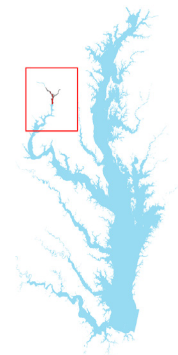
Attainable

Upper Potomac River, Washington, D.C. (POTTF-DC, ANATF-DC)

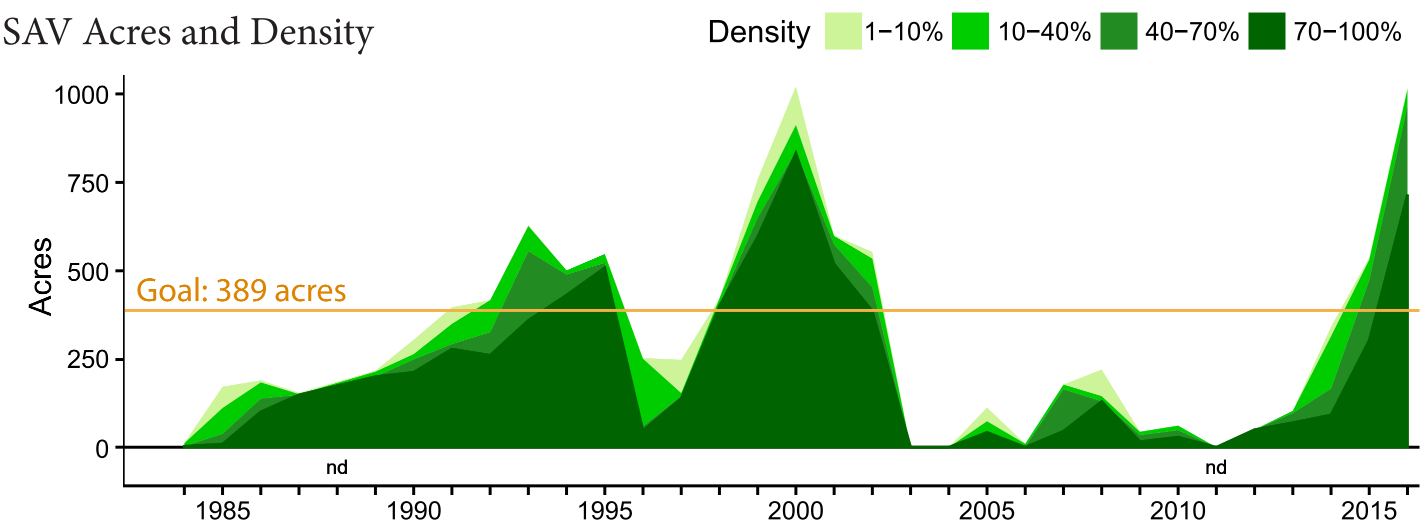


Submerged aquatic vegetation (SAV) in the upper Potomac River has been influenced by a variety of factors during the last century, but is diverse and resilient today.

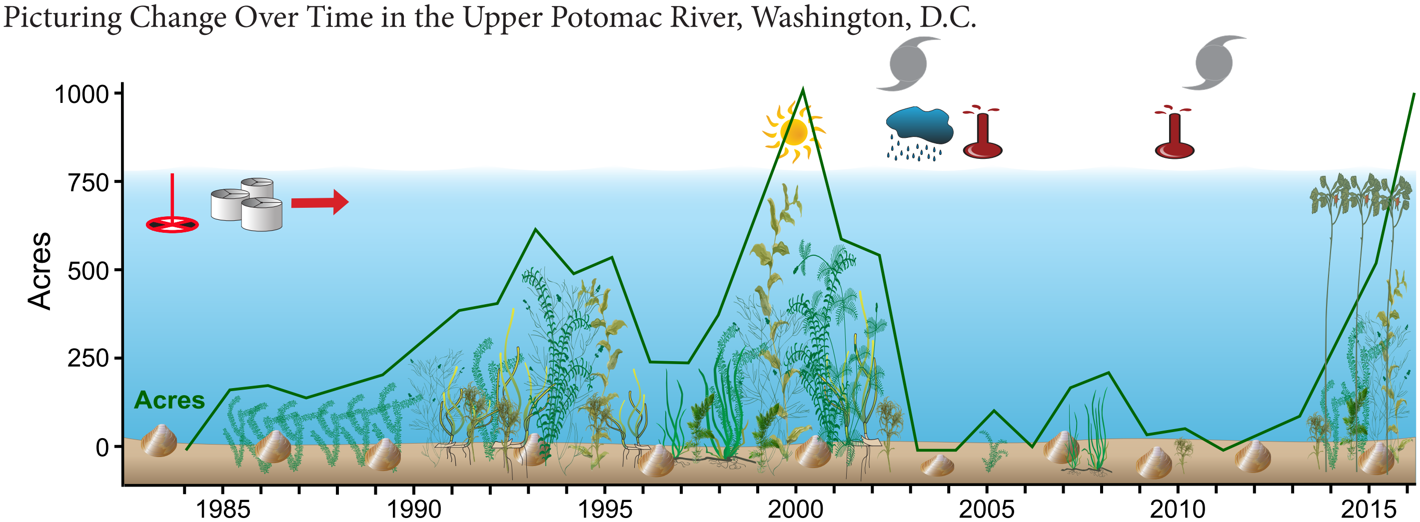
Executive Summary

The upper Potomac River, while playing an important role in the history of the region, was critically impaired in the early 20th century and SAV was greatly reduced during this time period. Beginning in 1980 and continuing through the early 2000s, multiple influencing factors, including upgrades to the Blue Plains Sewage Treatment Plant (Blue Plains STP), facilitated a recovery of SAV through associated improvements in water clarity. Today, dense and diverse SAV beds occupy much of the shoal area of this region, and despite some interannual variations in abundance, have persisted since they first reestablished.

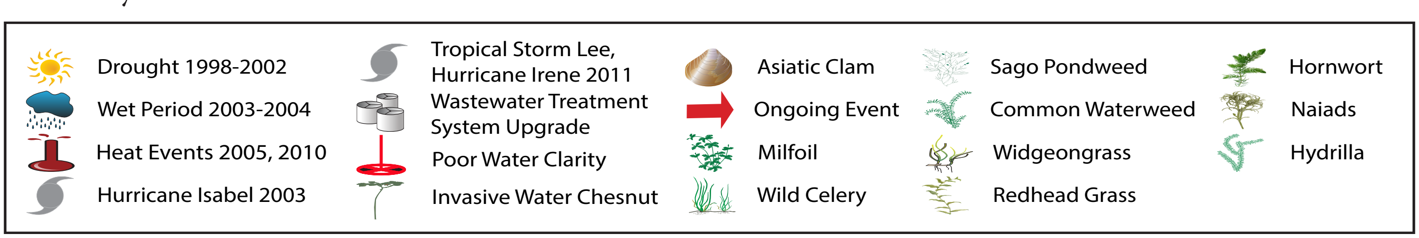
SAV Acres and Density



Picturing Change Over Time in the Upper Potomac River, Washington, D.C.



Key



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Take Home Points

Goal - Attainable
The goal of 389 acres is attainable and was achieved on multiple occasions; each year between 1991 and 1995, each year between 1998 and 2002, and again in 2015 and 2016.

Historical Coverage
Historical and recent coverage well known
Although herbarium specimens from the late 1800s through 1950s indicate a diverse array of SAV species in the upper Potomac River during that timeframe, including redhead grass, widgeongrass, milfoil, sago pondweed, wild celery, common waterweed, naiads and hornwort, it appears that actual abundance of SAV was relatively low. This was most likely due to poor water quality associated with the rapid development of Washington, D.C., and inadequate sewage treatment. In the 1920s, an invasive emergent aquatic plant, water chestnut (*Trapa natans)* was introduced and expanded throughout the upper Potomac River, which also would have reduced habitat available for SAV. Although water chestnut was eradicated in the 1950s due to intense management efforts, most SAV had disappeared from the area by the 1970s. When the annual Chesapeake Bay-wide aerial survey began in 1984, there was only a quarter of an acre of SAV in this segment. SAV cover expanded rapidly after 1985 with the expansion of hydrilla, but it practically disappeared again in 2003 and remained in low abundance until 2012, when cover increased rapidly again. At present, SAV remains abundant and relatively diverse in areas, but its abundance and diversity are currently threatened by the potential spread of another introduced species of water chestnut, *Trapa bispinosa*. This variety of water chestnut was discovered in the Virginia portion of the upper Potomac River, in Pohick Bay, in 2014 and has been spreading to nearby lakes and ponds since.

Key Events
Hydrilla introduction
In the early 1980s, hydrilla was inadvertently introduced into the Potomac River near the Dyke Marsh area, which, at that time, was completely unvegetated. Since that initial introduction, hydrilla has expanded downriver to Potomac Creek and into Port Tobacco River, but is limited from expanding further south by salinity. Although hydrilla itself is not a native species, its expansion contributed to the recolonization of numerous other native species by stabilizing the sediments, improving water clarity and possibly by catching seeds as they float downriver from upstream SAV beds. Today the dense beds found throughout this section of the river contain up to 12 different species of SAV.

Exotic clam introduction
Asiatic clams were first observed in the Potomac River in 1977 and expanded rapidly throughout this portion of the river thereafter. At the same time, phytoplankton (chlorophyll a) levels decreased and water clarity improved, potentially due to the filtration capacity of the clams.

Blue Plains Sewage Treatment Plant upgrades
Nutrient removal from the Blue Plains STP played a vital role in facilitating the recovery of SAV here. In 1980, the process of nitrification was implemented as part of the overall sewage treatment process. Two years later, in 1982, phosphorus effluent filters were installed and included in the treatment process. And finally, between 1998 and 2001, a new nitrification-denitrification system was added to the treatment process. Though gradual, all of these improvements led to a significant reduction in nutrient pollution to the upper Potomac River which in turn has contributed to the recovery of SAV over the last several decades.

Tropical Storm Lee and Hurricane Irene
Tropical Storm Lee and Hurricane Irene swept over the Bay and its watershed in late summer, 2011. The freshwater, scour and nutrient and sediment pollution from extensive runoff that resulted from the storms severely impacted SAV in areas throughout the Bay, including the upper Potomac River. The extent of impact, however, is unclear because SAV data is not available for this entire segment in 2011. SAV has recovered in the time since then.

2014 introduction of water chestnut
In 2014, a second species of invasive water chestnut, *Trapa bispinosa*, was introduced to Pohick Bay. As a floating emergent plant, water chestnut can outcompete SAV, particularly in areas where SAV is already stressed due to poor water quality.

Vulnerability/Resilience
Water clarity
Much of the watershed associated with this portion of the upper Potomac River is already heavily developed, which makes it vulnerable to land use practices that threaten water quality and clarity. The advanced wastewater treatment technology employed at Blue Plains STP, however, will contribute to SAV resilience because it reduces nutrient pollution associated with poor water quality, clarity and epiphytic algal growth on SAV blades. Furthermore, occasional increases in the abundance of invasive species like the Asiatic clam, a prolific filter feeder, may facilitate short-term recovery of SAV that leads to longer-term resilience of the habitat when density and diversity thresholds are reached.

Diversity
The potential for high SAV diversity makes this system generally more resilient as well.

Water chestnut
The 2014 introduction of invasive water chestnut, *Trapa bispinosa*, may eventually impact SAV abundance in the upper Potomac River if populations are allowed to expand. As a floating emergent plant, water chestnut can outcompete SAV, particularly in areas where SAV is already stressed due to poor water quality.

Management Implications
Development minimization; nutrient and sediment reductions; eradication of water chestnut
Managers should focus on efforts to minimize further development and maintain forested land in the watershed. Additionally, any technological advancements in wastewater treatment should be employed to further reduce nitrogen and phosphorus pollution to the river, particularly if additional development of the watershed does occur. If development can be balanced by additional nutrient removal, some of the stressors associated with development (e.g., reduced water quality and clarity) may be mitigated and abundant SAV sustained. Efforts to maintain systems for stormwater overflow are also critical to reduce nutrient and sediment levels in this river. Finally, management efforts to fully eradicate water chestnut from the upper Potomac River should be employed to avoid population increases that could outcompete SAV.

References
Cumming et al. 1916; Gwathmey 1945; Stevenson and Confer 1978; Carter et al. 1980; Orth and Moore 1983, 1984; Cohen et al. 1984; Carter and Rybicki 1994; Moore et al. 2000, 2004; Ruhl and Rybicki 2001; Rybicki and Landwehr 2007; Orth et al. 2010a, 2017; Patrick and Weller 2015; Lefcheck et al. 2018; Rybicki et al. 2019
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www.vims.edu/bio/sav/maps.html (species information)
www.eyesonthebay.org (Maryland water quality data)
http://vecos.vims.edu/ (Virginia water quality data)
https://waterdata.usgs.gov/dc/nwis/qw (Washington, D.C. water quality data)