

Restoration Treatments to Improve Vegetation Response to Environmental Flows in the Colorado River Delta



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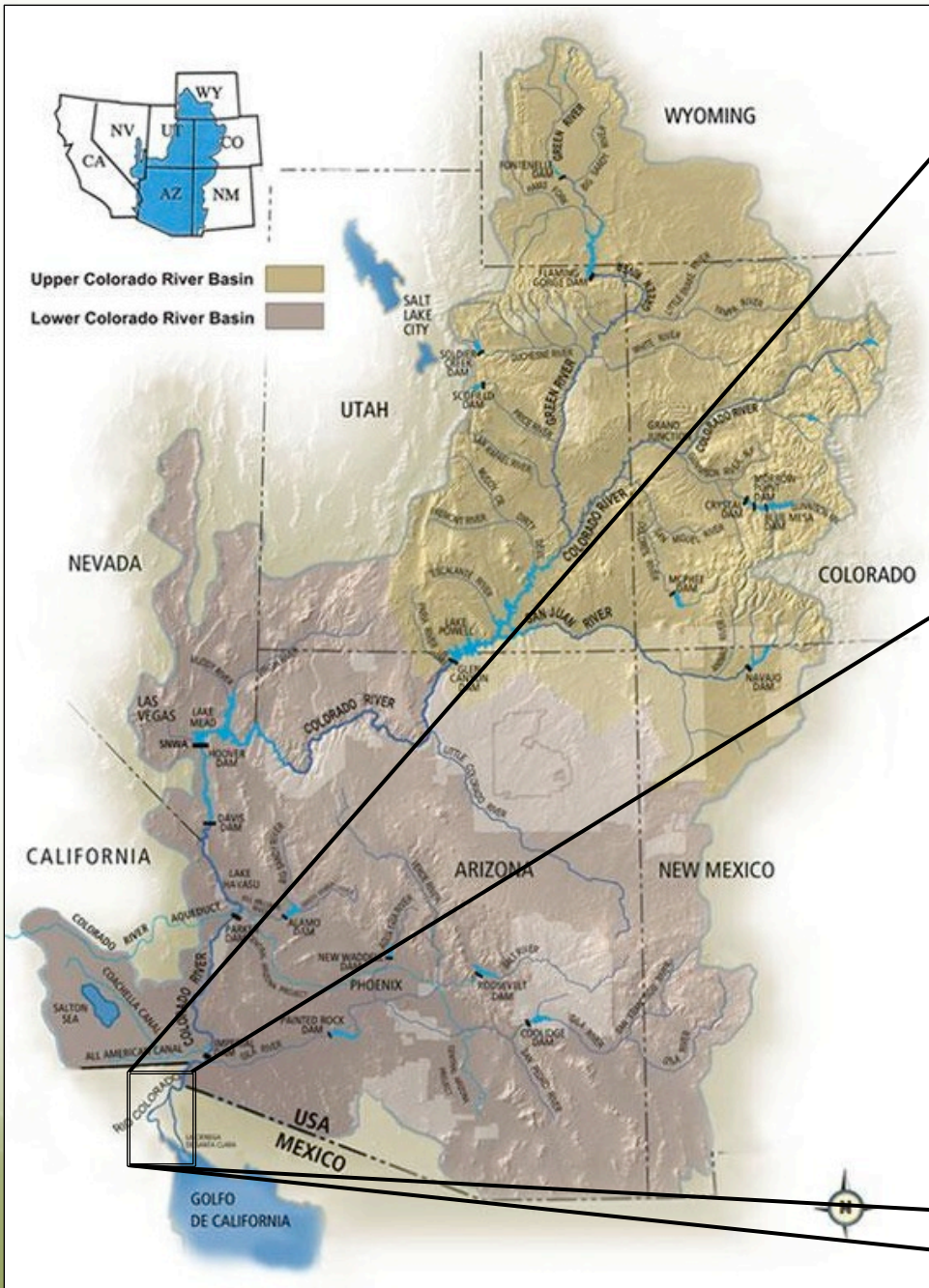
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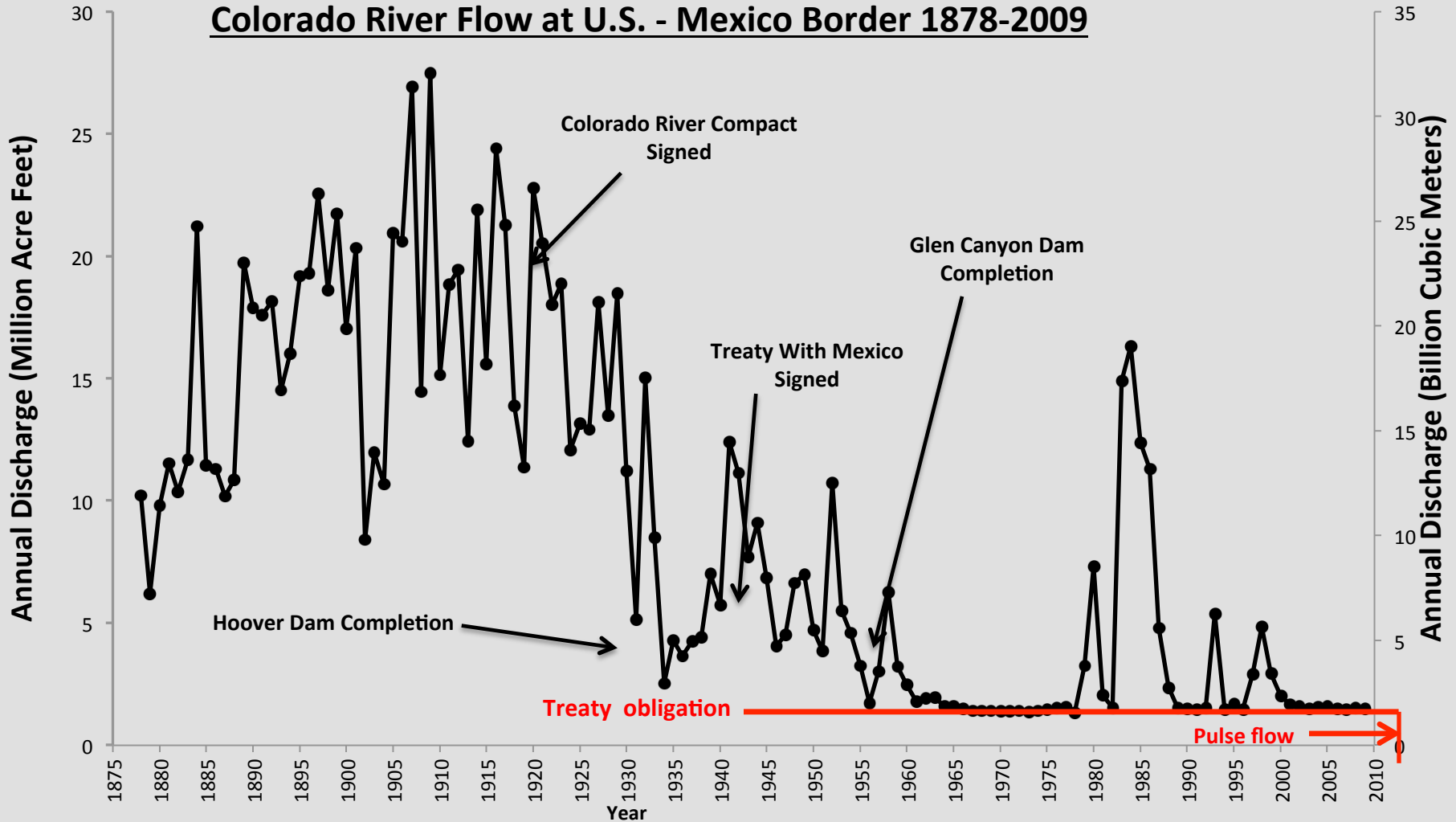


University
of Colorado
Boulder





Colorado River Flow at U.S. - Mexico Border 1878-2009



Binational Agreement Minute 319



Pulse flow: March 23 – May 18, 2014; 105,000 acre-feet (130 mcm)
Base flows: 2013-2017; 52,000 acre-feet (65 mcm)

Research focus:

- Vegetation response to restoration strategies in the Colorado River Delta including:
 - Environmental flow deliveries
 - Undesirable species removal
 - Native tree species seed application

Research questions:

- How do restoration strategies in the Colorado River Delta affect vegetation establishment and composition?
- Are additional management actions (such as the removal of undesirable species and/or seeding with native species) required for native species establishment following the pulse flow release?

Restoration Strategies

Treatment Number	Inundated with pulse flow	Creation of bare soils before seeding/ pulse flow	Seeded with native tree seed
1			
2	X		
3	X	X	
4	X	X	X

T1: Control: no restoration action

T2: Plots inundated by the pulse flow

T3: Plots inundated by the pulse flow that have had undesirable species removed prior to the release

T4: Plots inundated by the pulse flow that have had undesirable species removed prior to the release and are hydroseeded with native tree seed.

Hypotheses:

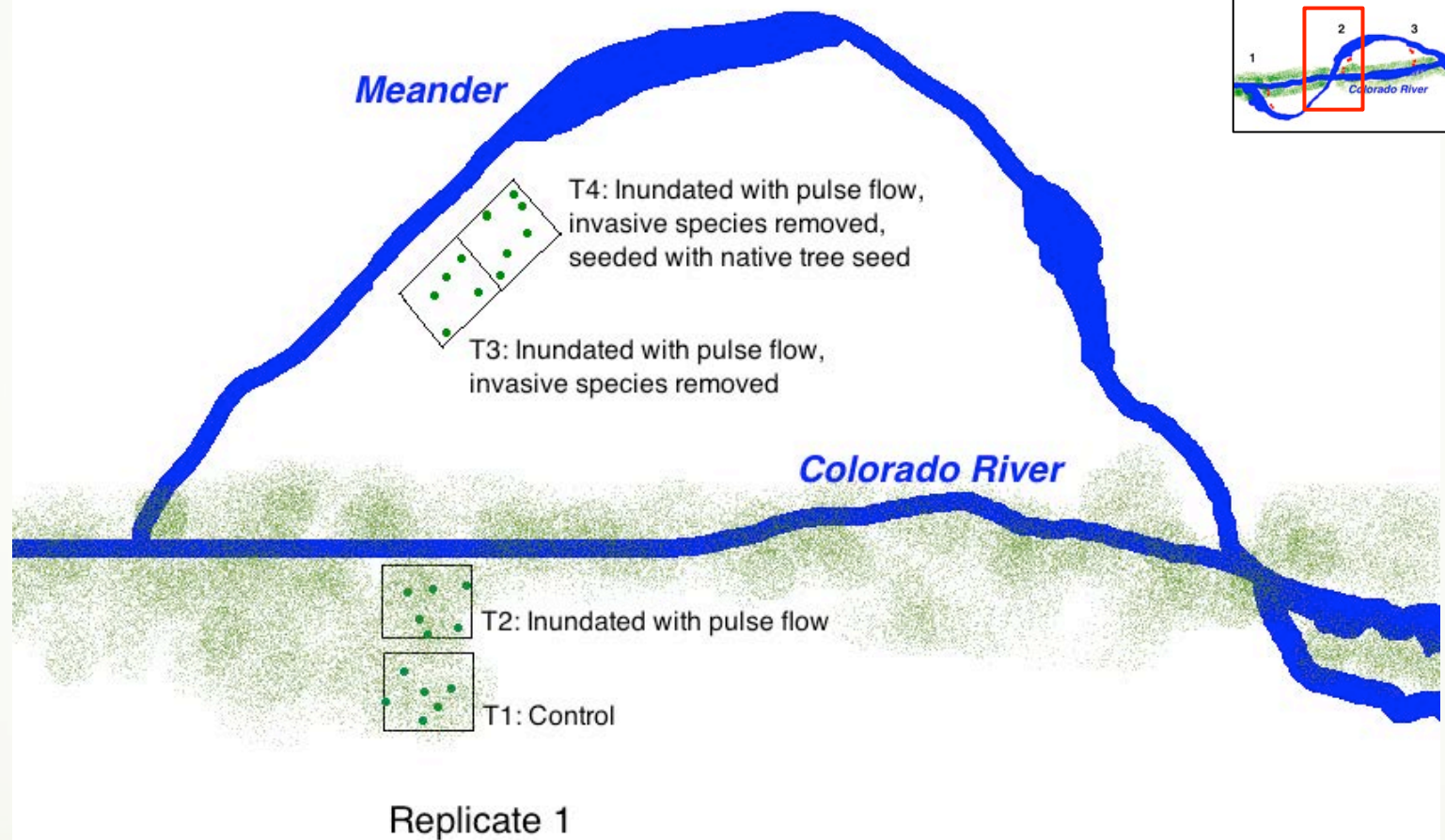
Because the Colorado River riparian corridor in Mexico is in an alternate ecosystem state, high levels of management are required to promote native seedling establishment and survival (i.e. shift back to previous state).

- Native seedling establishment and survival will increase with increasing levels of management.
- Predicted native seedling establishment success per treatment will be as follows: $T4 > T3 > T2 > T1$

Study Area: Laguna Grande

- 6 replicates located in Laguna Grande Restoration Area
- Approximately a 5-kilometer stretch of river
- Significant patches of existing riparian habitat
- Dominant vegetation is tamarisk (*Tamarix* spp.)







Methods: Vegetation surveys

- Conducted before the pulse flow (March), immediately after the pulse flow (May) and at the end of the growing season (October)
- Seedling counts and cover class for the following species:
 - *Populus fremontii* (cottonwood),
 - *Salix gooddingii* (willow),
 - *Tamarix spp.*,
 - *Pluchea spp.*,
 - *Baccharis spp.*,
 - “Other”
- Ground cover
- Canopy closure



Methods Continued:



Sediment
deposition



Soil moisture



Soil salinity
and texture



Groundwater
Levels

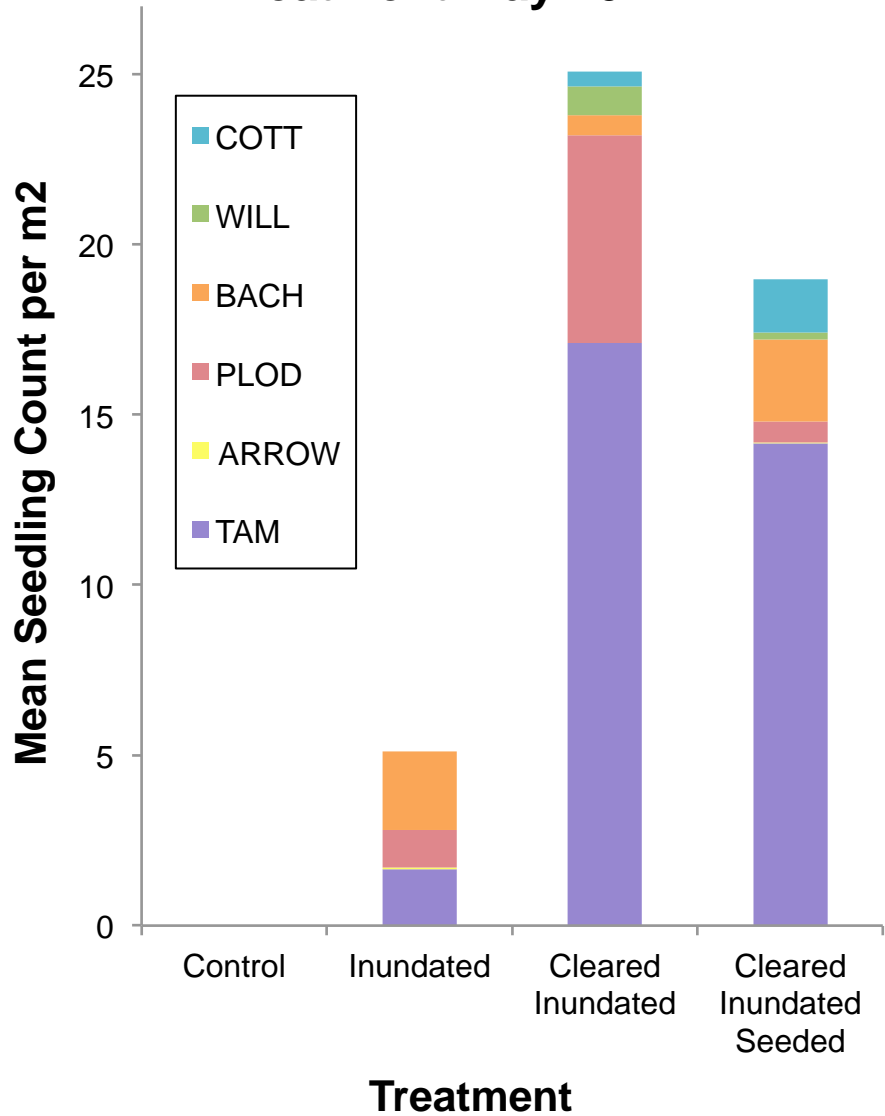


Seed dispersal
and abundance

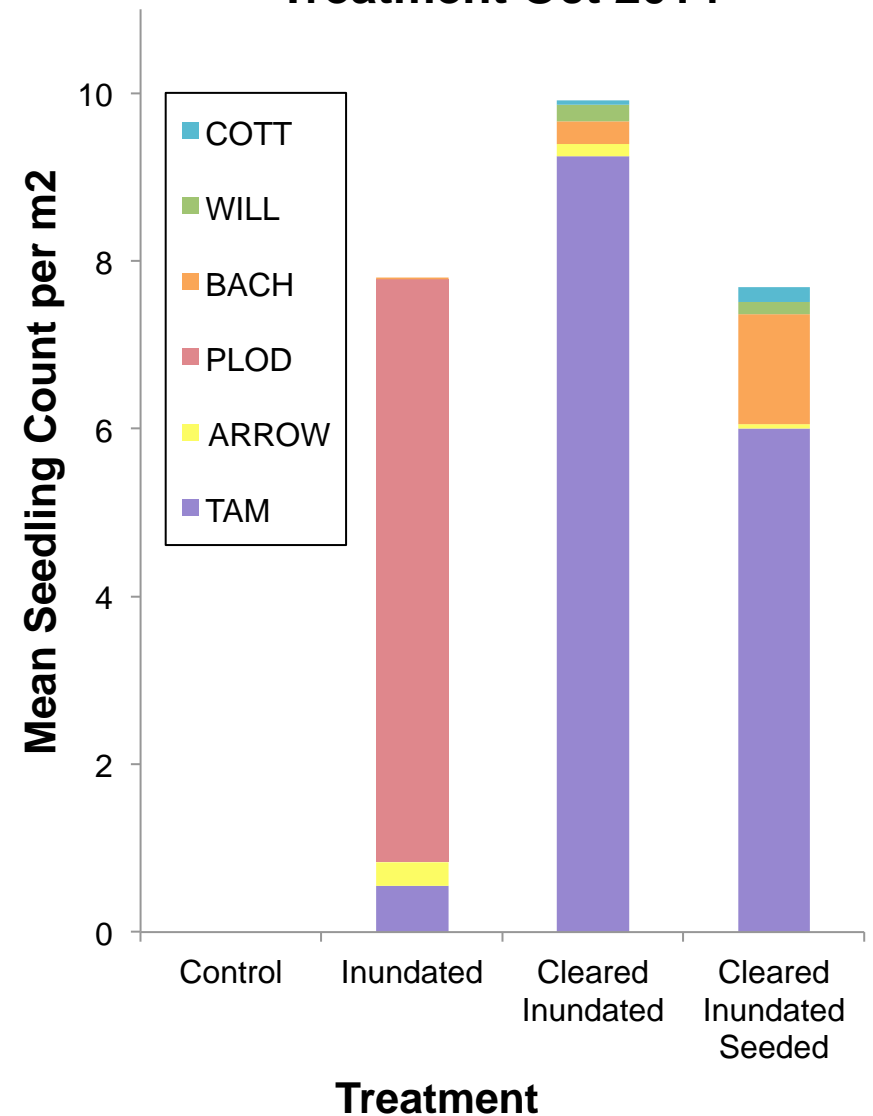


Preliminary Seedling Establishment Results:

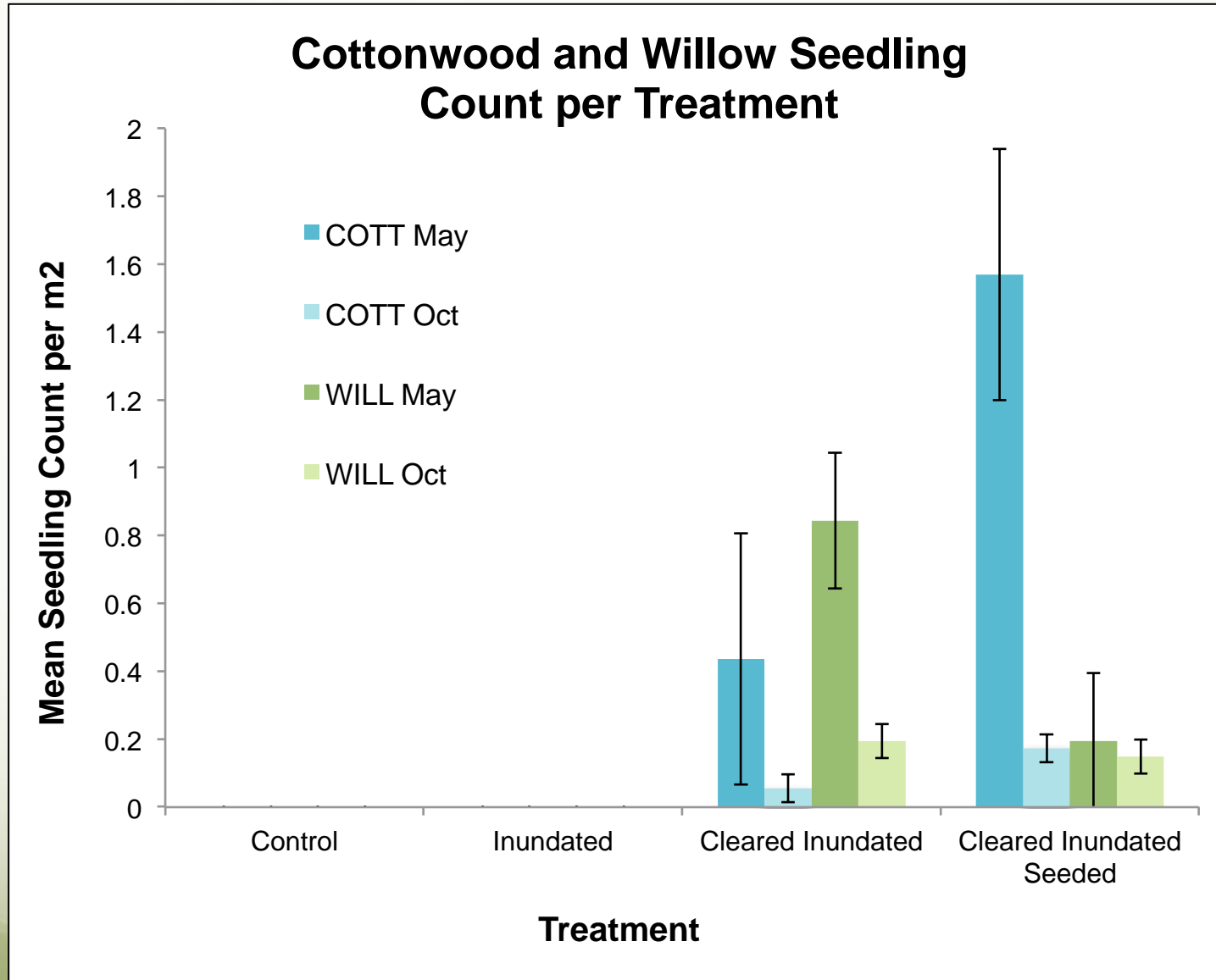
Mean Seedling Count per Treatment May 2014



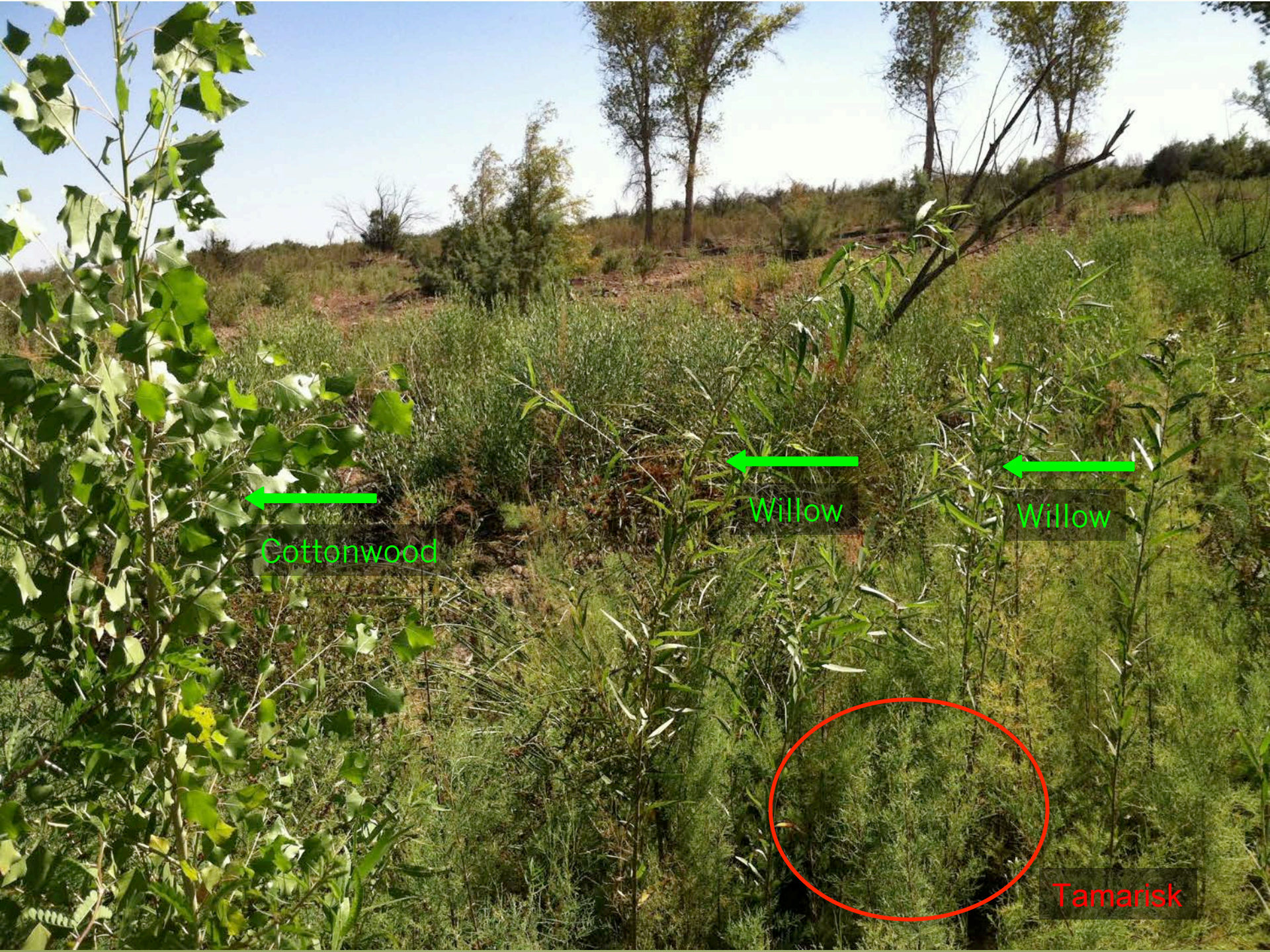
Mean Seedling Count per Treatment Oct 2014



Preliminary Seedling Establishment Results:







←
Cottonwood

←
Willow

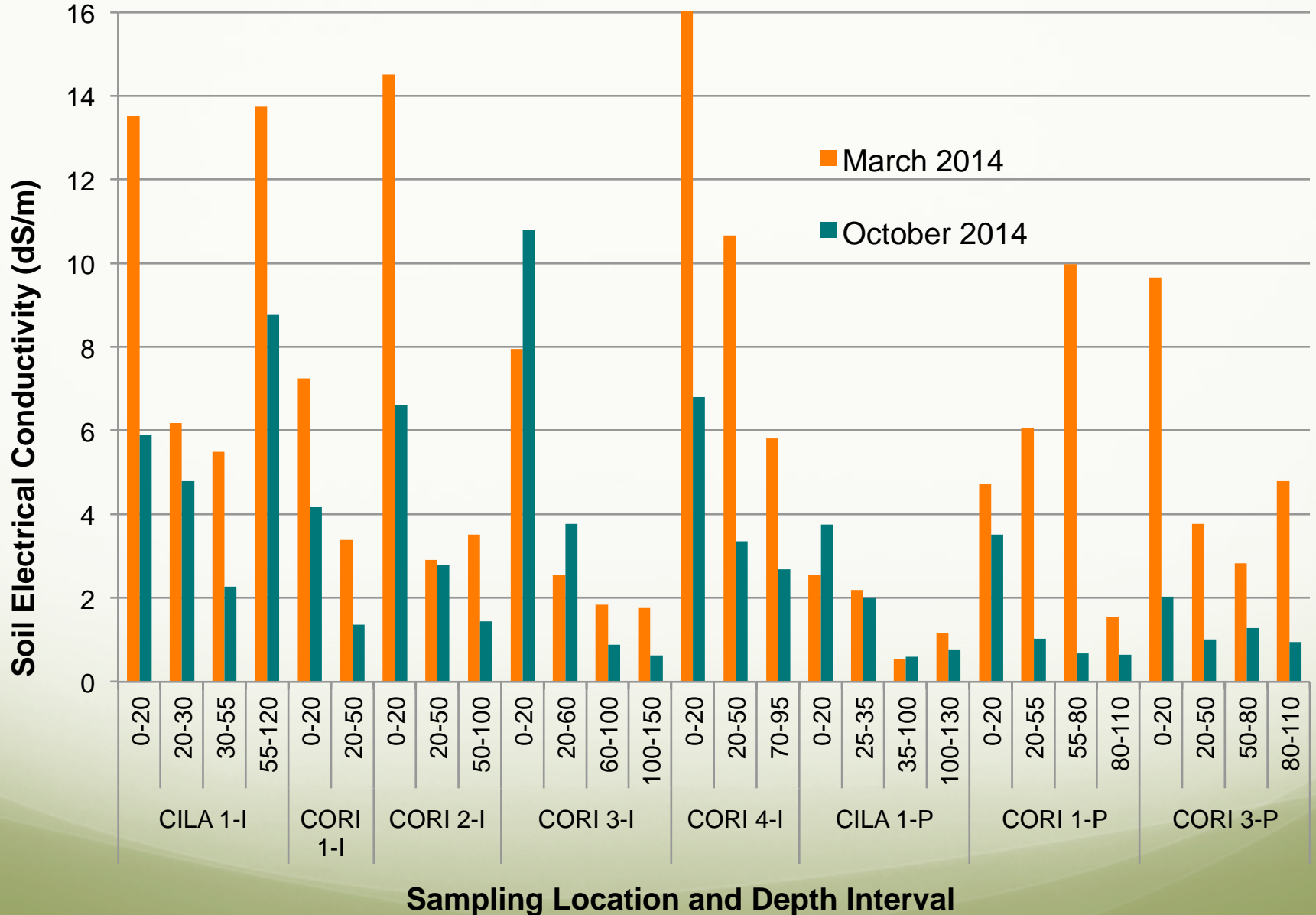
←
Willow



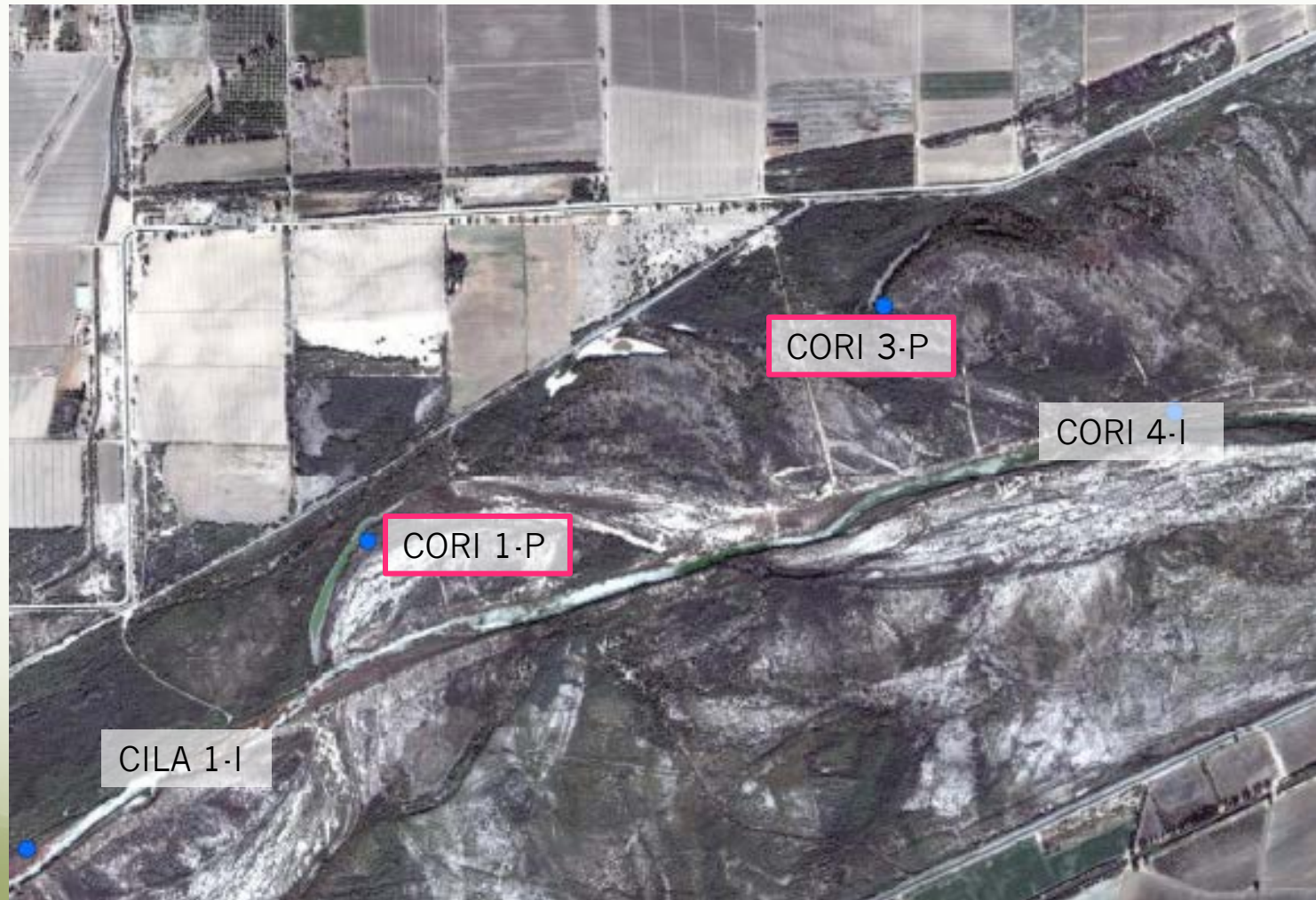
Tamarisk

Change in soil salinity:

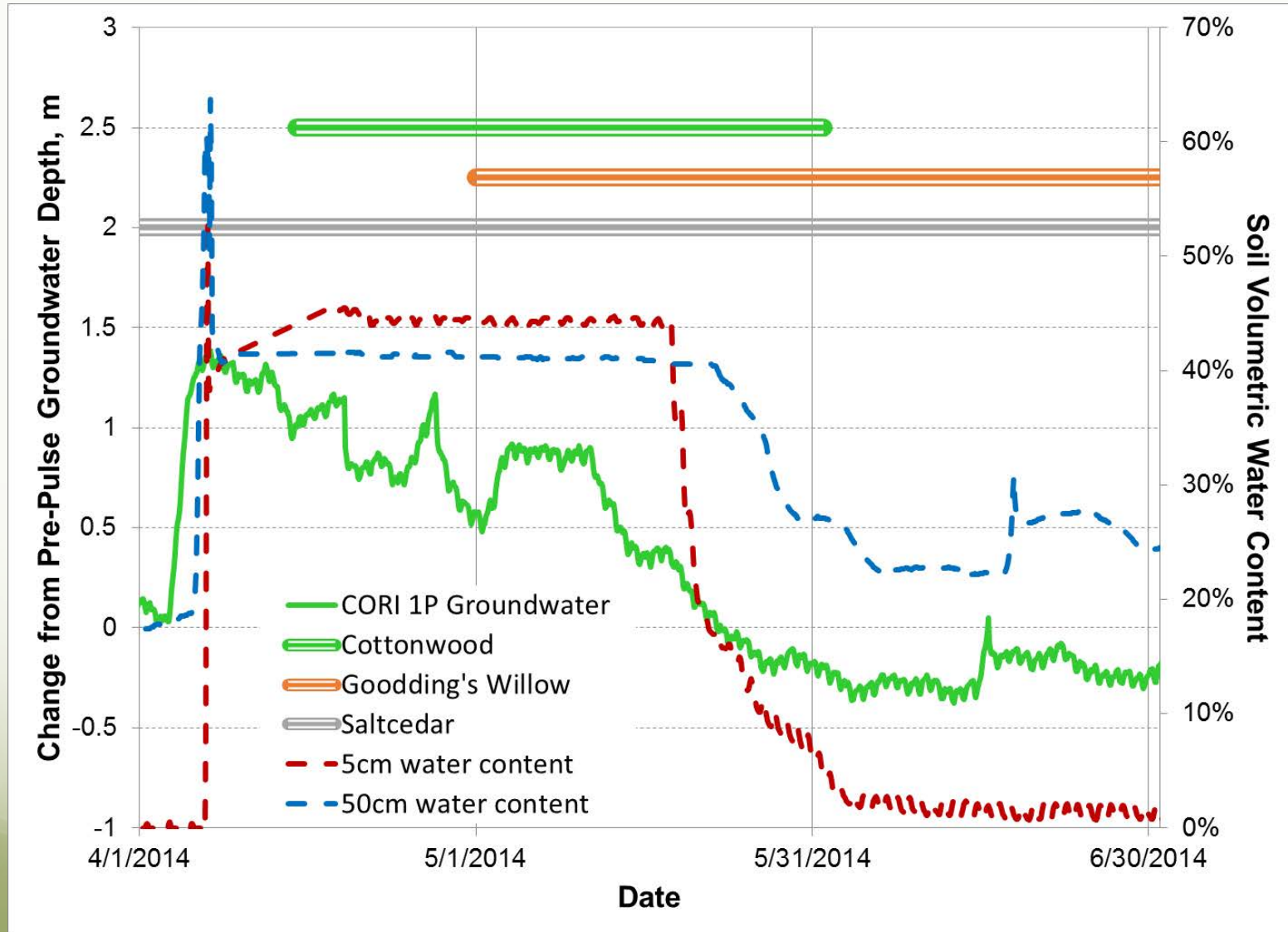
Mean Decrease: 56%
P = 0.0225



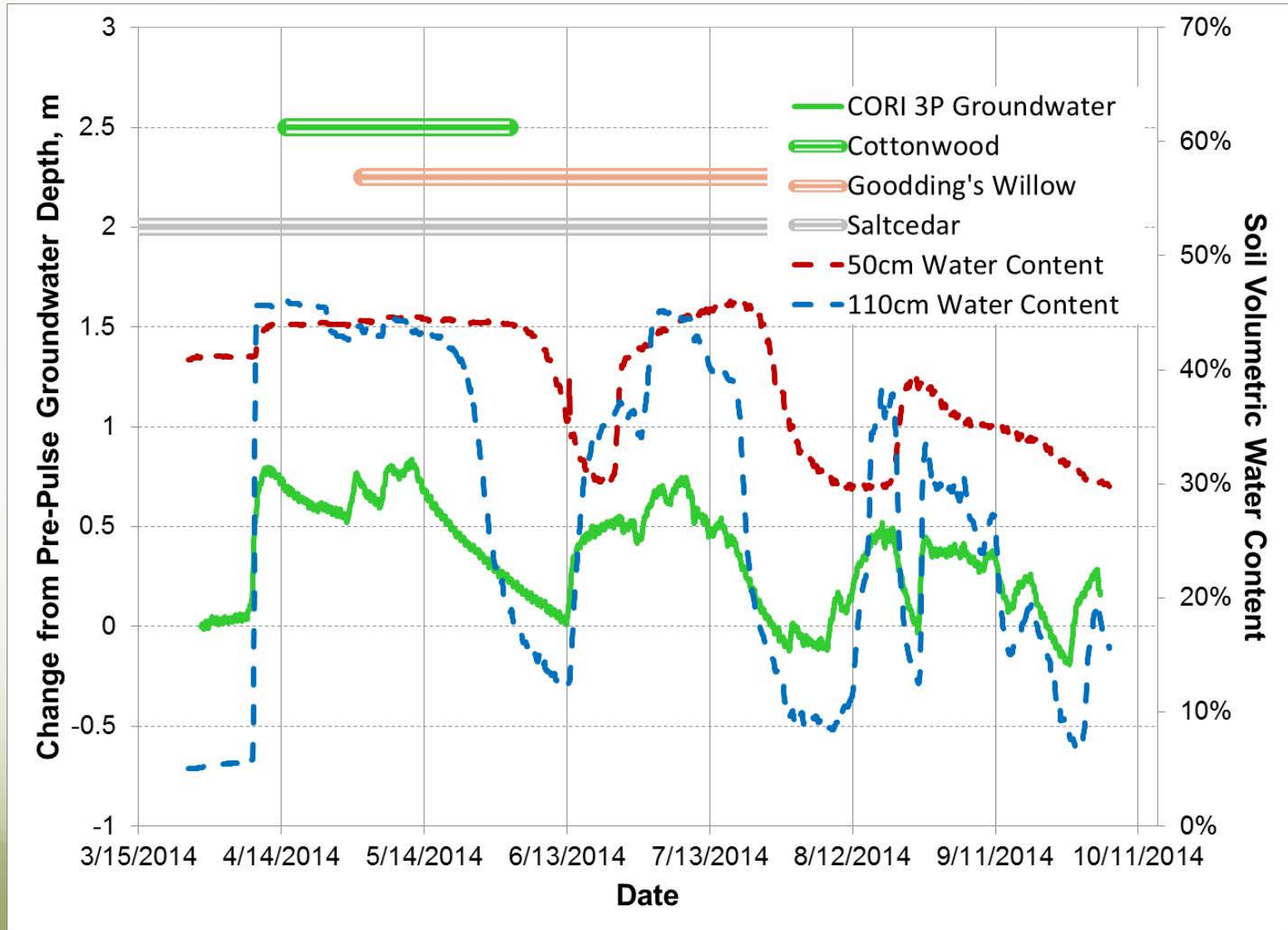
Soil Moisture and Groundwater Dynamics— Paired Piezo/Soil Moisture Sensors



Soil Moisture/Groundwater Response: *Cori 1P—Backwater Channel Near River Connection*



Soil Moisture/Groundwater Response: *Cori 3P—Backwater Channel Near Baseflow Delivery*



Groundwater Drawdown Rates, Initial Flow Recession

Location	Depth vs. Pre-Pulse, m		Δ Height, cm	Drawdown Rate, cm/day
	5/18/2014	6/12/2014		
CORI 4I	1.25	0.53	72	2.87
CORI 3P	1.12	0.61	51	2.04
CORI IP	0.91	0.20	71	2.84
CILA 1I	2.11	1.43	68	2.71

Generally, high drawdown rates or significant secondary inundation.



Key Results and Lessons Learned:

- Inundation from the pulse and base flows promoted native seedling establishment.
- Riparian tree species only were established in areas that had been cleared prior to the flow deliveries.
 - In the absence of disturbance from large flood flows, clearing may be necessary to create bare substrate.
- The pulse and base flows reduced soil salinity, in some cases to levels more favorable for native tree species establishment
- Management of water levels is critical after the initial flow release.
 - Rate of decline.
 - Preventing secondary inundation.

Thank you!

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