EVALUATING THE INFLUENCE OF FEDERAL PRESCRIBED FIRE REGIMES IN EAST TEXAS ON WHITE-TAILED DEER BODY CONDITION AND ANTLER SIZE

Trey P. Wall, Brian P. Oswald, Kathryn R. Kidd, and Ray L. Darville

Abstract—The physiological impacts of Federal prescribed burn regimes on white-tailed deer (*Odocoileus virginianus*) body weight and antler size was investigated in east Texas National Forests. Burn history was provided by the U.S. Department of Agriculture, Forest Service, National Forests and Grasslands in Texas. Many State wildlife management areas overlapped the National Forest boundaries; therefore, the burn histories were used in combination with Texas Parks and Wildlife Department deer harvest records to investigate the relationships between white-tailed deer physical attributes and prescribed fire. Deer antler beam and inside mean spread were significantly greater at 2 years post-burn than at less than 1 year post-burn. These results indicate that frequent prescribed fire is physiologically beneficial to white-tailed deer.

INTRODUCTION

Prescribed fire is a commonly used silvicultural practice deployed by the U.S. Department of Agriculture, Forest Service (USFS), National Forests and Grasslands in Texas (NFGT) for habitat management and ecosystem restoration (Wall and others 2019). The ecoregion in eastern Texas known as the Pineywoods occurs across the Davy Crockett, Angelina, Sabine, and Sam Houston National Forests. These forests have evolved alongside growing season fires and are host to many endangered, fire-dependent plants and animals such as Texas trailing phlox (*Phlox texensis*), red-cockaded woodpeckers (*Picoides borealis*; RCW), and Louisiana pinesnakes (*Pituophis ruthveni*) (Agee and Skinner 2005, Conner and others 1995, Diamond and others 1997). In 2010, the Pineywoods was listed as one of the most endangered ecoregions in the United States, with fire suppression considered one of the predominant contributing factors (Weakley and others 2019). Expansive and biologically diverse "open and park-like" longleaf pine (*Pinus palustris*) had an estimated pre-settlement range of 37 million hectares in the Southeastern United States (Jose and others 2006, Outcalt 2000, Van Lear and others 2005). In the early 1990s, less than 3 percent of the longleaf pine savanna was still intact, down to approximately 1.2 million hectares (Frost 1993, Landers and others 1995, Van Lear and others 2005). Some more contemporary estimates following restoration efforts of longleaf pine ecosystems suggest approximately 2.1% currently remaining (Jose and others 2006, Kush and others 2004)

The many well-recognized benefits of prescribed burns include reducing fuel accumulations, cycling nutrients, promoting the growth of herbaceous grasses and forbs, reducing hardwood and shrub stem encroachment, promoting browse availability for wildlife, and increasing anthropogenic access (Agee and Skinner 2005, Boyles and Aubrey 2006, Brown and Smith 2000, Ryan and others 2013).

The NFGT has implemented a standardized protocol for monitoring both long- and short-term effects of their prescribed fire programs and consists of randomized, permanently placed fuel plots within compartments of the National Forests (McWhorter 2012, Wall and others 2019) This program is a derivative of methods outlined in the U.S. Department of the Interior, National Park Service's Fire Monitoring Handbook as well as the Brown method for understory fuels analysis and aims to facilitate a uniform method of data collection and outline minimum monitoring standards associated with prescribed fire (Brown 1974, USFS 2014, USDI NPS 2003). The rationale behind the fire-monitoring program includes the use of the long-term data collection for comparative analysis of vegetation changes and fuel

Author information: Trey P. Wall, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX 75962; Brian P. Oswald, Joe C. Denman Distinguished Professor of Forestry, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX 75962; Kathryn R. Kidd, Assistant Professor, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX 75962; and Ray L. Darville, Professor and Chair, Department of Anthropology, Geography, and Sociology, Stephen F. Austin State University, Nacogdoches, TX 75962.

Citation for proceedings: Bragg, Don C.; Koerth, Nancy E.; Holley, A. Gordon, eds. 2020. Proceedings of the 20th Biennial Southern Silvicultural Research Conference. e–Gen. Tech. Rep. SRS–253. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 338 p.

reduction treatments in connection to quantified burn plan and ecosystem-specific objectives to increase interagency knowledge of fire effects, improve fire regime condition classes, and evaluate progress toward meeting those objectives (McWhorter 2012, Wall and others 2019)

Although the USFS prescribed burn objectives focus mainly on vegetation, fuel, and habitat trends, we wanted to investigate the direct physiological effects of the prescribed burn treatments on wildlife species. White-tailed deer (*Odocoileus virginianus*) is an appropriate species to measure physiological impacts in relation to fire because many management practices that are beneficial to the RCW likewise benefit white-tailed deer. Frequent growing season fires, thinning of overstory trees, and mosaics of burn treatments have shown to improve habitat composition for both species, evidencing the fire-evolved dependency and interconnectedness of these ecosystems (Lyons and Ginnett 2017, Masters and others 1996, Sparks and others 1998). Using deer harvest records provided by Texas Parks and Wildlife Department (TPWD) in combination with Federal historical prescribed fire archives for burn years, we correlated the effects of burn treatments on white-tailed deer body weight and antler measurements.

METHODS

Burn history information was attained from the Interagency Fuel Treatment Decision Support System (IFTDSS), Fuel Treatment Effectiveness Monitoring (FTEM), and personal communication with USFS personnel. Texas Parks and Wildlife Department provided deer harvest records from Alabama Creek, Bannister, Moore Plantation, and Sam Houston National Forest wildlife management areas (WMA). The data were recorded between 2010 and 2017 on the opening day of deer rifle hunting season and consisted of body weight, total antler points, and antler base, beam, and inside spread measurements. IFTDSS and FTEM were used to correlate burn years as the WMAs were nested within the National Forests.

Statistical Analysis

The white-tailed deer body condition variables were correlated to burn years and quantified using one-way analysis of variance followed by post-hoc comparisons (Tukey) for any significant variables. Due to the proximity of the WMAs to one another, combined with similar white-tailed deer management protocols, we assumed relative genetic homogeneity of the data and did not block by WMA. Burn years ranged from 0 to 3 years since the last prescribed fire. A 90 percent confidence level was used to test significance for all body weight and antler measurements ($p = 0.10$). All nubbin bucks, spikes, and male deer younger than 1.5 years of age were removed from the antler analyses to prevent juvenile antler measurements from skewing the data. Body weight analyses include both male and female deer.

RESULTS AND DISCUSSION

The majority of deer (64 percent) were harvested within Moore Plantation and Sam Houston National Forest. Eighty percent of deer were between 1.5 and 3.5 years of age at the time of harvest, with the most common age class being 2.5 years (29 percent). Sex composition consisted of 71 percent male and 29 percent female. More than 55 percent of deer ($n = 144$) were harvested in areas that had been burned the same year and dropped significantly as years since the last burn increased, bottoming at seven deer harvested 3 years post-burn. We hypothesize that the drop in harvests as years since the last burn increases may be attributed to either deer preference for more open areas or anthropogenic aversion to hunting in denser vegetation. As succession increases vegetation density over time, hunters may simply prefer to hunt in areas that are more easily accessible. Vegetation growth may also decrease visibility, making the deer more difficult to harvest. Likewise, deer may prefer less dense ecosystems consistent with literature in regards to predator-prey behavior exhibited in other cervid species (Henderson and others 2018, Wall 2018, White and others 2003).

Average field-dressed body weight (34 kg, standard error = 0.6) did not differ significantly ($p = 0.218$) among years since last burn. Mean total antler points ranged from 5.75 to 6.75 and did not differ among years ($p = 0.584$). Antler base measurement means ranged from 62 to 75 mm and were also similar among years ($p = 0.134$). Antler beam length ($p = 0.079$) and inside spread ($p = 0.099$) differed among years since last burn (fig. 1). Antler beam length and inside spread were greater than at 2 years post-burn than the year immediately following a burn.

Results suggest a beneficial link between prescribed fire and white-tailed deer physiology, where deer body weight and antler measurements increased after burns, peaking 2 years after the last prescribed fire. This analysis quantifies promising evidence and contemporary justification for the continued use of prescribed fire as a beneficial management tool to improve both habitat quality as well as overall white-tailed deer health, body condition, and antler size. Furthermore, the beneficial pattern displayed in deer condition in response to frequent burns likewise evidences the necessity of fire in these ecosystems (Wall 2018).

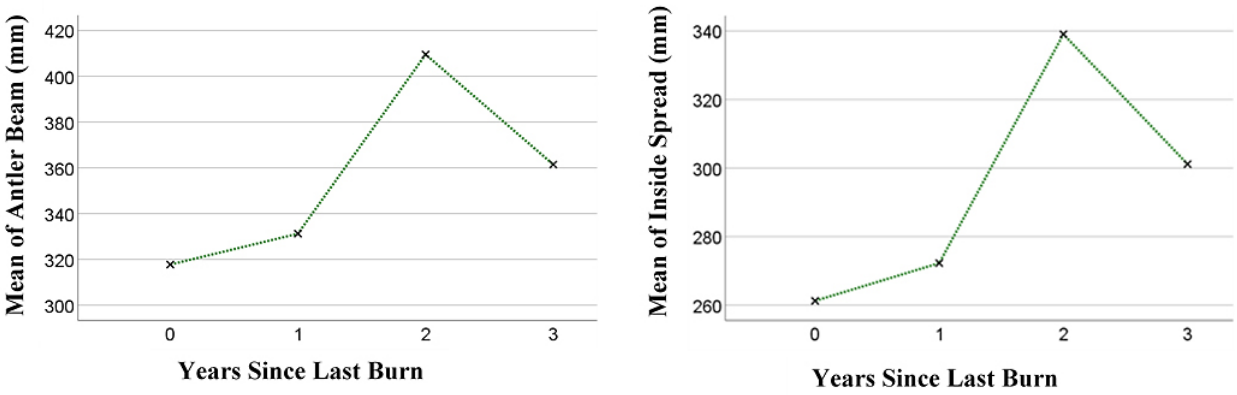

Figure 1—Least squares means for antler beam length (A) and inside spread (B) for white-tailed deer ≥1.5 years of age in relation to year since last burn.

CONCLUSIONS

Due to the infancy of research investigating direct physiological effects of fire on white-tailed deer, future research is imperative. Research involving increasing the sample size and fire return interval data in combination with adding browse surveys analyzing vegetative composition would be beneficial. It seems that the fire rotations native to these ecosystems improve overall deer health and hunter success. Continuing prescribed burn regimes on 2-4 year rotations may promote body weight and antler improvements while providing hunters with better access to game.

ACKNOWLEDGMENTS

Sincere appreciation is extended to the National Forests and Grasslands in Texas, U.S. Forest Service, and the McIntire-Stennis Cooperative Forestry Program for funding. Personnel who provided valuable insight and feedback include Ike McWhorter, Beth Buchanan, Gesse Bullock, Joey Silva, and Stuart Coombs. We also thank Bill Adams and Texas Parks and Wildlife Department for assisting with the white-tailed deer research and records. Data collection was also made possible by the assistance of Jeremy Lybrand, Catie Northen, Trevin Edwards, and Mason Danheim.

REFERENCES

Agee, J.K.; Skinner, C.N. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management. 211(1): 83–96.

Boyles, J.G.; Aubrey, D.P. 2006. Managing forests with prescribed fire: Implications for a cavity-dwelling bat species. Forest Ecology and Management. 222(1): 108–115.

Brown, J.K. 1974. Handbook for inventorying downed woody material. Gen. Tech. Rep. INT-16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 24 p.

Brown, J.K.; Smith, J.K. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

Conner, R.N.; Rudolph, D.C.; Bonner, L.H. 1995. Red-cockaded woodpecker population trends and management on Texas National Forests. Journal of Field Ornithology. 66(1): 140–151.

Diamond, D.D.; True, C.D.; He, K. 1997. Regional priorities for conservation of rare species in Texas. Southwestern Naturalist. 42(4): 400–408.

Frost, C.C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. In: Hermann, S.M., ed. The longleaf pine ecosystem: ecology, restoration and management. Proceedings of the Tall Timbers fire ecology conference no. 18. Tallahassee, FL: Tall Timbers Research Station: 17–43.

Henderson, C.B.; Michel, E.S.; Demarais, S.; Strickland, B.K. 2018. Camouflage patterns are highly heritable but predictability varies among three populations of white-tailed deer. Ecosphere. 9(3): e02169. 10 p.

Jose, S.; Jokela, E.J.; Miller, D.L. 2006. The longleaf pine ecosystem: an overview. In: Jose, S.; Jokela, E.J.; Miller, D.L., eds. The longleaf pine ecosystem: Ecology, silviculture, and restoration. New York, NY: Springer: 3–8.

Kush, J.S.; Meldahl, R.S.; Avery, C. 2004. A restoration success: longleaf pine seedlings established in a fire-suppressed, old-growth stand. Ecological Restoration. 22(1): 6–10.

Landers, J.L.; Van Lear, D.H.; Boyer, W.D. 1995. The longleaf pine forests of the Southeast: requiem or renaissance? Journal of Forestry. 93(11): 39-44.

Lyons, R.K.; Ginnett, T.F. 2017. Integrating deer, quail and turkey habitat. E-98. College Station, TX: Texas A&M AgriLife Extension. 6 p.

Masters, R.E.; Wilson, C.W.; Bukenhofer, G.A.; Payton, M.E. 1996. Effects of pine-grassland restoration for red-cockaded woodpeckers on white-tailed deer forage production. Wildlife Society Bulletin. 24(1): 77–84.

McWhorter, I. 2012. Prescribed fire effects monitoring. U.S. Department of Agriculture, Forest Service, National Forests and Grasslands of Texas. Available from Davy Crockett National Forest District Office, Houston County, Texas.

Outcalt, K.W. 2000. The longleaf pine ecosystem of the South. Native Plants Journal. 1(1): 42-53.

Ryan, K.C.; Knapp, E.E.; Varner, J.M. 2013. Prescribed fire in North American forests and woodlands: history, current practice, and challenges. Frontiers in Ecology and the Environment. 11(s1): e15–e24.

Sparks, J.C.; Masters, R.E.; Engle, D.M.; Palmer, M.W.; Bukenhofer, G.A. 1998. Effects of late growing-season and late dormant-season prescribed fire on herbaceous vegetation in restored pine-grassland communities. Journal of Vegetation Science. 9(1): 133–142.

U.S. Department of Agriculture, Forest Service [USFS]. 2014. Revised fire effects monitoring plan and sampling design for NFGT. U.S. Department of Agriculture, Forest Service, National Forests and Grasslands of Texas. Available from Davy Crockett National Forest District Office, Houston County, Texas.

U.S. Department of the Interior, National Park Service [USDI NPS]. 2003. Fire monitoring handbook. Boise, ID: U.S. Department of the Interior, National Park Service. 274 p.

Van Lear, D.H.; Carroll, W.D.; Kapeluck, P.R.; Johnson, R. 2005. History and restoration of the longleaf pine-grassland ecosystem: Implications for species at risk. Forest Ecology and Management. 211: 150–165.

Wall, T. 2018. Effectiveness of prescribed fire on meeting fuel load and wildlife habitat management objectives in east Texas National Forests. M.S. thesis. Nacogdoches, TX: Stephen F. Austin State University. 91 p.

Wall, T.P.; Oswald, B.P.; Kidd, K.R.; Darville, R.L. 2019. An evaluation of United States Forest Service prescribed fire regimes in east Texas. Forest Ecology and Management. 449: 117485. 8 p.

Weakley, A.; Dinerstein, E.; Wolfe, K. 2019. Piney Woods forests. World Wildlife Fund. |https://www.worldwildlife.org/ecoregions/na0523 [date accessed: January 15, 2019].

White, C.A.; Feller, M.C.; Bayley, S. 2003. Predation risk and the functional response of elk–aspen herbivory. Forest Ecology and Management. 181(1): 77–97.