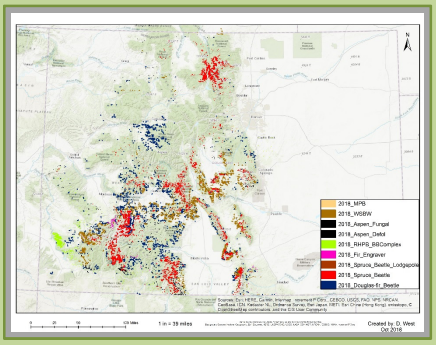
Colorado State Forest Service – Silverton, CO

Dr. Dan West
Forest Entomologist
Colorado State Forest Service
9.19.19

Where we're heading

2018 Statewide highlights:
- Bark Beetles
- Defoliators of Conifers



Avalanche – bark beetle interactions

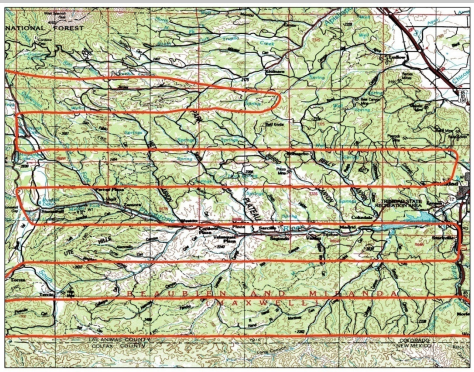
Pheromones

I&D Aerial Detection Survey

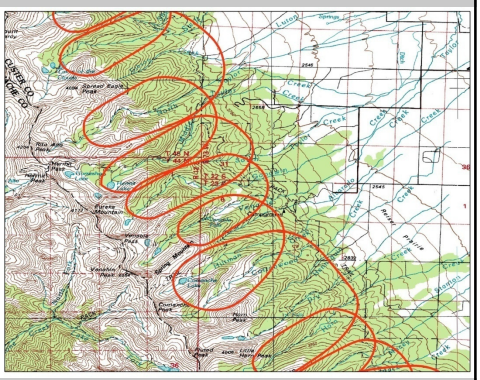
- Trained observers record all aerially detectable insect and disease signatures using digital aerial sketchmapping system

- Surveys are typically conducted:
  - 500-2000 feet AGL
  - 100 Knots (~115 MPH)
  - 1.5 - 2 mile swath
  - Approx. 25 acres per second
  - Approx. 2100 acres/min or 3.3 square miles/min

Flight Patterns Dictated by Terrain



Grid pattern flown over most terrain



Contour pattern flown over steepest terrain

Effective but Inherently hazardous method to collect annual “snapshot”

2016 Production Rates by Survey Type

Contour	171.3 hours flown
	15,085,430 acres flown
	88,064 acres/hour/aircraft
	1,468 acres/minute/aircraft
	24 acres/second/aircraft
Grid	129 hours flown
	26,332,250 acres flown
	203,968 acres/hour/aircraft
	3,399 acres/minute/aircraft
	57 acres/second/aircraft
	28 acres/second/observer

2018 highlights across the State

Bark Beetles:

Spruce Beetle – Park, Conejos, Gunnison, La Plata, Hinsdale, Grand, Chaffee, Archuleta, Custer, Freemont, Rio Grande, and San Juan Counties

Douglas-Fir Beetle – Eagle, Garfield, Gunnison, Hinsdale, Pitkin and Saguache Counties

Fir Engraver – Ouray, and Archuleta Counties

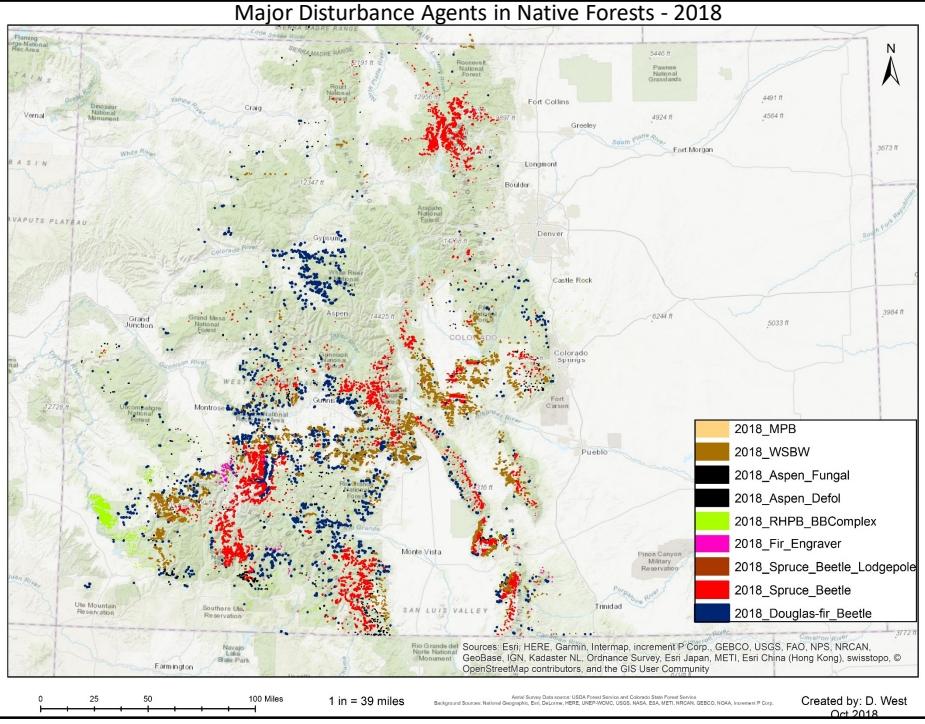
Roundheaded Pine Beetle & Native Complex- Dolores County

Defoliators:

Western Spruce Budworm – Chaffee, Freemont, Dolores, Park, San Miguel, and Saguache Counties

Western Tent Caterpillar- Archuleta, Gunnison, Conejos, La Plata, Mineral, and Saguache Counties

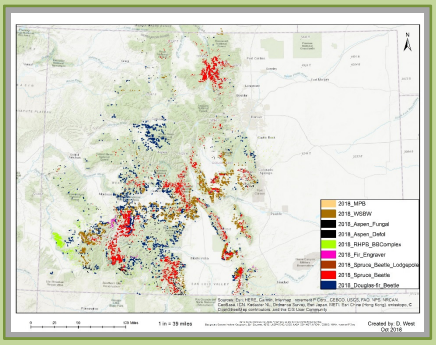
Major Disturbance Agents in Native Forests - 2018



Where we're heading

2018 Statewide highlights:

- Bark Beetles
- Defoliators of Conifers



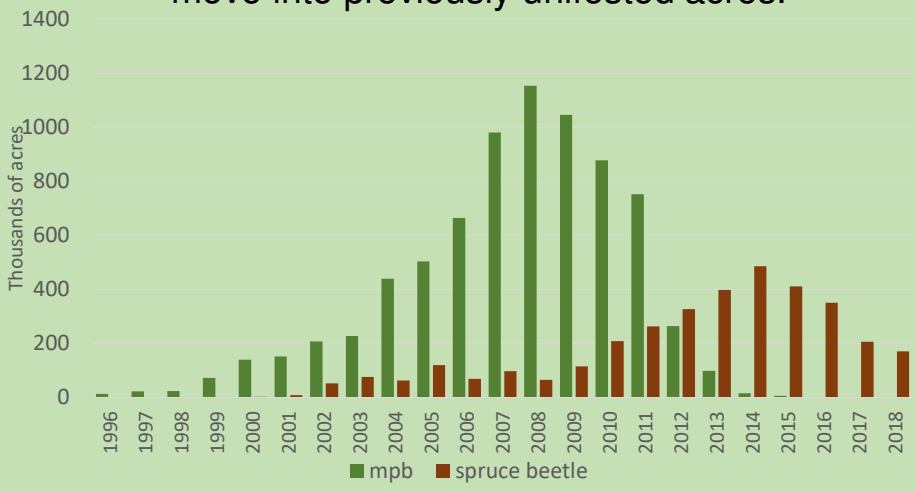
Avalanche – bark beetle interactions

Pheromones

Major bark beetles in Colorado's forests

Common Name	Scientific name	Host(s)
Mountain pine beetle	*Dendroctonus ponderosae*	Ponderosa, lodgepole, limber and other pines
Douglas-fir beetle	*Dendroctonus pseudotsugae*	Douglas-fir
Spruce beetle	*Dendroctonus rufipennis*	Engelmann spruce
Pinyon ips	*Ips confusus*	Pinyon pines
Blue spruce ips	*Ips hunteri*	Blue spruce
Pine engraver beetles	*Ips pini, Ips calligraphus, etc*	Various pines
Fir engraver	*Scolytus ventralis*	White fir
Western balsam bark beetle	*Dryocoetes confusus*	Subalpine fir

Mountain Pine Beetle-caused mortality is lower than pre-outbreak levels. For four years running, active Spruce Beetle-affected acres have decreased as they move into previously unifested acres.



~3.4M Cumulative Acres ~1.8M Cumulative Acres

Spruce Beetle

Dendroctonus rufipennis

- prefer underside of downed trees
- 1-3 year lifecycle – usually 2
- epidemics usually occur after wind throws
- flight July-August

Spruce Beetle life stages

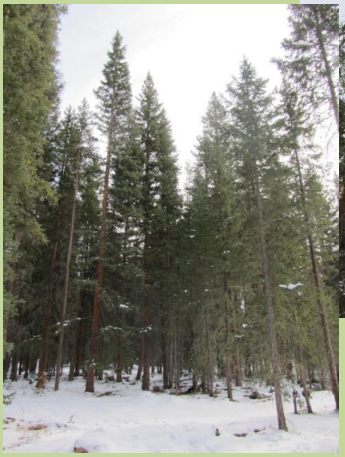
adult in egg gallery

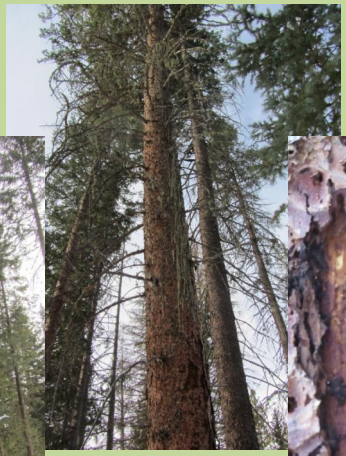
eggs in Gallery (June-July)

larval feeding (yrs 1 & 2)

pupae in Chambers (May-June)

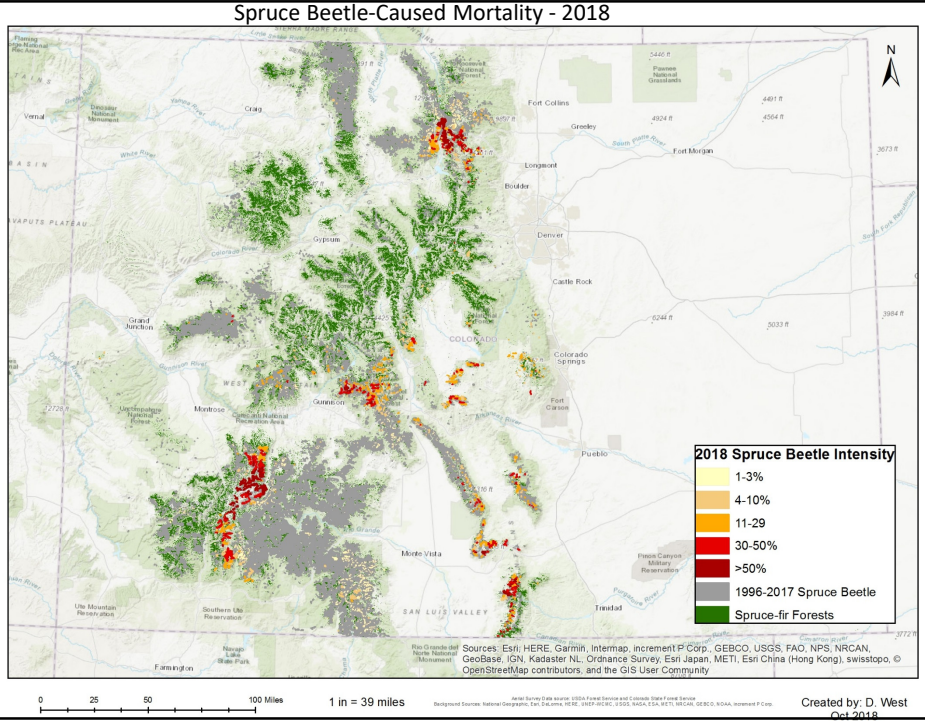
A Deceptive Death



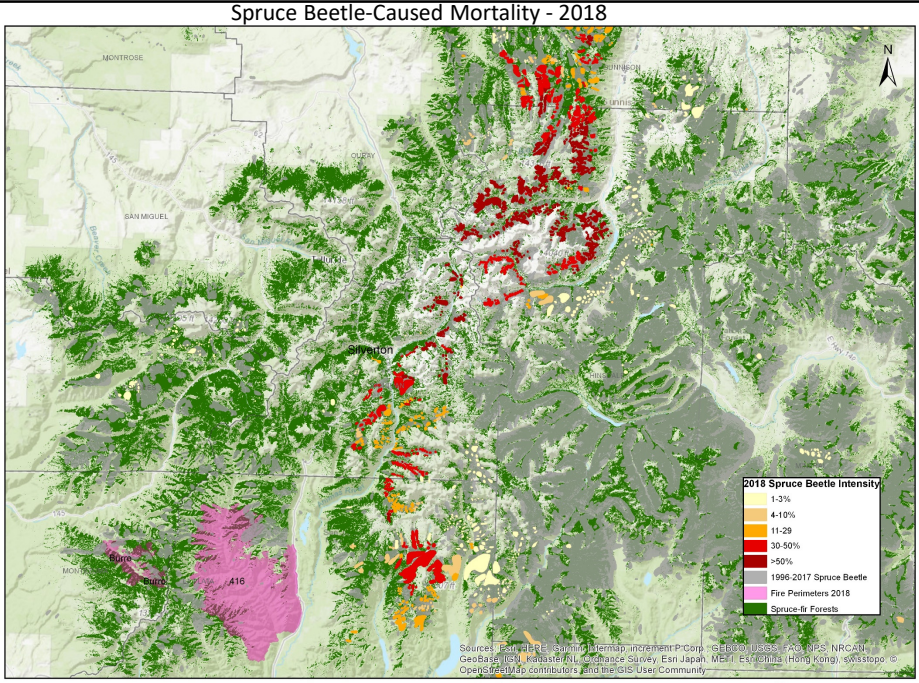


Spruce Beetle-Caused Mortality – 2019 St. Elmo, CO

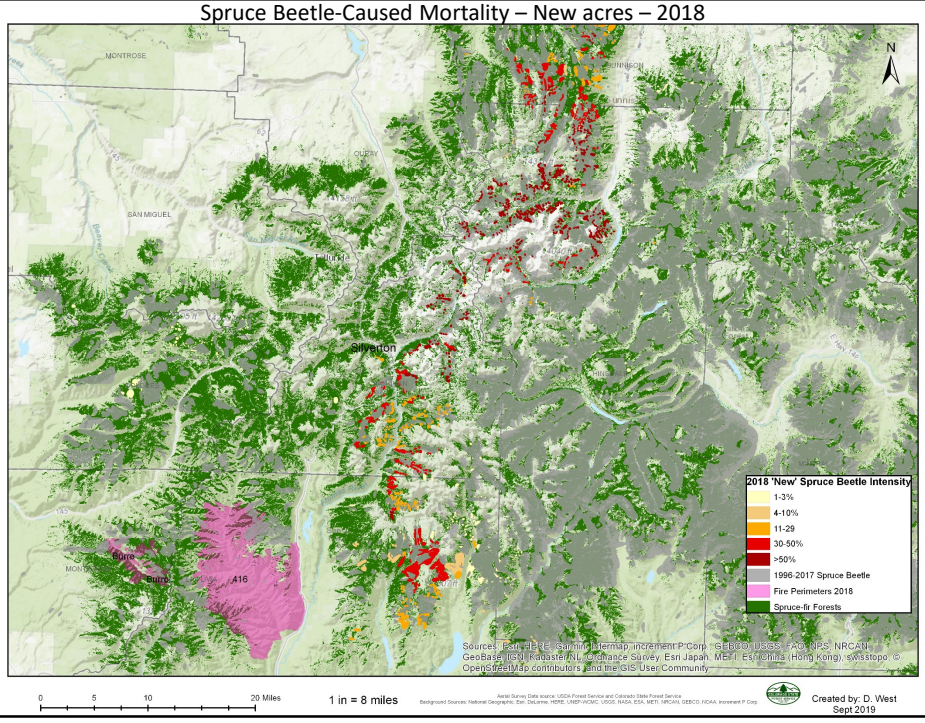
Spruce Beetle-Caused Mortality - 2018



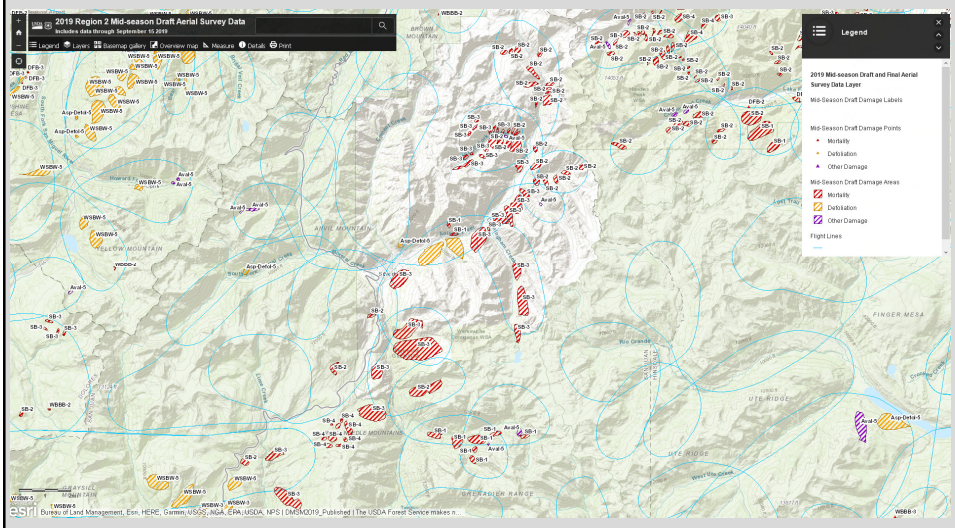
Spruce Beetle-Caused Mortality - 2018



Spruce Beetle-Caused Mortality – New acres – 2018



Aerial Detection Survey Draft Data - 2019



https://usfs.maps.arcgis.com/apps/View/index.html?appid=823346deb0294bcaa287cfab7f3e0423

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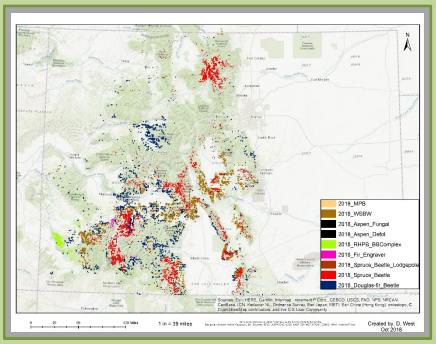
- Defoliators of Conifers



Avalanche – bark beetle interactions

Pheromones

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- Western Tent Caterpillar- Archuleta, Gunnison, Conejos, La Plata, Mineral, and Saguache Counties

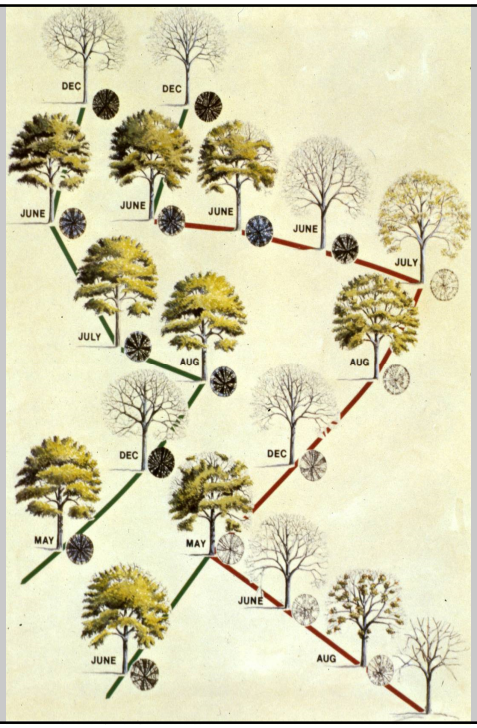
Western spruce budworm, *Choristoneura freemani*


Larva


Pupa

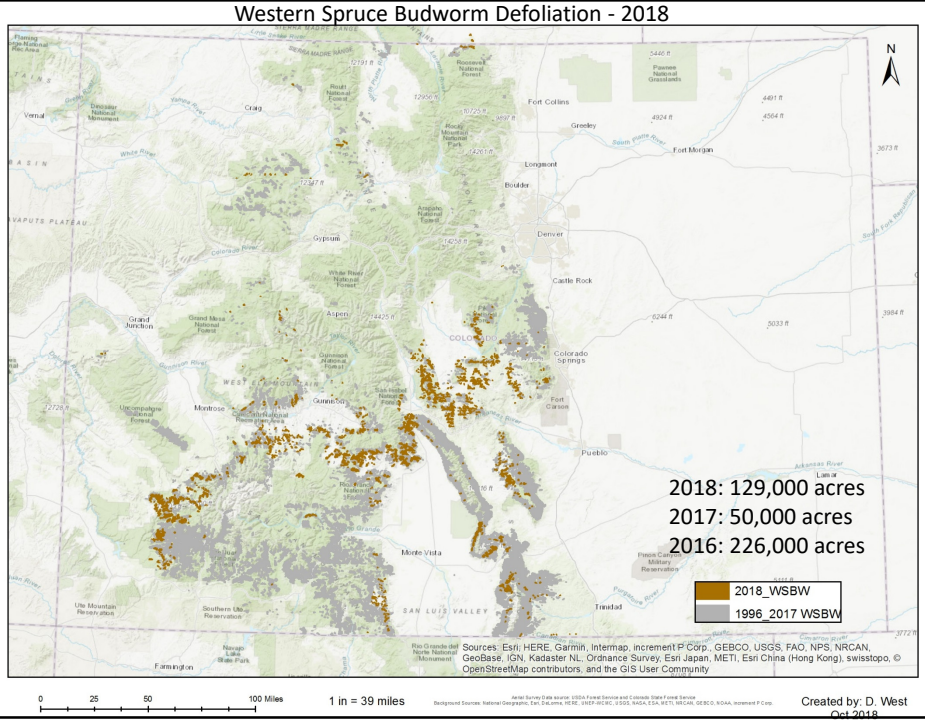

Adult

Energy Drain of Defoliated Trees



Western Spruce Budworm Defoliation - 2015

Western Spruce Budworm Defoliation - 2018



Marssonina & Septoria Leaf Spots

- Hosts: Poplars, Cottonwoods and Aspen
- Common in Colorado in years with wet springs and summer rains.
- Symptoms: Blotch/spot and early leaf drop and/or a large amount of defoliation (Spot has yellow halo if its Marssonina; no yellow halo with Septoria)

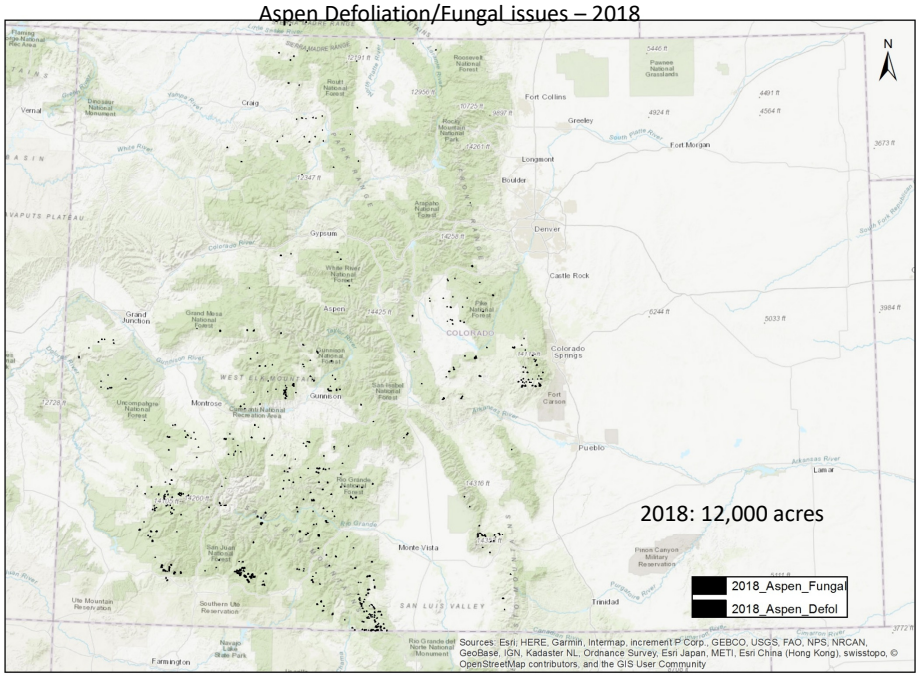
Septoria Leaf Spot on Cottonwoods

Marssonina Leaf Spot Symptoms

Aspen Discoloration from Foliar Fungal Pathogens – Rio Grande 2015

Aspen Discoloration from Foliar Fungal Pathogens – Grand Mesa 2015

Aspen Defoliation/Fungal issues – 2018



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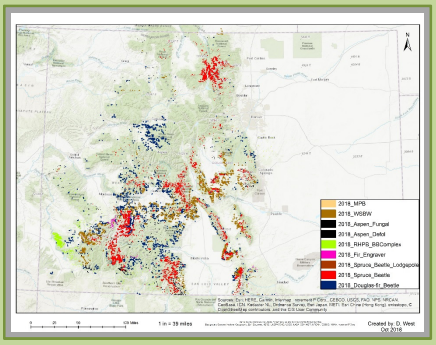
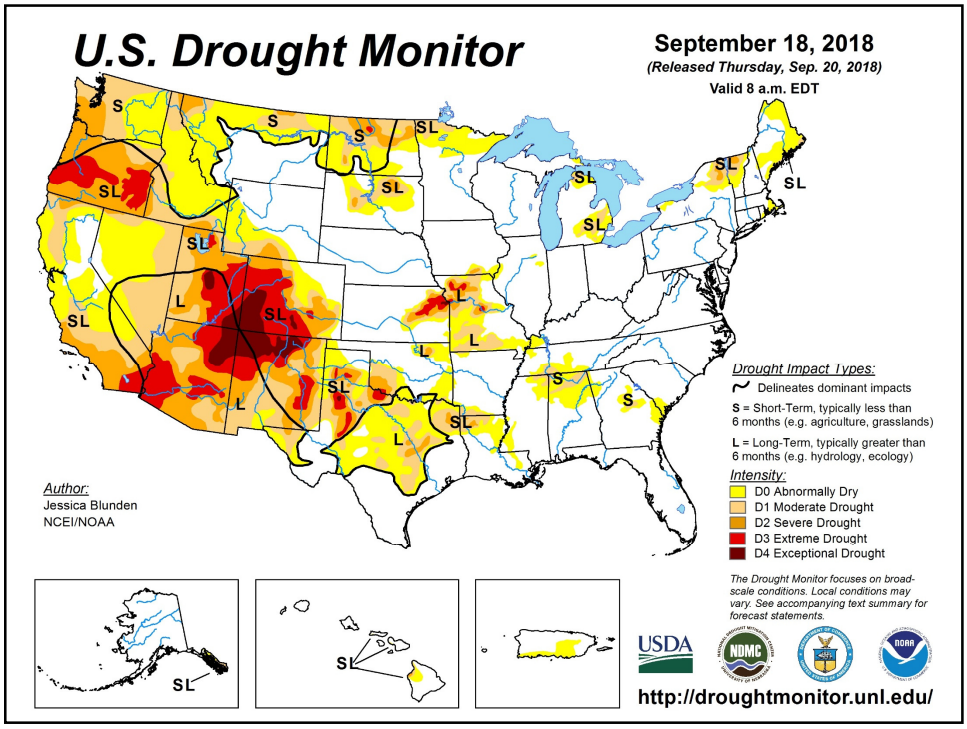
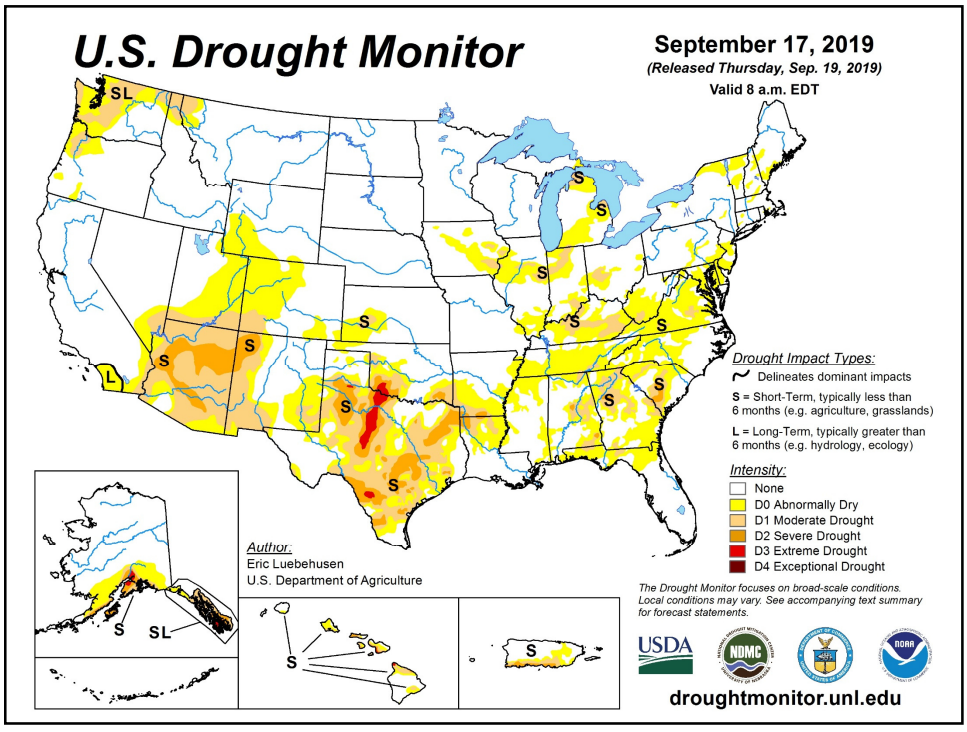


Avalanche – bark beetle interactions

Pheromones


U.S. Drought Monitor
September 18, 2018
(Released Thursday, Sep. 20, 2018)
Valid 8 a.m. EDT
Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)
Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
Author:
Jessica Blunden
NCEI/NOAA
http://droughtmonitor.unl.edu/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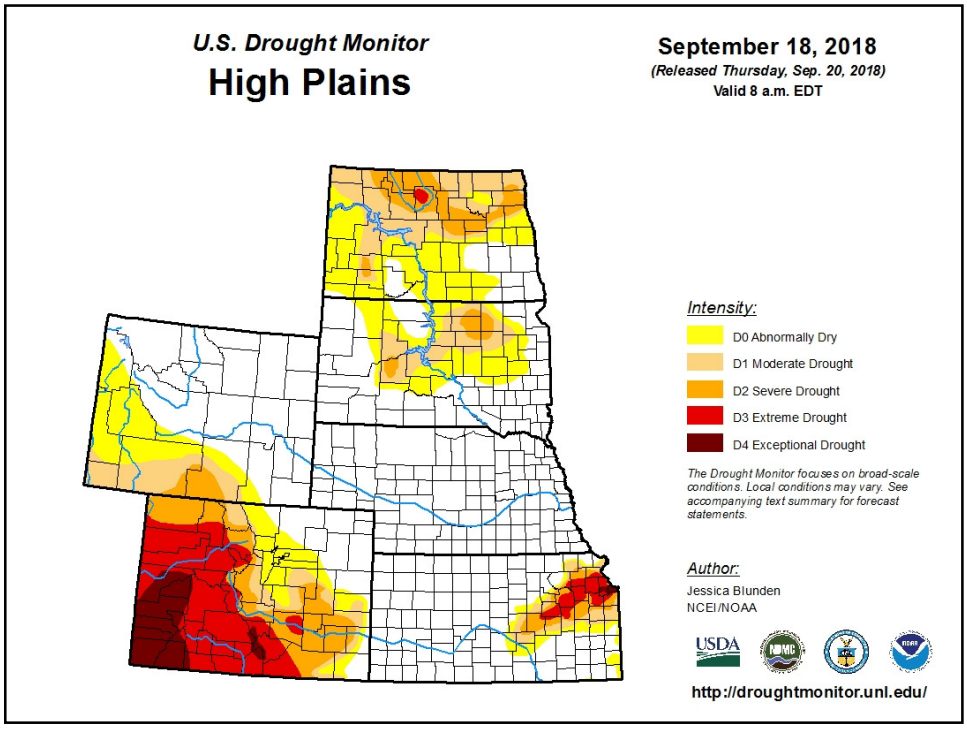
U.S. Drought Monitor
High Plains
September 18, 2018
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Valid 8 a.m. EDT
Intensity:
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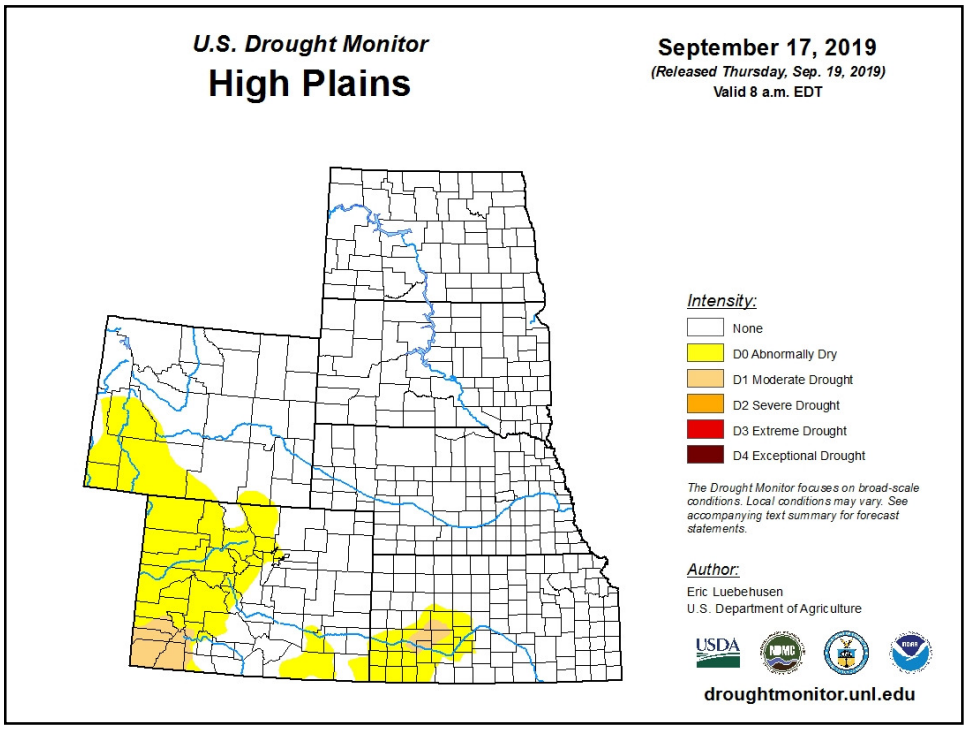
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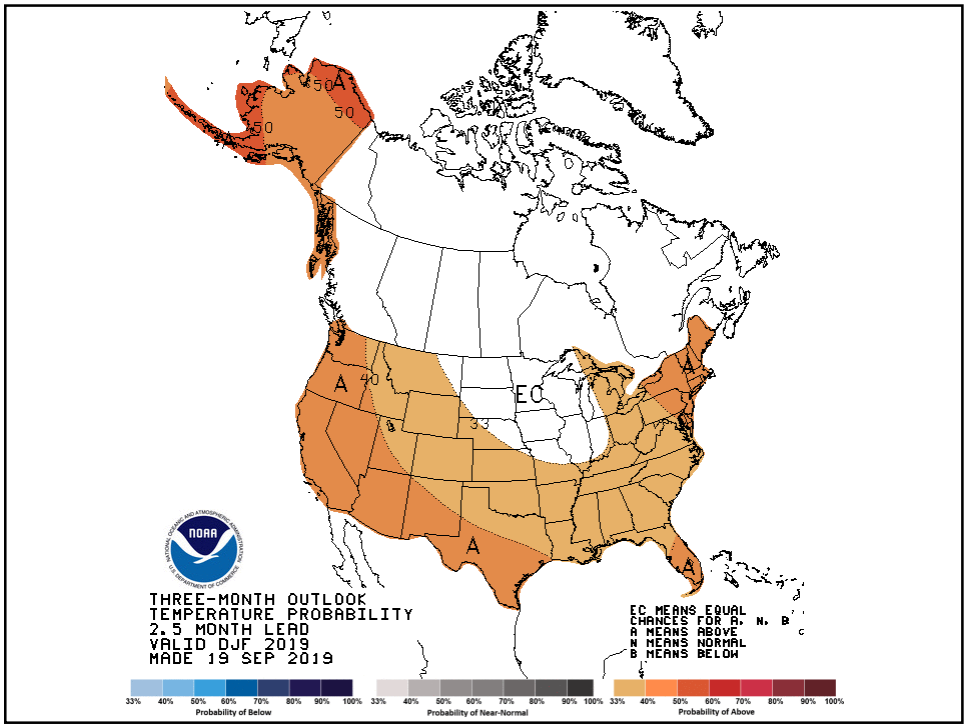
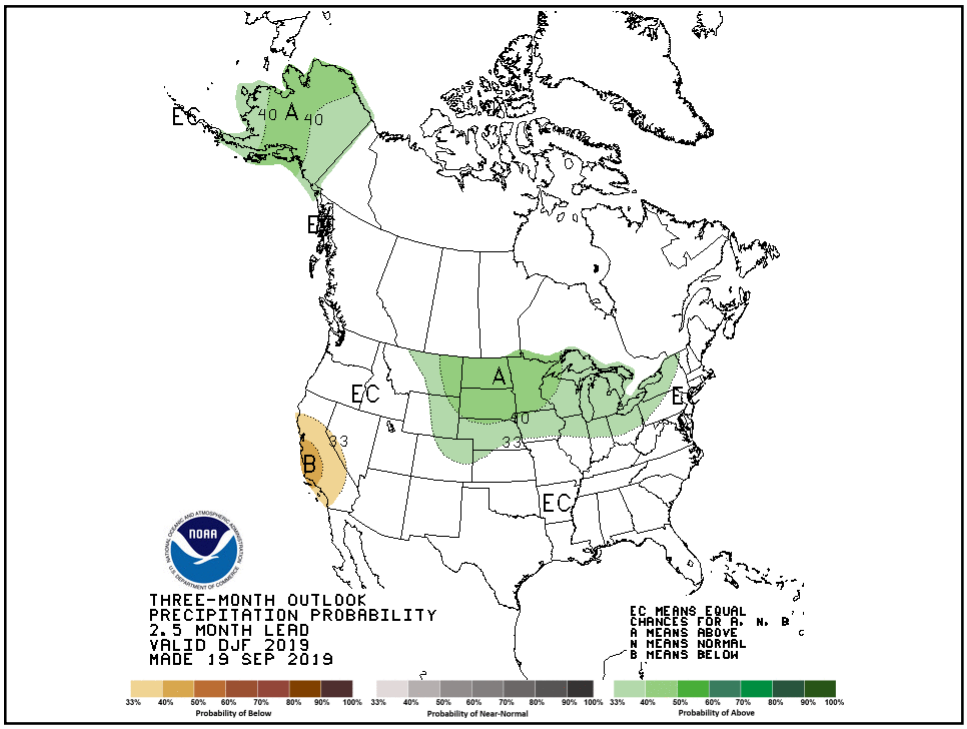

THREE-MONTH OUTLOOK
TEMPERATURE PROBABILITY
2.5 MONTH LEAD
VALID DJF 2019
MADE 19 SEP 2019
EC MEANS EQUAL CHANCES FOR A, N, B
A MEANS ABOVE
N MEANS NORMAL
B MEANS BELOW
Probability of Below
Probability of Near-Normal
Probability of Above


THREE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
2.5 MONTH LEAD
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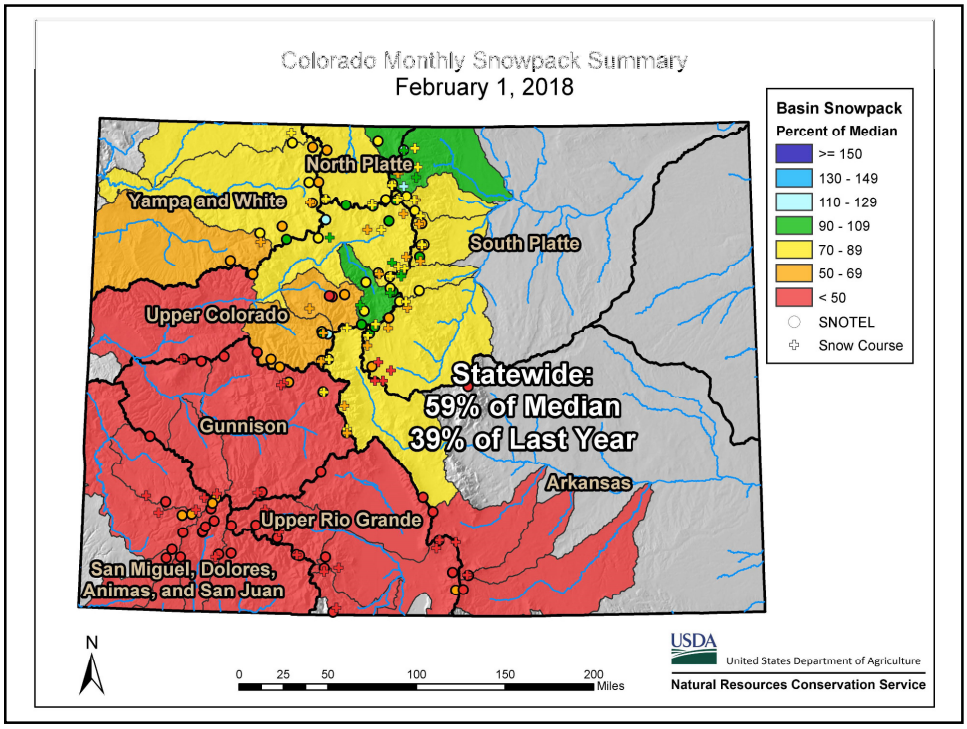
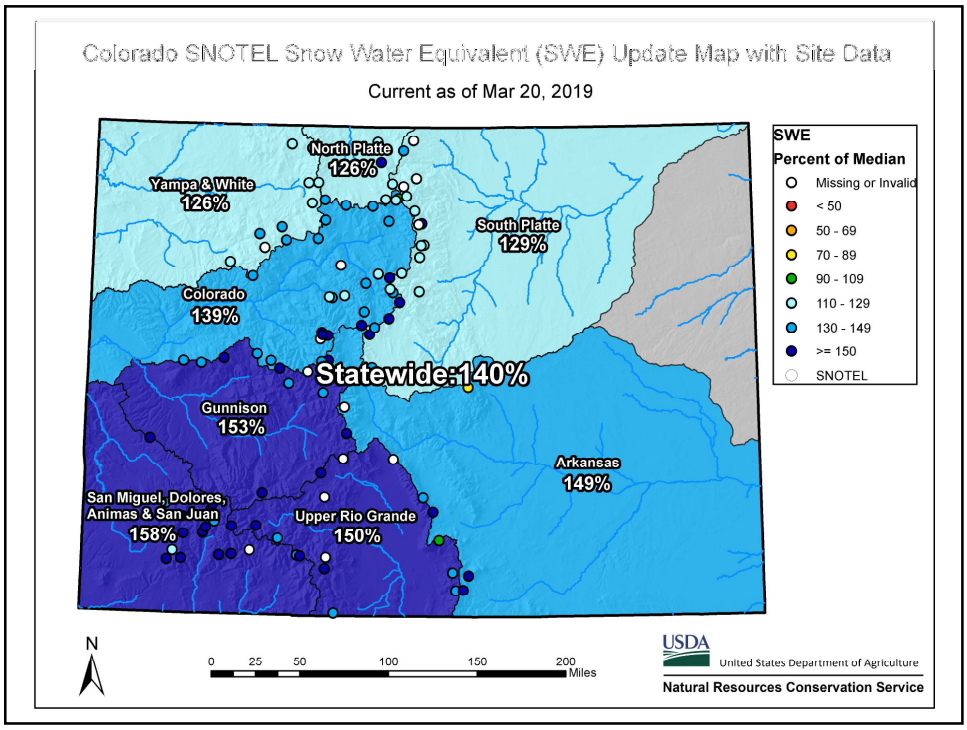

Colorado Monthly Snowpack Summary
February 1, 2018
Basin Snowpack
Percent of Median
>= 150
130 - 149
110 - 129
90 - 109
70 - 89
50 - 69
< 50
SNOTEL
Snow Course
North Platte
Yampa and White
South Platte
Upper Colorado
Statewide:
59% of Median
39% of Last Year
Gunnison
Arkansas
Upper Rio Grande
San Miguel, Dolores,
Animas, and San Juan
N
0 25 50 100 150 200
Miles
USDA
United States Department of Agriculture
Natural Resources Conservation Service


Colorado SNOTEL Snow Water Equivalent (SWE) Update Map with Site Data
Current as of Mar 20, 2019
SWE
Percent of Median
Missing or Invalid
< 50
50 - 69
70 - 89
90 - 109
110 - 129
130 - 149
>= 150
SNOTEL
North Platte
126%
Yampa & White
126%
South Platte
129%
Colorado
139%
Statewide:140%
Gunnison
153%
Arkansas
149%
San Miguel, Dolores,
Animas & San Juan
158%
Upper Rio Grande
150%
N
0 25 50 100 150 200
Miles
USDA
United States Department of Agriculture
Natural Resources Conservation Service

Four-Eyed Spruce Beetle

Polygraphus rufipennis

One generation per year in Colorado and West

Typically a secondary beetle – persists in small diameter trees or drought stricken trees

Monitoring of adjacent trees would be ideal

Areas of concern we will be surveying next flight season

Where we're heading

2018 Statewide highlights:
- Bark Beetles
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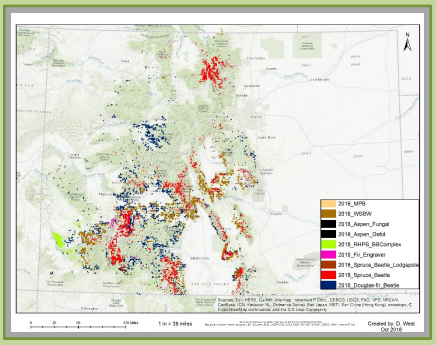


Avalanche – bark beetle interactions

Pheromones

Pheromones

- Act as an anti-aggregate or aggregate
- Available in pouches, gels, and flakes

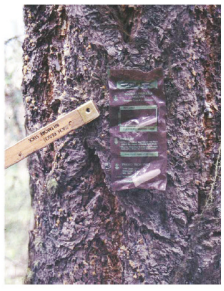

Phero Tech 7 g verbenone pouch (2007)

Synergy 7.5 g verbenone pouch (2007)

Anti-aggregate
- Verbenone - MPB
- MCH – DFB and SB (??)

Aggregates
- Species specific baits
- Ex. Ipsdienol – Ips spp

Attractant Pheromones
MCH (3-Methylcyclohex-2-en-1-one)
Verbenone Pheromone Anti-aggregants


Attractant pheromone tree bait

MCH (3-Methylcyclohex-2-en-1-one)

Douglas-fir

- Plots treated with MCH bubbles (paired with 3-4 funnel Lindgren funnels outside the plot baited with aggregate pheromones) showed an 80% reduction in attacked Douglas-fir compared to untreated plots. However, the baited Lindgren funnels resulted in an eightfold increase of trees killed outside of the treatment plot. (Ross and Daterman, 1994)

- Additionally, Ross and Wallin (2008) found that, "MCH formulated to release at three times the current standard rate and place at 3 times fewer points per unit area can effectively prevent the infestation of live Douglas-fir."

- Brookes, et.al. (2016), found that using higher release rate formulations (multiple bubbles) at wider spacing was equally effective in reducing Douglas-fir beetle as single bubble applications in narrower spacing. Treated plots experienced .5 to 4% infestation, whereas untreated control plots experienced 18% infestation. Thus concluding that higher release rate applications can reduce time (and therefore cost) of installing MCH treatments.

Douglas-fir beetle

MCH (3-Methylcyclohex-2-en-1-one)

Spruce Beetle

Scant research available on MCH and spruce beetle control
Compared Carbaryl to MCH (Hansen et al., 2016)
Compared elution rates of MCH within stands; single tree protection (Hansen et al., 2017)

Journal of Economic Entomology, 110(5), 2017, 2140–2148
doi: 10.1093/jee/tox208
Advance Access Publication Date: 7 September 2017
Research article

Forest Entomology

3-Methylcyclohex-2-en-1-one for area and individual tree protection against spruce beetle (Coleoptera: Curculionidae: Scolytinae) attack in the southern Rocky Mountains

E. Matthew Hansen,[1,5] A. Steven Munson,[2] Darren C. Blackford,[2] Andrew D. Graves,[3] Tom W. Coleman,[3] and L. Scott Baggett[4]

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OXFORD

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[1]US-Forest Service, Rocky Mountain Research Station, 860 North 1200 East, Logan, UT 84321 (matthansen@fs.fed.us), [2]Corresponding author, e-mail: matthansen@fs.fed.us, [3]US-Forest Service, Forest Health Protection, 4746 South 1900 East, Ogden, UT 84403 (smunson@fs.fed.us; dblackford@fs.fed.us), [4]Synergy Semiochemicals Corp, Box 50008 South Slope RPO, Burnaby, BC, V5J 5G3, Canada (david@semiochemical.com) and [5]US-Forest Service, Rocky Mountain Research Station, 240 West Prospect St, Fort Collins, CO 80526 (lsbaggett@fs.fed.us)

Received 5 May 2016; Accepted 5 July 2016

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Engelmann Spruce

Stand protection

Compared Carbaryl "spray treatments" against "spray repellents" - MCH and isophorone or sulcatone

i. Mass attacks were nearly twice as likely in baited control plots or unbaited control plots compared to sprayed treatments
ii. Baited control plots were 30 times more likely to be infested compared to spray repellent plots
iii. Lethal trap trees alone are not effective for epidemic spruce beetle populations
iv. Fertile area for ongoing research

MCH (3-Methylcyclohex-2-en-1-one)

Engelmann Spruce

Stand Protection

Compared elution rates of MCH within stands: MCH application rates of 20, 40, 80 grams/ha (40 Singles, 40 Doubles, 80 Doubles respectively) against control plots

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Forest Entomology

3-Methylcyclohex-2-en-1-one for area and individual tree protection against spruce beetle (Coleoptera: Curculionidae: Scolytinae) attack in the southern Rocky Mountains

E. Matthew Hansen,[1,5] A. Steven Munson,[2] Darren C. Blackford,[2] Andrew D. Graves,[3] Tom W. Coleman,[3] and L. Scott Baggett[4]

-Baited Spruce Beetle into stands to ensure beetle pressure
-Probabilities of more severe attacks was significantly reduced by ~50% across all applications
-No differences were detected in application rates

MCH (3-Methylcyclohex-2-en-1-one)

Engelmann Spruce

Single Tree

Compared Baited tree; MCH Double (1000 mg); Acer Kairomone Blend (AKB 6.8 g) ; MCH + AKB

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AKB; Linalool; beta-caryophyllene; and z-3Hexanol (leaf volatiles)

-Control Trees were more attacked (75%) than MCH (33%) or AKB alone (37%)
-Threshold of 20% (Shea et al., 1984)
-MCH plus AKB treatment NO mass or unsuccessful attacks (pitch-outs) were recorded


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Questions?

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