

Restoring the Crown Jewels: The High Five Pines and Why We Need Them

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WHITEBARK PINE
ECOSYSTEM FOUNDATION

University of Colorado Denver 

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Crown of the Continent Ecosystem

Encompasses

- Relatively undisturbed wildlands.
- Unsurpassed wildlife and plant biodiversity.
- Communities with keystone and apex predators.

Symbolizes

- Forest primeval.
- Traditional cultures.

Dynamic tension between anthropogenic activities vs. natural processes.



Forest Health Challenges

- Invasive pests, plants, and pathogens.
- Climate change.
 - Warming temperatures and changing hydrology.
 - Increasing mortality of older age classes.
 - Outbreaks of native forest insects.
 - Altered demographics and distributions.

The “High Five” Pines:

Play important ecological roles in high-mountain ecosystems (foundation species).

- Contribute considerable biodiversity to the Crown landscape (keystone species).
- Provide ecosystem services directly and indirectly benefiting humans.
- Enhance the aesthetics of the high-mountain experience.

Are “poster children” for the impact of current forest health challenges.

High elevation five-needle white pines— “high-five”
Genus *Pinus*, Subgenus *Strobus* .
Section *Quinquefoliae*, Subsection *Strobus*

Whitebark pine (*Pinus albicaulis*)

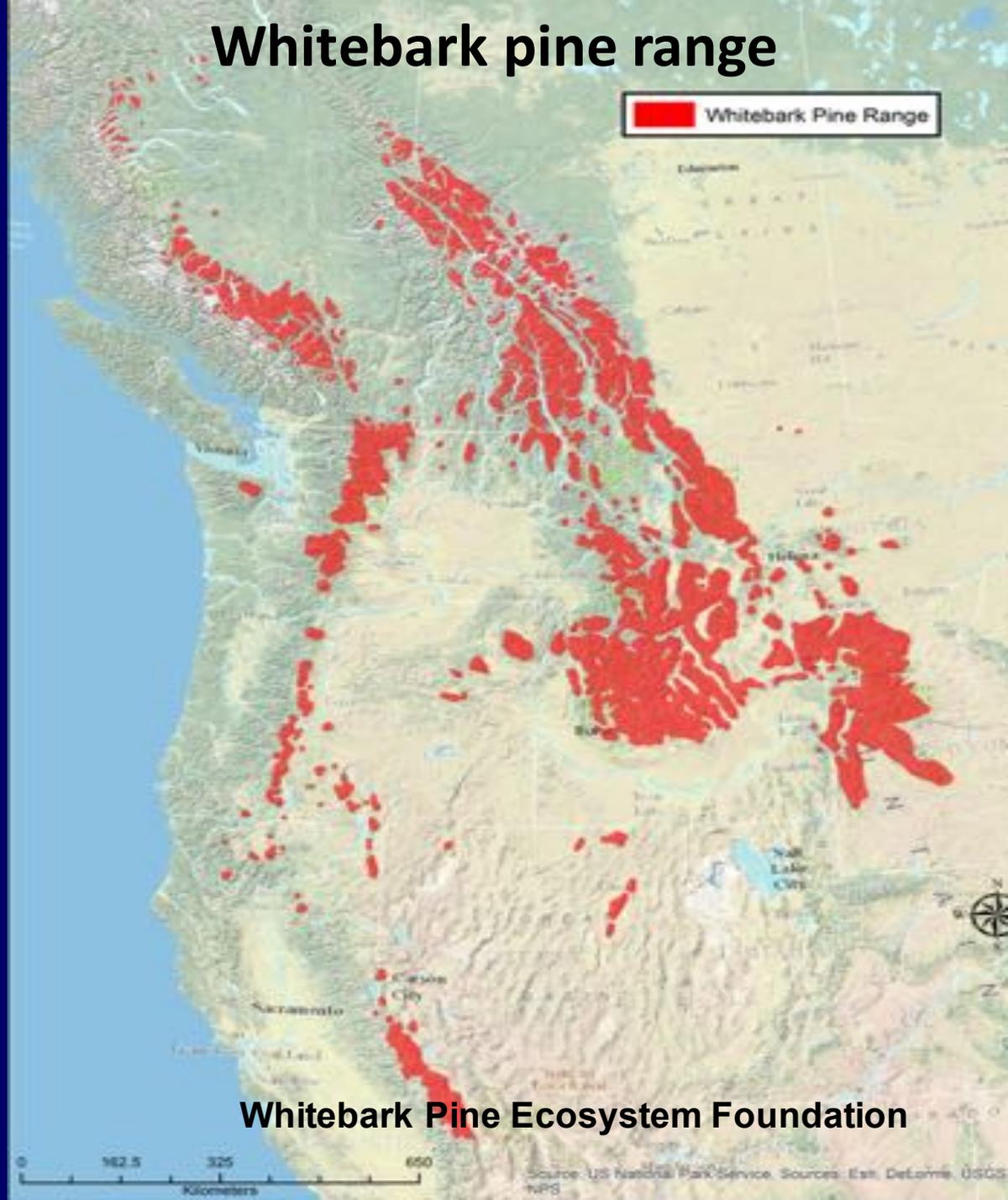


- Major component of high-elevation subalpine forest and treeline communities in the Crown.
- Tolerates exposed, arid sites and poor soils.

Whitebark pine range

Broadest latitudinal distribution of any five-needle white pine in North America.

- 37° to 55° N lat. (across 18°)
- 107° to 128° W long. (across 21°)
- From 900 to 3,660 m elevation across range.
- Narrow elevational range: subalpine and treeline.



Whitebark Pine Ecosystem Foundation



Wind River
Mountains, WY



Banff National Park
Alberta, Canada

Whitebark pine growth forms



Yosemite National Park,
CA



Rob Mutch Crater Lake National Park, OR

Limber pine (*Pinus flexilis*)



- In Canada, more widely distributed east of the Continental Divide than west.
- Lower elevation forest communities up to treeline.
- Patchy distribution—metapopulation structure.
- Sometimes mixed with whitebark pine in both subalpine and treeline communities.
- Tolerates arid, wind-swept sites and poor soils.



Broadest elevational distribution of any other five-needle white pine:

- Lower treeline to upper treeline.
- 850-3810 m.
- Range includes 19° lat. and 14° long.
- Along the eastern Front of the Crown, elevation typically ranges from 1350 to 1950 m.

Limber pine range





Limber pine growth forms

Shared ecology

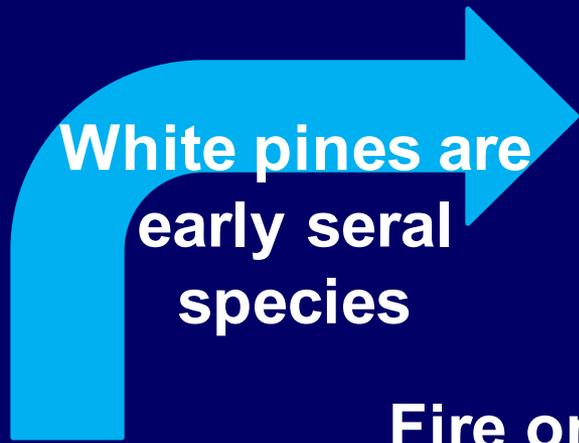
- Minor to major community components.
- Moderately to strongly shade intolerant.



Community type varies with site conditions: successional communities



Competitive replacement by shade-tolerant species



White pines are early seral species



Some white pines persist into late seral community



Fire or other disturbance renews early seral communities

Productive sites

Climax or self-replacing communities



**Arid, wind-swept sites,
nutrient-poor soils**

**Continuous but
sparse regeneration
over time**

**White pines co-
dominate or dominate
the community**

Shared seed dispersal mechanisms: both have large, wingless seeds

Pine

Mean seed mass

Cones

Whitebark

0.1745 g

Do not open

Limber

0.0926 g

Open



Whitebark pine

- Horizontally oriented cones on upswept branches.
- Seeds adapted for caching mode of dispersal.

Highly coevolved interaction with Clark's nutcracker.



Don Pigott



Clark's nutcrackers and whitebark pine



Limber pine

- Horizontally oriented cones on upswept branches.
- Nutcrackers are important dispersers in core range; some jay and rodent dispersal.
- Rodents are major dispersers in peripheral populations.



Krugman & Jenkinson 1974



Clark's nutcrackers and limber pine



Nutcracker seed dispersal influences tree distribution, population genetic structure and tree morphology

Tree cluster growth form—

- Caches typically contain 1 to 15 seeds.
- Most seedlings per cache survive.
- Produces “tree cluster” growth form.



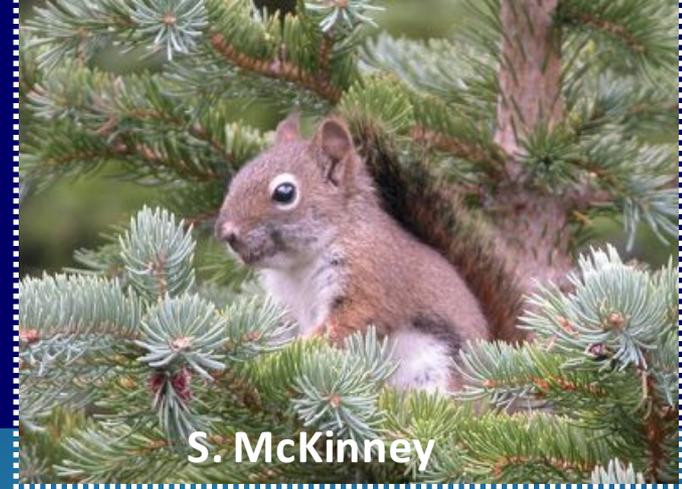
Crown High Five keystone and foundation species

Promote biodiversity

- **Wide spectrum of community types.**
- **Provide wildlife habitat, shelter, and nest sites.**
- **Seeds provide wildlife food.**

Whitebark and limber pine seeds are important wildlife food

- Birds: 7 families, 13 species
- Small Mammals: 2 families, >8 species
- Large Mammals: 2 families, >3 species: Grizzly and black bears, foxes.



Provide ecosystem services

- Regulate snow melt and downstream flow (WP).
- Reduce soil erosion; stabilizes snow---avalanche control.
- Foster community development after disturbance.
- Nurse trees on harsh sites.
- Initiates tree islands at treeline (WP).
- Rapid response to warming or cooling at treeline.

**Community development and stability;
protection for our “water towers”**

Grand Teton National Park

Provisioning services:

First Nations use of High Five pines

(Moerman 1998, 2009)

Seeds

- Cooked in hot ashes or roasted, eaten or stored: whitebark
- Dried seeds mixed w serviceberries & stored: whitebark
- Ground to make mush: whitebark
- Ground, hulled or intact: limber

Inner bark as food

- Roasted or raw: whitebark (probably under-reported for all pines)

Medicine

- Ceremonial emetic: limber
- Needles used for cough medicine: limber
- Fever relief: limber
- Smoked by hunters for 'good luck': limber

Aesthetics: the high-mountain experience

There is an especially powerful symbolism associated with trees, whereby they assume the symbolic role of a 'gatekeeper between what is civilized and what is wild.' (McCool and Freimund (2001).

Whitebark and limber pines signify endurance, stoicism, timelessness to mountain visitors.



The Crown Jewels are fading...

- In the U.S., whitebark pine is a candidate for listing under the Endangered Species Act.
- In Canada, whitebark pine was listed as endangered under SARA.
- Limber pine is being evaluated for SARA listing.

The epicenter of these declines is the Crown of the Continent.

Shared threats

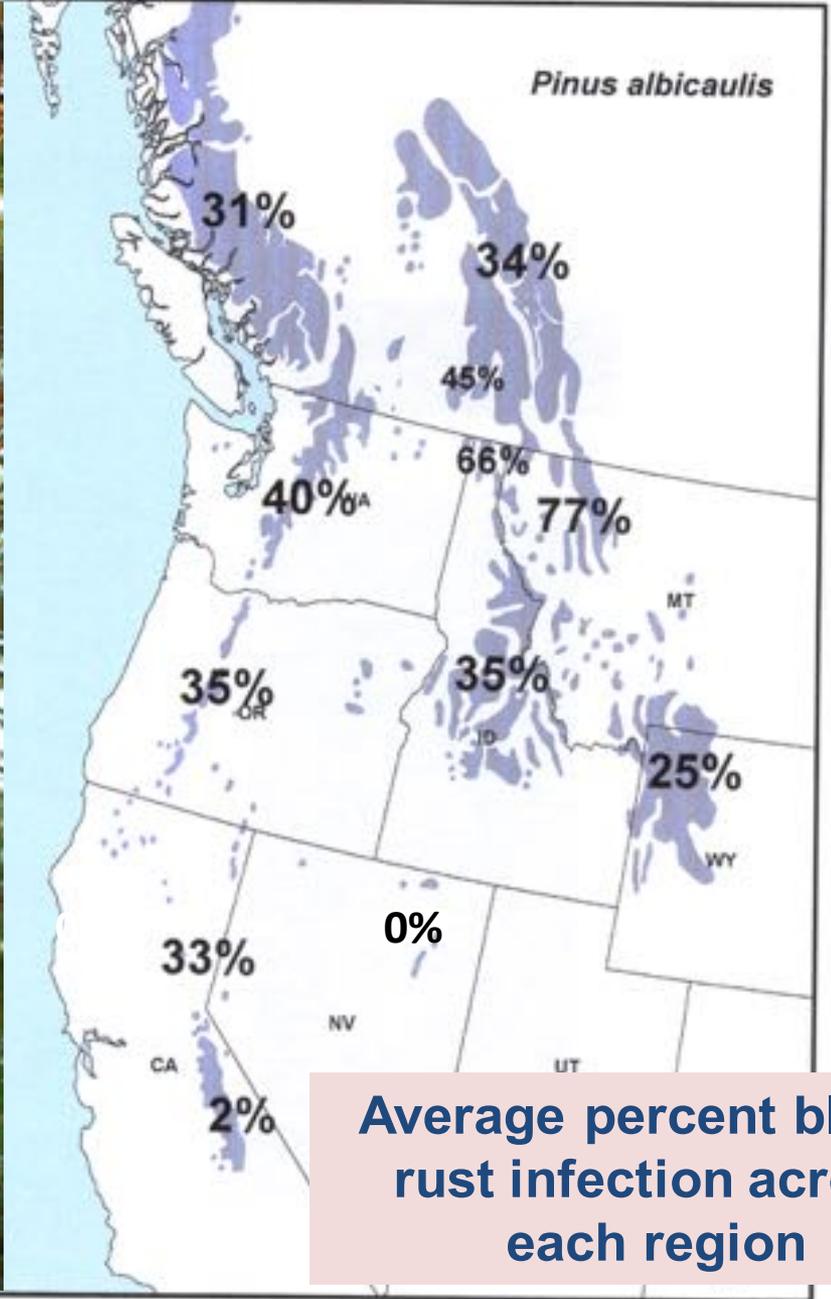
- The invasive pathogen *Cronartium ribicola*: white pine blister rust.
- Past and recent large-scale outbreaks of mountain pine beetles (*Dendroctonus ponderosae*).
- Altered fire regimes—advancing succession in seral white pine communities.
- Climate change: sustaining bark beetle outbreaks, producing drought stress and mortality, and altering pine distributions.





Blister rust distribution

Fig. 1,
Schwandt et al.
2010



Average percent blister rust infection across each region

Mortality from MPB, through 2007, USA

Gibson et al. 2008

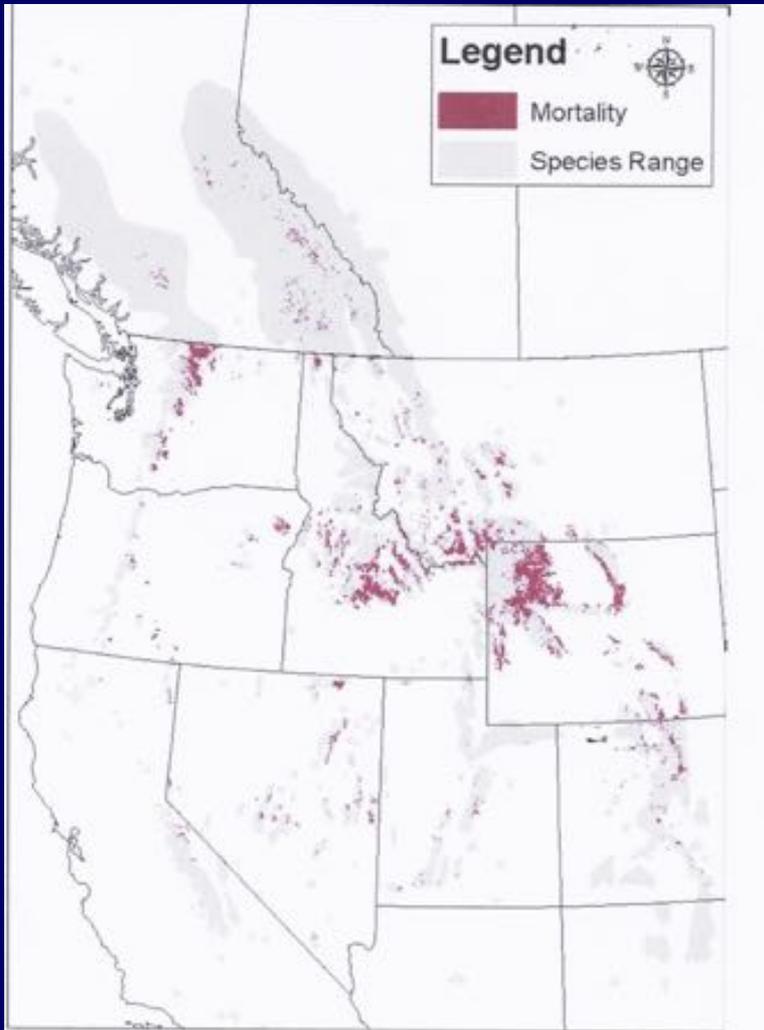
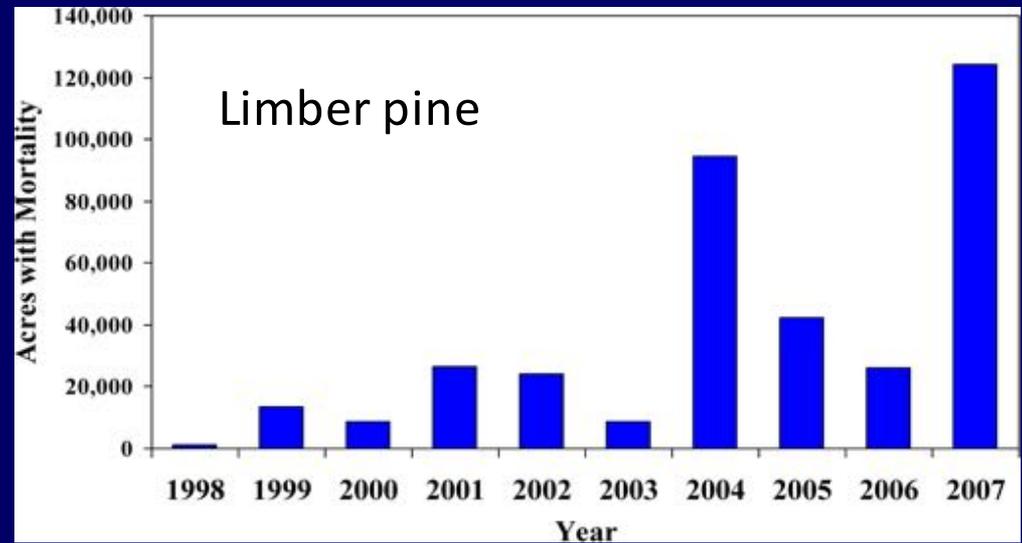
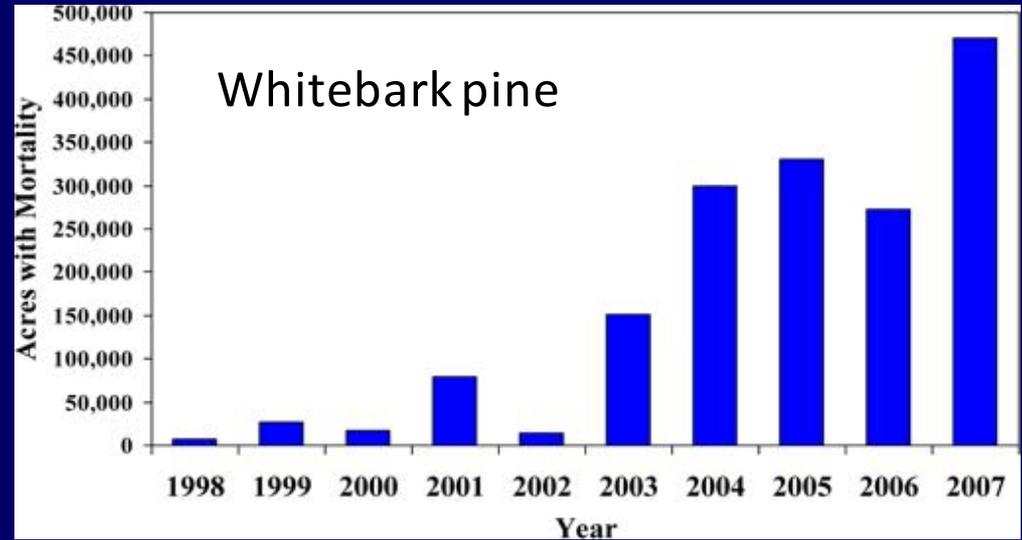


Figure 7. MPB-caused mortality of four pine species (whitebark, limber, Rocky Mountain bristlecone, and Great Basin bristlecone) in the western United States (1998-2007 ADS) and British Columbia (2006-2007) throughout the distributions of these tree species (United States Geological Survey).



Mountain pine beetle



AW Schoettle

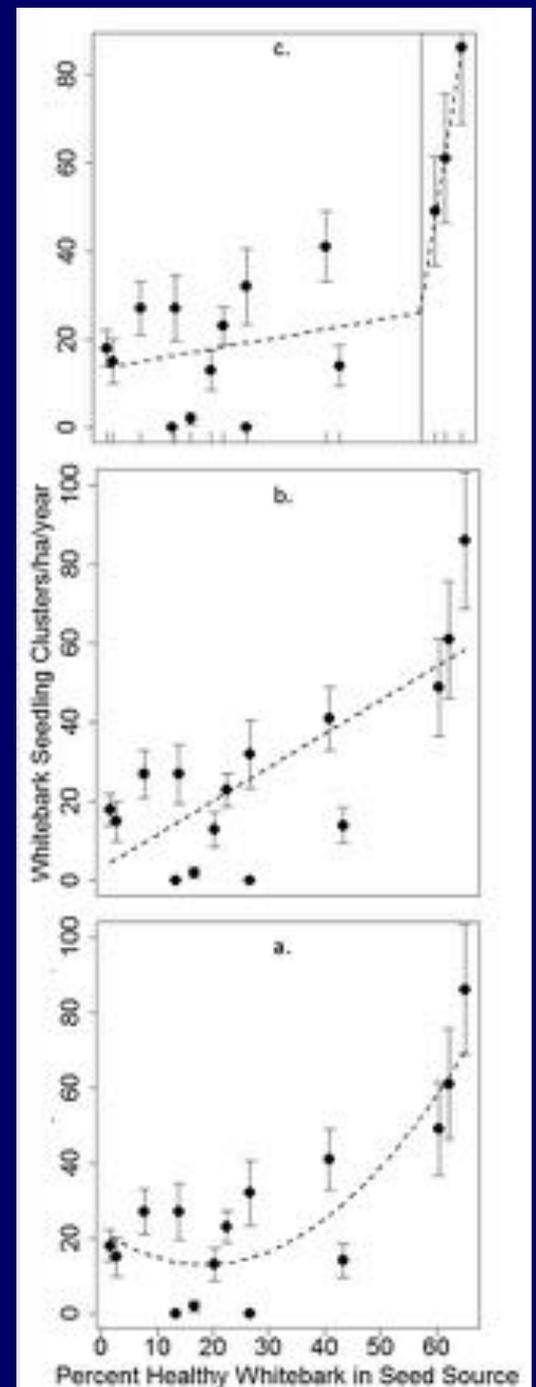


Seed source health vs. whitebark pine regeneration density

Leirfallom et al. (2015)

Sampled 15 burns:

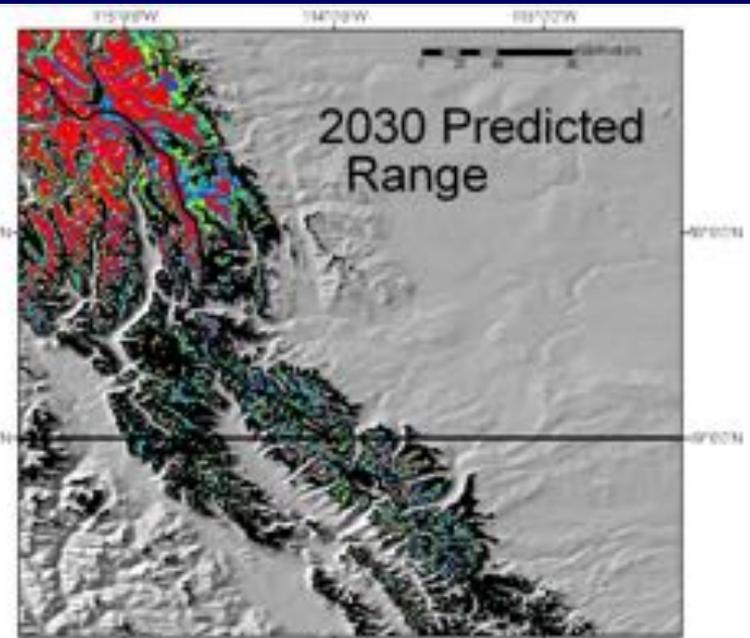
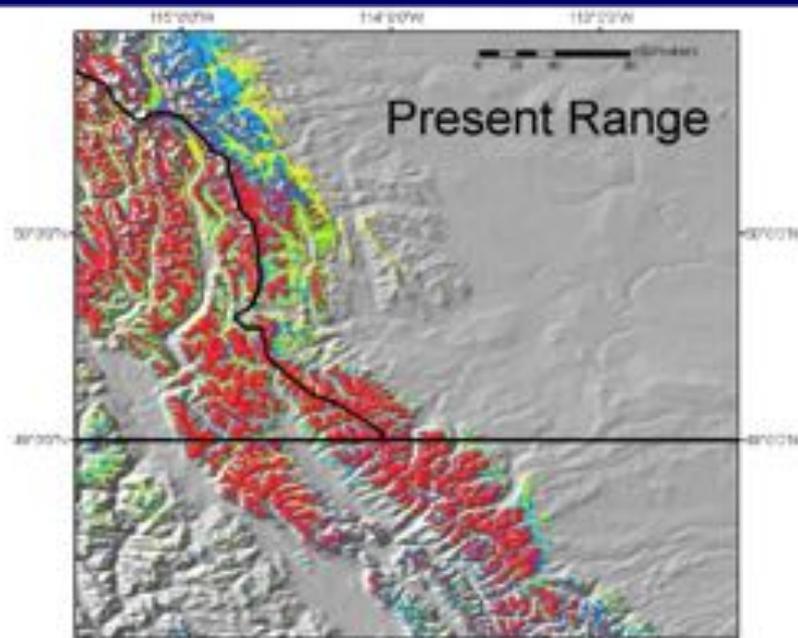
- 6 national forests and 3 wilderness areas in Montana.
- 5 to 23 years old.
- Significant positive relationship between seed source health and seedling density.
- Very poor regeneration when the proportion of dead or damaged whitebark pine >50%.



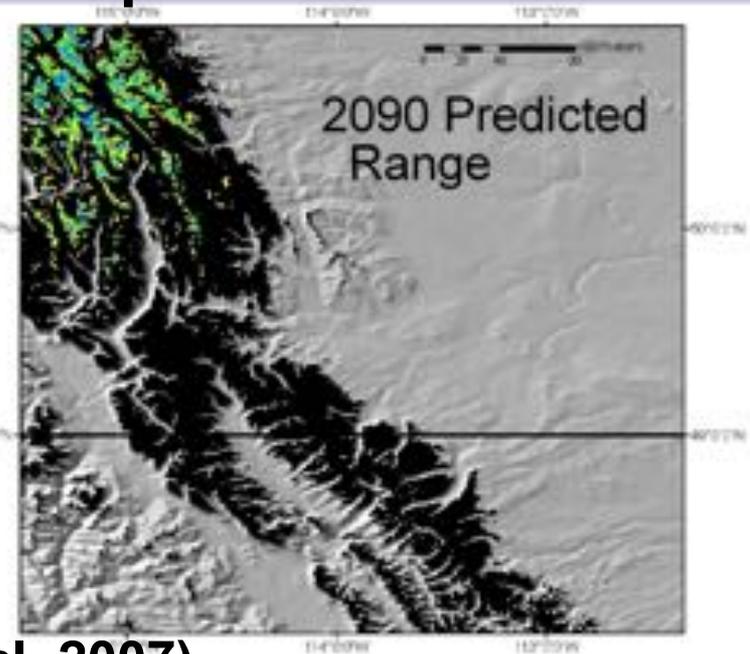
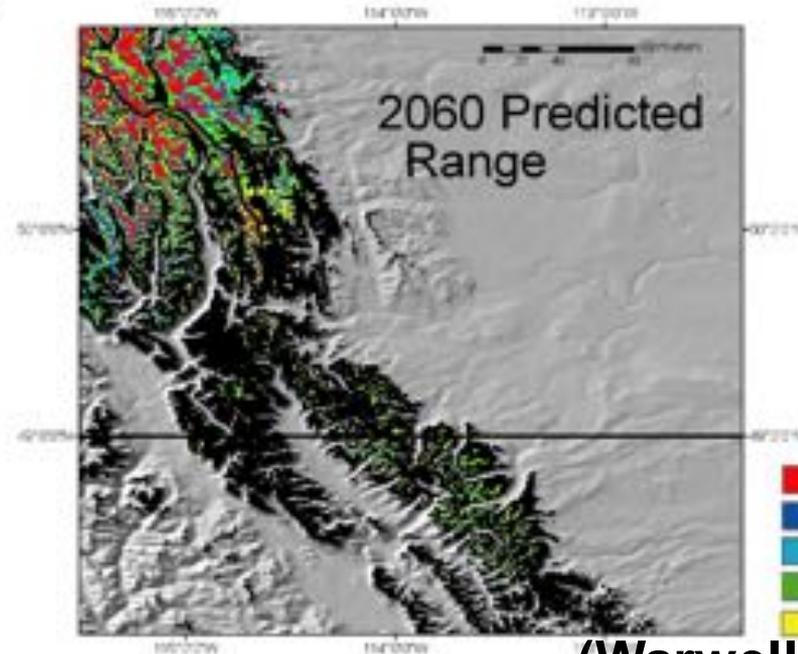
Without whitebark and limber pine

- Grizzlies wander in search of pre-hibernation food.
- Reduced carrying capacity for wildlife.
- Fewer forest habitat types = loss of biodiversity.
- Forest regeneration takes longer after fire.
- On harsh sites, less treeline vegetation.
- The “water towers” are not as effective.
- Treeline response to climate change delayed.

Whitebark pine is so widely distributed, its extirpation will have significant consequences for local forest composition, ecological function and ecosystem services.



Bioclimatic niche whitebark pine



(Warwell et al. 2007)

Hope: High Five pine restoration

Strategies: Speed up natural selection by developing and planting blister-rust resistant seedlings. Replace the seed dispersal services of Clark's nutcrackers.



Steps in restoration

Protect ripening cones.
Harvest cones.



Grow seedlings



Screen seedlings
for resistance.



Plant
seedlings.



Protect resistant seed
sources against mountain
pine beetles.

Restoring the Crown jewels

We are in a time of declining federal budgets. Restoration will require commitment for several human generations. Responsibility for whitebark pine restoration will be most effective as a partnership among:

- **Concerned citizens**
- **Non-profit organizations**
- **Corporate donors**
- **Cross-boundary agencies**
- **Provincial and federal governments**

Thanks to all of you for supporting
restoration of the High Five pines.

www.whitebarkfound.org

