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

by

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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
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
• 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
Large clusters had significantly cooler maximum air temps than controls in all corresponding seasons (p< 0.001)
• 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
Experimental design

• 4 shrub removal treatments
  • Mechanical
  • Mechanical + herbicide
  • Mechanical + fire
  • Mechanical + 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

![Graph showing the relationship between patch area (m²) and total shrub basal diameter (cm). The R² value is 0.5 and P < 0.0001.](image)
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

Spring 2014

• 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 $\rightarrow$ Fire $\rightarrow$ 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)