IDAHO POWER
An IDACORP Company

Spring Distribution and Relative Abundance of Upland Game Birds in Hells Canyon

Natalie J. S. Turley
Wildlife Technician

Frank Edelmann
Wildlife Biologist

Technical Report
Appendix E.3.2-3

Hells Canyon Complex
FERC No. 1971

June 2001
Revised July 2003

TABLE OF CONTENTS

Table of Contents i

List of Tables iii

List of Figures iii

List of Appendices iv

Abstract 1

1. Introduction 2

    1.1. State of Knowledge 2

    1.2. Justification 4

    1.3. Objectives 5

2. Study Area 5

    2.1. Location 5

    2.2. Physiography 6

    2.3. Land Features and Geology 7

    2.4. Soils 7

    2.5. Climate 8

    2.6. Vegetation 8

    2.7. Land Use 11

3. Plant Operations 11

4. Methods 12

    4.1. Survey Design and Protocol 12

    4.2. Incidental Data 13

    4.3. Species Distribution Maps 13

    4.4. Data Analysis 14

5. Results 15

5.1. Upland Game Bird Indices 15

5.2. Upland Game Bird Distribution 15

6. Discussion 16

6.1. Upland Game Bird Community 16

6.2. Upland Game Bird Distribution 17

7. Summary and Conclusions 19

8. Acknowledgments 19

9. Literature Cited 20

LIST OF TABLES

Table 1. Upland game bird species occurring in the Hells Canyon Study Area, Idaho and Oregon. 27

Table 2. Line transect survey effort for upland game bird species in the Hells Canyon Study Area, 1996. 28

Table 3. Upland game bird indices (birds/km) along the middle and lower Snake River corridor. 29

Table 4. Number of upland game bird detections within each cover type, Hells Canyon Study Area, 1996. 30

LIST OF FIGURES

Figure 1. Location of upland game bird transects within the Hells Canyon Study Area. 31

Figure 2. Köppen climate diagrams for the Weiser, Richland, Brownlee, and Lewiston weather stations, Hells Canyon Study Area, Idaho–Oregon border. 33

Figure 3. Predicted chukar spatial distribution, Hells Canyon Study Area. 35

Figure 4. Predicted mourning dove spatial distribution, Hells Canyon Study Area. 37

Figure 5. Predicted California quail spatial distribution, Hells Canyon Study Area. 39

Figure 6. Predicted ruffed grouse spatial distribution, Hells Canyon Study Area. 41

Figure 7. Predicted blue grouse spatial distribution, Hells Canyon Study Area. 43

Figure 8. Predicted gray partridge spatial distribution, Hells Canyon Study Area. 45

Figure 9. Predicted sage grouse spatial distribution, Hells Canyon Study Area. 47

Figure 10. Predicted ring-necked pheasant spatial distribution, Hells Canyon Study Area. 49

Figure 11. Predicted sharp-tailed grouse spatial distribution, Hells Canyon Study Area. 51

Figure 12. Predicted wild turkey spatial distribution, Hells Canyon Study Area..... 53

Figure 13. Predicted mountain quail distribution, Hells Canyon Study Area. 55

LIST OF APPENDICES

Appendix 1. Upland game bird species observed and their relative abundances, Hells Canyon Study Area, 1995–2000. From Turley and Holthuijzen 2000. 57

ABSTRACT

In spring 1996, the Idaho Power Company (IPC) investigated upland game bird resources in the Hells Canyon Study Area. The objectives were to 1) document the species composition of resident upland game birds, 2) index relative population levels during the reproductive period, 3) determine cover types used during this period, and 4) map the spatial distribution of upland game bird species during spring, with emphasis on habitat use near the Hells Canyon Complex.

We chose the line transect method for sampling and established 18 transects in the study area. Surveys were conducted twice—once in April and once in May. For both surveys combined, total transect length surveyed was 94,182 m.

Seven species were detected, and an average of 1.93 birds were observed per kilometer. The most common species was the chukar (*Alectoris chukar*, 0.76 birds/km), followed closely by the mourning dove (*Zenaida macroura*, 0.75 birds/km). Other species observed were the California quail (*Callipepla californica*, 0.25 birds/km), gray partridge (*Perdix perdix*, 0.07 birds/km), ruffed grouse (*Bonasa umbellus*, 0.06 birds/km), ring-necked pheasant (*Phasianus colchicus*, 0.01 birds/km), and blue grouse (*Dendragapus obscurus*, 0.01 birds/km). Four other species, the wild turkey (*Meleagris gallopavo*), mountain quail (*Oreortyx pictus*), sage grouse (*Centrocercus urophasianus*), and sharp-tailed grouse (*Tympanuchus phasianellus*) were observed incidentally during other IPC fieldwork.

The chukar was observed in a variety of cover types: *Shrub Savanna* (28 observations), *Grassland* (25), *Cliff/Talus* (7), *Shrubland* (6), several riparian (4), and *Roads* (1). The mourning dove was also found in a variety of cover types, including *Shrub Savanna* (37), *Grassland* (8), *Shrubland* (7), *Desertic Shrubland* (4), *Forested Wetland* (5), *Forbland* (3), *Tree Savanna* (3), and others (4). California quail were observed most frequently in riparian cover types (*Scrub-Shrub Wetlands*, 11 observations; *Forested Wetland*, 7 observations) but were also observed in *Shrubland* (4) and *Shrub Savanna* (2) types. Ruffed grouse were observed in *Forested Wetland* (3), *Scrub-Shrub Wetland* (2), and *Shrubland* (1) cover types, and gray partridge in *Shrub Savanna* (6) and *Grassland* (1).

Most of the upland game birds were distributed throughout the study area. The chukar, mourning dove, California quail, ruffed grouse, blue grouse, and gray partridge were observed throughout the canyon. The sage grouse, ring-necked pheasant, and sharp-tailed grouse were restricted to the southern part of the study area. IPC staff observed mountain quail at Temperance Creek below Hells Canyon Dam and at higher elevations above Pittsburg Landing. The Idaho Conservation Data Center (IDCDC) has documented recent mountain quail records for Granite Creek (1993) below Hells Canyon Dam, as well as Blue Creek (1999), Big Bar (1996) on Hells Canyon Reservoir, and upper Brownlee Creek (1994) on Brownlee Reservoir.

1. INTRODUCTION

1.1. State of Knowledge

Hells Canyon provides habitat for a diverse upland game bird community that includes both native and introduced species (Table 1). Native upland game birds potentially occurring in Hells Canyon are predominately grouse species: 1) blue grouse (*Dendragapus obscurus*), 2) ruffed grouse (*Bonasa umbellus*), 3) sage grouse (*Centrocercus urophasianus*), 4) sharp-tailed grouse (*Tympanuchus phasianellus*), and 5) spruce grouse (*Dendragapus canadensis*). The most common native migratory upland game bird occurring in the study area is the mourning dove (*Zenaida macroura*). The mountain quail (*Oreortyx pictus*), a species of special concern, also occurs in restricted areas of Hells Canyon.

The blue grouse is endemic to mountainous regions of western North America and is found from sea level to 3,600 m and above. Interior blue grouse may occur in virtually all montane forest communities having relatively open tree canopies, in alpine and subalpine ecotones, and in shrub-steppe and grassland communities as much as 2 km or more from forest edge (Zwickel 1992). During winter, blue grouse depend on the needles and buds of conifers including Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), and hemlock (*Tsuga heterophylla*). During spring and summer, food items include leaves, flowers, berries, conifer needles, and invertebrates (Zwickel 1992).

In mountains or heavily-forested areas, the ruffed grouse ranges from Alaska, Canada, and northern United States south to northern Georgia, northern California, and Utah (Leopold et al. 1981). This grouse prefers deciduous or mixed deciduous/coniferous forest communities. Catkins of mature aspen, alder, and birch constitute the primary winter food. Summer foods include fruits, berries, and succulent green leaves (Leopold et al. 1981).

The sage grouse is closely associated with sagebrush ecosystems of western North America, and its range includes the southeast quarter of Oregon, the southern half of Idaho, and portions of California, Nevada, Colorado, Utah, Wyoming, Montana, Washington, South Dakota, North Dakota, Alberta, and Saskatchewan (Schroeder et al. 1999). Sagebrush (*Artemisia* spp.) is essential for the species' survival; sagebrush dominates the diet during late autumn, winter, and early spring (Schroeder et al. 1999). During the breeding season, forbs and sagebrush dominate the diet, although insects are also eaten. Throughout the West, sage grouse populations have been declining, primarily due to loss, degradation, and fragmentation of habitat (Schroeder et al. 1999).

Historically, the sharp-tailed grouse was found in steppe, grassland, and mixed-shrub habitats throughout much of central and northern North America, but its numbers have declined in portions of its historical range (Connelly et al. 1998). Scattered populations of Columbian sharp-tailed grouse exist in Idaho, but the species is thought to be extirpated in Oregon (Connelly et al. 1998). Translocations of Columbian sharp-tailed grouse from southeastern Idaho to northeastern Oregon have had limited success (Crawford and Snyder 1995).

The spruce grouse is found in boreal forests throughout Alaska, Canada, the northern Rockies, Lake States, and New England. Typical habitat for the spruce grouse includes fire seres dominated by lodgepole pine (*Pinus contorta*). In winter, this grouse feeds on pine (*Pinus* spp.), fir (*Tsuga* spp.), or spruce (*Picea* spp.) needles and buds (Leopold et al. 1981, Boag and Schroeder 1992). The summer diet is more varied and includes berries and tender leaves, plus available insects and arthropods.

The mourning dove ranges throughout the lower 48 states, as well as portions of Canada. One of the most abundant and widespread terrestrial birds endemic to North America, the mourning dove nests in a wide array of habitats. It has generally benefited from human changes to the landscape, with highest breeding densities found in agricultural areas (Mirarchi and Baskett 1994). Mourning doves feed on the ground, and 99% of their diet is made up of seeds (Mirarchi and Baskett 1994). The species is a migratory upland game bird managed by the U.S. Fish and Wildlife Service (USFWS) by authority of the Migratory Bird Treaty Act. Nationwide and in Idaho, the long-term population trend for the mourning dove has been one of gradual decline (Sauer et al. 2000). This downward trend is believed to have resulted from habitat loss due to industrial and urban development and intensified agricultural practices.

The mountain quail is resident along the Pacific slope from southern British Columbia to Baja California and eastward to eastern Oregon and central Idaho. In California, mountain quail are distributed throughout extensive areas of chaparral and mixed forest/shrub communities. In Idaho and eastern Oregon, populations are restricted to the narrow, shrubby riparian habitats lining watercourses. In eastern Oregon and west-central Idaho, mountain quail numbers have declined dramatically during the last 40 years (Csuti et al. 1997, Groves et al. 1997). Loss and degradation of habitat is thought to be responsible for this decline, but other possibilities include disease, competitive interactions, severe winters, and location at the periphery of native ranges.

Other upland game birds are currently in Hells Canyon as a result of translocations to establish huntable populations of these exotics. Introduced species include 1) California quail (*Callipepla californica*), 2) chukar (*Alectoris chukar*), 3) gray partridge (*Perdix perdix*), 4) wild turkey (*Meleagris gallopavo*), and 5) ring-necked pheasant (*Phasianus colchicus*).

The California quail's historic range includes California, southern Oregon, and western Nevada. The species has been widely introduced in eastern Oregon and western Idaho and is locally common where conditions are suitable. The California quail prefers riparian areas, brushy foothills, and shrub thickets close to farmland (Leopold et al. 1981). Dense, shrubby vegetation provides roosting sites, thermal protection, and escape cover. Agricultural fields, grassy areas, and pastures provide foraging areas. During spring, summer, and fall, food is generally not limited, as quail eat a variety of seeds and leafy material. However, winter snow conditions often reduce the availability of adequate winter foods, limiting populations (IDFG 1990).

The chukar was first introduced to North America in 1893, to Idaho in 1933, and to Oregon in the 1950s. The species' preferred habitats are found in the Great Basin of the western United States and northward through eastern Oregon, western Idaho, and eastern Washington where steep, rocky, mountainous terrain harbors a mixture of shrubs, grasses, and forbs (Christensen 1996). The chukar thrives on overgrazed, open ranges of the West. Its primary foods are the leaves and seeds of annual and perennial grasses, primarily the introduced cheatgrass and

various forbs (Christensen 1996, Walter 2000). During winter, chukars prefer south-facing slopes and ridges that remain relatively free of snow (Oelklaus 1976). In summer and early fall, chukar distribution is largely determined by water availability (Christensen 1996).

Introduced to Oregon in 1900, the gray partridge moved into Idaho from Washington and Oregon sometime between 1912 and 1920 (Mendel 1979). Beginning in 1922, introductions were made in Idaho, resulting in establishment throughout the state. The gray partridge is generally associated with grain fields interspersed with woody cover; its distribution overlaps that of the chukar (IDFG 1990). The gray partridge is also found in sagebrush-grass dominated areas and prefers grassy areas and hayfields for nesting. The gray partridge benefits from traditional agricultural practices where hedgerows are maintained and pesticide use is limited (Carroll 1993).

The wild turkey is the most recently introduced addition to the upland game bird community. Native to the northeastern, midwestern, and southern United States, it has been widely introduced in the West (Groves et al. 1997). Usually found near water, wild turkeys inhabit open woodlands and riparian areas. In 1967, the Idaho Department of Fish and Game (IDFG) released Merriam's wild turkey in the Hells Canyon Study Area along the Wildhorse River, and in 1990 at Cottonwood Creek, Dukes Creek, Indian Creek, and the west fork of Brownlee Creek (IDFG 2001). Wild turkeys were also released at Sturgill Creek in 1993. In 1961, the Oregon Department of Fish and Wildlife (ODFW) released Merriam's wild turkey at Eden Bench in Wallowa County. All other introductions in the Hells Canyon vicinity were of the Rio Grande subspecies: in the Imnaha area of Wallowa County in 1984, at Big Sheep Creek in 1988, and in the Wenaha area in 1990. In Baker County, introductions were made at Deer Creek in 1988 and Summit Creek in 1992 (ODFW 1992).

Native to Eurasia, the ring-necked pheasant was first introduced to Oregon in 1881 and Idaho in 1903 (Burleigh 1972). By 1930, the species was widely distributed and abundant throughout portions of Idaho and Oregon that supported agriculture. Populations were probably highest in the 1950s and 1960s, with a steady decline occurring through the 1980s. Ring-necked pheasants are closely associated with agriculture and occur in varying abundance in or near farmland throughout Idaho. Riparian and wetland habitats near agricultural areas are critical to pheasant survival, especially during winter. Sagebrush habitats adjacent to farmland can provide important winter cover (IDFG 1990). In Idaho, ring-necked pheasant numbers are highest on irrigated lands in southern portions of the state (Burleigh 1972). Likewise, in Oregon, numbers are highest on irrigated croplands of Malheur County and wheat-growing areas of the Columbia Plateau (Csuti et al. 1997). As farming intensified in the 1970s, however, even small strips of cover along roadsides and fences were plowed to put all available land into agricultural production. These clean-farming practices have resulted in pheasant population decline due to lack of cover.

1.2. Justification

This study was proposed in Idaho Power Company's (IPC) *Formal Consultation Package for Relicensing the Hells Canyon Project* (IPC 1997). Updated study plans were made available in July 1999 and February 2000 (IPC 2000). This study on upland game birds in the Hells Canyon Reach is descriptive and will help IPC meet the Federal Energy Regulatory Commission's

(FERC) requirement to describe wildlife resources associated with the Hells Canyon Complex (HCC) and its vicinity. An important component of the biological diversity in Hells Canyon, upland game birds are considered important under FERC relicensing guidelines for their ecological, economic, recreational, and sensitive-status qualities.

1.3. Objectives

No recent broad-scale survey of the upland game bird community has been conducted in the HCC vicinity. Such a survey, however, is necessary for baseline descriptions of the relative abundance and spatial distribution of upland game birds in Hells Canyon. The following objectives were formulated to address the lack of information about this resource: 1) document the species composition of resident upland game birds, 2) index relative population levels during the reproductive period, 3) determine cover types used during this period, and 4) map the spatial distribution of upland game bird species during spring, with emphasis on habitat near the HCC.

2. STUDY AREA

2.1. Location

The Hells Canyon Reach of the Snake River is situated in west-central Idaho and northeastern Oregon (Figure 1). The Hells Canyon Study Area is located between the city of Weiser, Idaho, and the confluence of the Salmon and Snake rivers (from approximately river mile [RM] 351 to RM 188). The Snake River, a major tributary to the Columbia River, is the focal point of Hells Canyon. Its generally northward flow forms part of the boundary between Idaho and Oregon. The HCC is located on the Snake River in the southern portion of Hells Canyon and includes three reservoirs—Brownlee, Oxbow, and Hells Canyon. The reach below Hells Canyon Dam is unimpounded, although the three-dam complex controls flows.

Federal agencies, including the Bureau of Land Management (BLM) and U.S. Forest Service (USFS), are responsible for managing the majority of public land in Hells Canyon. These areas fall within the jurisdictional boundaries of the Wallowa-Whitman National Forest, Oregon; Payette National Forest, Idaho; Nez Perce National Forest, Idaho; Four Rivers Field Office (FO) of the Lower Snake River District, BLM–Idaho; Cottonwood FO of the Upper Columbia-Salmon Clearwater District, BLM–Idaho; and Baker FO and Malheur FO of the Vale District, BLM-Oregon. Other agencies with natural resource jurisdiction in the greater project area include the U.S. Department of Interior (USDI) National Marine Fisheries Service, Bureau of Indian Affairs, and USFWS, as well as state agencies from Idaho and Oregon.

The area upstream and downstream of Hells Canyon Dam can be broadly divided into 5 reaches, based on distinct geomorphic features, river characteristics, and legal project boundaries:

- Upstream of Brownlee Reservoir to the Weiser Bridge (approximately 12 mi; RM 351.2-339.2).

- Brownlee Reservoir (approximately 55 mi; RM 339.2–284.6), including the Powder River Arm (RM 0–8.5).
- Oxbow Reservoir (approximately 12 mi; RM 284.6–272.2).
- Hells Canyon Reservoir (approximately 25 mi; RM 272.2–247.0).
- Downstream of Hells Canyon Dam to the confluence of the Snake and Salmon rivers (approximately 59 mi; RM 247.0–188.2).

Generally, the lateral extent of these reaches includes all land within 0.5 mi of each shoreline above Hells Canyon Dam and all land within 0.25 mi of each shoreline below Hells Canyon Dam. However, the lateral extent of the study area can vary depending on which resources are being studied. For this study, the area from canyon rim to canyon rim for the 5 reaches was used to evaluate upland game bird resources (Figure 1).

In the upstream reach, the Snake River can be characterized as a low-gradient (0.2–0.4 m/km) river, with several island complexes. Agricultural impacts are apparent, with high amounts of irrigation returns causing high turbidities and increased nutrient loading. Farmland and rural development on flat to gentle topography surround this reach. Brownlee Reservoir is a steep-sided reservoir having a maximum depth approaching 300 ft near the dam. Large rock outcrops occur throughout the entire length. Oxbow Reservoir is a small re-regulating reservoir surrounded by moderate to steep topography (20–75% slopes). Shorelines are primarily basalt outcrops and talus, except for alluvial fans created by small tributaries. Hells Canyon Reservoir is also a re-regulating reservoir, with maximum depths approaching 200 ft. Shorelines in the reservoir are generally very steep, and substrates are primarily composed of basalt outcrops and talus slopes. The Snake River in the downstream reach is a high-gradient river (1.8 m/km) with a wide diversity of aquatic habitat, including numerous large rapids, shallow riffles, and deep pools. Substrates are highly diverse, ranging from large basalt outcrops and boulders to cobble/sand bars. This unimpounded reach of the Hells Canyon is considered to be the deepest gorge in North America. The Hells Canyon Reach is surrounded at the upstream end by nearly vertical cliff faces.

2.2. Physiography

Hells Canyon is the deepest and one of the most rugged river gorges in the continental United States. It ranges between 2,000 and 3,000 ft in depth from Weiser to Oxbow Dam. Below Oxbow Dam, the river enters a narrow, steep-sided chasm measuring up to 5,500 ft deep. From the confluence with the Grande Ronde River, the Snake River then flows into a lava-filled basin and through a much shallower canyon to Lewiston, Idaho (DOE 1985). The elevation of the Snake River near Weiser is about 2,090 ft msl, descending to about 910 ft msl at the confluence of the Salmon River about 59 mi below Hells Canyon Dam.

Throughout the canyon, topography is generally steep and broken, with slopes often dominated by rock outcrops and talus slopes. At the deepest points of the canyon, the walls rise almost vertically. Canyon walls are deeply dissected by numerous side canyons with tributaries to the

Snake River. The Seven Devils Mountains to the east and the Wallowa Mountains to the west form the upper reaches of the canyon walls. These mountains form a series of jagged peaks reaching almost 10,000 ft, with subalpine and alpine conditions to the west (USDA 1990).

2.3. Land Features and Geology

Hells Canyon consists of a series of folded and faulted metamorphosed sediments and volcanics overlain unconformably by nearly horizontal flows of Columbia River Basalt. This basalt group covered much of eastern Washington, northern Oregon, and adjacent parts of Idaho (Bush and Seward 1992). The older rocks in the series are Permian to Jurassic in age and represent at least two episodes of island arc volcanism and adjacent marine sedimentation similar to that found today in the Aleutian Islands west of Alaska. These rock units represent old island arc chains that were sequentially "welded" to the west coast of North America during the late Paleozoic and early to mid-Mesozoic eras by subduction of a tectonic plate beneath the North American continental tectonic plate (Asherin and Claar 1976, USDA 1994).

In more recent geologic time, Hells Canyon was formed through erosion by the Snake River of the Blue Mountains in Oregon and Seven Devils Mountains in Idaho (DOE 1985). The Snake River has existed since the Pliocene and probably cut to its present level during the Pleistocene. During the Pleistocene, glacial meltwater provided abundant runoff for down-cutting, while regional uplifting created weak points in the 2,000- to 3,000-foot-thick basalt plateau that overlaid the Blue and Seven Devils mountains. Resulting erosion formed the currently observed drainage pattern that established the Snake River (DOE 1985). Northeast-trending, high-angle fault patterns characterize the extensive Snake River fault system running throughout the study area (Fitzgerald 1982).

Besides basalt, other rock types are also present within the study area. Extensive limestone outcrops are found in some tributary drainage areas, and local granitic outcrops also occur.

2.4. Soils

The soils throughout Hells Canyon are derived primarily from Columbia River Basalt, covered in most areas with a thin mantle of residual soils from weathered native rock. Isolated areas contain deposits of windblown silt. Unconsolidated materials include river sands and gravel deposited during the Bonneville floods 15,000 years ago, ash-loess from the Mount Mazama eruption 6,900 years ago, and colluvium and talus deposited more recently. The amount of soil cover declines northward through Hells Canyon. Near Hells Canyon Dam (RM 247), most rock faces are nearly vertical with little soil cover (USDA 1994).

Most soil complexes are well drained and vary from very shallow to moderately deep. Loams are the dominant textural class and vary from very stony to silty, often with a clay subsoil component (NRCS 1995).

2.5. Climate

From late fall to early spring, the climate of west-central Idaho and eastern Oregon is typically influenced by cool and moist Pacific maritime air. Periodically, this westerly flow is interrupted by outbreaks of cold, dry continental air from the north, which is normally blocked by mountain ranges to the east. During the summer, a Pacific high-pressure system dominates weather patterns, resulting in minimal precipitation and more continental climatic conditions overall (Ross and Savage 1967). Hells Canyon, located in the High Desert region, is significantly influenced by the rain shadow of the Cascade Mountains to the west.

Climatological information is summarized for Weiser, Richland, Brownlee Dam, and Lewiston (Figure 2). Average annual precipitation is lowest at the southern end of the study area (Weiser, 286 mm), increases northward (Richland, 298 mm), peaks around Brownlee Dam (445 mm), and declines towards Lewiston (326 mm). The average annual precipitation ranges from about 380 to 500 mm (15 to 20 inches), depending on elevation. Nearly 45% of the average annual precipitation at Brownlee Dam (445 mm [17.8 inches]) falls from November through January; this strongly contrasts with the 9% average recorded for July through September. Thus, most precipitation occurs in the spring and winter (Tisdale et al. 1969, Tisdale 1986, Johnson and Simon 1987), and little or no precipitation falls during the hottest months of summer. Average annual evapotranspiration is estimated to be about 1,300 mm (52 inches).

Mean annual temperatures are similar among the four weather stations. Generally, the climate tends to become drier and warmer downstream of Brownlee Dam. Climatological information from Brownlee Dam (RM 284.6) is probably characteristic of the central section of the study area. The canyon bottom area is dry with seasonal temperatures ranging from lows of about −5 °C in January to highs of about 35 °C in July (Figure 2). Temperatures below freezing are normally experienced from mid-November through mid-April. As a rule, winters in the canyons are mild, while summers on the canyon floor may be hot. Mean temperatures above 2,000 m (6,562 ft msl) elevation range from −9 °C in January to 13 °C in July. By contrast, mean temperatures below 1,000 m (3,281 ft msl) elevation range from 0 °C in January to between 28 °C and 33 °C in July (Johnson and Simon 1987).

2.6. Vegetation

The types of vegetation growing along the canyon slopes of the middle Snake River are the result of three primary ecological factors: topography, soils, and climate. Of these factors, climate exerts the strongest influence on the development of plant life. For instance, the relatively mild winters below the canyon rim have allowed the development of disjunct species such as hackberry (*Celtis reticulata*), which is most often found in the southwestern states, though it commonly occurs in the middle and lower Snake River area (Tisdale 1979, DeBolt 1992).

Within the context of regional climate, topography is a major influence on the development and distribution of vegetation (Tisdale and others 1969; Tisdale 1979, 1986). The topographical complexity of Hells Canyon has produced a mosaic of vegetation types (Tisdale 1979, BPA 1984, USDI 1987). Grassland, shrubland, riparian, and coniferous forest communities exist in

close proximity. Interfingering of grassland and forest, for example, occurs at a number of sites throughout the canyon due to variations in aspect (Tisdale 1979).

Twenty-six cover types were identified along the Snake River in the Hells Canyon Study Area (Holmstead 2001). The area that was classified covered up to approximately 0.5 mi on each side of the Snake River or associated reservoirs. The dominant cover types were *Grassland* (35.5%), *Shrub Savanna* (21.0%), *Lotic* (16.1%), *Shrubland* (6.6%), and *Cliff/Talus* (5.6%). All remaining cover types covered less than 5% of the area classified.

Wetland and Riparian Communities—A narrow band of diverse riparian communities follows the course of the Snake River and its many tributaries (Huschle 1975, Asherin and Claar 1976, Miller 1976, Miller and Johnson 1976, DeBolt 1992). Although limited in geographic area, the riparian zone is vital because of its biological diversity (USDI 1987). Predominant tree species in riparian areas include white alder (*Alnus rhombifolia*), water birch (*Betula occidentalis*), and black cottonwood (*Populus trichocarpa*). Predominant shrub species in riparian areas include syringa (*Philadelphus lewisii*), netleaf hackberry, chokecherry (*Prunus virginiana*), black hawthorn (*Crataegus douglasii*), and poison ivy (*Toxicodendron radicans*). Emergent wetland communities are dominated by broad-leaved pepperweed (*Lepidium latifolium*), marsh grass (*Heleochloa alopecuroides*), purple loosestrife *(Lythrum salicaria*), cocklebur (*Xanthium strumarium*), hemp dogbane (*Apocynum cannabinum*), poison hemlock (*Conium maculatum)*, or alkali saltgrass (*Distichlis stricta*) (Holmstead 2001). Robust emergent vegetation such as common cattail (*Typha latifolia*), narrowleaf cattail (*Typha angustifolia*), American bulrush (*Scirpus americanus*), and common spikerush (*Eleocharis palustris*) are present but have a very limited distribution. Willows are sparsely represented, and various forbs grow on the shoreline side of these stands (Asherin and Claar 1976).

Many shoreline sections have no riparian vegetation (Holmstead 2001). Instead, upland vegetation on steep canyon slopes simply meets the rocky shoreline. Grassland communities are also common along the Snake River and its tributaries. Where these grassland communities occur, such as on the canyon slopes, the dominant species are bluebunch wheatgrass (*Pseudoroegneria spicata*), cheatgrass (*Bromus tectorum*), and Idaho fescue (*Festuca idahoensis*) (Asherin and Claar 1976, Holmstead 2001).

Herbaceous-Dominated Vegetation Types—The dry climate and typically stony, shallow soils of the canyon have favored the development of grassland steppe communities at the lower and middle elevations (Tisdale 1979, 1986). Commonly occurring grass species in the study area include bunchgrasses such as bluebunch wheatgrass, Sandberg bluegrass (*Poa secunda*), and Idaho fescue (Garrison et al. 1977, BPA 1984, Tisdale 1986, Franklin and Dyrness 1988). Sand dropseed (*Sporobolus cryptandrus*) and red threeawn (*Aristida longiseta*) are also common and, at times, dominant (BPA 1984, Tisdale 1986).

Habitat types in which bluebunch wheatgrass is dominant occur throughout the study area and occupy over half of its grassland area (Tisdale 1986). Bluebunch wheatgrass flourishes on deep, loamy soils but adapts to coarser and shallower soils as well. Generally, it is associated with Idaho fescue on deeper soils and with Sandberg bluegrass on shallower soils.

In upland habitats, the most common upland weed is cheatgrass (Holmstead 2001). This species can significantly alter native rangeland vegetation composition through competitive exclusion of native species reproduction and the facilitation of wildfires. Other widespread, introduced upland species include medusahead (*Taeniatherum caput-medusae*, Oregon listed noxious) and bulbous bluegrass (*Poa bulbosa*) (Holmstead 2001). These annual graminoids have probably been introduced and spread in the canyon by a number of vectors (e.g., livestock grazing, mining, homesteading, and recreation). Medusahead, a serious threat to upland assemblages in the canyon, cannot only take over sites previously dominated by weeds such as cheatgrass, but can also establish and maintain itself in diverse communities of native perennial plants (Miller 1996).

Shrub-Dominated Vegetation Types—Shrub species make up a large segment of the canyon's overall vegetation composition. Shrub-steppe vegetation types occur at mid-elevations in the Hells Canyon Study Area, especially in its southern region. For example, big sagebrush (*Artemisia tridentata*) is a dominant species in the southern sector of the study area, particularly in the area around Brownlee Reservoir (BPA 1984, Holmstead 2001). Commonly occurring shrubs include big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), hackberry, serviceberry (*Amelanchier alnifolia*), and bitter cherry (*Prunus emarginata*) (BPA 1984, Tisdale 1986). Other species of sagebrush are also present, including low sagebrush (*Artemisia arbuscula*), stiff sagebrush (*Artemisia rigida*), and silver sagebrush (*Artemisia cana*) (Tisdale and Hironaka 1981, Franklin and Dyrness 1988). For the most part, the study area's sagebrush stands are limited to the area around Brownlee Reservoir. In these stands, the herbaceous layer is dominated by Sandberg bluegrass and cheatgrass, with a variety of forbs also occurring.

Stands of hackberry (*Celtis reticulata)* were found mainly downstream of Brownlee Dam either on lower slopes with rocky residual/colluvial soil or on alluvial terraces with sandy soil (Tisdale 1986, Holmstead 2001). Hackberry is known to have occurred historically throughout the Brownlee Reservoir Reach along the Snake River, becoming increasingly rare upriver of the Farewell Bend area where broad floodplains favored establishment of more mesic species (Blair et al. 2001). Most hackberry-dominated sites along the Brownlee Reservoir Reach were inundated with reservoir construction. In the stands below Brownlee Dam, hackberry is often mixed with a number of other shrub and tree species, including antelope bitterbrush, blue elderberry (*Sambucus cerulea*), and ponderosa pine (BPA 1984). The herbaceous layer is most often dominated by bluebunch wheatgrass, with cheatgrass and sand dropseed dominant in areas that have been heavily disturbed by the grazing and trampling of cattle.

Tree-Dominated Vegetation Types—Although coniferous forest communities are generally restricted to the higher elevations of steep canyon slopes, they do reach down to the Snake River in certain locations of the study area. The predominant forest community is a ponderosa pine (*Pinus ponderosa*)/bluebunch wheatgrass plant association, which extends to the river on north-facing slopes at sites along Oxbow and Hells Canyon reservoirs (Asherin and Claar 1976, Bonneville Power Administration 1984). This association typically occurs as a savanna of ponderosa pine trees distributed over a grassland steppe dominated by bluebunch wheatgrass. Shrubs are almost completely absent, except for sparsely distributed, drought-resistant species such as antelope bitterbrush and serviceberry (Garrison et al. 1977, Johnson and Simon 1987). A ponderosa pine/hackberry type may also extend down to the river in this area. Hackberry

dominates the shrub layer in moderate density, and poison ivy is also abundant (Asherin and Claar 1976).

2.7. Land Use

The study area and vicinity is still dominated by the land-use patterns established at the turn of the century: irrigated and nonirrigated agriculture, livestock grazing, mining, large areas of open space, scattered rural development, and rapidly-growing recreational activities. The bottomlands adjacent to the reservoirs are generally used for grazing, some farming, and recreation. Since construction of the HCC, most anthropogenic influences have occurred above Hells Canyon Dam. This portion of the study area is more easily accessible for livestock operations, recreation, and other human activities (e.g., farming and residential pursuits), compared with the reach below Hells Canyon Dam (Blair et al. 2001). Significant disturbances occurred upstream of the Hells Canyon Dam area well before the 1950s (Blair et al. 2001). Mining, logging, and especially livestock grazing were pronounced in the upstream watershed. The relatively moderate hill slopes, from the headwaters of Brownlee Reservoir downstream to about Brownlee Dam, are more accessible to livestock grazing today and in the past than the steeper, rocky slopes more characteristic of Oxbow and Hells Canyon reservoirs.

3. PLANT OPERATIONS

Hells Canyon, on the Oregon–Idaho border, is the deepest canyon in North America and home to IPC's largest hydroelectric generating complex, the HCC. The HCC includes the Brownlee, Oxbow, and Hells Canyon dams, reservoirs, and power plants. Operations of the three projects of the complex are closely coordinated to generate electricity and to serve many other public purposes.

IPC operates the complex to comply with the FERC license, as well as to accommodate other concerns, such as recreational use, environmental conditions and voluntary arrangements. Among these arrangements are the 1980 Hells Canyon Settlement Agreement, the *Fall Chinook Recovery Plan* adopted in 1991, and, between 1995 and 2001, the cooperative arrangement that IPC had with federal interests in implementing portions of the Federal Columbia River Power System (FCRPS) biological opinion flow augmentation, which is intended to avoid jeopardy of the FCRPS operations below the HCC.

Brownlee Reservoir is the only one of the three HCC facilities—and IPC's only project—with significant storage. It has 101 vertical feet of active storage capacity, which equals approximately 1 million acre-feet of water. On the other hand, Oxbow and Hells Canyon reservoirs have significantly smaller active storage capacities—approximately 0.5 and 1.0% of Brownlee Reservoir's volume, respectively.

Brownlee Dam's hydraulic capacity is also the largest of the three projects. Its powerhouse capacity is approximately 35,000 cubic feet per second (cfs), while the Oxbow and Hells Canyon powerhouses have hydraulic capacities of 28,000 and 30,500 cfs, respectively.

Target elevations for Brownlee Reservoir define the flow through the HCC. However, when flows exceed powerhouse capacity for any of the projects, water is released over the spillways at those projects. When flows through the HCC are below hydraulic capacity, all three projects operate closely together to re-regulate flows through the Oxbow and Hells Canyon projects so that they remain within the 1-foot per hour ramp rate requirement (measured at Johnson Bar below Hells Canyon Dam) and meet daily peak load demands.

In addition to maintaining the ramp rate, IPC maintains minimum flow rates in the Snake River downstream of Hells Canyon Dam. These minimum flow rates are for navigation purposes and IPC's compliance with article 43 of the existing license. Neither the Brownlee Project nor the Oxbow Project has a minimum flow requirement below its powerhouse. However, because of the Oxbow Project's unique configuration, a flow of 100 cfs is maintained through the bypassed reach of the Snake River below the dam (a segment called the Oxbow Bypass).

4. METHODS

4.1. Survey Design and Protocol

Line-transect sampling methods are widely used to estimate the density of bird populations. They are the most efficient of all general bird survey methods (e.g., spot-mapping and point counts) in terms of data gathered per unit effort (Bibby et al. 1992). The basic line transect involves walking a predetermined straight line, or a series of straight lines, and recording bird detections along both sides of the line. We used transects to maximize the area surveyed because upland game birds in the study area generally have relatively low densities, are widely distributed, and occupy a diverse array of habitats.

We conducted surveys in early spring when males of many upland game bird species typically advertise audibly (by calling, wing clapping, and/or drumming) for mates (Davis 1982). We walked transects to identify relative spring distributions and index relative abundances of upland game birds (Caughley 1977, Davis and Winstead 1980, Rotella and Ratti 1986). A transect of variable but known distance was established in each sampling unit. To maximize surveying time, transects were placed in areas accessible by foot. To maximize the area sampled, transects were placed so that relatively large areas could be surveyed both visually and audibly (e.g., on ridgebacks and trails).

Areas with suitable access for surveying were identified from USGS topographic and orthophoto maps. Sampling sites were located as uniformly as possible between Weiser and Hells Canyon Dam and were within 3 air miles of any of the 3 reservoirs. Eighteen transects, averaging 2,819 m in length (range = 1,108 to 4,683 m), were established in the Hells Canyon Study Area (Table 2 and Figure 1). We conducted surveys twice during spring 1996—once during April and once during May. Two counts were used to decrease the variability in detectability due to changes in reproductive chronology among upland game bird species. All transects were surveyed in April, but only 15 transects were surveyed in May because of inclement weather.

For both surveys combined, the total distance surveyed was 94,182 m. Survey time per transect, standardized for a 1,000 m transect line, averaged 20 ± 6 min (N = 33).

Time of day influences bird behavior and, therefore, detectability. Studies suggest that counts conducted within 3 to 5 hours after sunrise can be quite comparable (Robbins 1981*a*, Skirvin 1981, Verner and Ritter 1986, Blake et al. 1991, Buckland et al. 1993). Therefore, to minimize variation within a sampling period, survey effort was standardized by conducting surveys at approximately the same time each day: between sunrise and no later than 4 hours after sunrise. In addition, surveys were conducted under generally similar weather conditions: clear, calm conditions when birds are expected to be more reproductively active. Surveys were not conducted during strong winds (> 20 km/hr), rain, or other inclement weather conditions (Robbins 1981*b*). Also, conditions that restrict reasonable visibility (e.g., fog) were avoided (Rotella and Ratti 1986).

Surveyors' start and end times (24-hour system) were recorded. Both visual and audible observations were recorded using species codes. When more than one bird was observed together, group size was recorded. We tried to avoid duplicate counts of flushed individuals by noting movement direction and distances. All auditory detections were recorded regardless of possible duplicate counting, but observers noted any suspicions of duplication. The cover type in which the individual or group was detected was also recorded.

4.2. Incidental Data

Upland game bird data recorded during spring nongame bird point count surveys were included in this study as incidental observations (Turley and Holthuijzen 2000). In addition, IPC field personnel were asked to record incidental observations of uncommon species encountered within the Hells Canyon Study Area. Data from both sources were combined and treated as one data set. This information supplemented upland game bird transects data and was useful for species that were observed only rarely or were not otherwise detected.

4.3. Species Distribution Maps

The spatial distributions of species in Hells Canyon were qualitatively assessed using a Geographic Information System (GIS). Wildlife habitat-relationship (WHR) models for each upland game bird species were acquired from Oregon and Idaho Gap Analysis projects (Kagan et al. 1999; J. M. Scott, University of Idaho, *unpubl. data)* and were overlaid with data collected during our survey effort.

The WHR models used were OR-GAP Version 2 for Oregon and second-generation WHR models for Idaho. Oregon's WHR models used a minimum mapping unit of 100 ha. The distribution maps were prepared using the revised hexagon data set from the Oregon Natural Heritage Program (ONHP), a revised version of the WHR matrix, and Oregon Department of Fish and Wildlife's (ODFW) OR-GAP Version 2 land-cover vegetation map consisting of 65 vegetation types grouped into 31 wildlife habitat types. For each species, the distributional limits were defined by recording the species' presence or absence within the Environmental

Protection Agency's hexagon grid system for Oregon. Next, a WHR matrix which defined the affinities of terrestrial vertebrate species to land-cover types was developed. The hexagon and WHR databases were used in a GIS-modeling process that assigned species-to-habitat polygons based on each species' known or expected occurrence within hexagons and the species' association to habitat features. Finally, hard-copy maps of predicted species distributions were reviewed by acknowledged experts (Kagan et al. 1999). The Oregon WHR model for mountain quail was not available.

The Idaho land-cover classification recognizes 81 cover types and is mapped at a resolution of 0.09 ha with a 2 ha minimum mapping unit. Idaho WHR models are stored as georeferenced TIFF images with a native resolution of 0.09 ha. They are in draft form, currently being peer-reviewed. Intended for applications at the landscape scale, Gap Analysis maps do not show every occurrence of animal habitat but provide a coarse-filter approach to vegetation/wildlife habitat relationships (J. M. Scott, University of Idaho, *unpubl. data*). These Gap Analysis maps provided our study with a general backdrop of expected species occurrences.

Lek locations for sharp-tailed grouse and sage grouse were obtained from the ODFW (Willis et al. 1993), IDFG (Dan Hislop, IDFG, *pers. comm.*), and BLM (M. Kneisel and J. LaRocco, BLM, *pers. comm.*). Mountain quail observations were obtained from the Idaho Conservation Data Center (IDCDC) database. Mountain quail are not tracked in Oregon.

4.4. Data Analysis

Upland game bird indices—Frequency indices (detections/unit survey effort) were calculated for all upland game birds combined and for each individual species. Also, indices were calculated for each reservoir and for all reservoirs combined. Absolute game bird densities were not estimated because of difficulties meeting assumptions of statistical estimators (Mayfield 1981, Buckland et al. 1993) when surveying these species (e.g., low densities and thus low detection rates).

Upland game bird distribution—From Idaho and Oregon WHR models, the predicted distribution of each upland game bird was overlaid with data from the spring upland game bird surveys indicating species presence or absence along survey transects. Upland game bird data collected during spring nongame bird surveys and observations recorded during other field activities were included as incidental observations. This supplemental information was useful for species that were observed only rarely or were not detected during the transect surveys. Active and historic lek locations for sage and sharp-tailed grouse and incidental observations of mountain quail were included on distribution maps because of these species' rarity. A more detailed habitat evaluation map for the mountain quail is available in Rocklage and Edelmann (2001).

5. RESULTS

5.1. Upland Game Bird Indices

Seven species were observed during transect surveys, and an average of 1.93 birds were reported per kilometer. The most common species was the chukar (0.76 birds/km), followed closely by the mourning dove (0.75 birds/km, Table 3). Other species observed included the California quail (0.25 birds/km), gray partridge (0.07 birds/km), ruffed grouse (0.06 birds/km), ring-necked pheasant (0.01 birds/km), and blue grouse (0.01 birds/km). Four other species, the wild turkey, mountain quail, sage grouse, and sharp-tailed grouse, were observed incidentally during other fieldwork activities. The spruce grouse was only observed incidentally at high elevations (i.e., Seven Devils and Wallowa mountains) in the vicinity of the study area.

The highest number of birds/km was observed on Oxbow Reservoir (2.90 birds/km), followed by Brownlee (1.83 birds/km) and Hells Canyon (1.73 birds/km) reservoirs. This numerical distribution was due primarily to high numbers of mourning doves observed on Oxbow Reservoir (1.79 birds/km; 0.80 birds/km on Brownlee Reservoir and 0.27 birds/km on Hells Canyon Reservoir). Chukars also had their highest indices on Oxbow Reservoir (0.94 birds/km), followed by Hells Canyon (0.87 birds/km) and Brownlee (0.67 birds/km) reservoirs.

5.2. Upland Game Bird Distribution

The chukar was observed in a variety of cover types: *Shrub Savanna* (n = 28 observations), *Grassland* (n = 25), *Cliff/Talus* (n = 7), *Shrubland* (n = 6), riparian cover types (n = 4), and *Roads* (n = 1) (Table 4). The mourning dove was also found in a variety of cover types including *Shrub Savanna* (n = 37), *Grassland* (n = 8), *Shrubland* (n = 7), *Forested Wetland* (n = 5), *Desertic Shrubland* (n = 4), *Forbland* (n = 3), and *Tree Savanna* (n = 3). California quail were observed most frequently in riparian cover types (*Scrub-Shrub Wetlands*, n = 11 observations; *Forested Wetland*, n = 7 observations), but were also observed in *Shrubland* (n = 4) and *Shrub Savanna* (n = 2) types. Ruffed grouse were reported in *Forested Wetland* (n = 3), *Scrub-Shrub Wetland* (n = 2), and *Shrubland* (n = 1). Gray partridge were found in *Shrub Savanna* (n = 6) and *Grassland* (n = 1) cover types.

Most of the upland game bird species were widespread within the study area. The chukar, mourning dove, California quail, ruffed grouse, blue grouse, and gray partridge were observed throughout the study area (Figures 3–8) (Turley and Holthuijzen 2001, Appendix 1). The sage grouse, ring-necked pheasant, and sharp-tailed grouse were observed only in the southern portion of the study area (Figures 9–11). The wild turkey was observed primarily at locations where introductions had taken place (Figure 12). Mountain quail were observed only below Hells Canyon Dam (Figure 13).

6. DISCUSSION

6.1. Upland Game Bird Community

A diverse upland game bird community is present in the Hells Canyon Study Area and includes both native and introduced species. Eleven species were observed during upland game bird surveys or incidentally during other IPC fieldwork. From studies in 1974 and 1975, Asherin and Claar (1976) reported the occurrence of 6 upland game bird species in Hells Canyon. They observed the chukar, gray partridge, and mourning dove throughout Hells Canyon; the ring-necked pheasant and ruffed grouse only along Brownlee Reservoir; and California quail on Brownlee, Oxbow, and Hells Canyon reservoirs but not below Hells Canyon Dam. The greater number of species observed in this IPC study is not surprising, considering the intensity of wildlife surveys conducted in the area and the inclusion of all incidental sightings.

The Hells Canyon Study Area had a more diverse upland game bird community than reported for other portions of the Snake River (Table 3). Only 2 species were reported in the Shoshone Falls area, the California quail and mourning dove (Holthuijzen 1997). Two additional species, the ring-necked pheasant and gray partridge, were found in the C.J. Strike Area (Sunderman et al. 1998), and a total of 5 species were reported at Hagerman: namely, the preceding 4 species and chukar (Holthuijzen 1995).

According to our surveys, the chukar and mourning dove were the most common and widespread species in Hells Canyon. Chukar numbers are below historic highs, but good populations exist in southwestern Idaho (IDFG 2001). Typically in late August or early September, IDFG conducts aerial surveys for chukars along Brownlee Reservoir. In 1996, IDFG reported 79.1 chukars/mi^2. In 1999, the average was 110.8 chukars/mi^2. Ratti and Giudice (2001) classified chukar populations as abundant in Hells Canyon during 1999 and 2000. These populations are largely dependent upon spring weather conditions during nesting and brood rearing (IDFG 2001). For a more comprehensive discussion of chukar and gray partridge status in the Hells Canyon Study Area, see Ratti and Giudice (2001).

In contrast to our results (chukars were detected approximately 10 times more often than gray partridge), Ratti and Giudice (2001) reported that the ratio of chukar to gray partridge was approximately 50:50. This discrepancy may result from several factors. Differences may exist in detectability of the 2 species during spring when the chukar, a particularly vocal species, could have been more easily detected. Another contributing factor may have been the different habitats sampled. Ratti and Giudice (2001) observed chukar on grass-dominated slopes with relatively few rock outcroppings and on steeper slopes with talus and rock outcroppings having less vegetative cover. In contrast, gray partridge were most abundant on the less-rocky slopes with good-quality stands of grass. Ten of our 18 transects (56%) were located from Brownlee Dam northward, whereas Ratti and Giudice (2001) placed only 8 of 26 transects (31%) from Brownlee Dam northward, a portion of the study area having steeper slopes with talus and rock outcroppings, more likely to be chukar habitat. Thus, different survey locations may partially account for the different proportion of chukar and gray partridge found. Another factor may have been natural population fluctuations. Our survey was conducted in 1996 following a period of

drought, whereas Ratti and Giudice (2001) conducted surveys in 1999 and 2000 after several years of above-average precipitation. Thus, gray partridge populations may have increased in response to increased vegetative cover.

The national Breeding Bird Survey (BBS) and call-count surveys indicate a generally decreasing population trend for mourning dove populations in the western United States (Sauer et al. 2000). From 1966 through 1999, both Idaho and Oregon had a significant decline in mourning dove numbers (Sauer et al. 2000). Population trends in the Hells Canyon Study Area are unknown, but mourning dove populations are generally stable in southwestern Idaho. Brood counts ranged from 4.5 birds/mi in 1991 to 3.9 birds/mi in 1999, with a low of 1.6 birds/mi in 1998 (IDFG 2001).

The ruffed grouse was probably underrepresented during game bird surveys in the study area. Only limited riparian habitat was surveyed along transects, which probably accounts for the low detection of ruffed grouse (0.06 birds/km). Data collected during nongame bird surveys in the study area indicated that the ruffed grouse is common and widespread in tributaries to the Snake River (Turley and Holthuijzen 2001). Riparian habitat in Hells Canyon appears quite suitable for the ruffed grouse, and many tributaries are dominated by alder and birch trees, the catkins of which are the ruffed grouse's primary winter food (Leopold et al. 1981).

6.2. Upland Game Bird Distribution

The topography, soil substrate, and precipitation show a marked gradient in the study area, which influences the distribution of the vegetation and land-use cover types (Holmstead 2001). For example, the southern portion of the study area near Weiser is characterized by flat topography, with a higher proportion of *Agriculture* land-use cover type present than elsewhere in the study area. The portion near Hells Canyon Dam is characterized by steep slopes, with a higher proportion of *Cliff/Talus* cover type than elsewhere in the study area.

The distribution of the vegetation influenced the distribution of several game bird species. The ring-necked pheasant was predicted to occur throughout the study area (Figure 10). However, the conspicuous ring-necked pheasant was only observed along the southern portion of the study area, as far north as the Powder River Arm, with one sighting below Hells Canyon Dam (Appendix 1 and Figure 10). Because the pheasant is closely associated with agriculture (Csuti et al. 1997, Groves et al. 1997), its presence was expected in the southern portion of the study area.

The California quail and mourning dove were common along all reaches except below Hells Canyon Dam (Appendix 1). Asherin and Claar (1976) did not report the California quail present in the reach from Hells Canyon Dam downstream to the Salmon River confluence. The mourning dove was also uncommon below Hells Canyon Dam (Appendix 1). In this study, the mourning dove was generally found in areas dominated by extensive *Grassland* or other suitable foraging sites near riparian vegetation but was absent from areas dominated by *Cliff/Talus*.

The chukar was predicted to occur and was observed throughout Hells Canyon (Figure 3 and Appendix 1). The chukar prefers steep, rocky, mountainous terrain harboring a mixture of brush,

grasses, and forbs (Christensen 1996). Its primary foods are the leaves and seeds of annual and perennial grasses, primarily the introduced cheatgrass, and various forbs. Not surprisingly, chukars thrive in Hells Canyon, where suitable habitat is found throughout the area.

The ruffed grouse was predicted to occur at higher elevations within the study area (Figure 5). However, information gathered during game bird surveys and a study of nongame birds (Turley and Holthuijzen 2001) indicated that the ruffed grouse also occurs at lower elevations within the study area and is widespread and common in Snake River tributaries in Hells Canyon. The discrepancy between predicted and observed occurrence is probably an artifact of the scale of predicted distribution mapping. Because the mapping resolution was not fine enough to delineate small tributaries (the Gap Analysis project data has a 100 ha minimum mapping unit for Oregon and 2 ha minimum for Idaho), ruffed grouse presence in these tributaries could not be predicted.

The blue grouse was predicted to occur at higher elevations in the Hells Canyon Study Area and also in patchy fingers of suitable habitat extending into lower elevations (Figure 7), but the blue grouse was only observed on one transect. However, Turley and Holthuijzen (2001) reported the species occurring in low numbers along each of the reservoirs and below Hells Canyon Dam, generally at slightly higher elevations. The species was also observed on one occasion displaying on the road next to Oxbow Reservoir.

The wild turkey was observed in and near various tributaries to the Snake River. This species was generally seen on the Idaho side in areas where recent translocations had taken place (e.g., Wildhorse River and Brownlee Creek) and along Pine Creek in Oregon.

Species with limited distributions included the sage grouse, sharp-tailed grouse, and mountain quail. Within the study area, big sagebrush is found only along Brownlee Reservoir (Holmstead 2001), and the sage grouse, a sagebrush obligate, was observed at several locations at the southern end of the study area and near the Powder River Arm. Surprisingly, the predicted distribution in Oregon did not include areas adjacent to the study area except near Farewell Bend (Figure 9). In March 2001, 2 incidental observations in Oregon documented sage grouse adjacent to the Powder River portion of the study area. Although incidental Idaho observations were recorded in December, they were included on the distribution map because of their rarity.

In 1997, helicopter surveys were conducted to survey for sage and sharp-tailed grouse leks along Brownlee Reservoir and the transmission lines associated with the HCC (Rocklage and Edelmann 2001). No leks were detected during this survey. However, in May 1999, a single sharp-tailed grouse was sighted incidentally on the Oregon side, approximately 8.3 mi from a known population in Idaho (Figure 11). For a more detailed and specific discussion of sage and sharp-tailed grouse status in the Hells Canyon Study Area, see Rocklage and Edelmann (2001).

IPC staff observed the mountain quail below Hells Canyon Dam at Temperance Creek and at higher elevations above Pittsburg Landing. The IDCDC has recent records for Granite Creek (1993) below Hells Canyon Dam, as well as Blue Creek (1999) and Big Bar (1996) on Hells Canyon Reservoir, and upper Brownlee Creek (1994) on Brownlee Reservoir (Figure 13). Ormiston (1966) conducted a study of mountain quail in Big Canyon Creek prior to the widespread decline of the species. Reese and Smasne (1996) surveyed Big Canyon Creek with the intent of conducting a comparative study but did not find mountain quail in the area.

Populations have declined dramatically in Idaho and northeastern Oregon over the last 40 years (Csuti et al. 1997, Groves et al. 1997). Declines are thought to be due to loss and degradation of habitat. Populations in the study area appear to be at very low levels. Rocklage and Edelmann (2001) applied a landscape-level habitat model for mountain quail to the Hells Canyon Study Area to evaluate the existing distribution and quality of mountain quail habitat; see that report for a more comprehensive discussion.

7. SUMMARY AND CONCLUSIONS

A diverse upland game bird community is present in the Hells Canyon Study Area and includes both native and introduced species. In spring 1996, 7 species were observed during transect surveys in the Hells Canyon Study Area. An average of 1.93 birds were observed per kilometer. The most commonly observed species was the chukar (0.76 birds/km), followed closely by the mourning dove (0.75 birds/km, Table 3). Other species observed included the California quail (0.25 birds/km), gray partridge (0.07 birds/km), ruffed grouse (0.06 birds/km), ring-necked pheasant (0.01 birds/km), and blue grouse (0.01 birds/km). Four other species—the wild turkey, mountain quail, sage grouse, and sharp-tailed grouse—were observed incidentally during other IPC fieldwork. Spruce grouse were observed incidentally at high elevations (i.e., Seven Devils and Wallowa mountains) in the vicinity of the study area.

The distribution of several upland game bird species was influenced by the distribution of vegetation and land-use cover types. The ring-necked pheasant, known to be associated with agriculture, was primarily found in the southern end of the study area and near the Powder River Pool. These areas are surrounded by extensive agricultural land not present in other portions of the study area. Sagebrush is found only along Brownlee Reservoir, and the sage grouse, a sagebrush obligate, was observed only adjacent to this reservoir. A sharp-tailed grouse was sighted on the Oregon side, approximately 8.3 mi from a known Idaho population. The mountain quail was observed below Hells Canyon Dam at Temperance Creek. Populations of this species have declined dramatically in Idaho and northeastern Oregon, probably because of loss and degradation of habitat. Populations in the study area appear to be at very low levels.

Most other species—including chukar, mourning dove, California quail, gray partridge, ruffed grouse, and blue grouse—were distributed throughout the study area. However, the mourning dove and California quail appeared to be present at lower population levels below Hells Canyon Dam. The lower abundance may be due to the dominance of the *Cliff/Talus* cover type and absence of suitable foraging sites in areas directly below the dam.

8. ACKNOWLEDGMENTS

Thanks go to Kelly Wilde and Von Pope for organizing the fieldwork for this study. Thanks also go to Sam Adams and Sonny Cabbage for GIS support. Toni Holthuijzen provided valuable comments to previous drafts. Pam Peterson edited the draft manuscript. Corporate Publishing, IPC, formatted the manuscript.

9. LITERATURE CITED

Asherin, D. A., and J. J. Claar. 1976. Inventory of riparian habitats and associated wildlife along the Columbia and Snake rivers. Volume IIIA. College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, ID, USA. 556 p.

Bibby, C. J., N. D. Burgess, and D. A. Hill. 1992. Bird census techniques. Academic Press, New York, NY, USA. 257 p.

Blair, C., J. Braatne, R. Simons, S. Rood, and B. Wilson. 2001. Effects of constructing and operating the Hells Canyon Complex on wildlife habitat. *In* License application for the Hells Canyon Complex. Technical Report E.3.2-44. Idaho Power Company, Boise, ID, USA.

Blake, J. G., J. M. Hanowski, G. J. Niemi, and P. T. Collins. 1991. Hourly variation in transect counts of birds. Ornis Fennica 68:139-147.

Boag, D. A., and M. A. Schroeder. 1992. Spruce grouse (*Dendragapus canadensis*). *In* A. Poole, P. Stettenheim, and F. Gill, eds. The birds of North America, No. 5. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Bonneville Power Administration (BPA). 1984. Hells Canyon environmental investigation. Prepared by CH2M-Hill, Boise, ID, USA.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: estimating abundance of biological populations. Chapman and Hall, New York, NY, USA. 446 p.

Burleigh, T. D. 1972. Birds of Idaho. Caxton Printers Ltd., Caldwell, ID, USA. 467 p.

Bush, J. H., and W. P. Seward. 1992. Geologic field guide to the Columbia River Basalt, northern Idaho and southeastern Washington. Idaho Geological Survey Information Circular 49. University of Idaho, Moscow, ID, USA. 35 p.

Carroll J. P. 1993. Gray partridge (*Perdix perdix*). *In* A. Poole and F. Gill, eds. The birds of North America, No. 58. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Caughley, G. 1977. Analysis of vertebrate populations. John Wiley & Sons, London, UK. 234 p.

Christensen, G. C. 1996. Chukar (*Alectoris chukar*). *In* A. Poole and F. Gill, eds. The birds of North America, No. 258. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Connelly, J. W., M. W. Gratson, and K. P. Reese. 1998. Sharp-tailed grouse (*Tympanuchus phasianellus*). *In* A. Poole and F. Gill, eds. The birds of North America, No. 354. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Crawford, J. A., and J. W. Snyder. 1995. Habitat use, movements, and reproduction by translocated Columbian sharp-tailed grouse in eastern Oregon. Oregon State University, Corvallis, OR, USA. Final Report. 48 p.

Csuti, B., A. J. Kimerling, T. A. O'Neil, M. M. Shaughnessy, E. P. Gaines, and M. M. P Huso. 1997. Atlas of Oregon wildlife: distribution, habitat, and natural history. Oregon State University Press, Corvallis, OR, USA. 492 p.

DeBolt, A. 1992. The ecology of *Celtis reticulata* Torr. (netleaf hackberry) in Idaho. M.S. thesis, Oregon State University, Corvallis, OR. USA.

Davis, D. E. 1982. CRC handbook of census methods for terrestrial vertebrates. CRC Press, Inc. Boca Raton, FL, USA. 397 p.

Davis, D. E., and R. L. Winstead. 1980. Estimating the numbers of wildlife populations. Pages 221-237 *in* S. D. Schemnitz, ed. Wildlife management techniques manual. 4th ed. The Wildlife Society, Washington, D.C., USA.

Department of Energy (DOE). 1985. Hells Canyon environmental investigation. Final report. U.S. Department of Energy, Bonneville Power Administration, Office of Power and Resource Management. DOE/BP-11548-1.

Fitzgerald, J. F. 1982. Geology and basalt stratigraphy of the Weiser embayment, west-central Idaho. Pages 103-128 *in* B. Bonnichsen and R. M. Breckenridge, eds. Cenozoic geology of Idaho. Idaho Bureau of Mines and Geology Bulletin 26. Moscow, ID, USA.

Franklin, J. F., and C. T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, OR, USA.

Garrison, G. A., A. J. Bjugstad, D. A. Duncan, M. E. Lewis, and D. R. Smith. 1977. Vegetation and environmental features of forest and range ecosystems. U.S. Department of Agriculture, Forest Service, Agriculture Handbook No. 475. Washington, D.C., USA. 68 p.

Groves, C. R., B. Butterfield, A. Lippincott, B. Csuti, and J. M. Scott. 1997. Atlas of Idaho's wildlife; integrating Gap Analysis and Natural Heritage Information. Idaho Department of Fish and Game, Nongame and Endangered Wildlife Program, Boise, ID, USA. 372 p.

Holmstead, G. 2001. Vegetation of the Snake River corridor in Hells Canyon—Weiser, Idaho to the Salmon River. Technical Report E.3.3-1 *in* License application for the Hells Canyon Complex. Idaho Power Company, Boise, ID, USA.

Holthuijzen, A. M. A. 1995. An investigation of upland game birds in the Hagerman Study Area. *In* License application for the Upper Salmon Falls, Lower Salmon Falls, and Bliss hydroelectric projects. Volume 2. Technical Report E.3.2-C. Idaho Power Company, Boise, ID, USA. 25 p.

Holthuijzen, A. M. A. 1997. An investigation of upland game birds in the Shoshone Falls Study Area. *In* License application for the Shoshone Falls Project. Volume 2. Technical Report E.3.2-B. Idaho Power Company, Boise, ID, USA. 30 p.

Huschle, G. 1975. Analysis of the vegetation along the middle and lower Snake River. M.S. thesis, University of Idaho, Moscow, ID, USA. 268 p.

Idaho Department of Fish and Game (IDFG). 1990. Upland game management plan 1991–1995. IDFG, Boise, ID, USA. 102 p.

Idaho Department of Fish and Game (IDFG). 2001. Upland game, Study II, Job 1. IDFG, Boise, ID, USA. 159 p.

Idaho Power Company (IPC). 1997. Formal consultation package for relicensing the Hells Canyon Hydroelectric Project, FERC No. 1971. IPC, Boise, ID, USA.

Idaho Power Company (IPC). 2000. Detailed final study plans Terrestrial Section, phase II, for relicensing the Hells Canyon Complex (FERC No. 1971). IPC, Boise, ID, USA.

Johnson, C. G., and S. A. Simon. 1987. Plant associations of the Wallowa–Snake Province, Wallowa-Whitman National Forest. U.S. Department of Agriculture, Forest Service PNR. R-6 ECOL-TP-225A-86. 272 p.

Kagan, J. S., J. C. Hak, B. Csuti, C. W. Kiilsgaard, and E. P. Gaines. 1999. Oregon Gap Analysis project final report: a geographic approach to planning for biological diversity. Oregon Natural Heritage Program, Portland, OR, USA. 72 p. plus appendices.

Leopold, A. S., R. J. Gutierrez, and M. T. Bronson. 1981. North American game birds and mammals. Charles Scribner's Sons, New York, NY, USA. 198 p.

Mayfield, H. F. 1981. Problems in estimating population size through counts of singing males. Pages 220-224 *in* C. J. Ralph and J. M. Scott, eds. Estimating numbers of terrestrial birds. Studies in Avian Biology No. 6. Cooper Ornithological Society and Allen Press, Inc., Lawrence, KS, USA. 630 p.

Mendel, G. W. 1979. The hungarian partridge in the Palouse Region of northern Idaho. M.S. thesis, University of Idaho, Moscow, ID, USA.

Miller, T. B. 1976. Ecology of riparian communities dominated by white alder in western Idaho. M.S. thesis, University of Idaho, Moscow, ID, USA.

Miller, H. C. 1996. Demography of medusahead on two soil types: potential for invasion into intact native communities. M.S. thesis, Department of Rangeland Resources, Oregon State University, Corvallis, OR.

Miller, T. B., and F. D. Johnson. 1976. Ecology of riparian communities dominated by white alder in western Idaho. Pages 111-123 *in* Proceedings—terrestrial and aquatic vegetation, Eastern Washington State College, Cheney, WA, USA.

Mirarchi, R. E., and T. S. Baskett. 1994. Mourning dove (*Zenaida macroura*). *In* A. Poole and F. Gill, eds. The birds of North America, No. 117. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Natural Resources Conservation Service (NRCS). 1995. Draft soil survey for Adams and Washington counties, Idaho. Weiser, ID, USA.

Oelklaus, W. F., III. 1976. Chukar partridge dispersion along the middle and lower Snake and Columbia rivers. M.S. thesis, University of Idaho, Moscow, ID, USA. 56 p.

Oregon Department of Fish and Wildlife (ODFW) 1992. Oregon wild turkey program history and draft management plan. ODFW, Enterprise, OR, USA. 28 p.

Ormiston, J. H. 1966. The food habits, habitat and movements of mountain quail in Idaho. M.S. thesis, University of Idaho, Moscow, ID, USA. 39 p.

Ratti, J. T. and J. H. Giudice. 2001. Assessment of chukar and gray partridge populations and habitat in Hells Canyon. *In* License application for the Hells Canyon Complex. Technical Report E.3.2-7. Idaho Power Company, Boise, ID, USA. 106 p.

Reese, K. P., and A. M. Smasne. 1996. Results of a pilot study: survey of mountain quail in Big Canyon Creek, Idaho. Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID, USA.

Robbins, C. S. 1981*a*. Effect of time of day on bird activity. Studies in Avian Biology 6:275-286.

Robbins, C. S. 1981*b*. Bird activity levels related to weather. Studies in Avian Biology 6:301-310.

Rocklage, A. M., and F. Edelmann. 2001. A landscape-level habitat assessment for mountain quail in Hells Canyon. *In* License application for the Hells Canyon Complex. Technical Report E.3.2-6 . Idaho Power Company, Boise, ID, USA.

Ross, S. H., and C. N. Savage. 1967. Idaho earth science. Idaho Bureau of Mines and Geology, Moscow, ID, USA.

Rotella, J. J. and J. T. Ratti. 1986. Test of a critical density index assumption: a case study with gray partridge. Journal of Wildlife Management 50:532-539.

Sauer, J. R., J. E. Hines, I. Thomas, J. Fallon, and G. Gough. 2000. The North American Breeding Bird Survey, results and analysis 1966–1999. Version 98.1. USGS Patuxent Wildlife Research Center, Laurel, MD, USA.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage grouse (*Centrocercus urophasianus*). *In* A. Poole and F. Gill, eds. The birds of North America, No. 425. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

Skirvin, A. A. 1981. Effect of time of day and time of season on the number of observations and density estimates of breeding birds. Studies in Avian Biology 6:271-274.

Smith, R. B. 1990. Upland game management plan: 1991–1995. Idaho Department of Fish and Game, Boise, ID, USA. 112 p.

Sunderman, N. J., F. B. Edelmann, and A. M. A. Holthuijzen. 1998. Presence and relative abundance of upland game birds in the C.J. Strike Study Area. *In* License application for the C.J. Strike Hydroelectric Project. Technical Report E.3.2-B. Idaho Power Company, Boise, ID, USA. 33 p.

Tisdale, E. W. 1979. A preliminary classification of Snake River canyon grasslands in Idaho. Forest, Wildlife and Range Experiment Station, University of Idaho. Moscow, ID. 8 p.

Tisdale, E. W. 1986. Canyon grasslands and associated shrublands of west central Idaho and adjacent areas. Forest, Wildlife and Range Experiment Station Bulletin No. 40. University of Idaho, Moscow, ID, USA. 42 p.

Tisdale, E. W., and M. Hironaka. 1981. The sagebrush-grass region: a review of the ecological literature. Forest, Wildlife and Range Experiment Station, University of Idaho. Moscow, ID, USA. 31 p.

Tisdale, E. W., M. Hironaka, and M.A. Fosberg. 1969. The sagebrush region in Idaho: a problem in range resource management. University of Idaho Agriculture Experiment Station Bulletin 512. Moscow, ID, USA. 12 p.

Turley, N. J. S., and A. M. A. Holthuijzen. 2000. An investigation of upland game birds in the Upper and Lower Malad Study Area. *In* License application for the Upper and Lower Malad Project. Technical Report E.3.2-B. Idaho Power Company, Boise, ID, USA. 20 p.

U.S. Department of Agriculture (USDA). 1990. Final environmental impact statement, land and resource management plan. U.S. Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, Baker, OR, USA.

U.S. Department of Agriculture (USDA). 1994. Final environmental impact statement: Wild and Scenic Snake River recreation management plan. U.S. Forest Service, Hells Canyon National Recreation Area, Pacific Northwest Region, Wallowa-Whitman National Forest, Baker, OR, USA.

U.S. Department of the Interior (USDI). 1987. Proposed resource management plan and final environmental impact statement: Cascade Resource Area. U.S. Bureau of Land Management, Boise District, Boise, ID, USA.

Verner, J., and L. V. Ritter. 1986. Hourly variation in morning point counts of birds. Auk 103:117-124.

Walter, H. 2000. Ecology of the chukar in eastern Oregon. M.S. thesis, University of Idaho, Moscow, ID, USA.

Zwickel, F. C. Blue grouse. 1992. *In* A. Poole, P. Stettenheim, and F. Gill, eds. The birds of North America, No. 15. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C., USA.

This page left blank intentionally.

Table 1. Upland game bird species occurring in the Hells Canyon Study Area, Idaho and Oregon.

Species	Status—ID	Status—OR	Origin	Reference
Blue grouse *Dendragapus obscurus*	Decreasing	?	Native	L. Nelson, IDFG, 1990, *Pers. Comm.*
California quail *Callipepla californica*	?	?	Introduced	IDFG 1990
Chukar *Alectoris chukar*	?	?	Introduced	IDFG 2001
Gray partridge *Perdix perdix*	?	?	Introduced	IDFG 1990
Wild turkey *Meleagris gallopavo*	Increasing	?	Introduced	IDFG 2001
Mountain quail *Oreortyx pictus*	Decreasing	Decreasing, E. Oregon	Native	IDFG 1990, Csuti et al. 1997
Mourning dove *Zenaida macroura*	Decreasing	?	Native	IDFG 1990
Ring-necked pheasant *Phasianus colchicus*	Decreasing	?	Introduced	IDFG 1990
Ruffed grouse *Bonasa umbellus*	?	?	Native	IDFG 1990
Sage grouse *Centrocercus urophasianus*	Decreasing	Decreasing	Native	IDFG 1990
Sharp-tailed grouse *Tympanuchus phasianellus*	Decreasing	Extirpated	Native	Smith 1990
Spruce grouse *Dendragapus canadensis*	?	?	Native	Smith 1990

Table 2. Line transect survey effort for upland game bird species in the Hells Canyon Study Area, 1996.

Location	Ref. No.	State	Reservoir	# of Surveys	Length (m)	Total Length Surveyed (m)
Allison Creek	GBALL96X	ID	HC	2	2,475	4,950
Ballard Creek	GBBAL96X	OR	HC	2	2,239	4,478
Brownlee Spillway	GBBRS96X	OR	BR	2	3,373	6,746
Connor Creek	GBCON96X	OR	BR	2	1,833	3,666
Dennett Creek	GBDEN96X	ID	BR	2	4,683	9,366
Dukes Creek	GBDUK96X	ID	BR	2	3,191	6,382
Eagle Bar	GBEAB96X	ID	HC	1	2,045	2,045
Fox Creek	GBFOX96X	OR	BR	2	1,796	3,592
Grouse Creek	GBGRO96X	ID	BR	2	4,498	8,996
Homestead Creek	GBHOM96X	OR	HC	2	1,108	2,216
Indian Creek	GBIND96X	ID	HC	2	3,080	6,160
Kleinschmidt Grade	GBKLI96X	ID	HC	1	2,963	2,963
McGraw Creek	GBMCG96X	OR	HC	2	3,619	7,238
Oxbow Substation	GBOXS96X	OR	OX	1	2,292	2,292
Oxbow Transmission	GBOXT96X	ID	OX	2	2,702	5,404
Quicksand Area	GBQUI96X	OR	BR	2	3,335	6,670
Trail Creek	GBTRA96X	ID	BR	2	3,505	7,010
Warm Springs Creek	GBWAR96X	ID	OX	2	2,004	4,008
All Transects						94,182

Table 3. Upland game bird indices (birds/km) along the middle and lower Snake River corridor.

	Hagerman		Shoshone Falls		C.J. Strike		Malad	Hells Canyon	Hells Canyon
	Holthuijzen (1995)		Holthuijzen (1997)		Sunderman et al. (1998)		Turley and Holthuijzen (2001)	This Study	Asherin and Claar (1976)
Species	R[1]	U	R	U	R	U	C	C	C
California quail	1.88	0.23	0.47		1.05	0.26		0.25	Present
Mourning dove	1.30	0.51	1.02	0.03	0.43	0.39	0.13	0.75	Present
Ring-necked pheasant	0.69	0.16			0.18	0.22		0.01	Present
Gray partridge	0.08				0.01	0.07		0.07	Present
Chukar								0.76	Present
Ruffed grouse								0.06	Present
Blue grouse								0.01	
Mountain quail								Present	
Sage grouse								Present	
Wild turkey								Present	
Sharp-tailed grouse								Present	

[1]R - Riparian habitat, U - Upland habitat, C - Canyon habitat, all habitats combined

Table 4. Number of upland game bird detections within each cover type, Hells Canyon Study Area, 1996.

Cover Type	Chukar	Mourning dove	California quail	Gray partridge	Ruffed grouse	Ring-necked pheasant	Blue grouse
Upland							
Shrub Savanna	28	37	2	6			1
Shrubland	6	7	4		1		
Grassland	25	8		1			
Desertic Shrubland		4					
Forbland		3					
Tree Savanna		3					
Forested Upland	1						
Riparian							
Forested Wetland	2	5	7		3	1	
Scrub-shrub wetland	2		11		2		
Natural Feature							
Cliff/Talus Slope	7						
Land Use							
Residential	1						
Roads							
Industrial		1					
Parks/Recreation		1					
Unknown		2					
Total	72	71	24	7	6	1	1

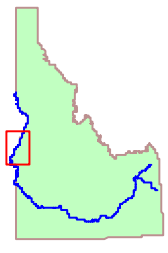
Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Powder River Arm

Farewell Bend

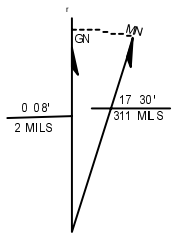


IDAHO POWER
An IDACORP Company

Legend

Game Bird Transects

Hells Canyon Rim-to-Rim Study Area



UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

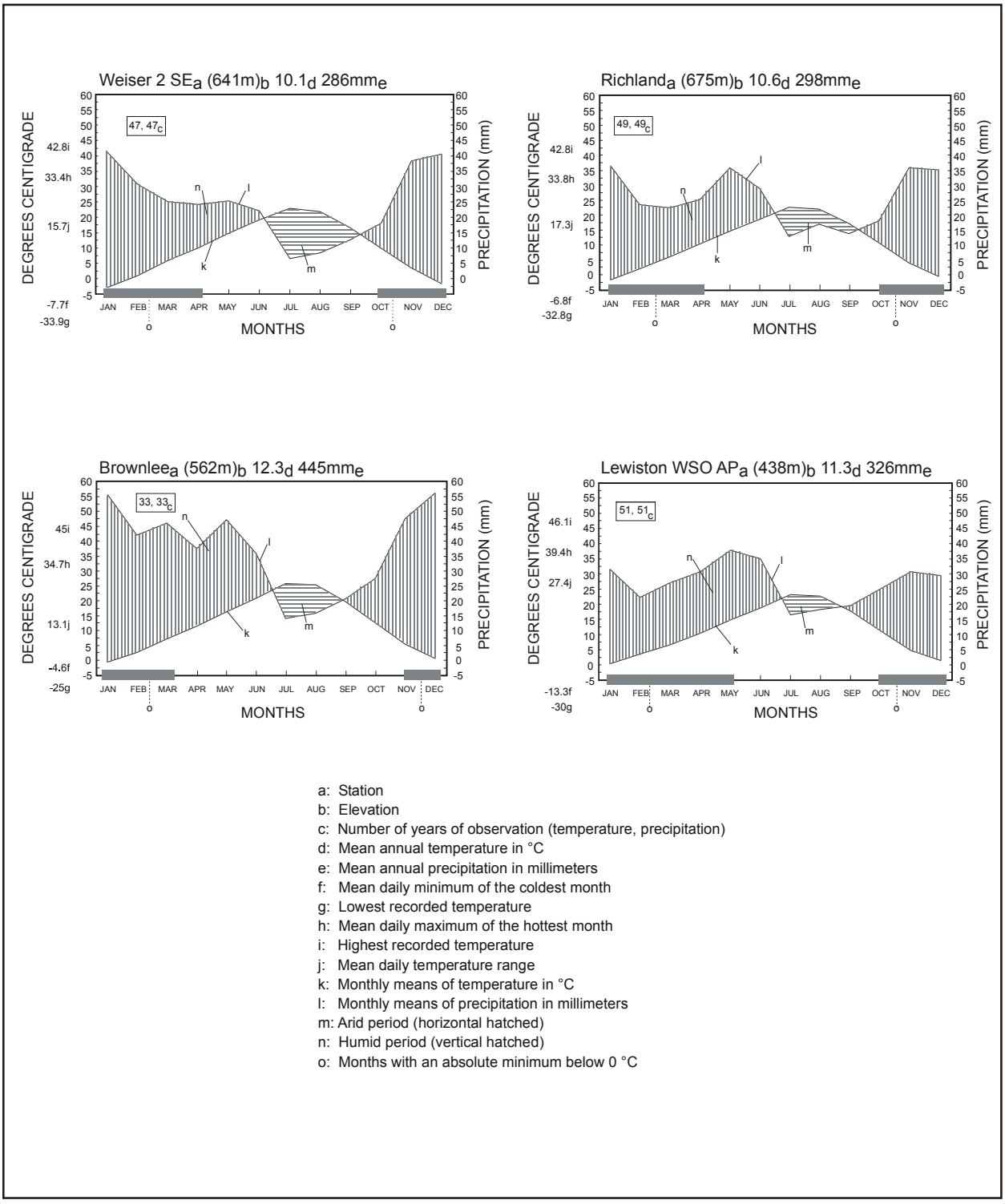
Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 1. Location of Upland Game Bird Transects within the Hells Canyon Study Area

Scale 1:315060

2 0 2 4 Miles

This page left blank intentionally.



a: Station
b: Elevation
c: Number of years of observation (temperature, precipitation)
d: Mean annual temperature in °C
e: Mean annual precipitation in millimeters
f: Mean daily minimum of the coldest month
g: Lowest recorded temperature
h: Mean daily maximum of the hottest month
i: Highest recorded temperature
j: Mean daily temperature range
k: Monthly means of temperature in °C
l: Monthly means of precipitation in millimeters
m: Arid period (horizontal hatched)
n: Humid period (vertical hatched)
o: Months with an absolute minimum below 0 °C

Figure 2. Köppen climate diagrams for the Weiser, Richland, Brownlee, and Lewiston weather stations, Hells Canyon Study Area, Idaho–Oregon border.

This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend

Features Legend

Present

Absent

Incidental Observation

Predicted Distribution

Hells Canyon Study Area

IDAHO POWER
An IDACORP Company

GN MN
0 08'
2 MILS
17 30'
311 MILS

UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 3. Predicted chukar spatial distribution, Hells Canyon Study Area

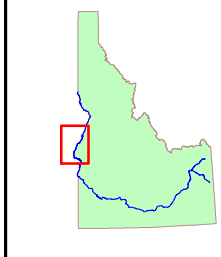
This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend



Features Legend

Absent

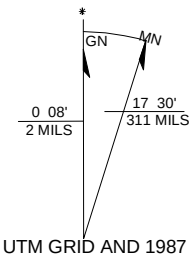
Present

Incidental Observations

Predicted Distribution

Hells Canyon Study Area

IDAHO POWER
An IDACORP Company



UTM GRID AND 1987 MAGNETIC NORTH DECLINATION AT CENTER OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 4. Predicted mourning dove spatial distribution, Hells Canyon Study Area.

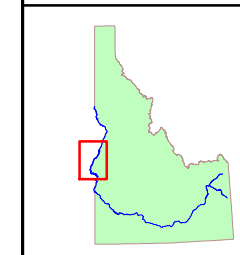
This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend



Features Legend

Present

Absent

Incidental Observations

Predicted Distribution

Hells Canyon Study Area

IDAHO POWER
An IDACORP Company

UTM GRID AND 1987 MAGNETIC NORTH DECLINATION AT CENTER OF OXBOW QUADRANGLE

0 08' 2 MILS

17 30' 311 MILS

GN MN

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 5. Predicted California quail spatial distribution, Hells Canyon Study Area.

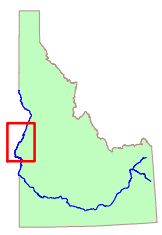
This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend



Features Legend

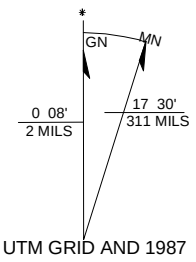
Present

Absent

Incidental Observations

Predicted Distribution

Hells Canyon Study Area



UTM GRID AND 1987 MAGNETIC NORTH DECLINATION AT CENTER OF OXBOW QUADRANGLE

IDAHO POWER
An IDACORP Company

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 6. Predicted ruffed grouse spatial distribution, Hells Canyon Study Area.

This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend

Features Legend

Absent

Present

Incidental Observation

Predicted Distribution

Hells Canyon Study Area

IDAHO POWER
An IDACORP Company

GN MN
0 08'
2 MILS
17 30'
311 MILS

UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 7. Predicted blue grouse spatial distribution, Hells Canyon Study Area.

This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend

Features Legend

Present

Absent

Incidental Observations

Predicted Distribution

Hells Canyon Study Area

GN

MN

0 08'
2 MILS

17 30'
311 MILS

UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

IDAHO POWER
An IDACORP Company

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 8. Predicted gray partridge spatial distribution, Hells Canyon Study Area.

This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

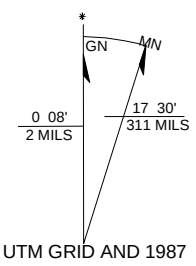
Brownlee Dam

Farewell Bend

Features Legend

- Absent
- IPC Incidental Observations
- Historic and Active Sage Grouse Leks
- Predicted Distribution
- Hells Canyon Study Area

IDAHO POWER
An IDACORP Company



UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 9. Predicted sage grouse spatial distribution, Hells Canyon Study Area

This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend

Features Legend

- Present
- Absent
- Incidental Observations
- Predicted Distribution
- Hells Canyon Study Area

UTM GRID AND 1987 MAGNETIC NORTH DECLINATION AT CENTER OF OXBOW QUADRANGLE

0 08' 2 MILS

17 30' 311 MILS

GN MN

Miles

0 1.5 3 6 9 12

IDAHO POWER
An IDACORP Company

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 10. Predicted ring-necked pheasant spatial distribution, Hells Canyon Study Area

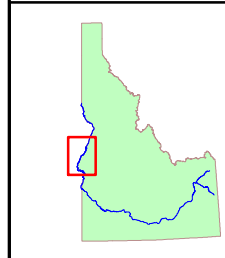
This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend



Features Legend

- Absent
- IPC Incidental Observations
- Historic and Active Leks
- Predicted Distribution
- Hells Canyon Study Area

IDAHO POWER
An IDACORP Company

GN MN
0 08'
2 MILS
17 30'
311 MILS

UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 11. Predicted sharp-tailed grouse spatial distribution, Hells Canyon Study Area.

This page left blank intentionally.

Hells Canyon Dam

Oxbow Dam

Brownlee Dam

Farewell Bend

Features Legend

Absent

Incidental Observation

Predicted Distribution

Hells Canyon Study Area

IDAHO POWER
An IDACORP Company

GN MN
0 08'
2 MILS
17 30'
311 MILS

UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

Miles
0 1.5 3 6 9 12

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 12. Predicted wild turkey spatial distribution, Hells Canyon Study Area

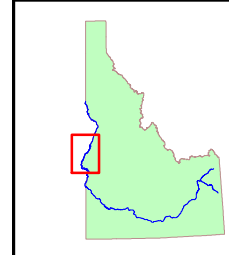
This page left blank intentionally.

Hells
Canyon
Dam

Oxbow Dam

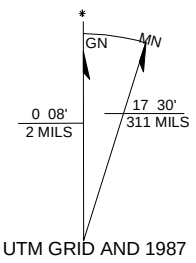
Brownlee
Dam

Farewell
Bend



Features Legend

- Absent
- IPC Incidental Observations
- Observations from IDCDC database
- Predicted Distribution
- Hells Canyon Study Area



UTM GRID AND 1987
MAGNETIC NORTH
DECLINATION AT CENTER
OF OXBOW QUADRANGLE

IDAHO POWER
An IDACORP Company

Hells Canyon Project - FERC No. 1971
Tech. Report E.3.2-3

Figure 13. Predicted mountain quail distribution, Hells Canyon Study Area.

Miles
0 2 4 8 12 16

This page left blank intentionally.

Appendix 1. Upland game bird species observed and their relative abundances, Hells Canyon Study Area, 1995–2000. From Turley and Holthuijzen 2000.

Species	Brownlee Above	Brownlee	Oxbow	Hells Canyon	Below HC Dam
Chukar		A	A	A	A
Mourning dove	C	A	C	C	U
California quail	C	C	C	C	U
Gray partridge		C	C	U	U
Ruffed grouse		C	C	C	C
Blue grouse		U	U	U	U
Ring-necked pheasant	C	U			R
Wild turkey		R	R		R
Sharp-tailed grouse		R			
Sage grouse		R			
Mountain quail					R

This page left blank intentionally.