

Temperature datalogger methodology

Data represent ambient temperature recorded from paired U22-001 HOBO® Pro v2 dataloggers (Onset®, Cape Cod, Massachusetts) above and below talus at 13 historic hoary marmot (*Marmota caligata*) and American pika (*Ochonta princeps*) occupied patches in the North Cascades National Park Service Complex, Washington, USA. Twelve datalogger sites were established in late summer/autumn 2015, with one additional site (Stiletto Peak) added in 2017. Dataloggers were programmed to record ambient temperature hourly for 5 years. Below ground dataloggers were placed in natural cavities within talus at an average depth of 72.5 cm (range= 48–94 cm). Because pika and other rodents have historically chewed such dataloggers, each subsurface datalogger was deployed in a wire cage that was anchored to a boulder. These cages were built of 19-gauge hardware cloth with 1.27 cm cells, and each datalogger was suspended out of contact with the cage by a single wire (Fig. 1). The paired surface datalogger at each site was placed inside a RS1 Solar Radiation Shield (Onset®, Cape Cod, Massachusetts), which was anchored to a surface boulder (Fig. 2). Datalogger sites ranged 483–2052 m in elevation, and across aspects ranging 10–330°. Six sites were west of the Cascade Mountains orographic divide, and 7 were east (Fig 3–6).

All 26 dataloggers (13 above ground/13 below ground) were replaced in late summer/autumn 2020 using identical equipment and programming. Data from 2015–2024 are provided as .CSV datasets consisting of only the dates and times each datalogger was in situ (all data logged between activation, transit, and installation times were removed). These in situ data are complete and any potentially anomalous data (outliers) remain in place: users may need to assess these data and omit records as deemed appropriate. Also of note, the data for site ‘Monogram2_below’ have a large gap from 8/18/2020 through 10/7/2023 due to a hardware malfunction that resulted in unrecoverable data. In the data for ‘Fisher_surface_2015-2024,’ values from 9/8/2015 @ 14:50 to 8/8/2017 @ 11:50 were originally recorded in Celsius but have been converted back to Fahrenheit.



Fig. 1. Subsurface datalogger suspended in its protective cage.



Fig 2. Datalogger station in situ, with above ground solar radiation shield anchored to a surface boulder (right) and the entrance to its paired subsurface datalogger marked with pink flagging (left).

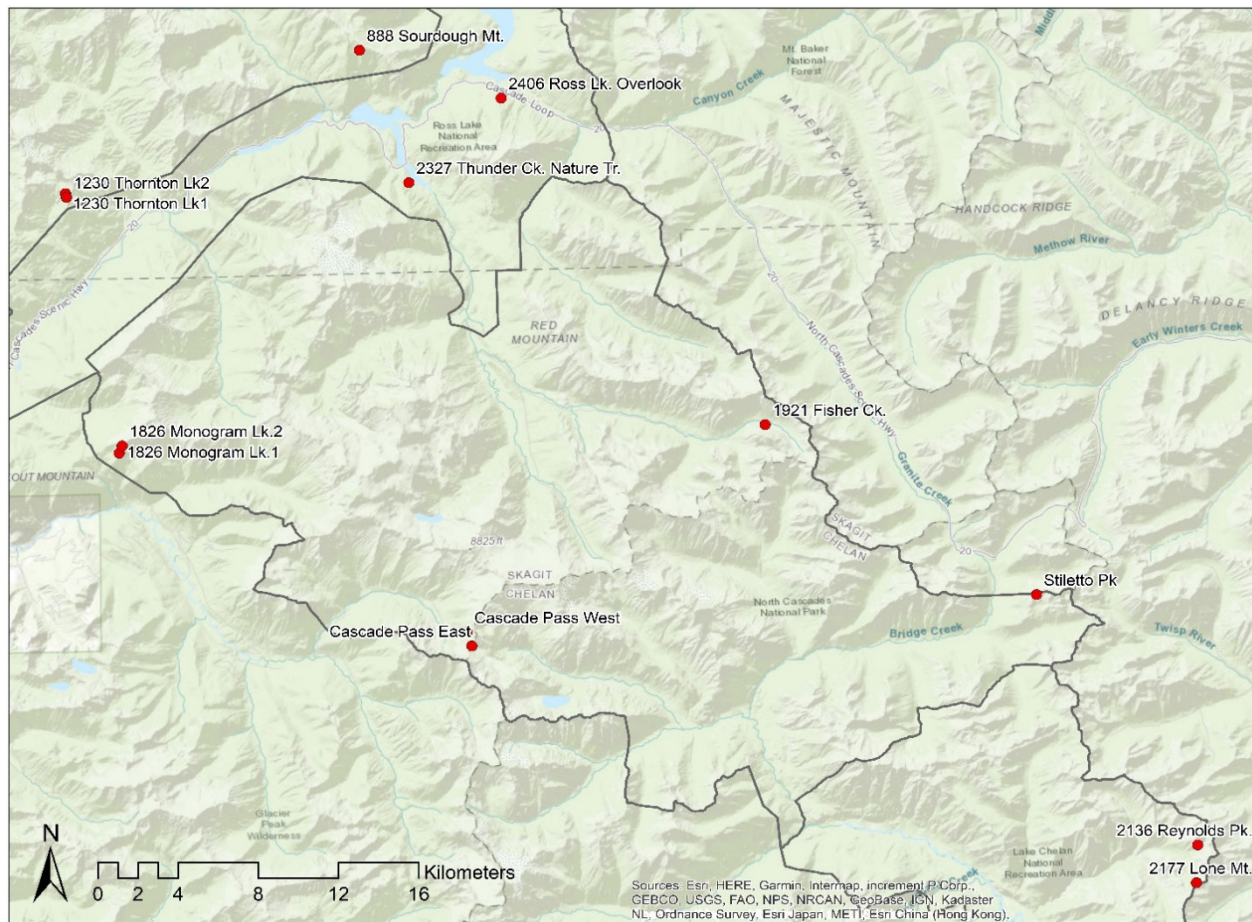


Fig 3. Map of alpine temperature datalogger sites in North Cascades National Park Service Complex.

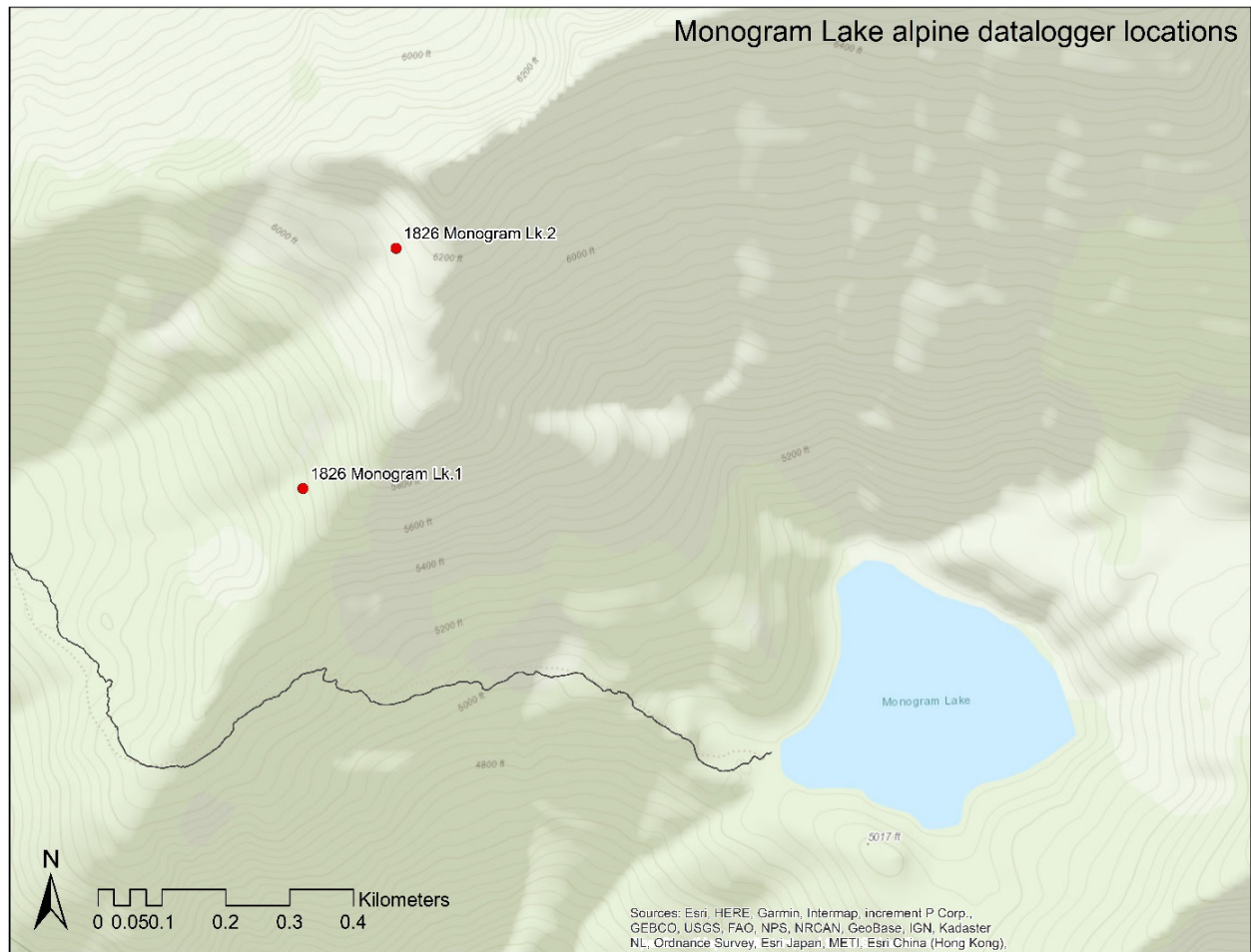


Fig 4. Location of two datalogger sites at Monogram Lake.

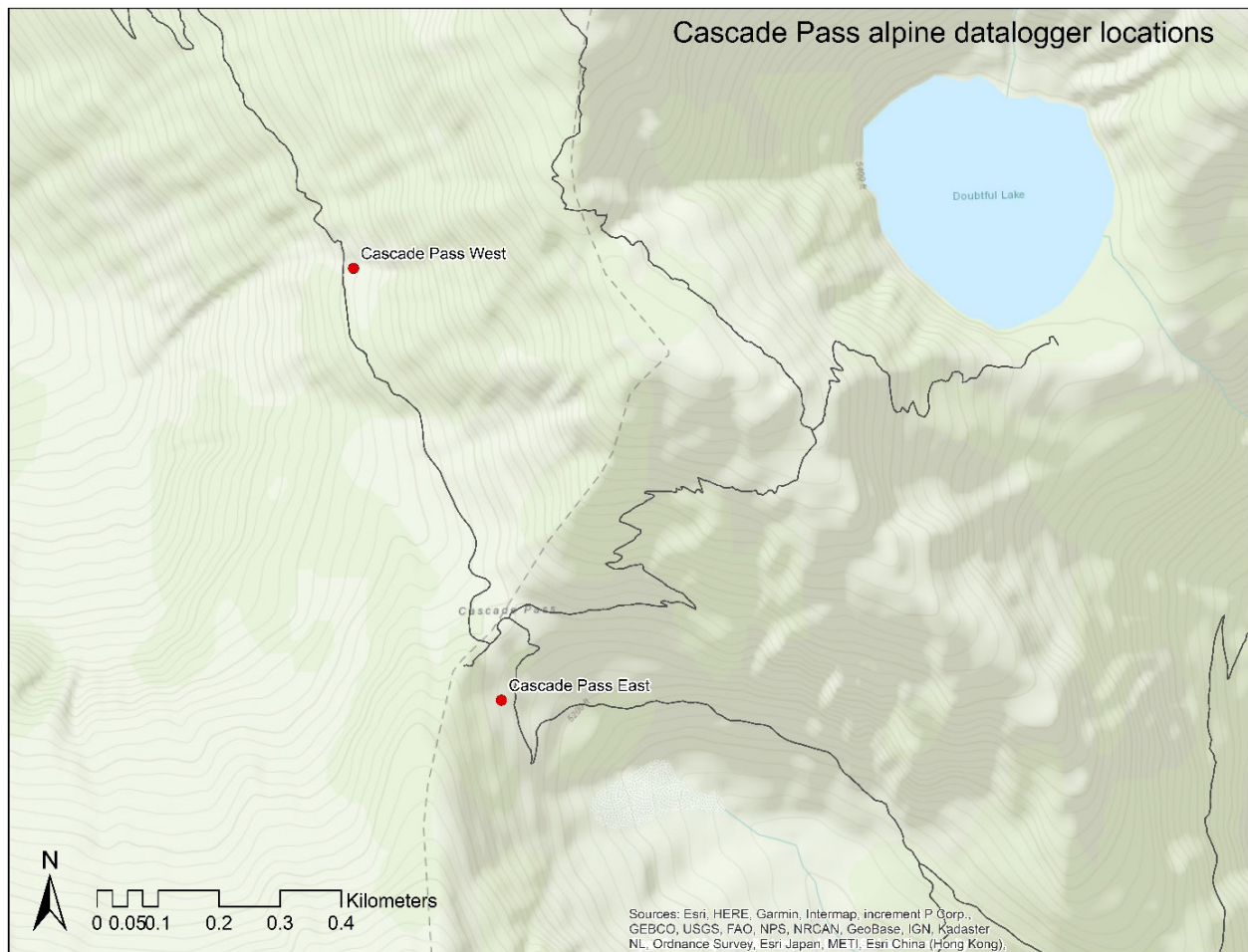


Fig 5. Location of two datalogger sites at Cascade Pass.

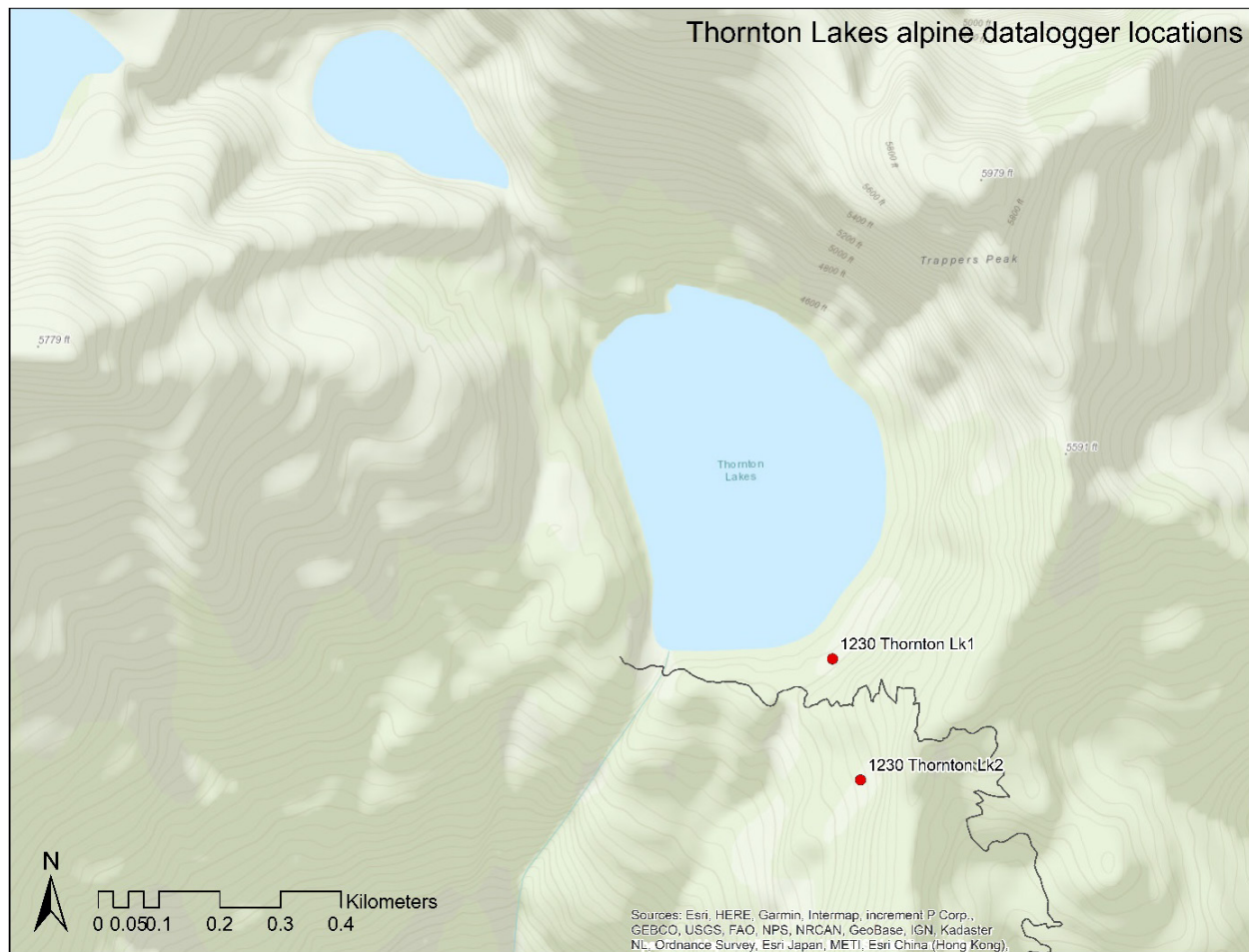


Fig 6. Location of two datalogger sites at Thornton Lakes.

Related Publications:

Christophersen, R. 2012. Distribution and Abundance of Hoary Marmots in North Cascades National Park Complex, Washington, 2007-2008. Natural Resource Technical Report NPS/NOCA/NRTR—2012/593. Fort Collins, Colorado.

Ferreira, A.T. 2025. Relating talus characteristics to habitat use by vulnerable alpine mammals in a changing climate. M.S. thesis. Washington State University, Pullman, Washington.
<https://www.proquest.com/openview/380e9ec39971b595bd2c89c731c77da8>

Johnston, A.N., Christophersen, R., Beever, E.A., and J.I. Ransom. 2021. Freezing in a warming climate: marked declines of a subnivean hibernator after a snow drought. *Ecology and Evolution* 11:1264–1279. <https://doi.org/10.1002/ece3.7126>

Johnston, A.N., Bruggeman, J.E., Beers, A., Beever, E.A., Christophersen, R., and J.I. Ransom. 2019. Ecological consequences of anomalies in atmospheric moisture and snowpack. *Ecology* 100: e02638. <https://doi.org/10.1002/ecy.2638>

Ransom, J.I., Rine, K.M., Christophersen, R.G., Hansen, M.E., Antonova, N., Braaten, A., Whiles, L., Akins, J., Schaming, T., and R. Rochefort. 2023. North Cascades National Park Service Complex at-risk terrestrial wildlife species: Focused condition assessment 1995–2020. Natural Resource Report NPS/NOCA/NRR—2023/2539. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2299559>

Whiles, L., Shipley, L.A., Akins, J.R., Christophersen, R.G., Ransom, J.I., Levi, T., and D.H. Thornton. 2024. Predation risk for hoary marmots in Washington’s North Cascades Mountains. *Journal of Mammalogy*: gyae086. <https://doi.org/10.1093/jmammal/gyae086>