Combining geospatial vulnerability assessment and scenario planning for climate adaptation: a fire management example

National Park Service
US Department of Interior

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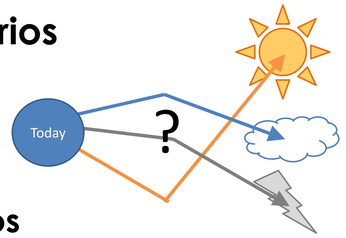
Purpose - Develop knowledge, process, and tools to answer: ***How should fire management in the Southern Sierra Nevada adapt to rapid change and uncertain future conditions?***

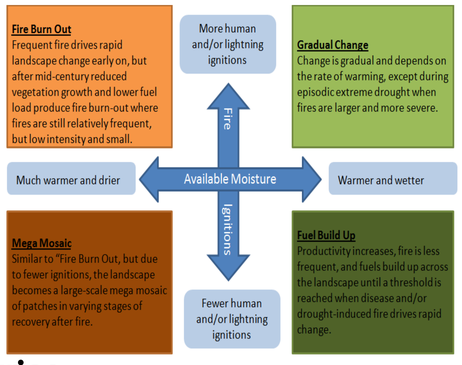
Alternative Future Scenarios

Scenarios are stories of the future that help us recognize and adapt to changing aspects of our current environment (Peterson et al. 2003)



Physical-biological scenarios

We considered 14 variables that are uncertain, yet important system drivers. We selected 2 (available moisture & frequency of fire ignitions) to construct 4 scenarios. Scenarios were described for 3 elevation zones.

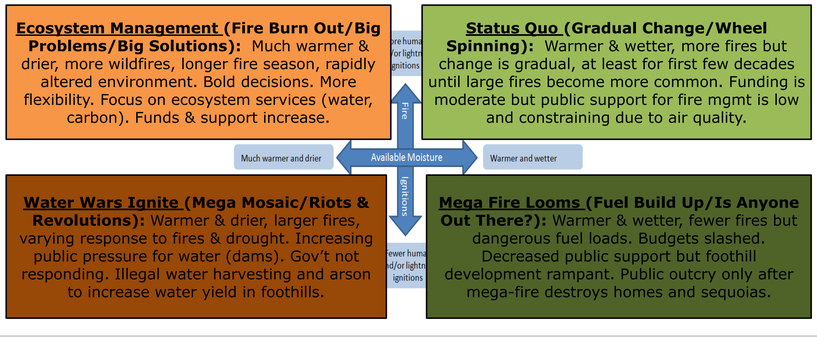


Socio-political scenarios

We integrated socio-political scenarios (developed by Global Business Network & NPS) with our physical-biological scenarios.

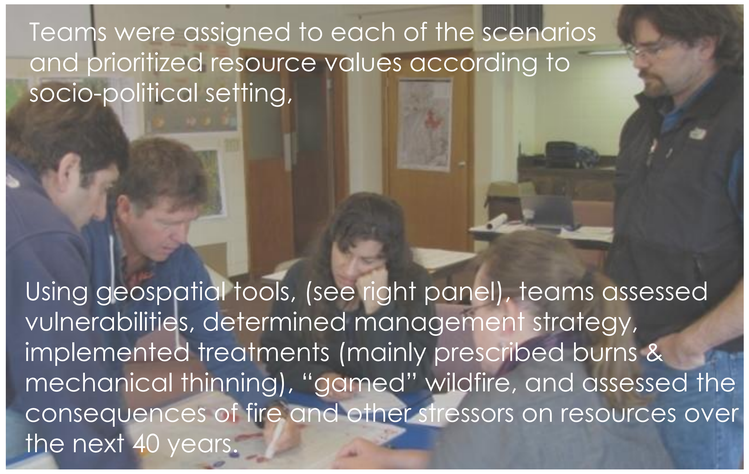
Scenario names	Leader-ship	Societal concern
Big problems/big solutions	+	+
Riots & revolutions	-	+
Wheel-spinning	+	-
Is anyone out there?	-	-

Integrated scenarios



Literature Cited: Glick et al. 2011. *Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment.* National Wildlife Federation; Flint & Flint. 2012. Downscaling future climate scenarios to fine scales for hydrologic and ecological modeling and analysis. *Ecological Processes* 1:1-15; Peterson et al 2003. Scenario planning: a tool for conservation in a n uncertain world. *Conservation Biology* 17:358-366.

Scenario Mapping Exercise



Teams were assigned to each of the scenarios and prioritized resource values according to socio-political setting,

Using geospatial tools, (see right panel), teams assessed vulnerabilities, determined management strategy, implemented treatments (mainly prescribed burns & mechanical thinning), "gamed" wildfire, and assessed the consequences of fire and other stressors on resources over the next 40 years.

Exercise Outcomes

Persistent Values
- Infrastructure & giant sequoia were most valued & targeted for protection.
- Still, loss of some infrastructure & giant sequoia were inevitable in all scenarios.

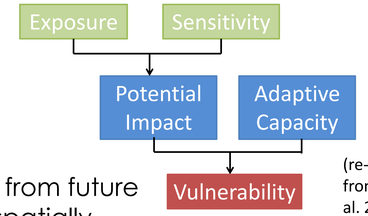
Changing Values
- Water delivery & carbon storage are ecosystem services not mandated for NPS today, but their societal value skyrocketed in 2 scenarios and were mandated in one.
- How should we prepare for this possibility?

Hard Choices
- Biodiversity and wildlife habitat consistently were valued below sequoia & infrastructure. Treatment allotments were not adequate to target them for protection.
- What trade-offs will we accept? What are the consequences?

Next Steps: We will model & "game" consequences of different management approaches across scenarios.

- Retain current mission: restore/maintain natural fire regime to the extent possible.
- Fortress: protect giant sequoia & development above all else.
- Create heterogeneous landscape for biodiversity.
- Protect landscape facets: geology, soils, aspect.
- Protect future climate refugia (low climate stress)
- Strategically place buffer treatments instead of directly protecting values.

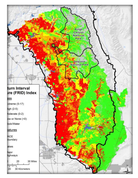
Geospatial Tools: Vulnerability Assessment



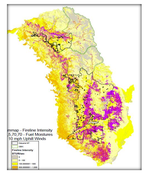
(re-drawn from Glick et al. 2011)

How do the potential impacts from future climate-fire interactions vary spatially across the landscape?

Current Conditions (sensitivity)



Fire Return Interval Departure (FRID) indicates the extent to which an area has departed from its pre-Euroamerican fire return interval. Areas with low FRID are considered less sensitive to other stressors.



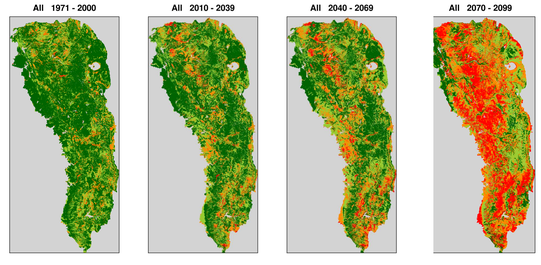
FlamMap is a fire behavior mapping program that computes potential fire behavior over an entire landscape (www.fire.org) We input "worst case" weather and moisture conditions to identify areas sensitive to catastrophic fire behavior.

Future Climate Stress (exposure)

We projected vegetation climate stress by comparing climate space currently occupied by a vegetation type to its projected future climate space. We used PCM and GFDL (shown) down-scaled models (Flint & Flint 2012) to characterize warmer/wetter and much warmer/drier futures (similar to scenarios x-axis).

- Central (<66%)
- Marginal (67-90%)
- Highly marginal (90-99%)
- Outside (>99%)

recent climate space for upper montane mixed chaparral



Treatment Prioritization Tool (adaptive capacity)

Next Steps: We will use these data layers to incorporate climate change into a geospatial decision support tool to guide location of prescribed burns and mechanical thinning.

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