32nd Prairie Grouse Technical Council Program
Hosted by:
North Dakota Game and Fish Department
Dickinson, ND
October 17-19, 2017

Tuesday, October 17th - All times are in MST

5:30 – 9:00 p.m. **Social & Registration** – appetizers provided, cash bar available

Wednesday, October 18nd

7:00 a.m.	**Registration** **Breakfast on your own**
8:00 a.m.	**Opening remarks –** RJ Gross – NDGF
8:10 a.m.	**Welcome to North Dakota –** Terry Steinwand – NDGF Director

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Technical Presentations (Moderator – RJ Gross)

8:20 a.m.	**Update – Interstate Working Group Sharp-tailed Grouse and GPCH -** Jon Haufler – G.M. Sutton Avian Research Center
8:40 a.m.	**Connections on the Lek: Applying Social Network Analysis to Lesser Prairie-chickens. –** Geoff Gould – Ohio State
9:00 a.m.	**Manipulating Grouse Populations: Translocation, Reintroduction, and Artificial Insemination Preliminary Findings –** Kade Lazenby – Utah State University

9:20 a.m.	**Evaluation of Methods Used To Improve Grasslands as Gallinaceous Brood Habitat –** Mandy Orth - SDSU
9:40 a.m.	**Predicting the Effects of Grassland Conservation Reserve Program Enrollments and Expirations on Greater Prairie-Chickens in Northwestern Minnesota –** Kalysta Adkins – U of Minnesota
10:00 a.m.	**Break –** coffee and cookies provided

Technical Presentations Cont'd (Moderator – Christian Hagen)

10:20 a.m.	**Why We Do Not Use Radio Transmitters with Long Whip Antennas on Prairie Grouse –** John Toepfer – G.M. Sutton Avian Research Center
10:40 a.m.	**Managing for Recovery of a Prairie Icon: The Future of Lesser Prairie-Chicken Management –** Kent Fricke – Kansas DWPT
11:00 a.m.	**Application of Drones in Upland Gamebird Research –** Roald Stander – University of Manitoba
11:20 a.m.	**Landscape Genetic Analysis Of A Planned Prairie Corridor Through A Midwestern Agricultural Landscape Using The Greater Prairie-Chicken (*Tympanuchus cupido*) As An Indicator –** Charlotte Roy – Minnesota DNR
11:40 a.m.	**Use of Clearcuts by Sharp-Tailed Grouse in British Columbia –** Michael Schroeder – Washington DFW
12:00 p.m.	**Genetic Analysis of Sharp-tailed Grouse in East-central Minnesota Indicates High Genetic Diversity Remains After a Recent Population Bottleneck –** A.J. Gregory – Bowling Green State University
12:30 p.m.	**Lunch** – buffet provided on site
1:30 p.m.	**Field Trip** – board buses at hotel
2:00 p.m.	**Historic Sharp-tail Grouse Lek Tour – Jerry Kobriger – retired, NDGF**

6:30 p.m. **Social & Dinner** – food provided, cash bar available

Thursday, October 19th

7:00 a.m. **Breakfast on your own**

8:00 a.m. **Orientation to 2nd Day**

Technical Presentations (Moderator – Dave Dahlgren)

8:05 a.m. **Present or Absent? What Does Multi-scale Occupancy Modeling Reveal About Range-wide Conservation Needs of Lesser Prairie-Chicken? –** Christian Hagen – Oregon State University

8:25 a.m. **Estimating Abundance of the Lesser Prairie-Chicken –** Kristen Nasman – WEST Inc.

8:45 a.m. **WAFWA Lesser Prairie-Chicken Range-Wide Conservation Plan: A Successful Model for Conserving At-Risk Species –** Jim Pitman - WAFWA

9:05 a.m. **Sharp-Tailed Grouse Nesting Ecology and Nest Predation in North Dakota's Bakken Oil Field –** Susan Ellis-Felege – University of North Dakota

9:25 a.m. **Effects of Energy Development and Rangeland Management on Space Use of Greater Prairie-Chickens in the Southern Great Plains –** David Londe – Oklahoma State University

9:45 a.m. **Why is Carrying Capacity of Lesser Prairie Chicken Populations Declining across the Southern Great Plains? –** Christian Hagen – Oregon State University

10:05 a.m. **Break** – coffee and cookies provided

Technical Presentations Cont'd (Moderator – Susan Ellis-Felege)

10:20 a.m. **Effects of Flushing on Sharp-Tailed Grouse Nest Survival –** Megan Milligan – Montana State University

10:40 a.m.	**Sharp-Tailed Grouse Cover Selection and Brood Survival on the Grand River National Grasslands in Northwest South Dakota –** Benjamin Geaumont - NDSU
11:00 a.m.	**Multiscale Habitat Selection of Lesser Prairie-Chickens in an Agriculture/Conservation Reserve Program Land Matrix –** Samuel Harryman – Texas Tech University
11:20 a.m.	**Acoustic and Thermal Characteristics of Greater Sage-Grouse Nest Sites in Northwest South Dakota –** Lindsey Bischoff - SDSU
11:40 a.m.	**Using Robots to Conduct Behavioral Research: A Case Study of Species Recognition in Prairie-Chickens –** Jackie Augustine – Ohio State University
12:00 a.m.	**Lunch** – buffet provided on site
1:00 p.m.	**PGTC Business Meeting**

Technical Presentations Cont'd (Moderator – Michael Schroeder)

1:40 p.m.	**Sparser Herds, Larger Pastures, and Imperiled Birds: Heterogeneity-Based Grazing Management is Essential for a Heterogeneity-Dependent Grassland Bird –** John Kraft – Kansas Cooperative Fish and Wildlife Research Unit
2:00 p.m.	**Lesser Prairie-Chicken Brood Ecology in the Sand Shinnery Oak Prairie Ecoregion –** Blake Grisham – Texas Tech University
2:20 p.m.	**Influence of Patch-Burn Grazing on Lesser Prairie-Chicken Habitat Selection in Kansas –** Johnathan Lautenbach – Kansas Cooperative Fish and Wildlife Research Unit
2:40 p.m.	**Is it Inbreeding Depression? A Molecular Population Genetic Primer for Grousers** – Charlotte Roy – Minnesota DNR
3:00 p.m.	**Break** – coffee and cookies provided

Technical Presentations Cont'd (Moderator – Dan Svedarsky)

3:20 p.m.	**Greater Prairie Chicken Production and Dispersal in Nebraska and Minnesota, 2012-2016 –** John Toepfer – G.M. Sutton Avian Research Center
3:40 p.m.	**Update on Experimental Captive Breeding and Raising of Prairie-Chickens for Release into the Wild –** Steve Sherrod – G.M. Sutton Avian Research Center
4:00 p.m.	**Indirect Effects of Fire Ants on Attwater's Prairie-Chicken Brood Survival –** Michael Morrow – Attwater Prairie Chicken NWR
4:20 p.m.	**Indirect Effects of Red Imported Fire Ants on Attwater's Prairie Chicken –** Nova Silvy – Texas A&M
4:40 p.m.	**History of the Minnesota Prairie Chicken Society** – Dan Svedarsky – University of Minnesota Crookston
5:00 pm.	**Tentative**: Free time
6:00 p.m.	**Silent Auction, Poster Session, & Social** – cash bar available
7:00 p.m.	**Awards Banquet** – dinner provided

Abstracts

Update on Interstate Working Groups for Greater Prairie-Chickens and Sharp-tailed Grouse

Jonathan Haufler, Ecosystem Management Research Institute, Seeley Lake, MT 59868

Interstate Working Groups (IWG's) for greater prairie-chickens (GPS) and sharp-tailed grouse (STG) were initiated by the directors of WAFWA and MAFWA in 2015. Fourteen states have been engaged in this work. The goal of the IWG's is to expand and coordinate grassland conservation efforts using GPC and STG as flagship species. The long-term goal is to develop large blocks of native grasslands in sufficient sizes, arrangements, and quality to support populations of these 2 species. The IWG's have compiled available population and distribution information, identified associated species that will be benefited by management of these species, developed habitat descriptions of the species, and addressed the challenge of identifying a system of focal areas for each species. A science advisory committee has been established. Broader coordination with other grassland conservation initiatives is an upcoming activity.

Connections on the Lek: Applying Social Network Analysis to Lesser Prairie-Chickens.

Geoffrey M. Gould* & Jacqueline K. Augustine, Dept. of Evolution, Ecology & Organismal Biology, The Ohio State University, Columbus, OH 43210

Social network analysis has gained popularity as a tool for understanding patterns of animal social behavior and how these patterns influence individual choices in a social context. Male Lesser Prairie-Chickens (LPC) form aggregated leks and attend daily during the breeding season. Therefore this species provides an excellent opportunity for researchers to construct detailed social networks and determine how these networks relate to individual breeding behavior. I observed 3 leks over 48 days in the spring of 2017, performed 272 focal observations on males, and recorded all instances of aggressive interactions and cooperative displays. Analysis of the data is pending and will focus on the number and strength of connections among males, lek centrality, and if these measures predict mating success. Preliminary analysis indicates that strength of the strongest social bond best predicts mating success, contrasting the traditional notion that centrality on a lek is required. Further analysis of multiple networks constructed for each lek will determine the relationship between aggressive interactions and cooperative displays among pairs of males. This study demonstrates the potential for social network analysis to improve our understanding of LPC breeding behavior. In the future, such analyses could be expanded to the regional level if leks could be connected through female movements during the breeding season or movements of juvenile males in the fall.

Manipulating Grouse Populations: Translocation, Reintroduction, and Artificial Insemination Preliminary Findings

Kade Lazenby[1], David Dahlgren[1], and Aaron Robinson[2]
[1]Utah State University, College of Natural Resources, Wildland Resources Department
[2]North Dakota Game and Fish Department, Upland Game Management

Many grouse species around the world are considered imperiled. As populations decrease managers often attempt intervention methods such as translocations to arrest declines, increase numbers, or reestablish populations. The majority of past grouse translocation efforts have lacked intensive monitoring necessary to provide key learning processes and adaptive management. To date, no published studies provide assessment of both the translocated and source populations. For those few projects that were monitored, often reproductive efforts, success, and survival of translocated females has been relatively low, especially the first breeding season post-translocation. We are currently participating with other partners to help develop protocols for sage-grouse (*Centrocercus urophasianus*) translocations. Three different projects dealing with imperiled populations are occurring simultaneously in south-west North Dakota, west-central Utah, and the Bi-State population in California. All three studies are incorporating 1) population vital rate monitoring of the translocated and source populations, 2) artificial insemination of translocated females with control, and 3) soft-release methods using remote release boxes. Our preliminary findings herein are focused on the south-west North Dakota efforts. In April of 2017 we translocated 20 male and 40 female sage-grouse from the Stewart Creek population near Rawlins, Wyoming to historical lek sites in south-west North Dakota. All translocated birds were radio-marked, with 20 females receiving necklace-style VHF and 20 females receiving GPS-PTT harness-style radios. Males were fitted with VHF harness-style radios. Movements post-release were generally large, though total distances varied considerably. Mortality rates were an issue the first few weeks post-release, but decreased over time. Approximately half or more of the females initiated nests, though preliminary information was inconclusive concerning the effects of artificial insemination. Nest success was below average compared to other published findings, but did not necessarily differ from the source population. Brood success showed similar results. We look forward to another translocation effort in the spring of 2018 and future analysis combining our results with two other collaborating studies.

Evaluation of Methods Used to Improve Grasslands as Gallinaceous Brood Habitat

Mandy Orth* and Kent Jensen, Dept. of Natural Resource Management, South Dakota State University, Brookings, SD, 57007
Travis Runia, South Dakota Department of Game, Fish and Parks, Huron, SD, 57350

Management practices designed for upland game species in the past have focused on nest survival and hen winter survival due to the importance of these life history stages on population vital rates. However, chick survival is an important component of gallinaceous bird population dynamics and is poorly understood and often tends to be overlooked. Recent population modeling studies have found that gallinaceous bird populations are more sensitive to chick survival than nesting success. Our research investigated the efficacy of various methods of Conservation Reserve Program (CRP) mid-contract management to improve brood rearing habitat for upland game birds. The objectives of this study were to (1) determine and compare relative arthropod abundance among CRP grasslands subject to several management techniques for three consecutive years post-management by using sweep nets, vacuum sampling and pitfall traps, (2) determine and compare relative arthropod availability among grasslands subject to several management techniques for three consecutive years post-management using human-imprinted chicks as models, and (3) determine and compare vegetation composition and structure characteristics among grasslands subject to several management techniques for three consecutive years post-management. Treatments that promoted vegetative diversity, such as interseeding of forbs and native wildflowers, led to increased abundance and diversity of the arthropod community and mass gain during chick foraging trials.

Predicting the Effects of Grassland Conservation Reserve Program Enrollments and Expirations on Greater Prairie-Chickens in Northwestern Minnesota

K. Adkins, University of Minnesota, Department of Fisheries, Wildlife, and Conservation Biology, St. Paul, MN 55108 USA, D.E. Andersen, U.S. Geological Survey, Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, MN 55108 USA, C. Roy*, MNDNR, Grand Rapids, MN 55744 USA, R. Wright, MN.IT @ MNDNR, Forest Lake, MN 55025, USA.

The Conservation Reserve Program (CRP) has potential to influence the abundance of greater prairie-chickens (*Tympanuchus cupido pinnatus; GPC),* a species of special concern in Minnesota, by altering the amount and configuration of grassland and wetland in agriculturally dominated landscapes. However, the CRP has experienced recent declines in enrollments in northwestern Minnesota that are expected to continue. These cuts increase the need to prioritize CRP enrollments that may have larger impacts on GPC populations. To predict changes in GPC abundance caused by

expirations of CRP contracts at both the landscape and lek scale, we used models relating GPC population metrics to CRP enrollments and resulting landscape structure. We simulated scenarios of CRP expirations, and results indicated that the abundance of GPC would be negatively impacted. Simulations of targeted CRP contract enrollment suggested mixed effects on GPC abundance. Adding grassland cover that increased existing grassland contiguity had a positive impact, while additions that decreased contiguity had a negative impact. Our findings highlight the importance of maintaining existing CRP grasslands and wetlands in landscapes that currently have low levels of grassland and wetland cover.

Why We Do Not Use Radio Transmitters With Long Whip Antennas On Prairie Grouse.

John E. Toepfer*, STCP Hamerstrom Prairie Grouse Research Chair, George Miksch Sutton Avian Research Center, P.O. Box 2007, Bartlesville, OK 74005
Mike E. Morrow, USFWS Wildlife Biologist, Attwater Prairie Chicken National Wildlife Refuge, P. O. Box 519, Eagle Lake, TX 77434
Don H. Wolfe, Senior Biologist, G. M. Sutton Avian Research Center, P. O. Box 2007, Bartlesville, OK 74005
Steve M. Oehlenschlager, Prairie Chicken Photographer, 21866 County Road 15, Elk River, MN 55330

In this presentation, we will tell our story of over 35 years of using and observing various types of radio transmitters and their effects on prairie grouse and why we all have chosen not to use radio transmitters with long whip antennas. Long whip antennas slap the wings of prairie grouse as they fly due to their twisting flight. Photographic evidence will be presented. There are various conflicting criteria that researchers must balance when deciding what type of radio package to use. These include but are not limited to: size, weight, color, range, power, life, cost and effects on the subject animal in this case prairie grouse. Regarding the latter for background see Marks, J. S., and V. Saab Marks. 1987. Influence of radio collars on survival of sharp-tailed grouse. Journal of Wildlife Management. 51:468-471.

Managing for Recovery of a PRAIRIE Icon: the future of lesser prairie-chicken management

Kent Fricke[1] and Liza Rossi[2], [1]Kansas Department of Wildlife, Parks and Tourism 1830 Merchant St. Emporia, KS 66801 620-342-0658 [2]Colorado Parks and Wildlife

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is an iconic species of the southern Great Plains. However, precipitous population and habitat declines have necessitated conservation actions across the bird's range. Key to managing and conserving the species has been collaborative partnerships. One such partnership between state wildlife management agencies has resulted in a translocation effort of lesser prairie-chickens from the shortgrass prairie of northwestern Kansas to the sand sagebrush ecoregion of southwestern Kansas and southeastern Colorado to augment limited populations in a region that was historically the stronghold for lesser prairie-chicken populations. The process of developing this unique partnership between Colorado Parks and Wildlife and the Kansas Department of Wildlife, Parks and Tourism will be discussed, as well as preliminary results from the first year of the translocation effort. Additionally, the current translocation efforts will be discussed in the political context of the species.

Application of Drones in Upland Gamebird Research.

R. Stander*, D.J. Walker, and R.K. Baydack, Dept. Environment and Geography, Univ. of Manitoba, Winnipeg, MB R3T2N2, CAN.

Agricultural land conversion has transformed 80 percent of the upland habitat in the southern range of sharp-tailed grouse (*Tympanuchus phasianellus*) and ring-necked pheasant (*Phasianus colchicus*). These birds have cryptic plumage, are difficult to observe in dense grasslands, and movements around leks can occur in twilight conditions. Emerging technologies such as small-unmanned aerial systems (sUAS) can revolutionize current survey methods, and with thermal imaging technology, improve detectability rates. The objective of this presentation is to report on the efficacy of thermal imaging from a sUAS platform to detect nesting birds, nocturnal movements, and to map leks. Lek sites in Manitoba, and nesting sites in North and South Dakota were studied. Sampling consisted of surveys flown with a DJI Inspire 1 v2.0 sUAS using both a FLIR Zenmuse XT 19mm 60 Hz thermal camera and a Zenmuse X3 RGB camera. Nesting and roosting pheasants were detected on nocturnal flights and did not react to presence of drones at low altitudes (ca. 10 m). Grouse reacted negatively to the drone at 100 m altitude in early morning and day flights, but could be detected under cover. Pheasant detectability was high with reduced risk of nest abandonment. Grouse were positively detected, but higher altitudes should be investigated for lek surveys.

Optical camera imagery provides high-quality lek and habitat maps, and drones represent a new tool for conservationists and managers.

Landscape genetic analysis of a planned prairie corridor through a Midwestern agricultural landscape using the Greater Prairie-chicken (*Tympanuchus cupido*) as an indicator

C. L. Roy*, Wildlife Research, Minnesota Department of Natural Resources (MNDNR), Grand Rapids, MN 55744; A. J. Gregory, Bowling Green State University, Bowling Green, OH 43403, USA, E. Nelson, MNDNR, Brainerd, MN 56401.

The multi-agency Minnesota Prairie Landscape Conservation Plan aims to create a grassland corridor of ~400 miles through Minnesota between Canada and Iowa. The Plan identifies the Greater Prairie-chicken (*Tympanuchus cupido*) as one of several indicators to evaluate success. We used a landscape genetic approach to identify landscape features that influence Greater Prairie-chicken movement and to identify gaps in connectivity in the tallgrass prairie of Minnesota. We collected 509 samples through feather collections from leks and submissions of hunter-harvested birds. Microsatellite amplification at 15 loci identified 294 distinct individuals. Genetic analysis indicated good connectivity in the existing range, but that improvements along the planned corridor in the northern portion of the extant range would be beneficial. Our landscape genetic approach produces geographically specific recommendations as to where land management can achieve the greatest impact, as well as identified landscape attributes that influence connectivity. This information helps prioritize areas where conservation efforts, like prairie acquisition, restoration, and enhancement, are likely to have the most impact.

Use of Clearcuts by Sharp-Tailed Grouse in British Columbia

M. A. Schroeder, Washington Department of Fish and Wildlife, Bridgeport, WA 98813 USA.

Lodgepole pine (*Pinus contorta*) forests of central British Columbia have been dramatically impacted by mountain pine beetle (*Dendroctonus ponderosae*). This impact has directly and indirectly resulted in vast areas of dead forests, increased risk of wildfires, and extensive areas of clearcuts. When intact, these forests primarily support Franklin's spruce grouse (*Falcipennis canadensis franklinii*). When altered by wildfires or clearcuts, these early successional forests often support Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*). We conducted surveys of leks in clearcuts near 70 Mile House, British Columbia in 2004, 2005, 2013, and 2017. Based on our data, use of clearcuts by lekking grouse appears to peak about 8–10 years after logging. The time from a clearcut, to the invasion and eventual disappearance of sharp-tailed grouse, appears to be about 20–25 years. Other factors that seem to be positively

correlated with grouse abundance include the cover of pinegrass (*Calamagrostis rubescens*) and the size of clearcuts. Anecdotal evidence suggests that spruce grouse start invading old clearcuts before the sharp-tailed grouse are completely gone. The Washington Department of Fish and Wildlife hopes to use this information to facilitate future translocation activities.

Genetic Analysis of Sharp-Tailed Grouse in East-Central Minnesota Indicates High Genetic Diversity Remains after a Recent Population Bottleneck

A.J. Gregory*, School of Earth Environment and Society, Bowling Green State University, Bowling Green, OH 43403, USA.
C. Roy, Minnesota Department of Natural Resources, MN, USA.
E. Nelson, Minnesota Department of Natural Resources, MN, USA

Minnesota DNR recognizes two distinct management units of Sharp-tailed grouse (*Tympanuchus phasianellus*). Recent population declines in the East-Central Management Unit (EC) has led to speculation that the EC sharp-tailed grouse population may be experiencing diminishing returns in reproductive success due to inbreeding depression. Alternatively, others have suggested that declines are due to habitat loss or degradation. To evaluate relative support for these hypothesized mechanisms for EC population declines, we conducted a landscape genetic analysis to assess contemporary levels of genetic diversity and gene flow, and to test for a genetic bottleneck. Cooperating biologists collected feathers from lek sites and hunters submitted wing samples, which were analyzed at 15 microsatellite loci. Genetic diversity was high (H_O=0.771), the inbreeding coefficient was low (F_{IS}=0.017), and a significant excess in heterozygosity (P=0.005) was detected. Population clustering analysis indicated greatest support for three populations; however, mapping sample locations of individuals by assigned population cluster revealed panmixia of population clusters. In sum, our findings are consistent with a recent demographic compression or bottleneck, but the EC population still retains high genetic diversity. Therefore, inbreeding depression was not supported, and declines are more consistent with changes in habitat quantity or quality.

Present or absent? What does multi-scale occupancy modelling reveal about range-wide conservation needs of Lesser Prairie-Chicken?

C. A. Hagen,* Oregon State University, Dept. of Fisheries and Wildlife, 104 Nash Hall, Corvallis, OR 97331, D. C. Pavlacky Jr., Bird Conservancy of the Rockies, 14500 Lark Bunting Lane, Brighton, Colorado 80603, M. Houts, Western Association of Fish and Wildlife Agencies, Lawrence, Kansas, K. Nasman, F. E. Hornsby, T. J. Rintz, J. Carlisle, and L. L. McDonald, Western EcoSystems Technology, Inc. 200 South Second Street, Laramie, Wyoming 82070

The range-wide monitoring program for the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) plays an important role in landscape conservation initiatives for the recovery of the species. Methodologies to evaluate prairie-chicken responses to habitat conditions and conservation practices are necessary to evaluate the success of these initiatives. We adapted the design of the range-wide monitoring program and applied a multi-scale occupancy model. The objectives were to 1) estimate the occupancy of the Lesser Prairie-Chicken at multiple spatial scales and 2) conduct an exploratory evaluation of prairie-chicken responses to habitat condition and conservation practices at multiple spatial scales. The application of the model to a single year of data from range-wide monitoring program yielded a Coefficient of Variation (CV) of large-scale occupancy = 17%. The CV of small-scale occupancy for the four eco-regions ranged between 21% and 52% and was acceptable for detecting differences between strata. We used predictions from fitted models and the method of multiple working hypotheses to evaluate a priori how a subset of habitat configuration and anthropogenic practices potentially affect site occupancy at multiple spatial scales. We derived a subset of habitat configuration and anthropogenic conservation covariates based on the 15-km × 15-km grid cells and 7.5-km × 7.5-km quadrants. We showed that prairie-chicken occupancy was positively affected by increased average patch size of native landcover in the landscape and by the percentage of land enrolled in prescribed grazing at the large scale (225 km^2), and Conservation Reserve Program in the landscape at the small scale (56 km^2).

Estimating the Abundance of the Lesser Prairie-Chicken

Kristen Nasman*, Western Ecosystems Technology, Inc. Fort Collins, CO 80525 USA; Lyman Mcdonald, Western Ecosystems Technology, Inc. Laramie, WY 80525 USA; Troy Rintz Western Ecosystems Technology, Inc. Corvallis, OR 97333 USA; and Grant Gardner Western Ecosystems Technology, Inc. Cheyenne, WY 82001 USA;

Monitoring population trend and estimation of population size is important for natural resource agencies in establishing and evaluating management practices. A probabilistic sample provides a precise and unbiased estimate of population size that assists in monitoring trends in population size and abundance.

Arial line transects were flown annually from 2012 to 2017 and mark-recapture distance sampling methods were used to estimate the abundance of lesser prairie-chickens (*Tympanuchus pallidicinctus*) and lesser prairie-chicken leks in occupied lesser prairie-chicken range in the Shinnery Oak, Sand Sagebrush, Mixed-Grass Prairie, and Short Grass Conservation Reserve Program Prairie Regions of New Mexico, Colorado, Texas, Oklahoma, and Kansas. The number of mixed species leks which contained both lesser and greater prairie-chickens (*T. cupido*), the number of hybrid lesser prairie-chicken/greater prairie-chicken, and the number of greater –prairie chickens where

these species' ranges overlap were also estimated in the Short Grass Conservation Reserve Program Prairie Region of northwest Kansas. In addition, estimates of trends in the lesser prairie-chicken populations were estimated from 2013 to 2017.

The WAFWA Lesser Prairie-Chicken Range-Wide Conservation Plan: A Successful Model for Conserving At-Risk Species

J. Pitman*, Western Association of Fish & Wildlife Agencies, Emporia, KS 66801 USA; R. Wolfe, Western Association of Fish & Wildlife Agencies, Topeka, KS 66614 USA; S. Kyle, Western Association of Fish & Wildlife Agencies, Lubbock, TX 79409; M. Houts, Kansas Biological Survey, Lawrence, KS 66047 USA

The lesser prairie-chicken range-wide conservation plan (RWP) unified conservation efforts and established a voluntary mitigation program administered by the Western Association of Fish & Wildlife Agencies (WAFWA). The primary goals of the RWP are to maintain sustainable populations of lesser prairie-chickens (LPC) and keep management authority for the species with the state wildlife agencies. The RWP was endorsed by the U.S. Fish & Wildlife Service in 2013 and was built to function regardless of the species legal status. Industry participants in the program agree to implement specific conservation measures and mitigate unavoidable impacts to LPC habitat. Industry participants have contributed >$63 million in enrollment and mitigation fees since inception of the program. WAFWA offsets their impacts in perpetuity using a 2:1 ratio and a combination of shifting term contracts and static conservation sites. WAFWA is currently offsetting participant impacts with conservation agreements encompassing 149,758 acres. Of which, 37,616 acres have been permanently conserved and 14,045 acres have been enhanced with restoration practices. To date, WAFWA has expended >$17.5 million on conservation activities and committed >$15 million additional dollars over the next 10 years through existing agreements.

Sharp-tailed Grouse Nesting Ecology and Nest Predation in North Dakota's Bakken Oil Field

Susan N. Ellis-Felege*, Department of Biology, University of North Dakota, Grand Forks, ND 58202 USA
Paul C. Burr, Department of Biology, University of North Dakota, Grand Forks, ND 58202 USA
Rebecca A. Kludt, Department of Biology, University of North Dakota, Grand Forks, ND 58202 USA
Aaron Robinson, North Dakota Game and Fish, Bismarck, ND 58501 USA

The expansion of oil and gas development in western North Dakota has unknown influences on the ecological interactions within and among wildlife species. We

evaluated nest success, nest behaviors, and nest predator dynamics of sharp-tailed grouse (*Tympanuchus phasianellus*) in areas of high and low energy development intensities in North Dakota. During the summers of 2012 and 2013, we monitored 163 grouse nests using radio telemetry. Of these, 90 nests also were monitored using miniature cameras to accurately identify nest predators and assess nesting behaviors. Scent stations were used to model nest predator occurrence. American badgers (*Taxidea taxus*) and striped skunks (*Mephitis mephitis*) were the primary nest predators, accounting for 56.7% of all video recorded nest depredations. Incubation constancy was approximately 95.2%. Hens took 2.5 recesses/day, averaging 27 minutes in length. Nests in high intensity gas and oil area were 1.95 times more likely to succeed compared to our minimal intensity area. Occupancy of mammalian nest predators was 6.9 times more likely in the minimal gas and oil intensity area compared to the high intensity area. Our results suggest energy development may alter the predator community, thereby increasing nest success for sharp-tailed grouse in areas of intense development, while adjacent areas may have increased predator occurrence and reduced nest success. Our study illustrates the potential influences of energy development on the nest predator - prey dynamics of sharp-tailed grouse in western North Dakota and the complexity of evaluating such impacts on wildlife.

Effects of Energy Development and Rangeland Management on Space Use of Greater Prairie-Chickens in the Southern Great Plains.

David Londe* *Department of Natural Resources Ecology and Management, Oklahoma State University, Stillwater, OK 74074, USA.*
Sam Fuhlendorf, Dwayne Elmore, Craig Davis *Department of Natural Resources Ecology and Management, Oklahoma State University, Stillwater, OK 74074, USA.*

Greater prairie-chickens (*Tympanuchus cupido)* have experienced range wide declines over the last century. The Flint Hills region of Oklahoma and Kansas has one of the largest remaining populations of greater prairie-chickens but the grasslands of this region are threatened with fragmentation from energy development and mismanagement of fire and grazing. However, little information is available about how fragmentation and management influence movement and space use of greater prairie-chickens throughout the annual cycle. Resource Selection Functions (RSF) were used to evaluate how various environmental factors relating to energy development and rangeland management influence the space use of female greater prairie-chickens across multiple spatial scales. Time since fire, use of lek sites, and avoidance of trees were the most consistent predictors of space use. Responses to different types of energy infrastructure varied throughout the year and across spatial scales with power lines and oil well density having the greatest negative effects. While greater prairie-chickens appeared to be negatively affected by some types of oil infrastructure,

response was constrained by other habitat requirements and dependent on spatial scales. Identifying the factors that are driving greater prairie-chicken declines will require consideration of the whole annual cycle and multiple spatial scales.

Why is Carrying Capacity of Lesser Prairie Chicken Populations Declining across the Southern Great Plains?

Edwar O. Garton, University of Idaho, Christian Hagen, Oregon State University, Adam Wells, University of Idaho, John Abatzoglou, University of Idaho, Mike Houts, Kansas Biological Survey, Jim Pitman, Western Association of Fish and Wildlife Agencies

Abstract: Stochastic growth models offer a powerful tool to evaluate long-term population dynamics of Lesser Prairie Chicken (*Tympanuchus pallidicinctus*) by integrating analysis of both density-dependent and density independent factors affecting annual rates of change into a single analysis capable of estimating carrying capacity while testing important hypotheses concerning a multitude of factors that potentially influence population dynamics. We identified the Gompertz model with declining carrying capacities (-1.8% to -9.6% per year) of 4 Lesser Prairie Chicken populations attending leks across the species range from 1964 to 2016 and as statistically superior to 25 alternative models. The best models imply substantially different probabilities of persistence for the 4 populations (100% to 70% in short-term, 15% to 0% in long-term). We found that drought, Conservation Reserve Program (CRP) acreages and number of oil and gas wells are critical factors influencing annual rates of change for Lesser Prairie Chicken populations with potentially profound influence in the future due to ongoing climate change across the Southern Great Plains. Policy changes such as increased support for CRP conversions of agricultural commodity production to natural grasslands and reductions in new oil and gas drilling could ameliorate future declines in carrying capacity for this threatened species.

Effects of Flushing on Sharp-Tailed Grouse Nest Survival

Megan C. Milligan*, Department of Animal and Range Sciences, Montana State University, Bozeman, MT 59717
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Intensive demographic studies of prairie grouse provide valuable demographic information to guide management recommendations. However, field techniques are frequently invasive, often necessitating concentrated capture efforts and frequent flushing, which could potentially bias results by altering either bird or predator behavior. If observed demographic rates are influenced by human presence, this could decrease their utility for management purposes. As part of a larger study on the effects of grazing management on sharp-tailed grouse, we monitored 85 radio-marked females in eastern Montana to better understand the effects of flushing on nest survival. A randomly selected subset of radio-marked females was flushed from the nest 1-2 times by researchers, while the remainder were never flushed during the nesting season. Daily nest survival was 0.97 ± 0.04 and overall nest survival during the 37-day nesting period was 0.28 ± 0.05 for females that were flushed at least once off the nest, compared to 0.47 ± 0.09 for females that were never flushed from their nests. Overall, we observed significant negative effects on nest survival from flushing females from nests, with reduced survival due almost entirely to predation rather than nest abandonment.

Sharp-Tailed Grouse Cover Selection and Brood Survival on the Grand River National Grasslands in Northwest South Dakota

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Sharp-tailed grouse are native gallinaceous birds found throughout much of the Northern Great Plains. Sharp-tailed grouse have been used by the Forest Service as both an indicator of management actions and more recently as a focal species of management. We used radio telemetry to evaluate the cover selection of brooding sharp-tailed grouse from 2013-2015 on the Grand River National Grasslands in Northwest South Dakota. Hens were trapped annually on leks and fitted with necklace style VHS collars. We monitored hens (41) with broods 3-4 times weekly via homing. We approached broods on foot once per week to determine weekly survival. We considered broods to have survived if at least one chick was observed or heard. We collected cover information including vegetation height, vegetation density and canopy cover estimates at approximately every third brood location and at one random point per

sampled brood location. Based on findings from conditional logistic regression models and Program MARK survival analysis, we found that both sharp-tailed grouse brood selection and survival was a function of vegetation height and density. The survival rate of broods for the 60 day monitoring period was 55%. Our findings provide evidence of the importance of vegetation heights and density for brooding hens.

Multiscale Habitat Selection of Lesser Prairie-Chickens in an Agriculture/Conservation Reserve Program Land Matrix

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The lesser prairie-chicken (*Tympanuchus pallidicinctus*) occurs in mixed-grass prairies in the Southern Great Plains of North America. Conservation Reserve Program (CRP) fields are habitat for LEPCs in Kansas, but information is lacking regarding 1) if lesser prairie-chickens select CRP fields for their daily activities in the High Plains of Texas and 2) how the species selects these areas given their availability on the landscape. We assessed habitat selection of lesser prairie-chickens within CRP fields in Texas using selection ratios after quantifying the amount and arrangement of different cover types across the study area. We assessed habitat selection at the second and third orders of selection. Conservation Reserve Program fields constituted 17% of the study area. At the second order of selection, lesser prairie-chickens selected non-native grass and native grass and forb CRP fields year-round. Cropland and native grassland were avoided, and native grass CRP fields were used in proportion to their availability. Only CRP fields seeded in native grasses and forbs were selected at the third order of selection. Based on our results, CRP fields were habitat for lesser prairie-chickens in our study area, and as such, beneficial to the species on the High Plains of Texas.

Acoustic and Thermal Characteristics of Greater Sage-Grouse Nest Sites in Northwest South Dakota

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Greater Sage-Grouse (*Centrocercus urophasianus*) are a species of conservation concern throughout the Intermountain West. Identifying sage-grouse resource selection during the critical nesting period can enhance management of the species and their habitat. In the spring of 2017, we monitored 43 radio-collared female sage-grouse. We detected 51 nests, 18 (35%) of which successfully hatched. To evaluate nest−site selection as a function of environmental attributes, we collected data on sound pressure (n=33) and temperature (n=27) at nest sites. Paired measurements were also made at a random site within 3.3 km of a nest. We used a multivariate Hotelling's t- test to assess differences between nests and random sites, temperature variables included maximum and minimum temperature and temperature variance. We detected no significant difference in temperature between nests and random sites (P=0.5). Sound was recorded using the dBc compression ratio for 8 minutes at both nest and random sites. We tested for differences in maximum and minimum sound level and total sound pressure. No noise variables differed significantly between nest and random locations. While no differences were detected on this minimally disturbed landscape, these data serve as an important baseline for potential future development such as the Keystone XL pipeline that would bisect South Dakota sage-grouse range.

Using Robots to Conduct Behavioral Research: A Case Study Of Species Recognition in Prairie-Chickens

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Behavioral research is often conducted by observing natural behaviors in the field, with follow-up vocal playback and model presentation experiments elucidating causation while controlling for confounding factors. Technological advances are giving behavioral researchers another tool: remotely-controlled robots. The benefits of remotely-controlled robots are that the model has the ability to respond to the focal bird and may elicit more realistic behaviors. Robots may also be preferred if focal birds are in close proximity to each other. I used robotic female Greater and Lesser Prairie-Chickens (*Tympanuchus cupido* and *T. pallidicinctus*, respectively) to study male mate choice and recognition in a hybrid zone. If male display behavior is costly, and males are able to correctly differentiate between conspecific and heterospecific females, then males should display

more intensely to conspecific females. Robotic females of each species were presented to males using the same path, and stayed on each focal male's territory for 5 min. The presentation of the robotic females was video-taped using a Sony HDR-CX160 video camera with 30x optical zoom. Proximity to the robot, time spent displaying and fighting, and intensity of display and aggression were recorded. Results suggest that both Greater and Lesser Prairie-Chicken males increase aggressive behaviors when Greater Prairie-Chicken females are present, suggesting a possible route to hybridization. This study demonstrates the value of robotic models in behavioral ecology.

Sparser Herds, Larger Pastures, and Imperiled Birds: Heterogeneity-Based Grazing Management Is Essential for a Heterogeneity-Dependent Grassland Bird

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Grazing strategies prescribed in the southern Great Plains often reduce structural heterogeneity and biodiversity in grasslands. Research indicates that patch-burn grazing yields promise for maintaining microhabitat beneficial to heterogeneity-dependent grassland fauna. However, grazing strategies that maintain heterogeneity of vegetation without pyric-herbivory are available, but knowledge of their impacts on grassland fauna is limited. The lesser prairie-chicken is an excellent candidate for investigating the impacts of heterogeneity-based grazing management strategies because of the various microhabitats required to fulfill all life-stage needs. We evaluated the influence of heterogeneity-based grazing management strategies on vegetation structure, habitat selection, and nest/adult survival of lesser prairie-chickens in western Kansas. Transmittered females were monitored to evaluate habitat use, nest success,

and adult survival. Grazing and vegetation data were collected via producer correspondence and vegetation surveys, respectively. Lesser prairie-chicken habitat use of rangeland declined steadily at forage utilization values > 40%. Probability of use increased as pasture area and deferment increased and stocking densities decreased. Almost 80% of nests were placed in pastures of forage utilization values less than 45%. Daily nest survival rates were negatively influenced as grazing pressure increased. Annual adult female survival was negatively influenced by greater forage utilization. Vegetation structure heterogeneity decreased at stocking densities > 0.26 AU/ha. Conservation actions in rangelands expressing flora community composition appropriate for lesser prairie-chickens should maintain microhabitat heterogeneity with low-moderate stocking densities, shorter deferment periods, and greater pasture areas. Rest-rotation or season-long deferment are more appropriate grazing management strategies in rangelands lacking nesting microhabitat potential.

Lesser Prairie-Chicken Brood Ecology in the Sand Shinnery Oak Prairie Ecoregion

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We evaluated brood-site selection and brood survival of lesser prairie-chickens among control sites and four combinations of treatments with tebuthiuron (0.60kg/ha) and a short-duration, rotational-grazing system used to restore sand shinnery oak prairies. We radio-tagged hens and located their nests and broods from 2006-2011. Unfortunately, low abundance, boom-bust reproductive strategy, and low fecundity resulted in sparse datasets. Only 16% of nests produced broods, 62% of broods failed within 14 days, and ~2% survived to independence. At treatment sites, all broods were in areas with either an herbicide or grazing application, and flush sites were not different from random sites. Survival was positively influenced by overhead cover and grass height coupled with increased precipitation during brood-rearing. Invertebrates, a primary food of chicks, were more abundant and diverse at treatment sites and in areas with high forb, grass, and litter cover, lower shrub cover (<25%) and visual obstruction, and within increased winter precipitation. Our results indicated starvation and thermal cover are two proximate mechanisms limiting brood recruitment on the Southern High Plains.

Influence of Patch-Burn Grazing on Lesser Prairie-Chicken Habitat Selection in Kansas

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Lesser prairie-chickens (*Tympanuchus pallidicinctus*) have experienced a significant population decline. Factors contributing to this decline include the conversion of native prairie, grassland mismanagement, and tree encroachment. Prescribed fire is a method for controlling tree encroachment; however, few studies have explored the influence of prescribed fire on lesser prairie-chickens. We evaluated prescribed fires effects on lesser prairie-chicken habitat selection. We measured the response of vegetation characteristics and female lesser prairie-chicken habitat selection to prescribed fire implemented in a patch-burn grazing system. We found that females avoided nesting in year-of-fire patches and selected >2-years post-fire patches to nest in. In addition we found that females selected 0, 1, and 2-years post-fire patches and avoided >2-year post-fire patches during post-nesting. Vegetation characteristics within these selected patches resembled that required by females during this time period. Overall, female patch and vegetation use varied across the breeding season, with females using all patches generated in a patch-burn grazing system. Due to this use, patch-burn grazing provides the suit of habitats needed by lesser prairie-chickens and may be a viable management option for controlling tree encroachment in areas inhabited by lesser prairie-chickens.

Is it Inbreeding Depression? A Molecular Population Genetic Primer for Grousers.

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Prairie-chickens are among the few species for which we have well documented evidence of inbreeding depression in wild populations. Indeed, the case of prairie-chickens in Illinois is literally a textbook case of inbreeding and genetic rescue of wild animals. The publication of this seminal work by Westemeier et al. 1998 has had mixed impacts for grouse ecology. On the positive side, it has increased awareness of the importance of genetics in managing grouse. One negative consequence is that we sometimes too quickly declare management challenges due to inbreeding. The question

is, is there really strong evidence for inbreeding depression in grouse? Although Westemeier et al. reported evidence for inbreeding depression, recent work reexamines these conclusions, and a slew of other studies have not detected inbreeding depression. Westemeier's work was conducted using selectively neutral microsatellites, not markers for coding regions which are subject to strong selective pressure. In this talk we provide a brief primer to the use and interpretation of genetic data for grousers. We also discuss the pros and cons of the use of selectively neutral verses selectively non-neutral markers. In general, we caution against the conclusion of inbreeding depression when using neutral microsatellite markers without other supporting data from other genetic marker types.

Greater Prairie Chicken Production and Dispersal in Nebraska and Minnesota, 2012-2016.

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In 2012 STCP initiated a five-year research project in the Nebraska sandhills to answer questions about the year-round ecology of a large greater prairie chicken (*Tympanuchus cupido pinnatus*) population. After five breeding seasons, results indicate that production of radio-marked greater prairie chicken hens in Nebraska was over twice that of hens in Minnesota. Nest success was lower in Nebraska than Minnesota (40.3%, n=253 versus 57.1%, n=191) but the percent of hens that fledged chicks in Nebraska was higher than Minnesota (51.0% versus 29.6%) and Nebraska radio-marked hens fledged more chicks/hen than Minnesota hens (4.7, n=71 versus 2.5, n=57). Contrary to other contemporary studies in Nebraska, prairie chickens in this study were very mobile dispersing up to at least 75 miles to their wintering areas. Each year a few hens dispersed 20-30 miles from their capture sites during the breeding season. The minimum dispersal range covered by all radioed birds was 3,828 square miles. Adult hens left their summer/autumn areas in mid-October and returned in mid-March the following year while young of the year hens did not return. Individuals mostly cocks that remained in the grasslands in winter fed where ranchers were feeding their cattle corn.

Update on Experimental Captive Breeding and Raising of Prairie-Chickens for Release into the Wild

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Grouse are difficult to raise in captivity, and producing large numbers for release into the wild has been challenging. However, releasing captive-raised birds is the only hope for recovery of endangered species such as Attwater's prairie-chicken (*Tympanuchus cupido attwateri*; APC). Sutton Avian Research Center (Sutton) is establishing a state-of-the-art breeding facility to aid in the recovery of APC initially using greater prairie-chickens as surrogates to test new raising and release protocols. In 2015, 41 eggs were collected from nests of greater prairie-chickens in Nebraska. The prairie-chickens hatched from these eggs established the breeding flock at the Sutton Prairie-Chicken Facility.

Sutton is testing captive breeding methods including natural pairs, trios, and female mate choice for birds housed in barns under lights, as well as natural lek breeding in a football field-sized outdoor enclosure. Incubation methods include commercial incubators as well as domestic hens. Raising tame chicks to become stress-free captive breeders and keeping conditions "wild" for birds to be released is being assessed. While hatching rates are high, significant chick mortality occurs at days five to ten post hatch. Birds raised in large netted fields show significant flight muscle development. Tests are underway comparing survival of captive produced, "wild" raised prairie-chickens released into Nebraska to that of birds raised naturally in the same geographic area.

Indirect Effects of Fire Ants on Attwater's Prairie-Chicken Brood Survival

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Poor survival of Attwater's prairie-chicken (*Tympanuchus cupido attwateri*) broods has confounded recovery efforts for this endangered species. Preliminary observations suggested that low invertebrate abundance during the first 2 weeks post-hatch was an important driver of brood success. Red imported fire ants (*Solenopsis invicta*) are known to adversely impact invertebrate communities. Therefore, we studied the relationship between brood (n = 63) survival and invertebrate abundance from 2009–2013. We also studied the effects of fire ant suppression using Extinguish Plus™ on invertebrate abundance at 5 replicate sites within the Attwater's historic range using an impact-reference design at each site. These results, published in the Journal of Wildlife Management in 2015, found a positive relationship between invertebrate abundance and brood survival. Fire ant suppression resulted in more invertebrates (+27% numbers, +26% biomass). Estimated survival of broods at 2 weeks was 2X higher for

broods spending all their time in fire ant suppressed fields (s = 0.67) compared to those that never used these areas (s = 0.32). Based on these findings, fire ant suppression was expanded on the Attwater Prairie Chicken National Wildlife Refuge. Although extreme rainfall events have confounded assessment of treatment expansion, general linear mixed regression continues to show support for increased invertebrate numbers, and more importantly increased brood (n = 34) survival during the first 2 weeks post-hatch, in fire ant suppressed areas.

Indirect Effects of Red Imported Fire Ants on Attwater's Prairie Chicken

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In 1957, red imported fire ants (RIFA, *Solenopsis invicta*) began to invade the Gulf Costal Prairies and Marshes Ecoregion of Texas. RIFA can potentially affect the endangered Attwater's prairie chicken (APC, *Tympanuchus cupido attwateri*) by direct predation of pipping chicks, reduced survival of young chicks, and competition with chicks and adults for food. The indirect effect of RIFA on invertebrate abundances, an important food source for breeding and newly hatched APC, requires study to determine if RIFA have an indirect negative effect on APC.

Research was conducted on the Attwater Prairie Chicken National Wildlife Refuge in Colorado County, Texas. Portions of the refuge received large-scale aerial treatment of *Extinguish Plus*^{TM} insecticide from 2013–2016 as a management action for APC. Invertebrates were sampled (sweep nets) at random sites using sweep nets and concurrently RIFA were sampled using baited petri dishes in areas treated for RIFA and areas non-treated for RIFA. A paired t-test was used to determine differences in invertebrate numbers and biomass on the 2 sites. Medium reduction of RIFA on treated areas over the 4 years of the study was 74% compared to non-treated areas. These data suggest treatment with *Extinguish Plus*^{TM} was successful in reducing RIFA. We found no significant difference in invertebrate biomass (P < 0.349) or numbers (P = 0.131) between treated and non-treated sites for the 4 years of the study. Therefore, it appears that treatment for RIFA had no effect on invertebrate biomass or abundance. Extreme rainfall did affect both RIFA numbers and invertebrate biomass and numbers.