PRONGHORN 2016

27th Biennial Western States and Provinces

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August 29 – September 1, 2016

Fairmont Hot Springs, Montana

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Schedule At-a-Glance

Monday, August 29

4:00 – 6:00 PM	Registration, Exhibitor Set-Up and Check-In
5:00 – 8:00	Welcoming Reception (Refreshments and appetizers included in registration)

Tuesday, August 30

7:00 – 8:00 AM	Breakfast (included in registration) Registration, Exhibitor Set-Up and check-In
8:00 – 8:25	Welcoming Comments, Housekeeping
8:25 – 10:40	Plenary Session: Fencing: A Tool or Obstacle for Managing & Conserving Wildlife?
10:40 – 11:00	Break
11:00 – 12:00 PM	Presentations (Session 1)
12:00 – 1:00	Lunch (Included in registration)
1:00 – 3:00	Presentations (Session 2)
3:00 – 3:20	Break
3:20 – 5:00	Presentations (Session 3)
5:00 – 5:30	Poster Session
6:00 – 9:00	Dinner (Included in registration)

Wednesday, August 31

7:00 – 8:30 AM	Breakfast (Included in registration)
8:30 – 4:30 PM	Field Trip (Lunch included in registration)
6:00 – 9:00	Banquet & Awards Ceremony (Included in registration) Featured speaker: Matt Kauffman, Director of the Wyoming Migration Initiative “Research and Conservation of Wyoming's Big Game Migrations”

Thursday, September 1

7:00 – 8:20 AM	Breakfast (Included in registration), Business Meeting
8:20 – 10:20	Presentations (Session 4)
10:20 – 10:40	Break
10:40 – 11:20 PM	State & Province Status Updates
12:00 – 1:00	Lunch (On your own)

Detailed Schedule

Monday, August 29

Start Time	End Time	
16:00	18:00	Registration, Exhibitor Set-up and Check-in
17:00	20:00	Welcoming Reception (Refreshments and appetizers included in registration)

Tuesday, August 30

Start Time	End Time	
7:00	8:00	**Breakfast (Included with registration), Exhibitor Set-Up, and Check-In**
8:00	8:25	**Welcoming comments, Lieutenant Governor Mike Cooney**
		Plenary Session: Fencing: A tool or obstacle for managing and conserving wildlife?
		Moderator: Andrew Jakes, University of Montana
8:25	8:40	Rob Ament- Effectiveness of mitigation measures to reduce the impacts of transportation on wildlife movement and mortality
8:40	8:55	Renee Seidler- Fencing: A tool or obstacle for managing & conserving wildlife?
8:55	9:10	Glen Dickens- Arizona Game & Fish Department & Arizona Antelope Foundation connectivity projects & results
9:10	9:25	Abel Guevara- Utilizing research to manage resources on public lands
9:25	9:40	Paul Jones- Prairie fences: reason to be concerned or just part of the landscape?
9:40	9:55	Christine Paige- Making it happen: outreach and partnerships for wildlife friendly fences
9:55	10:40	Group Discussion - Audience and Panel
10:40	11:00	**BREAK**
		Contributed Presentations Session 1- Fences
		Moderator: Melissa Foster, Montana Fish, Wildlife & Parks
11:00	11:20	Paul Jones- Evaluating the use of modified fence sites by pronghorn in the Northern Sagebrush Steppe
11:20	11:40	Whitney Gann- Fence crossing of translocated pronghorn in the Trans-Pecos, Texas
11:40	12:00	Emily Burkholder- To jump or not to jump: mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) crossing decisions
12:00	13:00	**LUNCH**

		Contributed Presentations Session 2- Population dynamics and management
		Moderator: Adam Grove, Montana Fish, Wildlife & Parks
13:00	13:20	Ryan O'Shaughnessy- Does birth synchrony influence fawn survival of pronghorn in the Trans-Pecos region of Texas?
13:20	13:40	Brett Panting- Environmental constraints on pronghorn neonate survival across Idaho
13:40	14:00	Emily Conant- Assessing translocated pronghorn adult and fawn survival in New Mexico
14:00	14:20	Shawn Gray- Post-release survival of translocated pronghorn on the Marfa Plateau, Texas
14:20	14:40	Justin Paugh- Creation and evaluation of trend areas that predict pronghorn populations to guide management actions
14:40	15:00	Caroline Ward- Evaluation of aerial population estimation techniques for pronghorn antelope in Texas
15:00	15:20	**BREAK**
		Contributed Presentations Session 3: Habitat delineation and conservation
		Moderator: Brad Schmitz Montana Fish, Wildlife & Parks
15:20	15:40	Scott Bergen- Determinants of pronghorn antelope seasonal range and migration in the Upper Snake River Plain, Idaho
15:40	16:00	Andrew Jakes- Factors influencing seasonal migrations of pronghorn across the Northern Sagebrush Steppe
16:00	16:20	Joseph Smith- Reducing cropland conversion risk to sage-grouse through strategic conservation of working rangelands
16:20	16:40	Catherine Wightman- Montana's grassland conservation strategy
16:40	17:00	Glen Dickens- Arizona Antelope Foundation southeastern Arizona grasslands pronghorn initiative
17:00	17:30	**Poster Session**
18:00	21:00	**Dinner (included with registration)**

<u>Wednesday, August 31</u>

Start Time	End Time	
7:00	8:30	**Breakfast (included with registration)**
8:30	16:30	**Field Trip (lunch included with registration)**
18:00	21:00	**Banquet & Awards Ceremony (included with registration)**
		Banquet MC: Julie Cunningham, Montana Fish, Wildlife & Parks

		Featured Speaker:
		Matt Kauffman- Research and Conservation of Wyoming's Big Game Migrations

Thursday, September 1

Start Time	End Time	
7:00	8:20	**Breakfast (included with registration), State & Provincial Business Meeting**
		Contributed Presentations Session 4: Population dynamics and management *Moderator: Sonja Andersen, Montana Fish, Wildlife & Parks*
8:20	8:40	Keri Carson- Hemorrhagic disease in Montana pronghorn
8:40	9:00	Mark Hebblewhite (Dan Eacker)- Impacts of severe winter weather on pronghorn survival in partially migratory populations
9:00	9:20	Adele Reinking- Survival of pronghorn in Wyoming's Red Desert: the influence of intrinsic factors and environmental and anthropogenic change
9:20	9:40	James Hoskins- Finding new ways to manage pronghorn populations in the Texas panhandle- update
9:40	10:00	Philip Boyd- Modeling translocation strategies for pronghorn populations in the Trans-Pecos, Texas
10:00	10:20	Jay Gedir- Predicting long-term pronghorn population dynamics in the southwest in response to climate change
10:20	10:40	**BREAK**
		State & Province status updates
10:40	11:20	John Vore, Montana Fish, Wildlife & Parks - Overview of pronghorn status in the Western States and Provinces
		Lunch on your own

Abstracts: Plenary Session

EFFECTIVENESS OF MITIGATION MEASURES TO REDUCE THE IMPACTS OF TRANSPORTATION ON WILDLIFE MOVEMENT AND MORTALITY

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Abstract: An overview of different highway measures that have been developed to reduce collisions with large wildlife (primarily ungulates) on roads will be presented, many which also improve habitat connectivity for all types of species. Those measures most appropriate to mitigate roads for pronghorn will be emphasized. The mitigation measures reviewed can be described to use three general strategies: change wildlife behavior, change driver behavior, separate wildlife from traffic. Many of these measures are ineffective, others are still poorly understood, while some are quite effective. Some of the proven solutions such as wildlife underpasses or overpasses with fencing, and electronic systems that automatically detect wildlife nearby and warn drivers, again using fencing, have been shown to reduce wildlife-vehicle collisions by 80 to over 90%. A look at some pronghorn specific research related to road crossings will be described. Despite their initial construction costs, wildlife crossings using infrastructure and fences have been shown to pay for themselves over their lifetime when installed on road segments with moderate to high wildlife-vehicle collision rates. A review of highway rights-of-way fencing will also be discussed.

ARIZONA GAME & FISH DEPARTMENT & ARIZONA ANTELOPE FOUNDATION PRONGHORN CONNECTIVITY PROJECTS & RESULTS

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Abstract: Established in 1992, the Arizona Antelope Foundation is an organization dedicated to the welfare of pronghorn antelope. The Foundation's Mission is to actively seek to increase pronghorn populations in Arizona through habitat improvements, habitat acquisition, the translocation of animals to historic range, and public comment on activities affecting pronghorn

and their habitat. Our bylaws require that we conduct at least 4-work projects per year. In the past 5 years we have conducted 20 such projects all focused specifically on achieving landscape level changes in connectivity for two specific pronghorn populations through fence removals and modifications. One supporting the *AZ Game and Fish Departments North of Interstate 10 Pronghorn Connectivity Project* and the second in support of our own National Fish and Wildlife Foundation grant funded *Southeastern AZ Pronghorn Initiative*. Results will be presented and have been highly effective and measurable in both project areas. In addition, we will outline our newest 5-year connectivity project the *Big Lake Pronghorn Herd Initiative* in response to two years of collar data and seasonal migration corridor definition.

UTILIZING RESEARCH TO MANAGE RESOURCES ON PUBLIC LANDS

ABEL GUEVARA, Wildlife Biologist, Bureau of Land Management – Glasgow Field Office, 5 Laser Drive, Glasgow, MT 59230, 406-228-3750, aguevara@blm.gov

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The Bureau of Land Management (BLM) Glasgow Field Office, located in northeast Montana, manages over 1 million acres of public lands. The Field Office has supported several university research projects in the last 10 years and is utilizing research conducted by Andrew Jakes on Pronghorn antelope (*Antilocapra americana*) to develop management strategies that accommodate migrating pronghorn. BLM has focused fence modification efforts on migration corridors identified by this research. The agency has completed 20 miles of fence removal or modification over the last three years. Land management agencies should strive to utilize research that provides direct management strategies and research should strive to provide management applications.

PRAIRIE FENCES: REASON TO BE CONCERNED OR JUST A PART OF THE LANDSCAPE?

PAUL JONES, Alberta Conservation Association, #400 817-4th Avenue South, Lethbridge, AB, Canada T1J 0P3, 403-382-4357, paul.jones@ab-conservation.com

Abstract: Fences are common place on the prairies of America and have been around since European settlement. Depending on the purpose or function of a fence, or the species of interest, fences can be viewed as either obstacles or tools to conserving wildlife. Most fences are viewed in a negative light due to their impacts on wildlife; direct source of mortality, movement barriers leading to habitat loss and fragmentation, or indirect mortality (hair loss, wounds, etc.). But there are cases where fences are used strategically to manage wildlife by directing their movements. There are also cases where wildlife use fences strategically for their benefit. Therefore, are species adaptable enough that managers need not worry about the impacts of fences on wildlife or should managers be concerned? So far one could argue that managers are leaning on the side of species adaptability, but is this the right side of the fence to be on when managing wildlife? I will present a technical overview of the interaction of fences and wildlife, with a focus on pronghorn, and provide rational as to why managers need to concentrate efforts on managing fences for the benefit of wildlife that also accounts for the needs of society.

MAKING IT HAPPEN: OUTREACH AND PARTNERSHIPS FOR WILDLIFE FRIENDLY FENCES

CHRISTINE PAIGE, Wildlife Biologist & Science Writer, Ravenworks Ecology, 962 Dusty Trail Rd, Driggs ID 83422, 406-544-6143, chrispaige@gmail.com

Abstract: Dismayed and inspired by watching a small herd of pronghorn trapped in a ranch road right-of-way by two impassable fences, I researched and wrote the first Landowner's Guide to Fences and Wildlife for Montana Fish, Wildlife and Parks. This and a subsequent version written for the state of Wyoming, present a host of fence ideas and solutions to create easier passage for wildlife, made user-friendly for landowners and land managers. The booklets went viral and have been adopted by agencies and conservation organizations throughout the western US and internationally. Partnerships are key to successful projects: funding, materials and volunteer labor from agencies and private groups help landowners adapt their fencing for wildlife. A couple of examples include the Jackson Hole Wildlife Foundation volunteer fencing team and Green River Valley Land Trust's initiative to modify fences in the Path of the Pronghorn.

FENCING: A TOOL OR OBSTACLE FOR MANAGING & CONSERVING WILDLIFE?

RENEE SEIDLER, Associate Conservation Scientist, Wildlife Conservation Society, Teton Valley, Idaho, (435) 760-7267, rseidler@wcs.org,

Abstract: Linear impediments on the landscape create an inordinate challenge for pronghorn since pronghorn did not evolve to navigate vertical obstacles. In their native environment on the prairies and plains of western North America, pronghorn evolved speed in a horizontal landscape to evade predators and they have not adapted as readily to fences, roads and traffic as other ungulates. Not only can linear impediments restrict movement, but they can also lead to risk-avoidance behaviors similar to those observed in response to predators, which may lead to reduced vigor of local pronghorn populations. We have found that high road densities, natural gas development, fences and crossing structures (the latter built as a management tool to benefit pronghorn) can change pronghorn movement patterns, reduce utilization of high-quality forage, decrease the success of crossing impediments and increase vigilance. While most linear structures were not built with wildlife needs in mind, more recently some have been built wholly with protection and conservation of wildlife and human safety in mind. Outside of Pinedale, Wyoming, a wildlife highway mitigation project built 6 underpasses, 2

overpasses and 20 kilometers of exclusionary fencing to provide safe wildlife crossings over US Highway 191. This setting created a perfect opportunity to evaluate how pronghorn react to construction, crossing structures and impermeable fencing along a 6,000-year-old migration path. While the goal of this mitigation was to reduce wildlife-vehicle collisions and increase permeability of the landscape for wildlife, novel structures in a migratory path may increase wildlife stress-levels or even truncate migrations. We found evidence of risk-avoidance behaviors in pronghorn at this mitigation site; however, we also detected evidence that pronghorn gradually acclimate to wildlife crossing structures. At the conclusion of the study, pronghorn still exhibited higher levels of vigilance when approaching the structures, but successful use of the overpass had increased. Some issues with the mitigation project that could have led to heightened stress include the sequence of project construction, the installation of fencing at the entrance and exit of the overpass and the continued presence of cattle fences near the crossing structures.

Abstract: Banquet Presentation

RESEARCH AND CONSERVATION OF WYOMING'S BIG GAME MIGRATIONS

MATTHEW KAUFFMAN, Director, Wyoming Migration Initiative, U.S. Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, University of Wyoming Laramie, WY 82071, 307-766-6404, mkauffm1@uwyo.edu

Abstract: Wyoming harbors vast, open landscapes still capable of supporting long-distance ungulate migrations. Recent research at the University of Wyoming has advanced our understanding of why animals make these migrations and how they are changing due to development. This talk will describe various big game migrations in Wyoming and discuss new findings that are helping researchers understand how and why animals migrate. The talk will also describe research indicating how the responses of migrating ungulates to disturbance, from energy and housing development, hold the potential to diminish the benefits of migration and lead to its loss across impacted landscapes. Because of these threats, the Wyoming Migration Initiative was founded in 2012 with a goal of creating new conservation tools that can facilitate the work of agencies and NGOs to make these journeys easier for migrating ungulates.

Abstracts: Presented Papers

DETERMINANTS OF PRONGHORN ANTELOPE SEASONAL RANGE AND MIGRATION IN THE UPPER SNAKE RIVER PLAIN, IDAHO.

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Abstract: Pronghorn antelope can have diverse behaviors in relation to their seasonal movement ranges and/or migration patterns. Pronghorn of the Upper Snake River Plain have a diversity of seasonal range and movement patterns that are predominantly migratory but also contain small populations and individuals that are non-migratory (residential). Using net-squared displacement procedures (NSD), seasonal ranges and migrations are estimated and characterized from GPS collar data deployed between 2003 and 2015 on does across the study region. Individual pronghorn does' seasonal movement patterns were estimated from the location data where they were characterized as seasonally migratory or residential. From these classifications of individual movement patterns, we can determine differences between migratory and residential individuals in their winter and summer ranges across a spectrum of environmental covariates known to effect pronghorn habitat suitability (i.e., snow depth, vegetation type, elevation, NDVI, paved road density, etc.). For those individuals that have a migratory behavior, we perform a case-controlled resource selection function modeling exercise to examine the covariates that determine location selection during the spring and fall migrations. These findings will then be used to evaluate different survey times and techniques for the purposes of providing pronghorn managers population estimates.

MODELING TRANSLOCATION STRATEGIES FOR PRONGHORN POPULATIONS IN THE TRANS-PECOS, TEXAS

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SHAWN S. GRAY, Texas Parks and Wildlife Department, 109 South Cockrell, Alpine, TX 79830, (432) 837-0666, shawn.gray@tpwd.texas.gov

Abstract: In 2011, the Borderlands Research Institute and Texas Park and Wildlife Department (TPWD) began an effort to boost populations of pronghorn (*Antilocapra americana*) in the Trans-Pecos region of Texas. Restoration efforts focused on translocating groups of pronghorn from the Texas Panhandle. Pronghorn are endemic to North America. Archaeological records, Native American paintings, and testimony of European settlers place large herds of pronghorn in the Trans-Pecos for millennia. The influx of human settlement to the Trans-Pecos, beginning in in the late 1800s, saw fluctuations in the regional pronghorn populations due to habitat fragmentation, overhunting, change in land-use practices, and drought. Since 1978, TPWD has collected population estimate data using aerial line transect surveys in the Trans-Pecos. A decrease from >17,000 pronghorn in the 1980s to a low of <4,000 in 2011 led to the initiation of translocation efforts. Ecological modeling is a tool that has been utilized in population viability analysis to evaluate the potential impacts of various management scenarios. Habitat fragmentation in the Trans-Pecos has caused multiple metapopulation arrangements which TPWD manage as unique herd units. We sought to evaluate potential for each herd unit to serve as a source or sink population. We used 30 years of aerial population estimates, fawn production, and survival data from recent studies on pronghorn in the Trans-Pecos to develop a simulation model. We also used various demographic and translocation timing combinations to determine projected long-term success of translocation on population viability.

TO JUMP OR NOT TO JUMP: MULE DEER (*ODOCOILEUS HEMIONUS*) AND WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) CROSSING DECISIONS

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Abstract: Mule deer (*Odocoileus hemionus*) and white-tailed deer (*O. virginianus*) negotiate barbed-wire fences by either jumping over or crawling under fencing. We examined crossing success and decisions of these two species to determine factors that influence crossing success and the impending decision to jump over or crawl underneath fencing. Using a Before-After-Control-Impact design, we deployed remote cameras along fence lines in three study areas across South-eastern Alberta and North-central Montana. Using logistic regression, we modelled the probability of deer successfully crossing and the decision between crawling under versus jumping over fencing based on demographic, environmental, and fence variables. Overall, 165 of 329 successful crossings (50%) occurred by crawling under fencing. Males were less successful (*P*=<0.01) and crossed under less (*P*=<0.01) than females. White-tailed deer crossed more successfully (*P*=0.046) but under less than mule deer (*P*=<0.01). In relation to spring, deer were more likely to cross successfully and under during the fall (*P*=<0.01, *P*=0.012) and summer (*P*=0.022, *P*=<0.001). Deer were also more successful at crossing during the winter(*P*=<0.001), but by jumping over (*P*=0.75). Bottom wire heights positively influenced crossing success (*P*=<0.01) and crossing underneath (*P*=<0.01). Calculated odds ratios showed that clip enhancements had the highest crossing success rate (94%) and were the most-used enhancement type. Goat bars were the least successful (17%) and least-used enhancement type. When applying wildlife-friendly fencing strategies, we recommend increased opportunities for deer to cross under fencing by using clips to raise the bottom wire, and suggest goat bars may act as a crossing deterrent.

HEMORRHAGIC DISEASE IN MONTANA PRONGHORN

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***Abstract**:* Bluetongue virus and epizootic hemorrhagic disease have been documented in Montana for decades. Recently the range of these hemorrhagic diseases has expanded into the western part of the state. Montana has experienced localized and variable population declines in wild cervids as well as pronghorn when these outbreaks occur. In 2007, the United States experienced one of the largest hemorrhagic disease outbreaks with an estimated 60,000 deer mortalities. Much of eastern and central Montana saw marked declines in pronghorn populations that year, followed by subsequent reductions in recruitment. During the fall of 2010, Montana Fish, Wildlife and Parks distributed sample collection kits to pronghorn hunters in two hunting districts: HD 513, which declined during the 2007 outbreak, and HD 510, which remained stable over the same period. The goal was to collect serum and fecal samples to assess exposure to a variety of diseases and parasites that could provide insight into the overall health of pronghorn herds occupying these areas. Five of 88 animals in our sampling efforts were positive for exposure to hemorrhagic disease (2% in HD 510 and 9% in HD 513). Since 2007, the population in HD 513 has continued to experience depressed recruitment and consistently low total counts, whereas HD 510 has remained stable. Little is known about the long-term effects of hemorrhagic diseases, but here we present hypotheses for the continued depression of HD 513's population post-outbreak.

ASSESSING TRANSLOCATED PRONGHORN ADULT AND FAWN SURVIVAL IN NEW MEXICO

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***Abstract*:** Translocations have been a common component of pronghorn management across the western United States to augment declining, or reestablish extirpated, populations. However, in most cases, post-translocation monitoring has either been minimal or non-existent. In 2013, New Mexico Department of Game and Fish entered into an agreement with a ranch located east of Cimarron to reduce winter crop depredation by pronghorn while simultaneously translocating those captured individuals to supplement declining populations in southeast New Mexico. We monitored and assessed the success of adult pronghorn translocation as a management tool in New Mexico for translocations occurring in 2013 and 2014. Low fawn:doe ratios were observed in 2013 (6:100), resulting in a closer examination of fawn survival from translocated does in 2014 and 2015. A total of 144 adults were translocated to Fort Stanton over two years (61 male and 83 female). Adult survival was estimated for both year of translocation (2013 and 2014) as well as year post-translocation (2013 animals in 2014). Adult survival was high in both year of translocation (0.68 ± 0.08 in 2013 and 0.91± 0.06) and year post-translocation (0.95 ± 0.05). Twenty-nine fawns were captured in 2014 and 31 fawns in 2015. Fawn survival for 2014 was 0.01 (± 0.1) and 0.04 (± 0.3) for 2015. High adult survival indicates translocation success at the site. However, poor fawn survival in both years suggests future efforts should focus upon identifying and remedying potential limiting factors negatively impacting fawn survival in this localized population.

PRONGHORN HABITAT TYPE CONVERSION FROM SHRUBLAND TO GRASSLAND IN NEVADA

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Abstract: Pronghorn in Nevada predominately occupy the Great Basin biome, historically a shrub-steppe dominated landscape. Historic records from the late 1880s suggest pronghorn

were present in regions of Nevada but not widespread or highly abundant in any one area. Since the late 1990s, massive and numerous wildfires have converted sagebrush-dominated pronghorn habitats into grasslands. We initiated a study to evaluate pronghorn population growth and expansion of occupied habitat with and without wildfire impacts since the 1980s. Other landscape-scale perturbations that have occurred include invasive plants, climate change, the introduction of immigrant forage kochia *(Kochia prostrata*) and domestic and feral livestock grazing. Multivariate analysis tools will be used to evaluate the relative contribution of each perturbation and other factors to the pronghorn herd response variables. We will analyze the predictor variables: wildfire acres burned, fire intensity, elevation and date of fire, post-fire restoration efforts, changes in livestock grazing, spring/summer moisture, winter temperatures, snow depth, forage species, diet selection, vegetative structure, water developments, and translocations. Pronghorn herds in 7 management areas with <3% of their current occupied habitat (10,650 sq. miles, predominately sagebrush) burned by wildfires since 1990 showed a 29% decline in population estimates from 1990 to 2016. Conversely, 7 management areas with 16 – 58% of their occupied pronghorn habitat (17,030 sq. miles, predominately sagebrush) burned since 1990 responded with a 600% population increase (1,300 to 8,900) over the same time frame. Predictor variables will be added to the analyses to assess their influence and interaction with pronghorn herd response to wildfire

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ARIZONA ANTELOPE FOUNDATION SOUTHEASTERN ARIZONA GRASSLANDS PRONGHORN INITIATIVE

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Abstract: In 2011, 2013, and 2014, the Arizona Antelope Foundation (AAF) secured three different Sky Islands Initiative-National Fish and Wildlife Foundation (NFWF) grants totaling $510,000 to support the AAF's 10-year Southeastern Arizona Grasslands Pronghorn Initiative, initiated in April 2010. Matching non-federal contributions valued at $800,000 include: AAF and private land owner project labor and materials; Pima County Sonoran Conservation Plan land acquisition funds, and Arizona Game and Fish Big Game Tag Habitat Partnership Funds.

The "Southeast Arizona Collaborative Grassland Workgroup", created in February 2010, collaboratively drafted a southeastern Arizona Regional Pronghorn Strategy to increase pronghorn population numbers, their distribution, and habitat connectiveness. Partners in this working group include: AAF, AZGFD, BLM, USFS, SLD, USDA, USFWS, NRCS, Pima County, Arizona Wildlife Federation, AZ Land Trust, Audubon Society, Tombstone High school, and local ranchers/landowners. Long-term goals for this 7-year grant period 2011-18 are to 1) establish a region-wide dynamic geodatabase with integrated multi-species layers to prioritize grasslands restoration/maintenance activities for pronghorn and other sensitive grassland species, 2) permanently record pronghorn travel corridors and remove or modify barriers, including fences, shrubs and trees, 3) target/plan grassland treatments/burns in priority habitat locations on an annual and long-term basis to benefit the highest number of keystone grassland species, 4) supplement at least one pronghorn population and increase numbers in two subpopulations, and 5) improve grassland habitat in five pronghorn subpopulation zones. We discuss the projects measureable progress to date regarding acres of grassland restoration, connectivity acres through fence modifications, predator removal and population supplements and increases.

FENCE CROSSING OF TRANSLOCATED PRONGHORN IN THE TRANS-PECOS, TEXAS

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Abstract: Translocations have been an important tool in improving and sustaining pronghorn antelope (*Antilocapra americana*) populations, particularly in areas where pronghorn have been nearly extirpated. However, agricultural fencing has the potential to restrict the effectiveness of restoration efforts. In west Texas, pronghorn movement is inhibited by barbed and net-wire livestock fencing. Following translocations from the Texas Panhandle to southwestern Marfa Plateau in 2011, the Marathon basin 2013, and southeastern Marfa Plateau in 2014; we monitored movements of 27 (16 female, 11 male), 49 (43 female, 6 male), and 39 (35 female, 4 male) pronghorn (age 1–4+) equipped with GPS collars. Collars were programed to record one location/hour for 38 weeks post-release. We began fence modification efforts in 2013 for the Marathon Basin release. Modifications entailed raising the bottom of a barbed or net-wire fence to a minimum of 45.7 cm from the ground in stretches of 9–27 m using intervals of 0.8 km. Priority was given to fence corners, natural travel corridors,

and grassland draws. Using location data from three different study sites over three different years, we sought to analyze movements of individual pronghorn. Our objectives were to: 1) total the number of fence crossings and attempted crossings by date, region, sex, and age, 2) understand frequency of fence crossings by fence type, 3) document the "pronghorn unfriendly" fences in our restoration areas to be targeted for future modification efforts, and 4) document patterns of pronghorn movement influenced by fences.

PREDICTING LONG-TERM PRONGHORN POPULATION DYNAMICS IN THE SOUTHWEST IN RESPONSE TO CLIMATE CHANGE

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Abstract: Over this century, the southwestern US is predicted to experience higher temperatures and more variable precipitation patterns, which will significantly alter grassland habitats. Developing a better understanding of the impacts of climate on species inhabiting these arid regions is critical for their management and conservation. We examined historical relationships between environmental factors and pronghorn (*Antilocapra americana*) population dynamics to gain insight into their potential response to predicted changes in climate. We adopted an information-theoretic approach in a Bayesian framework to analyze long-term data from 18 pronghorn populations in the Southwest, to determine climatic factors that predict annual rate of population growth (λ). We used these explanatory variables to project pronghorn population trends to 2090 in response to climate change under high and lower atmospheric CO_2 concentration scenarios using region-specific downscaled climate projection data. Climate projections on pronghorn range indicate increased temperatures across the region, and direction and magnitude of precipitation changes show high area-specific variation. Fifteen populations demonstrated a significant positive relationship between precipitation and λ, with late gestation and lactation being important periods, whereas temperature relationships were highly variable. We found little difference in pronghorn population projections between atmospheric CO_2 concentration scenarios. Our models predict that more than half (56%) of the pronghorn populations examined will be extirpated or approaching extirpation by the end of the century. Findings will contribute to a better

understanding of ungulate response to a changing climate, which will benefit development of management and conservation strategies for species on arid lands.

POST-RELEASE SURVIVAL OF TRANSLOCATED PRONGHORN ON THE MARFA PLATEAU, TEXAS

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Abstract: Recent severe population declines in pronghorn (*Antilocapra americana*) in the Trans-Pecos region of Texas prompted restoration efforts by Texas Parks and Wildlife Department and the Borderlands Research Institute at Sul Ross State University in 2011. Translocation, the intentional release of animals from one site into another, has often been used as a vital wildlife management tool to help restore vulnerable taxa. Therefore, translocations were used to supplement critically low populations in portions of the Trans-Pecos region (Marfa Plateau and Marathon Basin). Our objectives were to (1) evaluate success of restoration efforts, and (2) monitor mortality and factors that affect survival. All translocation efforts (2011, 2013, 2014, and continuing in 2016) have involved capturing pronghorn from healthy populations in the Panhandle region of Texas and relocating animals to the Trans-Pecos utilizing the net-gun capture method. In early 2016, we translocated a total of 112 pronghorn from areas around Dalhart, TX to the northwest Marfa Plateau, where 70 of the animals were equipped with either VHF, GPS, or satellite tracking radio-collars. For the first month after release, we conducted weekly aerial telemetry flights while additionally tracking collared animals on the ground 2–3 times per week. Following the first month, we conducted bi-weekly to monthly aerial telemetry flights. Status of radio-collar mortality signals (live/mortality), visual confirmations, group sizes, and GPS locations were recorded during flights and ground tracking. When GPS/VHF collars emitted a mortality signal, we marked the location of the signal and further investigated potential cause of mortality. As of 25 weeks following post-release, there have been 7 mortalities, with a total estimated survival rate of 90%. Six of the mortalities occurred within 10–14 days post-release and were likely from the effects of capture related injuries/myopathy.

IMPACTS OF SEVERE WINTER WEATHER ON PRONGHORN SURVIVAL IN PARTIALLY MIGRATORY POPULATIONS

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Abstract: The importance of migration to conserving ungulate populations is recognized across a variety of ungulate taxa, yet the demographic benefits for migratory individuals remain uncertain. We used a time-to-event approach to compare survival and cause-specific mortality rates across migration strategies and seasons for pronghorn (*Antilocapra americana*), a long-distance migrant, and test whether migration strategy mediated the effect of winter weather severity on mortality risk. We radio-collared 175 adult female pronghorn at the northern limit of their range in northern Montana, southeastern Alberta and southwestern Saskatchewan during 2004–2011. Annual survival probability was 7% higher for migratory adult female pronghorn (S_{mig} = 0.82) compared to residents (S_{res} = 0.75), but this difference was not statistically significant (P = 0.23). Summer survival of pronghorn was higher (S = 0.92) and less variable (P = 0.31) compared to lower (S = 0.86) and more variable (P = 0.001) winter survival rates. Mortality was negligible in autumn and spring. Human-related mortality was most important during summer (CIF = 0.04), while natural, non-predation mortality (CIF = 0.04) was most important in winter, followed by predation (CIF = 0.03) and human-related mortality (CIF = 0.02). We found no interaction between winter weather severity and migration strategy (P = 0.29), and winter survival was best explained by the negative effects of winter weather alone. Despite the high survival typical of adult female ungulates, our analysis suggests a large demographic advantage of migration in a long-distance migratory ungulate that has implications for conserving migratory corridors across the landscape.

FINDING NEW WAYS TO MANAGE PRONGHORN POPULATIONS IN THE TEXAS PANHANDLE – UPDATE

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Abstract: The current method of issuing pronghorn permits in the Texas Panhandle requires knowledge of pre-season pronghorn population and information about landownership. Obtaining this information is labor-intensive and expensive. To address these and other issues with Texas Parks and Wildlife Department's (TPWD) current method of permit issuance, an experimental season was implemented in three herd units (high, moderate and low density). In these units, landowners have complete control over hunting intensity/pressure on their property for bucks, but landowners are provided with harvest guidelines. Pronghorn harvest may be independent of survey results or property size, which is the harvest regime for other big game species in Texas. We have tested the experimental season over the past three hunting seasons (2013–2015). TPWD is closely monitoring the experimental season with mandatory check stations to monitor buck harvest intensity, age structure (estimated using cementum annuli), and horn development in each class, as well as conducting population surveys for these areas. Harvest varied among the three herd units. In the high and low-density units, harvest exceeded the TPWD "guidelines," but the harvest rate has decreased since 2013. In the medium density unit, harvest was similar to historic levels. Results indicate that population trends within the experimental areas are similar to adjacent non-treatment areas. However, average age of harvested bucks within the experimental areas after three hunting seasons was 3.3, younger than the initial year ($\overline{x}$ = 3.7; 2013), and younger than bucks harvested outside of the experimental areas ($\overline{x}$ = 4.4) during 2015. On average, horn measurements are greatest at 5.3 years of age, but similar to age classes ≥3.3. Stakeholder surveys conducted post-experiment indicated that the majority are in favor of continuing or even expanding the concept to new herd units. TPWD will continue with the experimental season in the three designated areas for an additional year with plans of expanding to three additional herd units while intensively monitoring pronghorn populations to determine effects.

FACTORS INFLUENCING SEASONAL MIGRATIONS OF PRONGHORN ACROSS THE NORTHERN SAGEBRUSH STEPPE

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Abstract: Globally, grassland systems have received the highest impacts from human activities, and therefore management of these systems is important for ungulate conservation. Pronghorn (*Antilocapra americana*) may undertake seasonal migrations to satisfy annual life history requirements. The effects from environmental gradients and anthropogenic factors on pronghorn migrations are not well understood. Our objectives were to: 1) classify and determine metrics for migration behaviors across individuals in the Northern Sagebrush Steppe (NSS), 2) predict multi-scale seasonal pronghorn migration pathways across the NSS and integrate scales into one spatial prediction, and 3) create pronghorn connectivity network maps across the NSS. Based on 170 animal years from collared females, 55% of individuals undertook seasonal migrations. Using between-class analysis of metrics, three distinct movement groupings were identified. Next, we modelled multi-scale migratory pathway selection in response to environmental and anthropogenic parameters. Generally, migratory pronghorn selected grasslands, intermediate slopes, and south-facing aspects, and avoided increased well and road densities. Pronghorn selected stopover sites with higher forage productivity values and lower well densities versus migratory pathways. We then used a scale-integrated mapping approach and found that these spatial predictions performed as well or better than single order scales to predict migration pathways. Finally, using a suite of approaches, we created seasonal pronghorn connectivity networks across the NSS. We concluded that multi-scale migration followed hierarchically nested theory where finer scale decisions are conditional on broader scales that can be assessed sequentially. We suggest that the pronghorn is a broad-scale focal species useful for conservation planning across the NSS.

EVALUATING THE USE OF MODIFIED FENCE SITES BY PRONGHORN IN THE NORTHERN SAGEBRUSH STEPPE

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Abstract: Pronghorn (*Antilocapra americana*) typically prefer to cross barbed-wire fencing by crawling under the bottom wire versus jumping over. If the bottom wire is too low, a fence can act as a semi-permeable or complete barrier and thus restricts pronghorn movements. A number of fence modification techniques have been recommended by wildlife management agencies to enable the movement of pronghorn under fences but none have been critically evaluated. Our study tests whether pronghorn will use modified fence sites, monitored with remote trail cameras, using a Before-After-Control-Impact study design. We tested the pronghorn use of goat-bars, clips, and bottom wire composed of smooth wire to determine if specific fence modifications facilitate easier passage by pronghorn at study sites in Alberta and Montana. We used ANOVA to test if both the magnitude in change and relative change in successful crossings was significantly different between modified sites, control sites and historic crossing locations. We used logistic regression to determine demographic, environmental and fence parameters that influence successful crossings by pronghorn. We discuss our interpretation of the results and implications for each technique to facilitate pronghorn daily and seasonal movements. This evaluation will allow mangers across the entire range of pronghorn to make informed recommendations to the ranching and conservation community as to which enhancements are appropriate and likely to increase fence permeability for pronghorn.

DOES BIRTH SYNCHRONY INFLUENCE FAWN SURVIVAL OF PRONGHORN IN THE TRANS-PECOS REGION OF TEXAS?

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Abstract: Birth synchrony is an often-used strategy by ungulates functioning to reduce risk of predation on young by increasing prey availability. The goal of birth synchrony is to saturate prey availability in a short time frame to predators and reduce individual risk of predation. In most of their range, pronghorn fawns are born within a 3-week period during early spring, and peak fawning occurs over a 10-day period. Our objectives were to: 1) determine the length of the pronghorn fawning season in the Trans-Pecos region of Texas, 2) identify the peak period of fawning, 3) determine cause specific mortality of fawns, and 4) estimate fawn survival rates. Using spotlights and vaginal implant transmitters we located and fit pronghorn fawns with expandable VHF radio collars. Collared fawns were monitored throughout the fawning season. We found the fawning season ranged between 30 and 56 days. Pronghorn in the Trans-Pecos do not appear to have a significant peak fawning period as described elsewhere. Predation accounted for most fawn mortalities, with coyotes and bobcats being the primary predators. There was no difference in survival of fawns born during peak fawning periods and those born outside of peak periods. Fawn survival rates increased with increasing precipitation across study sites.

ENVIRONMENTAL CONSTRAINTS ON PRONGHORN NEONATE SURVIVAL ACROSS IDAHO

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Abstract: Idaho pronghorn populations have failed to rebound to previously high levels found in the late 1980s. Pronghorn population recruitment is driven by nutritional conditions, climate, and predation. We are examining neonate pronghorn survival across Idaho, in three distinct study sites. The study sites will include habitat types of native high elevation shrub-steppe, altered/low quality shrub-steppe, and agriculture. Neonates will be collared and monitored daily to determine survival-ship of the fawns. Morphological measurements of fawns along with bed site cover selection were taken during collaring. Predator track plate surveys were completed to estimate predator densities. Alternative prey species were surveyed to estimate densities. Pronghorn fecal samples will be collected to assess fecal nitrogen and DAPA indices as a measure of habitat quality across the different populations. We will then compare survival rates across the three study sites and survival across the covariates collected throughout the study.

CREATION AND EVALUATION OF TREND AREAS THAT PREDICT PRONGHORN POPULATIONS TO GUIDE MANAGEMENT ACTIONS

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***Abstract*:** Trend area flights offer substantial cost and time savings over total population counts, but trend area data need to be calibrated to total count data before they can be used with confidence in wildlife management decisions. To develop trend areas for pronghorn in Montana Fish, Wildlife and Parks Administrative Region 5, herd location data from total surveys for the period 1984-2009 were combined with classification information by hunting district (HD) into a GIS. Grids, 5-mile (mi.) x 5 mi. to 12 mi. x 12 mi. (increasing by 1 square mile intervals) in size were overlain on the pronghorn locations as potential trend areas. The total number of pronghorn by year were calculated for each grid and cross-referenced with HD census data. The predictive ability of each candidate trend area was estimated and internally validated. We selected grids with the highest internally-validated predictive ability to be used as trend areas for each HD. Correlation coefficients between trend count data and total count data varied from a low of 0.88 to a high of 0.98. Newly-established trend areas varied in size from 64.3 to 216.6 square miles. Trend areas have been surveyed in Region 5 for eight years and biologists believe that population trend information has improved management with substantial savings in time and expense. However, trend areas failed to detect the severity of population declines

in some HDs during a bluetongue outbreak. The survey design incorporates these catastrophic population lows into our models improving predictive ability in the future.

SURVIVAL OF PRONGHORN IN WYOMING'S RED DESERT: THE INFLUENCE OF INTRINSIC FACTORS AND ENVIRONMENTAL AND ANTHROPOGENIC CHANGE

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Abstract: Pronghorn (*Antilocapra americana*) in Wyoming have declined by 28% from population highs reached in 2007. Over the same period, herds in the Red Desert of south-central Wyoming have seen declines in herd size of up to 35%. In addition to population declines over the past decade, Red Desert pronghorn herd estimates have frequently been below Wyoming Game and Fish Department objectives for over 20 years, and permitted hunting has declined considerably. Recently, the Red Desert region has experienced drastic changes in environmental conditions, with droughts becoming increasingly frequent and severe. In addition, portions of the area have been intensely developed for natural gas and coalbed methane extraction. To better understand the effects of such environmental and anthropogenic change, we monitored 132 adult female pronghorn across four study areas, each with differing levels of resource extraction intensity, between November 2013 and February 2016. We used the Cox Proportional Hazards regression model to identify covariates contributing to the risk of death for pronghorn. Covariates were related to environmental conditions, anthropogenic infrastructure, and intrinsic factors. Over the course of our study, we observed 41 deaths, with a Kaplan-Meier survival rate estimate of 65.1% (95% CI: 57.2–73.0). Our results enhance knowledge of pronghorn demographic responses to increasing climatic variability and anthropogenic disturbance. Given that greater than 50% of all pronghorn occur in Wyoming, it is crucial that we improve our ability to understand the influence of intrinsic factors, environmental change, and resource extraction on pronghorn populations in the state to guide management and mitigation.

REDUCING CROPLAND CONVERSION RISK TO SAGE-GROUSE THROUGH STRATEGIC CONSERVATION OF WORKING RANGELANDS

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Abstract: Conversion of native habitats to cropland is a leading cause of biodiversity loss. The northeastern extent of the sagebrush (*Artemisia* L.) ecosystem of western North America has experienced accelerated rates of cropland conversion resulting in many declining shrubland species including greater sage-grouse (*Centrocercus urophasianus*). Here we present point-process models to elucidate the magnitude and spatial scale of cropland effects on sage-grouse lek occurrence in eastern Montana, northeastern Wyoming, and the Dakotas. We also use a non-parametric, probabilistic crop suitability model to simulate future cropland expansion and estimate impacts to sage-grouse. We found cropland effects manifest at a spatial scale of 32.2 km^2 and a 10-percentage point increase in cropland is associated with a 51% reduction in lek density. Our crop suitability model and stochastic cropland build-outs indicate 5-7% of the remaining population in the region is vulnerable to future cropland conversion under a severe scenario where cropland area expands by 50%. Using metrics of biological value, risk of conversion, and acquisition cost to rank parcels, we found that a US $100M investment in easements could reduce potential losses by about 80%, leaving just over 1% of the population in the region vulnerable to cropland expansion. Clustering conservation easements into high-risk landscapes by incorporating landscape-scale vulnerability to conversion into the targeting scheme substantially improved conservation outcomes.

EVALUATION OF AERIAL POPULATION ESTIMATION TECHNIQUES FOR PRONGHORN ANTELOPE IN TEXAS

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Abstract: Aerial surveys are an efficient way to track population trends of large mammals, but often underestimate population size because some animals are not seen. Methods to correct for visibility bias are available, but must be validated for the habitat and survey protocols to which the correction will be applied. In Texas, aerial surveys for pronghorn (*Antilocapra americana*) are flown on strip transects using a fixed-wing aircraft at low altitude (30.5 m) to obtain abundance and herd composition estimates. We evaluated the performance of distance sampling and sightability modeling for aerial surveys of pronghorn in the Panhandle and Trans-Pecos regions of Texas. Pronghorn were captured and fitted with GPS collars at 2 sites in each region during March 2014 (Panhandle: Dalhart, Pampa) and February 2015 (Trans-Pecos: Alpine, Marathon). We surveyed herd units that contained collared pronghorn during June 2014 and 2015, and recorded activity, group size, habitat type, percent cover, terrain, color, and distance from the survey line. We used distance sampling and sightability modeling to estimate population size for each individual site, and compared all results to independent estimates derived via mark-resight. Traditional estimates underestimated population size, with a 16% difference when compared to mark-resight estimates, 33.4% to distance sampling estimates, and 18.5% to sightability modeling estimates. Pronghorn detection probabilities were similar to past studies at 51.9% according to sightability modeling and 64.9-66.5% according to distance sampling. Significant factors in the sightability model were animal activity, distance, cover, and color, whereas activity was the only significant variable in distance sampling.

MONTANA'S GRASSLAND CONSERVATION STRATEGY

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***Abstract*:** Montana is believed to have one of the last strongholds of intact mixed grass prairie in North America. Over one quarter of Montana's landscape provides habitat for grassland-associated wildlife species, however, the amount and intactness of native grassland is declining every year. Montana Fish, Wildlife and Parks (FWP) is developing a grassland conservation strategy designed to guide FWP's habitat conservation actions for sustaining viable populations of grassland-associated wildlife while recognizing important economic and social drivers in the grassland ecosystem. We will provide an overview of how we propose to prioritize landscapes for conservation to maintain and enhance the largest, most intact areas of grassland in the state. We will also discuss the spatial distribution of threats, ongoing conservation actions, and relevant conservation tools so we can target the right conservation action in the right places. We plan to conduct implementation and effectiveness monitoring to track success. Our hope is that this strategy, when combined with other grassland conservation efforts, will ensure the long-term persistence of functioning grassland systems in Montana.

Abstracts: Poster Session

FOLLOW-UP OBSERVATIONS OF A SMALL POPULATION OF TRANSLOCATED PRONGHORN (*ANTILICAPRA AMERICANA*) NEAR HILLSIDE, ARIZONA

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Abstract: We documented a 7-year persistence of a remnant population of 4 to 9 pronghorn near Hillside, Arizona, from May 2008 through November 2014. Follow-up surveys through May 2016 showed a population of 5 individuals— 3 adult females, 1 female yearling, and 1 adult buck in a pasture of *ca.* 866 ha. Although the possibility exists of animals immigrating or emigrating from the Hillside area, we did not document such behavior during our study. With no overt management actions, this population has persisted for >8 years with a mean annual recruitment rate of 35 yearlings:100 adult does. The loss of 4 animals during 2015-2016 possibly leaves only 1 buck remaining, and may be attributed to a May 2014 Palmer Drought Severity Index of -4.09. The continued presence of this population is attributed to low adult doe mortality and a greater recruitment of females than males on a well-managed rangeland.

DEVELOPMENT OF POPULATION GENOMIC TOOLS FOR CONSERVATION AND MANAGEMENT OF WYOMING PRONGHORN

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Abstract: Wildlife requiring large, contiguous landscapes for dispersal and seasonal movements are particularly vulnerable to reduced connectivity and population declines caused by anthropogenic landscape alterations. As humans continue to encroach on natural landscapes, it becomes increasingly critical to characterize and maintain genetic diversity and gene flow for impacted wildlife species. Pronghorn (*Antilocapra americana*) populations have experienced historical declines because of overharvest and habitat loss, and currently face threats to movement by manmade barriers. Using genetics, we can assess the underlying effects of these human impacts at a population level, adding vital and complementary data to population surveys, GPS tracking studies, and existing pronghorn research. First, we are developing statewide genomic data for Wyoming pronghorn to determine broad scale patterns in genetic diversity. To do this, we are sequencing muscle tissue samples collected by the Wyoming Game and Fish Department at hunter check stations in 2015. We are utilizing double digest restriction-site associated DNA (ddRAD) sequencing to discover and genotype thousands of single nucleotide polymorphisms (SNPs). This approach generates larger quantities of data at lower cost than more traditional methods (such as microsatellites). This large volume of DNA sequence data allows for detection of genetic structure and calculation of important monitoring indices (e.g., effective population size, relatedness among individuals) even with low genetic diversity populations that previously would have prohibited such analyses. We present preliminary results towards identifying natural and manmade barriers to gene flow, classifying essential dispersal corridors, and providing management agencies with genetic population delineations for Wyoming.

WHERE THE ANTELOPE ROAM: ANALYSES OF HOME RANGE SIZE AND HABITAT USE OF GPS-COLLARED PRONGHORN IN TEXAS

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Abstract: Movements and habitat use of pronghorn antelope (*Antilocapra americana*) are influenced by anthropogenic effects on the landscape, including livestock fences and brush encroachment. However, the effects of landscape alteration on pronghorn have rarely been quantified. We evaluated pronghorn home range and habitat use in a mosaic of agricultural and livestock production areas in Texas. Pronghorn were captured and fitted with GPS collars at 2 sites in the Panhandle (Dalhart, Pampa) during March 2014 and Trans-Pecos (Alpine, Marathon) during February 2015. We determined seasonal home range size through kernel density estimation using statistically independent data that was ≥ 120 minutes apart to ensure we did not underestimate home range size. Habitat use and availability were quantified on the animal and landscape scales based on classification of 10-m ecological system raster data. We observed that pronghorn movement was limited most by fencing and high-traffic highways. There was no difference in home range size between the sexes, but home range size was larger in the Panhandle (Dalhart = 11.7 km^2, Pampa = 12.3 km^2) than the Trans-Pecos (Alpine = 1.9 km^2, Marathon = 7.3 km^2). Habitat use for each region corresponded to site habitat availability. Pronghorn in the Panhandle used 60.3% grassland (available: 55.7%), 19.8% shrubland (19.6 available), and 16.6% agriculture (19.9% available). Trans-Pecos pronghorn used 70.1% grassland (64.9% available), 18.3% shrubland (20.8% available), and 11.3% scrub (13.9% available). We propose that differences in pronghorn home range size between the ecoregions are due to livestock fencing, agriculture, and brush encroachment.

Papers

DOES BIRTH SYNCHRONY INFLUENCE FAWN SURVIVAL OF PRONGHORN IN THE TRANS-PECOS REGION OF TEXAS?

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Abstract: Birth synchrony is an often-used strategy by ungulates functioning to reduce risk of predation on young by increasing prey availability. The goal of birth synchrony is to saturate prey availability in a short time frame to predators and reduce individual risk of predation. In most of their range, pronghorn fawns are born within a 3-week period during early spring, and peak fawning occurs over a 10-day period. Our objectives were to: 1) determine the length of the pronghorn fawning season in the Trans-Pecos region of Texas, 2) identify the peak period of fawning, 3) determine cause specific mortality of fawns, and 4) estimate fawn survival rates. Using spotlights and vaginal implant transmitters we determined the date of birth for 100 birth events and subsequently located and fit pronghorn fawns with expandable VHF radio collars. Collared fawns were monitored throughout the fawning season. We found the fawning season ranged between 30 and 56 days. Pronghorn in the Trans-Pecos do not appear to have a significant peak fawning period as described elsewhere. Predation accounted for the majority of fawn mortalities, with coyotes and bobcats being the primary predators. There was no difference in survival of fawns born during peak fawning periods and those born outside of peak periods. Fawn survival rates increased with increasing precipitation across study sites.

The Trans-Pecos region of far west Texas has historically held some of the highest densities of pronghorn in the southwestern United States (Southeastern Cooperative Wildlife Disease Study 1982, O'Gara and Yoakum 2004). In past decades, Trans-Pecos pronghorn have accounted for approximately 70% of the state's pronghorn population (Gray 2012). Pronghorn populations in the Trans-Pecos region have declined from an estimated 17,226 individuals in 1987, to a 75-year low of 2,751 animals in 2012. The Trans-Pecos now only supports <25% of Texas' herd (Gray 2012).

Possible reasons for the decline of the pronghorn population include: drought (Simpson et al. 2007), predation (Berger et al. 1983), malnutrition (Hailey et al. 1966), habitat loss (Boccadori et al. 2008), disease (Dubay et al. 2006), barriers to movement (Beckmann et al. 2012), low recruitment rates, and low fawn crops (Hailey et al. 1966). Of these elements, predation on neonates has often been described as the factor contributing most to mortality (Beale and Smith 1973, Von Gunten 1978, Corneli 1980, Tucker and Garner 1980, Trainer et al. 1983, Barrett 1984, Gregg et al. 2001).

Birth synchrony is an often-used strategy (see for example: Patterson 1965, Robertson 1973, Dauphine and McClure 1974, Estes 1976, Rutberg 1987, Boinski 1987, O'Gara and Yoakum 2004) functioning to reduce risk of predation on young by increasing prey availability within a short window of time. The goal of birth synchrony is to saturate prey availability to predators, thereby reducing individual risk of prey. In most of their range, pronghorn fawns are born within a 3-week period during early spring, and peak fawning occurs over a 10-day period (Autenrieth and Fitcher 1975, O'Gara and Yoakum 2004). Birthdates in northern portions of pronghorn range appear to be more tightly synchronized than those in southern areas (Byers 1997).

Birth synchrony in pronghorn is an important adaptation reducing neonate predation in southcentral Oregon (Gregg et al. 2001). Although 84% of marked fawns died during the monitoring period, individuals born during the peak of the fawning period had significantly higher survival rates than those born outside of the peak period (S = 0.23 vs S = 0.07). Average age at death was 8.4 days and 95% of the fawns that died were <18 days old. Predation accounted for 86% of the documented mortalities.

Synchronized births can be particularly important in populations already experiencing low fawn to doe ratios. Ratios of less than 0.5 (i.e., 0.5 fawns per doe) are considered to be low (Hailey et al. 1966, O'Gara and Yoakum 2004). Across the pronghorn range, fawn:doe ratios vary from 0.43 in Texas, to >1 in South Dakota (Vriend and Barrett 1978). The long-term (1977 to 2014) fawn:doe ratio of pronghorn populations in the Trans-Pecos region of Texas is 0.35 (Texas Parks and Wildlife Department, unpublished data). The cause of the low reproductive rate is beyond the scope of this paper, but is undoubtedly linked to poor range condition and nutrition at the southern edge of their distribution. With low numbers of births, the value of each neonate to the population increases, and because the effect of predator saturation is diminished, predation may have longer term population effects (Beale and Smith 1973). Population growth is therefore intrinsically dependent on neonate survival when reproductive rates are low. High rates of predation in small populations may drive production and recruitment rates to unsustainable levels resulting in local extirpation of populations (Veit and Lewis 1996, Courchamp et al. 1999, Stephens and Sutherland 1999, Stephens et al. 1999, Boukal and Berec 2002).

Reproductive rates (fawns per doe) of pronghorn in the Trans-Pecos were 0.22, 0.11, and 0.16 in 2010, 2011, and 2012 respectively (TPWD unpublished data). These reproductive rates are well below those documented elsewhere (see for example: Mitchell 1980, Danvir 2000, Barnowe-Meyer et al. 2010). In light of low reproductive rates in the Trans-Pecos, the goal of this project was to determine if the date of fawning influenced fawn survival. To help achieve this goal, we set the following objectives: 1) determine the length of the fawning season, 2) identify the peak period of fawning within the fawning season, 3) determine cause specific mortality of fawns, and 4) estimate fawn survival rates within the peak fawning period and outside of the peak period. Based on these objectives we predicted: 1) the fawning period would be approximately 3-weeks in length, 2) the peak in fawning would occur over a 10-day period, 3) coyotes would be the primary predator of fawns, and 4) survival rates would be higher for fawns born within the peak fawning period compared to those born outside of the peak period. We captured and radio collared pronghorn fawns over a 3-year period from 2011 to 2013.

STUDY AREA

The study area consisted of 3 major sampling areas within the Trans-Pecos; 1 ranch in northern Hudspeth County; 8 ranches in the Marathon Basin; and 6 ranches on the Marfa Plateau (Figure 1). The Trans-Pecos is a diverse ecosystem that containing 2.95 million ha within the Chihuahuan Desert Biotic Province. The region is bordered to the west and south by the Rio Grande, to the east by the Pecos River, and to the north by New Mexico (Hatch et al. 1990). Elevation ranges from 762-2,667 m, and most of the precipitation is received during the monsoonal season between July and October. Annual average rainfall varies from between 20-30 cm in the lower elevations, and 31-46 cm at higher elevations (Simpson et al. 2006).

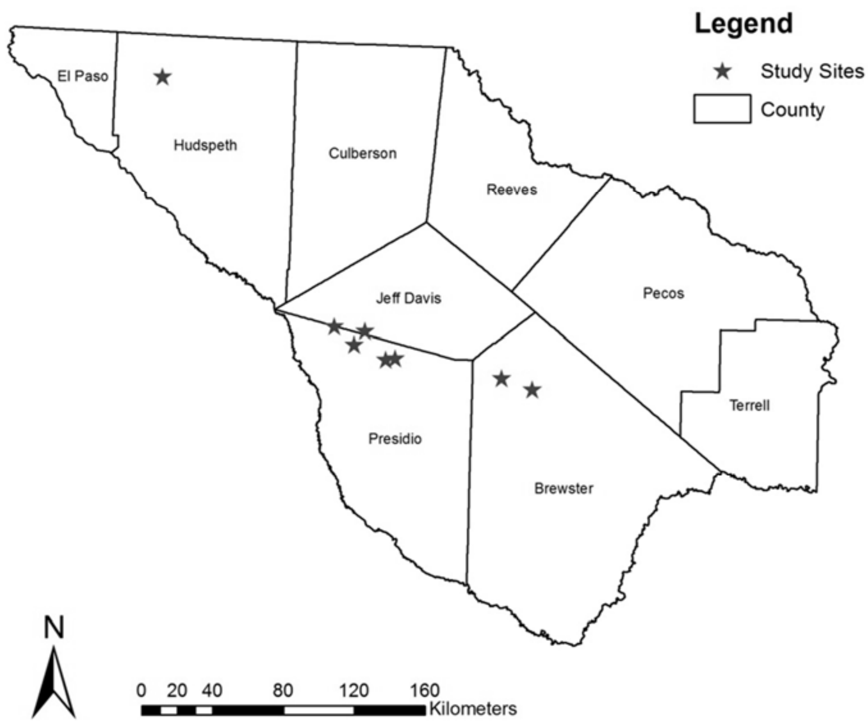

Figure 1. Locations of study sites used in pronghorn fawn survival in the Trans-Pecos region of west Texas, USA, 2011, 2012, and 2013.

The study area in Hudspeth County was located 72 km east of El Paso near the town of Cornudas and encompassed 44,515 ha (University of Texas Lands, Cannon and Bryant 1997). Elevation ranged from 1,465 m to 1,675 m with topography generally transitioning from steep hills in western regions near the Hueco Mountains, to open flats on the eastern side of the study area (Cannon and Bryant 1997). This area experienced monsoonal rain, which occurred in late summer through early fall. The temperature for this region ranged from -18°C in the winter to over 38°C in the summer (Cannon and Bryant 1997). Vegetation in the area is dominated by tabosa (*Hilaria mutica*) and grama (*Bouteloua* spp.) grasslands punctuated by mesquite (*Prosopis glandulosa*)-tarbush (*Flourensia cernua*) scrubland. The study area has historically been grazed by cattle, which continues today.

The study sites in the Marathon Basin, surrounding the town of Marathon, were active cattle ranches. The ranches were located about 29 km east of Alpine, Texas and encompassed 70,400 ha. This area was dominated by tobosa grassland occurring south and adjacent to US Highway 90. The study area was bordered to the west by the Del Norte Mountains, to the north by US Highway 90, to the east by US Highway 385, and to the south by mesquite-tarbush scrubland. Climate for this site was characterized as arid with an average rainfall of 35.6 cm per year, typically occurring in mid to late summer, and an annual temperature range of 7 ºC in winter to 26 ºC in summer (Warnock 1977).

The Marfa Plateau surrounds the town of Marfa, Texas and historically held some of the highest densities of pronghorn in the southwestern United States (Southeastern Cooperative Wildlife Disease Study 1982, O'Gara and Yoakum 2004). The study area for the Marfa Plateau consisted of 60,703 ha scattered across 7 ranches in the western portion of the Marfa Plateau. The ranches were mostly characterized as tobosa grasslands, which accounted for as much as 96% of the plant community (Soil Survey 2013). Two ranches contained tobosa grasslands, but also had rolling igneous hills, dominated by grama and bluestem (*Andropogon* spp.) grasses along with forbs such as buckwheat (*Erigonum* spp.) and crotons (*Croton* spp.). Elevation ranged from 1,064 m in the flats to 1,368 m in the hills (USDA 2013). This area was also characterized by monsoonal rains, where approximately 75% of the precipitation occurs as thunderstorms of short duration and high intensity during the months of June through October (USDA 2013). This area received 28 to 33 cm of rain annually and has temperatures comparable to those at the Hudspeth County study site. Annual temperatures in the area ranged from a mean of 5 ºC in winter to 24 ºC in summer.

METHODS

Capture and Collaring

All methods and activities related to capture and handling of pronghorn for this study were approved by the Institutional Animal Care and Use Committee (SRSU-IACUC-003) and by Texas Parks and Wildlife Department (Scientific Permit Number: SPR-0592-525) under contract number TPWD-402180.

We attempted to capture and collar 40 fawns per year. The nighttime hoop-net capture method was used to capture fawns (Brownlee and Hailey 1970). Fawns were captured shortly after parturition using hoop-nets (Tomahawk Live Trap 3350 Mighty Net, Hazelhurst, Wisconsin, USA), spotlights, and vehicles. Fawns were located during daylight hours with the use of spotting scopes (Leupold 15-45x60mm SX-1 Ventanna, Beaverton, Oregon). Once located, fawns were monitored until dark. After dark, technicians approached on foot and placed nets over the fawn. Once captured, fawns were blindfolded to reduce struggling and capture related stress (Byers 1997, Cancino et al. 2005).

To aid in locating and collaring fawns, in 2013 vaginal implant transmitters (VIT's, ATS VIT Model M3930) were inserted into pregnant does captured as part of a concurrent translocation program (Gray 2013). During capture, VIT's were inserted into the vagina of 20 pregnant females. Pregnancy was confirmed using ultrasound (US Pro 2000 2nd edition Portable Ultrasound, TENS Pros, St. Louis, MO). The VIT transmitters weighed 15 g and were equipped with battery duration of approximately 264 days. The VITs were temperature sensitive. In temperatures ≥34 ºC (such as while retained in the body) the transmitter emitted a pulse at a rate of 40 pulses per minute (ppm). In temperatures ≤30 ºC (i.e. once the transmitter has been passed from the body during parturition) the transmitter emitted a pulse at 80 ppm. The increased pulse rate notified the observer of birth. The transmitters were also equipped with a decoding system documenting the exact time of parturition. Prior to insertion, each VIT was sterilized using DYNA-HEX 4 (Chlorhexidine) and an Eazi-Breed CIDR gun (Genex Cooperative Inc, Shawano, WI) was used to facilitate insertion of VIT's. SAFE-LUB (non-spermicidal multi-purpose lubricant) was applied to ensure efficient insertion. The CIDR gun was inserted into the vagina where the VIT was released. The VIT's were seated 1 cm away from cervix with the antenna protruding from the vulva. Wire-cutters were used to cut the protruding antenna approximately 1-2 cm from the vulva preventing females from pulling out the VIT. Females with VIT's were monitored daily until parturition was confirmed (Johnstone-Yellin et al. 2006).

After locating fawns, an effort was made to minimize capture and handling times to reduce scent transfer and potential for capture myopathy. Rubber gloves were worn by handlers to reduce scent transference to fawns. A primary assumption of radio-telemetry studies is that radio-marking does not affect the animals' behavior, survival, or reproductive success (Holt et al. 2009), therefore to minimize the influence of collars on fawns, we used lightweight, self-adjusting collars (68 grams, ATS M4210 Expandable Breakaway Collar, Keister et al. 1988). Due to risks of doe-fawn abandonment, cryptic colored collars (e.g., brown) were used to reduce visual stress to dams and reduce predator detectability. As an additional measure, to reduce artificial scent on collars, collars were stored in plastic totes with cuttings of natural vegetation for 1 week prior to capture. Collars were programmed with a 4-hour mortality sensor, which allowed for recovery of fawns after death.

Estimating the fawning period

At capture, new hoof growth measurements were recorded. Fawn age was estimated using the regression equation: $Y = 0.893549 + 2.3419353\, x_i$ where x_i is the new hoof growth measurement for the individual (Figure 2), and Y is age estimate (Tucker 1979, Sams et al. 1996, Flueck and Smith-Flueck 2005). We subtracted the estimated age from the capture date to estimate the birthdate of the fawn. The length of the fawning period was taken as the number of days between the first estimated birthdate and the last estimated birthdate in each year.

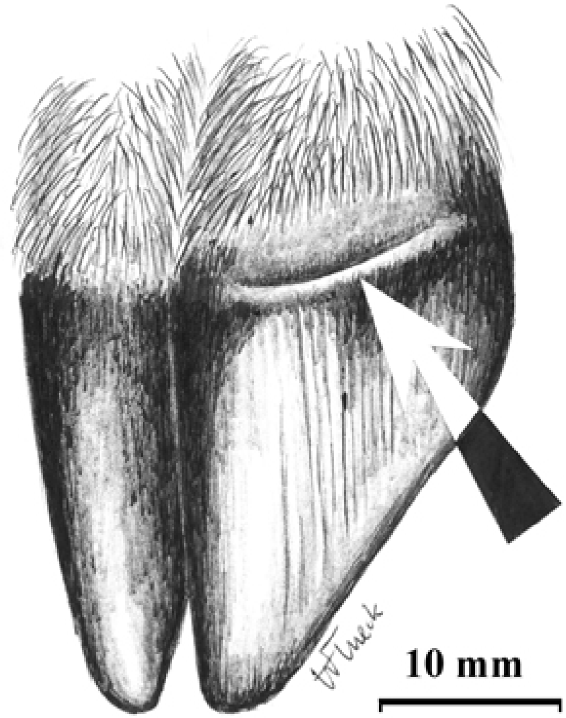

Figure 2. New hoof growth was determined by measuring the distance from the hairline to the ridged growth line (arrow) on the abaxial wall of a front hoof. New hoof growth and the regression equation: $Y = 0.893549 + 2.3419353\, x_i$ were used to predict pronghorn fawn age during capture (Tucker 1979, Sams et al 1996, Flueck and Smith-Flueck 2005).

Determining a peak in fawning

The peak of the fawning period was determined by plotting a histogram of the number of caught fawns each day across the fawning period. Quartiles were constructed across the fawning period, and the peak period of fawning was defined as the period between the 25^{th} and 75^{th} percentile i.e. this was the period between which 50% of births occurred. Fawns were subsequently assigned a binominal dummy variable for use in survival modeling, receiving 0 if the fawn was born outside of the peak and 1 if the fawn was born inside the peak fawning period.

We statistically validated our method of determining the peak and non-peak fawning periods, using 2-way ANOVA to test if the daily number of captured fawns born within the peak was significantly higher than the non-peak period in each year. In our model, the total number of fawns born each day was our dependent variable. Year by peak/non-peak period served as the grouping variable. Analyses were conducted using SPSS (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY), and significance was set at $\alpha = 0.05$.

Determining cause specific mortality
Using standard radio-telemetry techniques (Barrett 1984), collared fawns were monitored each day to document survival or mortality. If a mortality signal was detected, observers would locate the fawn and perform a thorough and timely investigation to determine cause of death. The immediate area around the carcass was examined for sign of struggle and/or predation, and the carcass was transported to Sul Ross State University for necropsy. During necropsy, the hide was skinned back to examine canine marks if present, stomachs were examined to evaluate presence of food, and all remaining organs were examined. All mortalities were classified and recorded for each year.

Estimating survival rates
To estimate survival rates, we monitored collared fawns for approximately 14-weeks after capture. Because most pronghorn fawn mortality occurs before formation of nursery groups, which usually occurs 5-6 weeks after the start of fawning season (Fairbanks 1992), fawns were monitored daily for the first 9 weeks post-capture. Thereafter, monitoring was reduced to twice per week.

Fawn survival was estimated using Kaplan Meier in SPSS (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY). In each year, survival of radio-marked fawns was estimated to 98 days (14 weeks) post-parturition. Using SPSS, the number of days alive was used as the 'time' function, with 'status' entered as a dichotomous variable (1 = alive, 0 = dead). Whether fawns were born during the peak fawning period or not (1 = born during peak, 0 = born outside of peak), was entered as a factor in the model. This allowed comparison of survival rates of fawns born during the peak fawning period and those born outside the peak period. Year was entered into the model as a stratum, allowing comparison of peak/non-peak survival estimates within each year, and across the 3 years of study. Lastly, we removed the peak/non-peak variable from the 'factor' dialogue and replaced it with year. This allowed us to compare overall survival among the years of study. For each comparison, the Breslow test (or generalized Wilcoxon test) was used. The Breslow test weighs the difference between the observed and expected number of deaths at each time point by the number at risk at each time point (Norušis 2008). The Breslow test places more weight on early deaths than later deaths because the number at risk decreases with time. Differences were considered significant at $\alpha = 0.05$.

RESULTS

Fawning period
In 2011, 26 fawns were captured (7 in Marathon Basin, 6 in Hudspeth County, and 13 in Marfa Plateau) and fitted with collars between 4 May and 2 June 2011. New hoof growth averaged 4.99 mm (SE = 0.56, range 1 – 9.5 mm). Average age of fawns at capture was 12.6 days old. The youngest fawn caught was 3.24 days old, while the oldest fawn was 23.1 days old. Fawning dates were variable resulting in a 30-day fawning period.

In 2012, 34 fawns were captured and collared in the Marfa Plateau between 3 May and 29 June 2012. New hoof growth averaged 3.79 mm (SE = 0.35, range 1 – 11 mm). In 2012, average age of fawns at capture was 9.8 days old. The youngest fawn was 3.2 days old while the oldest fawn was 26.7 days. The fawning period was estimated to be 56 days long in 2012.

In 2013, 40 fawns were captured and collared in the Marathon Basin between 3 May and 3 June 2013. Of the 40 captured fawns, 12 (30%) captures resulted from the use of VIT's. We were only able to locate fawns from 7 (35%) of the 20 does fitted with VIT's. Of the 13 VIT's remaining VIT's, we recorded 2 does dying from capture myopathy, 2 premature expulsions, and 9 unknown parturition sites. New hoof growth averaged 3.24 mm (SE = 0.36, range 1 – 10 mm). Average age of fawns captured in 2013 was 8.5 days. The youngest and oldest fawns captured in 2013 were 3.2 and 24.3 days old, respectively. In 2013 resources (i.e. the number of radio collars) limited capture to 40 fawns. It took 30 days for us to capture 40 fawns, and thus the fawning period was known to be ≥30 days long.

Peak fawning period

Overall, with all years combined, the peak fawning period appeared to fall between 17th May and 29th May, but varied across years. Peak fawning in 2011 lasted approximately 7 days from the 22 May to 29 May (Figure 3). The peak fawning period in 2012 was slightly longer than in 2011, lasting 12 days between 21 May and 2 June. Although beginning earlier, the peak fawning period in 2013 was similar in length to 2012, lasting 11 days from 15 May to 26 May.

Although not significant ($F_{2, 45}$ = 0.771, P = 0.470), the number of fawns captured per day during the non-peak period was lower than during the peak period in each year. On average 1.5, 1.5, and 2.6 fawns were captured per day during the non-peak period in 2011, 2012, and 2013 respectively, whereas 3.5, 2.6, and 2.8 fawns were captured per day during the peak fawning period (Figure 4).

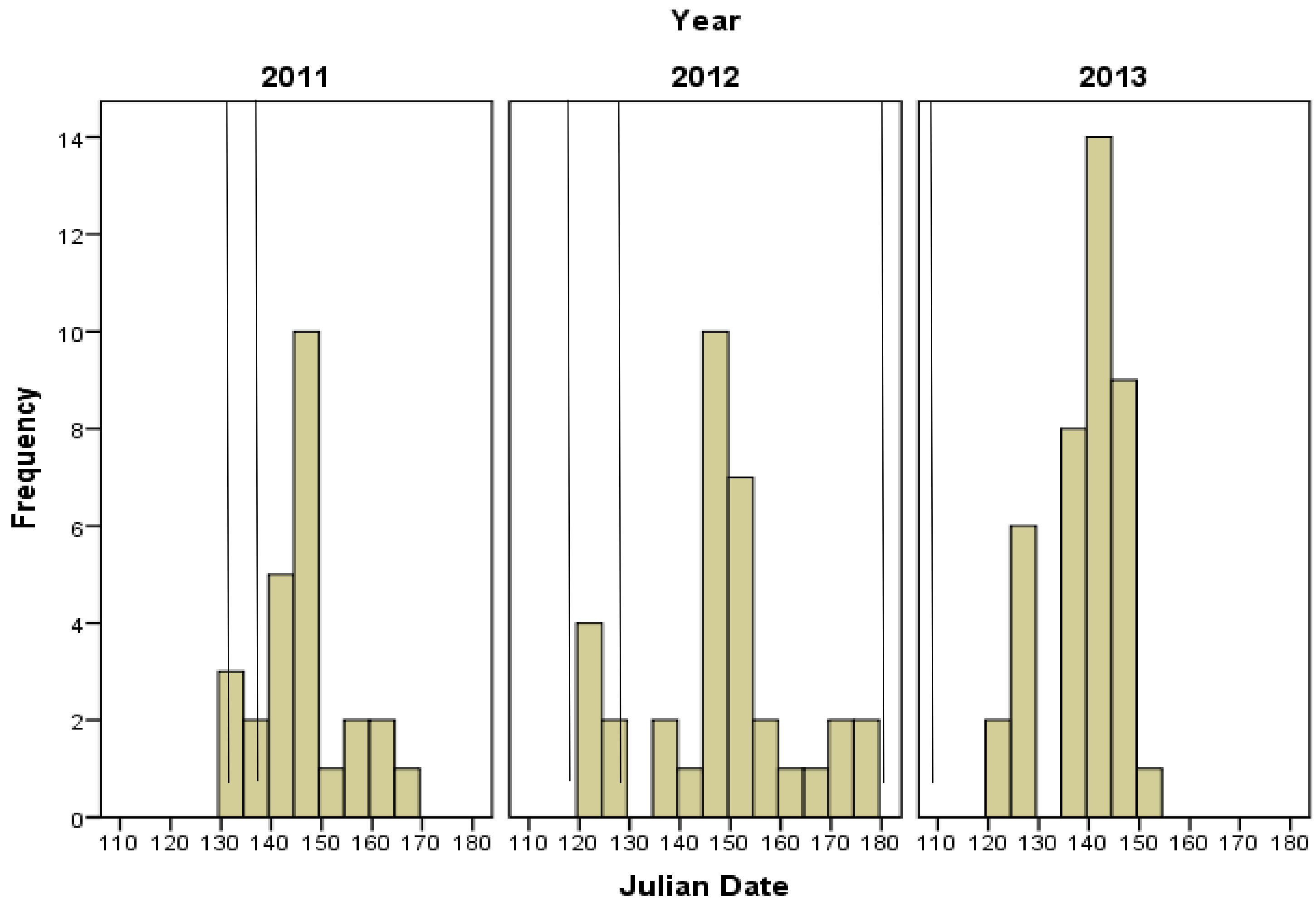

Figure 3. Histogram representing the number of pronghorn fawns born each day during birthing periods from 2011 to 2013. Vertical lines represent 25th and 75th quartiles, and periods between quartiles represent peak fawning periods in each year. The periods between 25th and 75th quartiles represent the period during which 50% of pronghorn fawns were born each year.

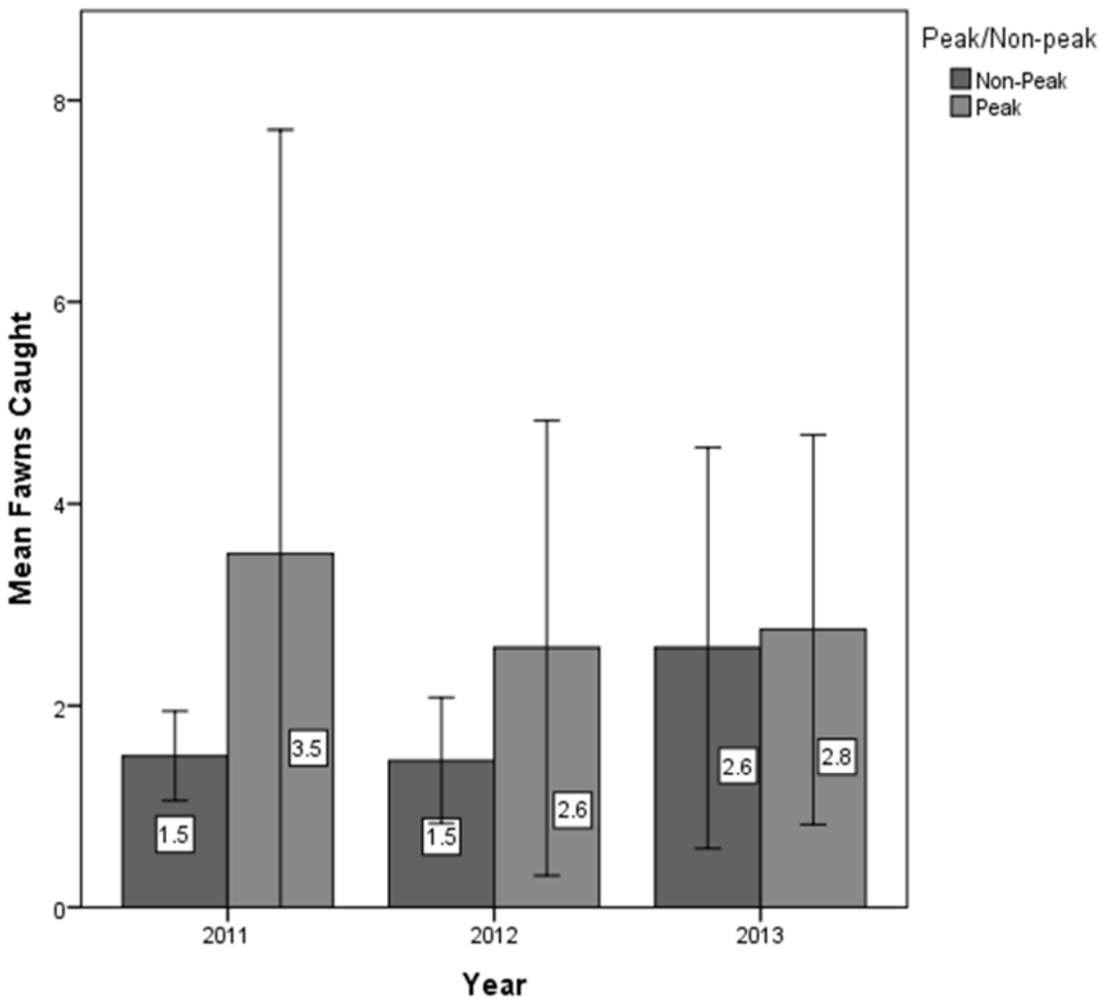

Figure 4. Estimated average daily number of pronghorn fawns born in the Trans-Pecos region of west Texas, USA during the period 2011 to 2013. Peak periods were defined as the period between the 25th and 75th percentiles where 50% of fawns were born.

Cause specific mortality

A total of 23 mortalities and 2 surviving fawns was recorded in 2011. One collar was censored from analysis (transmitter malfunction) and was not located after capture. Predation accounted for 96% (n = 22) of mortalities (Figure 5). Coyote (27%, *Canis latrans*) and bobcat (27%, *Lynx rufus*) predation accounted for the largest component of mortality. Unknown predation accounted for 45% of predation events. In 2012, 27 of 34 collared fawns died. Bobcat predation was highest of all predators accounting for 37% of the mortalities. 2012 was the only year in which a mortality due to a golden eagle (*Aguila chrysaetos*) was documented. Of the 40 collared fawns in 2013 we documented 20 mortalities. Predation was again the largest mortality factor, accounting for 85% of the recorded mortalities with coyotes being the most common predator.

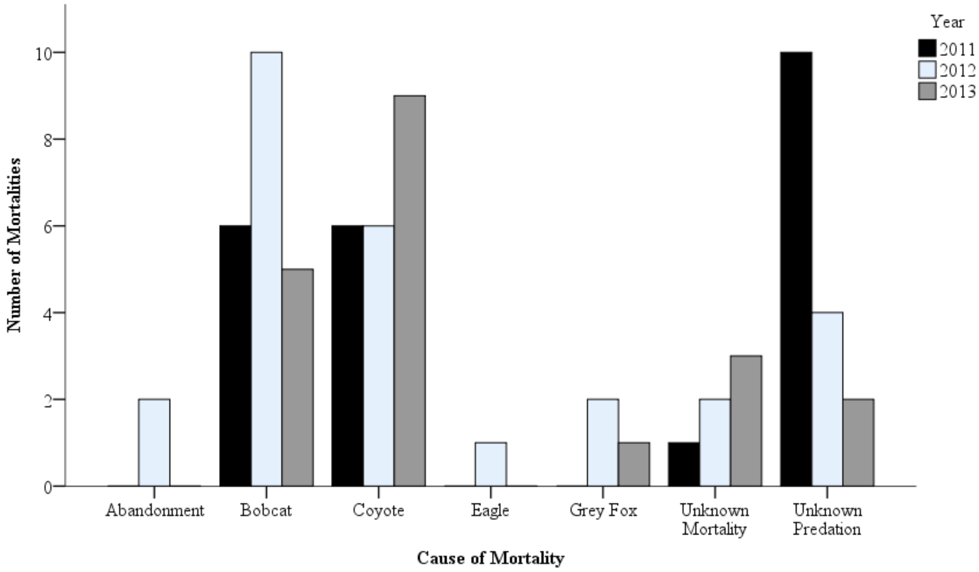

Figure 5. Number of cause specific fawn mortalities during the pronghorn fawning season across the Trans-Pecos region of far west Texas, USA during the period 2011 to 2013.

Survival rates

Overall survival of fawns across the study period differed significantly (χ^2 = 13.783, P = 0.001) across years. Both the survival rate and survival time (i.e., number of days alive) were highest in 2013 and lowest in 2011 (Table 1). In 2011 and 2013, survival rates and survival times of fawns born during the peak fawning period were higher than the non-peak period, but these differences were not statistically significant (2011: χ^2 = 0.003, P = 0.956, 2013: χ^2 = 2.193, P = 0.139). In 2012, fawns born outside of the peak fawning period generally had higher survival than those born during peak fawning, but again the difference was not significant (χ^2 = 2.799, P = 0.094). Even when pooled across years, fawns born within the peak fawning period did not have significantly higher survival than fawns born in the non-peak period (χ^2 = 0.016, P = 0.901).

Table 1. Survival rates and survival times (days) with standard erros (S.E.) and confidence intervals (C.I.) of pronghorn fawns during the fawning season in the Trans-Pecos region of west Texas, USA.

		Survival Rate		Survival Time			
						95% Confidence Interval	
Year	**Peak/Non-Peak**	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**	**Lower Bound**	**Upper Bound**
2011	Non-Peak	0.000	0.000	28.000	5.818	16.598	39.402
	Peak	0.133	0.088	31.133	7.238	16.947	45.320
	Overall	0.080	0.054	29.880	4.881	20.312	39.448
2012	Non-Peak	0.353	0.116	50.235	9.134	32.333	68.138
	Peak	0.059	0.057	26.412	5.256	16.110	36.714
	Overall	0.206	0.069	38.324	5.651	27.247	49.400
2013	Non-Peak	0.222	0.139	49.111	11.453	26.663	71.559
	Peak	0.581	0.089	69.194	6.484	56.485	81.902
	Overall	0.500	0.079	64.675	5.801	53.305	76.045
All years	Non-Peak	0.222	0.069	43.778	5.641	32.722	54.834
	Peak	0.333	0.059	48.587	4.662	39.450	57.725
	Overall	0.293	0.046	46.838	3.614	39.754	53.922

DISCUSSION

Contrary to our predictions, we found no difference in survival of fawns born in the peak fawning period compared to those born outside the peak period. Our findings do not concur with those documented elsewhere (see for example: Autenrieth and Fitcher 1975, Gregg et al. 2001, O'Gara and Yoakum 2004). A possible explanation for why we failed to detect a difference in survival between these periods is that we also did not detect a clearly defined peak during the fawning period. Both factors however could be the result of low sample size. Small sample size may have limited our ability to detect only very large differences in survival and peak/non-peak breeding periods. Even though the number of fawns born during the 'peak' was higher than other periods, this difference was not significant. This suggests that over the study period, on our study sites, pronghorn may have a relatively uniform fawning period without a well-defined peak as previously described (Rutberg 1987, Byers 1997, Gregg et al. 2001). Furthermore, in each year length of the fawning period was substantially longer than the 3-week average estimated across pronghorn range (Autenrieth and Fitcher 1975, O'Gara 2004, O'Gara and Yoakum 2004).

The protracted fawning period may have been a factor contributing to low survival rates of fawns. In 2011 and 2013 the fawning periods were at least 9 days longer than reported elsewhere (Autenrieth and Fitcher 1975, Gregg et al. 2001, O'Gara 2004, O'Gara and Yoakum 2004), and 35 days longer in 2012. Since birth synchrony has been linked to nutritional status of does during the breeding season (Dunbar: unpublished data, O'Gara and Yoakum 2004), we suspect the protracted fawning periods were a result of habitat conditions across the 3 years.

Below average precipitation coupled to above average drought conditions (Palmer Drought Severity Index, NOAA 2015) likely reduced body condition of does throughout the breeding and fawning seasons. Because it may take longer for some individuals to meet their nutritional needs, does in poor quality habitats come into estrus over a longer period of time compared to high quality habitats (Demarais and Krausman 2000, O'Gara and Yoakum 2004). Pronghorn does with adequate nutrition will breed, and consequently fawn, at about the same time. Conversely, does in poor nutritional condition, especially young and old individuals, will breed later, thereby extending the fawning period (Dunbar, Hart Mountain National Antelope Refuge: unpublished data, O'Gara and Yoakum 2004).

The variation in fawning period across years in our study was likely linked to habitat conditions. Because fawning date is intrinsically linked to condition of the doe during the previous year's breeding period, the extreme drought in 2011 (precipitation was 20 cm below average, South Central Climate Science Center 2013) likely resulted in the 56-day fawning period in 2012. Precipitation in 2010 and 2012, although below average for the region, had improved from 2011, resulting in better habitat conditions and shorter fawning periods.

Survival increased from 2011 to 2013 as precipitation and range conditions improved. Precipitation in 2011 averaged just 9.2 cm and increased to 29.8 cm by 2013 (South Central Climate Science Center 2013). Although we did not directly monitor vegetation cover, in 2011 many parturition and fawn capture sites were exposed bare dirt patches, whereas by 2013 all sites had some level of vegetative cover. Not surprisingly trends in fawn survival matched precipitation, increasing from 0.08 in 2011 to 0.50 in 2013. Our findings are supported by Fagan et al. (2004) who recorded a significant positive relationship between winter precipitation and pronghorn fawn survival. Due to the significant drought conditions, in 2011 some fawns appeared to be severely malnourished with low body weights compared to 2012 and 2013. Indeed in 2011, field technicians also documented numerous still-births and abandoned fawns, both of which were not documented in 2012 or 2013. Condition of does in late gestation can have a direct effect on fawn birth weight in ungulates (Thorne et al. 1976), and lactating does on poor nutrition may have lower milk production (Ginnett and Young 2000). Low birth weight of fawns can increase the risk of hypothermia or starvation (Thorne et al. 1976) and increase chances of predation (Clutton-Brock et al. 1982). Average body weight of fawns captured in 2011 was just 2.4 kg, whereas body weights were 3.8 kg in 2012 and 3.5 kg in 2013. The increased fawn weights in 2012 and 2013 likely improved survival rates as fawns may have been better able to evade predation, and fewer individuals died from starvation.

Studies throughout pronghorn range indicate predators are the main cause of fawn mortality (Neff and Woolsey 1979, Tucker and Garner 1980, Barrett 1984, Smith et al. 1986, Ockenfels et al. 1992). Indeed, predation was the greatest cause of mortality to fawns in this study. Predation rates may have been unusually high in this region as small mammal populations declined in response to drought (B. Allcorn, Borderlands Research Institute: unpublished data). Drought is known to reduce small mammal populations as availability of resources decline (Bradley et al. 2006). Reduced availability of small mammals, such as rabbits, increases dependency of predators on larger prey such as pronghorn. Coyotes and bobcats accounted for 55%, 70%, and 82% of all predation events in 2011, 2012, and 2013, respectively.

We were surprised to see such high predation rates by bobcats. Although bobcats have been known to account for up to 61% of fawn mortalities in other regions (Beale and Smith

1973), we did not expect bobcat predation rates to rival the predation rates of coyotes. Most predator management (trapping and aerial gunning) in the Trans-Pecos is targeted at coyotes, which may explain the high percentage of bobcat predation. Irrespective of the cause of mortality, we found mortality of fawns occurred at later ages than previously reported. Barrett (1984) found that the majority of predation occurred on fawns between 4-15 days of age, but predation was still of concern to animals 16-57 days old, whereas we found fawns typically survived 30 days in 2011, 38 days in 2012, and 65 days in 2013. Anecdotally, fawn capture crews reported an increase in jack-rabbits (*Lepus californicus*) and cottontail rabbits (*Sylvilagus audubonii*) from 2011 to 2013. We suspect as habitat conditions improved, small mammal populations increased and provided alternative food sources to predators thereby alleviating predation pressure on pronghorn. Additionally, predator management (aerial gunning) occurred extensively across study sites in 2013. Increased survival perceived to be a result of improved habitat quality may therefore be confounded by diminished predator numbers ensuing from management. We suspect improved survival rates, particularly in 2013, resulted from a combination of habitat improvement and predator management.

Since births are the primary mode of growth in a population (O' Gara 2004), fawn survival in the Trans-Pecos is essential. There are many management strategies that can be implemented to aid fawn survival, but abundant and timely precipitation is still the most important (Simpson et al. 2006). Hailey et al. (1964) reported that precipitation received during the late winter and early spring is responsible for the number of fawns produced that year. Fawn recruitment is essential for pronghorn population growth (Ockenfels 1995). Lee et al. (1989) proposed that dietary overlap with cattle and sheep, fences that prevent movement to more suitable habitat, loss of habitat due to human development, water availability, predators, diseases, and nutritional concerns may play a role in pronghorn population dynamics. The Trans-Pecos region is experiencing many of these problems (Sullins 2002, Simpson et al. 2007), which may have contributed to low fawn recruitment. If populations in arid regions of Texas are limited by forage production, increases due to rainfall should result in better lactation by females and correspondingly better nutritional status of fawns and females (Brown et al. 2002).

MANAGEMENT IMPLICATIONS

Fawn survival over the duration of our study was relatively low and we failed to detect a clearly defined peak fawning period. Low survival rates appeared to be the result of chronic predation. Although not directly measured in this study, anecdotal observations suggested that during dryer years effects of overgrazing by cattle were more apparent. Overgrazing served to reduce available cover for concealment of new-born fawns at parturition sites. Since management is unable to control the amount of precipitation received, and subsequently the production of concealment cover, the simplest and perhaps most effective form of management available is predator control. Implementation of predator control during the breeding and fawning periods can increase pronghorn fawn survival (Hailey 1979, Neff et al. 1985, Cannon 1995, Spencer and Beach 2006, Brown 2009). Coyotes are the most effective predator at killing pronghorn fawns (Barrett 1984, Gregg et al. 2001), and most of that mortality happens before fawns are 1-month old (Barrett 1984). If predators can be reduced from the landscape prior to the fawning season, fawn survival rates can be expected to be higher (Hailey 1979, Neff et al. 1985, Smith et al. 1986). In our study, pronghorn kill sites were often found along fences, and in fence corners.

Additionally, observers often witnessed predators (mostly coyotes) running pronghorn into fence corners to trap them. Remnants of net-wire fencing from sheep and goat ranching in the 1960s are the most significant barriers preventing pronghorn from escaping predators throughout the Trans-Pecos (Buechner 1950, Hailey et al. 1966, Garrison 2015). Unlike species such as deer, pronghorn rarely jump over fences, but prefer to crawl underneath fences when crossing. Removing or modifying (i.e. lifting the bottom strand) these barriers will allow pronghorn to escape from predators and/or move to areas of better nutrition benefitting both adults and fawns (Gray 2012).

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STATE AND PROVINCE PRONGHORN STATUS REPORT, 2016

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Abstract: As the host of the 27th Biennial Pronghorn Workshop, Montana provided the status report on pronghorn (*Antilocapra americana)* populations and management in North America. On April 6, 2016, we electronically mailed a standardized questionnaire to the 26 states and provinces within the current range of pronghorns in the United States, Canada, and Mexico. We received back 18 answered questionnaires. Based on these data, the North American pronghorn population (excluding Alberta, Nebraska and Mexican states other than Baja California Sur) was estimated to be at approximately 837,164 animals in 2015. Wyoming's population comprised over half of that estimated number at 407,400 animals. Montana, with 138,288 animals, and New Mexico, with 45,000 animals, had the next highest population sizes. Washington had the fewest pronghorn with an estimated 132 animals, but this was up from an estimated 23 in 2013. Wyoming, Montana, Colorado, and New Mexico, which together compose the core of North American pronghorn habitat, contained about 80% of North America's pronghorn, and populations have remained stable since at least 1983 at about 670,000. Buck:doe ratios varied from 25:100 in Oklahoma to 100:100 in Baja California Sur, and fawn:doe ratios ranged from as low as 28:100 in Oklahoma to 74:100 in Wyoming. An estimated 76, 632 pronghorns were harvested in 2015 (50,193 bucks and 23,493 does and fawns). Baja California Sur and Washington did not have hunting seasons in 2015. We also discussed research and management in the various jurisdictions (i.e., predator management, habitat projects, restocking efforts).

The Biennial Pronghorn Workshop is a Western Association of Fish and Wildlife Agencies (WAFWA)-sanctioned event, and Montana as the hosting state is proud to provide an update on the current status of pronghorn in North America. In April 2016, Montana Fish, Wildlife and Parks (MFWP) sent a standardized questionnaire (via electronic mail) to the 26 states and provinces in the United States, Canada, and Mexico that have pronghorn. Eighteen questionnaires were returned. We compiled a database and presented information from these 18 questionnaires plus Montana at the 27th Biennial Pronghorn Workshop, and the database MFWP created during this effort will be available for future use.

Pronghorn numbers and management in the states and provinces across North America vary considerably. This status update gives an overview of pronghorn population size, sex and age ratios, survey methods, hunting seasons, harvest numbers, predator management, and pronghorn research projects for 2015.

POPULATION ESTIMATES AND SURVEY METHODS

The estimated pronghorn population in North America (excluding Alberta, Nebraska and Mexican states other than Baja California Sur) was 837,164 in 2015 (Table 1). Estimates by state/province ranged from 132 animals in Washington to 407,164 animals in Wyoming. Washington's small population has increased substantially from the 23 animals estimated in 2013. At the other end of the spectrum, Wyoming was again home to over half of the pronghorn in North America. Wyoming, Montana, Colorado, and New Mexico provide the core habitat for North America's pronghorn and together contain over 80 percent of the continent's population. Based on data from past workshops, estimated pronghorn numbers in these four states increased from 272,750 in 1964 to 731,061 in 1983 and has remained relatively stable, averaging about 670,000 since (Figure 1). Data between 1964 and 1983 for these states are incomplete.

Table 1. North American pronghorn population estimates, demographic ratios, and survey methods by state/province in 2015. No data were available from Alberta and Mexican states other than Baja California Sur.

State/Province	Population Estimate	Ratio Per 100 Does 2015 (Long Term Average)		Survey Method[1]	Month(s) Surveyed
		Bucks	Fawns		
Arizona	11,000	34 (33)	33 (27)	FW/H	June-August
Baja California Sur	372	100 (100)	32 (50)	FW/G	-
California	4,572	-	-	H	February
Colorado	79,400	48 (49)	62 (48)	FW/H	July-August
Idaho	13,000	-	-	FW/H/G	Sporadic
Kansas	3,250	34 (36)	57 (57)	Aerial	July-August
Montana	138,288	-	-	FW/G	July
Nevada	28,500	38 (36)	39 (35)	H/G	September
Nebraska	-	46 ( )	57 ( )	FW	August
New Mexico	45,000	27 ( )	38 ( )	FW	July-August
North Dakota	5,250	44 (35)	52 (61)	FW	July
Oklahoma	2,250	25 (26)	28 ( )	FW/G	Feb.-March
Oregon	21,000	41 (31)	55 (36)	FW/G	-
Saskatchewan	11,250	48 (51)	62 (54)	G	July
South Dakota	34,300	42 (47)	68 (80)	FW/G	April-June
Texas	18,000	47 (56)	44 (34)	FW/G	May-July
Utah	14,200	46 (45)	58 (44)	FW	March-April
Washington	132	-	-	FW/G	February
Wyoming	407,400	51 (50)	74 (59)	FW/G	May-June
Total	837,164	-	-	-	-

[1]FW=Fixed Wing, H=Helicopter, G=Ground Surveys

Not all states and provinces summarized buck:doe or fawn:doe ratios at a statewide level, although those that did not (including Montana), collected this information at smaller scales for management purposes. Among states that collected these ratios at the state or provincial scale in 2015, values varied from 25 bucks:100 does in Oklahoma to 100 bucks:100 does in Baja California Sur, Mexico (Table 1). Most jurisdictions approximated 40 bucks:100 does. Fawn:doe ratios were as high as 74:100 in Wyoming and as low as 28:100 in Oklahoma (Table 1).

Survey methods used to count and classify pronghorn also varied among jurisdictions

(Table 1). Fixed-wing line transects were most commonly employed, although Arizona and Idaho also utilized helicopters and California did so exclusively. Idaho and Nevada conducted their surveys opportunistically as time and money allowed, or in conjunction with surveys for other species. Many states also applied ground surveys to supplement aerial data and/or collect buck:doe and fawn:doe ratios. Saskatchewan used only 50-mile ground surveys on 70 routes across the entire range of pronghorn in the province.

Survey timing varied among jurisdictions, ranging from April to February. Thirteen jurisdictions conducted summer surveys, three conducted winter surveys, and six conducted spring surveys. No states nor provinces surveyed during fall. Six states and provinces surveyed in two different seasons. Eleven surveyed pre-hunt, while seven jurisdictions surveyed post-hunt. Six jurisdictions reported using some sort of sightability correction for population estimates, while 11 jurisdictions did not correct for sightability, and two jurisdictions did not report whether they used a sightability correction or not.

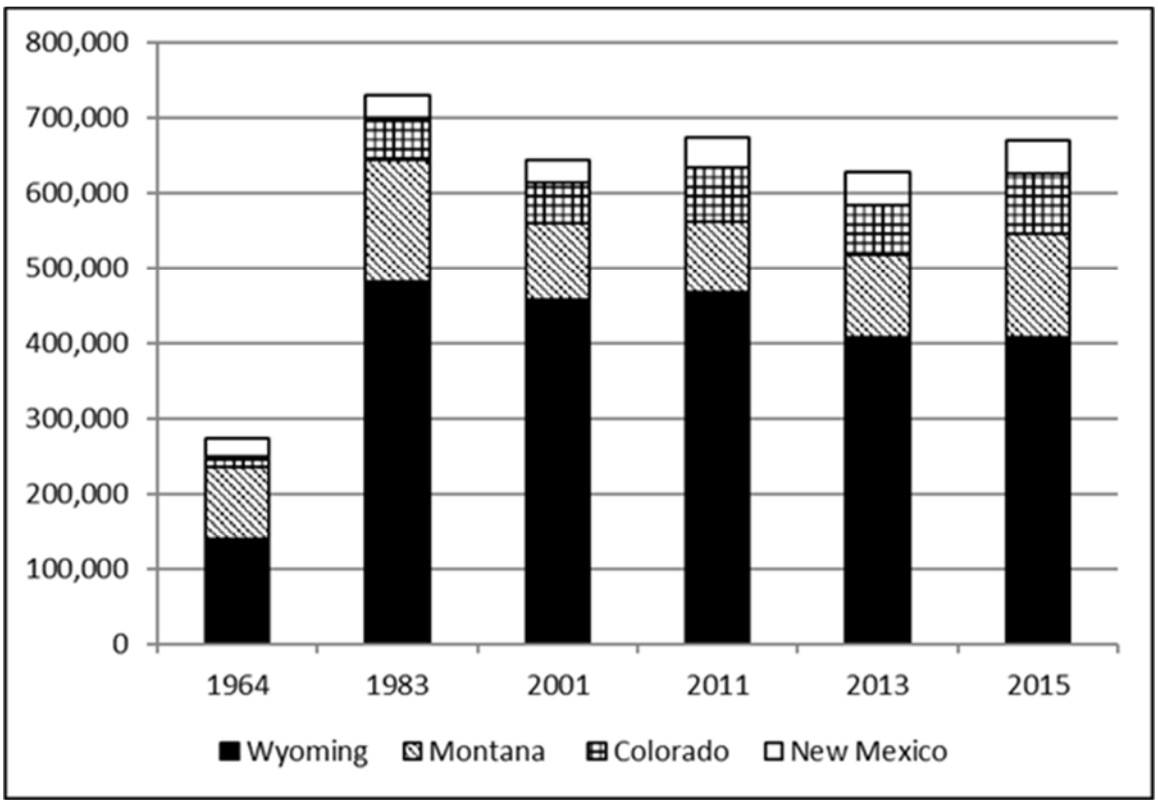

Figure 1. Estimated pronghorn numbers in the core of North American habitat, Wyoming, Montana, Colorado and New Mexico, 1964-2015.

HUNTING SEASON STRUCTURE

Hunting season lengths and methods varied considerably across North America. Hunting is an important component of pronghorn management and most jurisdictions attempt to provide resident and non-residents hunting opportunity. Baja California Sur and Washington, two states with <400 pronghorn each, did not have hunting seasons in 2015. "Standard" buck rifle seasons averaged 13 days long and ranged from 4 days in Kansas to 30 days in Idaho and Montana. Four states offered longer rifle opportunities for does, with Wyoming and Nebraska doe seasons as long as to 90 and 92 days respectively. Nine states had special muzzleloader hunts, which averaged 12 days, and Wyoming's muzzleloader seasons varied from 16 to 60 days depending on location. Every state that offered rifle hunts also offered special archery hunts. Texas had no special hunts for either muzzleloaders or archery, but hunters could use these weapons if they chose. Wyoming is the only state that managed some places for trophy quality by managing for 60-70 bucks per 100 does in 10% of hunt areas.

Fifteen of 17 jurisdictions used some variation of a draw system to issue pronghorn hunting licenses. For instance, Kansas used a preference point system in its draw, and in Texas, permits are issued to landowners. Seven jurisdictions all the taking of multiple pronghorn in a season. Fifteen jurisdictions allowed non-resident hunters, usually limited to some percentage of total available licenses, while North Dakota and Saskatchewan did not allow non-residents. Additionally, seven jurisdictions offered some type of youth hunt to recruit younger, new hunters.

HARVEST SUMMARY

Pronghorn hunters in North America, excluding Alberta, Nebraska and Mexican states other than Baja California Sur, harvested 73,632 animals in 2015 (50,193 bucks and 23,439 does and fawns; Table 2). Wyoming hunters harvested 49% of 2015's total harvest, or 35,766 animals. Commensurate with their populations, Oklahoma and Saskatchewan harvested the fewest with 72 and 125 animals each, respectively.

Harvest estimation methods varied among the states and province. Eleven jurisdictions utilized the internet, or some combination of internet and phone or mail, to gather harvest information (Figure 2). Three states used mail only, two had a mandatory physical check, and one used phone with a mailing to non-residents. Nine jurisdictions maintain a mandatory harvest reporting system, and among these an 88% of hunters reported on their hunting. Among states without mandatory reporting, an average of 57% of hunters reported. The three states with the highest harvest, Wyoming, Montana, and Colorado, do not have mandatory reporting; they contact a adequate random samples of hunters to estimate harvest with sufficient precision for management purposes.

Eleven states collected horn measurement data harvested pronghorn. Oklahoma, for example, did so by requiring hunters to check their animalsat a physical check station. Montana, on the other hand, collected these data at field check stations where hunters were required to stop only if they were driving past, but were otherwise not required to check their animals.

Table 2. Pronghorn harvest in 2015 by jurisdiction and season type.

	Rifle			Muzzleloader			Archery			Total		
State/Province	Bucks	Does	Total	Bucks	Does	Total	Bucks	Does	Total	Bucks	Does	Total
Arizona	401	0	401	50	0	50	102	0	102	553	0	553
Baja California Sur	------- No Season -------											
California	210	0	210			0	10	0	10	220	0	220
Colorado	4,098	3,722	7,820	154	74	228	481	51	532	4,733	3,847	8,580
Idaho	885	397	1,282	318	28	346	2,327	107	2,434	3,530	532	4,062
Kansas	115	7	122	27	3	30	33	5	38	175	15	190
Montana	7,032	3,006	10,038				730	99	829	7,762	3,105	10,867
Nebraska	471	120	591	101	4	105	204	31	235	776	155	931
Nevada	1,652	800	2,452	19	0	19	124	0	124	1,795	800	2,595
New Mexico	2,816	284	3,100	116	1	117	183	0	183	3,115	285	3,400
North Dakota	266	26	292				20	0	20	286	26	312
Oklahoma	23	40	63				8	1	9	31	41	72
Oregon	1,107	139	1,246	55	3	58	120	9	129	1,282	151	1,433
Saskatchewan	122	3	125							122	3	125
South Dakota	1,910	317	2,227				411	52	463	2,321	369	2,690
Texas	558	0	558							558	0	558
Utah	634	497	1,131	47	6	53	94	0	94	775	503	1,278
Washington	------- No Season -------											
Wyoming	20,845	12,871	33,716	117	1	118	1,197	735	1,932	22,159	13,607	35,766
Total	43,145	22,229	65,374	1,004	120	1,124	6,044	1,090	7,134	50,193	23,439	73,632

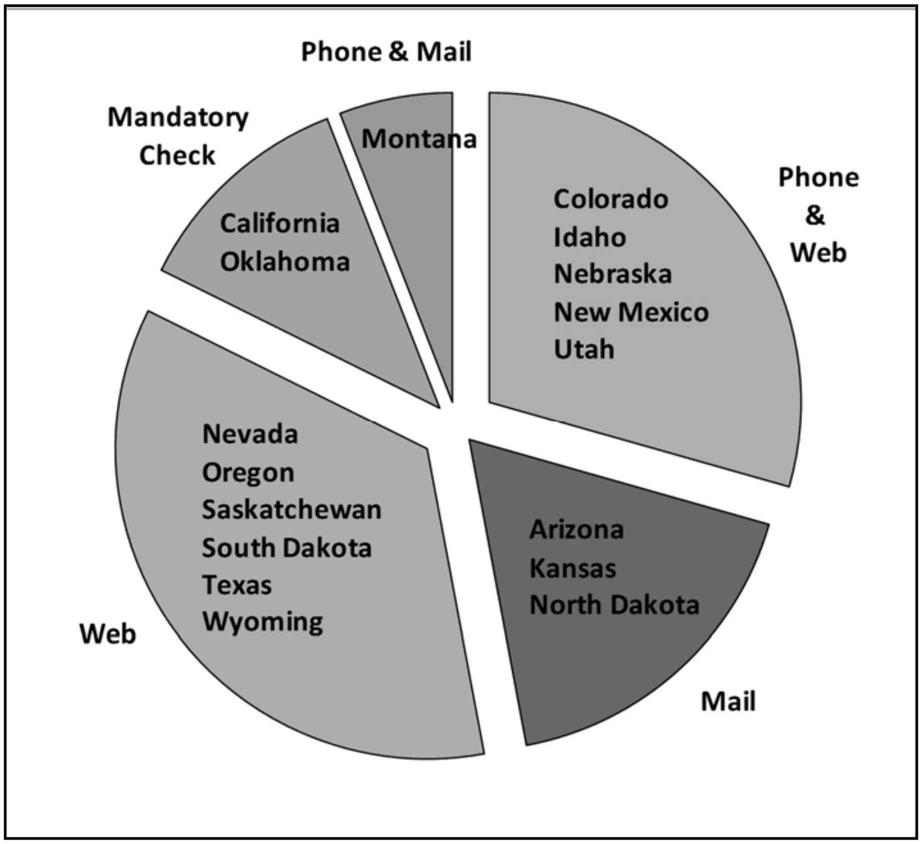

Figure 2. Methods used to gather pronghorn harvest information from hunters.

PREDATOR MANAGEMENT

Seven states, Arizona, Baja California Sur, Montana, New Mexico, Texas, Utah, and Wyoming, performed predator management to benefit pronghorn via increasing fawn survival, but Texas also noted it utilized predator management to protect translocated animals. Aerial gunning and trapping were the most common forms of predator removal, and USDA APHIS Wildlife Services was used in three states. Saskatchewan and South Dakota also conducted predator management, but only to protect livestock rather than directly benefitting pronghorn.

The effectiveness of predator management has been debated for decades, and success depends on whether “that removal is focused, intensive, substantive, and timed to provide advantage to prey” (Wakeling et al. 2014). Arizona, Baja California Sur, Montana, and Texas all reported that predator management was effective for them, while New Mexico stated it was too early to tell, Utah had too little data to say, and Wyoming reported that their efforts were not effective. Baja California Sur and Texas conveyed their predator management to be cost effective. Arizona said predator management was not cost effective from the standpoint of selling more licenses, but it was cost effective if one considered the increased hunting activity on local economies and the intrinsic value of a viable, growing pronghorn population. Montana and Wyoming informed us that predator management was not cost effective. Utah also thought predator management was not cost effective but added that it was "politically necessary."

HABITAT ENHANCEMENTS

Nine jurisdictions, Arizona, Baja California Sur, Colorado, Nevada, New Mexico, South Dakota, Texas, Utah, and Wyoming, are actively engaged in efforts to enhance pronghorn habitat. Fence modifications or removal, prescribed fire or fire rehabilitation, brush control, and water development are the most common enhancement projects performed. Most pronghorn habitat work is being done on federal, state, or provincial lands, but several jurisdictions are also working with landowners on private lands.

Partnering with private landowners is essential for pronghorn management since in many jurisdictions, the majority of pronghorn range is privately owned.

PRONGHORN RESEARCH AND RESTOCKING EFFORTS

Ten states were conducting pronghorn-related research in 2015. Of these states, Arizona, California, Oregon, South Dakota, and Wyoming examiningmovements, distribution and habitat use. Idaho was investigating neonate survival, and New Mexico studying the effects of predator removal. The ongoing population decline in the Trans-Pecos region is Texas's focus, and Wyoming is looking at habitat selection related to oil and gas development.

Fourteen states spoke to the need for further research. Investigations to determine factors affecting survival, especially neonate survival, were commonly expressed research needs. Other research needs identified included the effects of habitat loss and predation on populations, comparing the genetics of the *peninsular* and *oregona* subspecies, landowner attitudes toward pronghorns, pronghorn growth associated with wildfires, barber pole worm prevalence, livestock competition, translocation methods and success, effects of highway crossings, and survey methodologies.

Four states translocated pronghorn. Most notably, New Mexico has moved ~700 animals since 2009 from agricultural areas experiencing crop damage to areas with low numbers. In recent years, Texas has moved over 500 animals from healthy populations in the panhandle to the Trans-Pecos region where populations have been struggling. Utah has also translocated animals from high-population sites to areas with low populations. Finally, Baja California Sur has moved some animals to increase genetic diversity in a very small population of pronghorn.

DISCUSSION

The questionnaire used to generate this status report shared similarities to questionnaires used in previous Biennial Pronghorn Workshop status reports. Much variation exists in pronghorn survey techniques and analysis methods, hunting seasons and lengths, habitat enhancements, predator management practices, and research projects among jurisdictions within North American pronghorn range.

Private lands and working with private landowners also continue to be very important issues in regard to pronghorn management. This workshop attempts to facilitate the sharing of information between jurisdictions, which is crucial to the management and long-term survival of pronghorn across their range.

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Awards

BERRENDO AWARD

This award is the most significant award offered through the WAFWA sanctioned Pronghorn Workshop. One award per workshop is given to an individual or a group of collaborators who have made great contributions to management or research for pronghorn. The award is named for a desert pronghorn, an animal that epitomizes the difficulty of being a pronghorn.

Nomination Criteria

1. An individual, organization, or group of collaborators that has gone well beyond normal job expectations in a project related to pronghorn.
2. These contributions need to afford significant scientific advances in the management or research of pronghorn.
3. These contributions can represent a single event or a long-term commitment to pronghorn.

Previous Winners

2002 Jim Yoakum (deceased)
2004 Bart O'Gara (deceased)
2006 Tom Pojar
2008 Richard Ockenfels
2010 Rich Guenzel
2012 None
2014 Tommy Hailey
2016 Jorge Cancino was unable to attend the 2016 Pronghorn Workshop and in 2018 he should be recognized by his peers.

Nomination for 2016 Pronghorn Workshop Berrendo Award – Jorge Cancino

Berrendo Award Nomination - 2016
T. M. Pojar
July 24, 2016

To: Rebecca Mowry, Awards Chair
cc: Jay Newell, Workshop Chair
From: Tom Pojar

It is with great pleasure that I nominate Jorge Cancino, Centro de Investigaciones Biologicas del Nosoeste, Baja California Sur, Mexico for the 2016 Berrendo Award to be presented at the 27th Biennial Pronghorn Workshop. Jorge is a most deserving nominee given his contributions over the years for the advancement of the knowledge of pronghorn through hands-on research and management. He has authored or co-authored 39 publications both in english and spanish pertaining to management of pronghorn.

Two of his recent contributions are worth mention because of their broad application and utility for other researchers, managers, and students. He was a major contributor to the most recent (2014) edition of the Pronghorn Management Guides. These guides provide vital information for managers throughout pronghorn range. In addition, Jorge, in conjunction with his able co-authors, J. D. Yoakum and P. F. Jones, was instrumental in bringing the publication, Pronghorn Bibliography, to fruition. His tireless and persistent attention to detail has increased the number of citations from 354 in the last edition to 2,736 in the recent (2014) edition; the publications span years from 1649 to 2011. This is an amazing accomplishment.

Jorge qualifies as an outstanding and exceptional candidate because he meets the criteria set forth in the Pronghorn Workshop Operating Manual including being a long-time career contributor of publications and participation in Pronghorn Workshops and committees and has proven to have a long-term commitment to the wellbeing of pronghorn.

Two or our colleagues and previous Berrendo Award recipients, Richard Ockenfels (2008) and Rich Guenzel (2010), have provided further documentation of Jorge’s contribution; their endorsements of Jorge are gratefully acknowledged.

Letters of Endorsement

From Richard Ockenfels

I am adding my endorsement of Jorge Cancino Hernandez from Baja California Sur, Mexico as the 2016 recipient of the Berrendo Award. I have known Jorge since 1994, when he had an article in the Proceedings of the 16th Pronghorn Workshop. Jorge has regularly published papers or abstracts in most of the proceedings since 1994, either as lead author or a co-author with other Mexican biologists working with pronghorn in Mexico.

In 2000, Jorge served as the Chairman and host of the 19th Pronghorn Workshop, held in La Paz, Baja California Sur, Mexico. He followed me in hosting a workshop (I Chaired the 18th in Prescott, Arizona in 1998). I assisted Jorge with that workshop, since Arizona has an International Program to partner with Mexico on wildlife issues.

Jorge provided input to the 1998 version of the important Pronghorn Management Guides, and was a co-contributor to the 2006 version of the Guides. More importantly, Jorge translated the 2006 into Spanish so that his nation could more readily use the Guides in the management of the species.

In 2002, Jorge received, along with me and 2 others, the first "Special Recognition Awards" presented at the Pronghorn Workshops. He started working on the Peninsular Pronghorn subspecies in the 1980s, with the completion of his 1988 thesis from Universidad Automona Chapingo, Chapingo, Mexico.

As one can see, Jorge has spent 30 years of his career working on pronghorn (mostly Peninsular) in Mexico. He has been an important part of their federal management plans for pronghorn.

I wholeheartedly endorse Jorge for the 2016 Berrendo Award.

Sincerely,
Richard Ockenfels
Retired, Arizona Game and Fish Department

From Rich Guenzel

I am pleased to endorse Jorge Cancino's nomination for the 2016 Berrendo Award. He is certainly very deserving of this recognition. Jorge embodies the true spirit of the Berrendo Award in nearly every perspective. Jorge has been active in pronghorn research for over 25 years. He has been intimately involved in efforts to recover the endangered Peninsular pronghorn. He authored or coauthored numerous reports and articles on pronghorn. Jorge has been very involved in the Biennial Pronghorn Workshops, including organizing and chairing the 19th Workshop, presenting numerous papers, and helping revise and edit the latest editions of the Pronghorn Management Guides and the Pronghorn Bibliography. I can personally attest to Jorge's dedication to pronghorn conservation. My first professional collaborations with Jorge started at the 1996 Biennial Pronghorn Workshop, leading up to the successful capture, rearing and transfer of pronghorn fawns from Wyoming to Mexico for research on assisted reproduction and education. I've had the privilege of working with Jorge on the most recent revision of the management guides. If Jim Yoakum were alive today, he would certainly acknowledge Jorge's personal friendship that helped bring Jim's last major contributions to pronghorn management to fruition. The following summarizes some of Jorge's other significant contributions to pronghorn conservation:

Helped establish a captive breeding facility for endangered Peninsular Pronghorn in the El Vizcaino Preserve in BCS,

Helped develop a recovery plan for pronghorn in Mexico,

Conducted population viability analysis on endangered Peninsular pronghorn,

Translated pronghorn management guides and other significant works into Spanish to help disseminate recent findings for biologists in Mexico, and

Is acknowledged in O'Gara and Yoakum's 2004 book: *Pronghorn Ecology and Management.*

Given the years of service and myriad of contributions Jorge has provided for the advancement of pronghorn management, it is my honor to add my support to the nomination of Jorge Cancino for the 2016 Berrendo Award.

Respectfully,
Rich Guenzel
Retired, Wyoming Game and Fish Department

SPECIAL RECOGNITION AWARD

Many people or organizations make significant contributions that aid in the management of pronghorn. These can include projects that are oriented to pronghorn management or research. The Special Recognition Award is a certificate recognizing the accomplishments of an individual or group. Up to 4 awards can be presented per Workshop.

Nomination Criteria

A. Nominee should be living and currently/recently active and involved in pronghorn conservation.
B. Contribution(s) should be an important event or accumulation of important contributions to pronghorn management, research, or appreciation.
C. Contribution(s) can be a new field or analytical technique that has regional or range-wide application.

Previous Winners

2002: Karl Menzel, NE, Jorge Cancino, BCS, MX, Bill Rudd, WY, and Richard Ockenfels, AZ
2004: Rich Guenzel, WY, Alice Koch, CA, John Hervert, AZ, and Arizona Antelope Foundation
2006: Rick Danvir, UT, Fred Lindzey, WY, and Rick Miller, AZ
2008: Morley Barrett, AB, David Brown, AZ
2014 Joe Riis, SD, Hall Sawyer, WY, and Emilene Ostlind, WY

2016 Special Recognition Award Recipients

The special recognition award went to Jorge Cancino and Paul Jones for their tireless and extensive efforts to assist Jim Yoakum in bringing the latest editions of the Pronghorn Management Guidelines and the Pronghorn Bibliography (J. D.Yoakum, J.Cancino and P.F.Jones.2014. Pronghorn bibliography: a review of the literature and contributions to a bibliography from 1649 to 2011.) to publication in time for the 2014 Biennial Pronghorn Workshop.

PRONGHORN HALL OF FAME

The Pronghorn Hall of Fame was created to honor historic individuals or groups/teams that accomplished outstanding services for pronghorn conservation prior to the establishment of the Berrendo Award (pre-2002). Those involved in pronghorn conservation today owe much to the efforts of pronghorn biologists, managers, researchers, and other conservationists that produced worthy efforts prior to the establishments of any awards. The Pronghorn Hall of Fame awards are an ongoing effort to formally recognize the careers and long-term contributions of our predecessors. There is **no limit as to the number of Hall of Fame awards to be given** at a Pronghorn Workshop, however, it is likely that only 1 or 2 will be granted at any particular Pronghorn Workshop.

Nomination Criteria:
The nominee must be retired or deceased (criteria accepted at 2006 Pronghorn Workshop).

A. An inductee may be a pronghorn advocate, a land manager, an agency biologist, an academic, an artist, or various combinations thereof.
B. Nominee's career should have contributed to increases in pronghorn numbers, distribution, knowledge of, or appreciation.
C. Pronghorn conservation must have been a paramount part of nominee's career (criteria accepted at 2006 Pronghorn Workshop).
D. Contributions must be of historic significance to the management, research, or conservation of pronghorn.
E. Contributions should have regional, national, or international value or application.
F. Contributions can be scientific or popular books, chapters of major books, a monograph, agency/organization special reports, or a number of articles (>5) in scientific or popular journals.
G. Contribution(s) can be an important scientific advancement in either a field or analytical technique.
H. All Berrendo Award winners will automatically be inducted into the Pronghorn Hall of Fame, either upon retirement or passing (criteria accepted at 2006 Pronghorn Workshop).

Previous Winners

A. Jim D. Yoakum and Bart W. O'Gara (2002 and 2004 Berrendo Award recipients) automatically inducted.
B. Tom M. Pojar (2006 Berrendo Award recipient) automatically inducted.
C. 2008—Arthur S. Einarsen (OR), Helmut K. Buechner (TX), and T. Paul Russell (NM) elected as members.
D. Richard A. Ockenfels (2008 Berrendo Award recipient) automatically inducted.

Inducted into the Hall of Fame in 2016

In 2016 William G. Hepworth was nominated by Rich Guenzel and Jorge Cancino was automatically inducted into the Pronghorn Hall of Fame. The nomination letter for William Hepworth follows:

Nomination respectfully submitted by:

Rich Guenzel, Wyoming Game and Fish Department (retired).,
2504 Hillside Drive, Laramie, WY 82070-4844
Phone: 307-399-8058 Email: rguenzel@aol.com

I wholeheartedly nominate William G. Hepworth to the Pronghorn Hall of Fame. Bill Hepworth is the Dean of Pronghorn Research and Management in Wyoming, the State with the largest and most productive populations of pronghorn. He was instrumental in establishing and conducting several major research studies on pronghorn in Wyoming's Red Desert during the 1960's-1970's (see Severson et al. 1968 and Sundstrom et al. 1973 in the bibliography below, as well as E. Taylor. 1975. Pronghorn carrying capacity of Wyoming's Red Desert. Wildlife Technical Report No. 3, Wyoming Game and Fish Department, Cheyenne). Many of these projects are considered classic studies on the species and provide baseline for current and future research in the State.

Bill also served as an adjunct professor at the University of Wyoming while Director of Technical Research for the Wyoming Game and Fish Department. Bill was a member of numerous graduate committees in both wildlife and range management. His contributions are noted in nearly all theses and dissertations involving pronghorn in Wyoming at the University of Wyoming and other projects during his tenure, including studies by S.A. Boyle, J. G. Cook, R.J. Guenzel, D.A. Ingold, J. G. Jacobs, A. F. Reeve, T J. Ryder, K. E. Severson, C. Sundstrom, E. Taylor and J Yeo. Bill is renowned as an excellent technical editor. He is acknowledged in B. W. O'Gara and J. D. Yoakum's *Pronghorn Ecology and Management* book of 2004

Additionally, Bill played a major role in disease investigations of pronghorn and other wildlife. He also helped Floyd Blunt in developing procedures for handling and rearing pronghorn and other big game at the Wyoming Game and Fish Department's captive wildlife research facility in Sybille Canyon. Bill's knowledge and advice on pronghorn are still sought out today.

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