Bleats and Blats

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Desert Bighorn Council

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Hello DBC members!

We have several updates to share with you, so read on for more information related to bighorn sheep management and conservation. And, as always, for more information about the Desert Bighorn Council, or to download a membership form, please visit our website at www.desertbighorncouncil.org.

The next newsletter is scheduled for early March 2008 so if you have updates or announcements to share, please send them to me by February 15th. I hope to hear from you!

All the best to you -- I hope your holidays are safe and happy!

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DBC TRANSACTIONS

Past issues of the Desert Bighorn Council Transactions will soon be available online (in digital format), at no cost, at the DBC's website. Brian Wakeling (DBC Editor) and his staff have scanned all existing DBC Transactions (going all the way back to the first issue in 1957! That's a huge task!) and Karsten Kelm (DBC Webmaster) is in the process of making these PDF files available on the web. We hope to have all past issues available online in January.
Thank you to Brian for offering to spearhead this effort, and to Karsten for serving as our webmaster!!

BIGHORN SHEEP MANAGEMENT: RESPIRATORY DISEASES

As you know from past newsletters, a great deal of effort and expertise has gone into several recent workshops about the important issue of respiratory disease in bighorn sheep and related management implications. Much of the information is now available to you, as described below:

Payette National Forest Workshop: This workshop addressed the risk of disease transmission between domestic sheep and bighorn sheep on the Payette National Forest. The complete report "Risk Analysis of Disease Transmission Between Domestic Sheep and Bighorn Sheep on the Payette National Forest" and a summary of a science panel discussion can be obtained at:
http://www.fs.fed.us/r4/payette/publications/big_horn/bighorn%20sheep%20index_2007.shtml

"Respiratory Disease in Mountain Sheep: Knowledge Gaps and Future Research", U.C. Davis: This workshop was held in April 2007, Davis, California. A summary of the workshop can temporarily be found on the website of the American Association of Wildlife Veterinarians, at http://www.aawv.net/ (see link on their front page).

"Wild Sheep/Domestic Sheep Disease Risk Assessment Workshop", Tucson, Arizona: This workshop was held in conjunction with the annual meeting of The Wildlife Society. All abstracts and Powerpoint presentation files of talks presented at the workshop are available online at www.mwvcrc.org/content/view/100/102.

Upcoming meeting:
"Wild and Domestic Sheep Disease Risk and Management Workshop", Salt Lake City: A third in the series of workshops will take place on February 4-5, 2008 in Salt Lake City in conjunction with the annual meeting of the Foundation for North American Wild Sheep (FNAWS). The goal of this workshop will be to determine how best to integrate the results of the first two workshops into state and federal wild sheep and domestic sheep management policies. Sponsors of the workshop include FNAWS, the California Chapter of FNAWS, the National Fish and Wildlife Foundation, the Wildlife Health Center at the University of California, Davis, and the California Department of Fish and Game. More details will soon be posted at www.mwvcrc.org/content/view/100/102.

UPCOMING MEETINGS AND WORKSHOPS

Wild and Domestic Sheep Disease Risk and Management Workshop
February 4-5, 2008, Salt Lake City. See more information above, under "Bighorn Sheep Management: Respiratory Diseases".

16th Biennial Symposium of the Northern Wild Sheep and Goat Council
The symposium will be held at the Homestead Resort, Midway, Utah, on April 27-May1, 2008. The Utah organizing committee has put out its *First Call for Papers*, with a January 31, 2008 deadline for abstract submission. Abstracts should follow Journal of Wildlife Management format and be sent electronically to Charlie Greenwood (charlesgreenwood@utah.gov). For more information, contact Anis Aoude (Program Chair) at anisaoude@utah.gov.

FUNDING!

Students, researchers, and managers: ***Do you need money??*** Is your graduate research related to bighorn sheep? Or are you planning a project or program that will benefit desert bighorn sheep or their habitat? Here's an opportunity to apply for some of that much–needed money! The Hansen-Welles Scholarship Fund provides funding for projects that benefit desert bighorn sheep or their habitat. Although graduate students will receive preference in the selection of applicants, any person is eligible to apply for this scholarship. Applications are due by February 1, 2008. More information can be found at: http://www.desertbighorncouncil.org/scholarship.html

PROPOSED CHANGES TO CRITICAL HABITAT

The U.S. Fish and Wildlife Service is proposing to revise critical habitat for bighorn sheep in the Peninsular Ranges of southern California, with a large reduction in overall size and a loss of connectivity of critical habitat throughout the range. The full rule for this proposed revision can be found at http://www.fws.gov/carlsbad/PBHS_Docs.htm, and the public comment period is open until December 10, 2007.

RECENT LITERATURE RELATED TO BIGHORN SHEEP

Epps, C. W., J. D. Wehausen, V. C. Bleich, S. G. Torres, and J. S. Brashares. 2007. Optimizing dispersal and corridor models using landscape genetics. Journal of Applied Ecology 44:714-724.

Abstract: 1. Better tools are needed to predict population connectivity in complex landscapes.

"Least-cost modeling" is one commonly employed approach in which dispersal costs are assigned to distinct habitat types and the least-costly dispersal paths among habitat patches are calculated using a geographical information system (GIS). Because adequate data on dispersal are usually lacking, dispersal costs are often assigned solely from expert opinion. Spatially explicit, high-resolution genetic data may be used to infer variation in animal movements. We employ such an approach to estimate habitat-specific migration rates and to develop least-cost connectivity models for desert bighorn sheep *Ovis canadensis nelsoni*. 2. Bighorn sheep dispersal is thought to be affected by distance and topography. We incorporated both factors into least-cost GIS models with different parameter values and estimated effective geographical distances among 26 populations. We assessed which model was correlated most strongly with gene flow estimates among those populations, while controlling for the effect of anthropogenic barriers. We used the best-fitting model to (i) determine whether migration rates are higher over sloped terrain than flat terrain; (ii) predict probable movement corridors; (iii) predict which populations are connected by migration; and (iv) investigate how anthropogenic barriers and translocated populations have affected landscape connectivity. 3. Migration models were correlated most strongly with migration when areas of at least 10% slope had 1/10th the cost of areas of lower slope; thus, gene flow occurred over longer distances when "escape terrain" was available. Optimal parameter values were consistent across two measures of gene flow and three methods for defining population polygons. 4. Anthropogenic barriers disrupted numerous corridors predicted to be high-use dispersal routes, indicating priority areas for mitigation. However, population translocations have restored high-use dispersal routes in several other areas. Known intermountain movements of bighorn sheep were largely consistent with predicted corridors. 5. Synthesis and applications. Population genetic data provided sufficient resolution to infer how landscape features influenced the behaviour of dispersing desert bighorn sheep. Anthropogenic barriers that block high-use dispersal corridors should be mitigated, but population translocations may help maintain connectivity. We conclude that developing least-cost models from similar empirical data could significantly improve the utility of these tools.

Cassirer, E. F. and A. R. E. Sinclair. 2007. Dynamics of pneumonia in a bighorn sheep metapopulation. Journal of Wildlife Management 71:1080-1088.

Abstract: We investigated the dynamics of 8 populations of a bighorn sheep (*Ovis canadensis*) metapopulation in Hells Canyon, USA from 1997 to 2003. Pneumonia was the most common cause (43%) of adult mortality and the primary factor limiting population growth. Cougar (*Puma concolor*) predation was the second most-frequent source (27%) of adult mortality but did not reduce the rate of population growth significantly. Most pneumonia-caused mortality occurred in fall and early winter and most cougar predation occurred in late winter and early spring. Average annual survival of adult males (0.84) was lower than females (0.91). Pneumonia was the most common known cause of lamb mortality (86%), and pneumonia-related mortality was detected whenever summer lamb survival was <50%. Pneumonia-caused mortality rates in lambs were high from 21 days to 91 days of age and peaked at 42 days to 70 days. Summer pneumonia epizootics in lambs were independent of pneumonia-caused mortality in adults. Pneumonia-caused mortality occurred at the population level and was not synchronized geographically or temporally among populations. Although catastrophic all-age pneumonia-epizootics have previously been described in bighorn sheep, we found that chronic, although sporadic, pneumonia-caused mortality in adults and lambs can also have important effects on the dynamics of bighorn sheep populations.

Jansen, B. D., P. R. Krausman, J. R. Heffelfinger, T.H. Noon, and J. C. Devos, Jr. 2007. Population dynamics and behavior of bighorn sheep with infectious keratoconjunctivitis. Journal of Wildlife Management 71:571-575.

Abstract: Introduced disease is a major mortality factor in some populations of bighorn sheep (*Ovis canadensis*). Epizootics of infectious keratoconjunctivitis (IKC) and contagious ecthyma occurred in bighorn sheep in the Silver Bell Mountains of south-central Arizona, USA, from 1 December 2003 to 31 March 2004. Our objectives were to 1) investigate the influence of the epizootic on abundance and demographics and 2) examine how IKC affected the mortality, behavior, and movements of clinically affected animals. Morbidity was 39%, and all sex and age classes were affected. The population declined 23%, with most mortality in the adult female (1 M, 11 F) segment of the population. Of the diseased animals that were marked (n = 27), 44% recovered and 44% died. Predation (50%) and starvation (33%) were the primary causes of mortality of diseased bighorn sheep. Bighorn sheep that were infected spent less time feeding and moved less than noninfected animals during the epizootic. Managers might be able to minimize losses of infected animals through predator control. To minimize losses to starvation, managers should refrain from any activity that disturbs infected animals (including treatment) because disturbances increase energy expenditures and expose infected animals to injury.

Keating, K. A., P. J. P. Gogan, J. M. Vore, and L. R. Irby. 2007. A simple solar radiation index for wildlife habitat studies. Journal of Wildlife Management 71:1344-1348.

Abstract: Solar radiation is a potentially important covariate in many wildlife habitat studies, but it is typically addressed only indirectly, using problematic surrogates like aspect or hillshade. We devised a simple solar radiation index (SRI) that combines readily available information about aspect, slope, and latitude. Our SRI is proportional to the amount of extraterrestrial solar radiation theoretically striking an arbitrarily oriented surface during the hour surrounding solar noon on the equinox. Because it derives from first geometric principles and is linearly distributed, SRI offers clear advantages over aspect-based surrogates. The SRI also is superior to hillshade, which we found to be sometimes imprecise and ill-behaved. To illustrate application of our SRI, we assessed niche separation among 3 ungulate species along a single environmental axis, solar radiation, on the northern Yellowstone winter range. We detected no difference between the niches occupied by bighorn sheep (*Ovis canadensis*) and elk (*Cervus elaphus*; $P = 0.104$), but found that mule deer (*Odocoileus hemionus*) tended to use areas receiving more solar radiation than either of the other species ($P < 0.001$). Overall, our SRI provides a useful metric that can reduce noise, improve interpretability, and increase parsimony in wildlife habitat models containing a solar radiation component.

McClintock, B. T., and G. C. White. 2007. Bighorn sheep abundance following a suspected pneumonia epidemic in Rocky Mountain National Park. Journal of Wildlife Management 71:183-189.

Abstract: Anecdotal evidence of a pneumonia epizootic among bighorn sheep (*Ovis canadensis canadensis*) in Rocky Mountain National Park (RMNP), Colorado, USA, during the mid-1990s prompted park officials to examine the current condition of the herds. Here we present a mark-resight study design to estimate population abundance that, in many circumstances, is a reliable and cost-effective alternative to traditional mark-recapture or to indices of population abundance. We captured 59 adult females and radiocollared them via helicopter net-gunning during winter 2002-

2003. From ground resighting surveys conducted May-September, we estimated the total RMNP bighorn population at 389.9 (SE = 34.9, CI = 327.2-464.6) in 2003 and 366.4 (SE = 34.7, Cl = 304.4-441.0) in 2004. Previous abundance estimates suggest a park-wide decline has occurred between the late 1980s and the suspected pneumonia epidemic of the mid-1990s. Although the 2 years of data from our study are not enough to predict whether the herds are capable of recovering to previous levels, they provide park officials the tools necessary to make the most informed decisions for future monitoring and management of this fragile species.

Pettorelli, N., F. Pelletier, A. von Hardenberg, M. Festa-Bianchet, and S. D. Cote. 2007. Early onset of vegetation growth vs. rapid green-up: Impacts on juvenile mountain ungulates. Ecology (Washington, D. C) 88:381-390.

Abstract: Seasonal patterns of climate and vegetation growth are expected to be altered by global warming. In alpine environments, the reproduction of birds and mammals is tightly linked to seasonality; therefore such alterations may have strong repercussions on recruitment. We used the normalized difference vegetation index (NDVI), a satellite-based measurement that correlates strongly with aboveground net primary productivity, to explore how annual variations in the timing of vegetation onset and in the rate of change in primary production during green-up affected juvenile growth and survival of bighorn sheep (*Ovis canadensis*), Alpine ibex (*Capra ibex*), and mountain goats (*Oreamnos americanus*) in four different populations in two continents. We indexed timing of onset of vegetation growth by the integrated NDVI (INDVI) in May. The rate of change in primary production during green-up (early May to early July) was estimated as (1) the maximal slope between any two successive bimonthly NDVI values during this period and (2) the slope in NDVI between early May and early July. The maximal slope in NDVI was negatively correlated with lamb growth and survival in both populations of bighorn sheep, growth of mountain goat kids, and survival of Alpine ibex kids, but not with survival of mountain goat kids. There was no effect of INDVI in May and of the slope in NDVI between early May and early July on juvenile growth and survival for any species. Although rapid changes in NDVI during the green-up period could translate into higher plant productivity, they may also lead to a shorter period of availability of high-quality forage over a large spatial scale, decreasing the opportunity for mountain ungulates to exploit high-quality forage. Our results suggest that attempts to forecast how warmer winters and springs will affect animal population dynamics and life histories in alpine environments should consider factors influencing the rate of changes in primary production during green-up and the timing of vegetation onset.