

Bark beetle biology and management

BCIT

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Ministry of
Forests, Lands, Natural
Resource Operations
and Rural Development

Marnie Duthie-Holt, MPM, RPBio Provincial Entomologist

Outline

Biology/ Life cycles

Natural controls

Why do populations increase?

Monitoring techniques

Control strategies and tactics

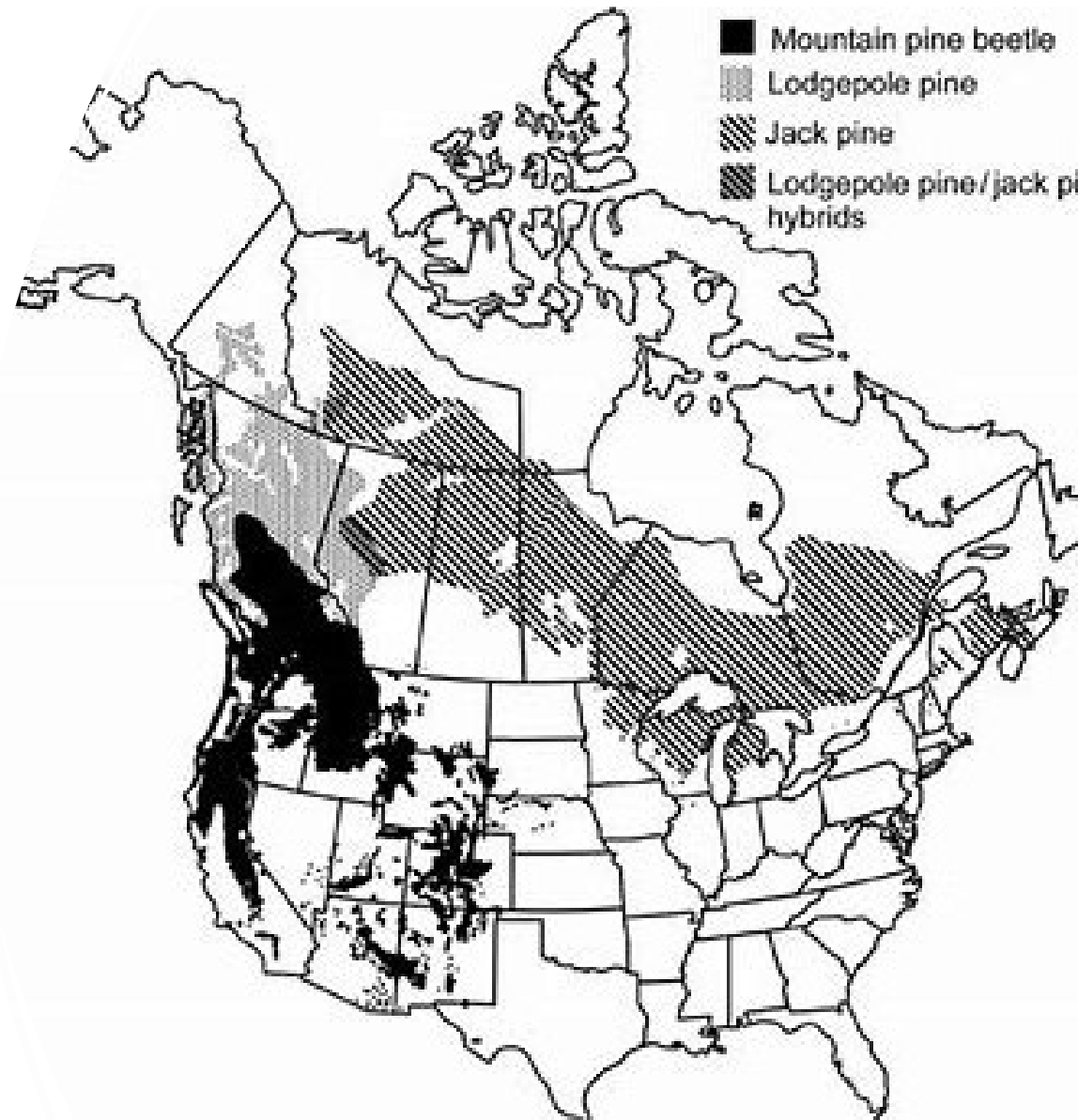
“Fab” 4 Bark Beetles in BC



Bark beetle	Code	Hosts
Mountain pine beetle	IBM	Pl, Py, Pw, Pa, Pf, Pj
Spruce beetle	IBS	Sx, Se, Sw, Ss
Douglas-fir beetle	IBD	Fd (Lx)
Western balsam bark beetle	IBB	Bl (Ba, Sx)

Why do we care?

- Bark beetles are integral components in our forest ecosystems
- All of the Fab 4 are native to western NA, however range expansion has occurred due to warmer climates
- Bark beetles are the most destructive group of forest pests in BC and cause widespread mortality to mature forests
- BC experienced the largest IBM outbreak on record which began around 1999 and subsided a decade later (18 M ha PI)



Other values at risk



Cultural Heritage - First Nations

Watersheds

Fish and Wildlife
(MWR-Mule deer winter range)

OGMAs (Old growth management areas)

Recreation and aesthetic values

Range Management

Parks and Protected Areas

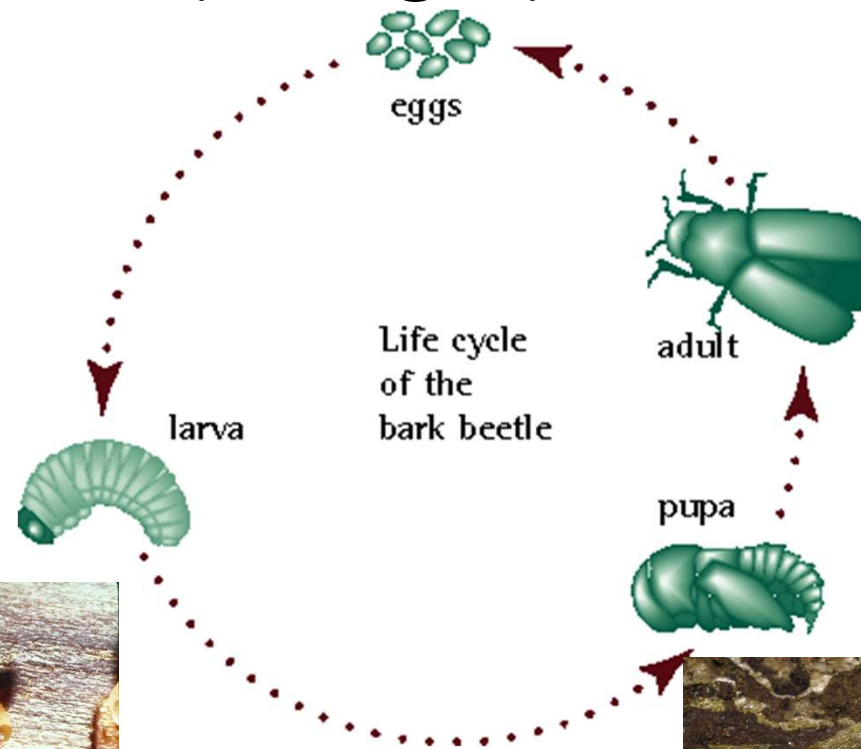
Visual quality objectives (VQO)

Large Fd valuable for;
• Thermal cover and shelter
• Reduce snow depth
• Forage – mule deer feed on fallen foliage

Hydrology

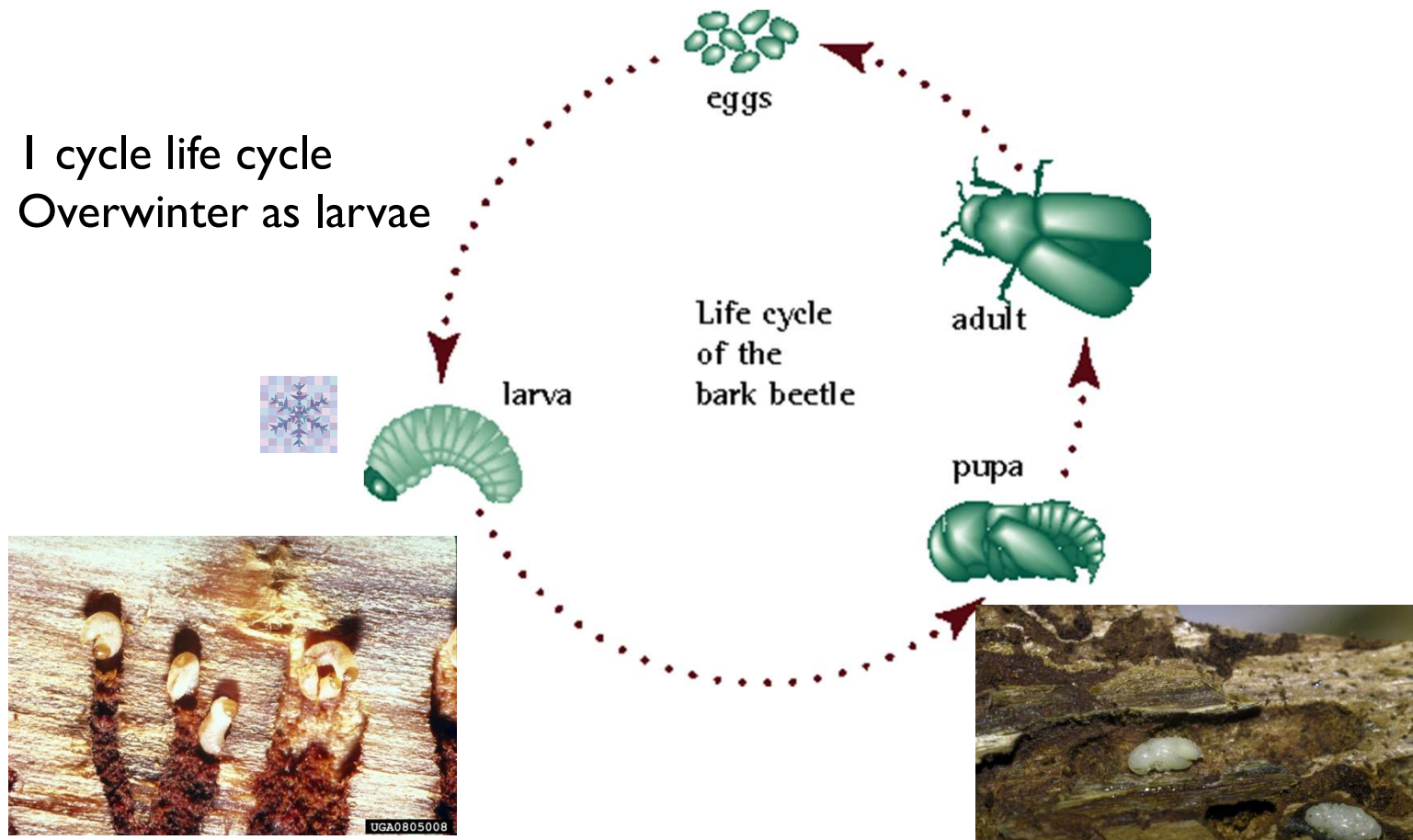
Wildfire risk; Terrain stability, etc.....

Biology/ Life cycle quick summary (4 stages)

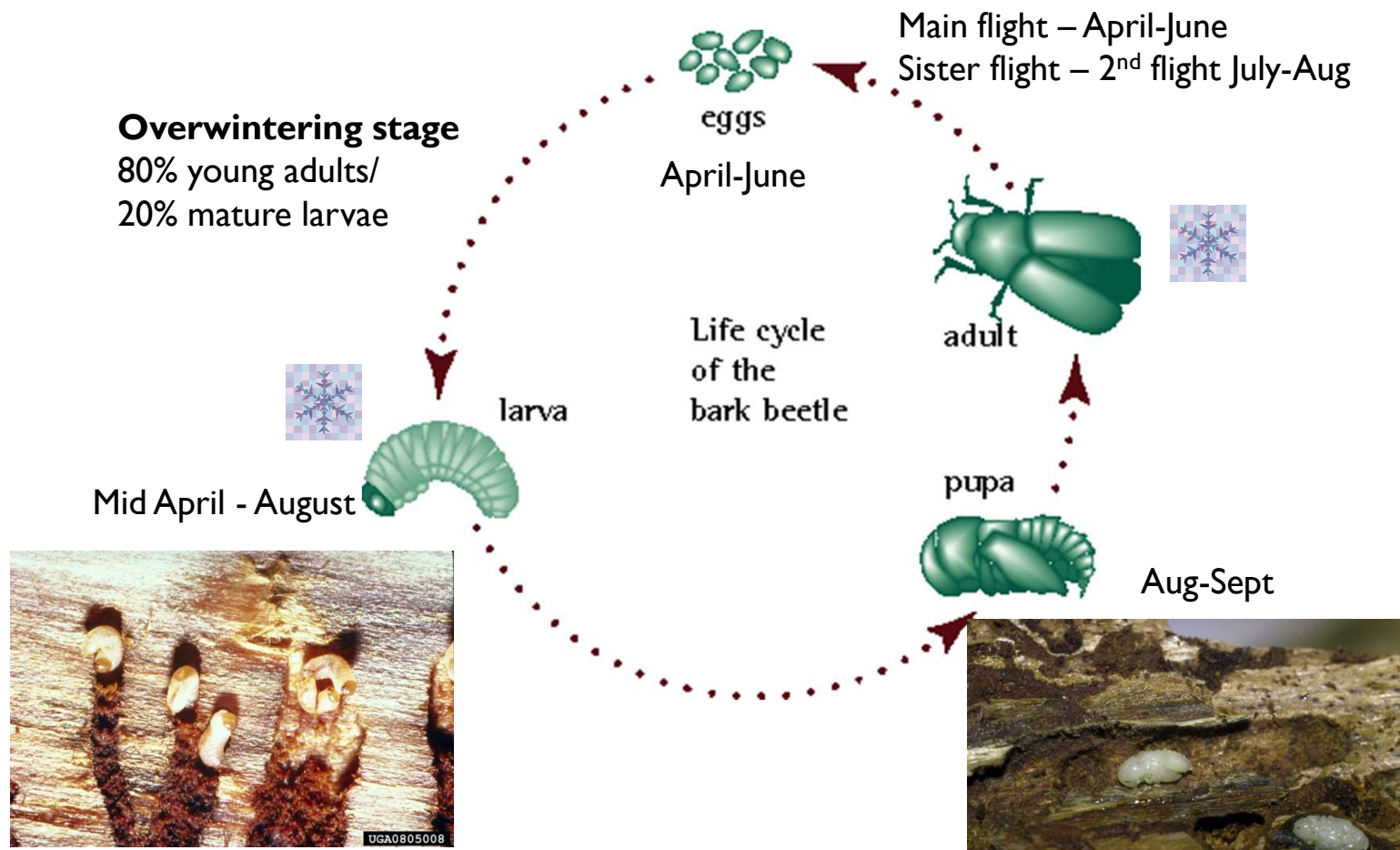


LIFE CYCLE (4 stages) IBM

I cycle life cycle
Overwinter as larvae

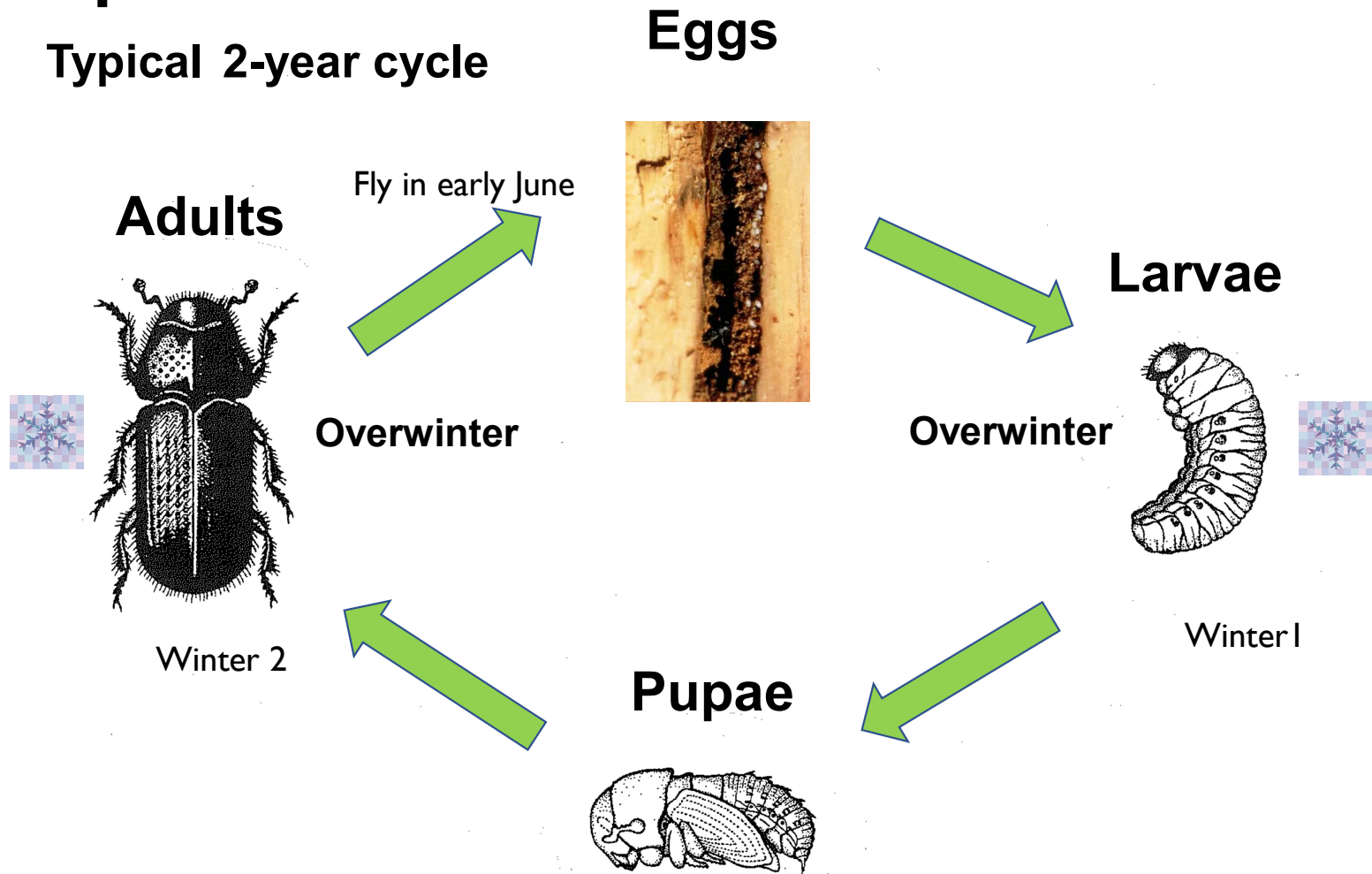


LIFE CYCLE (4 stages) IBD



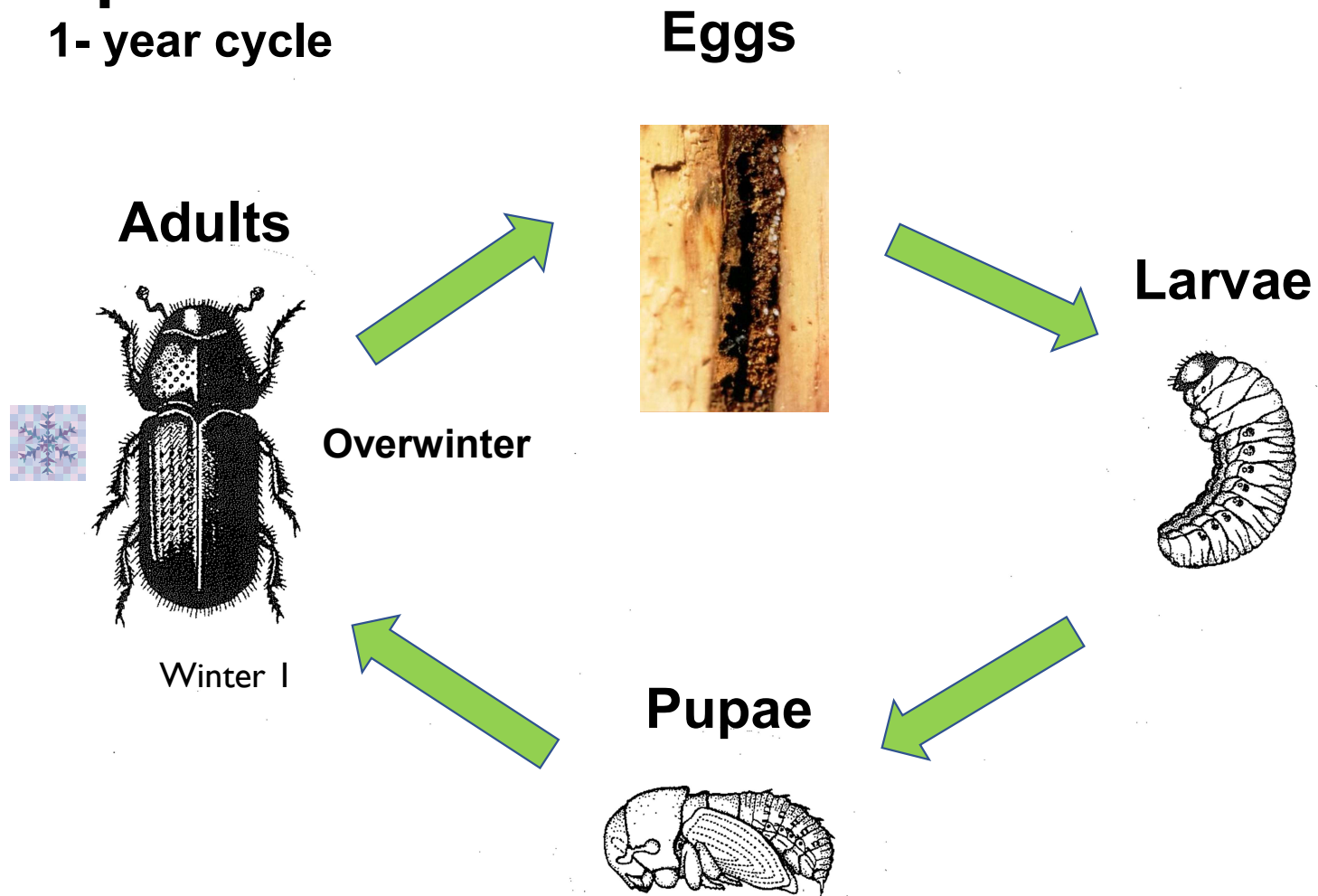
Spruce Beetle

Typical 2-year cycle



Spruce Beetle

1- year cycle



NATURAL CONTROL

- **Woodpeckers** and other beneficial birds effective predators
- $<0^{\circ}\text{C}$ woodpeckers can eat more than 2,200 larvae/day
- even if 90-95% of beetles killed outbreak can still continue!
- Woodpeckers are territorial keeping bird numbers down



NATURAL CONTROL

Parasitic wasp



- Beneficial insect like parasites and predators (checkered beetles= clerids) kill larvae and adults



Checkered/ clerid beetle

NATURAL CONTROL

- **Climate/ Weather**
- Tree diameter and phloem thickness major factors in population control by weather (underbark temp)
- Larvae most cold tolerant – **GLYCEROL** (anti-freeze)
- Cold/wet – spring – during flight as effective killing beetles





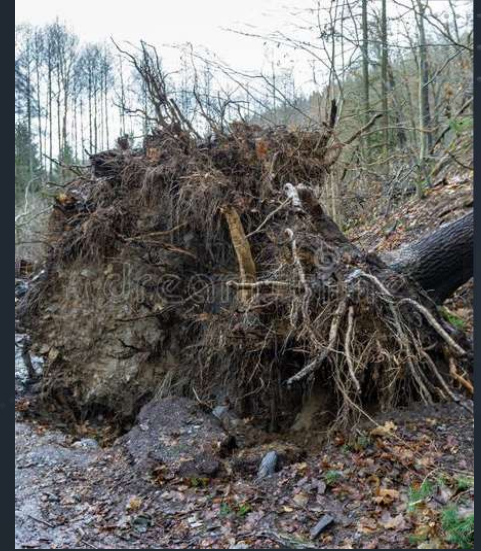
Bark beetles and cold temperatures

- As a cold-intolerant pest, cold temperatures in winter are key constraints limiting the distribution
- Overwintering success is critical for sustained pest outbreaks
- With reduced cold stress limitations in the future, bark beetles will be more likely to cause outbreaks in severe cold regions and expand its range into higher latitudes

Why do populations increase to epidemics (Natural Caused)?

- Fire Suppression = Overmature trees
- Drought stress
- Windthrow/ Avalanches/ Flooding
- Windshake/ broken tops
- Fire
- Root disease
 - IBD: *Armillaria ostoyae*;
 - *Phellinus weirii*
 - IBS: *Inonotus tomentosus*
- Defoliators
 - IBD: IDW, IDT
 - IBS: ID2

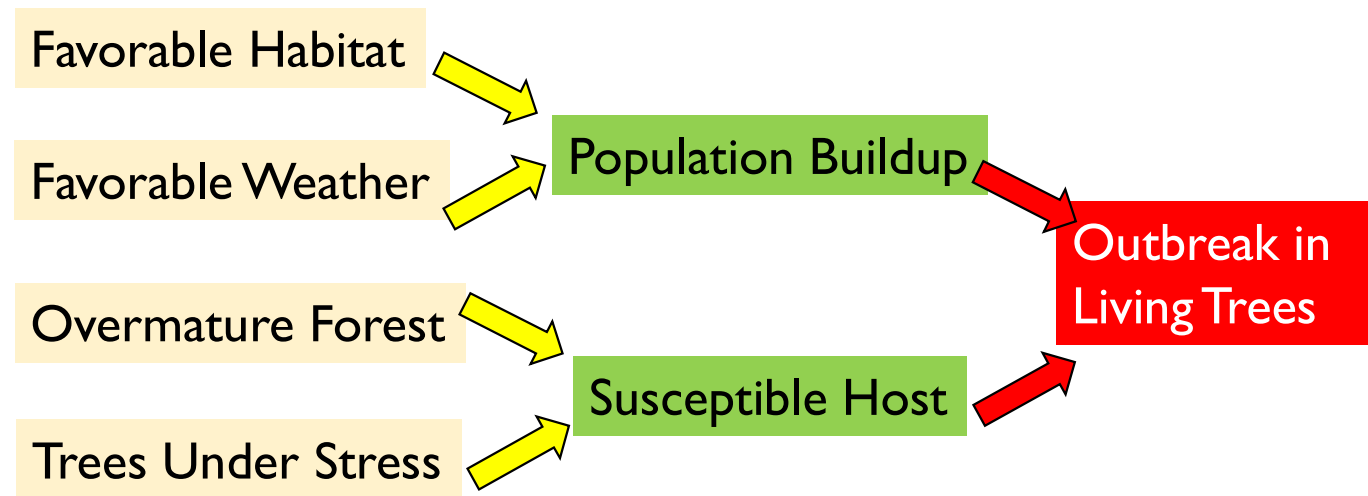




Mature Stands

- **Natural disturbance agents**
 - Fire
 - Insects (beetles/ defoliators)
 - Fungi
 - Wind
 - Drought
 - Flooding
- **Bark beetle outbreaks indicates stands are in decline**

Why do populations increase to epidemics (Natural Caused)?



Zoom: 2X
detailed aerial drought

Drought

- 1 year of drought – causes damage
- 2 years of drought – compounds damage
- Not enough resources left year 2 to deal successive years of drought
- Therefore, not twice as damage – exponential!



Fire

- Bark beetles will infest recently fire-killed trees and fire-scarred trees that are still alive
- Py:
 - Mountain pine beetle IBM
 - Western pine beetle IBW
 - Red turpentine beetle IBT
- Fd:
 - Douglas-fir beetle IBD

FIRE AND IBD ATTACK

- Classification of burned areas

None

- **Black**: tree boles completely charred and blackened, foliage destroyed, and understory vegetation burned. ***No IBD***

Some

- **Black/brown**: mostly black but some brown foliage. ***May develop IBD***

Lots

- **Mixed green/brown/black**: mostly green foliage, with brown and black spots, understory variously burned. ***Sig. beetles may develop.***



Why do populations increase to epidemics (Human Caused)?

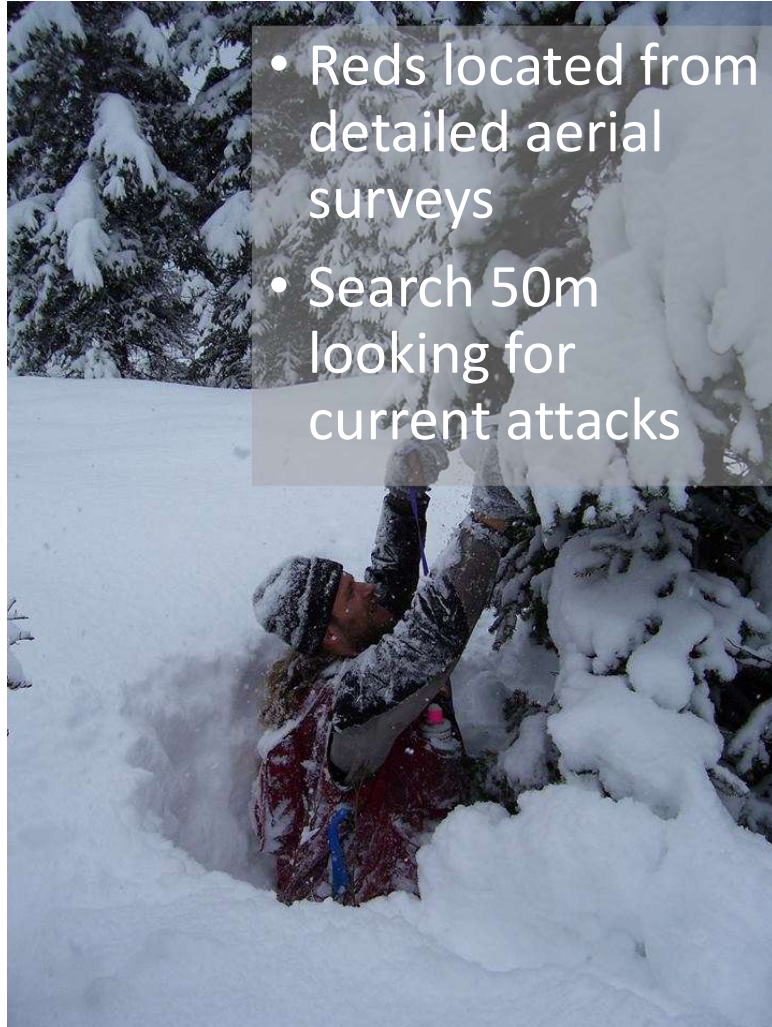
- Abandoned log decks
- Large debris (either green or with beetles)
- Unburned slash piles
- Right of way/roads
 - Damaged/buried roots
 - Windthrow
 - High stumps
 - Basal scars
 - Salt damage



Monitoring Techniques

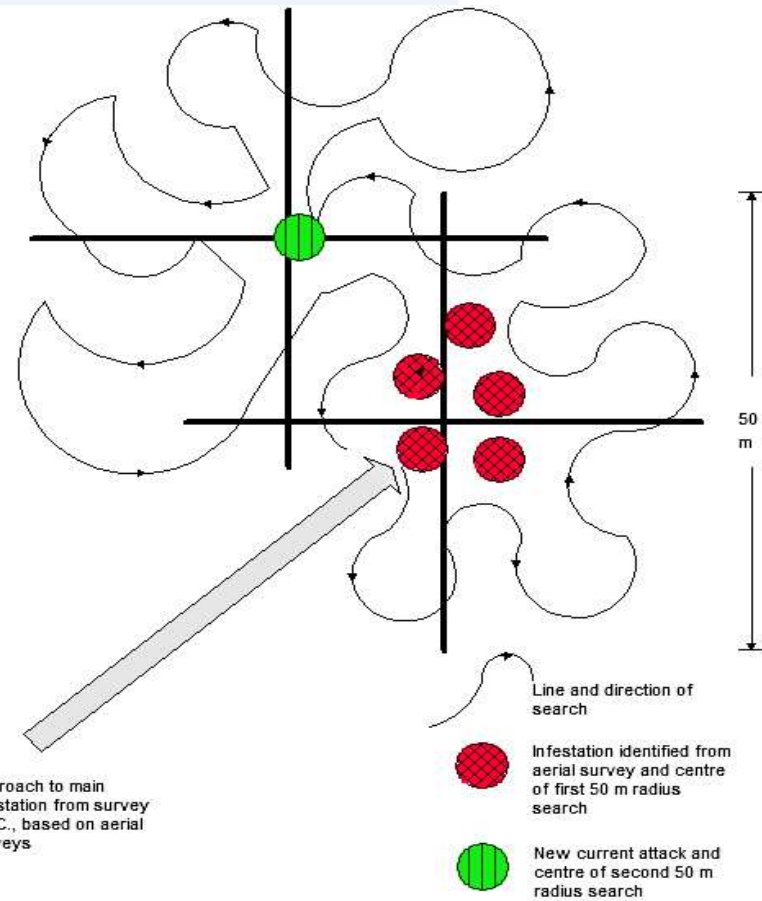
- Aerial surveys
 - **Aerial overview** (fixed wing – 1:100,000 scale, high, rough, cover all of BC for all pests)
 - **Detailed surveys** (helicopter – 1:30,000 scale, low, slow, specific areas for specific pests)
- Ground surveys
 - Walkthroughs
 - Star probes
 - Grid probes





- Reds located from detailed aerial surveys
- Search 50m looking for current attacks

Star Probe



Approach to main infestation from survey P.o.C., based on aerial surveys

Line and direction of search

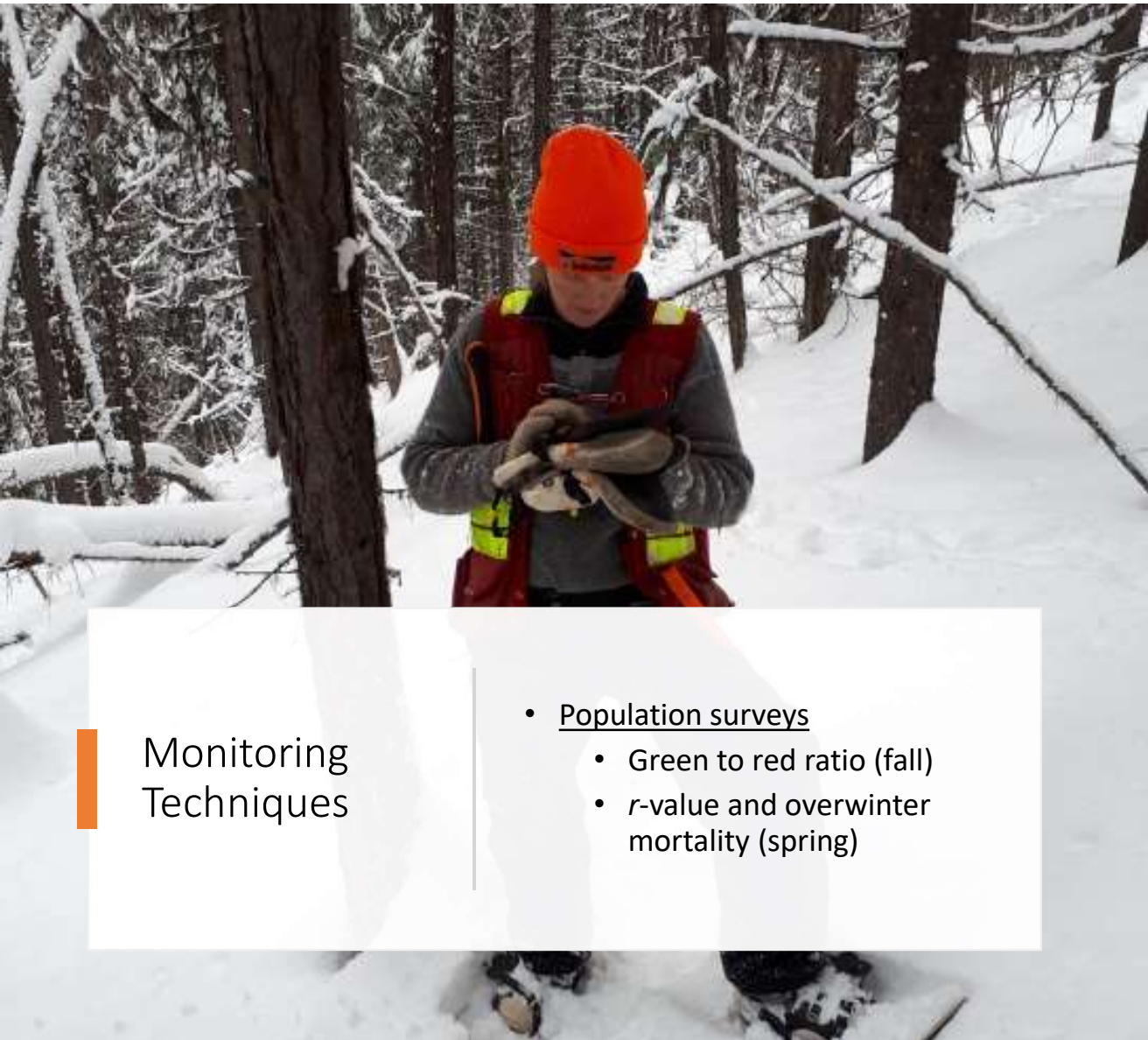
Infestation identified from aerial survey and centre of first 50 m radius search

New current attack and centre of second 50 m radius search

Ground surveys

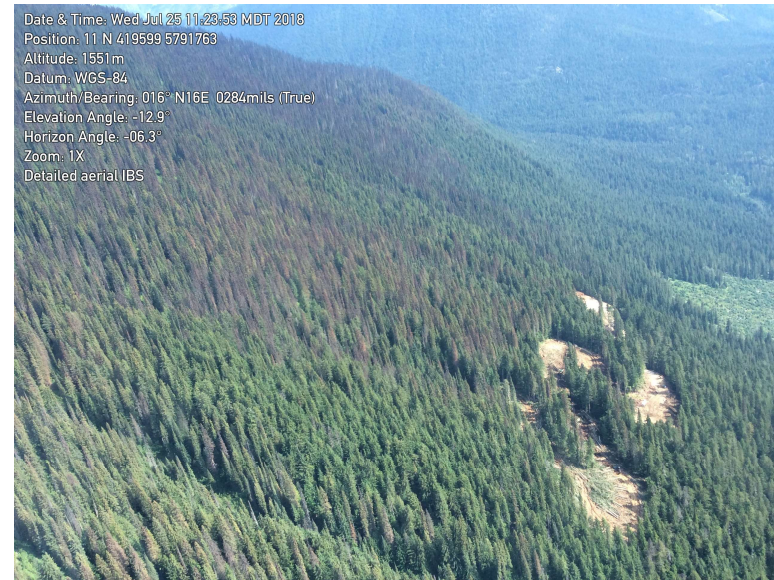
- **Grid Probe:** uniform survey lines, 50-100m apart
- GPS all current attacks, probe line strips at 5m wide





Monitoring Techniques

- Population surveys
 - Green to red ratio (fall)
 - r -value and overwinter mortality (spring)



Date & Time: Wed Jul 25 11:23:58 MDT 2018
Position: 11 N 419599 5791763
Altitude: 1551m
Datum: WGS-84
Azimuth/Bearing: 016° N16E 0284mils (True)
Elevation Angle: -12.9°
Horizon Angle: -06.3°
Zoom: 1X
Detailed aerial IBS



Green to red ratio surveys

- Measure of current to previous years attack
- Capture all “greens” and “reds” within 50m of detailed aerial survey point



Ratio G:R	Population estimates
>1	Increasing
1	Static
<1	Decreasing

$r\text{-value} = \frac{\text{avg. no. progeny per sample}}{\text{avg. no. entrance holes}}$



R-value	Population Interpretation	
0-2.5	Decreasing	↓
2.6-4.0	Static	▬
>4.1	Increasing	↑



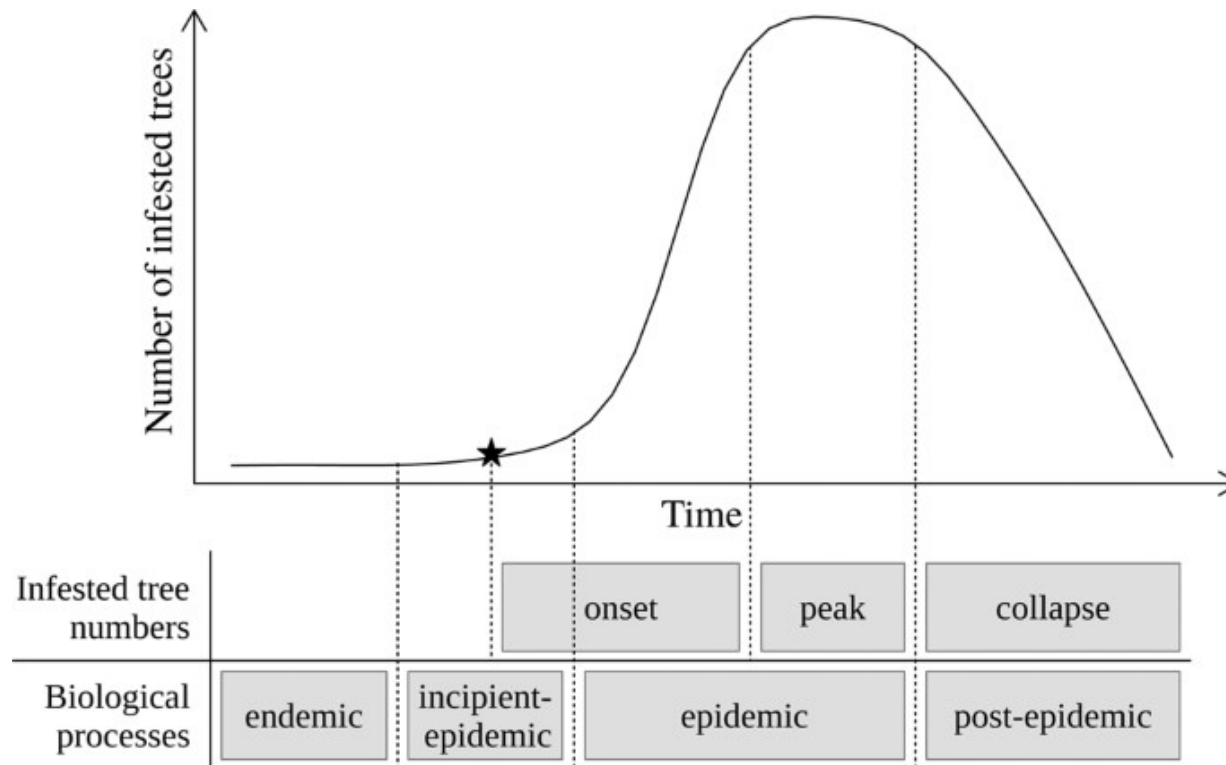
Bark Beetle Management Strategies



1. Proactive
2. Targeted
3. Reactive
4. Salvage
5. No Action

<https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/bark-beetles/management-strategies>

Bark beetle outbreak dynamics





Bark Beetle Management Strategies

1. Proactive

- applied where beetle populations are in the **endemic** population phase
- key goal is to prevent beetle populations from expanding to unmanageable levels.



STOCK

Ima

Bark Beetle Management Strategies

2. Targeted

- beetle populations that are in the **incipient** population phase
- applied where pest populations are building but can still be effectively reduced before more widespread infestation occurs.

Bark Beetle Management Strategies

3. Reactive

- pest populations that are in the **epidemic** population phase
- goal is to reduce and mitigate widespread bark beetle-caused host tree mortality.

Bark Beetle Management Strategies

4. Salvage

- Focus on the harvesting of mostly dead or dying trees and stands to minimize timber value losses in widespread infestations
- applied where management efforts would be ineffective in reducing beetle populations and subsequent levels of damage.
- most suited for beetle populations nearing the end of epidemic phase or in the post-epidemic phase.
- goal is to recover timber value, to regenerate impacted areas and to reduce fire risk to promote future more resilient forests.

Bark Beetle Management Strategies

5. No Action

- applied to designated areas where:
 - Natural disturbances are left unmanaged
- Management efforts would be ineffective in substantially reducing beetle populations and impacts
- There is no short-term possibility of salvaging dead timber
- Access cannot be put in place before substantial merchantable degradation of the dead material (economically constrained areas)
- Non-timber values or other management constraints such as wilderness areas, Parks or ecological reserves, culturally significant areas, supersedes that of timber or wood products
- Areas designated as no action should be large enough to allow for the full range of ecosystem processes through time.

Control Tactics

Tactic	IBM	IBD	IBS
Sanitation harvest*	Yes	Yes	Yes
Trap trees	No	Yes	Yes
Single tree treatments (Fall n burn; fall n peel; fall n chip)	Yes	Yes	Yes
Anti-aggregants	Verbenone	MCH	Research stage
Baited funnel trap	Yes	Yes	Yes
Bait trees	Yes	Yes	Yes

*Most effective tactic

Sanitation Harvesting

- Strategic target of stands to reduce beetle populations while maintaining non-timber values
- Remove all currently infested trees & mill before beetle flight
- Low stumps <30cm
- Planned over multiple years
- Burn debris piles
- **Most effective tactic, especially with trap trees (IBD)**



Salvage harvest

- Recover value
- Denim wood





Trap trees (IBD/ IBS)

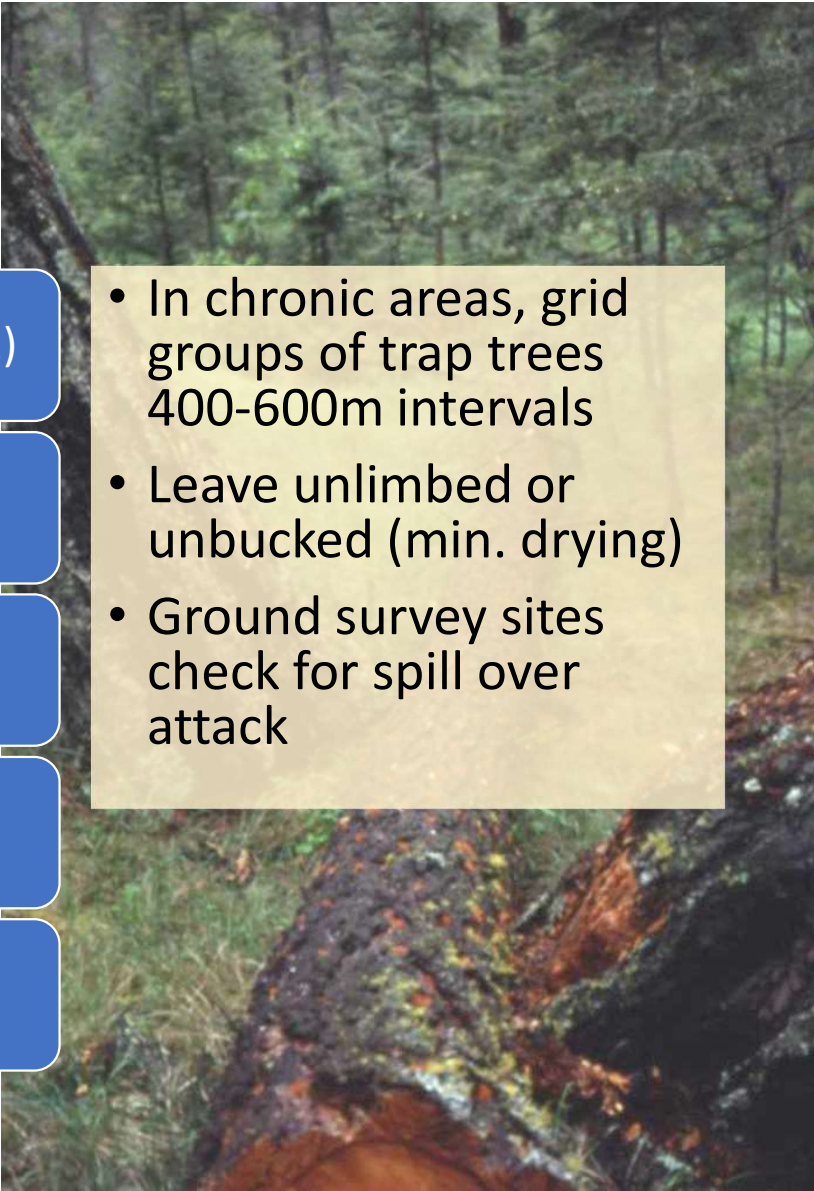
Place fall/late winter (before April 1)

Choose larger trees (>30cm DBH)

Into SHADE, min. opening size

Remove before next beetle flight
(late summer-early fall)

Can leave green decks over beetle
flight to act as trap trees

- 
- In chronic areas, grid groups of trap trees 400-600m intervals
 - Leave unlimbed or unbucked (min. drying)
 - Ground survey sites check for spill over attack

Singe tree treatments

- Fall and burn
- Fall and peel
- Fall and chip



Control standard: all bark and cambium completely destroyed for all treatments.
Chip size for IBM determined at 5.1cm or smaller bark attached to wood

Pheromones (4 main uses)

Grid/spot baiting aggregation pheromones to contain and concentrate populations prior to harvesting

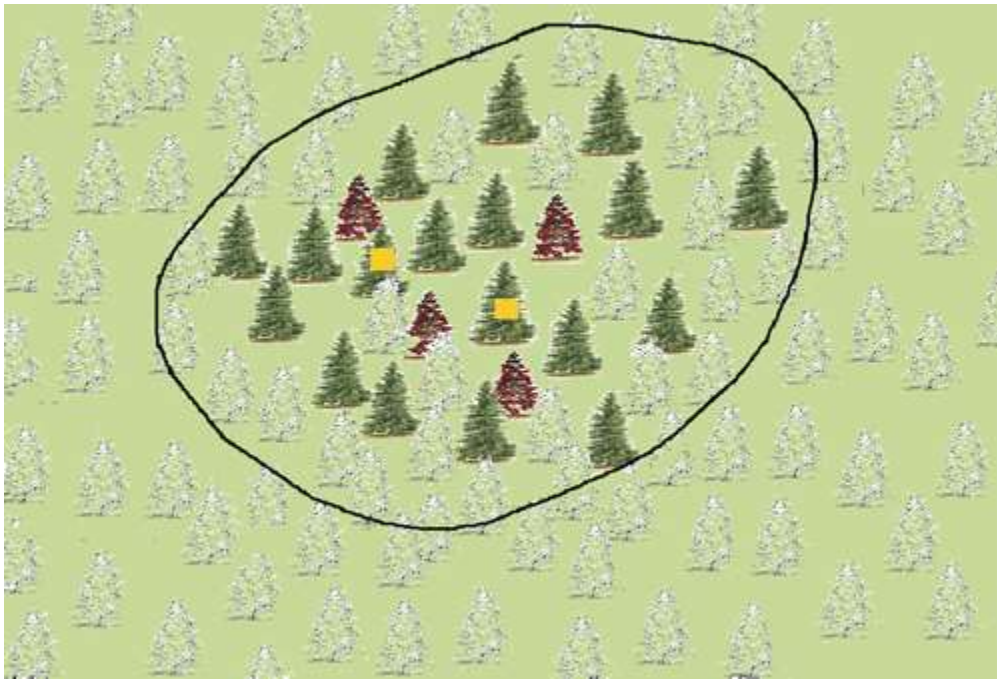
Trapping to monitor or suppress populations

Anti-aggregants (verbenone/MCH) deter attack

"Push-pull" tactic - use of both aggregation and anti-aggregation pheromones

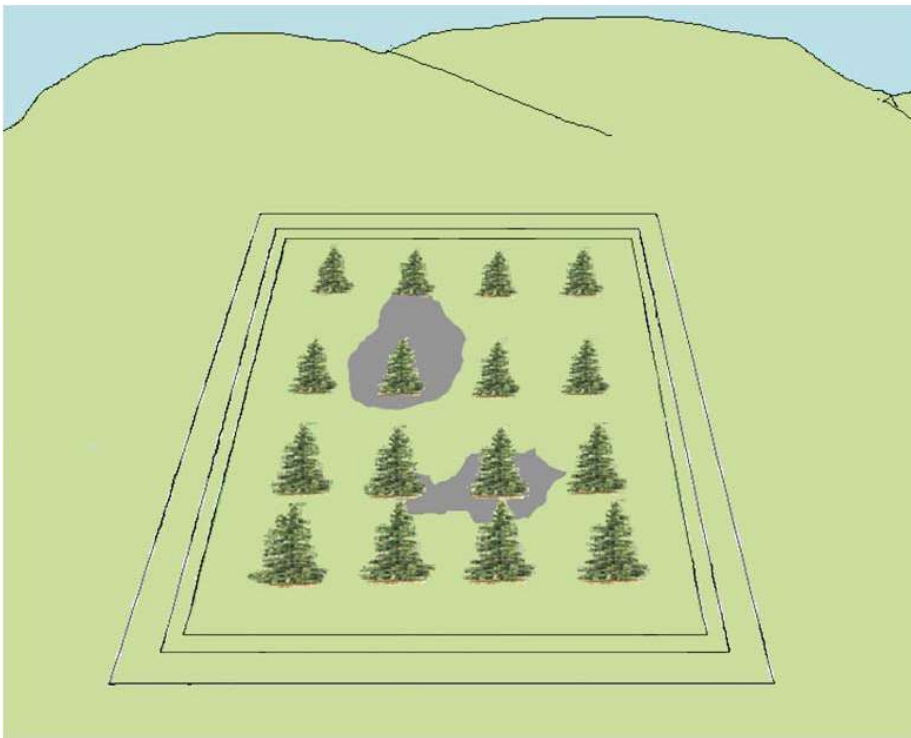
<https://semiochemical.com/wp-content/uploads/2017/03/Tree-bait-bulletin.pdf>

Spot baiting



- For use where infestations are limited to less than 30 trees (50 trees when dealing with IBM).
- Bait no less than 2-3 susceptible (unattacked) trees in the center of each spot, space baits at least 10 – 15 meters apart and up to 50 meters.
- Ensure all attacked trees are treated or removed and processed. (refer to – Tree Inspection and Removal)

GRID BAITING – To contain and concentrate beetles in infestations exceeding 50 trees or > 20 hectares



- Bait standing susceptible trees at 25 to 50 meter intervals to form a grid.
- Bait at least 25 meters (50 meters for IBM tree baits) within infestation or cut block boundaries to minimize beetle dispersal outside the boundaries = spillover effect

2. Trapping - Baited funnel trap (Monitoring and Control)

- Monitor time and magnitude of beetle flights
- Mop up tool after sanitation harvesting
- Population control – capture large numbers of beetles
- 3 multiple funnel trap clusters spaced 5-10m apart
- Use dry cups, hung from rebar
- Pheromone lures replaced mid-June (IBD)



2. Trapping - Baited Funnel Traps



PROS

Don't become saturated like trap trees/ baited trees = unlimited capacity

Fully infested TT or baited trees can become source of anti-aggregation – spill over attack

TT/ Baited trees – females can re-emerge = SISTER flight – can't in funnel traps

No disposal of infested trees

For ever 1,700 beetles caught = save a tree

• CONS

- Capital cost to purchase
- High risk of spill-over attack to standing trees if placed too near (within 100m)
- High maintenance (bears, wind, cows, hunters)
- High labour to monitor and maintain (traps must be checked & emptied regularly)
- Also catch predators (clerids)
- Vapona



IBS baited pheromone funnel traps near log storage
(Bear Lake PG Area 2016)



3. Anti-aggregants

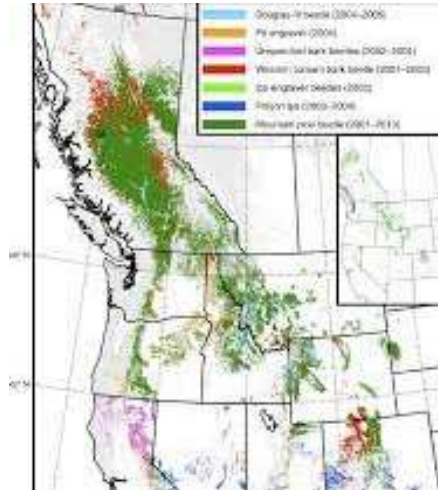
- IBM: Verbenone
 - IBD: MCH (Methylcyclohexenone)
 - IBS: MCH not effective by itself (Yet! Still in research phase)
-
- Tells beetles tree = full, go away
 - No vacancy sign
 - Repels and disperses beetles – die searching
 - Use for high-value trees
 - Protects healthy standing and uninfested windthrow
 - Use as push-pull with aggregants/trap trees
 - Timing & population levels important
 - Benefits: one entry, fairly cheap to buy

Anti-aggregants

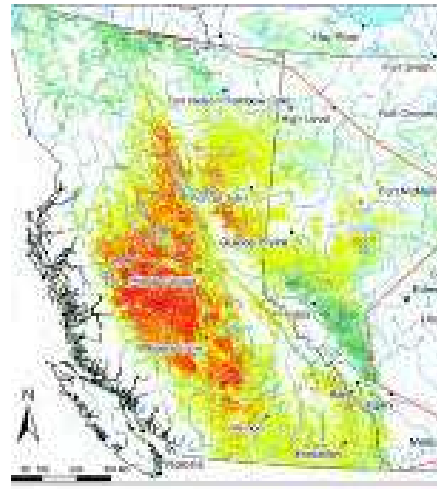
- Works best with small infestations (avoid in larger sites where may be ineffective or risky)
- Treat sites after sanitation harvesting to disperse beetles in stumps, debris, tops, etc.
- Protects damaged or stressed residual trees.
- Place on healthy Fd trees within 100m of baited funnel traps.

- Place on north side, as high as possible, at 10x10m spacing
- To protect individual trees – 2 bubble caps (opposite sides)





Combined



IBM



IBD

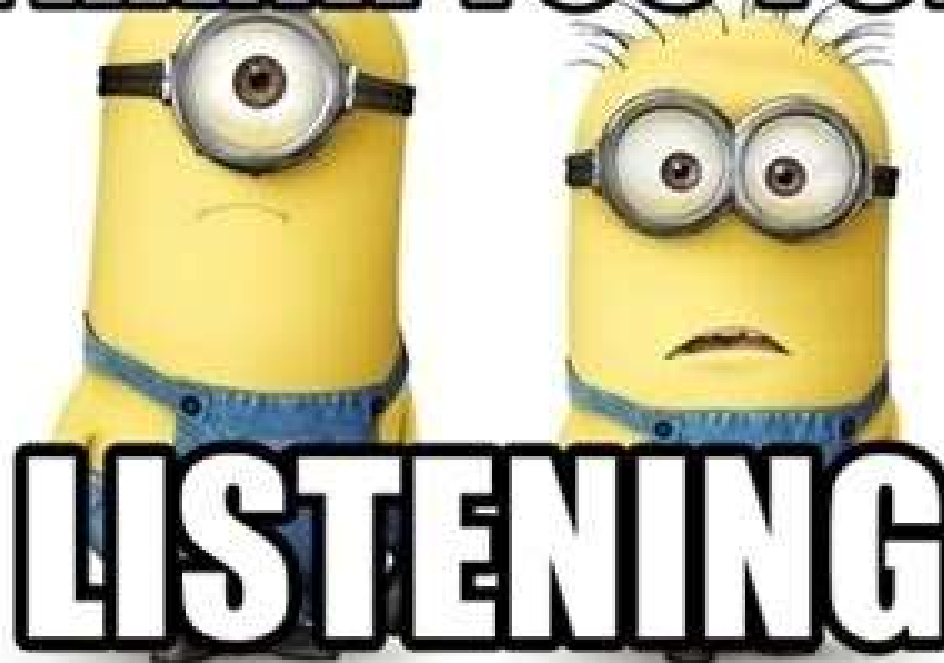


IBS

Bark Beetles



THANK YOU FOR



LISTENING

memegenerator.net

Any questions??