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Techniques and Methods for Salt Marsh Restoration to Account for Sea Level Rise

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[Wiki](#)

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Techniques and Methods for Salt Marsh Restoration to Account for Sea Level Rise¹

Research Need

Loss of coastal marsh areas critical for their ecological and storm protection functions has become a national concern, with decline attributed to sediment starvation and exacerbated by the impacts of sea level rise and subsidence. Little guidance exists pertaining to sustainable restoration and management of impacted marsh areas. Studies are needed to address information gaps such that suitable approaches can be developed and disseminated to agencies responsible for stewardship of these areas.

Project Objectives & Plan

Technical guidelines for restoring and sustaining ecological function of coastal marshes impacted by sea level rise will be developed through the efforts of a multi-disciplinary team focused on the environmental and ecological aspects of planning, designing, implementing and monitoring such projects. Objectives of the effort include:

- Consolidate a knowledge base incorporating relevant literature, case studies, lessons learned and best management practices for restoring and sustaining ecological function in salt water marshes impacted by sea level rise
- Quantify environmental “impacts” (positive and negative) of material placement (dredged material or other fill material) to nourish inter-tidal wetlands for the purpose of offsetting sea level rise
- Quantify environmental “impacts” (positive and negative) of other management practices intended to mitigate effects of sea level rise on inter-tidal wetlands
- Identify and address regulatory authority, stakeholder concerns, restrictions, and limitations related to all aspects and stages of a restoration project
- Develop recommended requirements for characterizing a restoration site, control site, and source materials for placement in ecologically sensitive areas

- Develop appropriate performance criteria to assess environmental and ecological response to management activities intended to offset adverse impacts of sea level rise
- Integrate historic and ongoing efforts with other projects focused on engineering aspects of material placement and site stabilization, such as placement methods, hydrodynamics and sediment transport
- Collaborate using multiple technology transfer platforms to achieve widest dissemination of information produced, to build multi-agency partnerships to leverage future efforts, and to establish a robust resource that will be continually updated as the body of available information grows

Products will include a technical summary of relevant literature and case studies, based upon available data and reports obtainable from participating agencies. Projects summaries will include technical, environmental and impacts considerations, with site selection and field monitoring to address data gaps. A factsheet will be developed and updated annually for each selected project. All documents will be housed on publicly available ERDC-hosted websites specific to beneficial use of dredged material, thin layer placement and engineering with nature, as appropriate.

A technical framework will be developed to delineate environmental considerations relevant to restoration of salt marshes for the purpose of offsetting effects of sea level rise, based on field monitoring for selected projects where appropriate management activities are planned. The work will be closely coordinated with related efforts examining the engineering aspects of material placement, stability, and material fate for different placement methods and hydrodynamic conditions. Work products will include project factsheets, a technical summary document, and a literature and case study review. Additional topic-specific papers and journal articles will include monitoring recommendations to evaluate effectiveness of management measures.

At least three web meetings are planned to engage interested representatives from USACE, regulatory agencies and resource agencies, to identify, develop and discuss relevant technical topics of mutual concern, common issues and management approaches, and a foundation for further collaborative work in these areas in the future.

Payoff

While there is significant interest in active management of coastal marsh areas to mitigate for sea level rise, technical uncertainties present a significant obstacle to implementation. Engagement with key stakeholders in the development of technical guidance will facilitate identification and resolution of key issues in order to move the state of the science forward. By making use of web-based tech transfer tools, more continuous and effective information sharing will be possible over a broader user base. We envision that this will motivate additional studies by other agencies and create new collaborative opportunities for data sharing, to strengthen the technical basis for development of mitigation measures and guidance. By developing a more structured approach to evaluating management alternatives to offset sea

level rise, resources can be invested in execution rather than consensus building, with greater assurance of successful ecological and financial outcomes.

Products

Journal Articles (Jas)

Berkowitz, J.F., VanZomeran, C.M., Piercy, C.D. and White, J.R. (2018). Evaluation of coastal wetland soil properties in a degrading marsh. *Estuarine, Coastal and Shelf Science*, 212(15), pp. 311-317.

Berkowitz, J.F., VanZomeran, C.M. and Piercy, C. (2017). Marsh restoration using thin layer sediment addition: initial soil evaluation. *Wetland Science and Practice*, 34(1). pp. 13-17.

VanZomeran, C.M., Berkowitz, J.F., Piercy, C.D. and White, J.R. (2018). Restoring a degraded marsh using thin layer sediment placement: short term effects on soil physical and biogeochemical properties. *Ecological engineering*, 120, pp.61-67.

Technical Reports (TRs)

Thorne, K.M. and Freeman, C.M. (2017). Thin-layer sediment application pilot project at Seal Beach National Wildlife Refuge: elevation change analysis, Unpublished Data Summary Report. U.S. Geological Survey, Western Ecological Research Center, Vallejo, California.

VanZomeran, C.M., Acevedo-Mackey, D., Murray, E.O. and Estes, T.J. (2019). Maintaining salt marshes in the face of sea level rise - review of literature and techniques (ERDC/EL SR-19-4), Technical Report. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Technical Notes (TNs)

VanZomeran, C.M., Murray, E.O. and Acevedo-Mackey, D. (2017). Marsh assessment and restoration implementation at three salt marshes in response to relative sea level rise: a report from webinars and supplemental findings (ERDC/TN EMRRP-EBA-23), Technical Note. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

White Papers and Factsheets

Acevedo-Mackey, D., Murray, E.O. and VanZomeran, C. (2017). Salt marsh function and sea level rise field activities factsheet, Factsheet. Seal Beach National Wildlife Refuge, Seal Beach, California.

Acevedo-Mackey, D., Murray, E.O. and VanZomeran, C. (2017). Salt marsh function and sea level rise field activities factsheet, Factsheet. Narrow River Estuary.

Acevedo-Mackey, D., Murray, E.O. and VanZomerem, C. (2017). Salt marsh function and sea level rise field activities factsheet, Factsheet. Avalon.

Conference Presentations/Webinars/Workshops

Acevedo-Mackey, D. (2017), Long-term coastal zone dynamics: interactions and feedbacks between natural and human processes along the U.S. Gulf Coast, Presenter/Representative. LA National Academies of Sciences, Engineering and Medicine (NASEM), New Orleans, Louisiana.

Acevedo-Mackey, D. (2016). Poster. Restore America's Estuaries and The Coastal Society 2016 Summit, New Orleans, Louisiana.

Murray, E.O. (2017). Addressing sea level rise research and projects in southern California and the east coast, Workshop. The Southwest Climate Science Center Briefing and Research Priorities Workshop, Los Angeles, California.

Murray, E.O. (2017). Sediment augmentation in a California salt marsh, Presentation. Headwaters to Oceans (H₂O), University of California, Irvine, California.

Murray, E.O. (2016). First National Nearshore Collaboration Workshop, Presenter/Moderator. American Shore and Beach Preservation Association, Kitty Hawk, North Carolina.

Oliver, L., Gilligan, K., White, J., Yepsen, M. (2016). [Ecological Function of Coastal Salt Marshes in Response to Sea Level Rise - Part 1](#). EMRRP webinar.

VanZomerem, C.M. (2017). Short term response of coastal marsh functions to restoration using thin layer placement of dredged material, Presentation. Society of Wetland Scientists, San Juan, Puerto Rico.

White, J., Jahn, J., Gilligan, K. (2016). [Ecological Function of Coastal Salt Marshes in Response to Sea Level Rise - Part 2](#). EMRRP webinar.

White, J., Jahn, J., Gilligan, K. (2016). [Ecological Function of Coastal Salt Marshes in Response to Sea Level Rise - Part 3](#). EMRRP webinar.

(2018). Thin layer placement of dredged material to maintain elevation in salt marshes facing sea level rise, Conference Session – 3 project-associated papers. National Conference on Ecosystem Restoration (NCER), New Orleans, Louisiana.

Project Activities

Ongoing multi-agency collaboration at Seal Beach, CA and Avalon, NJ marsh restoration sites through field demonstrations of thin layer placement and other measures to counteract the effects of sea level rise. Access to extensive datasets will help USACE address uncertainties in management of salt marshes and inform development of a best practices framework to identify threatened areas, determine causes of deterioration, and determine appropriate measures to sustain viability and preserve ecological, aesthetic and storm protection functions.

Ongoing multi-agency collaboration at Narrow River, RI. FWS personnel requested ERDCs assistance in determining causes of observed changes in soil morphology and vegetation mortality a year following placement of dredged material in two pilot plots. Sediment was collected and a simple laboratory pH incubation study followed. Findings will improve sediment testing and inform expected changes in sediment chemistry and test parameters for marsh restoration projects incorporating thin layer placement.

Mentored an ERDC University participant during the spring of 2017 addressing sulfide issues in saltmarsh areas due to TLP at the Narrow River site.

Advisory roles: Acevedo-Mackey advised on a National Estuary Research Reserve System (NERRS) effort to create a data portal focused on TLP site selection. Murray is serving as technical advisor on a NERRS project conducting TLP experiments in box frames across multiple marshes throughout the country.

¹**Project Alias – Work Unit Documentation Title:** *Restoring and Sustaining Ecological Function in Coastal Marshes Affected by Sea Level Rise – Current Practice, Management Alternatives and Guidance Development*