Biennial Strategy Review System Meeting

13-14 March 2019

Rounding the Curve by Addressing Uncertainty

Adaptive Management

Uncertainty

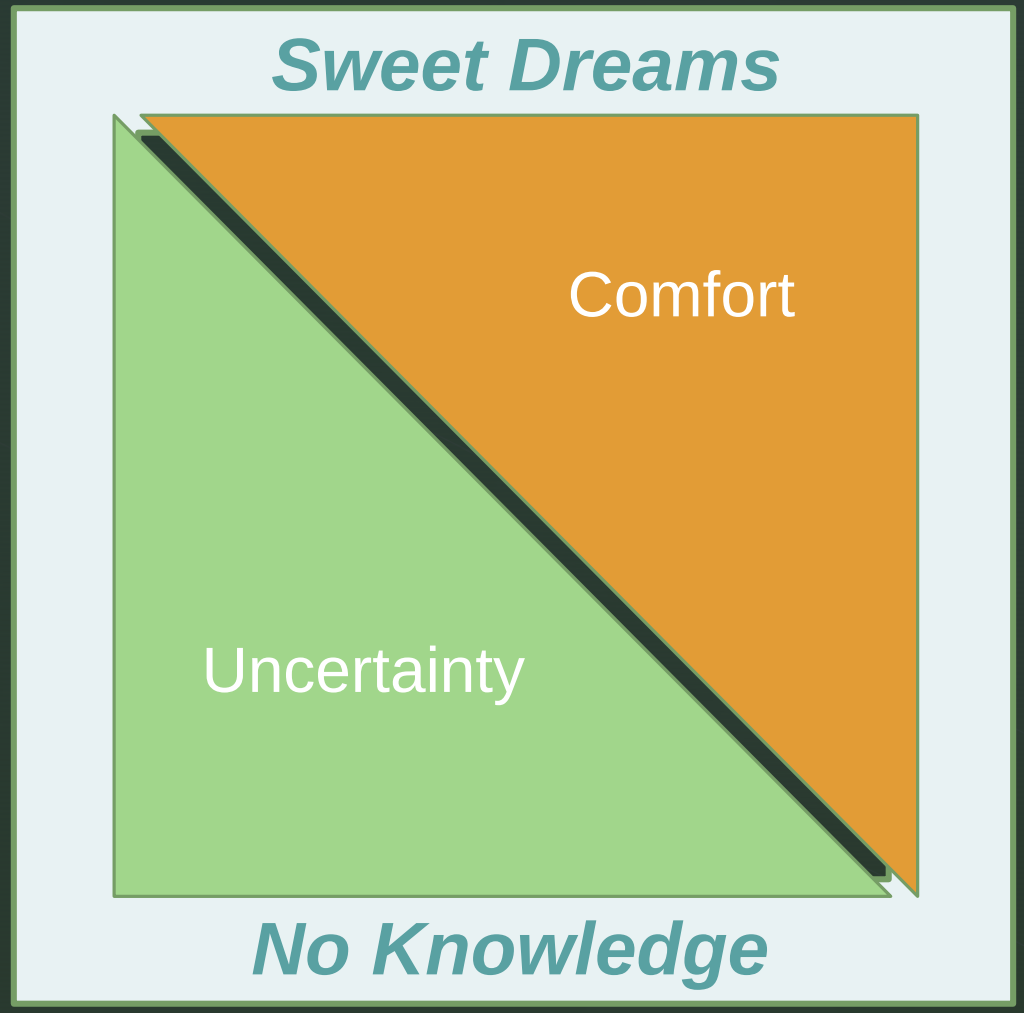
Uncertainty is a sign of humility, and humility is just the ability or the willingness to learn

Charlie Sheen

Does the SRS process provide documentation of learning?

- Q7:”Not enough insights on what we learned and what adjustments should we make”
- Q7: “Too many of the presentations were focused on the successes of the past 2 years, and not enough on what didn’t work….lessons learned as a result, and suggested adaptations”
- Q6: “Perhaps more time and leadership should be devoted to the “what are we going to do about it” versus reporting on what we have done”
- Q7: “A lot of the learning gets lost in the shuffle”

Two Opposing Forces



Operating space of Ecosystem-Based Management

Importance of Factors

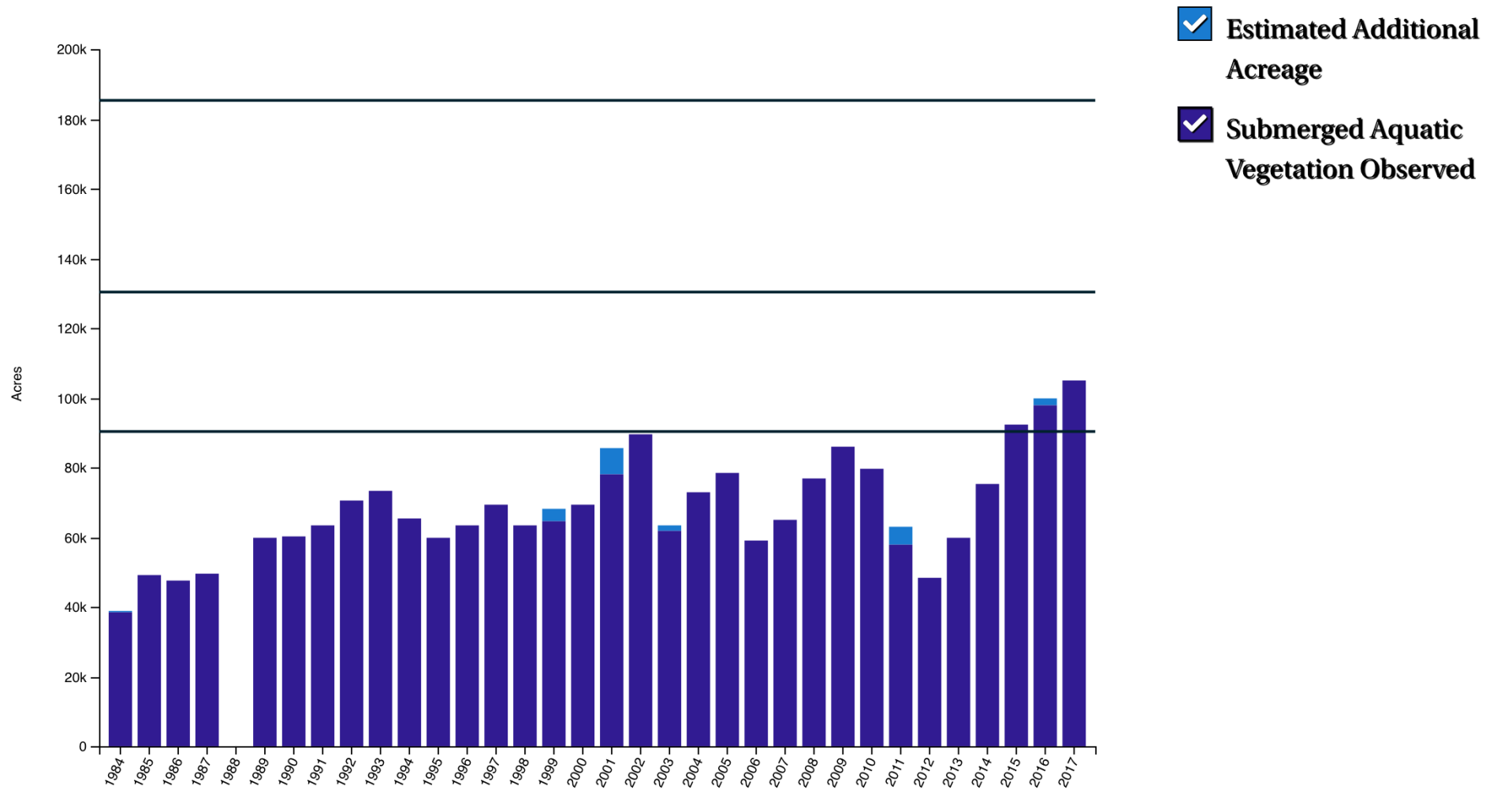
"Since restoration efforts began in the early 1980's, SAV surveys have indicated that grasses have begun to return to several tributaries of the bay. In theory, this reflected a response to the improved water quality. However, there were areas where SAV did not return despite an improvement in water quality in 1994 and 1995. This continued absence of SAV concerns scientists and resource managers….

What do recent trends in discharge, anoxia, sea grasses, and blue crabs mean? Are they caused by habitat change, overharvesting, or natural mortality related to long-term, external climatic factors? …..Detection of a trend can be easy, attribution of cause is much more difficult."

Ecosystem Trends and response: Chesapeake Bay, USGS, Fact Sheet 213-96

The stories we tell ourselves

Submerged Aquatic Vegetation (SAV) Abundance (1984-2017)



Significance

Human actions, including nutrient pollution, are causing the widespread degradation of coastal habitats, and efforts to restore these valuable ecosystems have been largely unsuccessful or of limited scope. We provide an example of successful restoration linking effective management of nutrients to the successful recovery of submersed aquatic vegetation along thousands of kilometers of coastline in Chesapeake Bay, United States. We also show that biodiversity conservation can be an effective path toward recovery of coastal systems. Our study validates 30 years of environmental policy and provides a road map for future ecological restoration.

Lefcheck et al., 2017. Long-term nutrient reductions lead to the unprecedented recovery of a temperate coastal region

From: M.S. Fonseca, 2011. Addy Revisited: What Has Changed with Seagrass Restoration in 64 Years?

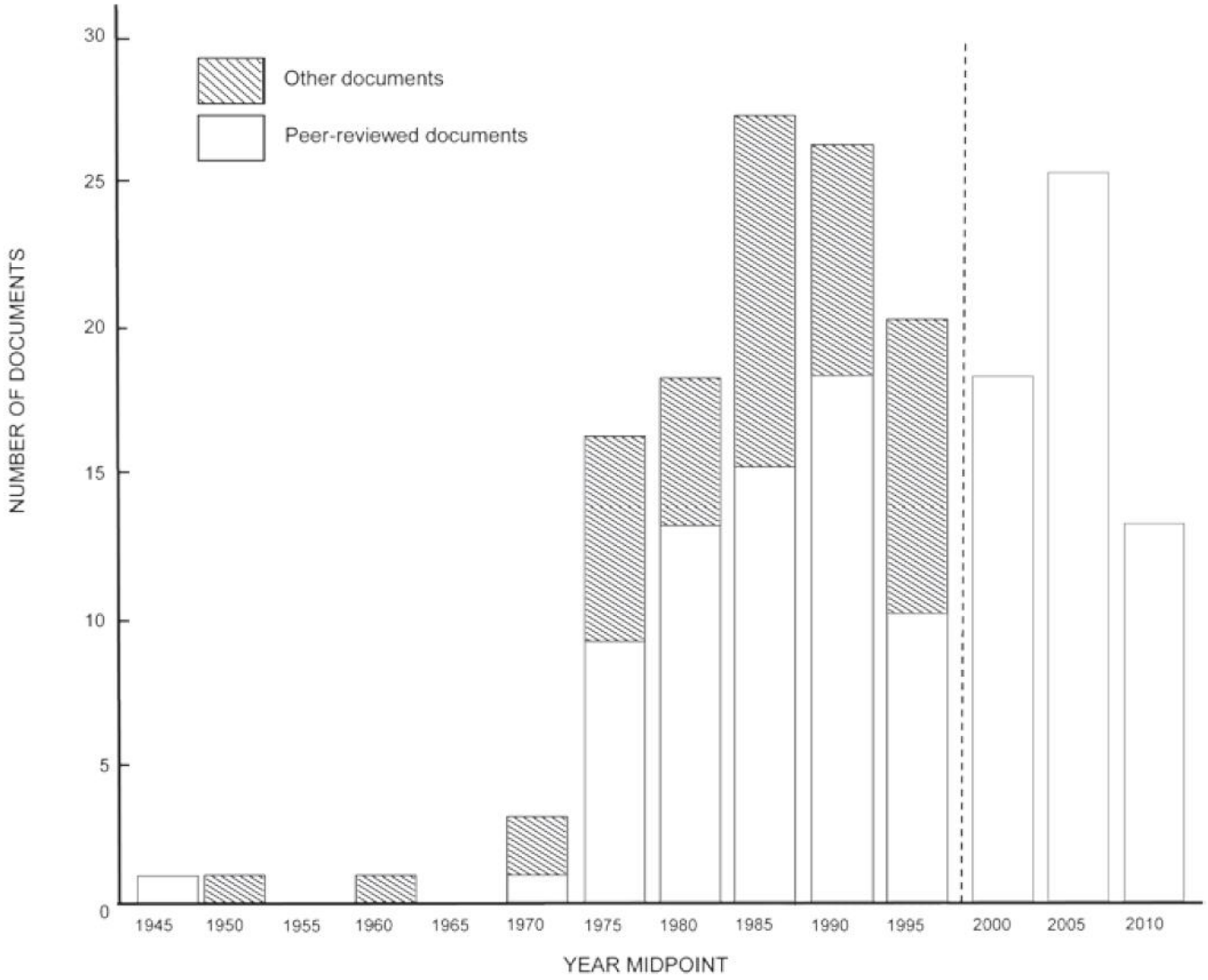


Figure 1. Historical trend in seagrass restoration literature for peer-reviewed (*white*) and all other (*gray*) documents. Records from before about 1998 (*dotted line*) are based on the literature reviewed by Fonseca and others (1998) that included project reports and obscure printing venues; more recent records are from a Web of Science search of peer-reviewed literature using the term "seagrass restoration."

WQ Parameters

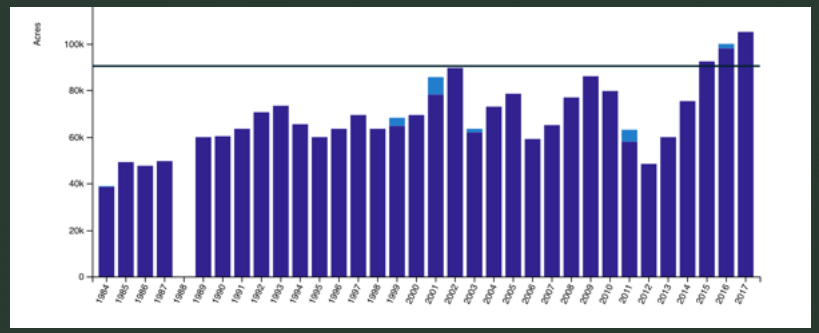
Restoration Techniques

Salinity Zones

Temperature impacts

Wet and dry

Scales of influence



Moore et al., 2000. Analysis of the Abundance of Submersed Aquatic Vegetation Communities in the Chesapeake Bay

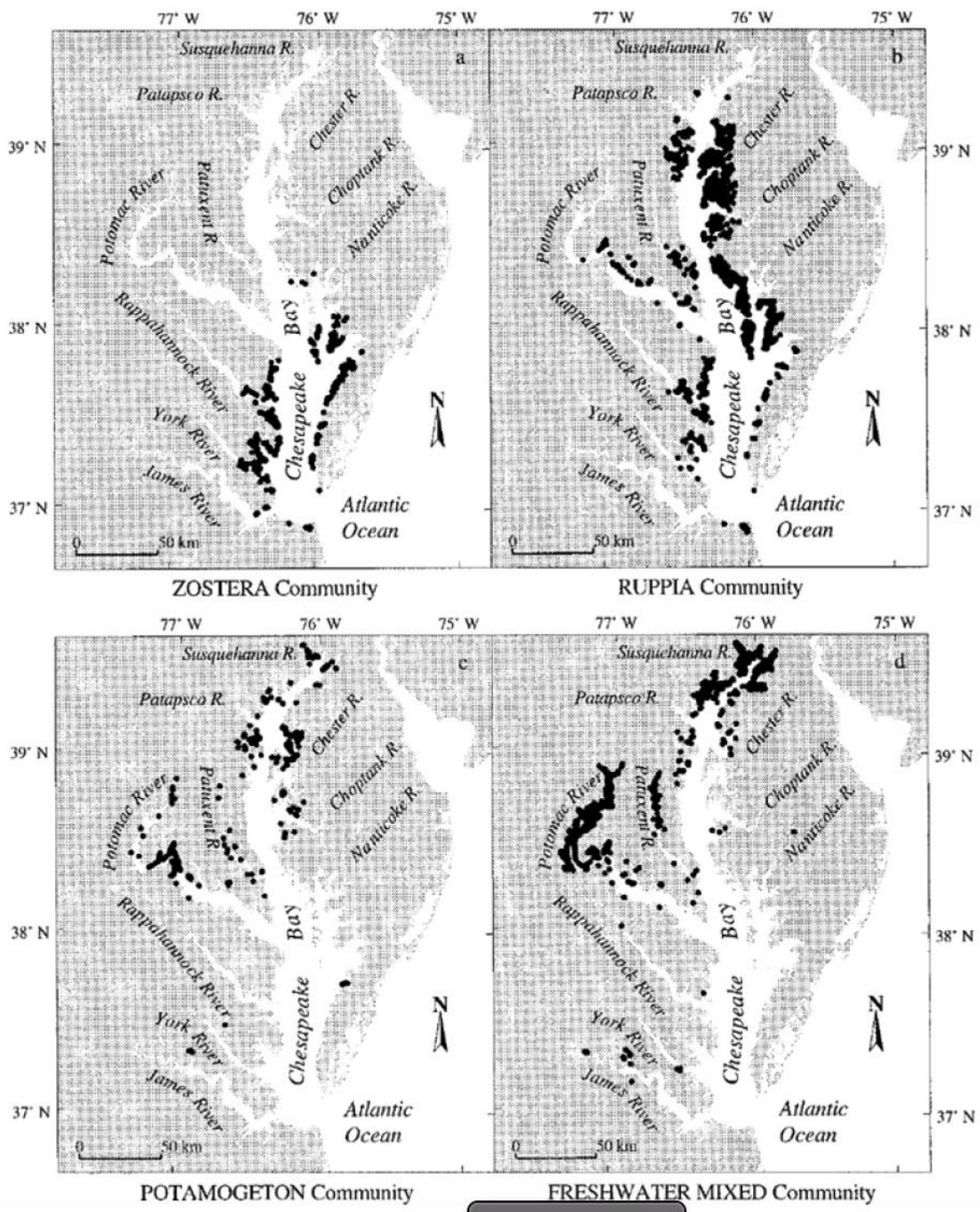


Fig. 3. Ground survey observations of SAV community type, 1985–1996.

Screenshot

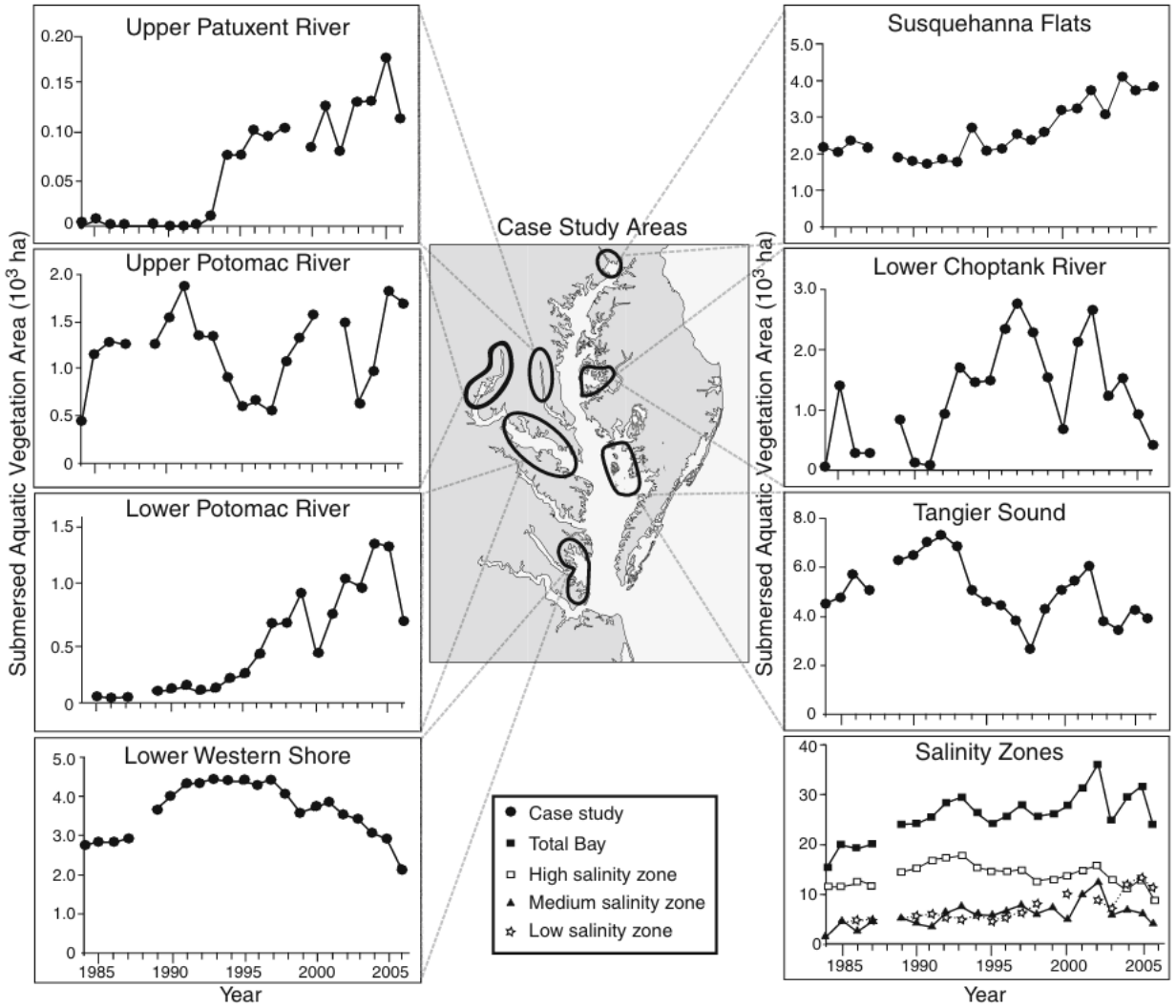
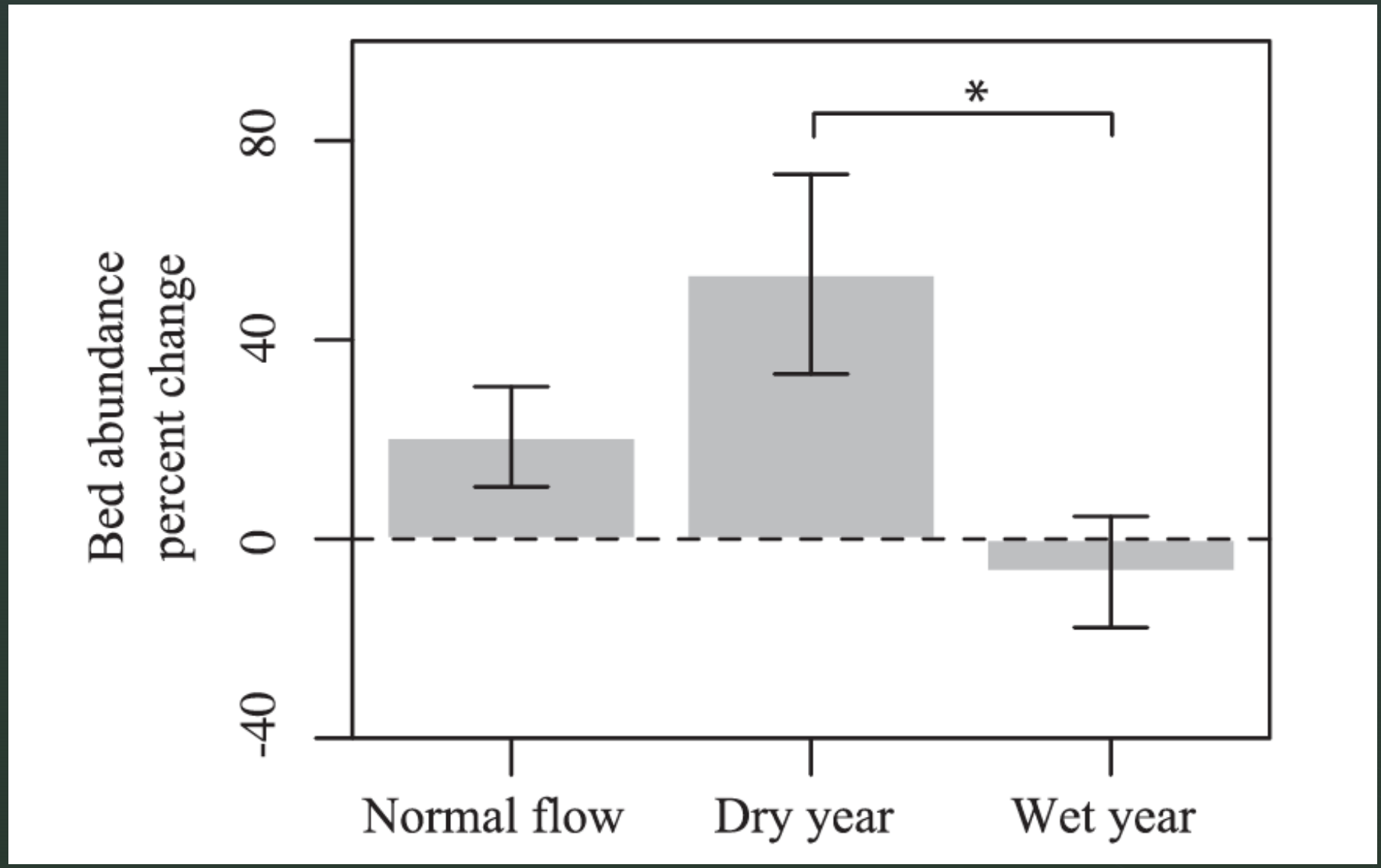


Fig. 2 SAV bed area from 1984 through 2006 for the entire Chesapeake Bay, the three salinity community-types (high, medium, and low), and the seven case-study areas: Susquehanna Flats, Upper Patuxent River, Upper Potomac River, Lower Potomac River, Lower Choptank River, Tangier Sound, and Lower Western Shore (note: no data for all sites in 1988. Some small portions of the Chesapeake Bay were not flown in several years resulting in partial data for the salinity community-types and case-study areas. Refer to the Methods section for details of sites with partial SAV data)

Orth et al., 2010:Long-Term Trends in Submersed Aquatic Vegetation (SAV) in Chesapeake Bay, USA, Related to Water Quality



Gurbisz and Kemp, 2014. Unexpected resurgence of a large submersed plant bed in Chesapeake Bay: Analysis of time series data

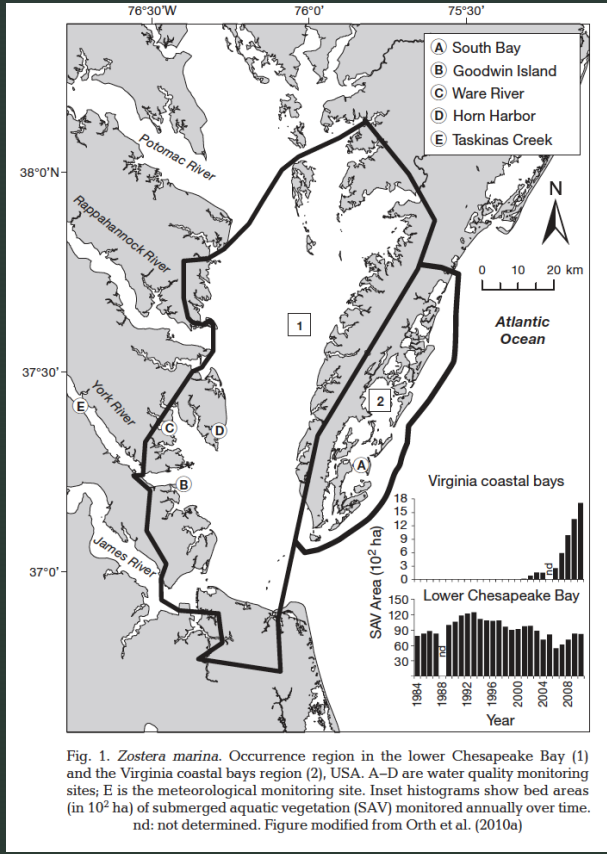


Fig. 1. *Zostera marina*. Occurrence region in the lower Chesapeake Bay (1) and the Virginia coastal bays region (2), USA. A–D are water quality monitoring sites; E is the meteorological monitoring site. Inset histograms show bed areas (in 10^2 ha) of submerged aquatic vegetation (SAV) monitored annually over time. nd: not determined. Figure modified from Orth et al. (2010a)

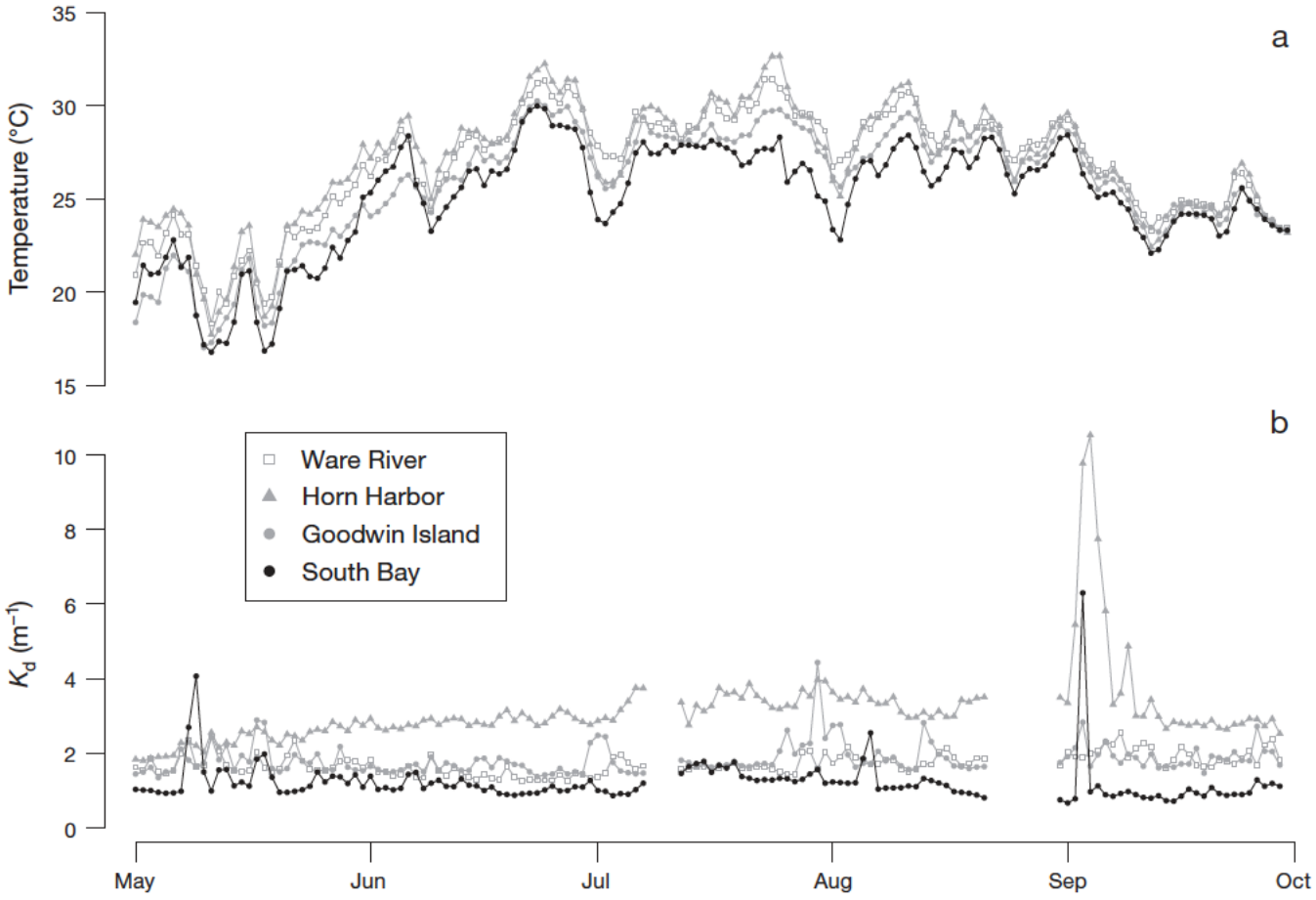
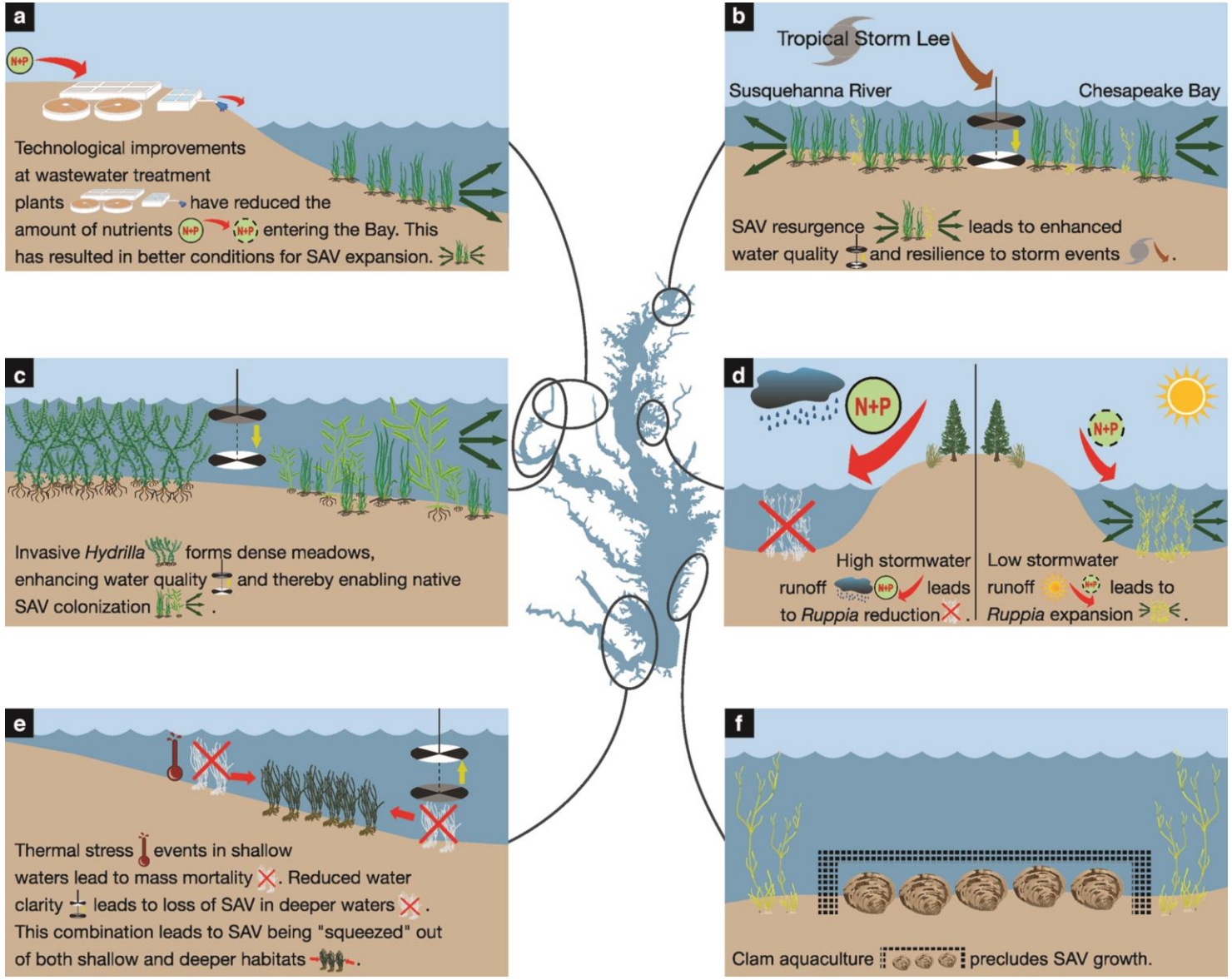
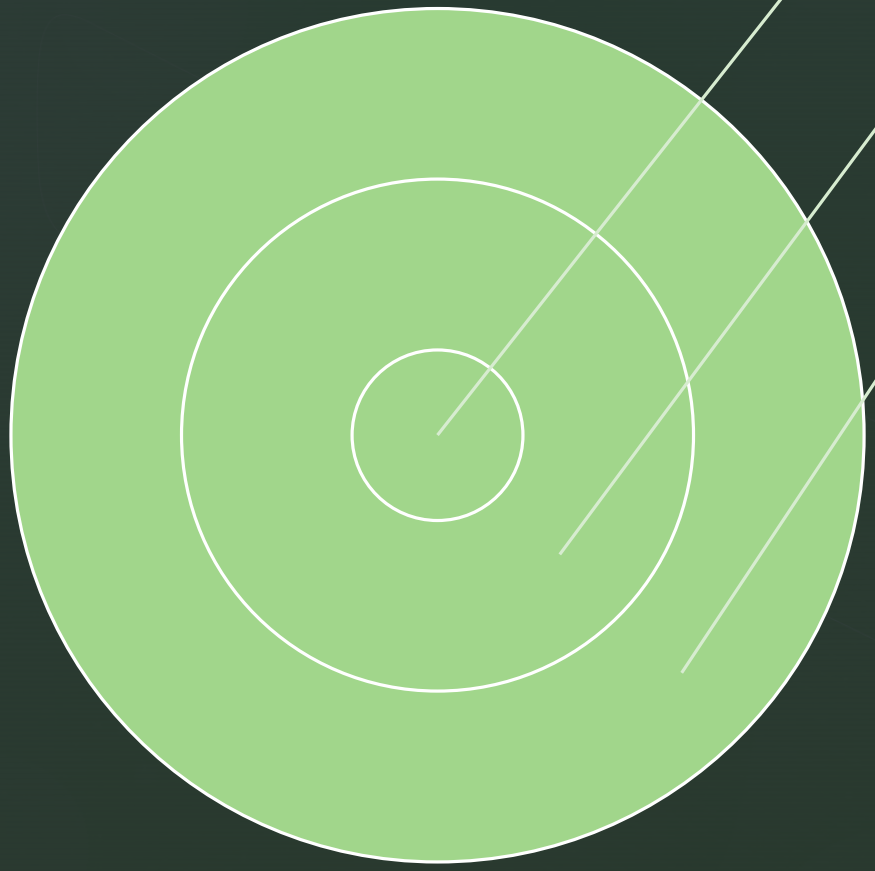


Fig. 4. May to October 2010 (a) daily mean water temperatures and (b) light attenuation (K_d) for Ware River, Horn Harbor, Goodwin Island, and South Bay

Moore et al., 2012. Eelgrass survival in two contrasting systems: role of turbidity and summer water temperatures



BioScience, Volume 67, Issue 8, 14 June 2017, Pages 698–712, https://doi.org/10.1093/biosci/bix058



Local (storms, grazing, temperature, algal blooms)

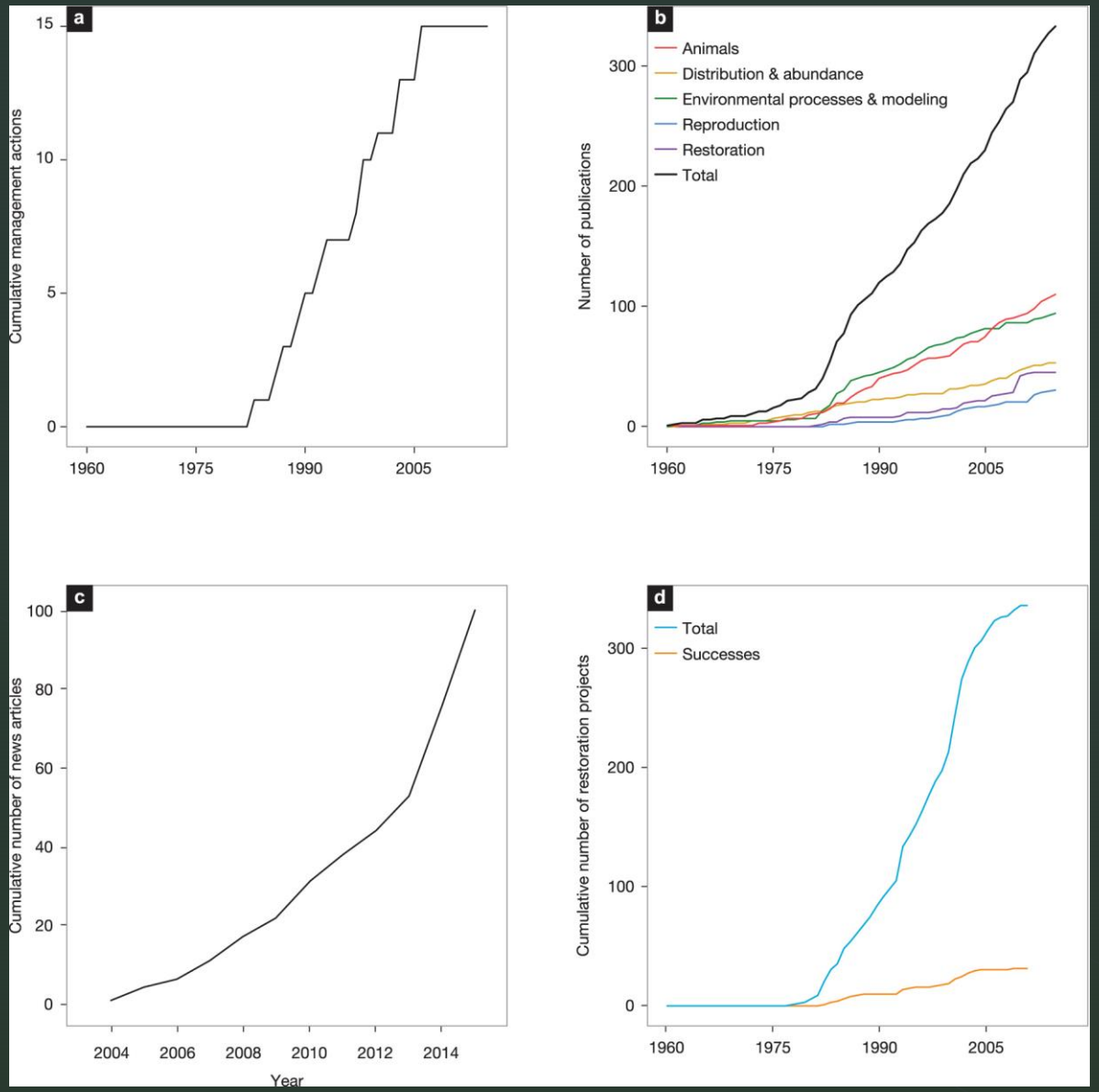
Salinity Zones (dry/wet years, water clarity, ecosystem interactions, invasive species)

Bay-wide (nutrients, sediment)

Where we started

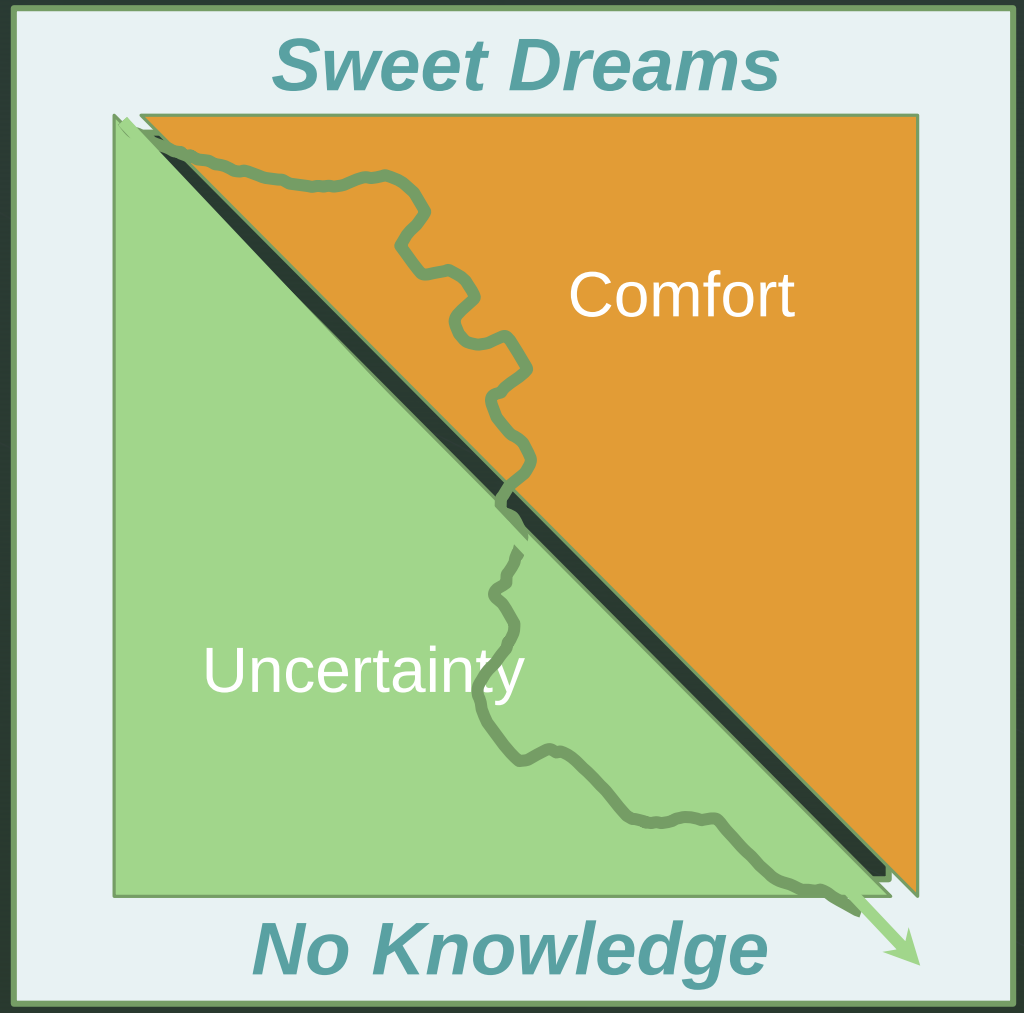
In Chesapeake Bay, requirements for light, turbidity, chlorophyll-a, and nutrients critical for the survival of SAV were developed concurrently to *allow managers to gauge the response of SAV to water quality improvements* (Batiuk et al. 1992; Dennison et al. 1993; Kemp et al. 2004).

Orth et al, 2010; Estuaries and Coasts (2010) 33:1144–1163



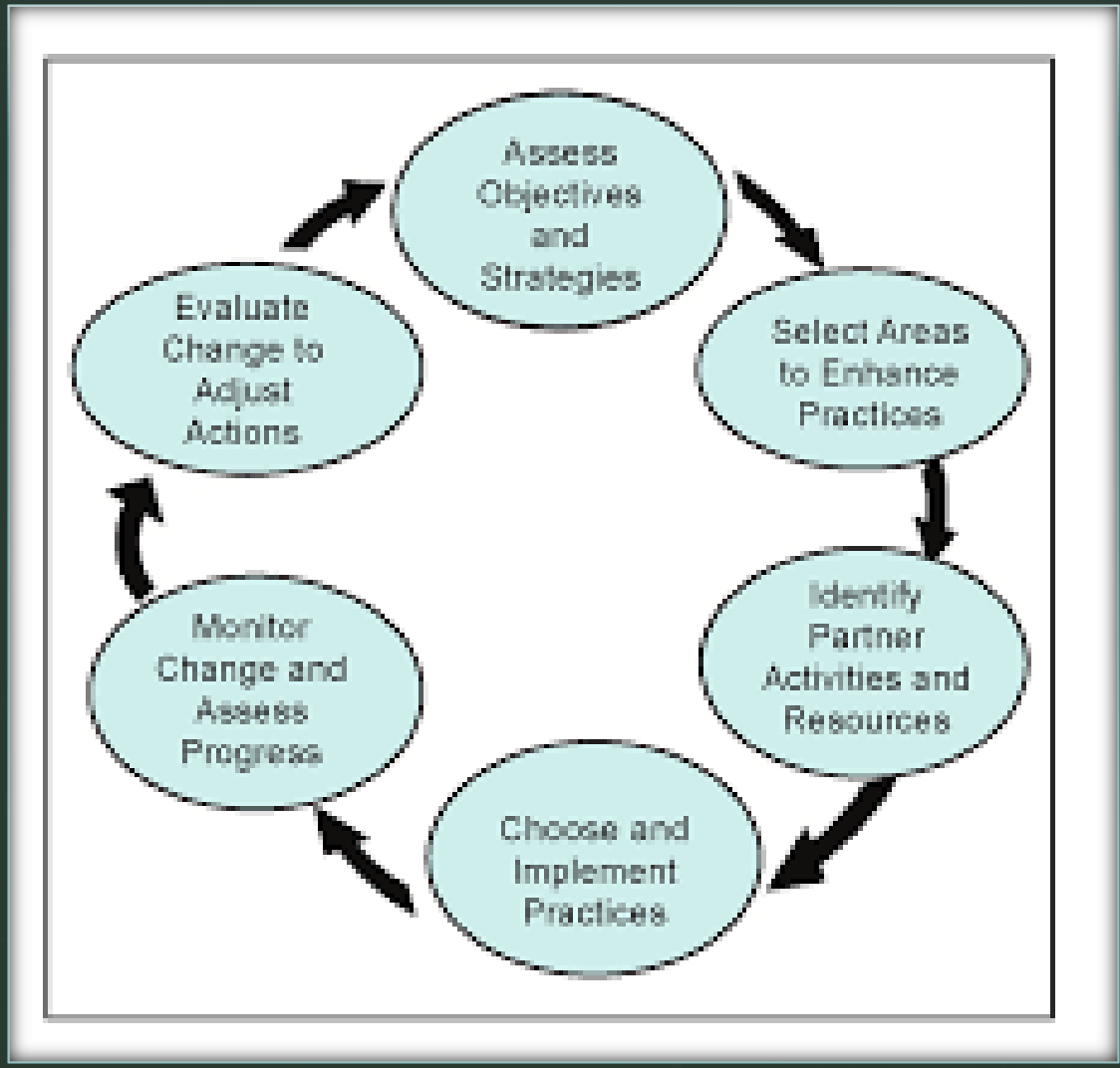
(a) Cumulative management actions (1980–2015) to protect, conserve, and restore SAV populations. (b) Cumulative peer-reviewed Chesapeake Bay SAV publications (1960– 2015) and five categories of publications. (c) Chesapeake Bay SAV media attention (cumulative since 2005). (d) Restoration efforts (cumulative 1975–2015, with the number of success projects surviving a minimum of 5 years). From: Orth et al., 2017. Submersed Aquatic Vegetation in Chesapeake Bay: Sentinel Species in a Changing World

Two Opposing Forces



Operating space of Ecosystem-Based Management

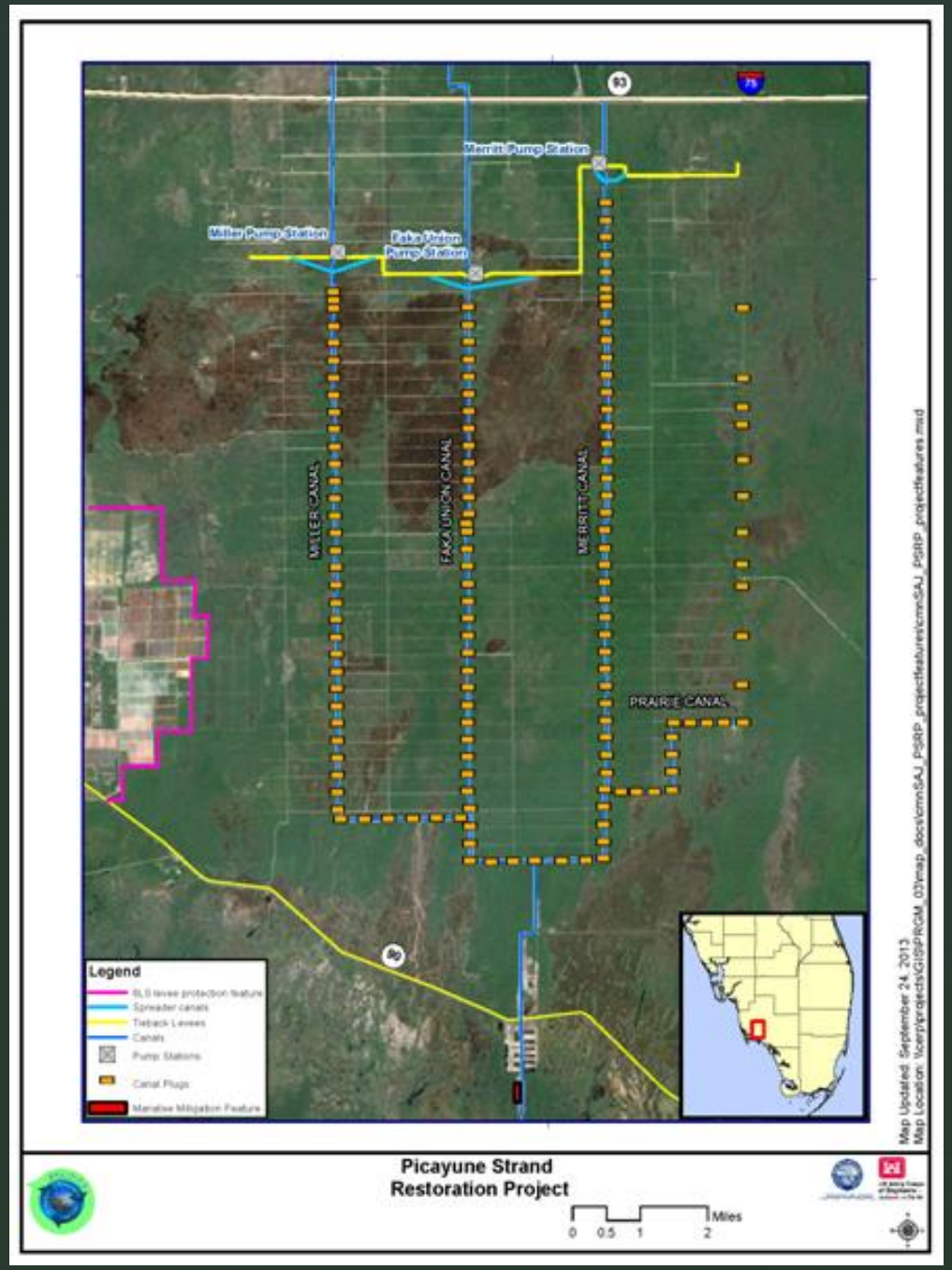
Adaptive Management



Adaptive management is not contingency planning. Adaptive management requires a compact between scientists and managers . If you experience uncertainty for more than four months contact your science provider.

The Fine Print

Adaptive management is not contingency planning. Adaptive management requires a compact between scientists and managers . If you experience uncertainty for more than four years or $400,000 in research, contact your science provider.


Merritt Pump Station
Miller Pump Station
Faka Union Pump Station
MILLER CANAL
FAKA UNION CANAL
MERRITT CANAL
PRAIRIE CANAL
Legend
Pump Stations
Canal Plugs
Picayune Strand
Restoration Project
Miles
0 0.5 1 2
Map Updated: September 24, 2013

Uncertainty

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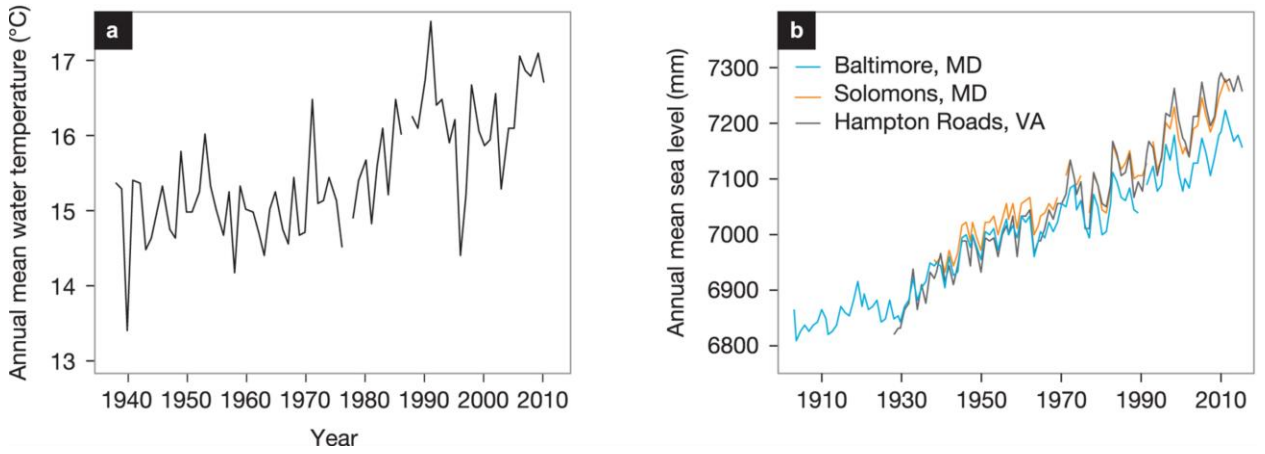
Figure 9. (a) The average annual water temperature at the University of Maryland's Solomons Laboratory (1937–2010; data ...



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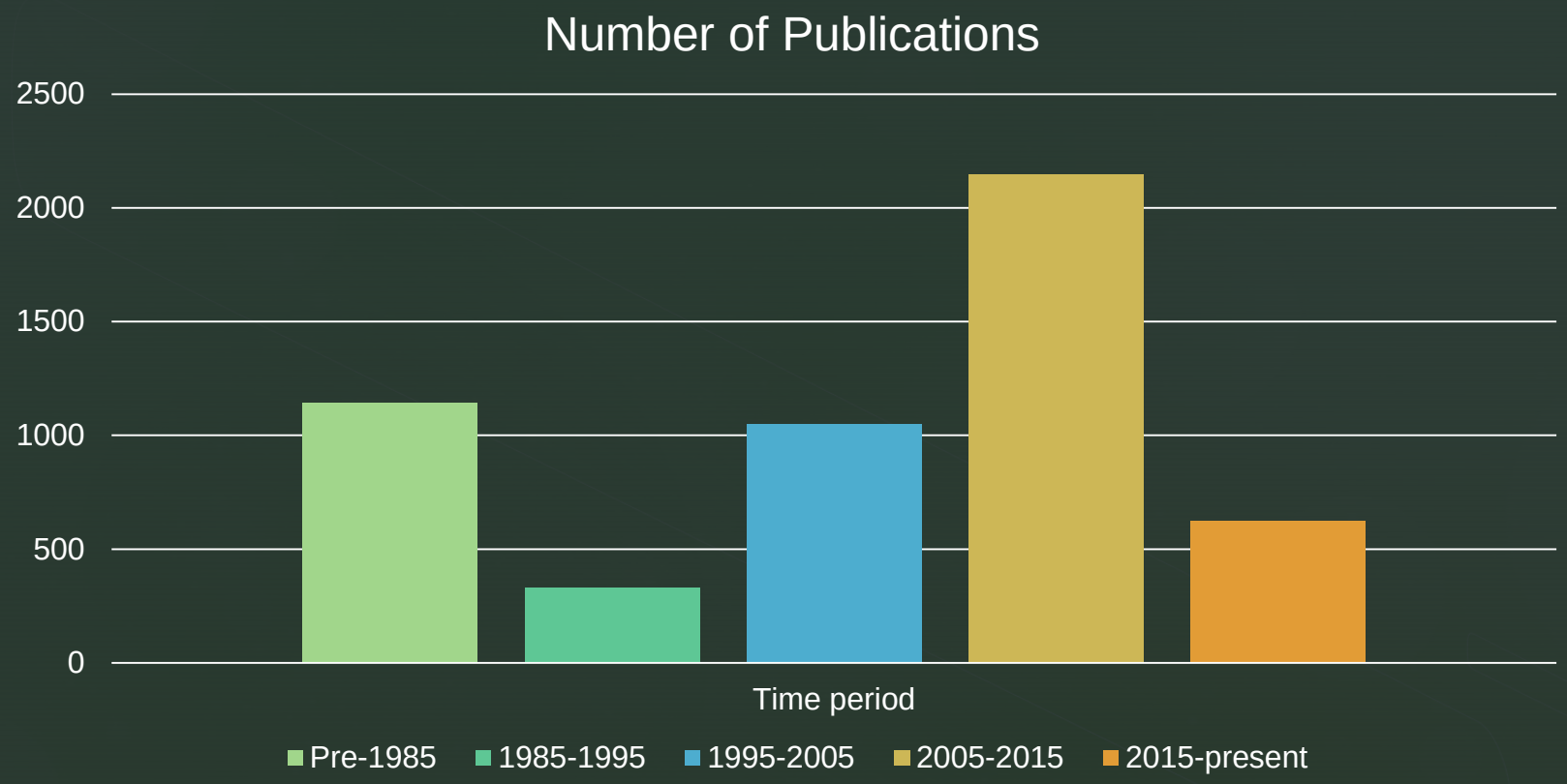
Search on “SAV and Chesapeake Bay”



Progression of Knowledge