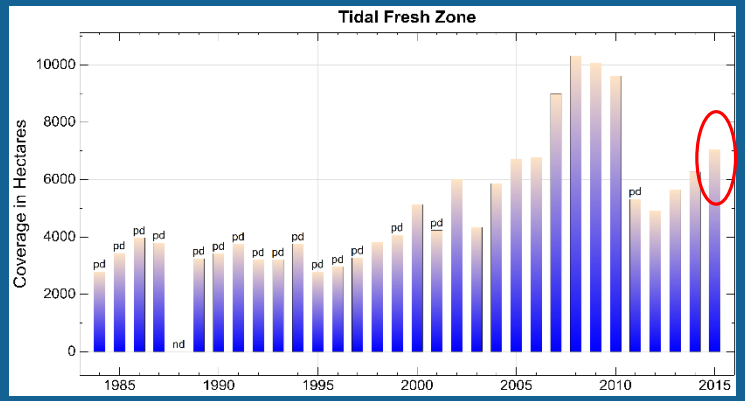
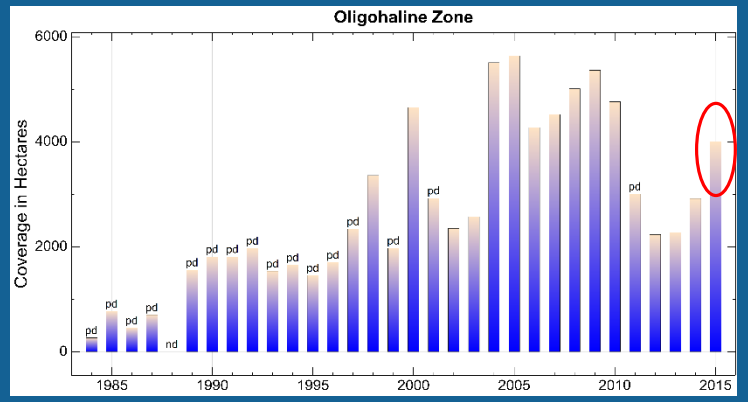
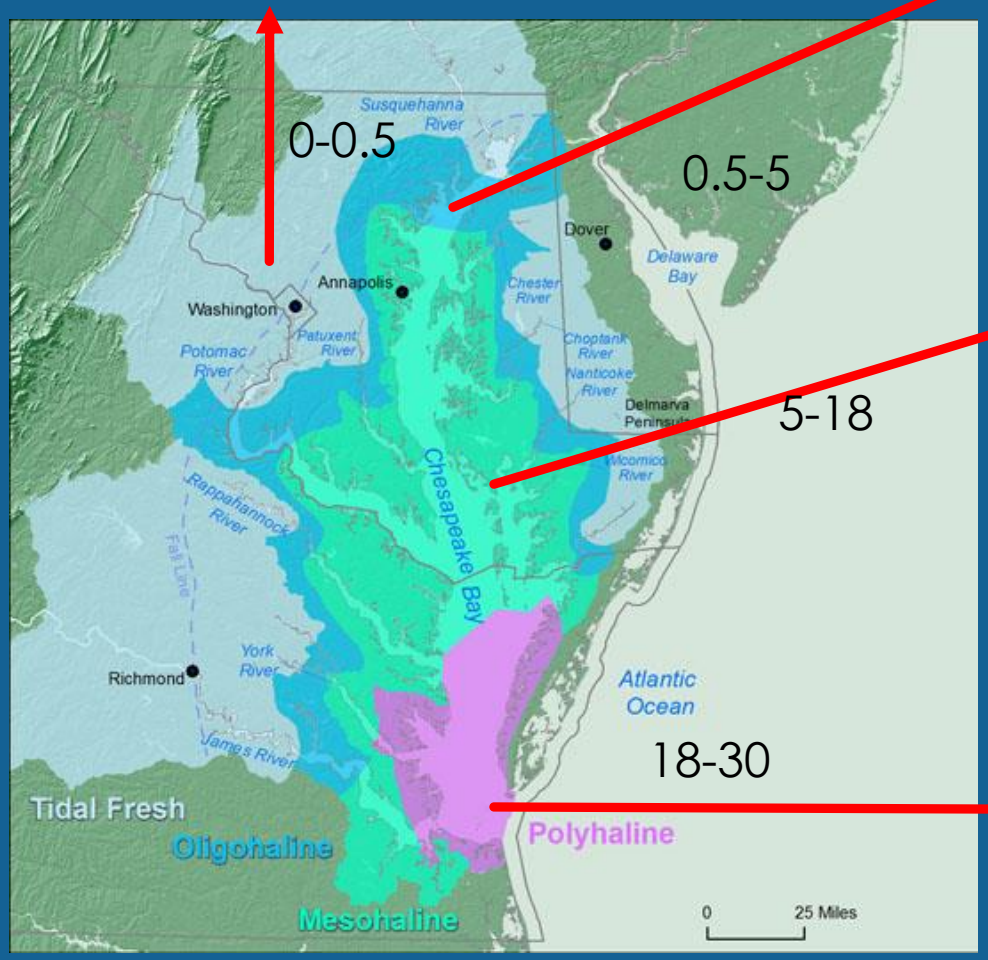
SAV in the Bay...going beyond the "What" to the "Why". Implications for the Choptank

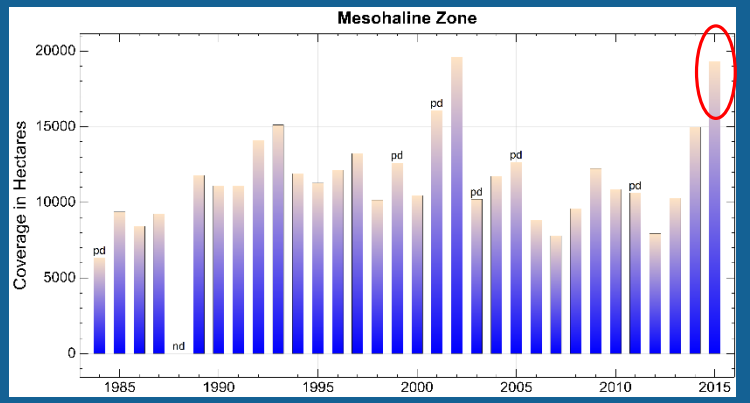
Bob Orth and Ken Moore

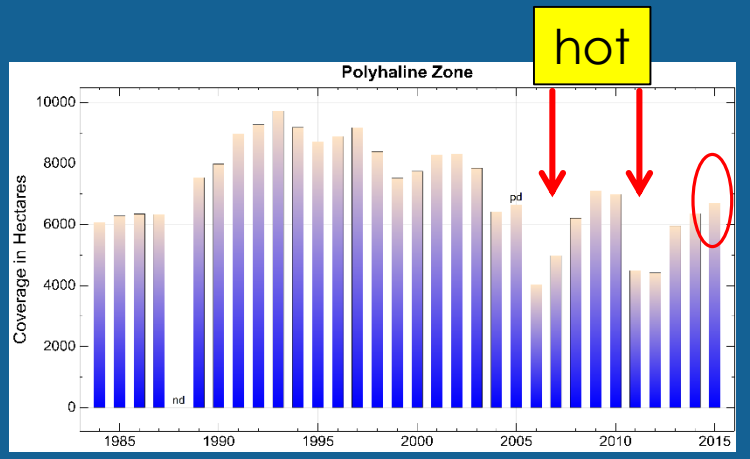
Virginia Institute of Marine Science


Tidal Fresh Zone
Coverage in Hectares
10000
8000
6000
4000
2000
0
pd
nd
1985
1990
1995
2000
2005
2010
2015

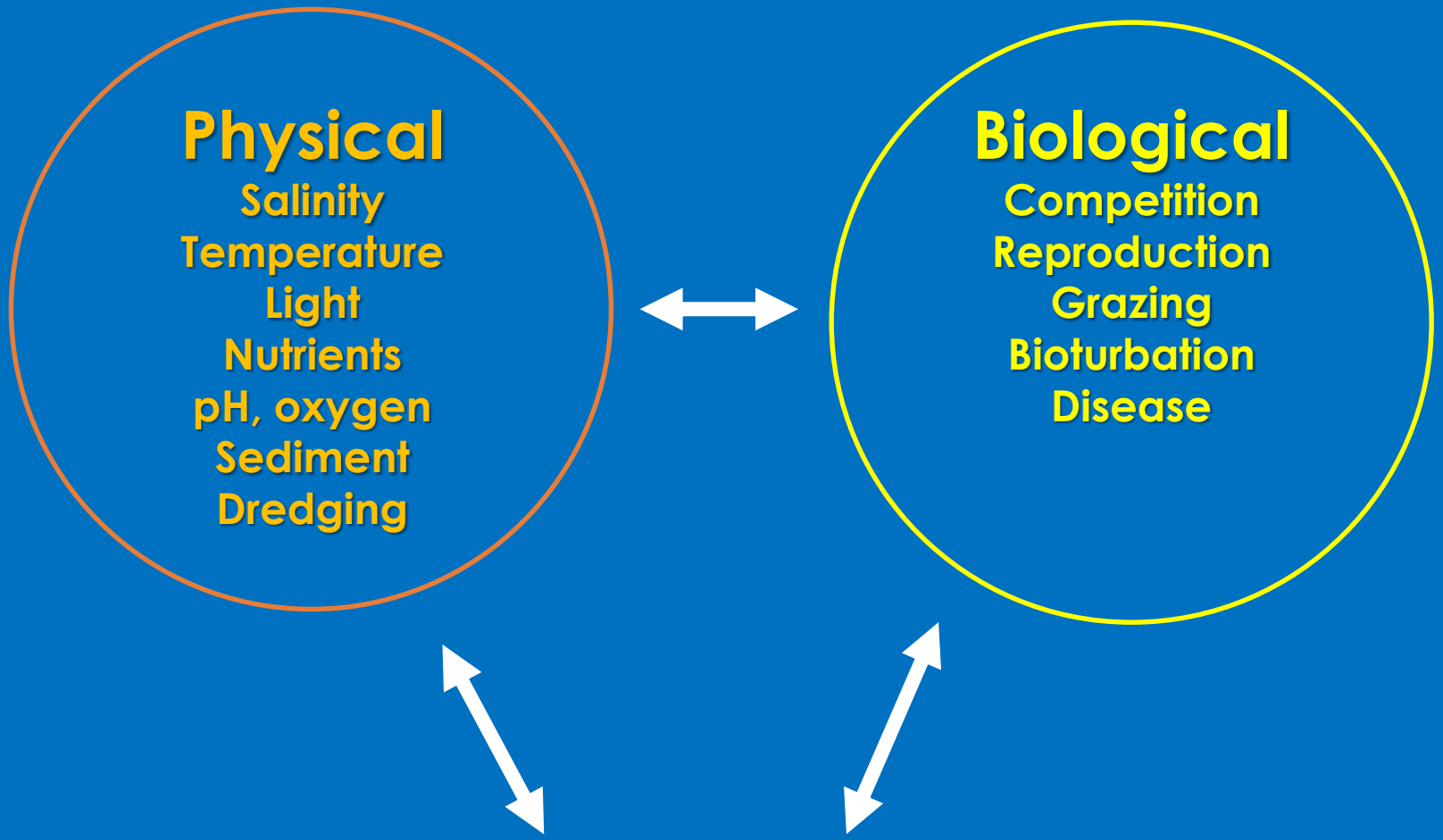

Oligohaline Zone
Coverage in Hectares
6000
4000
2000
0
pd
nd
1985
1990
1995
2000
2005
2010
2015

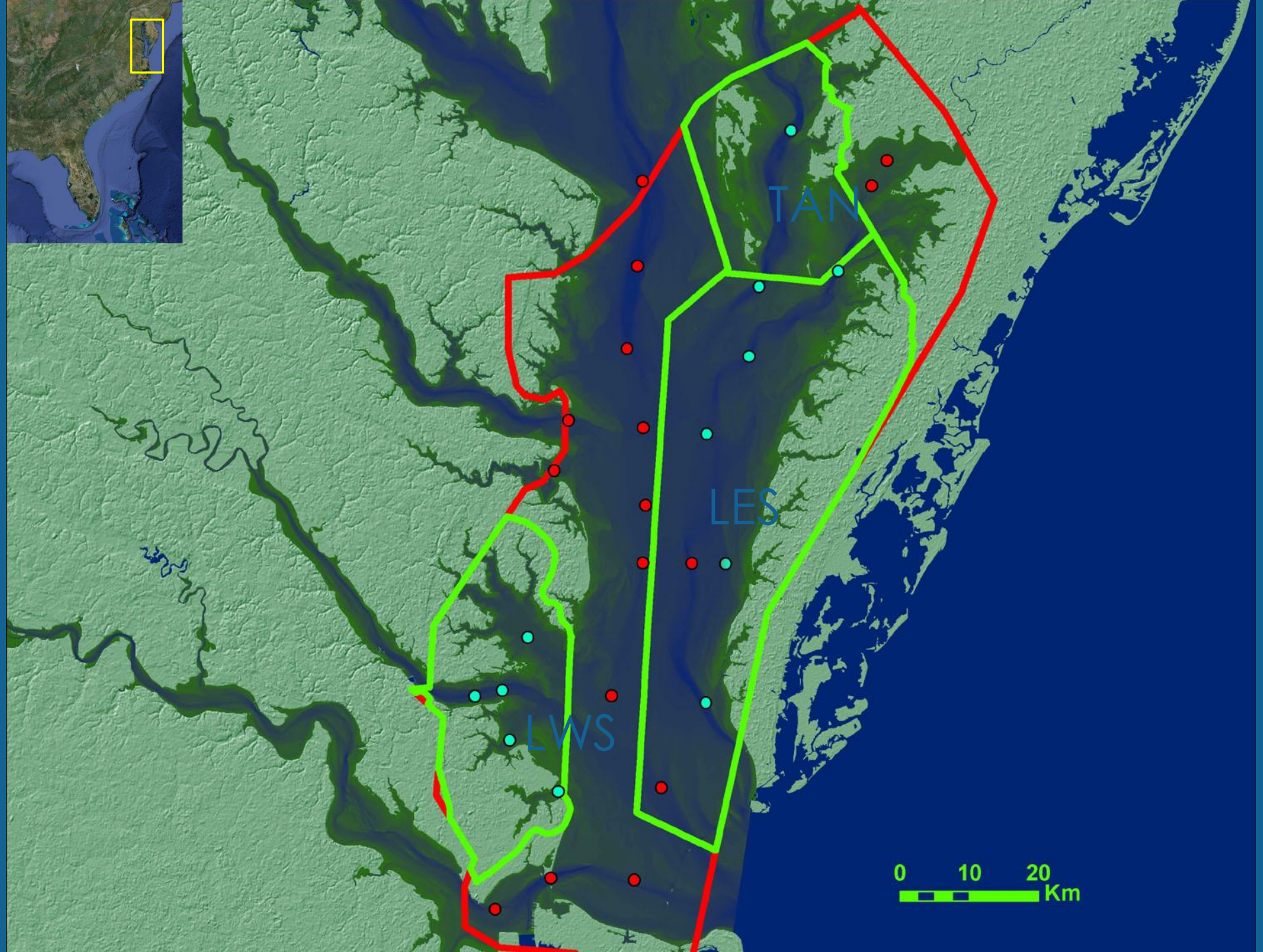

0-0.5
0.5-5
5-18
18-30
Susquehanna River
Dover
Delaware Bay
Annapolis
Washington
Chester River
Choptank River
Nanticoke River
Potomac River
Patuxent River
Delmarva Peninsula
Wicomico River
Rappahannock River
Fall Line
Chesapeake Bay
York River
Richmond
James River
Atlantic Ocean
Tidal Fresh
Oligohaline
Mesohaline
Polyhaline
0
25 Miles

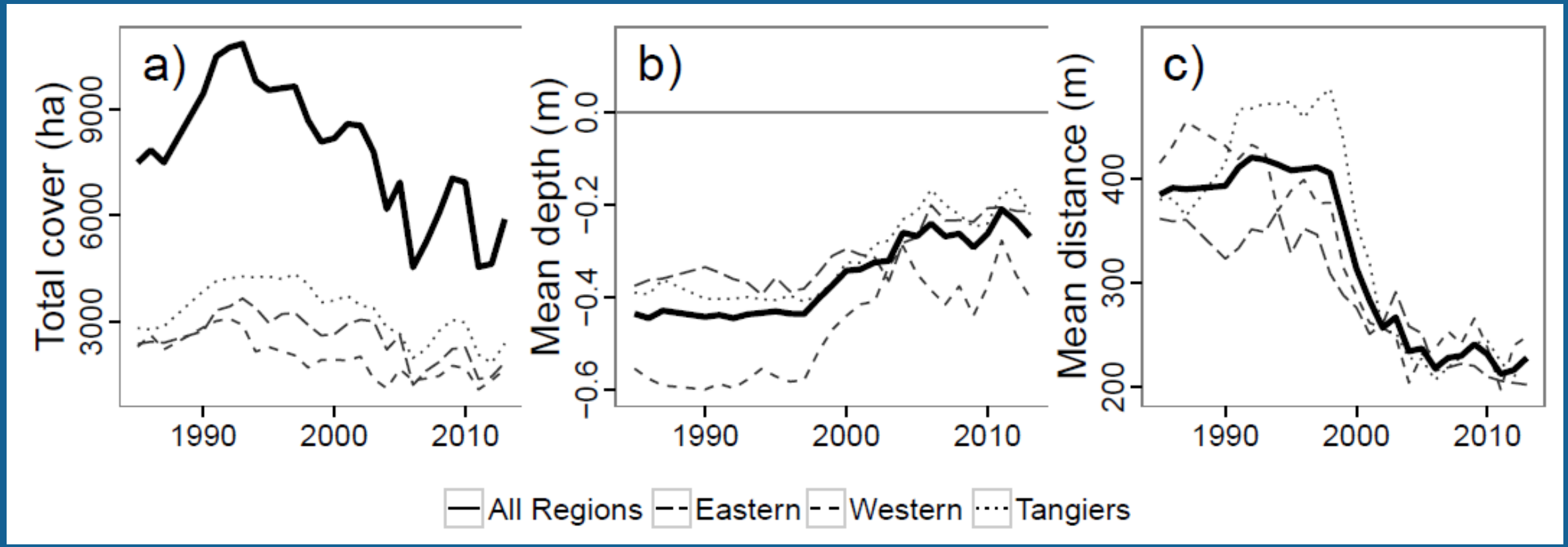

Mesohaline Zone
Coverage in Hectares
20000
15000
10000
5000
0
pd
nd
1985
1990
1995
2000
2005
2010
2015


hot
Polyhaline Zone
Coverage in Hectares
10000
8000
6000
4000
2000
0
pd
nd
1985
1990
1995
2000
2005
2010
2015

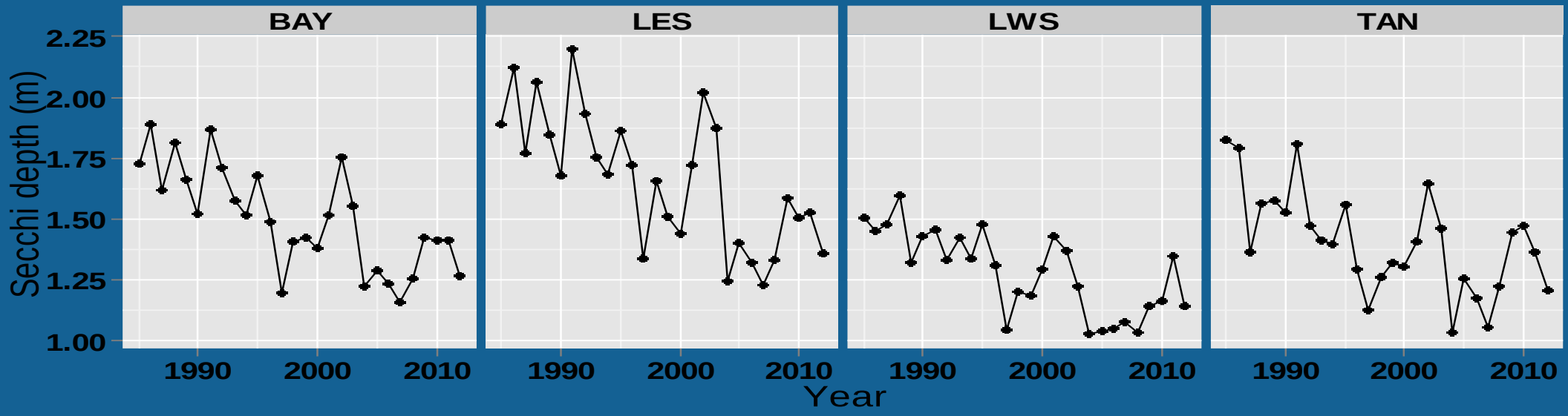
Physical and Biological Stressors and Existing SAV Condition all Interact to Affect Bed Persistence

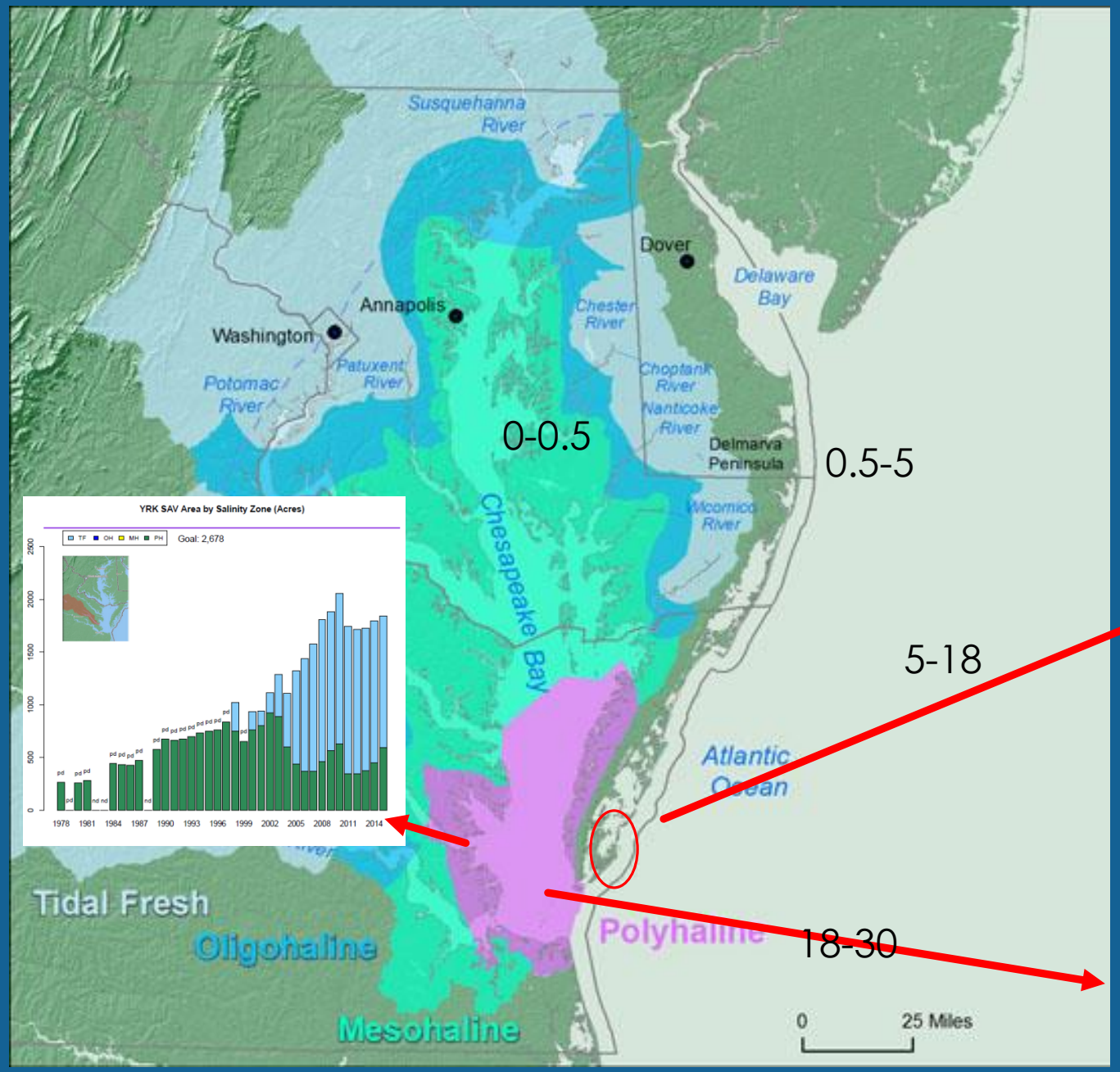



TAN
LES
LWS
0
10
20
Km

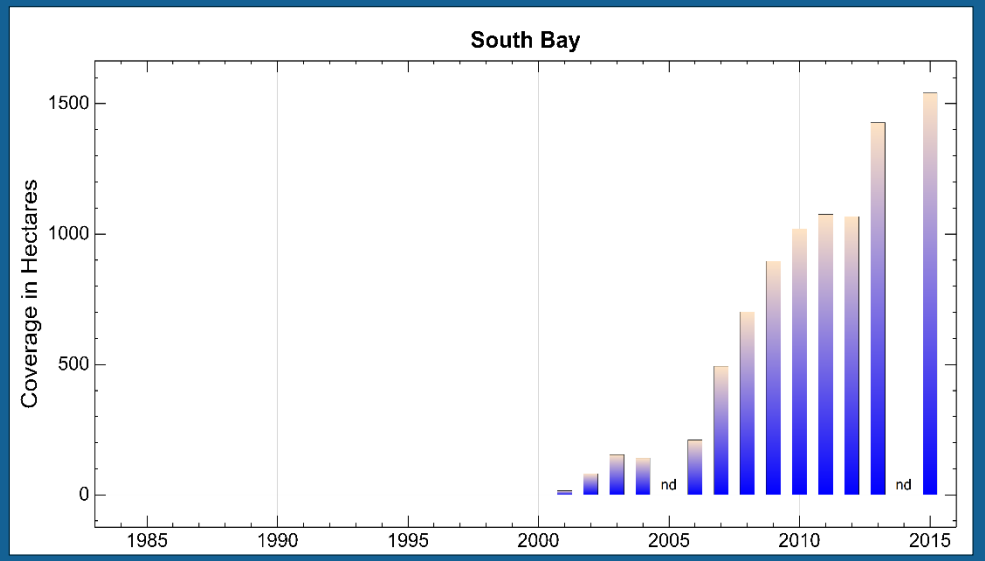

a)
Total cover (ha)
3000
6000
9000
1990
2000
2010
b)
Mean depth (m)
−0.6
−0.4
−0.2
0.0
1990
2000
2010
c)
Mean distance (m)
200
300
400
1990
2000
2010
All Regions
Eastern
Western
Tangiers

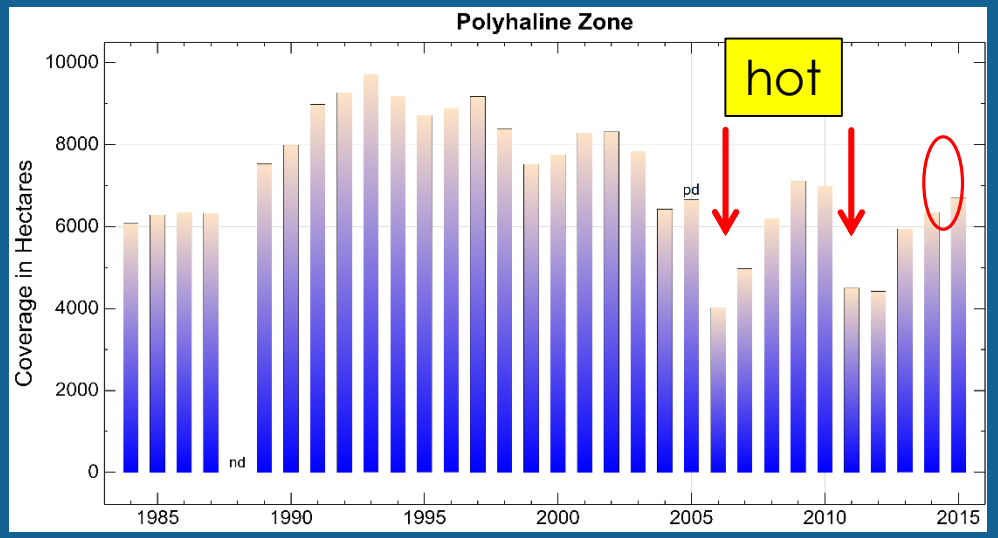
Water clarity has decreased dramatically



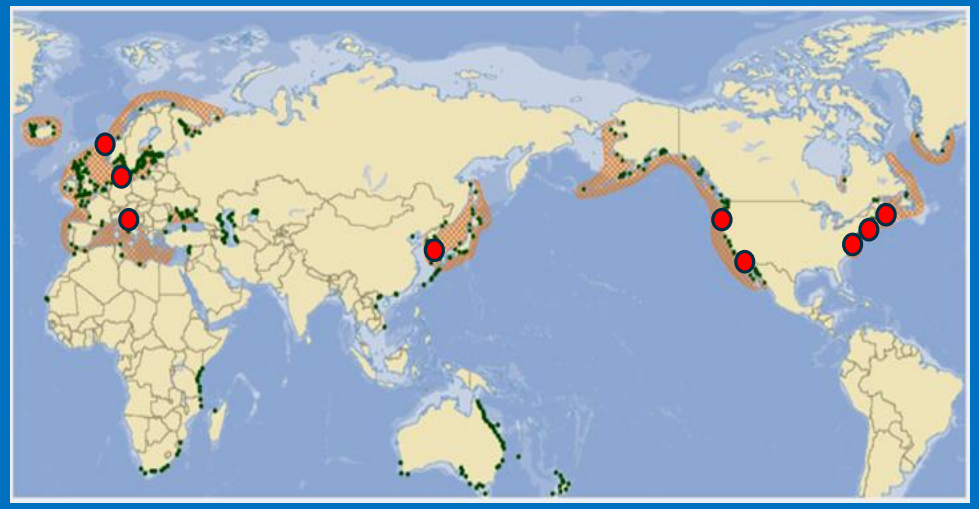

Susquehanna River
Dover
Delaware Bay
Annapolis
Washington
Chester River
Patuxent River
Potomac River
Choptank River
Nanticoke River
Delmarva Peninsula
Wicomico River
0-0.5
0.5-5
5-18
18-30
Chesapeake Bay
Atlantic Ocean
Tidal Fresh
Oligohaline
Mesohaline
Polyhaline
0
25 Miles

YRK SAV Area by Salinity Zone (Acres)
TF
OH
MH
PH
Goal: 2,678
1978 1981 1984 1987 1990 1993 1996 1999 2002 2005 2008 2011 2014


South Bay
Coverage in Hectares
1500
1000
500
0
nd
nd
1985 1990 1995 2000 2005 2010 2015

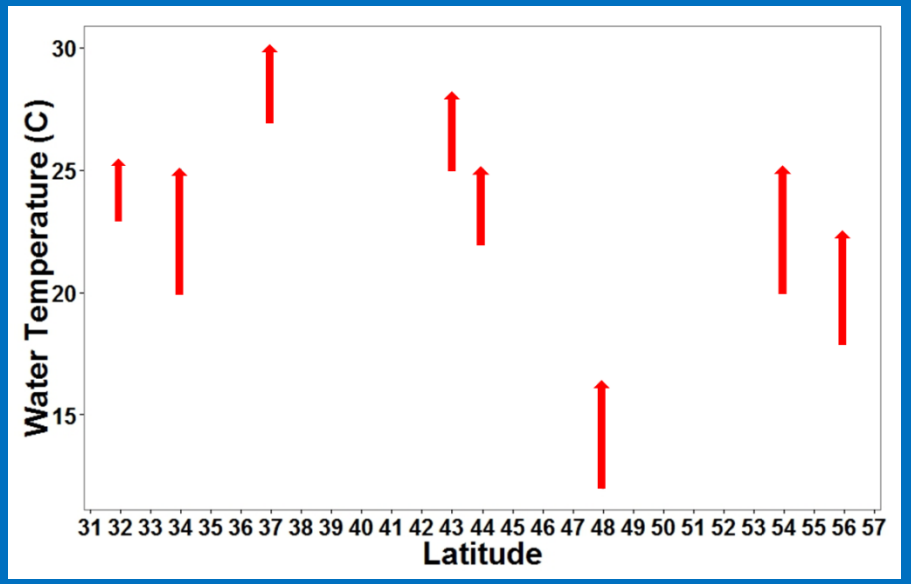

Polyhaline Zone
hot
Coverage in Hectares
10000
8000
6000
4000
2000
0
nd
pd
1985 1990 1995 2000 2005 2010 2015

Eelgrass Declines Associated With Episodic Heat Stress Events are Increasingly Observed Worldwide



- Locations reporting heat related eelgrass die-backs

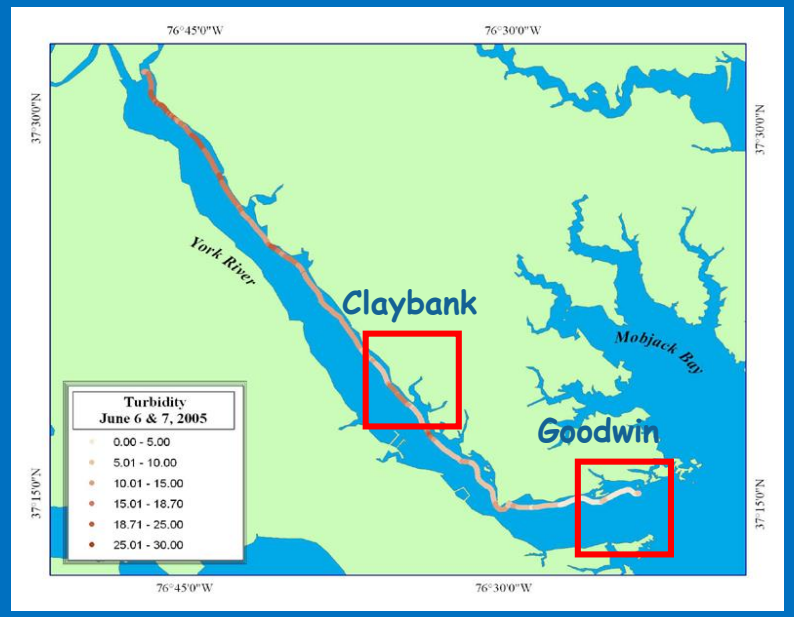
Short-term heat stress temperature increases (2-5 °C) are similar across latitudes (↑nominal to stress level)



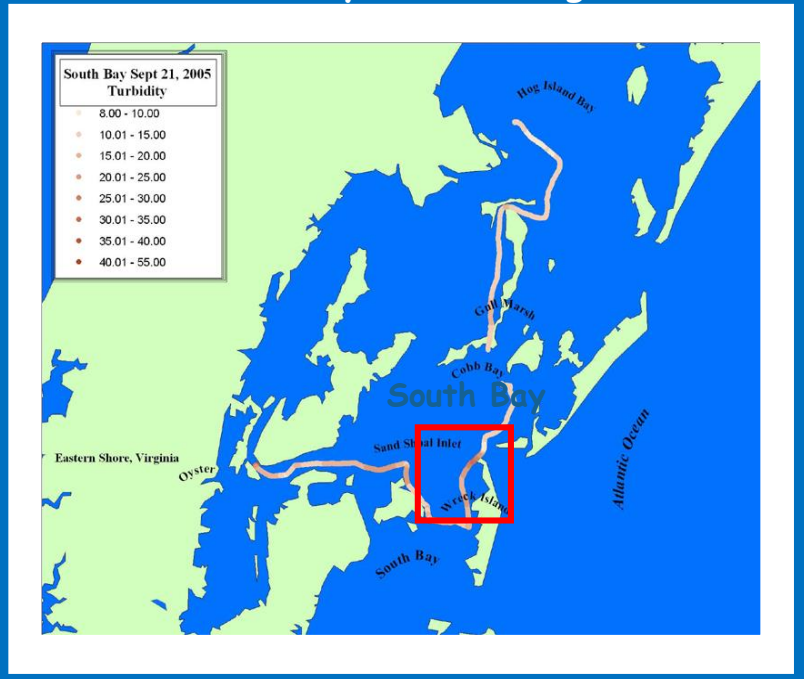
How might turbidity and temperature be interacting to influencing eelgrass persistence in South Bay compared to the lower Chesapeake Bay?

To what degree does the light availability (Iz) meet the light requirements (Ic) of the eelgrass community?

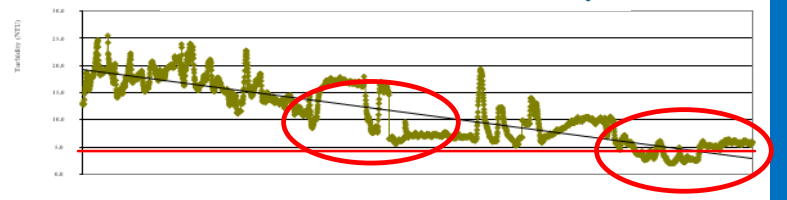
York River Estuary



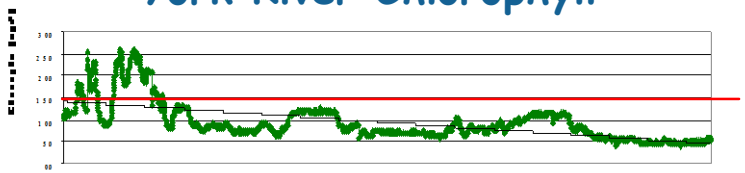
South Bay Coastal Lagoon



York River Turbidity

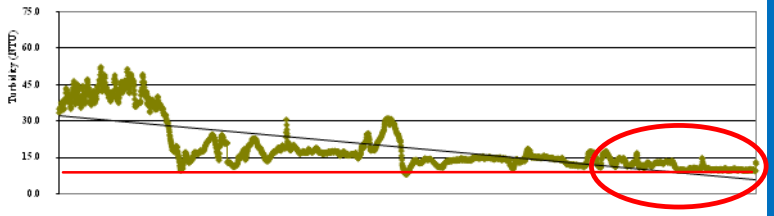


York River Chlorophyll

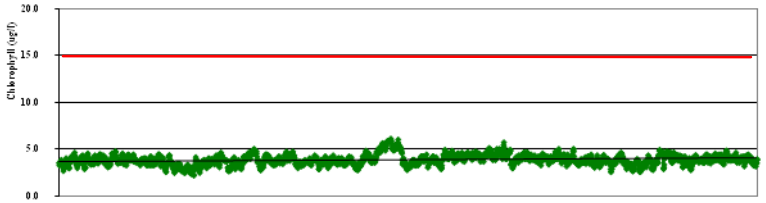


Seagrass Habitat Criteria (15%)

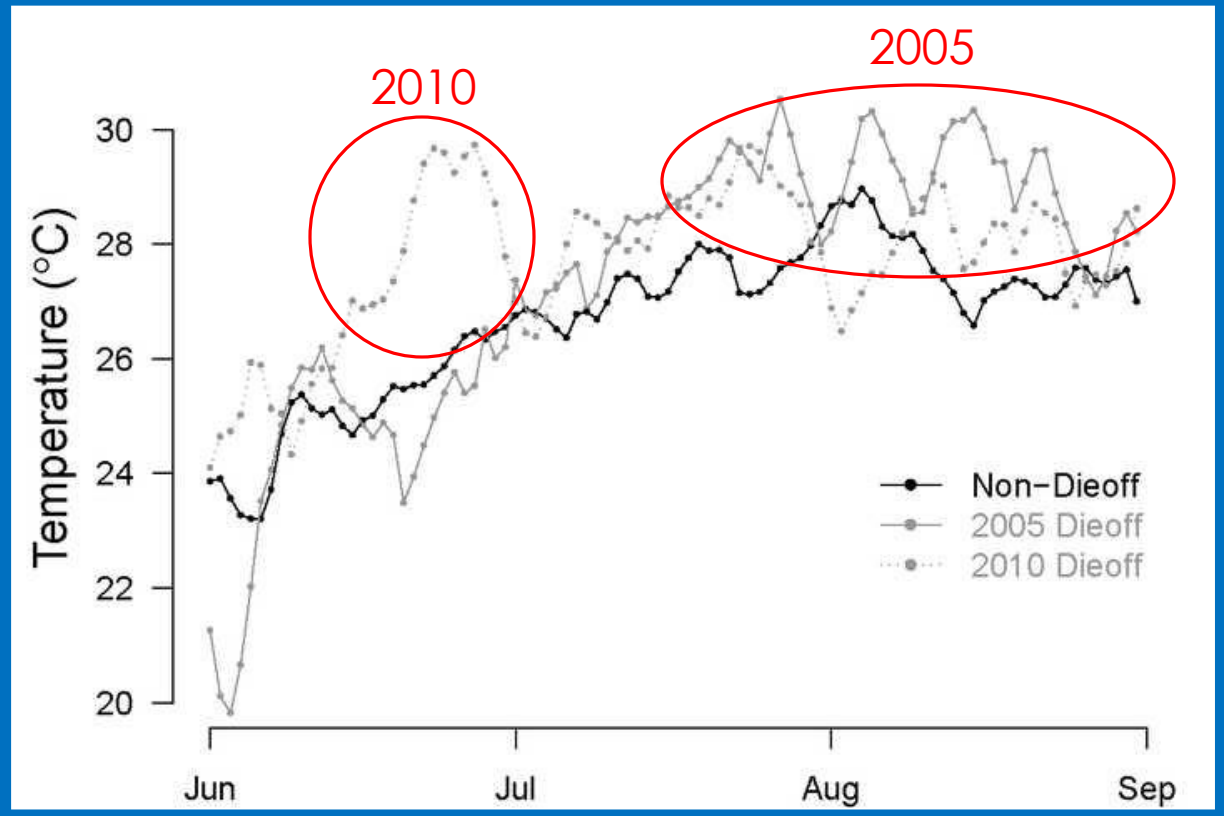
South Bay Turbidity



South Bay Chlorophyll



SHORT TERM EXPOSURES TO STRESSFUL CONDITIONS CAN HAVE LONG TERM CONSEQUENCES

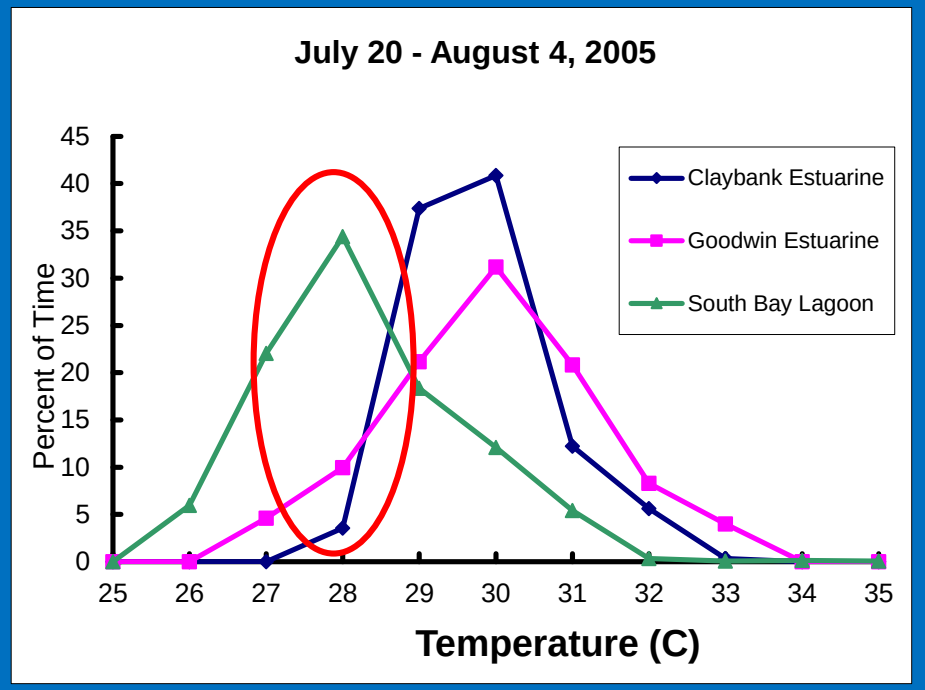


Seagrass Non-Dieoff Years = 2004, 2006, 2007, 2008, 2009

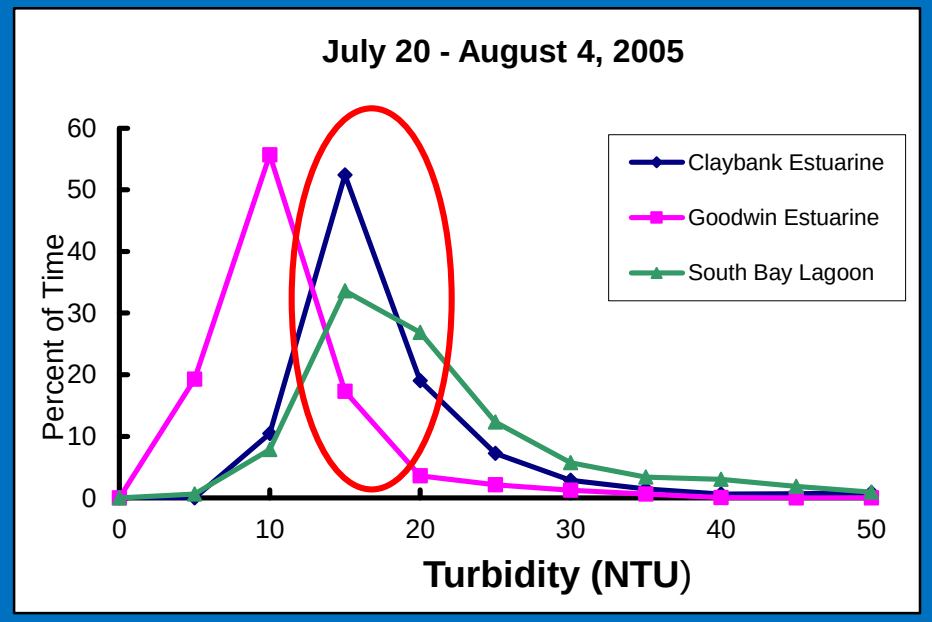
Seagrass Dieoff Years = 2005, 2010

Moore et al. 2014 Estuaries and Coasts

Summer **water temperatures** in eelgrass areas of South Bay were distinctly ***lower*** than stressed and denuded areas in the Chesapeake Bay



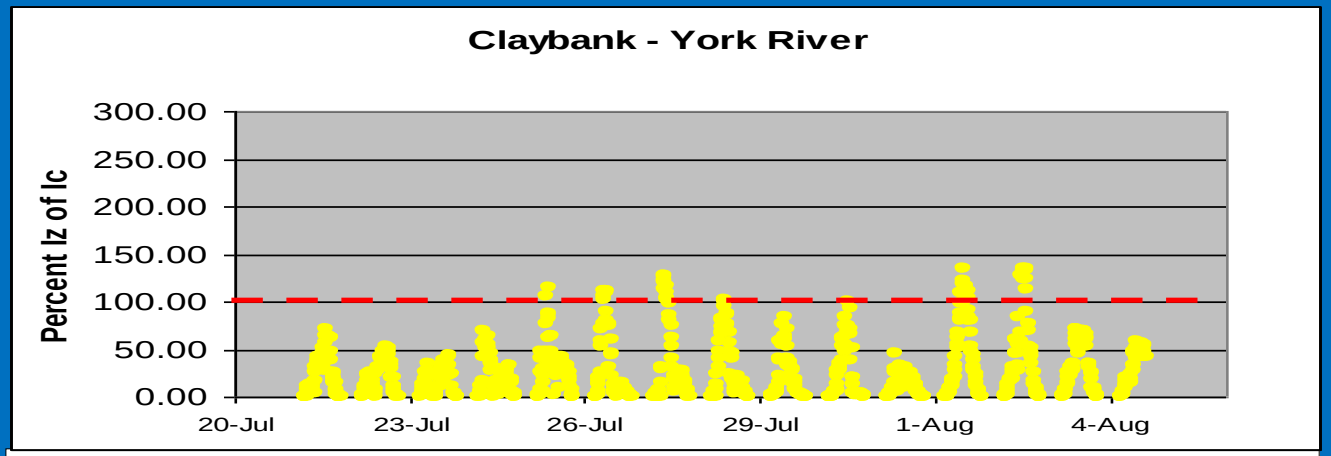
Summer **turbidity levels** in eelgrass areas of South Bay were ***comparable*** to stressed areas of Chesapeake Bay



Available light (I_z) as a proportion of eelgrass light requirements (I_c)

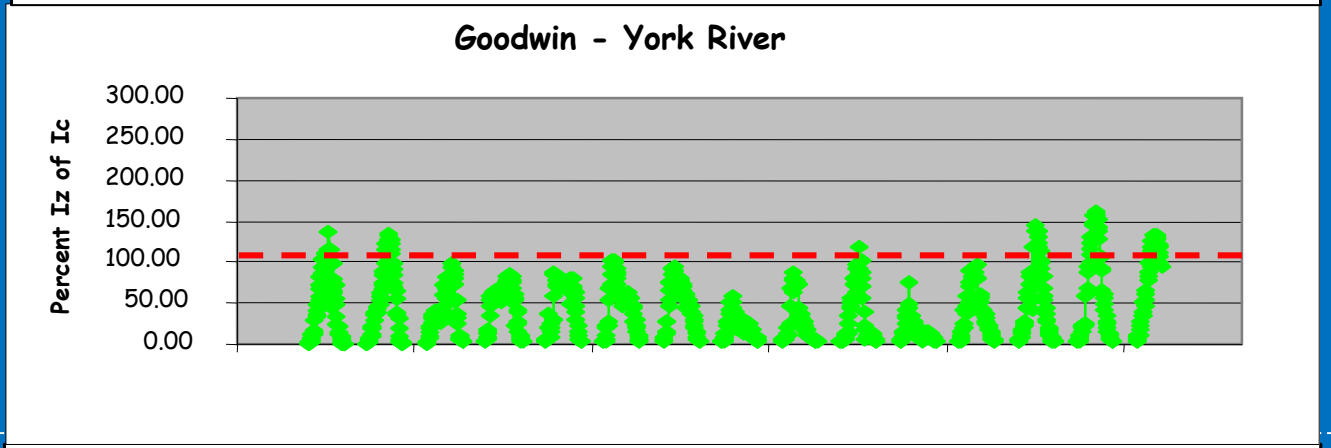
No Eelgrass

Mean I_z = 27% I_c



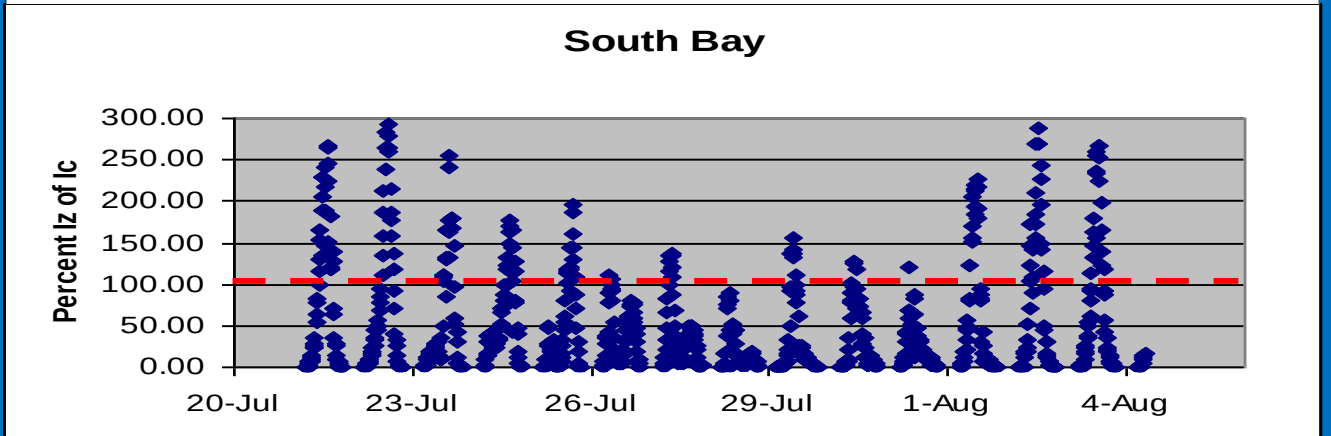
Stressed Eelgrass

Mean I_z = 42% I_c

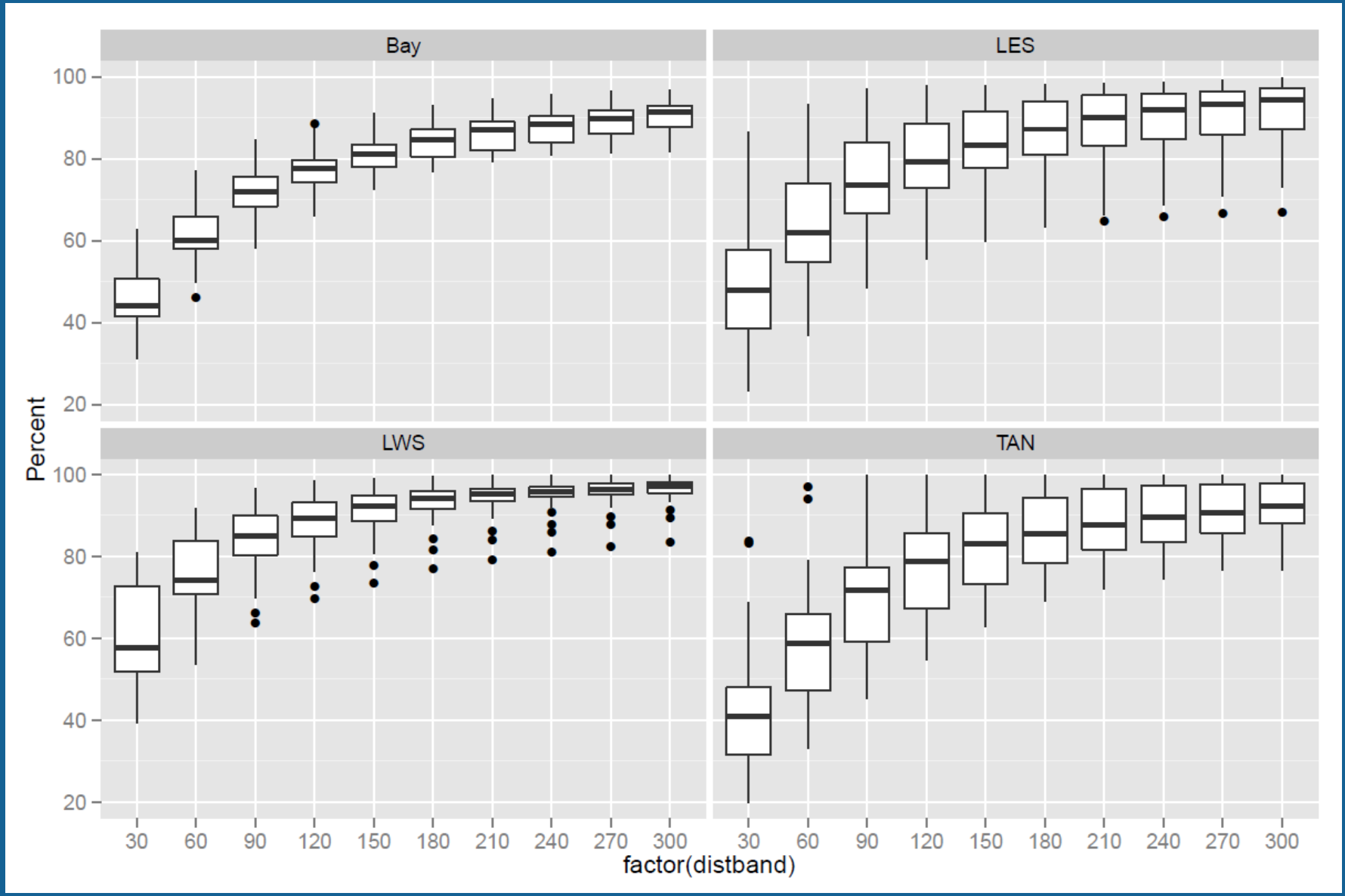


Expanding Eelgrass

Mean I_z = 55% I_c



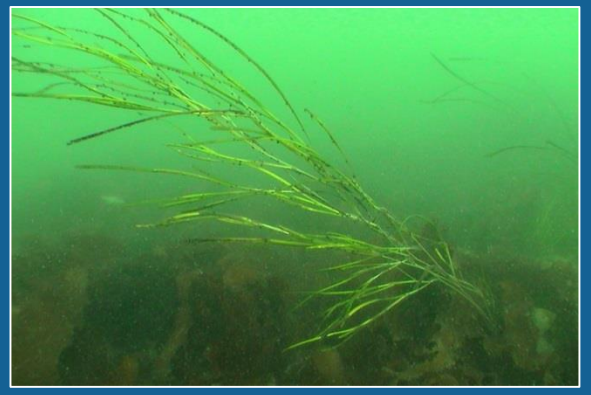
$I_z = I_c$

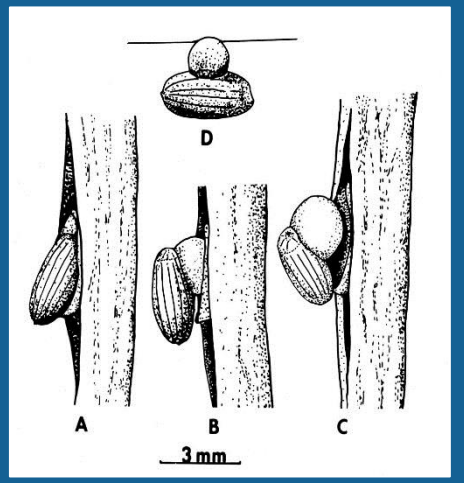


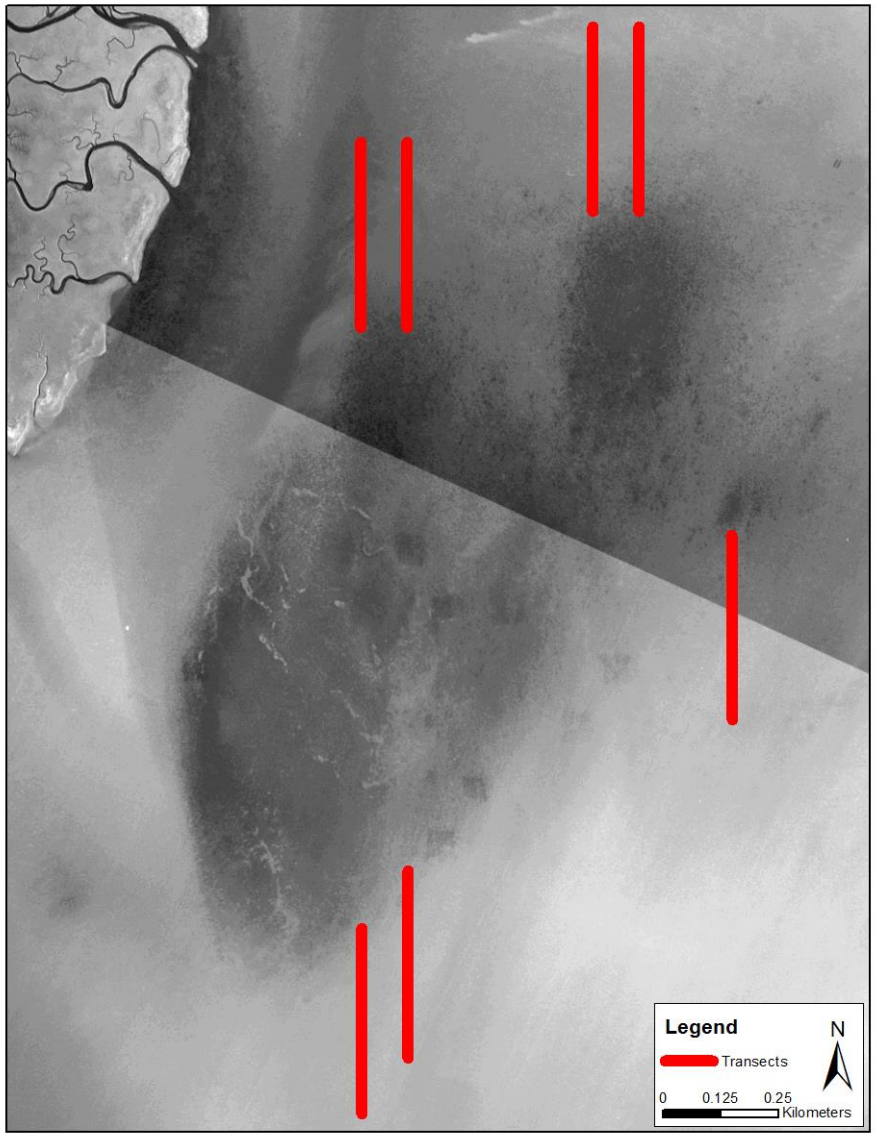
Percentage of new SAV growth each year by distance to existing SAV

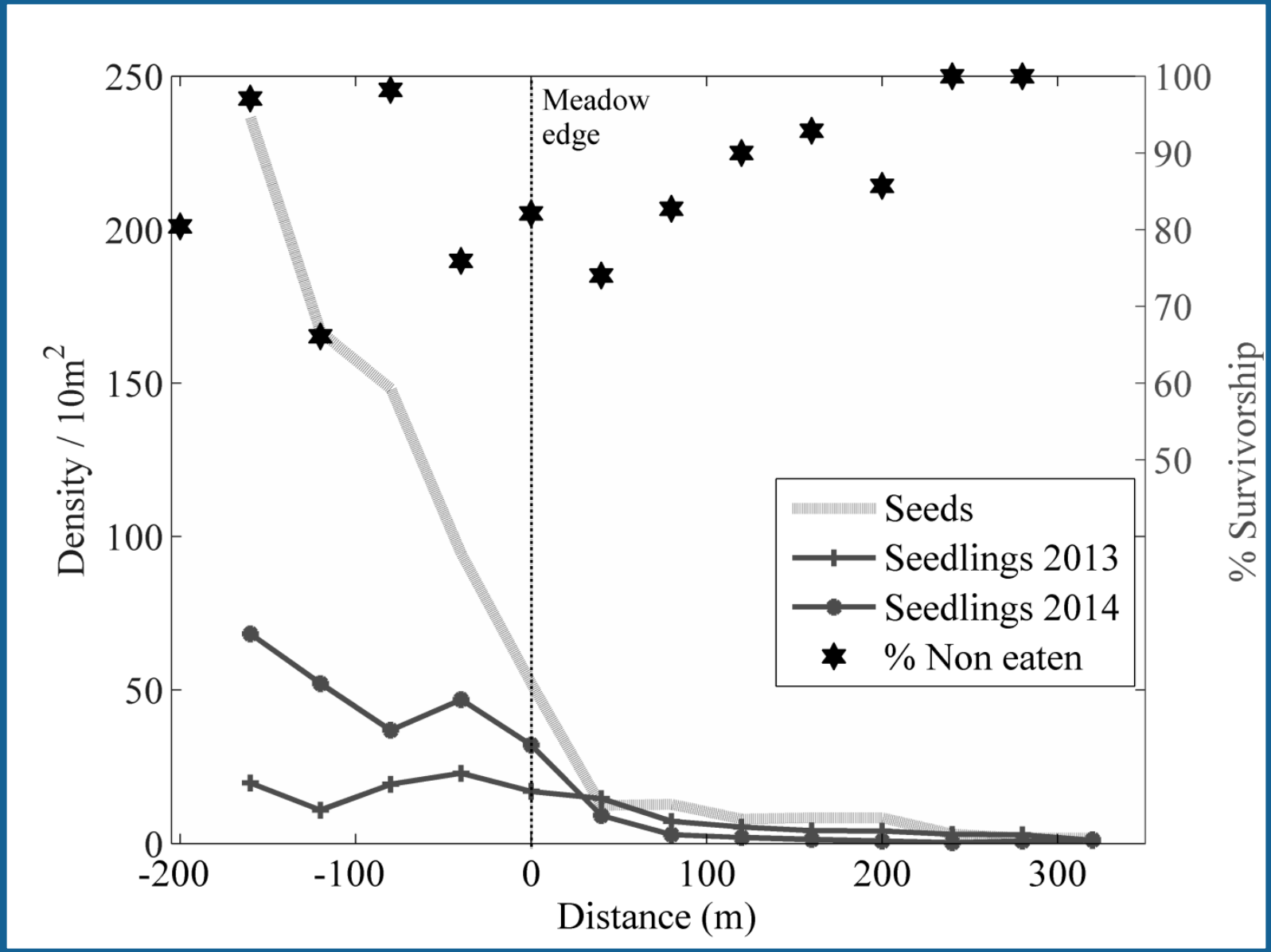
Z. marina Seed Dispersal

- Most seeds fall close to the parent plant
- Individual seeds carried by gas bubbles (m's to 200 m.
- Rafting of whole flowering shoots with seeds (100s m to 10s Kms)

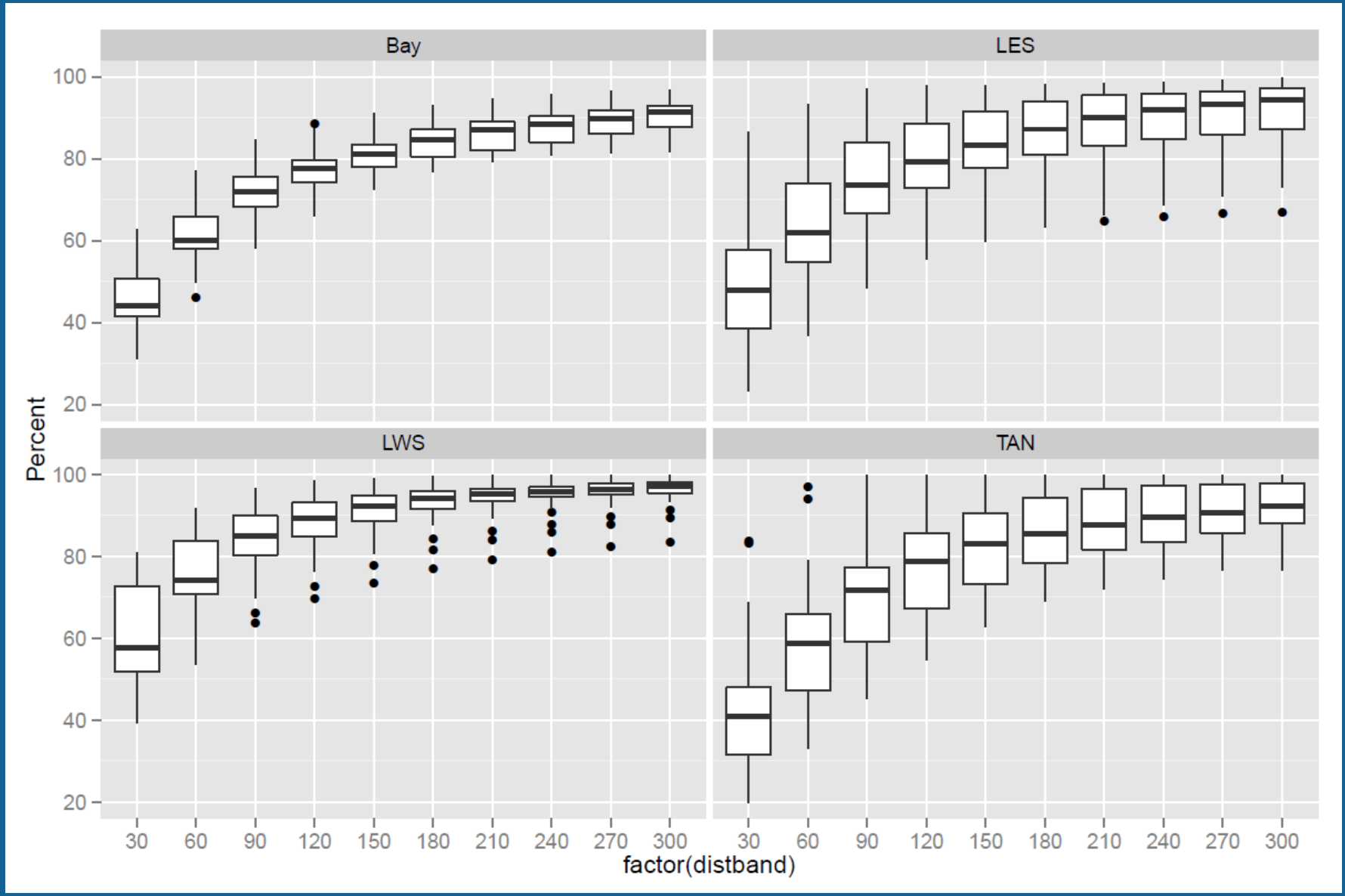






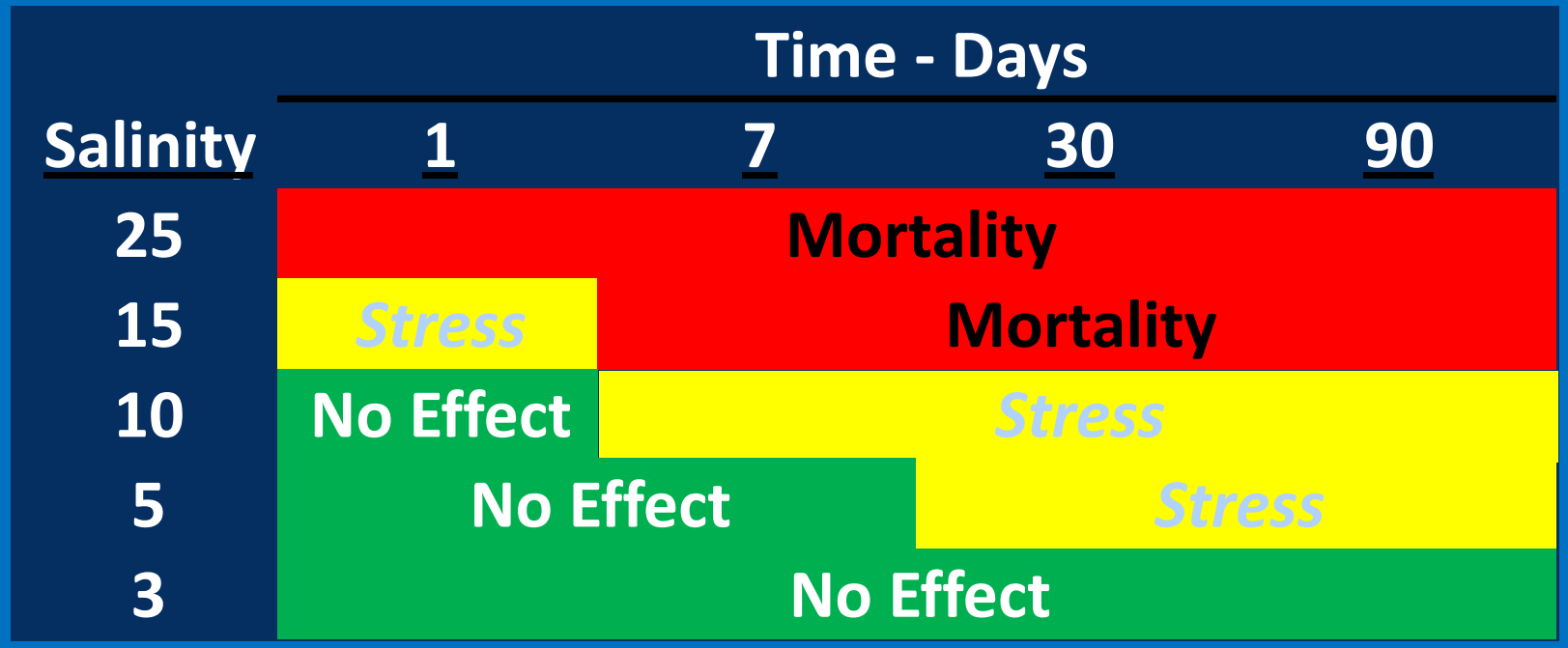


Manley et al 2015, MEPS

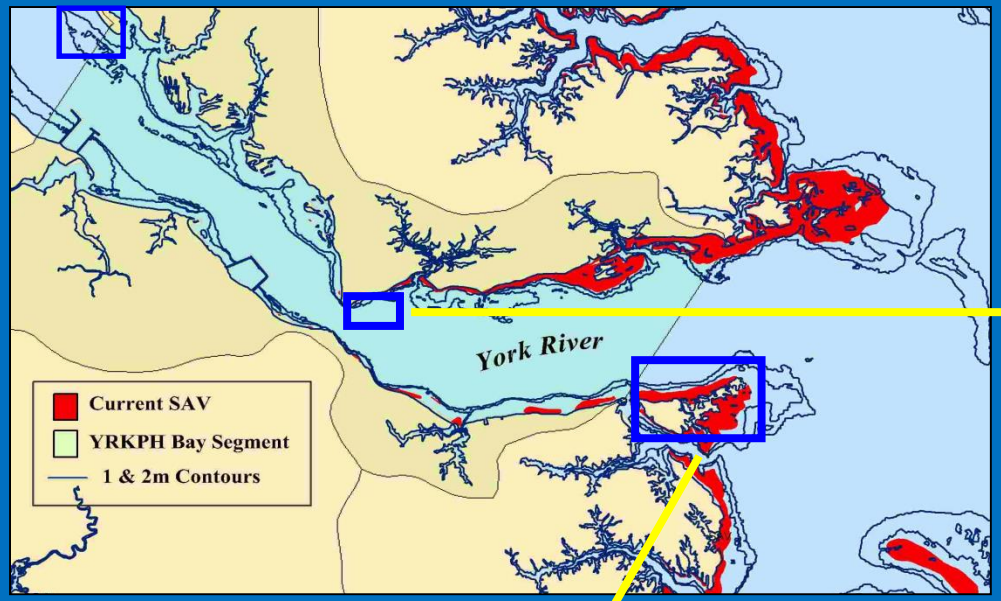


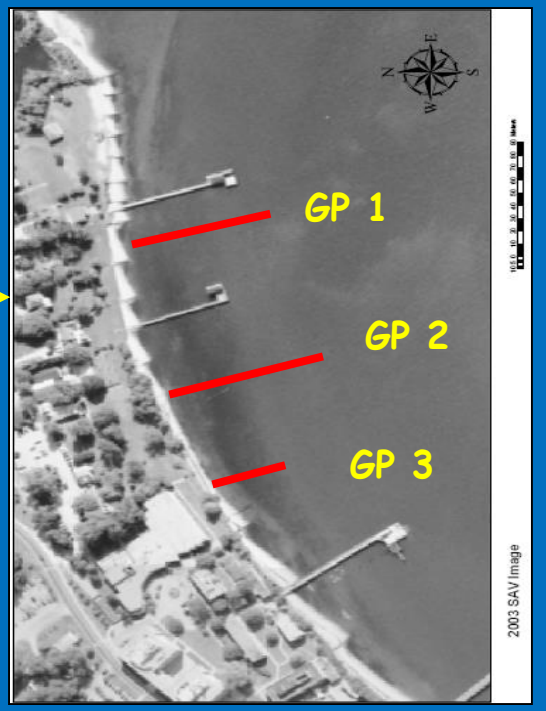
Percentage of new SAV growth each year by distance to existing SAV

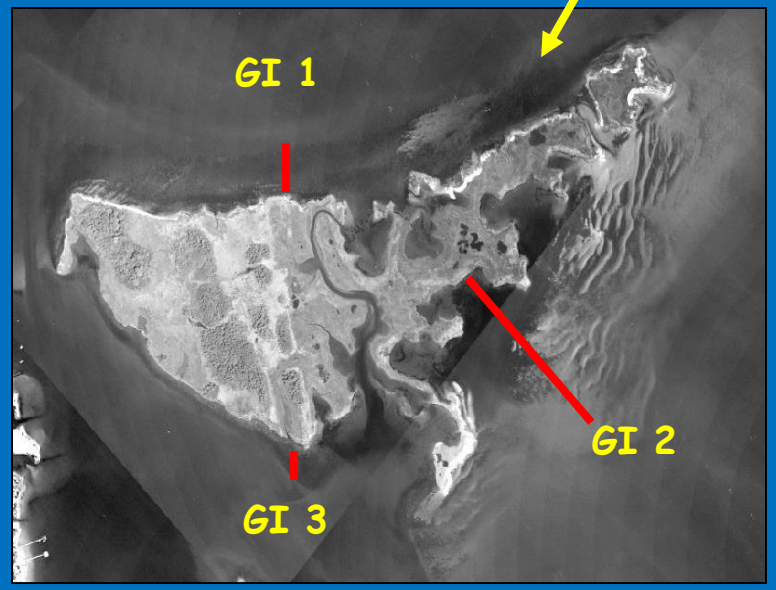
Duration and Intensity of Salinity Stresses to *Vallisneria americana* Are Similar to Those of Other Lower Salinity Tolerant SAV



INTERACTION OF *ZOSTERA* AND *RUPPIA* IN LOWER BAY



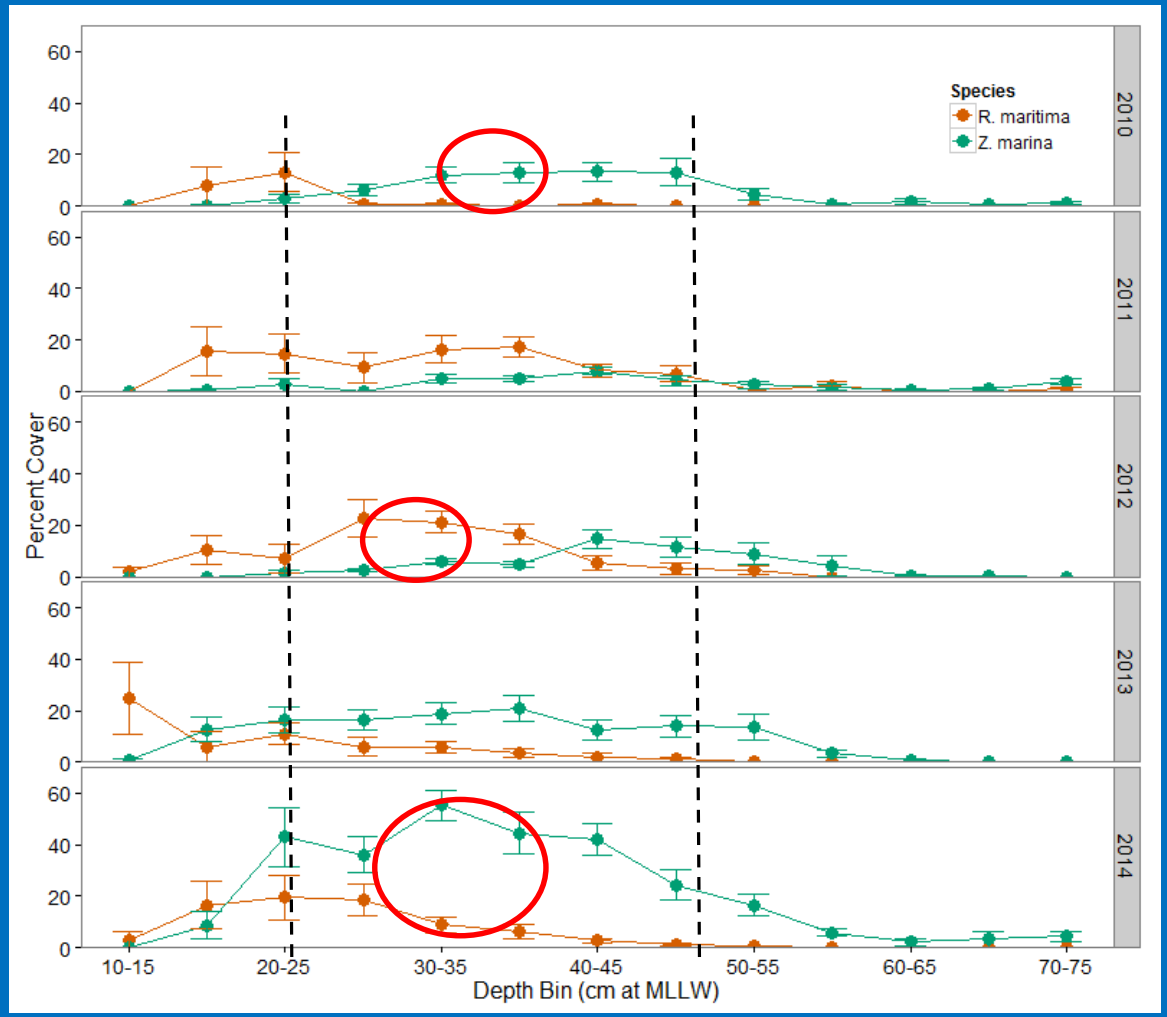




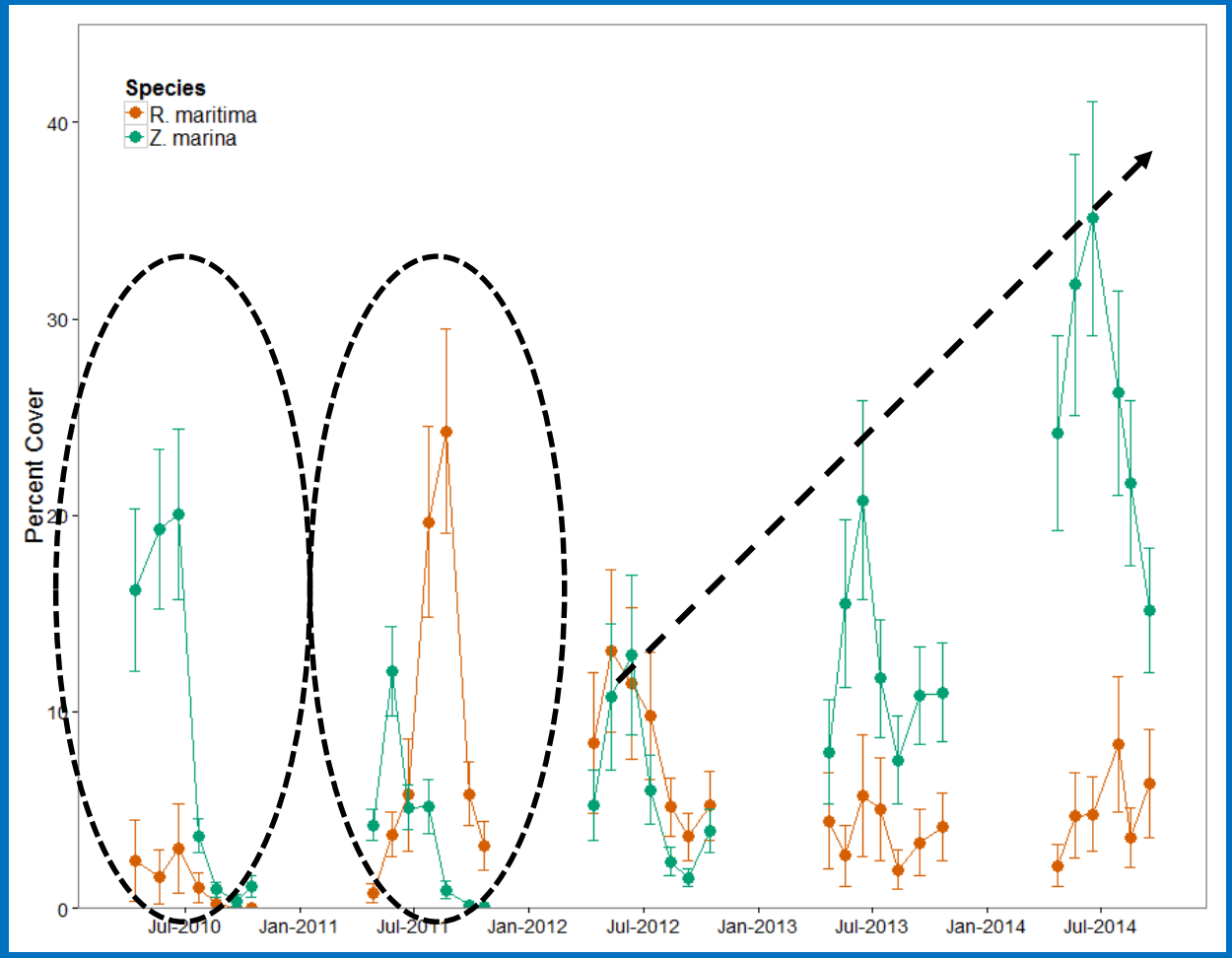
CBNERRVA Continuous monitoring stations

- YSI data sondes (15 minute)
- DO, Chl, Turb, Salinity, pH, Temp

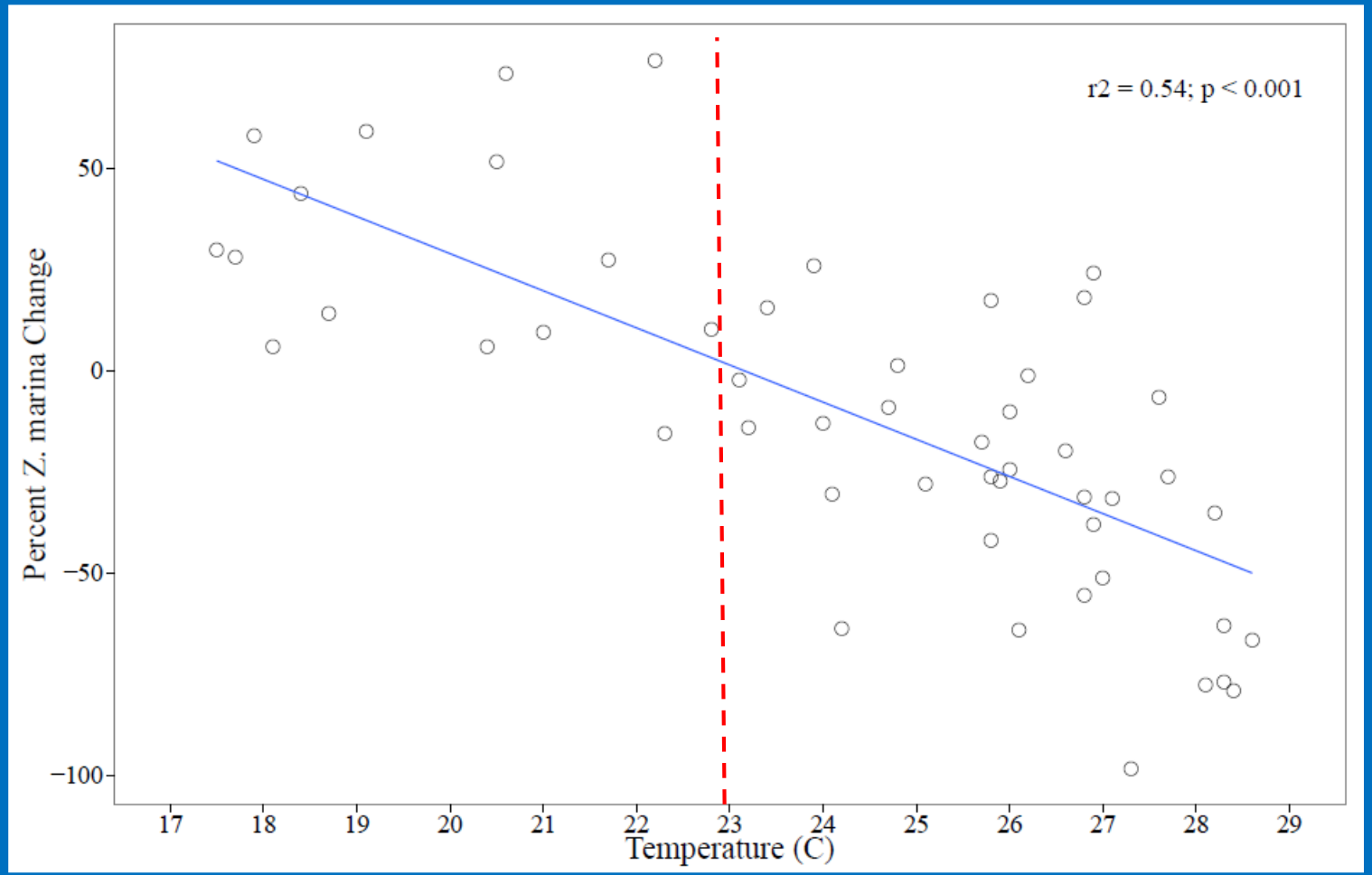
Abundance of *Z. marina* and *R. maritima* by depth (2010-2014)



Monthly mean (SE) *Z. marina and R. maritima* vegetative cover (2010-2014)

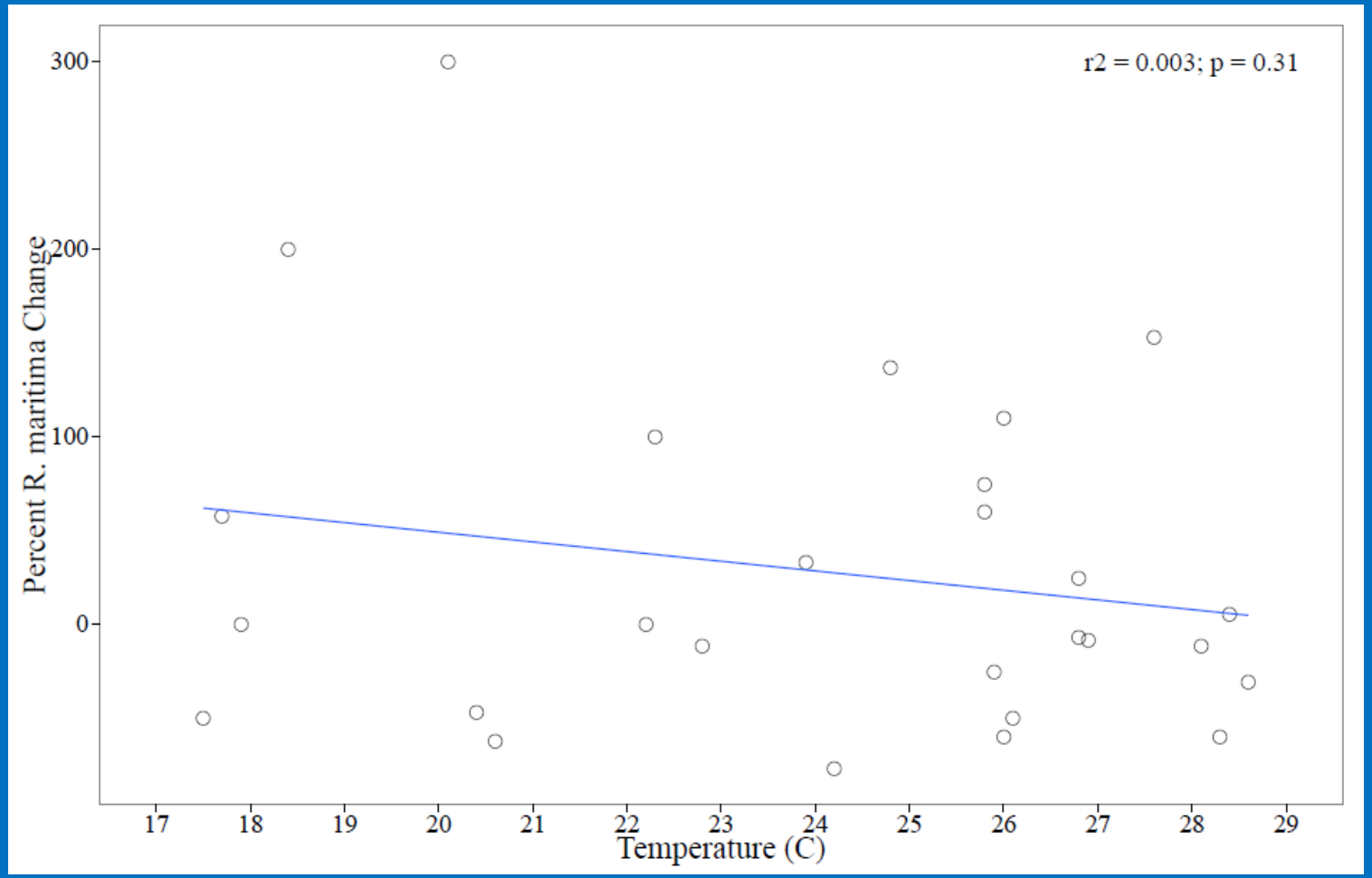


Monthly change in *Z. marina* cover vs. mean water temperature (April-October 2004-2014)

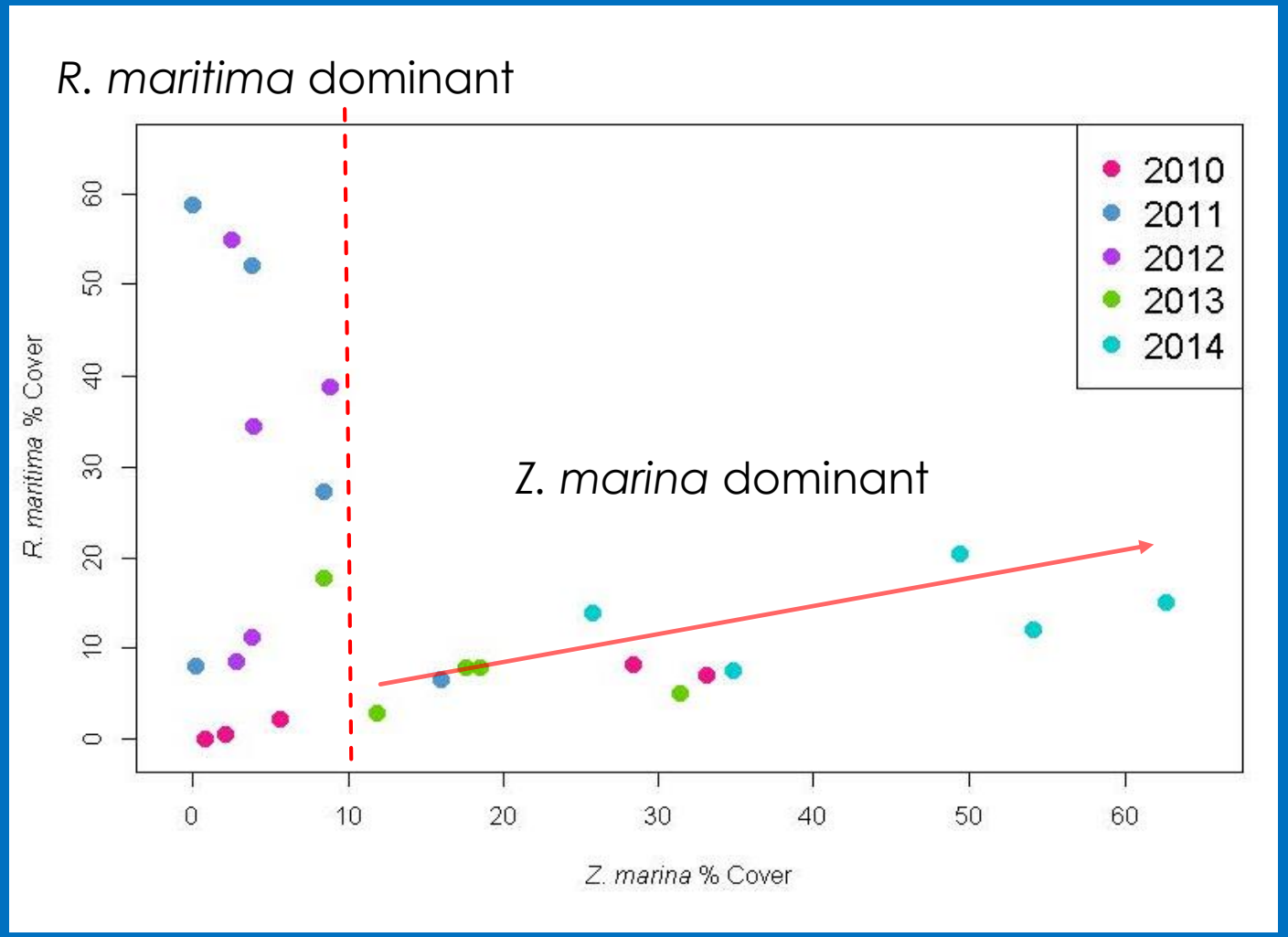


after Moore et al. 2014

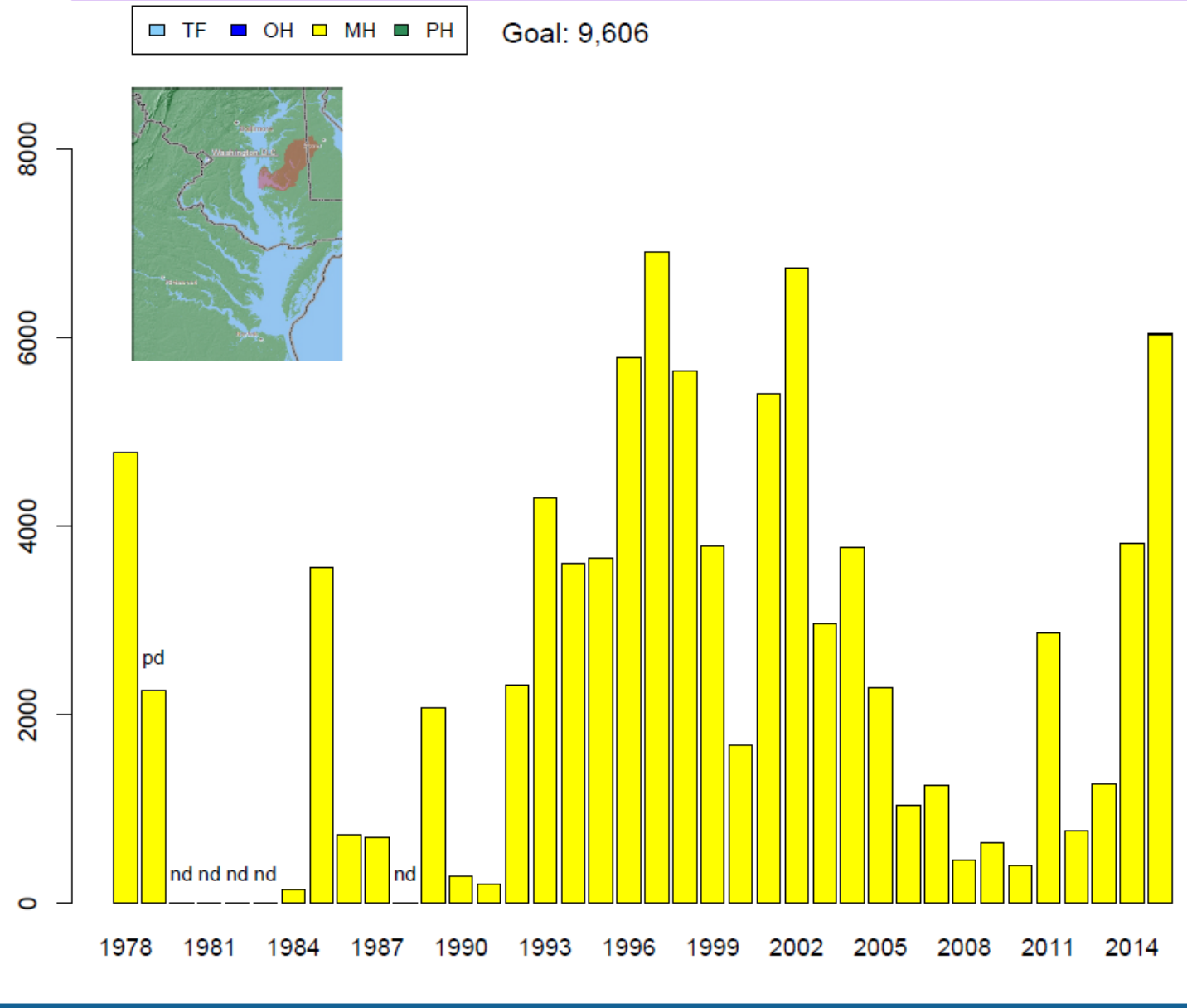
Monthly change in *R. maritima* cover vs. mean water temperature (April-October 2004-2014)



In Some Mixed Growth Areas Loss of *Zostera* May Allow *Ruppia* to Expand



CHO SAV Area by Salinity Zone (Acres)



Implications for the Choptank

- High Frequency Monitoring in addition to the annual monitoring SAV monitoring critical to understand trends
- What are the links between environmental conditions and drivers of SAV abundance and diversity populations?
- How important are controllable vs. non-controllable drivers affecting SAV abundance?
- What management and restoration efforts will be most productive and successful?