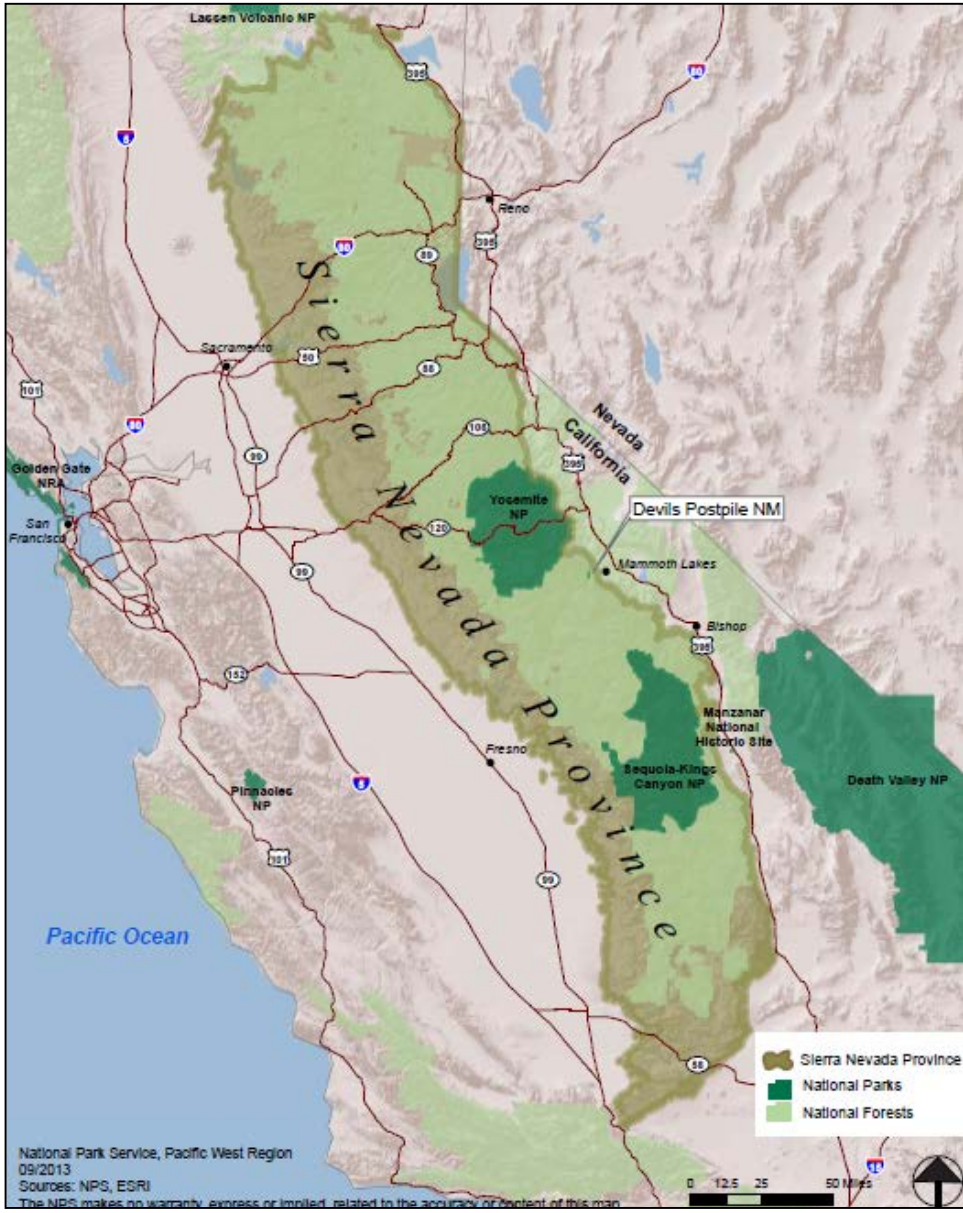
National Park Service
U.S. Department of the Interior

Devils Postpile National Monument

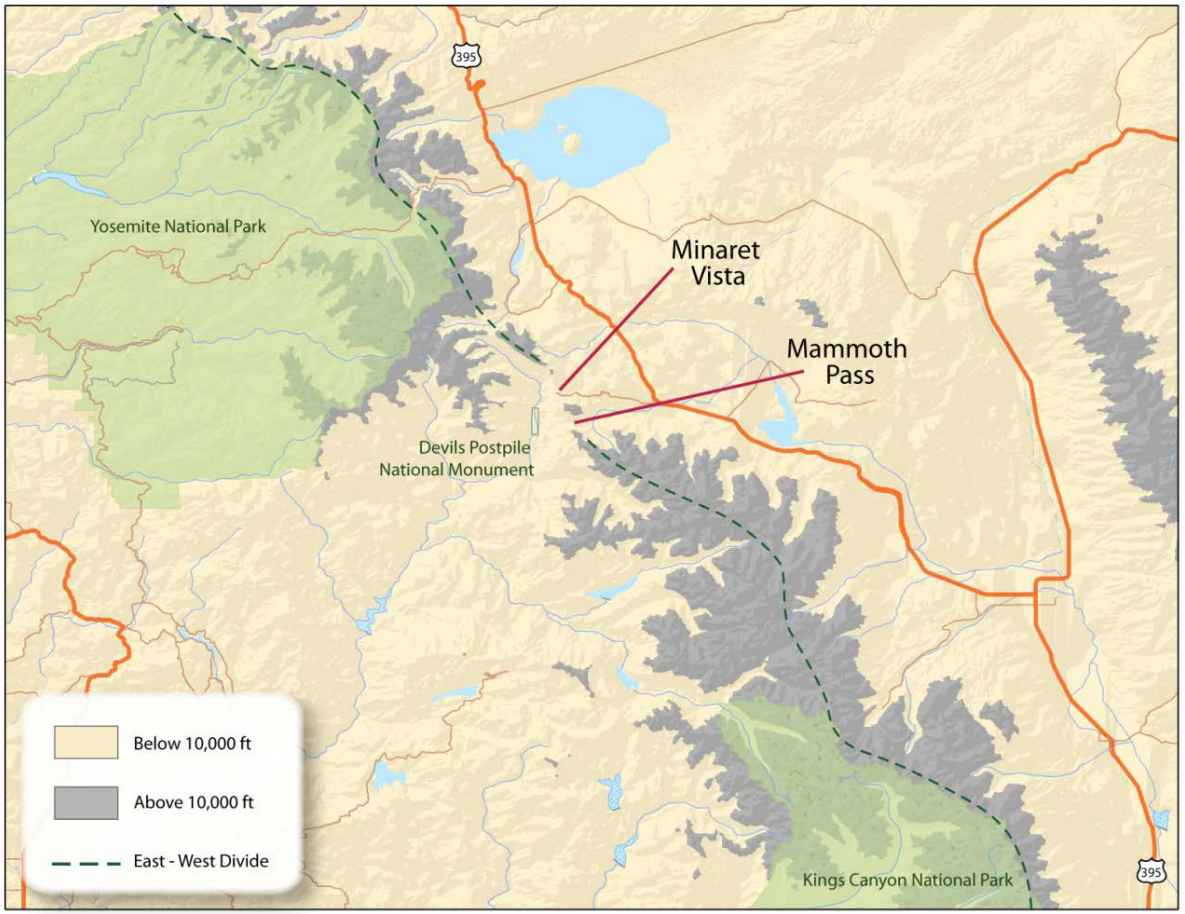
Managing Soda Springs Meadow as a Climate Change Refugium

- 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



Location & Migratory Corridors

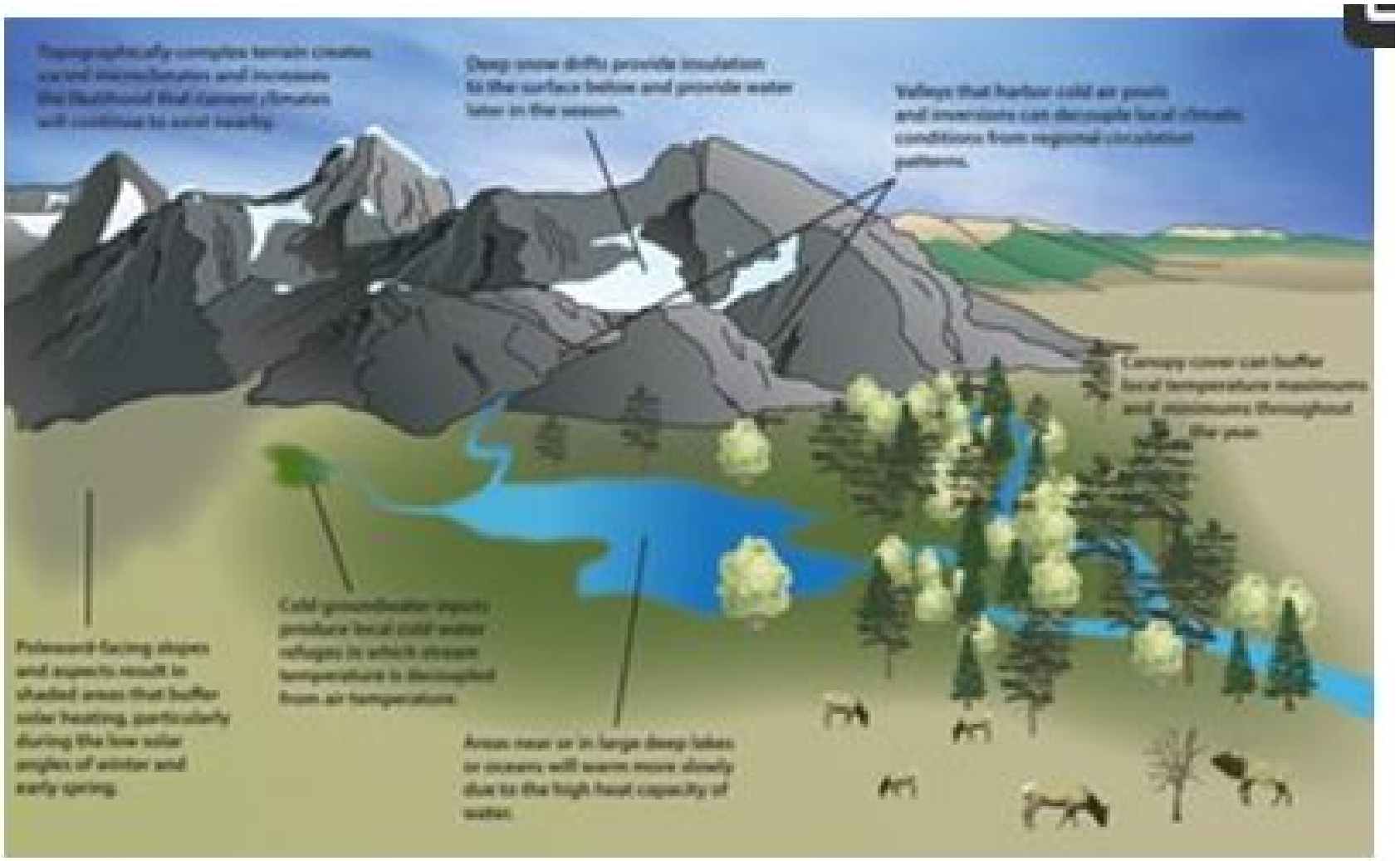
- In a transitional zone between Great Basin and Sierra Nevada, east and west Sierra Nevada = high diversity
- Near low mountain passes that that could facilitate migration
- Relatively isolated from direct anthropogenic influences (wilderness)



Ecological Diversity

- 380 plant species
- 114 bird species
- Low nonnative presence
  - Cheatgrass
  - Forage grasses
  - Cowbirds
  - STABLE?

DEPO's: Physical Characteristics buffer warming



Cooling/Hydrology

- Large watershed
- with snow melt rivers and groundwater
- River/meadows cooling
- Increased humidity
- Backwater promotes flooding
- High groundwater level (river dependent) cooling
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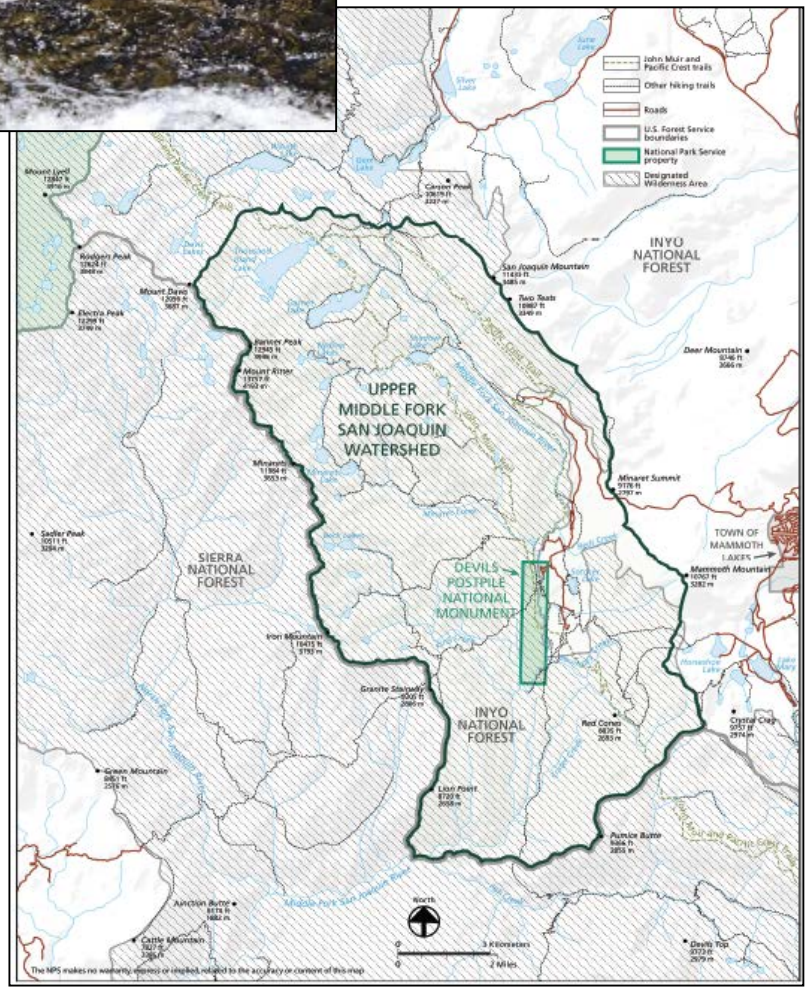


Shading: Canyon/Canopy

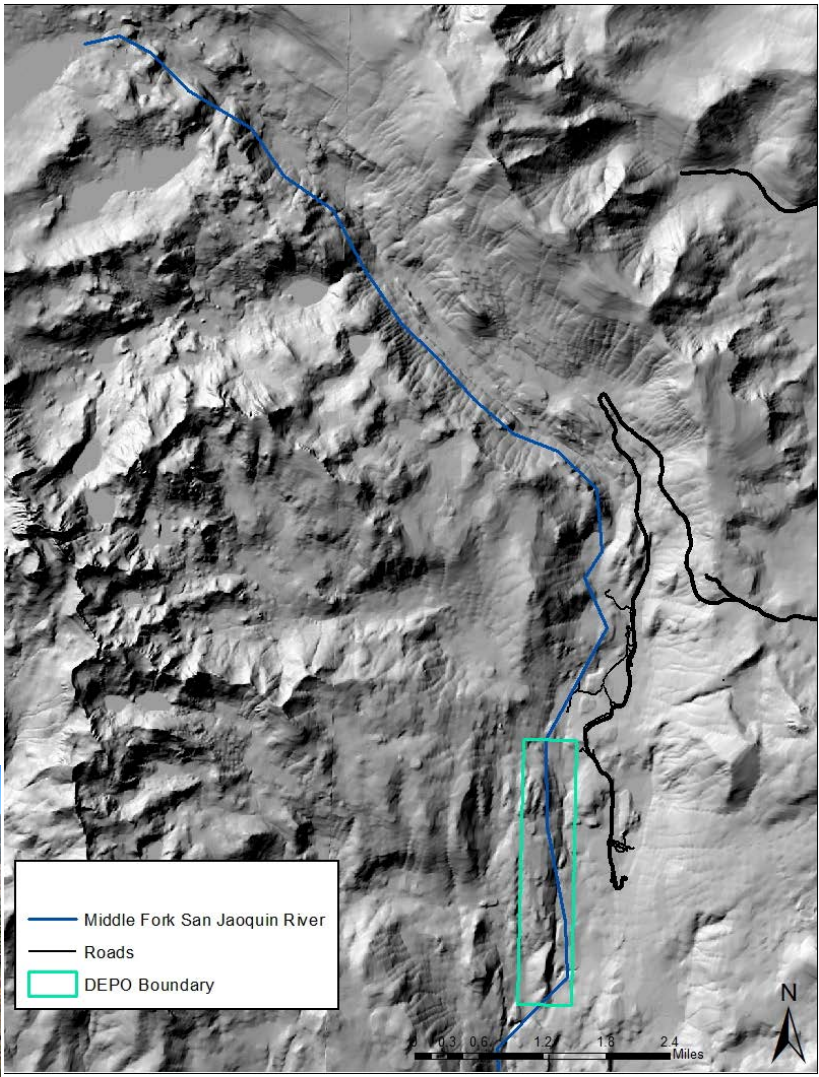
Topography:

- North-south river valley promotes microclimate heterogeneity, shading

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

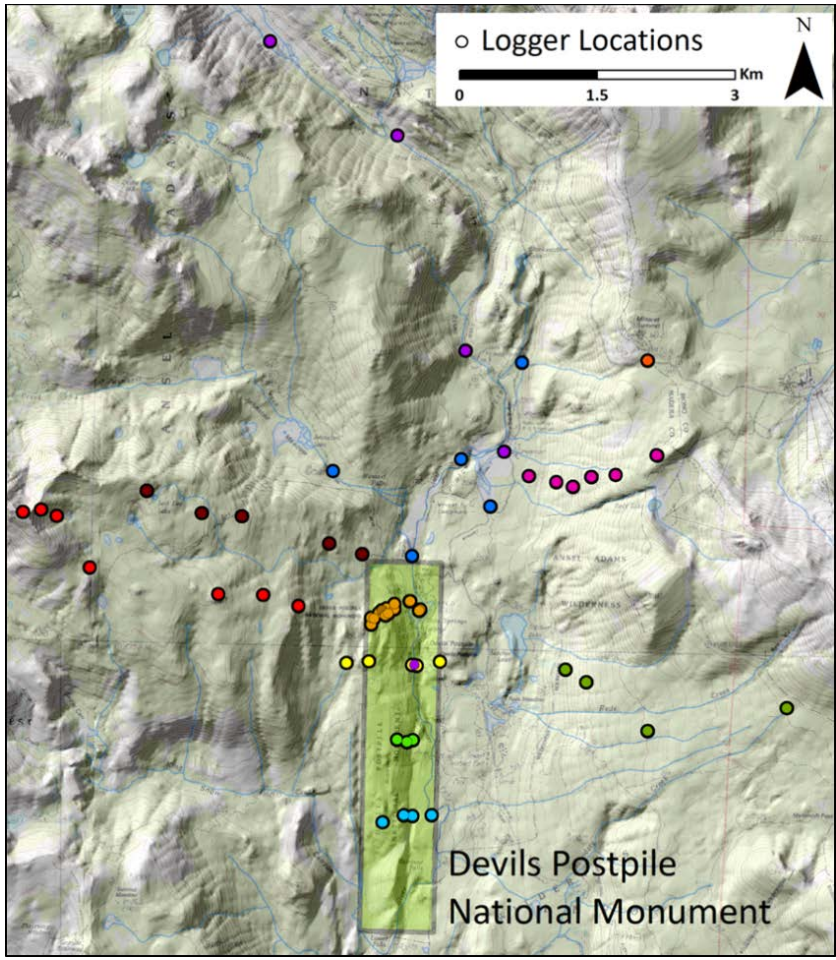
Canopy:

- 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**



Nighttime Relief from Hot Spells within a Mountain River Corridor - Cold Air Pooling in Devils Postpile National Monument”

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- Cold air pooling may be an attribute for climate change refugia
- Complex mountainous terrain like the Sierra Nevada may provide POSSIBLE cold air refuges in a warming climate.
- DEPO is a case study/natural laboratory
- Value of baseline, ongoing observations to inform science and management

What does managing as a refugium mean?

Start with Resilience…..

- Ecological restoration (riverbanks, informal trails, impacted areas)
- Reduce stressors such as pumice deposits from stormwater drainage and invasive species introductions (less control)
- Removing conifer encroachment
- Reduce non-native species
- Fire
- Managing visitor use
- Increase public awareness of impacts and change – inspire personal responsibility.

Resilience only or add Persistence?

- Workshop of 18 scientists and managers, and interns, following the seven step process, the group considered a primary management goal for the meadow, assessed known climate vulnerabilities, discussed climate change refugia attributes of the area, and then further refined the management goal.
- This led the group to explore the potential of managing Soda Springs Meadow as a refugium, with a goal of *persistence* rather than the more common ecosystem management goal of *resilience.*
- This is an important distinction because managing for persistence relies on strategies to “resist change” through management intervention and conservation of target species and ecosystems (Weeks *et al.* in draft). This allowed the group to focus on developing potential actions to maintain Soda Springs Meadow as a wetland and identify what knowledge is needed to strive for the persistence goal.

Where are current management goals to manage as a meadow refugium?

- **Knowledge-focused Goals**
- Improve knowledge of status and trends in biodiversity
- Improve knowledge of surface water and groundwater dynamics and drivers of trends
- Improve knowledge of groundwater/ecosystem relationships
- Understand climate vulnerabilities
- Continue to investigate the viability of Soda Springs Meadow as a climate change refugium (including CAP phenomenon)
- Understand management implications and actions associated with persistence strategy

- **Experience-focused Goals**
- Provide opportunities for learning and inspiration including science learning (transferability, interdisciplinary)
- Continue to provide recreational opportunities consistent with persistence goal

- **Management-focused Goals**
- Strategically control non-native plants to promote biodiversity
- Promote ecologically-based fire management
- Reduce local anthropogenic impacts to the meadow ecosystem
- **Initiate actions to support meadow persistence**

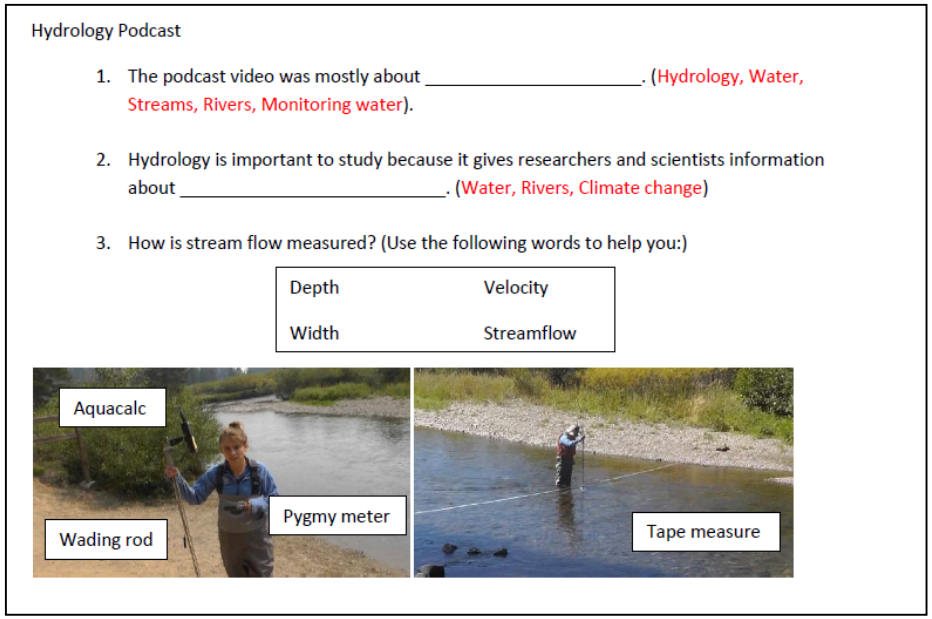
Knowledge Focused Goals

MANAGE and SCIENCE TO INFORM MANAGERS

- 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

Experience Focused Goals

- Provide opportunities for learning and inspiration including science learning (transferability, interdisciplinary)
- Continue to provide recreational opportunities adjacent to meadow including interpretation consistent with persistence goal.
- Expand the learning and stories of losses and successes to multiple audiences
- Climate change curriculum focused on hydrology, snowpack and phenology to engage local youth



Management Focused Challenges

Initiate actions to support meadow persistence…..

- Species often referred to as “naturalized” (*Poa annua, Poa pratensis, Phleum pratense, Taraxacum offionale*)
- 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

Further Challenges and Questions

- Who is the refugia for? Do you prioritize species? Do we focus on replacing species in ecosystem function niches that can no longer survive?
- Do we focus on those that on close to being extirpated or those that strongly influence ecosystem components?
- Timescale - significant limitations to predicting duration
  - Long term impacts of drought and high temps – are physical enough to buffer?
  - Tipping points for the buffering capacity of refugia – are they more vulnerable?
- When should resistance move to 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

Refugia:
Islands of Hope