

A proven process for developing Ecosystem Health Report Cards



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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	CCC0000		4/29/09	9.00
DNR	CCC0000		4/29/09	9.50
DNR	CCC0000		4/29/09	9.70
DNR	CCC0000		5/28/09	9.90
DNR	CCC0000		5/28/09	9.00
DNR	CCC0000		5/28/09	9.00
naa	ccccccc		6/18/09	9.00

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**

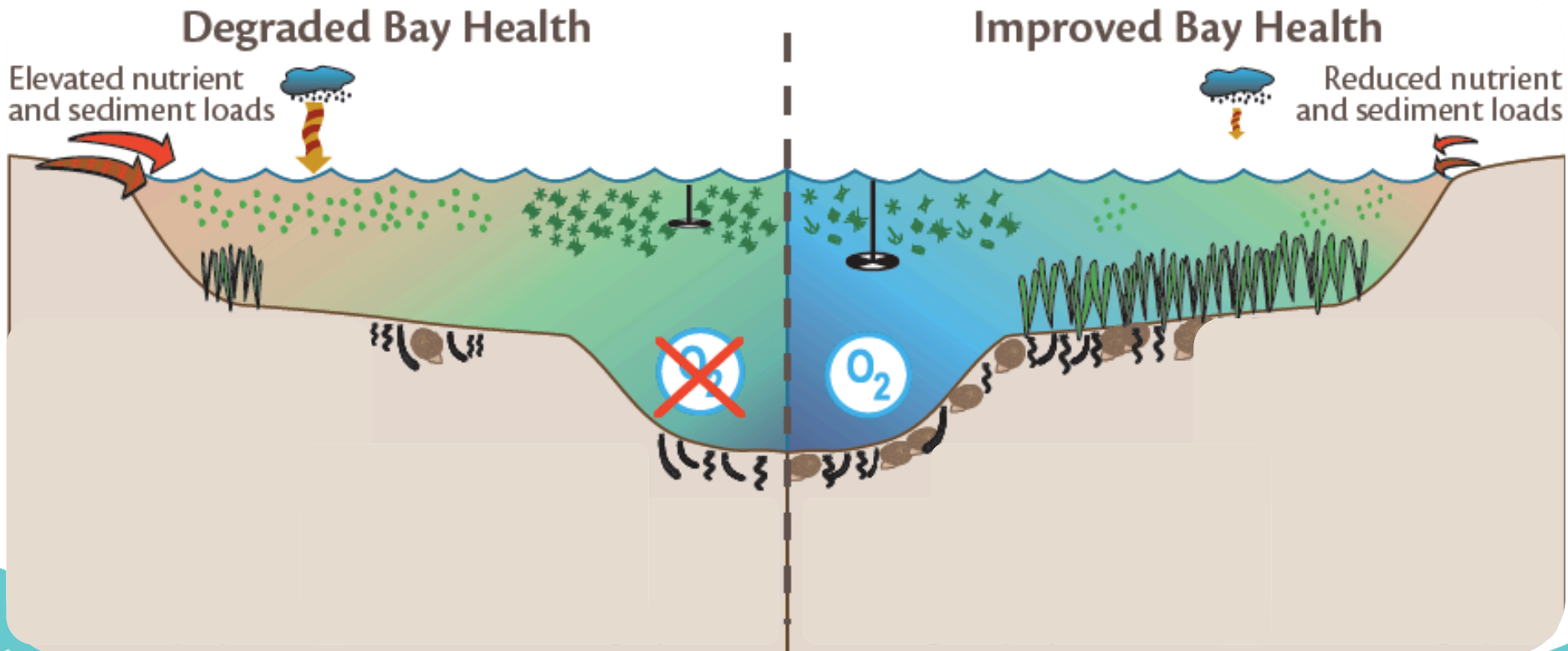
2.
Indicators

3.
Thresholds

4.
Calculate
scores

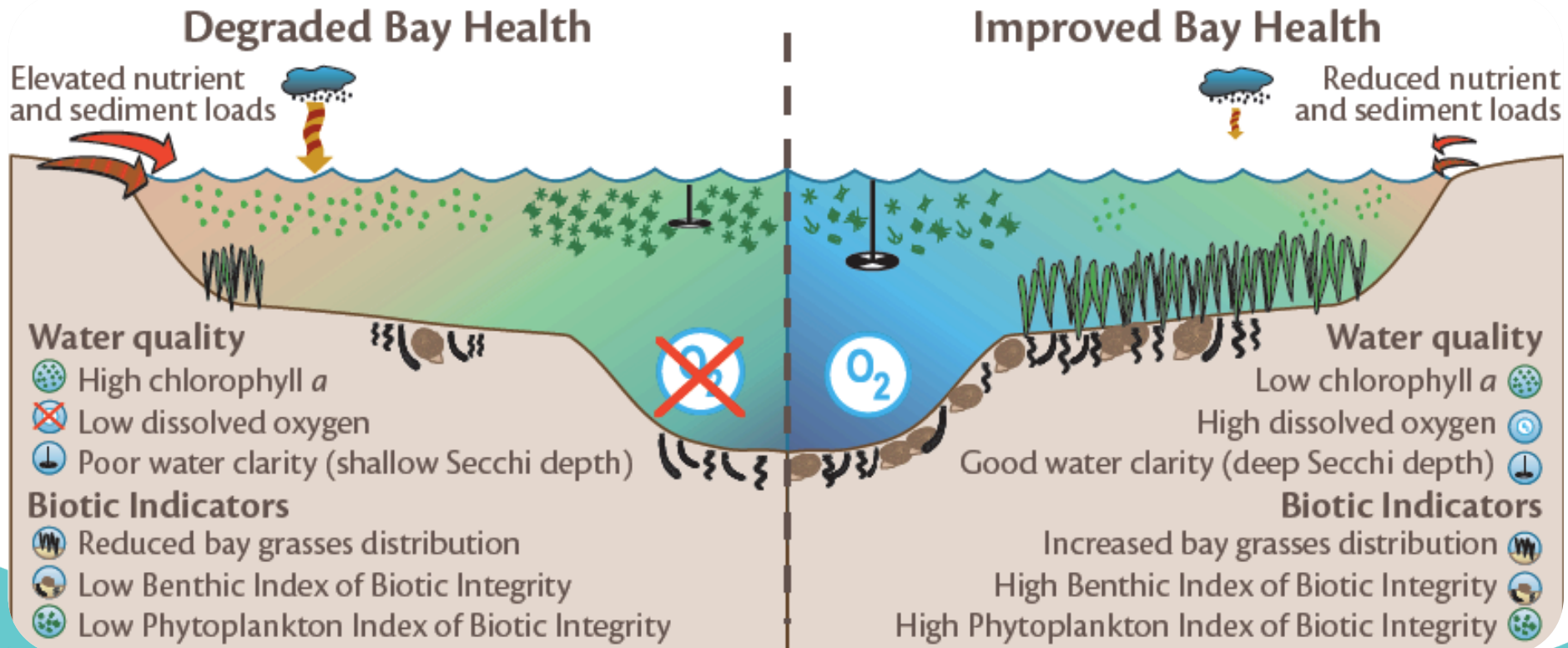
5.
Communicate
results

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





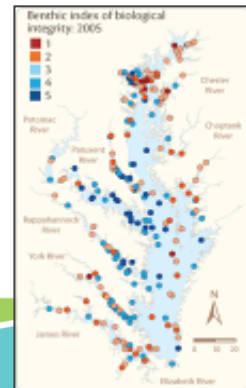
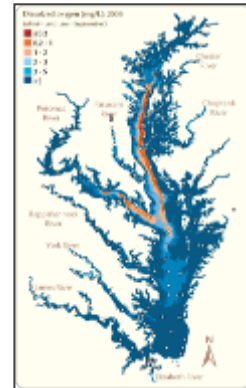
The method of assigning thresholds for each indicator can be based on either, or a combination, of the following:

- 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



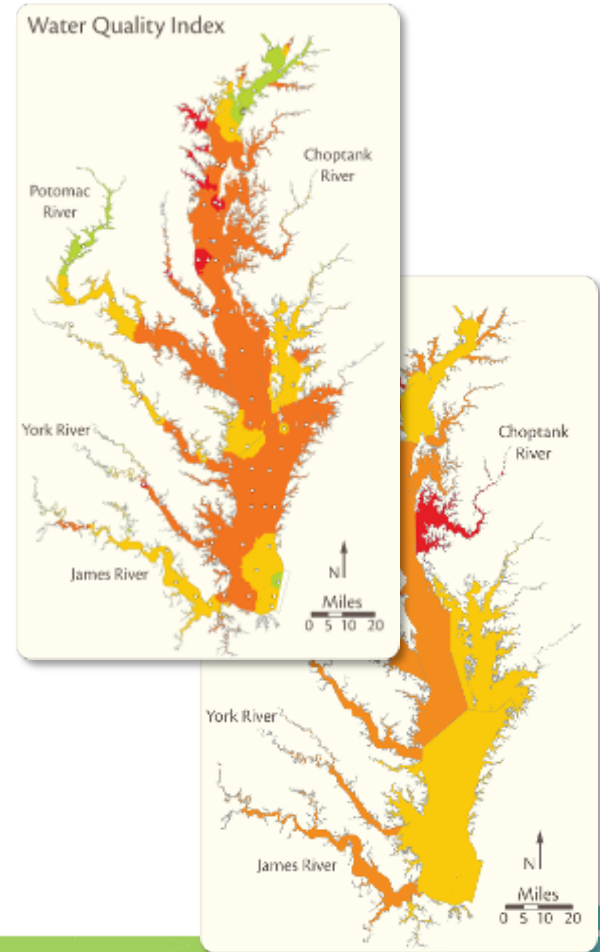
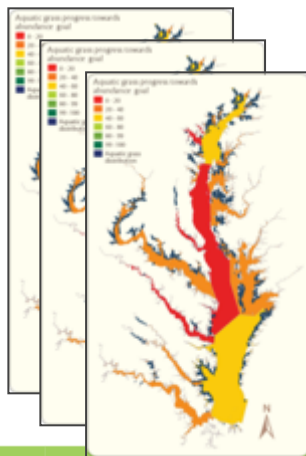
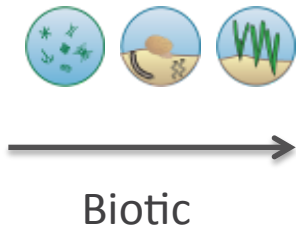
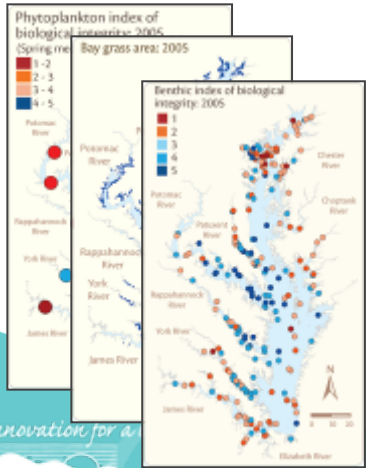
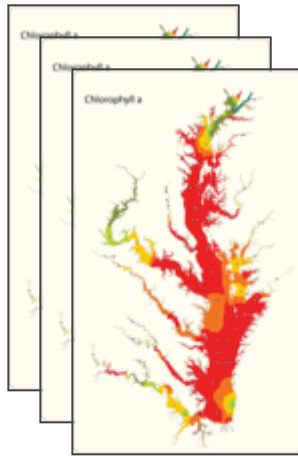
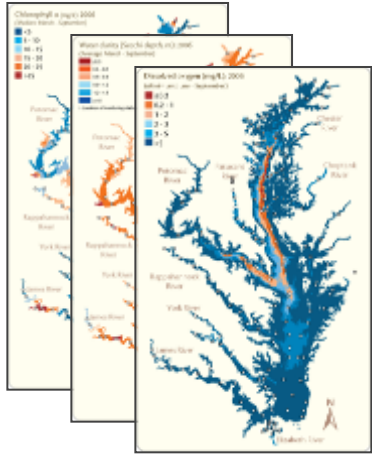
Score Calculation Methods

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.

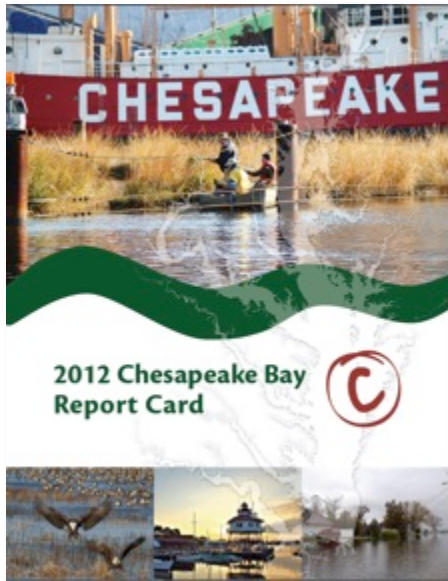
1. Conceptual framework

2. Indicators

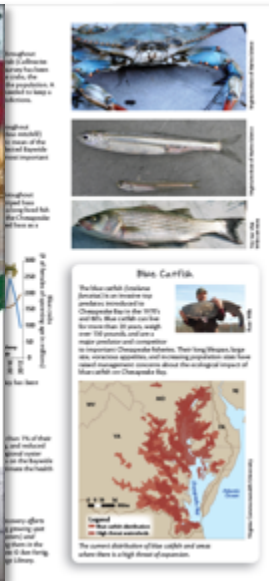
3. Thresholds

4. Calculate scores

5. Communicate results



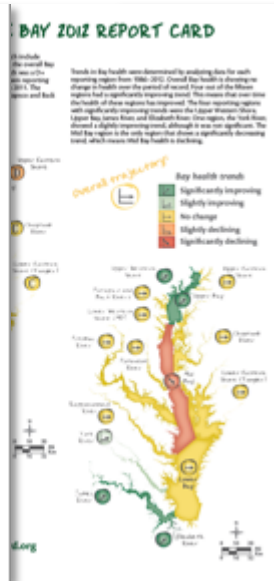
Cover



Values and threats



Indicators and methods



Scores/Grades



Trends



Credits

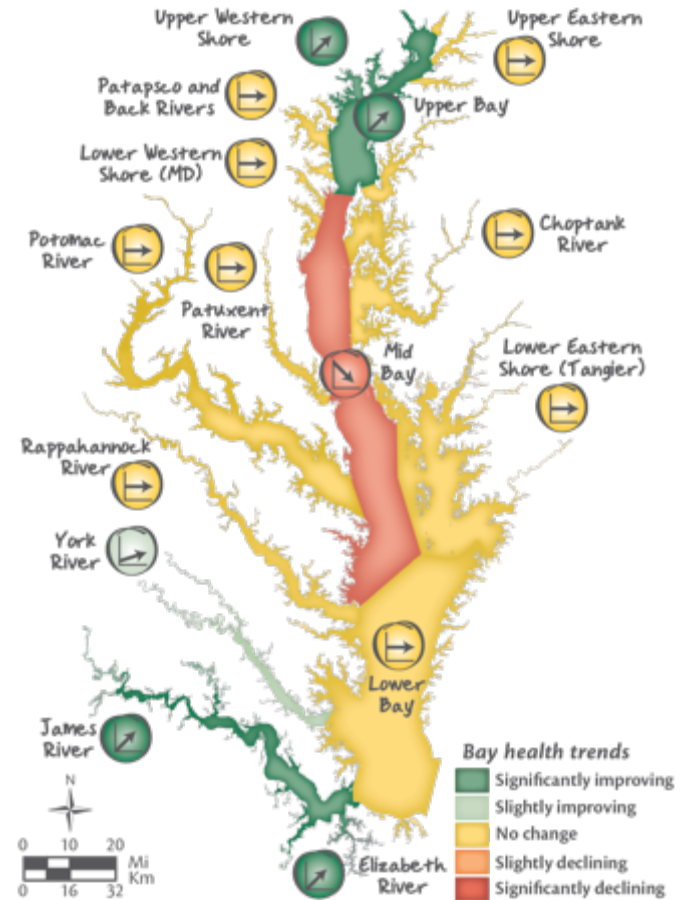
1. Conceptual framework
2. Indicators
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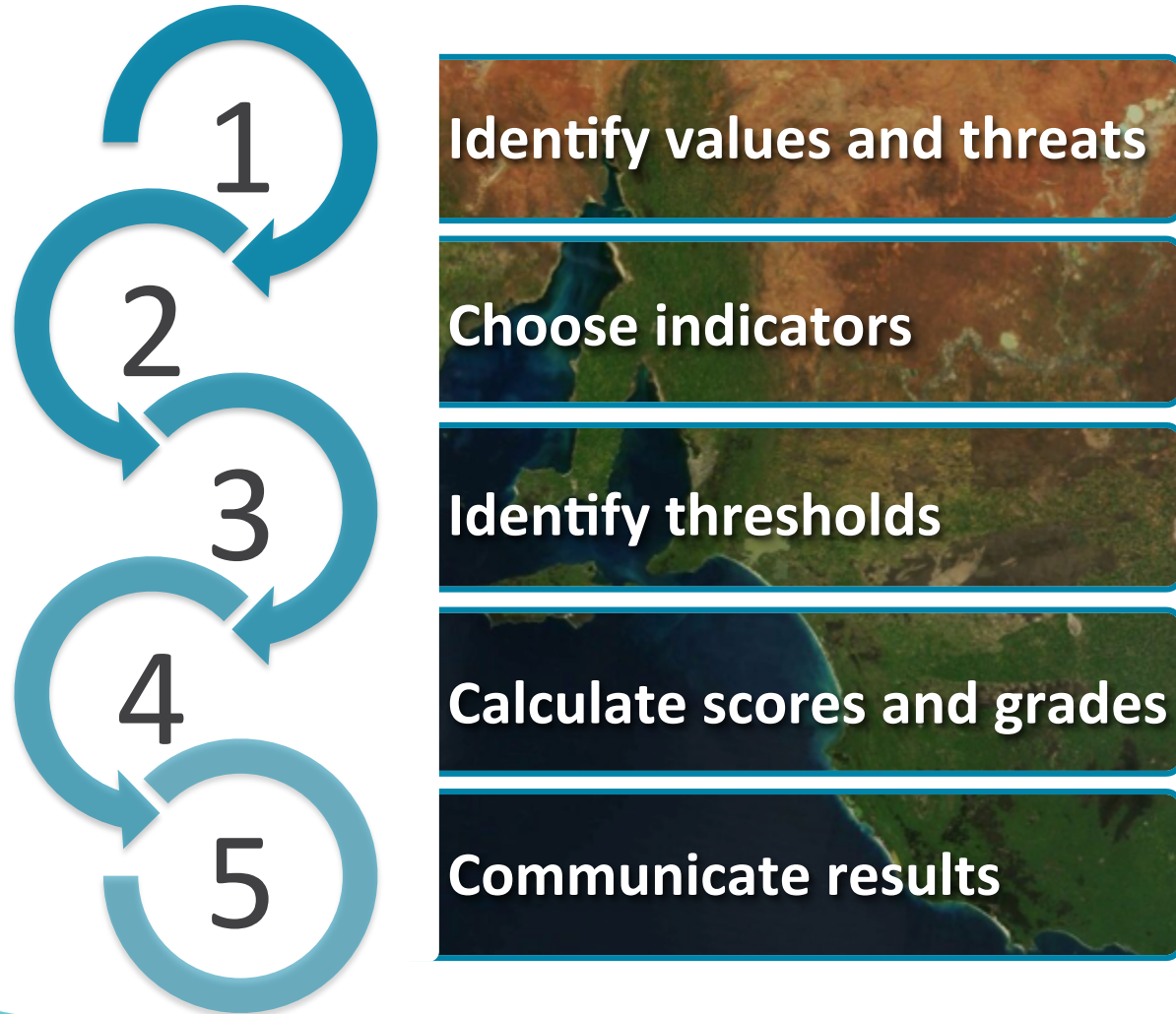
Keep evolving

Chesapeake Bay:

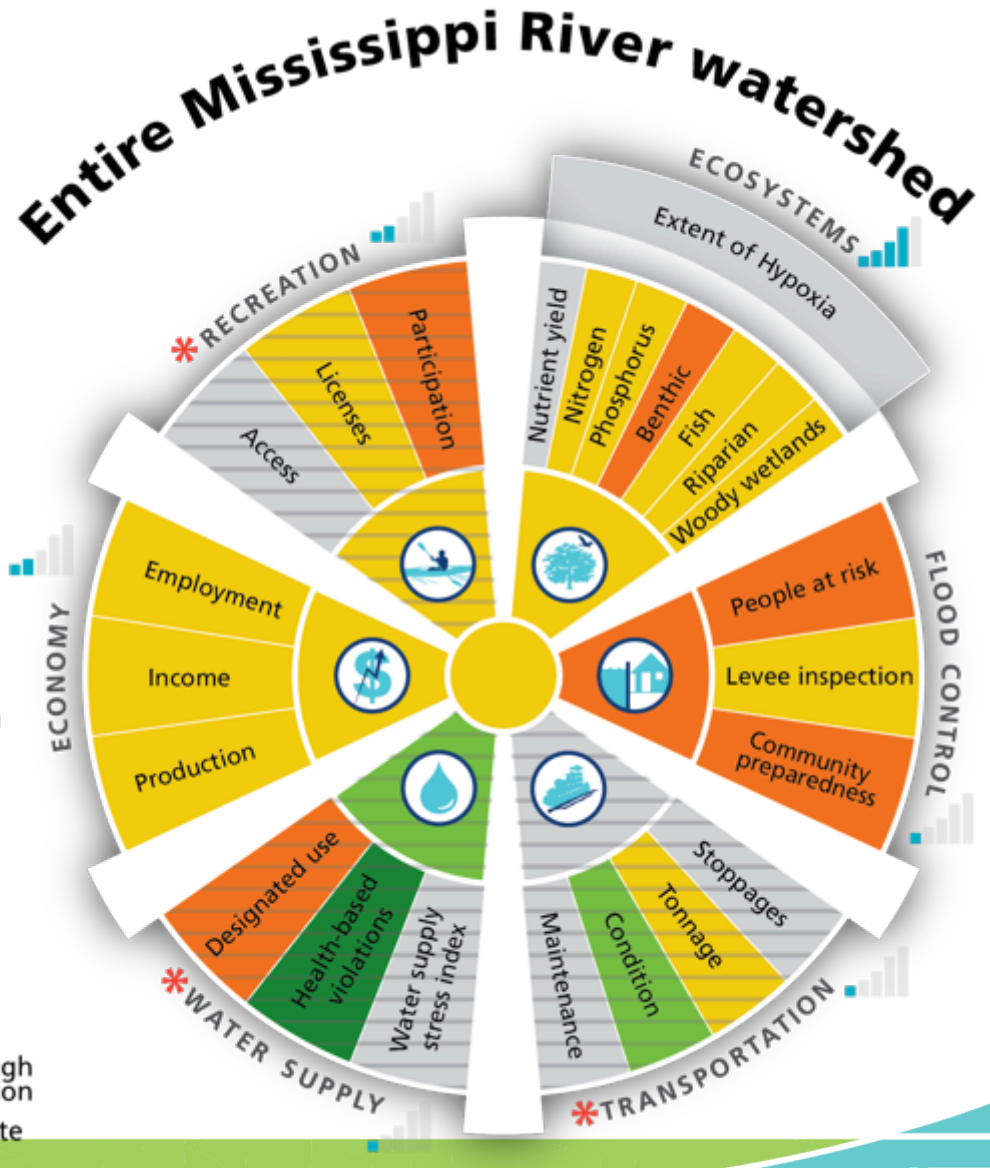
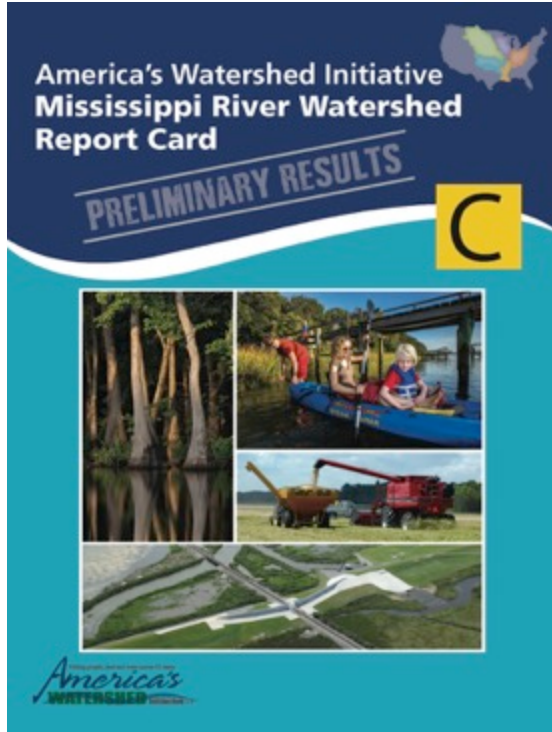
- has new indicators
- is now reporting trends
- Includes flow weighted scores



In summary:



Mississippi River Watershed Report Card



Scoring system

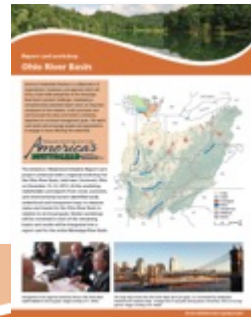


- Not enough information
- Incomplete analysis



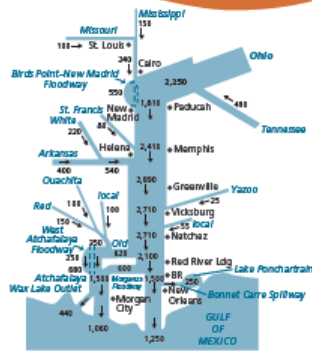
Mississippi River Report Card

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.

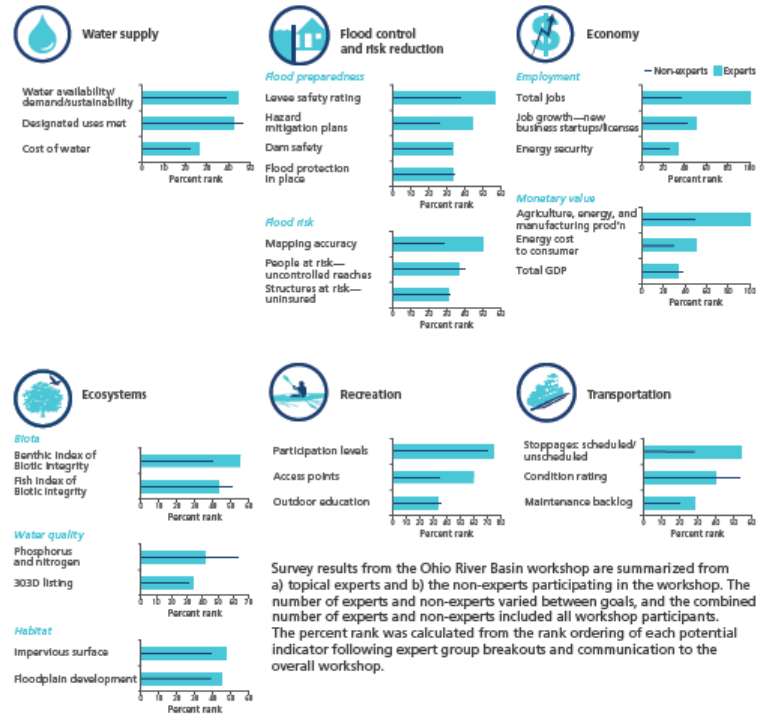
- Ohio Basin features**
- Locks and dams
 - Shipping/navigation
 - Power plants
 - Reservoir tourism
 - Riverboat
 - Corn belt
 - Soy farming
 - Forested areas
 - Recreation
 - Water supply
 - Biodiversity
 - Animal feed lots
 - Cattle grazing
- Ohio Basin issues and threats**
- Aging infrastructure
 - Combined sewer overflows
 - Habitat loss
 - Economic disparity
 - Stormwater
 - Flooding
 - Surface coal mining
 - Mountaintop mining
 - Hydraulic fracturing
 - Transportation corridors
 - Harmful algal blooms
 - Nutrients



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

Potential indicators for the Ohio River Basin

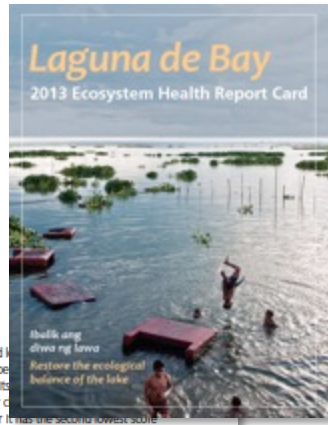
America's Watershed Report Card is designed to report on the status of achieving six broad goals developed at the America's Watershed Summit in September 2012. The goals were developed to reflect the things that people value in the watershed. Potential indicators for each goal were determined at the 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) typical 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 provides examples from what was generated at the workshop.

Laguna De Bay Report Card



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.

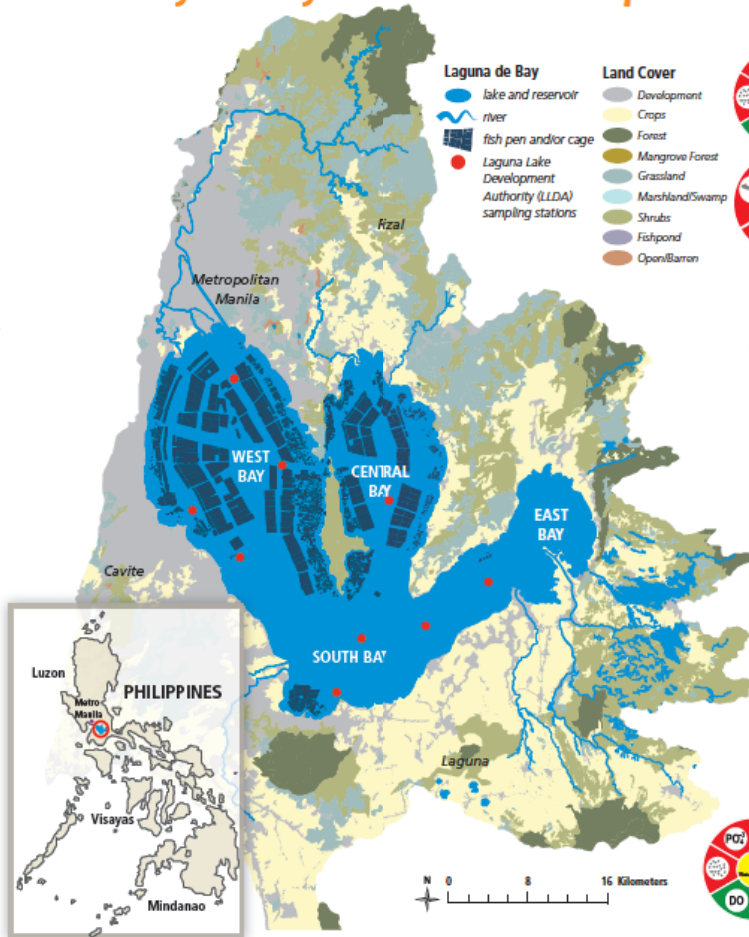
The Lake received an F in Fisheries (48%), with 53%, 68%, and 22% scores in fish native species composition, zooplankton ratio, and catch per unit effort (CPUE), respectively. Invasive fish species and competition among fisherfolk contributed to the low scores.

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 lowest water quality score. It is the most heavily developed and most populated. For 2013, it is within DENR's guideline for class C waters in DO, BOD, nitrate, and total coliforms at 98%. However, it has the lowest score in phosphates at 0%. It also has the lowest score 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 quality 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 down 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.

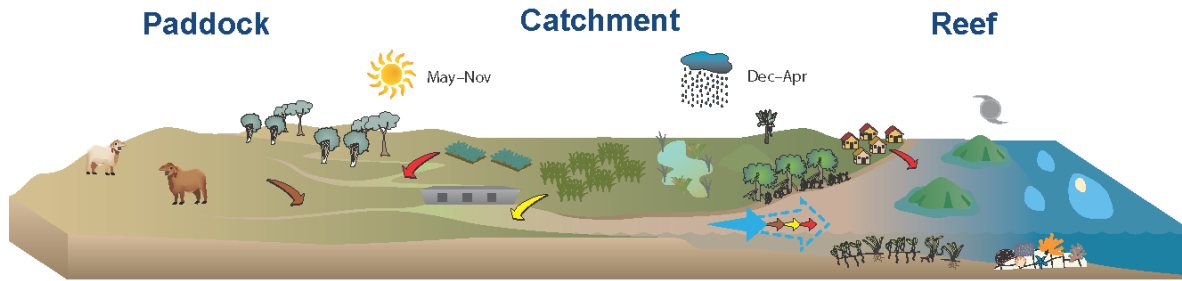
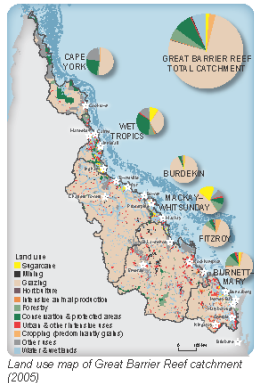
SOUTH BAY



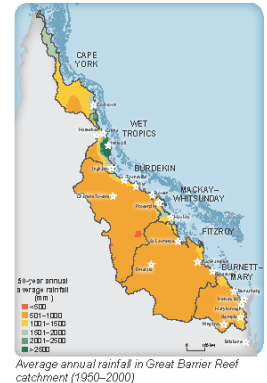
The South Bay has the second highest score in water quality at 77%, with 100% in nitrates, DO, BOD, and total coliforms. Like all the bays, it has a 0% in chlorophyll a and an F in phosphates at 63%. It had the second lowest score in fisheries, 43%, with the lowest score in native fish species composition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

Great Barrier Reef Report Card

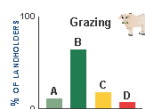
Evolution of report cards to include pressure and response indicators



Great Barrier Reef-wide Paddock to Reef conceptual diagram
 The Great Barrier Reef catchments are largely rural and dominated by summer monsoonal rains and occasional cyclones delivering sediments, nutrients, and pesticides to the inshore and sometimes offshore portions of the reef in pulsed flows, which can be affected by water reservoirs and dams. Grazing is the largest single land use, and sugarcane, horticulture, and cropping make up other agricultural land uses. Small urban centres are located on the coastal strip. Habitats include wetlands, reef, seagrass, and mangrove habitats, and continental and coral islands are present.

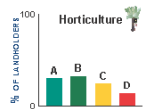


Land practice



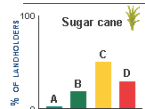
Grazing
 Land condition is influenced by a range of factors including climate, land types, and management practices.

Seventy-five percent of graziers in the Burdekin and Fitzroy regions had properties in A- or B-class land condition which represented 59% of the grazing land area, while 25% of graziers had properties in C- or D-class land condition which represented 41% of the grazing land area.



Horticulture
 The adoption of improved management practices for horticulture and sugar cane is presented using the following framework:
 A - Cutting-edge practice
 B - Current best practice
 C - Common practice
 D - Old or unacceptable practices

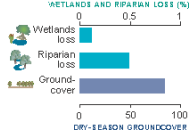
Cutting-edge or best management practices (A or B) have been adopted by 62% of horticultural producers. Practices considered common practice or unacceptable by industry or community standards (C or D) have been used by 38% of horticultural producers.



Sugar cane
 Cutting-edge or best management practices (A or B) have been adopted by 20% of sugar cane growers. Practices considered common practice (C) have been used by 50% of sugar cane growers, while practices considered unacceptable by industry or

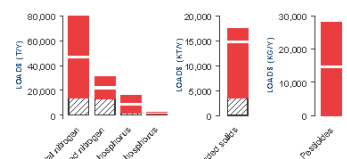
community standards (D) have been used by 30% of sugar cane growers.
 Land condition is ... Lorem ipsum dolor sit amet, consectetur adipiscing elit. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Lorem ipsum dolor sit amet, consectetur adipiscing elit.

Catchment indicators



Wetland loss between 2001-2005 was -0.1% of the total wetland area (720,000ha), although wetland loss prior to that had been extensive.
 Riparian vegetation (streamside vegetation within 50m of the stream) is extensive (6 million ha), and the loss between 2004-2008 has been significant (0.5%).
 Dry season groundcover for grazing lands was high (84%) in 2009, likely due to high rainfall, well above the 50% target.

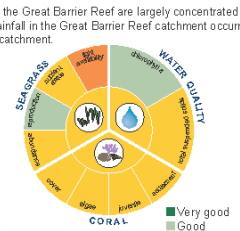
Catchment loads



The total pollutant load to the Great Barrier Reef is largely due to anthropogenic (human-induced) activities, although natural nutrient and sediment loads do occur. Annual sediment loads were estimated at 3 million tonnes due to natural processes, but a total of 17 million tonnes were delivered to the reef, largely from grazing lands in the Burdekin (4.7 million tonnes) and Fitzroy (4.1 million tonnes) regions. Fertilised agricultural lands are a key source of nutrient runoff, particularly of various types of nitrogen, with 31,000 tonnes of dissolved nitrogen leaving the Great Barrier Reef catchment each year. All pesticides are of human origin, and the highest annual loads of pesticides entering the Great Barrier Reef (~28,000kg per year) were from the Mackay-Whitsunday and Wet Tropics regions (~10,000kg each per year).

Marine indicators

Seagrass: Seagrass abundance in intertidal regions was highly variable and has declined over the last 5-10 years associated with reduced light availability and excess nutrients. Many seagrass meadows have low or variable numbers of reproductive structures, indicating limited resilience to disturbance.

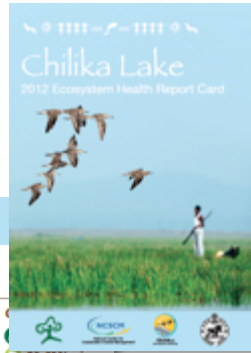


Coral: Most inshore reefs were in good or moderate condition, based on coral cover, macroalgal abundance, settlement of larval corals, and numbers of juvenile corals. Most inshore reefs had either high or increasing coral cover, however the Burdekin region corals were mostly in poor condition.

Water quality: Inshore waters often contain elevated concentrations of chlorophyll a (a measure of nutrient status) and highly elevated concentrations of total suspended sediments.

Pesticides: Monitoring during flood events detected pesticide concentrations above the water quality guidelines over 25km from the coast. Pesticide monitoring shows Lorem ipsum dolor sit amet, consectetur adipiscing elit.

Chilika Lake Report Card



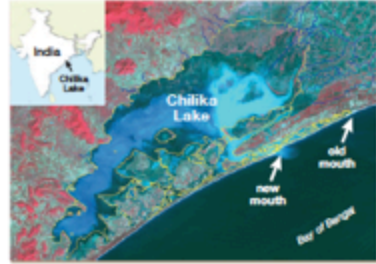
Calculating the ecosystem grade for Chilika Lake

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.

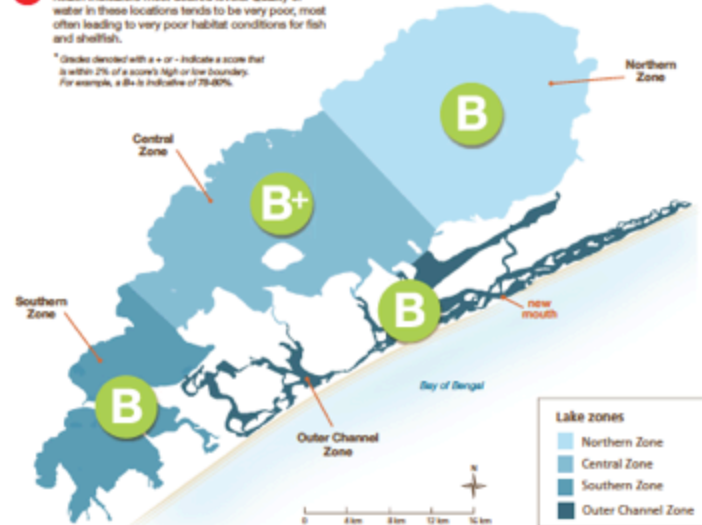
What do the grades mean? *

- A** 90-100%. 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 + 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 the area of invasive species, as well as improve water quality overall.



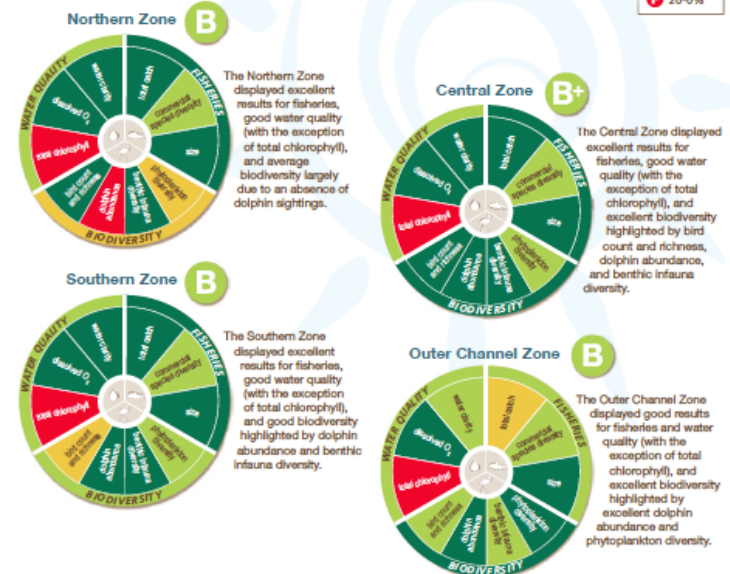
Lake zones	
Light Blue	Northern Zone
Medium Blue	Central Zone
Dark Blue	Southern Zone
Very Dark Blue	Outer Channel Zone

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 (P), 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 70% (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.

- A** 80-100%
- B** 60-80%
- C** 40-60%
- D** 20-40%
- F** 0-20%



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, CDIA opened a new mouth to restore the lake ecosystems. 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

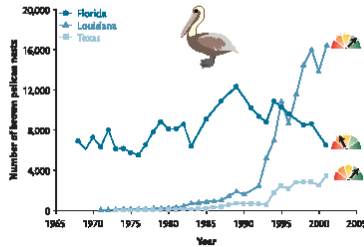
- DPSSIR framework
- Multinational effort



Example component: Birds

Report card prototype

Example component: Seagrass ecosystems



Brown Pelican populations over time in Florida, Louisiana, and Texas (John et al., 2004).

Gulf of Mexico birds
The Gulf of Mexico is a major flyway for migratory birds that provides essential stopover habitat along three migratory pathways. The Gulf has large, undisturbed, and diverse areas of coastal habitats that provide breeding and wintering habitat for shore birds, marsh birds, frigate birds, and waterfowl. These habitats support internationally significant populations of birds including Brown Pelican, American Flamingo, Redhead, Whooping Crane, Sooty Tern, and Snowy Plover. Representative bird species associated with different habitats can be effective indicators of Gulf ecosystem health.

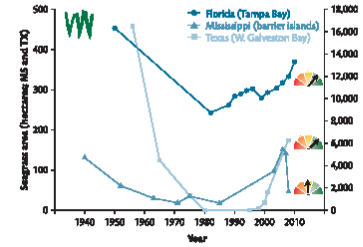
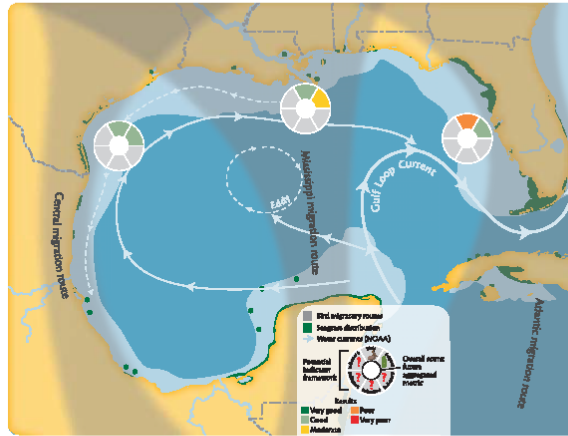
Brown Pelican trends
The Brown Pelican is an iconic symbol of the Gulf of Mexico and important indicator of the effects of human activities on Gulf ecosystem health. An estimated 25,000 Brown Pelicans nested along the Gulf Coast in the early 20th Century but populations began declining in the 1930s because of human disturbances. By the end of the 1960s, direct and indirect effects of DDT and dieldrin had resulted in catastrophic population declines, with Florida having the only remaining significant breeding population in the Gulf of Mexico.

With the listing as an endangered species (1970), the ban on DDT (1972), and effective management, the number of breeding pairs in the northern Gulf increased to 20,000–25,000 by the end of the 1990s. Brown Pelicans were removed from the endangered species list in Alabama and Florida in 1985, and in Mississippi and Texas in 2009. However, Brown Pelicans continue to be adversely impacted by human activities which have resulted in the decline of the Florida population since 1989 to levels approaching those seen in the 1960s, although the specific causes are presently unknown. The fully developed Report Card will provide indicators of both the ecological health of the Brown Pelican and the human activities and stressors affecting them. This Brown Pelican example illustrates the importance of the Gulf of Mexico Report Card in characterizing the causal links between human activities and ecological health and thereby informing decisions to achieve sustainability.

Birds as Indicators
Population patterns of bird species can be effective indicators of environmental

health because they utilize a wide range of habitats within the Gulf of Mexico. With input from the avian science community, we envision developing indicators for key species representing coastal water birds, waterfowl, marsh, beach, shore, wetland, and pelagic sea birds. These key species will serve as indicators for health of their particular habitats by reflecting the pressures and stressors acting upon them, such as coastal development and habitat alteration, human disturbance of nests and colonies, food availability, hunting, and contaminants. Metrics describing the health of bird populations will expand upon those described here for the Brown Pelican, and new indicators will be developed. Finally, a key element of the Gulf of Mexico Report Card framework is to develop new integrative metrics that characterize the pressures and stressors impacting on birds and their habitats.

Contaminants, in particular DDT and reduced populations prior to the chemical being banned in the USA in 1972. Brown Pelican populations rebounded, but habitat alterations continue to be a threat to the population.

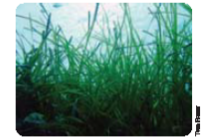


Seagrass area over time in Mississippi, Texas, and Florida (Hoadley et al., 2002; Carter et al., 2003; W. Pulich pers. comm.).

Gulf of Mexico seagrass ecosystems
Seagrass ecosystems are a dominant habitat in shallow waters throughout the Gulf of Mexico and are essential to its health and integrity. Expansive seagrass meadows provide an important refuge and foraging habitat for many species, supporting recreational and commercial fisheries. Unfortunately, seagrass ecosystems are often threatened by increased nutrient inputs and other stressors, e.g., dredging, coastal development. Thus the health of seagrass ecosystems provides an important indicator of the health of the Gulf of Mexico at both local and Gulf-wide scales.

Seagrass trends
Progressive deterioration of seagrass beds has occurred around the Gulf but notable recoveries exist in some areas (illustrated).

Urban development and agriculture runoff lead to turbidity and nutrient inputs into shallow coastal waters. Excess seagrass species are adversely affected by reduced light, reducing seagrass area.



rapidly urbanized watershed post World War II. The critical stressor was massive nitrogen inputs from sewage discharges into Tampa Bay but beginning in the 1990s, major improvements to sewage treatment plants reduced nitrogen inputs by 90%, leading to clearer water and ongoing recovery of seagrasses. At present, nitrogen inputs come from stormwater runoff and air pollution from power plants and automobiles. The Tampa Bay National Estuary Program was established in 1991 to further improve seagrass ecosystem health, focusing not only on nitrogen inputs but also reducing toxic pollutants, restoring and protecting seagrass habitats, and reducing dredging and other physical stressors.

Seagrass ecosystems as indicators
Many features of seagrass ecosystems can serve as indicators in addition to areal coverage. Seagrass species composition can be an indicator, e.g., comparing a single-species meadow like turbot grass to a mixture that includes other Gulf of Mexico species. Animals using seagrasses as a habitat (e.g., shellfish, reef fish) can food source (e.g., manatees, waterfowl) can be indicators. Because seagrasses are closely linked to water quality, particularly the underwater light regime, water quality metrics like chlorophyll and turbidity can be appropriate indicators. Seagrass ecosystems provide important services that also could be indicators, including primary and secondary production, carbon and nutrient sequestration, erosion protection, and recreational fishing.

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*

1. Conceptual framework
2. **Indicators**
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Report card indicators elsewhere

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

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Chesapeake Bay Thresholds (can be seasonal and vary geographically)



Chlorophyll *a*: ≤ 2.8 to $\leq 20.9 \mu\text{g L}^{-1}$ ⁽³⁾



Dissolved oxygen: ≥ 1.0 to $\geq 5.0 \text{ mg L}^{-1}$ ⁽⁴⁾



Water clarity: ≥ 0.65 to $\geq 2.0 \text{ m Secchi depth}$ ⁽³⁾



Bay grasses: Hectares ⁽²⁾



Benthic community: ≥ 3 Benthic IBI ⁽⁵⁾



Phytoplankton: ≥ 3 Phytoplankton IBI ⁽⁶⁾