

Thinhorn Sheep Summit 4 Handout

Effects of changing snowscapes on Dall sheep movements and demography

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NASA ABoVE Dall sheep project, 2015 - 2018

- Website: <https://dallsheep.weebly.com/>
 - Products page includes citations & links to 13 scientific papers, 6 datasets, 4 annual reports

4 Key Takeaways:

1. Spring snow cover has strong effect on recruitment in northern ranges

van de Kerk, M., D. Verbyla, A. W. Nolin, K. J. Sivy, and L. R. Prugh. 2018. Range-wide variation in the effect of spring snow phenology on Dall sheep population dynamics. *Environmental Research Letters* 13:075008. <https://iopscience.iop.org/article/075010.071088/071748-079326/aace075064>

2. Fall snow depth sets the stage, may be good predictor of spring recruitment

Cosgrove, C. L., J. Wells, A. W. Nolin, J. Putera, and L. R. Prugh. 2021. Seasonal influence of snow conditions on Dall's sheep productivity in Wrangell-St Elias National Park and Preserve. *PLoS One* 16:e0244787. <https://doi.org/10.1371/journal.pone.0244787>

3. Snow in 270 – 330 kg/m³ range gives wolves an advantage over sheep

Sivy, K. J., A. W. Nolin, C. Cosgrove, and L. Prugh. 2018. Critical snow density threshold for Dall sheep (*Ovis dalli dalli*). *Canadian Journal of Zoology* 96:1-8. <https://doi.org/10.1139/cjz-2017-0259>

Sullender, B. K., C. X. Cunningham, J. D. Lundquist, and L. R. Prugh. 2023. Defining the danger zone: critical snow properties for predator-prey interactions. *Oikos*:e09925. <https://doi.org/10.1111/oik.09925>

4. Icing events reduce adult survival

van de Kerk, M., S. Arthur, M. Bertram, B. Borg, J. Herriges, J. Lawler, B. Mangipane, C. Lambert Koizumi, B. Wendling, and L. Prugh. 2020. Environmental influences on Dall's sheep survival. *Journal of Wildlife Management* 84:1127-1138. <https://wildlife.onlinelibrary.wiley.com/doi/abs/10.1002/jwmg.21873>

Freely available snow and ice spatial layers

1) **Snow depth and density: SnowModel outputs 1980 – 2020, daily 3-km resolution (snow depth, density, SWE), entire ABoVE domain (covers all Dall sheep ranges)**

Liston, G. E., A. K. Reinking, and N. T. Boleman. 2023. Daily SnowModel Outputs Covering the ABoVE Core Domain, 3-km Resolution, 1980-2020 (Version 1). ORNL Distributed Active Archive Center, <https://doi.org/10.3334/ORNLDAAC/2105>

2) **Icing events: MEaSURES Global Record of Daily Landscape Freeze/Thaw Status**

- NASA passive microwave satellite remote sensing product, daily 25km resolution, 1979 – present, global: <https://nsidc.org/data/nsidc-0477/versions/5>

3) **Snow cover: NASA satellite remote sensing products**

- MODIS, daily 500m resolution snow cover, 2000 – present
<https://nsidc.org/data/mod10a1/versions/61>
- Other MODIS products can be found in the MODIS collection (<https://nsidc.org/data/modis>)
- Note the VIIRS satellite is replacing MODIS: <https://nsidc.org/data/viirs>
- Google Earth Engine tool for derived products like snow-on date, snow-off date, snow cover duration, 2000 - 2019: <https://www.snowcloudmetrics.app/home> (note this is a visualization tool; to download maps, need to run the code they provide)