

Balsam Woolly Adelgid

Adelges piceae



Glenn Kohler, Forest Entomologist
Washington Department of Natural Resources

Hosts

- Only known on true fir (*Abies*) in North America
- Native to Europe where spruces (*Picea*) are alternate hosts required for sexual reproduction
- European hosts can support high pops, but not severely damaged



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USDA Forest Service, Northern and Intermountain Region , USDA Forest Service, Bugwood.org

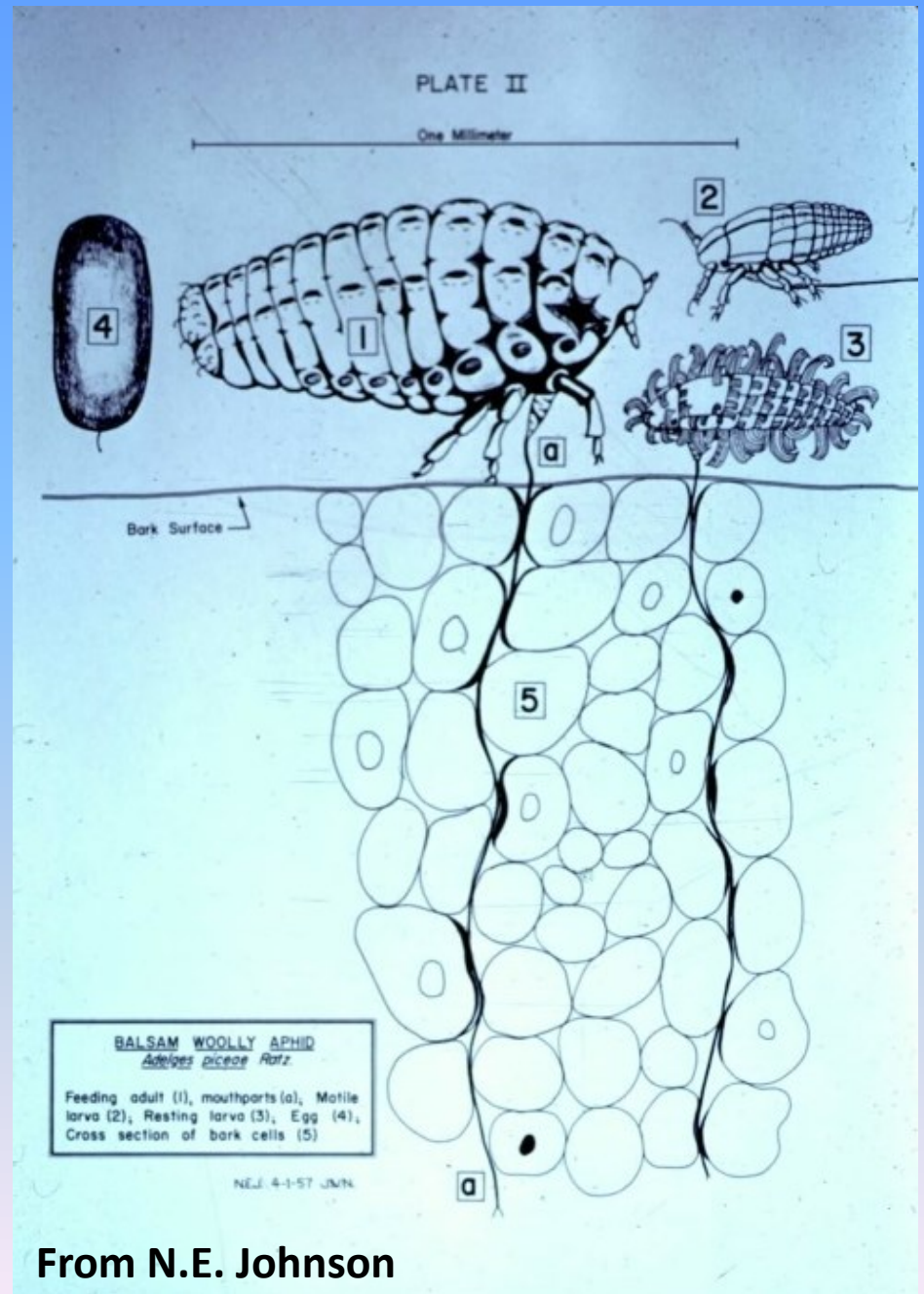
Hosts

- Pacific NW: subalpine fir, lowland Pacific silver fir & grand fir
- Noble fir and white fir more resistant in forest settings
- East NA: balsam firs & Fraser fir
- All sizes of hosts can be infested



Identification

- Aphid-like insect with waxy secretion or “wool” covering body
- Found on bark of bole or twigs (not on needles)
- Round/oval shape, 1-2 mm, purple to brown color



From N.E. Johnson



UGA1458079

North Carolina Forest Service , Bugwood.org

Ladd Livingston, Idaho Department of Lands,
Bugwood.org



UGA1241747

Identification

- No wings on adults in NA, all females reproducing by parthenogenesis
- Wool ovisacs may contain amber colored eggs
- Individuals don't move from feeding site except first nymph stage after hatching (crawler)



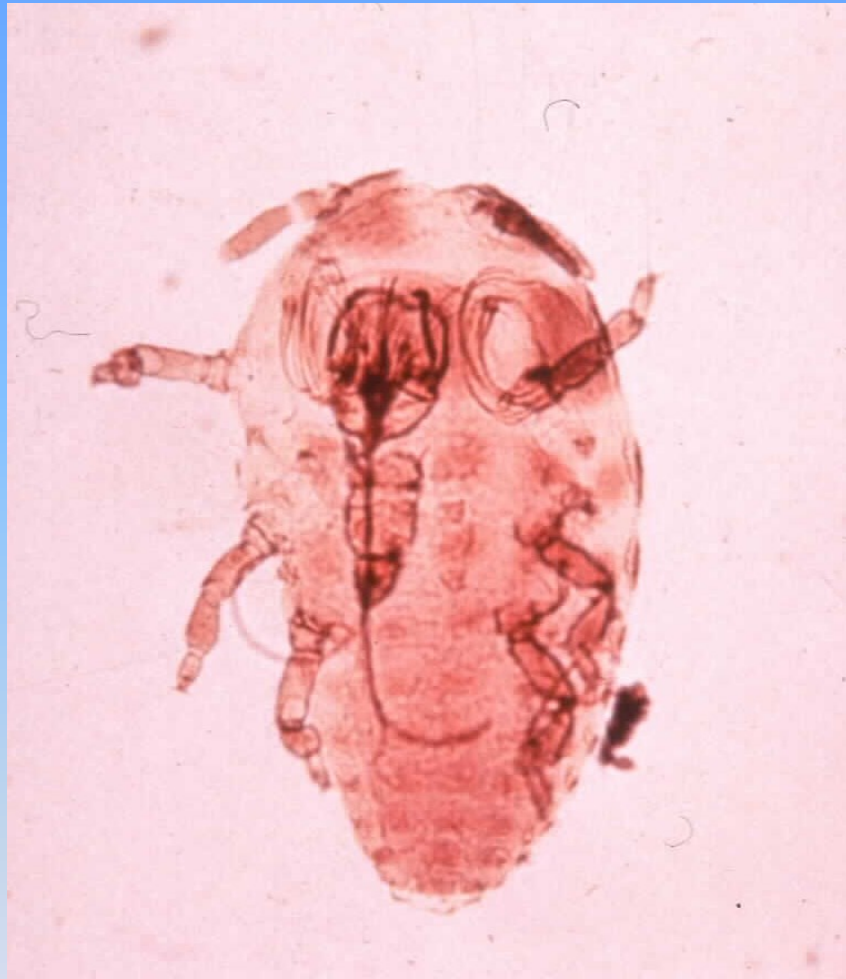
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Ronald S. Kelley, Vermont Department of Forests, Parks and Recreation, Bugwood.org



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USDA Forest Service - Ashville , USDA Forest Service, Bugwood.org





- “Wool” may be weathered, only found on branches or bark furrows

Adelgids in the west on hosts other than *Abies*



**Cooley spruce
gall adelgid
(Douglas-fir
and spruce)**



Hemlock woolly adelgid



***Pineus* species adelgids (commonly
on white pine and lodgepole)**

Tom Coleman, USDA Forest Service,
Bugwood.org



Petr Kapitola, Central
Institute for Supervising
and Testing in Agriculture,
Bugwood.org

Life cycle



Scott Tunnock, USDA Forest Service, Bugwood.org

- Egg, crawler, neosistens, sistentes, adult
- Look for adults and eggs in summer and fall
- Only neosistens (fall generation) can survive winter at high elevation
- Two generations per year at higher elevations in West (up to 3-4 in lowlands)

Distribution

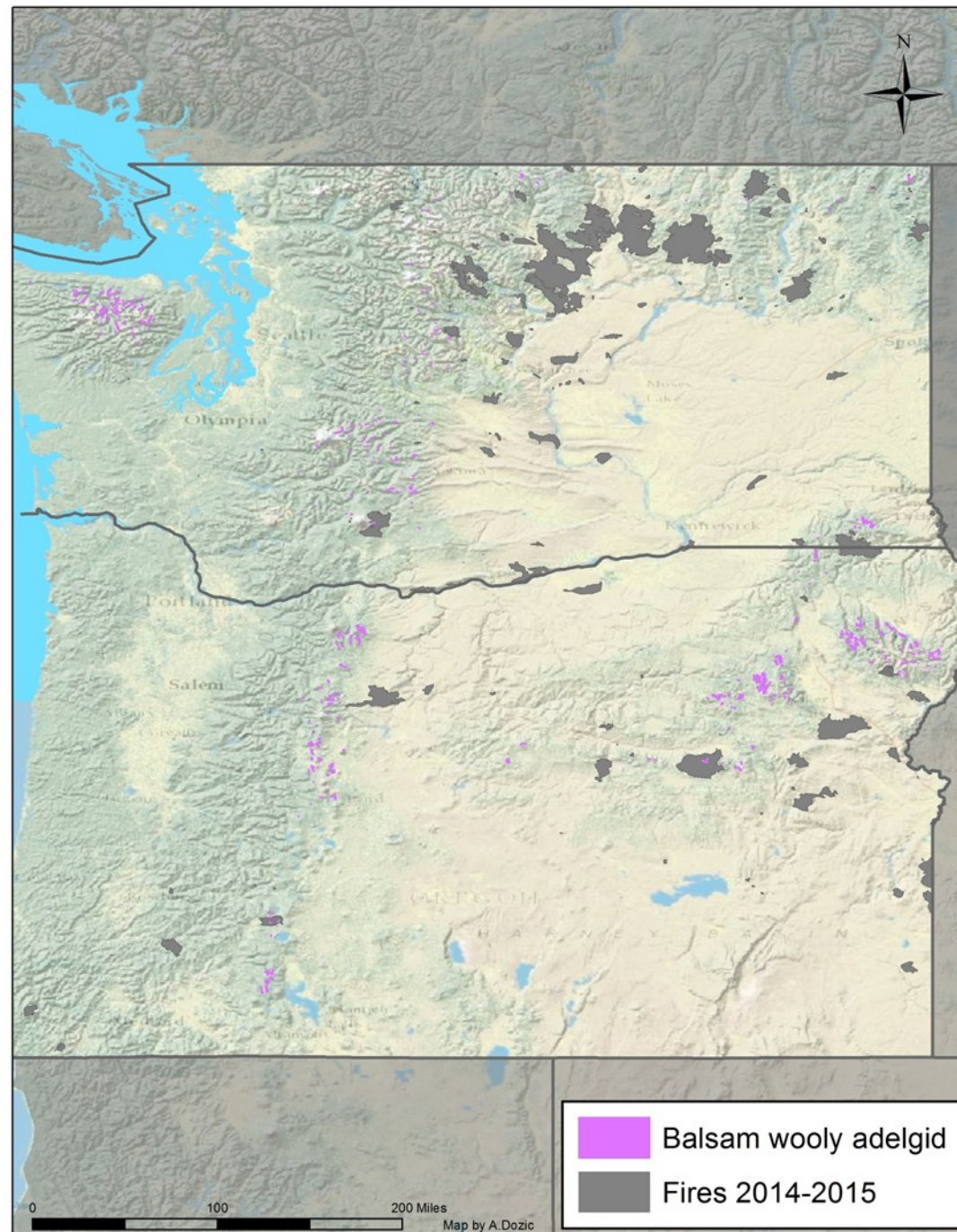
From Ragenovich and Mitchell (2006), Forest Insect and Disease Leaflet 118.

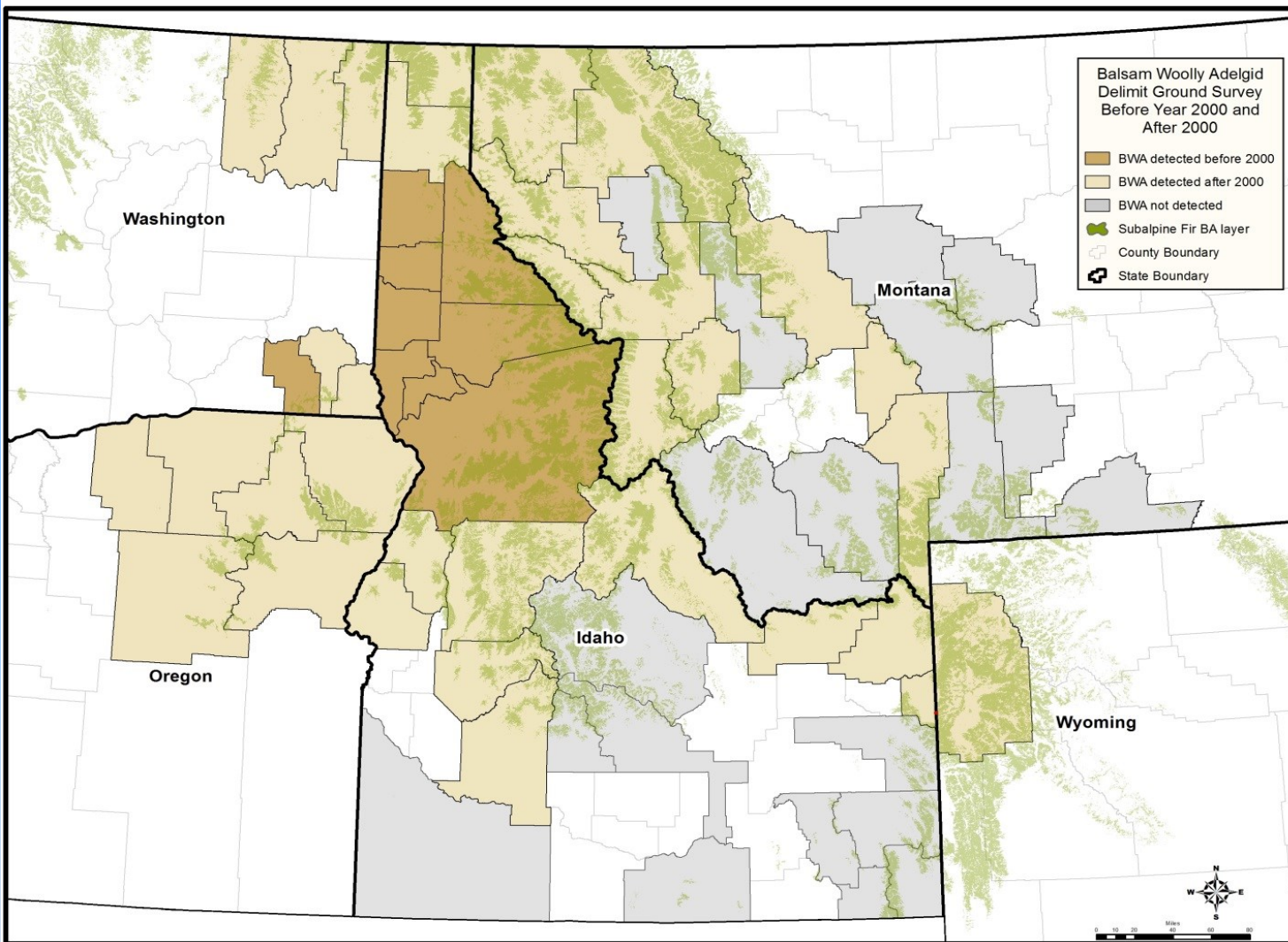


- Introduced to NA from Europe around 1900 on east coast, likely brought in on nursery stock
- 1928 found in CA and 1952 in OR & WA
- Transcontinental distribution – major pest of *Abies* in East and West
- Extreme cold may limit range in northern latitudes

2015 OR & WA detections of BWA damage in aerial survey

- Widespread mortality in Cascades by 1950s-1960s
- 2015: 61,000 ac. (OR);
19,600 ac. (WA)
- 2014: 77,500 ac. (OR);
35,400 ac. (WA)
- Ten-year averages:
109,000 ac. (OR);
35,000 ac. (WA)





From Tom Eckberg,
Idaho Dept.
Lands

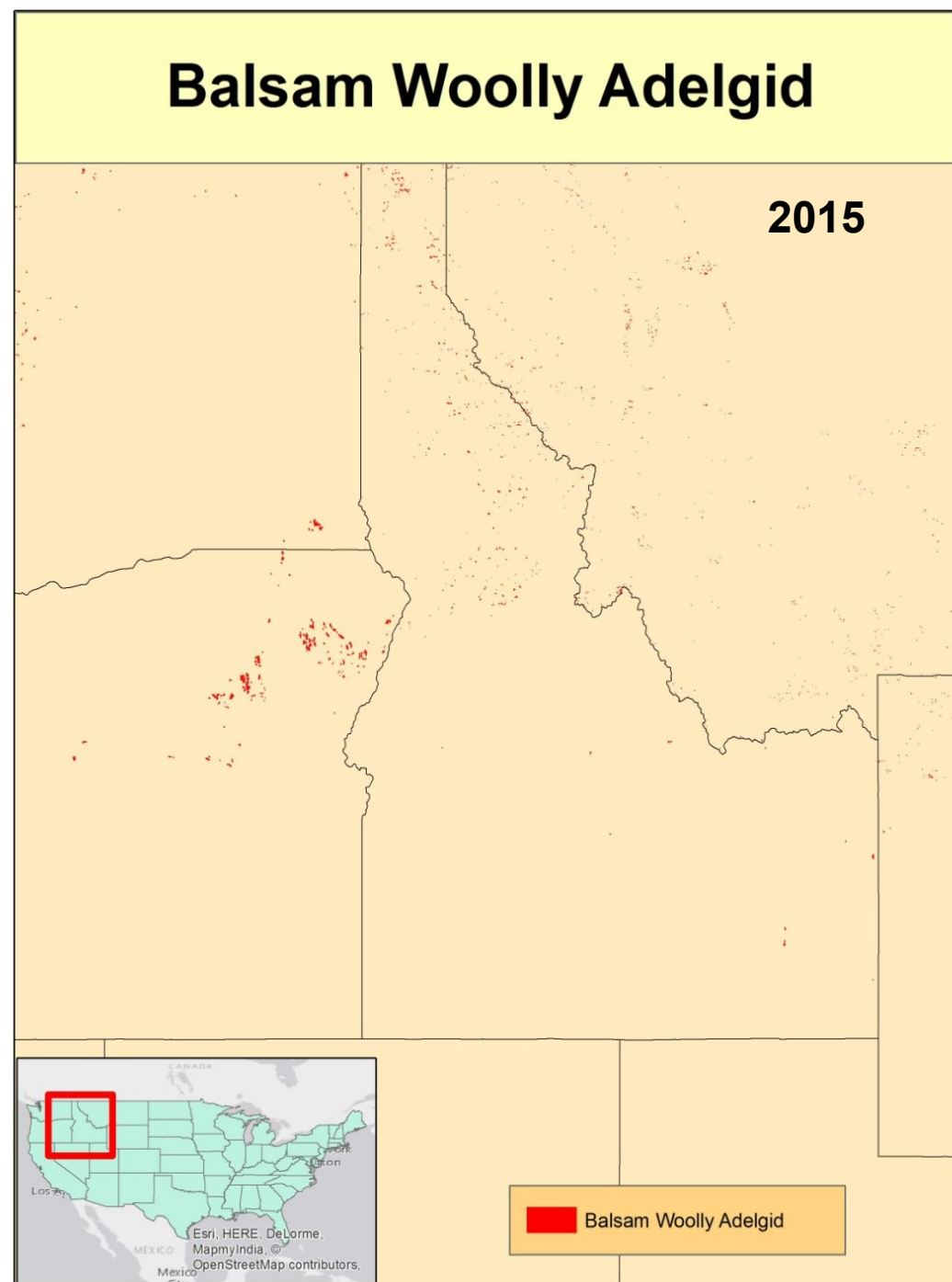
- Range expanding in PNW
- Since adults don't fly in North America, they depend on wind and wildlife (& people) for dispersal

2015 ID & MT detections of BWA damage in aerial survey

- Found in Idaho in 1983
 - Spread thru much of Idaho, mostly subalpine fir
- About 15,000 acres in Idaho in 2015;
25,000 acres in 2014



From Tom Eckberg,
Idaho Dept. Lands



Damage and Symptoms

- Twig Infection:
 - “Gouting”: swelling buds and branch nodes
 - Chronic infections that last years
 - stunts growth, inhibits cone production, and causes old foliage loss
 - Collapsed upper crown with “fiddle” shape



Ladd Livingston, Idaho Department of Lands,
Bugwood.org

UGA1241746

Damage and Symptoms

- Stem Infection:
 - BWA saliva induces abnormal growth in sapwood
 - Looks like compression wood (called “Rotholtz” or red wood); inhibits water movement
 - Causes crown decline (brown/red foliage) and tree mortality within a few years



UGA0795077a

James
McGraw,
North Carolina
State
University,
Bugwood.org



Elizabeth Willhite, USDA Forest Service, Bugwood.org

Crown defoliation and stunting in Pacific silver fir, typical of twig infection



David Beckman, Idaho Department of Lands, Bugwood.org

Brown/red foliage indicating mortality from stem infection (check for bark beetles)

Severity



- All female populations can have explosive growth
- New introductions may lead to high mortality levels within a few years (more stem infections)
- Local loss of hosts due to lack of resistance in population and reduced cone production

Severity

- Changes significant in high elevation ecosystems along with whitebark pine mortality
- Areas with older introductions (or factors that limit BWA populations) may have lower current mortality rates, ongoing chronic damage (more twig infections), and some trees showing tolerance



Severity

- In general: More stem infections on best sites and more twig infections on poor sites
- Surviving trees with twig infections often have crown dieback, top-kill, reduced growth, and are more susceptible to secondary attacks by pests (examples: bark beetles, higher mortality after budworm defoliation)



Grand fir in riparian area with BWA, budworm defoliation, and Indian paint fungus

Severity



- In general: hosts more susceptible in moist areas and lower elevations
- May inhibit pioneer subalpine fir in disturbed areas
- Chronic sub-lethal infections of grand fir in lowlands inhibits reproduction

Management

- Direct control:
 - Pesticides not practical in the forest situations, but effective on ornamentals or high-value trees
 - Topical sprays work best on crawler stage
 - Systemics are very effective against sucking insects



Great Smoky Mountains National Park Resource Management , USDI National Park Service, Bugwood.org



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Management

- Natural controls:
 - Adelgids have no parasitoids
 - Biological control programs in 1950s & 60s introduced 25 predator species in west US and Canada
 - 8 species established including specialists: Derodontid beetle, Cecidomyiid midges, and Chamaemyiid silver flies



Gabriella Zilahi-Balogh, Agriculture and Agri-Food Canada, Bugwood.org

- Native and introduced predators are abundant but not effective in controlling BWA or reducing damage. *Why not?*

Management

- Natural controls:
 - Winter mortality at north latitudes and high elevations



Management

- Host tolerance:
 - Noble and white fir, European firs tolerant unless off-site
 - Susceptible hosts may have individuals that show tolerance in infested areas
 - Some infected trees have wound response that blocks BWA feeding, new growth still susceptible



Robert L. Anderson, USDA Forest Service, Bugwood.org

Management

- Some stand conditions may affect susceptibility
 - Elevation: **grand fir** very susceptible below 1,000 ft with fewer stem infections at higher elev; **Pacific silver fir** rarely damaged above 3,000 ft; heavy damage to **SAF** at low elev and less at treeline
 - Site quality: **silver fir and SAF** tend to have more damage on good sites, so thinning and release of advanced regen may increase BWA damage
 - **Silver fir** near sea level on Olympic Peninsula not damaged (unknown why)
 - Risk & hazard rating systems use elevation, soil and site conditions (may be different for each host)

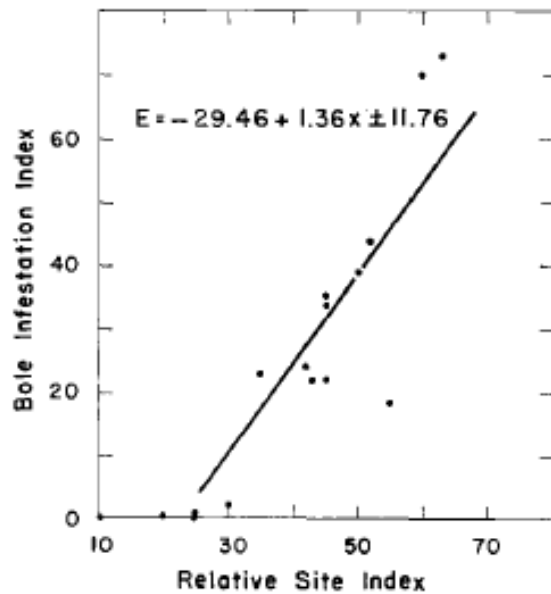


FIG. 9.—Relationship between relative site index and bole infestation index ($r = 0.876$).

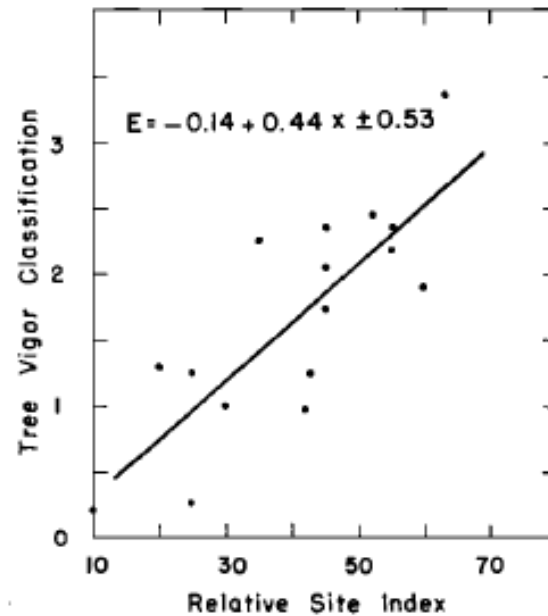


FIG. 10.—Relationship between relative site index and average tree vigor classification ($r = 0.799$).

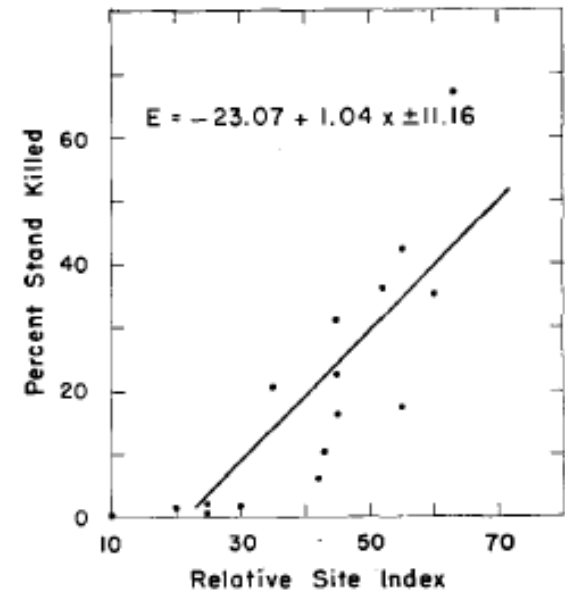


FIG. 11.—Relationship between relative site index and percent of stand killed by the balsam woolly aphid ($r = 0.826$).

Study of Pacific silver fir in SW Washington. Johnson, Mitchell, and Wright (1963) *Journal of Forestry*.

Management

- Silvicultural practices:
 - Very challenging to manage in forests (often chronic with permanent BWA populations)
 - Host specificity allows for species manipulation in some stands
 - If thinning, select against symptomatic trees and favor non-hosts (as leave trees or planting) or host trees that appear tolerant
 - If appropriate for site, favor noble fir and Pacific silver fir (above 3,000 feet)

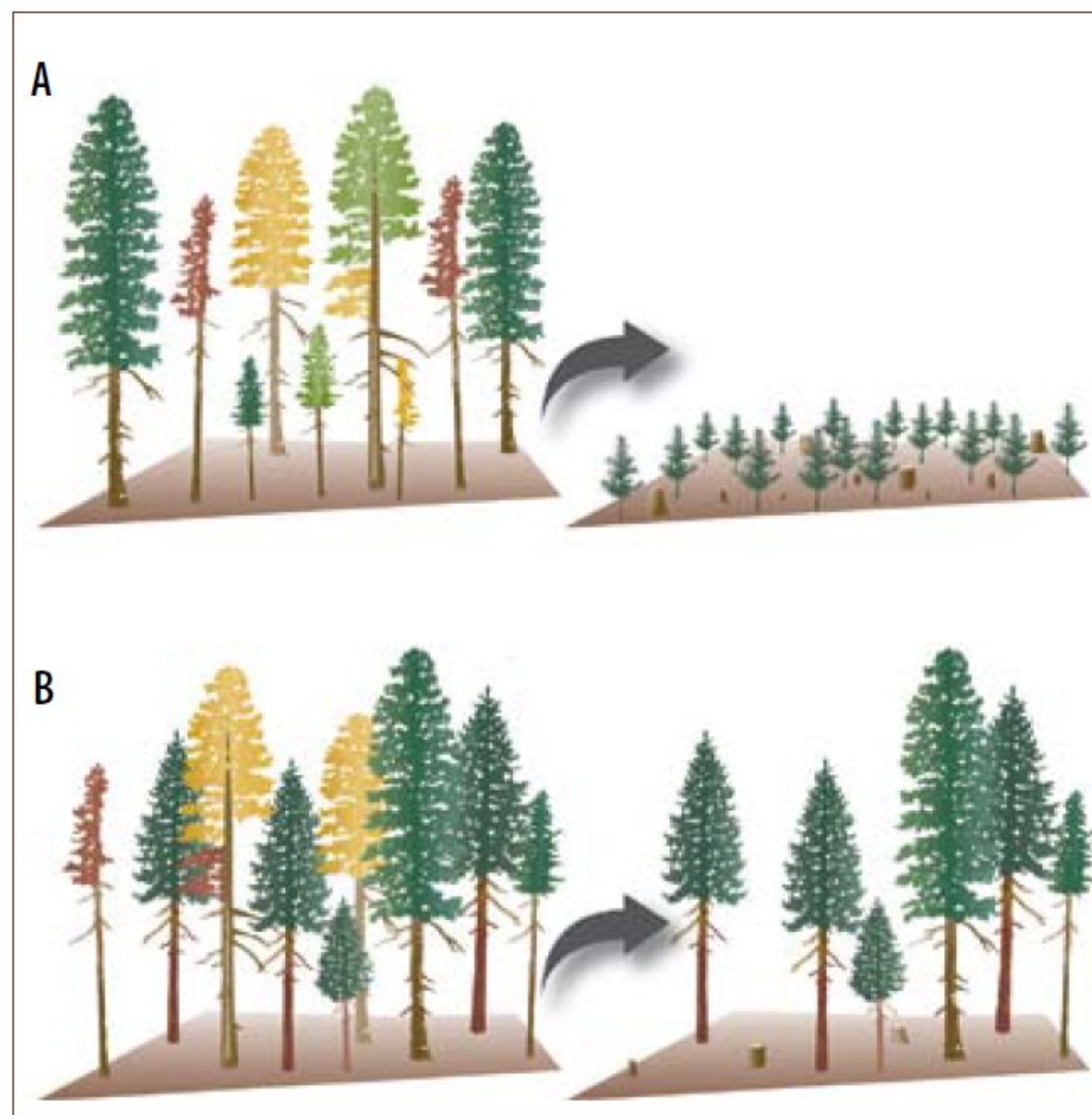


Figure 4-1. Balsam woolly adelgid management:

A) In infested stands dominated by true fir, harvest damaged and high-risk species and convert to nonhost species such as larch, pine, and Douglas-fir;

B) In mixed-species stands, remove damaged and high-risk hosts.

Illustration: Gretchen Bracher.

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