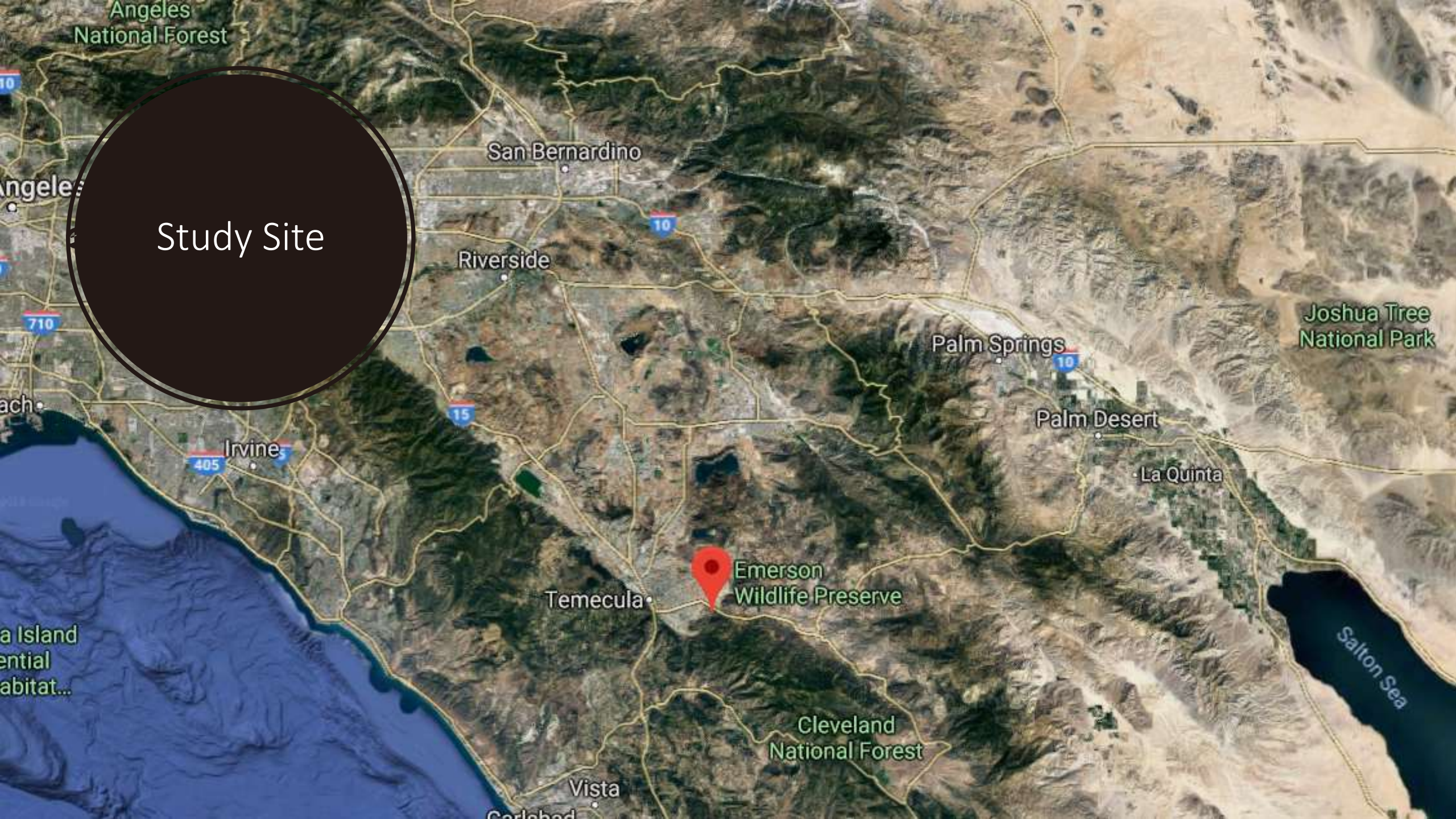
How do invasive grass water-use strategies affect belowground ecosystem services and native shrub re-establishment?

Michala Phillips and Edith Allen





Invasion in the chaparral?


Angeles
National Forest
Study Site
San Bernardino
Riverside
Palm Springs
Joshua Tree
National Park
Palm Desert
La Quinta
Irvine
Emerson
Wildlife Preserve
Temecula
Cleveland
National Forest
Vista
Salton Sea
710
10
15
405

Study Species

Adenostoma fasciculatum

Bromus diandrus

Research Objectives

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2. Monitor the effect invasive cover has on soil moisture and percolation.

Objective 1

- We planted *A. fasciculatum* seedlings 1m^2 plots with four treatments.


100%
Invasive
grass
removal –
one seedling


50% Invasive grass removal – one seedling


No Invasive grass removal – one seedling

Objective I –Study Design

- We watered seedlings bi-weekly for the first two months after transplant and maintained weeding treatments.
- During the summer, we watered seedlings monthly.

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- During the summer, we watered seedlings monthly.
- We measure each seedling's height and width on a monthly basis.

Estimate Seedling Biomass

- We used the height and width measurements to estimate shrub seedling biomass.
- $Shrub\ volume\ =\ \pi\ x\ D^2\ /4$

Estimate Seedling Biomass

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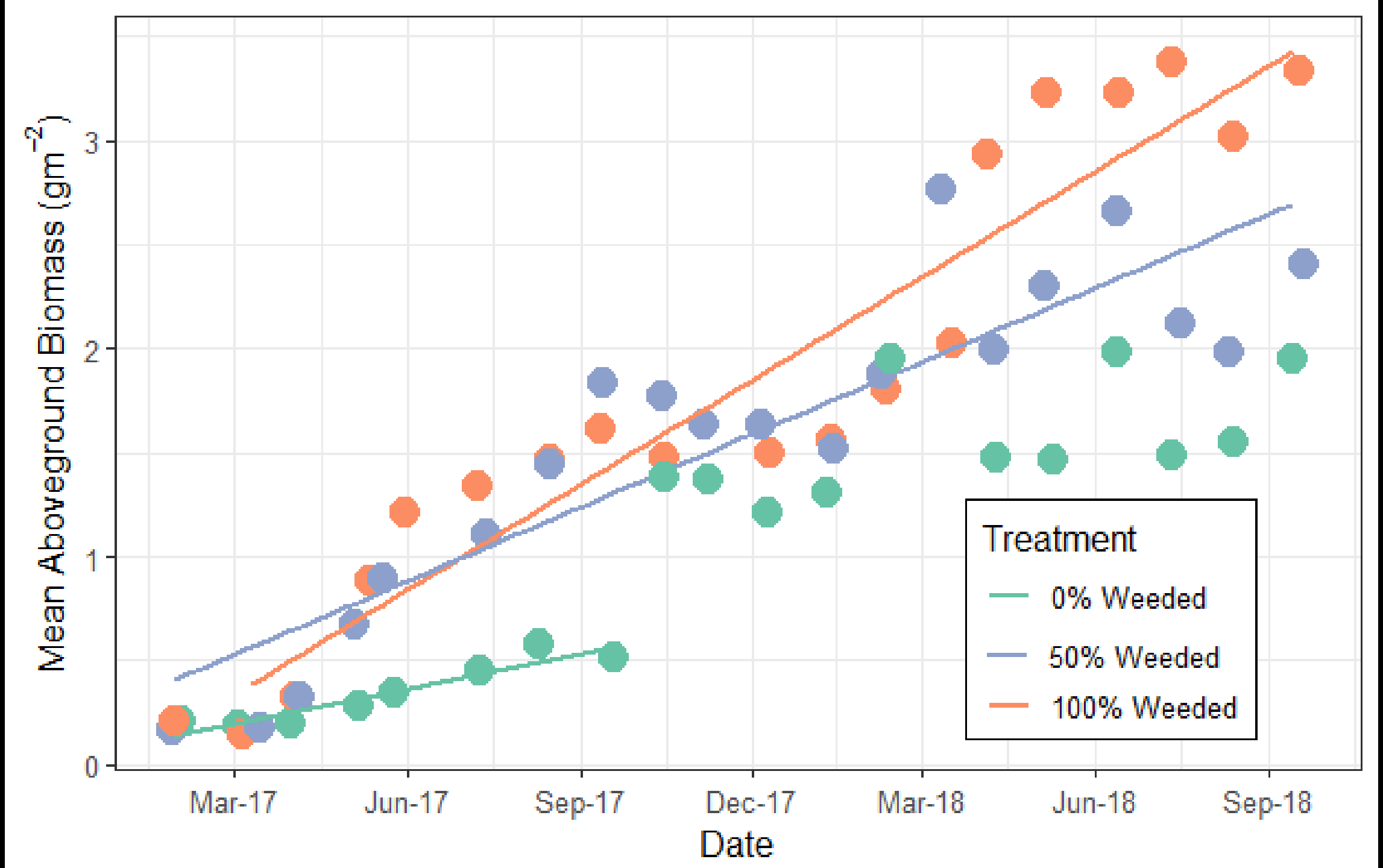
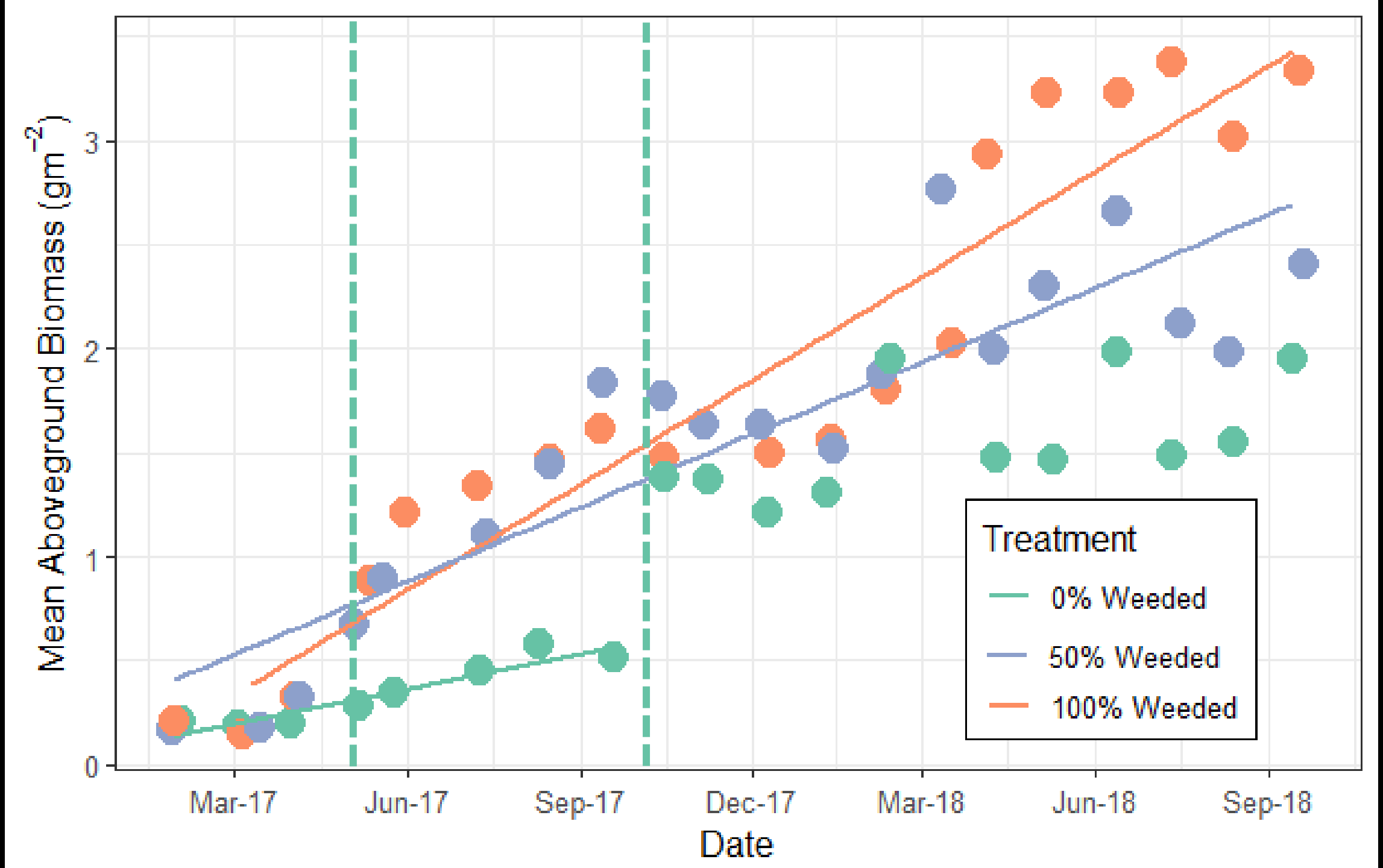
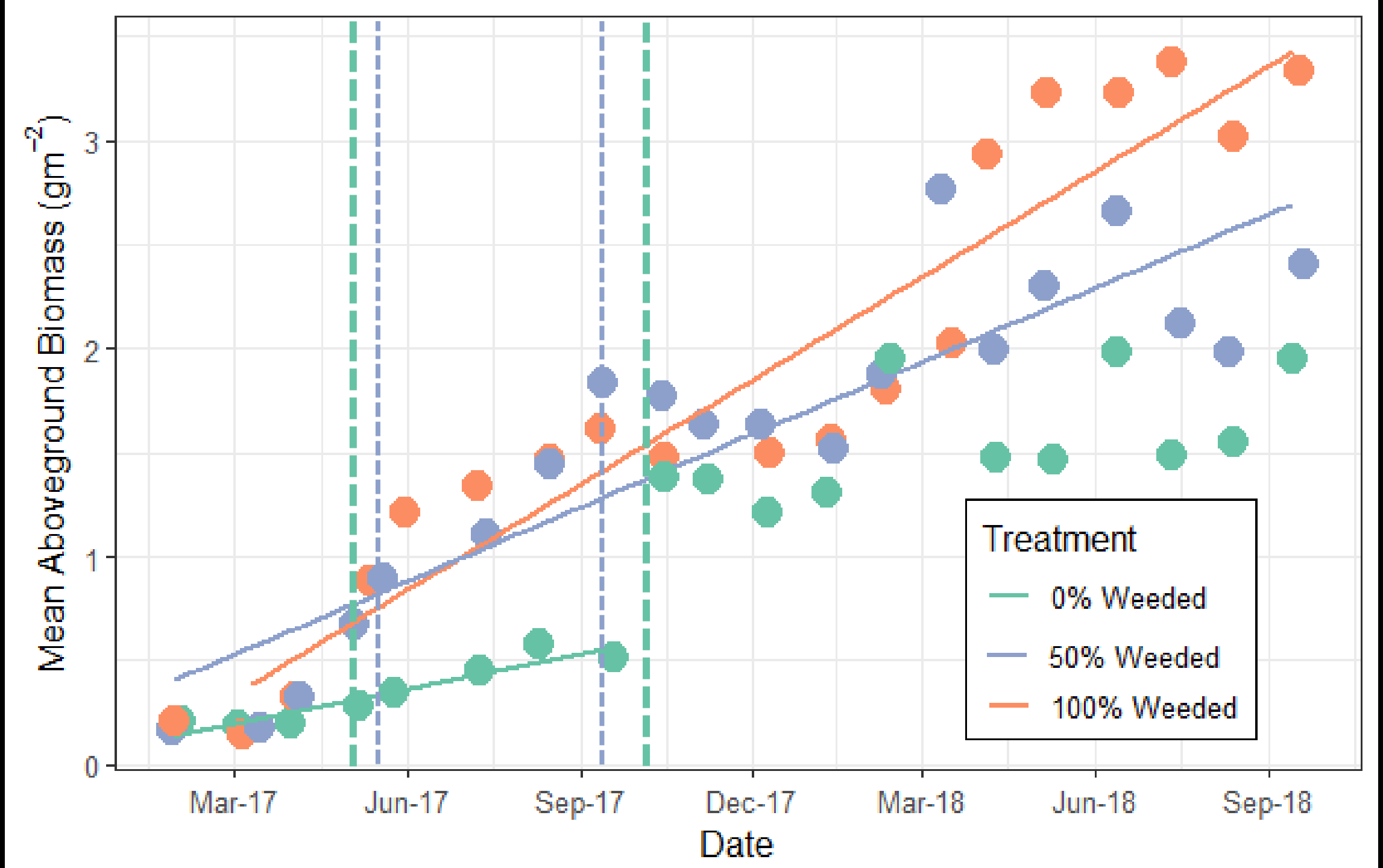
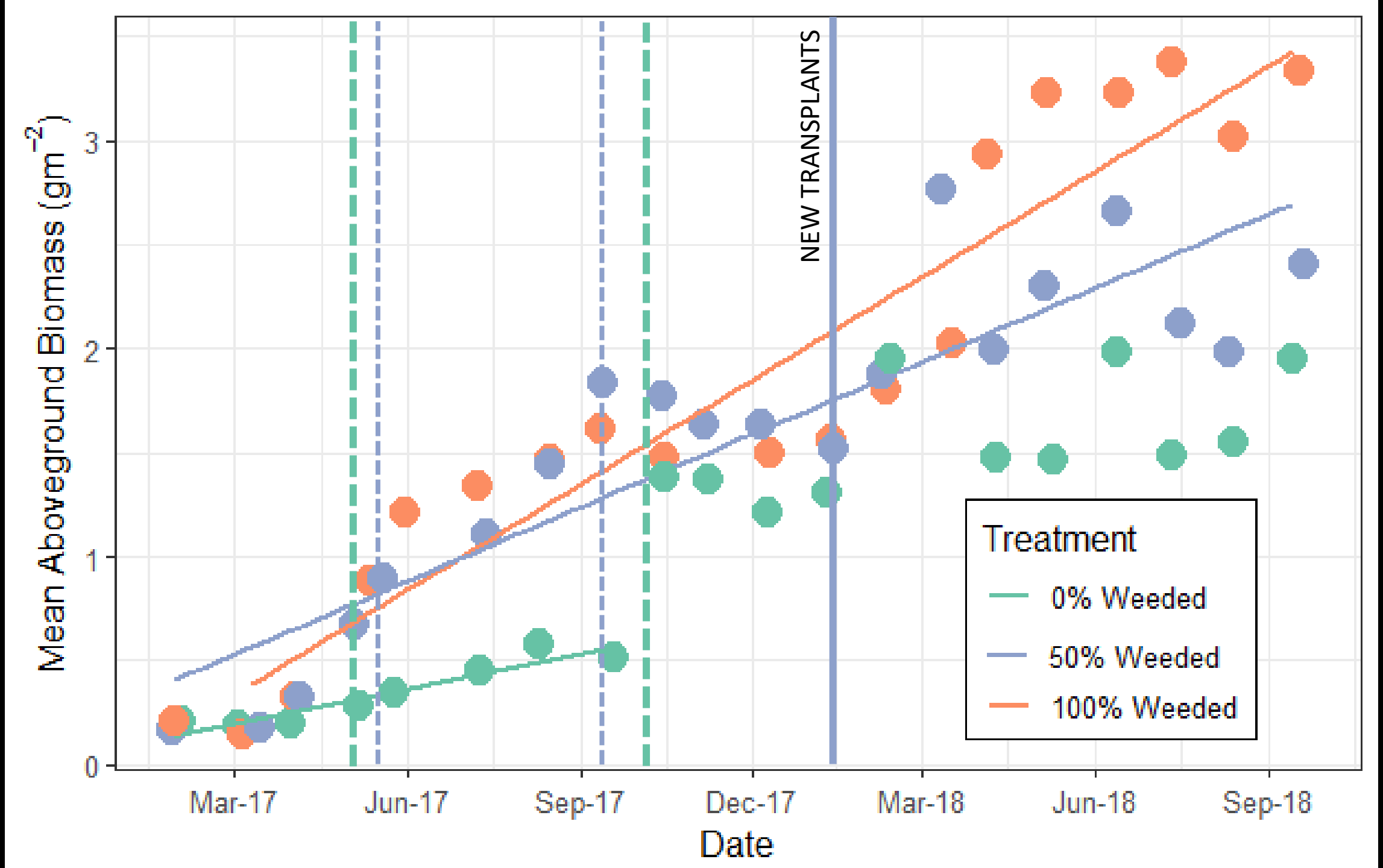
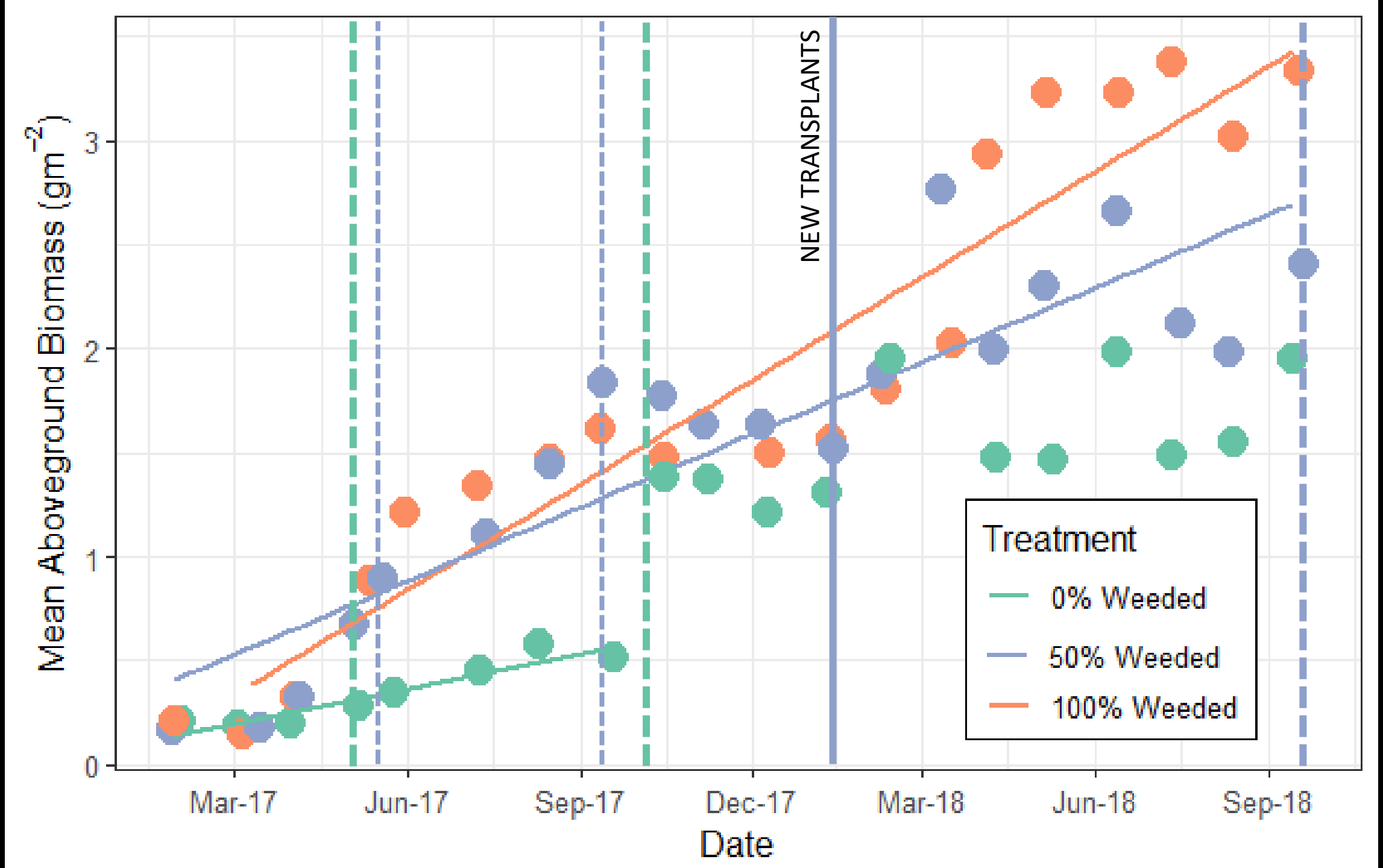
- $Shrub\ volume\ =\ \pi\ x\ D^2\ /4$
- D is average shrub diameter calculated from measurements of the maximum and perpendicular diameter (Bonham 1989).
- We used a regression equation developed by Vourlitis and Pasquini 2009 to estimate biomass from volume.


Mean Aboveground Biomass (gm^{-2})
0
1
2
3
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Date
Treatment
0% Weeded
50% Weeded
100% Weeded

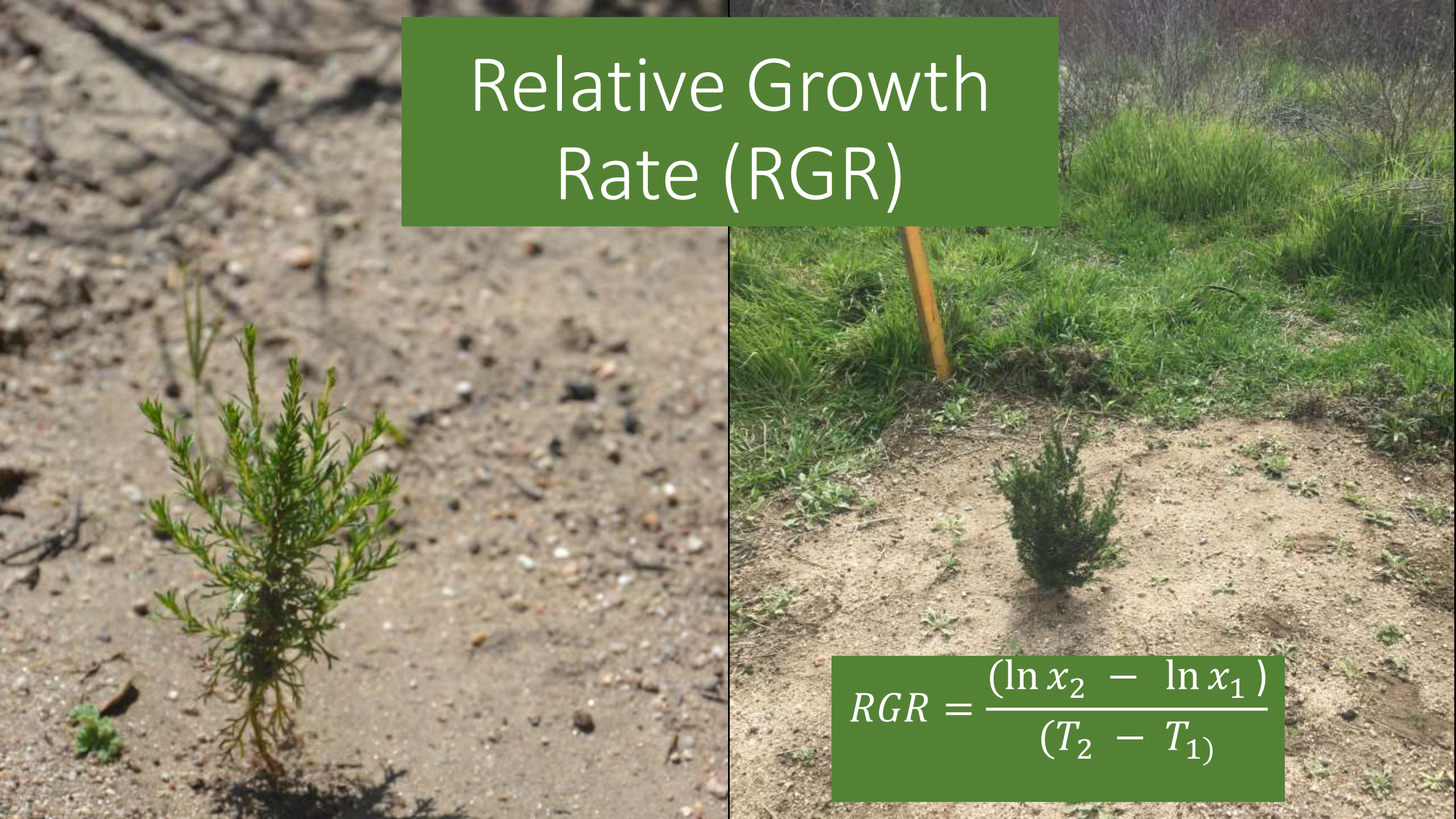

Mean Aboveground Biomass (gm^{-2})
0
1
2
3
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Date
Treatment
0% Weeded
50% Weeded
100% Weeded


Mean Aboveground Biomass (gm^{-2})
0
1
2
3
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Date
Treatment
0% Weeded
50% Weeded
100% Weeded

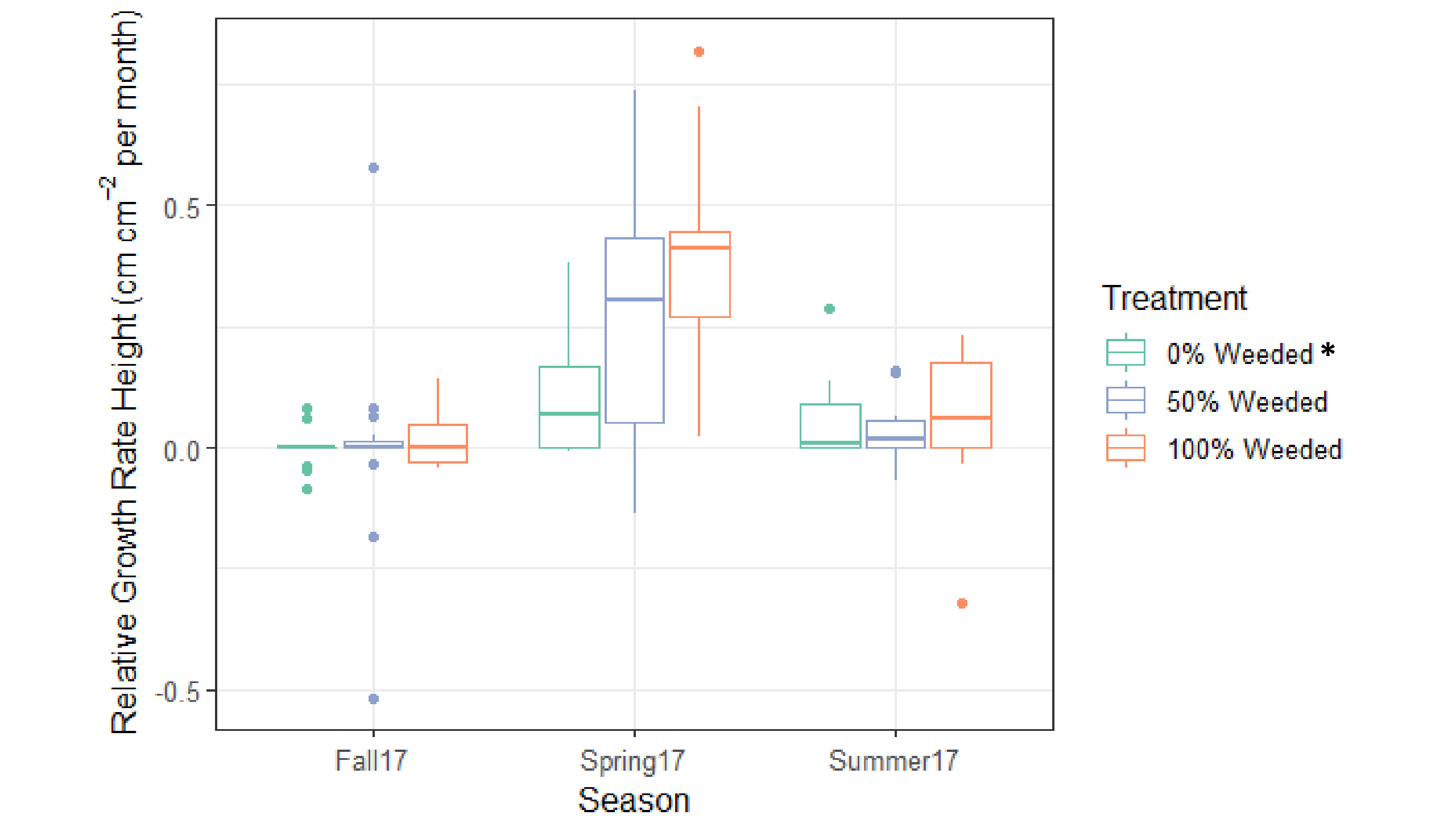

Mean Aboveground Biomass (gm^{-2})
0
1
2
3
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Date
NEW TRANSPLANTS
Treatment
0% Weeded
50% Weeded
100% Weeded

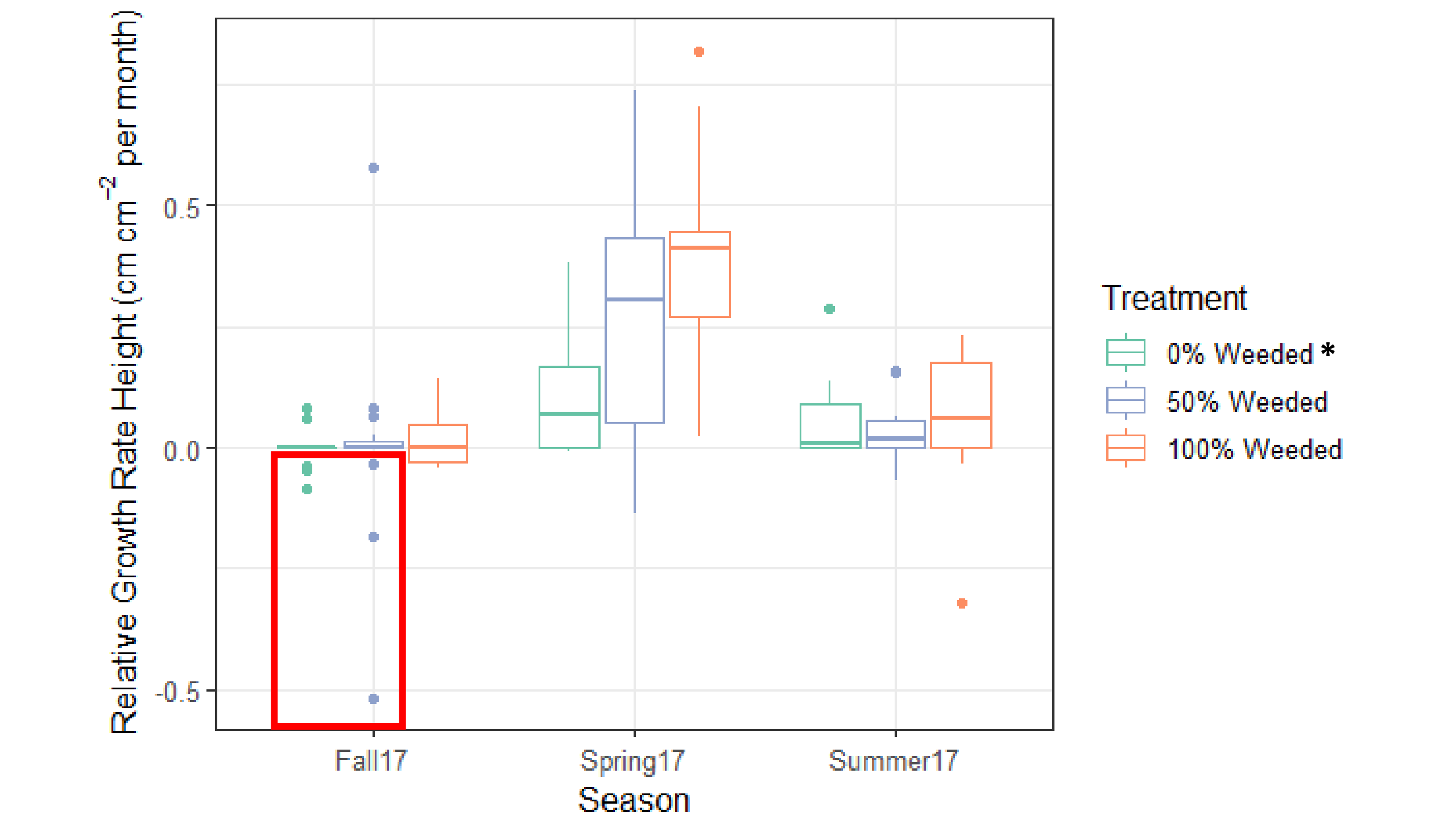

Mean Aboveground Biomass (gm^{-2})
0
1
2
3
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Date
NEW TRANSPLANTS
Treatment
0% Weeded
50% Weeded
100% Weeded

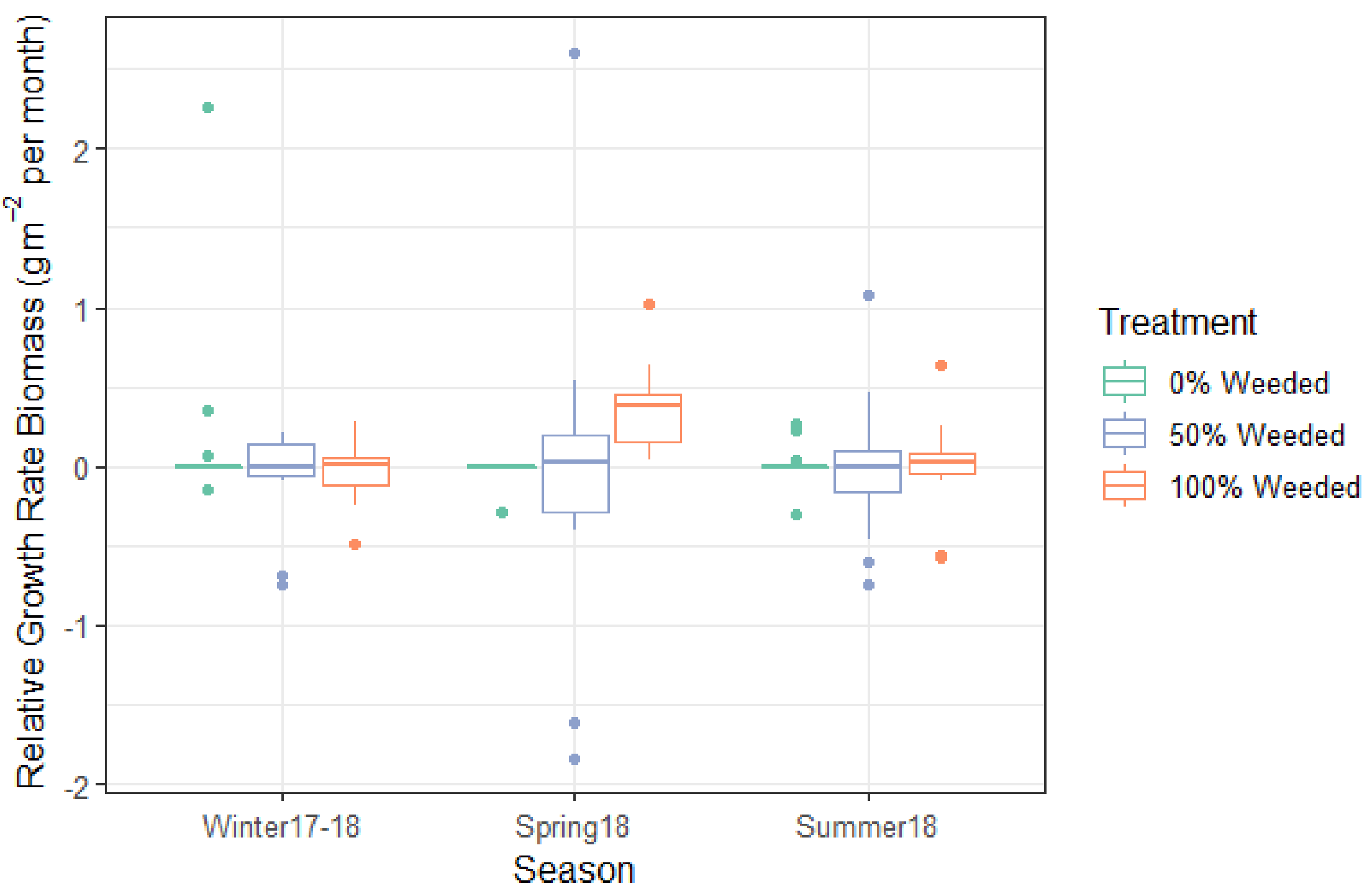
Relative Growth Rate (RGR)



$$RGR = \frac{(\ln x_2 - \ln x_1)}{(T_2 - T_1)}$$


Relative Growth Rate Height (cm cm-2 per month)
0.5
0.0
-0.5
Fall17
Spring17
Summer17
Season
Treatment
0% Weeded *
50% Weeded
100% Weeded


Relative Growth Rate Height (cm cm-2 per month)
0.5
0.0
-0.5
Fall17
Spring17
Summer17
Season
Treatment
0% Weeded *
50% Weeded
100% Weeded


Relative Growth Rate Biomass (g m-2 per month)
2
1
0
-1
-2
Winter17-18
Spring18
Summer18
Season
Treatment
0% Weeded
50% Weeded
100% Weeded

Research Objectives

1. Determine how invasive cover affects seedling establishment and survival.
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Objective 2 – Study Design

- In these same $1m^2$ plots, we installed soil moisture sensors at two depths: 15cm and 35cm.

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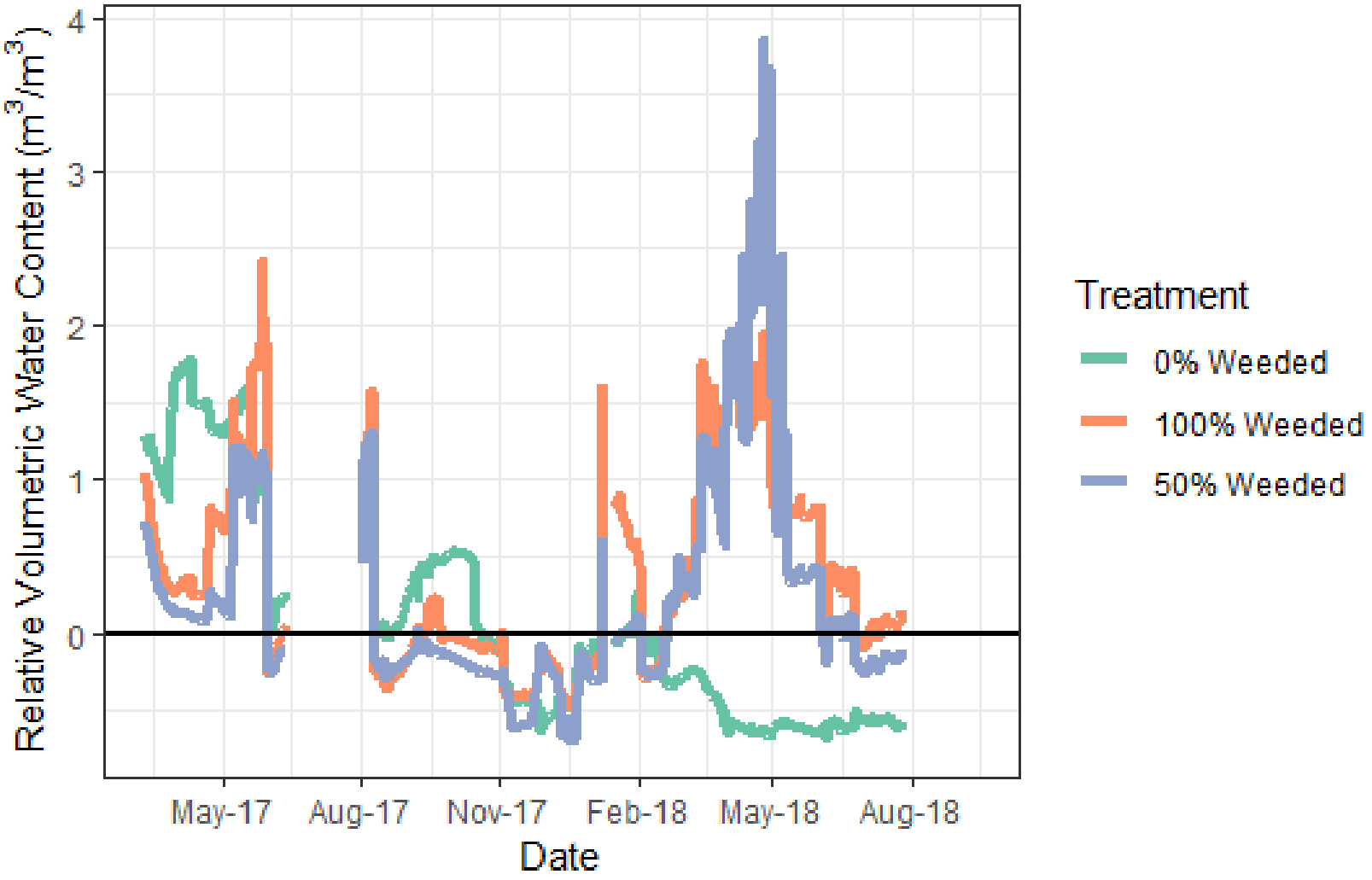
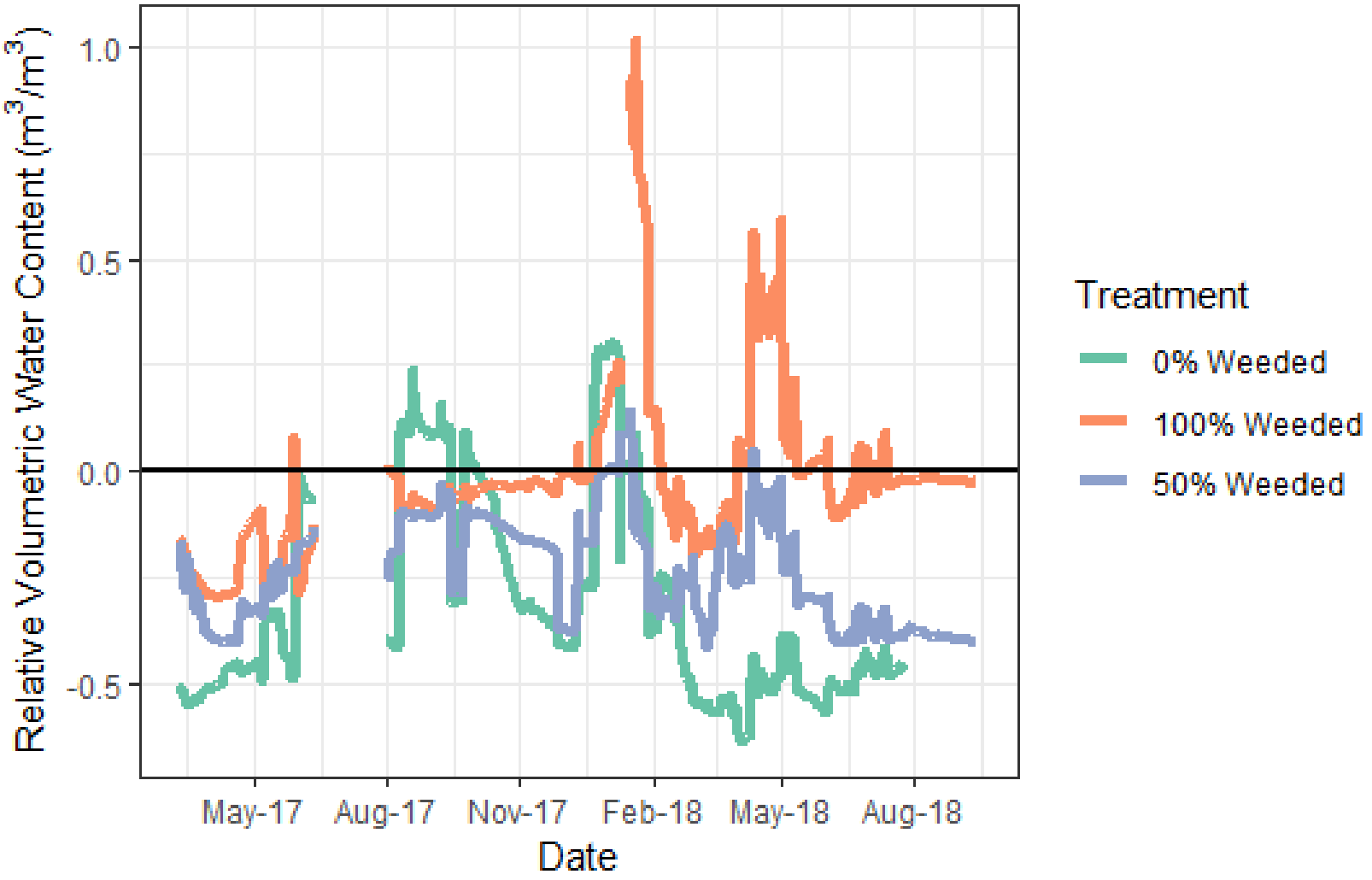
- In these same $1m^2$ plots, we installed soil moisture sensors at two depths: 15cm and 35cm.
- Sensors measure VWC at 15 minute intervals.

Relative diurnal soil moisture at 15cm



$$Relative\ VWC\ = \frac{(Treatment - Control)}{Control}$$

Relative diurnal soil moisture at 35cm



$$Relative\ VWC\ = \frac{(Treatment\ -\ Control)}{Control}$$

Implications

- Maintained weeding effectively increased establishment.
- Invasive removal has the potential to increase soil moisture below the invasive rhizosphere, which may be contributing to shrub establishment.
- Continued watering in year two could decrease the variability of the seedling growth response.
- Weeding stimulated the establishment of annuals.

Acknowledgements

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