Designing Sustainable Coastal Habitats

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stac

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http://www.chesapeake.org/stac/

Climate Change and Chesapeake Bay Habitats

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Sustainable Fisheries GIT Meeting
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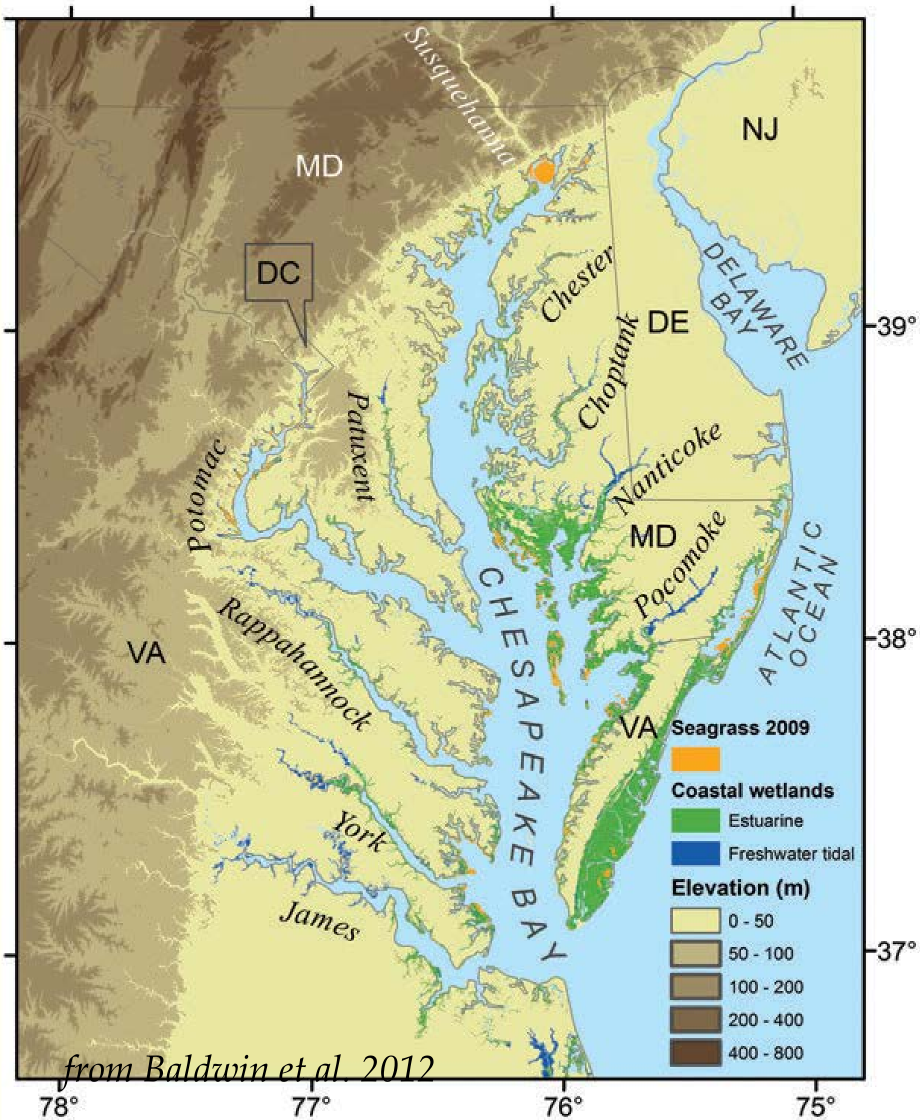
VIMS | William & Mary
Virginia Institute of Marine Science

Existing coastal wetlands – Chesapeake Bay



from Baldwin et al. 2012

Total Bay Coastal Wetlands
~~595,000 ha

NON-TIDAL COASTAL WETLANDS

State	Coastal (ha)	%
VA	**260,627**	**64**
MD	**136,558**	**90**

Havens, regional assessment

TIDAL FRESHWATER WETLANDS

State	(ha)
Delaware	823
Maryland	**10,345**
Virginia	**16,000**
North Carolina	1,200
South Carolina	26,115
Georgia	19,040

After: Mitsch & Gosselink 2000

BRACKISH & SALT MARSH

Salt Marsh	**27,438**
Brackish marsh	**123,651**

***SAV (2012)* ~ 19,500 ha**

Two principal drivers of bay habitat persistence, human use and climate, are constantly changing

Human Use

Climate Change

Climate Change can affect coastal wetlands through multiple ways

Temperatures can change plant growth and assemblages

Storms can physically remove SAV beds and marsh plants

Changing weather patterns can affect local salinity

Runoff can add to turbidity and nutrient levels

Sea level rise can increase water depth & reduce available habitat

Shoreline protection can prevent landward migration

Climate Projections for Chesapeake Bay

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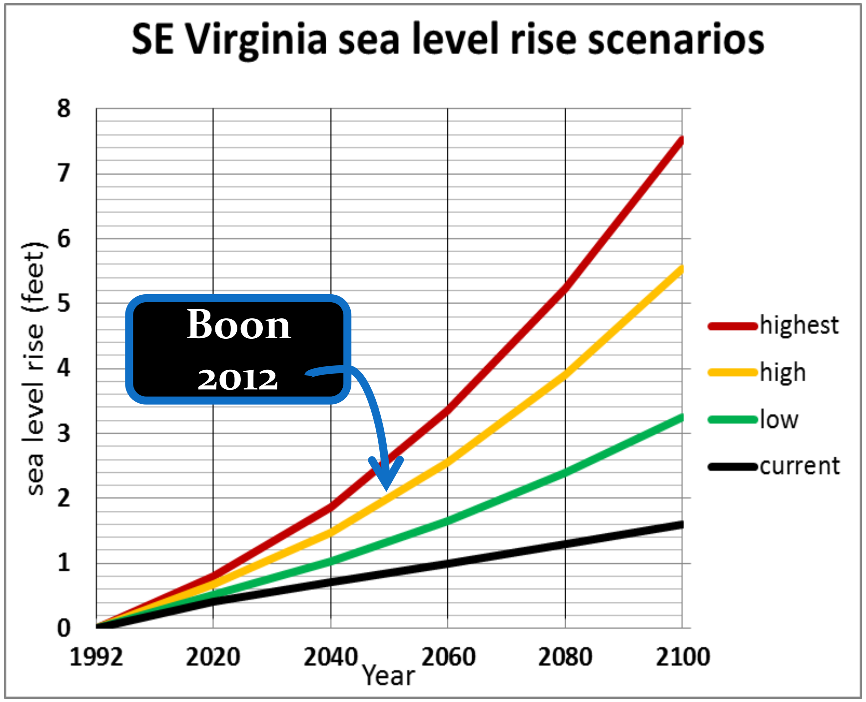
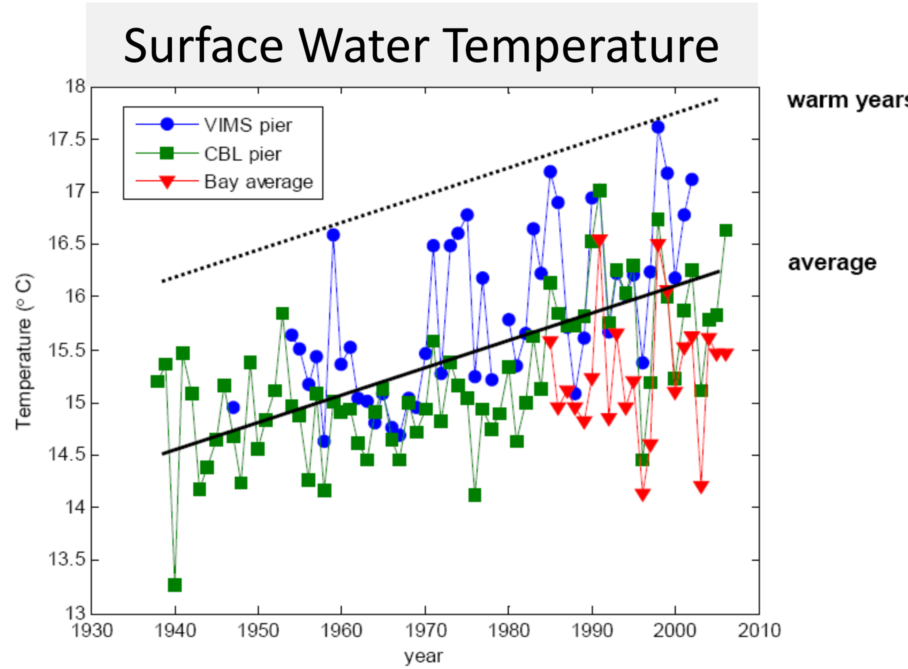




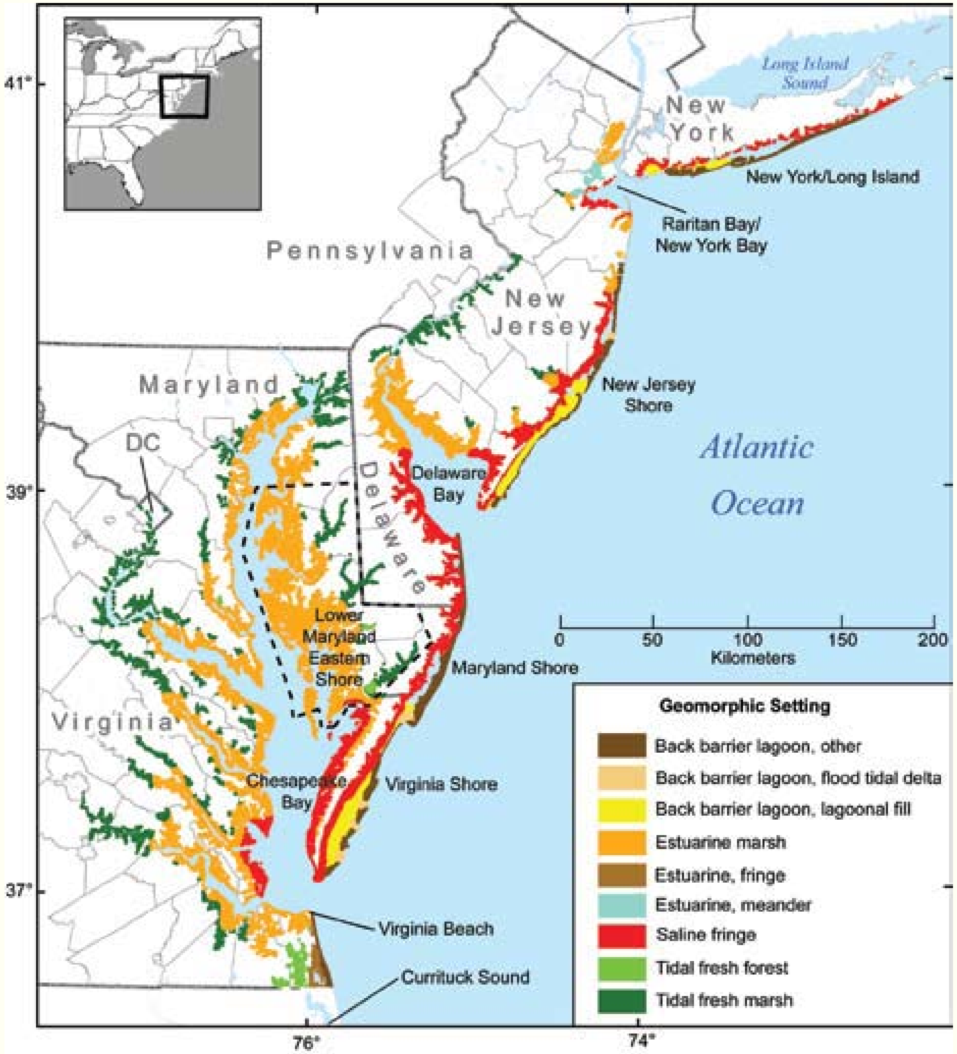
- SE VA Average Rate is 4.42 mm/yr & accelerating (~3.4 mm/yr baywide)
- **SE VA is likely to see a 2–3 ft rise by 2050**

- Both mean and max annual temps have increased by more than 1°C (1.8°F) over the past 5-6 decades
- Seasonal warming occurring ~3 weeks earlier than in the 1960s
- **Expected increase of 2 – 6° C by 2100**

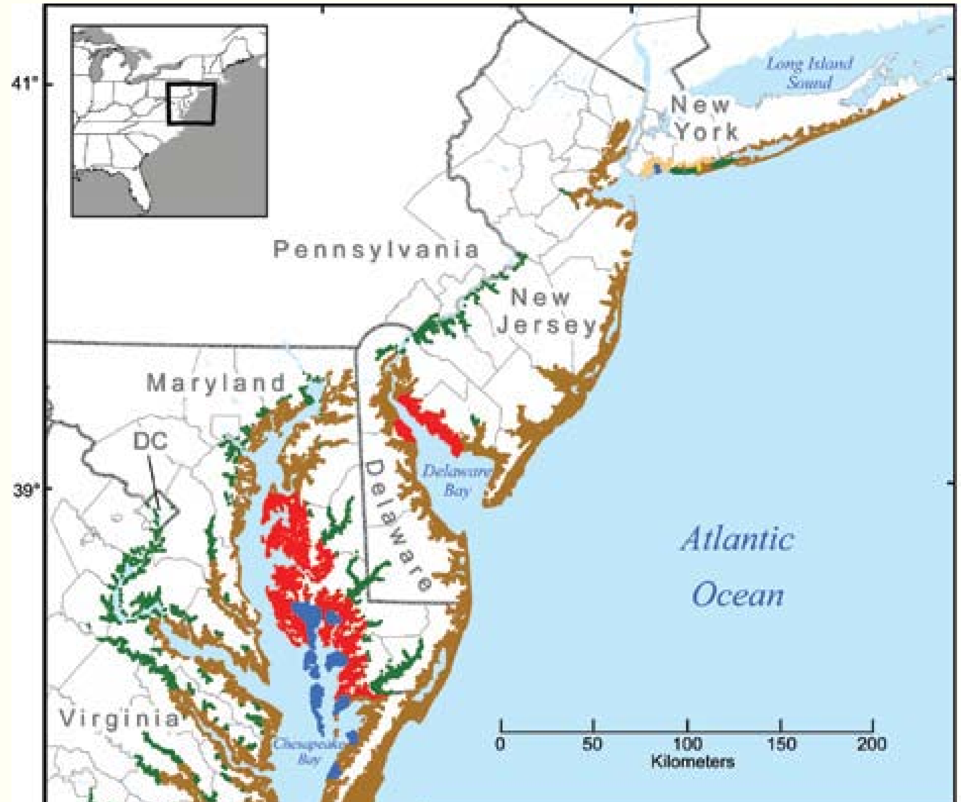
__Sources: Pyke et al. 2008__. Climate change and the Chesapeake Bay, CBP STAC Report. __Austin 2002__, AFS Symposium 32. __Boon 2012.__ Evidence of sea level acceleration at US and Canadian tide stations, Atlantic Coast, North America. JCR 28.6

Tidal wetlands and Sea level rise

Geomorphic settings of mid-Atlantic tidal wetlands



Conversion of tidal wetlands to open water



Will Wetlands Be Converted to Open Water?

Rate of Sea Level Rise								
Current rate	Yes	?	?	No	No	No	No	No
Current + 2 mm/yr	Yes	Yes	Yes?	?	No	No	No	No
Current + 7 mm/yr	Yes	Yes	Yes	Yes	Yes	Yes?	?	No

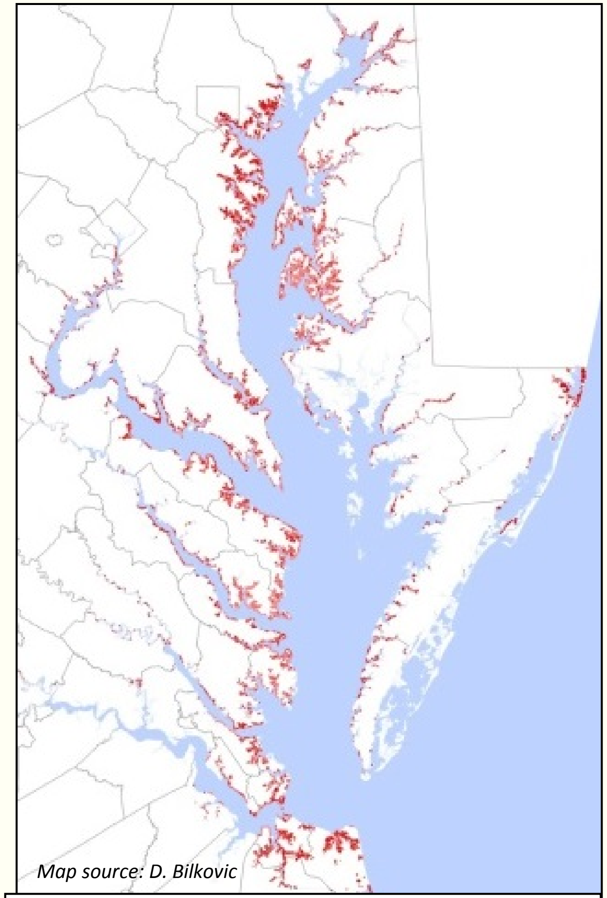
? = Wetlands would be marginal Yes? = Wetland would be marginal or lost

Geomorphic settings have differing hydrodynamics, sediment sources, & vegetative communities

Wetland response to sea level rise expected to vary with geomorphic setting

CCSP 2009: Cahoon et al. 2009; data source: Reed et al., 2008; map source: Titus et al., 2008

The Problem with Shoreline Hardening



Map source: D. Bilkovic

<u>Chesapeake Bay</u>

18% of tidal shoreline hardened

***VA**: 11%* ***MD**: 28%*

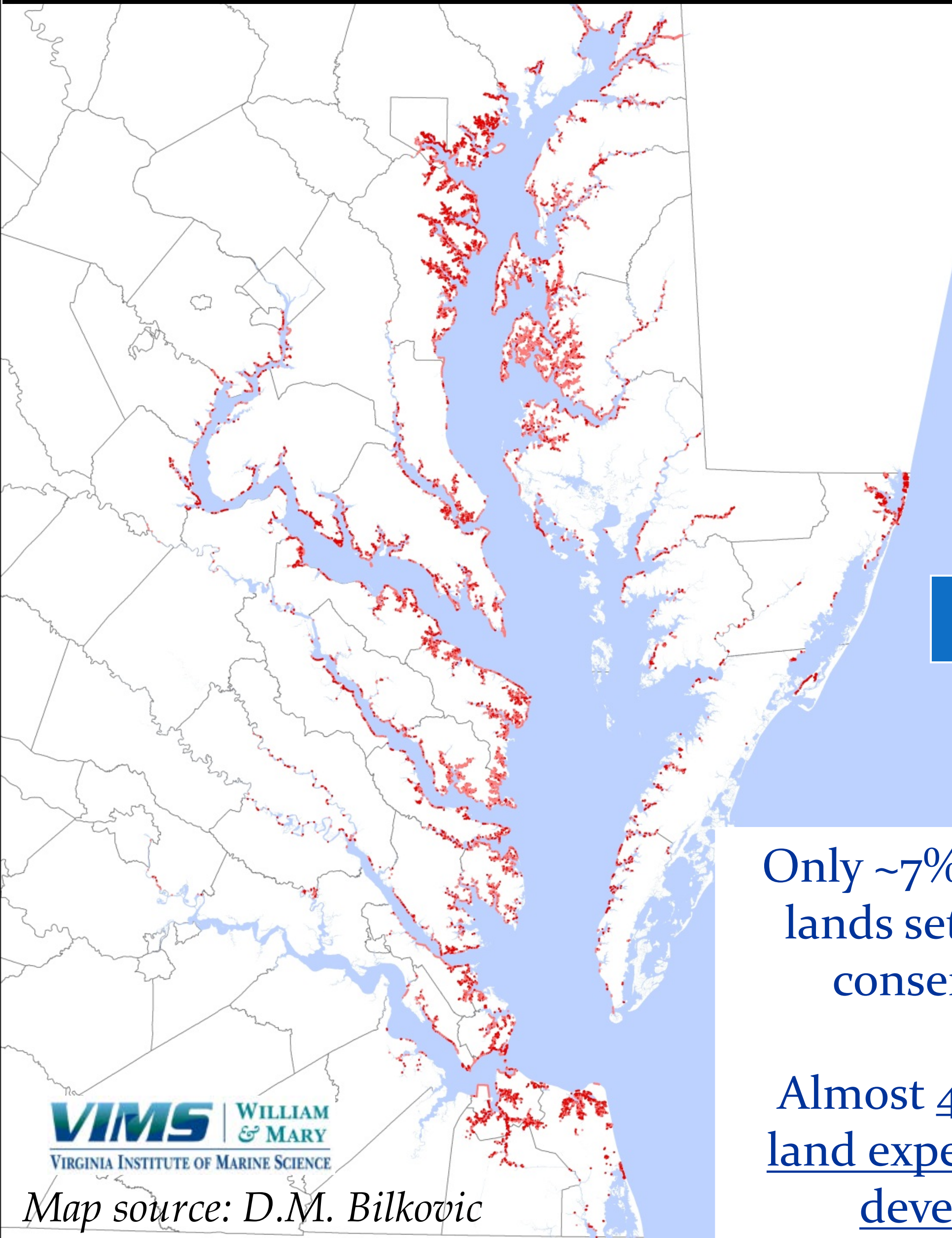
32% riparian land developed

~5 km^2 of artificial substrate introduced (*intertidal impacted*)

- Habitat loss & fragmentation – forest, wetlands (Peterson and Lowe 2009; Dugan et al 2011)
- Sediment supply & transport altered, increased scouring, turbidity (Bozek and Burdick 2005, NRC 2007)
- Increase in invasive spp (Chambers et al 1999)
- Decrease fish & benthos, marsh bird diversity, terrapin presence (Peterson et al 2000, Chapman 2003, King et al 2005, Bilkovic et al 2006, Seitz et al 2006, Bilkovic & Roggero 2008, Morley et al 2012, Isdell in review)
- Prevents natural migration of habitats with SLR
- Evidence of Low Thresholds (e.g. >5% riprap–no increase in SAV (*Patrick et al 2014*)

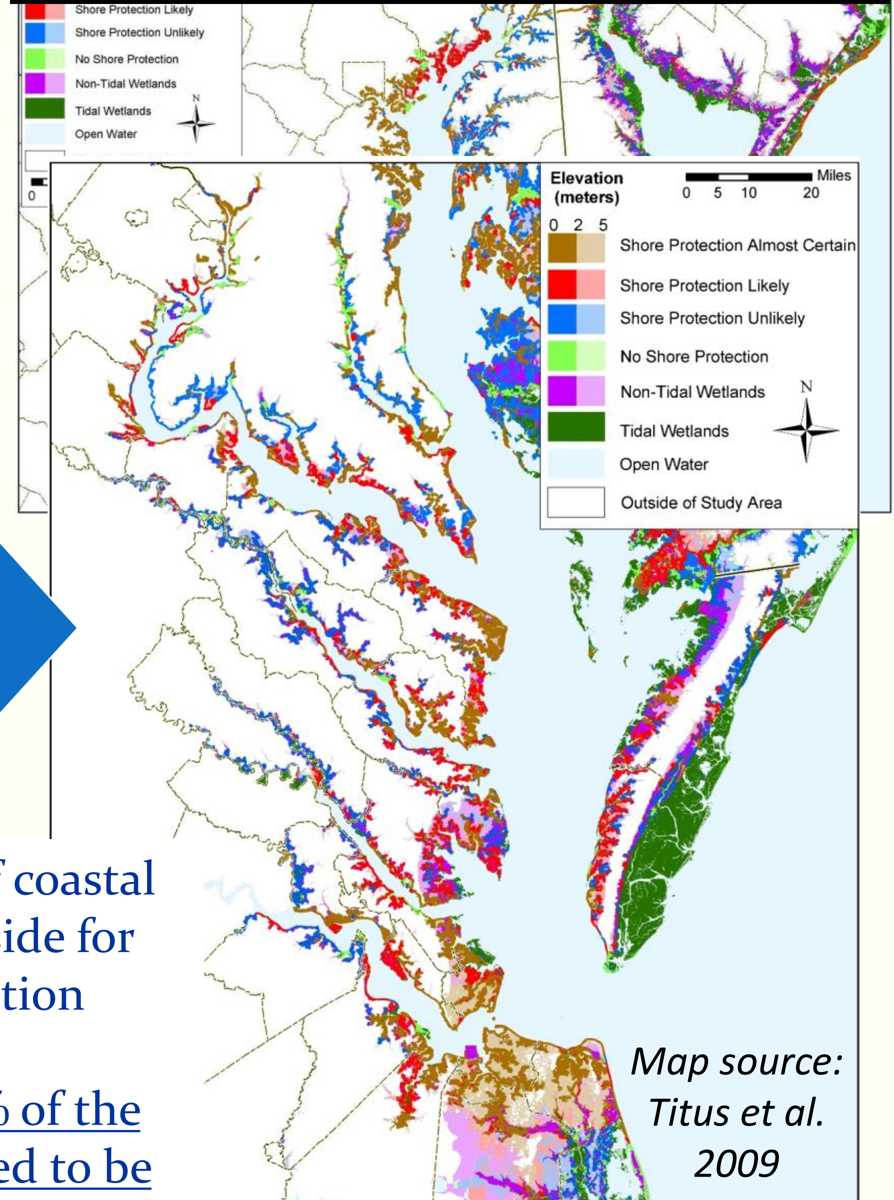
Coastal Development: Status and Future Trends

Current shoreline hardening – Bulkhead/Riprap



Map source: D.M. Bilkovic

Future shore protection

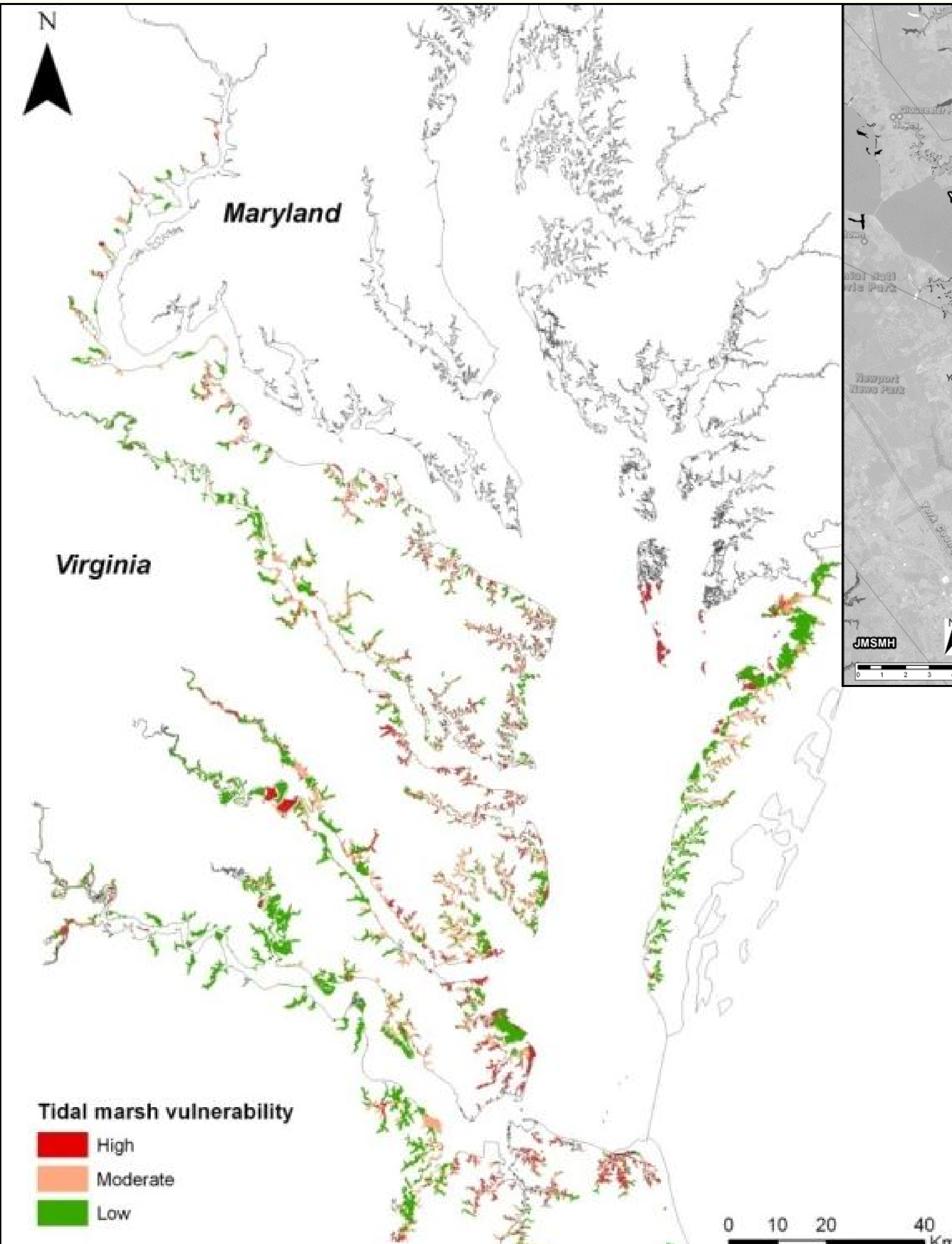


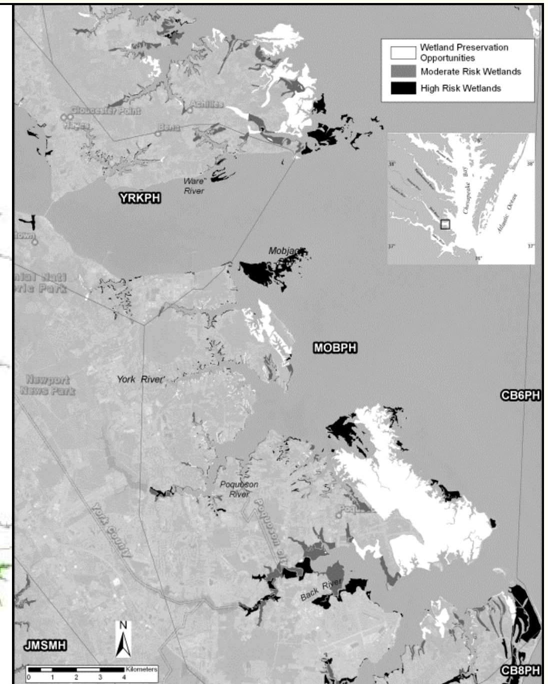
Map source: Titus et al. 2009

Only ~7% of coastal lands set aside for conservation

Almost <u>45% of the land expected to be developed</u>

Tidal Marshes – SLR & shoreline development





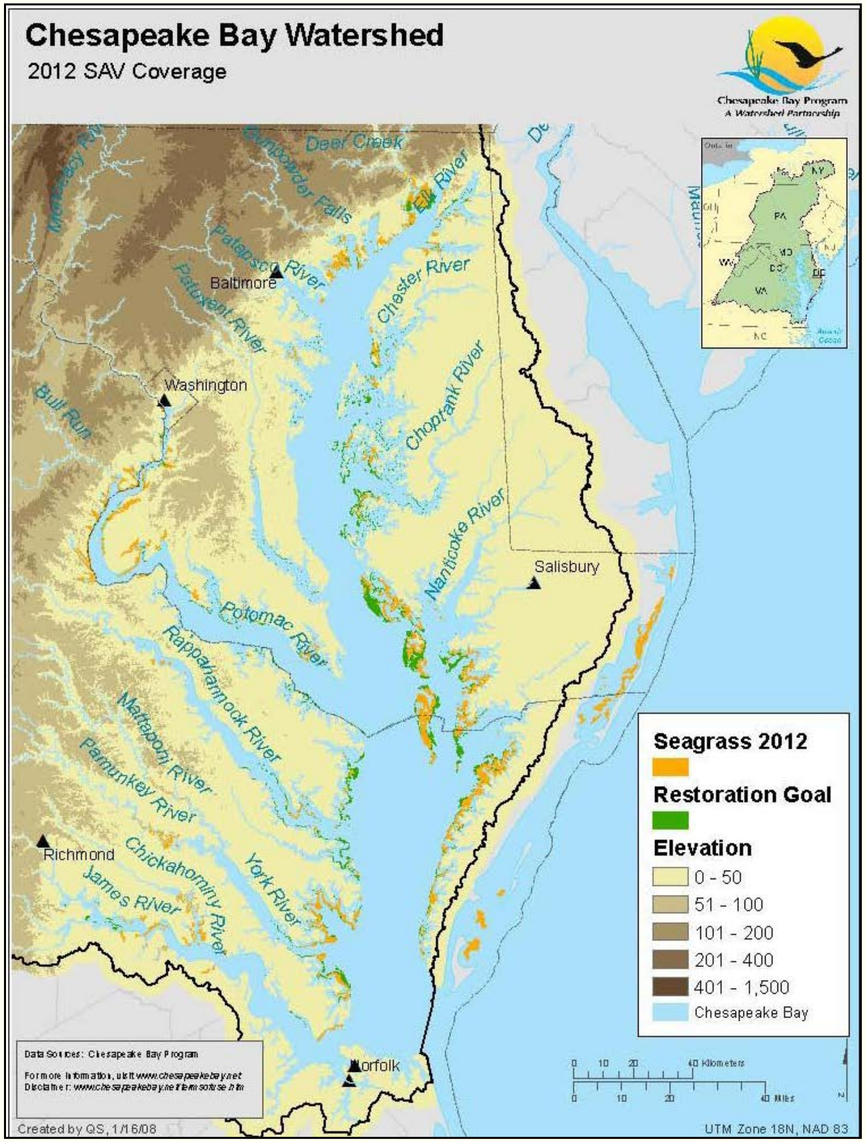
Tidal marshes in the meso-polyhaline reaches at highest risk due to land development & SLR

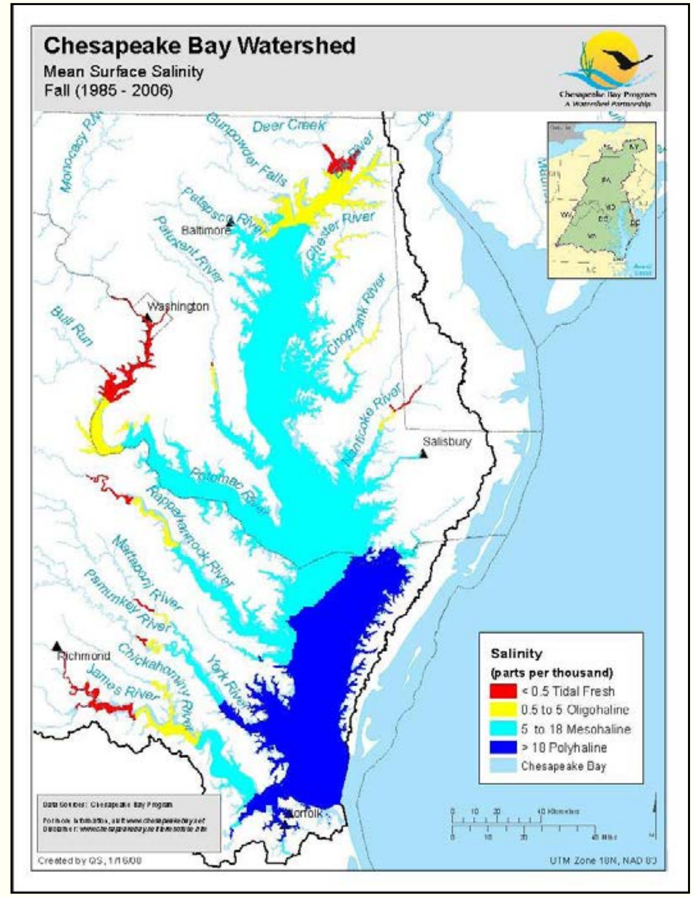
Nearly 40% of Virginia marshes are vulnerable to SLR due to adjacent development

High Risk Marsh

Low Risk Marsh

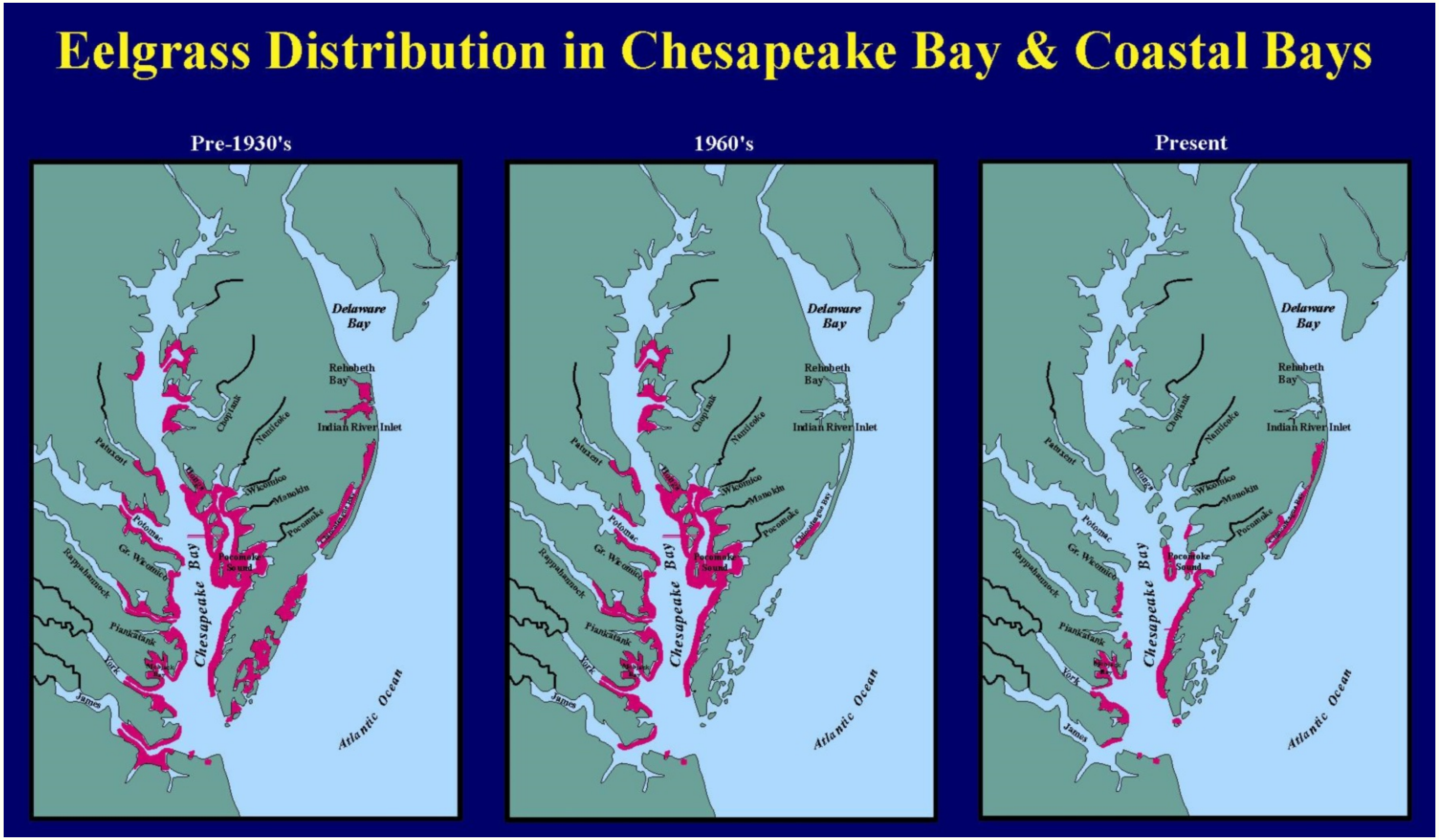
~ 20 SAV species are commonly found throughout Chesapeake Bay





SAV communities can be grouped by salinity tolerances

- *Zostera marina* –eelgrass (Polyhaline)
- *Ruppia maritima*–widgeongrass (Meso)



Stresses related to climate change that affect eelgrass survival include:

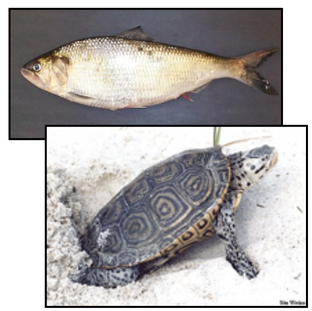
- Increased frequency and duration of high summer water temps , > 30°C (86°F)
  -Massive baywide decline observed during 2005 from >30°C
- Increased rainfall = Increased runoff of sediments and nutrients = decreased light availability
- Light requirements of eelgrass increase with increasing temps
- Increased storm intensity and frequency
- Increased water level/shl hardening = declines in habitat area

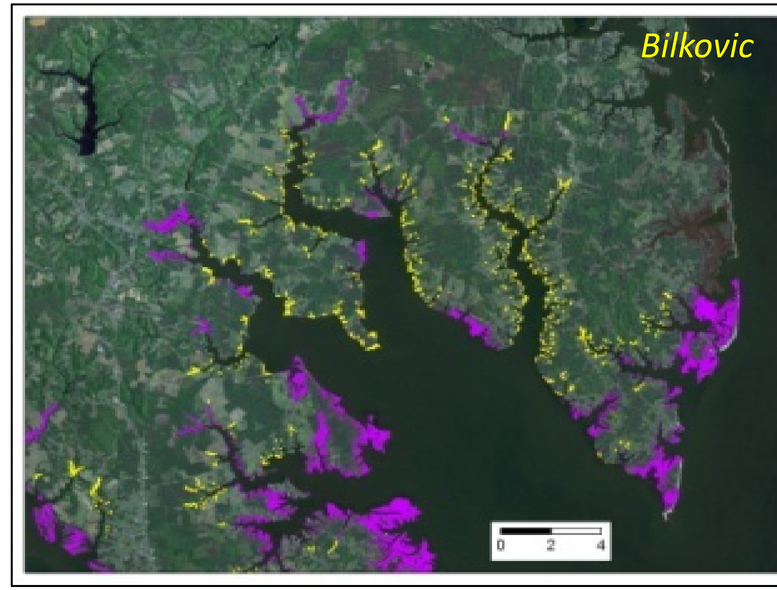
Map source: Ken Moore

Recommendations and Research Needs

- **More detailed data on sediment processes & Shallow water bathymetry**

- **Landscape-level influences on bay habitat resilience** - Better understanding of the extent that landscape setting moderates habitat connectivity, functionality, and species distribution





Fragmentation patterns of marshes
Dispersed wetlands (yellow) tend to occur in areas of developed land use

- **Align implementation & monitoring of habitat restoration activities with living resource objectives**.