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BLUE GROUSE NESTING PARAMETERS AND HABITAT ASSOCIATIONS IN NORTHEASTERN OREGON

Eric C. Pelren and John A. Crawford

ABSTRACT.—We examined Blue Grouse (Dendragapus obscurus) nesting characteristics in northeastern Oregon to identify relationships between hen age and nesting parameters and to ascertain habitat characteristics related to successful nests. Adult and yearling hens exhibited no differences in clutch size, percentage of eggs hatched, nesting success, or hatch dates. Among nests located under logs, 100% (n = 10) hatched ≥1 egg, whereas 58% (n = 10) of 17 nests not under logs hatched ≥1 egg.

Key words: Dendragapus obscurus, Blue Grouse, nest, age, Oregon, habitat, woody debris.

Blue Grouse (Dendragapus obscurus) occur in a broad range of climatic conditions in western North America. Breeding habitat for this species ranges from mesic conditions in northwestern coastal rain forests to some of the more xeric montane habitats in North America (Zwickel 1992). Nesting parameters of Sooty Blue Grouse (D. o. fuliginosus) were extensively examined in coastal British Columbia (Zwickel 1975, Zwickel et al. 1987). Clutch size was greater for adults than for yearlings; no differences in nesting success were reported between these groups. Zwickel and Lance (1965) documented Blue Grouse renesting following nest destruction during late incubation, and Sopuck and Zwickel (1982) noted greater renesting success among adults than among yearlings in British Columbia. Zwickel and Carveth (1978) suggested that hens that laid relatively few eggs deserted nests at a higher rate than other hens.

Nesting parameters have been examined less thoroughly among subspecies of Blue Grouse that occur in interior, more xeric conditions. Caswell (1954) reviewed Blue Grouse nesting parameters and quantified nesting characteristics in Idaho, and Mussehl (1960) estimated hatch dates based on juvenile plumage in Montana; however, no studies related nesting success to hen age or nest habitat.

Our goals were to describe Oregon Blue Grouse (D. o. pallidus) nesting characteristics in northeastern Oregon and identify factors that may influence nesting success. Objectives were to identify relationships of hen age with number of eggs/nest, percentage of eggs hatched/nest, nesting success (percent of nests that hatched ≥1 egg), and hatch date; and to examine relationships of nesting success with hatch date and habitat.

STUDY AREA

The study area is on Miller Ridge in the Wallowa-Whitman National Forest, ca 30 km north of Enterprise, Wallowa County, Oregon (Fig. 1). Blue Grouse were captured on a 10-km² area of Miller Ridge where elevation ranges from ca 950 to 1500 m.

North-facing slopes here historically were characterized by ponderosa pine (Pinus ponderosa) parklands, but land management practices during the last century resulted in encroachment of Douglas-fir (Pseudotsuga menziesii) and increased stand densities. Western larch (Larix occidentalis) is present, and lodgepole pine (Pinus contorta), true firs (Abies spp.), and junipers (Juniperus spp.) occur at low densities. Drainages contain mixed conifers; aspen and poplars (Populus spp.) are rare. Understory and transition-zone shrubs include hawthorn (Crataegus spp.), western snowberry (Symphoricarpos albus), and mallow ninebark (Physocarpus malvaceus). South-slope bunchgrass meadows are dominated by Idaho fescue (Festuca idahoensis) and bluebunch wheatgrass (Agropyron spicatum). Even- and uneven-aged management was used to harvest timber.
on the area before and during the study (U.S. Department of Agriculture 1994). Fires periodically burn portions of the area, the most recent occurring in 1986.

Potential predators are abundant on the area. Avian predators include Golden Eagles (*Aquila chrysaetos*), Bald Eagles (*Haliaeetus leucocephalus*), Red-tailed Hawks (*Buteo jamaicensis*), Cooper’s Hawks (*Accipiter cooperii*), Northern Goshawks (*Accipiter gentilis*), Great Horned Owls (*Bubo virginianus*), and corvids (*Corvus* spp.). Mammalian predators include badgers (*Taxidea taxus*), black bears (*Ursus americanus*), cougars (*Felis concolor*), coyotes (*Canis latrans*), striped skunks (*Mephitis mephitis*), ground squirrels (*Spermophilus* spp.), and long-tailed weasels (*Mustela frenata*), all of which are potential nest predators.

Regional topographic and elevational factors contribute to highly variable precipitation and temperature (Johnson and Simon 1987). Precipitation averages 20 cm at 950 m elevation and increases approximately 12.5 cm/300 m increase in elevation (Johnson and Simon 1987). Spring (March through May) precipitation averages 11 cm, and mean minimum temperature is –1°C.
Methods
Capture and Instrumentation

We captured Blue Grouse and equipped them with radio transmitters following incubation from June through August 1991–1996. Capture devices included interception-style walk-in traps (Pellren and Crawford 1995) and noose poles (Zwickel and Bendell 1967); handling procedures followed established guidelines (Oring et al. 1988). Birds were weighed to the nearest 10 g with Pesola spring scales. We assigned sex by visual examination of wing plumage (Braun 1971, Hoffman 1985). Age was recorded as juvenile or adult, with yearlings classified as adults; each juvenile was reclassified as a yearling at onset of spring following capture and, if monitored for ≥2 yr, as an adult thereafter. A numbered aluminum band was attached to 1 leg. We placed battery-operated 150–151 MHz transmitters weighing approximately 15 g (Advanced Telemetry Systems, Inc., Isanti, MN) or 18 g (Telemetry Systems, Inc., Mequon, WI) on captured females with necklace (Markström et al. 1989) or poncho mounts (Armstrup 1980) modified by a vertical slit at the base of the poncho to prevent esophageal obstruction (Pekins 1988). Transmitters had life expectancies of 12–20 months and were equipped with motion sensors. Juvenile birds with masses <500 g, which represents approximately 50% of adult weight (Boag 1965), were not equipped with transmitters.

Data Collection

Radio-equipped females were located weekly in spring by approach and visual observation to ascertain survival and presence of nests. Nest locations and numbers of eggs were recorded. Grouse on nests were monitored daily by triangulation and detection of radio motion-sensor activation to ascertain dates of departure from nests. We examined nests immediately after hens departed to determine number of eggs, number hatched, and site habitat characteristics. Distance to water and distance to nearest tree >10 cm dbh were noted. Cover type within a 1-m-diameter circular plot centered on the nest was categorized as shrub or grass/forb based on the type that composed the majority of cover. We noted maximum vegetation height within the plot, as well as percent of nest visible from 1 m over-head and average visibility from the 4 cardinal directions at a distance of 1.5 m and height of 1 m. Nest with overhead cover including logs ≥10 cm dbh were noted.

Data Analysis

We used number of eggs/nest, percent of eggs hatched/successful nest, and hatch date as response variables in general linear models (SAS Institute Inc., Cary, NC) to ascertain differences in nesting parameters between adult and yearling hens (indicator variable). To ascertain differences in nesting success between adult and yearling hens, we included hen age as an indicator variable in a logistic regression model with nesting success as a binary response variable. Nests that hatched ≥1 egg were considered successful. We also used a logistic regression model to identify the relationship between hatch date (indicator variable) and nesting success (binary response). One bird was censored from all analyses due to uncertainty concerning hatch date or clutch size, 6 birds with unknown incubation periods were not included in hatch date analyses, and 3 birds of unknown age were excluded from analyses that compared adults and yearlings.

Nest site habitat variables and their interactions were included as indicator variables in a logistic regression model with nesting success as a binary response variable. We used a stepwise selection procedure to identify habitat variables related to nesting success. A multiple regression model was constructed to further examine relationships between reproductive success and nesting habitat. This model included habitat parameters as indicator variables and numbers of eggs hatched as the response variable. All statistical relationships were tested at \( P \leq 0.10 \) level of significance.

Results

Twenty-seven Blue Grouse hens, monitored from spring 1992 through spring 1997, laid 7.7 ± 0.3 eggs/nest \((\bar{x} \pm s_x)\), Table 1). Among successful nests, 92.0 ± 2.2% of eggs hatched \((\bar{x} \pm s_x)\). Overall nesting success was 74.1 ± 9.0% \((\bar{x} \pm s_x)\). Mean hatch date was 31 May \((s_x = 2 \text{ d})\). Adult and yearling hens exhibited no differences in mean numbers of eggs/nest, percent of eggs hatched/successful nest, nesting success, or hatch date. Our observed clutch sizes were larger than noted for Oregon Blue
Table 1. Blue Grouse nesting parameters, Wallowa County, Oregon, 1992-1997.

<table>
<thead>
<tr>
<th>Nesting parameter</th>
<th>Yearlings</th>
<th>Adults</th>
<th>Unknown age</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of nests</td>
<td>6</td>
<td>18</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Mean hatch date</td>
<td>2 June</td>
<td>29 May</td>
<td>5 June</td>
<td>31 May</td>
</tr>
<tr>
<td>% nesting success</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With overhead log</td>
<td>100</td>
<td>100</td>
<td>—</td>
<td>100</td>
</tr>
<tr>
<td>Without overhead log</td>
<td>75.0</td>
<td>60.0</td>
<td>33.3</td>
<td>58.8</td>
</tr>
<tr>
<td>Total</td>
<td>83.3</td>
<td>77.8</td>
<td>33.3</td>
<td>74.1</td>
</tr>
<tr>
<td>All nests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # eggs</td>
<td>46</td>
<td>158</td>
<td>25</td>
<td>209</td>
</tr>
<tr>
<td>Total % hatched</td>
<td>78.2</td>
<td>72.5</td>
<td>32.0</td>
<td>68.9</td>
</tr>
<tr>
<td>Mean clutch size</td>
<td>7.7</td>
<td>7.7</td>
<td>8.3</td>
<td>7.7</td>
</tr>
<tr>
<td>Successful nests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # eggs</td>
<td>39</td>
<td>112</td>
<td>8</td>
<td>159</td>
</tr>
<tr>
<td>Total % hatched</td>
<td>91.8</td>
<td>91.3</td>
<td>100</td>
<td>91.8</td>
</tr>
<tr>
<td>Mean clutch size</td>
<td>7.8</td>
<td>7.9</td>
<td>8</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Grouse in north central Washington and western Montana (FC. Zwickel personal communication; Fig. 2) and represent the largest mean clutch sizes for any Blue Grouse populations for which such data exist (Zwickel personal communication).

No relationships were noted between nesting success and hatch date or habitat parameters in the logistic regression models; however, 10 nests under logs were 100% successful, whereas only 10 of 17 nests (58.8%) not under logs were successful. This relationship was not detectable by the logistic regression model because of separation of means among categories. Presence of overhead logs also was related to number of eggs hatched/nest ($R^2 = 0.27, P < 0.01$). No other habitat features were related to nesting success or number of eggs hatched per nest.

**DISCUSSION**

Blue Grouse hens at Miller Ridge exhibited relatively high nesting success (74.1%) compared with populations documented by Zwickel (1992) from British Columbia, Alberta, Washington, Colorado, and Montana (48–81%). At least 1 of 7 unsuccessful nests was trampled by cattle and subsequently predated. The remaining 6 nests were unsuccessful at least partially due to predation. The Miller Ridge population also exhibited higher clutch sizes than observed for other interior populations (Fig. 2). Understanding reasons for these results may aid in management decisions for interior populations.

Although no significant differences were detected in nesting parameters between adult and yearling hens, our sample size was small and may not have been sufficient to detect a difference in mean hatch dates. Observation of earlier hatch dates by adults than by yearlings also was documented by Zwickel (1977) and Hannon et al. (1982). Later nesting by yearlings could serve multiple functions. Yearling Blue Grouse hens typically have smaller mass than adult hens in spring (Zwickel 1992) and may require more time than adults to gain sufficient energy supplies for egg laying and incubation. Also, yearlings must undergo potentially

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Fig. 2. Percent of nests by size of clutch for Blue Grouse in north central Washington ($n = 29$), western Montana ($n = 20$), and northeastern Oregon ($n = 27$). Washington and Montana data from FC. Zwickel.
time-consuming searches for nesting territories, whereas adults on our area exhibited philopatry for ranges established during previous years (Pelren 1996). Hannon et al. (1979, 1982) found that reproductive organs develop more slowly in yearling females than in adults and suggested this delay could be a function of social inhibition of yearlings by adult females. Finally, although later nesting carries the disadvantage of lower probability of renesting in the event that the 1st nesting attempt fails, later primary nesting attempts allow time for vegetation and invertebrate food abundance to increase, which may increase nesting or brood-rearing success.

Zwickel (1992) noted that Blue Grouse nest successfully in a wide array of habitat conditions, ranging from nearly bare ground with almost no overhead cover to dense vegetation beneath full forest canopies. Grouse nests at Miller Ridge conformed to this observation. Although Blue Grouse apparently exhibit high tolerance for a variety of nesting conditions, presence of logs may be a common factor in nesting habitat associations among populations. FC. Zwickel (personal communication) synthesized observations of nesting habitat from interior forests in Alberta, Colorado, Idaho, and Montana and from shrub-steppe habitats in Idaho, Montana, Nevada, Utah, and Washington. Among 61 nests in forest habitats, 13% were under logs; but among 61 nests in shrub-steppe habitat, only 2% were under logs, likely a function of lower log availability in this habitat. Shrubs were the primary overhead cover at most nests in both habitats. Zwickel (personal communication) additionally noted that among 450 Blue Grouse nests in early coastal forest sere stages, frequency of use of logs, stumps, snags, or slash as overhead cover increased from 0% in very dense habitat to 47% in very open habitat. Among 605 nests throughout Blue Grouse range, <1% had no overhead cover (Zwickel 1992). Logs may be an important nesting resource in interior forests where vegetation density usually is open compared with coastal habitats. Our observation of 100% nesting success among hens that nested under logs provides inference that, although logs are not an obligate component of nesting habitat, their presence significantly improves chances for successful hatching.

The nests that occurred in association with logs in our study were, in all instances, completely or partially beneath logs that were suspended above the ground by branches or intact root systems. Distance from top of nest cup to bottom of log was approximately 15–50 cm, and many logs were partially burnt from forest fires. Nests also were associated with snags, stumps, branches, and other woody debris, which almost surely contribute to nest concealment; however, presence of overhead cover may be of primary value to nest success.

Blue Grouse in northeastern Oregon frequently nest in parkland habitats. These parkland conditions have decreased on the study area during the past several decades (Pelren 1996). Fire suppression has resulted in encroachment of dense, young stands of Douglas-fir into parkland ponderosa pine habitats, and fuel buildups have resulted in fires that destroyed entire forest stands and woody debris on forest floors, where relatively cool fires historically maintained parkland conditions. Additionally, timber harvest frequently occurred in the form of clearcuts and highgrading during the early 1900s. Recent management, including prescribed fire and timber-extraction techniques that involve thinning and retention of woody debris, may be restoring habitats to conditions similar to those that occurred historically. Our results suggest that management for Blue Grouse should emphasize the return of upland forested habitats to historical parkland conditions, with logs and woody debris present for nesting sites.

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