The distribution of wood-boring beetle damage in fire-killed black spruce

David J. Gervais
David F. Greene
Timothy T. Work

Introduction

- Reduced structural complexity
- Warmer, drier
- Abundance of standing snags

Introduction

- Reduced structural complexity
- Warmer, drier
- Abundance of standing snags

Rapidly colonized by insects

Introduction

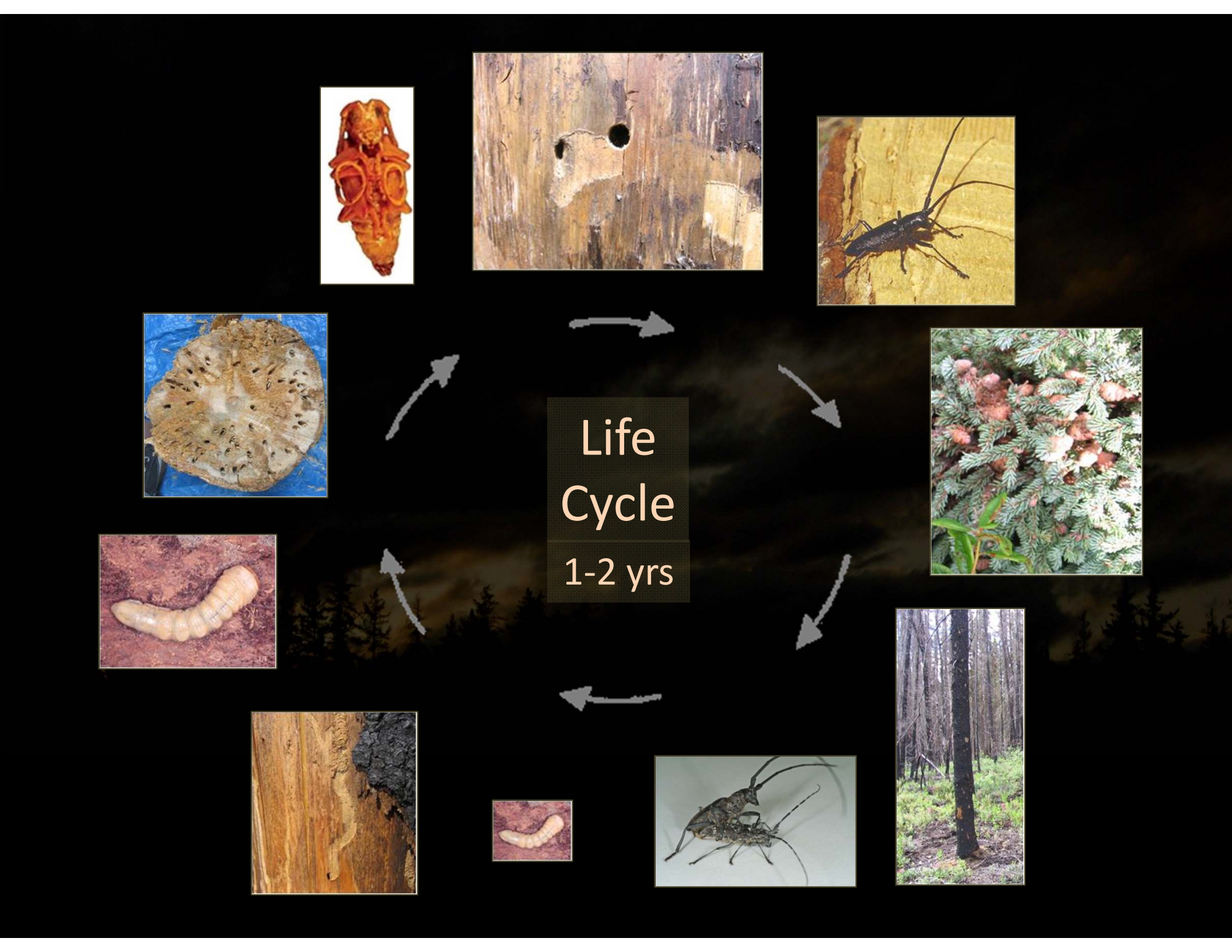
- Boulanger & Sirois, 2007
  - 8177 beetles

Introduction

- Boulanger & Sirois, 2007
  - 8177 beetles
    - 109 species

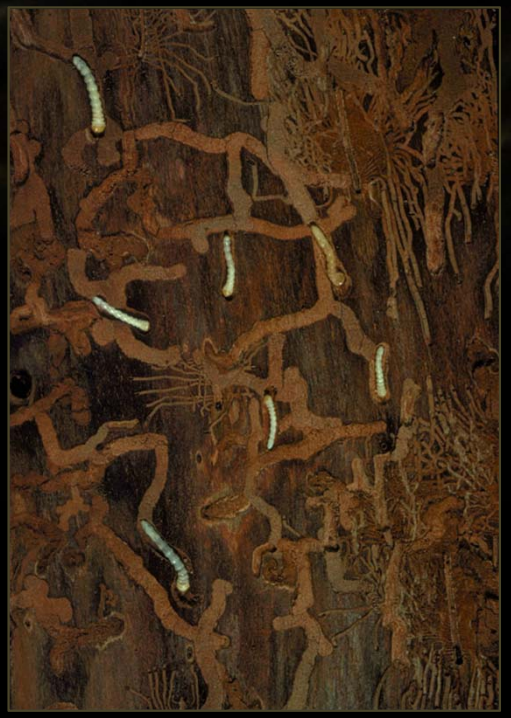
Introduction

- Boulanger & Sirois, 2007
  - 8177 beetles
    - 109 species
    - 84 saproxylic species


Life
Cycle
1-2 yrs

Introduction

- Fire-killed trees are salvaged for commercial use
- Lumber is downgraded due to presence of holes



Introduction

- Fire-killed trees are salvaged for commercial use
- Lumber is downgraded due to presence of holes
- Heterogeneity in beetle damage

Introduction

- Host selection
- Saint-Germain *et al*., 2004
  - Landscape-scale factors
  - Tree-scale factors

Introduction

- Host selection
- Saint-Germain *et al*., 2004
  - Fire Intensity

Introduction

- Host selection
- Saint-Germain *et al*., 2004
  - Fire Intensity
  - Phloem quality

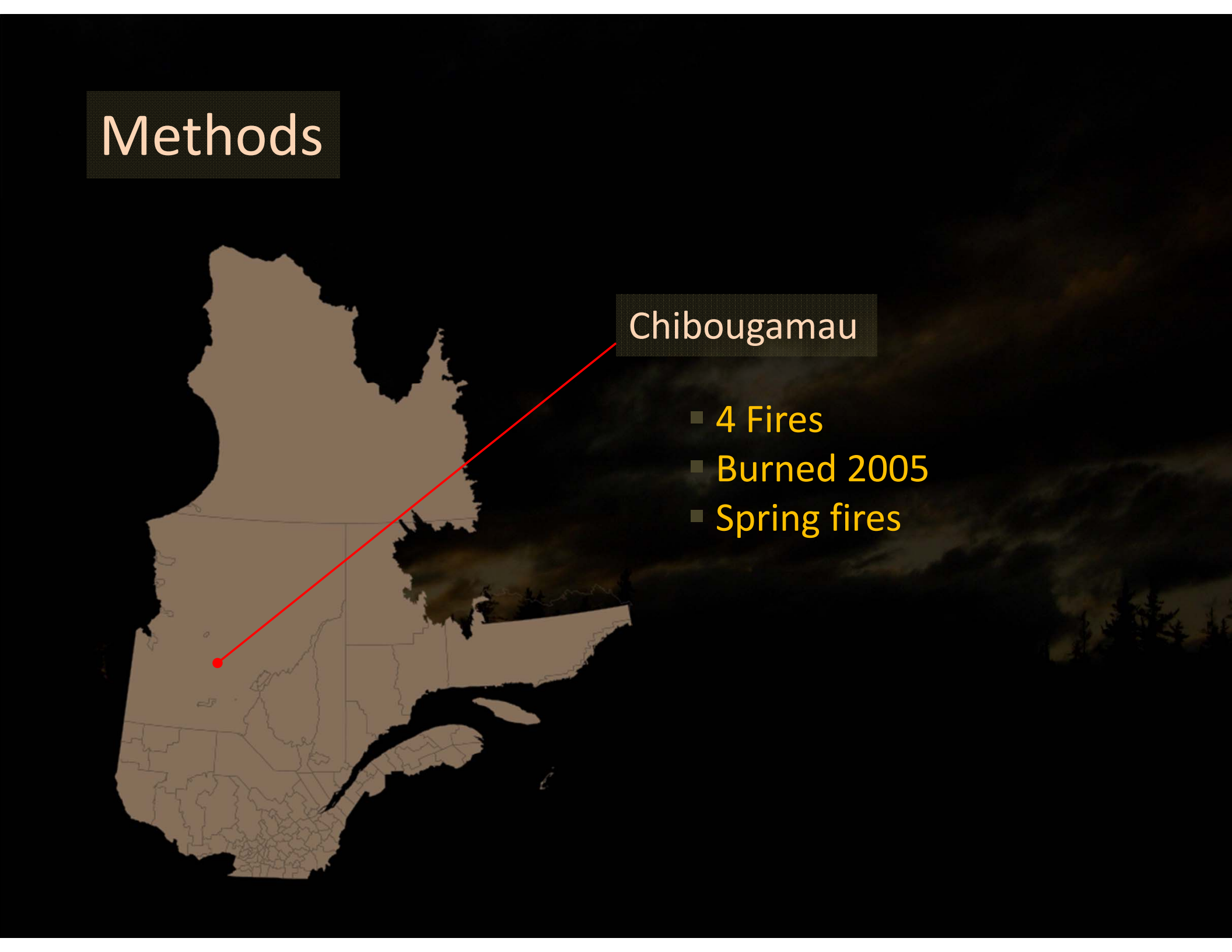
Introduction

- Host selection
- Saint-Germain *et al*., 2004
  - Fire Intensity – UNCLEAR
  - Phloem quality

Objectives

- Model the distribution of damage
  - Fire Intensity
  - Landscape- and tree-level processes

Methods



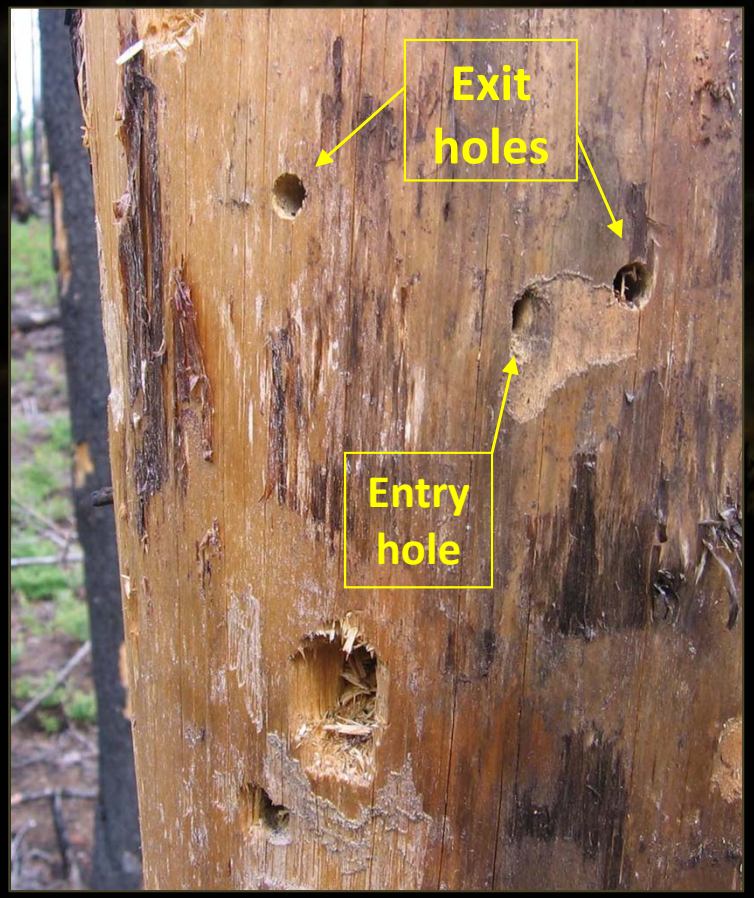
- 4 Fires
- Burned 2005
- Spring fires

Methods

- Removed bark (1.5 m)

749 trees

- Counted entry holes



Methods

- Host selection
  - Landscape-scale
    - Elevation
    - Distance to unburned forest

Methods

- Host selection
  - Landscape-scale
    - Elevation
    - Distance to unburned forest
  - Tree-scale
    - Tree size
    - Fire intensity (Scorch height)
    - Scorch side

Methods

- Host selection
  - Landscape-scale
    - Elevation
    - Distance to unburned forest
  - Tree-scale
    - Tree size
    - Fire intensity (Scorch height)
    - Scorch side

Methods

- Hypotheses
  - Damage will increase with fire intensity

Methods

- Hypotheses
  - Damage will decrease with fire intensity

Methods

- Hypotheses
  - Damage will be highest on trees with medium fire intensity

Results

Model name	k	AICc	Δ AICc	w_i	Cumul. w_i	LogLik.
Quadratic	12	11058.94	0.0000	0.9935	0.9935	-5517.432
Linear	11	11069.00	10.0568	0.0065	1.0000	-5523.466

Results

Model name	k	AICc	Δ AICc	w_i	Cumul. w_i	LogLik.
Quadratic	12	11058.94	0.0000	0.9935	0.9935	-5517.432
Linear	11	11069.00	10.0568	0.0065	1.0000	-5523.466

Results

Variable	Coefficients	Std. Error	DF	t-value	p-value
(Intercept)	31.062	1.465	689	21.203	<.0001
Dbh	2.309	0.144	616	16.061	<.0001
Elevation	0.138	0.058	73	2.372	0.0203
Scorch Height	-0.955	0.207	689	-4.619	<.0001
(Scorch Height)^2	0.063	0.013	689	4.682	<.0001
Scorch Side (Low)	-2.316	0.415	689	-5.577	<.0001

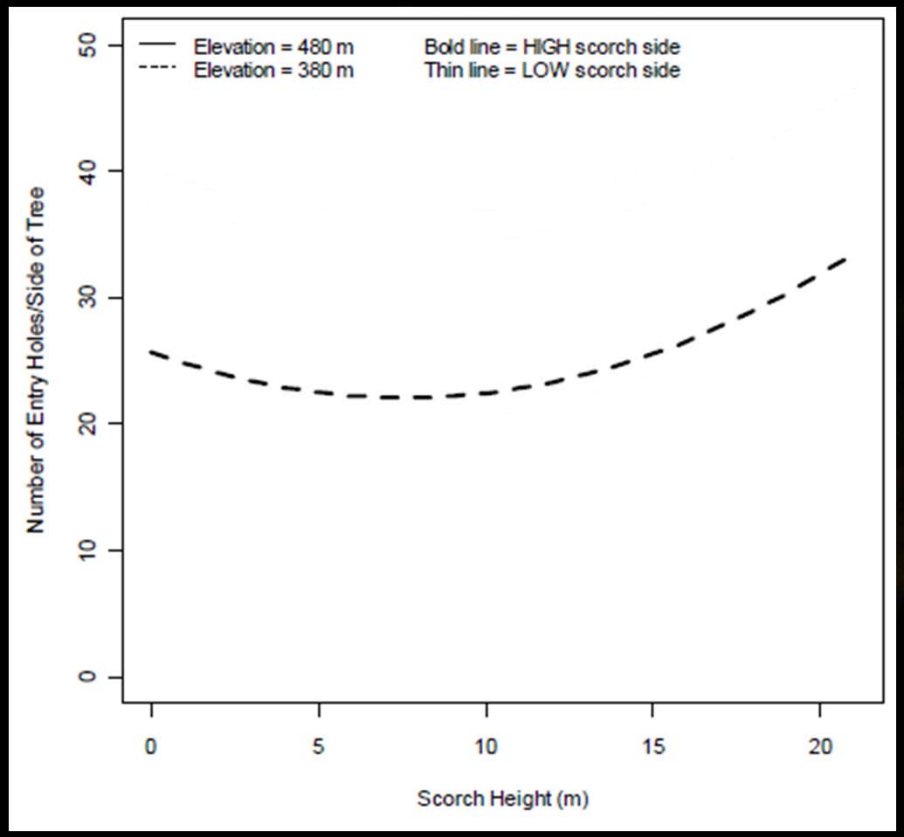
Results

Variable	Coefficients	Std. Error	DF	t-value	p-value
(Intercept)	31.062	1.465	689	21.203	<.0001
Dbh	2.309	0.144	616	16.061	<.0001
Elevation	0.138	0.058	73	2.372	0.0203
Scorch Height	-0.955	0.207	689	-4.619	<.0001
(Scorch Height)^2	0.063	0.013	689	4.682	<.0001
Scorch Side (Low)	-2.316	0.415	689	-5.577	<.0001

Results

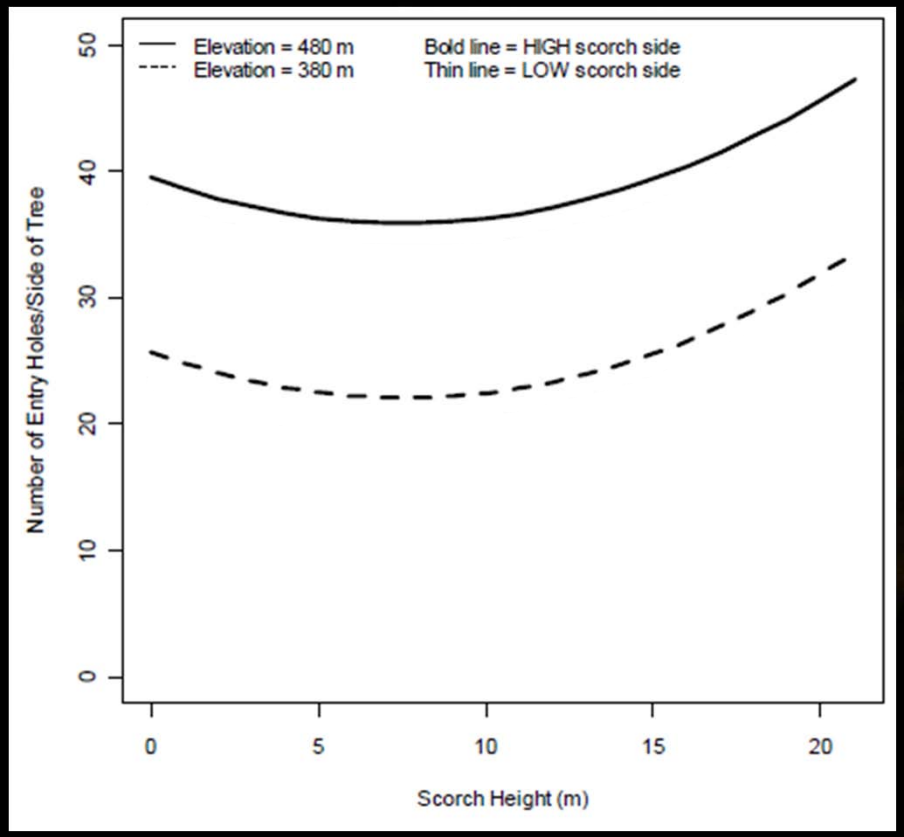
Variable	Coefficients	Std. Error	DF	t-value	p-value
(Intercept)	31.062	1.465	689	21.203	<.0001
Dbh	2.309	0.144	616	16.061	<.0001
Elevation	0.138	0.058	73	2.372	0.0203
Scorch Height	-0.955	0.207	689	-4.619	<.0001
(Scorch Height)^2	0.063	0.013	689	4.682	<.0001
Scorch Side (Low)	-2.316	0.415	689	-5.577	<.0001

Results



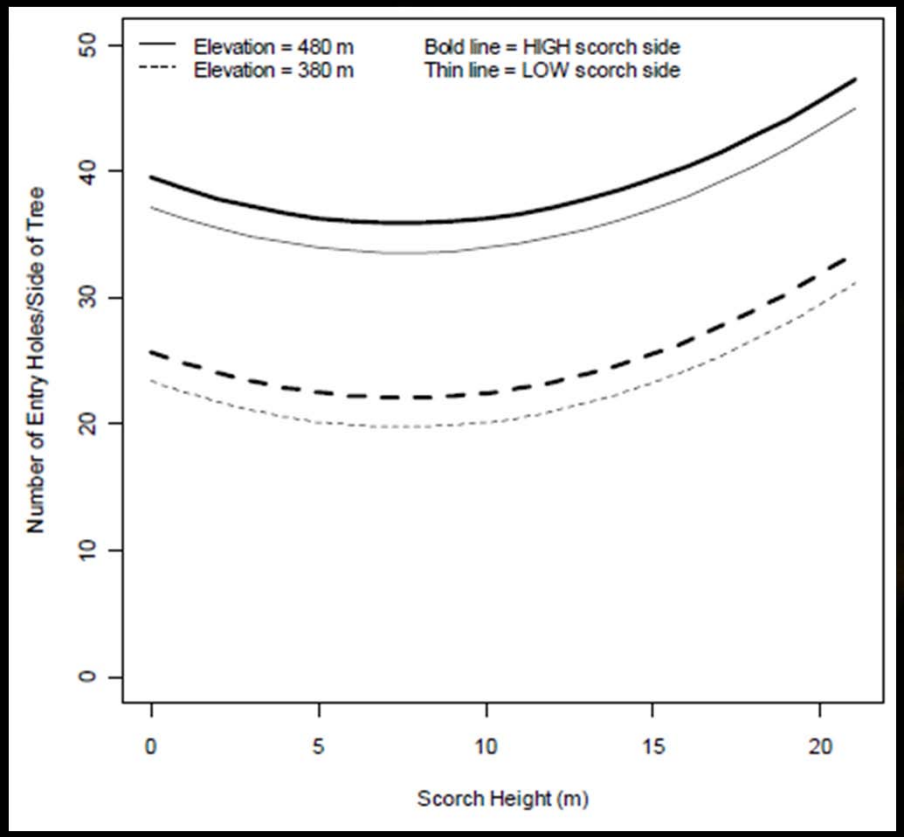
Elevation

Results



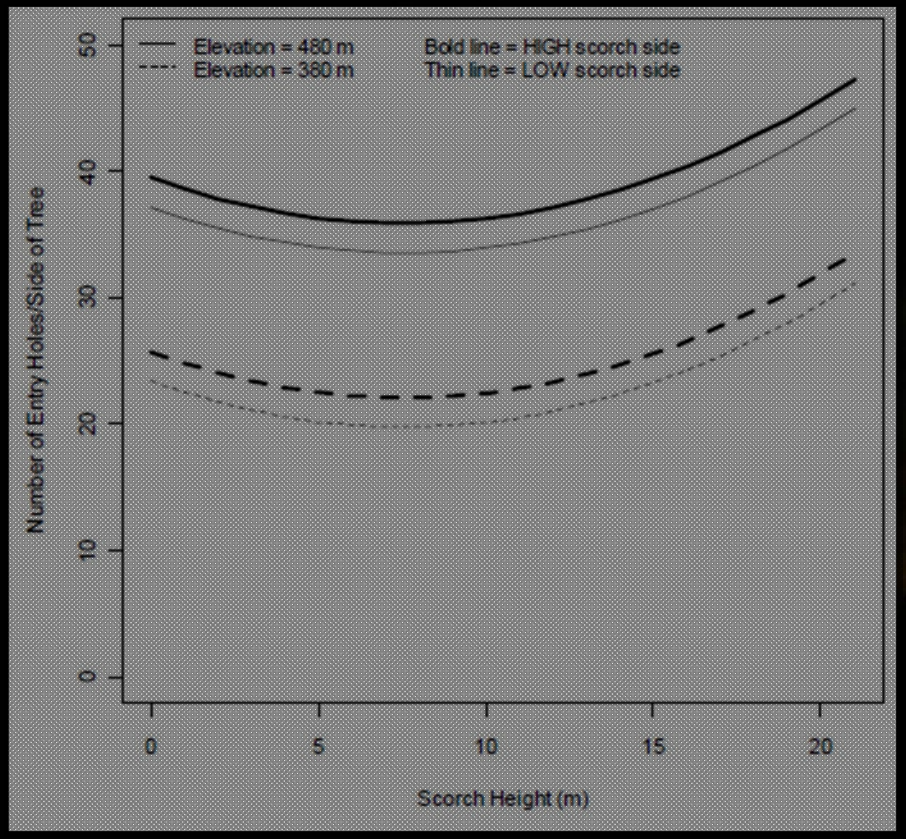
Elevation

Results

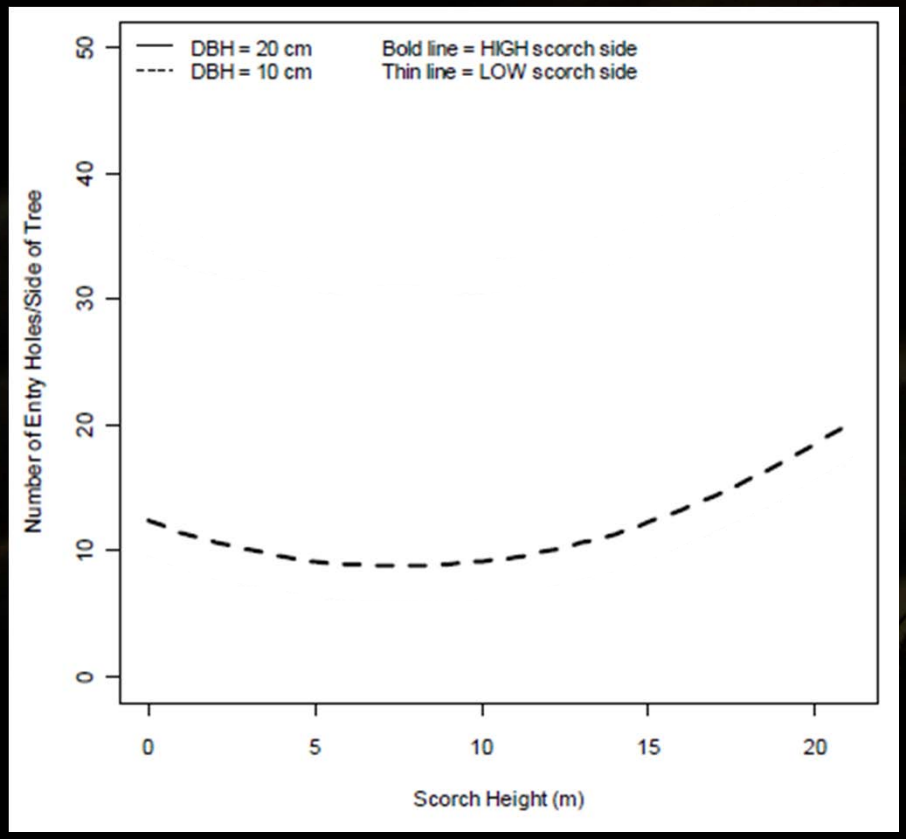


Elevation

Results

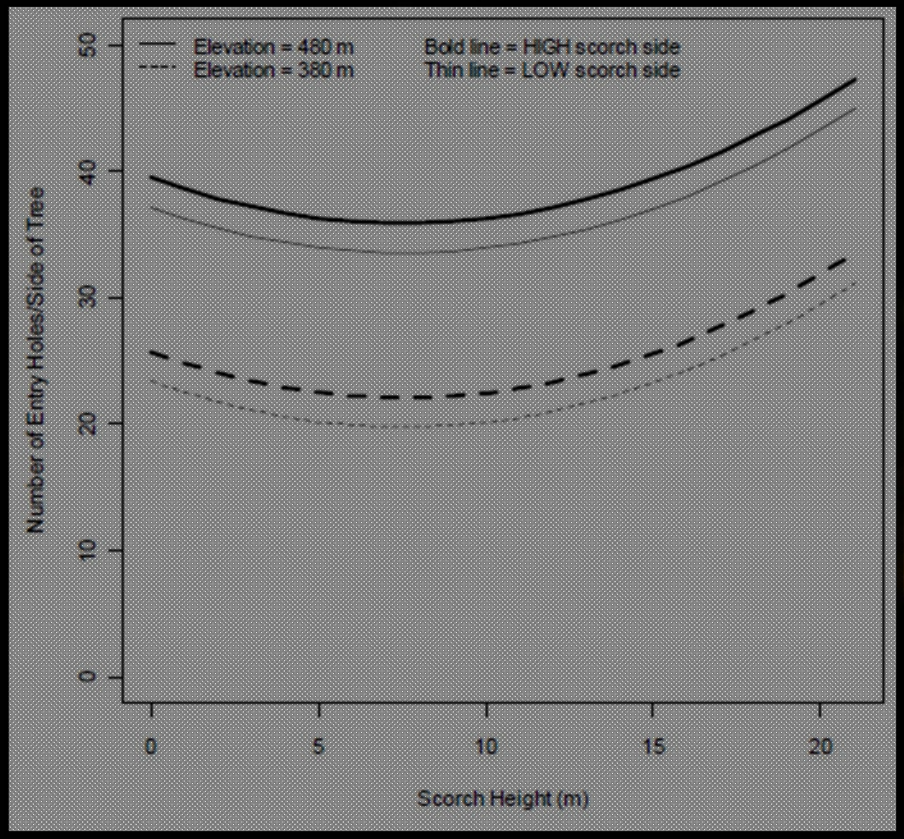


Elevation

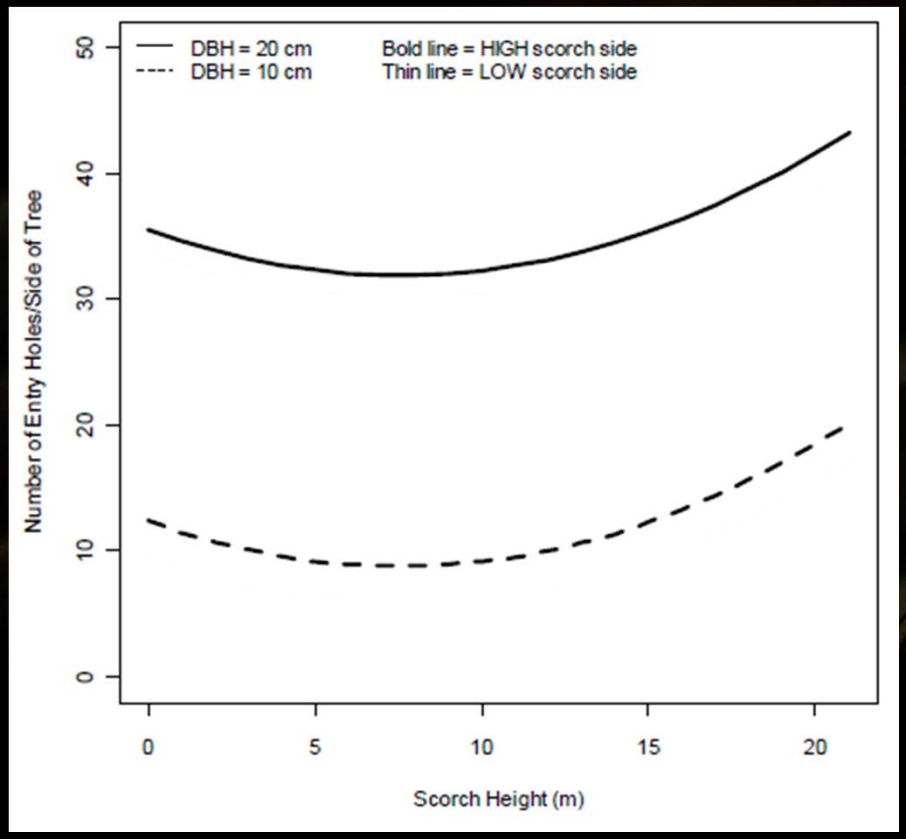


Tree Size

Results

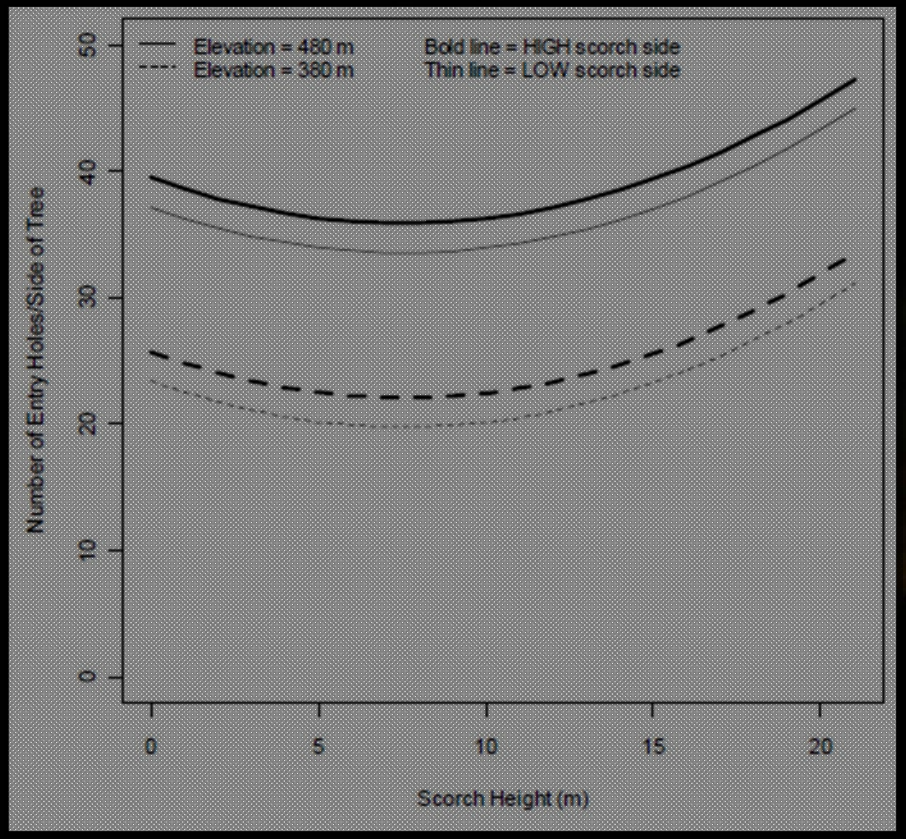


Elevation

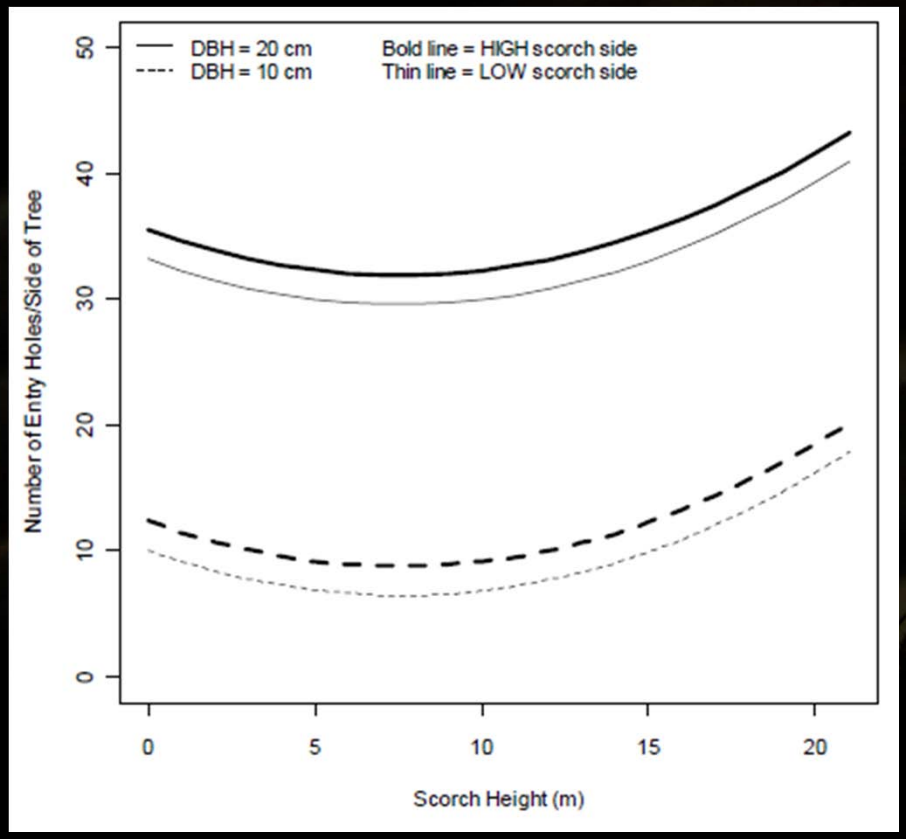


Tree Size

Results

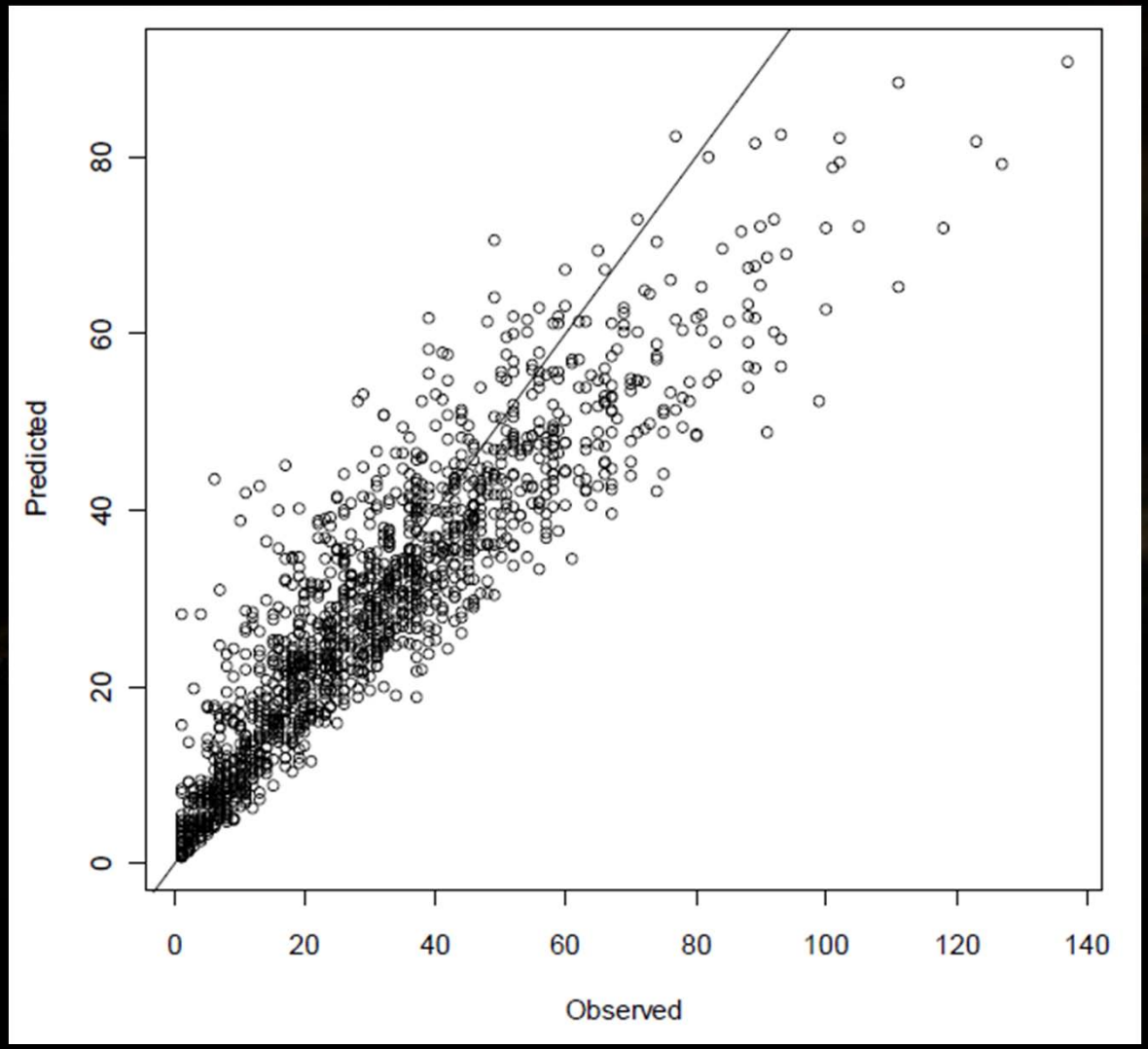


Elevation

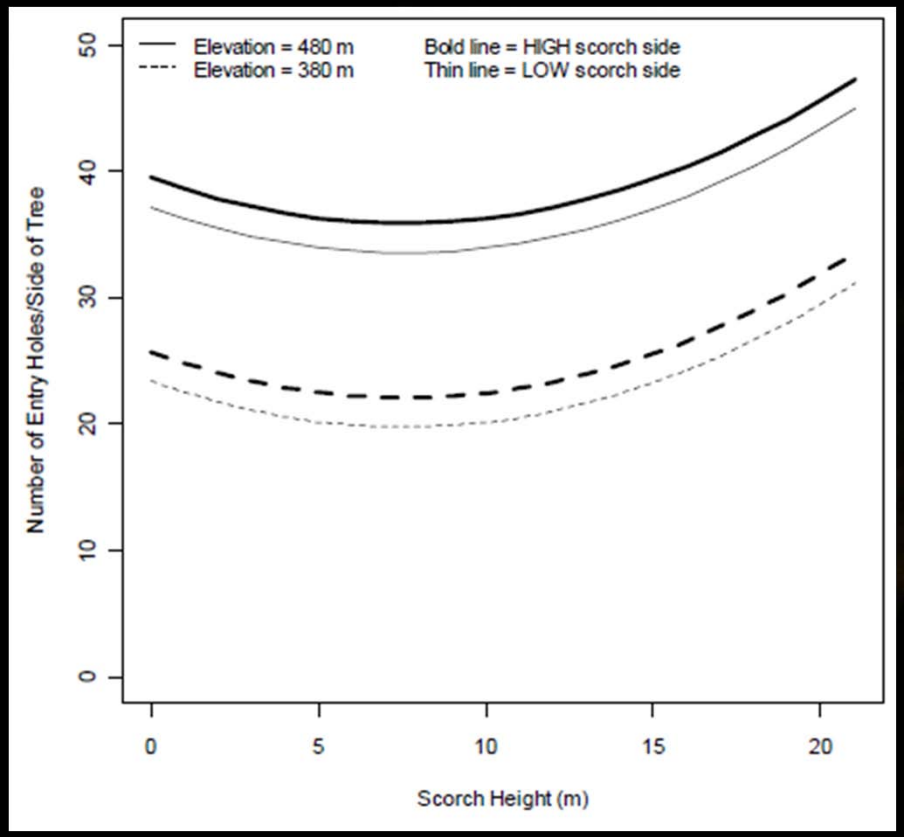


Tree Size

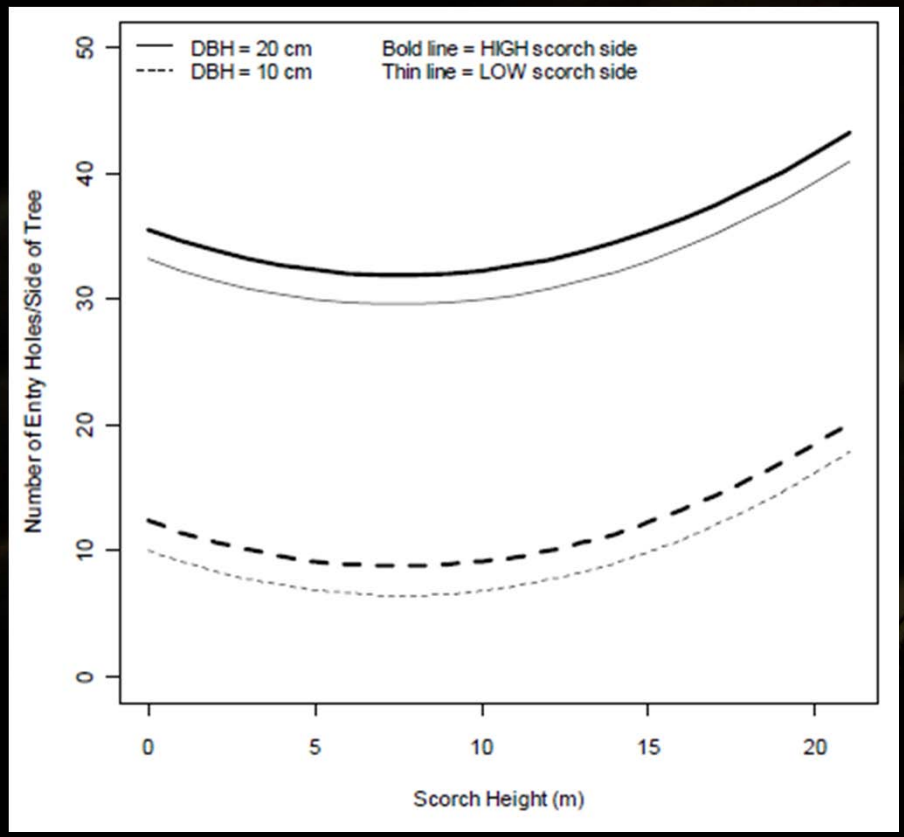
Results



Results



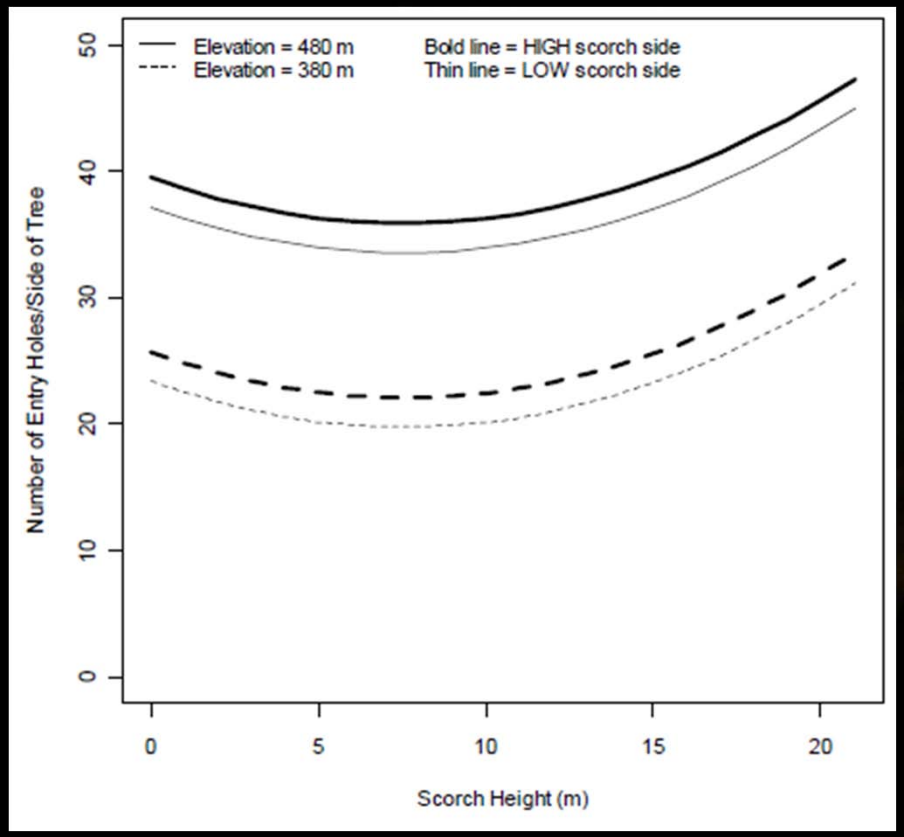
Elevation



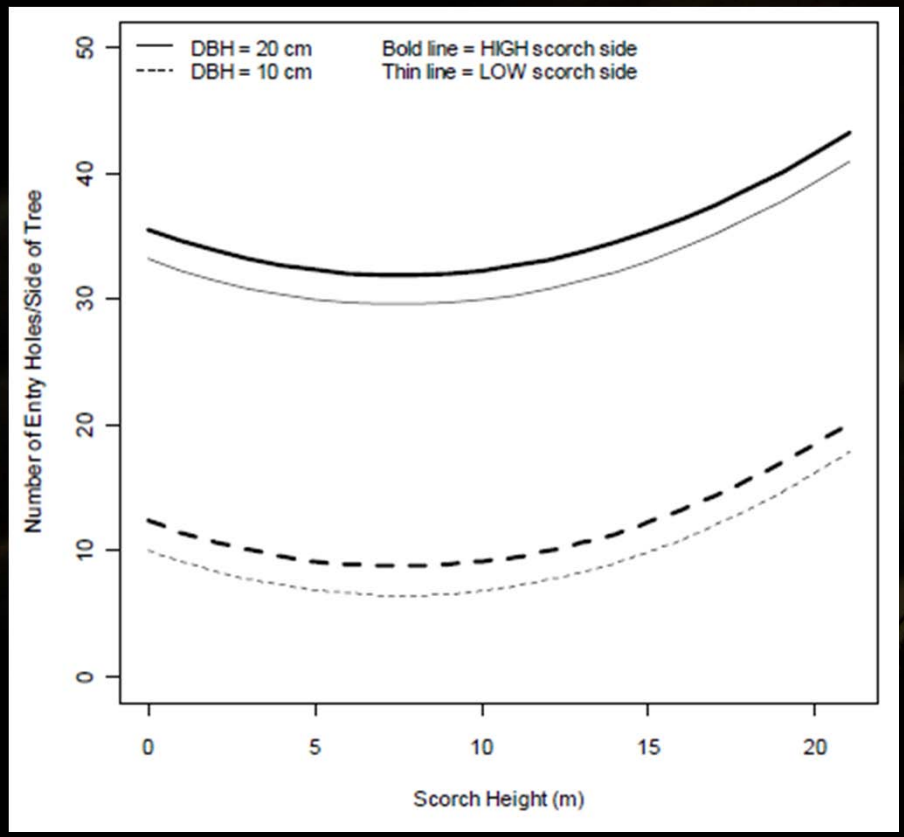
Tree Size

Results

Sampling was performed 2 years post-fire

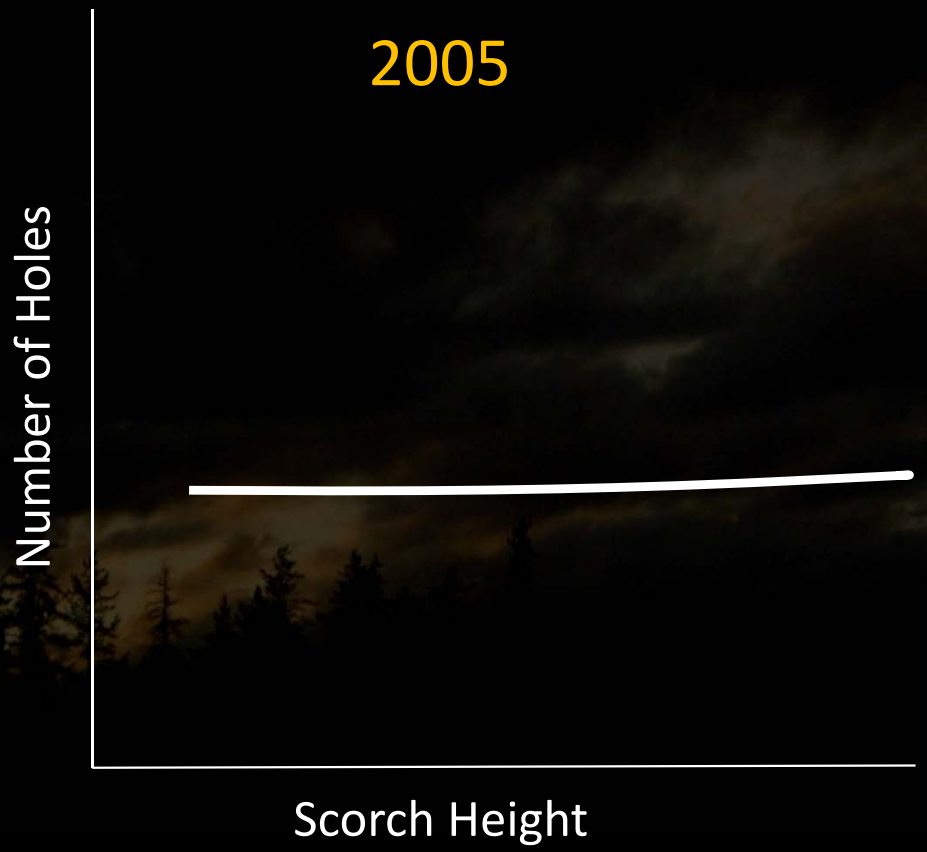


Elevation

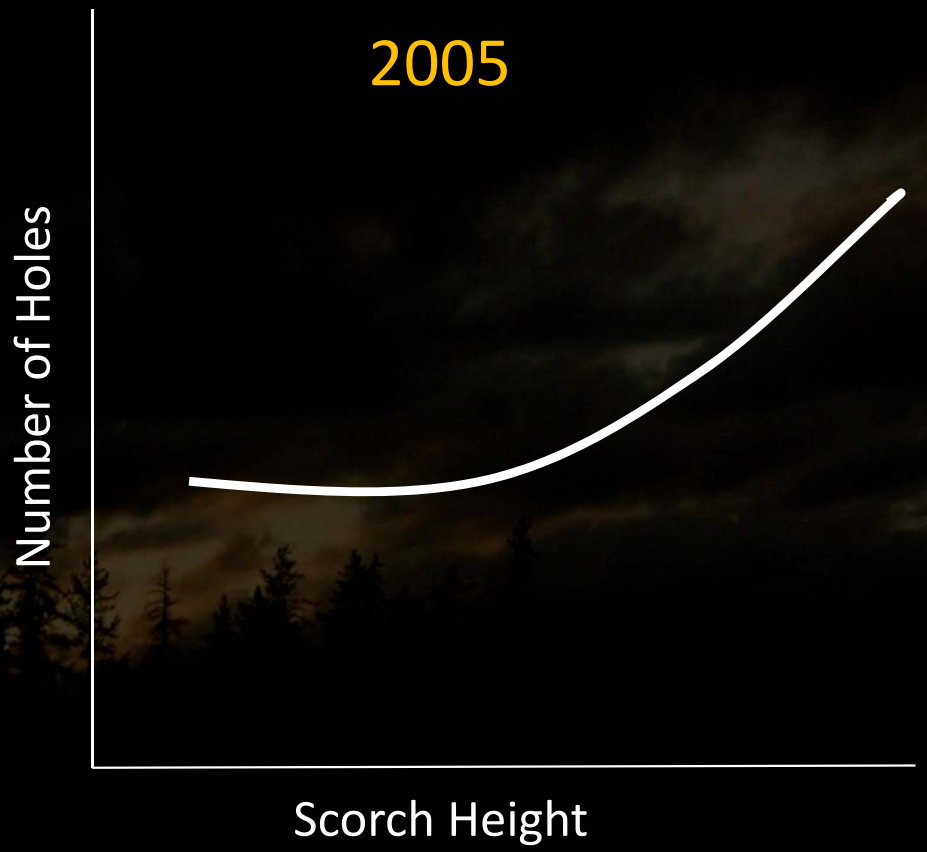


Tree Size

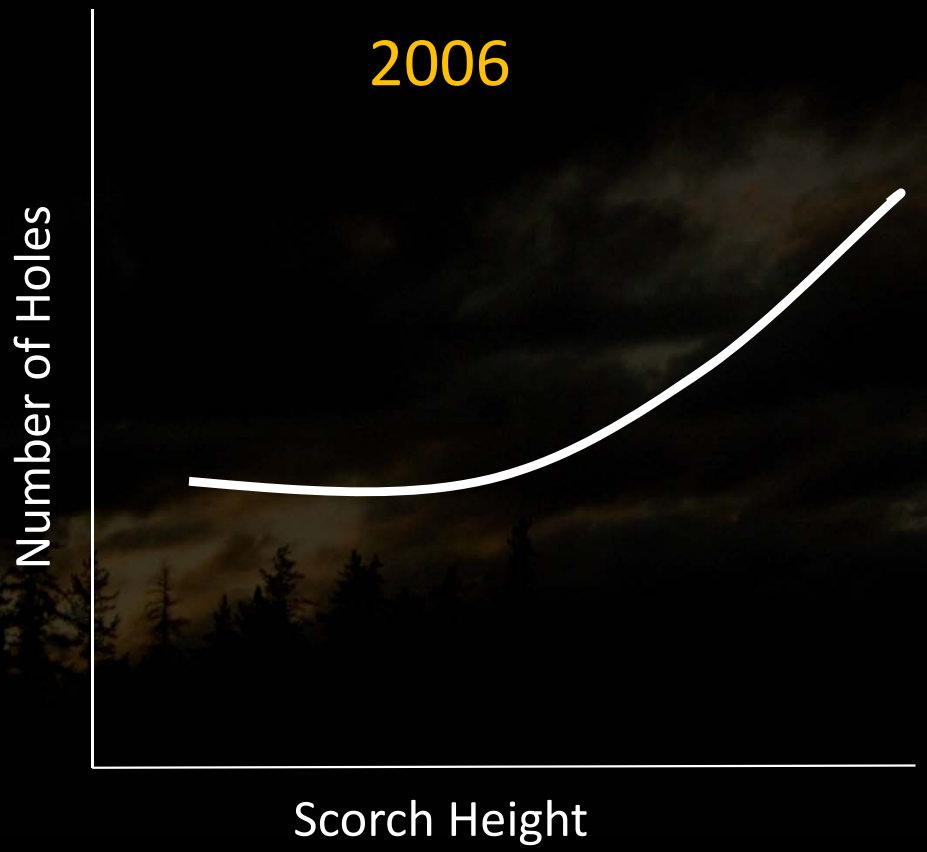
Results



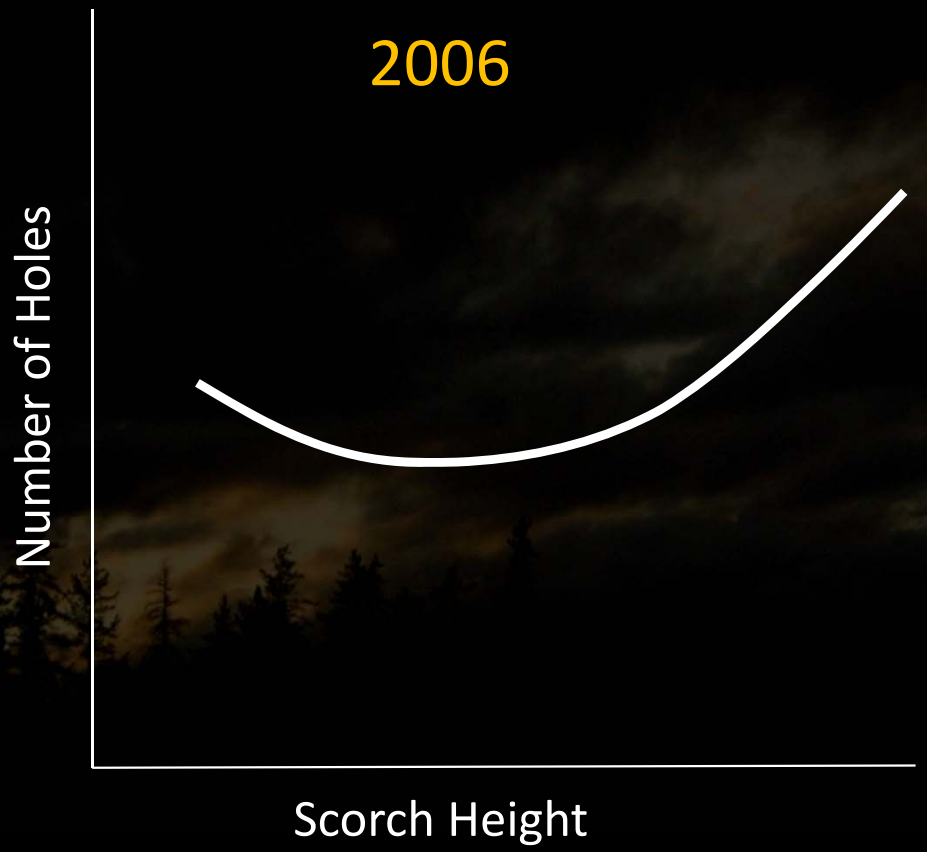
Results



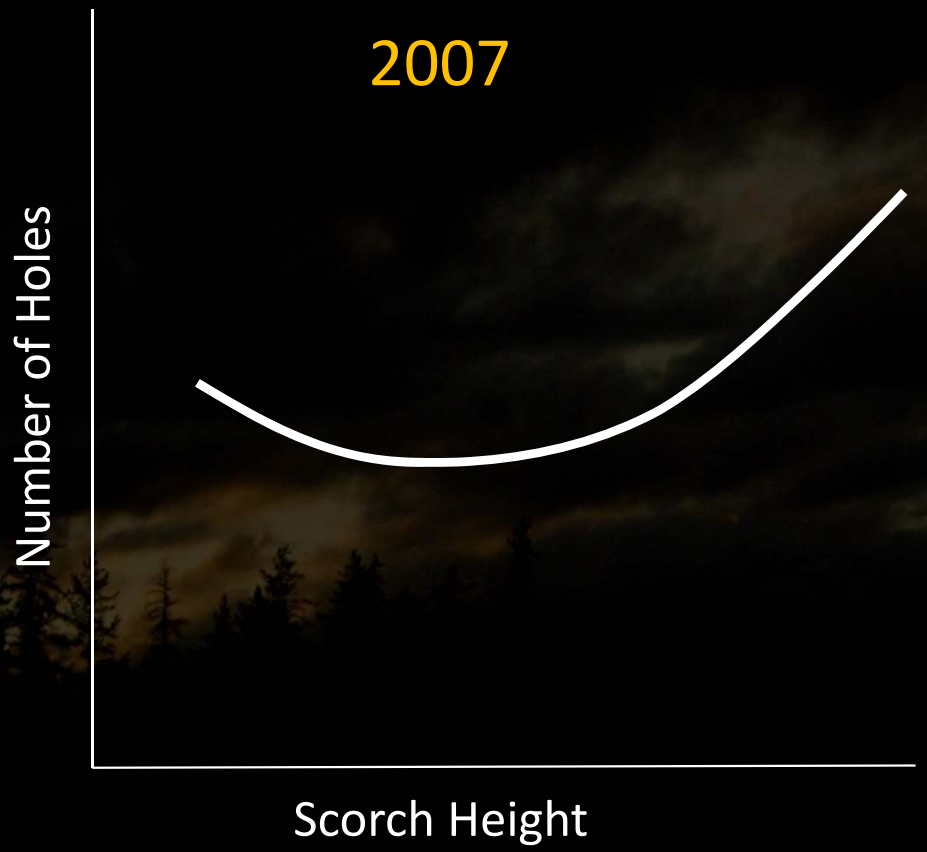
Results



Results



Results



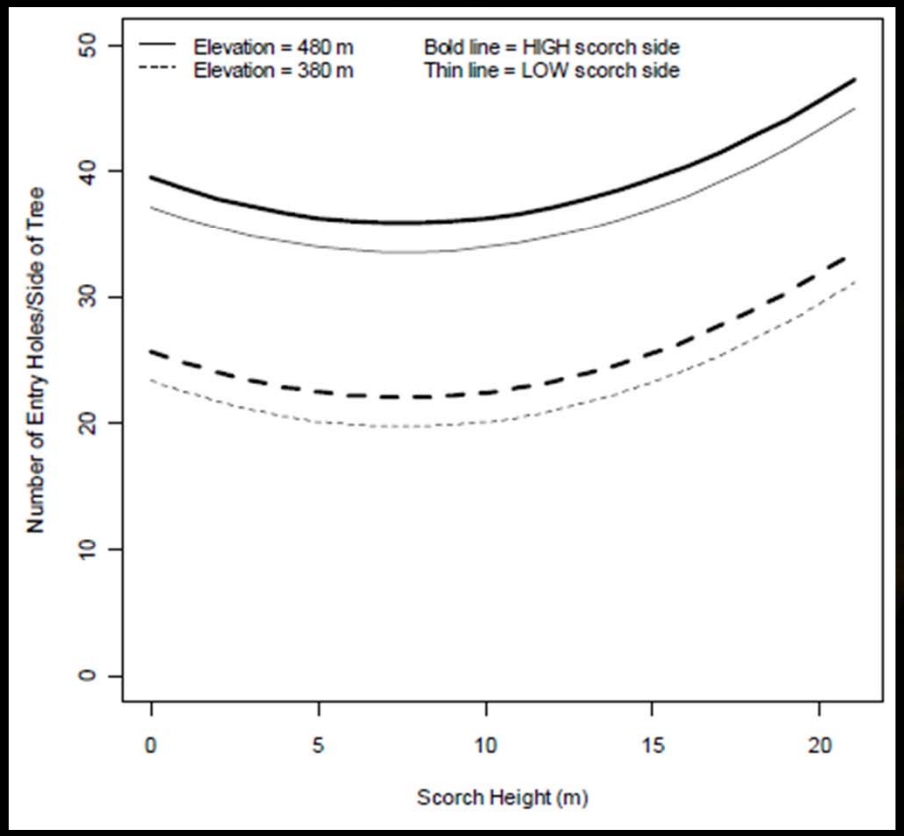
Conclusions

- Damage increases with fire intensity

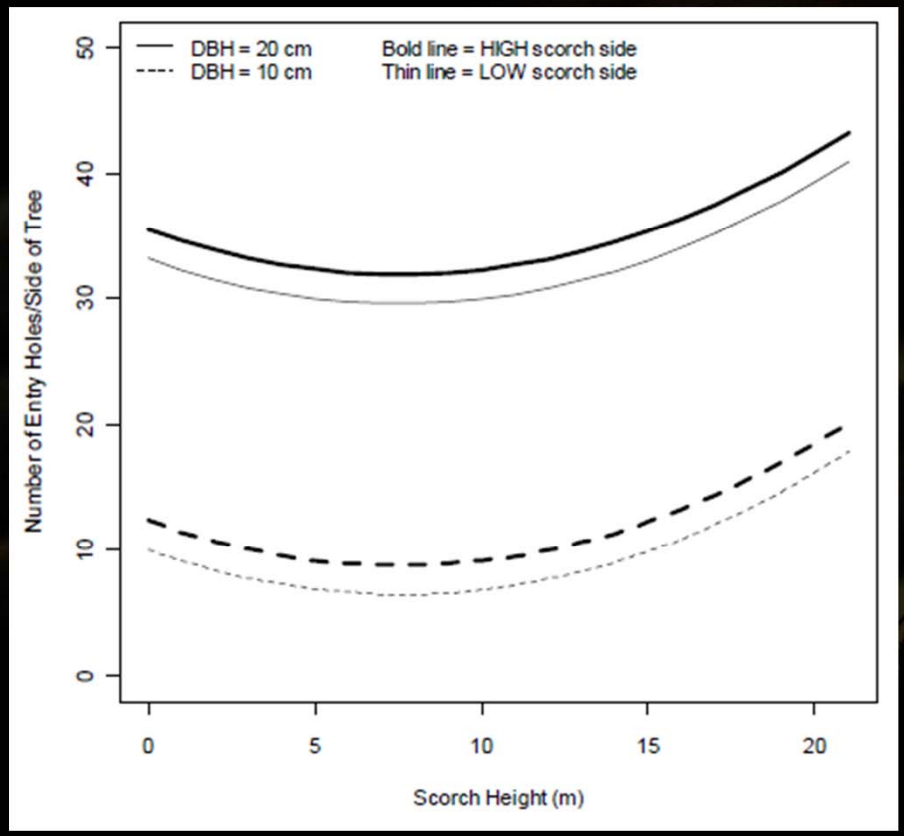
Conclusions

- Damage increases with fire intensity
- How important is this difference?

Conclusions



Elevation



Tree Size

Conclusions

- Industry Standards

Conclusions

- Industry Standards
  - Greater than 11 holes/1.5m

Conclusions

- Industry Standards
  - Greater than 11 holes/1.5m
    - Downgraded from “Select” to “No. 1”
    - Incurring substantial economic losses

Conclusions

- Recommendations
  - Salvage highly scorched trees first

Conclusions

- Recommendations
  - Salvage highly scorched trees first

    or
  - Leave highly scorched trees unsalvaged

Thank You!

- David Greene
- Timothy Work
- Michel Saint-Germain

- Maryse Marchand
- Annie Hibbert
- Félix Longpré
- Simon Paradis
- Jenna Jacobs
- Luana Graham-Sauvé
- Mélanie Desrochers
- Marc Mazerolle
- Cory Alder
- Geneviève Gélinas
- CEF

cef Centre d'étude de la forêt
Natural Resources Canada Ressources naturelles Canada
NSERC CRSNG
Université Concordia University
UQÀM