National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



Limber Pine Monitoring at Craters of the Moon National Monument and Preserve

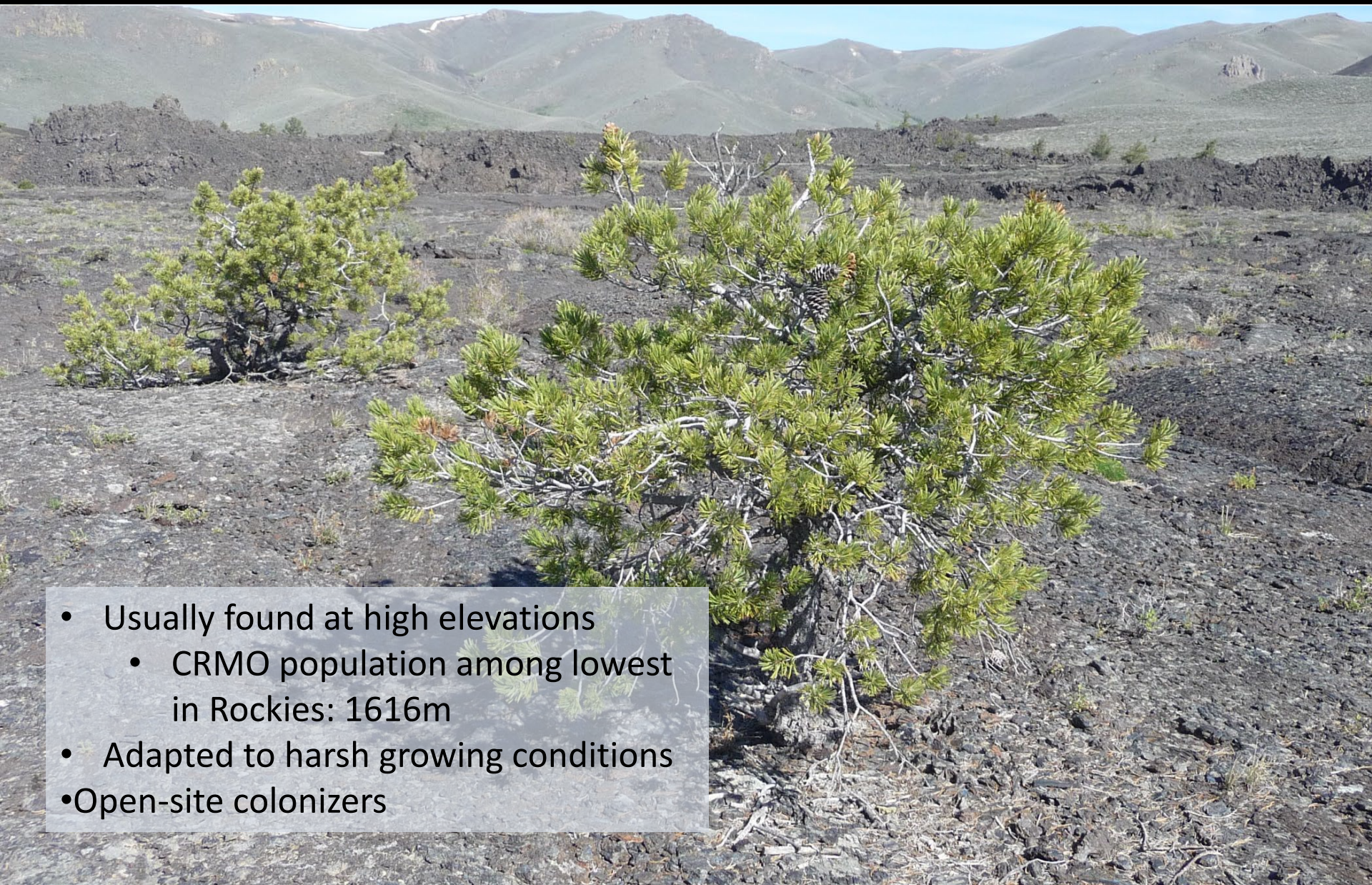
National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Pinus flexilis

- Pioneer and foundational species
- Widely distributed
- Long-lived trees (1350 yrs in CRMO)
- Focal resource of park



National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



- Usually found at high elevations
  - CRMO population among lowest in Rockies: 1616m
- Adapted to harsh growing conditions
- Open-site colonizers

Reproduction

- Trees 20-50 (200) years old at maturity
- Cones take 2 years to mature
- Largest seed of NA high-elevation white pine
- Gravity, small mammal dispersal possible but undesirable
- Closely associated with Clark's nutcracker





National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



Close ties to Clark's Nutcracker

- Responsible for seed distribution through caching

National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network









Rangewide Threats

- Introduced pathogens: white pine blister rust
- Native pests: mountain pine beetle, dwarf mistletoe
- High-intensity wildfires resulting from historic fire suppression
- Drought
- Precipitation as rain instead of snow

National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Limber pine dwarf mistletoe (*Arceuthobium cyanocarpum*)





National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



Limber pine with dwarf mistletoe

Pine pitch mass borer
(*Dioryctria spp.*)



Pine needle scale
(*Chionaspis pinifoliae*?)



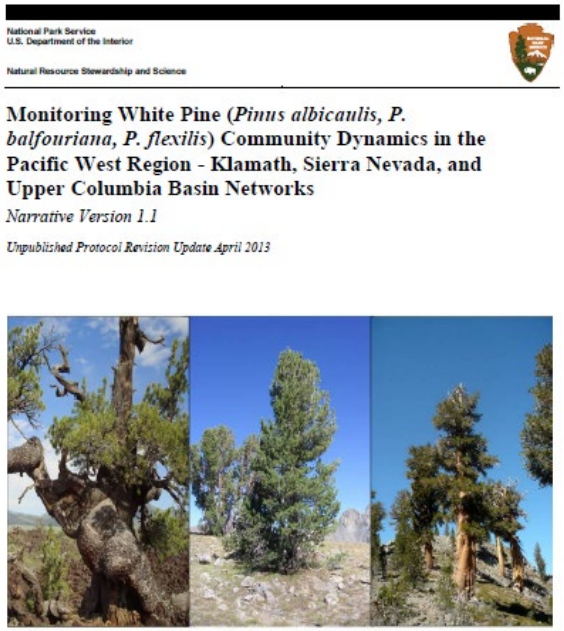
1960's limber pine culling effort to eradicate dwarf mistletoe within Craters of the Moon





Collaborative White Pine Monitoring Protocol

- Klamath (KLMN)
- Sierra Nevada (SIEN)
- Upper Columbia Basin (UCBN)
- Recent addition of Mojave Desert Network (MOJN)

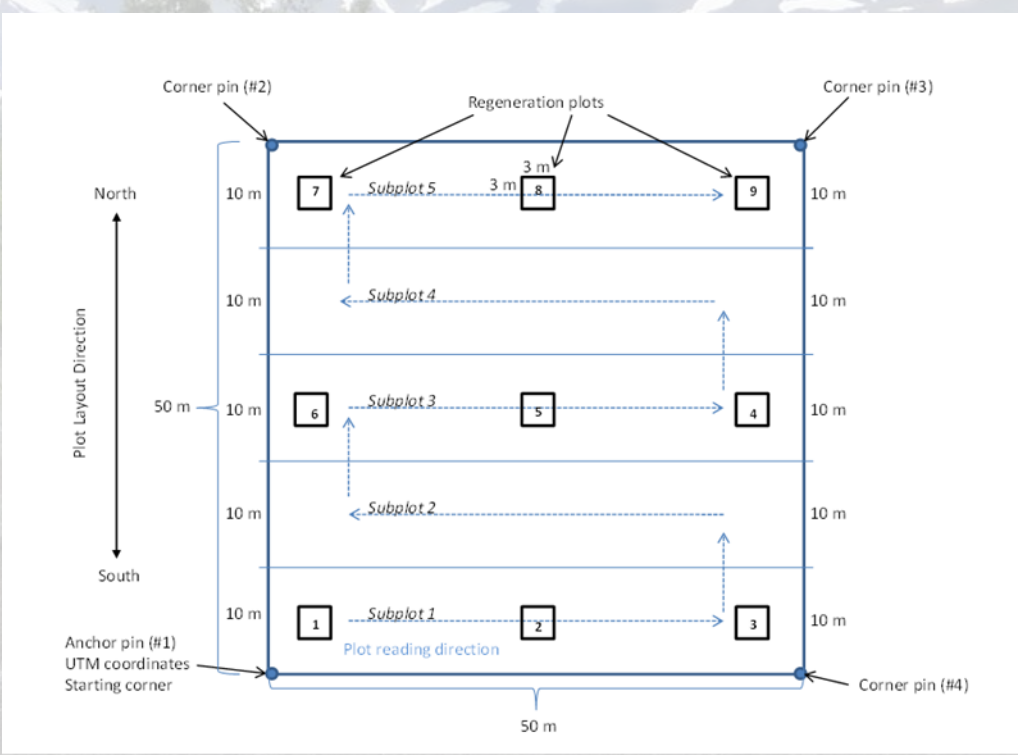


McKinney et al. 2013

Collaborative White Pine Monitoring Protocol

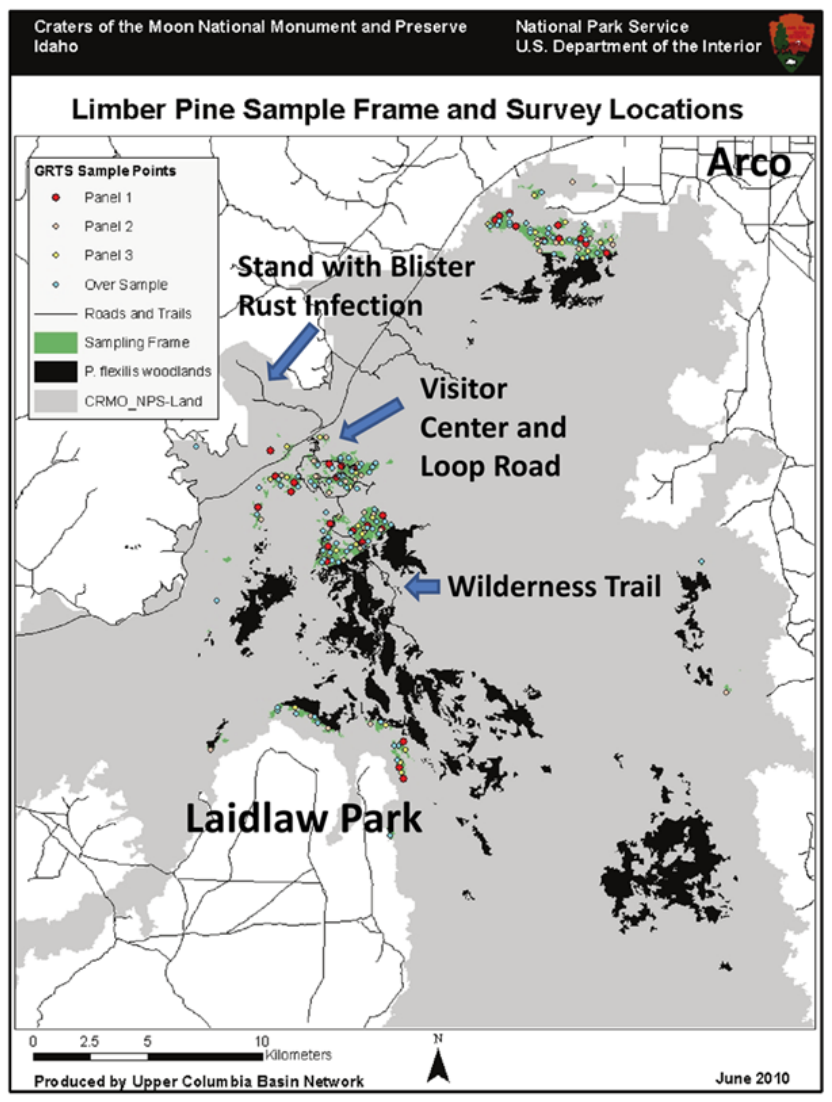
Methods

- Stand structure
  - Live/dead
  - Size
- Stand composition
  - Tree species
- Pests and Pathogens
  - Presence
  - Severity
- Reproduction
  - Cone presence
  - Tree regeneration



50 m x 50 m plot layout diagram

National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



Craters of the Moon

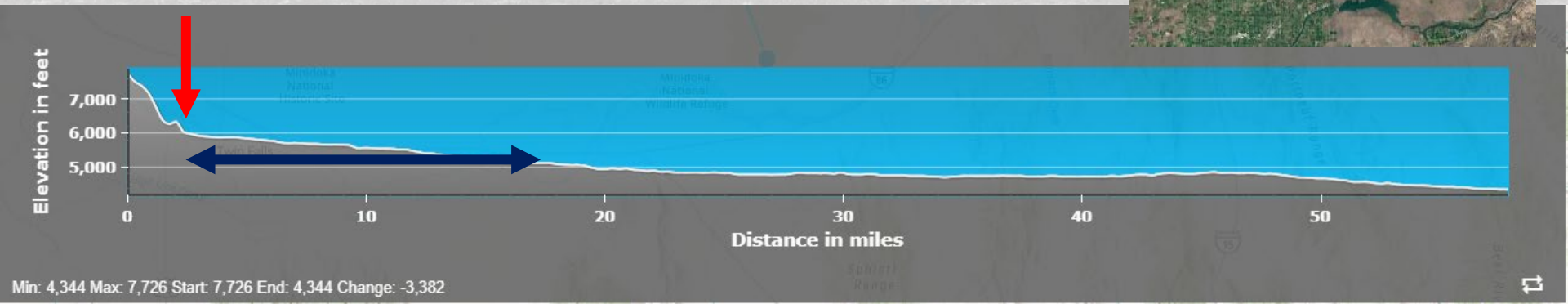
- 93 plots, 3 panels
- Sampling frame includes *P. flexilis* woodland associations
- Areas excluded:
  - >2 km from roads or trails
  - >30 degree slopes
- 1,260 ha (20%) of the woodland associations in CRMO
- Monitoring occurs across a 300 m elevational gradient

Geology of Craters of the Moon National Monument and Preserve

- Located on the Snake River Plain in Southern Idaho
- Gentle topography on landscape scale due to successive lava flows
  - Surface topography extremely complex
- Relatively young flows
  - 2000-15000 years ago
- Tree molds







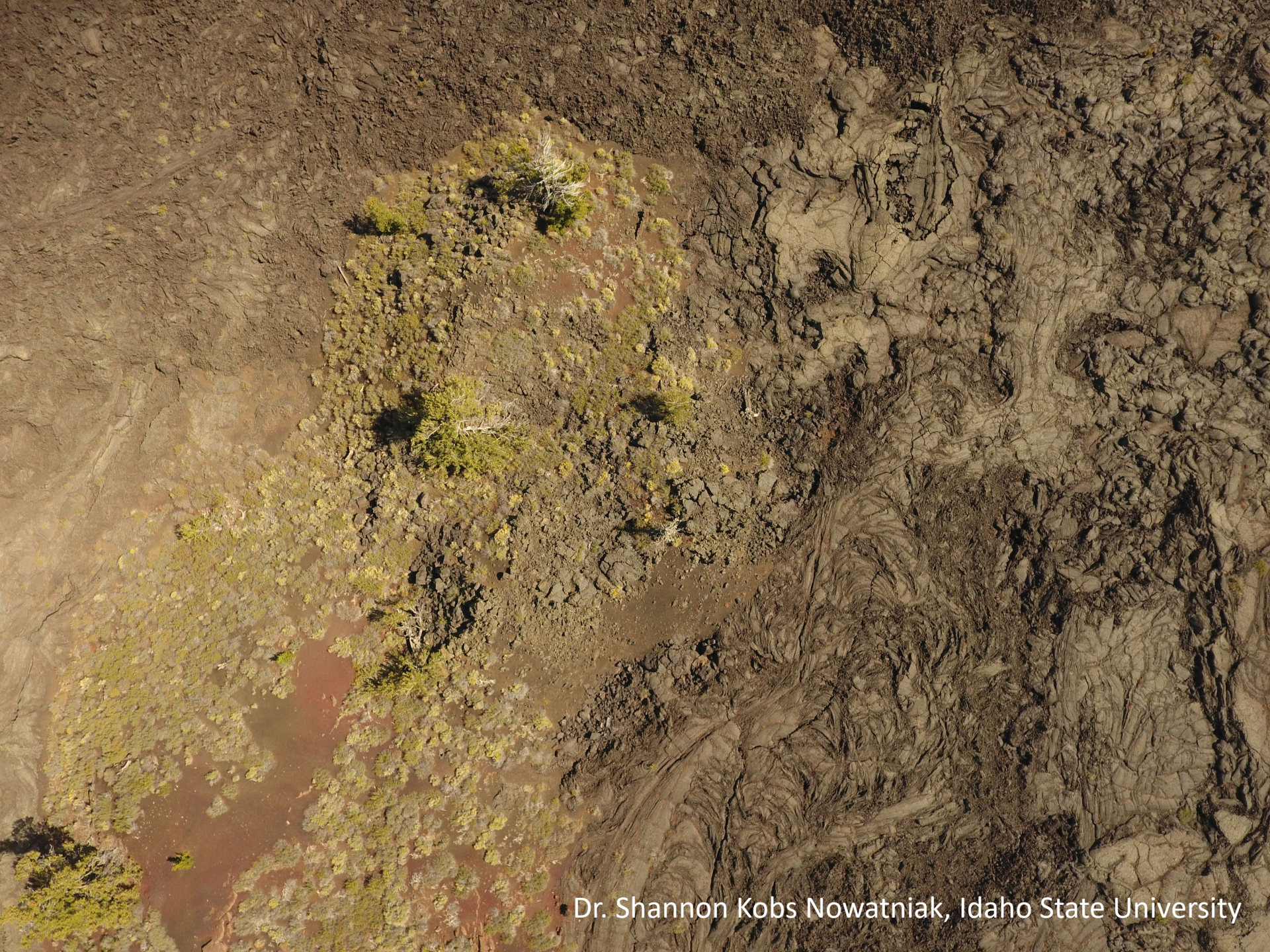










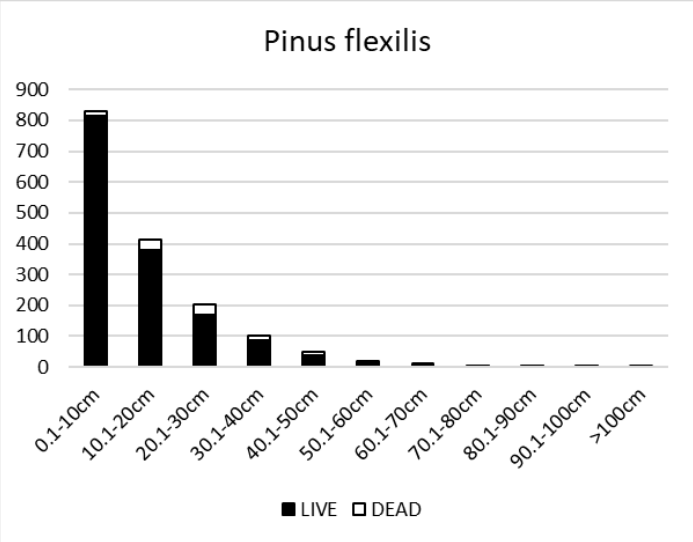

Dr. Shannon Kobs Nowatniak, Idaho State University

General Status (2017-2019)

- Low stand density
  - Min: 1 *P. flexilis* tree
  - Max: 118 *P. flexilis* (5 dead)
- Most trees are *P. flexilis*
  (1515 live/119 dead)
  - *Pseudotsuga menziesii* (61)
  - *Juniperus scopulorum* (85)

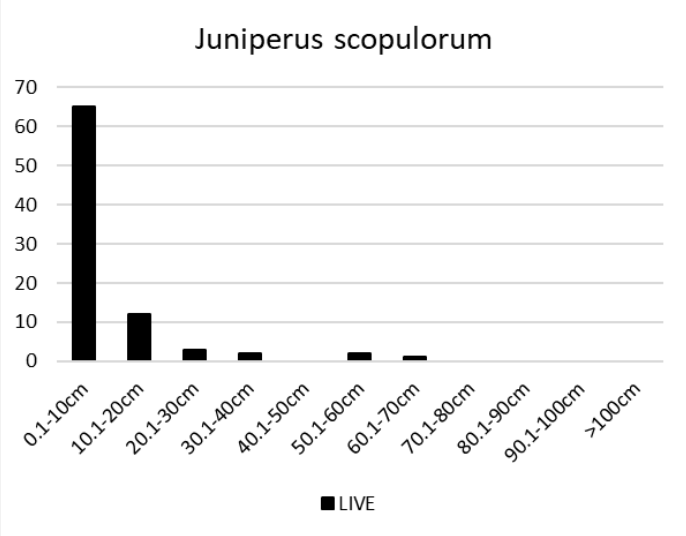


National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

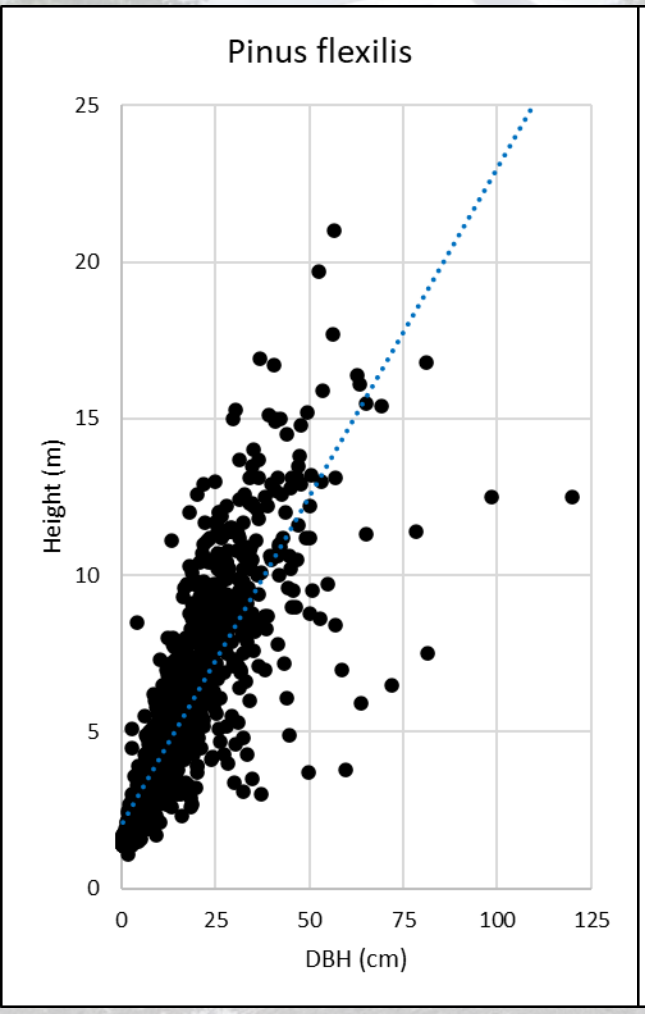


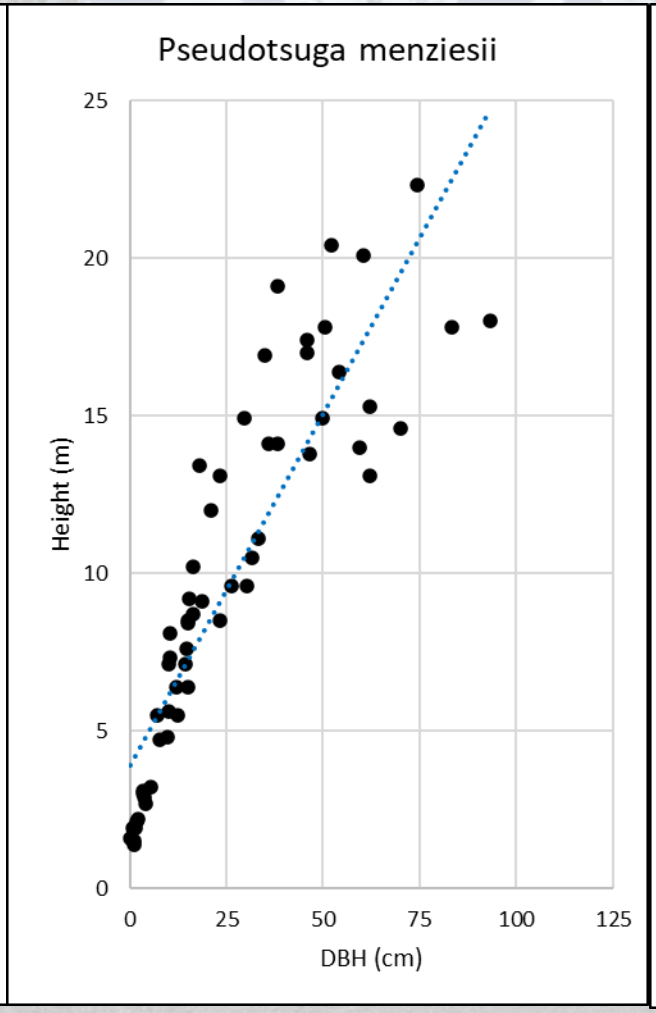
Size classes of trees within plots

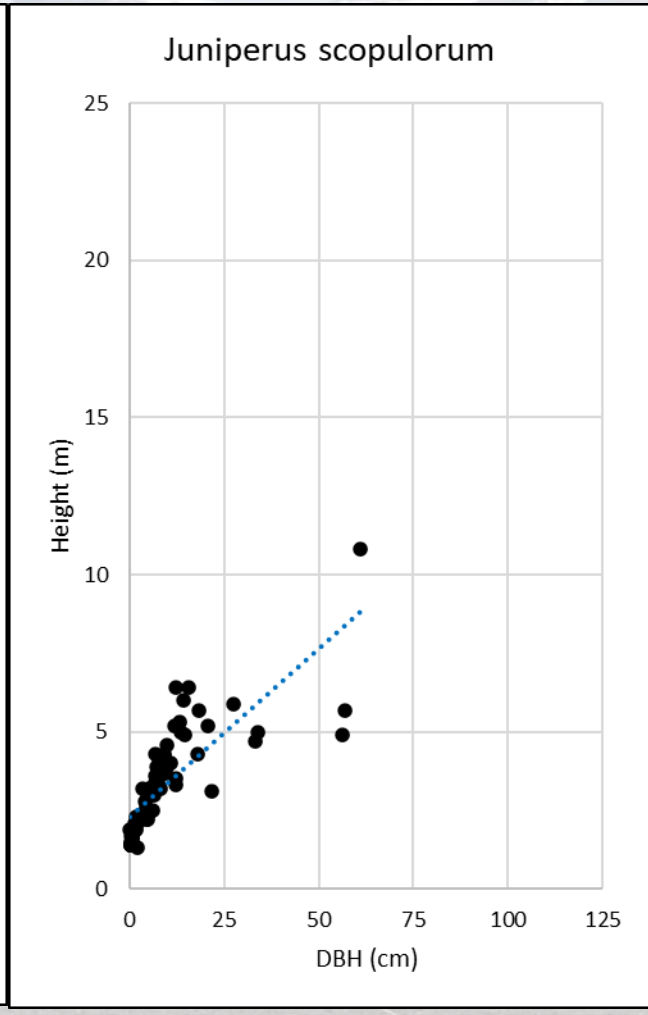




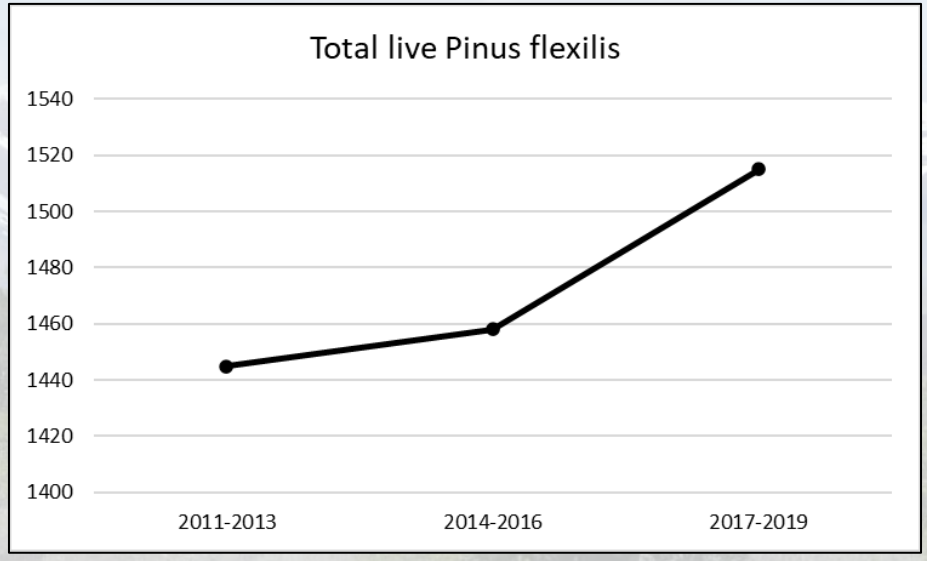
Stature by species (DBH x Height)

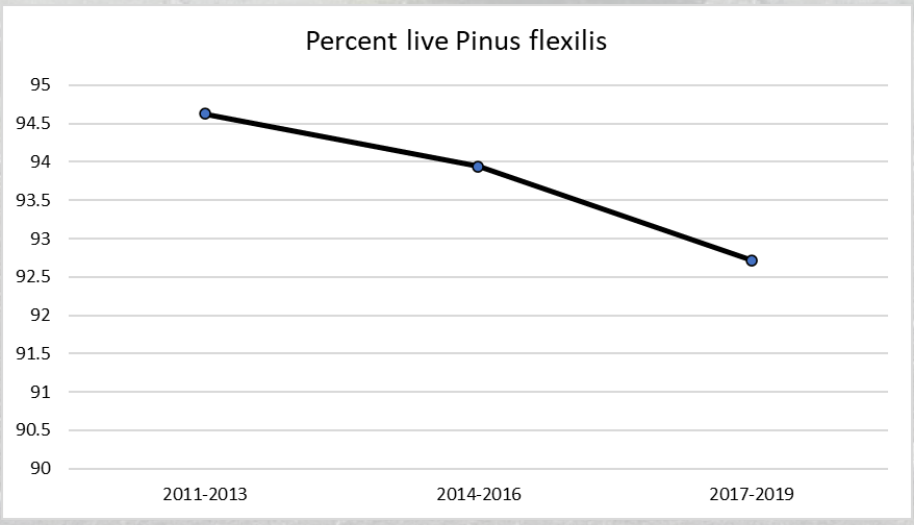




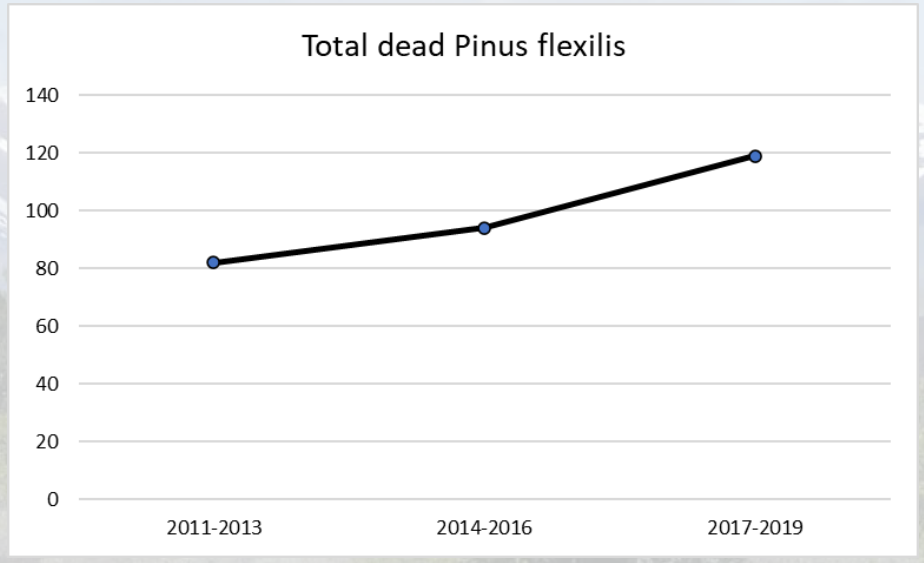


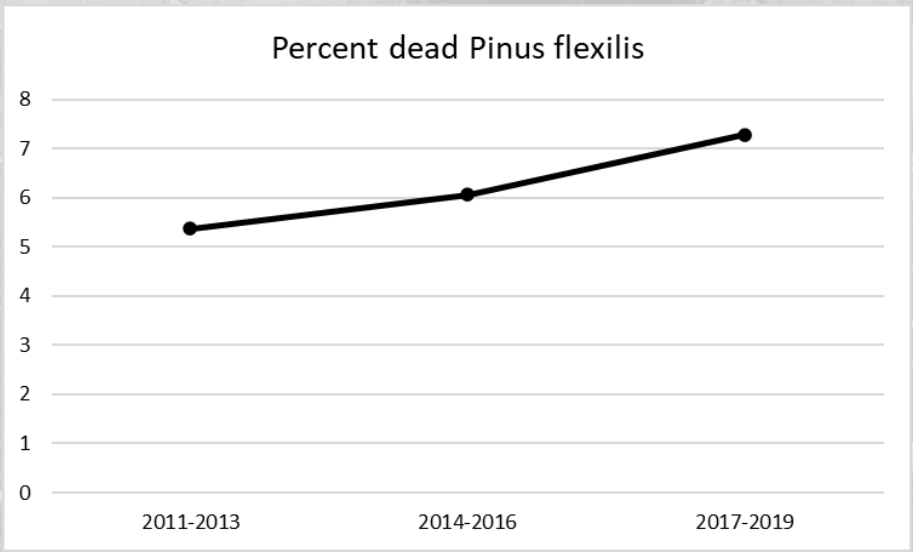
National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



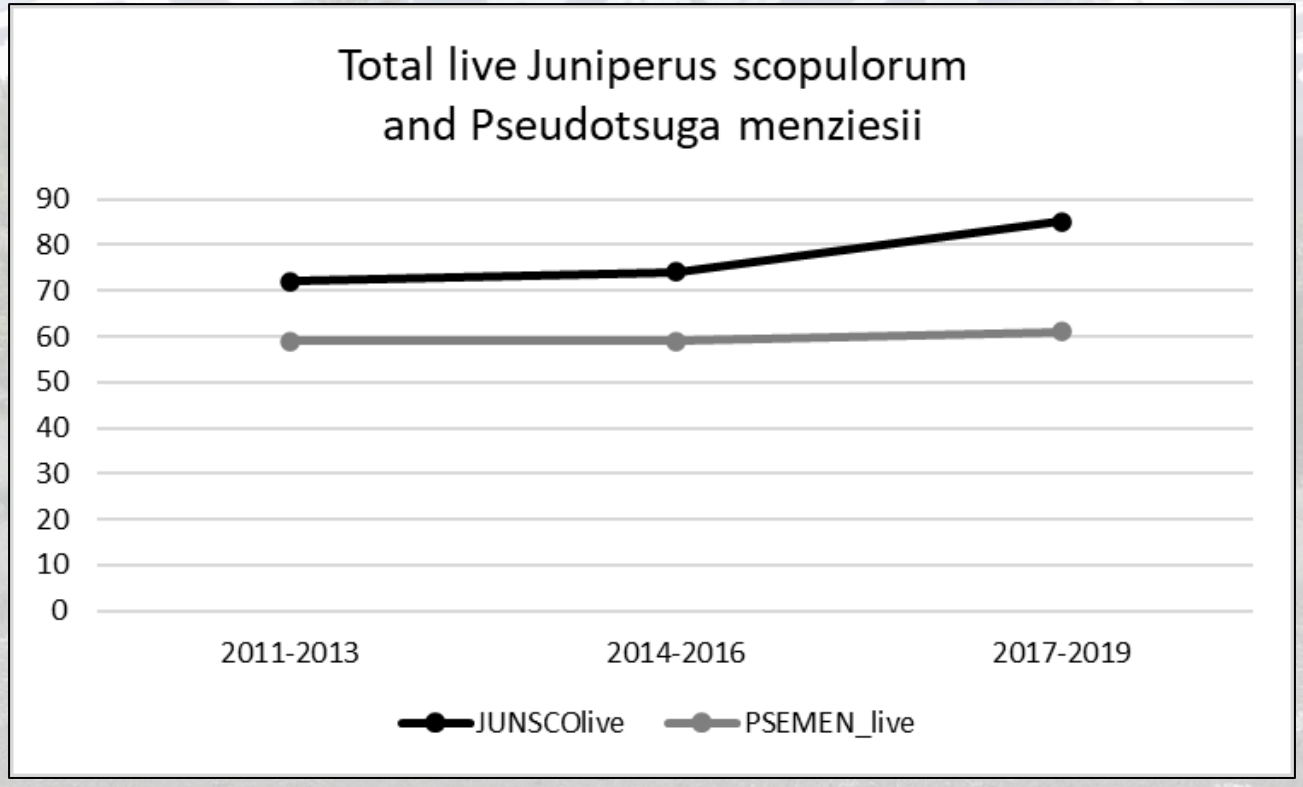


National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network





National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network



White Pine Blister Rust

- No infection found within or outside of plots during monitoring
- One isolated location in the extreme northern end of the site
  - Management has removed infected trees and branch infections
  - No evidence of infection since 2013



Mountain Pine Beetle

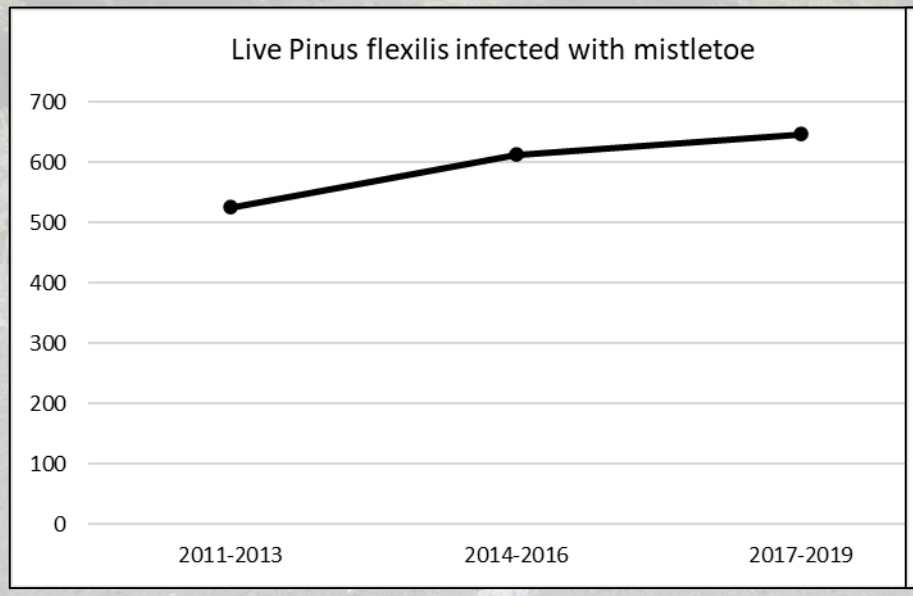
- Recorded just three times within plots
- No records during 2017-2019
- Found in isolated pockets of pine
  - A few individuals reproduce but densities fail to reach outbreak proportions
- Low tree density may prevent outbreaks but larger outbreak on nearby forest land could spill over

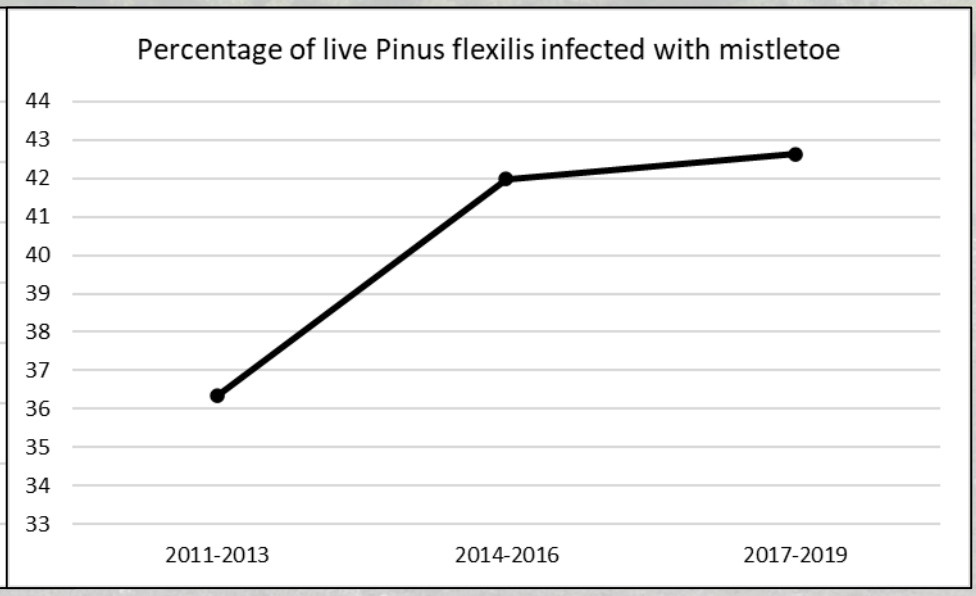


Dwarf mistletoe

- Infected trees found in 46% of plots
- Nearly 6.5% increase in overall tree infection
- Infection associated with larger diameter trees, northern aspects
- Most common recorded cause of death of *P. flexilis*

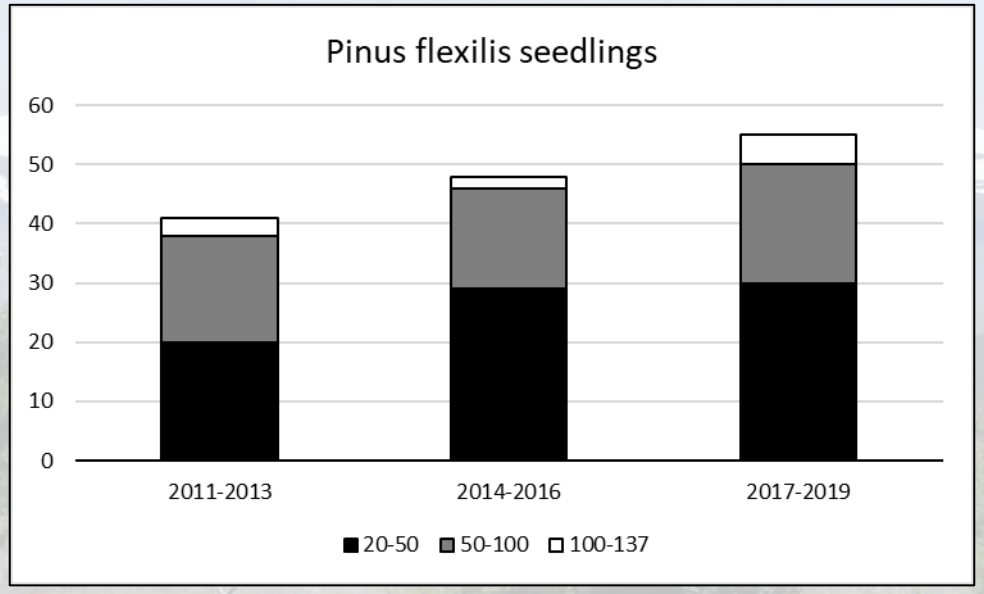


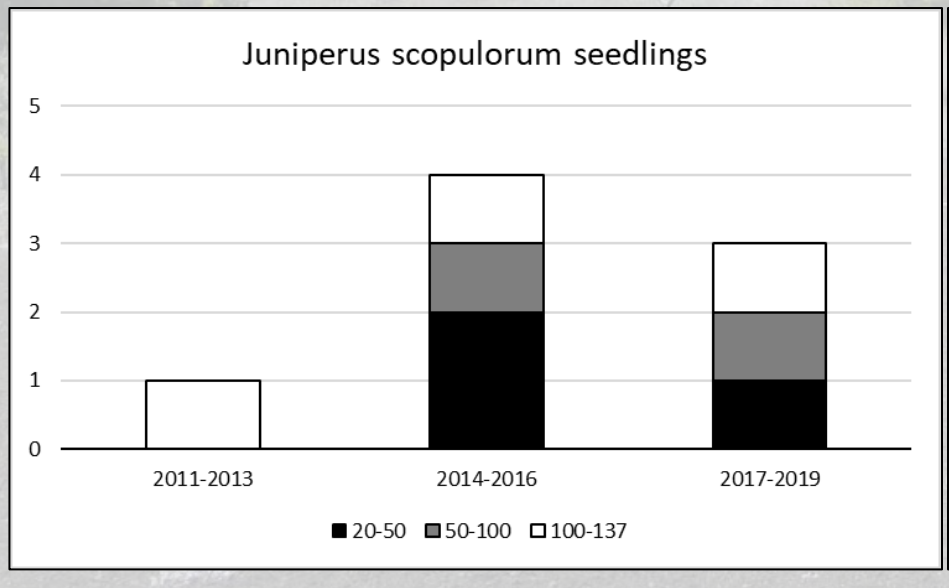


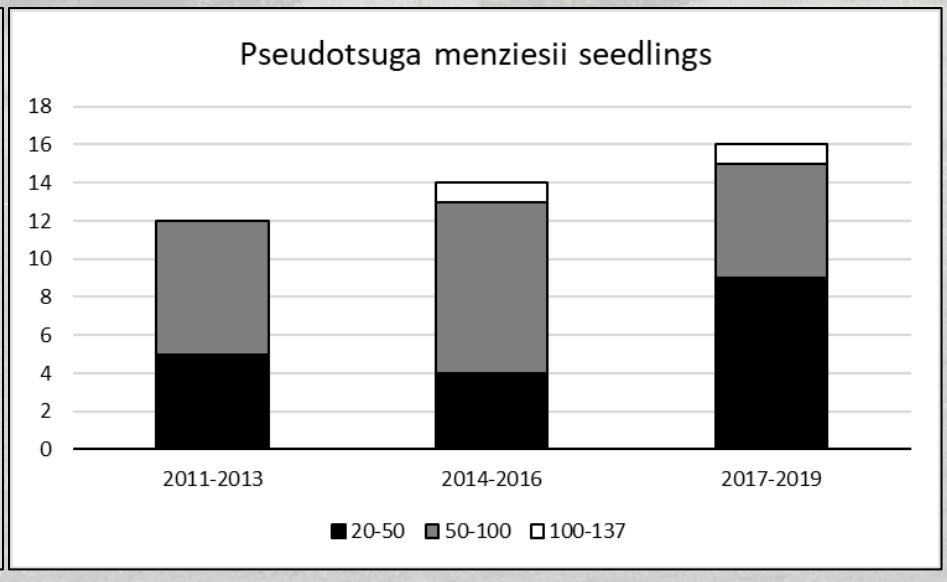


National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Regeneration







Ovulate Cones

- 63.3% live limber pine with cones (2017-2019)
- Larger trees more likely to produce cones
- Trees infected with dwarf mistletoe less likely to produce cones



Conclusion

- Tree density relatively low at CRMO but increasing
- Limber pine mortality increasing slightly
- Regeneration increasing, plot frequency about 78%
- White pine blister rust and mountain pine beetle presence remains low
- Dwarf mistletoe infection common (46% of plots and 42% of live *P. flexilis*)
- Ultimately, lower levels of WPBR and mountain pine beetle, similar levels of dwarf mistletoe when compared to other limber pine stands within the range

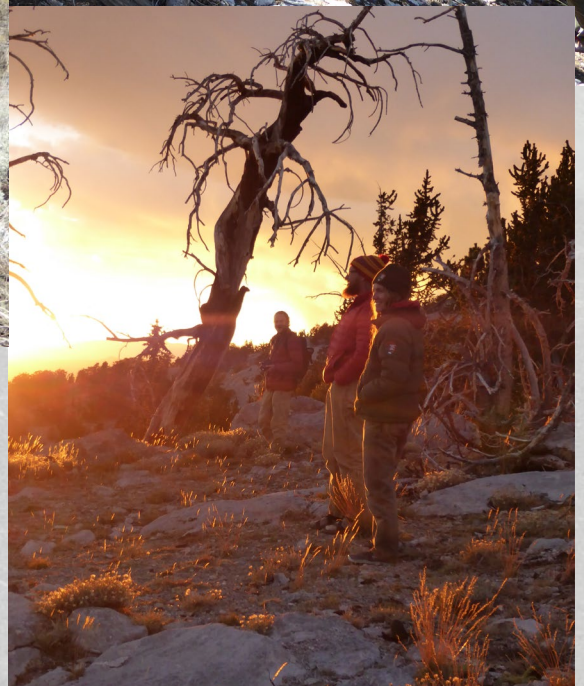


National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network











Related Woodland Projects

National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Douglas-fir tussock moth monitoring: Craters of the Moon NM&P





National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Limber pine and bristlecone pine monitoring: Great Basin National Park





National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Aspen monitoring:
Craters of the Moon NM&P
City of Rocks NR
Grand Canyon/Parashant NM
Great Basin NP





National Park Service
Inventory and Monitoring Program
Upper Columbia Basin Network

Pinyon pine monitoring:
City of Rocks National Reserve






Thank you!