

3. The bark beetles: biology, recognition, hazard and risk, damage assessment and management.

Curculionidae, Scolytinae

Common features of bark beetles

Mountain pine beetle, spruce beetle, Douglas-fir beetle, western balsam bark beetle, western pine beetle

- host selection
- mass attack
- fungi
- phloem feeders
- life stages



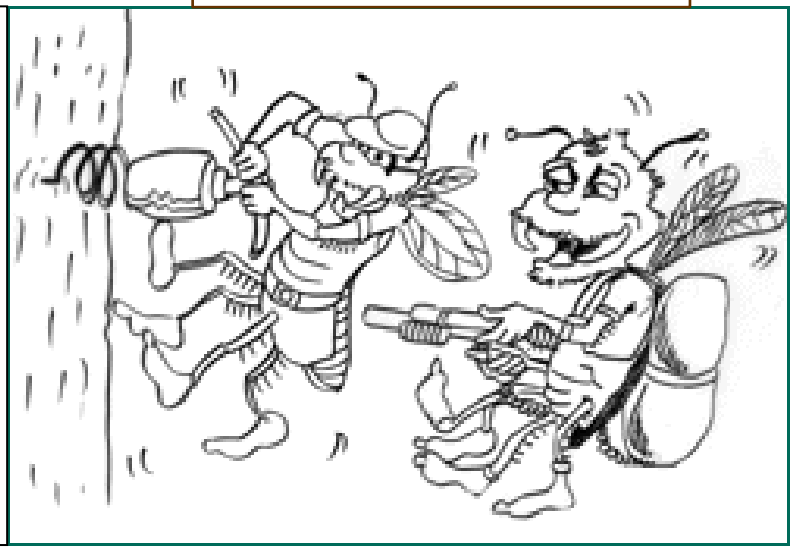
Common features of bark beetle life cycles

HOST SELECTION

- Host species are usually limited
- Prefer larger trees; older trees
- Primary attraction – stress produces detectable symptoms

MASS ATTACK

- produce large numbers of beetles to overcome tree defenses
- 2º attraction: aggregation pheromones
- Anti-aggregation pheromones: to mediate resource allocation



Common features of bark beetles
MORTALITY FACTORS

- COMPETITION and cannibalism
- CLIMATE cold
- DRYING
- PITCH
- PARASITES AND PREDATORS
  - Flies, beetles, wasps, and woodpeckers
- DISEASES



2° bark beetles



Wood borers

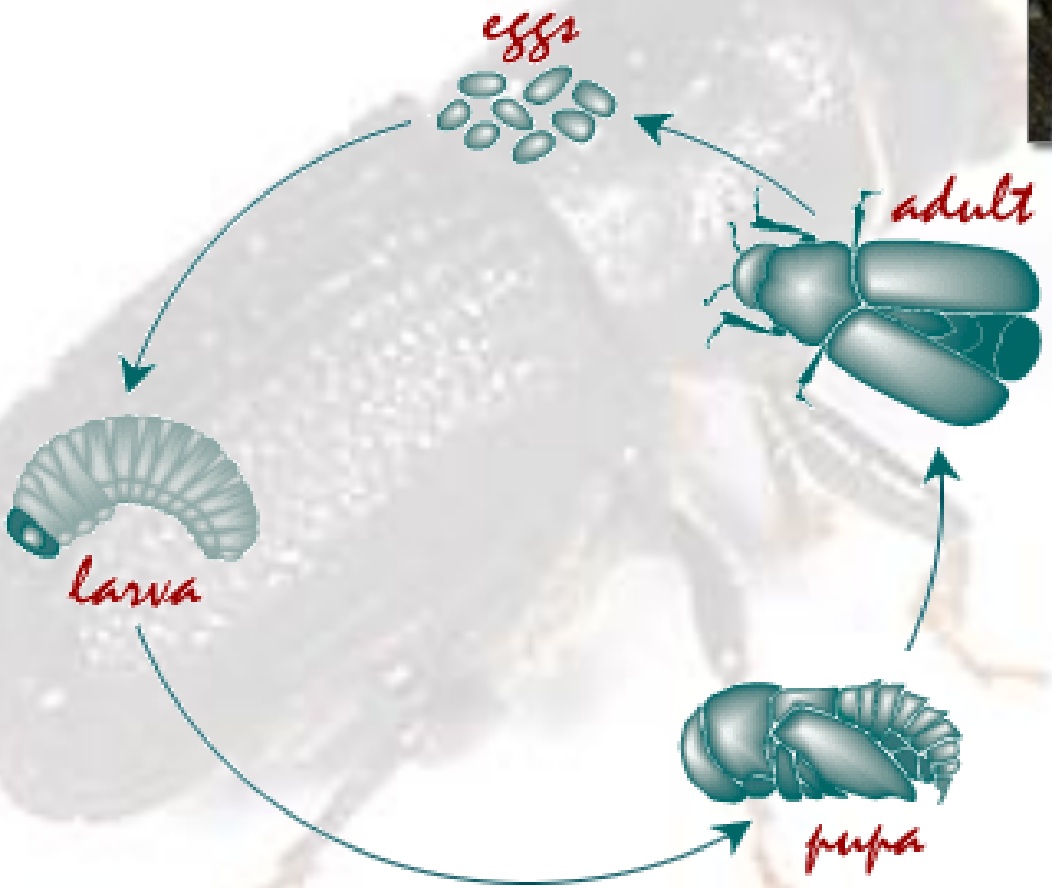


Clerid beetle



Bark Beetle Life Cycle





Assortment of fungi introduced into sapwood by attacking beetles.



Ophiostoma fungus in beetle gallery









Larval instars, *Dryocoetes confusus*



Pupae. teneral adults, adult, *Dendroctonus pseudotsugae*



Mountain pine beetle
Dendroctonus ponderosae



Douglas-fir beetle
Dendroctonus pseudotsugae



Spruce beetle
Dendroctonus rufipennis



Western pine beetle,
Dendroctonus brevicomis



Red turpentine beetle,
Dendroctonus valens



Lodgepole pine beetle,
Dendroctonus murrayanae



Western balsam bark beetle
Dryocoetes confusus







Douglas-fir beetle

Coleoptera

Family Curculionidae

Sub-family Scolytinae

Dendroctonus pseudotsugae Hopk.



- Life cycle, population dynamics
- Detection
- Management Options

Dendroctonus pseudotsugae



ADULTS

May - June
Peak flight

1st

WINTER

EGGS

1 year
Life Cycle

Aug. -
Sept.



ADULTS

June - July

2nd



Mid-May to
Mid-August

PUPAE



LARVAE



Flight period

Main Flight

Complete Flight Period

March | April | May | June | July | August

Douglas-fir beetle: host selection, signs, symptoms









Douglas-fir beetle

Host preference



- Douglas-fir
- Western Larch (rarely)

- large, old Douglas-fir (>30cm)
- fire-scarred
- fresh wind throw
- stressed, diseased . . .

→ when beetle numbers high enough DFB will kill healthy standing trees

Primary attraction: DFB is attracted by host oleoresin - alpha-pinene, camphene, and limonene

Host attraction **precedes** the beetle attraction which is produced by unmated females shortly after entering the host and which results in mass concentration of beetles around the center of attraction.


Mass attack on stressed host


Attack centre

Secondary attraction: attraction centers are established in freshly downed trees and in standing trees of subnormal physiological condition in latent (endemic) conditions.

Under outbreak (epizootic) conditions, the beetles can invade even vigorous trees.

Survival of trees depends on their ability to exude oleoresin, which is influenced greatly by environmental factors.



High quantities of host oleoresin is released from fire scorched trees



Bole symptoms:

The first sign of DFB attack is orange-brown frass and sawdust in bark crevices and around base of tree.

This is visible from first attack in April-June to early fall (after this time frass fades & gets washed away).



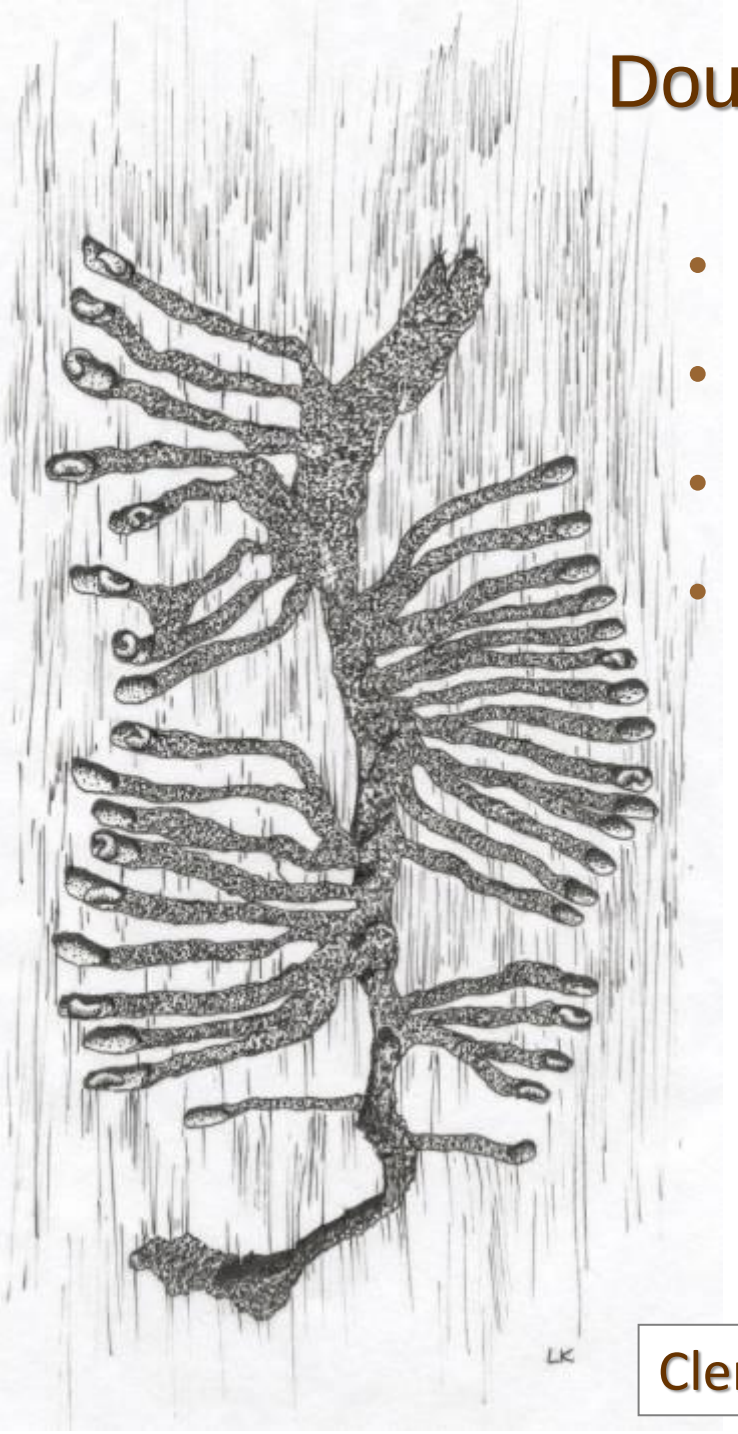


Foliage colour change is variable:

- Gradual or rapid
- **Green → Yellow → Red**
- never assume red & grey crown trees have no beetles
- fade can occur in the fall or more typically early summer the year after attack

Check under the bark

Douglas-fir beetle gallery



- Bottom hook on gallery
- 20 - 25 cm long parent gallery
- Alternate, fan-shaped larval mines
- Galleries packed with boring dust



Clerid beetle = predator



Douglas-fir beetle galleries



Douglas-fir pole beetle galleries

Key insects attacking stressed trees:

Bark beetles, woodborers, ambrosia beetles, wood wasps and others are attracted to bark beetle infested or stressed trees.

Each type of insect has its unique “signature”.

Bark beetles





Secondary bark beetles



Decomposers (woodborer, ambrosia beetle, wood wasp, ants)



Host = Douglas-fir

Douglas-fir beetle, *Dendroctonus pseudotsugae*

- 1° invader – kills trees
- Attacks April – July
- Red frass on bole, resin streaming, chlorotic foliage



Douglas-fir pole beetle, *Pseudohylesinus nebulosus*

Douglas-fir engraver beetle, *Scolytus unistriatus*





- 2° invader – infests weakened or DFB trees
  Multiple generations per season

Woodborers, woodwasps, ambrosia beetles



- 2° invader – decomposers / carnivores
- Attack immediately post-fire

Outbreak Triggers for Douglas-fir beetle:

- freshly down/cut Douglas-fir
- old, large Douglas-fir
- **fire-scarred** or damaged trees
- unseasonal weather
- drought events → stressed trees
- natural outbreak periodicity





Douglas-fir beetle management



- Hazard & Risk rating
- aerial detection
- ground surveys
- harvest - trap trees, baiting
- mass trapping and repellents

IDF/DFB Management: hot topic in south

Issues: disperse attack; difficult terrain; OGMA's; MDWR; mid-term Timber Supply: private land; regeneration; multiple pest issues; pressure from other users

Public Perception: visible; interface concerns; *historic;* municipalities demanding more say in land management



Mgmt: *think* large landscape plans; communication with FN & public; harvest over multiple years; consider other FH & land use concerns

Parasitism typically collapses DFB populations



Hazard and Risk Rating



Shore Safranyik Index:

- Age (>80 years)
- DBH (>30 cm)
- Basal Area (%) = the % of total stand BA composed of Df based on all trees with a DBH ≥12.5 cm

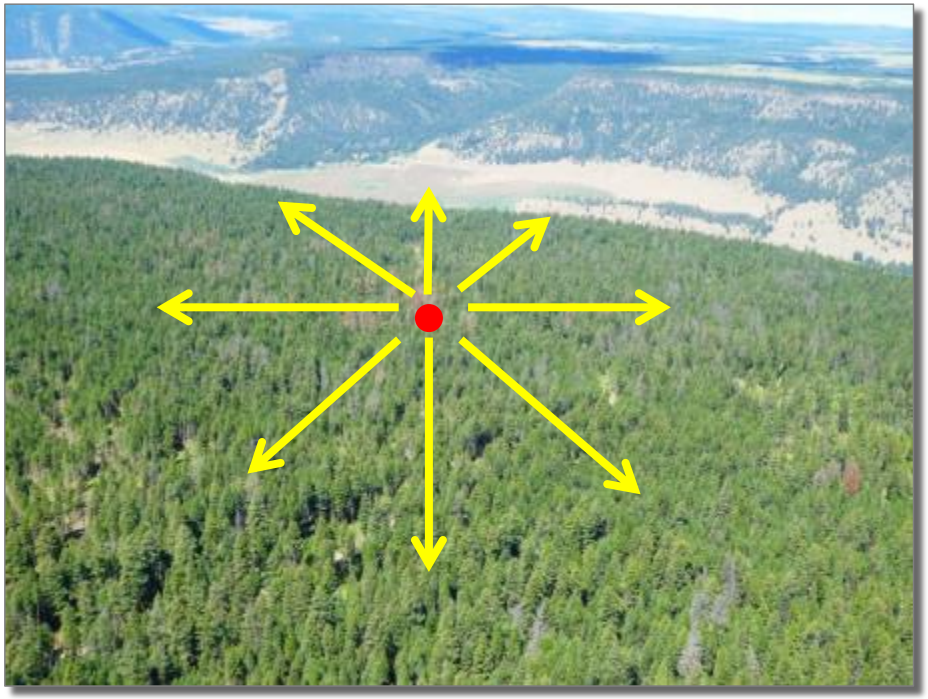
Useful as planning tool to determine where to put survey and management resources.

Aerial Surveys

DFB spatially discrete in patches (polygons) or spots (1-10 trees)



Ground Surveys

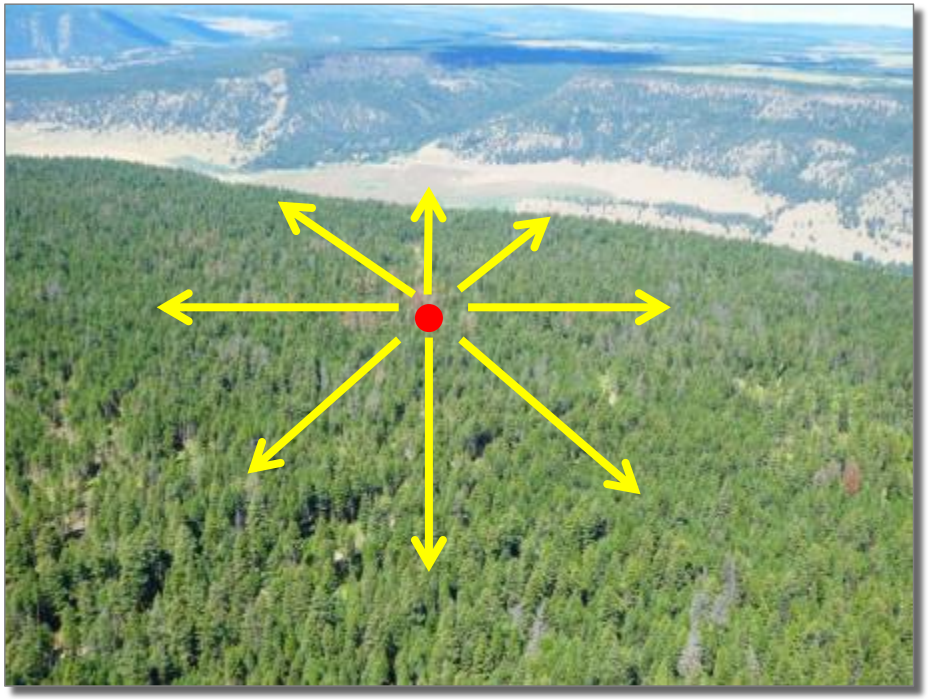


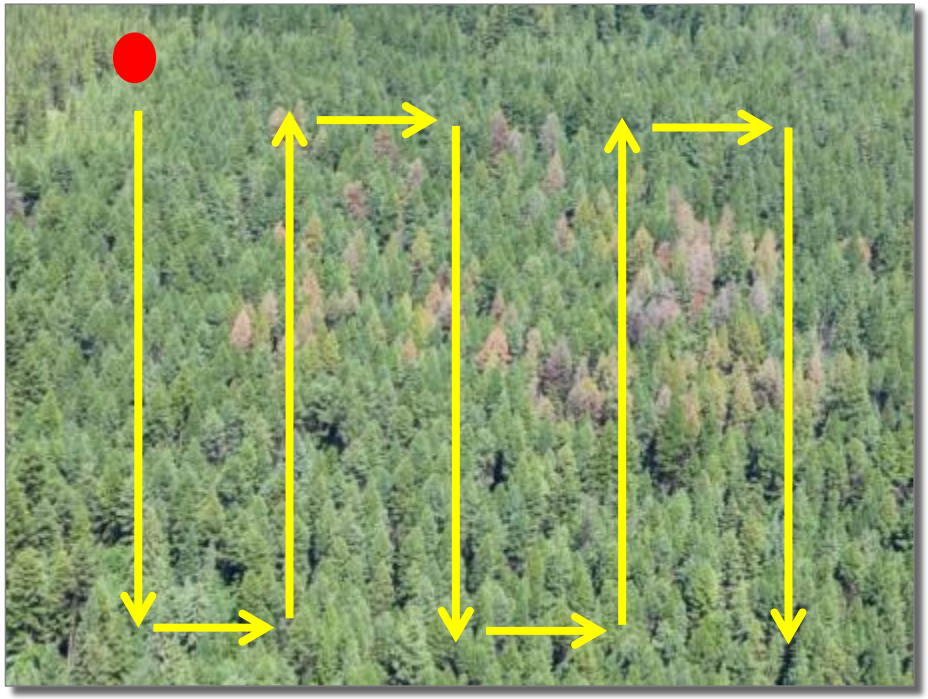


Star Probe:

- search at least 50 m (up to 300 m) beyond last current
- GPS all current attacks
- start at mapped infestation centre (red, green & old attack)
- work around centre looking for current attack

Ground Surveys





Grid Probe:

- uniform survey lines 50 m to 100 m apart
- GPS all current attacks
- survey throughout infestation centre or interest area
- work through and beyond attack centre looking for current attack

Distance of new attack from previous year attack centers:

- Unpredictable, 50m to 200m away from brood trees
- reduced dispersal may occur as population vigor declines







Success of DFB cannot be determined with great accuracy from the ground

- attacks above 2 m on bole
- strip attacks (partial attack or one side of a tree) are common in low level infestations or at end of DFB flight period
- second DFB flight often “fill-in” attack on lower bole



Chop!

Look up – frass, resin streams

Double attacks are “common”.

- attack at mid-bole (>2m) is difficult to see from the ground
- these trees will die and may sustain a later attack that fills up available bark surface area.

This may be a symptom of declining population vigour.

Check under bark – parasitized larvae (*mummies*) indicate declining population.

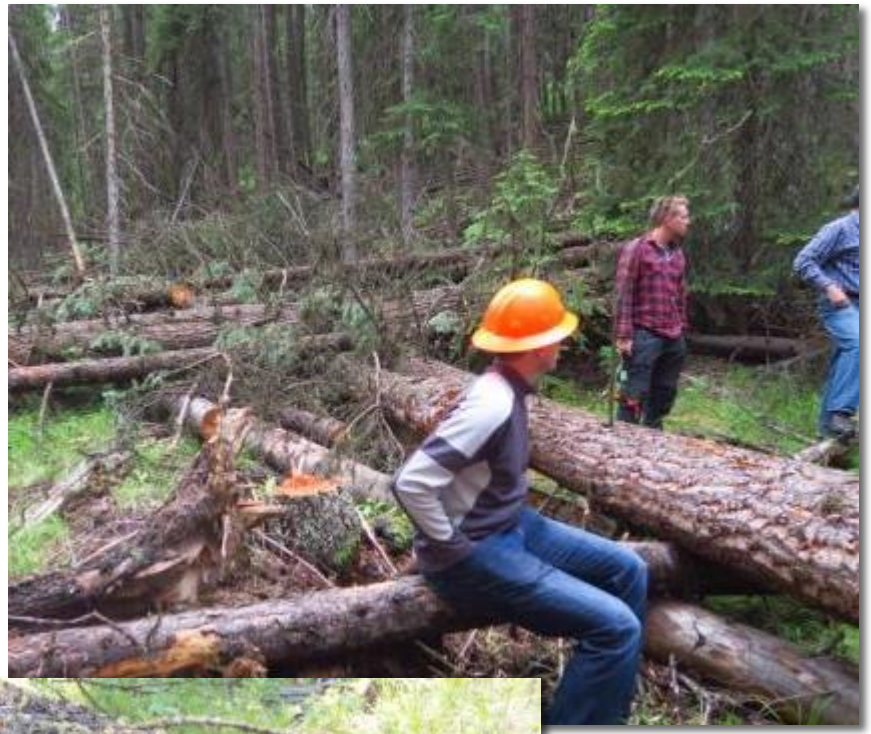




Parasitized Douglas-fir beetle larvae

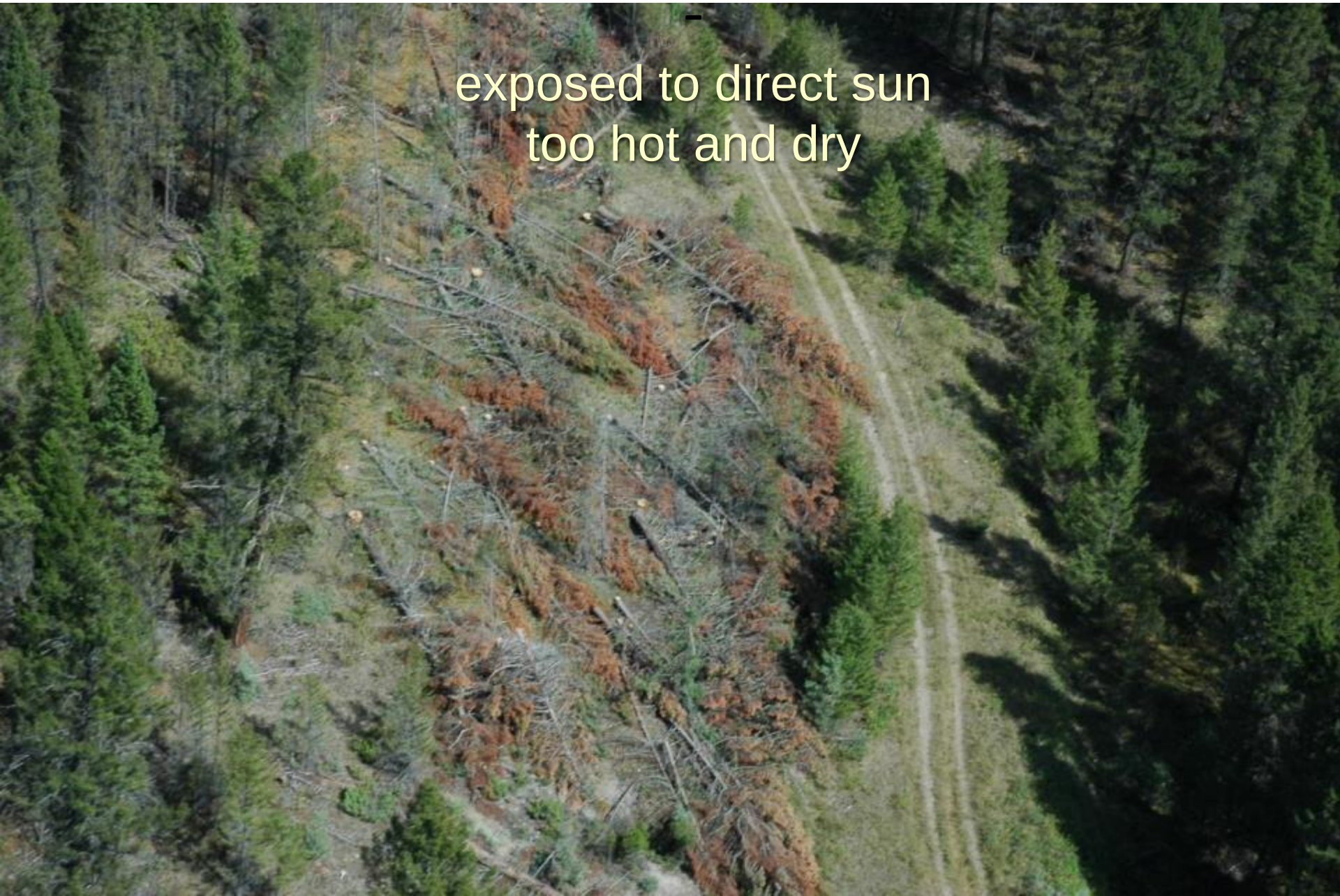
Harvest - trap trees, baiting

- 1 trap tree for every 4-10 infested trees
- largest available healthy trees
- shaded, not limbed or bucked
- use pre-felled roadways
- trap tree decks
- can saturate in 20-30 days
- spillover?
- ♀ + ♂
- max radius = 400m
- harvest, peel or burn





Poor Trap Tree Site



Grid bait proposed harvest blocks

Use only if clearcuts are guaranteed



- beetles may not utilize full bole of tree
- attack is spread over more trees (less attack/tree)
- trap beetles within stand, or flying through stand

Mass trapping and repellents

- ♂(♀)
- can run all summer
- catch is 2 to 3 x trap trees
- Spillover!! May not be an issue in post-fire scenarios
- place 100m from live Fd; optimize use of severely scorched sites for trap deployment
- maintain bi-weekly
- new baits mid-June
- protect residual trees with MCH (±200m)





Cleridae



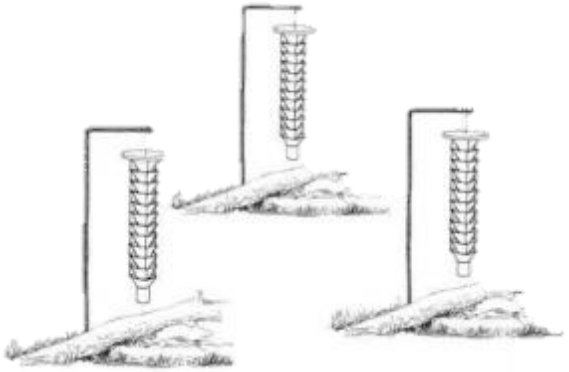
Mass trapping and repellents

MCH (Methylcyclohexenone) = The anti-aggregation pheromone for DFB serves to prevent overcrowding and optimize brood survival

- high value trees or stands
- blowdown
- seed trees near funnel traps
- easy to apply, effective
- 10m x 10m spacing
- PARKS (?)



Douglas-fir beetle management critical dates & planning



- Falling trap trees – by April 1st (April 15th)
- Deploying repellents – April 1 to 15
- Deploying funnel traps – April 1 to 15
- Maintaining funnel traps – April to August
- Surveys – July to mid-September
- Check aerial survey records for new infestations and blowdown (AOS complete by August)
- Harvesting beetle attacked trees – fall/winter
- Deal with trap trees – harvest, peel, burn (*last resort*)
- ***Repeat***

Post-wildfire – what comes next?

1. Minimize future tree mortality from insects
   - Douglas-fir beetle (DFB)
   - Black Army cutworm (BAC)
   - Secondary bark beetles
2. Facilitate maximum removal of DFB in the salvage of burnt wood
3. Monitor burnt/regeneration sites for BAC and secondary bark beetles

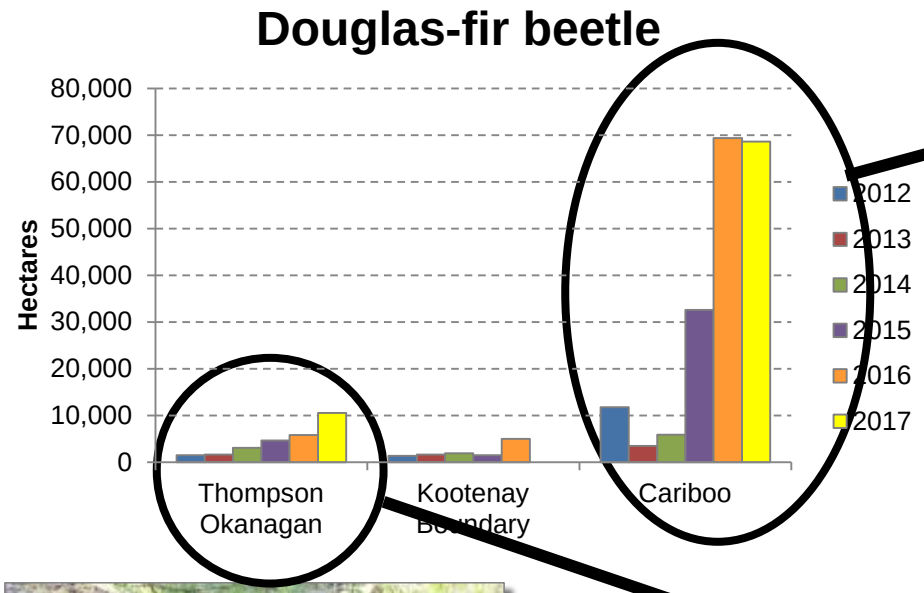
The worst case scenario . . .

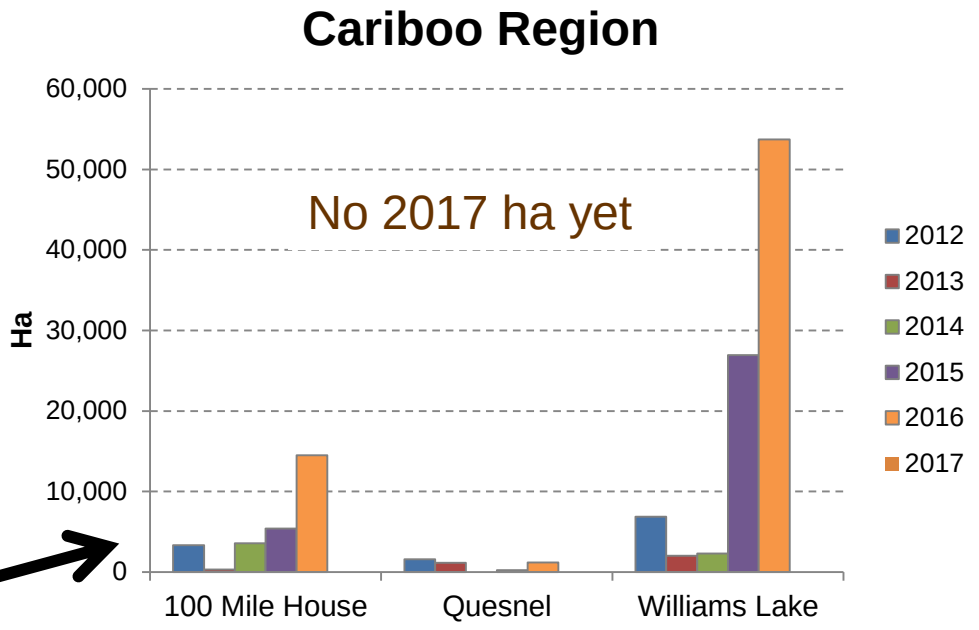
Numerous and extensive wildfires in Douglas-fir

Pre-existing Douglas-fir beetle activity (outbreak)



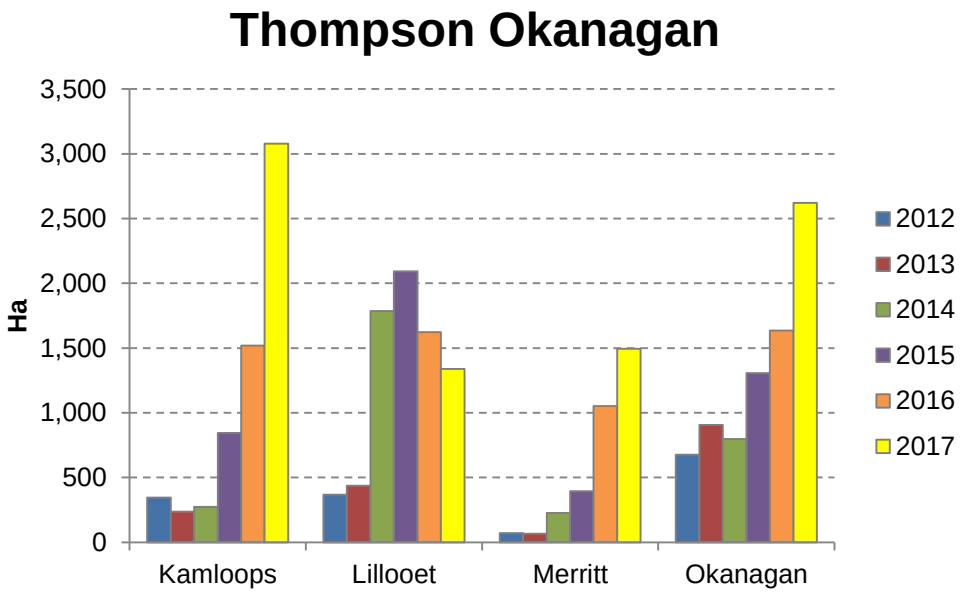








OGMA's
MDWR
Interface
Soils – water
Fire



The worst case scenario . . .

Area burned exceeds harvest capacity.

Salvage priorities for burnt wood *versus* DFB infestations.

Short time window for fire salvage & maximum DFB extraction.

DFB attack expanding in green wood.

DFB will colonize burnt areas in 2018 and further expand.

DFB will utilize burnt trees 1-3 years then move to green fir.

Pressure on mid-term timber

Harvest priority - ecological balance



Douglas-fir post-fire mortality is confounded by Douglas-fir beetle attacks.

Large Douglas-fir trees that could have survived fire-injuries alone are often attacked and killed

Douglas-fir beetle still seeks out the largest, burnt or semi-burnt trees within fire perimeter



Douglas-fir beetle concerns

- Pre-existing Douglas-fir beetle outbreak throughout Douglas-fir types in the southern interior
- Burnt trees are highly attractive to Douglas-fir beetle
- Burnt trees offer no resistance to invading beetles so few beetle die in the dispersal & colonization phase

Douglas-fir beetle concerns

- Signs of beetle attack are often *masked* in burnt areas – trees blackened & crowns already **red**
- Burnt trees remain attractive to beetles for ±2 years therefore building populations rapidly in this setting
- when burnt trees are no longer suitable or available beetles attack green trees outside fire perimeters

- Detection of DFB attack in fire-scorched areas/trees is difficult because trees may have no crown or crowns are already red so aerial detection confounded





- Detection of DFB attack in fire-scorched areas/trees is difficult because trees may have no crown or crowns are already red so aerial detection confounded
- Trees continue to die 1-3 years post-fire from fire stress and other factors so it is critical to discern these mortality factors from DFB

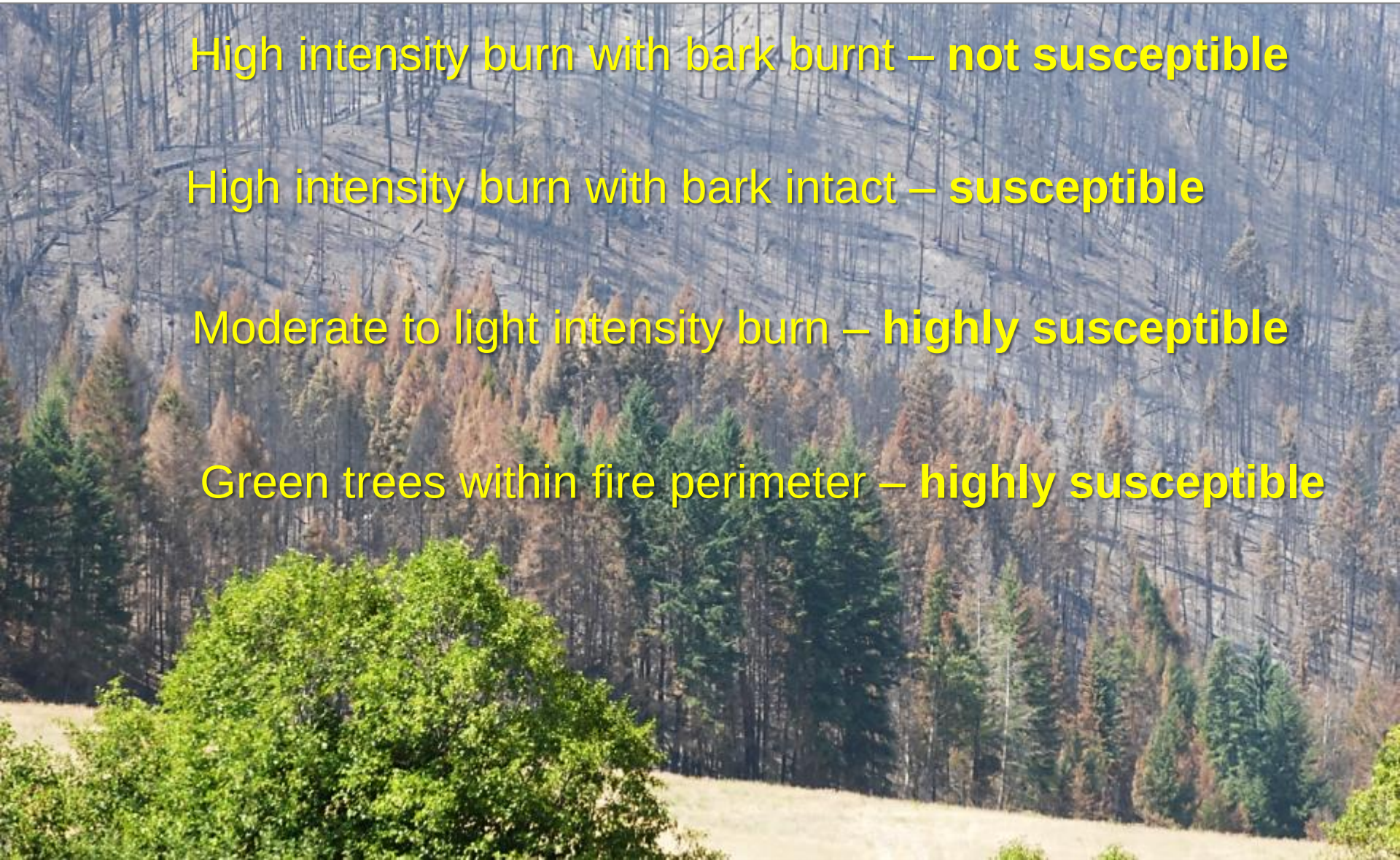



Stand near Elephant Hill fire – **drought, fire, DFB?**

- Green fir within fire perimeter is at high risk because roots may be compromised plus 2017 drought impacts



Burn severity and risk to Douglas-fir beetle attack



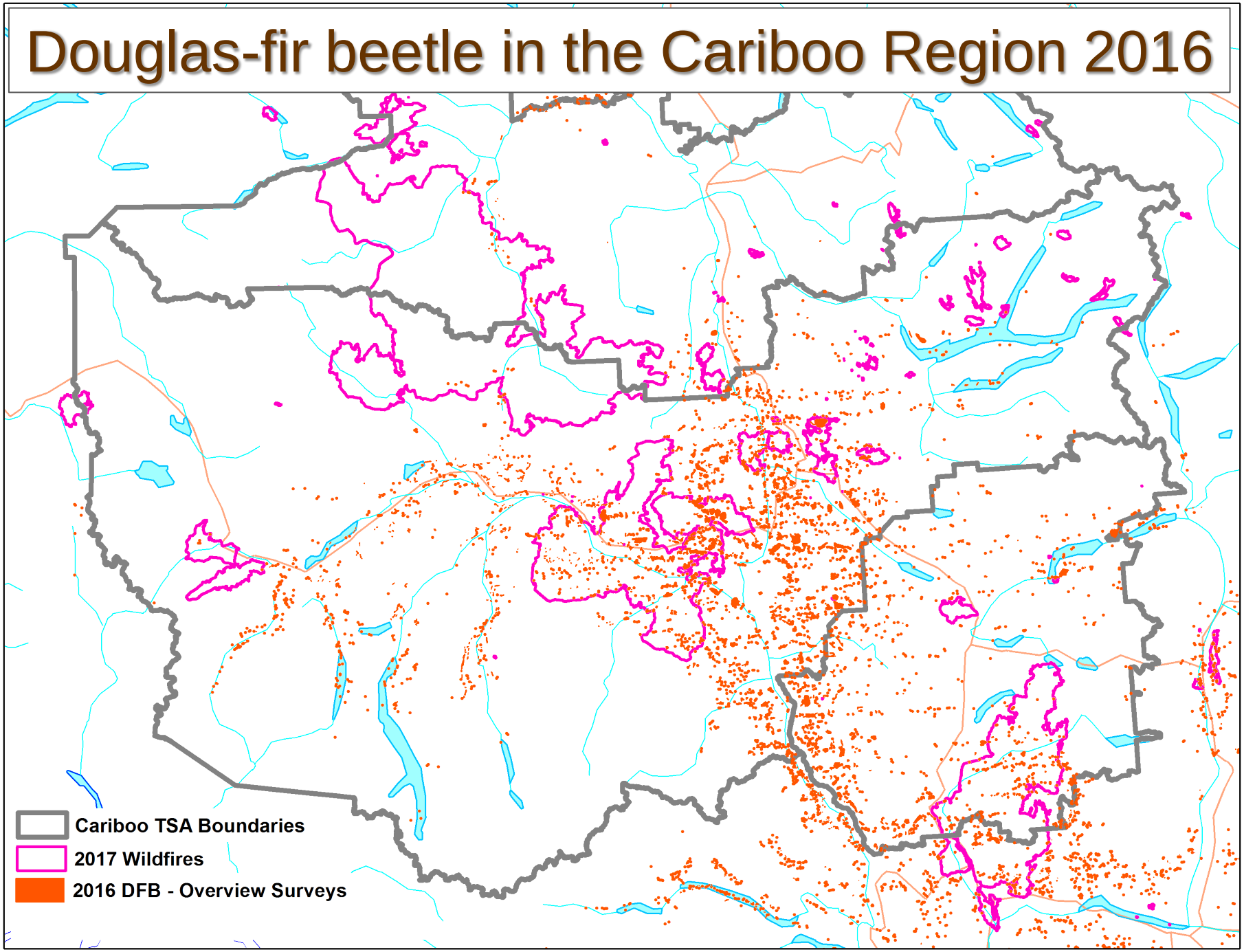
High intensity burn with bark burnt – **not susceptible**

High intensity burn with bark intact – **susceptible**

Moderate to light intensity burn – **highly susceptible**

Green trees within fire perimeter – **highly susceptible**

Douglas-fir beetle in the Cariboo Region 2016





Management sequence & options:

1. Identify burn severity and assign risk for further mortality (fire & DFB)
2. Identify closest and largest conflagrations of DFB attack (mapped reds & green attack)
3. DFB <u>still</u> prefers largest trees so optimize harvest based on both timber-beetle
4. Harvest after April 2018 should maximize beetle removal & burnt wood salvage.





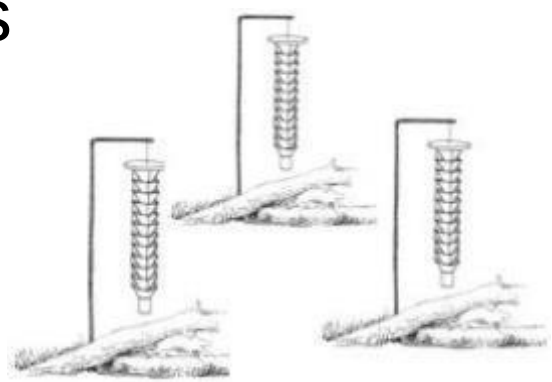
Management sequence & options:

5. Scorched trees are attractive host for DFB so conventional trap trees are less effective and likely a rare resource
6. Use in-block tree baiting to hold beetles in proposed blocks and to attract DFB populations that are adjacent or dispersing
7. Locate, assess and treat all fir felled in 2017 as trap trees or during fire fighting
8. Monitor DFB flight period with funnel traps throughout priority salvage areas



Management sequence & options:

9. Optimize use of mass trapping techniques in very severely burned areas or clearings near active DFB populations



10. MCH – applied to protect live, green trees from DFB in *special areas*





