

# Extrapolating Climate Change Data for Cultural Landscapes

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## Climate change

Climate change, for the purposes of this paper, refers to a “significant change in the measures of climate lasting for an extended period (decades or longer) ... measured by indicators such as temperature, precipitation, wind, etc.” (EPA 2010, 1). Scientific evidence indicates that climate change is a natural ongoing process. However, recent scholarship indicates that climate change is not always slow and systematic, but can also be abrupt leaving little time for civilization(s) to react. Paleo-climate study, benefiting from technological advancement, shows that climate change has occurred within a ten-year period, with global effects persisting over centuries (NAS 2002).

Adaptation to climate change is evident through the archeological record, and through paleo-environmental research where links between abrupt climate change and distinct cultural transitions or periods have been identified. The Paleo-Indian, Archaic, and Woodland periods and period subdivisions are defined by “technology, settlement patterns, and artistic traditions” and “change of material culture” (Munoz, Gajewski, and Peros 2010, 22009). These transitions have been found to correspond to a “major transition in the climate and vegetation of the region” (ibid.). The relationship between climate change and cultural transitions has been interpreted as native populations adapting to shifts in ecosystems resulting in cultural changes in areas such as “resource procurement strategy, technology, and/or population size” (ibid.). Essentially, “the ecosystems from which prehistoric humans subsisted changed periodically in response to new climatic regimes, and as a result humans adjusted their toolkits accordingly by developing or adopting new or existing technologies” (ibid., 22011).

This poster is not to debate climate change—natural or human-induced/accelerated. This display simply acknowledges that changes in climatic patterns have been and continue to be observed and explores how to utilize climate change science in a transitive way that would allow for better understanding of the effects of climate change on cultural landscapes. Identifying the potential range of climate change effects on cultural landscapes provides valuable information for “what if” scenario planning models that ultimately assist resource managers with adaptive treatment strategies that preserve cultural landscape resources for the “enjoyment, education, and inspiration of this and future generations” (www.nps.gov/aboutus/mission.htm).

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## Cultural landscapes

“A cultural landscape is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibit other cultural or aesthetic values. There are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes” (Page, Gilbert, and Dolan 1998, 12). A landscape listed on the National Register of Historic Places meets National Register criteria, and has significance and historic integrity. Characteristics and features that convey evidence of human manipulation and adaptation to an environment define cultural landscape integrity.

A landscape has historic integrity to an identified period of significance if it has most or all of the seven aspects that define integrity—location, design, setting, materials, workmanship, feeling, and association. There are several recognized characteristics and features of cultural landscapes as outlined in the *Cultural Landscapes Inventory Professional Procedures Guide* (Page 2009). These characteristics and features were adapted from several National Register Bulletins, including *Bulletin 30, Guidelines for Evaluating and Documenting Rural Historic Landscapes*. Several features are resource types in and of themselves, while others are combinations of human made and natural features:

- Archeological sites
- Buildings and structures
- Circulation
- Cluster arrangement
- Constructed water features
- Cultural traditions
- Land use
- Natural systems and features
- Small-scale features
- Spatial organization
- Topography
- Vegetation
- Views and vistas

While all of these characteristics and features can be affected by changes in climate, some may be more vulnerable affecting the integrity of the landscape as a resource. “The relationships between landscape characteristics and the seven aspects of integrity are complex. Patterns of spatial organization, circulation networks, and clusters directly relate to integrity of design and strongly influence the cohesiveness of a landscape. Boundary demarcations, small-scale elements, vegetation, and the evidence of responses to natural systems and features all add to location and setting. Continuing or compatible land uses and activities enhance integrity of feeling and association. Buildings and structures, vegetation, small-scale features, and land uses all reflect materials, workmanship, and design. Archeological sites may strengthen integrity by providing physical evidence of activities no longer practiced” (Page 2009, 7-2). The best way to preserve a cultural landscape as a resource is to protect the relationship of the components that convey integrity.

The issue with a manipulated environment is deterioration, aging, and/or weathering begins from the moment they are built or installed. Even under the most controlled conditions, nothing has proven to last forever. In respect to historic sites, the accepted pattern of deterioration and maintenance can become a challenge in terms of timing as well as availability and suitability of in-kind materials. With so many cultural landscape characteristics and features overlapping with natural resources, one of the most detrimental effects of changes in climate to cultural landscapes

Indicator/Trend	Climate Change Science Observations	Potential Changes to Cultural Landscapes
<b>Temperature &amp; Heat Waves</b> – increasing & more frequent	Vegetation & growing season Evaporation rates Precipitation/snowfall Drought Water Temperature Water Level Animal Behavior	<b>Vegetation</b> – Species stress & mortality from excess heat, moisture, disease, & pests <b>Constructed water features</b> – Water shortage or excess <b>Buildings/structures</b> – Material deterioration, stressed structural & mechanical systems <b>Cultural Traditions</b> – Practices and events may shift seasons or cease <b>Land Use</b> – Changes due to drought, excess precipitation, & altered growing season <b>Natural Systems/features</b> – Unbalanced ecological systems impact human response <b>Archeological Sites</b> – Above ground accelerated deterioration, subsurface shifting
<b>Precipitation &amp; Heavy Precipitation Storms</b> – increasing & more frequent	Vegetation/growing season Water Erosion Water Level/flooding Water Quality Animal Behavior Snowfall	<b>Vegetation</b> -Species stress & mortality from moisture, disease, pests, storm damage <b>Constructed water features</b> – Excess water <b>Buildings/structures</b> -Material deterioration, damage; structural & mechanical system stress <b>Cultural Traditions</b> -Practices and events may shift seasons or cease <b>Land Use</b> - Changes due to drought, excess precipitation, & altered growing season <b>Natural Systems/features</b> -Unbalanced ecological systems impact human response <b>Topography</b> – Erosion, landslide, slumping <b>Circulation</b> – Patterns may change due to flooding, perpetual wet areas <b>Archeological Sites</b> – Above ground accelerated deterioration, subsurface shifting, exposure
<b>Ocean Heat &amp; Sea Surface Temperature</b> - Increasing	Evaporation Ecosystems Water Erosion Water Level/flooding Animal Behavior Snowfall Weather patterns Ocean Currents	<b>Vegetation</b> -Species stress & mortality from temperature changes and weather patterns <b>Buildings/structures</b> -Material deterioration, damage; structural & mechanical system stress <b>Cultural Traditions</b> -Changes due to temperature, altered seasonal activity & animal behavior <b>Land Use</b> - Changes due to drought, excess precipitation, & altered growing season <b>Natural Systems/features</b> -Unbalanced ecological systems impact human response <b>Topography</b> – Change in relative Sea Level, land mass sink/rise <b>Archeological Sites</b> – Above ground accelerated deterioration, subsurface shifting, exposure
<b>Sea Level</b> – Increasing	Ecosystems Water Erosion Flooding Animal Behavior Topography	<b>Vegetation</b> -Species stress & mortality excess water, tidal erosion, water salinity <b>Buildings/structures</b> –Material damage; structural & mechanical system stress/failure <b>Cluster/Spatial Patterns</b> - Relationships of infrastructure change <b>Cultural Traditions</b> -Changes due to temperature, altered seasonal activity & animal behavior <b>Land Use</b> – Decreased land for infrastructure, land composition and elevation levels shift <b>Natural Systems/features</b> -Unbalanced ecological systems impact human response <b>Topography</b> - Change in relative sea Level, land mass sink/rise <b>Archeological Sites</b> – Above ground feature inundation
<b>Arctic Sea Ice &amp; Lake Ice</b> - Decreasing	Temperatures Sea Level Currents Storm Exposure Ecosystems Animal Behavior Climate Stability	<b>Vegetation</b> -Species stress & mortality due to temperature and composition changes <b>Buildings/structures</b> -Material damage; structural & mechanical system stress/failure <b>Cluster/Spatial Patterns</b> - Relationships of infrastructure change <b>Cultural Traditions</b> -Changes due to temperature, altered seasonal activity & animal behavior <b>Land Use</b> –Infrastructure instability, land composition and elevation levels shift <b>Natural Systems/features</b> -Unbalanced ecological systems impact human response <b>Topography</b> -Change in relative sea Level, land mass sink/rise <b>Archeological Sites</b> - Above ground inundation, subsurface shifting, exposure
<b>Plant Hardiness</b> – Zones Shifting North	Vegetation/growing season Animal Behavior Human Behavior Ecosystems	<b>Vegetation</b> -Species stress & mortality due to increased composition changes <b>Cultural Traditions</b> -Changes due to plant availability, altered seasonal or ceased activity <b>Land Use</b> – Changes in growing season, crop yields and responses to tradition methods <b>Natural Systems/features</b> – Ecological shifts in relationships of systems <b>Archeological Sites</b> – Cover vegetation species may not grow or too much in specific areas
<b>Length of Growing Season &amp; Leaf &amp; Bloom Dates</b> – Longer & Earlier	Vegetation/growing season Animal Behavior Human Behavior Ecosystems	<b>Vegetation</b> -Species stress & mortality due to increased composition changes <b>Cultural Traditions</b> -Changes due to plant availability, altered seasonal or ceased activity <b>Land Use</b> – Changes in growing season, crop yields and responses to tradition methods <b>Natural Systems/features</b> – Ecological shifts in relationships of systems <b>Archeological Sites</b> - Cover vegetation species may not grow or too much in specific areas
<b>Animal Behavior</b> – Shifting Northward and Inland	Habitat selection Mortality Migration Breeding Symbiotic relationships	<b>Vegetation</b> -Species stress & mortality due to increased animal demand for food, habitat <b>Buildings/structures</b> – Pest and nuisance animal behavior towards infrastructure <b>Cultural Traditions</b> -Changes due to animal availability, altered seasonal or ceased activity <b>Land Use</b> – Changes in hunting seasons and typical human animal relationships <b>Natural Systems/features</b> – Ecological shifts in relationships of systems <b>Archeological Sites</b> – Exposure/shifts due to animal behaviors such as digging & burrowing

**Table 1.** Climate change indicator/trend in relationship to climate change science observations which, through extrapolation, will result in potential changes to cultural landscapes.

could be a shift in environmental context and the difficulties in perpetuating it in a way that preserves integrity.

### **Climate change indicators**

Understanding that climatic patterns change naturally and abruptly with persistent and, at times, global effects, presents an opportunity for society to be proactive in indentifying vulnerabilities and adaptation strategies that will save time, money, and resources. In their report, *Climate Change Indicators in the United States*, the Environmental Protection Agency outlines 24 out of a set of 110 potential climate change indicators. While all indicators are related in the overall affect on climate, some have more direct effects than others on cultural landscapes. Of the 24 in the report, this display looks at a smaller subset (Table 1, above) that in general have the potential to directly impact cultural landscapes in the United States.

### **Extrapolating and planning**

Climate change science currently focuses primarily on natural resources. Cultural landscapes contain characteristics and features both natural and human-made that react to changes in climate which in turn affects historic integrity. Climate change trends and data can be extrapolated to identify potential vulnerabilities to cultural landscape characteristics and features. With vulnerabilities identified, adaptation strategies can be developed to provide the tools managers need to plan for plausible climate scenarios that may present themselves incrementally or abruptly in the future. Understanding the impacts of climate change on cultural landscapes not only forces a shift of preservation philosophy, but also technique which may include several possibilities and options including innovation, managed retreat, and/or documentation and release.

### **Conclusion**

Cultural landscapes convey human adaptation to an environment. Extrapolating data and using scenario-planning methods from the NPS Climate Change Response Program will help identify vulnerabilities and adaptation strategies. This approach reaches beyond preservation, restoration, and rehabilitation towards a balanced resource management model. A balanced approach will assist managers in mitigating impacts and adapting to change while honoring the National Park Service mission.

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