



Yellow-bellied marmots in the Great Basin: Low-elevation populations persist 75 years after E. R. Hall's survey

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The Great Basin: islands of montane habitat in a sea of desert scrub



Great Basin is an area > 500,000 km² that drains internally (no outlet to Pacific)



Montane zone habitat in the Great Basin, NV: Desatoya Range (A) and Snake Range (B).



- Species in montane zones are adapted to the relatively cool, moist conditions found in high-elevation, mountainous environments.
- With continued climatic warming, populations of montane species living at their lower-elevation limits may disappear.



The Great Basin ranges are "sky islands": virtual archipelagos of montane zones surrounded by deserts (left: Snake Range, NV)

Hot Creek Valley

- On July 20 1933, E. R. Hall was shown the carcasses of marmots trapped by the original residents of the ranch that is now called Page Place, located at 1,894 m elevation in the Hot Creek Valley, Nye County, NV. In his journal Hall describes a remarkable rock feature (hereafter referred to as the "cold talus" site) in which lived marmots during the time of his visit:

"The woodchucks (sic) here lived in a hill of broken rock at the base of which a crevice emitting cold air was found. Indeed the air from this crevice was so cold as to freeze water that trickled down there into ice-cycles (sic), or at least to preserve these ice-cycles (sic) which could be seen back in the crevice...It occurred to me that the cold air emerging at the base of this rock pile, and perhaps filtering through it at other places, might be a factor in making this place liveable (sic) for the marmots."

- Hall apparently believed that arid, low-elevation sites like those in the Hot Creek Valley provided only marginal habitat for marmots, in which case any increase in summer temperature or aridity might threaten local populations with extinction.
- Our goal in resurveying the Hot Creek Valley site was to determine whether it still supported marmots and explore the possibility that the cold talus site provided the marmots with a refuge from the hot weather that characterizes the May-August period in the Hot Creek Valley.



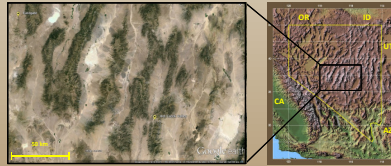
Right: at bottom of "cold talus" site located in the Hot Creek Valley, NV (left). Despite ambient temperatures of 24 C°, the air emanating from the cold talus was near freezing.



Results:

- During May 26-29, 2014, we searched for marmots on the valley floor and adjacent slopes approximately 2 km up-valley and 2 km down-valley of the Page Place. Marmots (and scats) were observed in four locations, including one near the cold talus. We found only one marmot burrow in the cold talus itself, and no scats or marmots were observed at the alcove at the bottom of the talus, where Hall documented the icy conditions in 1933. The largest deposit of marmot scats was found not in the talus but on a rocky outcrop approximately 50 m away. At least four different burrows were found (as indicated by scat accumulations) within 100 m of the talus, but they were not concentrated near that site.
- Temperatures at cold talus site: Ambient temperature (T_a) averaged 23.7 C° (range 21.1–28.6 C°). Temperatures in crevices averaged 21.1 C° below T_a (range 7.5–27.5 C° below T_a), the coldest reading being just above freezing (0.7 C°). Sun-exposed rock near the talus averaged 14.0 C° above T_a (range 8.4–18.1 C° above T_a).
- Temperatures at burrow sites: T_a averaged 24.1 C° (range 20.6–29.8 C°). Sun-exposed rock near burrows averaged 7.6 C° above T_a (range 0.4–18.1 C° above T_a), while burrow temperatures averaged 6.2 C° below T_a (range 3.7–12.3 C° below T_a).

Study Sites



Two field sites in Nevada surveyed for marmots during May 26-June 5 2014: Eastgate (Desatoya Range) and Hot Creek Valley (Hot Creek Range)

Methods

Searching for marmots and their burrows

- We walked transects along valley floors and adjacent slopes, and searched talus until we saw a marmot or (more commonly) heard a marmot or found scat.
- Marmot burrows were usually identified by us finding scat or other signs outside the hole.

Temperatures at burrow sites were measured using thermocouple thermometers:

- Air in the shade 1 m above the ground, 1-2 m from burrow
- Sun-exposed surface of the nearest rock used by marmots for basking/vigilance
- Temperature of inside surface of burrow at shallow (0.2-0.5 m) and deep (0.5-1.0 m) point.



Left: Surface temperature measurement of rock near marmot burrow. Right: Example of marmot retreat burrow in the Hot Creek Valley, NV



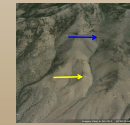
Summary and Conclusions

- Marmots continue to persist at Eastgate and in the Hot Creek Valley where they were documented >75 years ago.
- Persistence at these sites is remarkable given that they are far below the montane zones typically associated with marmots in the Great Basin. Also the 'habitat' at Eastgate was far from natural—namely a hot stack of railroad ties in the middle of a gravel lot.
- Contrary to our prediction, marmots in the Hot Creek Valley did not congregate in or around the cold talus site.
- Conclusion: Given that marmots have been able to persist at arid, low-elevation sites over the last 75 years it is plausible that marmots currently living in montane sites upslope will continue to persist there even if those sites become hotter and drier over the next century.
- Caveat: over the next century, low-elevation sites currently occupied by marmots might become too hot and dry to support the species.

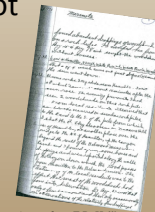
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The Yellow-bellied Marmot



Yellow-bellied marmot (*Marmota flaviventris*), a rodent closely related to ground squirrels, lives in montane environments of western N. America



A page from E.R. Hall's field notes (unpublished) from his work in Nevada.



Example of marginal marmot habitat in the Great Basin. Yellow arrow indicates a marmot burrow at 7,800 ft elevation in the Snake Range. More typical habitat would be found above 8,500 ft (blue arrow)

Marmots are occasionally found at sites that are much warmer, drier, and lower-elevation compared to the species' typical montane habitat upslope.

- Marmot presence and absence has been documented at various times in the Great Basin during 1928-2013, thus providing an opportunity to study recent changes in distributions.



Typical marmot habitat in the Great Basin (left: Clan Alpine Range). Note the montane meadow, sparse tree cover, and talus surrounded by thick shrub cover, including small aspens.

- Marmots in the Great Basin are mostly found in the montane zone (> 2,200 m elevation)
- They require open habitats with exposed rock features such as talus, ledges, and boulders, in which they construct burrows.

Eastgate

- Eastgate is an unincorporated community located at the base of the Desatoya Range at 1,556 m elevation in Churchill County, NV. Presence of marmots at Eastgate was documented by E. R. Hall in 1938 and C. Floyd in 1999-2013.
- As nothing else was known about the marmots at Eastgate, our objective was to find the burrow sites and characterize the thermal gradients around them.



The unincorporated community Eastgate, NV, (left), where a colony of marmots lives primarily in a stack of railroad ties (right, and indicated with arrow on left).



Results:

- On June 5, most of the marmots at Eastgate lived under large stack of railroad ties; at least two marmots and thousands of marmot scats were found among the stacks. A few scats were also found in rock faces approximately 300 m to the south; but the only sign of permanent residence was in the tie stacks.
- Temperatures at stacks of railroad ties: Ambient temperature (T_a) averaged 26.6 C° (range 22.2–31.1 C°). Temperatures in shaded spaces among the ties averaged 4 C° below T_a (range 0.5–6.4 C° below T_a). Sun-exposed wood on top of the stacks averaged 9.4 C° above T_a (range 6.0–12.7 C° above T_a).
- Temperatures at burrow sites ~ 300 m south of the stack: T_a averaged 25.3 C° (range 24.3–26.2 C°). Sun-exposed rock near burrows averaged 9.6 C° above T_a (range 6.7–15.4 C° above T_a), while burrow temperatures averaged 4.9 C° below T_a (range 2.5–6.9 C° below T_a).

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