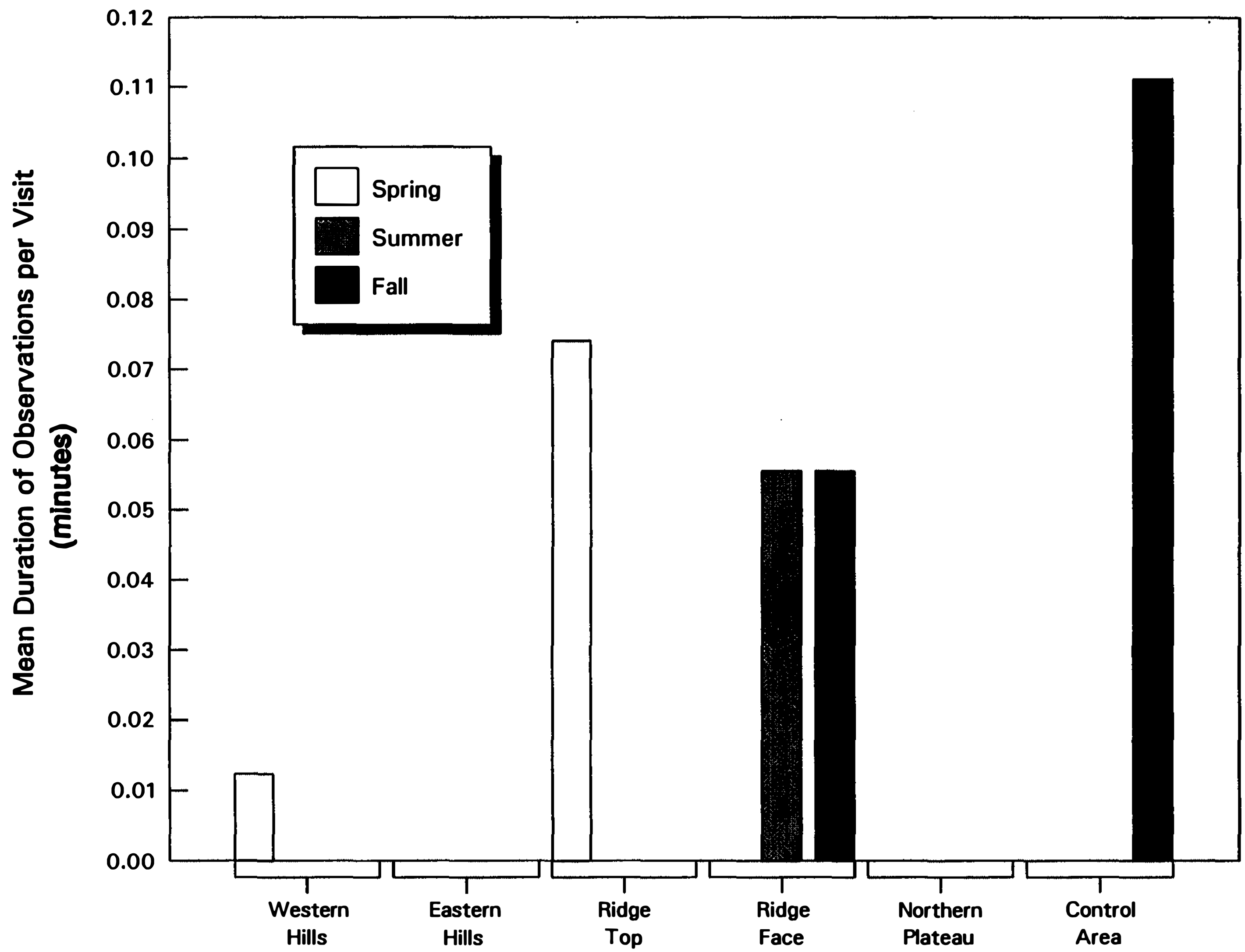

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Figure 4-19
Mean Duration of Observations of Cooper's Hawks by Study Unit and Season

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0026	0.72	0.6232
Error	13	0.0280		
Season	2	0.0056	3.05	0.0645*
Study Unit x Season	10	0.0023	1.23	0.3159
Error (Season)	26	0.0018		

Both mean number and the mean duration of observations per visit of sharp-shinned hawks were not significantly different among study units. Both mean number and mean duration of observations were marginally significantly different among seasons. In most study units, use was greatest in the fall (Figures 4-20 and 4-21). The interactions were not significant.

Red-Tailed Hawk. ANOVA tables for mean number and mean duration of observations of red-tailed hawks are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0317	6.02	0.0043**
Error	13	0.0053		
Season	2	0.0058	2.57	0.0957*
Study Unit x Season	10	0.0126	5.59	0.0002**
Error (Season)	26	0.0023		

Multiple Comparison Results

Spring	5[a]	4[ab]	3[ab]	2[b]	6[b]	1[b]
Summer	6[a]	5[ab]	4[ab]	1[ab]	3[b]	2[b]
Fall		6[a]	5[ab]	3[abc]	4[bc]	2[c]1[c]

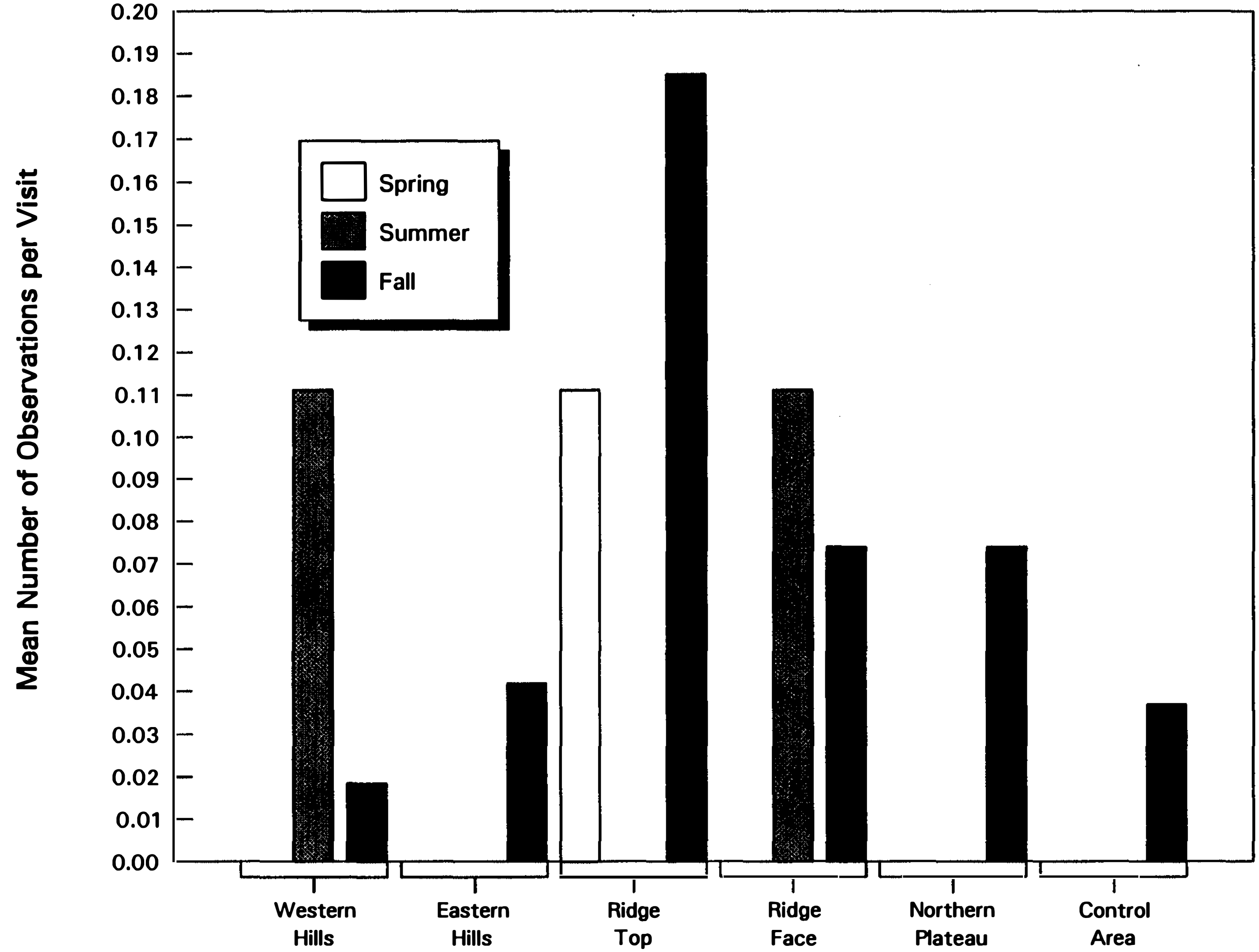

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Figure 4-20

Mean Number of Observations of Sharp-Shinned Hawks by Study Unit and Season

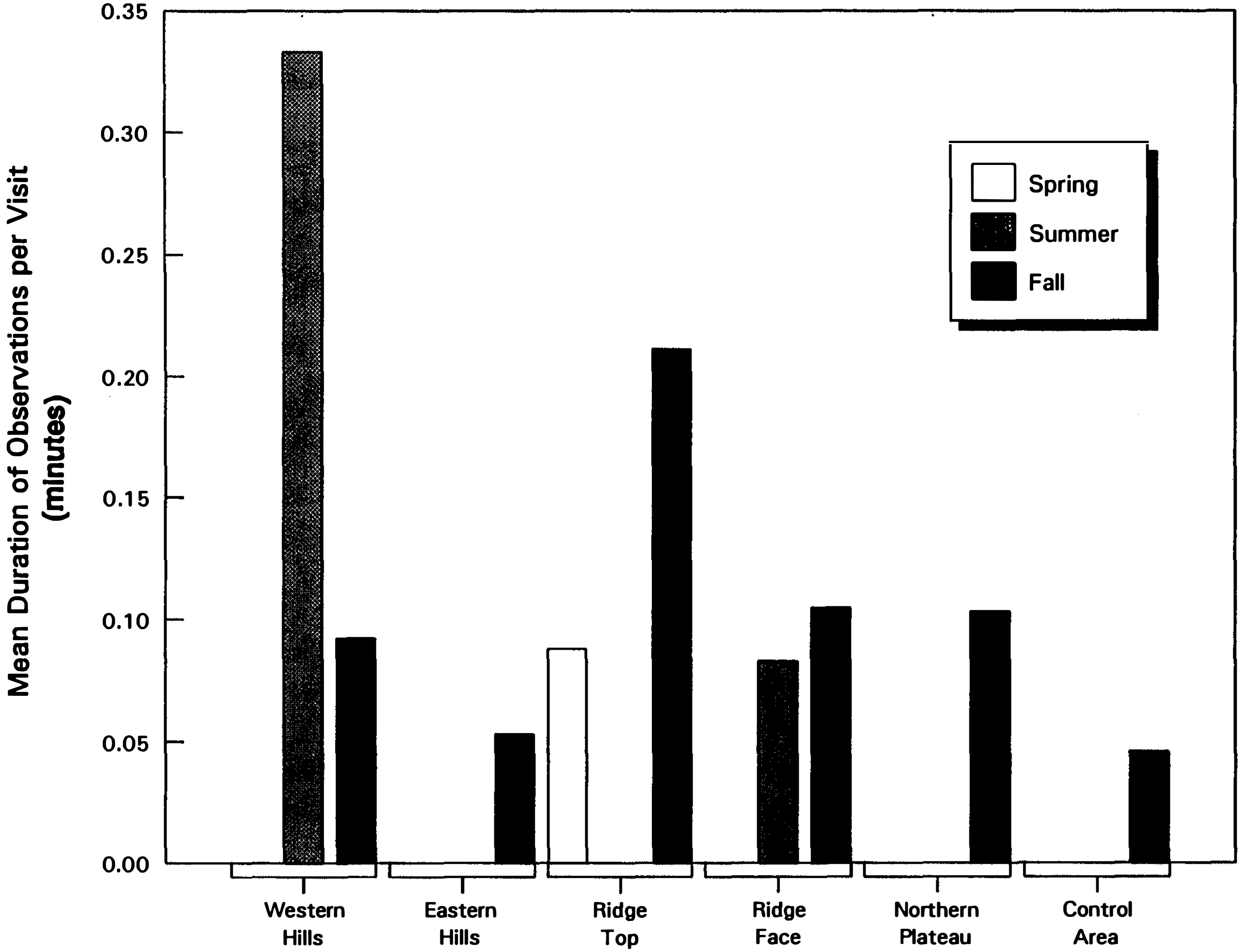

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Figure 4-21
Mean Duration of Observations of Sharp-Shinned Hawks by Study Unit and Season

Contrasts

Spring	Turbine sites lower than others (p=0.0015)**
	Control site lower than others (p=0.0988)*
Summer	Control site higher than others (p=0.0009)**
Fall	Turbine sites lower than others (p=0.0237)*
	Control site higher than others (p=0.0011)**

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.1755	4.09	0.0188*
Error	13	0.0043		
Season	2	0.2013	7.40	0.0029**
Study Unit x Season	10	0.0913	3.36	0.0063**
Error (Season)	26	0.0085		

Multiple Comparison Results

Fall	5[a]	6[ab]	3[abc]	2[c]	4[bc]	1[c]

Contrasts

Fall	Turbine sites lower than others (p=0.0096)**
	Control site higher than others (p=0.0063)**

The mean number of observations per visit of red-tailed hawks was significantly different among study units and the mean duration of observations was marginally significantly different. There was a marginally significant difference among seasons in mean number of observations, while mean duration of observations was significantly different. The interaction of study unit and season was significant for both mean number and mean duration of observations, indicating that the variation in use by red-tailed hawks among study units was not consistent among seasons.

Multiple comparison tests of mean number of observations showed that study unit 5 (northern plateau) was used significantly more than study units 2, 6, or 1 (eastern hills, control area, and western hills) during spring, but that study unit 6 was used more than several other study units during summer and fall (Figure 22). Mean number of observations during fall was also significantly higher in study unit 5 than in two other study units. Mean duration of observations was not significantly different among study units during spring or summer. Mean duration was significantly higher for study unit 5 than for study units 2, 4, and 1 during the fall, and was also significantly higher for study unit 6 than for study unit 1. Study units 1 and 2 had relatively low mean numbers and mean durations of observations for all seasons (Figures 4-22 and 4-23).

The contrasts results indicated that the difference between the combined mean number of observations of the study units in the primary study area in which siting of turbines is planned (study units 1, 2, and 3) and the combined mean of study units in which no or few turbines are planned (study units 4 and 5) was significant during the spring and marginally significant during the fall. The mean of the control study unit (study unit 6) was significantly lower than the combined mean of the primary area study units (study units 1 to 5) during spring, but was significantly higher during the summer and fall. The results for mean duration of observations were significant only in the fall, with the turbine study units significantly lower than other study units and the control site significantly higher than other study units.

Swainson's Hawk. ANOVA tables for mean number and mean duration of observations of Swainson's hawks are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0046	0.63	0.6828
Error	13	0.0074		
Season	2	0.0025	0.63	0.5004
Study Unit x Season	10	0.0026	1.66	0.7088
Error (Season)	26	0.0039		

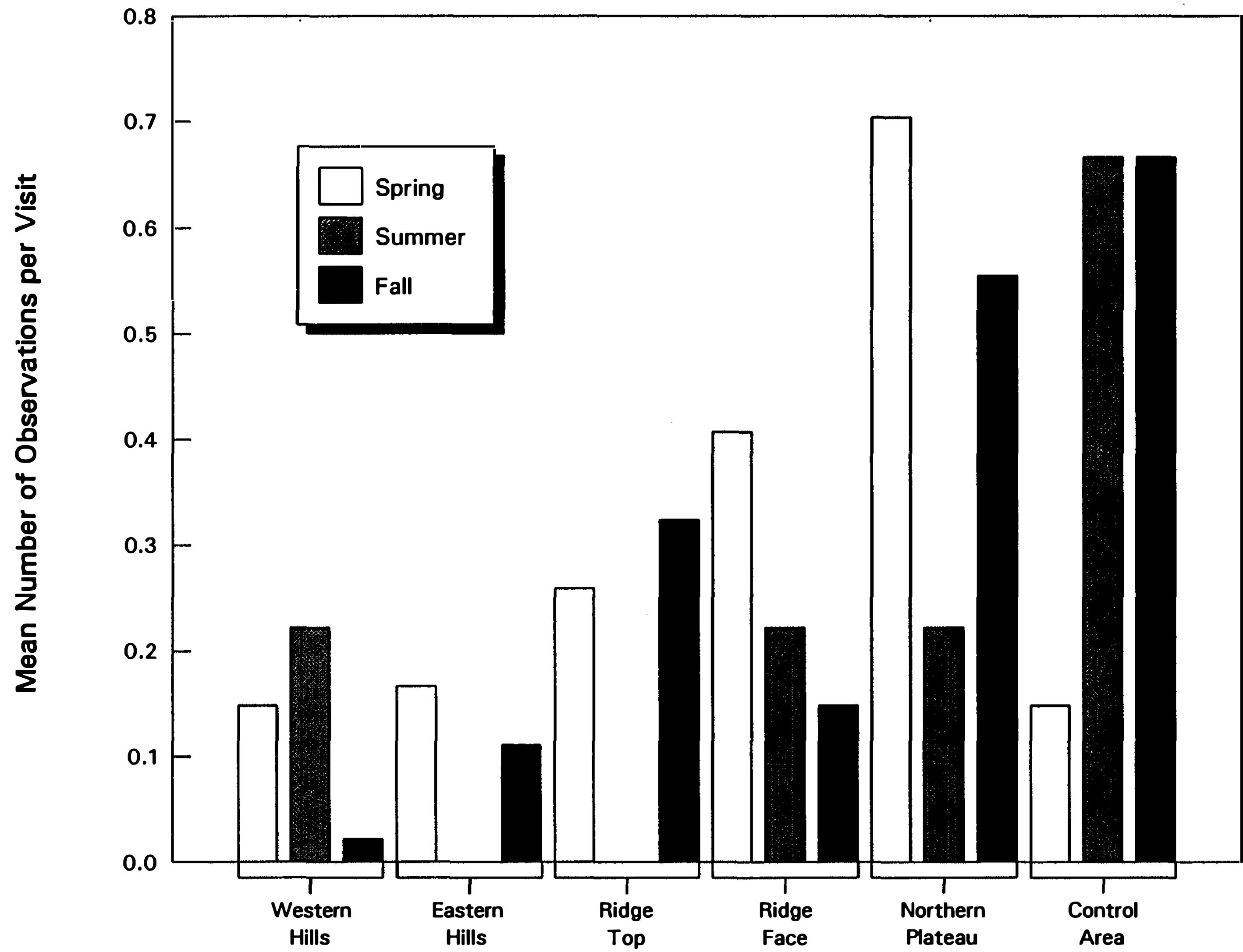

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Figure 4-22
Mean Number of Observations of Red-Tailed Hawks by Study Unit and Season

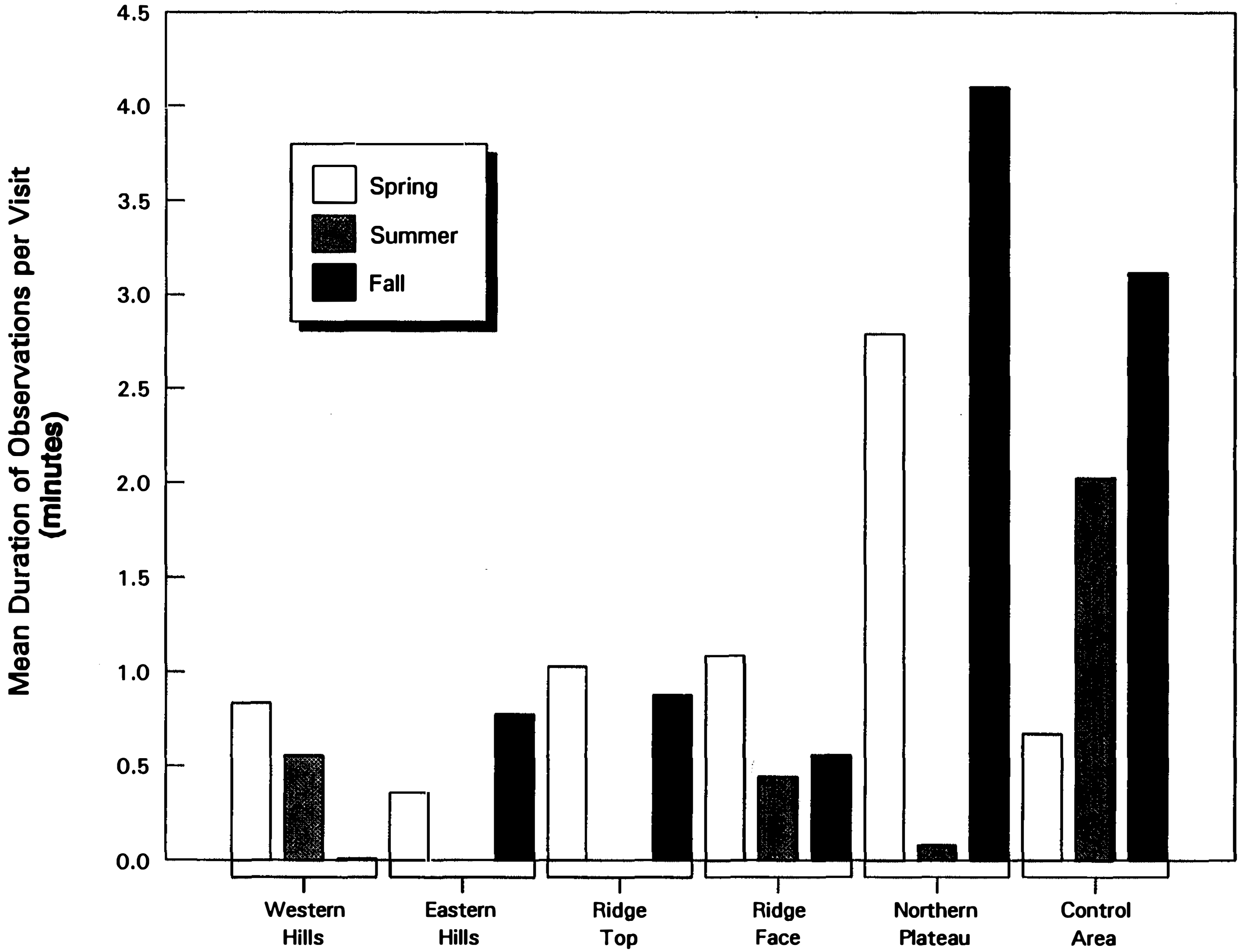

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Figure 4-23
Mean Duration of Observations of Red-Tailed Hawks by Study Unit and Season

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0154	0.65	0.6669
Error	13	0.0237		
Season	2	0.0057	0.27	0.7148
Study Unit x Season	10	0.0162	0.77	0.6293
Error (Season)	26	0.0209		

Both the mean number and the mean duration of observations per visit of Swainson's hawks were not significantly different among study units and among seasons. Few Swainson's hawks were observed during the study (Table 4-1), so differences in use patterns may be difficult to detect statistically. Figures 4-24 and 4-25 suggest relatively high use by the hawks of study unit 2 (eastern hills) during the summer.

Ferruginous Hawk. Insufficient data were gathered on ferruginous hawks to conduct statistical analyses. Mean number of observations and mean duration of observations are presented in Figures 4-26 and 4-27.

Northern Harrier. ANOVA tables for mean number and mean duration of observations of northern harriers are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0118	4.90	0.0097**
Error	13	0.0024		
Season	2	0.0004	0.22	0.7537
Study Unit x Season	10	0.0038	2.11	0.0841*
Error (Season)	26	0.0018		

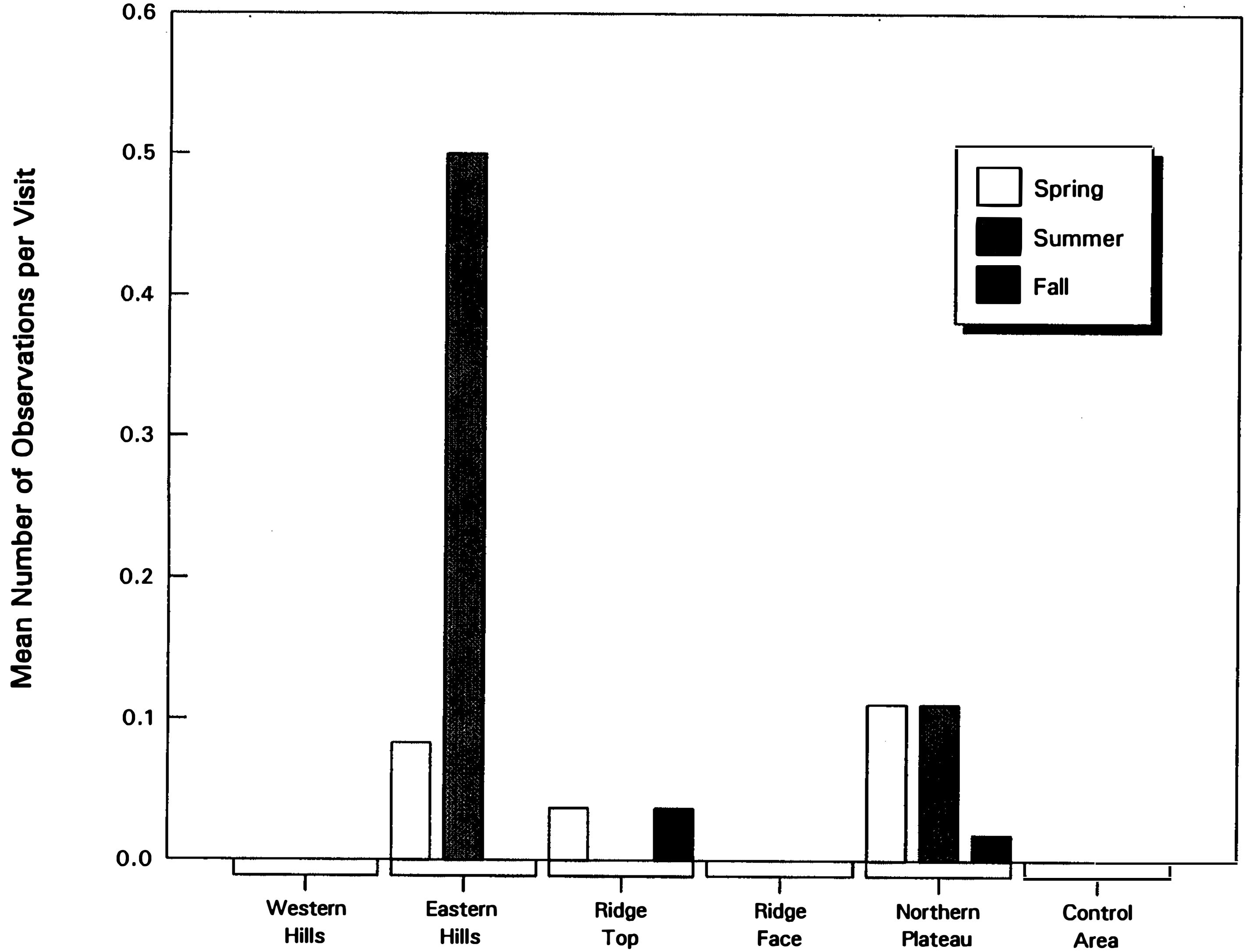

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Figure 4-24
Mean Number of Observations of Swainson's Hawks by Study Unit and Season

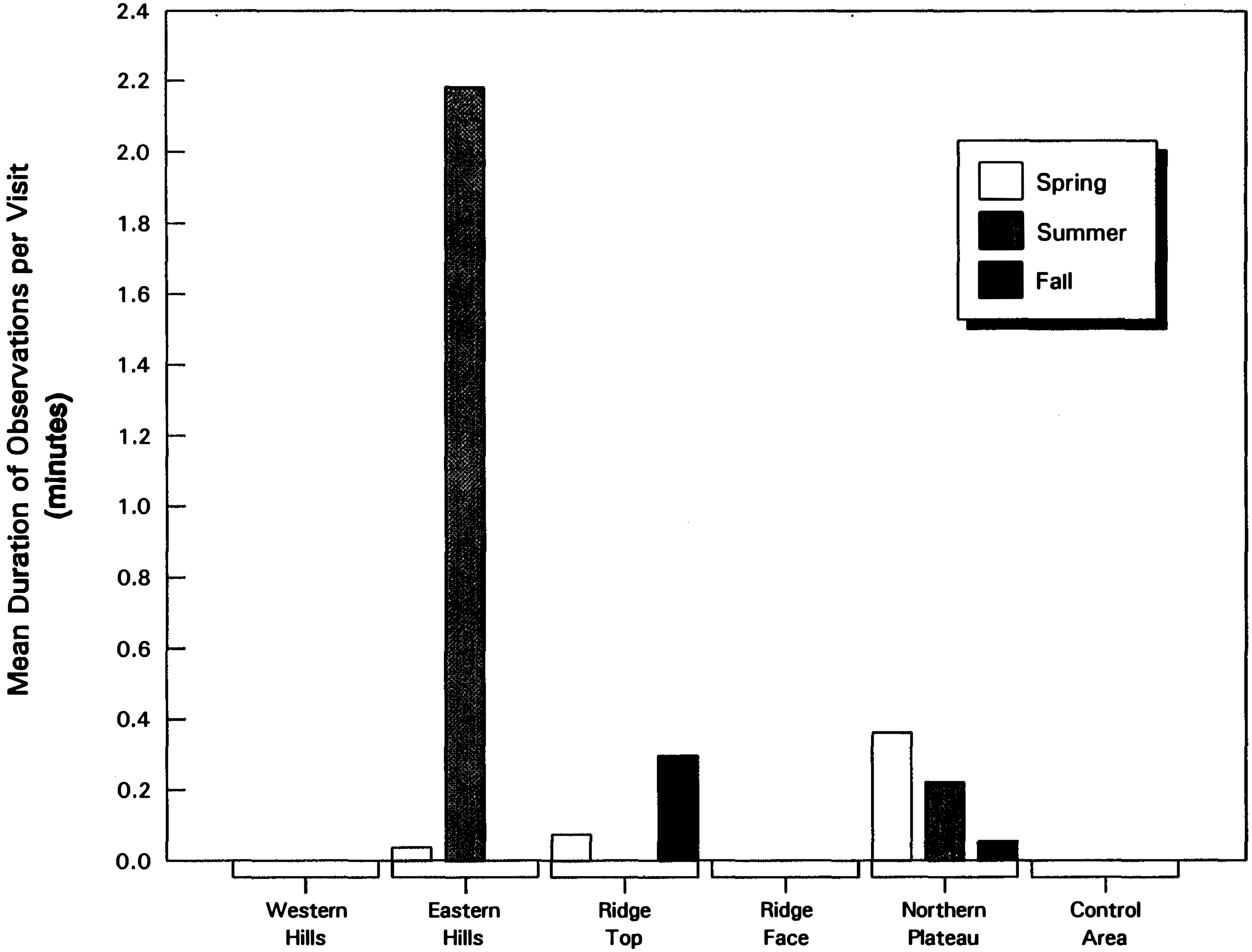

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Figure 4-25
Mean Duration of Observations of Swainson's Hawks by Study Unit and Season

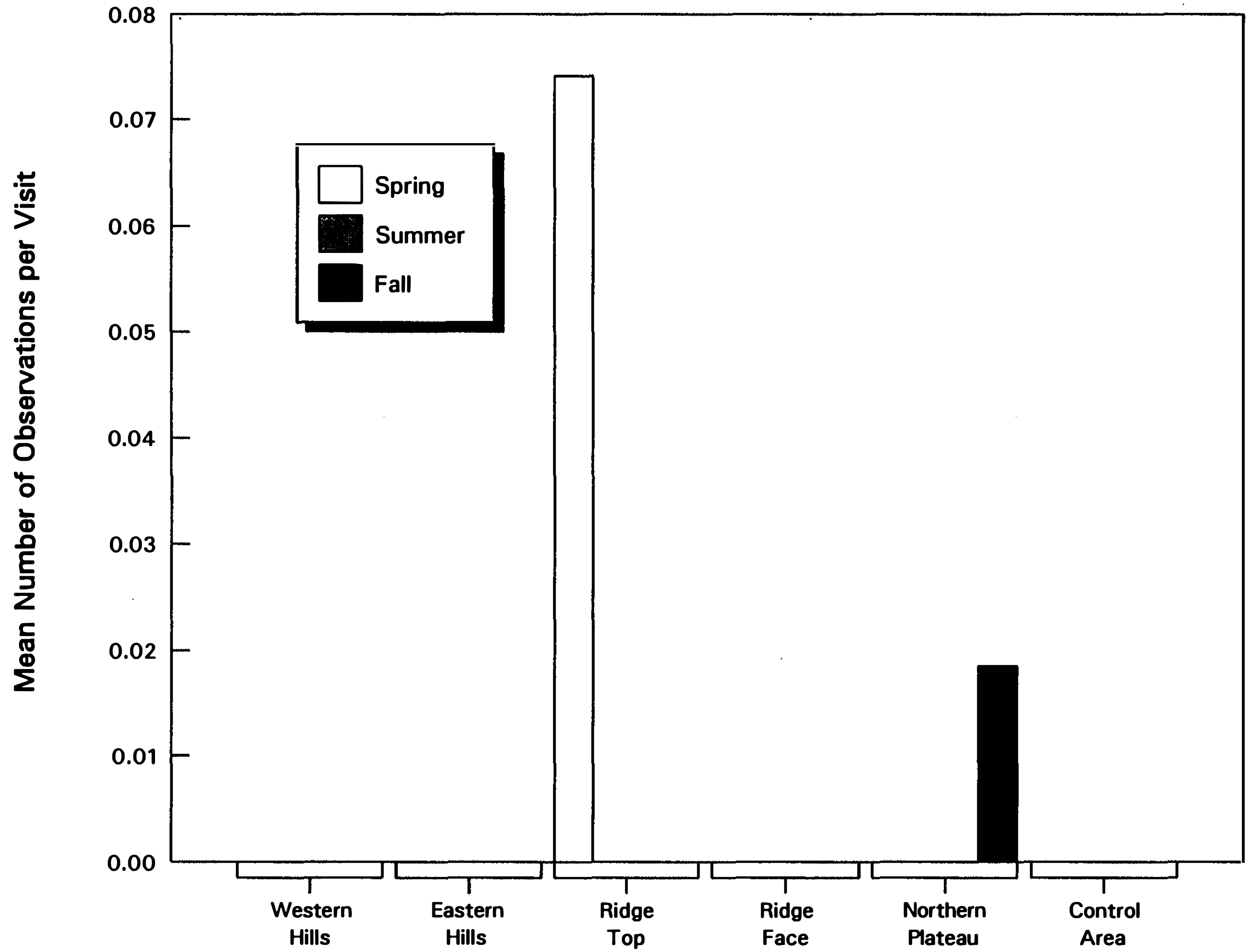

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Figure 4-26
Mean Number of Observations of Ferruginous Hawks by Study Unit and Season

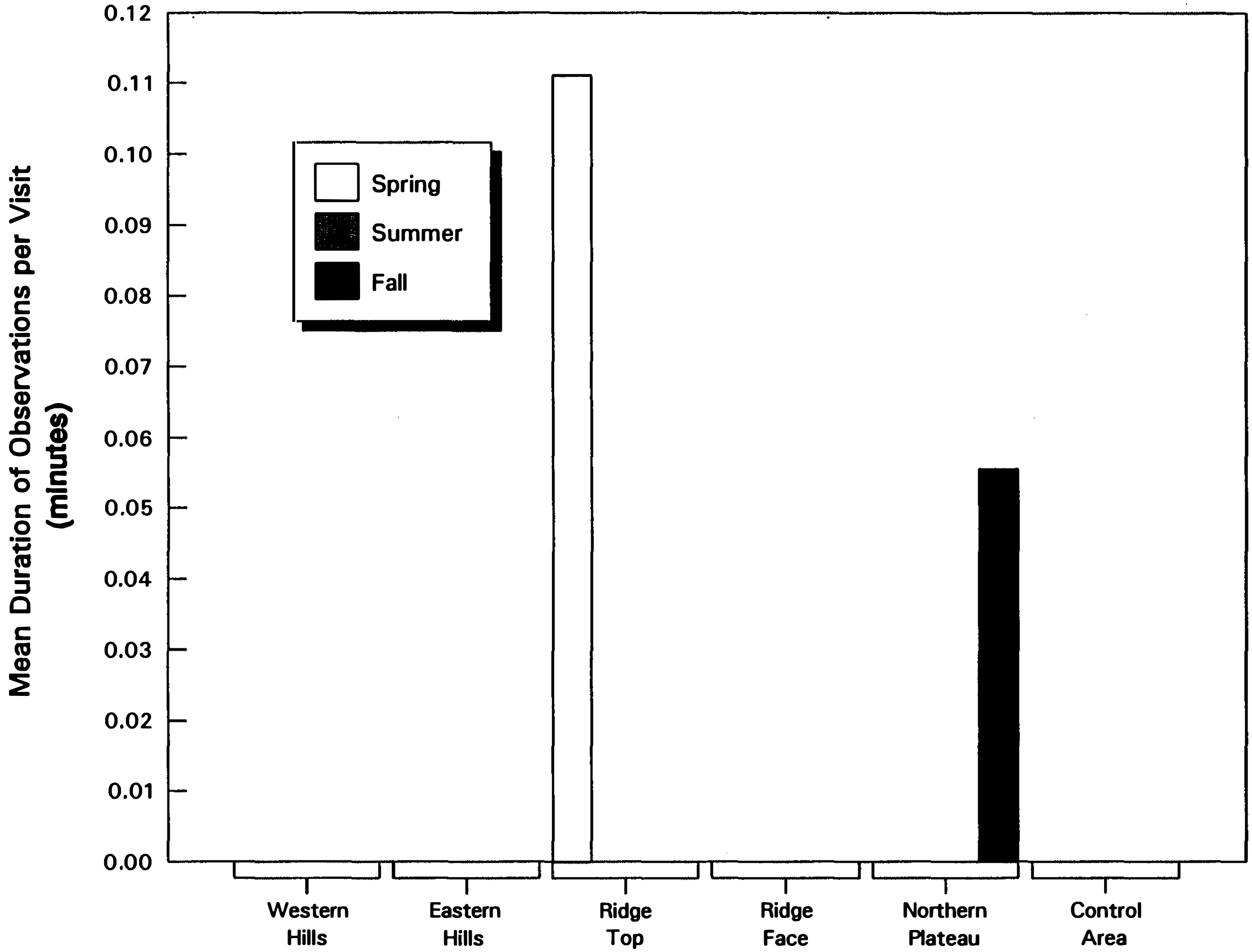

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Figure 4-27
Mean Duration of Observations of Ferruginous Hawks by Study Unit and Season

Multiple Comparison Results

Spring	5^a	3^b	4^b	2^b	1^b	6^b
Fall		5^a	3^b	2^b	6^b	$4^b 1^b$

Contrasts

Spring	Turbine sites lower than others ($p<0.0001$)**
	Control site lower than others ($p=0.0027$)**
Fall	Turbine sites lower than others ($p=0.0011$)**

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0201	3.36	0.0362*
Error	13	0.0060		
Season	2	0.0000	0.01	0.9899
Study Unit x Season	10	0.0122	2.00	0.0899*
Error (Season)	26	0.0061		

Multiple Comparison Results

Spring	5^a	3^b	4^b	2^b	1^b	6^b
Fall		5^a	2^b	3^b	4^b	$6^b 1^b$

Contrasts

Spring	Turbine sites lower than others ($p<0.0001$)**
	Control site lower than others ($p=0.0133$)*
Fall	Turbine sites lower than others ($p=0.0021$)**

The mean number of observations per visit of northern harriers was significantly different among study units and the mean duration of observations was marginally significantly different. Seasons were not significantly different both for mean number and for mean duration of observations. The interaction of study unit and season was marginally significant for mean number and mean duration of observations.

Multiple comparison tests of mean number and mean duration of observations indicated that study unit 5 (northern plateau), the northern plateau, was used significantly more by northern harriers during spring and fall than any other study unit (Figures 4-28 and 4-29). Note that differences among means during summer were not significant, although means for study unit 1 (western hills) were much greater than the means for the other sites. The means for study unit 1 had high variances, and high variances reduce confidence in estimates of means and, thereby, reduce detection by the multiple comparison test of differences between means.

The contrasts results indicated that the study units in the primary study area in which siting of turbines is planned (study units 1, 2, and 3, western hills, eastern hills, and ridge top) had significantly lower combined mean numbers and mean durations of observations than the study units in which no or few turbines are planned (study units 4 and 5, ridge face and northern plateau) during spring and fall. This difference resulted from the much greater use by northern harriers of study unit 5 than other study units. During spring, the combined mean number and combined mean duration of observations of the study units in the primary study area (study units 1 to 5) were significantly greater than the means of the control study unit (study unit 6).

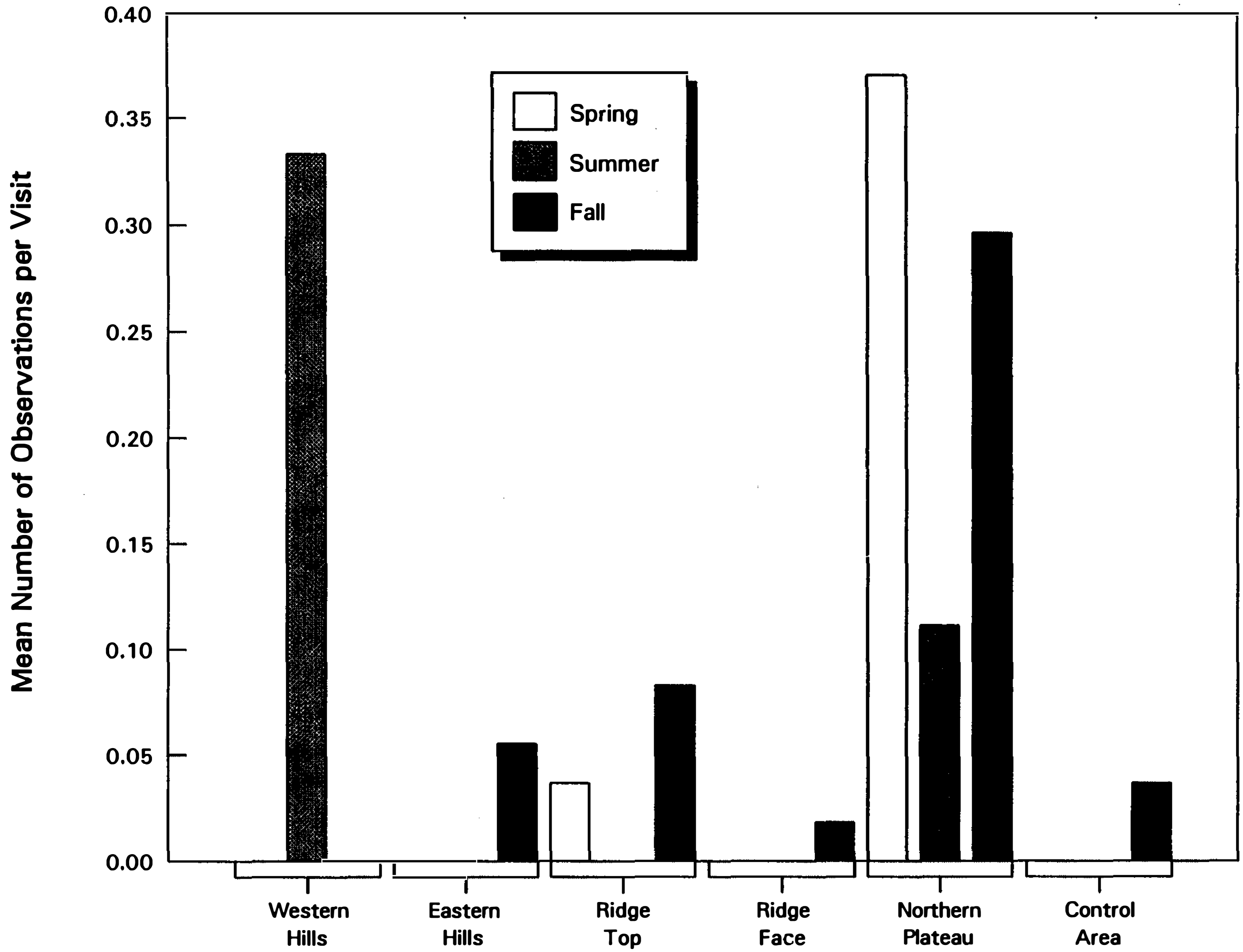

Figure 4-28
Mean Number of Observations of Northern Harriers by Study Unit and Season

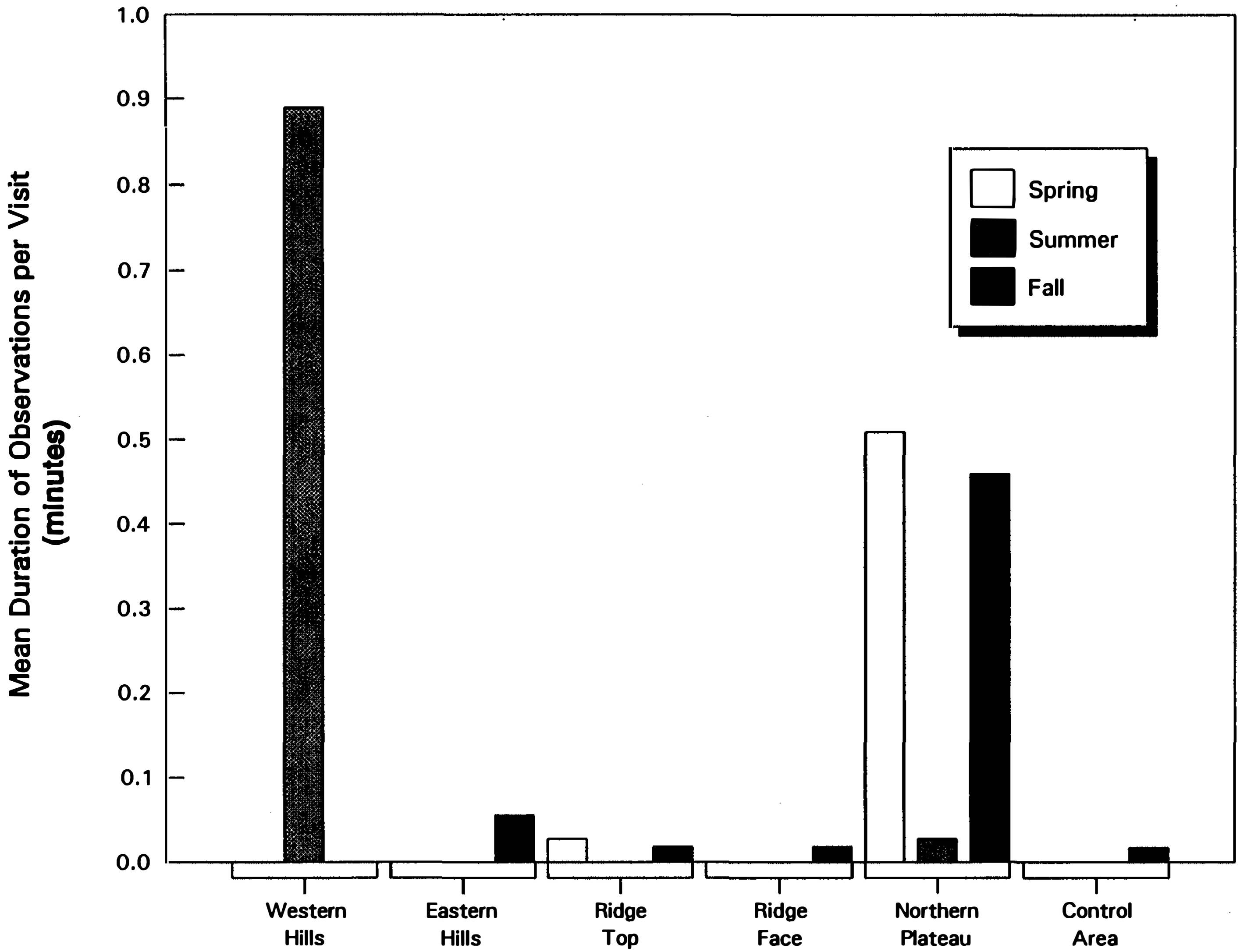

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Figure 4-29
Mean Duration of Observations of Northern Harriers by Study Unit and Season

Western Bluebird. ANOVA tables for mean number and mean duration of observations of western blue birds are as follows:

Mean Number of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0014	4.69	0.0114^{*}
Error	13	0.0040		
Season	2	0.0011	2.77	0.0810^{*}
Study Unit x Season	10	0.0005	1.22	0.3220^{**}
Error (Season)	26		0.0004	

Multiple Comparison Results

Fall	3^{a}	5^{ab}	2^{ab}	1^{b}	6^{b}	4^{b}

Contrasts

Spring	Turbine sites lower than others $(p=0.0015)^{**}$
	Control site lower than others $(p=0.0988)^{*}$
Summer	Control site higher than others $(p=0.0009)^{**}$
Fall	Turbine sites lower than others $(p=0.0237)^{*}$
	Control site higher than others $(p=0.0011)^{**}$

Mean Duration of Observations per Visit ANOVA

Source of Variation	df	MS	F	Prob.
Study Unit	5	0.0005	1.41	0.2838
Error	13	0.0004		
Season	2	0.0019	4.46	0.0364*
Study Unit x Season	10	0.0005	1.12	0.3926
Error (Season)	26	0.0004		

The mean number of observations per visit of western blue birds was marginally significantly different among study units, but the mean duration of observations was not significantly different. The differences among seasons in mean number and mean duration of observations were marginally significant. The interaction of study unit and season was significant for mean number of observations, but was not significant for mean duration of observations.

Multiple comparison tests of mean number of observations showed that study unit 3 was used significantly more than study units 1, 6, or 4 (western hills, control area, and ridge face) during fall (Figure 4-30). Mean duration of observations was not significantly different among study units during any season (Figure 4-31).

The contrasts results indicated that, during the fall, the combined mean number of observations of the study units in the primary study area in which siting of turbines is planned (study units 1, 2, and 3) was marginally significantly higher than the combined mean of study units in which no or few turbines are planned (study units 4 and 5). The mean of the control study unit (study unit 6) was marginally significantly lower than the combined mean of the primary area study units (study units 1-5) during fall.

Loggerhead Shrike. Too few loggerhead shrikes were observed to conduct statistical analyses. Mean number of observations and mean duration of observations are presented in Figures 4-32 and 4-33.

Waterfowl. Insufficient data were gathered on waterfowl to conduct statistical analyses. Mean number of observations and mean duration of observations are presented in Figures 4-34 and 4-35.

Passerines. The passerine data was not statistically analyzed because they were evaluated as a group of birds. The mean number of observations and the mean duration of observations are presented in Figures 4-36 and 4-37.

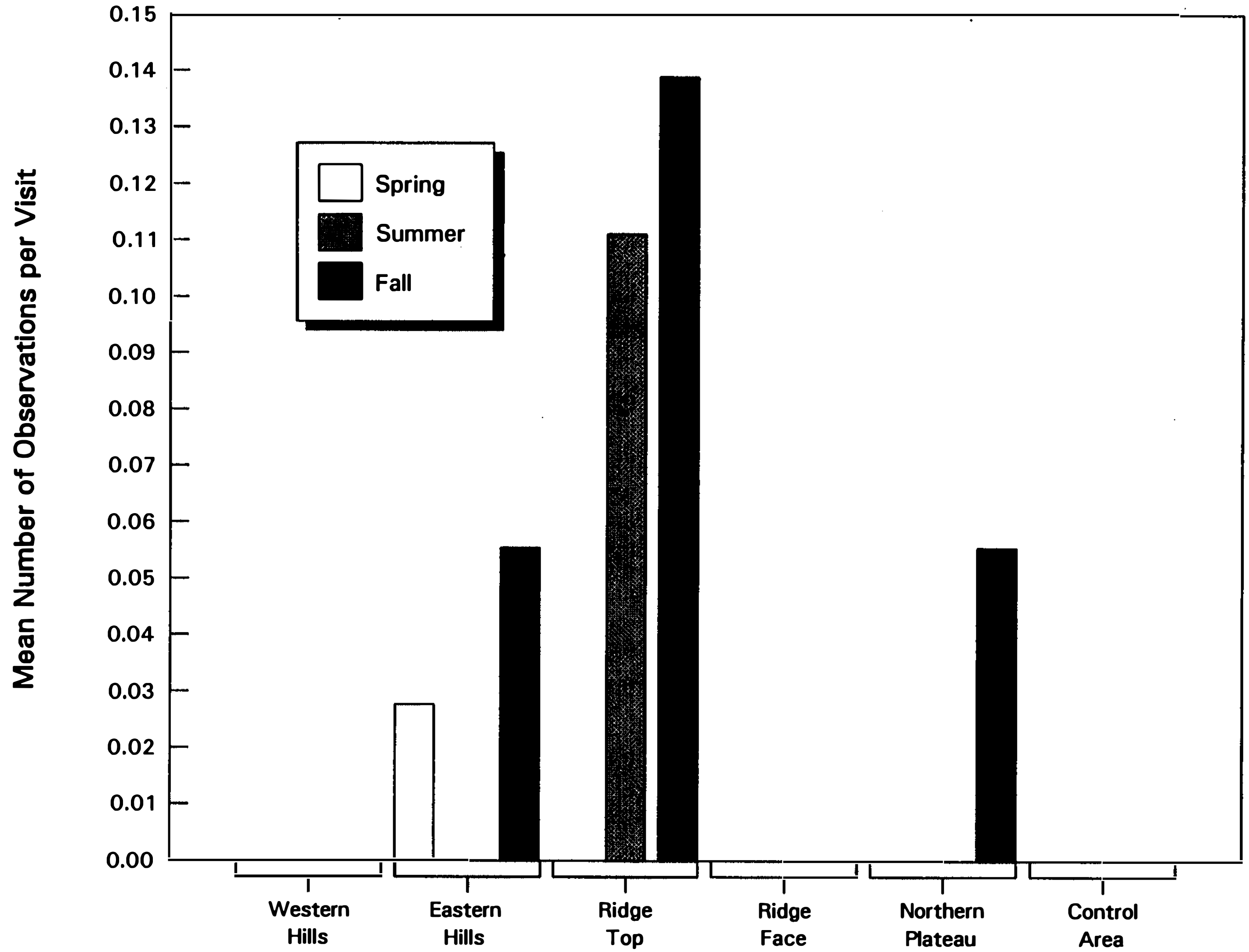

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Figure 4-30
Mean Number of Observations of Western Blue Birds by Study Unit and Season

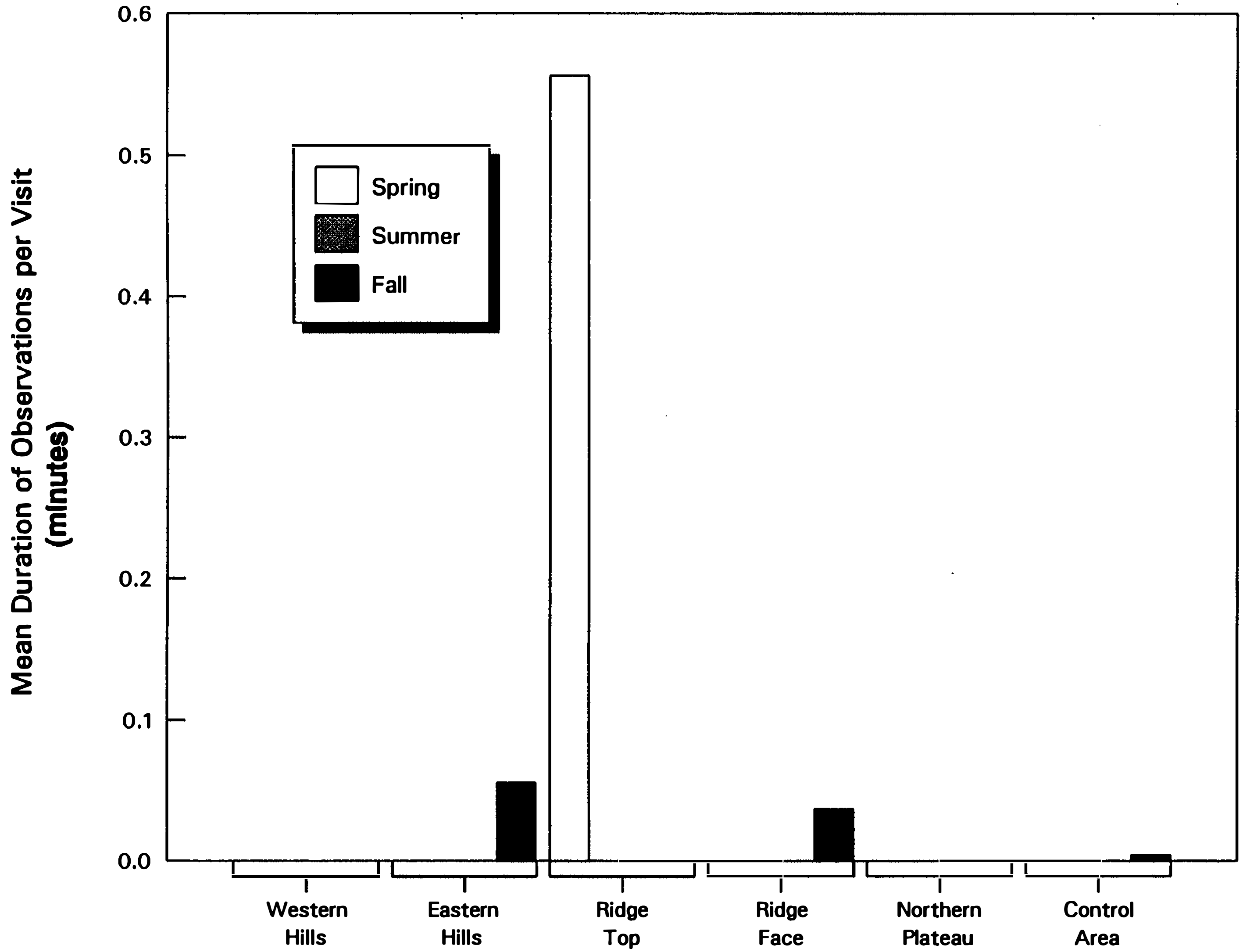

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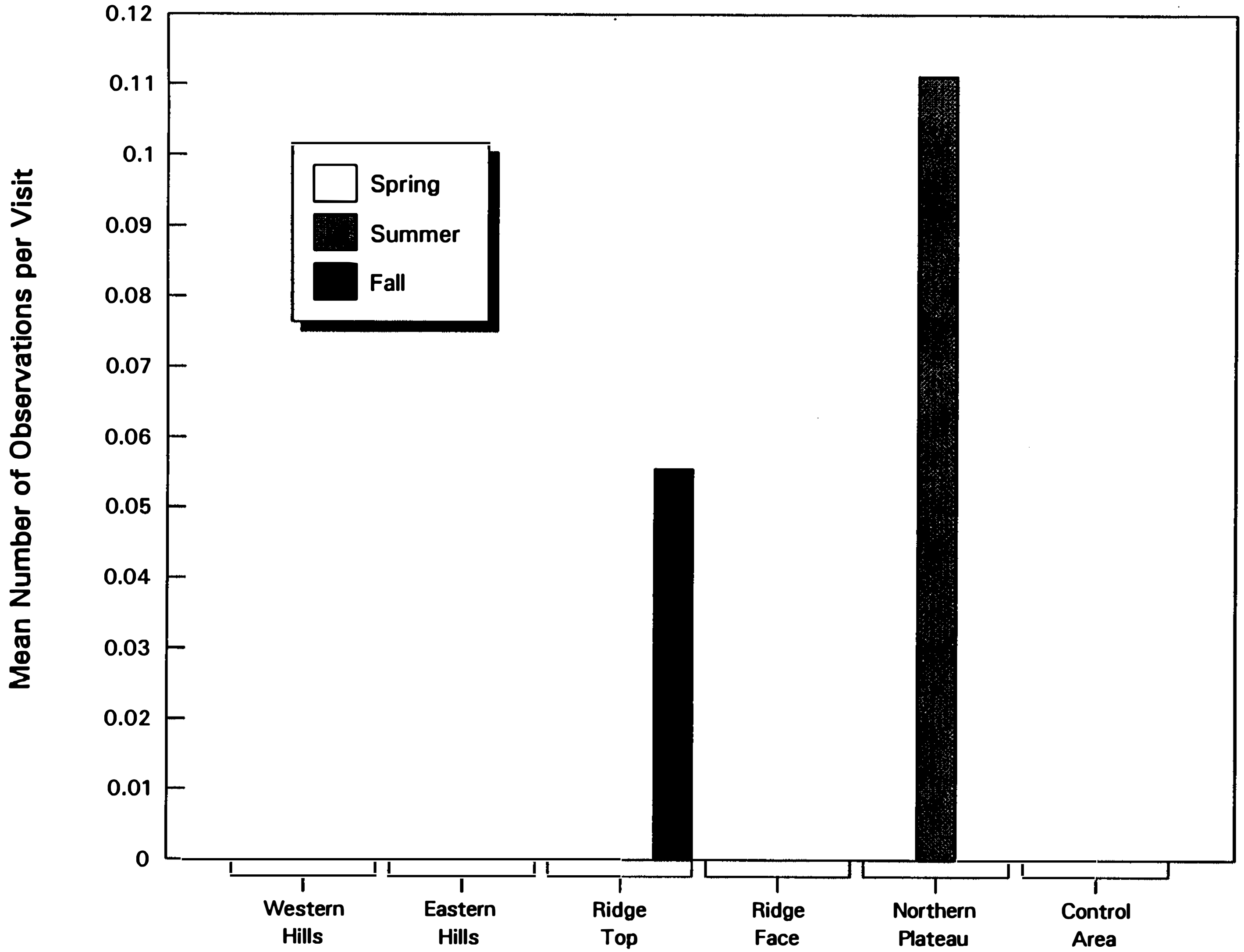
Figure 4-31
Mean Duration of Observations of Western Blue Birds by Study Unit and Season



Jones & Stokes Associates, Inc.

Figure 4-32
Mean Number of Observations of Loggerhead Shrikes by Study Unit and Season

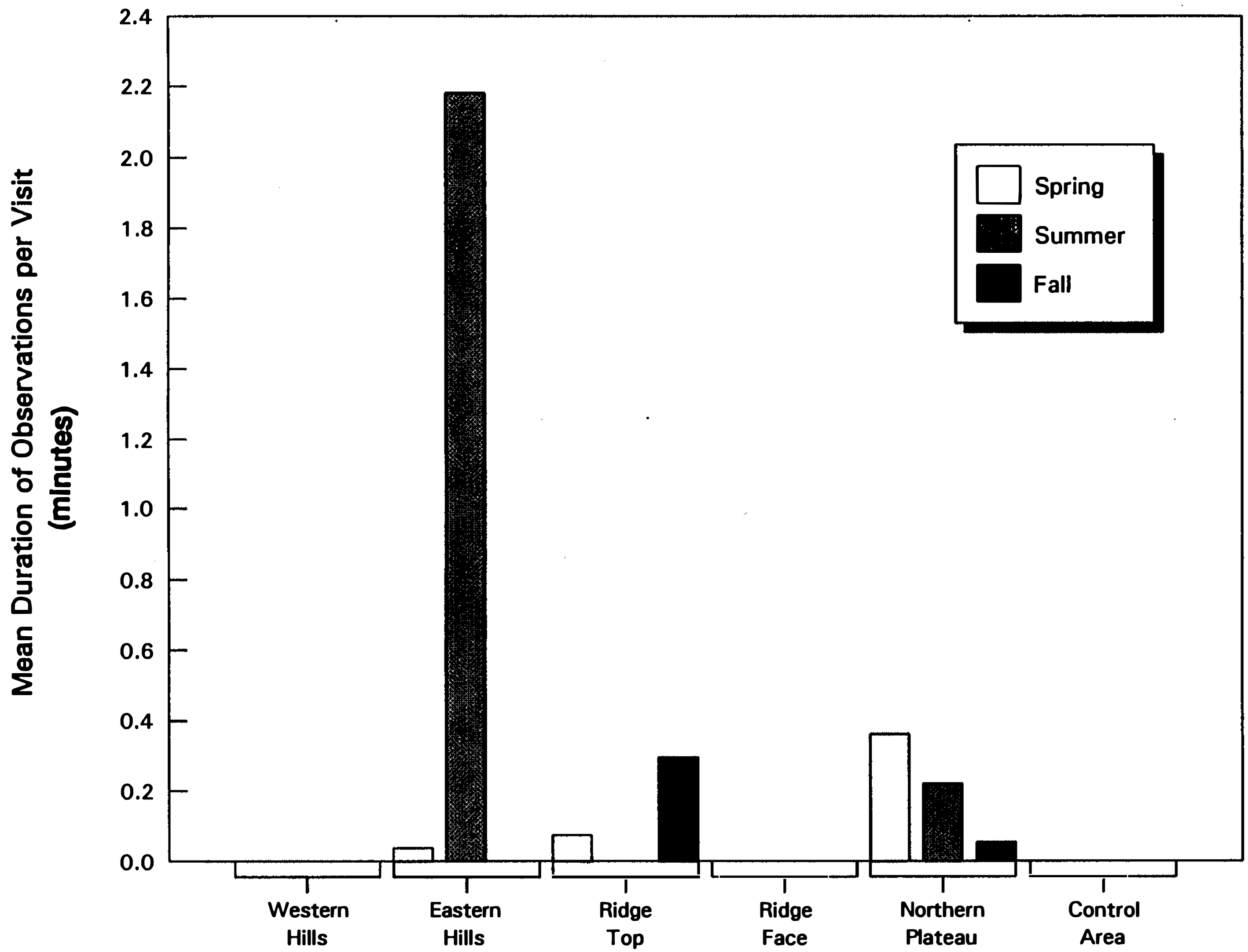


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Figure 4-33
Mean Duration of Observations of Loggerhead Shrikes by Study Unit and Season

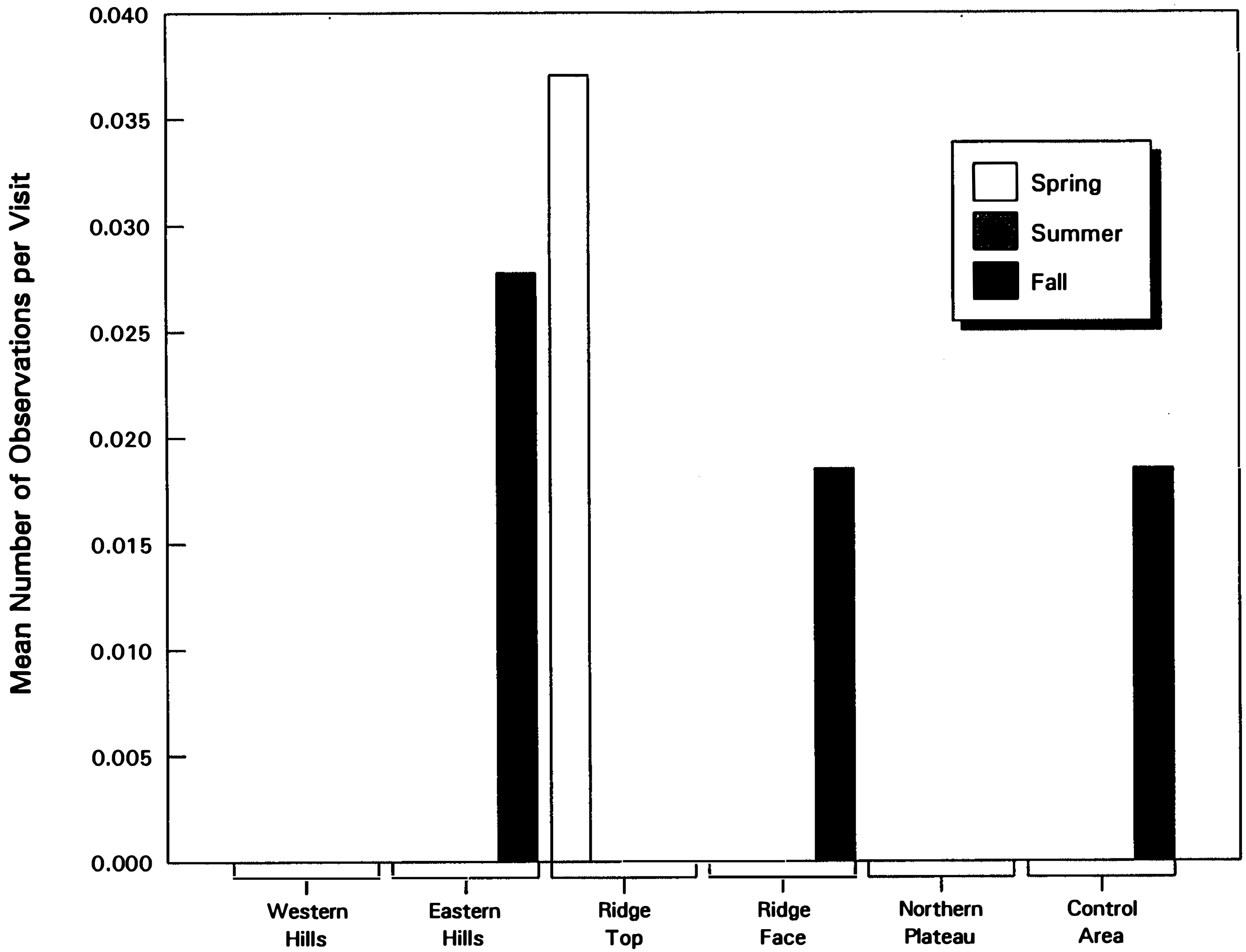

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Figure 4-34
Mean Number of Observations of Waterfowl by Study Unit and Season

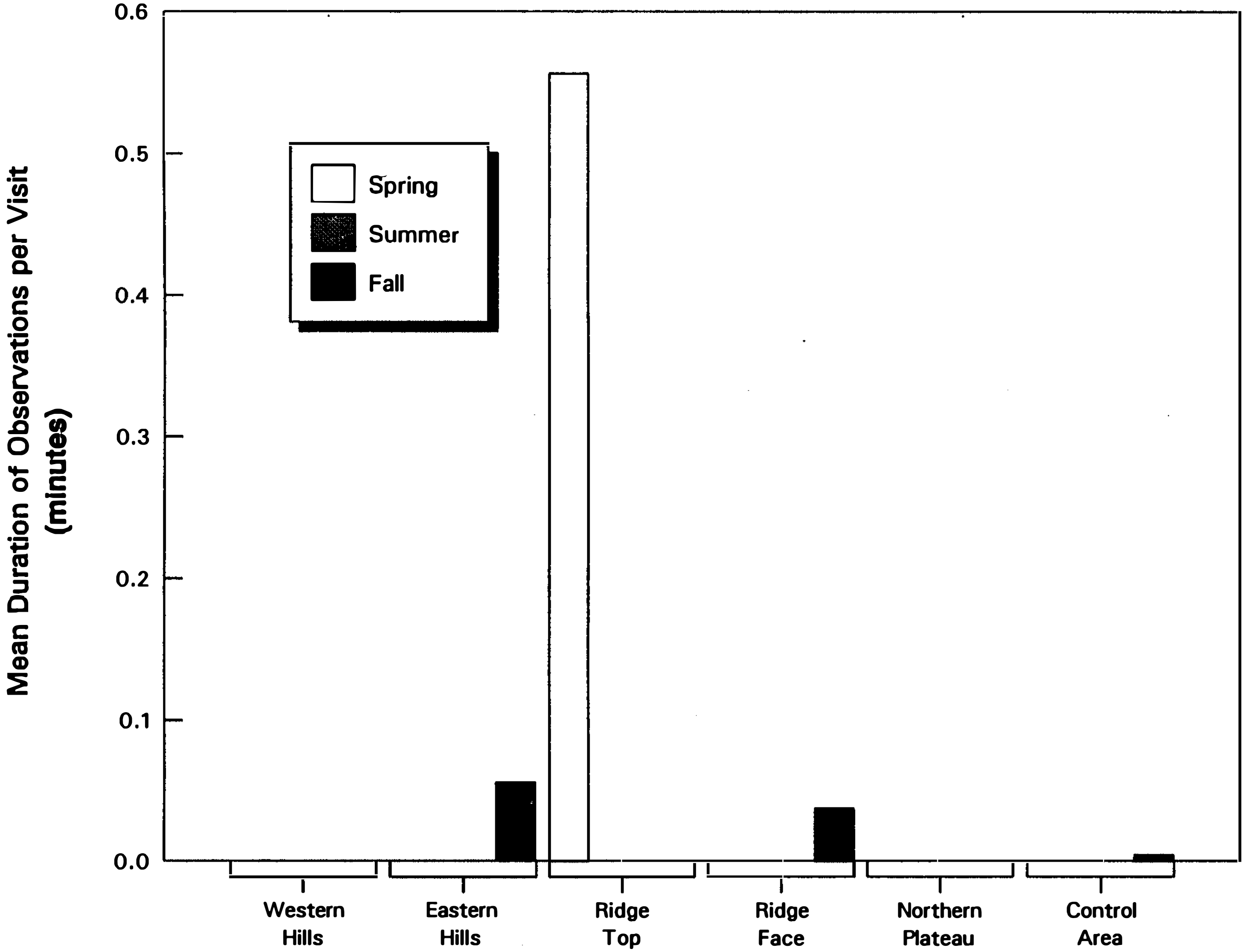

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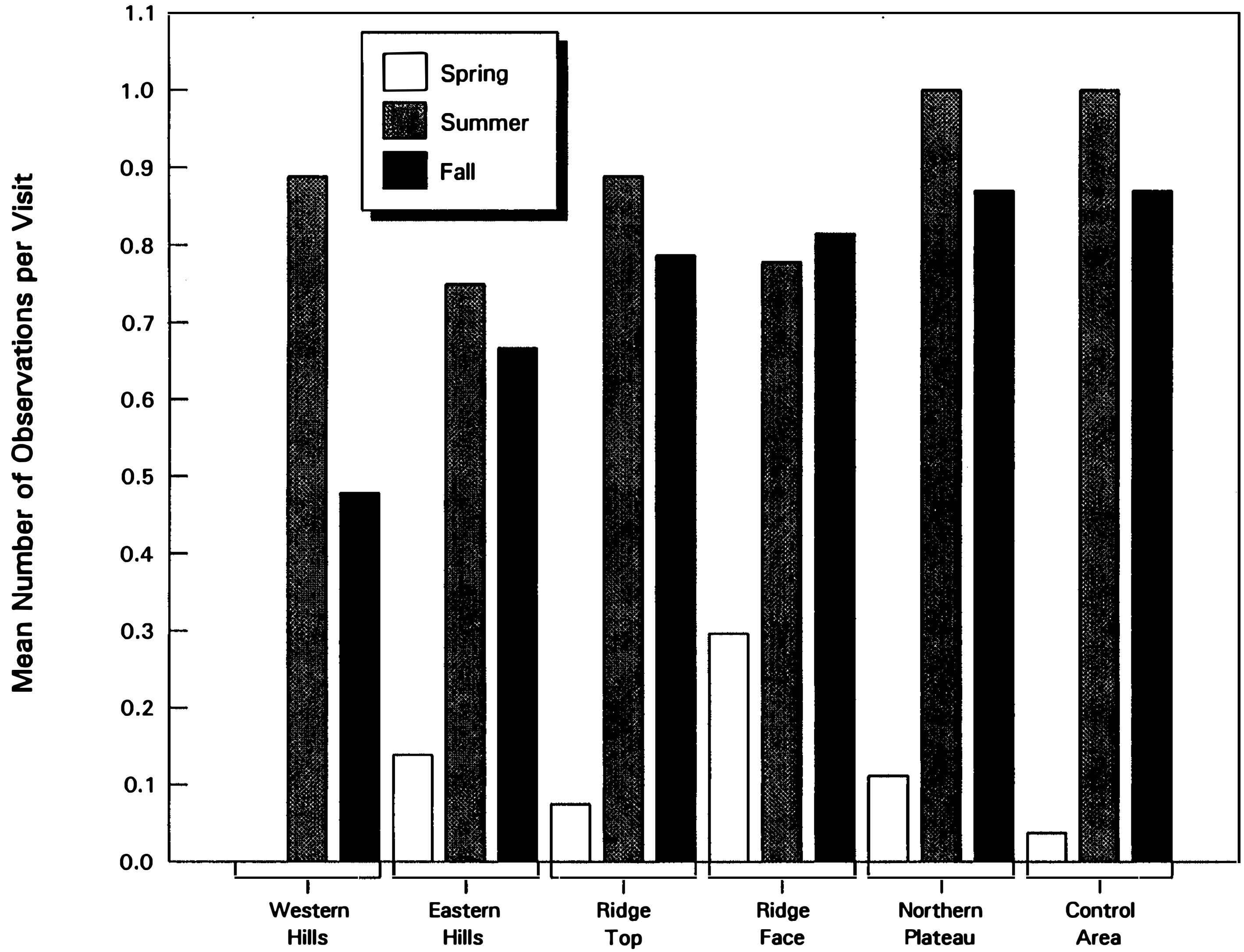
Figure 4-35
Mean Duration of Observations of Waterfowl by Study Unit and Season



Jones & Stokes Associates, Inc.

Figure 4-36
Mean Number of Observations of Other Passerines by Study Unit and Season

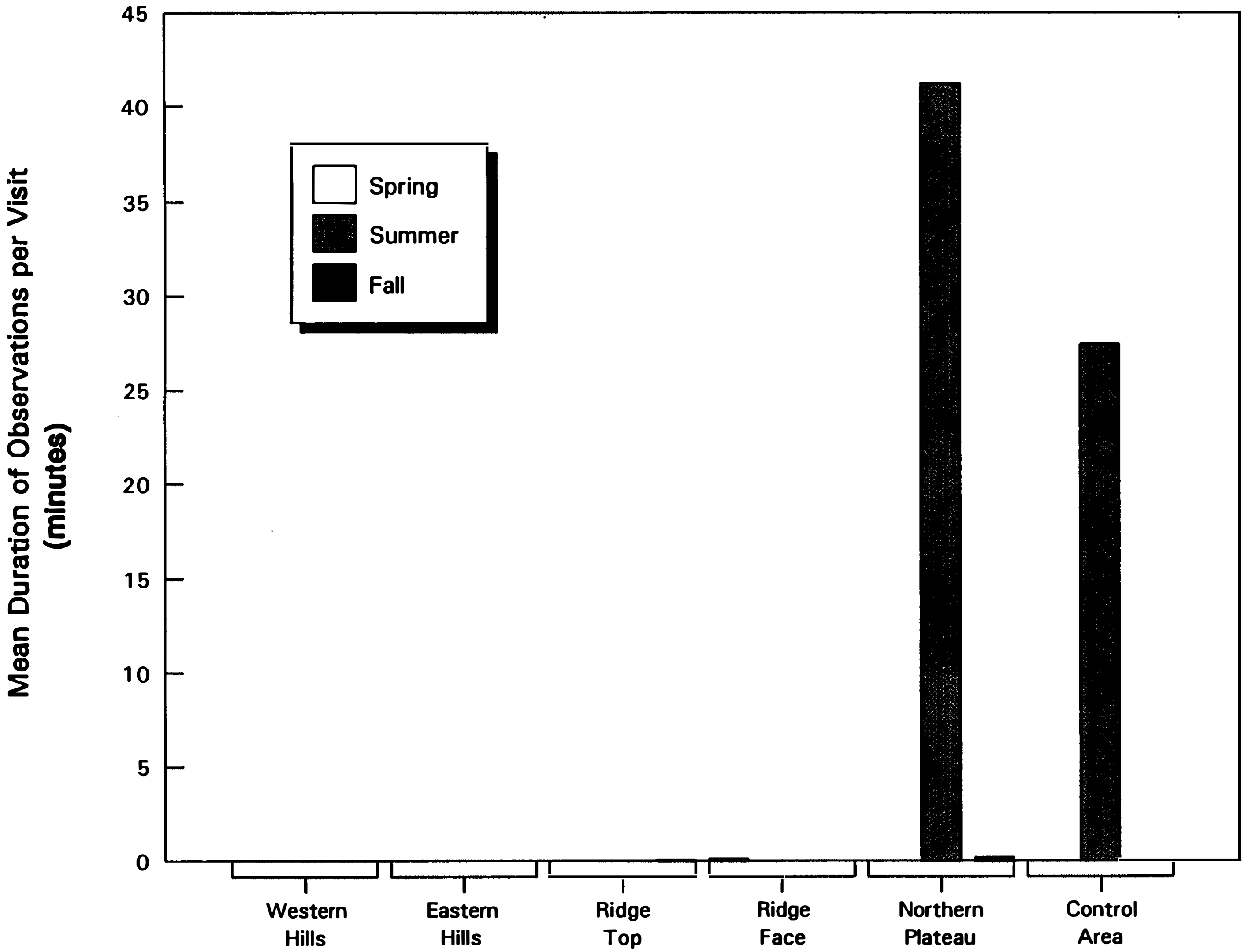


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Figure 4-37
Mean Duration of Observations of Other Passerines by Study Unit and Season

Conclusion

The above results indicate that season and study unit influence the frequency of occurrence of most of the primary species in the study area. For example, golden eagles occur in the study area most frequently during the summer in the ridge face study unit. Observations drop substantially during all other seasons in all study units. As expected, the ridge face is an important habitat area for golden eagles, particularly during the spring and summer seasons. This analysis also indicates that golden eagles are also more likely to occur in areas that are not planned for extensive wind turbine development (e.g., ridge face unit), than in areas that are (e.g., western hills, eastern hills, and ridge top units). As expected based on their behavior, results were similar for the turkey vulture.

The results for northern harrier are also as expected. The primary use areas are the agricultural areas of study unit 5 and the rolling grasslands of study unit 1, and they are expected to occur less in the steeper terrain of the ridge top and ridge face units.

Some seasonal and site differences occur among American kestrels, red-tailed hawk, sharp-shinned hawks, and prairie falcon; however, these species can be expected to occur in all study units, although in varying proportions seasonally. Site differences in Swainson's hawks use were expected. The eastern hills and northern plateau areas were more frequently used. These areas also correspond with the nest locations found during the breeding survey.

Data were too sparse to reach statistical conclusions for some species, such as the peregrine falcon, Cooper's hawk, ferruginous hawk, loggerhead shrike, and waterfowl. These species were found to be present in very small numbers.

4.2.3 Movements and Behavior

Flight Patterns

Bird flight data are tabulated as percentages within each season (Tables 4-2 through 4-5). Statistical analyses were not conducted for these data; however, there are no obvious consistent patterns. Flight direction data (Table 4-3) suggests that the area is not used as a migratory corridor. Birds did not funnel through the project area along a defined front. Instead, birds observed during the migratory seasons appeared to fly through the area on a broad front, with no detectable pattern. Birds probably do migrate along an east-west migratory route along the Columbia River and along north-south migratory route through the project area; however, no specific migratory corridor was detected from general observations or was detected in the database.

Table 4-4 indicates that the majority of observations were of birds either flying through the area or foraging with no obvious seasonal patterns.

Table 4-2. Number (Percent) of Observations in Different Flight Patterns during Spring, Summer, and Fall

Species	Season	Perched	Soaring[a]	Flapping[b]	Slow Gliding[c]	Moderate Gliding[d]	Flexed Gliding[e]	Hovering
Golden eagle	Spring	--	--	2 (28.6)	5 (71.4)	--	--	--
	Summer	--	--	1 (12.5)	5 (62.5)	1 (12.5)	1 (12.5)	--
	Fall	1 (5.9)	3 (17.6)	--	12 (70.6)	1 (5.9)	--	--
Peregrine falcon	Spring	--	--	--	1 (100.0)	--	--	--
	Fall	--	--	1 (100.0)	--	--	--	--
Prairie falcon	Spring	--	--	2 (40.0)	2 (40.0)	1 (20.0)	--	--
	Summer	1 (50.0)	--	1 (50.0)	--	--	--	--
	Fall	2 (20.0)	2 (20.0)	2 (20.0)	3 (30.0)	1 (10.0)	--	--
American kestrel	Spring	9 (25.7)	3 (8.6)	17 (48.6)	1 (2.9)	1 (2.9)	--	4 (11.4)
	Summer	4 (13.3)	1 (3.3)	18 (60.0)	1 (3.3)	3 (10.0)	--	2 (6.7)
	Fall	7 (15.6)	4 (8.9)	29 (64.4)	3 (6.7)	2 (4.4)	--	--
Turkey vulture	Spring	1 (5.9)	4 (23.5)	1 (5.9)	11 (64.7)	--	--	--
	Summer	--	1 (11.1)	--	8 (88.9)	--	--	--
	Fall	--	2 (18.2)	--	7 (63.6)	2 (18.2)	--	--
Northern goshawk	Fall	--	--	1 (100.0)	--	--	--	--
Cooper's hawk	Spring	--	--	--	2 (100.0)	--	--	--
	Summer	--	--	--	--	1 (100.0)	--	--
	Fall	--	1 (50.0)	--	1 (50.0)	--	--	--
Sharp-shinned hawk	Spring	1 (33.3)	--	1 (33.3)	--	--	1 (33.3)	--
	Summer	--	--	1 (50.0)	--	1 (50.0)	--	--
	Fall	--	4 (17.4)	13 (56.5)	5 (21.7)	--	--	--
Red-tailed hawk	Spring	4 (7.8)	20 (39.2)	14 (27.5)	7 (13.7)	6 (11.8)	--	--
	Summer	2 (16.7)	3 (25.0)	2 (16.7)	3 (25.0)	--	2 (16.7)	--
	Fall	26 (26.8)	19 (19.6)	15 (15.5)	25 (25.8)	11 (11.3)	1 (1.0)	--
Rough-legged hawk	Spring	--	--	1 (100.0)	--	--	--	--
Ferruginous hawk	Spring	--	1 (50.0)	--	1 (50.0)	--	--	--
	Fall	--	--	--	1 (100.0)	--	--	--
Swainson's hawk	Spring	--	5 (71.4)	1 (14.3)	--	--	--	1 (14.3)
	Summer	2 (28.6)	1 (14.3)	1 (14.3)	--	1 (14.3)	1 (14.3)	1 (14.3)
	Fall	1 (33.3)	--	1 (33.3)	--	1 (33.3)	--	--
Long-billed curlew	Spring	--	--	1 (100.0)	--	--	--	--
Loggerhead shrike	Summer	1 (100.0)	--	--	--	--	--	--
	Fall	1 (50.0)	--	1 (50.0)	--	--	--	--
Waterfowl	Spring	--	--	--	--	--	--	1 (33.3)

Table 4-2. Continued

Species	Season	Perched	Soaring[a]	Flapping[b]	Slow Gliding[c]	Moderate Gliding[d]	Flexed Gliding[e]	Hovering
	Fall	--	--	3 (75.0)	1 (25.0)	--	--	--
Western bluebird	Spring	1 (100.0)	--	--	--	--	--	--
	Summer	--	--	1 (100.0)	--	--	--	--
	Fall	2 (14.3)	--	10 (71.4)	--	--	--	--
Unidentified raptor	Fall	--	--	--	1 (50.0)	1 (50.0)	--	--
Unidentified hawk	Spring	--	2 (28.6)	5 (71.4)	--	--	--	--
	Fall	1 (20.0)	2 (40.0)	1 (20.0)	--	1 (20.0)	--	--
Unidentified accipiter	Spring	--	3 (60.0)	1 (20.0)	--	--	1 (20.0)	--
	Summer	--	--	1 (100.0)	--	--	--	--
	Fall	--	1 (50.0)	1 (50.0)	--	--	--	--
Unidentified large falcon	Spring	--	--	1 (100.0)	--	--	--	--
	Fall	--	--	2 (50.0)	1 (25.0)	1 (25.0)	--	--
Unidentified small falcon	Fall	--	--	1 (100.0)	--	--	--	--
Northern harrier	Spring	--	1 (9.1)	6 (54.5)	3 (27.3)	1 (9.1)	--	--
	Summer	--	1 (25.0)	1 (25.0)	1 (25.0)	1 (25.0)	--	--
	Fall	--	3 (11.1)	15 (55.6)	7 (25.9)	2 (7.4)	--	--
Osprey	Fall	--	--	--	1 (100.0)	--	--	--

[a] Circling flight, typically when a bird is using a thermal or an updraft.

[b] Powered flight, used when most of the bird's movement is powered by wing flaps, with little gliding.

[c] Used to describe a bird moving in a relatively straight line (as opposed to circling) with wings in full or mostly full extension and the tail mostly fanned.

[d] Used to describe when a bird is moving in a relatively straight line with wings partially extended (intermediate between slow and flexed gliding).

[e] Used to describe a bird moving in a relatively straight line with wings mostly flexed, or tucked back, and tail mostly closed. Typically when a bird is using strong, turbulent updrafts or when it is foraging close to the ground.

Table 4-3. Number (Percent) of Observations in Different Flight Directions during Spring, Summer, and Fall

Species	Season	North	Northwest	West	Southwest	South	Southeast	East	Northeast	Circling
Golden eagle	Spring	--	--	1 (14.3)	--	--	1 (14.3)	2 (28.6)	3 (42.9)	--
	Summer	--	1 (12.5)	4 (50.0)	--	1 (12.5)	--	2 (25.0)	--	--
	Fall	3 (18.8)	4 (25.0)	4 (25.0)	--	--	1 (6.3)	4 (25.0)	--	--
Peregrine falcon	Spring	1 (100.0)	--	--	--	--	--	--	--	--
	Fall	--	--	--	--	--	1 (100.0)	--	--	--
Prairie falcon	Spring	--	--	2 (40.0)	--	--	1 (20.0)	1 (20.0)	1 (20.0)	--
	Summer	--	--	1 (100.0)	--	--	--	--	--	--
	Fall	1 (12.5)	1 (12.5)	3 (37.5)	1 (12.5)	--	--	--	2 (25.0)	--
American kestrel	Spring	3 (12.0)	5 (20.0)	7 (28.0)	--	3 (12.0)	--	3 (12.0)	4 (16.0)	--
	Summer	4 (15.4)	1 (3.8)	4 (15.4)	3 (11.5)	4 (15.4)	--	10 (38.5)	--	--
	Fall	5 (13.2)	3 (7.9)	7 (18.4)	2 (5.3)	10 (26.3)	4 (10.5)	6 (15.8)	1 (2.6)	--
Turkey vulture	Spring	--	--	8 (50.0)	--	--	--	7 (43.8)	1 (6.3)	--
	Summer	2 (22.2)	--	2 (22.2)	1 (11.1)	--	--	3 (33.3)	1 (11.1)	--
	Fall	2 (18.2)	1 (9.1)	--	1 (9.1)	3 (27.3)	1 (9.1)	2 (18.2)	1 (9.1)	--
Northern goshawk	Fall	--	--	--	--	--	1 (100.0)	--	--	--
Cooper's hawk	Spring	1 (50.0)	--	--	--	--	--	--	1 (50.0)	--
	Summer	--	--	--	--	--	--	--	1 (100.0)	--
	Fall	--	--	2 (100.0)	--	--	--	--	--	--
Sharp-shinned hawk	Spring	--	1 (50.0)	--	--	--	--	--	1 (50.0)	--
	Summer	1 (50.0)	--	1 (50.0)	--	--	--	--	--	--
	Fall	--	3 (13.0)	4 (17.4)	3 (13.0)	8 (34.8)	2 (8.7)	3 (13.0)	--	--
Red-tailed hawk	Spring	7 (15.2)	2 (4.3)	8 (17.4)	6 (13.0)	4 (8.7)	1 (2.2)	11 (23.9)	7 (15.2)	--
	Summer	3 (30.0)	--	3 (30.0)	--	2 (20.0)	--	2 (20.0)	--	--
	Fall	13 (18.3)	9 (12.7)	17 (23.9)	4 (5.6)	9 (12.7)	5 (7.0)	11 (15.5)	2 (2.8)	1 (1.4)
Rough-legged hawk	Spring	--	1 (100.0)	--	--	--	--	--	--	--
Ferruginous hawk	Spring	--	--	2 (100.0)	--	--	--	--	--	--
	Fall	--	--	--	--	--	1 (100.0)	--	--	--
Swainson's hawk	Spring	--	1 (14.3)	--	1 (14.3)	2 (28.6)	--	1 (14.3)	2 (28.6)	--
	Summer	4 (80.0)	--	--	--	--	1 (20.0)	--	--	--
	Fall	--	--	1 (50.0)	1 (50.0)	--	--	--	--	--
Long-billed curlew	Spring	--	--	--	--	1 (100.0)	--	--	--	--
Waterfowl	Fall	--	--	--	--	3 (75.0)	--	1 (25.0)	--	--
Western bluebird	Summer	--	--	--	--	1 (100.0)	--	--	--	--
	Fall	2 (20.0)	1 (10.0)	1 (10.0)	2 (20.0)	--	1 (10.0)	2 (20.0)	1 (10.0)	--
Unidentified raptor	Fall	--	--	1 (50.0)	--	1 (50.0)	--	--	--	--

Table 4-3. Continued

Species	Season	North	Northwest	West	Southwest	South	Southeast	East	Northeast	Circling
Unidentified hawk	Spring	2 (28.6)	1 (14.3)	2 (28.6)	1 (14.3)	--	--	--	1 (14.3)	--
	Fall	--	1 (25.0)	1 (25.0)	--	--	--	1 (25.0)	1 (25.0)	--
Accipiter	Spring	1 (20.0)	--	--	1 (20.0)	1 (20.0)	--	2 (40.0)	--	--
	Summer	--	--	1 (100.0)	--	--	--	--	--	--
	Fall	--	--	--	--	1 (50.0)	1 (50.0)	--	--	--
Unidentified large falcon	Spring	--	1 (100.0)	--	--	--	--	--	--	--
	Fall	--	--	1 (25.0)	--	--	--	3 (75.0)	--	--
Unidentified small falcon	Fall	--	1 (100.0)	--	--	--	--	--	--	--
Northern harrier	Spring	2 (18.2)	--	3 (27.3)	2 (18.2)	2 (18.2)	--	2 (18.2)	--	--
	Summer	1 (33.3)	--	--	--	1 (33.3)	--	1 (33.3)	--	--
	Fall	3 (11.1)	2 (7.4)	5 (18.5)	2 (7.4)	5 (18.5)	1 (3.7)	5 (18.5)	4 (14.8)	--
Osprey	Fall	--	--	--	--	1 (100.0)	--	--	--	--

Table 4-4. Number (Percent) of Observations in Different Flight Behaviors during Spring, Summer, and Fall

Species	Season	Passing Through the Area	Courtship Flight/Pair Bonding	Foraging	Aggressive Interaction	Other Behavior	Perched
Golden eagle	Spring	1 (14.3)	--	4 (57.1)	2 (28.6)	--	--
	Summer	3 (37.5)	--	5 (62.5)	--	--	--
	Fall	5 (29.4)	1 (5.9)	10 (58.8)	--	--	1 (5.9)
Peregrine falcon	Spring	1 (100.0)	--	--	--	--	--
	Fall	--	--	1 (100.0)	--	--	--
Prairie falcon	Spring	--	--	4 (80.0)	1 (20.0)	--	--
	Summer	--	--	1 (50.0)	--	--	1 (50.0)
	Fall	2 (20.0)	--	5 (50.0)	1 (10.0)	--	2 (20.0)
American kestrel	Spring	4 (11.4)	--	19 (54.3)	3 (8.6)	--	9 (25.7)
	Summer	2 (6.9)	--	16 (55.2)	5 (17.2)	2 (6.9)	4 (13.8)
	Fall	17 (37.8)	1 (2.2)	14 (31.1)	2 (4.4)	4 (8.9)	7 (15.6)
Turkey vulture	Spring	5 (29.4)	--	9 (52.9)	--	2 (11.7)	1 (5.9)
	Summer	1 (12.5)	--	5 (62.5)	--	2 (25.0)	--
	Fall	3 (27.3)	--	8 (72.7)	--	--	--
Northern goshawk	Fall	1 (100.0)	--	--	--	--	--
Cooper's hawk	Spring	1 (50.0)	--	1 (50.0)	--	--	--
	Summer	--	--	--	1 (100.0)	--	--
	Fall	1 (50.0)	--	--	--	1 (50.0)	--
Sharp-shinned hawk	Spring	--	--	2 (66.7)	--	--	1 (33.3)
	Summer	1 (50.0)	--	1 (50.0)	--	--	--
	Fall	14 (63.6)	--	7 (31.8)	1 (4.5)	--	--
Red-tailed hawk	Spring	7 (13.7)	2 (3.9)	29 (56.9)	7 (13.7)	2 (3.9)	4 (7.8)
	Summer	2 (16.7)	--	7 (58.3)	1 (8.3)	--	2 (16.7)
	Fall	19 (19.6)	--	48 (49.5)	3 (3.1)	1 (1.0)	26 (26.8)
Rough-legged hawk	Spring	1 (100.0)	--	--	--	--	--
Ferruginous hawk	Spring	1 (50.0)	--	1 (50.0)	--	--	--
	Fall	--	--	1 (100.0)	--	--	--
Swainson's hawk	Spring	1 (14.3)	--	6 (85.7)	--	--	--
	Summer	--	1 (14.3)	4 (57.1)	--	--	2 (28.6)
	Fall	1 (33.3)	--	1 (33.3)	--	--	1 (33.3)
Long-billed curlew	Spring	1 (100.0)	--	--	--	--	--
Loggerhead shrike	Summer	--	--	--	--	--	1 (100.0)
	Fall	--	--	1 (50.0)	--	--	1 (50.0)

Table 4-4. Continued

Species	Season	Passing Through the Area	Courtship Flight/Pair Bonding	Foraging	Aggressive Interaction	Other Behavior	Perched
Waterfowl	Spring	--	--	--	--	1 (100.0)	--
	Fall	4 (100.0)	--	--	--	--	--
Western bluebird	Spring	--	--	--	--	--	1 (100.0)
	Summer	1 (100.0)	--	--	--	--	--
	Fall	9 (75.0)	--	1 (8.3)	--	--	2 (16.7)
Unidentified raptor	Fall	2 (100.0)	--	--	--	--	--
Unidentified hawk	Spring	4 (57.1)	--	3 (42.9)	--	--	--
	Fall	2 (40.0)	--	1 (20.0)	1 (20.0)	--	1 (20.0)
Unidentified accipiter	Spring	--	--	4 (80.0)	--	1 (20.0)	--
	Summer	--	--	--	1 (100.0)	--	--
	Fall	2 (100.0)	--	--	--	--	--
Unidentified large falcon	Spring	1 (100.0)	--	--	--	--	--
	Fall	2 (50.0)	--	1 (25.0)	1 (25.0)	--	--
Unidentified small falcon	Fall	--	1 (100.0)	--	--	--	--
Northern harrier	Spring	1 (9.1)	1 (9.1)	7 (63.6)	--	2 (18.2)	--
	Summer	--	--	3 (75.0)	--	1 (25.0)	--
	Fall	5 (18.5)	--	20 (74.1)	2 (7.4)	--	--
Osprey	Fall	1 (100.0)	--	--	--	--	--

Table 4-5. Number (Percent) of Observations in Different Flight Paths during Spring, Summer, and Fall

Species	Season	Path 1[a]	Path 2[b]	Path 3[c]	Path 4[c]	Path 5[d]
Golden eagle	Spring	--	--	4 (57.1)	1 (14.3)	2 (28.6)
	Summer	2 (25.0)	5 (62.5)	--	--	1 (12.5)
	Fall	1 (6.3)	6 (37.5)	--	6 (37.5)	3 (18.8)
Peregrine falcon	Spring	--	--	--	--	1 (100.0)
	Fall	--	--	--	1 (100.0)	--
Prairie falcon	Spring	--	--	2 (40.0)	2 (40.0)	1 (20.0)
	Summer	--	1 (100.0)	--	--	--
	Fall	--	1 (12.5)	--	1 (12.5)	6 (75.0)
American kestrel	Spring	2 (7.7)	1 (3.8)	2 (7.7)	2 (7.7)	19 (73.1)
	Summer	4 (15.4)	2 (7.7)	2 (7.7)	1 (3.8)	17 (65.4)
	Fall	1 (2.6)	1 (2.7)	--	7 (18.4)	29 (76.3)
Turkey vulture	Spring	3 (18.8)	7 (43.8)	3 (18.8)	1 (6.3)	2 (12.5)
	Summer	2 (22.2)	3 (33.3)	--	1 (11.1)	3 (33.3)
	Fall	--	2 (18.2)	--	3 (27.3)	6 (54.5)
Northern goshawk	Fall	--	--	--	1 (100.0)	--
Cooper's hawk	Spring	--	--	--	--	2 (100.0)
	Summer	--	--	--	1 (100.0)	--
	Fall	--	--	1 (50.0)	--	1 (50.0)
Sharp-shinned hawk	Spring	--	--	--	--	2 (100.0)
	Summer	--	--	--	1 (50.0)	1 (50.0)
	Fall	2 (8.7)	4 (17.4)	1 (4.3)	5 (21.7)	11 (47.8)
Red-tailed hawk	Spring	2 (4.3)	3 (6.5)	3 (6.5)	6 (13.0)	32 (69.6)
	Summer	--	3 (30.0)	--	--	7 (70.0)
	Fall	5 (7.0)	7 (9.9)	4 (5.6)	5 (7.0)	50 (70.4)
Rough-legged hawk	Spring	--	--	--	--	1 (100.0)
Ferruginous hawk	Spring	--	--	1 (50.0)	--	1 (50.0)
	Fall	--	--	--	--	1 (100.0)
Swainson's hawk	Spring	--	--	--	1 (16.7)	5 (83.3)
	Summer	--	--	--	1 (20.0)	4 (80.0)
	Fall	--	--	--	--	2 (100.0)
Long-billed curlew	Spring	--	--	--	--	1 (100.0)
Loggerhead shrike	Fall	--	--	--	--	1 (100.0)
Waterfowl	Fall	--	--	--	3 (75.0)	1 (25.0)
Western bluebird	Summer	--	--	--	--	1 (100.0)
	Fall	--	--	--	2 (16.7)	10 (83.3)

Table 4-5. Continued

Species	Season	Path 1[a]	Path 2[b]	Path 3[c]	Path 4[e]	Path 5[d]
Unidentified raptor	Fall	--	--	1 (50.0)	--	1 (50.0)
Unidentified hawk	Spring	1 (14.3)	--	--	--	6 (85.7)
	Fall	3 (75.0)	--	1 (25.0)	--	--
Unidentified accipiter	Spring	2 (40.0)	--	--	--	60.0
	Summer	--	--	1 (100.0)	--	--
	Fall	--	--	--	--	2 (100.0)
Unidentified large falcon	Spring	--	--	--	--	1 (100.0)
	Fall	1 (25.0)	--	1 (25.0)	--	2 (50.0)
Unidentified small falcon	Fall	--	--	--	1 (100.0)	--
Northern harrier	Spring	--	--	--	--	11 (100.0)
	Summer	--	--	--	--	4 (100.0)
	Fall	1 (3.7)	2 (7.4)	1 (3.7)	--	23 (85.2)
Osprey	Fall	--	--	--	1 (100.0)	--

[a] Flying parallel to ridge below ridgeline.

[b] Flying parallel to ridge along ridgeline.

[c] Flying parallel to ridge along ridgetop.

[d] Crossing ridge.

[e] Other path routes.

Table 4-5 describes the percent of observations of each species using specific flight paths. Of the flight paths considered, Path 3 (flying parallel to the ridge along the ridge top) and Path 4 (crossing the ridge) are the flight paths in which potential encounters with turbines would be the greatest. Most species were at least occasionally observed in these flight patterns. Certain species, such as golden eagle and prairie falcon, were observed in these flight paths for a relatively large percentage of observations. Both observations of peregrine falcons were of birds crossing the ridge in the eastern portion of the study area.

Results of Logistic Regression to Test Effects of Temperature, Wind Speed, and Cloud Cover on Probability of Entering the Critical Altitude, and Results of Exact Tests of Association of Study Unit, Season, Habitat, and Ground Wind Direction with Probability of Entering the Critical Altitude

General Results for all Species. During the majority of observations, all the species observed in this study entered the critical altitude (Figure 4-38). Of the species observed more than 15 times (Table 4-1), turkey vultures had the highest proportion of entry into the critical altitude, and northern harriers had the lowest proportion.

Proportions of observations during which a bird or birds entered the critical altitude are grouped by seasons in Table 4-6, by study units within seasons in Table 4-7, and by habitat type traversed within season in Table 4-8. The direction of the wind at ground level was not significantly associated with the probability of entering the critical altitude for any species, so no table is provided for this variable.

Golden Eagle

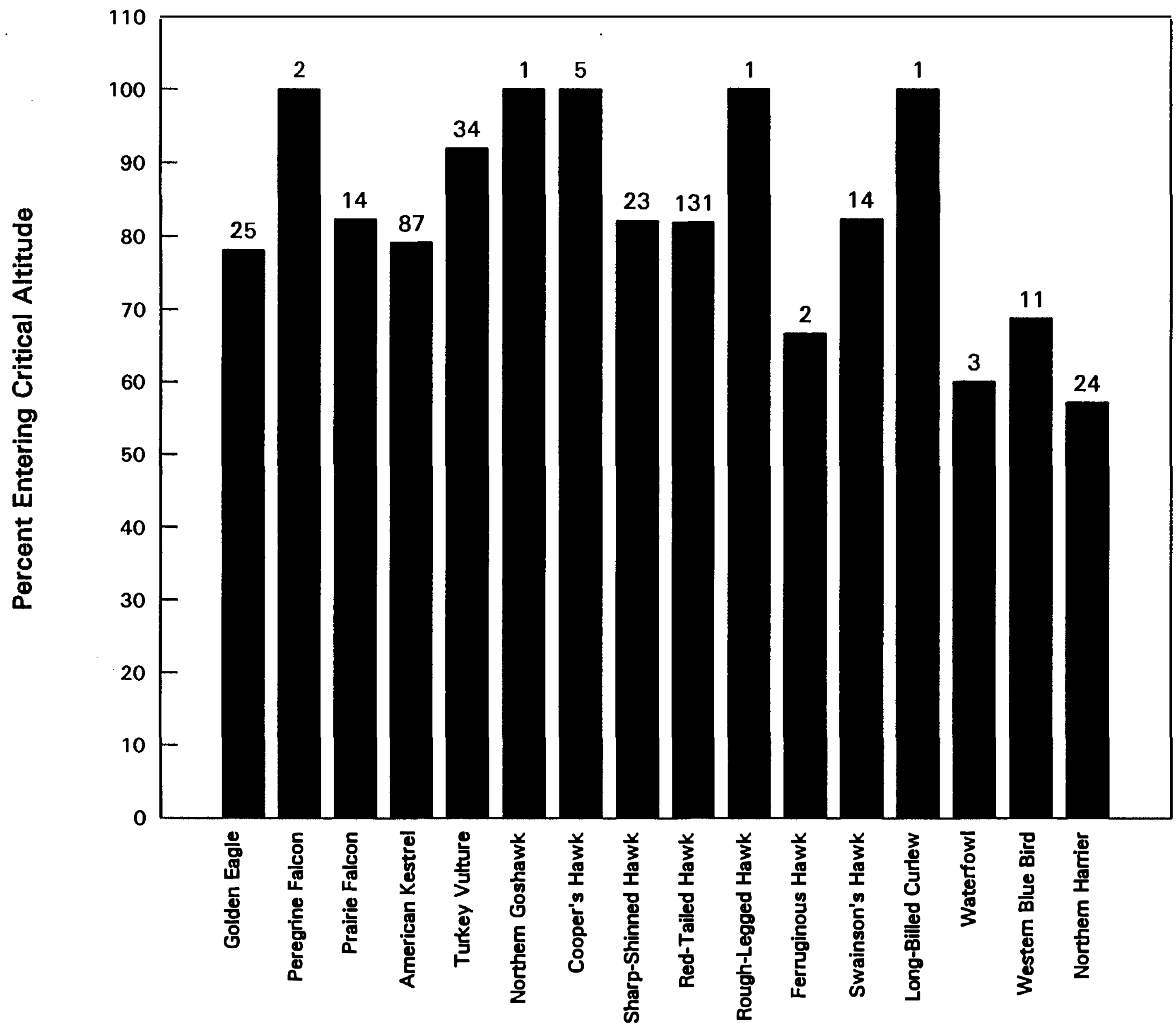
Seasons. Golden eagles entered the critical altitude during all observations in the spring, but during only 65% of the observations during the fall (Table 4-6). The differences among seasons were not statistically significant.

Spring. No analyses were possible for spring because golden eagles entered the critical altitude during all observations (i.e., they were not observed to vary with other factors).

Summer. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with the probability of entering the critical altitude.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.



Note: Numbers over bars indicate the numbers of observations with birds entering the critical altitude.

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Figure 4-38
Percent of Observations with Bird at Critical Altitude

Table 4-6. Number (Percent) of Observations with Birds at the Critical Altitude during Spring, Summer, and Fall

Species	Spring	Summer	Fall
Golden eagle	7 (100.0)	7 (87.5)	11 (64.7)
Peregrine falcon	1 (100.0)	--	1 (100.0)
Prairie falcon	5 (100.0)	2 (100.0)	7 (70.0)
American kestrel	23 (65.7)	26 (86.7)	38 (84.4)
Turkey vulture	15 (88.2)	9 (100.0)	10 (90.9)
Northern goshawk	--	--	1 (100.0)
Cooper's hawk	2 (100.0)	1 (100.0)	2 (100.0)
Sharp-shinned hawk	3 (100.0)	2 (100.0)	18 (78.3)
Red-tailed hawk	39 (76.5)	10 (83.3)	82 (84.5)
Rough-legged hawk	1 (100.0)	--	--
Ferruginous hawk	1 (50.0)	--	1 (100.0)
Swainson's hawk	6 (85.7)	6 (85.7)	2 (66.7)
Long-billed curlew	1 (100.0)	--	--
Loggerhead shrike	--	0 (0.0)	0 (0.0)
Waterfowl	0 (0.0)	--	3 (75.0)
Western bluebird	0 (0.0)	1 (100.0)	10 (71.4)
Unidentified raptor	--	--	2 (100.0)
Unidentified hawk	6 (85.7)	--	5 (100.0)
Unidentified accipiter	3 (60.0)	1 (100.0)	1 (50.0)
Unidentified large falcon	0.0	--	4 (100.0)
Unidentified small falcon	--	--	1 (100.0)
Northern harrier	6 (54.5)	2 (50.0)	16 (59.3)
Osprey	--	--	0 (0.0)

Table 4-7. Number (Percent) of Observations with Birds at the Critical Altitude in the Different Study Units during Spring, Summer, and Fall

Species	Season	Western Hills Study Unit 1	Eastern Hills Study Unit 2	Ridge Top Study Unit 3	Ridge Face Study Unit 4	Northern Plateau Study Unit 5	Control Area Study Unit 6
Golden eagle	Spring	–	–	1 (100.0)	4 (100.0)	1 (100.0)	1 (100.0)
	Summer	–	1 (100.0)	–	5 (83.3)	–	1 (100.0)
	Fall	1 (100.0)	0 (0.0)	3 (100.0)	5 (83.3)	0 (0.0)	2 (66.7)
Peregrine falcon	Spring	–	–	–	–	1 (100.0)	–
	Fall	–	–	–	–	1 (100.0)	–
Prairie falcon	Spring	–	1 (100.0)	1 (100.0)	3 (100.0)	–	–
	Summer	–	–	–	1 (100.0)	1 (100.0)	–
	Fall	1 (100.0)	1 (50.0)	–	–	0 (0.0)	5 (100.0)
American kestrel	Spring	1 (50.0)	3 (50.0)	5 (71.4)	8 (61.5)	5 (83.3)	1 (100.0)
	Summer	4 (66.7)	9 (81.8)	5 (100.0)	4 (100.0)	1 (100.0)	3 (100.0)
	Fall	2 (100.0)	6 (75.0)	11 (100.0)	4 (66.7)	9 (90.0)	6 (75.0)
Turkey vulture	Spring	–	–	2 (100.0)	11 (91.7)	1 (100.0)	1 (50.0)
	Summer	–	–	–	5 (100.0)	–	4 (100.0)
	Fall	0 (0.0)	2 (100.0)	4 (100.0)	–	4 (100.0)	–
Northern goshawk	Fall	–	–	–	–	–	1 (100.0)
Cooper's hawk	Spring	1 (100.0)	–	1 (100.0)	–	–	–
	Summer	–	–	–	1 (100.0)	–	–
	Fall	–	–	–	1 (100.0)	–	1 (100.0)
Sharp-shinned hawk	Spring	–	–	3 (100.0)	–	–	–
	Summer	1 (100.0)	–	–	1 (100.0)	–	–
	Fall	1 (100.0)	2 (66.7)	9 (100.0)	3 (75.0)	3 (75.0)	0 (0.0)
Red-tailed hawk	Spring	4 (100.0)	3 (50.0)	4 (57.1)	10 (90.9)	15 (78.9)	3 (75.0)
	Summer	1 (50.0)	–	–	1 (50.0)	2 (100.0)	6 (100.0)
	Fall	1 (100.0)	8 (100.0)	11 (78.6)	6 (75.0)	24 (80.0)	32 (88.9)
Rough-legged hawk	Spring	–	–	–	–	–	1 (100.0)
Ferruginous hawk	Spring	–	–	1 (50.0)	–	–	–
	Fall	–	–	–	–	1 (100.0)	–
Swainson's hawk	Spring	–	3 (100.0)	1 (100.0)	–	2 (66.7)	–
	Summer	–	5 (83.3)	–	–	1 (100.0)	–
	Fall	–	–	1 (50.0)	–	1 (100.0)	–
Long-billed curlew	Spring	–	1 (100.0)	–	–	–	–
Loggerhead shrike	Summer	–	–	–	–	0 (0.0)	–
	Fall	–	–	0 (0.0)	–	–	–
Waterfowl	Spring	–	–	0 (0.0)	–	–	–
	Fall	–	1 (50.0)	–	1 (100.0)	–	1 (100.0)
Western bluebird	Spring	–	0 (0.0)	–	–	–	–
	Summer	–	–	1 (100.0)	–	–	–
	Fall	–	3 (75.0)	5 (71.4)	–	2 (66.7)	–
Unidentified raptor	Fall	–	–	1 (100.0)	–	–	1 (100.0)
Unidentified hawk	Spring	–	2 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)	1 (50.0)
	Fall	1 (100.0)	2 (100.0)	1 (100.0)	–	–	1 (100.0)

Table 4-7. Continued

Species	Season	Western Hills Study Unit 1	Eastern Hills Study Unit 2	Ridge Top Study Unit 3	Ridge Face Study Unit 4	Northern Plateau Study Unit 5	Control Area Study Unit 6
Unidentified accipiter	Spring	–	0 (0.0)	1 (100.0)	1 (50.0)	–	–
	Summer	–	–	2 (100.0)	–	–	–
	Fall	–	1 (50.0)	–	–	–	–
Unidentified large falcon	Spring	–	0 (0.0)	–	–	–	–
	Fall	–	–	–	–	2 (100.0)	2 (100.0)
Unidentified small falcon	Fall	–	–	1 (100.0)	–	–	–
Northern harrier	Spring	–	–	1 (100.0)	–	5 (50.0)	–
	Summer	1 (33.3)	–	–	–	1 (100.0)	–
	Fall	–	3 (75.0)	2 (50.0)	1 (100.0)	10 (62.5)	0 (0.0)
Osprey	Fall	–	–	0 (0.0)	–	–	–

Table 4-8. Columbia River Windfarm Project Percent of Observations with Birds at the Critical Altitude Traversing Different Habitat Types in Spring, Summer, and Fall

Species	Season	Open Grassland[a]	Shrub Steppe[b]	Conservation Reserve Program Lands[c]	Juniper/ Grassland[d]	Juniper/ Rock[e]	Rock[f]	Oak[g]	Oak-Pine[h]	Cropland[i]	Pasture[j]	Developed Areas	Water[k]
Golden eagle	Spring	–	3 (100.0)	–	1 (100.0)	1 (100.0)	–	1 (100.0)	–	–	1 (100.0)	–	–
	Summer	1 (100.0)	5 (83.3)	–	–	1 (100.0)	–	–	–	–	–	–	–
	Fall	2 (40.0)	4 (80.0)	–	–	1 (100.0)	3 (75.0)	1 (100.0)	–	0 (0.0)	–	–	–
Peregrine falcon	Spring	–	–	–	–	–	–	–	–	1 (100.0)	–	–	–
	Fall	–	–	–	–	–	–	–	–	1 (100.0)	–	–	–
Prairie falcon	Spring	1 (100.0)	3 (100.0)	–	1 (100.0)	–	–	–	–	–	–	–	–
	Summer	–	1 (100.0)	–	–	–	–	–	–	1 (100.0)	–	–	–
	Fall	7 (100.0)	–	–	–	–	–	–	–	0 (0.0)	0 (0.0)	–	–
American kestrel	Spring	1 (100.0)	10 (71.4)	–	2 (100.0)	–	4 (100.0)	2 (40.0)	1 (50.0)	3 (75.0)	0 (0.0)	0 (0.0)	–
	Summer	10 (90.9)	8 (100.0)	1 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)	–	–	2 (50.0)	1 (50.0)	–	–
	Fall	7 (70.0)	18 (85.7)	–	–	1 (100.0)	2 (100.0)	1 (100.0)	–	8 (88.9)	1 (100.0)	–	–
Turkey vulture	Spring	0 (0.0)	3 (75.0)	–	1 (100.0)	1 (100.0)	8 (100.0)	–	–	2 (100.0)	–	–	–
	Summer	–	2 (100.0)	1 (100.0)	–	–	6 (100.0)	–	–	–	–	–	–
	Fall	1 (50.0)	4 (100.0)	–	–	–	–	–	–	5 (100.0)	–	–	–
Northern goshawk	Fall	1 (100.0)	–	–	–	–	–	–	–	–	–	–	–
Cooper's hawk	Spring	–	1 (100.0)	–	–	–	–	–	–	–	1 (100.0)	–	–
	Summer	–	–	–	–	1 (100.0)	–	–	–	–	–	–	–
	Fall	1 (100.0)	–	–	–	–	1 (100.0)	–	–	–	–	–	–
Sharp-shinned hawk	Spring	–	2 (100.0)	–	–	–	–	1 (100.0)	–	–	–	–	–
	Summer	1 (100.0)	–	–	–	1 (100.0)	–	–	–	–	–	–	–
	Fall	2 (50.0)	10 (90.9)	–	–	1 (100.0)	0 (0.0)	–	–	4 (80.0)	1 (100.0)	–	–
Red-tailed hawk	Spring	–	8 (61.5)	–	3 (100.0)	–	8 (100.0)	2 (66.7)	1 (33.3)	14 (87.5)	3 (60.0)	–	–
	Summer	1 (100.0)	5 (83.3)	2 (100.0)	–	–	–	–	–	2 (66.7)	–	–	–
	Fall	29 (90.6)	13 (81.3)	–	1 (100.0)	0 (0.0)	9 (81.8)	2 (100.0)	2 (100.0)	23 (82.1)	3 (75.0)	–	–
Rough-legged hawk	Spring	–	1 (100.0)	–	–	–	–	–	–	–	–	–	–
Ferruginous hawk	Spring	–	1 (50.0)	–	–	–	–	–	–	–	–	–	–
	Fall	–	–	–	–	–	–	–	–	1 (100.0)	–	–	–
Swainson's hawk	Spring	–	–	–	–	–	–	–	–	3 (75.0)	3 (100.0)	–	–
	Summer	3 (75.0)	1 (100.0)	–	–	–	–	–	–	2 (100.0)	–	–	–
	Fall	–	–	–	0 (0.0)	–	–	1 (100.0)	–	1 (100.0)	–	–	–
Long-billed curlew	Spring	–	–	–	–	–	–	–	–	–	1 (100.0)	–	–
Loggerhead shrike	Summer	–	–	–	–	–	–	–	–	0 (0.0)	–	–	–
	Fall	–	0 (0.0)	–	–	–	–	–	–	–	–	–	–
Waterfowl	Spring	–	–	–	–	–	–	–	–	–	–	–	0 (0.0)
	Fall	1 (50.0)	1 (100.0)	–	–	–	–	–	–	–	–	–	1 (100.0)
Western bluebird	Spring	–	–	–	–	–	–	0 (0.0)	–	–	–	–	–
	Summer	–	–	–	–	–	–	–	–	–	1 (100.0)	–	–
	Fall	4 (100.0)	3 (50.0)	–	1 (100.0)	–	–	–	1 (100.0)	1 (50.0)	–	–	–
Unidentified raptor	Fall	1 (100.0)	1 (100.0)	–	–	–	–	–	–	–	–	–	–
Unidentified hawk	Spring	–	3 (100.0)	–	–	–	0 (0.0)	–	1 (100.0)	2 (100.0)	–	–	–

Table 4-8. Continued

Species	Season	Open Grassland[a]	Shrub Steppe[b]	Conservation Reserve Program Lands[c]	Juniper/ Grassland[d]	Juniper/ Rock[e]	Rock[f]	Oak[g]	Oak-Pine[h]	Cropland[i]	Pasture[j]	Developed Areas	Water[k]
	Fall	1 (100.0)	2 (100.0)	–	–	–	1 (100.0)	–	1 (10.0)	–	–	–	–
Unidentified accipiter	Spring	–	–	–	–	1 (50.0)	0 (0.0)	–	2 (100.0)	–	–	–	–
	Summer	–	1 (100.0)	–	–	–	–	–	–	–	–	–	–
	Fall	–	0 (0.0)	–	–	–	–	–	1 (100.0)	–	–	–	–
Unidentified large falcon	Spring	–	0 (0.0)	–	–	–	–	–	–	–	–	–	–
	Fall	1 (100.0)	1 (100.0)	–	–	–	–	–	–	1 (100.0)	–	–	1 (100.0)
Unidentified small falcon	Fall	–	1 (100.0)	–	–	–	–	–	–	–	–	–	–
Northern harrier	Spring	–	–	–	–	–	–	–	–	6 (54.5)	–	–	–
	Summer	0 (0.0)	1 (50.0)	–	–	–	–	–	–	1 (100.0)	–	–	–
	Fall	2 (66.7)	1 (33.3)	–	–	–	1 (100.0)	–	1 (100.0)	10 (58.8)	1 (50.0)	–	–
Osprey	Fall	–	0 (0.0)	–	–	–	–	–	–	–	–	–	–

Note: Habitat traversed: The surveyor will record the type of habitat that the observed bird traversed during the time of first detection within the established observation zone of 1 kilometer (0.62 mile).

[a] Areas dominated by grasses.

[b] Areas containing greater than 20% cover of shrubs, including sagebrush and rabbitbrush.

[c] Lands containing planted perennial grasses, such as crested wheatgrass.

[d] Areas containing dispersed juniper among a well-established grass groundcover.

[e] Areas containing juniper dispersed among basalt outcrops or talus.

[f] Areas dominated by basalt outcrops or talus.

[g] Areas dominated by oak.

[h] Areas containing a combination of oak and ponderosa pine.

[i] Areas under cultivation.

[j] Grass areas used as pasture in the northern portion of the study area.

[k] Such as Columbia River.

Study unit was marginally significantly associated with the probability of entering the critical altitude (p=0.057). This association probably resulted in large part because none of the eagles observed in study unit 2 (eastern hills) entered the critical altitude (Table 4-7) (three eagles were observed there). Fourteen sightings of golden eagles were within the critical altitude in study unit 4 (ridge face), four were in study unit 3 (ridge top), and four were within study unit 6 (control area).

There was no statistically significant association of habitat with probability of entering the critical altitude.

Prairie Falcon

Seasons. Prairie falcons entered the critical altitude during all observations in the spring and summer and during 70% of the observations in the fall (Table 4-6). The differences among seasons were not statistically significant.

Spring. No analyses were possible for spring because prairie falcons entered the critical altitude during all observations (i.e., they were not observed to vary with other factors).

Summer. No analyses were possible for summer because prairie falcons entered the critical altitude during all observations.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit was marginally significantly associated with the probability of entering the critical altitude (p=0.050). Five sightings of prairie falcons were in the critical altitude in study unit 6 (control area) and four were in the critical altitude in study unit 4 (ridge face).

Habitat was significantly associated with the probability of entering the critical altitude (p<0.001). All of the falcons traversing open grassland entered the critical altitude and none of those crossing cropland entered the critical altitude (Table 4-8). However, sample size for prairie falcon was so low that only tentative conclusions regarding statistical significance are possible.

American Kestrel

Seasons. American kestrels entered the critical altitude during 66% of observations in the spring and during about 85% of the observations in the summer and fall (Table 4-6). The difference among seasons was marginally significant (p=0.082).

Spring. The logistic regression indicated that cloud cover had a marginally significant effect on the probability of entering the critical altitude. The parameter estimates, standard errors, and probabilities of the regression model are:

Variable	Estimate	Standard Error	Probability
Intercept	-1.2635	0.4745	0.0078**
Cloud Cover	0.0269	0.0128	0.0360*

The regressions equation is:

$$\text{Logit}(p) = -1.2635 + 0.0269(\%\ \text{Cloud Cover}),$$

where p is the probability of <u>not</u> entering the critical altitude. The equation estimates the probability of not entering the critical altitude rather than the probability of entering the critical altitude simply because of the way in which the analysis was set up. The equation gives an 81% probability of not entering the critical habitat when cloud cover is 100% and a 22% probability of not entering the critical habitat when cloud cover is 0%.

Temperature and wind speed had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with the probability of entering the critical altitude.

Summer. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with probability of entering the critical altitude.

Fall. The logistic regression indicated that wind speed has a marginally significant effect on the probability of entering the critical altitude. The parameter estimates, standard errors, and probabilities of the regression model are:

Variable	Estimate	Standard Error	Probability
Intercept	-0.4156	0.6756	0.5385
Wind Speed	-0.2500	0.1302	0.0549*

The regressions equation is:

$$\text{Logit}(p) = -0.4156 - 0.2500(\text{Wind Speed}),$$

where p is the probability of not entering the critical altitude. The equation gives about a 0% probability of not entering the critical habitat when wind speed is 25 mph and a 40% probability of not entering the critical habitat when wind speed is 0 mph.

Temperature and cloud cover had no significant effect on the probability of entering the critical altitude.

Turkey Vulture

Seasons. Turkey vultures entered the critical altitude during nearly 90% of observations in the spring and during more than 90% of observations in the summer and fall (Table 4-6). The were no significant differences among seasons.

Spring. The logistic regression indicated that cloud cover had a marginally significant effect on the probability of entering the critical altitude. The parameter estimates, standard errors, and probabilities of the regression model are:

Variable	Estimate	Standard Error	Probability
Intercept	-3.4674	1.4147	0.0142*
Cloud Cover	0.0829	0.0494	0.0937*

The regressions equation is:

$$\text{Logit}(p) = -3.4674 + 0.0829(\%\ \text{Cloud Cover}),$$

where p is the probability of not entering the critical altitude. The equation gives a 99% probability of not entering the critical habitat when cloud cover is 100% and a 3% probability of not entering the critical habitat when cloud cover is 0%.

Temperature and wind speed had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with probability of entering the critical altitude.

Summer. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with probability of entering the critical altitude.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit was marginally significantly associated with the probability of entering the critical altitude (p=0.091).

There was no statistically significant association of habitat with probability of entering the critical altitude.

Sharp-Shinned Hawk

Seasons. Sharp-shinned hawks entered the critical altitude during all observations in the spring and summer and during 78% of the observations in the fall (Table 4-6). The differences among seasons were not statistically significant.

Spring. No analyses were possible for spring because sharp-shinned hawks entered the critical altitude during all observations.

Summer. No analyses were possible for summer because sharp-shinned hawks entered the critical altitude during all observations.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit was marginally significantly associated with the probability of entering the critical altitude (p=0.043).

Habitat was not significantly associated with the probability of entering the critical habitat.

Red-Tailed Hawk

Seasons. Red-tailed hawks entered the critical altitude during 76% of the observations in the spring and during about 84% of the observations in the summer and fall (Table 4-6). The differences among seasons were not statistically significant.

Spring. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit was marginally significantly associated with the probability of entering the critical altitude (p=0.085).

Habitat was not significantly associated with the probability of entering the critical habitat.

Summer. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit and habitat were not significantly associated with the probability of entering the critical habitat.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit and habitat were not significantly associated with the probability of entering the critical habitat.

Northern Harrier

Seasons. Northern harriers entered the critical altitude during between 50% and 60% of observations in all three seasons (Table 4-6). The were no significant differences among seasons.

Spring. The logistic regression indicated that cloud cover had a marginally significant effect on the probability of entering the critical altitude. The parameter estimates, standard errors, and probabilities of the regression model are:

Variable	Estimate	Standard Error	Probability
Intercept	-2.1935	1.2169	0.0715*
Cloud Cover	0.0988	0.0599	0.0991*

The regressions equation is:

$$\text{Logit}(p) = -2.1935 + 0.0988(\%\ \text{Cloud Cover}),$$

where p is the probability of <u>not</u> entering the critical altitude. The equation gives about a 100% probability of not entering the critical habitat when cloud cover is 100% and a 10% probability of not entering the critical habitat when cloud cover is 0%.

Temperature and wind speed had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with probability of entering the critical altitude.

Summer. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit or habitat with probability of entering the critical altitude.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

There was no statistically significant association of study unit of habitat with probability of entering the critical altitude.

Western Bluebird

Seasons. Of the 2 western blue birds sighted during the spring and summer, none entered the critical altitude. During the fall, western blue birds entered the critical altitude during 71% of the observations (Table 4-6). The differences among seasons were not statistically significant.

Spring. No analyses were possible for spring because western blue birds did not enter the critical altitude during any observation.

Summer. No analyses were possible for summer because western blue birds entered the critical altitude during all observations.

Fall. The logistic regression analysis was not significant, indicating that temperature, wind speed, and cloud cover had no significant effect on the probability of entering the critical altitude.

Study unit and habitat were not significantly associated with the probability of entering the critical altitude.

Conclusion

The above results indicate that, in general, the continuous and nominal variables selected for analysis have little or no effect on the probability that birds in the primary study area will occur within the critical altitude. Few statistically significant relationships were obtained. In some cases, marginally significant results were obtained for certain species for study unit, habitat, cloud cover, wind speed, and season. But on the whole, it appears that site factors do not contribute significantly to overall flight behavior.

The general behavior and flight characteristics of a species will determine its likelihood for occurring within the critical altitude and its susceptibility to collision with wind turbines. For example, the foraging behavior, flight characteristics, and perching behavior of red-tailed hawks and American kestrels make them more susceptible to collision mortality than other species. Both often hunt from perches or from a low flight of between 9 to 46 meters (30 and 150 feet) from the ground, and pursue prey from a direct stoop. Both species have been found to use lattice tower type turbines located in California as perch sites and aggressively pursue prey within the critical altitude (BioSystems Analysis 1992). In contrast, turkey vultures do not hunt from a perch and do not typically pursue prey. Instead, they search for prey from a slow, soaring flight. So, although they also may spend a large portion of their active day within the critical altitude, their behavior probably makes them less susceptible to collision.

The low, gliding foraging behavior of golden eagles may also contribute to their susceptibility. Golden eagles often hunt along the slopes of ridges, crossing to the opposite side of the ridge in a swift motion to surprise prey. This movement, and the attention focused on prey capture, may contribute to golden eagle susceptibility.

4.3 SPRING BREEDING/NESTING STUDY

Figure 4-23 illustrates the raptor nest sites found during the spring nesting study.

4.3.1 Results by Species

Peregrine Falcon

A pair of apparently nonbreeding peregrine falcons was observed on four occasions at the Rock Creek area located outside of primary study area boundary. This area is located about 8.0 kilometers (5 miles) east of the KENETECH project site and 19.3 kilometers (12 miles) east of the CARES site.

The peregrine falcon pair near Rock Creek did not appear to be nesting because both the male and female were observed perching during a long rainstorm in May, when the young would have been downy and vulnerable to rain. Had they been nesting, the female would have been at the nest during this rainstorm. In addition, helicopter searches of this area located no active peregrine falcon nest sites.

The pair may have attempted to nest near Rock Creek but failed. The eggs or young might have died or been eaten by predators, such as foxes, coyotes, or great horned owls. The two falcons were together each time they were observed, indicating a strong pair bond. Such a bond usually develops as part of breeding, even if breeding attempts fail. Because this pair was repeatedly located at the mouth of Rock Creek, the area may be a center of activity and a nesting area may be located within 3.2 kilometers (2 miles) of Rock Creek. The term center of activity is defined as an area of regular occurrence. Such areas are sometimes used for management purposes in the absence of a known nest site.

The most typical peregrine falcon nesting habitat is located across the river on the Oregon side of the Columbia River. Although no peregrine falcon nest sites were found during searches of this area, some empty stick nests were found that were the size and type used by prairie and peregrine falcons. However, such empty stick nests are common in the area, and the ones found across the river do not strongly suggest that peregrine falcons are nesting there. They only support the possibility that they could nest in this area.

Single peregrine falcons were observed twice flying near Hoctor Road. These birds could be the same birds observed at Rock Creek. These sightings lead to the preliminary conclusion that the eastern portion of the KENETECH site may be occasionally used by the pair of peregrine falcons as part of a much larger foraging range. Based on habitat conditions, this foraging area could include portions of the Rock Creek canyon and cliffs along both sides of the Columbia River starting about 3.2 kilometers (2 miles) east of the project sites.

Golden and Bald Eagles

No bald eagle nests were found on the KENETECH or CARES project sites during the breeding field surveys.

A historically recorded golden eagle nest site, located on the steep hills above the Columbia Aluminum Plant, was confirmed by field biologists during this study. The nest site is located within 1.6 kilometers (1 mile) of turbine strings proposed to be built on the KENETECH site. The nest is located on a rock ledge up a narrow gap in the ridge face. In previous years, the nest was located in a dead ponderosa pine, but winds apparently damaged this nest over the winter and the pair used the alternate nest site on the cliff face.

A second golden eagle nest site was also confirmed at Miller Island, located about 14.5 kilometers (9 miles) from the CARES site and 11.3 kilometers (7 miles) from the western edge of the KENETECH site.

A third historical golden eagle nest site in the Rock Creek drainage was vacant during the helicopter survey.

Swainson's Hawk

Two Swainson's hawk nests were located within the primary study area: one near Hoctor Road and another downslope from Goodnoe Hills. The site near Goodnoe Hills is very near turbine string locations being considered by KENETECH, while the other site is over 1.6 kilometers (1 mile) away from any proposed turbine string locations of either the KENETECH or CARES projects.

Prairie Falcons

One prairie falcon nest site was found in the primary study area south of the KENETECH and CARES project areas on cliffs above SR 14. Another prairie falcon nest site has been reported by the Washington Department of Fish and Wildlife near the golden eagle nest site (upslope from the Columbia Aluminum Plant). This nest was not located during the breeding survey, which included specific searches for this nest.

Red-Tailed Hawks

Red-tailed hawks are the most common large raptor to nest in the KENETECH and CARES project areas (see Figure 4-39). Ten of the 19 nest sites found in the primary study area for both projects were those of red-tailed hawks. Red-tailed hawks nest mostly within the pine/oak woodland draws north of the ridge line.

Of the 10 nest sites found, eight are within 1.6 kilometers (1 mile) of proposed turbine string locations of the KENETECH project. Of these eight, three are also within 1.6 kilometers (1 mile) of the CARES project.

Northern Harrier

Two suspected northern harrier nest sites were found during the field surveys. While the specific nest locations were not visually confirmed, they are likely to be within 1.6 kilometers (1 mile) of the location identified in Figure 4-39. Because northern harriers are very secretive about their nesting sites, other undiscovered nests may be present in the study area. Suspected nesting areas were identified as areas where adult males were regularly observed during the breeding survey.

Turkey Vulture

Turkey vultures were commonly observed during the breeding survey, but no nest sites were located. A communal roost was found near Maryhill State Park about 6.4 kilometers (4 miles) southwest of the KENETECH project site and about 8.0 kilometers (5 miles) southwest of the CARES project site. Turkey vultures travel far during foraging,

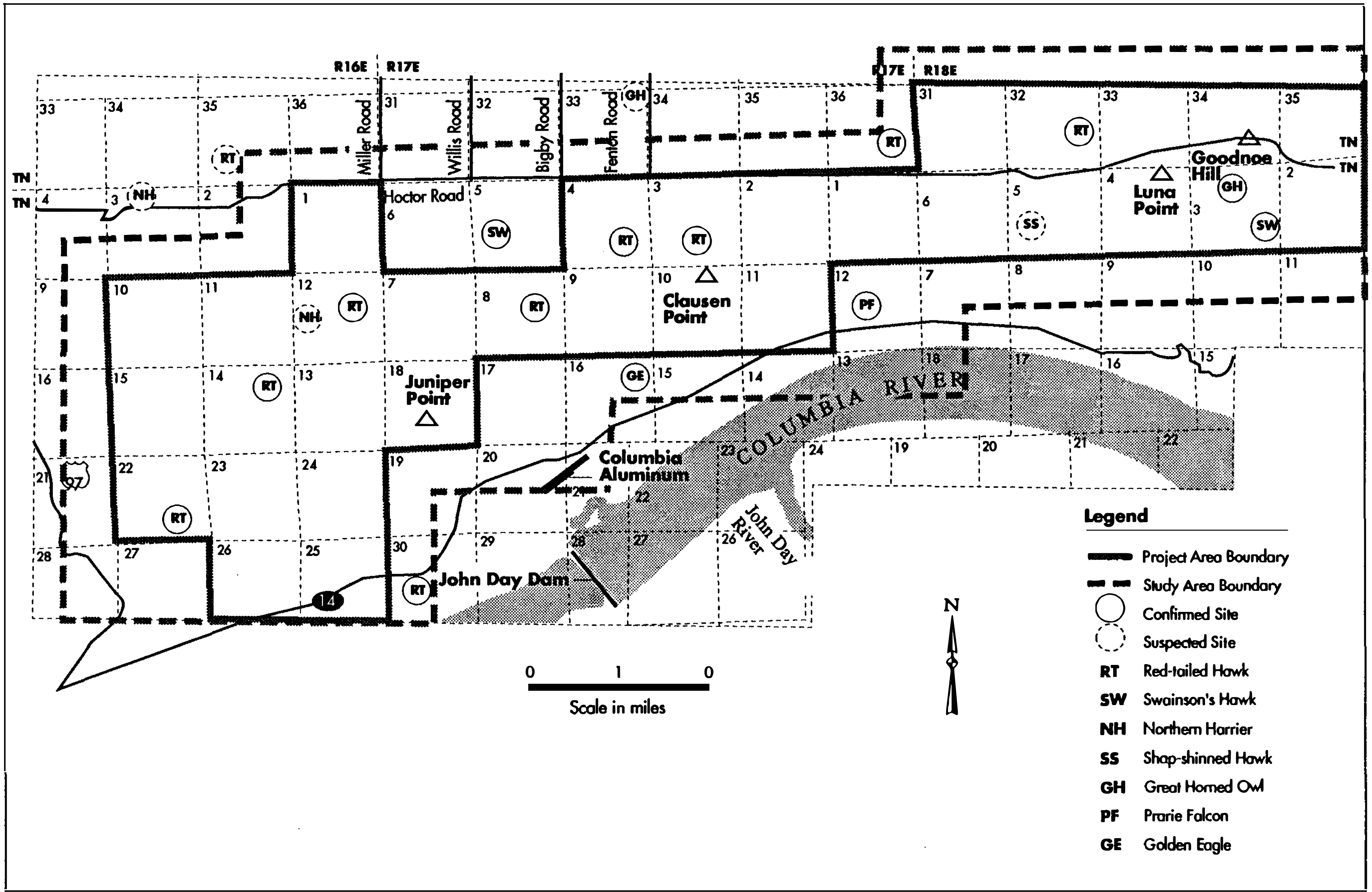

Figure 4-39. Raptor Nesting Locations within Primary Study

and individuals that roost in this area are likely to use both project sites as part of their much larger foraging territories.

American Kestrel

American kestrels are one of the most common raptors in the study area for the KENETECH and CARES projects. Suitable nesting habitat occurs throughout the area. Open areas adjacent to the pine/oak woodlands contain the most typical nesting habitat.

Accipiters (Sharp-Shinned and Cooper's Hawks)

Based on habitat conditions, sharp-shinned hawks may be present at low densities within pine/oak woodlands. A sharp-shinned hawk was observed only once during the breeding season, and no sharp-shinned or Cooper's hawks responded to played tape recordings of their calls. However, accipiter nests are notoriously difficult to find. Because the pine/oak habitat is apparently suitable for sharp-shinned hawks, they likely nest within this habitat at moderate to low densities.

Bluebirds

Mountain bluebirds were observed to migrate through the study area and a few remained to nest. Several flocks of 4 to 12 mountain bluebirds were observed during late March through the early part of May, but they were not found after May 13. The nesting season typically begins in April. This species likely nests in oak/pine woodlands.

Western bluebirds also nest in and near the study area. Western bluebirds were detected during the conducting of incidental surveys in most of the oak/pine woodlands.

Additional Non-Raptor Species Observed

A list of additional nonraptor species observed during the breeding surveys is provided in Table 4-9.

Other Special-Status Species Not Found to Nest within the Study Area

The following species were either absent from the study area or were present at very low densities:

- **Ferruginous Hawks.** Habitat is not typical of that used by ferruginous hawks for nesting. In general, the species typically occurs in more level terrain. The study area is south and west of areas supporting known nesting pairs. In addition,

Table 4-9. Nonraptor Species Observed During Breeding Surveys

Common Name	Scientific Name
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
Ash-throated flycatcher	*Myiarchus cinerascens*
Barn swallow	*Hirundo rustica*
Black-chinned hummingbird	*Archilochus alexandri*
Black-headed grosbeak	*Pheucticus melanocephalus*
Brewer's blackbird	*Euphagus cyanocephalus*
Brewer's sparrow	*Spizella breweri*
Brown-headed cowbird	*Molothrus ater*
California quail	*Callipepla california*
Chipping sparrow	*Spizella passerina*
Chukar	*Alectoris chukar*
Clark's nutcracker	*Nucifraga columbiana*
Cliff swallow	*Hirundo pyrrhonota*
Common nighthawk	*Chordeiles minor*
Common raven	*Corvus corax*
Dark-eyed junco	*Junco hyemalis*
Dusky flycatcher	*Empidonax oberholseri*
European starling	*Sturnus vulgaris*
Hairy woodpecker	*Picoides villosus*
Horned lark	*Eremophila alpestris*
House finch	*Carpodacus mexicanus*
House wren	*Troglodytes aedon*
Lark sparrow	*Chondestes grammacus*
Lazuli bunting	*Passerina amoena*
Lewis' woodpecker	*Melanerpes lewis*
Mourning dove	*Zenaida macroura*
Northern flicker	*Colaptes auratus*
Northern oriole	*Icterus galbula*
Red-breasted nuthatch	*Sitta canadensis*
Rock dove	*Columba livia*
Rufous-sided towhee	*Pipilo erythrophthalmus*
Say's phoebe	*Sayornis saya*
Townsend's solitaire	*Myadestes townsendi*
Townsend's warbler	*Dendroica townsendi*
Tree swallow	*Tachycineta bicolor*
Vaux's swift	*Chaetura vauxi*
Violet-green swallow	*Tachycineta thalassina*
Western bluebird	*Sialia mexicana*
Western kingbird	*Tyrannus verticalis*

Table 4-9. Continued

Common Name	Scientific Name
Western meadowlark	*Sturnella neglecta*
Western tanager	*Piranga ludoviciana*
Western wood-pewee	*Contopus sordidulus*
White-breasted nuthatch	*Sitta carolinensis*
White-crowned sparrow	*Zonotrichia leucophrys*
Yellow-rumped warbler	*Dendroica coronata*
Vesper sparrow	*Pooecetes gramineus*

these birds build very large stick nests, and no stick nests that were found contained ferruginous hawks.

- **Burrowing Owl.** Habitat is potentially suitable for breeding. However, burrowing owls were not detected in over 12 days (18 full staff days) of field surveys.

- **Long-Billed Curlew.** Habitat is potentially suitable for long-billed curlew at both the KENETECH and CARES sites. While no nests were found, one or two pairs might breed in the area and foraging adults could occur within the study area.

- **Loggerhead Shrike.** Loggerhead shrike were occasionally observed throughout the study area. While no nest sites were observed, this species is assumed to nest along the edge of oak woodlands and in riparian habitat along drainages.

- **Black Tern.** Neither site contains habitat suitable for black tern nesting.

- **Western Sage Grouse.** No sage grouse were observed during field surveys at the site.

4.3.2 Summary

The level of breeding raptors within the greater study area is not particularly dense or otherwise unique. The KENETECH and CARES project sites do support healthy populations of nesting red-tailed hawks, American kestrels, and prairie falcons, but these populations are typical for rangeland in eastern Washington.

Section 5. Environmental Consequences and Mitigation

Section 5. Environmental Consequences and Mitigation

This section assesses potential impacts and recommends mitigation measures independently for each project. An overview of the results of avian mortality studies at existing wind farms is also provided for general comparative purposes.

5.1 IMPACT MECHANISMS

Impacts on avian resources from construction and operation of the proposed KENETECH and CARES projects would result primarily from: (1) direct habitat removal caused by installation of wind turbines, access roads, and other appurtenant (accessory) facilities, (2) avian avoidance of the project sites from increased human presence, presence of turbines, or reduction in prey, and (3) avian mortality from collision with wind turbines or electric transmission lines, and from electrocution on electric transmission lines. Impact mechanisms are divided into construction impacts and operational impacts.

5.1.1 Construction Impacts

Construction impacts are those which would result from construction of towers, roads, and accessory facilities, including:

- loss of habitat affecting seasonal and resident avian populations and migratory birds;
- impacts on special-status species, including direct mortality and loss of breeding sites or essential habitat; and
- effects of construction-related disturbance (e.g., construction, traffic, noise, etc.) on birds, including special-status nesting birds such as peregrine falcons, bald eagles, and Swainson's hawks.

5.1.2 Operational Impacts

Operational impacts are those which result from the presence and operation of wind turbine generators and overhead power lines. Operational impacts could include:

- mortality from collision with wind turbine towers and blades, guy wires, or overhead power line wires, and electrocution from power lines;
- direct habitat loss due to project facilities; and
- indirect loss of habitat from avoidance of project site habitats due to human activity, etc.

This section assesses the effects of these potential impacts on breeding, wintering, resident, and migrating populations of raptors, waterfowl, and other birds.

5.2 OVERVIEW OF AVIAN MORTALITY STUDIES AT EXISTING WIND FARMS

Early studies of wind energy-related avian mortality focused on nocturnal migration of non-raptorial birds (McCrary et al. 1983; McCrary et al. 1984; Byrne 1983) or mortality associated with single or small numbers of wind turbines (Karlsson 1983; Moller and Poulsen 1984; Winkelman 1985). These studies identified occurrences of mortality and some possible causal factors and established a baseline of information for future large-scale studies.

Virtually all of the existing information on avian mortality from multiple turbine sites, or wind farms, is from wind resource areas (WRAs) in California. Overall, studies have estimated raptor mortality at wind farms in California to range from 1.7 to 5.8 raptors per 100 turbines per year (KENETECH Windpower 1994). The following is a summary of existing information from studies conducted in the San Gorgonio Pass WRA, Altamont Pass WRA, and the Solano WRA in California.

5.2.1 San Gorgonio Pass WRA

McCrary et al. (1986) conducted the first wind resource area-wide study to determine the extent of avian mortality in the San Gorgonio WRA in southern California. The San Gorgonio Pass was found to be an important migration corridor for passerine i.e., song birds) birds. However, raptors were not abundant in the area, particularly relative to the raptor populations in other WRAs in California (BioSystems Analysis, Inc. 1992). Thus, the San Gorgonio Pass study focused on the mortality of migrant passerine birds.

Of 38 bird mortalities found during the study conducted by Southern California Edison Company (McCrary et al. 1983, 1984, 1986), most were passerines or waterfowl/shorebirds and only one was a raptor. With over 4,000 turbines in the San Gorgonio Pass WRA, it was estimated that as many as 6,800 birds could be killed each year from collision with wind turbines. Southern California Edison considered this mortality to be insignificant when compared to the large numbers of migrants (estimated 69 million birds) passing through the area each year.

5.2.2 Altamont Pass WRA

The Altamont Pass WRA contains over 7,000 wind turbines, making it the largest wind generating facility in the world. In 1988-1989, Howell and DiDonato (1991) conducted a single-year (surveyed every other week for one full year) study assessing bird use and mortality related to wind turbine operations at two selected study sites in the Altamont Pass WRA. This study focused on mortality from collision with turbines. A total of 42 bird mortalities, including 17 raptors, was identified at the 359 turbines surveyed. Multiple mortalities tended to occur at swales and at the shoulders of hills. No relationships were found between mortality and other siting factors.

In 1989, BioSystems Analysis began a 2-year study of wind turbine effects on avian activity, habitat use, and mortality in the Altamont Pass WRA (BioSystems Analysis 1992). Over six survey seasons, 182 dead birds were recovered, including 119 (65%) raptors. Collision with turbines accounted for 55% of the mortality, 11% from collision with wires, 8% from electrocution on power lines, and 26% from unknown causes. Site factors appearing to affect mortality included location of the turbine (e.g., mortality was greater with end-row turbines than in-row turbines); topographical differences (e.g., mortality was higher near canyons than away from canyons); and tower type (e.g., mortality was higher at lattice towers than other tower types). There were no consistent seasonal or weather-related trends.

The data suggested that some species were more susceptible to collision with wind turbines due to species-specific flight characteristics and foraging behavior. Red-tailed hawks, American kestrels, and golden eagles appeared to be most susceptible. Estimates of annual mortality (with 69% attributed to collision with wind turbines) ranged from 164 to 403 birds, including 39 golden eagles.

5.2.3 Solano WRA

The Montezuma Hills is within the Solano WRA, northeast of San Francisco Bay. Studies in the Montezuma Hills focused on raptor, waterfowl, and passerine mortality at the U.S. Windpower facility (Howell and Noone 1992). Postproject monitoring surveys at the 600-turbine facility have measured a mortality rate of 0.0176 raptors per turbine for the

1990-1991 monitoring year, and a mortality rate of 0.0478 raptors per turbine for the 1991-1992 monitoring year (Howell and Noone 1992). This results in an average of 0.0327 raptor mortalities per turbine per year for the two study years. (Due to the fluctuation of bird populations in the area, much statistical variation is expected. This average is indicative of the mortality rate, which will continue to fluctuate.) Howell and Noone (1992) extrapolated the estimated per turbine mortality to the entire U.S. Windpower facility and estimated that 11 raptor mortalities occurred in the 1990-1991 study year and 29 raptor mortalities occurred in the 1991-1992 monitoring year.

One waterfowl mortality (a mallard) was reported for the 4 years of operation of the U.S. Windpower facility. This low mortality may have been due in part to wind turbines operating less in winter months, when migratory waterfowl passed through the area, than they operated during the summer months. Most waterfowl using the area apparently used flight corridors that went around the Montezuma Hills rather than through them. It was also reasoned that wind turbines operated less in the winter months, when migratory waterfowl passed through the area, and that flights that crossed the project area were typically far above the heights of the turbines.

Passerine mortality was also low. For the 1990-1991 monitoring year at the Montezuma Hills Wind Park, 0.011 passerine mortalities per turbine were recorded. For the 1991-1992 monitoring year, 0.026 passerine mortalities per turbine were recorded. This represented an average of 12 mortalities per year for the entire 600-wind-turbine facility.

Howell et al. (1991) collected data on bird sightings before and after construction of the Solano WRA facility. Preconstruction and postconstruction surveys indicated a decline in total bird sightings between the 1987-1988 and 1990-1991 seasons (Howell et al. 1991). Although species composition remained relatively stable, the numbers of raptor sightings and waterfowl flocks declined during that period. However, because the decline began occurring before construction of wind turbines, Howell et al. (1991) reasoned that the decline was likely a result of other ecological factors, such as drought, rather than the presence of wind turbines.

Also, although overall raptor sightings declined, sightings of golden eagles increased over the survey period, sightings of turkey vultures remained unchanged, and the number of active raptor nests in the study area increased. Over the survey period, habitat use patterns in the study area also remained unchanged, and only the overall numbers of birds decreased, indicating that there were reasons other than the presence of wind turbines for the decline in avian activity in the area.

5.2.4 General Conclusions from Past Studies

Past studies have suggested that certain species were more vulnerable to collision based on their behavior and flight characteristics (BioSystems Analysis 1992). Red-tailed hawks, golden eagles, and American kestrels, for example, appear to be particularly susceptible to collision. This may be because they spend more time flying below the tops of turbines and because they pounce on their prey from above.

Results of past studies have also suggested a possible difference in mortality potential based on turbine or tower type. Lattice towers, for example, may make certain species of raptors more susceptible to collision because they provide attractive perch sites. Red-tailed hawks, golden eagles, and American kestrels regularly perch on artificial structures, such as lattice-type towers. Thus, they spend greater amounts of time within the "danger zone" than other species. Certain turbine types, such as those with vertically oriented blades, may also be less of a mortality hazard than horizontal turbines (BioSystems Analysis 1992).

Past and ongoing mortality studies in the Altamont Pass and Montezuma Hills WRAs have provided some basis for estimating avian mortality from collisions with wind turbines and ancillary facilities, and they may be useful in predicting estimated mortality ranges in some areas. While the Altamont study has provided insight into the complex interactions of birds with wind facilities, it also revealed the variability that exists at each wind turbine site.

Recent studies of bird mortalities at wind energy facilities built in similar habitats (Montezuma Hills WRA and Tehachapi WRA, CA) with similar species present have not reported comparable mortality rates (Colson and Associates 1994; Howell and Noone 1992). At the Altamont WRA, BioSystems Analysis (1992) found 182 dead birds, of which 116 (65%) were raptors. At the Montezuma Hills, Howell and Noone (1992) surveyed 39.5% of the wind energy facility and reported 22 dead birds, of which 11 (50%) were raptors. Assuming a comparable mortality for the entire facility, the estimated total mortality at Montezuma would be 56 birds (28 raptors). Avian mortality at Tehachapi WRA included no dead raptors during 1991 studies, and 9 raptors during a previous 3-year period.

In general, the lack of correlative data and comparative analysis is a substantial variable affecting the use of other mortality studies to draw conclusions about potential impacts on the KENETECH and CARES project sites. In 1992, an Avian Research Task Force was established to oversee a research program focusing on the interaction of birds with wind turbines and, in part, to define means to establish methodologies to collect and analyze comparable data. The focus of the research was to: (1) develop and implement siting procedures designed to identify and resolve potential environmental conflicts, (2) develop mitigation to offset avian losses, and (3) develop research-based modifications to wind turbines (KENETECH 1994).

5.3 KENETECH PROJECT

5.3.1 Construction-Related Impacts

Direct Habitat Loss

Implementation of the proposed KENETECH project would result in the temporary disturbance of 155 hectares (382 acres) of rangeland, shrubland, and agricultural habitats from the installation of 345 wind turbine generators, meteorological towers, transformers, access roads, and a substation. Of that acreage, 79 hectares (193 acres) of habitat would be permanently occupied by facilities (i.e., towers, a substation, etc.), although some habitat would remain in the area occupied by the overhead power line. The remaining temporarily disturbed acreage would be restored and reseeded.

The permanent loss of 79 hectares (193 acres) of rangeland, shrubland, and agricultural habitat would not substantially affect resident or migratory avian populations on the project site because these habitats are common on the site and in the greater study area. This is not considered a significant impact of the project.

Special-Status Species. The permanent loss of 79 hectares (193 acres) of rangeland, shrubland, and agricultural habitat would affect nesting or foraging habitat of special-status species that occur in the greater study area (Tables 2-2 and 2-3). The removal of 79 hectares (193 acres) would represent an incremental loss of foraging habitat within the range of the federally listed peregrine falcon. This loss would not be significant because the primary prey (e.g., passerine birds and waterfowl) for the peregrine would not be affected by the habitat loss (see further impact discussion under **Collision with Wind Turbines** section).

The impact to bald eagles would include potential disturbance to and alteration of a night roost located in Section 5 by access road construction and construction of turbine strings Y and Z (see Figures 2-2 and 4-2). Removal of trees and associated shrubs in the grove of trees could make the site less attractive to the eagles, causing them to relocate to alternative sites such as north of Hoctor Road or to the woodland in Section 8 near Juniper Point (see further impact discussion under **Collision with Wind Turbines** section).

The impact on state listed sensitive species (Table 2-3) that forage in agricultural lands and grasslands habitat would be minimal because those habitats are common throughout the project site and the greater study area, and loss from implementation of the KENETECH project is considered negligible relative to available habitat in the greater study area. Also, none of these habitats are considered critical to the existence of special-status species on the project site.

Construction in grasslands and agricultural areas could affect nesting species such as the grasshopper sparrow and burrowing owl.

Construction in oak and pine woodlands could affect foraging and/or nesting habitat for several species, including the Lewis' woodpecker, western bluebird, gray flycatcher, and Swainson's hawk.

Construction-Related Disturbance

Construction-related disturbances include noise, dust, and vehicle traffic. Most raptors would avoid active construction sites, but would continue to use other areas. Some species are sensitive to disturbance and could abandon breeding sites if the disturbance exceeds levels of tolerance. If conducted during the breeding season, construction activities at turbine strings A, E, PP, N, and Q would disrupt red-tailed hawk nesting activities and construction at turbine string NN could disrupt a Swainson's hawk nesting site.

5.3.2 Operational Impacts

Indirect Habitat Loss

The presence of wind turbines may change the landscape such that avian habitat use patterns are altered, thereby displacing certain birds from the wind farm project site (Jones & Stokes Associates 1987). Habitat suitability for birds could be reduced by creating obstacles (i.e., towers and moving blades) to raptor foraging flight paths along ridge lines, by influencing the flight paths of waterfowl as they fly over the KENETECH wind farm, or by affecting prey populations from changing land uses or land management within the project site. Increased onsite human activity could also displace or discourage birds from using the KENETECH site.

Changes in Avian Use Patterns. Implementation of the KENETECH project could result in some changes in avian use patterns. However, there is no evidence to suggest that the presence of wind turbine structures, per se, would substantially affect overall breeding or foraging use of the KENETECH project site. The study by Howell et al. (1991) suggests that the presence of wind turbines does not affect overall avian use patterns.

Increased Human Activity Levels. Only small increases in postconstruction human activity are expected for the KENETECH project. Wind turbines require regular, but relatively infrequent, maintenance. The small crew required to maintain 345 turbines is not sufficient to result in disturbance effects on nesting or foraging birds, or to discourage avian use of the KENETECH project site.

Decreased Avian Use from Reduction in Prey Populations. Prey populations may decrease as a result of the permanent loss of 79 hectares (8,193 acres) of rangeland, shrubland, and agricultural habitats. The loss of this habitat may be partially offset by increased visibility of prey to raptors. Orloff and Flannery (1992) suggest that roads in the Altamont and Tehachapi WRAs have provided friable (i.e., loose soil) dirt berms easily excavated by burrowing ground squirrels and increased the visibility of prey to raptors. Although quantitative data have not been gathered, grazing, farming, and other land use practices have remained largely unchanged in that area since the installation of wind turbines.

Existing land use practices are not anticipated to change with or without the proposed action. The effect of any prey reductions on raptor populations, from the installation of wind turbines and appurtenant facilities, is not possible to predict because of insufficient information and data on the subject. While BioSystems Analysis (1992) surmised that there may be a threshold of prey abundance, they did not have sufficient data to draw conclusions.

Electrocution

Electrocution of birds on electrical power lines occurs when a bird touches two energized lines simultaneously or a ground wire and an energized conductor. Because of their larger wing spans, raptors such as golden eagles and red-tailed hawks are more prone to electrocution mortality. In their study of the Altamont Pass WRA, BioSystems Analysis (1992) attributed 11% of the avian mortality and 25% of the golden eagle mortality in the Altamont wind farm area to electrocution. Electrocution of raptors has been the second most reported cause of bird mortalities in some western wind energy facilities (Colson and Associates 1994).

KENETECH has identified a number of avian protection measures as part of the proposed action, including:

- reducing the potential for collision and electrocution by locating power lines underground where they run along turbine strings,

- reducing the potential for electrocution by designing the 34.5-kV power line with raptor protection measures. Raptor protection measures would be designed in accordance with "Suggested Practices for Raptor Protection on Power Lines" (Edison Electric Institute 1975) and may include: (1) using wood, rather than metal blades on crossarms, (2) spacing energized wires at least 60 inches apart, (3) providing insulated jumper wires, (4) lowering the crossarm at least 38 inches below the top of the pole, (5) providing protective equipment (i.e., lightening arrestors and power cutouts) on a secondary crossarm at least 48 inches below the crossarm that supports the power lines, and (6) covering all exposed terminals with avian boots or other insulating materials.

Most of these measures were initially recommended by Olendorff et al. (1981) and have become standard practice for new power line construction where the potential for raptor electrocution is identified as a project impact. Implementation of these measures would effectively reduce raptor mortality from electrocution below significant levels.

Waterfowl. Waterfowl are not susceptible to electrocution because they do not typically perch on utility poles or power lines. Therefore, the potential for electrocution at the KENETECH project site would not affect resident or migratory waterfowl.

Passerines and Other Birds. As a group, passerines and bird groups other than those previously mentioned, are not susceptible to electrocution by power lines because of their size and behavior. Smaller birds cannot span energized conductors, making electrocution less likely. Most other bird groups do not typically use power poles as perch sites. Mortality to passerines and other birds is not likely to be a significant impact of the KENETECH project.

Collision with Overhead Power Line Wires

Generally, collision with overhead power line wires and guy wires is not a major source of raptor mortality (Olendorff and Lehman 1986). BioSystems Analysis (1992) attributed 9% of the mortality at Altamont to collision with overhead wires. Most of the reported mortality was nonraptor birds. Shorebirds, ducks, geese, cranes, and other waterbirds are most prone to collision with overhead wires (e.g., utility wires and guy wires), primarily in low-visibility conditions (Arend 1970, Anderson 1978, Avery et al. 1978, Brown et al. 1985, Fannes 1987). No mitigation is required.

Although there would be overhead power lines, no guy wires would be used by the KENETECH project.

Raptors. Although many individual instances of raptor collisions with utility wires have been reported (CEC in preparation), as a group raptors are not particularly susceptible to such collisions. Keen eyesight and maneuverability allow most raptor species to avoid wires and other objects. In addition, most raptors do not tend to fly during inclement weather, when collisions would most likely occur. However, the possibility of raptor mortality from collision with KENETECH project power lines exists and would be expected to occur at some low level.

Although there would be mortality to individual birds from collisions with overhead power line wires, this mortality would not adversely affect local, regional, or state populations. Some "standard practices" to minimize the chance of mortality are presented in the mitigation section.

Waterfowl. Surveys conducted on the KENETECH project site and the greater study area suggested that while resident and migratory waterfowl were common along the Columbia and John Day Rivers, they were not abundant on the KENETECH site. Limited wetland habitat exists in or around the project site to support breeding or wintering waterfowl, and no defined migratory movement corridors were identified during surveys. Therefore, although the potential for waterfowl collisions with overhead power lines exists on the KENETECH project site, particularly during inclement weather, it would be unlikely to have a substantial effect on resident breeding or migratory populations.

Passerines and Other Birds. Several types of birds are susceptible to collision with overhead wires (CEC in preparation). Most of these are species that fly during fog or other inclement weather, such as shorebirds, cranes, some passerine species, and large migratory groups or large flocks (Walkinshaw 1956, Scott 1972, Fannes 1987).

One sandhill crane was observed within the survey radius during the spring through fall surveys and one migratory flock was observed outside of the survey radius during the spring. This suggests that the species occurred on the KENETECH project site infrequently and in low numbers. Although sandhill cranes are susceptible to colliding with overhead power lines in low-visibility conditions, the potential on the KENETECH project site is low.

The results of the field studies suggest that the KENETECH project site and greater study area are not an important migratory corridor and that large flocks of birds do not travel through, forage in, or otherwise use the area. Therefore, although mortality from collision with overhead power lines is expected to occur among certain species at some low level, it is not expected to substantially affect breeding or migrating populations.

Collision with Wind Turbines

The potential frequency of avian collisions with wind turbines (and other above-ground structures) depends primarily on the species' abundance, flight heights, the amount of activity that occurs under different visibility conditions, and the extent to which species modify their behavior to avoid turbines or other structures (Jones & Stokes Associates 1987).

Raptors. Based on the avian mortality experienced at California wind farms, development of wind turbines at the KENETECH site would result in avian mortality. Although conditions at California wind farms differ in many ways from the proposed KENETECH project, the California projects can provide a general indication about the expected magnitude of mortality. Based on the range of mortality estimates for wind farms in California (1.7 to 5.8 raptors per 100 turbines per year), mortality resulting from the 345 turbines proposed for the KENETECH project could range from 6 to 20 raptors a year (KENETECH Windpower 1994). Areas reporting lower mortality rates were not in known major migratory corridors and, similarly, the Columbia Hills area is not in a major migratory corridor. However, mortality rates differ widely between project sites and exact numbers cannot be predicted based on mortality studies in California. The above figure is intended only to provide a general order of magnitude estimate of what could be expected based on the best available information.

The degree of mortality potential for each species depends primarily on the frequency of occurrence on the KENETECH project site in general, the frequency of occurrence on specific sites proposed for wind turbine development, and behavior and flight characteristics. Some species occur infrequently on the KENETECH site and do not exhibit characteristics that make them susceptible to collision, including northern goshawk, Cooper's hawk, and osprey. These species also are not typically found in habitat types existing on the

KENETECH project site. Therefore, occurrences are likely to be of birds passing through the site, further reducing their potential for collision. A low number of collision mortalities is expected for these species in terms of: (1) the actual number of individual mortalities that would be expected and (2) the relation between numbers lost and local and regional population levels. For the purpose of this assessment, local populations are defined as those occurring within the immediate vicinity of the project sites. Unless otherwise noted, regional populations are defined as those occurring in eastern Washington.

Certain design features of the KENETECH project could reduce mortality potential for some species. Lattice towers are thought to contribute to mortality of red-tailed hawks in the Altamont Pass WRA. The use of tubular towers instead of lattice towers would eliminate opportunities for perching. Several species that occur on the KENETECH project site (i.e., red-tailed hawks, rough-legged hawks, ferruginous hawks, Swainson's hawks, and American kestrels) would likely have been attracted to the perch sites created by lattice towers if they had been used.

Peregrine Falcon. Peregrine falcons occur in the greater study area in low numbers. Two sightings of peregrine falcon were made during field surveys on the project site. These birds were observed for a total of 7 minutes and could have been members of one breeding pair, migrants, or nonbreeding individuals. No peregrine falcons were observed during the winter study.

Both sightings of peregrine falcons were made in the northern plateau study unit, an area not planned for turbine development by KENETECH. These sightings were probably birds traveling through the area between foraging habitats. Both birds were also observed within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

The pair of peregrine falcon that frequents Rock Creek, located about 8 kilometers (5 miles) east of the KENETECH project site, is within foraging distance from the KENETECH project site (typically 16 kilometers [10 miles]). While peregrine falcons are most likely to occur near the Columbia River, they are also known to forage in upland areas north of the river (Anderson pers. comm. 1994).

Should a peregrine falcon strike a turbine on the KENETECH site, the loss could measurably reduce populations within the Columbia River Gorge management unit. Currently, up to 7 known pairs occur within the Columbia River Gorge (not including the pair found to frequent Rock Creek located 8 kilometers [5 miles] east of the project site). The USFWS goal for peregrine falcons in the recovery plan was to reestablish at least 3 nesting pairs within the management unit that includes the Columbia River Gorge. Therefore, even with potential mortality at the KENETECH site, it is reasonable to assume that this goal could still be met within the management unit because this goal is currently being met outside of the project site.

An indirect effect of the KENETECH project would be a reduction of habitat suitability for the breeding of peregrine falcon within the eastern portion of the species' current distribution within the Columbia River Gorge. All known nesting sites within the Gorge are west of the project site.

Peregrine falcons are present in the project area and the project is likely to affect peregrine falcons because the KENETECH project would: (1) pose a risk of peregrine falcon mortality through collision with a wind turbine and (2) may reduce the habitat suitability of a portion of the Columbia River Gorge management unit (this management unit is not designated critical habitat). Although the likelihood of collision is relatively low based on the relatively few individuals in the area, the potential for mortality remains and a peregrine mortality could measurably reduce the Columbia River Gorge management unit population. However, the population would likely remain viable.

Bald Eagle. A small bald eagle wintering population occurs along the Columbia River in the vicinity of the KENETECH project site between November and March of any given winter. During the winter raptor study, 3 to 10 individuals were observed at any one time. Based upon this study, it was estimated that a maximum of 20 bald eagles winter in the vicinity of the project site during years of peak use. Winter observations of bald eagles on the KENETECH project site, however, indicated that they might be vulnerable to collision mortality.

Data collected by Dames & Moore during the winter of 1993-1994 indicated that bald eagles and golden eagles were the most common species to fly along the slopes of the Columbia River Gorge. Several winter observations of bald eagles crossing the Columbia Hills ridge were made during this study. These observations were of eagles flying from the river northward across the ridge top and ridge face study units, and in two instances into the eastern hills study unit. Birds could also be searching for carrion and hunting for chukar partridge within areas proposed for turbine development.

Three day-roost sites were located in the vicinity of the project site, along the Columbia River. Three night-roosts also were found during the winter study. One of these night-roosts was confirmed and another was suspected to exist (based upon flight activity) within the eastern hills study unit of the KENETECH site, a site proposed for turbine development.

Bald eagles cross areas proposed for turbine development on their way to and from night roosting areas. The greatest number of such crossings were associated with proposed wind turbine sites located on the eastern portion of the project site, where bald eagle night roosting was identified in Section 5 during January and December 1994 field surveys. Turbine strings that bald eagles would encounter on their way to and from the Section 5 night-roost would include strings Z, Y, AA, BB, and CC. Construction activity at strings Z and Y may cause bald eagles to abandon that roost site and, therefore, reduce their vulnerability to collision at that site. However, bald eagles would likely continue to cross the ridge to an additional roosting site at Luna Gulch. During the winter field studies, between 2 and 4 bald eagles were found to roost at Luna Gulch.

Although the federal threatened status of bald eagle indicates regional concern for populations levels, the effect of the KENETECH project is considered to be limited to the species abundance in the vicinity of the project site because: (1) the species has greatly recovered from previously low population levels and is at or near recovery goals established by the USFWS and (2) Klickitat County supports relatively few wintering bald eagles in relation to state populations. Therefore, within a regional context, the anticipated project effects on bald eagles would not pose a significant decline in regional breeding or wintering populations of bald eagles. Within a local context, the local wintering population could be adversely affected either through direct mortality or through disturbance in foraging and night roost areas.

Bald eagles are present in the project area and the project is likely to affect bald eagles because of: (1) the risk of bald eagle mortality through collision with a wind turbine, (2) the potential abandonment of bald eagle night roost sites from developing strings Z and Y nearby, and (3) the additional effect of developing strings AA, BB, and CC in areas that would disturb their flight paths to and from their night roosts.

Golden Eagle. Golden eagles were observed in low to moderate levels. A total of 37 sightings were made for a total of 90 minutes during 32 observations over the spring through fall studies. It was estimated that a total of approximately four juveniles and three adults were using the project site.

Golden eagles were observed in all study units on the KENETECH project site, although a greater number were observed in the ridge face study unit than all other study units. Most of the ridge face study unit is not proposed for turbine development by KENETECH. There is, however, occasional but regular use of the western hills, eastern hills, and ridge top study units, each of which is proposed for turbine development by KENETECH. Nearly 80% of golden eagle observations during this study were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

One active golden eagle nest was located in the vicinity of the project site. The nest site was approximately 1.6 kilometers (1 mile) from a proposed KENETECH turbine location. Another nest was located in the greater study area on Miller Island, 11.3 kilometers (7 miles) from the western edge of the site.

The behavior and flight characteristics of golden eagles make them more susceptible to collision with wind turbines than most other species of raptor. Although it is difficult to make direct comparisons between wind projects, golden eagle mortalities in Altamont Pass (BioSystems Analysis 1992) were the third greatest of all raptor species. Golden eagle mortality is expected from development of the KENETECH project because of: (1) the vulnerability of golden eagles to collision and (2) their presence in study units proposed for turbine development.

Because golden eagles breed at low densities, and only one is known to exist near the project site, mortality could also affect the local breeding population. However, the golden eagle population in Washington has been estimated to be 80 breeding pairs (Rodrick and

Milner 1991), so the KENETECH project is not expected to significantly affect the species viability within the context of the state-wide population.

Turkey Vulture. Turkey vultures are known to collide with wind turbines in the Altamont Pass WRA, although in low numbers relative to their occurrence in the area (BioSystems Analysis 1992). Because turkey vultures fly slowly and methodically, they are probably not particularly susceptible to collision. Turkey vultures were moderately common on the KENETECH project site. A total of 59 sightings were made for a total of 125 minutes during 37 observations over the spring through fall studies. Turkey vultures were not observed during the winter study because they leave the area during that period.

As expected, the turkey vultures were primarily seen in the updrafts of the ridge face study unit. Lower levels of use were observed for all study units proposed for turbine development. These areas are used primarily for foraging by turkey vultures, by slowly circling in search of carrion. They would approach KENETECH turbines during these slow flights toward the ground. Over 90% of turkey vulture observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

No nests were found on the site during the breeding survey. However, a communal nest was observed near Maryhill State Park about 6.4 kilometers (4 miles) southwest of the site.

Because several of the above listed factors indicate that mortality would be moderate to low in relation to abundance of turkey vultures on the site and the greater study area, predicted mortality may cause a moderate reduction in local breeding populations. However, reductions would not eliminate the local breeding population or significantly affect the regional population.

Sharp-Shinned Hawk. A total of 32 sightings of sharp-shinned hawks were made for a total of 39 minutes during 28 observations over the spring through fall studies. No sharp-shinned hawks were observed during the winter study. Sharp-shinned hawks were observed in moderate levels in all study units, including those proposed for turbine development by KENETECH.

Total duration of observations in this study indicated that most sharp-shinned hawks were moving through the overall area, rather than roosting or foraging. This type of flight pattern would reduce the potential for collision. However, over 80% of sharp-shinned hawk observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

One possible nest was located approximately 0.4 kilometer (0.25 mile) from the nearest proposed KENETECH turbine location. This species does not nest and does not usually forage in open habitats typical of turbine development sites.

A low level of mortality is possible from collision with KENETECH wind turbines because the species: (1) occurs at moderate levels on the project site, (2) occurs within study units proposed for development by KENETECH, and (3) is typically within the critical altitude.

Red-Tailed Hawk. The behavior and flight characteristics of red-tailed hawks make them more susceptible to collision with wind turbines than most other species of raptor. In addition, red-tailed hawks typically nest and forage in open habitats typical of wind farm lands, perch on a variety of structures including lattice towers, and pursue prey from an aerial stoop (a behavior suspected to contribute to avian mortality). Although direct comparisons between wind projects are difficult to make, because red-tailed hawks in Altamont Pass (BioSystems Analysis 1992) had the greatest mortalities of all species, mortality is likely to also occur on the KENETECH site.

A total of 186 sightings of red-tailed hawks were made for a total of 728 minutes during 160 observations over the spring through fall studies. Red-tailed hawks were also the most commonly observed species in the winter period. Although there were some seasonal and study unit differences in occurrence, red-tailed hawks were common in all study units. During the winter, observations were centered somewhat more around the oak/pine woodlands and were often seen perched on power lines along Hoctor Road. Over 80% of red-tailed hawk observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

The red-tailed hawk was the most commonly observed breeding raptor in the study area, with 10 active nest sites (of the 18 total nests found for all species during the breeding raptor study) found in the greater study area. Of these 10 sites, eight were located within 1.6 kilometers (1 mile) of proposed KENETECH turbine locations.

A high level of mortality is expected, relative to other species, because of: (1) the vulnerability of red-tailed hawks to collisions with wind turbines, (2) the species is common in study units proposed for turbine development by KENETECH, and (3) the percentage of the local population that might be affected. Design features of the KENETECH project could, however, lower the level of mortality of red-tailed hawks compared to that found at existing wind farms. Studies in the Altamont WRA suggest that lattice towers may contribute to red-tailed hawk mortality. Fewer mortalities were recorded from turbines having tubular towers (BioSystems Analysis 1992). Because KENETECH proposes to use a tubular tower design, mortality of red-tailed hawks is expected to be lower than would be expected if lattice towers were used.

Local breeding populations of red-tailed hawks are likely to be reduced by both direct mortality of nesting adults as well as potentially higher mortality of young birds just leaving the nest. Juvenile birds have been found to be more vulnerable to collisions than are adult birds. At the county and state level, red-tailed hawks are abundant and mortality at the KENETECH site would not significantly affect the regional population.

Swainson's Hawk. Like the red-tailed hawk, the Swainson's hawk also nests and forages in open habitats, uses a variety of perches, and pursues prey by diving from a perch or soaring flight. Thus, it is also considered to be more susceptible to collision than most other species of birds. There are no available data on Swainson's hawk mortality from collision with wind turbines, however, because existing sites in California are not within the range of Swainson's hawks.

During this study, a low to moderate number of Swainson's hawk sightings were noted. A total of 18 sightings of Swainson's hawks were made for a total of 60 minutes during 17 observations over the spring through fall studies. Swainson's hawks are the only hawk to completely migrate from the project site and greater study area, so none were observed during the winter study period.

The greatest levels of activity in the eastern hills study unit of the KENETECH project site. All observations were in the eastern hills, ridge top, and northern plateau study units. Over 80% of observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

Two active nest sites were found in the vicinity of the project site, in the greater study area. One site, located downslope near Goodnoe Hills, was within 0.4 kilometer (0.25 mile) of the nearest proposed KENETECH turbine location. The second site was located near Hoctor Road, 1.6 kilometers (1 mile) from proposed turbine string locations on the KENETECH site.

Because Swainson's hawks are susceptible to collision with wind turbines, and because they occur within study units proposed for turbine development by KENETECH, mortalities are expected to occur. Because the species occurs in low levels on the project site, the actual number of mortalities is expected to be low, but the local breeding population could be measurably reduced by collision mortality. Thus, mortality from the KENETECH project would likely have a local impact but would not be expected to affect regional Swainson's hawk populations. In Washington, 228 Swainson's hawk territories were documented between 1977 and 1986 (Harlow and Bloom 1989).

As with the red-tailed hawk, the potential for mortality is less than that found at existing sites because tubular towers would be used in place of lattice-type towers, effectively reducing the potential for perching on the towers.

Rough-Legged Hawk. The rough-legged hawk is similar to the red-tailed hawk and Swainson's hawk in its behavior, flight characteristics, and use of open foraging habitats. Rough-legged hawks typically pursue prey from a perch, circling flight, or hovering flight from 15 to 60 meters (50 to 200 feet) above the ground. In addition, the species is relatively abundant in the area during winter. Thus, the potential for any one individual rough-legged hawk to collide with KENETECH wind turbines is also high relative to the potential for some other species.

During the spring through fall surveys, a single sighting of 50 seconds was made of a rough-legged hawk during the spring (confirming that they are wintering populations), within the critical altitude. Rough-legged hawks were found to occur regularly on the KENETECH project site during the winter. They were observed most often within the northern plateau study unit but were observed in other study units. Potential rough-legged hawk winter habitats occurred primarily in the southernmost portion of western hills and in the northern plateau study units of the KENETECH project site.

The level of mortality expected for rough-legged hawks would likely be sufficient to cause a local reduction in wintering populations. The effect on breeding populations would be more dispersed than for locally breeding species, because rough-legged hawks disperse widely to breeding grounds in the arctic. Rough-legged hawks are a relatively common wintering species that would not be significantly affected at the regional population level.

Ferruginous Hawk. Ferruginous hawks are known to collide with wind turbines in other areas (BioSystems Analysis 1992). However, the ferruginous hawk occurs infrequently on the KENETECH project site. Only three sightings were made during all surveys for a total of 6 minutes, two in the spring and one in the fall. Both spring sightings of ferruginous hawks were within the ridge top study unit, a site proposed for turbine development by KENETECH. Also, two of the three sightings (67%) were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

A single ferruginous hawk was observed during the winter study. This hawk was observed in the ridge top study unit.

There is a potential for ferruginous hawk mortality from the KENETECH project. However, because this hawk occurs on the project site in low levels, the potential for collision is relatively small and would not be expected to adversely affect regional populations.

Northern Harrier. The northern harrier also nests and forages in open habitats. No mortality data are available for northern harriers. However, its low, gliding foraging behavior reduces the potential for collision with KENETECH wind turbines. A total of 45 sightings northern harriers were made for a total of 54 minutes during 42 observations over the spring through fall studies.

On the project site, harriers were observed primarily in the western hills and in the northern plateau study units, with few observations in all other study units. During summer surveys, nearly all observations were in the western hills study unit. During spring, fall, and winter surveys, nearly all observations were in the northern plateau study unit. About 60% of northern harrier observations made on the project site were within the critical altitude (7.5 to 58 meters [25 to 190 feet]). Although a substantial number of northern harrier observations were within the critical altitude, this was the lowest proportion for all raptor species observed.

Two suspected northern harrier nest sites were found in the northern plateau study unit during the breeding field study. The potential for northern harrier mortality exists because: (1) northern harrier were found to be common in the western hills study unit (an area proposed for turbine development by KENETECH), (2) harriers regularly use the open habitats common in proposed turbine sites, and (3) harriers were observed often within the critical altitude. This potential is reduced to some extent, however, because the flight behavior of northern harriers puts them at a lesser risk of collision than most other species regularly occurring on the site. Northern harrier mortality is expected to reduce local but not regional population levels.

Prairie Falcon. Prairie falcons are not particularly susceptible to collision with wind turbines because of their behavior and flight characteristics. Their swift flight and maneuverability, compared to buteos and eagles, aids in their ability to avoid objects.

A total of 17 sightings of prairie falcons were made for a total of 67 minutes over the spring through fall studies. In addition, prairie falcons were also observed regularly during the winter survey.

Most prairie falcon activity in the greater study area occurs in typical nesting, roosting, and foraging areas along the cliffs of the Columbia River. During the winter study, several observations were made along Hoctor Road in the northern plateau area and along SR 14 within and south of the ridge face unit. Some activity does occur, however, in all study units of the KENETECH project site. Because this species forages in several types of habitat, foraging is believed to occur in all habitats on the KENETECH project site. Over 80% (14) of all observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

One prairie falcon nest was found south of the KENETECH project site, on cliffs above SR 14. Another prairie falcon nest site was reported by the WDFW to be near the golden eagle nest site upslope of the Columbia Aluminum Plant. However, this nest was not located during the nesting study.

The potential for mortality of individual prairie falcons is considered low because of their behavior and flight characteristics. Mortalities are expected to occur, however, because: (1) the species occurs in study units proposed for turbine development by KENETECH and (2) it flies within the critical altitude. Prairie falcon mortality is expected to reduce local but not regional population levels.

American Kestrel. American kestrels are more likely to collide with wind turbines because they nest and forage in open habitats typical of wind farm lands, perch on a variety of structures, pursue prey from stooping flights, and occur frequently at low to moderate altitudes. In the Altamont WRA study, it was also second only to red-tailed hawks in the number of mortalities from collision with wind turbines.

The American kestrel is second only to red-tailed hawks in the number of observations made during surveys. A total of 125 sightings of American kestrels were made for a total of 214 minutes during 110 observations over the spring through fall studies. In addition, American kestrels were also observed during the winter survey.

Kestrels also occurred frequently in all study units proposed for turbine development by KENETECH. During this study, approximately 80% of American kestrel observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

American kestrels were common on the project site and suitable nesting habitat occurs throughout the site. Open areas adjacent to the pine/oak woodlands contain the most typical nesting habitat.

A high degree of mortality of individual American kestrels is expected, relative to other species, from project development because they: (1) commonly occurred in proposed KENETECH turbine development sites and (2) are known to collided with wind turbines more frequently than other species. American kestrel mortality is expected to reduce local but not regional population levels.

Waterfowl. Surveys conducted in the greater study area suggest that while resident and migratory waterfowl are common along the Columbia and John Day Rivers, they are not abundant on the KENETECH site. While concerns have been raised regarding the potential for waterfowl to cross the ridge on the site on their way to and from feeding areas, the observations made during field surveys determined that this did not occur with any regular frequency. A total of 48 sightings of waterfowl were made for a total of 21 minutes during 5 observations (i.e., in five flocks) over the spring through fall studies. Three flocks were observed during the first winter study and none were observed during the second.

The wintering population of ducks and geese has been estimated to be about 6,000 (Annear in Dames & Moore 1993). Road counts conducted along the Columbia River for the winter study found no concentrations greater than 200 birds. Most observations were of small groups of 10 to 15 individuals. Canada geese were the most frequently observed species, and flocks averaging 20 to 50 individuals were seen to fly up and down the Columbia River corridor. American coots were the second most common species observed, with observations also made of redhead, common goldeneye, Barrow's goldeneye, ring-necked duck, hooded merganser, bufflehead, mallard, and scaup.

Limited wetland habitat exists in or around the KENETECH project site to support breeding or wintering waterfowl, and no defined migratory movement corridors were identified during surveys. Therefore, the potential for waterfowl mortality from collision with wind turbines on the KENETECH project site is not considered significant.

Other Special-Status Birds. In general,non-raptor special-status birds are not as vulnerable to collisions with wind turbines because: (1) they do not display the flight behaviors that are believed to contribute to avian mortality and (2) mortalities at California projects are low relative to their abundance in the area.

Western bluebirds, a state candidate species, were observed to migrate through the KENETECH site and also breed on and near the site. Site observations were not at a level that would suggest that the entire county population moves throughout the project site during migration. In addition, it would be highly unusual for birds to follow such a defined migration route. Western bluebirds are believed to move through the county in a relatively broad front which includes the project site. For example, bluebirds have been observed in other locations in Klickitat County such as Lyle, 35 kilometers (21 miles) west of the project site (Wahl and Paulson 1991). The project is expected to cause a local reduction in populations of this species. The project could also affect migrants that breed offsite but pass through the project site. However, the project effects on western bluebirds are not likely to be regional in context because: (1) as a passerine, they are less likely to be vulnerable to collisions than are raptors and (2) they are expected to move through other areas besides the KENETECH site. Therefore, while the project could result in some local and migrant mortality of western bluebirds, the project does not pose a significant risk to the viability of western bluebird populations in Klickitat County.

Lewis's woodpecker, a state candidate species, are relatively common near oak woodlands and typically fly below the critical altitude. Although some mortality may occur, the project is not likely to significantly alter regional populations.

The other non-raptor special-status species that could potentially use or fly of over the project site were determined to be present in such low numbers (in relation to their numbers in commonly known use areas off the project site) that they were generally not considered to be of special concern on the KENETECH project site. Four of these species (i.e., long-billed curlew, loggerhead shrike, sandhill crane, and ash-throated flycatcher) were infrequently observed on the site. The number of these species observed was sufficiently low to conclude that the project would not pose a significant risk to their local or regional distribution.

Five species (i.e., western sage grouse, gray flycatcher, grasshopper sparrow, bank swallow, and sage sparrow) were not observed on the project site. Although these species may be present in small numbers or occasionally pass through the site as part of their natural movements, because there were no observations of them it was determined that the project site did not provide habitat that was important for the local or regional abundance or distribution of these species.

Other Birds. The common raven, black-billed magpie, and the northern flicker are commonly occurring birds that were observed to fly within the critical altitude in locations proposed for wind turbine. Of these species, the common raven is most likely to have significant mortality because its flight behavior is similar to the red-tailed hawk, a species known to be more vulnerable to collisions with wind turbines than most other species. In addition, common raven are known to collide with turbines on wind farms located in California.

Black-billed magpie and northern flicker do not fly like red-tailed hawks and have not been reported to be prone to colliding with wind turbines. Nevertheless, because of their abundance on the project site and their tendency to fly within critical altitudes, some mortality may occur for these species as well. Because these species are common in the region, project-related mortality would be localized and would not significantly affect regional population levels.

The western meadowlark, Brewer's blackbird, horned lark, and the Townsend's solitaire are also common species that are generally found in grassland habitats typical of those existing on the project site. These species typically occur below the critical altitude of wind turbines. Swallows, which are also common on the site, may be more vulnerable to mortality because they fly rather erratically within critical altitudes.

Other birds are expected to migrate through the site, but in numbers similar to other areas in the county. The oak and oak/pine woodlands were observed to be used by several types of birds during migration. Similar use is expected to occur in other woodland areas in Klickitat County, including the Rock Creek area located east of the project site and the Klickitat River area located west of the project site.

During surveys of the KENETECH project site, the total number of sightings and the total number of observations were greatest for passerines. This was as expected, because passerines are much more commonly present than the larger raptors. A total of 6,443 sightings of various passerines were made during 317 observations over the spring through fall studies. Species observed to migrate through the area included the house finch, American robin, American goldfinch, dark-eyed junco, and white-crowned sparrow. In addition, several types of warblers were observed to stop within oak and oak/pine woodlands present on and near the project site.

The KENETECH project would not result in a significant regional decline in other passerine species. This conclusion is based on: (1) the expected low vulnerability of migratory passerines to collisions with wind turbines and (2) the determination that the KENETECH site is not within a major regional migratory flyway. The expected low vulnerability is based on the following considerations:

- Results from the Altamont Pass WRA indicated that passerine mortality was low relative to passerine numbers in the project area (BioSystems Analysis 1992).

- Migrating passerines typically fly at altitudes well above the highest point of wind turbines (Bellrose in Alerstam 1990). Using the flight altitude patterns described by Alerstam (1990), birds would be vulnerable to collisions only during landing and take offs.

- Passerines are suspected to be less vulnerable to collision with wind turbines than are raptors because passerines do not typically pursue prey in a manner that places them at risk of colliding with wind turbines.

The site was determined not to be a major migratory flyway for passerines because of the following:

- Site surveys, which included dawn and dusk observations during spring and fall, identified no large concentrations of passerines. Birds were migrating through the site, but they did not do so in a defined pattern. Instead, migrating passerines and other birds appeared to move through the KENETECH site in a dispersed, broad front. While flocks of robins, western bluebirds, mountain bluebirds, and house finch were regularly observed, they were present in scattered groups composed of 10 to 30 individuals, rather than in larger flocks or in larger gatherings of groups.

- Migratory use of the project site is likely similar or lower than other areas of the greater study area and region that have more shrub and woodland areas, such as the Rock Creek and Klickitat River areas.

- Major migratory flyways are typically well known and present along north-south topographic features. No known major migratory flyways have been reported on the project site and the site is on a ridge oriented east-west, rather than north-south.

- Predominant westerly winds create a wind-shear near the ground that is typically avoided by migrating birds (Alerstam 1990).

Thus, while mortality of passerines and other birds from collision with KENETECH wind turbines is expected to occur at proposed turbine locations, losses are not expected to be sufficient to significantly affect regional breeding, wintering, or migrating populations.

Summary and Conclusions

Collision with wind turbines was determined to have the most potential for significant impacts on raptors and other non-raptor, non-special status birds. Based on the avian mortality experienced at California wind farms, development of wind turbines at the KENETECH site would result in avian mortality.

Certain design features of the KENETECH project could reduce mortality potential for some species. Lattice towers are thought to contribute to mortality of red-tailed hawks in the Altamont Pass WRA. The use of tubular towers by KENETECH, instead of lattice towers, would eliminate opportunities for perching. Several species that occur on the KENETECH project site (i.e., red-tailed hawks, rough-legged hawks, ferruginous hawks, Swainson's hawks, and American kestrels) would be attracted to the perch sites created by lattice towers, if used on the site.

Because of differences in behavior and abundance, different bird species would experience different levels of mortality in terms of intensity (i.e., actual number of bird mortalities) and in terms of context (i.e., number of bird mortalities relative to local and regional populations). Because the peregrine falcon, a federal endangered species, and the bald eagle, a threatened species, were found to use areas were KENETECH wind turbines would be located, the project could result in mortality to these species. Because of this potential mortality, the KENETECH project may affect peregrine falcons and bald eagles, BPA should initiate formal consultation with the USFWS under Section 7 of the Endangered Species Act.

Peregrine falcons were observed on the KENETECH project site, and one pair of peregrine falcons likely includes the site within its home range. The pair was observed to frequent the Rock Creek area, located approximately 8 kilometers (5 miles) from the eastern edge of the KENETECH site. Peregrine falcons are known to travel widely and often fly up to 10 miles from their nesting areas. The KENETECH site is located on the eastern edge of the peregrine falcon's current range in the Columbia River Gorge. There are up to seven pairs of peregrine falcons in the gorge area, not including the pair found near Rock Creek. Thus, although the likelihood of collision is low based on the relatively few individuals in the area, the potential for mortality remains and a peregrine mortality could measurably reduce the Columbia River Gorge peregrine population. However, it is not expected to affect the viability of the population in the gorge.

Bald eagles were observed to fly within areas proposed for wind turbine placement. Bald eagles traveling at dawn and dusk to and from night roosting areas were observed crossing the eastern portion of the site. Turbine strings Z, Y, AA, BB, and CC could be approached by bald eagles on their way to and from these night roosts. Construction activity at strings Z and Y may cause bald eagles to abandon a nearby roost site and, therefore, reduce their long-term vulnerability to collision. However, they would likely continue to cross the ridge to access Luna Gulch and area north of the KENETECH site where between 2 and 4 bald eagles were determined to roost during winter field studies.

Although bald eagles do not typically dive or fly erratically in pursuit of prey, a behavior believed to contribute to collisions, they were observed to fly at altitudes that would put them at risk of colliding with wind turbines and some mortality could occur. Between 3 and 10 bald eagles were estimated to use the project site over the 1993-1994 winter. This number may increase to as many as 20 bald eagles in some years.

When viewed from a regional perspective, impacts on wintering bald eagles would be localized and would not likely affect overall populations in eastern Washington. Klickitat County provides only a small percent of bald eagle winter populations in Washington. In addition, the species has greatly recovered from previously low population levels, and the regional population is stable or increasing. Therefore, within a regional context, the project's effects on bald eagles would not pose a significant decline in regional breeding or wintering populations.

Some raptors are common in the area and display behaviors that make them more vulnerable to collisions than some other birds. Raptors that would have the greatest mortality, but low levels relative to their regional populations, include the red-tailed hawk, American kestrel, turkey vultures, and rough-legged hawk. In the case of the red-tailed hawk and American kestrel, which are year-around residents, local breeding populations would be reduced. However, these reductions would not affect the regional distribution or abundance of the species because they are so common. Turkey vultures were moderately common during the spring through fall and would experience moderate to low mortality, but would not affect local populations. In the case of the rough-legged hawks, which only winter on the project site, local wintering populations would be reduced. However, the losses on breeding populations would be more dispersed because these birds migrate from many different breeding areas. As with the red-tailed hawk and American kestrel, mortality levels of rough-legged hawks would not significantly affect their regional distribution or abundance.

Other raptors are less common in the area, but still display behaviors that make them more vulnerable to collisions than some other birds. Species that would have low overall mortality levels, but high levels relative to local populations, include the golden eagle and Swainson's hawk. Collision mortality could affect the low local breeding populations of these species. However, mortality would not be sufficient to affect the regional distribution or abundance of these species because of the size of the regional populations.

The results of the spring through fall study indicate that wind turbines on the KENETECH project site would create a mortality hazard for certain species of raptors. It is difficult to estimate, with any degree of confidence with data from existing sites, raptor mortality from implementation of the KENETECH project. Site conditions, raptor use and composition, and proposed project design features differ sufficiently from existing wind farm sites to make comparisons unreliable. Thus, mortality estimates from existing wind farms are useful only in making general comparisons.

Two measures of mortality can be used to determine impacts, a comparison of mortalities based upon the duration of observations and the overall mortality levels relative to the number of turbines. Based upon a time comparison of observations from the Altamont WRA (1.26 raptors per 10-minute visit over 6 seasons) and the Solano WRA (1.11 raptors per 10-minute visit over 4 seasons), raptor occurrence on the KENETECH project site (1.21 raptors per 20-minute visit) was relatively low. Based solely on the overall levels of raptor use of the KENETECH project site compared with existing sites, the potential for raptor mortality is expected to be lower.

In addition, per turbine mortality rates were estimated from postproject monitoring surveys at the U.S. Windpower facility in the Solano WRA (Howell and Noone 1992). The average estimated mortality for the two study years was 0.0327 raptors per turbine. Because of the fewer raptors using the KENETECH project site, mortality is also expected to be lower if the project is developed.

Other features of the KENETECH project may result in greater mortality levels, and should be considered as another unit of measuring bird mortalities, when compared with other existing wind farms. For example, the turbine blades of the 33M-VS wind turbines proposed by KENETECH, and thus the blade-swept area, are larger than the turbines used in the Solano WRA analyzed by Howell and Noone (1992). Although there are no supportive data, it is possible that there is a correlation between blade-swept area and raptor mortality. If so, bird mortalities could also be measured relative to blade-swept area to standardize analyses.

In conclusion, mortality of peregrine falcons, bald eagles, golden eagles, red-tailed hawks, and Swainson's hawks from implementation of the KENETECH project could affect local populations of these species. Mortality is expected to occur with several other species (i.e., turkey vulture); however, overall population levels of these species should not be affected.

5.3.3 Mitigation

Construction-Related Disturbance

The Applicant's proposal includes a number of measures to reduce the potential for avian mortality, including raptor-protection measures on project overhead power lines, use of tubular rather than lattice towers, eliminating guy wires from the design, and minimizing the amount of habitat that would be occupied by project features. In addition to the mitigation measures proposed by the Applicant, the following measures could reduce the potential for impacts to birds caused by construction activity:

- Avoid construction activities within 400 meters (1,300 feet) of bald eagle roosts during November through March.

- Avoid construction activity within 400 meters (1,300 feet) of red-tailed hawk nests from April through July.

Electrocution

The following measures proposed by KENETECH, when implemented, will reduce the level of potential electrocution mortality on the KENETECH project. Most of these measures were initially recommended by Olendorff et al. (1981) and have become standard practice for new utility construction where the potential for raptor electrocution is identified as a project impact.

- All jumper wires should be insulated (5 kV minimum rating and preferably 10 kV to 15 kV).

- All exposed terminals (e.g., pot heads, lightning arresters, and transformer bushings) should be covered by avian boots or other insulating materials.

- Nonconductive material (e.g., fiberglass and wood) should be used instead of the straight, aluminum-type combination arms on riser poles.

- All overhead power line construction should incorporate raptor protection for wood pole distribution lines.

- Energized wires should be placed a safe distance apart: 60 inches for a crossarm configuration and 55 inches for an armless configuration.

- No cutouts should be used on riser poles.

- Jumper leads should be oriented in a vertical configuration to discourage bird perching.

- Bonding of pole top devices mounted on nonconductive arms should be done with insulated wire.

Collision with Overhead Power Line Wires

The following measures, if implemented, would reduce the potential for avian collision with power line wires:

- A minimum conductor wire size of 4/0 should be used to increase the visibility of the wire.

- Above-ground power line wires should not be sited near wetlands or other waterfowl feeding or resting habitat.

Collision with Wind Turbines

Although studies are currently being conducted to determine the underlying causes and circumstances of avian collisions with wind turbines, there are currently no known scientifically supportable measures to entirely prevent some incidental avian mortality. Post-construction monitoring of avian impacts may be considered by USFWS and BPA pursuant to the consultation process under Section 7 of the Endangered Species Act.

While it is currently impossible to entirely alleviate avian collisions with wind turbines, KENETECH proposes to use a modified tubular tower rather than a lattice tower structure to support the wind turbines. This measure has been proposed based on the results of studies conducted at the Altamont Pass WRA by The Predatory Bird Research Group at the University of California, Santa Cruz (SCPBRG) (KENETECH 1994). SCPBRG field observations determined that raptors often perch (both day and night) on lattice towers, and some species (i.e., red-tailed hawks and ravens) may also construct nests. The frequent use of the towers by raptors increases the time period that birds are within the "danger zone" of the wind turbines.

5.4 CARES PROJECT

5.4.1 Construction-Related Impacts

Direct Habitat Loss

Implementation of the proposed CARES project would result in the permanent occupation of 19,4 hectares (48 acres) of rangeland, shrubland, and agricultural habitats from the installation of 91 wind turbine generators, meteorological towers, transformers, access roads, and a substation. Although the area occupied by overhead power lines would be disturbed, some habitat would remain in the corridor. A total of 42 hectares (95 acres) would be temporarily disturbed from construction activities. However, after completion of construction of the CARES project, these areas would be restored and reseeded.

The permanent loss of 19.4 hectares (48 acres) of rangeland, shrubland, and agricultural habitat would not substantially affect resident or migratory avian populations on the CARES project site because these habitats are common and widespread throughout the greater study area.

Special-Status Species. The permanent loss of 19.4 hectares (48 acres) of rangeland, shrubland, and agricultural habitat would affect special-status species that occur on the CARES project site (Tables 2-2 and 2-3). The removal of 19.4 hectares (48 acres), would represent an incremental loss of foraging habitat within the range of the federally listed peregrine falcon. This loss would not be significant because the primary prey (i.e., passerine birds and waterfowl) for the peregrine would not be affected by the habitat loss.

Based on the field studies, the CARES project would not directly affect bald eagle habitat or use on the project site.

The impact on State species of concern that forage in agricultural lands and grasslands habitat would be minimal because those habitats are common throughout the project site and the greater study area, and loss from implementation of the CARES project is considered negligible relative to available habitat in the greater study area. Also, none of these habitats are considered critical to the existence of special-status species on the project site.

Construction in grasslands and agricultural areas could affect nesting species such as the grasshopper sparrow and burrowing owl.

Construction in oak and pine woodlands could affect foraging and/or nesting habitat for several species, including the Lewis' woodpecker, western bluebird, gray flycatcher, and Swainson's hawk.

Construction-Related Disturbance

Construction-related disturbances include noise, dust, and vehicle traffic. Most raptors would avoid active construction sites, but would continue to use other areas. Many raptors and ground nesting birds are sensitive to disturbance and could abandon breeding sites if the disturbance exceeds levels of tolerance. If conducted during the breeding season, construction activities at turbine strings A, E, PP, N, and Q would disrupt red-tailed hawk nesting activities and construction at turbine string NN could disrupt a Swainson's hawk nesting site.

5.4.2 Operational Impacts

Indirect Habitat Loss

The presence of wind turbines may change the landscape such that avian habitat use patterns are altered, thereby displacing certain birds from the wind farm project site (Jones & Stokes Associates 1987). Habitat suitability for birds could be reduced by creating obstacles (i.e., towers and moving blades) to raptor foraging flight paths along ridge lines, by influencing the flight paths of waterfowl as they fly over the CARES wind farm, or by affecting prey populations by changing land uses or land management within the project site. Increased onsite human activity could also displace or discourage birds from using the CARES site.

Changes in Avian Use Patterns. Implementation of the CARES project could result in some changes in avian use patterns. However, there is no evidence to suggest that the presence of wind turbine structures, per se, would substantially affect overall breeding or foraging use of the CARES project site. The study by Howell et al. (1991) suggests that the presence of wind turbines does not affect overall avian use patterns.

Increased Human Activity Levels. Only small increases in postconstruction human activity are expected for the CARES project. Wind turbines require regular, but relatively infrequent, maintenance. The small crew required to maintain 91 turbines is not sufficient to result in disturbance effects on nesting or foraging birds, or to discourage avian use of the CARES project area.

Decreased Avian Use from Reduction in Prey Populations. Prey populations may decrease as a result of the permanent loss of 19 hectares (49 acres) of rangeland, shrubland, and agricultural habitats. The loss of this habitat may be partially offset by increased visibility of prey to raptors. Orloff and Flannery (1992) suggest that roads in the Altamont and Tehachapi WRAs have provided friable (i.e., loose) dirt berms easily excavated by burrowing ground squirrels and increased the visibility of prey to raptors. Although quantitative data have not been gathered, grazing, farming, and other land use practices have remained largely unchanged in that area since the installation of the wind turbines.

Existing land use practices are not anticipated to change with or without the proposed action. The effect of any prey reductions on raptor populations, from the installation of wind turbines and appurtenant facilities, is not possible to predict because of insufficient information and data on the subject. While BioSystems Analysis (1992) surmised that there may be a threshold of prey abundance, above which the effect of prey abundance, they did not have sufficient data to draw conclusions.

Electrocution

Electrocution of birds on electrical power lines occurs when a bird touches two energized lines simultaneously or a ground wire and an energized conductor. Because of their larger wing spans, raptors such as golden eagles and red-tailed hawks are more prone to electrocution mortality. In their study of the Altamont Pass WRA, BioSystems Analysis (1992) attributed 11% of the avian mortality and 25% of the golden eagle mortality in the Altamont wind farm area to electrocution. Electrocution of raptors has been the second most reported cause of bird mortalities in some western wind energy facilities (Colson and Associates 1994).

Many raptor-proof mitigation measures were initially recommended by Olendorff et al. (1981) and have become standard practice for new power line construction where the potential for raptor electrocution is identified as a project impact. Assuming CARES implements these measures, they would effectively reduce raptor mortality from electrocution below significant levels.

Waterfowl. Waterfowl are not susceptible to electrocution because they do not typically perch on utility poles or power lines. Therefore, the potential for electrocution at the CARES project site would not affect resident or migratory waterfowl.

Passerines and Other Birds. As a group, passerines and bird groups other than those previously mentioned, are not susceptible to electrocution by power lines because of their size and behavior. Smaller birds cannot span energized conductors, making electrocution less likely. Most other bird groups do not typically use power poles as perch sites. Mortality to passerines and other birds is not likely to be a significant potential impact of the CARES project.

Collision with Overhead Power Lines and Guy Wires

Generally, collision with overhead power lines and guy wires is not a major source of raptor mortality (Olendorff and Lehman 1986). BioSystems Analysis (1992) attributed 9% of the mortality at Altamont to collision with overhead wires. Most of the reported mortality was nonraptor birds. Shorebirds, ducks, geese, cranes, and other waterbirds are most prone to collision with overhead wires (e.g., utility wires and guy wires), primarily in low-visibility conditions (Arend 1970, Anderson 1978, Avery et al. 1978, Brown et al. 1985, Fannes 1987).

The proposed CARES project would include new overhead power lines and the turbine towers would be supported by guy wires.

Raptors. Although many individual instances of raptor collisions with utility wires have been reported (CEC in preparation), as a group raptors are not particularly susceptible to such collisions. Keen eyesight and maneuverability allow most raptor species to avoid wires and other objects. In addition, most raptors do not tend to fly during inclement weather, when collisions would most likely occur. However, the possibility of raptor mortality from collision with CARES project power lines exists and is expected to occur at some low level.

Although there would be mortality to individual birds from collisions with overhead power line and guy wires, this mortality would not adversely affect local, regional, or state populations. Some "standard practices" to minimize the chance of mortality are presented in the mitigation section.

Waterfowl. Surveys conducted on the CARES project site and the greater study area suggested that while resident and migratory waterfowl are common along the Columbia and John Day Rivers, they were not abundant on the CARES site. Limited wetland habitat exists in or around the project site to support breeding or wintering waterfowl, and no defined migratory movement corridors were identified during surveys. Therefore, although the potential for waterfowl collisions with overhead power lines and guy wires exists on the CARES project site, particularly during inclement weather, it would be unlikely to have a substantial effect on resident breeding or migratory populations.

Passerines and Other Birds. Several types of birds are susceptible to collision with overhead wires (CEC in preparation). Most of these are species that fly during fog or other inclement weather, such as shorebirds, cranes, some passerine species, and large migratory groups or large flocks (Walkinshaw 1956, Scott 1972, Fannes 1987).

One sandhill crane was observed within the survey radius during the spring through fall surveys and one migratory flock was observed outside of the survey radius during the spring. This suggests that the species occurs on the CARES project site infrequently and in low numbers. Although sandhill cranes are susceptible to colliding with overhead power lines and guy wires in low-visibility conditions, the potential on the CARES project site is low.

The results of field studies suggest that the CARES project site and greater study area are not an important migratory corridor and that large flocks of birds do not travel through, forage in, or otherwise use the area. Therefore, although mortality from collision with overhead power lines and guy wires is expected to occur among certain species at some low level, it is not expected to substantially affect breeding or migrating populations.

Collision with Wind Turbines

The potential frequency of avian collisions with wind turbines (and other aboveground structures) depends primarily on the species' abundance, flight heights, the amount of activity that occurs under different visibility conditions, and the extent to which species modify their behavior to avoid turbines or other structures (Jones & Stokes Associates 1987).

Raptors. Based on the avian mortality experienced at California wind farms, development of wind turbines at the CARES site would result in avian mortality. Although conditions at California wind farms differ in many ways from the proposed CARES project, the California projects can provide a general indication about the expected magnitude of mortality. Based on the range of mortality estimates for wind farms in California (1.7 to 5.8 raptors per 100 turbines per year), mortality resulting from the 91 turbines proposed for the CARES project could range from 2 to 6 raptors a year (KENETECH Windpower 1994). Areas sporting lower mortality rates were not in known major migratory corridors and, similarly, the Columbia Hills area is not in a major migratory corridor. However, mortality rates differ widely between project sites and exact numbers cannot be predicted based mortality studies in California. The figure above is intended only to provide a general order of magnitude estimate of what could be expected based on the best available information.

The degree of mortality potential for each species depends primarily on the frequency of occurrence on the CARES project site in general, the frequency of occurrence on specific sites proposed for wind turbine development, and behavior and flight characteristics. Some species occur infrequently on the CARES site and do not exhibit characteristics that make them susceptible to collision, including northern goshawk, Cooper's hawk, and osprey. These species also are not typically found in habitat types existing on the CARES project site. Therefore, occurrences are likely to be of birds passing through the site, further reducing their potential for collision. A low number of collision mortalities is expected for these species in terms of: (1) actual number of individual mortalities that would be expected and (2) the relation between numbers lost and local and regional population levels. For the purpose of this assessment, local populations are defined as those occurring within the immediate vicinity of the project sites. Unless otherwise noted, regional populations are defined as those occurring in eastern Washington.

Certain design features of the CARES project could reduce mortality for some species. Lattice towers are thought to contribute to mortality of red-tailed hawks in the Altamont Pass WRA. The use of tubular towers instead of lattice towers would eliminate opportunities for perching. Several species that occur on the CARES project site (i.e., red-tailed hawks, rough-legged hawks, ferruginous hawks, Swainson's hawks, and American kestrels) would likely have been attracted to the perch sites created by lattice towers if they had been used.

Peregrine Falcon. Peregrine falcons occur in the greater study area in low numbers. The two separate sightings of peregrine falcons were made during field surveys on the project site. These birds were observed for a total of 7 minutes and could have been members of one breeding pair, migrants, or nonbreeding individuals. No peregrine falcons were observed during the winter study.

Both sightings of peregrine falcons were made in the northern plateau study unit, an area not planned for turbine development by CARES. These sightings were probably birds traveling through the area between foraging habitats. Both birds were also observed within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

No known breeding pairs of peregrine falcon exist within foraging distance of the CARES project site. The Rock Creek pair are 19.3 Kilometers (12 miles) from the CARES site, outside of the 16-kilometer (10-mile) foraging distance for peregrine falcons. While peregrine falcons are most likely to occur near the Columbia River, they are also known to forage in upland areas north of the river (Anderson pers. comm. 1994).

Should a peregrine falcon strike a turbine on the CARES site, the loss could measurably reduce populations within the Columbia River Gorge management unit. Currently, up to 7 known pairs occur within the Columbia River Gorge (not including the pair found to frequent Rock Creek). The USFWS goal for peregrine falcons in the recovery plan was to reestablish at least 3 nesting pairs within the management unit that includes the Columbia River Gorge. Therefore, even with potential mortality at the CARES site, it is reasonable to assume that this goal could still be met within the management unit because this goal is currently being met outside of the project site.

An indirect effect of the CARES project would be a reduction of habitat suitability for the breeding of peregrine falcon within the eastern portion of the species' current distribution within the Columbia River Gorge. All known nesting sites within the Gorge are west of the project site.

Peregrine falcons are present in the project area and the project is likely to affect peregrine falcons because, while peregrine falcons use of the CARES project site is believed to be infrequent, the potential for mortality cannot be ruled out to the point of being "unlikely" to occur.

Bald Eagle. Although no bald eagles were observed on the CARES project site during the surveys that were conducted, it is likely that they occur periodically on the project site. A small bald eagle wintering population occurs along the Columbia River in the vicinity of the CARES project site. During the winter raptor study, 3 to 10 individuals were observed at any one time. Based upon this study, it was estimated that a maximum of 20 bald eagles winter in the general vicinity of the project site during years of peak use.

Data collected by Dames & Moore during the winter of 1993-1994 indicated that bald eagles and golden eagles were the most common species to fly along the slopes of the Columbia River Gorge. Several winter observations of bald eagles crossing the Columbia Hills ridge were made during this study. These observations were of eagles flying from the river northward across the ridge top and ridge face study units, and in two instances into the eastern hills study unit. Birds could also be searching for carrion and hunting for chukar within areas proposed for turbine development.

Three day roost sites were located about 5 miles east of the CARES project site, along the Columbia River. Three night roosts also were found during the winter study. One of these night roosts was confirmed and another was suspected to exist (based upon flight activity), but both were over 7 miles away from the CARES project site.

Although the federal threatened status of bald eagle indicates regional concern for populations levels, the effect of the CARES project is considered to be limited to the species abundance within Klickitat County because: (1) the species has greatly recovered from previously low population levels and is at or near recovery goals established by the USFWS and (2) Klickitat County supports relatively few wintering bald eagles in relation to state populations. Therefore, within a regional context, the anticipated project effects on bald eagles would not pose a significant decline in regional breeding or wintering populations of bald eagles. Within a local context, the local wintering population could be adversely affected either through direct mortality or through disturbance in foraging areas.

Bald eagles are present in the project area and the CARES project is likely to affect bald eagles because, while bald eagle use of the CARES project site is believed to be infrequent, the potential for mortality cannot be ruled out to the point of being "unlikely" to occur.

Golden Eagle. Golden eagles were observed in low to moderate levels. A total of 37 sightings were made for a total of 90 minutes during 32 observations over the spring through fall studies. It was estimated that approximately four juveniles and three adults were using the project site.

Golden eagles were observed in all study units on the CARES project site, although a greater number were observed in the ridge face study unit than in all other study units. Most of the ridge face study unit is not proposed for turbine development by CARES. There is, however, occasional but regular use of the ridge top study unit, a portion of which is proposed for turbine development by CARES. Nearly 80% of golden eagle observations during this study were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

One active golden eagle nest was also located in the vicinity of the project site. The nest site was approximately 3.2 kilometers (2 miles) from the nearest proposed CARES turbine location. Another nest was located in the greater study area on Miller Island, 14.5 kilometers (9 miles) from the CARES project site.

The behavior and flight characteristics of golden eagles make them more susceptible to collision with wind turbines than most other species of raptor. Although it is difficult to make direct comparisons between wind projects, golden eagle mortalities in the Altamont Pass (BioSystems Analysis 1992) were the third greatest of all raptor species. Golden eagle mortality is expected from development of the CARES project because of: (1) the vulnerability of golden eagles to collision and (2) their presence in study units proposed for turbine development.

Because golden eagles breed at low densities, and only one is known to exist on the project site, mortality could also affect the local breeding population. The golden eagle population in Washington has been estimated to be 80 breeding pairs (Rodrick and Milner 1991), so the CARES project is not expected to significantly affect the species viability within the context of the state-wide population.

Turkey Vulture. Turkey vultures are known to collide with wind turbines in the Altamont Pass WRA, although in low numbers relative to their occurrence in the area (BioSystems Analysis 1992). Because turkey vultures fly slowly and methodically, they are probably not particularly susceptible to collision. Turkey vultures were moderately common on the CARES project site. A total of 59 sightings were made for a total of 125 minutes during 37 observations over the spring through fall studies. Turkey vultures were not observed during the winter study because they leave the area during that period.

As expected, the turkey vultures were primarily seen in the updrafts of the ridge face study unit. Low levels of use were observed for all study units proposed for turbine development. These areas are used primarily for foraging by turkey vultures, by slowly circling in search of carrion. They would approach CARES turbines during these slow flights toward the ground. Over 90% of turkey vulture observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

No nests were found on the site during the breeding survey. However, a communal nest was observed hear Maryhill State Park about 8.0 kilometers (5 miles) southwest of the CARES project site.

Because several of the above listed factors indicate that mortality would be moderate to low in relation to abundance of turkey vultures on the site and the greater study area, predicted mortality may cause a moderate reduction in local breeding populations. However, reductions would not eliminate the local breeding population or significantly affect the regional population.

Sharp-Shinned Hawk. A total of 32 sightings of sharp-shinned hawks were made for a total of 39 minutes during 28 observations over the spring through fall studies. No sharp-shinned hawks were observed during the winter study. Sharp-shinned hawks were observed in moderate levels in all study units, including those proposed for turbine development by CARES.

Total duration of observations in this study indicated that most sharp-shinned hawks were moving through the overall area, rather than roosting or foraging. This type of flight pattern would reduce the potential for collision. However, over 80% of sharp-shinned hawk observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

While only one suspected nest site was found in the greater study area and was located over 9.6 kilometers (6 miles) from the CARES project site, the species is expected to breed within the oak woodlands located in the northern portion of the CARES site. This species does not nest and does not usually forage in open habitats typical of turbine development sites.

A low level of mortality is possible from collision with CARES wind turbines because the species: (1) occurs at moderate levels on the project site, (2) occurs within study units proposed for development by CARES, and (3) is typically within the critical altitude.

Red-Tailed Hawk. The behavior and flight characteristics of red-tailed hawks make them more susceptible to collision with wind turbines than most other species of raptor. In addition, red-tailed hawks typically nest and forage in open habitats typical of wind farm lands, perch on a variety of structures including lattice towers, and pursue prey from an aerial stoop (a behavior suspected to contribute to avian mortality). Although direct comparisons between wind projects are difficult to make, because red-tailed hawks in Altamont Pass (BioSystems Analysis 1992) had the greatest mortalities of all species, mortality is likely to also occur on the CARES site.

A total of 186 sightings of red-tailed hawks were made for a total of 728 minutes during 160 observations over the spring through fall studies. Red-tailed hawks were also the most commonly observed species in the winter period. Although there were some seasonal and study unit differences in occurrence, red-tailed hawks were common in all study units. During the winter, observations were centered somewhat more around the oak/pine woodlands and were often seen perched on power lines along Hoctor Road. Over 80% of red-tailed hawk observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

The red-tailed hawk was the most commonly observed breeding raptor in the study area, with 10 active nest sites (of the 18 total nests found for all species during the breeding raptor study) found in the greater study area. Of these 10 sites, three were located within 1.6 kilometers (1 mile) of proposed CARES turbine locations.

A high level of mortality is expected, relative to other species, because of: (1) the vulnerability of red-tailed hawks to collisions with wind turbines, (2) the species is common in study units proposed for turbine development by CARES, and (3) the percentage of the local population that might be affected. Design features of the CARES project could, however, lower the level of mortality of red-tailed hawks compared to that found at existing wind farms. Studies in the Altamont WRA suggest that lattice towers may contribute to red-tailed hawk mortality. Fewer mortalities were recorded from turbines having tubular towers (BioSystems Analysis 1992). Because CARES proposes to use a tubular tower design, mortality of red-tailed hawks is expected to be lower than would be expected if lattice towers were used.

Local breeding populations of red-tailed hawks are likely to be reduced by both direct mortality of nesting adults as well as potentially higher mortality of young birds just leaving the nest. Juvenile birds have been found to be more vulnerable to collisions than are adult birds. At the county and state level, red-tailed hawks are abundant and mortality at the CARES site would not significantly affect the regional population.

Swainson's Hawk. Like the red-tailed hawk, the Swainson's hawk also nests and forages in open habitats, uses a variety of perches, and pursues prey by diving from a perch or soaring flight. Thus, it is also considered to be more susceptible to collision than most other species of birds. There are no data available on Swainson's hawk mortality from collision with wind turbines, however, because existing sites are not within the range of Swainson's hawks.

During this study, a low to moderate number of Swainson's hawk sightings were noted. A total of 18 sightings of Swainson's hawks were made for a total of 60 minutes during 17 observations over the spring through fall studies. Swainson's hawks are the only hawk to completely migrate from the project site and greater study area, so none were observed during the winter period.

The greatest levels of activity occurred in the eastern hills study unit of the KENETECH project site. All observations were in the eastern hills, ridge top, and northern plateau study units. Over 80% of Swainson's hawk observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

Two active nest sites were found in the vicinity of the CARES project site, in the greater study area. The nearest of these nests was located near Hoctor Road, approximately 2.4 kilometers (1.5 miles) from proposed turbine string locations on the CARES project site. The other nest site was located downslope near Goodnoe Hills, over 14 kilometers (9 miles) from the nearest CARES turbine location.

Because Swainson's hawks are susceptible to collision with wind turbines, and because they potentially occur within areas proposed for turbine development by CARES, mortalities could occur. Because the species occurs in low levels on the project site, the actual number of mortalities is expected to be low, but the local breeding population could be measurably reduced by collision mortality. Thus, mortality from the CARES project could have a local impact but would not be expected to affect regional Swainson's hawk populations. In Washington, 228 Swainson's hawk territories were documented between 1977 and 1986 (Harlow and Bloom 1989).

As with the red-tailed hawk, the potential for mortality is less than that found at existing sites because tubular towers would be used in place of lattice-type towers, effectively reducing the potential for perching on the towers.

Rough-Legged Hawk. The rough-legged hawk is similar to the red-tailed hawk and Swainson's hawk in its behavior, flight characteristics, and use of open foraging habitats. Rough-legged hawks typically pursue prey from a perch, circling flight, or hovering flight from 15 to 60 meters (50 to 200 feet) above the ground. In addition, the species is relatively abundant in the area during winter. Thus, the potential for any one individual rough-legged hawk to collide with CARES wind turbines is also high relative to the potential for some other species.

During the spring through fall surveys, a single sighting of 50 seconds was made of a rough-legged hawk during the spring, within the critical altitude. Rough-legged hawks were found to occur regularly on the CARES project site during the winter. They were observed most often north of the CARES site, within the northern plateau study unit, but were also observed in other study units.

The level of mortality expected for rough-legged hawks would likely be sufficient to cause a minor reduction in local wintering populations. The effect on breeding populations would be more dispersed than for locally breeding species, because rough-legged hawks disperse widely to breeding grounds in the arctic. Rough-legged hawks are a relatively common wintering species that would not be significantly affected at the regional population level.

Ferruginous Hawk. Ferruginous hawks are known to collide with wind turbines in other areas (BioSystems Analysis 1992). However, the ferruginous hawk occurs infrequently on the CARES project site. Only three sightings were made during all surveys for a total of 6 minutes, two in the spring and one in the fall. Both spring sightings of ferruginous hawks were within the ridge top study unit, a site proposed for turbine development by CARES. Also, two of the three sightings (67%) were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

A single ferruginous hawk was observed during the winter study. It was not observed on the CARES site.

There is a potential for ferruginous hawk mortality from the CARES project. However, because this hawk occurs on the project site in low levels, the potential for collision is relatively small and would not be expected to adversely affect regional populations.

Northern Harrier. The northern harrier also nests and forages in open habitats. No mortality data are available for northern harriers. However, its low, gliding foraging behavior reduces the potential for collision with CARES wind turbines. A total of 45 sightings of northern harriers were made for a total of 54 minutes during 42 observations over the spring through fall studies.

On the project site, harriers were observed primarily in the western hills and in the northern plateau study units, with few observations in all other study units. During summer surveys, nearly all observations were in the western hills study unit. During spring, fall, and winter surveys, nearly all observations were in the northern plateau study unit. About 60% of northern harrier observations made on the project site were within the critical altitude (7.5 to 58 meters [25 to 190 feet]). Although a substantial number of northern harrier observations were within the critical altitude, this is the lowest proportion for all raptor species observed.

Two suspected northern harrier nest sites were found in the northern plateau study unit during the breeding field study, one of which was within 1 kilometer (0.6 mile) of the CARES site. Some potential for northern harrier mortality exists because: (1) they were found to be common in the western hills study unit, (2) harriers regularly use the open habitats common in proposed turbine sites, and (3) harriers were observed often within the critical altitude. This potential is reduced to some extent, however, because the flight behavior of northern harriers puts them at a lesser risk of collision than most other species regularly occurring on the site. Northern harrier mortality is expected to reduce local but not regional population levels.

Prairie Falcon. Prairie falcons are not particularly susceptible to collision with wind turbines because of their behavior and flight characteristics. Their swift flight and maneuverability, compared to buteos and eagles, aids in their ability to avoid objects.

A total of 17 sightings of prairie falcon were made for a total of 67 minutes over the spring through fall studies. In addition, prairie falcons were also occasionally observed during the winter study.

Most prairie falcon activity in the greater study area occurs in typical nesting, roosting, and foraging areas along the cliffs of the Columbia River. During the winter study, several observations were made along Hoctor Road in the northern plateau area and along SR 14 within and south of the ridge face study unit. Some activity occurs in all of the study units on the CARES project site. Because this species forages in several types of habitat, foraging is believed to occur in all habitats on the CARES project site. Over 80% (14) of all observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

One prairie falcon nest was found south of the CARES project site, on cliffs above SR 14. Another prairie falcon nest site was reported by the WDFW to be near the golden eagle nest site upslope of the Columbia Aluminum Plant. However, this nest was not located during the nesting study.

The potential for mortality of prairie falcons is considered low in terms of the number of individuals that would be killed because of their behavior and flight characteristics. Mortalities are expected to occur, however, because the species occurs in study units proposed for turbine development by CARES and because it flies within the critical altitude. Prairie falcon mortality is expected to reduce local but not regional population levels.

American Kestrel. American kestrels are more likely to collide with wind turbines because they nest and forage in open habitats typical of wind farm lands, perch on a variety of structures, pursue prey from stooping flights, and occur frequently at low to moderate altitudes. In the Altamont WRA study, it was also second only to red-tailed hawks in the number of mortalities from collision with wind turbines.

The American kestrel is second only to red-tailed hawks in the number of observations made during surveys. A total of 125 sightings of American kestrels were made for a total of 214 minutes during 110 observations over the spring through fall studies. In addition, American kestrels were also observed during the winter survey.

Kestrels also occurred frequently in all study units proposed for turbine development by CARES. During this study, approximately 80% of American kestrel observations were within the critical altitude (7.5 to 58 meters [25 to 190 feet]).

American kestrels were common on the project site and suitable nesting habitat occurs on the southern portion of the CARES site in oak woodlands.

A high degree of mortality of individual American kestrels is expected, relative to other species, from project development because they: (1) commonly occurred in proposed CARES turbine development sites and (2) are known to collide with wind turbines more frequently than other species. American kestrel mortality is expected to reduce local but not regional population levels.

Waterfowl. Surveys conducted in the greater study area suggest that while resident and migratory waterfowl are common along the Columbia and John Day Rivers, they are not abundant on the CARES site. While concerns have been raised regarding the potential for waterfowl to cross the ridge on the site on their way to and from feeding areas, the observations made during field surveys determined that this did not occur with any regular frequency. A total of 48 waterfowl were seen for a total of 21 minutes during 5 observations (i.e., in five flocks) over the spring through fall studies. Three flocks were observed within the project boundaries during the first winter study and none were observed during the second winter study.

The wintering population of ducks and geese has been estimated to be about 6,000 (Annear in Dames & Moore 1993). Road counts conducted along the Columbia River for the winter study found no concentrations greater than 200 birds. Most observations were of small groups of 10 to 15 individuals. Canada geese were the most frequently observed species, and flocks averaging 20 to 50 individuals were seen to fly up and down the Columbia River corridor. American coots were the second most common species observed, with observations also made of redhead, common goldeneye, Barrow's goldeneye, ring-necked duck, hooded merganser, bufflehead, mallard, and scaup.

Limited wetland habitat exists in or around the CARES project site to support breeding or wintering waterfowl, and no defined migratory movement corridors were identified during surveys. Therefore, the potential for waterfowl mortality from collision with wind turbines on the CARES project site is not considered significant.

Other Special-Status Birds. In general, non-raptor special-status birds are not as vulnerable to collisions with wind turbines because: (1) they do not display the flight behaviors that are believed to contribute to avian mortality and (2) mortalities at California projects are low relative to their abundance in the area.

Western bluebirds, a state candidate species, were observed to migrate through the CARES site and also breed on and near the site. Site observations were not at a level that would suggest that the entire county population moves throughout the project site during migration. In addition, it would be highly unusual for birds to follow such a defined migration route. Western bluebirds are believed to move through the county in a relatively broad front which includes the project site. For example, western bluebirds have been observed in other locations in Klickitat County such as Lyle, 35 kilometers (21 miles) west of the project site (Wahl and Paulson 1991). The project is expected to cause a local reduction in populations of this species. The could also affect migrant that breed offsite but pass through the project site. However, the project effects on western bluebirds are not likely to be regional in context because: (1) as a passerine, they are less likely to be vulnerable to collisions than are raptors and (2) they are expected to move through other areas besides the CARES site. Therefore, while the project could result in some local and migrant mortality of western bluebirds, the project does not pose a significant risk in the viability of western bluebird populations in Klickitat County.

Lewis's woodpecker, a state candidate species, are relatively common near oak woodlands and typically fly below the critical altitude. Although some mortality may occur, the project is not likely to significantly alter regional populations.

The other non-raptor special-status species that could potentially use or fly of over the project site were determined to be present in such low numbers (in relation to their numbers in known use areas off the project site) that they were generally not considered to be of special concern on the CARES project site. Four of these species (i.e., long-billed curlew, loggerhead shrike, sandhill crane, and ash-throated flycatcher) were infrequently observed on the site. The number of these species observed was sufficiently low to conclude that the project would not pose a significant risk to their local or regional distribution.

Five of these species (i.e., western sage grouse, gray flycatcher, grasshopper sparrow, bank swallow, and sage sparrow) were not observed on the site. Although these species may be present in small numbers or occasionally pass through the site as part of their natural movements, because there were no observations of them it was determined that the project site did not provide habitat that was important for the local or regional abundance.

Other Birds. The common raven, black-billed magpie, and the northern flicker are commonly occurring birds that were observed to fly within the critical altitude in areas proposed for wind turbine. Of these species, the common raven is most likely to have significant mortality because its flight behavior is similar to the red-tailed hawk, a species known to be more vulnerable to collisions with wind turbines than most other species. In addition, common raven are known to collide with wind farms in California.

Black-billed magpie and northern flicker do not fly like red-tailed hawks and have not been reported to be prone to colliding with wind turbines. Nevertheless, because of their abundance on the project site and their tendency to fly within critical altitudes, some mortality may occur for these species as well. Because these species are common in the region, project-related mortality would be localized and would not significantly affect regional population levels.

The western meadowlark, Brewer's blackbird, horned lark, and the Townsend's solitaire are also common species that are generally found in grassland habitats typical of those existing on the project site. These species typically occur below the critical altitude of the wind turbines. Swallows, which are common on the site, may be more vulnerable because they fly rather erratically within critical altitudes.

Other birds are expected to migrate through the site, but in numbers similar to other areas in the county. The oak and oak/pine woodlands were observed to be used by several types of birds during migration. Similar use is expected to occur in other woodland areas in Klickitat County, including the Rock Creek area located east of the project site and the Klickitat River area located west of the project site.

During surveys for the CARES project site, the total number of sightings and the total number of observations were greatest for passerines. This was as expected, because passerines are much more commonly present than the larger raptors. A total of 6,443 sightings of various passerines were made during 317 observations over the spring through fall studies. Species observed to migrate through the area included house finch, American robin, American goldfinch, dark-eyed junco, and white-crowned sparrow. In addition, several types of warblers were observed to stop within oak and oak/pine woodlands present on and near the project site.

The CARES project would not result in a significant regional decline in other passerine species. This conclusion is based on: (1) the expected low vulnerability of migratory passerines to collisions with wind turbines and (2) the determination that the CARES site is not within a major regional migratory flyway. The expected low vulnerability is based on the following considerations:

- Results from the Altamont Pass WRA indicated that passerine mortality was low relative to passerine numbers in the project area (BioSystems Analysis 1992).
- Migrating passerines typically fly at altitudes well above the highest point of wind turbines (Bellrose in Alerstam 1990). Using the flight altitude patterns described by Alerstam (1990), birds would be vulnerable to collisions only during landing and take offs.
- Passerines are suspected to be less vulnerable to collision with wind turbines than are raptors because passerines do not typically pursue prey in a manner that places them at risk of colliding with wind turbines.

The site was determined not to be a major migratory flyway for passerines because of the following:

- Site surveys, which included dawn and dusk observations during spring and fall, identified no large concentrations of passerines. Birds were migrating through the site, but they did not do so in a defined pattern. Instead, migrating passerines and other birds appeared to move through the CARES site in a dispersed, broad front. While flocks of robins, western bluebirds, mountain bluebirds, and house finch were regularly observed, they were present in scattered groups composed of 10 to 30 individuals, rather than in larger flocks or in larger gatherings of groups.

- Migratory use of the project site is likely similar or lower than other areas of the greater study area and region that have more shrub and woodland areas, such as the Rock Creek and Klickitat River areas.

- Major migratory flyways are typically well known and present along north-south topographic features. No known major migratory flyways have been reported on the project site and the site is on a ridge oriented east-west, rather than north-south.

- Predominant westerly winds create a wind-shear near the ground that is typically avoided by migrating birds (Alerstam 1990).

Thus, while mortality of passerines and other birds from collision with CARES wind turbines is expected to occur at proposed turbine locations, losses are not expected to be sufficient to significantly affect regional breeding, wintering, or migrating populations.

Summary and Conclusions

Collision with wind turbines was determined to have the most potential for significant impacts on raptors and other non-raptor, non-special status birds. Based on the avian mortality experienced at California wind farms, development of wind turbines at the CARES site would result in avian mortality.

Certain design features of the CARES project could reduce mortality potential for some species. Lattice towers are thought to contribute to mortality of red-tailed hawks in the Altamont Pass WRA. The use of tubular towers by CARES, instead of lattice towers, would eliminate opportunities for perching. Several species that occur on the CARES project site (i.e., red-tailed hawks, rough-legged hawks, ferruginous hawks, Swainson's hawks, and American kestrels) would be attracted to the perch sites created by lattice towers, if used on the site. In addition, the density of turbines on the CARES project site could reduce the frequency of avian mortality because the turbines would be more visible and the density might cause raptors to avoid the area (BioSystems Analysis 1992).

Because of differences in behavior and abundance, different bird species would experience different levels of mortality in terms of intensity (i.e., actual number of bird mortalities) and in terms of context (i.e., number of bird mortalities relative to local and regional populations). Because peregrine falcon, a federal endangered species, and the bald eagle, a threatened species, may use areas were CARES wind turbines would be located, the project could result in mortality for these species. Because of this potential mortality, the CARES project may affect peregrine falcons and bald eagles, BPA should initiate formal consultation with the USFWS under Section 7 of the Endangered Species Act.

Although peregrine falcon were not observed on the CARES project site, the Rock Creek pair was observed 19.3 Kilometers (12 miles) from the CARES site. This is outside of the 16-kilometer (10-mile) foraging distance for peregrine falcons, and the distance is likely too far from the CARES site to be regularly used by this pair. The CARES site is located on the eastern edge of the peregrine falcon's current range in the Columbia River Gorge. There are up to seven pairs of peregrine falcons in the gorge area, not including the pair found near Rock Creek. Thus, although the likelihood of collision is relatively low based on the relatively few individuals in the area, the potential for mortality remains and a peregrine mortality could measurably reduce the Columbia River Gorge peregrine population. However, it is not expected to affect the viability of the population in the gorge.

Bald eagles were not observed to fly within areas proposed for wind turbine placement, but they are assumed to occasionally fly over the site. Although bald eagles do not typically dive or fly erratically in pursuit of prey, a behavior believed to contribute to collisions, they were observed fly in the primary study area at altitudes that would put them at risk of colliding with wind turbines and some mortality could occur. Between 3 and 10 bald eagles were estimated to be present in the project vicinity over the 1993-1994 winter. This number may increase to as many as 20 bald eagles in some years.

When viewed from a regional perspective, impacts on wintering bald eagles would be localized and would not likely affect overall populations in eastern Washington. Klickitat County provides only a small percent of bald eagle winter populations in Washington. In addition, the species has greatly recovered from previously low population levels, and the regional population is stable or increasing. Therefore, within a regional context, the project's effects on bald eagles would not pose a significant decline in regional breeding or wintering populations.

Some raptors are common in the area and display behaviors that make them more vulnerable to collisions than some other birds. Raptors that could have the greatest mortality, but low levels relative to their regional populations, include red-tailed hawk, American kestrel, and rough-legged hawk. In the case of rough-legged hawk and American kestrel, which are year-around residents, local breeding populations would be reduced. However, these reductions would not affect the regional distribution or abundance of the species because they are so common. Turkey vultures were moderately common during the spring through fall and would experience moderate to low mortality, but would not affect local populations. In the case of rough-legged hawks, which only winter on the project site, local wintering populations would be reduced. However, the losses on breeding populations would be more dispersed because these birds migrate from many different breeding areas. As with the red-tailed hawk and American kestrel, mortality levels of rough-legged hawks would not significantly affect their regional distribution or abundance.

Other raptors are less common in the area, but still display behaviors that make them more vulnerable to collisions than some other birds. Species that would have low overall mortality levels, but high levels relative to local populations, include the golden eagle and Swainson's hawk. Collision mortality could affect the low local breeding populations of these species. However, mortality would not be sufficient to affect the regional distribution or abundance of these species because of the size of regional populations.

The results of the spring through fall study indicate that wind turbines on the CARES project site would create a mortality hazard for certain species of raptors. It is difficult to estimate, with any degree of confidence with data from existing sites, raptor mortality from implementation of the CARES project. Site conditions, raptor use and composition, and proposed project design features differ sufficiently from existing wind farm sites to make comparisons unreliable. Thus, mortality estimates from existing wind farms are useful only in making general comparisons.

Two measures of mortality can be used to determine impacts, a comparison of mortalities based upon the duration of observations and the overall mortality levels relative to the number of turbines. Based upon a time comparison of observations from the Altamont WRA (1.26 raptors per 10-minute visit over 6 seasons) and the Solano WRA (1.11 raptors per 10-minute visit over 4 seasons), raptor occurrence on the CARES project site (1.21 raptors per 20-minute visit) was relatively low. Based solely on the overall levels of raptor use of the CARES project site compared with existing sites, the potential for raptor mortality is expected to be lower.

In addition, per turbine mortality rates were estimated from postproject monitoring surveys at the U.S. Windpower facility in the Solano WRA (Howell and Noone 1992). The average estimated mortality for the two study years was 0.0327 raptors per turbine. Because of the fewer raptors using the CARES project site, mortality is also expected to be lower if the project is developed.

Other features of the CARES project may result in greater mortality levels, and should be considered as another unit of measuring bird mortalities, when compared with other existing wind farms. For example, the turbine blades of the 33M-VS wind turbines proposed by CARES, and thus the blade-swept area, are larger than the turbines used in the Solano WRA analyzed by Howell and Noone (1992). Although there are no supportive data, it is possible that there is a correlation between blade-swept area and raptor mortality. If so, bird mortalities could also be measured relative to blade-swept area to standardize analyses.

In conclusion, mortality of peregrine falcons, bald eagles, golden eagles, red-tailed hawks, and Swainson's hawks from implementation of the CARES project could affect local populations of these species. Mortality is expected to occur with several other species (i.e., turkey vulture); however, overall population levels of these species should not be affected.

5.4.3 Mitigation

Construction-Related Disturbances

To avoid construction-related disturbances to bald eagle night roosting sites in Section 5, construction activities should be avoided within 400 meters (1,300 feet) of the roosts during the winter months of November through March. Similarly, to avoid disturbances to red-tailed hawk nests, construction should be avoided within 400 meters (1,300 feet) of nests from April through July.

Electrocution

The following measures, when implemented, will reduce the level of potential electrocution mortality on the CARES project. Most of these measures were initially recommended by Olendorff et al. (1981) and have become standard practice for new utility construction where the potential for raptor electrocution is identified as a project impact.

- All jumper wires should be insulated (5 kV minimum rating and preferably 10 kV to 15 kV).
- All exposed terminals (e.g., pot heads, lightning arresters, and transformer bushings) should be covered by avian boots or other insulating materials.
- Nonconductive material (e.g., fiberglass and wood) should be used instead of the straight, aluminum-type combination arms on riser poles.
- All overhead power line construction should incorporate raptor protection for wood pole distribution lines.
- Energized wires should be placed a safe distance apart: 60 inches for a crossarm configuration and 55 inches for an armless configuration.
- No cutouts should be used on riser poles.
- Jumper leads should be oriented in a vertical configuration to discourage bird perching.
- Bonding of pole top devices mounted on nonconductive arms should be done with insulated wire.

Collision with Overhead Power Lines and Guy Wires

The following measures, if implemented, would reduce the potential for avian collision with utility lines.

- A minimum conductor wire size of 4/0 should be used to increase the visibility of the wire.

- Above-ground power line wires should not be sited near wetlands or other waterfowl feeding or resting habitat.

Collision with Wind Turbines

Although studies are currently being conducted to determine the underlying causes and circumstances of avian collisions with wind turbines, there are currently no known scientifically supportable measures to entirely prevent some incidental avian mortality. Post-construction monitoring of avian impacts may be considered by USFWS and BPA pursuant to the consultation process under Section 7 of the Endangered Species Act.

Section 6. Cumulative Effects

Section 6. Cumulative Effects

Habitat Loss

The proposed KENETECH and CARES wind energy projects are proposed to be developed on 5,505 hectares (13,605 acres) of agricultural, shrub, steppe grassland, and oak/ponderosa pine habitat. Of those 5,505 hectares (13,605 acres), the KENETECH project would permanently convert 79 hectares (193 acres) while the CARES project would convert 19.4 hectares (48 acres) to roads, wind turbine towers, and other structures. This conversion would cumulatively result in the permanent loss of 98 hectares (241 acres) of habitat for a variety of bird species which utilize the habitat for at least a portion of their life requirements (e.g., foraging, nesting, and shelter). The loss of habitat would result in an incremental decrease in nesting birds occupying the 98 hectares (241 acres) under construction and may result in a shift in foraging and other uses to adjacent areas.

The loss of bald eagle night roosting habitat in Section 5 of the KENETECH site, when added to any other night roost or winter habitat conversion and tree removal in Klickitat County, would reduce the wintering habitat value along the John Day Dam portion of the Columbia River. Based on field observations during January and December 1994 (two winter seasons), bald eagle use of the roost site is well established.

The permanent loss of 98 hectares (241 acres) of habitat would also result in an incremental reduction in the amount of foraging habitat for the peregrine falcon. While a cumulative impact, this reduction in foraging habitat should not result in a reduction in the principal prey (e.g., waterfowl, shorebirds, and rock doves) because none of those prey groups extensively utilize the site as a part of their life requirements.

Collisions with Turbines and Other Facilities

Raptors. At full development, the KENETECH and CARES projects combined would include the eventual placement of up to 436 wind turbines. Based on avian studies conducted in California, the wind turbines and associated project features (e.g., overhead powerlines and guy wires) would cause avian mortality. Using some of the higher raptor mortality estimates for wind farms in California (0.06 raptors per turbine per year), the cumulative annual mortality of raptors for the two projects could be 26 raptors. The species most susceptible to mortality would include golden eagles, red-tailed hawks, and American kestrels. Based on studies at Altamont (1992), mortality for those three species was disproportionately greater than for any other species.

The combined KENETECH and CARES projects raptor mortality would result in a reduction in the local raptor populations, but would not significantly affect regional or state populations.

Other Species. Over six survey seasons, BioSytems Analysis (1992) found that 35% of the avian mortality (182 birds) at Altamont were non-raptorial birds (63 birds). Collision with turbines accounted for 55% of the mortality, 11% from collision with wires, 8% from electrocution on power lines, and 26% from unknown causes.

The combined KENETECH and CARES projects would result in mortality to non-raptorial birds, most likely passerines. Waterfowl and shorebirds were found to infrequently use the sites or pass over the sites at critical altitudes (7.5 to 58 meters [25 to 190 feet]) and, therefore, would not represent species groups that would be at risk.

Assuming a passerine mortality of 0.032 birds per turbine, the estimated annual passerine mortality for the KENETECH and CARES projects combined would be 14 birds per year. This mortality would result in a less-than-significant reduction in the local populations of passerines and would not represent an adverse impact on either regional or state populations.

Section 7. Citations

Section 7. Citations

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7.2 PERSONAL COMMUNICATIONS

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Bush, Jody. Biologist. U.S. Fish and Wildlife Service, Olympia, WA. February 15, 1994 - telephone conversation; March 10 and December 14, 1994 - meetings.

Carey, Christopher. Regional nongame biologist. Oregon Department of Fish and Wildlife, Bend, OR. February 24, 1994 - scoping letter to Bonneville Power Administration.

Frederick, David. State supervisor. U.S. Fish and Wildlife Service, Olympia, WA. June 23, 1993, and January 27, 1994 - letter and species lists for vicinity of proposed windfarm projects.

McAllister, K. Wildlife biologist. Washington Department of Fish and Wildlife, Olympia, WA. November 23, 1994 - telephone conversation.

Nelson, Harvey K. Harvey K. Nelson Consulting Services, Bloomington, MN. March 22, 1994 - meeting.

Strickland, Dale. Vice president and senior ecologist. Western Ecosystems Technology, Inc., Cheyenne, WY. March 22, 1994 - meeting.

Appendix A. U.S. Fish and Wildlife Service Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192
(206) 753-9440 FAX: (206) 753-9008

RECEIVED DEC 2 1 1994

December 15, 1994

Kathy Fisher, ECN3
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

FWS Reference: 1-3-95-SP-92

Dear Ms. Fisher:

This is in response to your letter dated December 14, 1994 and received in this office that same day. Enclosed is a list of listed threatened and endangered species, and candidate species (Attachment A), that may be present within the area of the proposed Windfarm Power Project near Goldendale in Klickitat County, Washington. The list fulfills the requirements of the Fish and Wildlife Service (Service) under Section 7(c) of the Endangered Species Act of 1973, as amended (Act). We have also enclosed a copy of the requirements for Bonneville Power Administration (BPA) compliance under the Act (Attachment B).

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the BPA should request Section 7 consultation through this office. If the biological assessment determines that the proposed action is "not likely to adversely affect" a listed species, the BPA should request Service concurrence with that determination through the informal consultation process. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Candidate species are included simply as advance notice to federal agencies of species which may be proposed and listed in the future. However, protection provided to candidate species now may preclude possible listing in the future. If early evaluation of your project indicates that it is likely to adversely impact a candidate species, the BPA may wish to request technical assistance from this office.

There may be other federally listed species that may occur in the vicinity of your project which are under the jurisdiction of the National Marine Fisheries Service (NMFS). Please contact NMFS at (503) 230-5430 to request a species list.

In addition, please be advised that federal and state regulations may require permits in areas where wetlands are identified. You should contact the Seattle District of the U.S. Army Corps of Engineers for federal permit requirements and the Washington State Department of Ecology for state permit requirements.

Your interest in endangered species is appreciated. If you have additional questions regarding your responsibilities under the Act, please contact Jim Michaels or Jodi Bush of this office at the letterhead phone/address.

Sincerely,

David C. Frederick
State Supervisor

jb/dm
Enclosures
SE/BPA/1-3-95-SP-92/Klickitat

c: WDFW, Region 5
WNHP, Olympia
Jones & Stokes, (J. Ives)

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES WHICH MAY OCCUR WITHIN THE VICINITY OF THE PROPOSED WINDFARM WINDPOWER PROJECT NEAR GOLDENDALE, IN KLICKITAT COUNTY, WASHINGTON (T03N R16E S1/10-15/22-26; T03N R17E S1-4/7-11/18; T03N R18E S2-6; T04N R18E S31-35)

FWS Reference: 1-3-95-SP-92

LISTED

Bald eagle *(Haliaeetus leucocephalus)* - wintering bald eagles may occur in the vicinity of the project from about October 31 through March 31.

Peregrine falcon *(Falco peregrinus)* - spring and fall migrant falcons may occur in the vicinity of the project.

Major concerns that should be addressed in your biological assessment of project impacts to bald eagles and peregrine falcons are:

1. Level of use of the project area by eagles and falcons.

2. Effect of the project on eagles' and falcons' primary food stocks, prey species, and foraging areas in all areas influenced by the project.

3. Impacts from project construction and implementation (e.g., increased noise levels, increased human activity and/or access, loss or degradation of habitat) which may result in disturbance to eagles and falcons and/or their avoidance of the project area.

PROPOSED

None

CANDIDATE

The following candidate species may occur in the vicinity of the project:

Black tern *(Chlidonias niger)*
Bull trout *(Salvelinus confluentus)*
Fringed myotis (*Myotis thysanodes*)
Northern sagebrush lizard (*Sceloporus graciosus graciosus*)
Small-footed myotis (*Myotis ciliolabrum*)
Western burrowing owl (*Athene cunicularia hypugea*)
Western sage grouse *(Centrocercus urophasianus phaios)*
Yuma myotis (*Myotis yumanensis*)

ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects *

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Division, 3704 Griffin Lane SE, Suite 102, Olympia, WA 98501-2192.

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* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

February 4, 1994

In reply refer to: RAE

Ms. Harriet Allen
State Biologist
State of Washington Department of Wildlife
600 Capitol Way North
Olympia, Washington 98501-1091

Dear Ms. Allen:

Bonneville Power Administration (BPA) is considering requests to provide transmission services for the electricity produced from a wind energy projects proposed by Kenetech, Inc. The proposed project location is in Klickitat County, Washington; the legal description is as follows:

T4N, R18E, Sections 31 through 35,
T3N, R18E, Sections 2 through 6,
T3N, R17E, Sections 1 through 4 and 7 through 11,
T3N, R16E, Sections 1, 10 through 15, and 22 through 26.

In order to assess potential environmental impacts, we are requesting a listing of any species of importance or their habitats in the proximity of the proposed project location. Species of importance include any that are considered by the State of Washington to be candidate, proposed or listed as endangered or threatened.

I understand your response is not to be construed as a complete inventory of the project area and does not eliminate Bonneville's need or responsibility to conduct more thorough research.

Please mail your response and any billings associated with this request to the letterhead address, attention Kathy Fisher, RAE.

Sincerely,

Kathy Fisher

Kathy Fisher
Environmental Specialist

cc: Official Files - RAE (EQ-14 Washington Windplant EIS)

CURT SMITCH
Director

STATE OF WASHINGTON
DEPARTMENT OF WILDLIFE
600 Capitol Way North • Olympia, Washington 98501-1091 • (206) 753-5700

February 16, 1994

Kathy Fisher, RAE
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208-3621

Re: Species of importance in the vicinity of Kenetech wind energy project.

Dear Ms. Fisher:

We have completed a review of WDW's databases containing locations of species and habitats of importance (Nongame Heritage, Priority Habitats and Species, and Washington Rivers Information System databases) in your project area. The following information was obtained within one mile radius of your project section:

Species	Approximate Location	Species Status
Black-tailed deer	Rock Creek drainage	Game
Golden Eagle	T03N R17E S16	State Candidate
Prairie Falcon	T03N R17E S16	State Monitor
West. gray squirrel	T03N R17E S08	State Threatened
West. gray squirrel	T03N R17E S09	State Threatened
West. gray squirrel	T03N R18E S32	State Threatened

If important species or habitats are found within the vicinity of your project area, tabular reports containing more information about the occurrences is included. High resolution maps are also available to provide more detailed locational data for an additional cost.

Please note that sensitive information (ie. threatened, endangered, and candidate species) may be included in this data request. These species are vulnerable to disturbance and harassment. In order to protect the viability of these species we request that you not disseminate the information as to their whereabouts. Please refer to their presence in general terms. For example: A Peregrine Falcon is located within two miles of the project area.

The information provided for this request only includes data that WDW maintains in a centralized data system. It is not an attempt to provide you with an official agency response as to the impacts of your project on wildlife. Nor is it designed to provide you with any guidance on interpreting this information and determining how to proceed in consideration of wildlife. This data only documents the location of important wildlife resources to the best of our knowledge.

Your project may require further field inspection or contacting our field biologists or others in WDW to assist you in interpreting and applying these data. Refer to the enclosed directory and regional map for those contacts. Generally, for assistance on specific projects contact the appropriate regional office and ask for the Area Habitat Biologists for your project area.

Data in this package are dynamic. This data should not be used for future projects. Please request new information rather than use outdated information.

Because of the high volume of data requests for information that WDW receives, we need to charge for these data searches to recover some of our costs. On the back of the enclosed Data Order Form is an invoice itemizing the costs for your search and instructions for submitting payment.

We hope that these products fill your needs. If you have any questions regarding the data you have received please contact Lea Knutson at (206) 664 9476, or Terence Johnson at (206) 664-0044.

Sincerely,

Terence Johnson

Terence Johnson
Cartographer

TJ:jl

WASHINGTON DEPAR[illegible]MENT OF WILDLIFE

FISH & WILDLIFE DATA ORDER FORM

AND REQUEST FOR PUBLIC RECORD

Agency/Organization: BONNEVILLE POWER ADMINISTRATION.

Contact Person: KATHY FISHER, RAE

Address: P.O. BOX 3621
PORTLAND, OR. 97208-3621

Phone #:

Date of Request: 2-4-94

Identify yourself (or the party you represent if you are a consultant) as one of the following:

❑ owner of the land covered by this request ❑ government agency ❑ tribe
❑ researcher with a university ❑ other

REQUESTER READ AND SIGN

By receiving wildlife information from the Washington Department of Wildlife (WDW), you incur an obligation to use it in a way that does not cause undue harm to our public wildlife resource.

All wildlife species are vulnerable to harm from human activities. Harm can occur directly (e.g., an animal is harrassed or injured) or indirectly (e.g., a nest tree is felled or a wetland is drained.) Harm can occur unintentionally, even by those who value the wildlife resource (e.g., repeated visits to a heron rookery which flushes birds from the nest and exposes eggs to cold weather and predators). The most serious threats to wildlife, rather than being direct and malicious acts, are indirect human actions where harm to wildlife was unintentional.

The Washington State constitution confers wildlife ownership to all citizens of the state. WDW is mandated to safeguard this ownership by preserving, protecting, and perpetuating wildlife resources. The public has a crucial role in fulfilling this mandate, for two reasons. First, the statewide distribution of wildlife species and habitat is beyond the monitoring capability of any single agency. Second, the state's constitution gives to the people ownership of wildlife but not of the habitat on which wildlife's survival ultimately depends. Property owners are also habitat owners, and their collective actions have a profound effect on the state's wildlife.

The WDW data gives you information on the location of many of Washington's most sensitive and vulnerable wildlife resources. Use of this information must be commensurate with the vulnerability of wildlife resource.

Wildlife species are protected through specific legislation. Regulations most applicable to users of WDW information include RCW 77.16.120 (Taking of protected wildlife), WAC 232-12-292 (Bald Eagle protection rules), and WAC 232-12-064 (Live wildlife).

I have read and understand the information above.

I understand that the species and habitats covered by this information are especially sensitive to human disturbance.

I understand human disturbance may be direct or indirect, and may occur intentionally or unintentionally.

I understand that I have an obligation to use this information in a way that does not cause undue harm to the wildlife resource.*

I understand that WDW information is dynamic, with species changing distribution and with new information on species and habitats being incorporated into the data over time.

* Use caution when providing this information to others: communicate the above information to any party who receives.

REQUESTER'S SIGNATURE X

Use of Data: ENV REV -

Special Requests:

Geographic coverage of request [Specify in one of the following formats – **7.5 minute quad map name** (preferred), County name, legal description, 1:100,000 scale quad map name, USGS hydrologic unit. List here or attach listing.] T4N/R18E Sect 31-35
T3N R18E Sect 2-6
T3N R17E Sec 1-4, 7-11
BPA.PRN T3N R16E 1, 10-15, 22-26

Mail completed form to: WDW, PHS Program, 600 Capitol Way N, Olympia, WA 98501-1091

(over)

BPA

WASHINGTON DEPT OF WILDLIFE

PRIORITY HABITATS AND SPECIES
Tabular Data Report - General Information - DRAFT
2/15/1994

FORM NUMBER: 901,169
SPECIES/HABITAT: TALUS

SPECIES USE:
SEASON OF USE:

DEFINITION: 5
MAP ACCURACY: 1

SITENAME: JOHN DAY TALUS

GENERAL DESCRIPTION -
TALUS ABOVE JOHN DAY DAM

SOURCES OF INFORMATION-
DATE: 100692 CITATION: ANDERSON, DAVID-WDW BIOLOGIST
SYNOPSIS-
LARGE STEEP TALUS AREA

DATE: 100692 CITATION: MORRISON, DAN-WA MANAGER
SYNOPSIS-

PRIORITY HABITATS AND SPECIES
Tabular Data Report - General Information - DRAFT
2/15/1994

FORM NUMBER: 901,170
SPECIES/HABITAT: CLIFF

SPECIES USE:
SEASON OF USE:

DEFINITION: 5
MAP ACCURACY: 1

SITENAME: JOHN DAY CLIFFS

GENERAL DESCRIPTION -
CLIFFS ABOVE JOHN DAY

SOURCES OF INFORMATION-

DATE: 100692 CITATION: MUSSER, GLENN-WDW AGENT
SYNOPSIS-

DATE: 100692 CITATION: ANDERSON, DAVID-WDW BIOLOGIST; MORRISON, DAN-WDW WA MANAGER
SYNOPSIS-

WASHINGTON DEPT OF WILDLIFE

PRIORITY HABITATS AND SPECIES
Tabular Data Report - General Information - DRAFT
2/15/1994

FORM NUMBER: 901,173
SPECIES/HABITAT: RIPAR

SPECIES USE:
SEASON OF USE:

DEFINITION: 5
MAP ACCURACY: 1

SITENAME: MARYHILL LOOPS

GENERAL DESCRIPTION -
RIPARIAN AREA AT MARYHILL

SOURCES OF INFORMATION-

DATE: 100692 CITATION: ANDERSON, DAVID-WDW BIOLOGIST
SYNOPSIS-

DATE: 100692 CITATION: MORRISON, DAN-WDW WA MANAGER
SYNOPSIS-

PRIORITY HABITATS AND SPECIES
Tabular Data Report - General Information - DRAFT
2/15/1994

FORM NUMBER: 901,182
SPECIES/HABITAT: OAK

SPECIES USE:
SEASON OF USE:

DEFINITION: 5
MAP ACCURACY: 2

SITENAME:

GENERAL DESCRIPTION -
OREGON WHITE OAK

SOURCES OF INFORMATION-

DATE: 102292 CITATION: MORRISON, DAN-WDW WA MANAGER
SYNOPSIS-

DATE: 102292 CITATION: MUSSER, GLENN-WDW AGENT
SYNOPSIS-

PRIORITY HABITATS AND SPECIES
Tabular Data Report - General Information - DRAFT
2/15/1994

FORM NUMBER: 905,251
SPECIES/HABITAT: ODHE

SPECIES USE: RSC
SEASON OF USE: W

DEFINITION: 5
MAP ACCURACY: 3

SITENAME: ROCK CREEK DRAINAGE

GENERAL DESCRIPTION -
BLACK-TAILED DEER WINTER RANGE-ROCK CREEK DRAINAGE

SOURCES OF INFORMATION-

DATE: 02 90 CITATION: MORRISON, DAN; MUSSER, GLEN WDW
SYNOPSIS-
OVER 10 YEARS OF ROUTINE PATROL AND MONITORING

DATE: 06 90 CITATION: MORRISON, DAN WDW; MCKORKLE, SCOTT YAKIMA INDIAN NATION BIOLOGIST
SYNOPSIS-
RADIO TELEMETRY STUDY INITIATED IN 1986 DOCUMENTING DEER WINTER USE RANGES AND M
OVEMENTS, STUDY TO CONTINUE THROUGH 1991.

13AA

SPECIES: Golden eagle NUMBER: 413- 1 CLASS:SA CRIT:B
INDEXCODE: DF.370 REGION: 5
DATAPT: 12 COUNTY: KLICKITAT
YEAR: 1986 QUADCODE: 4512066
FED STAT: TRS: T03N R17E S16 NEOFNE
STA STAT: SC OWNCODE: ST DNR
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
JOHN DAY DAM TERR. GOLDEN EAGLE NEST ON CLIFF. 2 YG IN 1986.

SPECIES: Prairie falcon NUMBER: 51- 1 CLASS:SA CRIT:B
INDEXCODE: DG.952 REGION: 5
DATAPT: 1 COUNTY: KLICKITAT
YEAR: 1988 QUADCODE: 4512066
FED STAT: TRS: T03N R17E S16 NE
STA STAT: SM OWNCODE: ST DNR
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
JOHN DAY NORTHEAST TERR, PRAIRIE FALCON EYRIE. EYRIE NOT CONFIRMED BY ALLEN & S
LLIVAN, 4-81.

SPECIES: Western gray squirrel NUMBER: 219- 1 CLASS:SA CRIT:B
INDEXCODE: FG.B63 REGION: 5
DATAPT: 1 COUNTY: KLICKITAT
YEAR: 1993 QUADCODE: 4512076
FED STAT: TRS: T03N R17E S08 SEOFNE
STA STAT: ST OWNCODE: PVTUUU
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
WESTERN GRAY SQUIRREL. 2 SQUIRRELS SEEN AND 27 NESTS FOUND IN THIS DRAINAGE
OCCURRING IN P. PINE. LOCATION IS EAST OF HWY 97 IN UPPER SWALE CREEK
DRAINAGE.

SPECIES: Western gray squirrel NUMBER: 219- 2 CLASS:SA CRIT:B
INDEXCODE: FG.B63 REGION: 5
DATAPT: 2 COUNTY: KLICKITAT
YEAR: 1993 QUADCODE: 4512076
FED STAT: TRS: T03N R17E S08 NEOFSE
STA STAT: ST OWNCODE: PVTUUU
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
WESTERN GRAY SQUIRREL. 2 SQUIRRELS SEEN AND 27 NESTS FOUND IN THIS DRAINAGE
OCCURRING IN P. PINE. LOCATION IS EAST OF HWY 97 IN UPPER SWALE CREEK
DRAINAGE.

SPECIES: Western gray squirrel NUMBER: 219- 3 CLASS:SA CRIT:B
INDEXCODE: FG.B63 REGION: 5
DATAPT: 3 COUNTY: KLICKITAT

YEAR: 1993 QUADCODE: 4512076
FED STAT: TRS: T03N R17E S09 SWOFSW
STA STAT: ST OWNCODE: PVTUUU
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
WESTERN GRAY SQUIRREL. 2 SQUIRRELS SEEN AND 27 NESTS FOUND IN THIS DRAINAGE OCCURRING IN P. PINE. LOCATION IS EAST OF HWY 97 IN UPPER SWALE CREEK DRAINAGE.

SPECIES: Western gray squirrel NUMBER: 219- 4 CLASS:SA CRIT:B
INDEXCODE: FG.B63 REGION: 5
DATAPT: 4 COUNTY: KLICKITAT
YEAR: 1993 QUADCODE: 4512076
FED STAT: TRS: T03N R17E S09 SWOFNW
STA STAT: ST OWNCODE: PVTUUU
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
WESTERN GRAY SQUIRREL. TWO SQUIRRELS SEEN AND 27 NESTS FOUND IN THIS DRAINAGE OCCURRING IN P. PINE. LOCATION IS EAST OF HWY 97 IN UPPER SWALE CREEK DRAINAGE.

SPECIES: Western gray squirrel NUMBER: 222- 1 CLASS:SA CRIT:B
INDEXCODE: FG.B63 REGION: 5
DATAPT: 21 COUNTY: KLICKITAT
YEAR: 1993 QUADCODE: 4512075
FED STAT: TRS: T04N R18E S32 SEOFNW
STA STAT: ST OWNCODE: PVTUUU
PRECISION: LOCATION SHOWN ACCURATE TO 1/4 MI RADIUS & CONFIRMED BY WDG.
GENERAL DESCRIPTION:
WESTERN GRAY SQUIRREL NEST NORTH OF COLUMBIA HILLS EAST OF GOLDENDALE.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192
(206) 753-9440 FAX: (206) 753-9008

FILE COPY

January 27, 1994

Vanessa L. Artman
Dames & Moore
500 Market Place Tower
2025 First Avenue
Seattle, Washington 98121

FWS Reference: 1-3-94-SP-117

Dear Ms. Moore:

This is in response to your letter dated November 23, 1993 and received in this office on November 24. Enclosed is a list of listed threatened and endangered species, and candidate species (Attachment A), that may be present within the area of the proposed Windplant Project Area, near Goldendale, in Klickitat County, Washington. The list fulfills the requirements of the Fish and Wildlife Service (Service) under Section 7(c) of the Endangered Species Act of 1973, as amended (Act). We have also enclosed a copy of the requirements for Bonneville Power Administration (BPA) compliance under the Act (Attachment B).

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the BPA should request Section 7 consultation through this office. If the biological assessment determines that the proposed action is "not likely to adversely affect" a listed species, the BPA should request Service concurrence with that determination through the informal consultation process. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Candidate species are included simply as advance notice to federal agencies of species which may be proposed and listed in the future. However, protection provided to candidate species now may preclude possible listing in the future. If early evaluation of your project indicates that it is likely to adversely impact a candidate species, the BPA may wish to request technical assistance from this office.

In addition, please be advised that federal and state regulations may require permits in areas where wetlands are identified. You should contact the Seattle District of the U.S. Army Corps of Engineers for federal permit requirements and the Washington State Department of Ecology for state permit requirements.

Your interest in endangered species is appreciated. If you have additional questions regarding your responsibilities under the Act, please contact Jim Michaels or Kristi Swisher of this office at the letterhead phone/address.

Sincerely,

David C. Frederick
State Supervisor

ks/kr
Enclosures
SE/BPA/1-3-94-SP-117/Klickitat
c: WDW, Region 5
WNHP, Olympia

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES WHICH MAY OCCUR WITHIN THE VICINITY OF THE PROPOSED
WINDPLANT PROJECT AREA, NEAR GOLDENDALE (No. 27772-001-020),
IN KLICKITAT COUNTY, WASHINGTON
(T3N R16E S1/10-15/22-26; T3N R17E S1-4/7-11/18;
T3N R18E S2-6; T4N R18E S31-35)

FWS Reference: 1-3-94-SP-117

LISTED

Bald eagle (*Haliaeetus leucocephalus*), threatened - wintering bald eagles may occur in the vicinity of the project from October 31 through March 31.

Major concerns that should be addressed in your biological assessment of the project impacts to listed species are:

1. Level of use of the project area by listed species.

2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas in all areas influenced by the project.

3. Impacts from project construction (i.e., habitat loss, increased noise levels, increased human activity) which may result in disturbance to listed species and/or their avoidance of the project area.

PROPOSED

None

CANDIDATE

The following candidate species may occur in the vicinity of the project:

Black tern *(Chlidonias niger)*
Bull trout *(Salvelinus confluentus)*
Loggerhead shrike *(Lanius ludovicianus)*
Western sage grouse *(Centrocercus urophasianus phaios)*

ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects *

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Division, 3704 Griffin Lane SE, Suite 102, Olympia, WA 98501-2192.

* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

1-3-94-SP-117

due 2/4/94

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

In reply refer to: RAE

U.S. FISH & WILDLIFE SERVICE
FISH & WILDLIFE ENHANCEMENT
OLYMPIA, WA

JAN 06 1994

RECEIVED

January 5, 1994

Ms. Kim Flottin
U.S. Fish & Wildlife Service
Fish and Wildlife Enhancement
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192

Dear Kim:

Bonneville Power Administration (BPA) is considering a request to provide transmission services for the electricity produced from a wind energy project proposed by U.S. Windpower, Inc. The proposed project location is in Klickitat County, Washington. The legal description is as follows:

T4N, R18E, Sections 31 through 35,
T3N, R18E, Sections 2 through 6,
T3N, R17E, Sections 1 through 4 and 7 through 11,
T3N, R16E, Sections 1, 10 through 15, and 22 through 26.

In order to assess potential environmental impacts and as required by Section 7(c) of the amended Endangered Species Act of 1973, we are requesting a listing of the candidate, listed and proposed endangered or threatened species habitat in the proximity of the proposed project location. This will help us determine the appropriate level of environmental analysis required by the National Environmental Policy Act (NEPA).

I understand your response normally takes between 14 and 30 days to complete. Please mail your response to the letterhead address, attention Kathy Fisher, RAE.

Sincerely,

Kathy Fisher

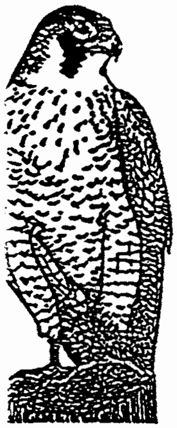
Kathy Fisher
Environmental Specialist

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
3704 Griffin Lane SE, Suite 102
Olympia, WA 98501-2192

From the desk of: Jodi Bush, Fish & Wildlife Biologist



Peregrine falcon

Eskimo Curlew

Dear Ms. Fisher:

Enclosed please find a copy of a species request for Dames & Moore and your area of concern. The species list (1-3-94-SP-117), was sent to them on January 27, 1994.

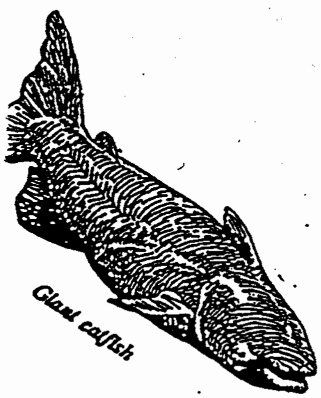
If you require more information, please feel free to contact me at the above address or call (206) ~~357~~-9440.
753

Thank you for your time.

Jodi L. Bush

s Island Tree snail

Northern Rocky Mountain Wolf



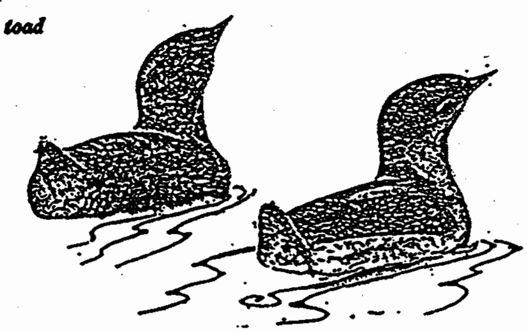
Giant catfish

ll's Hole Pupfish

Houston toad

Grizzly bear

Tiger



Marbled murrelet

Bald eagle

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192
(206) 753-9440 FAX: (206) 753-9008

June 23, 1993

Kathy Fisher, RAE
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

FWS Reference: 1-3-93-SP-565

Dear Ms. Fisher:

This is in response to your letter dated April 15, 1993 and received in this office on April 19, 1993. Enclosed is a list of listed threatened and endangered species, and candidate species (Attachment A), that may be present within the area of the proposed purchase of power from a proposed wind energy demonstration project, near Goldendale in Klickitat County, Washington. The list fulfills the requirements of the Fish and Wildlife Service (Service) under Section 7(c) of the Endangered Species Act of 1973, as amended (Act). We have also enclosed a copy of the requirements for Bonneville Power Administration (BPA) compliance under the Act (Attachment B).

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the BPA should request Section 7 consultation through this office. If the biological assessment determines that the proposed action is "not likely to adversely affect" a listed species, the BPA should request Service concurrence with that determination through the informal consultation process. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Candidate species are included simply as advance notice to federal agencies of species which may be proposed and listed in the future. However, protection provided to candidate species now may preclude possible listing in the future. If early evaluation of your project indicates that it is likely to adversely impact a candidate species, the BPA may wish to request technical assistance from this office.

There may be other federally listed species that may occur in the vicinity of your project which are under the jurisdiction of the National Marine Fisheries Service (NMFS). Please contact NMFS at (503) 230-5430 to request a species list.

In addition, please be advised that federal and state regulations may require permits in areas where wetlands are identified. You should contact the Seattle District of the U.S. Army Corps of Engineers for federal permit requirements and the Washington State Department of Ecology for state permit requirements.

Your interest in endangered species is appreciated. If you have additional questions regarding your responsibilities under the Act, please contact Jim Michaels or Camille Bennett of this office at the letterhead phone/address.

Sincerely,

For David C. Frederick
State Supervisor

cb/blk
Enclosures
SE/BPA/1-3-93-SP-565/Klickitat Co
c: WDW, Olympia (Nongame)
WNHP, Olympia

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES WHICH MAY OCCUR WITHIN THE VICINITY OF THE PROPOSED PURCHASE OF POWER FROM A PROPOSED WIND ENERGY DEMONSTRATION PROJECT, NEAR GOLDENDALE, IN KLICKITAT COUNTY WASHINGTON
(T3N R17E S18; T5N R16E S13/14)

1-3-93-SP-565

LISTED

Peregrine falcon (*Falco peregrinus*) - spring and fall migrant falcons may occur in the vicinity of the project.

Bald eagle (*Haliaeetus leucocephalus*) - wintering bald eagles may occur in the vicinity of the project from about October 31 through March 31.

Major concerns that should be addressed in your biological assessment of the project impacts to listed species are:

1. Level of use of the project area by listed species.

2. Effect of the project on listed species' primary food stocks and foraging areas in all areas influenced by the project.

3. Impacts from project construction and/or implementation (i.e., habitat loss, increased noise levels, increased human activity) which may result in disturbance to listed species and/or their avoidance of the project area.

PROPOSED

None.

CANDIDATE

Black tern (*Chlidonias niger*) - may occur in the vicinity of the project.

Bull trout (*Salvelinus confluentus*) - may occur in the vicinity of the project.

Loggerhead shrike (*Lanius ludovicianus*) - may occur in the vicinity of the project.

· ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects *

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Division, 3704 Griffin Lane SE, Suite 102, Olympia, WA 98501-2192.

---

* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

BPA ASC6 Oct 19 '93 11:50 No.011 P.07

CURT SMITCH
Director

STATE OF WASHINGTON
DEPARTMENT OF WILDLIFE
600 Capitol Way North • Olympia Washington 98501-1091 • (206) 753-5700

April 22, 1993

Kathy Fisher
DOE - BPA
P.O. Box 3621
Portland, OR 97208-3621

Re: Species of Importancein the vicinity of T. 33 N., R. 17 E., Sec. 18 and T. 3 N., R. 16 E., Sec. 13, 14

Dear Ms. Fisher:

We have completed a review of WDW's databases containing locations of species and habitats of importance (Nongame Heritage, Priority Habitats and Species, and Washington Rivers Information System databases) in your project area. At this time we have no information on important animal species or habitats within a one mile radius of your project section.

High resolution maps are also available to provide more detailed locational data if needed for an additional cost. If important species or habitats are found within the vicinity of your project area, the WDW's Management Reccommendations for Priority Habitats and Species document is included in this packet as well as a computer report containing more information about the occurrence(s).

Please note that sensitive information (ie. threatened, endangered and/or candidate species) may be included in this data request. These species are vulnerable to disturbance and harassment. In order to protect the viability of these species we request that you not dosseminate the information as to their whereabouts. Please refer to these species' presence in general terms. For example: A Peregrine Falcon is located within two miles of the project area.

The information provided for this data request only includes data that WDW maintains in a centralized data system. It is not an attempt to provide you with an *official agency response as* to the impacts of your project on wildlife. Nor is it designed to provide you with any guidance on interpretting this information and determining how to proceed in consideration of wildlife. This data only documents the location of important wildlife resources to the best of our knowledge.

Your project may require further field inspection or contacting our field biologists or others in WDW to assist you in interpreting and applying these data. Refer to the enclosed directory and regional map for those contacts. Generally, for assistance on specific projects contact the appropriate Regional office and ask for the Area Habitat Biologist for your project area.

Data in this package are dynamic. These data should not be used for future projects. Please request new information rather than use outdated information.

Because of the high volume of data requests for information that WDW receives, we need to charge for these data searches to recover some of our costs. On the back of the enclosed Data Order Form is an invoice itemizing the costs for your data search and instructions for submitting payment.

We hope these products fill your needs. If you have any questions regarding the data you have received please call Jennifer McPeck at (206) 438-8894. For all other questions, please call Lea Knutson at (206) 664-9476.

Sincerely,

Jennifer McPeck

Jennifer McPeck, Cartographic Technician
GIS/PHS Data Systems

Enclosures.

Mailed 4/15/93

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

In reply refer to: RAE

April 15, 1993

Ms. Harriet Allen
State Biologist
State of Washington Dept. of Wildlife
600 Capitol Way North
Olympia, Washington 98501-1091

Dear Harriet:

Bonneville Power Administration (BPA) is considering purchasing electricity produced from a proposed wind energy demonstration project. The proposed project location is in Klickitat County, Washington; the legal description is T3N, R17E, Section 18 and T3N, R16E, Sections 13 and 14. In order to assess potential environmental impacts, we are requesting a listing of any significant observations of species of concern in the proximity of the proposed project location. Species of concern include any that are considered by the State of Washington to be candidate, proposed or listed as endangered or threatened.

I understand your response is not to be construed as a complete inventory of the project area and does not eliminate Bonneville's need or responsibility to conduct more thorough research. We will use your response to help us determine the appropriate level of environmental analysis required by the National Environmental Policy Act (NEPA). Please mail your response to the letterhead address, attention Kathy Fisher, RAE.

Sincerely,

Kathy Fisher

Kathy Fisher
Environmental Specialist

mailed 4/15/93 KPF

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

In reply refer to: RAE

USFWS - 206-753-9444
5/27/93 - John Engbring will return call - Kim is in the field. John took info - he will see if he can track it down - running late on things.
6/24/93 - typed + will be in the mail tomorrow per J. Engbring's replacement.

April 15, 1993

Ms. Kim Flottin
U.S. Fish & Wildlife Service
Fish and Wildlife Enhancement
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192

Dear Kim:

Bonneville Power Administration (BPA) is considering purchasing firm power produced from a proposed wind energy demonstration project. The proposed project location is in Klickitat County, Washington; the legal description is T3N, R17E, Section 18 and T3N, R16E, Sections 13 and 14. In order to assess potential environmental impacts and as required by Section 7(c) of the amended Endangered Species Act of 1973, we are requesting a listing of the candidate, listed and proposed endangered or threatened species habitat in the proximity of the proposed project location. This will help us determine the appropriate level of environmental analysis required by the National Environmental Policy Act (NEPA).

I understand your response normally takes between 14 and 30 days to complete. Please mail your response to the letterhead address, attention Kathy Fisher, RAE.

Sincerely,

Kathy Fisher

Kathy Fisher
Environmental Specialist

Appendix B. Bird Observation Data Variables to Be Collected and Codes to Use on Field Data Forms

Appendix B. Bird Observation Data Variables to Be Collected and Codes to Use on Field Data Forms

Each observation made by the surveyor at a given observation station and time period will be recorded on a field data form. An example field data form is provided in Appendix C. The field data forms will be filled out completely, identifying the species observed, time of observation, weather conditions, location of avian activities, type of movement, and type of habitat over which movement occurred. The following sections identify, in detail, the types of information that will be observed and recorded, as well as how the data will be recorded. The data to be collected generally can be categorized as: (1) type, location, and time of the survey observations, (2) weather characteristics at the time of observations, and (3) species and flight characteristics of the bird observed.

TYPE, LOCATION, AND TIME OF SURVEY

B.1 Observation Number

A uniquely assigned number for each observation made.

B.2 Date of Observations

A six-digit code will be used, using two digits for the month, day, and year. For example, May 9, 1994, will be recorded as: 050994.

B.3 Time of Observation

Military time will be used to record the time that an observation was made. For example, 2 p.m. will be recorded as 1400. We will use Pacific Standard Time or Pacific Daylight Time, whichever is in effect at the time of the survey. The date when conversion occurs from Pacific Standard Time to Pacific Daylight Time (April 3) and back in the fall will be noted independently by the avian study leader so that field recorded times can be adjusted during the data analysis phase of the project. This will ensure that the time of all recorded observations will be standardized.

B.4 Station Number

Fixed point observation stations for migration and summer surveys have been numbered sequentially. The stations were numbered by starting in the northwest corner of the study area and proceeding southward, then moving eastward to the next column of stations and proceeding from north to south again, and so on, ending in the southeast portion of the study area. Each station will be referred to by its designated number regardless of the order in which it is surveyed.

B.5 Duration of Species in Unit

The amount of time that each bird(s) observation is within the 1-kilometer (0.62-mile) observation zone will be recorded in minutes or seconds, as appropriate.

B.6 Survey Type

Survey types to be recorded include:

1. Fixed Point (FP)
2. Transect (TS)
3. Breeding Survey (BS)
4. Incidental (IN): includes any observation not made during any of the more formal survey types.

B.7 Study Unit

The entire study area has been divided into five study units based upon similarity in topography, vegetation, and overall similarities of features. The study units include:

1. Western Hills (WH).

   This unit includes the steep, rounded hills located on the western quarter of the primary study area. The entire unit is grassland.

2. Eastern Hills (EH).

   This unit includes the steep, rounded hills located on the eastern quarter of the primary study area. The unit contains mostly grassland interspersed with a few parcels of cropland.

3. Ridge Top (RT).

This unit includes lands within 0.5 kilometer (0.3 mile) north of the ridge line, where the ridge face peaks and begins to gently slope downward to the north. The unit contains grassland along rolling topography connecting the various points (e.g., Juniper and Clauson) along the ridge top. These points are separated by shallow gaps (also known as saddles).

4. Ridge Face (RF).

This unit includes the ridge that dominates the study area. The ridge is composed of the steep, south-facing slopes and cliffs situated on the southern edge of the study area (between the western hills and eastern hills study units). This study unit begins approximately 1 kilometer (0.6 mile) west of Juniper Point and continues about 13 kilometers (8 miles) east. The ridge is paralleled by SR 14 to the south.

5. Northern Plateau (NP).

This unit includes lands beginning 0.5 kilometer (0.3 mile) north of the ridgeline and continuing north to the northern limit of the study area. The unit contains grassland and oak/pine woodland in the southern portion and agricultural lands (mostly pasture) in the northern portion.

B.8 Time Period

In addition to the time of day when an observation occurs, the time period in which it occurs will be recorded. Codes for military time periods include:

1. dawn (DWN) = from 1 hour before sunrise to sunrise
2. morning (MRN) = sunrise to 1000
3. mid-day (MDY) = 1000 to 1400
4. afternoon (AFT) = 1400 to 1800
5. evening (EVN) = 1800 to sunset
6. dusk (DSK) = sunset to 1 hour after sunset
7. night (NIT) = between dusk and dawn

WEATHER CHARACTERISTICS

B.9 Temperature

The temperature will be recorded at each fixed point station in degrees Fahrenheit using a standard outdoor thermometer. All avian observations made during a given time period at a given station will receive the same temperature rating. The thermometer will be kept out of direct sunlight for the first half of the observation period to ensure that it has reached equilibrium from any influences from vehicle temperatures, body temperatures, and direct sunlight. Temperatures will be recorded to the nearest whole degree. For example, a temperature of 76°F will be recorded as 76.

B.10 Wind Characteristics

Wind characteristics to be recorded include the wind speed at the time of the avian observations, as well as whether it was a gusting or steady wind condition.

B.10.1 Wind Speed

Wind speed will be measured using a Dwyer wind meter. The meter measures wind speed in miles per hour (mph). Wind speed will be measured with each observation, because winds may change dramatically over the course of a few minutes. If no observations are made, then the wind speed will be recorded at the end of the survey time limit.

B.10.2 Wind Conditions

In addition to wind speed, the surveyor will record the following types of wind conditions:

1. Steady Winds
2. Gusty Winds

B.11 Wind Direction

B.11.1 Ground-Level Wind Direction

Ground-level wind direction will be determined based upon the surveyor's determination of the direction relative to the nearest compass bearing. Compass bearings will be recorded as the wind coming from the following directions:

1. North (NO)
2. Northwest (NW)
3. West (WE)
4. Southwest (SW)
5. South (SO)
6. Southeast (SE)

7. East (EA)
8. Northeast (NE)

B.11.2 High Altitude Wind Direction

In addition to ground-level wind direction, high altitude wind direction will be observed based upon the movement of high elevation clouds. The surveyor will note the high altitude wind direction in a field journal, along with other notes regarding weather conditions that are not specifically listed on the standardized field data forms or this protocol. If no clouds are available to determine direction, or if the direction cannot otherwise be determined, "unknown" will be recorded.

B.12 Cloud Cover and Visibility

B.12.1 Cloud Cover

Cloud cover will be measured as "percentage of cover" by ocular estimate. The surveyor will record cloud cover to the nearest 10% (e.g, 50%, 60%, etc.).

B.12.2 Visibility

Visibility within the 1-kilometer (0.62-mile) observation zone will be recorded based upon the existence of fog and the distance that can be seen by the surveyor. The surveyor will record the visibility using the following conventions:

1. Clear (C)
2. Fog (F)

The surveyor will also estimate the number of feet of visibility. Visibility will be estimated using topographic features (e.g., a ridge, draw, or point) compared with a known observation location (e.g., section line) on a U.S. Geological Survey topographic map to be carried by each surveyor. For example, the surveyor will record a visibility of 30 feet as 30.

B.13 Precipitation

Type of precipitation occurring at the time of each observation will be recorded by the surveyor using the following codes:

1. Dry (D)
2. Light rain or drizzle (L)

3. Rain (R)
4. Other (O) (refers to comment section)

AVIAN SPECIES AND FLIGHT CHARACTERISTICS

B.14 Species of Primary Concern

B.14.1 Identifiable Species

Species identified as being of primary concern for this study and observed during field surveys will be recorded on field forms using the data codes identified below. To avoid possible misidentification of species, field surveyors will record an observed species only if the surveyor is certain of the species' identification. The following species will be identified during field studies:

Eagles

01. bald eagle
02. golden eagle

Falcons

03. peregrine falcon
04. prairie falcon
05. American kestrel
06. merlin

Other Raptors

07. turkey vulture
08. northern goshawk

Hawks

09. Cooper's hawk
10. sharp-shinned hawk
11. red-tailed hawk
12. rough-legged hawk
13. ferruginous hawk
14. Swainson's hawk

Other Species

15. burrowing owl
16. long-billed curlew
17. loggerhead shrike
18. black tern
19. western sage grouse
20. waterfowl (specific species or species group identified in comments)

Passerines (song birds)

21. western blue bird
22. mountain blue bird
23. other passerine (identified in comments)

B.14.2 Unidentifiable Species

For all survey methods, avian observations that cannot be identified to the species level will be recorded using the following standard codes:

24. Unidentified Raptor (URP).

    Identified as a falcon, hawk (including harrier), owl, or raven, but not certain which one it is. This will likely be used mostly for brief, long-distance sightings.

25. Unidentified Hawk, Eagle, or Vulture (UHE).

    Identified as a raptor, but the surveyor knows it is not a raven.

26. Unidentified Hawk (UIH).

    Identified as a buteo or accipiter hawk, but the surveyor is not certain which one it is.

27. Unidentified Eagle (UIE).

    Identified as an eagle, but the surveyor cannot determined if it is a bald or golden eagle.

28. Unidentified Accipiter (UIA).

    Identified as an accipiter, but the surveyor is uncertain about what species it is.

29. Unidentified Large Falcon (ULF).

    Identified as either a prairie falcon or peregrine falcon, but the surveyor is not certain which one it is.

30. Unidentified Small Falcon (USF).

    Identified as either an American kestrel or merlin, but the surveyor is not certain which one it is.

B.15 Number of Birds Observed

If two or more individuals of the same species are observed flying together at the same time, one observation will be recorded and the number of individuals will be recorded in the designated space.

B.16 Location of Observed Avian Activity

This information will include the observed location of avian activity at first detection (either an individual or group exhibiting flocking behavior). The location will be recorded at the quarter-section level, specifying township, range, section, quarter-section, or other spacial references. For example, an observation occurring in Township 4 North, Range 17 East, and the southwest quarter of Section 7 would be recorded as T4N R17E S07SW.

The following codes will be used to record the township (T) and range (R) locations of observations:

1. North (N)
2. West (W)
3. South (S)
4. East (E)

The following codes will be used to record the quarter-section (S) locations of observations:

1. Northwest (NW)
2. Southwest (SW)
3. Southeast (SE)
4. Northeast (NE)

In addition, actual siting locations will be mapped on topographic maps. This will provide the option of analyzing siting locations at a finer scale than quarter sections if field findings indicate it is appropriate to do so (see Section 3.3.3).

B.17 Flight Behavior

The surveyor will note the type of flight behavior exhibited by each observed species, using the following codes:

1. Passing Through the Area (PT).

   Used when a bird apparently is moving from one place to another and not displaying the searching behavior more typical of foraging birds.

2. Courtship Flight/Pair Bonding (CF).

   Includes talon grasping, tumbling, synchronous soaring, parachuting, or other obvious displays of courtship behavior.

3. Foraging (FG).

   Used when a bird is obviously searching for food, with head down and moving from side to side, when moving in a "criss-cross" or "zig-zag" search pattern. This will typically include birds at lower elevations.

4. Aggressive Interaction (AG).

   Used to describe strikes, "divebombing", violent talon clasping, or other obvious displays of aggression.

5. Other Behaviors (OB).

   Refers the surveyor and reviewers to the comment section of the field data form for additional information.

B.18 Flight Pattern

The flight patterns observed will be described using the following classifications. The flight pattern is for first detection.

1. Perched (P).

   If a bird is perching, the structure used for perching will also be recorded in the comment section using the following codes:

   1. telephone pole (P)
   2. transmission line tower (T)
   3. transmission line (L)
   4. fence (F)

5. tree (E)
6. ground (G)
7. rock outcrop (R)

For example, a bird perching in a tree would be recorded on the field data form as PE.

2. Soaring (SR).

Circling flight, typically when a bird is using a thermal or an updraft.

3. Flapping (FP).

Powered flight, used when most of the bird's movement is powered by wing flaps, with little gliding.

4. Slow Gliding (SG).

Used to describe a bird moving in a relatively straight line (as opposed to circling) with wings in full or mostly full extension and the tail mostly fanned.

5. Moderate Gliding (MG)

Used to describe when a bird is moving in a relatively straight line with wings partially extended (intermediate between slow and flexed gliding).

6. Flexed Gliding (FG).

Used to describe a bird moving in a relatively straight line with wings mostly flexed, or tucked back, and tail mostly closed. Typically when a bird is using strong, turbulent updrafts or when it is foraging close to the ground.

B.19 Flight Direction

The flight direction of each avian observation will be recorded by the surveyor as the direction toward which the bird is moving. Flight direction will be recorded using the following compass bearings:

1. North (NO)
2. Northwest (NW)
3. West (WE)
4. Southwest (SW)
5. South (SO)
6. Southeast (SE)

7. East (EA)
8. Northeast (NE)

B.20 Flight Path

The flight path will be described in terms of the type of topographic features that are traversed during the course of avian flight. Codes to be used by the surveyor to record this information include:

1. Flying parallel to ridge below ridgeline (PB)
2. Flying parallel to ridge along ridgeline (PA)
3. Flying parallel to ridge along ridgetop (PT)
4. Crossing ridge (CR)
5. Other Path Routes (OP). Refers the surveyor and reviewers to notes made in the comment section of the form. Also used when bird takes several flight paths.

B.21 Flight Altitude

Surveyors will observe two types of flight altitudes: the altitude at first observation and whether there is entrance into the critical altitude zone.

B.21.1 Altitude at First Observation

The surveyor will record a bird's altitude at first detection using the following categories of heights as measured in meters and feet:

1. = at ground level or 0 meters (0 feet)
2. = 0.1 to 7 meters (1 to 23 feet)
3. = 8 to 30 meters (24 to 99 feet)
4. = 31 to 45 meters (100 to 149 feet)
5. = 46 to 61 meters (150 to 199 feet)
6. = 62 to 91 meters (200 to 299 feet)
7. = 92 meters or more (300 feet or more)

Surveyors will calibrate their visual estimating ability by periodically viewing features of known height from various distances. Several meteorological and transmission towers in the area will be measured for height and used for such visual calibration.

B.21.2 Critical Altitude

In addition, field surveyors will note whether at any time the observed bird(s) flew within the critical altitude of between 7.5 and 58 meters (25 and 190 feet). The point(s) at which they enter this zone will also be recorded to the quarter-section and described in the comments section.

B.22 Habitat Traversed

The surveyor will record the type of habitat that the observed bird traversed during the time of first detection within the established observation zone of 1 kilometer (0.62 mile). The types of habitat to be observed and recorded include:

01. Open Grassland (OG).

    Areas dominated by grasses.

02. Shrub Steppe (SS).

    Areas containing greater than 20% cover of shrubs, including sagebrush and rabbitbrush.

03. Conservation Reserve Program Lands (CP).

    Lands containing planted perennial grasses, such as crested wheatgrass.

04. Juniper/Grassland (JG).

    Areas containing dispersed juniper among a well established grass groundcover.

05. Juniper/Rock (JR).

    Areas containing juniper dispersed among basalt outcrops or talus.

06. Rock (RK).

    Areas dominated by basalt outcrops or talus.

07. Oak (OK).

    Areas dominated by oak.

08. Oak-Pine (OP).

    Areas containing a combination of oak and ponderosa pine.

09. Pine-Fir (PF).

Areas containing a combination of ponderosa pine and Douglas-fir.

10. Ponds and Livestock Watering Areas (OW).

Includes small open water areas present in the northern portion of the study area.

11. Cropland (CL).

Areas under cultivation.

12. Pasture (PS).

Grass areas used as pasture in the northern portion of the study area.

13. Developed Areas (DA).

Areas containing houses, roads, stockyards, or other human developments.

B.23 Audio Recordings of Behavioral Observations

As time allows, field surveyors will augment field notes by using audio cassette recorders to verbally record observations of raptor flight behavior. In addition to behavior, observations such as color phase and other distinct features will be recorded. All recordings will be verbally tagged by date, time, and observation station location. These recorded notes will be transferred into written field notes or a word processing file not later than 1 week after the recording but will be transferred on the same day when possible. A note will be made on the field data form indicating whether such a narrative was recorded for a specific observation using the following codes:

1. Audio Recording Made
2. No Audio Recording

B.24 Observation In or Out of Fixed Survey Radius

For fixed point surveys only, the surveyor will record in the appropriate place on the field data form whether the avian observation occurs within or outside of the 1-kilometer (0.62-mile) observation zone. Codes include:

1. Inside (I)
2. Outside (O)
3. Not applicable (N)

B.25 Comments Section

This section will be used to record any additional information about the observations that cannot be coded under the above preestablished variables and codes.

Appendix C. Standard Field Data Form

OBSERVATION NO:__________ DATE:____________________ TIME OF OBSER: ______________

STATION NUMBER: __________ VISIT: I II III SPECIES:______________________________

Circle One Choice or Fill in Blank For Each Category

OBSERVATION IN OR OUT OF FIXED SURVEY RADIUS: 1. Inside 2. Outside 3. Not applicable

DURATION OF OBSERVATION IF WITHIN FIXED POINT RADIUS: _______ seconds / minutes (*circle appropriate unit*)

SURVEY TYPE: 1. Fixed Point 2. Transect 3. Breeding Survey 4. Incidental

STUDY UNIT:

TIME PERIOD: 1. Dawn (from 1 hour before sunrise to sunrise 2. Morning (sunrise to 1000h) 3. Mid-day (1000h to 1400h) 4. Afternoon (1400h to 1800h) 5. Evening (1800h to Sunset) 6. Dusk (Sunset to 1 hour after sunset) 7. Night (between dusk and dawn)

TEMPERATURE (°F): _________WIND SPEED (MPH): __________ WIND CONDITIONS: 1. Steady Winds 2. Gusty Winds

GROUND LEVEL WIND DIRECTION:
1. North 2. Northwest 3. West 4. Southwest 5. South 6. Southeast 7. East 8. Northeast 9. No measurable wind

HIGH ALTITUDE WIND DIRECTION:
1. North 2. Northwest 3. West 4. Southwest 5. South 6. Southeast 7. East 8. Northeast 9. Unknown

CLOUD COVER (%): __________ VISIBILITY: 1. Clear 2. Fog PRECIPITATION: 1. Dry 2. Light Rain or Drizzle 3. Rain 4. Other (refer to comment section) ____

IDENTIFIABLE OR UNIDENTIFIABLE SPECIES
01. Bald Eagle 02. Golden Eagle 03. Peregrine Falcon 04. Prairie Falcon 05. American kestrel 06. Merlin 07. Turkey Vulture
08. Northern Goshawk 09. Cooper's Hawk 10. Sharp-shinned Hawk 11. Red-tailed Hawk 12. Rough-legged Hawk
13. Ferruginous Hawk 14. Swainson's Hawk 15. Burrowing Owl 16. Long-billed Curlew 17. Loggerhead Shrike 18. Black Tern
19. Western Sage Grouse 20. Waterfowl (specific species or species group identified in comments)
21. Western Blue Bird 22. Mountain Bluebird 23. Other Passerine (identified in Comments)

24. Unidentifiable Raptor (Identifiable as a falcon, hawk (including harrier), owl, or raven, but not certain which one it is. This will likely be used mostly for brief, long-distance sightings).
25. Unidentifiable Hawk, Eagle, or Vulture (Identified as a raptor, but the surveyor knows it is not a raven).
26. Unidentifiable Hawk (Identified as a Buteo or accipiter hawk, but the surveyor is not certain which one it is).
27. Unidentified Eagle (Identified as an eagle, but the surveyor cannot determined if it is a bald or golden eagle).
28. Unidentified Accipiter (Identified as an accipiter, but the surveyor is uncertain about what species it is).
29. Unidentified Large Falcon (Identified as either a prairie falcon or peregrine falcon, but the surveyor is not certain which one it is).
30. Unidentified Small Falcon (Identified as either an American kestrel or merlin, but the surveyor is not certain which one it is).

NUMBER OF BIRDS OBSERVED:______________

LOCATION OF ACTIVITY: T____ R____ S____ QUARTER SECTION: 1. NW 2. SW 3. SE 4. NE

FLIGHT BEHAVIOR:
1. Passing Through the Area 2. Courtship Flight/Pair Bonding 3. Foraging 4. Aggressive Interaction
5. Other Behavior (Refers the surveyor and reviewers to the comment section of the field data form for additional information

____

FLIGHT PATTERN:
1. Perched– *if perched, choose one of the following*: 1. telephone pole 2. transmission line tower 3. transmission line 4. fence 5. tree 6. ground 7. rock outcrop 8. swimming
2. Soaring (Circling flight, typically when a bird is using a thermal or an updraft).
3. Flapping (Powered flight, used when most of the bird's movement is powered by wing flaps, with little gliding).
4. Slow Gliding (Used to describe a bird moving in a relatively straight line (as opposed to circling) with wings in full or mostly full extension and the tail mostly fanned).
5. Moderate Gliding (Used to describe when a bird is moving in a relatively straight line with wings partially extended (intermediate between slow and flexed gliding).
6. Flexed Gliding (Used to describe a bird moving in a relatively straight line with wings mostly flexed, or tucked back, and tail mostly closed. Typically when a bird is using strong, turbulent updrafts or when it is foraging close to the ground).

FLIGHT DIRECTION: 1. North 2. Northwest 3. West 4. Southwest 5. South 6. Southeast 7. East 8. Northeast

OBSERVATION NO:__________ DATE:____________________ TIME OF OBSER: ________________

FLIGHT PATH:
1. Flying parallel to ridge below ridgeline 2. Flying parallel to ridge along ridgeline 3. Flying parallel to ridge along ridgetop
4. Crossing Ridge 5. Other Path Routes. Refers the surveyor and reviewers to notes made in the comment section of the form. Also used when bird takes several flight paths.

FLIGHT ALTITUDE AT FIRST OBSERVATION:
1. = at ground level or 0 meters (0 feet).
2. = 0.1 to 7 meters (1 to 23 feet).
3. = 8 to 30 meters (24 to 99 feet).
4. = 31 to 45 meters (100 to 149 feet)
5. = 46 to 61 meters (150 to 199 feet)
6. = 62 to 91 meters (200 to 299 feet)
7. = 92 meters or more (300 feet or more)

CRITICAL ALTITUDE?: Yes No
In addition, field surveyors will note whether at any time the observed bird(s) flew within the critical altitude of between 7.5 and 58 meters (25 and 190 feet). The point(s) at which they enter this zone will also be recorded to the quarter-section and described in the comments section.

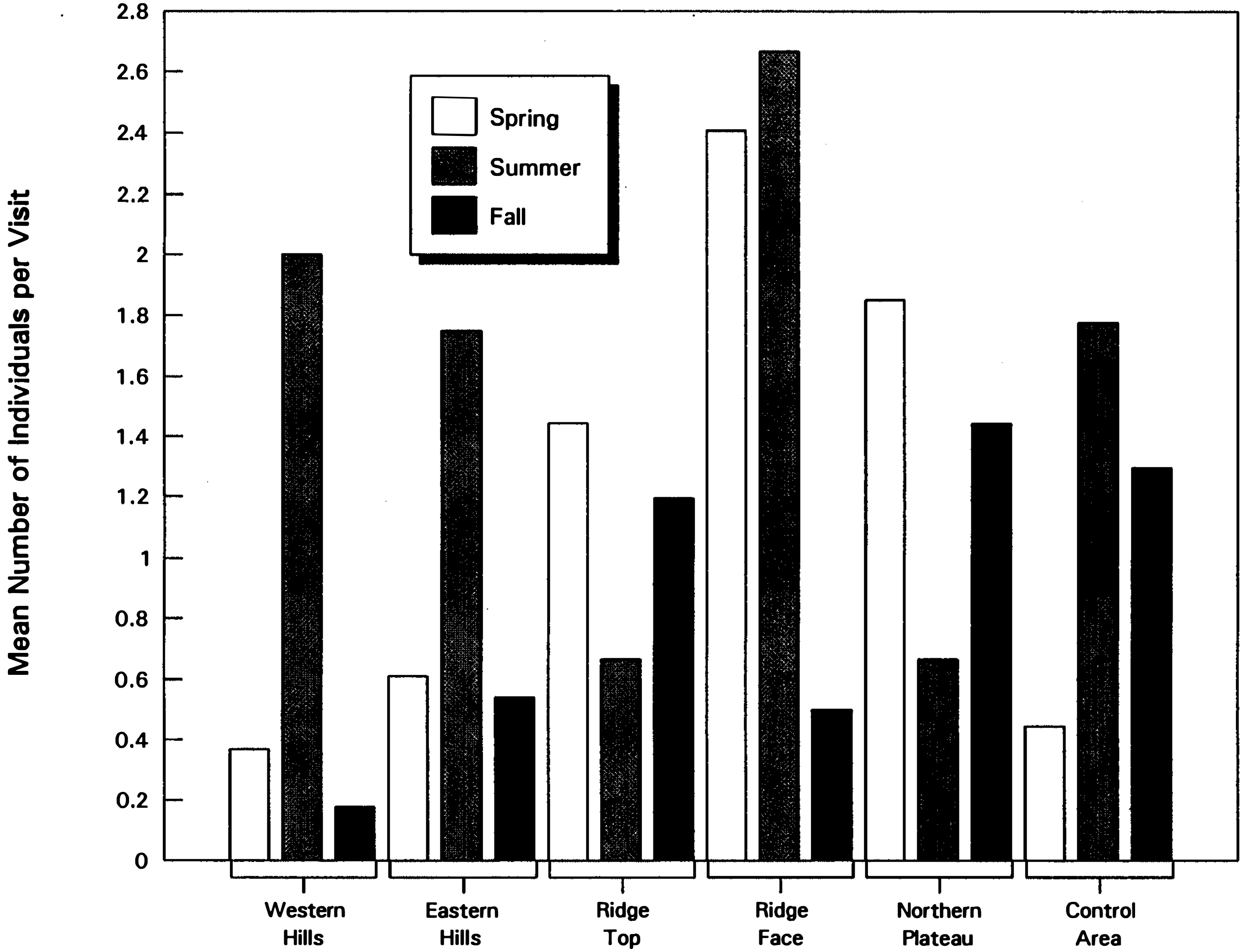
HABITAT TRAVERSED:
The surveyor will record the type of habitat that the observed bird traversed during the time of first detection within the established observation zone of 1 kilometer (0.62 mile). *Circle the appropriate habitat:*
01. Open Grassland. Areas dominated by grasses.
02. Shrub Steppe. Areas containing greater than 20 % cover of shrubs, including sagebrush and rabbitbrush.
03. Conservation Reserve Program Lands. Lands containing planted perennial grasses, such as crested wheatgrass.
04. Juniper/Grassland. Areas containing dispersed juniper among a well established grass groundcover.
05. Juniper/Rock. Areas containing juniper dispersed among basalt outcrops or talus.
06. Rock. Areas dominated by basalt outcrops or talus.
07. Oak. Areas dominated by oak.
08. Oak-Pine. Areas containing a combination of oak and ponderosa pine.
09. Pine-fir. Areas containing a combination of ponderosa pine and Douglas-fir.
10. Ponds and Livestock Watering Areas. Includes small open water areas present in the northern portion of the study area.
11. Cropland. Areas under cultivation.
12. Pasture. Grass areas used as pasture in the northern portion of the study area.
13. Developed Areas
14. Water (e.g. Columbia River)

AUDIO RECORDINGS OF BEHAVIORAL OBSERVATIONS: 1. Audio Recording Made 2. No Audio Recording

OBSERVER (S): ____

COMMENTS OR MAP, ETC:

Appendix D. Number of Sightings per Visit by Study Unit and Season



Jones & Stokes Associates, Inc.

Figure D-1
Mean Number of Raptors by Study Unit and Season

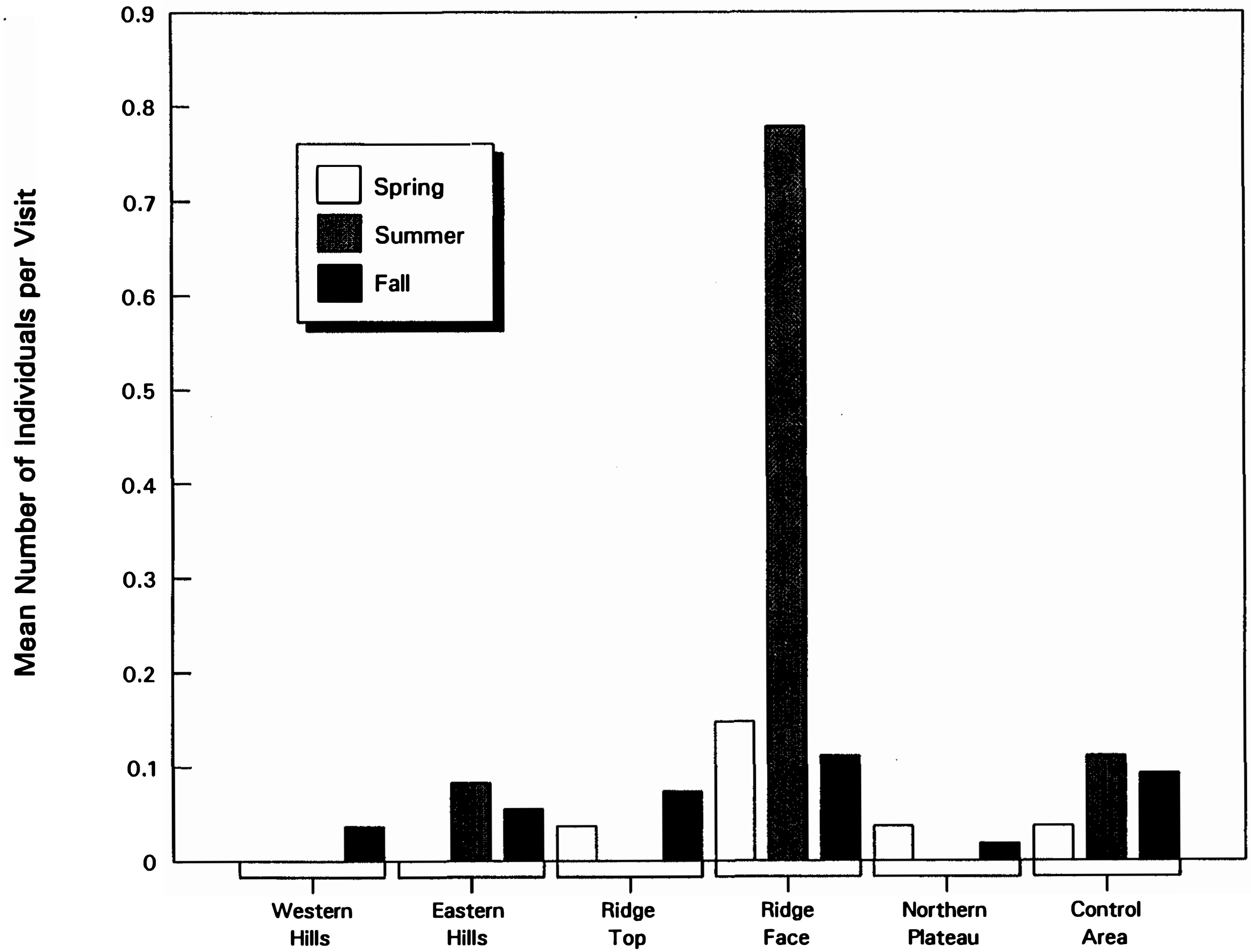
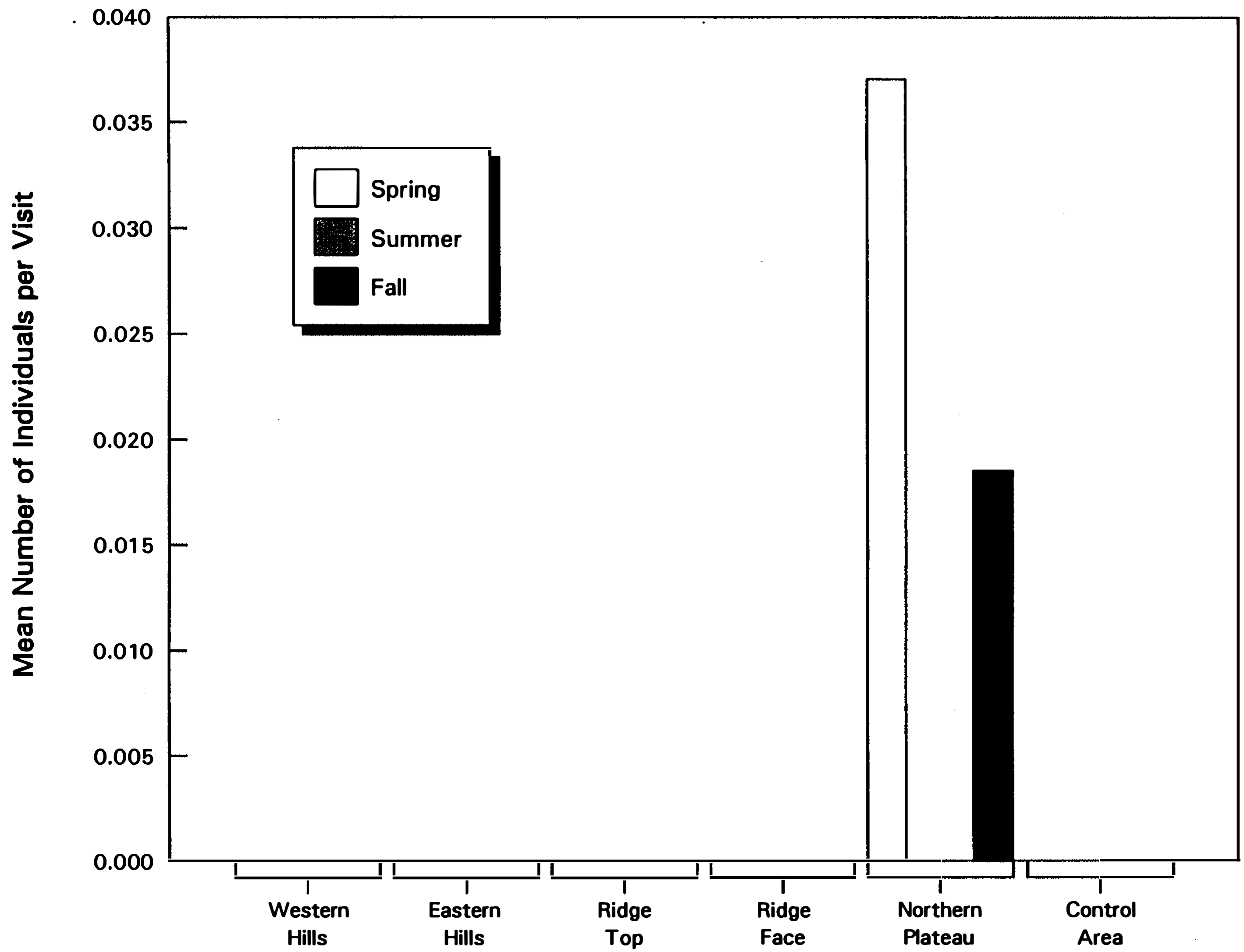
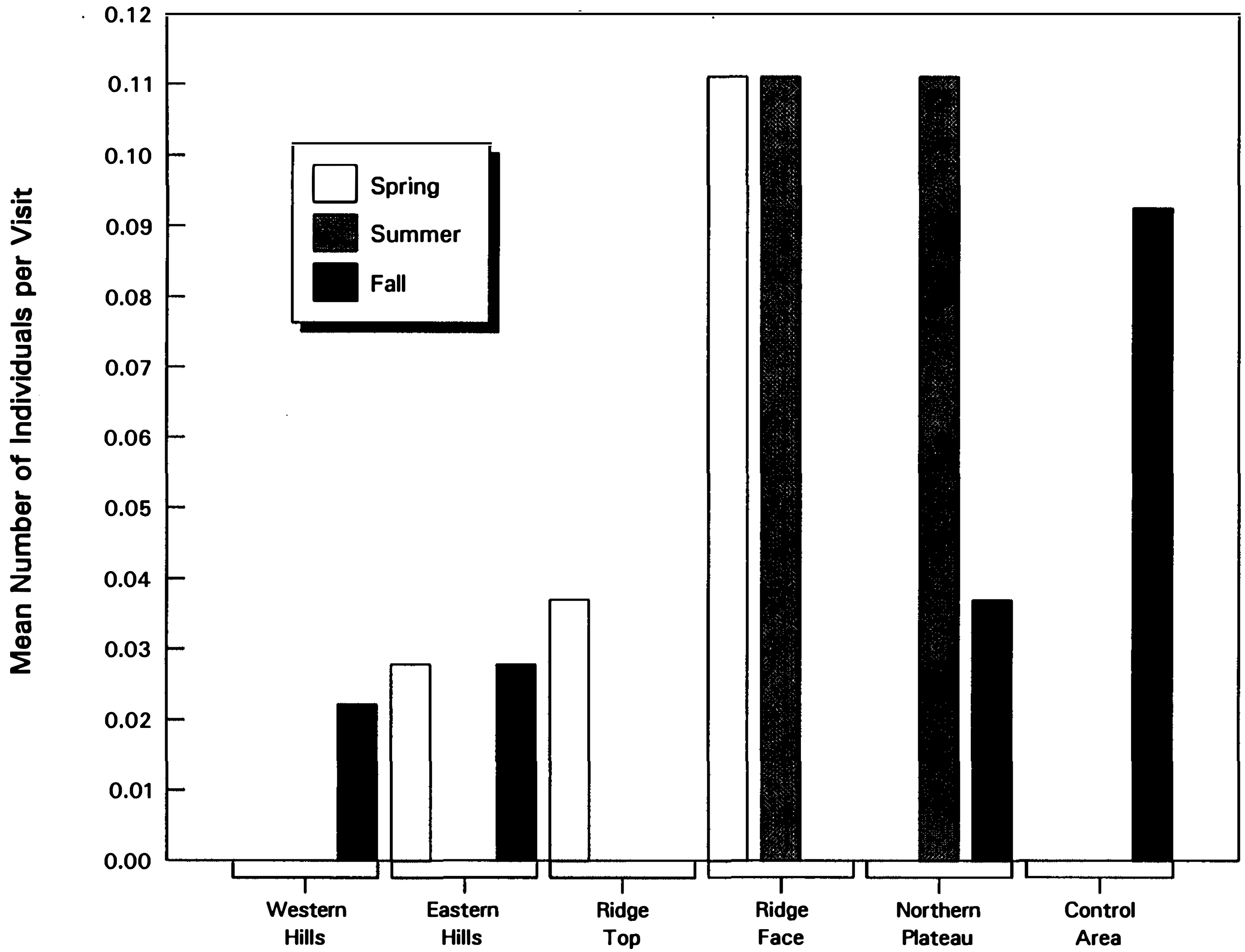


Figure D-2
Mean Number of Golden Eagles by Study Unit and Season



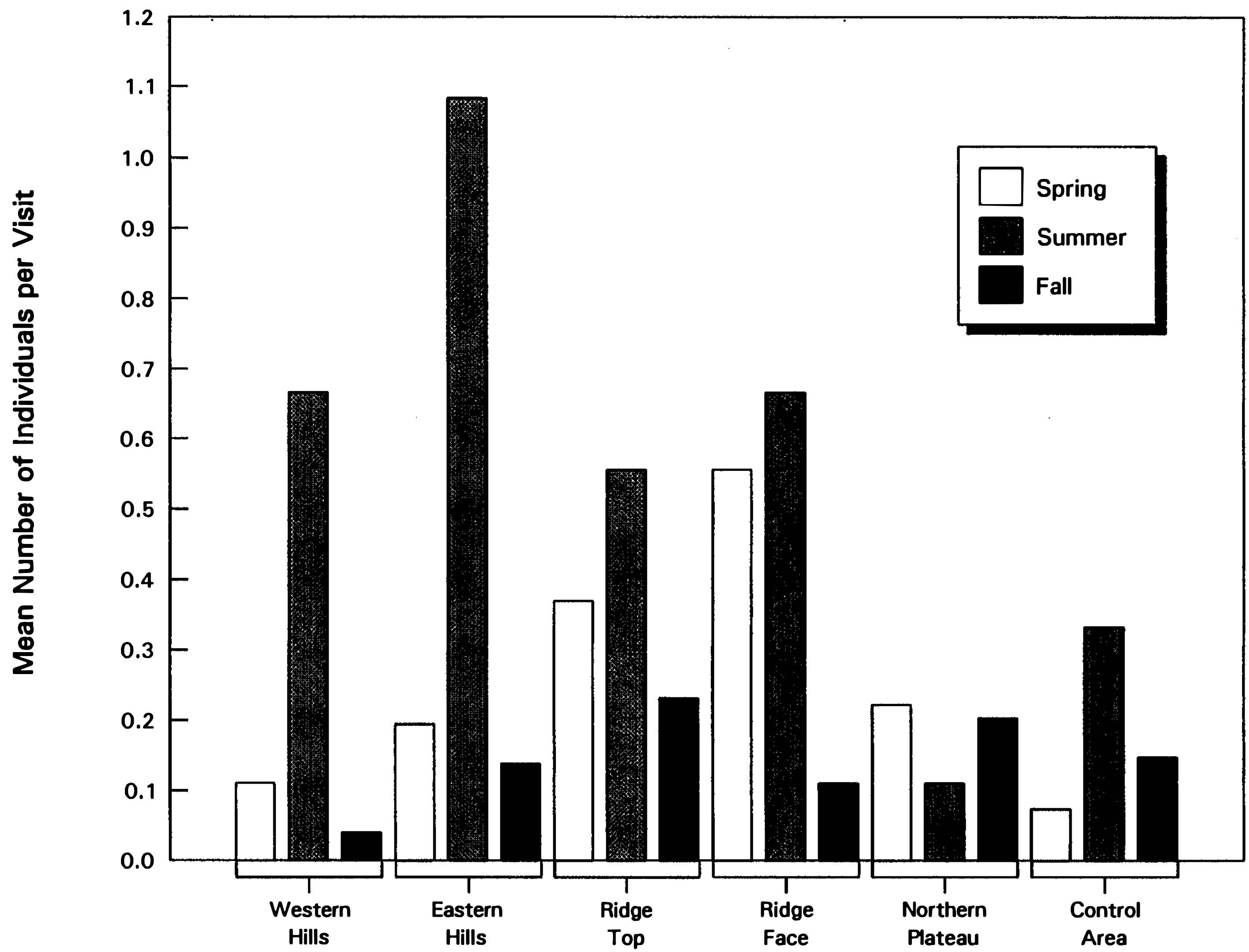
Jones & Stokes Associates, Inc.

Figure D-3
Mean Number of Peregrine Falcons by Study Unit and Season



Jones & Stokes Associates, Inc.

Figure D-4
Mean Number of Prairie Falcons by Study Unit and Season



Jones & Stokes Associates, Inc.

Figure D-5
Mean Number of American Kestrels by Study Unit and Season

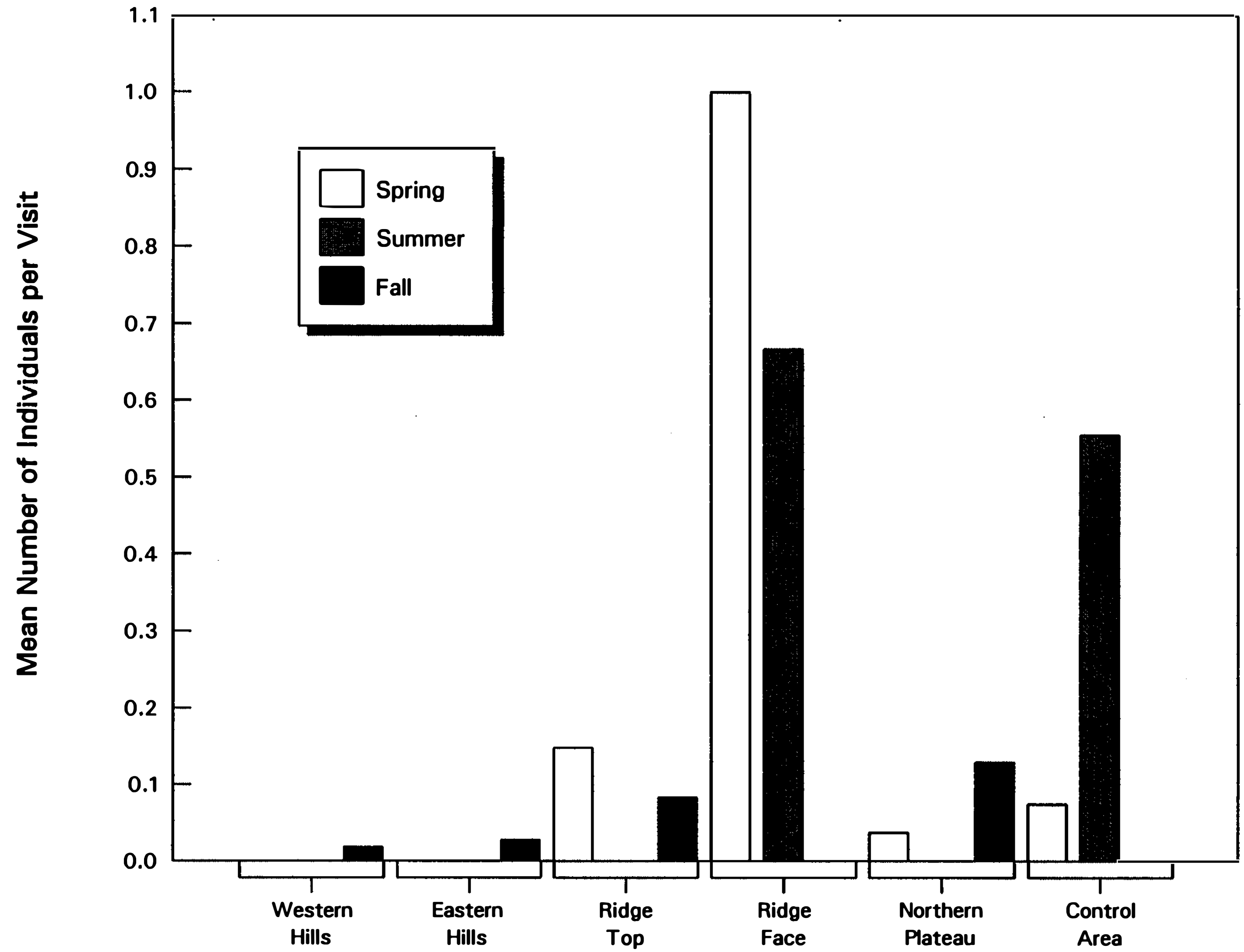


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Figure D-6
Mean Number of Turkey Vultures by Study Unit and Season

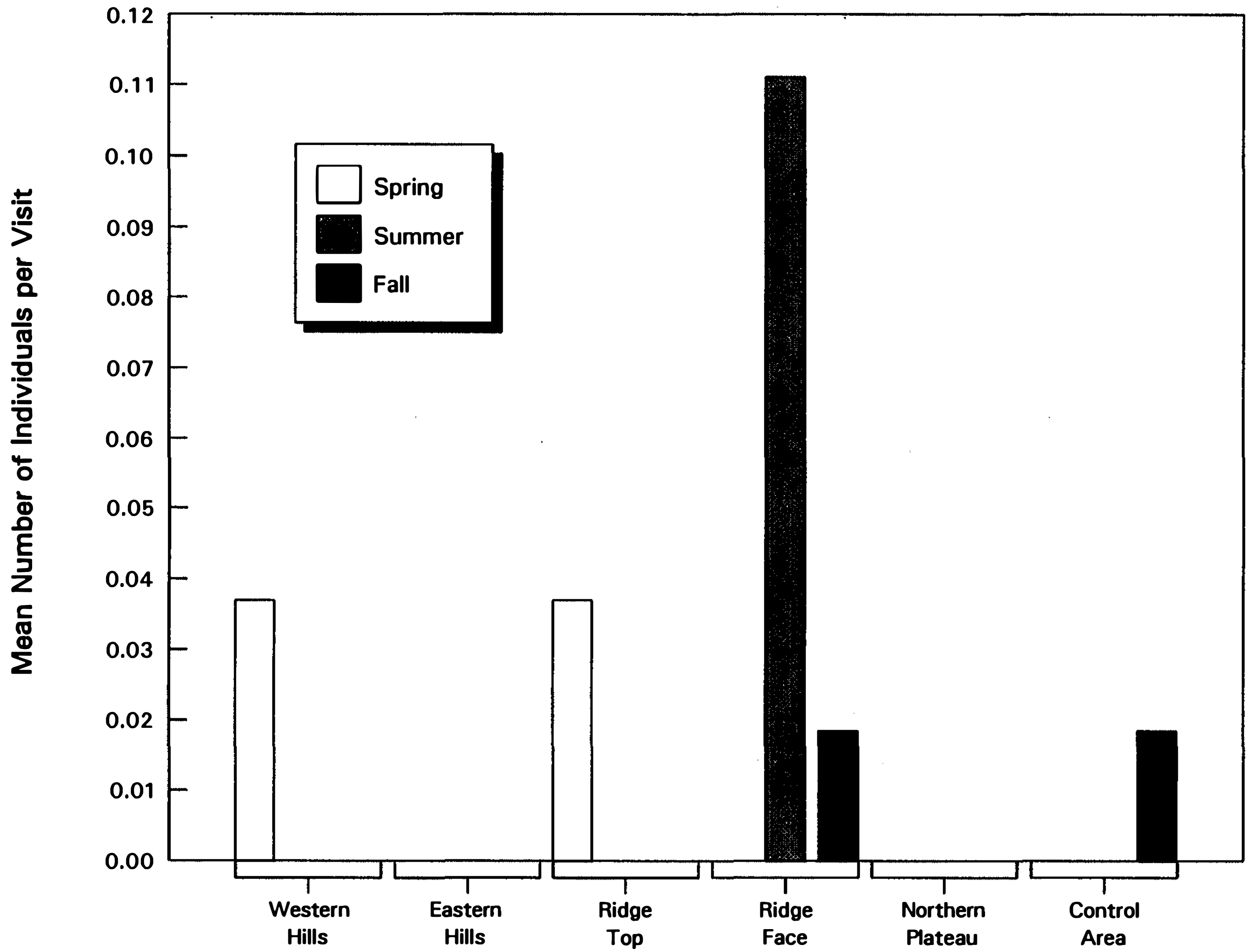

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Figure D-7
Mean Number of Cooper's Hawks by Study Unit and Season

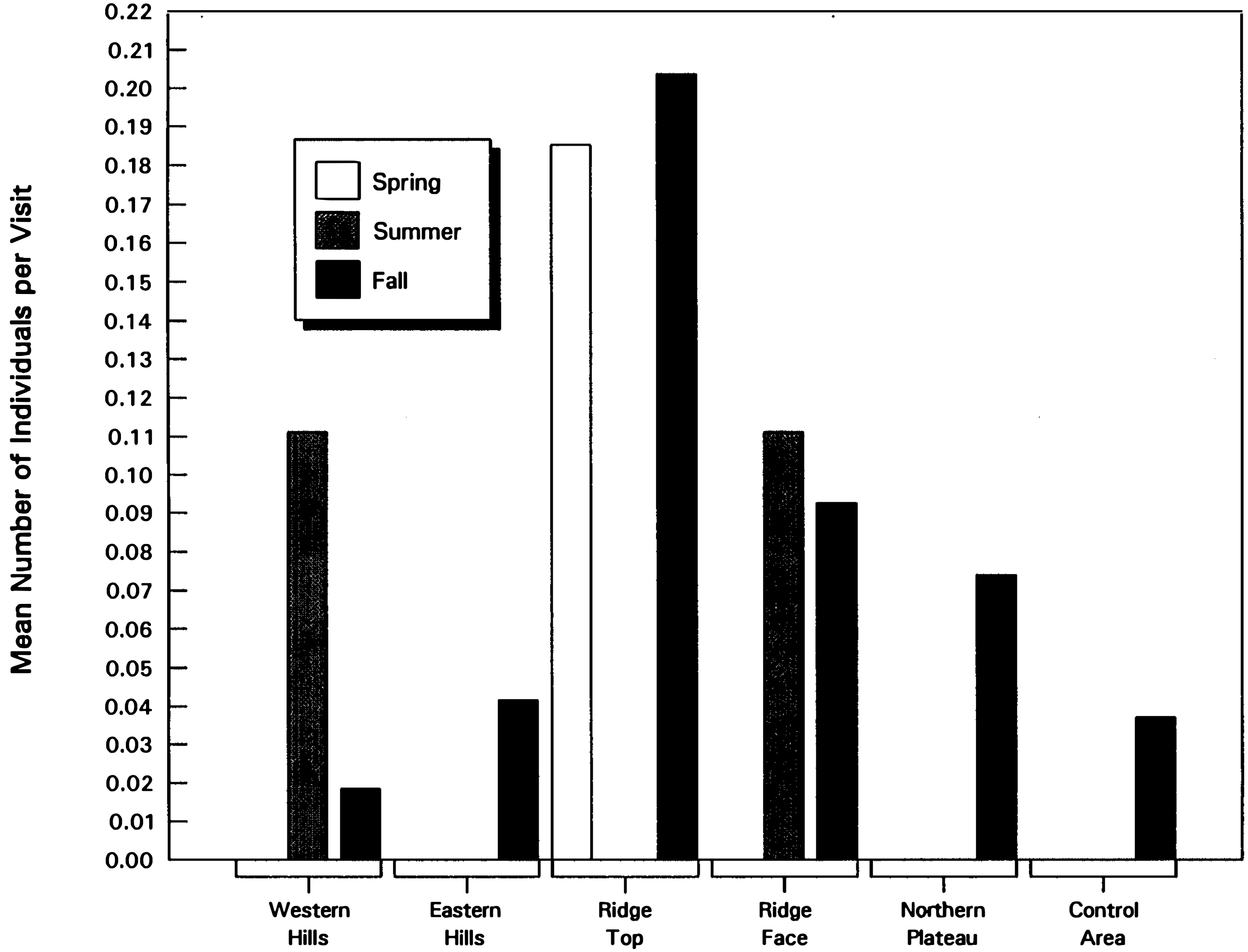

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Figure D-8
Mean Number of Sharp-Shinned Hawks by Study Unit and Season

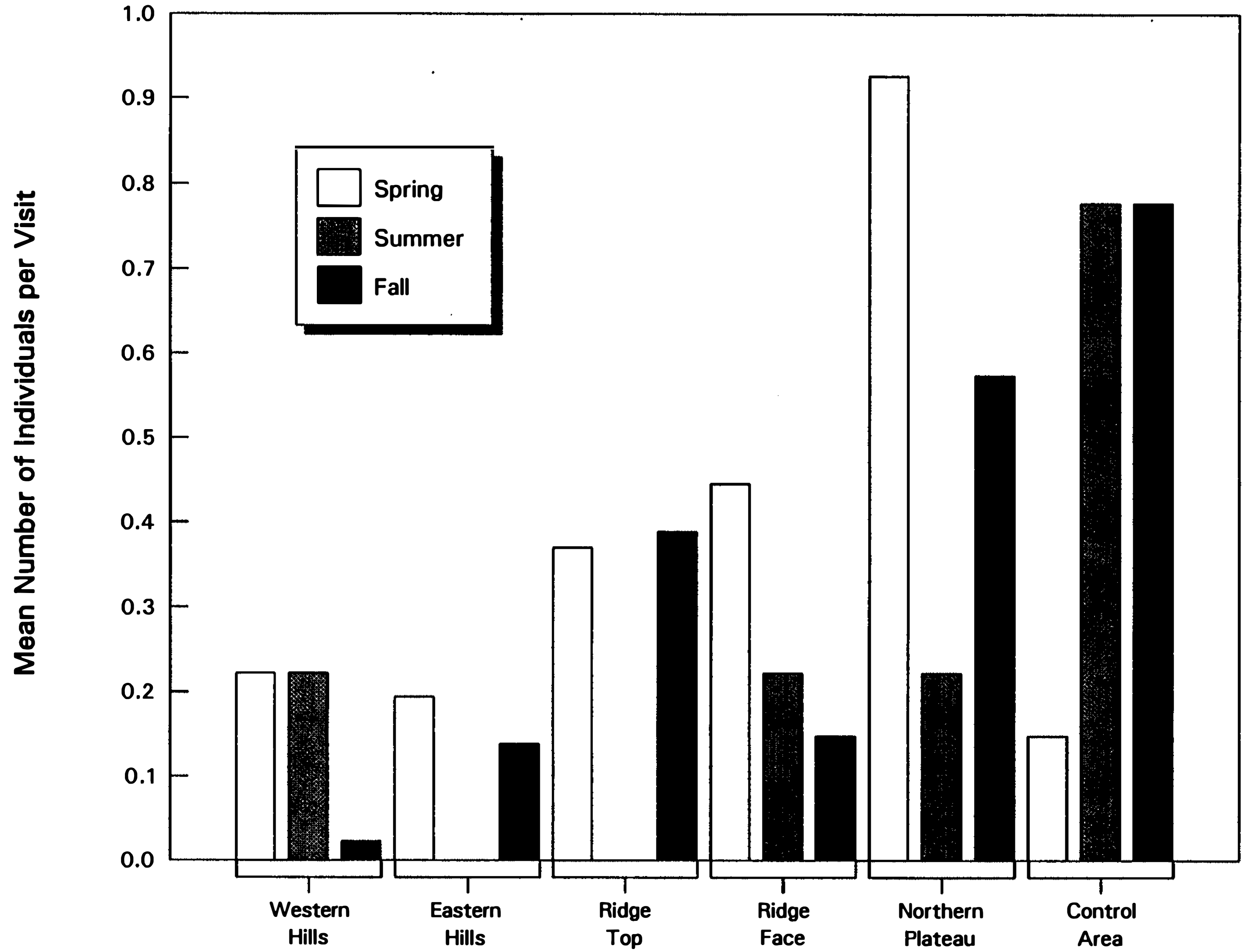

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Figure D-9
Mean Number of Red-Tailed Hawks by Study Unit and Season

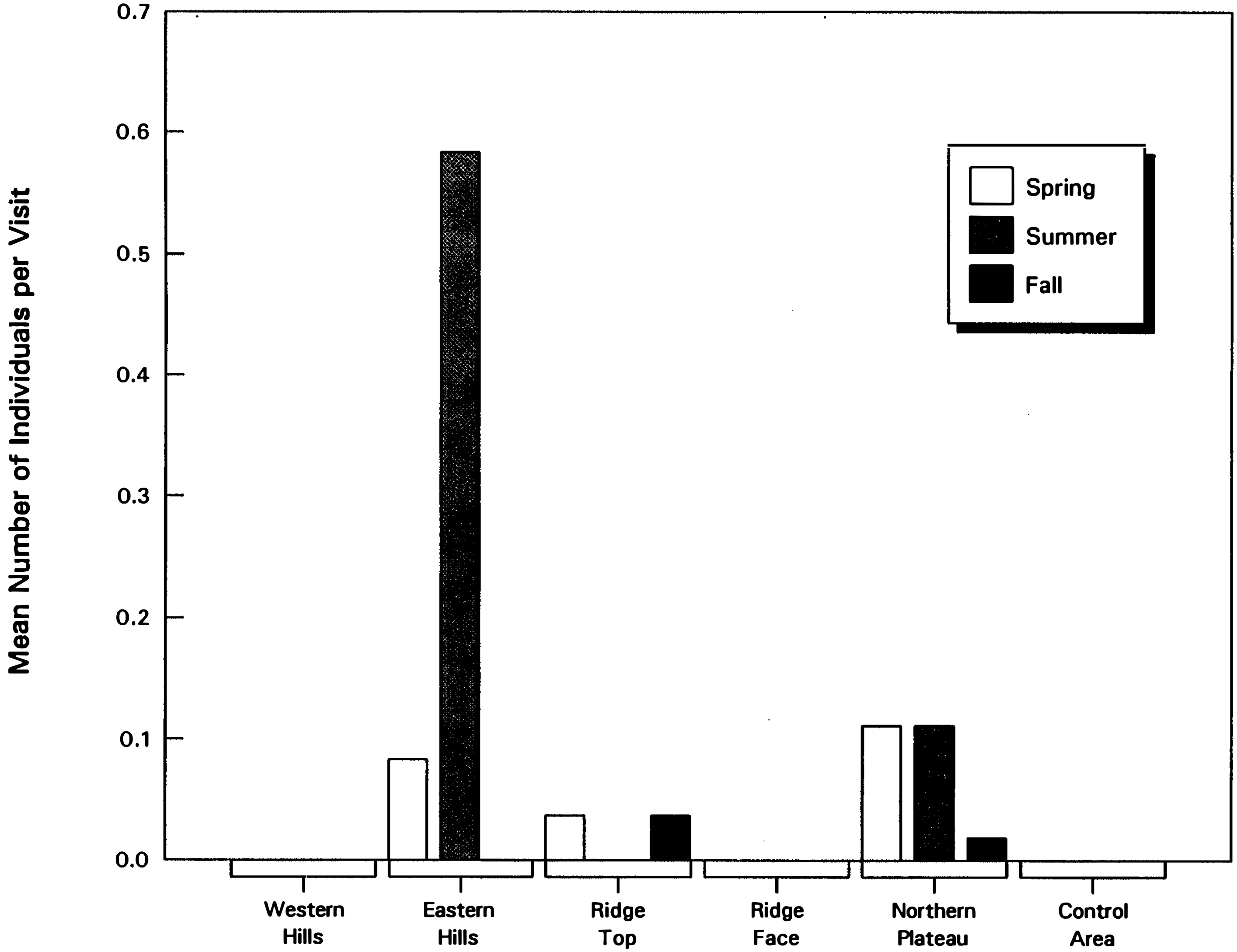

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Figure D-10
Mean Number of Swainson's Hawks by Study Unit and Season

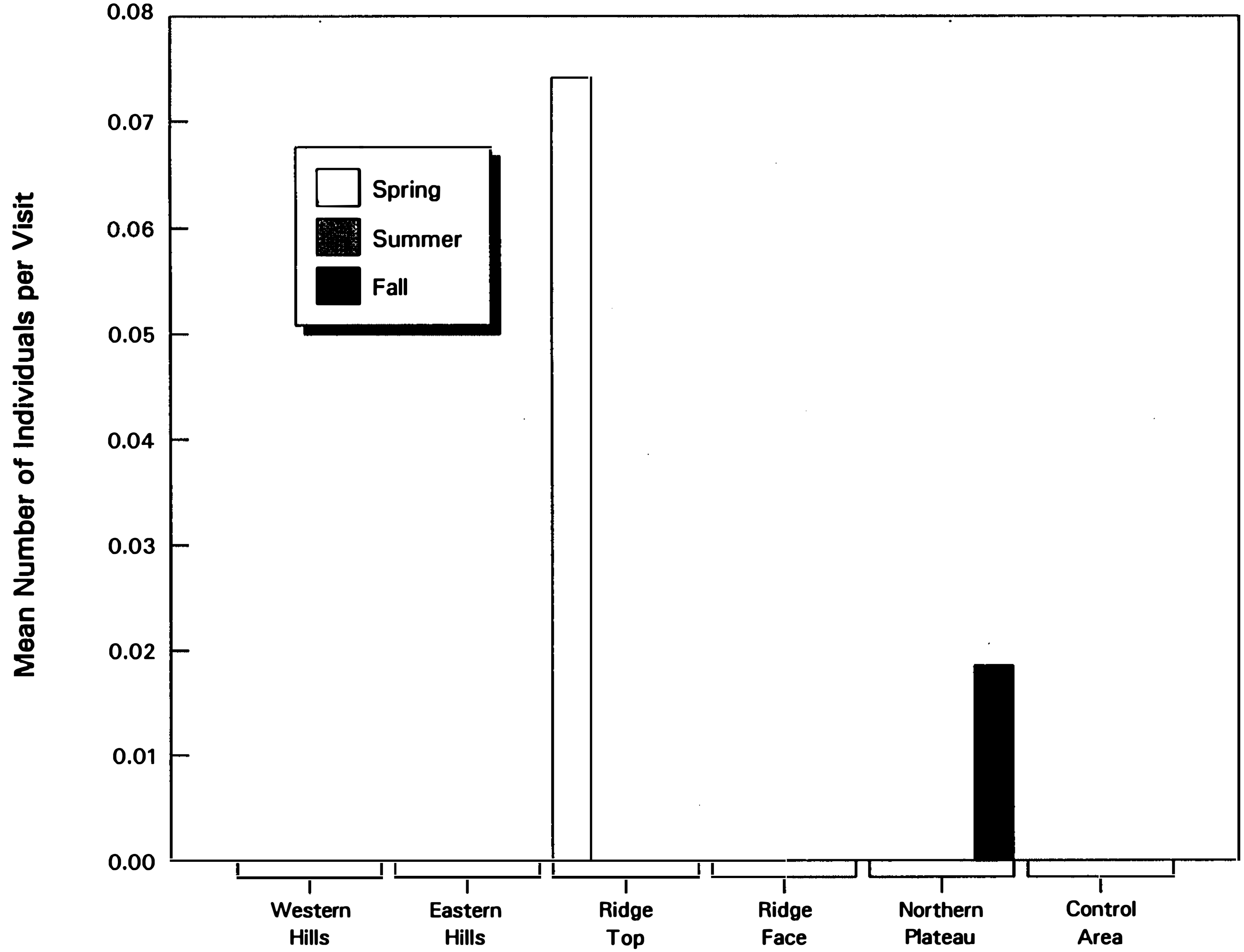

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Figure D-11
Mean Number of Ferruginous Hawks by Study Unit and Season

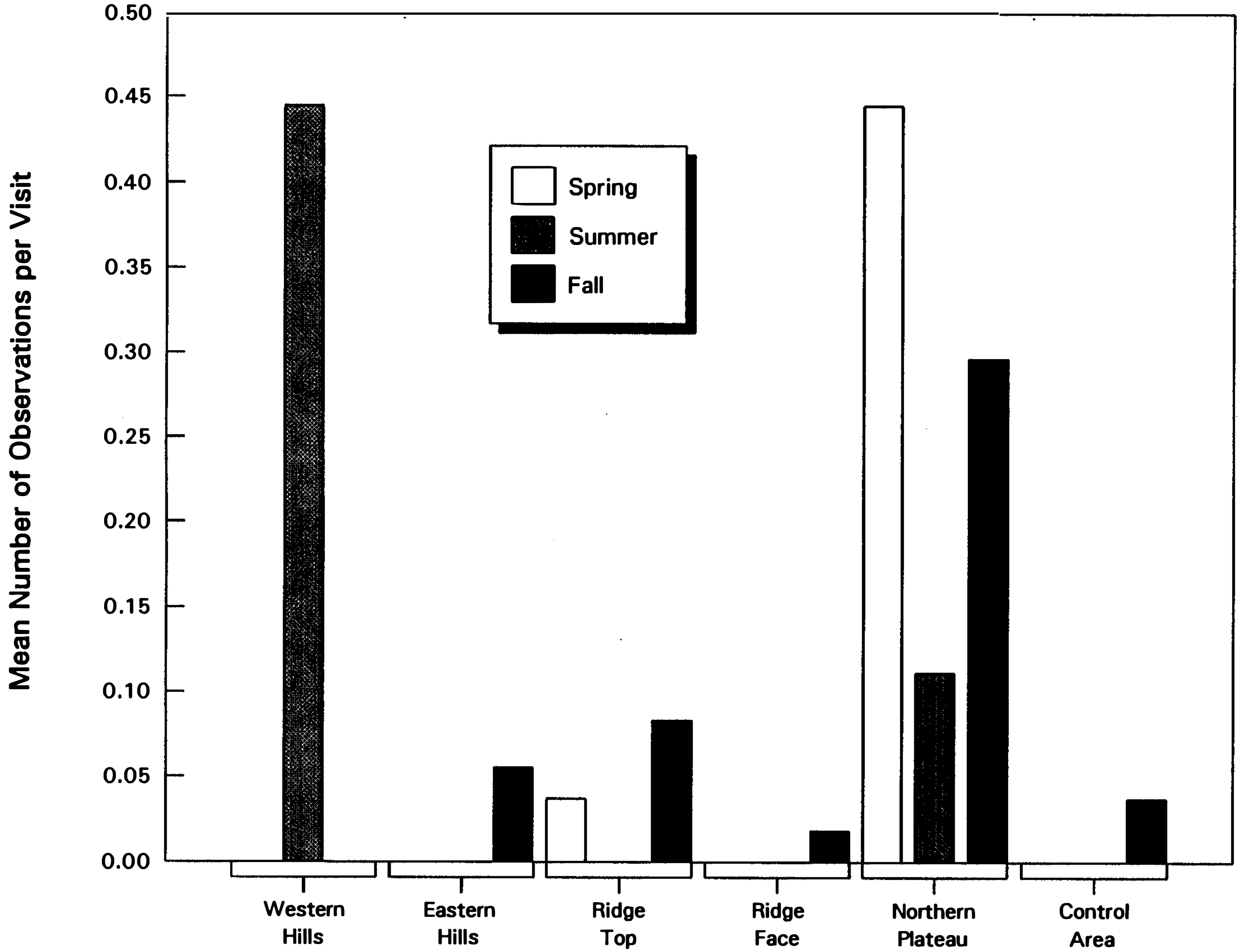

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Figure D-12
Mean Number of Northern Harriers by Study Unit and Season

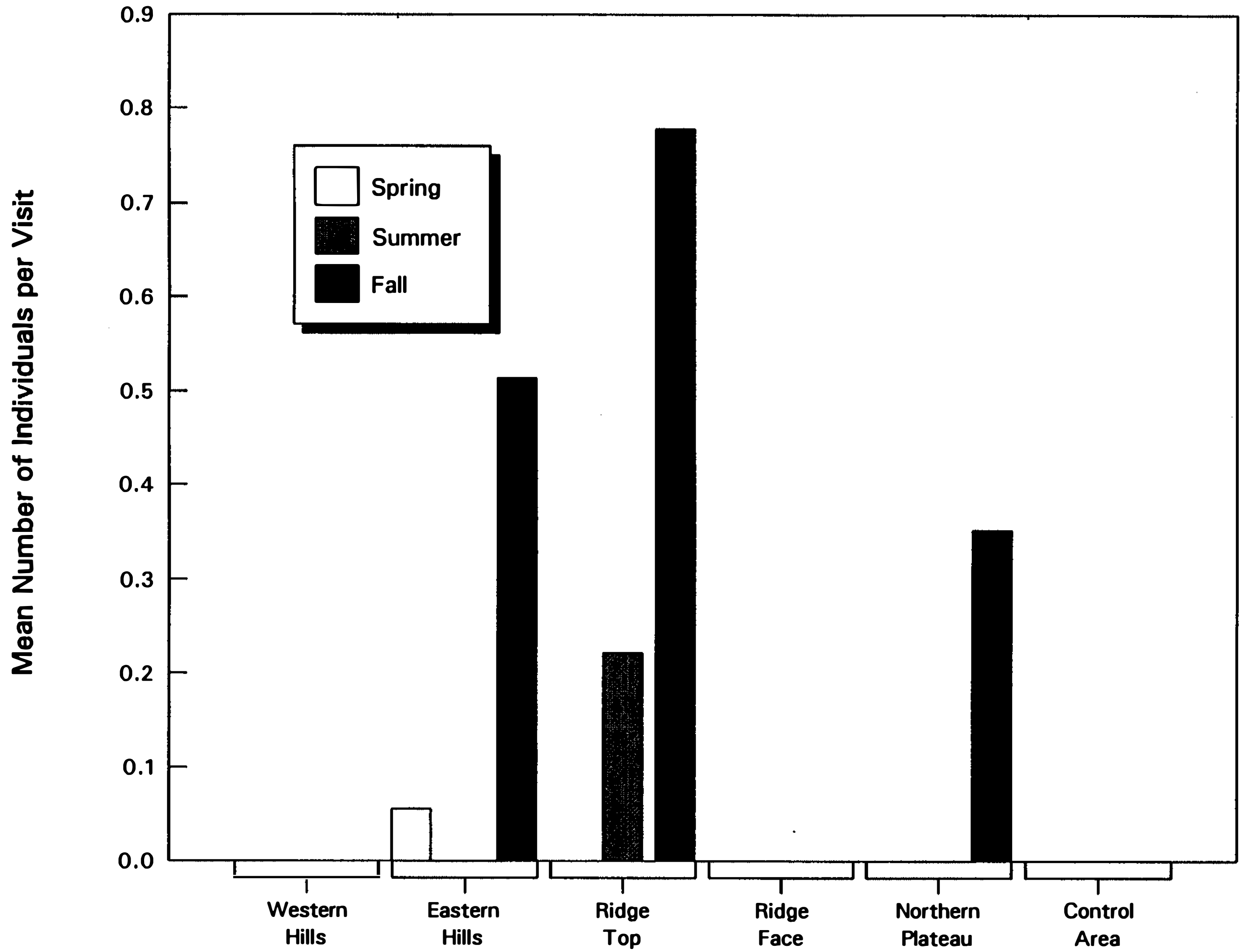

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Figure D-13
Mean Number of Western Blue Birds by Study Unit and Season

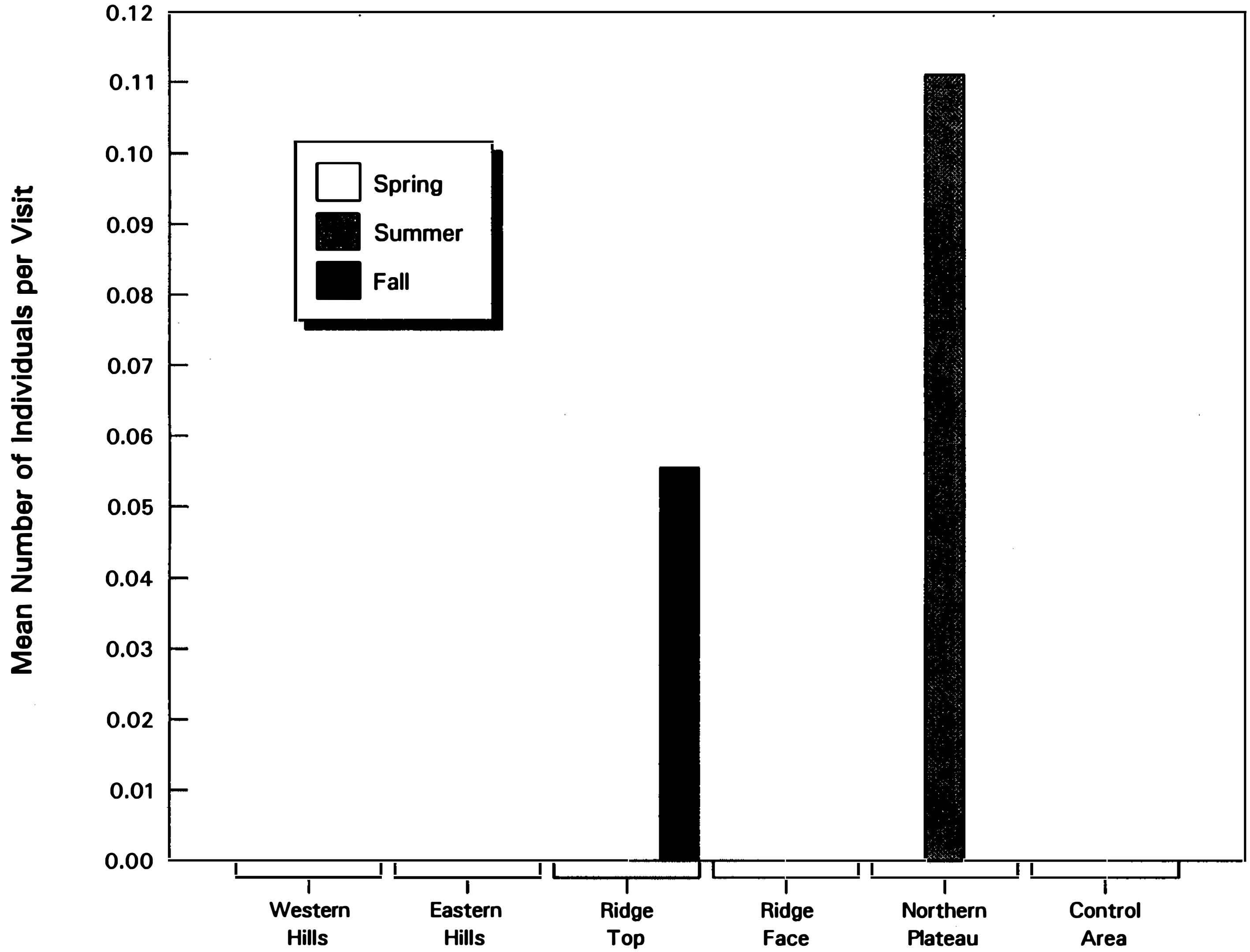

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Figure D-14
Mean Number of Loggerhead Shrikes by Study Unit and Season

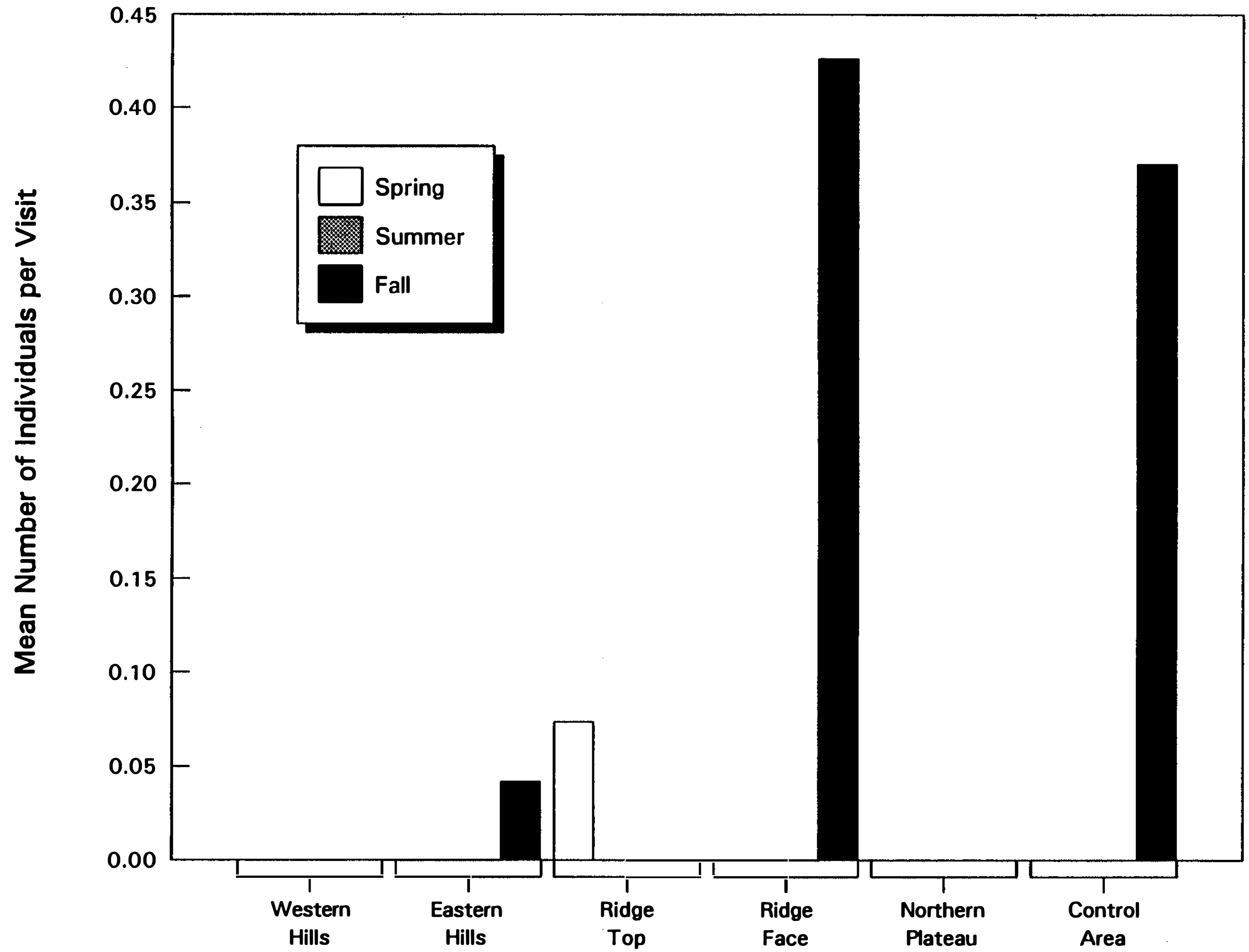

Figure D-15
Mean Number of Waterfowl by Study Unit and Season