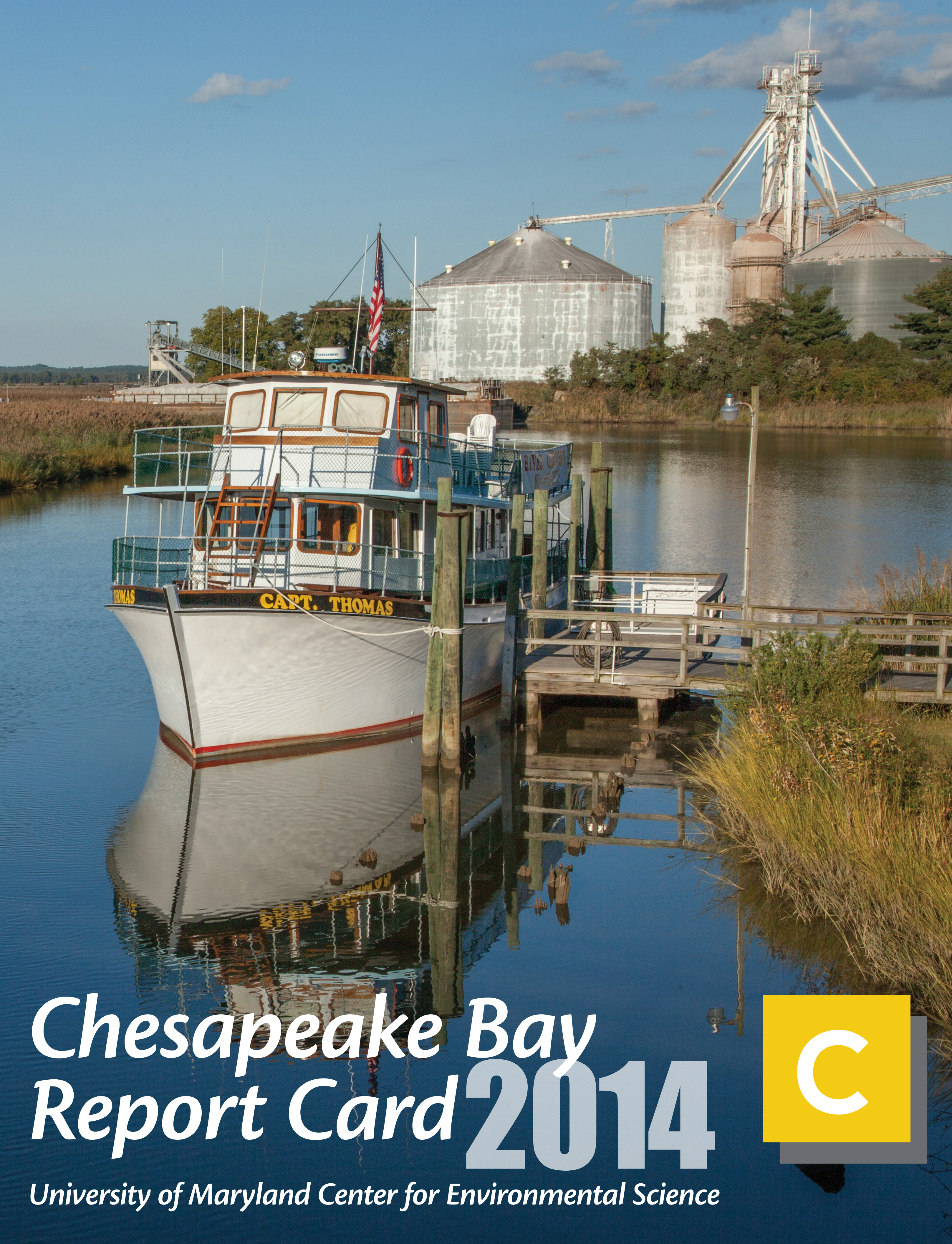


Chesapeake Bay Report Card 2014

C

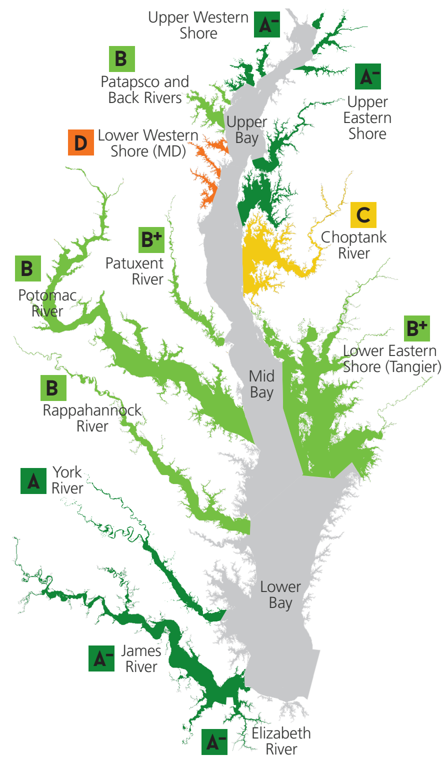
University of Maryland Center for Environmental Science

Coastal wetlands will become less resilient in the near future

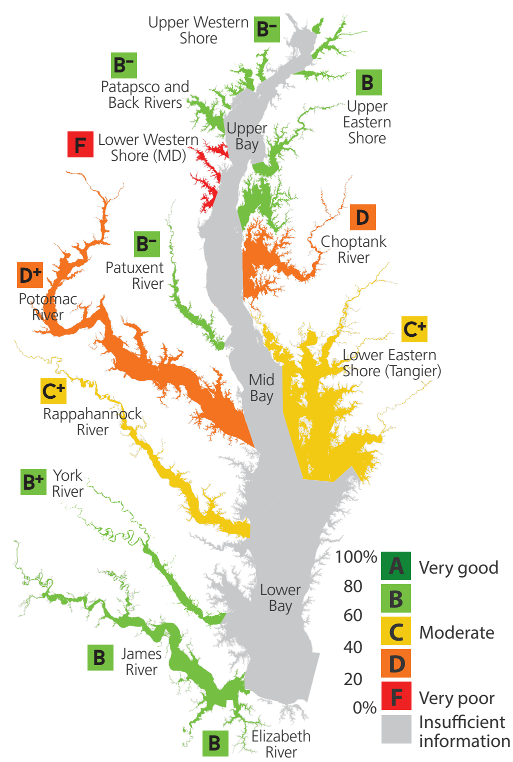
When coastal wetlands are protected from erosion, have adequate sediment supply, and have access to landward migration pathways, they will have high resilience to climate change impacts. To evaluate coastal wetland resiliency to climate change, we examined one aspect of climate change: sea level rise. 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.

Current coastal wetlands resiliency

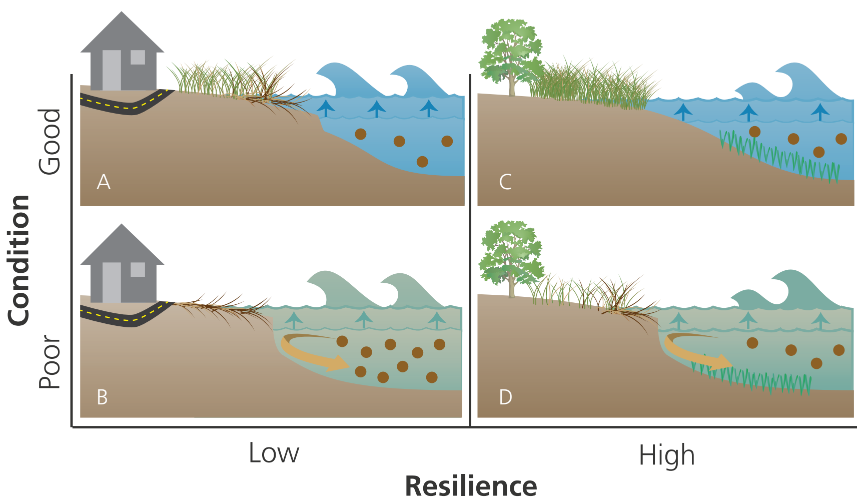


Future coastal wetlands resiliency



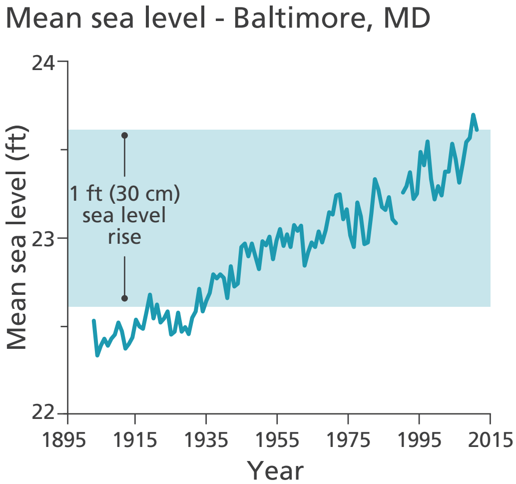
Coastal wetlands resilience under current sea level rise rates (top) and future sea level rise rates (bottom).

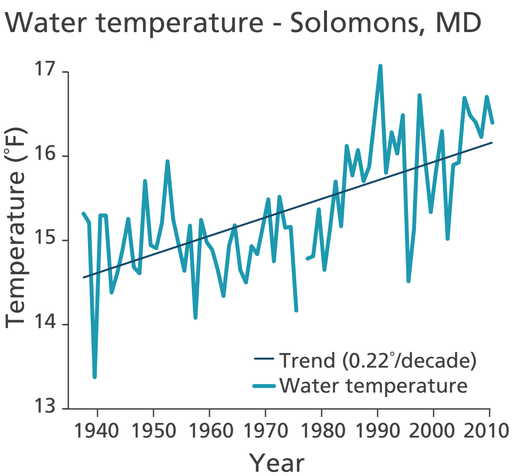
Resilience of poor and good coastal wetlands to climate change

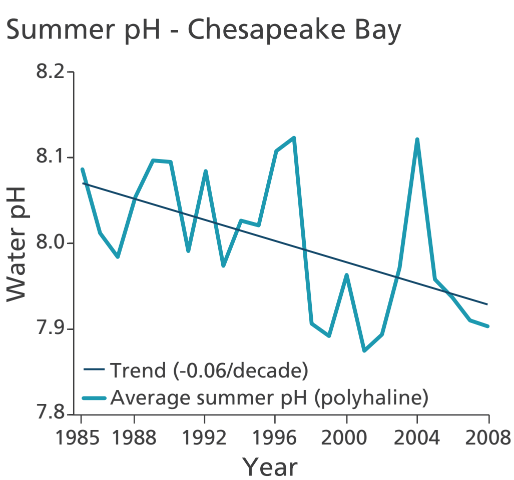


A combination of condition (health) and resilience determines the fate of coastal wetlands in Chesapeake Bay in the face of sea level rise. Coastal wetlands in good condition can have low resilience to climate change impacts, if there are no migration corridors available and no wave dampening due to 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.

Climate change and Chesapeake Bay resilience







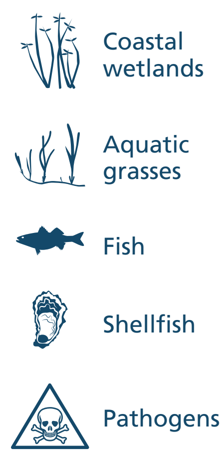
Climate change is already occurring in Chesapeake Bay with increasing sea level rise (top), increasing water temperatures (middle), and decreasing pH during the summer (bottom).

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.



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

Overall improvement but still poor to moderate conditions

Bay health trends

- Significantly improving
- Slightly improving
- No change
- Slightly declining
- Significantly declining

2014 Chesapeake Bay Health: C

C Upper Western Shore

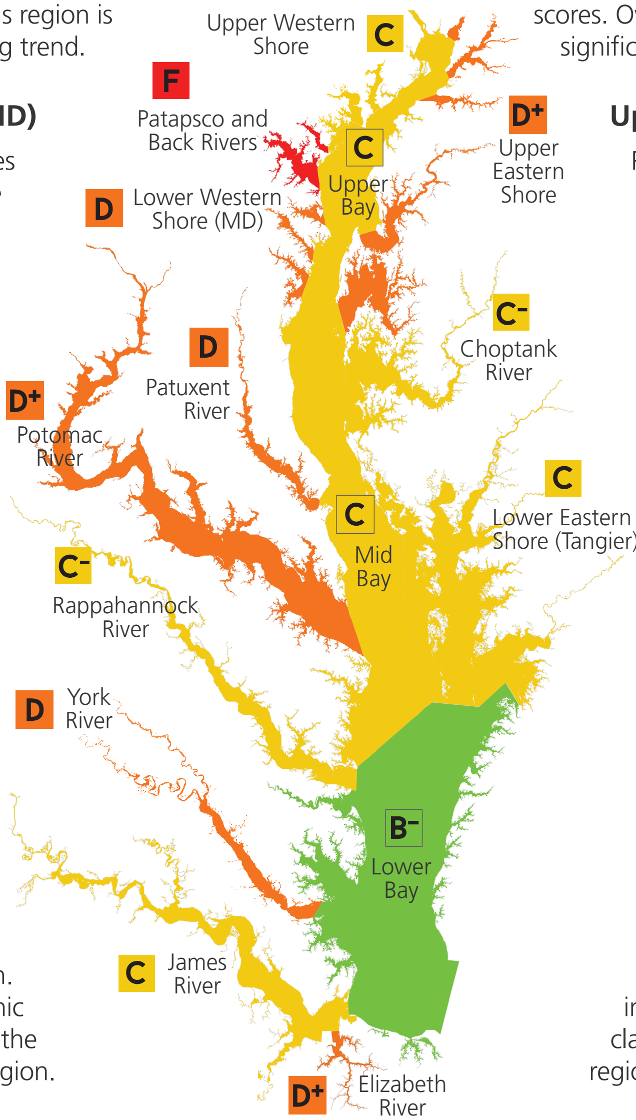
Moderate ecosystem health. Improved the most in water clarity and chlorophyll *a*, and had a perfect dissolved oxygen score. Over time this region is showing a significantly improving trend.

F Patapsco and Back Rivers

Very poor ecosystem health. Overall health declined from the previous year and this continues to be the lowest ranked region. However, overall this region is showing a significantly improving trend.

Upper Bay C

Moderate ecosystem health. This area slightly improved with gains in water clarity and total phosphorus scores. Over time this region is showing a significantly improving trend.



D Lower Western Shore (MD)

Poor ecosystem health. Failing scores for five out of seven indicators are leading to continued poor health. Improvements in total phosphorus were offset by declines in benthic community.

D Patuxent River

Poor ecosystem health. This region remains steady. While some indicators improved, others declined. This region had one of the lowest water clarity scores.

D+ Potomac River

Poor ecosystem health. This region's score slightly decreased from the previous year. Improvements in dissolved oxygen and total phosphorus were balanced by declines in chlorophyll *a*.

C- Rappahannock River

Moderately poor ecosystem health. Large improvements in benthic community and aquatic grasses, with the highest aquatic grass score of any region.

Upper Eastern Shore D+

Poor ecosystem health. Improvements in five out of seven indicators and the overall score increased the most out of any region. Unfortunately, overall this region is still showing a significantly declining trend.

Choptank River C-

Moderately poor ecosystem health. A large decrease in the benthic community score was offset by improved total phosphorus and aquatic grass scores.

Lower Eastern Shore (Tangier) C

Moderate ecosystem health. There were improvements in all indicators except benthic community. Over time this region is showing a significantly improving trend.

Mid Bay C

Moderate ecosystem health. Most indicator scores increased, with water clarity scoring the highest of all regions. This region is showing a slightly declining trend.

D York River

Poor ecosystem health. Declines in total nitrogen were balanced by increases in other indicators. Over time this region is showing a slightly improving trend.

Lower Bay B-

Moderately good ecosystem health. Continues to be the highest scoring region, especially for total nitrogen, total phosphorus, and benthic community. Aquatic grasses and dissolved oxygen also improved.

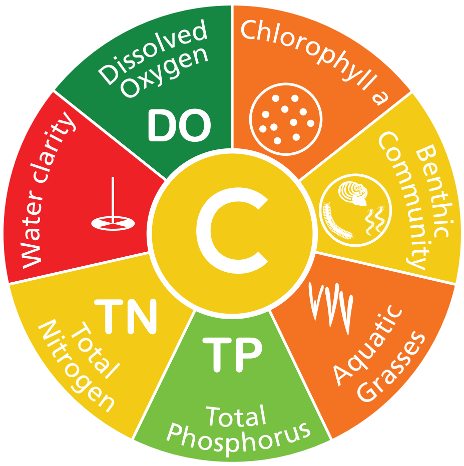
C James River

Moderate ecosystem health. Second highest ranked region with a perfect score in dissolved oxygen. Over time this region is showing a significantly improving trend.

Elizabeth River D+

Poor ecosystem health. Some indicators improved while others declined. There is no benthic community score for 2014. Over time this region is showing a significantly improving trend.

Strong improvements in 2014 Bay Health



Overall, Chesapeake Bay scored a 50%, a C, which is an improvement from the previous year's score of 45%. This is considered moderate health. All indicator scores improved or stayed the same except chlorophyll *a* which slightly declined. The highest scoring indicator continues to be dissolved oxygen (89%, an A), and the lowest scoring indicator was water clarity (15%, an F). Both total nitrogen and benthic community scored a 55%, a C+, or moderate. Chlorophyll *a* scored a 22%, a D-, and aquatic grasses scored a 31%, a D, both poor scores. Total phosphorus scored a 79%, a B+, or moderately good. Indicators with significantly declining trends are chlorophyll *a* and water clarity. Both total nitrogen and total phosphorus are showing significantly improving trends in the Bay.

Bay health scale

Indicators in the Chesapeake Bay Report Card

There are seven indicators that make up the Bay Health Index for the Chesapeake Bay report card. Each indicator is compared to scientifically derived thresholds or goals and scored to determine the overall grade. Each indicator is scored by reporting region, and then the reporting regions are weighted by area to come up with the overall Bay Health Index. There are 15 reporting regions that make up Chesapeake Bay. There are also three fisheries indicators that make up the Fisheries Index (see back page).

Chlorophyll *a* is used as a measure of phytoplankton (microalgae) biomass. High phytoplankton levels lead to reduced water clarity and decomposing phytoplankton result in reduced dissolved oxygen levels.

DO Dissolved oxygen is critical to the survival of Chesapeake Bay's aquatic life. The amount of dissolved oxygen needed before aquatic organisms are stressed, or even die, varies from species to species.

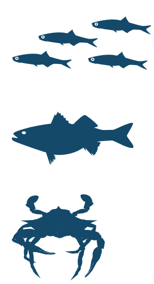
TP Total phosphorus is an indicator of excess phosphorus in the Bay. Too much phosphorus can lead to algae blooms, which cause poor dissolved oxygen conditions and stresses Bay organisms.

Water clarity is a measure of how much light penetrates though the water column. Water clarity plays an important role in determining aquatic grasses and phytoplankton distribution and abundance.

The Benthic Index of Biotic Integrity (BIBI) measures the condition of the benthic community living in or on the bottom areas of the Bay. These organisms are a key food source for fish species.

TN Total nitrogen is an indicator of excess nitrogen in the Bay. Too much nitrogen can lead to algae blooms, which cause poor dissolved oxygen conditions and stresses Bay organisms.

Aquatic grasses, or submerged aquatic vegetation, are one of the most important habitats in Chesapeake Bay. Aquatic grasses provide critical habitat to key species such as blue crab and striped bass, and can improve water clarity.



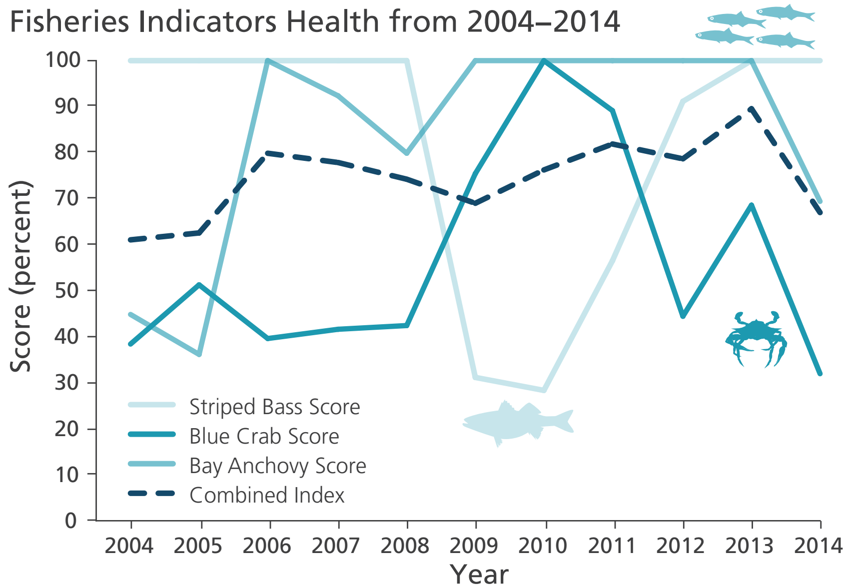
Bay anchovy are one of the most abundant schooling fishes in the Bay, providing an important food source for top predators. Striped bass, is a key top predator, and uses the Bay as an important spawning and nursery area. Blue crabs are both predator and prey in the Bay's food web and use aquatic grasses as habitat.

For more information, visit chesapeakebay.ecoreportcard.org

Key fish populations variable over time

Striped bass, bay anchovy, and blue crab are ecologically, economically, and socially important fish species in Chesapeake Bay. While the Fisheries Index is variable over time, it decreased from an 89% in 2013 to a 67% in 2014. This is a moderately good score, or a B.

The Index is an average of all three species scores. Striped bass held steady with a 100% score, an A+, while both blue crab and bay anchovy declined. Blue crab received the lowest score, 32%, a D, a poor score and bay anchovy received a 69%, a B, a moderately good score. Fisheries indicators can have large variation from year to year since these species move throughout the Bay and are highly managed.

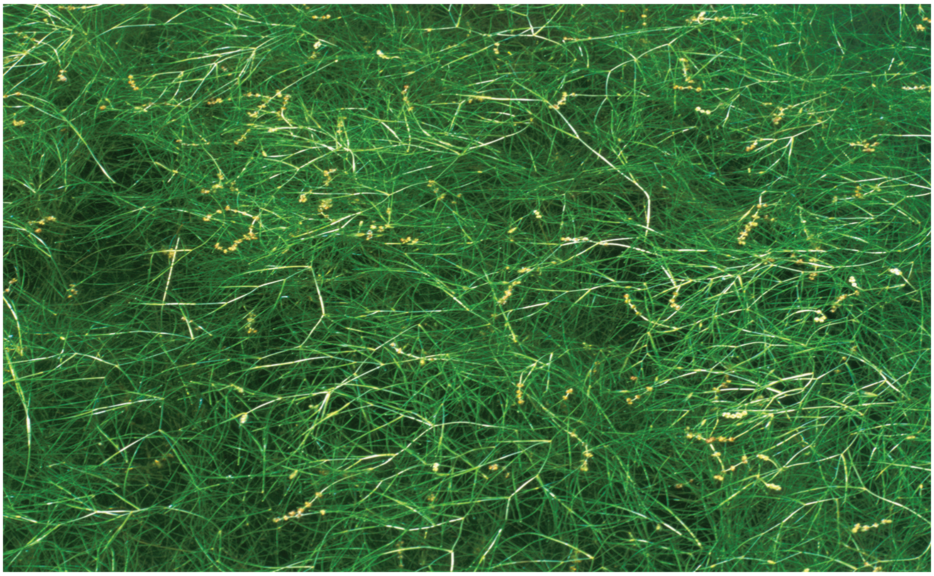


Fisheries indicators are variable over time, and in 2014, the Fisheries Index decreased.

Expansion of Ruppia *increases overall aquatic grass score*

In 2014, aquatic grasses scored a 31%, a D overall, which was an increase from the 2013 score of 24%, a D-. These are poor scores. All reporting regions had aquatic grass scores that improved or stayed the same. Regions with the largest improvements in aquatic grass scores were the Rappahannock River, Choptank River, Mid Bay, and Lower Eastern Shore. Aquatic grasses in these four regions improved by 10% or greater.

Scores improved due to an expansion of *Ruppia*, or widgeon grass, in salty waters of the Bay as well as new areas of *Ruppia* where there had not been grasses growing before. There were also some areas where *Zostera* (eelgrass) had recovered in highly salty waters.



Aquatic grasses improved throughout the Bay in 2014. Photo of Ruppia *by Adrian Jones.*

About the Chesapeake Bay Report Card

Report card produced and released in August 2015 by the Integration & Application Network, University of Maryland Center for Environmental Science. This report card provides a transparent, timely, and geographically detailed assessment of Chesapeake Bay. The data and methods underpinning this report card represent the collective effort of many individuals and organizations working within the Chesapeake Bay scientific and management community. The following organizations contributed significantly to the development of the report card: Chesapeake Bay Program, University of Maryland Center for Environmental Science, National Oceanic and Atmospheric Administration, Maryland Department of Natural Resources, Virginia Department of Environmental Quality, Virginia Institute of Marine Science, Versar Incorporated, U.S. Environmental Protection Agency, Maryland Department of the Environment, Interstate Commission on the Potomac River Basin, Old Dominion University, Morgan State University, and U.S. Geological Survey. Cover photo by Chesapeake Bay Program.

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