Potential Climate Change Adaptation Options for US National Forests

4th USDA Greenhouse Gas Conference: Positioning Agriculture and Forestry to Meet the Challenges of Climate Change

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Linda Joyce, Geoffrey M. Blate*[1], **Susan Julius**[2], **Steven McNulty**, **Constance Millar**, **Susanne Moser**, **Ronald P. Neilson**, **David L. Peterson** and **Jordan M. West**[2]

*AAAS Science & Technology Policy Fellow Located at EPA

blate.geoffrey@epa.gov

[1]As a AAAS Fellow, the views expressed here are the author 's own and do not represent the official policy of the Environmental Protection Agency.

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Main Points

- Adaptation may complement mitigation; both needed to minimize climate change impacts
- Natural adaptation is occurring. Fast enough?
- Adaptation options to enhance resilience – changes in processes, practices, or structures
- Adaptation approaches: reactive & anticipatory
- Adaptation via reframing current management and changing practices & institutions
- Decision rules for setting & balancing priorities

Climate Change Science Program (CCSP) Mission and Goals

US Climate Change Science Program
www.climatescience.gov

Mission:

- Facilitate the creation and application of knowledge of the Earth's global environment through research, observations, decision support, and communication

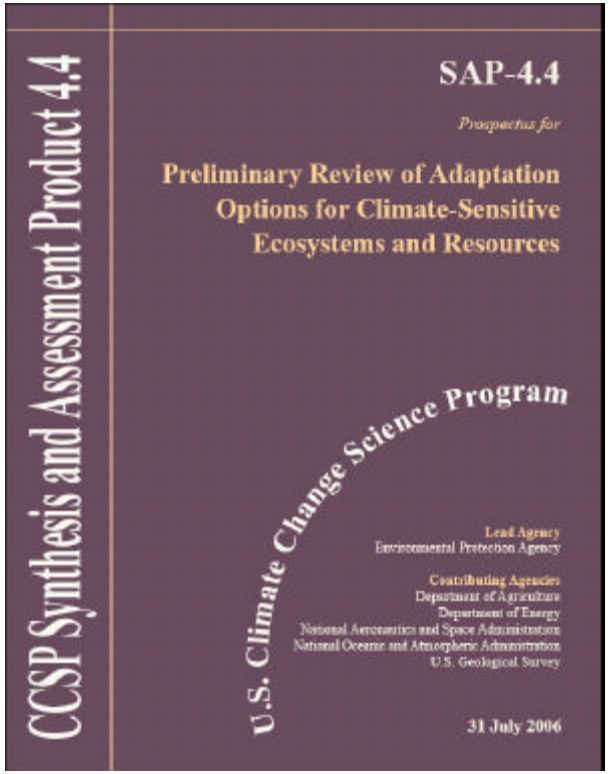
Five Integrated Goals:

- Goal 1: Improve knowledge of past and present climate
- Goal 2: Improve quantification of the forces bringing about climate changes
- Goal 3: Reduce uncertainty in climate projections
- Goal 4: Understand the sensitivity and adaptability of human systems, natural and managed ecosystems
- Goal 5: Explore the uses and limits of knowledge to manage risks and opportunities related to climate change

Synthesis and Assessment Product (SAP) 4.4

Preliminary Review of Adaptation Options for Climate Sensitive Ecosystems and Resources

- **National Forests**
- National Parks
- National Wildlife Refuges
- National Estuary Program
- Wild & Scenic Rivers
- Marine Protected Areas



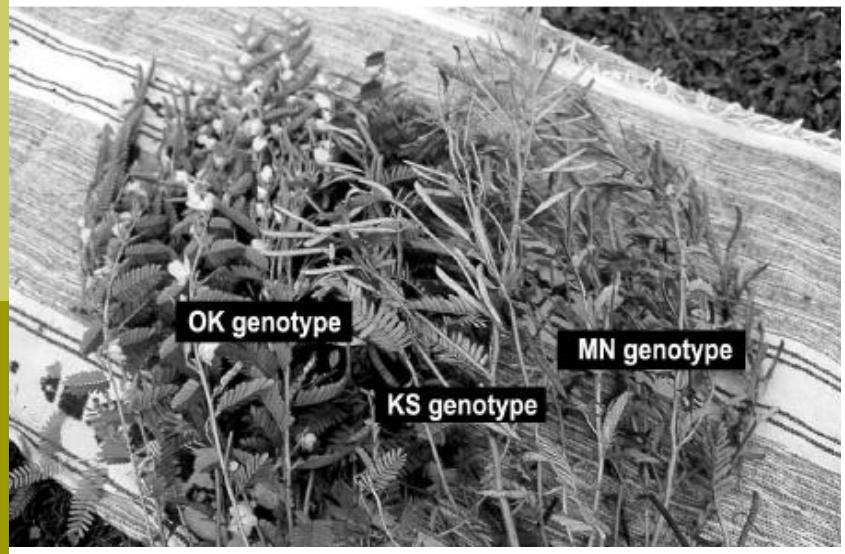
Goals of SAP 4.4: Adaptation Options for Climate-Sensitive Ecosystems – National Forests

- **Identify:**
  - Climate sensitive management goals
  - Options for adapting to climate change
  - Characteristics of human & ecological systems that enhance or inhibit implementation
- **Communicate information to stakeholders:**
  - National Workshops, Dec. 2006, Jan. 2007
  - Workshop in Tahoe National Forest, Jan. 2007
  - Public Comment Period – Spring 2007

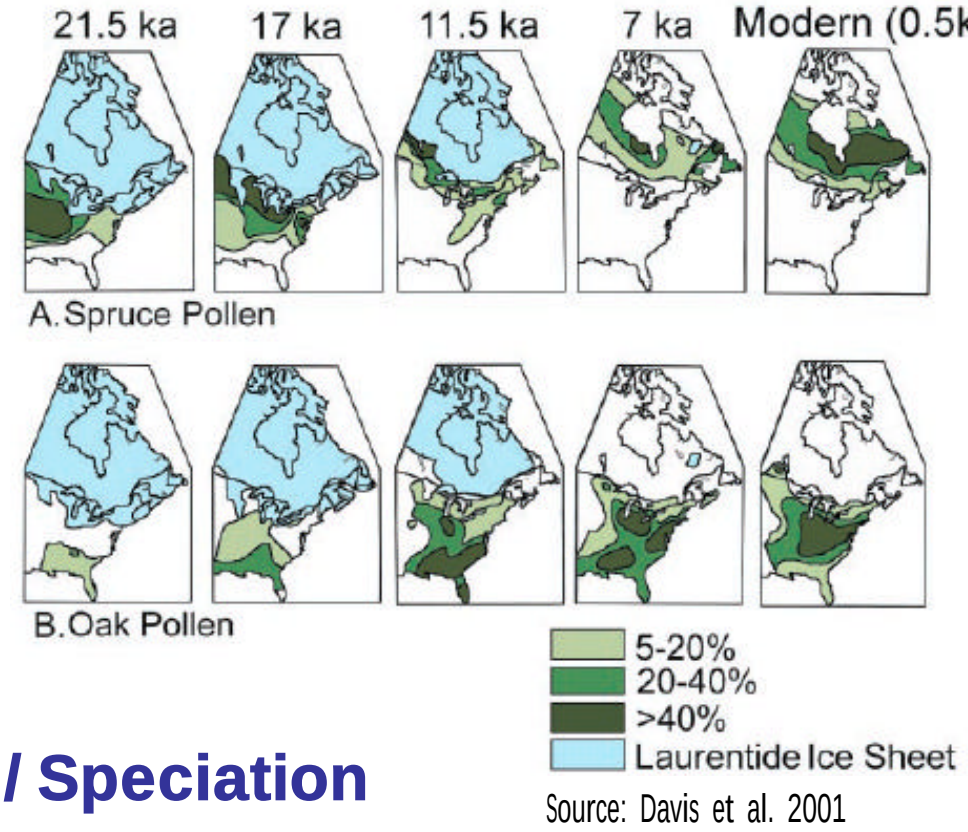
Natural Responses to Environmental Change

1. *In situ* adaptation

- **Genetic change via selection**
- **Phenotypic plasticity**



2. Migration (to suitable habitats)



Source: Davis et al. 2001

3. Extinction / Speciation

Observed Adaptation to Past Climate Change

- Climate variation / change: decades–millennia
- Species track cycles in complex ways
- Populations lag environmental optima
- Genetic variation hedges vs. rapid environmental change
- Few extinctions / new taxa in N. America in past 1.65 M yrs (4 major ice ages)
- *In situ* adaptation lags behind migration

(Sources: Eldredge 2000, Westfall & Millar 2004)

Forest Ecosystems and Climate Change: Is Natural Adaptation Sufficient?

- **Rates compatible?**
  - Species & population dependent
  - Extinction most likely when environment changes too quickly (Eldredge 2000 Davis et al. 2001)
- **Other human impacts (invasive species, land-use change, etc.)**
  - Species extirpations
  - Changing communities
  - Asynchronies in food webs

Adaptation in Human Systems

- Adaptation: adjustment in ecological, social, or economic systems in response to climate stimuli and their effects (SAP 4.4 Prospectus)
- Aim: reduce risk of adverse outcomes by increasing ecosystem resilience and reducing ecosystem vulnerability (SAP 4.4 Prospectus)
- Adaptive capacity: ability of a system, region, or community to adapt to the effects of climate change (SAP 4.4 Prospectus, Adger 2003, Smit & Wandel 2006)

Adaptation in Human Systems: 2 Broad Categories

		Anticipatory	Reactive
Natural Systems			• Changes in length of growing season • Changes in ecosystem composition • Wetland migration
Human Systems	*Private*	• Purchase of insurance • Construction of houses on stilts • Redesign of oil rigs	• Changes in farm practices • Changes in insurance premiums • Purchase of air-conditioning
	Public	• Early-warning systems • New building codes, design standards • Incentives for relocation	• Compensatory payments, subsidies • Enforcement of building codes • Beach nourishment

Figure TS-9, IPCC WG2, TAR

Reactive Adaptation Approaches

- **No Planned Reaction**
  - Scientific uncertainty considered too great to plan well for the future
  - Historical range of variability used to plan future landscape dynamics
- **Planned Reaction to Changing Disturbances**
  - Acknowledge need for responses to changing disturbances; focus on response
  - Post-fire (or windfall) replanting with species better adapted to anticipated future climate

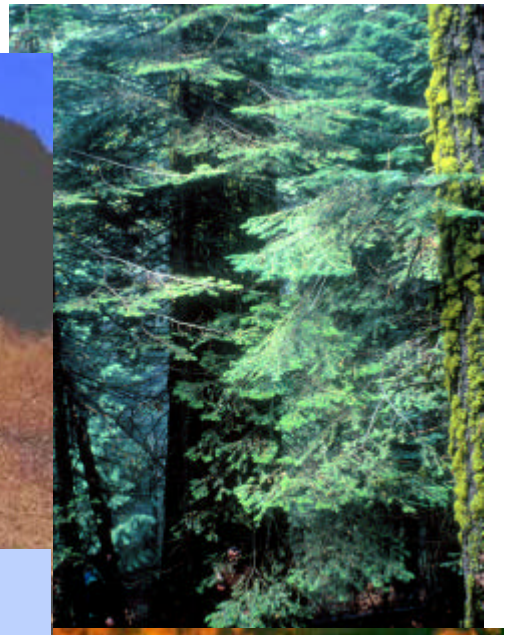
Anticipatory Adaptation Approaches

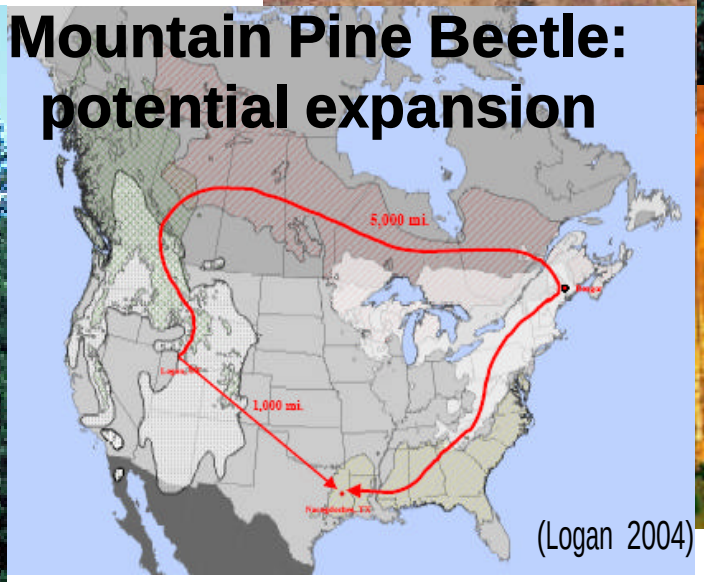
- **Considering observed / projected changes in:**
  - Species
  - Communities
  - Disturbances (e.g., wildfire and insects)
- **4 principal approaches:**
  1. Create resistance to effects of climate
  2. Increase resilience to climate change
  3. Allow ecosystems to respond to climate change
  4. Realign goals to acknowledge large changes

1. Create / Increase Resistance to Impacts of Climate Change

Management examples

- Mixed species plantations
- Fire management
- Fighting insects





2. Create Resilience to Ongoing Changes & Climate-Related Disturbances

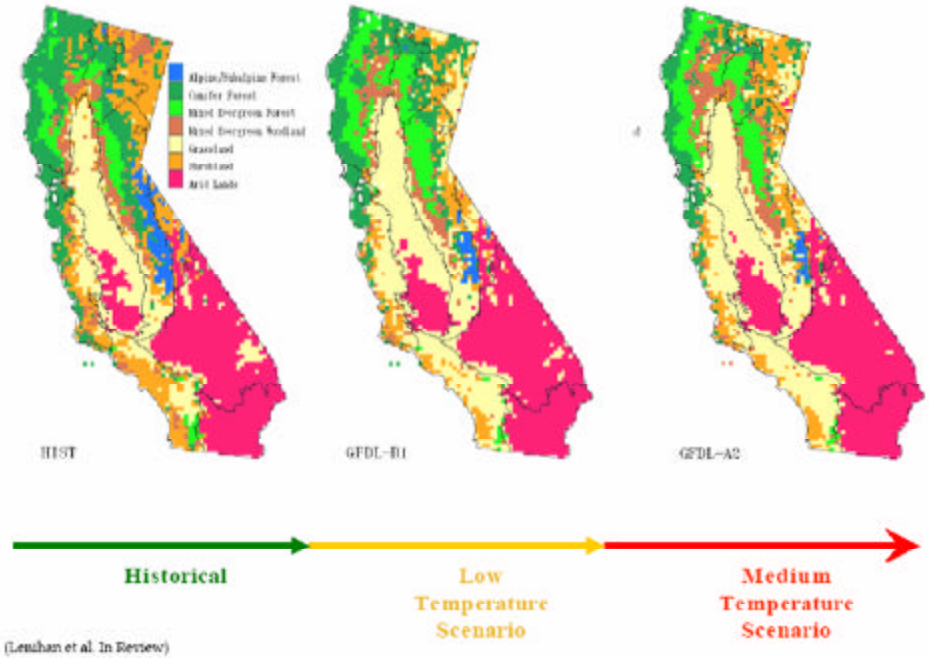
Management examples

- Increase TES pop. sizes
- Fire management
- Increase heterogeneity

3. Facilitate Ecosystem Response to Projected Climate Influences

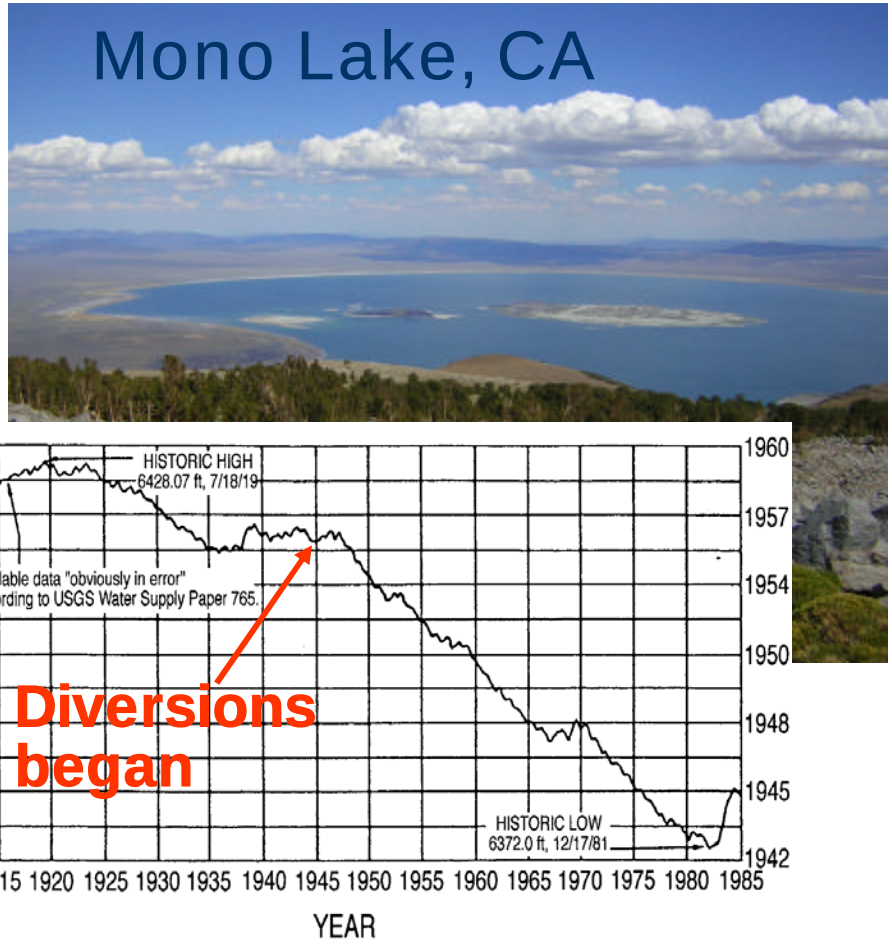
Management Examples

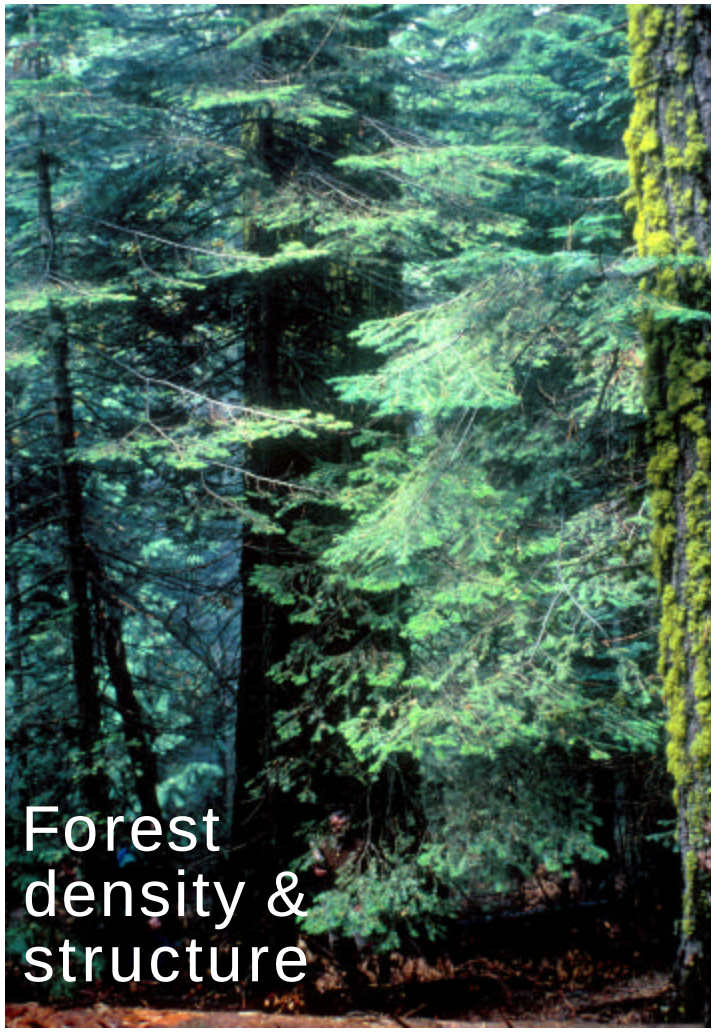
- Follow climate change
  - Use climate projections to plan vegetation options
  - Where do species' niches move?



- Learn from experiments
- Promote porous landscapes

4. Realign Planning Goals to Acknowledge Shifting Baselines and New Dynamics

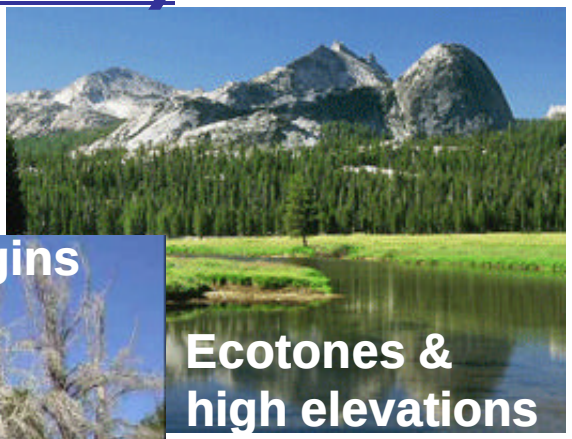




Decision Rules for Priority Setting

Decision Rules (science & value-based)

1. Try to save everything
2. Triage (science & value-based)
   a. Ecosystem services
   b. Sensitive & vulnerable
   c. Resistant & resilient
   d. …
3. CO2 mitigation
4. …



Summary & Conclusions

- Natural adaptation is occurring, probably insufficient to track climate change
- Human adaptation: enhance resilience by changing processes, practices, or structures
- Rationales for both reactive & anticipatory
- Anticipatory adaptation – reframe current management / change practices & institutions
- Decision rules for setting priorities; triage is one (potentially necessary) approach
- Adaptation may complement mitigation; both needed to minimize climate change impacts