



OKLAHOMA STATE UNIVERSITY WILDLIFE CHAIRS



Division of Agricultural Sciences and Natural Resources

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Influence of Food and Water Supplementation on Northern Bobwhite

By: Evan Tanner



Even though water developments are a common practice, there is no evidence that surface water benefits northern bobwhite.

Management efforts associated with northern bobwhite often are targeted to increase those factors that limit northern bobwhite such as food, water, or cover. Though the limiting factor throughout most of the bobwhite's distribution is cover, in regions where ample cover exists, supplementation of food and/or water is sometimes provided by managers.

Research has provided mixed conclusions about the direct effects of food supplementation on bobwhite. The most obvious effect of food supplementation is that it can influence the distribution of birds. Coveys are often attracted to the feeding sites, which can be used to increase covey detections for hunting.

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Oklahoma State University Wildlife Chairs

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Effects of Climate Change on Long-Distance Animal Movements

By: Julia Earl

Climate Change is expected to cause shifts in the geographic distribution of many wildlife species. The challenge is for wildlife biologists to understand which species will be able to shift their distributions and which will not in order to inform management decisions. One method to assess distribution shifts is through species distribution models. There are many different versions of these models that require different types of information and assumptions. In some cases, researchers do not have good information to assess how realistic these modeling efforts are. One of the major assumptions affecting the results of these models is how animal movement is incorporated, which relates to a species' ability to colonize new areas. However, we do not know whether climate change will also affect animal movement patterns and particularly long-distance movements, which are most important for colonizing new areas.

To address this, we are currently analyzing data from GPS satellite transmitters placed on seven different species of wildlife from across North America. This study contains three data sets from Oklahoma: lesser prairie-chickens in the panhandle and bison from the Tallgrass Prairie Preserve and Wichita Mountains NWR. Other species include white-tailed deer, mule deer, elk, coyote, and gray wolves from North Carolina, Colorado, and Alberta, Canada, respectively. We are examining whether the long-distance movement paths of these species are affected by temperature and whether it is warmer than normal during the movements. By looking across a variety of wildlife species, we can determine if there are common effects of climate change on movement. The results from this work will help refine species distribution models to predict geographic range shifts in the face of climate change.



Northern bobwhite visiting a gallinaceous guzzler during drought conditions in 2012 at Beaver River Wildlife Management Area, Beaver County, Oklahoma. These guzzlers have been suggested as a means of water supplementation for upland gamebirds throughout arid rangelands yet there is no evidence that they increase quail populations.

Additionally, supplemented food can attract undesirable species (including predators), and research has suggested that quail visitation to these sites is <8% of the total visits meaning that most of the feed is not consumed by the target species. Finally, when using supplementation, aflatoxin is of concern. Aflatoxin is produced by a fungus on grain. It can cause significant health issues and death in bobwhite. Warm, moist conditions favor its growth. Some grains, such as corn, seem to produce higher rates of aflatoxin than other grains, such as milo.

Water supplementation is used less than food supplementation, as surface water is typically abundant throughout bobwhite distribution. However, in the western portion of bobwhite distribution, surface water is less abundant. Water supplementation has similar effects on bobwhite populations as those discussed with food supplementation. Artificial water sources can influence the movement patterns and distributions of individuals and coveys throughout the year. Furthermore, these water sources can influence the locality of nest sites, in which quail will nest closer to water sources. However, there is no evidence that water supplementation influences nest success or adult survival. It is likely that quail are meeting their water requirements through preformed water sources such as those obtained through food sources (i.e., insects and seeds).

Ultimately supplementation may be an effective management practice if landowners are only interested in influencing the distribution of their local quail populations during the hunting season. However, these practices are most effective only when cover requirements are already met. Therefore, resources invested into quail management should focus on providing adequate vegetation and cover before using supplementation practices. It may be that through proper management of vegetation, food and water requirements for quail will be met without the need for supplementation. If using food supplementation, pay considerable attention to reducing aflatoxin (NREM 9021, <http://pods.dasnr.okstate.edu>).

Yet, if increased bobwhite abundance is the goal, supplemental feeding may not yield desirable results. Although bobwhite may have increased body fat through supplemental feeding, this does not necessarily yield more quail in the fall population. For instance, no published research has linked increased nesting efforts to food supplementation. This is relevant in the western portion of the bobwhite distribution as the number of nest initiations is strongly related to the subsequent fall population. Effects of food supplementation on adult survival vary based on year and location, suggesting increased survival may be achieved under some circumstances, but it is not guaranteed.

Managing Northern Bobwhite in Forested Ecosystems

By: Dwayne Elmore

Northern bobwhite require short dense woody cover (shrubs or resprouting trees), bare ground, perennial grass cover, and abundant forbs (broadleaf herbaceous plants). A primary limitation in forests is lack of sunlight due to a closed canopy of overstory trees which limits understory cover. Most unmanaged forests in the Southern Great Plains have >80% canopy cover. Research in eastern Oklahoma has demonstrated that overstory canopy cover of trees is the primary factor in whether bobwhite will be present on a site. To provide adequate herbaceous and shrub cover in the understory, the overstory canopy cover should be below 60%. However, if the goal is to maximize density of bobwhite, land managers should reduce the canopy below 40%.

Prescribed fire, herbicide, and mechanical tree removal can all be used to open up the forest canopy and allow sunlight to reach the forest floor. However, in most situations, prescribed fire alone will not result in sufficient opening of the forest canopy in a closed canopy forest to allow for a high density of bobwhite. Some type of mechanical or herbicide treatment will be necessary initially and then prescribed fire should be used to maintain the appropriate cover.

Mechanical

Mechanical removal of overstory cover can include tree harvest, girdling, felling, and mulching. It is important to remember that many woody species in the Southern Great Plains are resprouting. Therefore, mechanical methods will generally result in abundant resprouts in hardwood forest stands. This can be advantageous for bobwhite as they require shrub cover. However, if the entire understory is hardwood resprouts, forb and grass cover will be limited. This would reduce food resources and make using prescribed fire in the future difficult without sufficient grass litter for fuel. In pine forests, resprouting of pines is not an issue, however, hardwood sprouts and seedlings likely will increase following the overstory thinning. Prescribed fire will generally be sufficient to maintain the appropriate understory cover, following a pine thinning, assuming fire is introduced immediately before eastern redcedar seedlings become established and other undesirable woody plants begin to resprout.



This post oak savannah has a diverse mix of grass, forb, and shrub cover while still maintaining a few overstory trees. Fire frequency of 2-3 years is needed to maintain this area for northern bobwhite.

Herbicide

In areas where a commercial timber market does not exist, selective use of herbicides can be effective at opening the forest canopy. Stem injection or felling followed by stump treatment offer the most selectivity. This may be important for aesthetics or if certain size classes or woody species are to be retained in the overstory. Application of foliar or pelletized herbicide from aircraft or from the ground can also be used but care should be taken to retain desired tree and shrub cover. In areas with an overabundance of hardwood sprouts, foliar herbicide can be used to create a mosaic of herbaceous and shrub cover. However, landowners should remember that bobwhite are shrub obligates, therefore, landowners should maintain at least 20% of the shrub understory.

Prescribed Fire

Once the forest overstory has been thinned, prescribed fire offers the best long-term management option to maintain understory cover and minimize overstory shading. Prescribed fire also removes leaf litter which can increase forb cover and facilitate movement of bobwhite.

When using fire for bobwhite management in forests, the frequency of fire is the most important factor. The ideal frequency will vary depending on the initial conditions of the plant community, precipitation, and soil type. In general, fire frequencies will need to be between 2 and 3 years. The more frequent fire return intervals may be in conflict with loblolly pine regeneration during the first few years after pine germination, so landowners should consider managing multiple pine stands on different rotation schedules to ensure a portion of the property is suitable for bobwhite. If possible, landowners should not burn the entire forested area in the same year. Rather, landowners should burn 1/3-1/2 each year on a rotation.

While fire frequency is the most important factor, the season of fire and intensity does matter. Fire in different seasons will tend to favor certain plants that may be more or less desirable for bobwhite. In general, summer fires tend to reduce woody plant composition more so than dormant season fires. Thus, if your goal is to reduce woody plants and increase herbaceous plants, this may be an ideal time to conduct a fire. High intensity fire may be beneficial if more overstory cover needs to be reduced. However, if timber value is also a consideration, fires should be conducted when intensity is low to minimize tree damage. Burning during the dormant season, using backfires, and burning with good atmospheric lift and during high relative humidity will typically reduce fire intensity.



This loblolly pine stand has recently been commercially thinned, providing the landowner with significant income. The stand will be burned every 2-3 years and periodically commercially thinned to provide bobwhite habitat.

Summary

Forests can be managed to produce densities of bobwhite exceeding a bird per acre. In forests that are closed canopy, some type of initial thinning will need to be conducted to reduce canopy below 60%, although canopy cover below 40% should be attained if high density bobwhite is the objective. In pine stands, mechanical removal is the method of choice. Either mechanical and herbicide, or herbicide alone can be used in hardwood stands. Prescribed fire will be a critical practice to maintain sufficient understory cover and to prevent canopy closure in the long-term. If bobwhite is a management consideration in forests, landowners should consider contacting a forestry professional to help achieve your forest management goals.

Donor support of research and outreach programs is welcomed. We are always eager to hear from land owners, land managers, and donors regarding research ideas, concerns, and management questions.

To make a donation to the Wildlife Chairs at OSU:

- go to <http://secure.osugiving.com>, click “search here”
- type “wildlife chairs” in the search box
- when the results appear, choose either “Bollenbach Chair for Wildlife Management” or “Wildlife Conservation Chair” (Groendyke).



The Effects of Weather on Incubation Behavior and Nesting Success of Quail

By: Rachel Beyke



The Beaver River Wildlife Management Area quail project is focused on investigating quail nest success as a function of incubation temperature, incubation behavior, weather variables, and nest site-specific characteristics. Ultimately, we seek to gain insight on how two species, northern bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*), regulate their temperature during nesting season under equivalent weather conditions. This work will aid in bridging the gap between quail reproduction and the population crashes associated with weather events. Data is being collected during the 2015 and 2016 nesting seasons. To capture the incubation temperature of developing embryos, modified data loggers are inserted into the center of the nests for the entirety of the incubation period. Camera traps are then situated outside nests to monitor the incubation behavior (i.e., -on/-off bouts) of the incubating adult. Once a nest fate is determined, a black bulb temperature probe is inserted into the nest bowl to collect microclimate data. Furthermore, vegetation sampling is conducted at the nest site and at a random site to compare nest site characteristics with the surrounding landscape.

During the 2015 nesting season, we collected data on 59 quail nests. The 37 bobwhite nests had a 62% success rate and the average clutch size was 13.6 and the average incubation temperature was 95.9°F. We had a total of 22 scaled quail nests, with a 27% success rate. The average clutch size for scaled quail was 11.6 and the average incubation temperature was 93.6°F. The 2016 field season began in May, and final results available early next year.

Funding is provided by the Oklahoma Department of Wildlife Conservation and administered by the Oklahoma Cooperative Fish and Wildlife Research Unit. The project is additionally supported by the Bollenbach Endowed Chair for Wildlife Management and Groendyke Endowed Chair for Wildlife Conservation.

Managing Vegetation for Prairie-Chicken Conservation and Reduced Wildfire Hazard

By: Heath Starns

Over the past two years, we have examined the vegetation response to patch-burning (prescribed fire coupled with grazing) at multiple sites in the Southern Great Plains. Our study sites include Tallgrass Prairie Preserve in northeastern Oklahoma, Packsaddle Wildlife Management Area (WMA) in western Oklahoma, the Attwater's Prairie Chicken National Wildlife Refuge (NWR) in southern Texas, and Aransas NWR in southern Texas. This project is supported by Joint Fire Science, the Natural Resource Conservation Service and the Groendyke Endowment. These sites represent three distinct plant communities of the Southern Great Plains: tallgrass prairie, sand-shinnery oak/mixed-grass prairie, and coastal prairie. Our primary objectives include: 1) test for differences in rate of fuel accumulation between patch-burning and prescribed fire alone, 2) evaluate differences in fire suppression capabilities over time for areas managed with patch-burning and prescribed fire, and 3) evaluate the impacts of these two management strategies on prairie-chicken habitat.

Although we still have the summer of 2016 data collection to perform, preliminary results indicate that time since fire is the main source of variation in fuel loads across all sites. Differences in fuel loads translate into differences in fire suppression capabilities, with higher fuel loads leading to decreased probability of successful suppression. We are also analyzing data collected at Attwater's Prairie Chicken NWR to assess whether prairie-chickens are selecting for specific times since fire. We hope our results can be used to inform conservationists, fire managers, and the general public of the benefits that patch-burning can have to conservation goals and managing fire fuels.



Two Attwater's prairie-chicken hens at the Attwater's Prairie-Chicken National Wildlife Refuge. The hen on the left has a VHF radio collar.

Post Doc and Grad Student Updates

Rachel Beyke, M.S. student, is researching thermal ecology and behavior of nesting quail. She has completed her first field season.

Matt Carroll, Postdoctoral Fellow, is researching thermal ecology of northern bobwhite across multiple life stages. He completed his Ph.D. in December 2015.

Presentations:

- Carroll, JM, CA Davis, RD Elmore, SD Fuhlendorf. 2015. Proximate thermal environments constrain diurnal behavior of northern bobwhite broods. 2015 Oklahoma Natural Resources Conference, Tulsa, OK.
- Carroll, JM. 2015. Thermal patterns constrain behavior: Implications for ground-dwelling birds in rangelands. Department of Natural Resource Ecology and Management. Graduate Student Seminar Series, Stillwater, OK.
- Carroll, JM, CA Davis, RD Elmore, SD Fuhlendorf. 2015. Thermal constraints on critical life history periods of northern bobwhite. 22nd Annual Conference of The Wildlife Society, Winnipeg, Manitoba.
- Carroll, JM. 2015. Connecting environmental and management factors with northern nobwhite (*Colinus virginianus*) movement and habitat use patterns. Update on northern bobwhite research. Oklahoma Department of Wildlife Conservation Commission Commissioner's Meeting, Oklahoma City.

Cameron Duquette, M.S. student, is studying the impacts of fragmentation on northern bobwhite and vegetation and arthropod communities. He is analyzing data from his first field season and preparing for a second field season.

Dan Dvoretz, Ph.D., is studying mapping of depressional wetlands. He is currently writing his dissertation.

Presentations:

- Dvoretz, D, C Davis. 2015. Three-dimensional mapping of temporary wetlands using LIDAR and recurrent satellite imagery, Society of Wetland Scientists Meeting, Providence, RI.
- Dvoretz, D, C Davis, B Tramell. 2015. The what and why of wetland mapping and assessment in Oklahoma. Oklahoma Clean Lakes and Watershed Association, Stillwater, OK.

Julia E. Earl, Postdoctoral Fellow, is working on the effects of climate change on long distance animal movements. She is currently working on data analysis.

Presentations:

- Earl, JE 2015. Effects of global change on populations and ecosystem connections. Seminar at the Savannah River Ecology Laboratory, University of Georgia, Aiken, GA.
- Earl, JE, S Fuhlendorf. 2015. Effects of climate variables on Lesser Prairie Chicken vital rates: a meta-analysis. Oral Presentation at the Annual meeting of the American Ornithological Union, Norman, OK.
- Earl, JE. 2015. Subsidies and wildlife: Connections between ecosystems. Seminar at Purdue University in the Forestry and Natural Resources Department, West Lafayette, IN.
- Earl, JE. 2015. Cross-ecosystem transport: connections between ponds and forest. Seminars at the University of Arkansas and Mississippi State University in their Departments of Biological Sciences.
- Earl, JE, PA Zollner. 2015. Wildlife as ecosystem connectors: importance of movement ecology. Symposium on individual based models at the midwest fisheries and wildlife meeting, Indianapolis, IN.

Shelby Fraser, M.S. student, is studying coyote ecology in relation to anthropogenic and natural disturbances. She is currently writing her thesis.

Sarah Gallaway, M.S. student, is evaluating rapid assessment methods in depressional and lacustrine wetlands in Oklahoma. Her field work has been completed and she is in the process of writing her thesis.

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Kate Golden, Ph.D. student, is evaluating the effects of fire on wetland plant communities and whooping cranes. She has completed two field seasons and is preparing to analyze data.

Daniel Harrington, M.S. student, is studying roost site selection of northern bobwhite in winter with a focus on the vegetative and thermal characteristics of roost sites. He finished his first field season in March and has begun data analysis.

Dave Londe, M.S. student, is researching the response of grassland obligate birds to rangeland management practices and energy development. This is his first field season.

Allie Rakowski, M.S. student, is studying thermal ecology and effects of land use on wild turkey. This is her first field season.

Rheinhardt Scholtz, Postdoctoral Fellow, is researching the dynamics of woody encroachment in the Great Plains. He is currently analyzing data and writing manuscripts.

Heath Starns, Ph.D. student, is researching how patch-burning can enhance prairie-chicken habitat while managing rangeland fuels. He is analyzing data from his first two years while preparing for his final field season.

Presentations:

- Starns, HD, SD Fuhlendorf, RD Elmore, TJ Hovick, D Twidwell, ET Thacker. 2015. Impacts on prairie-chicken habitat from management of rangeland fuels. 2015 Annual Meeting of the Society for Range Management, Sacramento, CA.
- SStarns, HD, SD Fuhlendorf, RD Elmore, TJ Hovick, D Twidwell, ET Thacker. 2015. Impacts on prairie-chicken habitat from management of rangeland fuels. Patch Burn Grazing Meeting 2015, Pratt, KS.
- Starns, HD, SD Fuhlendorf, RD Elmore, TJ Hovick, D Twidwell, ET Thacker. 2015. Patch-burning impacts on prairie-chicken habitat. 31st Prairie Grouse Technical Council, Nevada, MO.
- Starns, HD, SD Fuhlendorf, RD Elmore, TJ Hovick, D Twidwell, ET Thacker. 2015. Impacts on prairie-chicken habitat from management of rangeland fuels. 6th International Fire Ecology & Management Congress, San Antonio, TX.
- Starns, HD JR Weir. 2015. Flammability characteristics of select native prairie species. 6th International Fire Ecology & Management Congress, San Antonio, TX.

Ashley Tanner, Ph.D. student, is studying the effects of anthropogenic development on lesser prairie-chickens. She is currently analyzing data from the past three years of data collection and writing her dissertation.

Presentations:

- Tanner, A, SD Fuhlendorf, CA Davis, RD Elmore. 2015. Modeling Habitat Suitability for Lesser Prairie-Chickens using Aerial Surveys and Citizen Science. The Wildlife Society National Meeting, Winnipeg, MB, Canada.
- Tanner, A, SD Fuhlendorf, CA Davis, RD Elmore. 2015. Modeling Habitat Suitability for Lesser Prairie-Chickens using Aerial Surveys and Citizen Science. Prairie Grouse Technical Council, Nevada, MO.
- Tanner, A, SD Fuhlendorf, CA Davis, RD Elmore. 2015. A Maximum Entropy Approach to Modeling Lesser Prairie-Chicken Habitat. Oklahoma Natural Resources Conference, Tulsa, OK.

Evan P. Tanner, Postdoctoral Fellow, is researching mediation of thermal extremes as a landscape function. He is beginning his first field season.

Presentations:

- Tanner, EP, RD Elmore, SD Fuhlendorf, CA Davis. 2015. Status of Northern Bobwhite and Scaled Quail in Western Oklahoma. Oklahoma Department of Wildlife Conservation Commissioner's Meeting, Oklahoma City.
- Tanner, EP, M Papeş, RD Elmore, SD Fuhlendorf, CA Davis. 2015. When Strongholds Collapse: Gains in Future Distributions May Cost Current Population Sources Under Future Climate Projections. The Wildlife Society 22nd National Conference, Winnipeg, Manitoba.

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- Tanner, EP, RD Elmore, CA Davis, SD Fuhlendorf. 2015. Predicting shifts in northern bobwhite and scaled quail distribution from climate change. Oklahoma Natural Resources Conference. Tulsa, OK.

Matt Walters, Ph.D. student, is studying sublethal effects of herbicides on spotted salamander and tiger salamander larvae. He is currently collecting data.

Wildlife Chairs' 2015 Research & Extension

2015 Research Publications

- Albanese, G, CA Davis. 2015. Characteristics within and around stopover wetlands used by migratory shorebirds: Is the neighborhood important? *Condor* 117:328-340.
- Allred, BW, WK Smith, D Twidwell, JH Haggerty, SW Running, DE Naugle, SD Fuhlendorf. 2015. Ecosystem services lost to oil and gas in North America. *Science* 348:401-402.
- Andersson, K, CA Davis, G Harris, DA Haukos. 2015. An assessment of nonbreeding waterfowl surveys on National Wildlife Refuges in the Central Flyway. *Wildlife Society Bulletin* 39:79-86.
- Bried, JT, NE McIntyre, AR Dzialowski, CA Davis. 2015. Resident-immigrant dichotomy matters for classifying wetland site groups and metacommunities. *Freshwater Biology* 60:2248-2260.
- Carroll, MJ, CA Davis, RD Elmore, SD Fuhlendorf. 2015. A ground nesting galliform's response to thermal heterogeneity: Implications for ground-dwelling birds. *PLoS ONE* DOI: 10.1371/journal.pone.0143676.
- Carroll, MJ, CA Davis, RD Elmore, SD Fuhlendorf, ET Thacker. 2015. Thermal patterns constrain diurnal behavior of ground-dwelling bird. *Ecosphere* 6: art222.
- Crosby, AD, RD Elmore, DM Leslie, RE Will. 2015. Looking beyond rare species as umbrella species: northern bobwhite and conservation of grassland and shrubland birds. *Biological Conservation* 186:233-240.
- Hovick, TJ, DK Dahlgren, M Papes, RD Elmore, JC Pitman. 2015. Predicting greater prairie-chicken lek site suitability to inform conservation actions. *PLoS ONE* 10(8):e0137021.doi:10.1371/journal.pone.0137021.
- Hovick, TJ, BW Allred, RD Elmore, SD Fuhlendorf, RG Hamilton. 2015. Dynamic disturbance processes create dynamic habitat selection in a prairie grouse. *PLoS ONE*. DOI: 10.1371/journal.pone.0137882.
- Hovick, TJ, RD Elmore, SD Fuhlendorf, DK Dahlgren. 2015. Weather constrains the influence of fire and grazing on nesting greater prairie-chickens. *Rangeland Ecology and Management* 68:186-193.
- Hovick, TJ, RD Elmore, SD Fuhlendorf, DM Engle, RG Hamilton. 2015. Spatial heterogeneity increases diversity and stability in grassland bird communities. *Ecological Applications* 25:662-672.
- Krueger, ES, TE Ochsner, DM Engle, JD Carlson, D Twidwell, SD Fuhlendorf. 2015. Soil moisture affects growing-season wildfire size in the southern great plains. *Soil Science Society of America Journal* 79:1567-1576.
- Meyer, Micah, D, CA Davis, D Dvoretz. 2015. Response of wetland invertebrate communities to local and landscape factors in north central Oklahoma. *Wetlands* 35:533-546.
- Scasta, JD, DM Engle, JL Talley, JR Weir, SD Fuhlendorf, DM Debinski. 2015. Drought influences control of parasitic flies of cattle on pastures managed with patch-burn grazing. *Rangeland Ecology & Management* 68:290-297.
- Scasta, JD, DM Engle, SD Fuhlendorf, DD Redfearn, TG Bidwell. 2015. Meta-analysis of exotic forages as invasive plants in complex multi-functioning landscapes. *Invasive Plant Science and Management* 8:292-306.
- Scasta, JD, ET Thacker, TJ Hovick, DM Engle, BW Allred, SD Fuhlendorf, JR Weir. 2015. Patch-burn grazing (PBG) as a livestock management alternative for fire-prone ecosystems of North America. *Renewable Agriculture and Food Systems*, 1-18.
- Smith, JA, TW Matthews, ED Holcomb, LP Negus, CA Davis, MB Brown, LA Powell, JS Taylor. 2015. Invertebrate prey selection by ring-necked pheasant (*Phasianus colchicus*) broods in Nebraska. *American*

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Midland Naturalist 173:318-325.

- Tanner, EP, RD Elmore, SD Fuhlendorf, CA Davis, ET Thacker, DK Dahlgren. 2015. Behavioral responses at distribution extremes: How artificial surface water can affect quail movement patterns. *Rangeland Ecology and Management* 68:476-484.
- Twidwell, D, AS West, WB Hiatt, AL Ramirez, JT Winter, DM Engle, SD Fuhlendorf, JD Carlson. 2015. Plant invasions or fire policy: Which has altered fire behavior more in tallgrass prairie? *Ecosystems* 2015:1-13.
- Winter SL, BW Allred, KR Hickman, SD Fuhlendorf. 2015. Tallgrass prairie vegetation response to spring fires and bison grazing. *The Southwestern Naturalist* 60:30-35.

2015 Extension Publications

- Arnall, B, H Herje, RD Elmore. 2015. Wildlife Food Plots. DASNR app.
- Dale, LL, TJ O'Connell, RD Elmore. 2015. Aflatoxins in Wildlife Feed: Know How to Protect Wildlife. Oklahoma Cooperative Extension Service, NREM-9021.
- Elmore, RD, KH Hickman, K Holmes. 2015. Problem Horticultural Plants. NREM-2895.
- Hovick, TJ, RD Elmore. 2015. Interacting Fire and Grazing is for the Birds. Great Plains Fire Science Exchange, Research Brief 2015-13.
- Jacques, M, K McBee, RD Elmore. 2015. Determining Sex and Reproductive Status of Rodents. NREM-2896.
- Jacques, M, K McBee, RD Elmore. 2015. Managing for Small Mammal Diversity. NREM-2897.
- Starns, HD, SD Fuhlendorf, RD Elmore, TJ Hovick, D Twidwell, ET Thacker. 2015. Patch-Burning to Manage Prairie-Chicken Habitat and Rangeland Fuels. *Grouse News* 49.

2015 Outreach Activities

- Conservation Leaders for Tomorrow Workshop. 2015. Tipton, KS.
- Deer Management. 2015. Workshop and Extension In-Service. Stillwater, OK.
- Fire and Grazing. Field Tour for Kansas CES. Stillwater, OK.
- Filmed 1 segment for Oklahoma Gardening, Oklahoma State University's gardening television program, 2015.
- Filmed 3 segments for SUNUP, OSU's agriculture and natural resources television program, 2015.
- Fire and Grazing. Field Tour for NDSU students. Stillwater, OK.
- Fire Effects on Wildlife. NRCS Fire Training Workshop. Stillwater, OK.
- Fire Effects on Wildlife. NRCS Fire Training Workshop. Stillwater, OK.
- Fire and Prairie-Chickens. Great Plains Fire Science Consortium. Webinar.
- Food Plot Management. Kellyville, OK.
- NRCS Wetland Management. 2015. Field Day and Extension In-Service. Chandler, OK.
- NRCS Wetland Management. 2015. Field Day. Claremore, OK.
- Organized Symposium on Rangeland Wildlife. 2015 Annual Meeting of the Wildlife Society. Winnipeg, Manitoba.
- Presentation on drought. Drought Conference. Beaver, OK.
- Presentation on Status of Northern Bobwhite in Oklahoma. Oklahoma City Chapter of the Audubon Society, Oklahoma City.
- Quail Research Summary. ODWC Commissioner's Commission meeting. Stillwater, OK.
- Quail Research in Oklahoma. Grand National Quail Club. Enid, OK.
- Quail Field Day. 2015. Field Day. Spavinaw WMA, OK.
- Quail Field Day. 2015. Field Day. Sandy Sanders WMA, OK.
- Quail Field Day. 2015. Field Day. Crosstimbers WMA, OK.

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- Range Management Field Day. 2015. Extension In-Service and Landowner Workshop. Pawhuska, OK.
- Tour of Rangelands for Lesser Prairie-Chicken Initiative.

2015 Professional Meetings Attended

- Ecological Society of America
- International Grouse Symposium
- Prairie Grouse Technical Council
- Society for Range Management
- Society of Wetlands Scientists
- Southeast Deer Study Group
- The Wildlife Society

2015 Awards and Honors

- **Adam Gourley** (former student), Creative Publication Award, Oklahoma Chapter of The Wildlife Society.
- **Ashley Tanner**, 1st place, Moser Student Research Award, Oklahoma Chapter of The Wildlife Society.
- **Evan Tanner**, 2nd place, Student Research and Presentation Award at the Oklahoma Natural Resource Conference.
- **Kate Golden**, received the Lochmiller Award at the Natural Resource Ecology and Management Banquet.
- **Matt Carroll**, Outstanding Peer-reviewed Scientific Article from the Oklahoma Chapter of The Wildlife Society.
- **Shelby Fraser**, Outstanding Masters Student in Leadership and Service at the Presidents Leadership and Service Recognition Ceremony, at Oklahoma State University.