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Received 25 January 1988.
Accepted 13 October 1988.

EVALUATION OF A DENSITY INDEX FOR TERRITORIAL MALE SPRUCE GROUSE

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Abstract: We compared an index of abundance for territorial male Franklin's spruce grouse (*Dendragapus canadensis franklinii*) based on wing clapping with population counts obtained with playbacks of recorded female calls on 24 study areas in the Sheep River Valley, southwestern Alberta. The population counts obtained with playbacks appeared accurate because results obtained in 1984 were positively correlated with results obtained in 1985 ($r_s = 0.85$, $P = 0.0001$), the disappearance rate for marked males (30%) from 1984 to 1985 was similar to the typical mortality rate (28%), and all territorial males found with a time-consuming complete-census technique were located. The results for the wing-clapping index were positively correlated with population counts obtained with playbacks during 1984 ($r_s = 0.87$, $P = 0.0001$). Either the wing-clapping index or playbacks of recorded calls are useful for estimating size of territorial male spruce grouse populations.

J. WILDL. MANAGE. 53(2):475–478

Indices of population abundance potentially can provide results comparable to total population counts with greatly reduced effort and minimal expense (Bull 1981). Indices of abundance include numbers of individuals seen, sounds heard, and signs detected on a specific area or transect over a specific time. Despite their frequent use, reliance on indices requires meeting assumptions often unsupported by data (Kendeigh 1944, Bell et al. 1973, Dawson 1981). Indices rarely are validated by comparison with actual population abundance (Szuba 1982, Rotella and Ratti 1987) because the latter is often difficult to determine.

One method for determining the abundance of secretive birds is with the playback of recordings of various calls (Glahn 1974, Griese et al. 1980, Johnson et al. 1981, Marion et al. 1981). Falls (1981) suggested that playbacks can approach 100% effectiveness for locating territorial males, thus providing a potential method for testing more rapid census techniques.

Spruce grouse are excellent research subjects for comparing indices and actual numbers because they are relatively easy to observe, capture, and mark; the males are territorial and advertise with audible displays (including wing claps); and virtually all the males in any given area can be marked and counted. Territorial male Franklin's spruce grouse display with an audible wing clap by flying from a perch to the ground and clapping their wings twice above their backs (MacDonald 1968). Wing claps can be heard from 300 to 750 m (Nugent 1979). We compared an auditory index with actual numbers of territorial males, as determined with playbacks, in populations of Franklin's spruce grouse.

We thank B. D. Mott and D. P. Schlesinger for assistance with the fieldwork and L. A. Robb and J. Schmutz for reviewing earlier drafts of the manuscript. Access to data collected by previous students under the supervision of DAB was provided by P. W. Herzog, D. M. Keppie, K. H. McCourt, D. T. McKinnon, R. A. McLachlin, D. P. Nugent, and K. E. Smyth. Financial assistance was provided by the University of Alberta and a Natural Science and Engineering Research Council Grant A2010 to DAB.

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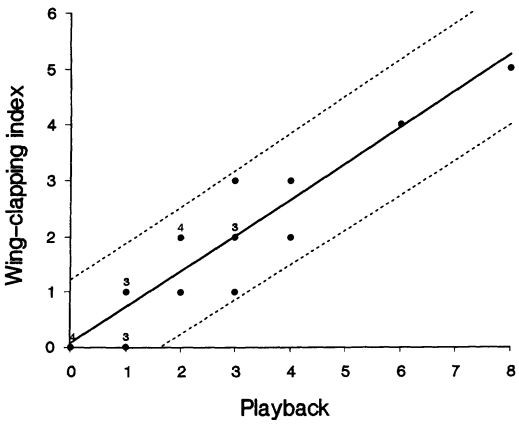

Fig. 1. Comparison of the number of territorial male spruce grouse counted with the wing-clapping index and playback recordings of the female aggressive call on each of 24 study areas in southwestern Alberta ($y = 0.07 + 0.65x$). Dotted lines show 95% confidence intervals for predicting values.

METHODS

We studied spruce grouse in forests of lodgepole pine (*Pinus contorta*) in the foothills of southwestern Alberta (50°39′N, 114°39′W). Their numbers were counted annually from 1965 to 1985 on parallel transects (Boag and McKinnon 1982) on a 555-ha study area (specific areas studied in each year were described in detail by McKinnon 1983). Over 98% of all spruce grouse found were captured with noose poles (Zwickel and Bendell 1967, Schroeder 1986) and marked with combinations of colored leg bands (Boag and McKinnon 1982). The effectiveness of this census technique was apparent because no unbanded territorial males were observed during the breeding season after the initial spring census each year. Unmarked nonterritorial yearling males were sometimes located later in the summer, perhaps because they typically have relatively large home ranges that extend beyond the study area boundaries (Herzog and Boag 1978).

In 1984, 24 areas ranging from 25 to 61 ha were selected in the same valley for population censuses. These areas were selected to provide habitat consistency within areas and an array of habitats among areas, thus assuring that sampling was done on areas with different spruce grouse densities. Most of the area bordering the 24 study sites consisted of habitats that potentially were occupied by spruce grouse. Four of the study areas overlapped the main study area. All unbanded birds encountered were captured and banded.

We used a recorded female call (a loud advertising "cantus" emitted during spring [Nugent 1979]) to census populations on the 24 areas during spring (Apr–May) in 1984 and 1985. A similar technique was used by Stirling and Bendell (1966) for blue grouse (*D. obscurus*). The recording was 5 minutes, alternating 1.5 minutes of female call and 1 minute of silence. We censused each study area by playing the recording once/station at a series of 150-m intervals (a spacing that ensured that the playback would be detected by resident males [Nugent and Boag 1982]) along parallel transects (12–24 stn./area). Each area was censused between 0.5 hours before and 2.5 hours after sunrise during May and early June (peak period for wing-clapping displays by territorial males). Males responded to the playback by displaying with wing claps or by flying or walking towards the source of the playback (MacDonald 1968). When the recordings were played within 75–150 m of 11 radio-marked males, all responded to the recording in a similar fashion. Census of each area was done only once during each spring to prevent the waning of responses by males (Falls 1981).

We obtained a visual or auditory index of territorial male spruce grouse abundance on each area. A single transect was walked through each of the 24 areas so the maximum distance from any point in the study area to the transect was 250 m. The typical length of a transect was 0.5–1.0 km for a 25–40-ha area. Each transect was walked at a mean rate of 2.0 km/hour at sunrise (0.5 hr before to 2.5 hr after sunrise) during April and May 1984. Wing clapping was assumed to represent a single male and was counted for the index, unless it was perceived to be beyond the boundary of the study area. The results for the index were then compared with population counts based on census data collected from playbacks.

RESULTS

Densities of territorial male spruce grouse on the 24 blocks of habitat (Fig. 1), as determined from playback of the female call, ranged from zero to 28 males/100 ha. Playback on the 4 areas overlapping the main study area confirmed the presence of all 9 territorial males found by more thorough parallel transect census technique.

Moreover, of the 53 territorial males found on the areas in 1984, 16 (30%) were missing in 1985. This disappearance rate approximated the annual mortality rate of 28% determined for birds on the main study area (Boag et al. 1979). Consistency of the census procedure was supported by the positive correlation ($r_s = 0.85$, $P = 0.0001$) between the numbers of males found on the 24 areas in 1984 ($n = 53$) and 1985 ($n = 55$).

The wing-clapping index enabled 36 (68%) of 53 birds found with playbacks to be identified. There was a positive correlation ($r_s = 0.87$, $P = 0.0001$) between the results obtained from these 2 methods of counting grouse (Fig. 1). The relationship was linear. On the 4 areas overlapping the main study area, 7 of 9 territorial males were located with the wing-clapping index.

Female spruce grouse do not display like males and are more difficult to detect. However, the number of females ($n = 17$) responding to playbacks on each area was positively correlated ($r_s = 0.63$, $P = 0.0004$) with the number of males ($n = 53$) responding, although the female response was much less (32% of M response). Research during 21 years on the main study area has shown that number of females ($x = 20.7 \pm 9.9$ [SD]) was positively correlated ($r_s = 0.94$, $P = 0.0001$) with number of males ($x = 23.2 \pm 8.5$ [SD]). The sex ratio for spruce grouse appears to approximate 1:1.

DISCUSSION AND MANAGEMENT IMPLICATIONS

The different methods for counting territorial male spruce grouse provided quantitatively and qualitatively different measures of population abundance. All methods produced significantly correlated results. Parallel transects (Boag and McKinnon 1982) allowed complete census of all sex and age categories. However, this method required a large commitment of time. The use of a recorded female call was effective for finding territorial males and some females; however, many females and nonterritorial yearling males were not detected. The wing-clapping index provided a relative estimate of territorial male density and required relatively little time. However, the index did not give an absolute count.

The apparent linearity of the correlation between the results of the wing-clapping index and the response of males to playbacks indicated that the index may reflect relatively small differences in the populations of territorial males. This type of index may be useful for monitoring territorial male populations between years or areas.

Seventeen of 53 birds (32%) on the areas (as determined with playbacks) were not detected wing clapping in the morning. One possible explanation is that by trying to avoid counting males twice, we occasionally may have ignored a male that was in a similar direction as another displaying male that was counted. A second possibility is that males displayed variable rates of wing clapping and some males may not have wing clapped when the observer was close enough to hear them. Finally, some males are known to use widely separated (>0.5 km) display areas (perhaps because they change territories) within the same breeding season (M. A. Schroeder, unpubl. data).

The use of an index to determine population density must be viewed with caution. Unless a significant positive relationship exists between the index and the actual total population, the use of the index is questionable (Rotella and Ratti 1987). Rotella and Ratti (1987) recently showed that call counts for gray partridge (*Perdix perdix*) were positively correlated with density estimates. More examples of similar tests are needed to confirm the nature of the relationship between commonly used indices and the actual populations.

The apparent effectiveness of playbacks for locating all the territorial male spruce grouse found with the time-consuming transect method is important. Research on other bird species indicated that playbacks may be 100% effective for finding territorial songbirds (Falls 1981), 80% for plain chachalacas (*Ortalis vetula*) (Marion 1974), 75% for spotted owls (*Strix occidentalis*) (Forsman et al. 1977), and 79% for great horned owls (*Bubo virginianus*) (Springer 1978). Censusing territorial male spruce grouse with playbacks of a female call may be a useful compromise between the accuracy of a complete population count and the time efficiency of a wing-clapping index.

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Received 23 July 1987.
Accepted 18 October 1988.