



# Wilderness and Climate Change

## *Redefining Untrammeled?*



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# 20,000 years ago

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- The parched salt flats of today's Death Valley Wilderness were drowned under a 600-foot-deep lake.
- The Yosemite Wilderness's stately forests, lush meadows, and high mountain lakes were buried under hundreds of feet of ice.



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# What a difference a few degrees can make!

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- Pleistocene-to-the-present global warming of about 4° to 7°C
- Current projections indicate that a further 4° to 6°C global warming could be reached by as early as 2100
- In the coming decades wilderness will face its greatest stewardship challenge yet, in the form of profound climatic and other global changes



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# Climate change and a wilderness experience quite unlike today

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- ❑ Glaciers and snowfields will continue their retreat
- ❑ Some perennial streams will become ephemeral, losing fish and other native biota
- ❑ Fire seasons will lengthen and fires will become more severe
- ❑ Floods and droughts will intensify and become more frequent



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# A wilderness experience quite unlike today

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- Forest stand die-offs—from insects, disease, insufficient water, or excessive heat—will accelerate
- Native vegetation and wildlife will be replaced by invasives better adapted to warmer temperature and catastrophic disturbance



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# The Future

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- Western wildernesses may offer the best opportunities for conserving native biodiversity because they tend to be large intact ecosystems with fewer anthropogenic stressors
- Intentional manipulation of forest stand structure, hydrologic manipulation of watersheds, and control of invasive species will be required to improve ecosystem resilience and resistance to climate change



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# Wilderness, climate change and water

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- The headwaters of large, economically important watersheds are frequently found at the top of mountains in wilderness
- The need for better understanding of climate at a fine scale, and hydrologic systems in particular will increase pressure to install more water-measuring devices in wilderness



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# Wilderness, climate change and water

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- When climate change begins to impose substantial hardships on society, as when water storage from mountain snowpack has been substantially lost, we can expect renewed calls for water storage and diversion projects. Some of these inevitably will involve western mountain wildernesses.



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# Climate change: Wilderness's greatest challenge

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□ In the Wilderness Act, wilderness is “recognized as an area where the earth and its community of life are untrammeled by man ... retaining its primeval character and influence ... and managed so as to preserve its natural conditions and which ... generally appears to have been affected primarily by the forces of nature”



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# Evolving understanding of ecology

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- The Wilderness Act of 1964 was written in a time when nature was thought to be static, or at least changing at the pace of millennia.
- In living systems however, “primeval” just does not happen.



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# Nostalgia for a more primitive and stable world

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- By the 1980s, ecologists had come to realize that while ecosystems trend toward homeostasis in the absence of disruptive forces, those forces—fire, flood, drought, disease outbreaks—impinge periodically, if not frequently, on most ecosystems.



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# The Wilderness Act in the era of rapid climatic changes

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- The careful choice of “untrammeled” was underlain by a critical assumption: that for generations to come Earth’s environment would be inherently stable within its historically observed bounds of variation
- The dominant thinking of that era had not yet awakened to the onset of rapid, human-induced, boundary-transcending global changes.



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# The Wilderness Act in the era of rapid climatic changes

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- If untrammeled was meant to refer to an absence of intentional human influences, what are we to make of pervasive *unintentional* human influences, like anthropogenic climatic change that precipitates events far departed from historical variability?



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# Untrammelled? Scenarios

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- *With rising temperatures and earlier snowmelt, a forested wilderness experiences a massive crown fire well outside of the range of historical fire behavior. Most of the local seed sources are killed, and subsequent rains cause extensive erosion. Rising temperatures and soil loss preclude the reestablishment of continuous forest cover, and the wilderness is colonized by shrubs and an array of nonnative invasive grasses and forbs adapted to disturbed sites.*



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# Untrammeled? Scenarios

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- *If, in an alternative scenario, wilderness managers had intentionally thinned the forest, enabling it to survive the fire relatively intact, would the resulting forest have less wilderness character than the eroded shrubland of the first scenario?*



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# Untrammeled does not equal historic conditions anymore

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- At the time of the act's passage it would have been normal to assume that a protected (untrammeled) landscape would preserve the historic characteristics of a landscape. We now know this assumption is false, and we must explicitly consider the relationship between untrammeled quality and historical fidelity.



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# Untrammeled does not equal historic conditions anymore

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- Trade-offs between these two strongly defining characteristics of wilderness—untrammeled quality and historical fidelity (primeval and natural character)—will be inevitable.
- Climatic and other global changes will increasingly act to erode historical fidelity.



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# Reasons to intervene in wilderness will increase

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- With rapidly accelerating global changes, efforts to maintain critical and sometimes legally protected aspects of historic wilderness character—such as native biodiversity and key ecosystem functions like hydrologic regulation—will require increasing management intervention (trammeling).



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# Potential management actions in response to rapid climatic changes

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- Will vary widely among wilderness areas, and in many cases will need to be founded on careful, site-specific thought and research
- Consider a spectrum of possible management actions
  - ▣ Restraint
  - ▣ Resilience
  - ▣ Resistance
  - ▣ Realignment



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# Restraint (leave some places alone)

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- Maintain wilderness as a baseline for understanding unmanaged climate impacts
- Prioritize strategic, small scale treatments that have a high probability of achieving desired results focused on resources of particularly high value and vulnerability (such as a popular grove of giant sequoias or an endangered species).



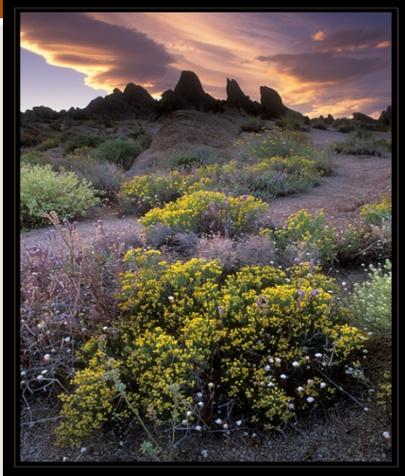
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# Restraint

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- When managers might have the ability to affect every part of a wilderness landscape, strong consideration should be given to restraint—selecting certain areas in which no interventions will occur



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# Resilience - enhance ecosystem resilience

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- Resilience is an ecosystem's ability to absorb a stress without flipping into an entirely new state, such as from forest to eroded shrubland
- Of all possible near-term actions wilderness stewards can take, maintaining or increasing resilience is one of the most important



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# Resilience

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- Resilience is a means of buying time to assess the policy and management implications of climatic changes for wilderness, and develop and test possible long-term adaptive responses
- Actions that maintain or increase resilience might include, for example, strategically controlling selected nonnative invasive species and thinning forests



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# Resistance (resist changes)

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- Resistance includes properties of an ecosystem itself, and management actions designed to resist change and can provide a critical means of buying time
- Examples include intensive actions taken to protect an endangered species, such as creating fuel breaks to diminish the probability of severe wildfire, controlling a tree-killing beetle outbreak, or keeping an endangered plant population healthy by drip irrigation.



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# Realignment - facilitate changes

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- In the long term, maintenance of native biodiversity and key ecosystem functions into the future may be most successful if wilderness stewards actively facilitate change



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# Realignment

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## □ Examples

- ▣ If a species is unable to migrate fast enough to keep up with geographic shifts in suitable habitat, physically moving the species—assisted migration—might be appropriate, especially if the alternative is losing the species entirely



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# Realignment

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## □ Examples

- Following a major disturbance, it may be appropriate to plant an area with species better adapted to warmer conditions
- Adaptive potential of some species might be increased by purposefully mixing genotypes from other regions
- All actions demand deep forethought and extreme caution, and depending on site-specific context might be rejected as undesirable.



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# Conclusions

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- Accelerating global climate change will confront wilderness stewards with trade-offs that were not anticipated by the act's authors—trade-offs that will be accompanied by increasing impetus for management intervention in wilderness



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# Conclusions

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- Wilderness stewards must determine how best to respond to this greatest of challenges. It's time to begin that discussion, strategize, and develop policies and protocols.



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# ?Questions?

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