Artificial Warming Increases Adult Mangrove and Salt Marsh Growth Rates and May Enhance Transition to Mangrove Dominance

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Photo Credit: Samantha Chapman
Reduced freeze frequency allows mangrove encroachment into new habitat

References:
- Cavanaugh et al. 2014
- Saintilan et al. 2014
- Osland et al. 2013
Mangrove Encroachment Under Chronic Warming

Mangrove Colonizing Site

- Salt Marsh Dominance
- Warming Enhances Mangroves
- Warming Impedes Mangroves

Time

Freeze Event

Time between Freeze Events

Freeze Event

Time After Rare Freeze Event

Salt marsh or Bare or Mangrove?

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Cape Canaveral Study Site

Mangrove
*Laguncularia racemosa*

Salt Marsh
*Distichlis spicata*
Small Chamber Warming Study
Mangrove Seedlings & Salt Marsh
Coldren et al. In Press (Ecology)

Response to Warming
Mangrove Seedlings (Avicennia)
Minimal

Salt marsh (Distichlis)
Strong positive effect but only in Summer
Warming Study Experimental Design

Warming Treatments
August 2014 to June 2016

Size and Coverage:
- Mangroves
- Salt Marsh

Physical Characteristics:
- Air Temperature
- Soil Temperature
- Humidity
- Salinity

3 Replicates
Sediment Elevation Table (SET)
Warming Chamber Effect on Air Temperature

Other Physical Characterizes: No significant Effects

Max.: 15.6 °C

Avg. Diff.: 1.8 °C

Min.: -4.9 °C
Distchlis Over Time

Distchlis Height

- Green line: Ambient
- Orange line: Warmed

- Chart shows Distchlis Height (cm) over time:
  - August 2014 (Initiation)
  - January 2015
  - August 2015
  - January 2016
  - June 2016

- The chart indicates a significant increase in Distchlis Height during the warm period, surpassing the ambient conditions.
Change in *Laguncularia* Size  
(22 Months)

**Height**

- Ambient: Height change (cm) P<0.0479
- Warmed: Height change (cm)

**Canopy Volume**

- Ambient: Canopy volume change (m³)  
- Warmed: Canopy volume change (m³)  
P<0.0400
Laguncularia Leaves
(After 22 months warming)

Leaf Abundance

- Ambient
- Warmed

P<0.1036

Leaf Size

- Ambient
- Warmed

P<0.0582

# Leaf Pairs Present/Branch

Leaf Area (mm²)
Laguncularia Transition
(22 Months)

Recruitment
~3-4 Seedlings
0 Saplings

Change in % Mangrove Cover

P<0.0063

Ambient Warmed
Sediment Elevation Change (22 Months)

**Whole Plot** (NS)

**Salt Marsh** (P<0.097)

**Mangrove** (P<0.046)
Conclusion

Under chronic warming

– Adult mangroves responded strongly
  • Increased size and leaf characteristics
    – Previous Work: *Avicennia* seedlings showed minimal responses

– Salt marsh only responded in summer
  – Previous Work: Same response

– Enhanced transition to mangrove dominance
  • A result of increased canopy expansion

– Sediment Elevation Gain:
  • Mangrove areas increased
  • Salt marsh areas decreased
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Questions?