

Climate change and archaeology

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I'd like to start with an assumption, namely, that world-wide it seems that the United States is one of the only countries still arguing over whether climate change is happening or not. For the purposes of my talk, I am going to take the perspective of the rest of the planet—all available evidence indicates that climate change is happening, that it is changing progressively rapidly, and that the impacts, if left unchecked, will be catastrophic. My assumption in giving this paper is that we all understand and accept that this is taking place, and I am not going to spend any time in my presentation trying to convince anyone that climate change is real. It is real, the proof is over-whelming at this point, and scientific consensus is near-universal.

I'm going to begin the presentation here, looking at the small stuff at a coastal shell midden up north. This site has a large amount of cultural material on the surface—chert debitage and cores, faunal bone, several types of shellfish, ground stone, fire-cracked rock, and a whole host of formed tools. The problem is that none of these artifacts should be lying around on the surface.

They belong to archaeological site SMA-283, in San Mateo County, south of San Francisco. For thousands of years, the dune systems and archaeological sites here have been stable. It's an important site, it's been monitored for the past 30 years by Mark Hylkema, an archaeologist with the California Department of Parks and Recreation. Last summer, he brought me here to see recent damage to the site. In this slide, you can see that high waves have been reaching past the old high water mark and onto the site. The water is not just flowing onto the site, it is stripping it down to bedrock, taking all of the sand and finer materials with it and leaving the larger, heavier artifacts on the surface, essentially carving away all of the site stratigraphy.

SMA-283 is the “smoking gun” for climate change's impacts to archaeology in California Norte. Dunes that were once stable are now being blown out, because the wind patterns here have changed directions and are now coming in from the southwest. High tide and storm events, which previously were too low to reach the site, are now high enough and strong enough to reach it. Over the past decade, wave action has stripped the site down to bedrock, deflating the artifacts down to the rock surface and destroying the site stratigraphy. One of our oldest coastal shell middens, and next to it, one of the great centers for bead production, is almost destroyed. In a decade, if not less, SMA-238 will be gone save for a scattering of artifacts across the bedrock surface.

Why is this site getting destroyed like this? There are two main culprits here. The first is that there has been an increase in the number and severity of storms. As can be seen in this chart, the number of El Niño events has been steadily increasing. These storms are not only contributing high flood episodes, they are also changing the wind direction, blowing large sand dunes out throughout the park. The second is that sea level is rising, now, today, in a measurable and appreciable amount, as can be seen here in tide chart measurements taken from Fort Point, at the tip of San Francisco.

Elsewhere along the western edge of North America, the impacts of climate change have

been felt for some time. Recent storms have had a devastating effect on Native Alaskan villages. Ice sheets used to protect the coastline during seasonal storms, pushing the edge of the wave front far from shore. Now, storm surges reach the villages, destroying houses, infrastructure, and food storage cellars. Even as local authorities and tribal councils work to move villages to safer areas, these impacts serve as foreshadowing of events to come.

The Intergovernmental Panel on Climate Change (IPCC) started to release pieces of the Fifth Assessment report this fall. They are predicting anywhere between 0.5 and 1.2 m of sea level rise over the next century.

The U.S. Government released a graph last January that contains an important piece of information. The U.S. is looking at a worse-case scenario of a 2-m sea-level rise over the next century. What does a 2-m sea level rise look like? I'd like to take a look at three cities along the California coast, with images for 2-m sea level rise, plus storm surge from a large winter storm. San Francisco International Airport is one of the busiest trans-continental airports in the world. Much, if not most, of it will be underwater during winter storms by 2100. Santa Cruz is one of our most visited beach and vacation communities. The boardwalk here is one of our major attractions. At the rate climate change is progressing, it will be entirely inundated, along with much of the older part of downtown. Long Beach will probably be one of the hardest hit areas. In this one city alone we'll be looking at billions of dollars in damage. This is just a taste of things to come.

As part of their recent data release, the IPCC has made some rough projections as to what to expect by the year 2500. In their best case scenario, we're looking at a 0.5-m to 1-m sea level rise; in the worst case scenario, anywhere from a 2-m to 7-m sea level rise. I can't say how the latter would affect Mexico, but in California this would destroy most of our coastal cities and turn much of our Central Valley back to an inland sea, something that it hasn't been since the Cenozoic era some 40 million years ago.

Over the past two years, the Society for California Archaeology has been working on a survey of our coastline in preparation for climate change. We understand that our federal and state governments are likely going to be focused on protecting infrastructure and cities, not archaeological sites. Moreover, when it comes time to build levees and sea-walls, we expect that sites will be overlooked in favor of protecting property.

We have started in Marin County, and, so far, have surveyed about 40 mi. of coastline using entirely volunteer efforts. We will continue to chip away at it; we have some 1,600 miles to do. Much of it is already done, and much of it is on private land and won't be looked at. But we know climate change is going to happen, and that the impacts to archaeology will be devastating. If we start now, we might have at least an idea as to what we'll lose.

We're not the only ones. Scotland has also launched its own efforts to survey for sites along its coastline. They started a few years before we did and are going full steam ahead on it. They have some 3,000 mi. to look at, so we have no reason to complain here that it's too much. I mention all of this because, if INAH and the archaeologists here haven't started already, I encourage you to consider surveying your coastline. It's an impossible task, I know, but if anyone can understand the long-term impacts of climate change, it's us. It is archaeologists who, for the past century, have been looking into our species past to see how we adapted, or didn't, to climate change.

For example, consider a site my center has been looking at. This is SFR-175, located 2 m below the streets of San Francisco. It's a buried shell mound, and it's on the edge of one of the many marshes lining the San Francisco Bay. In its stratigraphy, the site is underlain with

inorganic sand dune, followed by the first occupation episodes at the site, starting around A.D. 300 and continuing onward to A.D. 880, at which point the site was abandoned. At the time of abandonment, the site had a well-developed A-horizon that indicates a stable landform suitable for human habitation. This timeframe of A.D. 880, though, marks the start of the Medieval Climatic Anomaly, or MCA, which had a profound impact on the bay area.

After A.D. 880, not only did the A Horizon cease to develop further, the site ceased to be a viable place to live. Inorganic sand dunes rolled back over the site—changes in climate resulted in a change in the landform, and in the suitability for human occupation. Of eight other nearby sites, all except one were abandoned at this same time, some 1,200 years ago at the onset of the MCA. This occurred all over the Bay Area.

Not only do the climate and landforms change, how people relate to each other changes, as does population health. Recent research by Al Schwitalla on nearly 7,000 sets of human remains in northern California show that, at the onset of the MCA, evidence for violence, disease, and famine sky rockets.

I bring all of this up because this was a pan-tribal event—regardless of the religion, the language, or where they were on the landscape, this occurred throughout the northern half of our state. It's important to note that, had you seen these cultures before climate change, you would never have expected them to become so violent, and so riddled with health and nutrition problems. And while we may not have that many hunter-gatherers in the world any more, most of our species still lives hand-to-mouth, depending on what the weather does.

I'd like to turn our attention to a much older and more dramatic climate shift, the one that took place towards the end of the Middle Holocene. For some time now, archaeologists in California have been noting the lack of sites over much of California dating to this time period, particularly in the Mojave Desert and in the Sonoran Desert. This phenomenon has regionally become known in the desert areas as the Middle Holocene Hiatus. It's particularly pronounced between 3000 and 2000 B.C. It coincides with a projected temperature increase of about 1.4°C, and it also coincides with extended periods of drought. This in turn resulted in the substantial degradation of the environment throughout much of California. At that same time, in the Mojave and Sonoran deserts themselves, the environmental conditions during this hiatus resulted in the complete abandonment of most sites there for a millennia.

I remember discussing this issue with Greg White, an archaeologist in northern California and an expert in the prehistoric archaeology of the region. I was asking him about a site near Clear Lake, in oak woodlands, that spanned the early Holocene up to historic contact, but noted that this Middle Holocene component seemed to be missing. He said that it was very likely that there was a small population still here along the lake's edge, but that the environment had changed so much that soil development ceased to occur. All the stratigraphy from this time is gone, as the organics leached out of the soil, and the artifacts eventually deflated down into the earlier Holocene levels and showed signs of severe erosion as a result of being exposed for so long. It wasn't until the climate changed again to something we would recognize as normal today that soil development resumed. Until then, for that time period, he noted that the Clear Lake Basin might have looked more like the Mojave.

That process of wide-spread environmental change is underway now. We're not just seeing sea level rise. We're seeing massive die-offs of forests. In New Mexico, the pinyon forests there are in rapid decline. In Alaska and Canada they've tracked the die off of over 600,000 acres of yellow cedar. In some places, this accounts for nearly half of all adult trees.

I mentioned above that the Middle Holocene Hiatus that led to the abandonment of sites

and environmental degradation was probably a temperature change of about 1.4°C. The 2007 IPCC report shows different temperature projections over the next century. For our region, the best case scenario – the scenario under which the governments and private corporations of the world unite in their efforts to aggressively combat climate change – we will be looking at a 1.5-3°C temperature change in our region. In the worst case scenario, if our governments and business sector do nothing, we’re looking at a 3-5°C temperature shift. The Middle Holocene Hiatus is upon us again; it is already under way.

I believe these archaeological data are something that we can contribute to the larger discussion of climate change, and are why we need to be participating in the preparations as our respective governments go forward. These data are in our archaeological sites; they’re information we should be looking for.

When I was at the “Balances” meeting last year, I asked some of the presenters working in Baja California whether they had seen a similar pattern: an abandonment of sites during the MCA. They said that their sites were continuously occupied, that there was no break. This is a huge difference between the sites in the north and those of the south, and it makes me ask, “What’s different? Why did people here in the south fare better than those in the north?” I also would want to know more about how the indigenous peoples of Mexico fared during the Middle Holocene. I believe that the time has come for us to engage in policy discussions in addition to our own academic conversations. In addition, the differences between our two regions may hold some clues as to how our two nations go forward over the next century.