

Investigating the interconnectedness of climate change, nuisance mosquito populations, and long-term resilience of coastal salt marsh systems

Research Team: Richard G. Lathrop¹ (PI), Michael J. Kennish^{1,2} (Science Lead), Lisa Auermuller² (Collaborative Lead), Dina Fonseca¹ (Mosquito Research Lead), Scott Crans³ (Mosquito Outreach Coordinator), Kaitlin Gannon² (Education Coordinator)

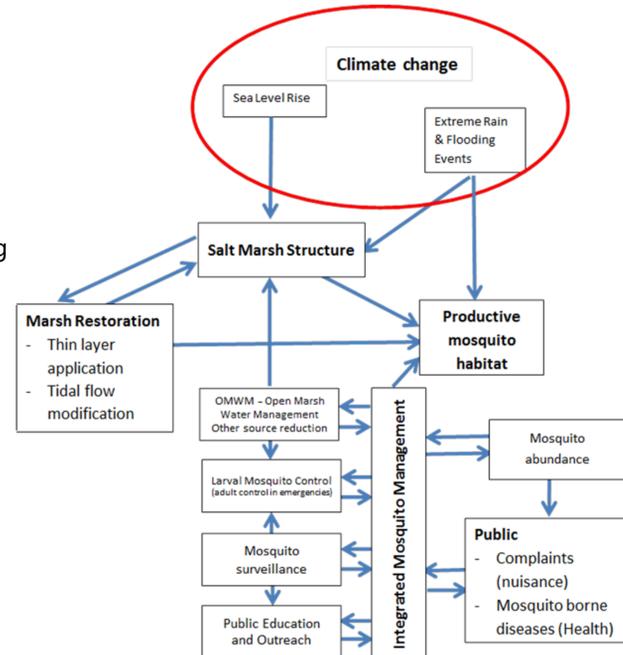
¹Rutgers University; ²Jacques Cousteau National Estuarine Research Reserve, ³NJ Office of Mosquito Control Coordination

End Users: Michael Romanowski, Ocean County Mosquito Extermination Commission; Martha Maxwell-Doyle, Barnegat Bay Partnership; Peter Winkler, NJ Division of Fish & Wildlife

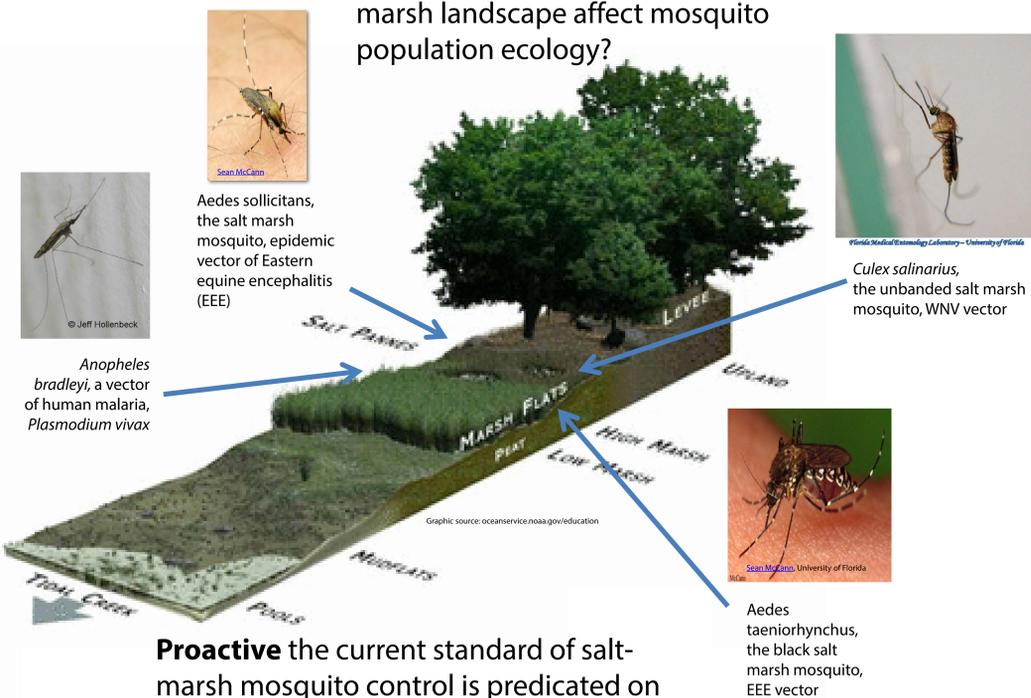
Problem Statement and response to end user needs: The JCNERR convened a roundtable of mosquito control and land management agencies to examine the intersection between sea level rise, salt marsh structure, habitat modification/restoration, and nuisance mosquito populations which can pose serious health risks to humans, livestock, and pets. Chief concerns are how climate change and sea level rise may affect marsh habitats and consequent mosquito production but also how past physical alterations to reduce mosquito habitat affect the ability of salt marshes to maintain their relative elevation position and thereby their long term resiliency in the face of sea level rise.

Recognizing the valuable role that salt marshes play in buffering coastal communities, coastal decision-makers are advocating various techniques to restore and sustain salt marshes under sea level rise and shoreline erosion as a means of promoting enhanced resiliency of coastal communities. Restoration techniques designed to maintain marsh elevation capital will likely affect mosquito production. High resolution habitat mapping/modeling coupled with enhanced monitoring of mosquito populations and identification of other critical environmental cues would aid in their strategic planning and operational decision-making.

Jointly-constructed conceptual model



How will a change in the coastal marsh landscape affect mosquito population ecology?



Proactive the current standard of salt-marsh mosquito control is predicated on knowing the location of larval habitats.

Major outputs will include:

- The collaborative design and development of information on potential future coastal habitat change (out to 2050) to aid place-based decision making;
- Enhanced techniques for monitoring mosquito populations based on specific environmental cues and past trends and to identify potential mosquito production hotspots; and,
- A module for middle school and high school educators focused on biology, ecology and impacts of climate change on mosquitoes and their salt marsh habitats.

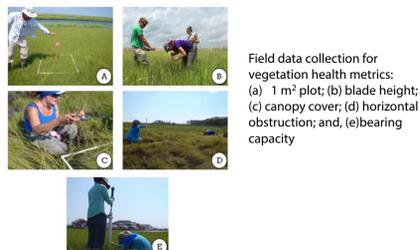
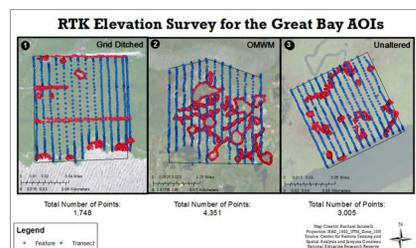
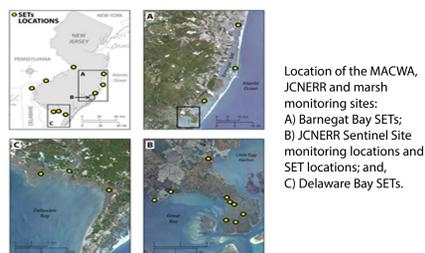
Major outcomes will include:

- Efficient and effective mosquito control operations based on planning that keeps pace with changing conditions;
- Results that inform policy decisions to the management and restoration of New Jersey salt marshes to sustain the ecosystem services they provide;
- Translation of the results to information products customized to meet the needs of coastal decision-makers.

Project Approach: Using an adapted mediated modeling collaborative approach, mosquito control agencies and other land management partners (ends users) will aid in the design and implementation of a research program to inform management actions, plans and strategies.

Marsh Landscape Structure

Collect the baseline data to characterize temporal and spatial structural and composition changes of the marsh surface with *in situ* surface elevation tables, field collection of mosquito, water and soil samples, environmental DNA analyses, remote sensing, and marsh habitat analyses.



Salt Marsh Mosquito Population Hotspots and Disease Risk

- identify physical and biological correlates of salt marsh mosquito production;
- recover past patterns of salt marsh mosquito distribution using eDNA and soil cores and compare them to known shifts in marsh hydrology;
- develop measures of human mosquito-borne disease risk from human blood meal analyses.



Photo from US FWS

Model Future Marsh Landscape Under Sea Level Rise

Model future composition and spatial configuration of New Jersey's coastal marsh under 1 to 3 feet of sea level rise (i.e., brackets the range of the expected rates of sea level rise projected by 2050) using SLAMM and MEM.

Investigate the degree to which prior mosquito control practices (grid ditching and OMWM) affects the vertical accretion rates).



Graphic from NJfloodmapper.org

Marsh Restoration Case Study

Employ ongoing thin-layer application of dredge spoil as 'natural experiments' to measure their effects on salt marsh mosquito production and current mosquito control practices.



Photo from Delaware Department of Natural Resources & Environmental Control