Effects of shrub encroachment and shrub removal on South Texas coastal prairies

by

Parker Alex Watson[1], Heather D. Alexander[2], Jonathan Moczygemba[3]

[1]The University of Texas Rio Grande Valley, [2]Mississippi State University
[3]U.S. Fish & Wildlife Service

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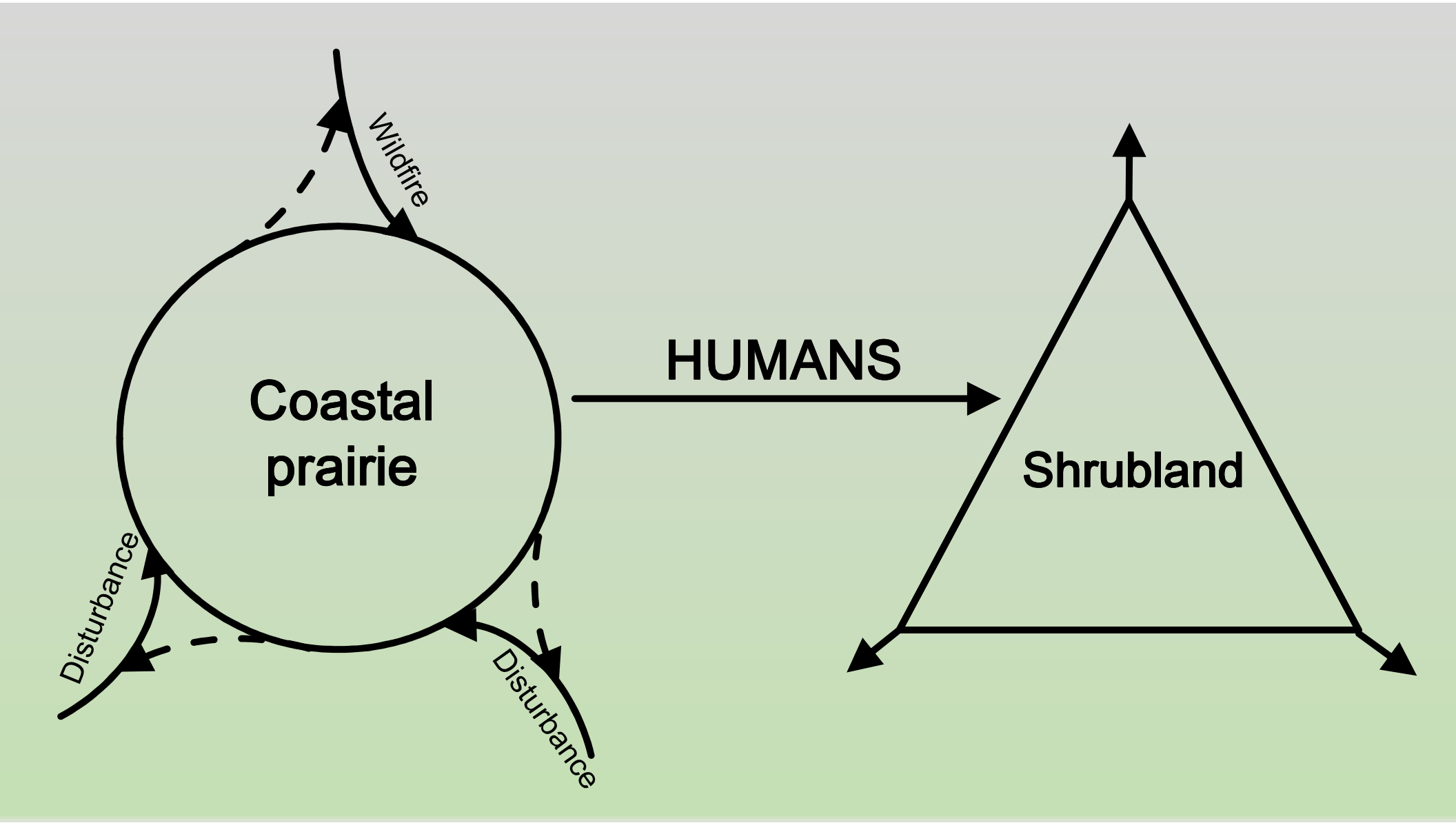
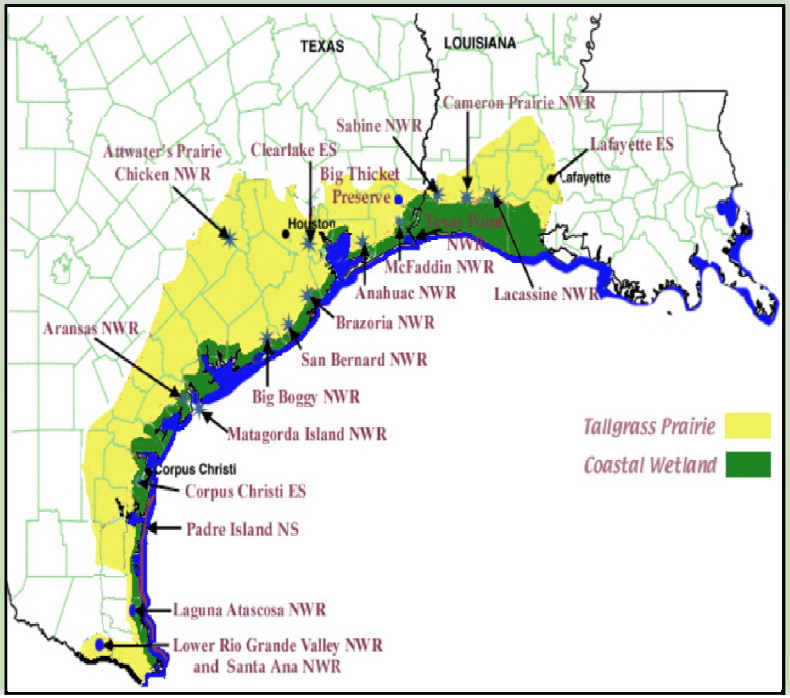

Wildfire
Coastal prairie
HUMANS
Shrubland
Disturbance
Disturbance

Gulf coastal prairies

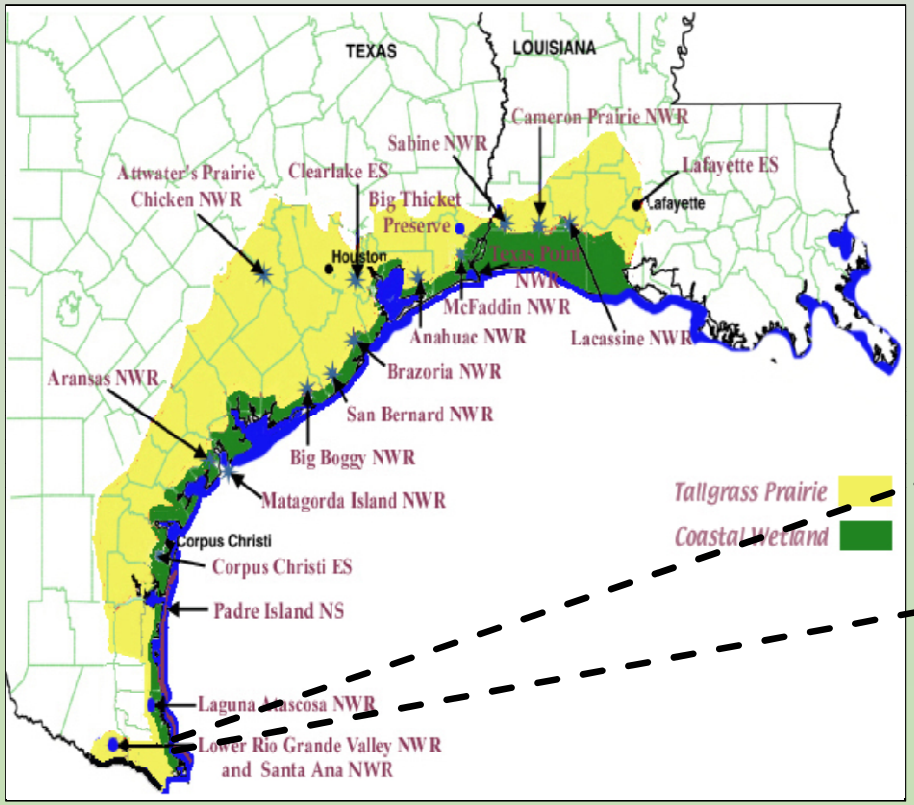
- Found along the western Gulf coast of the U.S.
- Once covering 3.8 million ha, now <0.1% remains due to increased urbanization and agriculture (Smeins et al., 1991; United States Geological Survey-National Wetlands Research Center, 2015)
- Provide habitat, biodiversity, regulate erosion, hydrology, nutrient cycling, and opportunities for tourism and education

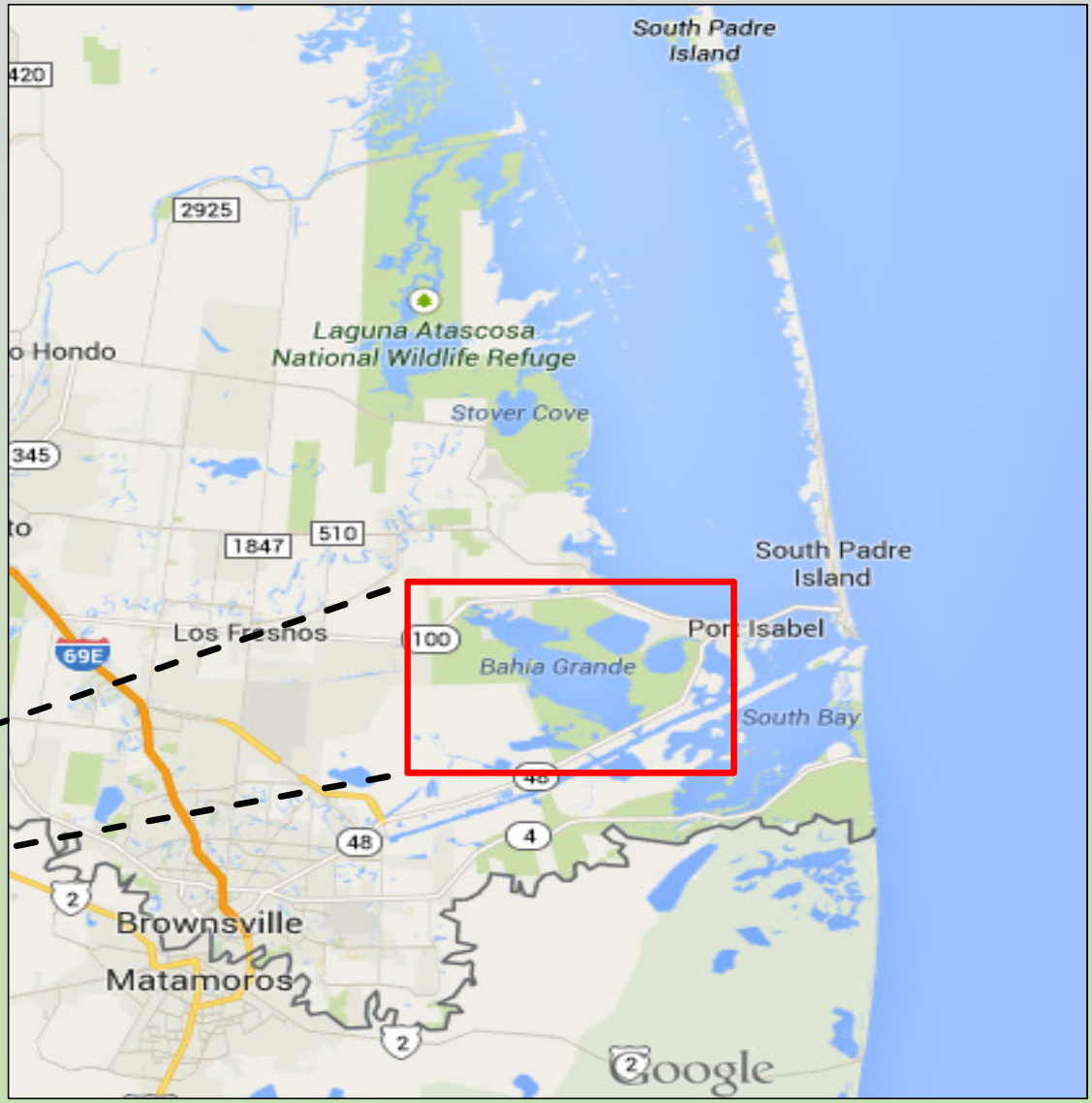


Hypotheses

1. Characterize effects of shrub canopy cover on understory grass cover and microclimate
    - Understory light, soil and air temperature decrease with increasing canopy cover
2. Assess the effects of 4 different combinations of mechanical, herbicide and prescribed fire shrub removal treatments and degree of shrub encroachment prior to removal on coastal prairie flora regeneration and growth
    - Patches with less shrub encroachment (small) and subsequently treated with mechanical, fire and herbicide have the greatest abundance of Gulf cordgrass and least abundance of mesquite & huisache

Study area


TEXAS
LOUISIANA
Cameron Prairie NWR
Sabine NWR
Lafayette ES
Attwater's Prairie Chicken NWR
Clearlake ES
Big Thicket Preserve
Lafayette
Houston
McFaddin NWR
Anahuac NWR
Lacassine NWR
Aransas NWR
Brazoria NWR
San Bernard NWR
Big Boggy NWR
Matagorda Island NWR
Tallgrass Prairie
Coastal Wetland
Corpus Christi
Corpus Christi ES
Padre Island NS
Laguna Atascosa NWR
Lower Rio Grande Valley NWR and Santa Ana NWR


South Padre Island
420
2925
Laguna Atascosa National Wildlife Refuge
Hondo
Stover Cove
345
1847
510
South Padre Island
Los Fresnos
69E
100
Port Isabel
Bahia Grande
South Bay
48
4
2
Brownsville
Matamoros
Google

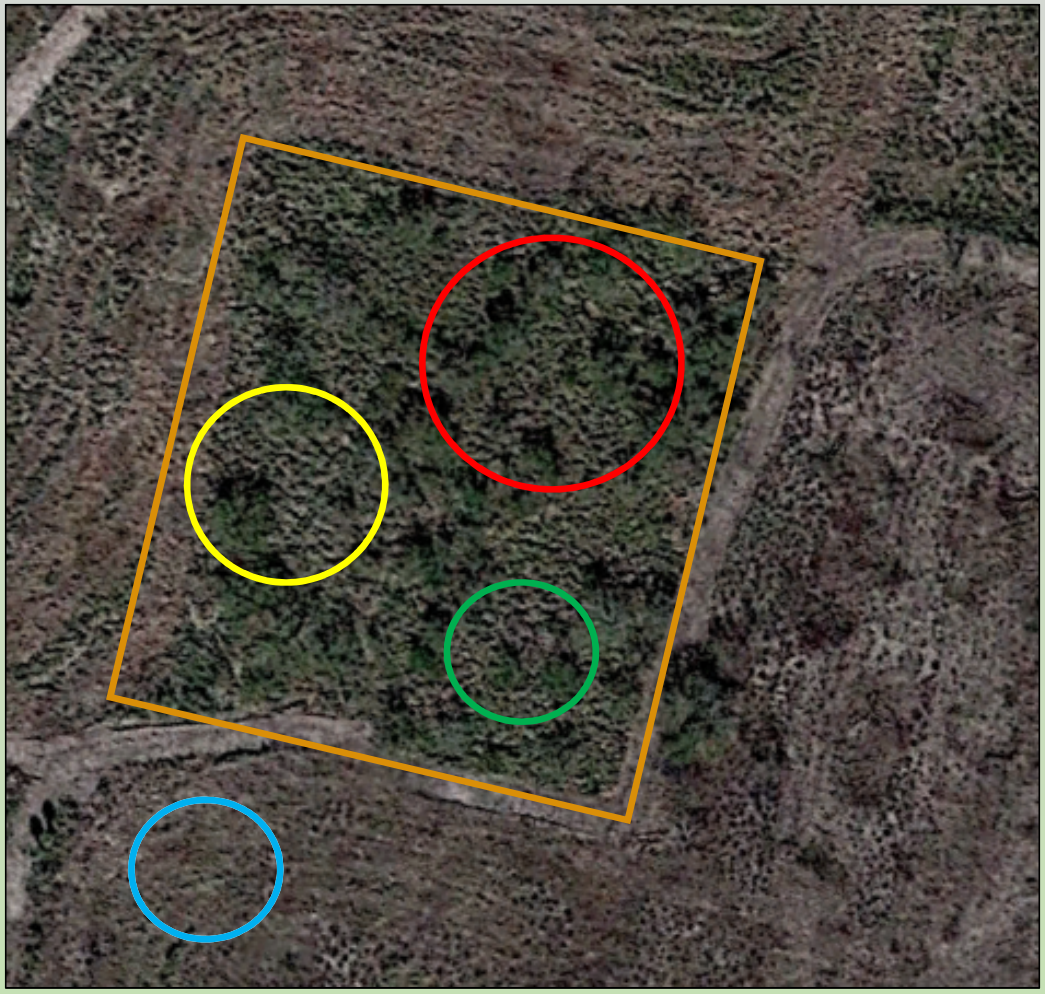
Experimental design

= Small shrub cluster
(3 – 4 m diameter)

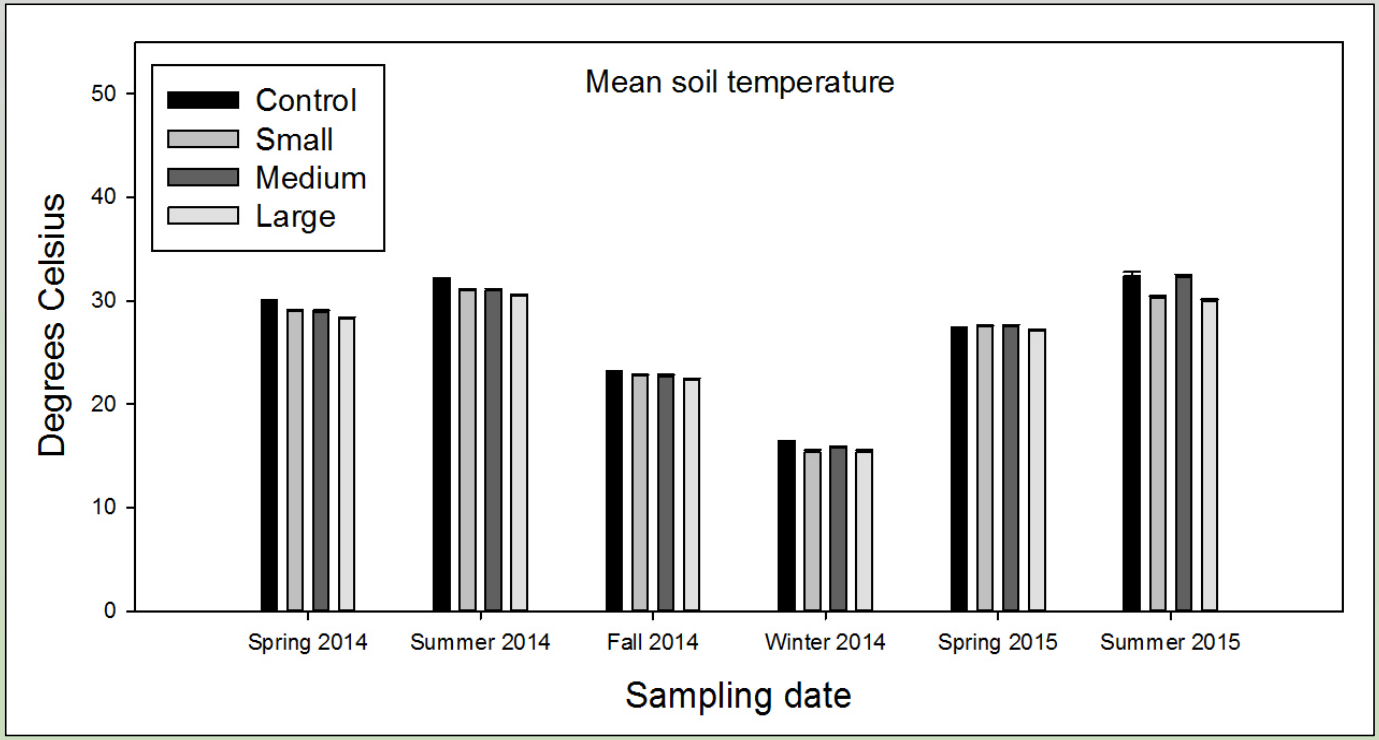
= Medium shrub cluster
(5 – 7 m diameter)

= Large shrub cluster
(10 – 12 m diameter)

= Control in grass



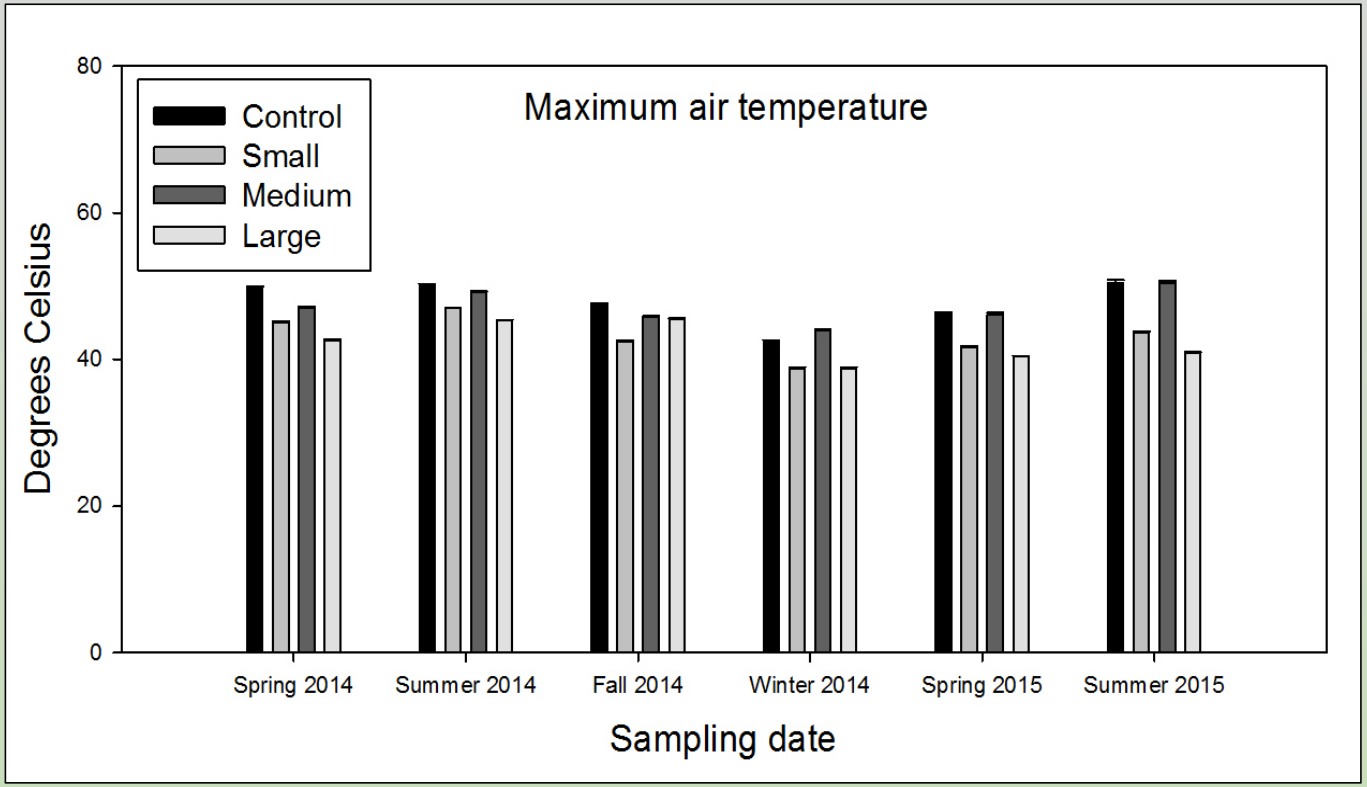
Understory soil temperatures



- Large clusters had significantly cooler mean temperatures in Summer 2015 compared to controls in Summer 2014 ($p < 0.001$) and Summer 2015 ($p < 0.001$)

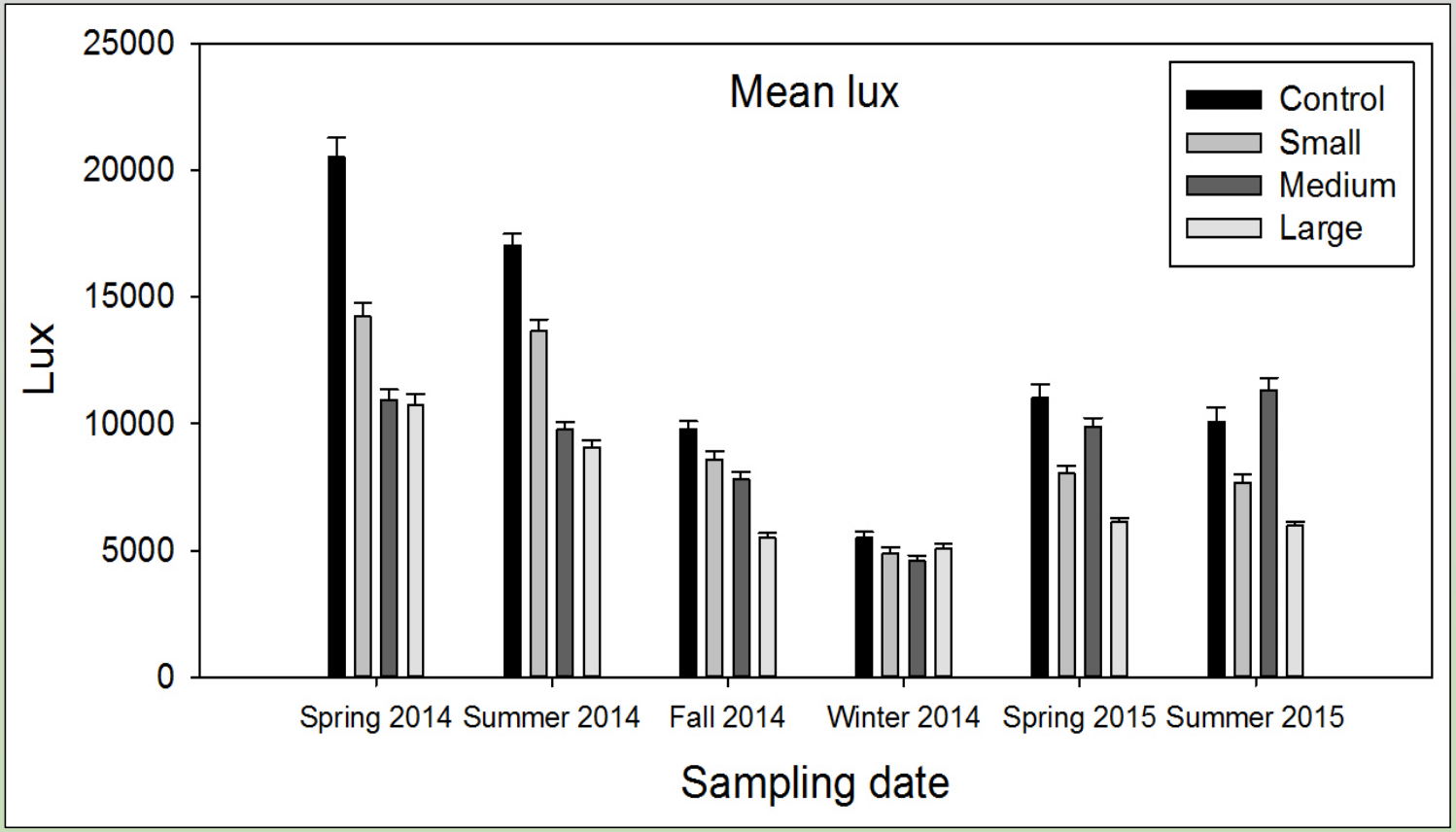
- Large clusters had significantly cooler maximum temps in Spring 2014 ($P < 0.001$) and Summer 2015 ($P < 0.001$) than controls in the same seasons

Understory air temperatures



- Large clusters had significantly cooler maximum air temps than controls in all corresponding seasons ($p < 0.001$)

Understory lux

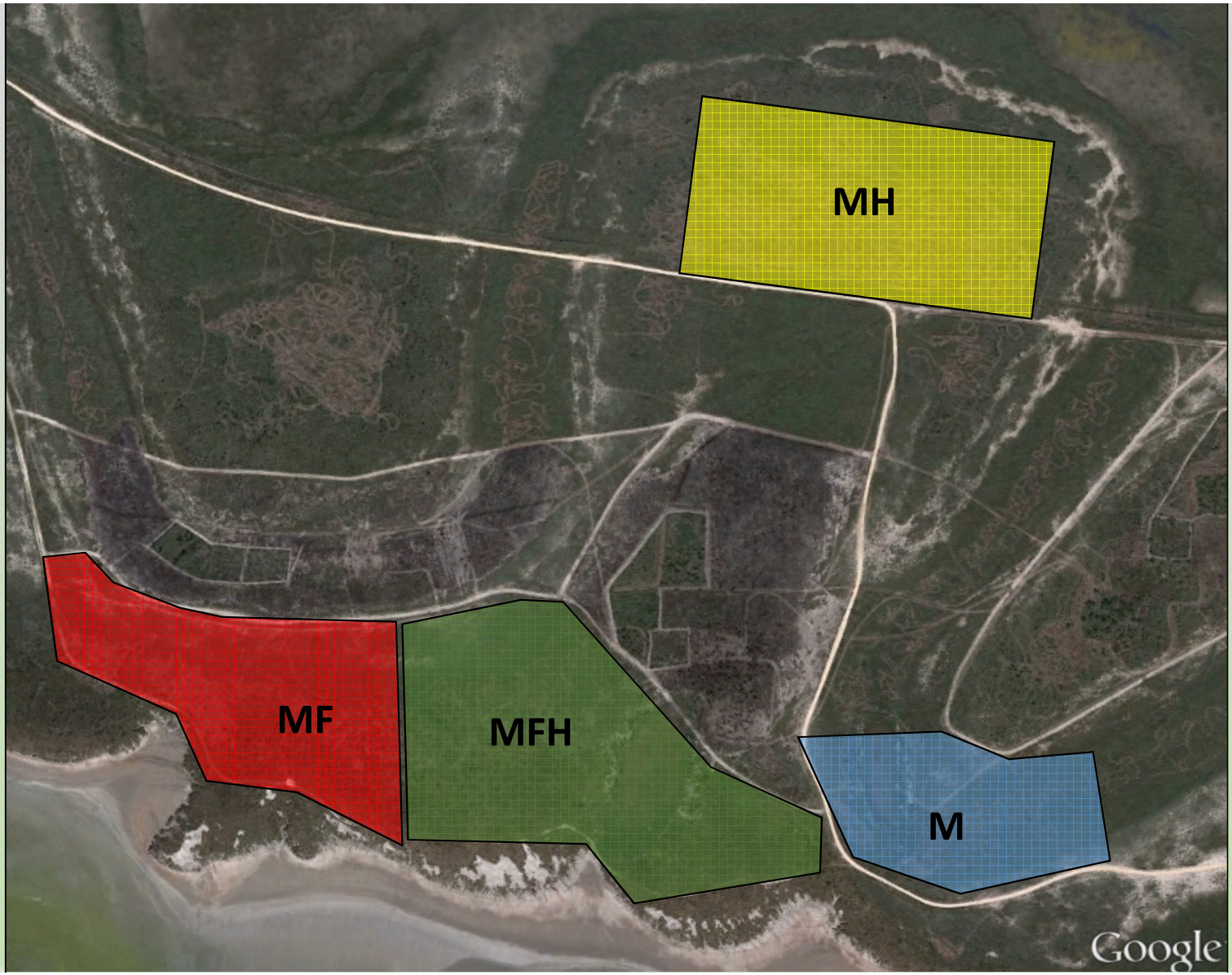


- Large clusters had significantly less mean ($p < 0.001$) and maximum ($p < 0.001$) lux than controls in all corresponding seasons

Hypotheses

1. Characterize effects of shrub canopy cover on understory grass cover and microclimate
    - Gulf cordgrass cover decreases as shrub canopy cover increases
    - Understory light, soil and air temperature decrease with increasing canopy cover
2. Assess the effects of 4 different combinations of mechanical, herbicide and prescribed fire shrub removal treatments and degree of shrub encroachment prior to removal on coastal prairie flora regeneration and growth
    - Patches with less shrub encroachment (small) and subsequently treated with mechanical, fire and herbicide have the fastest recovery rates, greatest abundance of Gulf cordgrass and least abundance of mesquite & huisache


BARKO 930
BARKO
FECON


MH
MF
MFH
M
Google

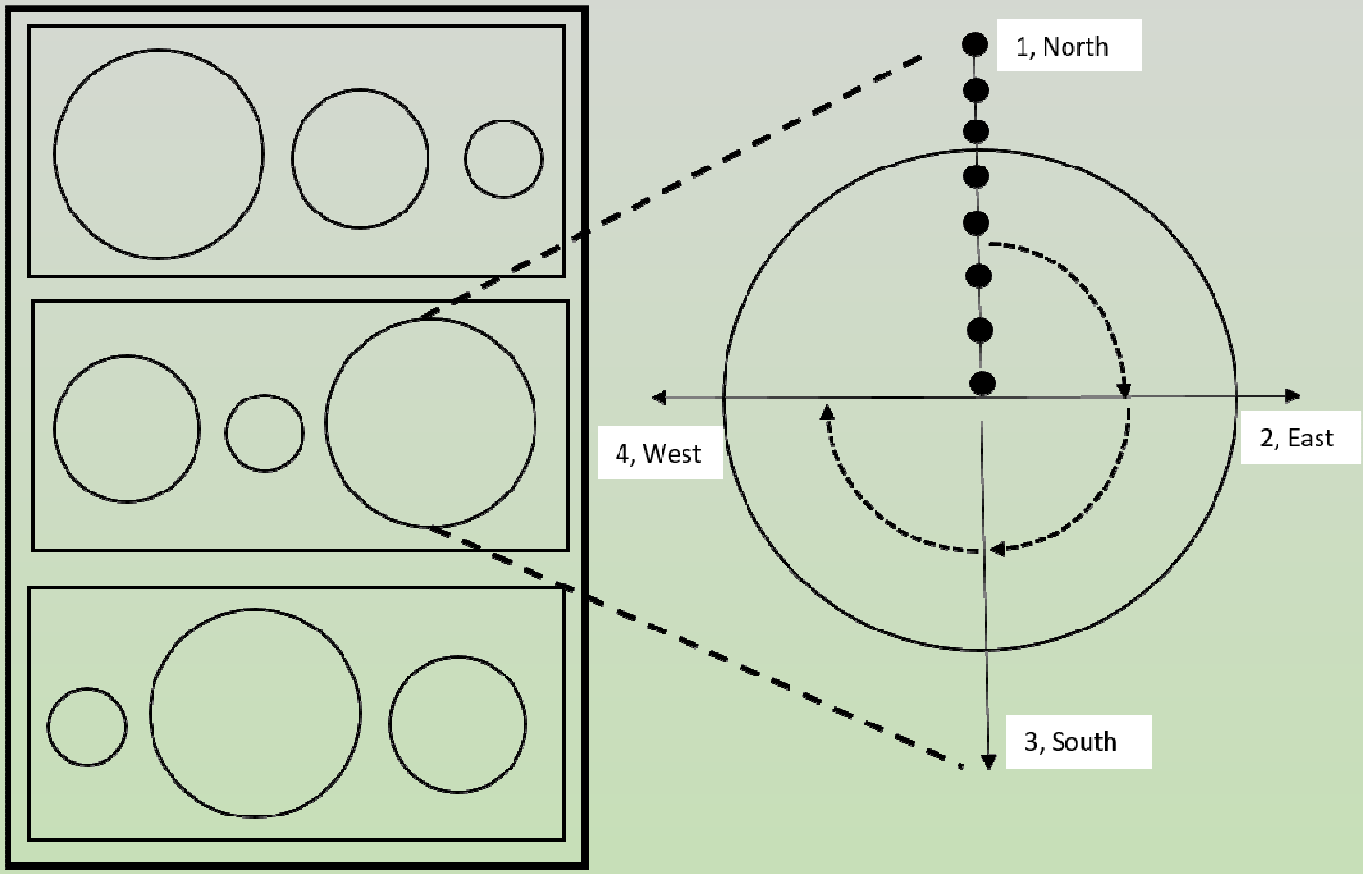
Experimental design

- 4 shrub removal treatments
  - Mechanical
  - Mechanical + herbicide
  - Mechanical + fire
  - Mechancial + fire + herbicide

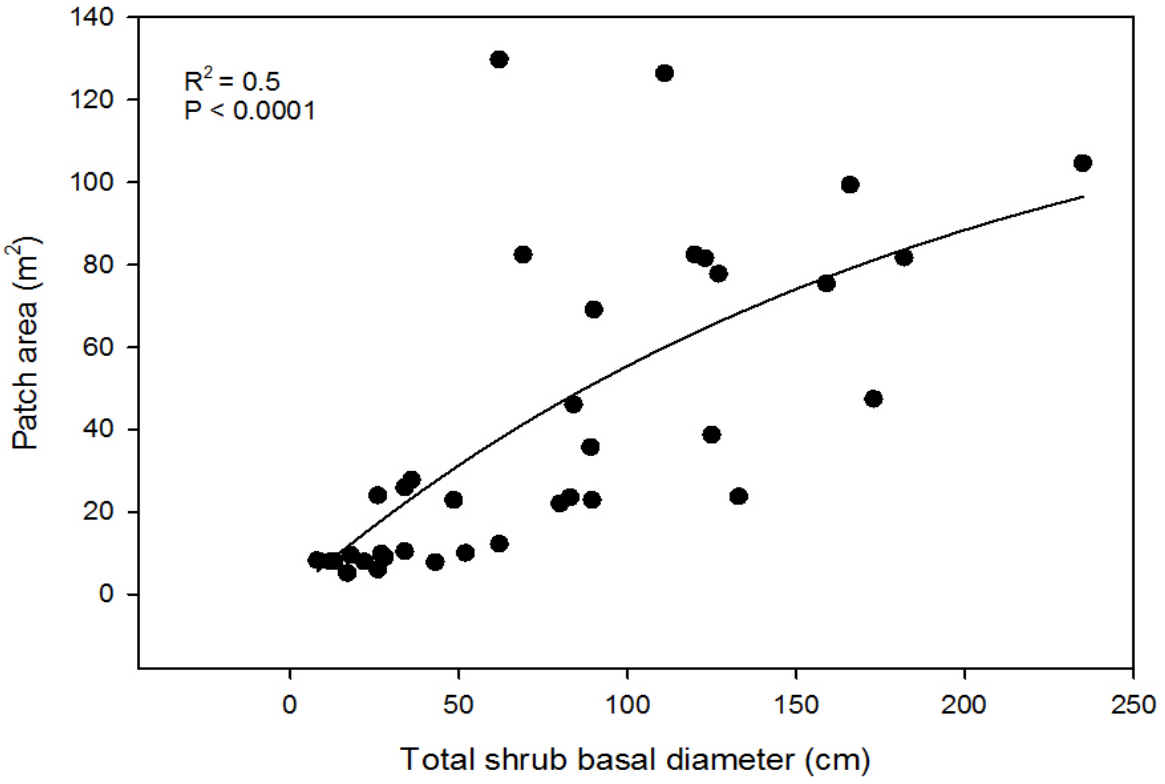
- Small, medium and large bare patches identified in each treatment
  - Small (< 4 m diameter)
  - Medium (4.1 – 7.9 m)
  - Large (> 8 m)

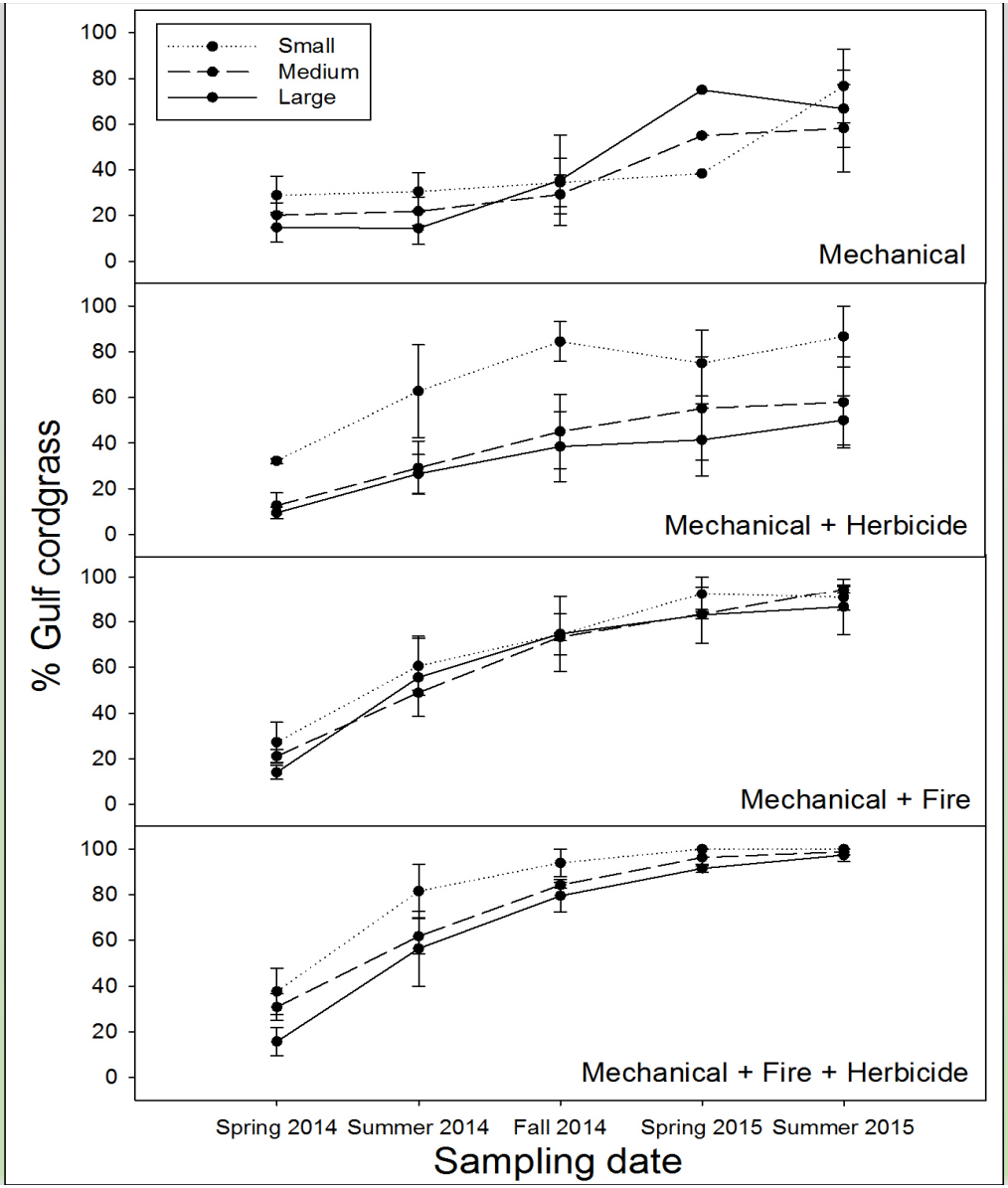
- “Gap-makers” < 2 cm measured in each patch

Experimental design



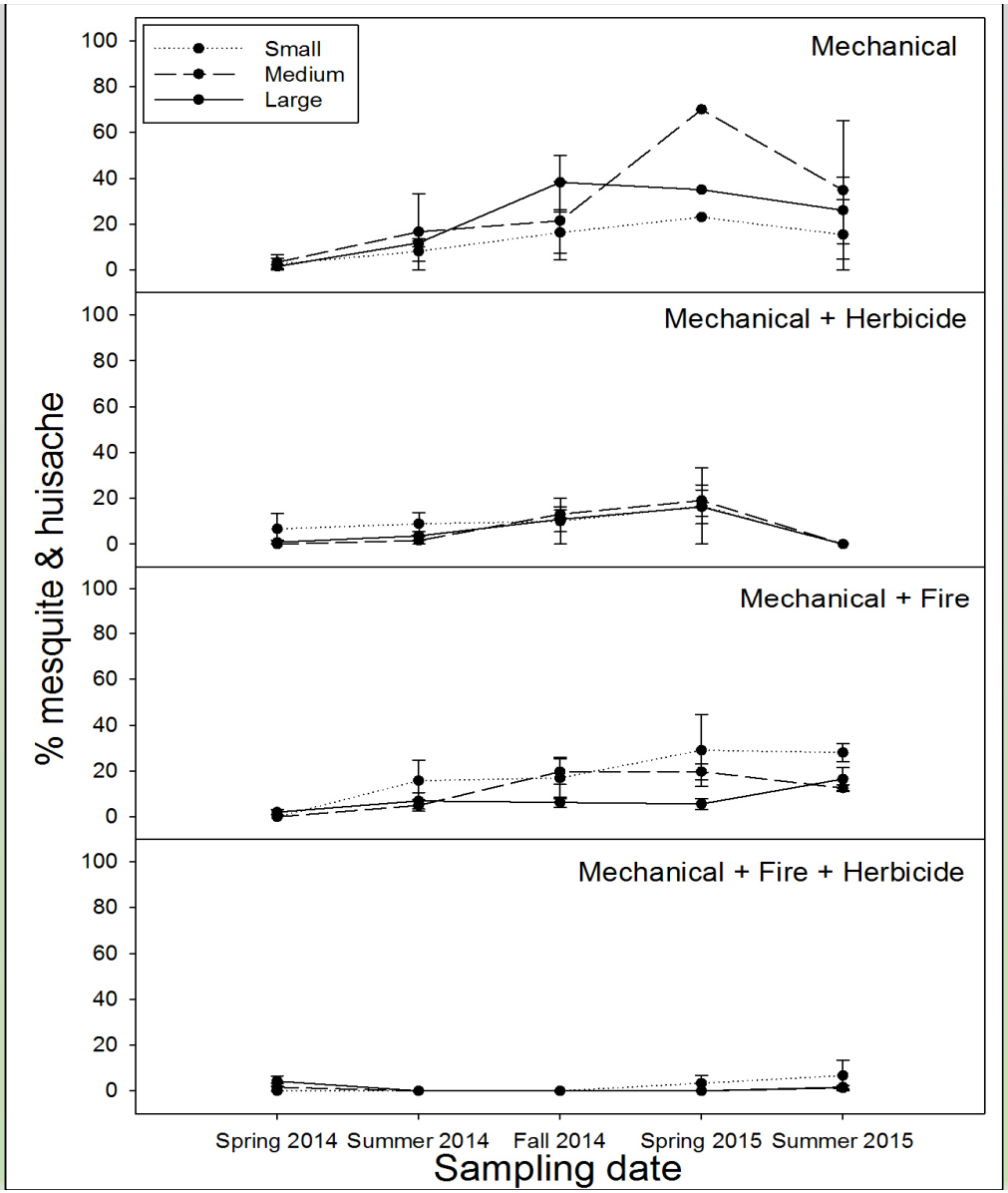
Gap-makers


R^2 = 0.5
P < 0.0001
Patch area (m^2)
0
20
40
60
80
100
120
140
0
50
100
150
200
250
Total shrub basal diameter (cm)



Gulf cordgrass abundance

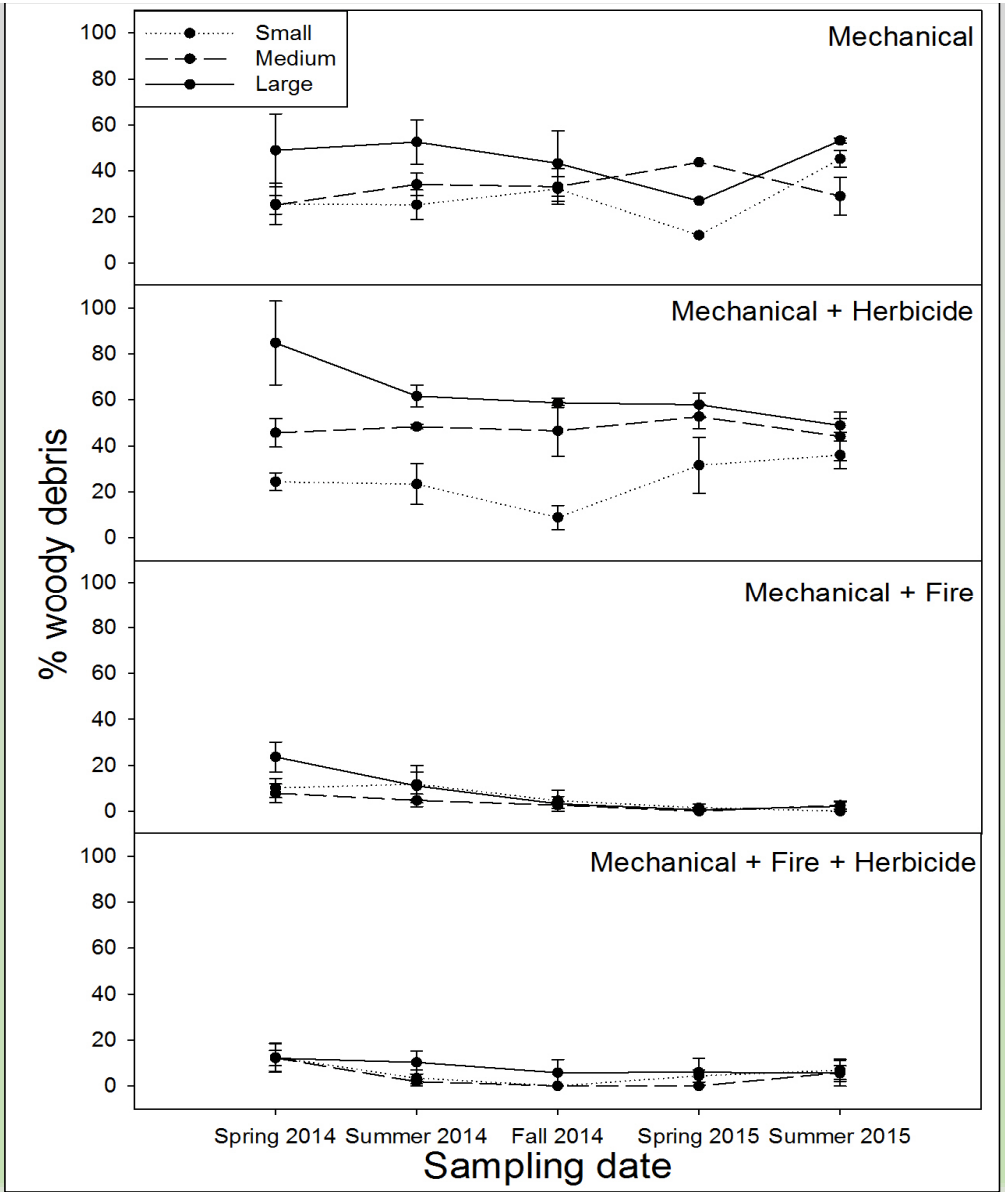
- **Small** patches had more cordgrass than medium ($p = 0.009$) and large ($p < 0.001$)
- **MF** and **MFH** had significantly greater abundance of cordgrass than **M** ($p < 0.001$) and **MH** ($p < 0.001$)
- Fire treatments had approximately 100% cordgrass abundance after 16 mos.
- **MH** as low as 50% and **M** as low as 66%



Mesquite & huisache abundance

Summer 2015

- **MH** significantly less than **M** ($p = 0.01$) and **MF** ($p < 0.001$)
- **MFH** significantly less than **MF** ($p = 0.03$)
- **MH** is 0%
- **MFH** is < 7%
- **M** as high as 35%



Woody debris substrate

<u>Spring 2014</u>

- Fire treatments significantly less than **M** ($p < 0.001$) and **MH** (MF $p = 0.02$; MFH $p = 0.01$)
- Fire treatments had at most 26% (large MF)
- Non-fire treatments had at most 84% (large MH)

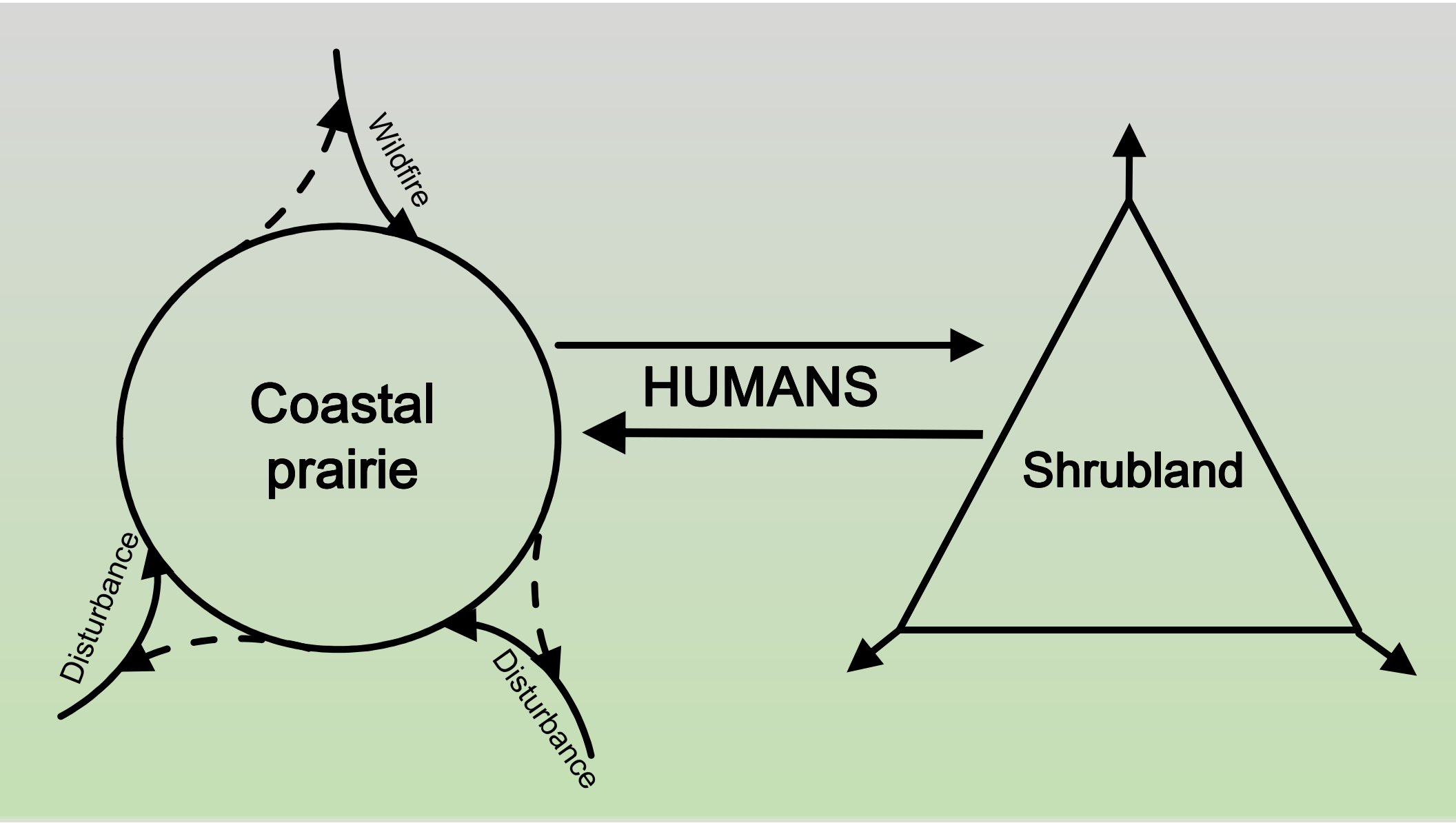
Management implications

- All three treatments applied early in encroachment with specific sequence of:

Mechanical → Fire → Herbicide

1. Minimizes effects of pre-existing shrubs on Gulf cordgrass
2. Greatest abundance of Gulf cordgrass
3. Less mesquite and huisache

- While this strategy has the most expensive overhead, the long-term ecological results outweigh initial economic costs (Verderber 2015)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Shrubland
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