

Impacts of shoreline hardening and watershed land use on nearshore habitats

NOAA-funded 7 year SERC-led project:

Participants (19 PIs, 8 Institutions: SERC, USGS, Utah State, MD DNR, UMCES, VIMS, UDE, PSU)
Prepared for Ocean Caucus Congressional Staff (August 28, 2015) by D. Whigham and T. Jordan (SERC)

Background (Gittman et al. 2015. *Frontiers in Ecology and Environment* 13: 301-307)

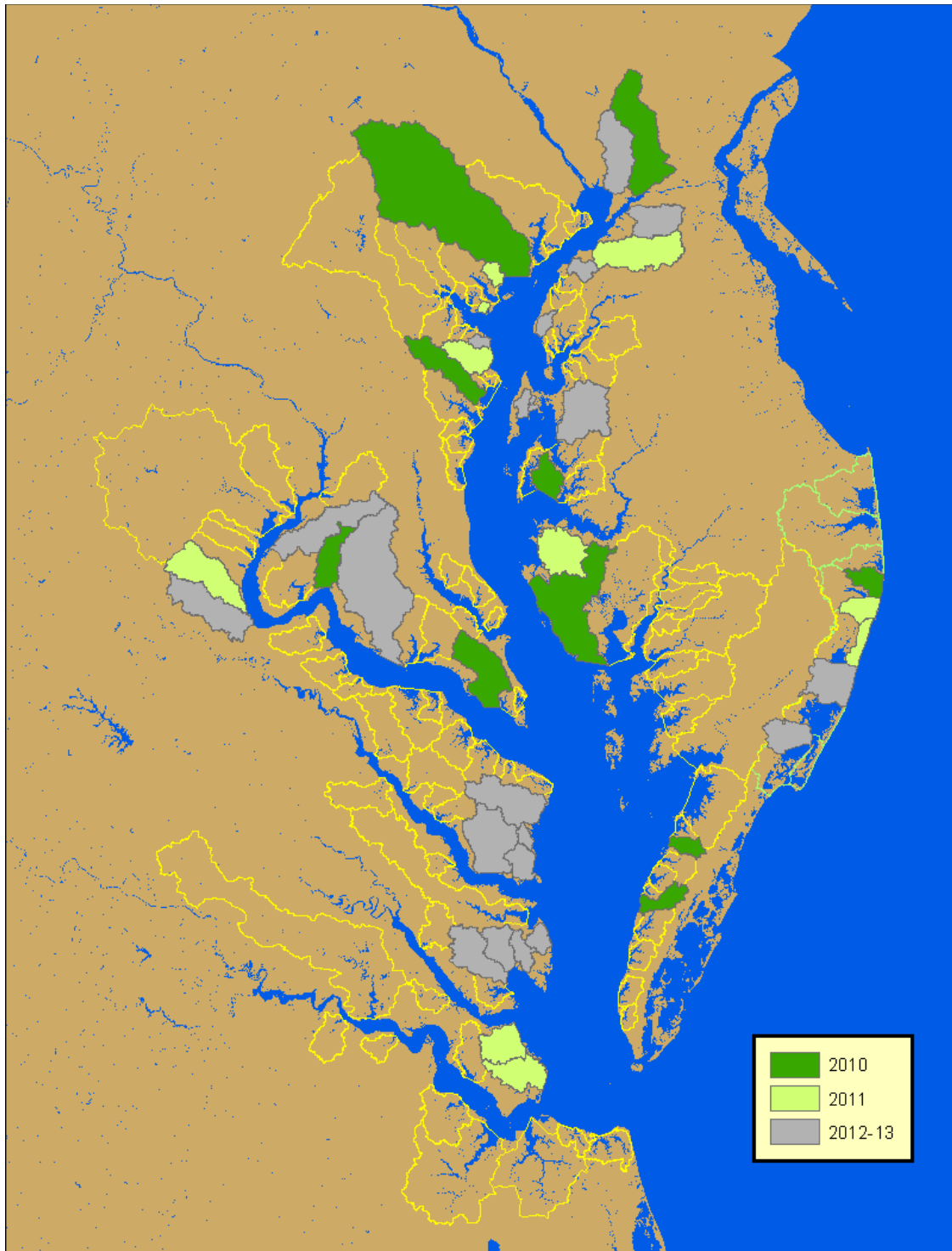
- 14% of US shorelines have been hardened with 64% on the Atlantic and Pacific coasts
- Housing density and GDP are best predictors of armoring the coasts
- By 2100 nearly 1/3 of all shorelines will be hardened
- Hardening will have a negative impact on remaining coastal wetlands

Main findings from NOAA project (focus = land-use, shoreline structures): The combined effects of shoreline hardening and watershed nutrient discharges can degrade nearshore habitats for submerged vegetation, waterbirds, fish, crabs, benthic invertebrates, and wetland plants.

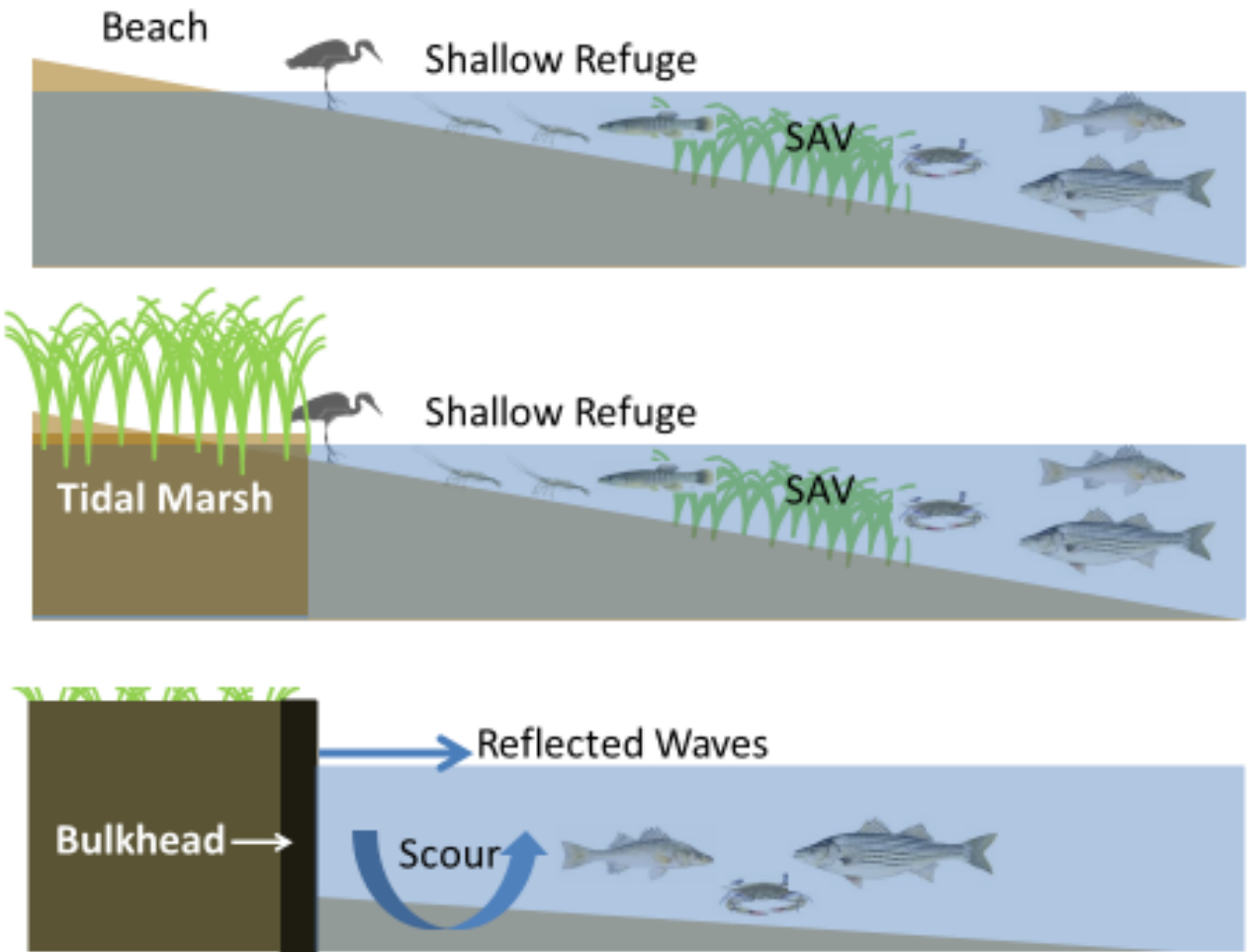
Findings from component parts of the NOAA project:

- **Water quality** (Contact: Tom Jordan – jordanth@si.edu)
 - ✓ Water quality in subestuaries differs from adjacent Ches. Bay due to local land use
 - ✓ Total nitrogen and chlorophyll increase with % cropland and % developed land
 - ✓ Total phosphorus increases with % cropland
 - ✓ Eutrophication is most intense in summer and early autumn
- **Submerged Aquatic Vegetation (SAV)** (Contact: Don Weller – wellerd@si.edu)
 - ✓ Stressor impacts differ among SAV community types
 - ✓ SAV abundance, density and diversity are less in watersheds dominated by agriculture and developed land
 - ✓ Shoreline hardening reduces SAV abundance and habitat availability
 - ✓ Shoreline hardening has less impact where upland land use has reduced SAV abundance
 - ✓ Forested watersheds are positively related to SAV abundance and diversity
- **Waterbirds** (Contact: Diann Prosser – dprosser@usgs.gov)
 - ✓ Diversity and abundance of development-sensitive waterbird species decreases with % bulkhead and increases with % wetland in a subestuary
- **Fish and Crabs** (Contact: Denise Breitburg – breitburgd@si.edu)
 - ✓ Higher % agriculture in a watershed results in a decrease in blue crabs and some bottom-oriented fish species
 - ✓ Higher % hardening is associated with decreased abundance of many fish and crabs
 - ✓ Higher % of wetlands is associated with increased fish and crab abundance
 - ✓ Riprap-sill structures provide higher habitat quality than riprap revetments
- **Benthic Invertebrates** (Contact: Rochelle Seitz – seitz@vims.edu)
 - ✓ Shoreline hardening with rock results in increased overwintering of sea nettles
 - ✓ Natural shorelines have higher invertebrate abundance, biomass and diversity
 - ✓ Riprap-sill structures provide higher habitat quality than riprap revetments
 - ✓ Living shorelines result in higher benthic biomass

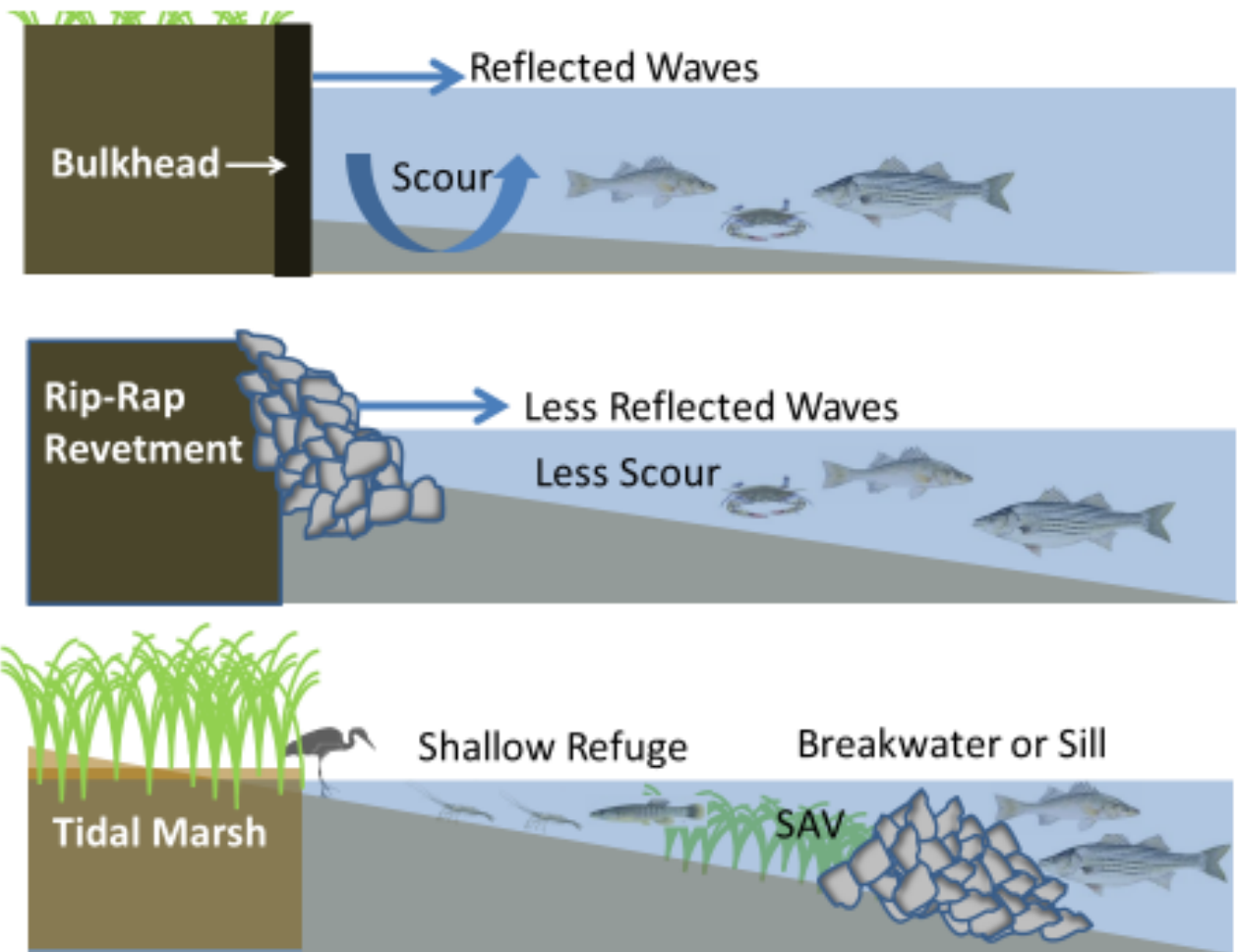
- *Wetland vegetation* (Contact: Dennis Whigham – whighamd@si.edu)
 - ✓ Invasive *Phragmites* abundance in wetlands is highest in developed and agricultural watersheds
 - ✓ Invasive *Phragmites* abundance along individual shorelines is related to shoreline agriculture and shoreline hardening
 - ✓ Genetic diversity (contributes to rapid spread) of *Phragmites* is highest along hardened shorelines and highest in subestuaries dominated by agriculture and development
 - ✓ Wetlands dominated by this invasive species have reduced habitat quality



Examples of Chesapeake Bay and Delaware and Maryland Coastal Bays subestuaries that were sampled during the NOAA project



Examples of shorelines with no hardened structures (Beach and Tidal Marsh) and a shoreline with a bulkhead



Examples of three shorelines with different types of shoreline structures