

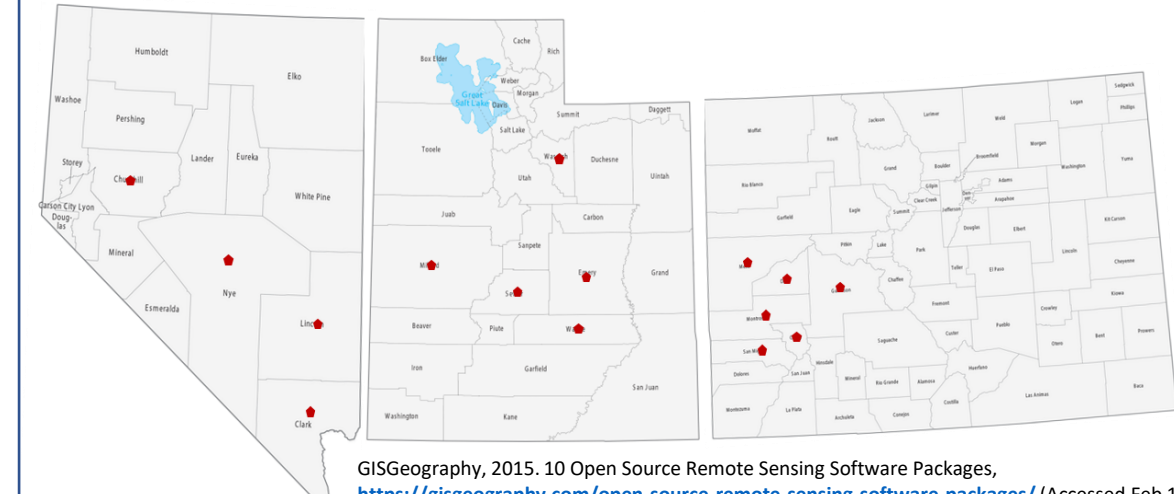
Investigation of Contracting Stem Points from the Great Basin and West Central Colorado

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

Teri Hauser, MA
Coal Creek Research, Inc, Montrose, Colorado

Question: Are the contracting stem points in West Central Colorado the same shape and size as those in the Great Basin?

Data: Contracting Stem Points Study Area



GISGeography, 2015. 10 Open Source Remote Sensing Software Packages. <https://gisgeography.com/open-source-remote-sensing-software-packages/> (Accessed Feb 10, 2023).

Red symbols are centered in counties where contracting stem points used in this analysis were found.

Data set composed of 332 points from:

Nevada: (75)
Hidden Cave (34) (AMNH)
Gatecliff Shelter (13) (AMNH)
O'Malley Shelter (24) (NSM)
Gypsum Cave (4) (NSM)

Utah: (36) (UMNH)
Sudden Shelter (18)
Cowboy Cave (7)
42MD2531 (1)
42SV2940 (2)
42SV2480 (1)
42SV3417 (1)
42SV3419(1)
42WS2440 (1)
42WS5748 (1)
42EM625 (1)
42EM693 (1)
42XX (1)

West Central Colorado: (221) (p3.coalcreekresearch.org)
5ME97 (1)
5OR1485 (1)
5MN3859 (1)
Private collectors (218)

Format: Area/Site number (no. of points)/(Source or provided access for images)

Approach: Analysis of Geometric Morphometrics (GMM)

Characterization of projectile points:

- Distances from center of neck to edge of point.
- This approach was used instead of specific measurements like stem length, neck width, etc. to allow any considerations the knapper might have had to be represented.
- This approach also allows any part of the points to be analyzed, e.g., 90 degrees to 180 degrees to examine just the hafting element.

Parameters consist of distances (dx) from center of stem to edge of point. The edge of the point is defined by straight line approximations, usually requiring between 10 and 35 landmarks (black dots in Figure 1). The distance (dx) is calculated for every degree from a line perpendicular to the line defining the stem width with origin at the center of the stem. Only the most complete side of the point is used to obtain distances and thus describe the point. Symmetry is assumed.

Line defines stem width
(Point 42WN420_FS_721_7 from UMNH)

Figure 1: Example of measuring distances from center of stem

In this analysis distance measurements from 60 degrees to 180 degrees (120 landmarks) were used so that points missing their tips could be used and to minimize the effects of reworking of points on the analysis.

Agglomerative Hierarchical Clustering (AHC) was used to evaluate the similarity of the contracting stem points across the study area.

When the contracting stem points are examined, there are points with and without barbs and tangs and points. Before performing AHC on the points' parameters, the measurements on the tangs were removed.

Size is often eliminated in GMM analysis using Generalized Procrustes Analysis. I believe size may be one of the considerations of the knapper and shape may have a relationship to the size. Therefore, in the first analysis in this investigation the size was NOT removed. Following that a separate analyses was done scaling all points to the average point size thus removing size as a consideration.

Results:

When the 332 contracting stem points used in this analysis are divided into the two groups, those with tangs and those without, there are 229 without tangs and 103 with tangs. Notice (Table 2) that the majority of points in western Nevada sites are points with tangs. However, the majority of points from eastern Nevada, Utah, and west central Colorado do not have tangs. When broken into three regions (Nevada representing western Great Basin, Utah representing eastern Great Basin, and west central Colorado the distribution of tangless points is significantly different ($p < .05$) from that expected if they were proportionally distributed. There are more barbed and tangless points than expected in the western Great Basin (Nevada), about as expected in the eastern Great Basin, and fewer than expected in west central Colorado.

Table 2: Distribution of tangless points by site and region

	without tangs	with tangs
West Great Basin (Nevada)	12 (35%)	22 (85%)
Gatecliff Cave	2 (15%)	11 (85%)
O'Malley Shelter	17 (71%)	7 (29%)
Gypsum Cave	2 (50%)	2 (50%)
East Great Basin (Utah)	12 (67%)	6 (33%)
Cowboy Cave	4 (57%)	3 (43%)
42SV2480	1	0
42SV2940	0	2
42SV3417	1	0
42SV3419	0	1
42WS2440	1	0
42WS5748	1	0
42EM625	0	1
42EM693	0	1
42MD2531	0	1
42XX	1	0
West Central Colorado	5ME97	0
	5MN3859	0
	5OR1485	1
	private collectors	173 (79%)
		46 (21%)

Table 3: Statistical significance of distribution of tangless points from the expected distribution

	Actual	No tangs	Tangs
West Great Basin	33	42	
East Great Basin	22	13	
West Central Colorado	174	48	
Expected			
West Great Basin	52	23	
East Great Basin	25	11	
West Central Colorado	153	69	

$p=0.00$

To determine if the presence of tangs altered the shape and size of the stem or if the stem shape and size was independent of their presence, the measurements associated with the tangs were removed before performing cluster analysis. The dendrogram (Figure 2) shows there are arguably five clusters of point shapes and sizes when the tangs are not considered.



Figure 2: Dendrogram of all points, ignoring the tangs

The composition of each group (Table 4) shows that Group 2 and 5 are composed almost entirely of points from west central Colorado. When the compositions of the groups are compared to that expected by proportional distribution, Groups 1, 2, and 3 are significantly different. Groups 1 and 3 have more points from west Great Basin while Group 2 has more from west central Colorado. Interestingly, the eastern Great Basin has about the expected number of points except for Group 2.

Table 4: Spatial composition and statistical significance of Figure 2 groups

	Actual	Group 1	Group 2	Group 3	Group 4	Group 5
West Great Basin	25	1	30	18	1	0
East Great Basin	15	4	8	11	0	0
West Central Colorado	41	111	36	43	12	0
Expected						
West Great Basin	18	26	12	16	3	0
East Great Basin	9	13	6	8	1	0
West Central Colorado	53	77	36	48	8	0

$p=0.02$ 0.00 0.00 0.36 0.17

The mean shape and size of the points in each group are shown in Figure 3. The points in Group 2 and 5 have, on the average, >20% longer stems than the points in the other groups.

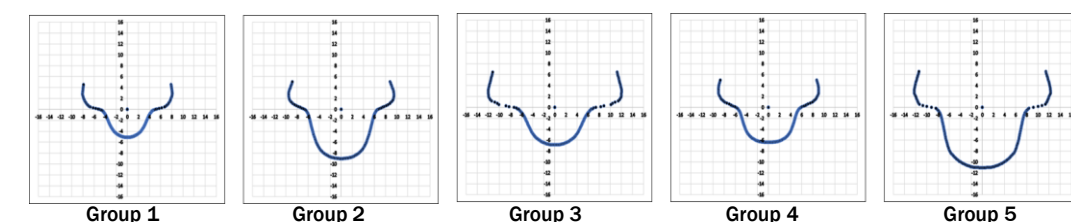


Figure 3: Synthetic outline of the average shape and size point in each group

Finally, the points (ignoring the tangs) were scaled to the average size and shape to minimize the influence of size and investigate the shape of the stemmed points. When AHC clustering was used with these scaled points arguably four groups seem most likely (Figure 4).

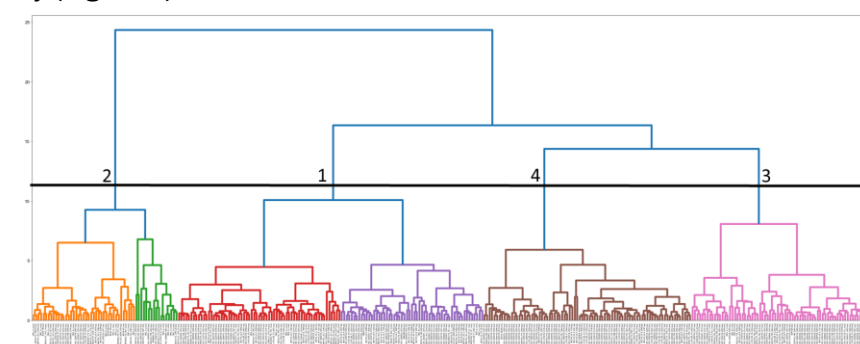


Figure 4: Dendrogram of points scaled by the average size and shape of all points in assemblage

When just shape is considered, the five groups of Figure 3 become just four groups (Figure 5). The composition by region of the four groups indicate that Group 1 and 2 are composed of significantly more points from the Great Basin and Group 3 and 4 are composed of significantly more points from west central Colorado (Table 5). This indicates there is a difference in shape between points in the Great Basin and those in west central Colorado.

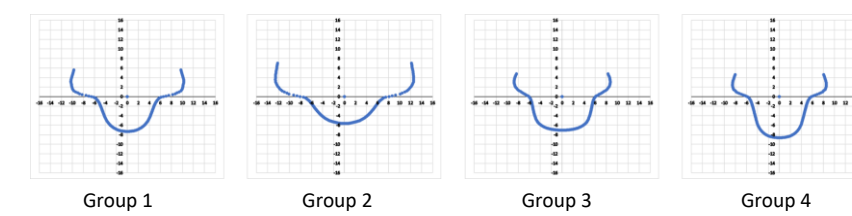


Figure 5: Synthetic outline of the average point shape for each group

Table 5: Spatial composition and statistical significance of Figure 5 groups

	Actual	Group 1	Group 2	Group 3	Group 4
West Great Basin	36	25	7	7	0
East Great Basin	21	10	1	4	0
West Central Colorado	65	23	62	72	0
Expected					
West Great Basin	27	13	16	19	0
East Great Basin	13	6	8	9	0
West Central Colorado	81	39	47	55	0

$p=0.005$ 0.000 0.000 0.001

Discussion

In the Great Basin, both west and east, radiocarbon dates from strata where contracting stem points have been found indicate they occurred between about 4200-2600 BP (Coulam, 2022). Only one contracting stem point from west central Colorado has an associated radiocarbon date. That is from 5ME97 (Taylor Site), obtained by Denver Museum of Nature and Science and Coal Creek Research, with a date between 3500-3100 BP. However, since that projectile point changed groups when size and shape were considered (Group 2, Figure 3) versus only shape (Group 1, Figure 5), that date may not be representative of the majority of points in Group 2, Figure 3.

When considering Figure 3, point shapes and sizes represented by Groups 4 and 5 have distributions across the study region that are not statistically different from the expected, given the proportions of the assemblage each region contributes to the assemblage (proportional distribution). However, there are groups that have distributions across the study region that are significantly different from the expected. Group 1 and Group 3 occur more in the Great Basin while Group 2 occurs more in the west central Colorado region. The distributions, relative to expected, in the east Great Basin appear to follow the west Great Basin and never west central Colorado. This could reflect movement of people using the points or the acceptance of the point shapes and sizes by different peoples across the region.

This analysis uses AHC cluster analysis of geomorphometric parameters. AHC cluster analysis is simply a way of grouping things that have the most similar values for all the parameters being considered, in this case distances from the center of the neck to the edge of the projectile point from 60° to 180°. Points within a cluster or group are more similar to each other than to points in the other groups. The groups shown should NOT be interpreted as representing types. Figure 6 shows images of the two projectile points from each group that are closest to the mean values.

When points within a group are compared visually, invariably there are points that a person would not include in that group. This is due to the fact that the clustering treats all the parameters equally (unless specifically told to weight some parameters more than others) but a person does not. What's more, the importance a person gives to some parameters may change unconsciously from case to case or over time. That is not to say that cluster analysis doesn't have problems as well. Clusters are based only on the points in the assemblage being used. Changes in the membership of the assemblage can result in points moving from one cluster to another. This is especially true for points with parameter values furthest (most unlike) from the average for that cluster.

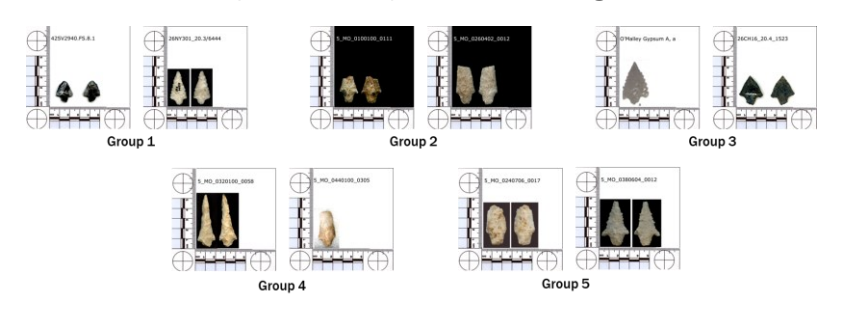


Figure 6: Images of the two points that are closest to the mean for that group.

The projectile points that compose Group 2 in Figure 3 have been decomposed into the subgroups shown in Figure 7. The images of those points are shown in Figure 8. By examining the images, it is clear there are similarities between the points in each sub-group as well as across sub-groups. There are also points in each sub-group that appear to be more like points in a different sub-group, mathematically, they are not but may be the extremes of the sub-group.

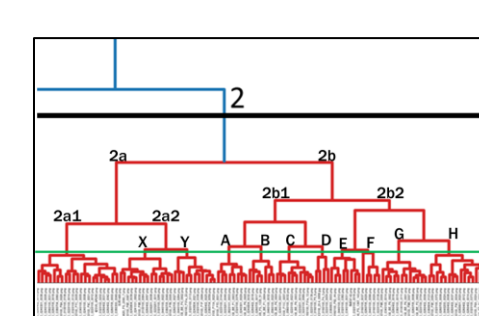


Figure 7: Nomenclature for subgroups composing Group 2

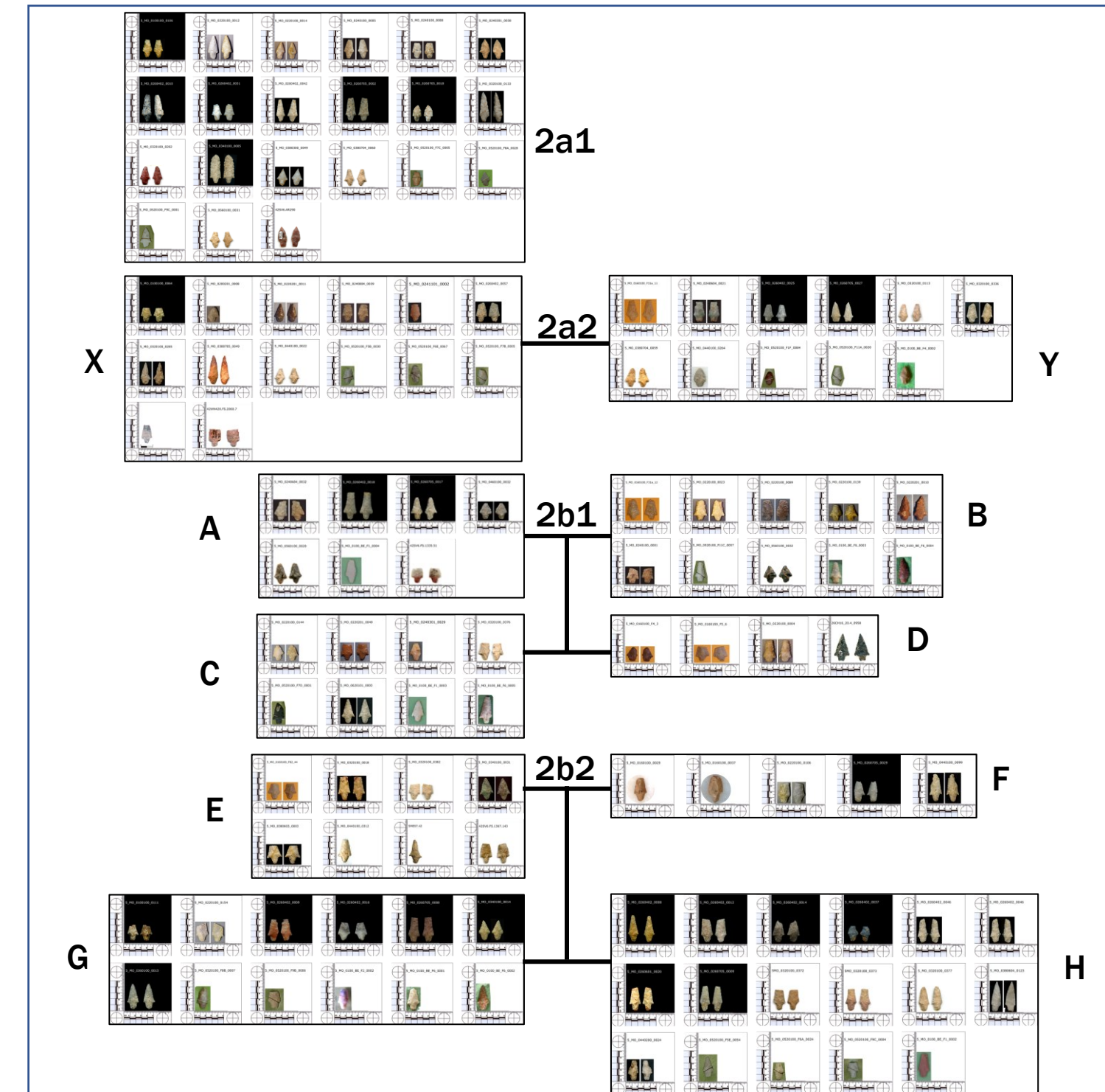


Figure 8: Projectile points composing each sub-group of Group 2 shown in Figure 6

Conclusions

From this analysis, it appears that there are contracting stem point sizes and shapes, that occur significantly more often in the western Great Basin, and others that occur significantly more often in west central Colorado. Other sizes and shapes are distributed proportionately over the study region. The tangless contracting stem points appear to be most prevalent in the western Great Basin, while many contracting stem points in west central Colorado have a distinctive shape, including a longer stem. This may reflect differences in movement or levels of acceptance of some shapes across the study region or drift over time. Given the lack of radiocarbon dates associated with contracting stem points in west central Colorado, it may also be that the points that occur nearly exclusively in west central Colorado occurred during a different time than those in the Great Basin.

Clearly, finding sites in west central Colorado that contain the distinctive contracting stem points like those in Figure 8 and can provide associated radiocarbon dates would inform some of the questions raised by this analysis.

Lastly, what constitutes a style or variant within a style? Since points in different groups in this analysis appear to have size, shape, and barb or tang differences, which if any of these should be considered when defining a style or a variant of a style for contracting stem points? To realize the potential of projectile points to inform human behavior, having an agreed to, less subjective methodology for defining and assigning points to styles would facilitate diachronic and synchronic analysis of points and associated human behavior.

Future work is planned:

- Add more contracting stem points from the current study region, especially from eastern Nevada and western Utah to improve the spatial fidelity and confidence of the results of this analysis.
- Expand the study region by adding contracting stem points from Arizona, New Mexico, and California.
- Attempt to locate sites in west central Colorado that could provide radiocarbon dates for Group 2 points.

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Nancy J. Coulam (2022) The Appearance of Contracting Stem Dart Points in the Western United States, Diffusion or Migration?, KIVA, 88:3, 355-371. DOI: [10.1080/00231940.2022.2068898](https://doi.org/10.1080/00231940.2022.2068898)