Environmental Monitoring and Communication

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LGAC
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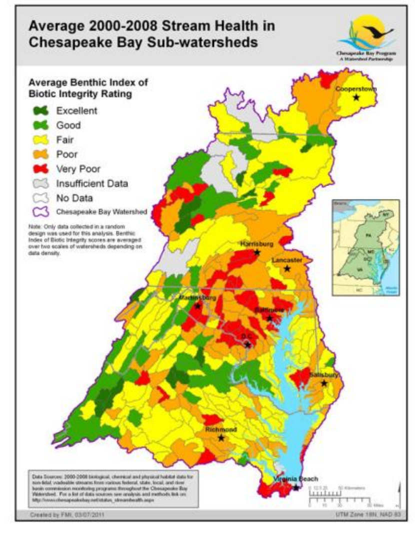
Today’s Monitoring Presentation

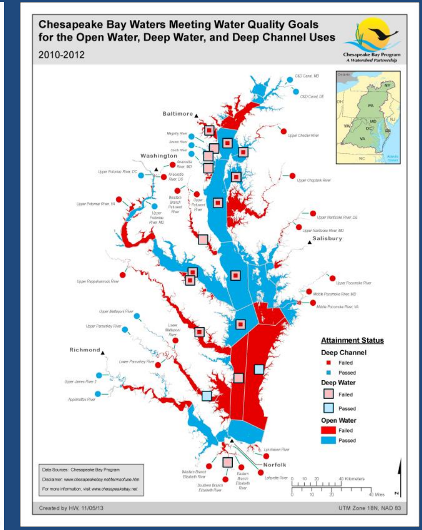
- Why and How we monitor
- What gets monitored
- Communicating *Environmental Intelligence*!

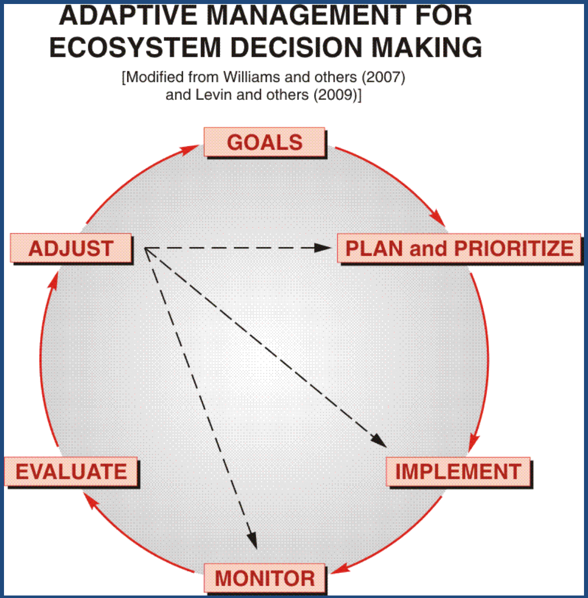
Why Monitor?

- Assess and Communicate Status and Change Effectively
  - Separate Fact from Fiction
  - Confront models with data

- Adaptive Monitoring to Supporting Adaptive Management
  - Target limited resources





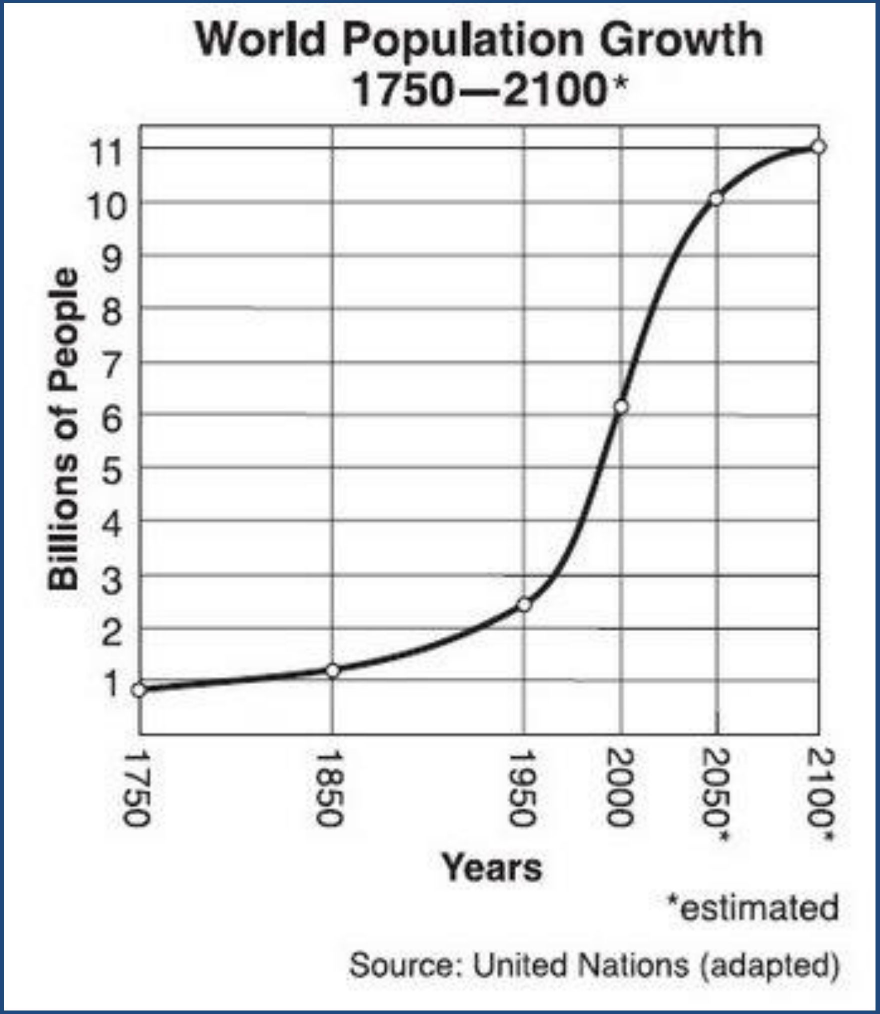


Assess and Communicate Status and Change Effectively : Example

Status

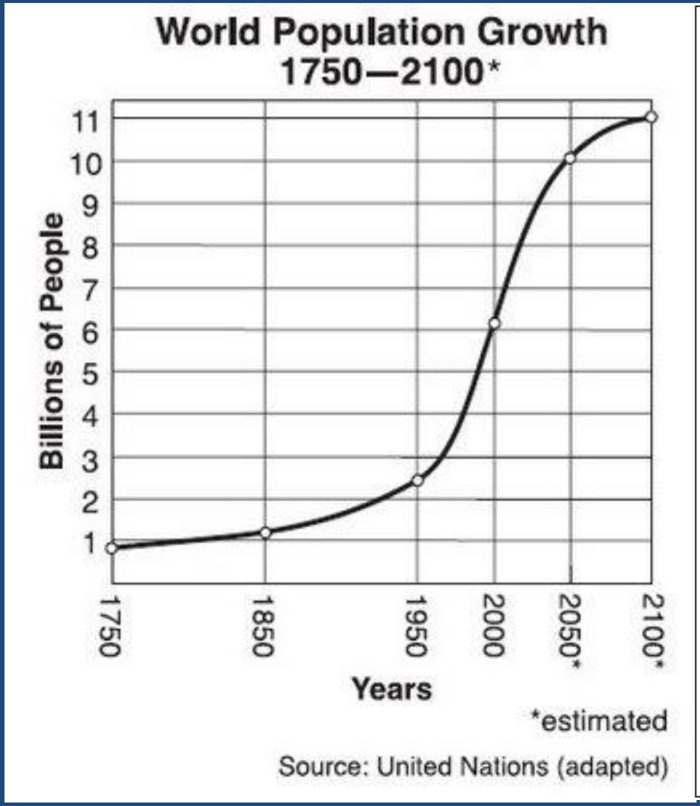
2011: 7 billion people

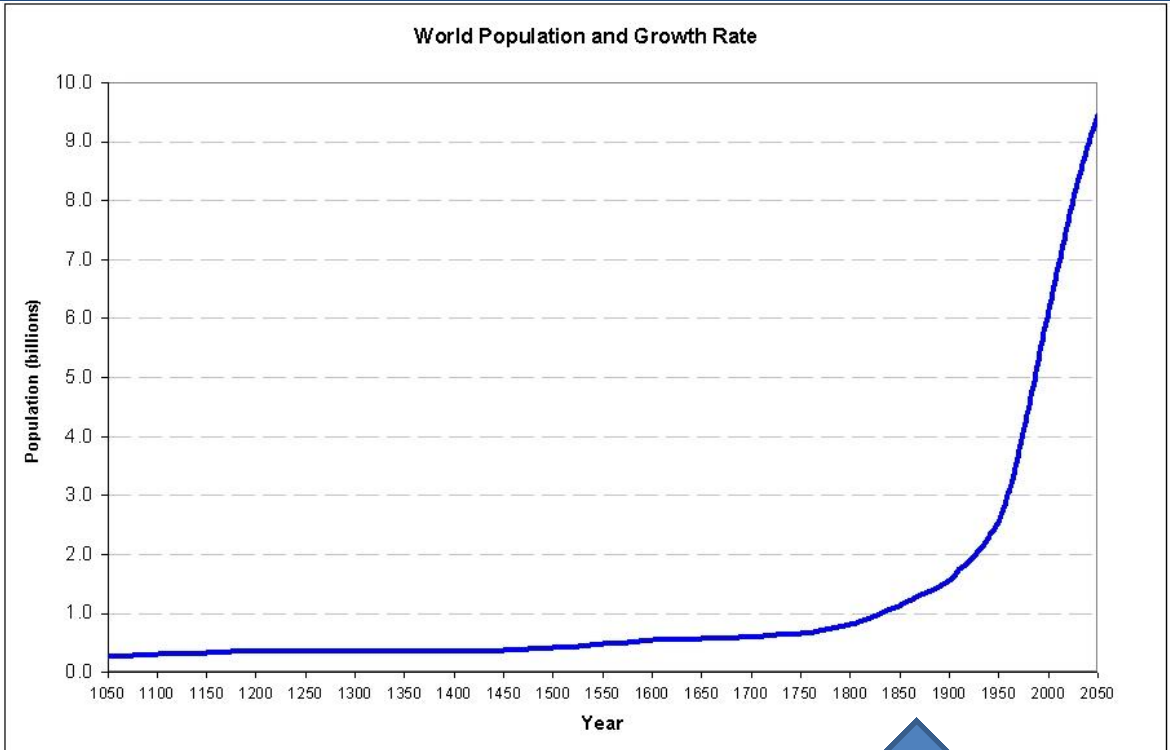
Assess and Communicate Status and Change Effectively



Change over time

Assess and Communicate Status and Change Effectively

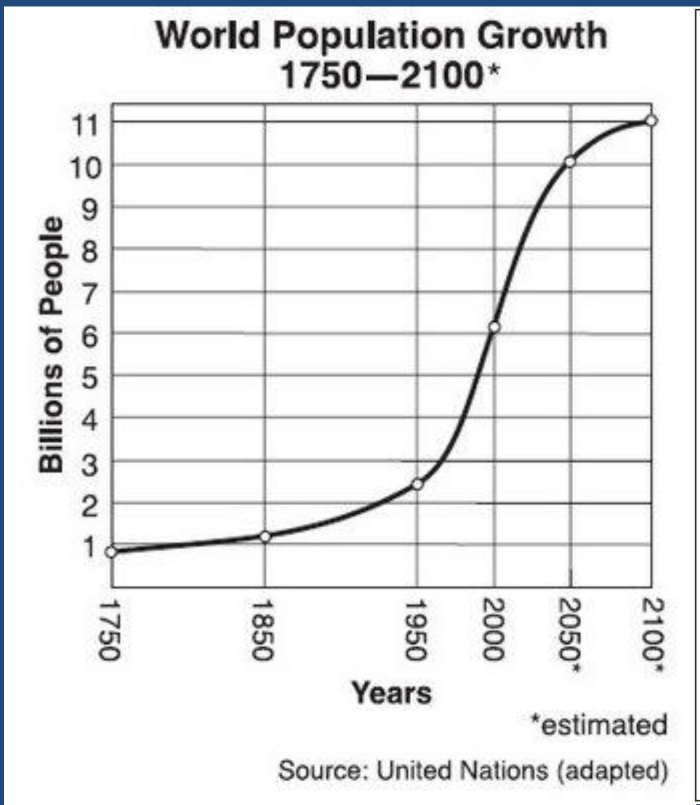


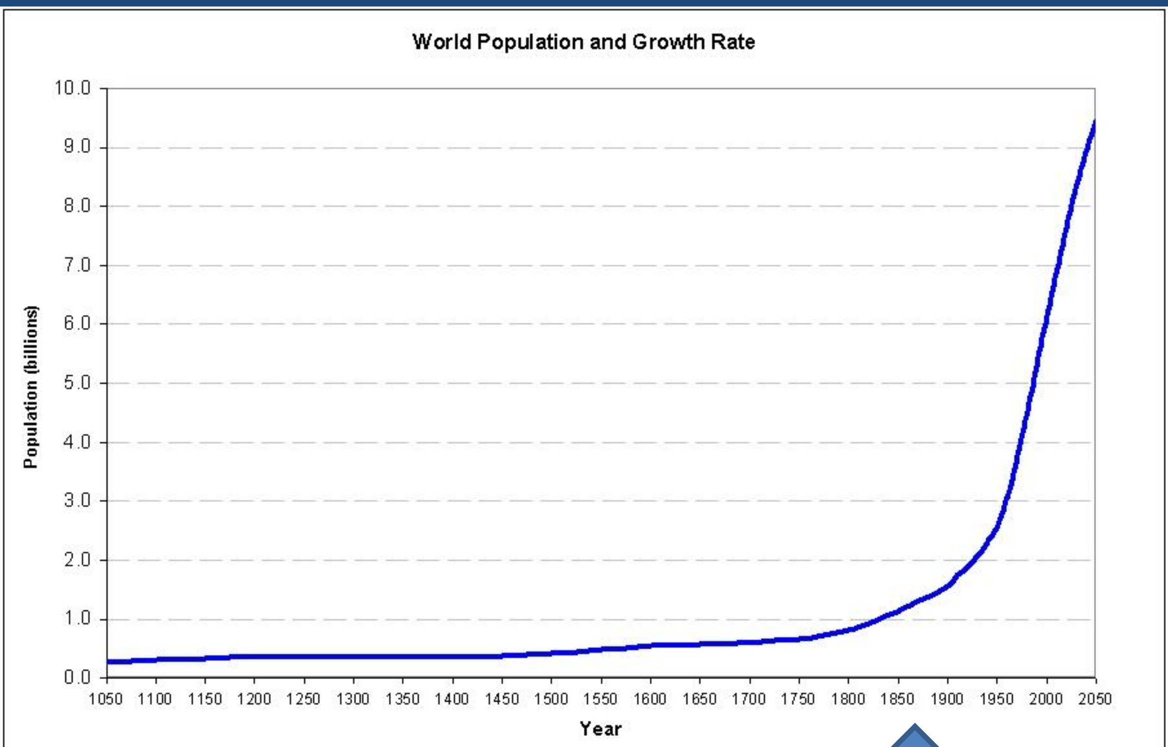


UN and U.S. Census Bureau

1000 yr Perspective: Threshold Response!

Assess and Communicate Status and Change Effectively



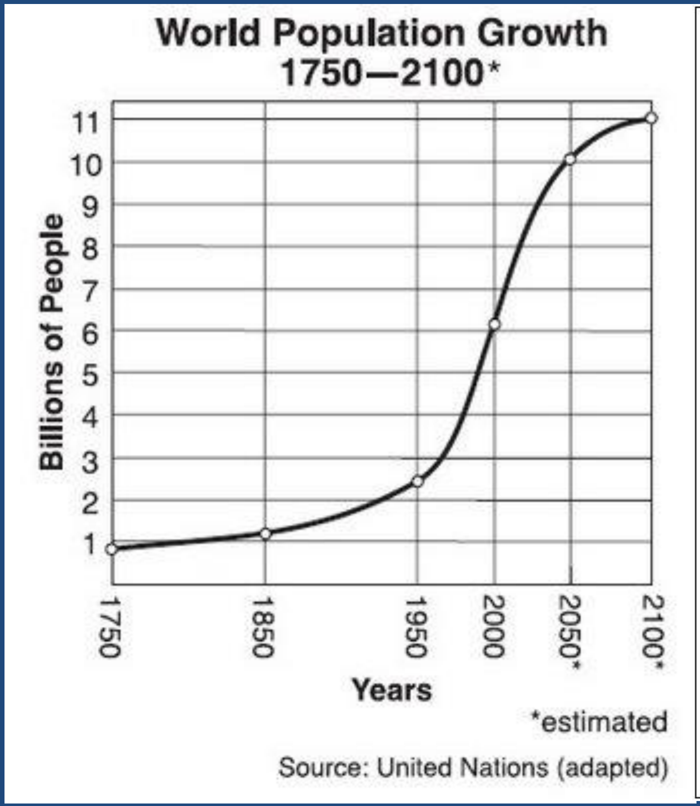


UN and U.S. Census Bureau

What happened???

Threshold Response!

Assess and Communicate Status and Change Effectively



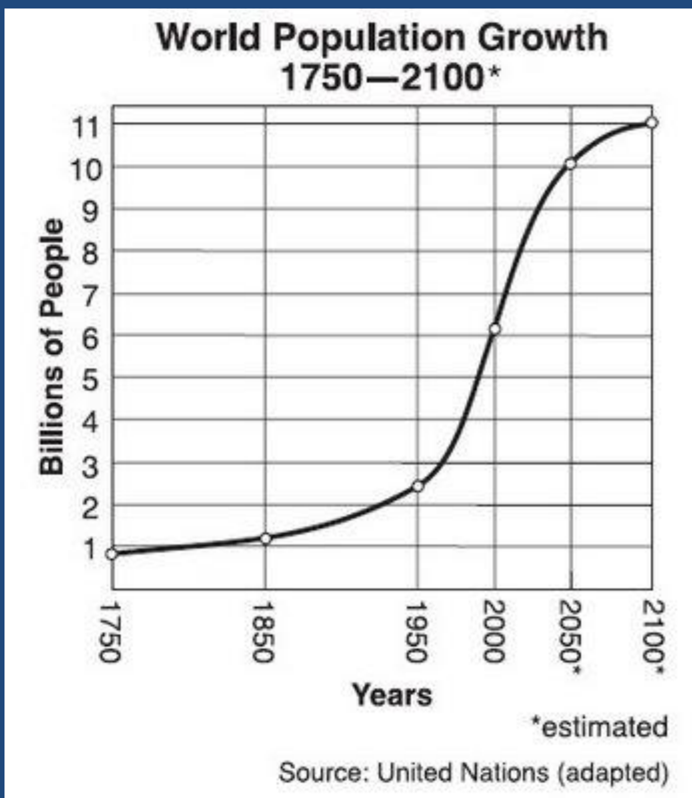
"It's not that people suddenly started breeding like rabbits, it's that they stopped dying like flies." (U.N. Consultant.)

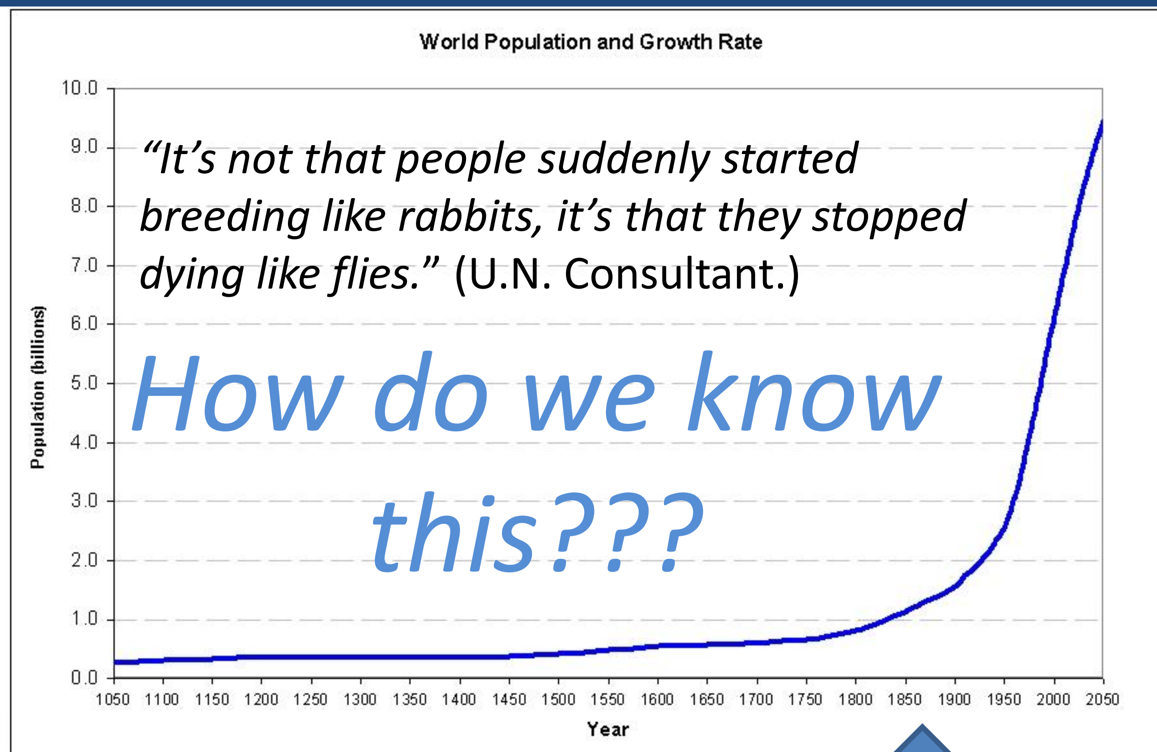
UN and U.S. Census Bureau

What happened???

Threshold Response!

Assess and Communicate Status and Change Effectively





"It's not that people suddenly started breeding like rabbits, it's that they stopped dying like flies." (U.N. Consultant.)

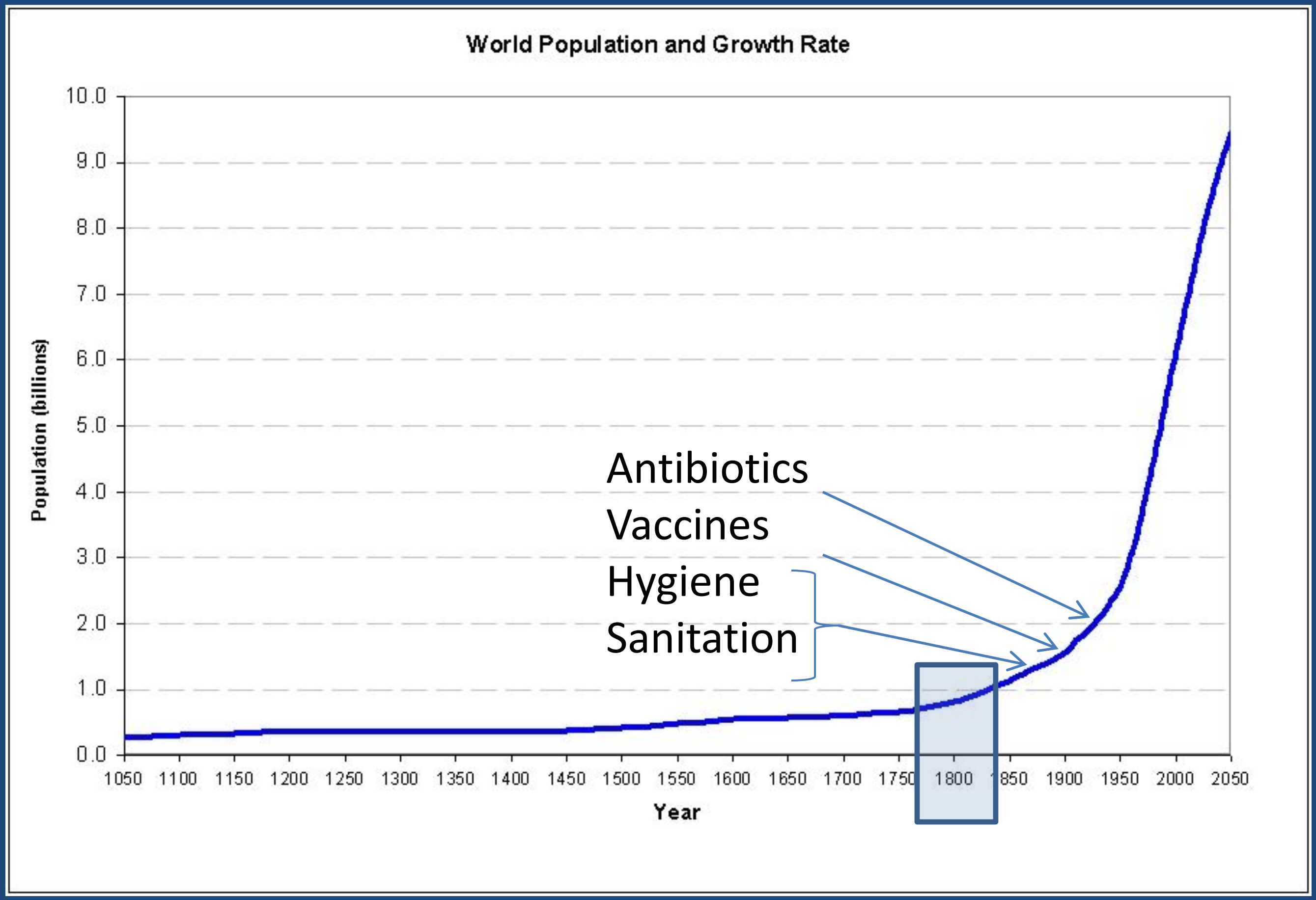
How do we know this???

UN and U.S. Census Bureau

What happened???

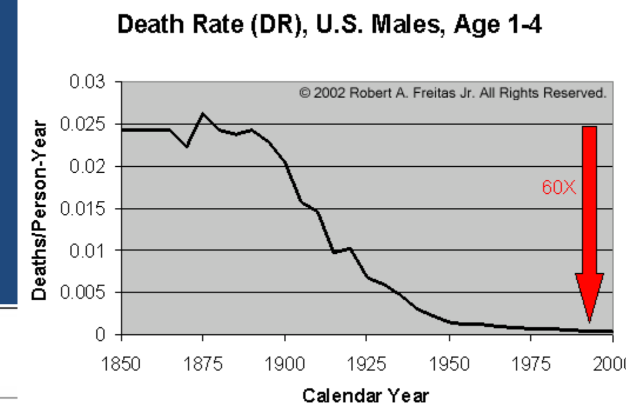
Threshold Response!

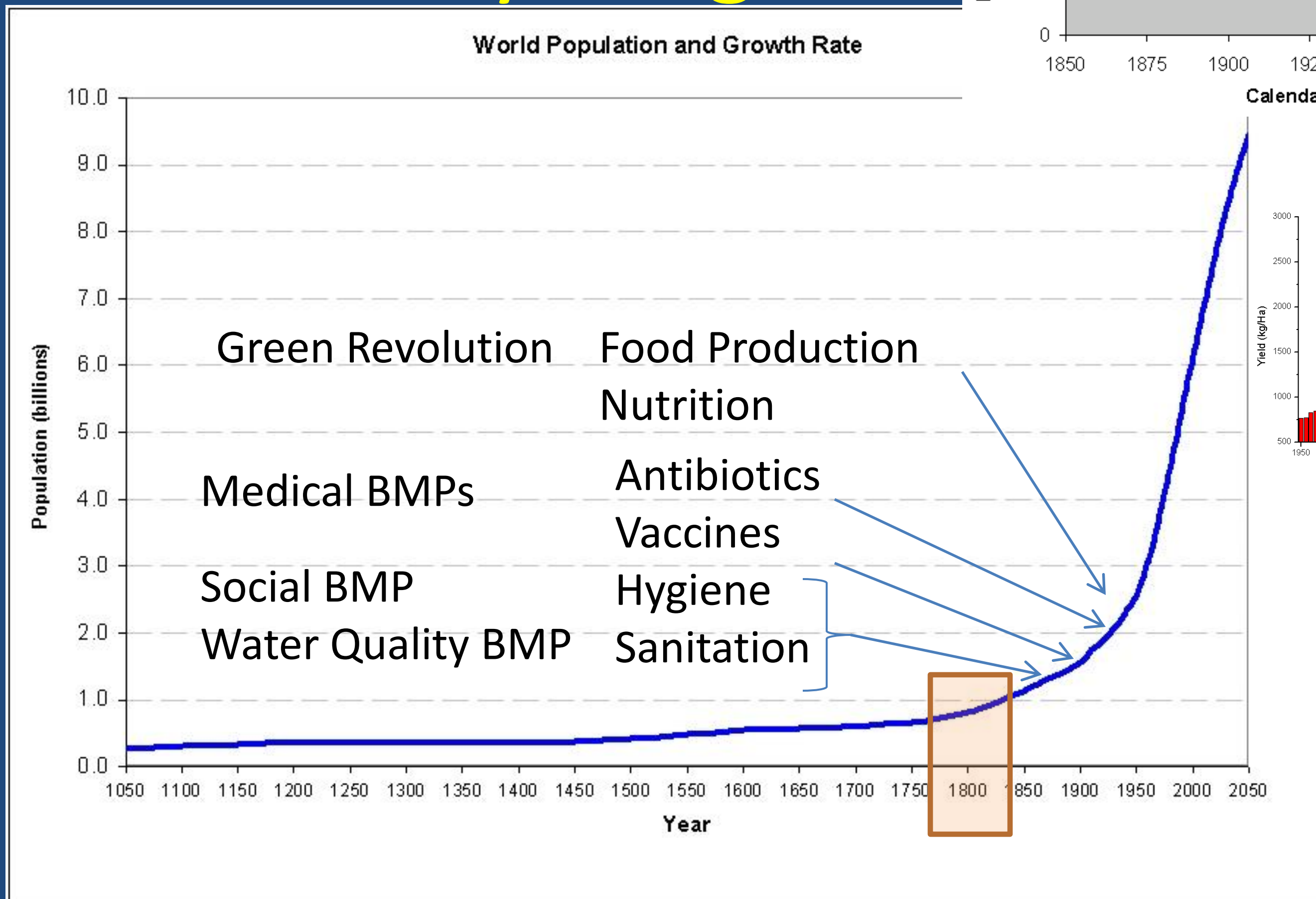
We humans are historians! We track everything!

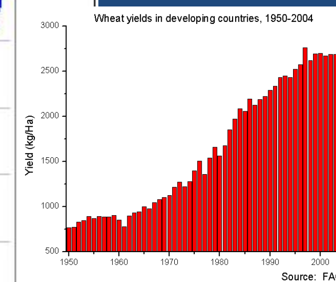


Industrial Revolution – major turning point in human history raising living standards for the masses.

We humans are historians!
We track everything!







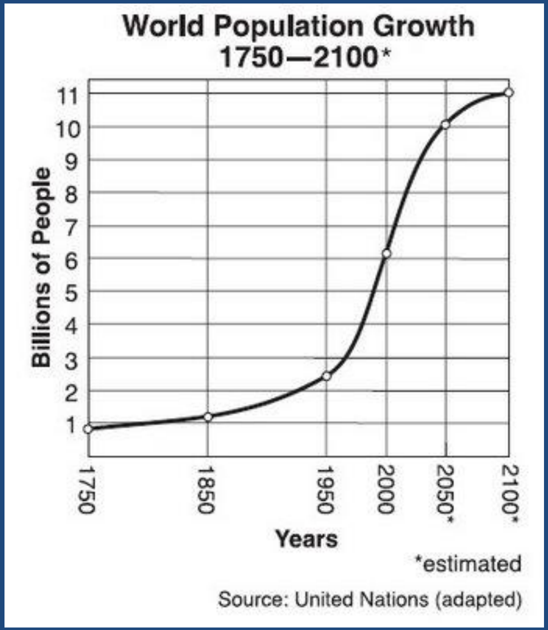
Industrial Revolution – major turning point in human history raising living standards for the masses.

Assess and Communicate Status and Change Effectively

Status

2011: 7 billion people

Trend: Change over time

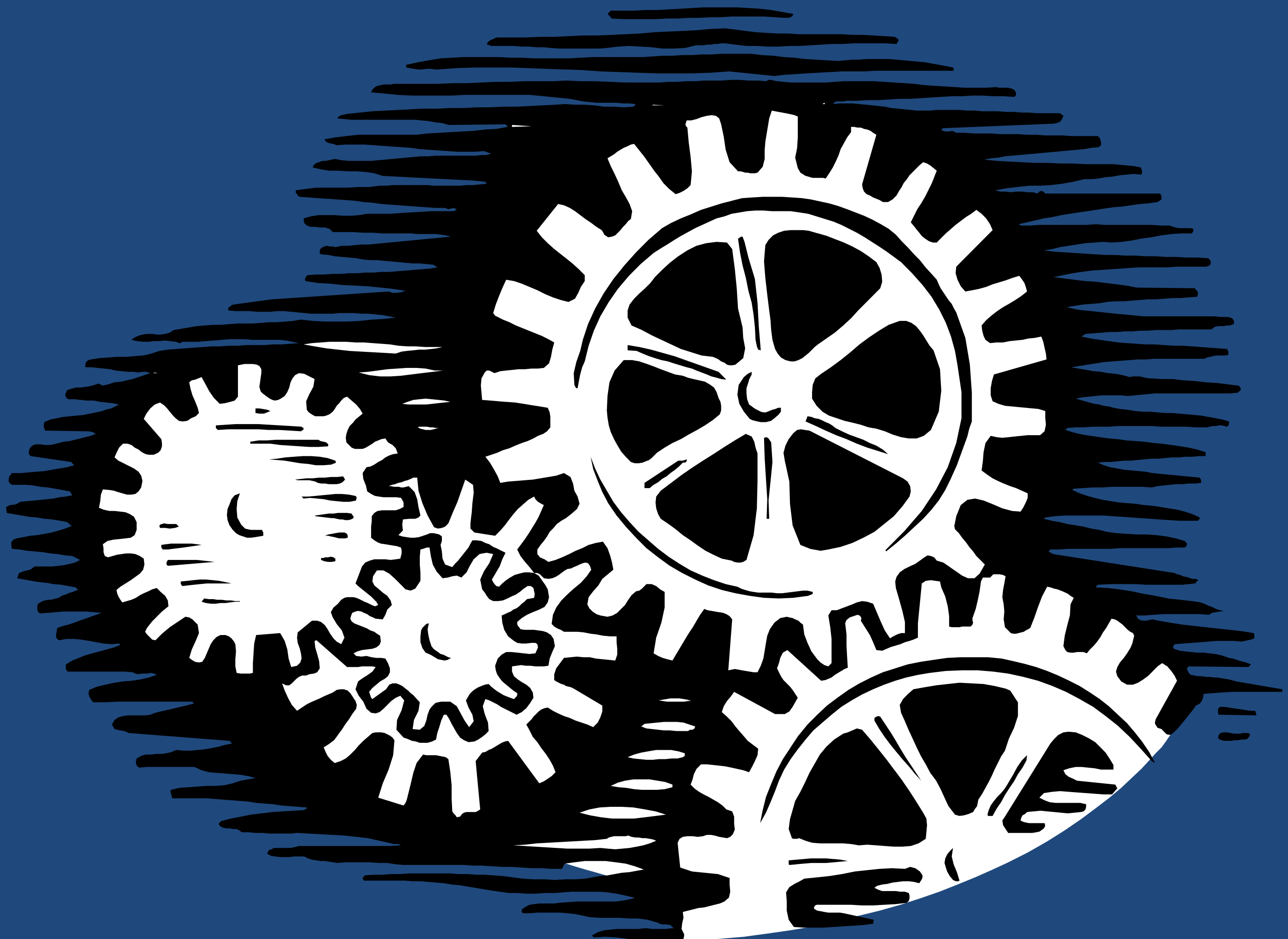


Explanatory Measures: Explain and Communicate Change

Population Counts
Births
Deaths
Longevity
Disease events (plague, influenza)
Economics (Industrial Revolution)
Environmental Science (Sanitation)
Social behavior (Hygiene)
Science II (Medical therapies arise)
Science II I (Green Revolution – yield/acre increase)
Science IV (Nutrition)

Analysis, Synthesis, Visualize, Give Context

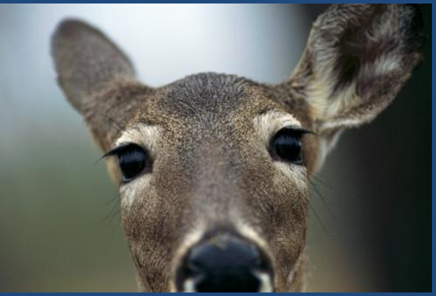
Let’s shift gears…

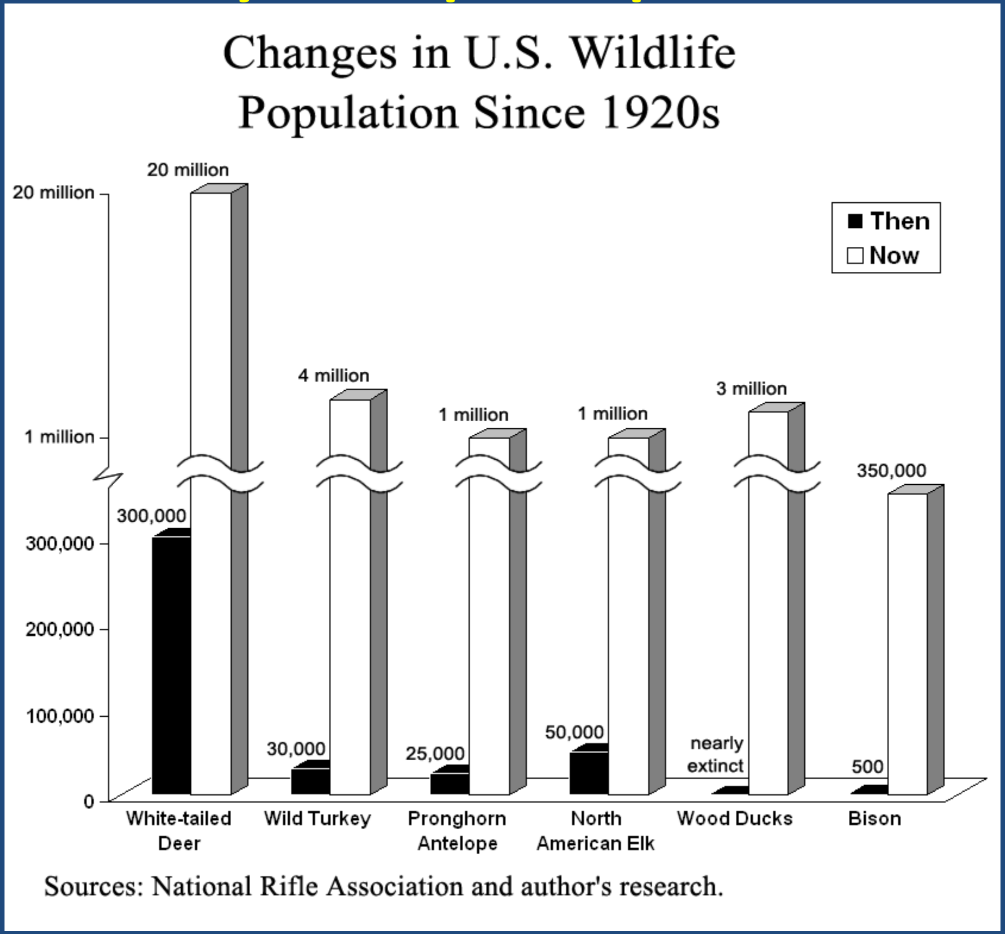


Some Roots of Conservation

- 1849: U.S. Dept of Interior is established.
- 1872: Congress establishes Yellowstone National Park.
- Lacey Act (1900): Protect plants and wildlife; civil and criminal penalties introduced.
- Theodore Roosevelt: Father of Conservation
  - 51 bird sanctuaries created
  - Forest reserves increased from 43M to 194M acres
  - Antiquities Act (1906) – roots of National Park Service
- Aldo Leopold (1930s) – A Sand County Almanac; Game Management
- Pittman-Robertson Act (1937): FDR. Earmarked funds to States for Wildlife Restoration.

Monitoring Responses to Restoration Activities: 90 year perspective

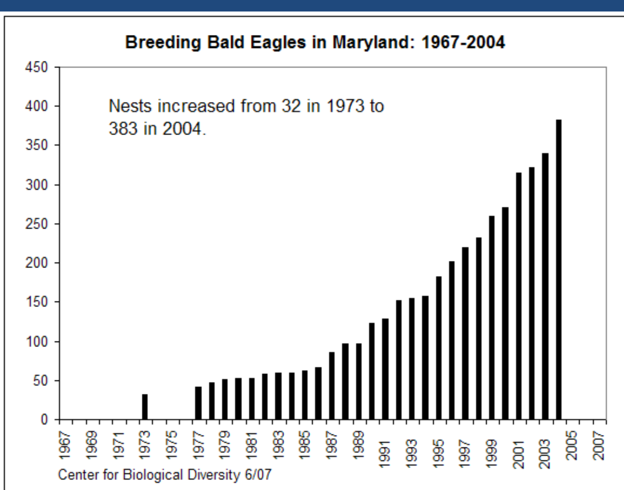


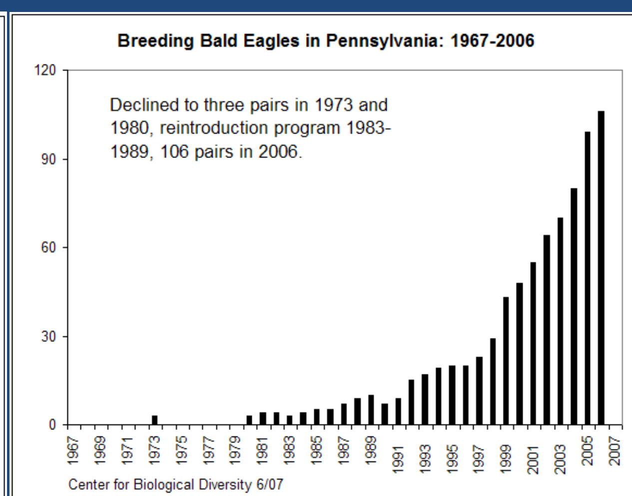


Status and Trends: Recovery takes time .

1964 Peregrine Falcon
Extinct in the eastern U.S.

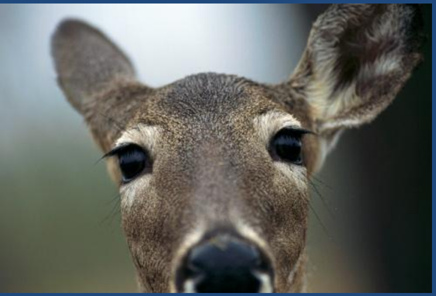
1997: 174 nesting pairs in eastern U.S.; 27 pairs in the Ches apeake Bay watershed

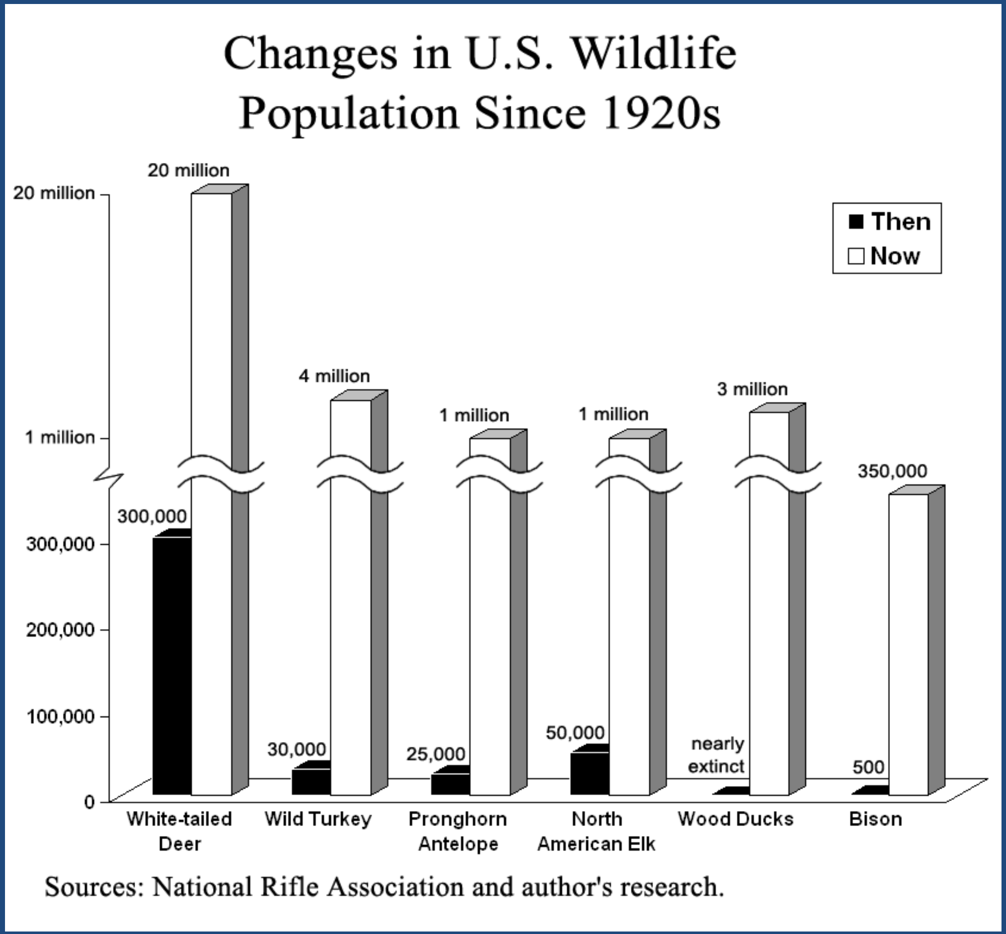




Pittman Robertson Fund investments : >$2 billion since 1937.

Return on investments: Habitat acquisition, habitat improvement and species saved from threatened or extinct status

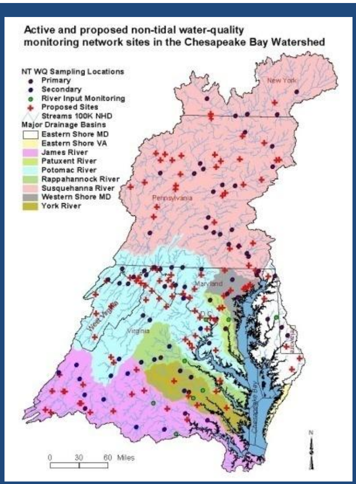




Chesapeake Bay: Key Policy Actions with Goals and Outcomes

- 1983 Chesapeake Bay Agreement
- 1987 Chesapeake Bay Agreement
- 1992 Amendments
- Chesapeake 2000
- Presidential Executive Order 2009
- Chesapeake Bay TMDL 2010

Tracking Change: Chesapeake Bay Program Monitoring Networks



Watershed Monitoring

Bay Water Quality Monitoring

Shallow Water Habitat

Living Resources Monitoring

There are models about how we think that the Bay works…

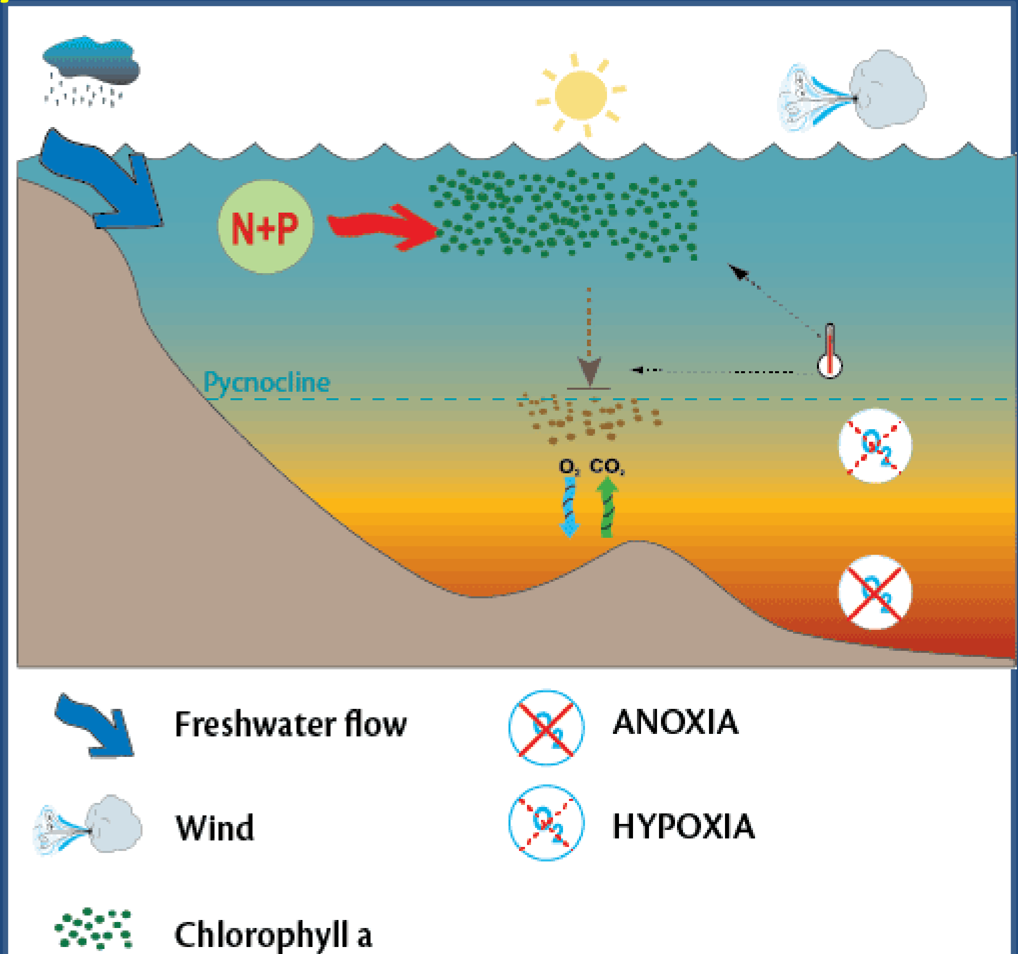
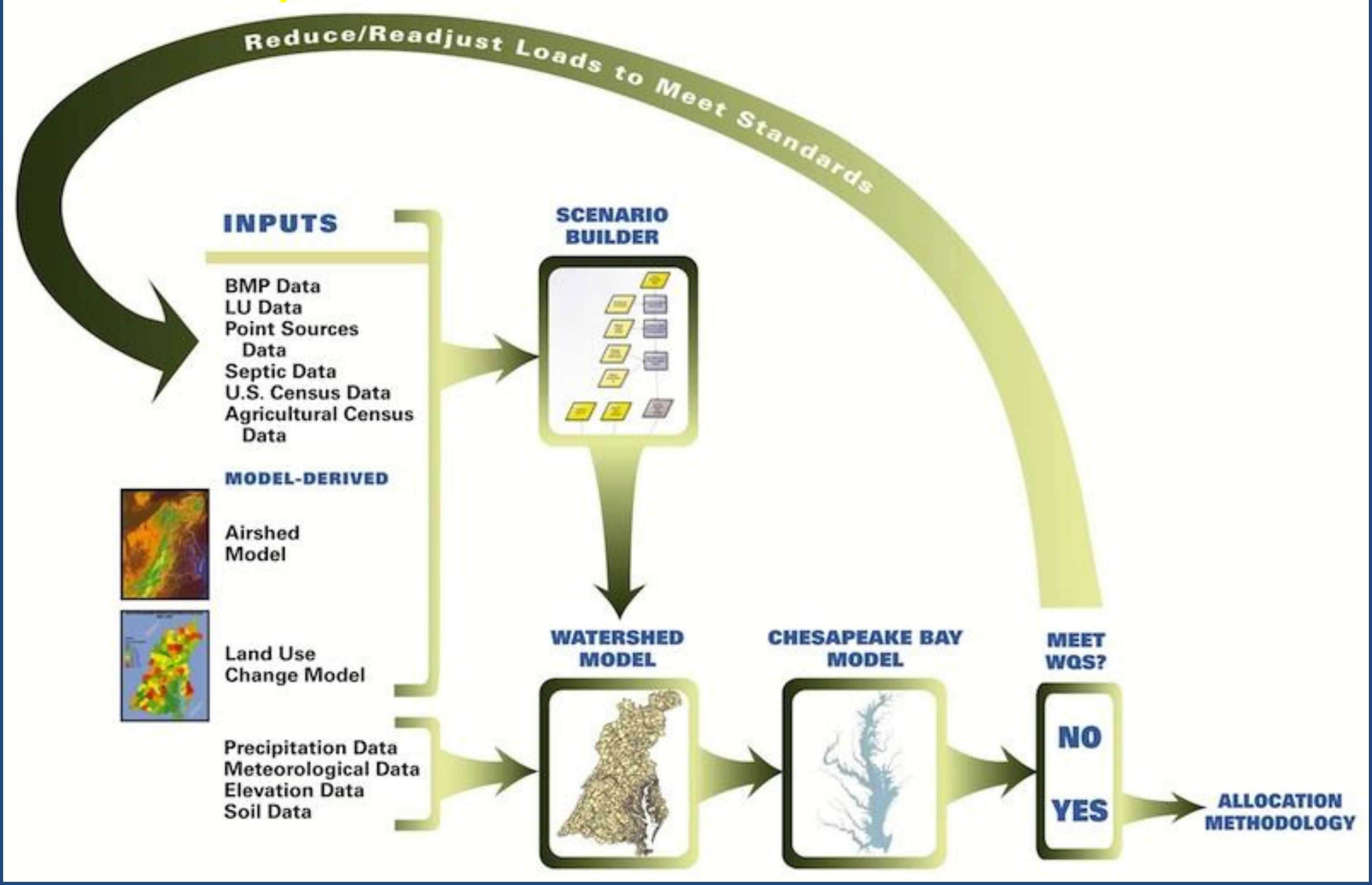


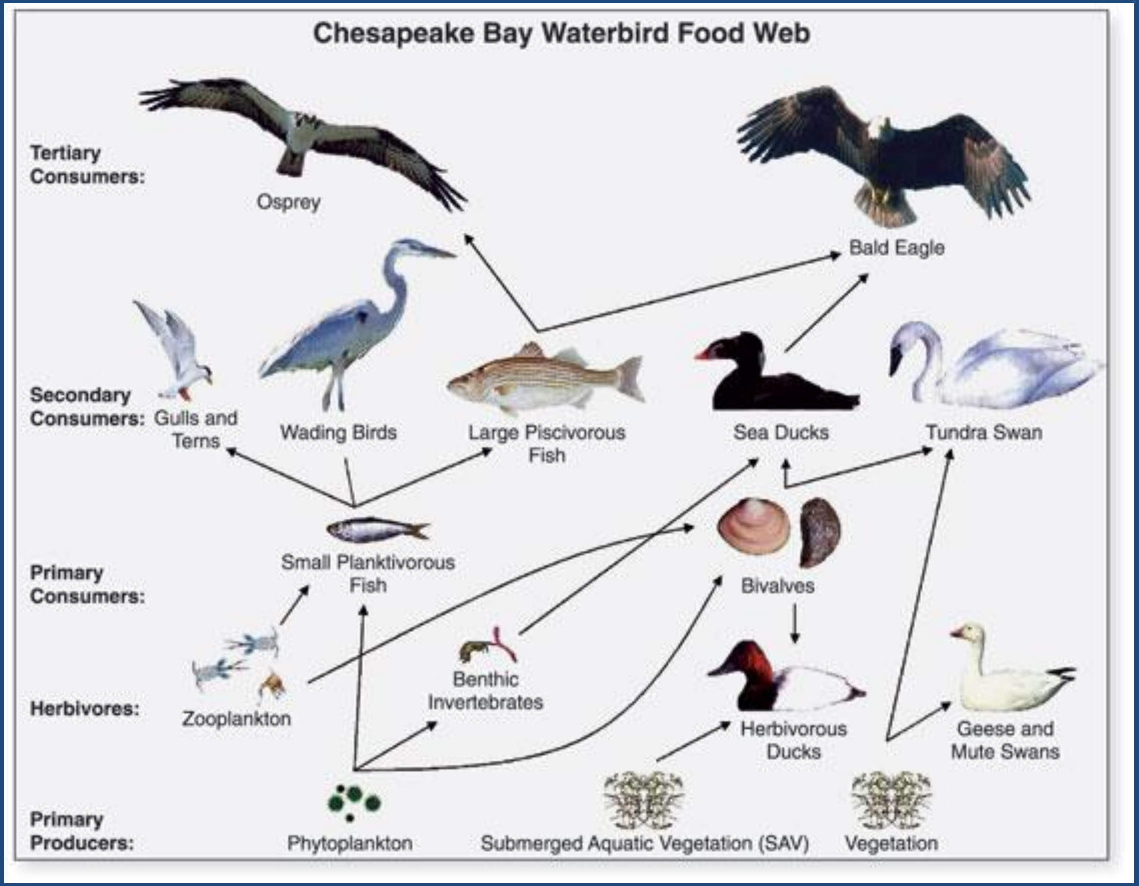
Illustration: IAN Ecocheck

Conceptual Model:
Rain> Runoff> (Nutrients + Sun + Temperature + Wind) > Algae Blooms >
Algae die and sink>Poor Dissolved Oxygen Conditions

And there are models about how we think that the Bay works…

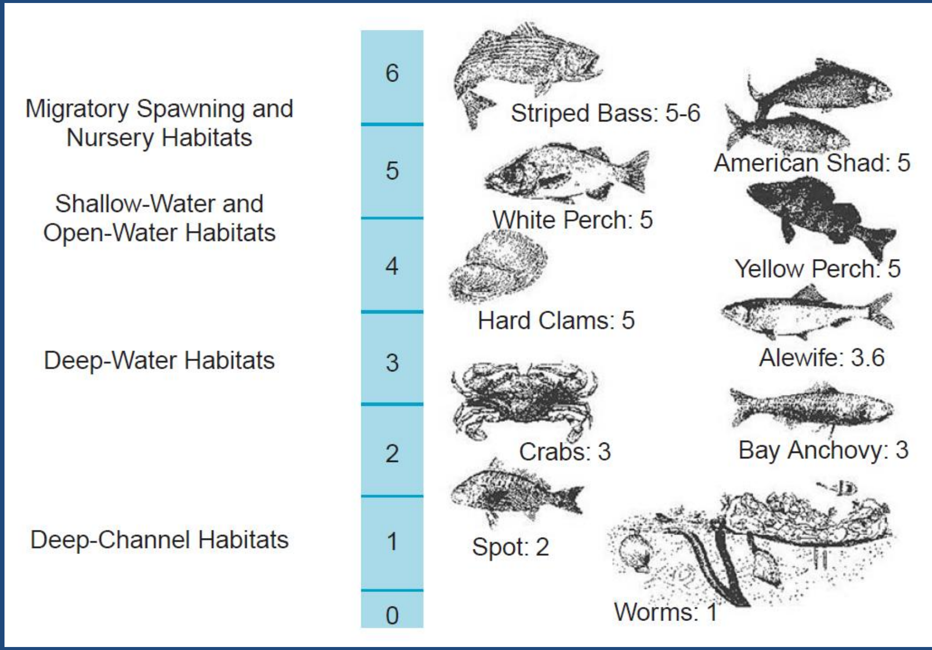


But wait, there are also food web models about how we think that the Bay works…



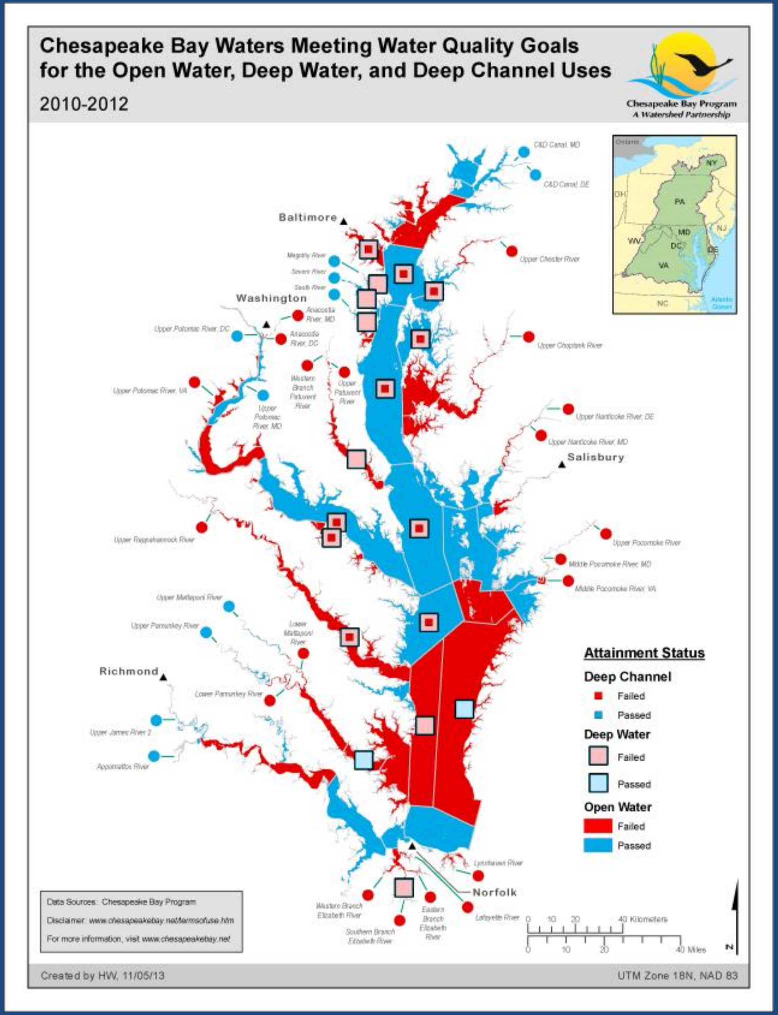
Complexity increases…

Bay Health Status – Spatial Snapshot



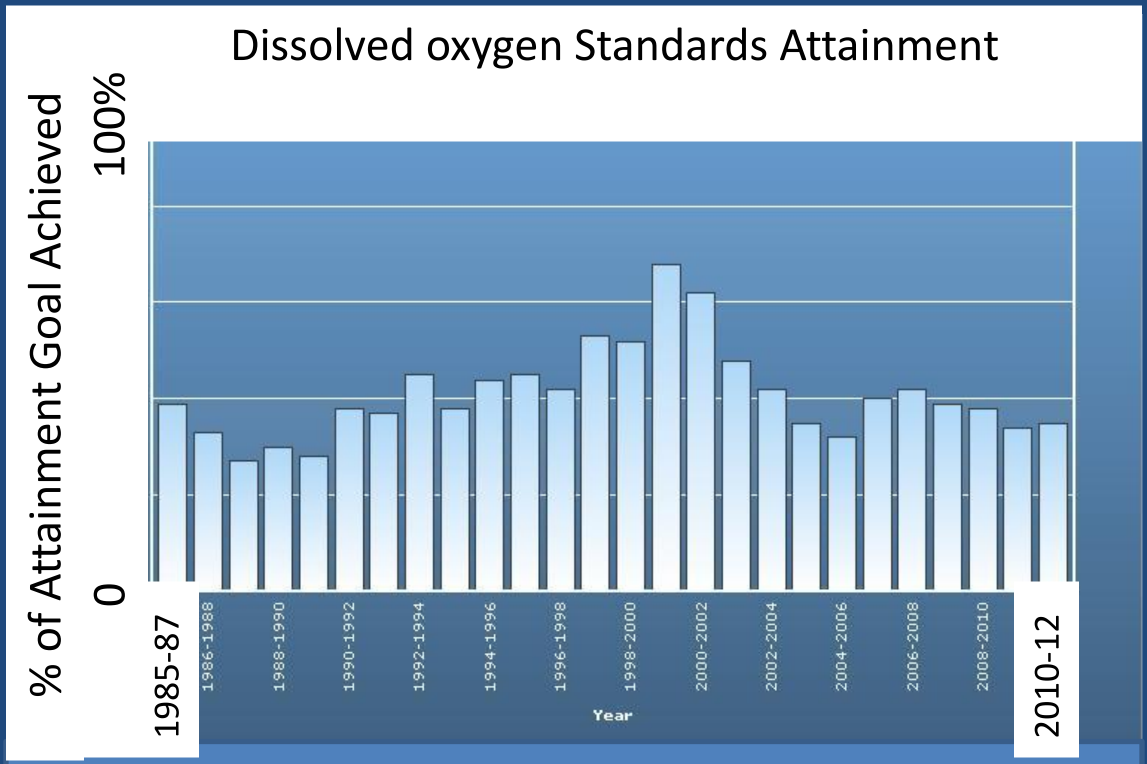
USEPA 2003

The Dissolved Oxygen Criteria Yardstick: Science-derived species requirements for Protecting survival, growth and reproduction In different Bay habitats.



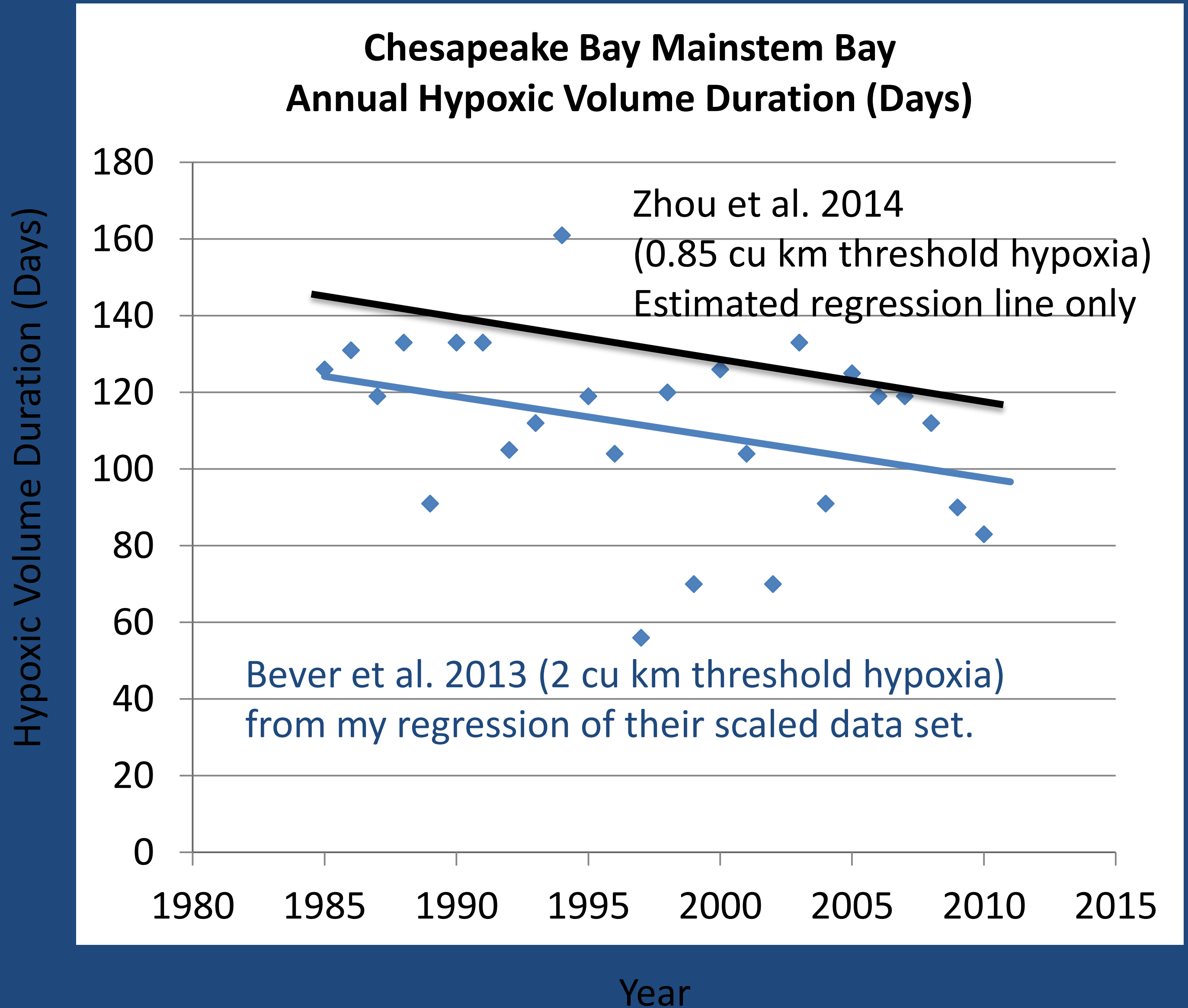
Status – water quality meets or Fails

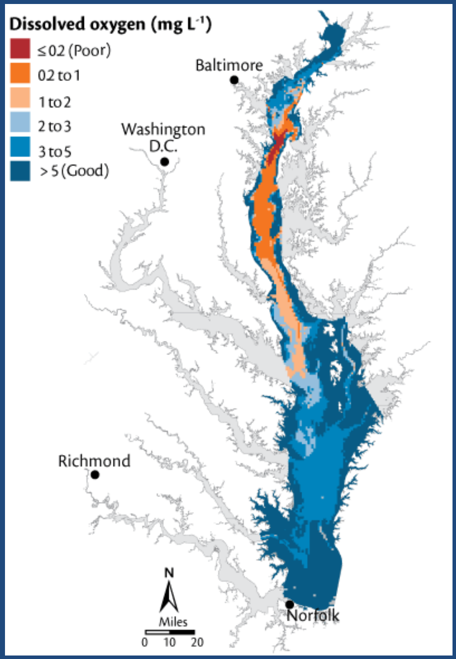
Bay Health Status: Dissolved Oxygen Time Series Water Quality Standards Criteria Attainment for All Tidal Waters 1985-2012



http://www.chesapeakebay.net/indicators/indicator/dissolved_oxygen

Indicators: What the Public Sees of Our Water Quality Monitoring Program.





Chesapeake Bay Hypoxia Summer 2012

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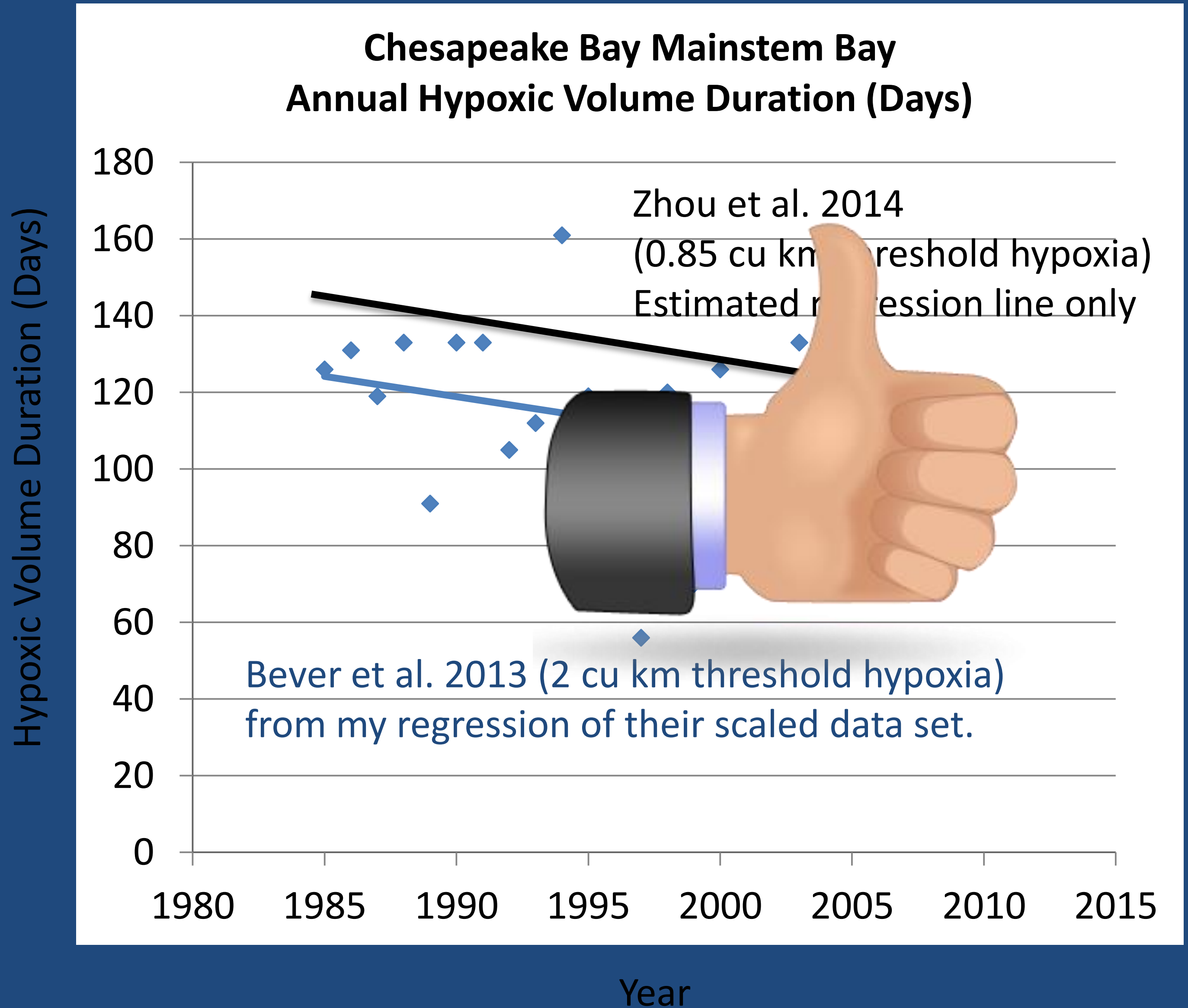
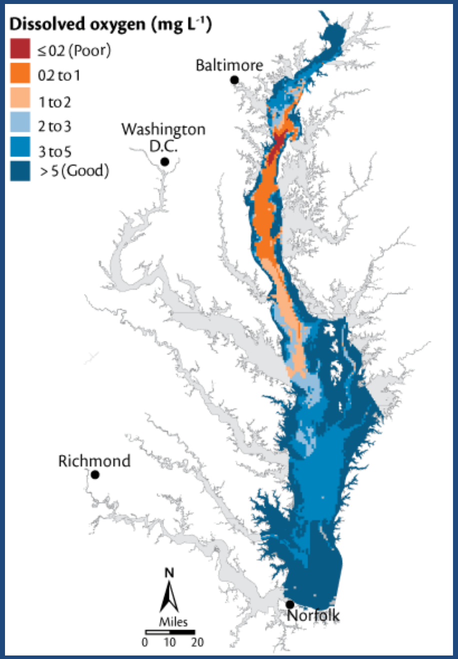




Chesapeake Bay Hypoxia Summer 2012

Key Policy Actions Influence Timing of Monitoring Program Reviews and Program Tuning

Chesapeake Bay
Agreement
2014*

Ecosystem Health Goals and Outcomes

Management Strategies

- 1983 Chesapeake Bay Agreement
- 1987 Chesapeake Bay Agreement
- 1992 Amendments
- Chesapeake 2000
- Presidential Executive Order 2009
- Chesapeake Bay TMDL 2010
- New Bay Agreement forthcoming*

Why Monitor?
Restoring watersheds project by project: Trends in Chesapeake Bay tributary restoration. Palmer et al.

- 1990-2005 study: 4700 Tributary restoration projects.

- Estimated $400 million invested in Bay and watershed restoration

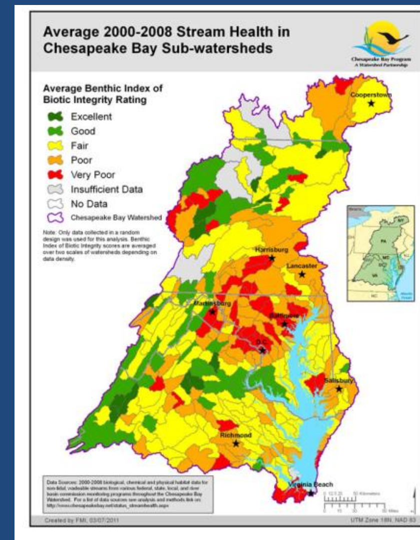
Why Monitor?
Restoring watersheds project by project: Trends in Chesapeake Bay tributary restoration. Palmer et al.

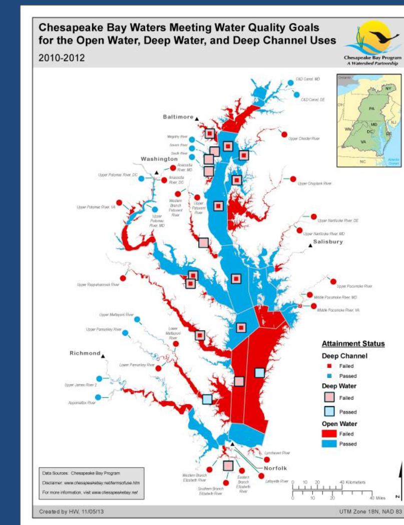
- 1990-2005 study: 4700 Tributary restoration projects.
- Estimated $400 million invested in Bay and watershed restoration

- *Only 5% of projects had any kind of monitoring.*
  - *That means 95% of projects, **maybe $380M** worth of effort, we have no idea if it did what it was targeted to do.*

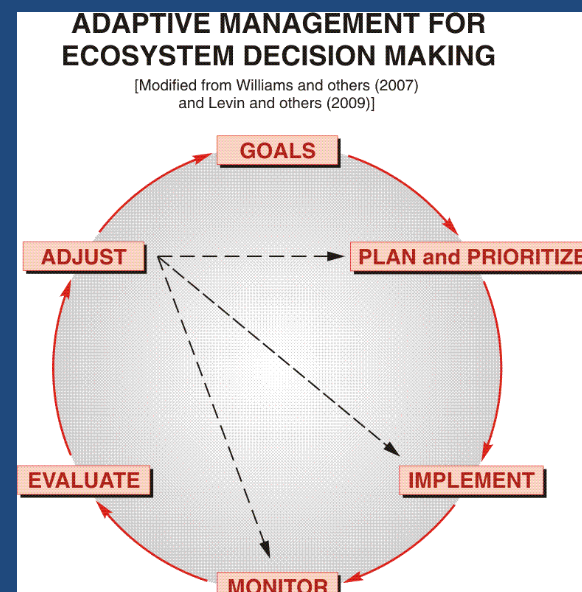
Why Monitor?

- Assess and Communicate Status and Change Effectively
  - Assess: CBP Tidal and Nontidal Monitoring Program
  - Separate Fact from Fiction
  - Confront models with data





- Adaptive Monitoring to Supporting Adaptive Management
  - Target limited resources
  - Understand your return on investment
  - Gain new understanding
  - Adjust monitoring and management if we are not getting the expected results

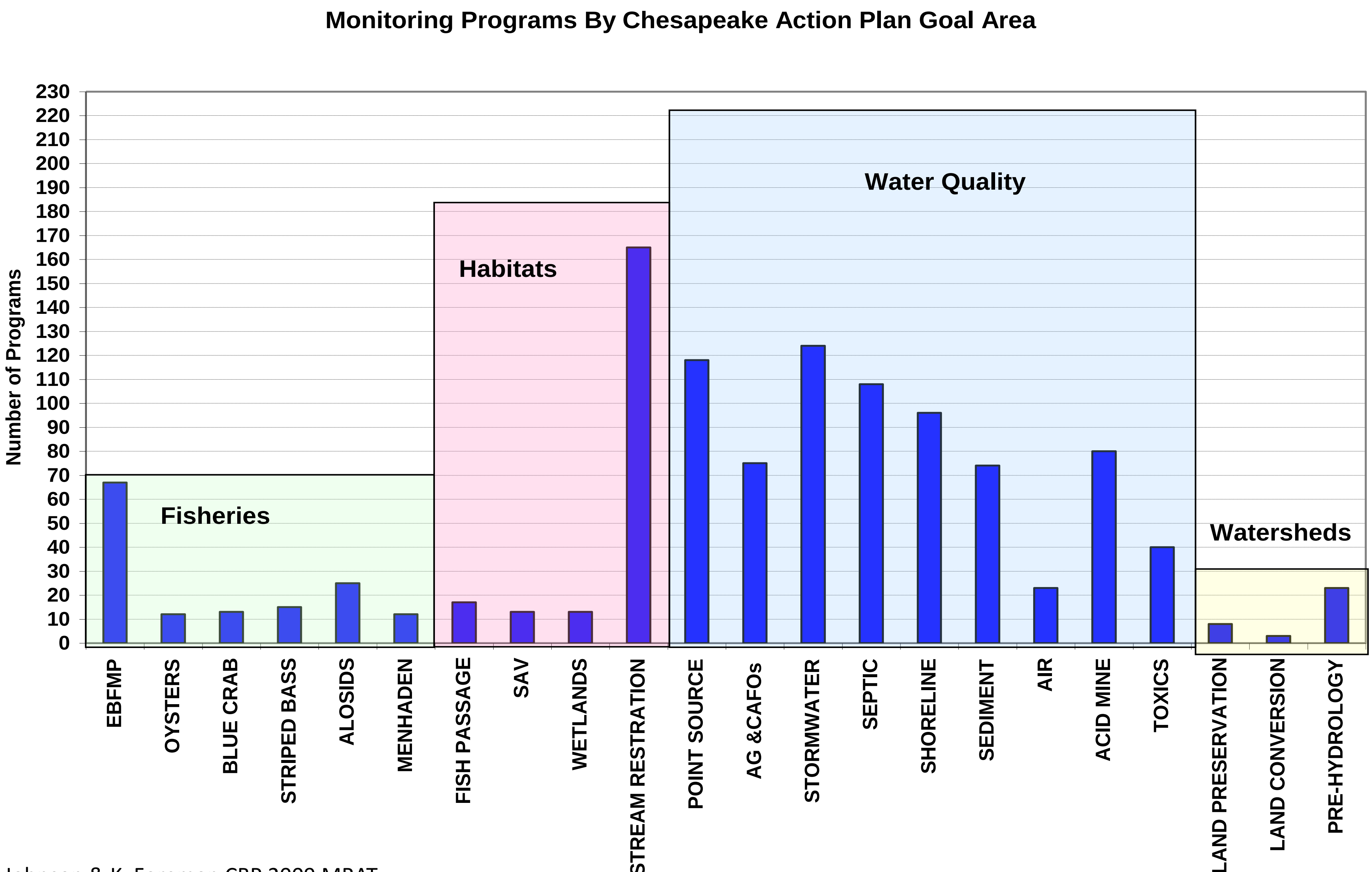


What to Monitor?

What to Monitor?

It depends…

295 monitoring programs identified in the watershed and counting!

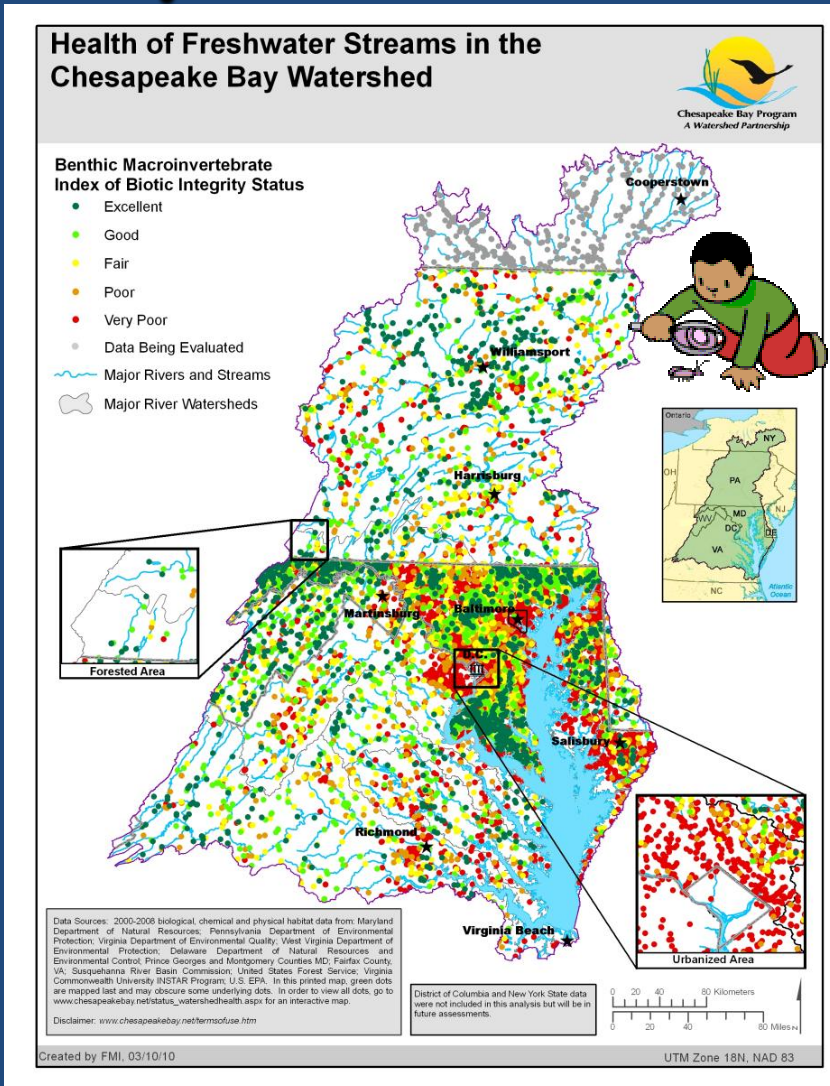


J. Johnson & K. Foreman CBP 2009 MRAT

Data uses generated by monitoring programs (source: EPA - Surf Your Watershed)

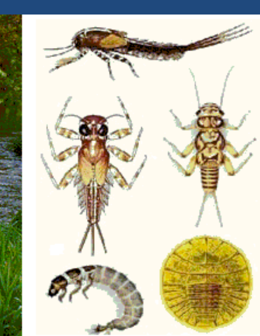
Data Uses:	Example: ALLARM in PA
Education	Our program, Non-governmental community organizations, University scientists
Advocacy	Non-governmental community organizations
Research	Our program, University scientists
Community organizing	Non-governmental community organizations
Screen for problems	Our program, Non-governmental community organizations, University scientists
Establish baseline conditions	Our program, Non-governmental community organizations, University scientists
Nonpoint source assessment	Our program, Non-governmental community organizations, University scientists
BMP evaluation	
Land use decisions	
Watershed planning	Our program, Non-governmental community organizations, State government, University scientists
Plan restoration projects	State government
Enforcement	
Legislation	
Shellfish bed closures	
Swimming advisories	
State 305(b) report	
Other	

Bay Watershed Health Indicators



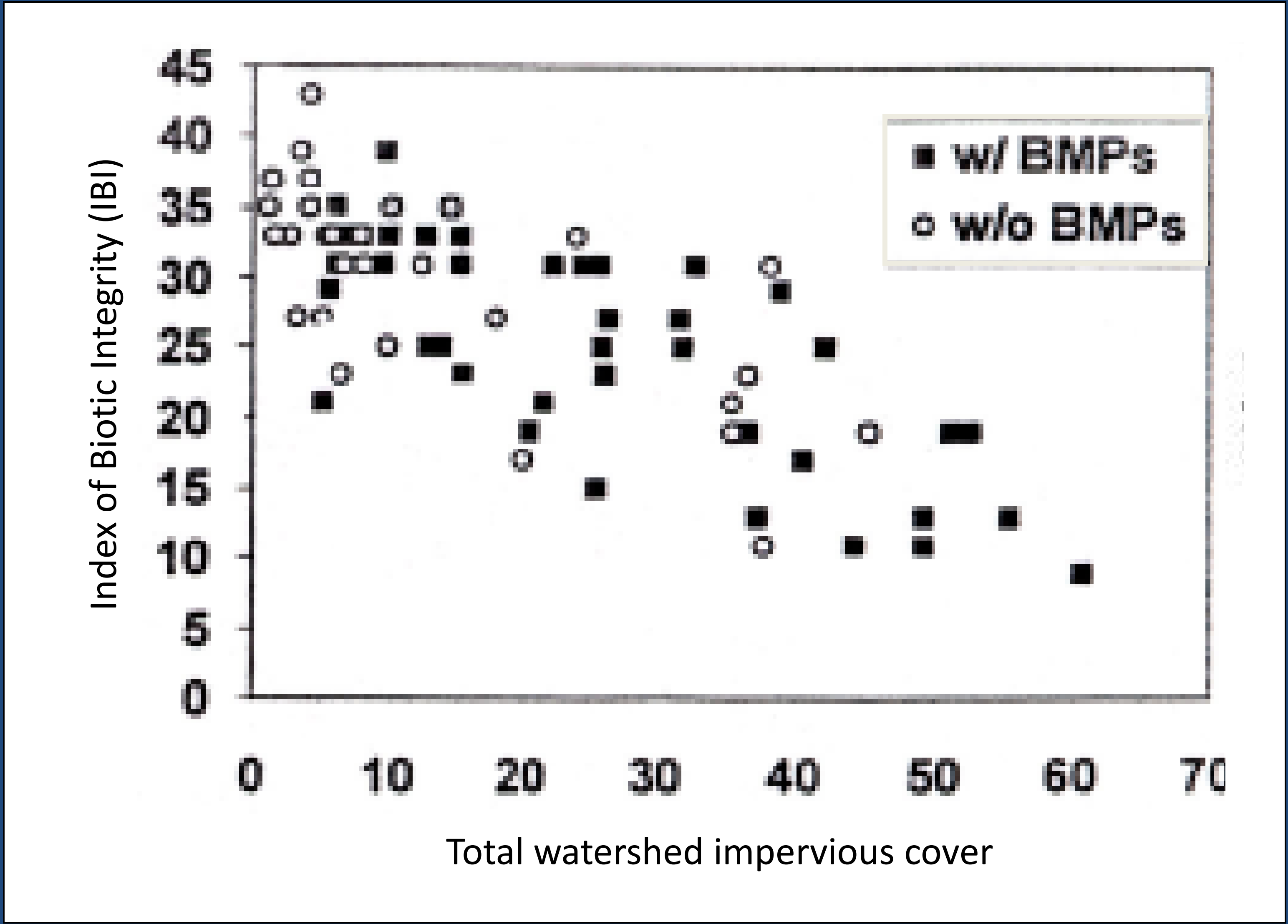
Buchanan et al. 2010. Acknowledgements

"An adhoc CBP workgroup created to guide development of the Chessie B-IBI consisted of benthic macroinvertebrate experts from the six states in the watershed (New York, Pennsylvania, Maryland, Virginia, West Virginia, and Delaware) as well as federal, academic, and River Basin Commission partners. The authors wish to give special thanks to the members of the adhoc workgroup for their diligence in providing technical guidance and feedback: A.J. Smith (NYDEC), Aimee Budd (VADEQ), Bill Richardson (US EPA Region 3), Brian Chalfant (PADEP), Charlie Poukish (MDE), Dan Boward (MD DNR), Ed Reilly (NYDEC), Ellen Dickey (DNREC), Greg Garman (VCU), Greg Pond (US EPA Region 3),Hassan Mirsajadi (DNREC), Jeff Bailey (WVDEP), Jen Hoffman (SRBC), John Wirts (WVDEP), Kevin McGonigal (SRBC), Maggie Passmore (US EPA Region 3), Mike Fritz (EPA-CBPO), Nita Sylvester (EPA-CBPO), Peter Tango (USGS-CBPO),Rick Hoffman (VADEQ), Rod Kime (PADEP), Ron Klauda (MD DNR), Scott Stranko (MD DNR), Tony Prochaska (MD DNR), and Wayne Davis (EPA). Other members of the Chesapeake Bay Program's Non-Tidal Water Quality Workgroup as well as the Indicator Workgroup provided input on final presentation of the results."



Furthering communication product development: Watershed-wide status and targeting maps

BIBI performance: Variation *among* watersheds



Horner and May (1999) in CWP (2003)

2013 Montgomery County, MD. Benthic macroinvertebrate assessments (BIBI) were used as a planning tool for model scenarios of stream protection strategies.

Watershed study with different imperviousness in each watershed.

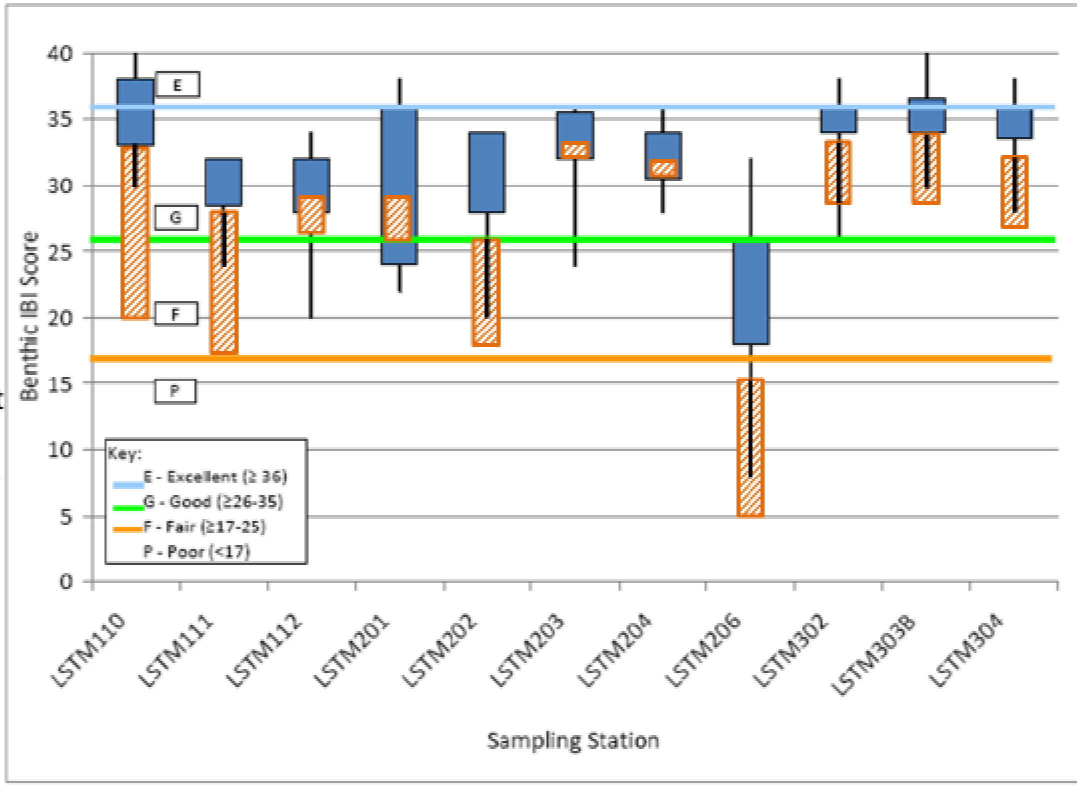
Comparison: Existing Benthic IBI with Estimated Post-Development IBI

1994-2012 Benthic IBI (range of the middle 50% of scores)

Max – Min

Estimated range of Benthic IBI Post Development*

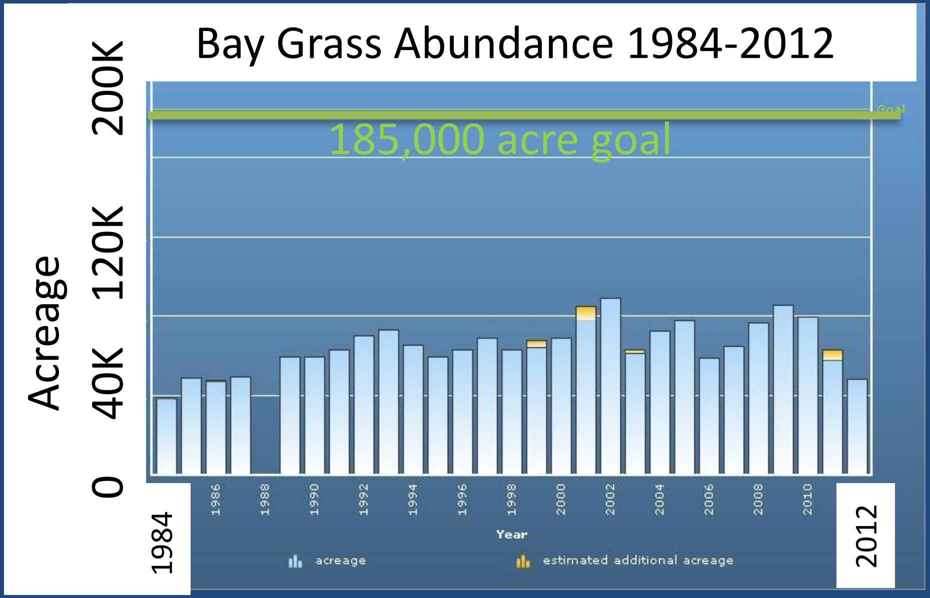
*The top of the striped bar indicates the best potential outcome (high score) for imperviousness resulting from Scenario 5 (7% overall watershed imperviousness), while the bottom is the lowest likely outcome (low score) for Scenario 2 (1994 Plan).



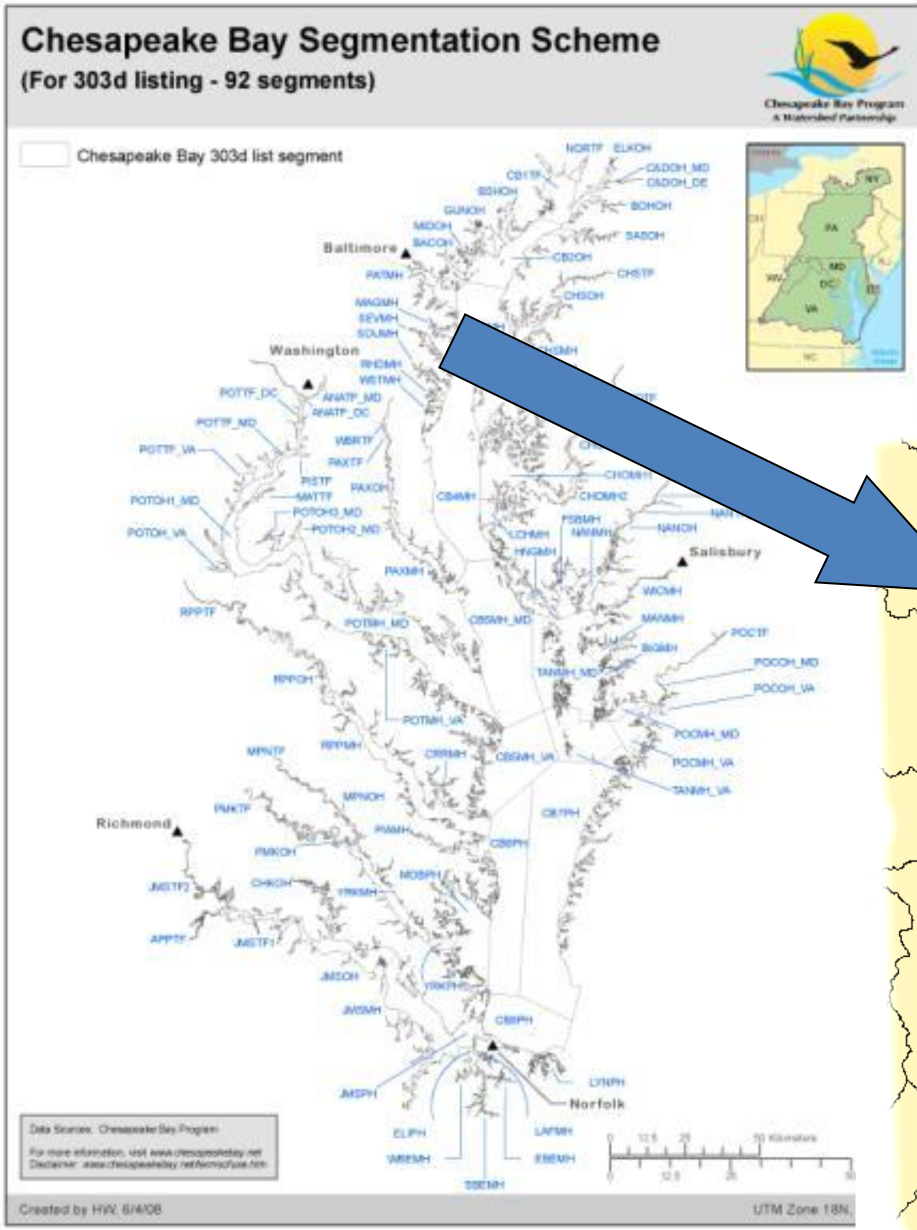
The 1985-2011 Baywide assessment of Water Clarity based on Secchi depth measurements illustrates degrading conditions. Submerged Aquatic Vegetation peaked in 2002 and remains below goal conditions.

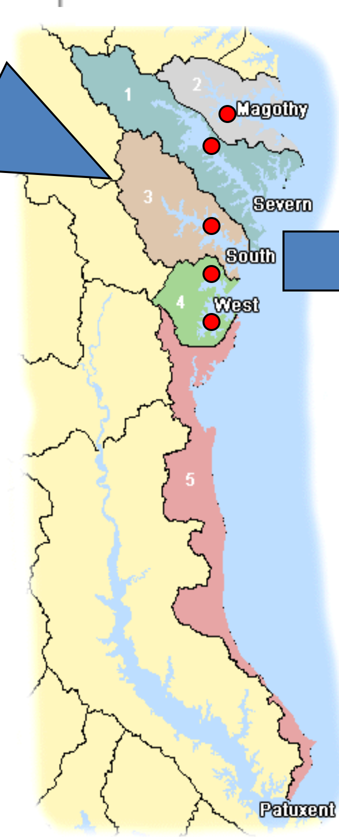
- Bay Grasses ground-truthing for the annual assessment

- SAV abundance peaked in 2002 (1984-2012). (Regulatory assessment)

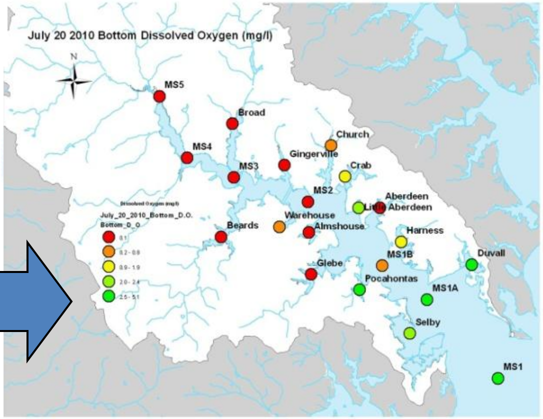


Maryland is piloting work for Regulatory Assessments: South River Federation

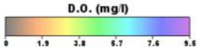




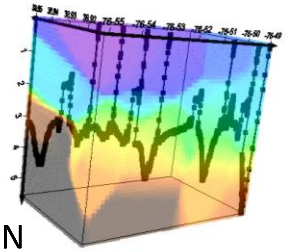
South River Federation



Increasing resolution



Reducing uncertainty



A Muller. USN

Many Other Opportunities: Each Program with its own Indicators and Protocols

Audubon

Christmas Bird Count
PA Bird Habitat Recognition Program

The Shark Trust

The Cornell Lab of Ornithology
Exploring and Conserving Nature

eBird

OPAL
Soil and earthworm survey

United Kingdom
Butterfly Monitoring Scheme

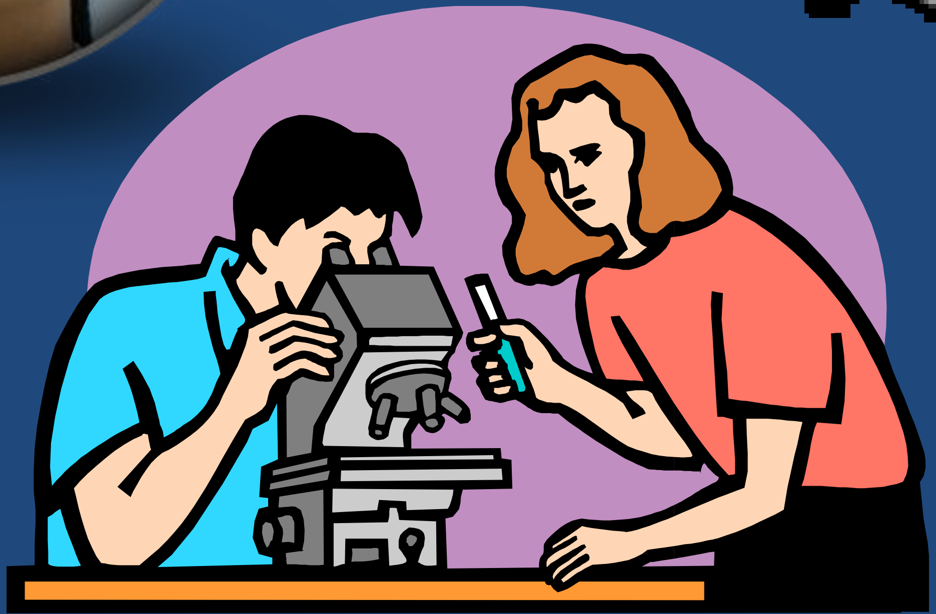
What to Monitor?
It depends on your priorities and interests.

- Status: water quality (nutrients, sediments, toxics, temperature, algae, dissolved oxygen), bugs, fish, birds, herps, bacteria, pH, conductivity, trash, etc.
  - Regulatory, Bay Agreement outcomes, model calibration and verification support, conservation planning, education and stewardship.
- Restoration tracking: Document and monitor the BMP itself
  - riparian zone: plantings-growth-success,
  - stream fencing
  - dam removals
  - rain gardens

- Support for planning efforts and targeting resources

- Explaining change and understanding your return on investment.

Communicating our Environmental Intelligence!

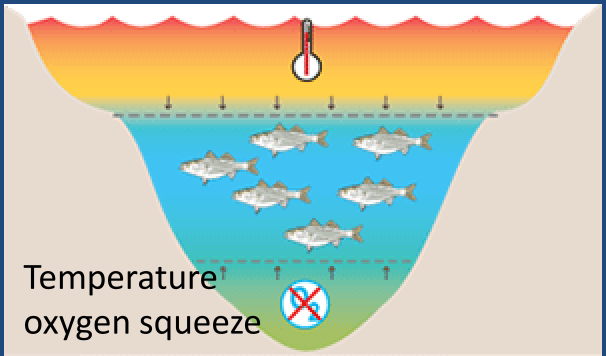


Principles of good science communication

- Provide synthesis, visualization & context
- Respect your audience
  - Relate to audience
  - Simplify terms but not content
  - Prepare for & invite questions
- Don't be a geek
  - Lose the jargon, dude
  - Define all terms
  - Minimize AU (acronym use)
- Make it look good
  - Assemble self-contained visual elements
  - Consistent *style* and *format*
  - Use color, but use it judiciously

Develop a Synthesis

Use Visualization



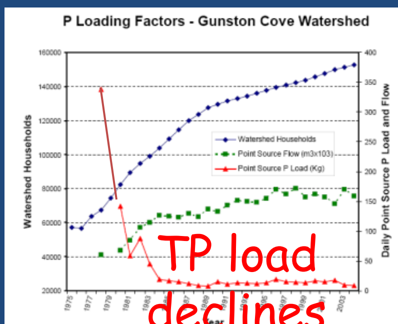
Provide Context: So what about the results?

http://ian.umces.edu/learn/science_communication/

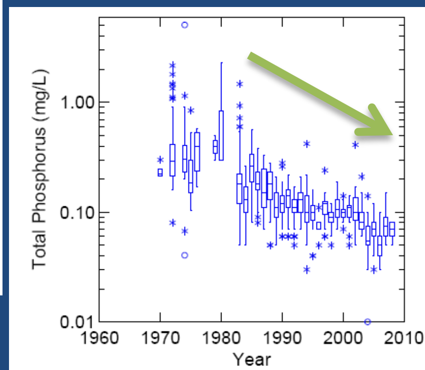
Synthesis I: Watershed to Estuary Recovery
Response to Management Actions in Gunston Cove, Potomac River

R. Chris Jones
George Mason Univ.

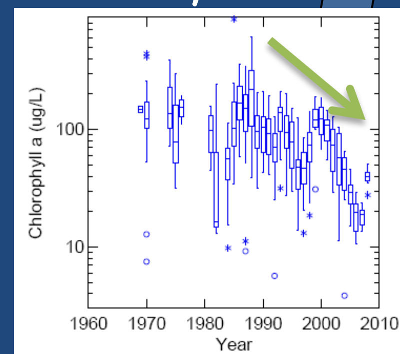
Point Source Mgt late 1970s



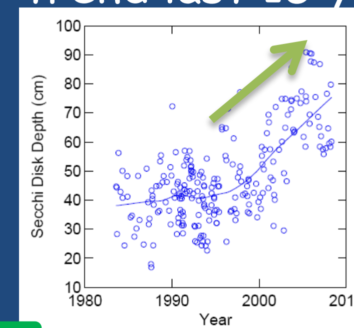
Estuary Nutrients Declining over 30 yrs



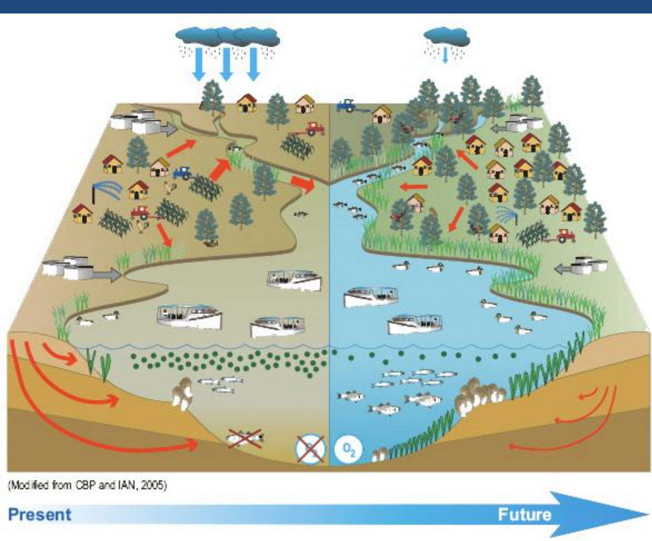
CHLA declines last 20 yrs



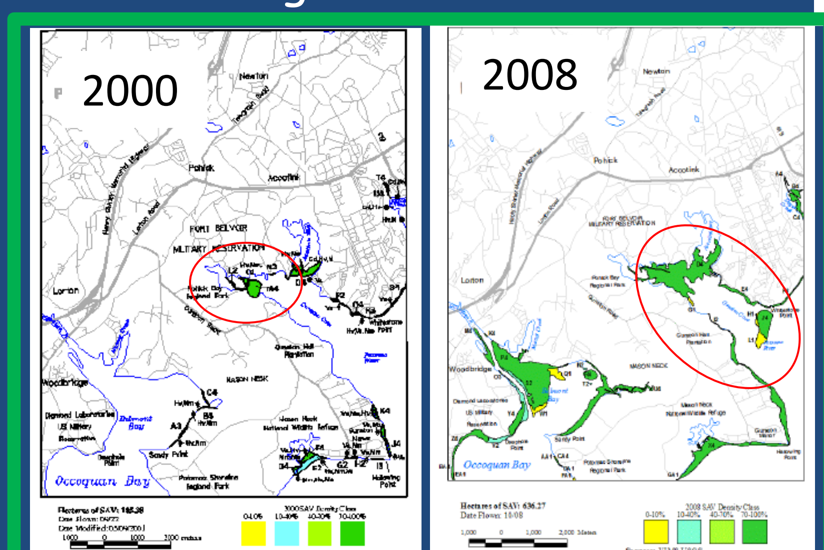
Water Clarity shows improving trend last 15 yrs



Bay recovery model:

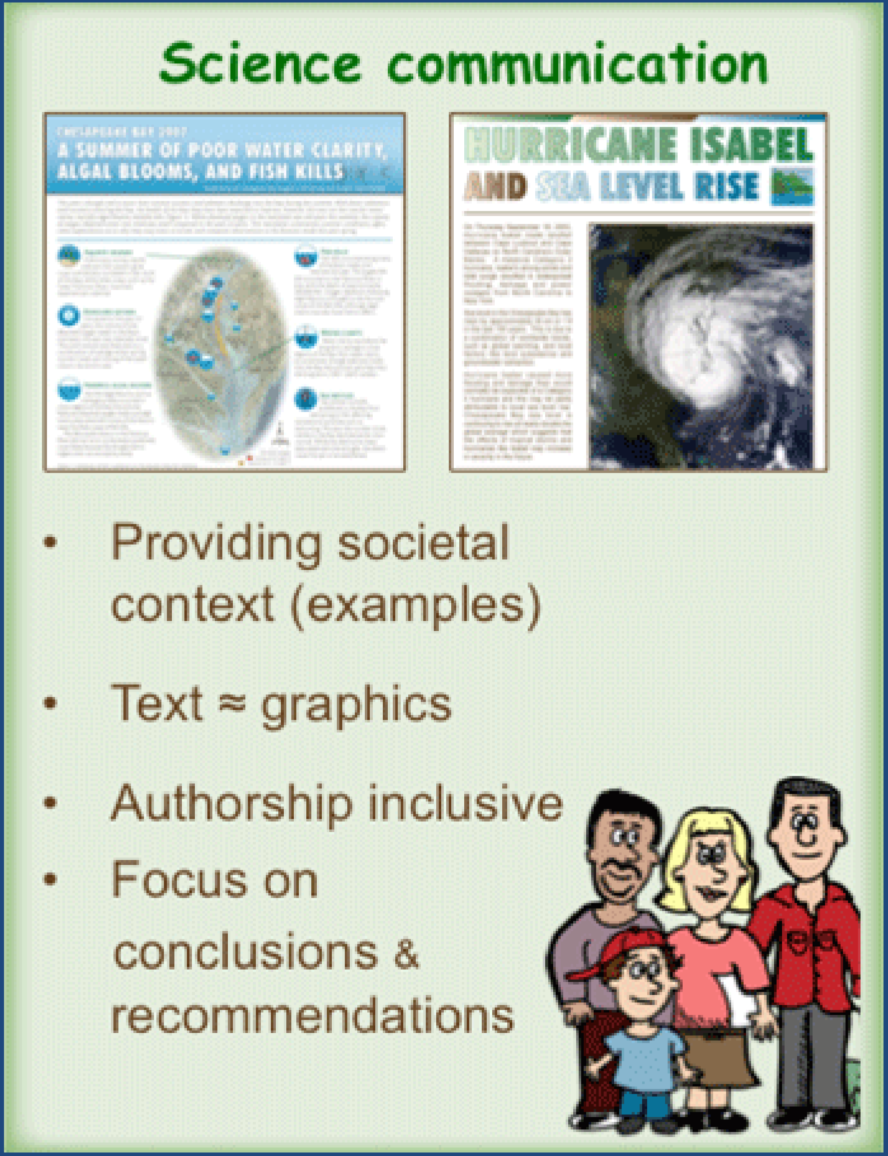


SAV resurgence and continues…

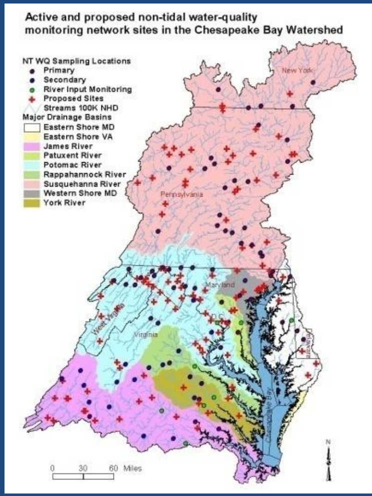


Science Communication requires…

- *Enthusiasm* counts: get excited!
- *Quality time* needed: schedule it
- *Feedback & revision* essential: seek it out



Summary:
Lessons of Monitoring and Communication

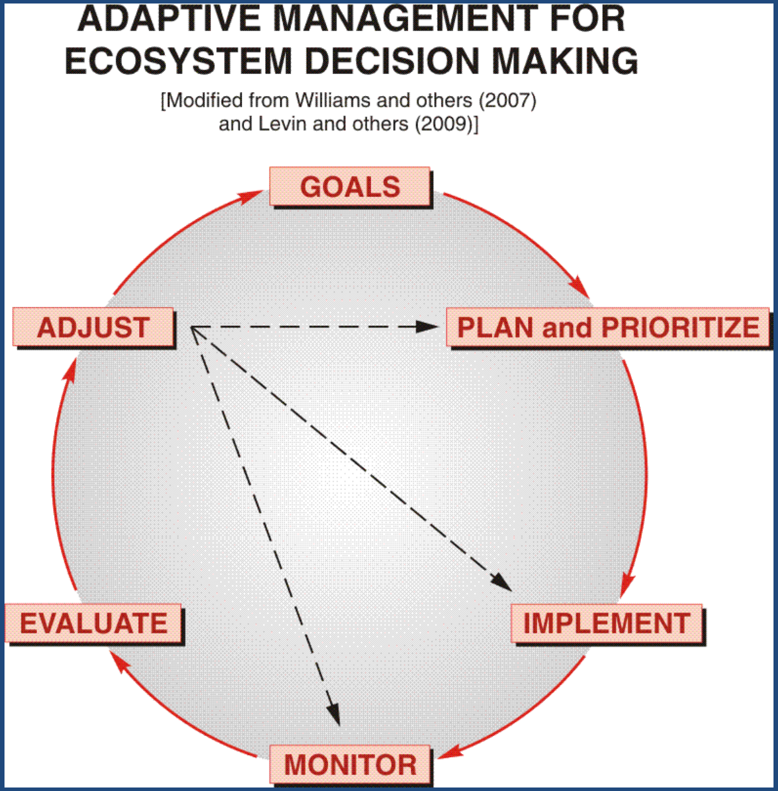


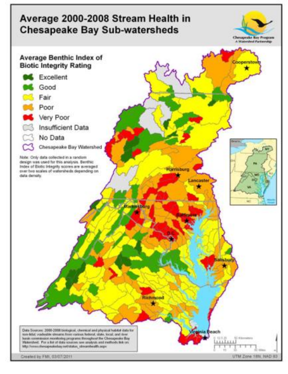
Sustaining Core Networks and Conducting Peer-reviews, Planning, Coordination and Implementation

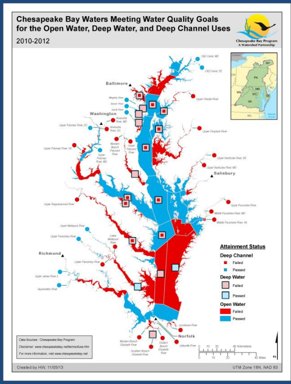
Managing Uncertainty

Chesapeake Bay Program
A Watershed Partnership

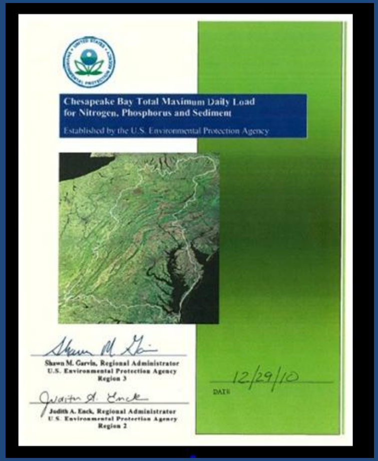
Leveraging & Growing Partnerships







Assessing and Communicating Ecosystem Status and Change Effectively



Evolving Policy

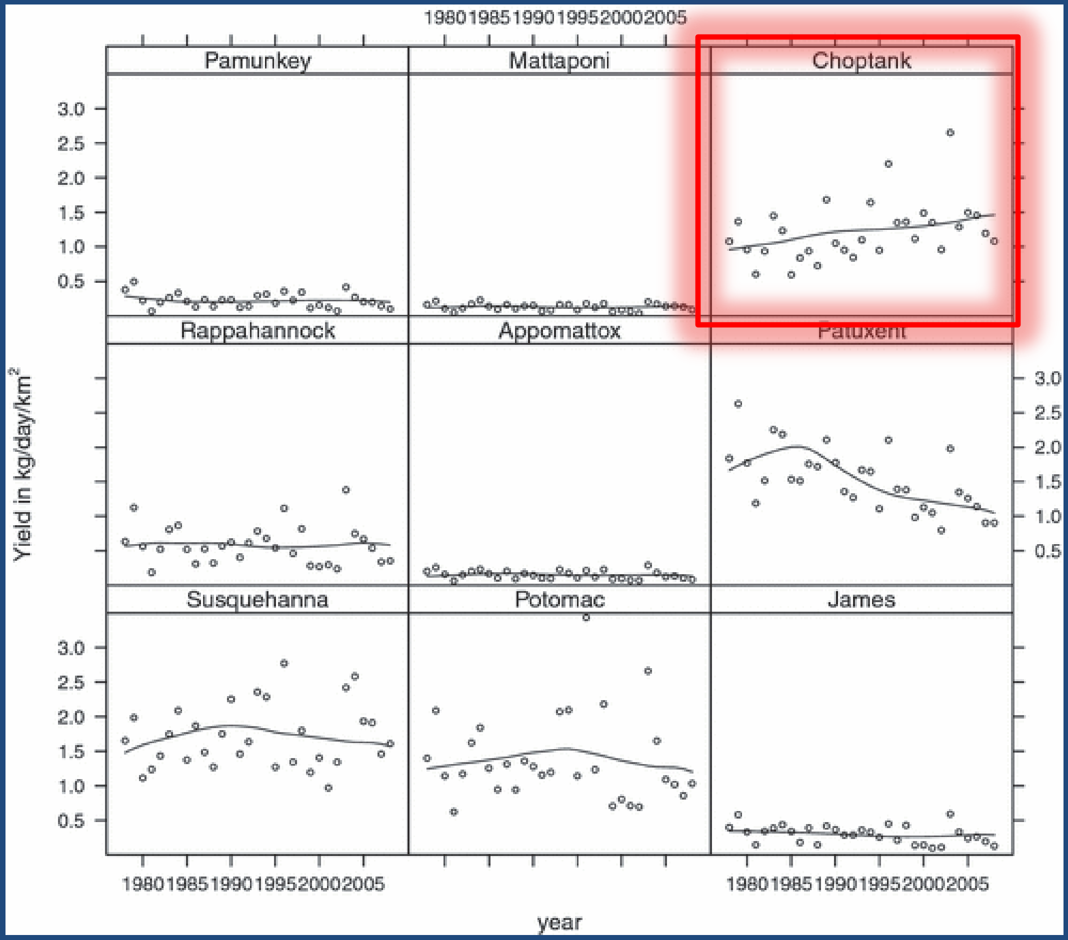
Adaptive Monitoring Supporting Adaptive Management

THANK YOU ☺

Regulatory Monitoring Interests

- TMDL – track change toward delisting Bay segments based on water quality standards for dissolved oxygen, water clarity/SAV and chlorophyll a.
- 303d list – additional parameters like pH and bacteria are monitored.
- New Bay Agreement – outcomes are being finalized, more than water quality (e.g. brook trout populations, black duck habitat, etc.)

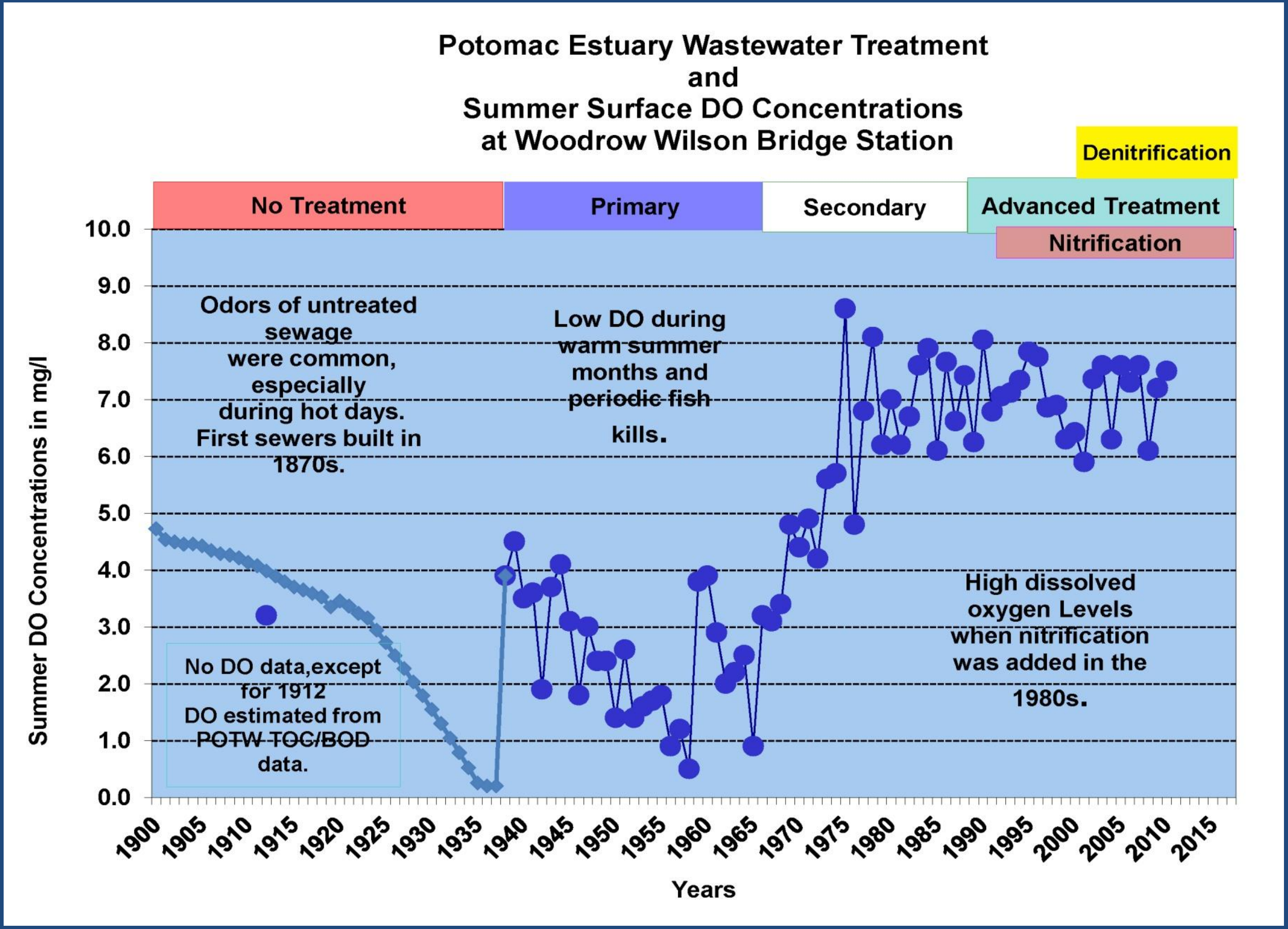
Weighted Regressions on Time, Discharge, and Season (WRTDS), with an Application to Chesapeake Bay River Inputs



Nitrate+Nitrite
Hirsch et al. 2010

JAWRA Journal of the American Water Resources Association
Volume 46, Issue 5, pages 857-880, 7 SEP 2010 DOI: 10.1111/j.1752-1688.2010.00482.x
http://onlinelibrary.wiley.com/doi/10.1111/j.1752-1688.2010.00482.x/full#f15

River Health in the Bay: Longer times series perspectives.
113 years: Summer Dissolved Oxygen on the Potomac River.
Estimated (light blue) and Actual (dark blue) Data



Norbert Jaworski, Pers. Comm

A Century of Dissolved Oxygen Resource Degradation and Recovery Around the Globe

Thames River, England Rhine River, Germany

New York Harbor, NY USA Potomac River, MD USA