An update on propagation and mitigation efforts: Greenhouse irrigation control and determining which species can be planted in cheatgrass.

Steven Link, Gail Redberg, Janice Jones

Department of Natural Resources
Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR 97801
stevenlink@ctuir.org
509-429-7765 (w), 509-948-0054 (c)

Topics

- **The purpose of the US Department of Energy – CTUIR propagation and ecological restoration program**

- **Which species can survive being planted into cheatgrass. The survivors will chosen for seed collection, propagation, and installation in cheatgrass. If there is a significant increase in survivors then breeding efforts to improve the competitive abilities of native plants may be warranted.**

- **Long-term stability of a soil moisture sensor to control irrigation in a greenhouse.**

The purpose of the DOE – CTUIR propagation and ecological restoration program

Propagate and install First Foods Native Plants and all other native species needed to create sustainable ecosystems.

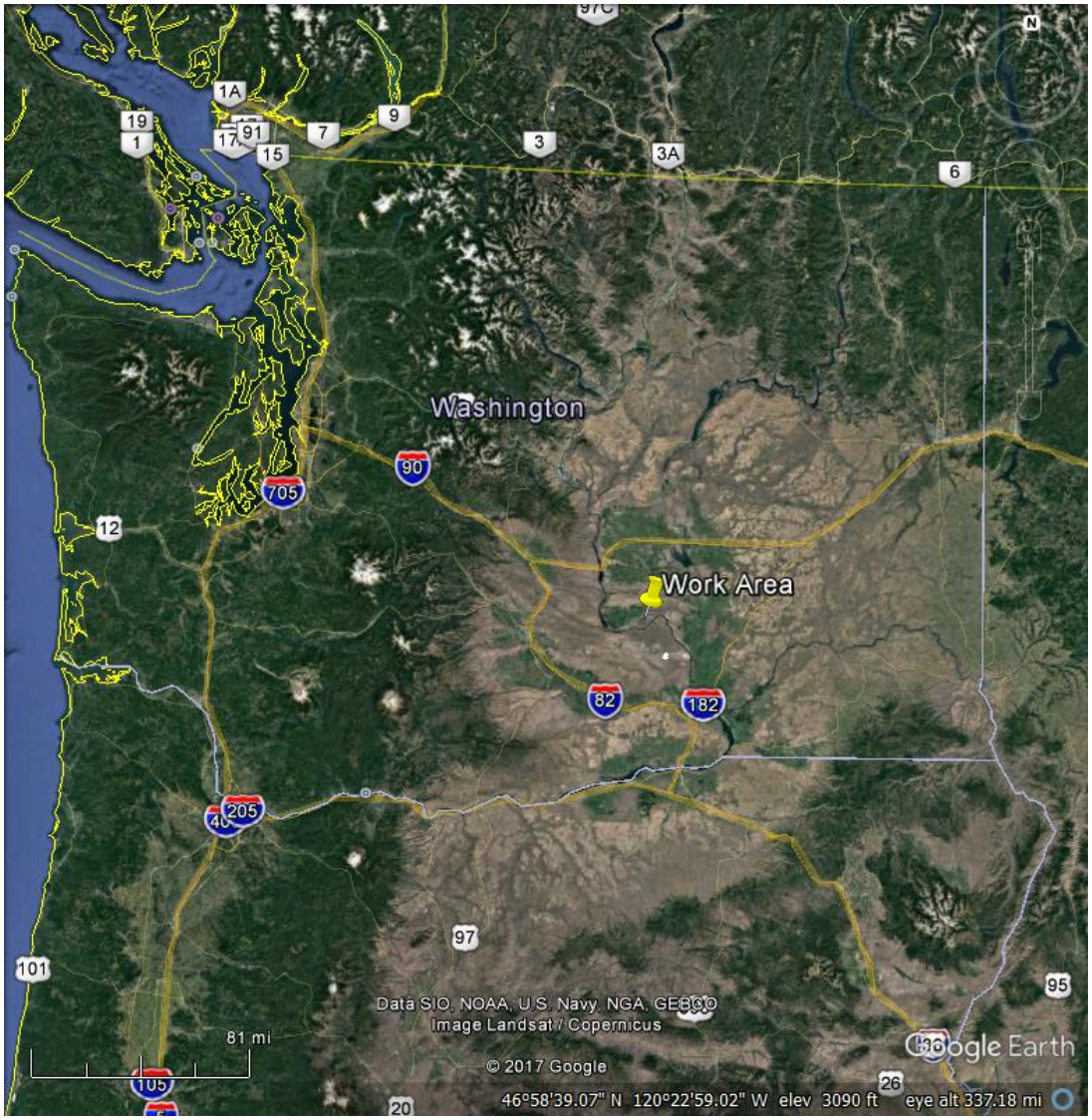
Installing native plant seedlings into cheatgrass.

Cheatgrass everywhere!

This is very upsetting, disturbing, and frustrating. The area burned about 4 years ago and was drill-seeded with perennial grasses. They did not establish here.

Cheatgrass wins again!

A sandy area on the Hanford Reach National Monument burned and provided an opportunity to install native plants and assess survival.



Study location

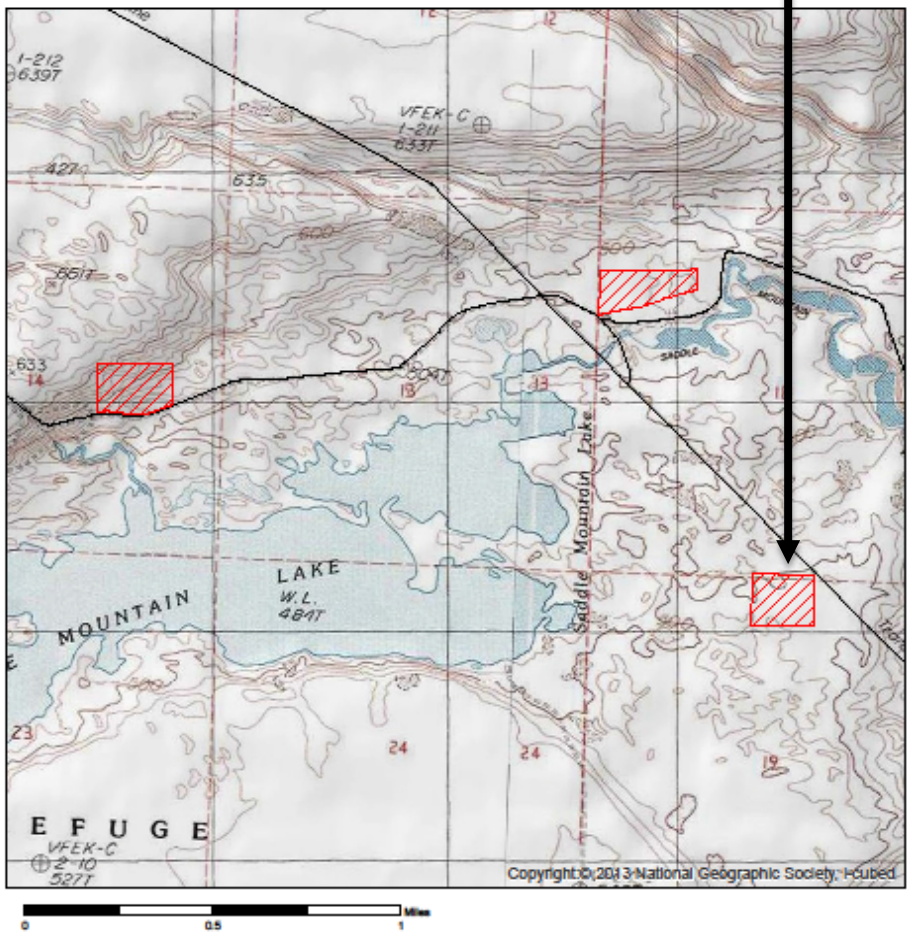


Figure 1.

Ecological restoration experiments on cheatgrass competition

Fourteen native plant species were installed across 11 acres to determine how well they establish when planted into cheatgrass.

Half the plants were installed in bare soil patches and the other half in cheatgrass.

Greenhouse propagation

Achillea millefolium
Yarrow

Nursery growth and hardening

Elymus elymoides- Squirrel tail

Achillea millefolium - Western yarrow

Sporobolus cryptandrus – Sand dropseed

Artemisia tridentata – Wyoming big sagebrush

Eriogonum niveum – Snow buckwheat

Sphaeralcea munroana – Munro's globemallow

Dalea ornata - Blue mountain prairie clover

Grayia spinosa – spiny hopsage

Phacelia hastata – silverleaf phacelia

Chaenactis douglasii – Douglas' dusty maiden

Elymus elymoides- Squirrel tail seedling

Seedling installation

Species and 6 planting strips or replicates

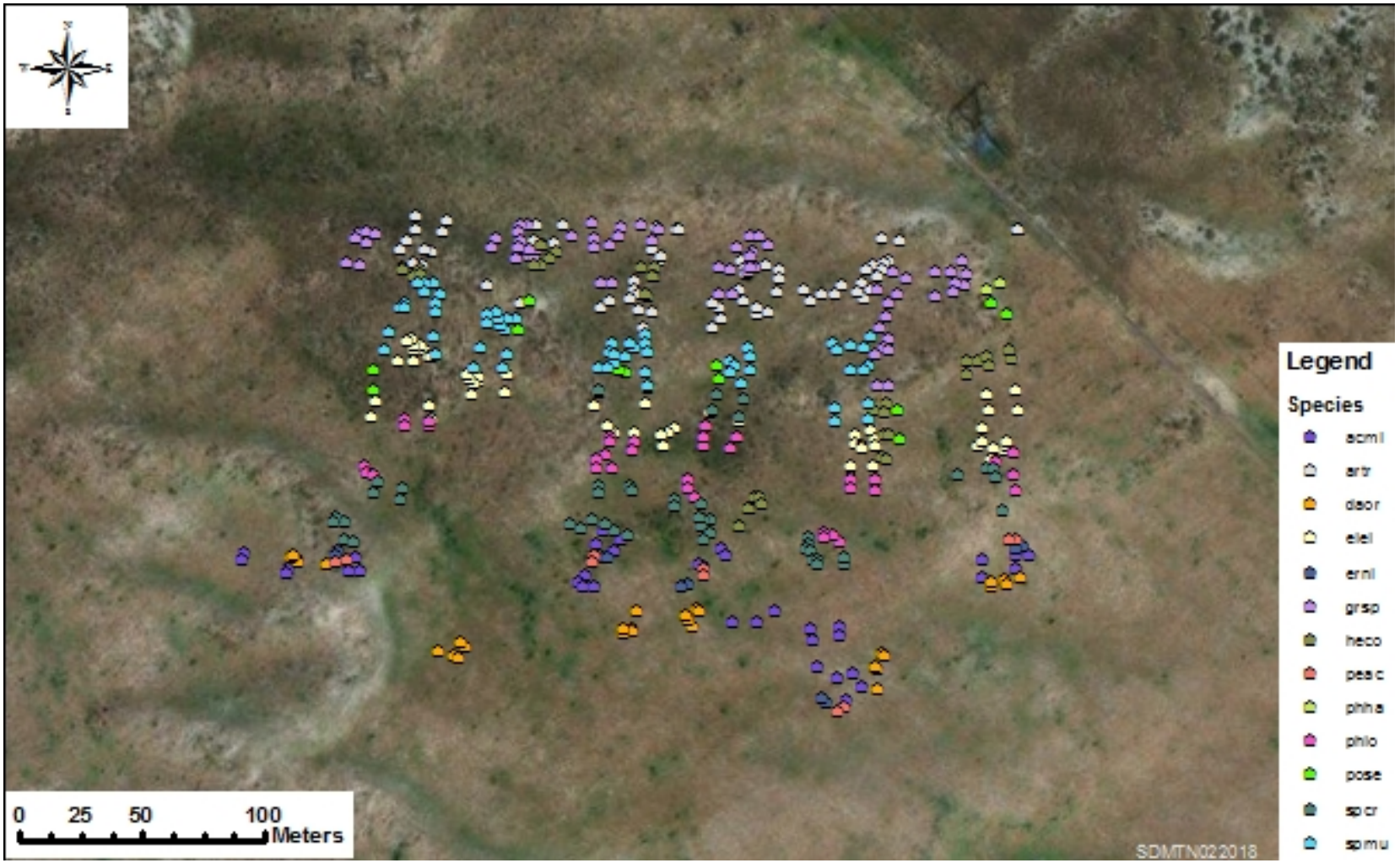


Table 1. Species and numbers installed at the Saddle Mountain National Wildlife Refuge.

Scientific name	Common name	Number installed
Achillea millefolium	common yarrow	1200
Artemisia tridentata	Wyoming big sagebrush	600
Chaenactis douglasii	Douglas' dustymaiden	26
Dalea ornata	Blue Mountain prairie clover	144
Elymus elymoides	squirreltail	680
Eriogonum niveum	snow buckwheat	60
Grayia spinosa	Spiny hopsage	400
Hesperostipa comata	Needle and thread grass	288
Penstemon acuminatus	sharp-leaf penstemon	72
Phacelia hastata	Silverleaf phacelia	24
Phlox longifolia	longleaf phlox	284
Poa secunda	Sandberg’s bluegrass	528
Sphaeralcea munroana	Munro's globemallow	600
Sporobolus cryptandrus	sand dropseed	600
	Total	5506

Elymus elymoides- Squirrel tail installed in bare soil

Elymus elymoides- Squirrel tail installed in cheatgrass

Sporobolus cryptandrus – Sand dropseed about May 1 with no leaf rolling

Sporobolus cryptandrus – Sand dropseed about May 1 in cheatgrass with leaf rolling.

Phlox longifolia – Long-leaved phlox about May 1 in cheatgrass

Phlox longifolia – Long-leaved phlox about May 1

Penstemon acuminatus – Sharp-leaved penstemon planted in cheatgrass. Late April.

Penstemon acuminatus – Sharp-leaved penstemon planted in bare soil. Late April.

Sphaeralcea munroana – Munro's globemallow in Late April

Achillea millefolium - Western yarrow

Achillea millefolium - Western yarrow planted in cheatgrass. Late April.

Dalea ornata - Blue mountain prairie clover

Dalea ornata - Blue mountain prairie clover
Late April

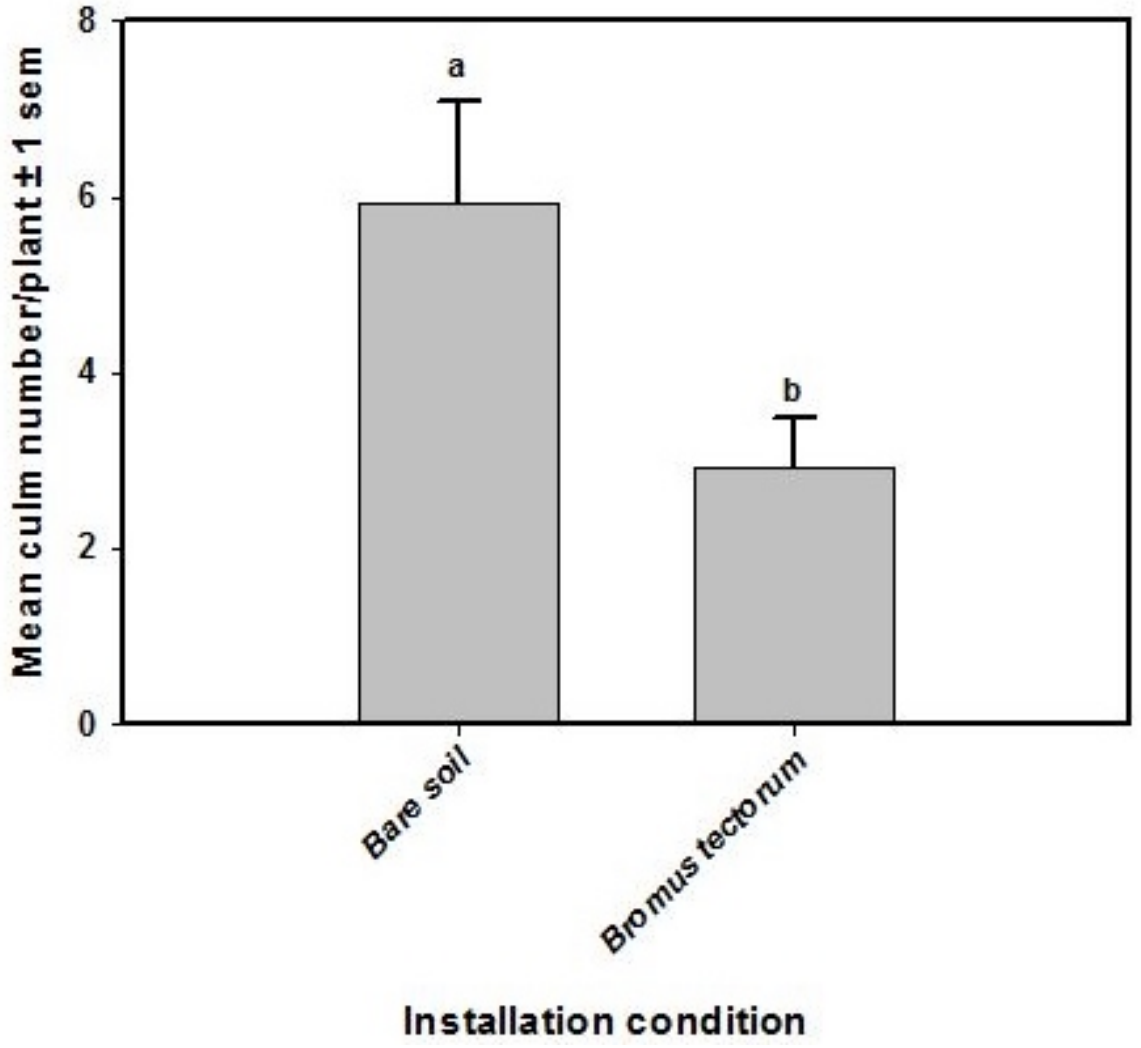
Eriogonum niveum – Snow buckwheat
Mid-April

Eriogonum niveum – Snow buckwheat planted in cheatgrass. Mid-April

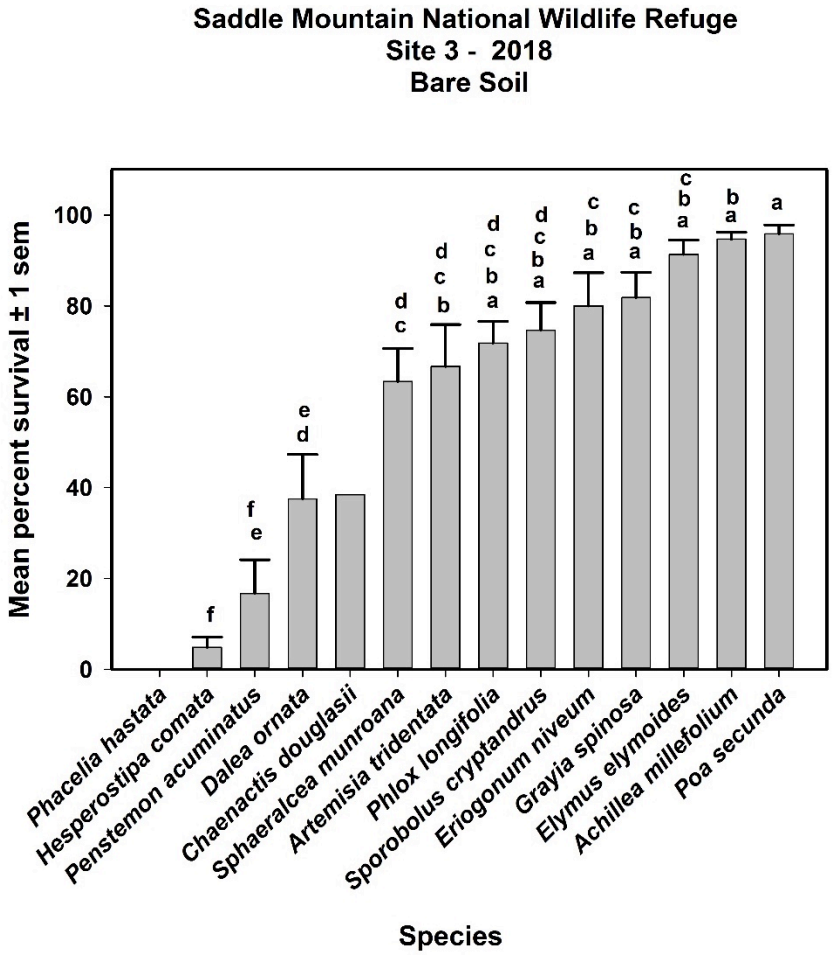
Poa secunda – Sandberg's bluegrass
Late April

Poa secunda – Sandberg's bluegrass planted in cheatgrass. Late April

Effect of installing *Poa secunda* – Sandberg's bluegrass in cheatgrass compared with bare soil on culm number per plant.

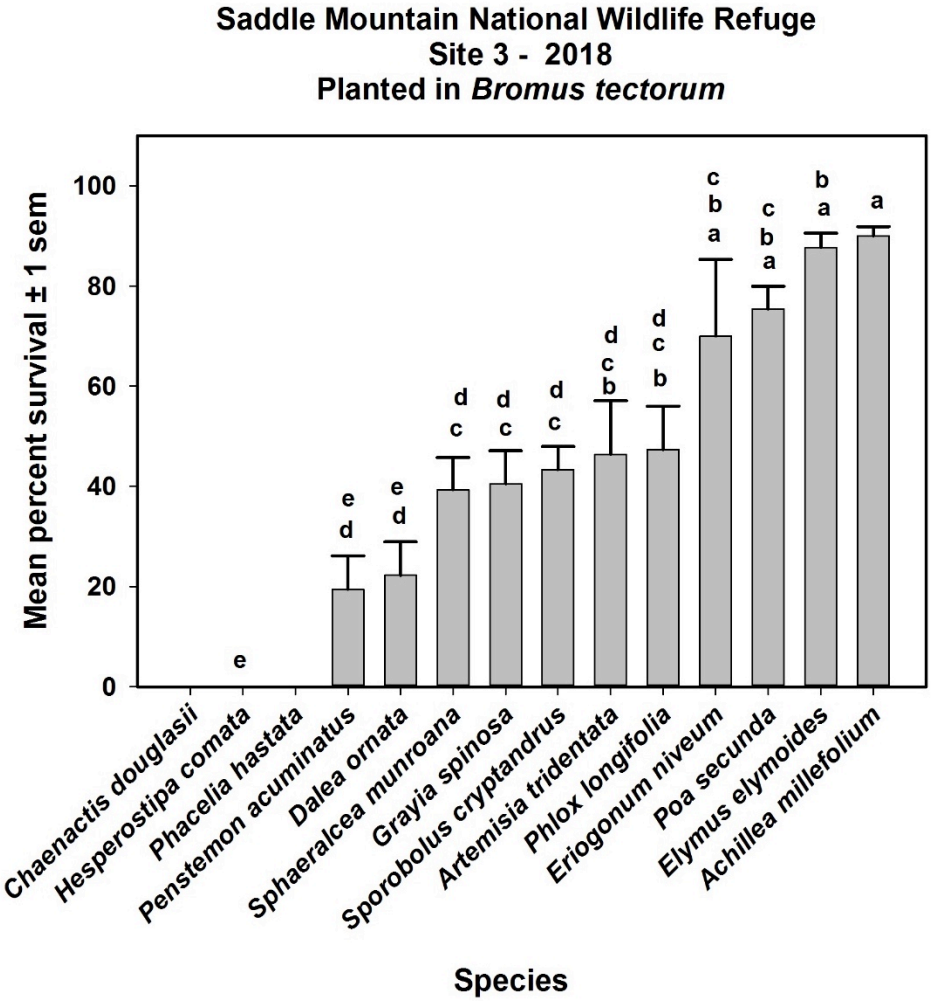


Ecological restoration trials with cheatgrass competition



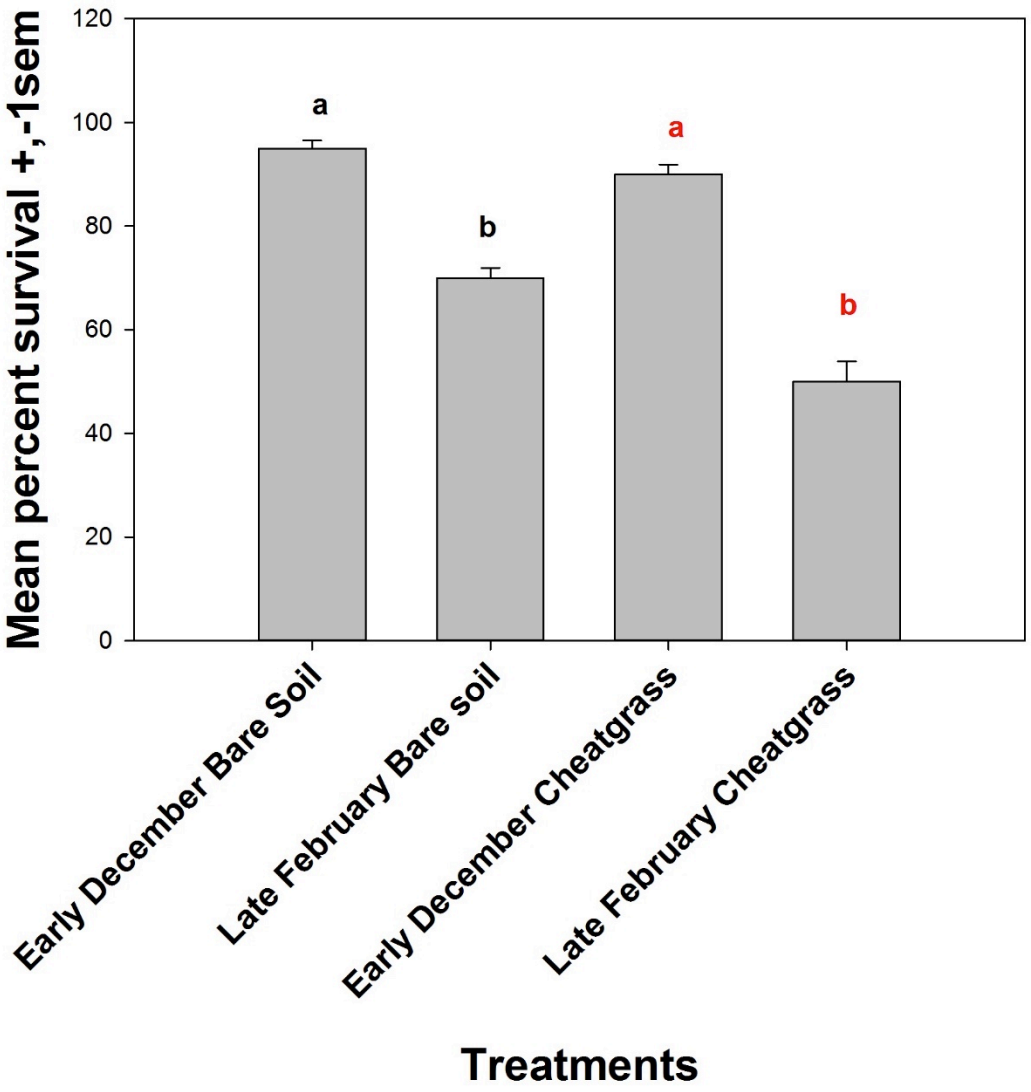
Means with the same letters are not significantly different (α = 0.05)

Ecological restoration trials with cheatgrass competition

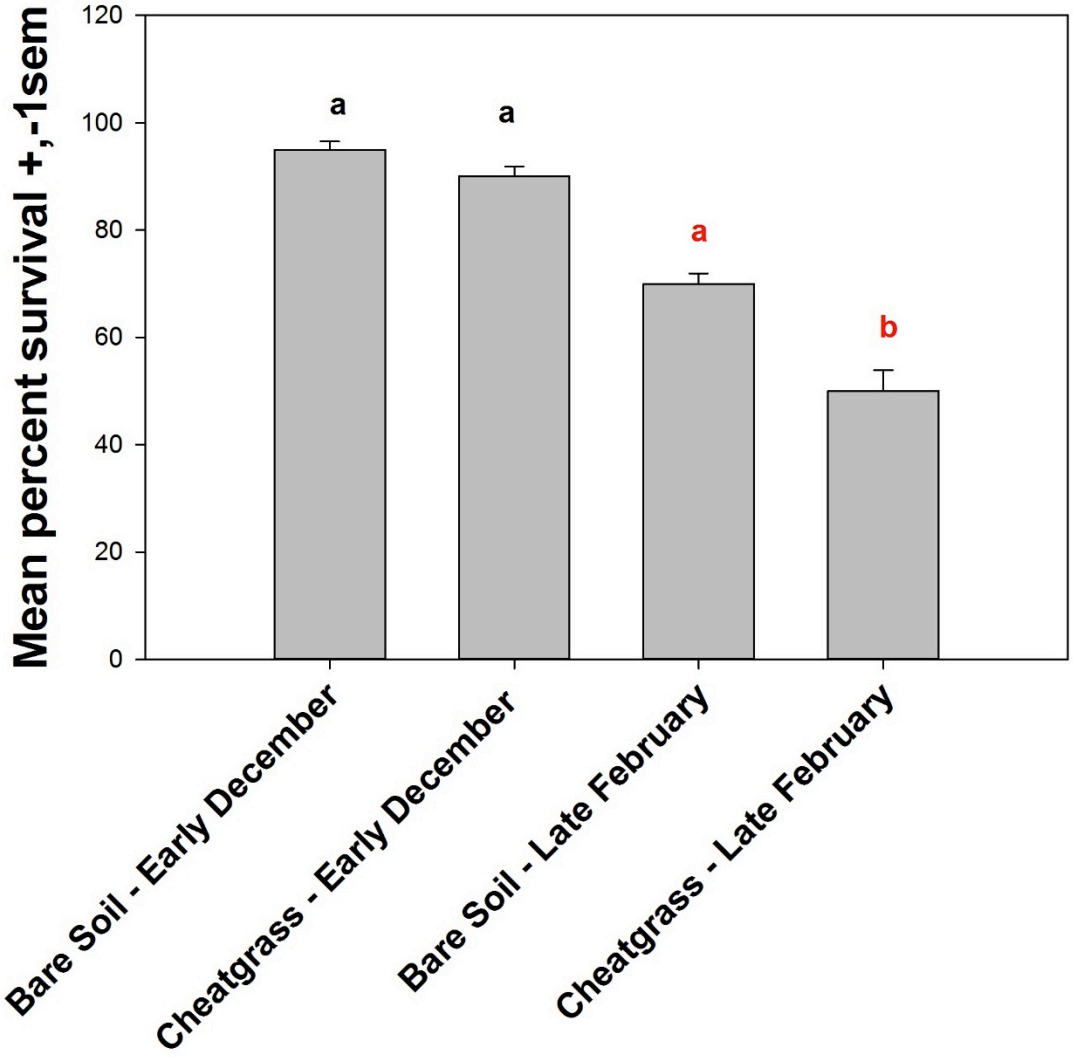


Means with the same letters are not significantly different (α = 0.05)

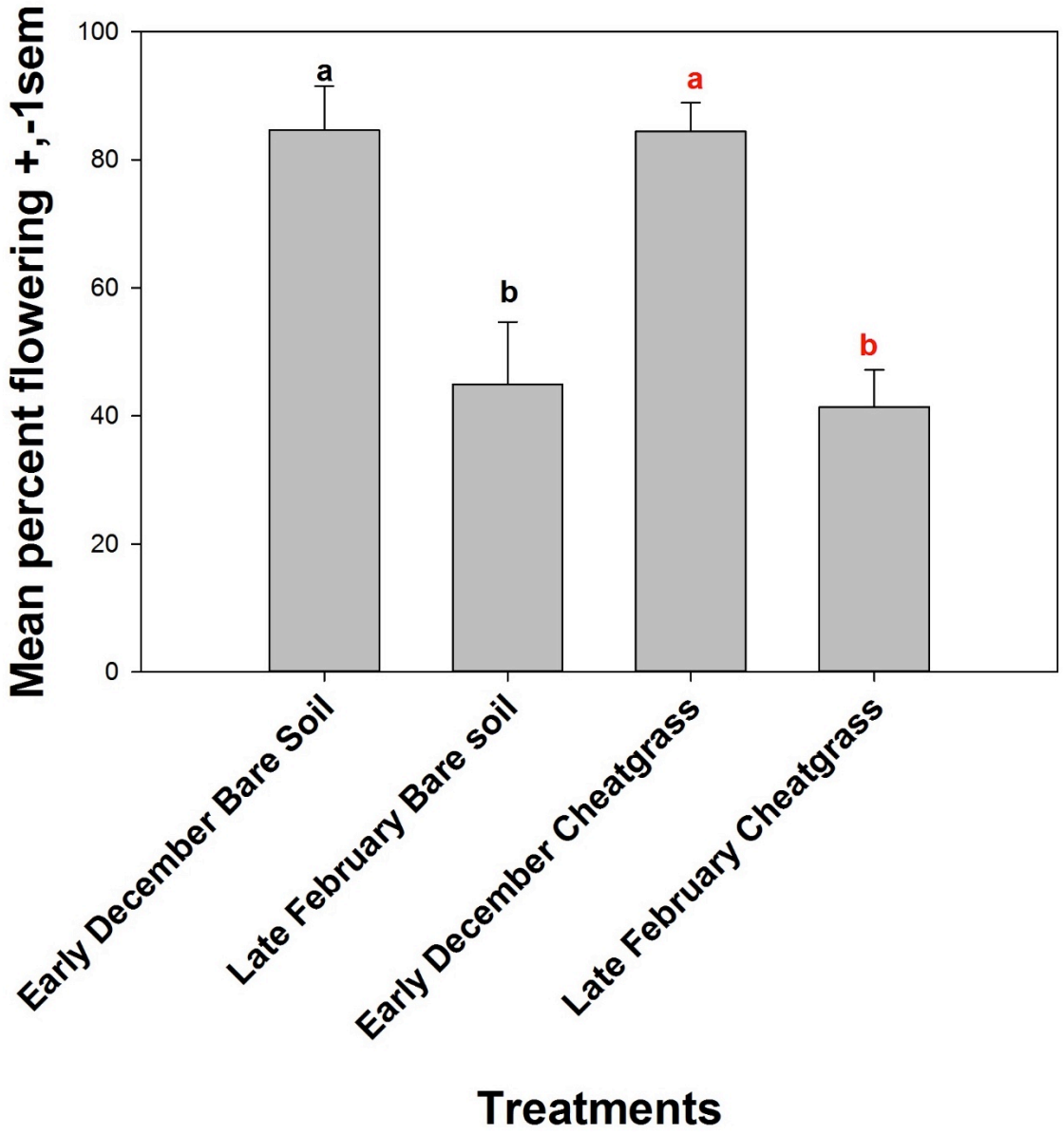
Effect of installation date on *Achillea millefolium* survival in bare soil and in cheatgrass



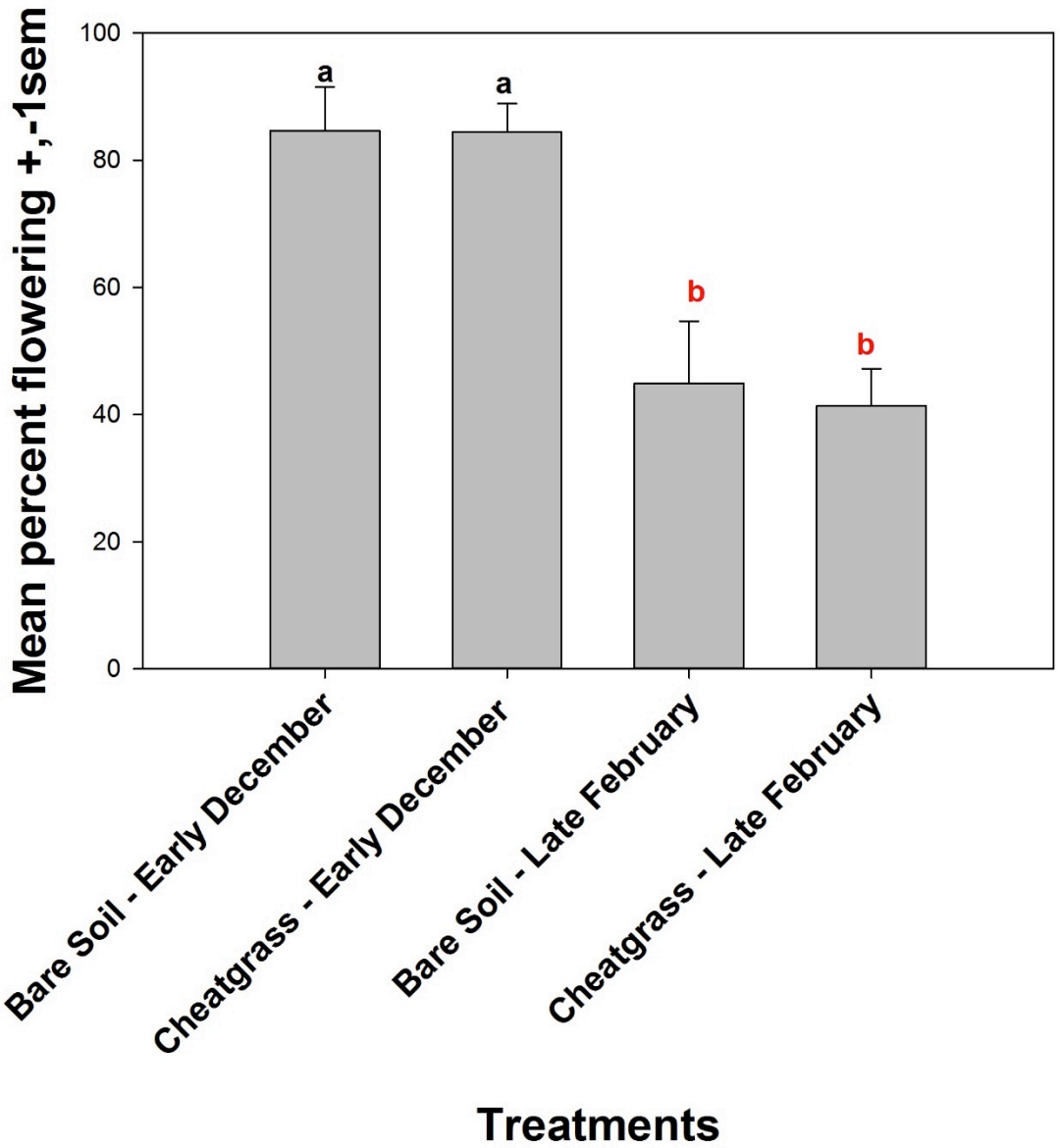
Effect of installation in bare soil and in cheatgrass on *Achillea millefolium* survival in early December and in late February



Effect of installation date on *Achillea millefolium* flowering in bare soil and in cheatgrass



Effect of installation in bare soil and in cheatgrass on *Achillea millefolium* flowering in early December and in late February



Ecological restoration trials with cheatgrass competition

Species	Installed in bare soil	Installed in *Bromus tectorum* dominated areas	Significance (α=0.05)
	% survival ± 1 sem n=6	% survival ± 1 sem n=6	
Achillea millefolium	95 ± 1.5	90 ± 1.9	0.085
Elymus elymoides	91 ± 3.2	88 ± 2.8	0.28
Poa secunda	96 ± 2.0	75 ± 4.6	0.0012
Eriogonum niveum	80 ± 7.3	70 ± 15.3	0.60
Phlox longifolia	72 ± 4.8	47 ± 8.6	0.0436
Artemisia tridentata	67 ± 9.2	46 ± 10.8	0.19
Sporobolus cryptandrus	75 ± 6.1	43 ± 4.6	0.0024
Grayia spinosa	82 ± 5.6	40 ± 6.6	0.0008
Sphaeralcea munroana	63 ± 7.3	39 ± 6.4	0.0333
Dalea ornata	38 ± 9.8	22 ± 6.7	0.21
Penstemon acuminatus	17 ± 7.5	19 ± 6.7	0.84
Hesperostipa comata	5 ± 2.3	0	0.08
	n=1	n=1	
Chaenactis douglasii	38	0	
Phacelia hastata	0	0	

Ecological restoration conclusions

- Cheatgrass appears to be winning.
- Results from early monitoring indicate that species vary in their survival when planted in bare soil and in cheatgrass. The species can then be ordered.
- Efforts at increasing species diversity in cheatgrass communities may be improved by breeding native species to have more resistance to cheatgrass. Such breed plants may then provide First Foods value to these landscapes. If populations can expand with cheatgrass competition then some First Foods sustained value may be returned to these areas.
- Then I may retire! Probably not.

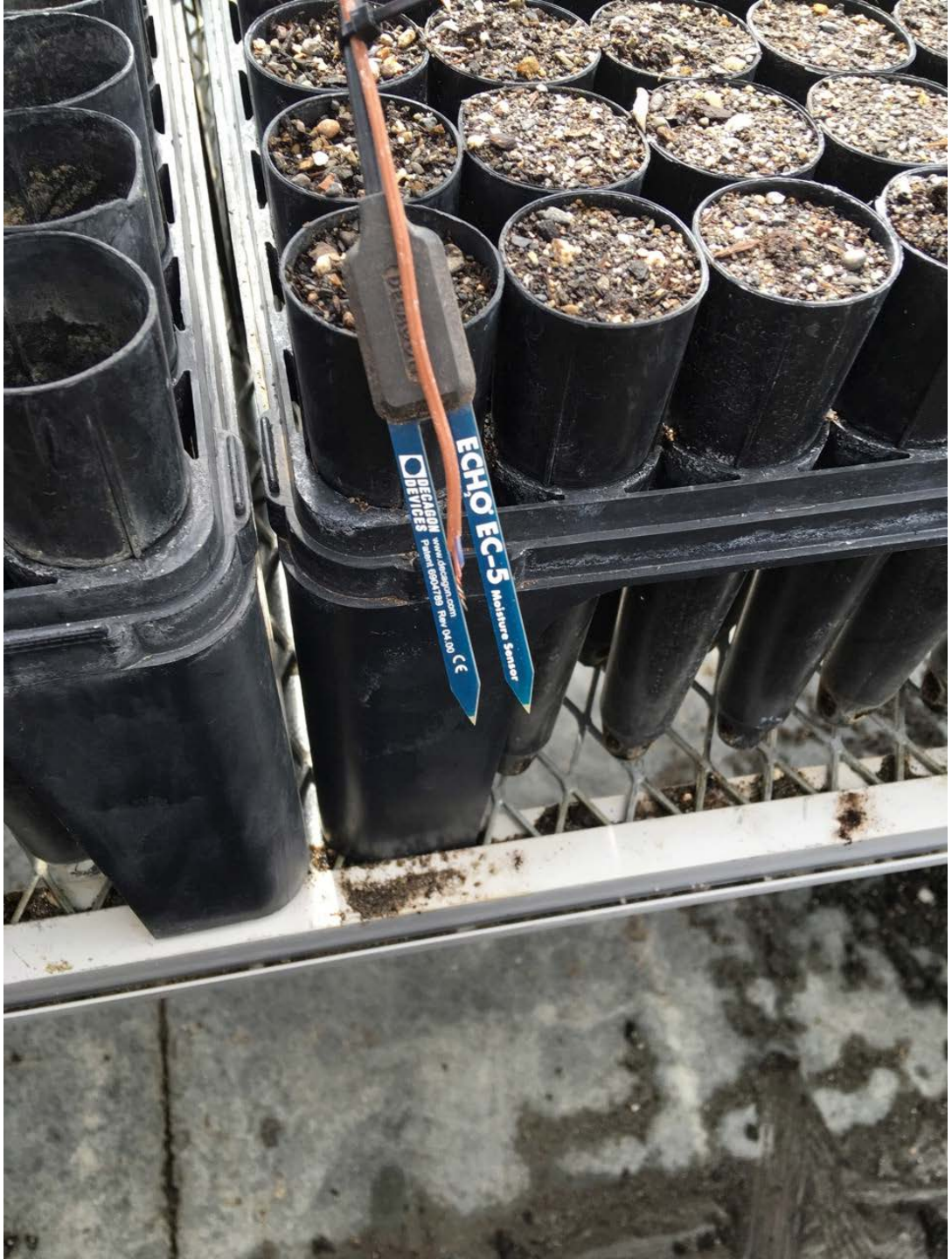
Long-term stability of a soil moisture sensor to control irrigation in a greenhouse.

- **The EC-5 sensor appears to work to control irrigation in small pots. It can detect when media water content has dried to a control set point. Water can then be applied with the help of a controller and software.**

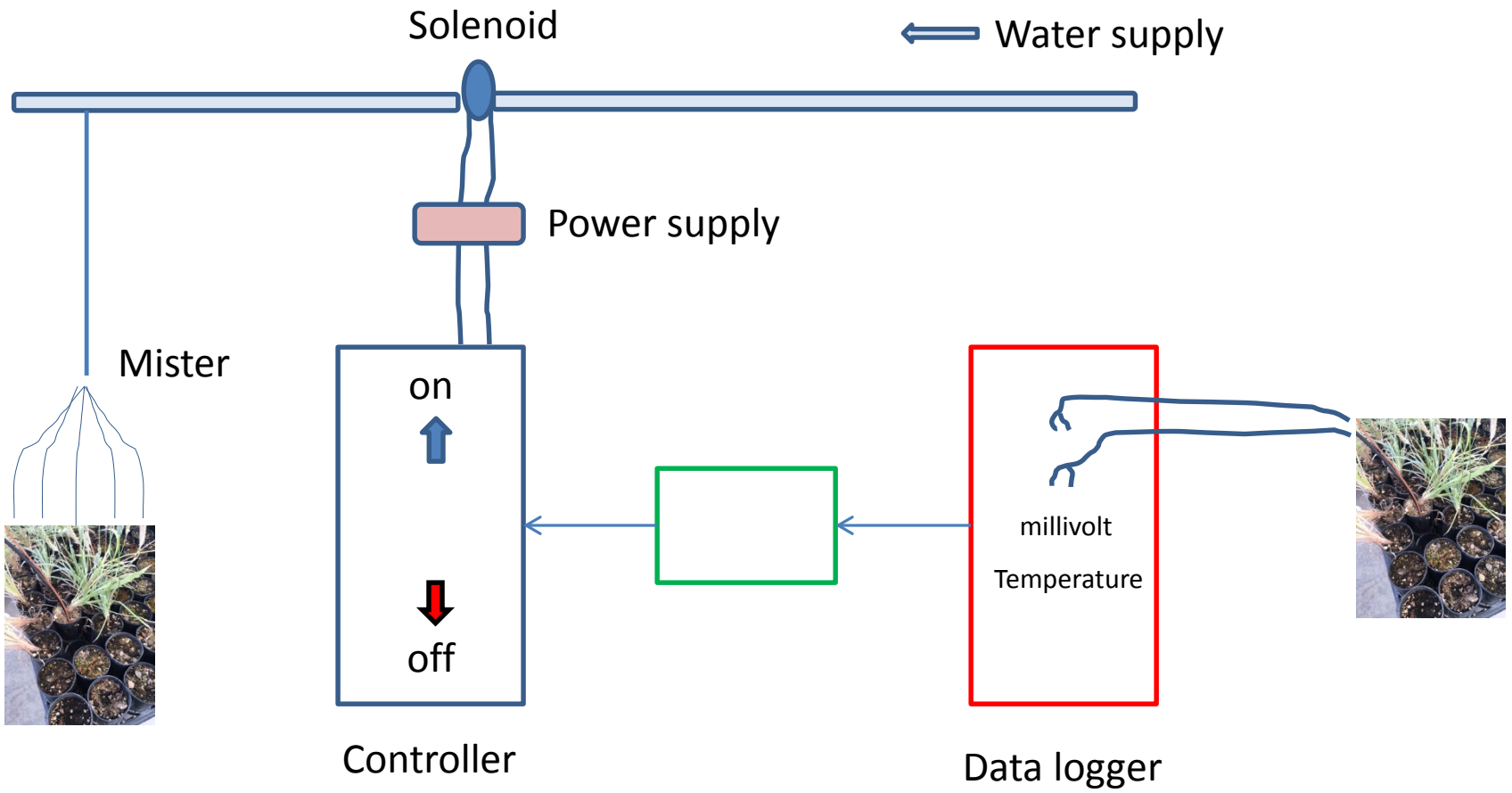
- **The long-term stability of the sensor is an open question. After working from June 2017 sensors were recalibrated in December 2017. Data were collected in May 2018.**

Problem

The Decagon EC-5 sensor is used in bulk soil. The sensor measurement dimension is about 3 cm from the sensor.



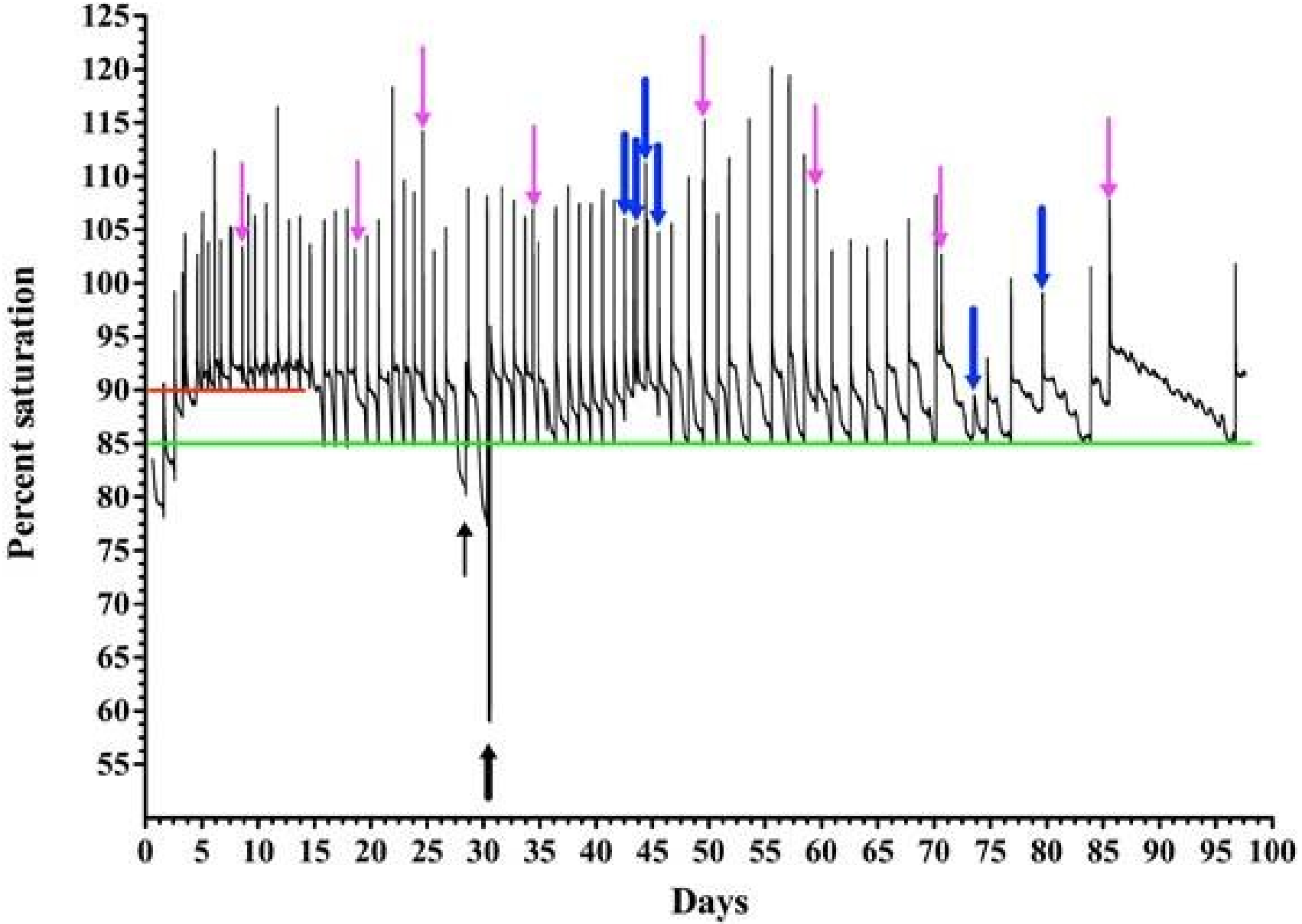
Sensor and irrigation control design

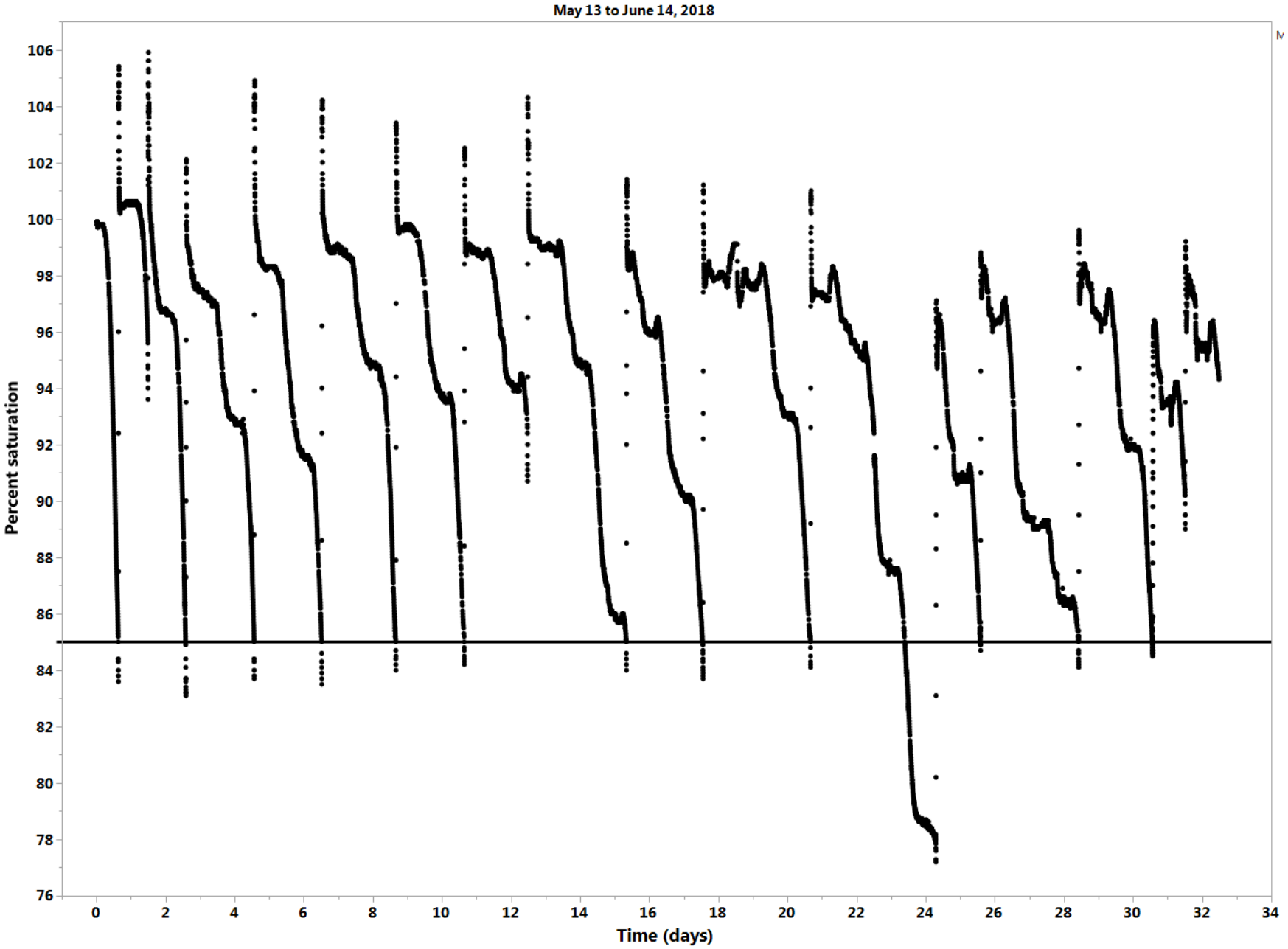


Computer Basic code

If % saturation < low % saturation setting then turn on the solenoid valve to irrigate. Continue watering for 35 minutes until draining then shut off.

June 19 to September 25, 2017




May 13 to June 14, 2018
Percent saturation
106
104
102
100
98
96
94
92
90
88
86
84
82
80
78
76
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
Time (days)

Conclusions

- **The soil moisture sensor has been useful as a way to irrigate. It is sensitive to conditions in the greenhouse providing more water when it is hot and dry and less water when it is cool and wet.**

- **The sensor appears to be stable for at least a year.**

- **Weighing racks of pots now only needs to be done during sensor calibration.**

- **Water management in propagation facilities and nurseries can now be based on media water content and automated.**