Bark Beetles in Ponderosa Pine

(Pacific Northwest)

Glenn Kohler, Forest Entomologist

Washington Dept. Natural Resources

Most damaging bark beetles in ponderosa pine

- **Mountain pine beetle:**

  hosts – ponderosa, lodgepole, western white, whitebark, and ornamental pines

- **Western pine beetle:**

  host – ponderosa pine

- ***Ips* pine engravers:**

  hosts – most common in ponderosa, also in other pines

- **Red turpentine beetle:**

  hosts – all pines

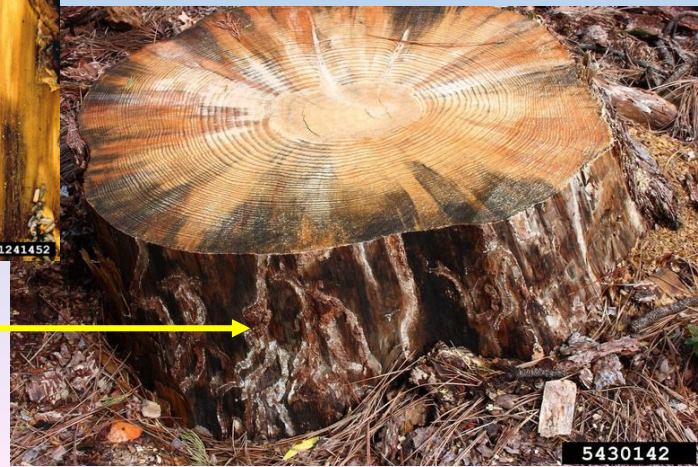
Pine bark beetle adult identification

- ***Dendroctonus ponderosae* (MPB):** 4-7 mm, black, rounded rear of wing covers (declivity)
- ***D. brevicomis* (WPB):** 3-5 mm, dark brown, rounded declivity with short hairs
- ***D. valens* (RTB):** 6-9 mm, red-brown, rounded declivity
- ***Ips pini:*** 3-4 mm, brown-black, concave declivity with 4 pairs of spines
- ***Ips paraconfusus* (CFI):** 4-6 mm, brown-black, concave declivity with 5 pairs of spines

Pine bark beetle gallery identification

- **MPB:** Vertical egg gallery, J-shaped hook at bottom (avg 10”), distinct pupal chambers
- **WPB:** winding, criss-crossing egg gallery, short or absent larval galleries

- **RTB:** vertical, wide egg gallery, often obscured by cave-like larval galleries



Pine bark beetle gallery identification

- ***Ips pini:*** 3-4 branched egg gallery with nuptial chamber
- **CFI:** 3 branched egg gallery
- **Both Ips:** central nuptial chamber, distinct larval galleries and/or mazelike adult feeding galleries

Ips pini

CFI

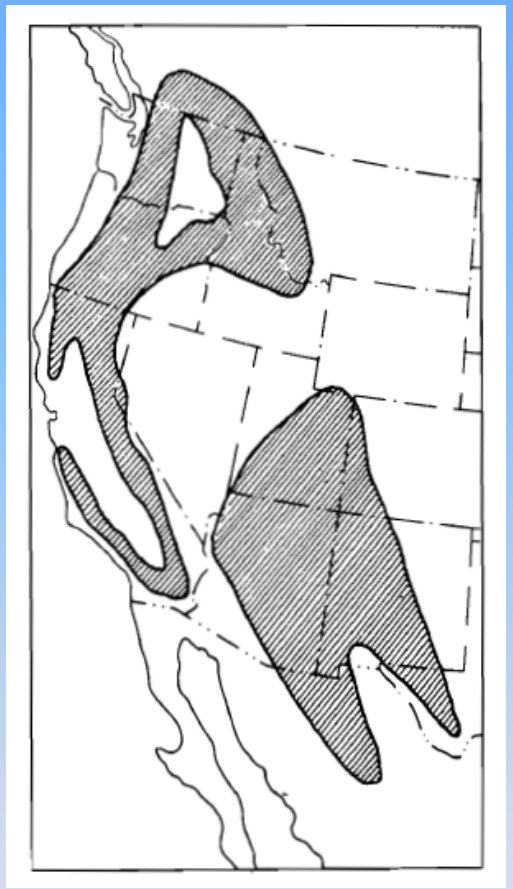
CFI

Adult feeding

Distribution of major pine hosts (green) of MPB and its range south of red line

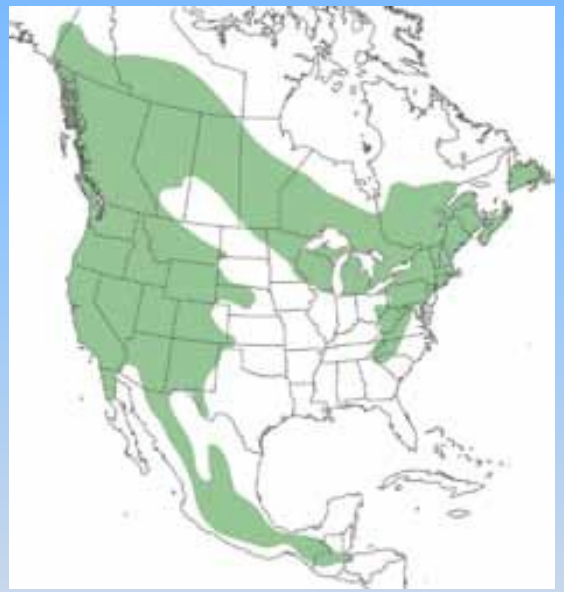
From Gibson, Kegley, and Bentz (2009), Forest Insect and Disease Leaflet 2.

WPB Distribution



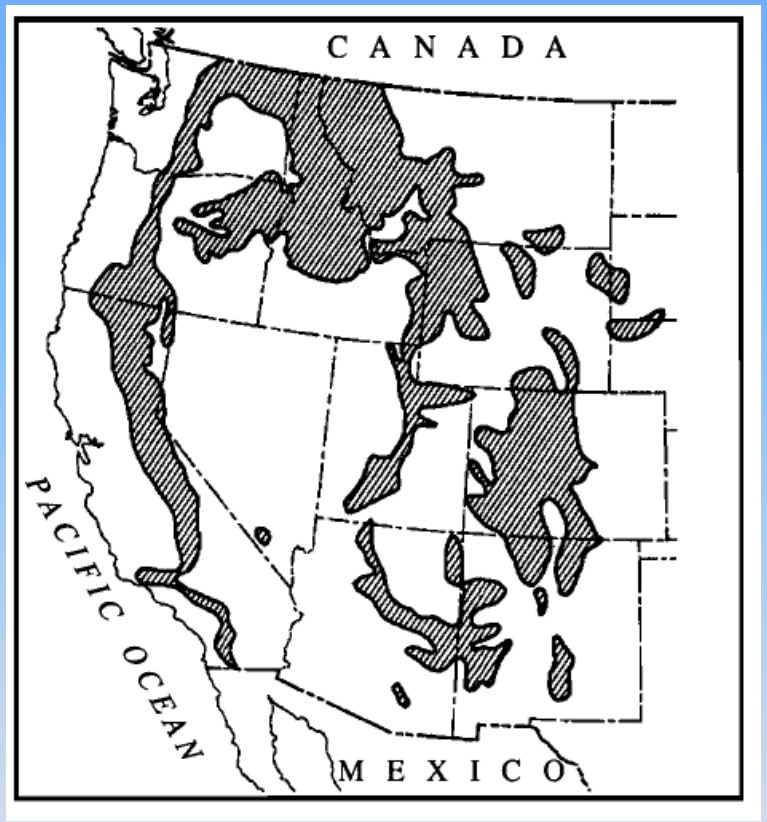
From DeMars & Roettgering (1982), Forest Insect and Disease Leaflet 1.

RTB Distribution (probable)



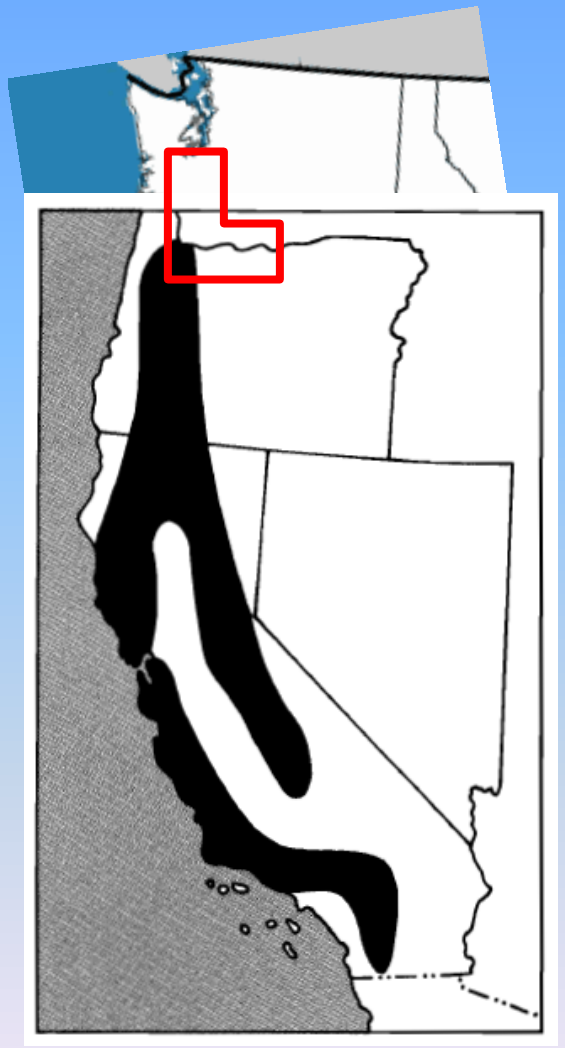
From Owen, Smith, and Seybold (2010), Forest Insect and Disease Leaflet 55.

Ips pini Distribution



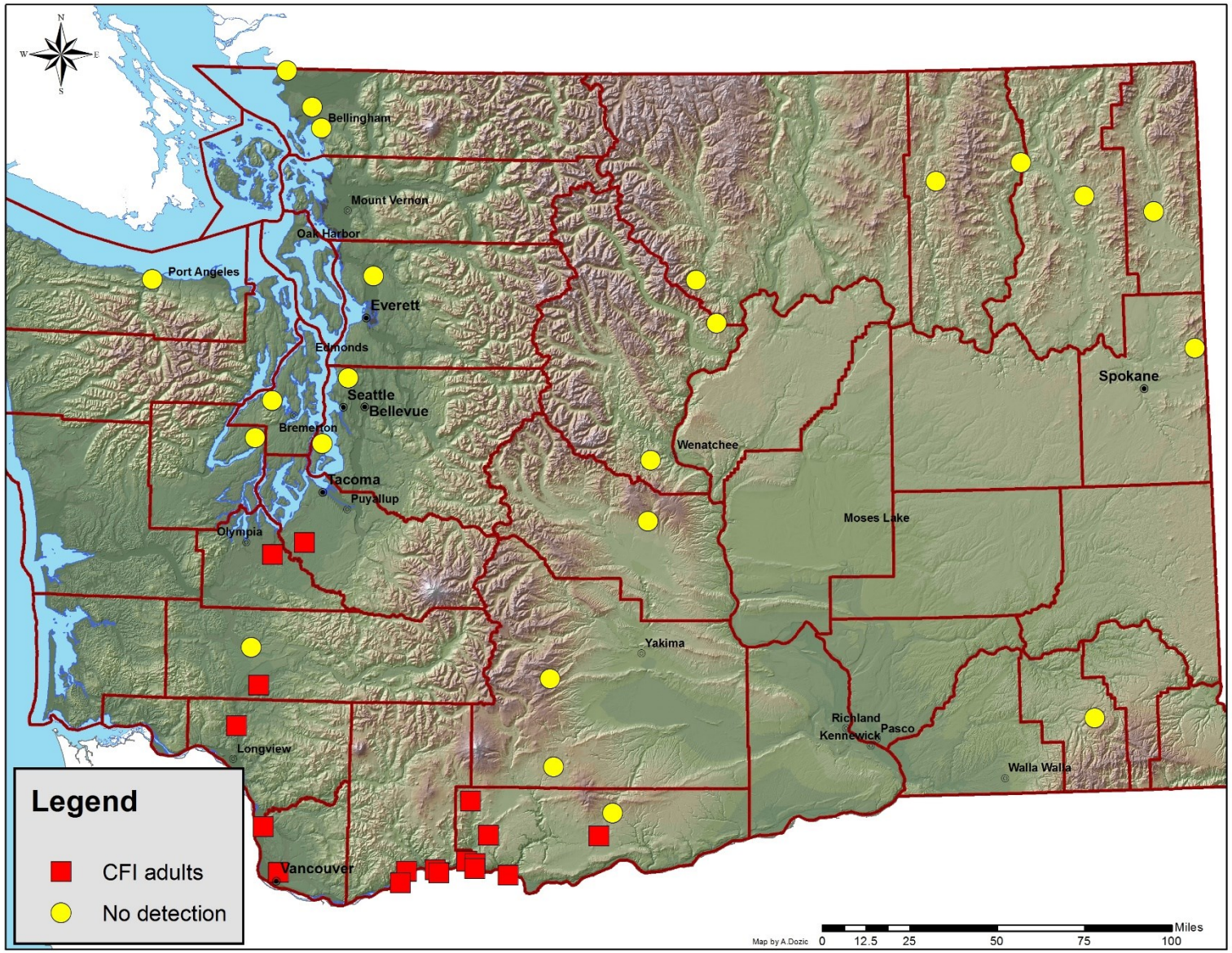
From Kegley, Livingston, and Gibson (1997), Forest Insect and Disease Leaflet 122.

CFI Distribution (black = 1987; + red outline = current)



From Schultz & Bedard (1987), Forest Insect and Disease Leaflet 102.

California fivespined Ips trap monitoring in WA (2010-2015)



MPB Damage and Symptoms in ponderosa pine

- Pitch tubes on bark (possible red boring dust), exit holes
- Whole tree mortality (straw-orange colored crown)
- Strip attacks in injured trees
- Woodpecker holes in bark
- Blue-stained wood

MPB Severity

- In terms of acres affected, most damaging BB in West (primarily in lodgepole)
- Active in pole sized and/or low-vigor ponderosa
- More likely in ponderosa when growing near infested lodgepole
- Normally breeds in stressed, injured, diseased trees resulting in scattered mortality
- Outbreaks related to tree age, overstocking, and climate factors
- Epidemic populations kill apparently healthy trees over extensive areas (last years with enough susceptible hosts)

WPB Damage and Symptoms

- Pitch tubes on bark (not always)
- Whole tree mortality (straw-orange colored crown)
- Larvae feed and pupate in outer bark, so woodpeckers often flake bark
- Round exit holes
- Blue-stained wood

WPB Severity

- Prefers mature (large diameter), weakened (injured or drought-stricken) hosts
- Usually scattered mortality, but outbreaks result in group kills
- Outbreaks often follow drought
- Overlapping broods, 1-2 generations per year
- May occupy trees attacked by Ips in tops and branches

RTB Damage and Symptoms

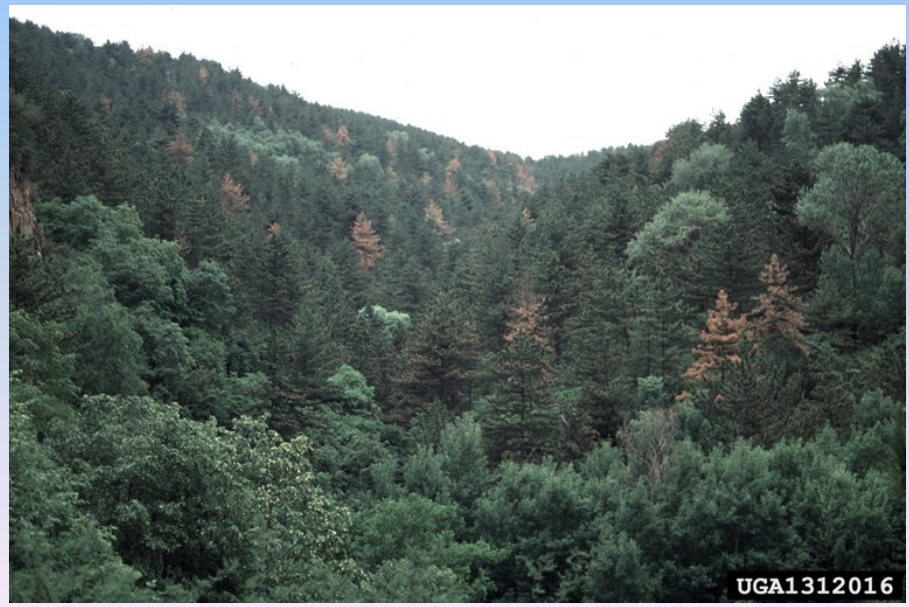
- Usually attack bottom 6 ft
- Forms large, ‘grainy’ pitch tubes near the base

Connie Mehmel, USDA Forest Service

RTB Severity

- Common in stressed, wounded or scorched trees, stumps
- Capable of killing mature ponderosa (typically secondary to other damage)
- Trees can survive patch attacks
- One generation per year, but overlap, so fly thru summer and fall
- An invasive pest in China

Connie Mehmel, USDA Forest Service



RTB in China

Ips Damage and Symptoms

- Piles of red boring dust indicate attacks (not always visible in standing trees), exit holes
- Pole size tree mortality and tops and large branches of mature trees (red-orange colored crown)
- Blue-stained wood

Ips Severity

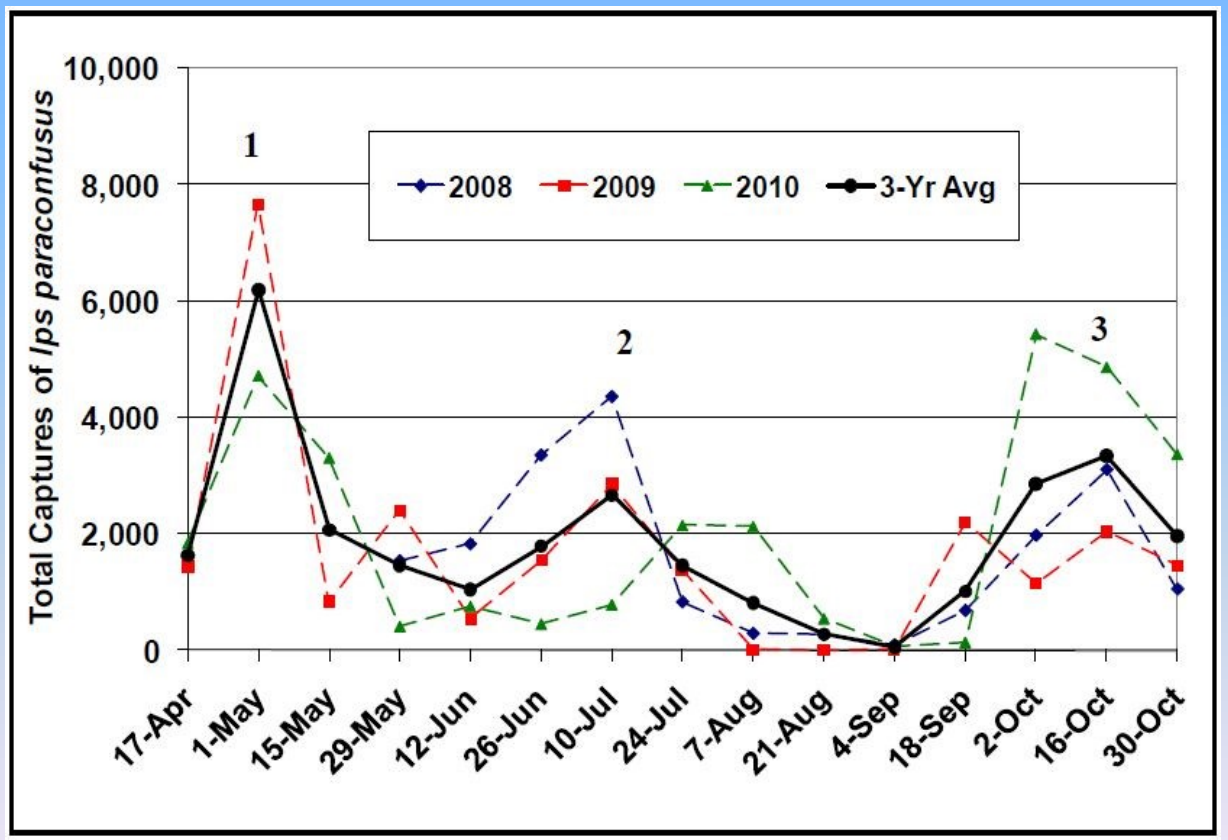
- 2-3 generations per year in PNW
- Large amounts of fresh slash or windthrow can rapidly increase populations which can attack nearby live pine.
- All diameters downed pine can be colonized (<3” doesn’t produce damaging brood)
- Prefer to attack thin barked live trees (pole size, tops, branches)
- Outbreaks typically collapse after one year (high overwintering mortality, less host material)
- Live trees at much higher risk during drought
- Mature trees may be killed during drought or in combination with WPB and/or RTB

Remove Green Pine Blowdown

- Don’t Dawdle!

Ips management

- Slash <3 inch diameter not suitable for increased 'brood'
- Timing is key



CFI flight periods in Willamette Valley, 2008-2010

Courtesy of Rob Flowers (Oregon Dept. Forestry) and Beth Willhite (USDA Forest Service).

Ips management

- Attack flight period is mid-April to July
- Don't leave fresh breeding material >3" diameter from Jan to July (unless treated)
- Salvage storm or fire damage

Slash creation:
"SAFE" = Aug – Dec
RISKY = Jan – Jul

Pine slash management options:

- **Pile and burn** before flight (Mar – April)

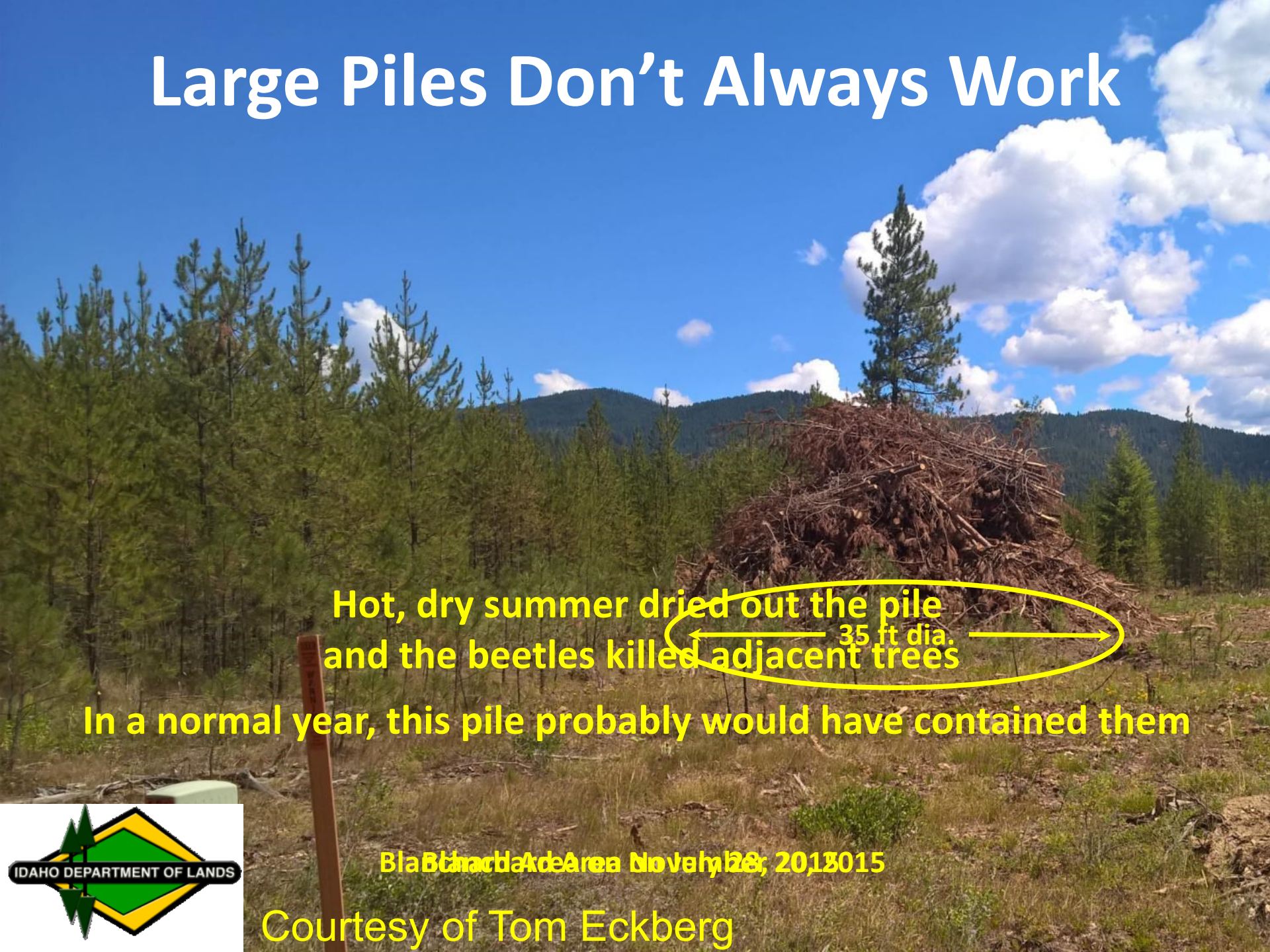
Slash treatment options:

- **Chipping**
  - Outside flight period best
  - Scatter or remove
  - don't pile near live trees
- **Direct removal** of slash during flight period (2 miles from pines if infested)
- **Lop and scatter** in open areas
  - Done in late summer/fall to allow dry time
  - 1-2 ft pieces
  - May not work in cold areas

Slash treatment options:

- **Solarization** under plastic in sunny spot for several weeks
- **"green chain"**
  - Ips prefers slash over live trees
  - Provide slash in April/May
  - And a second fresh cut in June/July
- **House-sized piles**
  - 10-20 ft diameter and height
  - Emerging brood from outer layer will enter center

Large Piles Don't Always Work



Hot, dry summer dried out the pile and the beetles killed adjacent trees

In a normal year, this pile probably would have contained them

Black Ridge Area November 28, 2015

Courtesy of Tom Eckberg

IDAHO DEPARTMENT OF LANDS

Courtesy of Tom Eckberg

Slash treatment options:

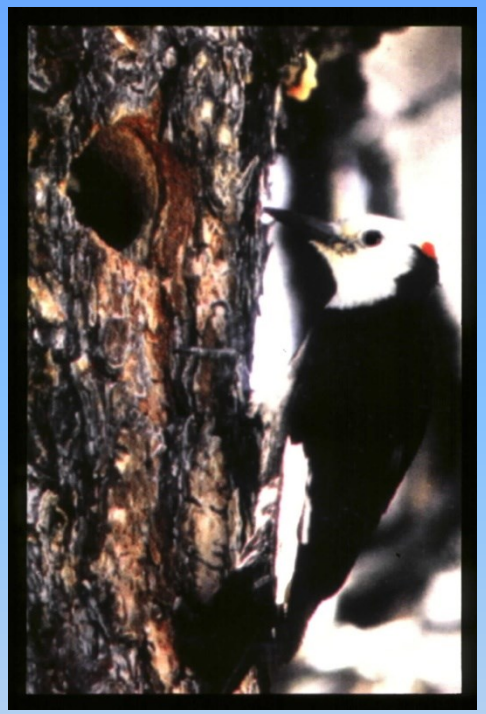
- **Don't stack fresh pine near live trees**
  - Uninfested – OK for 6 weeks during flight period
  - Infested – remove ASAP

Pine bark beetle management

- *Typically* beetles have already flown from trees with red crowns.
- There are exceptions (of course!)
  - Very hot summers: trees may fade early or fade on sunny winter days
  - These early faders still contain beetles
- Sanitation harvest of dead and “green-attacked” trees may reduce BB populations

Pine bark beetle management

- Natural controls:
  - Predators and parasites
  - Temperature variability and winter mortality
  - Host tree defenses
  - Reduced host quality
  - Competition with other wood infesting beetles



Pine bark beetle management

- Direct control:
  - Insecticides
    - can be used to protect high value trees
    - Topical sprays on bark surface prevent attacks
    - Systemics may also be effective but plan ahead (time for uptake)
    - Neither systemics or sprays work once BB are already in tree
  - Manage large inputs of fresh dead trees before broods develop
  - Sanitation salvage, trap trees

Pine bark beetle management

- Pheromones:
  - Lures (aggregation pheromones) can be used for monitoring, trap trees, or mass trapping
  - Repellents (anti-aggregation pheromones) can be used protect high value trees
    - **Verbenone** sold as a “pine beetle” repellent. Works for MPB in some situations. Has not been shown to protect trees from Ips and WPB.

Pine bark beetle management

- Hazard and Risk Ratings:
  - Hazard ratings assess stand conditions that may support a future outbreak (variables such as stand density, age, site class, proportion of host, tree vigor…)
  - Risk ratings couple hazard with some measure of "beetle pressure" and proximity to determine likelihood of outbreak in the stand
  - Management actions used to alter stand condition and reduce hazard
  - Can determine target stand density for site class

Example risk rating system for bark beetles

		SCORE
(1)	**Stand Susceptibility**	
	What is the current SDI[1] for plant association of this stand?	
	< 50% of UMZ	(value = 1)
	50-100% of UMZ	(value = 2)
	> 100% of UMZ	(value = 3)
(2)	**External Beetle Pressure** (Last Year)	
	What is the distance from this stand to the nearest known similar bark beetle infestation occurring outside this stand?	
	> 2.0 Miles	(value = 1)
	0.25-2.0 Miles	(value = 2)
	< 0.25 Miles	(value = 3)
(3)	**Internal Beetle Pressure** (Last Year)	
	How many beetle-killed trees (red-top trees killed last year) occur inside the stand?	
	< 3	(value = 1)
	3-10	(value = 2)
	> 10	(value = 3)

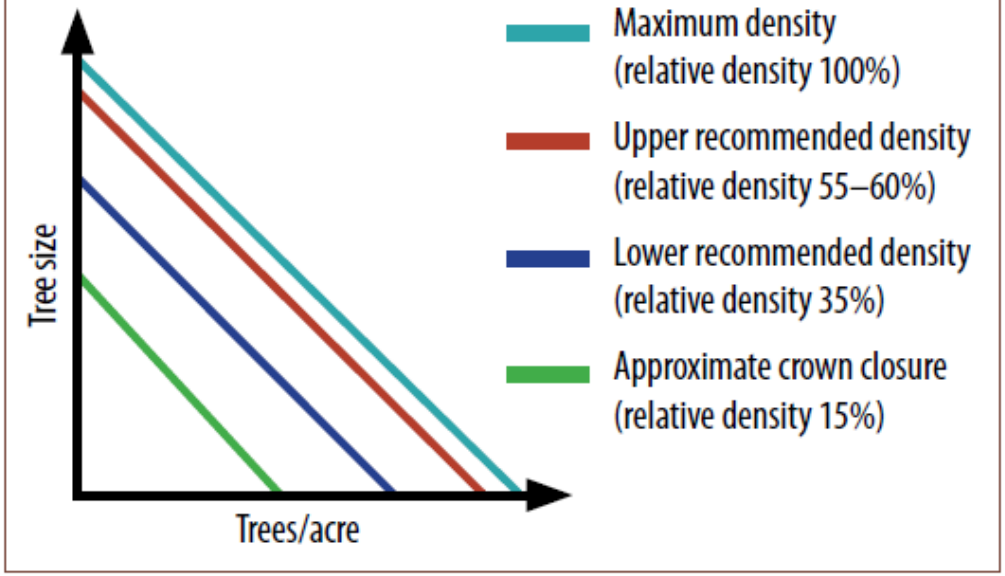
Upper Management Zone (UMZ) = 60% max Stand Density Index (SDI)

Scott, D. W. 1996. A rationale and procedure for determining imminent susceptibility of stands to insects in the Blue and Wallowa Mountains of southeastern Washington and northeastern Oregon. BMZ-96-15. USDA Forest Service.

Pine bark beetle management

- Silvicultural practices:
  - Thinning increases vigor and host defenses, reduces competition stress, and allows more airflow to dissipate BB pheromones
  - Thinning is not “beetle-proofing” – mass-attacks in severe outbreaks and droughts can overwhelm even vigorous trees
  - Thinning during an outbreak may not be effective right away and can attract more BB if done during flight period

- **Silvicultural practices:**



(UMZ)

(LMZ)

Figure 2-4. Relationship between density and tree diameter and its effect on stand productivity and tree vigor. Stands with densities between the upper and lower recommended density lines will be productive and at low risk for bark beetle attack.

From **Shaw, Oester, and Filip (2009).** Managing Insects and Diseases of Oregon Conifers. Oregon State Univ Extension.

dry

↓

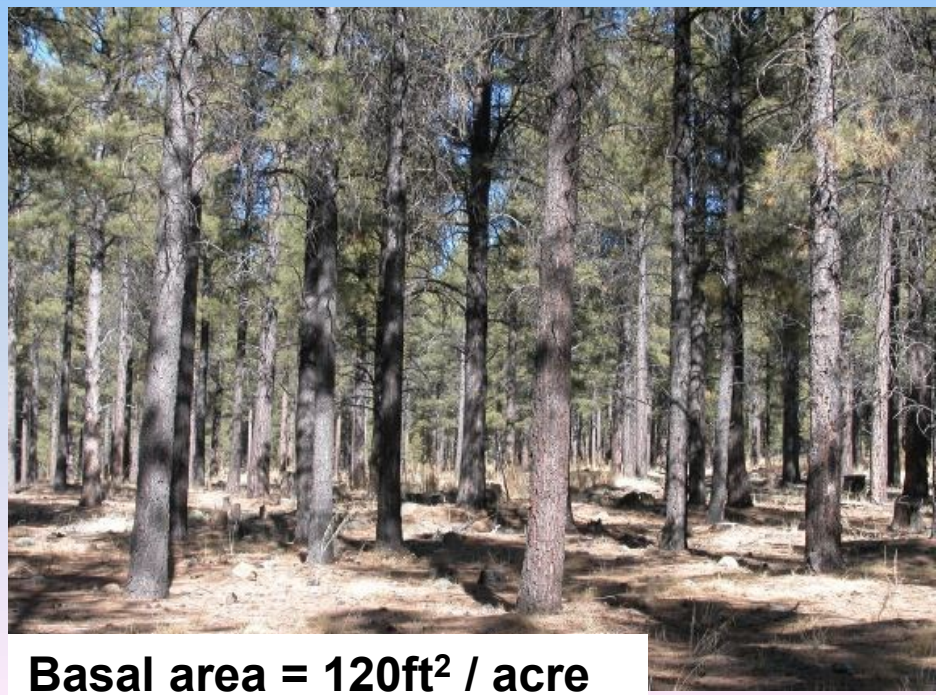
moist

Plant association	UMZ (60% max SDI) Moderate BB hazard	LMZ (35% max SDI) Low BB hazard
Ponderosa/snowberry	161 (BA 90)	94 (BA 45)
Ponderosa/bluebunch wheatgrass	191 (BA 120)	112 (BA 60)
Ponderosa/ninebark	268 (BA 170)	156 (BA 90)

Data source: **Scott McLeod**, Washington DNR

- **Silvicultural practices:**
  - General ponderosa target stand density – basal area less than 100 ft^2/acre (less on dry sites ~65 ft^2)
  - Select against low-vigor trees
  - Thin from below

Basal area = 60ft^2 / acre



Basal area = 120ft^2 / acre

F.P. Keen (1943). Ponderosa pine tree classes redefined. Journal of Forestry

4 age classes

Bark beetle mortality rates higher for less vigorous (low crown ratio) and older ponderosa pines

4 crown vigor classes

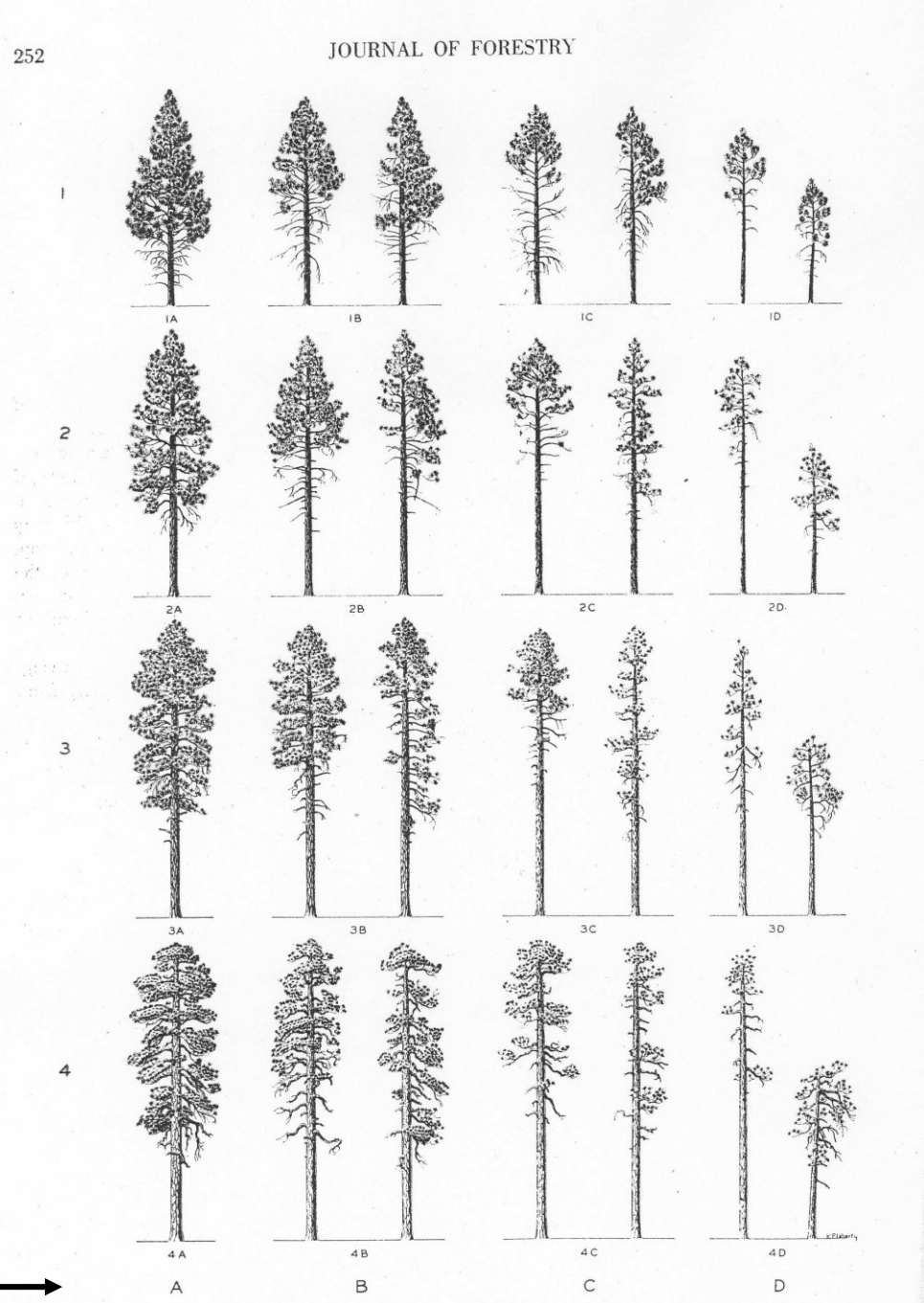


Fig. 1.—A ponderosa pine tree classification, based on age and vigor.

	Regime 1	Regime 2	Regime 3
Inter-tree spacing (Feet)	13.1	19.7	26.3
Stem Density (Trees per Acre)	133	80	67
Tree Diameter (Inches)	11.4	12.2	12.7
Basal Area ($Feet^2$/Acre)	94	66	65

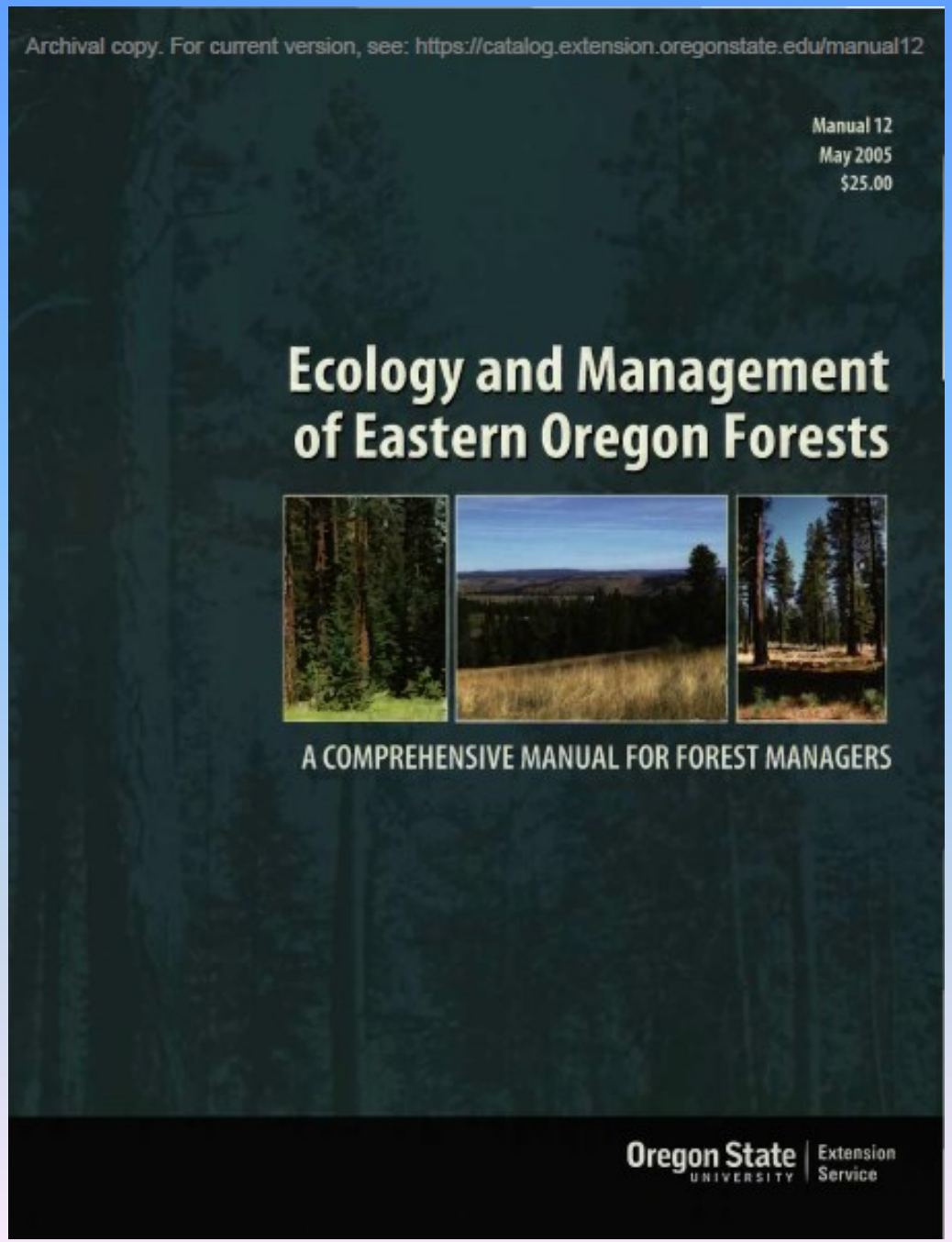
Data from central WA study of MPB attacks in ponderosa

D.R. Braun & R.I. Gara (1993). The host selection behavior of the mountain pine beetle in central Washington State. Univ Washington College of Forest Resources AR-10.

D-plus spacing system:

- Inter-tree spacing D + 7, D + 8, or even D + 9 on very dry sites
- D = diameter, so 14in diameter tree + 7 = 21 ft spacing

Courtesy of Andy Perleberg (WSU)



Thank you!

Includes information on silvicultural practices for managing eastside conifer pests

Emmingham, Oester, Fitzgerald, Filip, & Edge (2005). Oregon State Univ. Extension.

https://catalog.extension.oregonstate.edu/sites/catalog/files/project/preview/manual12_1.pdf