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PHYSICAL CHARACTERISTICS OF BLUE GROUSE WINTER USE-TREES AND ROOST SITES

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ABSTRACT.—Physical characteristics of winter use-trees and roost sites of Blue Grouse (*Dendragapus obscurus*) were studied in northeastern Utah. Blue Grouse selectively roosted in the largest Douglas-fir (*Pseudotsuga menziesii*) trees during the day and subalpine fir (*Abies lasiocarpa*) trees at night. Diurnal and nocturnal roosts were typically adjacent to tree trunks in the lower two-thirds of trees. Nocturnal roosts provided greater canopy and denser shelter than diurnal roosts. Roost site selection was consistent with occupation of favorable microhabitat, particularly at night, and foraging strategy during the day. Timber management strategies should perpetuate large trees within Douglas-fir–subalpine fir habitat in areas occupied by wintering Blue Grouse.

Key words: Abies lasiocarpa, *Blue Grouse,* Dendragapus obscurus, *Douglas-fir,* Pseudotsuga menzeisii, *roost sites, subalpine fir, winter habitat.*

Winter habitat of Blue Grouse in the intermountain region consists of snowbound open stands of conifers on moderately steep to steep upper slopes and ridgetops (Marshall 1946, Cade 1985, Stauffer and Peterson 1985). Douglas-fir is the dominant winter food and may constitute as much as 95% of the diet (Beer 1943, Stewart 1944, Marshall 1946); selectivity for Douglas-fir has been documented from use-availability measures (Cade 1985, Stauffer and Peterson 1986). Douglas-fir sites used most frequently have 45–55% tree cover and are dominated by "wolf" trees (Stauffer 1983, Cade 1985), which are uniquely large with atypical shapes and dense foliage.

Blue Grouse winter habitat relationships are usually described in terms of food habits, although other factors are likely involved. Trees used for diurnal roost sites may be chosen for a favorable microclimate in addition to food (Stauffer 1983, Cade 1985). Presumably, the selection of nocturnal use-trees by Blue Grouse is influenced by microclimatic and protective conditions. The physical characteristics of nocturnal use-trees and roost sites have not been previously described. The objective was to describe the physical characteristics of diurnal and nocturnal use-trees and associated roost sites used by Blue Grouse during winter.

STUDY AREA

The study area is located on the Cache National Forest in the Bear River Range of the Wasatch Mountains in northeastern Utah. The primary study area is on a north-south ridge 2.5 km east of Logan Peak (USGS, Logan Peak, Utah, 7.5 min quadrangle, 1969) and encompasses approximately 700 ha. The forest is a subalpine fir/Douglas-fir mix with a shrubby undergrowth classified as the *Abies lasiocarpa* climax series–*Pseudotsuga menziesii* phase (Mauk and Henderson 1984). Topography varies from flat ridgetops to steep canyons and includes all aspects. Elevations range from 2500 to 2950 m; the regional mean January temperature is −10 C, and the mean annual precipitation is 102 cm, with 85% occurring from September through April, the majority as snow (Mauk and Henderson 1984). Snow depth on the study area ranged from approximately 2 m to 3.5 m during the winter of 1985–86. The area is characterized by strong winter temperature inversions that result in temperatures 5–10 C higher at high elevations than in valley bottoms (Wilson et al. 1975).

METHODS

The point sample method (Grosenbaugh 1952) was used to inventory vegetation. A

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40-basal-area-factor prism was used because the area was dominated by large trees. The area was inventoried along parallel transects with point samples (n = 216) taken at 50-m intervals along transects spaced 65 m apart. Canopy cover at each point was the average of four measurements obtained with a densitometer. Cover readings were taken parallel to the ground at waist level.

Grouse were located by ground searches and captured with a telescopic noose pole (Zwickel and Bendell 1967) when possible. Captured grouse were weighed, classified to sex and age, and fitted with a 25–30 g (<3% body weight) poncho-mounted radio transmitter (Amstrup 1980, Pekins 1988a). Diurnal use-trees and roost sites were found by locating radio-marked and unmarked Blue Grouse from December 1985 to March 1986. Any tree from which a grouse was flushed or observed was considered a use-tree, but a site was categorized as a roost only if a roosting (vs. standing) bird was observed in a nonalarmed state (e.g., crown feathers were not raised). Use-trees were marked immediately, and roost sites were marked the following day.

Nocturnal use-trees and roost sites were identified from visual sightings of radio-marked birds. The general area within a tree in which a grouse roosted was ascertained using a portable receiver and antenna. The tree was then searched with flashlights until the bird was sighted. Sites were then marked and the grouse left undisturbed.

Physical measurements of use-trees included diameter at breast height (dbh) and height. Roost site measurements included roost height, distance from tree trunk, diameter of tree trunk adjacent to the roost site, roosting branch diameter and compass direction, and percent canopy cover. Roost site height was expressed as a percentage of the total height of the tree; both heights were corrected for snow depth. Canopy cover was estimated with a densitometer. Chi-square and t tests (Steele and Torrie 1980) were used to test for differences in frequency of trees used and in physical characteristics of trees and roost sites. A level of significance was set at .05.

RESULTS

The average basal area of trees in the study area was 19.5 m^2/ha. Nearly one-third of the sample points had no trees or had trees too small to be measured with the prism. Douglas-fir, subalpine fir, and Engelmann spruce (*Picea engelmannii*) represented 51%, 47%, and 2% of the total basal area, respectively. Average canopy coverage was 44%, and an equal number of plots had canopy coverage above and below 50%; 20% had less than 10% cover since openings and forest islands were common.

We identified 270 use-trees (47 nocturnal), of which 267 were fir (Douglas or subalpine), 1 was Engelmann spruce (nocturnal), and 2 were limber pines (*Pinus flexilis*) (diurnal). Use of Douglas-fir and subalpine fir (90% and 70% of the diurnal and nocturnal use-trees, respectively) was greater than expected, based on availability (X^2 = 127 and 8.7, $P <$ .05, respectively). For each species, average dbh of use-trees was greater ($P <$ .05) than dbh of the stand average (Table 1). Ninety percent of the Douglas-fir trees used by grouse had dbh >35 cm. Douglas-fir trees used during the day were shorter than those used at night.

Physical characteristics were measured at 161 roost sites (Table 2). Diurnal and nocturnal roost sites were typically located adjacent or close to large tree trunks in the lower two-thirds of trees and were not oriented (X^2 = 6.1, $P >$ .05) in any direction. Nocturnal subalpine roost sites had greater (t = 6.91, $P <$ .05) canopy cover (91%) than diurnal Douglas-fir roost sites (73%), and more nocturnal than diurnal roosts were adjacent to tree trunks. Seven Douglas-fir nocturnal roosts averaged 85% canopy cover; 5 of these were 1.7 m ($\pm$1.1) away from the tree trunk.

DISCUSSION

The study area used by Blue Grouse during winter was dominated by large Douglas-fir and subalpine fir trees in both clumped and open stands. Blue Grouse in Idaho also selected open conifer stands (50:50 ratio of conifer cover to open) dominated by islands of Douglas-fir and subalpine fir (Caswell 1954, Stauffer 1983). Wintering areas in Colorado include dense and open second growth, mature, and old-growth coniferous forests, with an average basal area (20.9 m^2/ha; Cade 1985) similar to that measured in this study.

TABLE 1. Characteristics of trees used and unused by Blue Grouse during winter, Logan, Utah, 1985–86.

	Douglas-fir (diurnal)					Subalpine-fir (nocturnal)				
	Use-tree			Stand average		Use-tree			Stand average	
	$\bar{x}$	SE	n	$\bar{x}$	SE	$\bar{x}$	SE	n	$\bar{x}$	SE
dbh, cm	65.0*	1.4	200	59.1	1.3	47.5*	2.7	32	38.3	1.0
Range	20.0 – 139.7					18.8 – 98.1				
Height, m	18.3*	0.4		19.4	0.4	20.9*	1.3		18.1	0.4
Range	8.7 – 30.2					8.3 – 37.0				

*Difference ($P < .05$) between use-tree and stand average.

TABLE 2. Physical characteristics of diurnal and nocturnal winter roost sites of Blue Grouse, Logan, Utah, 1985–86.

	Douglas-fir roost sites				Subalpine fir roost sites			
	Diurnal (127)[a]		Nocturnal (7)		Diurnal (5)		Nocturnal (22)	
Characteristic	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Cover, %	73	2	85	4	91	1	91*	2
Southern hemisphere, %	55		43		0		36	
Lower 2/3 of tree, %	87		100		100		91	
Adjacent to trunk, %	70		14		80		82	
Distance to trunk, m	1.0	0.3 (38)	1.7	1.1 (5)	0.7 (1)		1.4	0.7 (4)
Adjacent trunk dbh, cm	38.5	4.2	40.5	5.8	29.1	13.3	32.5	3.2
Branch diameter, cm	8.8	0.3	8.8	1.2	4.2	1.5	4.2	0.3

[a] Sample size indicated by numbers within parentheses.
*Difference ($P < .05$) between diurnal-used Douglas-fir and nocturnal-used subalpine fir roost sites.

Douglas-fir with atypical growth patterns (larger dbh and shorter height) were selectively used by Blue Grouse as in other wintering areas at similar elevations (Caswell 1954, Stauffer 1983, Cade 1985). The diurnal use of atypical Douglas-firs likely reflects Blue Grouse foraging strategy (Cade 1985). The average dbh of Douglas-fir in our area (65.0 cm) is the largest reported; the average for other intermountain studies is about 50 cm. Subalpine fir trees were preferentially used as nocturnal roost sites in this study area. Blue Grouse in Colorado were often observed flushing to a subalpine fir at dusk after feeding in Douglas-fir or lodgepole pine (*Pinus contorta*) trees (T. E. Remington, personal communication).

The physical characteristics of roost sites we measured indicate that diurnal and nocturnal roost sites provide a favorable microclimate for Blue Grouse. The single exception was that grouse did not consistently roost on branches with a southerly orientation as previously reported (Hoffman 1961). However, 71% of diurnal roosting Blue Grouse observed on the study area were in sunlight (Pekins 1988b).

Moderation of wind speed is the most significant energy-saving characteristic of roost sites (Walsberg 1985). Wind speed is typically higher at the top of the canopy (Monteith 1973), and wind penetration is reduced as the horizontal structure of the vegetation is widened (Jones 1983). The typical diurnal roost site we identified provided a solid shelter (tree trunk) on one side with encircling, wide coniferous boughs that modify exposure to wind. A typical nocturnal roost site provided a solid shelter on one side surrounded by a dense network of small coniferous branches. Mistletoe often provided proximate dense growth at nocturnal roost sites.

Blue Grouse seldom ate subalpine fir foliage in our study area (<5% of the diet; Pekins, unpublished data), but they likely selected subalpine fir trees for nocturnal roosting because of its associated microclimate. Further, subalpine fir use-trees generally occurred in large, continuous stands, unlike the more variable locations of Douglas-fir use-trees. The roost tree location, large size, and dense growth presumably provided significant wind protection during the night. Measurements within both tree species substantiated that wind speed was consistently lower in subalpine fir (Pekins 1988b).

Bergerud and Gratson (1988) suggested that grouse roosting in conifers affords

protection from avian predators (e.g., Goshawks [*Accipter gentilis*] and Great Horned Owls [*Bubo virginianus*]) and may serve as an alternative to occupying snow roosts for predator avoidance. They assume neither strategy is consistent with a thermoregulatory hypothesis. However, the energetic advantage for grouse occupying a thermoneutral environment in a snow roost is well documented (Marjakangas et al. 1984, Thompson and Fritzell 1988, Korhonen 1989). Blue Grouse undoubtedly benefit, although remaining vulnerable to avian predators (Goshawks killed several grouse in the study area), while roosting in conifers. However, a switch to subalpine fir from Douglas-firs suggests that energy conservation, not predator avoidance, is the primary determinant of nocturnal roost sites selection.

Forests occupied during winter by Blue Grouse in the intermountain region are frequently of limited commercial value and often in inaccessible areas (Stauffer 1983, Cade 1985). However, some Blue Grouse wintering areas have been cut or are potentially harvestable (e.g., Cade 1985, this study). Selection and patch cuts, which would ensure the presence of large conifers, are recommended management practices in Blue Grouse wintering areas (Cade 1985). Old-age stands at high elevations are irreplaceable within reasonable stand regeneration time. Loss of wintering habitat may severely impact local Blue Grouse populations.

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