

Envisioning the future for Chesapeake Bay SAV ecosystems under climate change: shifting stressors and shifting foundation species

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SAV WG 3.14.22



Climate change and human activities create conditions outside the realm of the past



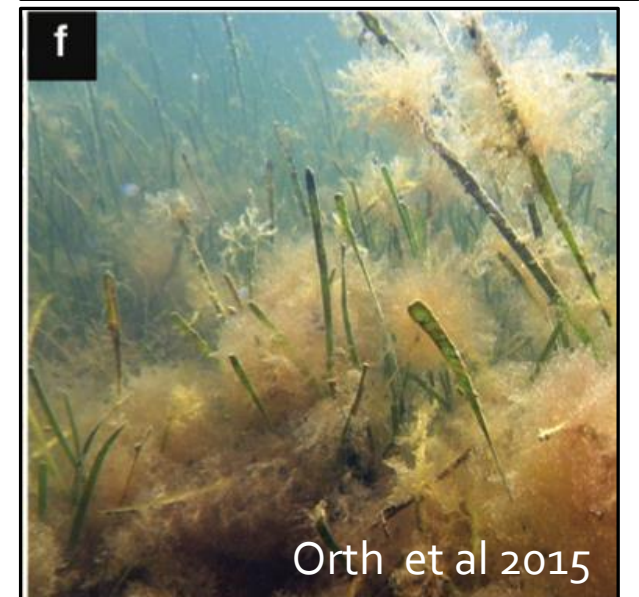
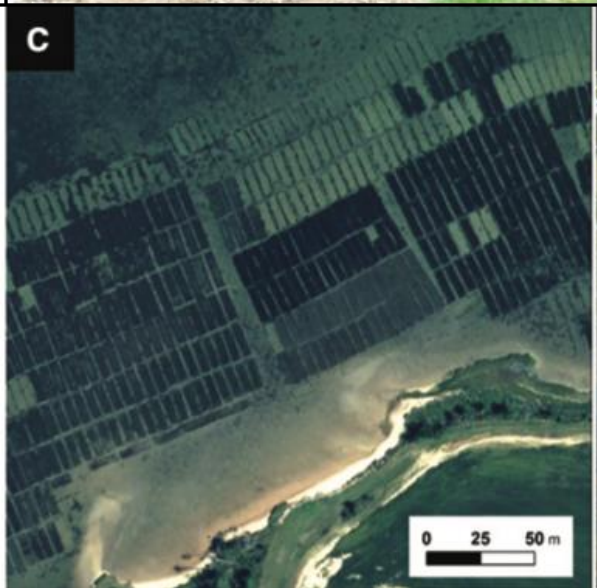
Local & regional

Changing nutrients,
flow, shoreline,
Water quality

Climate

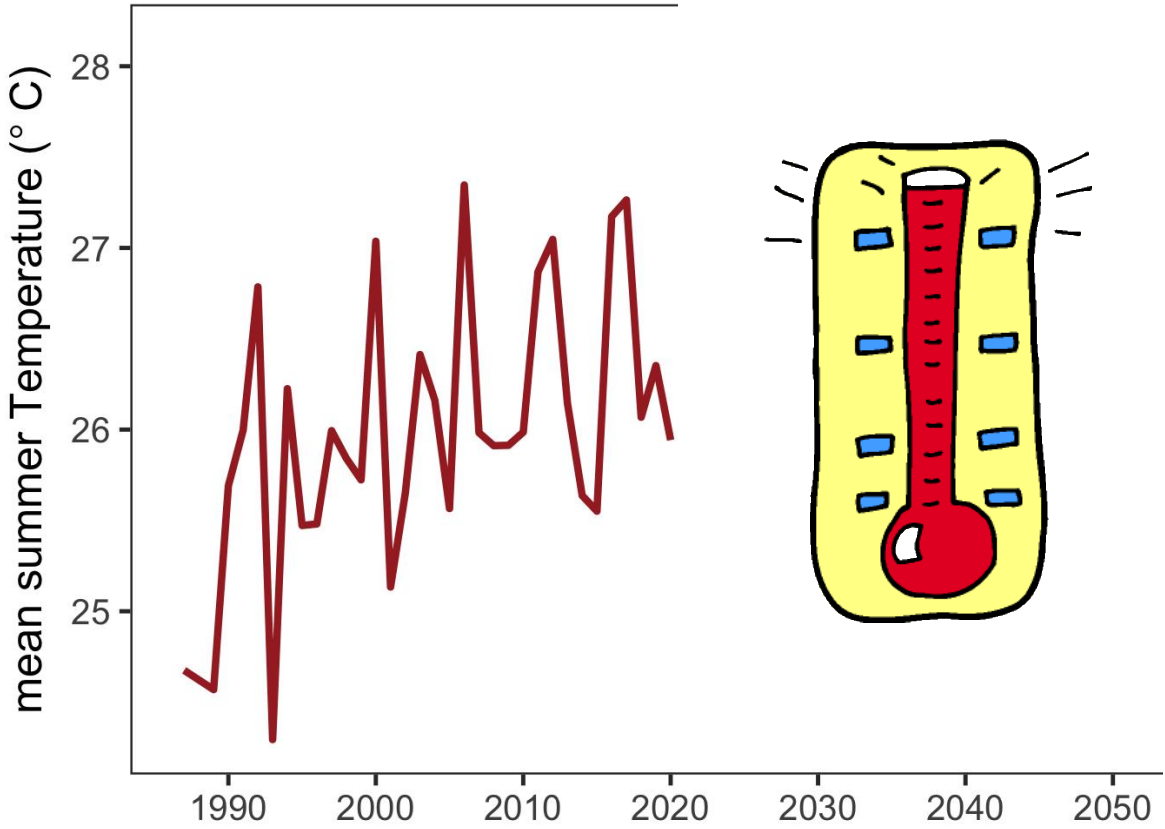
Changing rainfall,
Habitat avail (SLR),
temperature

Chesapeake Bay
SAV Cover

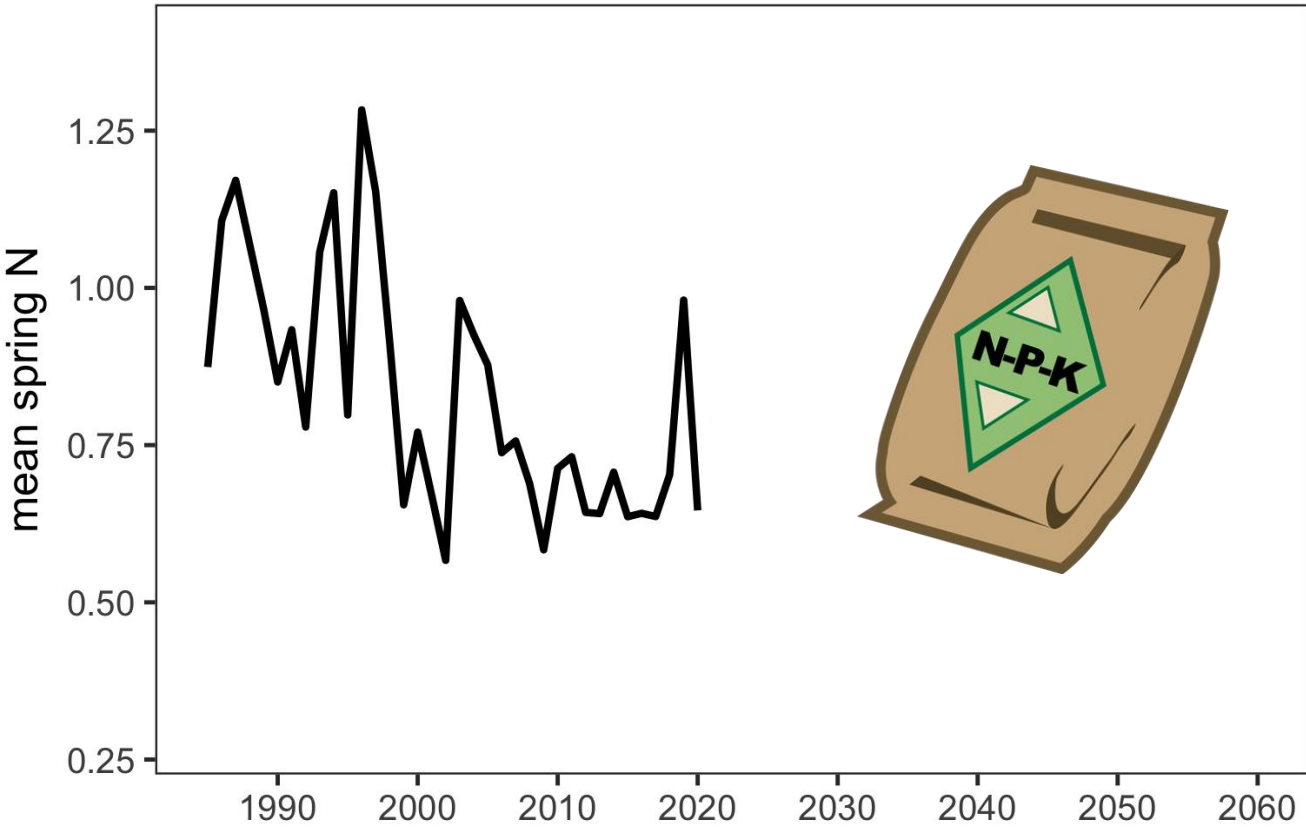


Climate change and human activities create conditions outside of the realm of the past

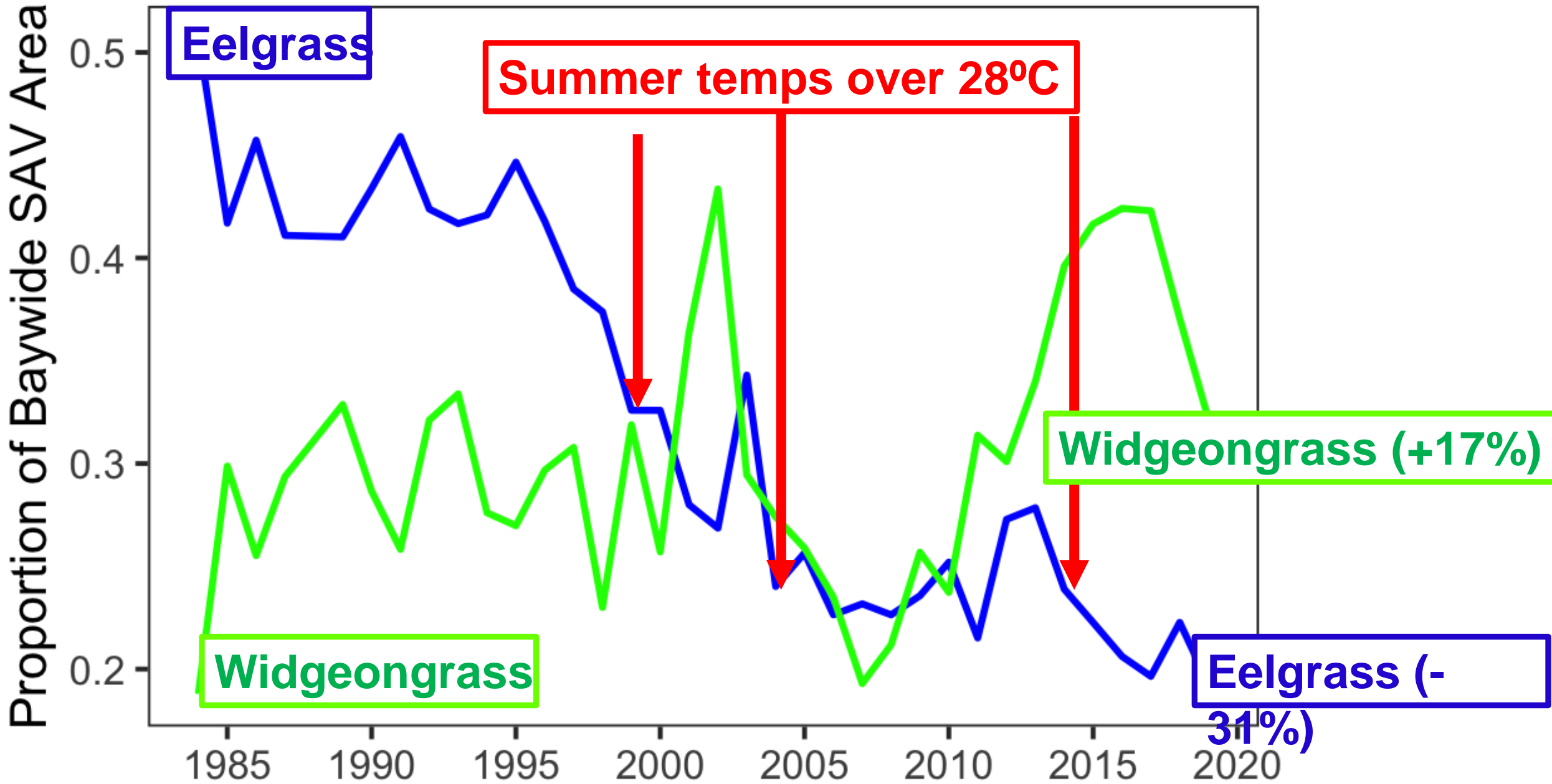
Temperature Rise



Nutrient reductions

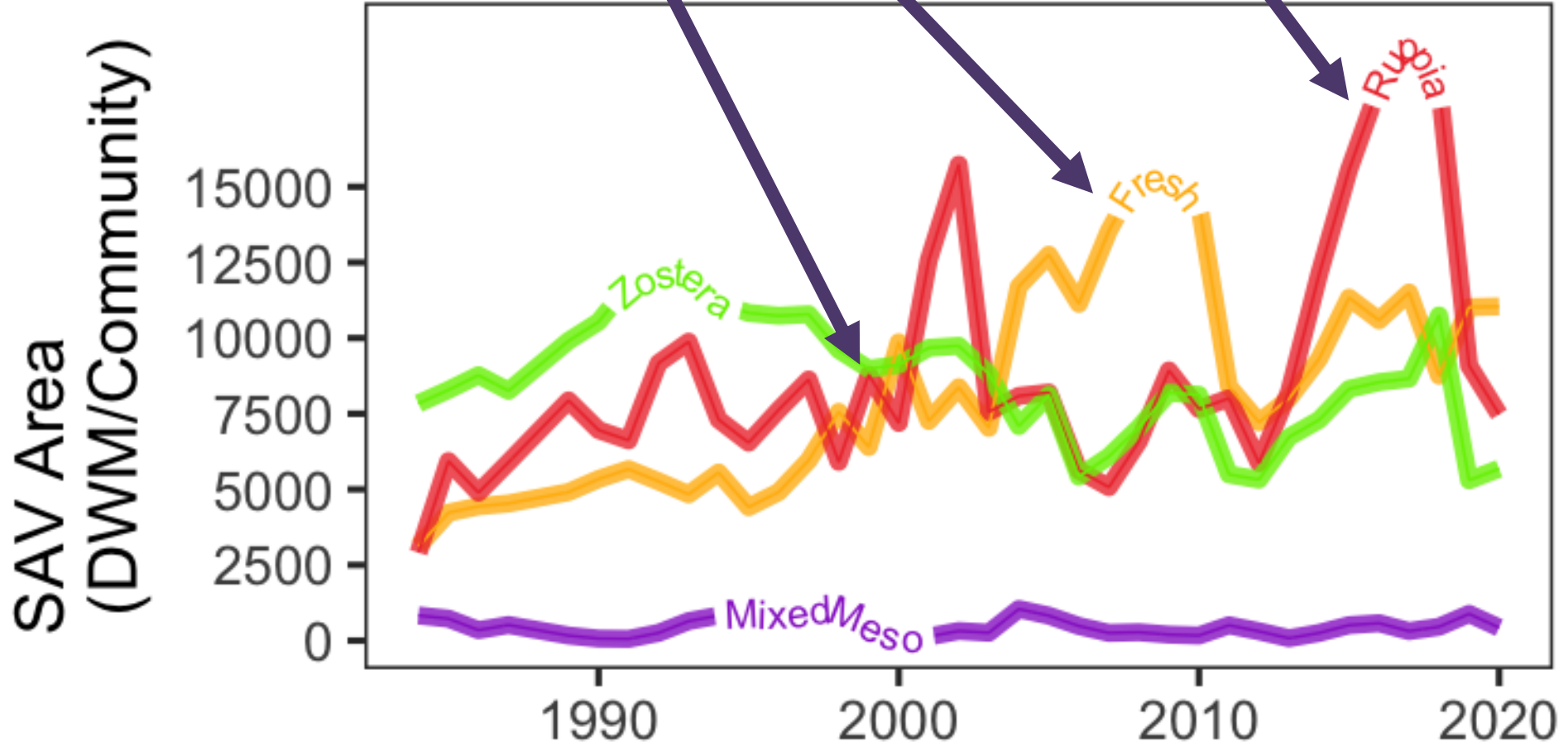


Dominant foundation species has shifted!

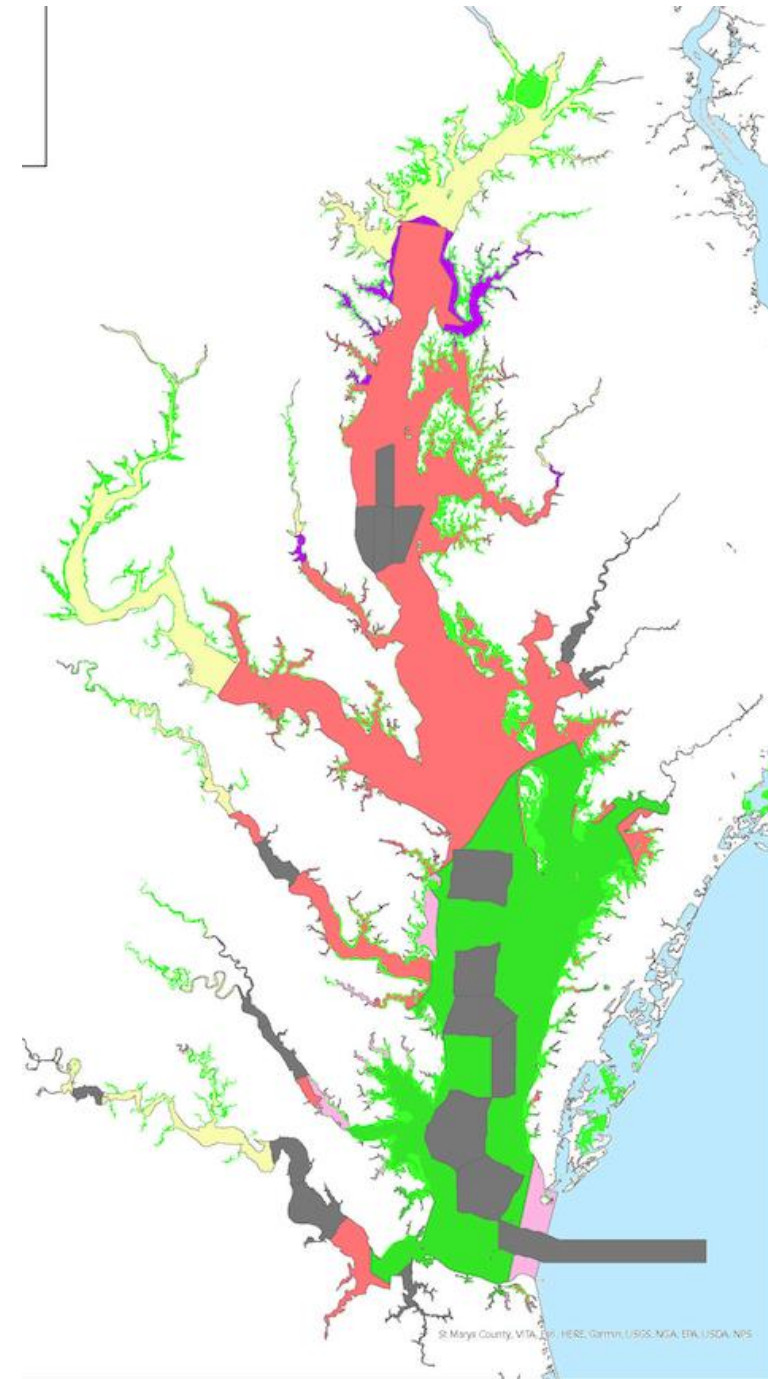
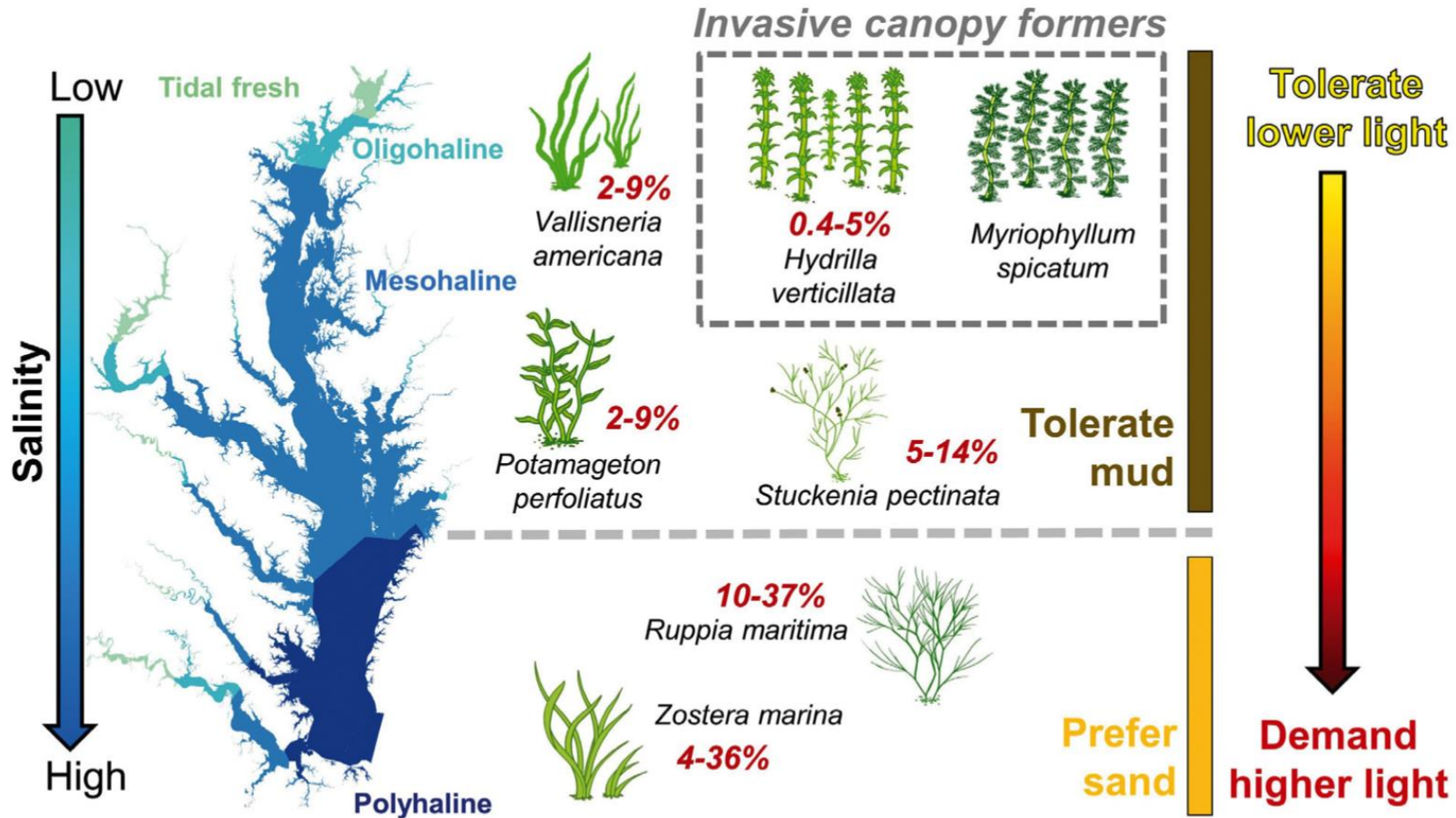


Dominant foundation species has shifted due to climate change

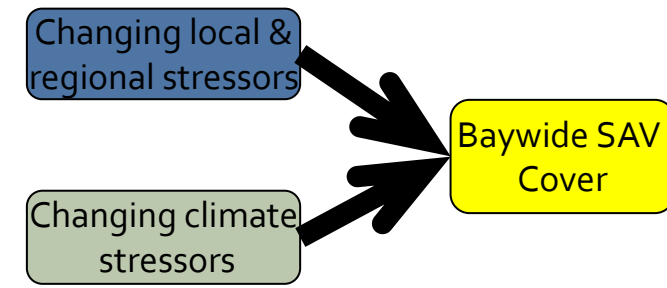
Tidal fresh and widgeongrass are the dominant SAV communities now



SAV foundation species respond to change differently, so how do we predict and create management solutions?



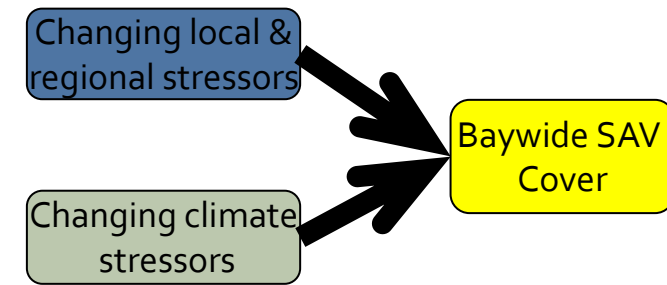
Research Questions|



1. How does water quality, habitat availability, and climate forcing (rainfall, sea level rise, temperature) affect dominant SAV communities across the Chesapeake Bay?

2. How will different future climate change and human activities affect dominant SAV communities across the Bay through time?

Approach|



1. How does water quality, habitat availability, and climate forcing (rainfall, sea level rise, temperature) affect dominant SAV communities across the Chesapeake Bay?

35 years of **mainstem** bay water quality data, aerial survey data
Analyzed with structural equation models

2. How will different future climate change and human activities affect dominant SAV communities across the Bay through time?

Four Dominant SAV communities in the Chesapeake Bay:

Oligohaline/Tidal fresh

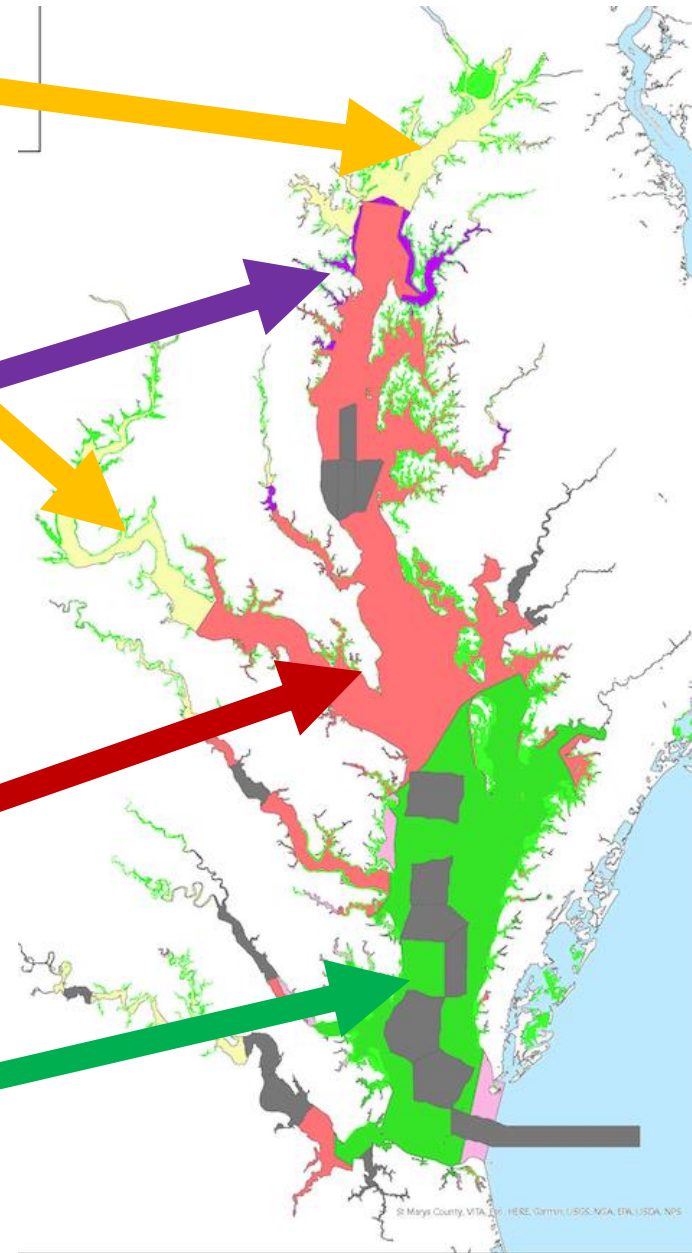
Ceratophyllum demersum
Elodea canadensis
Hydrilla verticillate
Myriophyllum spicatum
Najas minor
Valisneria americana

Mixed Mesohaline

Potamogeton sp
Ruppia maritima
Zanichellia palustris

Ruppia monoculture

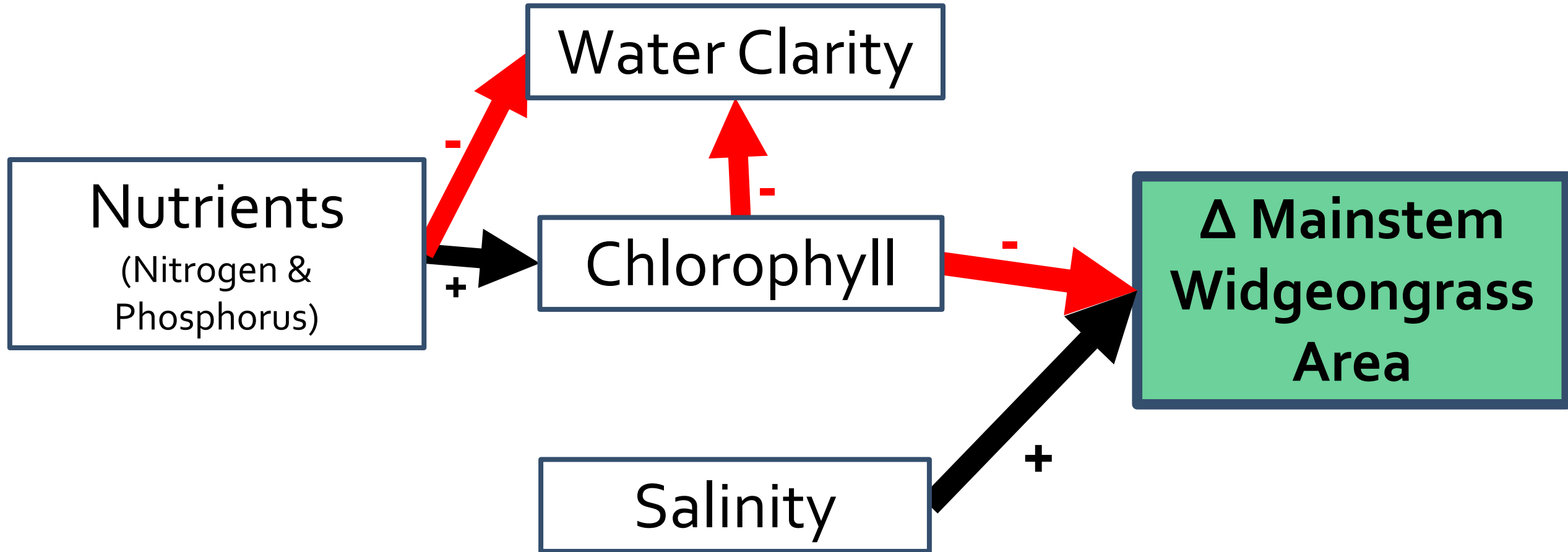
Zostera monoculture



SEM Example from *Ruppia* community |

Nutrients power springtime phytoplankton blooms.

Expansion occurs with high salinity

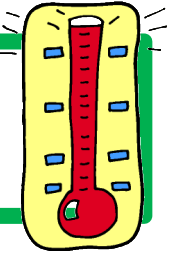


Δ Widg: $R^2_c = 0.59$

Community SEM quick summaries:

Zostera monoculture

-high summer temperatures predict big declines,
clear cool summer waters predict big increases



Ruppia monoculture

-wet spring (high chl_a) predicts big declines,
high salinity spring predict big increases



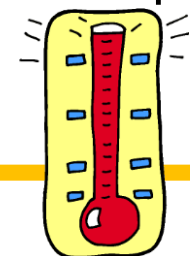
Mixed Mesohaline

-Summer salinity rise, summer phosphorus predict declines
-High temporal stability

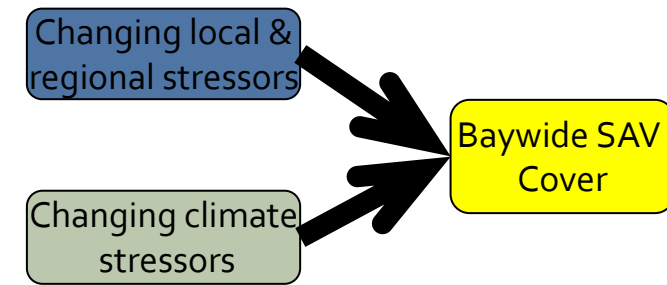


Oligohaline/Tidal fresh

-Summer nutrients (Phosphorus) and temperature predict declines
-High temporal stability



Approach|



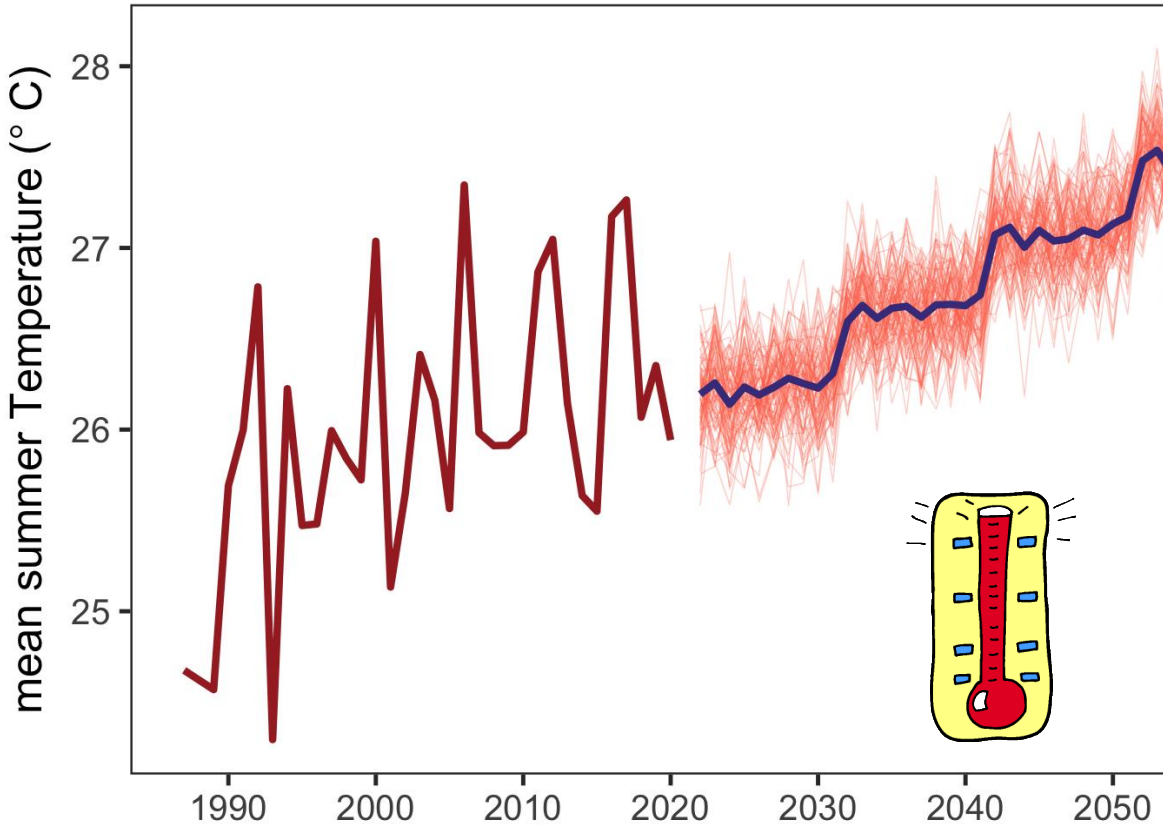
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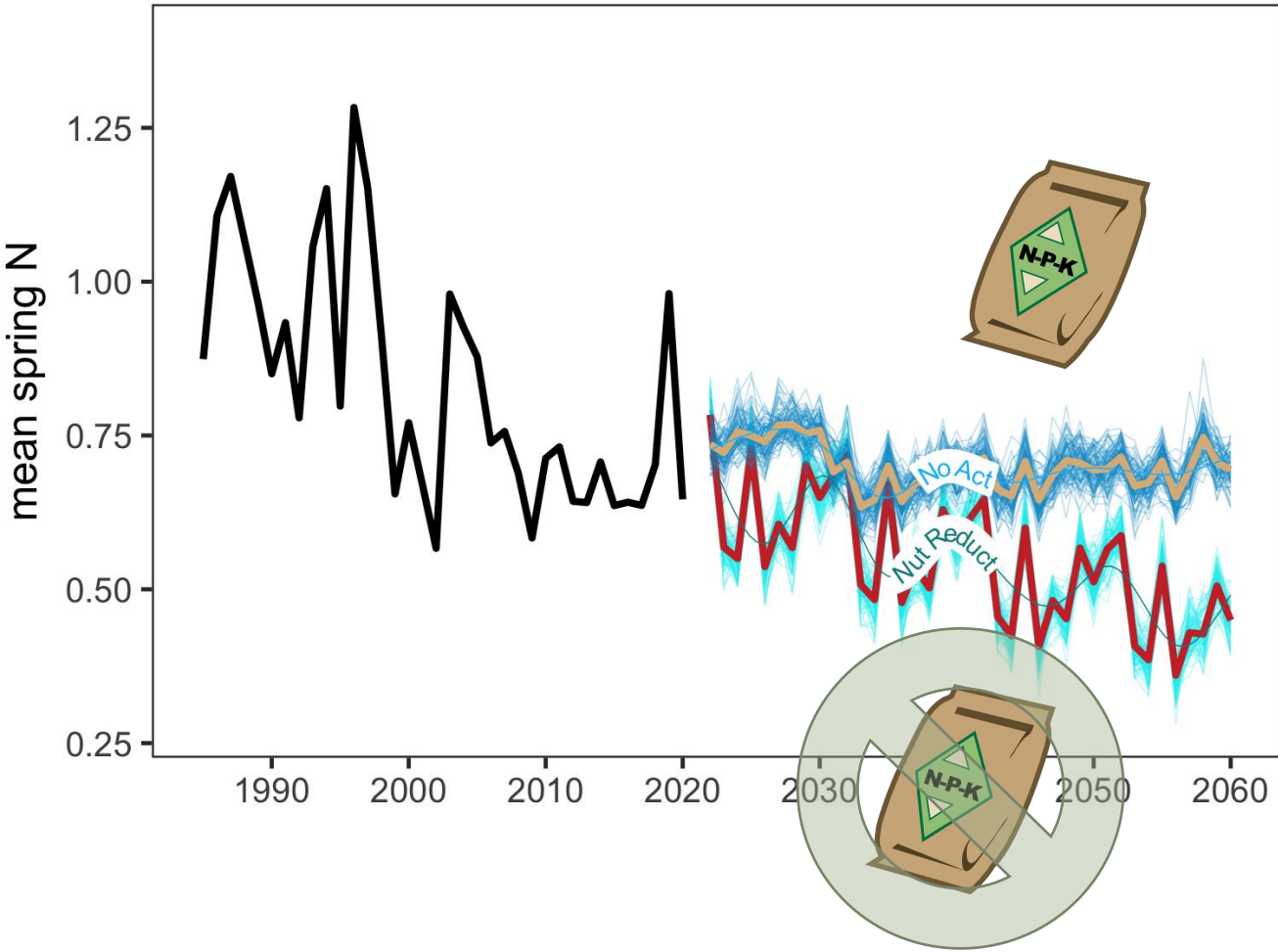
40 years of projected change in environmental variables for two scenarios, nutrient management and no action

Future Scenarios: Temperature and Nutrient Management

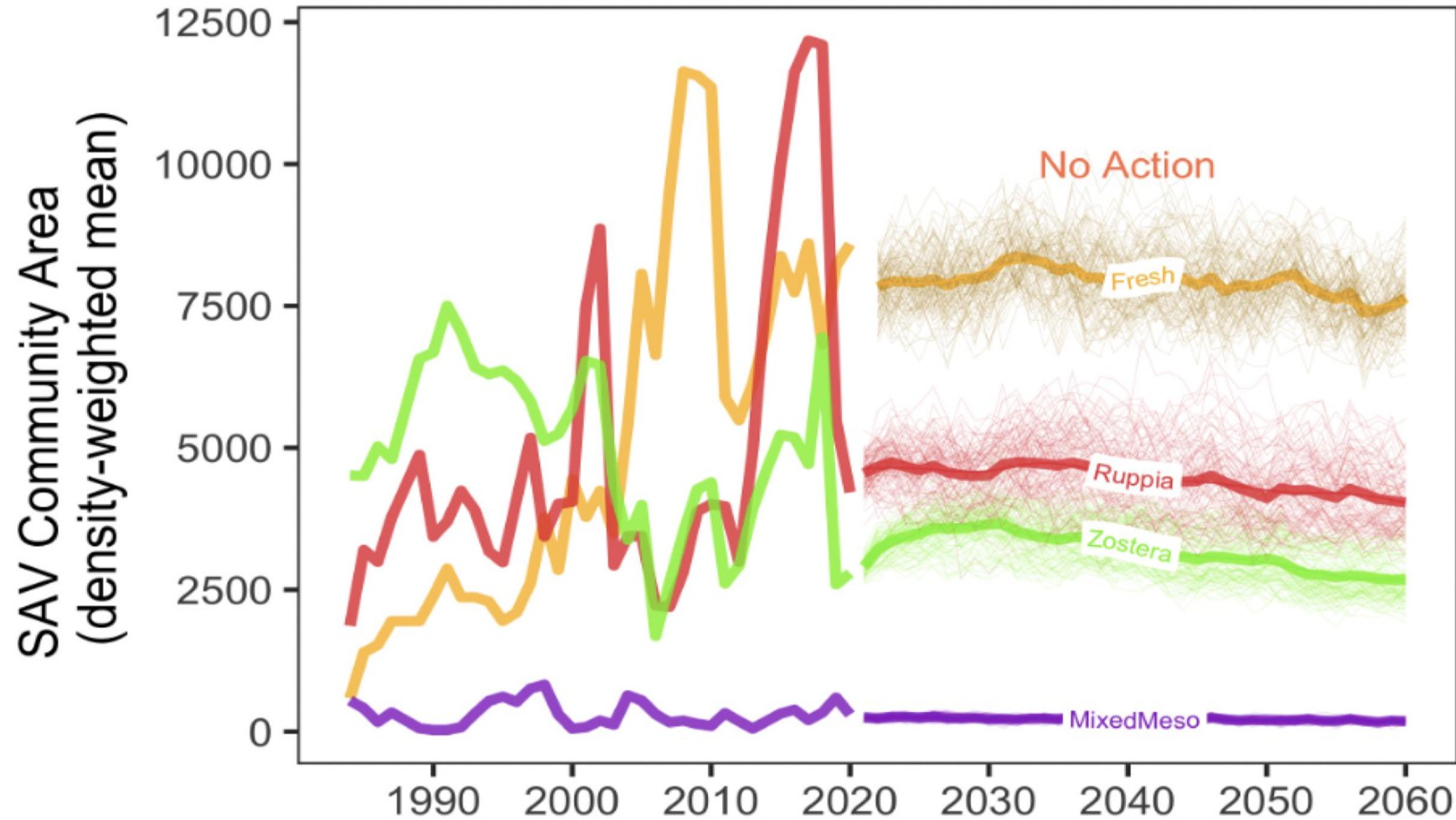
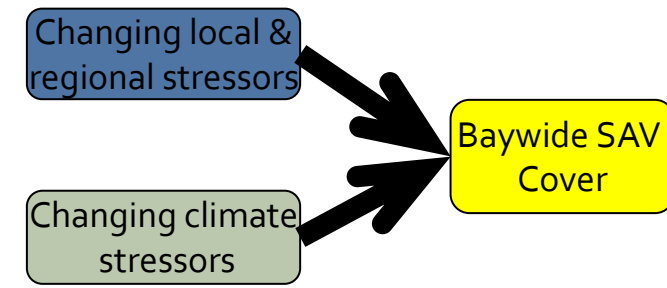
Temperature Rise occurs no matter what



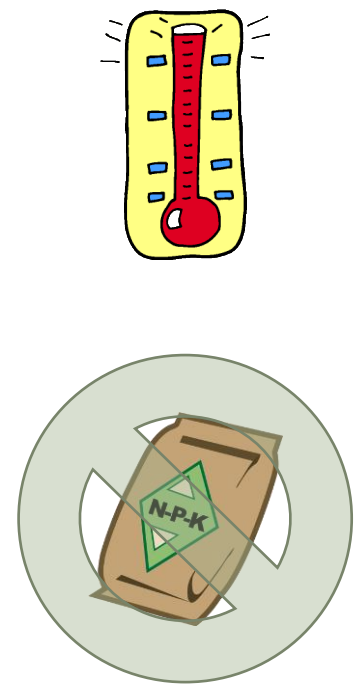
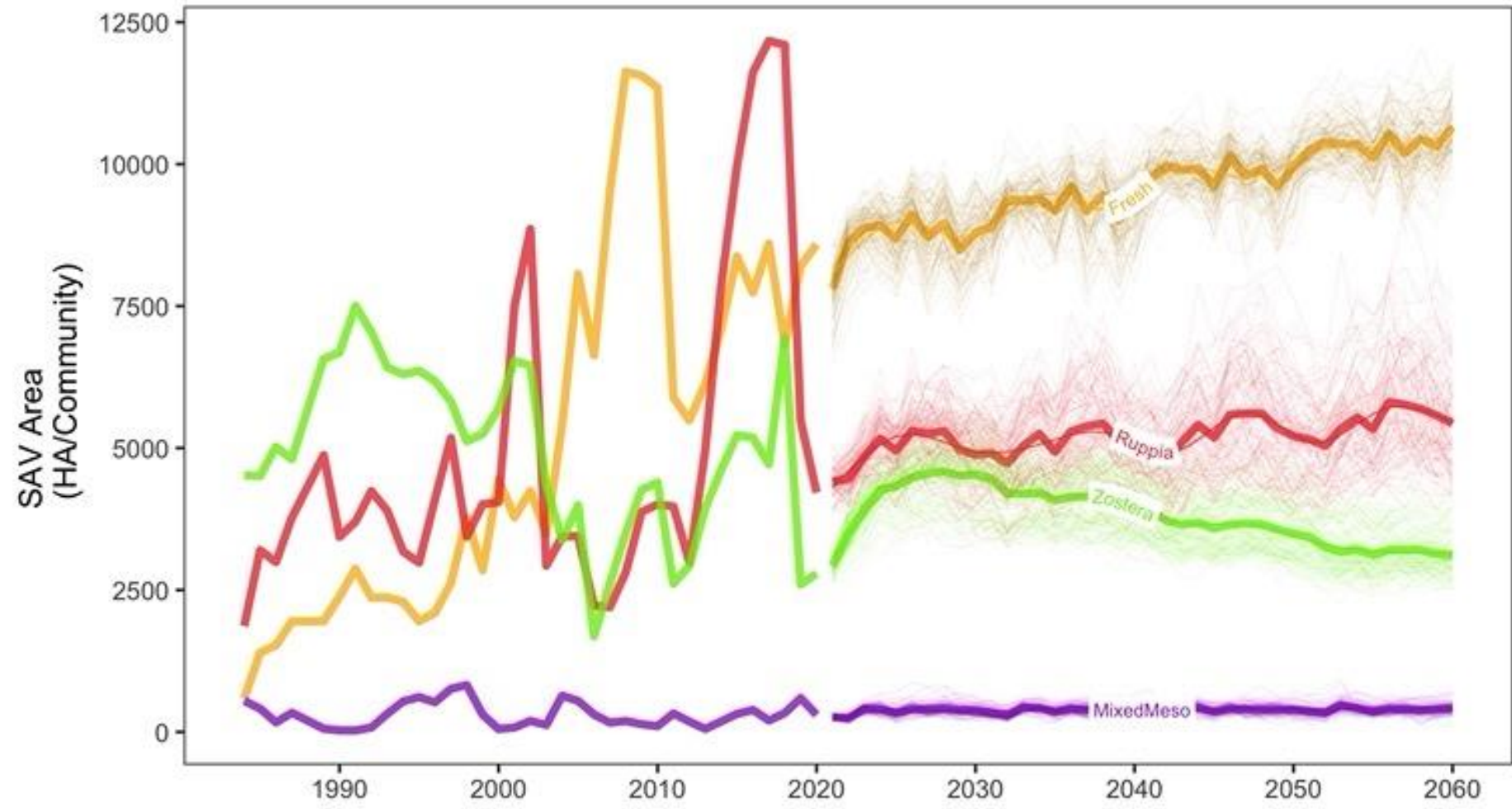
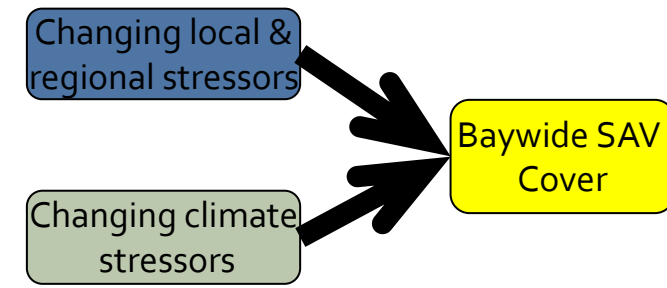
Continued nutrient reductions vs no more reductions



PREDICTING THE FUTURE| Community change with No Action



PREDICTING THE FUTURE| Community change with Nutrient Reduction

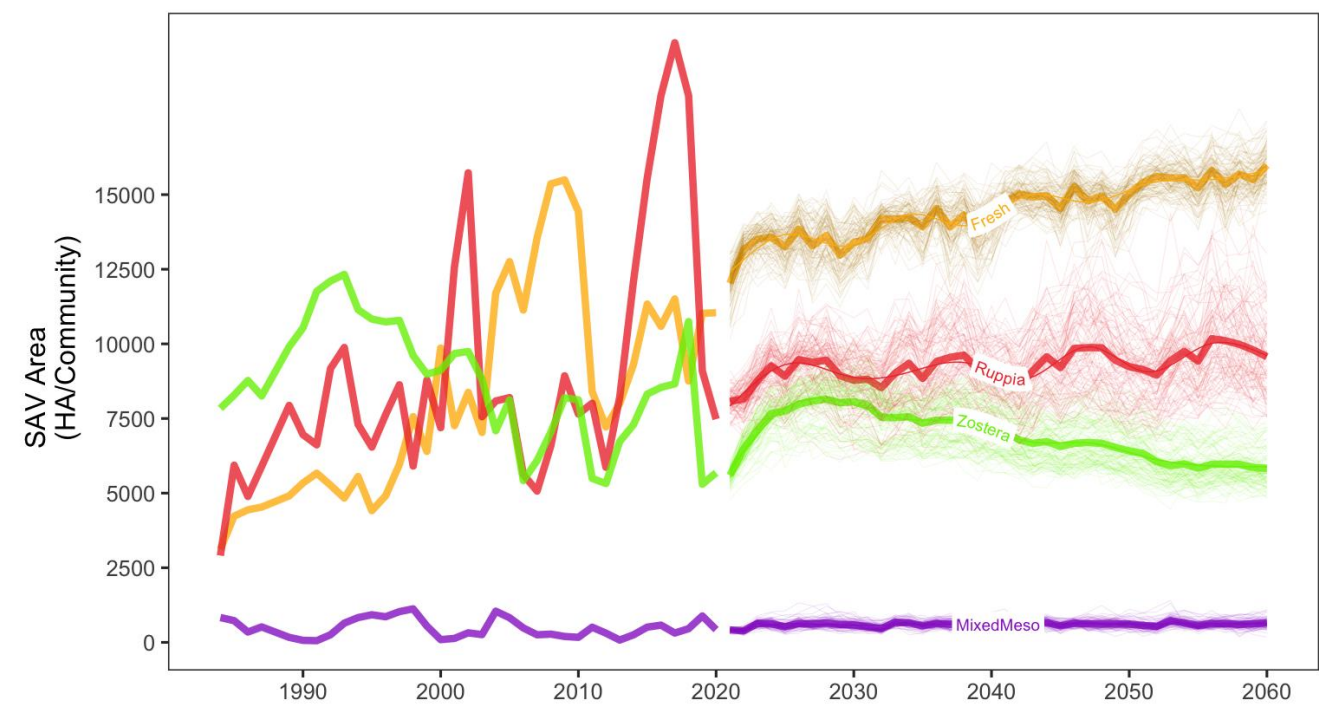
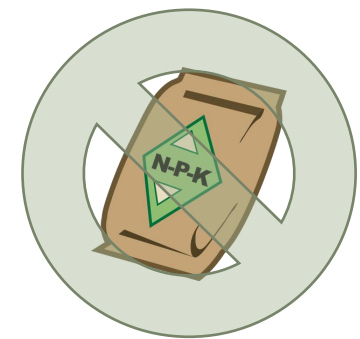
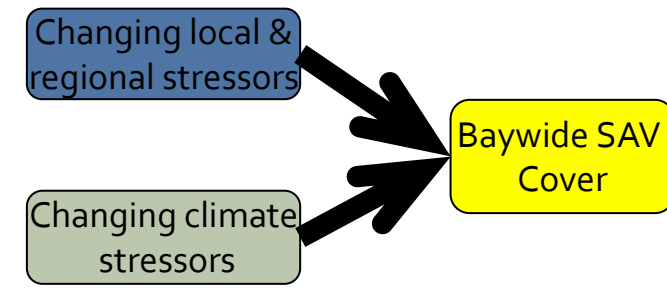


PREDICTING THE FUTURE

Initial results show nutrient reductions are required

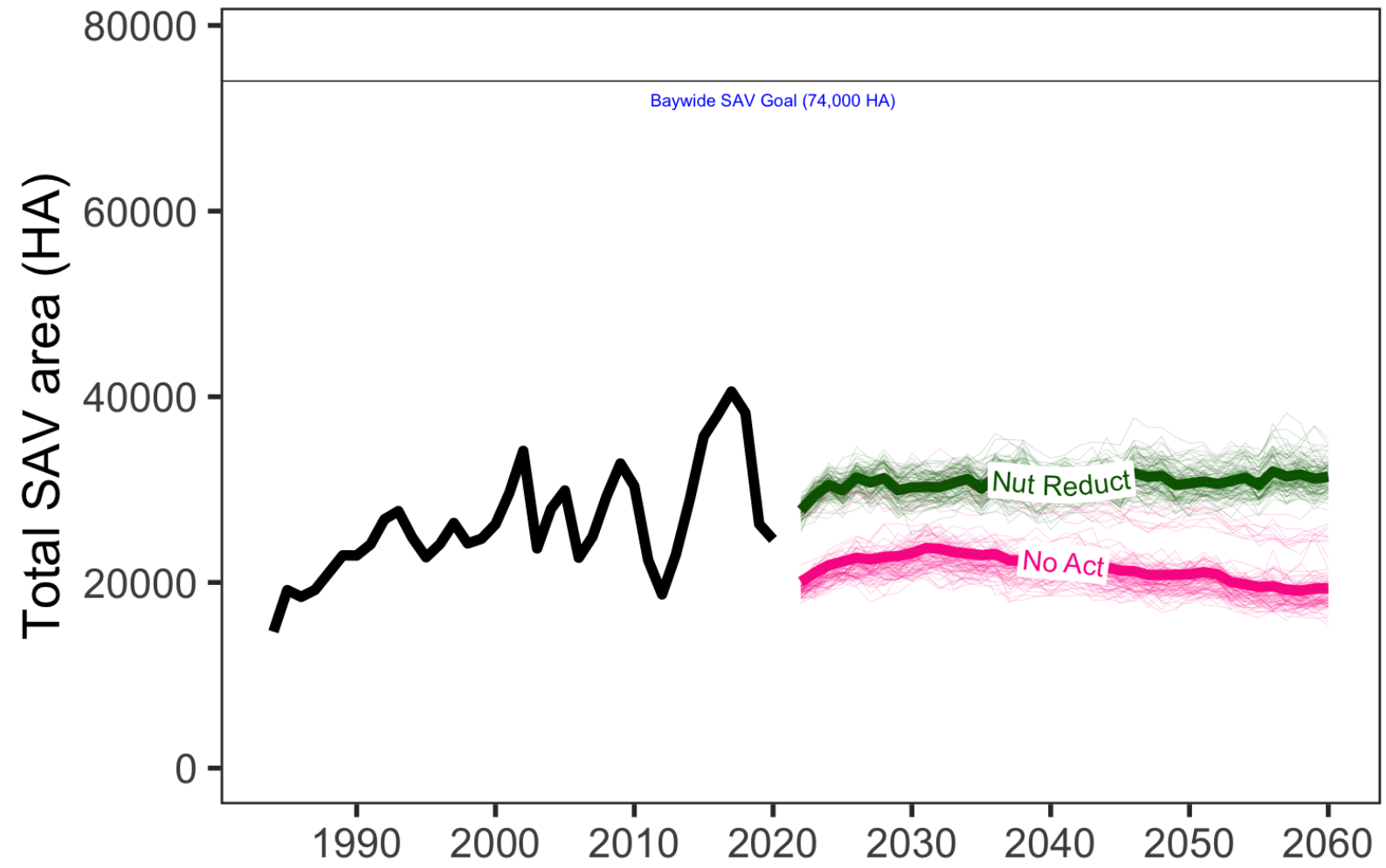
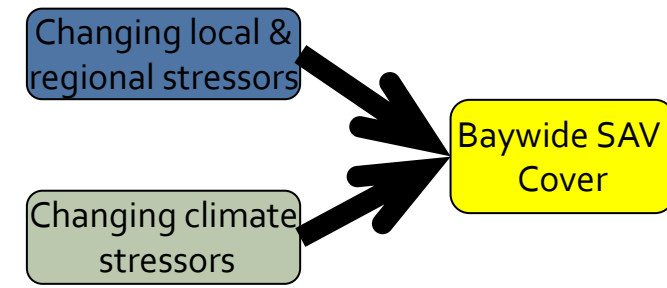
Ruppia + Tidal fresh/oligohaline expand under nutrient reduction!

Zostera declines tempered initially

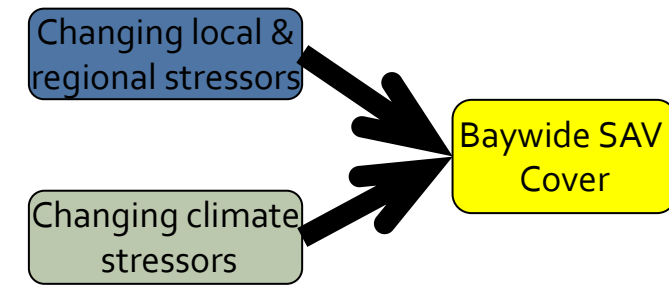


PREDICTING THE FUTURE

Initial results show nutrient reductions are required



Research Questions|



1. How does water quality, habitat availability, and climate forcing (rainfall, sea level rise, temperature) affect dominant SAV communities across the Chesapeake Bay?

Different communities affected by different variables across different seasons and time scales (Temp and Nutrients, mostly)

2. How will different future climate change and human activities affect dominant SAV communities across the Bay through time?

Nutrient reductions are essential across the board, will temper eelgrass decline, and encourage fresh and widgeongrass expansion

PREDICTING THE FUTURE|

What's next?!

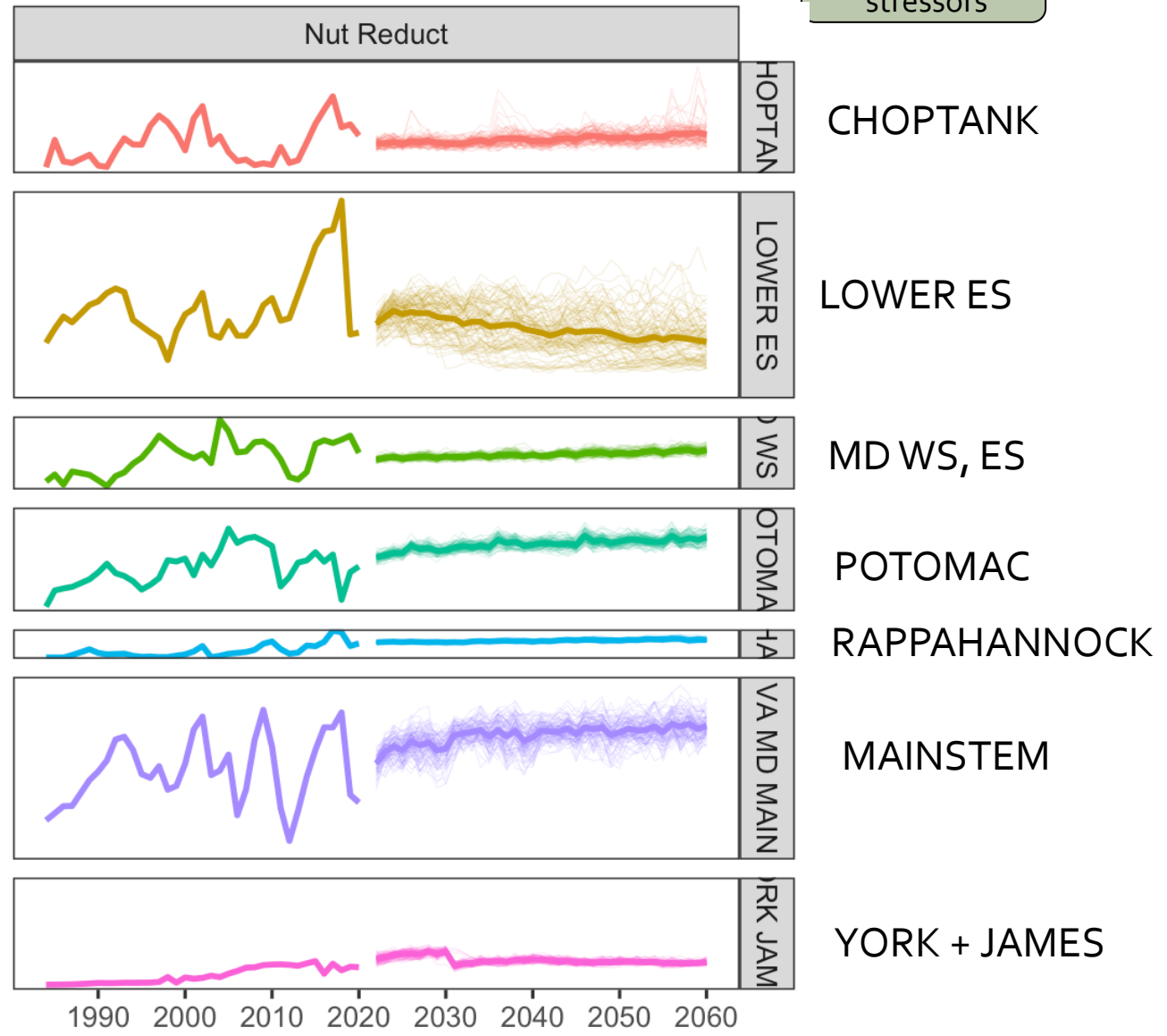
Segments/areas of interest

Incorporating sea level rise

Changing local & regional stressors

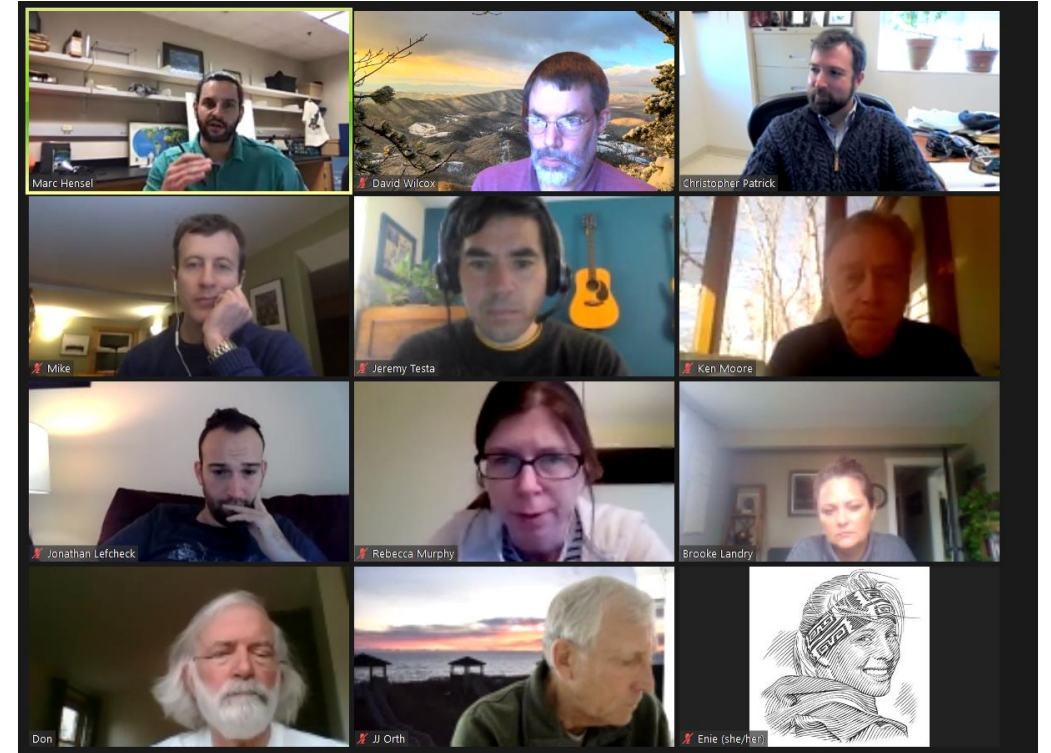
Changing climate stressors

Baywide SAV Cover



THANKS to our steering committee!

Robert J. Orth, Bill Dennison, Rebecca Murphy, Jeremy Testa, Matt Fitzpatrick, Katia Engelhardt, Cassie Gurbisz, Karen McGlathery, Aaron Kornbluth, Joel Carr, Lewis Linker, Brooke Landry, Kathrynlynn Theuerkauf, Rebecca Golden



Smithsonian

