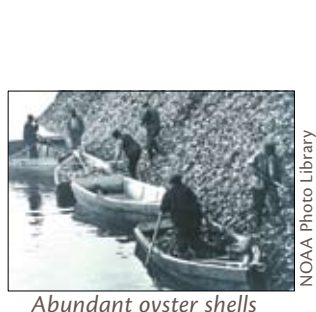# THE ROLE OF BENTHIC COMMUNITIES IN THE HEALTH OF MARYLAND'S COASTAL BAYS

Benthic communities, such as aquatic grasses and shellfish, are critical to Maryland's Coastal Bays because they provide a variety of ecosystem services, improve water quality and are commercially valuable. This newsletter describes the historical and current trends of aquatic grasses and shellfish in the Coastal Bays.
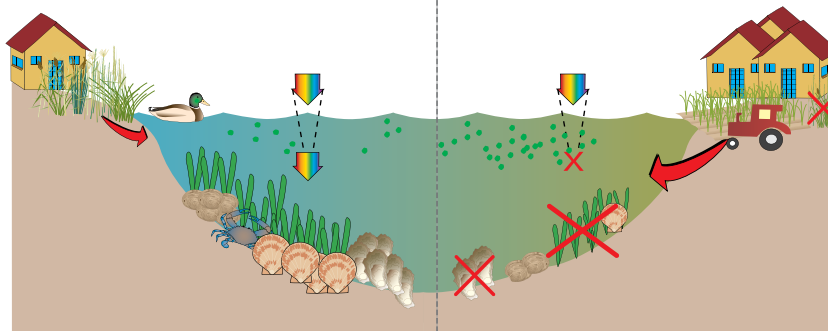
ARE MARYLAND COASTAL BAYS DEGRADING?

A healthy ecosystem includes thriving benthic communities

A degraded ecosystem has lost its benthic communities

NOAA Photo Library

Abundant oyster shells

A. Dungan, UMCES

Oyster mortality from disease

A healthy ecosystem incudes good water quality, a diverse benthic community and a balance between development and the natural system. Good water quality is essential to support healthy benthic communities. Healthy wetlands and careful nutrient management will help maintain aquatic grasses, oysters, clams, scallops, and water clarity.

Poorly planned development, excessive fertilizer from agriculture, loss of wetlands, and poor nutrient management result in poor water quality. Introduced diseases cause oyster dieoffs and decreased water clarity causes aquatic grass dieoffs. With no aquatic grasses, scallops are also lost. Hard clams have not suffered from disease problems as oysters have.

DEPTH AND SEDIMENT TYPE CHARACTERIZE BENTHIC HABITAT

a)

Washington D.C.

Meters
0   5,250 10,500

Depth (m)
- Surface to -1
- -1.01 to -2
- -2.01 to -3
- -3.01 to -4
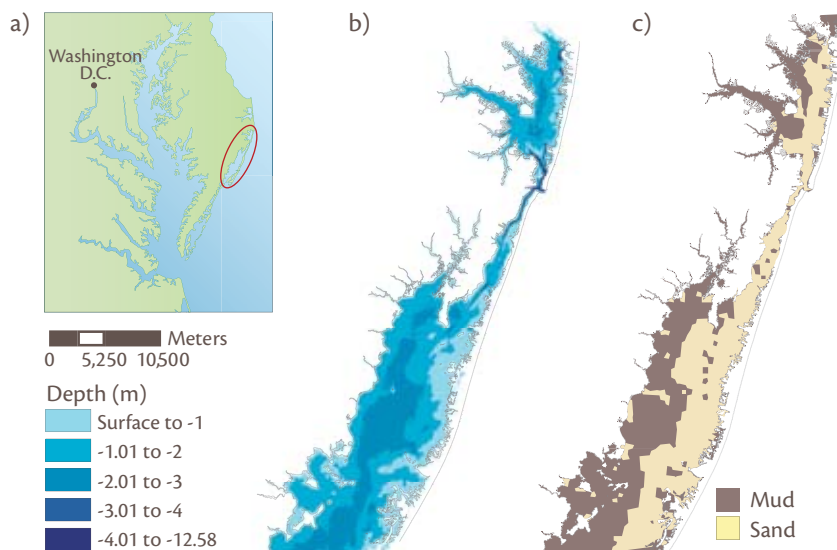- -4.01 to -12.58

b)

c)

Mud
Sand

Figure 1: Location (a, red circle), bathymetry (b) and sediment type (c) of Maryland's Coastal Bays. (Data: Maryland DNR)

Maryland's Coastal Bays are considered lagoonal estuaries, with low oceanic flushing and low riverine input. Groundwater is the main source of freshwater. The bays are bordered by barrier islands on their eastern side and the mainland on their western side. The bathymetry of the Coastal Bays is naturally shallow, with man-made channels as deep as 12 meters (Figure 1b). Bottom sediment type can be roughly divided into sandy sediments in the eastern parts of the bays (due to overwash and wind from barrier islands) and muddy sediments in the western parts of the bays (Figure 1c). The sediment and depth characteristics influence the type of benthic organisms that can survive. The relative shallow nature of these bays and a variety of sediment types provide excellent habitat for aquatic grasses. Similarly, the combination of depth, sediment type and other habitat characteristics leads to a diversity of shellfish species that are able to thrive here.

AQUATIC GRASSES, AN IMPORTANT LIVING RESOURCE, ARE LEVELING OFF AS WATER QUALITY DECLINES

The presence of healthy aquatic grass beds is an indicator of good water quality and therefore, a healthy coastal ecosystem. The functioning of the Coastal Bays ecosystem depends on healthy aquatic grass beds as nurseries for juvenile fish and shellfish. Grass beds decrease wave action, which in turn decreases turbidity of the water column by allowing particles to settle on the bottom. Light availability is the primary limiting factor for aquatic plant survival and is affected by nutrient and sediment inputs. Excess nutrients cause algal blooms, which block sunlight from reaching aquatic grasses (Figure 2).
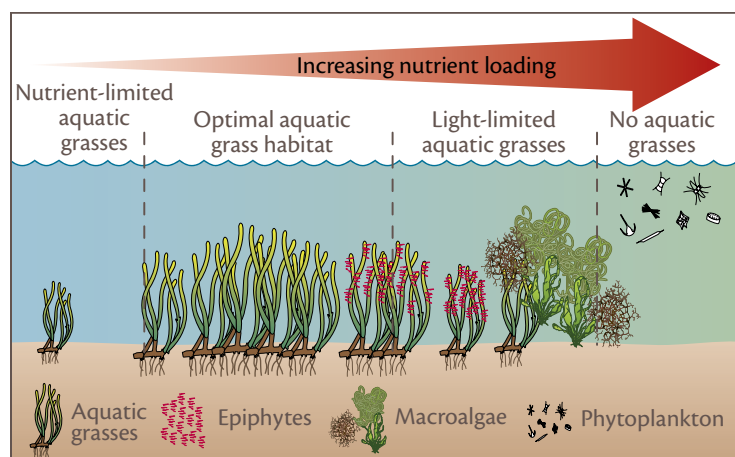

Figure 2: Diagram of aquatic grass responses to nutrients. (Data: Wazniak et al. in press)

Although there are no precise historical aquatic grass abundance data before 1986, anecdotal reports, fishery practices, and local historical knowledge indicate that eelgrass (*Zostera marina*) existed in lower Chincoteague Bay in the early 1900s. Aquatic grass beds that may have existed were completely lost by the end of 1933, due to a wasting disease compounded in August 1933 by one of the most significant hurricanes to affect the region in the 20th century. The hurricane killed any remaining aquatic grasses and created a new inlet near Ocean City, Maryland, that changed the physical and biological characteristics of the Coastal Bays. The loss of grass beds resulted in major changes in many of the ecosystem services provided by aquatic grasses and led to the loss of bay scallops (*Argopecten irradians*) and decreased numbers of brant (*Branta*

bernicla, a type of goose). Natural recovery of aquatic grasses, mainly eelgrass and widgeon grass (*Ruppia maritima*), starting the 1960s and 1970s, has been significant. A high of 7,319 hectares was reported in 2001, with an average expansion rate of 305 ha yr^{-1} between 1986 and 2004 (Figure 3).

Aquatic grass abundance is responsive to nutrient concentrations: at low concentrations, nutrients can critically limit aquatic grass growth, while moderately increasing nutrients will increase abundance. However, as nutrient loads continue to increase, aquatic grasses are shaded out by epiphytes and conditions favor macroalgae (seaweed) and eventually phytoplankton (Figure 2). Water quality was improving in the 1980s and 1990s, but now is degrading in the southern Coastal Bays (Figure 4a, red pie pieces). Aquatic grasses appear to have responded to the improving water quality in the past but abundance is currently leveling off, reflecting degrading water quality conditions. Additionally, a clear distinction can be seen between regions in terms of aquatic grass abundance and nutrients (Figure 4b). Within the Coastal Bays, areas with higher nutrients have less aquatic grasses, suggesting that the currently increasing nutrient concentrations is of concern for aquatic grass survival.

a)

b)

Figure 4: (a) Water quality trends and 2004 aquatic grass distribution in the Coastal Bays. (b) Comparison of different regions within the Coastal Bays that show aquatic grass responses to nutrient loading, 2001–2003. (Data: Wazniak et al. in press, www.vims.edu/bio/sav)
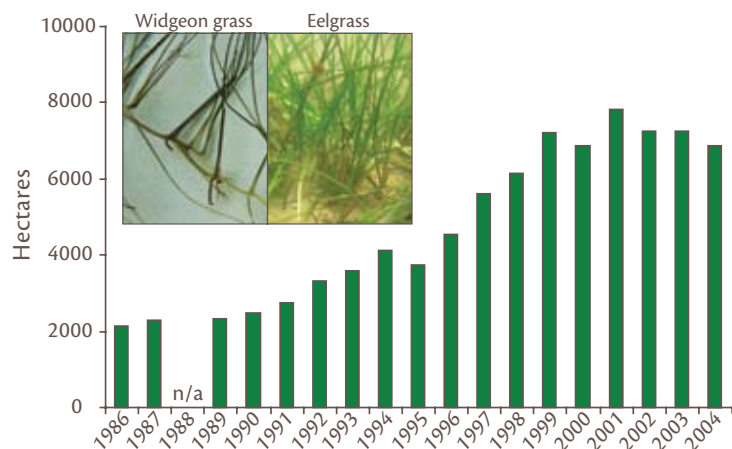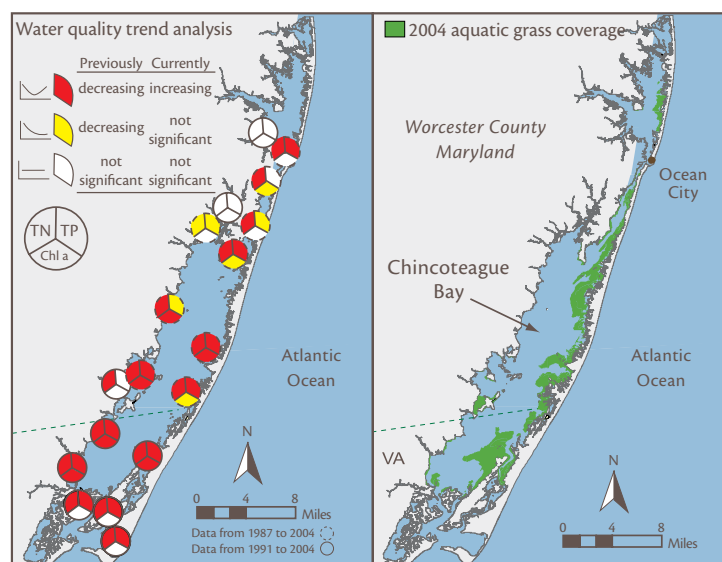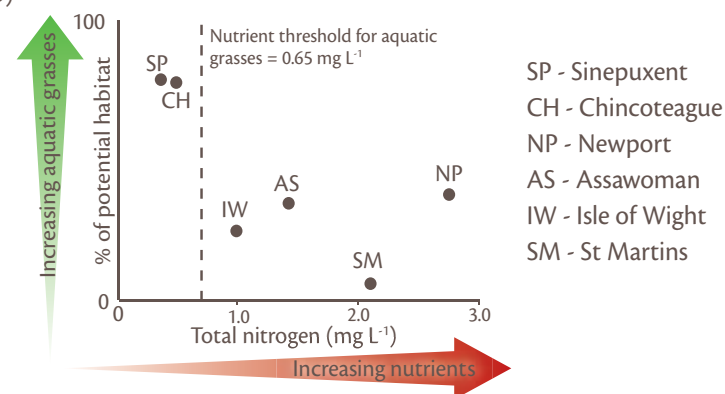

Figure 3: Aquatic grass abundance over time in Maryland's Coastal Bays. (Data: www.vims.edu/bio/sav. Widgeon grass photo: USDA, eelgrass photo: P. Tango, MD DNR)

SHELLFISH ARE ECOLOGICALLY AND ECONOMICALLY IMPORTANT

The ecological significance of shellfish to estuarine ecosystems has long been recognized. Shellfish serve as a key link between primary producers (phytoplankton) and higher consumers (fish). They are important agents in benthic-pelagic (water column to sediment) coupling because they filter organic matter (predominantly phytoplankton) from the water column and deposit it onto bottom habitats (Figure 5 and 6). This shift of organic matter from the water column to the bottom is an important energy pathway for other organisms like aquatic grasses and bottom-feeding
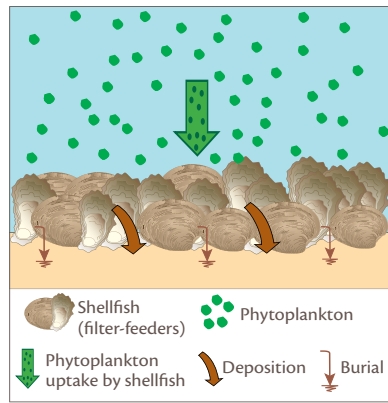

Figure 5: Shellfish are a part of the connection between the water column and the benthos.
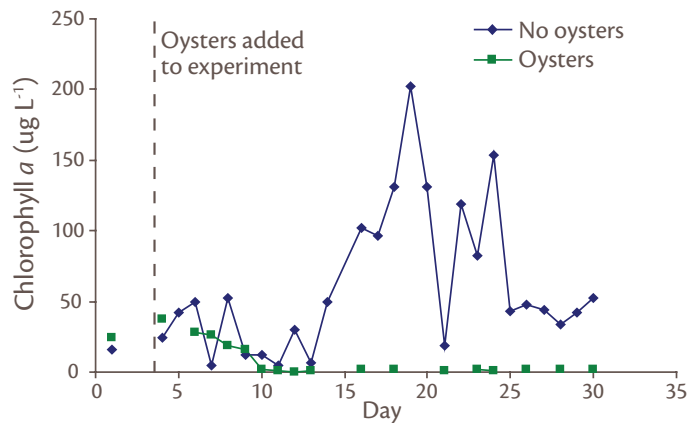

Figure 6: In a mesocosm experiment, oysters had a significant impact on phytoplankton concentration (Data: Porter et al. 2004).

invertebrates. In addition, shellfish can have a pronounced impact on the physical structure of an ecosystem, whether by reworking the sediment, binding or securing existing substrate, or by building new substrate such as oyster reefs. Lastly, many shellfish are commercially valuable, both directly as a harvestable resource and indirectly as a food source for commercially and recreationally important species including crabs, fish, and waterfowl.

Historically, the benthic communities of Maryland's Coastal Bays have been shaped by the creation and disappearance of inlets, which allowed the flow of high salinity ocean water into the bays. For example, a thriving scallop industry was present in the 1920s in southern Chincoteague Bay, due to the eelgrass beds that occurred there. However, with the demise of eelgrass due to the
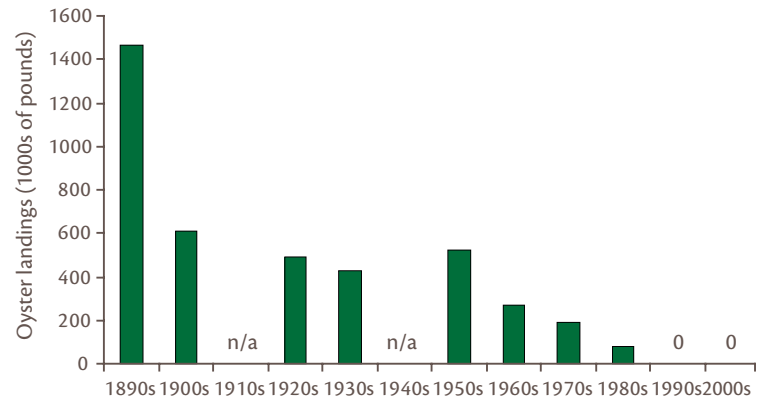

Figure 7: Decadal averages of oyster landings over the last century in the Coastal Bays. (Data: MD DNR)

wasting disease in the 1930s, scallops also disappeared.

After the current Ocean City Inlet opened in 1933, the bays supported a healthy and diverse benthic community of shellfish, due to a unique combination of the convergence of northern and southern species' geographic ranges, the mix of estuarine and marine species, and a variety of habitats. Oysters and hard clams were found in harvestable quantities that supported commercial and recreational fisheries (Figure 7). However, the loss of most of the historically productive oyster grounds due to disease, predators, and competitors, has contributed to water quality problems in the Coastal Bays. Efforts to reestablish healthy oyster populations have been largely unsuccessful due to the presence of oyster parasites. Hard clams are also important benthic-pelagic couplers and do not appear to suffer from similar disease problems. However, hard clam densities are currently much lower than historical levels (Figure 8). Loss of shellfish populations is a concern for the continued health of Maryland's Coastal Bays.
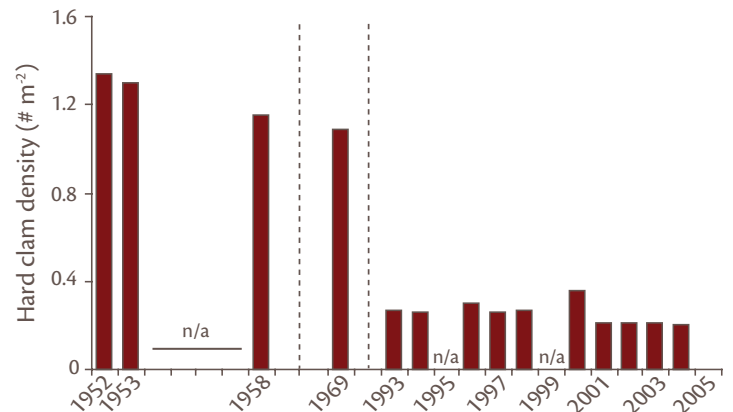

Figure 8: Hard clam densities from fisheries independent surveys in the Coastal Bays. (Data: MD DNR, UMD)

Left to right: Hard clams, Mercenaria mercenaria; Eastern oyster, Crassostrea virginica; Bay scallop, Argopecten irradians

BROWNS TIDE ARE A THREAT

Harmful algal blooms are an ongoing problem in the Coastal Bays. Brown tides, caused by the phytoplankton *Aureococcus anophagefferens*, can affect shellfish populations by decreasing the nutrition of the shellfish's food and by impairing the reproductive success and growth of shellfish. Additionally, brown tides can block light that is necessary for aquatic grass growth. Brown tides do not become a nuisance until they reach Category 2, which is classified as 35,000 to 200,000 cells per milliliter. Chincoteague Bay, where most shellfish industry and most aquatic grass beds are located, has the largest and most abundant brown tides in the Coastal Bays (Figure 9).

C. Wazniak, MD DNR

Waters darkened by brown tide

Brown tide distribution
Average peak concentrations
1999-2001
- 2500–35000 cells ml^{-1}
- 35000–200000 cells ml^{-1}
- Greater than 200000 cells ml^{-1}

Worcester County Maryland

Public Landing

Chincoteague Bay

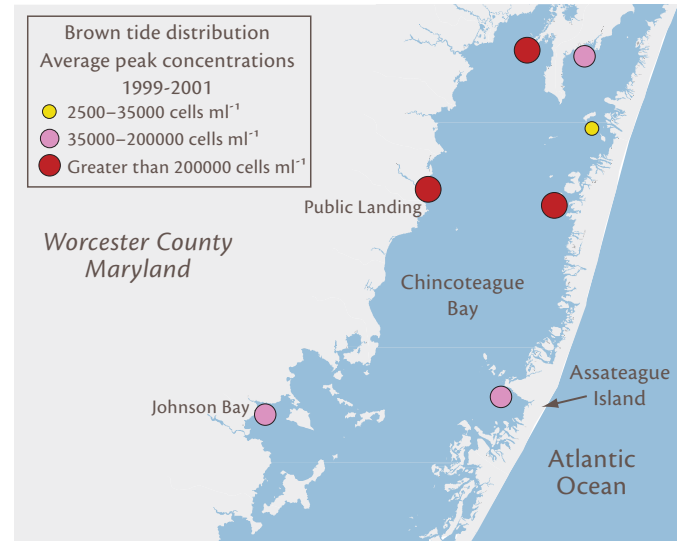Johnson Bay

Assateague Island

Atlantic Ocean

Figure 9: Brown tide occurrence in Chincoteague Bay. Brown tides are detrimental to aquatic grasses and shellfish. (Data: MD DNR)

CONCLUSIONS

- Water quality is essential for maintaining a healthy lagoonal ecosystem.

- Maryland's Coastal Bays may be close to exceeding their ability to cycle nutrient input while maintaining health.

- Monitoring of key water quality parameters is essential for tracking the health of an ecosystem.

- Shellfish and aquatic grasses provide important nutrient cycling, wave dampening, erosion control, and biomass development.

- More accurate fisheries independent data on shellfish and accurate aquatic grass data could provide key information on the status of these important living resources.

- Physical characteristics, such as wind, bathymetry, and sediment may affect water quality and the health of aquatic grasses and shellfish.

RECOMMENDATIONS

- Provide effective oversight of water quality parameters and biological resources to assess the health of the Coastal Bays.

- Develop controls for minimizing nutrient input into the bays, with inspection and enforcement where necessary to ensure compliance.

- Develop methods of increasing the population of shellfish and aquatic grasses to ensure the continued health of the bays.

- Encourage programs that increase the biomass of shellfish and aquatic grasses to provide benefits for long-term water quality.

- Develop accurate methods of catch statistics for commercial and recreational fisheries and continue current efforts to measure aquatic grasses for timely and accurate data collection and use.

- Create educational programs and materials for Coastal Bay users so that they understand the importance of stewardship to the continued health of water quality and living resources in Maryland's Coastal Bays.

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Orth RJ, ML Luckenbach, SR Marion, KA Moore, DJ Wilcox. 2006. Seagrass recovery in the Delmarva Coastal Bays, USA. *Aquat Bot* 84: 26-36.

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