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Precision Ag Business Planning: A New Approach to Conservation Delivery
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Pheasants Forever continually seeks and implements new and innovative ways to work with farmers and ranchers to demonstrate how conservation can improve their operation and quality of life. With the advancement of precision agriculture technology, we believe this information can be harnessed to increase both Return On Investment (ROI) while also providing water quality benefits, improving soil health, and creating wildlife habitat. Pheasants Forever believes working collaboratively with private landowners to reach their goals is the best way to accomplish this. The main underpinning of this strategy is the integration of precision agriculture technology with business planning and environmental performance metrics to showcase how conservation can improve profitability. This is a paradigm shift, since conservation programs and other best management practices have historically been viewed by growers as sacrificing economic opportunities rather than augmenting. The key advancement is the development of technology capable of evaluating opportunities at a sub-field scale rather than the historic view of entire fields, and by examining ROI as opposed to bushels per acre. During the business performance review and planning steps, alternative land-use options including conservation practices are explored, which may result in increased profits on those acres and a greater ROI over the entire field. Precision Ag Business Planning clearly demonstrates to operators the financial impacts of farming the "trouble spots". The process also allows operators to better understand what parts of a field (down to a 3-meter accuracy) make them the most profit and which areas are costing them money to farm.

Ranching for Conservation: Sustaining Biodiversity, Livelihoods, and Communities
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The Northern Great Plains (NGP) is one of the last remaining intact temperate grasslands in the world. Representing approximately 25% of the total area of the Great Plains, the NGP remains largely intact. In recent years, however, this landscape has been fragmented due to agricultural and urban growth, which has a devastating effect on bird species. Grassland birds have shown the most sustained population declines of any bird group in North America. In order to address these issues of loss and fragmentation, Audubon has developed the Conservation Ranching Program. The purpose of our Conservation Ranching Program is to promote healthy ecosystems through responsible ranching practices that improve the ecological function and economic sustainability of large grassland landscapes in the Northern Great Plains (NGP). We believe that ranchers provide the best opportunity for keeping grasslands intact across large areas; however, ranching practices are not sufficiently incentivized for conservation outcomes. Many factors affect the ability of ranchers to achieve their desired level of profitability, including severe weather events that reduce herd size; high commodity prices resulting in

significant losses for grain-fed beef; challenging family ranching succession and tax laws, which make it increasingly hard for children to carry on the family business; and other costs. Audubon is working with ranchers across the region to promote bird-friendly practices that result in thriving grasslands and wildlife, economic stability, and cultural benefits for ranching communities. By identifying and incentivizing ranching practices that are beneficial for grassland ecosystems, we can help create a large network of functional landscapes that are sustained by ranching communities over the long term. This program focuses on developing the ability to deliver at-scale conservation results through a "bird-friendly beef" strategy on working ranches that connects ranchers to premium beef markets.

A First Look at the Distribution, Status, and Future Role of South Dakota's Native Grasslands and Woodlands

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Native grasslands and their associated wetlands are crucial to emerging natural resource issues in South Dakota. We utilized the South Dakota Farm Service Agency's Common Land Unit (CLU) data and U.S. Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP) county mosaic aerial imagery to evaluate 22.6 million acres of land in 44 eastern South Dakota counties to determine the extent of remaining native grasslands. We analyzed land in approximately 1 mile^2 sections to identify all cropping and other land disturbances. Remaining land tracts were then categorized as potentially native grassland or woodland. Finally, we removed all known water bodies $\geq$40 acres as defined by the South Dakota Statewide Water Bodies layer to determine the remaining undisturbed grassland/wetland complex. Overall, 5,488,025 acres (24.2%) of eastern South Dakota were designated as potentially native land. Approximately 14.9 million acres (65.9%) were deemed to have a cropping history while approximately 1.6 million acres (6.9%) were found to have some type of land disturbance not indicated by a CLU crop code, for a total of 16.5 million acres (72.8%) of all lands with a proven disturbance history. Within the 22.6 million-acre evaluation area, 1.4 million acres (6.1%) were found to have permanent protection from future conversion. Nearly 1 million acres of the approximately 5.5 million acres of undisturbed land (17.5%) had some type of permanent conservation protection status. In total, we identified 962,734 protected native acres, representing only 4.3% of eastern South Dakota's total land base. We are continuing this work in western South Dakota, which has unique challenges in relation to land use histories. We anticipate the application of SD NRCS LiDAR data will significantly enhance our understanding of the landscape. We will also discuss the applicability of our data for future change analysis that documents loss of native grasslands.

Highlights from the Second South Dakota Breeding Bird Atlas

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A Breeding Bird Atlas is an effort to document as many breeding species as possible with the highest level of certainty using standardized protocols. The first South Dakota Breeding Bird Atlas was conducted from 1988-1992. A second Atlas, conducted from 2008-2012, included resurveying random blocks from the first Atlas, additional sampling blocks, and added techniques to predict occupancy. Repeating the Atlas allows us to assess changes in distributions of breeding birds in light of environmental challenges, such as the loss of native grasslands and CRP acreage, continued energy

development, and urbanization. This presentation will focus on methodology and results of the second Atlas and comparisons with results of the first Atlas. Atlasers made more than 2,500 visits and spent more than 7,500 hours surveying Atlas blocks. More than 250 species were recorded at least once; 95% of these (239) were confirmed as breeding species. Mallard was the most frequently reported species. Brown-headed Cowbird, Western Meadowlark, and Mourning Dove were reported from the highest percentage of Atlas blocks. Twenty-eight species were reported from all 66 counties in South Dakota.

Breeding Biology of Northern Saw-whet Owls (*Aegolius acadicus*) in Northwestern South Dakota

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Northern Saw-whet Owls (*Aegolius acadicus*) have bred in nest boxes erected in Custer National Forest, Harding County, South Dakota since 2003. During these 11 years, we monitored box occupancy and recorded reproductive success of 211 nesting attempts, which produced 772 fledglings. Means of clutch size (5.1 eggs per full clutch), brood size (4.4 nestlings per nest), and number fledged (3.7 fledglings per nest) on this study area are similar to those reported in other parts of the continent. We discovered the existence of a 4-year breeding cycle, in which there are significantly higher numbers of nest attempts and fledglings produced every 4 years (2007, 2011, 2015), followed by an 'average' year (2003 and 2004, 2008, 2012, 2016), then a very low year (2005, 2009, 2013). This has never before been documented in this species. However, there were no among-year differences in breeding metrics, such as mean clutch size, brood size, or number fledged. Starting in 2012, many of the breeding adults and nestlings were banded, and some of these have been recaptured at other times and places, providing additional new information on these birds. New discoveries include the first documentation in the wild of double-brooding in this species, and two instances of natal philopatry. The long-term data set from the Harding County nest box project offers a unique opportunity to study many questions about saw-whet owl breeding, movements, and survival. Continued nest monitoring and banding will contribute to our understanding of these common, but little-known, owls.

Working Lands Habitat on Saline Soils: New Programs and Partnerships on Marginal Acres

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In 2016, Pheasants Forever was awarded a grant from the South Dakota Conservation Fund, a fund that originated as a recommendation from the South Dakota Governor's Pheasant Habitat Working Group plan from 2014. The project was proposed to enroll saline affected agricultural lands into grass cover that could be utilized annually by both grassland nesting birds and the landowner or renter of the land. The target area for the project was the Upper James River Valley in South Dakota, which includes Beadle, Brown, and Spink Counties, with Spink County being the primary focus. The program has been popular, with nearly all of the funds being contracted within 8 months of the application period opening. Natural Resources Conservation Service estimates that saline and sodic affected soils range in the millions of acres for South Dakota alone. These marginal acres provide tremendous potential for habitat development through working grasslands programs. PF is currently partnering with SD corn growers and NRCS to develop an EQIP initiative to create additional habitat on these fragile sites.

Ungulate Migrations in Wyoming: Incorporating New Science into Wildlife Policy and Management

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The cumulative effect of landscape scale development threatens the integrity of long distance ungulate migrations. The Wyoming Migration Initiative (WMI), in cooperation with the Wyoming Game and Fish Department (Department) and multiple partners, uses data from GPS collared ungulates to map migration corridors. Animals are captured and fitted with GPS collars, and multiple locations are collected daily throughout an annual cycle of migration. With an adequate and representative sample of the population and through the use of Brownian Bridge Movement Models, it is possible to statistically map migration corridors, stopover habitats, and migration bottlenecks. The Wyoming Chapter of The Wildlife Society, WMI, and others helped the Department develop defensible definitions for each of these migration habitats. After an extensive public outreach effort, the Wyoming Game and Fish Commission designated migration corridors, stopover habitat, and bottlenecks as "Vital" in their mitigation policy. This policy directs the Department to work with project proponents on a case-by-case basis, "to recommend no significant declines in species distribution or abundance or loss of habitat function". The Department is working to officially delineate migration habitats so that land management agencies and project proponents can consider these important landscape features in project planning.

Prevalence of *Yersinia pestis* from Small Mammal Fleas in Lower Brule, SD: Comparisons to Host Blood using Lateral Flow Tests for the Presence of F1 Antibodies

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Small mammals are considered to be one potential reservoir of sylvatic plague in prairie systems. Small mammal fleas have been shown to be carriers of *Yersinia pestis*, with some flea species being capable of transmitting the pathogen, although some fleas are better able to transmit the pathogen than others. Seroconversion in small mammals is an important indicator of the likelihood of plague transmission, as a lack of seroconversion indicates low bacterial loads and low transmission potential. In systems with enzootic plague, the absence of seroconversion in small mammals would indicate that small mammal fleas might serve as reservoirs for *Y. pestis*. High levels of seroconversion are necessary for flea-borne transmission from mammal to mammal due to the small blood meals taken by fleas. The lack of seroconversion and small bacterial loads would make bacterial acquisition unlikely, unless another mechanism exists which would enhance bacterial uptake by fleas. In this study, we estimated the prevalence of infection from both fleas and small mammals. Testing was two-fold: 1) fleas were tested via conventional PCR utilizing a nested approach targeting the *PLA* gene, and 2) small mammal blood was tested using *Yersinia pestis* (F1) Smart™ II lateral flow tests targeting the F1 polyclonal antibody. All fleas and blood tested came from small mammals live trapped and released in Lower Brule, SD from 2014-2016. Preliminary results show 1.6 % of fleas tested to date were positive for *Y. pestis* presence. This study compares prevalence of *Y. pestis* from fleas and small mammals in the shortgrass prairie ecosystem. We explore the role of both fleas and small mammal hosts as reservoirs of sylvatic plague in our study foci, and any potentially ecologically important connections between fleas and their small mammal hosts with respect to plague transmission.

Distribution and Habitat Selection of Swift Fox (*Vulpes velox)* in the Northern Great Plains

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The swift fox (*Vulpes velox*), a native species once abundant throughout the Northern Great Plains (NGP), has declined due to changes in land use and historic predator eradication programs. Currently, the species is estimated to occupy 44% of its historic range. Swift foxes are considered a rare species in North Dakota and are listed as State Threatened in South Dakota. However, knowledge of the current status of swift foxes in the NGP is lacking due to an absence of systematic population monitoring. There have been occasional reported sightings of swift foxes in northwest South Dakota and southwest North Dakota; however, the population is thought to be small. The purpose of our study was to evaluate the status of swift fox populations in the Dakotas and identify existing habitats suitable to swift fox. We conducted a systematic camera trap survey to assess occupancy and distribution of swift fox. Most of this study was performed on private property, with over 90% of the trail camera locations being on privately owned, grazed pastures. Using the results of the survey, we identified 15 family groups. Using camera trap detections and anecdotal sightings, we live trapped 25 swift foxes and fitted 20 foxes with radio-collars. We tracked collared swift foxes and located den sites and assessed den site habitat selection. This analysis will improve understanding of the current population size and habitat selection of swift foxes in the Dakotas.

The Hazards of Disease: Strain-Specific Consequences of *Mycoplasma ovipneumoniae* Bighorn Sheep Epidemics

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Bighorn sheep (*Ovis canadensis*) managers continually face dynamic challenges associated with population-limiting bronchopneumonia epizootics transmitted by domestic Caprinae. Although the etiology of pneumonia is not completely understood, we consider *Mycoplasma ovipneumoniae* (*M. ovi*) to be a primary pathogen responsible for bighorn sheep respiratory disease. Individuals recovered from initial *M. ovi* disease outbreaks become carriers of the *M. ovi* strain type encountered, and these strains are usually unique in independent outbreaks. Our objectives are to present information resulting from *M. ovi* strain cross-transmission in captive bighorn sheep. Unique *M. ovi* strains detected were 393 (Black Butte herd), 398 (Badlands and Rapid Creek herds), 400 (Snowstorm herd), and 404 (Asotin, Lostine, and Sheep Mountain herds). By July 2015, a *M. ovi* 400 strain spread across all populations within the South Dakota State University Captive Wildlife Research Facility. Serial samples were collected every 4-6 weeks, and we documented exposure to the 400 *M. ovi* strain. Of these, 84% of sheep, at some point, actively shed 400 strain bacteria, which contributed to >35% all-age-adult mortality. Within our herd, we compared pneumonia-related lamb mortality prior to the spread of the 400 strain (2014) versus mortality post 400 strain spread (2015). Mortality increased nearly two-fold after the spread of the pathogen, with rates of 40% and 81%, respectively. To examine infection rates among populations, we estimated apparent *M. ovi* prevalence, which ranged from 0.19 to 0.83. We used event-time analyses to retrospectively model lamb and adult survival and determine force-of-

infection of the 400 strain, and examined factors influencing the virulence of *M. ovi* strain types. By effectively modeling the response of populations to a novel *M. ovi* strain challenge, we aim to provide insight into the management of *M. ovi* cross-strain transmissions within and among wild bighorn sheep populations.

Brood Rearing Resource Selection of Greater Sage-Grouse on the Eastern Fringe of their Range

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Greater Sage-Grouse (*Centrocercus urophasianus*) are a species of conservation concern throughout the Intermountain West, and have been nominated for listing under provisions of the U.S. Endangered Species Act eight times. Consequently, numerous studies have documented drivers of demographic performance at the core of their distribution; however, relatively few studies have examined sage-grouse inhabiting the eastern extent of their range in South Dakota. Identifying sage-grouse resource selection during the critical brood rearing period can enhance management of the species and their habitat. In the spring of 2016, we monitored 27 radio-collared female sage-grouse. We detected 20 nests, 7 of which successfully hatched. We located broods 2 times per week for the first 4 weeks following hatch. We indexed vegetation structure using Daubenmire frames and Robel poles, and collected arthropods via pitfall trapping and sweep netting weekly at used sites, as well as two paired random sites within 1.55 km of each used site. This resulted in a total of 21 use sites and 42 paired random sites being sampled. Arthropods were grouped into the following orders to be counted and weighed; Coleoptera, Orthoptera, and Hymenoptera, and "others". Vegetation was compared among brood use sites and random sites using a MANOVA test. Brood sites were significantly different from random sites ($p=0.034$), specifically, differing in Robel readings ($p=0.0004$) and grass height ($p=0.0002$). We used a Wilcoxon rank sum test and MANOVA to determine if arthropod count and mass differed between brood sites and random sites. The only significant variable between used and random sites was the number of "other" arthropods collected ($p=0.052$). Understanding sage-grouse resource selection during the brood rearing period may help us assess current agricultural and other land management practices, while mitigating anthropogenic land modification.

Evaluation of Gamebird Production in Roundup© Ready Alfalfa used for Seedbed Preparation during Perennial Grassland Conversion on State Game Production Areas in Eastern South Dakota

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The Prairie Pothole Region provides migratory and breeding habitats for 50-80% of waterfowl in the United States. Increased agricultural production and declining Conservation Reserve Program reenrollment in the Midwest has resulted in declines in grassland habitats on private land, which supports the need for investigating and identifying effective management strategies to maximize available grassland nesting habitat on public lands. South Dakota Game, Fish and Parks manages over 119,000 hectares of Game Production Areas (GPA) of primarily grassland habitat. To improve the quality and availability of grassland nesting habitat, marginal grassland and cropland cover are cleared and

reseeded to perennial grass and forb mixes. Current management techniques for perennial grassland conversion use genetically modified planted row crops and herbicide treatment to remove noxious weeds and enrich the seedbed prior to reseeding. Although this technique is effective, planted row crops provide poor nesting cover. To evaluate other management techniques, we examined the use of Roundup Ready© alfalfa (*Medicao sative*) for preparing seedbeds for perennial grassland conversion. Previous research with alfalfa has indicated haying, which typically occurs during the peak nesting period, hinders nest productivity. Therefore, we investigated the influence of delaying the first cutting date (July 10) on waterfowl production by systematically nest dragging alfalfa and other typical grassland plantings. During 2015 and 2016, the density of successful nests in Roundup Ready© alfalfa ($\bar{x}$ =0.174, SE=0.05) was comparable to smooth brome (*Bromus inermis)* dominated stands ($\bar{x}$ =0.178, SE=0.05) and higher than cool season mix ($\bar{x}$=0.157, SE=0.04) and warm season mix ($\bar{x}$=0.104, SE=0.02). Nest survival in Roundup Ready© alfalfa (52%, SE=1.38) was lower than in the warm season mix (63%, SE=4.81) but higher than observed in other grassland types (cool season mix [41%, SE=0.54], smooth brome dominated stands [29%, SE=1.32]). Nest initiation dates in 2015 and 2016 were found to vary among field types. During 2015, the average nest initiation date in Roundup Ready© alfalfa ($\bar{x}$=161, SE=4.15) was upwards of 30 days earlier than other field types. Despite this delay in nest initiation, only 8% (*n*=3) of nests in Roundup Ready© alfalfa were destroyed by haying of the field. An analysis of vegetation height, density, and litter depth measured at the nest site, paired random, and stand level sites revealed considerable inter-field heterogeneity. Further analysis will examine the relative influence of vegetation characteristics on nest site selection among field types. The results of our study will provide land managers with information to maximize the quality and availability of waterfowl nesting habitat on GPAs.

Effects of Neonicotinoid Insecticides on Physiology and Reproductive Characteristics of Captive Adult Female and Fawn White-tailed Deer

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Over the past decade, morphological and developmental abnormalities were documented in elk (*Cervus canadensis*) and white-tailed deer (*Odocoileus virginianus*) in west-central Montana. Hypotheses concerning these anomalies include contact with endocrine disrupting pesticides. Insecticides potentially involved with abnormalities include the neonicotinoids, which are a class of neuroactive insecticides developed in the 1990s. In the United States, neonicotinoids are predominantly used as seed dressings but can also be used as foliar sprays on horticultural crops and direct applications to soil and water, making use widespread. The captive animal facility at South Dakota State University provides a unique opportunity to mimic neonicotinoid concentrations found in wetlands in the region within a controlled experimental framework, and assess whether abnormalities occurred among adult female white-tailed deer that consumed the insecticide-treated water. Our objectives were to 1) test function of thyroid hormones in adult females exposed to Imidacloprid to determine physiological responses of insecticide exposure via consumption of treated water, 2) determine Imidacloprid concentrations in milk of lactating females, and 3) compare jaw and genital characteristics of fawns (0-6 months) born to females exposed to the neonicotinoid, Imidacloprid. Twenty does were bred during 2015 and 2016. We randomly assigned females to 3 treatments (low 1,500ng/L, medium 3,000ng/L, and high 15,000ng/L) and a control. We collected behavioral observations, body masses, milk, blood, and tissue samples from females and fawns. We assayed milk, blood, and tissue samples for concentrations

of Imidacloprid using ELISA testing. We also analyzed blood samples (serum and whole blood tubes) for thyroid stimulating hormone (TSH), triiodothyronine (FT3), and thyroxine (FT4) in electrochemiluminescence immunoassays to assess thyroid function. We will present results relative to concentrations in samples obtained from free-ranging deer.

Characteristics of Successful Puma Kill Sites of Elk in the Black Hills, South Dakota

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Elk (*Cervus canadensis nelsoni*) in our study area within the Black Hills of South Dakota have been declining since 2006, and there is concern by resource managers and hunters that puma (*Puma concolor*) predation may be contributing to declining herds. We evaluated characteristics at sites where puma successfully killed elk in the Black Hills of South Dakota. We evaluated characteristics at coarse (79 ha plots) and fine (0.2 ha plot) scales across the landscape. Our primary objective was to obtain a better understanding of vegetation and terrain characteristics that may have facilitated greater susceptibility of elk to predation by puma. We evaluated effects of road density, terrain heterogeneity, probability of elk use, and vegetation variables at 62 puma kill sites of elk and 186 random sites to identify key landscape attributes where elk were killed by puma. Elk were killed by puma in high use areas. Elk were also killed in areas that had greater amounts of edge and intermediate ruggedness at the coarse scale. Further, elk were killed in areas with greater small tree density and woody debris at the fine scale. High germination rates of ponderosa pine trees are unique to the Black Hills and provide dense patches of cover for puma. We hypothesize that cover from small trees and woody debris provided conditions where puma could stalk elk in areas with optimal security cover for elk. We suggest managers implement vegetation management practices that reduce small tree density and woody debris in areas with greater density of meadow-forest edge if they are interested in potentially diminishing hiding cover for puma in elk high use areas.
