Examination of stand, site and climate relationships with r-value

Outline

- What is an *r*-value?
- What are the key stand characteristics, site and climate factors influencing r-values?
- Can we predict r-values?
- Management implications

Examination of stand, site and climate relationships with r-value

What is an r-value?

$$r = \sum \frac{\text{larvae + pupae + adults}}{\text{entrance holes}}$$

Collected in May / June to assess population trends

Adapted from FIDS (1970s)

From:
(Lux, 2008)

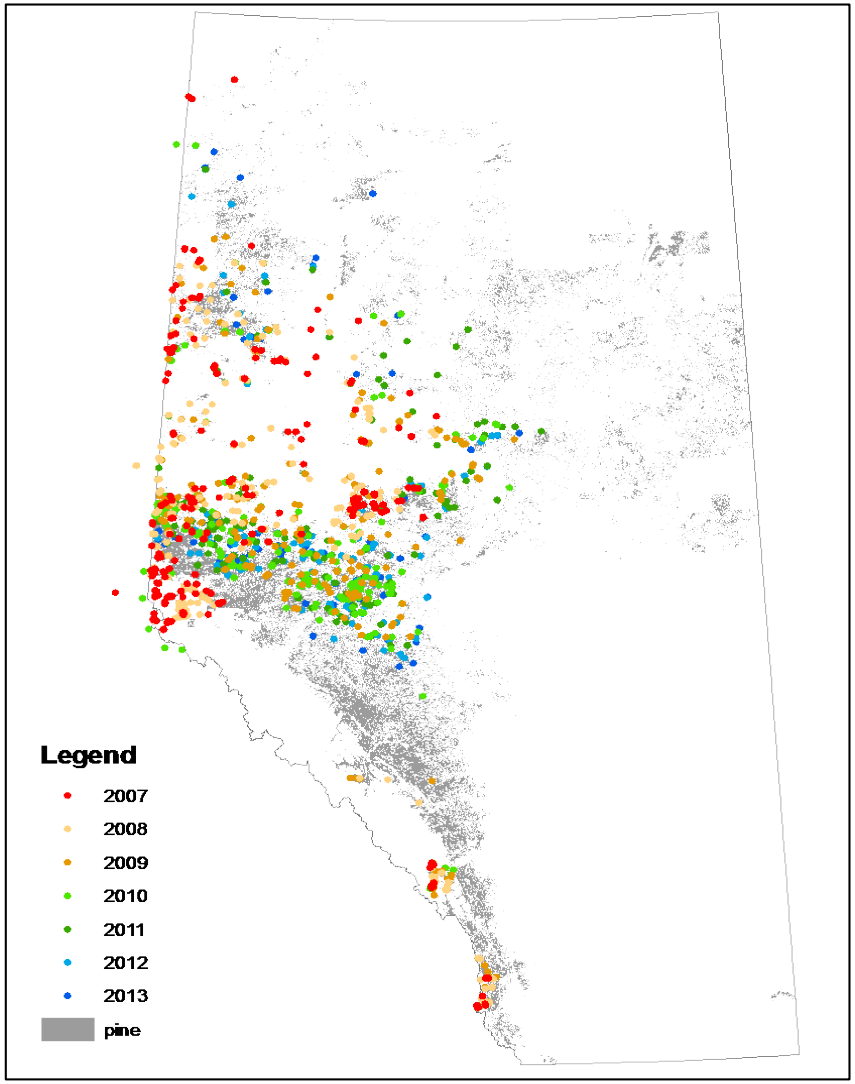
Examination of stand, site and climate relationships with r-value

What are the key stand characteristics, site, and climate factors influencing *r*-values?

- **Survey data from multiple years (2007-2015)**
- **Stand characteristics:** DBH, # of infested trees, height, age, % pine etc., SSI (data from field and inventory)
- **Site features:** Elevation, latitude, aspect
- **Climate data:** daily climate data from multiple climate stations (min temp, # of cold days, seasonal effects, ppt patterns)

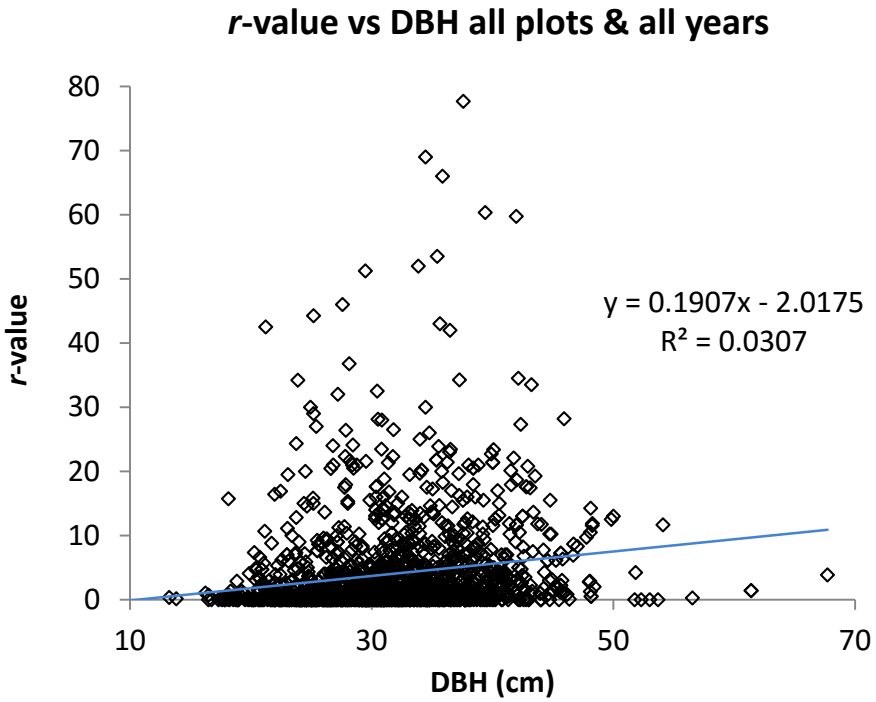
r-value data collected for multiple years

- ***r*-surveys conducted 2007-2015**
- **Year represents beetle-year** (year of adult beetle attack)
- **Offspring emerge the following year**



Influence of stand characteristics on *r*-value

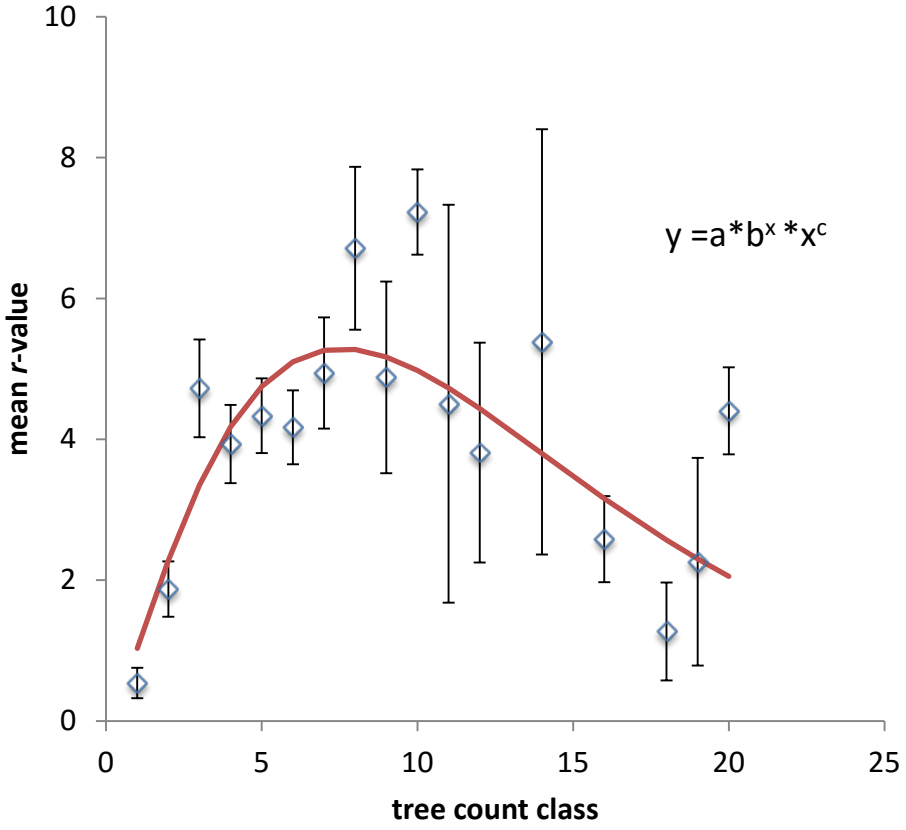
Sources of variability in *r*-value?



- **Climate variation**
- **Site factors**
- **Beetle populations dynamics**

Influence of stand characteristics on *r*-value

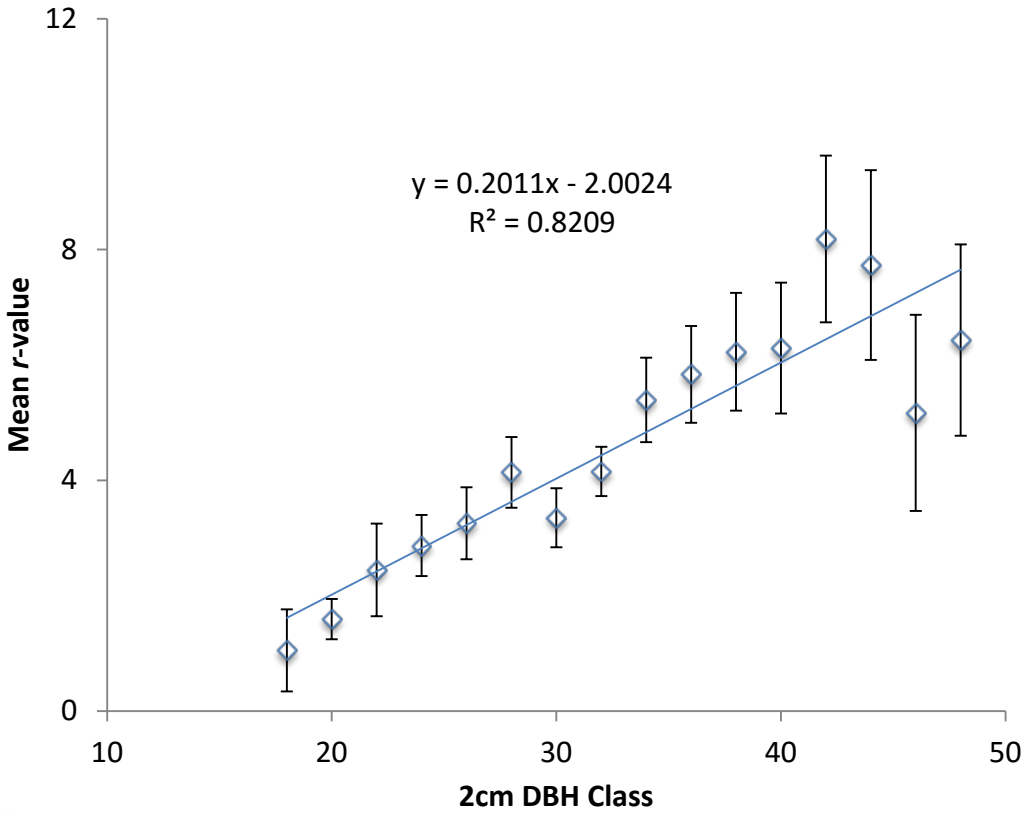
Influence of attacking size of beetle population on *r*-values



- # of infested trees (tree count) is an indicator of size of attacking population
- Excluded plots where tree count was < 3 from further analyses

Influence of stand characteristics on *r*-value

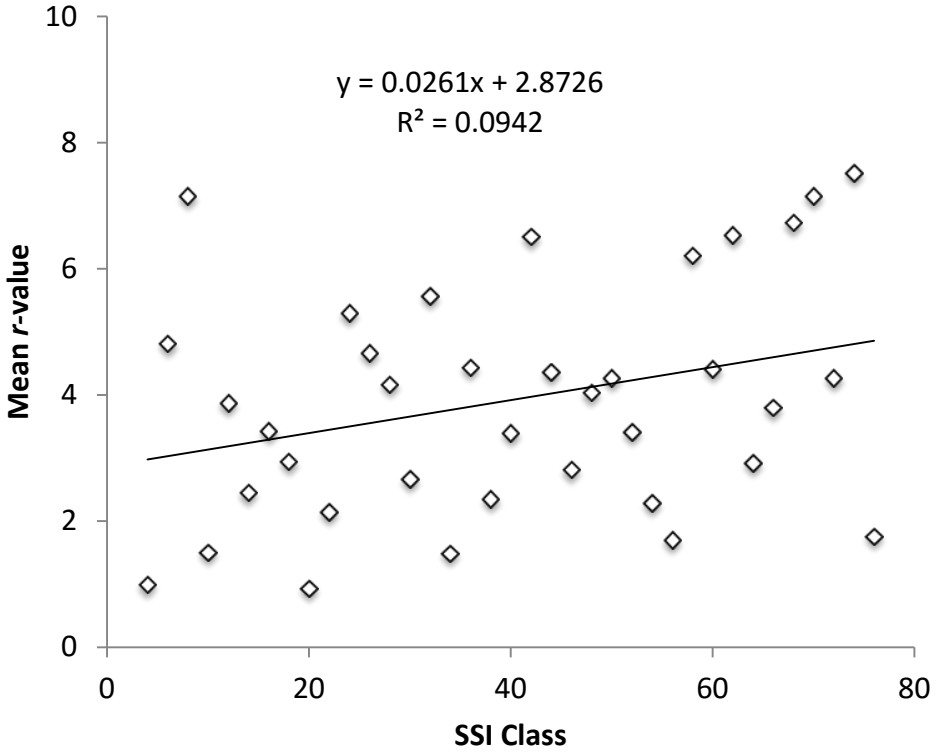
Mean DBH was the best predictor of *r*-value



- **Binning data helps to clarify the relationship**
- **Must have >4 plots in DBH class to be included**

Influence of stand characteristics on *r*-value

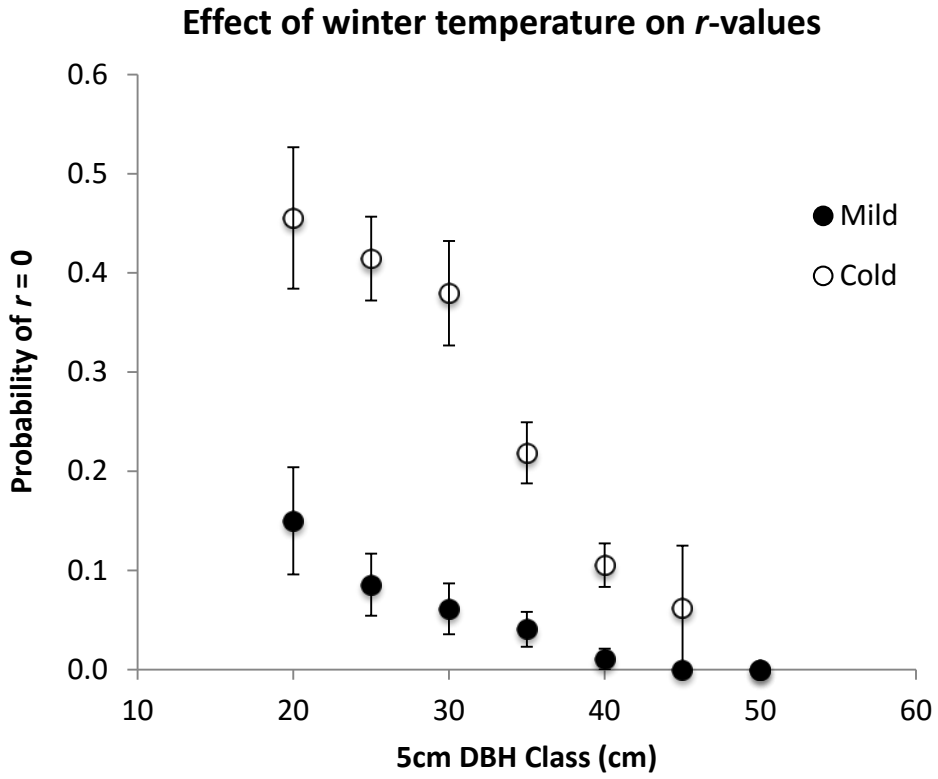
Inventory derived SSI was not a good predictor of *r*-value



- **SSI = Stand Susceptibility Index developed by Shore and Safranyik (1992) for BC conditions**
- **None of the other stand characteristics were good predictors of r-value**

Influence of stand characteristics on r-value

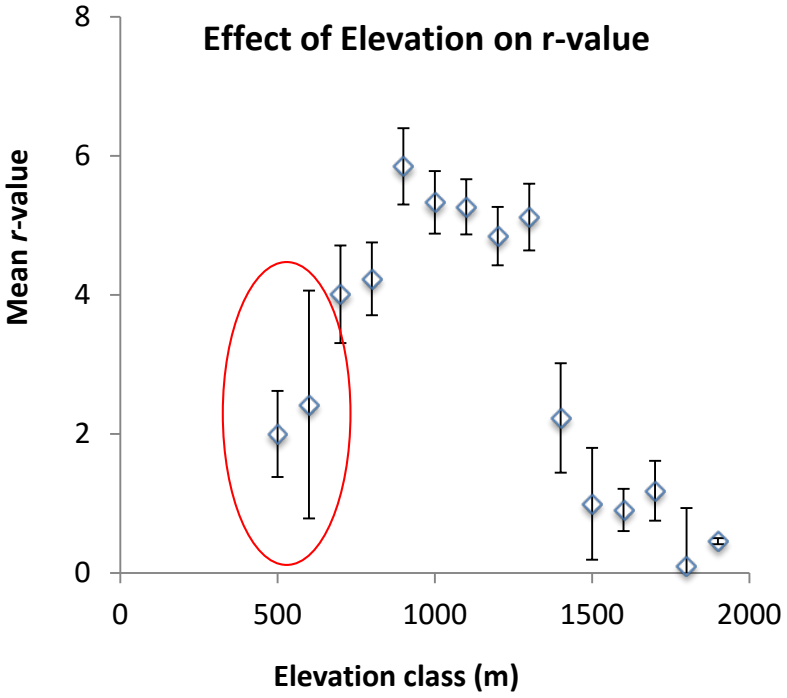
Effect of DBH on *r*-value is moderated by climate

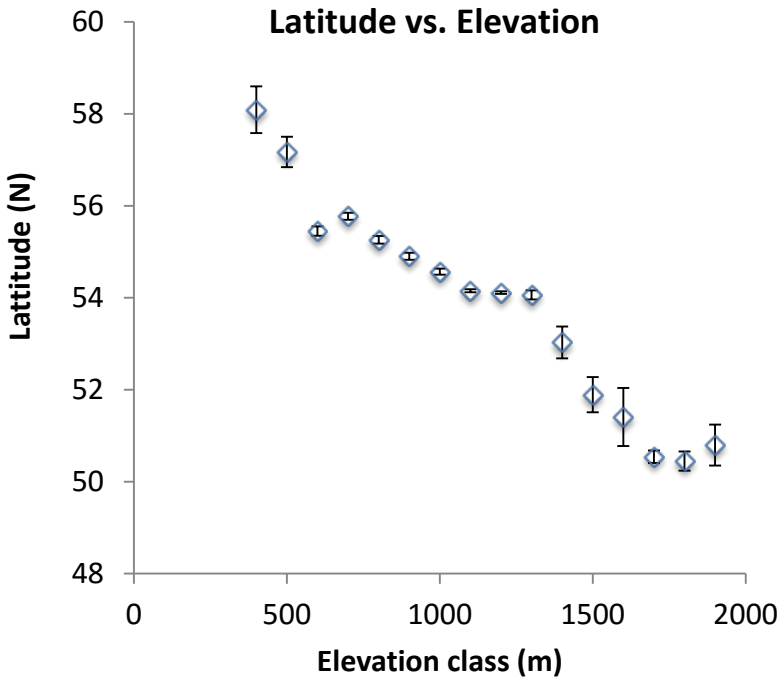


- **Cold: min winter temp < -35 °C**
- **Mild: min winter temp > -35 °C**

Influence of site characteristics on *r*-value

Both elevation and, to a lesser degree, latitude have an impact on *r*-values





Influence of site characteristics on *r*-value

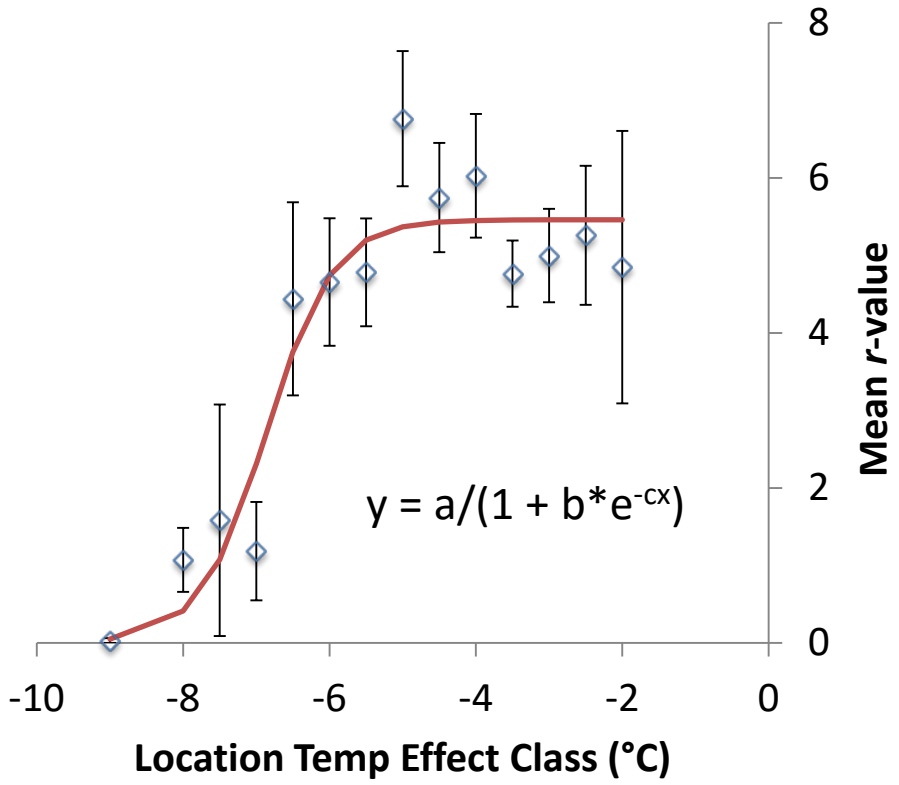
Development of Location Temp Effect (LTE)

- **Designed to capture the effect of elevation and latitude on *r*-value**

  -1 °C per 100m above 1000m elevation

  -0.7 °C per degree latitude above 49.6° N

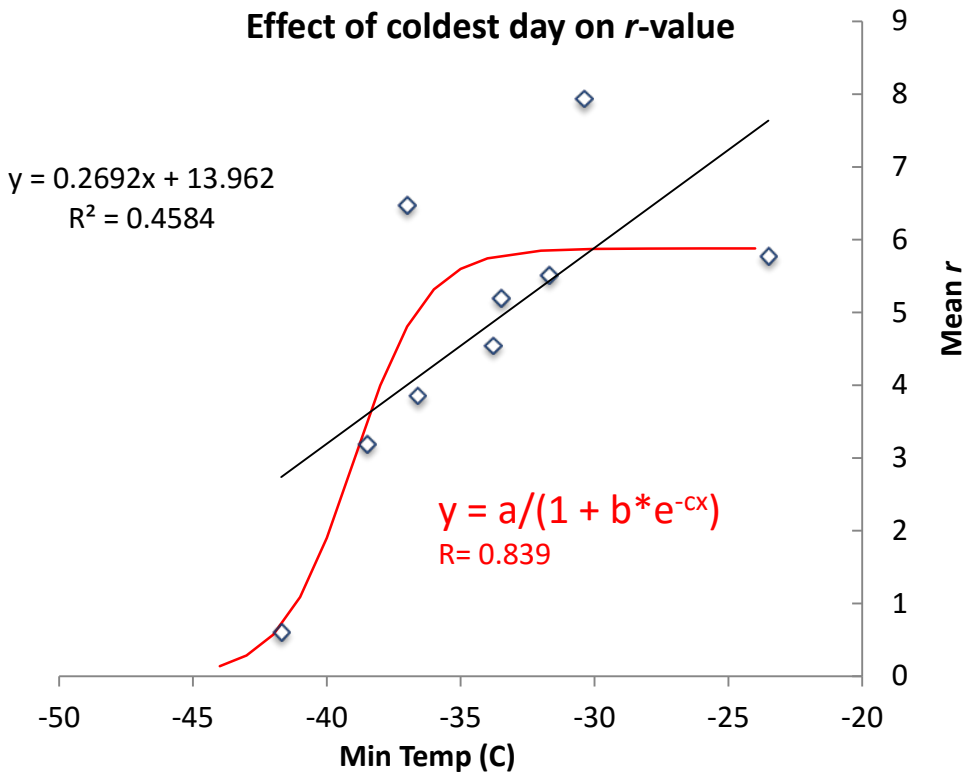
- **Fit with logistic regression equation**



Influence of annual climate on *r*-value

Analysis of annual climate variation on *r*-values

- Others have developed detailed models of MPB development in relation to climate (e.g. Régnière and Bentz, 2007)
- -37 °C represents a threshold for MPB winter mortality
- Only min winter temperature showed a good relationship with mean *r*-values



Development of *r*-value model

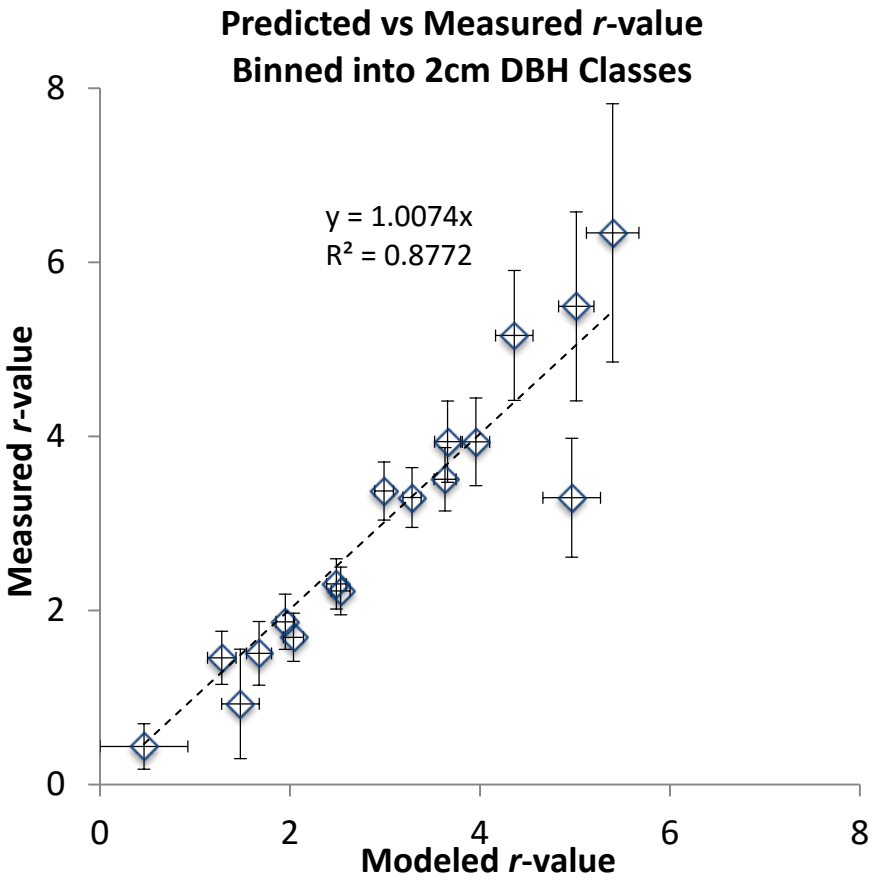
Multiple linear regression analysis

- **Excluded r-values >20**

MLR Results

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-6.785	0.655	-10.36	<.0001
Annual_ T_Min	0.511	0.053	9.66	<.0001
DBH	0.130	0.015	8.98	<.0001
Tree_count	0.535	0.076	7.05	<.0001
LTE	0.223	0.078	2.88	0.0041

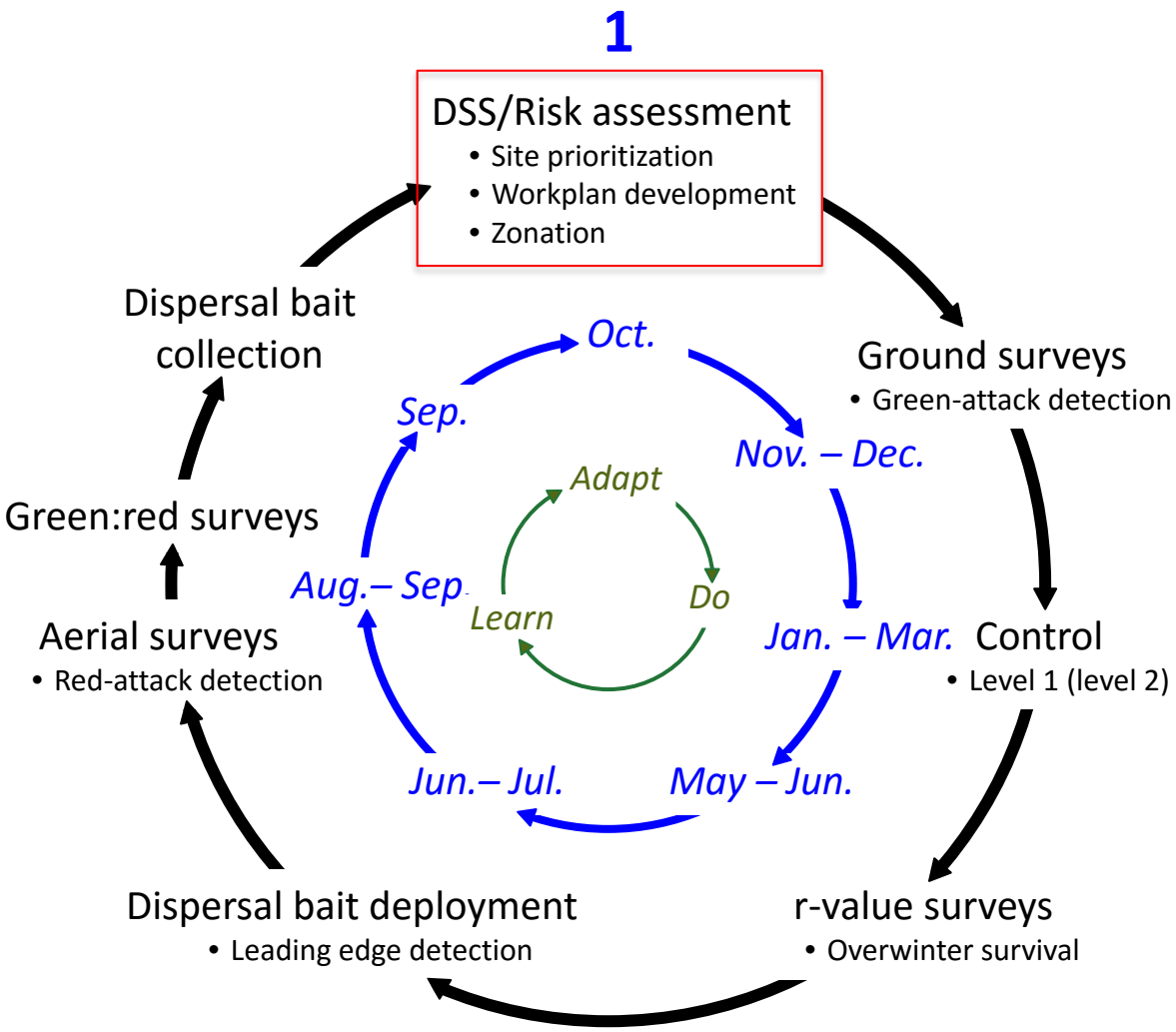
- ***r*** **model can be used to predict r-values over space and time**
- **DBH can be estimated as a function of inventory top height and stand age**
- **Min winter temp can be actual or projected**
- **Used in our spatial model: MPB Spread**



Examination of stand, site and climate relationships with *r*-value

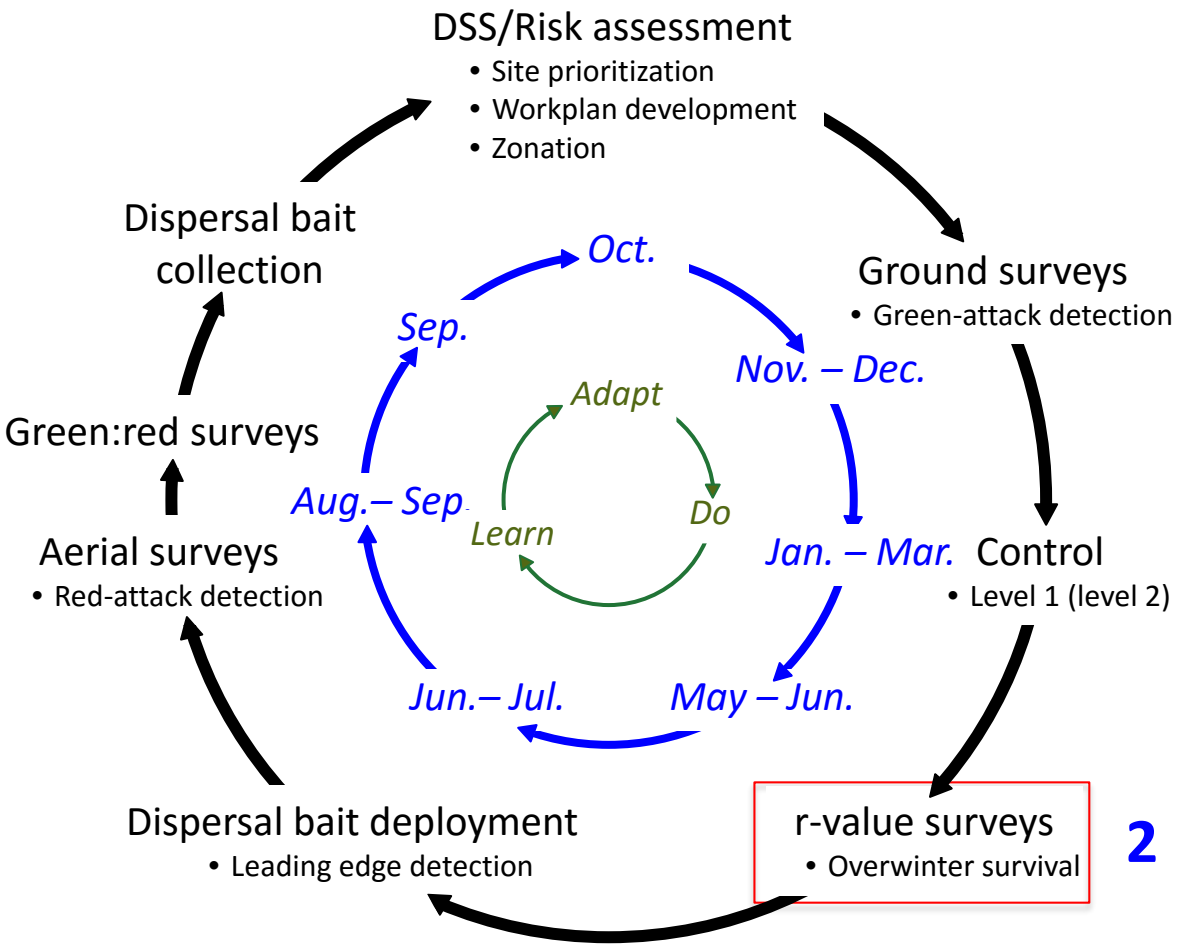
Management Implications:

MPB productivity (*r*) model: relevance and integration



1. Complement DSS (assume mild winter; combine with SSI, stand size, connectivity, etc.)

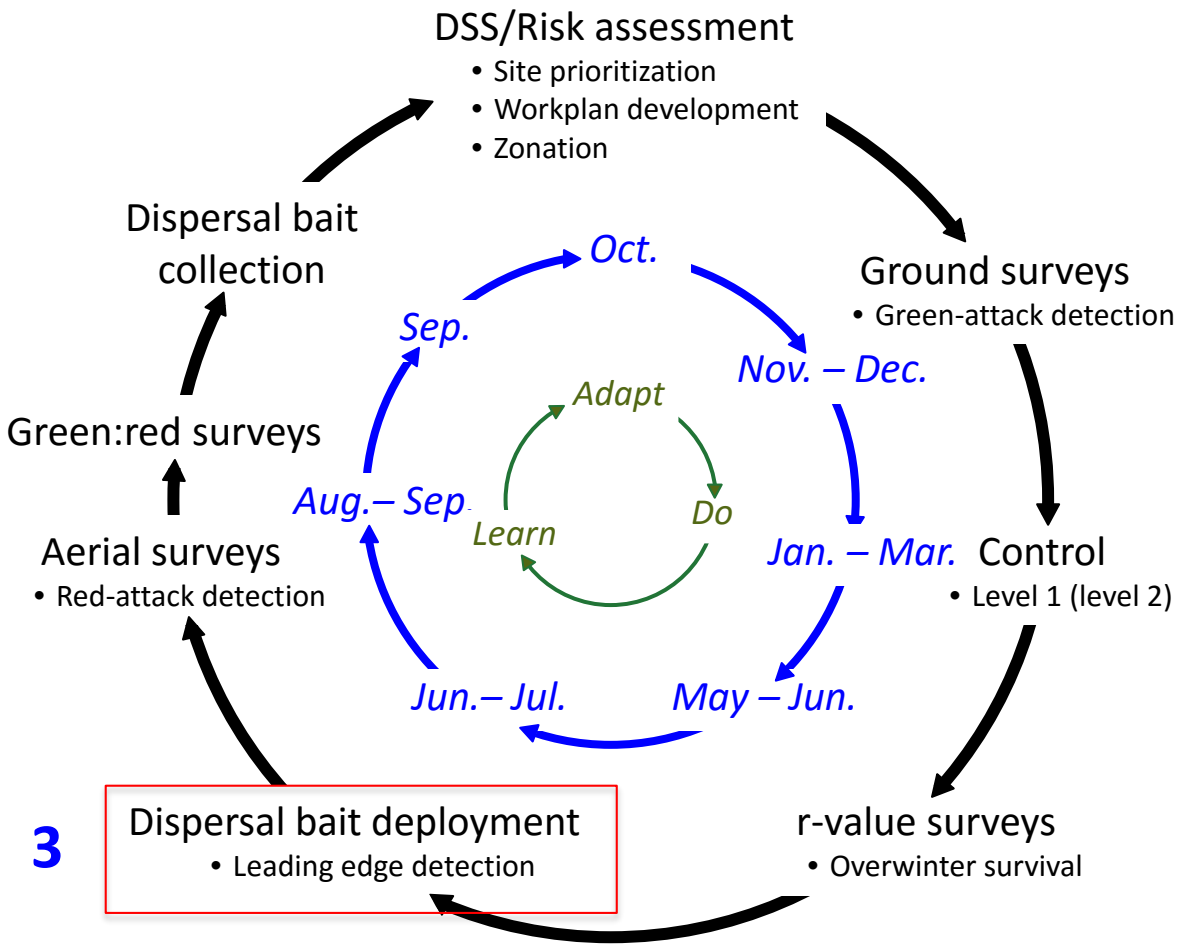
MPB productivity (*r*) model: relevance and integration



2

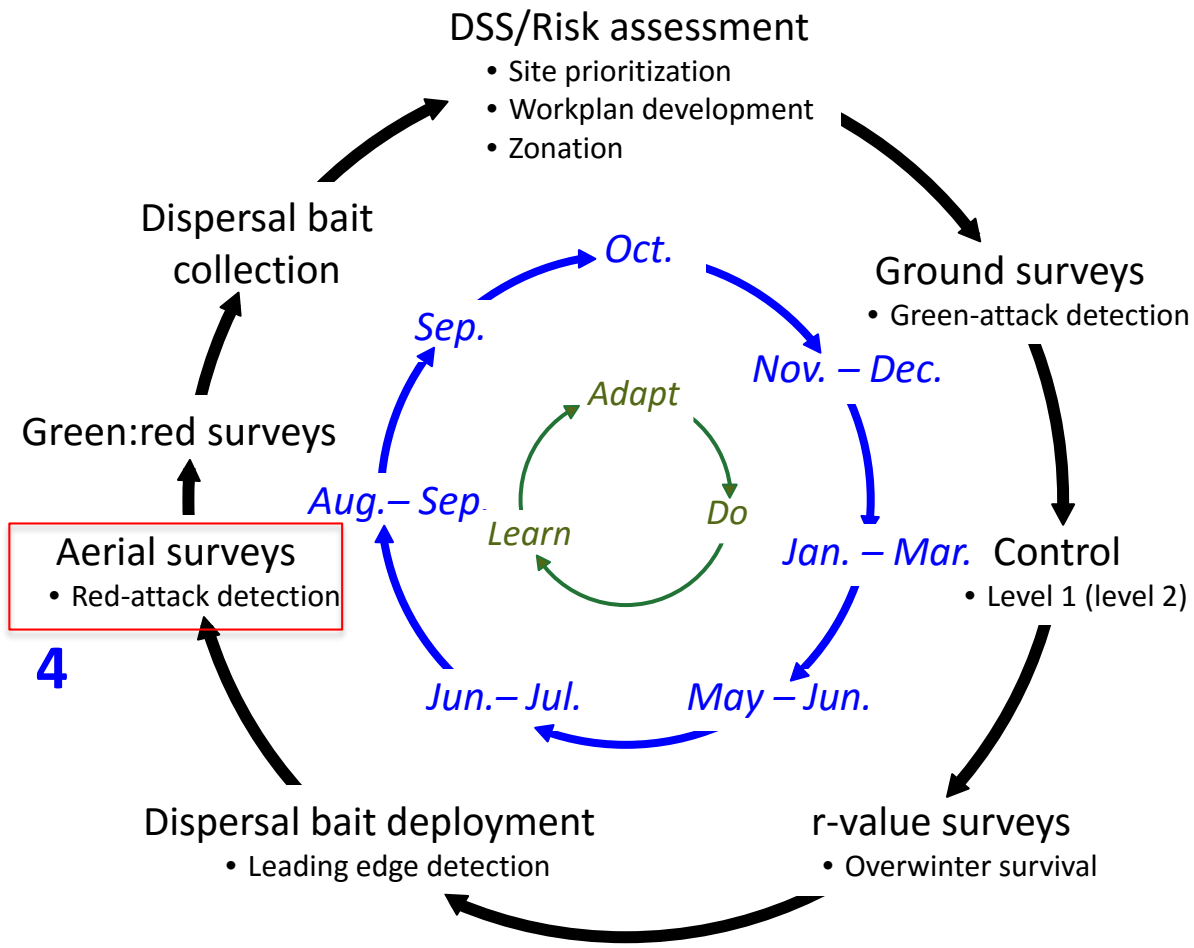
1. Complement DSS (assume mild winter; combine with SSI, stand size, connectivity, etc.)
2. Reduce/redirect *r*-value surveys

MPB productivity (*r*) model: relevance and integration



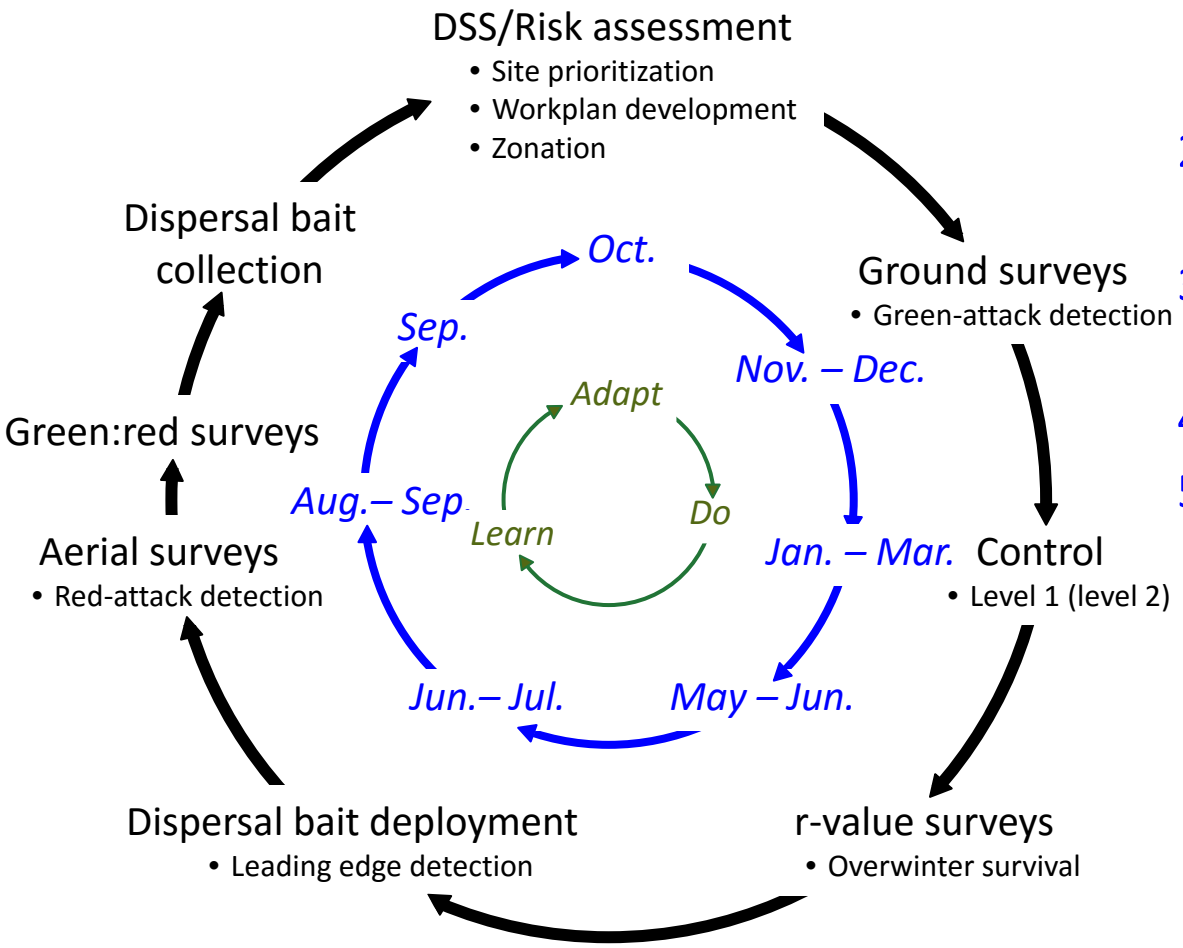
1. Complement DSS (assume mild winter; combine with SSI, stand size, connectivity, etc.)
2. Reduce/redirect *r*-value surveys
3. Inform dispersal bait deployment

MPB productivity (*r*) model: relevance and integration



1. Complement DSS (assume mild winter; combine with SSI, stand size, connectivity, etc.)
2. Reduce/redirect *r*-value surveys
3. Inform dispersal bait deployment
4. Inform aerial survey priorities

MPB productivity (*r*) model: relevance and integration



1. Complement DSS (assume mild winter; combine with SSI, stand size, connectivity, etc.)
2. Reduce/redirect *r*-value surveys
3. Inform dispersal bait deployment
4. Inform aerial survey priorities
5. Inform Level 3 priorities

Discussion