The Finish Line: Post-planting Activities Improving Reforestation Success

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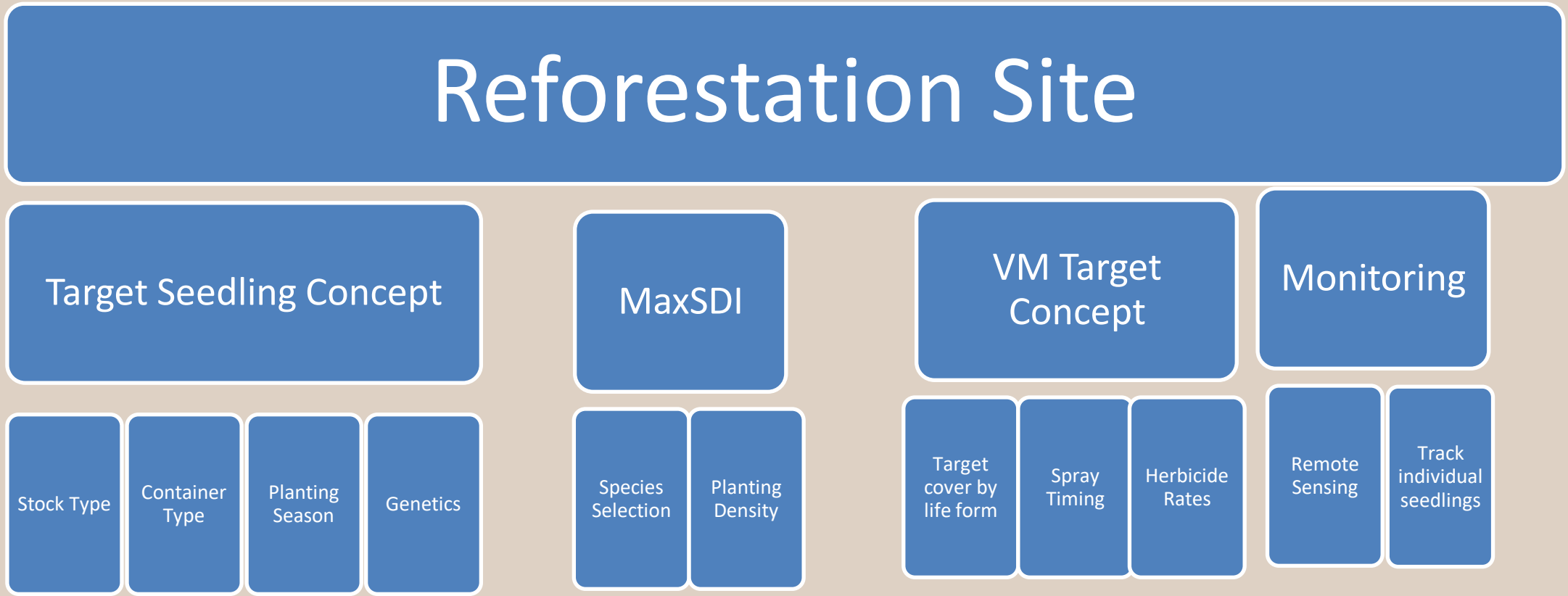
Maxwell Wightman, WADNR

Photo credit: AP Photo

Context – Precision Forestry

- Not more of the same; site-specific approaches



Outline

- Post-planting activities get **neglected. What's the problem?**
- Why post-planting activities are important?
- Post-planting to-**do's (aka "Unplugging" the pipeline)**
  - Physical protection
  - Managing water availability
  - Monitoring
- Summary

What's the problem?

#1 Most variables driving seedling survival and forest productivity are already set

Species

Seed/Genetics

Stock Type

Site Preparation

Seedling Quality

Storage & Handling

Micro-site Planting

DONE

Post-**planting activities can't compensate for** poor seedling quality, storage, handling or planting practices

What's the problem?

#2 Assuming what has worked in the past will work in the future.

"Forest environment" hasn't changed – plant & walk away

"Wait & see" approach - reactive

- 2015 historic drought
- 2021 heat dome

What's the problem?

3 "Trees die"

- Lack of follow-up to investigate causes of **seedling "stress" or** mortality
- **Nurseries don't have a** feedback loop


HELENA
DiscStore


LANE PARRY
FORESTRY CONSULTING
BIG DAWG

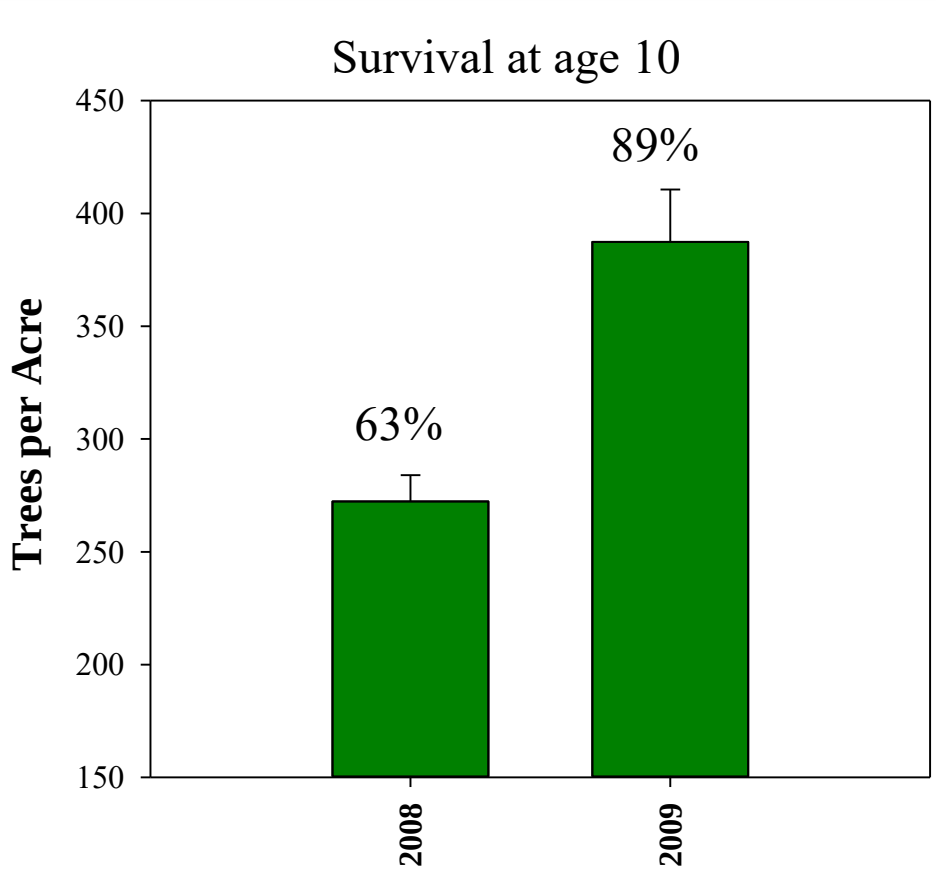
What's the problem?

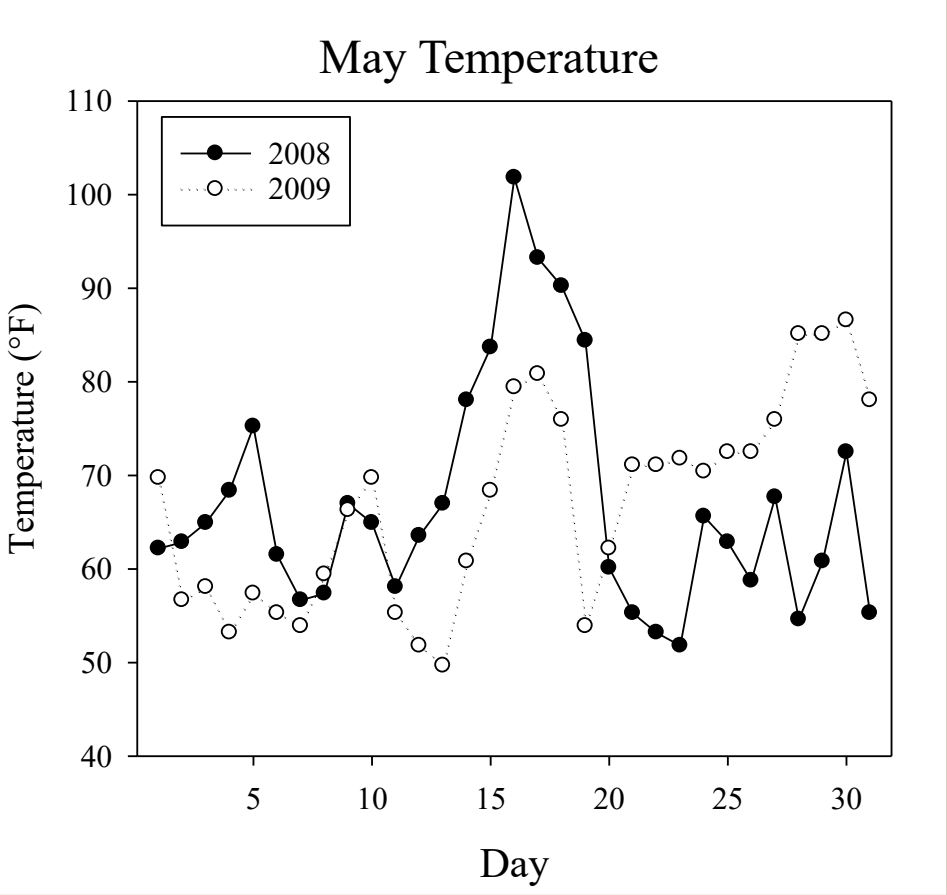
#4 Benefits from post-planting activities can vary from unit to unit, region to region, year to year (especially weather – VM)

Challenging to draw conclusions or sustain consistent programs

VMRC study: Same treatment & site, one delayed for 1 year

1st year plots: poor survival due to a heat wave in May





What's the problem?

#5 Forest Industry Changes

- More acres/forester, less field time, troubleshooting & follow-up
- Lack of reforestation expertise & technology transfer
- Budget priorities

What's the problem?

#6 Organizations focus on cost and process– deliverables are often production oriented

(acres planted, pre-commercially thinned, # seedlings **planted, acres certified "free**-to-**grow", etc.)**

Outcome/performance oriented metrics

- Survival %
- Seedling performance (root development)
- % ac with target stocking
- Time (years) to free-to-grow
- **Reforestation "delay"**
- Vegetation Cover %

What's the problem?

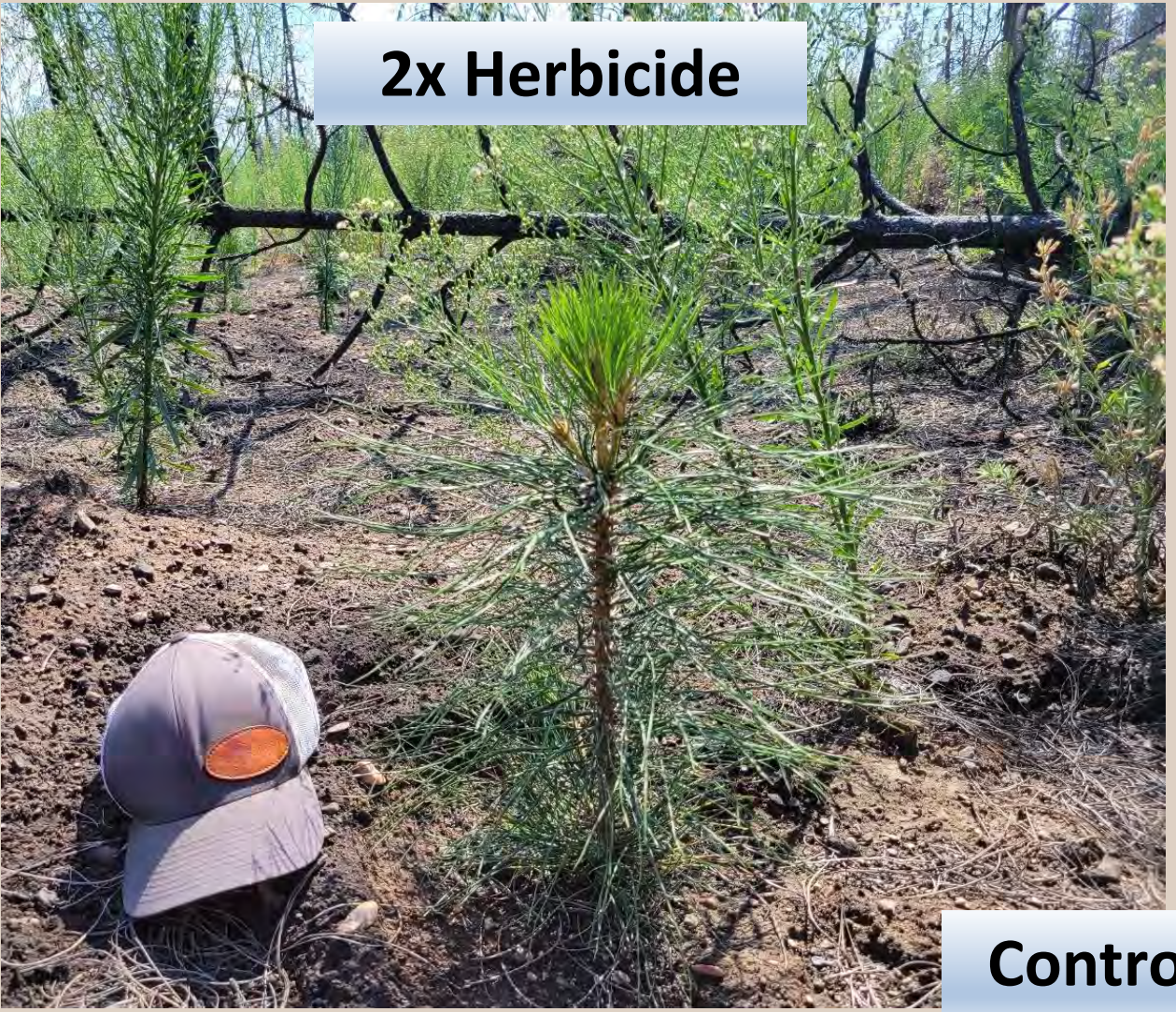
#7 Lack of data

- Organizations lack the necessary internal data (quantity/quality) and/or analytics to evaluate the performance & value of post-planting activities
- Lack of capacity to integrate external data (research), i.e. hemlock VM

Photo credit: Jake Thiemens

What's the problem?

2 Growing Seasons



Control treatments are powerful “story tellers”

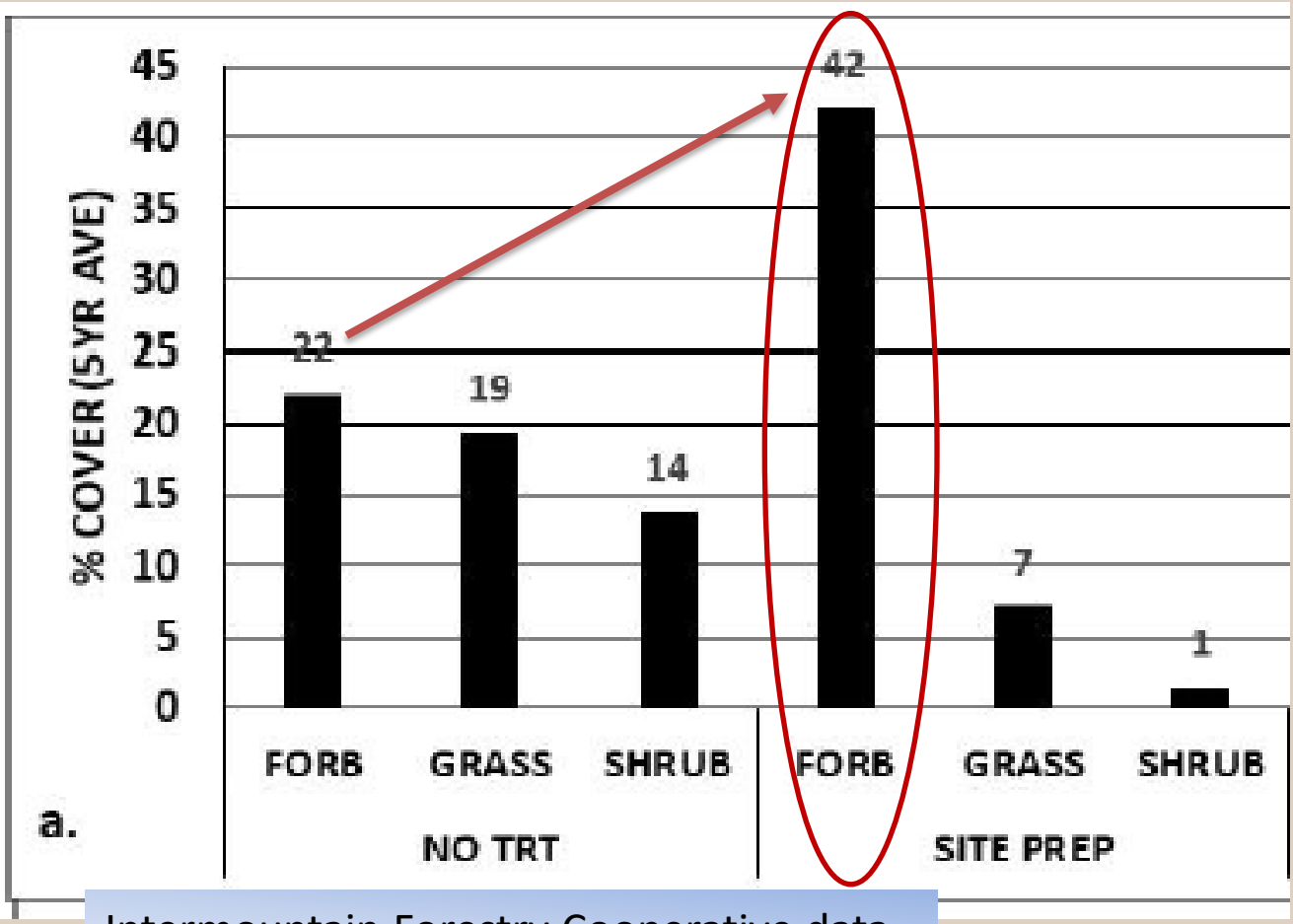
Why post-planting activities?

- Prevent (expected) regeneration failures – achieve objectives (ecological, financial)
- **More predictable outcome; "insurance policy"**
- Respond to (unexpected) post-planting challenges
- Workload (acres treated)
- **Minimize time ("age shift")–** increase landscape **"return", habitat thresholds, carbon capture, etc.**

Regeneration Failures

Post-planting challenges

Post site-prep invasions of resistant weed communities

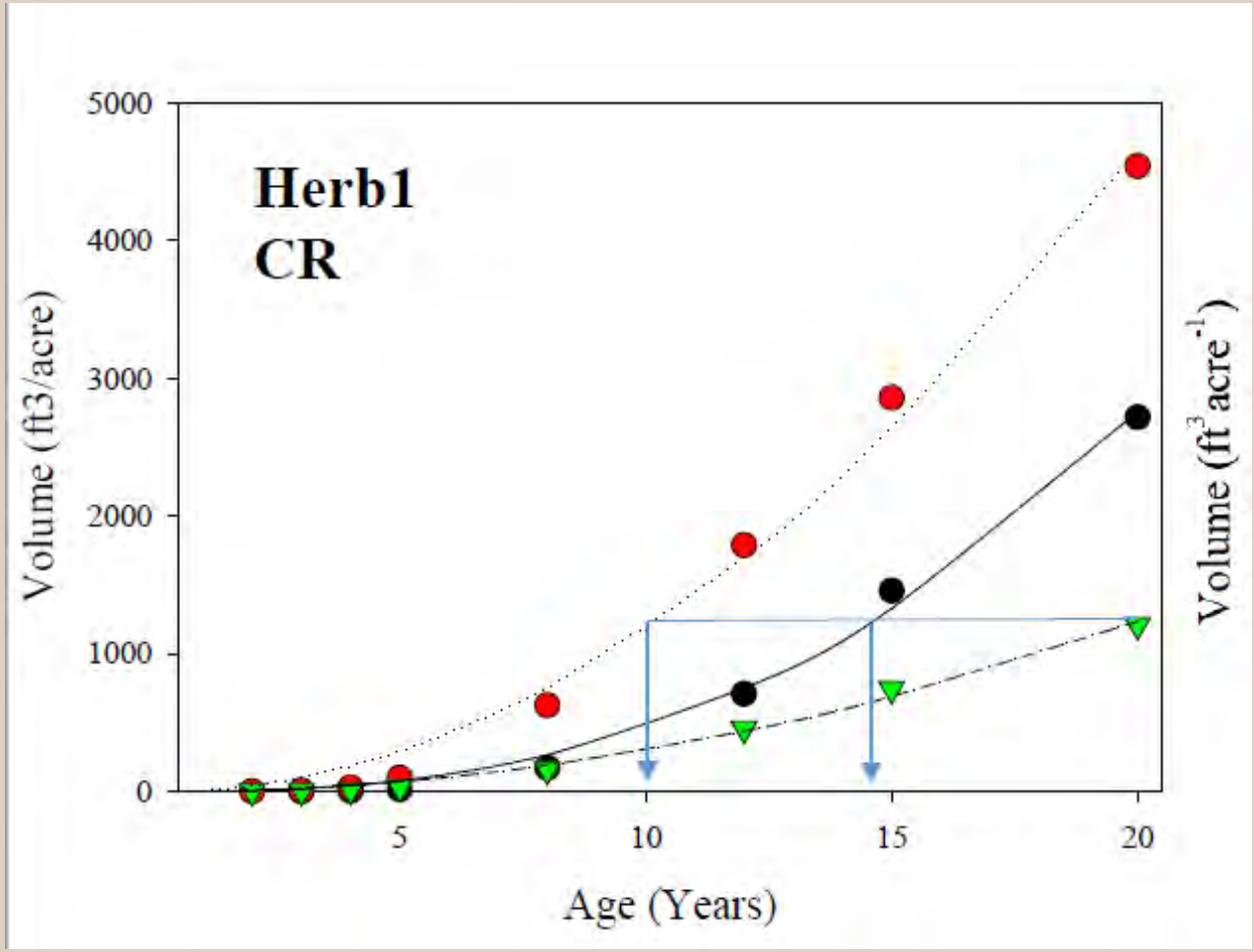


Intermountain Forestry Cooperative data

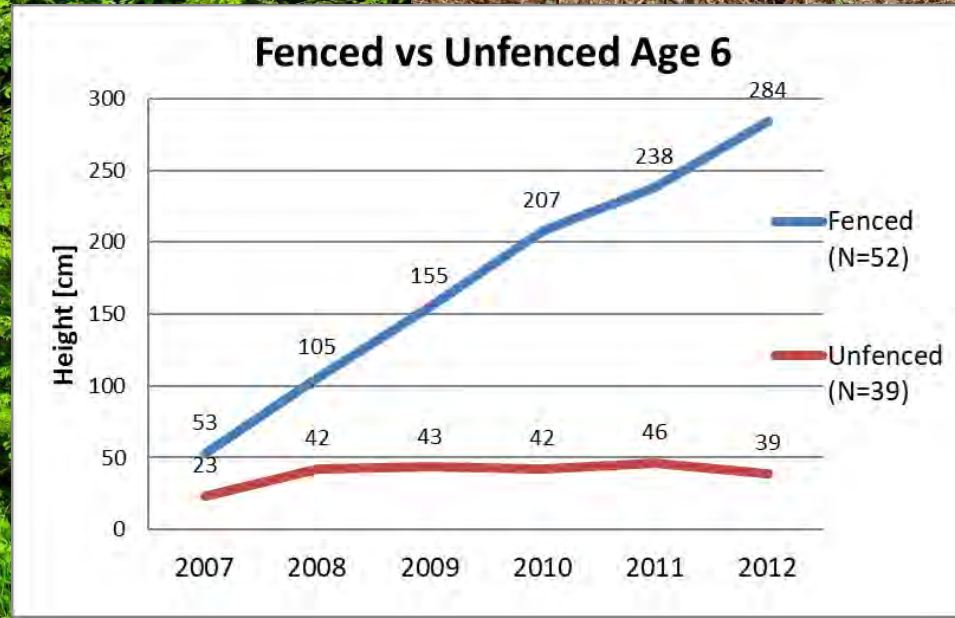
Age Shift through VM

VMRC

- 4 sites; 20 growing seasons
- Treatments created age shift from 0 to 10 years
- Species specific



Age Shift through Physical Protection



15th Growing Season (2021)

Why post-planting activities?

Push seedlings across the FINISH LINE

Activity	Cost/ac
Site prep (mechanical)	$100 - 250
Site prep (herbicide)	$90 - 120
Seedlings	$125 - $200
Planting	$80 - $120
Monitoring	$5
Compliance	?
Administration	?
TOTAL	$400 - 695

When post-planting activities?

- 1st year vigor critical for future performance
- Root-soil contact – **"coupled" to** the site (Grossnickle **"Why Seedlings Survive" New Forests** 2012)
- Similar rooting depth of seedlings & competition
- Competition better at exploiting moisture
- Resilience after establishment

When post-planting activities?

- 1st year

Post-Planting To-**Do's**

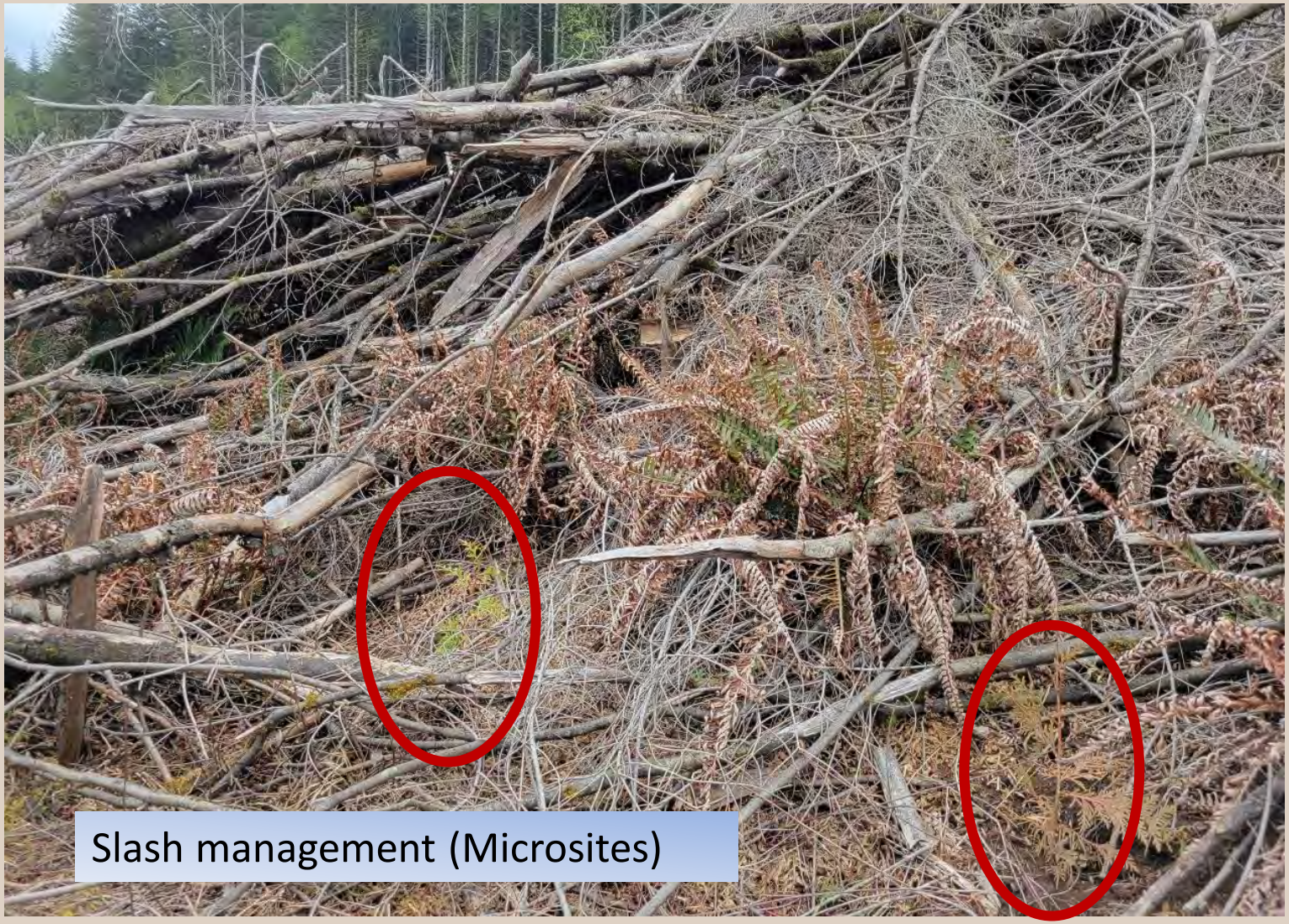
- Management to minimize seedling stress
  - Manage physical damage
  - Manage post-planting water availability
- Monitor performance & collect data
  - immediate & actionable feedback
  - meeting performance metrics?
  - allow for trend analyses
  - learn & gain experience

Managing Physical Damage

- Slash management (Microsites)
- Repellents
- Physical barriers
  - Netting
  - Bud caps
  - Tubes
  - Fencing

Managing Physical Damage

Repellents (TRICO)



Slash management (Microsites)

Best choice – depends on various factors such as species, anticipated mortality/FTG delay, stocking objectives, availability of labor, risk, local experience, etc.

Performance-**based analysis to get seedlings to "free**-to-**grow"(FTG) vs cost per acre or seedling**

	ALTERNATIVES				
	Plant Only	**Microsite**	**Plant + Nursery Repellent**	**Plant +Tube**	**Plant+Fence**
Seedling cost	$0.50	$0.50	$0.50	$0.50	$0.50
Planting Density	400	35	400	360	360
Treatment Cost/Seedling	$0.00	$0.00	$0.05	$2.50	$3.11
Cost/acre	$200.00	$17.50	$220.00	$1,080.00	$1,299.60
Survival%	70%	80%	85%	90%	90%
TPA Surviving	280	28	340	324	324
Cost/Surviving seedling	$0.71	$0.63	$0.65	$3.33	$4.01
FTG%	10%	60%	10%	80%	100%
TPA FTG	28	17	34	259	324
Cost/FTG Seedling	$7.14	$1.04	$6.47	$4.17	$4.01

Managing Water Availability

- Irrigation
- Mulching
- Shading
- Vegetation Management
  - Mechanical
  - Chemical

TABLE 2 | Percentage of foresters implementing various post-planting activities in a typical reforestation effort by US region.

Post-planting activity	Eastern	Southern	Western	Total
Sample size (*n*)	*23*	*25*	*22*	*70*
Mechanical vegetation management	39	28	23	30
Chemical vegetation management	70	76	36	61
Trapping	0	4	14	6
Tree shelters	35	4	41	26
Fencing	30	4	14	16
Fertilization	4	24	9	13
Irrigation	0	0	9	3
Pre-commercial thinning	17	36	41	31
Mulching	0	4	5	3
Soil amendments	0	0	0	0
Shading	0	0	32	10

Values other than sample size are presented as percentage of respondents.

Irrigation & Mulching

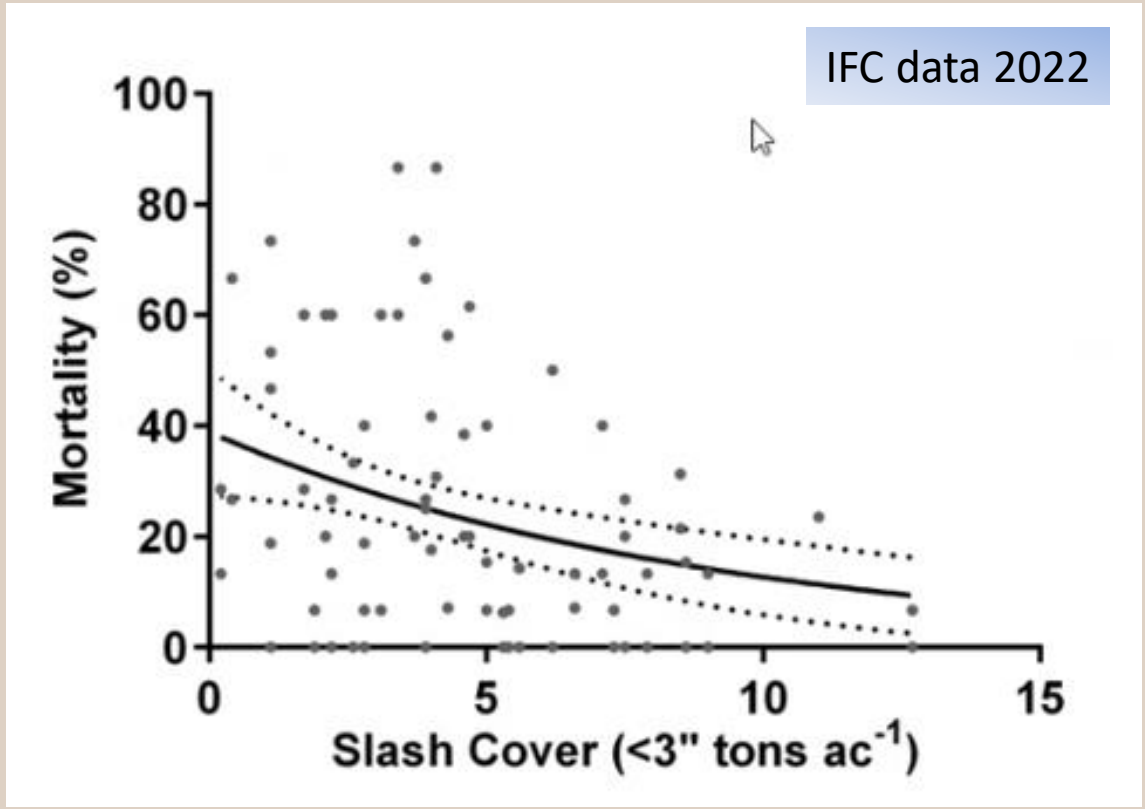

Photo credit: Don Kaczmarek

- For high value crops in certain circumstances
- ODF Schroeder Seed orchard:
  - No irrigation **– survival ≈ 50**-60%
  - Irrigation since 2015 **–** 13/14 orchards with 95+% survival

Slash Management "Mulching"

+ Slash benefits survival

- Soil residual herbicide efficacy



Shading

- Reduce incoming solar radiation, increase soil water; mitigates potential heat damage
  - Natural features (pre-plant)
  - Post-planting shade cards
    - cost – benefit?

Grossnickle REFORESTA (2018) 6:110-139

Photo credit: PacForest Supply

Vegetation Management (VM)

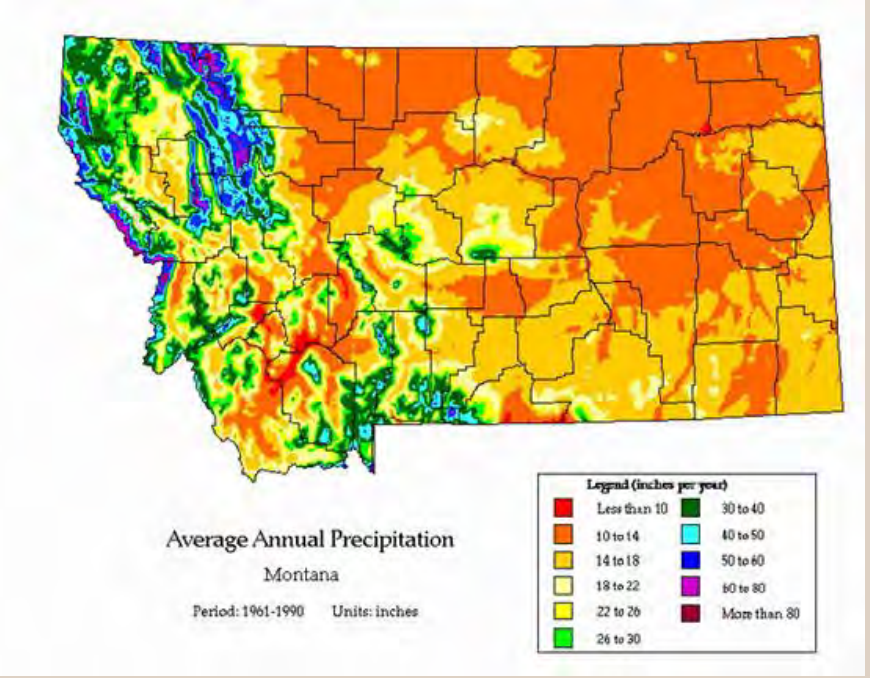
- Most important post-planting tool

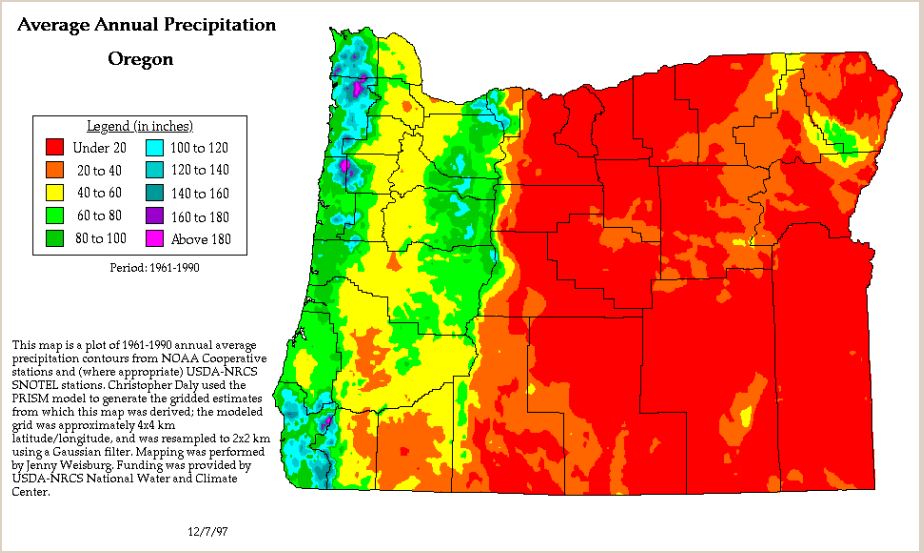
The role of vegetation management for enhancing productivity of the world's forests. Wagner et al. (2006) Results from 60 of the longest-term studies. In North America gains in wood volume ranged from 4 – 11 800 per cent in Pacific north-western forests

  - Mechanical
    - Effective on woody vegetation
    - WA DNR ongoing study looking at hand-weeding
  - Herbicides
    - All types of vegetation
    - Can last 1+ years

Vegetation Management (VM)

- VM needs depend on
  - Climate
  - Soils
  - Topography (slope/aspect/elevation)
  - Stock size/type (see VMRC CW study)
  - Species
  - Etc.

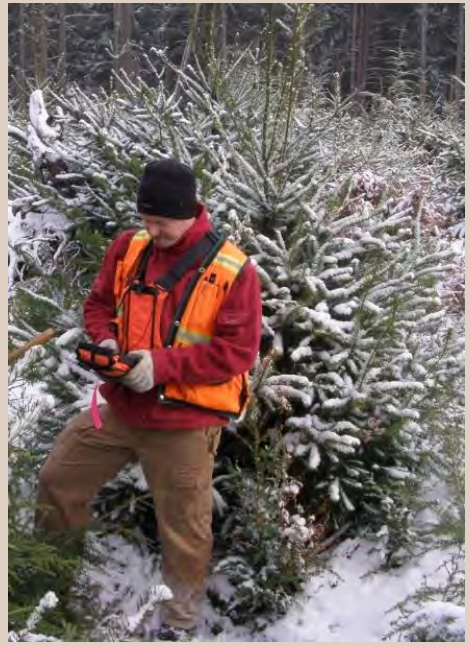




3 Growing Seasons

Performance Monitoring

- Post-planting data collection
  - Seedlings
    - Common gardens
  - Vegetation
  - Damage
- Data analysis to direct future management decisions (i.e. stock types, nurseries, planting contractor, planting season, etc)



Performance Monitoring

Roots?

DIG Seedlings!

6 weeks

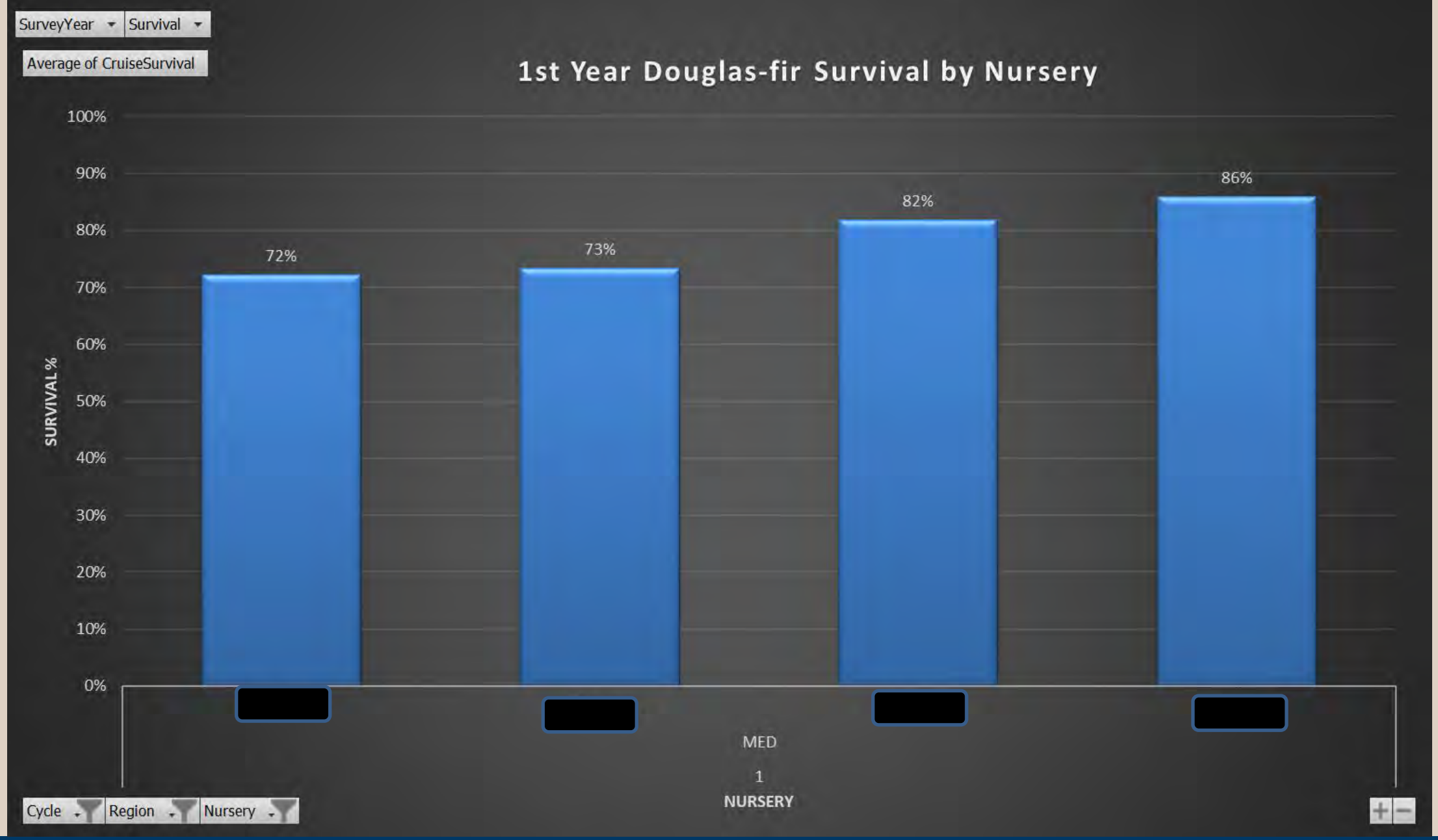
4 months

Performance Monitoring

Common Gardens make for a great outdoor lab

Performance Monitoring

Amount and type of vegetation


SurveyYear
Survival
Average of CruiseSurvival
1st Year Douglas-fir Survival by Nursery
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
SURVIVAL %
72%
73%
82%
86%
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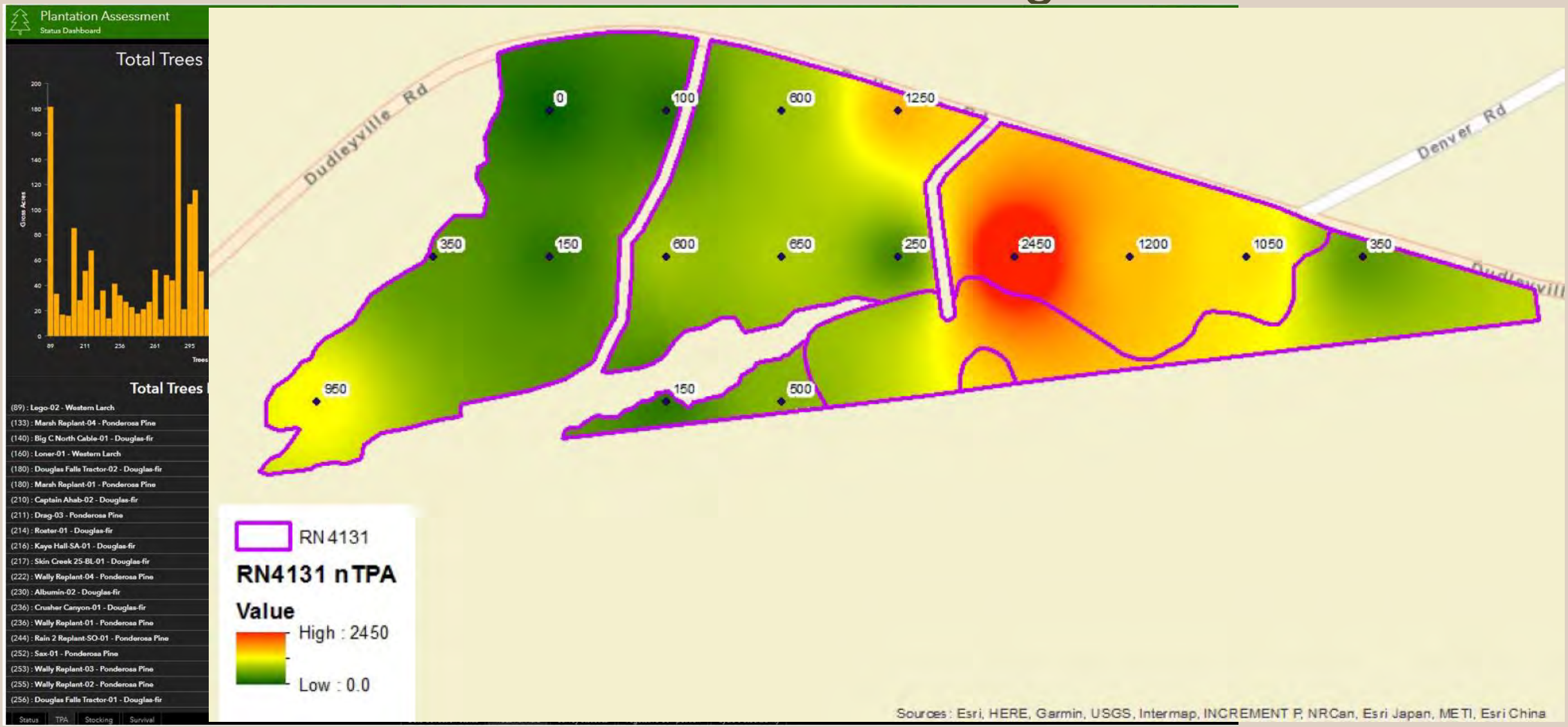
MED
1
NURSERY
Cycle
Region
Nursery

Performance Monitoring



Summary – Finish Line

- **It's (almost) all about the Seedling**
- Grow roots
- Manage water / Minimize stress
- Monitor – collect & use data
- 1st Year critical – INVEST in follow-up when anticipated
- Continuous improvement

Less seed & less seedlings wasted

=

Minimize impacts on seedling pipeline

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