Vegetation Response to Restoration Thinning and Slash Pile Burning in Aspen

Aspen-conifer stand at Blackwood Creek before and after mechanical removal of smaller conifers

John-Pascal Berrill & Christa M. Dagley

Department of Forestry and Wildland Resources

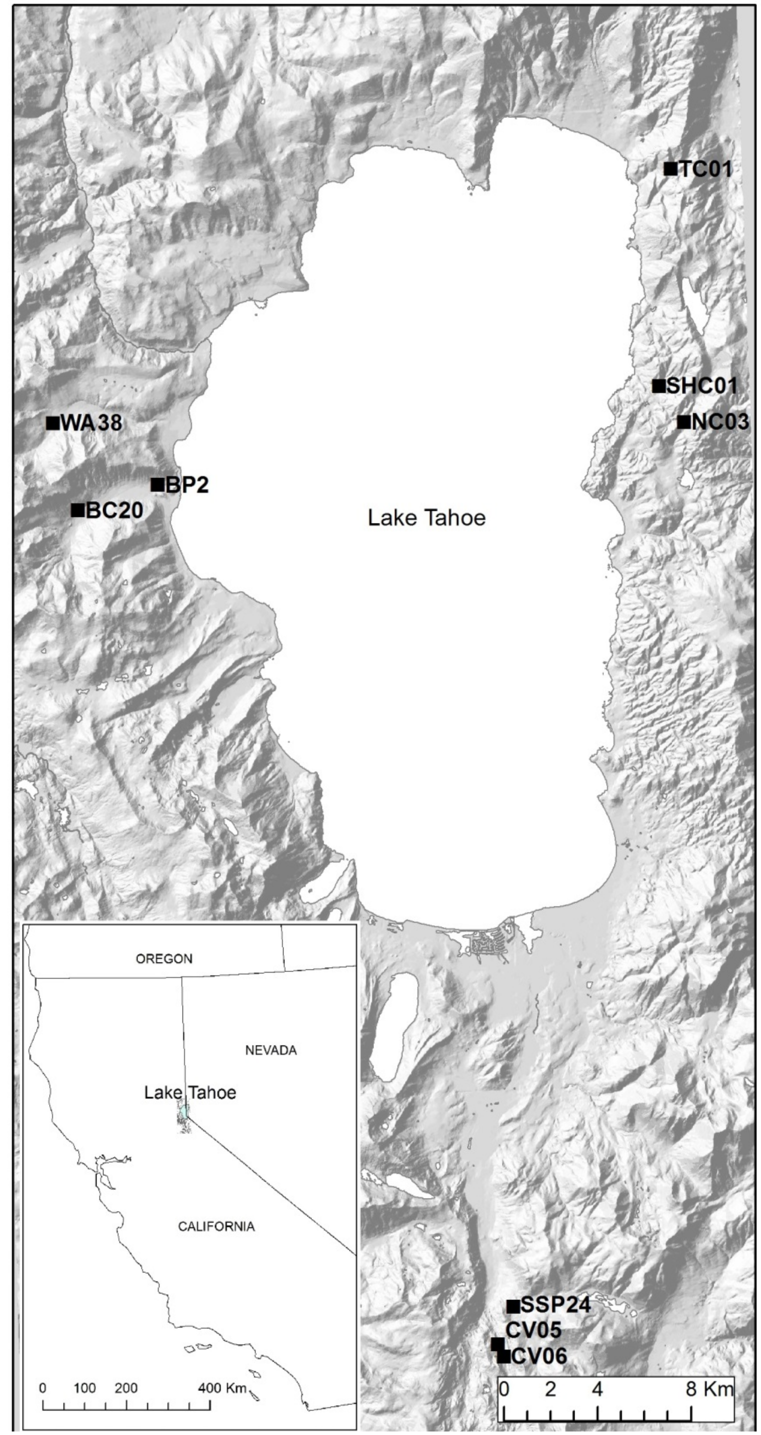
Humboldt State University, Arcata, CA.

Study Sites (9)

3 west + 3 east + 3 south shore

(currently 2 thinned + 1 unthinned)

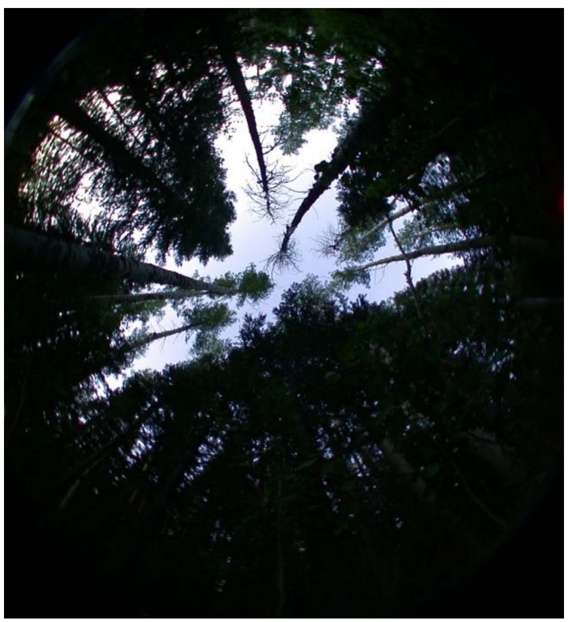
Unthinned CTC stand near Eagle Rock on west shore



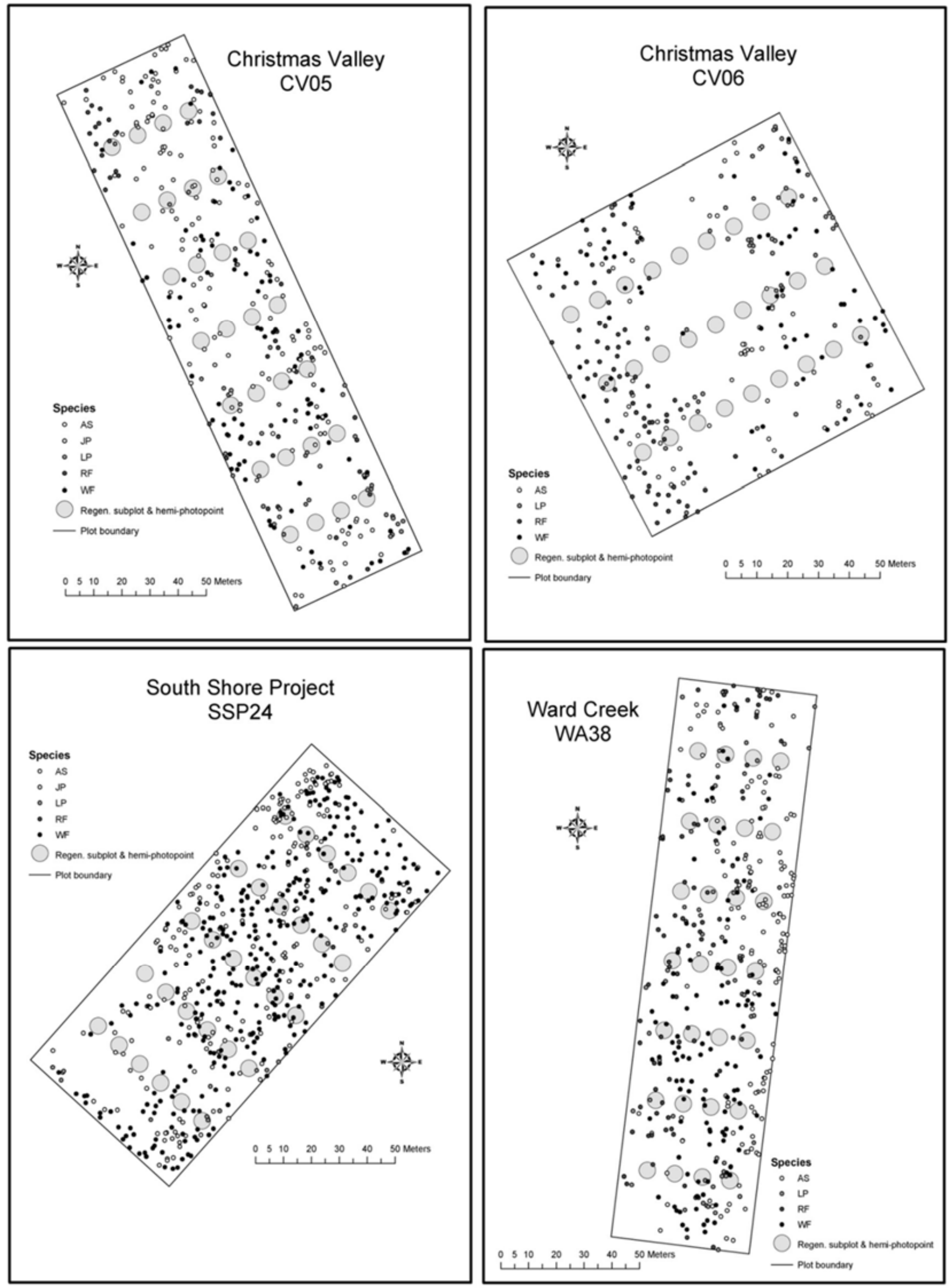
Monitoring

2.5 acre permanent plots

- Tree locations mapped
- Tree size, damage, health
- Regeneration subplots



Hemispherical image in each subplot



Stand-level summary data for basal area (BA), stand density index (SDI), volume (Vol), and bone dry mass in U.S. tons (short tons) by species at each study site, LTBMU.

Site	Species	Trees/ac	BA (ft^2/ac)	Vol (ft^3/ac)	U.S. tons (t/ac)
CV05	Aspen	46	106.6	3136	29.4
	Jeffrey pine	1	2.2	47	0.4
	Lodgepole pine	21	38.7	1384	13.0
	Red fir	19	23.1	495	4.6
	White fir	37	50.0	1133	10.6
	Conifer	**78**	**114.1**	**3059**	**28.7**
	Total	**124**	**220.7**	**6195**	**58.1**
CV06	Aspen	18	30.7	810	7.6
	Lodgepole pine	26	50.0	1846	17.3
	Red fir	34	80.8	2727	25.6
	White fir	25	65.4	1851	17.4
	Conifer	**85**	**196.3**	**6424**	**60.2**
	Total	**103**	**227.0**	**7234**	**67.8**
SSP24	Aspen	49	67.3	2113	19.8
	Jeffrey pine	3	11.4	617	5.8
	Lodgepole pine	11	21.6	857	8.0
	Red fir	1	12.7	582	5.5
	White fir	142	187.5	5461	51.2
	Conifer	**158**	**233.1**	**7517**	**70.5**
	Total	**206**	**300.5**	**9630**	**90.3**
WA38	Aspen	21	28.7	638	6.0
	Lodgepole pine	25	64.6	2463	23.1
	Red fir	38	55.9	1533	14.4
	White fir	47	75.4	2043	19.2
	Conifer	**110**	**195.9**	**6039**	**56.6**
	Total	**132**	**224.6**	**6677**	**62.6**

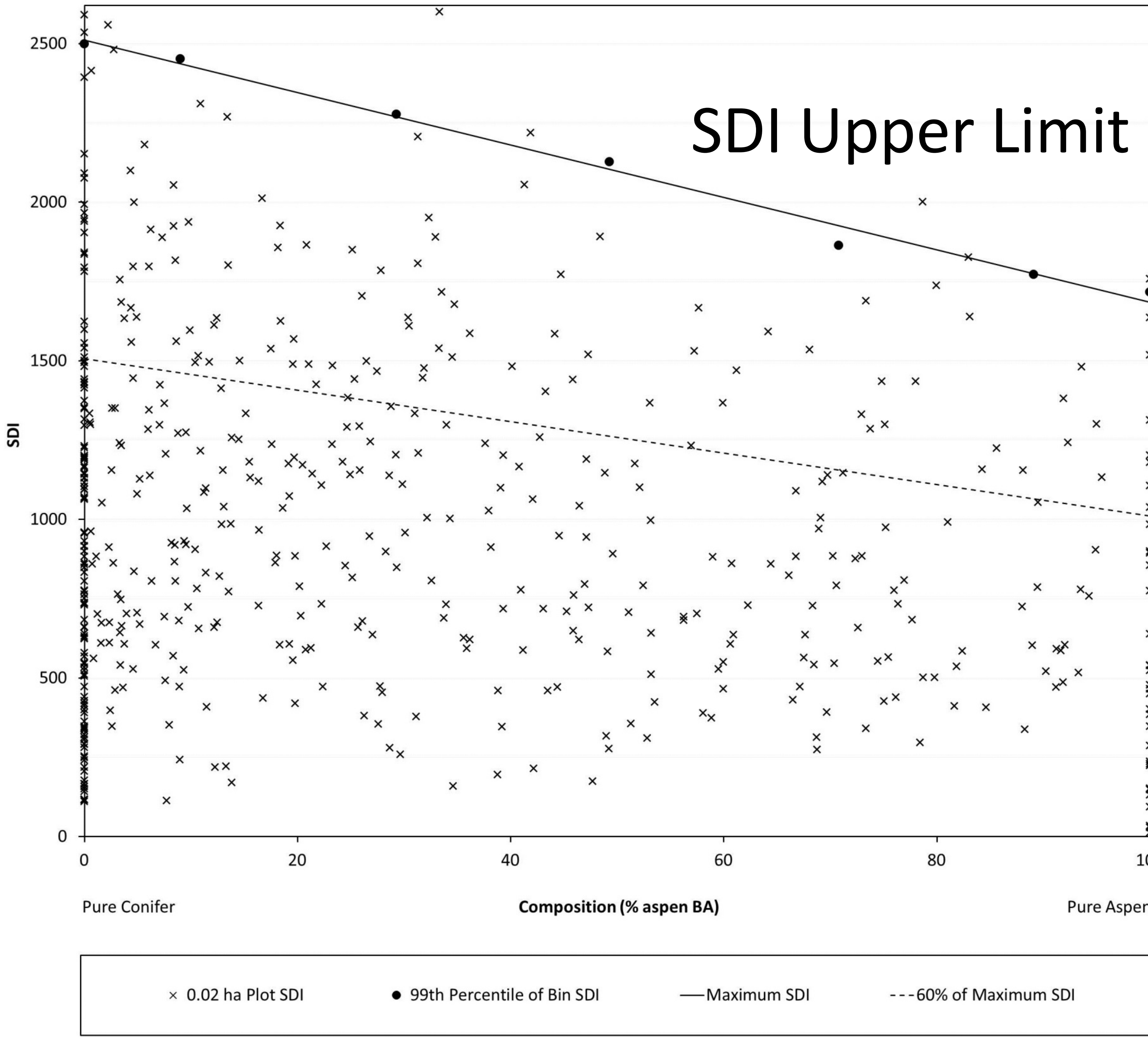
Stand-level summary data for basal area (BA), stand density index (SDI), volume (Vol), and bone dry mass in U.S. tons (short tons) by species at each study site, LTBMU.

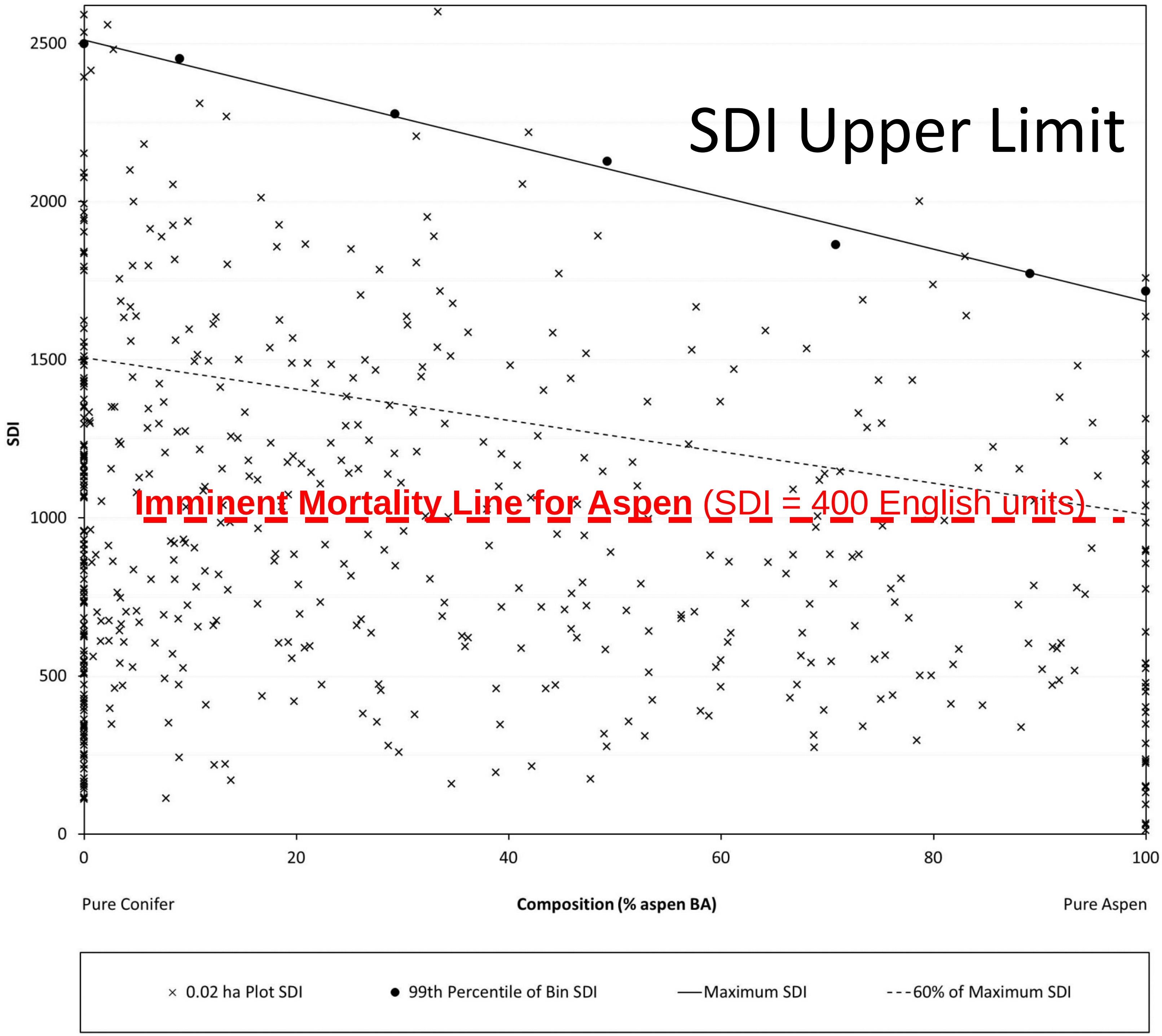
Site	Species	Trees/ac	BA (ft^2/ac)	Vol (ft^3/ac)	U.S. tons (t/ac)
CV05	Aspen	46	106.6	3136	29.4
	Jeffrey pine	1	2.2	47	0.4
	Lodgepole pine	21	38.7	1384	13.0
	Red fir	19	23.1	495	4.6
	White fir	37	50.0	1133	10.6
	Conifer	**78**	**114.1**	**3059**	**28.7**
	Total	**124**	**220.7**	**6195**	**58.1**
CV06	Aspen				7.6
	Lodgep				17.3
	Red fi				25.6
	White				17.4
	Conif				**60.2**
	Total				**67.8**
SSP24	Asper				19.8
	Jeffrey				5.8
	Lodge				8.0
	Red fi				5.5
	White				51.2
	Conif				**70.5**
	Total				**90.3**
WA38	Asper				6.0
	Lodge				23.1
	Red fi	[illegible]	[illegible]	[illegible]	14.4
	White fir	47	75.4	2043	19.2
	Conifer	**110**	**195.9**	**6039**	**56.6**
	Total	**132**	**224.6**	**6677**	**62.6**

Species Composition (Conifer %)

Site	No. trees (%)	BA (%)	Vol (%)
CV05	63	52	49
CV06	83	86	89
SSP24	76	78	78
WA38	84	87	90

SDI Upper Limit





SDI Upper Limit
Imminent Mortality Line for Aspen (SDI = 400 English units)
SDI
2500
2000
1500
1000
500
0
0
20
40
60
80
100
Pure Conifer
Composition (% aspen BA)
Pure Aspen
0.02 ha Plot SDI
99th Percentile of Bin SDI
Maximum SDI
60% of Maximum SDI

Aspen Burn Injury Models

Effect of pile size on probability of injury

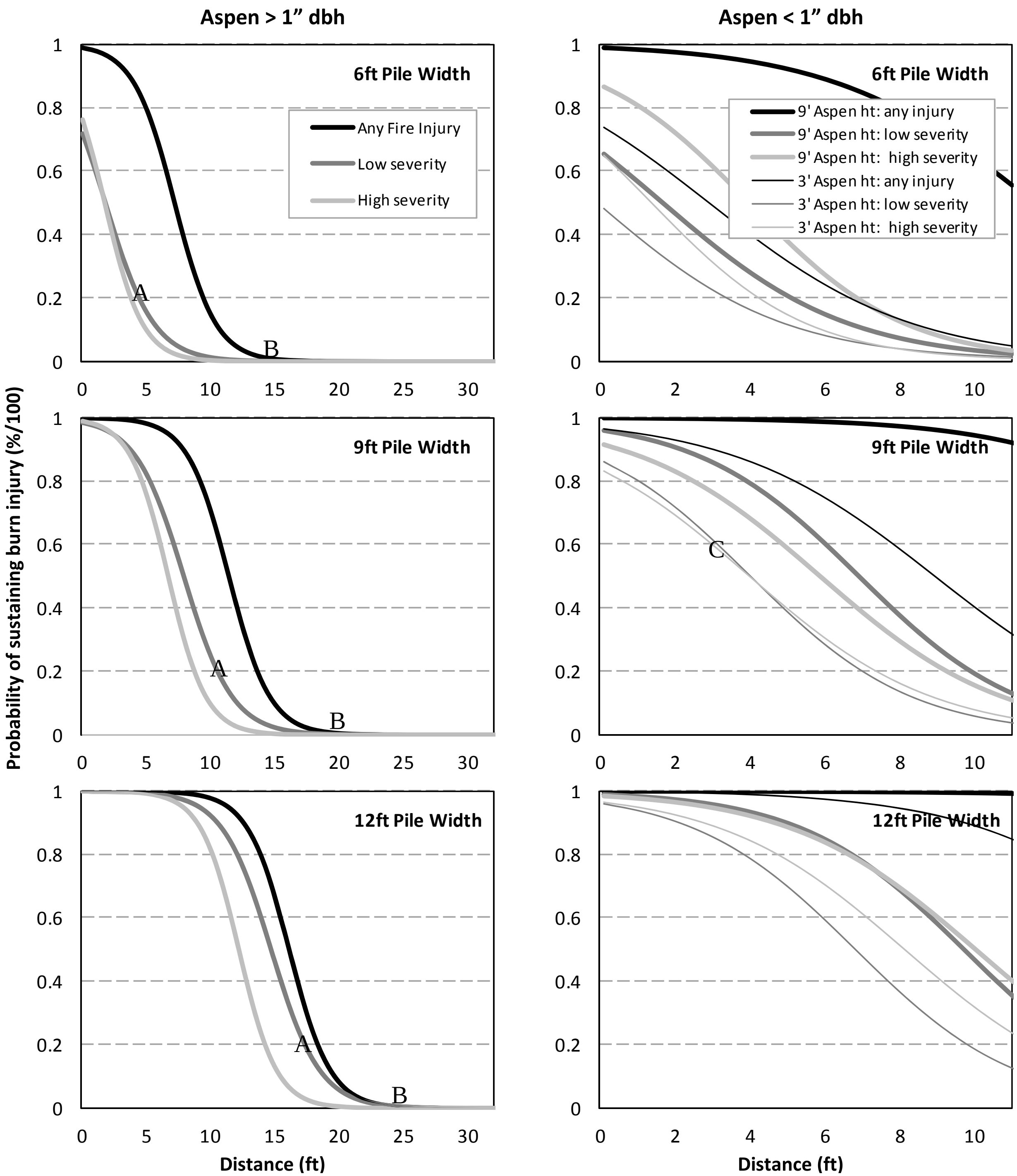
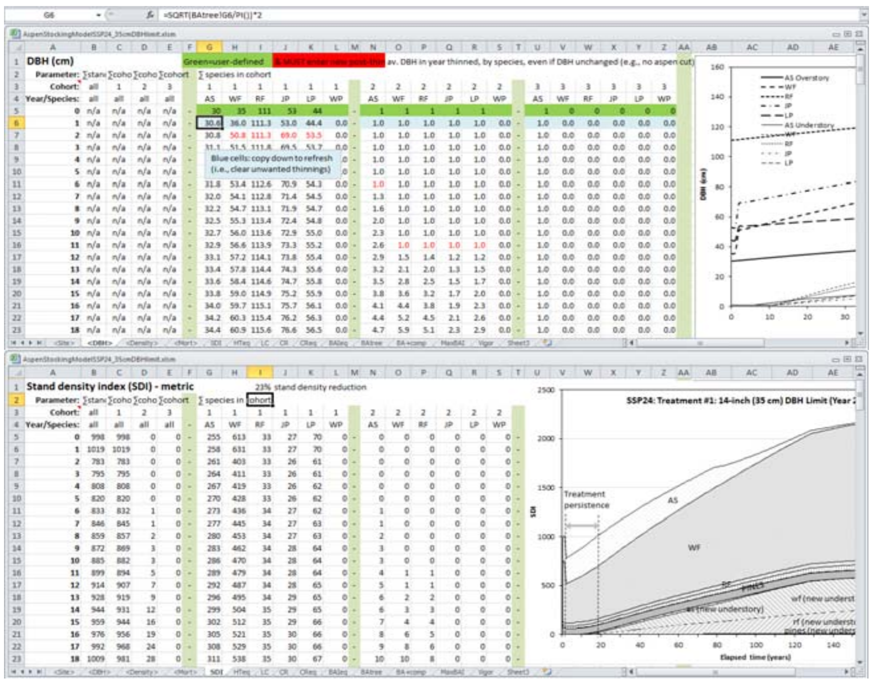


Figure caption:
Predicted probability of aspen injury related to pile width and distance from burn pile (e.g. where probability of 0.5 = 50% chance of injury) based on pile and injury data from fall burning in 2011 at one site (WA38). Scenario A: 20% probability of "low severity" injury; B: 0% probability of "Any injury"; C: 60% probability of "high severity" injury to small trees.

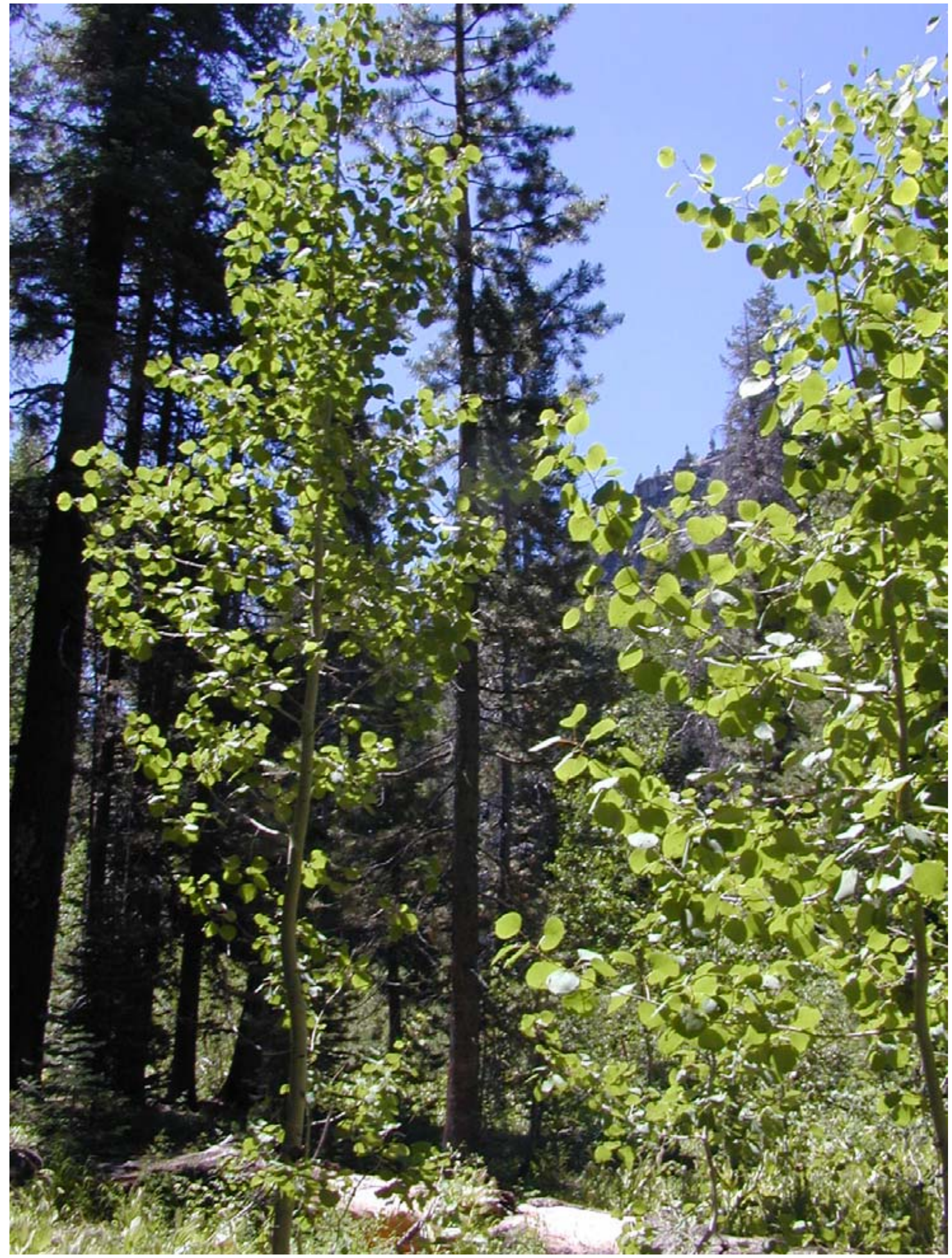
Question

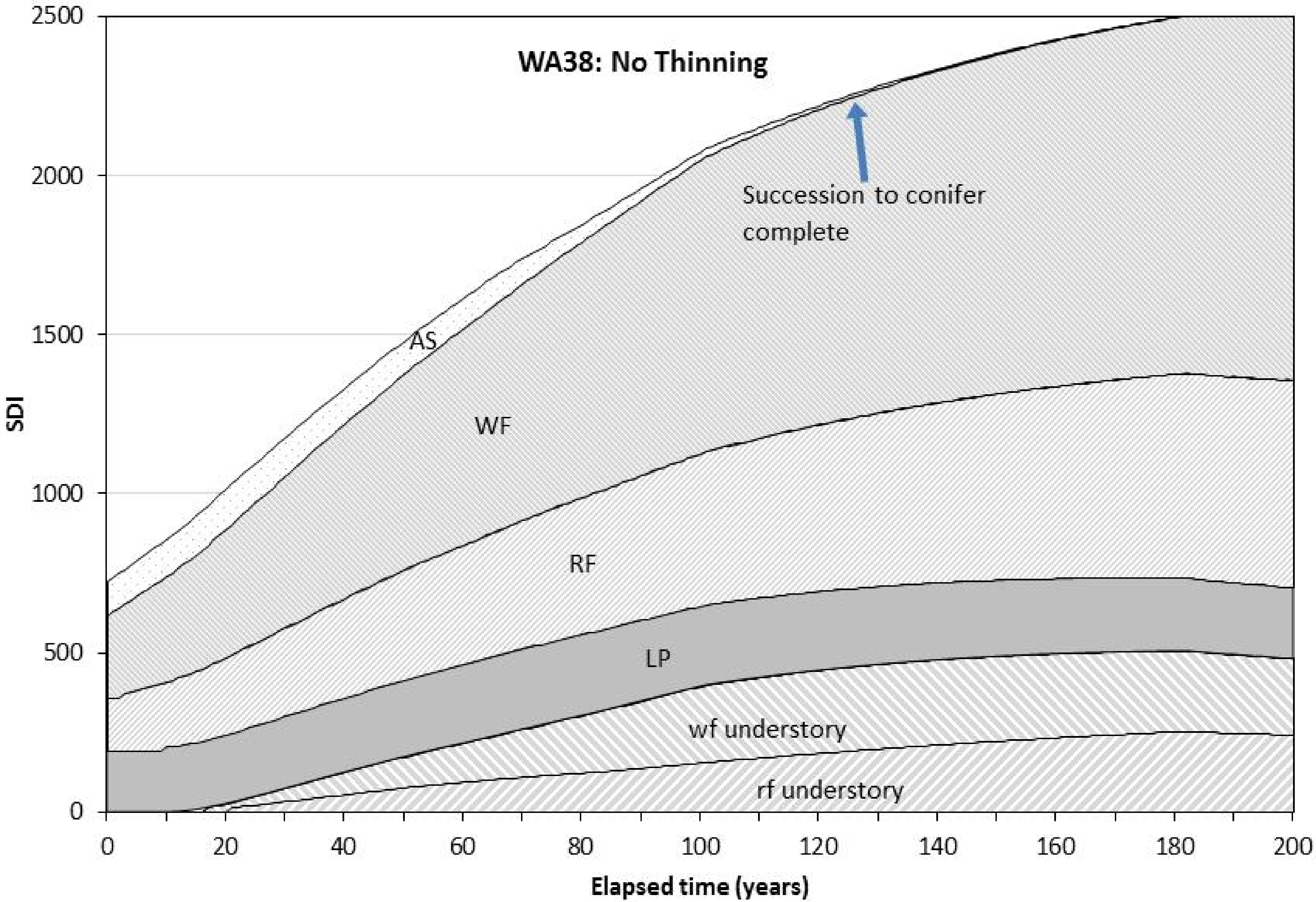
"How much growing space does aspen need to regenerate and/or maintain vigor?"

1. User-friendly DSS

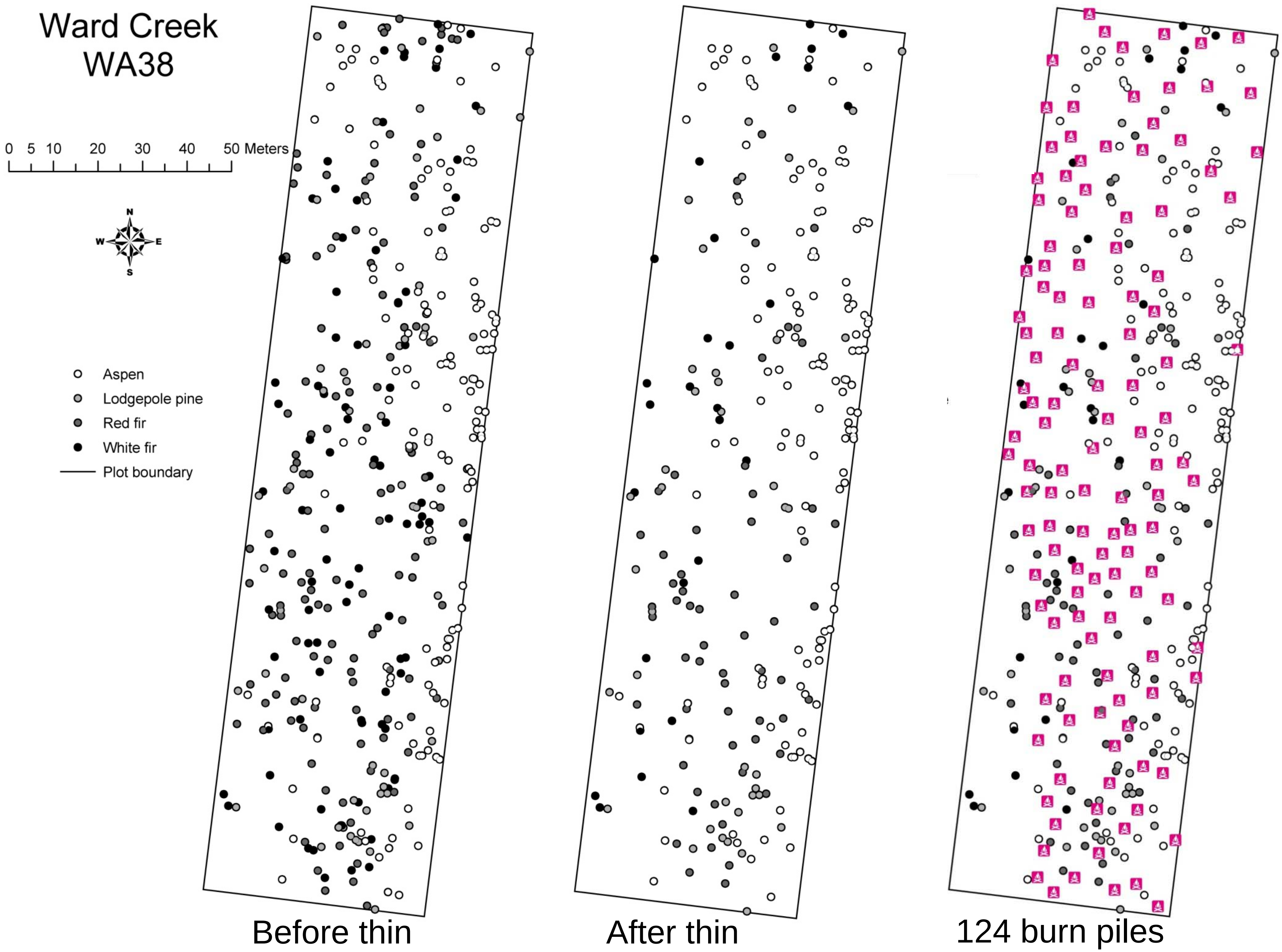


2. Stocking guidelines for aspen restoration

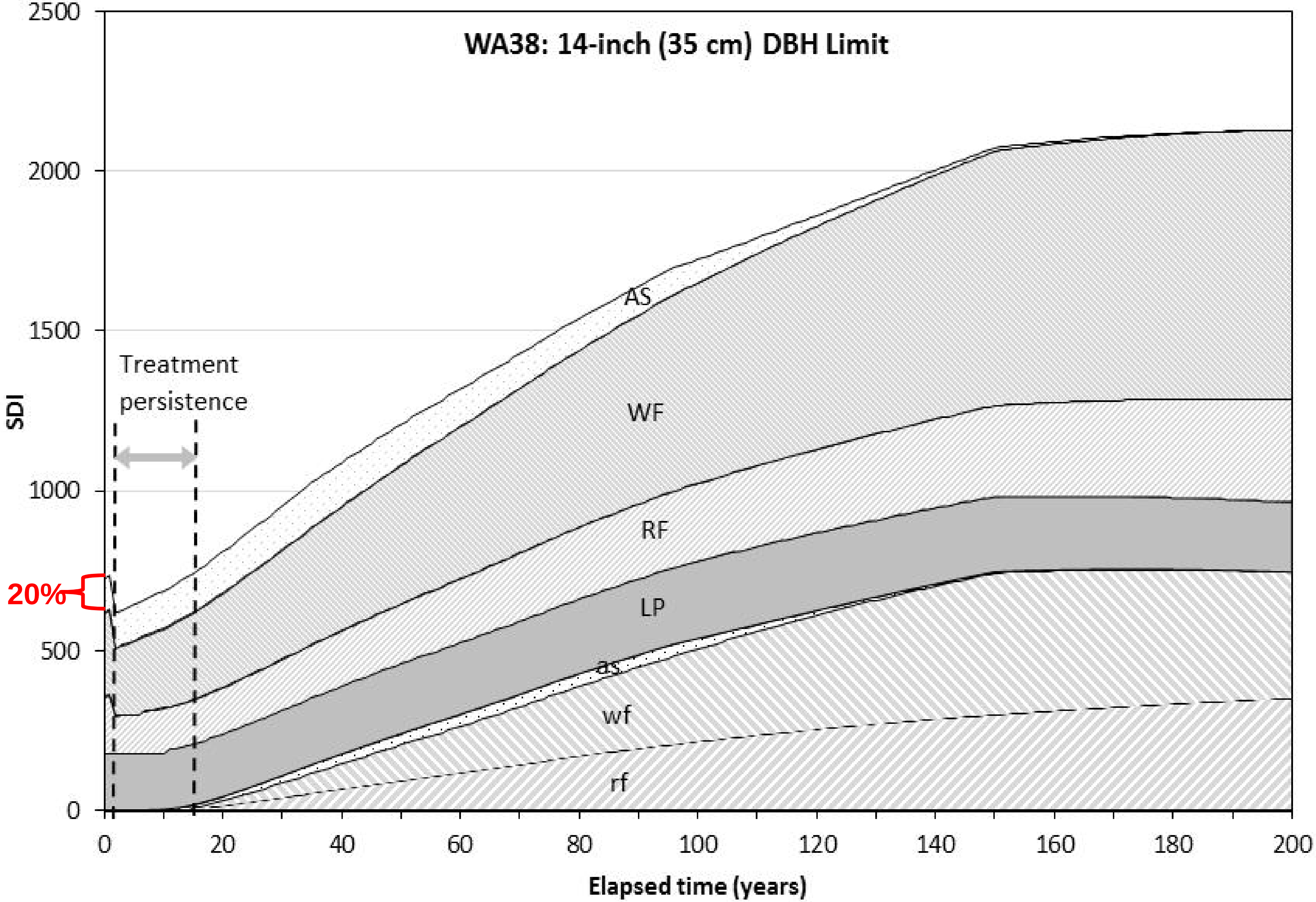




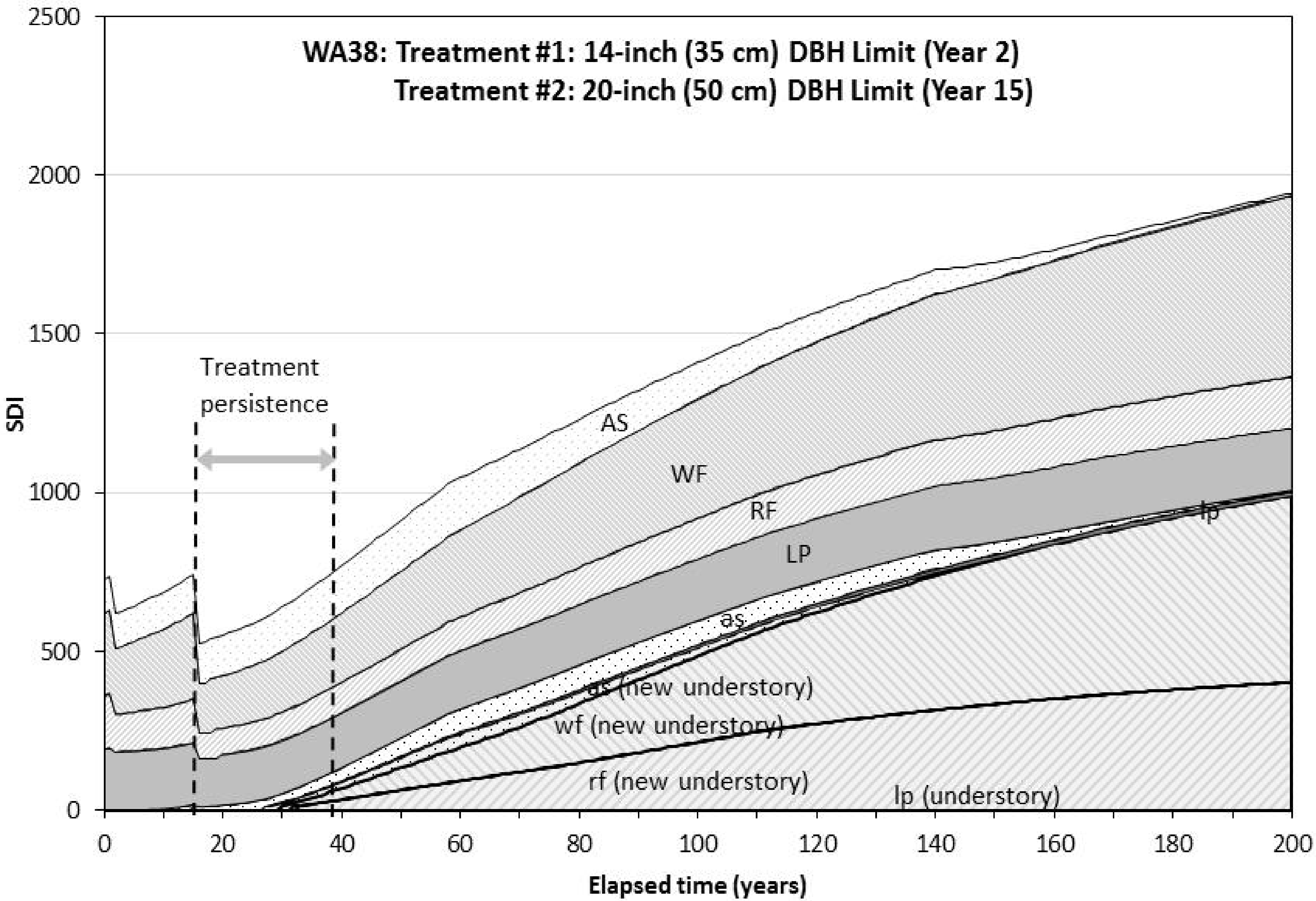
No treatment “do nothing” scenario - simulated change in stand density index (SDI)



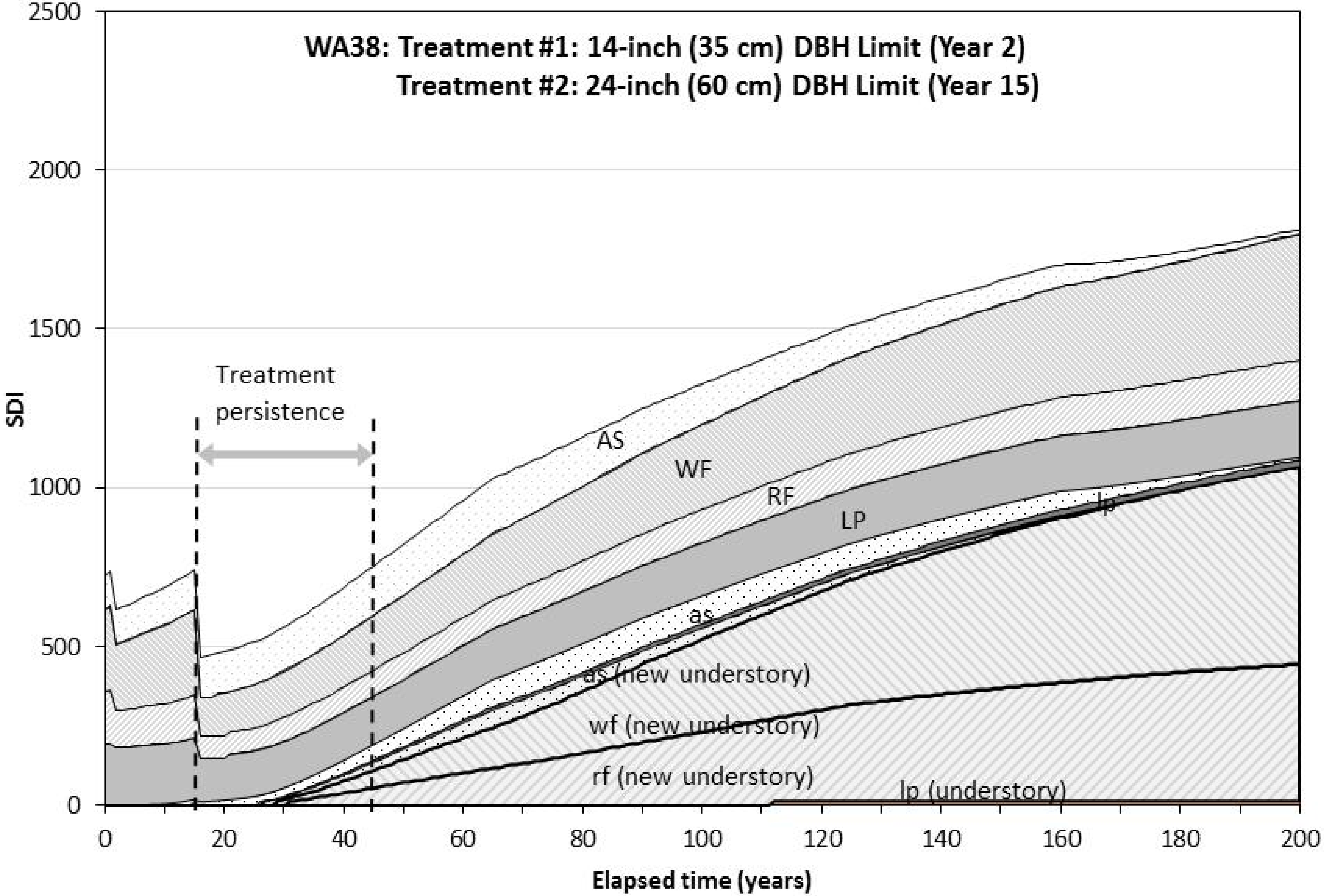
Ward Creek
WA38
0 5 10 20 30 40 50 Meters
N
W
E
S
Aspen
Lodgepole pine
Red fir
White fir
Plot boundary
Before thin
After thin
124 burn piles



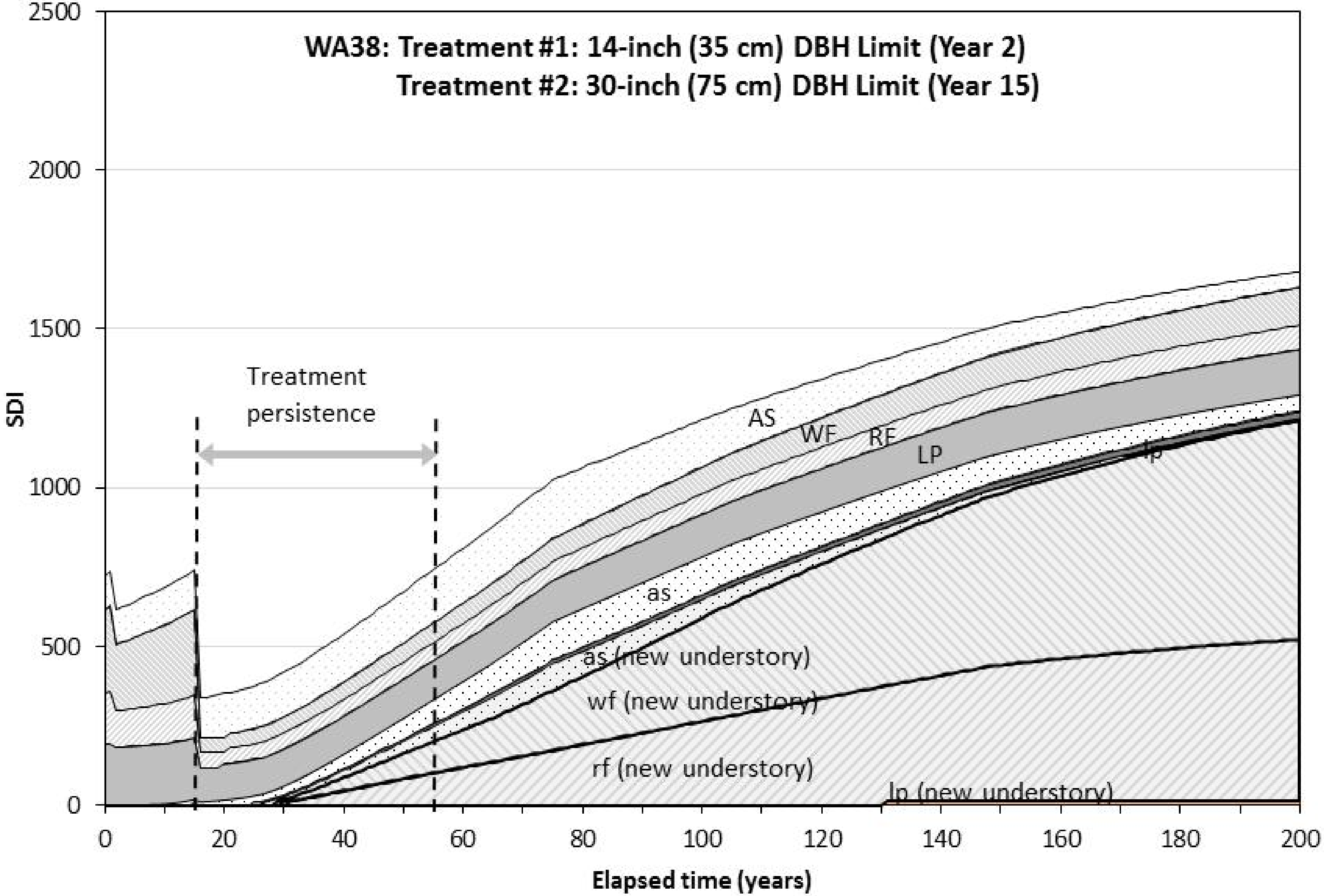
One thinning cuts conifer <14 in. DBH - simulated change in stand density (SDI)



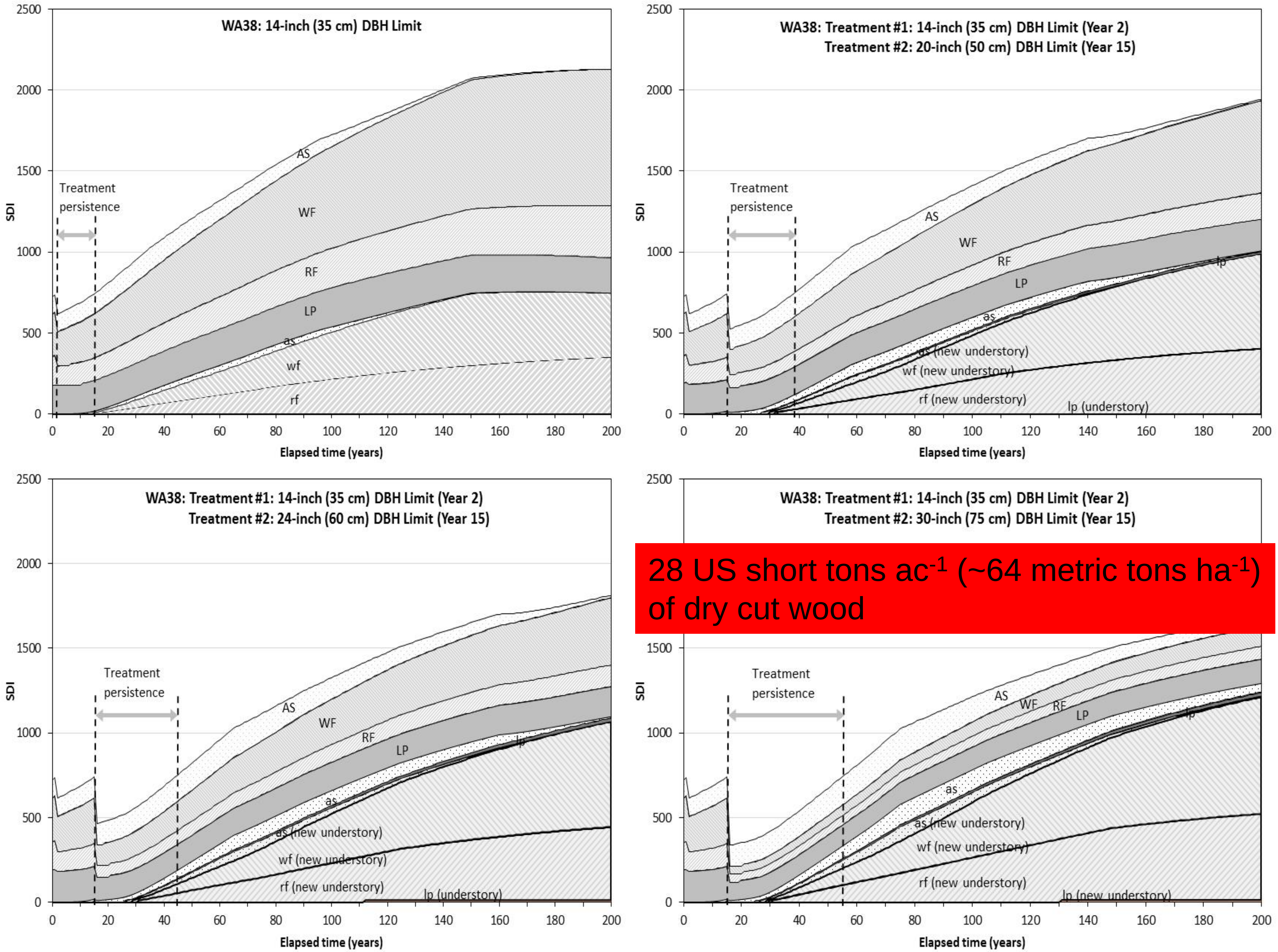
Second thin cuts conifer <20 in. DBH - simulated change in stand density index (SDI)

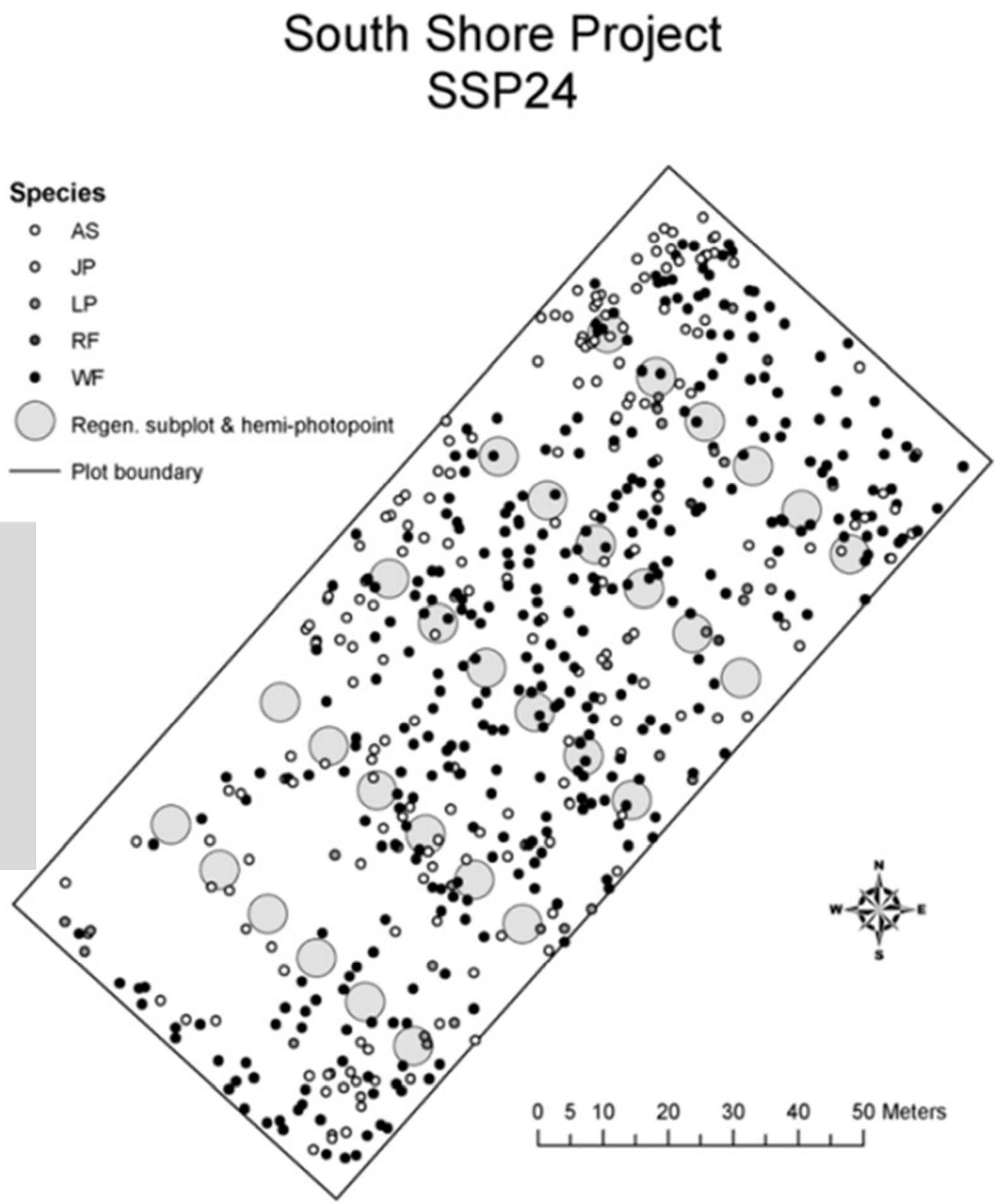


Alternate second thin cuts conifer <24 in. DBH - simulated change in stand density



Alternate second thin cuts conifer <30 in. DBH - simulated change in stand density

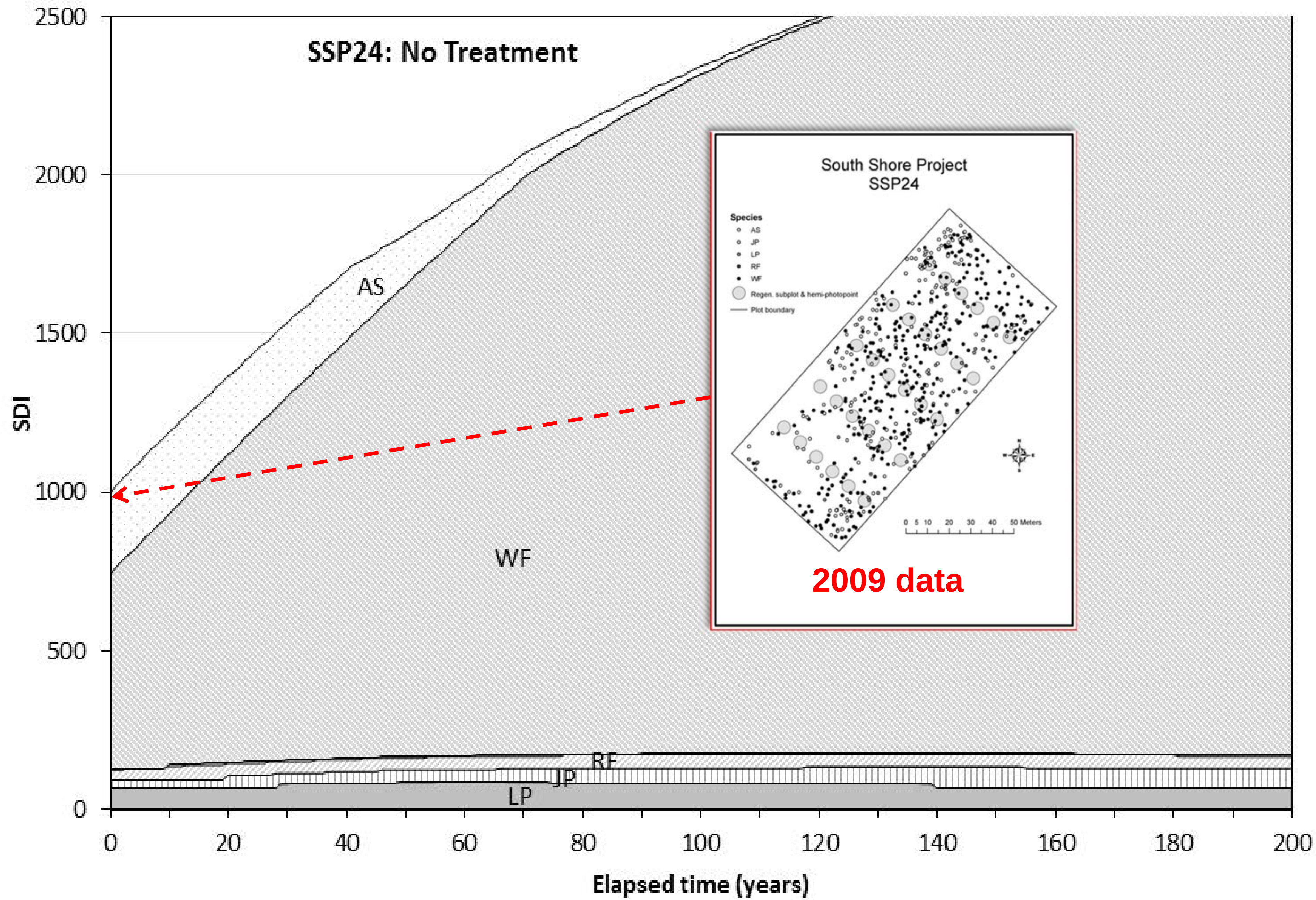

WA38: 14-inch (35 cm) DBH Limit
WA38: Treatment #1: 14-inch (35 cm) DBH Limit (Year 2)
Treatment #2: 20-inch (50 cm) DBH Limit (Year 15)
WA38: Treatment #1: 14-inch (35 cm) DBH Limit (Year 2)
Treatment #2: 24-inch (60 cm) DBH Limit (Year 15)
WA38: Treatment #1: 14-inch (35 cm) DBH Limit (Year 2)
Treatment #2: 30-inch (75 cm) DBH Limit (Year 15)
28 US short tons ac^{-1} (~64 metric tons ha^{-1}) of dry cut wood
Treatment persistence
AS
WF
RF
LP
as
wf
rf
lp
as (new understory)
wf (new understory)
rf (new understory)
lp (understory)
lp (new understory)
SDI
Elapsed time (years)



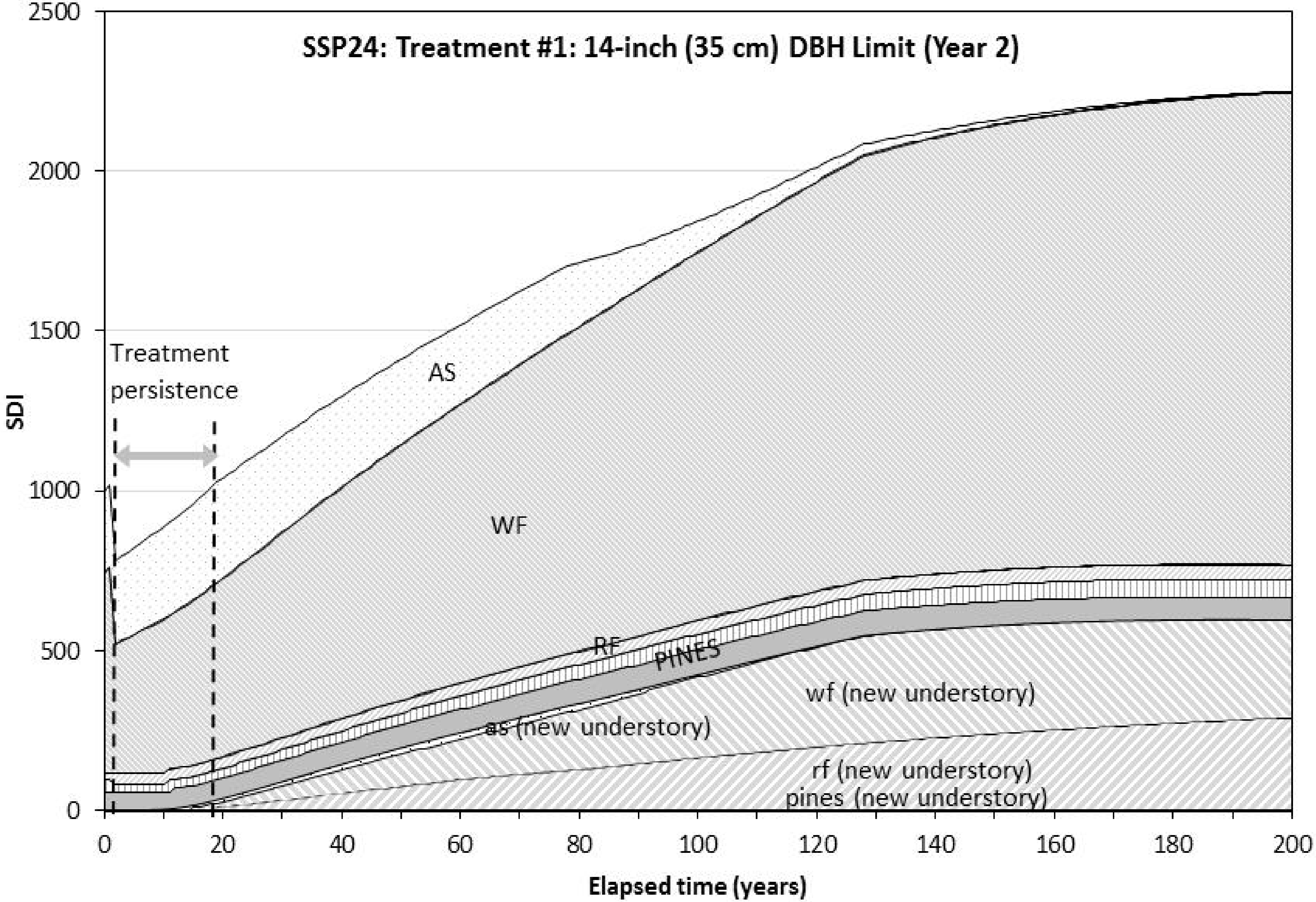
Untreated stand

2009 measurement data:

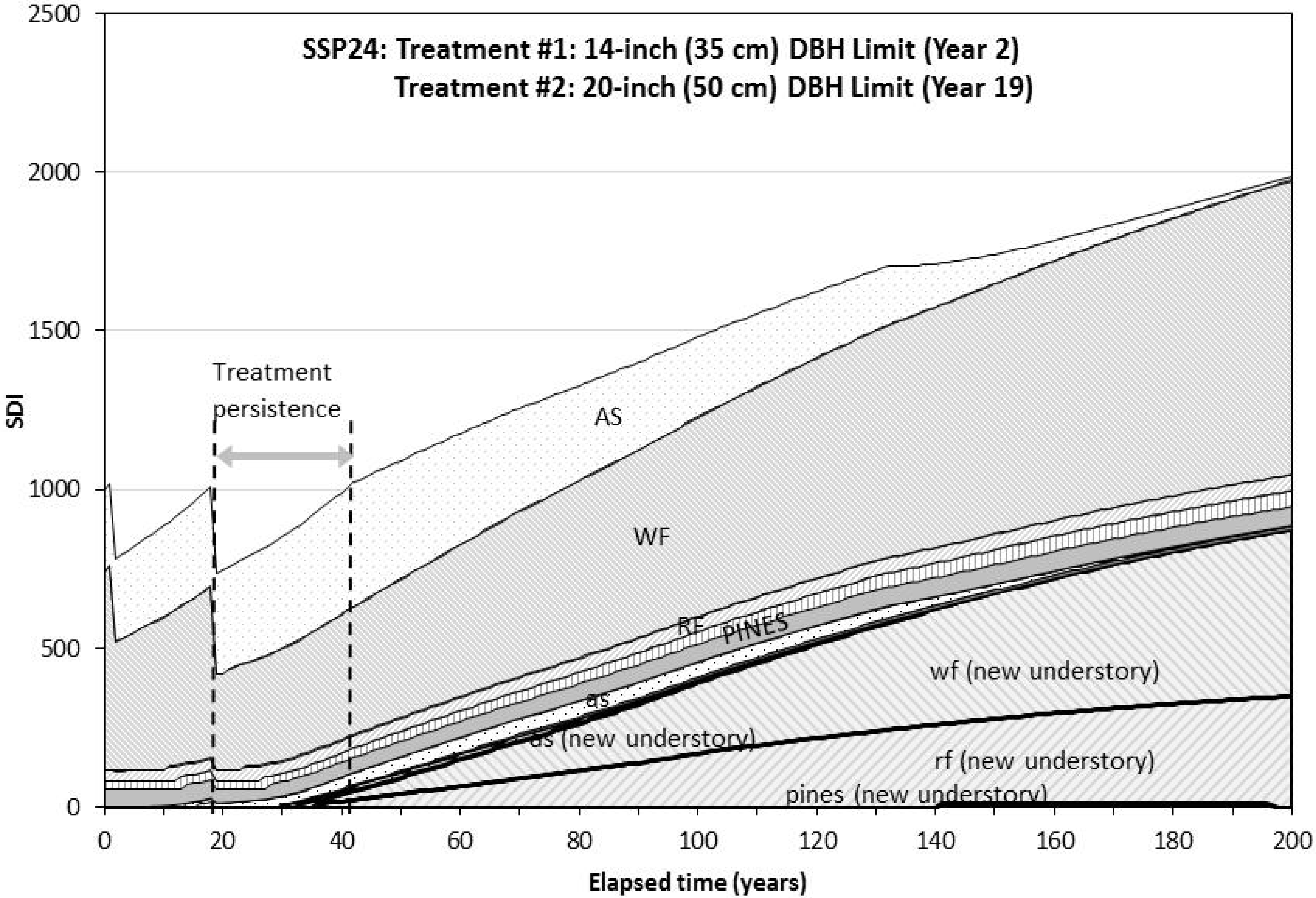
- 78% conifer BA & volume
- 70 tons/ac conifer stem wood (excl. crowns & saplings <8” DBH)



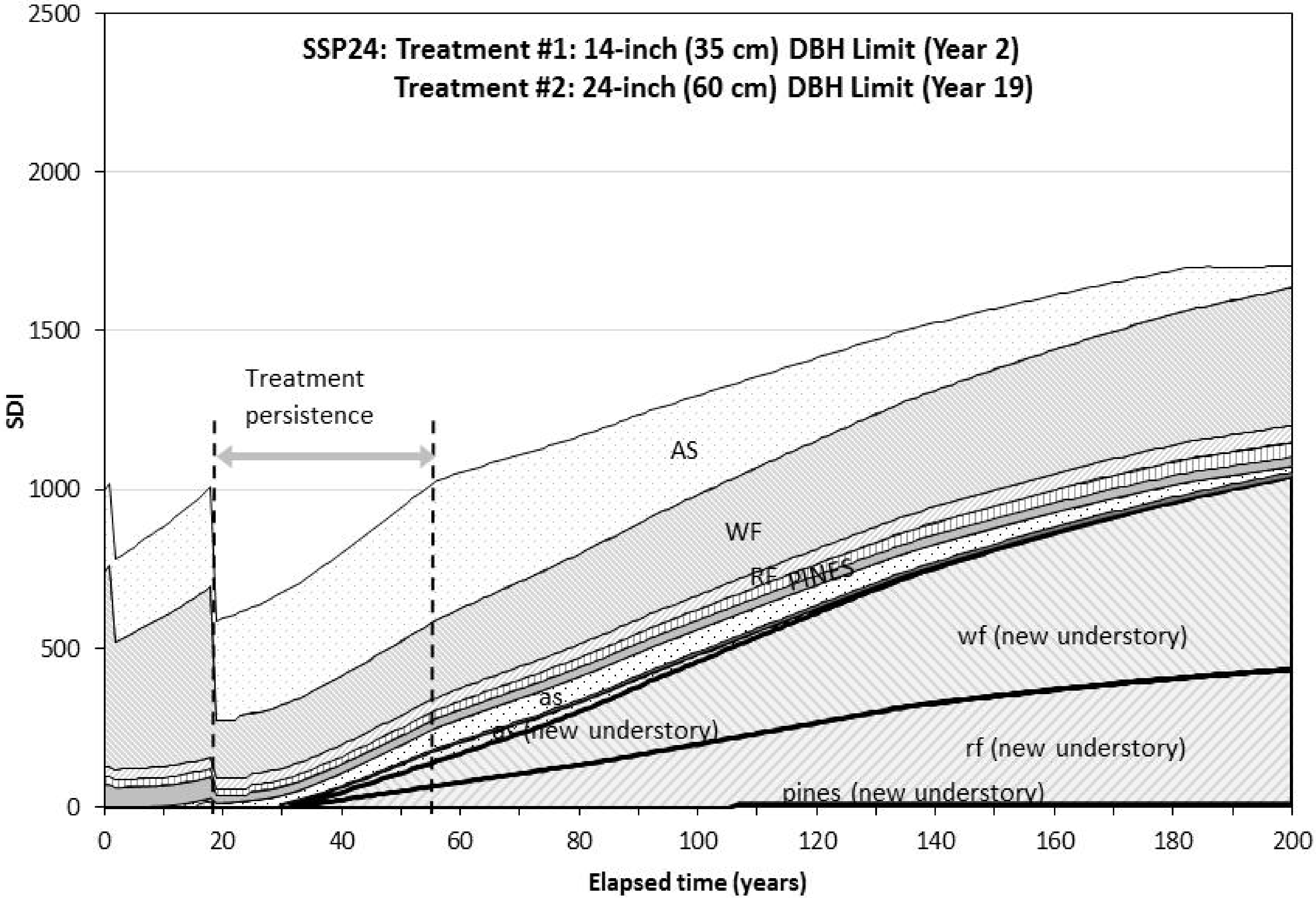
No treatment “do nothing” scenario - simulated change in stand density index (SDI)



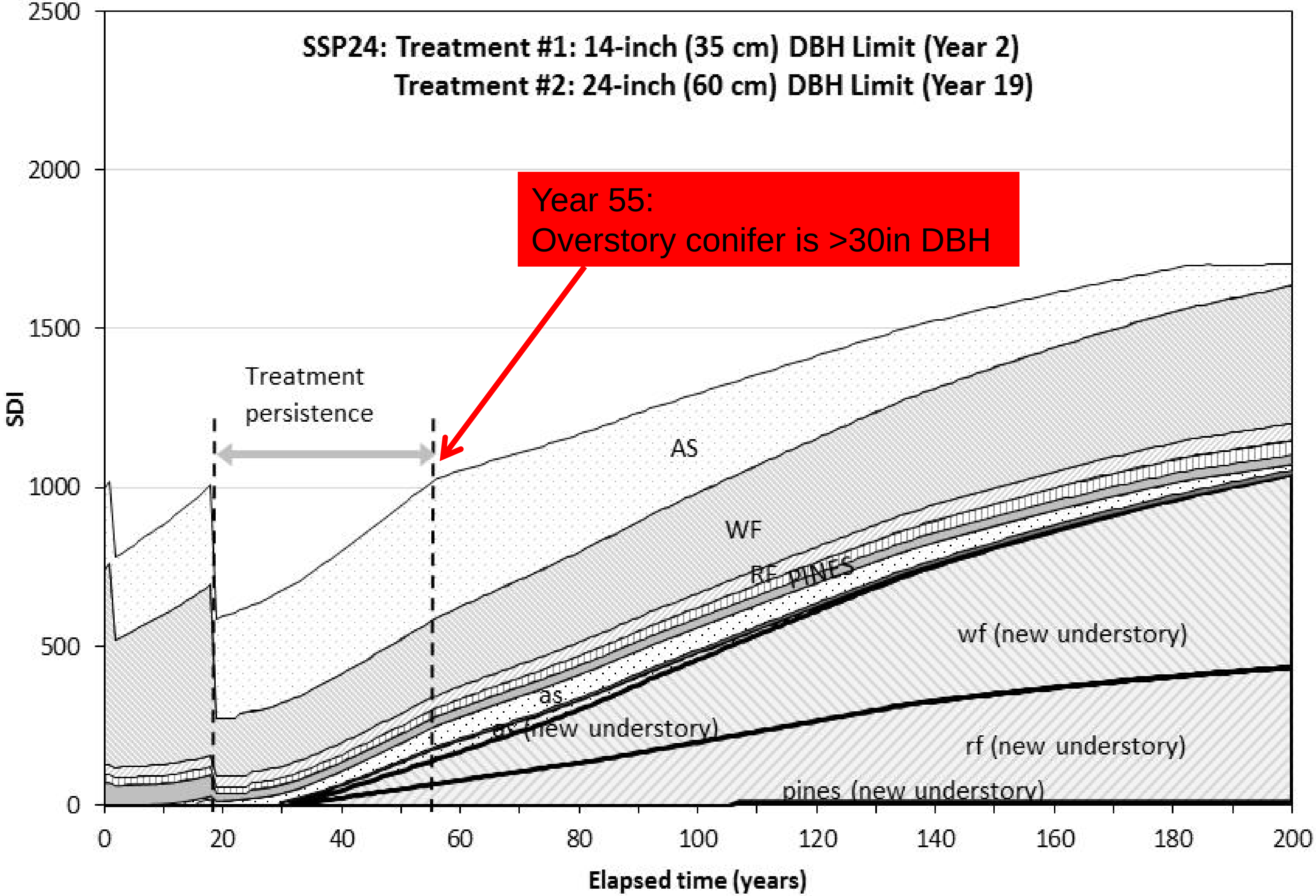
One thinning cuts conifer <14 in. DBH - simulated change in stand density (SDI)



Second thin cuts conifer <20 in. DBH - simulated change in stand density index (SDI)



Alternate second thin cuts conifer <24 in. DBH - simulated change in stand density



Alternate second thin cuts conifer <24 in. DBH - simulated change in stand density

Conclusions

- **Our findings support notion that heavier thinning:**
  - favors aspen and plants, longer treatment persistence,
  - but cut conifer fuel load becomes excessive
- **Combine complimentary treatments with hand-piling and burning to mitigate fuel disposal problem** (that otherwise precludes heavier thinning), e.g.:
  - girdle larger conifers (leave dead wood standing)
  - leave large conifer logs lying intact as coarse woody debris
- **Cutting/killing conifer >30" DBH will be necessary**
  - After two thinning treatments with progressively higher DBH limits, any subsequent thinning >14% of SDI (i.e., cut all conifer regen.+ some large conifer) at SSP24 necessarily involves cutting/killing conifer >30" DBH

ACKNOWLEDGEMENTS

We sincerely thank our collaborators Stephanie Coppeto, Kyle Jacobson, and Victor Lyon (USDA Forest Service), David Catalano and Mark Enders (Nevada Division of Wildlife), Tamara Sasaki and Silver Hartman (California State Parks), and Judy Clot (California Tahoe Conservancy).

Field assistance was provided by Arron Cox, Chris Harrison, Chris Hightower, Jesse Jeffress, Christopher Kirk, Forest Kirk, Nick Knipe, Matthew Lyons, Brandon Namm, Kirk Perttu, Dustin Revel, and Chris Valness.

This research was supported using funds provided by the Bureau of Land Management through the sale of public lands as authorized by the Southern Nevada Public Land Management Act (SNPLMA).

LITERATURE CITED (Products of SNPLMA-funded science project are shown below in **bold**).

Berrill, J-P.; Dagley, C.M.; Lyon, V. 2009. Monitoring Aspen Restoration Treatments in the LTBMU: Methodology and Pre-treatment Data Summary. Final Report: LTBMU Aspen Monitoring Project.

Berrill, J-P.; Dagley, C.M. 2010. Preliminary stocking guidelines for aspen restoration in the LTBMU: Comparing thinning prescription diameter limits. Report prepared for Lake Tahoe Basin aspen forest managers.

Berrill, J-P.; Dagley, C.M. 2012. Geographic patterns and stand variables influencing growth and vigor of Populus tremuloides in the Sierra Nevada (USA). ISRN For. Vol. 2012, ID: 271549, 1-9. Open Access.

Dagley, C.M.; Berrill, J-P.; Coppeto, S.; Jacobson, K. 2012. Effects of slash pile burning after restoring conifer-encroached aspen: interim pile building guidelines for aspen injury risk reduction. USDA Forest Service, Lake Tahoe Basin Management Unit Monitoring Report, December 2012.

Berrill, J-P.; Dagley, C.M. 2014. Regeneration and recruitment correlate with stand density and composition in long-unburned aspen stands undergoing succession to conifer in the Sierra Nevada, USA. For. Res. 3(2): 1-7. Open Access.

Berrill, J-P.; Dagley, C.M. 2014. Stocking Guidelines for Aspen Restoration: Predicting Treatment Persistence after Successive Conifer Removals. SNPLMA Round 10 Science Project P051 Final Report. 18p.