Nevada Chapter of The Wildlife Society

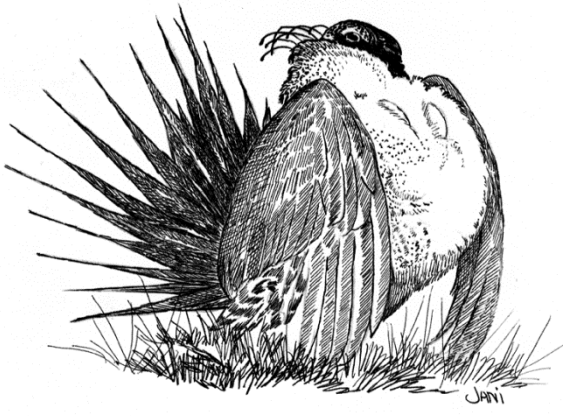
Annual Meeting

February 11-12, 2015

Commission Hearing Room
Nevada Department of Wildlife
1100 Valley Road
Reno, NV 89503

Opening Address:

Ken Mayer
President, Nevada Chapter



Conference Agenda

Nevada Chapter of The Wildlife Society

Nevada Department of Wildlife Conference Room, Reno

Wednesday, February 11th, 2015	
1:00 pm to 1:10 pm	**Nevada Chapter of The Wildlife Society General Meeting Welcome**
1:10 pm to 1:30 pm	**Understanding Climate Variables Inside Caves and Mines: Does Nevada Have What it Takes to Support White Nose Syndrome Disease?** *Jason Williams*
1:30 pm to 1:50 pm	**Lek Geography Drives Fine-Scale Genetic Structure of Greater Sage-Grouse** *Joshua P. Jahner, Daniel Gibson, Chava L. Weitzman, Erik J. Blomberg, James S. Sedinger, and Thomas L. Parchman*
1:50 pm to 2:10 pm	**The Influence of Transmission Lines on Sage-Grouse Demographic Rates** *Daniel Gibson, Erik J. Blomberg, Michael T. Atamian, and Jim S. Sedinger*
2:10 pm to 2:30 pm	**Late Brood-Rearing Habitat Limits Sage-Grouse in Nevada** *Jim S. Sedinger, Daniel Gibson, Levi Jaster, Phillip A. Street, Kristin Kane, Erik J. Blomberg, and Michael T. Atamian*
2:30 pm to 3:00 pm	**BREAK**
3:00 pm to 3:20 pm	**Small-Scale Environmental Gradients: Effects on Trace Mineral Levels, Immune Function, and Disease Prevalence in Mule Deer** *Cynthia J. Downs, Kelley, M. Stewart, Sabrina Morano, and Peregrine L. Wolff*

3:20 pm to 3:40 pm	**Effects of Mate Quality and Pair-Bond Dynamics on Survival and Breeding Probability of Black Brant** *Alan G. Leach, Jim S. Sedinger, David H. Ward, and W. Sean Boyd*
3:40 pm to 4:00 pm	**Effects of Large Scale Gold Mining on Migratory Behavior of a Large Herbivore** *Marcus E. Blum, Kelley M. Stewart, and Cody Schroeder*
4:00 pm to 4:20 pm	**Survival and Growth Rates of Wood Duck Ducklings** *Benjamin S. Sedinger, Christopher A. Nicolai and Kelley Stewart*
Wednesday Evening, February 11th, 2015	
5:30 pm onwards	**Evening Social at Great Basin Brewery** Address: *846 Victorian Avenue, Sparks* Food will be provided by the Chapter and drinks will be available for purchase
Thursday, February 12th, 2015	
8:20 am to 8:40 am	**Use of Hunter-Harvested Wings to Predict Reproductive Success of Greater Sage-Grouse at Local and Statewide Scales** *Erik J. Blomberg, **Daniel Gibson**, Mike Podborny, Shawn Espinosa, and Jim Sedinger*
8:40 am to 9:00 am	**Photo-Sensor Equipped Vaginal Implant Transmitters: New Technology Aids in Assessing Birthing Times, Locations, and Capture of Neonates** *Anthony P. Bush, Kelley M. Stewart, Vernon C. Bleich, and Neal Darby*
9:00 am to 9:20 am	**How to Get the Biggest Bang For Your Buck: Wildlife Monitoring on Shrublands of the Nevada Test Site** *Derek B. Hall and Paul D. Greger*

9:20 am to 9:40 am	**Modelling Ungulate Demography From Count Data with Open N-Mixture Models** *Thomas. V. Riecke, Daniel Gibson, Phillip A. Street, James S. Sedinger, and Warren C. Conway*
9:40 am to 10:00 am	**A General Framework for Estimating Abundance: Examples in the Critically Endangered Waved Albatross and an Isolated Population of White-Tailed Ptarmigan** *Phillip A. Street, Paul F. Doherty, Jr., Kathryn P. Huyvaert, and Amy Seglund*
10:00 am to 10:30 am	**BREAK**
10:30 am to 10:50 am	**Effects of Conifer Removal on Small Mammal Diversity** *Bryan Hamilton*
10:50 am to 11:10 am	**Modelling the Importance of Habitat for Population Growth of Greater Sage-grouse in Eureka County, Nevada** *Kristin Kane, Jim Sedinger, and Daniel Gibson*
11:10 am to 11:30 am	**Is the White-tailed Jackrabbit an Indicator Species of Mountain Big Sagebrush-Perennial Grass Community Resilience in Northern Nevada?** *Kent McAdoo and George Gruell*
11:30 am to 11:50 am	**Modeling Habitat Suitability for the Pale Kangaroo Mouse Using Maximum Entropy** *Thomas Dilts, Marjorie Matocq, Sarah Hegg, and Peter Weisberg*
LUNCH	
1:00 pm to 3:00 pm	**Nevada Chapter of The Wildlife Society Business Meeting**

ABSTRACTS

(In alphabetical order by first author's last name)

Use of hunter-harvested wings to predict reproductive success of greater sage-grouse at local and statewide scales

Erik J. Blomberg, Daniel Gibson[a], Mike Podborny, Shawn Espinosa, and James S. Sedinger

Abstract: The recruitment process is fundamental to population persistence, but can be difficult to measure at large spatial and temporal scales. Ratios of young to adult animals (i.e. age ratios), which are commonly derived from hunter-harvested animals, are often used as indices to recruitment. However, age ratios may be biased relative to true recruitment because of differential harvest among age classes. Our objective for this work was to evaluate the utility of age-ratios as an index to recruitment in greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse). We calculated juvenile to adult female age-ratios from sage-grouse wings collected by NDOW in Eureka County, Nevada, from 2005 to 2012. We then used 8 years of concurrent radio-telemetry data to estimate the average number of sage-grouse chicks produced per adult female during each year, which we will term the per-capita reproductive success (R). Our assessment of age-ratios consisted of two components. First, we directly compared age ratios to R on a year-to-year basis using a simple linear model. In general, age-ratios over-estimated reproductive success (β_0=0.81 +/- 0.41 SE), but were otherwise positively correlated with R (β_1=1.33 +/- 0.81 SE). This model had a moderate fit to the data (R^2=0.31), which was reduced due to a single outlying year. Second, we used state space models in Bayesian framework to evaluate whether age-ratios provided a reliable index to temporal changes in R. Based on posterior distributions, the annual change in age-ratios corresponded very closely with annual change in R. These results suggest that age ratios are not reliable predictors of sage-grouse reproductive success during any given year, but are likely useful when tracking temporal changes in sage-grouse reproductive performance. Age ratios demonstrate substantial temporal covariance among populations throughout Nevada, suggesting large-scale synchrony in sage-grouse reproductive dynamics at a statewide scale.

[a] presented by second author

Effects of large scale gold mining on migratory behavior of a large herbivore

Marcus E. Blum, Kelley M. Stewart, and Cody Schroeder

Abstract: Loss of migratory corridors has been identified as an important ecological issue among species that exhibit long-distance migration worldwide. Increased mineral exploration and development has raised the level of concern over the protection of terrestrial migration routes for ungulates. Mineral exploration and other types of development may adversely affect migratory corridors for large herbivores, but little is known about functional effects on migratory behavior and resource selection. To address these important questions we examined movement patterns and resource selection to understand the effects of an operating gold mine on migratory pathways of mule deer (*Odocoileus hemionus*). We captured and applied radio collars to female mule deer (n=43) on the migratory pathway and in proximity of an active mine in the Ruby Mountains of eastern Nevada. We used Brownian Bridge Movement Models to delineate stopover sites for each individual during both the autumn and spring migrations. We calculated linear efficiency of movement along the migration path and movement rate between stopover locations outside and within the mining area to determine the effects of the mine on movement patterns. We also used resource selection functions to determine if mule deer avoided areas with extensive excavation and disturbance of the land surface when navigating through the mine complex. Our results indicated greater linear efficiency of movement along the migration path and movement rates between stopover locations outside the mine when compared with movement through the mine complex. Additionally, mule deer that migrated through the mine avoided the highest disturbance levels by spending the majority of their time in undisturbed habitat patches. These results suggest an increase in energy expenditure of mule deer navigating through highly disturbed areas, which may have fitness consequences for migratory animals. Such increases in energy expenditure may decrease survival or productivity of migratory populations of large, terrestrial mammals.

Photo-sensor equipped Vaginal Implant Transmitters: New technology aids in assessing birthing times, locations, and capture of neonates

Anthony P. Bush, Kelley M. Stewart, Vernon C. Bleich, and Neal Darby

Abstract: Vaginal implant transmitters (VIT) greatly improve the success of neonate studies by facilitating location of neonates shortly after birth. Most VITs use internal temperature sensors, which often causes logistical issues because solar radiation raises the temperature of the device, resetting the pulse-rate, and limiting the amount of time researchers have to assess implant status. Daily aerial telemetry flights have often been used to assess signal status, which greatly increases budgetary costs. We used newly designed VITs equipped with photo-sensors and precise event timing (PET) coding on 47 adult female deer in Mojave National Preserve, CA during 2013-2014. With the combination of temperature and photo-sensors the status of these VITs can be assessed anytime day or night. PET coding records the time elapsed since expulsion in half-hour increments and provides the exact timing of parturition and age of the fawn at capture. The binary coding repeats every minute and can be assessed using hand-held telemetry equipment. This new technology allowed for ground telemetry monitoring and assessment parturition without the need for aerial flights. The new design of VITs is an effective way to operate neonate studies over large geographic areas while substantially reducing costs and necessary man power.

Modeling habitat suitability for the pale kangaroo mouse using maximum entropy

Thomas Dilts, Marjorie Matocq, Sarah Hegg, and Peter Weisberg

The pale kangaroo mouse (Microdipodops pallidus) is one of two kangaroo mouse species in North America and is endemic to Nevada and eastern California. It has been described as a sand-obligate species, although this description has been somewhat debated in the scientific literature. As part of a larger study of multi-scale habitat relationships, landscape connectivity and potential threats to population viability, our goal was to quantify range-wide habitat associations and model the potential distribution of this little-known species. Predictor variables included a wide range of climatic variables including climatic water deficit, monsoonality, and bioclimatic variables based on monthly precipitation and temperature. Topo-edaphic predictors included a

variety of measures of soil texture and depth derived from the STATSGO database, slope, topographic position index, valley fetch length (valley eastness), surface albedo, and a novel measure of surface texture based on the difference between daytime and nighttime temperatures derived from MODIS satellite data. Prior to habitat modeling we employed two contrasting methods in order to reduce sampling bias. Geographic thinning removed data points within 10 km of each other while environmental filtering based on a pairwise distance matrix ensured that sample points were evenly distributed in environmental space. Preliminary results support the use of environmental filters over geographic thinning and point to a broad area of suitable habitat within the study area. Unexpectedly, we found that climatic rather than topo-edaphic variables were far more important in determining suitable habitat with precipitation, climatic water deficit, and monsoonality being the most important. However, this finding may partially be the result of the geographic uncertainty in the location of museum records, the coarse spatial scale of the predictor variables (1 km), and the co-occurrence of suitable climatic and edaphic conditions. Further work will address these issues and result in a refined habitat suitability model.

Small-scale environmental gradients: effects on trace mineral levels, immune function, and disease prevalence in mule deer

Cynthia J. Downs, Kelley, M. Stewart, Sabrina Morano, and Peregrine L. Wolff

Abstract: Environmental conditions directly affect the nutritional quality of food. Nutritional quality of food, in turn, mediates individual-level heterogeneity in phenotypes physiological. We investigated how habitat use at small scales affected constitutive immune function and trace-mineral levels in mule deer (*Odocoileus hemionus*) in the Jackson mountain range in Nevada. Using GPS collar data we assigned deer to a land-use groups: field (primarily used alfalfa fields), uplands (primarily used natural, upland habitat), and split (split time between habitats). We found that habitat use on a small scale resulted in differences in serum levels of selenium, magnesium, and iron, but not differences in levels of calcium, copper, phosphorous, and zinc. Levels of calcium, phosphorous, and zinc differed among study years. These results indicate that differences in environmental conditions over short ranges can affect nutritional status of individuals. Interestingly, we found evidence of immunosenescence for one functional measures

of constitutive immune function, bactericidal capacity, but not another measure of constitutive immune function, reactive nitrogen metabolites; neither measure of immune function differed among study groups. We found no differences in disease prevalence among study groups, but we found links between constitutive immunity and disease prevalence. Because physiology is regulated by a complex network of response and many aspects of physiology must be studies to understand how environmental conditions and ontogeny affect phenotypes. Our study shows that new insights can be gained by investigating linkages among physiological measures.

The influence of transmission lines on sage-grouse demographics

Daniel Gibson, Erik J. Blomberg, Michael T. Atamian, and James S. Sedinger

Abstract: Elevated structures can provide perches for avian predators that are higher than those supplied by local vegetation and topography. It is hypothesized that avian predators of sage grouse (nest or predators) may use utility poles to increase their hunting efficiency, which may result in sage-grouse population declines though either direct mortality or avoidance of habitat near transmission lines. Previous literature on the influence of transmission lines on sage-grouse population demographics have not accounted for correlations between an individual's distance from the transmission line and other confounding variables (e,g,, elevation, habitat quality), which casts uncertainty on what mechanisms are influencing reductions in demographic processes. In 2003, 345 kilovolt transmission line was constructed in central Nevada through sage-grouse habitat. Our goal was to assess if this transmission line influenced population demographics of nearby sage-grouse after accounting for heterogeneity in demographic rates among individuals. We found support that nest site selection and nest survival was negatively influenced by proximity to transmission lines, which resulted in reductions in recruitment, and ultimately, population growth. Additionally, we found that these negative impacts were most likely related to Common raven abundance and habitat use patterns associated with the transmission line as opposed to outright avoidance of the elevated structures themselves by sage-grouse. Together, these results suggest that management of Common raven populations may be required to stabilize sage-grouse populations in certain management units.

How to get the biggest bang for your buck: wildlife monitoring on shrublands of the Nevada test site

Derek B. Hall and Paul D. Greger

Abstract: The Nevada Test Site (NTS) covers 1,375 square miles and extends over portions of both the Mojave and Great Basin Deserts. The resulting diverse and complex flora and fauna exhibit elements of both deserts. There are 20 vegetation associations, composed primarily of shrubs, nested within 10 vegetation alliances. Of the more than 1,200 invertebrates and 339 vertebrates found in these shrubland habitats, 267 are considered sensitive or protected/regulated by federal or state laws. Wildlife and wildlife habitat monitoring ensures NTS activities comply with all federal and state laws enacted for the protection of these valuable biological resources. This paper describes the monitoring approach used at this large site. Monitoring strategies include conducting preactivity surveys, repeated sampling of permanent plots, proactively monitoring sensitive species, and collaborating with other agencies and biologists. Ways to make monitoring more efficient and examples of successful monitoring and collaborations are discussed.

Influence of woodland expansion on small mammal diversity

Bryan Hamilton

Abstract: Woodland expansion is major issue that reduces productivity and diversity; increases soil erosion and fire severity; and can impacts sensitive wildlife populations. Conifer removal has been implemented as a means to restore wildlife populations. Small mammals are conservation targets and important in ecosystem function and conifer removal projects have not adequately addressed small mammal diversity. We hypothesized that tree encroachment into sagebrush habitat has negatively impacted small mammal diversity and that conifer removal can mitigate the loss of diversity by restoring the desirable vegetative attributes of sagebrush habitat. We monitored small mammals in Great Basin national Park for 11 years using a BACI design and compared tree encroached, sagebrush and wet meadow habitat and examined the impacts of conifer removal on small mammal diversity. We also monitored the vegetative attributed of the

site. Tree encroachment into sagebrush habitat dramatically reduced small mammal abundance and biomass. However, conifer removal treatments negatively impacted small mammal abundance and biomass and failed to restore desirable vegetative attributes of sagebrush habitat. Of particular concern is the increase in annual grasses with no corresponding increase in native herbaceous vegetation or shrubs. Species specific effects included a decrease in woodland specialist piñon mice and an increase in harvest mice. If conifer removal could restore the habitat attributes of sagebrush habitat, small mammal diversity would be expected to benefit due to an increase in resource availability. Our results have troubling implications for small mammal diversity in the Great Basin ecoregion and call into question the effectiveness of sagebrush restoration projects to benefit wildlife populations.

Lek geography drives fine-scale genetic structure of greater sage-grouse

Joshua P. Jahner, Daniel Gibson, Chava L. Weitzman, Erik J. Blomberg, James S. Sedinger, and Thomas L. Parchman

Abstract: Empirical studies of landscape genetic variation are essential for understanding evolutionary processes and for guiding conservation. Greater sage-grouse exhibit strong site fidelity and a lek-based mating system, which could drive fine-scale population genetic structure and have conservation significance for this rapidly declining species. We quantified genetic variation at ~28,000 single-nucleotide polymorphisms across ten leks (140 males) in central Nevada using a genotyping-by-sequencing approach. Leks formed distinct and identifiable clusters in principal components analysis, providing evidence for fine-scale geographic genetic differentiation and indicating reduced gene flow among leks separated by an average distance of only 35 kilometers. Lek geography strongly predicted genotypic variation and genetic similarity was higher among individuals within the same leks. Our results reveal geographic genetic structure across a very small spatial scale, presumably driven by reproductive skew and strong site fidelity in a lek-based mating system, rather than by physical barriers to gene flow. Further analyses indicated that data sets of <4,000 SNPs had poor statistical precision and would have failed to detect the observed geographic genetic structure, highlighting how studies based on

small sets of loci may underrepresent genetic structure over small ecological and geographic scales in sage-grouse and other organisms of conservation significance.

Modelling the importance of habitat for population growth of Greater Sage-grouse in Eureka County, Nevada

Kristin Kane, James S. Sedinger, and Daniel V. Gibson

Abstract: Populations of sage-grouse (*Centrocercus urophasianus*), have declined range-wide over the last 50 years. Assessment of habitat importance during various life history stages is essential for species persistence and for appropriate management. We developed spatial models which link demographic processes (fecundity and recruitment) to spatial vegetation data to assess and rank habitat quality. We then modelled population growth (lambda) as a function of the spatial variation in those demographic processes to predict contributions of specific habitats to regional population processes. Sage-grouse use a complex suite of vegetation that varies among patches within the landscape. Nevertheless, our results demonstrate that only a small subset of habitat patches are being selected by sage-grouse populations as suitable nesting habitat and contributing positively to fitness. More importantly, it is also apparent that late-brood rearing habitat is likely limiting population growth. Low chick survival rates are usually attributed to the availability and the quality of brood rearing habitat. High-quality brood habitat is located around high elevation riparian areas and is highly restricted in spatial distribution. Nesting habitat may be far away from these areas and brood mortality rates may be high because of distance effects.

Effects of mate quality and pair-bond dynamics on survival and breeding probability of black brant

Alan G. Leach, James S. Sedinger, David H. Ward, and W. Sean Boyd

Abstract: Survival and breeding probability are important fitness components for long-lived vertebrates. Given the socially monogamous mating system of arctic nesting geese including black brant (*Branta bernicla nigricans*) we hypothesized that mate quality (e.g., body mass) and mate change (due to apparent death of previous mate or divorce) may influence the probability

that brant survive and breed. We used longitudinal data from a long-term mark-recapture study of black brant at the Tutakoke River brant colony (TRC) on the Yukon-Kuskokwim Delta in southwestern, AK, USA. From 1990-2014, we encountered 3,039 adult females and 3,063 adult males breeding at TRC whom had at least one marked mate during their lifetime. We used the Barker robust design implemented in Program Mark to conduct the current analysis. Body mass of an individual's mate during the previous year's brood rearing period positively affected future breeding probability of females (β = 0.55; SE = 0.24), but not males (β = 0.07; SE = 0.12). Survival is apparently reduced for females (β = -0.14; SE = 0.01) and males (β = -0.24; SE = 0.02) following initial breeding attempts with new mates when the previous mate apparently died. Interestingly, individuals who had been divorced from the previous mate (i.e., mate still alive) seem to not suffer reduced survival. Alternatively, a reduction in breeding probability is experienced by females (β = -0.12; SE = 0.02) and males (β = -0.19; SE = 0.03) after the initial breeding attempt with their new mate. While we stress that these results are preliminary they suggest that to fully understand factors affecting vital rates of adult brant, consideration must be given to mate quality and pair-bond dynamics. Future analyses, will explore interactions between individual quality, mate quality, pair-bond dynamics, and fitness components including permanent emigration from TRC.

Is the White-tailed Jackrabbit an Indicator Species of Mountain Big Sagebrush-Perennial Grass Community Resilience in Northern Nevada?

Kent McAdoo and George Gruell

Abstract: According to mammalogists, anthropologists, historians, and newspaper accounts, white-tailed jackrabbits (*Lepus townsendii)* were once an important faunal component of mid-to upper elevation sagebrush-grass communities and meadows in northern and central Nevada. Some of these same accounts attribute the decline of this species to heavy grazing that occurred from the 1870s through the early to mid-20th century. Before Euro-American settlement, aboriginals in some areas of the Great Basin used white-tailed jackrabbits extensively as a source of food and fiber. Throughout the West, there has been a gradual reduction in the range of this species in areas where habitats have changed to favor black-tailed jackrabbits (*L. californicus*), a

closely related species with a stronger shrub affinity. Where the two species occur sympatrically, white-tails typically use areas that are more grass-dominated and/or higher in elevation than the shrub-dominated valley floors frequented by black-tails. In recent years, the authors have observed white-tailed jackrabbits moving into areas in northern Nevada that became dominated by native perennial grasses after wildfire, apparently expanding into these areas from a remnant nucleus population. However, similar fire-recovered areas in central Nevada that held white-tails historically have not apparently had colonization by this species, ostensibly due to the absence of nucleus populations. Because the perennial grass component to which white-tails are adapted is the cornerstone of sagebrush-grass community resilience, the presence of this species may be an indicator of ecological integrity and functionality, especially at mid- to upper elevations (for primarily mountain big sagebrush communities). As the perennial grass component ebbs and flows proportionately through plant succession, the abundance of white-tails, irrespective of cyclic population irruptions, may follow this same pattern. The authors will review the history of this species across its previous and current range in Nevada and overview proposed research to test this hypothesis.

Modelling ungulate demography from count data with open N-mixture models

Thomas V. Riecke, Daniel Gibson, Phillip A. Street, James S. Sedinger, and Warren C. Conway

Abstract: Open N-mixture models allow biologists to model lambda as a function of ω (emigration and death) and γ (immigration and birth) solely using count data. To illustrate the modelling process, we simulated the effects of site quality and a temporally variable environment on survival, emigration, immigration, and reproduction for a hypothetical ungulate metapopulation, roughly analogous to Nevada's mule deer population. We subsequently simulated observation data for a portion of the populations, and analyzed these data using a modified open N-mixture model. Preliminary analyses indicated that a global model was able to accurately quantify population parameters and covariate effects, where modified open N-mixture models may be an effective tool for monitoring demographic trends in ungulate populations.

Survival and Growth Rates of Wood Duck Ducklings

Benjamin S. Sedinger, Christopher A. Nicolai, and Kelley Stewart

Abstract: Duckling survival is an important component of recruitment into the breeding population. We uniquely marked wood duck ducklings on the day of hatch along the Carson River near Fallon, NV from 2008-2014. We then recaptured individuals throughout their lifetimes and measured a host of morphological characteristics at each capture event. We used regression to model the linear portions (ranging from 0-125 days) of these measures to calculate growth rate per day for the period of growth. We used a multistate approach in program MARK to estimate duckling survival rates for wood ducks. The best performing model for duckling survival contained the temporal variables year and month, and cohort. The probability of surviving the first month of life was highest for the first hatched (May) cohorts (0.15 ± 0.04 – 0.27 ± 0.03) and lowest for late hatched (July) cohorts (0.05 ± 0.02 – 0.11 ± 0.04) across all years. Duckling survival during the first month of life was highest in 2011 and lowest in 2008. These results suggest a survival benefit to broods hatched early in the season and annual variation in duckling survival rates.

Late Brood-Rearing Habitat Limits Sage-grouse in Nevada

James S. Sedinger, Daniel V. Gibson, Levi Jaster, Phillip A. Street, Kristin Kane, Erik J. Blomberg, and Michael T. Atamian

Abstract: All Greater Sage-grouse (*Centrocercus urophasianus*) chicks must have access to green vegetation throughout their growth period, which extends into the month of July for most broods. Nevada is the driest state in the United States and in most of sage-grouse range in Nevada green vegetation is only available in high elevation sites or in mesic meadows supported by intermittent streams. In 10-year study in Eureka County every successfully fledged chick was reared in one of two late-brood rearing areas, which together represented < 3% of the total area. Assessment of the importance of all habitats for population growth showed that late brood-rearing habitat had the greatest impact on population growth in Eureka County. In an ongoing study in northern Washoe County every female sage-grouse attending chicks was using small mesic meadows before the end of June in 2014. The necessity of using mesic habitats to

successfully rear chicks, also limits the extent of nesting habitat that contributes to population growth because broods moving longer distances suffer higher mortality. We believe the small size of many late brood-rearing habitats has resulted in the importance of such habitats being unrecognized. We suggest such habitats deserve substantially more attention.

A General Framework for Estimating Abundance: Examples in the Critically Endangered Waved Albatross and an Isolated Population of White-tailed ptarmigan

Phillip A. Street, Paul F. Doherty, Jr., Kathryn P. Huyvaert, and Amy Seglund

Abstract: Unbiased abundance estimates play a critical role in the management of species, yet abundance can be difficult to estimate. Through a combination of sampling design and model-based estimation, researchers may be able to achieve an unbiased estimate of population size by formally considering sampling error, animal availability, and detection error in data collection protocols and analysis. When these issues are not explicitly addressed, biased estimates and poor inference can result, which can lead to inappropriate management actions. We present a general framework to help researchers think about and address these issues, and apply it to two species. First, the Waved Albatross (*Phoebastria irrorata*) is a critically endangered seabird species for which past estimates of abundance suggest a decline in population size from 1994 to 2007, however, these estimates did not formally address the above issues. We estimated abundance for a major breeding colony, and this estimate suggests a continued decline in the population size of the Waved Albatross. Second, we apply the framework to a southern subspecies of White-tailed ptarmigan (*Lagopus leucura altipetens*) that have been petitioned to be listed as threatened under the endangered species act, with climate change as a major threat. To address this concern, we provide baseline estimates of abundance for future monitoring. Not all of the parameters we discuss will be needed for each sampling situation, but our general approach allows for an organized thought process and strategy for planning a sampling scheme. Sampling schemes are a mixture of field biology and statistical theory and we found our organizational approach useful when designing and implementing abundance surveys.

Understanding climate variables inside caves and mines: Does Nevada have what it takes to support White Nose Syndrome disease?

Jason Williams

We installed data loggers that record both temperature and humidity in a suite of caves and mines across parts of Nevada in order to better characterize climate inside bat hibernacula. This effort is ongoing, and in part is in response to national research on White Nose Syndrome. With a better understanding of how bats use caverniculous hibernacula in Nevada, our goal is to determine how prolific the WNS disease could be if it reaches the western United States. Our data identifies quite a range in climatic conditions based on geological characteristics of these roost sites.