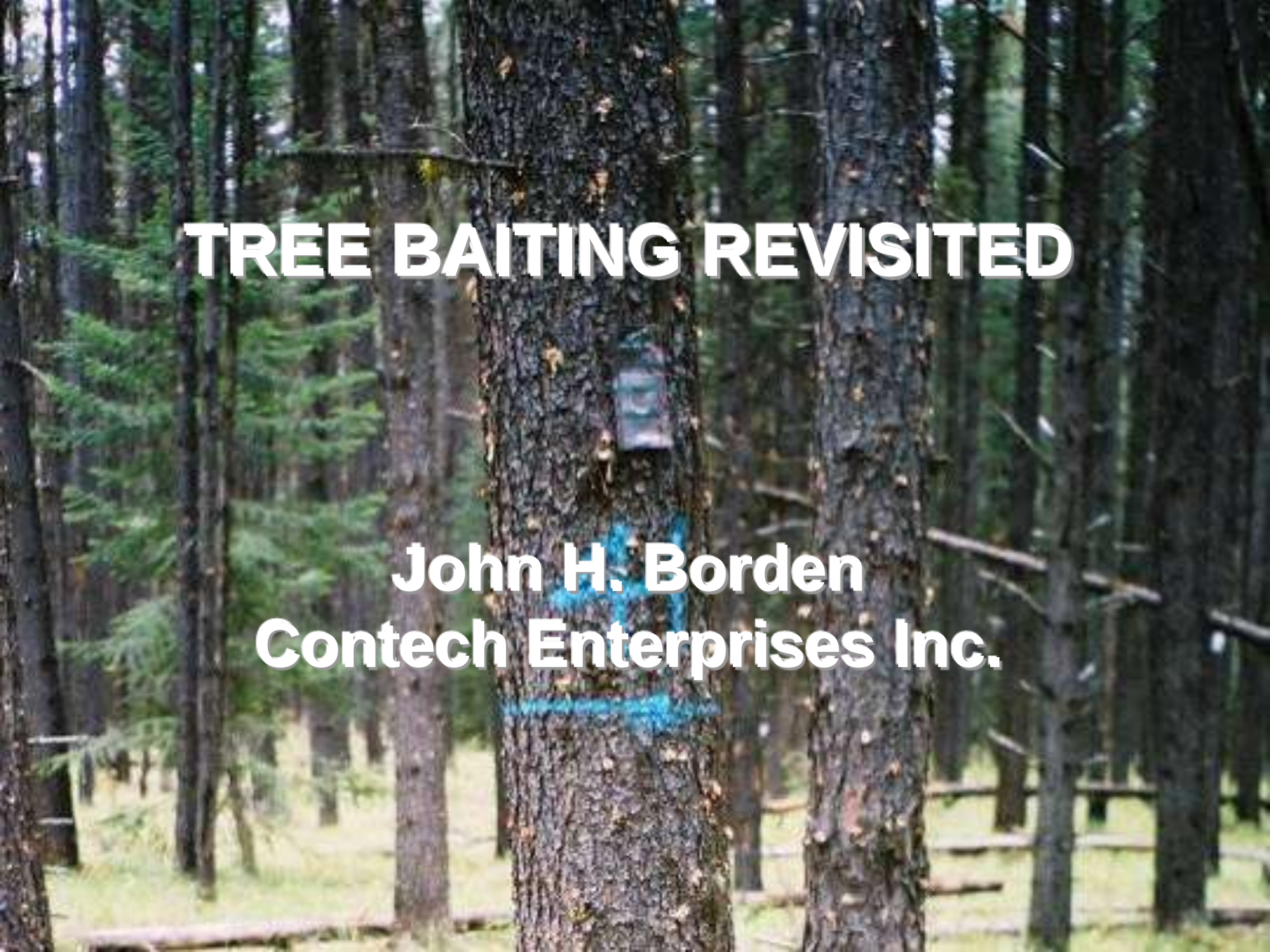


A photograph of a forest with a tree trunk in the foreground. The tree trunk has a blue spray-painted 'X' and a small metal trap attached to it. The background shows other trees and a grassy area.

TREE BAITING REVISITED

**John H. Borden
Contech Enterprises Inc.**



NOTE

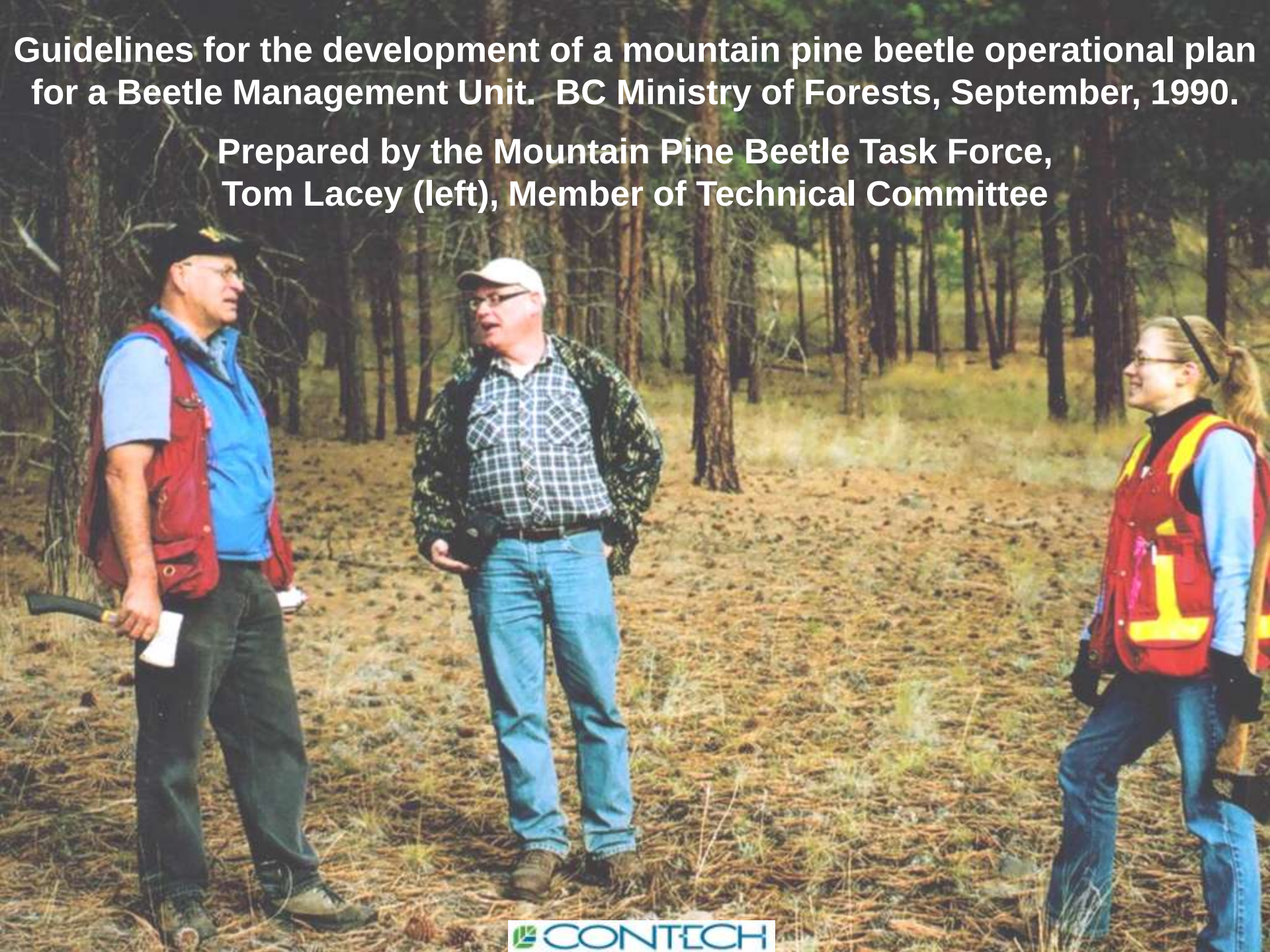
After 37 years in academia, I joined the dark side in 2003. I now work for a company that sells the bark beetle semiochemical products that I helped to develop when I was at Simon Fraser University.

STRATEGIES AND TACTICS

- **Strategies can generally be defined as broad plans** (e.g. gain terrain advantage over the enemy by capturing Pork Chop Hill)
- **Tactics are specific actions or maneuvers that alone, or in combination with other tactics, can be used to satisfy a strategic objective** (e.g. use aerial reconnaissance to identify enemy positions, then artillery barrage, then combine frontal tank assault with flanking maneuver by infantry)

Guidelines for the development of a mountain pine beetle operational plan for a Beetle Management Unit. BC Ministry of Forests, September, 1990.

**Prepared by the Mountain Pine Beetle Task Force,
Tom Lacey (left), Member of Technical Committee**



STRATEGIES

TASK FORCE

- **Abandon/Do nothing**
- **Salvage**
- **Prevention**
- **Maintain low**
- **Holding action**
- **Suppression**

BORDEN

- **Let Nature prevail**
- **Prevent a problem from occurring**
- **Maintain problem at a tolerable level**
- **Suppress problem to a tolerable level**

SOME POTENTIAL OR ACTUAL TACTICS

Access development, hauling restrictions, hazard rating, risk rating, harvest priority rating system, high-hazard host removal, overview flights, detailed sketch mapping, remote sensing, ground probes, fall and burn, broadcast burning, thinning (beetle proofing), tree baiting, species manipulation, tree age manipulation, induced resistance, repellent semiochemicals, sanitation harvesting, salvage harvesting, MSMA, preventative insecticidal spray, debarking *in situ* (tree monkey, primer cord), small patch selection, single tree selection, heli-logging, competitive displacement.....



Select the most appropriate strategy, along with a group of applicable tactics, and you've got your IPM program.

(but probably not in this location)

SOME POTENTIAL OR ACTUAL TACTICS

Access development, hauling restrictions, hazard rating, risk rating, harvest priority rating system, high-hazard host removal, overview flights, detailed sketch mapping, remote sensing, ground probes, fall and burn, broadcast burning, thinning (beetle proofing), tree baiting, species manipulation, tree age manipulation, induced resistance, repellent semiochemicals, sanitation harvesting, salvage harvesting, MSMA, preventative insecticidal spray, debarking *in situ* (tree monkey, primer cord), small patch selection, single tree selection, heli-logging, competitive displacement.....

**Female finds tree, begins to bore in.
Produces *trans*-verbenol.**



**Males (+ some females) attracted.
Males release *exo*-brevicommin.**



**Females (+ some males) attracted.
Many beetles respond to pheromone blend
+ host terpenes. Tree fills up.**

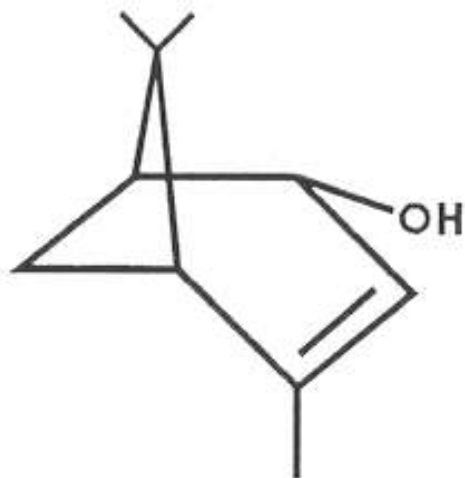


Females (then males) produce verbenone.

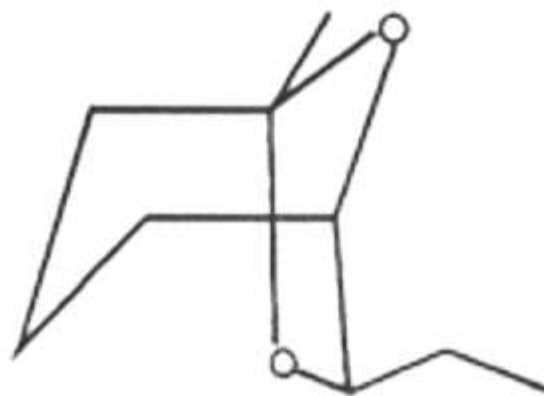


**Galleries evenly spaced.
Attack shifts to adjacent tree.**

AGGREGATION PHEROMONES



trans-verbenol



exo-brevicomine



TREE BAITING TACTICS

- **Monitoring**
- **Lethal trap trees**
- **Integration with silvicultural treatment**
- **Containment and concentration**
- **Push-pull**

EVOLUTION OF TREE BAIT



We started with blocks of 2x4s.

We drilled holes in them to hold pheromone dispensers.

We then tied them to trees using plastic flagging.

They were bulky and heavy.

The Missionary Bait



**Bless you my tree, for you
are about to die.**



The Phero Tech Bait



Better, but still too labour-intensive



Hi-Tech Baits



- Flat plastic bag, heat sealed – just staple and walk away
- *Exo-brevicom* switched from Hercon laminate to Wakarchuk flexlure – made in house at Phero Tech
- Myrcene removed based on work by Borden et al. 1993, Can. J. For. Res. 23: 1108-1113.

THE PMRA-EPA SOLUTION



**PRECAUTION
MAKE SURE YOU AND YOUR CREWS
KNOW WHAT YOU ARE DOING**



Bait this



Not this!

MONITORING

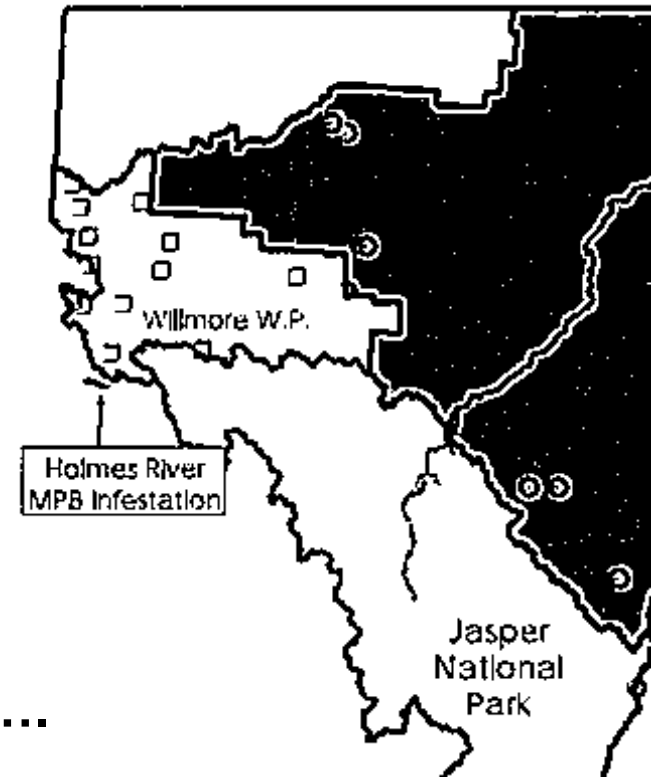


In 2002, 2006 and 2009 massive flights of MPBs crossed these mountains, and landed in northern Alberta. Was this the first time such an event happened?



In 1998 baited tree surveys detected MPBs in Wilmore Wilderness Park (square dots) (Ranasinghe et al. 1998 Annual Report, Forest Health in Alberta. Alberta Dept of Environmental Protection).

The report suggested that the beetles could have come from an infestation in the Holmes River Valley in BC. Did they?



OR.....

Was this an endemic infestation established between 1975 and 1984 by airborne beetles from BC's Chilcotin infestation?

In any case, baited trees are probably the most sensitive detection tool ever.

LETHAL TRAP TREES

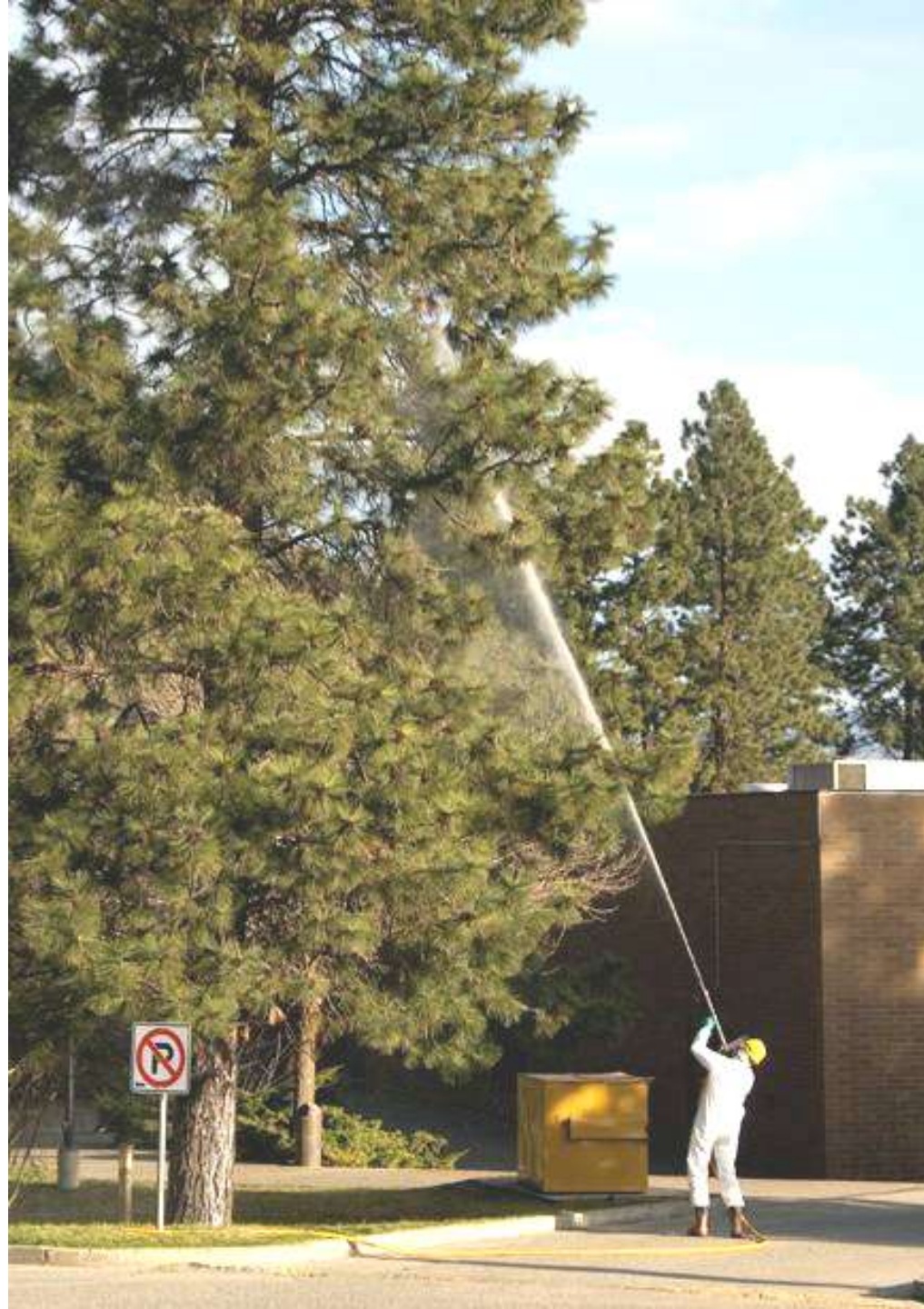




Smith, R.H. 1981. Preserving the green sale value of dying ponderosa pine with Lindane. USDA Forest Service Research Note PSW-350.

- sprayed trees to 6 m with a 1% aqueous emulsion**
- baited trees with exo-brevicomin, frontalin and myrcene**
- thousands of western pine beetles arrived at six sprayed and baited trees**
- concludes that “The large number of western pine beetles killed at the treated trees to which pheromone was attached suggests that such trees could be used as a direct method of reducing the beetle population in an area.”**

**We have the
capability of
spraying the bole
accurately with
very little drift.**



DOES SPRAY AND BAIT WORK?

- In 1998, Ian Wilson treated ponderosa pines around the mill at Armstrong, BC with Sevin (carbaryl). Many MPBs on ground and in unbaited Lindgren traps. All trees survived. Next year spray applied late. Many trees died.**
- Bob Hodgkinson treated backyard lodgepole pines in Prince George with Dursban (chlorpyrifos). No bait, but yard covered with dead MPBs. Trees died.**
- John Ball, South Dakota State University, claims spray and bait works against the MPB in the Black Hills, but no data available yet.**

OTHER LETHAL TRAP TREE TACTICS





INTEGRATION WITH SILVICULTURAL TREATMENTS





MANNING

PARK





FOLLOW UP TO SANITATION HARVESTING

1982

- **5,500 trees harvested on 65 ha in the spring**
- **50 trees baited – 48 attacked along with 80 more within 12 m of the baited trees**
- **86 additional nearby trees beyond the 12 m radius**
- **all mass-attacked trees felled and burned in the fall**

1983

- **10 trees baited - 29 trees attacked, all within 12 m of baited trees**
- **all 29 trees felled and burned**

1984

- **3 trees baited – all mass-attacked, felled and burned**



CONTAINMENT AND CONCENTRATION



ONE OF LIFE'S LESSONS: adversity can be flipped over into success.

ADVERSITY: mass-trapping is impossible because of spillover attack on green trees.

FLIP SIDE: use baits to induce attack on trees to contain and concentrate infestations prior to harvesting.

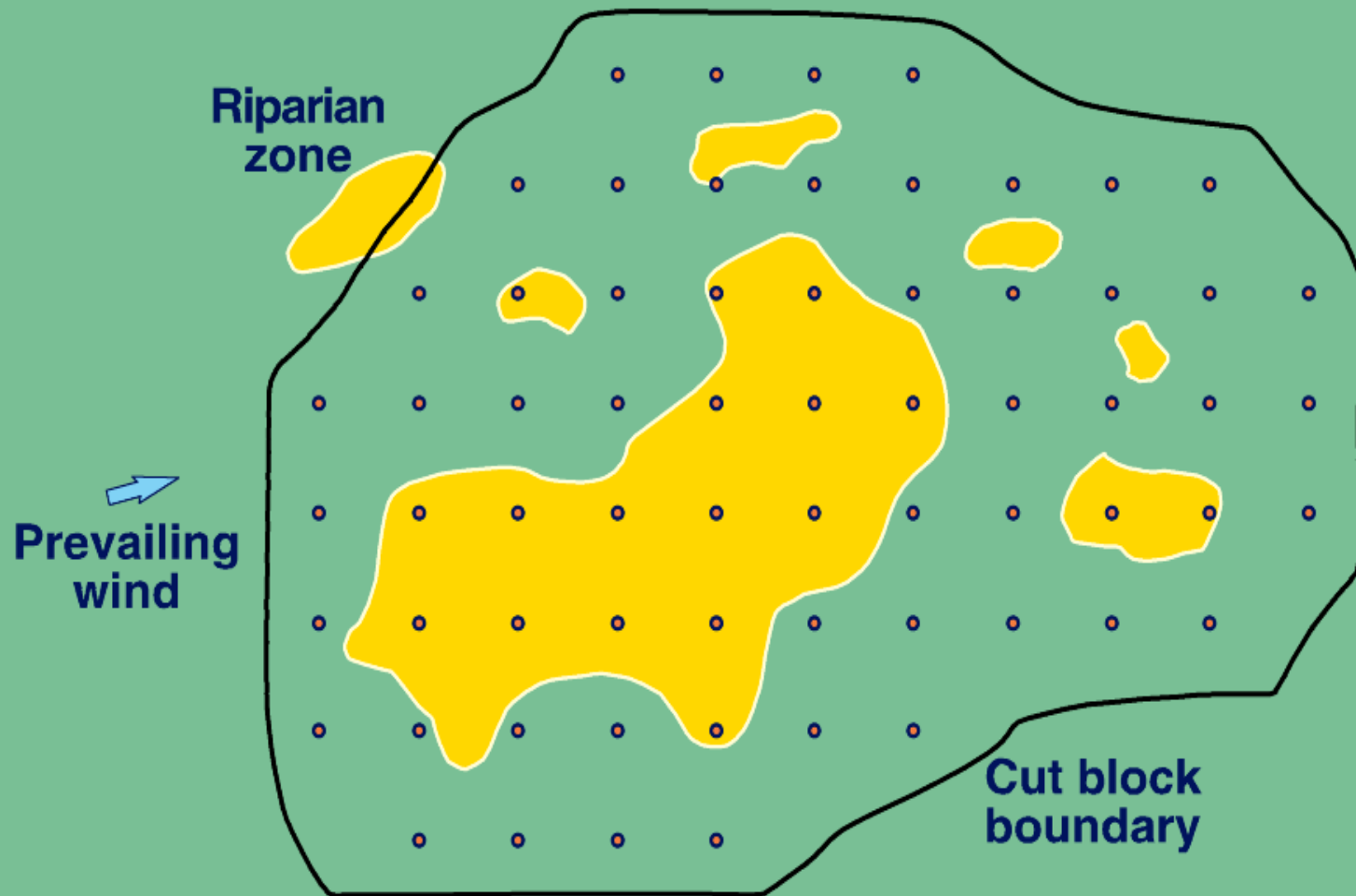


**Leslie Chong, 1981,
Graphite Creek near
Smithers, BC.**

**“John, we don’t have
enough baits to deploy
them at 25 m intervals.”**

**John’s flippant
response: “OK, we’ll do
50 m intervals.”**

Grid Baiting



Shaded areas represent infestation as identified by probing or walkthroughs.

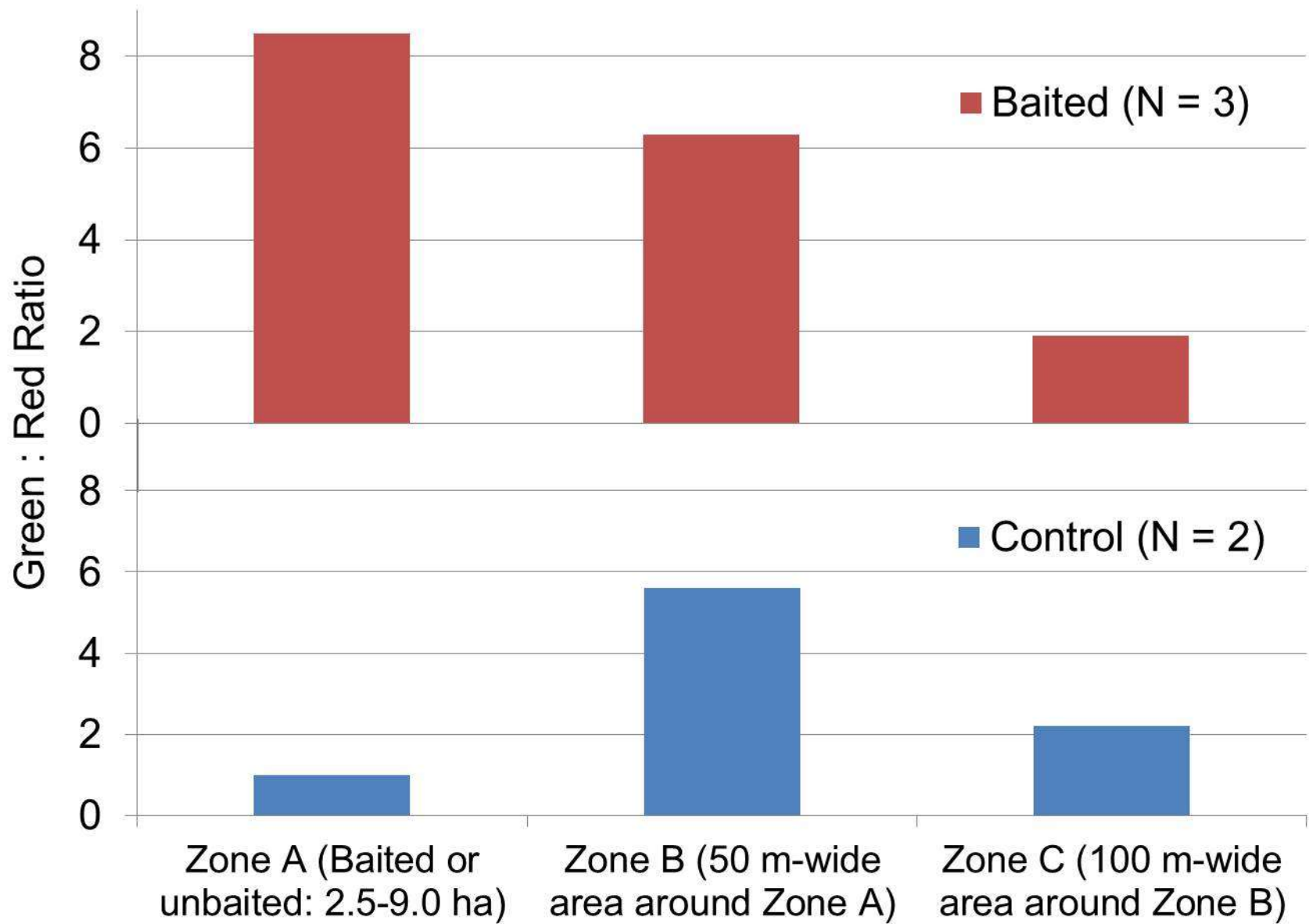
Dots represent baited trees at 50 m centres.

Reference	Treatment	No. reps	G:R
Borden et al. 1983. For. Chron. 59: 235-239	Baited	5	2.5**
	Control	5	1.8
Borden et al. 1986. For. Chron. 62: 20-23	Baited	3	4.8**
	Control	3	2.6
Gray and Borden 1989. J. Econ. Entomol. 82: 1399-1405.	Baited	3	8.5**
	Control	2	1.0



DAVID GRAY with hair!

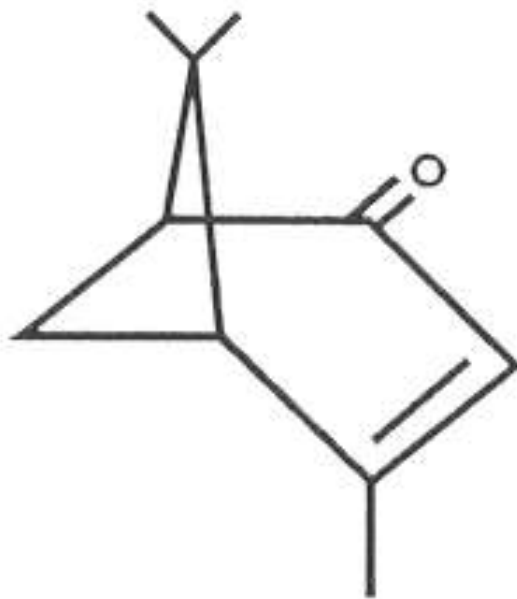
- **Study done in Kootenays on 5 infestations**
- **In 3 infestations, central zones (A) (5.0, 6.5 and 9.0 ha were baited at 50 m centres**
- **In two control infestations central zones (A) (2.5 and 4 ha) unbaited**
- **In all 5 infestations, central zones were surrounded by a 50 m-wide Zone B and a 100 m-wide Zone C**
- **100% cruise for all green and red attack done after attack in all 3 zones for all 5 infestations**



PUSH-PULL

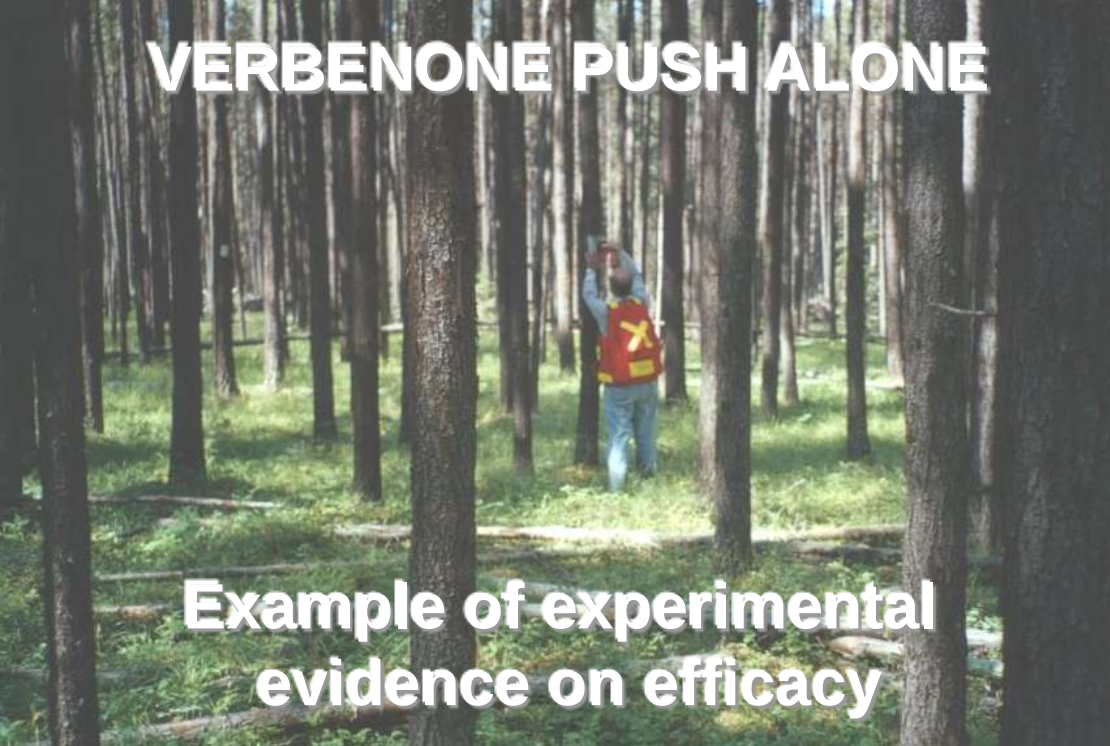


ANTIAGGREGATION PHEROMONE

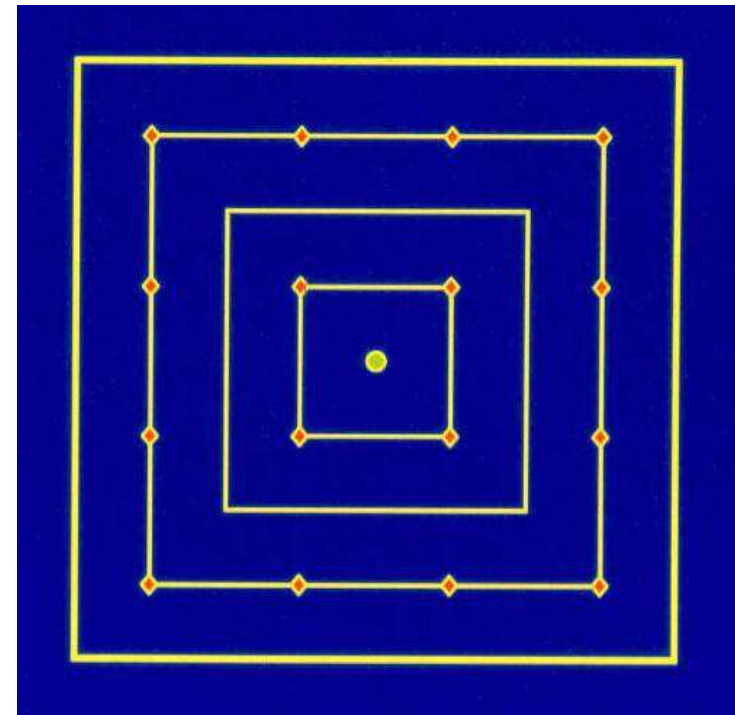


verbenone

VERBENONE PUSH ALONE



Example of experimental evidence on efficacy



- One experiment in 2001, another in 2003
- Both east of Williams Lake, BC (one of 3 locations in 2001 was at Bare Ass Lake before its name was changed to protect the innocent)
- Each experiment had 10 replicates of 40 x 40 m blocks, built around a pheromone-baited tree at the centre
- A grid of 16 trees at 10 m centres was treated with verbenone

Year	Treatment	No. available trees $\geq$ 17.5 cm dbh	% of available trees mass- attacked
2001	Control	432	21.3 a
	Verbenone	521	6.0 b
2003	Control	422	37.6 a
	Verbenone	369	6.5 b

Dispersing beetles
initiate search for host

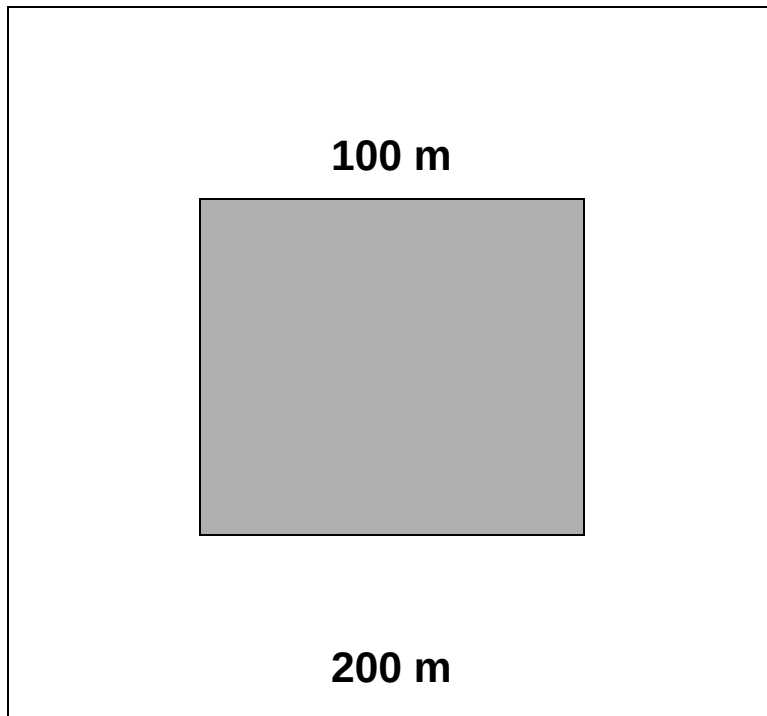
PUSH

PULL

Host species that
smells like a non-host
fully colonized by
conspecifics

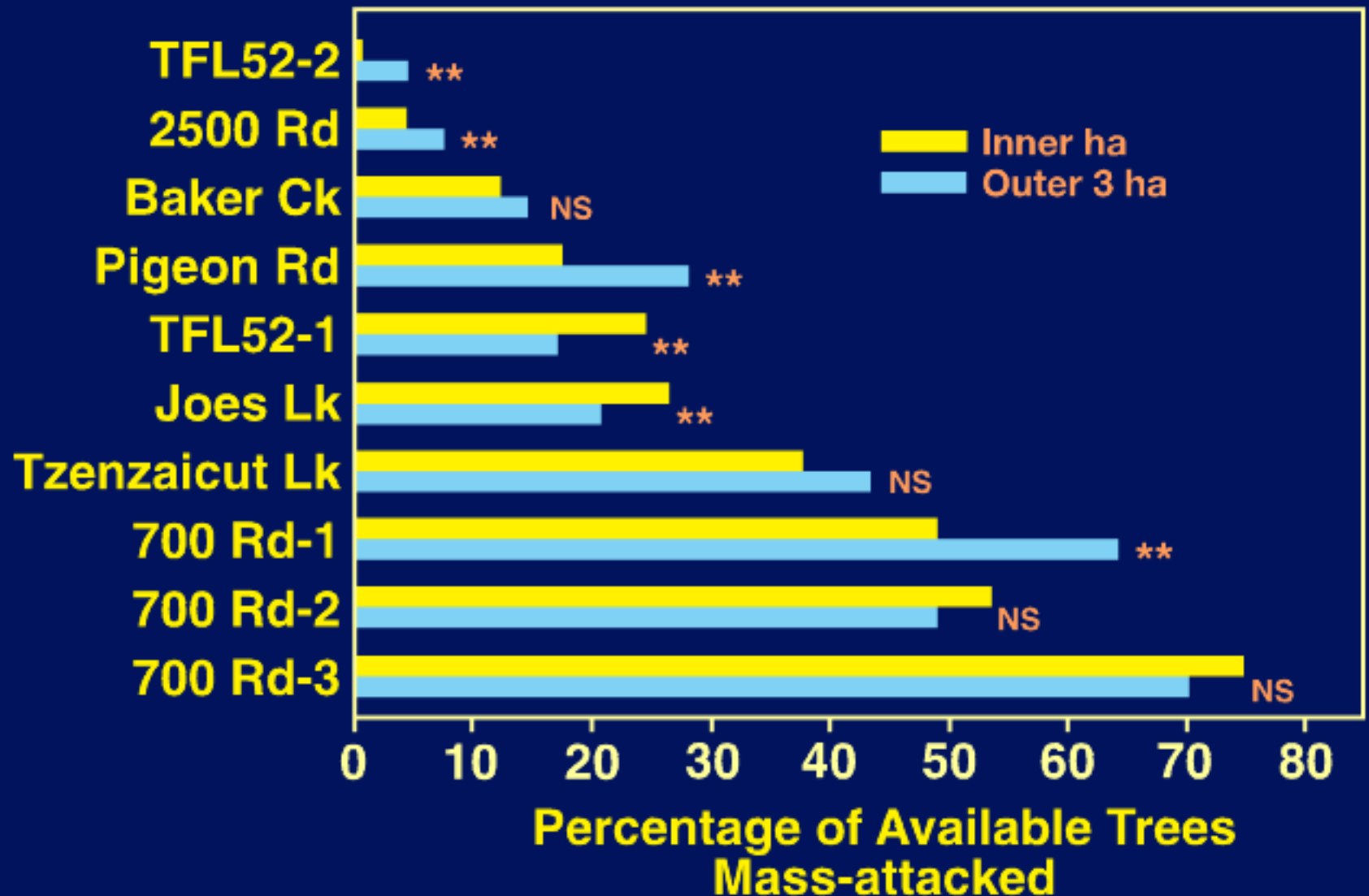
Host species (or traps)
that smell as if they
are under attack by
conspecifics producing
attractive pheromones

Attack or be trapped

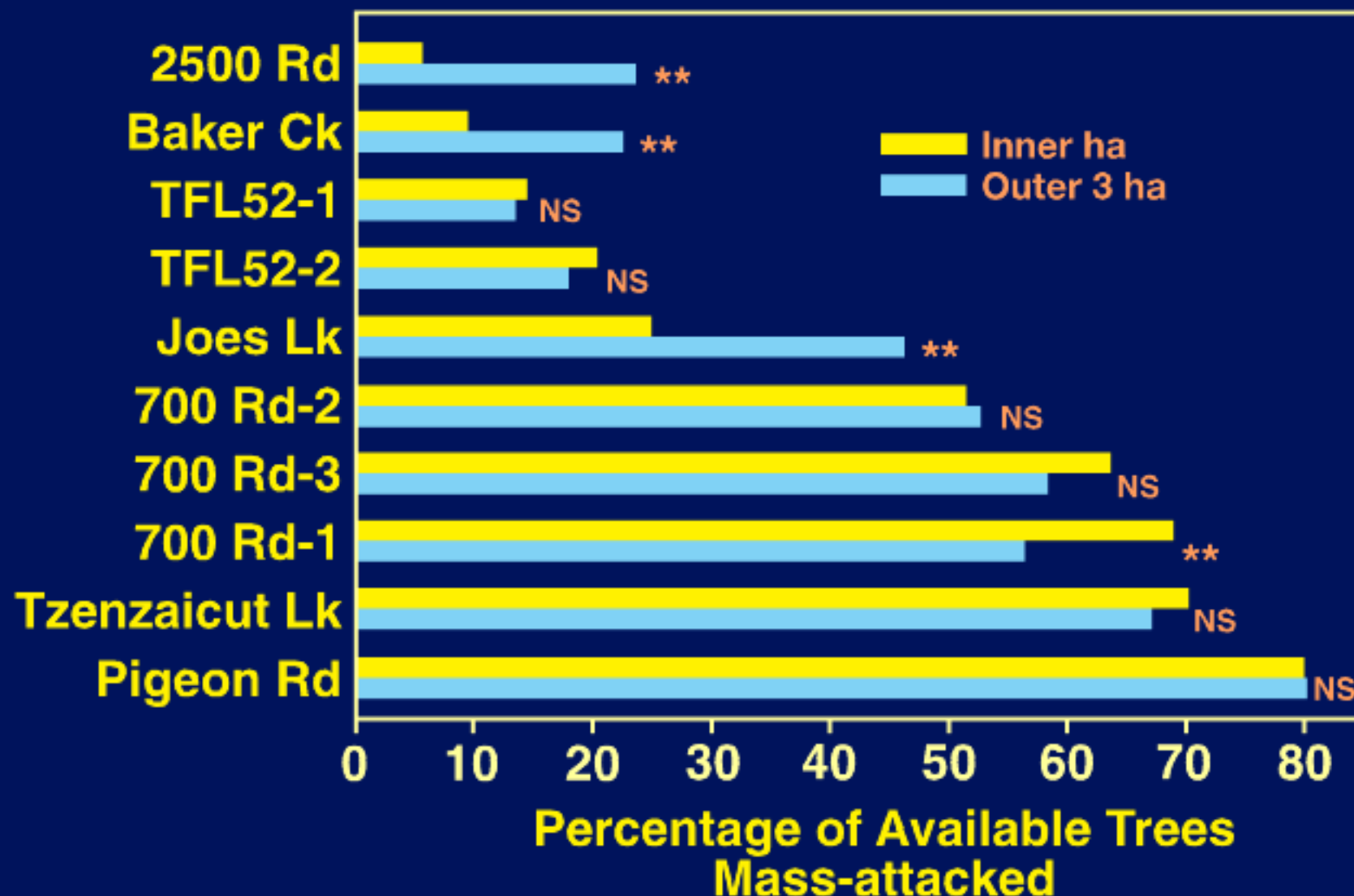


- 10 replicates in 7 locations in the east Cariboo/Chilcotin in 2003
- Verbenone at 15 m centres (44.4 per ha) in central ha
- 12 pheromone-baited trees at 50 m intervals in outer 3 ha
- Evaluated by 100% cruise

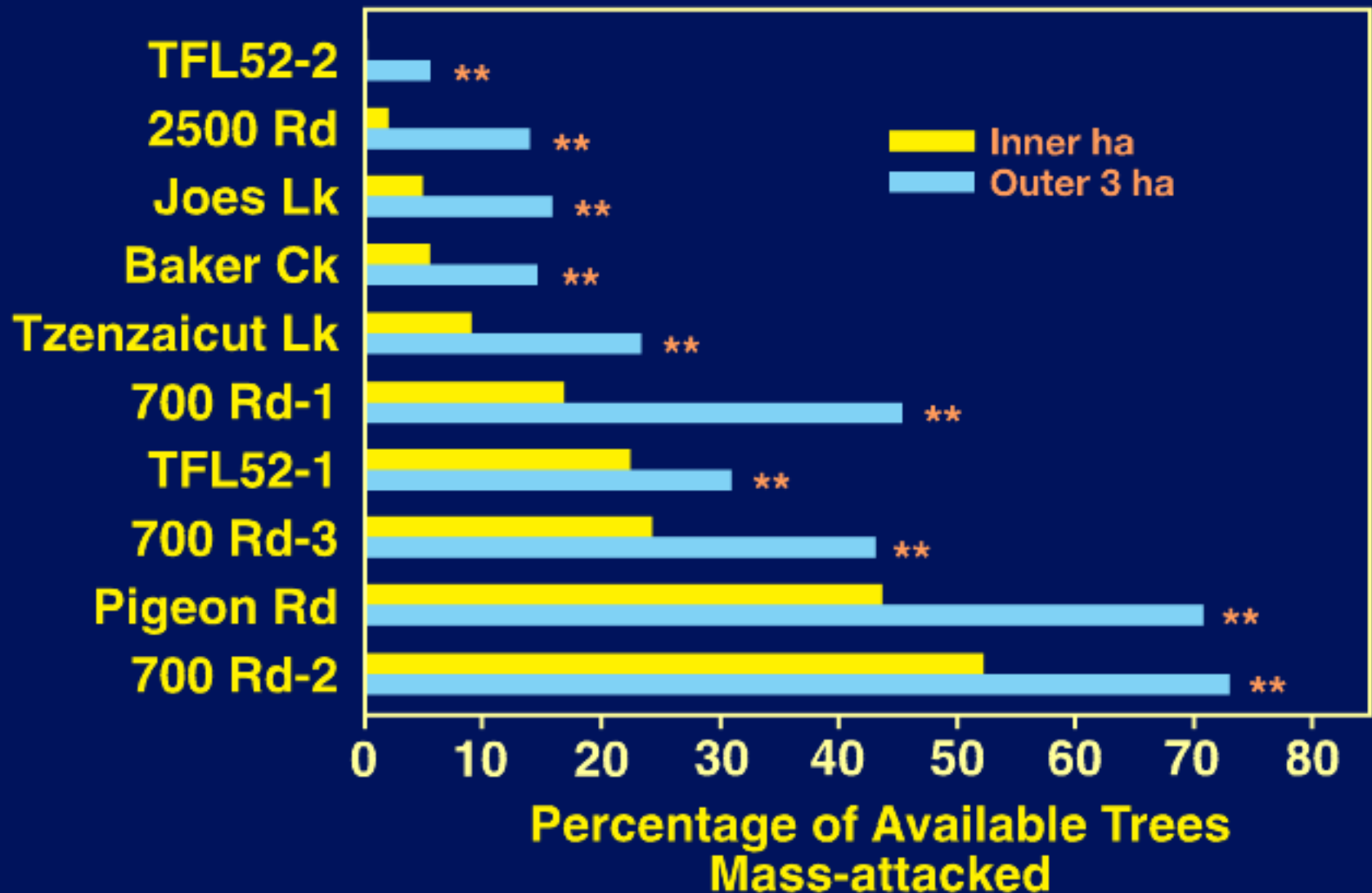
Untreated Control



Bait Only



Verbenone + NHVs 15 x 15 m



Treatment	No. available trees ≥ 17.5 cm dbh		% of available trees mass-attacked	
	Inner ha	Outer 3 ha	Inner ha	Outer 3 ha
Control	3,847	10,569	21.2	25.4 ns
Bait	3,000	9,276	33.5	33.6 ns
Bait + verbenone	4,073	11,313	11.4	23.7**

RECOMMENDATIONS FOR IMPLEMENTATION OF TREE BAITING IN IPM PROGRAMS





Strategy

Prevent a problem from occurring

Tree Baiting Tactics

- **Use tree baiting as the principal tool to detect expansion beyond known MPB range**
- **Within known range when beetle populations are thought to be low, run a line of baited trees across all cutblocks when harvesting planned after beetle flight**



Strategy

Suppress problem to a tolerable level

Tree Baiting Tactics

- **Integrate tree baiting with sanitation harvesting**
- **Consider implementation of push-pull tactic**
- **Consider implementation of pheromone-baited lethal trap trees**



Strategy

Maintain problem at a tolerable level

Tree Baiting Tactics

- **Grid bait at 50 m intervals to contain and concentrate infestation prior to harvesting (if $\leq 25\%$ of trees attacked)**
- **Consider push-pull tactic**

Thanks for listening

