Session B3: Assessing Water Quality Conditions in Estuaries

Room B117-119
1:30 – 3:00 pm

0297
B3-1

Application of Spatially-Referenced Regression (SPARROW) Modeling to Nitrogen and Phosphorus Management in the Chesapeake Bay Watershed as part of a Total-Maximum Daily Load (TMDL)

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Restoration and management activities in recent decades have been insufficient to meet established standards for water quality in Chesapeake Bay, the largest estuary in North America. As a result, a Total-Maximum Daily Load (TMDL) for nitrogen and phosphorus in the 166,000-km^2 (square kilometer) bay watershed was published in December 2010. Spatially-referenced regression (SPARROW) models were developed to improve the understanding of the sources, fate, and transport of nitrogen and phosphorus in the bay watershed, and are particularly useful for targeting management and restoration activities to priority watersheds in support of load reductions mandated by the TMDL. The models were constructed at a scale of 1:100,000 (mean catchment, 2.1 m^2 a significant improvement over previous 1:500,000-scale SPARROW models for the area (mean catchment, 75 km^2). The models illustrate and quantify significant sources of nitrogen and phosphorus to Chesapeake Bay tributaries and significant factors affecting terrestrial and aquatic nutrient transport in the watershed. They also provide empirical estimates of mean-annual total nitrogen and total phosphorus loads in each of 80,579 nontidal tributary stream reaches. Chesapeake Bay receives an estimated 1.32×10^8 kilograms (132,000 metric tons) of nitrogen and 9.74×10^6 kilograms (9,740 metric tons) of phosphorus, annually, from its watershed, primarily through its two largest tributaries, the Susquehanna and Potomac Rivers. Agriculture (primarily fertilizer applications and direct fixation by crops) provides the majority of nitrogen inputs from the watershed to the bay; phosphorus inputs are more evenly split between agricultural and urban (including point) sources. Nitrogen transport from the land surface to streams is greater in areas of greater groundwater flow and certain carbonate rocks, and mitigated by reducing conditions and by greater plant growth, which was represented by an enhanced vegetative index derived from the satellite-based Moderate Resolution Imaging Spectroradiometer (MODIS). Phosphorus transport to streams is greatest in areas most likely to generate overland runoff and in the Coastal Plain, possibly due to saturation of soils with phosphorus applications in the past.

0502
B3-2

Evaluation of Broader Water Quality Assessments for Coastal National Parks

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Water quality issues do not begin or end at the boundaries of our ocean and Great Lakes national parks. New efforts to combine park and regional water quality data with national assessment criteria give park managers a more holistic perspective on park water quality issues and may help identify needed management actions. Two approaches for providing a broader view of water quality are being explored. One approach attempted to synthesize water quality data and put National Park water quality monitoring data into a regional context; fixed and probabilistic site data were analyzed within park boundaries and evaluated along with various federal, state and local data sets. This pilot project demonstrated that integrating the various study designs, time scales, and parameters into the analysis limited conclusions. A second approach uses the US Environmental Protection Agency's (USEPA) National Coastal Assessment (NCA) methods to advance a regional perspective for water quality monitoring. Surveys conducted in partnership with the US EPA using NCA protocols have been used in single and multi-park surveys with great success. The ultimate value of different approaches to water quality monitoring lies in the questions being asked. As with terrestrial systems it is important to understand resources that transcend park boundaries. The broader view of water quality is a piece of information we do not have, yet it is important to the understanding of what is occurring in our coastal parks. Results from these approaches will be discussed.

0503
B3-3

Water Quality and Salmon in the Lower Columbia River: Results of the Lower Columbia Estuary Partnership's Ecosystem Monitoring Project

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Currently, thirteen Columbia Basin salmonid stocks are listed as "threatened" or "endangered" under the US Endangered Species Act. Toxic contaminants and related water quality issues are increasingly recognized as risk factors for salmon health and a barrier to the recovery of these listed stocks. Since 2005, NOAA, USGS, and the Lower Columbia Estuary Partnership (LCREP) have been monitoring water quality and toxicants in juvenile Chinook salmon in the Lower Columbia River and Estuary as part of LCREP's Ecosystem Monitoring Program (EMP). Our results indicate widespread exposure to persistent organic pollutants, including DDTs, PCBs, PAHs, and PBDEs, in juvenile fall Chinook salmon. While contaminant concentrations are typically among the highest in salmon sampled from heavily urbanized areas in the vicinity of Portland, OR and Vancouver, WA, exposure levels are surprisingly high in some fish collected from relatively undisturbed areas which are being monitoring to characterize reference conditions as part of the EMP. For example, in 14% of "reference site" fish samples, concentrations of PCBs were above the estimated threshold for adverse effects in juvenile salmon (2400 ng/g lipid). Current-use pesticides and contaminants in wastewater and urban storm water are additional threats to salmon health, and juvenile salmon at some sites shows signs of exposure to estrogenic compounds. Moreover, low energy reserves in outmigrating salmon and elevated water temperatures may exacerbate the effects of toxics chemical on these fish. Overall, our results suggest that chemical contaminants should be considered in restoration planning, and that toxics reduction activities may play an important role in salmon recovery in the Columbia Basin.

0439
B3-4

Integrating Estuarine Water Quality Monitoring in Northeastern National Parks at Local and Regional Scales

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Estuaries in National Parks in the northeastern US are severely threatened by the adverse impacts of nutrient over- enrichment, and estuarine monitoring places high priority on water quality indicators of nutrient inputs. The Northeast Coastal and Barrier Network (NCBN) of the National Park Service includes six parks from Massachusetts to Virginia with significant estuarine resources. Water quality monitoring was initiated in NCBN estuaries in 2003 and currently occurs every two years within individual parks. Indicators of estuarine response to nutrient enrichment (dissolved oxygen, chlorophyll concentration, turbidity, and light attenuation) are monitored during a four-week summer index period at a hierarchy of spatial and temporal scales. Within each park, a spatial survey is conducted once during the index period following a probability design that uses a grid of tessellated hexagons as the basis for random sample-site selection. To improve trend detection, this spatial survey is supplemented with weekly measurements at a subset of the probability sites and continuous monitoring at a single reference site. Evaluation of park-specific data permits determination of the mean condition of park estuaries, the percent of the estuarine area exceeding threshold values, trends in estuarine condition over different time scales, and the likelihood that nutrient enrichment is a primary stressor on park ecosystems.

All NCBN estuaries are contiguous with adjacent state waters and are influenced by land-based threats originating in watersheds outside park boundaries. Therefore, evaluation of NCBN data in a broad regional context enhances understanding of water quality in park estuaries. NCBN estuarine monitoring was designed deliberately to be

compatible with coastal water quality monitoring programs implemented by the US Environmental Protection Agency throughout the northeastern states, which permits integration of park data with those from surrounding waters. Additionally, for NCBN estuaries with significant surface-water inputs, water quality data collected in rivers and streams through the USGS National Water Quality Assessment Program can help identify sources of nutrient enrichment. Combining park estuarine data with regional coastal condition indicators, watershed characteristics, and riverine inputs will help park managers identify water quality problems, causes, and potential management solutions.