**The History of Water and Vegetation in Bears Ears National Monument, Southeastern Utah**

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On December 28, 2016, President Barack Obama created the Bears Ears National Monument on 1.35 million acres in southeastern Utah, primarily to protect its world-class archaeological heritage. Bears Ears was the first national park or monument to be jointly managed by federal agencies (U.S. Forest Service and Bureau of Land Management) and a Native American agency (the Bears Ears Commission, which includes representatives from the Hopi Nation, Navajo Nation, Ute Mountain Ute Tribe, Ute Indian Tribe of the Uintah Ouray, and Zuni Tribe). Bears Ears is filled with the homes, granaries, kivas, tools, art and trash of the Ancestral Pueblo (formerly called Anasazi) people who abandoned the region by 1300 AD. On that basis, the preservation of Bears Ears is crucial to addressing one of the fundamental questions of archaeology: Why do people migrate? Climate change, especially drought, is often invoked as a cause, although actual changes in climate must be combined with consideration of resilience to climate change on behalf of both the culture and the ecosystem.

This project seeks to address the ecosystem response to climate change in the Bears Ears region. Specifically, this project seeks to address the following questions with regard to Bears National Monument:

1. What would mega-drought maps look like? That is, what water sources and vegetation would persist after droughts of various degrees and durations?
2. On the other hand, what would the hydrography and vegetation look like under increased precipitation or a change in the seasonality of precipitation?

The above questions were initially addressed by fieldwork in the summers of 2015 and 2017 by five UVU students, including Morgan Abbott, who collected water samples from 18 springs in Bears Ears National Monument. Analysis of stable isotopes showed that the source of all springs was local precipitation. These water samples are still being analyzed for concentrations of the anthropogenic gas CFC in order to determine groundwater residence times. Results on two springs thus far indicate groundwater residence times of 30 and 39 years, so that these springs could persist as viable water sources even after mega-droughts lasting for three decades. The objective of this project is to use the above and other published data to create hydrography and vegetation maps for Bears Ears National Monument for the six centuries (700 – 1300 AD) of occupation by the Ancestral Pueblos.

The objective will be addressed using the following steps:

1. Correlations will be sought among groundwater residence time, watershed area, elevation, and other factors in order to estimate the residence times for all of the unsampled springs.
2. Correlations will sought among the current vegetation, elevation, and the amount and seasonality of precipitation. If such correlations exist, they should be readily visible due to the strong vegetation and precipitation gradients that occur in the Bears Ears region.
3. Historical hydrography maps will be created based on the climatic record in the Four Corners area from dendroclimatology, the persistence of springs under drought conditions, and empirical data from various regions regarding the conditions under which streams transition between ephemeral and perennial.
4. Historical vegetation maps will be created based on the climatic record and the dependence of vegetation on climate and the existence of persistent water sources.