



Spatial Analysis of the  
Western Pluvial Lakes Tradition  
in the Southern Columbia Plateau  
and Northern Great Basin  
of North America

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Archaeologists have consistently argued that Great Basin settlement patterns were focused on wetlands associated with lakes from the earliest occupations at the Pleistocene-Holocene transition, based on the proximity of early sites to wetlands.

## Objective

Were Paleoindian subsistence-settlement patterns focused on pluvial lakes in the Plateau-Basin region or is a lake-centered pattern the product of the region's archaeological research history?

However, some researchers have questioned the extent to which early economies were focused on lakes, citing lack of direct evidence of exploitation and what appears to be a more diverse settlement pattern of which lake exploitation was only a part rather than the primary focus. The tendency for Basin-Plateau archaeologists to focus research on pluvial lakes has potentially created a situation in which basin-specific analyses emphasize the importance of pluvial lakes to Paleoindian peoples, ignoring broader regional patterns. "Were Paleoindian subsistence-settlement patterns focused on pluvial lakes in the Plateau-Basin region, or is a lake-centered pattern the product of the region's archaeological research history?" Using data gathered in a cultural resource management context, I test theories of early Holocene spatial patterning proposed in the Western Pluvial Lakes Tradition as well as survey bias that may be producing perceived patterns.

## Western Pluvial Lakes Tradition

“from Fort Rock Basin ... south along the Cascade-Sierra-Nevada Uplift ... south into the desert areas of southeastern California and pluvial Lake Mohave.”

Bedwell 1973



Following excavations in Fort Rock Valley in central Oregon, Stephen Bedwell defined an early culture which he believed was adapted to the pluvial lake environments of the western Great Basin. Bedwell hypothesized this early cultural tradition, the Western Pluvial Lakes Tradition, extended “from Fort Rock Basin (the northernmost point), south along the Cascade-Sierra-Nevada Uplift in western Nevada and part of northeastern California (in the region of Lake Lahontan) and finally south into the desert areas of southeastern California and pluvial Lake Mohave.”

## Western Pluvial Lakes Tradition

- “specialized in the exploitation of a lake, marsh, and grassland environment”
- “never leave the lacustrine environment which the hundreds of viable lakes at that time provided”

According to Bedwell’s definition, the Western Pluvial Lakes culture focused their economy on the lake-marsh-grassland environment of the western Great Basin. Although he recognized similarities between the archaeological assemblages of the Columbia Plateau and Northern Great Basin, Bedwell believed Western Pluvial Lakes Tradition people followed a unique adaptation which allowed them to “never leave the lacustrine environment which the hundreds of viable lakes at that time provided.”

Much of what we know about the environment and history of this region has changed in the last forty years, but this hypothesis, that lakes were to some degree central to early economies, has largely been supported following the initial definition of the Western Pluvial Lakes Tradition. The term is ubiquitous in regional literature, and the idea that Great Basin peoples have always valued lake resources is at the core of this region’s archaeology.

## Objective

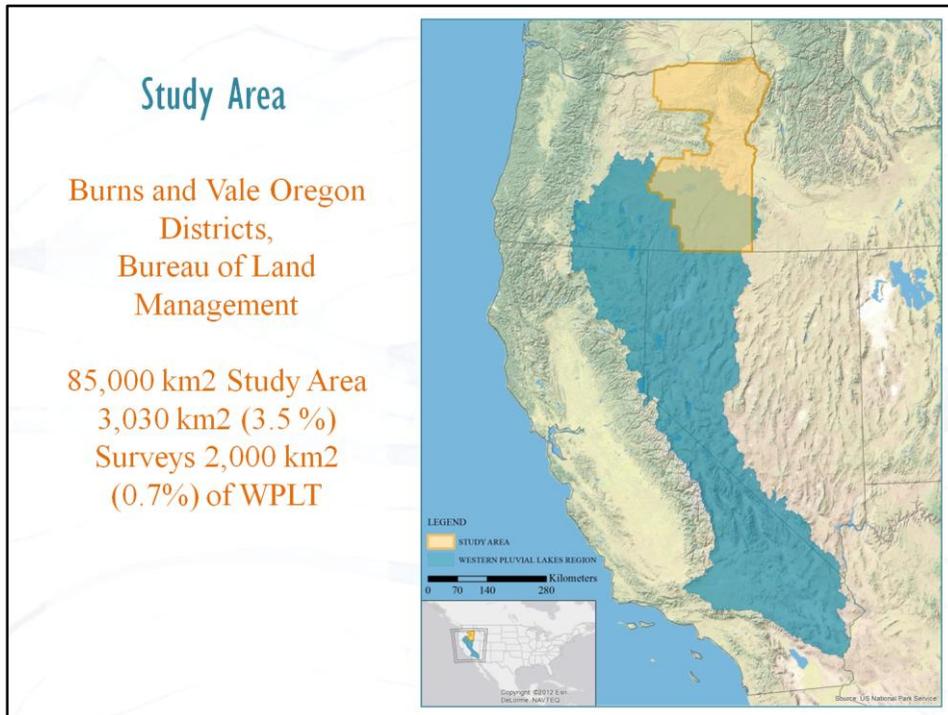
Q. Were Paleoindian subsistence-settlement patterns focused on pluvial lakes in the Plateau-Basin region?

A. [Spatial analysis of early Holocene sites]

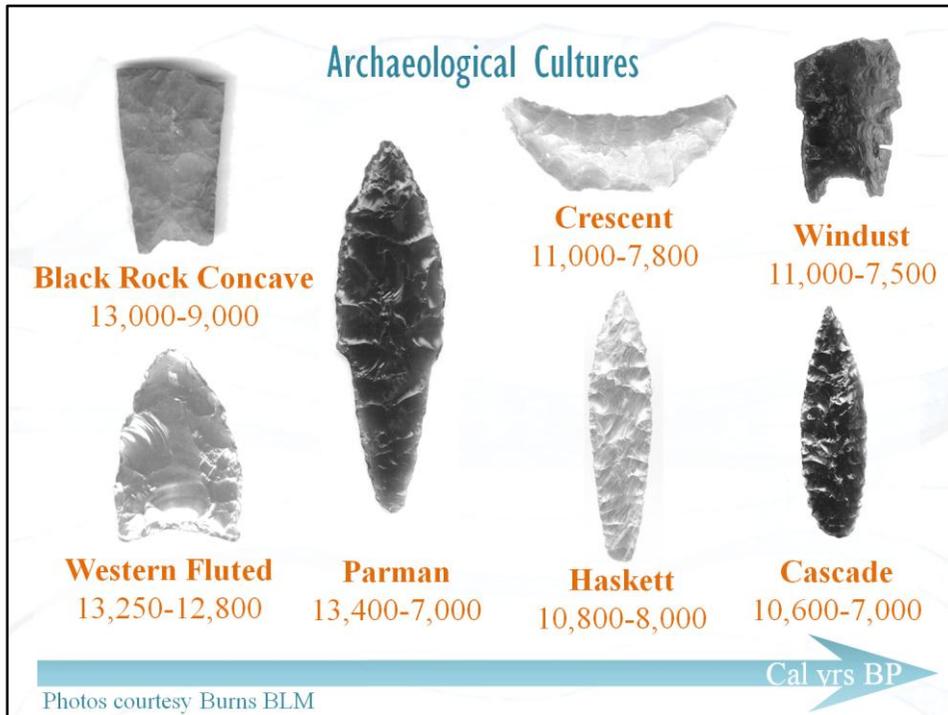
Q. Is a lake-centered pattern a product of the region's archaeological research history?

A. [Regression analysis of survey bias]

I answer the question “Were Paleoindian subsistence-settlement patterns focused on pluvial lakes in the Plateau-Basin region?” with spatial and other traditional statistical analyses exploring the relationship between early Holocene sites and environments. Analyses of survey distributions are used to examine how the region’s research history may have impacted site discovery bias in order to address the question “Is a lake-centered pattern a product of the region’s archaeological research history?”



The Burns district of the Bureau of Land Management in eastern Oregon was selected as my initial study area. Burns has a large data set of Pleistocene-Holocene transition sites and a strong history of research on Pleistocene-Holocene Transition archaeology making it an ideal place to begin questioning early site patterning in the region. In addition to the Burns data I was able to search the Vale BLM databases, which not only created a larger archaeological site database, but allowed me to analyze differences between the Columbia Plateau and Great Basin physiographic provinces. The study area covers nearly 85,000 km<sup>2</sup> although only 3,000 km<sup>2</sup> have been included in Bureau of Land Management projects that might lead to archaeological site discovery, making this analysis a 3.5% sample of the study region. The sample includes approximately 1% of the Western Pluvial Lakes Tradition region.



Early Holocene sites were classified based on the presence of diagnostic tools. While Bedwell noted that a particular kind of biface, which would now be described as a Haskett stemmed point, was typical of Western Pluvial Lakes Tradition assemblages, archaeologists have since included several diagnostic artifacts in discussions of regional early Holocene cultures. Most of these tools are dated to very broad time ranges, collectively spanning the period between about 13,000 to 7,000 years ago. Sites included in this database contain fluted points, Black Rock concave base points, Western Stemmed points (including Haskett, Windust and Parman types), crescents, and Cascade points.

## Archaeological Site Counts

| <b>Diagnostic Artifact Type</b> | <b>Vale Count</b> | <b>Burns Count</b> | <b>Study Area Count</b> |
|---------------------------------|-------------------|--------------------|-------------------------|
| Fluted                          | 2                 | 25                 | 27                      |
| Black Rock Concave              | 0                 | 14                 | 14                      |
| Stemmed (No further class)      | 8                 | 434                | 442                     |
| Haskett                         | 0                 | 6                  | 6                       |
| Parman (Total)                  | 12                | 68                 | 80                      |
| Parman                          | 4                 | 49                 | 53                      |
| Parman Square Stemmed           | 8                 | 19                 | 27                      |
| Stemmed (Total)                 | 20                | 510                | 530                     |
| Windust                         | 0                 | 2                  | 2                       |
| Crescent                        | 0                 | 119                | 119                     |
| Foliate                         | 5                 | 44                 | 49                      |
| Cascade                         | 3                 | 3                  | 6                       |
| <i>Total</i>                    | <i>30</i>         | <i>715</i>         | <i>745</i>              |

The final database contains 745 locations. Artifacts were either originally recorded as isolate finds or were surface finds located within site boundaries. As artifacts found on the surface of a site in the course of pedestrian survey are not necessarily contemporaneous, especially in deflated environments like Great Basin playas, each artifact was considered a separate event that contributes to the broader regional settlement pattern.

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The majority of these artifacts were discovered in the Burns district, which comprises the western half of the study area and is largely contained within the Western Pluvial Lakes Tradition region. Only 30 early Holocene artifacts were recorded during surveys in the Vale district. Given that cultural resource survey protocols are guided by state historic preservation standards, that resource management practices are similar across agency districts, and that survey coverage is not biased toward the Burns district as will be discussed in a minute, this statistic alone suggests early cultural differences between the Columbia Plateau and Great Basin regions.

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By including the Vale district we get a slightly better understanding of fluted point traditions in this region.

## Archaeological Site Counts

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Stemmed points (which include Haskett, Parman and other non-classified stemmed types) make up the largest portion of the Vale dataset, although the numbers pale in comparison to the number of artifacts found on the Burns district.

## Archaeological Site Counts

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Crescents are found only in the Burns district, while artifacts typically associated with the early Archaic

## Archaeological Site Counts

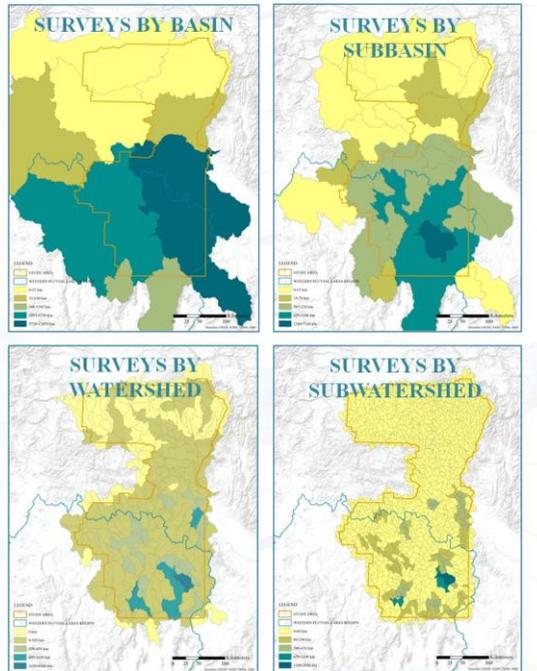
| Diagnostic Artifact Type   | Vale Count | Burns Count | Study Area Count |
|----------------------------|------------|-------------|------------------|
| Fluted                     | 2          | 25          | 27               |
| Black Rock Concave         | 0          | 14          | 14               |
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have a more even distribution between the two districts in the case of Cascade points, though foliate points are still skewed to the Great Basin.

While some differences were noted between the Columbia Plateau and Great Basin in this initial statistics summary, ultimately the goal of this project was to study spatial patterning regardless of preconceived theories of culture and environmental regions.

## Scales of Analysis

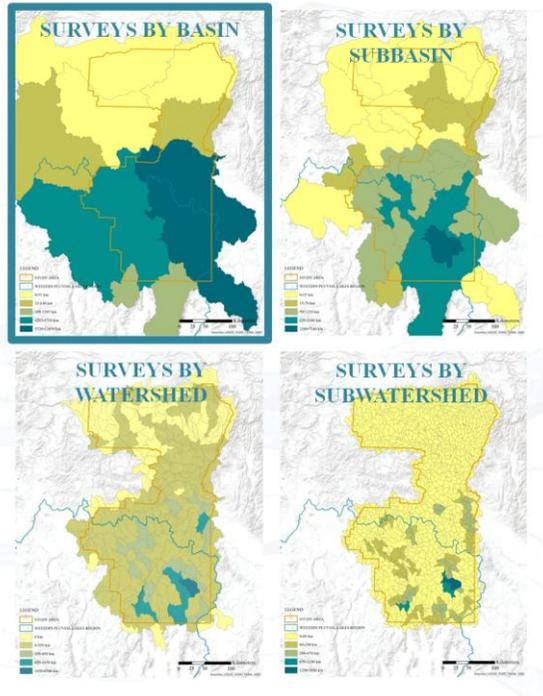
- Columbia Plateau
- Great Basin
- Western Pluvial  
Lakes Tradition
- Basin
- Subbasin
- Watershed
- Subwatershed



Hydrologic units were used to summarize the distribution of archaeological sites, surveys and environment features. Basins, subbasins, watersheds, and subwatersheds were all included in the analysis, but some of these levels were better at detecting patterning than others. I use archaeological survey coverage for my examples here. Studies of toolstone sources in the Great Basin have determined that forager territories may have ranged between 20-40,000 km<sup>2</sup>.

## Scales of Analysis

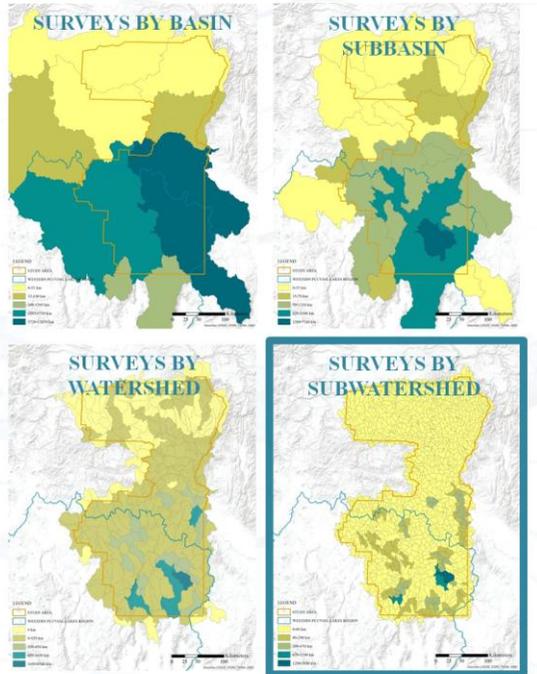
- Columbia Plateau
- Great Basin
- Western Pluvial  
Lakes Tradition
- **Basin**
- Subbasin
- Watershed
- Subwatershed



The basin hydrologic unit is representative of this range, and provides a scale that allows for general regional summaries consistent with what we know about long-term hunter-gatherer mobility in this region. Unfortunately, given the size of the study area, this grain size was not ideal for detecting statistically significant patterning.

## Scales of Analysis

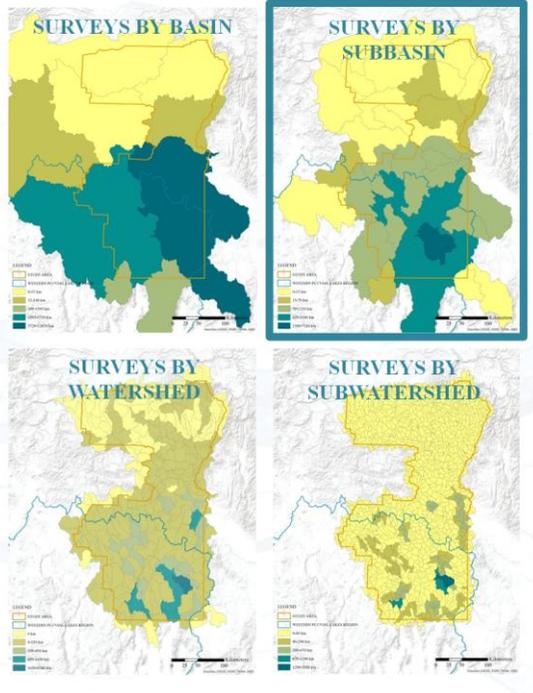
- Columbia Plateau
- Great Basin
- Western Pluvial  
Lakes Tradition
- Basin
- Subbasin
- Watershed
- **Subwatershed**



On the other end of the scale, using subwatersheds to summarize archaeological site patterns was also not very effective given the low density of some of these site types. Some clustering was detected among subwatersheds, but this scale would be better suited to a larger database or to more localized studies.

## Scales of Analysis

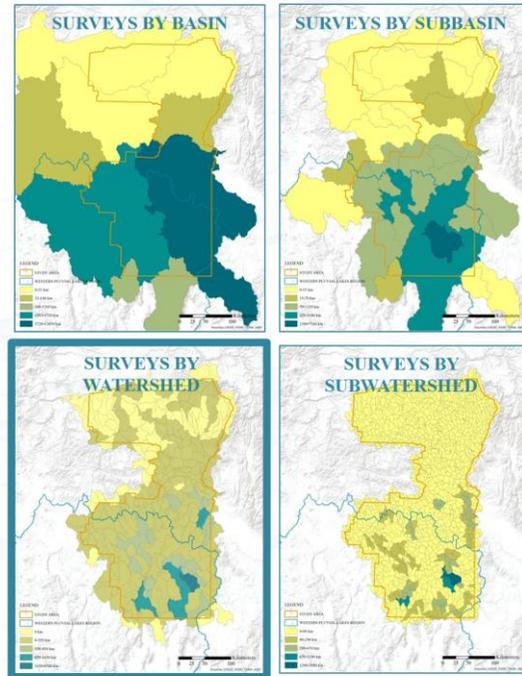
- Columbia Plateau
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Summaries of features on the subbasin level were much better for detecting clustering,

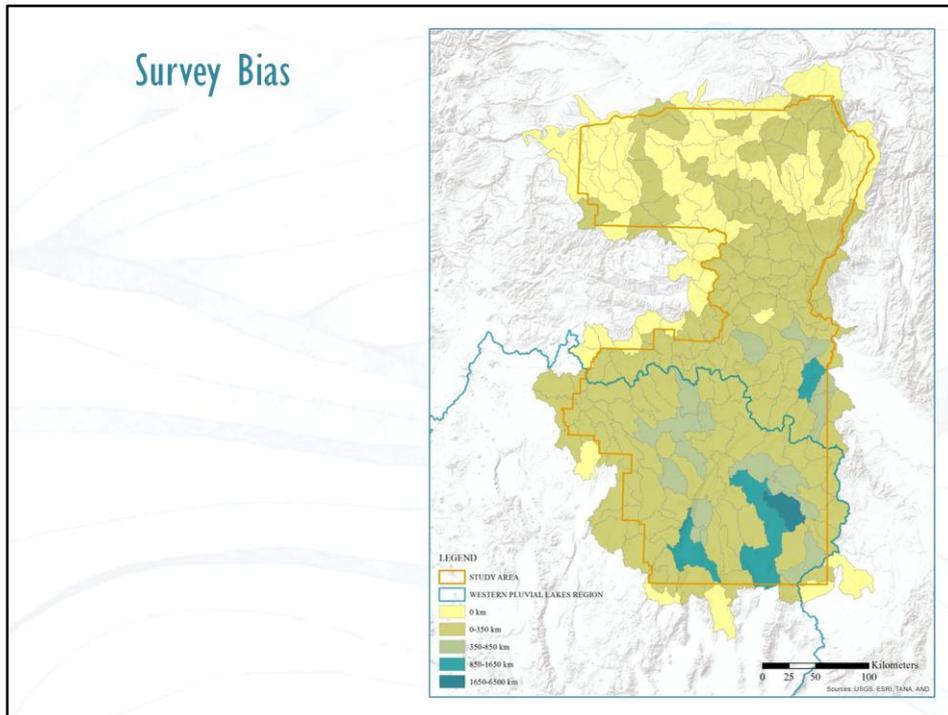
## Scales of Analysis

- Columbia Plateau
- Great Basin
- Western Pluvial
- Lakes Tradition
- Basin
- Subbasin
- **Watershed**
- Subwatershed

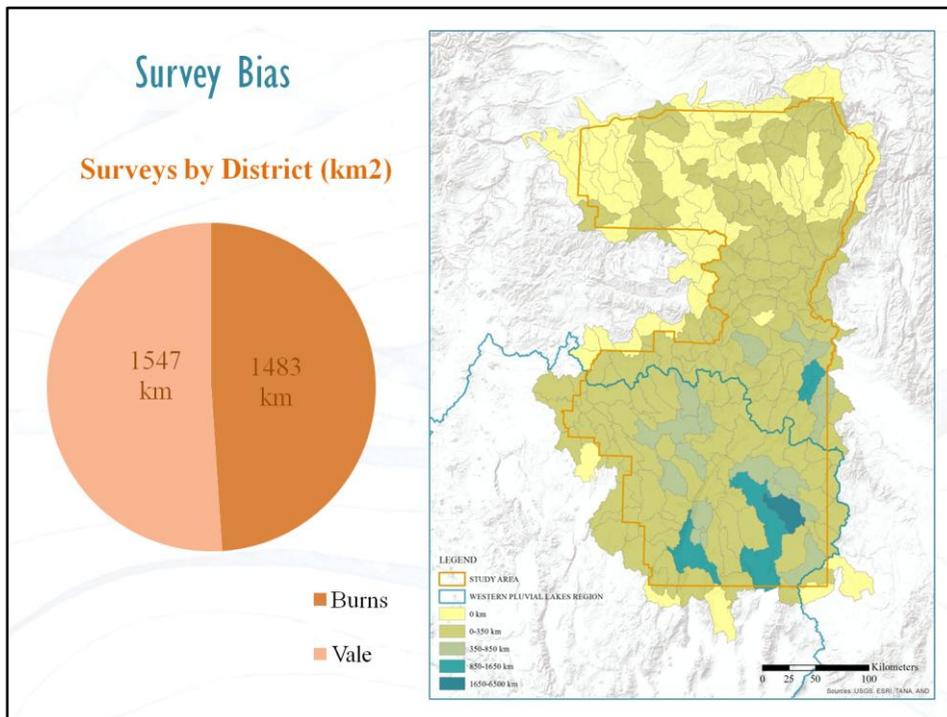


but watersheds were determined best for detecting statistically significant spatial patterning. In the United States we have a tradition of reporting early Holocene site locations at the state or county level, but as a side note I'd like to argue here that reporting sites by watershed location would be a much more effective way to communicate meaningful spatial information while still obscuring the precise location of a site.

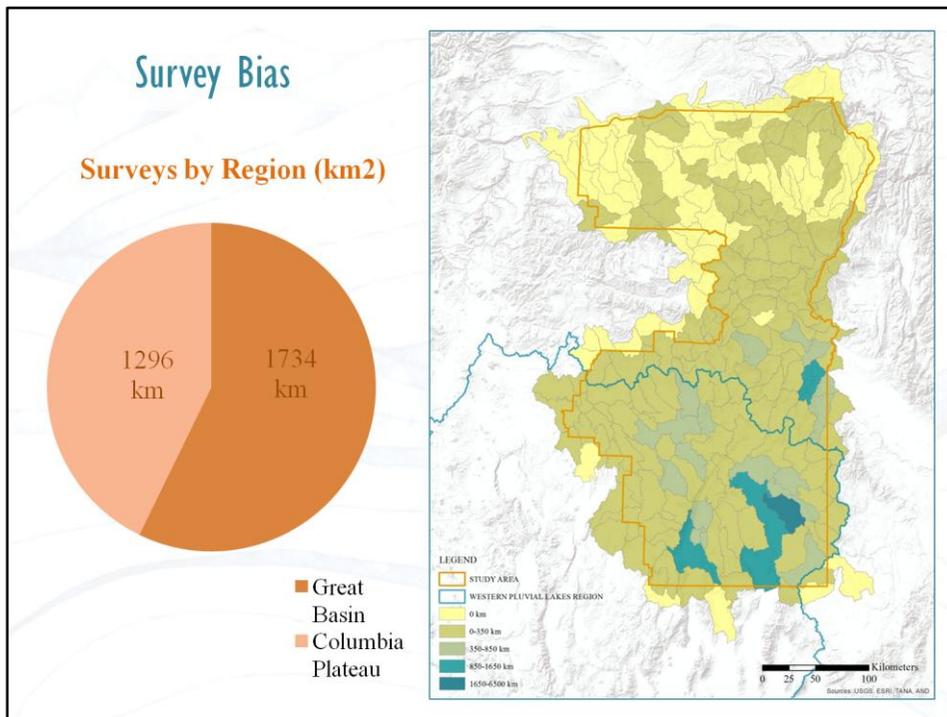
After maps of spatial distributions were created, spatial clustering was measured through Moran's I autocorrelation analyses. Moran's I analysis measures how similar features are to each other across space.



For instance, when the total survey coverage of a watershed is similar to that of adjacent watersheds, whether counts are high or low, survey coverage is considered clustered in that area. So in this example, survey coverage is clustered with low values in the north, while a greater percentage of watersheds are surveyed in the southern, dark blue areas.



The distribution of surveys was fairly even between the Burns and Vale districts. This is surprising given the huge difference in early site counts and immediately suggests culture region differences.

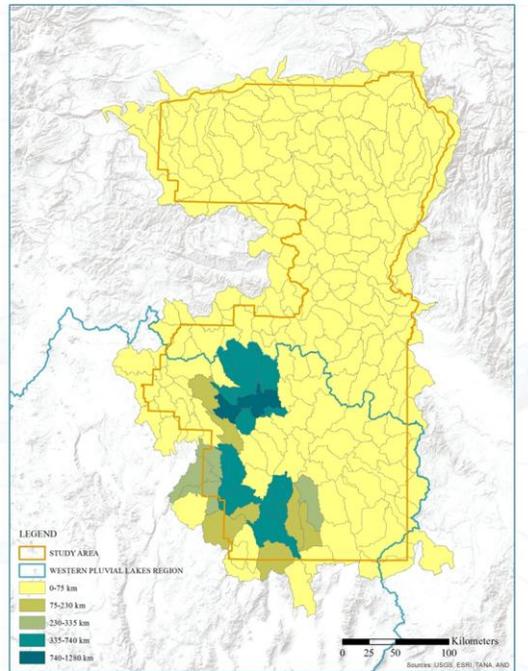


Surveys were slightly biased toward the Great Basin, with only 43% of surveys occurring in the Columbia Plateau. Spatial autocorrelation analysis determined that survey coverage was significantly clustered within a few watersheds in the Western Pluvial Lakes Tradition region, including the Malheur and Alvord Lake areas. So while survey coverage is fairly even regionally, some local bias seems to be occurring in pluvial lake areas.

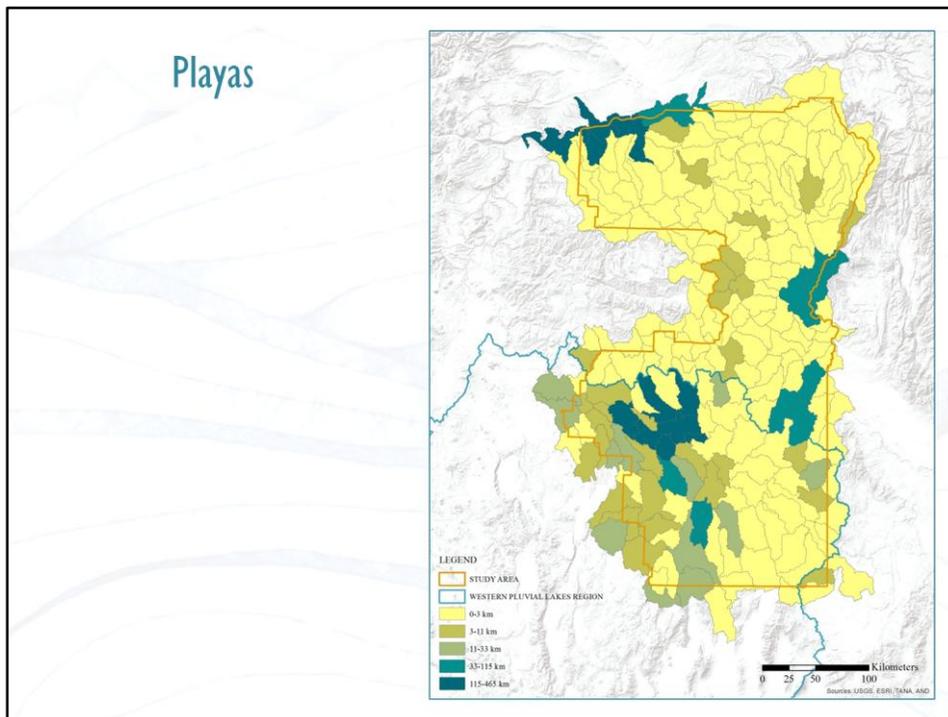
The extent of paleoenvironmental features and extant watered places was modeled to determine site and survey correlations.

## Pluvial Lakes

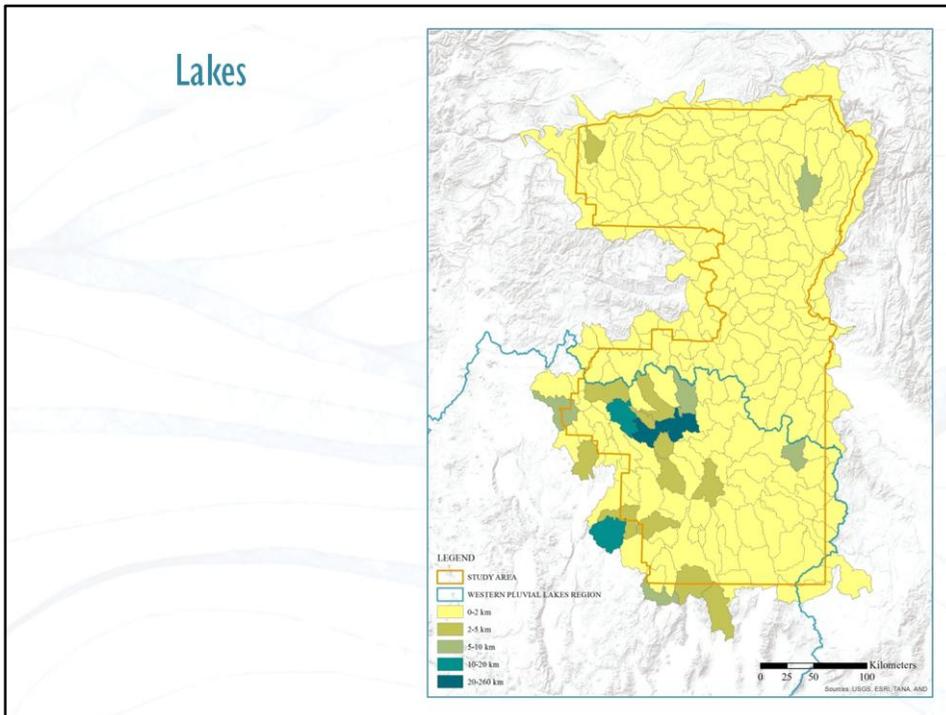
| Pluvial Lake | Cal yrs BP       | Elevation |
|--------------|------------------|-----------|
| Alvord       | 17,000-16,000    | 1280 m    |
| Catlow       | Late Pleistocene | 1400 m    |
| Coyote       | 17,000-16,000    | 1278 m    |
| Malheur      | 11,300-9,700     | 1255 m    |



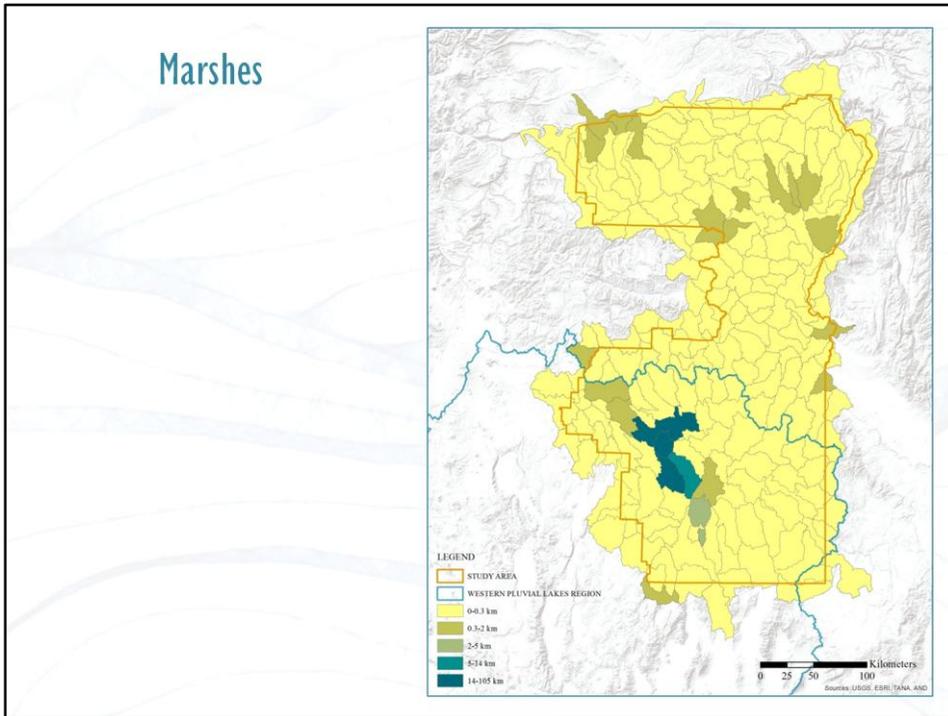
Pluvial lakes were modeled using the elevation of lakes Alvord, Catlow, Coyote, and Malheur at the end of the Pleistocene. In some instances these lake elevations overlap archaeological sites and thus likely over-represent the extent of pluvial lakes in the early Holocene. However, these pluvial lake models still serve as proxies for the wetland environment which would have fringed these large lakes as they fluctuated in the early Holocene. To get a better understanding of the distribution of lakes in general, data on extant lakes and playas was obtained from the Natural Resource Conservation Service Geospatial Data Gateway. The climate of this region has changed substantially since the late Pleistocene, but this data is considered a minimum representation of environmental features.



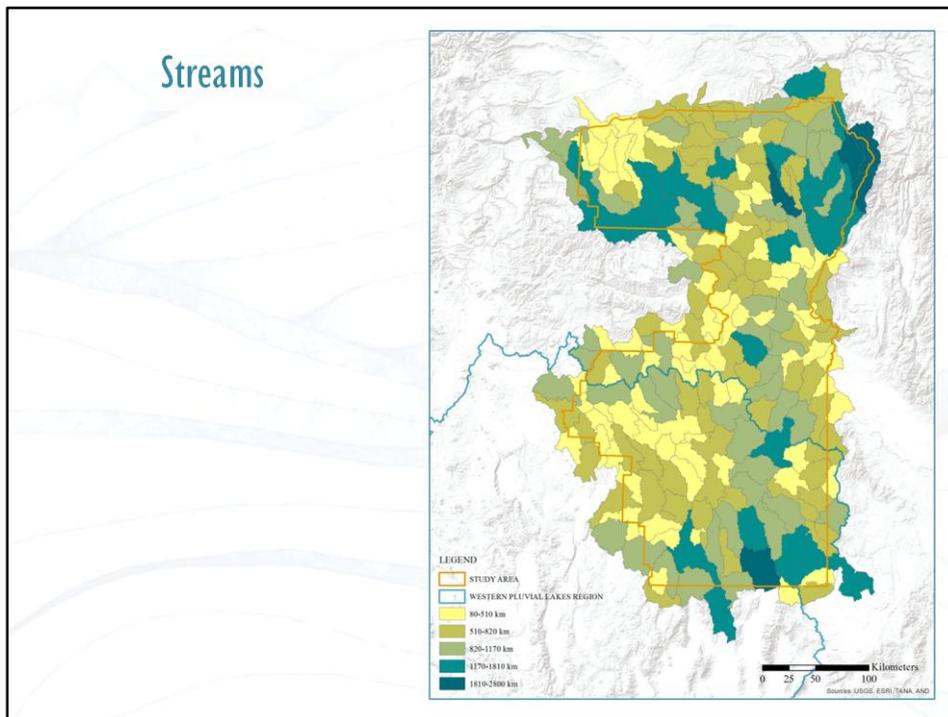
Playas were more dispersed throughout the region,



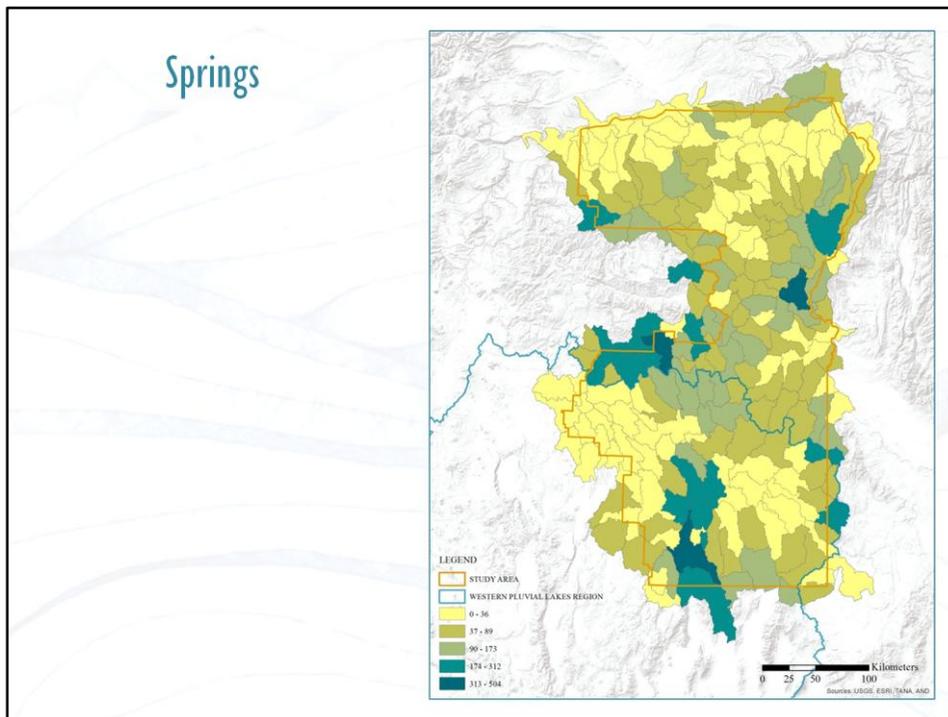
lakes cover less area and still more dispersed,



marshes cluster in a few areas but are mostly concentrated in the Lake Malheur area.

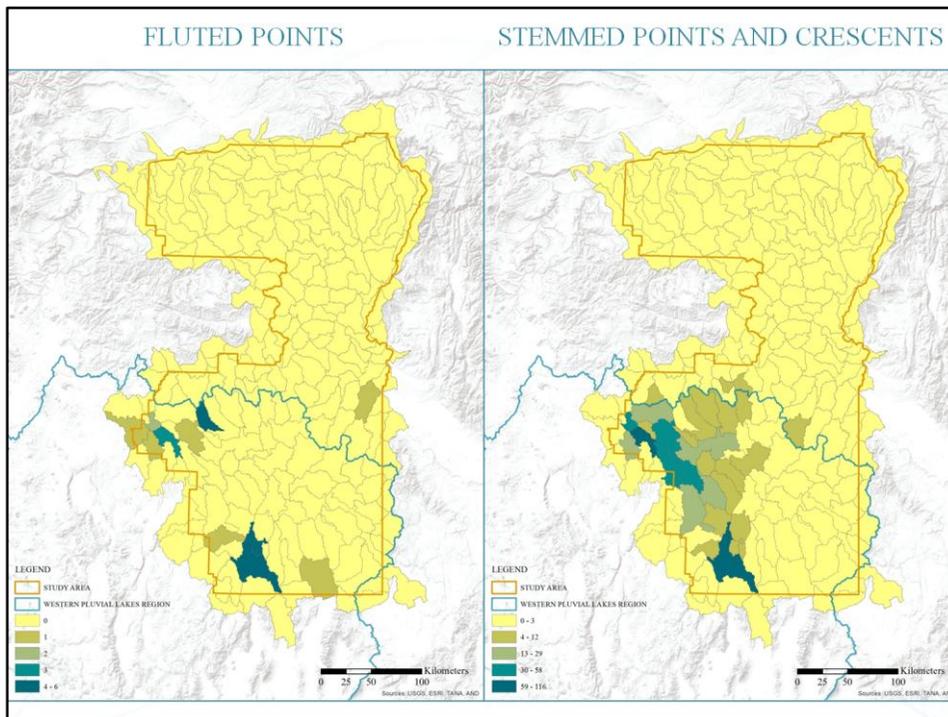


Streams are much more widely dispersed regionally with local clustering,



and springs also have some hot spots within the study area with a much wider coverage than pluvial lakes.

Spatial autocorrelation analysis of the archaeological data



found statistically significant clustering in all of the site categories, with the exception of Windust and Cascade sites which had small data sets that complicate pattern recognition.

Rather than run through all of the site types, here are just two examples that summarize the dominant trend, which is clustering in the pluvial Lake Malheur and Lake Alvord areas. This is the distribution of fluted sites, and sites containing any stemmed point type or crescent.

## Site-Environment Correlations

| Diagnostic Artifact        | Spring | Stream | Lake | Playa | Marsh | Pluvial |
|----------------------------|--------|--------|------|-------|-------|---------|
| Fluted                     |        |        |      | +     |       | ++      |
| Black Rock Concave         |        |        |      |       |       |         |
| Stemmed (No further class) |        | -      |      |       |       | +       |
| Haskett                    |        |        |      |       |       |         |
| Parman (Total)             |        | -      |      | ++    | ++    | +       |
| Parman                     |        | -      |      | ++    | ++    | +       |
| Parman Square Stemmed      |        | -      |      | +     | ++    |         |
| Stemmed (Total)            |        | -      | +    |       | +     | +       |
| Windust                    |        |        |      |       |       | +       |
| Crescent                   |        |        |      |       |       | ++      |
| Foliate                    |        | -      |      |       |       |         |
| Cascade                    |        |        |      |       |       |         |
| <i>All</i>                 |        | -      | +    |       | +     | ++      |

+ very weak positive correlation    ++ weak positive correlation

Regression analysis was used to study how the presence of environmental features in a watershed might predict the number of sites discovered there. Unfortunately, all correlations were fairly weak. Springs had no correlation. Streams had weakly negative correlations in most cases, which may be caused by a lack of survey in stream dense areas. Lakes also had very little or no correlation with site counts. Playas, marshes and pluvial lakes were in fact the best predictors of site density, as suggested by the Western Pluvial Lakes Tradition hypothesis. Although the correlation is still weak, pluvial lake areas were best at predicting the presence of early Holocene sites.

However, the rate of survey in a watershed was most strongly associated with pluvial lake coverage, which means that not only is there slightly more survey happening in the Great Basin, there is also more survey coverage and therefore more site discovery in pluvial lake basins.

In conclusion, spatial and regression statistics indicate when compared to other water features the percent of a watershed that was once covered by a pluvial lake is the best predictor of early Holocene sites in this region. It does appear that surveys are taking place at a greater rate in pluvial lake areas, and may be causing an overrepresentation of the association between early Holocene sites and pluvial lakes. Given that the regional survey bias is not great, and that these basins are large features of the Great Basin landscape, the validity of the Western Pluvial Lakes Tradition would be best served by expanding the study area to include larger areas of the Columbia Plateau and Great Basin.

## Contact

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Paper uploaded to Academia.edu

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  - 78<sup>th</sup> SAA organizers

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