Using report cards to enhance environmental intelligence

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20 May 2019

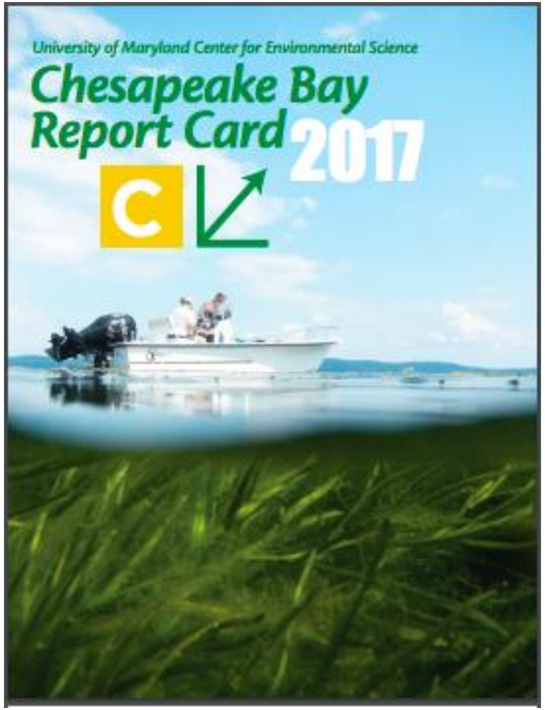
University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
INTEGRATION AND APPLICATION NETWORK

What is environmental intelligence?

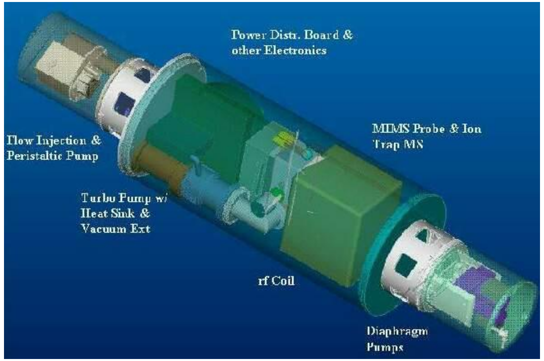
1. The ability to acquire and apply environmental knowledge.
2. The collection of information of environmental value.

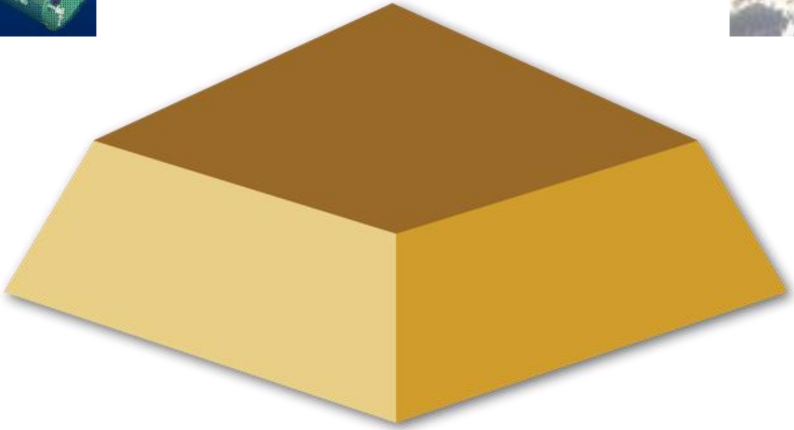
   Environment is derived from a French word ‘environ’ (surrounding)

   Intelligence is derived from a Latin word *intelligere* (to comprehend or perceive)
3. The ability to perceive your surroundings.



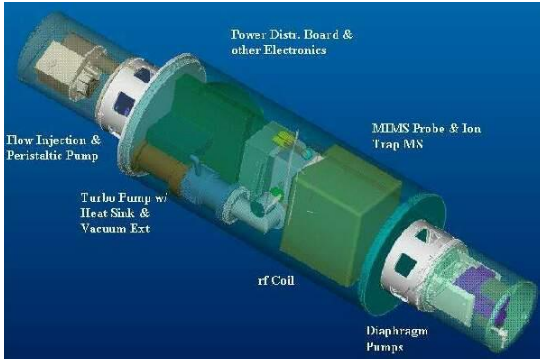
Observation revolution: Sensors rapidly expanding

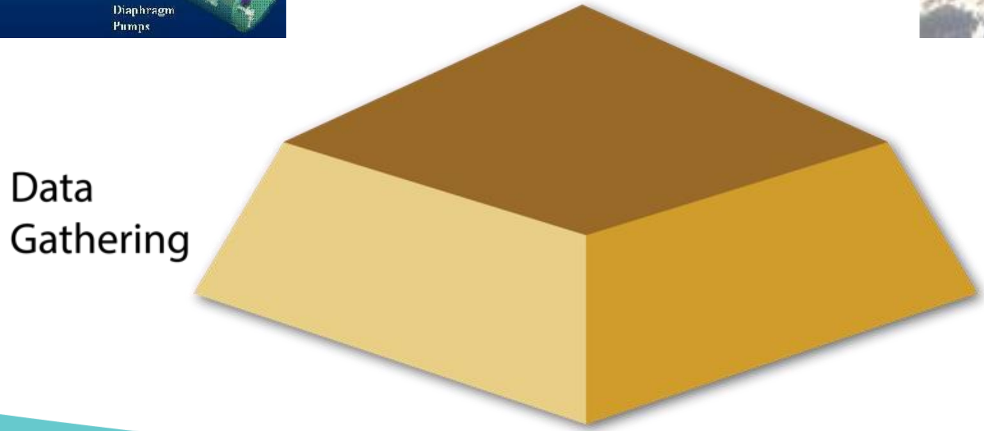




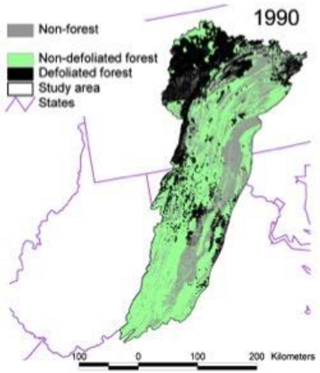
Data
Gathering

Observation revolution: Sensors rapidly expanding



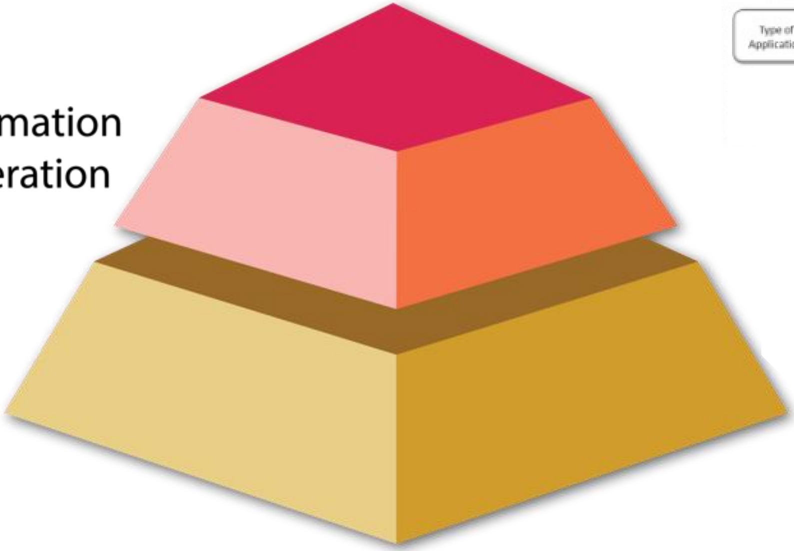


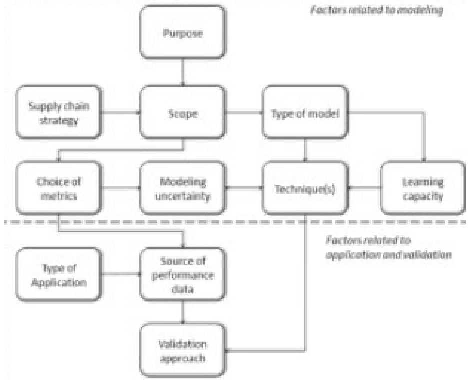
Capacity for data analysis increasing



Information Generation

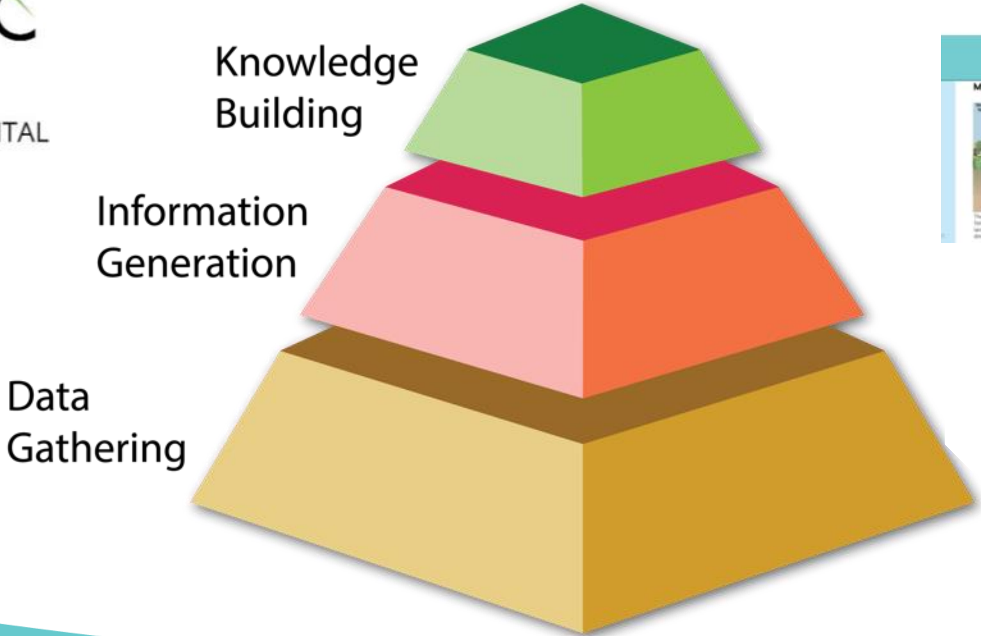
Data Gathering





Synthesis and visualization techniques emerging

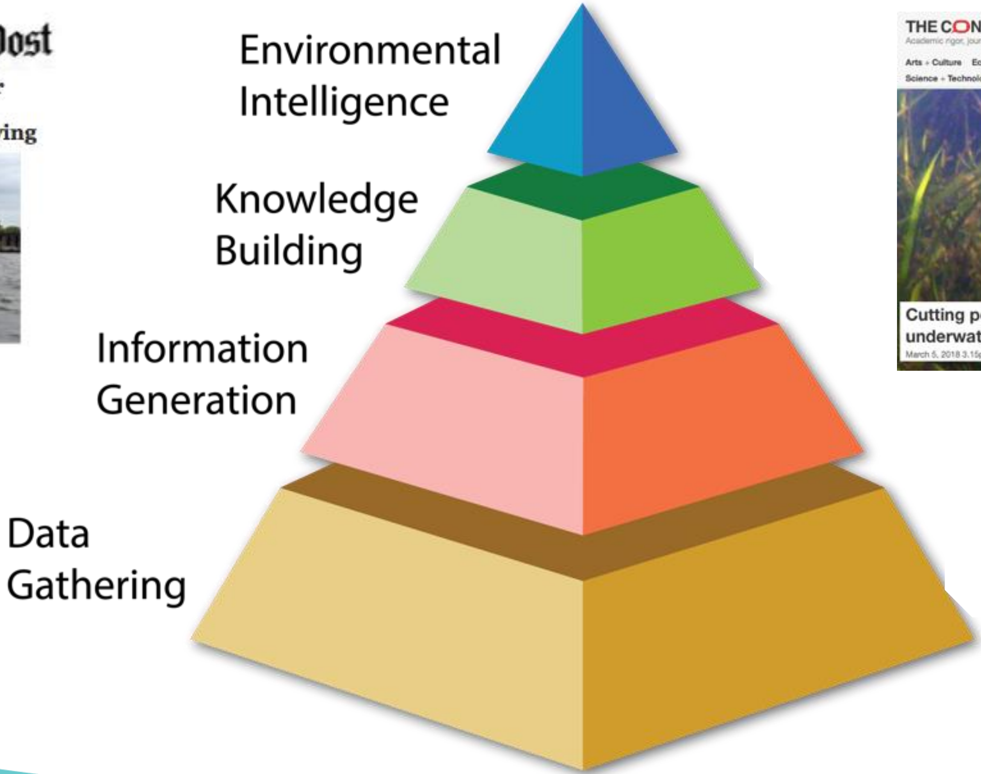
SESYNC
NATIONAL
SOCIO-ENVIRONMENTAL
SYNTHESIS CENTER



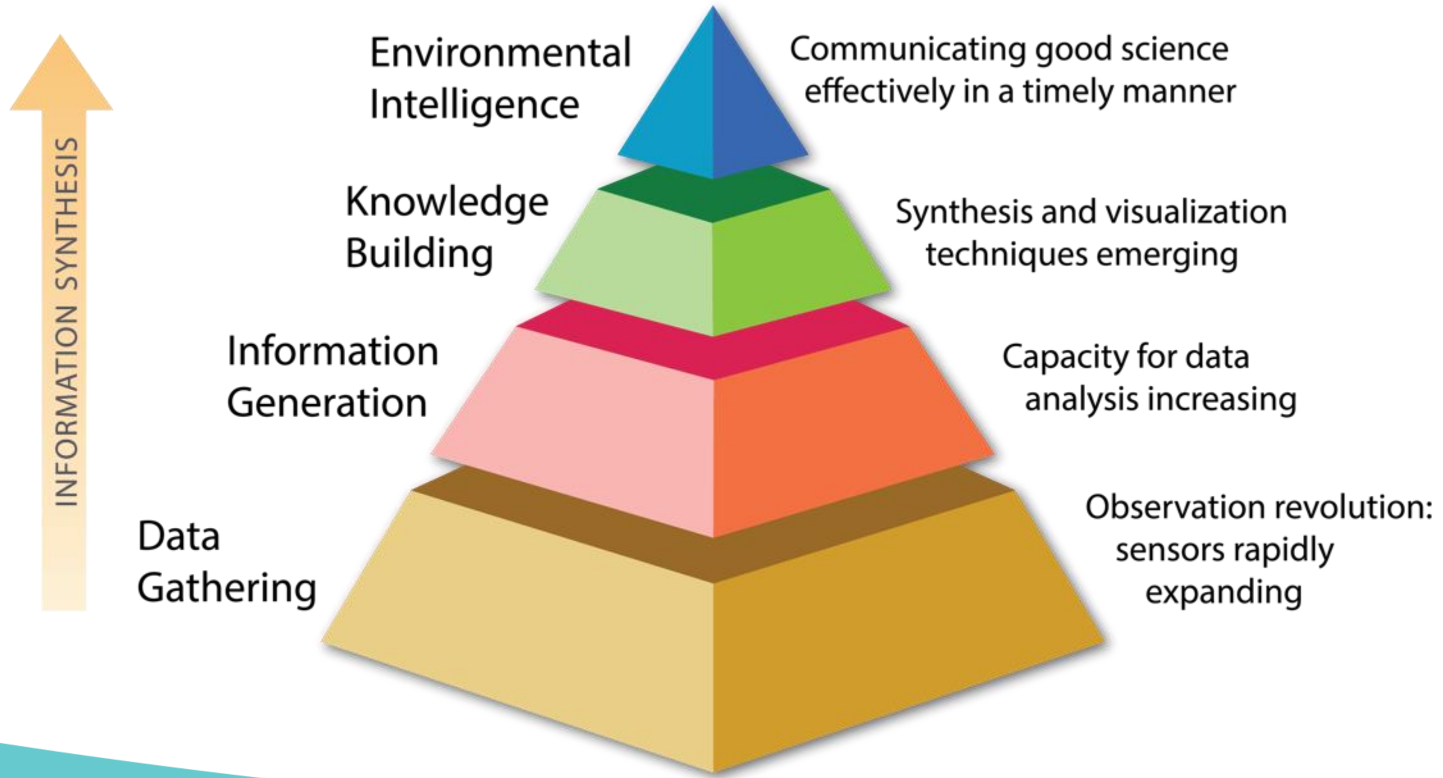
SCIENCE VISUALIZATION
INTEGRATION AND APPLICATION NETWORK

Communicating good science effectively in a timely manner

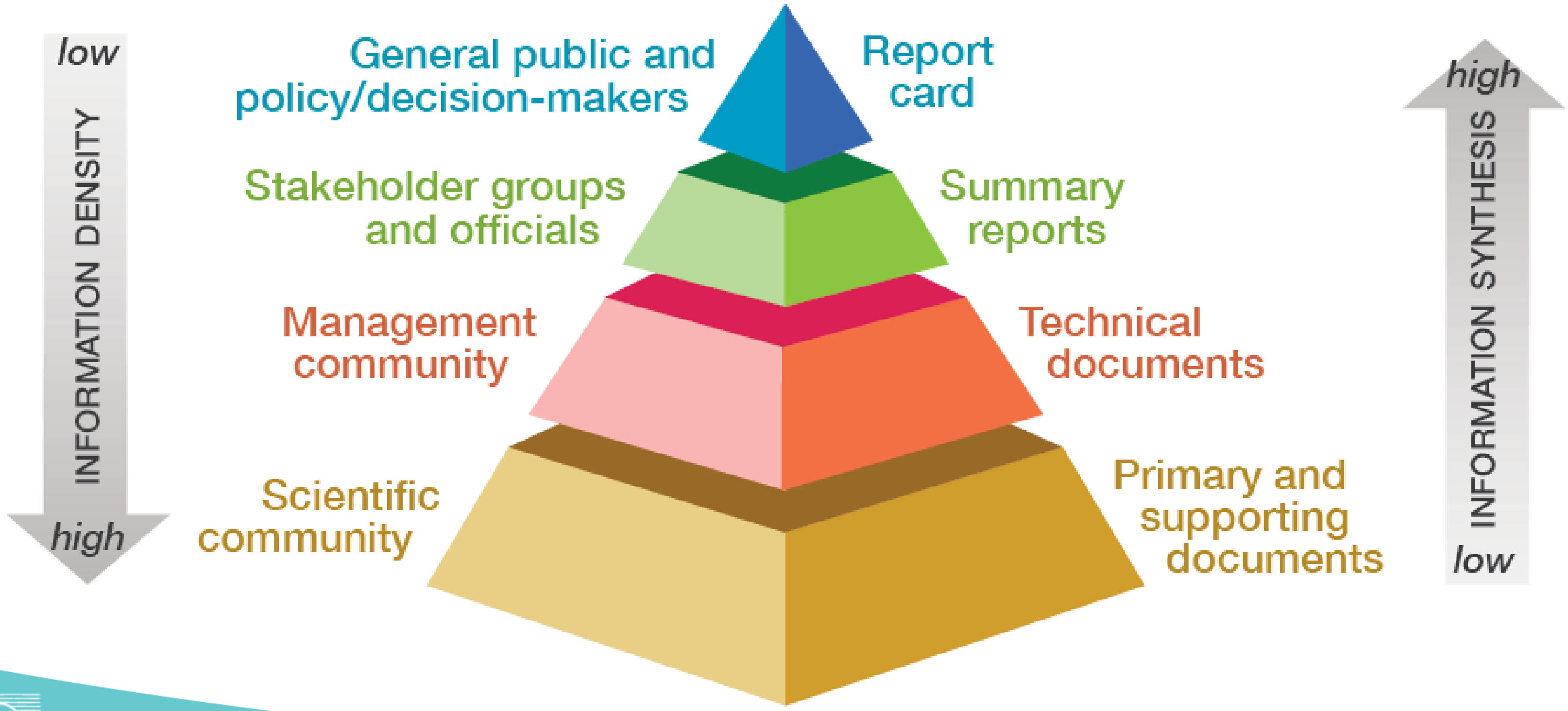

The Washington Post
Chesapeake Bay earns 'C' for overall health; blue crabs, rockfish, anchovies are thriving



Environmental intelligence pyramid



Report cards create environmental intelligence



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Began producing report cards in Australia

Report cards expanded throughout Australia

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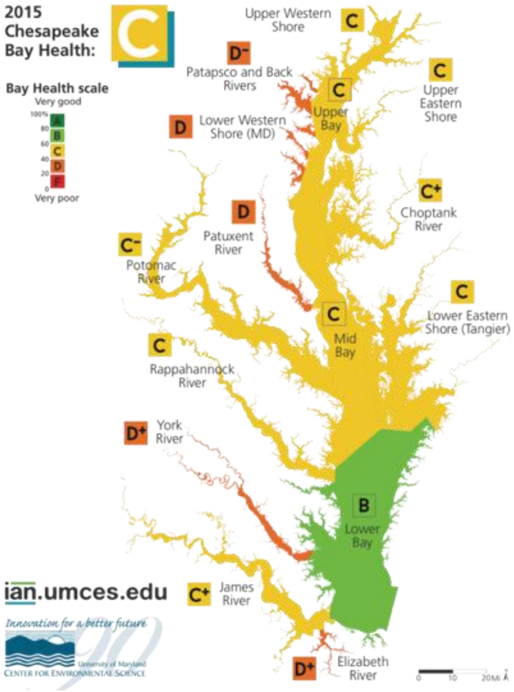
Chesapeake Bay: Data rich but synthesis poor



Chesapeake Bay Program indicators

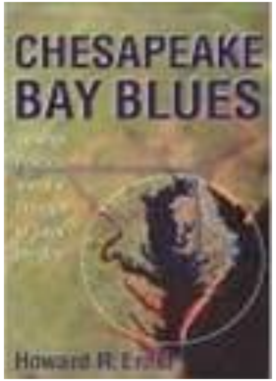
- In 2005, there were 101 indicators; mixed ‘state’ and ‘response’ indicators
- No hierarchy or combined indices; No stories
- Conflicting stories: “Happy Talk” vs. “Doom and Gloom” about perceived progress

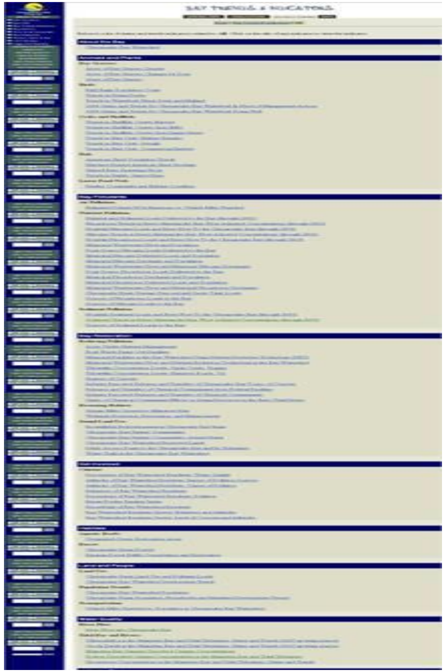
Hamilton Leads Els by One in British Open

The Washington Post

Bay Pollution Progress Overstated

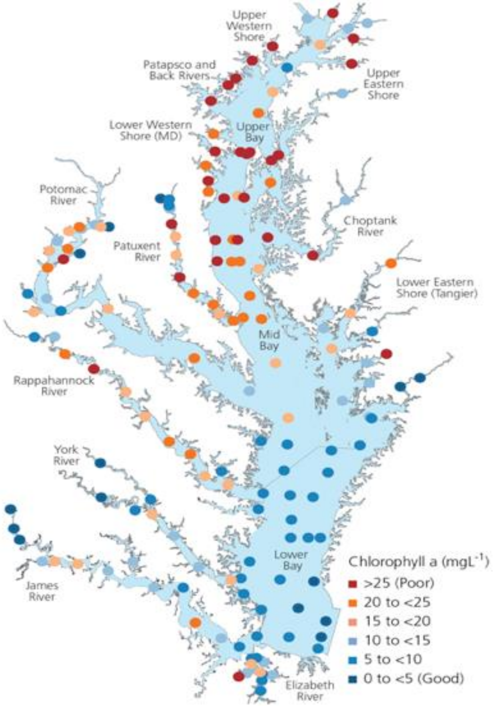
Government Program's Computer Model Proved Too Optimistic

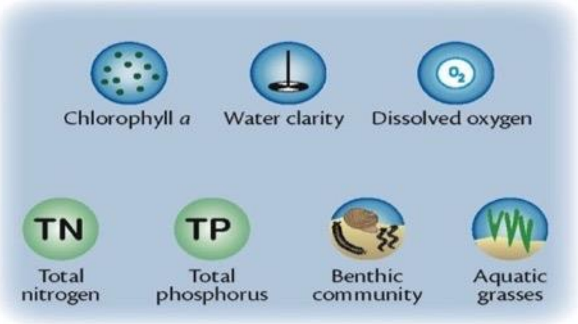


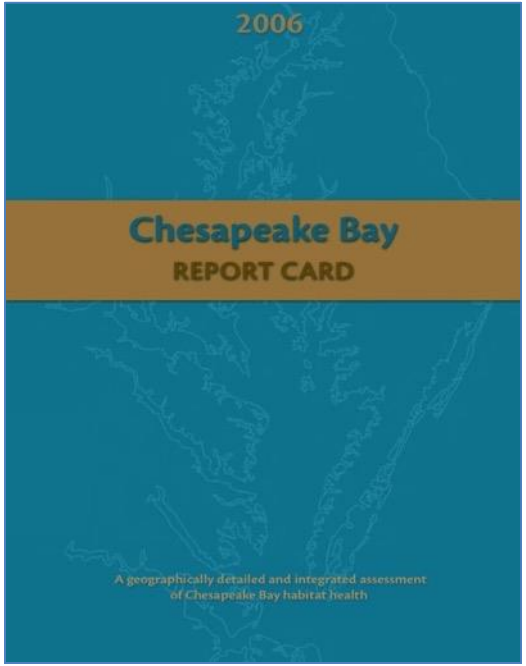


Chesapeake Bay Program indicators as they appeared on the website

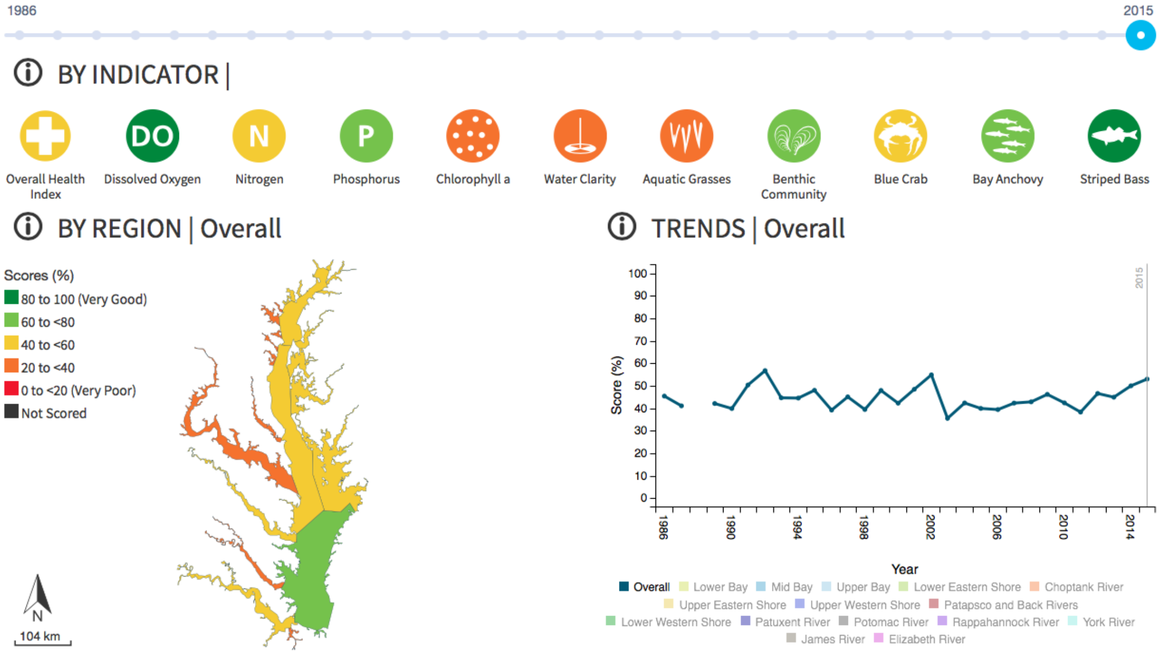
Initial Chesapeake Bay report card produced in 2006







Report card website created
www.ecoreportcard.org



Chesapeake Bay report card generates media attention

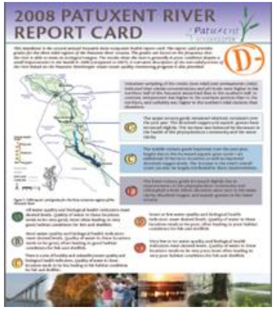
Report card media reach

2016

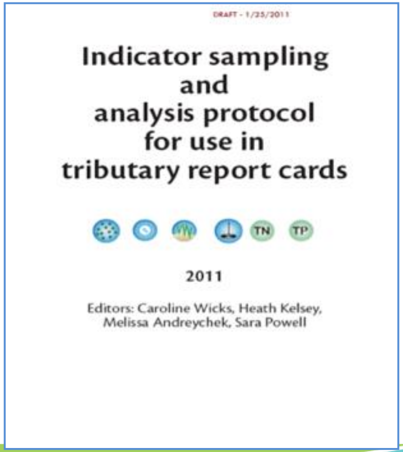
Associated Press	24 M
CNN	29 M
Print/on-line media	40 M
Broadcast media	31 M
TOTAL	124 M

Citizen scientists conducting regional environmental monitoring

MTAC Mid-Atlantic Tributary Assessment Coalition



Tributary/Waterbody	Indicators: Core	Indicators: Elective	First year of production
Chester River *Chester River Association*			2007
Coastal Bays (MD) *Maryland Coastal Bays Program*	TP, TN		2009
Magothy River *Magothy River Association*			2003
Nanticoke River *Nanticoke Watershed Alliance*	TN, TP		2010
Patuxent River *Patuxent Riverkeeper*			2008
Sassafras River *Sassafras River Association*	TP, TN		2010
Severn River *Severn Riverkeeper*			2009
South River *South River Federation*	TP, TN		2007
West and Rhode Rivers *West/Rhode Riverkeeper*	TP, TN		2009



DRAFT - 1/25/2011

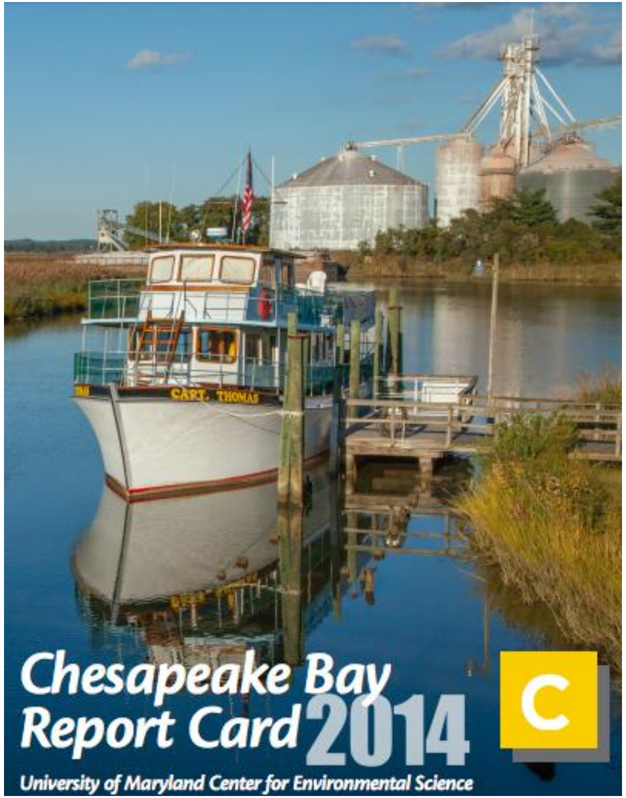
Indicator sampling and analysis protocol for use in tributary report cards

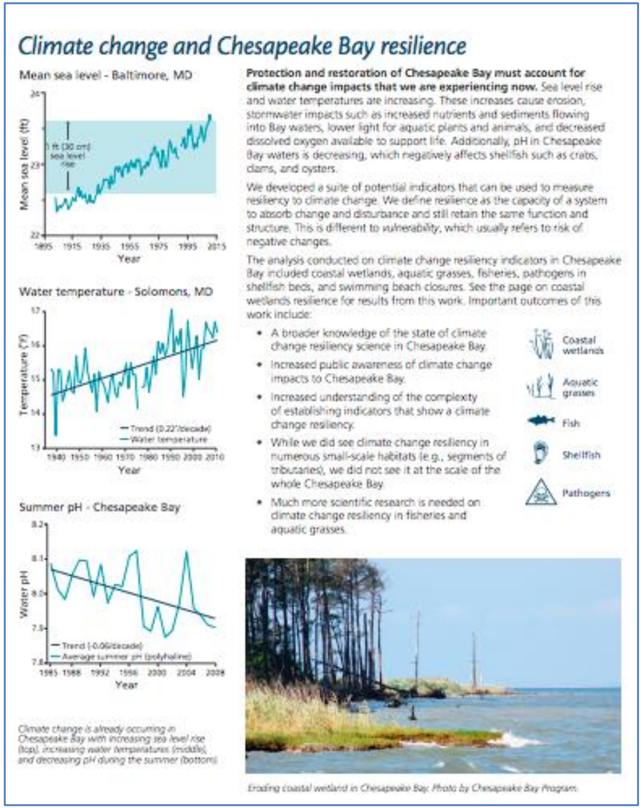
TN TP

2011

Editors: Caroline Wicks, Heath Kelsey, Melissa Andreychek, Sara Powell

Introducing resilience in 2014 report card





Climate change and Chesapeake Bay resilience

Mean sea level - Baltimore, MD

1 ft (30 cm) sea level rise

Water temperature - Solomons, MD

Trend (0.22°/decade)
Water temperature

Summer pH - Chesapeake Bay

Trend (-0.06/decade)
Average summer pH (polyhaline)

Climate change is already occurring in Chesapeake Bay with increasing sea level rise (top), increasing water temperatures (middle), and decreasing pH during the summer (bottom).

Protection and restoration of Chesapeake Bay must account for climate change impacts that we are experiencing now. Sea level rise and water temperatures are increasing. These increases cause erosion, stormwater impacts such as increased nutrients and sediments flowing into Bay waters, lower light for aquatic plants and animals, and decreased dissolved oxygen available to support life. Additionally, pH in Chesapeake Bay waters is decreasing, which negatively affects shellfish such as crabs, clams, and oysters.

We developed a suite of potential indicators that can be used to measure resiliency to climate change. We define resilience as the capacity of a system to absorb change and disturbance and still retain the same function and structure. This is different to vulnerability, which usually refers to risk of negative changes.

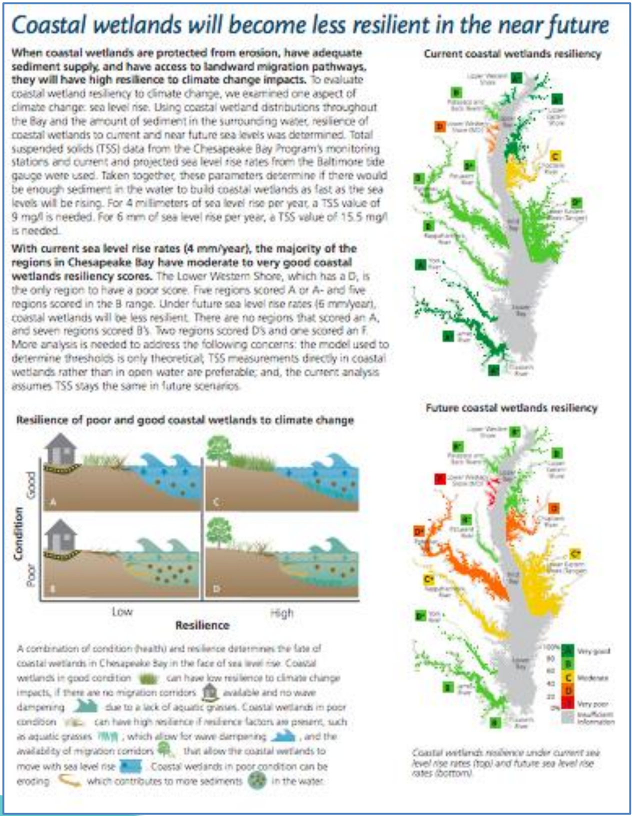
The analysis conducted on climate change resiliency indicators in Chesapeake Bay included coastal wetlands, aquatic grasses, fisheries, pathogens in shellfish beds, and swimming beach closures. See the page on coastal wetlands resilience for results from this work. Important outcomes of this work include:

- A broader knowledge of the state of climate change resiliency science in Chesapeake Bay.
- Increased public awareness of climate change impacts to Chesapeake Bay.
- Increased understanding of the complexity of establishing indicators that show a climate change resiliency.
- While we did see climate change resiliency in numerous small-scale habitats (e.g., segments of tributaries), we did not see it at the scale of the whole Chesapeake Bay.
- Much more scientific research is needed on climate change resiliency in fisheries and aquatic grasses.

Coastal wetlands
Aquatic grasses
Fish
Shellfish
Pathogens

Eroding coastal wetland in Chesapeake Bay. Photo by Chesapeake Bay Program.

Distinguishing condition from resilience



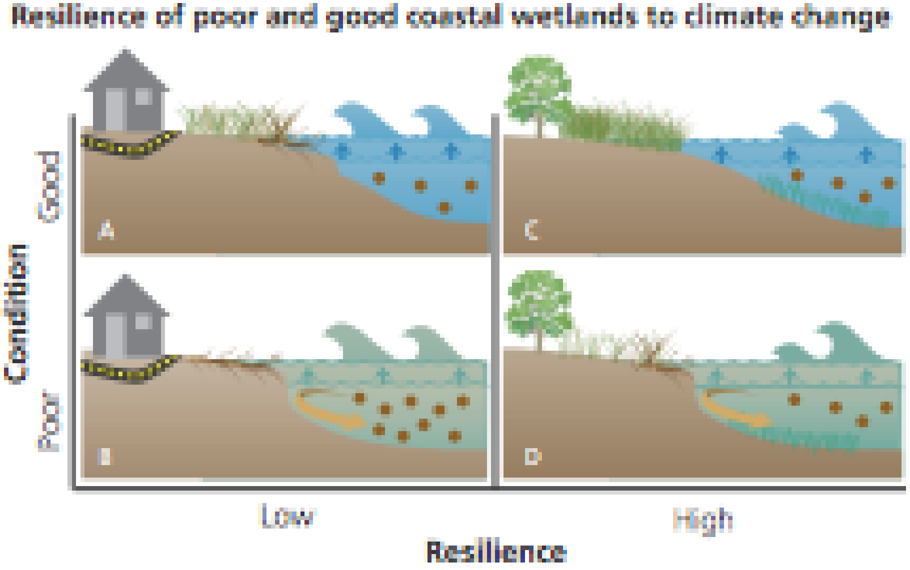
Coastal wetlands will become less resilient in the near future

When coastal wetlands are protected from erosion, have adequate sediment supply, and have access to landward migration pathways, they will have high resilience to climate change impacts. To evaluate coastal wetland resiliency to climate change, we examined one aspect of climate change: sea level rise. Using coastal wetland distributions throughout the Bay and the amount of sediment in the surrounding water, resilience of coastal wetlands to current and near future sea levels was determined. Total suspended solids (TSS) data from the Chesapeake Bay Program's monitoring stations and current and projected sea level rise rates from the Baltimore tide gauge were used. Taken together, these parameters determine if there would be enough sediment in the water to build coastal wetlands as fast as the sea levels will be rising. For 4 millimeters of sea level rise per year, a TSS value of 9 mg/l is needed. For 6 mm of sea level rise per year, a TSS value of 15.5 mg/l is needed.

With current sea level rise rates (4 mm/year), the majority of the regions in Chesapeake Bay have moderate to very good coastal wetlands resiliency scores. The Lower Western Shore, which has a D, is the only region to have a poor score. Five regions scored A or A- and five regions scored in the B range. Under future sea level rise rates (6 mm/year), coastal wetlands will be less resilient. There are no regions that scored an A, and seven regions scored B's. Two regions scored D's and one scored an F. More analysis is needed to address the following concerns: the model used to determine thresholds is only theoretical; TSS measurements directly in coastal wetlands rather than in open water are preferable; and, the current analysis assumes TSS stays the same in future scenarios.

A combination of condition (health) and resilience determines the fate of coastal wetlands in Chesapeake Bay in the face of sea level rise. Coastal wetlands in good condition can have low resilience to climate change impacts, if there are no migration corridors available and no wave dampening due to a lack of aquatic grasses. Coastal wetlands in poor condition can have high resilience if resilience factors are present, such as aquatic grasses, which allow for wave dampening, and the availability of migration corridors that allow the coastal wetlands to move with sea level rise. Coastal wetlands in poor condition can be eroding which contributes to more sediments in the water.

Coastal wetlands resilience under current sea level rise rates (top) and future sea level rise rates (bottom).



Several basic steps are involved in producing report cards

Step 1 — Create conceptual framework

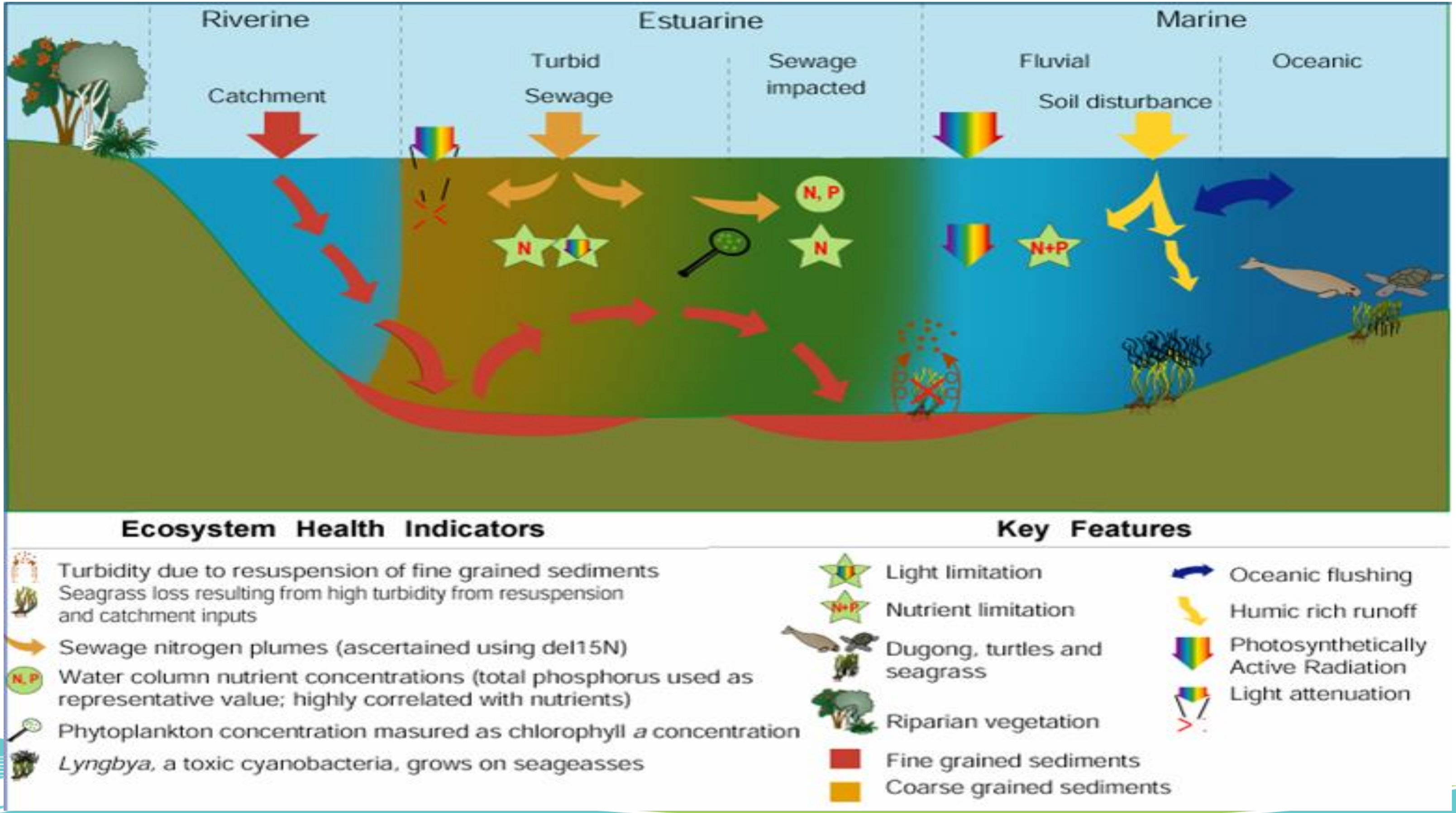
Step 2 — Choose indicators

Step 3 — Define thresholds

Step 4 — Calculate scorecard

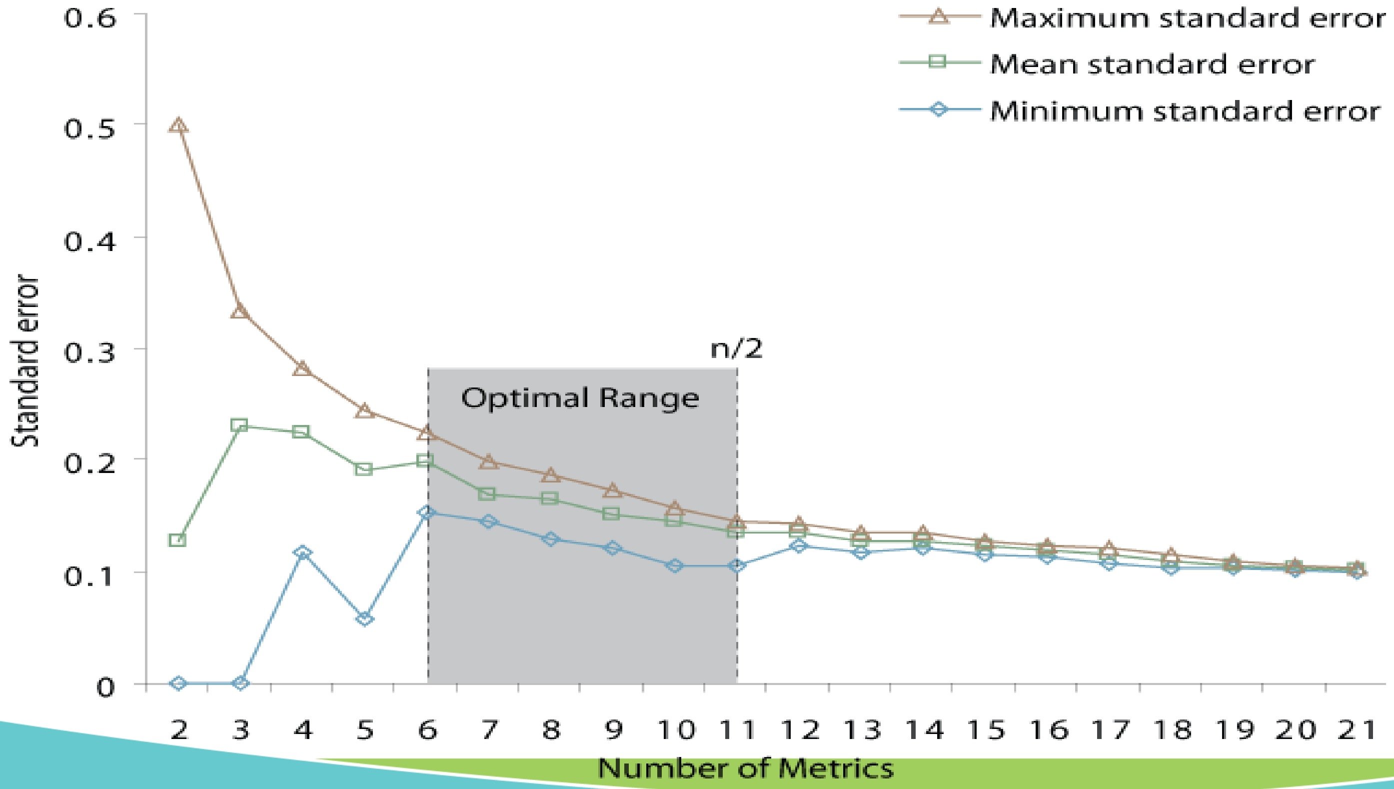
Step 5 — Communicate results

Step 1: Create conceptual framework



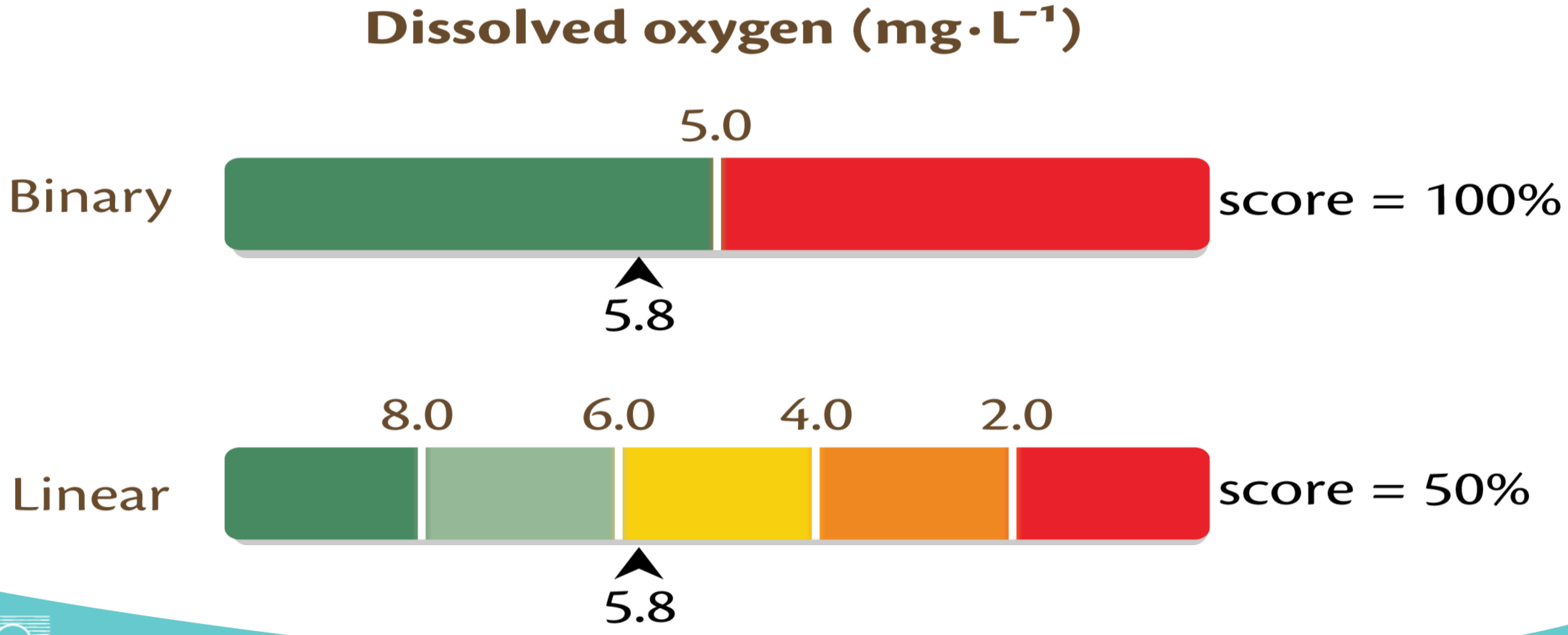
Step 2: Choose indicators

that convey meaningful ecological information and can be measured reliably



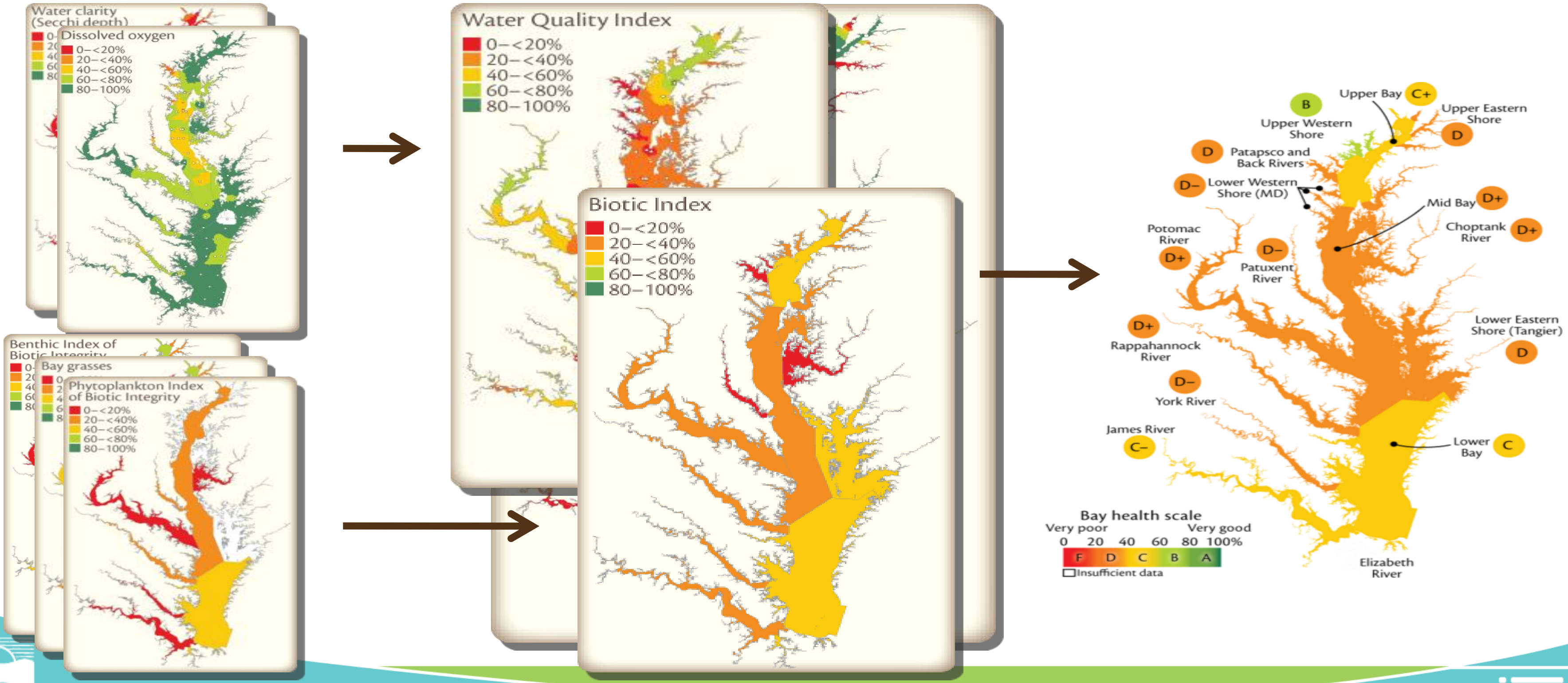
Step 3: Define thresholds

and reporting regions to establish environmental benchmarks and spatial details



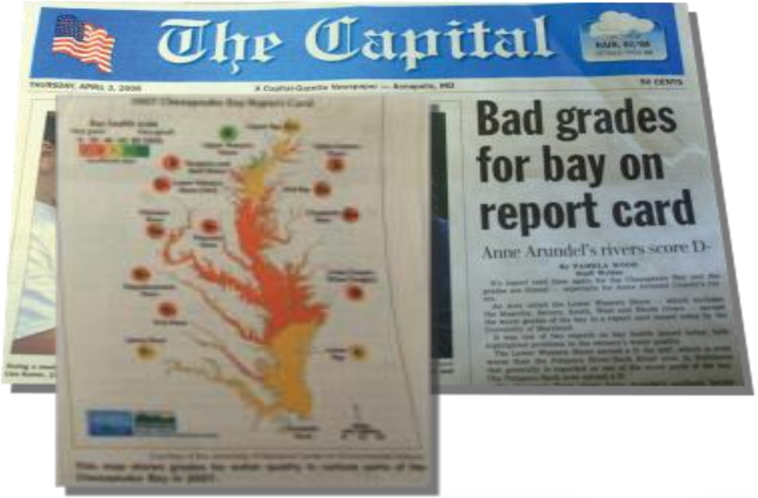
Step 4: Calculate scorecard

for dissemination to decision-makers, resource managers, and interested public



Step 5: Communicate results

effectively through mass media with supporting material in technical or web-based venues


The Capital

Bad grades for bay on report card

Anne Arundel's rivers score D-


THE SUN

FROM THE COVER

Arundel rivers get low grades

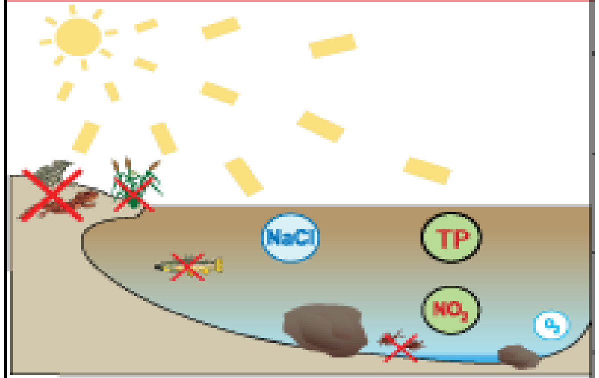
Arundel rivers among state's most polluted

Report cards vs. integrated assessments

Report cards		Integrated assessment
Annual (tactical)	Repeat Frequency	Multiple years (strategic)
Grades (based on indices)	Major Product	Recommendations (data gaps, management priorities)
< 12	# Indicators	Dozens
Data, maps, observations	Supporting Materials	Data, maps, observations & references
Geographic reporting regions	Reporting Units	Habitats, functional areas

Integrated assessment: Wetlands habitat

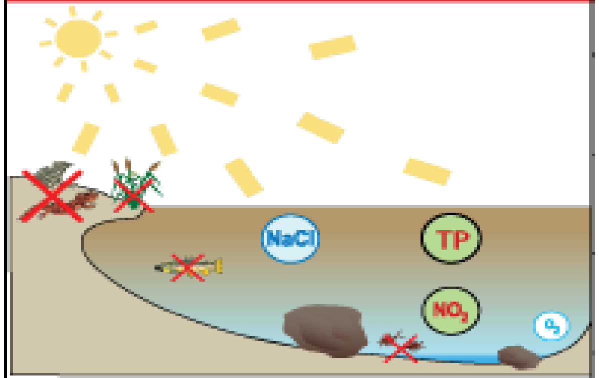
DEGRADED



Degraded wetland habitat has eroded streambanks and no shade , high nutrients NO_3 TP and salinity NaCl , resulting in turbid water , low oxygen levels , and low populations of fish , amphibians , and benthic invertebrates .

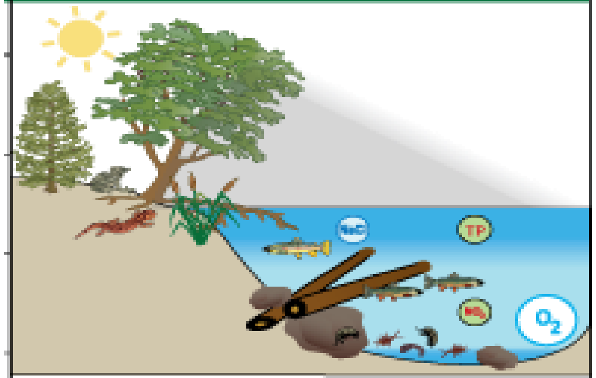
Integrated assessment: Wetlands habitat

DEGRADED



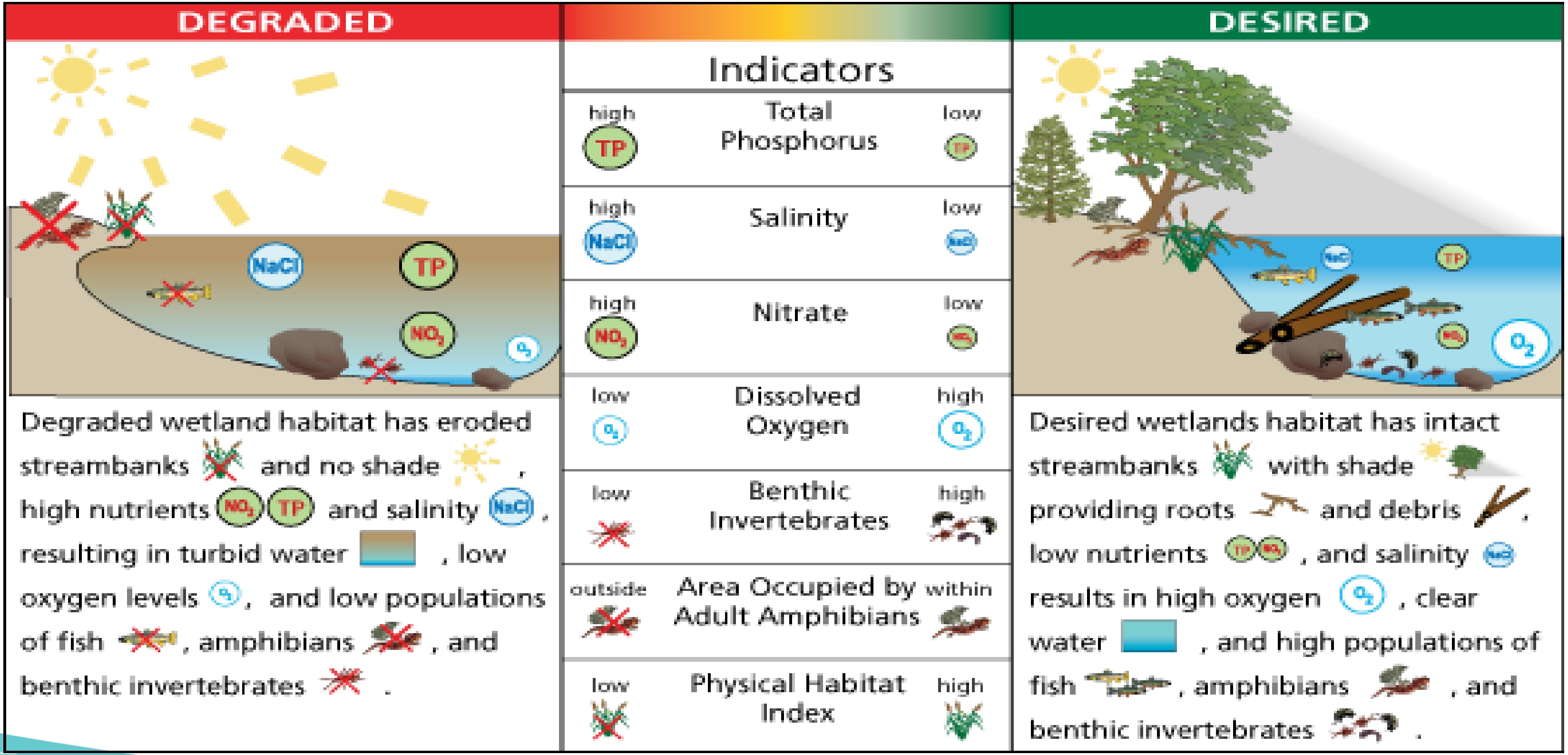
Degraded wetland habitat has eroded streambanks and no shade, high nutrients and salinity, resulting in turbid water, low oxygen levels, and low populations of fish, amphibians, and benthic invertebrates.

DESIRED

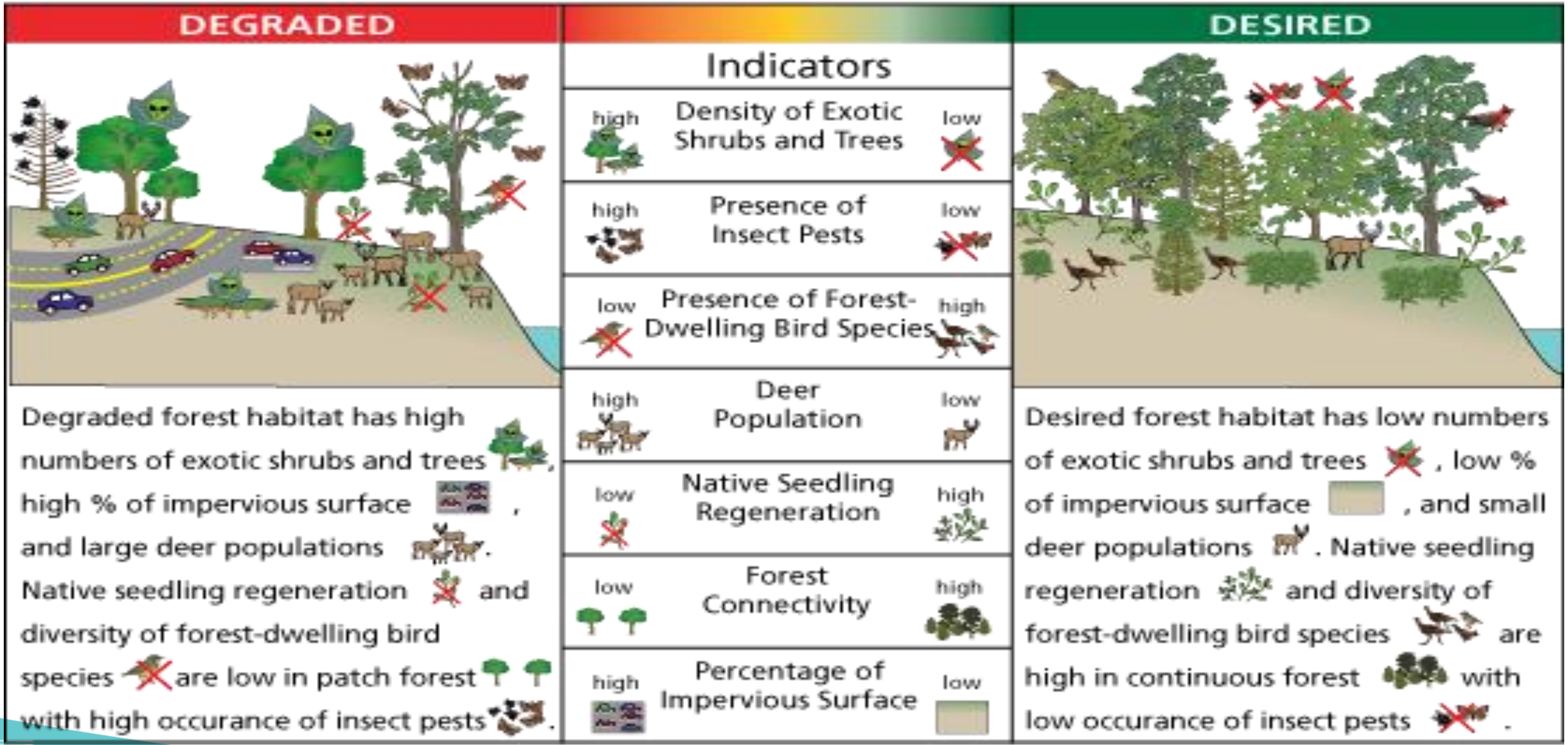


Desired wetlands habitat has intact streambanks with shade providing roots and debris, low nutrients, and salinity results in high oxygen, clear water, and high populations of fish, amphibians, and benthic invertebrates.

Integrated assessment: Wetlands habitat



Integrated assessment: Forest habitat



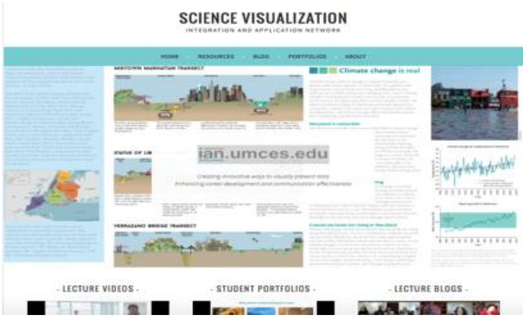
Assessing cultural resources as well as natural resources

- Exotic herbaceous cover
- Exotic tree and sapling cover
- Forest pest species
- Stocking index
- Fish index
- Bird Community Index (BCI)
- Amphibian area cover
- Forest interior bird species
- Grassland bird diversity
- Deer density

- Scenic views
- Recreation
- Green space
- Sense of place
- Park 7 aspects of integrity

IAN efforts began to become more globalized

IAN began to teach globally



Incorporating cultural resources in report cards

Surveyed report card practitioners

80 % responded the report cards increased public awareness

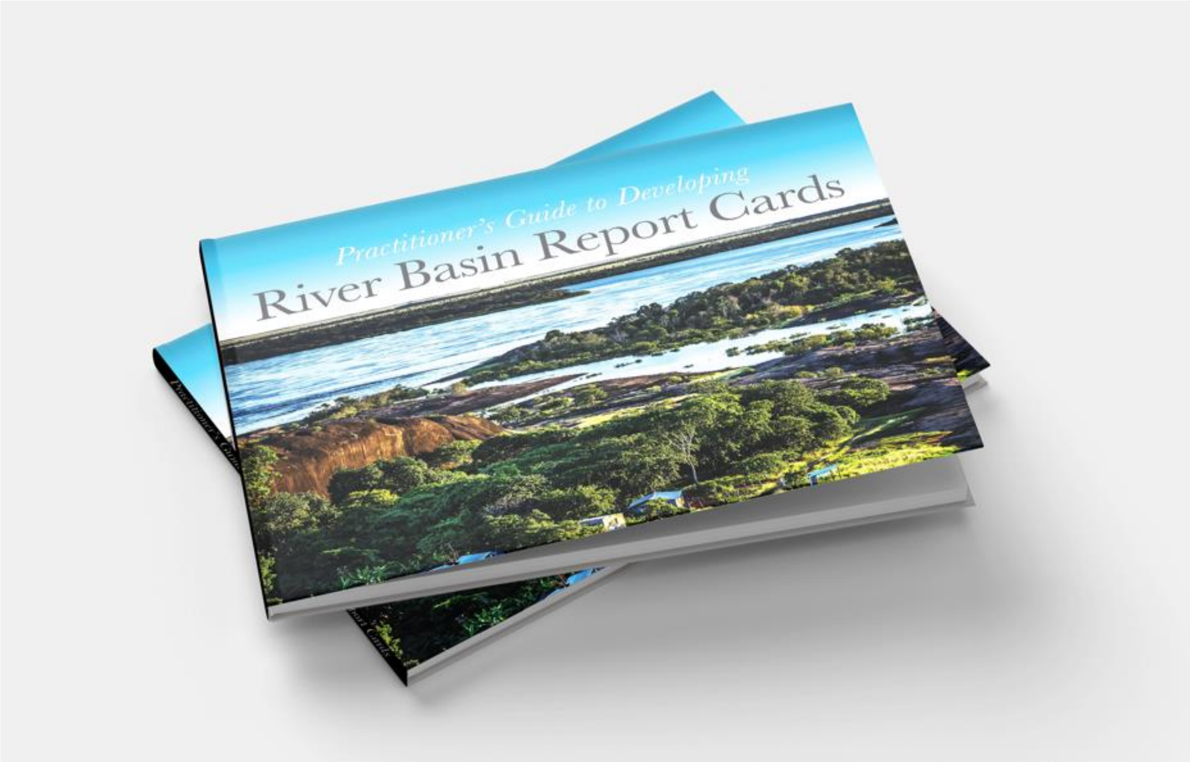
50 % responded the report cards had a positive effect on stakeholder behavior and resource allocation

60 % responded the report cards had a positive impact on their basin

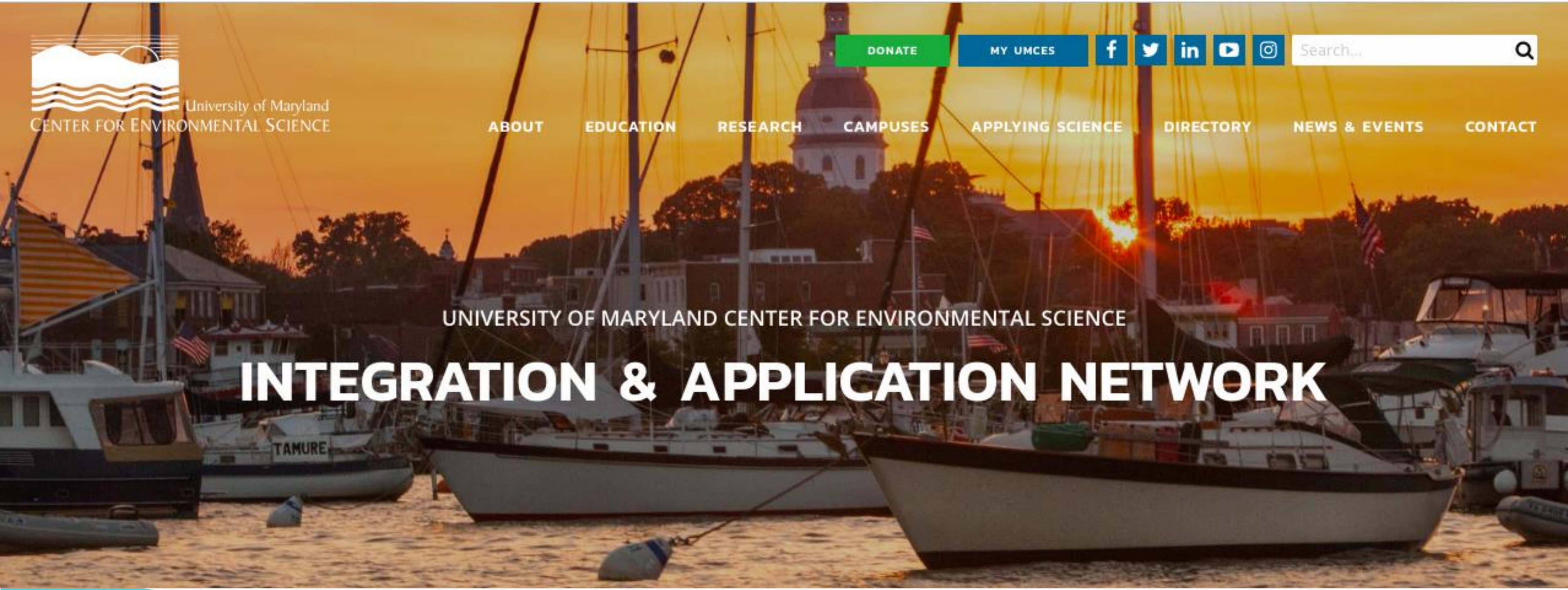
86 % responded the report cards increased the demand for additional information

97 % responded they would recommend using report cards to their peers

Published Practitioner's Guide



Tools, blogs, publications: www.umces.edu/ian

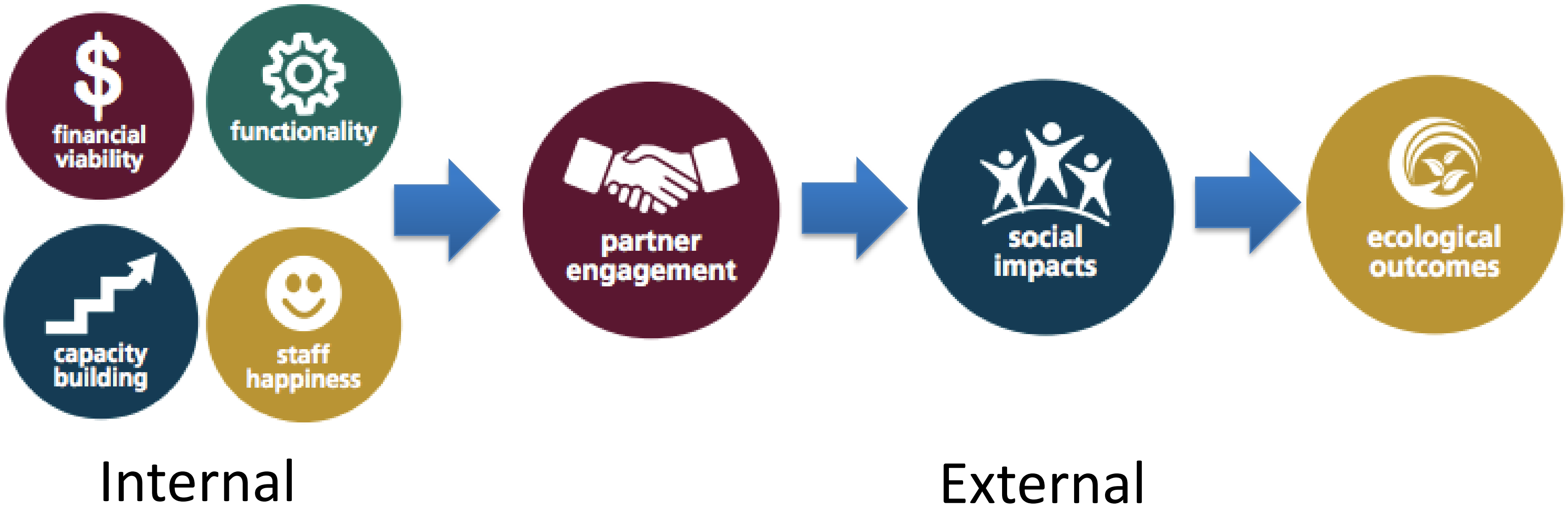


New first step: Stakeholder mapping

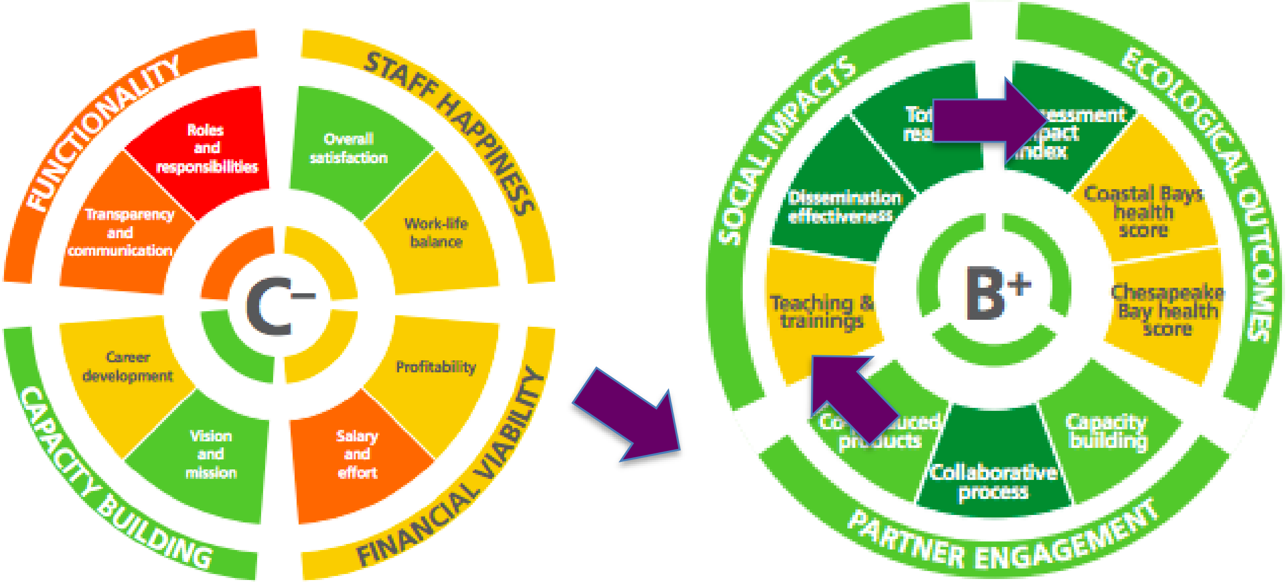
Original 5 steps converted to 3 steps

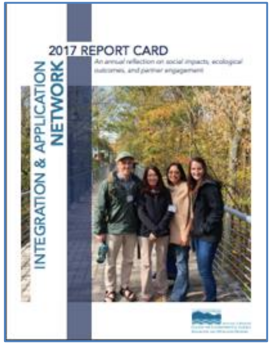
New fifth step: Raise the grade

IAN developed a theory of change



IAN report cards are based on theory of change






Education
Student learning
Student services
Student progression
Mission and Goal
Discovery
Integration
Service and Application
People
Collegial and Supportive culture
Work-life balance
Inclusion & diversity
Operational Effectiveness
Financial viability
Facilities
Governance & Leadership