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Effect of previous occupancy on recruitment to territorial sites of male Blue Grouse.— Male Blue Grouse (*Dendragapus obscurus*) use territories primarily as areas for display and mating (Bendell and Elliott 1967, McNicholl 1978). During a 10-year study on Vancouver Island, British Columbia, some sites were used almost every year, whereas others were occupied sporadically (persistent and transient sites, respectively; Lewis and Zwickel 1981, also see Boag 1976). Male Blue Grouse that occupied persistent sites survived better than those on transient sites (Lewis and Zwickel 1981), and replacements preferentially settled on areas that had been occupied continuously when residents were removed (Lewis and Zwickel 1980). We inferred from this that persistent sites were of higher quality than transient sites. Since it seems advantageous to select the best sites for territories, what cues might young males use to distinguish between good and poor areas? Two possibilities are: (1) habitat differences between high and low quality sites, and (2) previous occupancy by another male. Here I examine the use of these two factors in territorial site selection by male Blue Grouse.

In a removal experiment (Lewis and Zwickel 1980), we shot original residents from 11 persistent and 11 transient territorial sites in early spring 1978. Throughout the rest of the spring and summer, all males were shot as soon as they were heard singing on a removal site. Males that took territories on the 22 vacant removal sites in 1979 still showed a preference for persistent sites, including 5 of 6 yearlings (Lewis and Zwickel 1980). These yearlings could not have been influenced in their choice of site by the presence of a previous occupant, since they hatched after residents were removed in 1978. Thus, they apparently distinguished between high and low quality areas on the basis of habitat. Persistent and transient sites did differ with respect to topography (Lewis 1981), so such cues seem to exist.

Although young males may use habitat features as an indicator of territorial quality, previous occupancy by another male could be used as an additional cue. Observations I obtained after conducting another removal experiment on Hardwicke Island, British Columbia, in 1982 enabled me to examine the effect of this factor on a male's choice of territory. In spring 1982, 17 territorial males were present on my 95 ha study plot, and between 4 and 8 April 14 they were removed by shooting. All subsequent replacements to these sites were removed as soon as they were heard singing. The remaining 3 territorial males, and 11 that resided in areas immediately adjacent to the study plot, were left alive; 9 were individually color banded and 5 were unmarked. At least 8 of the 14 males that survived throughout spring and summer 1982 did not return in spring 1983 and are presumed to have died over winter. Seven of the vacant territories were occupied by new males in 1983, including the 3 within the study plot. In contrast, only 2 of the 14 vacant removal sites were occupied by new males in 1983. Rate of recruitment in 1983 was significantly greater to sites that had males on them in 1982 than to sites that had residents artificially removed (log-likelihood $\chi^2 = 8.91$, $P = 0.003$).

Quality of territorial sites on Hardwicke Island could not be determined prior to the removal experiment in 1982 because I lacked long-term occupancy and survival data as was available prior to the Vancouver Island removal experiment. Therefore, a possible explanation for the greater rate of recruitment to sites left vacant by overwinter disappearance is that by chance all were of high quality, whereas most of those vacated by artificial removal were of poor quality. However, 9 of the 14 removal sites had replacement males settle on them in 1982, suggesting that at least these 9 were good areas for territories. Rate of replacement in 1983 to sites that had been occupied throughout 1982 still was greater than to the 9 sites that were kept vacant artificially and that likely were high in quality (log-likelihood $\chi^2 = 5.15$, $P = 0.023$).

Females may be attracted to the vicinity of a territory by the resident's singing. If males are more likely to take territories in areas where they previously encountered females, this might account for their preference for territorial sites that had been occupied previously. However, this likely was not a factor in the pattern of preference shown by new males in 1983. Despite the removal of most territorial males from the study plot in 1982, the density of females and their movement patterns were unaffected (Lewis 1984). The lack of replacement to removal sites in 1983 therefore cannot be attributed to a lack of females in those areas. The preference by recruiting males in 1983 for territories that had been used throughout 1982 suggests that selection of a territorial site can be influenced by the mere presence of a resident male the previous year.

Yearling male Blue Grouse are rarely territorial (Bendell and Elliott 1967, Jamieson and Zwickel 1983) but have home ranges that overlap the territories of a few adult males (Sopuck 1979, Jamieson and Zwickel 1983). As yearlings, they may evaluate the quality of all potential territorial sites within their home range. Results of my removal experiments suggest that features of the habitat and previous occupancy by another male are both used as cues when choosing a territorial site. Direct habitat assessment would seem the most reliable means of determining territory quality, since quality ultimately will be related to vegetative or structural features that affect survival and/or reproduction. However, this may not always be the most expedient means for selecting a territory, especially if the assessment must be done quickly (Stamps 1987). Additionally, little is known of the importance of social factors in territorial site selection, and they should not be overlooked when seeking to explain why some areas are used consistently and others intermittently.

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Phenetic relationships among the warblers in the *Dendroica virens* complex and a record of *D. virens* from Sonora, Mexico.—Four species of warblers of western North America are closely related to the eastern Black-throated Green Warbler (*Dendroica virens*): the Black-throated Gray (*D. nigrescens*), Townsend's (*D. townsendi*), Hermit (*D. occidentalis*), and Golden-cheeked (*D. chrysoparia*) warblers (Mengel 1964). These species seem to be related closely, but there is debate about their taxonomy. For example, *D. townsendi* and *D. occidentalis* hybridize where their ranges overlap in Oregon and Washington (Jewett 1944, Morrison and Hardy 1983) and may be conspecific. Mayr and Short (1970) regard *D. chrysoparia* as a subspecies of *D. virens* and suggest that *D. virens*, *D. occidentalis*, and *D. townsendi* comprise a superspecies complex, with *D. nigrescens* a close relative of the complex. The A.O.U. Check-list (AOU 1983:613) states that "*D. townsendi*, *D. occidentalis*, *D. virens* and *D. chrysoparia* appear to constitute a superspecies." These opinions are based on the birds' geographic distributions and a "largely subjective" evaluation of plumage patterns and song (Mengel 1964). Other than Morrison's (1983) study of morphometric variation within *D. townsendi*, there are no published analyses of the size variations within this complex. The present analyses of the *D. virens* complex (including *D. nigrescens*), based on measurements of 21 skeletal features, provide information about the phenetic variation among these warblers, and confirm the identity of a skeletal specimen in the collection of the University of Kansas, Museum of Natural History (KU 37136). KU 37136 was collected 20 December 1956 by A. A. Alcorn 21 miles SSE of Nogales, Sonora. It was eviscerated in the field, dried, and sent to KU, where it was identified as *D. virens* before being prepared as a skeleton. It is not known who identified the bird, or on what basis (presumably plumage characters). Other than this individual, there are no specimens of *D. virens* from Sonora (S. M. Russell, pers. comm.).

Methods.—I measured the following specimens (adult males unless otherwise noted): 13 *D. townsendi*; 6 *D. occidentalis*; 35 *D. virens* (12 females); 18 *D. nigrescens* (2 females); 1 *D. chrysoparia*. With the exception of two specimens from Mexico (KU 37136 and one from Veracruz), all of the *D. virens* used were from the northeast, and thus on geographic grounds are not *D. v. waynei*. With the exception of *D. virens*, these were all of the adult male specimens of these species available in the following collections: Royal Ontario Museum, University of Michigan, Burke Museum University of Washington, University of Kansas, U.S. National Museum, and Delaware Museum of Natural History. I did not attempt to obtain samples of females (with the exception of *D. virens*) because only small numbers are available. KU 37136 is a male.

I measured 21 skeletal features (Table 1) on each specimen, as described by Robins and Schnell (1971), except that gonys length is their "minimum mandible length" (gonys with rhamphotheca removed), synsacrum width is width across the antitrochanters, bill length (skull) is length of the premaxilla from the base of the skull, and bill length (nost.) is length