Research update on *Sirex noctilio* in North America

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USDA APHIS PPQ

Selected Forest Pests Introduced into North America and Their Impacts

Species	Tree Genera Impacted
Asian longhorned beetle *Anoplophora glabripennis*	*Acer, Aesculus Albizia, Betula, Celtis, Fraxinus, Populus, Ulmus, Salix, Sorbus,* and others
Brown spruce longhorned beetle *Tetropium fuscum*	*Picea and occasionally Abies*
Emerald ash borer *Agrilus planipennis*	*Fraxinus*
Gypsy moth (European and Asian) *Lymantria dispar*	*Quercus, Populus, Ulmus*
Hemlock wooly adelgid *Adelges tsugae*	*Tsuga*
Sirex noctilio	*Pinus*
Winter moth *Operophtera brumata*	*Quercus, Acer, Tilia, Fraxinus, Malus, Vaccinium*

Some Selected Forest Pests Introduced into North America and Their Impacts (continued)

Species	Tree Genera Impacted
Beech bark disease *Nectria coccinea var. faginata* vectored by *Cryptococcus fagisuga*	*Fagus*
Butternut canker *Sirococcus clavigignenti-juglandacearum*	*Juglans*
Chestnut blight *Cryphonectria parasitica*	*Castanea*
Dogwood anthracnose *Discula destructiva*	*Cornus*
Dutch elm disease *Ceratocystis ulmi* vectored by *Scolytus multistriatus* and *Hylorgopinus rufipes*	*Ulmus*
Laurel wilt disease *Ophiostoma* vectored by *Xyloborus glabratus*	*Laurus, Persea, Litsea, Lindera, Sassafras, etc.*
Port Orford cedar disease *Phytophthora lateralis*	*Chaemaecyparis lawsoniana*
Sudden oak death *Phytophthora ramorum*	*Quercus, Lithocarpus* species in many other genera serve as host

Research Focal Areas

- **Survey** – Sentinel “trap trees” traps, attractants (pheromone and kairomones)
- **Control** – Chemical pesticides, bio-pesticides, biological control, stand management, and tree resistance
- **Regulatory Treatments** – physical (heat, vacuum, R.F. & microwave) chipping, and chemical (fumigants and pesticides)
- **Behavior & Biology** – Dispersal propensity and ability, mating and host finding, population dynamics
- **Supporting Work**

2006 Studies – *Sirex noctilio*

- Test the feasibility of using trap trees to attract *Sirex noctilio* in North America
- Optimal trap and lure tests
- Log attractiveness study
- Mating behavior
- Nematode search
- *Sirex noctilio* impacts

Tree Girdling Study

Objectives: Determine the sequence of attack by *Sirex* and other insects

Determine the prevalence of attack by *Sirex* on three species of pine

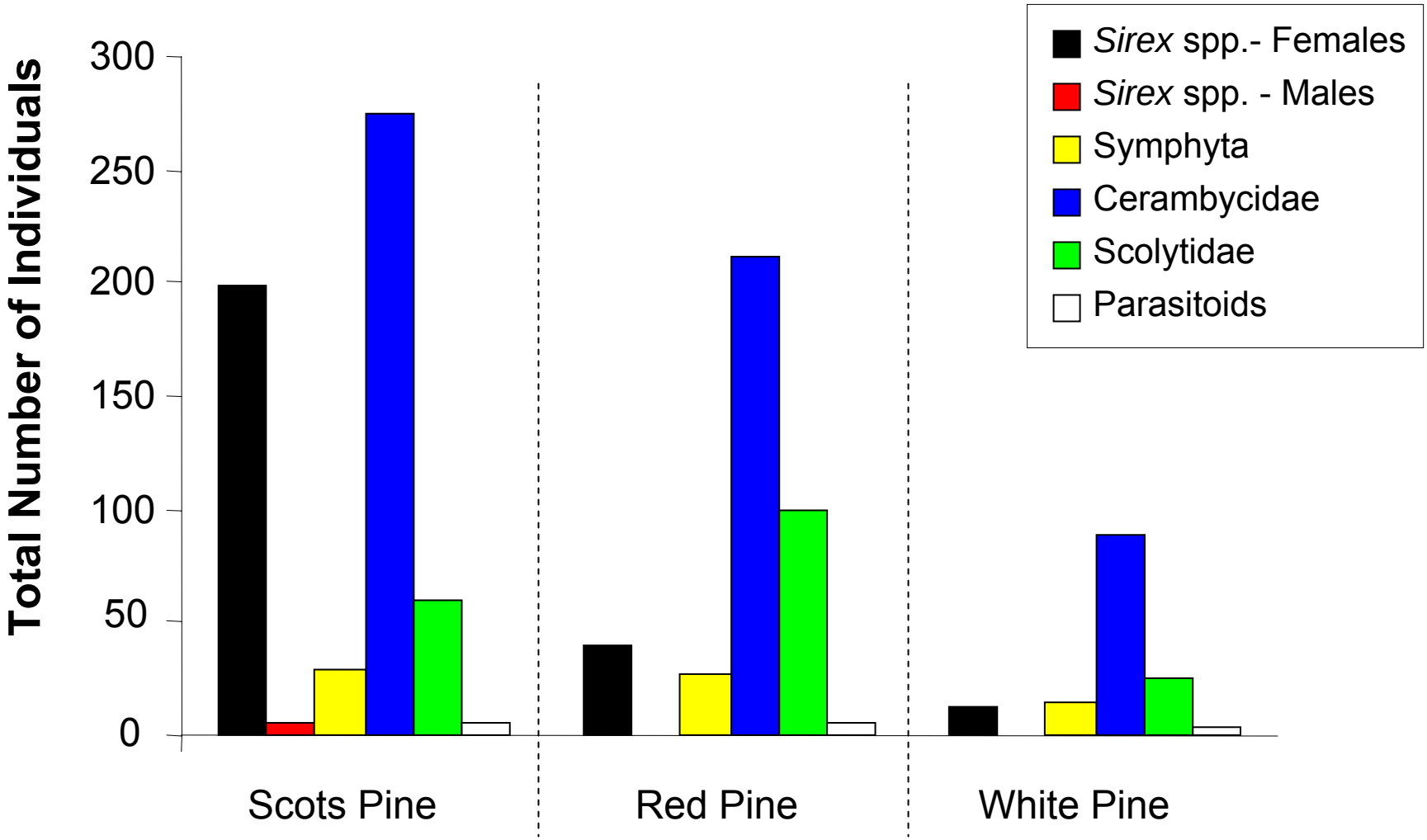
Tree Girdling Study

- Three host species
  - Scots pine (*Pinus sylvestris*)
  - Red pine (*P. resinosa*)
  - White pine (*P. strobus*)

- Three girdle dates (Spring 2006)
  - May 17
  - May 31
  - June 12

  - For each host species / girdle date group 3 replicates were performed. Five trees were girdled with Dicamba in each replicate.

Total Number of Insects Collected on Sticky Panels



Tree Girdling Study

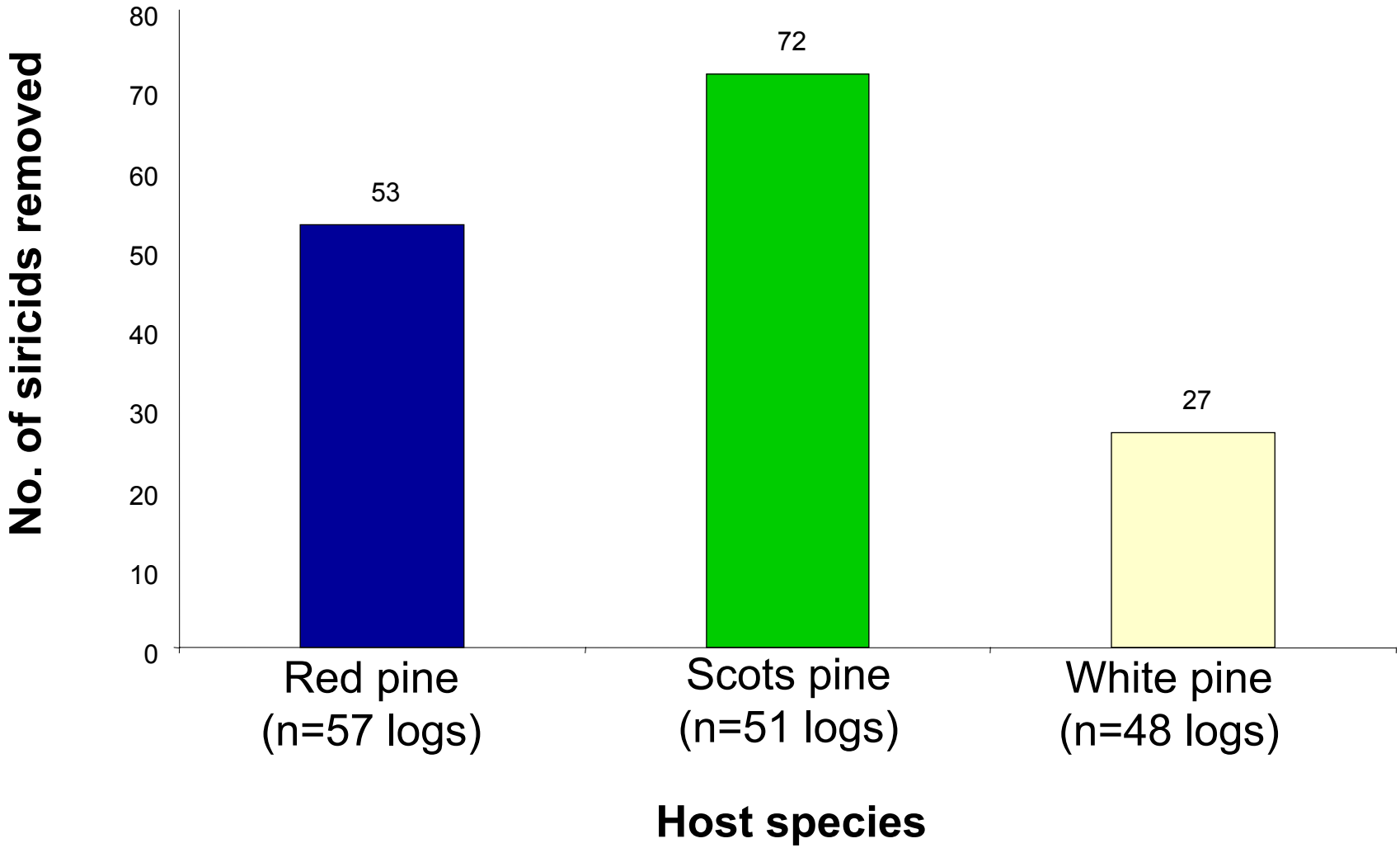
All paneled trap trees were felled Oct/Nov 2006

Logs returned to lab in Syracuse NY

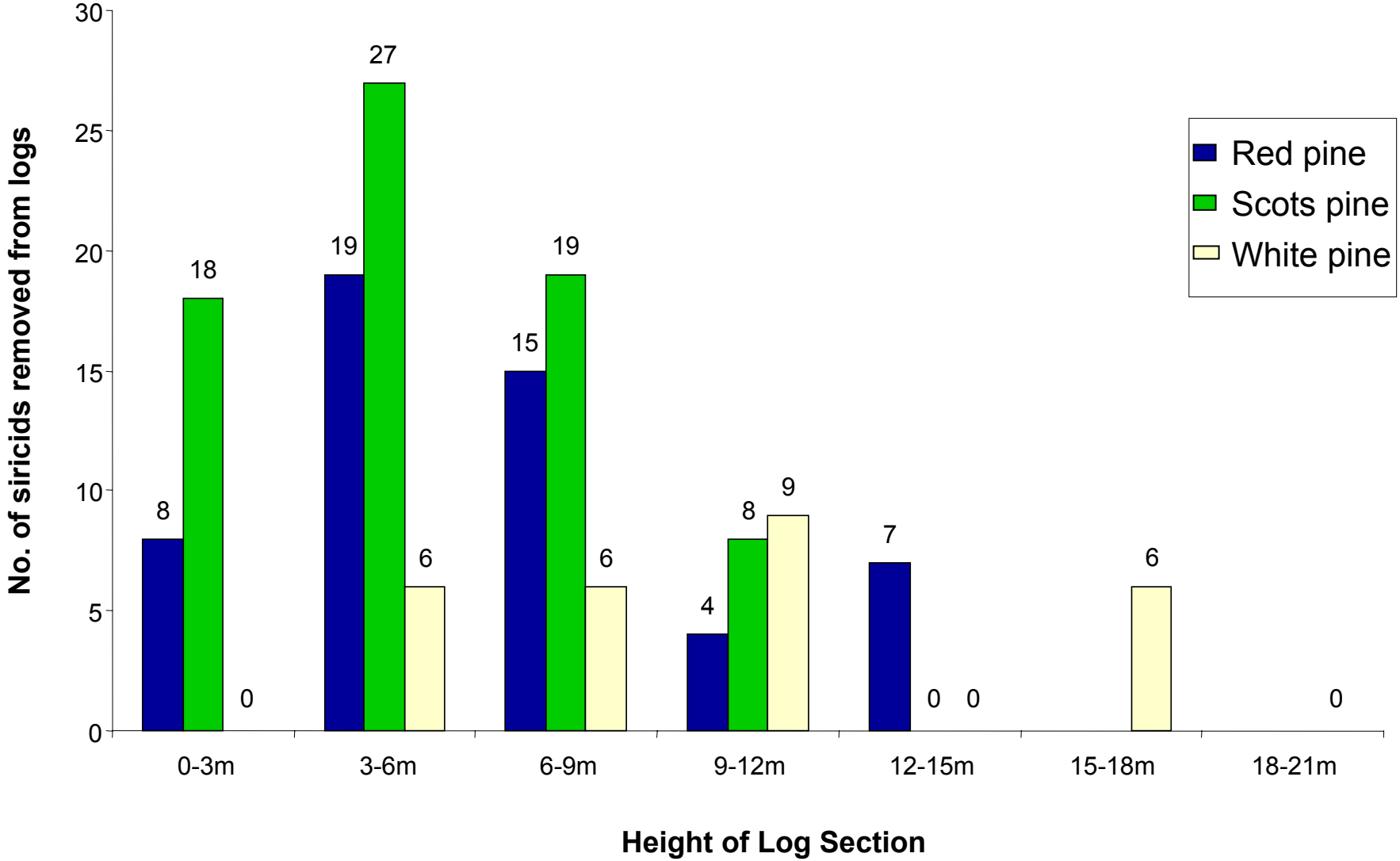
Logs placed in barrels for emergence (checked weekly)

15% of logs from each tree were split and assessed

Siricids Removed from a Subsample of Logs Returned to the Laboratory



Total number of siricids removed from logs representing 7 height groups



Trap Design & Optimal Lure

Pine volatiles

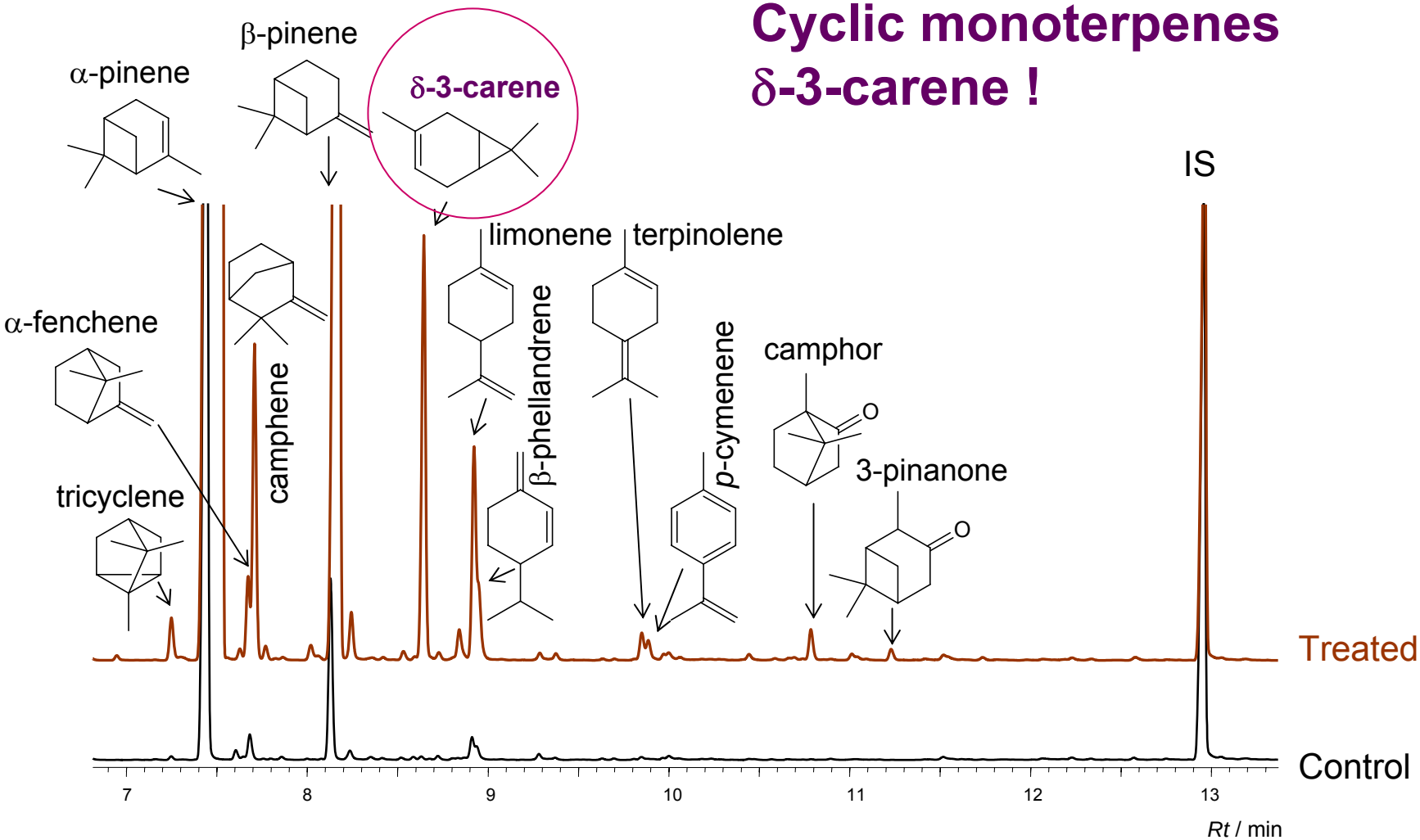
Volatile collection off living trees

- Treatment with herbicide vs. control

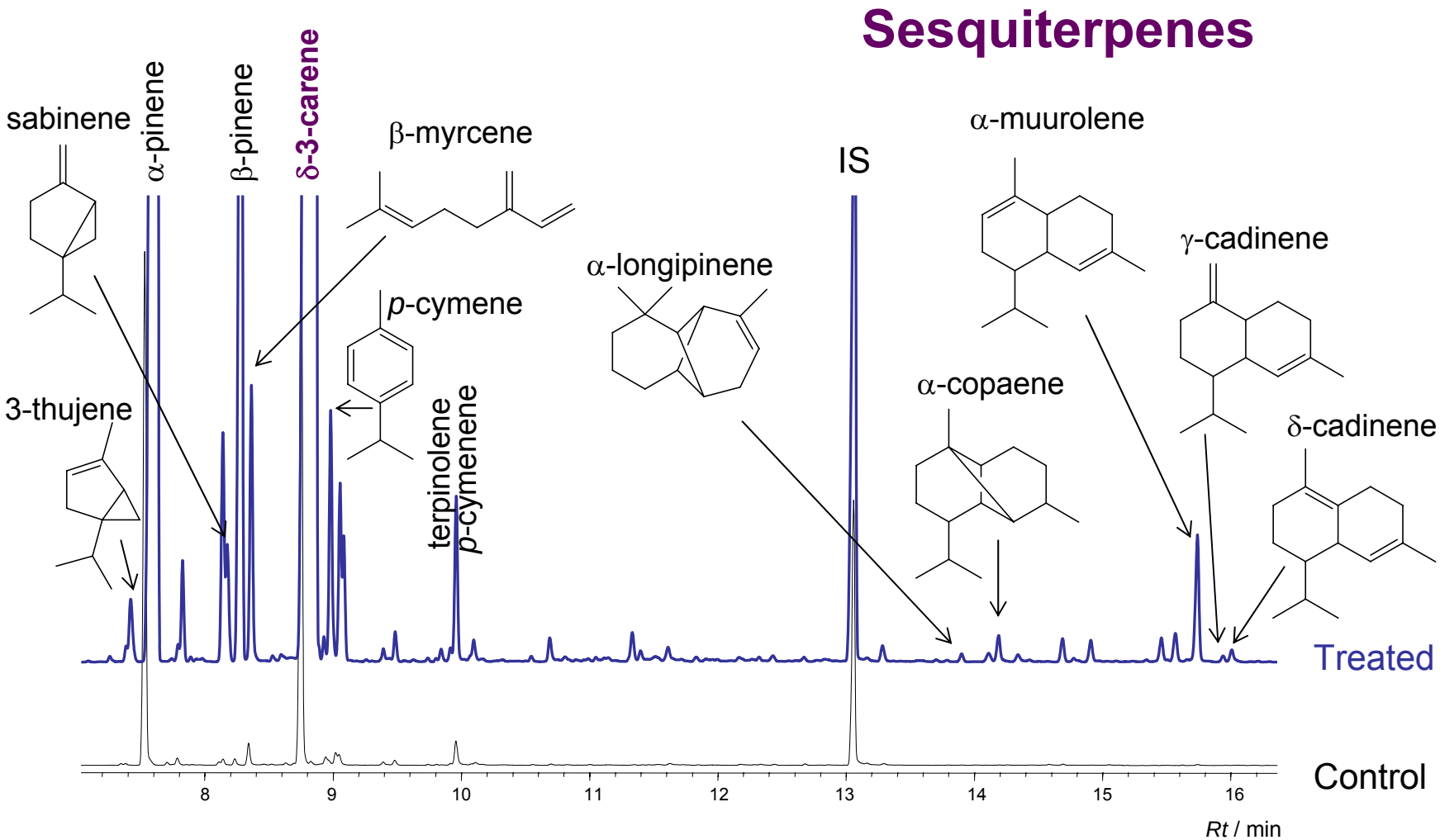
- Red and Scotch pine

- Trunk vs. needles

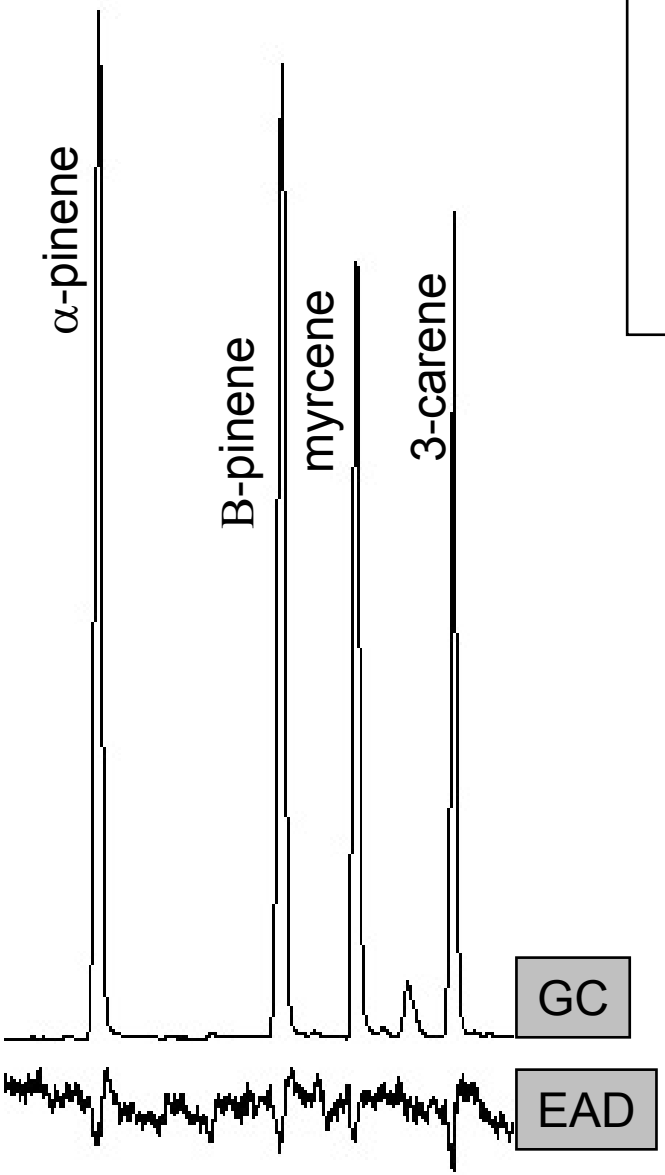
Red pine (*Pinus resinosa*)

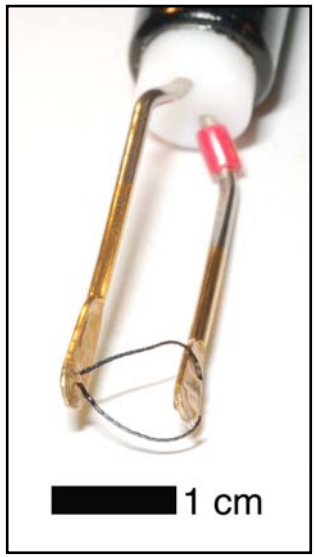


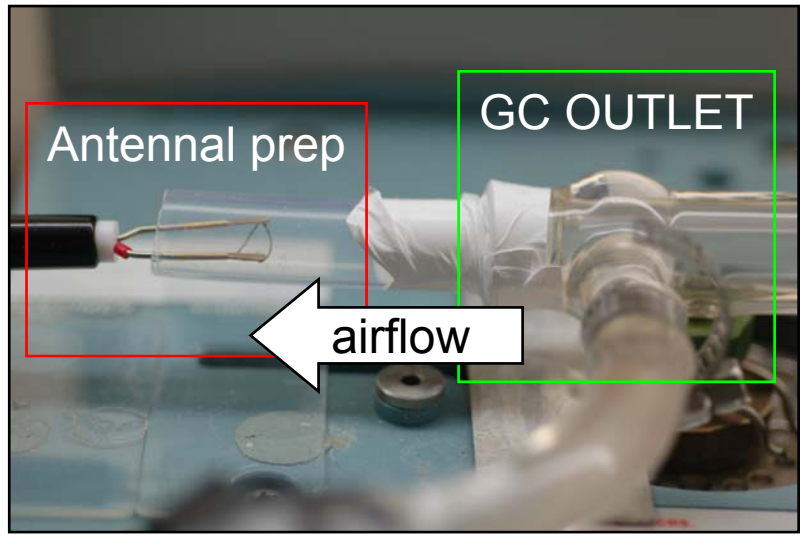
Scots pine (*Pinus sylvestris*)



GC-EAD







Sirex female antennal preps respond to monoterpene volatiles identified in tree bark aerations.

Antennae also respond to many other unidentified volatiles in tree aeration samples

Identification of tree volatiles very difficult

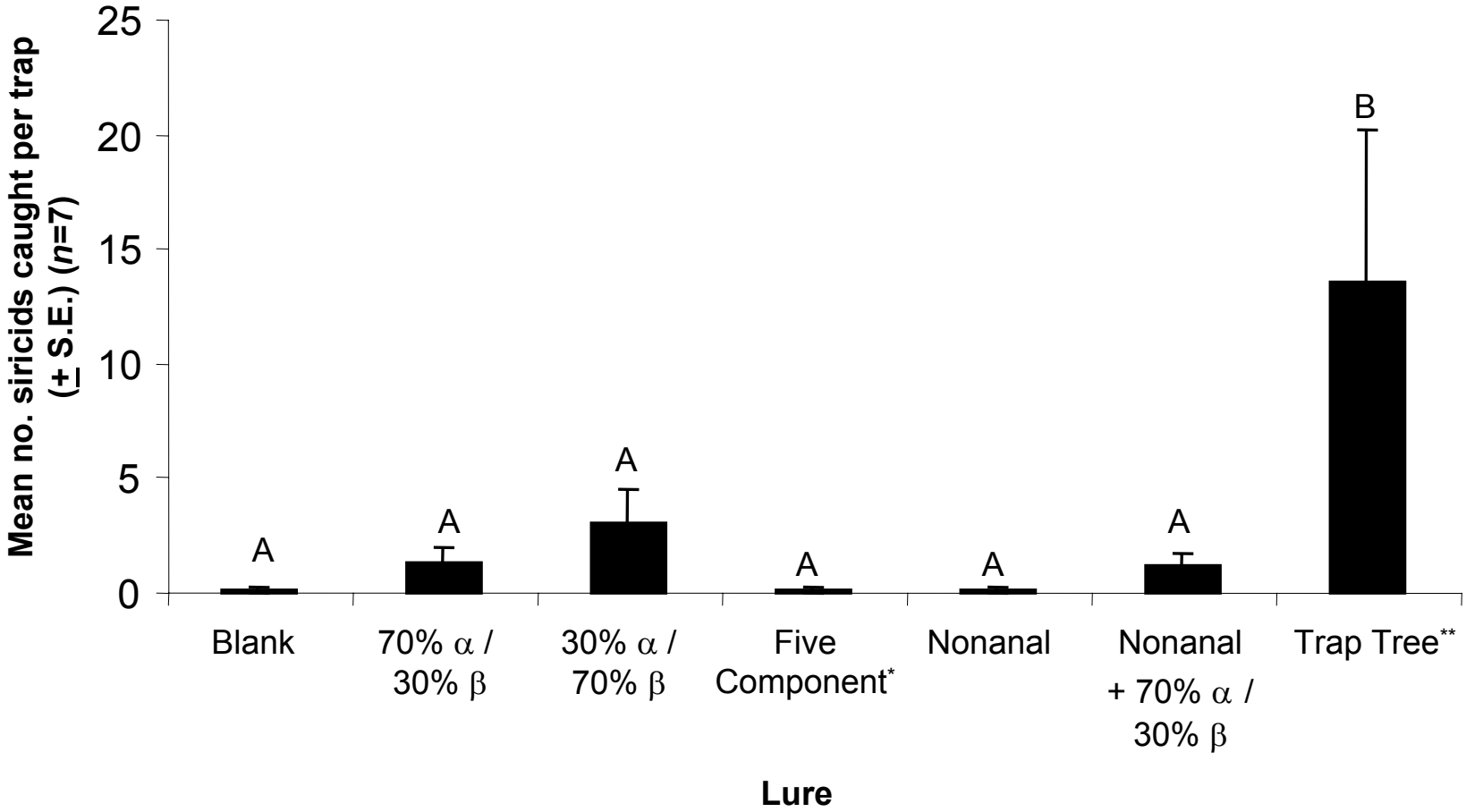
Work is ongoing to develop a more complete STRESS TREE BLEND lure

Optimal Lure 2006

Treatments

- 70% α-pinene, 30% β-pinene
- 30% α-pinene, 70% β-pinene
- Nonanal
- Nonanal + 70% α-pinene, 30% β-pinene
- 5 Component (α-pinene, β-pinene, limonene, myrcene, carene)
- Trap tree (girdled June 19)

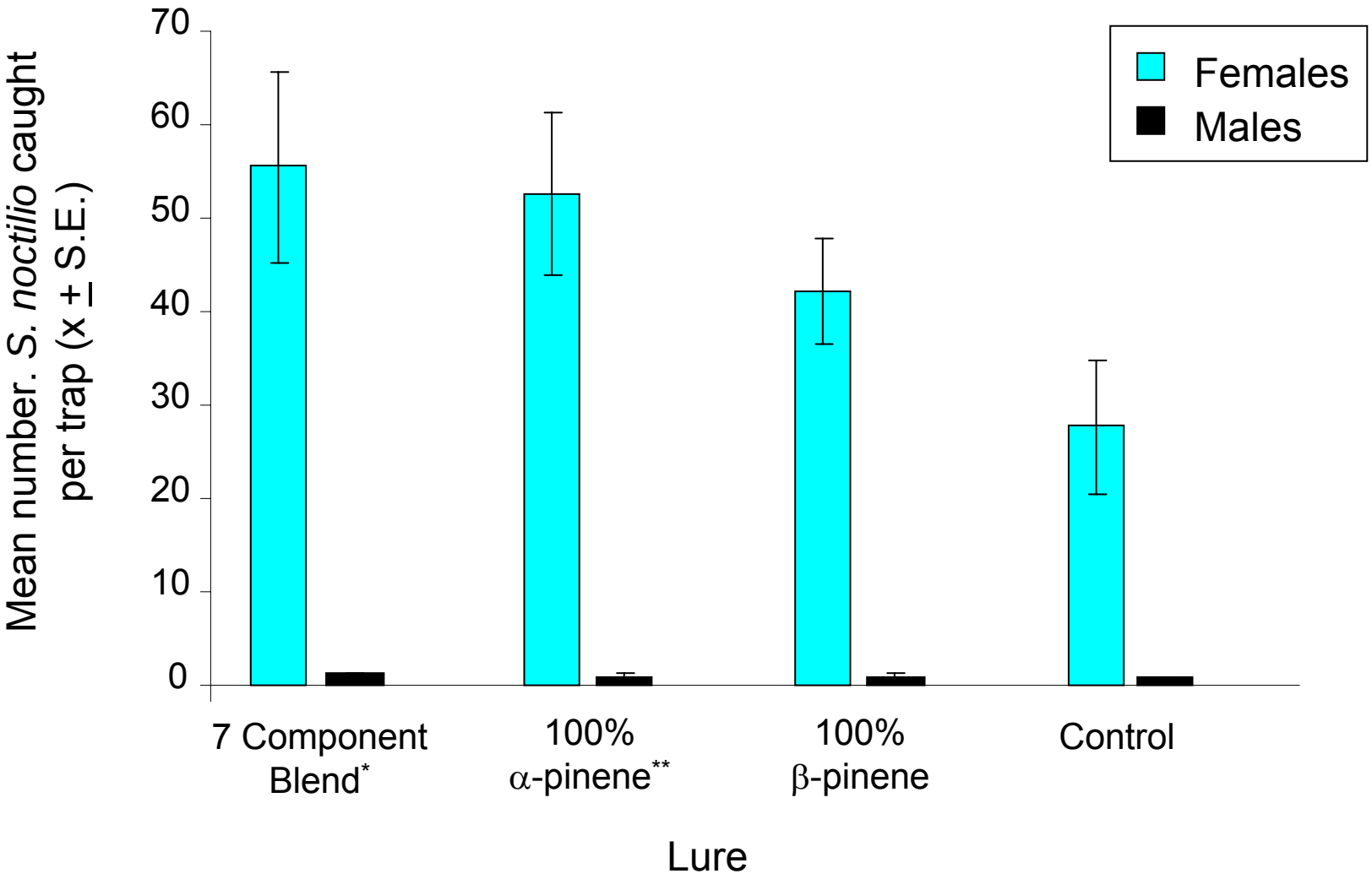
2006 Semiochemical Lure Comparison -- NY



* -- 63% (+)-a-pinene, 30% b-pinene, 3%-limonene, 3 % myrcene, 1% carene

** -- Trap trees were girdled on June 18 and 19, 2006

2006/2007 Semiochemical Lure Comparison – SOUTH AFRICA



* - 60% α-pinene, 3% β-pinene, 2% camphene, 2% β-myrcene, 30% 3-carene, 2% limonene, 1% β-phellandrene
* - 75% (+)

2006 Trap Design -- NY

Sante

Crossvane

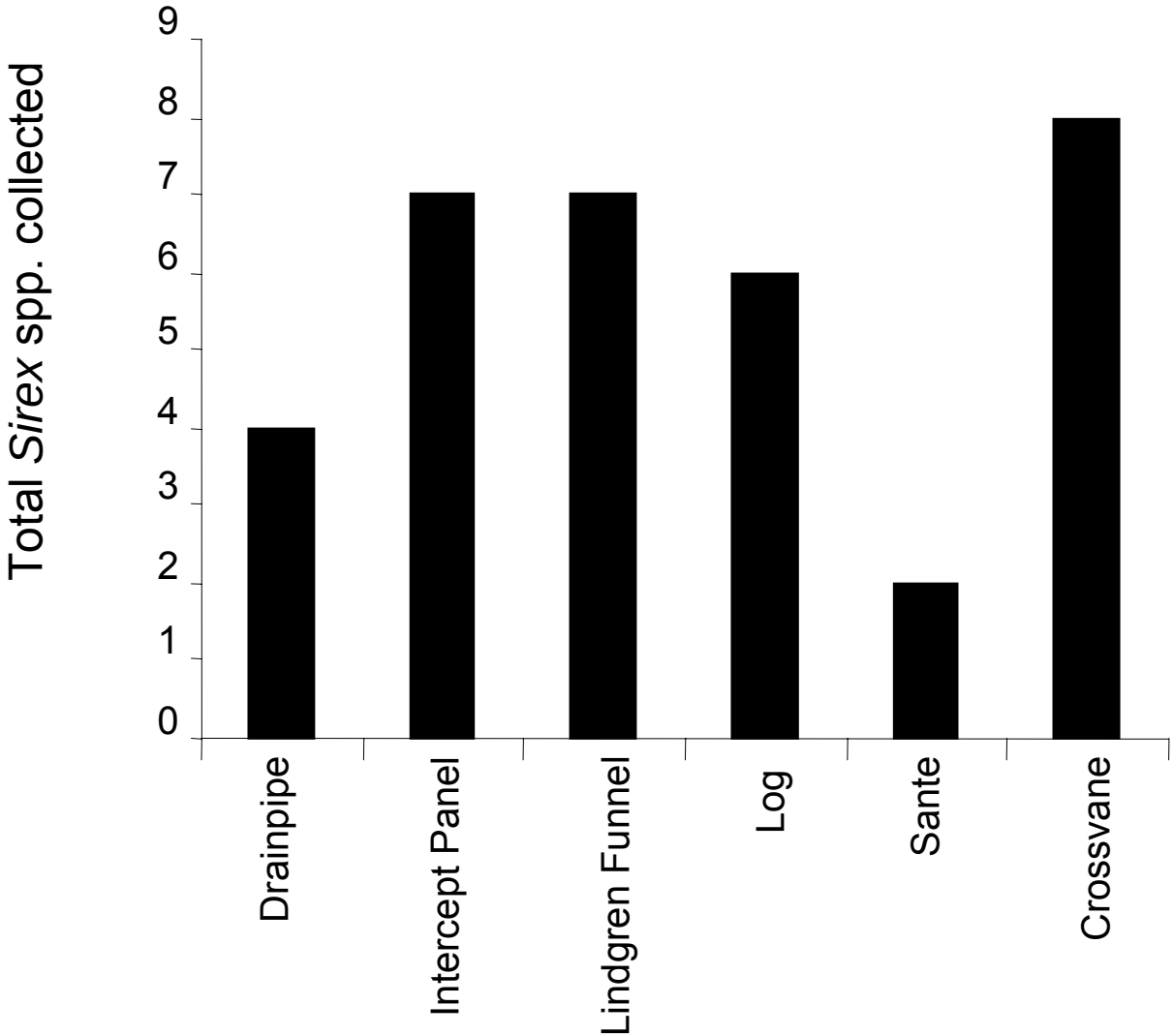
Log

Intercept Panel

Drainpipe

Lindgren Funnel

2006 Trap Design Study



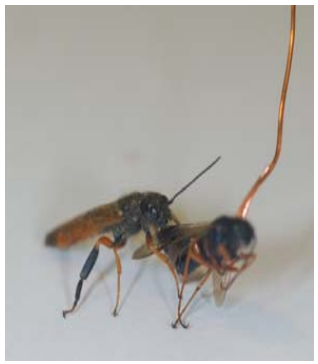
Conclusions

- Trap trees were effective for attracting siricids. Scots pine were attacked more often than other species
- Trap/lure: more tests needed

Mating behavior

Antennation

Grasping



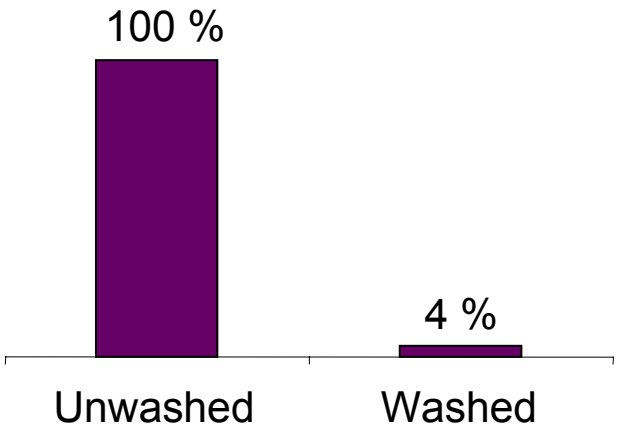
Mounting

Abdomen bending

Copulation

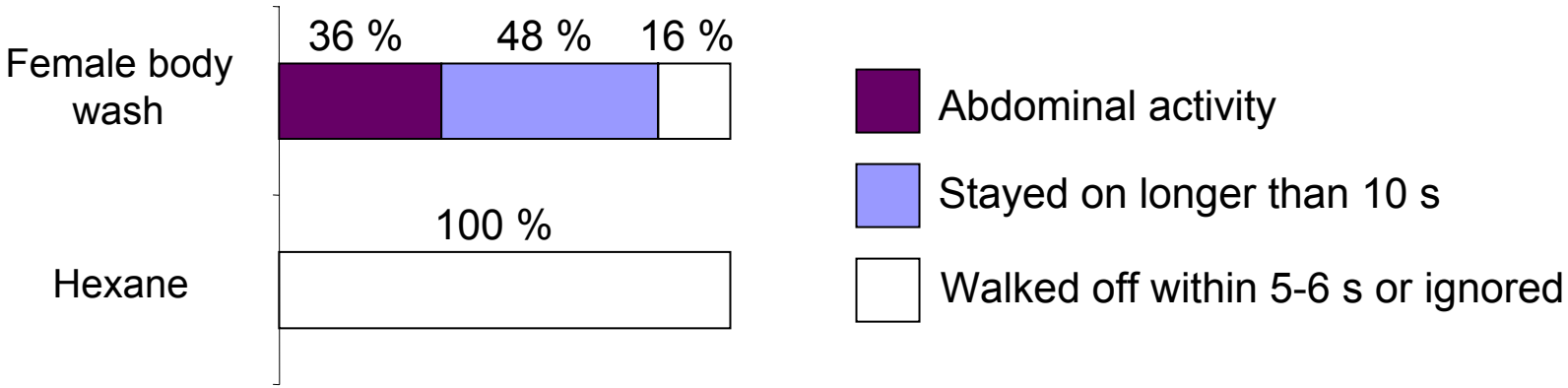
Behavioral assays

A) Female models*
Abdominal bending



*4 females
3-4 males each
5 replicates each

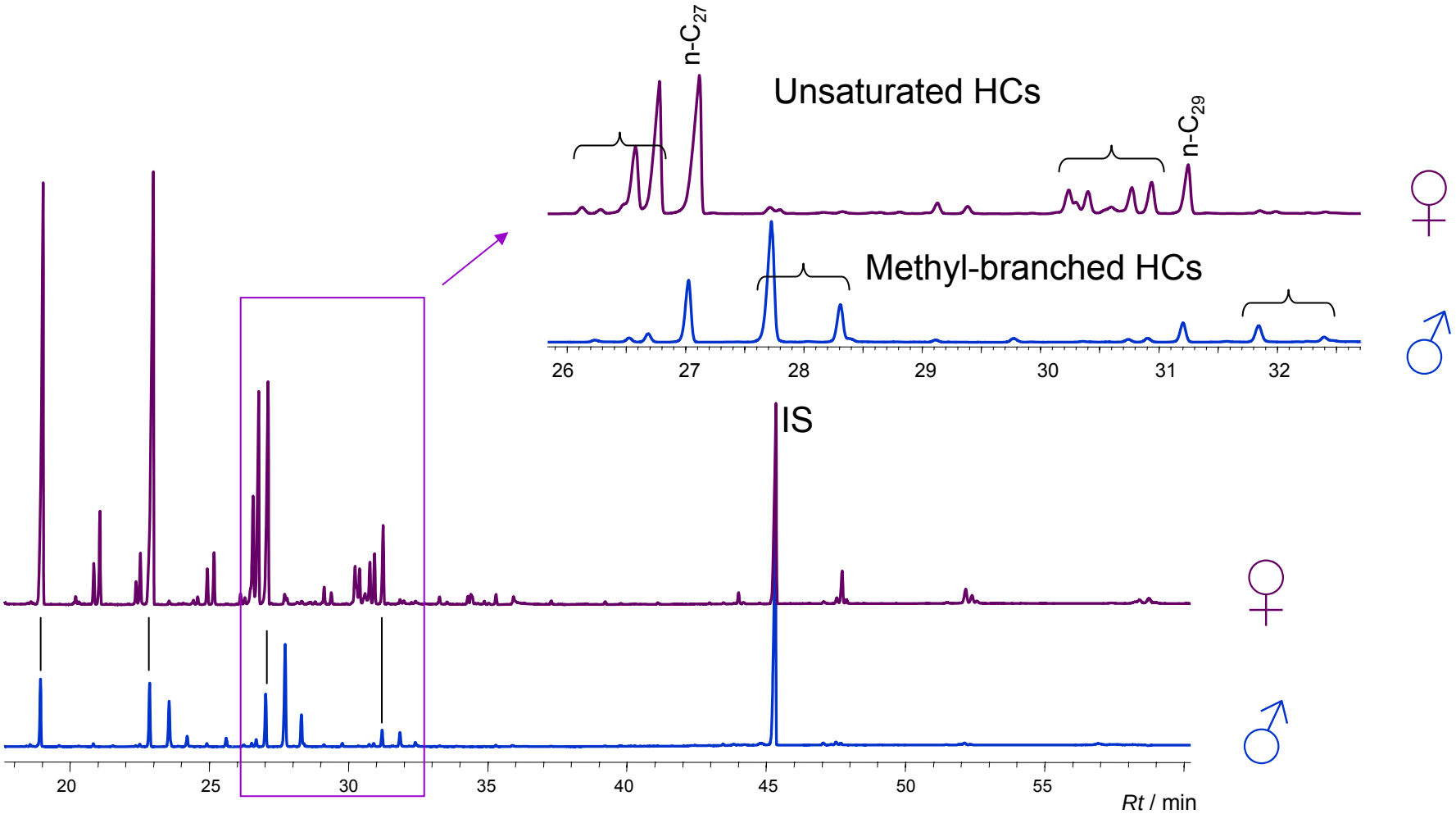
B) Body wash applied to an Eppendorf pipette**



**5 males, 5 replicates each

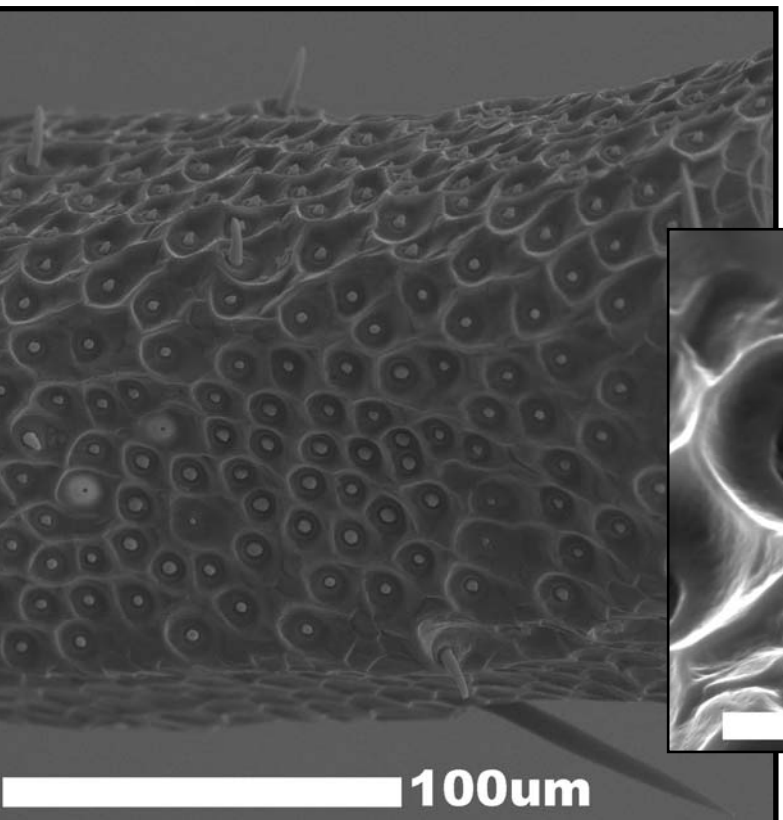
Cuticular hydrocarbons (HCs)

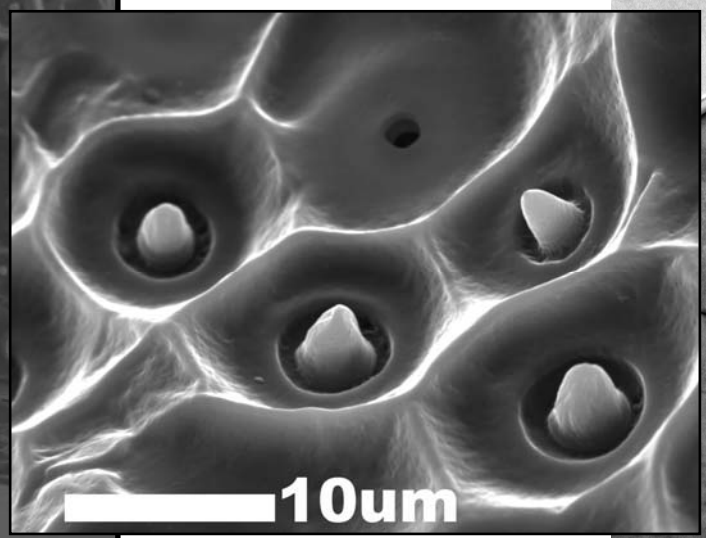
Hexane body washes

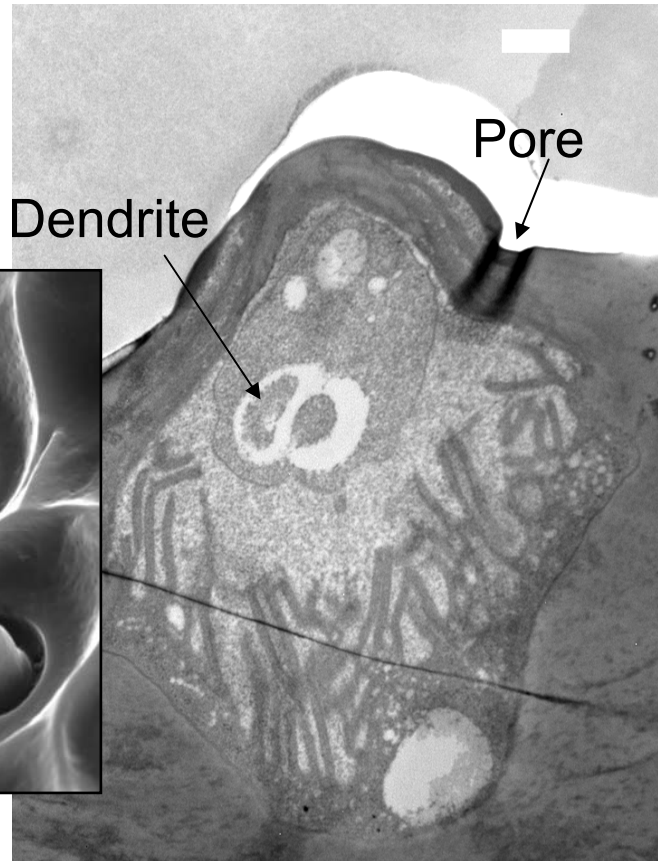


Antennal morphology

Antennae are covered in small uniporous sensory pegs. Structure is suited to contact chemo-reception.







2007

- Trap trees – operational
- Age of girdle
- Girdling techniques
- Trap/lure tests

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- USDA APHIS PPQ - Dave Williams, Robin Tait, Dave Lance, Scott Myers and Ron Mack
- USDA FOREST SERVICE - Kevin Dodds
- PENN STATE UNIVERSITY - Jim Tumlinson & Katalin Boroczky

Acknowledgments

- Dave Cowan, Mike Crawford, Stefanie Kroll, Mike Morse, Mike Rietz and Dave Tessein
- Garret Dubois
- Landowners in NY