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Blue Grouse Winter Movements, Habitat, and Survival in Northeastern Oregon

Abstract

Winter movements, habitat associations, and survivorship were compared among blue grouse age and sex groups in northeastern Oregon from 1991 to 1993. Distances moved between winter and breeding ranges were greater for adult females (1450 m) than adult males (774 m). Among birds located more than six times within the winter period, 13 immature grouse exhibited greater mean movement between sequential winter locations (594 m) and all possible pairs of winter locations (848 m) than adults (457 m and 661 m). All age and sex groups preferred parkland habitats to forested stands, and forested stands to grasslands. Immature grouse used Douglas-firs to a greater degree than adult males. Adult female survivorship (95%) was higher than immature survivorship (71%) in winter. Blue grouse management practices should consider differential life history characteristics among age and sex groups.

Introduction

Blue grouse (*Dendragapus obscurus*) inhabit areas with relatively harsh climatological conditions and low-quality forage during winter (Zwickel 1992). The size dimorphism of blue grouse age and sex groups (Zwickel 1992) may result in different winter life-history characteristics among groups. Comparison among age and sex groups of movements within winter ranges and habitat associations on these ranges may refine the understanding of different winter life-history strategies in blue grouse. Comparison of winter survival among age and sex groups may aid in understanding the effectiveness of different strategies and importance of winter habitat characteristics.

Studies of blue grouse winter ecology have been conducted in a wide range of habitats and climatological conditions (Hines 1986, Zwickel and Bendell 1986, Pekins et al. 1991, Cade and Hoffman 1993, Remington and Hoffman 1996). None has been conducted where ponderosa pine (*Pinus ponderosa*) is a major component of the habitat, however, such as the range of blue grouse in parts of northeastern Oregon. The full range of winter habitats used by blue grouse must be examined before a comprehensive synthesis of winter life history can be formulated for the species.

We hypothesized that blue grouse age and sex groups would differ in winter movement and habitat selection, and would exhibit different winter survival. Specifically, we sought to quantify movements within winter ranges and between winter and breeding ranges, determine habitat relationships on winter ranges, estimate winter survival, and compare movement, habitat associations, and survival among age and sex groups. A secondary objective of this study was to provide baseline movement, habitat association, and survival data in an ecosystem that contains ponderosa pine as a major habitat component.

Study Area

The study area was on the Wallowa Ranger District of the Wallowa-Whitman National Forest in an area ~100 km^2, 30 km north of Enterprise, Wallowa County, Oregon. Topography exceeded 45° in numerous areas; elevation ranged from ~950-1500 m. North-facing slopes were covered at all elevations with parklands dominated by mixed stands of mature Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine, or more dense forests composed primarily of regenerating Douglas-fir. Western larch (*Larix occidentalis*) also was present, and lodgepole pine (*Pinus contorta*), true firs (*Abies* spp.), and junipers (*Juniperus* spp.) occurred at low densities. South-facing slopes were dominated at all elevations by bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*) meadows. Drainages and valley bottoms supported mixed conifers and shrubs;

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aspens (*Populus* spp.) were scarce. Blue grouse were hunted in September and October during the study. Timber was harvested before and during the study; 97% were partial cuts and 3% were clearcuts (U.S. Department of Agriculture 1994). Timber management included burning, thinning, and removal of trees infested with Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*). Winter temperatures average -10 to 1°C in the region surrounding the study area, and precipitation averages 20 cm at 950 m elevation with an increase of approximately 12.5 cm/300 m increase in elevation (Johnson and Simon 1987). Snow depth ranges from 0 m on windswept ridgetops to several meters in drifted areas. Snow melted from all except highly-drifted and shaded areas by late April during this study.

Methods

Capture, Instrumentation, and Radiotelemetry

We captured blue grouse with interception-style walk-in traps (Pelren and Crawford 1995) and noose poles (Zwickel and Bendell 1967) from June through August, 1991 through 1993. We were unable to capture birds efficiently during other periods. Handling procedures followed Oring et al. (1988). Captured birds that weighed > 500 g were equipped with radio transmitters. We determined age (immature or adult, with yearlings classified as adults) and sex of captured birds by visual examination of plumage characteristics and primary feather replacement (Hoffman 1985). Battery-operated transmitters, which weighed 15 g (Advanced Telemetry Systems, Inc., Isanti, Minnesota) or 18 g (Telemetry Systems, Inc., Mequon, Wisconsin) and operated in the 150-151 MHz range, were placed on captured grouse with necklace mounts (Markström et al. 1989) or poncho mounts (Amstrup 1980) modified by vertical slits at the bases of the poncho holes to prevent esophageal obstruction (Pekins 1988). Transmitters remained active for approximately 12 mo and were equipped with motion sensors.

We began monitoring radio-equipped grouse in late November. We conducted initial winter telemetry aerially within 30 km of the study area to locate birds that moved from their capture locations; thereafter, we used a scanning receiver (Advanced Telemetry Systems, Isanti, Minnesota) with a 3-element hand-held antenna (AF Antronics, Inc., White Heath, Illinois) to approach birds on foot. We located radio-tagged grouse approximately bi-weekly by visual observation during daylight hours until late June. Most observations were made between 1000 and 1400 hours.

Habitat Sampling

We identified three cover-types at sites where radio-tagged grouse were observed. These cover types were based on 30 x 30 m pixels pre-established by the U. S. Forest Service using the GIS program Arc-Info. Percent canopy cover within these pixels was estimated from landsat imagery. Locations that fell within pixels with ≥10% canopy cover were termed forests. Parklands were defined as areas of ≥ 30 x 30 m with <10% canopy cover and <30 m between trees. Areas with ≥30 m between trees were termed grasslands.

Species of tree in which the bird was located (use-tree) was noted. A diameter tape was used to measure diameter-at-breast-height (dbh) of use-trees. Dwarf mistletoe was detected in Douglas-fir trees by observing dense clusters of stems and needles grown as a response by the trees to the parasite. Presence of other blue grouse in use-trees or trees within 30 m of use trees was noted.

We configured a minimum convex polygon around Universal Transverse Mercator coordinates of all bird use sites, and ArcInfo and USGS aerial photographs were used to calculate percent of each cover-type within the polygon for an estimate of population-level cover-type availability. We excluded two winter locations of one hen that moved 12 km; these locations added 29 km^2 (30%) to the polygon that was unused by all other radio-equipped grouse.

Data Analysis

We tested data for normality with the computer program SAS (SAS Institute Inc. 1985). Highly skewed distributions were transformed with logarithms. Levene's test was used to examine sample variances for heteroscedasticity. All statistical tests were considered significant at $P = 0.10$.

We quantified winter (December–March) movements with a multiresponse permutation procedure (MRPP) as described by Cade and Hoffman (1993). The statistical program Blossom (Slauson et al. 1991) was used to determine

mean distance between sequential winter locations and all possible pairs of winter locations for each grouse located more than six times during a winter, and serial correlation of locations. General linear models were used to compare mean distances between sequential locations and among all possible pairs of locations among age and sex groups.

We measured the linear distance between the bivariate medians of early winter (December–January) and spring (April–June) locations for each bird to determine movement distance between winter and breeding range. February and March were excluded because several grouse exhibited increased movements and more frequent use of the ground during these months, which may have represented initial movements toward breeding ranges. We verified that birds were on breeding ranges by observing male breeding behavior and, for females, presence of nests. Mean distances moved were compared between adult females and adult males with general linear models (SAS Institute Inc. 1985). An insufficient number of immature grouse were located on breeding range to include in analysis.

We compared percentage of locations in each cover-type used by each individual to availability and ranked to estimate cover-type preference by each age and sex group (Johnson 1980). To ascertain differences in habitat associations within cover-types, we used a general linear model to compare the following variables among age and sex groups: percentage of locations of each individual in Douglas-fir trees, percentage of locations of each individual in mistletoe-infested trees, and mean dbh of trees in which each bird was located.

We estimated winter (December through March) survivorship and 90% confidence intervals with the Kaplan-Meier product limit estimator (Kaplan and Meier 1958) and compared among groups with a log-rank test (Cox and Oakes 1984) provided by Proc Lifetest (SAS Institute Inc. 1985). Immature birds of both sexes were combined for this analysis because of low sample sizes (16 females and 13 males).

Results

We captured 124 blue grouse and equipped them with radio transmitters during summers 1991 through 1993. Forty-six either died or were unavailable for winter monitoring for one of the following reasons: loss of radio, suspected radio failure, or loss of radio contact for unknown reasons. The remaining 78 birds (22 adult females, 27 adult males, 16 immature females, and 13 immature males) were alive at the onset of winter following trapping. We relocated these birds 536 times ($\bar{x}$ = 7 locations/grouse, range = 1 to 23) during the three winters of study. Winter relocations numbered 160 for adult females, 224 for adult males, 66 for immature females, and 86 for immature males.

Movements

Forty radio-tagged grouse (13 adult females, 14 adult males, 6 juvenile females, and 7 juvenile males) were located > 6 times each throughout an entire winter ($\bar{x}$ number of days between locations = 12; SE = 0.53). Mean distance moved between sequential winter locations was 501 m (range = 150 to 1233). Mean distance among all possible pairs of locations per grouse was 722 m (range = 204 to 2650). Sexes exhibited no significant differences in mean movement distances. Adults exhibited shorter movements between sequential locations ($\bar{x}$ = 457, range = 150 to 1121) and among all possible pairs of locations ($\bar{x}$ = 661 m, range = 204 to 2650) than immature grouse ($\bar{x}$ = 594 m, range = 303 to 1233, $P = 0.08$; and $\bar{x}$ = 848, range = 436 to 1917, $P = 0.08$). Serial correlation occurred in sequential winter locations of 25 radio-tagged grouse (56% of adults and 77% of immatures).

We were able to follow 12 adult females and 10 adult males from winter ranges to breeding areas. Immature grouse were omitted from this analysis due to insufficient sample size. Movement distances ranged from 179 m to 4399 m ($\bar{x}$ = 1143 m). Females moved significantly greater distances ($\bar{x}$ = 1450 m, SE = 342 m) than males ($\bar{x}$ = 774 m, SE = 156 m, $P = 0.07$).

Habitat Associations

Of sites used by blue grouse, forests comprised 17%, parklands 70%, and grasslands 13%. Cover-types available to blue grouse consisted of 19% forest, 11% parkland, and 70% grassland. All age and sex groups selectively used cover-types in the same order: parklands were preferred to forests, and forests were preferred to grasslands ($P < 0.01$, Table 1).

TABLE 1. Selection of forest (19%), parkland (11%) and grassland (70%) cover-types by blue grouse age and sex groups during winter, 1991-1992 through 1993-1994.

	n	Mean % Use	Rank
Adult female	22		
Parkland		64	1
Forest		18	2
Grassland		18	3
Adult male	27		
Parkland		72	1
Forest		14	2
Grassland		14	3
Immature female	16		
Parkland		59	1
Forest		24	2
Grassland		17	3
Immature male	13		
Parkland		56	1
Forest		16	2
Grassland		28	3

Immature birds used Douglas-firs significantly more than adult males ($P = 0.06$). We did not detect differential use of tree diameters or mistletoe-infested trees among age or sex groups (Table 2).

We located radio-equipped birds on the ground in 169 instances from December through March (32% of winter locations). Percentage of observations on the ground was 8% in December, 13% in January, 27% in February, and 57% in March. No snow roosts were detected; birds on the ground were primarily in areas without snow, although tracks indicated grouse traversed >100 m over snow. Of the ground locations, 52% were in parklands, 35% were in grasslands, and 13% were in forests.

We located radio-tagged grouse in trees with other blue grouse for 57% of winter observations (42%, 49%, 65%, and 66% of locations in December through March). Mean group size was 3 in December and 2 from January through March. Maximum group size was 30. Ages or sexes of grouse without transmitters were not identified. Location of ≥2 radio-tagged grouse in the same tree on 11 occasions revealed association among all age and sex groups, except immature males were not located together and adult females were not located with adult males.

Survivorship

Winter survivorship was 0.84 (90% CI = 0.78 - 0.90). Comparison of winter survivorship among adult females, adult males, and immature birds (Table 3) revealed significantly greater survivorship by adult females than by immature grouse ($\chi^2 = 6.35$, 2 df, $P = 0.04$). Survival of adult males did not differ significantly from the other groups.

TABLE 3. Blue grouse winter survivorship, 1991-1994.

	Survivorship	90% CI
Adult female (22)	0.95	0.88–1.00
Adult male (27)	0.89	0.79–0.98
Immature (29)	0.71	0.60–0.83

Discussion

Some adult and immature grouse moved to breeding territories in late winter; several grouse moved greater distances during February and March than during the rest of the winter monitoring period, and we observed breeding displays as early as February. We located more grouse on the ground as winter progressed, and we detected forbs in crops of birds collected from the ground where snow had melted. Early movement to breeding range partially explains the discrepancy between winter movement in our study and Cade and Hoffman (1993), who observed mean distance of 135 m between all possible pairs of blue grouse

TABLE 2. Arboreal habitat use by blue grouse age and sex groups during winter, 1991-1992 through 1993-1994.

		% in Douglas-fir[a]		% Mistletoe infested trees		cm dbh	
	n	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Adult female	22	61	7	18	7	49	4
Adult male	25	48	5	13	4	52	3
Immature female	12	73	9	31	11	42	3
Immature male	13	70	9	21	7	43	3

[a]The remaining percentage of observations were in ponderosa pines.

winter locations in Colorado. Early movement in our study likely is a function of a milder climate and lower elevation, which facilitated snow melt and subsequent access to ground-level food resources or breeding sites.

Grouse movements between winter and breeding ranges in our study were similar to those noted by Hines (1986), who observed a median of 1.4 km among immature females and 0.9 km among immature males. Cade and Hoffman (1993) observed median movements of 1.0 km among female blue grouse in Colorado, but males moved 10.5 km. Dobson and Jones (1985) attributed differential movement of age and sex groups to avoidance of competition for resources or mates. Habitats selected by both sexes were well-distributed throughout our study area, and we frequently saw grouse of both sexes in flocks. Likely, blue grouse movement between seasonal ranges is influenced by interspersion of seasonal habitats that were in close proximity in our study.

Beer (1943) suggested blue grouse distribution may be limited to Douglas-fir and true fir forests, however, Boag (1958), Harju (1974), and Zwickel and Bendell (1986) noted that pines and other conifers were more heavily used for food by blue grouse in winter or early spring than Douglas-firs or true firs. Remington and Hoffman (1996) observed equal preference by blue grouse for Douglas-fir and lodgepole pine needles, followed by limber pine (*Pinus flexilis*). Ponderosa pines were not present on their study area. Although we were unable to quantify specific uses of Douglas-fir and ponderosa pine by blue grouse, both species were used for food resources. Blue grouse are known to use Douglas-firs for winter feeding and subalpine firs (*Abies lasiocarpa*) for nocturnal roosting (Zwickel and Bendell 1986, Pekins et al. 1991). The relatively dense cover provided by subalpine firs in these studies was provided by mistletoe-infested Douglas-firs on our study area (Table 2). We observed copious droppings under the dense witches brooms in many mistletoe-infested trees.

Ponderosa pine ecosystems in this region were historically in open, patchy parklands on mid and upper slopes. Fire return intervals of 7 to 38 years (Agee 1994) limited dense Douglas-fir stands to mesic drainages and scattered patches. Fire exclusion and timber management allowed dense, young Douglas-fir stands to encroach into areas historically dominated by ponderosa pine parklands. Management of timber for wintering blue grouse in ponderosa pine habitats should emphasize maintaining or increasing parklands, which provide winter habitat for all age and sex groups (Table 1). Where trees are limited to north slopes, north aspects should be managed for forests or parklands to maximize blue grouse winter habitat.

Many blue grouse winter habitat associations observed likely represented more complex interactions between birds and their environments that remain poorly understood. As historically-existent habitat conditions are better understood, such conditions should be promoted in areas of historical blue grouse occupancy to maximize the possibility that habitat needs are being met for all age and sex groups.

Acknowledgements

Funds were provided by the USFS and Oregon Department of Fish and Wildlife (ODFW). We especially acknowledge ODFW biologists Victor Coggins and Kenneth Durbin and USFS biologist Kevin Martin for financial and technical support. This is Oregon Agricultural Experiment Station Technical Publication No. 11797.

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Received 2 August 2000
Accepted for publication 23 June 2001

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