Spruce Beetle 101

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Kootenay Boundary

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

Course Overview

- Welcome and introductions
- Spruce beetle biology and life cycle
- Detection techniques
  - Symptoms of attack
- Field Session
  - flights up Elk Valley Oct 10th 11:30 meet at Elkford Gas Station

Main bark beetles

- Mountain pine beetle IBM Pl, Py, Pw, Pa, Pf, Pj
- Spruce bark beetle IBS Spruce (Se, Sw, Ss)

- Douglas-fir beetle IBD Fd (Lx)

- Western balsam BB IBB Bl (Ba, Sx)

- Periodically reach outbreak levels in BC
- Will kill large numbers of large diameter, mature and overmature trees

Why do we care?

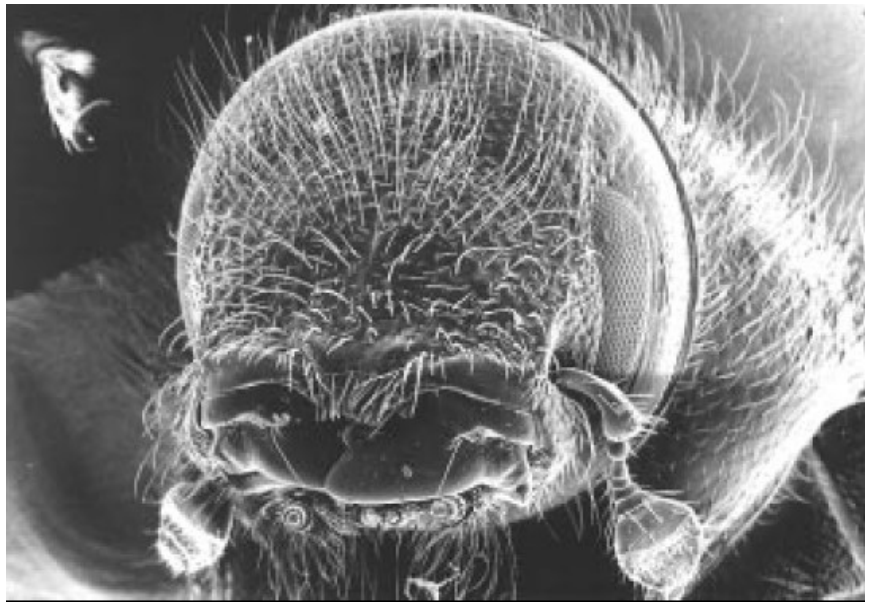
- Most bark beetles cause little or no economic damage but a few will attack and kill living, apparently health trees.
- Bark beetles are integral components in forest ecosystems. All these BBs are native to western NA but range expansion has occurred due to warmer climate
- Typically bark beetles are the most common and widespread damaging agents affecting approximately 70% of the damage in our area.

BIOLOGY

- Host selection
- Mass attack
- Phloem feeders
- Fungal interactions

Where will I raise my young?

Will they have enough to eat?

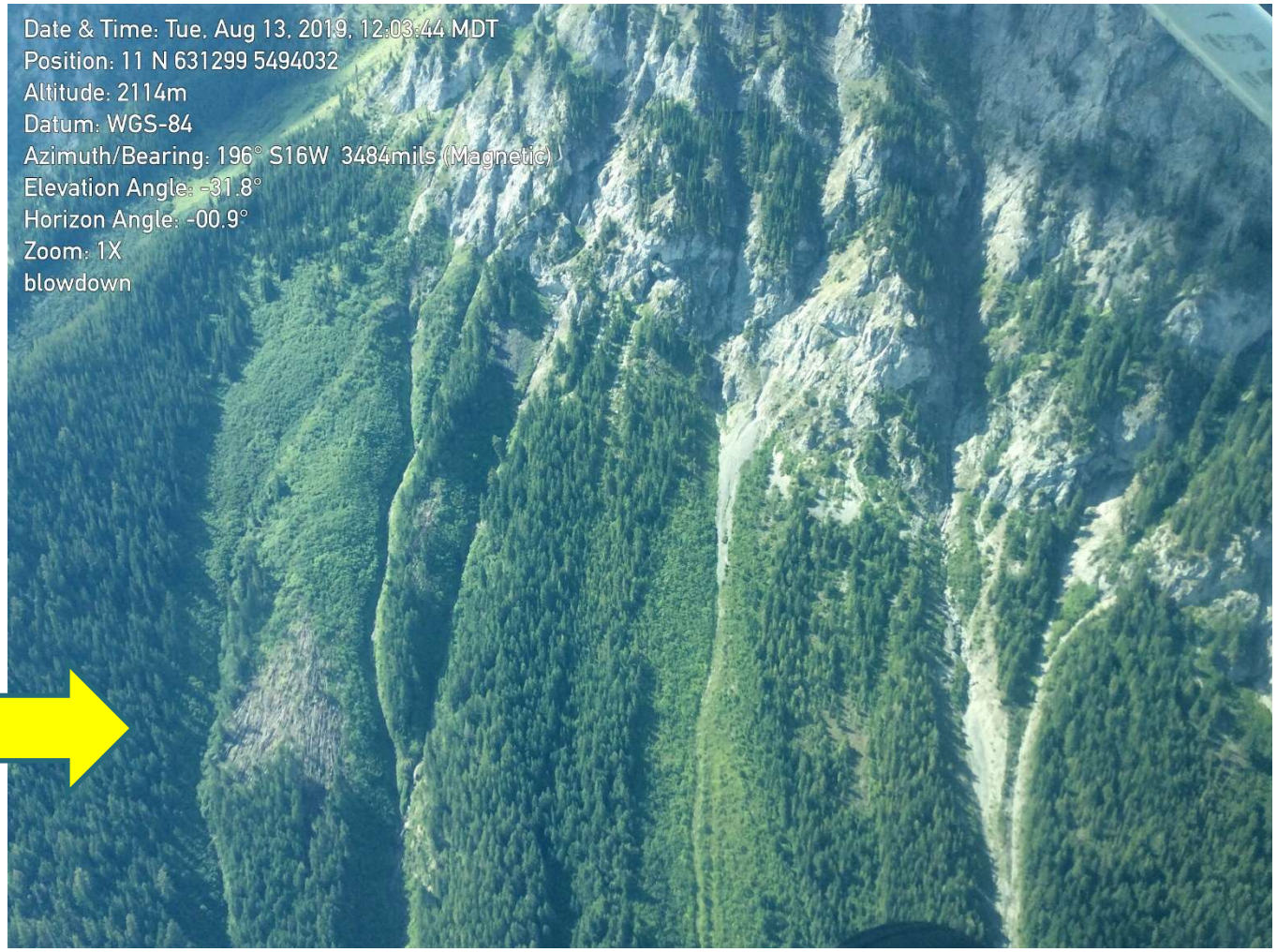


SPRUCE BARK BEETLE HOST SELECTION

- Windthrow

- Prefers freshly felled/ stressed trees;
  - Windthrow
  - Flooding
  - Drought stressed
  - Snow snapped
  - Fire scarred
  - Root rot areas
- Will kill healthy standing trees if populations increase

Blowdown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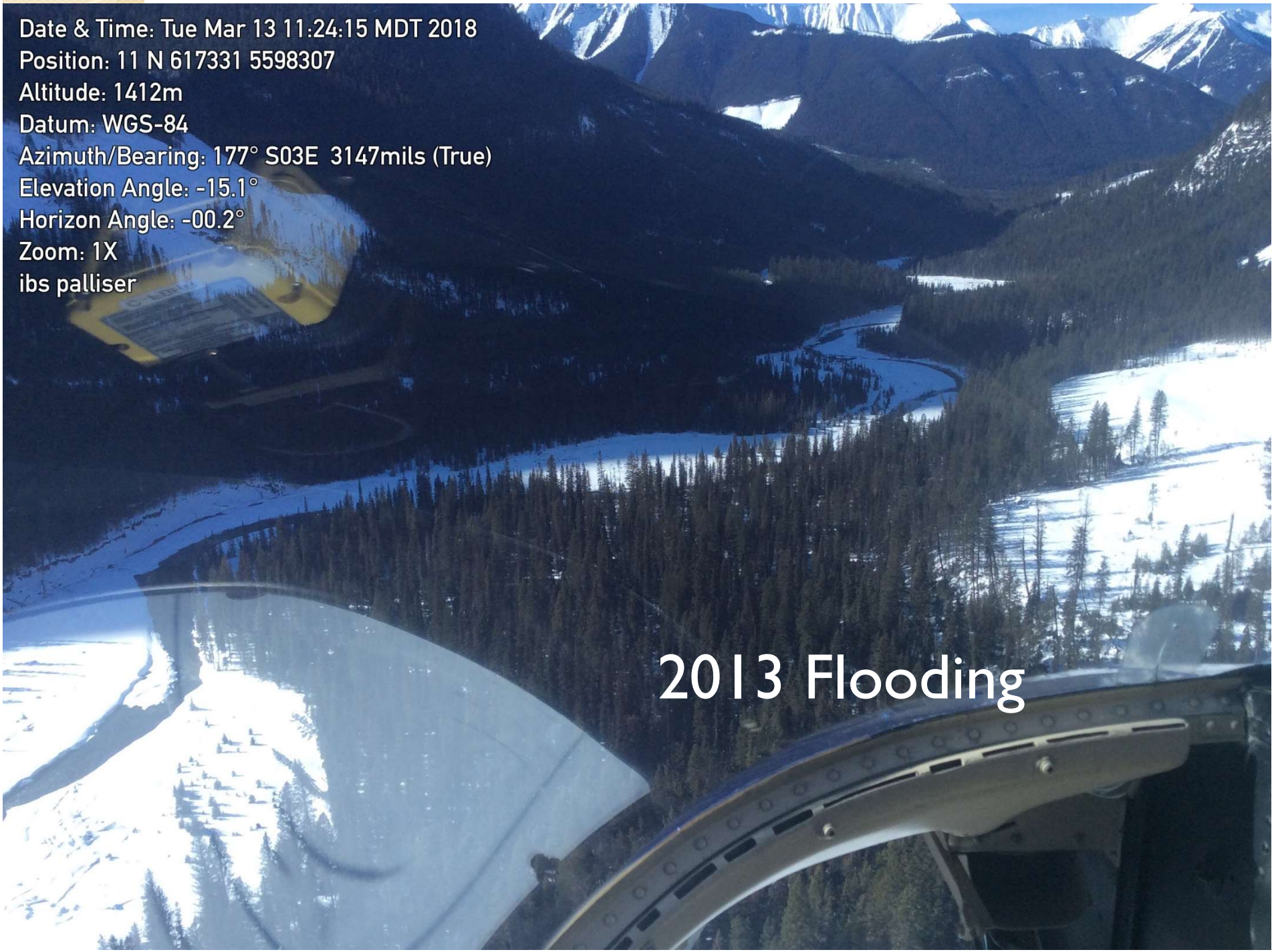
blowdown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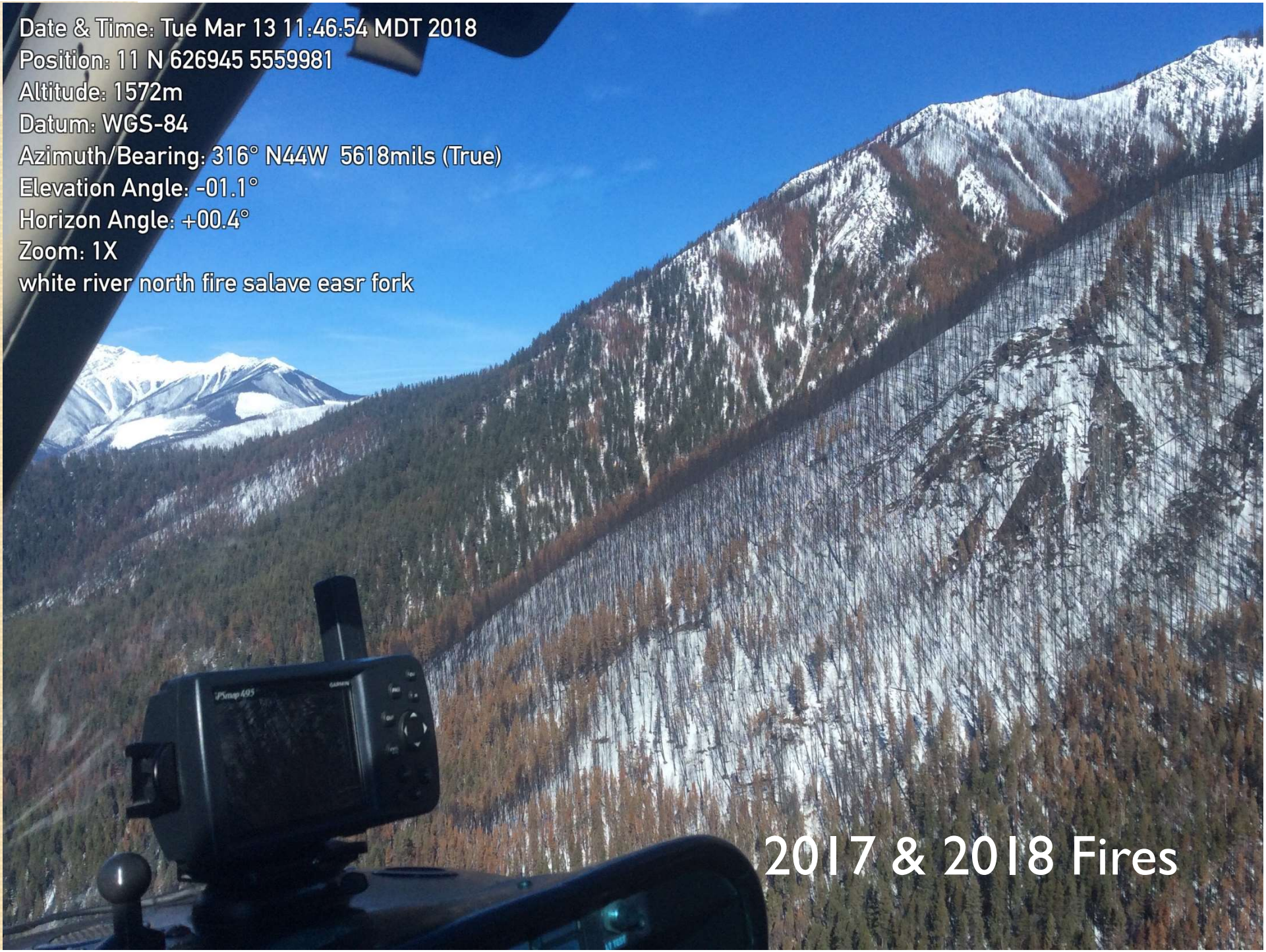
ibs palliser
2013 Flooding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Horizon Angle: +00.4°
Zoom: 1X
white river north fire salave easr fork
2017 & 2018 Fires

Date & Time: Tue Mar 13 12:45:14 MDT 2018
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Altitude: 2604m
Datum: WGS-84
Azimuth/Bearing: 220° S40W 3911mils (True)
Elevation Angle: -07.4°
Horizon Angle: -00.5°
Zoom: 1X
galibreth
Avalanches

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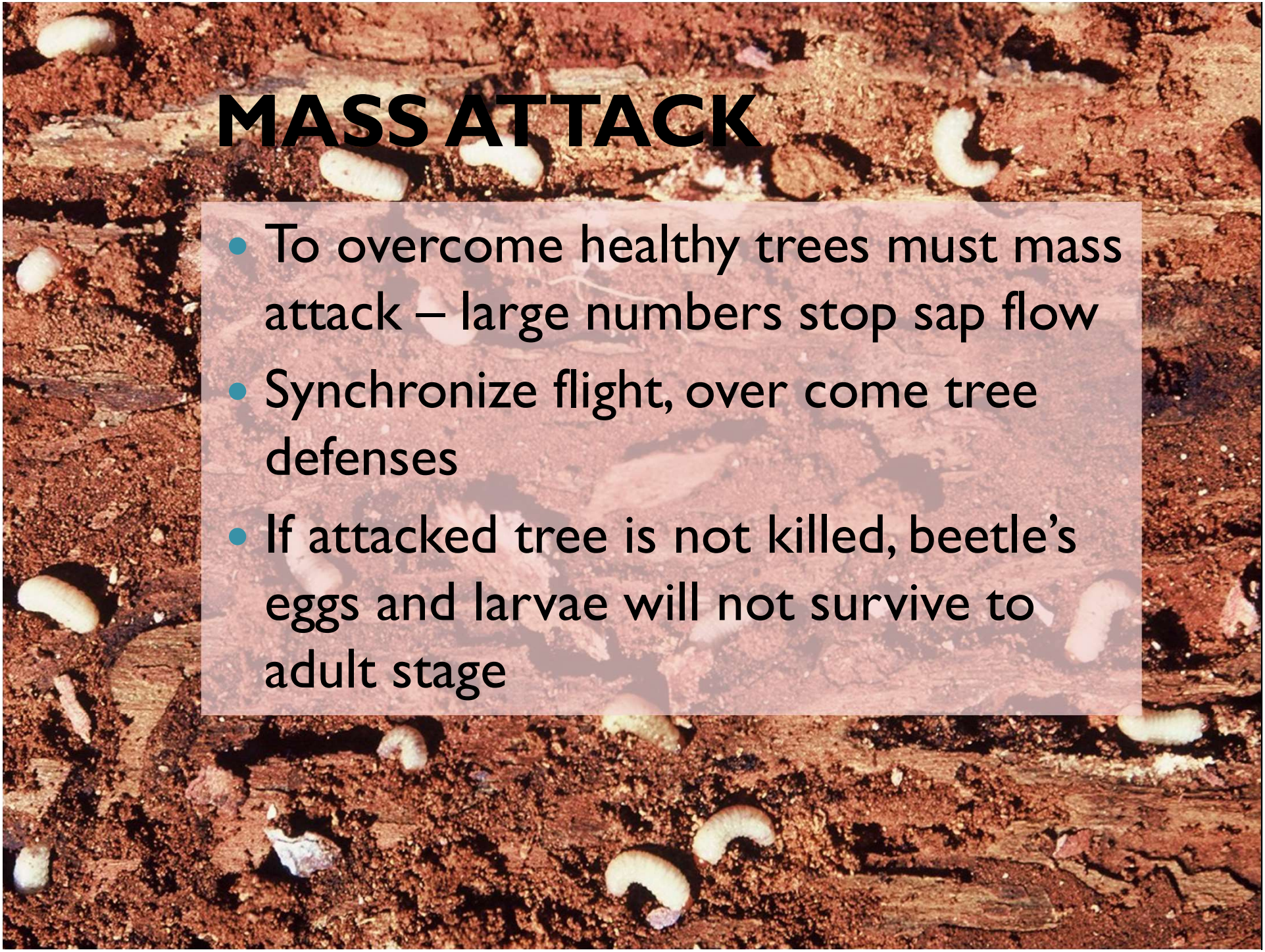
1 N 463024 5700023
078m
GS-84
Landslide
earing: 085° N85E 1511mils (Magnetic)
Angle: -15.0°
ngle: +01.3°

11 N 423199 5795420
1518m
/GS-84
Bearing: 034° N34E 0604mils (Magnetic)
Angle: -09.8°
Angle: +03.4°
erial DCO IBS wood river
Drought

2-Year Cycle Budworm

Snow snap

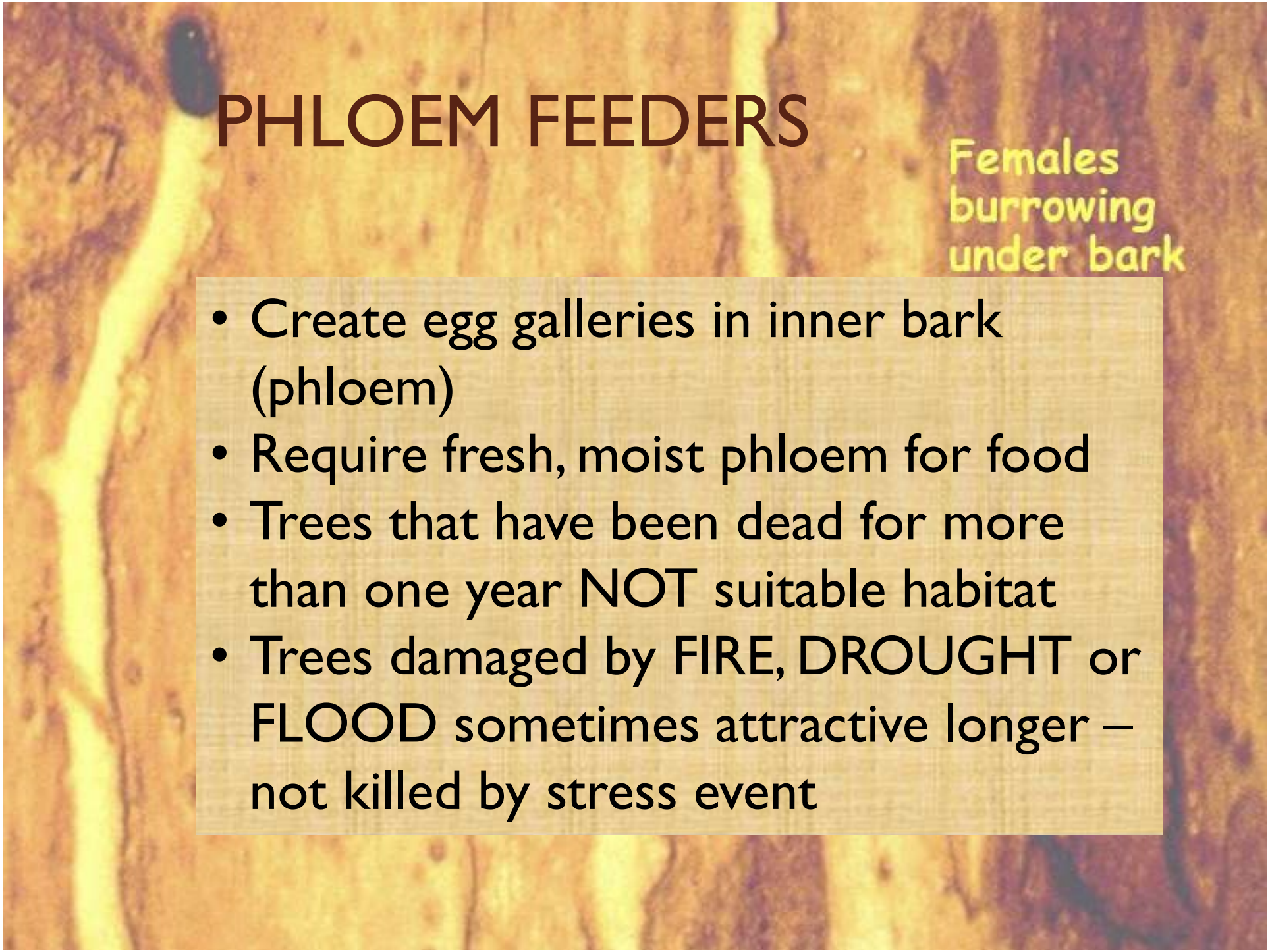
Date & Time: Wed Jun 6 11:48:23 MDT 2018
Position: 11 N 603959 5553179
Altitude: 1113m
Datum: WGS-84
Azimuth/Bearing: 059° N59E 1049mils (True)
Elevation Angle: -08.1°
Horizon Angle: -89.9°
Zoom: 1X
Whiteswan Alice Lake IBS



MASS ATTACK

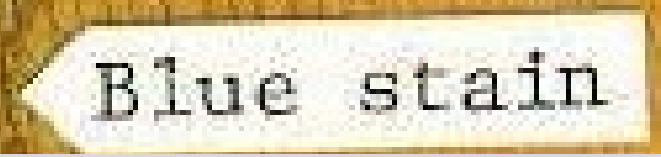
- To overcome healthy trees must mass attack – large numbers stop sap flow
- Synchronize flight, over come tree defenses
- If attacked tree is not killed, beetle's eggs and larvae will not survive to adult stage

PHLOEM FEEDERS



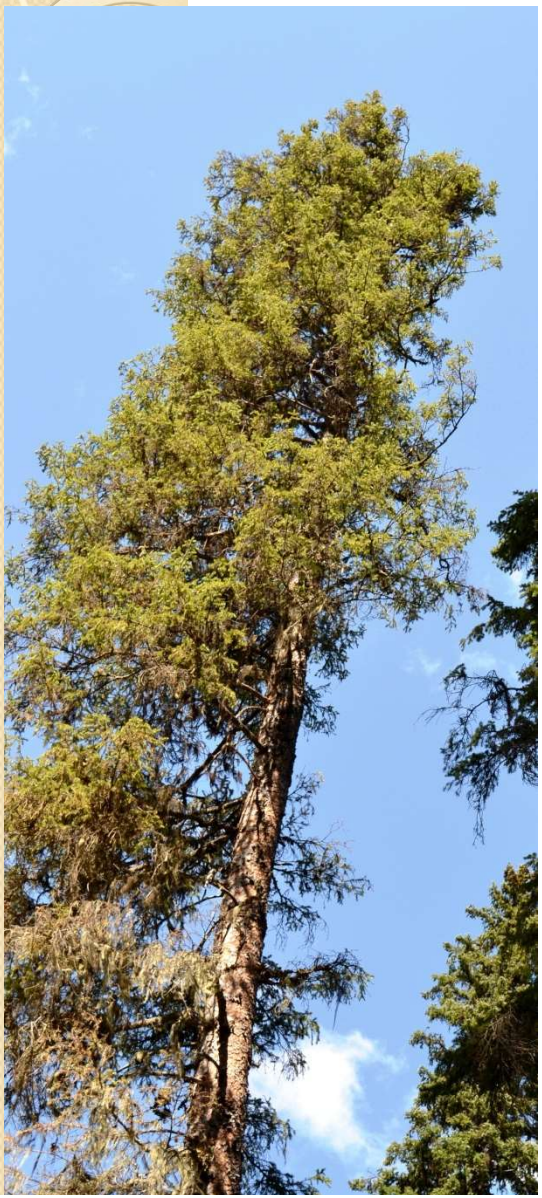
- Create egg galleries in inner bark (phloem)
- Require fresh, moist phloem for food
- Trees that have been dead for more than one year NOT suitable habitat
- Trees damaged by FIRE, DROUGHT or FLOOD sometimes attractive longer – not killed by stress event

FUNGAL INTERACTIONS



- A symbiotic relationship – helps beetle kill tree - "Blue stain" kill the tree in combination with larval feeding
- Prevents resinosis and translocation – tree **dies of thirst**!
- Maintains micro-climate (moisture) under the bark
- Volatile (pheromone) production
- Nutritional role

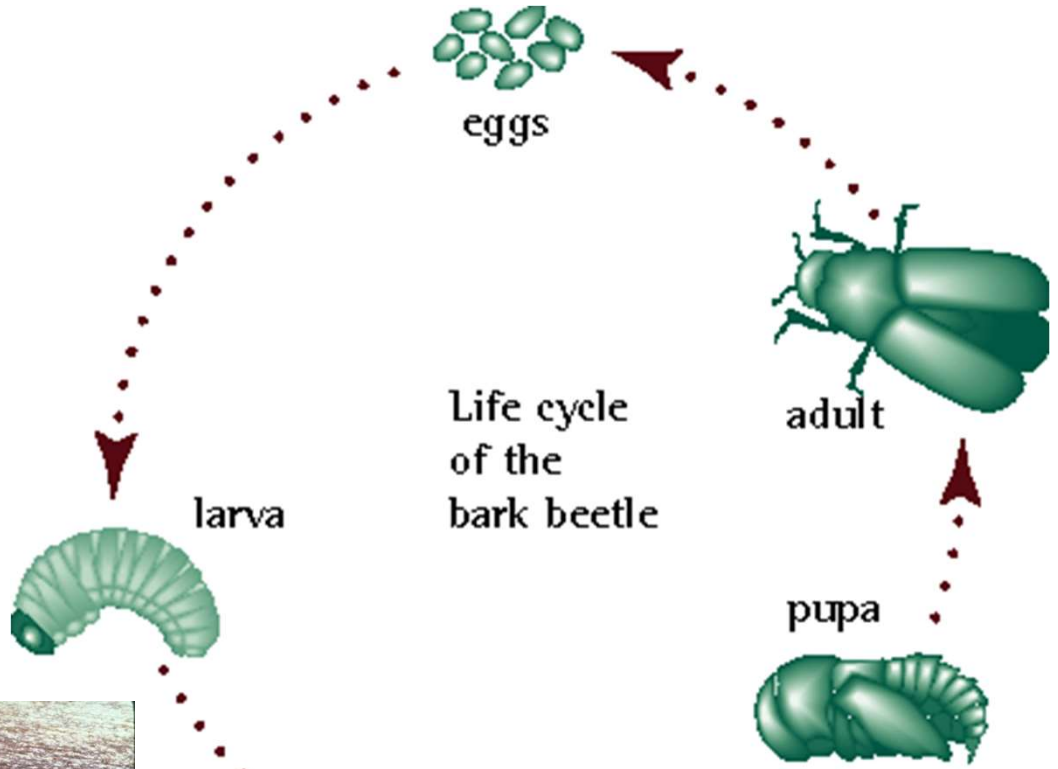
Tree is killed = die of thirst (reduced sap flow)



Blue staining

Denim wood

LIFE CYCLE (4 stages)



Life cycle temperature dependant

- 1 year – becoming more common
- 2 year – was typical
- 3 year – at higher elevations/ latitudes

Life cycle

- Females fly when air temperatures exceeds 16oC – find new tree
- Send signal for males to join her
- Pair constructs EGG GALLERY under bark parallel to wood grain

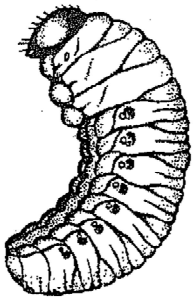
Spruce Beetle

Typical 2-year cycle

Eggs

Fly in early June after snow has melted

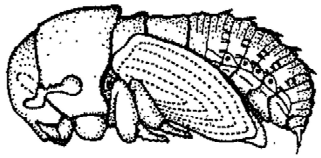
Larvae



Overwinter

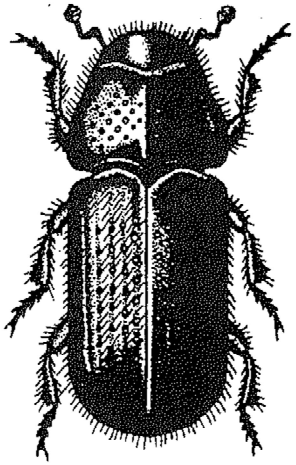
Winter I

Pupae



Overwinter

Adults



Winter 2

Life cycle range 1-3 years, typically 2 years

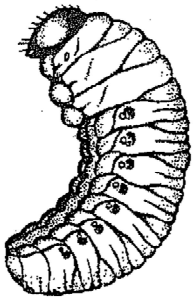
MUST overwinter as adult at some point

Spruce Beetle

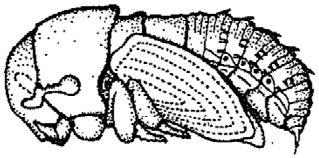
1- year cycle

Eggs

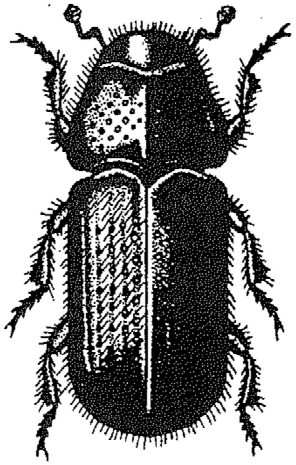
Larvae



Pupae



Adults



Overwinter

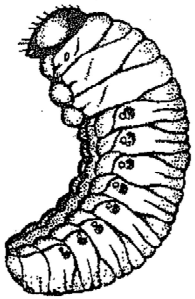
Winter 1

Spruce Beetle

3- year cycle

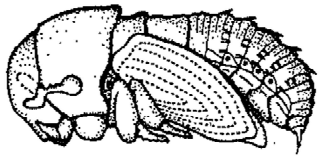
Eggs

Larvae 1

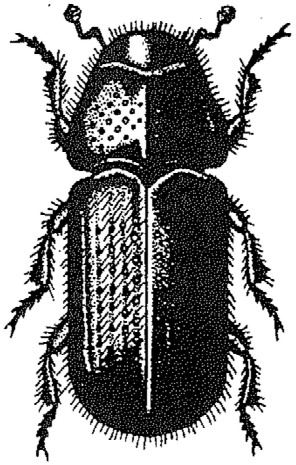


2

Pupae



Adults



3

Winter 1

Overwinter

Spruce beetle life cycle

- **2 year cycle**
  - 40-60% of immature adults emerge and overwinter in the root collar at the duff
  - Warm blanket of snow and no woodpeckers
- **1 year cycle**
  - Warmer temperatures

LIFE CYCLE - adults

LIFE CYCLE- eggs

Eggs

- Female lays 3-4 groups of around 100 eggs per gallery
- Average egg gallery 12 cm long

LIFE CYCLE – Larvae (4 instars)

LIFE CYCLE – IBS larvae

- 2 anal shields

LIFE CYCLE - Pupae

LIFE CYCLE – immature adults (callow)

Life cycle

- Eggs: pearly white, oblong, 0.75-1.0mm long. Laid in individual niches along egg gallery
- Larvae: creamy white, cylindrical, stout, wrinkled, legless grub 6-7mm (L4), head pale tan to pale rusty (4 instars)
- Pupa: creamy white, 6mm long, pale tan at maturity. Have legs and wings are mature.
- Adult: immature/ callow adult – from pupa initially white, then brown, mature adults black or rusty wing coverings. 6mm long

SURVEYS: Symptoms of attack

1. Crowns symptoms
2. Pitch tubes/ resin
3. Boring frass
4. Woodpeckering
5. Position of attack
6. Galleries
7. Blue staining fungus

sition: 11 N 420307 5792423
itude: 1471m
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evation Angle: -15.4°
rizon Angle: -02.9°
om: 4X
tailed aerial IBS

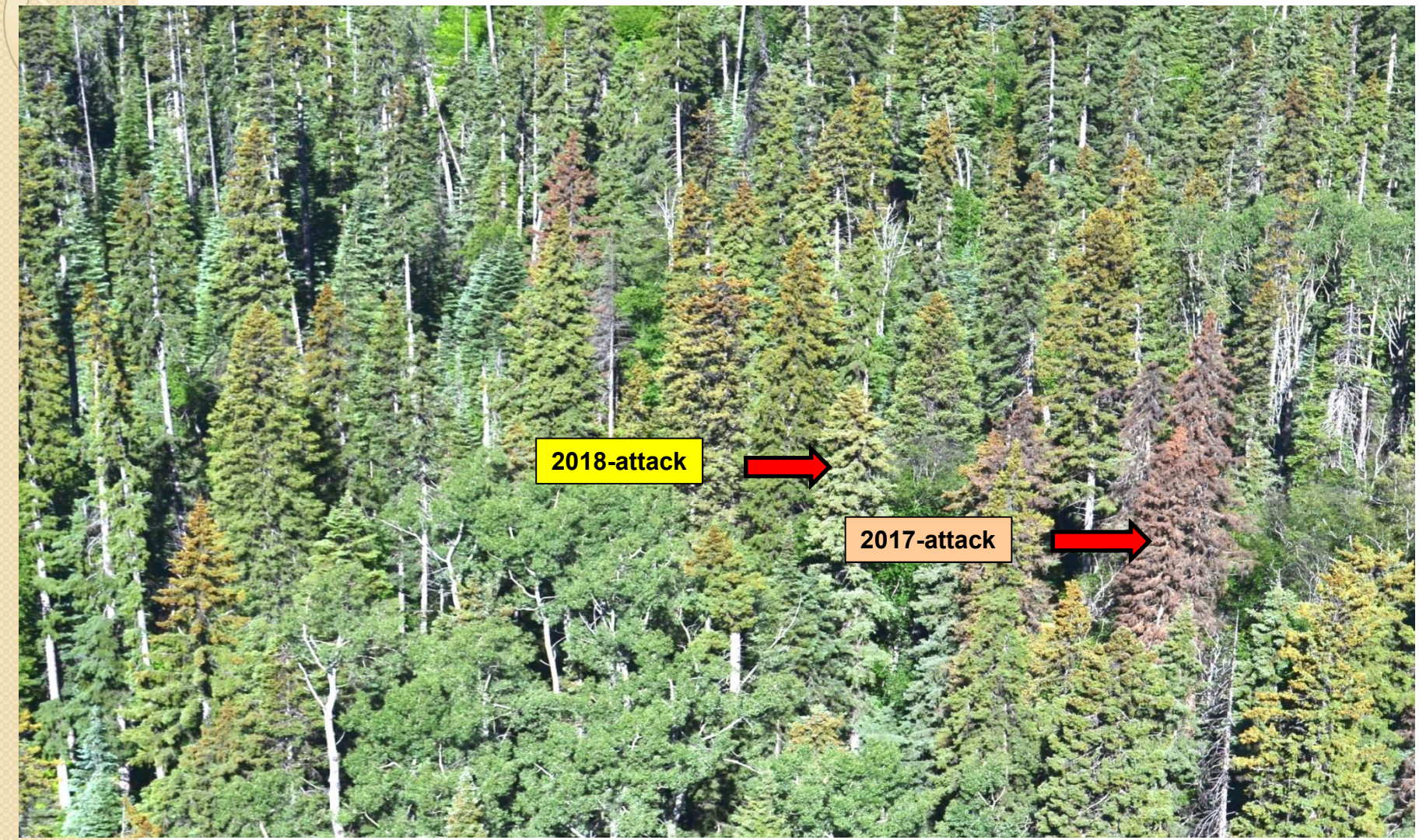
IBS crown

- GREEN
- CHLOROTIC
- YELLOW
- DULL RED

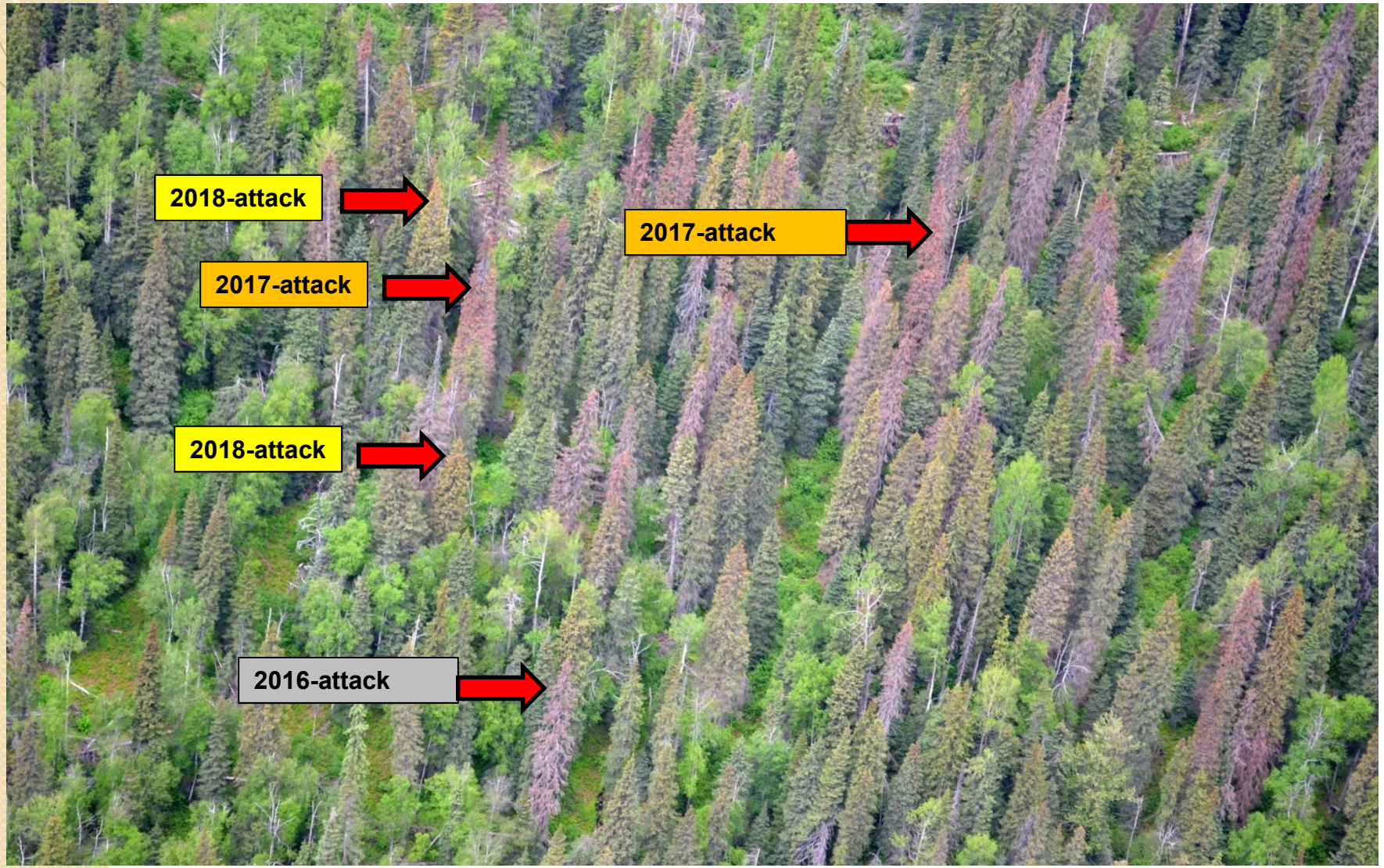
Off-color (chlorotic green then yellow)

Sx often show no signs from the air for 13-18 months post attacl

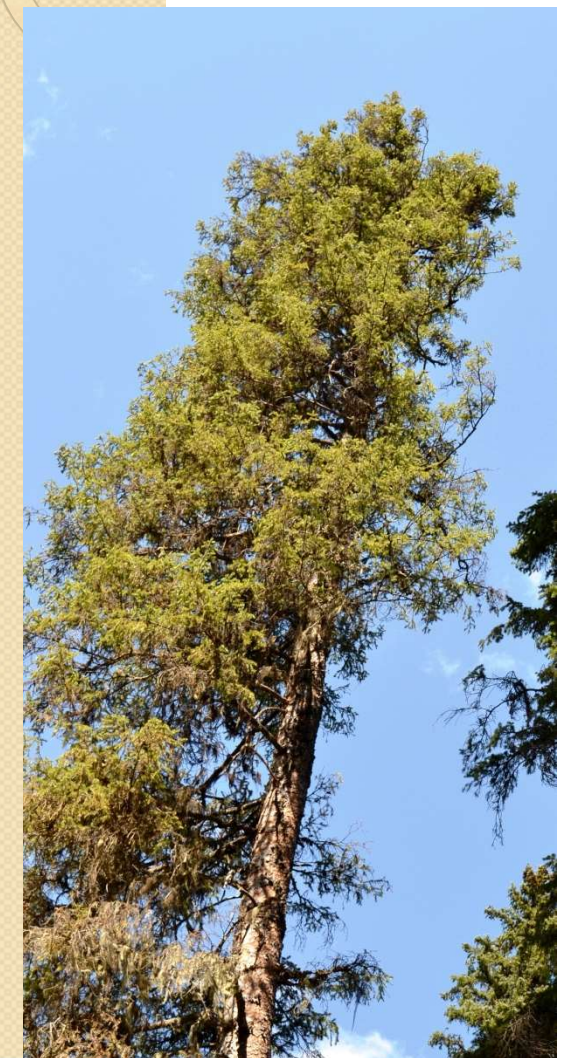
IBS crown symptoms



IBS Progression of color change

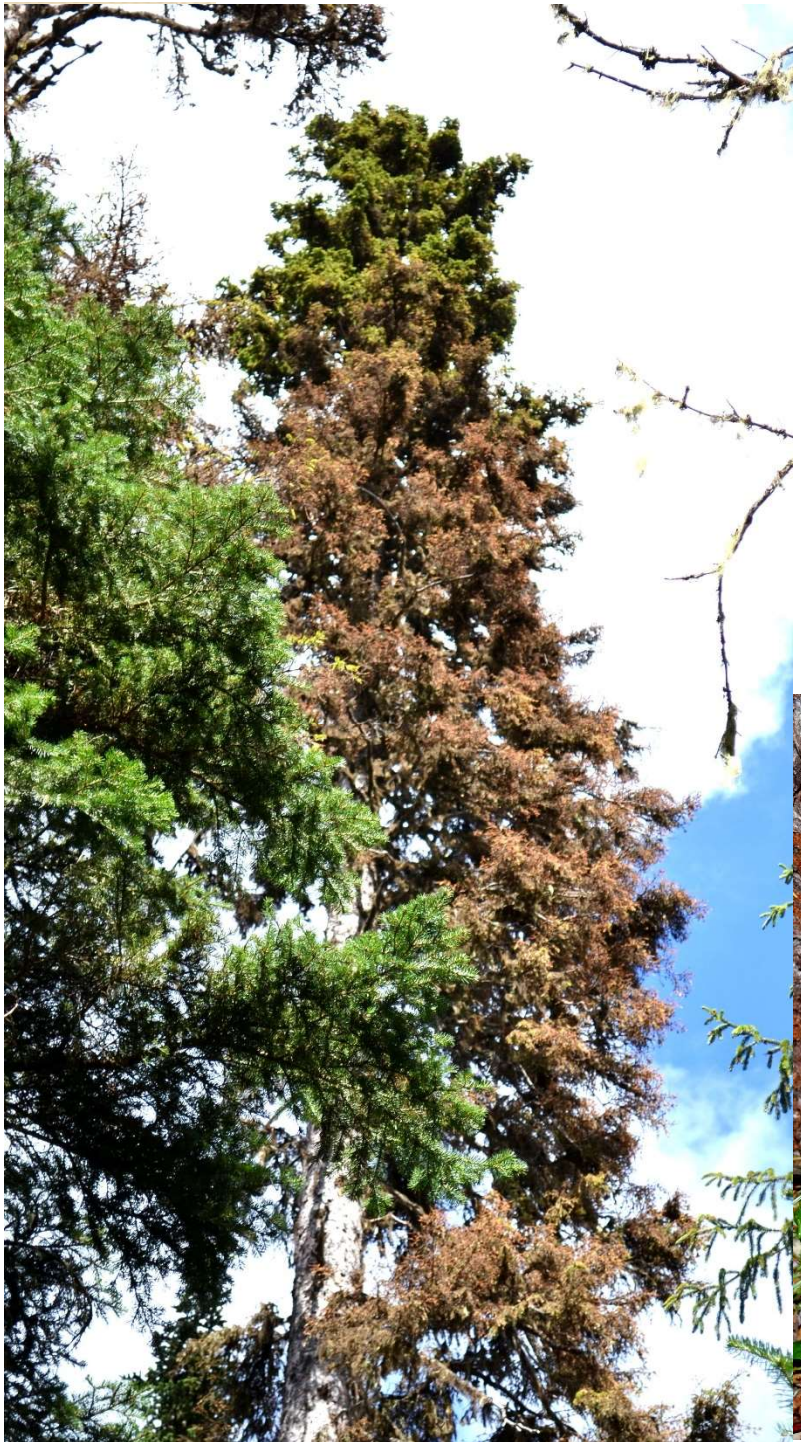


Spruce fully attacked in 2013.
Photo taken July 20, 2014



Same tree re-photographed.
Photo taken Sept. 17, 2014

Same tree re-photographed.
Photo taken Oct. 2, 2014

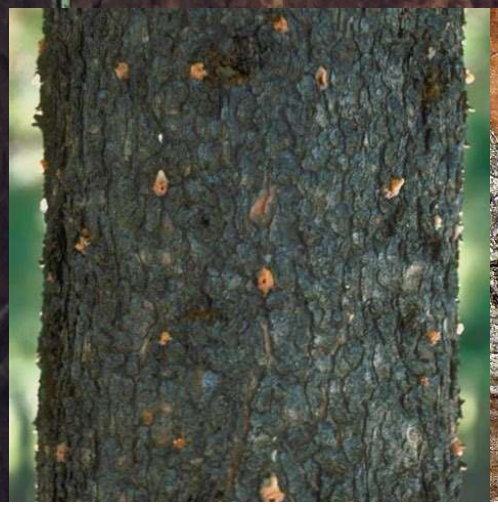


Sometimes newly-attacked spruce will drop interior green needles first if under extra stress then the lower bole can turn chlorotic and then brown.

Foliage fade from green to brown in fast succession

Bole symptoms of successful bark beetle attack

	IBS
Pitch tubes/ resin/ boring frass	Yes, small, boring dust
Woodpecker signs	Yes, fall/winter
Position of attack	Lower 4m standing trees; underside downed trees



IBS pitch tubes & boring frass

- Rusty brown pitch tubes

Pitch tubes - Tree defense

- Trees defend against bark beetle attack with resin (pitch)
- Host defense increases with tree size
  - Flushes beetles out of entrance hole
  - Toxic chemicals kills eggs & larvae
  - Vigorous trees have more resources to produce defensive compounds
- Pitch tubes may not be present if trees are **drought stressed**

Woodpeckering

Date & Time: Tue Mar 13 11:03:22 MDT 2018
Position: 11 N 618069 5598884
Altitude: 1327m
Datum: WGS-84
Azimuth/Bearing: 319° N41W 5671mils (True)
Elevation Angle: -30.8°
Horizon Angle: -86.1°
Zoom: 1X
palliser

Date & Time: Tue Mar 13 10:59:15 MDT 2018
Position: 11 N 618023 5598887
Altitude: 1304m
Datum: WGS-84
Azimuth/Bearing: 344° N16W 6116mils (True)
Elevation Angle: -86.6°
Horizon Angle: -88.7°
Zoom: 1X
palliser

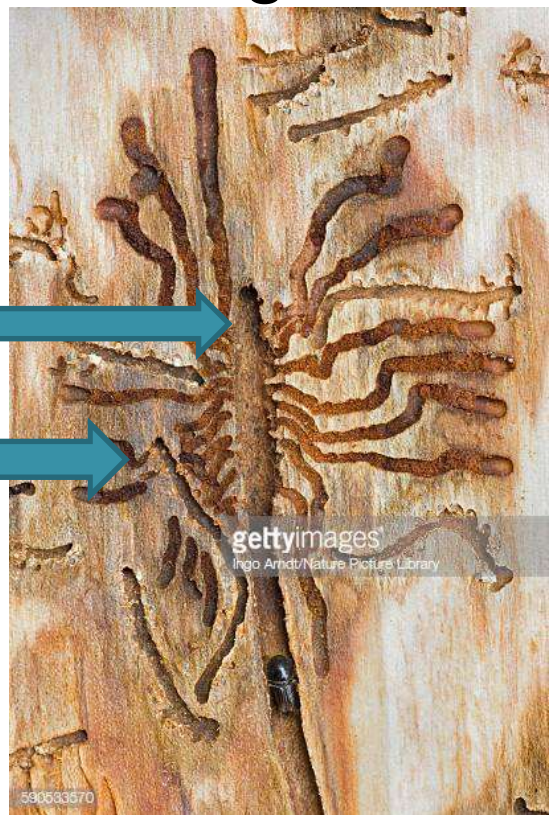
Attack after a couple of days

Galleries under bark

- 12cm long egg galleries
- Eggs clumped together
- larvae feed gregariously – **fan shaped** larval galleries

Egg gallery

Larval galleries



IBS gallery – dense fanning on each side of egg gallery

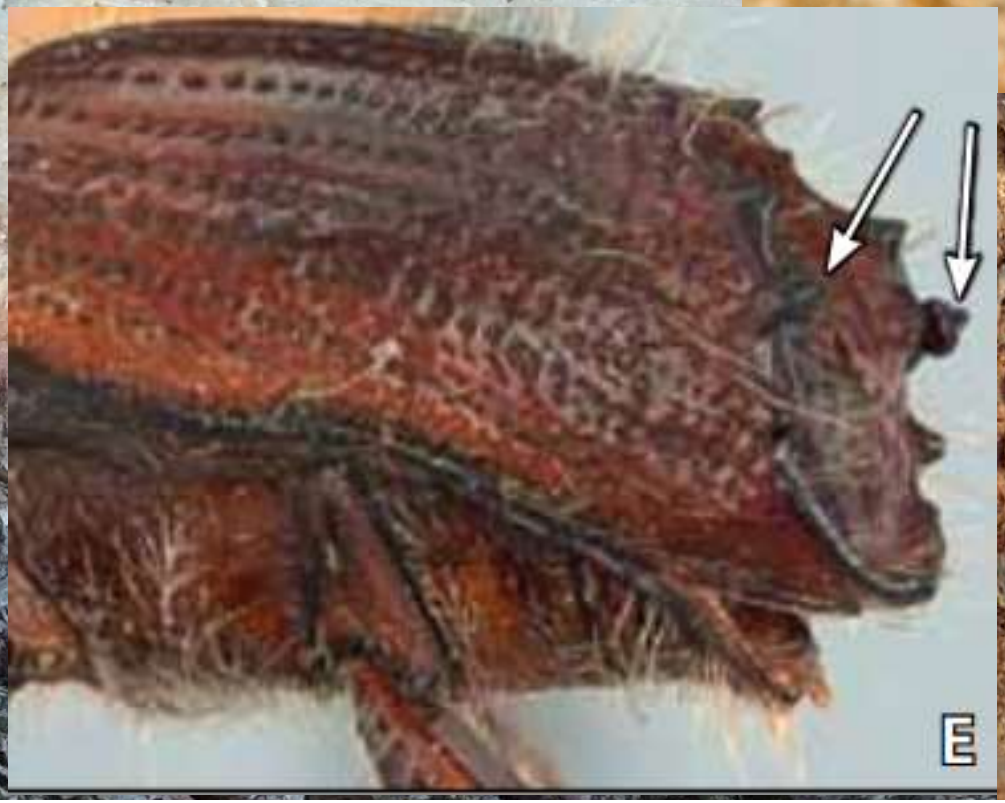
- Dense fanning on each side of egg gallery
- Eggs laid in clusters

Larval galleries

Egg gallery

Ips (Engraver beetle) on Sx & P

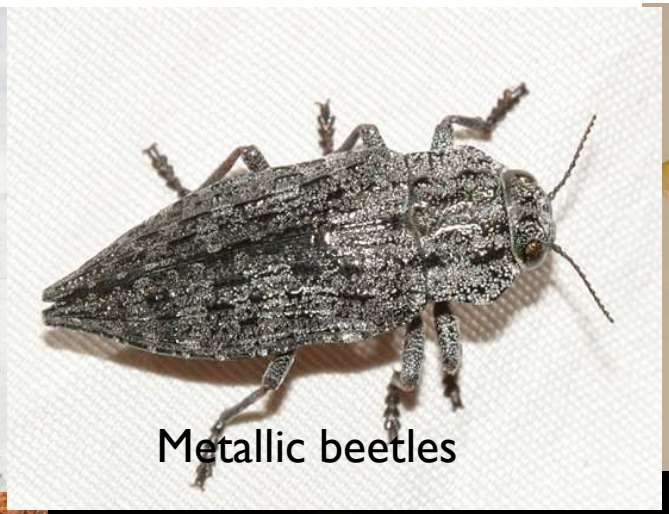
- Star shaped gallery
- Spines on back end
- Multiple females to one male



Woodborers

- Flatheaded = Metallic beetles
- Rounded headed = Long horn beetles
- Wasp wasps

Long horn beetles


Metallic beetles

Wood wasps

Round heads

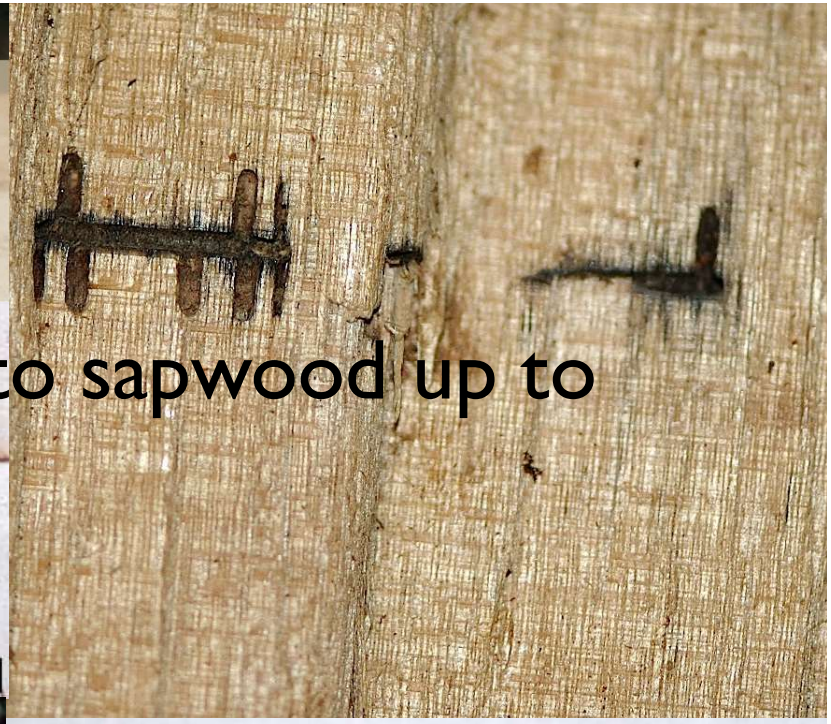
D shaped head

Round holes

D shaped holes

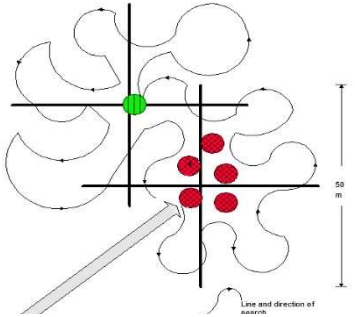
Ambrosia beetle

- Pin holes directly into sapwood up to 10cm
- Fine, white frass



How do we find them?

- Aerial surveys – fixed wing/ helicopter
- Hazard rating maps
  - Site quality (good, medium, poor)
  - Stand age (low<100, mod 100-120, high >120)
  - Stand density (growth rate)
  - % susceptible spruce basal area
  - Stand location (elevation, latitude, longitude, aspect) – extra weight to stand N aspect
- Ground surveys



Management Actions

- After detection, treatment options are limited to three general tactics:
- ☐ Harvesting
- ☐ Trap trees
- ☐ Prevention
  - limit habitat
  - high hazard host removal

Management Tactics

- **Sanitation harvesting (Pest reduction harvest)**
  - Removal of currently infested trees to reduce population and prevent future spread
- **Salvage harvesting**
  - Removal of previously IBS killed stands to reduce economic impacts, maintain future timber supply, to maintain healthy forest ecosystems, and to conserve non-timber values. Beetle population reduction is a 2nd objective.

Management Tactics

- **Sanitation harvesting (Pest reduction harvest)**
  - Stands with <10% gross basal area containing live spruce at the time of harvest should be low to very low priority.
- **Salvage harvesting**
  - Stands with >50% dead gross basal area at the time of harvest should be considered

Management Tactics

- **Trap trees**
  - Fall living, large-diameter spruce to attract beetles which prefer downed material
  - Draw from 400m away
  - Absorb 10times # beetles as standing trees

Distribution IBS

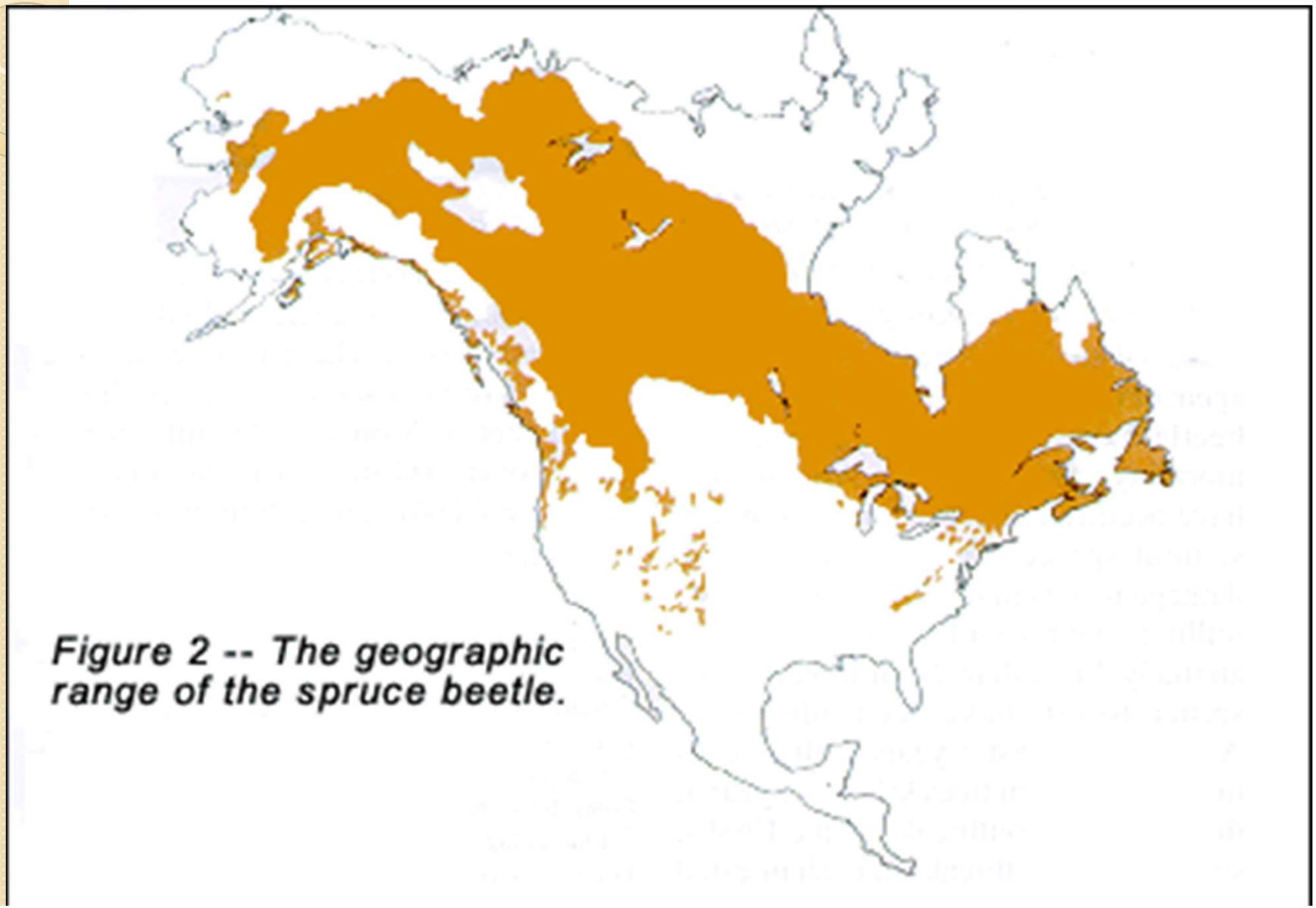
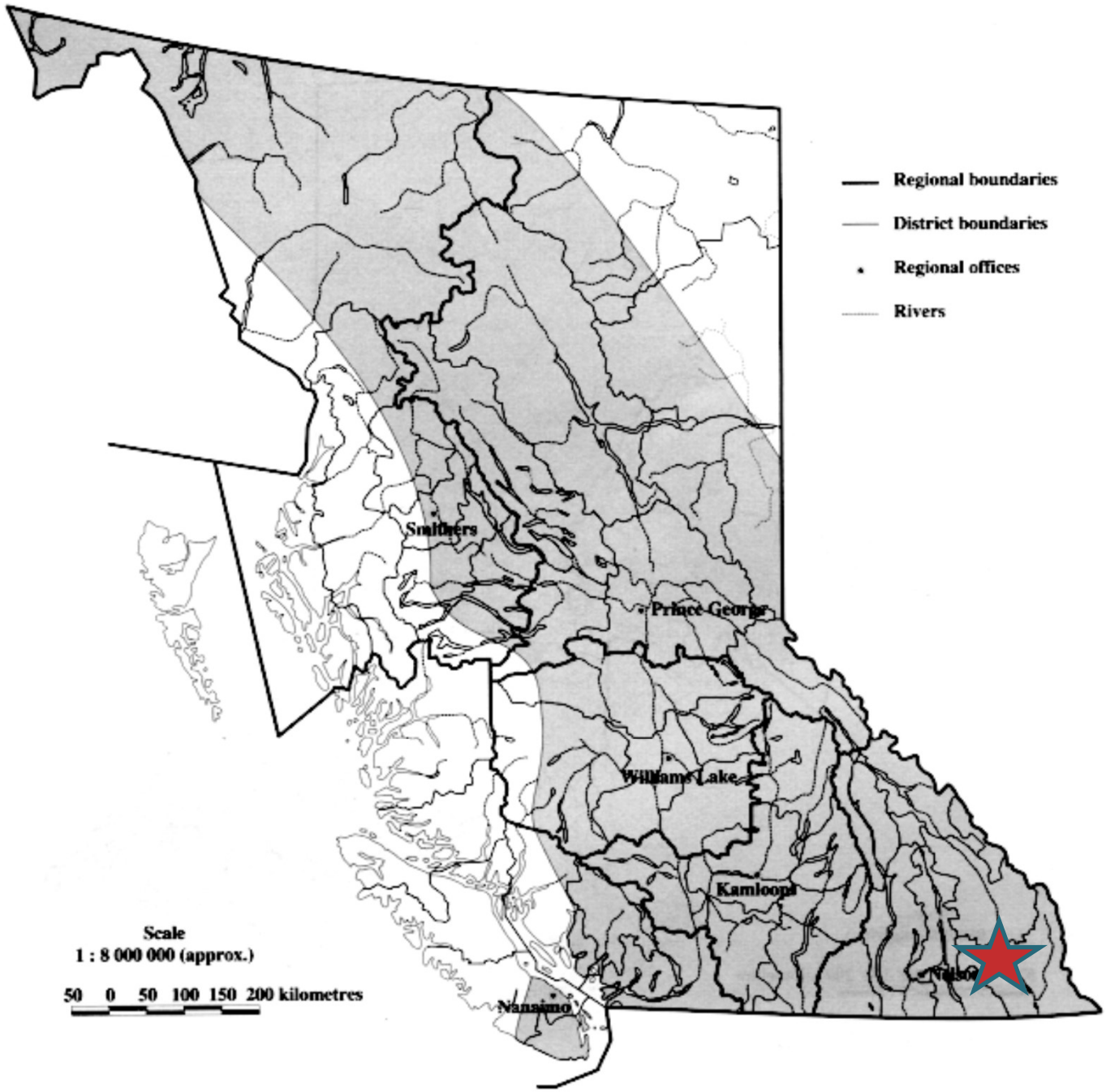
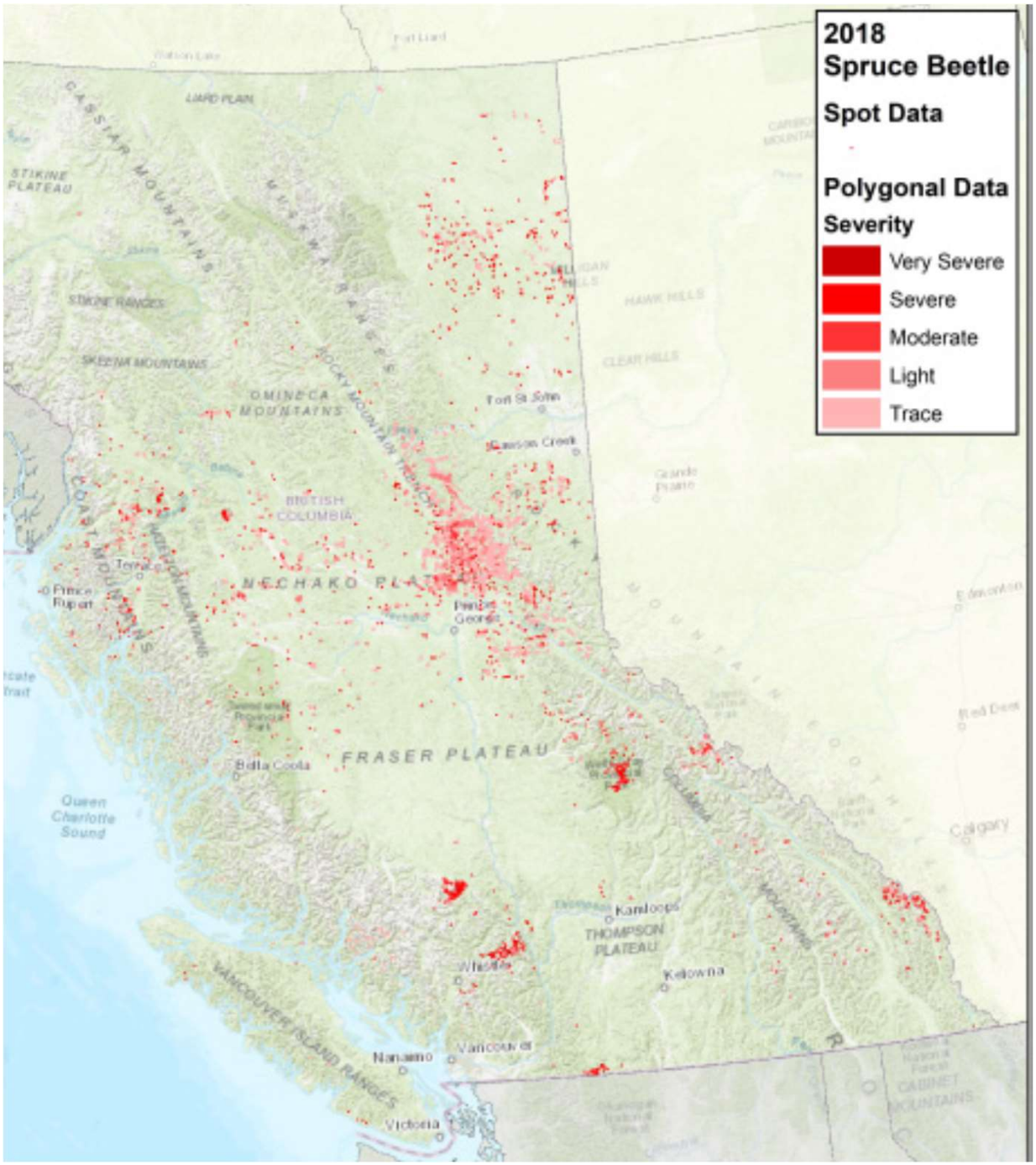
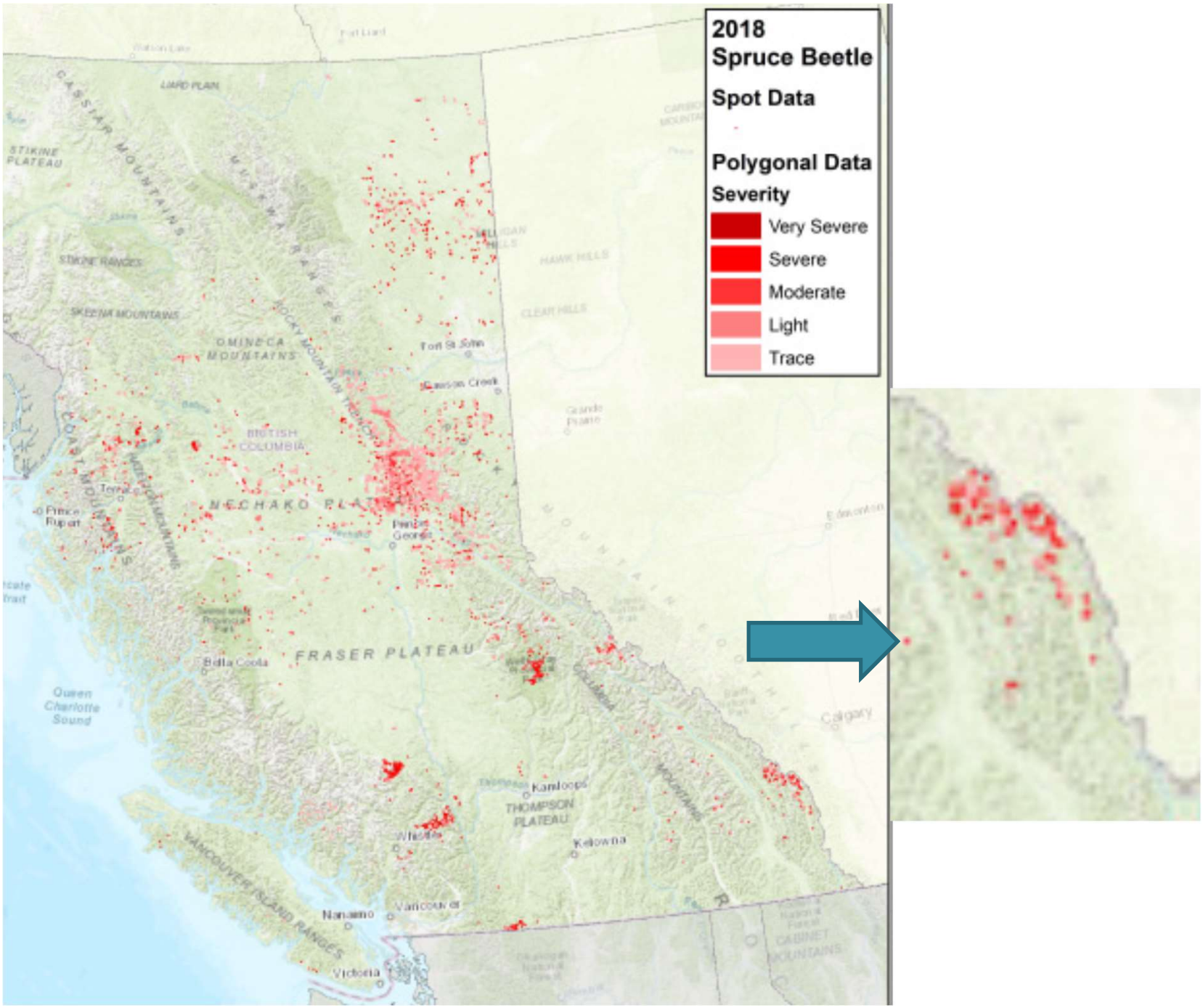


Figure 2 -- The geographic range of the spruce beetle.


Regional boundaries
District boundaries
Regional offices
Rivers
Smithers
Prince George
Williams Lake
Kamloops
Nanaimo
Scale
1 : 8 000 000 (approx.)
50 0 50 100 150 200 kilometres


2018
Spruce Beetle
Spot Data
Polygonal Data
Severity
Very Severe
Severe
Moderate
Light
Trace
LIARD PLAIN
STIKINE PLATEAU
CASSIAR MOUNTAINS
STIKINE RANGES
SKEENA MOUNTAINS
OMINECA MOUNTAINS
ROCKY MOUNTAIN TRENCH
HAWK HILLS
CLEAR HILLS
Fort St John
Dawson Creek
Grande Prairie
BRITISH COLUMBIA
COAST MOUNTAINS
NECHAKO PLATEAU
Prince Rupert
Prince George
FRASER PLATEAU
Bella Coola
Queen Charlotte Sound
Kamloops
THOMPSON PLATEAU
Kelowna
Whistler
Vancouver
Nanaimo
Victoria
VANCOUVER ISLAND RANGES
Calgary
Red Deer
CABINET MOUNTAINS


2018
Spruce Beetle
Spot Data
Polygonal Data
Severity
Very Severe
Severe
Moderate
Light
Trace
LIARD PLAIN
STIKINE PLATEAU
CASSIAR MOUNTAINS
STIKINE RANGES
SKEENA MOUNTAINS
OMINECA MOUNTAINS
ROCKY MOUNTAIN TRENCH
HAWK HILLS
CLEAR HILLS
Fort St John
Dawson Creek
Grande Prairie
BRITISH COLUMBIA
COAST MOUNTAINS
NECHAKO PLATEAU
Prince Rupert
Prince George
Bella Coola
FRASER PLATEAU
Queen Charlotte Sound
Calgary
Kamloops
THOMPSON PLATEAU
Kelowna
Whistler
Vancouver
Nanaimo
Victoria
VANCOUVER ISLAND RANGES
CABINET MOUNTAINS

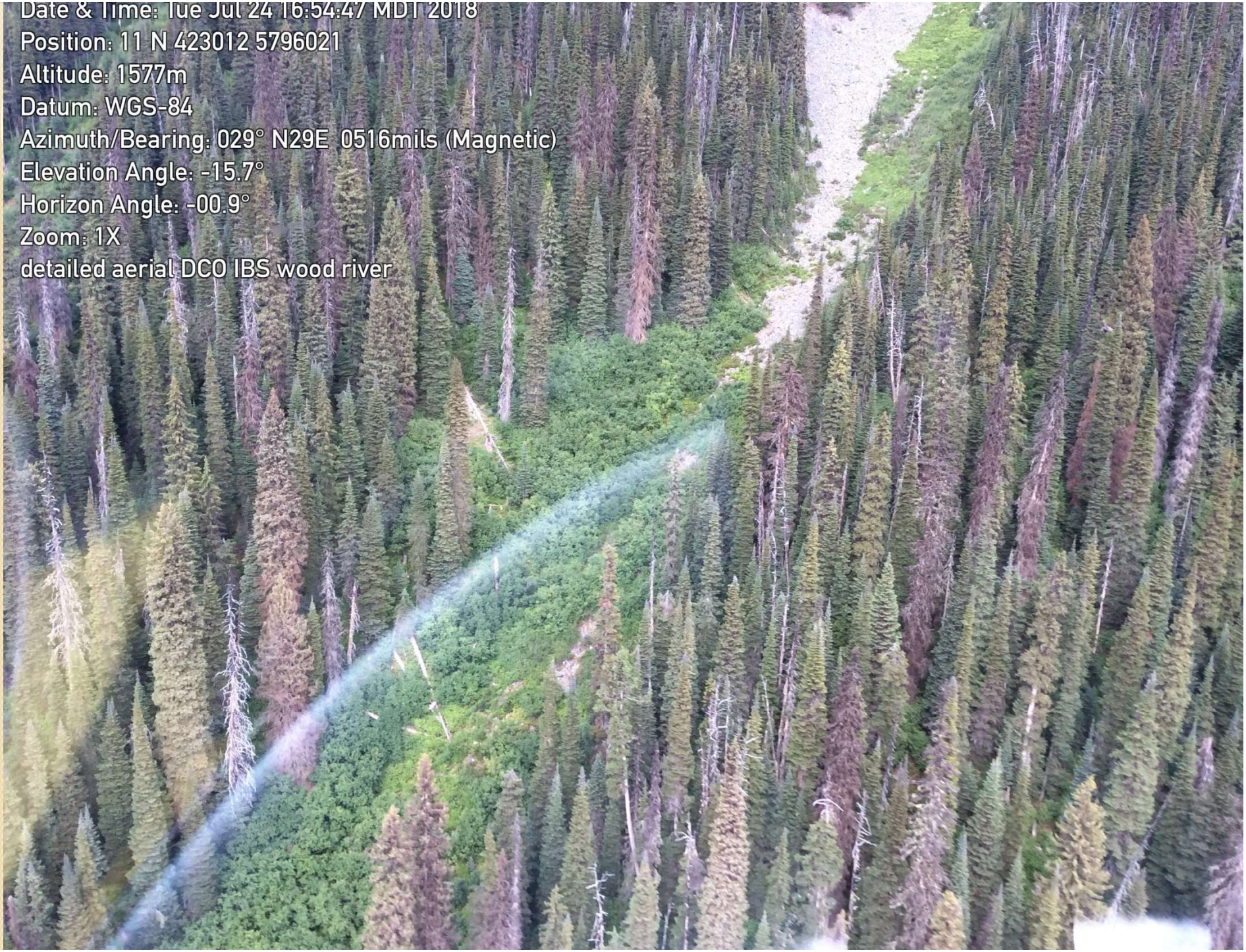
Provincial Scope

- "BC is experiencing higher than normal populations of IBS with potential for significant impacts to timber and non-timber resources, and for lasting social, cultural and economic impacts to communities" Diane Nicholls, ADM Chief Forester July 2018

- “I expect that forest professionals will work collaboratively with First Nations on management responses to spruce beetle, and will consider potential impacts to Indigenous rights, title and interests during spruce beetle mitigation activities” Diane Nicholls, ADM Chief Forester July 2018

2018 KBR Attack Levels

- Infestations in Kootenay/Boundary Region declined slightly to 8,237 ha.
- Invermere TSA sustained 3,652 ha of damage, primarily in an active infestation around Mount King George. This infestation continued into the north tip of Cranbrook TSA, where 2,123 ha were delineated (mostly in the Elk Valley)


Date & Time: Tue Jul 24 16:54:47 MDT 2018
Position: 11 N 423012 5796021
Altitude: 1577m
Datum: WGS-84
Azimuth/Bearing: 029° N29E 0516mils (Magnetic)
Elevation Angle: -15.7°
Horizon Angle: -00.9°
Zoom: 1X
detailed aerial DCO IBS wood river

: 11 N 425005 5797890
: 1490m
WGS-84
n/Bearing: 250° S70W 4444mils (Magnetic)
n Angle: -44.1°
Angle: -00.8°
X
aerial DCO wood river IBS mostly dead