ABSTRACTS

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Oral Presentations:

SENTINEL FOR ECOSYSTEM CHANGE: THE YORK RIVER ESTUARY. **William G. Reay**. Chesapeake Bay National Estuarine Research Reserve, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. wreay@vims.edu

The National Estuarine Research Reserve (NERR) system is a network of 28 coastal sites designated to protect and study estuarine systems. Established through the Coastal Zone Management Act, the reserves represent a partnership program between NOAA and the coastal states. The Chesapeake Bay NERR (CBNERR or Reserve) encompasses four reserve components along the salinity gradient of the York River (YR) system and is administered by the Virginia Institute of Marine Science/William & Mary. Based on their economic value, population densities and potential vulnerability, coastal ecosystems and their tributaries have been identified as a U.S. research priority with respect to climate change. Due to their long-term protected status and availability of site specific information, the YR reserve components have long served as living laboratories attracting numerous independent research projects. Through a concerted effort, the YR reserve components are now serving as climate change sentinel sites integrated into broader regional and national networks. While there exist numerous climate related issues, initial efforts in the YR have focused on emergent wetland and underwater grass ecosystem vulnerability as related to rising sea levels (and associated variables) and water temperatures. Supporting this effort is focused environmental and ecosystem data collection, data analysis and synthesis, and model forecast and hindcast simulations. The goal of the YR sentinel site effort is to increase our understanding of ecosystem response to climate change and ultimately inform management of critical coastal resources.

Key words: NERRS, climate change, sentinel site

THE CHESAPEAKE BAY SENTINEL SITE COOPERATIVE: A REGIONAL COLLABORATIVE NETWORK TO MONITOR SEA LEVEL CHANGE IMPACTS AND BUILD COASTAL RESILIENCE. **Sarah Wilkins,** Maryland Sea Grant Extension. sarah.wilkins@maryland.gov

Sea level rise is a particular concern in the Chesapeake Bay where waters are rising at twice the global average. NOAA tide gauges show a one-foot rise in relative sea level across much of the Bay during the 20th Century. As a result, many coastal areas are eroding or even drowning across low-lying areas, reducing the capacity of these systems to provide essential ecosystem services. Sea level change is expected to continue impacting the Bay's marshes, including the salt and tidal freshwater marshes found along the York River Estuary. To better understand how these vital ecosystems respond to changing sea levels and how to manage for these changes, the CBNERRVA has teamed up as a key member of the Chesapeake Bay Sentinel Site Cooperative (CBSSC). The Chesapeake Bay Sentinel Site Cooperative (CBSSC) is a partnership among local, state and federal agencies as well as academic institutions, non-profit organizations, local communities and regional organizations. The purpose of the CBSSC is to provide long term data, information, tools, and educational resources, derived from local observations collected at sentinel sites, to improve planning and management decisions regarding rising sea levels and coastal flooding. Comprised of seven core ecological sites scattered throughout Maryland and Virginia, the CBSSC network strives to better coordinate existing resources among partners while reducing redundancy and increasing effectiveness in understanding these coastal challenges. This presentation highlights the vision for the CBSSC, its key priorities, as well as ongoing projects and opportunities for fostering increased collaboration across the Chesapeake Bay.

Key Words: sea level rise, collaborative networks

HARMFUL ALGAL BLOOMS IN THE LOWER YORK RIVER: EMERGING PATTERNS AND IMPACTS ON OYSTERS. **Kimberly S. Reece**[1], Ryan B. Carnegie[1], Thomas M. Harris[1,2], William M. Jones III[1], Patrice L. Mason[1], Sarah K. D. Pease[1], Gail P. Scott[1], Juliette L. Smith[1], Wolfgang K. Vogelbein[1], [1]Aquatic Health Sciences, Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA 23062 & [2]Chemistry Dept. Vanderbilt University, Nashville, TN 37235. kreece@vims.edu

Several harmful algal bloom (HAB) species are found in the lower York River. Blooms of two species, *Cochlodinium polykrikoides* and *Alexandrium monilatum* have been particularly intense and widespread in recent years. *Alexandrium monilatum* historically has bloomed along the US southern Atlantic and Gulf coasts. A significant bloom event in the York River, VA in 2007 marked the re-emergence of this toxic species in the mid-Atlantic since intermittent reports of blooms during the 1940's and 1960's. *Cochlodinium polykrikoides* blooms have occurred almost annually in the York for decades and throughout the southern Chesapeake Bay since the early 1990's. Until 2011, however, *A. monilatum* blooms were localized in and near the York. During blooms in 2012-2015, *A. monilatum* cells were found at increasing concentrations into the mainstem of the bay and at locations to the north and south of the York. There is a predictable population progression in the York River with peak cell concentrations of *C. polykrikoides* followed two to three weeks later by peak concentrations of *A. monilatum*. Blooms of both species have been associated with local mass mortalities of oyster larvae and VIMS research organisms exposed to natural water. Laboratory bioassays exposing oyster larvae and spat to field-collected bloom samples and to clonal isolate cultures established from York River samples have demonstrated acute dose dependent toxicity. The toxin goniodomin A (GDA), produced by *A. monilatum*, was isolated from cells collected from the York River during blooms and has been found to cause rapid mortality in larval shellfish.

Key Words: *Alexandrium monilatum*, *Cochlodinium polykrikoides,* HABs, toxicity, goniodomin A

***ALEXANDRIUM MONILATUM* IN THE LOWER CHESAPEAKE BAY: CYST DISTRIBUTION AND POTENTIAL HEALTH IMPACTS ON ADULT OYSTERS.** **Sarah K. D. Pease,** Wolfgang K. Vogelbein, Kimberly S. Reece. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA 23062. skpease@vims.edu

The harmful algal bloom (HAB) species *Alexandrium monilatum* produces the lipophilic, cytolytic toxin 'goniodomin A', and has been long-associated with finfish and shellfish mortalities in the Gulf of Mexico. Recent blooms of this species in the southern Chesapeake Bay have reached record high densities, particularly in the lower York River. In 2015, the *A. monilatum* bloom was suspected in die-off events of adult Eastern oysters (*Crassostrea virginica*) grown locally for aquaculture and restoration projects. Representatives from Virginia's oyster aquaculture industry have expressed concern over *A. monilatum* impacts to their businesses; field and lab studies were designed to address this issue. Sediment samples were collected from the southwest portion of the Chesapeake Bay in a systematic grid-sampling design to assess cyst (resting cell stage) distributions. Cysts were present in low densities at most sites, and cyst densities were high where blooms had been recorded in previous years. Laboratory HAB toxicity bioassay methods developed at VIMS were modified to investigate potential adverse health impacts of *A. monilatum* on adult triploid *C. virginica*. Oyster feeding behavior, morbidity, and mortality were monitored. A 96 hour bioassay led to high morbidity, and erosion of the gill and mantle epithelial tissues in oysters exposed to *A. monilatum*. In the summer of 2015, oysters were deployed in cages near Goodwin Island to assess damage done by natural *A. monilatum* blooms. Cages were subsampled weekly before, during, and after the bloom and oysters were processed for histopathological analysis.

Key words: harmful algal bloom, York River, *Alexandrium monilatum, Crassostrea virginica,* cyst distribution, toxicity bioassay

EMERGENCE OF *ALEXANDRIUM MONILATUM* IN THE LOWER YORK RIVER: IMPACTS ON AQUATIC ORGANISMS. **Wolfgang K. Vogelbein[1]**, Thomas M. Harris[1, 2], Juliette Smith[1], Patrice Mason[1], William Jones[1] and Kimberly S. Reece[1]. [1]Dept. of Aquatic Health Sciences, Virginia Institute of Marine Science, College of

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Alexandrium monilatum is a toxic dinoflagellate long known to be associated with major fish kills in the southern US Atlantic and Gulf of Mexico. In 2007, we identified *A. monilatum* as the cause of a late summer bloom that persisted for several weeks in the York River, VA. This bloom coincided with impacts on experimental animals held at VIMS, including total mortality of a *Rapana* whelk colony and a cohort of cownose rays maintained in flow-through systems receiving York River water. Blooms in subsequent years (2012 to 2015) coincided with chronic larval mortalities in commercial oyster hatcheries, and during summer 2015, with high mortalities of adult oysters held for grow-out in cages deployed in local tributaries. This has raised significant concerns among aquaculturists about the potential impacts on oyster culture operations and human health. *A. monilatum* is known to produce a toxic lipophilic metabolite called goniodomin A (GDA). We therefore conducted laboratory toxicity bioassays and field studies to better understand the potential impacts this bloom-forming dinoflagellate may exert on aquatic organisms. Exposure of *Artemia*, oyster and sheepshead minnow larvae to live and lysed *A. monilatum* cultures resulted in significant dose-dependent mortality. Exposure of adult finfish to live culture (1000 and 4000 cells/ml) resulted in severe gill pathology and rapid mortality. Similarly, exposure of larval finfish to purified GDA showed gill pathology and mortality. A preliminary 2015 field study suggested that *A. monilatum* may also have cryptic impacts, regulating abundance of the broader phytoplankton community through a process called allelopathy
Key Words: Harmful Algal Bloom, Health Effects

TEMPORAL DYNAMICS OF YORK RIVER MICROBIOMES. **B. Song**, W. Jones, E. Miles, B. Neikirk, G. Scott, and K. Reece. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. songb@vims.edu
Harmful algal blooms (HAB) have been monitored in York River Estuary for several decades. Biweekly water sampling and microscopic examination have been conducted to identify and quantify toxigenic dinoflagellates such as *Alexandrium monilatum* and *Cochlodinium polykrikodes*. As a new collaborative initiative between the VIMS HAB monitoring program and microbial ecology laboratory, bacterioplankton and phytoplankton communities (river microbiomes) at two York River monitoring sites, Clay Bank and Goodwin Island, were examined in the summer and fall of 2015 using a next generational sequencing techniques. Data generated was examined using bioinformatic programs. Based on 16S rRNA gene sequences of bacteria and chloroplasts, river microbiomes were determined to compare those associated with blooms of *A. monilatum* and *C. polykrikodes* to those observed during non-bloom periods. *Synechococcus* and *Pelagibacter* were found to be the dominant bacterial taxa during the blooms. Metabolic prediction based on bioinformatic analysis indicated that urea was a potential nitrogen source for the blooming bacteria and phytoplankton in York River Estuary.
Key words: HAB, bacterioplankton, dinoflagellate, 16S rRNA gene, Next generation sequencing, Bioinformatics

WHAT CONTROLS BED ERODIBILITY IN MUDDY, PARTIALLY-MIXED ESTUARIES? INSIGHTS FROM THE YORK RIVER, VIRGINIA. **Carl T. Friedrichs[1]**, Grace M. Cartwright[1], Patrick J. Dickhudt[2], Kelsey A. Fall[1], and Lindsey M. Kraatz[3]. [1]Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062 & [2]U.S. Army Engineer Research and Development Center, Duck, NC & [3]National Oceanic and Atmospheric Administration, Washington, DC. Carl.Friedrichs@vims.edu
Appropriate parameterization of time-dependent erodibility of muddy seabeds is a significant barrier to improved understanding and accurate modeling of sediment dynamics in estuaries and other coastal regions. In an effort to better understand controls on muddy seabed erodibility, bed erodibility and associated bed sediment properties have been measured by our group on cores collected on dozens of cruises over the last decade in the York Estuary. We have also inferred time-varying erodibility indirectly in the York Estuary over several years by vertically integrating observations of tidally-varying suspended sediment concentration. This presentation synthesizes the results of these long-term observations in this partially-mixed estuary, whose seabed is similar to that of many other moderately energetic, muddy estuaries. Key instrumentation/

techniques applied in these studies have included Gust erodibility microcosms, digital x-radiography, measurement of Be-7 activity, acoustic Doppler velocimeters, a "worm camera", and analysis of cores for water content, organic content, disaggregated grain size, and the size and concentration of resilient muddy pellets. Our main conclusions are (1) large increases/decreases in erodibility are due to major deposition/erosion of muddy flocs, (2) gradual decreases in erodibility are due to armoring by muddy pellets and consolidation, and (3) short-term increases in erodibility follow short-term resuspension (e.g., by tides or storms).

EXAMINING SPRING-NEAP CYCLE VARIATION IN BED ERODIBILITY IN THE YORK RIVER ESTUARY, VA: A NUMERICAL STUDY. **Danielle R. N. Tarpley,** Courtney K. Harris, Carl T. Friedrichs. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. drtarpley@vims.edu

The York River estuary is categorized as micro-tidal with a tidal range ~0.8 m; however, tidal velocities are higher than typical, ~1 m s^{-1} during spring tide. The tidal velocities periodically produce enough shear stress to erode sediment from the bed and redistribute it along the estuary. However, the supply of mobile sediment differs over various temporal and spatial scales. The primary focus here is to examine the tidal variation in bed mobility by comparing variations in bed erodibility over the spring-neap cycle. To accomplish this goal, the Community Sediment Transport Modeling System (CSTMS) is implemented in a three-dimensional domain using the Regional Ocean Modeling System (ROMS). This version of the CSTMS accounts for suspended transport, erosion, deposition and cohesive processes via consolidation and swelling of the sediment bed, which changes the critical shear stress of the seafloor in response to sedimentation. In this way, the model tracks changes to the erodibility of the seabed that can be characterized as the amount of sediment that could be resuspended under a given bed shear stress, i.e. 0.2 Pa. Past observations from the York River have shown good agreement with tidal variations in modeled bed stress and the shoal to be more erodible than the channel. We expect the model to reproduce patterns in erodibility that are similar to the observed patterns, and that the modeled time of peak erodibility will be associated with the onset of the spring tide, possibly with a lag time related to the model's time-scale of consolidation.

Key words: Bed erodibility, ROMS

INFLUENCE OF SUSPENDED PARTICLE PROPERTIES ON OPTICAL PROPERTIES AND RESULTANT WATER CLARITY ALONG A PARTIALLY-MIXED ESTUARY, YORK RIVER, VIRGINIA, USA. **Kelsey A. Fall[1]**, Carl T. Friedrichs[1], Grace M. Cartwright[1], and David G. Bowers[2]. [1]Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA 23062 USA & [2]School of Ocean Sciences, Bangor University, Menai Bridge, Angelsey, LL595AB, UK. kafall@vims.edu

The Chesapeake Bay and its associated tidal tributaries are among the many coastal systems where degraded water clarity is a major concern. Despite long-term decreases in sediment input, water clarity has continued to deteriorate, especially in the southern Bay. Here it is proposed that the disconnect between water clarity and sediment input is related to the dynamic nature of locally suspended estuarine particles, as well as the interaction between suspended organic particles and inorganic solids. Typical estuarine particles are not single solid particles, but clusters of inorganic and organic particles and water (i.e., flocs). Floc properties (such as size, composition, density and settling rate) are challenging to observe in-situ, so their influence on the optical properties of the system are not well-defined. By measuring important floc properties, the influence of organic particles and local hydrodynamics on those properties was investigated, and the influence of suspended flocs on light propagation was evaluated. This presentation focuses on observations collected along the York River estuary, a major tidal tributary in the lower Chesapeake Bay. Observations of estuarine particle properties and physical parameters were collected utilizing a combination of optical and acoustic instrumentation with transmissometers and irradiance meters. Light attenuation was more strongly correlated to total particle area than total mass concentration. Near the mouth, at low mass concentrations, smaller, compact, organic particles were observed. Particles became larger, less organic, and less dense up-estuary as

mass concentrations increased. Results indicate the importance of organic material on suspended estuarine particle properties and resultant water clarity.
Key words: flocculation, estuarine optics

HIGH-RESOLUTION SUB-GRID INUNDATION MODELING AND FORECASTING ALONG THE YORK RIVER ESTUARY. **Jon Derek Loftis.** Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA 23062. jdloftis@vims.edu
The effects of coastal climate change are readily observed with the increased frequency of harsh weather events such as hurricanes and nor'easters bringing with them record amounts of precipitation and high winds. Storm surge-induced coastal inundation poses numerous challenges for society. This research expands upon lessons learned from modeling forecasts for 2011 Hurricane Irene in the York River estuary and Mobjack Bay, to ascertain the most effective way to approach predicting street-level inundation. An effective method involves the coupling of multi-scale models. A large-scale ocean model (SCHISM) was provided atmospheric forcing from the National Oceanic and Atmospheric Administration's (NOAA) Global Forecast System, which was iteratively updated every six hours to simulate nine separate 30-hour simulations. Forecast results were subsequently provided to emergency managers and the National Weather Service to help make informed management decisions. Street-level inundation predictions were then calculated based upon SCHISM water elevation outputs at key points near the mouth of the York River at the Yorktown USCG NOAA gauge to drive a separate street-level high-resolution sub-grid model (UnTRIM) to simulate localized flooding along the York River at 5-meter resolution scale using Lidar-derived topography including building and roadway infrastructure. Tropical storm surge flood heights were validated via temporal comparison with water level observations from NOAA, the USGS, and NASA aggregated to an average R^2=0.8120 and average RMSE=17.1cm. Spatial flooding extents were evaluated using USGS data retrieved from high water marks and from overland water level gauges to reveal favorable agreement with the model's inundation predictions during Hurricane Irene.
Key words: Flood modeling, storm surge, sea-level rise, Hurricane Irene, Hurricane Isabel

NOVEL PATHWAYS TO DINITROGEN VIA METAL-MEDIATED ANAEROBIC AMMONIUM OXIDATION. **Julie L. Krask**, Aaron J. Beck. Department of Physical Sciences, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. jlkrask@vims.edu
Nitrogen cycling in anoxic environments is fundamentally important to local and global fixed nitrogen budgets but remains poorly understood with respect to underlying biogeochemical mechanisms and controls. Following the discovery of anammox, evidence of additional novel N-cycling pathways rooted in the anaerobic oxidation of ammonium has been accumulating and investigations have expanded to focus on the potential interaction between nitrogen transformations and the geochemical cycles of common metals, notably iron and manganese. This study aimed to evaluate whether an iron-mediated anoxic ammonium oxidation process, or "feammox," occurs in the coastal subterranean estuary, an environment characterized by complex and highly interactive biogeochemical cycles. Iron-rich sediments were collected from the subterranean estuary in Gloucester Point (VA, USA) and incubated under anoxic conditions with ammonium-rich groundwater. Chemical concentrations were monitored through time, and isotope ratio mass spectrometry was used to determine production of enriched dinitrogen gas from $^{15}NH_4^+$ added to incubation bottles. Results of four sediment incubation experiments consistently indicated consumption of $^{15}NH_4^+$ in ammonium-spiked treatments and subsequent production of $^{29}N_2$ and $^{30}N_2$, which strongly suggests the occurrence of the hypothesized iron-mediated ammonium oxidation reaction. However, data on ammonium and ferrous iron concentrations revealed a number of competing biogeochemical processes that make it difficult to evaluate the quantitative importance of this reaction *in situ*. The importance of the feammox reaction appears to depend on availability of specific chemical substrates and active microbial populations, both of which may vary with biogeochemical conditions across different environmental settings (*e.g.,* pH, seasonal temperatures, oxygen saturation, magnitude and pattern of groundwater advection, redox cycle interactions).

Key words: nitrogen, subterranean estuary, anoxic, metal-oxides

CARBON DYNAMICS AT THE MARSH-ESTUARINE INTERFACE. **Amanda L. J. Knobloch[1]**, Elizabeth A. Canuel[1], Mark J. Brush[1], Patrick J. Neale[2], Maria Tzortziou[3], and William G. Reay[1]. [1]Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA 23062 & [2]Smithsonian Environmental Research Center, Edgewater, MD & [3]The City College of New York, City University of New York, New York, NY. alknobloch@vims.edu

The coastal ocean plays an important role in the oceanic carbon cycle due to its role in the uptake and processing of carbon from a variety of sources. However, gaps remain in quantifying carbon fluxes at key interfaces in the coastal zone. This study measured the amounts, sources, and composition of carbon pools exchanged in one coastal system, Taskinas Creek, a marsh-estuarine interface along the York River. Water samples were collected over tidal cycles on a monthly basis over ~1.5 years to determine temporal variations in the concentrations, sources, and composition of three carbon pools: particulate organic carbon (POC), dissolved organic carbon (DOC), and dissolved inorganic carbon (DIC). Sources of POC were determined using stable isotopes and C:N ratios, while optical properties were used to study the source, composition, and degradation state of DOC. The highest concentrations of DOC and POC were recorded in the spring, and optical properties of DOC indicate that this spring material was less altered and higher in molecular weight than in other seasons. Tidal stages primarily affected POC concentrations, which were lowest at high tide, indicating that the estuary was likely a source of POC to the marsh. Based on information collected by this study this marsh is a net sink for POC and provides a source of DOC to the adjacent estuary on an annual basis. These data reinforce the need to better understand variations in carbon exchanges in marsh-estuarine environments in order to estimate their roles in carbon cycling.
Key Words: Carbon cycling, marsh, estuary, organic carbon, CDOM

ASSESSING CHANGES IN SEAGRASS SPECIES DOMINANCE AND HABITAT SERVICES AFTER A DIE-OFF EVENT IN THE YORK RIVER, VA. **Erin Shields[1]**, Kenneth Moore[1], Emily French[2], and Bongkeun Song[1]. [1] Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062 & [2] Oyster Recovery Partnership, Annapolis, MD. **eshields@vims.edu**

Seagrass vegetation monitoring has been an integral component of the NOAA/NERRS System-wide Monitoring Program (SWMP). At CBNERRVA we have been assessing seagrass condition and change in the York River using repeated measure fixed transects and have related these results to climate and water quality variability. This monitoring also provides a background to investigate various seagrass bed functions and services, and to understand how these may change with seagrass change. Here we explore drivers of spatial and temporal seagrass change and how shifts in species dominance may affect seagrass bed function. Declines here in the dominant species, *Zostera marina*, have been related to a combination of short-term summertime heat stress events and chronically reduced water clarity. *Ruppia maritima*, which co-occurs with *Z. marina*, is more tolerant of high temperatures and therefore has the potential to expand in coverage as *Z. marina* declines. We quantified the decline of *Z. marina* in 2010, which resulted in *R. maritima* dominance the following year. Subsequently more moderate summertime climate conditions have allowed *Z. marina* to recover. Bed functions, including sediment trapping capabilities, epifaunal abundance, and biogeochemical cycling potentials, inferred by next generation sequencing and bioinformatic analyses of 16S rRNA genes, varied seasonally from early to late summer and were generally greater with *Z. marina* as its plant biomass is greater than *R. maritima*. However when *R. maritima* abundance is greater in the late summer or during years of *Z. marina* decline, its habitat services may replace some of those lost through *Z. marina* die-off.
Key Words: Zostera, Ruppia, climate, sediment, epifauna, biogeochemical cycling

UNDERSTANDING COASTAL HABITAT VULNERABILITY TO SEA LEVEL RISE IMPACTS TO INFORM RESOURCE MANAGEMENT EFFORTS. **Scott Lerberg[1]**, William G. Reay[1], Alex Demeo[1]. [1] Chesapeake Bay National

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The Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR) is engaged in understanding the vulnerability of critical habitats with respect to climate related stressors. This presentation highlights the various tools and approaches being utilized and implemented to understand the impact of sea level change and coastal inundation on polyhaline emergent marshes and ecotone habitats at the Goodwin Island Reserve (operating as a long-term sentinel site for sea level rise impacts) and introduce and compare approaches to communicate these results, both to the scientific community and Reserve stakeholder audiences. Installed observational infrastructure at Goodwin Islands includes vegetation monitoring transects, surface elevation tables and complementary substrate accretion plots, groundwater monitoring wells, water level and quality and weather stations all tied to a common vertical datum. Derived information includes first order vulnerability assessments addressing marsh capacity to maintain appropriate elevations under current conditions and use of a marsh equilibrium model to forecast future response. Through implementation of historical shoreline and habitat change analysis, horizontal and vertical habitat change rates have been quantified and related to spatially variable relative sea level changes. Additional topics covered will include the value of sentinel site data in validating the role of regionally available large-scale predictive models (i.e. SLAMM, threshold models), data dissemination/communication strategies for transferring this information to appropriate audiences/stakeholders (i.e. marsh sustainability indices and vulnerability assessment tools), and broadening the geographic scale of sentinel site monitoring and analysis efforts to include lower salinity marsh habitats and newly derived local climate change estimates.
KEYWORDS: Chesapeake Bay, habitat vulnerability, Research Reserve, sea level rise

A DENDROLOGICAL ASSESSMENT OF LOBLOLLY PINE (*PINUS TAEDA*) ALONG A SALINITY GRADIENT WITHIN FOUR TIDAL WETLAND SITES ALONG THE YORK RIVER ESTUARY, VA. **Robert Atkinson,** Brittany Bowen, Department of Organismal and Environmental Biology, Christopher Newport University, Newport News, VA 23606. Atkinson@cnu.edu
Loblolly pine, *Pinus taeda* (L.), is a dominant tree species in supratidal (marsh/upland transitional) plant communities throughout the southeastern US and the species occurs at elevations that may be subject to the effects of rising sea level. Stressors known to influence community structure in *P. taeda* habitats include frequency and duration of flooding, which is a local factor related to elevation; and osmotic stress and ionic toxicity, which are geographic factors that are associated with a salinity gradient. The purpose of this study was to evaluate the effect of elevation and salinity on annual growth of 40 *P. taeda* trees located at varied elevations within four sites along a salinity gradient (19.0 – 4.2 ppt) along the York River Estuary, Virginia. Tree cores were collected from 10 trees at each site using an increment borer, dried, mounted and were measured to 10^{-6} m-resolution using a stereo boom microscope. Tree rings were transformed to Basal Area Increment (BAI) and growth rate was calculated as change in cumulative BAI during the first 20 years of each tree. In spite of higher sunlight intensity, growth rates of trees located at forest edge were slower than for trees located at higher elevations, particularly at Goodwin Island, and the effect was reduced upstream. Growth rates of trees located at forest edge were also significantly lower at Goodwin Island compared to other sites, indicating reduced growth in response to higher salinity.
Key words: dendrochronology, Loblolly Pine, supratidal, stress, salinity

COMPETITION BETWEEN MARSH EROSION AND FOREST RETREAT DRIVES 150 YEARS OF WETLAND CHANGE INFERRED FROM HISTORICAL MAPS OF THE CHESAPEAKE BAY. **Nathalie W. Schieder**, David C. Walters, Matthew L. Kirwan. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. nwschieder@vims.edu
Coastal wetlands are among the most valuable ecosystems on Earth, where ecosystem services such as flood protection depend nonlinearly on wetland size. The vulnerability of marshes to sea level rise has traditionally been evaluated through comparisons between rates of sea level rise and vertical soil building, whereas

wetland size is most fundamentally determined by changes in the position of their seaward and upland boundaries. Here, we compare the extent of salt marshes identified on 1850's era maps to modern imagery throughout the Chesapeake Bay region to explore the processes responsible for changes in marsh size. We delineated the marsh-upland boundary and the marsh-water boundary in 39 U.S. Coast Survey T-sheet maps containing about 300 km^2 of marshland, and compared them to modern wetland inventories to determine rates of coastal forest retreat and marsh erosion. Preliminary analysis suggests that marshes remained stable over the entire Chesapeake region. However, marshes near the York River have expanded (58%) because rates of forest retreat (0.054 m yr^{-1}) exceed rates of shoreline erosion (0.028 m yr^{-1}). In general, marshes tended to expand where upland slopes were low, and tended to contract where upland slopes were high. Rates of forest retreat and marsh migration were much lower than would be predicted on the basis of sea level rise and slope alone. This observation suggests more complicated ecosystem dynamics at the marsh-forest boundary, and the possibility that a lag between sea level rise and marsh migration will lead to short-term loss of marshland.
Key words: sea level rise, marshes, Chesapeake Bay, remote sensing

ASSESSING THE SUSTAINABILITY OF VIRGINIA'S COMMERCIAL SNAPPING TURTLE HARVEST. **John (J. D.) Kleopfer[1]**, Benjamin Colteaux[2]. [1]Virginia Department of Game and Inland Fisheries, Charles City, VA & [2]Virginia Commonwealth University, Richmond, VA 23284. John.Kleopfer@dgif.virginia.gov
Overharvesting of animal populations, largely for human consumption, has profoundly impacted freshwater and marine ecosystems worldwide. Localized population crashes in aquatic systems have led to the creation of a global market in order to meet increasing consumer demand. An increasing number of freshwater turtles are being targeted by commercial harvesters in the United States. The snapping turtle, *Chelydra serpentina*, has been harvested and exported at an alarming rate in recent history. Over 2 million live snapping turtles were exported from the US to Asia in 2012-13 alone. Much of this export has been supplied by wild snapping turtle populations, which are being harvested in unprecedented numbers. In Virginia, the harvest rates have precipitously increased almost 1200% over the past 10 years. With whole female snapping turtles being sold for $2 a pound and males for $1 a pound, this lucrative harvest is expected to increase. And with many states in the mid-Atlantic region implementing stricter regulations on the commercial harvest, Virginia has also seen an increase in the number of out-of-state harvesters. In 2012, out-of-state harvesters accounted for almost 70% of the harvest. This situation has led to some outrage from Virginia harvesters and what is being perceived as an unsustainable level of harvest being conducted by a few commercial operators. In order to address this issue, three rivers of varying harvest pressure were investigated through the use of radio-telemetry and mark-recapture to characterize the demography, habitat use and home ranges, and assess sustainability under current and projected harvest rates.
Key words: commercial harvest, snapping turtle

BIRDS OF A FEATHER FLOCK TOGETHER? EXPLORING POPULATION STRUCTURE AND INTROGRESSION IN THE KING-CLAPPER RAIL COMPLEX. **Stephanie S. Coster[1]**, Amy B. Welsh[1], Gary Costanzo[2], Jeff Cooper[2], Sergio Harding[2], James T. Anderson[1], Todd E. Katzner[3]. [1]School of Natural Resources, West Virginia University, Morgantown, WV & [2]Virginia Department of Game and Inland Fisheries, Richmond, VA & [3]US Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID. sscoster@mail.wvu.edu
King rails (*Rallus elegans*) and clapper rails (*R. longirostris*) are two marsh bird species with similar distributions, morphology, and behavior. They are said to be found along a salinity gradient with the king rail in freshwater marshes and the clapper in estuarine marshes. However, this separation is not absolute and there are reports of introgression. In Virginia along the York and James river watersheds, clapper rails are thought to be more abundant than king rails, the latter of which are listed as a Species of Greatest Conservation Need in the state's wildlife action plan. We used mitochondrial DNA, microsatellites and single nucleotide polymorphisms (SNPs) to identify species, population structure, and hybridization of two clapper rail populations along a salinity gradient in coastal Virginia. The focal areas included Eltham marsh along the Pamunkey River and Mockhorn Island. Preliminary results indicate approximately 10% of the birds we

identified in hand as clapper rails had king rails in their maternal lineage and population structure is defined by high gene flow. The results from this study will help managers identify allopatric and sympatric breeding populations of king, clapper, and hybrid rails and aid in developing future conservation strategies.
Key words: Clapper Rail, King Rail, introgression, genetics

LARVAL FISH ASSEMBLAGE DYNAMIC IN YORK RIVER ESTUARY. **Cindy Marin Martinez** and Eric J. Hilton Virginia Institute of Marine Science-College of William and Mary, Gloucester Point, VA 23062. cmmarin@vims.edu
The York River estuary provides habitat for the early life history stages of many estuarine, marine, and anadromous species of commercial and recreational importance. While in residence in the estuary, larval fishes can experience high rates of mortality, which can influence variability in recruitment to adult populations. The VIMS Larval Fish Monitoring Program has been collecting larval fishes weekly during the night-time flood tide at a fixed station located on the York River at Gloucester Point, Virginia, since 2007. This eight-year time series allows us to investigate inter- and intra-annual patterns in the larval fish assemblage and examine how environmental conditions such as temperature and freshwater discharge might affect the assemblage. Furthermore, this study seeks to evaluate whether the station located in the York River estuary can be used as a proxy of the larval ingress in the Chesapeake Bay in terms of abundance and composition. As of May 2015, a total of 144,372 larvae have been collected, representing 41 taxa from 24 families. The assemblage between 2007 to 2015 is dominated by six taxa (*Anchoa* spp., *Gobiosoma bosc*, *Microgobius thalassinus*, *Micropogonias undulatus*, *Brevoortia tyrannus*, *Bairdiella chrysoura*, and *Anguilla rostrata*) that form 96% of the total larval fish density. Larval fishes are most abundant in the river between June and September; this pattern is driven primarily by the presence of *Anchoa* spp. In this study, we will present trends of abundance for five species: *Brevoortia tyrannus, Anchoa* sp*., Micropogonias undulatus, Leiostomus xanthurus* and *Paralichthys dentatus.*
Key words: early life stages, York River estuary, larval fish assemblage

YORK RIVER STEWARDSHIP PROJECT: YORKTOWN SHIPWRECKS SURVEY. **Michael Steen. Director of Education, Watermen's Museum, Yorktown, VA. msteem1781@cox.net**
At the conclusion of the battle of Yorktown on October 18, 1781 the naval report stated that there were up to 100 watercraft left behind by the British. Of the 32 large ships, only one was still afloat. The remaining vessels had either been scuttled by the British or had been destroyed by cannon fire from the American and French artillery. Several archeological projects have been conducted over the years, the most extensive being led by John Broadwater between 1978 and 1985. Nine vessels were identified to include the frigate *Charron* at Gloucester Point and the *Betsy* on the Yorktown waterfront. Two more vessels were partially uncovered in 2012. How many more vessels are still on the bottom of the York River? The York River Stewardship Project team, working in conjunction with the ABPP Grant program have conducted a new non-invasive archeological survey to check on the condition of the known shipwrecks and explore further to discover the remains of the other unaccounted for vessels. What damage has been caused by weather and human impact? What new has been discovered? Can the Yorktown Shipwrecks site be protected and nominated for a Maritime Heritage National Marine Sanctuary?
Key words: York River, shipwrecks, archeological survey

Posters:

MARSH MADNESS: KEEPING DIAMONDBACK TERRAPINS OUT OF THE BLUE CRAB FISHERY. **R. M. Chambers[1]**, T. M. Russell[1], A. D. Corso[1], D. Stanhope[2], K. Angstadt[2], K. J. Havens[2], and D. M. Bilkovic[2], [1]Keck Environmental Field Lab, College of William and Mary, Williamsburg, VA & [2]Center for Coastal Resources Management, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. rmcham@wm.edu

Blue crabs are fished commercially and recreationally in estuaries from New England to the Gulf Coast --a range that largely overlaps with the diamondback terrapin. The small percentage of commercial-style crab pots placed in tidal marsh habitat where terrapins live appear responsible for a majority of the mortality of juvenile and adult terrapins that drown as bycatch in the pots. Bycatch reduction devices (BRDs) made of plastic are most effective at excluding terrapins, but the BRDs tend to reduce blue crab catch. Because both crabs and terrapins have tetra-chromatic vision, we have explored their responses to different colors. Results of preliminary studies suggested that male crabs are attracted to the color red, whereas terrapins are not. In tributaries to the York River, we conducted field trials using red BRDs in shallow water of tidal marshes (where light extinction is minimal) to determine whether the use of red BRDs on commercial-style crab pots might reduce terrapin bycatch and not diminish crab catch. During summer 2015, BRDs reduced terrapin bycatch by ~80%. Further, we caught over 2,000 blue crabs, with almost identical catches in pots with red BRDs and pots without BRDs. The average size of legal crabs from pots with red BRDs, however, was ~1 mm smaller than from pots without BRDs. Video analysis of crab behavior around pots indicated that fewer crabs entered pots with BRDs, but fewer crabs also found their way back out of pots, yielding a net capture rate similar to pots without BRDs.

Key words: Bycatch reduction device, crab pot, tetra-chromatic vision

IMPACTS OF SALTWATER ON MICROBIAL CARBON DYNAMICS IN TIDAL FRESHWATER WETLANDS: DIFFERENT SOIL CARBON RESPIRATION AND EXTRACELLULAR ENZYME ACTIVITY. **Dong Yoon Lee**, Georgios Giannopoulos, Olivia A. De Meo, Bonnie L. Brown, Rima B. Franklin, Scott C. Neubauer. Virginia Commonwealth University, Richmond, Virginia, 23284. dylee@vcu.edu

Salinization of historically freshwater soils can cause a shift in microbial structure and their associated metabolism, but we know little about how the structure and metabolism will undergo that transition into a brackish system. Using coupled studies from a riverine salinity gradient and from a tidal freshwater wetland where an automated system increases salinity to oligohaline levels, we measured responses of metabolic processes (production of CO_2, CH_4) and activities of extracellular enzymes involved in the carbon cycles from soil samples. During the first year of the salinization experiment, which began in May 2015, salinity increased to ~2 at the soil's surface, resulting in a depression of plant growth. Our measurements reveal a classic maximum in carbon respiration in the rhizosphere and dramatic decreases below the root zone. Unexpectedly, potential carbon respiration rates were not significantly different at any depth between freshwater and salinized plots. Along an existing salinity gradient, however, carbon respiration below the root zone gradually increased towards more saline sites, while surface respiration remained at a constant level, resulting in greater depth-integrated respiration in more saline sites. These data will be discussed in order to investigate mechanisms resulting in different vertical patterns and magnitudes of soil carbon respiration.

Key words: saltwater intrusion, sea level rise, anaerobic respiration, Virginia

INTEGRATING YORK RIVER CLIMATE SCIENCE INTO LOCAL HIGH SCHOOLS. **Sarah Nuss.** Chesapeake Bay National Estuarine Research Reserve in Virginia, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. mcguire@vims.edu

The National Oceanic and Atmospheric Administration (NOAA) Bay Watershed Education and Training (BWET) grant funded a two year project with high school students and teachers in rural Virginia. Educations from the Chesapeake Bay National Estuarine Research Reserve (CBNERR) focused education efforts on students' understanding changes in sea level and inundation, and the associated responses of critical habitats and coastal communities that are key to the Chesapeake Bay region. Relative sea level rise rates and the associated impacts within the southern Chesapeake Bay region represent some of the highest reported along the Atlantic coast. Through the Climate Education for a Changing Bay program, educators are improving climate literacy within local high schools by advancing the use of locally relevant environmental data and information in classroom curriculum. New curriculum is being created which focuses on broad aspects of

climate change, sea level rise, water quality, and coastal community impacts. Attendees to this session will be introduced to the Climate Education for a Changing Bay program, which has been incorporated into a system-wide education program and teacher professional development opportunity to increase not only climate literacy, but also the use of scientific data in high school curriculum. Components of the program have been adapted for use in other estuarine locations, such as Delaware and Florida, and for other age groups. At the conclusion of the session, the completed lesson and guiding questions to help students understand the impact of climate change on the natural ecosystem and coastal community will be available to participants.
Key words: Education, broader impacts, translation, students, teachers

AN ADVANCED MODEL FOR TIDAL MARSH EVOLUTION. **Karinna Nunez**, Joseph Zhang, Robert Isdell, Julie Herman, and Carl Hershner. Center for Coastal Resources Management – Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. karinna@vims.edu
Coastal habitats are experiencing growing threats from sea-level rise and recurrent flooding due to changes in global climate. In past decades, special attention has focused on tidal marshes and how they respond to changes in sea-level rise. To evaluate the vulnerability of these valuable habitats, different models were developed to predict their spatial extent and future distribution. Nevertheless, more accurate predictions are needed to properly manage and conserve these habitats. This study presents an advanced modeling framework that integrates the physical, biogeochemical, and human components needed to simulate and assess the evolution and persistence of tidal marshes under different sea-level rise scenarios. Unlike existing marsh models, our Tidal Marsh Model (TMM) version 1.0, was generated using an unstructured grid, which allows highly resolved marsh areas (e.g. 1-meter cross-shore, 10-20 meters along-shore for fringe marshes). TMM is based on the SCHISM modelling system. The highly efficient and accurate semi-implicit finite-element/finite-volume method combined with the Eulerian-Lagrangian method are used to solve the hydrodynamic, sediment transport, and wave action equations relevant for marsh persistence. Preliminary decadal results obtained in the area of Catlett Island in the York River show that the model captures some basic processes important for marsh evolution, such as marsh inundation frequency, wave energy attenuation by marsh plants, erosion-deposition patterns in cross-shore marsh direction and around coastal structures, and marsh landward migration. Future enhancements to the model will include biological processes, relative sea-level rise, and sediment input from uplands.
Key words: marsh evolution, unstructured grid, high-resolution, sea-level rise, sediments

DETECTION OF KING AND CLAPPER RAILS USING AUTONOMOUS ACOUSTIC SURVEYING TECHNIQUES. **LYDIA L. STIFFLER[1]**, JAMES T. ANDERSON[1], and TODD E. KATZNER[2]. [1] West Virginia University, School of Natural Resources, PO Box 6125, Morgantown, WV 26505 & [2]U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, 970 Lusk. llstiffler@mix.wvu.edu
Acoustic sampling allows sampling of secretive marsh bird populations that are difficult to locate or trap. Because of logistical considerations, there is a growing trend towards the use of autonomous recording units (ARUs) as a substitute for field personnel. We implemented two acoustic surveying techniques using ARUs at five marshes along the Pamunkey River, Virginia to survey king (*Rallus elegans*) and clapper (*Rallus longirostris*) rails during May to July 2015. To determine the effectiveness of an ARU in replacing traditional human observers, we compared the results of 70 double observer broadcast point count surveys with the results of concurrent acoustic recordings from a SongMeter SM3TH and we calculated estimates of detection probability for both rail species together. Preliminary results suggest that ARU detection success decreased with distance ($p = 0.025$), such that rails < 25 m were detected most frequently (96.6 % ARU success rate), but rails detected by human observers at >75 m were only detected 32.4 % of the time by the ARU. The ARU never detected rails that a human observer missed. To determine the occupancy and distribution of rails across the marshes, we conducted 60 48-hr passive surveys using SongMeters. Preliminary findings suggest the presence of rails in four out of five marshes with decreasing relative densities following the decreasing salinity gradient.

When sampling rail species in salt marsh environments, our data suggests that ARU sampling should be combined with an understanding of success rates when making inferences about species.
Key words: acoustic sampling, ARU, king rail, clapper rail

COASTAL TRAINING PROGRAM: MAKING SCIENTIFIC, TECHNICAL AND RESOURCE MANAGEMENT INFORMATION AVAILABLE TO LOCAL COASTAL DECISION-MAKERS. **Sandra Y. Erdle**. Chesapeake Bay National Estuarine Research Reserve in Virginia, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062. syerdle@vims.edu
The Chesapeake Bay National Estuarine Research Reserve was designated in 1991, and is one of 28 reserves that make up the National Estuarine Research Reserve System (NERRS). The system was established to promote informed management of the Nation's estuaries and coastal habitats. Partially to that end, each of the 28 reserves employs a professional training coordinator to run the Coastal Training Program (CTP). Through the CTP, coastal managers and decision-makers can receive training and exposure to science, technology, tools, and skills through a variety of means, including workshops, courses, seminars and technical assistance. The NERRS CTP facilitates effective, science-based decisions that positively impact coastal ecosystems, communities and economies. In Virginia, the Chesapeake Bay NERR began full implementation of its Coastal Training Program in 2005, for the purpose of further educating coastal resource and local decision-makers in Virginia's Coastal Zone and the broader Chesapeake Bay region. Training topics and focus areas are audience and program driven and vary widely to include coastal habitat restoration, natural resource management, climate change, water quality, land use, science communication and coastal development issues. Key target issues are refined by use of needs assessments, post-workshop surveys, contacts, and pressing issues. Training is monitored and evaluated based on post-training evaluations, which are subsequently reported to NOAA's Office of Coastal Management semi-annually through the Performance Monitoring Database.
Key words: training, CTP, decision-makers, evaluation