

National Park Service  
U.S. Department of the Interior



Devils Postpile National Monument

# Managing Soda Springs Meadow as a Potential Climate Change Refugium



# Goal: Manage for persistence of riparian and meadow habitat in a warmer climate

## Planning:

- Fundamental Resource and Value
- General Management Plan
- Draft Resource Stewardship Strategy

## Values:

- Ecological
- Scientific
- Cultural and Visitor experience

## Characteristics - may provide conditions for refugia

- Vulnerabilities

## Monitoring

## Management actions

## Where do we go from here?

## Challenges



- Located in Devils Postpile National Monument (800 acres)
- Supported by the Middle Fork of the San Joaquin River
- Well established riparian vegetation
- Wet and dry meadow



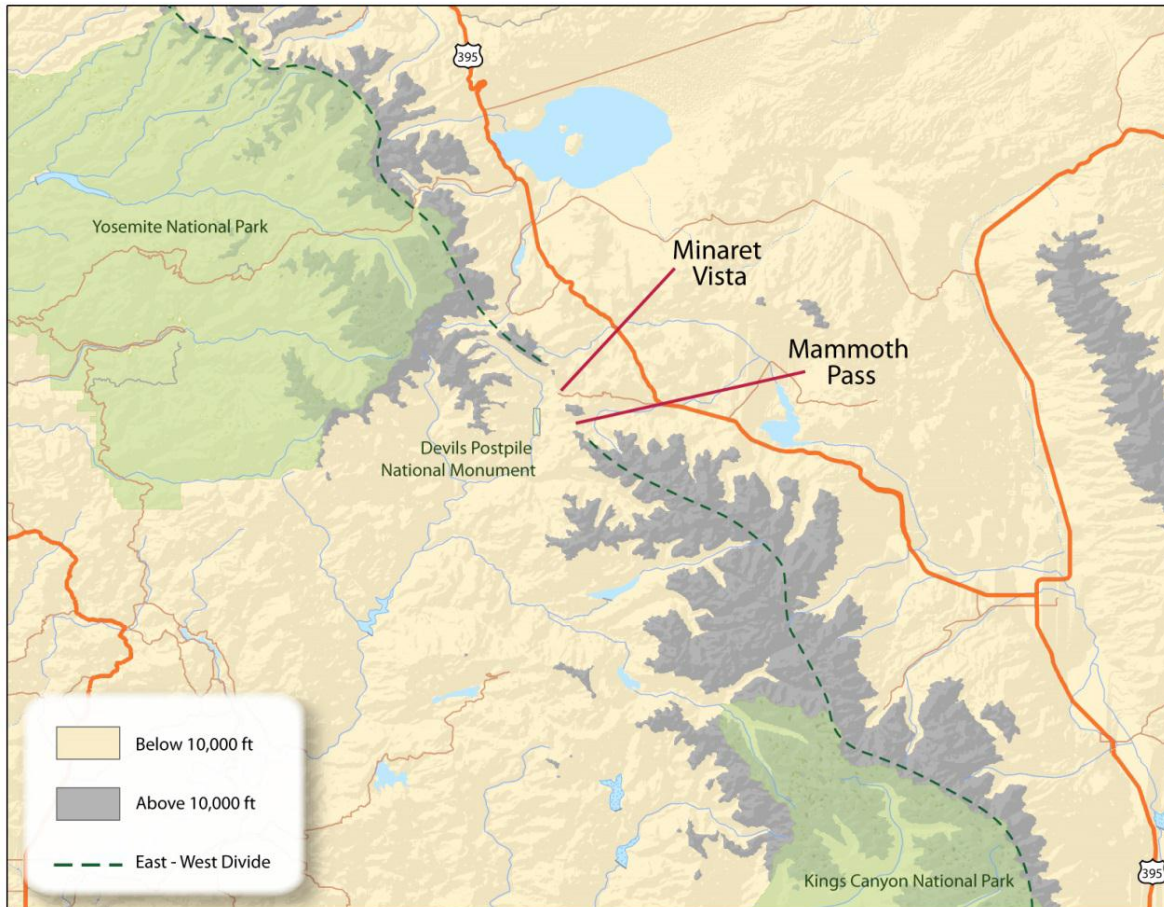
# Diversity

- 380 plant species
- 114 bird species
- No unique habitat
- Low nonnative presence



# Location

- In a transitional zone between Great Basin and Sierra Nevada, east and west Sierra Nevada = high diversity
- Near low mountain passes that could facilitate migration
- Relatively isolated from direct anthropogenic influences (wilderness)



# Shading

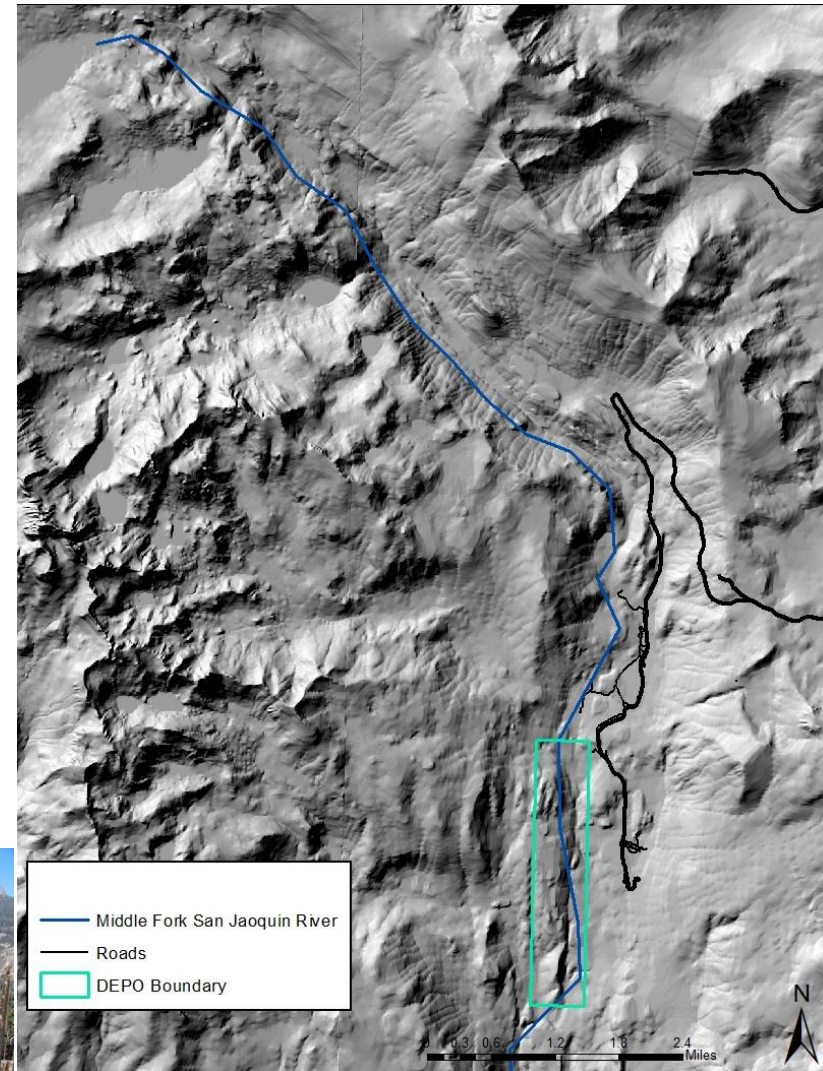
## Topography:

- North-south river valley promotes microclimate heterogeneity, shading

Won't change unless we have massive volcano eruptions or earthquakes

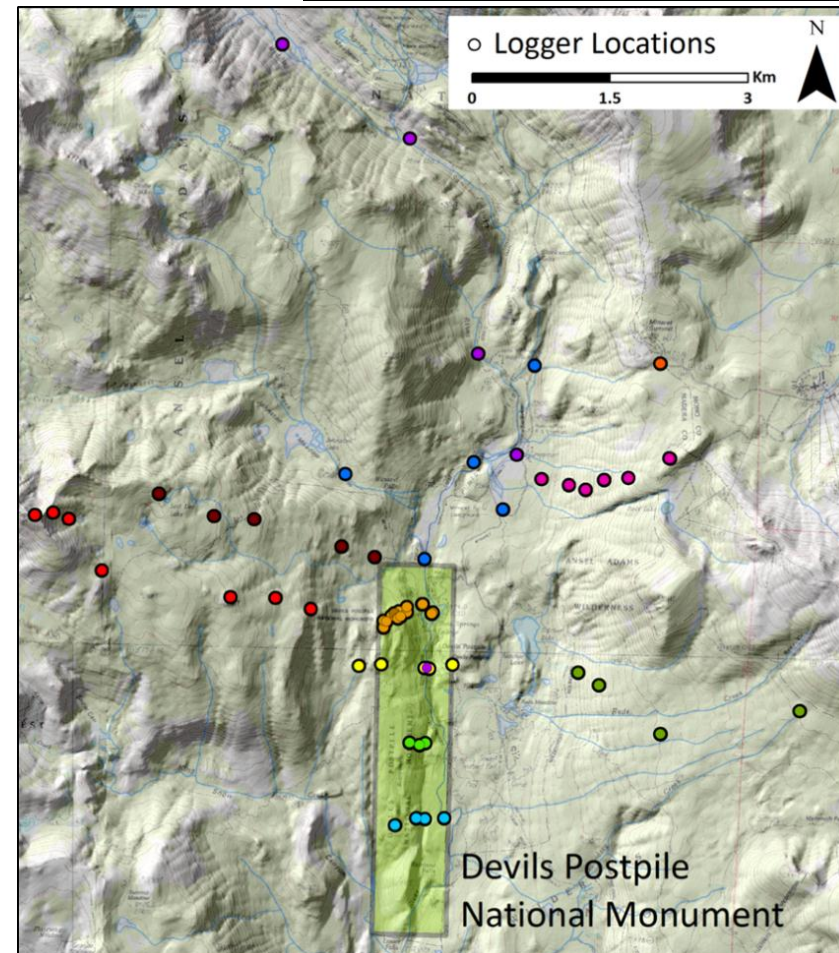
## Canopy:

- Forested but disturbance events such as the 1992 Rainbow Fire and the 2011 Devils Windstorm opened canopy



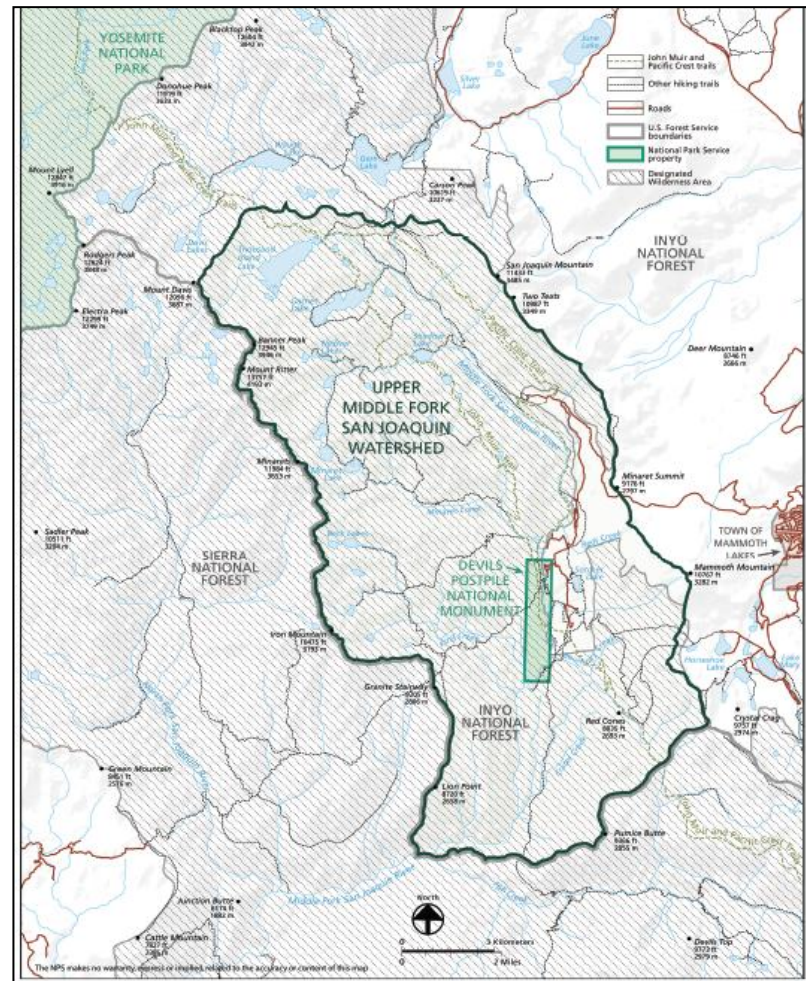
# Cold Air Pooling

- Study began in 2008
- Over 100 loggers recording temperature
- 30 loggers recording relative humidity
- Placed in trees at differing elevations
- Strong pressure gradient with as much 10 degrees C cooler than 1000 feet higher
- **Could change**

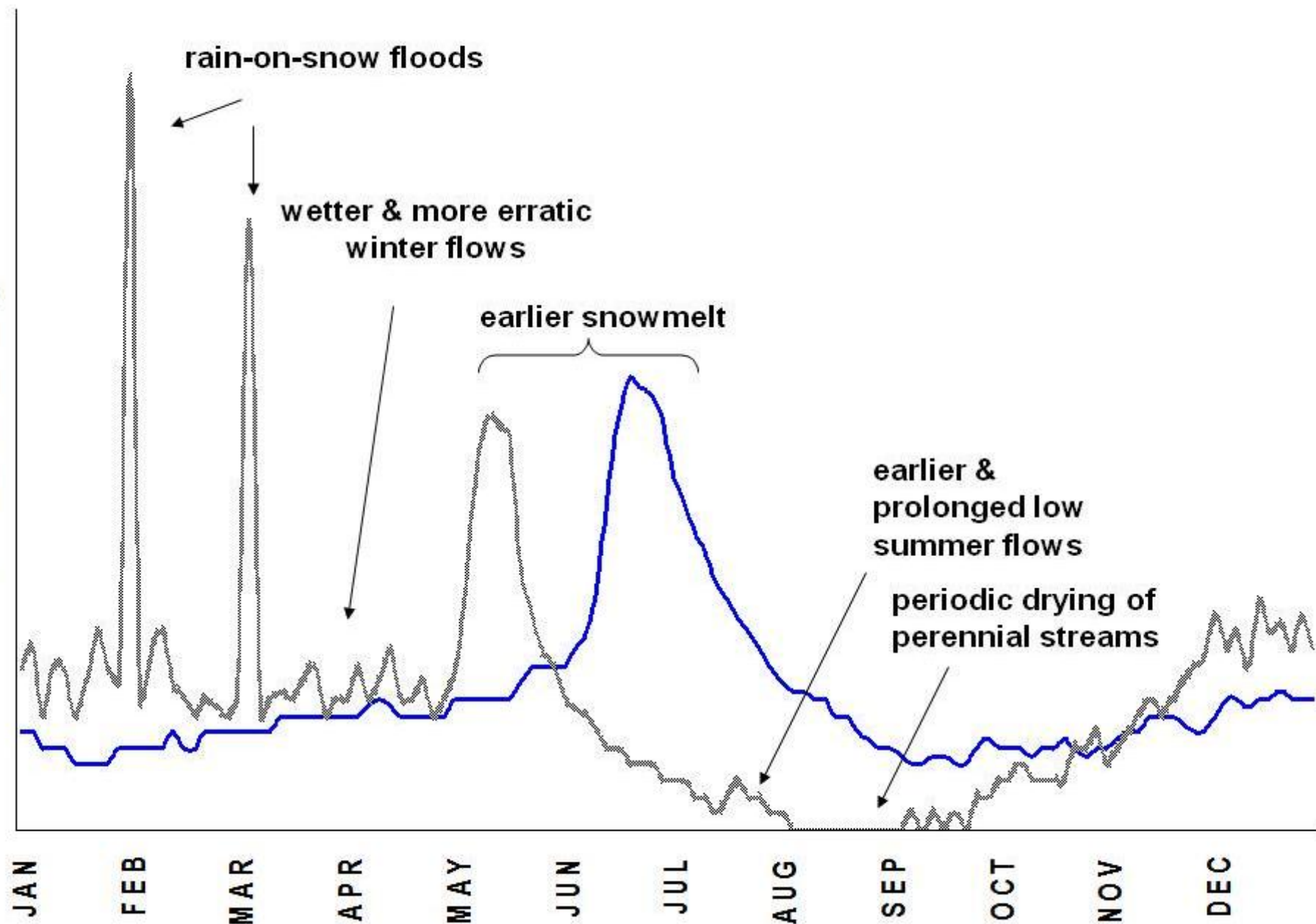


# Hydrology

- 55,000 acre watershed
- Backwater promotes flooding
- High groundwater level (river dependent)
- **Changing**



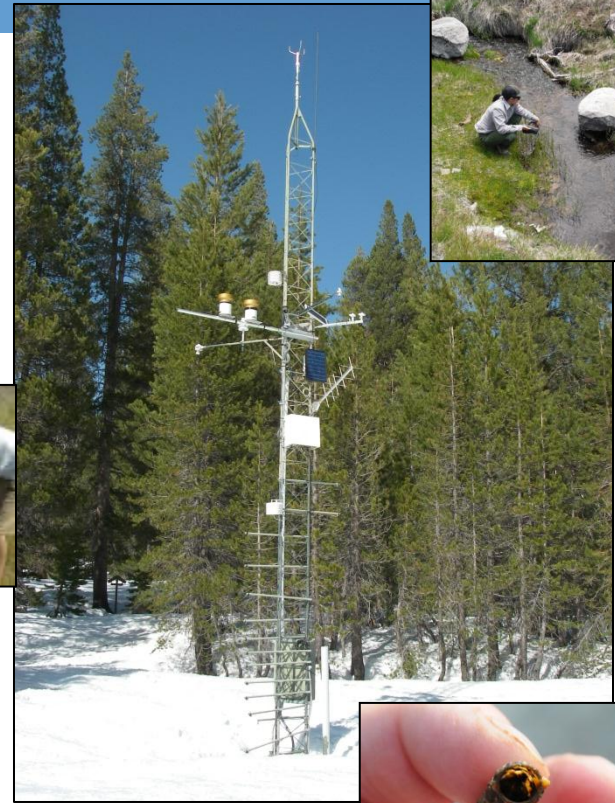
Stream Discharge



- David Herbst, Sierra Nevada Aquatic Research Lab

# Research\Monitoring to establish baseline and detect trends

- Weather and climate
  - CAP
  - Meteorological station installed in 2006
  - Snow survey course established in 2010
  - Snow pillow Installed in 2009
- Air Quality
  - Several studies beginning in 2007
  - Ongoing monitoring of ozone and PM2.5 and nitrogen
- Hydrology
  - USGS gage
  - Manual discharge measurements
  - Water quality (dissolved oxygen, pH, specific conductance, temperature)
  - Discharge and water quality on tributaries
  - Surface water/groundwater relationship in Soda Springs Meadow
  - Riverbank condition assessment
- Wildlife
  - Mist netting and banding in 2002-2010
  - Annual point counts (I&M)
  - Vertebrate inventory
  - Bat inventory
  - Invertebrate inventory (terrestrial)
  - Benthic macroinvertebrate survey
- Vegetation
  - Wetland index site (I&M)
  - CRAM (2005)
  - Inventory (2001)
  - Limited monitoring of nonnative species
  - Photo monitoring (2002)



# What does managing as a refugium mean?



# Persistence (resistance and resilience)

- Ecological restoration (riverbanks, informal trails, impacted areas)
- Reduce stressors such as pumice deposits from stormwater drainage
- Removing conifer encroachment
- Invasive species management (prevention and treatment)
- Fire/mechanical treatments
- Managing visitor use
- Increase public awareness of impacts and change – inspire personal responsibility.



# Challenge

- Species often referred to as “naturalized” (*Poa annua*, *Poa pratensis*, *Phleum pratense*, *Taraxacum officinale*)
- Not dominant but widely distributed – how will they respond to climate change?
- Aggressive removal?
- Experimental
- Determining whether new species that are climate immigrants are a component of meadow habitat process and structure, or are undesirable and might disrupt ecosystem functions.



Lindsay

Rasbak

Hugo.arg.

NPS

# Where do we go from here?

## MONITOR/RESEARCH

- We know we have physical components; cooler, moister, shady - but need to quantify vulnerabilities
- We are unsure about the ecological: should we identify particular species or suite of species or ecological function
- Vulnerability assessments
- Ecological niche models – estimate potential distribution
- Size – is it adequate? Depends on the size and ecology of the species (Ashcroft *et al.* 2009).
- Connectivity across the landscape
- Capacity – potential for facilitating species persistence (Keppel *et al.* 2015)
- Accessibility

# Where do we go from here?

## **MANAGE**

- Reduce stressors – recognize external ones remain such as air quality
- Develop short and medium term action plan
- Develop response plan for potential catastrophic events (e.g. high severity fire)
- Flexible approaches that promote reversible and incremental steps, and encourage ongoing learning and modification – no regrets

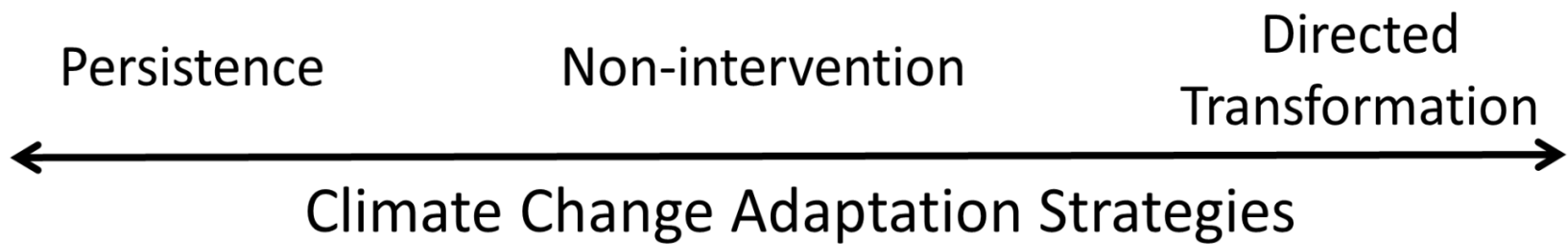
# Where do we go from here?

## **EDUCATE\SHARE**

- Expand the learning and stories of losses and successes to multiple audiences
- Citizen Science
- Climate change curriculum focused on hydrology, snowpack and phenology to engage local youth
- Interpretation

# Challenges and Questions

- Who/What is the refugia for? Function or a particular species? Do we focus on species close to being extirpated or those that strongly influence ecosystem function and structure?
- Timescale - significant limitations for predicting duration
  - Uncertainty of climate change predictions
  - Long term impacts of drought and high temperature
  - Tipping points for the buffering capacity of refugia – are they more vulnerable?
- Non-intervention (restraint)
- Directed Transformation (realignment) - when (if ever) is it time for intervention?
  - How do we separate what we value from what is important ecologically?
  - Organic Act – natural processes
  - Wilderness



Fisichelli, N, Schuurman, G, Hawkins Hoffman, C. 2015. in review.