THE GUANABARA BAY REPORT CARD

Bill Dennison

29 April 2016

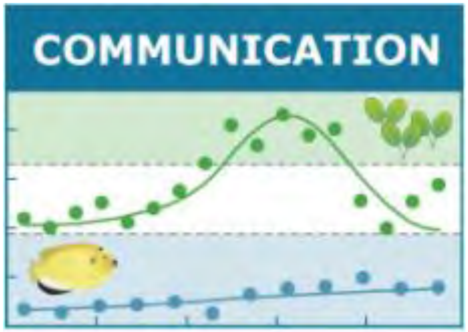
UNIVERSITY OF MARYLAND CENTER FOR ENVIRONMENTAL SCIENCE AND THE INTEGRATION AND APPLICATION NETWORK

- UMCES formed in 1925 to provide practical environmental advice
- UMCES defines scholarship as discovery, integration, application, and teaching
- IAN was created in 2002 to address integration and application

WHO ARE WE?

IAN's aim is to enable better communication to empower change.

IAN has three main focus areas



Develop Science Communication products

Environmental Report Cards

Science Communication Training

SOLVING, NOT JUST STUDYING ENVIRONMENTAL PROBLEMS

STUDY

- Dispassionate
- Embrace complexity
- Publish & funding via peer review
- Getting it right

SOLVE

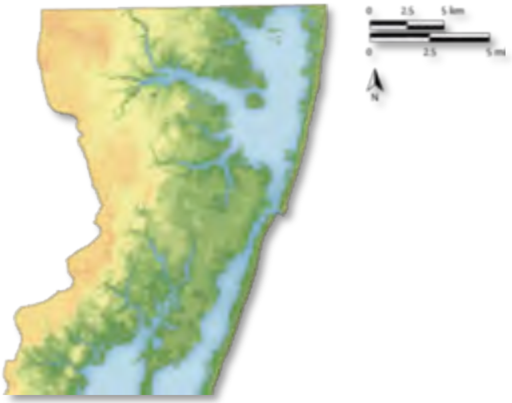
- Passionate
- Simplify
- Publish & funding via stakeholders
- Getting it done

SYNTHESIZING INFORMATION FOR LESS TECHNICAL AUDIENCES

Synthesis

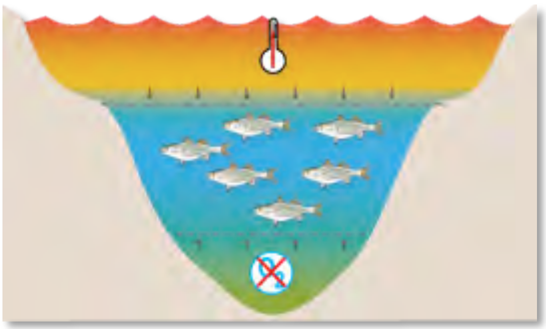
Synthesized data

Visualization



Illustrate key points

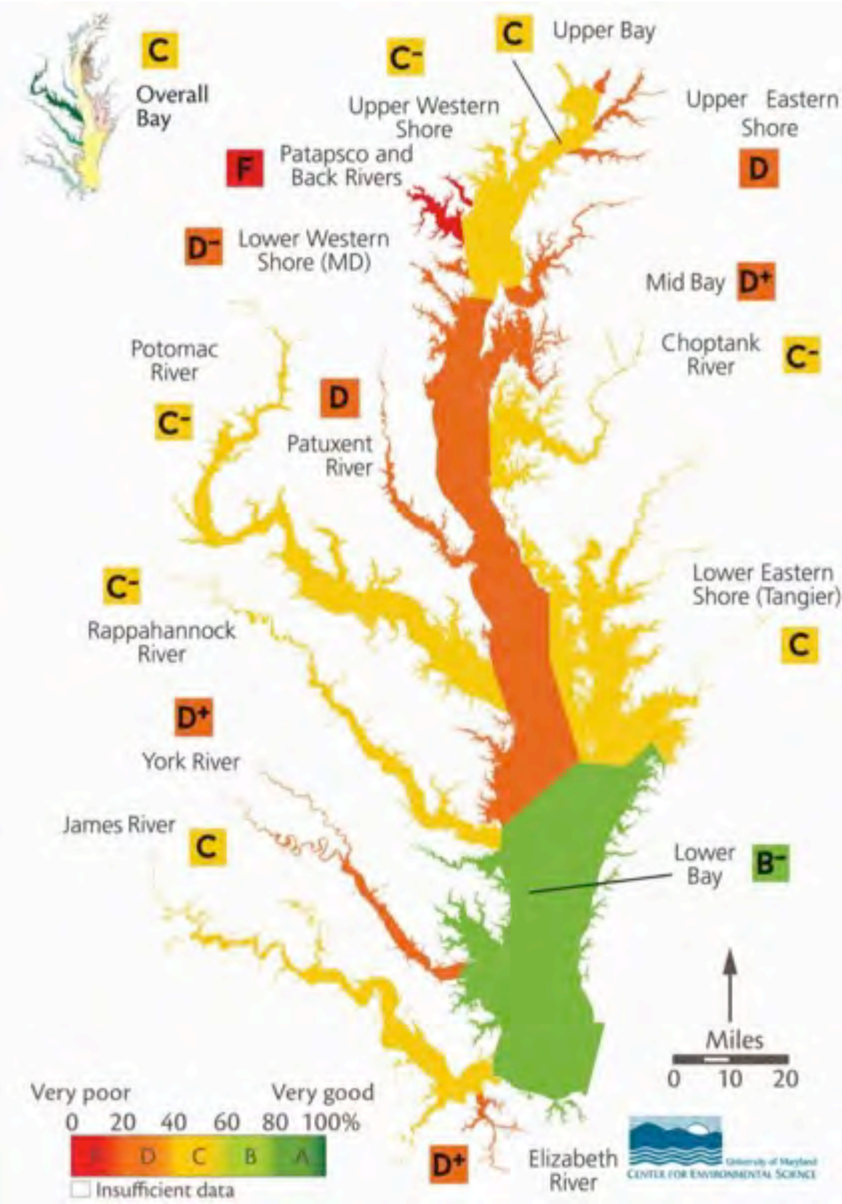
Context



So what?

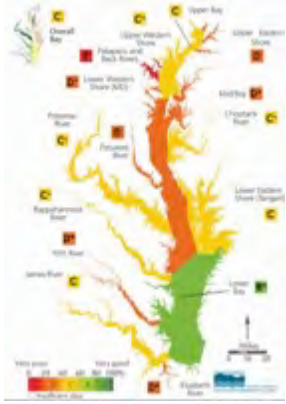
What is an Ecosystem Health Report Card?

- Broad-level assessments of a region or system
- Communicate complex information
- Based on real data: transparent and defendable
- Provide accountability
- Engage communities



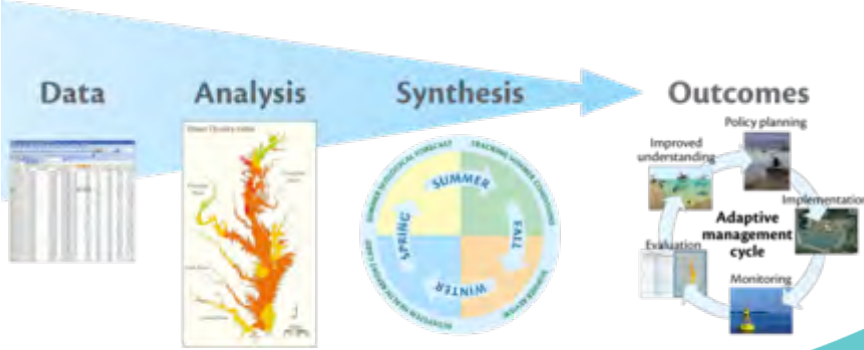
Ecosystem Health Report Cards are an Effective Communication Tool

- Peer pressure is a powerful human motivator



- Educational report cards are a common experience

- Report cards synthesize large amounts of data



OUTCOMES OF ECOSYSTEM HEALTH REPORT CARDS

- Well received and influential
- Comprehensive package – goes beyond simple grading
- Visually appealing
- Being local – sense of ownership
- Educational

Report Cards Address Many Audiences

- Top tier = Report card
- 2nd Tier = Newsletter, website
- 3rd Tier = Technical reports, scientific literature
- Base = Data

WE HAVE DEVELOPED REPORT CARDS IN ICONIC REGIONS AROUND THE WORLD

Report Cards are a Five Step Process

1 Create a conceptual framework

Create a framework defining goals and major aspects of each goal that should be evaluated over time.

2 Choose indicators

Select indicators that convey meaningful information and can be reliably measured.

3 Define thresholds

Define status categories, reporting regions, and method of measuring threshold attainment.

4 Calculate scores

Source	Station	Region	Date	DO Value
DNR	CCC0008		4/29/09	9.00
DNR	CCC0008		4/29/09	9.50
DNR	CCC0008		4/29/09	9.70
DNR	CCC0008		5/28/09	8.90
DNR	CCC0008		5/28/09	9.00
DNR	CCC0008		5/28/09	9.00
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Calculate indicator scores and combine into index grades.

5 Communicate results

Communicate results using visual elements, such as photos, maps, and conceptual diagrams.

WE USE A PARTNERSHIP APPROACH AND WANT TO ENGAGE YOU IN THIS PROCESS

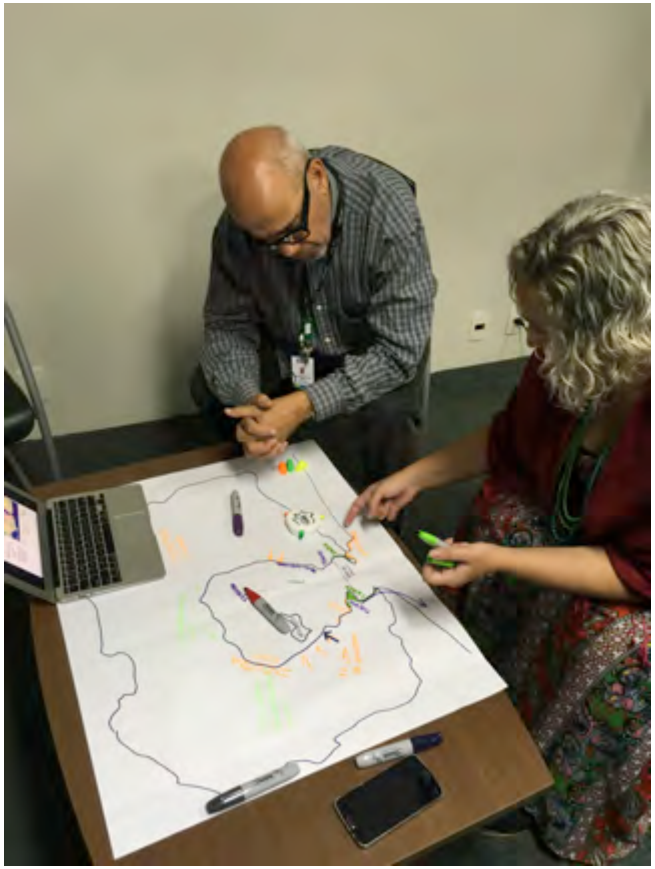
This workshop was led by KCI, University of Maryland Center for Environmental Science, and PSAM supported by the Inter-American Development Bank. Participants included Izidro Paes Leme Arthou, José Paulo Azevedo, Guido Gelli, Marcos Santanna Lacerda, Nair Palhano, Marco Pessoa, Stella Procópio da Rocha, Marcio Santarosa, Mariana Correa dos Santos, Klinton Senra, José Alfredo Sertã, Leonardo Daemon Doliveira Silva, Fátima de Freitas Lopes Soares, Rony Sutter, Luciana Ventura, and Victor Zveibil.

Some workshop participants at Instituto Estadual do Ambiente (INEA) on 25 April 2016.

KCI ABES CBH-BG ICMBio MMA PSAM inea instituto estadual do ambiente Governo do Rio de Janeiro Innovation for a better future University of Maryland Center for Environmental Science

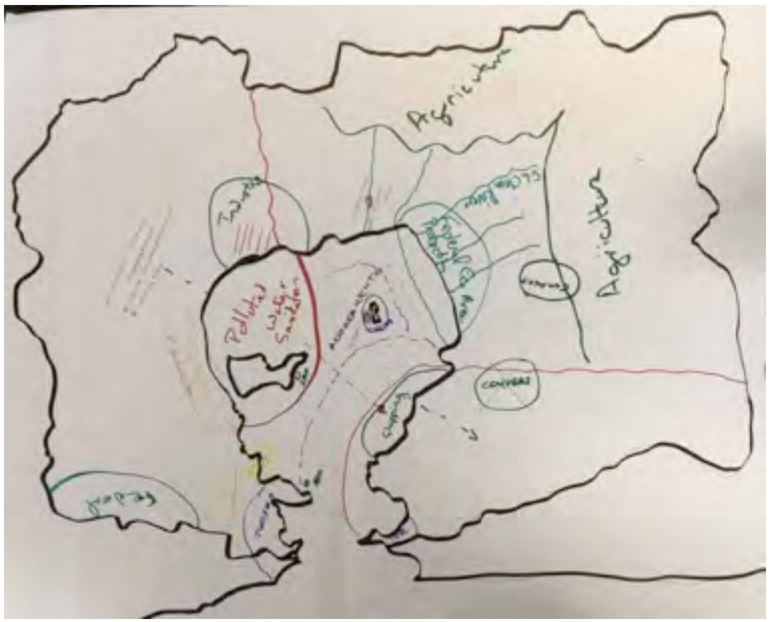
BID Secretaria do Ambiente Instituto terrazul COPPE UFRJ UERJ Universidade do Estado do Rio de Janeiro Masterplan ian.umces.edu

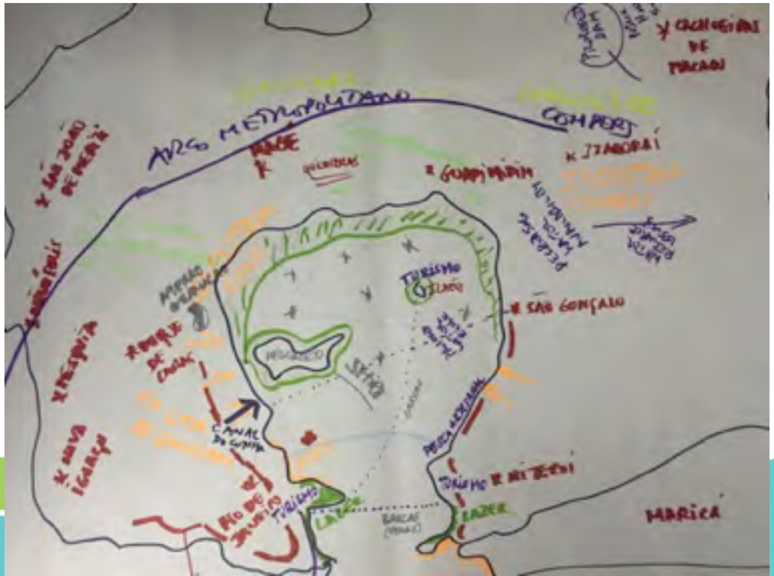
CONCEPTUAL MAPPING EXERCISE



Create a conceptual framework

INITIAL CONCEPTUAL MAPS

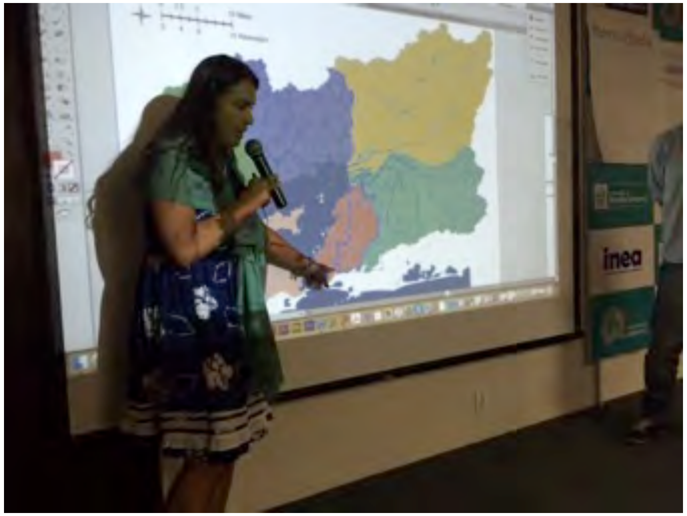




Create a conceptual framework

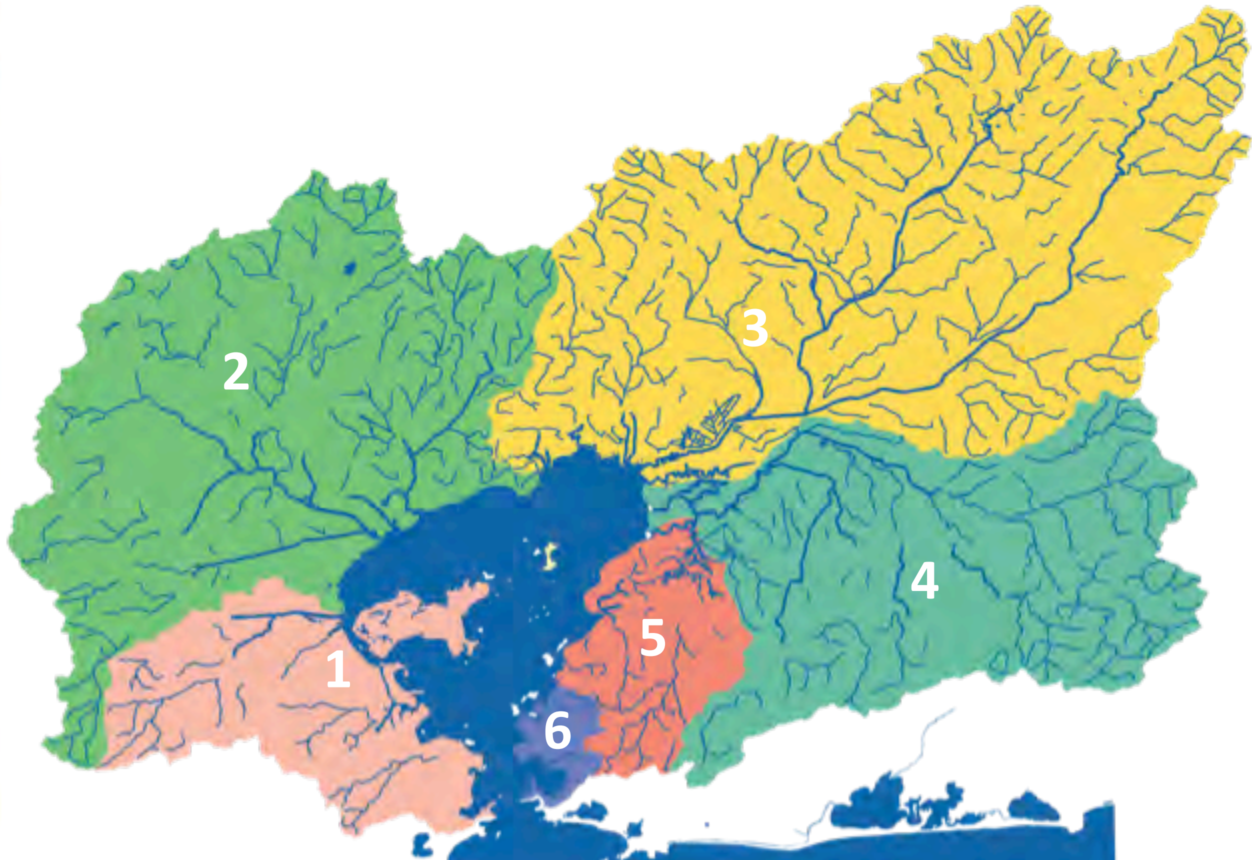
GUANABARA BAY KEY VALUES & MAJOR THREATS

REPORTING REGION DISCUSSION



Create a conceptual framework

Reporting Regions: Guanabara Bay & River Basin



2 Choose indicators

Potential indicators for Guanabara Bay

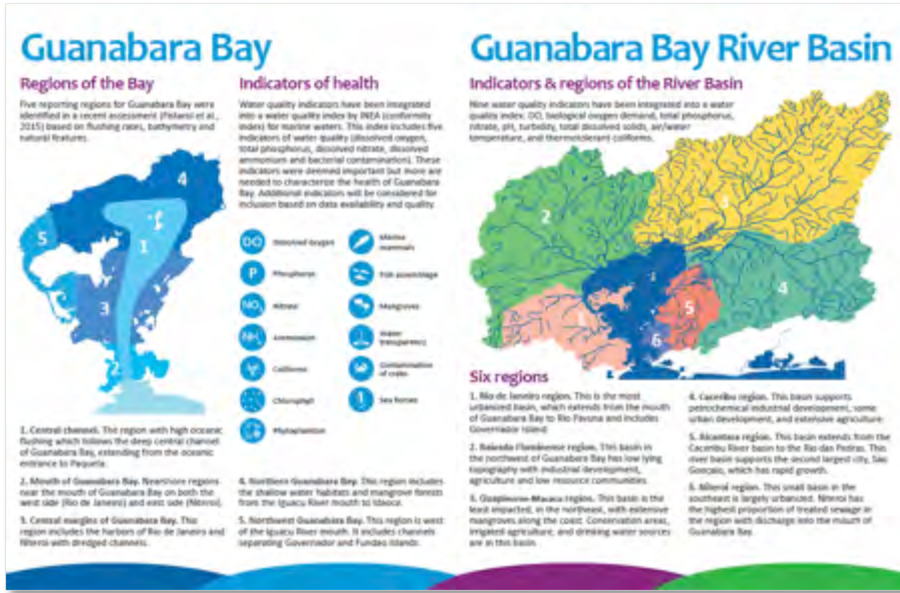
- DO — Dissolved oxygen
- P — Phosphorus
- NO_3 — Nitrate
- NH_4^+ — Ammonium
- Coliforms
- Chlorophyll
- Phytoplankton
- Marine mammals
- Fish assemblage
- Mangroves
- Water transparency
- Contamination of crabs
- Sea horses

2 Choose indicators

Potential Indicators for the Guanabara Bay Basin

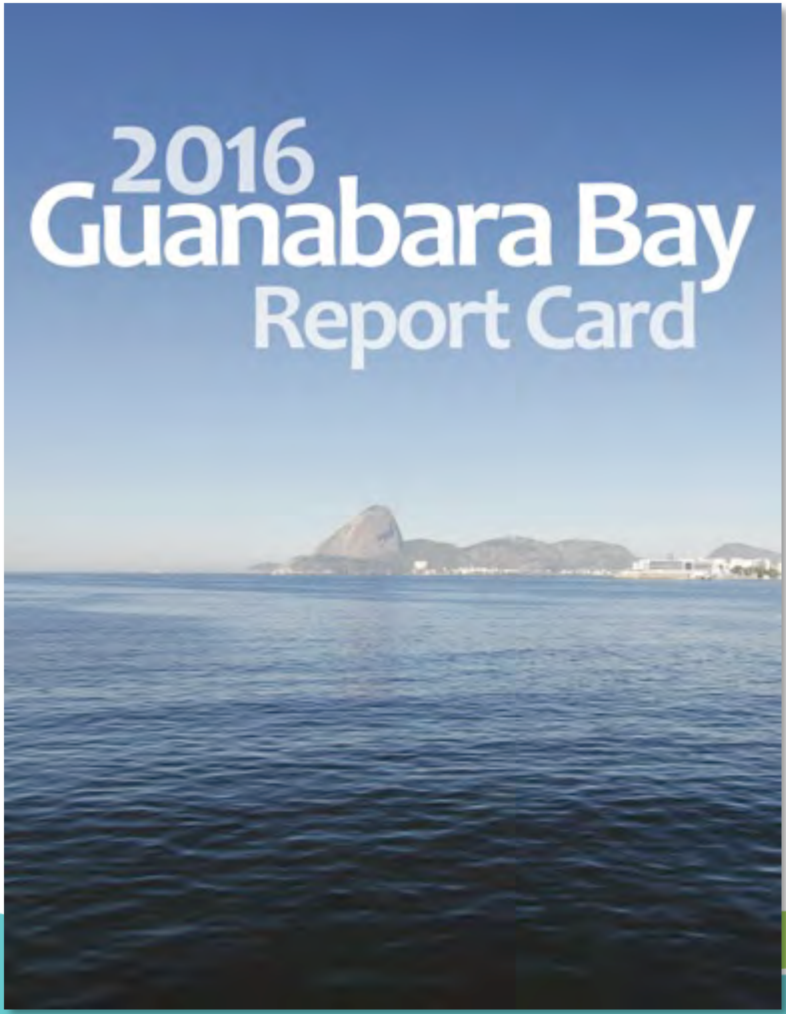
- **DO** – Dissolved oxygen
- **BOD** – Biological oxygen demand
- **P** – Total phosphorus
- **NO_3** – Nitrate
- Turbidity
- **TDS** – Total dissolved solids
- Air/water temperature
- Coliforms
- **pH** – pH

Initial Workshop Newsletter will be discussed after lunch

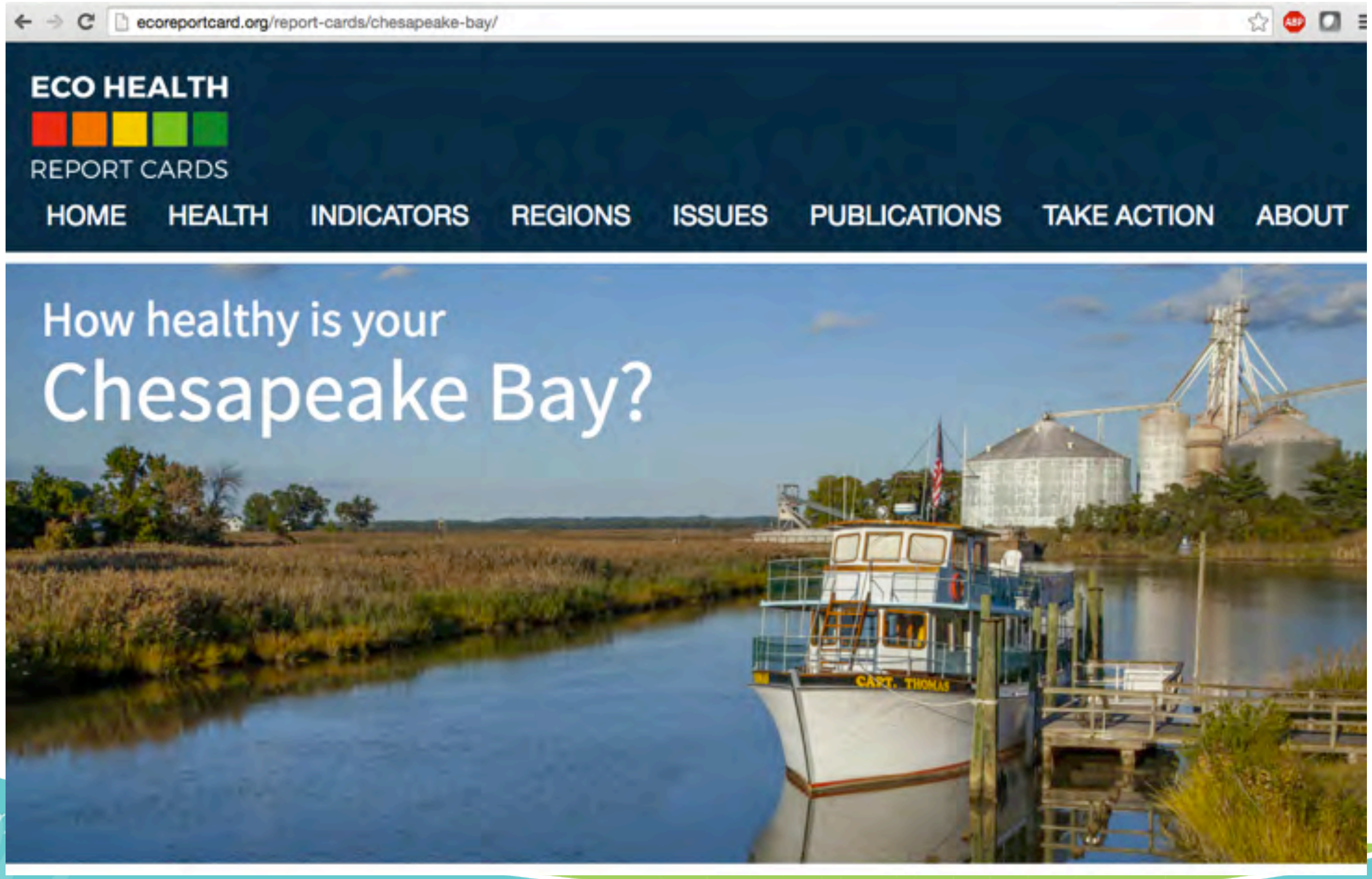


- Globally iconic location
- Pressing environmental problems
- Need for scientifically rigorous, transparent assessments to track restoration progress

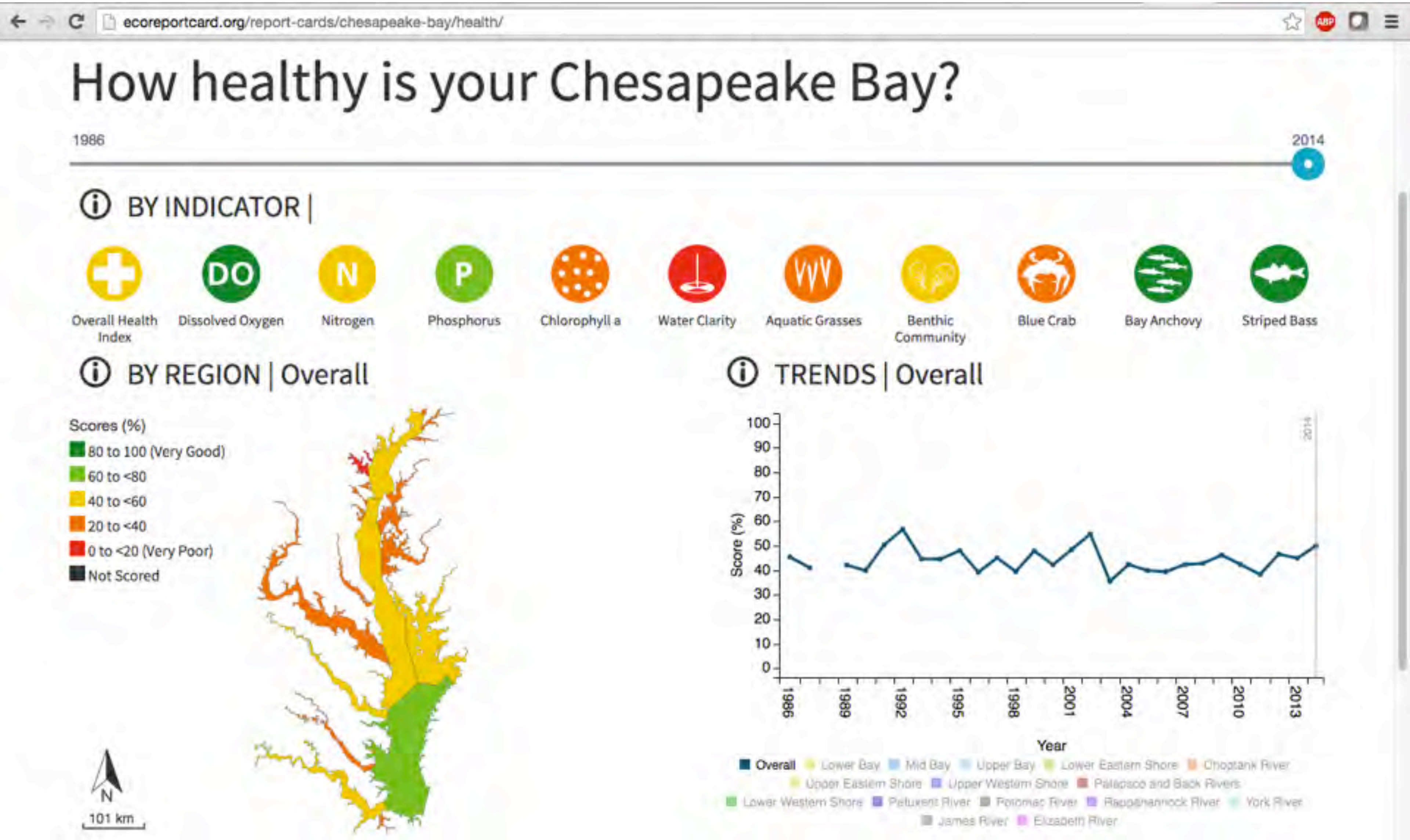
WE WILL PRODUCE A PRINTED REPORT CARD FOR GUANABARA BAY (LIKE CHESAPEAKE BAY)



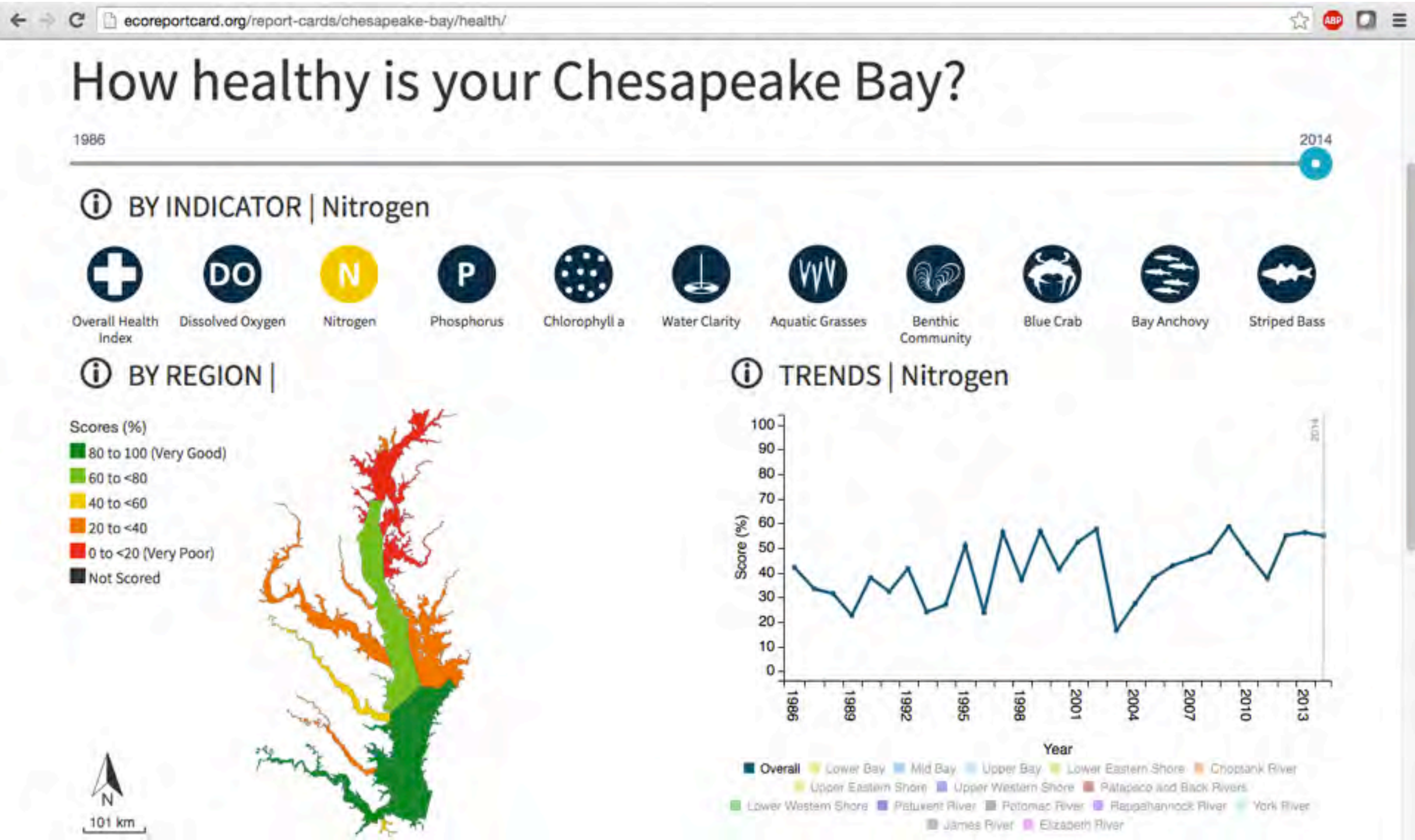
WE ALSO WILL ADD THE GUANABARA BAY REPORT CARD TO ECOREPORTCARD.ORG



THE WEBSITE ALLOWS PEOPLE TO INVESTIGATE THE DATA



THE WEBSITE PROVIDES DETAILED EXPLANATIONS



THE WEBSITE PROVIDES THE METHODOLOGY

ECO HEALTH
REPORT CARDS

HOME HEALTH INDICATORS REGIONS ISSUES PUBLICATIONS TAKE ACTION ABOUT

HOME / REPORT CARDS / CHESAPEAKE BAY / INDICATORS / PHOSPHORUS

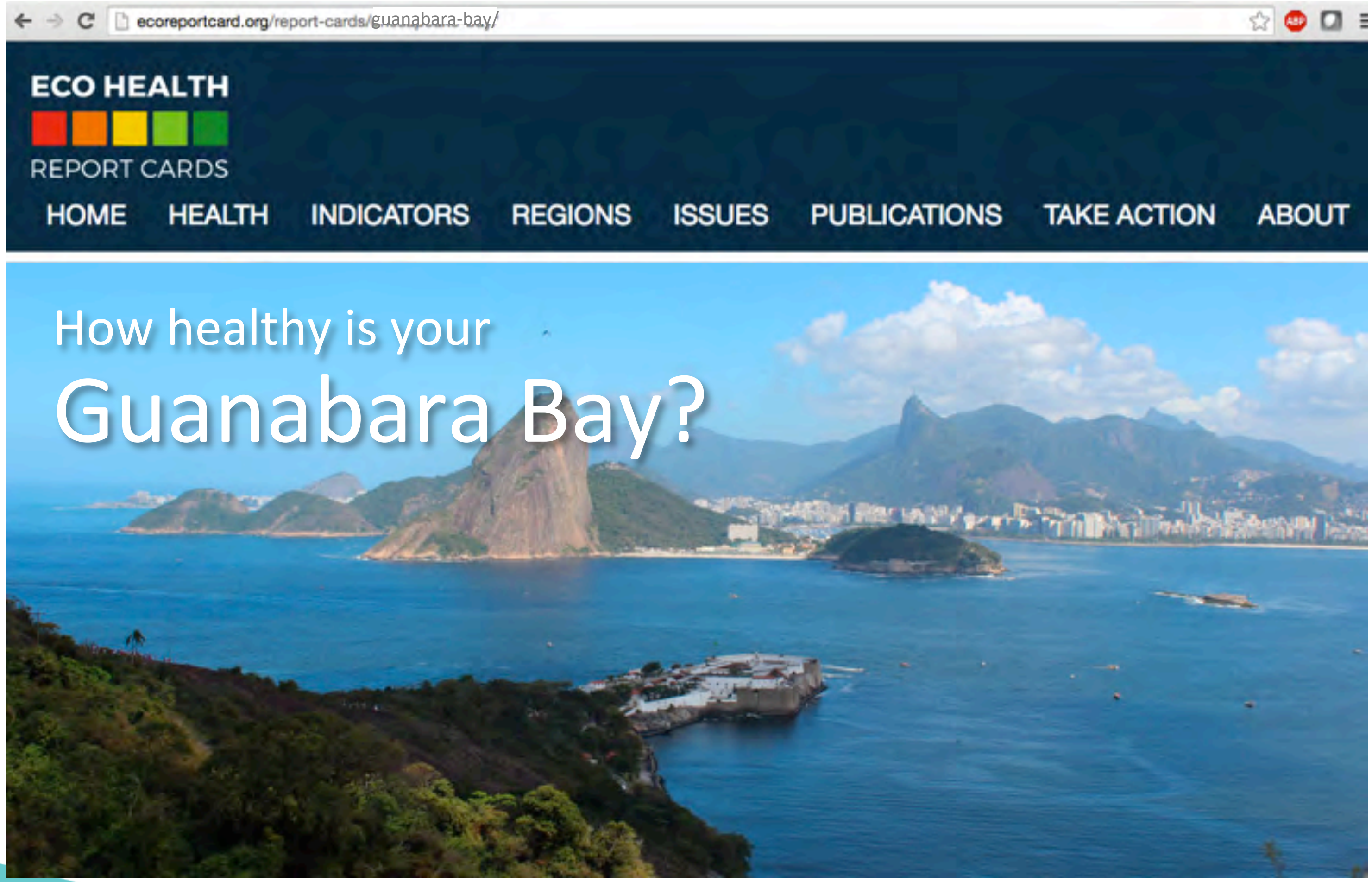
P

What is the Phosphorus indicator?

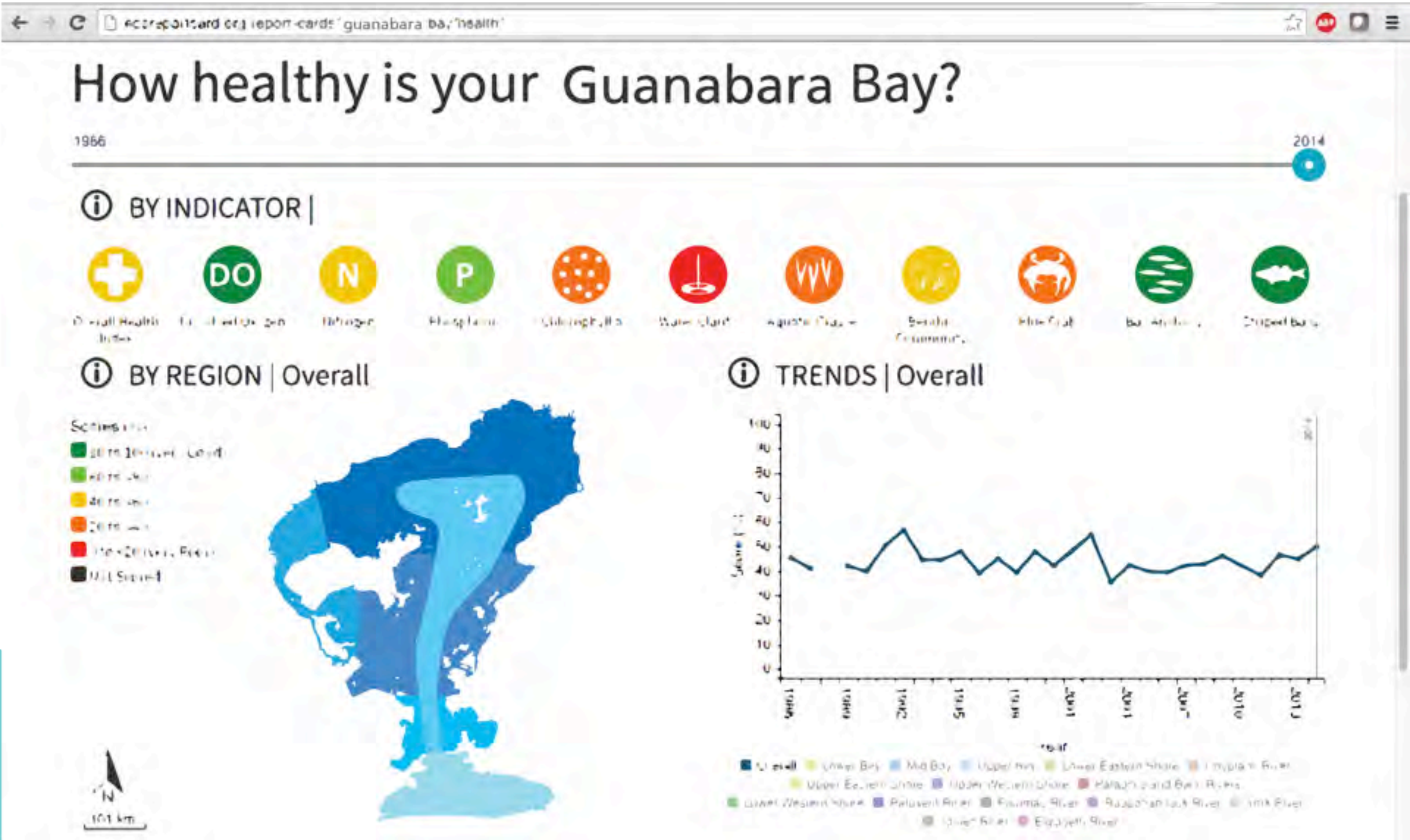
Total phosphorus is an indicator of too much phosphorus in the water. Phosphorus attaches to sediment particles, so phosphorus and sediment pollution are linked. Phosphorus is an essential nutrient for all plants and animals. But too much phosphorus in the water causes algae to grow in large, dense algal blooms, which depletes oxygen for fish and other marine organisms.

When sediment runs off land, it can carry nutrients like phosphorus into the water.

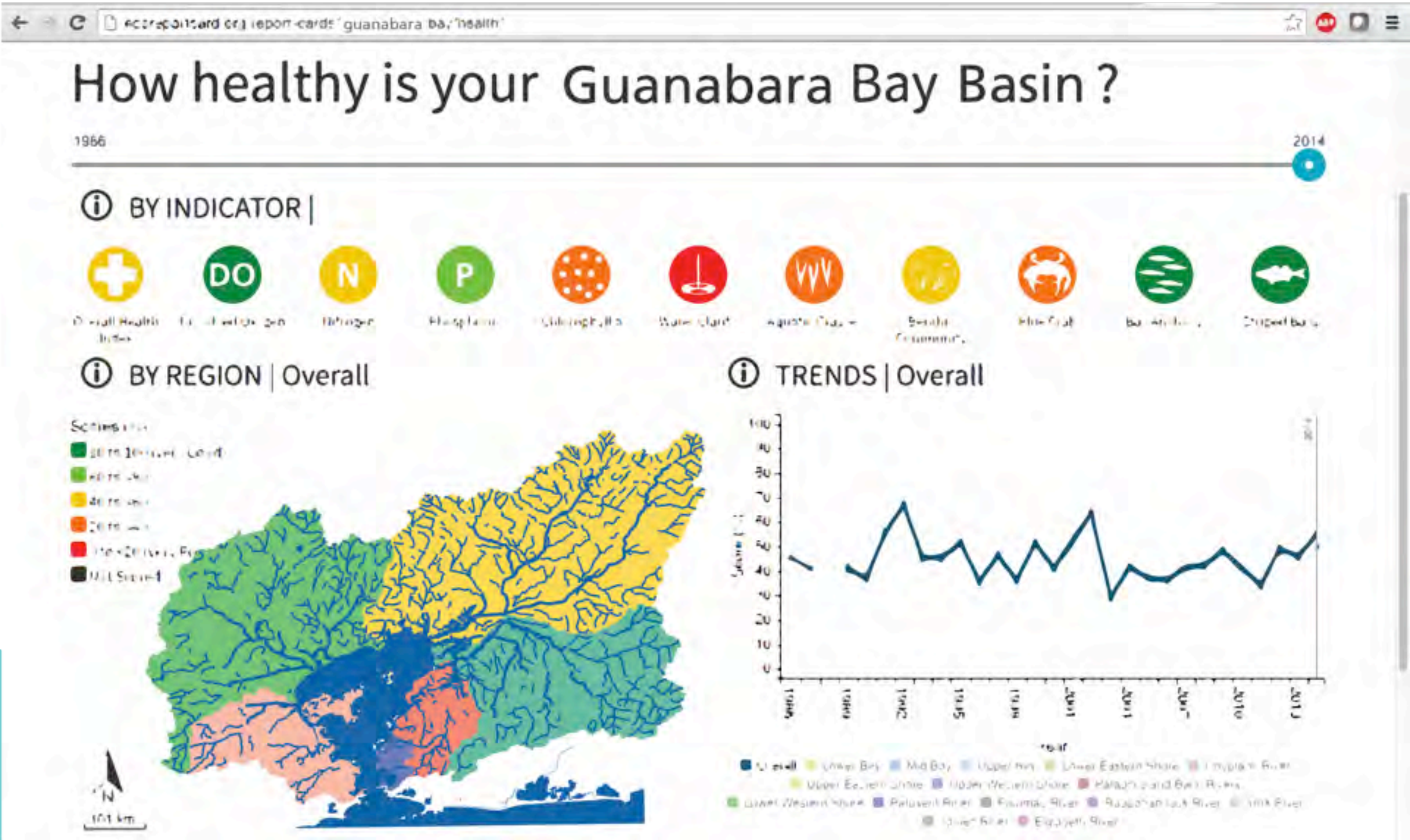
GUANABARA BAY REPORT CARD HOME PAGE EXAMPLE



GUANABARA BAY REPORT CARD



GUANABARA BAY BASIN REPORT CARD



Guanabara Bay Basin Report Card Example

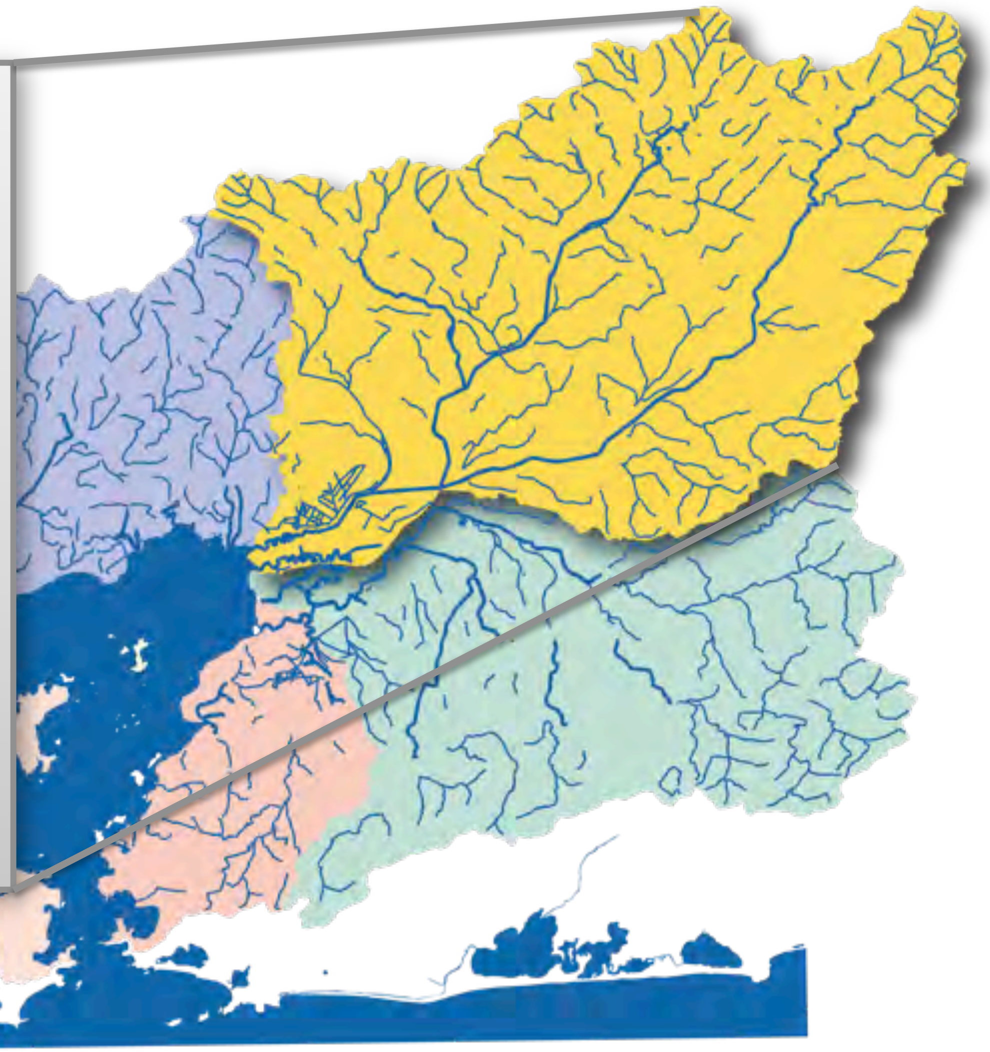
Guapimirim-Macacu Basin

Coliform:

Dissolved oxygen: DO

Nitrate: NO_3

Overall Score: ?



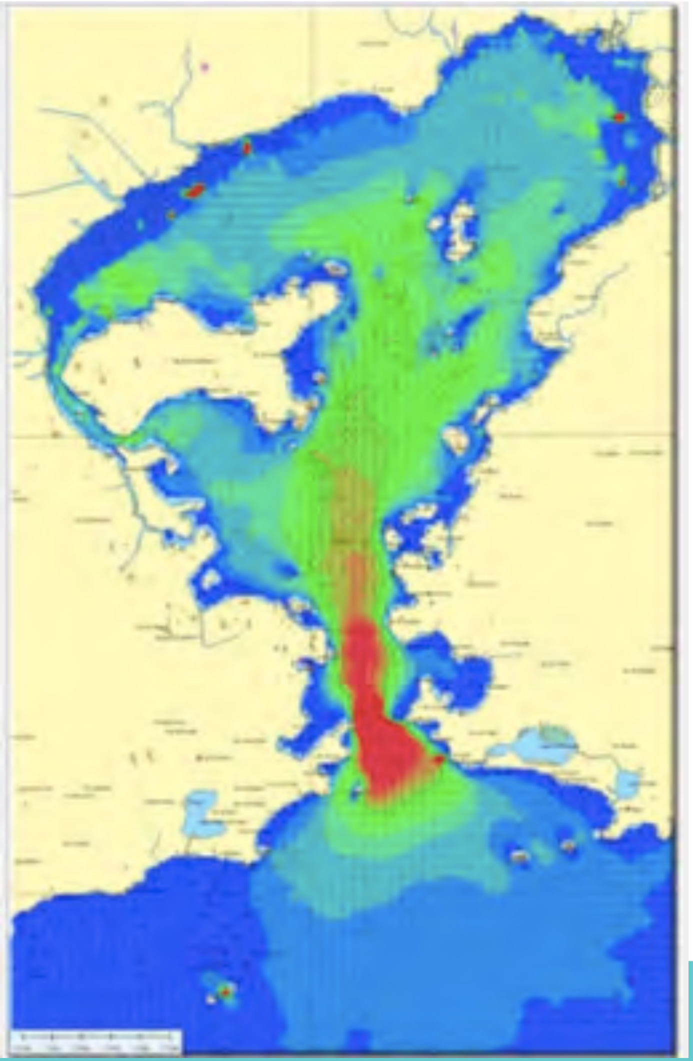
Guanabara Bay is an amazing place

- Beautiful natural harbor
- It attracts people to live, work, and play



GUANABARA BAY IS VULNERABLE TO HUMAN IMPACT

- Restricted exchange with ocean
- Poor flushing where it is needed most



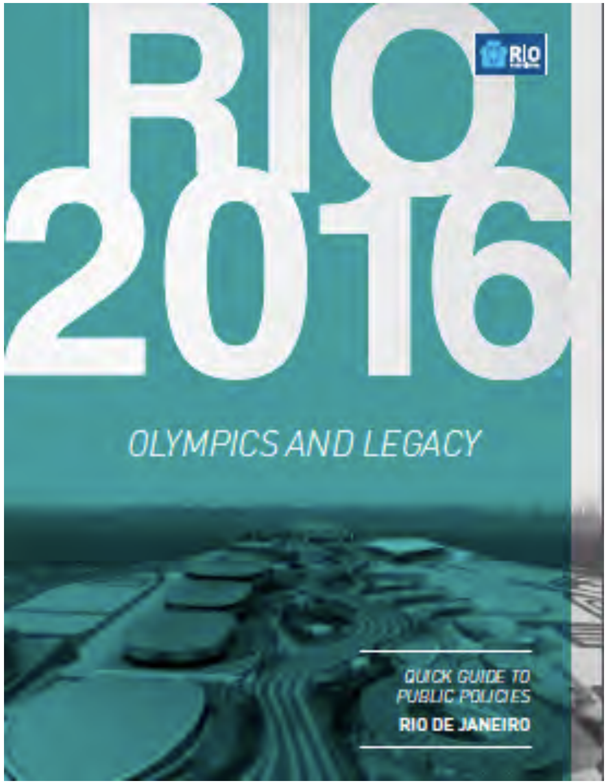
Guanabara Bay has some significant environmental impacts

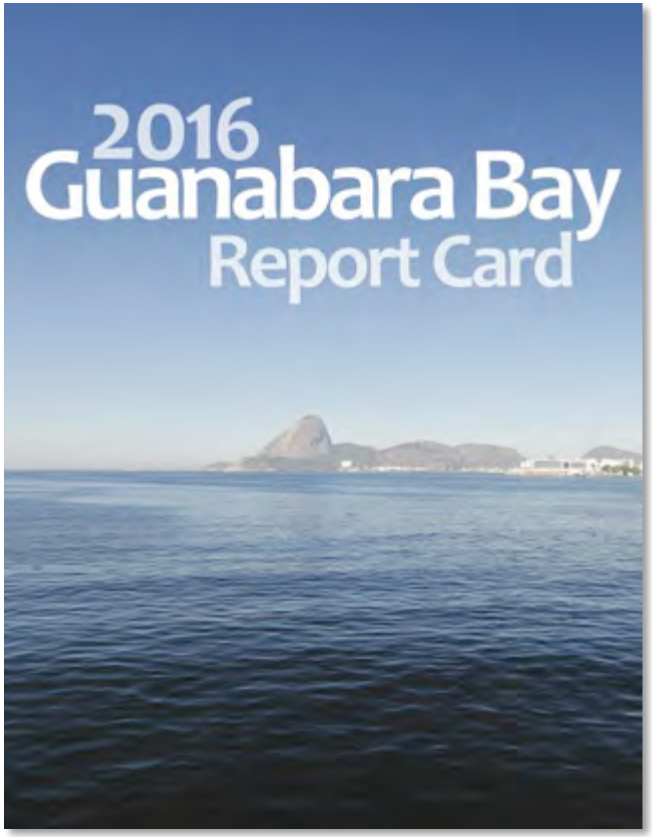
Visible (e.g. litter)

Invisible (e.g. bacterial contamination)

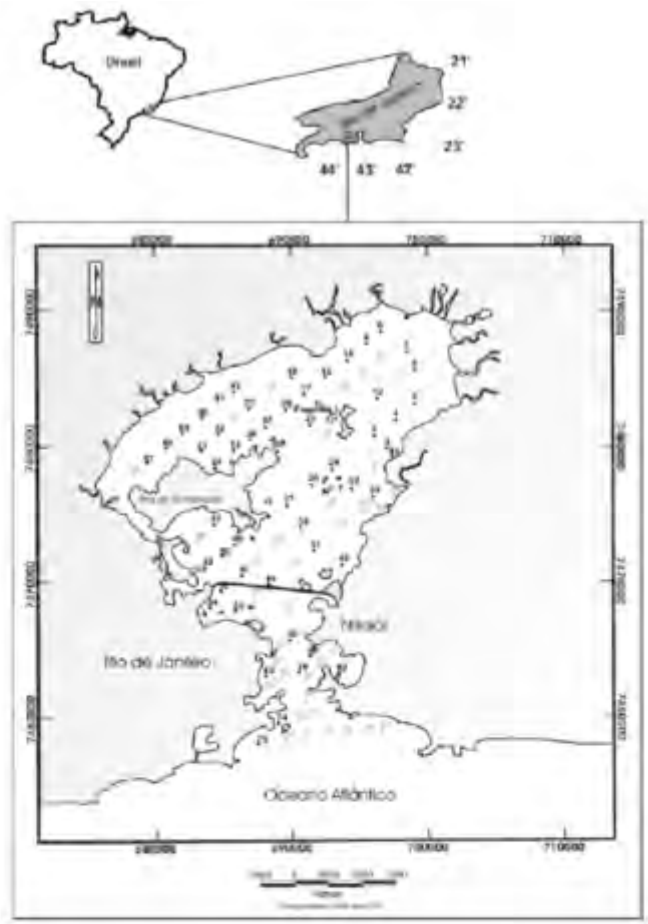
THERE IS STRONG INTEREST IN IMPROVING GUANABARA BAY
(THIS IS WHY WE ARE ALL HERE TODAY)

WE HAVE A UNIQUE OPPORTUNITY TO ACCELERATE GUANABARA BAY RESTORATION

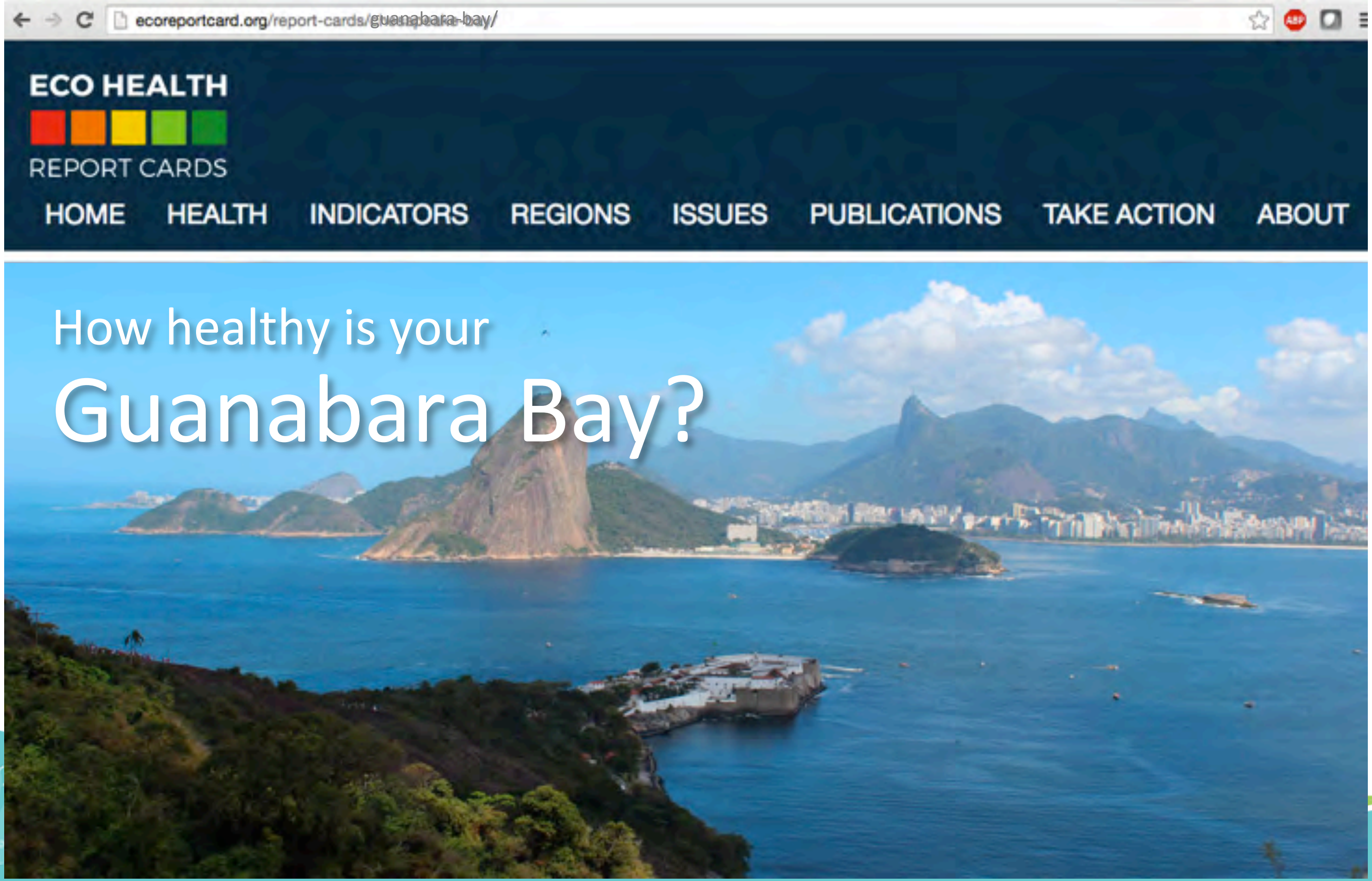




THERE IS A STRONG SCIENTIFIC FOUNDATION FOR GUANABARA BAY RESEARCH AND MONITORING



WE CAN BUILD ON THIS FOUNDATION TO CREATE A SCIENTIFICALLY RIGOROUS, TRANSPARENT PROCESS FOR TRACKING RESTORATION PROGRESS



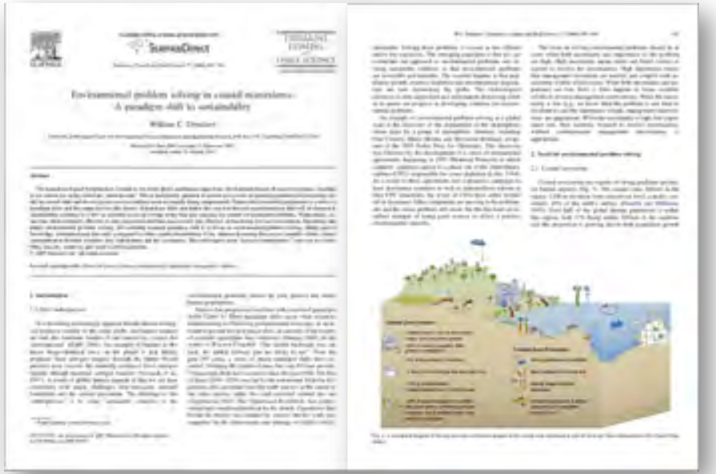
WE LOOK FORWARD TO ENGAGING WITH YOU IN THIS PROCESS

THANK YOU

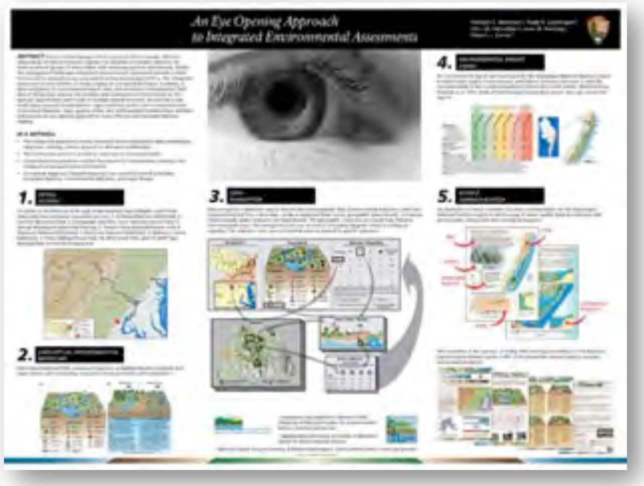
DEVELOPING A VARIETY OF SCIENCE COMMUNICATION PRODUCTS

Newsletters

Science Journals

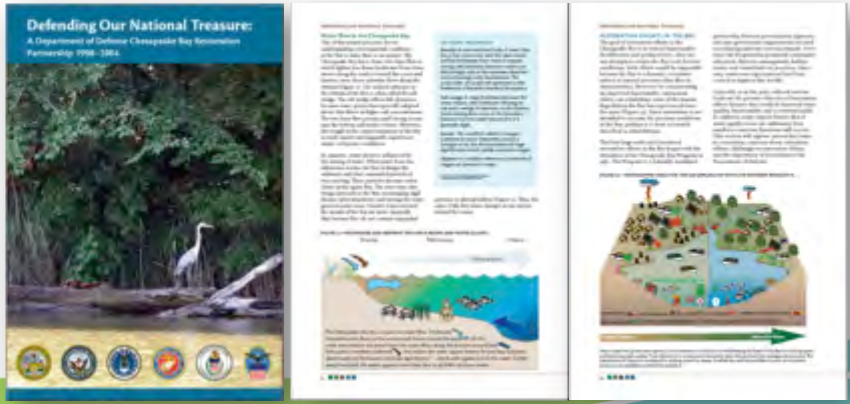


Posters

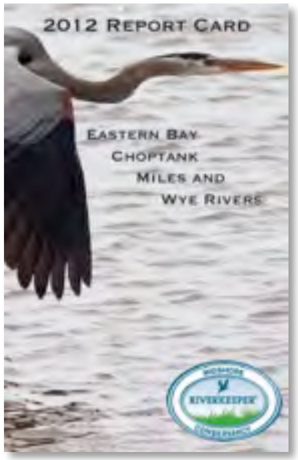


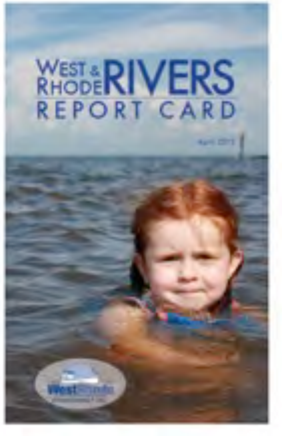
Reports

Books



REPORT CARD EXAMPLES





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Report cards are a five step process

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DNR	CCC0008		5/28/09	9.00
[illegible]	[illegible]		[illegible]	[illegible]

Calculate indicator scores and combine into index grades.

5 Communicate results

Communicate results using visual elements, such as photos, maps, and conceptual diagrams.

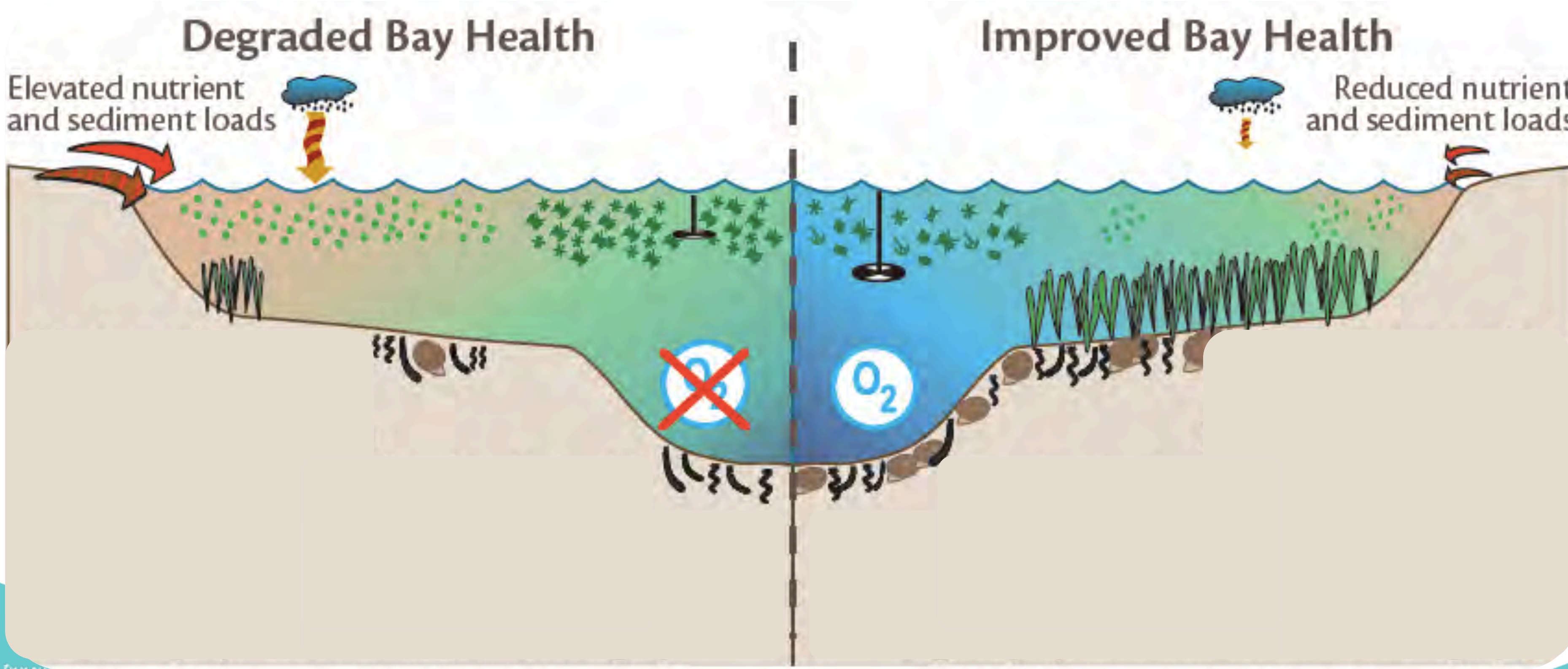
1. Conceptual framework | 2. Indicators | 3. Thresholds | 4. Calculate scores | 5. Communicate results

Workshop to identify values and threats

- Brings together relevant experts and stakeholders in one place at one time
- Together develop content and structure of report card
- Builds consensus amongst different parties
- Iterative – review and editing during and after workshop

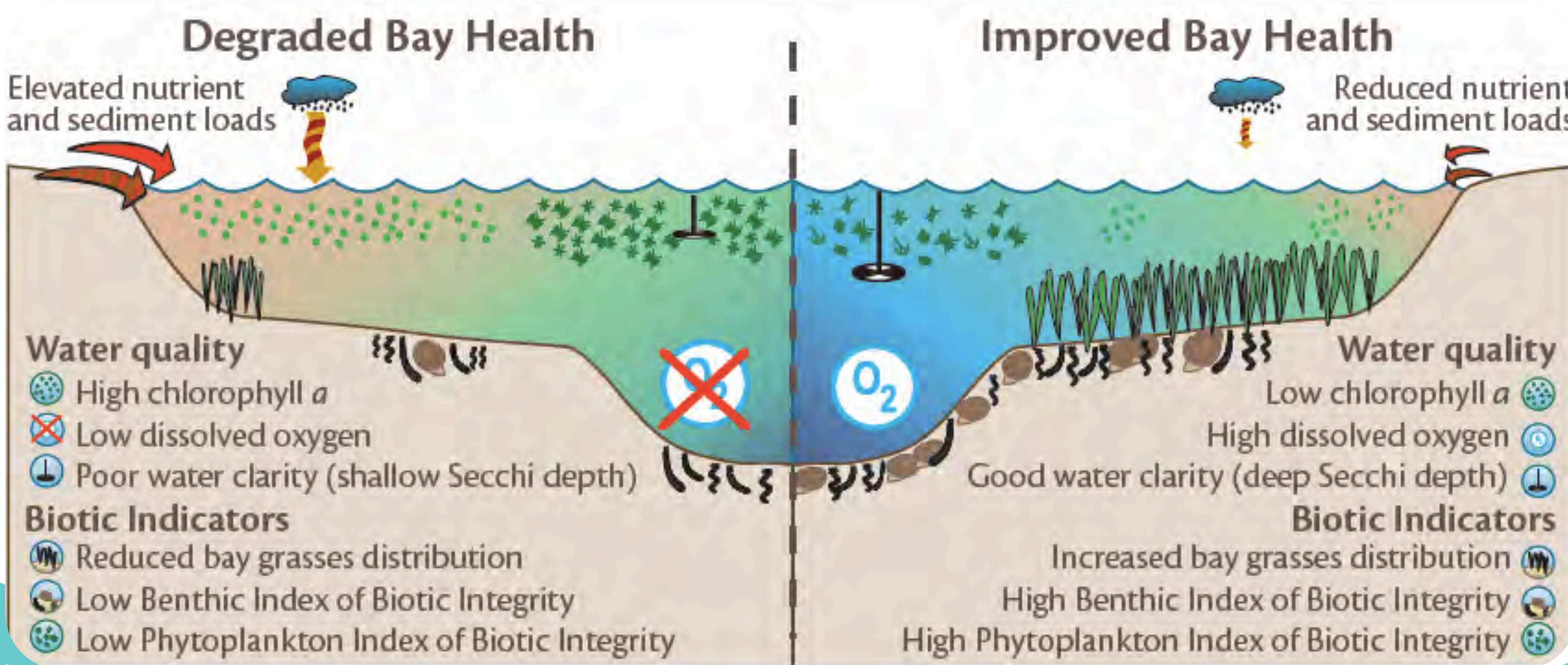
1. Conceptual framework | 2. Indicators | 3. Thresholds | 4. Calculate scores | 5. Communicate results

Chesapeake Bay – Build conceptual diagrams



1. Conceptual framework | **2. Indicators** | 3. Thresholds | 4. Calculate scores | 5. Communicate results

Chesapeake Bay – Indicators measure values and threats



The method of assigning thresholds for each indicator can be based on either, or a combination, of the following:

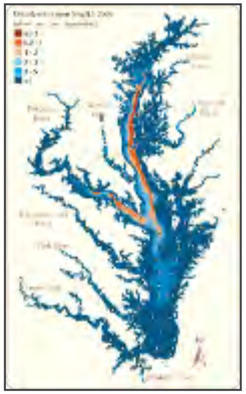
- Regulatory guidelines (e.g. local or regional water quality guidelines);
- Biological limits (e.g. dissolved oxygen requirements for protection of an important species);
- Socio/economic requirements (e.g. minimal fish stocks determined to be required for sustainable fishery);
- Reference conditions (e.g. historical baseline or nearby system with conditions that would like to be matched);
- Professional judgment

Score Calculation Methods

1. Prepare Data : Calculate annual mean, median (or multi-year rolling mean or median) for each indicator
2. Assess data against thresholds
   - % of measured or interpolated area that meets or does not meet threshold

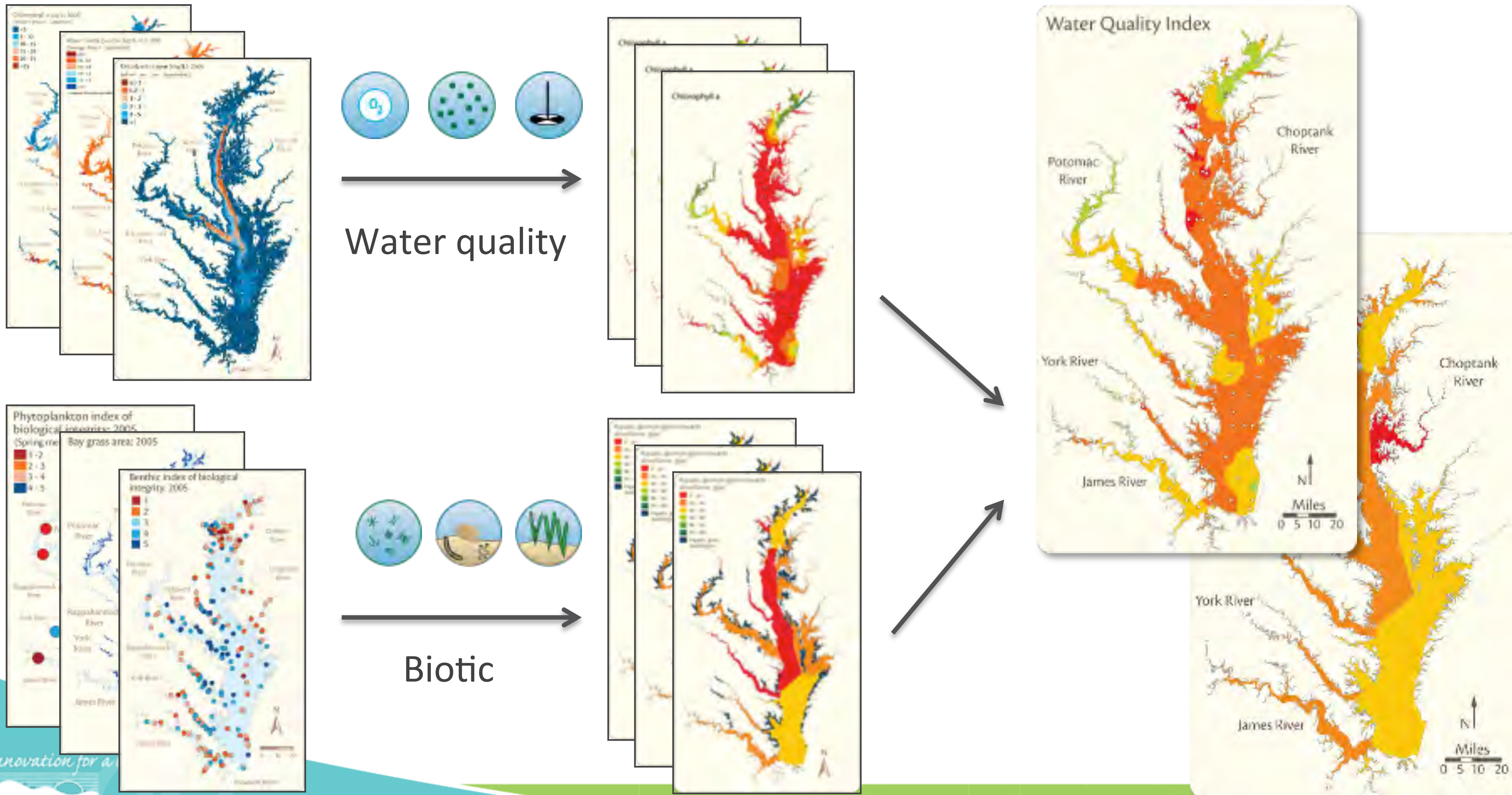
   OR

   - % of sites that meets or does not meet threshold



1. Conceptual framework | 2. Indicators | 3. Thresholds | **4. Calculate scores** | 5. Communicate results

Chesapeake Bay Methods



Data integrated | Compared to thresholds | Combined into indices

1. Conceptual framework | 2. Indicators | 3. Thresholds | **4. Calculate scores** | 5. Communicate results

Score	Grade	Explanation
80-100 %	A	All water quality and biological health indicators meet desired levels.
60-80 %	B	Most water quality and biological health indicators meet desired levels.
40-60 %	C	There is a mix of good and poor levels of water quality and biological health indicators.
20-40 %	D	Some or few water quality and biological health indicators meet desired levels.
0-20 %	F	Very few or no water quality and biological health indicators meet desired levels.

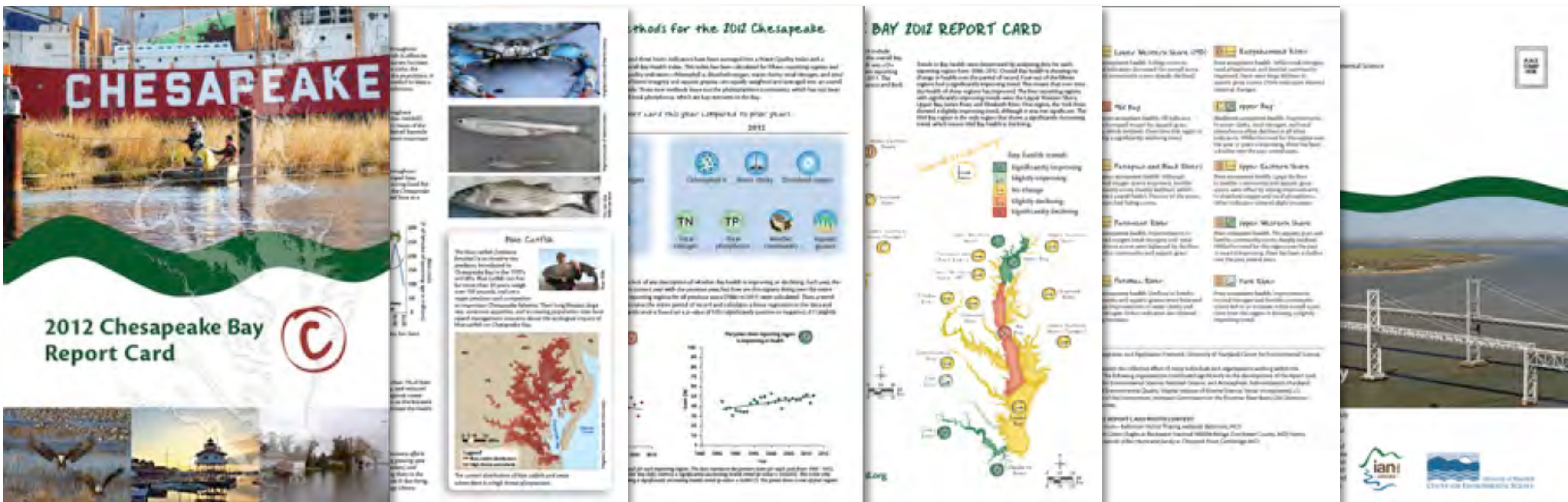
1. Conceptual framework

2. Indicators

3. Thresholds

4. Calculate scores

5. Communicate results



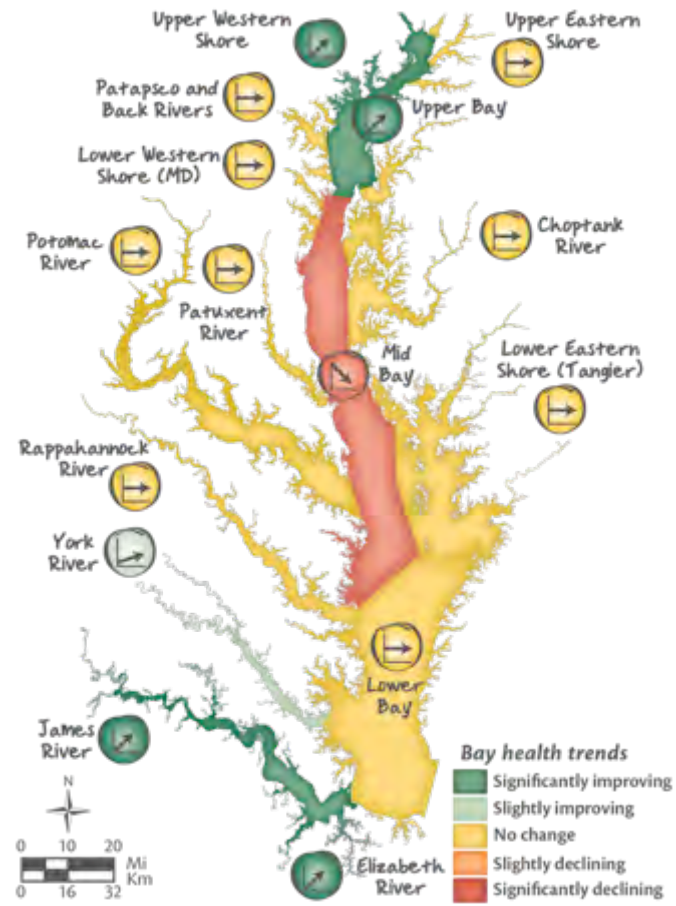
Cover | Values and threats | Indicators and methods | Scores/ Grades | Trends | Credits

1. Conceptual framework | 2. Indicators | 3. Thresholds | 4. Calculate scores | 5. Communicate results

Keep evolving

Chesapeake Bay:

- has new indicators
- is now reporting trends
- Includes flow weighted scores



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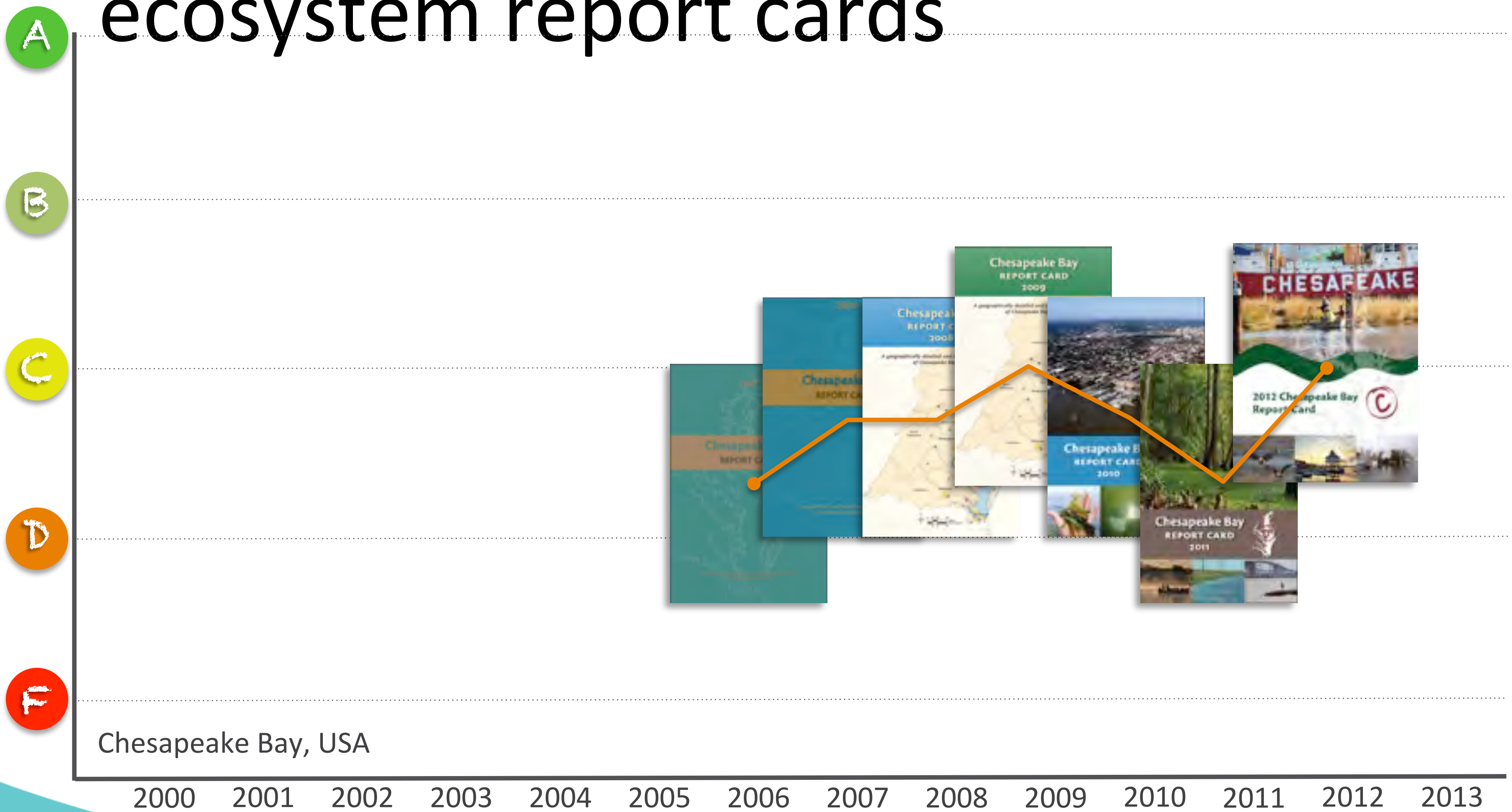
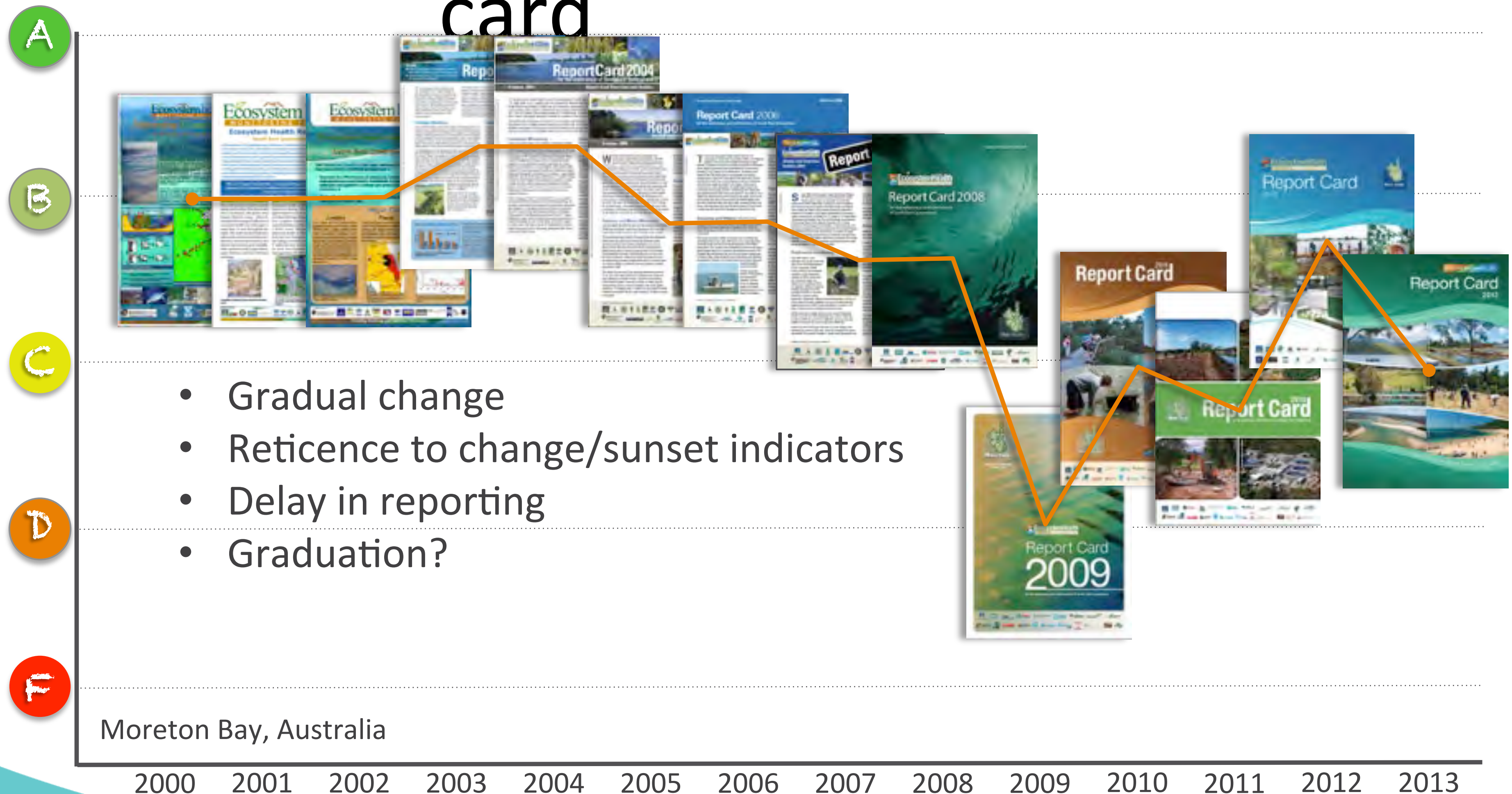
Retrospective on ecosystem report cards



Moreton Bay report card

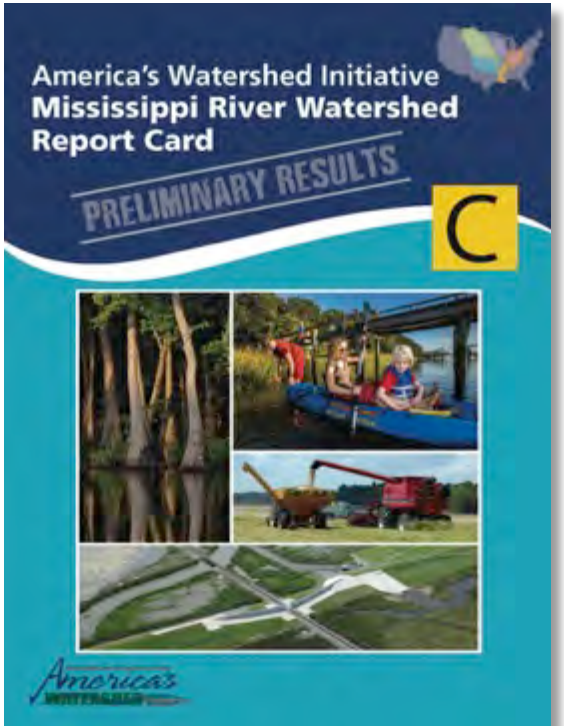


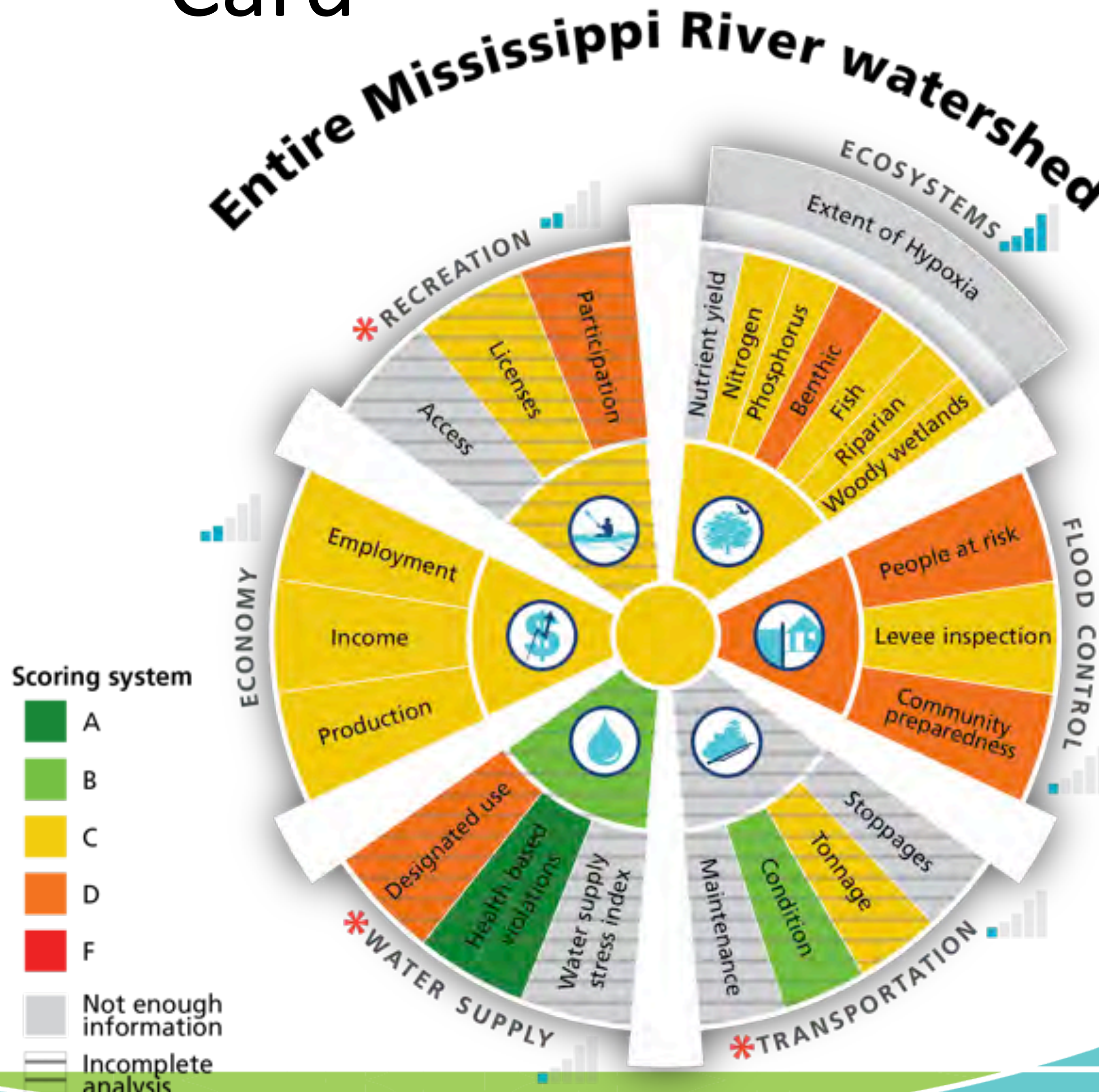
- Gradual change
- Reticence to change/sunset indicators
- Delay in reporting
- Graduation?

In summary:

1. Identify values and threats
2. Choose indicators
3. Identify thresholds
4. Calculate scores and grades
5. Communicate results

Mississippi River Watershed Report Card





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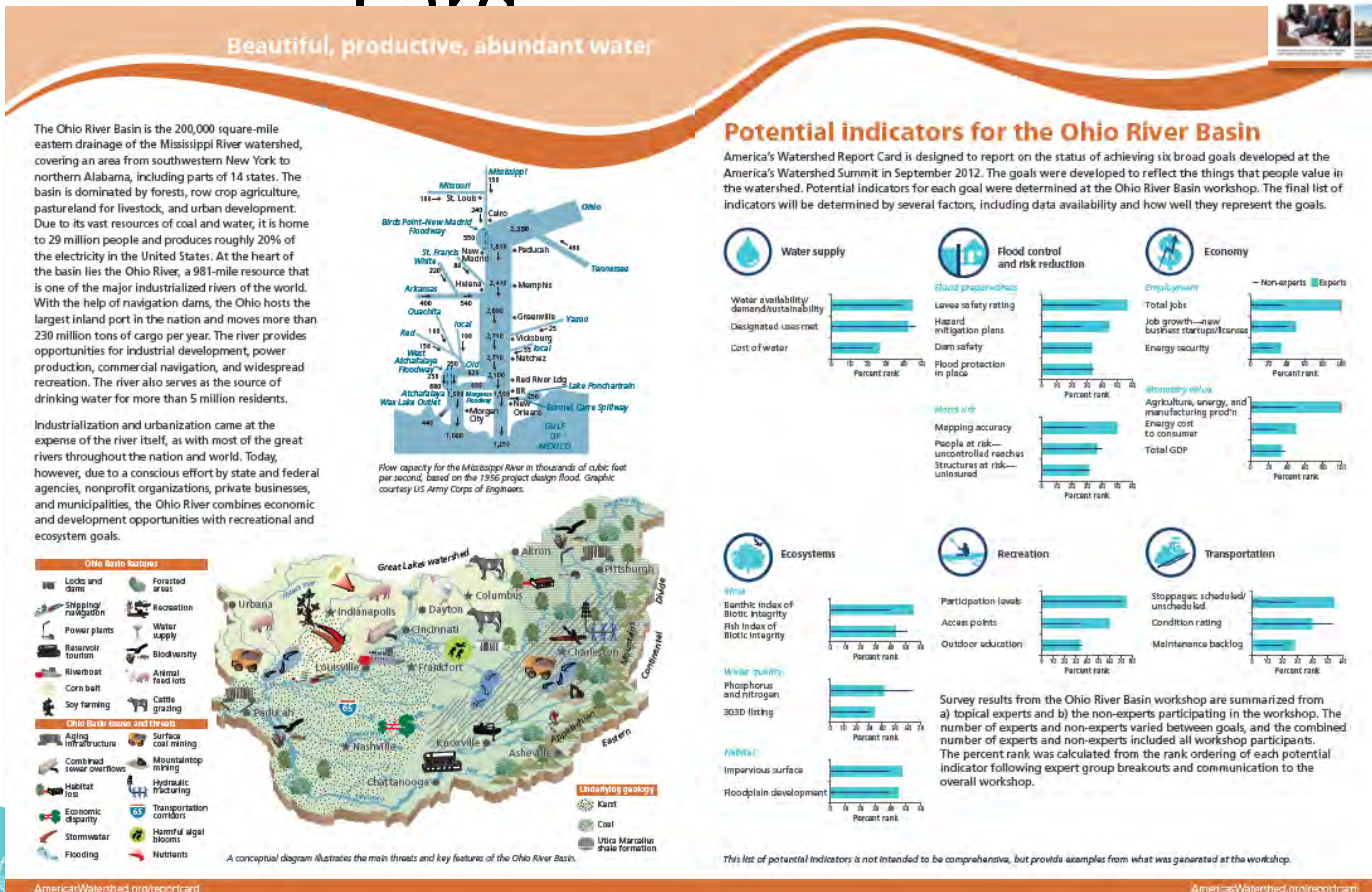
Mississippi River Report Card



Beautiful, productive, abundant water

The Ohio River Basin is the 200,000 square-mile eastern drainage of the Mississippi River watershed, covering an area from southwestern New York to northern Alabama, including parts of 14 states. The basin is dominated by forests, row crop agriculture, pastureland for livestock, and urban development. Due to its vast resources of coal and water, it is home to 29 million people and produces roughly 20% of the electricity in the United States. At the heart of the basin lies the Ohio River, a 981-mile resource that is one of the major industrialized rivers of the world. With the help of navigation dams, the Ohio hosts the largest inland port in the nation and moves more than 230 million tons of cargo per year. The river provides opportunities for industrial development, power production, commercial navigation, and widespread recreation. The river also serves as the source of drinking water for more than 5 million residents.

Industrialization and urbanization came at the expense of the river itself, as with most of the great rivers throughout the nation and world. Today, however, due to a conscious effort by state and federal agencies, nonprofit organizations, private businesses, and municipalities, the Ohio River combines economic and development opportunities with recreational and ecosystem goals.

Flow capacity for the Mississippi River in thousands of cubic feet per second, based on the 1956 project design flood. Graphic courtesy US Army Corps of Engineers.

A conceptual diagram illustrates the main threats and key features of the Ohio River Basin.

Potential indicators for the Ohio River Basin

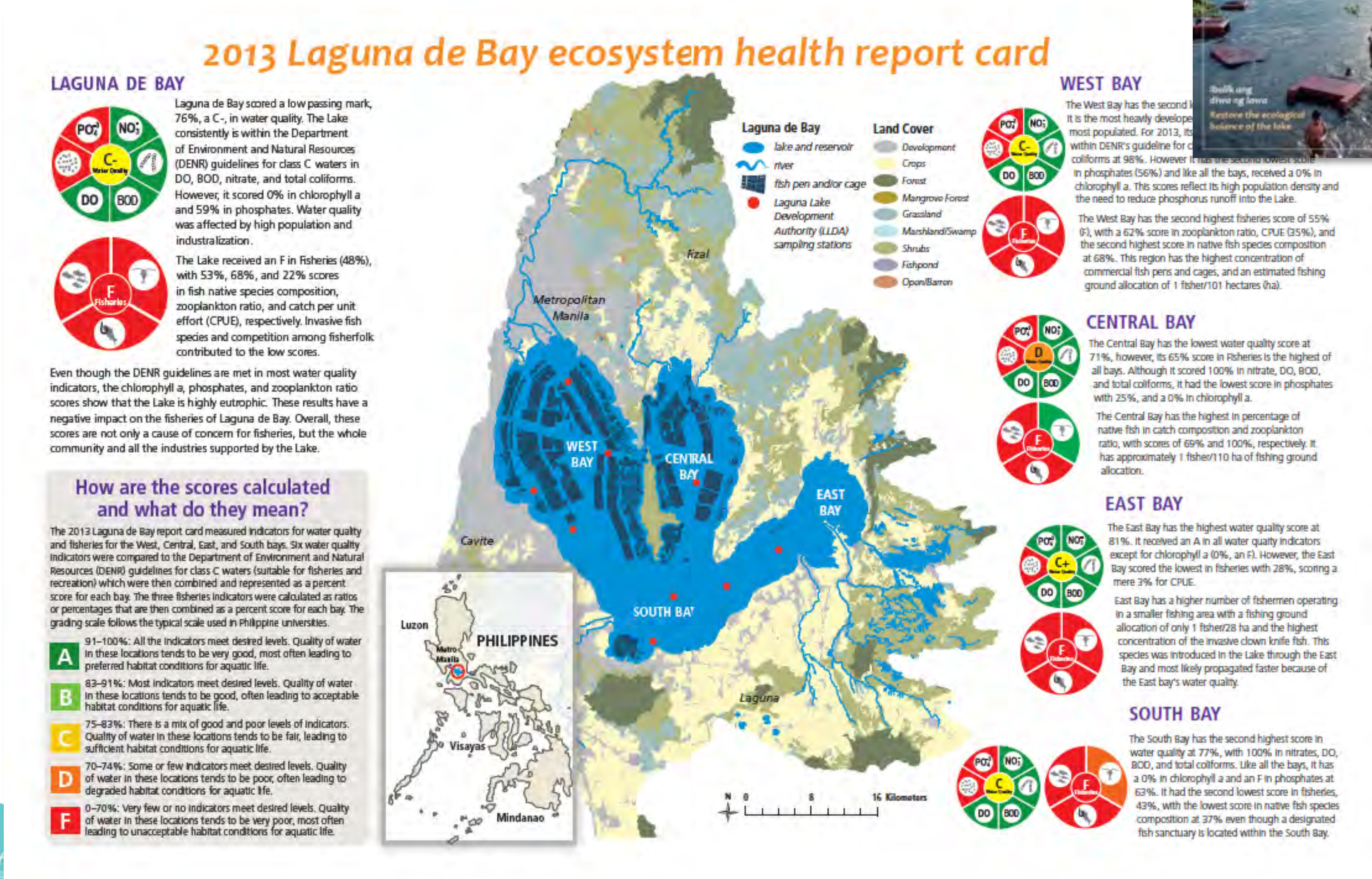
America's Watershed Report Card is designed to report on the status of achieving six broad goals developed at the America's Watershed Summit in September 2012. The goals were developed to reflect the things that people value in the watershed. Potential indicators for each goal were determined at the Ohio River Basin workshop. The final list of indicators will be determined by several factors, including data availability and how well they represent the goals.

Survey results from the Ohio River Basin workshop are summarized from a) topical experts and b) the non-experts participating in the workshop. The number of experts and non-experts varied between goals, and the combined number of experts and non-experts included all workshop participants. The percent rank was calculated from the rank ordering of each potential indicator following expert group breakouts and communication to the overall workshop.

This list of potential indicators is not intended to be comprehensive, but provide examples from what was generated at the workshop.

AmericasWatershed.org/reportcard

Laguna De Bay Report



2013 Laguna de Bay ecosystem health report card

LAGUNA DE BAY

Laguna de Bay scored a low passing mark, 76%, a C-, in water quality. The Lake consistently is within the Department of Environment and Natural Resources (DENR) guidelines for class C waters in DO, BOD, nitrate, and total coliforms. However, it scored 0% in chlorophyll a and 59% in phosphates. Water quality was affected by high population and industrialization.

The Lake received an F in fisheries (48%), with 53%, 68%, and 22% scores in fish native species composition, zooplankton ratio, and catch per unit effort (CPUE), respectively. Invasive fish species and competition among fisherfolk contributed to the low scores.

Even though the DENR guidelines are met in most water quality indicators, the chlorophyll a, phosphates, and zooplankton ratio scores show that the Lake is highly eutrophic. These results have a negative impact on the fisheries of Laguna de Bay. Overall, these scores are not only a cause of concern for fisheries, but the whole community and all the industries supported by the Lake.

How are the scores calculated and what do they mean?

The 2013 Laguna de Bay report card measured indicators for water quality and fisheries for the West, Central, East, and South bays. Six water quality indicators were compared to the Department of Environment and Natural Resources (DENR) guidelines for class C waters (suitable for fisheries and recreation) which were then combined and represented as a percent score for each bay. The three fisheries indicators were calculated as ratios or percentages that are then combined as a percent score for each bay. The grading scale follows the typical scale used in Philippine universities.

- **A** 91–100%: All the indicators meet desired levels. Quality of water in these locations tends to be very good, most often leading to preferred habitat conditions for aquatic life.
- **B** 83–91%: Most indicators meet desired levels. Quality of water in these locations tends to be good, often leading to acceptable habitat conditions for aquatic life.
- **C** 75–83%: There is a mix of good and poor levels of indicators. Quality of water in these locations tends to be fair, leading to sufficient habitat conditions for aquatic life.
- **D** 70–74%: Some or few indicators meet desired levels. Quality of water in these locations tends to be poor, often leading to degraded habitat conditions for aquatic life.
- **F** 0–70%: Very few or no indicators meet desired levels. Quality of water in these locations tends to be very poor, most often leading to unacceptable habitat conditions for aquatic life.

WEST BAY

The West Bay has the second l… It is the most heavily develope… most populated. For 2013, its… within DENR's guideline for c… coliforms at 98%. However it has the second lowest score in phosphates (56%) and like all the bays, received a 0% in chlorophyll a. This scores reflect its high population density and the need to reduce phosphorus runoff into the Lake.

The West Bay has the second highest fisheries score of 55% (F), with a 62% score in zooplankton ratio, CPUE (35%), and the second highest score in native fish species composition at 68%. This region has the highest concentration of commercial fish pens and cages, and an estimated fishing ground allocation of 1 fisher/101 hectares (ha).

CENTRAL BAY

The Central Bay has the lowest water quality score at 71%, however, its 65% score in Fisheries is the highest of all bays. Although it scored 100% in nitrate, DO, BOD, and total coliforms, it had the lowest score in phosphates with 25%, and a 0% in chlorophyll a.

The Central Bay has the highest in percentage of native fish in catch composition and zooplankton ratio, with scores of 69% and 100%, respectively. It has approximately 1 fisher/110 ha of fishing ground allocation.

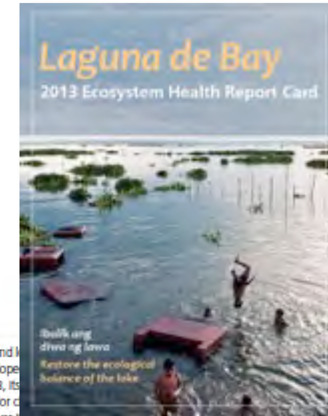
EAST BAY

The East Bay has the highest water quality score at 81%. It received an A in all water qualty indicators except for chlorophyll a (0%, an F). However, the East Bay scored the lowest in fisheries with 28%, scoring a mere 3% for CPUE.

East Bay has a higher number of fishermen operating in a smaller fishing area with a fishing ground allocation of only 1 fisher/28 ha and the highest concentration of the invasive clown knife fish. This species was introduced in the Lake through the East Bay and most likely propagated faster because of the East bay's water quality.

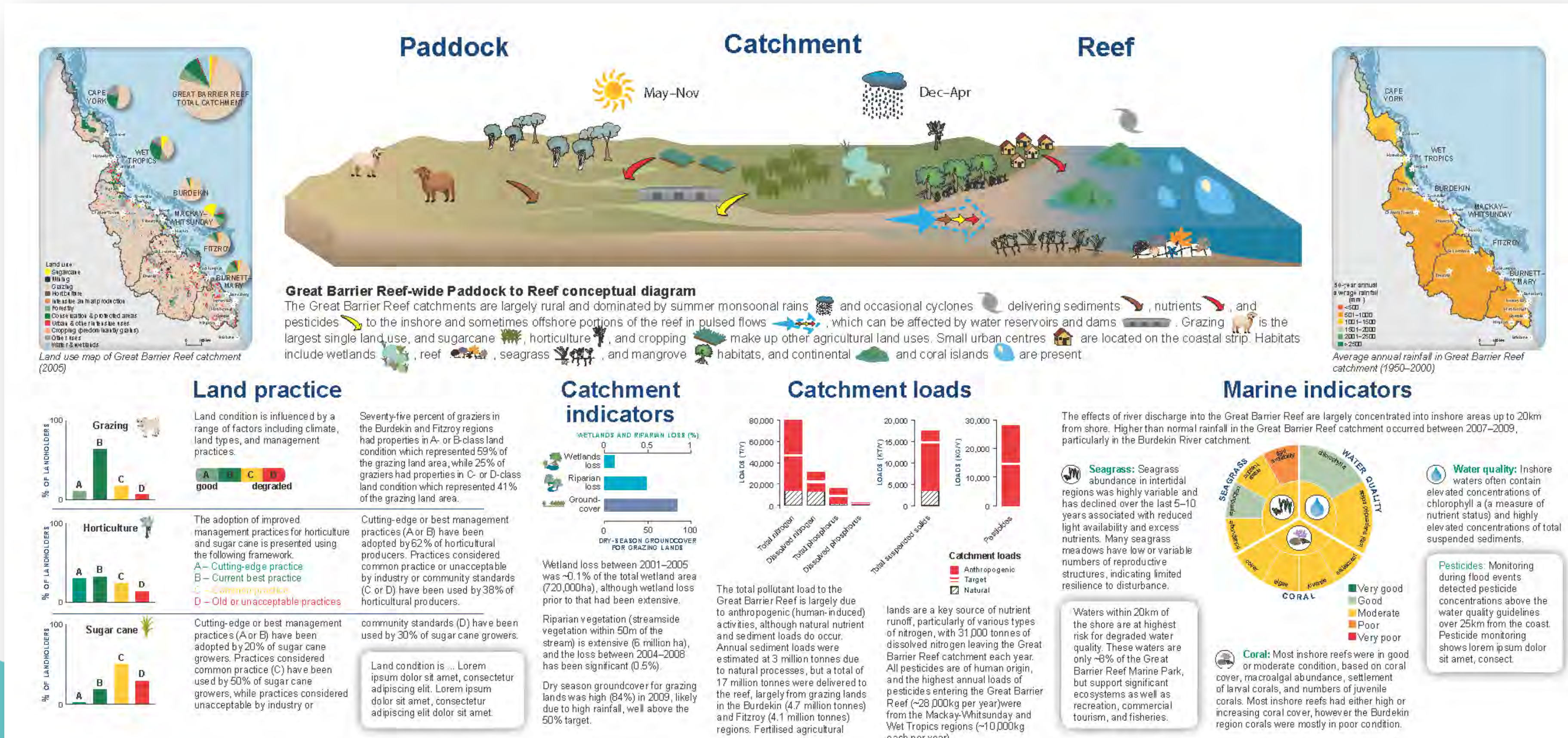
SOUTH BAY

The South Bay has the second highest score in water quality at 77%, with 100% in nitrates, DO, BOD, and total coliforms. Like all the bays, it has a 0% in chlorophyll a and an F in phosphates at 63%. It had the second lowest score in fisheries, 43%, with the lowest score in native fish species composition at 37% even though a designated fish sanctuary is located within the South Bay.

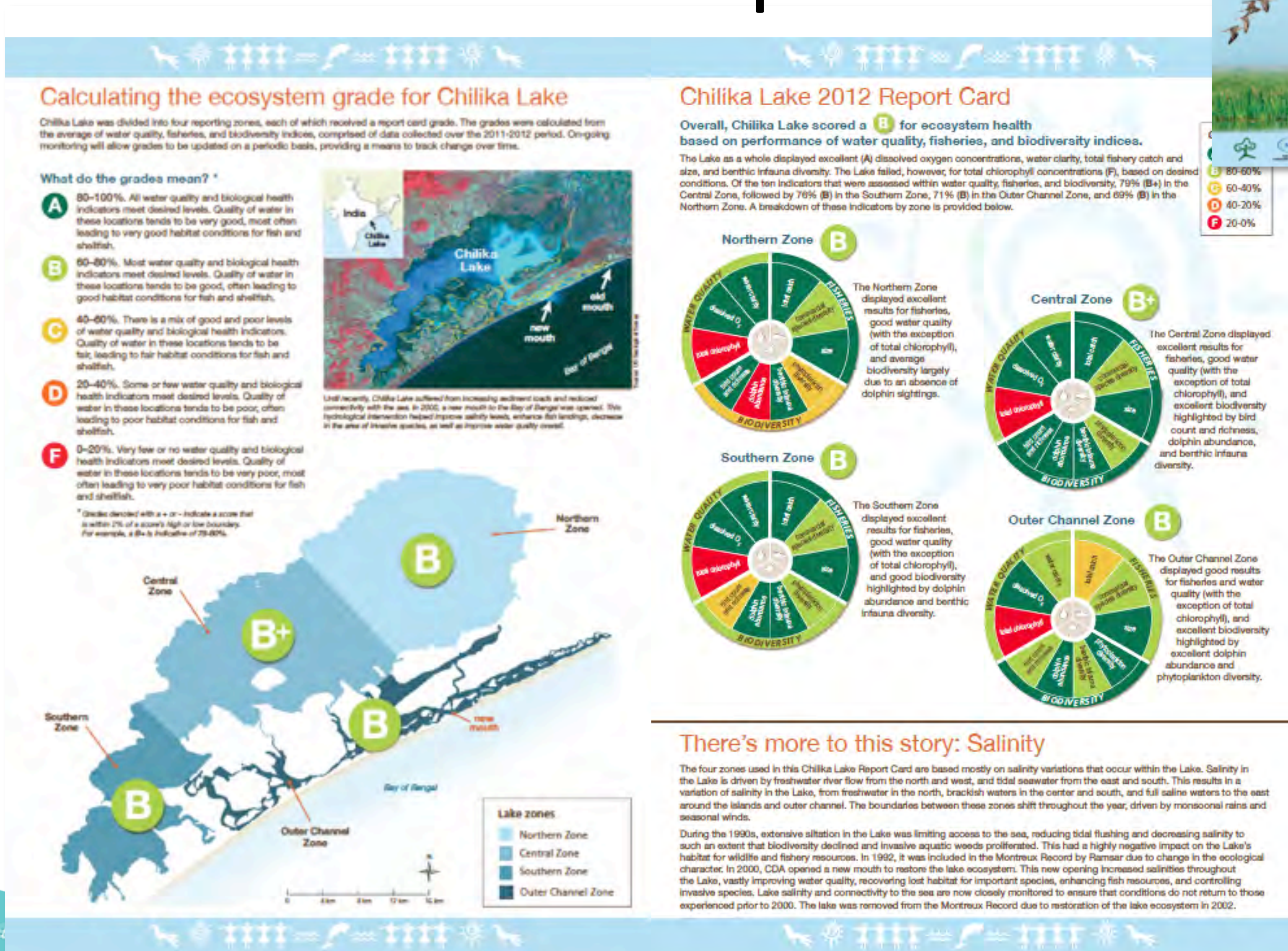


Great Barrier Reef Report Card

Evolution of report cards to include pressure ar
response indicators



Chilika Lake Report Card



Calculating the ecosystem grade for Chilika Lake

Chilika Lake was divided into four reporting zones, each of which received a report card grade. The grades were calculated from the average of water quality, fisheries, and biodiversity indices, comprised of data collected over the 2011-2012 period. On-going monitoring will allow grades to be updated on a periodic basis, providing a means to track change over time.

What do the grades mean? *

- **A** 80–100%. All water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be very good, most often leading to very good habitat conditions for fish and shellfish.
- **B** 60–80%. Most water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be good, often leading to good habitat conditions for fish and shellfish.
- **C** 40–60%. There is a mix of good and poor levels of water quality and biological health indicators. Quality of water in these locations tends to be fair, leading to fair habitat conditions for fish and shellfish.
- **D** 20–40%. Some or few water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be poor, often leading to poor habitat conditions for fish and shellfish.
- **F** 0–20%. Very few or no water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be very poor, most often leading to very poor habitat conditions for fish and shellfish.

* Grades denoted with a + or – indicate a score that is within 2% of a score's high or low boundary. For example, a B+ is indicative of 78-80%.

Until recently, Chilika Lake suffered from increasing sediment loads and reduced connectivity with the sea. In 2000, a new mouth to the Bay of Bengal was opened. This hydrological intervention helped improve salinity levels, enhance fish landings, decrease in the area of invasive species, as well as improve water quality overall.

Chilika Lake 2012 Report Card

Overall, Chilika Lake scored a B for ecosystem health based on performance of water quality, fisheries, and biodiversity indices.

The Lake as a whole displayed excellent (A) dissolved oxygen concentrations, water clarity, total fishery catch and size, and benthic infauna diversity. The Lake failed, however, for total chlorophyll concentrations (F), based on desired conditions. Of the ten indicators that were assessed within water quality, fisheries, and biodiversity, 79% (B+) in the Central Zone, followed by 76% (B) in the Southern Zone, 71% (B) in the Outer Channel Zone, and 69% (B) in the Northern Zone. A breakdown of these indicators by zone is provided below.

Northern Zone B

The Northern Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and average biodiversity largely due to an absence of dolphin sightings.

Central Zone B+

The Central Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by bird count and richness, dolphin abundance, and benthic infauna diversity.

Southern Zone B

The Southern Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and good biodiversity highlighted by dolphin abundance and benthic infauna diversity.

Outer Channel Zone B

The Outer Channel Zone displayed good results for fisheries and water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by excellent dolphin abundance and phytoplankton diversity.

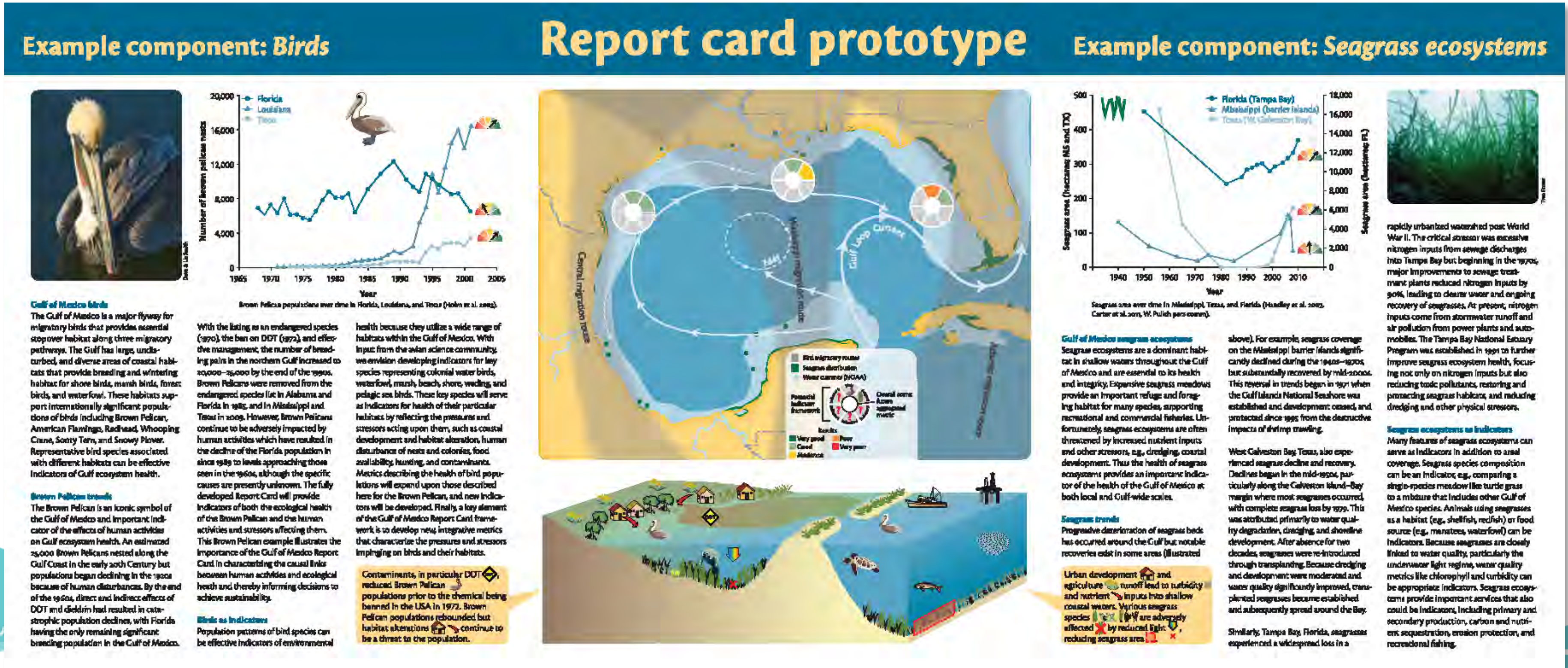
There's more to this story: Salinity

The four zones used in this Chilika Lake Report Card are based mostly on salinity variations that occur within the Lake. Salinity in the Lake is driven by freshwater river flow from the north and west, and tidal seawater from the east and south. This results in a variation of salinity in the Lake, from freshwater in the north, brackish waters in the center and south, and full saline waters to the east around the islands and outer channel. The boundaries between these zones shift throughout the year, driven by monsoonal rains and seasonal winds.

During the 1990s, extensive siltation in the Lake was limiting access to the sea, reducing tidal flushing and decreasing salinity to such an extent that biodiversity declined and invasive aquatic weeds proliferated. This had a highly negative impact on the Lake's habitat for wildlife and fishery resources. In 1992, it was included in the Montreux Record by Ramsar due to change in the ecological character. In 2000, CDA opened a new mouth to restore the lake ecosystem. This new opening increased salinities throughout the Lake, vastly improving water quality, recovering lost habitat for important species, enhancing fish resources, and controlling invasive species. Lake salinity and connectivity to the sea are now closely monitored to ensure that conditions do not return to those experienced prior to 2000. The lake was removed from the Montreux Record due to restoration of the lake ecosystem in 2002.

Gulf of Mexico Report Card

- DPSSIR framework
- Multinational effort



1. Conceptual framework | 2. Indicators | 3. Thresholds | 4. Calculate scores | 5. Communicate results

Chesapeake Bay (Chesapeake 2000 Agreement)

- Values to protect
  - *Fisheries (fish, oysters and crabs)*
  - *Recreation*
  - *Tourism*
- Threats
  - *Sewage*
  - *Urban and agricultural runoff*
  - *Overfishing*
  - *Loss of habitat*

Report card indicators elsewhere

Report Card	Indicators
Chesapeake Bay	**Pre 2012** = BIBI, PIBI, aquatic grasses, DO, Chlorophyll, water clarity, **Current** = BIBI, aquatic grasses, DO, chlorophyll, water clarity, TN, TP, Blue Crabs, Bay Anchovy
Chilika Lake	**Water Quality** = Chlorophyll, DO, water clarity, **Biodiversity** = Bird richness and abundance, dolphin abundance, benthic infauna diversity, **Fisheries** = total fish catch, fish diversity and fish size
Moreton Bay	**Bay** = **Rivers** =
Laguna de Bay	????

1. Conceptual framework

2. Indicators

3. Thresholds

4. Calculate scores

5. Communicate results

Chesapeake Bay Thresholds (can be seasonal and vary geographically)

Chlorophyll *a*: ≤2.8 to ≤20.9 μg L^{-1} [3]

Dissolved oxygen: ≥1.0 to ≥5.0 mg L^{-1} [4]

Water clarity: ≥0.65 to ≥2.0 m Secchi depth[3]

Bay grasses: Hectares[2]

Benthic community: ≥3 Benthic IBI[5]

Phytoplankton: ≥3 Phytoplankton IBI[6]