



Bleats and Blats

Official Newsletter of the
Desert Bighorn Council



January 2013

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Hello DBC members and friends,

It's hard to believe that 2013 is already here. That means our April meeting in New Mexico is just around the corner! Be sure to save the date, and see this issue for more information. You'll also find updates on recent literature, the status of our soon-to-be released Transactions, and more.

Please let me know if you have materials to share in our next newsletter. Also, if you'd like to share your bighorn sheep stories, reports, and/or photos on our website, they would be most welcome. We hope to hear from you!

Happy New Year, and all the best in 2013!

Esther Rubin (DBC Secretary)

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2013 Biennial DBC Meeting Call for Papers

The 2013 Biennial meeting of the Desert Bighorn Council will be held April 17-20, 2013, at the Hotel Encanto, in Las Cruces, New Mexico. The early registration deadline is March 7 (see link below for more information).

The 52nd meeting of the Desert Bighorn Council encourages papers on all current research and management issues related to bighorn sheep management. You are invited to submit abstracts for oral or poster presentations. Speakers should plan for a 15 minute presentation, with an additional 5 minutes for questions and answers. A laptop PC and projector will be provided for PowerPoint presentations. Please inquire about other audio-visual aids, if needed.

Instructions for Oral Presentation and Poster Abstracts

In Microsoft Word format, please type the title in capital letters and bold font. List all authors in capitals using first and last names, followed by their affiliation, address, and contact information in standard letters. Abstracts are restricted to 250 words and should summarize findings. Please identify whether the abstract is for an oral presentation or poster presentation immediately after the abstract. An example format is provided below. We encourage each state to present a status update. The printed abstract booklet will be available at the meeting.

Abstract example:

USING HARVEST AND AERIAL SURVEY DATA TO ESTIMATE BIGHORN POPULATIONS IN NEW MEXICO

RYAN WALKER, New Mexico Department of Game and Fish, 215 York Canyon Road, Raton, NM 87740. (575) 445-2311, ryan.walker@state.nm.us

KEVIN RODDEN, New Mexico Department of Game and Fish, 2715 Northrise Drive, Las Cruces, NM 88011. (575) 532-2111, kevin.rodden@state.nm.us

Abstract: Population reconstruction.....

Oral presentation.

Please submit abstracts electronically by February 15, 2013, to:

Elise Goldstein, 505-476-8041 Elise.Goldstein@state.nm.us

For additional information contact:

Elise Goldstein, 505-476-8041 Elise.Goldstein@state.nm.us

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Patrick Morrow, 575-678-7095 patrick.c.morrow.civ@mail.mil

Meeting registration information can be found at <http://www.rsvpbook.com/DBC2013>

Call for Desert Bighorn Council Awards Nominations

Submitted by Rick Brigham, DBC Awards Committee

Do you know someone who has done much for desert bighorns and should be recognized by the Council? The Council bestows two awards: The Ram Award and the Honor Plaque. If you have someone in mind for either of these, please contact: Dick Weaver, Awards Chair, at P.O. Box 100, Glenwood Springs, NM 88039 or 575-539-2378; or Rick Brigham at 509-751-0310 (home) or 509-769-7350 (cell), or at rickceil30@cableone.net. The earlier you get your nominations in, the easier the Awards committee's job. The committee also includes Vern Bleich and Bruce Garlinger. Nominations are due by February 15, 2013.

DBC Transactions Update

Submitted by Brian Wakeling, Arizona Game and Fish Department, DBC Transactions Editor

Production of Volume 51 of the *Desert Bighorn Council Transactions* is on track for publication in January. Six manuscripts were submitted for publication, and the review and editing of these papers relied on the volunteer efforts of willing referees, who also happen to have full time jobs of their own. The final review and layout occurred this fall, after diligent work by authors and reviewers. Upon publication, all current members will receive a printed copy. I want to thank each of the authors and referees that have worked so hard to make this an outstanding and useful publication. My thanks extend to the authors of the status reports as well.

Recommendations for Management of Domestic Sheep and Goats in Wild Sheep Habitat

The Wild Sheep Working Group of the Western Association of Fish and Wildlife Agencies recently released a publication entitled "*Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat.*" The Executive Summary is reprinted here (with permission).

Executive Summary: Although the risk of disease transmission from domestic sheep or goats to wild sheep is widely recognized, a unified set of management recommendations for minimizing this risk has not been adopted by responsible agencies. These Western Association of Fish and Wildlife Agencies (WAFWA) recommendations were produced to help state, provincial, and territorial wild sheep managers, federal/crown land management agencies, private landowners and others take appropriate steps to eliminate range overlap, and thereby, reduce opportunities for transmission of pathogens to wild sheep. Transmission of *Mannheimia haemolytica* from domestic sheep to bighorn sheep was irrefutably demonstrated by Lawrence et al. (2010) and provides justification sufficient for preventing range overlap and potential association of domestic sheep and goats with wild sheep. The higher the conservation value of a wild sheep population (e.g., federally or state listed, "sensitive species" status, native herds, transplant source stock, herds in areas with no history of domestic livestock presence), the more aggressive and comprehensive wild sheep and domestic sheep or goat separation management strategies should be. Practical solutions will be difficult, if not impossible to achieve until the risk of disease transmission from domestic sheep or goats to wild sheep is acknowledged by those responsible for wildlife and agricultural management. All parties benefit when risk is assessed and actively managed to minimize the potential for transmission of pathogens. The recommendations contained within this report are intended to help achieve that objective to benefit all sectors and are summarized as follows:

WAFWA agencies should:

(1) assess wild sheep conservation value/status and complete risk assessments of interspecies contact in a meta-population context; (2) remove wild sheep that have likely associated with domestic sheep or goats and develop a policy to promptly respond to wild sheep wandering from occupied wild sheep ranges; (3) thoroughly explore demographic consequences of translocations and conduct appropriate analyses of habitat suitability and risk of disease transfer prior to implementing any translocations; (4) coordinate with other agencies, land owners and stakeholders regarding management of domestic sheep or goats on or near ranges occupied by wild sheep; (5) fully consider the risk of disease transmission when issuing or commenting on permits/regulations associated with private lands used for domestic production; and (6) develop educational materials and outreach programs to interpret the risk of association between wild sheep and domestic sheep or goats.

Land management agencies should:

(1) reduce risk of association by eliminating overlap of domestic sheep or goat allotments or grazing permits/tenures within wild sheep habitat; (2) ensure that annual operating instructions or their equivalent include measures to minimize domestic association with wild sheep and confirm appropriate methods to remove stray domestic sheep or goats; and (3) manage wild sheep habitat to promote healthy populations in areas without domestic sheep or goats.

Wild sheep conservation organizations should:

(1) assist with educational/extension efforts to all parties; (2) negotiate alternatives and incentives for domestic sheep or goat grazers on public land to find alternatives to wild sheep habitat; and (3) advocate for and support research concerning disease and risk associated with domestic sheep and goats in proximity to wild sheep.

Domestic sheep and goat permittees/owners should:

(1) implement best management practices (BMPs) to prevent straying by domestic sheep or goats; and (2) establish protocols to respond to straying.

Private landowners should:

(1) educate themselves and work with wild sheep managers and advocates to support effective separation through a variety of site-specific mitigation measures; and (2) promptly report the potential or actual association between domestic sheep or goats and wild sheep.

The complete recommendation document can be found at:

<http://www.wafwa.org/documents/wswg/RecommendationsForDomesticSheepGoatManagement.pdf>

Recent Literature Related To Bighorn Sheep

Besser, T. E., E. F. Cassirer, C. Yamada, K. A. Potter, C. Herndon, W. J. Foreyt, D. P. Knowles, and S. Srikumaran. 2012. Survival of bighorn sheep (*Ovis canadensis*) commingled with domestic sheep (*Ovis aries*) in the absence of *Mycoplasma ovipneumoniae*. Journal of Wildlife Diseases 48:168-172.

Abstract: To test the hypothesis that *Mycoplasma ovipneumoniae* is an important agent of the bighorn sheep (*Ovis canadensis*) pneumonia that has previously inevitably followed experimental commingling with domestic sheep (*Ovis aries*), we commingled *M. ovipneumoniae* free domestic and bighorn sheep (n=4 each). One bighorn sheep died with acute pneumonia 90 days after commingling, but the other three remained healthy for >100 days. This unprecedented survival rate is significantly different (P=0.002) from that of previous bighorn-domestic sheep contact studies but similar to (P>0.05) bighorn sheep survival following commingling with other ungulates. The absence of epizootic respiratory disease in this experiment supports the hypothesized role of *M. ovipneumoniae* as a key pathogen of epizootic pneumonia in bighorn sheep commingled with domestic sheep.

Besser, T. E., M. A. Highland, K. Baker, E. F. Cassirer, N. J. Anderson, J. M. Ramsey, K. Mansfield, D. L. Bruning, P. Wolff, J. B. Smith, and J. A. Jenks. 2012. Causes of pneumonia epizootics among bighorn sheep, western United States, 2008-2010. *Emerging Infectious Diseases* 18:406-414.

Abstract: Epizootic pneumonia of bighorn sheep is a devastating disease of uncertain etiology. To help clarify the etiology, we used culture and culture-independent methods to compare the prevalence of the bacterial respiratory pathogens *Mannheimia haemolytica*, *Bibersteinia trehalosi*, *Pasteurella multocida*, and *Mycoplasma ovipneumoniae* in lung tissue from 44 bighorn sheep from herds affected by 8 outbreaks in the western United States. *M. ovipneumoniae*, the only agent detected at significantly higher prevalence in animals from outbreaks (95%) than in animals from unaffected healthy populations (0%), was the most consistently detected agent and the only agent that exhibited single strain types within each outbreak. The other respiratory pathogens were frequently but inconsistently detected, as were several obligate anaerobic bacterial species, all of which might represent secondary or opportunistic infections that could contribute to disease severity. These data provide evidence that *M. ovipneumoniae* plays a primary role in the etiology of epizootic pneumonia of bighorn sheep.

Forde, T., S. Kutz, J. De Buck, A. Warren, K. Ruckstuhl, M. Pybus, and K. Orsel. 2012. Occurrence, diagnosis, and strain typing of *Mycobacterium avium* subspecies paratuberculosis infection in Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) in southwestern Alberta. *Journal of Wildlife Diseases* 48:1-11.

Abstract: The role that wildlife may play in the transmission of *Mycobacterium avium* subspecies paratuberculosis (Map), the causative agent of Johne's disease (JD), and the potential consequences of infection in these populations are being given increasing consideration. A yearling male Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) from southwestern Alberta, Canada, was found infected with Map in August 2009. Clinical signs of emaciation and diarrhea and histologic findings of diffuse granulomatous enteritis of the distal ileum, lymphadenitis of the mesenteric lymph nodes, and lymphangitis of the ileum were similar to previously described cases of JD in bighorn sheep. Infection with Map was confirmed by bacterial isolation through fecal culture, acid-fast staining, and polymerase chain reaction (PCR) of IS900. The Map1506 gene was sequenced, and the isolate was identified as a Cattle (Type TT) strain. In a follow-up herd-level survey, three of 44 fecal samples (7%) from individual bighorn sheep from the same herd as the index case were PCR-positive and identified as Type II Map strains. Twenty-five samples from a distant bighorn population were negative. Additional strain typing of the isolates from the index case and the positive fecal samples was done by sequencing three discriminatory short sequence repeat (SSR) regions. All four SSR profiles differed from one another, suggesting multiple introductions or a long-existing circulation of Map within this bighorn population. Detailed molecular analyses are essential for understanding and managing diseases at the wildlife-livestock interface.

Miller, J. M., R. M. Malenfant, S. S. Moore, and D. W. Coltman, David W. 2012. Short reads, circular genome: skimming SOLiD sequence to construct the bighorn sheep mitochondrial genome. *Journal of Heredity* 103:140-146.

Abstract: As sequencing technology improves, an increasing number of projects aim to generate full genome sequence, even for nonmodel taxa. These projects may be feasibly conducted at lower read depths if the alignment can be aided by previously developed genomic resources from a closely related species. We investigated the feasibility of constructing a complete mitochondrial (mt) genome without preamplification or other targeting of the sequence. Here we present a full mt genome sequence (16,463 nucleotides) for the bighorn sheep (*Ovis canadensis*) generated through alignment of SOLiD short-read sequences to a reference genome. Average read depth was 1240, and each base was covered by at least 36 reads. We then conducted a phylogenomic analysis with 27 other bovid mitogenomes, which placed bighorn sheep firmly in the *Ovis* clade. These results show that it is possible to generate a complete mitogenome by skimming a low-coverage genomic sequencing library. This technique will become increasingly applicable as the number of taxa with some level

of genome sequence rises.

Miller, J. M., J. Poissant, J. T. Hogg, and D. W. Coltman. 2012. Genomic consequences of genetic rescue in an insular population of bighorn sheep (*Ovis canadensis*). *Molecular Ecology* 21:1583-1596.

Abstract: Genetic rescue is a management intervention whereby a small population is supplemented with individuals from other populations in an attempt to reverse the effects of inbreeding and increased genetic load. One such rescue was recently documented in the population of bighorn sheep (*Ovis canadensis*) within the National Bison Range wildlife refuge (Montana, USA). Here, we examine the locus-specific effects of rescue in this population using a newly developed genome-wide set of 195 microsatellite loci and first-generation linkage map. We found that the rate of introgression varied among loci and that 111 loci, 57% of those examined, deviated from patterns of neutral inheritance. The most common deviation was an excess of homozygous genotypes relative to neutral expectations, indicative of directional selection. As in previous study of this rescue, individuals with more introduced alleles had higher reproductive success and longevity. In addition, we found 30 loci, distributed throughout the genome, which seem to have individual effects on these life history traits. Although the potential for outbreeding depression is a major concern when translocating individuals between populations, we found no evidence of such effects in this population.

Miller, D. S., G. C. Weiser, A. C. S. Ward, M. L. Drew, and P. L. Chapman. 2012. Pasteurellaceae isolated from bighorn sheep (*Ovis canadensis*) from Idaho, Oregon, and Wyoming. *American Journal of Veterinary Research* 73:1024-1028.

Abstract: Objective-To elucidate the species and biovariants of Pasteurellaceae isolated from clinically normal bighorn sheep (*Ovis canadensis*) or bighorn sheep with evidence of respiratory disease. Sample-675 Pasteurellaceae isolates from 290 free-ranging bighorn sheep in Idaho, Oregon and Wyoming. Procedures-Nasal and oropharyngeal swab specimens were inoculated onto selective and nonselective blood agar media. Representatives of each colony type were classified via a biovariant scheme. The association of respective beta-hemolytic isolates with respiratory disease was evaluated via chi-square analyses. Results-Bacterial isolates belonged to 4 species: *Histophilus somni*, *Mannheimia haemolytica*, *Pasteurella multocida*, and *Bibersteinia (Pasteurella) trehalosi*. Within the latter 3 species, 112 subspecies, biotypes, and biovariants were identified. *Bibersteinia trehalosi* 2 and *B. trehalosi* 2B constituted 345 of 675 (51%) isolates. Most (597/618 [97%]) isolates from adult sheep were from clinically normal animals, whereas most (47/57 [82%]) isolates from lambs were from animals with evidence of respiratory disease. Twenty-two Pasteurellaceae biovariants were isolated from sheep with respiratory disease; 17 of these biovariants were also isolated from clinically normal sheep. The ability of isolates to cause beta-hemolysis on blood agar was associated with respiratory disease in adult bighorn sheep (OR, 2.59; 95% confidence interval, 1.10 to 6.07). Conclusions and Clinical Relevance-Bighorn lambs appeared more susceptible to respiratory disease caused by Pasteurellaceae than did adult sheep. Beta-Hemolytic Pasteurellaceae isolates were more likely to be associated with respiratory disease than were non-beta-hemolytic isolates in adult sheep. Identification of Pasteurellaceae with the greatest pathogenic potential will require studies to estimate the risk of disease from specific biovariants.

Poissant, J., C. S. Davis, R. M. Malenfant, J. T. Hogg, and D. W. Coltman. 2012. QTL mapping for sexually dimorphic fitness-related traits in wild bighorn sheep. *Heredity* 108: 256-263.

Abstract: Dissecting the genetic architecture of fitness-related traits in wild populations is key to understanding evolution and the mechanisms maintaining adaptive genetic variation. We took advantage of a recently developed genetic linkage map and phenotypic information from wild pedigreed individuals from Ram Mountain, Alberta, Canada, to study the genetic architecture of ecologically important traits (horn volume, length, base circumference and body mass) in bighorn sheep. In addition to estimating sex-specific and cross-sex quantitative genetic parameters, we tested for the presence of quantitative trait loci (QTLs), colocalization of QTLs between bighorn sheep and domestic sheep, and sex x QTL interactions. All traits showed significant additive genetic variance and genetic correlations tended to be positive. Linkage analysis based on 241

microsatellite loci typed in 310 pedigreed animals resulted in no significant and five suggestive QTLs (four for horn dimension on chromosomes 1, 18 and 23, and one for body mass on chromosome 26) using genome-wide significance thresholds (Logarithm of odds (LOD) > 3.31 and > 1.88, respectively). We also confirmed the presence of a horn dimension QTL in bighorn sheep at the only position known to contain a similar QTL in domestic sheep (on chromosome 10 near the horns locus; nominal $P < 0.01$) and highlighted a number of regions potentially containing weight-related QTLs in both species. As expected for sexually dimorphic traits involved in male male combat, loci with sex-specific effects were detected. This study lays the foundation for future work on adaptive genetic variation and the evolutionary dynamics of sexually dimorphic traits in bighorn sheep.

Poppenga, R. H., J. Ramsey, B. J. Gonzales, and C. K. Johnson. 2012. Reference intervals for mineral concentrations in whole blood and serum of bighorn sheep (*Ovis canadensis*) in California. Journal of Veterinary Diagnostic Investigation 24:531-538.

Abstract: Whole blood and serum mineral concentrations were measured in diverse bighorn sheep (*Ovis canadensis*) metapopulations in California, and 90% reference intervals were determined. While there were some statistical differences between median concentrations among the different metapopulations, detected values were generally in good agreement with concentrations reported for other bighorn sheep populations and with reference ranges widely accepted for domestic sheep (*Ovis aries*). Although median whole blood selenium and serum copper concentrations were within adequate ranges reported for domestic sheep, some metapopulations had substantial numbers of individuals whose concentrations would be considered suboptimal for domestic sheep. There are a number of factors that can influence mineral concentrations in wildlife species such as bighorn sheep and that make the establishment of reference ranges challenging. However, the establishment of mineral reference ranges is important for such species, as their health and productivity are increasingly scrutinized and actively managed.

Walsh, D. P., L. L. Wolfe, M. E. P. Vieira, and M. W. Miller. 2012. Detection probability and pasteurellaceae surveillance in bighorn sheep. Journal of Wildlife Diseases 48:593-602.

Abstract: We investigated the influence of detection probability (i.e., the probability of detecting the disease or organism of interest) on the repeatability of results reported from bacterial culture tests used to demonstrate the presence of species in the Pasteurellaceae family that infect bighorn sheep (*Ovis canadensis*). We also estimated occupancy probabilities (i.e., the probability an individual bighorn in a herd is infected) for each cultured biovariant and examined the effects of detection probability on the number of samples needed to detect the Pasteurellaceae biovariants from within an individual sheep as well as from within a herd. We collected 5-15 samples from free-ranging bighorns in Colorado, using oropharyngeal swabs or swabs of lungs, and submitted these swabs either immediately or after 2 days for bacterial culture. We saw significant variability in results for repeated samples from each of the sheep, and detection probabilities were ≤ 0.71 for all Pasteurellaceae biovariants cultured. The delayed (≥ 2 days) sample submission reduced both the microbial diversity detected and the detection probability for the biovariants characterized when compared to samples submitted immediately. Oropharyngeal sampling had higher detection probabilities of the individual biovariants than did lung swabs, and there was a difference in the biovariants detected between oropharyngeal and lung sampling. Depending on the biovariant of interest, estimates of occupancy probabilities ranged from 0.37-0.89, and we estimated that three to >30 swab samples were necessary to obtain a 95% confidence of detecting the cultured biovariants if they were present in an individual sheep. We estimated that the optimal sample sizes to detect the observed biovariants within a sheep herd with a 95% confidence ranged from sampling two bighorns twice to sampling 40 individuals once. Detection probability impacts the results reported from bacterial cultures for Pasteurellaceae in bighorn sheep, and confounding effects of the detection process should be addressed to improve the rigor of surveillance.

Weiser, G. C., M. L. Drew, E. F. Cassirer, A. C. S. Ward. 2012. Detection of *Mycoplasma ovipneumoniae* and *M. Arginini* in bighorn sheep using enrichment culture coupled with genus- and species-specific

polymerase chain reaction. *Journal of Wildlife Diseases* 48:449-453.

Abstract: *Mycoplasma* species are of interest as possible primary pathogens in the pneumonia complex of bighorn sheep (*Ovis canadensis*). Previous investigations have not commonly detected low frequencies of *Mycoplasma* spp. from free-ranging bighorn sheep, possibly due to the fastidious and slow growth of these organisms. We developed a culture protocol that employed an average initial 3-day enrichment culture in liquid Hayflick broth in a CO₂-enhanced atmosphere. The broth was plated to solid Hayflick medium and the cultures observed for growth for up to 30 days. Polymerase chain reaction (PCR) was performed on DNA isolated from the enrichment broth and on isolates obtained from culture using *Mycoplasma* genus-specific PCR assays and species-specific PCR assays for *M. arginini* and *M. ovipneumoniae*. Some cultures that grew on Hayflick plates were picked as single colonies but were mixed because two organisms may grow together and appear as a single colony. Culture and PCR tests produced similar results for *M. arginini*, but for *M. ovipneumoniae*, culture alone was less accurate than PCR. Use of genus-specific primers also may allow detection of other species in samples negative for *M. arginini* and *M. ovipneumoniae*. Two methods of transport from field to laboratory (Port-a-Cul (TM) tubes, cryoprotectant in liquid N-2 and Fisher Transport System) gave similar results under our study conditions.

Whiting, J. C., D. D. Olson, J. M. Shannon, R. T. Bowyer, R. W. Klaver, and J. T. Flinders. 2012. Timing and synchrony of births in bighorn sheep: implications for reintroduction and conservation. *Wildlife Research* 39: 565-572.

Abstract: Context - Timing (mean birthdate) and synchrony (variance around that date) of births can influence survival of young and growth in ungulate populations. Some restored populations of ungulates may not adjust these life-history characteristics to environments of release sites until several years after release, which may influence success of reintroductions. Aims - We quantified timing and synchrony of births from 2005 to 2007 in four populations of reintroduced bighorn sheep (*Ovis canadensis*) occupying two ecoregions (Central Basin and Range and Wasatch and Uinta Mountains) in Utah, USA, to investigate whether bighorns would adjust these life-history characteristics to environmental conditions of the two ecoregions. We also compared timing and synchrony of births for bighorns in their source herd (Antelope Island) with bighorns in an ecologically similar release site (Stansbury Mountains) during 2006 and 2007. Methods - We relocated female bighorns to record birthdates of young, and observed groups of collared bighorns to quantify use of elevation by those ungulates. We also calculated the initiation, rate and timing of peak green-up by ecoregion, using the normalised difference vegetation index. Key results - We quantified 274 birthdates, and although only separated by 57 km, bighorn populations occupying the Central Basin and Range Mountains gave birth an average of 29 days earlier than did those on the Wasatch and Uinta Mountains, which corresponded with the initiation of vegetation green-up. Additionally, bighorn sheep on the Stansbury Mountains (ecologically similar release site) gave birth at similar times as did bighorns on Antelope Island (source area). Conclusions - Populations of bighorn sheep that were reintroduced into adjacent ecoregions adjusted timing of births to environments and green-up of vegetation in restoration areas. Timing and synchrony of births for reintroduced bighorn sheep in an ecologically similar release site were the same as those of their source area. Implications - Consideration should be given to the adjustment of timing and synchrony of births when reintroducing bighorns, especially when animals are released into different ecoregions. Also, biologists should select release sites that are ecologically similar to source areas, thereby reducing potential negative effects of animals adjusting timing and synchrony of births to environmental conditions of restoration areas.

Wilson, D. J. and L. McFarlane. 2012. Contagious ecthyma in a Rocky Mountain bighorn sheep from Utah. *Human-Wildlife Interactions* 6:7-11.

Abstract: In December 2008, near Flaming Gorge Reservoir in northeastern Utah, a 21/2-year-old male Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) was reported in poor body condition with bloody lesions covering the muzzle area. The sheep was euthanized, and samples were submitted to the Utah Veterinary Diagnostic Laboratory in Logan, Utah. The gross and microscopic lesions confirmed the diagnosis of contagious

ecthyma (CE). This is the first documented report of CE in bighorn sheep from Utah.

Sesnie, S. E., B. G. Dickson, S. S. Rosenstock, and J. M. Rundall. 2012. A comparison of Landsat TM and MODIS vegetation indices for estimating forage phenology in desert bighorn sheep (*Ovis canadensis nelsoni*) habitat in the Sonoran Desert, USA. *International Journal of Remote Sensing* 33: 276-286.

Abstract: Sonoran Desert bighorn sheep (*Ovis canadensis mexicana*) occupy rugged upland areas that experience irregular periods of vegetation growth associated with precipitation events. These episodic and often spatially limited events provide important forage and preformed water resources that may be important drivers of animal movement and habitat use. Habitat-use models that incorporate forage phenology would broaden our understanding of desert bighorn ecology and have considerable potential to inform conservation efforts for the species. Field-based methods are of limited utility to characterize vegetation phenology across large areas. Vegetation indices (VI) derived from satellite imagery are a viable alternative, but may be confounded by areas of high relief and shadow effects that can degrade VI values. The varying spatial and temporal resolutions of readily available satellite sensors, such as the Landsat thematic mapper (TM) and moderate-resolution imaging spectrometer (MODIS), present additional challenges. In this study, we sought to minimize degrading effects of terrain on TM- and MODIS-based estimates of vegetation phenology. We compared effects of high topographic relief on time series MODIS- and TM-based VI such as the normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI) using VI departures from average (DA) in shaded and unshaded areas. Sun elevation angle negatively impacted TM-derived NDVI and EVI values in areas of steep terrain. In contrast, MODIS-derived NDVI values were insensitive to sun elevation and terrain effects, whereas MODIS-derived EVI was degraded in areas of steep terrain. Time series MODIS NDVI and EVI DA values differed significantly during months of low sun elevation angle. Average MODIS EVI departure values were $\geq 20\%$ lower than NDVI under these conditions, confounding time series estimates of plant phenology. Our best results were obtained from MODIS 16-day composited NDVI. These remote-sensing-based VI estimates of seasonal plant phenology and productivity can be used to inform models of habitat use and movements of desert bighorn over large areas.

Sirochman, M. A., K. J. Woodruff, J. L. Grigg, D. P. Walsh, K. P. Huyvaert, M. W. Miller, and L. L. Wolfe. 2012. Evaluation of management treatments intended to increase lamb recruitment in a bighorn sheep herd. 2012. *Journal of Wildlife Diseases* 48:781-784

Abstract: We administered a suite of treatments to a herd of Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) that was experiencing poor lamb recruitment and showing signs of respiratory disease. Despite 3 yr of treatment with various combinations of anthelmintics, antibiotics, vaccines, and hyperimmune serum products, recruitment was not improved.

Valdez, R. 2011. Caprinae. Pages 712-749 in D. E. Wilson and R.A. Mittermeier, editors. *Handbook of the Mammals of the World. Vol. 2. Hoofed Mammals. Lynx Edicions, Barcelona, Spain. 885 pp. Large format (12 X 9.5 in.) with hundreds of color illustrations.*

Description (from Raul Valdez): Covers 60 species of wild sheep and wild goats and related species (gorals, serows, chamois, and tahrs, among others) and their subspecies. It follows the controversial classification of Colin Groves and Peter Grubb as detailed in their book (*Ungulate Taxonomy, 2011, Johns Hopkins University Press*). Most former subspecies of wild sheep, wild goats, gorals, serows, and chamois have been elevated to full species. However, only two wild sheep species are recognized in North America: Dall's and bighorn. Each species is illustrated in color and includes sections on taxonomy, distribution plus a map for each species, descriptive notes, habitat, food and feeding, breeding, activity patterns, movements, home range, social organization and status and conservation, and references. The book is the most comprehensive available account of the ungulates of the world. It has over 6000 references. The HMW will be issued in 8 volumes.

DBC Says Good-Bye to Long-Time Friends

In Memory of Michael D. Hobson 1948-2012

Prepared by Clay Brewer, Texas Parks and Wildlife Department, DBC Tech Staff Member

Long-time Desert Bighorn Council member Mike Hobson passed away on August 7, 2012. Mike was born in the south Texas community of Edinburg on July 12, 1948. He began his collegiate studies at Pan American College and later graduated from Texas A&M University with a B.S. in Wildlife Management in 1971. Mike married his high school sweetheart, Hamila, in 1970 and was happily married for over 42 years. Together they raised two successful sons, Michael Jr. and Joshua.



He began his professional career with Texas Parks and Wildlife Department (TPWD) as a summer intern for the Wildlife Division during the summers of 1968 and 1969. In 1973, he was hired full-time as a Fish and Wildlife Technician on the Chaparral Wildlife Management Area. He later served as a Regulatory Biologist for Duval, Jim Hogg, Webb and Zapata counties. During this period he helped pioneer a newly emerging helicopter survey technique for the development of white-tailed deer harvest recommendations on private lands. Mike was placed in charge of the Division's experimental buck permit program in Webb County (1974-1978) that included oversight of 4 high-volume check stations. These stations produced some of the first age-weight data for South Texas buck harvests that was used to fine tune a deer harvest-habitat management system that remains in place today. Mike participated in numerous South Texas deer-capture operations for restocking depleted ranges in East Texas and neighboring Tamaulipas, Mexico.

Mike is well remembered by his South Texas comrades for his ability to nimbly scale great heights to the nests of Bald Eagles in order to band chicks and then rappel to ground's safety. In the late-1970s, Mike was placed on special assignment with the Canadian Fish and Wildlife Service to work in the Northwest Territories where he was part of team that banded over 96,000 Snow Geese in a 6-week period. In 1985 and 1986, antlerless deer hunting on the 44,000 ac Tomas Ranch in Duval County was placed under Mike's supervision representing the Department's first large-scale lease of private lands for the promotion of public hunting opportunity. In 1986, Mike was promoted to District Leader of the Trans-Pecos District. From 1989-1995, he also supervised the management of Black Gap and Sierra Diablo Wildlife Management Areas. Of special significance, Mike help guide the first Texas desert bighorn sheep hunt in 1988 following an 83 year hunting prohibition. He retired from TPWD in 2005 after 32 years of dedicated service. In 2009, Mike received the Texas Chapter of The Wildlife Society's "Outstanding Achievement Award" and was recognized by the Desert Bighorn Council in 2011 with an Honor Plaque for his efforts in helping to restore desert bighorns in Texas.

Mike devoted his entire career to the restoration, conservation and management of the natural resources of Texas and mentored hundreds of us while in the process. He was a highly dedicated professional with a proven track record in applying wildlife conservation principals where it mattered most, on the ground. He consistently demonstrated initiative and commitment throughout his career and practiced a work ethic that is unmatched by most others in the profession. A friend summed it up best, "Mike was old-cut. He always led by example and

expected no less of his staff than of himself. No job was too low, too dirty, or too toilsome for him to pitch in shoulder-to-shoulder with his troops.” He earned the respect of his fellow employees, wildlife professionals, academia, conservation organizations, and landowners throughout Texas as well as a number of other states. Mike’s dedication to the resource along with his persistence in doing the job right is what set him apart from most others in the profession. More important was the value he placed on God, family, country and friends.

While many spend their career building a resume, Mike spent his building a legacy that is reflected on the landscape and within those of us left behind to continue making a difference using the skills and qualities he passed on to us. The path leading to the easy way out is crowded and the line long. Rest assured, Mike Hobson is on the other trail and is first in line. Well done Mike.

- Clay E. Brewer

In Memory of Lanny Wilson

Prepared by Rick Brigham, DBC Member

Another bighorn sheep herder has climbed his last mountain. Lanny Wilson died of post-heart surgery problems on July 24, 2012, surrounded by Colleen, his wife of 52 years, and his kids Justin, Megan, and Sean.

Lanny was very active in the Council from 1970 through the mid 1980’s. He served as Vice Chair, Secretary-Treasurer, and sat on the Tech Staff as both member and chair. He initiated the (Charles) Hansen Memorial Fund, which later morphed into the Hansen-Welles Memorial Fund, from which many of you have benefitted. He also was lead or co-author on several papers dealing with capturing and re-establishing desert bighorns, bighorn reintroductions into southwest Utah, and habitat requirements and management recommendations for desert bighorns.



His career was spent with the Bureau of Land Management as a wildlife biologist, and later as an Area Manager. He worked for the BLM at the field level and as wildlife program lead in several western states, retiring to Cottonwood, Idaho, near Hells Canyon.

He is remembered for his determined, often very vocal support of bighorn sheep in the face of hostile opponents, usually the domestic sheep industry. He is also remembered for his promotion of Cap-Chur guns in lieu of drugs, instituting the first governor’s bighorn (drawing) tag, and not allowing the introduction of more exotic megafauna on public lands in New Mexico.

On the path of wildlife management, he left more than a few footprints.

