

Investigation of a Projectile Point Typology for the Uncompahgre Plateau

Neil Hauser, Coal Creek Research Inc., Montrose, CO
nhauser.ccr@gmail.com

Geographic Area of Interest

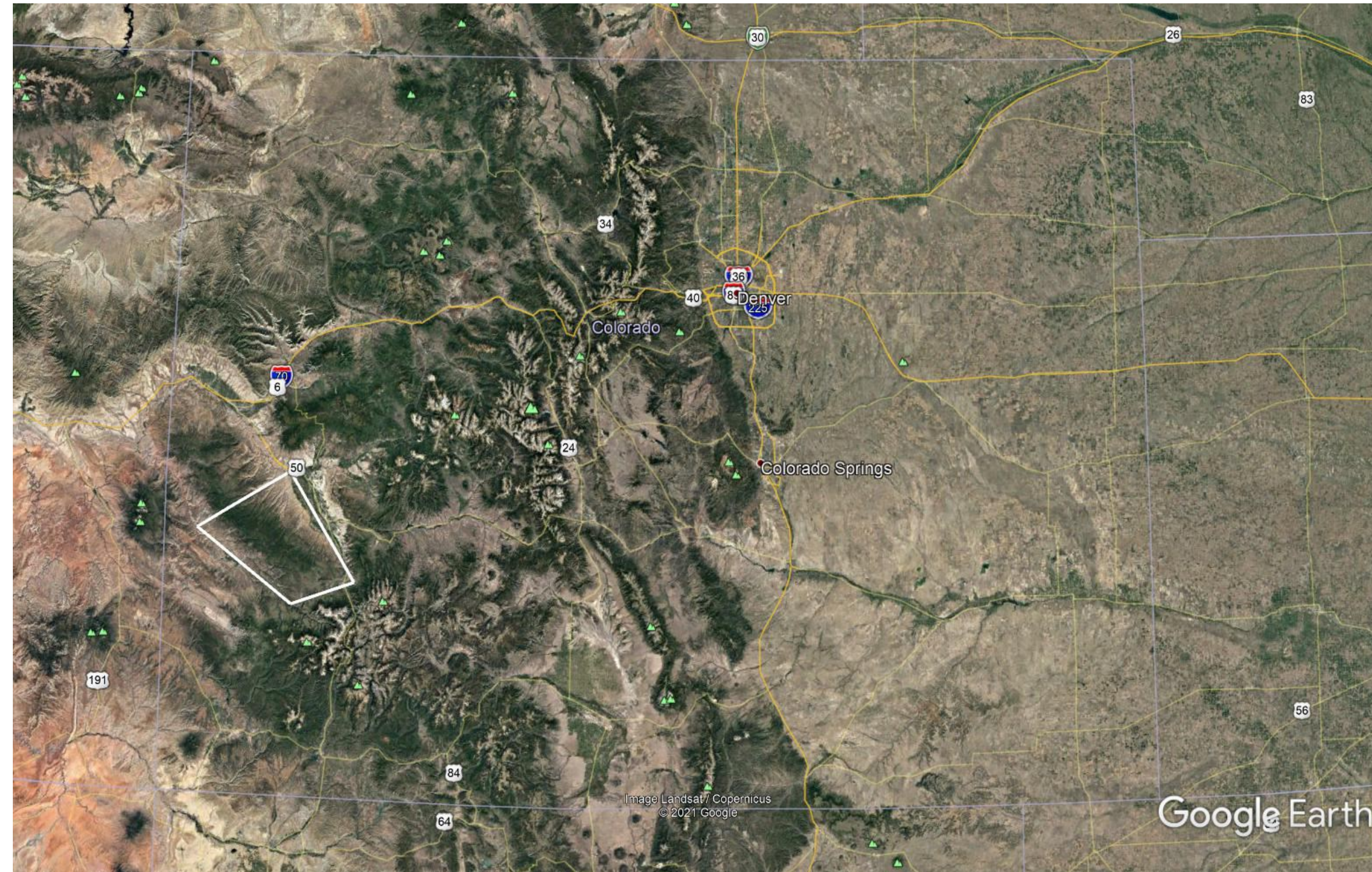


Figure 1. Uncompahgre Plateau, West Central Colorado, study area outlined in white

Problem

- Existing typology for the area (Buckles¹, Berry²) focused on chronology, therefore used only the relatively small number of projectile points found in excavated sites

Approach

- Compared 1,548 projectile points from excavated and private surface collections within study area
 - points are part of Coal Creek Research Inc. project to create online Colorado projectile point database³
- Only projectile points that had a shoulder or notch (stemmed, corner-notched, side-notched) were used
- Only projectile points with at least the hafting element and lower part of blade complete (complete and broken projectile points) were used
- Created high resolution, scanned images of the projectile points and recorded 18 landmarks on the images (plus two for scaling) (Figure 2) using tpsDig2⁴
- Calculated 11 metrics (Figure 3)
 - Shoulder width (SW), neck width (NW), total angle (TA), distal edge angle (DA), proximal edge angle (PA), base width (BW), neck-to-base length (NB), base concavity (BC), base width (BW), base extent (BE), tang or shoulder extent above or below neck (SE), blade angle (BA) (blade angle was used as a surrogate for point length)
- Used 13 parameters in cluster analysis: SW, NW, TA, DA, PA, BW, NB, BC, BA, and ratios NW/SW, BW/SW, BE/BW, SE/NB
- Applied both an unsupervised cluster algorithm (Affinity Propagation⁵) and a supervised cluster algorithm (Agglomerative Hierarchical Cluster⁵) to scaled values of the parameters
- Used a decision tree algorithm⁵ based on unscaled parameter values to identify most similar projectile points within each clusters

Results

- Unsupervised, Affinity Propagation clustering gave 76 clusters
- Used supervised, Agglomerative Hierarchical Clustering to create a second set of 76 clusters
- Selected those clusters that had at least 8 projectile points (0.5% of total data set) that occurred together in a cluster in both clustering results, which gave 50 clusters
- A decision tree algorithm⁵ was applied to those 50 clusters using the unscaled values of the 13 parameters
- Clusters that had 50% or more of the points in a single leaf were then selected to represent types, resulting in 45 types (Figure 4)
- Effect of this process on an original Agglomerative Hierarchical cluster is seen in the "radar plots" for points in Type UP 5 before and after (Figure 5a and 5b)
- Created a 10 level Uncompahgre Plateau decision tree using those 45 types⁶
- Average value of the parameters of the core projectile points within each group used to create synthetic point outlines representative of each group (Figure 4)
- Not all points should be in a type, 324 of the 1548 points in this data set were not included in a type
- Points from excavated sites occurred in 23 of the 45 types
- Several "types" have previously been named in other areas, e.g., Sudden (UP 8), Gypsum (UP 1)
- Often those with some parameter values outside the trend for a cluster don't appear to be similar enough to be included (Figure 5a).
- The natural tendency would be to combine several of the 45 types, e.g., UP 35 and UP 41

Discussion

- Should types be combined? When is splitting too much?
 - Depends on the question being investigated
 - Could a flint-knapper repeatably create the difference(s)
 - Repeatability and accuracy of the data.
- Questions that need to be answered
 - How much variation is representative of a single flint-knapper and between different flint-knappers?
 - What is the repeatability and accuracy of measured data?
 - Are there other lines of evidence that justify combining or splitting types?

Acknowledgements

Appreciation to Craig Banister for image processing and Teri Hauser for help with the analysis.

References

- Buckles, William G. "The Uncompahgre Complex: Historic Ute Archaeology and Prehistoric Archaeology of the Uncompahgre Plateau, West Central Colorado. Ph.D. dissertation, 1971, University of Colorado, University Microfilms, Ann Arbor.
- Berry, Michael. "The Uncompahgre Plateau Project: Projectile Point Typology and Chronometry," Colorado State Historical Fund Project #2018-02-035, 2019, Denver, Colorado
- Coal Creek Research Inc. a 501 (c) (3) non-profit research company, Projectile Point Project database, <https://p3.coalcreekresearch.org/>
- Rohlf, F. James. tpsDig2, digitized landmarks and outlines, version 2.0, 2004, Department of Ecology and Evolution, State University of New York at Stony Brook
- Pedregosa, et al. "Scikit-learn: Machine Learning in Python," JMLR 12, pp. 2825-2830, 2011
- Coal Creek Research Inc. a 501 (c) (3) non-profit research company, "Uncompahgre Projectile Point Typology Decision Tree," <https://p3.coalcreekresearch.org/reports.php>



Figure 2. Position of Landmarks

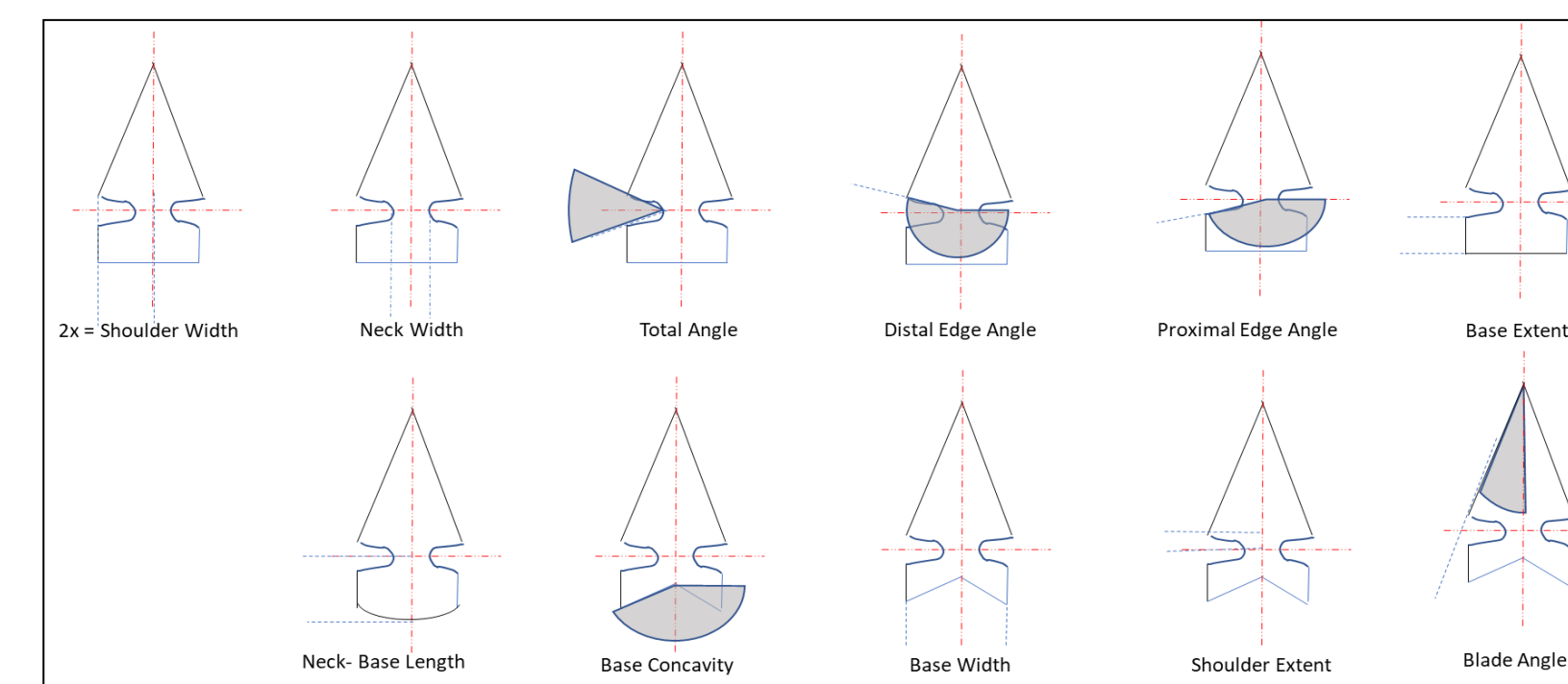


Figure 3. Parameter Definitions

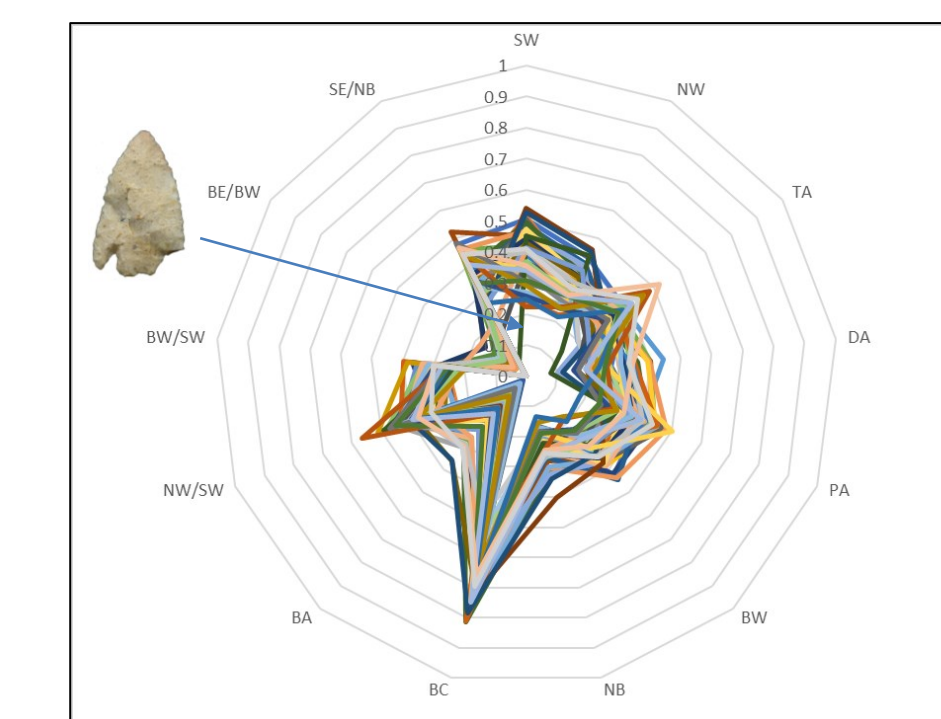


Figure 5a. All Thirteen Parameter Values for All Type UP 5 Points from Agglomerative Hierarchical Clustering

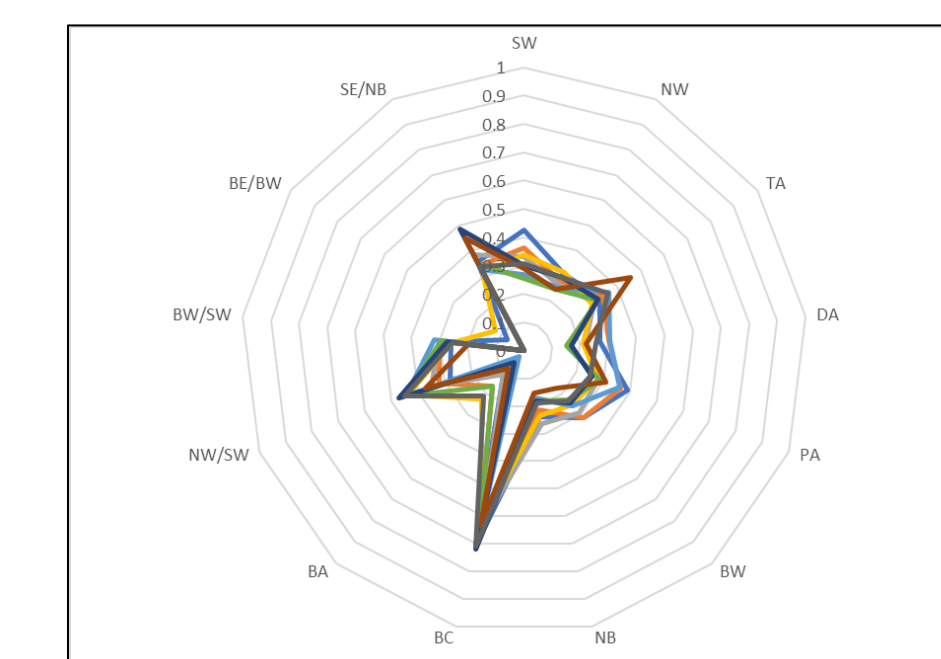


Figure 5b. All Thirteen Parameter Values for Core points in Type UP 5

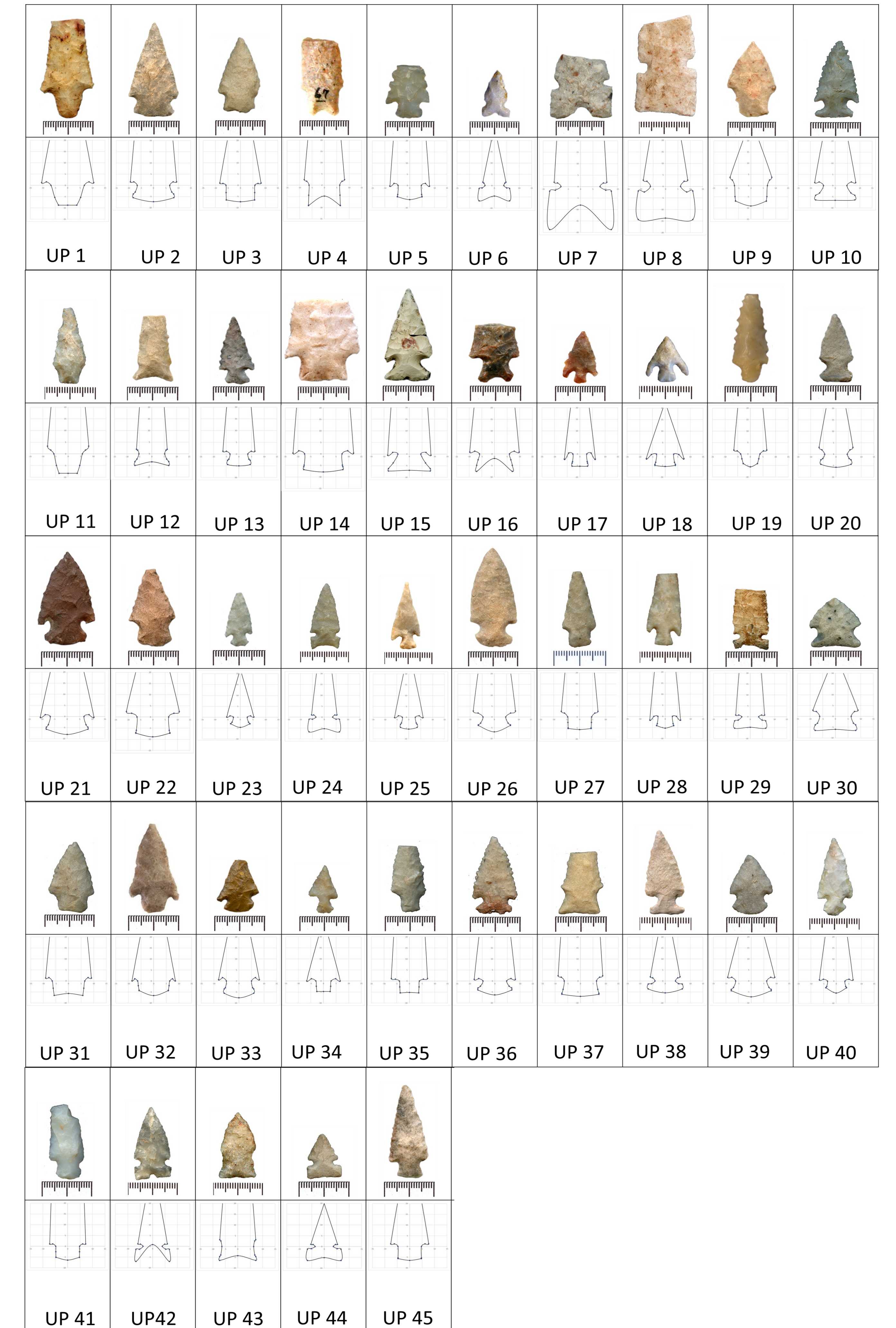


Figure 4. Projectile Point Typology with Synthetic Points (basal notched points are not accurate since the 13 parameters do not provide enough information)