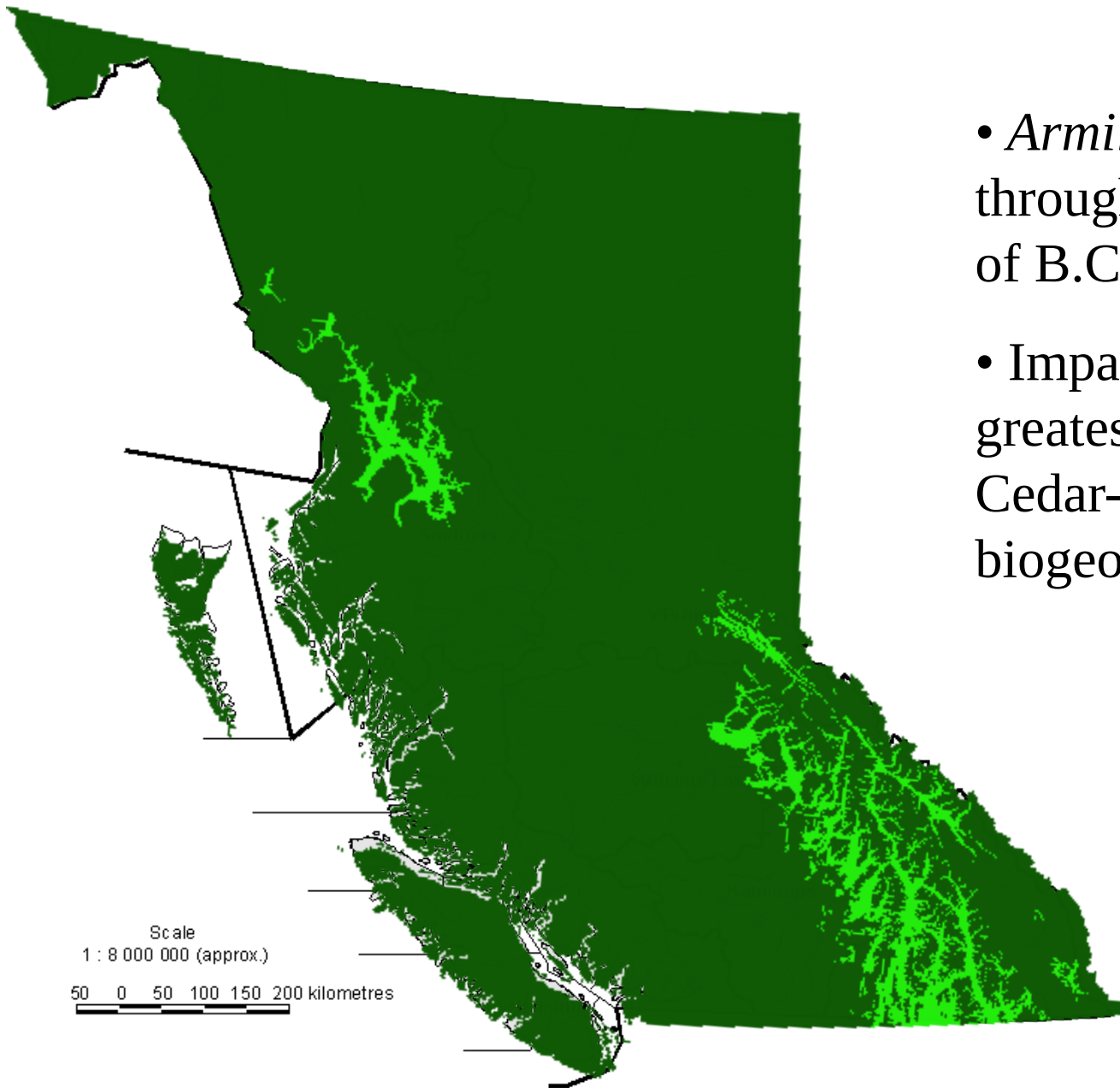


Stumping to control root disease in interior B.C., Canada -- what did we get for \$50,000,000?

Michelle Cleary

BC Ministry of Forests, Lands and Natural Resource Operations,
Southern Interior Region, British Columbia, Canada
Dept. of Forest Mycology and Pathology,
Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden

59th WIFDWC, Leavenworth, WA
October 13, 2011



- *Armillaria ostoyae* occurs throughout the southern 1/3 of B.C.
- Impact of *A. ostoyae* is greatest in the Interior-Cedar-Hemlock (ICH) biogeoclimatic zone

The problem...



Unstocked openings in juvenile stands

55 year old Fd
natural regen

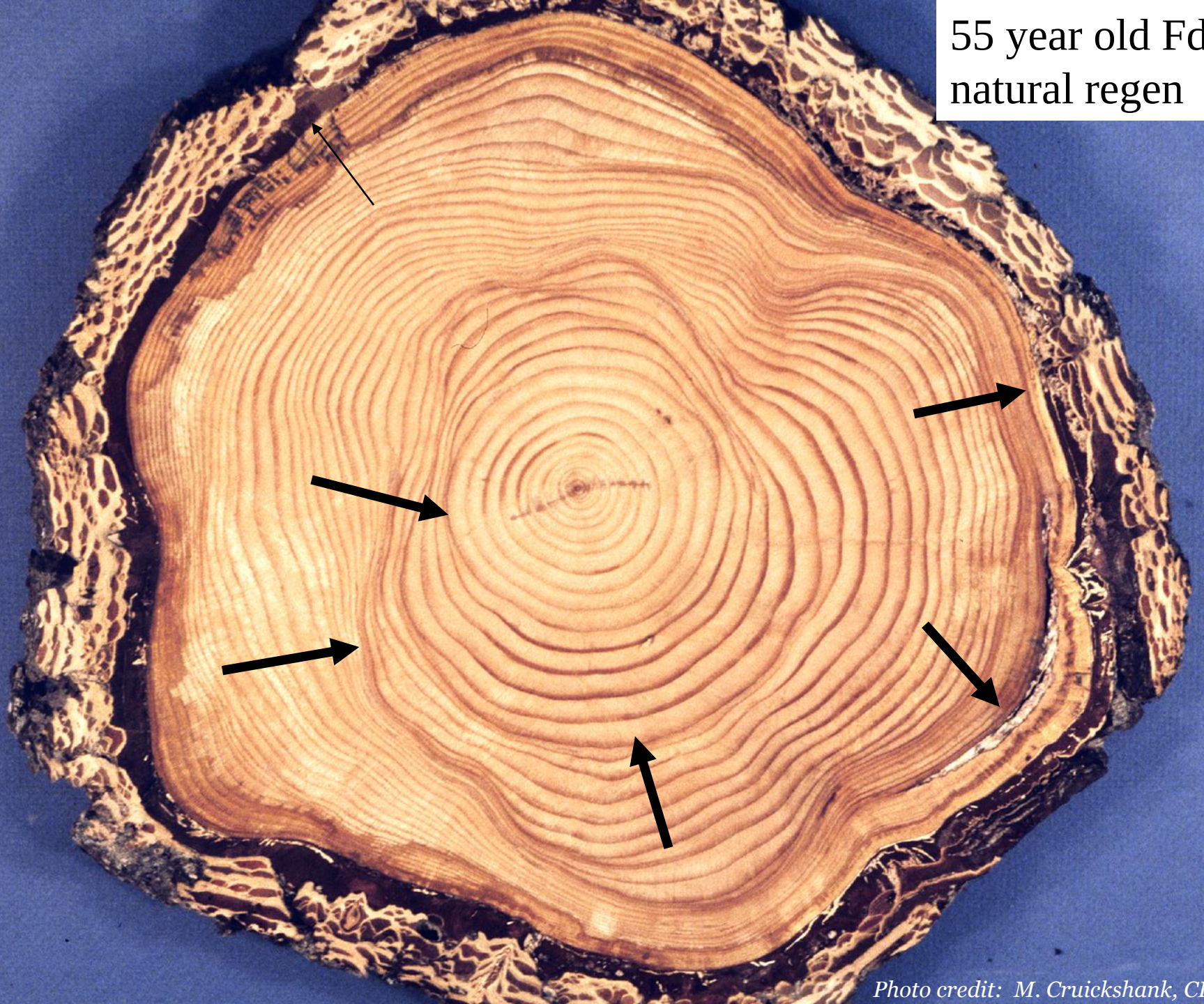
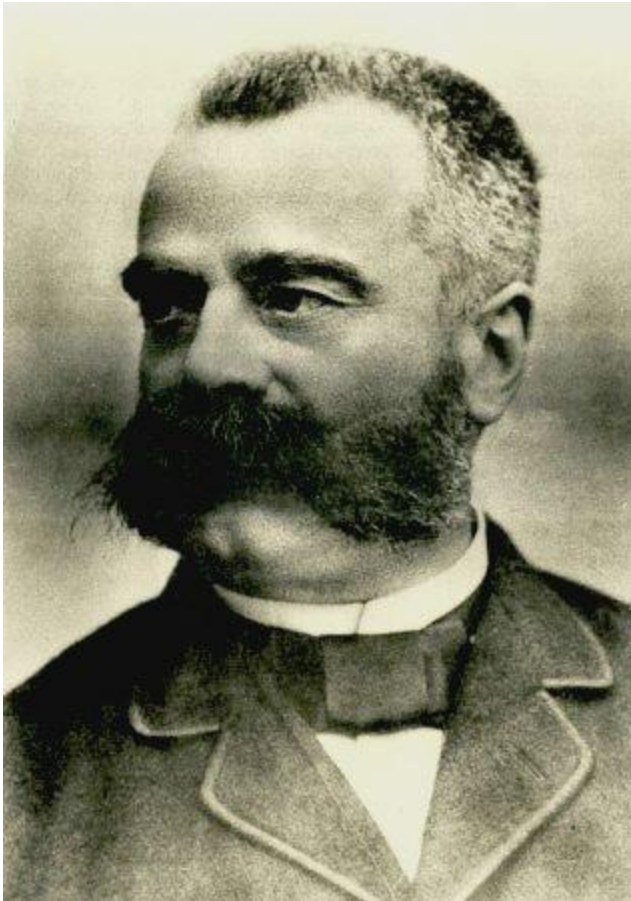


Photo credit: M. Cruickshank, CFS

Pioneer ideas....



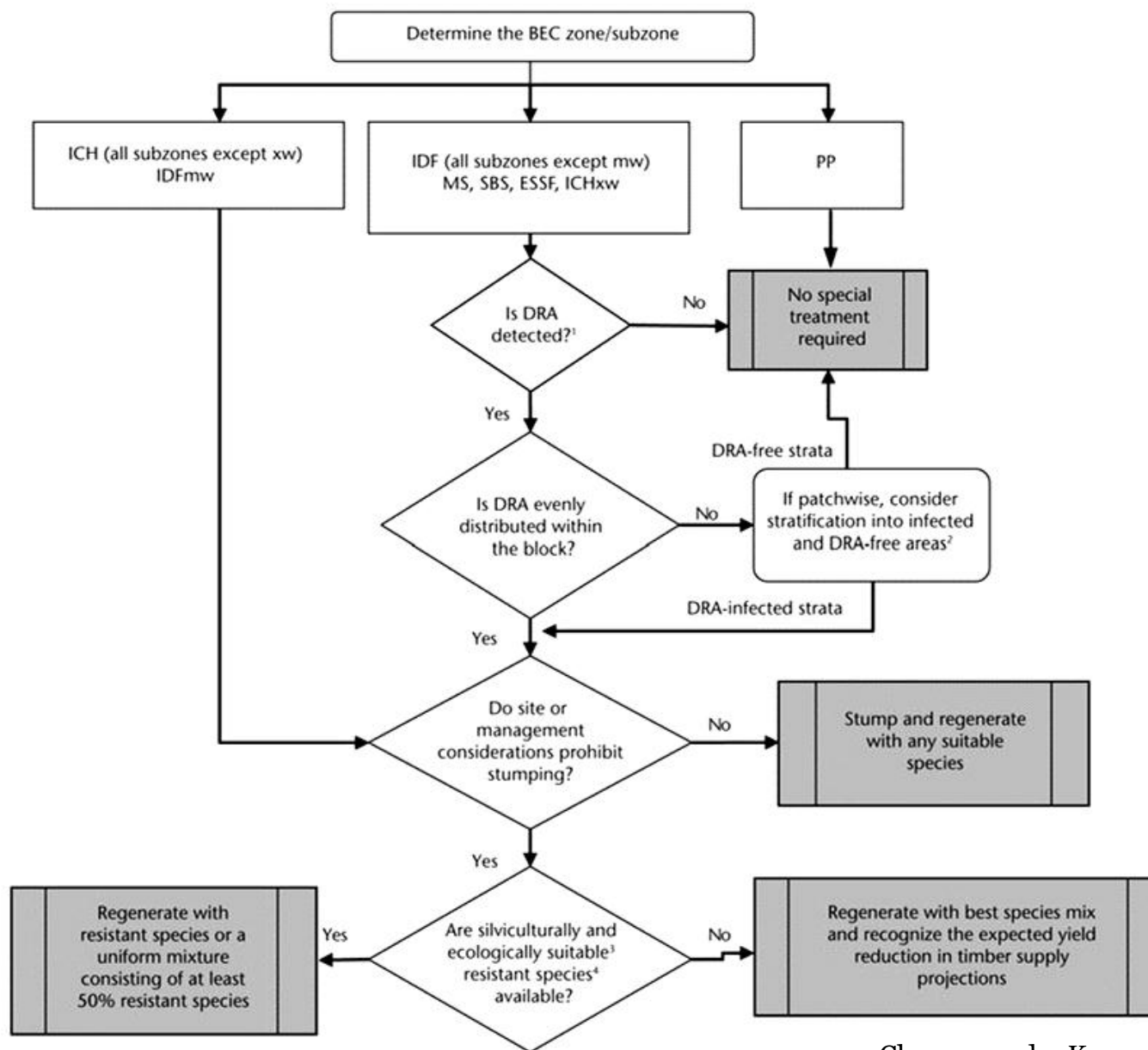
- Robert Hartig, in 1874, first recommended removal of infested root systems from soil as a means of reducing future infections caused by the 'honey fungus'.

The underlying principle behind stumping: to remove the food base from which the fungus thrives, reduce the amount of inoculum available to infect newly regenerating trees, and lower the probability of root disease transmission.

The size of the food base is important in terms of fungal longevity.

Armillaria Root Disease – Southern Interior Forest Region

FIGURE 1. Decision key for different treatment strategies for *Armillaria*-infested sites by BEC zone/subzone for the Southern Interior Region.



BC crown investment in stump removal for root disease control

Destumping and Push-over Harvest for Root Disease Control Appraisal Allowance for Major Licensees:

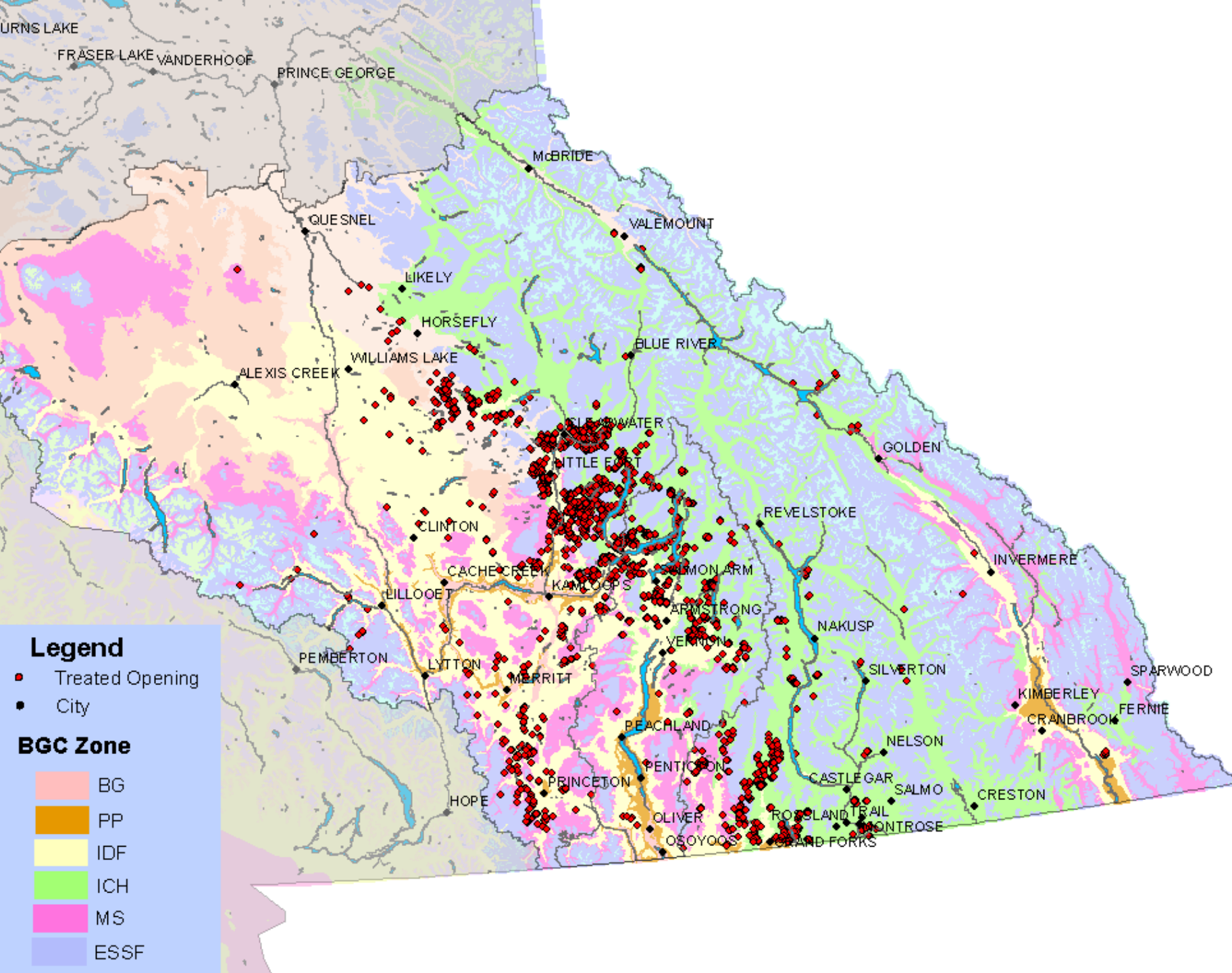
- An adjustment will be determined for that part of the cutting authority area where destumping for root disease control is required.
- The treatment area must be accurately delineated and shown on the appraisal map and included in the site plan.
- A cost estimate is calculated based on piece size.
- The range for stumping costs → \$600-\$1200/ha; average ~ \$1000/ha.

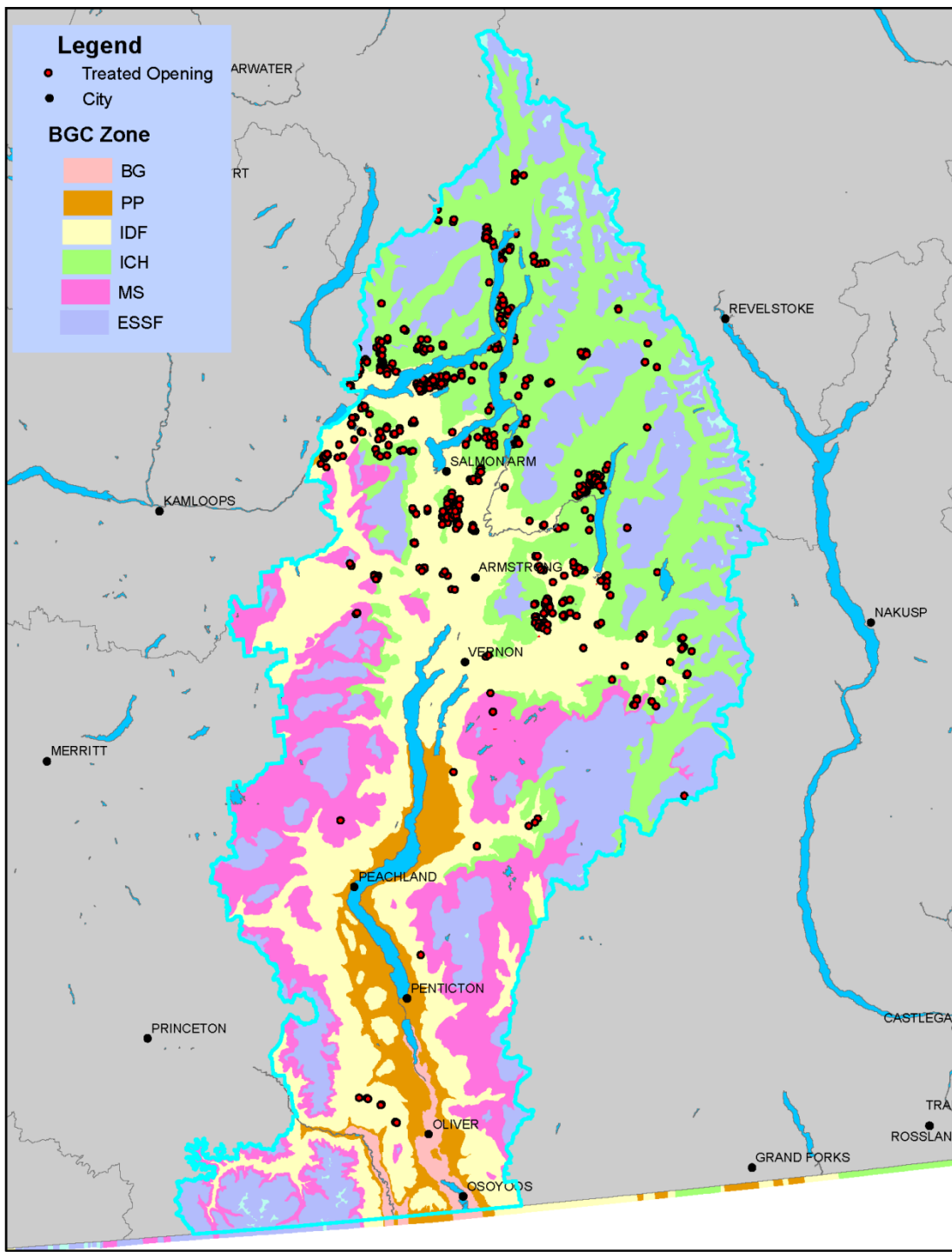
Total area stumped in the southern interior : 49,684 hectares (~ 122,771 acres)

Source: Reporting Silviculture Updates and Land status Tracking System (RESULTS) report , July, 2010

Cost estimates for root disease control (ca. 1991): \$53,390,549

Source: General Appraisals Report for southern Interior forest region, 2010





Most stumping
occurs in ICH-
biogeoclimatic
zone and its
transitional areas



Does stumping actually work?

Operational restrictions for stumping:

- Continuous slopes >30%
- Soil textures susceptible to compaction (e.g. clay, silt) unless otherwise demonstrated that it will not cause soil disturbance limit greater than 5%
- Where soil depths are shallow over bedrock
- Soil moisture regimes that are subhygric or wetter
- Within Riparian Reserve Zones or in wet microsites, fish bearing streams, or wetlands
- Where stumping will negatively affect reserve trees, reserved areas, or reserved standard units



What do we know about the long-term effect of stumping treatment?

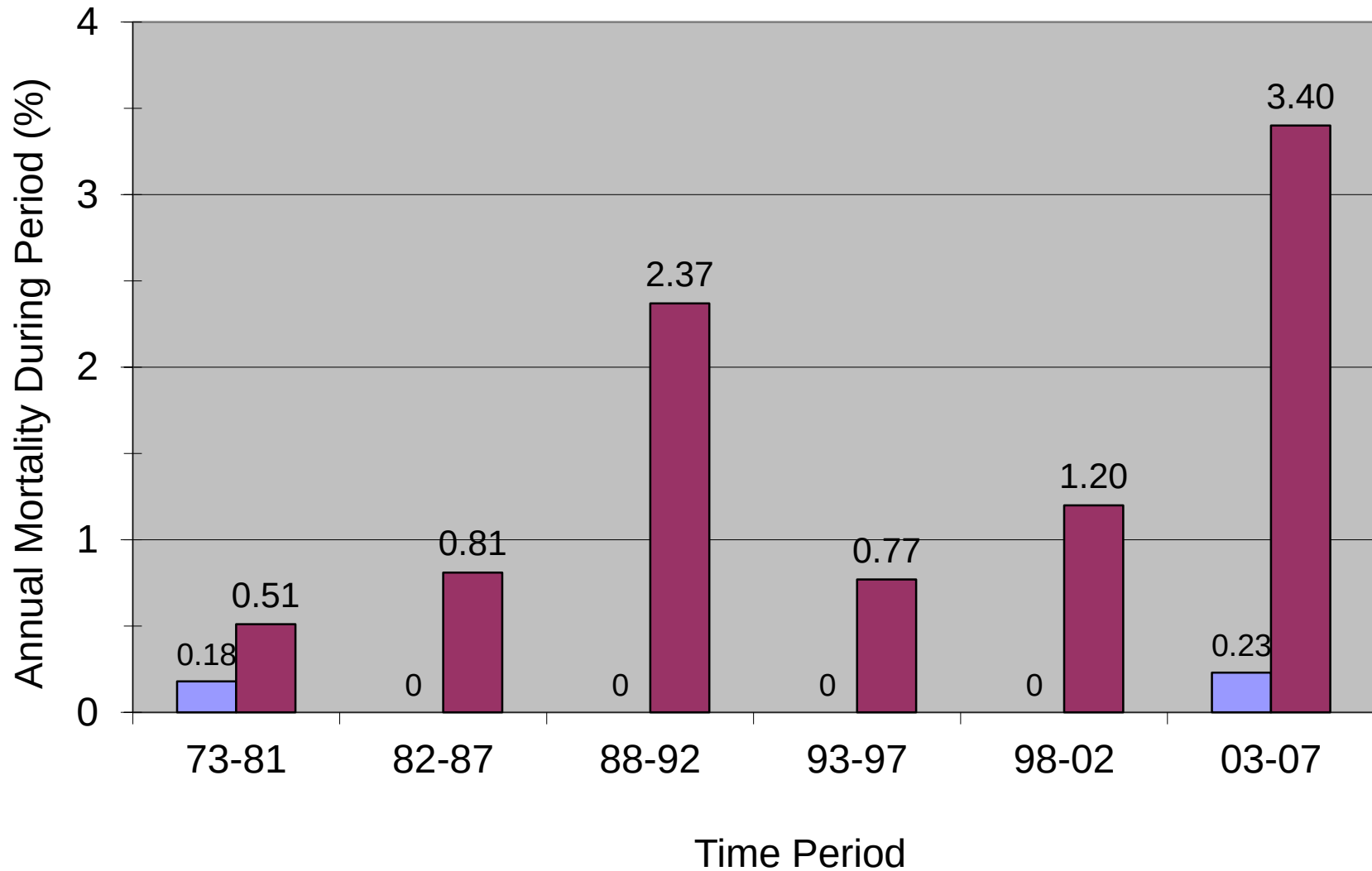
Skimikin Stumping Trial (history)

- Est. 1968 by L. Weir to 1) determine the efficacy of inoculum removal for control of *Phellinus* root disease. ; also 2) to assess the resistance of several tree species, 3) to test the effect on disease spread of alternating rows of susceptible and less susceptible spp.
- Experiment located near Salmon Arm, BC; ICH mw ecosystem, elevation = 750m.
- In the previous stand: mature Doug-fir (major), lodgepole pine, western redcedar (minor).
- At harvest, ~20% trees killed by *Phellinus*; ~60-70% of coniferous stumps had stain or decay typical of *Phellinus*. Subsequently, *Armillaria* also discovered on site.
- Design: Two 80m x 160m blocks. In one block, trees pushed over + root raked. In the other block, trees felled. A 10 m. wide border was cleared + root raked around blocks.
- In each block, 32, 20m x 20m plots and a number of species plots were randomly established comprising Douglas-fir, lodgepole pine, western redcedar, and paper birch (3 species plots; alone and in all combination of two species). One of the two remaining plots in each block was planted with western larch and Engelmann spruce.
- Seedlings that suffered planting failure were replaced in 1969 and 1970.
- Tree condition assessed since 1973 ; no. of living trees in 1973 taken as the starting point. Mortality from *Armillaria* and *Phellinus*, and other causes was determined during 1977, 1981, 1983, 1987*, 1992, 1997, 2007 (at 40 years).

* Morrison et al. 1987, Inf. Report BC-X-302, Pacific Forestry Centre

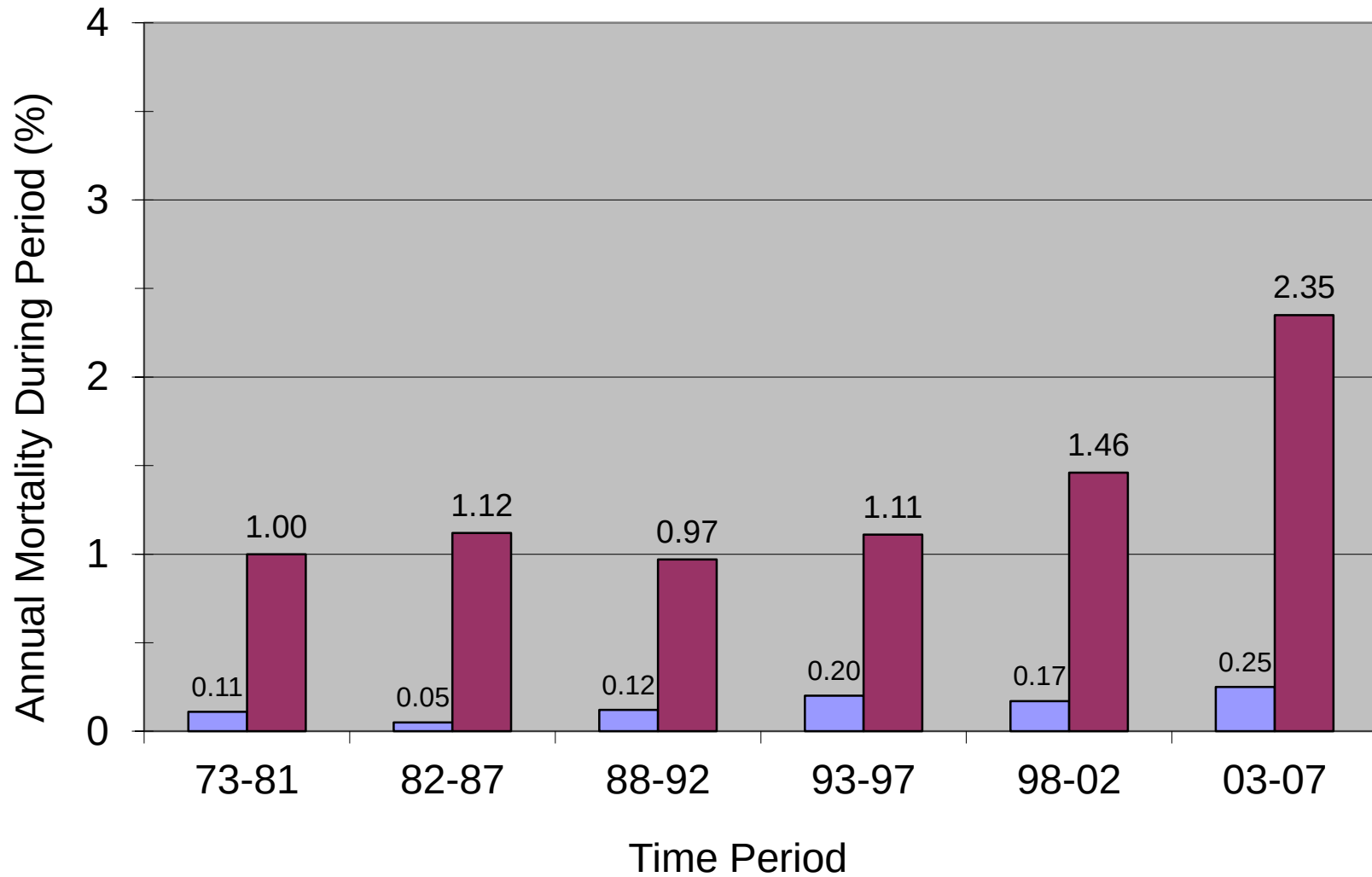
Engelmann spruce *A. ostoyae* mortality

■ Treated ■ Untreated



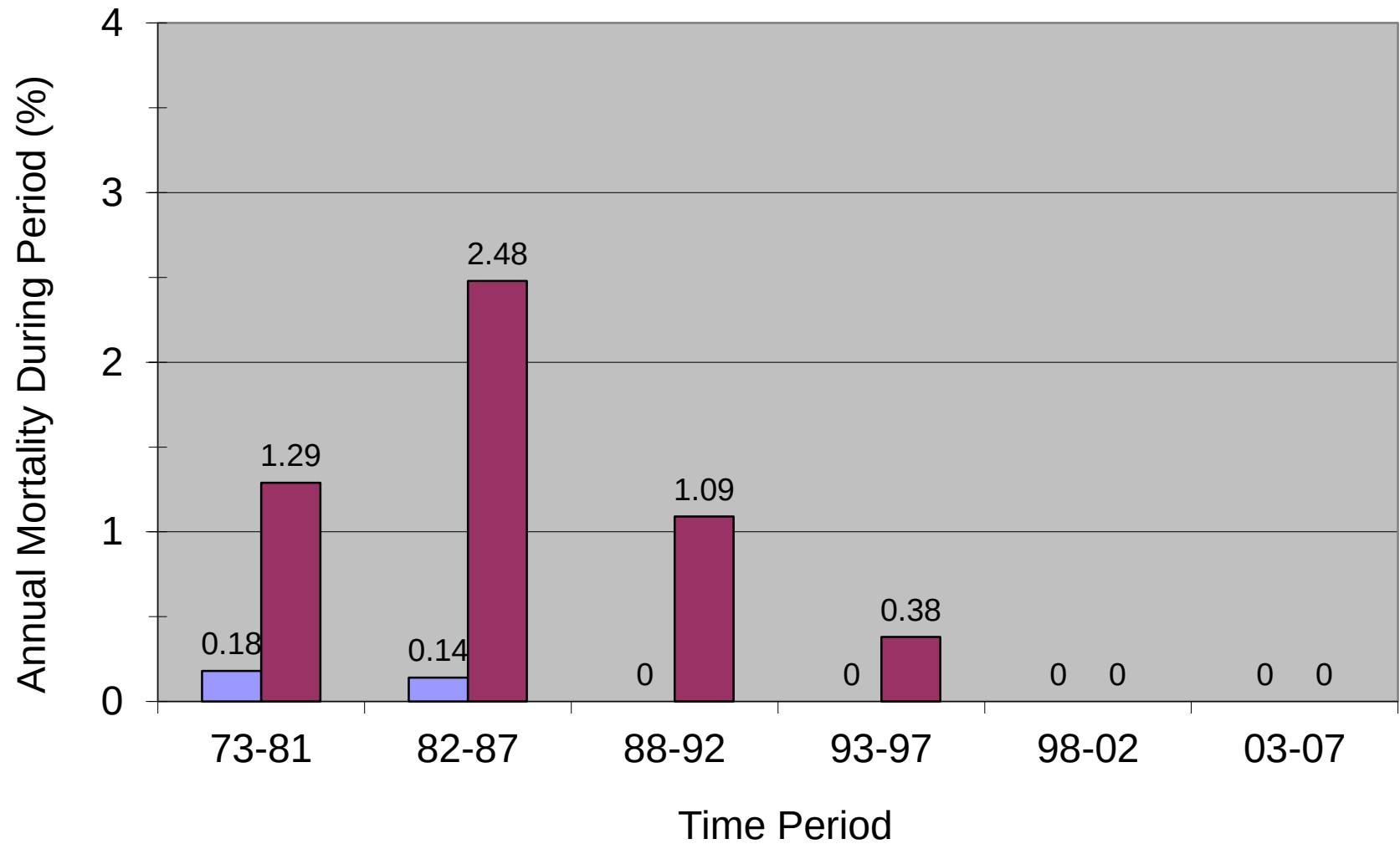
Lodgepole pine *A. ostoyae* mortality

■ Treated ■ Untreated

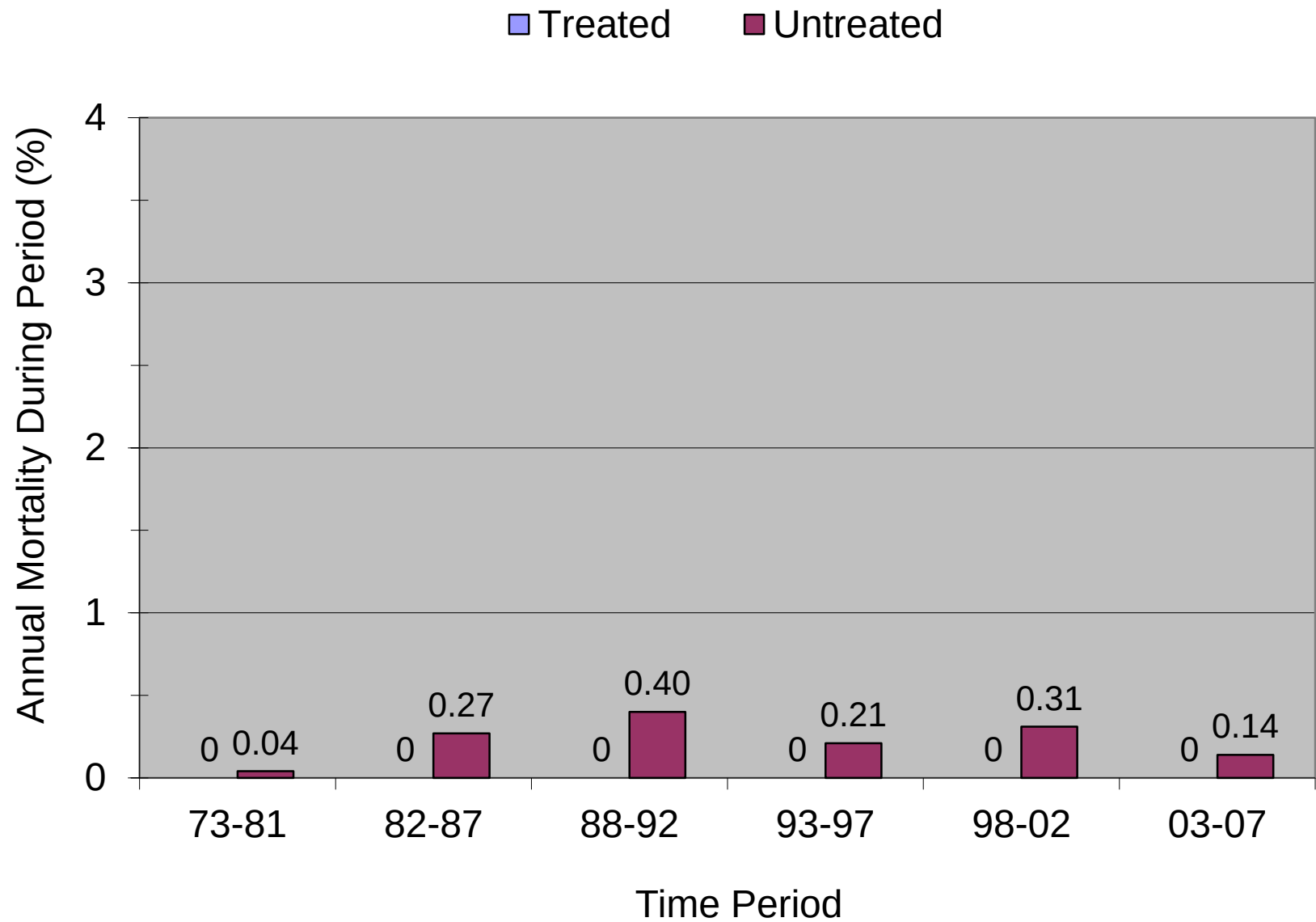


Western larch *A. ostoyae* mortality

■ Treated ■ Untreated

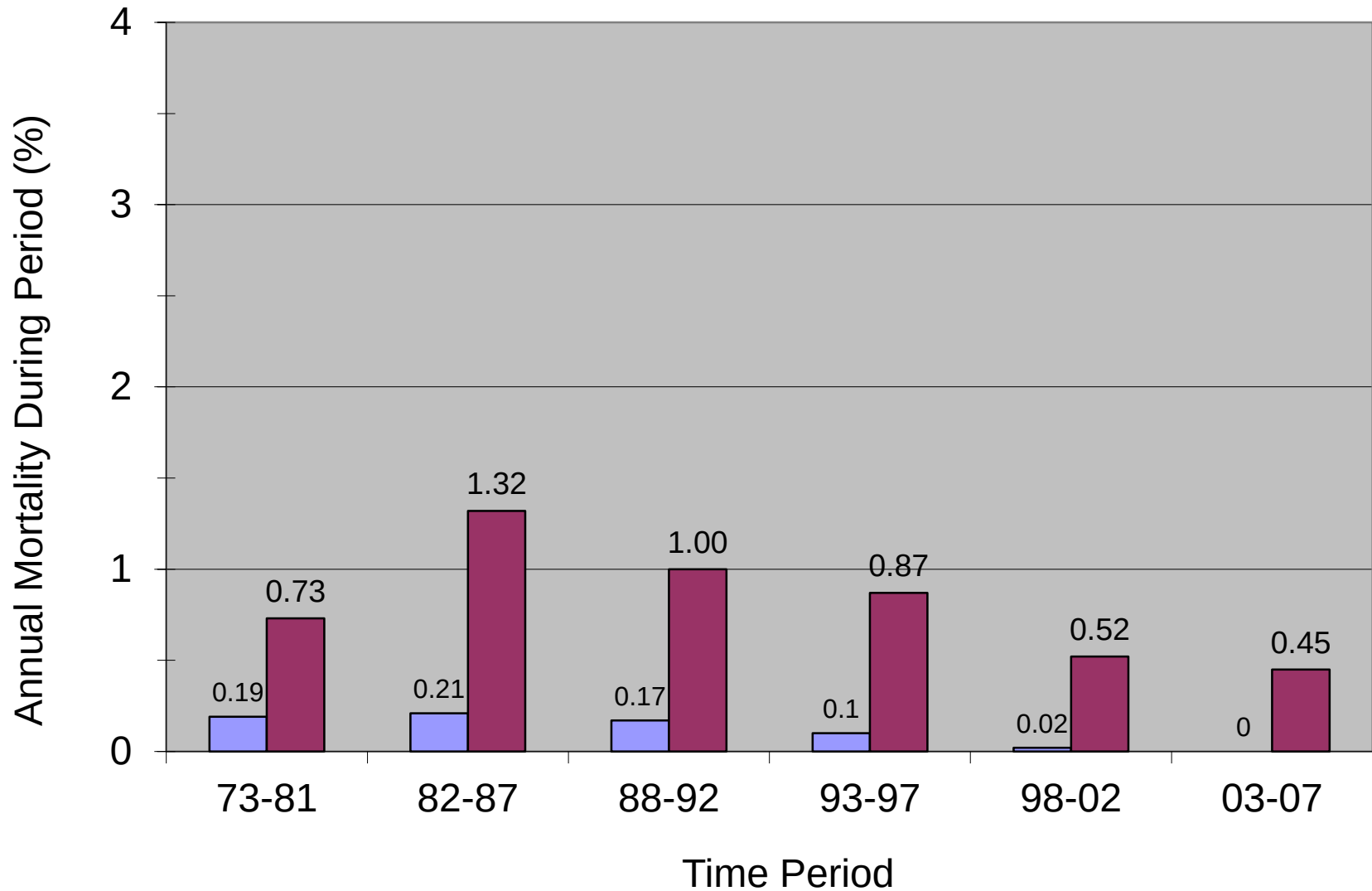


Western redcedar *A. ostoyae* mortality



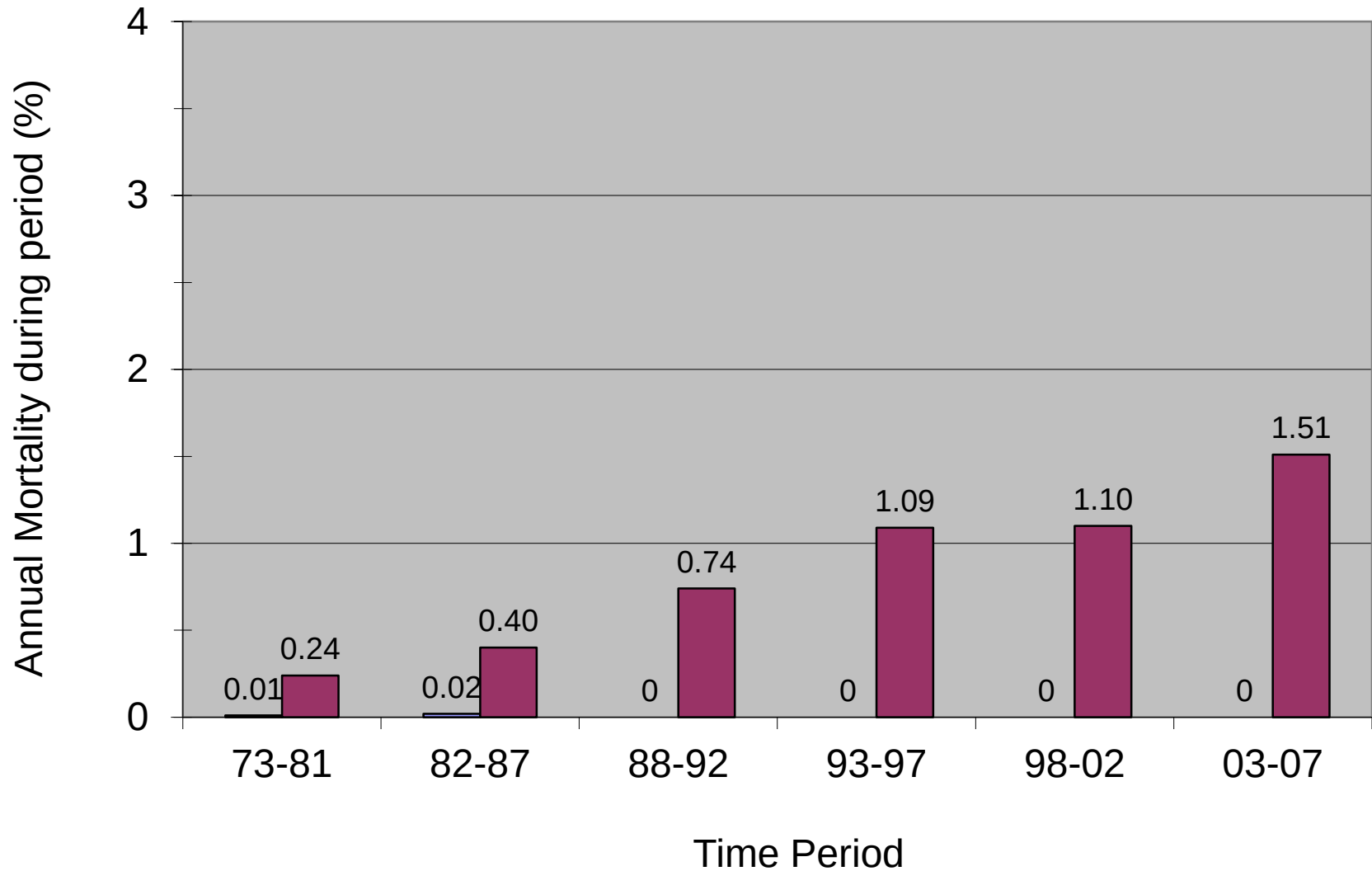
Douglas-fir *A. ostoyae* mortality

■ Treated ■ Untreated



Douglas-fir *P. sulphurascens* mortality

■ Treated ■ Untreated

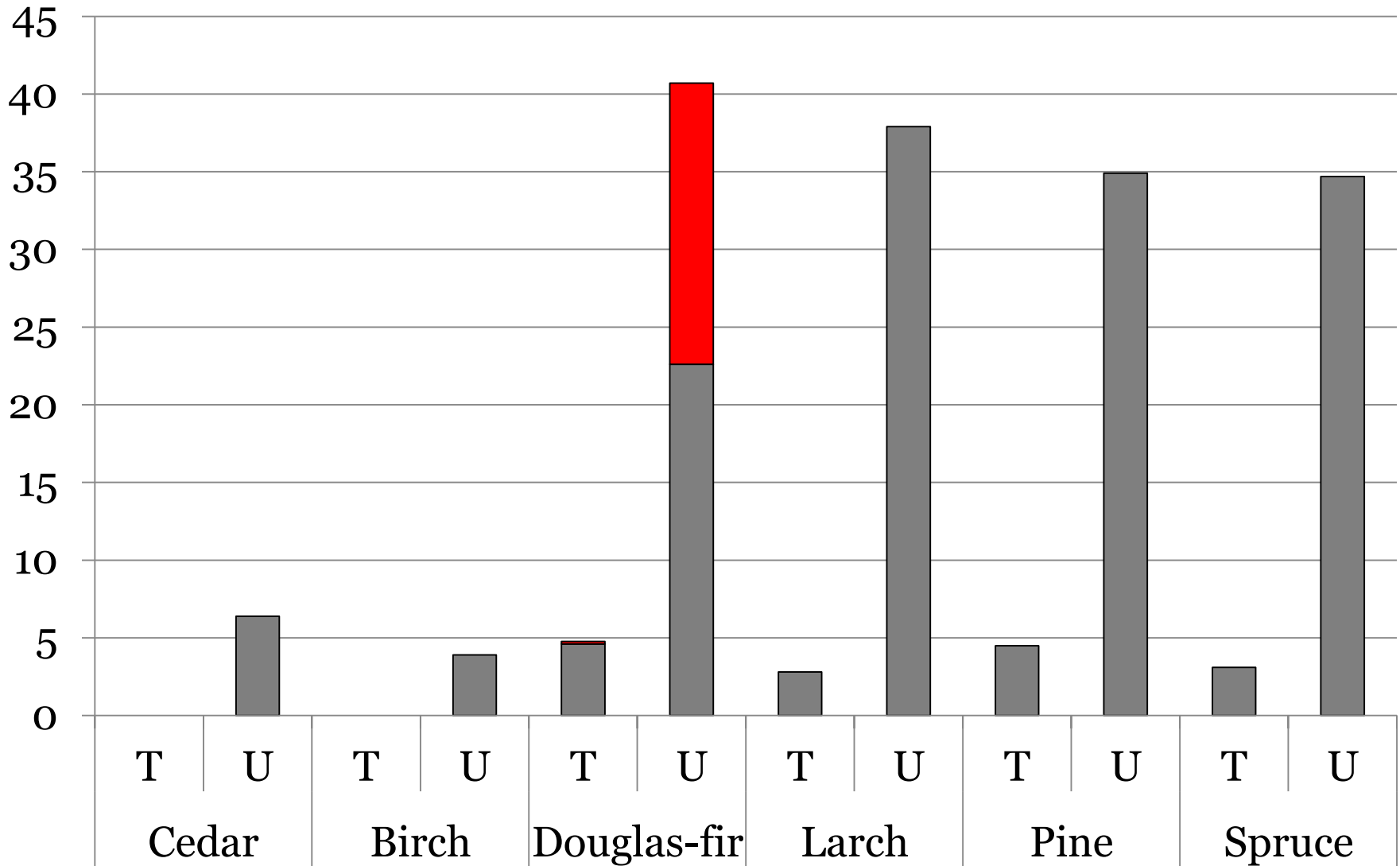


Skimikin Cumulative Mortality

■ *Armillaria*

■ *Phellinus*

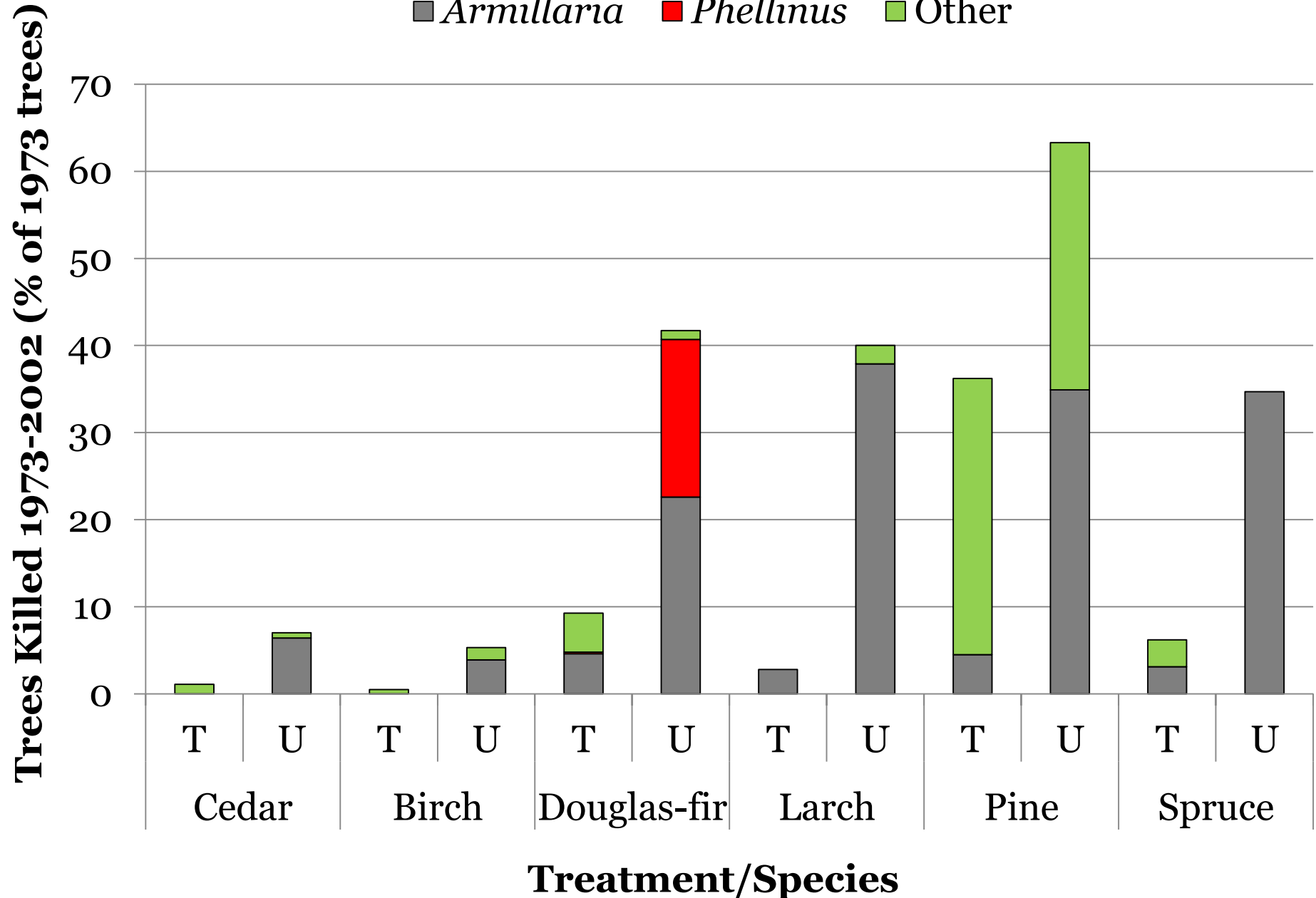
Trees Killed 1973-2002 (% of 1973 trees)



Treatment/Species

Skimikin Cumulative Mortality

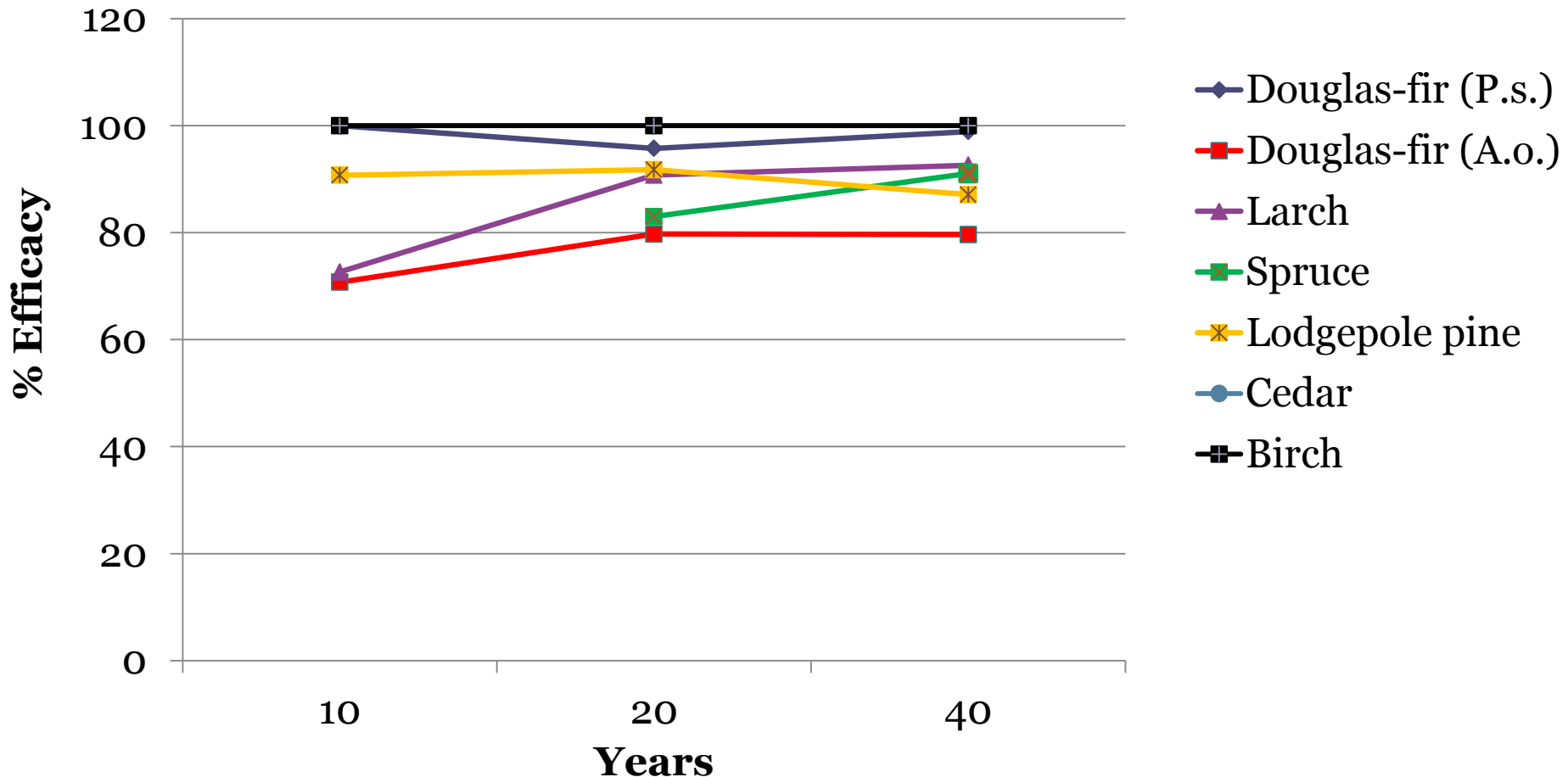
■ *Armillaria* ■ *Phellinus* ■ Other



Efficacy of Treatment (Skimikin)

- Did it change over the years???

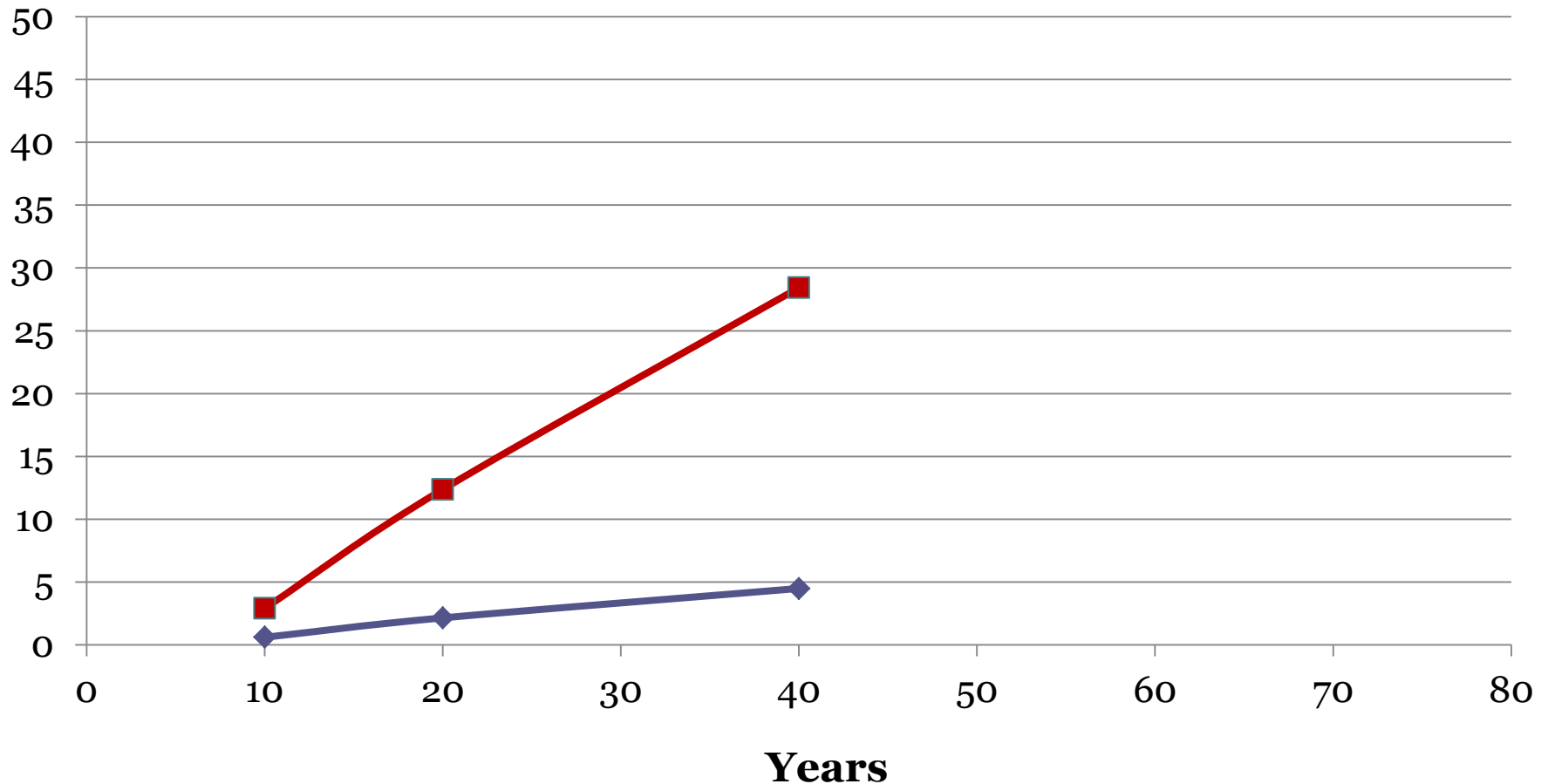
Treatment Efficacy (Skimikin)



What about projected mortality?? (Skimikin)

Cumulative percent mortality (all species)

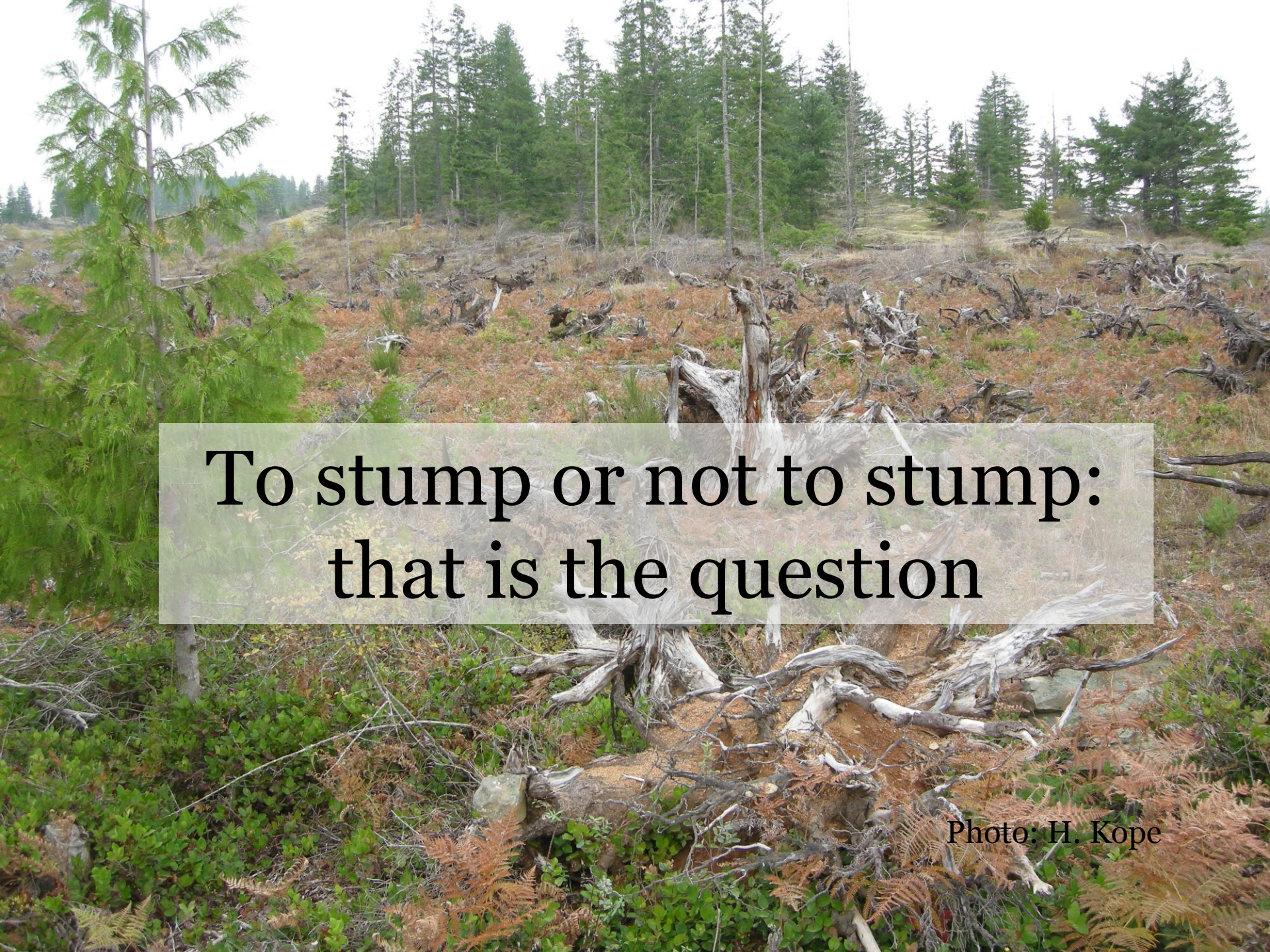
—◆— Treated —■— Untreated



Problems with comparisons between sites/trials

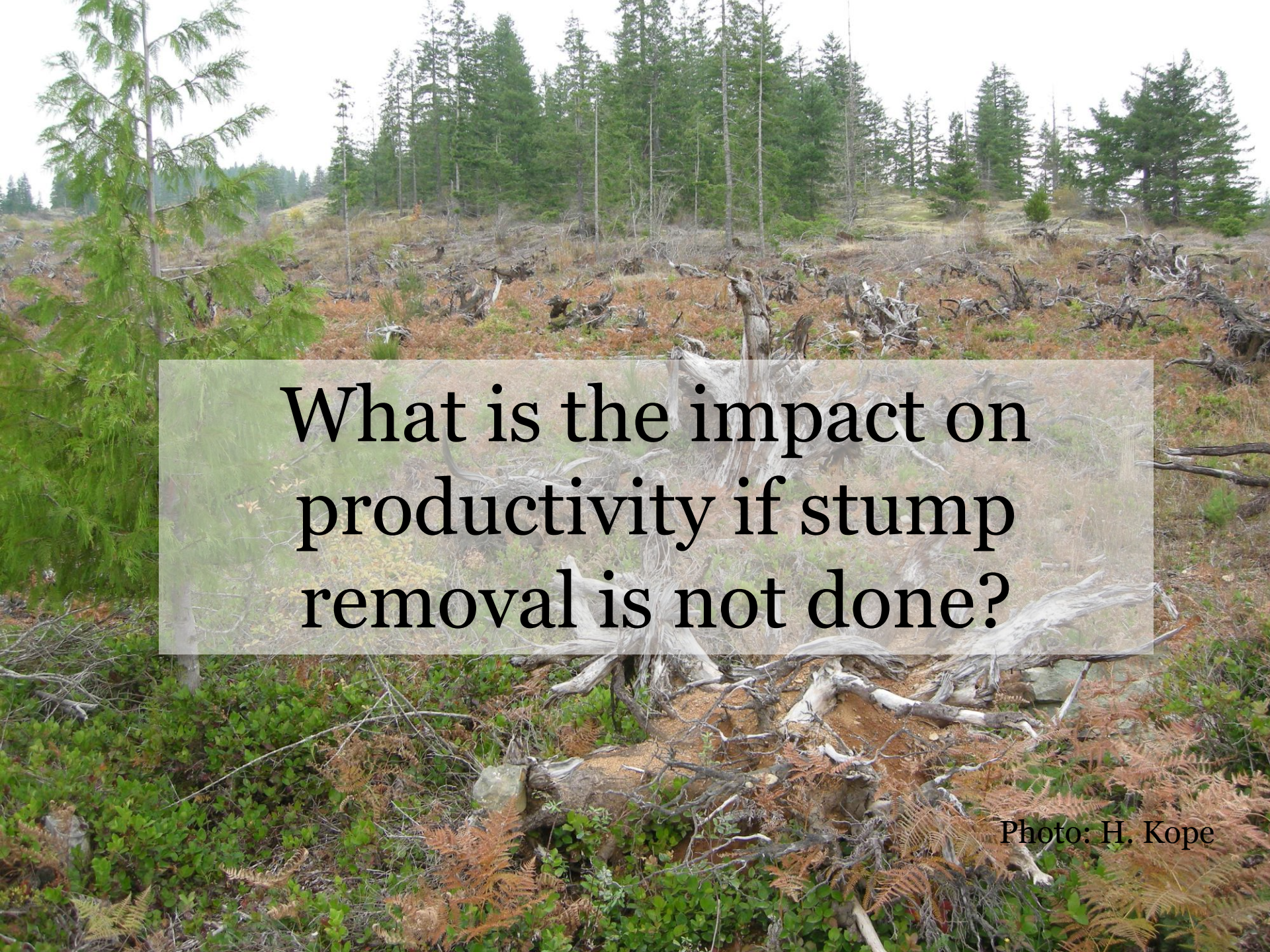
- Skimikin probably represents the best case scenario; other stumping trials in BC have had less success, but there were other anomalies that reduced the likelihood of treatment differences.
- Other operational trials in BC difficult to assess long-term effects → lack the rigour of tracking causes of mortality through the years

**** Stump removal is not a full-proof sanitation treatment!**



To stump or not to stump:
that is the question

Photo: H. Kope

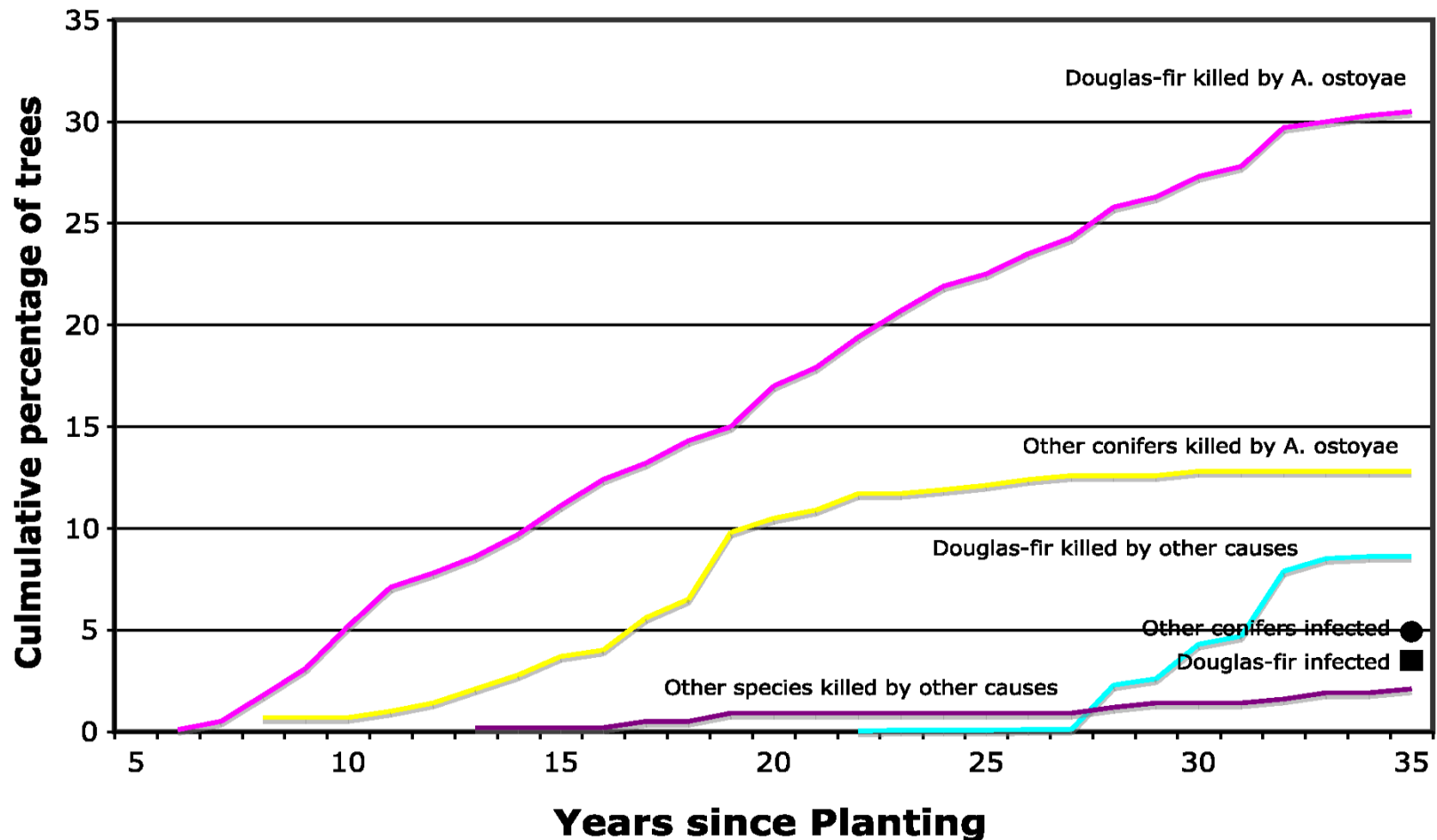


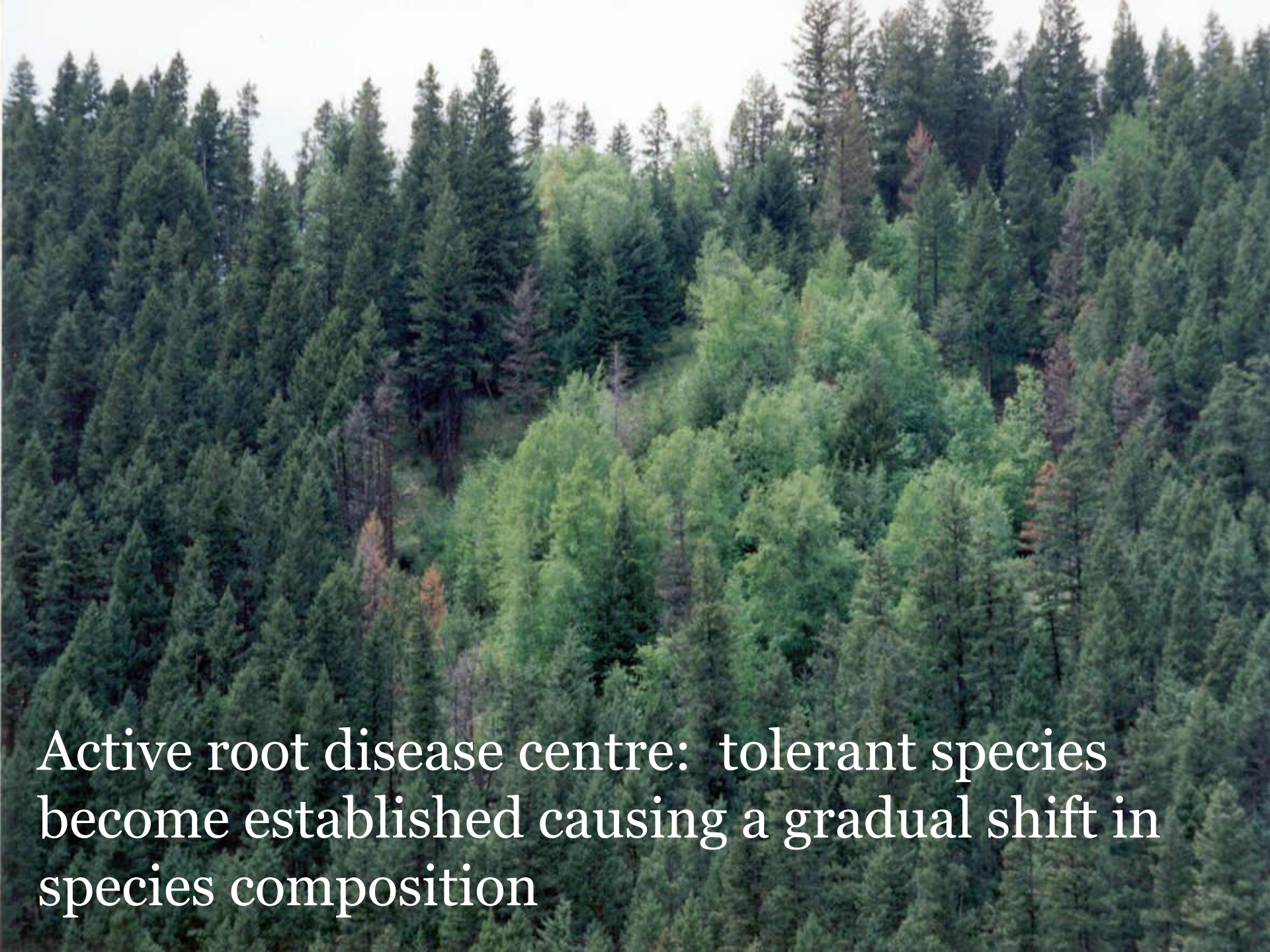
What is the impact on
productivity if stump
removal is not done?

Photo: H. Kope

Long-term Armillaria Root Disease PSP

Sugar Lake Cumulative





Active root disease centre: tolerant species become established causing a gradual shift in species composition

Other examples...

82L075-58 (Larch Hills):

12 yrs after being declared FG (at age 11),
the presence of Armillaria decreased the
Douglas-fir component by 32%.

Incidentally, western redcedar component
increased by 24%

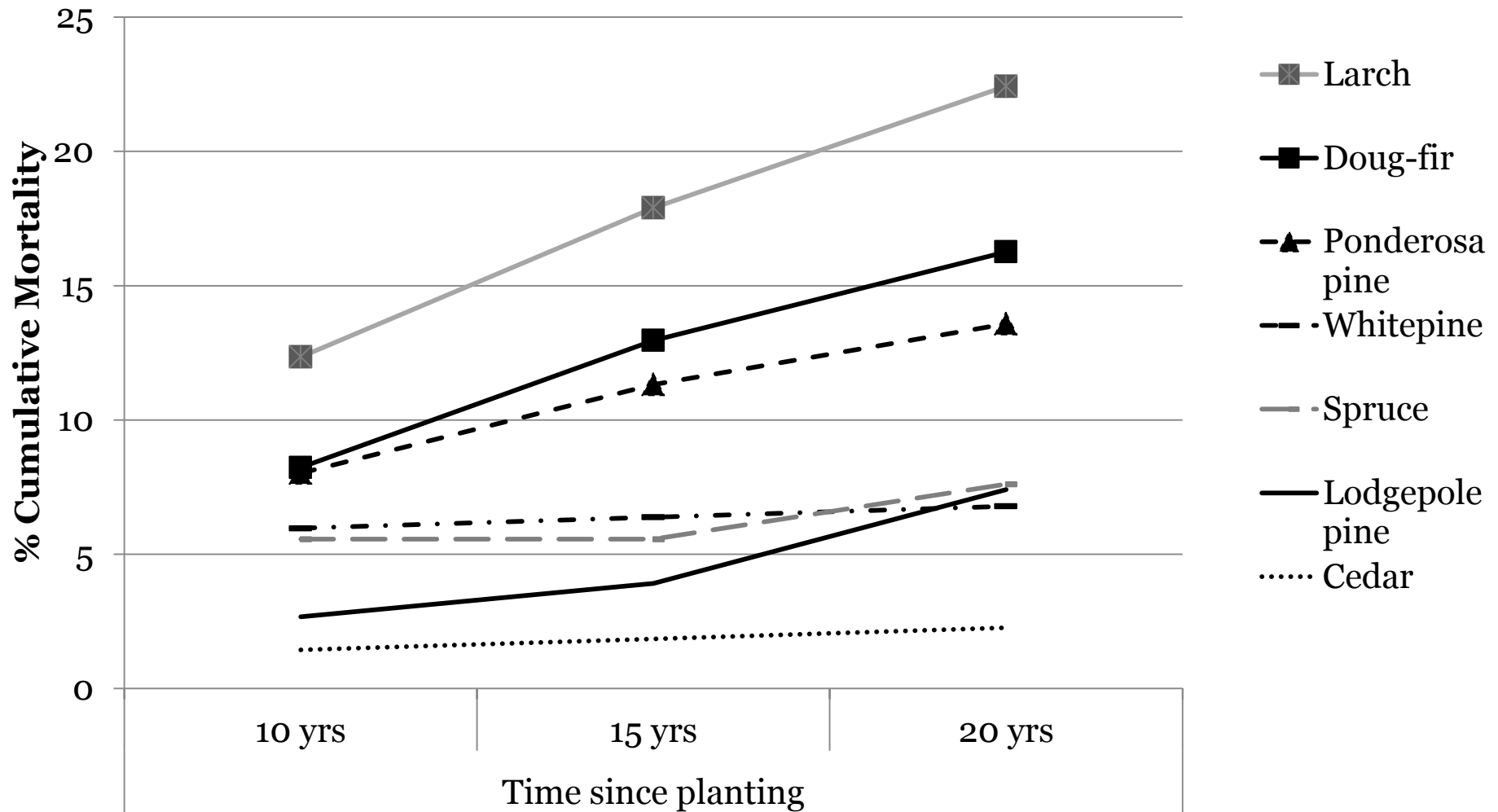
A. Woods, Okanagan E² report (unpublished)



Surveys of juvenile mixed conifer
stands in the ICH showed ~25% of
the Douglas-fir component killed
by Armillaria compared to only 2%
in western redcedar.

M. Cleary (unpublished)

Species trial (Hidden Lake)



Monitoring to Improve Management Practices of Juvenile Lodgepole Pine in British Columbia

By Jim Snetsinger, ADM Stewardship Division/Chief Forester, Ministry of Forests, Mines and Lands

“Practitioners need to take advantage of opportunities to maximize productivity through effective species selection and silviculture practices. Examples include regenerating lodgepole pine, where appropriate, as a component of a broader species mix, planting genetically improved white pine, **and using stumping treatments in areas of high root disease.**”

Special thanks to:

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Jason Nunn & Ken Chantler, Timber Pricing & Revenue Branch

Mei -Ching Tsoi & Caroline McLeod, Forest Practices Branch

Mike Ryan, Ecologist,

Ministry of Forests, Lands & Natural Resource Operations

Photo: H. Kope