BAY GRASS RESTORATION IN CHESAPEAKE BAY

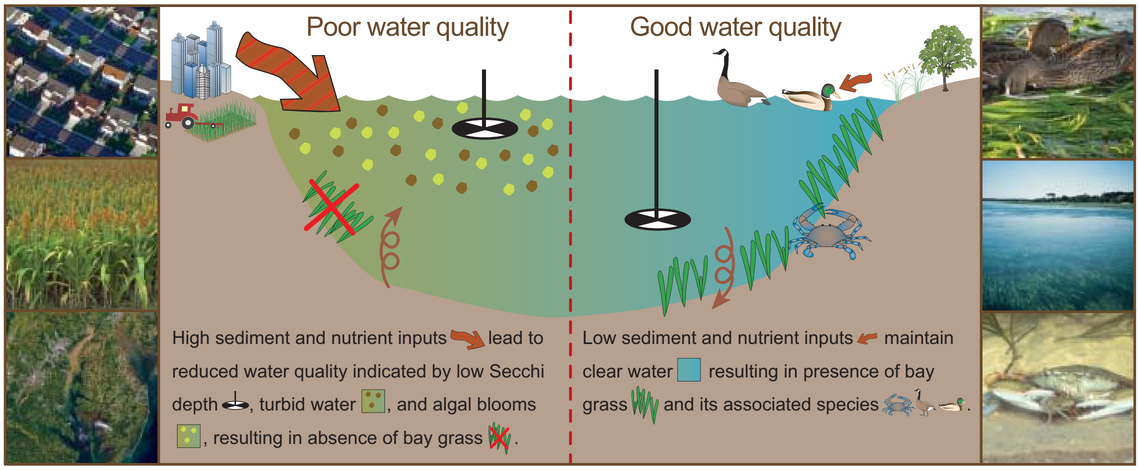
Prepared by the SAV Restoration Workgroup and IAN, August 2005

Chesapeake Bay has historically supported extensive bay grass (underwater grasses) meadows (>75,000 ha). However, water quality degradation from increased sediment and nutrient inputs has reduced the areal coverage and depth penetration of bay grasses, with one third of historical distributions remaining (21,648 ha; 1985–2004 mean). Chesapeake Bay underwater grasses are comprised of a variety of freshwater, brackish, and marine species. These various species form different communities, largely related to salinity, which have different environmental factors limiting their effective restoration.

Development and associated impervious surfaces increases sediment and nutrient runoff.

Intense agricultural practices increase sediment and nutrient runoff.

Sediment and nutrient plumes decrease light availability for bay grasses.

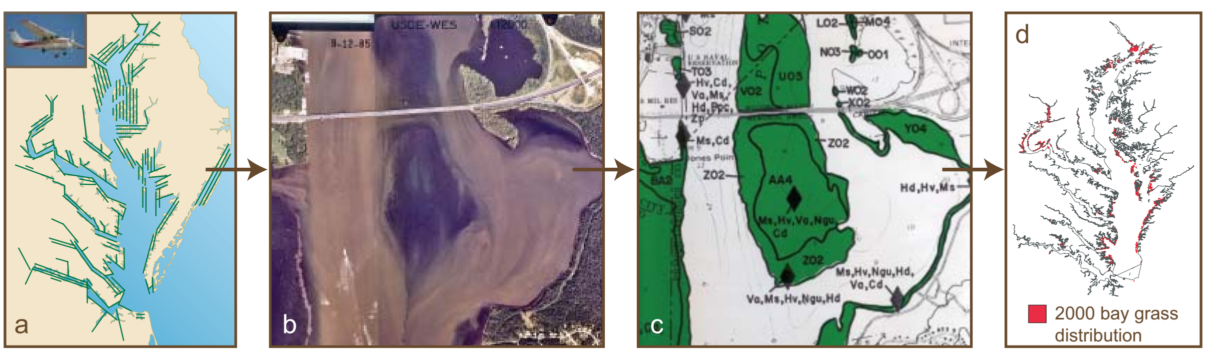


Seeds, roots, and rhizomes (below-ground stems) provide food for waterfowl.

Bay grass meadows can improve water clarity by causing sediment to settle.

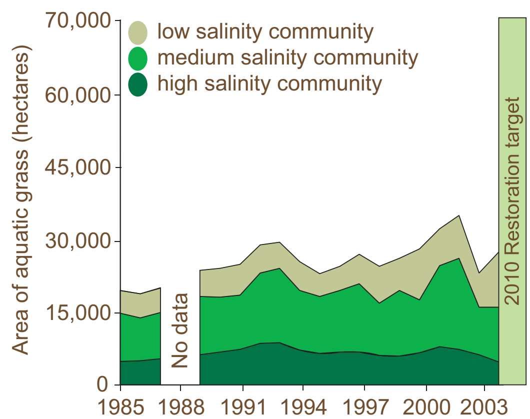
Blue crabs and other species rely on bay grasses to provide habitat.

MEASURING COVERAGE OF BAY GRASS



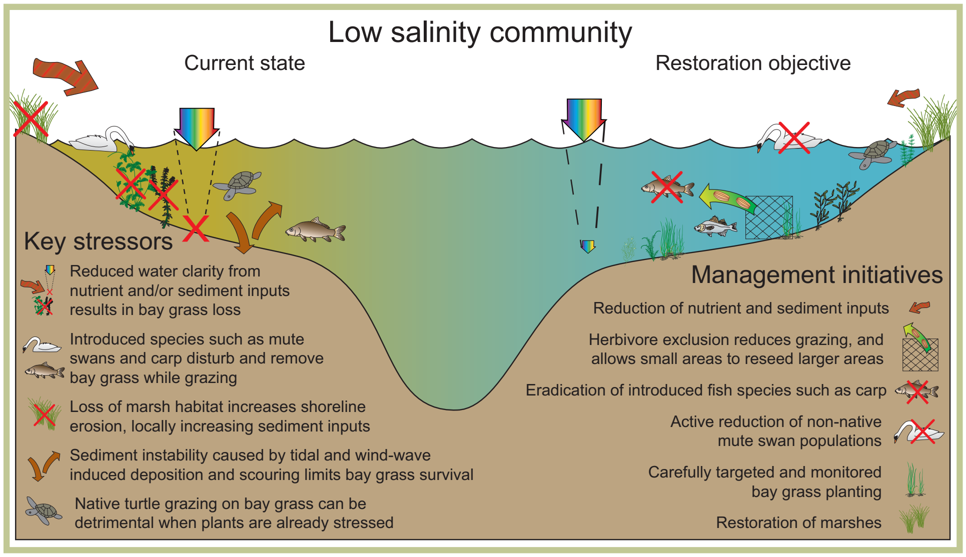
a) Small aircraft fly 173 flightlines around the Bay annually. b) A total of 2,033 photographs are taken at a scale of 1:24,000. c) Bay grass density is estimated from photographs and ground observations (diamonds). d) Bay grass maps are compiled by segment for the whole of Chesapeake Bay. http://www.vims.edu/bio/sav/

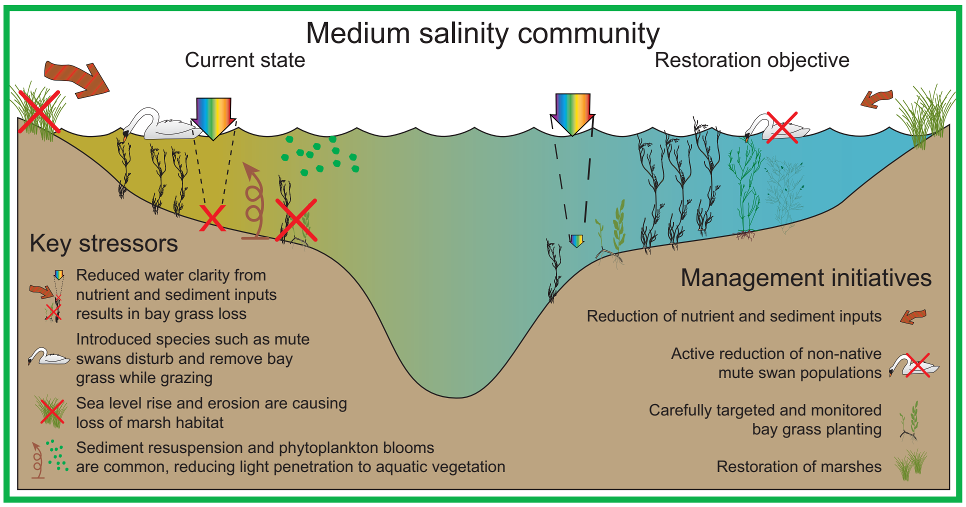
Bay grass coverage and density is assessed annually by the Virginia Institute of Marine Science (VIMS). Accurate annual assessment of the abundance of bay grass within Chesapeake Bay is essential for determining the status and resilience of grass to changes in water quality. The medium salinity community is consistently abundant, however this is predominantly composed of widgeon grass (*Ruppia maritima*). Widgeon grass is more ephemeral than many other Chesapeake Bay species, and the presence of meadows in this community is therefore highly variable from year to year.

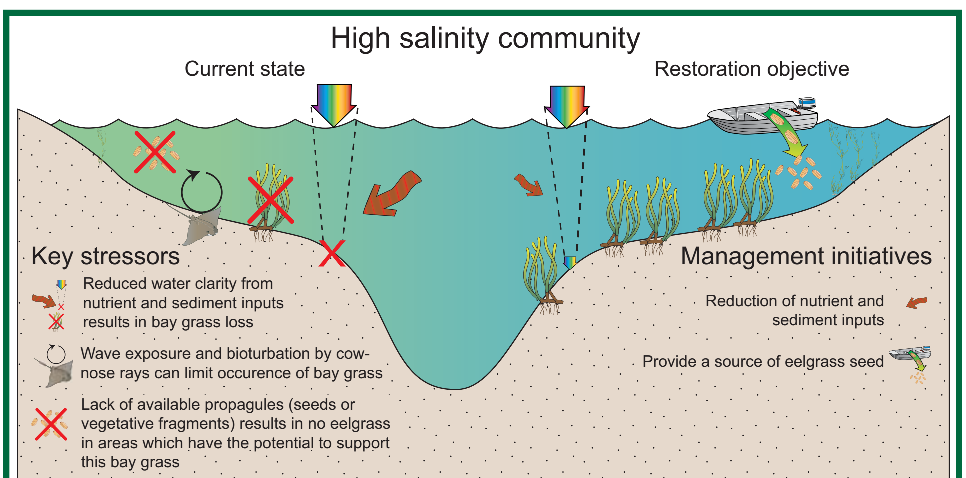


Total area of bay grass in Chesapeake Bay has varied from 16,700–31,000 ha over the past ten years. Although annual variation in total area occurs, there has been no major directional recovery or further decline in total bay grass area.

COMMUNITY TYPES







Key features	Low salinity	Medium salinity	High salinity
*Salinity**	< 10 ppt	5–15 ppt	> 15 ppt
*Shoots present**	May–Nov	Apr–Oct (max Aug)	All year
*Total species**	14	4	2
*Area of habitat***	5,871 ha	11,050 ha	5,867 ha
*% of bay grass***	26%	48%	26%

*Moore, KA *et al.*, 2000, Estuaries 23(1): 115–127
**data from 1985–2004

Common species:

Low salinity

Native species
- *Heteranthea dubia* (Water stargrass)
- *Elodea canadensis* (Common waterweed)
- *Vallisneria americana* (Wild celery)
- *Stuckenia pectinata* (Sago pondweed)
- *Ceratophyllum demersum* (Coontail)
- *Najas guadalupensis* (Southern naiad)
- *Najas sp.* (Naiad)
- *Najas gracillima* (Slender naiad)
- *Potamogeton pusillus* (Slender pondweed)
- *Potamogeton perfoliatus* (Redhead grass)

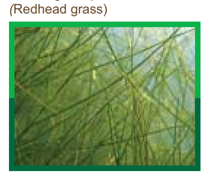
Non-native species
- *Hydrilla verticillata* (Hydrilla)
- *Myriophyllum spicatum* (Eurasian watermilfoil)
- *Potamogeton crispus* (Curly pondweed)
- *Najas minor* (Spiny naiad)

Medium salinity
- *Stuckenia pectinata* (Sago pondweed)
- *Ruppia maritima* (Widgeon grass)
- *Potamogeton perfoliatus* (Redhead grass)
- *Zannichellia palustris* (Horned pondweed)

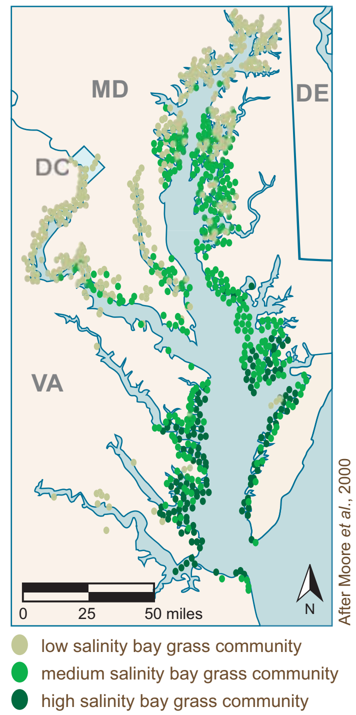
High salinity
- *Ruppia maritima* (Widgeon grass)
- *Zostera marina* (Eelgrass)


Vallisneria sp (Wild celery)


Potamogeton perfoliatus (Redhead grass)


Ruppia maritima (Widgeon grass)


Zostera marina (Eelgrass)



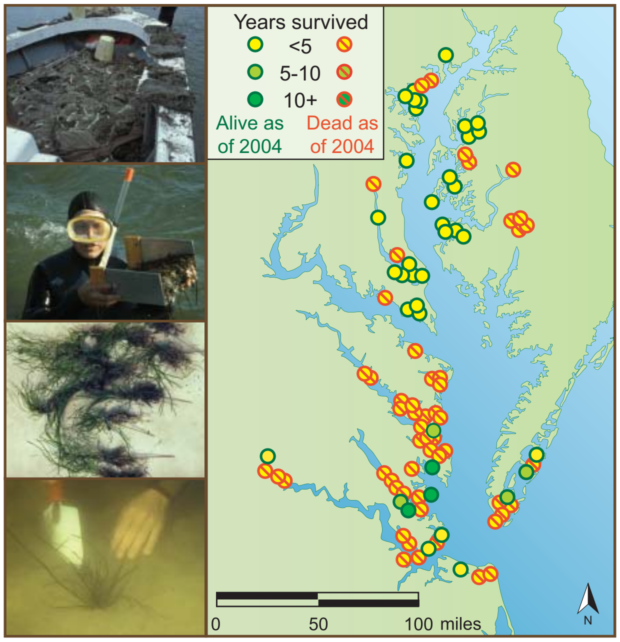
Bay grass communities reflect salinity gradients from north to south in Chesapeake Bay, as well as within the tributaries. The medium salinity community, dominated by widgeon grass, is currently the most abundant bay grass community.

Chesapeake Bay is the longest estuary in the world with freshwater input from a large watershed and seawater exchange in the south of the Bay. The resulting salinity gradient is reflected in the major bay grass communities, which can be defined as low, medium, and high salinity communities. There are approximately 17 species of underwater bay grass within Chesapeake Bay, and the different species display a wide variety of reproductive and survival strategies. The low salinity species mostly spread via asexual fragmentation, medium salinity by vegetative growth as well as sexual seed production, while the high salinity eelgrass relies almost exclusively on sexual seed production.

RESTORATION

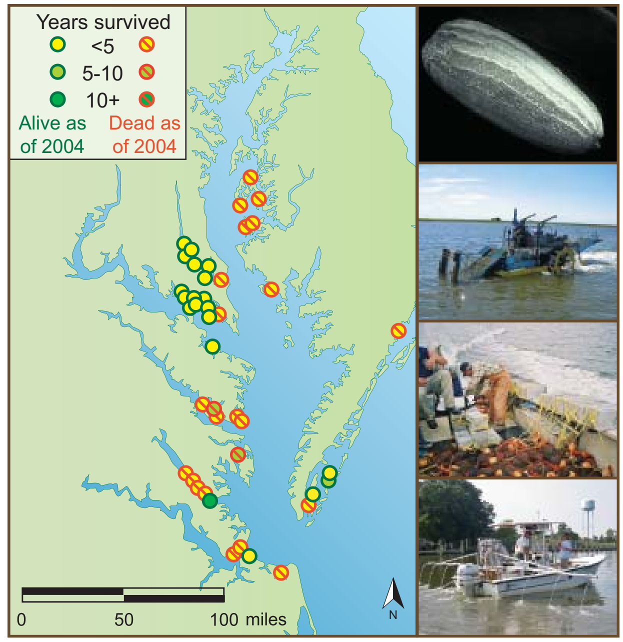
An intensive effort has been undertaken to actively restore bay grass to Chesapeake Bay by transplanting adult shoots or planting seeds. With a few exceptions, such as some sites in the York River, these efforts have achieved limited long-term establishment of new bay grass meadows. In contrast, moderate improvement in water quality in tributaries such as the Potomac River have led to large-scale natural recovery in bay grass growth and establishment. Restoration techniques are labor-intensive, tedious, have potential donor bed impacts, and currently can only plant relatively small areas. The figures below show results of restoration efforts by the Virginia Institute of Marine Science (VIMS), Maryland Department of Natural Resources (MD DNR), and Chesapeake Bay Foundation (CBF) between 1979 and 2004. Regardless of whether adult shoots or seeds were used in active restoration, most transplants survived for less than five years.

Restoration using adult shoots



Adult plants are harvested from natural donor beds and are either transported with intact sediment directly to restoration sites, sorted into individual shoots and planted by hand, or grown indoors from seeds, cuttings, or winter buds before transplanting at a later date.

Restoration using seeds



Mature eelgrass seeds are roughly 3.5 mm long and are harvested by hand or mechanically, collecting the reproductive shoots from mature beds. These shoots can be placed into mesh bags and left for the seeds to drop, or the seeds are removed from the shoots and then seeds dispersed from a boat.

Eelgrass transplants have survived for over a decade in the York River at VIMS

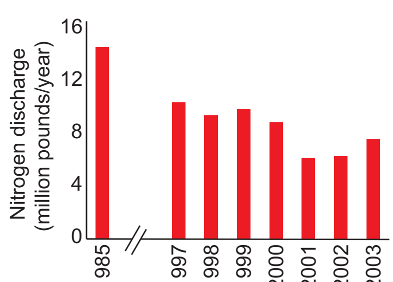
In some cases long-term survival and meadow expansion has occurred after replanting, which shows the importance of careful site selection when actively restoring bay grass meadows.

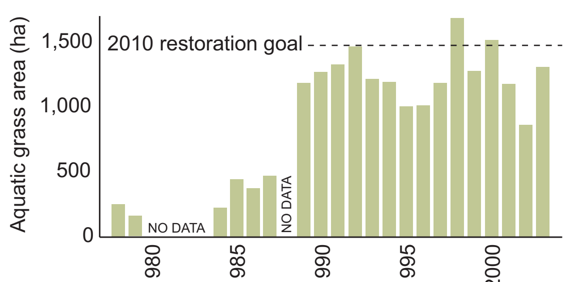
Large areas of bay grasses have recovered naturally

Improvements in water quality can lead to recovery of bay grass without the need for active restoration. In the middle Potomac River, bay grass increased in area by some 1,500 ha between 1980 and 1997. During this period, the annual discharge of total nitrogen from one of the major sewage treatment plants into this section of the river was reduced by nearly half. In 1990, coverage of *Hydrilla,* an exotic species, expanded and became the dominant species, however native species have been colonizing among the *Hydrilla* in recent years.

Annual discharge from the Blue Plains sewage treatment plant in the middle Potomac River.

Sources: MD DNR, Metropolitan Washington Council of Governments





Area of bay grass in the middle Potomac River.

RESTORATION TARGETING

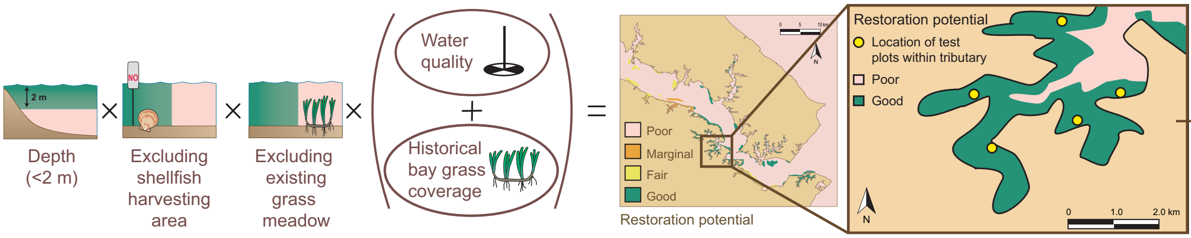
To improve potential success of restoration efforts, the Maryland Department of Natural Resources has developed a bay grass restoration targeting model for identifying potential restoration locations within a region (tens of square kilometers) of Chesapeake Bay. Test plots are required within these regions to determine specific sites (hundreds of square meters) with the best restoration potential.

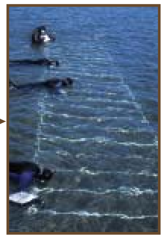
Model: Choose a tributary/bay

The restoration targeting model currently uses interpolated water quality, historical bay grass distribution, depth, and areas free from clam dredging. It identifies promising shallow areas for grass planting where water quality is adequate for grass growth but no grasses are currently present, especially where grasses grew in the past. Areas with clam dredging are avoided. Extra data that may improve the accuracy of the model include measurements of sediment slope and sediment type, as well as modeled data of wave exposure.

Site-specific: Choose locations within tributary/bay

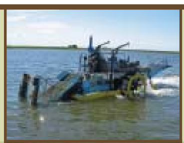
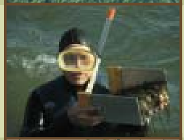
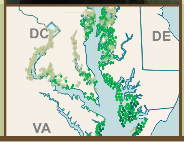
The model provides the general region of a tributary or bay that has good potential for successful restoration of bay grass. However, site-specific targeting is essential to determine exact locations for restoration efforts and the recommended method is the use of test plots within the tributary or bay recommended by the model.





Conducting test plots requires intensive effort by field staff.

CONCLUSIONS | RECOMMENDATIONS

Conclusions		Recommendations
Where good water quality occurs, targeted local restoration efforts are valuable.		Improve water quality by reducing sediment and nutrient inputs, thereby promoting natural restoration of bay grasses in Chesapeake Bay.
Natural recovery of bay grasses has occurred where water quality has improved.		Continue annual bay grass mapping to quantify natural recovery events.
Seed and shoot transplanting is sometimes successful, but less than 10% of the transplants survive more than five years.		Due to limited long-term survival, restoration projects must include long-term monitoring. In addition, improved targeting of restoration techniques and sites is essential.
Underwater bay grass communities are widespread in Chesapeake Bay. They are also ephemeral and coverage is greatly reduced from historical distributions.		Increase our understanding of variability and recovery of bay grass communities through targeted scientific research.

Acknowledgements

William & Mary VIMS — Virginia Institute of Marine Science, School of Marine Science: Scott Marion, Ken Moore, Robert Orth, Dave Wilcox

University of Maryland Center for Environmental Science: Walter Boynton, Tim Carruthers, William Dennison, Katia Englehardt, Michael Kemp, Evamaria Koch, Laura Murray, Court Stevenson, Michael Williams

Maryland Department of Natural Resources: Dave Goshorn, Lee Karrh, Mike Naylor, Tom Parham

USGS science for a changing world: Julie Baldizar, Nancy Rybicki

NOAA: Peter Bergstrom, Ben Longstaff

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Photographs courtesy of:
Robert Orth, Adrian Jones, Damon Delistraty, Ralph Adkins, Evamaria Koch, Chris Gregerson, MODIS, and the Maryland Department of Natural Resources.

University of Maryland Center for Environmental Science
http://www.umces.edu

FURTHER INFORMATION
MD DNR: http://www.dnr.state.md.us/bay/sav/restoration.asp
VIMS: http://www.vims.edu/bio/sav/
IAN: http://www.ian.umces.edu

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Integration Application Network

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