Forest Health Cooperative
School of Forestry and Wildlife Sciences
Auburn University

Silviculture Disturbances Effect on Root-feeding Bark Beetle Population Dynamics and Incidence of Ophiostomatoid Fugal Species in Loblolly Pine Stands

Yuan Zeng, Rebecca Kidd and Lori Eckhardt

Introduction

- Loblolly pine (*Pinus taeda*) is a native pine species to the southern U.S.

Introduction

- Loblolly pine decline (LPD) is caused by interaction of environmental, insect, and pathogen agents (Eckhardt and Menard, 2007).

    1. Slope and aspect

    2. Sandy, well-drained soils

    3. *Leptographium* spp.

    4. Root-feeding bark beetles and weevils

Introduction

- Declining loblolly pines appear to be more vulnerable to attack by SPB than healthy trees in the southeastern U.S. (Otrosina *et al*.,1997 ; Hess *et al*.,1999).

- Higher numbers of Scolytidae following anthropological disturbances were reported in longleaf pine (*P. palustris*) stands on the Coastal Plain of Alabama (Campbell *et al*., 2008).

- **Study I**

  Thinning effect on root-feeding bark beetle populations.

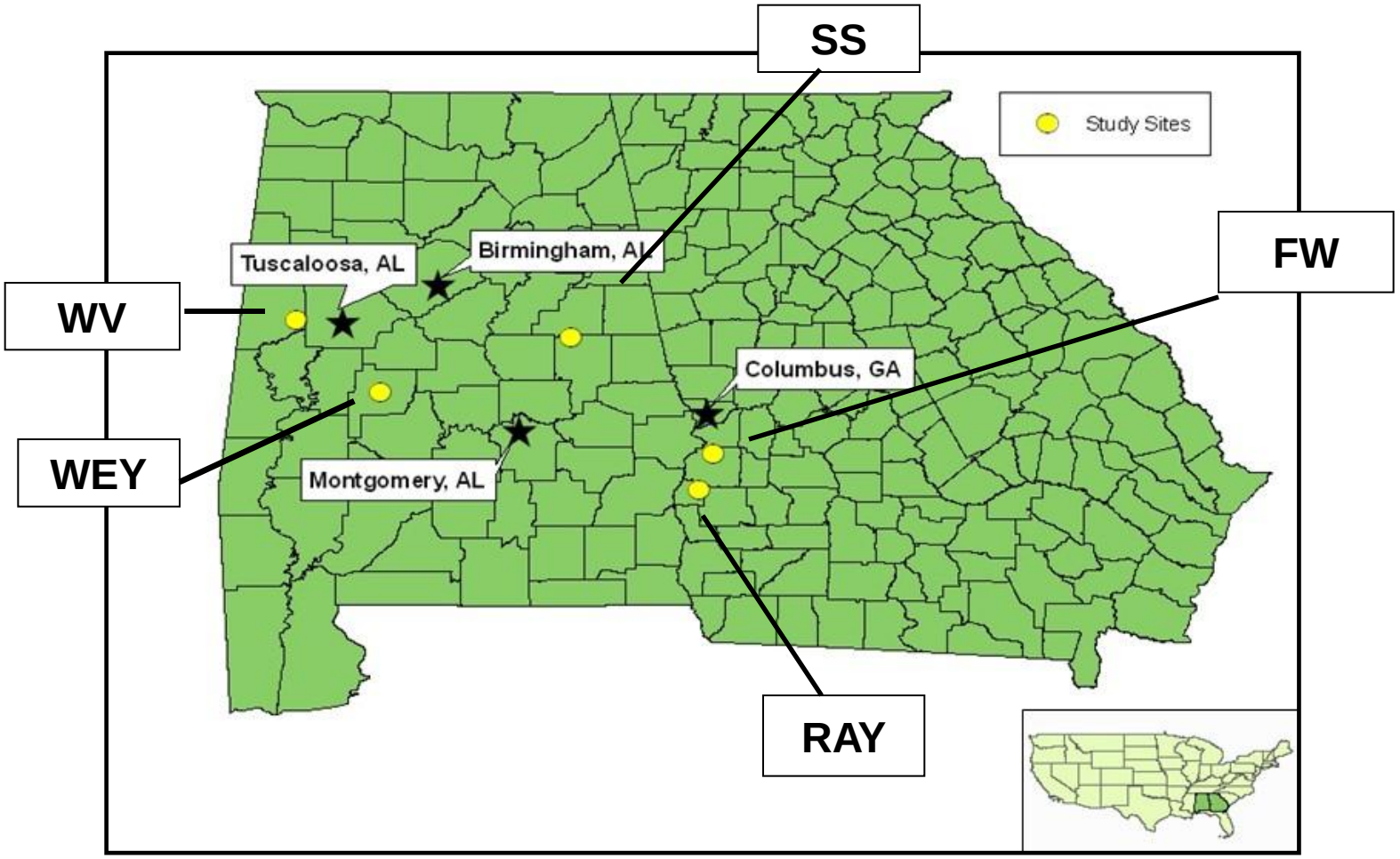
- **Study II**

  Harvesting (site preparation & disturbances) effect on populations of root-feeding bark beetle.

- **Study III**

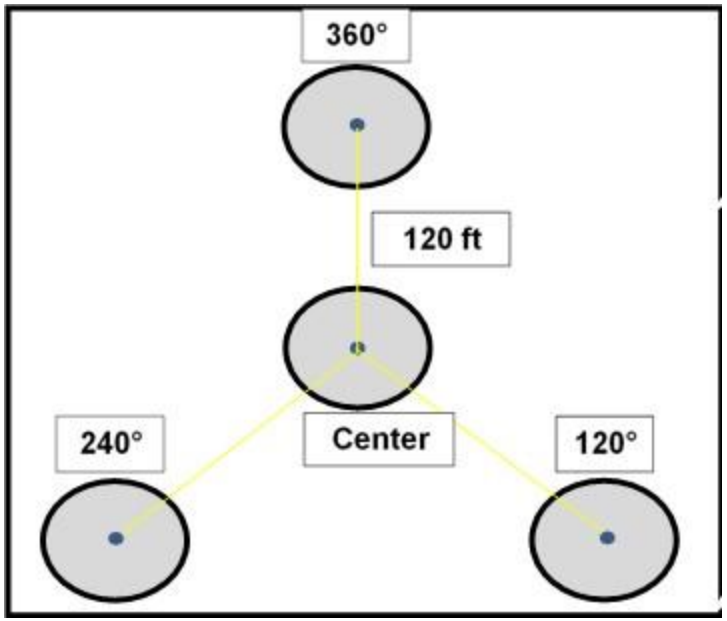
  Factors associated with incidence of Ophiostomatoid fungal species contributing to LPD.

Methods


SS
FW
WV
WEY
RAY
Study Sites
Tuscaloosa, AL
Birmingham, AL
Columbus, GA
Montgomery, AL

Methods

- Nine Forest Health Monitoring (FHM) research plots



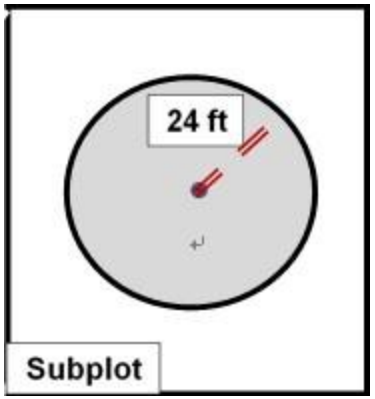


Fig 1. Plot Layout in Each Selected Plot

Methods

- Insect Sampling (for 1 year pre- & 1 year post treatment)

Fig 2. Three Different Traps

Methods

- Crown Evaluation Measurements

  DBH, crown density, crown transparency, etc. were measured in each subplot.

- Site Characteristic Measurements

  Basal area, aspect, landform, topographic position were record in center subplot.

Fig 3. Crown Evaluation

Methods

- Three loblolly pines per subplot were chosen randomly. From each tree, two lateral roots were sampled to 1m from the base horizontally.
- Twelve trees per plot were sampled pre-treatment.

Fig 4. Root Sampling

Methods

- Two roots per stump were sampled, three stumps per center subplot in CC plots.

Fig 5. Stump Sampling

Results

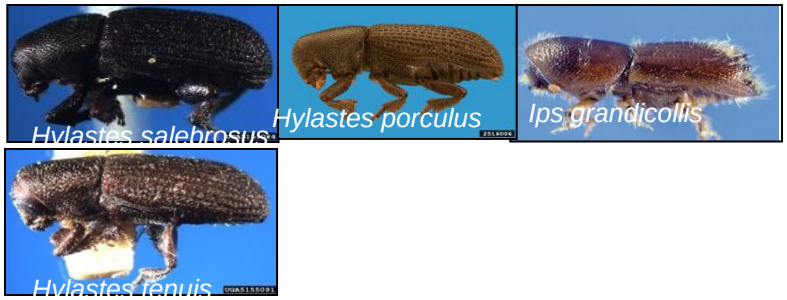
Insect Species Captured

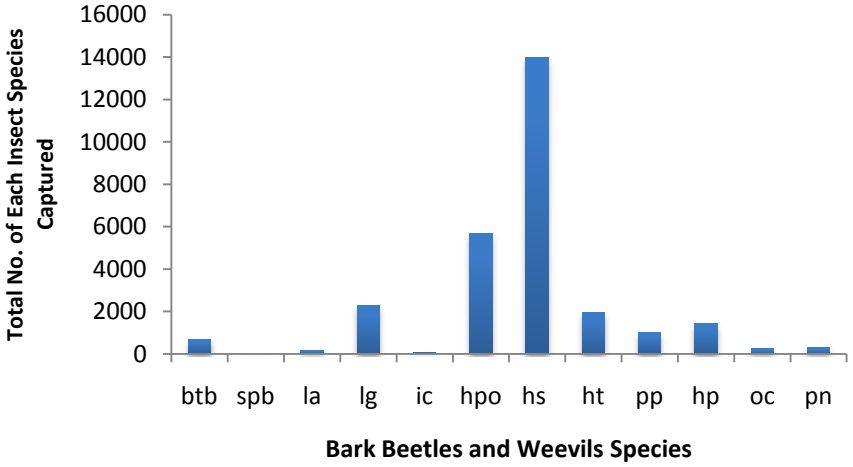
Dendroctonus terebrans	*Pityoborus comatus*
Dendroctonus frontalis	* *Xylosandrus crassiusculus*
Ips avulsus	*Xylosandrus compactus*
Ips grandicollis	*Xylosandrus germanus*
Hylastes porculus	* *Xylosandrus mutilatus*
Hylastes salebrosus	*Xyleborus atratus*
Hylastes tenuis	*Xyleborinus saxesenii*
Orthotomicus caelatus	*Gnathotrichus materiarius*
Pachylobius picivorus	*Monarthrum mali*
Hylobius pales	*Monarthrum fasciatum*
Pissodes nemorensis	* *Dryoxylon onoharaensum*
Xyleborus pubescens	*Trypodendron scabricollis*
Xyleborus ferrugineus	

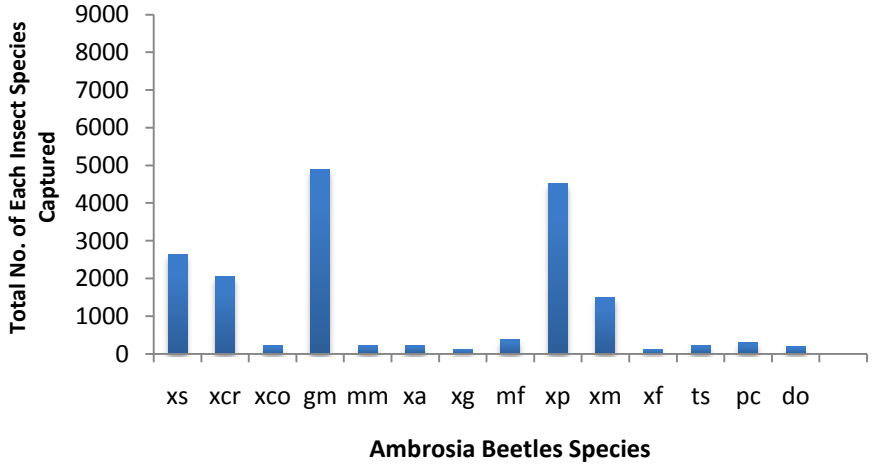
* Exotic Species

Results

Insect Captured for Total







Preliminary Results

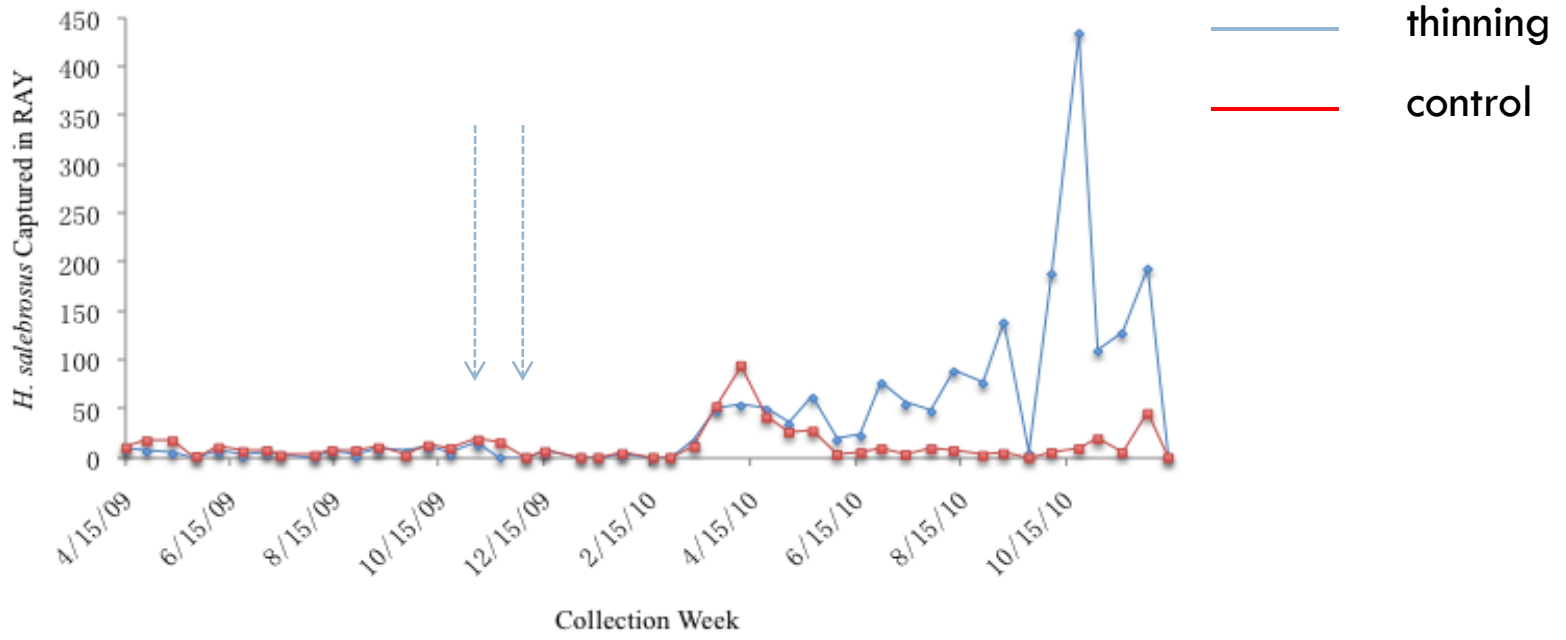
Thinning Timelines

Study Sites	3rd Row Thinning
SS	Nov. 20th, 2009-Feb.24th,2010 (plot 2) Oct. 9th-Dec. 17th, 2010 (plot 1 & 3)
RAY	Nov. 19th,2009-Dec. 4th, 2009
WEY	July 25th, 2010-Aug. 10th,2010 (Plot 2 has not been thinned)
WV	July 21st, 2010-Aug. 5th, 2010

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes salebrosus* in RAY

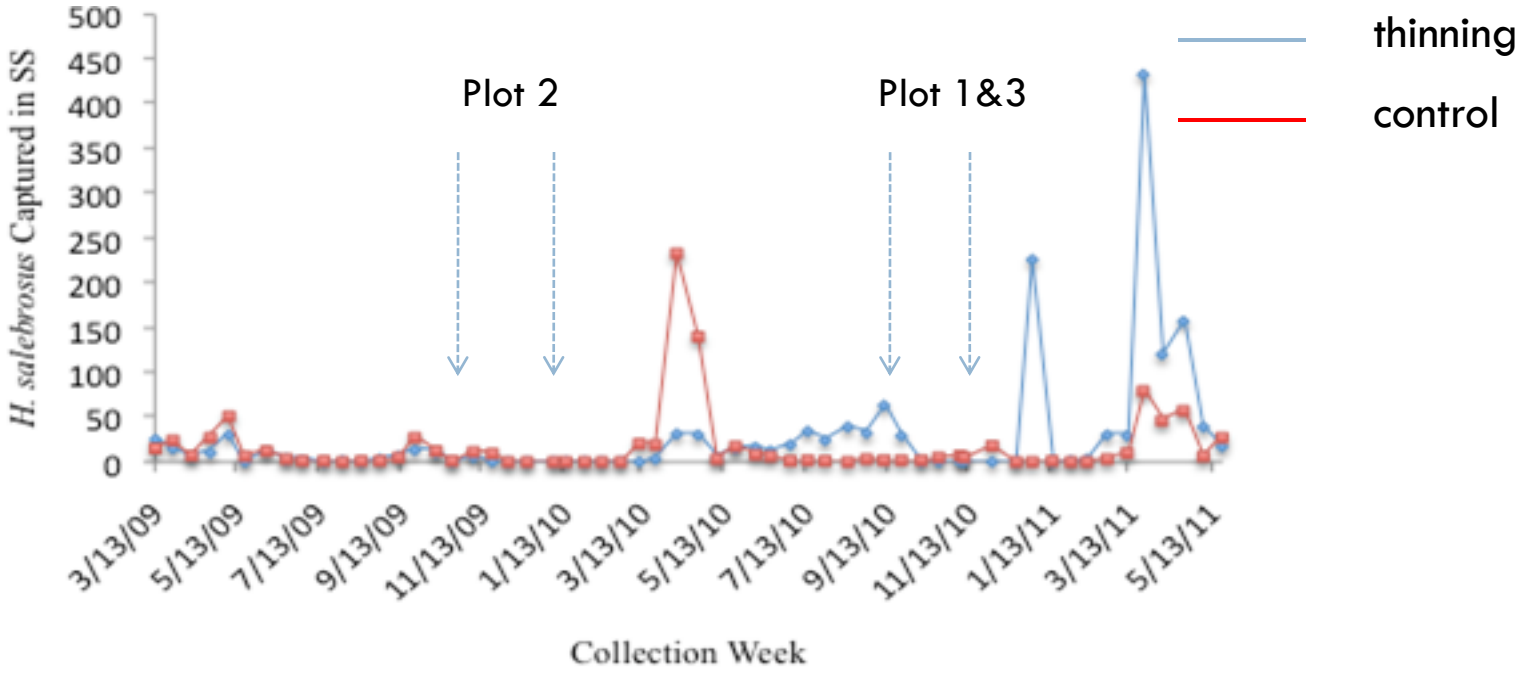


$p_{(control)}$=0.6548, $p_{(thinning)}$<0.0001 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes salebrosus* in SS

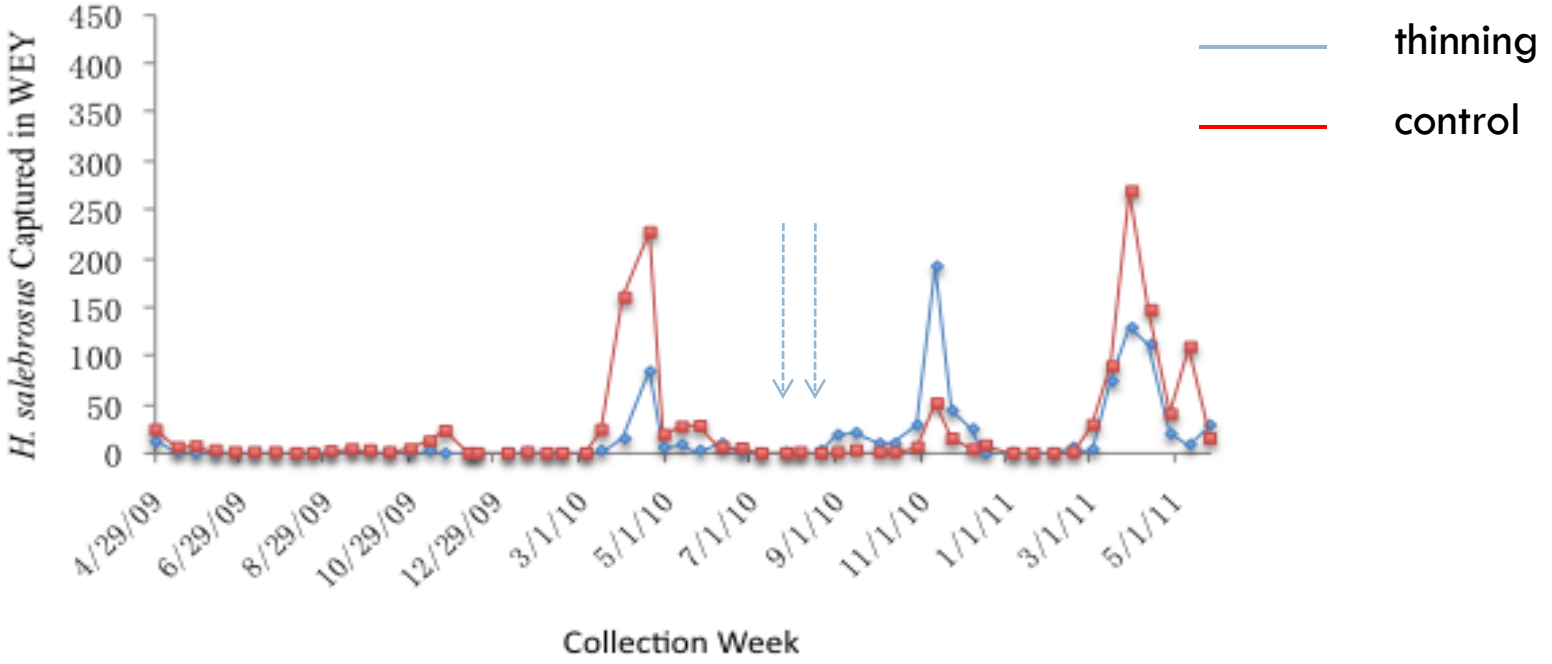


$p_{(control)}$=0.3405, $p_{(thinning)}$=0.0235 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes salebrosus* in WEY

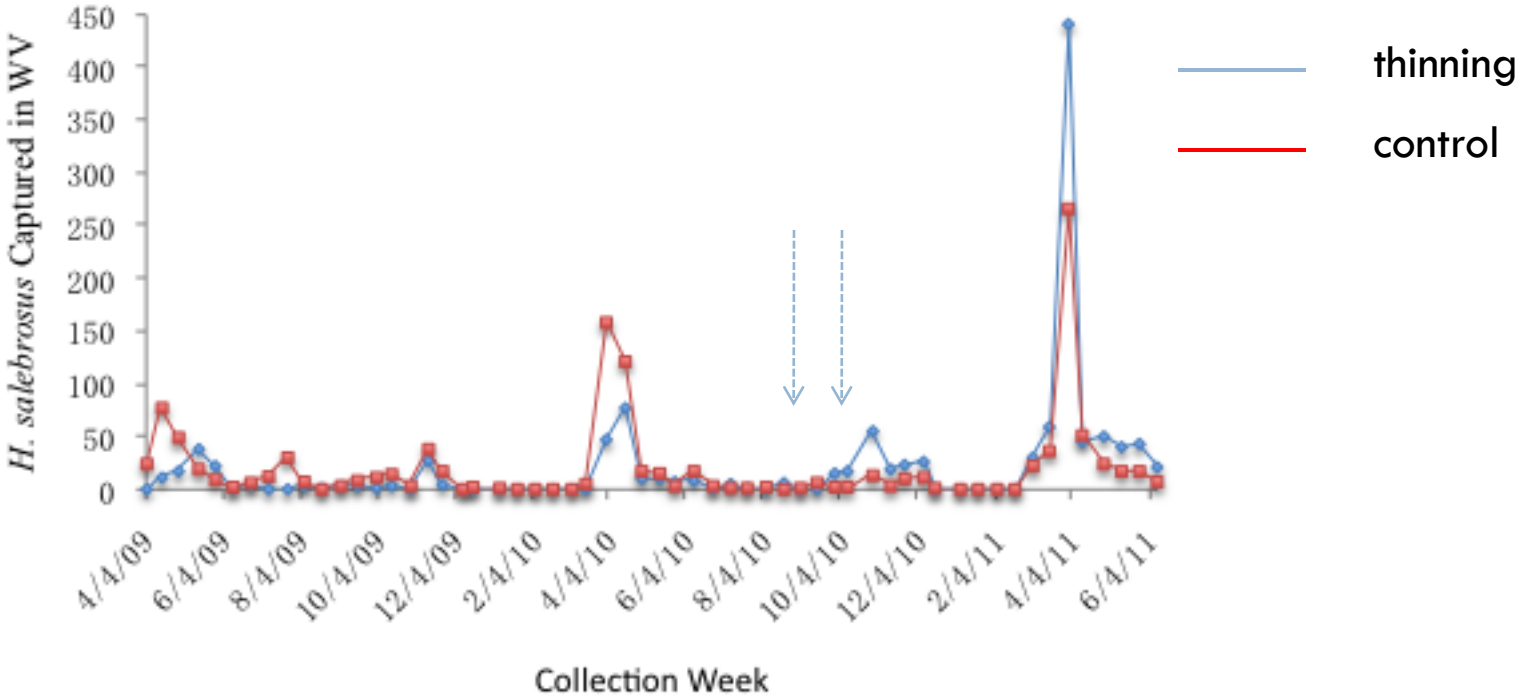


$p_{(control)}$=0.8917, $p_{(thinning)}$=0.0280 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes salebrosus* in WV

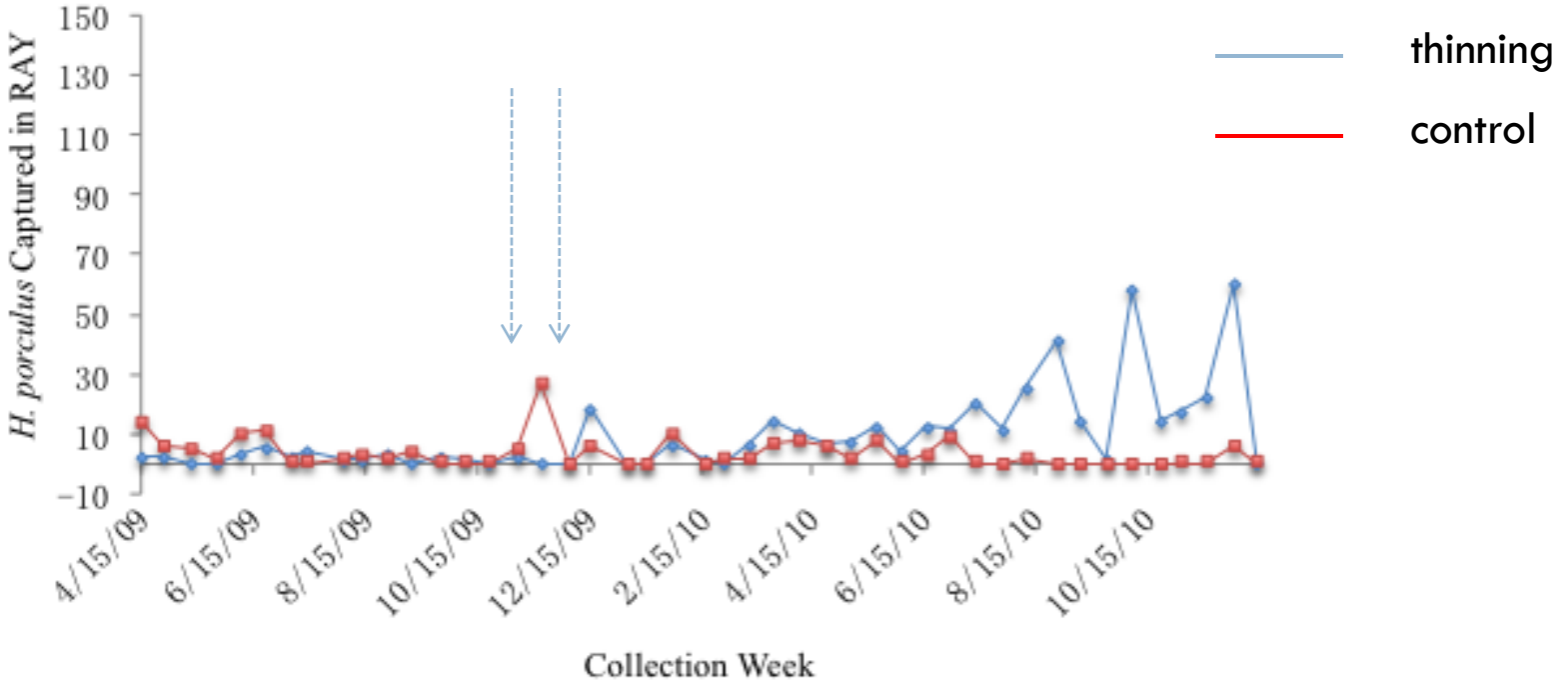


$p_{(control)}$=0.6206, $p_{(thinning)}$=0.0377 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes porculus* in RAY

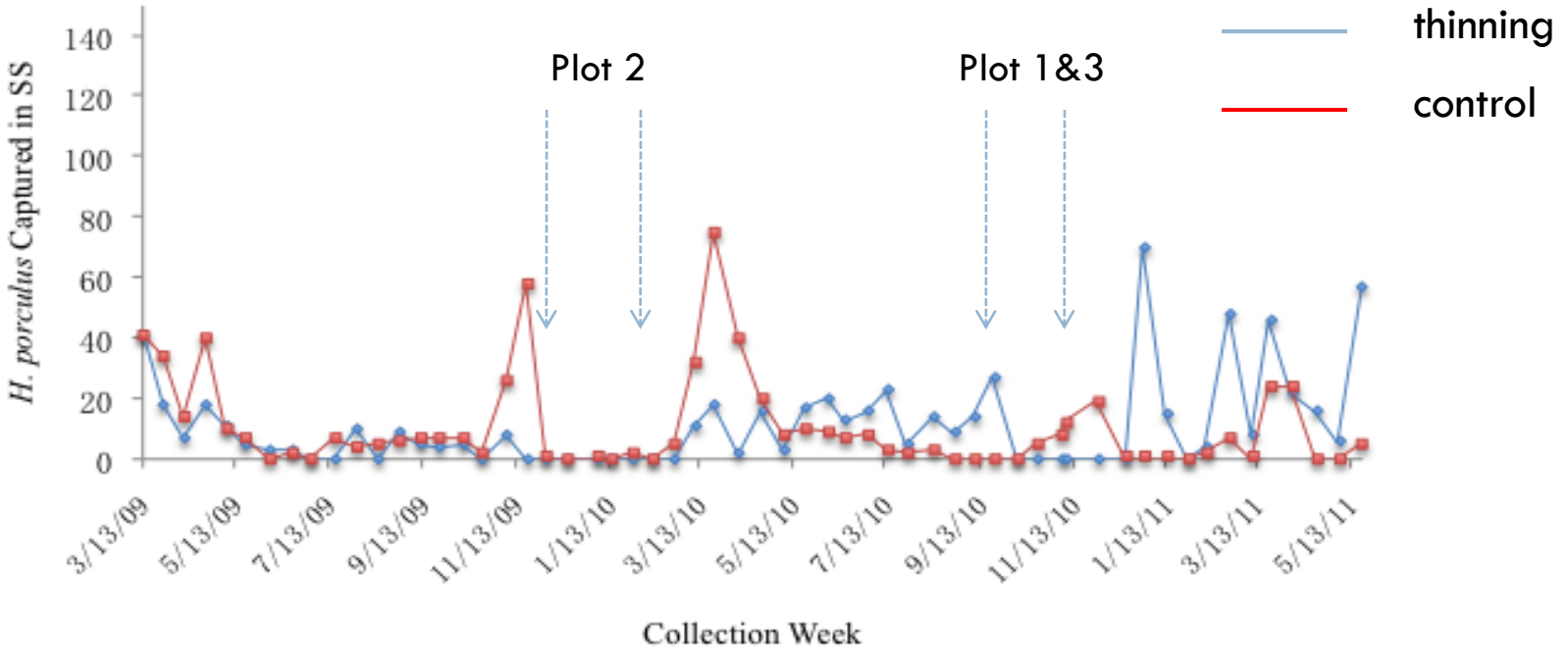


$p_{(control)}$=0.2430, $p_{(thinning)}<0.0001$ α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes porculus* in SS

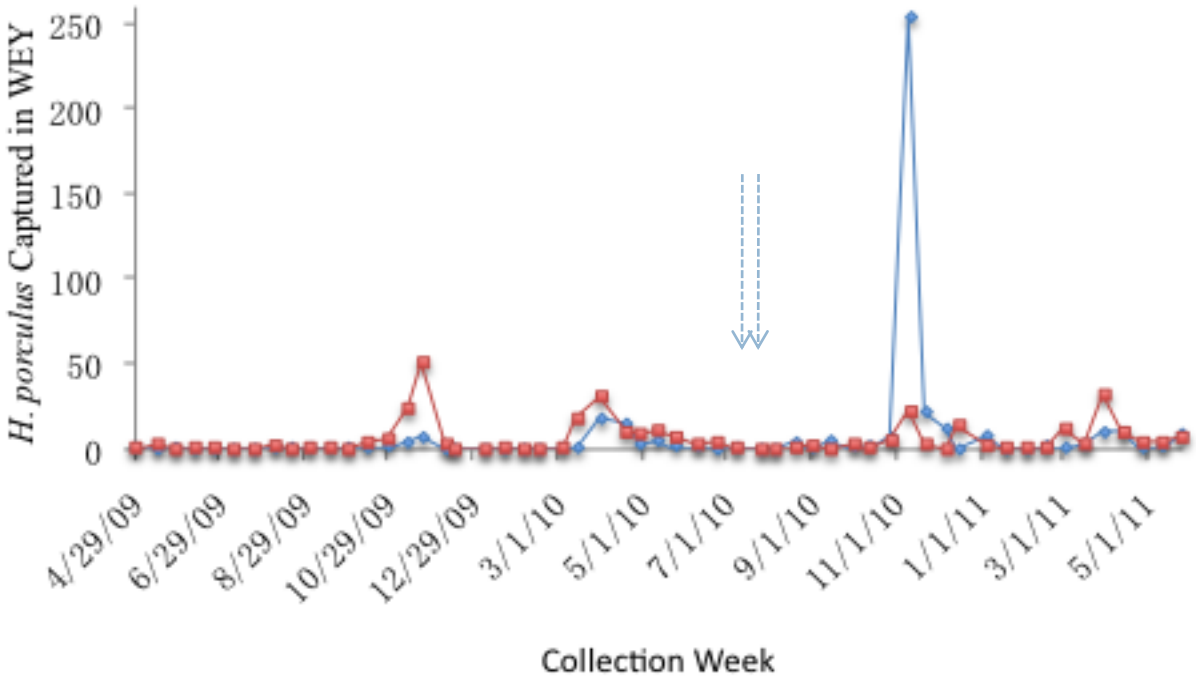


$p_{(control)}$=0.9792, $p_{(thinning)}$=0.0175 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes porculus* in WEY

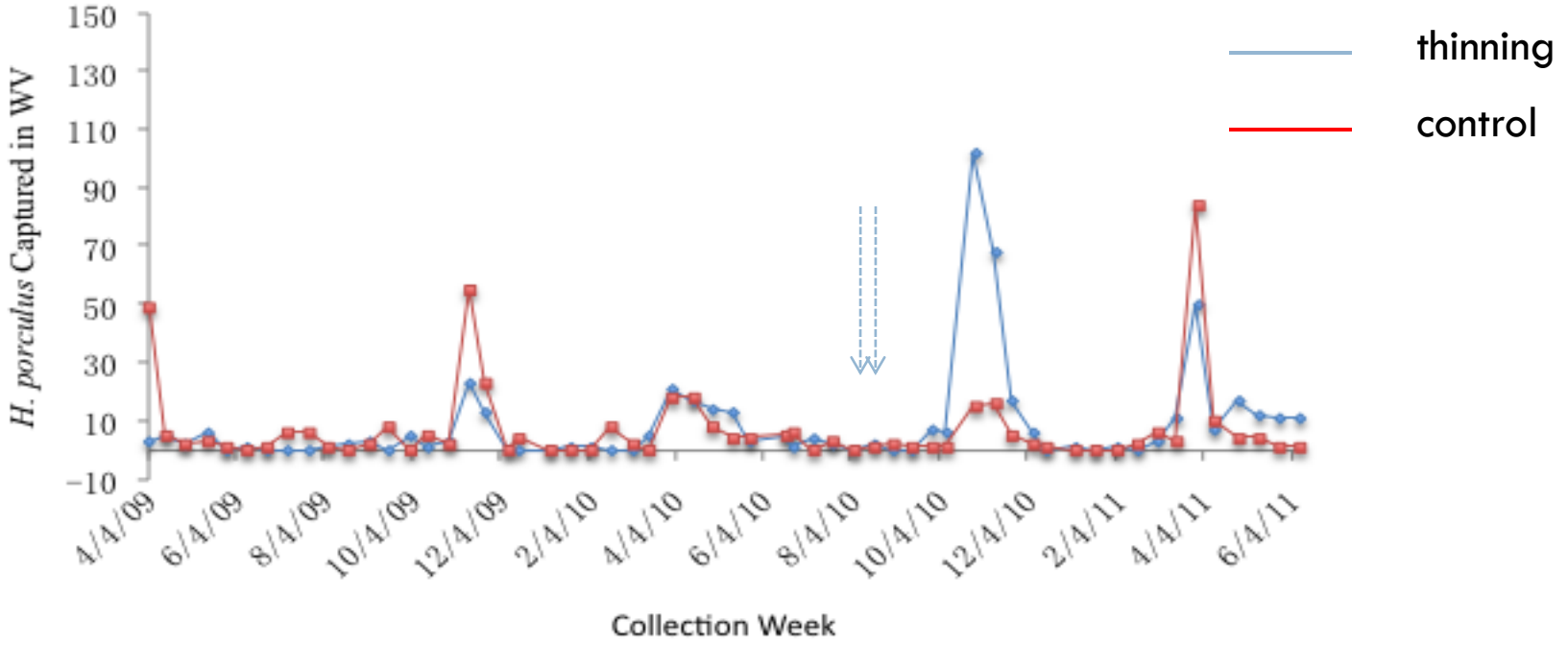


$p_{(control)}$=0.9213, $p_{(thinning)}$=0.0214 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes porculus* in WV

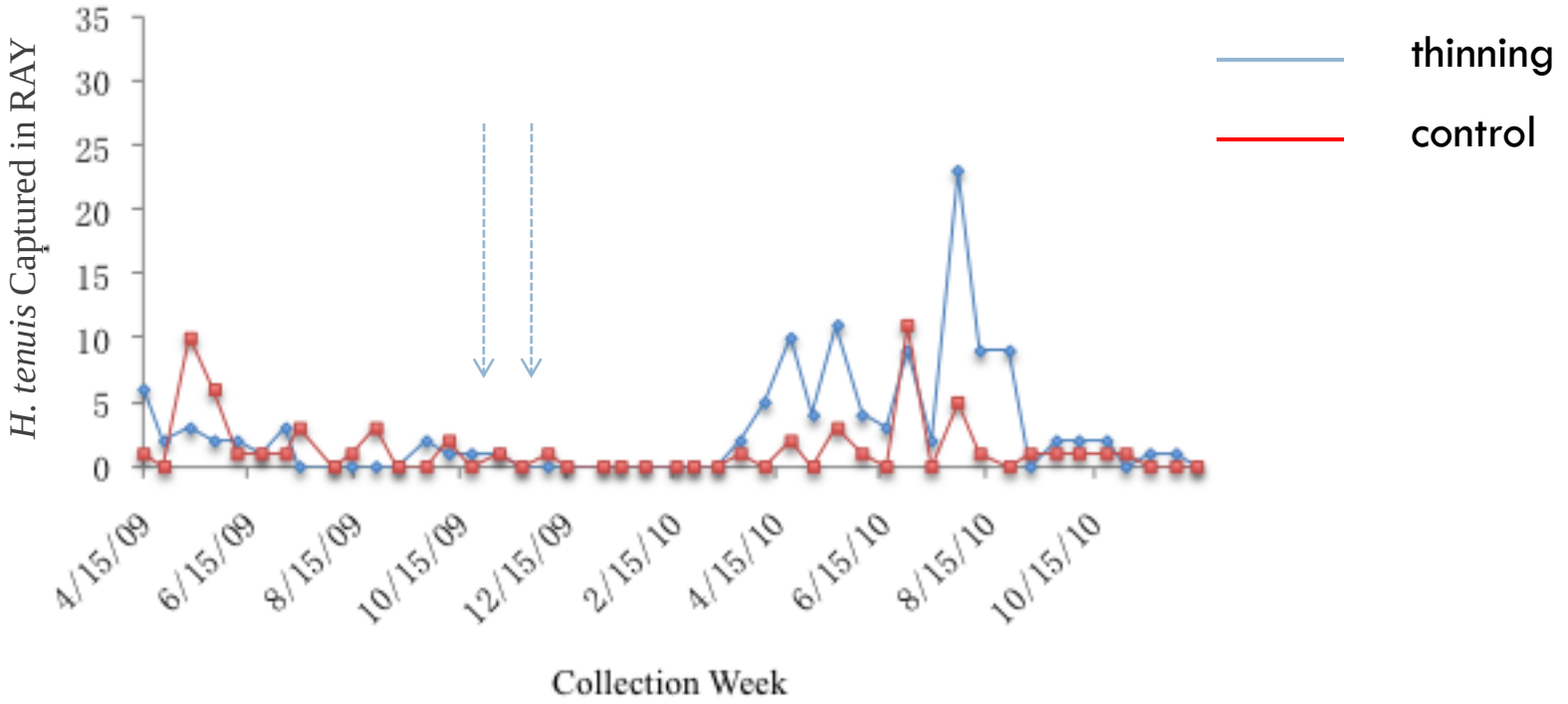


$p_{(control)}$=0.7034, $p_{(thinning)}$=0.0130 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes tenuis* in RAY

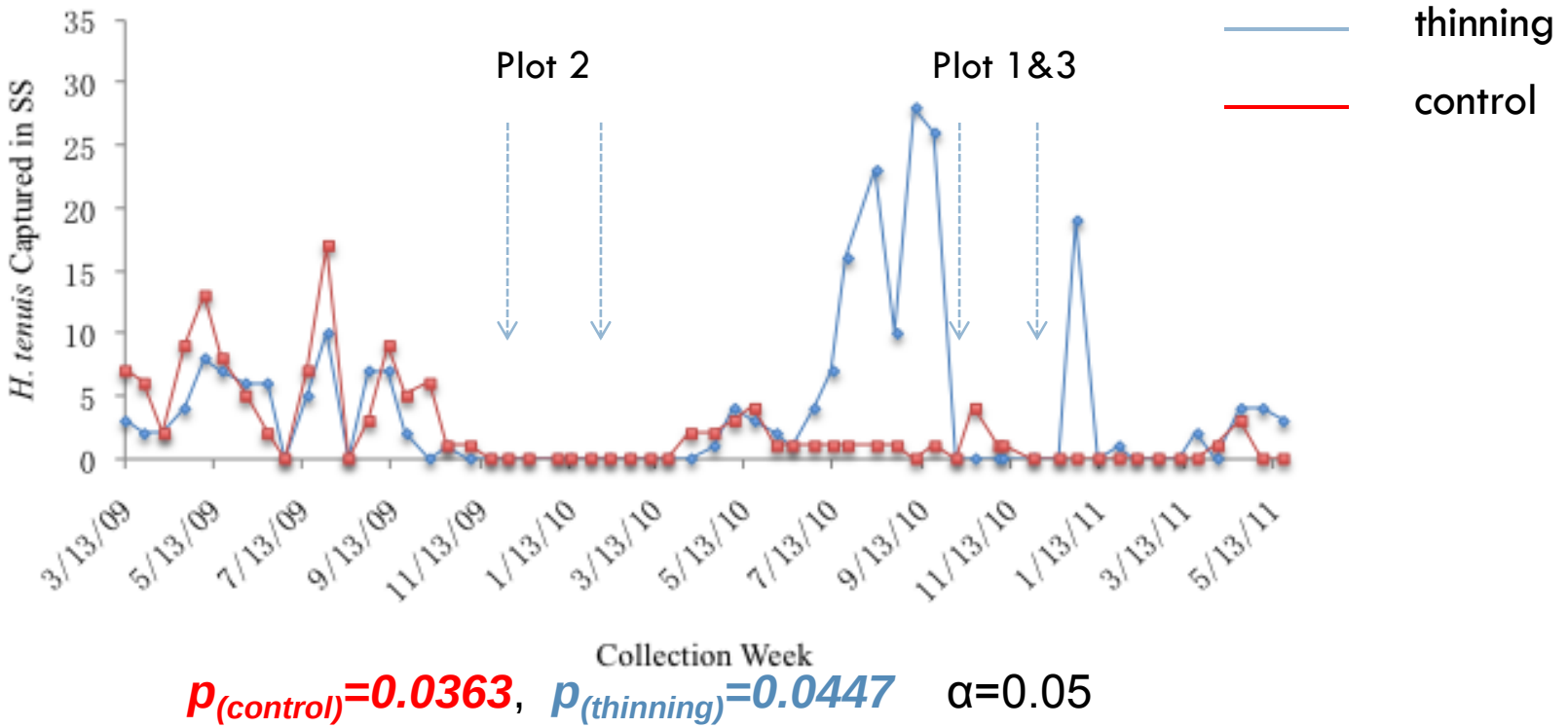


$p_{(control)}$=0.6466, $p_{(thinning)}$=0.0040 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes tenuis* in SS

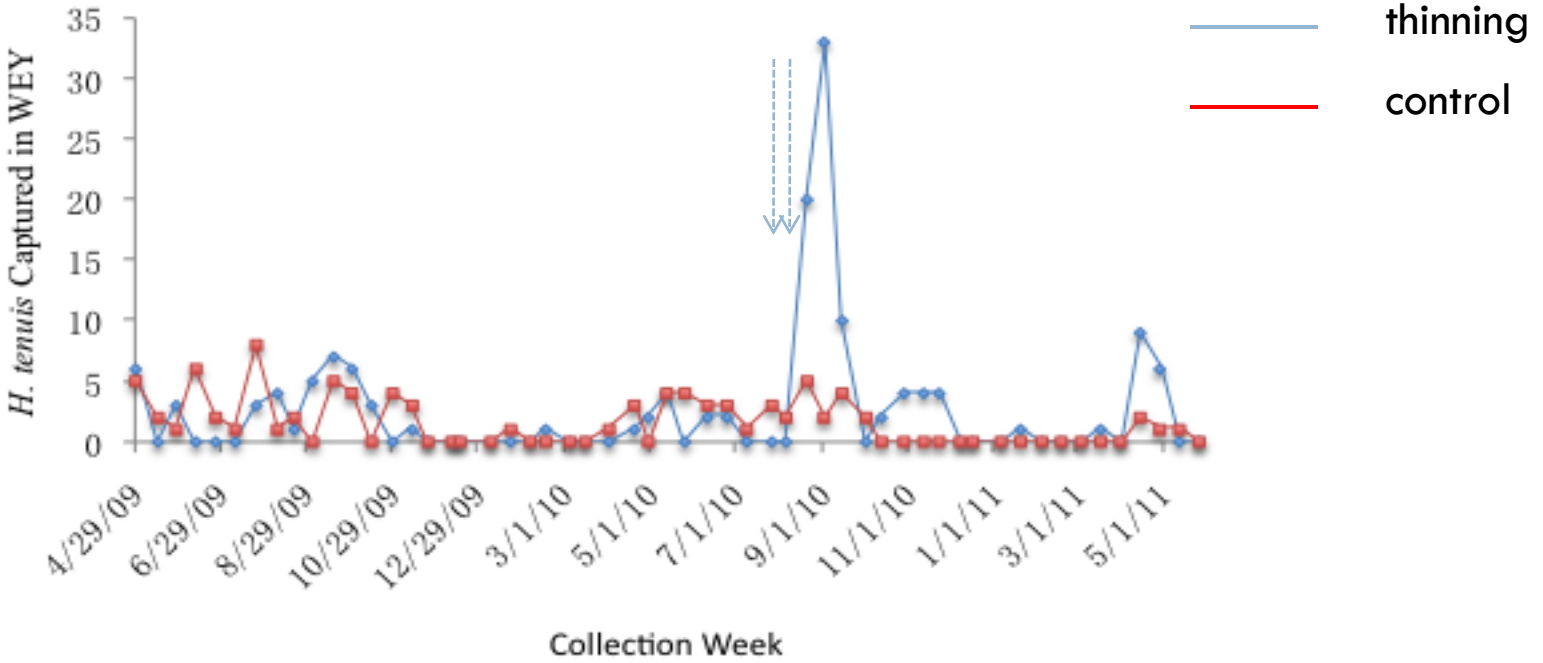


$p_{(control)}=0.0363$, $p_{(thinning)}=0.0447$ α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

- *Hylastes tenuis* in WEY

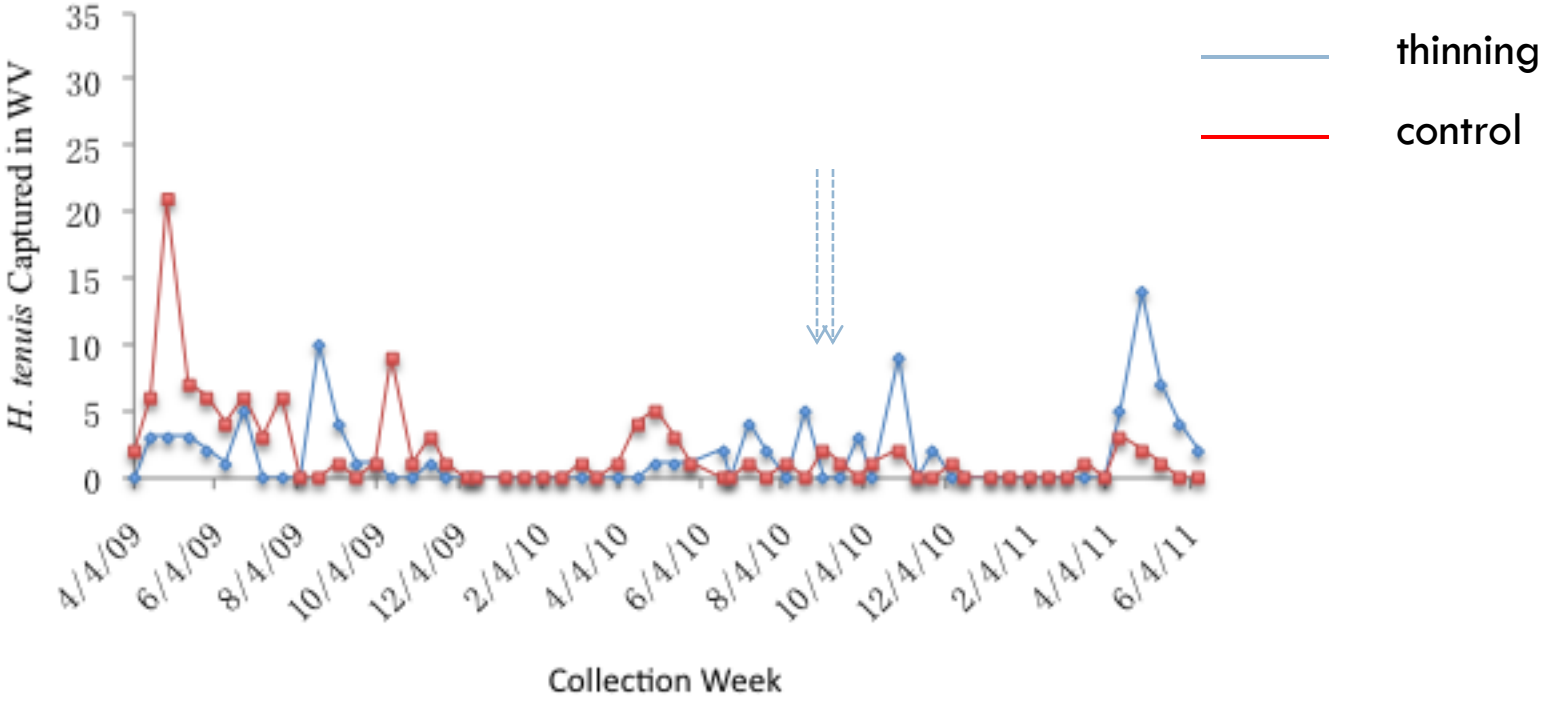


$p_{(control)}$=0.3545, $p_{(thinning)}$=0.0162 α=0.05

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands.

Preliminary Results for Study I

- *Hylastes tenuis* in WV



$p_{(control)}=0.0331$, $p_{(thinning)}=0.6745$ $\alpha=0.05$

Alternative Hypothesis: Thinning will increase root-feeding bark beetle populations in LP stands

Preliminary Results for Study I

Summary

- Pre-thinning data shows a spring and fall peak of *H. salebrosus* and *H. porculus*, but *H. tenuis* appears to change frequently from spring to fall.

- Populations of all three *Hylastes* spp. significantly increase after thinning treatment.

Preliminary Results

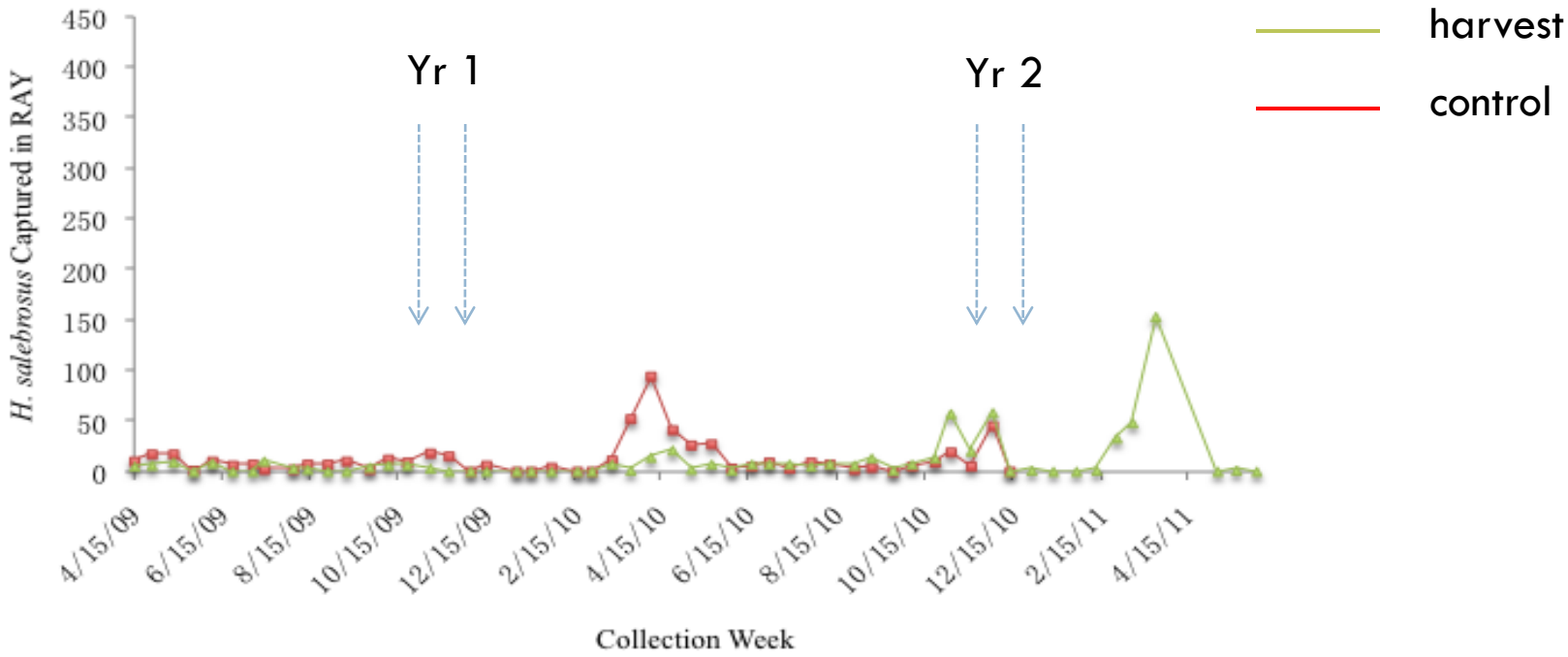
Harvesting Timelines

Study Sites	Clearcut
F&W	Nov. 19, 2009-Jan. 29th, 2010
SS	Feb. 2010 (plot 9 only)*
RAY	Nov. 19th,2009-Dec. 4th, 2009
WEY	Dec.16th, 2009-Feb.28th,2010
WV	Dec.9th,2009 (WV9); Jan.7th, 2010(WV7,8)-Jan,22nd,2010

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes salebrosus* in RAY

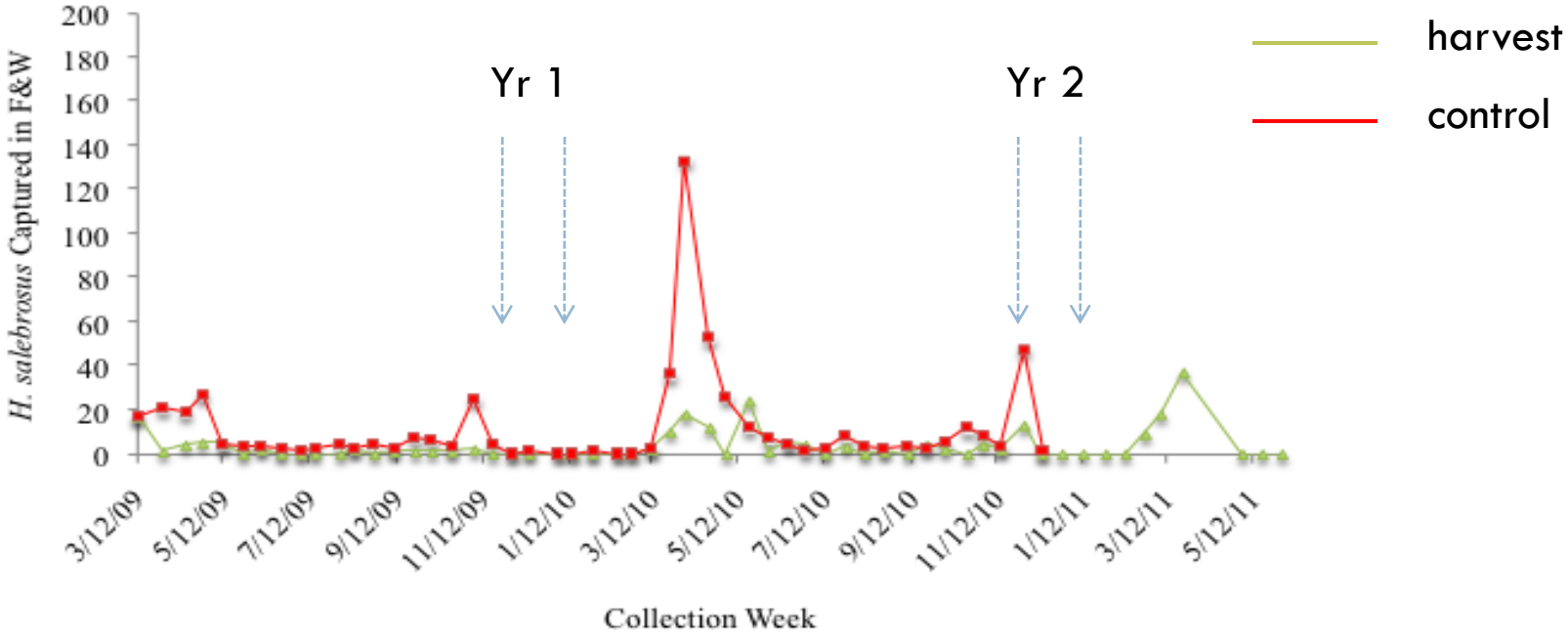


Year 1: $p_{(control)}=0.6548$, $p_{(clearcut)}=0.6491$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes salebrosus* in FW

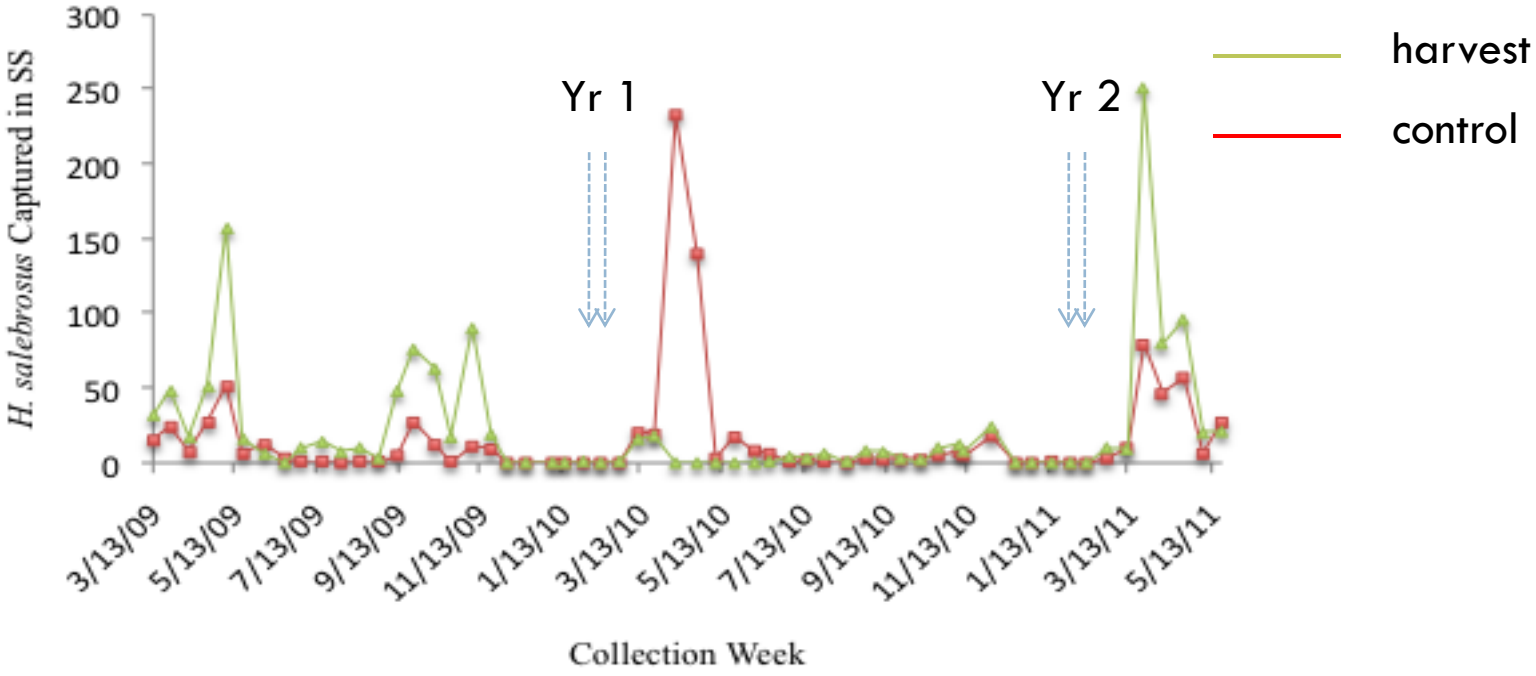


Year 1: $p_{(control)}=0.0101$, $p_{(clearcut)}=0.6574$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes salebrosus* in SS

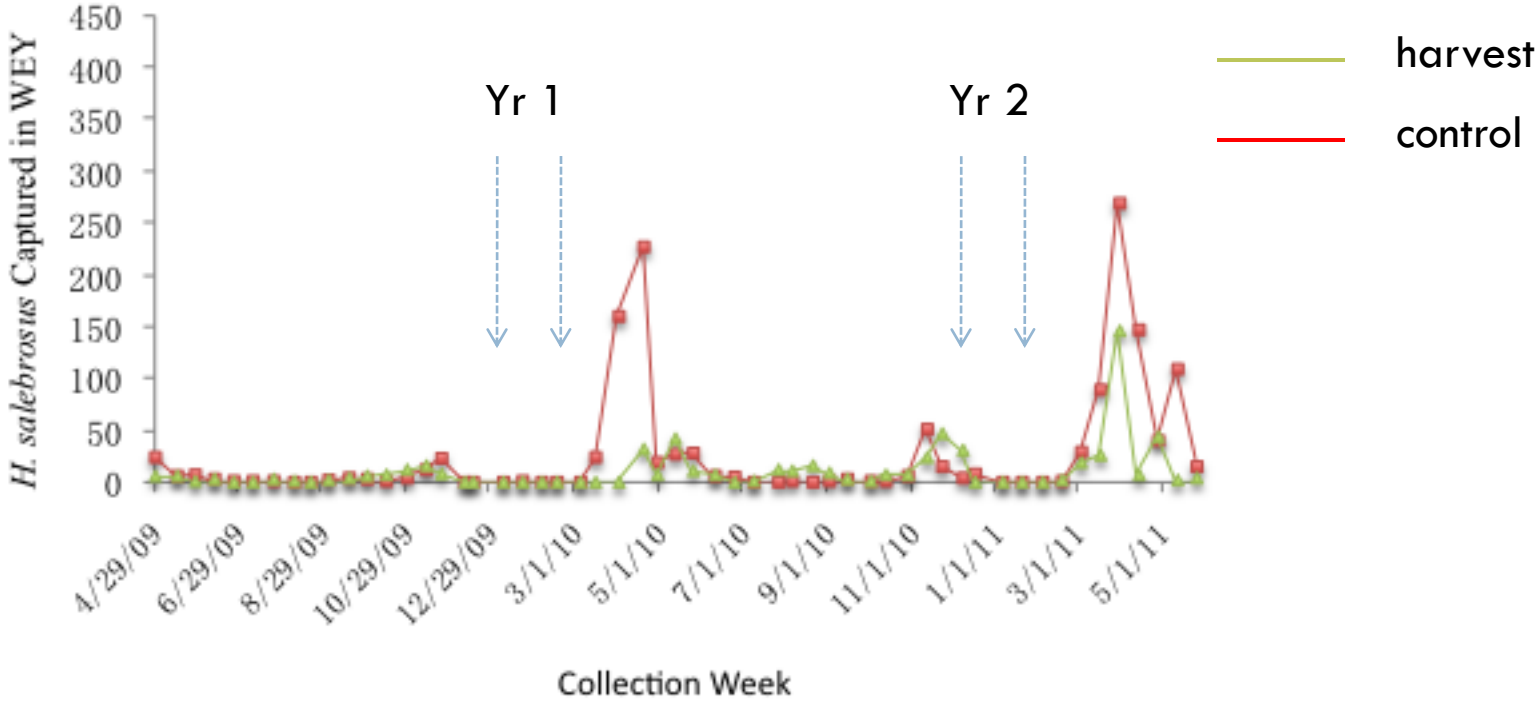


Year 1: $p_{(control)}=0.5150$, $p_{(clearcut)}=0.3152$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes salebrosus* in WEY

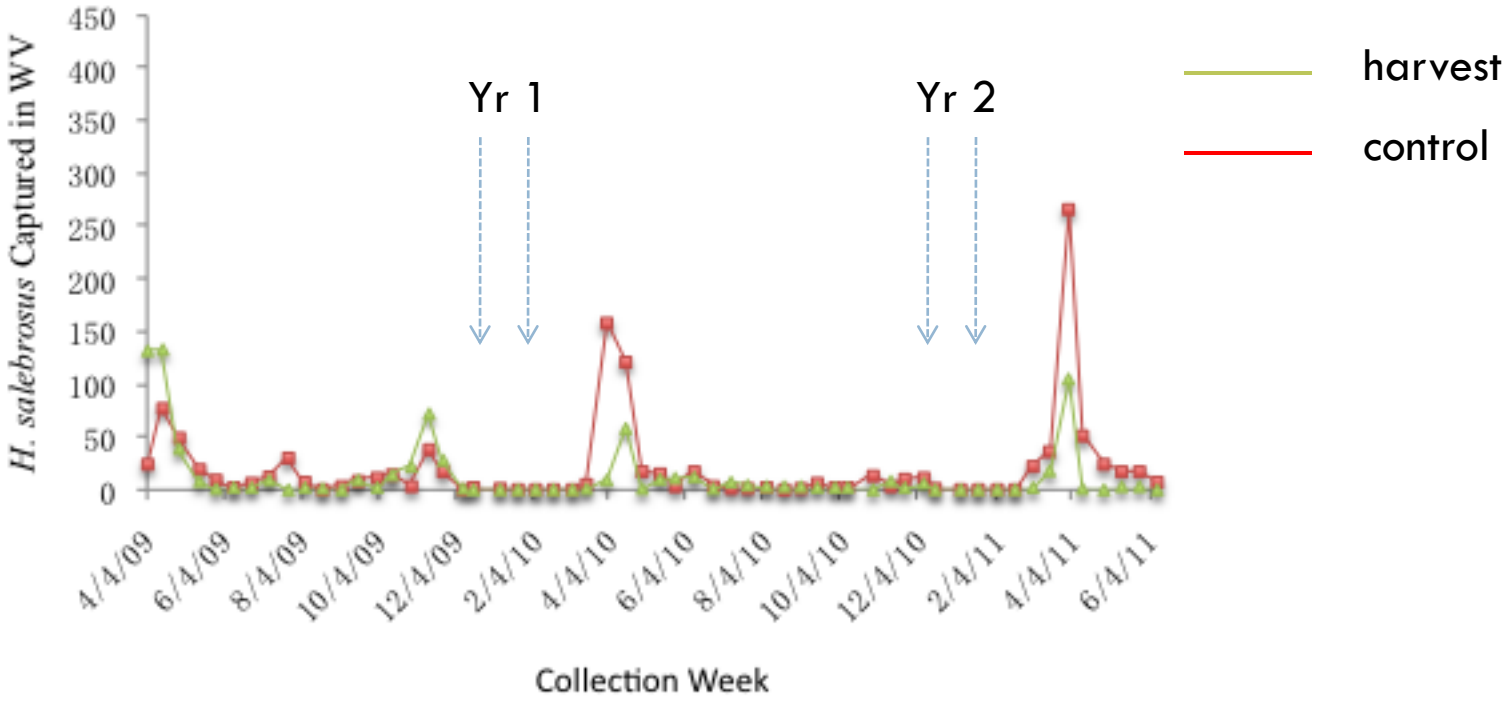


Year 1: $p_{(control)}=0.2641$, $p_{(clearcut)}=0.2005$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes salebrosus* in WV

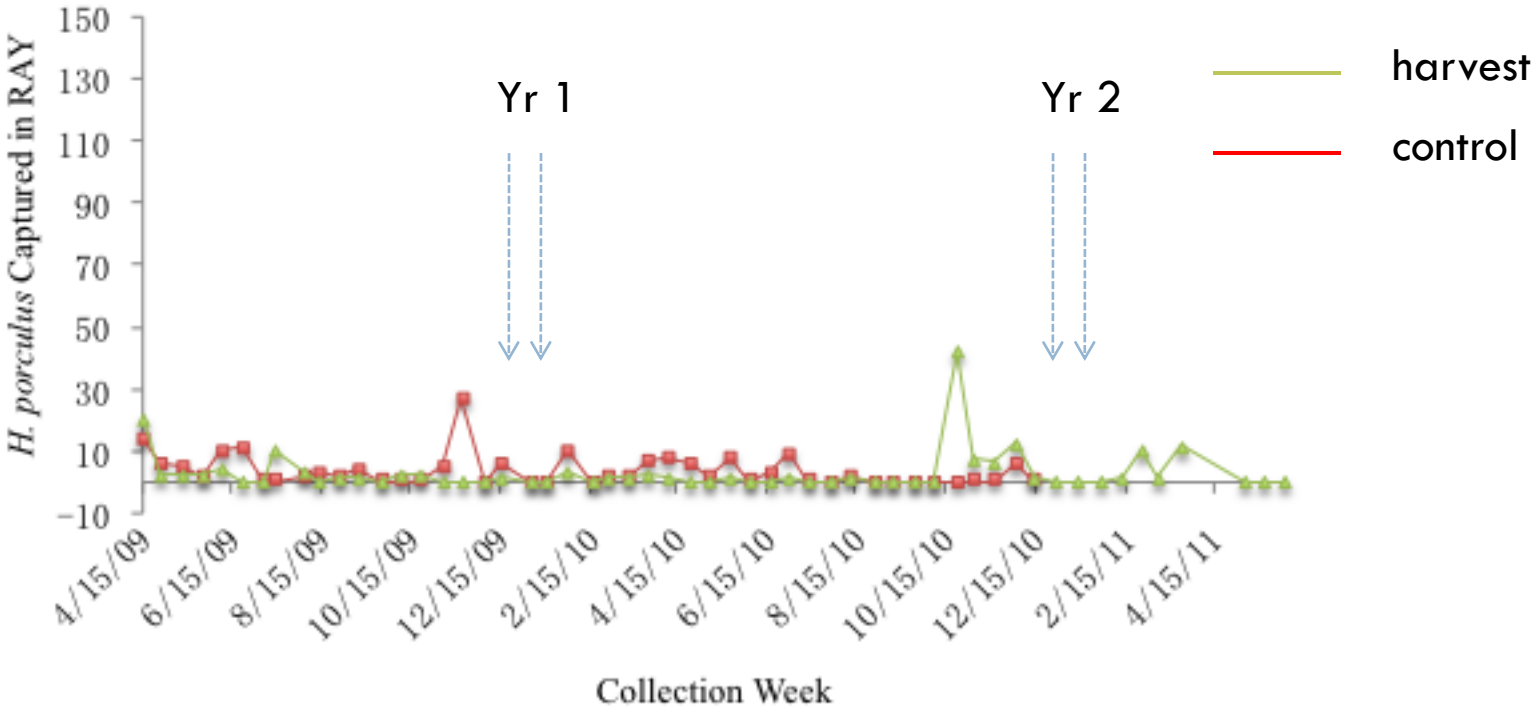


Year 1: $p_{(control)}$=0.6920, $p_{(clearcut)}$=0.0391 α=0.05

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes porculus* in RAY

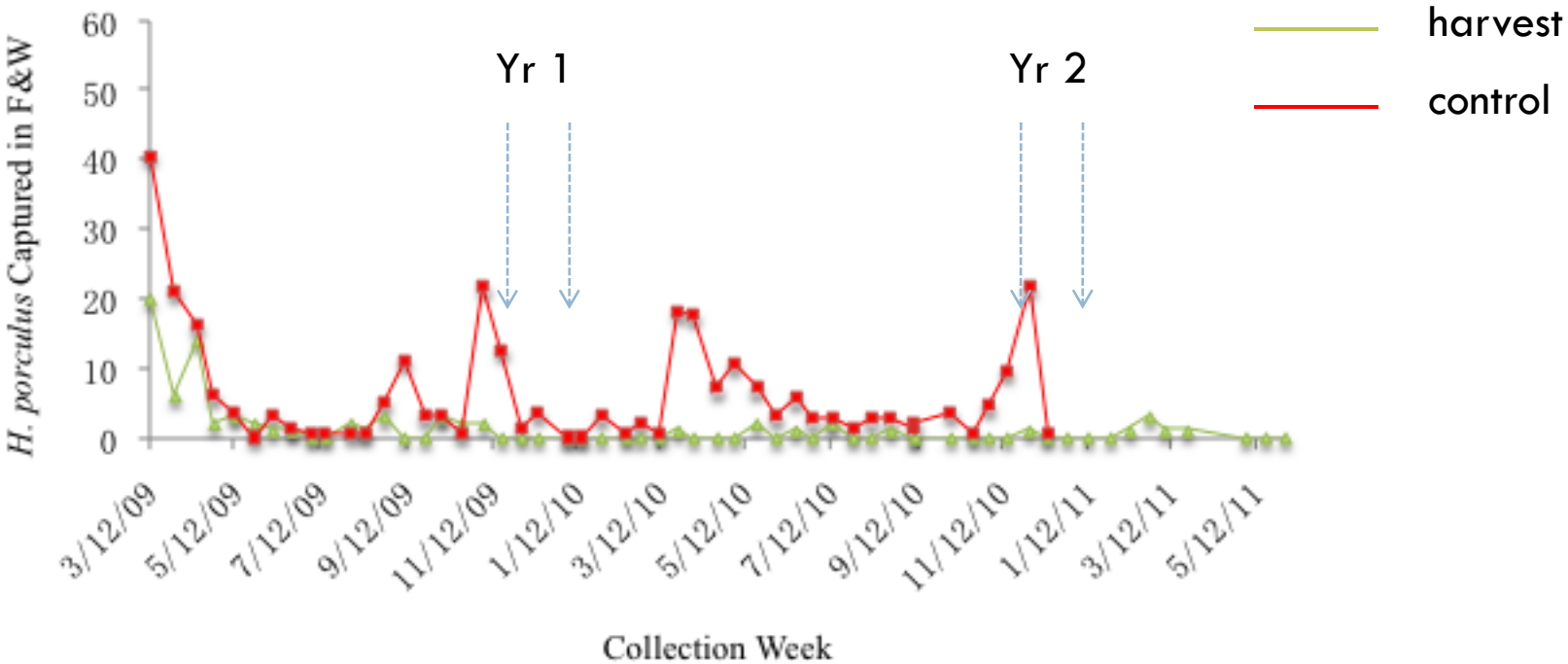


Year 1: $p_{(control)}=0.2430$, $p_{(clearcut)}=0.9727$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes porculus* in FW

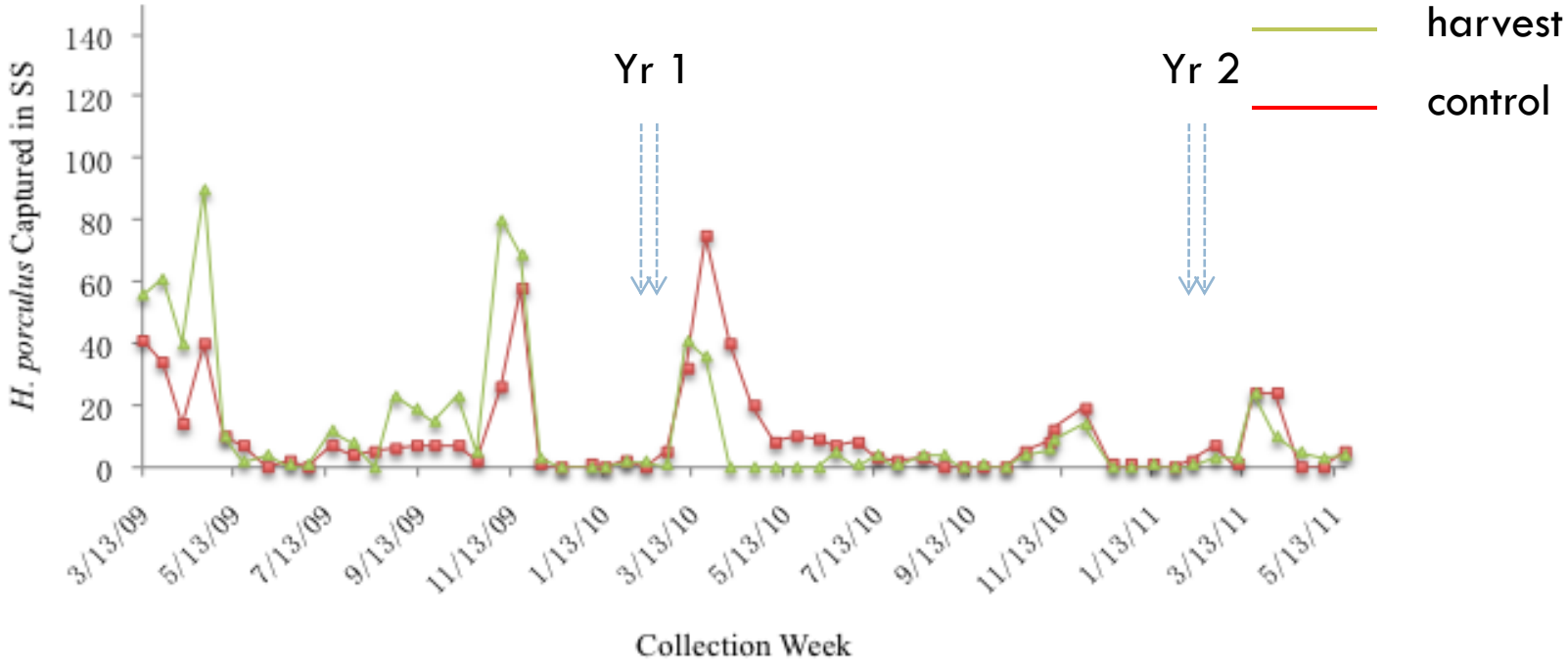


Year 1: $p_{(control)}=0.9167$, $p_{(clearcut)}=0.0830$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes porculus* in SS

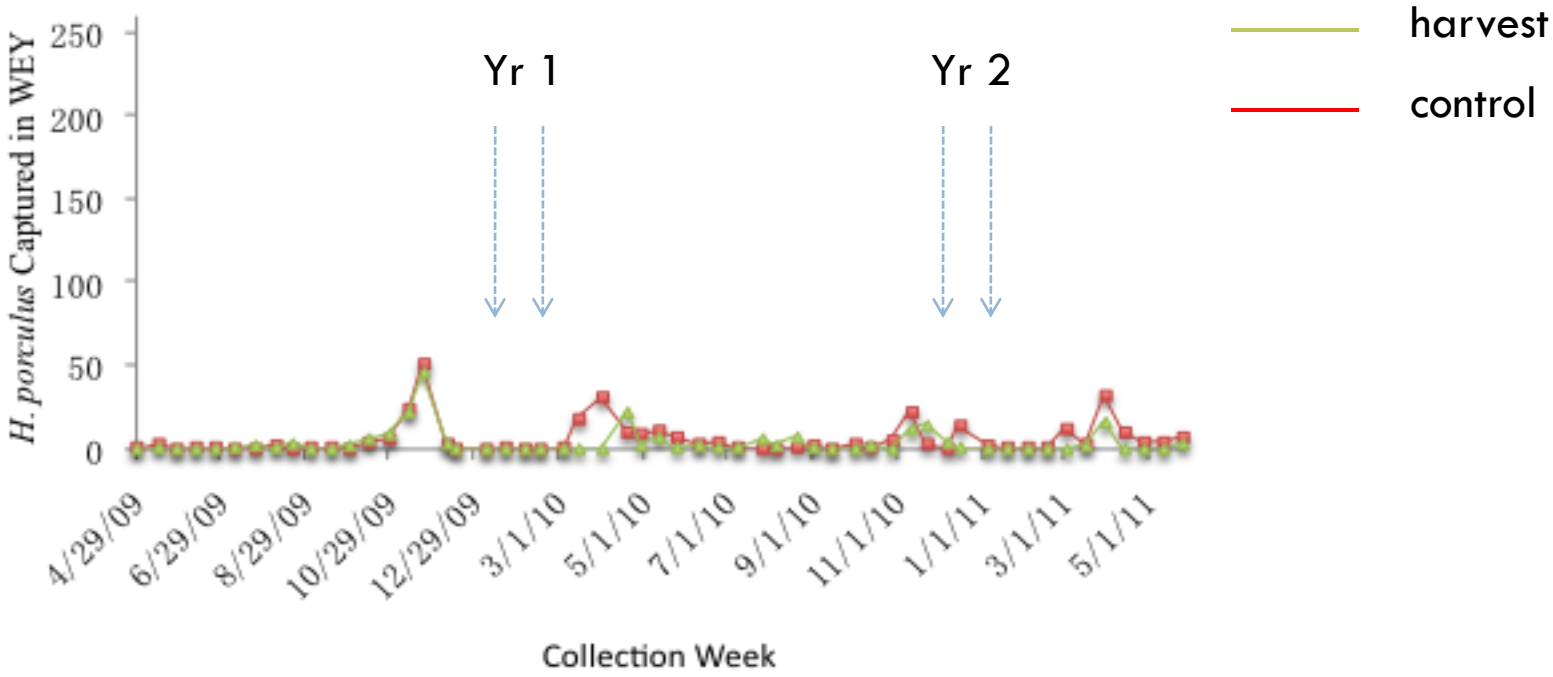


Year 1: $p_{(control)}$=0.0735, ***$p_{(clearcut)}$=0.0006*** α=0.05

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes porculus* in WEY

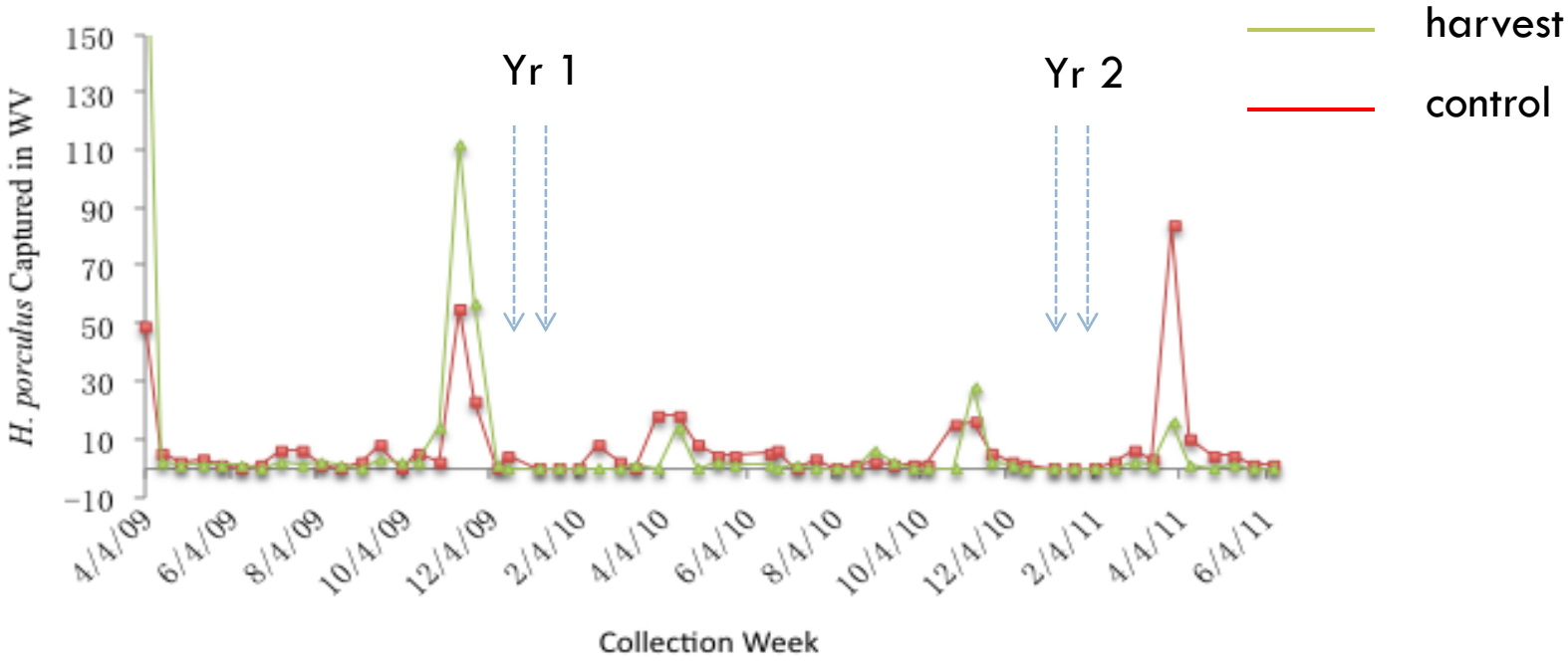


Year : $p_{(control)}$=0.7963, $p_{(clearcut)}$=0.4511 α=0.05

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes porculus* in WV

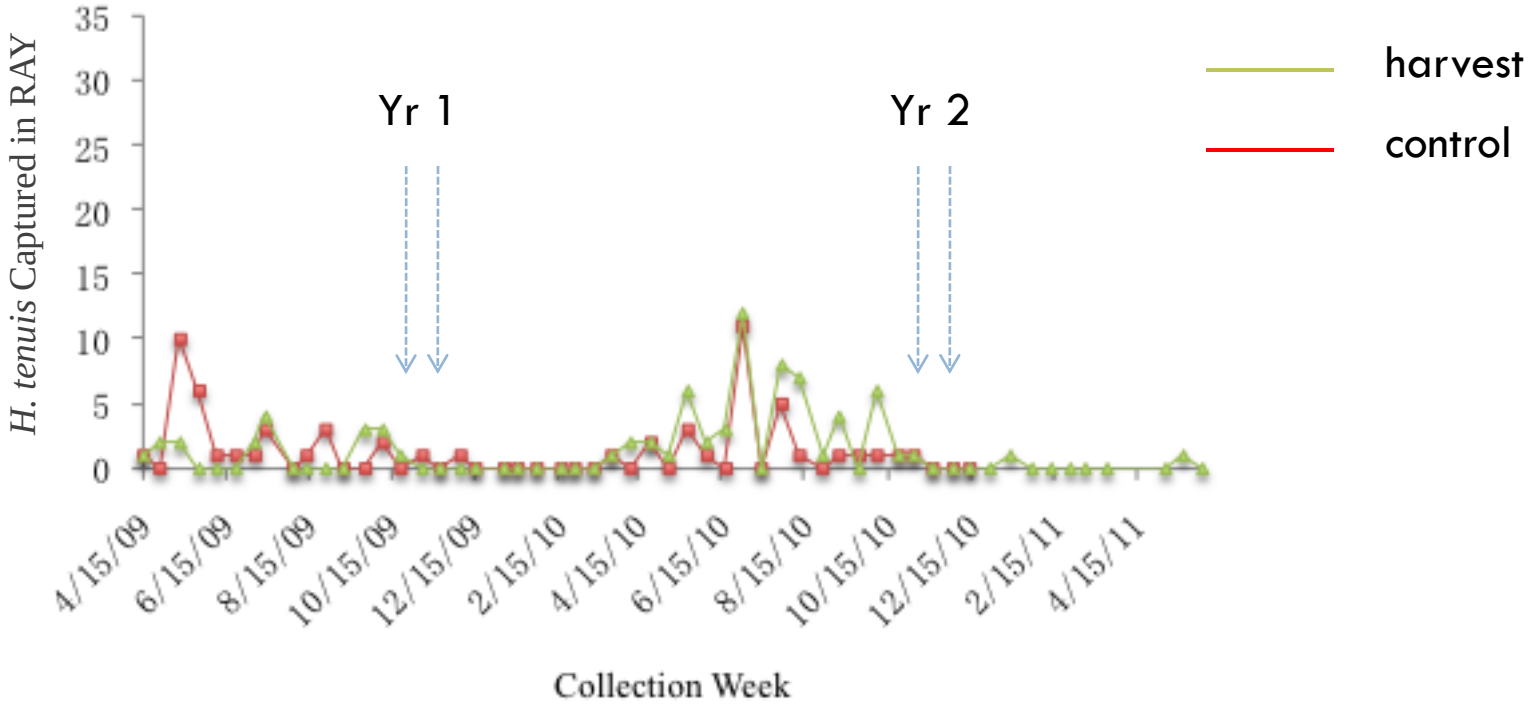


Year 1: $p_{(control)}=0.6410$, $p_{(clearcut)}=0.0066$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes tenuis* in RAY

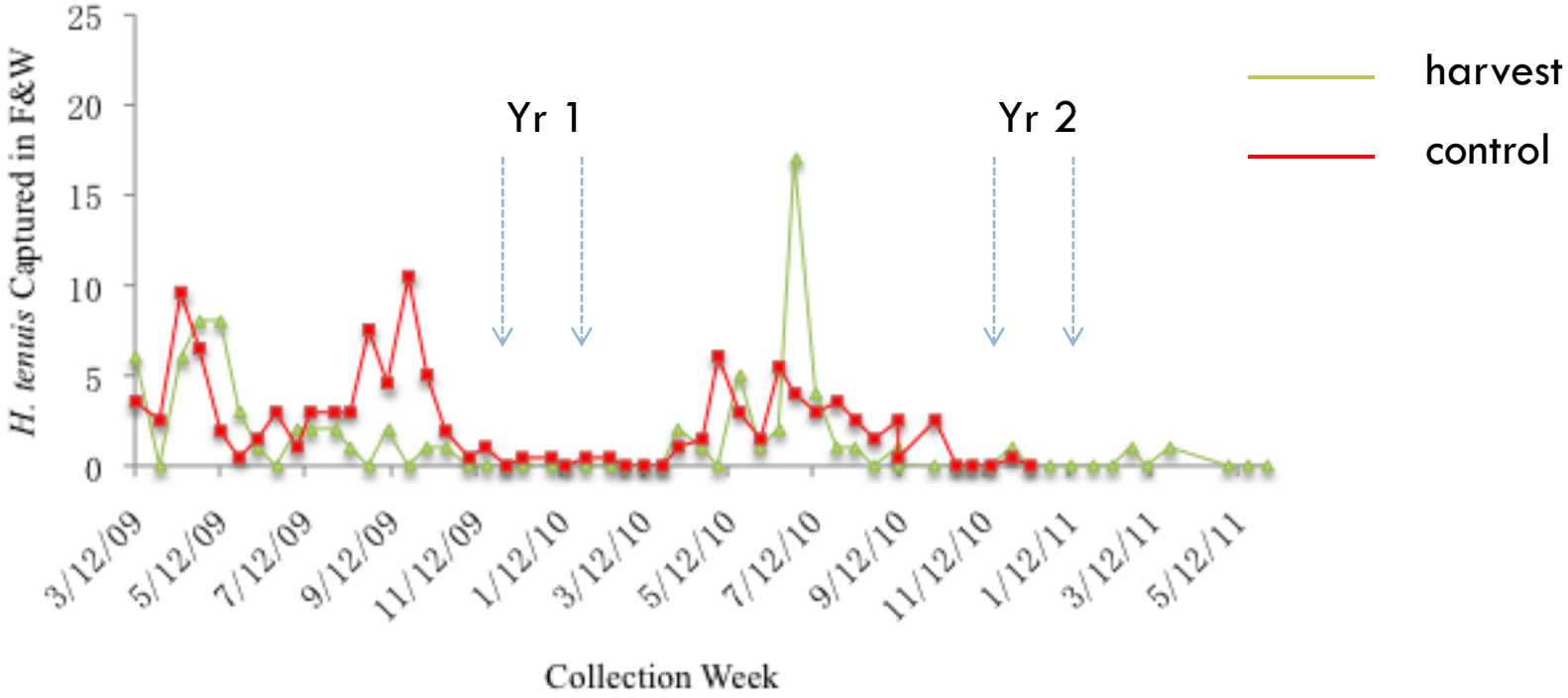


Year 1: $p_{(control)}=0.6466$, $p_{(clearcut)}=0.2081$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes tenuis* in FW

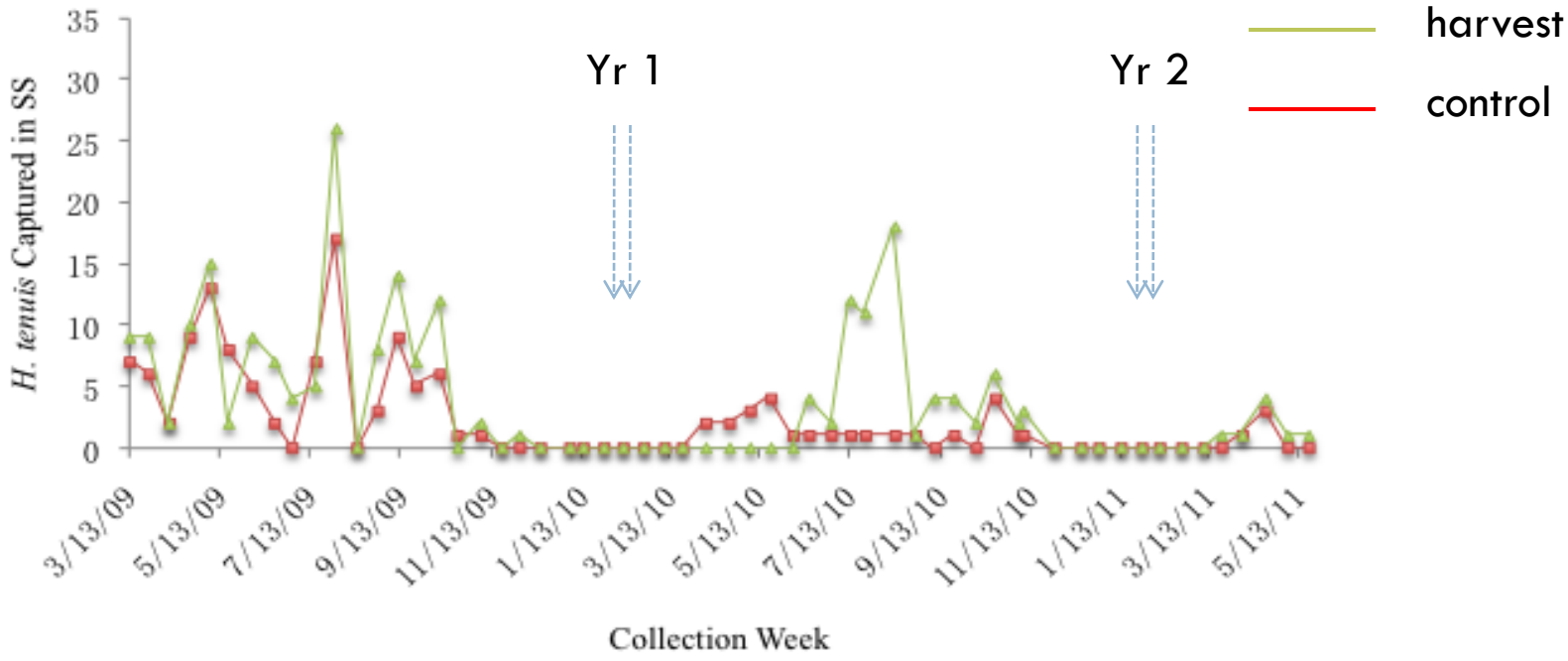


Year 1: $p_{(control)}=0.0448$, $p_{(clearcut)}=0.3200$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes tenuis* in SS

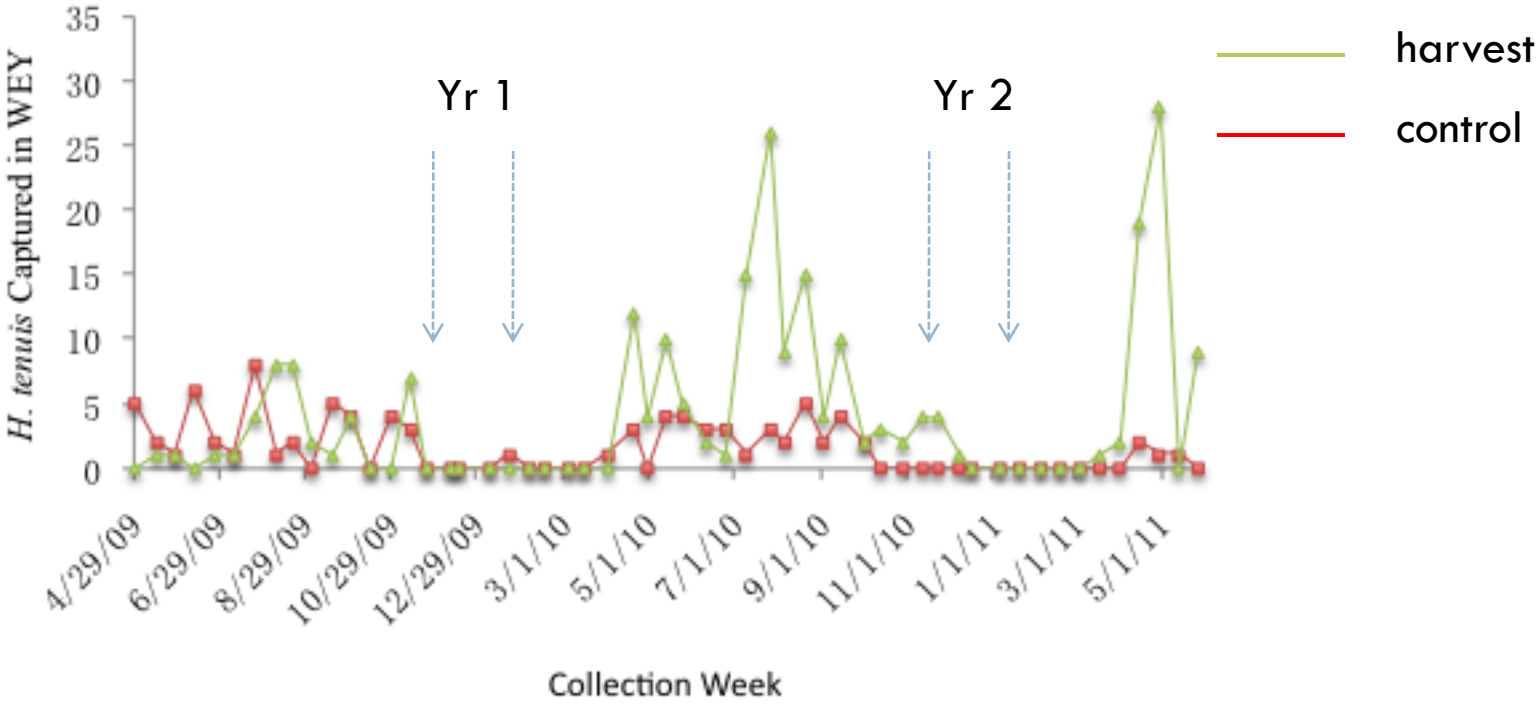


Year 1: $p_{(control)}=0.0329$, $p_{(clearcut)}=0.1820$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes tenuis* in WEY

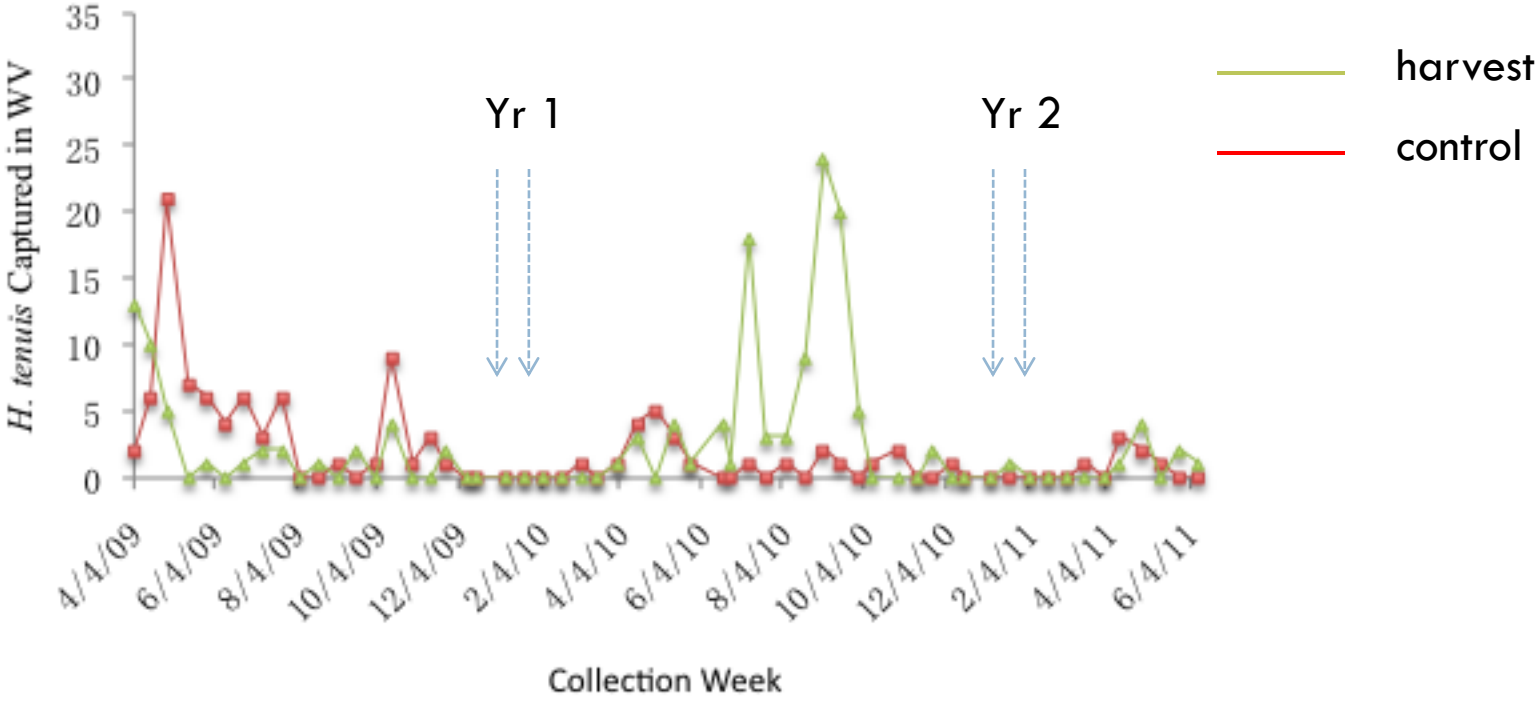


Year 1: $p_{(control)}$=0.7153, $p_{(clearcut)}$=0.0167 α=0.05

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

- *Hylastes tenuis* in WV



Year 1: $p_{(control)}=0.0288$, $p_{(clearcut)}=0.2705$ $\alpha=0.05$

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

Summary

Study Site	Root-feeding Bark Beetle Species		
	H. salebrosus	*H. porculus*	*H. tenuis*
RAY	**Negative**	**Negative**	—
F&W	—	—	**Positive**
SS	—	**Negative**	—
WV	—	—	—
WEY	—	—	—

‘—’ indicates no response to harvest treatment

Null Hypothesis: Clearcut will decrease root-feeding bark beetle populations in LP stands.

Preliminary Results for Study II

Plot	Average Length (inch)	Average Diameter (inch)	Percentage of how many roots had galleries	Range of Exit holes	Percentage of how many roots had insects present	Percentage of stain fungus observed
FW7	14.4	1.5	50%	0-22	50%	0
FW8	15	1.5	33%	0-23	17%	17%
FW9	10.6	2.0	67%	0-28	33%	17%
RAY7	12.5	1.5	50%	0-5	33%	0
RAY8	12.4	1.4	17%	0-2	0	0
RAY9	12.9	2.5	50%	0-19	50%	17%

Preliminary Results for Study II

Plot	Average Length (inch)	Average Diameter (inch)	Percentage of how many roots had galleries	Range of Exit holes	Percentage of how many roots had insects present	Percentage of stain fungus observed
WEY7	16.7	1.6	33%	0-4	33%	17%
WEY8	13	1.8	50%	0-8	50%	50%
WEY9	12.7	1.8	83%	0-4	50%	50%
WV7	13.8	2.5	50%	0-7	33%	17%
WV8	11.1	2.2	33%	0-7	17%	0
WV9	12.3	2.2	67%	2-11	33%	0

Preliminary Results for Study III

Study Site	Treatment	*L. terebrantis*	*L. serpens*	*G. huntii*	*L. procerum*	*O. ips*
F&W	Thinning	2.8	0	2.8	11.1	0
	Control	5.6	0	33.3	16.7	0
	Clearcut	5.6	2.8	0	11.1	0
RAY	Thinning	0	0	2.8	11.1	0
	Control	2.8	5.6	8.3	13.9	0
	Clearcut	8.3	2.8	2.8	16.7	0
WEY	Thinning	0	30.6	19.4	38.9	2.8
	Control	2.8	0	8.3	11.1	0
	Clearcut	2.8	0	0	8.3	0
WV	Thinning	19.4	8.3	8.3	22.2	2.8
	Control	13.9	0	5.6	11.1	5.6
	Clearcut	11.1	2.8	5.6	36.1	13.9
SS	Thinning	13.9	0	0	11.1	2.8
	Control	0	0	0	2.8	0
	Clearcut	5.6	0	0	5.6	0

Preliminary Results for Study III

Correlation for Fungal incidence and slope, insect captured, aspect and convex in all site

Study Site		Slope	Mean Insect	Aspect	Convex
F&W	FI	0.19657	**0.71486**	-0.1515	0.38332
	P-value	0.6122	**0.0304**	0.6972	0.3085
RAY	FI	0.17815	0.58663	-0.17498	0
	P-value	0.6465	0.097	0.6525	1
WV	FI	0.0816	0.27913	-0.07096	-0.02003
	P-value	0.8347	0.467	0.856	0.9592
SS	FI	0.57253	-0.05201	0.1823	0.28554
	P-value	0.1071	0.8943	0.6388	0.4564
WEY	FI	-0.20743	**-0.75827**	-0.36728	.
	P-value	0.5923	**0.0179**	0.3309	.

Preliminary Results for Study III

- Fungal incidence in RAY's thinning and control plots

$p_{(control)}$=0.1046, **$p_{(thinning)}$=0.0022** α=0.05

After one year thinning, the fungal isolation in RAY plots increased compared to pre-treatment data.

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Rayonier

Questions?