

# Successes of restoration in Gunston Cove, a tidal freshwater embayment of the Potomac River

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## Background

To restore Gunston Cove from a highly eutrophic state, nutrient loading in treated wastewater from i.a. the Noman M. Cole, Jr. Pollution Control Plant was significantly reduced since the early 1980's. SAV used to cover all shallow habitat; a survey from 1978-81 documented no SAV in Gunston Cove, and algal blooms were frequently documented. To monitor recovery, water quality parameters and biological communities in the Gunston Cove area have been sampled since 1984 in an ongoing long-term study.

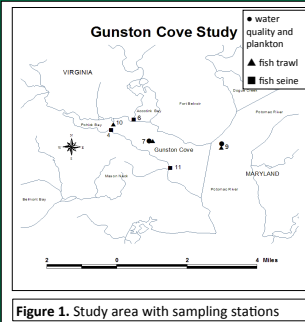


Figure 1. Study area with sampling stations

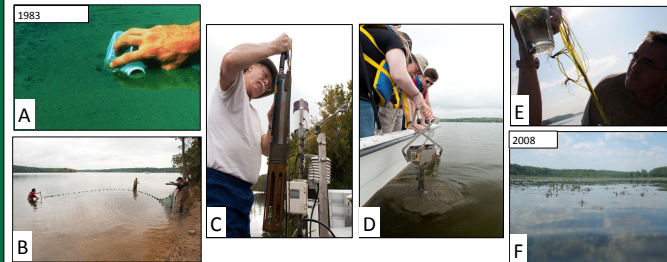


Figure 2A-F. Pictures from Gunston Cove. (A) algal bloom; (B) sampling fish with seine; (C) monitoring water quality with hydrosonde; (D) sampling zoobenthos; (E) and (F) increased water clarity and presence of SAV.

## Results of restoration: SAV

The increased water clarity has brought the rebound of SAV, which provides increased habitat value for fish and fish food organisms. Figures 4A-D show a steady state shift when colonization depth reaches 1 meter.

## Results of restoration: fish

Increases in SAV provide refuge and additional spawning substrate for the adhesive eggs of banded killfish (*Fundulus diaphanus*), which is now the most abundant species in the cove. Overall, the fish assemblage in Gunston Cove is dynamic and supports a diversity of commercial and recreational fishing activities. While total abundance of fish has not significantly changed over the years, the community structure has changed and shows shifts in composition that corresponds to the SAV cover states 'no', 'medium', and 'full'. Community structure of these three periods ('84-'92, '93-'04, '05-'11) was compared using ANOSIM in PRIMER. SIMPER and CAP analyses revealed which species were most responsible for the differences. Though not among the most abundant, commercially important species like striped bass, largemouth bass, and alewife are among the species indicative of the community present in '05-'11.

## The Gunston Cove study: What is monitored?

Parameters monitored include: water clarity (PAR and secchi depth), temperature, conductivity, pH, DO, Chl *a*, and the nutrients TP, SRP, TN, NH<sub>3</sub> and NH<sub>4</sub><sup>+</sup>. Abundance/cover and community composition of algae, SAV, zooplankton, benthic invertebrates, and fish is monitored as well. The sampling season is from April-October.

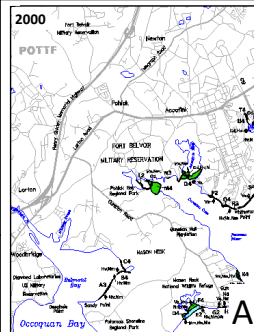
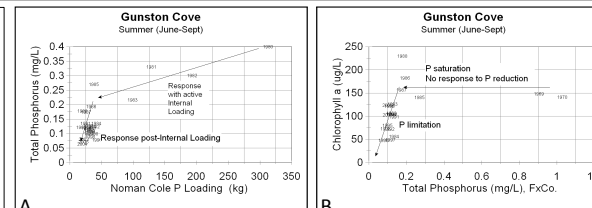


Figure 3A and B. Non-linear response of total phosphorus (A) and Chl *a* (B) to reduction in P loading. Delay in response due to P release from sediment (A), and P saturation (B).



## Results of restoration: water quality

Phosphorus loadings were dramatically reduced in the early 1980's. Nitrogen loadings have also been greatly reduced in the last several years. Phytoplankton populations in Gunston Cove have shown a clear pattern of decline since 1989. A lag period of 10-15 years between phosphorus control and phytoplankton decline was observed, like in many other freshwater systems, resulting at least partially from continued loading of P from enriched sediments to the water column. Another significant change in water quality has been the removal of chlorine and ammonia from the effluent. A decline of over an order of magnitude in ammonia nitrogen has been observed in the cove as compared to earlier years. This and a decrease in pH has led to much lower levels of NH<sub>3</sub>, another important factor in the recovery of Gunston Cove.

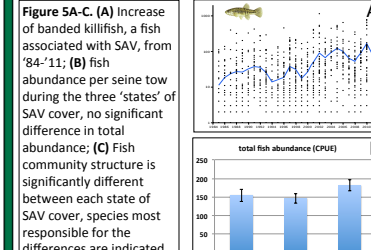
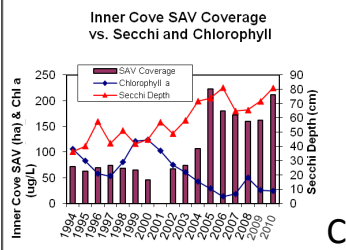
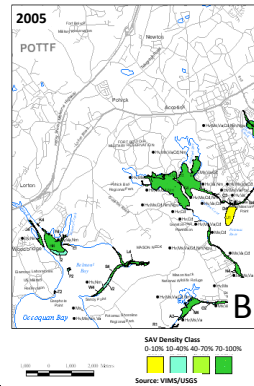


Figure 4A-D. The increased water clarity has brought the rebound of SAV. Because of a water clarity threshold in SAV establishment, the SAV cover changed in steps rather than gradually. There was no/very sporadic SAV before 1993 (not pictured). With the increase of water clarity, SAV started to re-establish and formed 'medium' cover (represented in A, see also C and D). When the threshold of 1 m colonization depth was reached, the majority of the shallow bay was recolonized during summer months, this new steady state will be referred to as 'full' cover (B, C and D).

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