Sound Intensity of Booming in Lesser Prairie-Chickens

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Source: Journal of Wildlife Management, 74(5):1160-1162. 2010.
Published By: The Wildlife Society
DOI: 10.2193/2009-423
URL: http://www.bioone.org/doi/full/10.2193/2009-423

Journal of Wildlife Management 74(5):1160–1162; 2010; DOI: 10.2193/2009-423

Tools and Technology Note

Sound Intensity of Booming in Lesser Prairie-Chickens

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ABSTRACT Wildlife managers traditionally monitored lesser prairie-chicken (*Tympanuchus pallidicinctus*) populations using road-based lek surveys and assumed booming can be heard ≥1.6 km from a lek. To assess this assumption, we measured sound intensity (decibels) of booming lesser prairie-chickens. Our results indicated sound intensity 1.6 km from a lek would be less than or equal to the sound intensity of a whisper. Thus, 1.6 km is probably too great a distance for audible detection of booming in many conditions.

KEY WORDS attenuation, audibility, booming, lek, lesser prairie-chicken, population monitoring, sound intensity, *Tympanuchus pallidicinctus*, vocalization.

The conservation status of lesser prairie-chickens (*Tympanuchus pallidicinctus*) has prompted widespread population monitoring of this species (Sullivan et al. 2000, Davis et al. 2008, U.S. Fish and Wildlife Service 2008). Wildlife managers have traditionally monitored prairie grouse populations using road-based lek surveys (Best et al. 2003, Wildlife Management Institute [WMI] 2005, Davis et al. 2008, Ripper et al. 2008). One of the underlying assumptions of this survey technique is that lesser prairie-chicken booming (i.e., vocalizations emitted during breeding displays) can be heard by surveyors ≥1.6 km from a lek (Lionberger 2007, Davis et al. 2008).

Rusk et al. (2009) recently examined sound intensity and radius of audibility of northern bobwhite (*Colinus virginianus*) calls. Rusk et al. (2009) found sound intensity of bobwhite calls was 100 decibels (dB) at 10 cm and estimated a radius of audibility of 900 m. At 900 m, the sound intensity of bobwhite calls would be ≤20.9 dB (see inverse square law below; Davis and Masten 2004), which is quieter than a whisper (i.e., 30 dB; Extech Instruments 2002). To our knowledge, no measures of sound intensity of booming lesser prairie-chickens exist in the literature. To assess the underlying assumption that lesser prairie-chicken booming can be heard by surveyors ≥1.6 km from a lek, we measured sound intensity (dB) of booming lesser prairie-chickens.

STUDY AREA

We measured sound intensity of booming lesser prairie-chickens at leks on the Southern Great Plains of Texas, USA. Leks were located in Hemphill and Yoakum counties. Landscape around the leks was a short-mixed grass prairie ecosystem dominated by little bluestem (*Schizachyrium scoparium*), sand sagebrush (*Artemisia filifolia*), and shinnery oak (*Quercus havardii*; Haukos and Smith 1999). Primary land uses were cattle ranching interspersed with oil and gas development and some Conservation Reserve Program lands, center-pivot agriculture, and dry-land agriculture (McRoberts 2009).

METHODS

We measured sound intensity of booming lesser prairie-chickens at 2 leks. Booming is a bubbling or gobbling vocalization associated with breeding displays and is described as a bubbling hoot (Madge and McGowan 2002). From a pickup truck or blind, we observed lesser prairie-chickens booming on leks on 6 days between 5 and 24 March 2009. We measured sound intensity using a digital sound level meter (Extech 407736; Extech Instruments Corp., Waltham, MA) placed on the lek. We observed the digital sound level meter with 10-power binoculars (10 × 42 mm, Nikon Monarch; Nikon Corp., Tokyo, Japan). We recorded the maximal decibel reading observed and distance from the sound level meter to the booming lesser prairie-chicken. We measured distance using a combination of laser rangefinder (Nikon Laser 800, Nikon Corp.) and measuring tape (15-m open reel fiberglass tape).

The inverse square law explains the attenuation (i.e., reduction) of sound intensity over distance and is represented as

$$L_2 = L_1 - 10 \log (r_2/r_1)^2$$

where L_1 is sound intensity (dB) at distance r_1 and L_2 is sound intensity at distance r_2 (Davis and Masten 2004). To standardize measures of sound intensity obtained at various distances, we used the inverse square law (Davis and Masten 2004) to estimate sound intensity at 10 cm. Based on the inverse square law, we predicted sound intensity of booming lesser prairie-chickens at 1.6 km.

RESULTS

We obtained 27 measurements (1 from Hemphill County and 26 from Yoakum County) of booming intensity on 2 leks from >10 hours of observation time. We observed 6–15 lesser prairie-chickens on the leks during our observations. Lesser prairie-chickens were 2.0–29.5 m (10.1 ± 3.54; $\bar{x}$ ±

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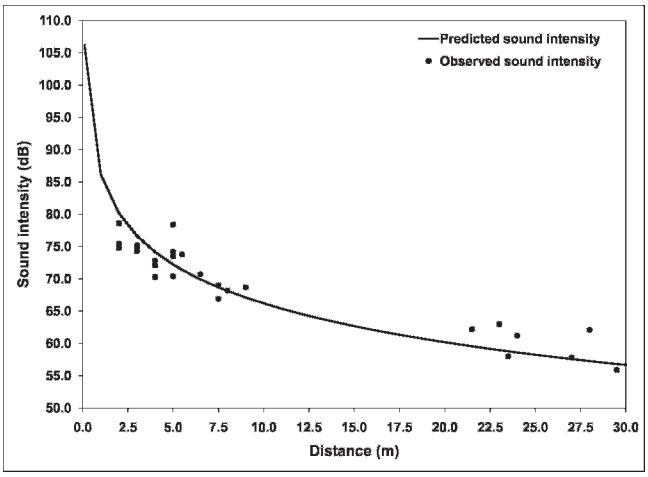

Figure 1. Predicted and observed sound intensity (decibels [dB]) of booming lesser prairie-chickens during March 2009 at 2 leks in Hemphill and Yoakum counties, Texas, USA. Predicted sound intensity was based on the inverse square law (Davis and Masten 2004).

95% CI) from the sound level meter. We estimated booming intensity was 106.2 ± 1.05 dB ($\bar{x}$ ± 95% CI) at 10 cm. Maximum estimated sound intensity was 112.4 dB at 10 cm. We predicted sound intensity of booming would be ≤60 dB at 21 m (Fig. 1) and ≤30 dB at 645 m.

DISCUSSION

Our results suggested sound intensity at 1.6 km from booming lesser prairie-chickens would be on average 22.1 dB. Our results indicated that it is possible to hear lesser prairie-chicken booming at or beyond 1.6 km from a lek, but the sound intensity would be equivalent to or below that of a whisper. Frequency of lesser prairie-chicken booming was reported at 500–1,000 Hz (Sharpe 1968), and low frequencies such as those observed for lesser prairie-chickens generally transmit better than higher ones (Catchpole and Slater 2008). However, excess attenuation from weather and habitat conditions is likely to reduce the audible range of booming lesser prairie-chickens (Barnard 1983, Catchpole and Slater 2008).

Several state wildlife agencies have estimated lek densities based on the assumption that leks within 1.6 km of roads were detectable during road surveys (Davis et al. 2008). Protocols used during these surveys limited survey efforts to days in which wind speed was ≤32 km/hour for Texas Parks and Wildlife Department personnel and ≤19.2 km/hour for Kansas Department of Wildlife and Parks personnel (WMI 2005, Davis et al. 2008). However, wind speeds ≥16 km/hour can have sound intensities >60 dB (M. J. Butler, Texas Tech University, unpublished data), which can dampen quieter sounds. The inverse square law predicts sound intensity of booming lesser prairie-chickens would drop to 30 dB (i.e., intensity of a whisper) at 645 m. Furthermore, Catchpole and Slater (2008) suggested bird vocalizations may have excess attenuation (i.e., greater attenuation than predicted by the inverse square law) because sound transmission can be affected by topography, wind speed, humidity, temperature, background noise, and habitat conditions. In addition, the magnitude of attenuation of lesser prairie-chicken booming may change from year to year due to changes in climatic and vegetative conditions resulting in annual and survey route-specific changes in lek detectability. Therefore, variation in annual indices of lek density is not only a result of population trends but also changes in lek detectability (Anderson 2001).

Management Implications

We suggest the underlying assumption that booming can be heard by surveyors ≥1.6 km from a lek is probably too great of a distance. We recommend further investigation to determine the influence of weather and habitat conditions on the transmission and attenuation of lesser prairie-chicken booming. Audibility trials, where observers listen for prerecorded booming at various distances, could be used to determine the relationships among audibility of booming and environmental and weather conditions (e.g., Rusk et al. 2009).

Acknowledgments

Our study was funded by Texas Parks and Wildlife Department. We gratefully acknowledge private landowners and The Nature Conservancy who allowed access to their lands. This is Texas Tech University, College of Agricultural Science and Natural Resources technical publication T-9-1175.

LITERATURE CITED

Anderson, D. R. 2001. The need to get the basics right in wildlife field studies. Wildlife Society Bulletin 29:1294–1297.

Barnard, C. J. 1983. Animal behaviour: ecology and evolution. Croom Helm, London, United Kingdom.

Best, T. L., K. Geluso, J. L. Hunt, and L. A. McWilliams. 2003. The lesser prairie chicken (*Tympanuchus pallidicinctus*) in southeastern New Mexico: a population survey. Texas Journal of Science 55:225–234.

Catchpole, C. K., and P. J. B. Slater. 2008. Bird song: biological themes and variations. Second edition. Cambridge University Press, Cambridge, United Kingdom.

Davis, D. M., R. E. Horton, E. A. Odell, R. D. Rogers, and H. A. Whitlaw. 2008. Lesser prairie-chicken conservation initiative. Lesser prairie chicken interstate working group, Colorado Division of Wildlife, Fort Collins, USA. <http://www.wafwa.org/documents/LPCCI_FINAL.pdf>. Accessed 17 Aug 2009.

Davis, M. L., and S. J. Masten. 2004. Principles of environmental engineering and science. McGraw-Hill, New York, New York, USA.

Extech Instruments. 2002. Model 407736 digital sound level meter instruction manual. Extech Instruments Corp., Waltham, Massachusetts, USA.

Haukos, D. A., and L. M. Smith. 1999. Effects of lek age on age structure and attendance of lesser prairie-chickens (*Tympanuchus pallidicinctus*). American Midland Naturalist 142:415–420.

Lionberger, J. E. 2007. Lesser prairie chicken monitoring and harvest recommendations. Texas Federal Aid in Wildlife Restoration Report, Federal Aid Grant W-126-R-15, Texas Parks and Wildlife Department, Austin, USA.

Madge, S., and P. McGowan. 2002. Pheasants, partridges, and grouse: a guide to the pheasants, partridges, quails, grouse, guineafowl, buttonquails, and sandgrouse of the world. Christopher Helm, London, United Kingdom.

McRoberts, J. T. 2009. Aerial surveys for lesser prairie-chicken leks: detectability and disturbance response. Thesis, Texas Tech University, Lubbock, USA.

Ripper, D., M. McLachlan, T. Toombs, and T. VerCauteren. 2008. Assessment of Conservation Reserve Program fields within the current distribution of lesser prairie-chicken. Great Plains Research 18:205–218.

Rusk, J. P., J. L. Scott, F. Hernández, and F. C. Bryant. 2009. Refining the morning covey-call survey to estimate northern bobwhite abundance. Pages 38–45 *in* S. B. Cederbaum, B. C. Faircloth, T. M. Terhune, J. J. Thompson, and J. P. Carroll, editors. Gamebird 2006: quail VI and perdix XII. 31 May–4 June 2006. D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, USA.

Sharpe, R. S. 1968. The evolutionary relationships and comparative behavior of prairie chickens. Dissertation, University of Nebraska, Lincoln, USA.

Sullivan, R. M., J. P. Hughes, and J. E. Lionberger. 2000. Review of the historical and present status of the lesser prairie-chicken (*Tympanuchus pallidicinctus*) in Texas. Prairie Naturalist 32:177–188.

U.S. Fish and Wildlife Service. 2008. Review of native species that are candidate for listing as endangered or threatened; annual notice of finding on resubmitted petitions; annual description of progress on listing actions; proposed rule. Federal Register 73:75175–75244.

Wildlife Management Institute [WMI]. 2005. A comprehensive review of science-based methods and processes of the Wildlife and Parks Divisions of the Texas Parks and Wildlife Department. A Report to the Executive Director of Texas Parks and Wildlife Department, Wildlife Management Institute, Washington, D.C., USA.

Associate Editor: L. Brennan.