- The -
WILDLIFE SOCIETY
Wyoming Chapter

The Wildlife Society
CENTRAL MOUNTAINS and PLAINS SECTION
Colorado · Kansas · Nebraska
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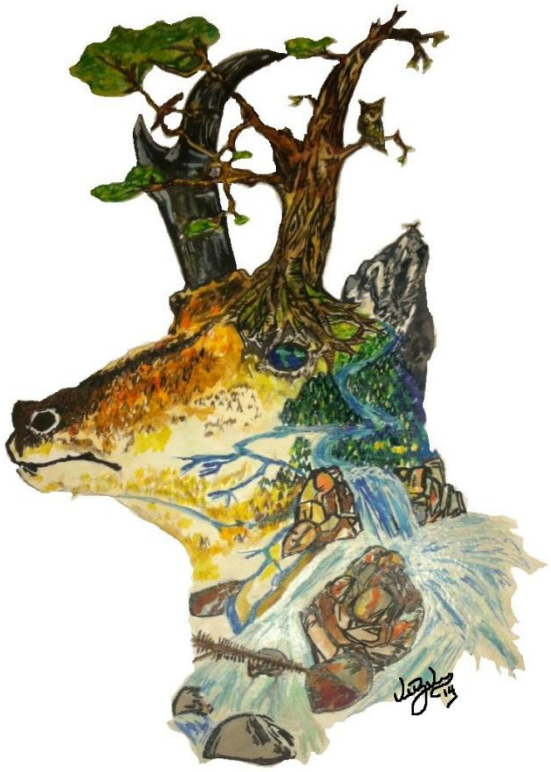
2014 WYTWS/CMPS Joint Annual Meeting



"Manifesting the Destiny of Wildlife and Habitat Science, Stewardship, and Solvency"

Holiday Inn – Sheridan, WY

August 25-28, 2014

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We also sincerely thank our numerous Quartz sponsors, who are recognized by name on the label attached to each donated item. We greatly appreciate your support!

Annual Meeting Overview

MONDAY, AUGUST 25

10:00 am – 2:00 pm	Northeast Level 1 Team Meeting
3:00 – 5:00 pm	WYTWS Board/Member Meeting

COWCH Interviews (see separate COWCH schedule for time slots)

Dinner on your own

TUESDAY, AUGUST 26

5:30 – 6:30 am	Early-Bird Birding Field Trip – Acme Site
7:00 – 8:00 am	Registration
8:00 – 8:20 am	Introductory remarks
8:20 – 10:00 am	Student oral presentations
10:00 – 10:20 am	Break (Sponsors: KLJ Engineering and Muley Fanatic Foundation) and registration
10:20 am – 12:00 pm	Student oral presentations
12:00 – 1:00 pm	Lunch – Mentor Program or on your own
1:00 – 2:20 pm	Student oral presentations
2:20 – 2:40 pm	Break (Sponsors: Audubon Rockies and Theodore Roosevelt Conservation Partnership) and registration
2:40 – 5:00 pm	Professional oral presentations
5:00 – 6:30 pm	Dinner on your own
6:30 – 8:00 pm	Student/Professional Mixer and Poster Session
8:00 – 10:00 pm	Inter-Chapter Student/Professional Mixed Team Quiz Bowl

WEDNESDAY, AUGUST 27

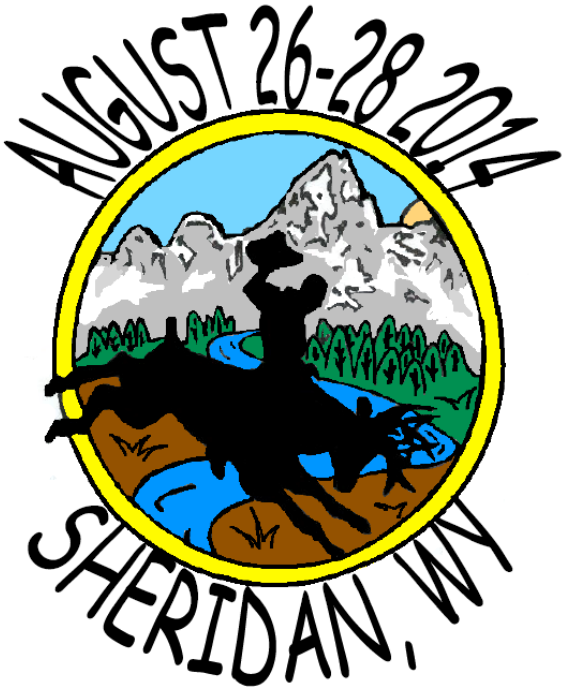
5:30 – 6:30 am	Early-Bird Birding Field Trip – Welsh Property
7:00 – 8:00 am	President's Breakfast (Sibley Room), and registration
8:00 – 9:40 am	Professional oral presentations
9:40 – 10:00 am	Break (Sponsor: Wyoming Wildlife Federation) and registration
10:00 – 11:40 am	Professional oral presentations

11:40 am – 12:45 pm	Lunch – CMPS Board/Member Meeting
12:45 – 2:45 pm	Mini-workshops, 1st Session
2:45 – 3:00 pm	Break (Sponsor: Rocky Mountain Elk Foundation) and registration
3:00 – 5:00 pm	Mini-workshops, 2nd Session
5:30 – 6:30 pm	Happy hour, Tom Easterly Memorial Fund gun raffle, silent auction/raffle
6:30 – 9:00 pm	Banquet, keynote speech, awards, live auction, end silent auction/raffle
9:00 pm – 12:00 am	Dancing to live music by Jarad Rogerson (Sponsor: Wyoming Arts Council and National Endowment for the Arts) and the Teka Brock Band

THURSDAY, AUGUST 28

COWCH Interviews (see separate COWCH schedule for time slots)

7:00 – 11:30 am	Field Trips – Field Necropsy Techniques; Habitat Projects and More
8:00 – 11:30 am	Workshop – Designing and Constructing VHF and GPS Radio Transmitters
11:30 am – 1:00 pm	Lunch on your own
1:00 – 2:00 pm	Special Session – Big Game Nutrition
2:00 – 2:15 pm	Break (Sponsors: University of Wyoming Biodiversity Institute and Wyoming Natural Diversity Database)
2:15 – 4:00 pm	Special Session – Big Game Nutrition
4:00 – 4:15 pm	WYTWS/CMPS Annual Meeting closing remarks



Schedule of Events

MONDAY, AUGUST 25

10:00 am – 2:00 pm **NORTHEAST LEVEL 1 TEAM MEETING** – All are welcome
Federal Section 7 consultation streamlining
U.S. Forest Service Office, 2013 Eastside 2nd Street, Sheridan

3:00 – 5:00 pm **WYTWS BOARD/MEMBER MEETING** – All are welcome
Stripmine Meeting Room

COWCH INTERVIEWS – Andrea Orabona (see separate COWCH schedule for time slots)

DINNER ON YOUR OWN

TUESDAY, AUGUST 26

5:30 – 6:30 am **EARLY-BIRD BIRDING FIELD TRIP** – Tim Thomas, North Hotel Entrance
Vehicles provided by Wyoming Department of Environmental Quality and Wyoming Game and Fish Department

7:00 – 8:00 am **REGISTRATION** – Therese Hartman, South Bighorn Ballroom

8:00 – 8:20 am **INTRODUCTORY REMARKS** – Eric Maichak, Bill Vodehnal, and Jon Haufler; Bighorn Ballroom

Student Oral Presentations – Moderator: Dave Edmunds, Bighorn Ballroom, 8:20 – 10:00 am

8:20 – 8:40 am **COMPARATIVE DEMOGRAPHY OF TWO MOOSE POPULATIONS WITH CONTRASTING PREDATOR DENSITIES**
Brendan A. Oates, Jacob R. Goheen, Matthew J. Kauffman, Gary L. Fralick, and Kevin L. Monteith

8:40 – 9:00 am **LINKING HABITAT AND NUTRITION WITH POPULATION PERFORMANCE IN MOOSE**
Brett R. Jesmer, Jacob R. Goheen, Kevin L. Monteith, and Matthew J. Kauffman

9:00 – 9:20 am **FACTORS AFFECTING SURVIVAL OF NEONATE ROCKY MOUNTAIN ELK IN THE BLACK HILLS OF SOUTH DAKOTA AND WYOMING**
Benjamin D. Simpson, Jonathan A. Jenks, Troy Grovenburg, Andrew J. Lindbloom, and John T. Kanta

9:20 – 9:40 am **FOREST REGENERATION RESPONSE TO LARGE UNGULATE REDUCTION AT SULLYS HILL NATIONAL GAME PRESERVE: IS SEEDLING RECRUITMENT WITHOUT RETURN OF SPECIES RICHNESS ENOUGH?**
Bethany J. Walters, Mark R. Fisher, and Susan N. Ellis-Felege

9:40 – 10:00 am **CONNECTING TABANID RELEVANCE AND PREVELANCE WITH ELAEOPHOROSIS IN WYOMING MOOSE**
Amy L. Williams, Will Laegreid, Myrna Miller, John Henningsen, and Brant Schumaker

10:00 – 10:20 am **BREAK – *Sponsored by KLJ Engineering and the Muley Fanatic Foundation***

REGISTRATION – Therese Hartman, South Bighorn Ballroom

Student Oral Presentations – Moderator: Daly Edmunds, Bighorn Ballroom, 10:20 am – 12:00 pm

10:20 – 10:40 am **CAUSE-SPECIFIC MORTALITIES AND SURVIVAL RATES OF WHITE-TAILED DEER IN THE RED RIVER VALLEY OF NORTH DAKOTA**
Kristin Sternhagen, William Jensen, and Jonathon Jenks

10:40 – 11:00 am **NATURAL SELECTION OF MULE DEER (*ODOCOILEUS HEMIONUS*) ASSOCIATED WITH REDUCED SUSCEPTIBILITY TO CHRONIC WASTING DISEASE**
Melia DeVivo, David Edmunds, Bryan Richards, Terry Kreeger, Brant Schumaker, Hermann Schatzl, and Todd Cornish

11:00 – 11:20 am **A COMPREHENSIVE EVALUATION OF DISTRIBUTIONAL SHIFTS IN PAIRED HOME RANGE ESTIMATES**
Justin G. Clapp and Jeffrey L. Beck

11:20 – 11:40 am **USE OF MULTI-STATE MARK-RECAPTURE MODELS TO ASSESS MALE GREATER SAGE-GROUSE MOVEMENTS BETWEEN LEKS**
Aleshia L. Fremgen, Christopher T. Rota, Christopher P. Hansen, Mark A. Rumble, and Joshua J. Millspaugh

11:40 am – 12:00 pm **2014 WYTWS FELLOWSHIP**
Victor Villalobos, Corinna Riginos, Martin Grenier, and Daly Edmunds

12:00 – 1:00 pm **MENTOR PROGRAM LUNCH** – Tony Mong, Sibley Room

LUNCH ON YOUR OWN

Student Oral Presentations – Moderator: Tony Mong, Bighorn Ballroom, 1:00 – 2:20 pm

1:00 – 1:20 pm **USING STABLE ISOTOPES TO IDENTIFY GREATER SAGE-GROUSE INTERSEASONAL MOVEMENT BEHAVIOR**
Aaron C. Pratt and Jeffrey L. Beck

1:20 – 1:40 pm **A TYPICALLY SPECIALIST PREDATOR, THE GREATER SHORT-HORNED LIZARD (*PHRYNOSOMA HERNANDESI*), REVEALS VARIABLE DIET ACROSS ITS GEOGRAPHIC RANGE, OBSCURING CONSTRAINTS THAT MOST LIMIT DISTRIBUTION**
Reilly R. Dibner and Daniel F. Doak

1:40 – 2:00 pm **ASSESSING THE EFFICACY OF FATHEAD MINNOWS (*PIMEPHALES PROMELAS*) FOR MOSQUITO CONTROL**
Ryan Watchorn and Dr. Brad Fedy

2:00 – 2:20 pm **GOLDEN EAGLE RANGE DYNAMICS**
Jason D. Tack, Zachary H. Bowen, Barry R. Noon, and Bradley C. Fedy

2:20 – 2:40 pm **BREAK – *Sponsored by Audubon Rockies and the Theodore Roosevelt Conservation Partnership***

REGISTRATION – Therese Hartman, South Bighorn Ballroom

Professional Oral Presentations – Moderator: Dan Thompson, Bighorn Ballroom, 2:40 – 5:00 pm

2:40 – 3:00 pm **MULE DEER ACCLIMATION TO ENERGY DEVELOPMENT: FACT OR FICTION?**
Hall Sawyer and Ryan Nielson

3:00 – 3:20 pm **CONSERVING MIGRATORY MULE DEER THROUGH THE UMBRELLA OF SAGE-GROUSE**
Holly E. Copeland, Hall Sawyer, Kevin L. Monteith, David E. Naugle, Amy Pocewicz, Nicholas Graf, and Matthew J. Kauffman

3:20 – 3:40 pm **PREDICTING UNGULATE PARTURITION USING MOVEMENT DATA**
Matthew M. Hayes, Matthew J. Kauffman, Kevin L. Monteith, and Emma C. Fuller

3:40 – 4:00 pm **MITIGATION EFFECTIVENESS FOR IMPROVING PRODUCTIVITY OF GREATER SAGE-GROUSE INFLUENCED BY ENERGY DEVELOPMENT**
Christopher P. Kirol, Andrew L. Sutphin, Laura Bond, Mark R. Fuller, and Thomas L. Maechtle

4:00 – 4:20 pm **THE INFLUENCE OF MITIGATION ON ANIMAL HABITAT SELECTION WITHIN ENERGY DEVELOPMENT FIELDS**
Bradley Fedy, Chris Kirol, Andrew Sutphin, Jason D. Tack, and Tom Maechtle

4:20 – 4:40 pm **RESOURCE SELECTION BY PRONGHORN EXPOSED TO WIND ENERGY DEVELOPMENT ON WINTER RANGE**
Katie L. Taylor, Jeffrey L. Beck, and Shannon E. Albeke

4:40 – 5:00 pm **AN OVERVIEW AND UPDATE ON THE DRAFT STRATEGIC PLAN FOR THE WILDLIFE SOCIETY**
Ken Williams

5:00 – 6:30 pm **DINNER ON YOUR OWN**

6:30 – 8:00 pm **STUDENT/PROFESSIONAL MIXER AND POSTER SESSION**
Bighorn Ballroom and Foyer

RESPONSE OF PRONGHORN POPULATION PRODUCTIVITY TO ANTHROPOGENIC AND ENVIRONMENTAL CHANGE IN THE RED DESERT, WYOMING
Adele K. Reinking, Jeffrey L. Beck, Kevin L. Monteith, Tony W. Mong, and Mary Read

MODELING WETLAND EPHEMERALITY UNDER CLIMATE CHANGE: IMPLICATIONS FOR AMPHIBIAN BIODIVERSITY AND GENE FLOW
Charlotte Gabrielsen, Melanie Murphy, and Jeffrey Evans

EVALUATING THE INFLUENCE OF DEVELOPMENT ON MULE DEER MIGRATIONS
Teal Wyckoff[1,3], Matthew Kauffman[2], Shannon Albeke[3], and Hall Sawyer[4]

NUTRITIONAL RELATIONSHIPS BETWEEN MULE DEER BEHAVIOR AND HUMAN DISTURBANCE
Samantha P.H. Dwinnell, Matthew J. Kauffman, Hall Sawyer, Gary L. Fralick, and Kevin L. Monteith

A PRELIMINARY LOOK AT THE SECRET LIFE OF FLEDGLING SAGEBRUSH SONGBIRDS
Jason D. Carlisle and Anna D. Chalfoun

ANTHROPOGENIC DISTURBANCE ALTERS THE ISOTOPIC NICHE AND INTERSPECIFIC INTERACTIONS OF TWO SYMPATRIC SMALL MAMMALS
Carolyn A. Eckrich, Elizabeth A. Flaherty, and Merav Ben-David

ASSIGNING COYOTES TO UTAH POPULATIONS USING MICROSATELLITE DNA MARKERS
James A. Walton, John A. Shivik, Katelin J. Madsen, and Karen E. Mock

MULTI-TAXA INVENTORIES ON NATIONAL LANDSCAPE CONSERVATION INITIATIVE LANDS IN WYOMING
Ian Abernethy, Wendy Estes-Zumpf, Lusha Tronstad, and Bonnie Heidel

AMBIENT AIR TEMPERATURE COMPARISONS OF 3 DIFFERENT RIPARIAN VEGETATION COMMUNITIES
Nick Scribner

ASSESSING THE FUTURE VULNERABILITY OF WYOMNG'S TERRESTRIAL WILDLIFE SPECIES AND HABITATS
Amy Pocewicz, Holly E. Copeland, Martin B. Grenier, Douglas A. Keinath, and Lindsey M. Washkoviak

LONG-TERM POPULATION MONITORING OF MOUNTAIN PLOVER, UPLAND SANDPIPER, LONG-BILLED CURLEW, AND BURROWING OWL IN WYOMING
Andrea C. Orabona and Jeffrey S. Coyle

8:00 – 10:00 pm **INTER-CHAPTER STUDENT/PROFESSIONAL MIXED TEAM QUIZ BOWL**
Moderators: Tony Mong, Martin Grenier, and Eric Maichak, Bighorn Ballroom

WEDNESDAY, AUGUST 27

5:30 – 6:30 am **EARLY-BIRD BIRDING FIELD TRIP** – Tim Thomas, North Hotel Entrance
Vehicles provided by Wyoming Department of Environmental Quality and Wyoming Game and Fish Department

7:00 – 8:00 am **PRESIDENT'S BREAKFAST** – Tony Mong and Martin Grenier, Sibley Room

REGISTRATION – Therese Hartman, South Bighorn Ballroom

Professional Oral Presentations – Moderator: Dr. Kevin Monteith, Bighorn Ballroom, 8:00 – 9:40 am

8:00 – 8:20 am **LIVESTOCK MANAGEMENT FOR COEXISTENCE WITH LARGE CARNIVORES, HEALTHY LAND, AND PRODUCTIVE RANCHES**
Matthew K. Barnes

8:20 – 8:40 am **PRAIRIE FLORA AND FAUNA: JUST WAVING IN THE WIND**
Kenneth F. Higgins

8:40 – 9:00 am **RANGE-WIDE POPULATION SIZE OF THE LESSER PRAIRIE-CHICKEN**
Lyman McDonald, Troy Rintz, Kristen Adachi, Fawn Hornsby, and Grant Gardner

9:00 – 9:20 am **THE WYOMING MIGRATION INITIATIVE MIGRATION VIEWER: A TOOL FOR UNDERSTANDING AND CONSERVING WYOMING'S UNGULATE MIGRATIONS (AN UPDATE)**
Bill Rudd and Shannon E. Albeke

9:20 – 9:40 am **TWENTY YEARS LATER: EVALUATING MANAGEMENT AND MONITORING OF TRUMPETER SWANS (*CYGNUS BUCCINATOR*) IN WYOMING**
Susan Patla

9:40 – 10:00 am **BREAK – *Sponsored by the Wyoming Wildlife Federation***

REGISTRATION – Therese Hartman, South Bighorn Ballroom

Professional Oral Presentations – Moderator: Eric Maichak, Bighorn Ballroom, 10:00 – 11:40 am

10:00 – 10:20 am **DESIGN, METHODS, AND PRODUCTS OF THE INTEGRATED MONITORING IN BIRD CONSERVATION REGIONS (IMBCR) PROGRAM**
Nick Van Lanen and David Hanni

10:20 – 10:40 am **SOUND LEVELS NEAR LEKS OF GREATER SAGE-GROUSE IN WYOMING, 2013, AND RECOMMENDED PROTOCOLS FOR MEASUREMENTS**
Skip Ambrose and Chris Florian

10:40 – 11:00 am **IMPLEMENTATION OF THE BLACK-FOOTED FERRET PROGRAMMATIC SAFE HARBOR AGREEMENT IN THE GREAT PLAINS**
John P. Hughes and Donald R. Gober

11:00 – 11:20 am **FORAGING PLASTICITY IN A HIGHLY SPECIALIZED CARNIVORE, THE ENDANGERED BLACK-FOOTED FERRET**
Katrina M. Brickner, Martin B. Grenier, Adrienne E. Crosier, and Jonathan N. Pauli

11:20 – 11:40 am **HISTORY OF THE CENTRAL MOUNTAINS AND PLAINS SECTION OF THE WILDLIFE SOCIETY**
Jerry Kobriger

11:40 am – 12:45 pm **CMPS BOARD/MEMBER LUNCH MEETING** – Sugarland Mining Company

12:45 – 2:45 pm **MINI-WORKSHOPS, 1ST SESSION** – Bighorn Ballroom

Introduction to GIS with Management Applications, Part I – Geneva Room
Matt Hayes, University of Wyoming

Introduction to Quadrat, Distance, and Occupancy Sampling – Solitude Room
Dr. Mary Conner, Utah State University

Wildlife Chemical Immobilization – Diamond Room
Dr. Mary Wood, Wyoming Game and Fish Department

Harnessing the Power of Partnerships – Sibley Room
Jill Randall, Wyoming Game and Fish Department

2:45 – 3:00 pm **BREAK – *Sponsored by the Rocky Mountain Elk Foundation***

REGISTRATION – Therese Hartman, South Bighorn Ballroom

3:00 – 5:00 pm **MINI-WORKSHOPS, 2nd SESSION** – Bighorn Ballroom

Introduction to GIS with Management Applications, Part II – Geneva Room
Matt Hayes, University of Wyoming

Wildlife Disease Investigations and Field Necropsies – Solitude Room
Dr. Todd Cornish, University of Wyoming
Jeremy Brown, Private Consultant

Wyoming Chapter, TWS: 2014 Leadership Institute – Diamond Room
Tom Ryder, TWS Past President, Wyoming Game and Fish Department (Retired)
Sarah Bucklin, 2009 TWSLI Graduate, Bureau of Land Management
Nichole Cudworth, 2011 TWSLI Graduate, Wyoming Game and Fish Department
Tony Mong, 2011 TWSLI Graduate, Wyoming Game and Fish Department

Connecting People with Science – Sibley Room
Mark Gocke, Wyoming Game and Fish Department

5:30 – 6:30 pm **HAPPY HOUR AND TOM EASTERLY MEMORIAL FUND GUN RAFFLE**
Moderator: Tim Thomas, West Terrace

START SILENT AUCTION AND RAFFLE
Moderators: Andrea Orabona and Therese Hartman, Ballroom Foyer

6:30 – 9:00 pm **BANQUET AND MORE** – Bighorn Ballroom

7:00 – 7:15 pm **KEYNOTE SPEECH** – Dr. Chris Madson

7:15 – 8:00 pm **AWARDS**
Awards – WYTWS Service, Best Student Poster Presentation, Best Student Oral Presentation, Best Newsletter Award, Professional of the Year, Citizen of the Year, Lifetime Achievement

8:00 – 9:00 pm **LIVE AUCTION – *Sponsored by Carl Wolfe***
Auctioneer: Nick Siddle

9:00 pm **END SILENT AUCTION AND RAFFLE** – Winners to be posted

9:00 pm – 12:00 am **LIVE MUSIC AND DANCING**

9:00 – 9:30 pm Jared Rogerson
Sponsored by the Wyoming Arts Council and National Endowment for the Arts

9:30 pm – 12:00 am Teka Brock Band

THURSDAY, AUGUST 28

COWCH INTERVIEWS – Andrea Orabona (see separate COWCH schedule for time slots)

Field Trips – Meet at the Holiday Inn North Entrance, 7:00 – 11:30 am

7:00 – 11:30 am **WILDLIFE NECROPSY LABORATORY** – WGFD Sheridan Regional Office
Dr. Todd Cornish, University of Wyoming

HABITAT PROJECTS AND MORE – WGFD Habitat Management Areas
Seth Roseberry, Tim Thomas, and Ben Wise, Wyoming Game and Fish Department

Workshop – Bighorn Ballroom, 8:00 – 11:30 am

8:00 – 11:30 am **DESIGNING AND CONSTRUCTING VHF AND GPS RADIO TRANSMITTERS – *Sponsored by the National Science Foundation***
Bryan Bedrosian, Beringia South, and Doug Bonham, Hawk-Owl Systems

11:30 am – 1:00 pm **LUNCH ON YOUR OWN**

Special Session – Bighorn Ballroom, 1:00 – 4:00 pm

1:00 – 4:00 pm **BIG GAME NUTRITION – *Sponsored by the University of Wyoming Biodiversity Institute and Wyoming Natural Diversity Database***

1:00 – 2:00 pm **INTRODUCTION AND OVERVIEW**
Dr. Gary Beauvais, Wyoming Natural Diversity Database

LINKING NUTRITIONAL CONDITION TO POPULATION PERFORMANCE IN UNGULATES: APPROACHING THE HOLY GRAIL
Thomas R. Stephenson and Kevin L. Monteith

LINKING HABITAT ATTRIBUTES TO NUTRITIONAL CONDITION AND REPRODUCTIVE PERFORMANCE: NEW DIRECTIONS FOR ELK
Rachel C. Cook, John G. Cook, and Larry L. Irwin

FAT AND FEARFUL OR SKINNY AND FEARLESS? BODY CONDITION AND THE ECOLOGY OF FEAR
Arthur D. Middleton and Carlos Martinez del Rio

RISK-SENSITIVE ALLOCATION IN SEASONAL DYNAMICS OF FAT AND PROTEIN RESERVES IN A LONG-LIVED MAMMAL
Kevin L. Monteith, Thomas R. Stephenson, Vernon C. Bleich, Mary M. Conner, Becky M. Pierce, and R. Terry Bowyer

2:00 – 2:15 pm **BREAK – *Sponsored by the University of Wyoming Biodiversity Institute and Wyoming Natural Diversity Database***

2:00 – 4:00 pm

WYOMING'S BIG GAME POPULATION MANAGEMENT – NUTRITION AND HABITAT CONDITION CONSIDERATIONS
Daryl W. Lutz, Keith Shoup, and Justin Binfet

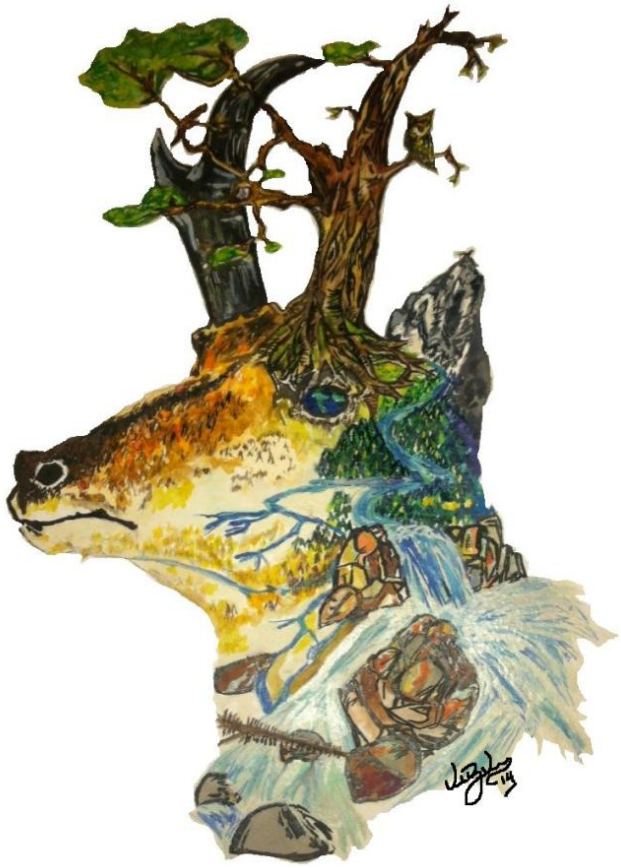
THE WYOMING RANGE MULE DEER INITIATIVE: A CASE STUDY IN MULE DEER MANAGEMENT THROUGH PUBLIC COLLABORATION AND EDUCATION
Gary L. Fralick, Scott G. Smith, Susan S. Boston, Jessica M. Clement, Elaine C. Walsh, Daryl W. Lutz, and William Rudd

UNDERSTANDING UNGULATE POPULATION DYNAMICS: IS NUTRITION THE ANSWER?
Matthew J. Kauffman

PANEL DISCUSSION

4:00 – 4:15 pm

WYTWS/CMPS ANNUAL MEETING CLOSING REMARKS
Eric Maichak, WYTWS President-Elect



Thank you for attending the 2014 WYTWS/CMPS joint Annual Meeting!

Abstracts – Professional Oral Presentations

MULE DEER ACCLIMATION TO ENERGY DEVELOPMENT: FACT OR FICTION?

Hall Sawyer[1] and Ryan Nielson[1]

[1]Western Ecosystems Technology, Inc., 200 South 2nd Street, Suite B, Laramie, WY 82071, USA

Despite numerous studies that show mule deer modifying their behavior in response to energy development, there remains a common perception that ungulates readily adapt to altered landscapes and quickly acclimate to infrastructure associated with energy development. It is frequently presumed that behavioral impacts to ungulates are short-term and restricted to the development phase, but once an energy project transitions to the production phase, any potential impacts are quickly ameliorated. This misperception is especially prevalent in National Environmental Policy Act (NEPA) documents designed to identify and disclose potential impacts associated with development projects on federal lands. We used 15 years of fine-scale GPS data collected from >200 animals before and during large-scale gas development to assess the long-term behavioral patterns of mule deer in western Wyoming. Our results suggest mule deer continued to avoid well pads more than a decade after development began and found no evidence of acclimation. Our data show how winter severity can influence the degree of avoidance and highlight the importance of long-term studies for evaluating energy impacts to wildlife.

CONSERVING MIGRATORY MULE DEER THROUGH THE UMBRELLA OF SAGE-GROUSE

Holly E. Copeland[1], Hall Sawyer[2], Kevin L. Monteith[3], David E. Naugle[4], Amy Pocewicz[1], Nicholas Graf[5], and Matthew J. Kauffman[6]

[1]The Nature Conservancy, 258 Main Street, Lander, WY 82520, USA
[2]Western Ecosystems Technology, Inc., 415 West 17th Street, Suite 200, Cheyenne, WY 82001, USA
[3]Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071, USA
[4]Wildlife Biology Program, University of Montana, Missoula, MT 59812, USA
[5]Wyoming Geographic Information Sciences Center, University of Wyoming, Laramie, WY 82071, USA
[6]U.S. Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071, USA

Conserving migratory ungulates in increasingly human-dominated landscapes presents difficult challenges to land managers and conservation practitioners. Nevertheless, ungulates may receive ancillary benefits from conservation actions designed to protect species of greater conservation priority where their ranges are sympatric. Greater Sage-Grouse (*Centrocerus urophasianus*), for example, have been proposed as an umbrella species for other sagebrush (*Artemesia spp.*) -dependent fauna. We examined a landscape where conservation efforts for sage-grouse overlap spatially with mule deer (*Odocoileus hemionus*) to determine

whether sage-grouse conservation measures might also protect important migration routes and seasonal ranges of mule deer. We conducted a spatial analysis to determine what proportion of migration routes, stopover areas, and winter ranges used by mule deer were located in areas managed for Greater Sage-Grouse conservation. Conservation measures overlapped with 66-70% of migration corridors, 74-75% of stopovers, and 52-91% of wintering areas for two mule deer populations in the upper Green River Basin, Wyoming. Of those proportions, conservation actions targeted towards sage-grouse accounted for approximately half of the overlap in corridors and stopover areas, and nearly all overlap on winter ranges, indicating that measured benefits represent an important step in conserving migrating mule deer. Conservation of migratory species presents unique challenges because, although overlap may be high, connectivity of the entire route must be maintained and barriers to movement anywhere within the corridor could render it unviable. With the goal of protecting entire migration routes, our analysis highlights areas of potential conservation focus for mule deer, which are characterized by high exposure to residential development and use by a large proportion of migrating deer.

PREDICTING UNGULATE PARTURITION USING MOVEMENT DATA

Matthew M. Hayes [1], Matthew J. Kauffman[2], Kevin L. Monteith[1], and Emma C. Fuller[3]

[1]Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, 1000 East University Avenue, Department 3166, University of Wyoming, Laramie, WY 82071, USA
[2]U.S. Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, 1000 East University Avenue, Department 3166, University of Wyoming, Laramie, WY 82071, USA
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Parturition and recruitment are key components of population dynamics in ungulates. The timing and location of parturition in northern ungulates is often thought to occur coincidently with the flush of nutrients during spring. Parturition sites are considered critical habitat, providing cover and nutritional benefits to birthing females, and subsequently to newborn young. Understanding when and where parturition occurs is important to better understand and manage this important life stage. At present, over 1100 elk (*Cervus canadensis*), moose (*Alces alces*), pronghorn (*Antilocapra americana*), and mule deer (*Odocoileous hemionus*) have been captured and fitted with GPS collars throughout Wyoming. Unfortunately, few of these studies also included the ability to monitor and track parturition. We have developed several techniques to determine the date and location of parturition using movement data from GPS collars, and have applied these methods to elk, moose, and mule deer. Using X and Y locations, coupled with the time between successive relocations, we were able to derive attributes of the movement patterns of individuals. By analyzing these movement patterns during spring, when migration and parturition occur, clear patterns emerged that allow detection of the birth event. Our research shows that given a small validation data set for each species, such as VITs (vaginal implant transmitters), we can reliably and accurately determine the date and location of parturition for several ungulate taxa. These methods provide added value to GPS collar datasets, and they will facilitate a better understanding of the ecology and management of parturition in northern ungulates.

MITIGATION EFFECTIVENESS FOR IMPROVING PRODUCTIVITY OF GREATER SAGE-GROUSE INFLUENCED BY ENERGY DEVELOPMENT

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To meet growing energy demands, sagebrush habitats are being developed for oil and gas reserves. These habitats are inhabited by a suite of wildlife species including the Greater Sage-Grouse (*Centrocercus urophasianus*; hereafter "sage-grouse") that is currently being considered for protection under the U.S. Endangered Species Act. Consequently, there is a great need for on-site mitigation that is effective at reducing impacts to co-occurring wildlife, including the sage-grouse. To empirically test the effectiveness of on-site mitigation on sage-grouse nest success, from 2008 to 2011 we monitored 296 nests from radio-marked female sage-grouse in a natural gas (NG) field in the Powder River Basin, Wyoming, USA. Using logistic exposure, we explored and compared nest success in mitigated and non-mitigated development areas and relatively unaltered areas. With GIS, we formed a suite of anthropogenic variables to investigate direct associations between oil and gas infrastructure features and nest success to assess if mitigation was targeting features consequential to nest success. We found that nest success was highest in relatively unaltered habitats; however, nest success was higher in mitigated development areas when compared to non-mitigated development areas. Of the features and habitat modifications assessed (e.g., NG wells, reservoirs, and power lines), reservoirs used for holding NG discharge water had the greatest support as a predictor of nest success. Within a 5 km^2 area surrounding a nest, the probability of nest failure increased by about 15% for every 1.5 km increase in reservoir water edge. Reducing reservoir construction was one mitigation focus, and sage-grouse nesting in mitigated areas were exposed to almost half of the amount of water edge compared to those in non-mitigated areas. Our work is the first to quantify and evaluate the benefits of mitigation to sage-grouse productivity and demonstrate that adaptive management can result in reduced impacts to sage-grouse in energy-altered landscapes.

THE INFLUENCE OF MITIGATION ON ANIMAL HABITAT SELECTION WITHIN ENERGY DEVELOPMENT FIELDS

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Human-wildlife interactions are one of the primary issues in wildlife ecology and management. In order to maintain self-sustaining, healthy wildlife populations, we need to minimize and mitigate the impacts of human endeavors. Mitigation of human development to benefit wildlife involves altering development practices to minimize or offset negative impacts to wildlife populations. Energy development occurs in many prime wildlife habitats and can negatively affect wildlife populations. Despite widespread energy development and mitigation suggestions, few studies have quantitatively assessed the efficacy of on-site mitigation efforts within energy development fields. We examined the influence of on-site mitigation efforts on the distribution and abundance of important Greater Sage-Grouse (*Centrocercus urophasianus*; sage-grouse) nesting habitat within an energy development area. Sage-grouse are a gallinaceous species, year-round resident across

sagebrush-steppe habitats in North America, and co-occur with many prime energy development areas. Sage-grouse responses to energy development are well documented and the species experiences several negative impacts within energy development areas. We conducted our research in an energy development area in the Powder River Basin of northeastern Wyoming. In efforts to mitigate energy development impacts to sage-grouse, several mitigation strategies were implemented in our study site in 2008. We asked the question: did the mitigation efforts implemented produce measurable improvement in sage-grouse nesting habitats within the development area? We used a before-after experimental design. We developed nesting habitat selection models for sage-grouse within the development over 4 years prior to mitigation and 4 years following mitigation. We compared the nesting habitat model structure and the distribution and abundance of preferred habitats pre- and post-mitigation. We documented less avoidance of energy infrastructure and roads in the post-mitigation models.

RESOURCE SELECTION BY PRONGHORN EXPOSED TO WIND ENERGY DEVELOPMENT ON WINTER RANGE

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Increasing demand for wind-generated electricity has raised concerns about potential impacts to wildlife. Landscapes with high potential for wind energy development often coincide with suitable wintering habitat for pronghorn (*Antilocapra americana*). Evaluating the influence of energy development on pronghorn winter habitat selection is particularly critical given that they encounter elevated energetic demands during this time of year. We evaluated pronghorn response to wind energy development over three winters (2010, 2010-2011, 2011-2012) in south-central Wyoming, USA, to better understand potential impacts of wind energy development on wintering ungulates. We obtained data from 47 adult female pronghorn equipped with GPS transmitters and developed resource selection functions for pronghorn at both the population and individual scales. At the population scale, pronghorn selected for areas closer to wind energy facilities and with lower slopes, standard deviation in snow depth, and density of fences. For 37 individuals whose home ranges encompassed wind energy facilities, coefficients for distance to nearest wind energy facility did not differ from zero across all three winters, suggesting wind energy development did not influence individual pronghorn habitat selection. In addition, pronghorn daily net displacement did not increase closer to wind energy facilities (r^2 = 0.001-0.012) during each winter. Avoidance behaviors and increased movement rates previously documented in ungulate populations in relation to energy development are commonly associated with increased human presence within oil and gas fields. Low traffic rates observed within wind energy facilities in our study may have contributed to the lack of avoidance observed by pronghorn. Pronghorn response to wind energy development may deviate from our findings if wind energy developments at equivalent or larger scales encompass higher levels of human activity (i.e., increased traffic rates and longer construction periods) than those associated with our study.

LIVESTOCK MANAGEMENT FOR COEXISTENCE WITH LARGE CARNIVORES, HEALTHY LAND, AND PRODUCTIVE RANCHES

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The livestock-large carnivore coexistence field can be more effective by expanding from a direct focus on carnivores and predation prevention tools to the context of livestock management and the broader social-ecological systems of ranches and rural communities. Ranchers may be able to apply many of the same approaches that work for rangeland health and livestock production to reduce conflicts with large carnivores. Generally, in the presence of their predators, wild grazing animals tend to form large, dense herds that then move around the landscape to seek fresh forage, avoid fouled areas, and escape predators; and to have their young in short, synchronized birthing seasons (predator satiation). Grazing management involving high stocking density and frequent movement, such as rotational grazing and herding with low-stress livestock handling, can improve rangeland health and livestock production by managing the distribution of grazing across time, space, and plant species. Short calving seasons can increase livestock production and reduce labor inputs, especially when timed to coincide with peak availability of forage quality. Livestock management, including grazing management and calving in short seasons that correspond with those of wild ungulates, may directly and synergistically reduce predation risk, while simultaneously establishing a management context in which other predation prevention practices and tools can be used more effectively. Case studies on summer cattle range in the U.S. Northern Rockies involving rotational grazing and herding suggest methods that can be more widely used to improve grazing distribution and prevent depredations.

PRAIRIE FLORA AND FAUNA: JUST WAVING IN THE WIND

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Having worked, played, partied, and personally experienced numerous wildlife research and management successes and failures during the past 50+ years in the CMPS region, it provides a person like me several opportunities to clarify some of the myths, quotes, and rumors. And it also enables me to address some likely scenarios for you to anticipate in the future. During this presentation, I will discuss changes in demographics of humans and a few select wildlife species during the past 16,000 years ±, changes in agricultural practices and equipment, changes in education and communication processes, and the general trend of putting little education effort toward the historic key people associated with the various disciplines in our respective fields of wildlife. I will address the correctness of quotable political statements such as “I will work to save the family farm” and how our growing global economy is, in reality, destroying our land base and sacrificing our soils, our flora and fauna, and our lifestyles so that other economies, such as China, can prosper. To be blunt, each person’s I.Q. index level is strongly associated to their home environment from birth to age 12 and their cognitive development is largely associated to their exposure to a large variety of diverse surroundings and cultural conditions and objects. Thus, urbanization commonly precludes experiences with nature and agricultural food production and results in mental stratification of our populations. In closing, education and climatic disasters, such as a 10-year drought, are the primary incentives to conserving and/or restoring our native prairie flora and fauna – otherwise “We’re Just Waving in the Wind”.

RANGE-WIDE POPULATION SIZE OF THE LESSER PRAIRIE-CHICKEN

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Monitoring population trend and estimation of population size is important for natural resource agencies in establishing and evaluating management practices. A probabilistic sample provides a precise and unbiased estimate of population size that assists in monitoring trends in population size and abundance. Arial line transects were flown in 2012, 2013, and 2014 and mark-recapture distance sampling methods were used to estimate the abundance of Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) and Lesser Prairie-Chicken leks in four ecoregions in the Great Plains, USA. The number of mixed species leks which contained both Lesser and Greater Prairie-Chickens (*T. cupido*), the number of hybrid Lesser-Greater Prairie-Chickens, and the number of Greater Prairie-Chickens where these species' ranges overlap were also estimated. The study area included the 2011 estimated occupied Lesser Prairie-Chicken range in five states and was divided into four ecoregions. The sampling frame over the study area consisted of 536 15- by 15-km grid cells. In 2012, 512 transects within a probabilistic stratified sample of 256 cells totaling 7,680 km were flown, and 566 transects within a probabilistic stratified sample of 283 cells totaling 8,490 km were flow in 2013 and 2014. A total of 2,930 Lesser Prairie-Chicken leks were estimated in 2012 (2,036 in 2013) and 453 Lesser and Greater Prairie-Chicken mixed leks in 2012 (356 in 2013) were estimated in the study area from data collected in 2012 and 2013. A total of 34,440 individual Lesser Prairie-Chickens (17,616 in 2013) and 350 hybrid Lesser-Greater Prairie-Chickens (342 in 2013) were estimated in the study area in 2012. Estimates will be updated based on 2014 data, and 2014 estimates of population size will be reported. We discuss the implications of alternative sampling designs with regard to conservation questions to be addressed.

THE WYOMING MIGRATION INITIATIVE MIGRATION VIEWER: A TOOL FOR UNDERSTANDING AND CONSERVING WYOMING'S UNGULATE MIGRATIONS (AN UPDATE)

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The Wyoming Migration Initiative (WMI) mission is to advance the understanding, appreciation, and conservation of Wyoming's migratory ungulates by conducting innovative research and sharing scientific information through public outreach. Currently, data from migration studies are typically only available for the researcher(s) who conducted the work or in a static report or publication, limiting its use. This method of "data storage" greatly increases the risk of the information being lost over time since there is no systematic way to preserve these data. We are in the final stages of the development of a GPS migration database and online viewer, which is being engineered and housed by the Wyoming Geographic Information Science Center at the University of Wyoming. This project provides a secure and consistent infrastructure to store and protect this valuable information. Data are being contributed by a variety of researchers, agencies, and organizations that have conducted migration research in Wyoming. To date, 45 GPS datasets have been identified, although it will also house future datasets. The project is being developed in a flexible, hierarchical manner, aiming to accommodate researchers who wish to share their data with others, yet maintain a level of control for how the raw data are shared and analyzed by others. The migration viewer, now in beta version, allows users to access datasets in a manner that displays basic information including study location, date, species, number of animals monitored, researcher name, and available reports or publications. Public users can also view individual animal hulls, migration corridors, and animate animal movements through time. Agency users will have

additional access to a richer set of data layers and tools, allowing for more in-depth review of migration patterns and potential management risks. Interviews are currently being conducted with potential users to refine the viewer and add functionality, and the project is scheduled for completion in early 2015. We believe this project provides a platform for a potential suite of other datasets. The viewer can be viewed online at migrationinitiative.org.

TWENTY YEARS LATER: EVALUATING MANAGEMENT AND MONITORING OF TRUMPETER SWANS (*CYGNUS BUCCINATOR*) IN WYOMING

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The Trumpeter Swan is one of the rarest breeding birds in Wyoming and is classified as a Species of Greatest Conservation Need. It is perhaps the best monitored avian species in the state, with census data collected annually in fall and winter. In 1994, the Wyoming Game and Fish Department initiated a range expansion project to increase the number and distribution of the nesting population, which remained confined to the Greater Yellowstone area in northwestern Wyoming. From 1994 through 2002, a total of 75 captive-raised swans were released at sites in the Green River basin north of Pinedale, Wyoming. By all measures, the program has been a success. Comparing census data from 2004 to 2013, the total number of adult and subadult swans in the state nesting population increased by 106%, the number of active nest pairs doubled, and the number of mature cygnets produced increased by 40%. A project involving multiple partners to create additional shallow water wetland habitat in the range expansion area has provided new sites readily used by the expanding population of swans. Increases in number and productivity of swans, however, have been confined to the range expansion area. Demographic and population viability analyses show that exponential growth is occurring in the Green River nesting population, while swans in the core Snake River area are declining. Yellowstone National Park (YNP), with only two nesting pairs remaining, initiated a project in 2012 to test whether supplementation with captive-raised swans can reverse this trend. Outside of YNP, only a few nest sites consistently produce young in the Snake River drainage. Trumpeter Swan management demonstrates the ability of an iconic wildlife species to generate widespread public support and funding, as well as the challenges for managing small, vulnerable populations that require a long-term focus and effort for success.

DESIGN, METHODS AND PRODUCTS OF THE INTEGRATED MONITORING IN BIRD CONSERVATION REGIONS (IMBCR) PROGRAM

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In 2007, the North American Bird Conservation Initiative (NABCI) monitoring sub-committee developed a report titles “Opportunities for Improving Avian Monitoring”. This report outlined goals and recommendations to further improve avian monitoring programs including: using more rigorous statistical methodology, integrating monitoring programs, and making data and results widely accessible to land managers and the public. Rocky Mountain Bird Observatory (RMBO), with the help of numerous partners, has developed and implemented an avian monitoring program spanning all or portions of 13 states, named Integrated Monitoring in Bird Conservation Regions (IMBCR). The IMBCR program has produced statewide occupancy and density estimates for over 160 bird species in Wyoming since 2009. Continued monitoring under the IMBCR program

will allow managers to detect trends in density and occupancy estimates over time. Data collected under the IMBCR program can also be used to model habitat needs for species of concern. RMBO incorporated these models into a structured decision-making framework to predict changes in occupancy rates under various habitat management strategies for several species of sagebrush-obligate songbirds that are considered priority species by the Bureau of Land Management, U.S. Forest Service, and Wyoming Game and Fish Department. These models can help land managers target areas for habitat management, indicate which habitat management treatment may be the most effective in increasing species occupancy, and determine the most cost-effective habitat management to maximize the use of each conservation dollar spent. Information gathered through the IMBCR program is made accessible to program partners and the public through the Rocky Mountain Avian Data Center (RMADC), a high-quality, internet-accessible database. The RMADC serves as a "one stop shop" for accessing datasheets, protocols, reports, population estimates, and raw count data through a single website.

SOUND LEVELS NEAR LEKS OF GREATER SAGE-GROUSE IN WYOMING, 2013, AND RECOMMENDED PROTOCOLS FOR MEASUREMENTS

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Greater Sage-Grouse (*Centrocercus urophasianus*) use elaborate audio and visual display behaviors to attract and select mates, and depend on audio communication between females and nestlings during brood rearing. A potential threat to Greater Sage-Grouse is anthropogenic noise associated with human activity. We conducted a study to monitor sound levels at leks near gas field activity in the Pinedale Anticline Project Area, and to determine baseline ambient sound levels in sage land cover at reference areas outside the gas field. At three reference leks, the baseline ambient sound level (L_{90}) was 15.8 dBA, and the existing ambient sound level (L_{50}) was 19.4 dBA (0000-2400). At one reference lek, human-caused sounds were uncommon (<25%), and at this site the L_{90} was 14.5 dBA and the L_{50} was 16.8 dBA. At 19 leks in the gas field, the existing ambient sound level (L_{50}) was 26.6 dBA (all hours, 0000-2400). The L_{50} sound level at leks in the gas field varied (17.5 dBA to 35.9 dBA) according to distance from and type of gas field sound source. Methodologies and equipment types used in grouse-related sound level studies in the western United States have varied considerably, and results were occasionally unusable and often misleading. A standard protocol is needed to ensure measurements are accurate and results useful for management of Greater Sage-Grouse. Measurements should capture the full acoustic environment experienced by Greater Sage-Grouse. This includes placing microphones at grouse ear height (0.3 m), using sound level meters capable of measuring the full range of sound levels experienced by Greater Sage-Grouse (~15-85 dBA), and measuring for periods long enough to capture natural variations in the acoustic environment.

IMPLEMENTATION OF THE BLACK-FOOTED FERRET PROGRAMMATIC SAFE HARBOR AGREEMENT IN THE GREAT PLAINS

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Despite a successful captive propagation and reintroduction program, the black-footed ferret (*Mustela nigripes*) remains one the most endangered mammals in North America due to widespread lethal control of prairie dogs (*Cynomys spp.*), diseases such as sylvatic plague and canine distemper, and conversion of rangeland to rowcrop agriculture. Black-footed ferrets have been reintroduced at 21 separate sites throughout the Great Plains and Intermountain West, primarily on public lands. Private rangelands throughout the Great Plains, the historic core of black-footed ferret range, represent a unique opportunity to recover the species, provided that regulatory concerns, financial incentives, disease management, and prairie dog management issues can be addressed to the satisfaction of private landowners, agricultural producer groups, and local governments. We provide an update on the implementation of the Black-footed Ferret Programmatic Safe Harbor Agreement in the Great Plains, its potential future use, and an update on ongoing challenges to black-footed ferret recovery rangewide.

FORAGING PLASTICITY IN A HIGHLY SPECIALIZED CARNIVORE, THE ENDANGERED BLACK-FOOTED FERRET

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The extirpation of black-footed ferrets (*Mustela nigripes*; ferrets) from the wild resulted from the rangewide decline of prairie dogs (*Cynomys* spp.) brought about by poisoning campaigns, the arrival of an exotic disease, and habitat loss. It is widely accepted that ferrets are an obligate, near monophagous, dietary specialist of prairie dogs and that high-density prairie dog colonies are necessary for effective recovery. To evaluate the extent to which ferrets are dietary specialists, we measured the stable isotopic values of 321 ferrets of known age and sex, as well as of their potential prey (e.g., prairie dogs, mice, ground squirrels, and rabbits). The three potential groups of prey for ferrets – mice, mid-sized mammals, and prairie dogs – were isotopically distinct ($p < 0.001$). Our results confirmed that prairie dogs are the most common diet item for ferrets, although ferrets possessed greater foraging plasticity than previously reported, consuming substantial quantities of other species. The degree to which ferrets were specialized on prairie dogs differed between age-sex groups. Adult male and juvenile ferrets had equivalent diets, with prairie dogs constituting nearly 75% of their assimilated diet. In contrast, adult females obtained over one third of their diet from other species, notably mice. However, female ferrets appeared to have provisioned prairie dogs to their dependent offspring. The implications of our findings are wide ranging and potentially problematic for management of disease, namely sylvatic plague.

Abstracts – Professional Poster Presentations

MULTI-TAXA INVENTORIES ON NATIONAL LANDSCAPE CONSERVATION INITIATIVE LANDS IN WYOMING

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Wyoming has 42 Wilderness Study Areas (WSAs) on Bureau of Land Management (BLM) lands. These WSAs are part of the National Landscape Conservation System (NLCS) and are currently managed to preserve their natural characteristics. Unfortunately, basic knowledge of the biological resources within many WSAs is severely limited, impacting BLM Wyoming's ability to manage these areas. As a result, BLM Wyoming drafted a strategy for its NLCS lands in order to identify and address information needs and develop cohesive goals and guidelines for managing NLCS lands across the state. However, a lack of baseline biotic information inhibits the BLM from adequately addressing goals presented in the Wyoming NLCS 3-year strategy, the National NLCS 15-year strategy, and BLM Sensitive Species goals. One of the key aspects outlined in all of these strategic documents is the implementation of scientifically rigorous monitoring of biological resources on NLCS lands. Monitoring is an essential component of managing species and ecosystems. Specifically, monitoring of populations allows managers to determine population status and detect changes in populations over time. Since 2011, the Wyoming Natural Diversity Database (WYNDD) has conducted multi-taxa inventories and developed monitoring strategies for three WSAs in Wyoming. The scope of these inventories has been broad and has included a diverse suite of biological taxa including plants, pollinating insects, aquatic invertebrates, amphibians, reptiles, small mammals, bats, songbirds, and large mammals. To inventory these taxa, we used a variety of survey methods including visual encounter surveys, vane traps, bee cups, Surber samplers, live-trapping, passive acoustic monitoring, mist-net surveys, point count surveys, and motion activated cameras. These surveys have provided land managers with baseline data regarding biological resources within these WSAs. Additionally, monitoring strategies have been developed to track the status of these taxa and species of management interest that occur within these areas.

AMBIENT AIR TEMPERATURE COMPARISONS OF 3 DIFFERENT RIPARIAN VEGETATION COMMUNITIES

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In 2009, a conifer removal project began adjacent to Bear Creek near Dubois, Wyoming to enhance deciduous vegetation and increase soil moisture and invertebrate biomass, and thereby improve aquatic and riparian habitat. The project has been ongoing since 2009; however, the original scale of the project was reduced in size because of concerns with the loss of big game thermal cover when removing conifers. To quantify the potential outcomes of removing conifers, ambient air temperatures were collected for 1 year under three vegetation communities that provide thermal cover along Bear Creek. The community types chosen were

aspen, conifer, and shrub dominated systems that were located on relatively flat ground within the valley bottom. Data collection ran every 30 minutes from July 5, 2012 to July 8, 2013 with the use of HOBO Pro v2 data loggers that were placed approximately 1.5 m off the ground in the middle of each community type and in the shade. Overall, differences in mean temperatures were less than 0.22˚C between community types, with the highest temperature (31.5˚C) recorded in the shrub community and the lowest (-27.5˚C) occurring in the aspen community. The conifer stand had less diurnal temperature fluctuation compared to both the aspen and shrub communities, yet still had similar mean temperatures throughout the year. Wind and humidity would undoubtedly influence the "real" temperatures felt by wildlife in these community types; however, we were unable to capture these data. Regardless, this information will be useful for designing future habitat treatments within riparian areas with thermal cover concerns.

ASSESSING THE FUTURE VULNERABILITY OF WYOMNG'S TERRESTRIAL WILDLIFE SPECIES AND HABITATS

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Vulnerability assessments are useful for highlighting species or habitats that may be most susceptible to changes. This assessment analyzed the future vulnerability of 131 terrestrial Species of Greatest Conservation Need (SGCN), 11 terrestrial habitat types, and 44 terrestrial priority areas to climate change, residential and energy development, and wildlife disease, as well as overall vulnerability. Fifty-one species were identified as highly or very highly vulnerable and 33 as moderately vulnerable. The factors contributing to species vulnerability varied among taxonomic groups. Amphibians were the most vulnerable taxonomic group, and most amphibians were highly vulnerable to climate change. No bird species were highly vulnerable to climate change, but birds were the most vulnerable taxonomic group to disease, by number and proportion. Reptiles were the taxa most exposed to development, with nearly half of the species highly vulnerable. Mammals were the least vulnerable taxonomic group, with only one-fifth of mammal species ranked as highly vulnerable. Overall landscape-based vulnerability was highest for wetlands and prairie grasslands. These habitat types had high or moderate vulnerability to both climate change and development, low resilience to development, very limited legal protections, and some of the greatest numbers of associated highly vulnerable species. Sagebrush shrublands, desert shrublands, and riparian areas also had high vulnerability, and riparian areas had the second highest number and percentage of associated highly vulnerable species. These findings can guide activities of the Wyoming Game and Fish Department, public land management agencies, and conservation organizations by highlighting which species and habitats have the greatest conservation needs and where additional information may be needed. Our results could be used to inform the next revision of the State Wildlife Action Plan, to help to reevaluate and prioritize Wyoming's list of SGCN, prioritize terrestrial habitat types and priority areas for conservation action, and provide additional information about disease.

LONG-TERM POPULATION MONITORING OF MOUNTAIN PLOVER, UPLAND SANDPIPER, LONG-BILLED CURLEW, AND BURROWING OWL IN WYOMING

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Wyoming grasslands are home to 35 species of birds. Currently 12 species of nongame grassland birds in Wyoming are listed as Species of Greatest Conservation Need (SGCN). These include Bobolink, Burrowing Owl, Chestnut-collared Longspur, Dickcissel, Ferruginous Hawk, Grasshopper Sparrow, Lark Bunting, Long-billed Curlew, McCown's Longspur, Mountain Plover, Short-eared Owl, and Upland Sandpiper. Across their range, grassland birds have declined more dramatically, more consistently, and over a more geographically widespread area than any other group of birds in North America. Their habitat is threatened from cultivation, fragmentation, industrialization, the spread of invasive plants, urban sprawl, and the loss of natural disturbances such as fire. Personnel from many agencies and organizations are currently involved in monitoring grassland birds: Wyoming Game and Fish Department, Rocky Mountain Bird Observatory, Bureau of Land Management, U.S. Forest Service, National Park Service, Audubon Rockies, and the Wyoming Natural Diversity Database. Volunteers in Wyoming have also been very instrumental in our efforts to monitor these species. However, species-specific techniques are needed for those that are not adequately detected with existing monitoring programs. The Mountain Plover, Upland Sandpiper, Long-billed Curlew, and Burrowing Owl all require species-specific survey methods to determine distribution, estimate occupancy, and evaluate population trend. Thanks to funding provided by the Wyoming Governor's Endangered Species Account, Wyoming Game and Fish Department Nongame Program personnel developed permanent road-based survey routes in 2013 for the Mountain Plover and Upland Sandpiper across their range in the state. We are developing permanent survey routes for the Long-billed Curlew and Burrowing Owl in 2014 with the remainder of the funding. Once all routes have been established, we plan to use regional personnel to assist us in conducting annual surveys for these grassland SGCN.

Abstracts – Student Oral Presentations

COMPARATIVE DEMOGRAPHY OF TWO MOOSE POPULATIONS WITH CONTRASTING PREDATOR DENSITIES

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During the past two decades, Shiras moose (*Alces alces shirasi*) in western Wyoming have exhibited population declines. Recent work in northwestern Wyoming suggested that the 1988 Yellowstone fires and regional drought contributed to a considerable decline in calf recruitment, which also coincided with the recovery of grizzly bears (*Ursus arctos horribilis*) and gray wolves (*Canis lupus occidentalis*) to the Greater Yellowstone Ecosystem. Predation is presumed to have contributed to declines in calf recruitment, but the relative influence of these predators has yet to be evaluated. In an adjacent herd directly to the south, moose are exposed to markedly lower abundance of apex predators. We are quantifying the relative influence of predation on the demography of these two herds, while accounting for the influence of browse pressure, winter severity, habitat quality, and the effect of the Yellowstone fires. We are comparing two time series of demographic rates (pregnancy, parturition, neonate survival, calf recruitment, adult survival) to identify the spatial extent and intensity at which predation, habitat, and interacting abiotic factors limit population growth. Thus far, Sublette moose have exhibited low rates of pregnancy (<75%), which is consistent with poor habitat quality, and high neonate survival (>80%). Overall, Jackson moose exhibited higher rates of pregnancy (>80%) and lower neonate survival (58%); however, previous work also noted a negative effect of burned habitat on demography. Our spatial analysis of individual fitness in these two herds is enabling us to identify the relative contributions of abiotic factors and predation to population performance. Quantifying the influence of restored apex predators on Shiras moose populations will aid the management of moose in montane ecosystems throughout North America.

LINKING HABITAT AND NUTRITION WITH POPULATION PERFORMANCE IN MOOSE

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A major goal in population ecology is to understand the factors underlying density-dependent shifts in demography, including nutritional drivers. Simultaneously, management agencies strive for long-term stability in wildlife populations to serve a variety of public interests. Populations approaching carrying capacity may be characterized by a sequence of events where population growth is accompanied by density-dependent shifts towards lowered nutritional condition and depressed vital rates. Rates of calf recruitment in many moose (*Alces alces shirasi*) populations are declining in the Intermountain West. Although an increase in apex predators may be contributing to poor recruitment and population declines in some regions, many other moose populations continue to exhibit poor recruitment in the absence of such predators. This pattern suggests that resource limitation may underlie the poor population performance observed in moose across the Intermountain West. From 2011-2013, we linked data on habitat condition (Keigley live-dead index) and nutritional condition (kidney fat) with calf recruitment in six populations in Wyoming and northern Colorado. Results indicated that habitat condition is related strongly to nutritional condition and trends in recruitment rate, and willow condition is poor in most areas. In 2014, we expanded our study to include three populations in eastern Wyoming and central Colorado in an effort to characterize habitat condition and nutritional condition in recently established populations. We present comparative results on willow condition amongst all nine populations. Our overall goal is to use these results to develop a system of "early warning" indicators that will allow managers to detect when populations are resource limited to prevent large fluctuations in moose populations.

FACTORS AFFECTING SURVIVAL OF NEONATE ROCKY MOUNTAIN ELK IN THE BLACK HILLS OF SOUTH DAKOTA AND WYOMING

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Recent declines in numbers and juvenile recruitment (i.e., 53 calves to 46 calves/100 adult females) of Rocky Mountain elk (*Cervus elaphus canadensis*) in the Black Hills require information on factors affecting mortality and survival. We conducted a 2-year study of survival and cause-specific mortality of elk calves to determine the current status of elk occupying the southwestern region of the Black Hills. We captured and fit with expandable radiotransmitters 70 neonates $\leq$10 days of age during summer 2012 (n = 37) and 2013 (n = 34). We monitored calves daily throughout the summer (15 May-25 September) in both years. We investigated mortalities and lost collars within 12 hours of detecting a mortality signal. We determined cause of death and classified each mortality as predation, disease, starvation, vehicle collision, or unknown. We recorded 16

mortalities during the duration of the study. Predation accounted for 87.5% of our mortalities; remaining mortalities were from starvation (6.25%) and unknown (6.25%). Cougars (*Puma concolor)* accounted for all known mortality events. We used known-fate analysis in Program MARK to estimate summer (15 May-25 September) and annual survival for elk calves. We used a set of intrinsic variables to investigate their effects on survival and tested for annual variation in rates. Based on AIC_c values in our analysis, intrinsic values had no effect on survival analyses. Summer survival of calves was 0.80 (SE = 0.05, *n* = 70) while annual (12 month) survival was 0.67 (SE = 0.08, *n* = 7). Survival was constant over time. High survival for both adult females and neonates indicates that elk occupying the southwestern region of the Black Hills have a positive rate of growth.

FOREST REGENERATION RESPONSE TO LARGE UNGULATE REDUCTION AT SULLYS HILL NATIONAL GAME PRESERVE: IS SEEDLING RECRUITMENT WITHOUT RETURN OF SPECIES RICHNESS ENOUGH?

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Overexploitation of vegetation by white-tailed deer *(Odocoileus virginianus*) has been well documented, but determining effects of multiple large herbivores such as Rocky Mountain elk (*Cervus elaphus*), Plains bison (*Bison bison*), and white-tailed deer is much less understood. After 50 years of ungulate densities >0.06 animals/ha (>70 AUMs), a forest survey conducted at Sullys Hill National Game Preserve showed little to no forest regeneration in 2005. Herd sizes of all three ungulates were reduced and maintained at 0.03 animals/ha (33.5 AUMs) from 2008 to 2012. The objectives of our study were to determine 1) if herd reduction has successfully improved forest regeneration (i.e., sustainable germination and recruitment of tree seedlings), and 2) if diversity of woody vegetation is returning as compared to reference areas. Seventy random points were surveyed by counting and determining species of woody stems in a 0.0004 ha (1/1000 acre) plot. We found improved regeneration in grazed/browsed areas post-herd reduction using a negative binomial regression. Individual based species accumulation curves showed lower stem species diversity in grazed versus reference areas. Our findings suggest that lower densities of ungulates allowed for improved regeneration, but not a return of species richness during the study period.

CONNECTING TABANID RELEVANCE AND PREVELANCE WITH ELAEOPHOROSIS IN WYOMING MOOSE

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Many moose herds in North America have experienced decreasing population trends. Several factors such as marginal habitat, increases in minimum and maximum temperatures, parasites, and predators, have been implicated as detrimental to moose fitness and population growth. In Wyoming, several moose herds have concurrent decreased calf:cow ratios and population trends. In addition to the above factors, the arterial worm *Elaeophora schneideri* has recently been found in many moose herds throughout Wyoming. A change in prevalence from 0 to 60% and 52.2% respectively, has been seen in Teton and Fremont counties with a prevalence as high as 82.6% in one southwest Wyoming herd. Elaeophorosis causes morbidity and mortality in abnormal hosts, such as moose, and has been found to depress population growth in elk. To better understand what drives the prevalence of *E. schneideri* in Wyoming moose, we examined the tabanid vector and its relationship with potential ungulate hosts. We hypothesize that prevalence of *E. schneideri* among

Wyoming moose herd units is related to the distribution of relevant vectors and host preferences of tabanids. From field-collected horse flies, there were differences in the species composition among four study sites, with two species comprising 70% of the entire collection. After testing horse flies for *E. schneideri* larvae using real-time PCR, we expect that differences in species composition of flies will correlate with the prevalence of *E. schneideri* among the 18 different species of horse flies identified. In addition, we detected DNA from elk, moose, deer, sheep, or cattle in 2% of samples tested. Livestock DNA was found in 66% of positive samples, suggesting livestock may influence prevalence of *E. schneideri* in some moose herds. The results from this study will help researchers better understand the dynamics of *E. schneideri* transmission and the conditions that lead to elaeophorosis in Wyoming moose.

CAUSE-SPECIFIC MORTALITIES AND SURVIVAL RATES OF WHITE-TAILED DEER IN THE RED RIVER VALLEY OF NORTH DAKOTA

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Cause-specific mortality and survival rates of white-tailed deer (*Odocoileus virginianus*) have been well documented in regions of the Northern Great Plains, but limited information is available in agriculture dominated (86.8% land cover) regions. The objectives of this project were to document cause-specific mortality and survival rates of adult female and neonate white-tailed deer in the Red River Valley of North Dakota. We captured and radio collared 60 adult female (> 1.5 year) and 37 neonate (20 males and 17 females) white-tailed deer and ear-tagged 5 adult males (>1.5 year) and 24 fawns (< 1.0 year; 10 male, 14 female). Natural causes (e.g., starvation, predation) were attributed to the majority (66.7 %, *n* = 22) of mortalities among adult deer. Adult female annual survival rates during 2012 and 2013 were 0.75 (SE = 0.05, *n* = 54) and 0.74 (SE = 0.05, *n* = 47), respectively. Seasonal adult female survival rates during 2012 summer, fall, and winter were 0.98 (SE = 0.01), 0.96 (SE = 0.02), and 0.99 (SE = 0.01), respectively, and during 2013 summer, fall, and winter were 0.98 (SE = 0.01), 0.98 (SE = 0.01), and 0.96 (SE = 0.01), respectively. Neonate summer survival during 2012 and 2013 was 0.35 (SE = 0.11, *n* = 18) and 0.64 (SE= 0.12, *n* = 19), respectively. The majority of neonate mortalities (64.7%, *n* = 17) were due to predation, primarily by coyotes (*Canis latrans)* and red fox (*Vulpes vulpes*). Approximately 58.8% (*n* = 17) of neonate mortalities occurred at 0-2 weeks of age, 23.5% at 2-6 weeks of age, and 17.6% at >6 weeks of age. The high amount of natural mortality in adult and neonate white-tailed deer was likely associated with recent changes in landscape (i.e., increasing amount of CRP expiring and the conversion of wetlands and tree belts to row crops).

NATURAL SELECTION OF MULE DEER (*ODOCOILEUS HEMIONUS*) ASSOCIATED WITH REDUCED SUSCEPTIBILITY TO CHRONIC WASTING DISEASE

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Since the early 2000s in southeast Wyoming, chronic wasting disease (CWD) prevalence has steadily increased in mule deer (*Odocoileus hemionus*; approximately 30% in females and 50% in males), while simultaneously this population declined to half its original size. The impact of CWD on cervid populations is poorly understood; however, recent studies demonstrated deleterious effects when modeling elk population sustainability burdened by moderate to high levels of CWD. Nevertheless, those negative impacts appeared to be dampened when considering different genotypes linked to varying CWD susceptibilities. Previous studies showed mule deer with phenylalanine (F) at codon 225 on the prion protein gene (PRNP) were less susceptible to CWD than deer homozygous serine (S). Thus, we hypothesized that 1) CWD-positive deer experience lower annual survival compared to CWD-negative deer, 2) 225SS deer would be over-represented in CWD-positive samples, and 3) frequency of less susceptible genotypes (225SF/FF) in the population would increase over time due to their decreased likelihood of dying as a result of CWD. Survival was adversely affected by CWD, whereby annual survival of CWD-negative deer and CWD-positive deer was 0.76 (95% CI = 0.68, 0.85) and 0.32 (0.21, 0.47) (χ^2 = 21.8, df = 1, P < 0.01), respectively. Only one 225SF deer tested CWD positive and 225SS deer were over-represented in our CWD-positive group (Yate's χ^2 = 35.48, df = 2, P < 0.01). Furthermore, genotypes 225SF/FF frequencies in the population increased from <2% in 2003 to >20% in 2014. These results support our hypotheses and 225SF/FF deer appear to live longer without CWD-infection, allowing them to recruit more fawns into the population. Our findings suggest microevolution is occurring in this mule deer population as a result of CWD exerting selective pressure favoring less susceptible genotypes.

A COMPREHENSIVE EVALUATION OF DISTRIBUTIONAL SHIFTS IN PAIRED HOME RANGE ESTIMATES

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A variety of methods are commonly used to quantify animal home ranges using location data acquired with telemetry. High-volume location data acquired from global positioning system (GPS) technology provides the additional ability for researchers to determine various intensities of habitat use within home ranges, typically quantified through utilization distributions (UD). However, challenges may arise when summarizing distributional shifts among multiple UDs. Our objective was to investigate a comprehensive approach to gain population-level inference of distributional home range shifts using individual comparisons of UD outputs derived from paired data. We used paired GPS location data from 16 bighorn sheep (*Ovis canadenis*) collected before and after fire-mediated habitat alterations in the Seminoe Mountains, central Wyoming, USA from 2009-2013. We used Brownian bridge movement models to create a pair of UDs that we compared for each

animal. We summarized these comparisons at multiple home range proportions to define population-level estimates of distributional shifts and joint-space use across a spectrum of home range levels. We report our results as mean shifts in relative home range size, proportion of home range overlap, and joint-space use within paired distributions through various home range similarity indexes. We encourage researchers to expand comparative home range analyses to gain a more comprehensive evaluation of distributional shifts, and not to limit the potential to assess trends in comparisons across a spectrum of home range levels.

USE OF MULTI-STATE MARK-RECAPTURE MODELS TO ASSESS MALE GREATER SAGE-GROUSE MOVEMENTS BETWEEN LEKS

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Interlek movements of male Greater Sage-Grouse (*Centrocercus urophasianus*) are important to quantify because they could affect genetic flow in a population, complicate the use of lek counts as a population index, and potentially indicate a change in breeding behavior following a disturbance. Previous researchers have evaluated interlek movement frequencies as proportions of marked males that attended multiple leks during a single season, but daily interlek movement probabilities have not been extensively investigated. Additionally, factors that affect movements between leks by males, such as bird age and mass, weather, date, and lek characteristics, have not been explored. However, all of these factors may influence lek counts and genetic connectivity of populations. We used a Bayesian multi-state mark-recapture model to assess the daily probability of interlek movements and to determine which factors influenced interlek movement rates for male sage-grouse. We fit 145 males with Solar Argos Global Positioning Systems Platform Transmitter Terminals over 4 years in Carbon County, Wyoming. We assessed the importance of bird characteristics, lek characteristics, date, and weather on the daily probability of interlek movements. The daily probability of a male sage-grouse to move between leks ranged from 0.010 ± 0.005 (mean ± standard error) in 2011 to 0.061 ± 0.006 in 2013. Males were at least 2.5 times less likely to move between leks on days with precipitation than days with no precipitation, larger males were up to five times more likely to move between leks than smaller males, and males were more likely to move between leks earlier in the breeding season than later. Lek counts early in the breeding season and during inclement weather may not accurately reflect the breeding population because daily interlek movement probabilities were higher during those conditions.

2014 WYTWS FELLOWSHIP

Victor Villalobos[1], Corinna Riginos[1], Martin Grenier[2], and Daly Edmunds[3]

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The WYTWS fellowship strives to provide a unique opportunity for a student member of The Wildlife Society (TWS) to acquire a diverse skillset important for addressing a variety of issues and conservation goals surrounding Wyoming wildlife and natural resources. Summer 2014 marks the third year of this unique program. As a WYTWS fellow, I participated in ongoing projects and programs affiliated with a diverse group of agencies, non-governmental organizations, research programs, and other wildlife professionals throughout the 2014 summer. Through shadowing and meeting with a series of mentors, I gained first-hand experiences ranging from working in the field and in the lab to assisting with science education. I traveled throughout Wyoming to learn how to collect wildlife population and habitat data for threatened, endangered, and common bird, mammal, and plant species. I also attended a variety of professional meetings and engaged with members of the public to gain a better understanding of the complexities surrounding wildlife conservation and policy enforcement. This multifaceted approach helped me develop a sense of the diversity of careers within the wildlife and natural resources fields and also taught me the duties and responsibilities necessary to become a successful professional in these fields. The WYTWS fellowship has helped me to think more critically about wildlife management issues and how best to pursue a career in wildlife management and conservation.

USING STABLE ISOTOPES TO IDENTIFY GREATER SAGE-GROUSE INTERSEASONAL MOVEMENT BEHAVIOR

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An important aspect of Greater Sage-Grouse (*Centrocercus urophasianus*) life history is their ability to access different seasonal habitats. Individuals within a population can employ different strategies, which could affect demographic rates, resulting in selection of different behaviors in the population. For conservation, it may be advantageous to identify and evaluate these different strategies. Our research in the Bighorn Basin, Wyoming, and Montana has identified two dominant categories of interseasonal movement behavior: 1) individuals that move shorter distances and summer in irrigated hayfields/pasture, and 2) individuals that travel farther and summer at higher elevations in mountain big sagebrush (*Artemisia tridentata vaseyana*). We plan to compare survival and reproductive success between these groups which are about equally represented in our study area. We will use stable isotope measurements (^{13}C, ^{15}N, ^{2}H, ^{18}O) from a feather collected at capture to identify summer habitat used and, therefore, behavior. We predicted that Nitrogen-15, which varies with nitrogen source (fertilizer use in hayfields vs. no fertilizer in mountain big sagebrush), and Hydrogen-2, which varies with water source (irrigation from snowmelt/groundwater in hayfields vs. rain in mountain big sagebrush) will be important in distinguishing habitat types. Feather keratin contains a record of food resources used while it was grown during summer and then becomes inert. We collected blood samples from 90 grouse captured during summer to assess the validity of this methodology. On average, all isotope ratios analyzed were significantly higher in samples from mountain habitat than hayfield habitat. A Discriminant Function Analysis using these isotopes was able to correctly classify 70% of the observations.

A TYPICALLY SPECIALIST PREDATOR, THE GREATER SHORT-HORNED LIZARD (*PHRYNOSOMA HERNANDESI*), REVEALS VARIABLE DIET ACROSS ITS GEOGRAPHIC RANGE, OBSCURING CONSTRAINTS THAT MOST LIMIT DISTRIBUTION

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In Wyoming, the greater short-horned lizard (*Phrynosoma hernandesi*) is classified as a Species of Greatest Conservation Need based on its vulnerable population status and associated limiting factors. The most pressing threat at this time is energy development, which will result in dramatically lower sagebrush acreage, an important habitat type for these lizards, in the next 50 years. At a finer scale, however, we have little understanding of what specific factors limit population abundance and distribution. Horned lizards are classically 'specialized' species, with narrow diets consisting primarily of ants. Some short-horned species, however, have more varied diets, though it is unclear how diet composition changes among populations. Untangling how diet varies across a short-horned species' distribution can provide insight into factors that limit its population sizes and influence its responses to environmental change. We asked, how does diet specificity vary geographically among greater short-horned lizards in Wyoming? To address our question, we searched systematically for lizards and collected lizard scat in 100 half-hectare plots across Wyoming. We compared prey selection with prey availability to identify differences in specialization among populations. To corroborate the data from our scat samples, we used stable isotope techniques on lizard claws to identify $\delta^{13}C$ and $\delta^{15}N$ levels in diet and compare those levels with signature values from potential prey sources. Our results suggest that this species is more general in its dietary habits than other horned lizard species, and its food use shows strong spatial variation. Our research highlights that it can be a mistake to identify a single factor, diet in this case, as the most important limitation to a species across a broad range, and that it is necessary to consider how limiting factors may vary intraspecifically.

ASSESSING THE EFFICACY OF FATHEAD MINNOWS (*PIMEPHALES PROMELAS*) FOR MOSQUITO CONTROL

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West Nile virus (WNv) has become a significant and increasing threat to wildlife populations and human health throughout North America. Mosquito control is an important and potentially effective means of controlling the spread of WNv, as the virus is primarily spread between avian and mosquito vectors. This is of particular concern for avian host species such as the Greater Sage-Grouse (*Centrocercus urophasianus*), where WNv has been documented to negatively affect sage-grouse survival to the point of possible local extirpations. The most common mosquito control methods focus on controlling mosquitoes at their larval life stages. Efforts have primarily been limited to larvacide pucks or sprays, which require repeated application and could have potentially negative ecological consequences. Here, our primary objective is to test the efficacy of using fathead minnows (*Pimephales promelas*) as a biological control for mosquito populations in northeastern Wyoming. Specifically, we address two main questions: 1) does the presence of fathead minnows influence mosquito larva density within reservoirs?, and 2) what pond and water quality characteristics support viable populations of fathead minnows? In summers of 2013 and 2014, we introduced minnows into 9 of 16 monitored reservoirs. The presence of fathead minnows, mosquito larva density, and adult mosquito

populations were monitored at all sites on a weekly basis. Preliminary results suggest that minnows are a promising alternative to controlling mosquito larvae density in the region. Additionally, self-sustaining minnow populations became established at some of the study sites.

GOLDEN EAGLE RANGE DYNAMICS

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Species distribution models are critical in informing effective conservation prioritization. Modeling approaches typically provide a snapshot of landscape features that influence species presence, yet often fail to account for temporally and spatially dynamic processes that underlie species distributions. Golden Eagles are a species of conservation concern globally, due in part to potential adverse impacts from anticipated growth in wind energy development. This is particularly relevant to wildlife conservation in Wyoming, which maintains some of the highest density eagle use areas and large potential for renewable energy development. We applied dynamic occupancy models to survey data collected across the western U.S. since 2006, using a Bayesian hierarchical spatial parameterization to estimate how biotic and anthropogenic features converge to influence Golden Eagle occupancy over time. Annual estimates of gross primary productivity, drought severity, and human disturbance all shaped Golden Eagle occupancy over a 7-year time period. Model predictions applied spatially 1) represent a powerful tool for prioritizing Golden Eagle conservation in the face of expanding wind energy development, 2) identify areas to target off-site mitigation efforts for Golden Eagles, and 3) highlight the dynamic use patterns of a large-ranging predator during an important life stage. Forecasting models with projected climate data and development scenarios highlight areas that will aid decision makers in prioritizing landscapes for conservation, while responsibly siting for renewable energy development.

Abstracts – Student Poster Presentations

RESPONSE OF PRONGHORN POPULATION PRODUCTIVITY TO ANTHROPOGENIC AND ENVIRONMENTAL CHANGE IN THE RED DESERT, WYOMING

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Over the past two decades, pronghorn in the Red Desert of southwestern Wyoming have declined by approximately 50% as this region has experienced prolonged drought, harsh winter weather, and an increase in energy extraction. Such environmental and anthropogenic stressors may influence movement patterns, habitat selection, and behavior, or may compromise availability and quality of forage, thereby degrading body condition and ultimately affecting demography. In autumn 2013, we captured and equipped 130 adult female pronghorn with GPS or VHF transmitters to initiate a new study to evaluate the influence of environmental and anthropogenic factors on population productivity in the Red Desert. Our study will evaluate measures of productivity (i.e., fawn production, adult female survival), resource selection, behavior (i.e., time budgets), and physiological response (i.e., stress levels, body condition) to environmental and anthropogenic change in two sites impacted by energy extraction and a control site located in south-central Wyoming. Our work will increase knowledge of pronghorn responses to increasing climatic variability and human presence on the landscape. As environmental conditions change and the demand for energy infrastructure expands, our ability to separate and understand the influence of environmental change and resource extraction on pronghorn populations will be critical to guide efforts to manage and mitigate for their effects.

MODELING WETLAND EPHEMERALITY UNDER CLIMATE CHANGE: IMPLICATIONS FOR AMPHIBIAN BIODIVERSITY AND GENE FLOW

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Climate change, a major landscape stressor, is predicted to substantially alter ecosystem characteristics. In semi-arid regions where water availability is a crucial concern, wetlands constitute a critical, though highly

sensitive and dynamic, ecosystem component. Altered temperature and precipitation regimes under climate change may affect wetland ephemerality, or the persistence of wetlands across the growing season. Our research combines remote sensing, field observations, and model-building to develop a novel, cost-effective, and large-scale method for relating the effects of climate change to wetland ephemerality. By using field observations to train remotely sensed data, we classified wetland ephemerality in the Plains and Prairie Pothole Region, a highly productive yet sensitive ecosystem, under a range of climatic conditions representing potential changes to temperature, and precipitation amount and timing. Our approach resulted in highly accurate classifications of wetlands of varying size and ephemerality. We found that wetland ephemerality was best predicted by precipitation in the form of snow. Lastly, we observed an increase in highly ephemeral and ephemeral wetlands compared to current conditions under climate change. These results have important implications for wetland biodiversity and genetic connectivity of wetland-dependent species, such as amphibians, that require a network of wetlands for dispersal. Future research will use environmental DNA assays from water samples to estimate current and future wetland amphibian and microbial diversity across prairie wetlands. Furthermore, we will evaluate the influence of landscape features and wetland ephemerality on amphibian gene flow and functional connectivity using a landscape genetics approach.

EVALUATING THE INFLUENCE OF DEVELOPMENT ON MULE DEER MIGRATIONS

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Migratory ungulates are faced with increasing levels of development within their migration corridors, around the globe, and throughout the American West. The influence of development on migratory behavior is only beginning to be understood. Although ungulates can behaviorally adapt to some types of development, the consequences of such behaviors for population performance are unclear. In addition, it is unknown if migration routes are lost beyond some threshold level of development. We evaluated the influence of development intensity on migratory behavior of several western Wyoming mule deer (*Odocoileus hemionus*) populations using GPS collar data. Migration routes spanned a gradient of development, from intact habitat, to housing infrastructure, to landscapes developed for petroleum extraction. We built disturbance layers for each year with corresponding mule deer migration data. Next, we identified developed and intact segments of each corridor, attributed on a continuous scale from relatively intact to highly disturbed. Next, we evaluated differences in migration timing, rate of movement, and use of stopover habitat within segments and full corridors for each animal, season, and year. Finally, we assessed if migration behaviors differed as a function of development. Our findings indicate that mule deer speed up through highly developed areas and stopover less, compared to deer using relatively intact routes. These results underscore the need to incorporate our understanding of migratory behavior and behavioral thresholds into wildlife planning and management as development expands across the western U.S.

NUTRITIONAL RELATIONSHIPS BETWEEN MULE DEER BEHAVIOR AND HUMAN DISTURBANCE

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Resource availability on winter ranges for North American ungulates is often limited, and reliance on somatic-energy reserves during this season of forage limitation is an adapted strategy used to promote reproduction and survival. Encroachment of human disturbance onto winter ranges may further exacerbate the nutritional bottleneck by prompting alterations in habitat selection and foraging behavior. Although behavioral responses to human disturbance have been observed to inflict deleterious effects on population dynamics, the proximate mechanisms that underpin these effects are difficult to identify. Nutritional condition is a measure of somatic-energy reserves and is a direct reflection of the environment an individual encounters. Furthermore, behavioral and life-history decisions are often mediated by nutritional condition. We hypothesize that the integrative relationship between behavior and nutritional condition is the pathway by which human disturbance affects ungulate populations. We aim to identify the nutritional relationships of behavioral responses to winter habitat conditions of mule deer (*Odocoileus hemionus*) exposed to human disturbance. Over two years, we will measure seasonal changes in nutritional condition of 90 female mule deer equipped with GPS collars across three discrete winter ranges that vary in levels of intensity of human disturbance resulting from energy development. Using GPS data and longitudinal measurements of individual characteristics, we will explore the relationships among nutritional condition, behavior, winter habitat conditions, and exposure to human disturbance to reveal how disturbance affects nutritional condition and how nutritional condition may, in turn, affect behavior. Results of our research will provide managers and planners with a better understanding of how human disturbance affects nutritional ecology of ungulates and will provide insight for conservation and management of ungulate populations in the face of rapid increases in human disturbance.

A PRELIMINARY LOOK AT THE SECRET LIFE OF FLEDGLING SAGEBRUSH SONGBIRDS

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Due to the small size and cryptic nature of juvenile songbirds that have recently fledged from the nest (hereafter "fledglings"), little is known about the basic ecology (e.g., habitat preference, movement patterns, and survival rates) of songbirds during this life stage. A few recent studies have used small (<1 g) VHF radio transmitters to relocate fledglings of a few forest-dwelling songbird species in the midwestern and eastern U.S., and these studies suggest that the fledgling life stage has important, but previously unknown, effects on breeding habitat selection and overall population dynamics. In the summer of 2014, we initiated the first-ever study of the fledgling life stage of a sagebrush-obligate songbird species (Brewer's Sparrow, *Spizella breweri*) using radio telemetry, and report here preliminary findings. Brewer's Sparrow is one of several sagebrush-

obligate songbird species of regional conservation interest, and is on the Wyoming Species of Greatest Conservation Need list. During the summer of 2014, we attached 0.41 g VHF radio transmitters to 45 Brewer's Sparrow nestlings 1-2 days prior to fledging, and relocated each fledgling daily using ground-based telemetry once it left the nest. Preliminary results indicate that for at least the first few weeks post-fledging, fledgling Brewer's Sparrows remain near (within ~50 m) the nest they fledged from and in habitats similar to the nest site, possibly because the fledglings are still actively fed by their parents during this time. Anecdotally, fledgling survival appears to be very low, with most deaths occurring within the first few days post-fledging, and likely attributed primarily to exposure, and secondarily to predation. A better understanding of fledgling ecology and limiting factors imposed during this life stage holds promise as a way to improve conservation efforts for at-risk songbird species, including the Brewer's Sparrow.

ANTHROPOGENIC DISTURBANCE ALTERS THE ISOTOPIC NICHE AND INTERSPECIFIC INTERACTIONS OF TWO SYMPATRIC SMALL MAMMALS

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The isotope ratios of all potential food sources in an area allow for estimation of the diet of consumers within that area. In addition to diet selection, foraging strategy and habitat use may also affect the $\delta^{13}C$ and $\delta^{15}N$ values of consumers. Small mammals in southeast Alaska live in a landscape of habitat patches comprised of old-growth, young-growth, thinned, and clearcut forest stands. Keen's mice (*Peromyscus keeni*), an omnivore and dietary generalist, and dusky shrews (*Sorex monticolus*), an insectivore specialist, occupy all habitat types on Prince of Wales Island (POW), Alaska. Our objective was to determine how landscape heterogeneity and foraging strategy affect the isotopic niche of small mammal consumers. We used stable carbon and nitrogen isotopes to estimate the diets of sympatric mice and shrews on POW across these four habitat types in summers from 2010-2012. We also collected and analyzed all potential prey items. Multi-source dual-isotope mixing models were used to determine the range of possible contributions of each food source. Mice exhibited variation of up to 7 ‰ in $\delta^{13}C$ and 11 ‰ in $\delta^{15}N$ between habitats and across the landscape. In contrast, shrews exhibited a relatively narrow niche. The isotope ratios of mice and shrews overlap slightly in $\delta^{13}C$ and completely in $\delta^{15}N$ but the degree of overlap is habitat specific. Mixing models indicate the highest overlap in diet selection in young-growth stands. The relatively wide isotopic niche of mice suggests specialized foraging behavior of individuals within a generalist population. This type of individual resource use affects competition, social interactions, and risk of predation. This study highlights the importance of considering habitat use and foraging strategy as well as diet selection when examining isotopic patterns of consumers.

ASSIGNING COYOTES TO UTAH POPULATIONS USING MICROSATELLITE DNA MARKERS

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Coyotes (*Canis latrans*) are habitat generalists found throughout Utah's deserts, grasslands, forests, and urban areas. They are known to prey on mule deer fawns. After passage of the Mule Deer Protection Act in Utah in 2012, a need arose for a method to determine whether coyotes that were submitted for bounties truly came from Utah. The objective of this research was to examine the use of microsatellite data for determining the origin of coyotes from specific regions in Utah. Using 13 microsatellite loci, we contrast three disjunct geographic areas in the state of Utah. We genotyped 63 individuals to determine whether individual samples could be correctly assigned to their populations. Pairwise assignment to populations reveals patterns of distinction between genotyped groups. Overall we found that there was a 79% chance of assigning an individual to the correct population. This is an encouraging result for future forensic analysis, as additional variable loci and additional samples are expected to increase the power of assignment. The probability of two randomly selected individuals having the same genotype within a population is calculated using probability of identity (PI). Our PI is substantial, with a minimum of 1.4×10^{-15} in the Roosevelt-Vernal population. These methods can be used to assist in law enforcement cases against fraudulently submitted coyotes from outside the state of Utah. Future research may contribute to knowledge of coyote movements and origins. Continued analysis of samples, provided by the Utah Department of Wildlife Resources collected as part of the Mule Deer Protection Act, will continue to strengthen population assignment, probability of identity, and further clarify possible genetic boundaries within the state of Utah.

Abstracts – Workshops

INTRODUCTION TO GIS I AND II

Matt Hayes, MS[1]

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This two-part GIS workshop will explore basic methods to interact with, explore, and analyze spatial data. The workshop will focus on foundational knowledge necessary to use spatial data, extract information, overlay features, convert between data types (points, lines, polygons, rasters), conduct analyses and make maps. Course material will be prepared, but course participants will be able to give input into what they would like to learn more about. This workshop will use ArcGIS; however, theory learned in the course is spplicable to open-source GIS softward (QGIS, GRASS, Program R). Participants should bring a laptop with ArcGIS 10.x installed. Forquestions about course specific, please contact Matthew Hayes (mhayes1@uwyo.edu).

INTRODUCTION TO QUADRAT, DISTANCE, AND OCCUPANCY SAMPLING

Dr. Mary Conner[1]

[1]Utah State University, Department of Wildland Resources, 5230 Old Main Hill, Logan, UT 84322, USA

Class will start with an hour of lecture on model fundamentals, followed by a 20 minutes exercise on quadrat sampling and population estimation. Class will finish with some thoughts about occupancy monitoring in lieu of population monitoring for large scales. A full outline will be available prior to class. Class participants must have a laptop with Microsoft Excel.

WILDLIFE CHEMICAL IMMOBILIZATION

Mary Wood, DVM, PhD, Wildlife Disease Veterinarian[1]

[1]Department of Veterinary Sciences, Wyoming State Veterinary Laboratory, University of Wyoming, 1174 Snowy Range Road, Laramie, WY 82070, USA

This workshop will cover a brief introduction to wildlife handling and chemical immobilization. There will be a short lecture on common drug classes used for wildlife immobilization and a brief review of handling and anesthetic monitoring. The remainder of the workshop will be focused on hands-on practice with immobilization equipment including blow guns, dart guns, pole syringes, and hand syringes. We will set up targets outdoors for darting practice, so please wear closed-toed shoes and appropriate clothing to be outside.

HARNESSING THE POWER OF PARTNERSHIPS

Jill Randall[1]

[1]Wyoming Game and Fish Department, P.O. Box 850, Pinedale, WY 82941, USA

In our current world of "do more with less!", who does not want to maximize their impact on the landscape we manage? Hear examples of how relationships and communication have increased effectiveness and productivity. By working with partners, we can multiply our impact and gain public support for management actions of project implementation. We will discuss the steps of wildlife habitat project implementation and where to emphasize the human side of wildlife management in order to maximize results. Also, we will discuss a variety of funding opportunities that make project work feasible in our world of tighter budgets and greater time demands. Private and public land examples will be discussed by a variety of wildlife professionals. This session will include discussion from the audience regarding success stories and ideas for other professionals to take home in order to improve partnerships at a local level.

WILDLIFE DISEASE INVESTIGATIONS AND FIELD NECROPSIES

Todd Cornish, DVM, PhD, DACVP[1] and Jeremy Brown, MS[1]

[1]Department of Veterinary Sciences, Wyoming State Veterinary Laboratory, University of Wyoming, 1174 Snowy Range Road, Laramie, WY 82070, USA

In this session attendees will be introduced to the philosophies and practices that guide wildlife disease field investigations and field necropsies, including risk assessment, selection and use of personal protective equipment, building a suitable field necropsy kit, proper carcass examination and sampling protocols, disposal and cleanup, and follow-up and monitoring activities. Instruction will occur via mixed formats making use of interactive activities and discussions, rather than didactic lecture. This session will serve as a complementary introduction for participants in the wildlife necropsy wet lab, but attendance is open to all interested individuals (space permitting).

WILDLIFE NECROPSY LABORATORY

Todd Cornish, DVM, PhD, DACVP[1], Jeremy Brown, MS[1], BreAnna Bonner[1], Melia DeVivo, MS[1], and Amy Williams[1]

[1]Department of Veterinary Sciences, Wyoming State Veterinary Laboratory, University of Wyoming, 1174 Snowy Range Road, Laramie, WY 82070, USA

In this laboratory session attendees will perform necropsies on a variety of wildlife species under supervision of wildlife disease experts. Emphasis will be on teaching of standardized, safe, and effective necropsy techniques and introductory instruction lesion recognition and proper diagnostic sampling. Students should bring their own over-the calf rubber boots (steel-toed recommended); all other personal protective equipment will be supplied. Not for the weak stomached or gore aversive, but encouraged for all budding or seasoned wildlife professionals that spend any time working in the field with free-ranging wildlife.

WYOMING CHAPTER OF THE WILDLIFE SOCIETY: 2014 LEADERSHIP INSTITUTE

Tom Ryder[1], Sarah Bucklin[2], Nichole Cudworth[3], and Tony Mong[4]

[1]29 Meandering Way, Lander, WY 82520, USA
[2]Bureau of Land Management, 2987 Prospector Drive, Casper, WY 82604, USA
[3]Wyoming Game and Fish Department, 260 Buena Vista Drive, Lander, WY 82520, USA
[4]Wyoming Game and Fish Department, Savery, WY 82332, USA

Initiated in 2006, The Wildlife Society's Leadership Institute (TWSLI) has become a valuable tool for training tomorrow's generation of TWS leaders, and Wyoming is proud to have five graduates of this prestigious training. Graduates include Nick Kaczor and Sarah Bucklin in 2009, Martin Grenier in 2010, and Nichole Cudworth and Tony Mong in 2011. Instructors of this 2-hour workshop will present a condensed bersion of TWSLI, divided into four 30-minute segments. The first segment will discuss why strong leaders are necessary in the natural resources profession and outline success characteristics of previous conservation leaders. Segment two will delve into the basic principles of leadership. Participants will then be provided with techniques to develop a vision and personal leadership goals in segment three. The workshop will conclude with a discussion of why utilizing a team leadership approach is the most successful way to accomplish goals.

CONNECTING PEOPLE WITH SCIENCE

Mark Gocke[1]

[1]Wyoming Game and Fish Department, 420 North Cache Street, P.O. Box 67, Jackson, WY 83001, USA

Ever wonder why some people's research or management project makes front page news and is shared over and over again through social media while other, equally fascinating, research remains in relative obscurity? This panel of local experts will share their unique perspective and years of experience on this all-important topic of effectively publicizing your work, not only for educating the public, but also generating political support and, of course, funding. Each panelist will have an opportunity to share their insightful thoughts on the matter with a short presentation before settling in for a lively panel discussion with the audience, which should prove enlightening for everyone in attendance. This one is not to be missed! Panel will include: Chris Madson, Outdoor Writer and former editor of Wyoming Wildlife magazine; Hall Sawyer, Wildlife Researcher, WEST, Inc.; Christine Peterson, Outdoor Writer, Casper Star Tribune; Emilene Ostlind, Western Confluence magazine editor; and Lindsay Simpson, Video Specialist, Wyoming Game and Fish Department.

DESIGNING AND CONSTRUCTING VHF AND GPS RADIO TRANSMITTERS

Bryan Bedrosian[1] and Doug Bonham[2]

[1]Craighead Beringia South, 6955 East 3rd Street, Kelly, WY 83011, USA
[2]Hawk-Owl Systems, 454 Parma Drive, Essex, MT 59916, USA

A special workshop sponsored by the National Science Foundation will be held for biologists interested in learning more about the details of GPS tracking technology and manufacture of transmitters for wildlife. Biologist Bryan Bedrosian from Craighead Beringia South and telemetry engineer Doug Bonham from Hawk-Owl Systems will be leading the session detailing the technology and components of store-on-board, remote download, and satellite GPS tracking. The workshop will begin with a discussion on the current technologies, limitations, and advantages of different systems. There will be a hands-on portion of the workshop dedicated to discussing collars, housings, attachments, battery, solar systems, and VHF integration into circuitry. Attendees will learn the basics of constructing their own GPS transmitters that can be later adapted to specific studies and species.

Abstracts – Nutrition Symposium

LINKING NUTRITIONAL CONDITION TO POPULATION PERFORMANCE IN UNGULATES: APPROACHING THE HOLY GRAIL

Thomas R. Stephenson[1] and Kevin L. Monteith[2]

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We expanded a unique approach to quantify nutritional status in free-ranging ungulates that establishes a direct link between populations and their habitats. Body fat integrates caloric gain and loss as determined by factors such as forage supply, competition for food among conspecifics, winter severity, and reproduction. Consequently, body fat in free-ranging animals is an optimal measure of nutritional condition and represents how animals balance the energetics of their environment. Energy from forage and fat, in conjunction with protein, is the currency that drives growth and reproduction in animals. We present data from one cervid species (mule deer) and one bovid species (bighorn sheep) that couples life-history traits and nutrition. We used ultrasonography and body condition scoring to estimate body fat across its full range, which we then analyzed with vital rates estimated from radio-collared individuals. We estimated population size and the finite rate of population growth (λ). The physiological limits of total body fat in the ungulates sampled varied between 0.5 and 26%. Body fat of adult female mule deer in March ranged from 5% in 2009 to 8.7% in 1999. November body fat in mule deer females varied between 8.4 and 11% in 2007 and 2005, respectively. In Sierra Nevada bighorn sheep, mean pre-winter body fat among 8 herds was 8.2 – 15.1% and 14.8 – 23.7% for lactating and non-lactating females, respectively. Mean body fat of females in late winter in Sierra Nevada bighorn herds ranged from 10.1 – 13.6%. Nutritional condition in those ungulate species was related to the probability of pregnancy, survival of young, age at first reproduction, adult survival, and population growth rates in wild populations. The relationship between body fat and population growth rate supports the potential to assess the proximity of a population to its nutritional carrying capacity (NCC) that we term animal-indicated NCC.

LINKING HABITAT ATTRIBUTES TO NUTRITIONAL CONDITION AND REPRODUCTIVE PERFORMANCE: NEW DIRECTIONS FOR ELK

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A primary goal of our research on elk nutrition is to develop a mechanistic link between habitat attributes, nutritional condition, and reproductive performance of free-ranging elk herds. The benefit of such a linkage is the ability to predict how current or altered habitat conditions may affect large ungulate populations. Over the past two decades, we have taken a novel approach to identify these linkages by integrating data collected on captive, tractable elk with data collected on wild elk. Nutritional condition data from wild elk can help identify the seasonality, location, and severity of nutritional limitations but cannot identify causes of nutritional limitations. Captive elk data, via detailed "bottom-up" analyses, can be used to identify which attributes of habitat may cause nutritional limitations and how habitat management may be used to improve the nutritional environment. Integrated, these data have the potential to provide a rigorous test of previous perceptions and provide new insights about nutritional ecology. We present the steps we have taken on this path and demonstrate how these data are being used to influence management and policy on behalf of elk in the Pacific Northwest.

FAT AND FEARFUL OR SKINNY AND FEARLESS? BODY CONDITION AND THE ECOLOGY OF FEAR

Arthur D. Middleton[1] and Carlos Martinez del Rio[2]

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A prey animal's quandary is to avoid predation while also eating sufficient food to meet its energy requirements. The behavioral tradeoff between these two needs is mediated by prey body condition. A large body of theoretical work predicts that when prey animals are in poor condition, and are pressed by hunger, their antipredator behaviors are attenuated. Although well known to behavioral ecologists, the important role of prey body condition has yet to be integrated into our conceptualization of the population- and community-level effects of predation risk. Many ecological conditions and biological processes, including resource scarcity, seasonality, and reproduction, tend to compromise prey condition. Thus, the dependency of antipredator behavior on body condition might commonly introduce bottom-up modulation of predation risk effects. In order to evaluate this notion, we synthesized theoretical and empirical studies that explored the influence of body condition on antipredator behavior across a variety of systems. We found that predictions of a well-known patch-use model of Brown and Kotler (2004), where antipredator behaviors are predicated partly on the marginal value of new energy gained by prey, was broadly supported by 46 studies of fish, mammals, birds, reptiles, amphibians, and invertebrates. Antipredator behaviors can carry costs for prey populations and benefits for the plant communities they feed upon, and these risk effects are now perceived as being strong and widespread. However, we suggest that the countervailing influence of bottom-up controls on prey body condition and behavior – largely overlooked to-date in studies conducted at the population and community level – must be more fully integrated into existing theory if we are to resolve the increasingly apparent context-dependency of predation risk effects.

RISK-SENSITIVE ALLOCATION IN SEASONAL DYNAMICS OF FAT AND PROTEIN RESERVES IN A LONG-LIVED MAMMAL

Kevin L. Monteith[1], Thomas R. Stephenson[2], Vernon C. Bleich[2], Mary M. Conner[3], Becky M. Pierce[2], and R. Terry Bowyer[4]

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Body reserves of numerous taxa follow seasonal rhythms that are a function of temporal patterns in food availability and life-history events; however, tests of the theory underlying the allocation of somatic reserves for long-lived organisms are rare, especially for free-ranging mammals. We evaluated the hypothesis that allocation of somatic reserves to survival (i.e., metabolic processes) and reproduction should be sensitive to current nutritional state relative to seasonal thresholds in those reserves. Our evaluation was based on seasonal dynamics in fat (measured as ingesta-free body fat; IFBFat) and protein reserves (measured as ingesta-free, fat-free body mass; IFFFBMass) of 136 female mule deer (*Odocoileus hemionus*) over 8 years. Although mean changes in fat and protein reserves were positive over summer and negative over winter, accretion and catabolism of those reserves were not consistent among individuals. Over winter, both lipid and protein stores available in autumn were catabolized in proportion to their availability above a post-winter threshold; however, lean-body tissue was spared at the expense of lipid reserves. Female deer mostly synthesized lean-body tissue over summer, and committed post-winter fat reserves to reproduction relative to their availability above an autumn threshold, which was lowered by 2.8 percentage points (pp) for each additional young recruited. Mothers reduced their autumn fat threshold to secure current reproductive investment and, thereby, endured a cost of reproduction at the expense of fat accumulation. Allocation of somatic reserves occurred in a risk-sensitive framework; females allocated reserves relative to their availability above seasonal thresholds. In contrast to current notions of summer accretion and winter catabolism of body reserves, some individuals deposited reserves over winter and catabolized reserves over summer, mainly because regulation of individual condition was state-dependent. Consequently, behavior and life-history strategies may be as much a function of nutritional contributions of the previous season as of the current one.

WYOMING'S BIG GAME POPULATION MANAGEMENT – NUTRITION AND HABITAT CONDITION CONSIDERATIONS

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Big game (e.g., pronghorn, mule deer, elk, moose, and bighorn sheep) population management in Wyoming is driven by a "management by objective" paradigm. Population size objectives are based on desired numbers of animals after the hunting season or "postseason". Objectives are a bio/socio/political proposition and agreed to as management targets by the Department, landowners, hunters, the public, and Federal land management agencies (i.e., BLM and USFS). In times of changing habitat (nutrition), capacity managers need to best gauge the appropriate population size to ensure appropriate and sustainable wildlife populations. Habitat data are

considered when proposing changes to population objectives and recommended hunting seasons. Assessment of nutritional planes of big game animals will help to ensure population size objectives are appropriate. If correlations exist between nutritional condition and productivity/use of key forage, evaluation of habitat condition could be utilized to direct future management. Analysis of sagebrush productivity and use by pronghorn is presented as a potential technique to assess population size objectives and management action and direction.

THE WYOMING RANGE MULE DEER INITIATIVE: A CASE STUDY IN MULE DEER MANAGEMENT THROUGH PUBLIC COLLABORATION AND EDUCATION

Gary L. Fralick[1], Scott G. Smith[2], Susan S. Boston[3], Jessica M. Clement[4], Elaine C. Walsh[5], Daryl W. Lutz[6], and William Rudd[7]

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[4]The Collaboration Program in Natural Resources, Ruckelshaus Institute, Haub School of Environment and Natural Resources, University of Wyoming, Laramie, WY 82071, USA
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Wildlife agencies are increasingly tasked with managing mule deer (*Odocoileus hemionus*) populations to appeal to a diverse public sentiment that is often manifest with inherent conflicting views on management. The ability of a wildlife agency to disentangle and understand conflicting public opinions and perceptions that are relevant to mule deer management programs can be challenging. These challenges are further complicated by a persistent decline in western mule deer populations and an associated negative public response to mule deer management programs. In response to growing public dissatisfaction with mule deer management in Wyoming, the Wyoming Game and Fish Department (Department) developed the Wyoming Mule Deer Initiative (WMDI) in 2007. This statewide initiative created a framework with which to involve the public in a collaborative learning approach to address management issues and develop viable solutions that affect individual mule deer herds. Subsequent to the development of the WMDI, the Department unveiled the first-ever collaborative effort with the public at the herd unit level. The mule deer herd selected for this initial public review process was the Wyoming Range herd. The Wyoming Range Mule Deer Initiative (WRMDI) was launched in four communities in southwestern Wyoming in 2010, and focused on an interactive process that emphasized educational opportunities and information exchange between the public and the Department. This collaborative exchange of information was assimilated into a comprehensive management plan for the Wyoming Range herd and was the first-ever herd specific plan developed for mule deer in Wyoming. The essential components of the WRMDI were based on public education, habitat changes, and the role of nutrition in the ecology of this mule deer herd. We will describe the process that transformed public perception of the Wyoming Range mule deer management program from polarized and contentious to consensus and understanding.

UNDERSTANDING UNGULATE POPULATION DYNAMICS: IS NUTRITION THE ANSWER?

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This symposium has explored various aspects of the nutritional ecology of large ungulates, including how biologists measure condition in the field, how condition mediates the behavior of individuals, and how the environment (i.e., resource levels) influences the nutrition of individuals and populations. Incorporating nutrition into how we understand the ecology and management of big game holds great potential to advance the field. Some of the most promising new approaches are those that evaluate the nutritional carrying capacity (NCC) of populations. Ever since Aldo Leopold's seminal text on the subject over half a century ago, the management of big game has been fundamentally based on the notion of resource limitation. In this context, harvest is a tool to keep populations from approaching or overshooting carrying capacity. But how do we know where a population sits relative to its carrying capacity? Several authors have argued that understanding nutrition-demography relationships provides a powerful lens into the carrying capacity of a population, and that this tool can serve as an alternative method to traditional approaches that evaluate density-dependent relationships. In this talk, I will explore several approaches researchers use to detect density dependence in ungulate populations, including time series approaches, density-dependent vital rate estimation, assessment of resource levels or use, and animal density manipulations. I will endeavor to evaluate the strengths and weaknesses of these methods and compare their use to new methods aimed at estimating nutritional carrying capacity.

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