Bleats and Blats

Official Newsletter of the Desert Bighorn Council

JULY 2006

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Hello DBC members and friends!

I hope you're all having a great summer! I just got back from the annual Anza-Borrego Desert State Park bighorn sheep count, which was very successful, and now want to fill you in on the latest Desert Bighorn Council news. This newsletter includes a variety of updates related to funding, awards, new literature, and requests for information from you.

Our next newsletter is scheduled for October 2006, so if you have material to submit, please send it to me by October 1, 2006.

*And, as always, additional information about the Desert Bighorn Council can be found on our website (*http://www.desertbighorncouncil.org).

Esther Rubin
DBC Secretary (esrubin@consbio.org)

TECHNICAL STAFF CHAIR MESSAGE

Submitted by Ray Lee, Technical Staff Chair

I have the very good fortune to travel about and view wild sheep management programs with many excellent wildlife biologists. While these programs may be in very different habitats, many times the management issues are quite similar. In the past month I have observed bighorn sheep management programs in:

Nebraska
Bighorn sheep occur in Nebraska in two locations - Fort Robinson and the Wildcat Hills. The Wildcat Hills area experienced a pneumonia-related die-off last winter that reduced this population to 40-50 animals. There is now a full time technician monitoring this population. Todd Nordeen (you may remember his recent solicitation for information regarding hoof deformities) is working with the Platte River Basin Environments group to acquire new lands and to remove an adjacent domestic sheep herd from this area.

South Dakota
Bighorn sheep occur in South Dakota in three locations totaling nearly 350 animals. Gary Brundige noted that Custer State Park experienced a pneumonia-related die-off last year, reducing the Park's sheep population from nearly 200 to 40-50 animals. A large lightening-caused fire has opened up large areas in the Park and should prove beneficial to the remaining sheep.

Alberta
Biologists are dealing with the issues of resident/non-resident permits and with the Metis hunting rights. The latter issue seems to be resolving itself as (like us) very few Metis actually hunt. The issue seems to be more that the Metis are using hunting rights as an avenue to tap into much more lucrative funding for social programs.

British Columbia
An anti-hunting group bought one of the larger hunting concessions along the coast and intends to close the area to hunting. This group is aggressively raising funds to buy additional concessions. British Columbia has become a hotbed for anti-hunting efforts, particularly within the European Union.

Baja California
The Mexicali Zoo is developing a display for desert bighorn sheep. The desert sheep is the mascot for the University in Mexicali. I am taking Zoo personnel and municipal officials to the Phoenix Zoo, Arizona/Sonoran Desert Museum, and the Centro Ecologico de Sonora to visit with their mammal curators and to observe their displays.

TREASURER'S REPORT

$100,000 Gift received from Robert S. Campbell Trust

Submitted by Stacey Ostermann-Kelm, Treasurer

DBC Members,

As you may remember, long-time DBC member, friend, and conservationist Bob Campbell, passed away last year (see the September 2005 issue of Bleats and Blats). In addition to his many years of on-the-ground conservation work improving conditions for desert wildlife, Bob left a very generous gift to the DBC.

In June 2006, the DBC received a $100,000 check from the Robert S. Campbell Trust. Bob's generous donation is sure to have a lasting effect on the Council's ability to achieve its mission: to promote the advancement of knowledge concerning desert bighorn sheep and the long-range welfare of these animals.

Checking account balance:	$ 5,488.83
Citibank account (4.5% interest):	$100,000.00

Certificates of Deposit:

Acct	Balance	Maturity Date	Interest Rate
#920	$36,690.00	4/22/07	5.13%
#885	$21,475.14	3/28/07	3.25%
#022	$ 8,248.37	7/02/07	3.87%

SEEKING DBC AWARDS NOMINATIONS

Submitted by Rick Brigham, Technical Staff Member

Awards Chair Dick Weaver is seeking nominations for awards for the upcoming (50th anniversary!!) meeting at Las Vegas. PLEASE! Think about individuals who have contributed significantly to the betterment of desert bighorn sheep and who might be awarded the Ram Award, a plaque, or a certificate of appreciation. It would be great to make several awards at the Las Vegas meeting in April 2007. Contact Dick at 505-539-2378, or regular mail at P.O. Box 100, Glenwood NM 88039. Do it soon! Thanks! Or, if you function best via email, contact Rick Brigham at rick-ceil@syringa.net with your nomination.

SEEKING CONTACT INFORMATION FOR DBC MEMBERS

Submitted by Rick Brigham, Tech Staff Member

VERY OLD, EARLY, AND NOT-SO-OLD DBC MEMBERS! Has anyone seen, or do you know the whereabouts of the following people?:

Clair Aldous, Winston E. Banko, Bonnie Blaisdell, Bonnar Blong, Ray Brechbill, O.C. Deming, Amy Fisher, C.Gordon Fredine, Tommie Hailey, Fred Jones, Al Ray Jonez, Cecil Kennedy, Jack Kilpatrick, Bob McQuivey, Gale Monson, John Reed, Pete Sanchez, Norm Simmons, Lloyd Tevis, Jr., George Tsukamoto, Paul Webb, Jim Yoakum

All of these folks have made notable contributions to the Desert Bighorn Council. It would be great if as many of them as possible were able to attend the Council's 50th anniversary. If you have contact information for any of these individuals, please email Rick Brigham (rick-ceil@syringa.net)

AWARDS AND PROMOTIONS

Congratulations to the following individuals for their accomplishments!

Joe Cresto (Tech Staff Member) received the Award of Excellence from the Utah Chapter of The Wildlife Society in recognition of his career-long achievement and professional excellence in wildlife research and management. Congratulations, Joe!

Clay Brewer (Tech Staff Member) has accepted a promotional position as one of four Wildlife Division Regional Directors in the State of Texas (Region 2 – central Texas). Good for you, Clay!

If you have news of DBC member accomplishments, send us an update to include in the next newsletter!

RECENT LITERATURE RELATED TO DESERT BIGHORN SHEEP

Bunch, T. D., C. Wu, Y. P. Zhang, and S. Wang. 2006. Phylogenetic analysis of snow sheep (*Ovis nivicola*) and closely related taxa. Journal of Heredity 97:21-30.

Abstract: Based on mitochondrial cytochrome b gene sequence analysis, the history of true sheep (*Ovis*) began approximately 3.12 million years ago (MYA). The evolution of *Ovis* resulted in three generally accepted genetic groups: Argaliforms, Moufloniforms, and Pachyceriforms. The Pachyceriforms of the subgenus Pachyceros comprise the thin-horn sheep *Ovis nivicola* (snow sheep), *Ovis dalli* (Dall and Stone sheep), and *Ovis canadensis* (Rocky Mountain and desert bighorn). North American wild sheep (*O. canadensis* and *O. dalli*) evolved separately from Eurasian wild sheep and diverged from each other about 1.41 MYA. Ancestral stock that gave rise to snow sheep, Moufloniforms, and Argaliforms occurred 2.3

MYA, which then gave rise to two different extant lines of snow sheep that diverged from each other about 1.96 MYA. The more recent *nivicola* line is genetically closer to the North American wild sheep and may represent a close association during the refugium when Alaska and Siberia were connected by the Bering land bridge. The earlier period of evolution of the Pachyceriforms suggests they may have first evolved in Eurasia, the oldest ancestor then giving rise to North American wild sheep, and that a *canadensis*-like ancestor most likely gave rise to *nivicola*. Cytogenetic analysis further validates that the standard diploid number for modern *nivicola* is 52.

Cain, J. W. III, H. E. Johnson, and P. R. Krausman. 2005. Wildfire and desert bighorn sheep habitat, Santa Catalina Mountains, Arizona. Southwestern Naturalist 50:506-513.

Abstract: The desert bighorn sheep (*Ovis canadensis mexicana*) population in the Santa Catalina Mountains, Arizona, has declined since the 1920s and was virtually extirpated in the late 1990s. Urban development, human recreation, and changes in habitat conditions due to wildfire suppression have contributed to the decline. Wildfires in 2002 and 2003 burned approximately 46,701 ha in the Santa Catalina Mountains, including areas previously inhabited by desert bighorn sheep. Our objectives were to estimate the amount of potential and historical bighorn sheep habitat in the Santa Catalina Mountains and to determine if the fires improved habitat quality for bighorn sheep. We created a spatial habitat suitability model to estimate the amount of potential and historical habitat available for bighorn sheep in the Santa Catalina Mountains. We then used Burn Severity maps and the Normalized Difference Vegetation Index to examine the impact of recent wildfires on bighorn sheep habitat. We calculated 39,201 and 9,017 ha of potential and historical habitat of desert bighorn sheep, respectively. Historical bighorn sheep habitat in the western Santa Catalina Mountains declined 64% since 1989. Approximately 21% of potential habitat and 24% of historical bighorn sheep habitat were burned during the fires, most of which experienced low burn severity that was not high enough to remove vegetation that decreases habitat quality for desert bighorn sheep. Any consideration of translocation of desert bighorn sheep to the Santa Catalina Mountains should further assess the suitability of the areas identified as potential habitat.

DeCesare, N. J. and D. H. Pletscher. 2005. A dynamic test of spatial independence among bighorn sheep. Intermountain Journal of Sciences 11:25-30.

Abstract: The spatial interactions of marked study animals are often of interest in studies of wildlife ecology. All forms of resource selection analysis assume that marked individuals move and select resources independently, and this is often violated when animals are social or territorial. For this paper we deal with relocation data collected from a gregarious species, bighorn sheep (*Ovis canadensis*), and wish to assess the spatial independence of marked animals. Many commonly used methods for quantifying spatial interactions do not include the spatial and temporal details of simultaneous relocation data. In their place, we used a modified nearest-neighbor method and data from three small herds of bighorn sheep in western Montana to test for independence among marked animals. Results suggested that marked ewes within each study area were not selecting habitat independently of one another. Consideration of spatial independence can be important in a posteriori analysis and interpretation of data, as well a priori consideration of necessary sample sizes.

Jansen, B. D., P. R. Krausman, J. R. Heffelfinger, and J. C. DeVos, Jr. Saguaro spine penetrated bighorn sheep skull. Southwestern Naturalist 50:513-515.

Abstract: Animals that inhabit vegetative communities where thorns and spines are common should be capable of moving while avoiding injury from thorns and spines. On 21 December 2003, we found that a saguaro cactus (*Carnegiea gigantea*) spine had penetrated the lacrimal bone into the orbit of a desert bighorn sheep (*Ovis canadensis*) in south-central Arizona. The animal was observed with clinical infectious

keratoconjunctivitis and was blind for 3 weeks prior to death. It is likely that the animal collided with a saguaro cactus after she became blinded by disease.

Liu, W., K. A. Brayton, J. Lagerquist, W. J. Foreyt, and S. Srikumaran. 2006. Cloning and comparison of bighorn sheep CD18 with that of domestic sheep, goats, cattle, humans and mice. Veterinary Immunology and Immunopathology 110:11-16.

Abstract: Previously, we have shown that CD 18, the beta-subunit of beta(2)-integrins, serves as a receptor for leukotoxin (Lkt) secreted by *Mannheimia* (*Pasteurella*) *haemolytica* on bovine leukocytes. Anti-CD18 monoclonal antibodies (mAbs) inhibit Lkt-induced cytolysis of bighorn sheep (*Ovis canadensis*) leukocytes suggesting that CD18 may serve as a receptor for Lkt on the leukocytes of this species as well. Confirmation of bighorn sheep CD18 as a receptor for Lkt, and elucidation of the enhanced Lkt-susceptibility of bighorn sheep polymorphonuclear leukocytes (PMNs), necessitates the cloning and sequencing of cDNA encoding bighorn sheep CD18. Hence, in this study we cloned and sequenced the cDNA encoding CD 18 of bighorn sheep, and compared with that of other animal species. The cDNA of bighorn sheep CD 18 has an open reading frame (ORF) of 2310 bp. CD18 sequences obtained individually from peripheral blood mononuclear cells (PBMCs) and PMNs were identical to each other. Comparison of the deduced 770-amino acid sequence of CD18 of bighorn sheep with that of domestic sheep, goats, cattle, humans and mice revealed 99, 98, 95, 82 and 80% identity, respectively. Availability of cloned bighorn sheep CD18 cDNA should allow the molecular characterization of *M. haemolytica* Lkt-receptor interactions in bighorn sheep and other ruminants that are susceptible to this disease.

Loehr, J., K. Worley, A. Grapputo, J. Carey, A Veitch, and D. W. Coltman. 2006. Evidence for cryptic glacial refugia from North American mountain sheep mitochondrial DNA. Journal of Evolutionary Biology 19:419-430.

Abstract: The separation of populations by ice sheets into large refugia can account for much of the genetic diversity found in present day populations. The evolutionary implications of small glacial refugia have not been as thoroughly explored. To examine refugial origins of North American mountain sheep *Ovis* spp., we analyzed a 604 bp portion of the mitochondrial DNA (mtDNA) control region from 223 *O. dalli* and *O. canadensis*. Major refugia were identified in eastern Beringia and southern North America, and we found evidence for two smaller refugia situated between the Laurentide and Cordilleran glaciers. Our results are the first to demonstrate support for survival of any organism in the latter two refugia. These refugia also appear to have conserved a genetic signal that confirms past hybridization of *O. dalli* and *O. canadensis*.

Pelletier, F. and M. Festa-Bianchet. 2006. Sexual selection and social rank in bighorn rams. Animal Behaviour 71:649-655.

Abstract: For many ungulates, male reproductive success increases with social rank. Because rank is established through contests, it should be correlated with individual mass and select for high sexual dimorphism in body mass. It is difficult to weigh free-ranging ungulates, however, so empirical data on the relation between mass and social rank are scarce. We monitored individual mass and social rank of marked bighorn rams, *Ovis canadensis*, at Sheep River, Alberta, Canada over 5 years. Each year, rams were organized in a linear hierarchy. Social rank increased with age, and rank in one year was a good predictor of rank in the next year. The stability of dyadic relationships increased with the difference in age of individuals in the dyad but decreased as rams aged. Until about 6 years of age, the positive effects of age and individual mass on social rank were indistinguishable, because rams gained mass each year. The relation between body mass and social rank strengthened with age, probably because, after the heavier rams attain their lifetime asymptotic weight, they can challenge older conspecifics. In mature bighorn rams, social rank is a major

determinant of reproductive success. By providing evidence that mass is an important determinant of rank, our study supports the contention that sexual selection leads to high sexual dimorphism in this species.

Schoelkopf, L., C. E. Hutchison, K. G. Bendele, W. L. Goff, M. Willette, J. M. Rasmussen, and P. J. Holman. 2005. New ruminant hosts and wider geographic range identified for *Babesia odocoilei* (Emerson and Wright 1970). Journal of Wildlife Diseases 41:683-690.

Abstract: *Babesia odocoilei* was found to infect two previously unknown host species, desert bighorn sheep (*Ovis canadensis nelsoni*) and musk oxen (*Ovibos moschatus*), both of which are members of the family Bovidae. Previously, *B. odocoilei* has been reported in only Cervidae hosts. New geographic regions where *B. odocoilei* infections have not been reported previously include Pennsylvania and New York, where fatal babesiosis has occurred in reindeer (*Rangifer tarandus tarandus*); New Hampshire, where elk (*Cervus elaphus canadensis*) have been affected; and California, home of the infected desert bighorn sheep. Infection with *B. odocoilei* in these hosts was confirmed by parasite small subunit ribosomal RNA gene sequence analysis. A serosurvey for *B. odocoilei* antibody activity in New Hampshire showed prevalence rates of 100% at two elk farms and 12% at another farm. Control of potential vector ticks, *Ixodes scapidaris*, especially when translocating livestock, is imperative to prevent outbreaks of babesiosis in managed herds of potential host species.

Ward, A. C. S., G. C. Weiser, B. C. Anderson, P. J. Cummings, K. F. Arnold. and L. B. Corbeil. 2006. *Haemophilus somnus* (*Histophilus somni*) in bighorn sheep. Canadian Journal of Veterinary Research 70:34-42.

Abstract: Respiratory disease and poor lamb recruitment have been identified as limiting factors for bighorn-sheep populations. *Haemophilus somnus* (recently reclassified as *Histophilus somni*) is associated with respiratory disease in American bison, domestic sheep, and cattle. It is also harbored in their reproductive tracts and has been associated with reproductive failure in domestic sheep and cattle. Therefore, reproductive tract and lung samples from bighorn sheep were evaluated for the presence of this organism. Organisms identified as *H. somnus* were isolated from 6 of 62 vaginal but none of 12 preputial swab samples. Antigen specific to *H. somnus* was detected by immunohistochemical study in 4 of 12 formalin-fixed lung tissue samples of bighorn sheep that died with evidence of pneumonia. Notably, *H. somnus* was found in alveolar debris in areas of inflammation. The 6 vaginal isolates and 2 *H. somnus* isolates previously cultured from pneumonic lungs of bighorn sheep were compared with 3 representative isolates from domestic sheep and 2 from cattle. The profiles of major outer membrane proteins and antigens for all of the isolates were predominantly similar, although differences that may be associated with the host-parasite relationship and virulence were detected. The DNA restriction fragment length profiles of the bighorn-sheep isolates had similarities not shared with the other isolates, suggesting distinct phylogenetic lines. All of the isolates had similar antimicrobial profiles, but the isolates from the bighorn sheep produced less pigment than those from the domestic livestock, and growth of the former was not enhanced by CO2. Wildlife biologists and diagnosticians should be aware of the potential of these organisms to cause disease in bighorn sheep and of growth characteristics that may hinder laboratory detection.

Wilson A. J., L. E. B. Kruuk, and D. W. Coltman. 2005. Ontogenetic patterns in heritable variation for body size: Using random regression models in a wild ungulate population. American Naturalist 166:E177-E192.

Abstract: Body size is an important determinant of fitness in many organisms. While size will typically change over the lifetime of an individual, heritable components of phenotypic variance may also show ontogenetic variation. We estimated genetic (additive and maternal) and environmental covariance structures for a size trait (June weight) measured over the first 5 years of life in a natural population of bighorn sheep

Ovis canadensis. We also assessed the utility of random regression models for estimating these structures. Additive genetic variance was found for June weight, with heritability increasing over ontogeny because of declining environmental variance. This pattern, mirrored at the phenotypic level, likely reflects viability selection acting on early size traits. Maternal genetic effects were significant at ages 0 and 1, having important evolutionary implications for early weight, but declined with age being negligible by age 2. Strong positive genetic correlations between age-specific traits suggest that selection on June weight at any age will likely induce positively correlated responses across ontogeny. Random regression modeling yielded similar results to traditional methods. However, by facilitating more efficient data use where phenotypic sampling is incomplete, random regression should allow better estimation of genetic covariances for size and growth traits in natural populations.

MANAGEMENT IMPLICATIONS OF DOMESTIC GOATS IN WILD SHEEP HABITATS

A Summary of the Wildlife Professionals Annual Meeting,
Foundation for North American Wild Sheep 2006 Convention

Submitted by Eric Rominger, DBC Technical Staff Member

Synopsis: About 40 professional biologists attended this meeting to discuss the current state of knowledge on domestic goat/bighorn sheep relationships. Kevin Hurley (Wyoming Department of Game and Fish) and Eric Rominger (New Mexico Department of Game and Fish) co-chaired the meeting. Below are notes taken during the meeting by Melanie Woolever (USFS) with additions by Frances Cassirer (Idaho Department of Game and Fish) and edited by Eric Rominger. University of Arizona graduate student Brian Jansen worked on the Silver Bell Mine debacle in Arizona and presented his findings at the meeting. Increased goat production in the United States and concerns, primarily related to disease transmission, were discussed. The agenda and a short bibliography are attached.

- Currently 2 million goats used for meat production in US. The projection is for this to increase to 15 million by 2007. Additionally hair-goats, pygmy goats, and pack-goats are potential problems for bighorn sheep.
- Primary concern in bighorn habitat is goat use for weed control and recreational pack-goats because of higher probability of direct contact. However, escaped goats from meat or hair-goat operations can be a problem as well. Even penned flocks of pygmy goats have attracted young rams.
- Potential for disease transmission is paramount concern. Diseases include infectious keratoconjunctivitis, contagious ecthyma, and pneumonia.

Infectious Keratoconjunctivitis {Presentation from Brian Jansen/U. of Arizona}

- Distribution is world-wide and is found in wild ungulates in North America and Europe. Affected species include domestic livestock and wild ruminants including moose, sheep and elk. The bacterium responsible is *Mycoplasma conjunctivae* which is fragile in the environment. Infected animals become blind. Their eyes become opaque and cheeks are wet early from tears/mucous. If the sheep recovers, it will no longer have the usual orange eye color. The bacteria don't persist in wildlife populations. However, no source has been identified in other wildlife epizootics. The Arizona outbreak at the Silver Bell Mine herd was determined to be from goats. It is unclear in NA if transmission can occur from flies or if it requires physical contact. It is co-incident with co-mingling with domestic sheep/goats. It seems to be more common in the winter in NA. Three to four weeks are required before clinical symptoms appear. It seems to persist about 4 months in wild populations (found in Utah in deer). Morbidity can be high. In the Silver Bells case, it was about

40%. Mortality was about 23% in the Silver Bells situation. Most infectious keratoconjunctivitis research is from Europe.

- Individuals can recover. At Silver Bells, the segment most affected was adult females. In the case in Yellowstone it was adult males. The Silver Bell incident occurred at parturition when there was the highest energetic demand for the adult females. At Yellowstone, the occurrence was after the rut in mid-winter.
- Average blindness duration at Silver Bells was 40 days with a maximum of 78 days. That individual succumbed to predation. Predation and starvation were the immediate causes of mortality. Individuals would lie down and stop eating and starved or became vulnerable to predation prior to recovery.

What can be done, specifically?

- Prevent co-mingling. The disease is highly contagious. The goats responsible for infecting the bighorn sheep were only in contact with the sheep for 4-5 days.
- Treatment: antibiotic gel and injected antibiotic. Didn't shorten blindness duration. Better to leave them alone.
- Deal with mortality sources. Predator removal may be possible but it's unknown whether this will improve survival. Providing food did not work in this instance as they had access to natural forage (which they didn't eat) and would not consume food presented.
- Protect them from harassment and just allow them to lay there.

Pneumonia—{Notes from F. Cassirer}

- Domestic goats can carry *Pasteurella* and *Mannheimia* bacteria that may cause pneumonia in bighorn sheep.
- Domestic goats and bighorn sheep will co-mingle if given the opportunity.
- Transfer of *Pasteurella* and *Mannheimia* bacteria between domestic goats and bighorn sheep has been documented in the field.
- Pneumonia is a very important cause of mortality for bighorn sheep and can have long-lasting effects on populations.

What can be done, specifically?

- Prevent co-mingling. Do not graze goats in or near areas used by bighorn sheep. There is no successful field treatment for pneumonia in bighorn sheep.

What can be done generally?

- We need a war chest to be able to deal with these situations before they occur. We need to mobilize our membership and elevate the information level within agencies on the seriousness of the problem. Case histories might help elevate the focus. More emphasis should be placed on ground efforts to collect population and health data from wild sheep and domestic goats during pneumonia outbreaks to provide accurate information for case histories. We need to educate the legislatures as well. However, note that California biologists haven't had much success in elevating the Sierra Nevada bighorn issue to the wool-growers in the region. Outreach to weed/pest folks and increase their information base too. Get information to 4H clubs, county commissioners, etc.
- British Columbia has done extensive work in this arena on domestic sheep, within all levels of relationship from individual flock owners to highest levels of government.
- Northwest Territory has produced most complete document to date on disease issues of domestic sheep and goats and wild sheep.

Goat/Bighorn Sheep Bibliography

Arizona Game and Fish. 2003. Bighorn sheep disease epizootic in the Silver Bell Mountains, southern Arizona. Project No. W-78-R-54.

Coggins, V. 2002. Rocky Mountain bighorn sheep/domestic sheep and goat interactions, a management perspective. Biennial Symposium Northern Wild Sheep and Goat Council 10.

Cassirer, E. F., L. E. Oldenburg, V. L. Coggins, P. Fowler, K. Rudolph, D. L. Hunter, and W. J. Foreyt. 1996. Overview and preliminary analysis of Hells Canyon bighorn sheep die-off, 1995-96. Proceedings of the Biennial Meeting of the Northern Wild Sheep and Goat Council 10:78-86.

Drew, M., A. Ward, G. Weiser, V. Coggins, T. Schommer. (2004). Survey of disease agents in domestic goats. Unpubl. Rpt. Wildlife Health Lab, Caldwell, ID

Foryet, W. J. 1994. Effects of controlled contact exposure between healthy bighorn sheep and llamas, domestic sheep, mountain goats, cattle, domestic goats, or mouflon sheep. Biennial Symposium Northern Wild Sheep and Goat Council 9: 7-14.

Garde, E., S. Kutz, H. Schwantje, A. Veitch, E. Jenkins, B. Elkin. 2005. Examining the risk of disease transmission between wild Dall's sheep and mountain goats, and introduced domestic sheep goats, and llamas in the Northwest Territories. 139pp.

Foryet, W. J. 1994. Effects of controlled contact exposure between healthy bighorn sheep and llamas, domestic sheep, mountain goats, cattle, domestic goats, or mouflon sheep. Biennial Symposium Northern Wild Sheep and Goat Council 9: 7-14.

Jansen, B. 2005. Surface mining, infectious keratoconjunctivitis, and bighorn. M.S. Thesis, University of Arizona, Tucson.

Rudolph, K. M., D. L. Hunter, W. J. Foreyt, E. F. Cassirer, R. B. Rimler, and A. C.S. Ward. 2003. Sharing of Pasteurella spp. between free-ranging bighorn sheep and feral goats. Journal of Wildlife Diseases. 39:891-903.

Taylor, S. K., et al. 1996. Infectious keratoconjunctivitis in free-ranging mule deer (Odocoileus hemionus) from Zion National Park. Journal of Wildlife Diseases 32:326-330.

Ward, A. C. S., G. C. Weiser, W. J. DeLong, and G. H. Frank. Characterization of *Pasteurella* spp. isolated from healthy domestic pack goats and evaluation of the effects of a commercial *Pasteurella* vaccine. American Journal of Veterinary Research 63:119-123.

Wehausen, J. D., S. T. Kelley, and R. R. Ramey. in review. A brief review of respiratory disease interactions between domestic sheep and bighorn sheep.

Link to Sheep, Goats, Weeds, and Wildlife Workshop in Missoula, MT 2005
http://www.forestry.umt.edu/kiosk/workshops/weedgrazing/index.htm

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FNAWS Wildlife Professionals Annual Meeting
Wednesday February 1, 2006
Reno Hilton (Nevada Room #6)
2:00 – 4:00 PM

"Management Implications of Domestic Goats in Wild Sheep Habitats"
Chairs: Eric Rominger (New Mexico Department of Game and Fish) &
Kevin Hurley (Wyoming Game and Fish Department)

2:00 PM Welcome/Opening Comments	Ray Lee, President/CEO, FNAWS
2:10 PM Introduction/Outline	Eric Rominger & Kevin Hurley
2:20 PM Silver Bell Mountains update	Brian Jansen, University of Arizona
2:40 PM Moderated Discussion	Eric Rominger & Kevin Hurley

- Management Issues
  - Disease
    - Risk Assessment (e.g., NWT, ID)
    - Pneumonia (e.g., Hells Canyon, WSU captive trials, Caldwell Lab)
    - Keratoconjunctivitis (e.g., AZ)
    - Contagious ecthyma (e.g., AZ)
    - Other diseases/parasites
  - Fencing

- Direct Competition/Forage Overlap
- Indirect Competition/Subsidization of Predators

- Management Strategies
  - Current Land Management Agency Guidelines/Approaches, and Efficacy
    - Seeking Separation
    - Total Ban
  - Options to Preclude or Minimize Potential Contact
    - Land Use Planning (e.g., USFS, BLM, Crown lands, ordinances, zoning, covenants)
    - Best Management Practices (how to ensure implementation?)
    - Litigation (e.g., Hells Canyon)
    - Legislation (e.g., ongoing effort in BC, AK)
    - Education
      - Internal (e.g., within resource/land/wildlife/agricultural management agencies)
      - External (e.g., wild sheep advocates, local/tribal/First Nation/state/ provincial/federal governments & decision-makers, politicians, Weed & Pest districts, hunting public, non-hunting public)
  - Management Decisions, Prior to Contact
    - Wild Sheep Translocations – worth the risk?
  - Management Response, Following Contact
    - Intervention (e.g., Hells Canyon, Silver Bell)
    - Lethal Take of Wild Sheep and/or Domestic Goats
- Bibliography/Information Sources/Outlets (through NWSGC, DBC, FNAWS, ???)
- Contact List/Advice/Professional Resources

3:45 PM Wrap-up/Summary Eric Rominger & Kevin Hurley

MEETINGS OF INTEREST

Desert Bighorn Council: Our next biennial meeting will be held in Las Vegas, Nevada, in April 2007. Ross Haley (Program Chair) is currently working on arranging the venue, program, and activities for the meeting. Ross can be contacted at Ross_Haley@NPS.gov and detailed information such as exact dates and location will be posted on our website (http://www.desertbighorncouncil.org) at a later date and will be announced in our October newsletter.