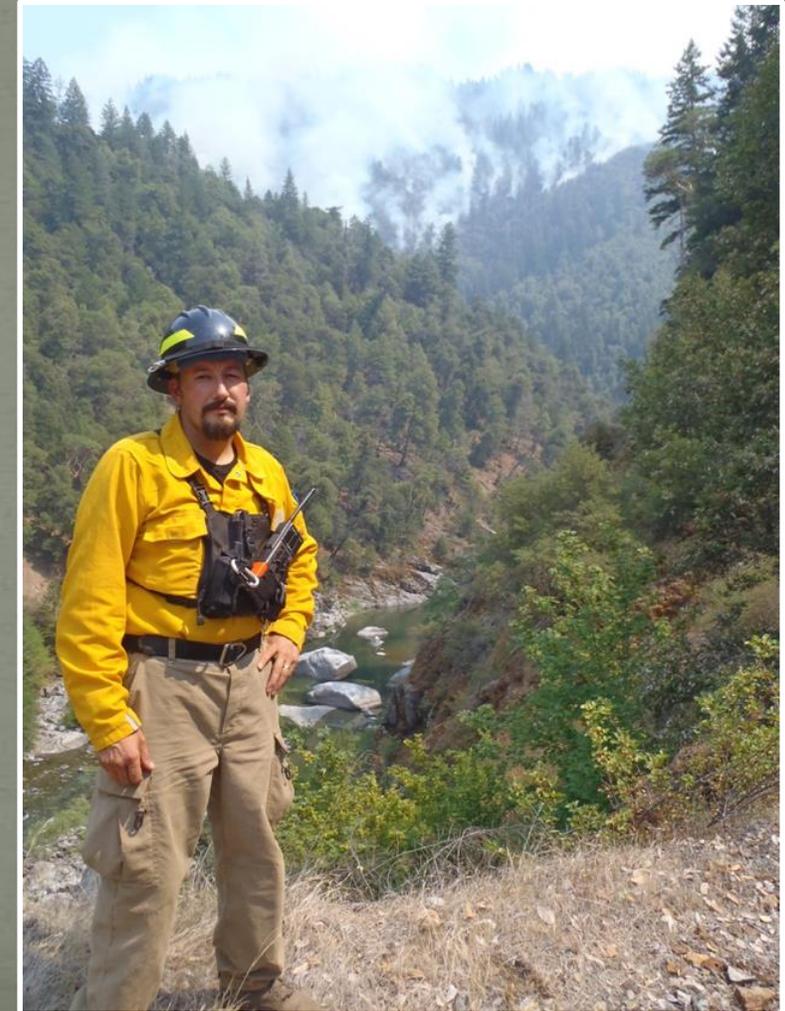


# Consideration of how climate change, fire regimes and related fire effects can affect American Indian and First Nations resource management practices, in the North Pacific Landscape Con. Coop. region

## Frank K. Lake

- Education
  - 1995 B.S. University of California, Davis.
  - 2007 Ph.D Oregon State University
- USDA Forest Service-PSW Orleans/Redding, Ca.
  - Fire and Fuels Program
- Research
  - Traditional Ecological Knowledge and Ethnobiology
  - Fire Effects and Climate Change Impacts to Tribally Valued Habitats and Resources
- Management
  - Resource Advisor on Wildfires
  - Interdisciplinary team assignments

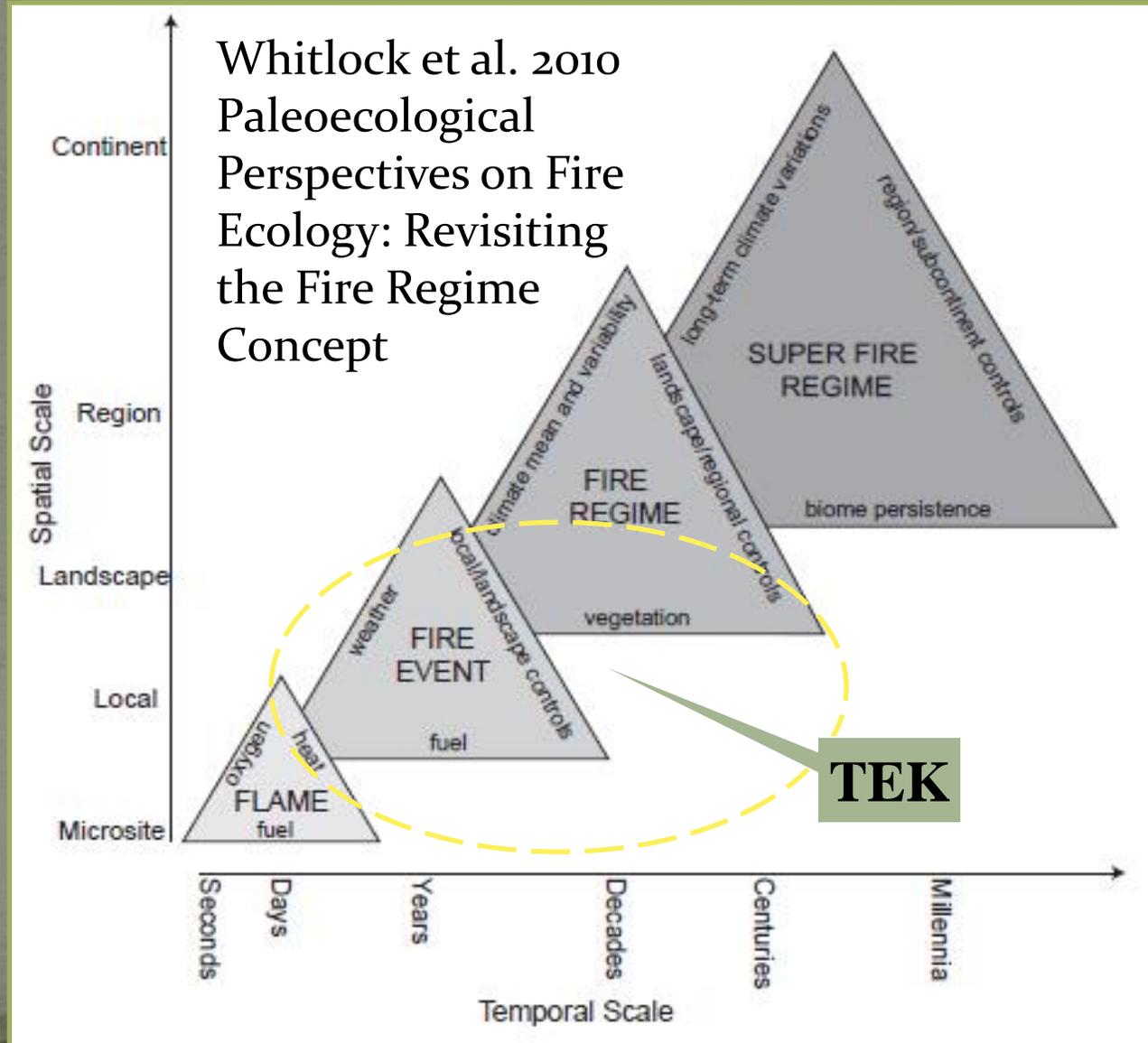


*S-TEK subcommittee presentation, 16 March, 2016*

# Climate Variability and Change: Tribal Traditional Ecological Knowledge (TEK) and Adaptive Practices

- Tribal homelands as past and *future* Climate Refugia?
- Millennia of climatic change, variability of ecosystem processes, habitats and resources and affects to resources
- Evolution of tribal knowledge systems and cultural adaptive practices
- Traditional stories are the ecological prescription of how to live in place.
- Traditional teachings derived from Natural Laws-First teachings from the environment and resources
- Animals as messengers and indicators of weather or extreme disturbances

# Traditional Ecological Knowledge, Fire Regimes and Climate



TEK is applicable at what spatial and temporal scale?

How do socio-cultural systems adapt to climate and fire regimes?

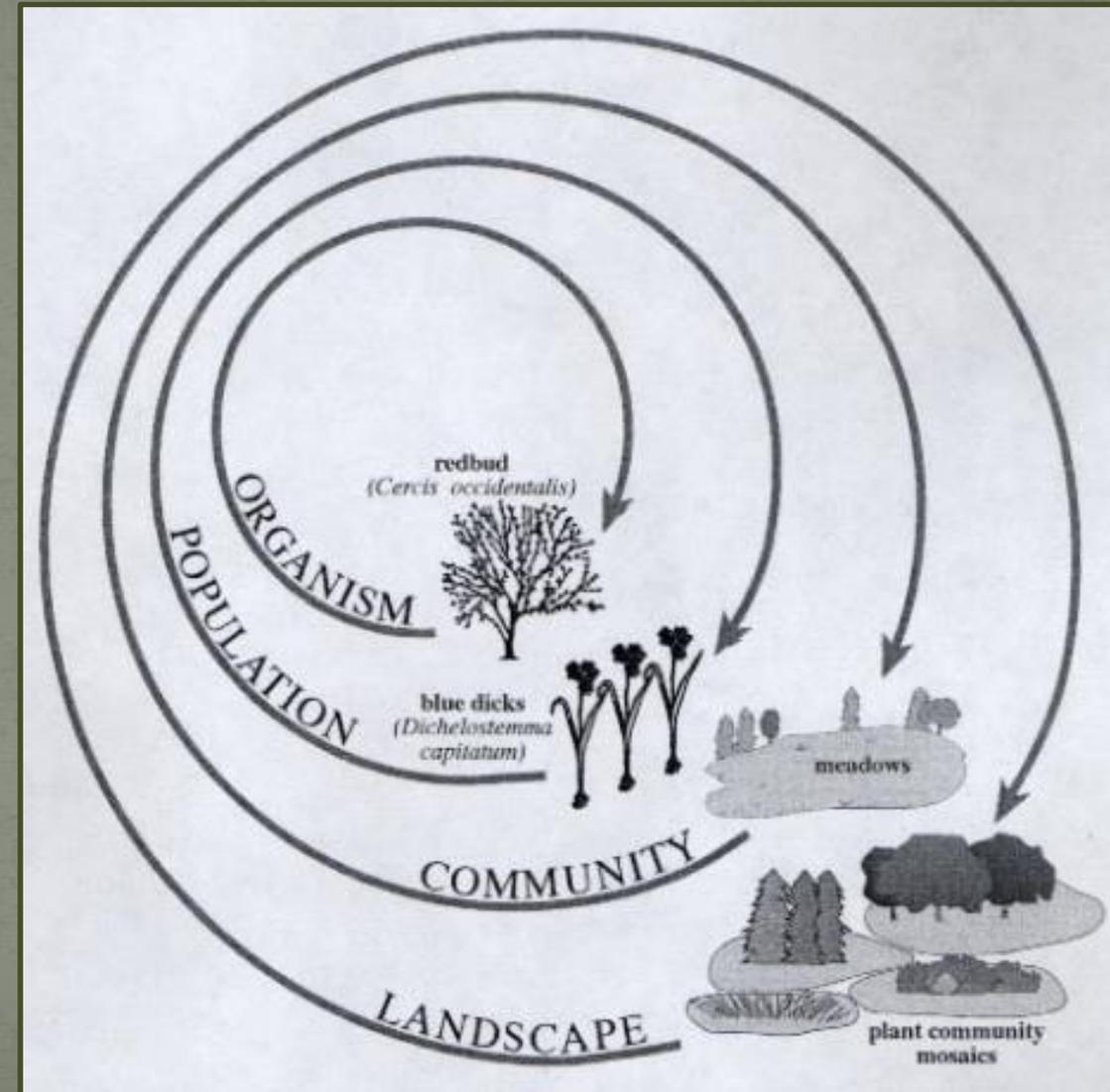
# Levels of biodiversity: Fire as an ecological processes

M.K. Anderson 2002:53 in  
Stewart: Forgotten Fires

Tribal adaptive practices ranged in scale from patches to stands to watersheds with individuals to populations of communities across the landscape

Valued resources and habitats form landscape patterns

Ecosystems services derived from cultural landscapes



# What are the Tribally Valued Resources and Habitats? With A Cultural Ecosystem Services Framework

- **Resources:**
  - Tangible and Intangible elements of the environment
  - Landscapes (Areas), Sites, Objects, State of Mind
  - Past, Present and Future cultural knowledge and related practices
  - Natural and Cultural Resources utilized to perpetuate tribal customs, practices and knowledge systems.
- **Habitats:**
  - Landscapes or places that support tribal ceremonial and subsistence practices
  - Bio-physically or Socio-Culturally defined site characteristics
  - Places that support or potentially support a single or multiple resources of tribal value



# Evaluation: What tribally valued resources are at risk from Climate Change and associated disturbances?

- How do tribes and agency managers identify and define resources?
  - Natural and Cultural Resources (Agency vs. tribal definitions?)
  - World view: Biophysical and Metaphysical
  - Legal definitions?
  - Intrinsic and economic values



# How are tribal communities' TEK changing in response to the changes in climate ?

- Elder and practitioner's observations and experiences?
- Lessons and teachings for particular places on the landscapes, certain plants, fungi, or animals?
- Indicators across the landscape from ocean to rivers, forest/grasslands, to higher mountains?



Photo: Colleen Rossier

# TEK in a modern context

- Predictive strength of TEK
  - Individuals (practitioners/elders)
  - Families (cultural roles)
  - Communities (villages)
  - Tribes/cultural groups
  
- Vulnerability assessments that are applicable to tribes/native communities
  - Valued habitats and species as resources
  - Findings, solutions or approaches relevant to indigenous/tribal people



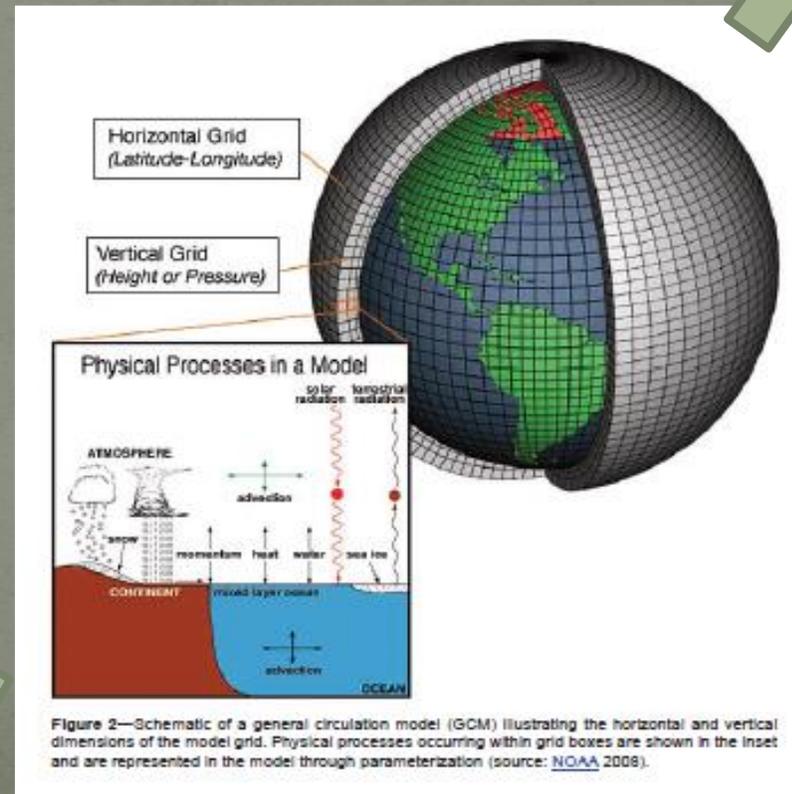
# TEK in a modern context:

- Traditional practices
  - Cultural relationships with ecosystems, habitats, and species
- Current and projected climate change
  - Downscaled climate models
  - Western science and TEK of species niche and range shifts
  - Integration of tribal TEK to inform assessments and plans



# TEK in a modern context

- Recognizing and identifying broad and local scale threats and stressors
- Understanding the mechanisms of change to ecological processes, habitat conditions and valued species



Daniels et al. 2012  
GTR-RMRS 277  
Climate  
Projections FAQ

# Examples of threats, stressors and changes in ecological processes in the PNW

- Increased or extreme changes in temperature
  - Summer/winter
  - Daily ranges
- Changes in the precipitation
  - Snow/rain
  - Seasonal amounts
- Magnitude and severity of disturbances
  - Extreme weather events
  - Wildfires
  - Drought
  - Pests
  - Sea level rise



# TEK in a modern context

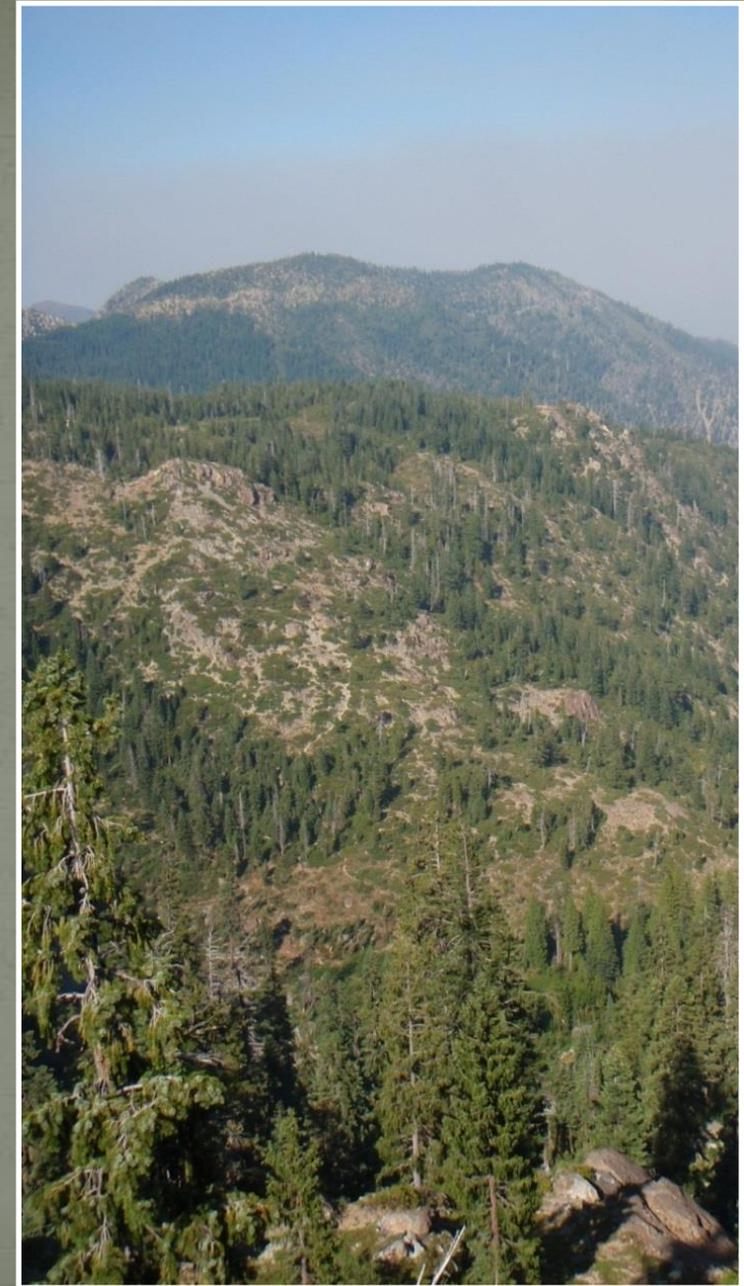
- Are the threats and stressors for climate science similar or different for TEK?
- Examples:
  - Increased temperature
  - Changes in the precipitation
  - Changes in fire regimes
- Coupled or synergistic impacts: Drought, Pests, and Wildfires
- Wildfire: Good, bad or what it is?
  - Depends on resource or habitat condition over time



# Short- and Long-Term Climate and Fire Effects on Tribal Valued Resources : Landscape to Patches

- Resource abundance and quality changes over time at the site or across the area
- Different “patches” of similar resources can be maintained & geographically distributed
- Spatial and temporal resources availability (E.g., Time since Fire by Severity)
- How can understanding tribal resource needs be integrated with Climate Change assessments and adaptation strategies?

Climate Refugia-Klamath Mountains Brewers spruce or Yellow-Alaskan Cedar and high elevation sacred sites: Ecology and Culture



# Wildland Fire Management and Working with American Indian Tribes: Cultural resources and tribal values

- **Management issue:** Increased consultation and coordination with tribes on fuels reduction treatments and wildland fires
- **Solution:** Agency-Tribal Fire Management Agreements
  - Use of tribal elders and heritage consultants
  - Coordinating resources for implementation
- **Results:** Understanding the effects of fire (suppression and exclusion) and fuel treatments on cultural use quality and fire effects on cultural use species
- **Applications:**
  - Wildland Fire Decision Support System *Values at Risk*
  - Risk Matrix or Landscape modeling: Linking Climate Assessments-Habitats, Fire Risk, and Adaptive Response Planning
  - Local implementation of the National Cohesive Strategy



# Fire Effects on Cultural Resources and Tribal Values:

## Fire Impacts to Cultural Resources

**Direct**

Combustion Environment  
 + CR Material Properties  
 + CR Location  
 + Heat Transfer Mechanisms  
 → First-Order Effects  
 (Physical Alteration)  
 (e.g. consumption, cracking, melting,  
 sooting, etc.)

**Indirect**

**What can be prevented or mitigated to lessen or to avoid non-desired impacts?**

Fire Environment/First-Order Effects  
 + Post-Fire Environment  
 (precipitation, wind)  
 → Second-Order Effects  
 (Additional Physical Alterations)  
 (e.g. erosion, weathering, deflation, etc.)

Human Environment  
 Third-Order Effects  
 (Socioeconomic, Cultural, Political)

**Tangible**  
 suppression  
 rehabilitation  
 mitigation  
 hunting/gathering  
 looting/vandalism

**Intangible**  
 aesthetics  
 sense of place  
 cultural landscape  
 spiritual value

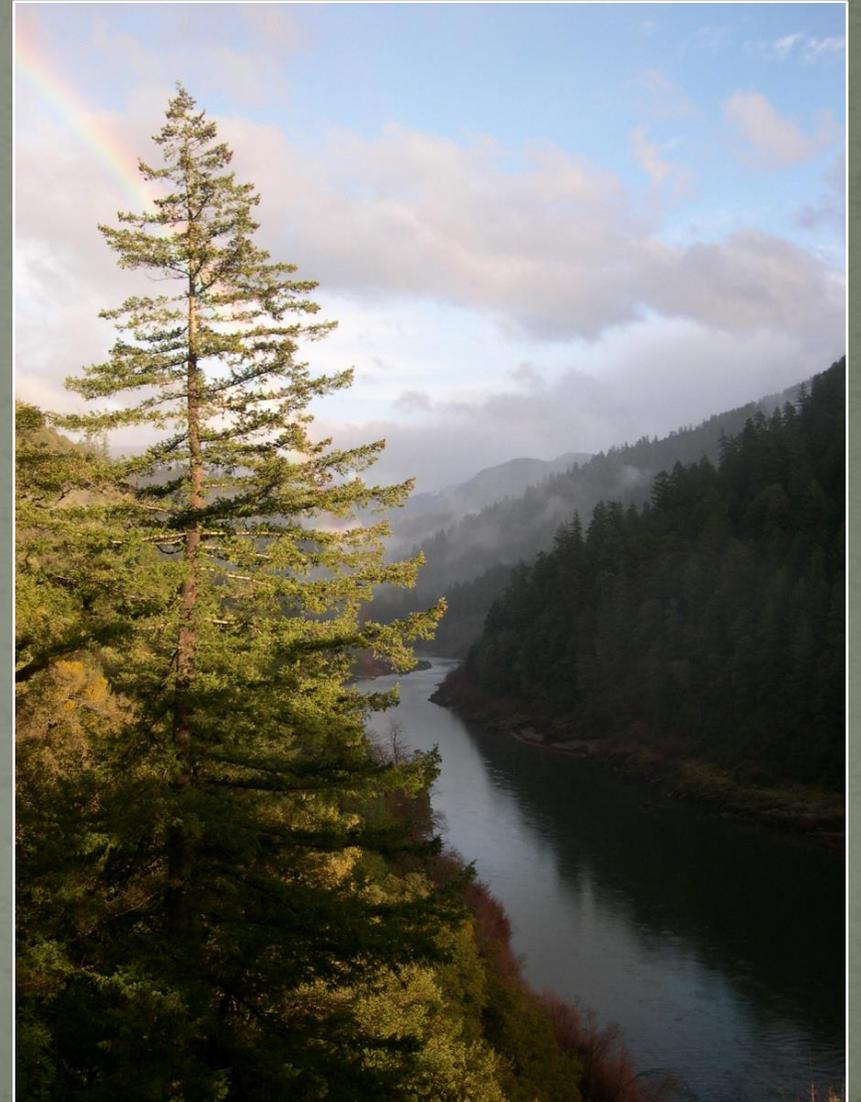
+ : Plus  
 → : Lead to

\*Ryan et al. 2012, RMRS-GTR 42, Vol. 3



# How to Evaluate and Forecast Effects to Tribal Valued Habitats and Cultural Resources

- Forecasting Effects:
  - What processes and mechanisms are affecting valued resources?
  - At what scales? Species, population, habitat, ecosystem, regionally.
  - How do such changes affect or impact the access, condition of and possible cultural uses?



# How to Evaluate and Forecast Effects to Tribal Valued Habitats and Cultural Resources

- Evaluation:

- What tribally valued resources are at risk from Climate Change and associated disturbances?
- Identification of and understanding pathways or mechanisms of disturbance.
- What evaluation and assessment processes are use?
- What metrics are used? Science vs. Cultural-are they similar?
- What indicators are tribal communities using to evaluate variability and magnitude of change?

Karuk Tribe subsistence fishing and monitoring



# Evaluation: What evaluation and assessment processes are used?

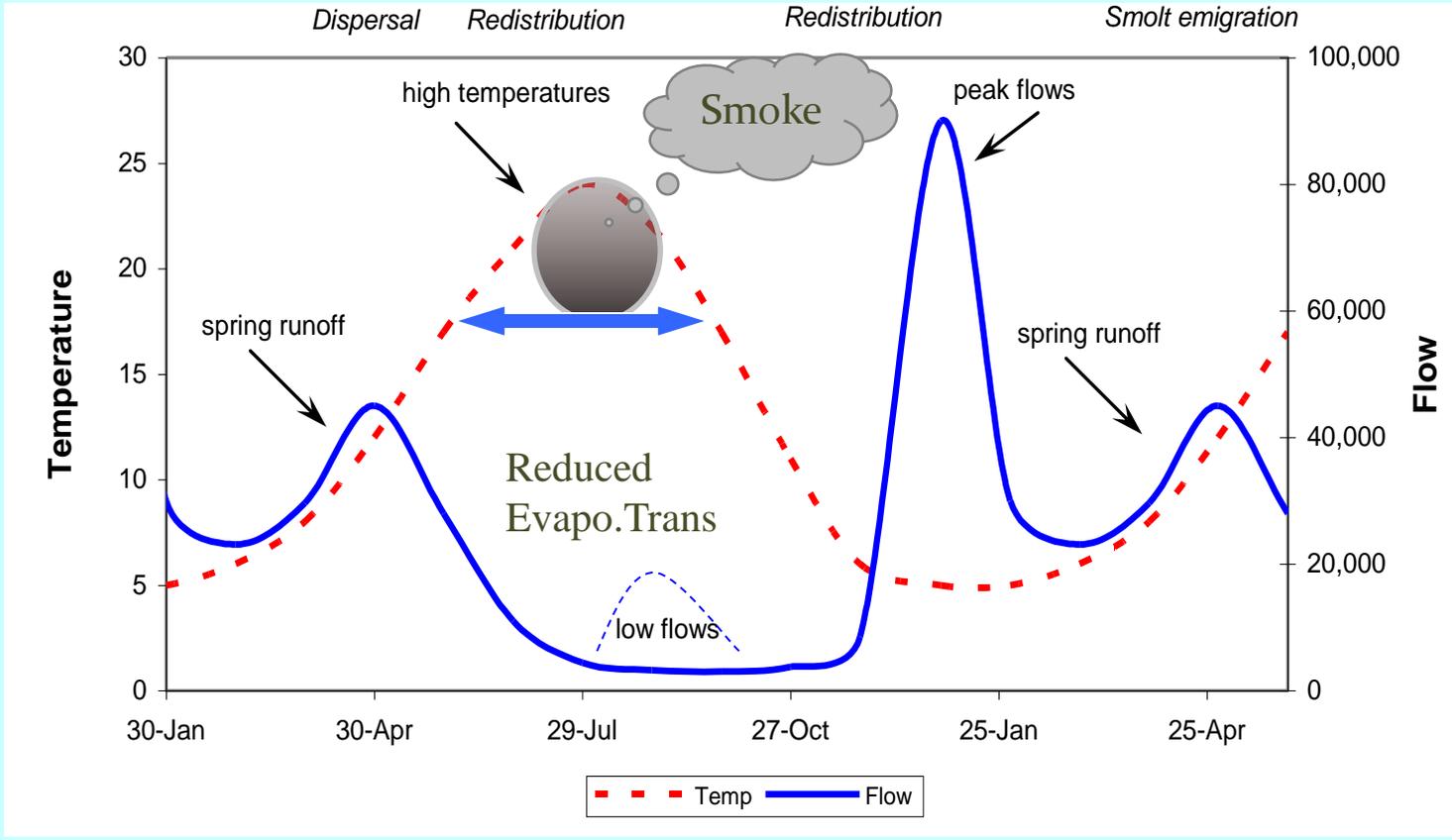
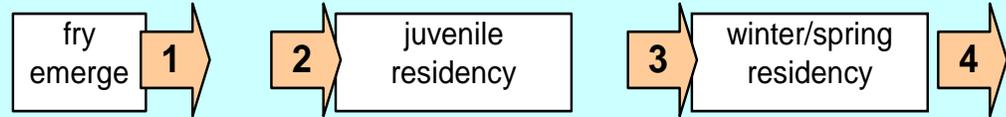
- Down scaled regional climate models
- Forecasting resolution can vary spatially and temporally
- Habitat-vegetation change studies
- Species response studies
  - Stressors
  - Shifts in ranges or habitat loss/gained.

Karuk Tribe and Mid Klamath Watershed Council.  
Monitoring Klamath River off channel habitat-  
beavers, coho, and western pond turtles



# Tribal TEK: Linking salmon life history migration, thermal refugia, and wildfire research

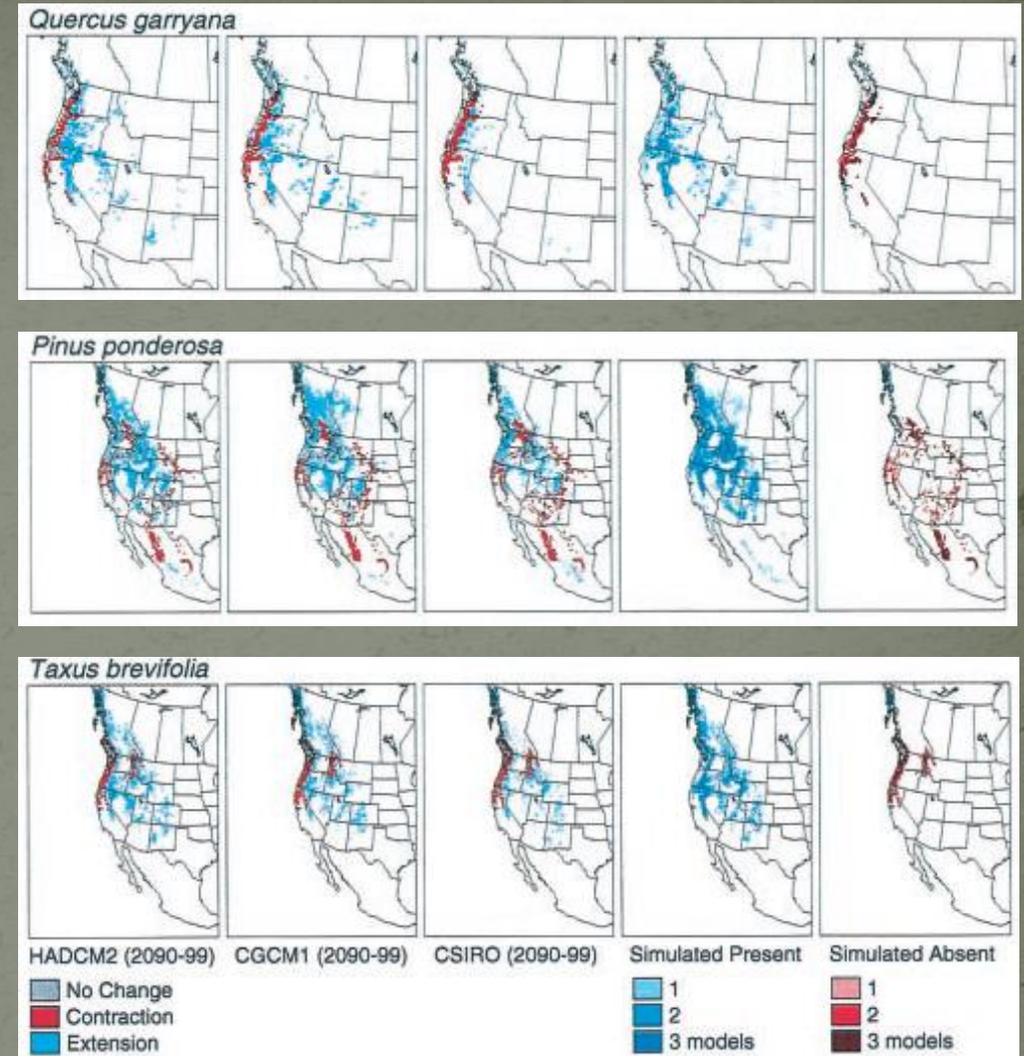
## Movement of juvenile coho within the mainstem river corridor



Graph: Karuk Tribe,  
Top Photo: MODIS,  
Collaborative ideas  
and data sharing

# How to Evaluate and Forecast Effects to Tribal Valued Habitats

- Pacific Northwest Climate Change Vulnerability Assessment-Habitat Suitability Models
  - University of Washington and other collaborators
  - Provides resource managers and decision makers with some of the most basic and important information about how species and ecological systems will likely respond to climate change.
  - Allows researchers to answer important scientific questions regarding the potential impacts of climate change on natural resources
    - How do these assessments address tribally valued habitats and tree species?
    - Cultural specific information [Cross-walk the Tribal TEK and ethnobotany-for traditional uses]

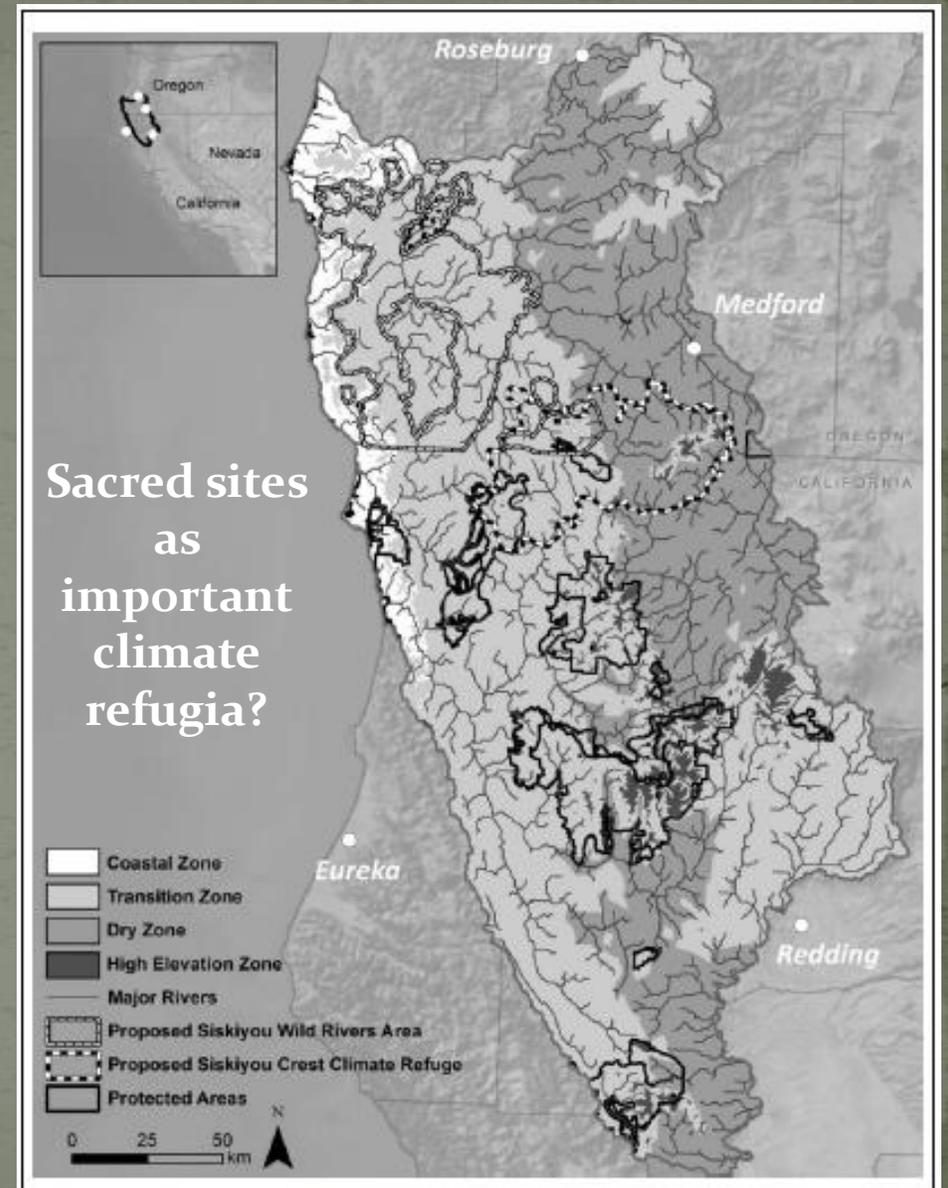
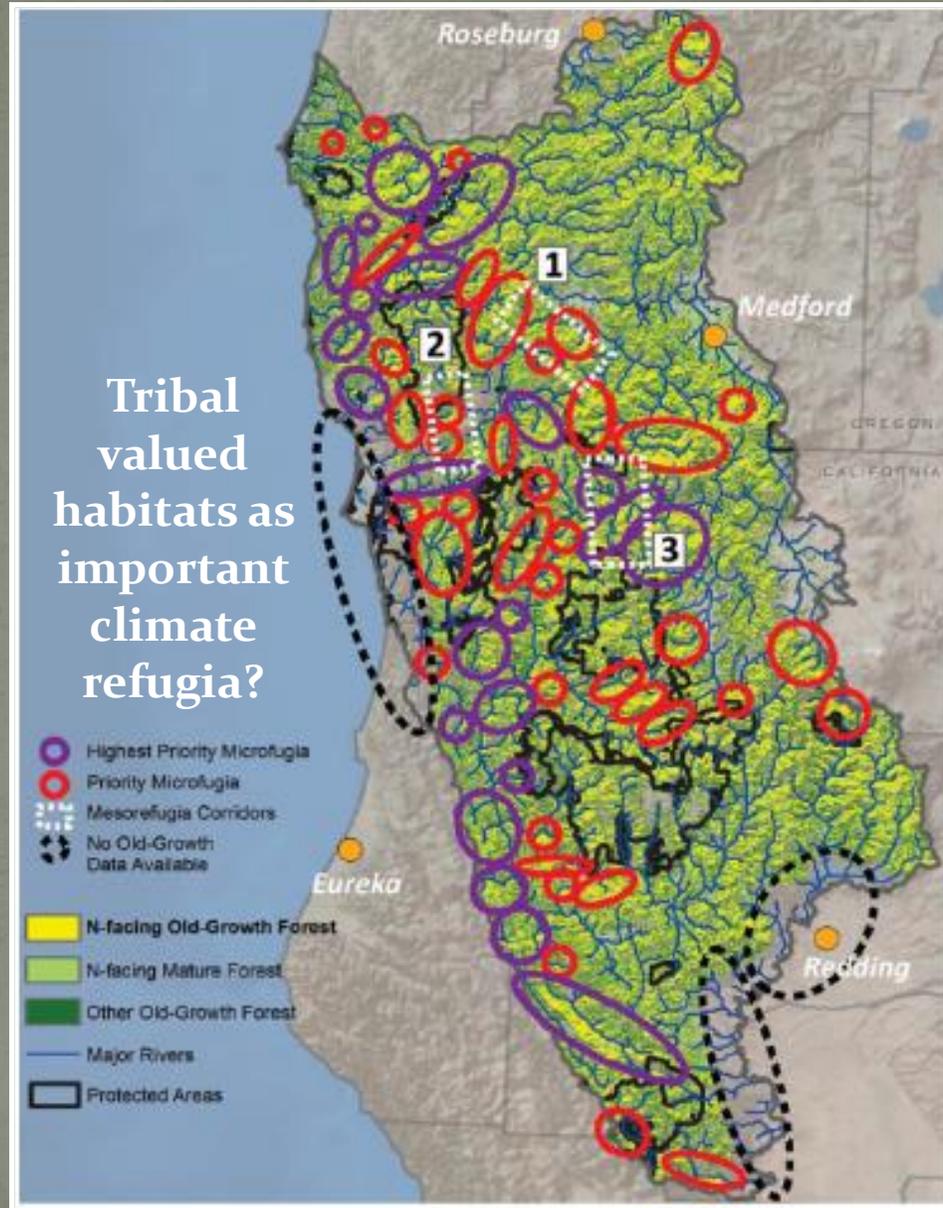


Shafer et al. 2001. Potential Changes in the Distributions of Western North America Tree and Shrub Taxa under Future Climate Scenarios. *Ecosystems* 2001, Vol. 4: 200-215

# How Does the Concept of Climate Refugia Apply to Tribes?

Climate change will:

1. Affect regional weather patterns (PDO/El Niño).
2. Increase the likelihood of drought
3. Increase probability of fire
4. Change/shift fire regimes
5. Increase vulnerability to resources and habitats
6. Requiring tribes to adapt and respond in various ways.



Olson et al. 2012 *Natural Areas Journal*

Figure 1. Climate change vulnerability zones (coastal, transition, dry, high elevation) of the Klamath-Siskiyou Ecoregion, southwest Oregon and northern California, used in the analysis to inform priority site selection for conservation action.

# How can tribal/native community's TEK inform Climate Adaptation Strategies?

- Coping with vs. Preparing for the future?
- Traditional and Modern approaches for mitigation activities and adaptation strategies
- Local to regional tribal approaches as up-scaled models or frameworks
- Landscape restoration strategies that increasing heterogeneity and resilience for valued resources and habitats
- Eco-cultural revitalization processes



# Climate Change Vulnerability and Adaptation Approaches: Working with or supporting tribes shall consider?

- Consider: Cultural Ecosystem Services regrading ecological and cultural processes, influences on habitat quality, and access to desired quantity and quality of valued resources through tribal adaptive practices as various cross-scale *Strategies*.
- Adaptation Strategies:
  - **Resistance to-**
    - [Political, Socio-Cultural, Economic Threats and Stressors]
  - **Resilience for-**
    - [Landscapes and Cultural Processes that reduce vulnerability]
  - **Response of-**
    - [Individual, Family, Community, Governance as successful adaptation]



The role of tribes in landscape restoration collaboratives preparing for Climate Change: Sharing knowledge-*All Lands, All Hands* stewardship approaches

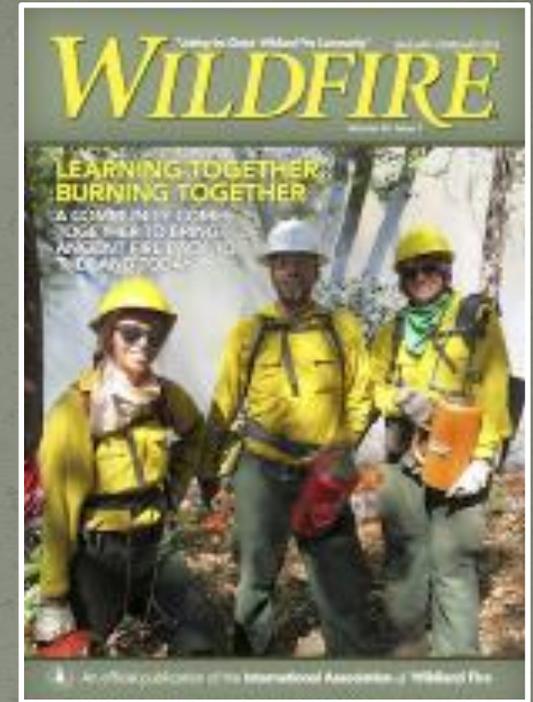
# Cross Walking Forestry and Cultural Variables

Forestry - Fire	Variable(s)	Cultural-Tribal Values	Variable(s)	Restoration treatments
Forest and understory plant diversity	Species per area, diversity index	Higher density of foods, material, medicinal plants	Increase seasonal use for multiple purposes	Thinning different tree and shrub types, wildland fire
Tree diameter or size ranges	Dia. Breast Height (dbh), basal area, site index	Larger full crown, structurally diverse trees, fewer per area	Older/mature forest with favored tree species	Thinning different trees types, wildland fire
Crown fire initiation, ladder fuels, canopy-tree volume & density	Ground to Crown height, Torching index	Increased mobility, foraging and viewing	Walking and searching quality; site quality for valued species	Limb up larger trees, remove smaller trees, Remove selective trees thinning above
Brown's fuels transects, surface fuel loading	Tons/area by fuels size classes	Increased mobility, foraging and viewing; % duff for fungi and herbs	Walking and searching quality	Removal of surface fuel by manual, mechanical or wildland fire
Canopy Cover/Closure	Density of tree crowns (bulk density), amount of sun light at plot	Filtered or partial sunlight for fruiting and understory plants (shrubs, forbs, ferns, grasses)	Quality & Quantity of fruit, or light for understory plants	Manual or mechanical thinning different trees types, Single tree treatments



# TEK – Restoration of Forests, Fire Regimes, and Cultural Practices: A form of Climate Adaptation?

- Primary objectives are to restore cultural fire regimes which will restore forest structure, composition, and ecological and culturally valuable functions of forest habitats. \*Teaching TEK and fire ecology to tribal youth
- Initial fuels reduction and prescribed fire treatments located near communities (WUI) and road systems.
- Key habitats are riparian-aquatic, oak-pine, mixed conifer-hardwood, and grassland environments where fire has been absent. (Formerly tribal burned areas)
- Examples: TNC-TREX support of local tribes, Fire Safe Councils, and community members. BIA-Tribal Reserved Treaty Lands Program with agreements for tribal burning across all jurisdictions in partnership.



Bottom Photo: Eric Knapp, USFS

# Creating the best available science with Tribes

- Consider tribes and tribal organizations as research partners
- Learn of tribal researchable questions and science support needs
- Develop and implement national and regional scale initiatives or programs (Federal agency budget allocations & Fiduciary Trust responsibility to tribes)
- Request For Proposals (RFPs) review and award criteria for tribal participation and partnerships
- Tribal input to, oversight of and review with research methods, analysis, results, and how “data” is shared with public.
- Tribal participation assist with the creation of the best available science to inform policy development and management of landscapes and resources



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- Wimberly and Liu 2014. Interactions of climate, fire and management in future forests of the Pacific Northwest. *Forest Ecology and Management*. Vol. 327, Pages: 270-279
- Van Mantegem et al. 2013. Climate Stress Increases Forest Fire Severity across the Western United States. *Ecology Letters*, doi: 10.1111/ele.12151.
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- Gedalof et al. 2005. Atmospheric, Climate, and Ecological Controls on Extreme Wildfire Years in the Northwestern United States. *Ecological Applications* Vol. 15, No. 1, Pages: 154-174.
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- Case et al. 2015. Relative sensitivity of climate change of species in northwestern North America. *Biological Conservation* Vol. 187, Pages: 127-133
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- William and Hardison 2013. Culture, law, risk and governance: context of traditional knowledge in climate change adaptation. *Climate Change* Vol. 120, Pages: 531-544.