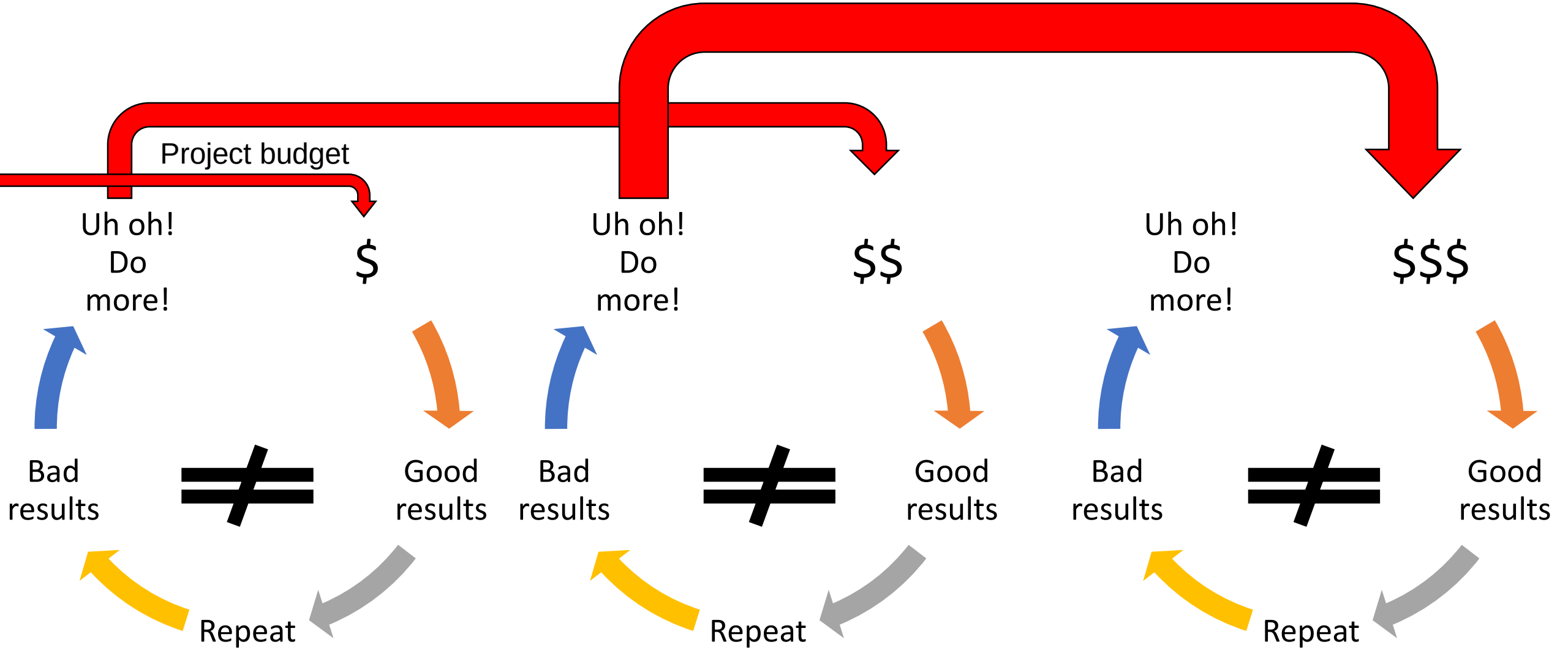
Be a mad scientist! Use experiments to magnify your impact.

Joshua Latterell, Ph.D., Environmental Programs Section Manager
King County Department of Natural Resources and Parks


These plants better stay alive!
09/24/2012 13:42

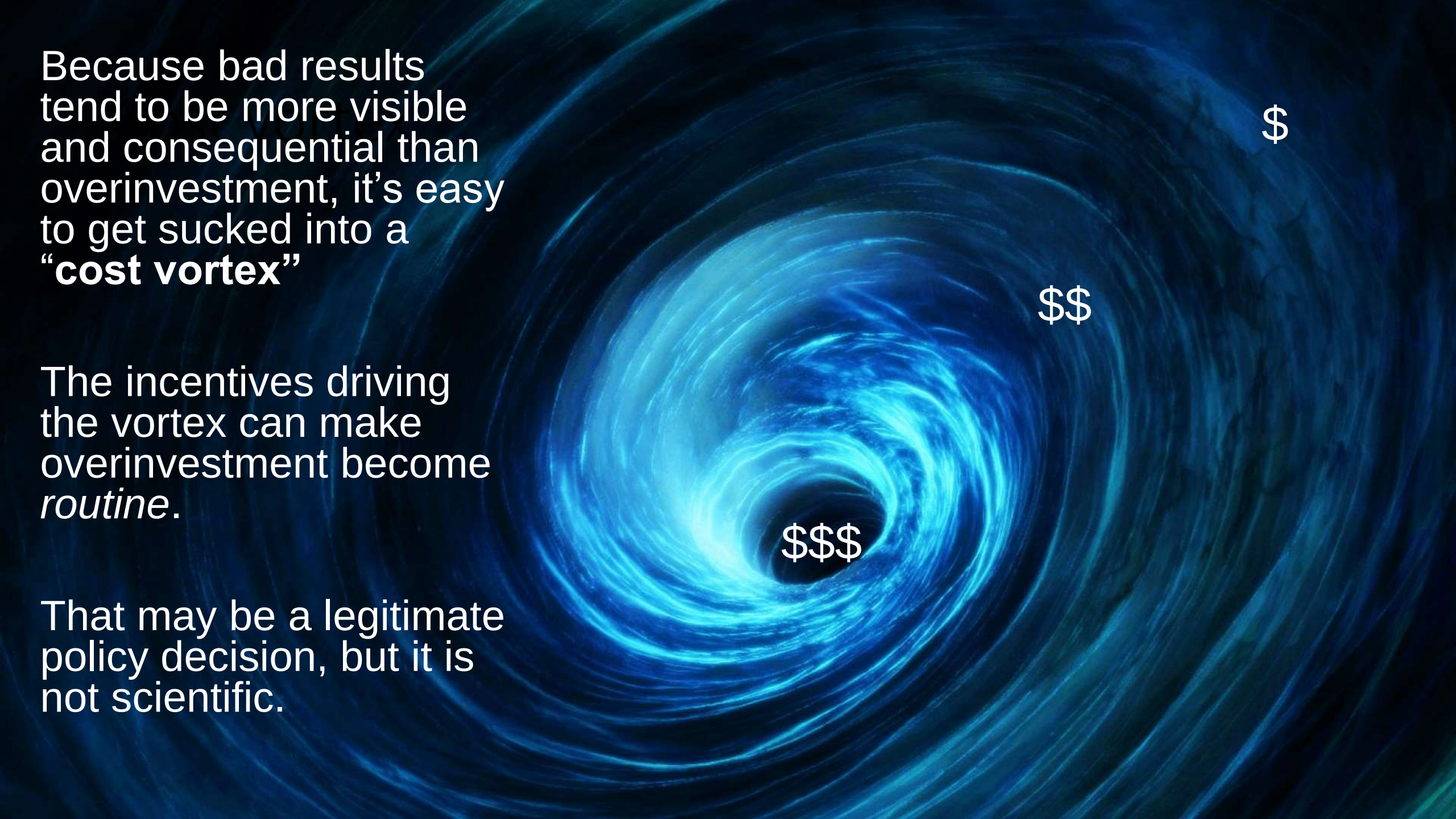
What happens when risk and reward are out of balance?



Because bad results tend to be more visible and consequential than overinvestment, it's easy to get sucked into a "**cost vortex**"

The incentives driving the vortex can make overinvestment become *routine*.

That may be a legitimate policy decision, but it is not scientific.



To break free of the vortex…

Discover and build on root causes of success

How we learn

Unconscious incompetence

Conscious incompetence

Where we too often are

Conscious competence

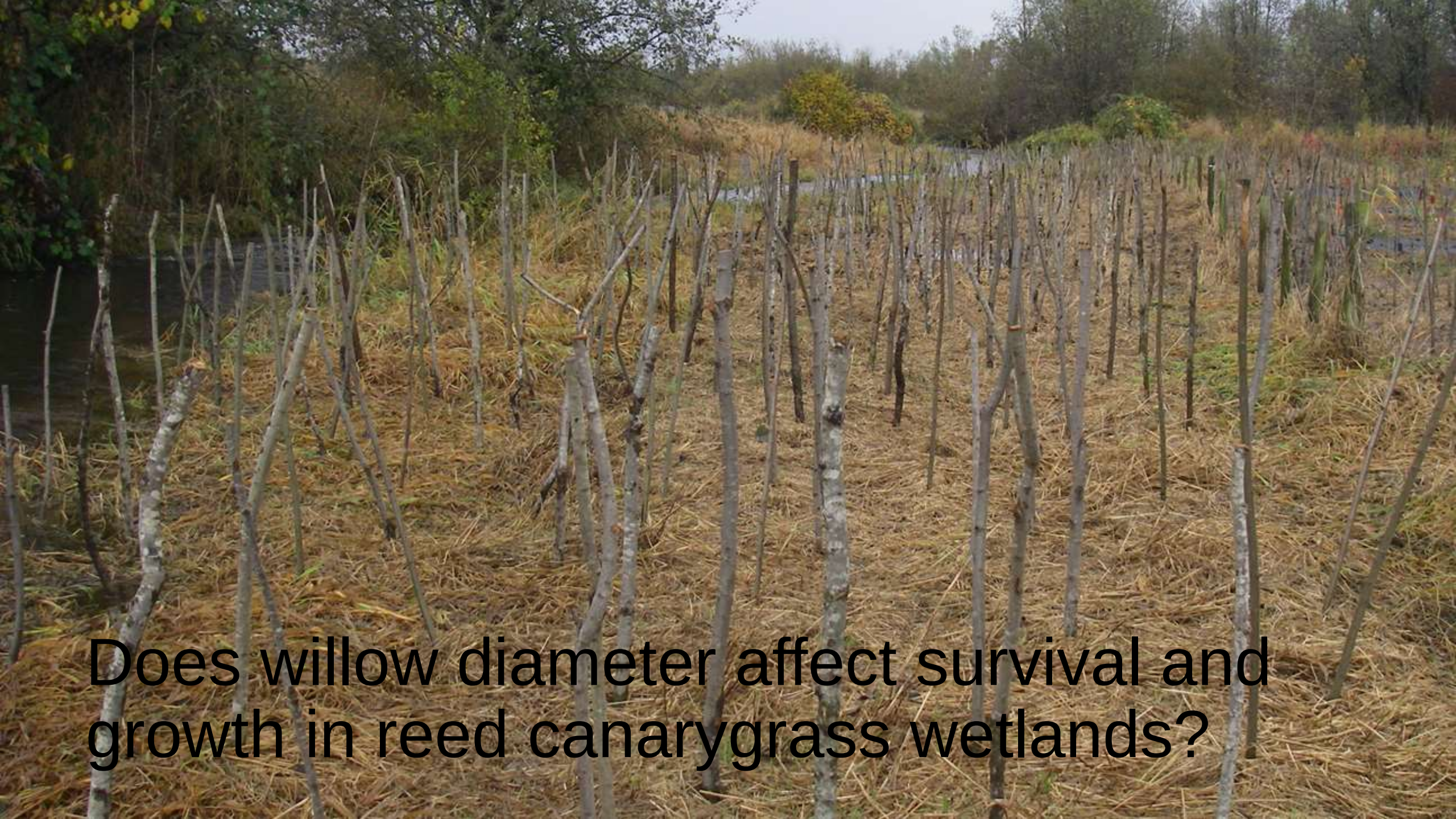
Where we can hope to go with science

Unconscious competence

Where we wish we were

Examples of how the scientific method can help us become better stewards of urban natural areas and of public funds.

What is the most cost-effective way to restore this wetland?



Does willow diameter affect survival and growth in reed canarygrass wetlands?

Experimental design

- Completely randomized design
  - **30 plots**, 15’X30’
  - Planted with **50, 6’ Sitka willow**
  - **3’ o.c. ~18” deep**
- 3 treatments, 10 plots each
  - Small (1/4-1/2” dia.), nursery
  - Medium (3/4 to 1” dia.), nursery
  - Large (1” to 2” dia.), field harvest
- Response variables
  - Cover
  - Survival

Jan 2013

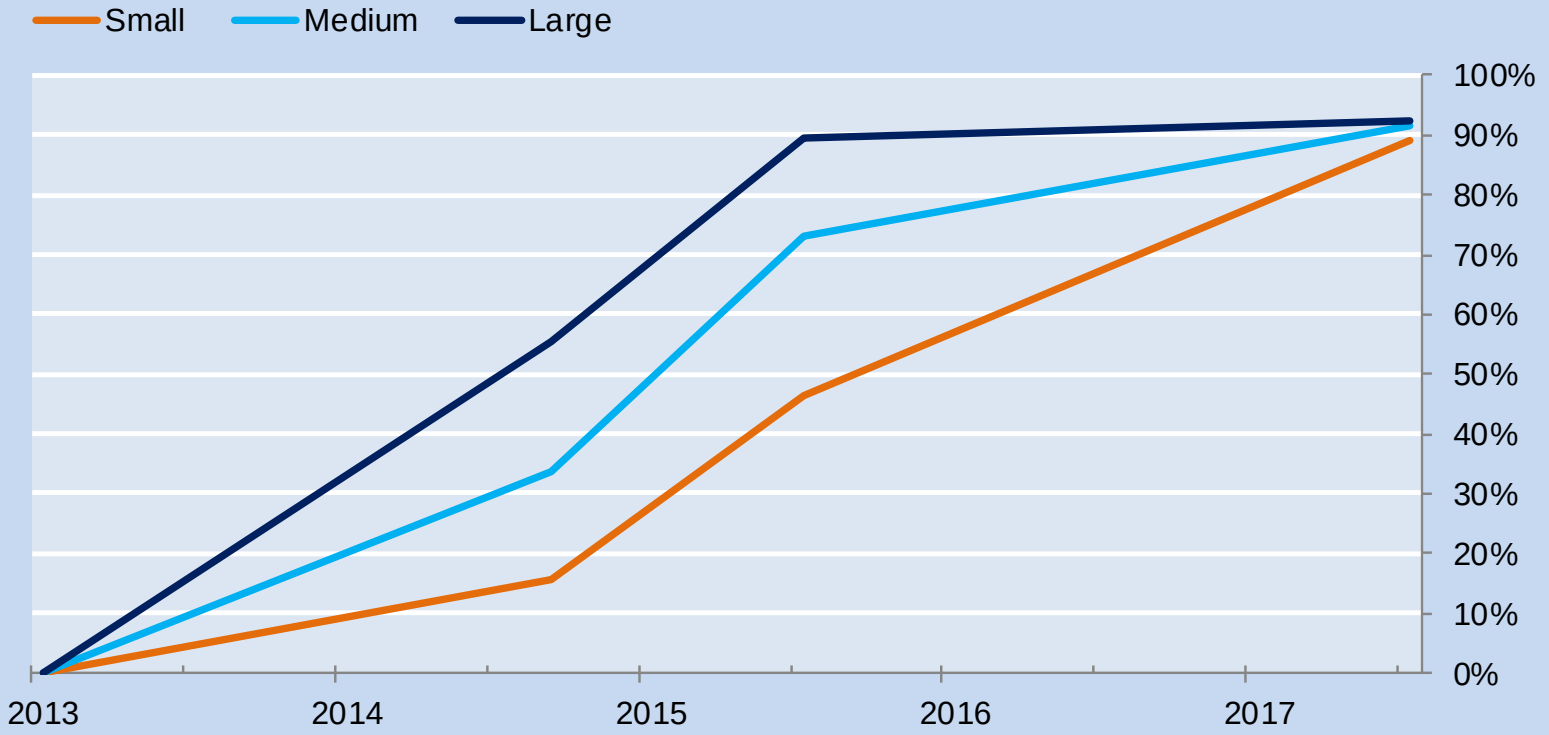
Small

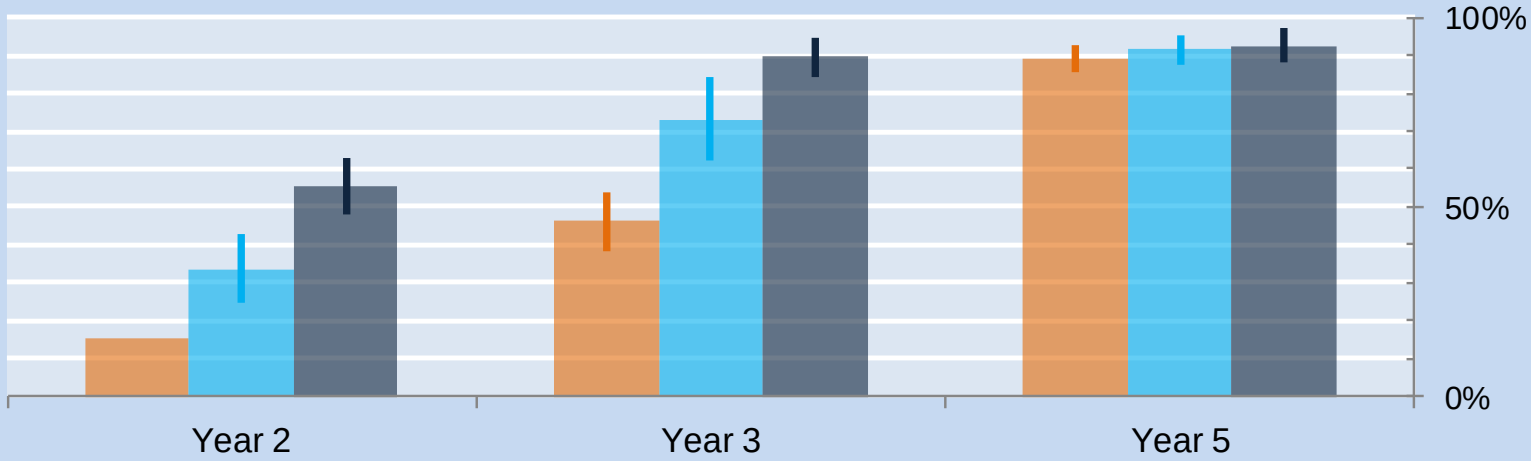

Medium


Large

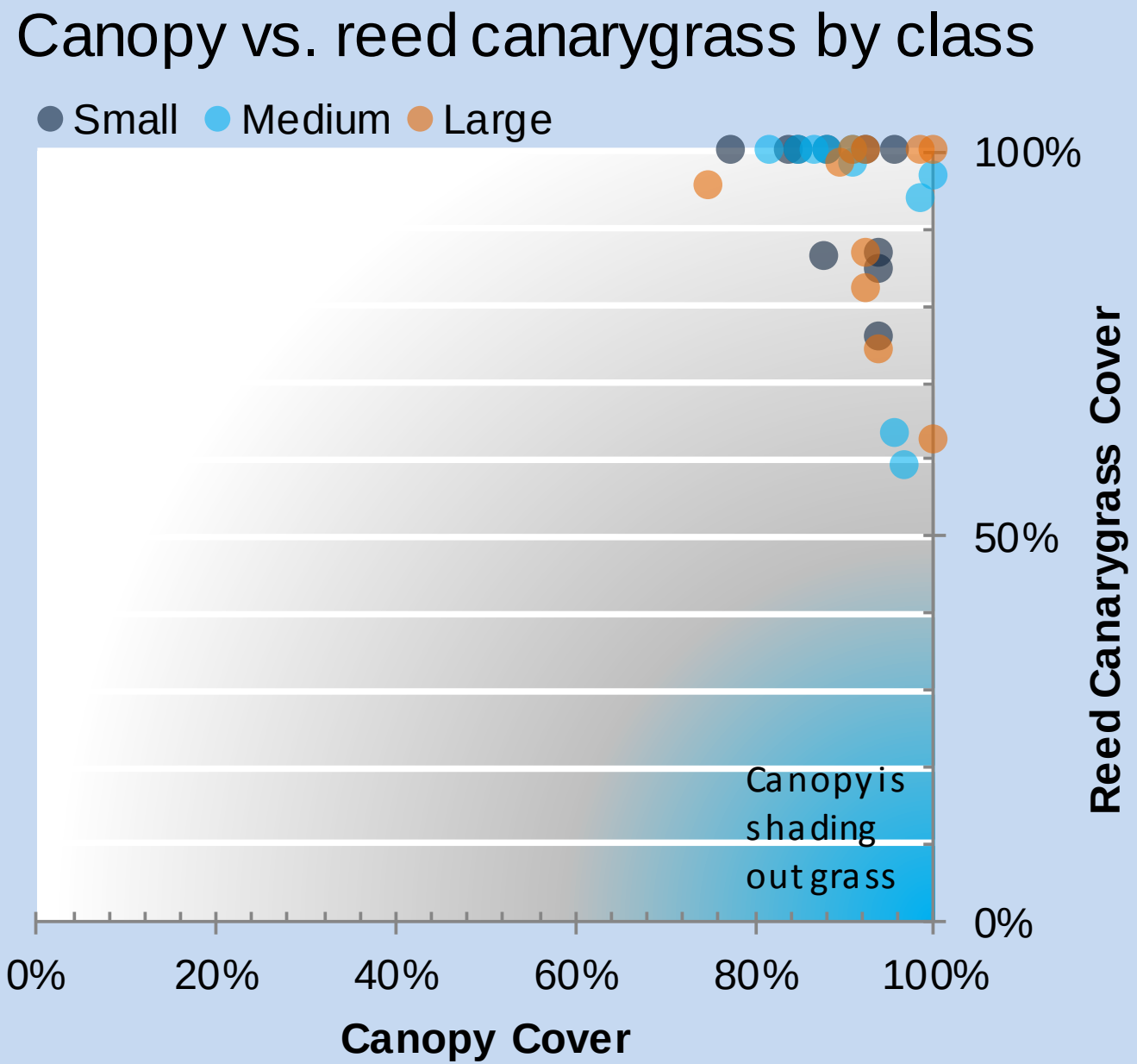
Large leads at first but others catch up

Average canopy cover of willow poles by diameter class



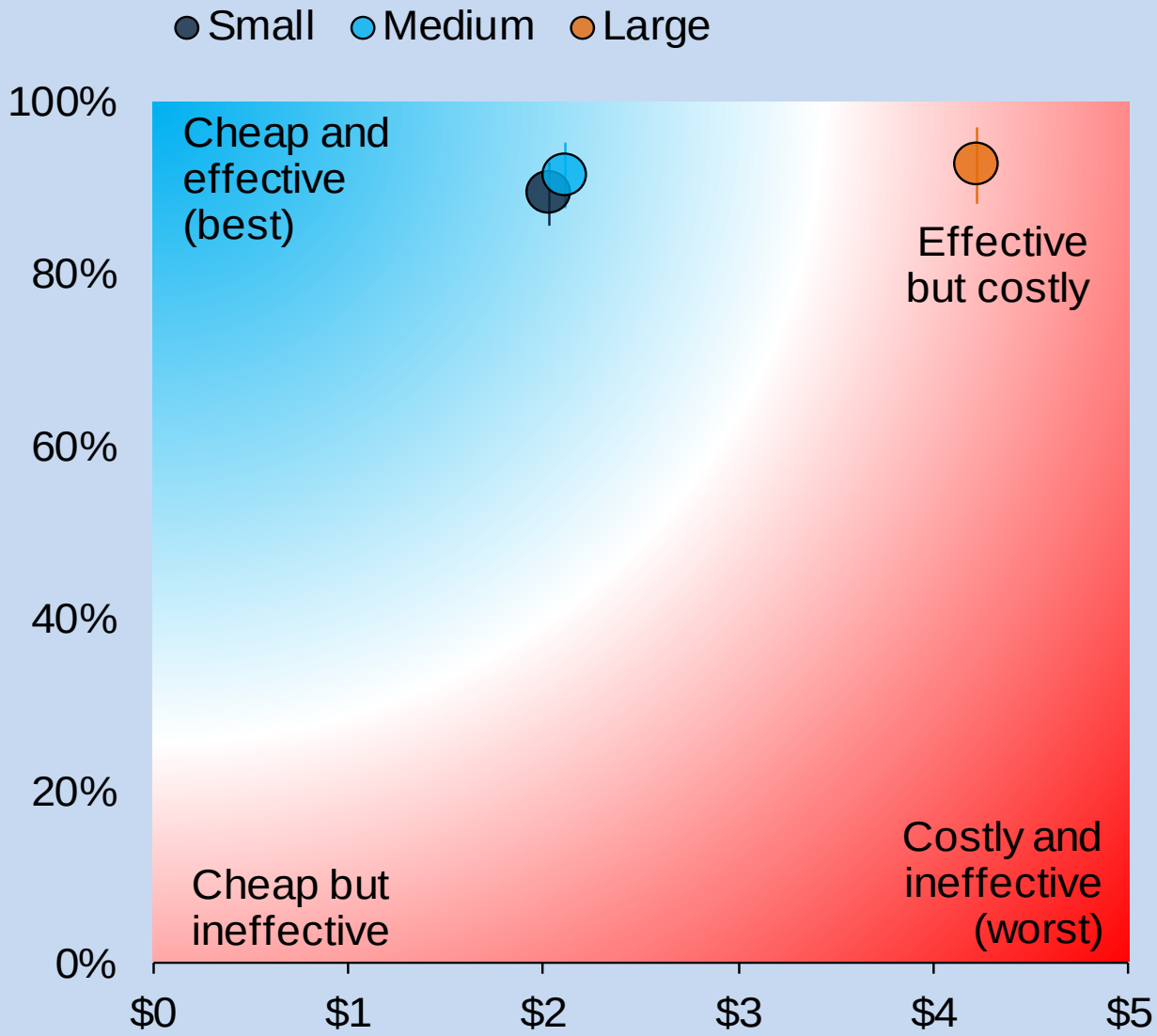


Not shading out



Size isn't everything

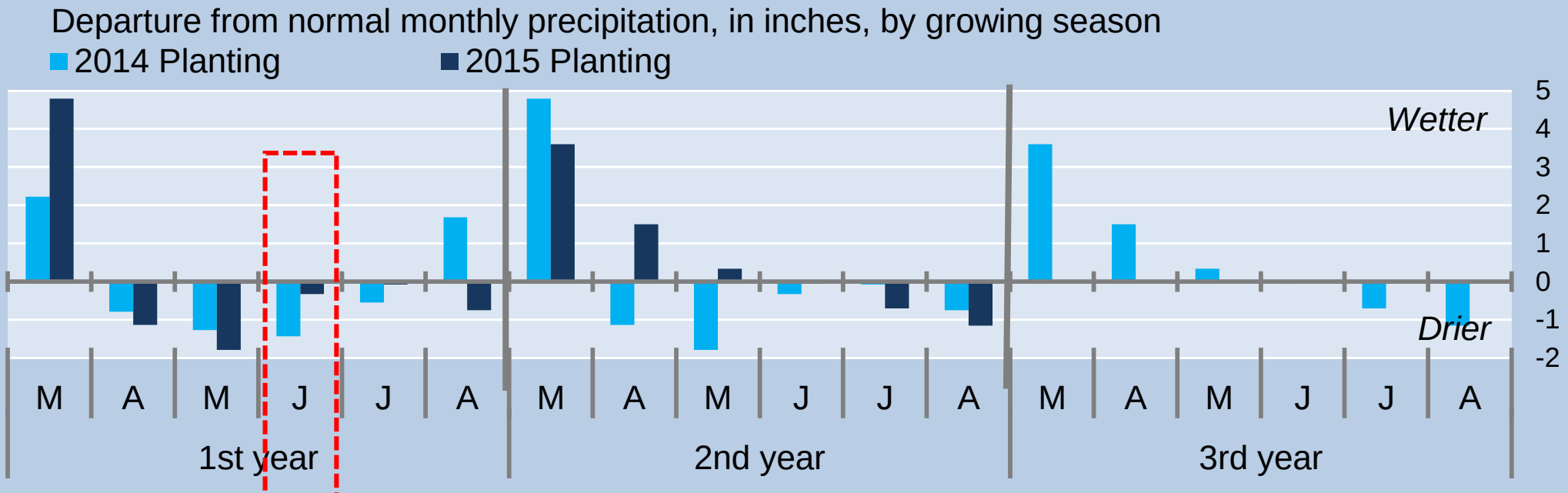
Per-plant cost-effectiveness of treatments; average cover after five years, *plant cost only*, ±*95% CI*



Treatment	Description	Experiment 1 2014 Planting	Experiment 2 2015 Planting
Glyphosate and water	Treated grass/weeds in entire plot with foliar application of glyphosate[5] and watered[6] each plot five to six times from July-August, each time at a rate of approx. one gallon per plant.	10 plots	5 plots
Glyphosate only	Treated grass/weeds in entire plot with foliar application of glyphosate.	10 plots	5 plots
Water only	Watered each plot five to six times	10 plots	5 plots
None (Control)	No water or glyphosate treatment	10 plots	5 plots
	TOTAL	40 plots	20 plots

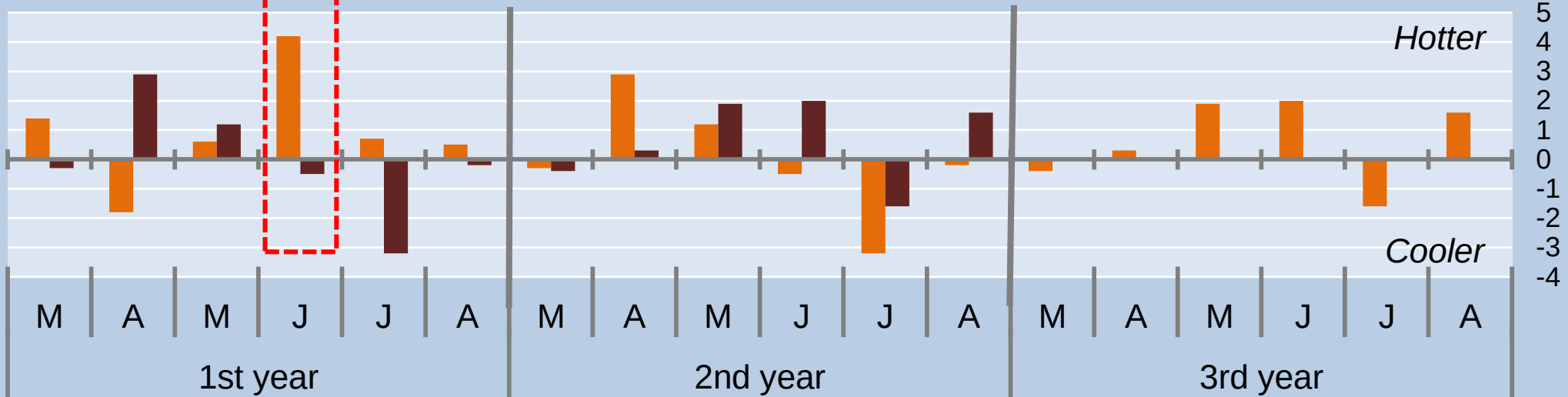
Precipitation

Departure from normal monthly precipitation, in inches, by growing season



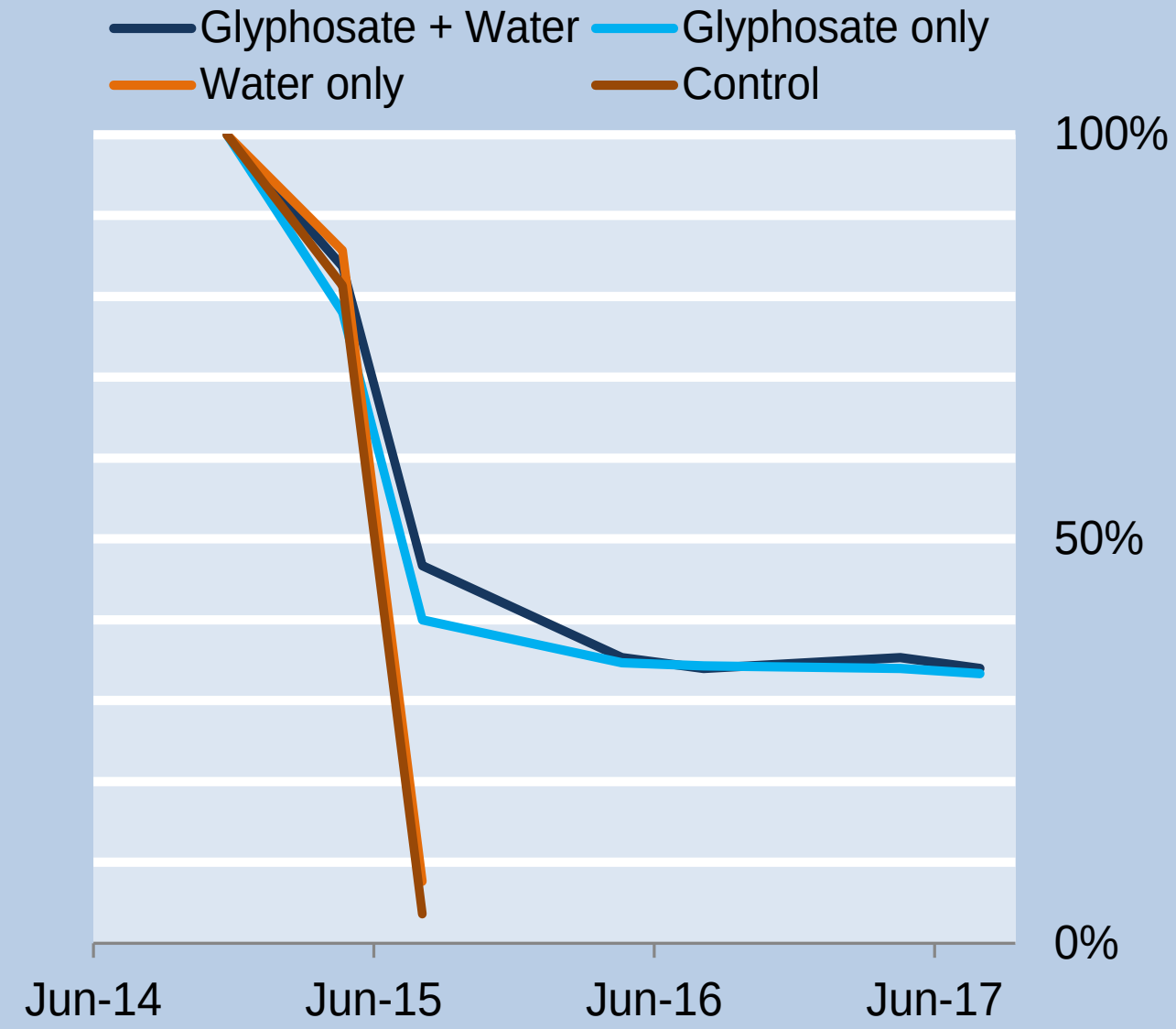
Temperature

Departure from normal monthly temperature, in °C, by growing season



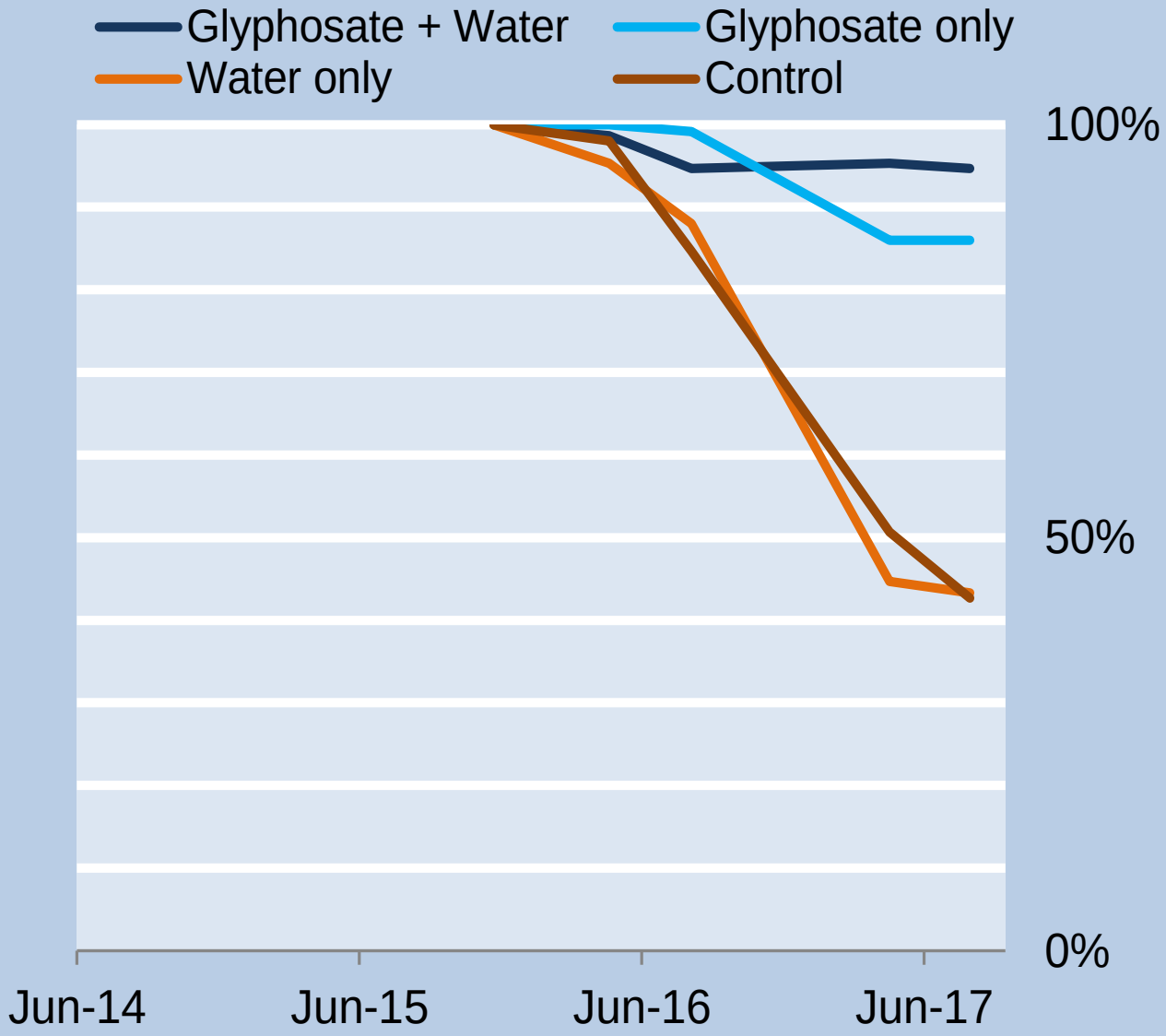
2014 Planting

Change in average survival rate



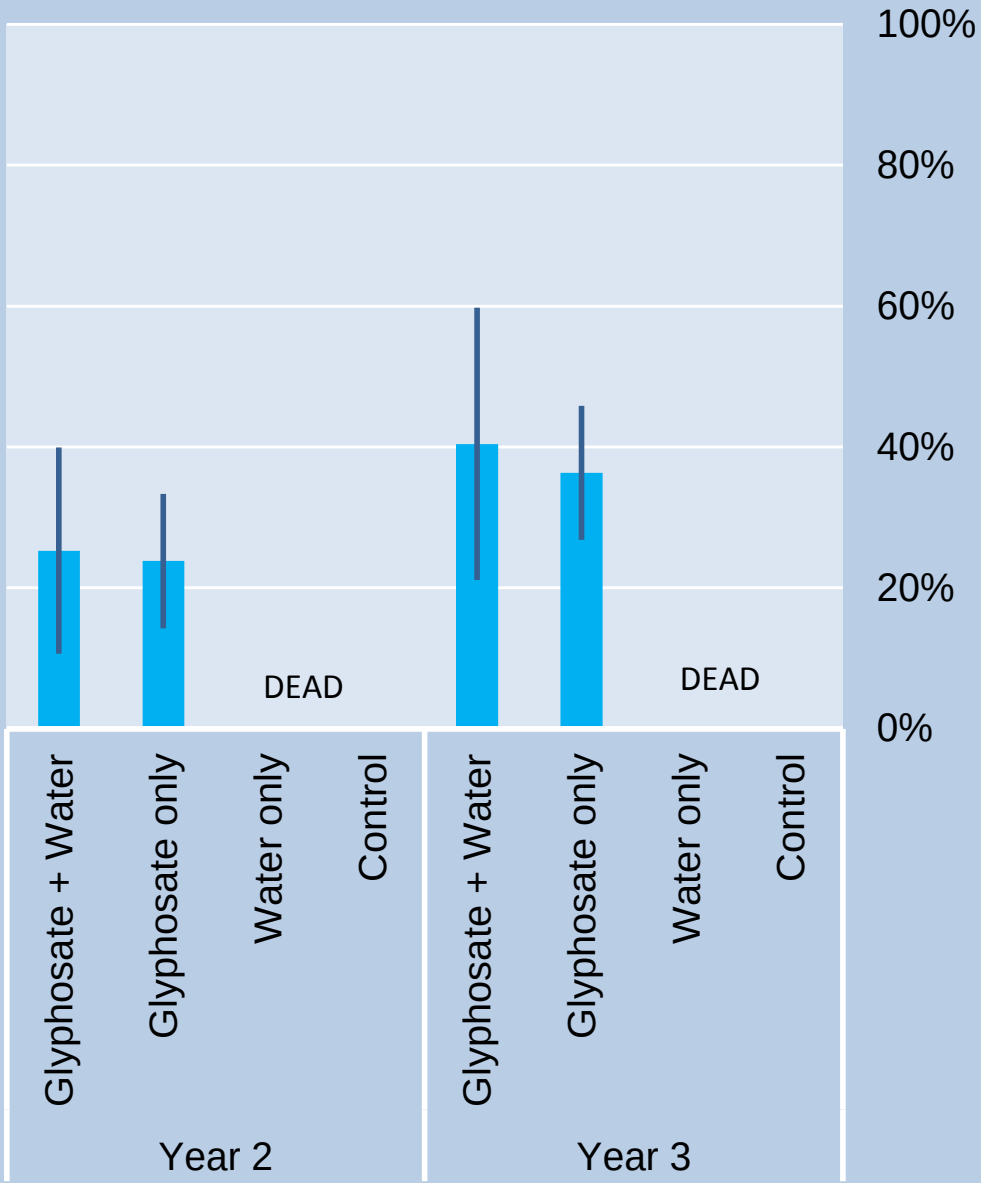
2015 Planting

Change in average survival rate



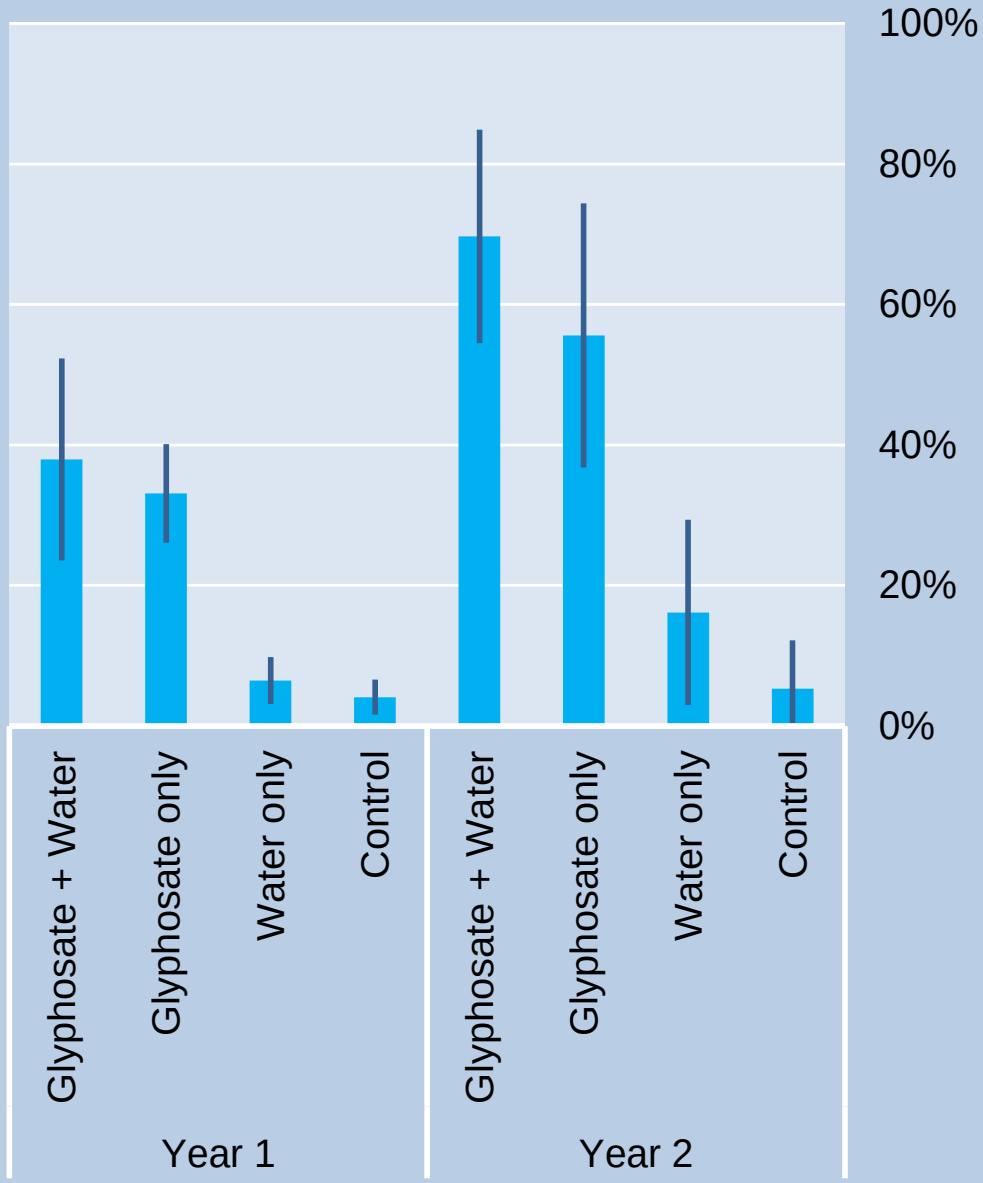
2014 Planting

Average cover (± 95% confidence interval)



2015 Planting

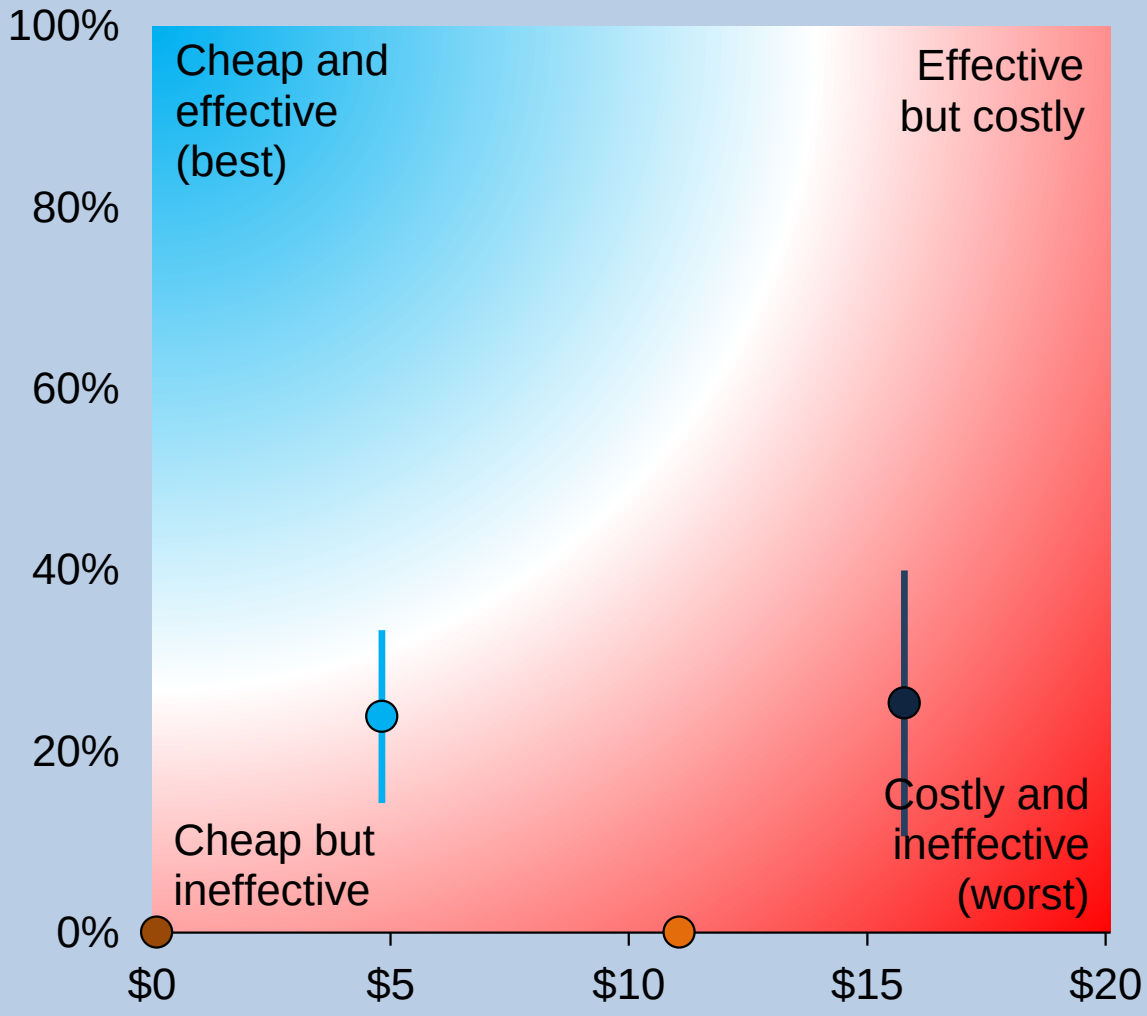
Average cover (± 95% confidence interval)



2014 Planting

Per-plant cost-effectiveness of treatments; average cover achieved after two years of maintenance.

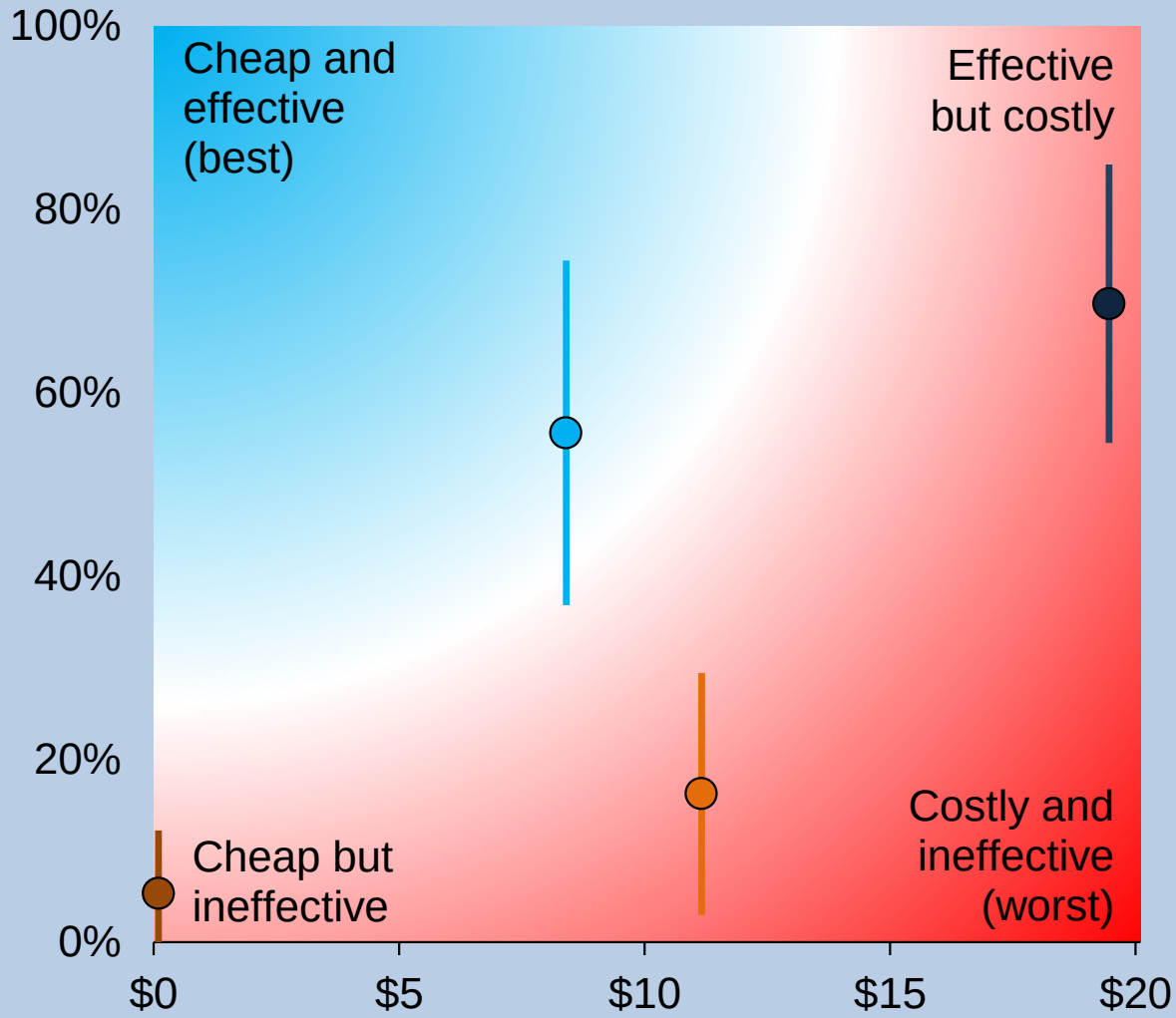
- Control
- Glyphosate only
- Water only
- Glyphosate and water



2015 Planting

Per-plant cost-effectiveness of treatments; average cover achieved after two years of maintenance.

- Control
- Glyphosate only
- Water only
- Glyphosate and water

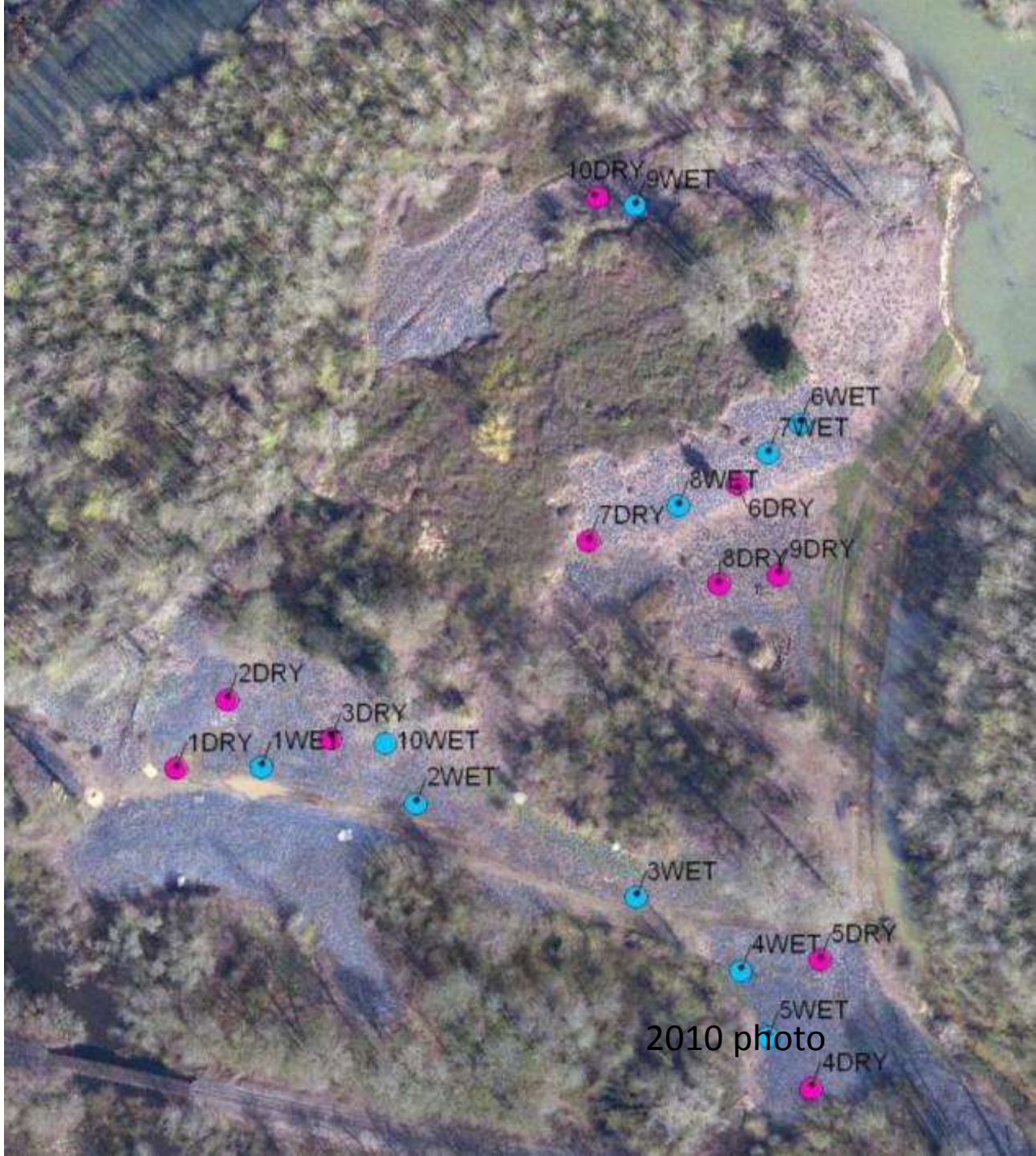


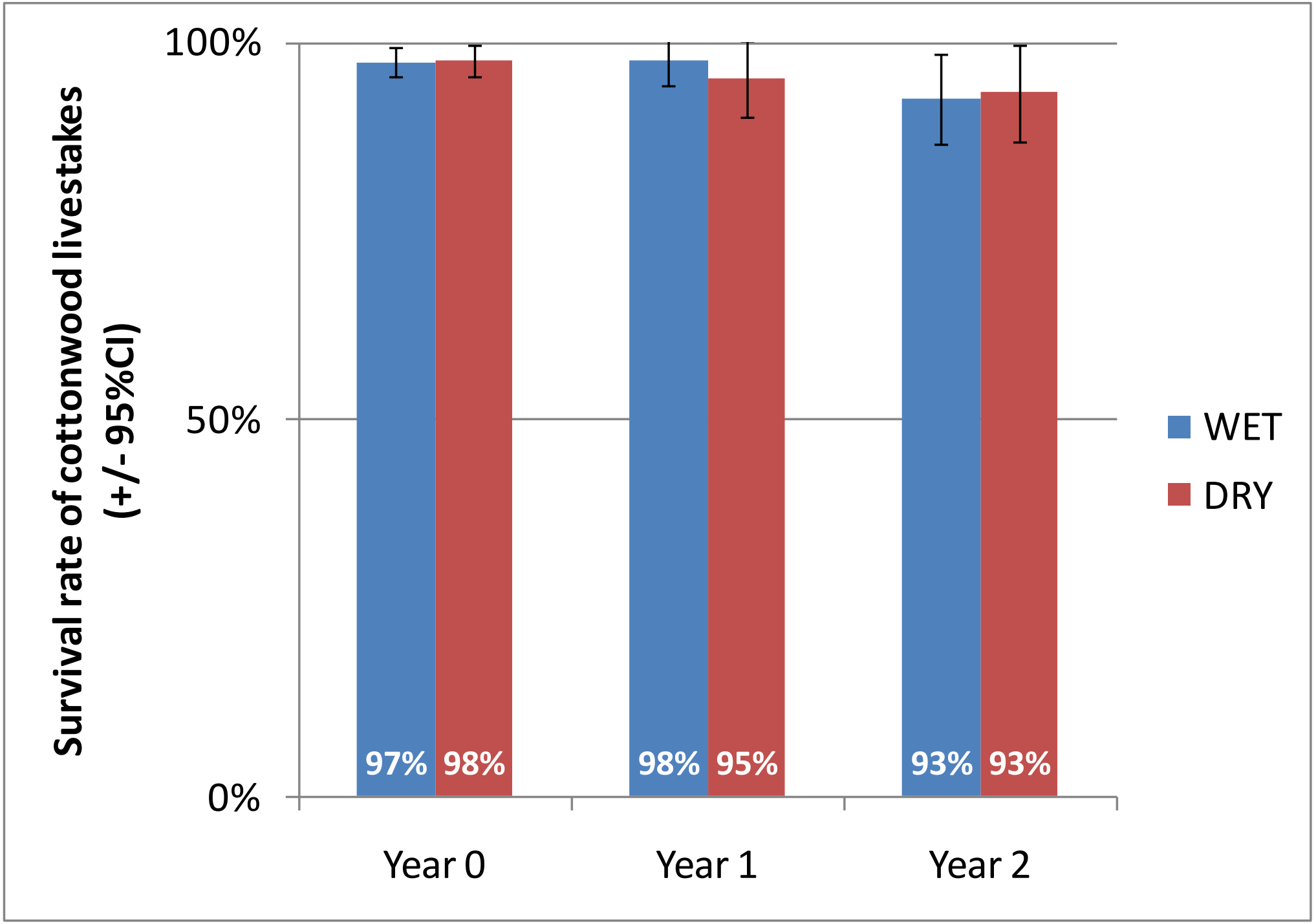
GLYPHOSATE-ONLY TREATMENT	NO TREATMENT (control)
	
Plot TD11 (2015 Planting, Year 1)	Plot UD11 (2015 Planting, Year 1)

Figure 11. Experiment 2 (2015 Planting). Photo comparison of a plot treated with glyphosate only (i.e., high survival and high cover) compared to a control plot (i.e., good survival, low cover).

Effect of irrigation on cottonwood survival?

- 20 plots (10 x 10 m)
  - 10 wet
  - 10 dry
- Spatially randomized
- 721 cottonwood stakes
  - Avg. 36 per plot
  - fabric
- 165 cedar
  - Avg 8 per plot
  - fabric
- Treatment randomly assigned at plot level
- Watered 3 times in 2010
  - 15 July – 30 Aug

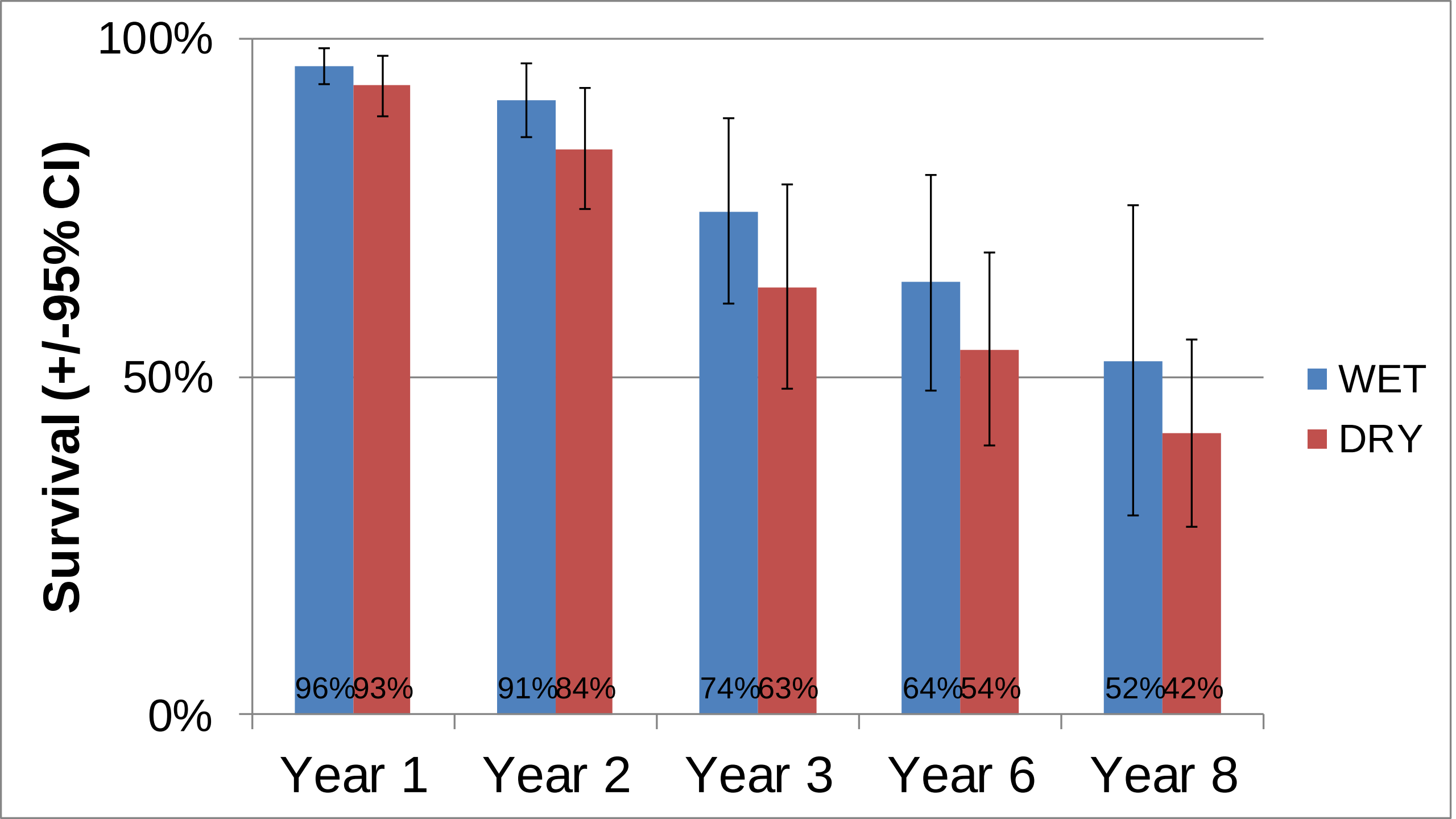


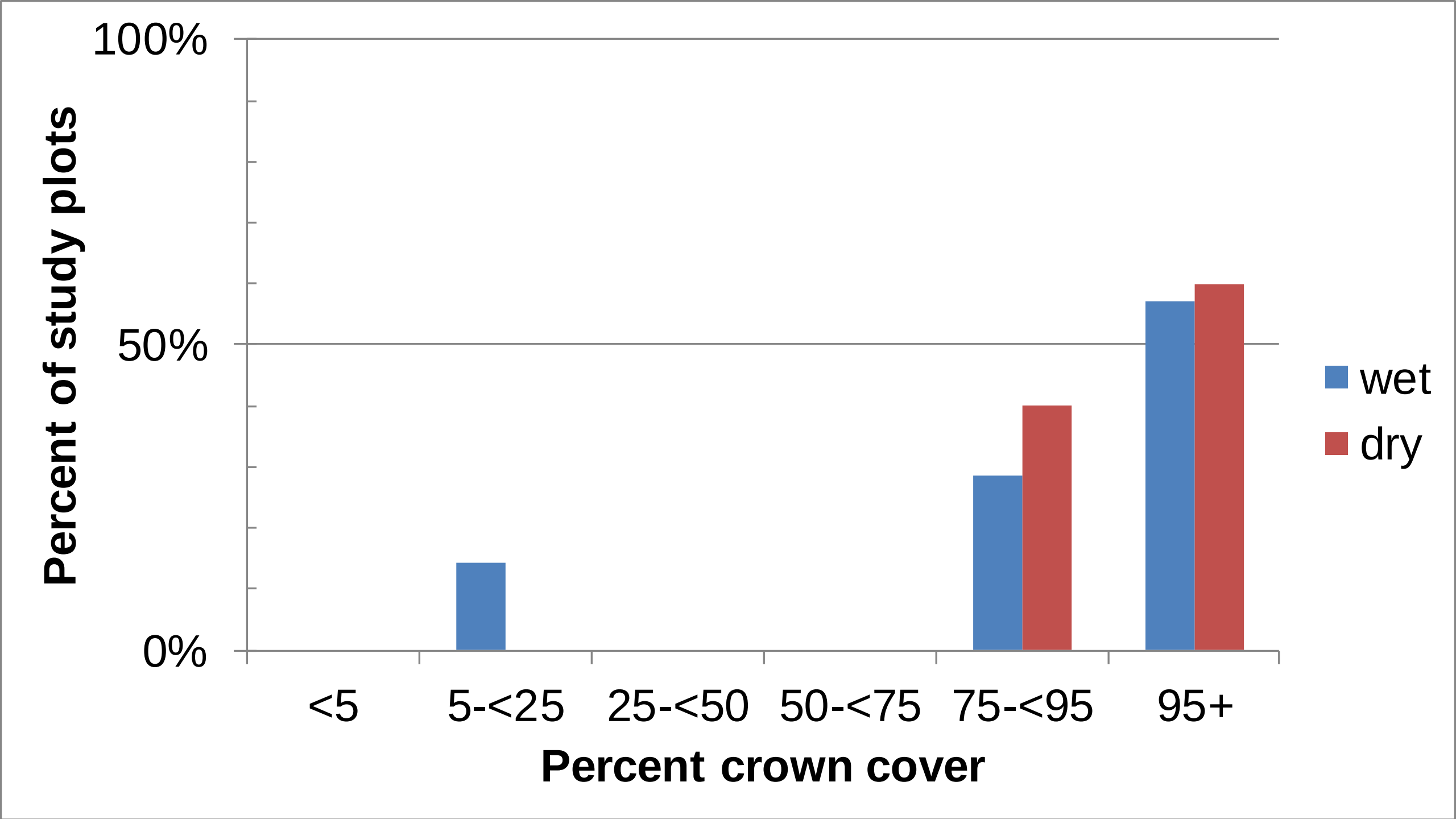

Survival rate of cottonwood livestakes
(+/- 95%CI)
100%
50%
0%
97%
98%
98%
95%
93%
93%
Year 0
Year 1
Year 2
WET
DRY


09/11/2014 13:39

Effect of irrigation on cottonwood survival?

- 24 paired plots (4 x 16 m)
  - 12 wet
  - 12 dry
- Spatially randomized
- 960 cottonwood stakes
  - Avg. 77 per plot (49-109)
- Randomly assigned treatment at plot level
- Watered 3 times in 2011
  - 2 gallons each plant


100%
50%
0%
Survival (+/-95% CI)
96%
93%
91%
84%
74%
63%
64%
54%
52%
42%
Year 1
Year 2
Year 3
Year 6
Year 8
WET
DRY

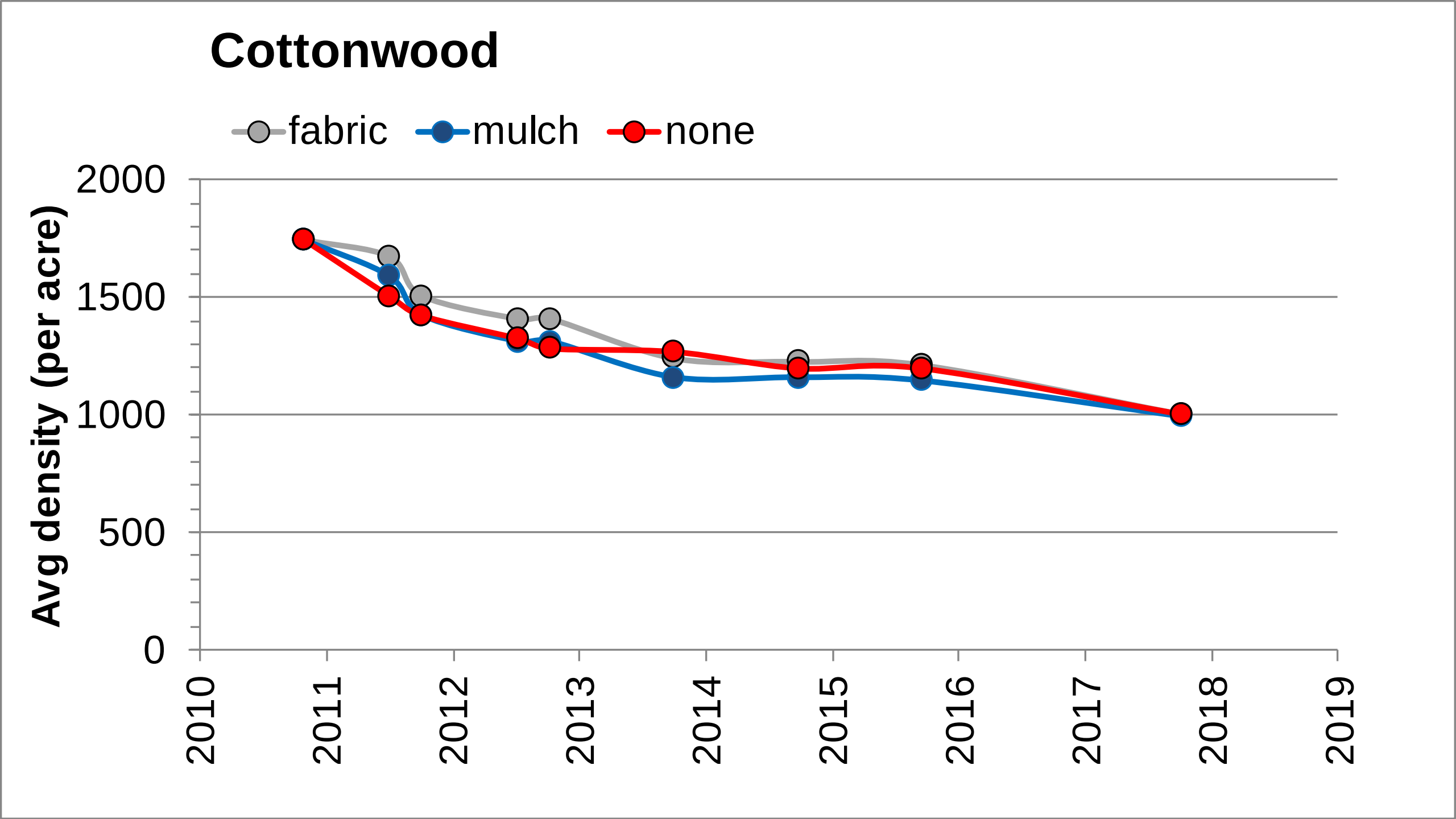

100%
50%
0%
Percent of study plots
<5
5-<25
25-<50
50-<75
75-<95
95+
Percent crown cover
wet
dry

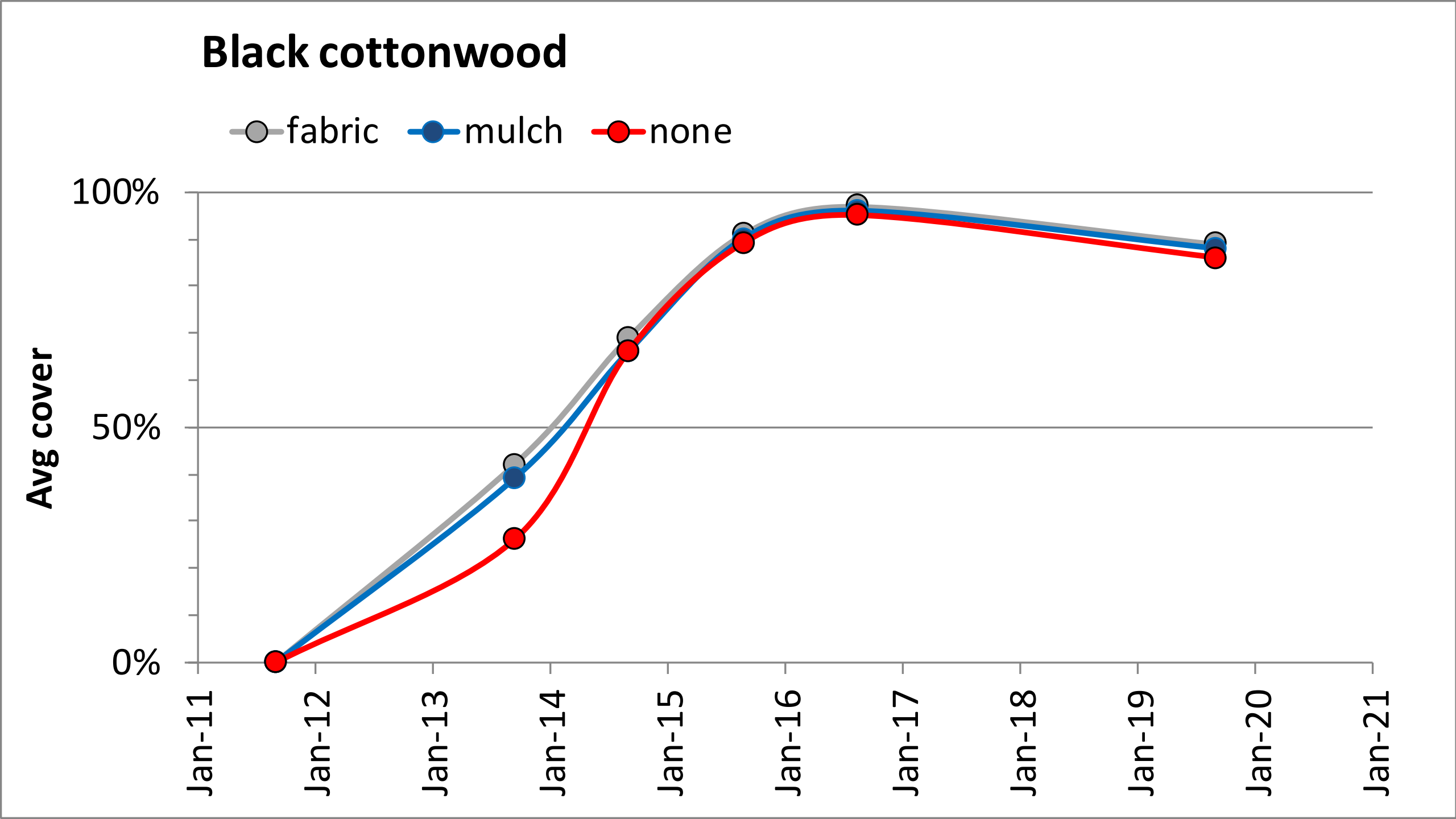
Effects of wood mulch vs. plastic fabric?

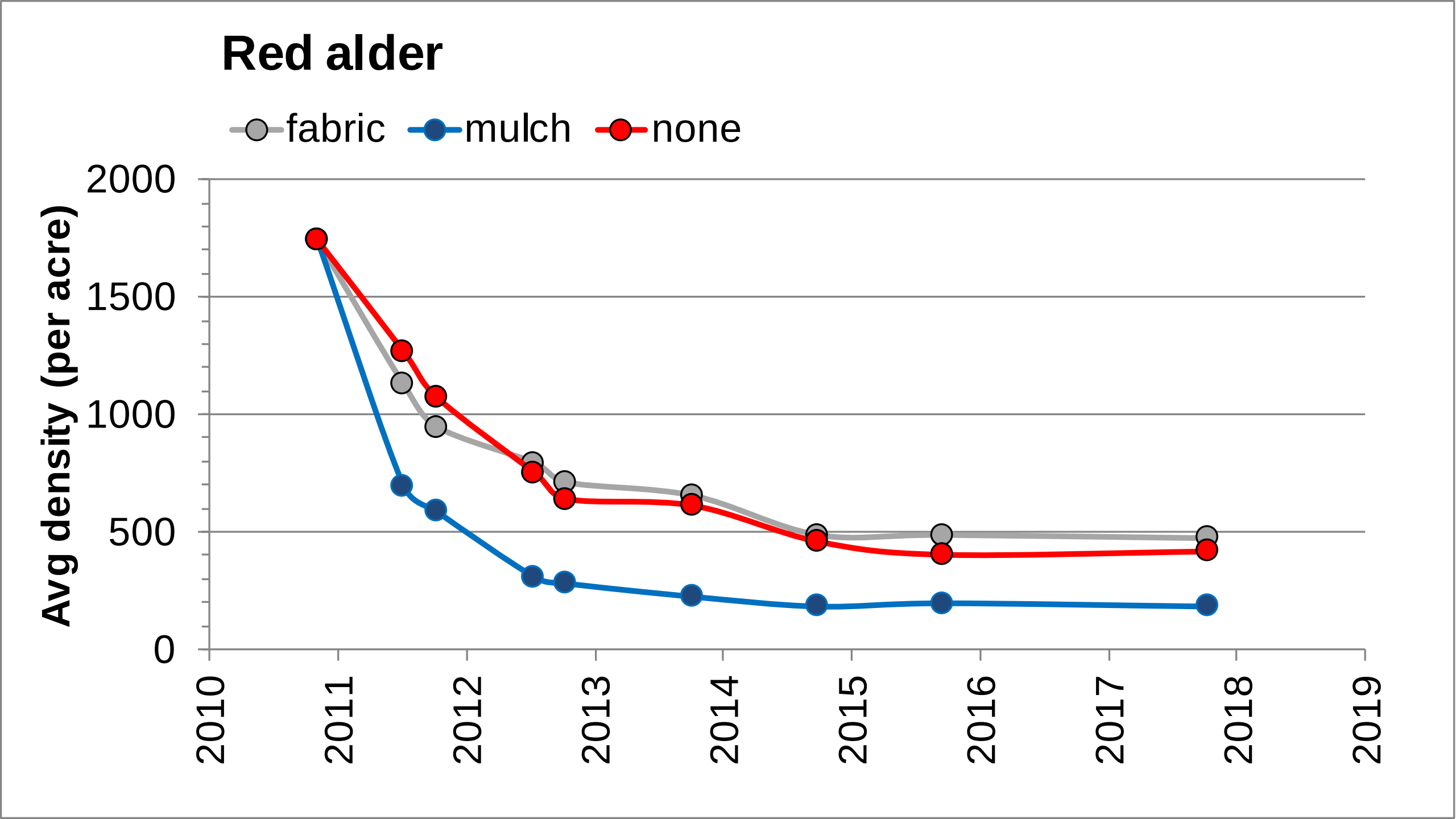
- 30 plots (7.6 x 7.6 m)
  - 15 alder
    - 5 mulch
    - 5 fabric
    - 5 nothing
  - 15 cottonwood
- 650 trees
  - 25 plants per plot
- Treatment randomly assigned at plot level
- Not watered

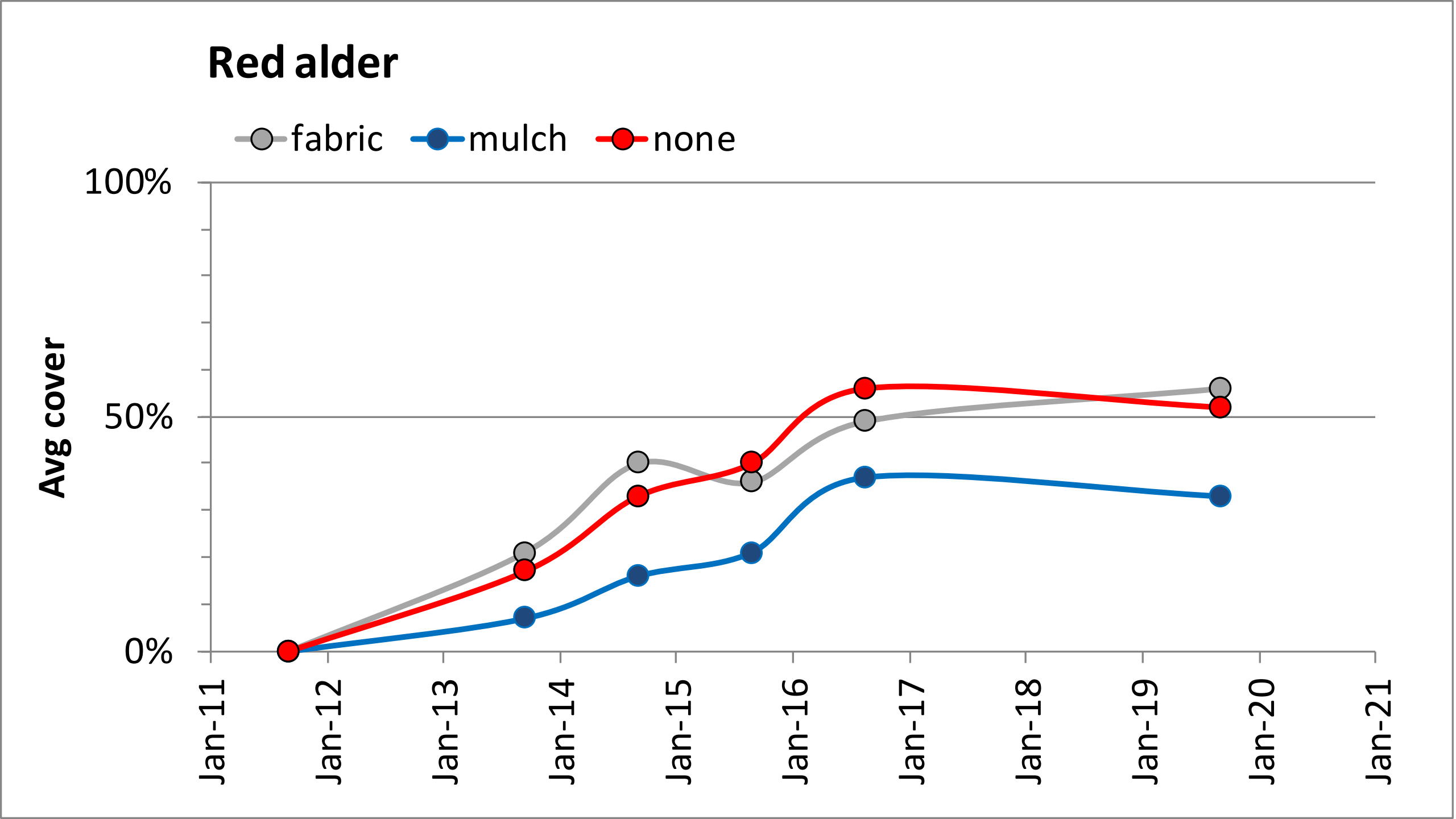
- Cottonwood live stakes

- Potted 1-gal red alder


Cottonwood
fabric
mulch
none
Avg density (per acre)
2000
1500
1000
500
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Black cottonwood
fabric
mulch
none
100%
50%
0%
Avg cover
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Red alder
fabric
mulch
none
Avg density (per acre)
2000
1500
1000
500
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Red alder
fabric
mulch
none
100%
50%
0%
Avg cover
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

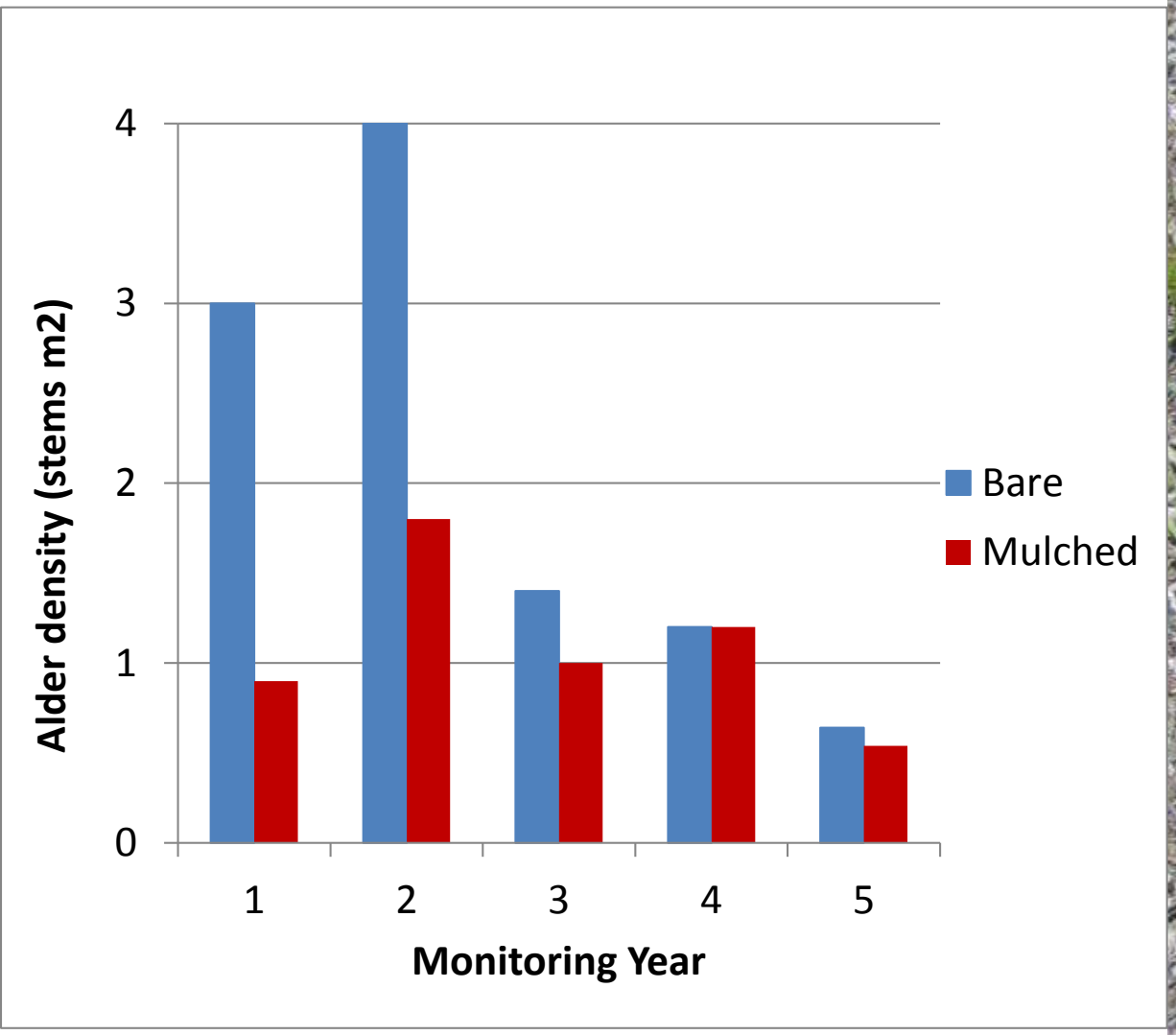
Cost : Benefit Analysis

Treatment	Install & removal
None	$0
Mulch	$1.81
Fabric	$4.09

Adding fabric to the entire site (3.3 acres) would have unnecessarily added a cost of roughly **$23,000**.

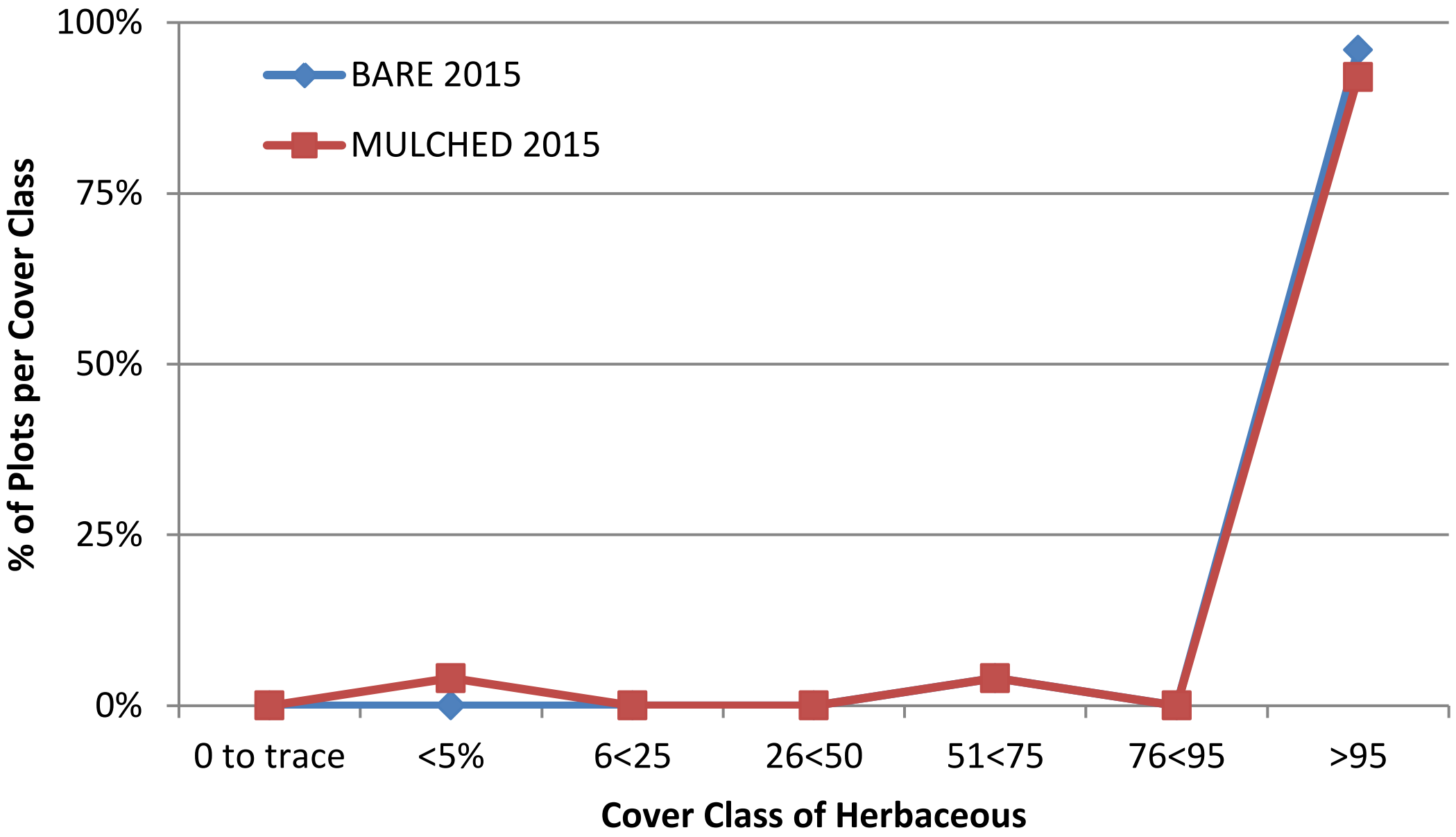
Effect of mulch on recruitment and herb cover?

- Systematic random design
- 1 m^2 quadrats
  - 26 mulched
  - 25 bare
- Watered


Alder density (stems m2)
4
3
2
1
0
1
2
3
4
5
Monitoring Year
Bare
Mulched


05/11/2012

Herbaceous cover after 5 years

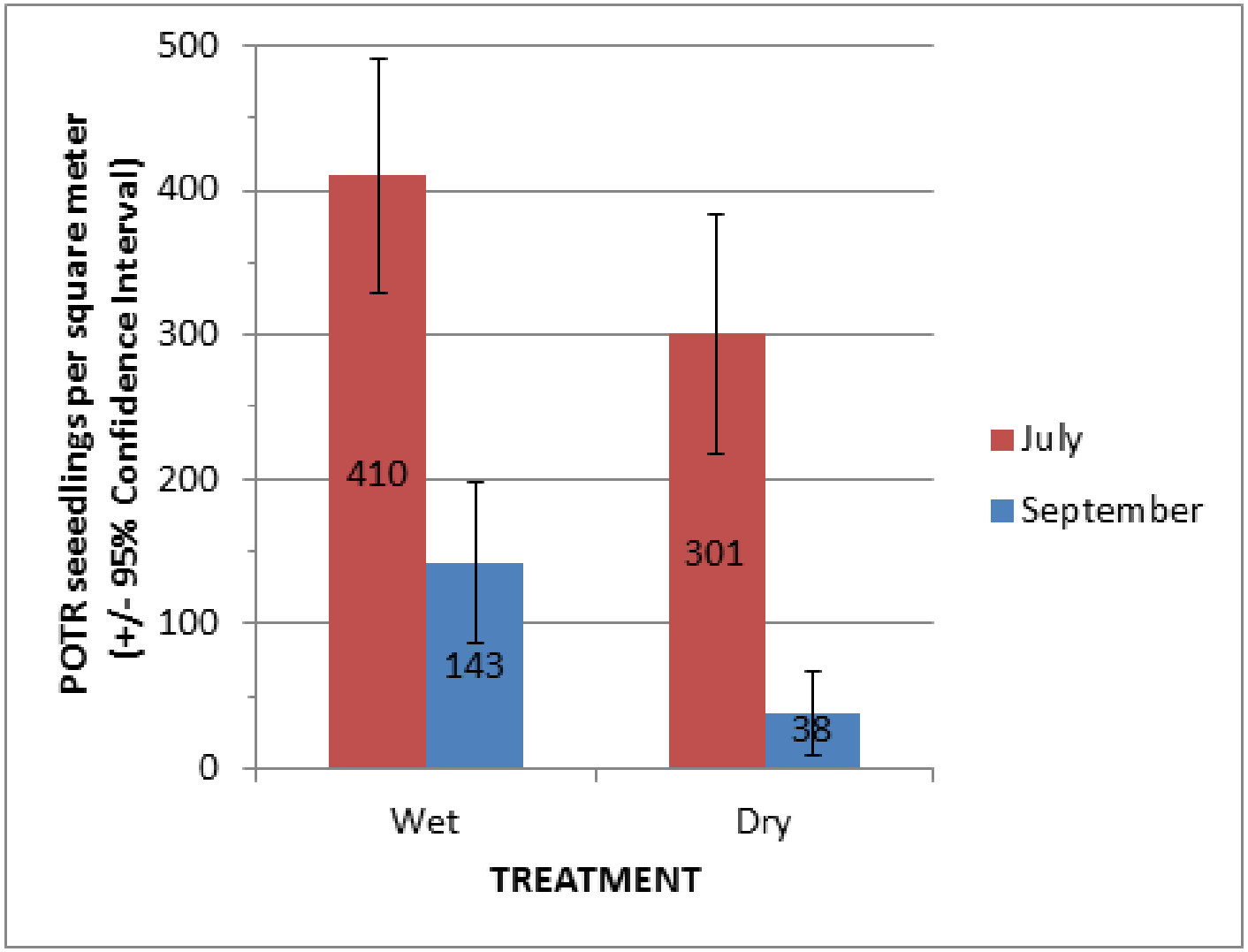



06/21/2013 10:07

Can we use targeted watering to improve local cottonwood recruitment?

- 10 dry (unwatered) plots, 10 wet (irrigated) plots
- 12 x 12-foot plots w/ 10-foot buffers
- Irrigation treatment was randomly assigned to individual plots
- Water twice per week 15 gallons
- Start on May 7th (peak seed drop) through early July
- Weekly from July to August.

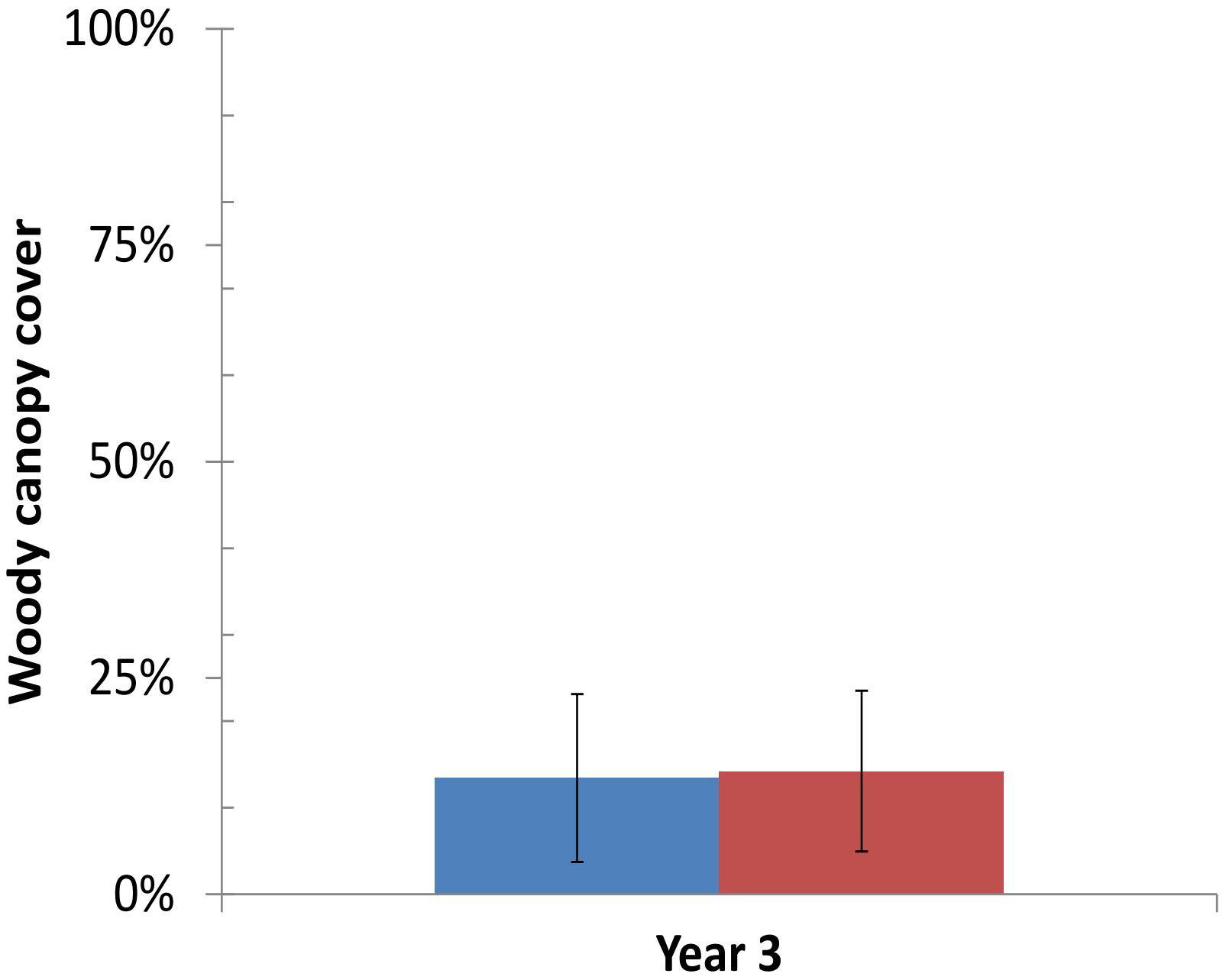

09/10/2013 08:41



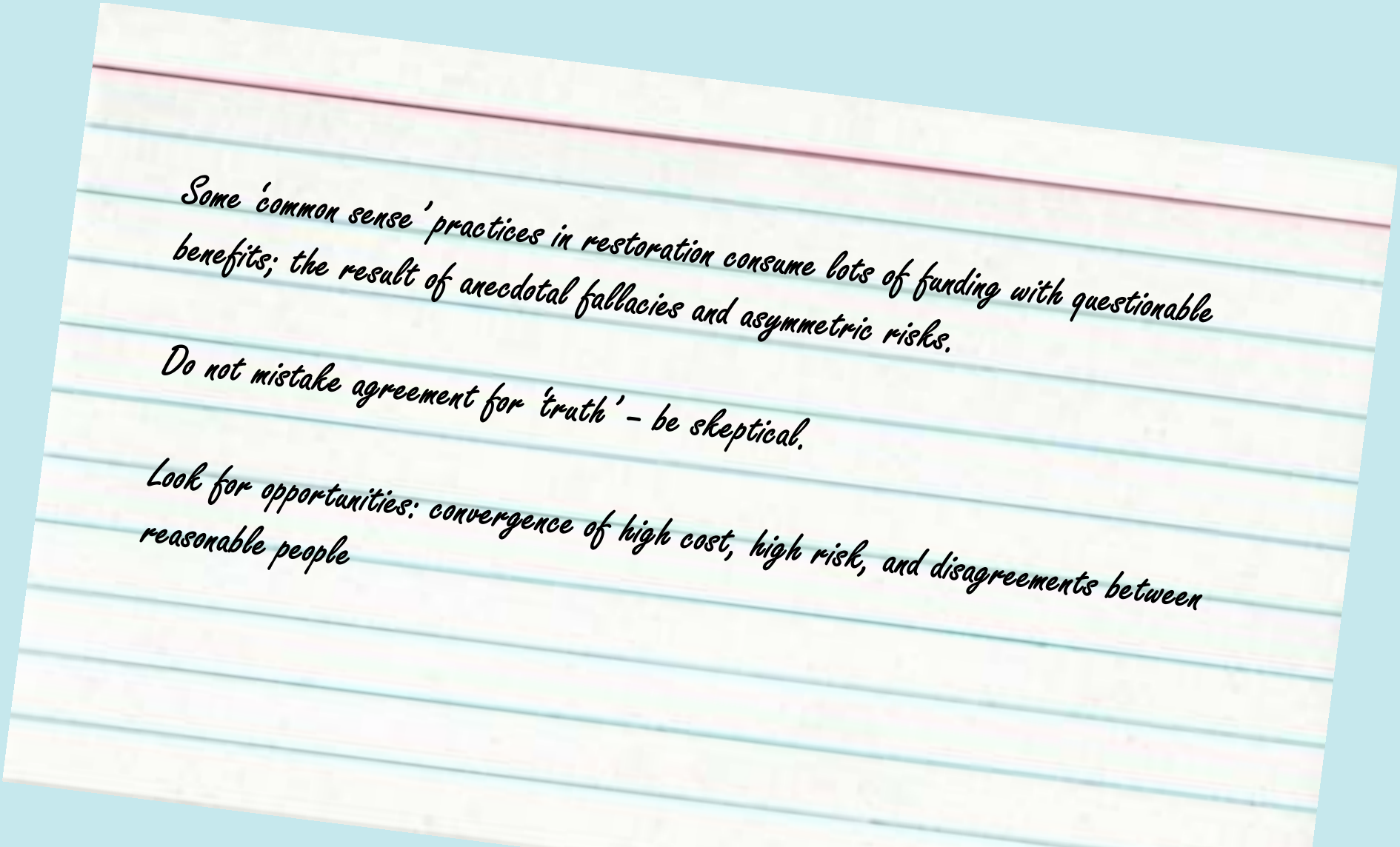
+ 422,000 seedlings per acre

Totaled 577,000 per acre by end of 1st summer

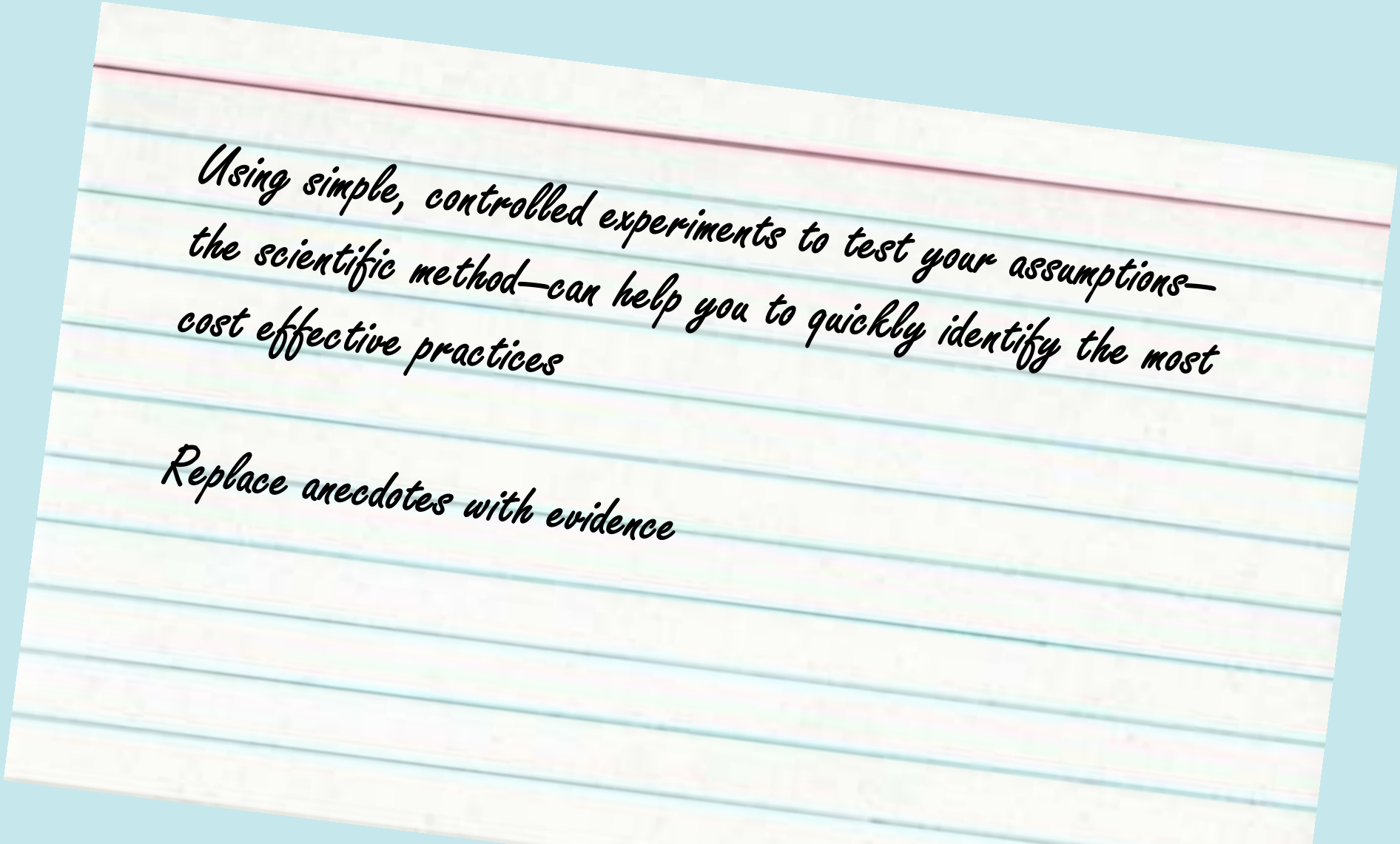
Watering significantly increased the density of cottonwood seedlings by a factor of 3.7 or 370% (p = 0.002, only a 1 in 500 chance of seeing a difference this large owing to chance alone).


100%
75%
50%
25%
0%
Woody canopy cover
Year 3
Wet
Dry

Question the ‘status quo’



If you are a scientist, act like one!



Magnify your impact