



Bleats and Blats

Official Newsletter of the
Desert Bighorn Council



August 2011

Inside:

- **Update on a successful DBC meeting**
- **Hansen-Welles Scholarship history and update**
- **Recent literature related to bighorn sheep**
- **DBC says good-bye to a longtime friend**
- **And more.....**

Hello DBC members and friends!

It was great to see many of you in April at our biennial meeting in Laughlin, Nevada. We had a great turn-out for the meeting, which presented an excellent opportunity for everyone to share their efforts towards the conservation and management of desert bighorn sheep. I'd like to thank all of you who attended and helped make this meeting a success. This newsletter includes an overview of the meeting for those who were not able to join us.

This newsletter also includes several other updates and a list of recent literature related to bighorn sheep, which I'm sure you'll find to be an interesting mix of research papers.

The next newsletter is scheduled for mid-December so if you have updates or announcements to share, please send them to me by November 30. Also, if you'd like to share your bighorn sheep stories, reports, and/or photos on our website, they would also be most welcome. We hope to hear from you!

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DBC Meeting Overview

The DBC held its 51st meeting on April 6-8, 2011 at the Aquarius Casino Resort Hotel in Laughlin, Nevada. The meeting featured State status reports, technical paper sessions, an excellent barbeque dinner, a field trip to nearby desert bighorn sheep habitat to view the first highway overpasses specifically designed and built for bighorn sheep, and opportunities for everyone to share information about desert bighorn sheep biology, management, and conservation.

The meeting was attended by 107 participants representing five Federal agencies, six State agencies, and several universities and non-governmental organizations. Larry Voyles, Director of the Arizona Game and Fish Department, presented a welcome to the group at a wonderful barbeque prepared by Department employees. A highlight of the evening was the presentation of the following awards:

- Jack Kilpatric (Texas Parks and Wildlife Division, retired) received a prestigious Ram Award for his role in initiating and overseeing the restoration of bighorn sheep in west Texas, and in establishing the Sierra Diablo "brood pens".
- The Texas Parks and Wildlife Division also received a Ram Award for its highly successful bighorn sheep restoration program.
- The Texas Bighorn Society also received a Ram Award for its role in initiating the bighorn restoration program, and for its long term support of bighorn sheep conservation in Texas.
- Clay Brewer, Mike Pittman, and Mike Hobson (Texas Parks and Wildlife Division) each received an Honor Plaque in recognition of their long-term contributions to the restoration of bighorn sheep in west Texas.
- The Society for the Conservation of Bighorn Sheep received a Ram Award in recognition of the 50th anniversary of the founding of the first "grass-roots" organization to advocate specifically for bighorn sheep, and for their long term role in the political arena as advocates for bighorn sheep, for their role in enhancing habitat, and providing recreational opportunities through the passage of legislation.

The meeting also included the Desert Bighorn Council's Business Meeting. The meeting included elections for officers and the Technical Staff.

- New members were elected to the Technical Staff, which is now comprised of the following individuals:
 - Ray Lee (Chair, term expires April 2017)
 - Elise Goldstein (term expires April 2017)
 - Brian Wakeling (term expires April 2017)
 - Clay Brewer (term expires April 2015)
 - Mara Weisenberger (term expires April 2015)
 - Mark Jorgensen (term expires April 2015)
 - Ben Gonzales (term expires April 2015)
- New officers were also elected, with the resulting individuals serving new terms:
 - Council Chair: Eric Rominger
 - Council Vice-Chair: To be determined
 - Secretary: Esther Rubin
 - Treasurer: Kathy Longshore

Brian Wakeling and Erin Butler did a great job as Meeting Chair and Vice-Chair, respectively, leading a team of Department employees and DBC members and officers who made the meeting a huge success. Thank you everyone! The next Biennial DBC meeting will be held in April 2013 in New Mexico. Please check our website (www.desertbighornCouncil.org) for future updates.

Desert Bighorn Council Transactions Update

Submitted by Brian Wakeling, DBC Transactions Editor

Following the 2011 meeting in Laughlin, four manuscripts have been submitted for publication in the DBC Transactions (Volume 51). Five state status reports have been submitted as well. The review and editing processes are ongoing, and authors should hear on the status of their papers within the next couple of months. Any states that have not contributed a status report are encouraged to do so by October 15th. Don't hesitate to contact me should you have any questions (623-236-7385).

Hansen-Welles Scholarship History and Update

Submitted by Ray Lee, DBC Tech Staff Chair

The Desert Bighorn Council's Hansen-Welles Memorial Scholarship is named after a few of the Council's earliest members.

Ralph Welles was the Council's Secretary-Treasurer in 1961. Ralph and his wife Florence were the Chairmen in 1969. Ralph and Florence Welles were recognized with the first Ram Award in 1960 while working for the National Park Service in Death Valley. During the 1960s, Ralph and Florence authored papers about the bighorn sheep of Death Valley. The 1988 Transactions were dedicated to Ralph Welles – he was “a dedicated scientist, talented artist, and a stalwart friend of the desert bighorn.”

Charles Hansen was the Council's Secretary-Treasurer from 1962-1964; the Transactions Editor in 1962, 1964, and 1972; and the Technical Staff Chairman in 1965. In the 1960s, he published a number of papers regarding the wild sheep on the Desert Game Range in Nevada. Charles was recognized with the fourth Ram Award in 1966 while with the US Bureau of Sport Fisheries and Wildlife.

According to some sleuthing work by Eric Rominger, the Memorial Scholarship was apparently established in 1988, and the first awards appear to have gone to Jonna Mazet (\$1,000) in 1990 and Jef Jaeger (\$700) in 1991.

In 1993, Dori Borjesson received \$1000 to work on a fecal pregnancy assay at UC Davis.

In 1996, Esther Rubin received \$1,000 to develop a predictive habitat model for Peninsular bighorns.

In 1997, Luis Tarango received \$1,000 for his work on desert bighorn sheep in Mexico.

In 2002, James Cain received \$500 to work on artificial water sources; Heather Johnson received \$750 to work on the Sierra Nevada wild sheep; and Jeff Villepique received \$850 to work on the responses of desert bighorn sheep to predation risk.

In 2003, James Cain received \$2,000 to continue his work on the influences of artificial water sources.

In 2005, James Cain received \$2,000 to complete his work on the influence of artificial water sources on desert bighorn sheep; Brian Jansen received \$2,500 to study the relationships of desert bighorn sheep to surface mining and a disease epizootic; and Jeff Villepique received \$4,200 to continue his work on responses of desert bighorn sheep to predation risk.

In 2007, Esther Rubin received \$4,000 to complete her work on bighorn sheep in the Peninsular Ranges.

In 2009, Kevin Hurley received \$1,500 for mapping wild sheep translocations; Ashwin Naidu received \$3,500 to study desert bighorn sheep predation management; and Ben Gonzales and Heidi Zurawka jointly received \$4,500 to study respiratory disease in desert bighorn sheep.

In 2010, Cerissa Hoglander received \$4,000 to study the effects of artificial water sources.

Most recently, Jonathan Escobar Flores received \$4,000 in 2011 to determine the conservation status of desert bighorn sheep in Baja California. Jonathan is a Technician (and Student) at the Autonomous University of Baja California in Ensenada.

To date, the Council has made 18 awards to 14 individuals, for a total of \$39,000! If you, or someone you know, have a financial need to help support work on desert bighorn sheep, contact Technical Staff Chairman Ray Lee for information on applying for the Hansen-Welles Memorial Scholarship – or visit our website www.desertbighornCouncil.com.

Update on the Western Association of Fish and Wildlife Agencies’ Wild Sheep Working Group

Submitted by Ray Lee, DBC Tech Staff Chair

The Western Association of Fish and Wildlife Agencies (WAFWA) organized their Wild Sheep Working Group in January 2007. The Group is comprised of representatives from the 19 states, provinces, and territories with wild sheep; plus representatives from the US Forest Service and the Bureau of Land Management.

Since the initial formation, the Group has been chaired by Kevin Hurley of the Wyoming Game and Fish Department. When Kevin retired from the Department this past year, he was no longer able to chair the Group. In June, this position passed to Desert Bighorn Council Technical Staff Member Clay Brewer of the Texas Parks and Wildlife Department. Clay is eager to take on this new position and new tasks.

Kevin remains active in the wild sheep arena as the Conservation Director for the Wild Sheep Foundation, Executive Director for the Wyoming Chapter of the Wild Sheep Foundation, Executive Director of the Northern Wild Sheep and Goat Council, and NGO member of the WAFWA Wild Sheep Working Group – as well as a member of the Desert Bighorn Council.

Notes from the Field

Submitted by Mara Weisenberger (U.S. Fish and Wildlife Service), DBC Tech Staff member

For desert bighorn sheep, every glance is like looking through binoculars and it’s this keen eyesight that keeps bighorn sheep safe—that is unless juniper and pinyon pine trees grow too dense, creating ideal cover for mountain lions. Consequently, the San Andres National Wildlife Refuge (NWR) initiated a prescribed fire program in 1999 with resource objectives to increase visibility and enhance habitat not only for bighorn sheep, but also mule deer and other native wildlife.

Since the Refuge’s establishment in 1941, primary emphasis in resource management has been focused on restoring a remnant population of desert bighorn sheep (*Ovis canadensis mexicana*), a State-listed threatened species in New Mexico. While the Refuge will continue to play an important role in the recovery of healthy desert bighorn populations in the State, the Refuge will continue broadening its focus to include all trust resources for which we are responsible. With a better understanding of natural biodiversity, ecosystem approaches to wildlife and habitat management are a high priority for the Refuge. Baseline inventories of various taxonomic groups of flora and fauna will continue to serve the Refuge well to improve understandings

of natural regimes of succession, recruitment, and predator/prey relationships, and climate change on the Refuge and surrounding lands.

But whether the burns were achieving the desired outcome was in question. Thus began a two-year habitat monitoring project to use Landsat satellite imagery to inventory fires dating from 1984 - 2009 that occurred on the entire, 3 million acre study area. Lands within that perimeter include San Andres and Bosque Del Apache NWRs, White Sands Missile Range (WSMR) and other adjacent federal and state properties.

Using a geographic information system, the inventory illustrates a spatially explicit landscape in layers, one year superimposed on the next, using polygons, to show the temporal and spatial variability of historic fires and their intensities. Among other details, the data are beginning to reveal: associations between historic fire behavior, extent of plant communities burned, impacts of drought, fire frequencies and how the vegetation responded after a burn. They also indicate whether the cause was lightning, or human-induced such as from missile firing, prescribed burns, or careless handling of cigarettes, matches, etc.

In total, 96 fires were inventoried covering 165,155.5 acres. Ground truthing confirmed the accuracy of the data and San Andres NWR hopes to continue to expand and build on the data set over time. With 25 years' worth of fire data now in hand, areas that have burned can be compared with those that have never burned, providing both control and test sites for looking at the effects of fire. The data also will be useful for additional projects, including several current studies to evaluate fire effects in various vegetation types on the Refuge.

In 2009, the Fish and Wildlife Service's New Mexico Fire District was requested to conduct the first prescribed burn on WSMR by their Environmental Stewardship Division. The 2009 prescribed burn objective was to restore desert bighorn sheep habitat. One of the goals related to the Refuge prescribed fire program is to restore the San Andes bighorn population to a viable level that, once again, includes ram hunts. The collaboration and long-term planning between the many partners to improve wildlife habitat at the landscape scale will benefit not only the trust resources on the Refuge, but the greater San Andres Mountains ecosystem.

Recent Literature Related to Bighorn Sheep

Brown, N. A., Ruckstuhl, K. E., Donelon, S., and C. Corbett. 2010. Changes in vigilance, grazing behaviour and spatial distribution of bighorn sheep due to cattle presence in Sheep River Provincial Park, Alberta. *Agriculture Ecosystems and Environment* 135:226-231.

Abstract: The physical presence of livestock can influence the behaviour of native ungulates. Behavioural data on bite rates and vigilance of Rocky Mountain bighorn sheep were collected during the summer and fall of 2006 in Sheep River Provincial Park, Alberta. Spatial distributions of bighorn sheep and domestic cattle were recorded using daily censuses and GPS collar locations during the same time period. We hypothesized that the presence of cattle would induce a negative behavioural response in bighorn sheep and cause avoidance behaviour. As predicted, foraging bite rates decreased and vigilance rates increased when cattle were located nearby. Vigilance in females was higher than in males. The average distances between bighorn sheep and cows were found to be smaller than expected at random, and minimal distances were not affected by the presence of cows. The sheep were found in the same general areas used by cattle. The cattle presence was shown to influence distribution and behaviour of bighorn sheep, although not in the way we expected.

Cassaigne, G. I., R. A. Medellin, and J. A. Guasco O. 2010. Mortality during epizootics in bighorn sheep: Effects of initial population size and cause. *Journal of Wildlife Diseases* 46:763-771.

Abstract: One of the most severe threats to bighorn sheep (*Ovis canadensis*) populations is disease. With the objective of projecting possible epizootic consequences to bighorn sheep population dynamics,

we examined 23 epizootic mortality episodes from presumably known causes that occurred in the United States and Canada from 1942 to 2005. These outbreaks were correlated with population size using regression models. Epizootic origins were documented by considering contact with a "new" pathogen for the bighorn sheep population or pneumonic processes, presumably triggered by stress. We suggest mortality rates are negatively related to population size in a logarithmic function, and offer a model to estimate the percentage of disease-related mortalities for a given population size of bighorn sheep. From a disease dynamics perspective, we suggest a minimum population of 188 bighorn sheep would be required to insure long-term persistence in the presence of epizootic disease.

Dassanayake, R. P., Shanthalingam, S., Herndon, C. N., Subramaniam, R., Lawrence, P. K., Bavananthasivam, J., Cassirer, E. F., Haldorson, G. J., Foreyt, W., Rurangirwa, F. R., Knowles, D. P., Besser, T. E., and S. Srikumaran. 2010. *Mycoplasma ovipneumoniae* can predispose bighorn sheep to fatal *Mannheimia haemolytica* pneumonia. *Veterinary Microbiology* 145:354-359.

Abstract: *Mycoplasma ovipneumoniae* has been isolated from the lungs of pneumonic bighorn sheep (BHS). However experimental reproduction of fatal pneumonia in BHS with *M. ovipneumoniae* was not successful. Therefore the specific role, if any, of *M. ovipneumoniae* in BHS pneumonia is unclear. The objective of this study was to determine whether *M. ovipneumoniae* alone causes fatal pneumonia in BHS, or predisposes them to infection by *Mannheimia haemolytica*. We chose *M. haemolytica* for this study because of its isolation from pneumonic BHS, and its consistent ability to cause fatal pneumonia under experimental conditions. Since in vitro culture could attenuate virulence of *M. ovipneumoniae*, we used ceftiofur-treated lung homogenates from pneumonic BHS lambs or nasopharyngeal washings from *M. ovipneumoniae*-positive domestic sheep (DS) as the source of *M. ovipneumoniae*. Two adult BHS were inoculated intranasally with lung homogenates while two others received nasopharyngeal washings from DS. All BHS developed clinical signs of respiratory infection, but only one BHS died. The dead BHS had carried leukotoxin-positive *M. haemolytica* in the nasopharynx before the onset of this study. It is likely that *M. ovipneumoniae* colonization predisposed this BHS to fatal infection with the *M. haemolytica* already present in this animal. The remaining three BHS developed pneumonia and died 1-5 days following intranasal inoculation with *M. haemolytica*. On necropsy, lungs of all four BHS showed lesions characteristic of bronchopneumonia. *M. haemolytica* and *M. ovipneumoniae* were isolated from the lungs. These results suggest that *M. ovipneumoniae* alone may not cause fatal pneumonia in BHS, but can predispose them to fatal pneumonia due to *M. haemolytica* infection.

Ezenwa, V. O., Hines, A. M., Archie, E. A., Hoberg, E. P., Asmundsson, I. M., and J. T. Hogg. 2010. *Muellerius capillaris* dominates the lungworm community of bighorn sheep at the National Bison Range, Montana. *Journal of Wildlife Diseases* 46:988-993.

Abstract: Lungworm infections are common among bighorn sheep (*Ovis canadensis*) North America, and the predominant species reported are *Protostrongylus stilest* and *P. rushi*. The only records of another lungworm species, *Muellerius capillaris*, infecting bighorns come from South Dakota, USA. At the National Bison Range (NBR), Montana, USA we found that across six sampling periods, 100% of wild bighorn sheep surveyed were passing first-stage dorsal-spined larvae (DSL) which appeared to be consistent with *M. capillaris*. By contrast, only 39% or fewer sheep were passing *Protostrongylus* larvae. Using molecular techniques, we positively identified the DSL from the NBR bighorns as *M. capillaris*. This is the first definitive record of *M. capillaris* infection in a free-ranging bighorn sheep population outside of South Dakota.

Lawrence, P. K., Shanthalingam, S., Dassanayake, R. P., Subramaniam, R., Herndon, C. N., Knowles, D. P., Rurangirwa, F. R., Foreyt, W. J., Wayman, G., Marciel, A. M., Highlander, S. K., and S. Srikumaran. 2010. Transmission of *Mannheimia haemolytica* from domestic sheep (*Ovis aries*) to bighorn sheep (*Ovis canadensis*): unequivocal demonstration with green fluorescent protein-tagged organisms. *Journal of Wildlife Diseases* 46:706-717.

Abstract: Previous studies demonstrated that bighorn sheep (*Ovis canadensis*) died of pneumonia when commingled with domestic sheep (*Ovis aries*) but did not conclusively prove that the responsible pathogens were transmitted from domestic to bighorn sheep. The objective of this study was to determine, unambiguously, whether *Mannheimia haemolytica* can be transmitted from domestic to bighorn sheep when they commingle. Four isolates of *M. haemolytica* were obtained from the pharynx of two of four domestic sheep and tagged with a plasmid carrying the genes for green fluorescent protein (GFP) and ampicillin resistance (AP(R)). Four domestic sheep, colonized with the tagged bacteria, were kept about 10 m apart from four bighorn sheep for 1 mo with no clinical signs of pneumonia observed in the bighorn sheep during that period. The domestic and bighorn sheep were then allowed to have fence-line contact for 2 mo. During that period, three bighorn sheep acquired the tagged bacteria from the domestic sheep. At the end of the 2 mo of fence-line contact, the animals were allowed to commingle. All four bighorn sheep died 2 days to 9 days following commingling. The lungs from all four bighorn sheep showed gross and histopathologic lesions characteristic of *M. haemolytica* pneumonia. Tagged *M. haemolytica* were isolated from all four bighorn sheep, as confirmed by growth in ampicillin-containing culture medium, PCR-amplification of genes encoding GFP and Ap(R), and immunofluorescent staining of GFP. These results unequivocally demonstrate transmission of *M. haemolytica* from domestic to bighorn sheep, resulting in pneumonia and death of bighorn sheep.

Miller, J. M., Poissant, J., Kijas, J. W., and D. W. Coltman. 2011. A genome-wide set of SNPs detects population substructure and long range linkage disequilibrium in wild sheep. *Molecular Ecology Resources* 11:314-322.

Abstract: The development of genomic resources for wild species is still in its infancy. However, cross-species utilization of technologies developed for their domestic counterparts has the potential to unlock the genomes of organisms that currently lack genomic resources. Here, we apply the OvineSNP50 BeadChip, developed for domestic sheep, to two related wild ungulate species: the bighorn sheep (*Ovis canadensis*) and the thimhorn sheep (*Ovis dalli*). Over 95% of the domestic sheep markers were successfully genotyped in a sample of fifty-two bighorn sheep while over 90% were genotyped in two thimhorn sheep. Pooling the results from both species identified 868 single-nucleotide polymorphisms (SNPs), 570 were detected in bighorn sheep, while 330 SNPs were identified in thimhorn sheep. The total panel of SNPs was able to discriminate between the two species, assign population of origin for bighorn sheep and detect known relationship classes within one population of bighorn sheep. Using an informative subset of these SNPs (n = 308), we examined the extent of genome-wide linkage disequilibrium (LD) within one population of bighorn sheep and found that high levels of LD persist over 4 Mb.

Perry, T. W., Newman, T. and K. M. Thibault. 2010. Evaluation of methods used to estimate size of a population of desert bighorn sheep (*Ovis canadensis mexicana*) in New Mexico. *Southwestern Naturalist* 55:517-524.

Abstract: Reliable estimates of size of populations are critical for successful management of translocated desert bighorn sheep (*Ovis canadensis mexicana*). As costs decrease and quality improves, remote cameras are increasingly used as a non-invasive tool to monitor populations of wildlife but their efficacy has yet to be evaluated in a diversity of species and habitats. Here we investigate whether remote cameras, in combination with a simple mark-resight model, produce estimates of size of populations of desert bighorn sheep comparable to those derived from surveys conducted on the ground and using helicopters in the Fra Cristobal Range of south-central New Mexico. We determined that

estimates of size of populations derived from remote cameras were comparable to those produced from direct observations obtained by surveys from helicopters and on the ground that ca 25 sequential samples of photographs produced comparable estimates of size of populations but that photographs of single desert bighorn sheep dramatically lowered estimates of size of populations and that placement of remote cameras on wildlife guzzlers in July produced the greatest number of photographs in the shortest time. Our results suggest that use of remote cameras may be an accurate low cost and non-invasive means of estimating size of populations of desert bighorn sheep in New Mexico. Further research is warranted, ideally in tandem with ongoing surveys on the ground and using helicopters in other management areas.

Poissant, J., Shafer, A. B. A., Davis, C. S., Mainguy, J., Hogg, J. T., Cote, S. D., and D. W. Coltman. 2009. Genome-wide cross-amplification of domestic sheep microsatellites in bighorn sheep and mountain goats. *Molecular Ecology Resources* 9:1121-1126.

Abstract: We tested for cross-species amplification of microsatellite loci located throughout the domestic sheep (*Ovis aries*) genome in two north American mountain ungulates (bighorn sheep, *Ovis canadensis*, and mountain goats, *Oreamnos americanus*). We identified 247 new polymorphic markers in bighorn sheep (≥ 3 alleles in one of two study populations) and 149 in mountain goats (≥ 2 alleles in a single study population) using 648 and 576 primer pairs, respectively. Our efforts increased the number of available polymorphic microsatellite markers to 327 for bighorn sheep and 180 for mountain goats. The average distance between successive polymorphic bighorn sheep and mountain goat markers inferred from the Australian domestic sheep genome linkage map (mean \pm 1 SD) was 11.9 \pm 9.2 and 15.8 \pm 13.8 centimorgans, respectively. The development of genomic resources in these wildlife species enables future studies of the genetic architecture of trait variation.

Rioux-Paquette, E., Festa-Bianchet, M., and D. W. Coltman. 2010. No inbreeding avoidance in an isolated population of bighorn sheep. *Animal Behaviour* 80:865-871.

Abstract: Inbreeding avoidance mechanisms such as mate choice should be selected for when inbreeding produces fitness costs. Several studies, however, suggest that animals tolerate inbreeding despite its costs. We studied inbreeding avoidance in bighorn sheep, *Ovis canadensis*, on Ram Mountain, Alberta, Canada, a population with limited dispersal. We used a randomization procedure to simulate a mean inbreeding coefficient of lambs if mating was random every year, and compared these random mating scenarios with known pairings from 1996 to 2007. We considered three sets of candidate males: all males aged 2 years or more, only males known to reproduce, and all males but accounting for age differences in reproductive success. In all cases, mean cohort inbreeding coefficients did not differ from those expected under random mating. We found no evidence of avoidance of mating between close relatives (half-cousins and higher degrees of relatedness). Mate choice was possibly constrained by the generally high level of relatedness among individuals in the population. Selective pressures for inbreeding avoidance, however, may also be weak for this species because of sex-differential costs of inbreeding, limited opportunities of meeting close relatives and breeding migrations of males. The apparent lack of inbreeding avoidance has important implications for the conservation of small and isolated populations of bighorn sheep, where high levels of inbreeding should be expected.

Schroeder, C. A., Bowyer, R. T., Bleich, V. C., and T. R. Stephenson. 2010. Sexual segregation in Sierra Nevada bighorn sheep, *Ovis canadensis sierrae*: ramifications for conservation. 2010. *Arctic Antarctic and Alpine Research* 42:476-489.

Abstract: We studied sexual segregation in an endangered alpine ungulate, Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*) in the Sierra Nevada, California, U S A, during winter 2005-2006. We tested hypotheses for sexual segregation to better understand that phenomenon and to obtain information critical for the conservation of these rare mammals. Females foraged in larger groups that were closer to escape terrain than did males. Areas used by males had higher biomass of vegetation and

were less open than areas used by females. Males foraged more efficiently in larger groups, whereas females foraged more efficiently when close to escape terrain. Females exhibited a higher bite rate than did males. Males traveled farther per day and in more open terrain than did females. Sexes of bighorn sheep also differed in their dietary niches. Those niches differed most where sexes of bighorn sheep overlapped more in spatial distribution, and differed less where spatial separation was more pronounced. These outcomes are most parsimoniously explained by the gastrocentric and predation hypotheses. In addition, sexes of bighorn sheep behaved as if they were separate species by exhibiting avoidance on one niche axis (space) when there was overlap on another axis (diet). Management and conservation plans must consider the disparate requirements of males and females to help assure the viability of these endangered mountain ungulates.

Subramaniam, R., Dassanayake, R. P., Norimine, J., Brown, W. C., Knowles, D. P., and S. Srikumaran. 2010. Molecular cloning, characterization and in vitro expression of SERPIN B1 of bighorn sheep (*Ovis canadensis*) and domestic sheep (*Ovis aries*) and comparison with that of other species. *Veterinary Immunology and Immunopathology* 137:327-331.

Abstract: *Mannheimia haemolytica* infection results in enhanced PMN-mediated tissue damage in the lungs of bighorn sheep (BHS) compared to that of domestic sheep (DS). SERPIN B1 is an inhibitor of PMN-derived serine proteases. It prevents lung tissue injury by inhibiting the serine proteases released as a result of PMN lysis and degranulation. It is conceivable that PMNs of BHS exhibit decreased quantity and/or activity of SERPIN B1 which results in enhanced tissue injury and decreased bacterial clearance in pneumonic lungs of BHS. The objective of this study was to clone and express SERPIN B1 of BHS and DS, and develop antibodies to facilitate quantification of SERPIN B1. The 1,134 bp cDNA of SERPIN B1 of BHS and DS encodes a polypeptide of 377 amino acids. SERPIN B1 of BHS and DS exhibits 100% identity at the nucleotide and amino acid levels. The amino acid sequence of ovine (BHS/DS) SERPIN B1 displays 69%, 71%, 74%, 78% and 80% identity with that of rats, dogs, mice, humans and horses, respectively. Ovine SERPIN B1 expressed in *Escherichia coli* was used to develop polyclonal antibodies in mice. Western blot analysis revealed the specificity of these antibodies for ovine rSERPIN.

Whiting, J. C., Bowyer, R. T., Flinders, J. T., Bleich, V. C., and J. G. Kie. 2010. Sexual segregation and use of water by bighorn sheep: implications for conservation. *Animal Conservation* 13:541-548.

Abstract: Males and females of most dimorphic ruminants segregate outside the mating season, which may necessitate that conservation efforts focus on differential resources used by the sexes. Dimorphic bighorn sheep *Ovis canadensis* are one of the rarest ungulates in North America with some populations listed as endangered. Water sources are important for the persistence of populations of bighorns, especially in a changing climate. Understanding whether the sexes use different water sources could influence the conservation of this species and the habitats they occupy; however, little research exists regarding this important topic. We tested hypotheses relating to use of water sources by reintroduced male and female bighorns in Utah, USA. We investigated whether use of this resource differed across seasons by sex, and if sexes used water more during drought compared with non-drought conditions. Bighorns used small, adjacent core areas during segregation, and males and females used different sources of water during that time. Males visited water sources used by females more during aggregation. Males and females used water sources more in summer, and males visited water sources more during rut than did females. Males and females did not use water sources more during drought compared with non-drought conditions; however, sexes visited water sources more during the season following drought than following non-drought conditions, indicating a time-lag in use of this resource. Our results highlight the importance of water sources used by sexes of bighorns, and indicate that the existing criterion for distance of bighorn reintroductions from water may be inadequate for successful establishment of populations. We recommend conservationists assess availability of water sources near habitat used by male and female ungulates before conserving and manipulating habitat, siting artificial sources of water and reintroducing animals.

Wolfe, L.L., Diamond, B., Spraker, T. R., Sirochman, M. A., Walsh, D. P., Machin, C. M., Bade, D. J., and M. W. Miller. 2010. A Bighorn Sheep Die-off in Southern Colorado Involving a Pasteurellaceae Strain that May Have Originated from Syntopic Cattle. *Journal of Wildlife Diseases* 46:1262-1268.

Abstract: We investigated a pasteurellosis epizootic in free-ranging bighorn sheep (*Ovis canadensis*) wherein a Pasteurellaceae strain carried by syntopic cattle (*Bos taunts*) under severe winter conditions appeared to contribute to pneumonia in affected bighorns. Twenty-one moribund or dead bighorn sheep were found on the "Fossil Ridge" herd's winter range, Colorado, USA, between 13 December 2007 and 29 February 2008. Eight carcasses examined showed gross or microscopic evidence of acute to subacute fibrinous bronchopneumonia. All eight carcasses yielded at least one beta-hemolytic *Mannheimia haemolytica* biogroup 1((+/- c)) strain, and seven also yielded a beta-hemolytic *Bibersteinia trehalosi* biogroup 4(CDS) strain; evidence of *Pasteurella nmultocida*, *Mycoplasma ovipneumoniae*, and parainfluenza 3 and bovine respiratory syncytial viruses was also detected. Isolates of beta-hemolytic *Mannheimia haemolytica* biogroup 1(C) from a bighorn carcass and a syntopic cow showed 99.5% similarity in genetic fingerprints; *B. trehalosi* biogroup 4(CDS) isolates were $\geq 94.9\%$ similar to an isolate from a nearby bighorn herd. Field and laboratory observations suggested that pneumonia in affected bighorns may have been caused by a combination of pathogens including two pathogenic Pasteurellaceae strains one likely of cattle origin and one likely of bighorn origin with infections in some cases perhaps exacerbated by other respiratory pathogens and severe weather conditions. Our and others' findings suggest that intimate interactions between wild sheep and cattle should be discouraged as part of a comprehensive approach to health management and conservation of North American wild sheep species.

DBC Says Good Bye to a Long-Time Friend

Al Ray Jonez

September 24, 1928 – April 6, 2011

Al Ray Jonez passed away recently in Wheat Ridge, Colorado. Mr. Jonez was a long time employee of the Nevada Game and Fish Commission and subsequently the Nevada Fish and Game Department (which preceded the Nevada Department of Wildlife). He served many years as the District Supervisor in Las Vegas.

Al participated in the first annual meeting of the Desert Bighorn Council held in the Palm Room of the Royal Nevada Hotel in Las Vegas in 1957. He was one of the 27 attendees, and gave the state status report for Nevada. He continued reporting on the hunting results and the status of bighorn sheep in Nevada for many years. In 1963, Al chaired the Council meeting held at the University of Nevada at Las Vegas.

After retiring from state service, Al left the Nevada desert for Colorado. He is survived by his wife of many years, Barbara. Wild sheep lost a true friend with the passing of Al Ray Jonez.

