Integrating site sampling and landscape taphonomy: bridging gaps between culture, cognition, and landscapes in the Absarokas

Katy Waechter kwaech@live.com

Colorado State University

Abstract: Discrete disturbances such as the 2006 Little Venus Fire in northwestern Wyoming generate opportunities to integrate human occupational history with landscape changes. This study combines aspects of archaeological statistics and behavioral ecology to investigate multiple stable states of local landscapes at prehistoric sites. Examining pre- and post-fire artifact distributions, beaver dam modifications, and fire effects provides insight into mechanisms that shape a site's record of human occupation. Knowledge of site structure is tied to various taphonomic processes that determine artifact visibility. Using the Statistical Precision Model, a prehistoric site's artifact assemblage can be used to understand cultural activities that create and structure archaeological sites.

Introduction:

The Greybull River Sustainable Landscape Ecology 2008 crew surveyed and recorded a previously recorded site, 060-07 (temporary field number). The landscape of 060-07 is distinct in addition to the recent burn in 2006 by the Little Venus Fire: the area is characterized by extreme geomorphologic activity, has experienced shifts in stream channel, contains a system of midlevel terraces, and is directly downstream of an abandoned beaver dam meadow and spring. Using exclusively surface survey, findings of the GRSLE crew are more immediately impacted by surface visibility. Examined factors influencing surface visibility in this study are biotic landscape modifications controlling sediment deposition as well as fire-induced soil deflation. These processes have distinct effects in perceptions of archaeological sites in terms of human organization, resource distribution, and landscape stability.

The image to the left shows non-systematic surface survey done by the GRSLE 2008 crew.

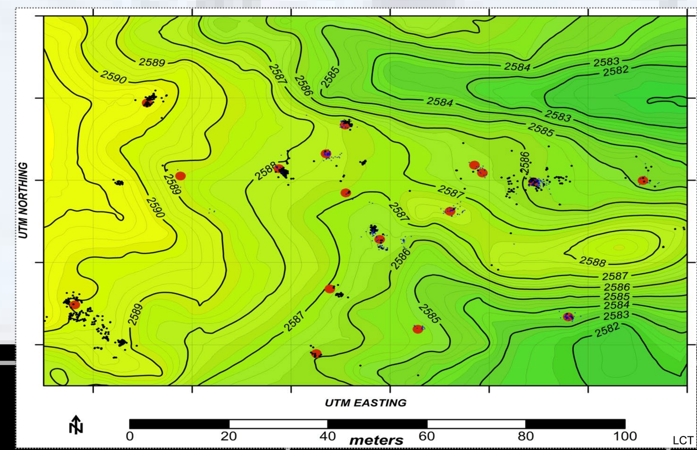
The image above shows a finer systematic survey done by the GRSLE team.

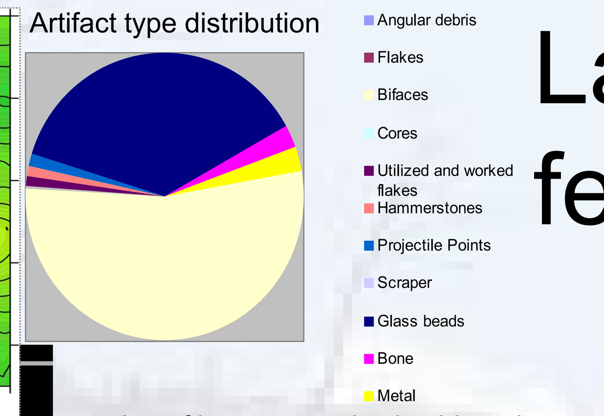
Background:

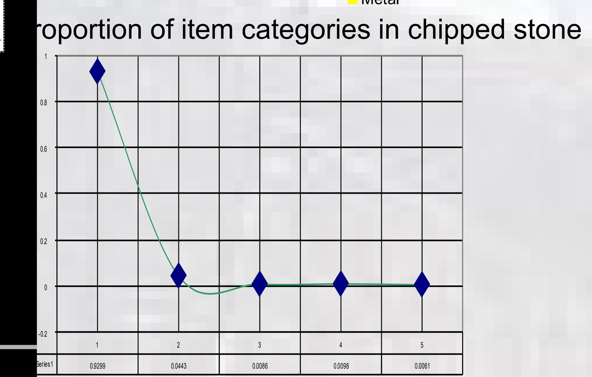
Using systematic and non-systematic survey, GRSLE 2008 crew recorded artifact assemblage at 060-07 using electromagnetic distance measure (< 2 mm accuracy). Artifact classes recorded include chipped stone, glass beads, metal, and bone. Chipped stone showed the most variability and diagnostic artifacts, and occurred in clusters of various densities and exhibit distinct patterns within the site.

Since recording of surface artifacts was not in random and arbitrary samples, but rather throughout the site, the Statistical Precision Model presents the best representation of data and estimation of subsurface finds. Group sampling and feature assemblage variation tend to minimize effects of aggregation, but the sample size at 060-07 of 1,698 artifacts overcomes this obstacle and gives appropriate expected variance of estimates ($p(1-p)/n-1$).

While changing recorder perceptions of a site are immeasurable, it is necessary to consider taphonomic processes that shape understanding. Without subsequent exposure by fire, data from the previous site recording would have been unable to utilize the SPM (<N). Had soil deflation not occurred, protohistoric artifacts, multiple hearths and landscape features, and diagnostic lithics would not be part of site 060-07.

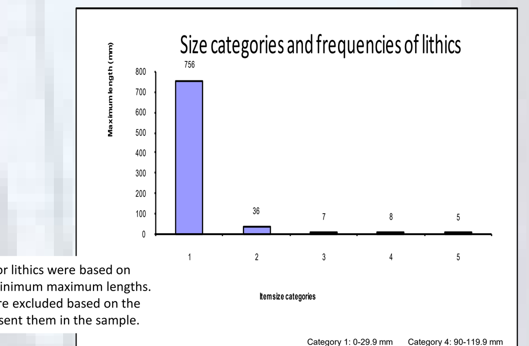






Landscape feature and proportions of feature assemblages

- Because artifacts are typically clustered around features, this study used Statistical Precision Model based on group sampling.
- The degree of proximal homogeneity of item classes affects variability of the assemblage from feature to feature.
- Variability affecting the sample can occur in sampling size (number of clusters examined), within-feature homogeneity, and cluster size.
- The most significant risks in using this model include emphasis on in-unit homogeneity with large clusters, as well as varying sample sizes skewing perceived abundance and heterogeneity of clusters.



Size categories for lithics were based on maximum and minimum maximum lengths. Lost artifacts were excluded based on the inability to represent them in the sample.

Feature
Proportion of chipped stone per feature:

p=x/n

Variance of proportion:

var(p) = p(1-p)/n-1

Calculations per feature available upon request

Site
Proportion of chipped stone across site:

p=ΣXi/ΣMi = .5733

Variance of proportion across site:

var(p)=1-f/Nc(∑(Mi/Mo)^2)(Pi-p)/Nc-1)= .000145

Using Nance's Statistical Precision Model, we can calculate an expected proportion of chipped stone from each feature. This estimation can be used to represent proportions subsurface artifacts. The variance of this proportion is important measure of possible errors in the sampling projection.

Feature specific proportions and variances may be useful in determining variability in feature assemblages and their relationship to microterrain. Since the taphonomic actors of this study are at and above site scale, individual features will not be analyzed.

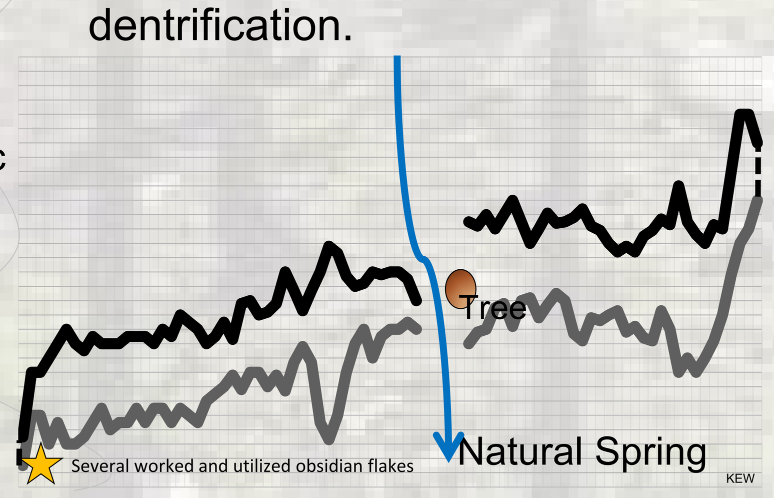
On the site level, proportion of chipped stone accurately represents population against other sample elements. Proportional variance across site is illustrative of moderately variable cluster sizes. Since sample size is very large, aggregation trends are unmodified, and is an acceptable value in failing to prove bias (< 0.2).

Taphonomic processes that alter understanding of site structure at 060-07

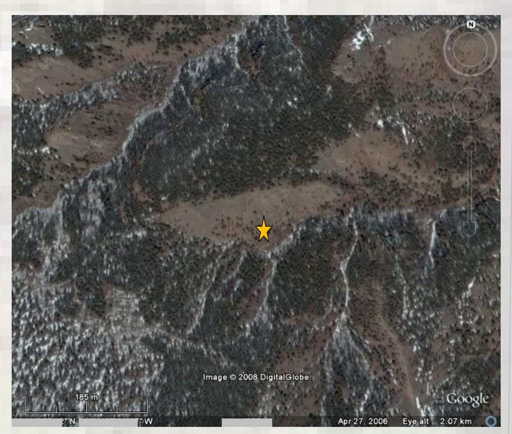
Sediment deposition and soil deflation are related processes based on multitudinous factors. On site 060-07, the most active processes with the greatest magnitude are deposition from an abandoned beaver dam as well as deflation from the 2006 Little Venus Fire. Understanding these processes is crucial to spatial patterning of site features and associated artifacts. With surface survey, it is quite plausible and there is evidence suggesting that additional cultural material is buried and excluded from the significant record of 060-07.

Biotic agents of change: *Castor canadensis*

- Beaver dam shapes depend on the strength of a stream's current: dams in stronger currents are curved, with the convexity pointing upstream (towards the spring in this case).
- Beaver dams influence the distribution, stock, and availability of chemical elements by shifting pathways and element storage from vegetation to sediments and soils (Naiman, 1994).
- Large-scale beaver pond and stream relationships influence the permeability of geomorphologic boundaries and are critical in controlling immediate resource distribution (Schlosser, 1995).
- Dams may function as creators of wetlands, grazing meadows, forests, bottom land, and to promote dentrification.

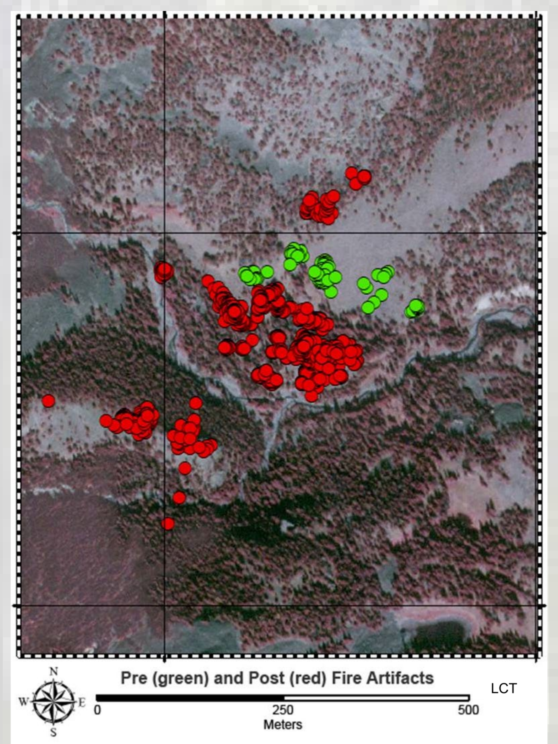


One square map



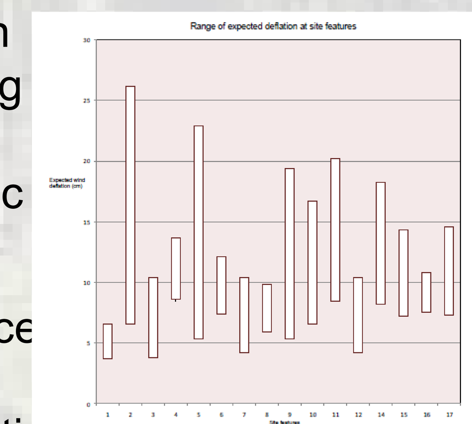
Satellite image of beaver dam in 060-07 locality before 2006 Little Venus Fire

Fire as a geomorphologic mechanism

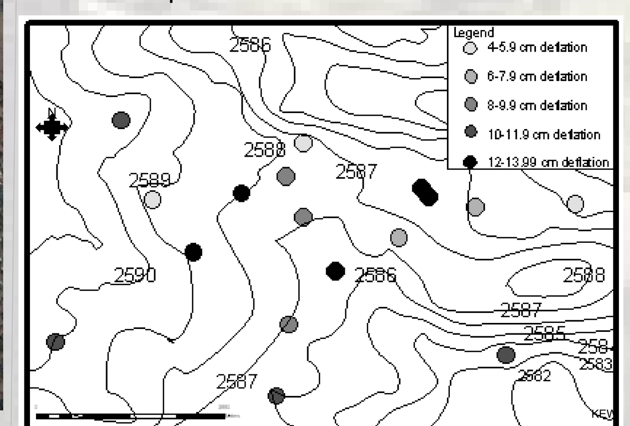


Pre- and post-fire artifact distribution. Green represents previously recorded artifacts and the extent of site structure at that time. Red represents artifacts recorded by GRSLE 2008 and an expanded site structure.

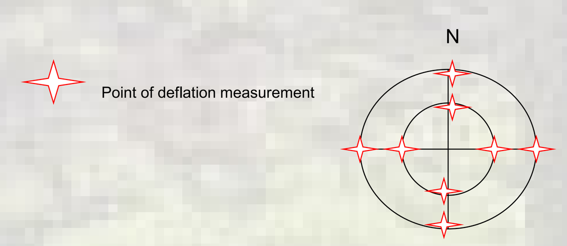
- Previous GRSLE studies have focused on direct effects of the 2006 Little Venus Fire in northwestern Wyoming (Knapp 2006). Fire, profoundly influencing geomorphologic processes, also functions as a chemical process by removing moisture and organic content from surface soils.
- Fire-induced changes in sediment size and absence vegetative cover dramatically increase micro-topographic variation, specifically through soil deflation at 060-07.
- The illustrated levels of deflation highlight areas of the landscape more prone to deflation, and with higher surface visibility. It is expected that more intensely deflated areas exhibit higher artifact counts.
- Soil deflation data were taken at site 060-07 on each archaeological feature, recording measurements at the cardinal directions as well as a minimum and maximum deflation for those directions.



This series of expected values is based on ninety-five percent confidence intervals (t) for each feature. The most geomorphologically active features display the largest ranges, while the more evenly deflated features exhibit more concise ranges.



Average feature deflation intensity laying over site topography. Darkened areas represent the most intense soil deflation and correlate with natural wind sheltering.



The left image shows an example of soil deflation: the charred portion of the rock marks previous soil level, while the bottom of the tape measure (cm) indicates current soil levels.

The right image also depicts soil level variation as well as vegetative islands that were key to measuring much of the soil deflation data.

Discussion:

As sites have different structural features in terms of stratification and depositional history, their material patterns vary in density. Site sampling limits observed elements and densities, influencing perception of site structure and function. High artifact densities and substantial features indicate intensity and duration of occupation (Bamforth, 1988). Artifacts can be measured, counted, and densities computed, but since measurable significance of landscape features is not often clear, they must be roughly gauged on a relative scale to assemblage. Various explanations and models are expected, but archaeologists can still use relatively simple statistics to address important issues in archaeology.

Based on parameters of Statisical Precision Model (Nance, 1981), current analyses of site 060-07 fail to show a relationship between homogeneity in clusters and the selected taphonomic processes in surface survey. Surface visibility, as a paramount value, was achieved through a discrete event, and did alter the total representation of material culture. However, the inherent variability between features is indicative of further taphonomic processes at work and the possible influence of culture and organization on site structure.

Site sampling is a primary component of assemblage representation. The ability to represent assemblages ought to be actively incorporated into survey design and methods. Using site features in lieu of grid lines and the assemblage documented in 2008, clustered sampling is appropriate to obtain precise estimates of item populations on a site. The redundancy exhibited between features is paralleled by item class aggregation and helps to point to correlations in feature assemblages with very large sample sizes. These patterns exhibited by statistical procedure point more clearly to the processes that control site visibility.

References:

Ammerman, Albert J.
1992 Taking Stock of Quantitative Archaeology. Annual Review of Anthropology 21:231-255.

Bamforth, Douglas
1988 *Ecology and human organization on the Great Plains*. Plenum Press, New York, NY.

Gallant, T. W.
1982 "Background Noise" and Site Definition: a Contribution to Survey Methodology. Journal of Field Archaeology 13(4):403-418.

Naiman, Robert J. and Gilles Pinay
1994 Beaver Influences on the Long-Term Biogeochemical Characteristics of Boreal Forest Drainage Networks. Ecology 75(4):905-921.

Nance, Jack D.
1981 Statistical Fact and Archaeological Faith: Two Models in Small-Site Sampling. Journal of Field Archaeology 8:151-165.

Schlosser, Isaac J.
1995 Dispersal, Boundary Processes, and Trophic-Level Interactions in Streams Adjacent to Beaver Ponds. Ecology 76(3):908-925.

Acknowledgments:

I would like to thank Larry Todd, Becky Thomas, Abe Thompson, Jason LaBelle, Mikah Jaschke, Joshua Craft, and the 2008 GRSLE crew for their help in helping me refine ideas into a concentrated synopsis of the influence of sampling.