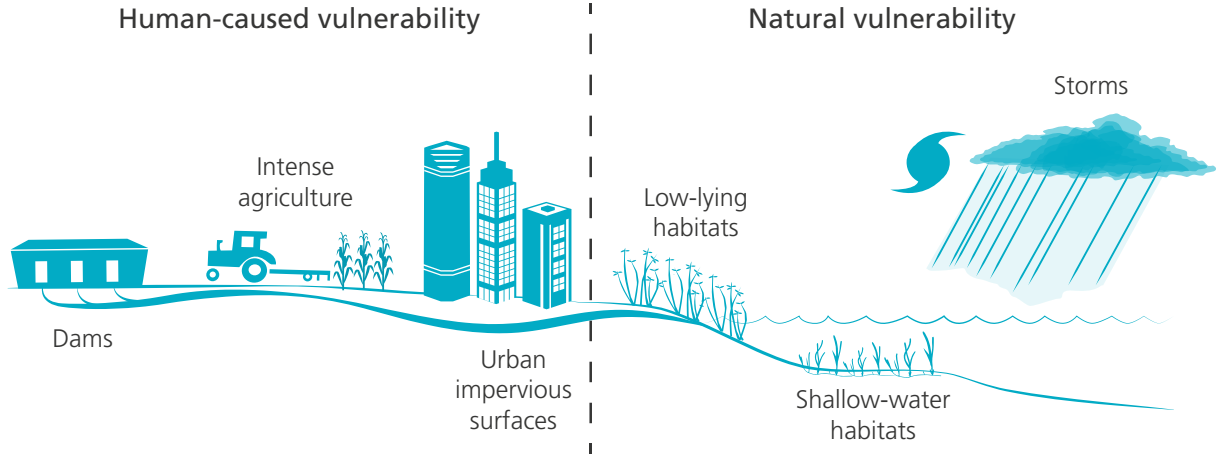


Chesapeake Bay
Report Card 2013



How will Chesapeake Bay respond to climate change?

Protection and restoration of the Chesapeake Bay must account for climate change impacts that we are experiencing now. These impacts include sea level rise, increasing water temperatures and rainfall, increasing storm frequency and intensity, changes in salinity, and ocean acidification (pH). We are currently developing a suite of indicators that will measure resilience of Chesapeake Bay to climate change. These indicators are coastal wetlands, submerged aquatic vegetation, fish, shellfish, and pathogens.

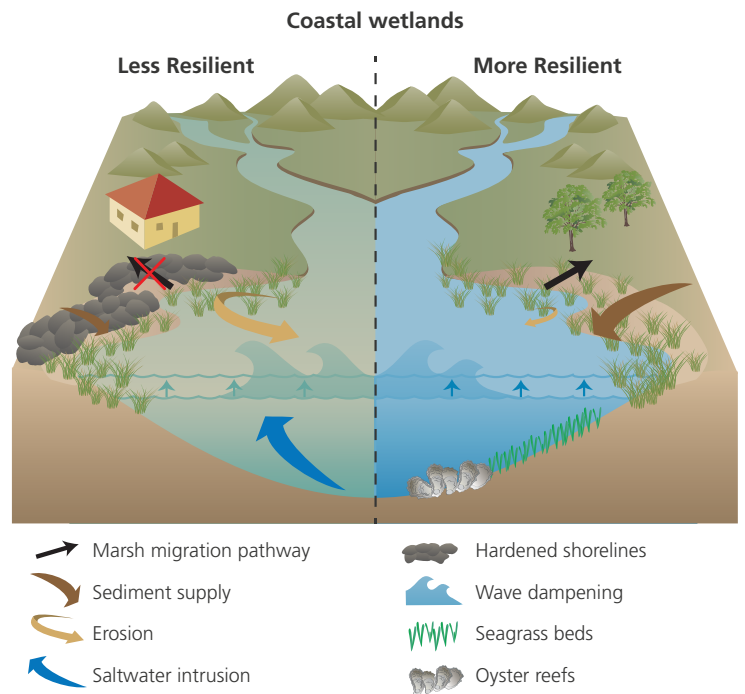


The new Climate Change Resilience Index addresses both human-caused and natural vulnerabilities of Chesapeake Bay to climate impacts.

How can we measure resilience to climate change?

We are creating the Climate Change Resilience Index using a 5-step process:

- 1. Conceptualize:** illustrate the ways that climate change may affect resources from sea level rise, increased temperature, precipitation, and storm frequency and intensity, and ocean acidification.
- 2. Choose Indicators:** choose indicators that reflect the processes from the conceptualization.
- 3. Define Thresholds:** determine the desired condition for each one of the indicators.
- 4. Calculate Scores:** compare data to the desired conditions, and combine into an index for climate resilience.
- 5. Communicate Results:** the index will be incorporated into the Chesapeake Bay Report Card, and will be highlighted in newsletters and other reports.



A conceptual diagram shows that coastal wetlands that are protected from erosion have adequate sediment supply to build upwards, and have access to landward migration pathways, will likely be more resilient to climate change effects.

As an example, Conceptualization shows that coastal wetlands are likely to be affected by their ability to migrate landward or grow upwards as sea levels rise, and will be protected by underwater grasses and oyster habitat, which reduce wave action and erosion during storms. Indicators that can be used to measure wetland resilience include migration pathways that will allow the wetlands to migrate landward, and sediment supply, which allows wetlands to grow upward as sea levels rise.

Climate change impacts

- Sea level rise
- Temperature
- Precipitation
- Storms
- Salinity
- pH

Climate change indicators

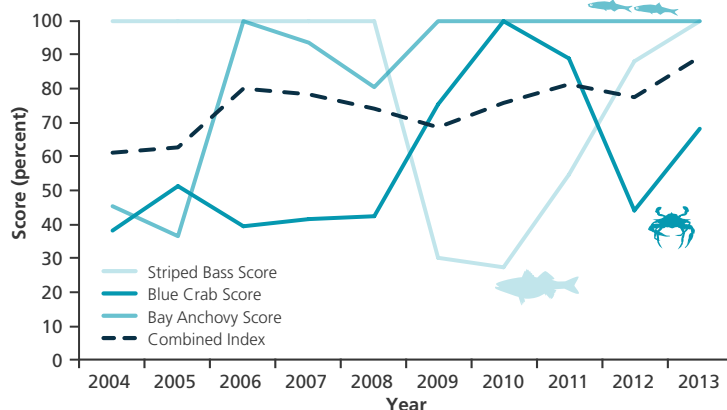
- Coastal wetlands
- Submerged aquatic vegetation
- Fish
- Shellfish
- Pathogens

Key fish populations are improving

Striped bass, bay anchovy, and blue crabs are ecologically, economically, and socially important fish species in Chesapeake Bay. Analysis of abundance data over the last ten years shows variability but general improvements.

The overall Fisheries Index Score for 2013, which is an average of all three species scores is an 89%. Based on these three fish stocks, there is an improving trend. The data used in this analysis is from the 2012—2013 sampling season for most species.

Fisheries Indicators Health from 2004–2013



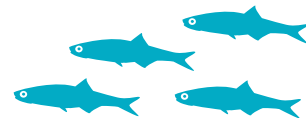
Fisheries indicators are variable over time, but generally are showing improving scores.



Bay Anchovy

Bay anchovy are one of the most abundant schooling fishes in the Bay, providing an important food source for top predators.

A beach seine survey is conducted throughout Maryland and Virginia to estimate bay anchovy (*Anchoa mitchilli*) abundance throughout the Bay (mean fish per seine). Data for bay anchovy has been collected Baywide since 1980. Bay anchovies have improved since 2004 and in 2013, the bay anchovy score was 100%.



Blue Crab

Blue crabs are both predator and prey in the Bay's food web. They use aquatic grasses as habitat to hide from predators and to mate and molt.

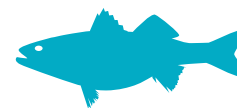
A winter dredge survey is conducted annually since 1980 throughout Maryland and Virginia to assess blue crab (*Callinectes sapidus*) populations (number of adult females). A target of 215 million adult female crabs has been set by Bay managers as the amount needed to keep a sustainable crab population. In 2013, the blue crab score was 68%.



Striped Bass

Striped bass, or rockfish, is a key top predator, and uses the Bay as an important spawning and nursery area. Striped bass is Maryland's state fish and a popular commercial and recreational fishery.

A trawl survey is conducted annually since 2002 throughout Maryland and Virginia to estimate striped bass abundance index (*Morone saxatilis*). Since striped bass are a long lived fish, a three year average of the numerical index is used to determine the score. Striped bass populations are naturally variable, and short-duration declines in the index are not generally a cause for concern. In 2013, the striped bass score was 100%.



Bay health: eastern shore degrading, western shore improving



**2013
Chesapeake
Bay Health:**

C- **Upper Western Shore**

Moderately poor ecosystem health. Improved the most in overall score and scored the best dissolved oxygen score. Over time this region is showing a significantly improving trend.

F **Patapsco and Back Rivers**

Very poor ecosystem health. Although overall health improved, this continues to be the lowest ranked region. Four out of the seven indicators had failing scores. Over time this region is showing a slightly improving trend.

C **Upper Bay**

Moderate ecosystem health. This area remained steady in 2013 with small improvements in some indicators and small declines in others. Over time this region is showing a significantly improving trend.

D- **Lower Western Shore (MD)**

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

D **Patuxent River**

Poor ecosystem health. This region remains steady in poor health. While some indicators improved, other declined. This region had one of the lowest dissolved oxygen scores.

C- **Potomac River**

Moderately poor ecosystem health. Continued improvement from a low score in 2011. This region remains in the middle ranks of all regions with average indicator scores.

C- **Rappahannock River**

Moderately poor ecosystem health. One of the only areas where water clarity improved, but is still failing. Other indicators showed small improvements.

D+ **York River**

Poor ecosystem health. Continued improvements in total nitrogen, total phosphorus, dissolved oxygen, and aquatic grasses has led to an increase in the overall score.

C **James River**

Moderate ecosystem health. Second highest ranked with highest scores in dissolved oxygen, aquatic grasses, and chlorophyll. Over time this region is showing a significantly improving trend.

D+ **Elizabeth River**

Poor ecosystem health. There were improvements in all indicators. There is no benthic community score for 2013. Over time this region is showing a significantly improving trend.

D **Upper Eastern Shore**

Poor ecosystem health. Most indicators showed a decline in scores with only marginal improvements in benthic community. Over time this region is showing a significantly declining trend.

C- **Choptank River**

Moderately poor ecosystem health. Continued decreases in total phosphorus and chlorophyll were offset by small improvements in other indicators. Benthic community continues to be one of the highest scoring indicators.

C **Lower Eastern Shore (Tangier)**

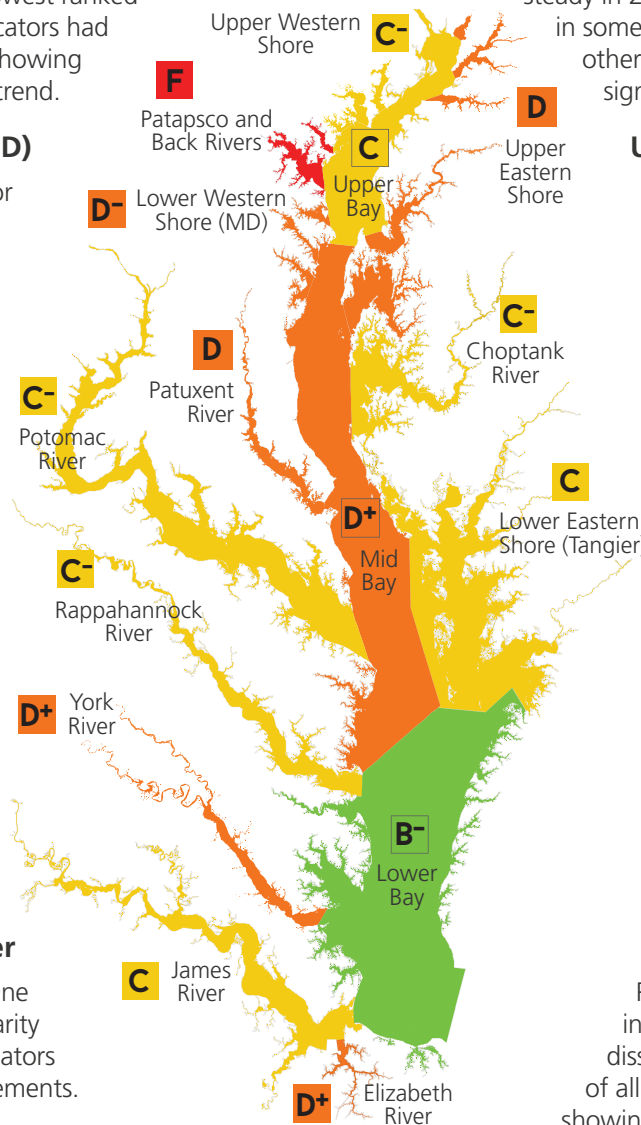
Moderate ecosystem health. There were improvements in the total nitrogen and aquatic grasses scores. All other indicators declined.

D+ **Mid Bay**

Poor ecosystem health. Most indicator scores decreased, with dissolved oxygen scoring the poorest of all regions. Over time this region is showing a significantly declining trend.

B- **Lower Bay**

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



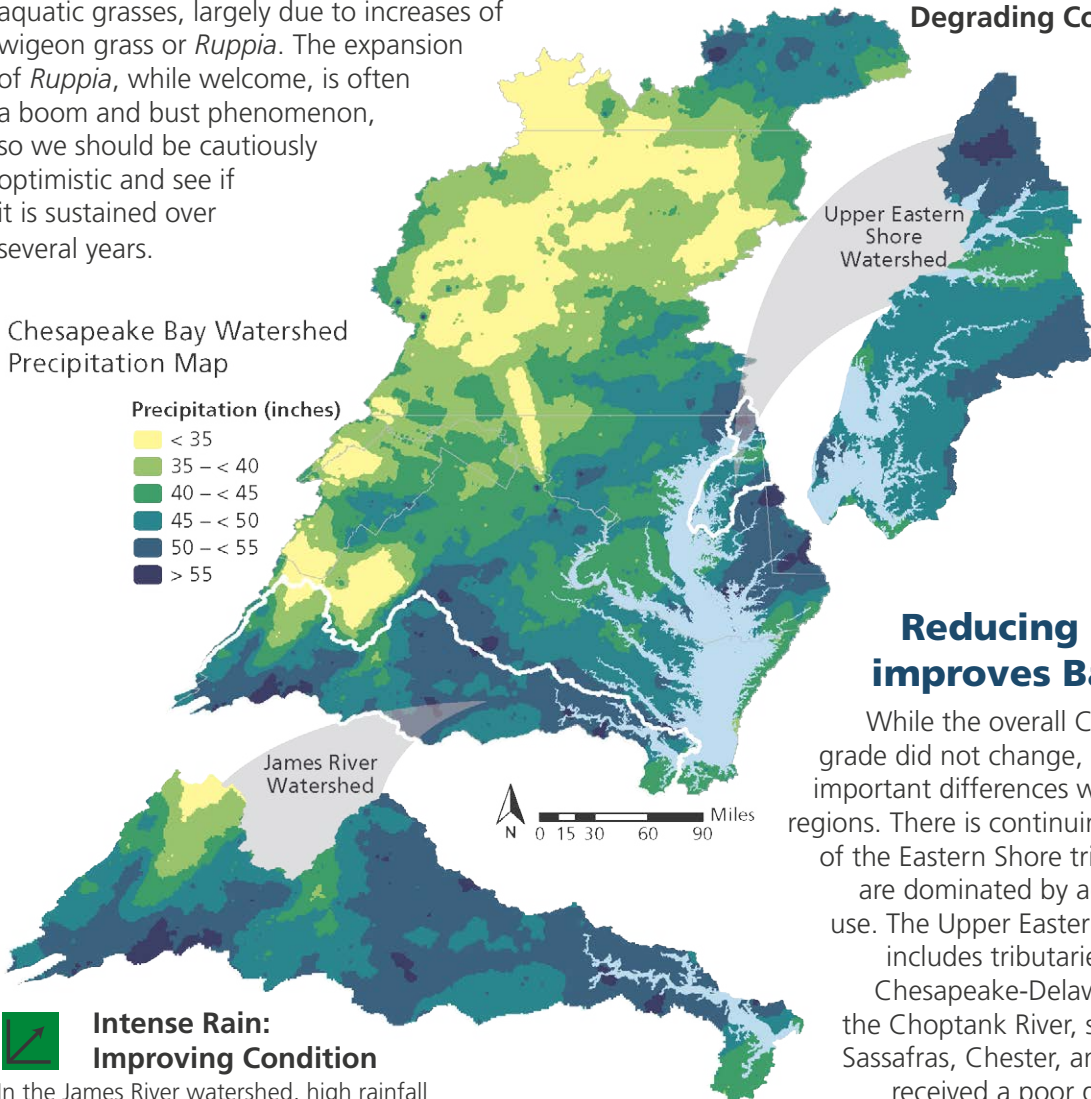
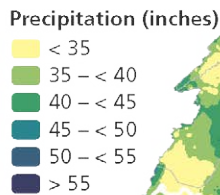
It's not the rain, it's what the rain carries

Although it was a quiet year for extreme events like hurricanes, July 2013 was one of the hottest on record, and annual rainfall was above average. Nutrients and sediments carried by stormwater are important factors in Chesapeake Bay Health.

Overall, Chesapeake Bay scored a 45%, a C, which is almost the exact same score as last year even though there was a lot more rain. Water clarity in the Bay is declining; the amount of chlorophyll in the water was also higher, which added to the murkier water conditions.

The indicator with the most improvement was aquatic grasses, largely due to increases of wigeon grass or *Ruppia*. The expansion of *Ruppia*, while welcome, is often a boom and bust phenomenon, so we should be cautiously optimistic and see if it is sustained over several years.

Chesapeake Bay Watershed Precipitation Map



Intense Rain: Degrading Condition



High rainfall was accompanied by degrading scores from nutrient and sediment runoff in the Upper Eastern Shore Watershed.

Reducing nutrients improves Bay health

While the overall Chesapeake Bay grade did not change, there are some important differences within reporting regions. There is continuing degradation of the Eastern Shore tributaries which are dominated by agricultural land use. The Upper Eastern Shore, which includes tributaries between the Chesapeake-Delaware Canal and the Choptank River, such as the Elk, Sassafras, Chester, and Miles Rivers, received a poor grade, a D. This region has a negative trajectory, so it is getting worse, not better. The Choptank

River and the Lower Eastern Shore regions also had low grades, in part due to rainfall in excess of 50 inches on the Delmarva peninsula, which washed fertilizer and chicken manure from fields into the Bay.

The western shore tributaries generally improved last year, due in part to the success of the sewage treatment upgrades removing nitrogen and phosphorus, and the decline in atmospheric nitrogen deposition noted in the recently released New Insights report (see back page). Of particular note is the James River which has a positive trajectory and whose grade dramatically improved in 2012, despite high rainfall.

Intense Rain: Improving Condition

In the James River watershed, high rainfall was accompanied by improving scores in this forested and developed region, due in part from wastewater treatment plant upgrades.

Bay health scale



Bay health trends



Water quality improvements, challenges, and opportunities



Investments in sewage treatment plants provide rapid water quality improvements.

Upgrades to wastewater treatment plants are effective restoration practices. Wastewater treatment plant upgrades result in decreased nitrogen and phosphorus loadings to the Chesapeake Bay. Reduced nitrogen and phosphorus loads lead to improved water quality and in some cases increased submerged aquatic vegetation.



The Clean Air Act is benefiting the Chesapeake Bay through reducing nitrogen.

Almost one-third of the nitrogen load to the Chesapeake Bay comes from atmospheric deposition. Atmospheric nitrogen originates from power plants, industrial facilities, vehicle emissions, and the volatilization of ammonia from animal waste and ammonia-based fertilizers. Reductions in atmospheric nitrogen deposition are directly linked to improvements in water quality.



Agricultural practices such as cover crops are providing local benefits to streams.

Reducing agricultural nutrient input onto the land and in streams leads to significant water quality and aquatic habitat improvements in as little as one to six years. Winter cover crops decrease the levels of nutrient inputs into shallow groundwater, and consequently, streams. Manure and fertilizer management reduces nutrients and sediment loads. Controlling livestock access to streams decreases sediment, nutrients, and bacteria in streams, and prevents stream bank erosion.



Stormwater management practices need to be implemented as development expands.

Urban and suburban development will continue to expand as population grows, necessitating best management practices. Development is associated with increased impervious surfaces, lawn fertilizer, vehicle emissions, septic systems, gas-powered lawn tools, and construction. Resulting increases in nutrients and sediment reach the Bay through stormwater runoff. Best management practices that reduce stormwater nutrient and sediment loads include above-ground retention ponds, rain gardens, and sand filters.

Photos and text from the New Insights Report; see <http://ian.umces.edu/link/newinsights>

About the Chesapeake Bay Report Card

Report card produced and released in May 2014 by the Integration and 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 (VIMS), 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. Bay anchovy photo from Aimee Comer (VIMS).



ian.umces.edu