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Making Mountains out of Molehills: Taphonomic Processes in High Elevation Environments

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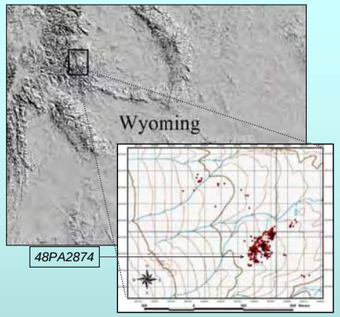
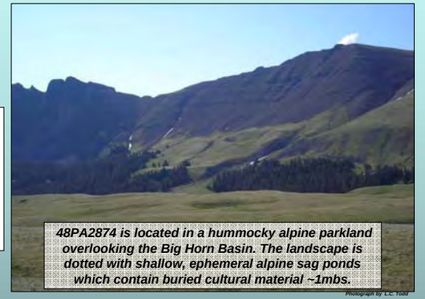
Pocket Gophers and Archaeology

The pocket gopher is a key component of ecosystem function and diversity. Nutrient availability in soil, vegetation communities, and topographic features on multiple spatial scales are all, in part, structured by pocket gopher activity. In addition to influencing the trophic structure of ecosystems, gopher activity greatly impacts archaeological sites.



The impact of activity by *Thomomys talpoides*, the Northern Pocket Gopher on archaeological material was examined at a multi-component prehistoric site in the Absaroka Mountains of Wyoming.

The study compared patterns in artifact distribution expected with gopher disturbance to the actual distribution of surface and sub-surface artifacts.

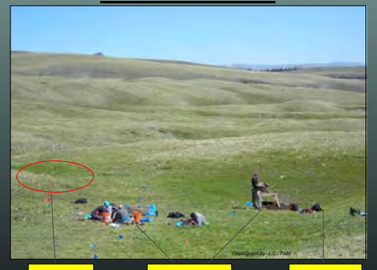


48PA2874 is located in a hummocky alpine parkland overlooking the Big Horn Basin. The landscape is dotted with shallow, ephemeral alpine sag ponds which contain buried cultural material ~1mbs.

Photograph by L.C. Todd

TO DETERMINE THE EXTENT OF DISTURBANCE
burrows surrounding an alpine sag pond were documented & test excavation was conducted downslope of the mounds.

Test Excavation



Gopher Documentation

- *Location*
- *Volume of sediment & rock*
- *Mound L/W*
- *Activity*
- *Artifacts*

The Sequence of Events

How Gopher Activity Impacts Artifact Distribution

VERTICAL TRANSPORTATION OF ARTIFACTS

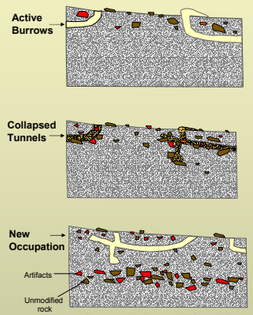


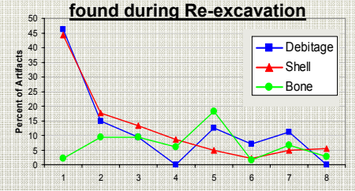
Figure based on Johnson's 1986 model of 'stone zone' formation and Erlandson's 1984 research on bimodal artifact distribution resulting from gopher activity.

- **Tunneling and mound building begin to redistribute material through the soil profile.**
- **Abandoned burrows collapse, creating non-cultural concentrations of multi-sized clasts at the depth of tunnels.**
- **Gophers are unable to transport material greater then the tunnel diameter (~6cm). Johnson 1989 found that the burrowing around larger stones causes the larger clasts to sink while smaller diameter material is unaffected. Overtime layers of rocks/artifacts with lengths ≥6cm accumulate at the depth of burrowing forming non-cultural 'stone zones.'**
- **Erlandson (1984:787) found gopher activity causes a bimodal vertical distribution of artifacts with a peak at 10-20cm and again at 50-60cmbs a less dramatic peak. No size sorting was found.**

LATERAL TRANSPORTATION OF ARTIFACTS

Bocek (1992) investigated lateral movement of artifacts by re-excavating a site 7-years after initial excavation. Units had been backfilled with sediment screened with 0.6 cm mesh, therefore contained no material greater than 6cm in 1981. Re-excavation in 1988 showed the units contained as much as 46% of the number of artifacts recovered during the initial excavation.

Percent of Artifacts from Initial Excavation found during Re-excavation



- **Majority of material less than 1.8cm length**
- **Transportation of artifacts influenced by shape, size and density- shells display a unimodal distribution unlike debitage and bone**
- **No new artifacts transported to the surface**
- **With depth the amount of introduced material decreases**

CONCLUSIONS

Mitchell, 3rd grade, Ivy Hill Elementary

Gopher activity transports artifacts laterally and vertically in predictable ways, tending to displace smaller artifacts upward and larger materials downward to the depth of maximum burrowing. This distribution was not identified in test excavation. While gopher activity cannot be ruled out unequivocally, it does not appear burrowing has resulted in significant or observable mixing of artifacts or soil horizons.

However gopher activity does impact sub-surface archaeological material. Initial research at 48PA2874 (not discussed here) supports the proposal that sediment exhumed by pocket gophers is being redistributed by erosion into ephemeral alpine sag ponds scattered across the landscape, creating intact buried cultural deposits.

What potential artifact patterns result from gopher activity?

SUB-SURFACE

- Bimodal distribution of artifact frequency with depth
- Smaller artifacts displaced upward, larger materials sink
- The formation of a 'stone zone'

SURFACE

- Spatial patterning of surface artifacts, sorting by size/maximum length, elongation, flatness, & blockiness

Works Cited

Bocek, B.
1992 The Jasper Ridge Reexcavation Experiment – Rates of Artifact Mixing by Rodents. American Antiquity 57(2):261-269.

Erlandson, J.
1984 A Case Study in Faunalturbation: Delineating the Effects of the Burrowing Pocket Gopher on the Distribution of Archaeological Materials. American Antiquity 49(4):785-790.

Johnson, D. L.
1989 Subsurface Stone Lines, Stone Zones, Artifact-Manuport Layers, and Biomantles Produced by Bioturbation Via Pocket Gophers (Thomomys-Bottae). American Antiquity 54(2):370-389.

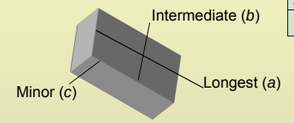
Detecting Gopher Activity

A comparison of physical characteristics of artifacts from gopher burrows, the site surface, & excavation units was conducted to help determine if different post-depositional processes are occurring across the site.

Artifacts Characteristics

Maximum length, Elongation, Flatness, & Blockiness/Sphericity:

Max Length	Elongation	Flatness	Sphericity
a	b/a	c/b	$(bc/a^2)^{1/5}$



The longest axis (a), the intermediate (b), and the minor (c) of each artifact were determined. Elongation, flatness, and blockiness (or sphericity) were calculated with the following ratios respectively of b/a, c/b, and $(bc/a^2)^{1/5}$ (Scally and Owens 2005:50).

Artifact Lengths (mm)

Location	Maximum	Minimum	Mean
Burrows	48.8	4.8	14.8
Surface	96.9	1.4	15.6
Excavation	72.6	3.0	10.5

Site Surface & Gopher Artifact Characteristics

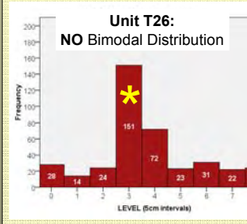
No statistically significant difference in **ANY** of the variables compared.
Conclusion? Gopher activity is not effecting the distribution of surface artifacts based on size and shape in an observable manner.

Excavation & Gopher Artifact Characteristics

Statistically significant differences in **ALL** artifact characteristics

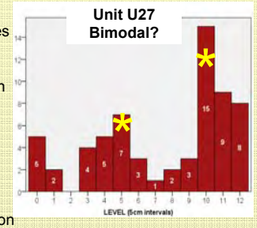
Characteristic	t	df	Sig. (2-tailed)
Max Length	5.218	570	0.000
Elongation	2.033	570	0.043
Flatness	570	570	0.010
Blockiness	3.95	570	0.000

Artifact Distribution in Excavation Units



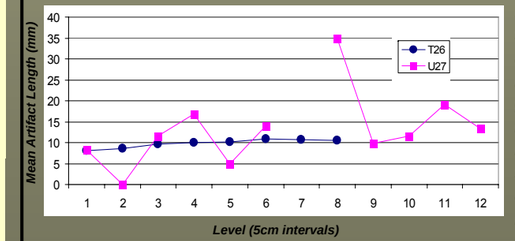
Excavation unit U27
The bimodal distribution in U27 does NOT conform to the artifact distribution expected in gopher churned sediment. While there is an increase in between 20-25 cmbs, which could be the depth of gopher tunneling, the **dramatic** spike at 50cmbs is **not** be expected with gopher bioturbation.

Unit T26: Not Bimodal
Does NOT exhibit bimodal distribution expected in gopher disturbed sediment.



Conclusion? This may indicate gophers are not influencing artifact distribution in the pond area where excavation occurred.

Mean Artifact Length by Level from Two Excavation Units



Excavators did not encounter a stone zone (concentration of artifacts at 50-60 cmbs with lengths > 6cm) as predicted with gopher disturbance. Unit T26 maintained a steady mean artifact length. U27 was variable, with a spike at L8, however only two artifacts were recovered from that level, easily skewing the mean.