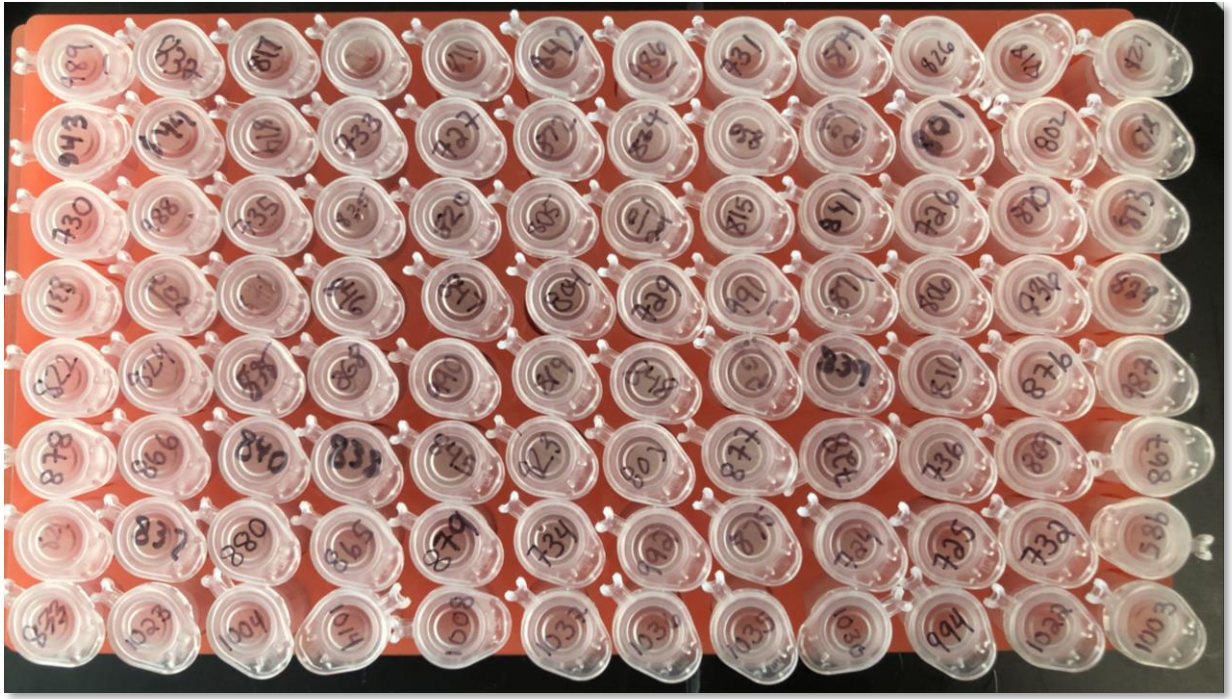
Conservation in a Changing Climate: Impacts on Seagrass Resiliency & Restoration

Stephanie J. Kamel

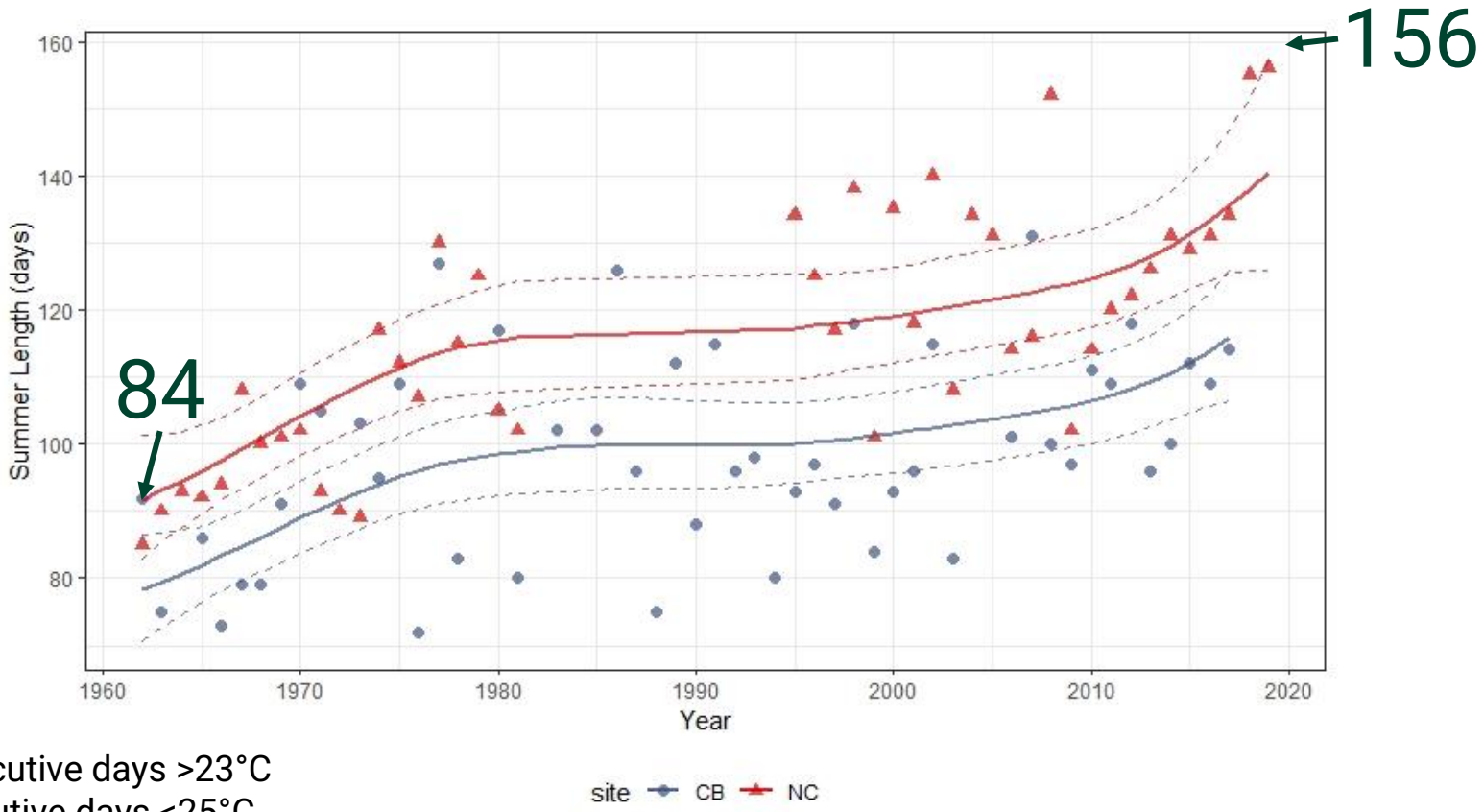
Seagrass?

Seagrass!

Seagrass!



Climate Change and Seagrass

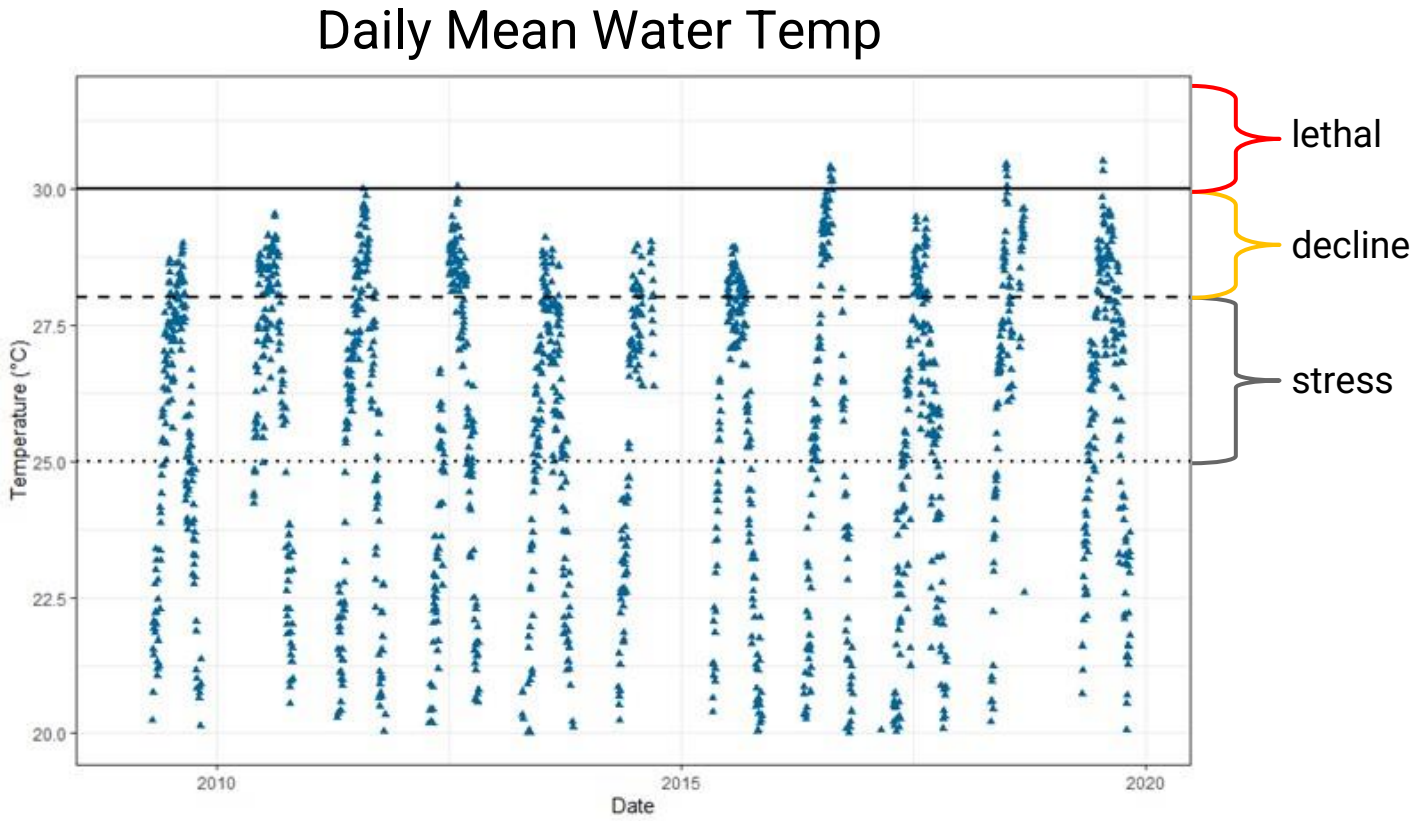


Start: 3 consecutive days >23°C
End: 3 consecutive days <25°C
Total # of days in season

(Methods & CB data from Shields et al. 2018)

Climate Change and Seagrass

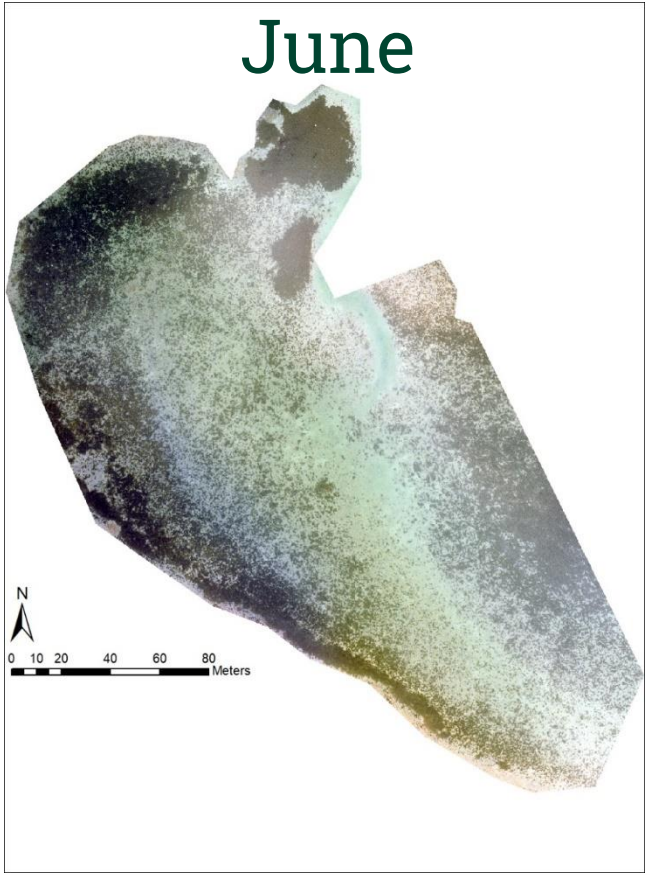
Stressful summer season
1962 = 84 days
2019 = 156 days

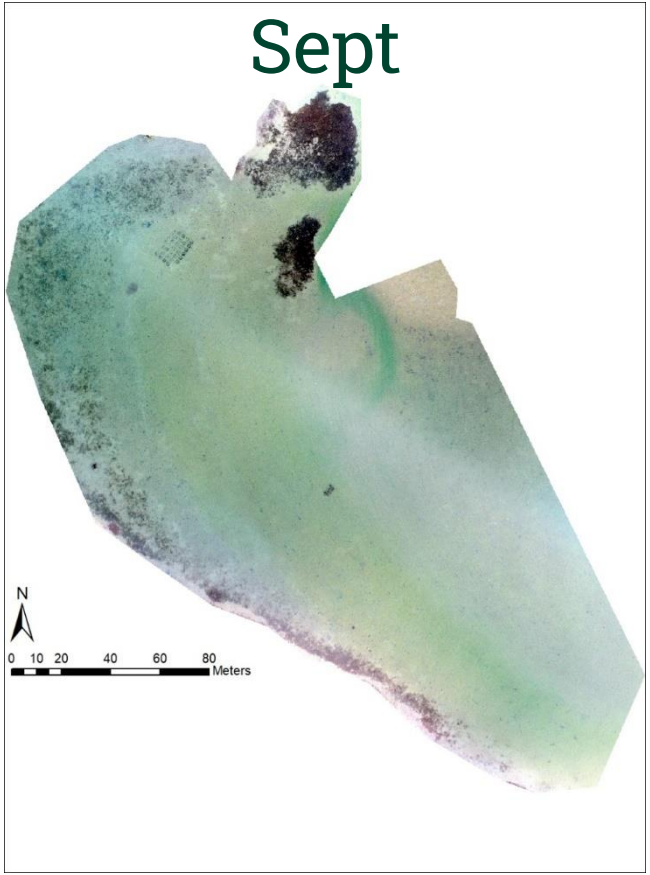


(Bartenfelder et al. 2022)

Climate Change and NC Seagrass

- Greater resilience?
- Switch in life history strategy?
- Genetically based localized temperature adaptation?



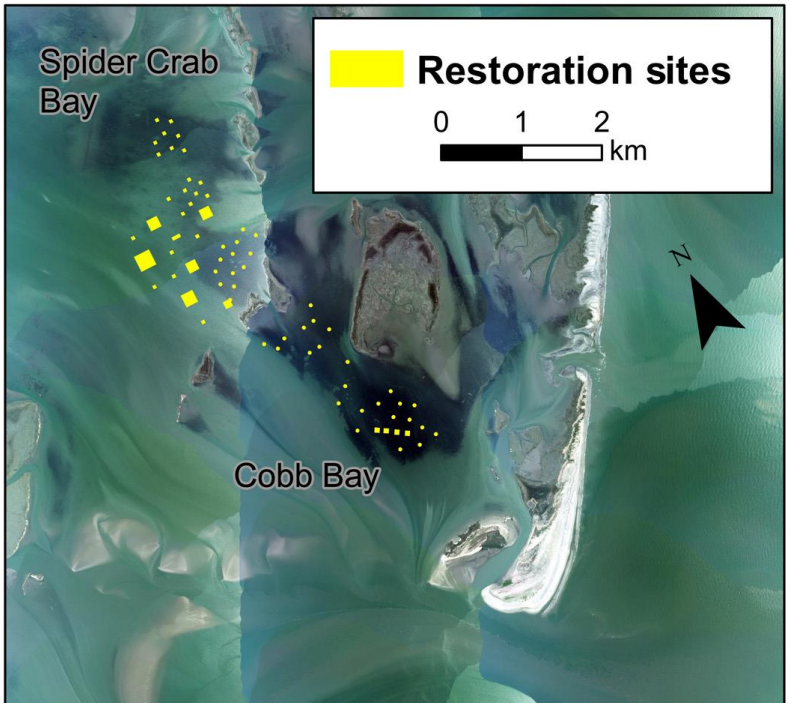


Seagrass Restoration via Seeds

(© Nina Constable/WWF-UK)

Seagrass Restoration via Seeds

- After 23 months 22- 44% of seedlings survive on average globally
- Successful restoration requires:
  - Careful site selection
  - Large numbers of seeds/shoots
  - **Removal of stressor**

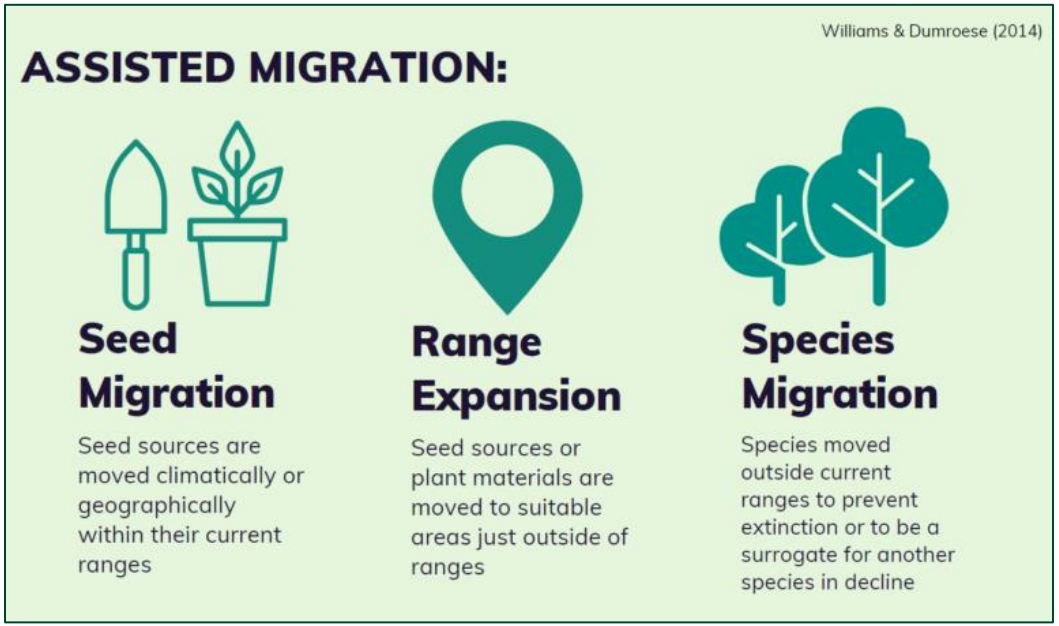


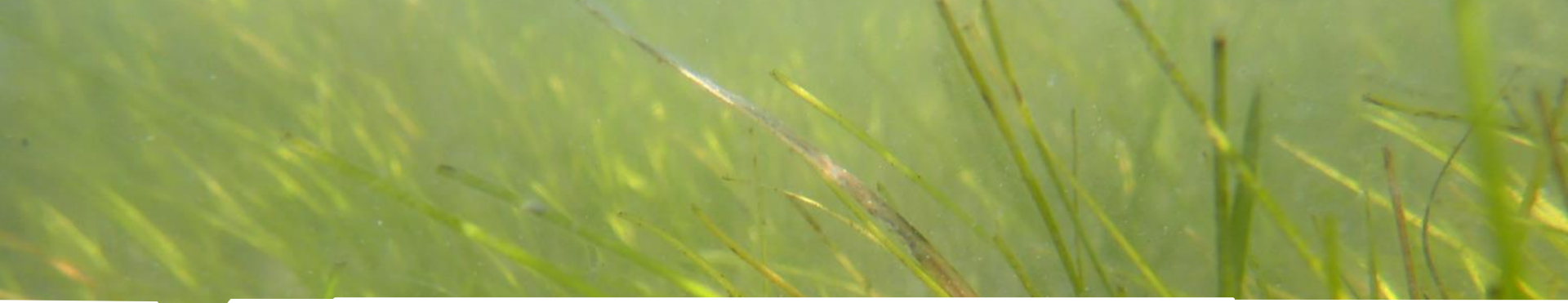
(van Katwijk et al. 2015)

(Orth et al. 2020)

Seagrass Conservation & Restoration with Climate Change

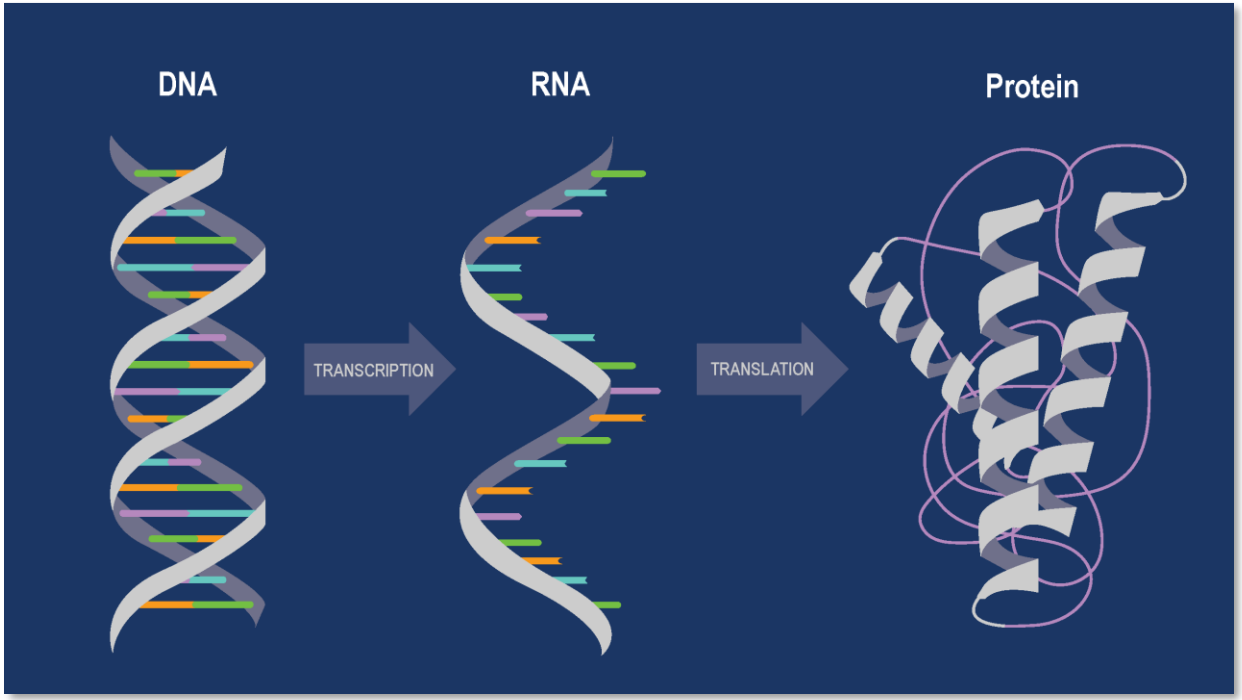
- How do you conserve/restore seagrass under threat from climate change?



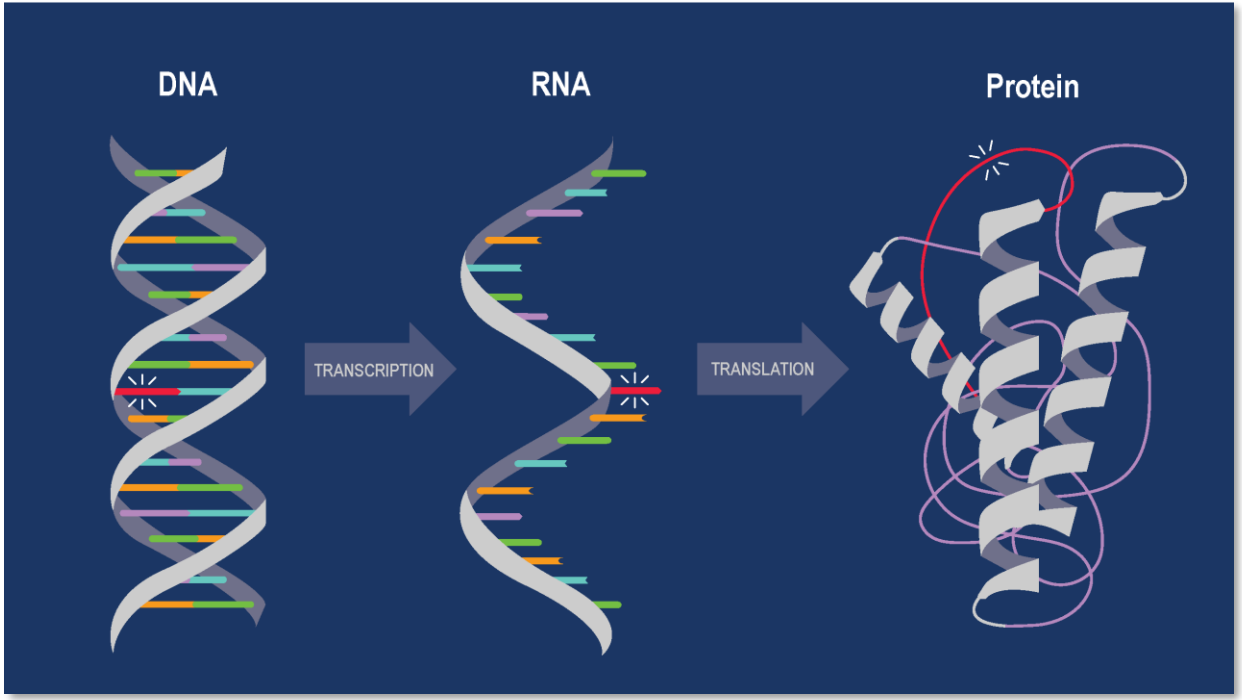


Can we restore seagrass to be climate resilient?

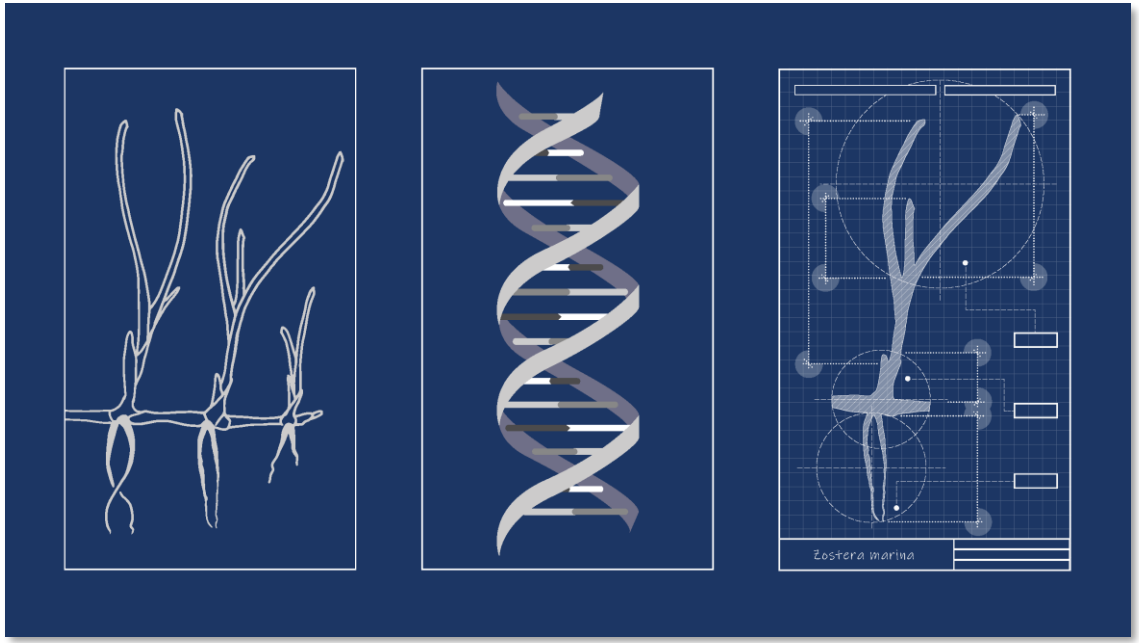
The Central Dogma



The Central Dogma

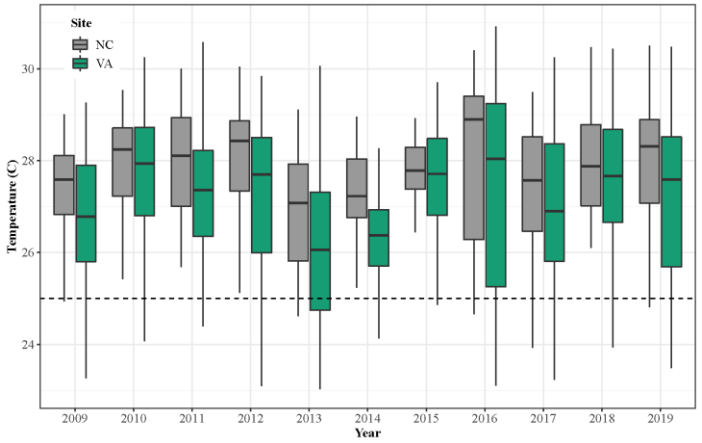


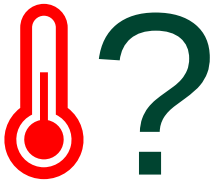
Adaptive Genetic Variation



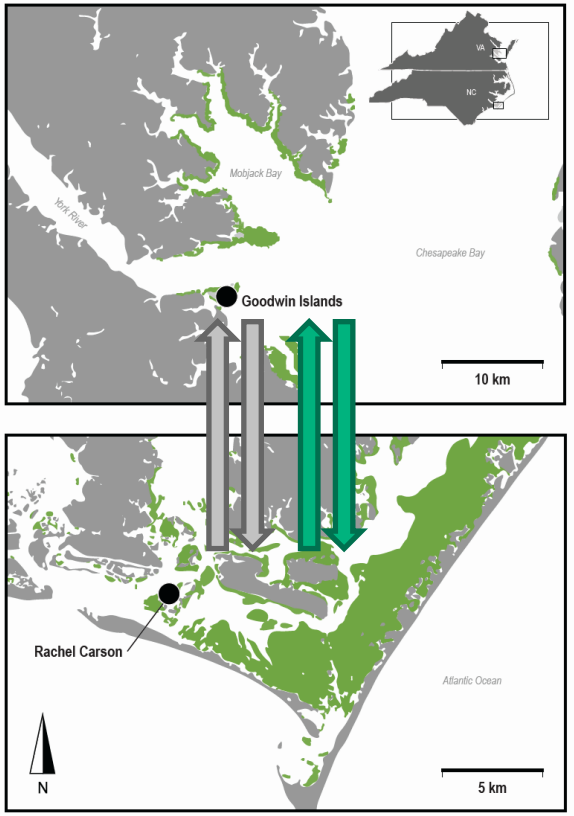
- Genetic variation that affects function
  - Genes are responsible for selected phenotypes

Climate Resilient Restoration





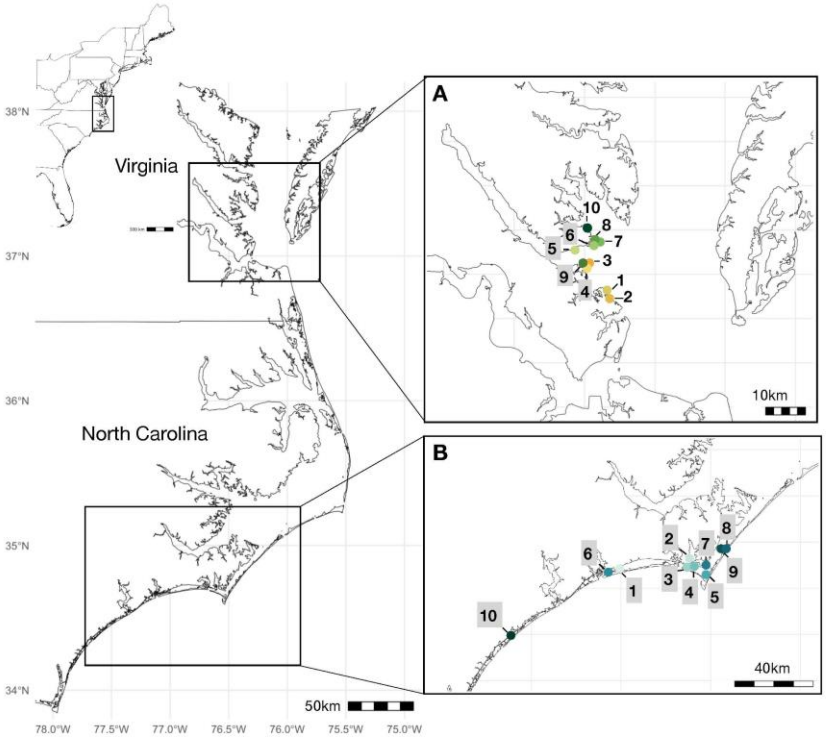
(© Nina Constable/WWF-UK)



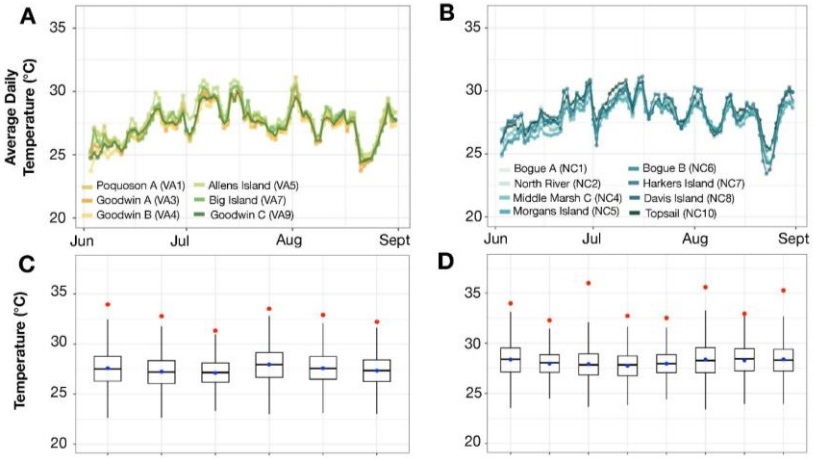
How do you conserve/restore seagrass under threat from climate change?

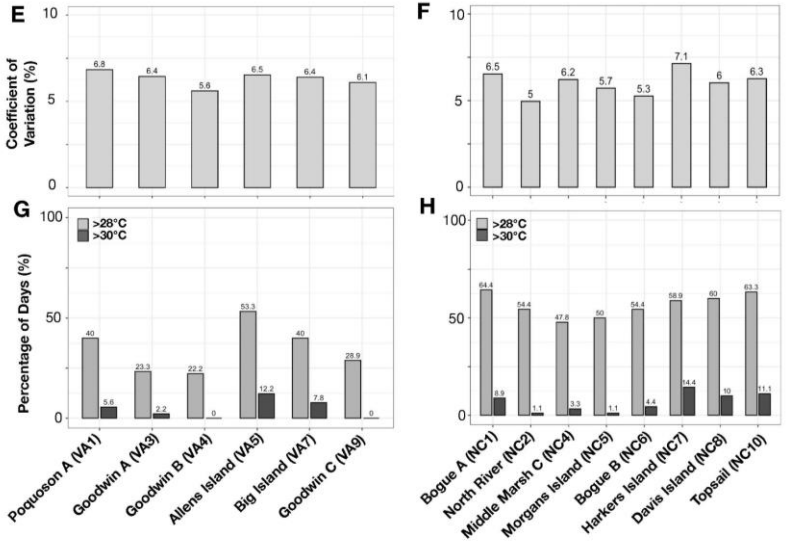
National Estuarine Research Reserves Science Collaborative

Study Sites

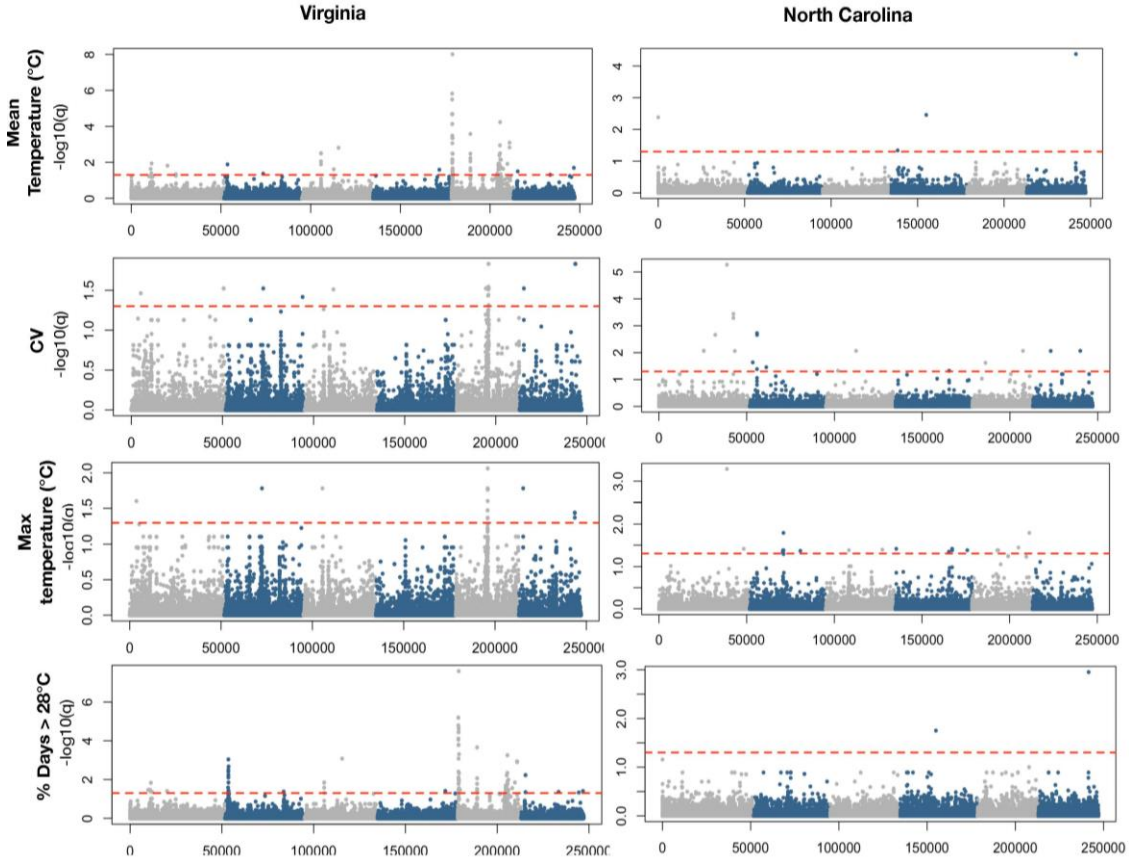

38°N
37°N
36°N
35°N
34°N
78.0°W
77.5°W
77.0°W
76.5°W
76.0°W
75.5°W
75.0°W
Virginia
North Carolina
50km
A
10
8
6
7
5
3
9
1
4
2
10km
B
2
8
7
6
9
3
1
4
5
10
40km

Environmental Variation

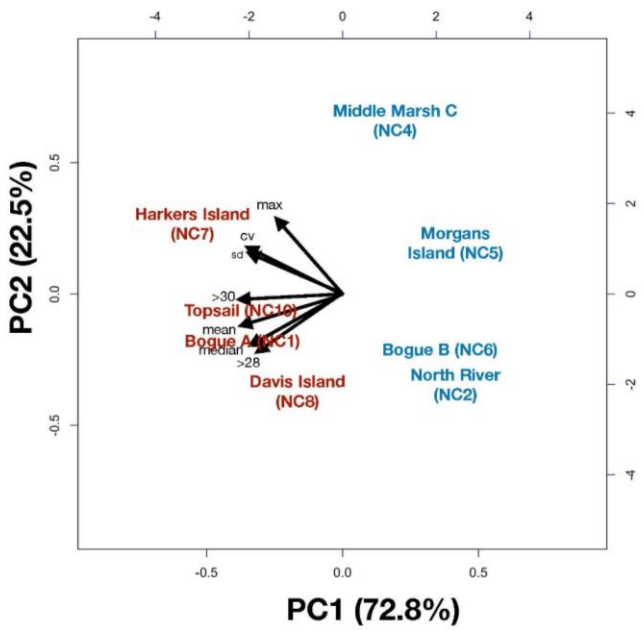


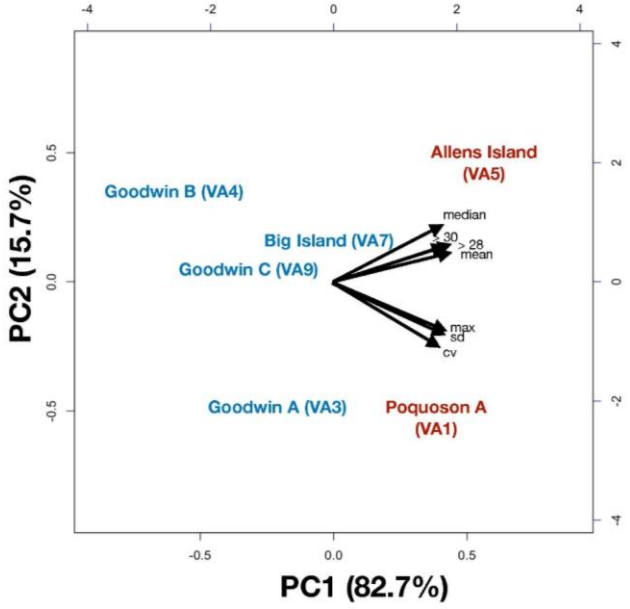


Environmental Association Analyses

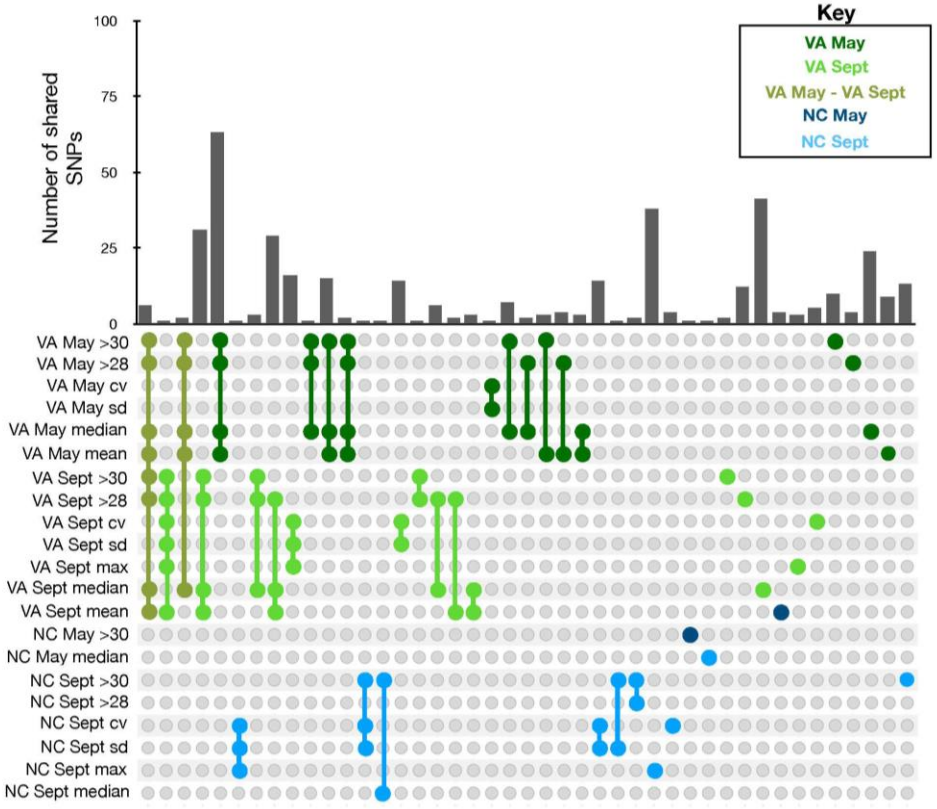


Outlier Analyses

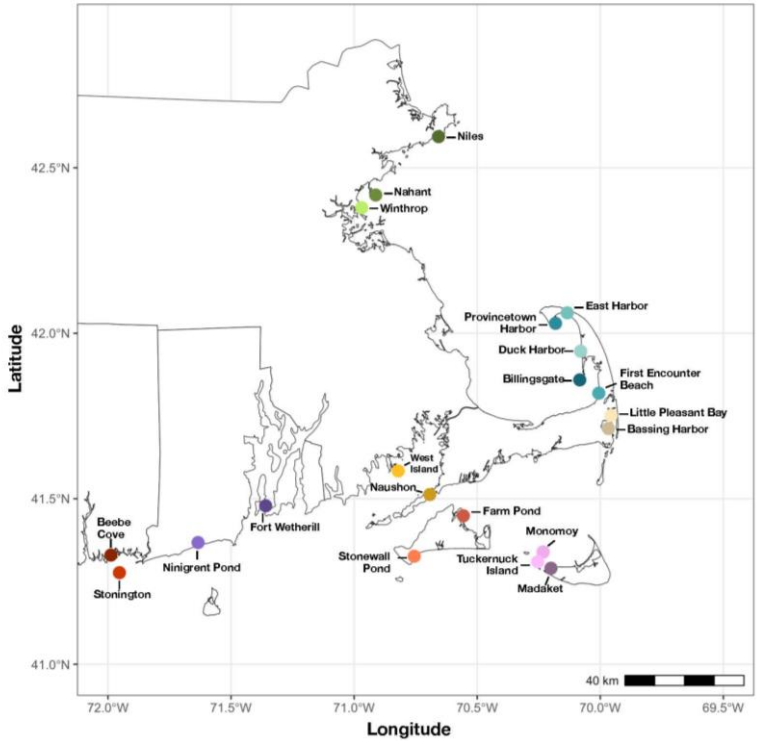




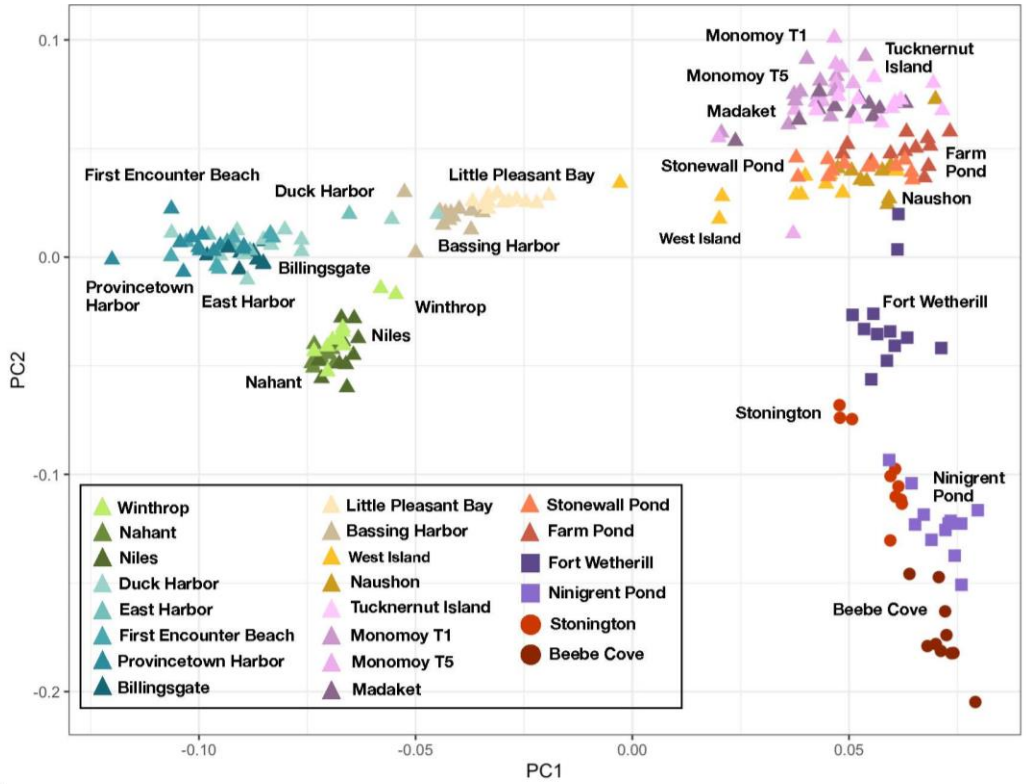
Overlapping SNPs and Molecular Pathways



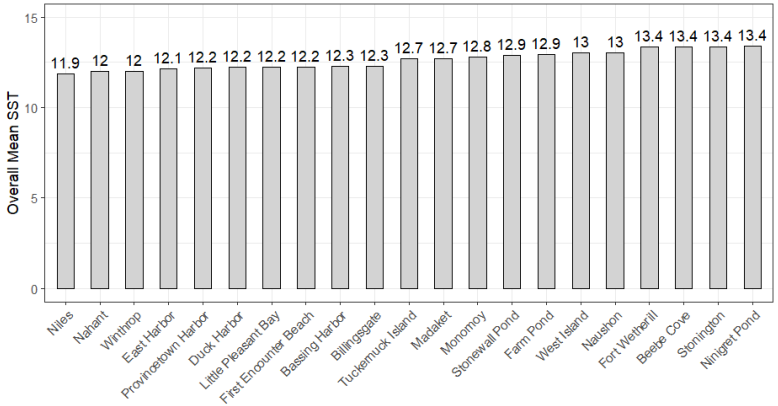
From Maine to North Carolina

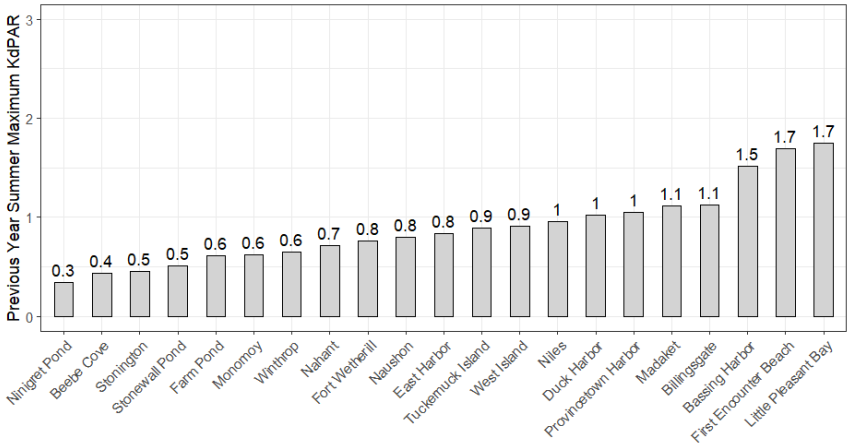


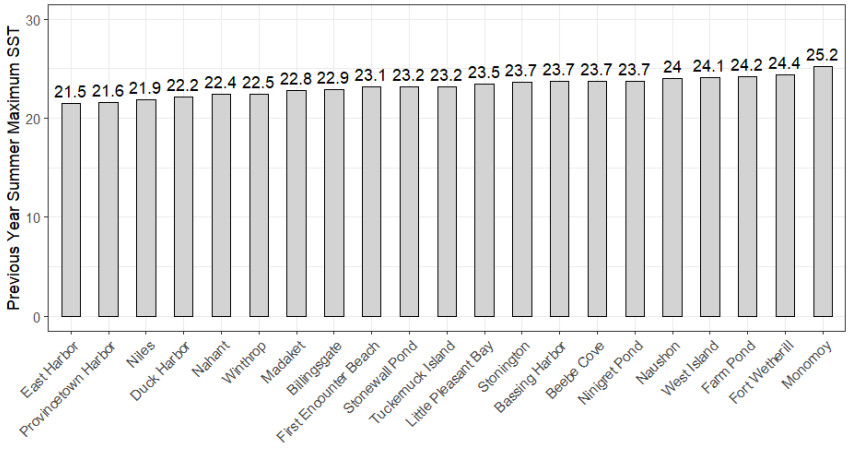
Population Differentiation



Environmental Variation

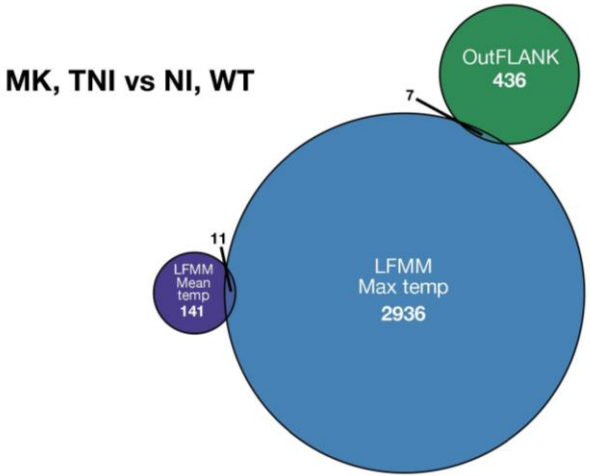






Temperature Associated Divergence?

OutFLANK groupings	q<0.05
WT, NI, NHT vs. MT1, MT5, MK, TNI	0
WT, NI, NHT vs. ST, BBC, NP, FW	0
WT, NI, NHT vs. ST, BBC	6
WT, NI, NHT vs. NP, FW	0
MK, TNI vs NI, WT	443



Winthrop
Niles
Nahant
Monomoy
Madaket
Tuckernuck Island
Stonington
Beebe Cover
Ninigret Pond
Fort Wetherill

Thank you! Any Questions?

NERRS Science Collaborative
Jessie Jarvis
Erin Shields
Cirse Gonzalez

Bioinformatics
Karina Scavo Lord

National Park Service
Jessie Jarvis
Bradley Peterson
Stephen Tomasetti
Alyssa Novak
Jon Lefcheck
Holly Plaisted
Sara Stevens
Jamie Vaudrey

Steve Heck
Steve Schott
Joel Carr
Audrey Brown
Rachel Schaefer