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Title

Part II, Conclusion: Ecology and Regional Context of Tidal Wetlands in the San Francisco Bay National Estuarine Research Reserve

Permalink

<https://escholarship.org/uc/item/91815085>

Journal

San Francisco Estuary and Watershed Science, 10(2)

Author

Ferner, Matthew C.

Publication Date

2012

DOI

<https://doi.org/10.15447/sfews.2012v10iss2art1>

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Conclusion to the Special Issue: Ecology and Regional Context of Tidal Wetlands in the San Francisco Bay National Estuarine Research Reserve

Matthew C. Ferner¹, Special Issue Editor

ABSTRACT

China Camp State Park and Rush Ranch Open Space Preserve contain rare examples of historic tidal wetlands, undeveloped coastal hills and grasslands, and a variety of ecotones once common (but now rare) in the San Francisco Estuary. The San Francisco Bay National Estuarine Research Reserve was designated in 2003 to support coastal management through long-term monitoring and research at China Camp and Rush Ranch. This two-part Special Issue [9(3) and 10(2)] summarizes the current regional context of the marshes at China Camp and Rush Ranch and reviews key aspects of their ecology. Scientific activities at these sites are complemented by stewardship and education programs that offer unique opportunities to improve the conservation and restoration of tidal wetlands throughout the estuary.

KEYWORDS

China Camp, conservation, marsh-terrestrial ecotones, monitoring, reference site, Rush Ranch

THE SAN FRANCISCO BAY NATIONAL ESTUARINE RESEARCH RESERVE

Conservation of natural resources is critically important in the San Francisco Estuary (SFE) where recent human activities have had devastating effects on wetlands and other estuarine habitats, their associated terrestrial ecosystems, and the species that live there. The combination of rising sea level, climate change, and other persistent anthropogenic stressors makes it especially important that at least selected estuarine wetlands and their upland counterparts are protected as much as possible from further alteration and development. Such minimally disturbed ecosystems could serve both as refuges for sensitive species and as points of reference for understanding and managing other, more impacted areas around the estuary.

To address the regional need for estuarine conservation, well-preserved tracts of historic tidal marsh at China Camp State Park in Marin County and Rush Ranch Open Space Preserve in Solano County were included in the 2003 designation of the San Francisco Bay National Estuarine Research Reserve (SF Bay NERR, or NERR). SF Bay NERR is part of the National Estuarine Research Reserve System (Figure 1), a nationwide network of estuarine areas protected for the purpose of informing coastal management through a combination of research,

¹ San Francisco Bay National Estuarine Research Reserve, Romberg Tiburon Center, San Francisco State University, 3152 Paradise Drive, Tiburon, CA 94920; mferner@sfsu.edu

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education and stewardship. The designation of SF Bay NERR brought national attention to the intrinsic value of tidal wetlands in the SFE and strengthened regional initiatives to connect science and management in the estuary. The NERR established monitoring programs that utilize nationally standardized protocols for measuring short-term variability and long-term change at China Camp and Rush Ranch. These growing collections of environmental data are freely available (<http://nerrsdata.org/>) and can be used to complement experimental research on a variety of scales.

The NERR sites of China Camp and Rush Ranch occur in two distinct regions of the SFE: San Pablo Bay and Suisun Marsh, respectively (Figure 2). Together these sites bracket a substantial portion of

the estuarine salinity gradient from predominantly salt marsh at China Camp to brackish marsh at Rush Ranch. Both sites include complex channel systems and intact marsh–terrestrial ecotones that are no longer present in most other tidal wetlands in the region. Interconnectedness of physical marsh structure, hydrology and vegetation at these sites would take many decades to develop in a disturbed wetland. This interconnectedness is closely tied to the ecological function that the wetlands provide as well as to the rare, threatened, and endangered species of resident plants and animals. Such species benefit from the protected nature of the NERR sites, but as is the case in the rest of the estuary they also are threatened by watershed influences (e.g., reductions in sediment supply needed for marsh accretion) and other regional

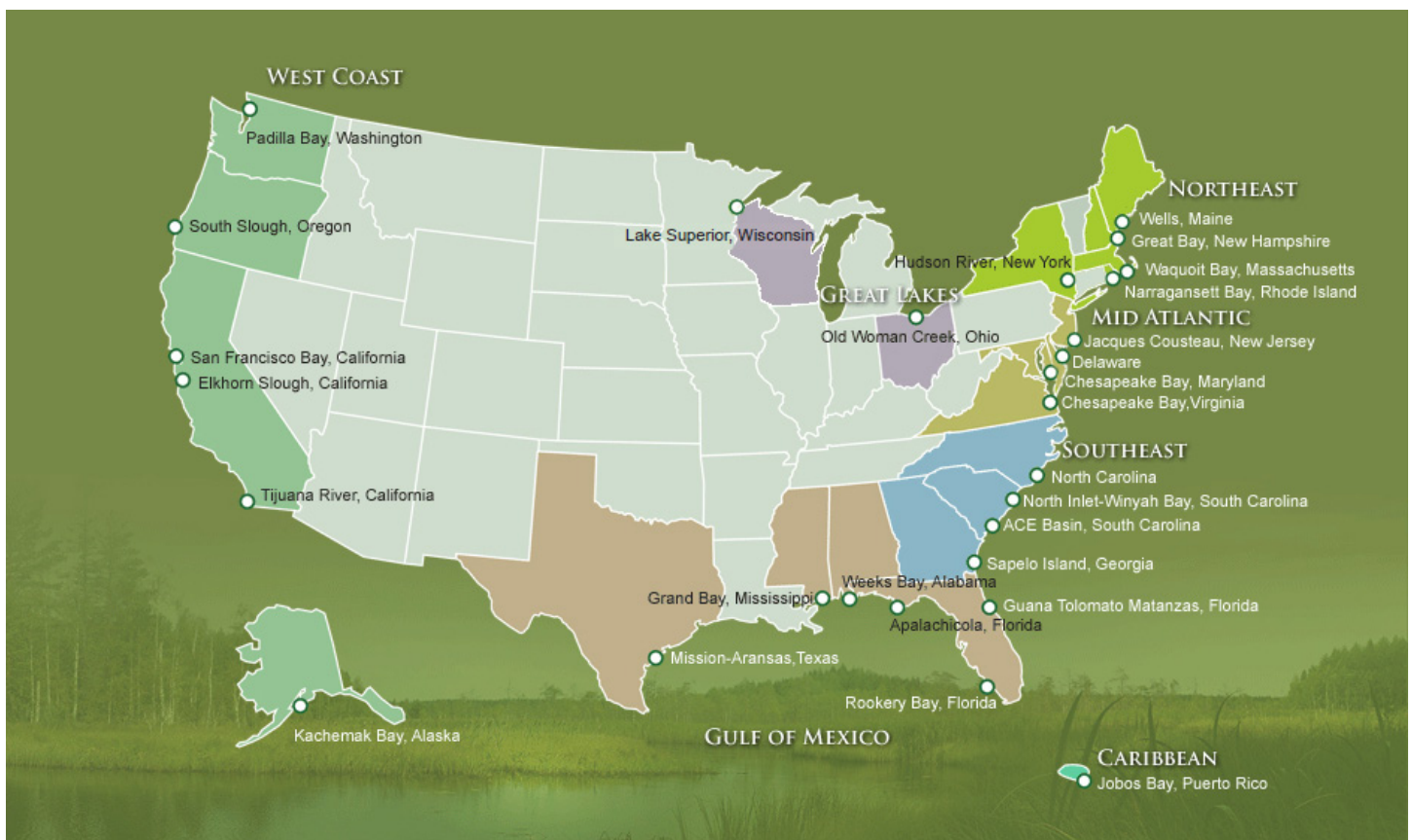


Figure 1 Map of the National Estuarine Research Reserve System (NERRS). This network of protected estuaries was established in 1972 by section 315 of the Coastal Zone Management Act. The National Oceanic and Atmospheric Administration (NOAA) is the lead federal agency in the NERRS federal-state partnerships to develop and maintain a network of biogeographically representative special-use areas dedicated to long-term research, monitoring, education, and stewardship activities that contribute to improvements in coastal zone management.

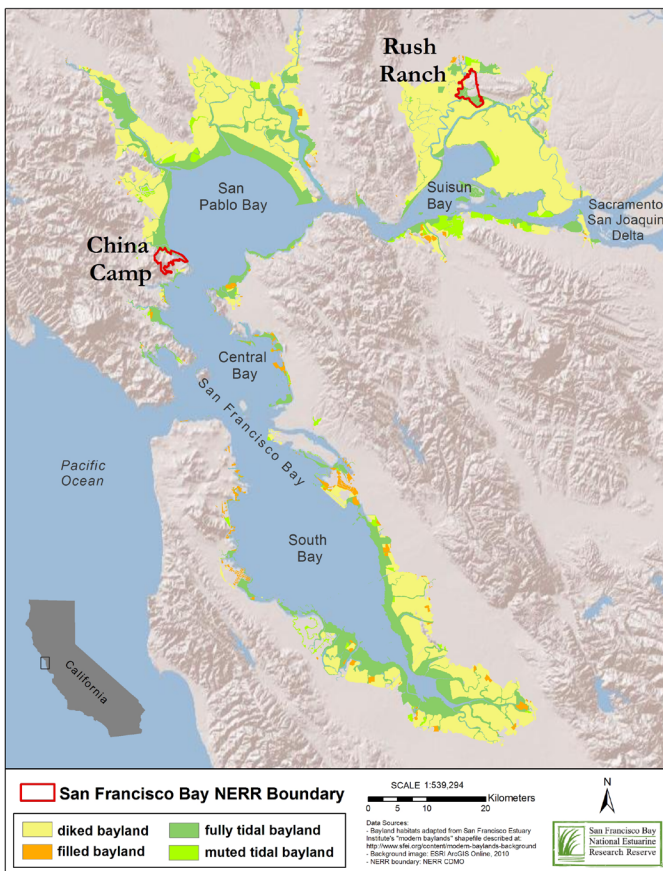


Figure 2 Map of the San Francisco Estuary showing the reserve sites and modern distribution of tidal baylands

problems (e.g., invasive species). Site-focused research and monitoring offer opportunities to learn from ecological processes and responses to stressors in these relatively protected habitats, potentially leading to more effective management of natural resources elsewhere in the region.

SF Bay NERR is a relatively recent addition to the long list of groups working to improve understanding and management of the SFE. For decades, scientific investigations at both China Camp and Rush Ranch have been led by academic institutions, environmental organizations, and local, state and federal governmental agencies. Examples of these groups include the U.S. Geological Survey (<http://www.usgs.gov>), U.S. Fish and Wildlife Service (<http://www.fws.gov>), California Department of

Fish and Game (<http://www.dfg.ca.gov>), California Department of Water Resources (<http://www.water.ca.gov>) and the Interagency Ecological Program (<http://www.water.ca.gov/ieep/>), San Francisco Estuary Institute (<http://www.sfei.org>), and PRBO Conservation Science (<http://www.prbo.org>). Many of these groups continue to conduct monitoring and research at China Camp and Rush Ranch, both independently and in collaboration with the NERR.

Some defining objectives of SF Bay NERR include:

- Implementation of long-term monitoring using rigorous protocols standardized across estuarine research reserves around the country;
- Promotion of site-based research to inform resource management and restoration;
- Integration with a national system of reserves that employ similar approaches to conservation science and management in other estuaries; and
- Coordination of research, education, and stewardship with the goal of connecting scientists and managers with each other and the human communities they serve in order to improve resource management and conservation (Figure 3).

In pursuit of these objectives, the NERR actively facilitates regional and national research with a spirit of cooperation and collaboration. That impetus is reflected in the communication of this Special Issue.

OVERVIEW OF THE SPECIAL ISSUE

This two-part Special Issue [9(3) and 10(2)] reviews the basic ecology of tidal wetlands in the SFE with a focus on China Camp and Rush Ranch. Articles in the Special Issue span a wide range of topics including regional perspectives on tidal wetland vegetation (Vasey and others), wildlife (Takekawa and others), restoration (Callaway and others) and climate change (Parker and others). More detailed, site-specific assessments of vegetation (Whitcraft and others; Baye), invertebrates (Robinson and others), birds (Wood and others; Spautz and others) and mammals

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(Shellhammer) summarize a vast amount of existing knowledge about the NERR sites and provide a solid foundation for further study.

It is clear from these articles that rare, threatened and endangered species living in and around tidal wetlands provide an important focal point for research, conservation, restoration and adaptive

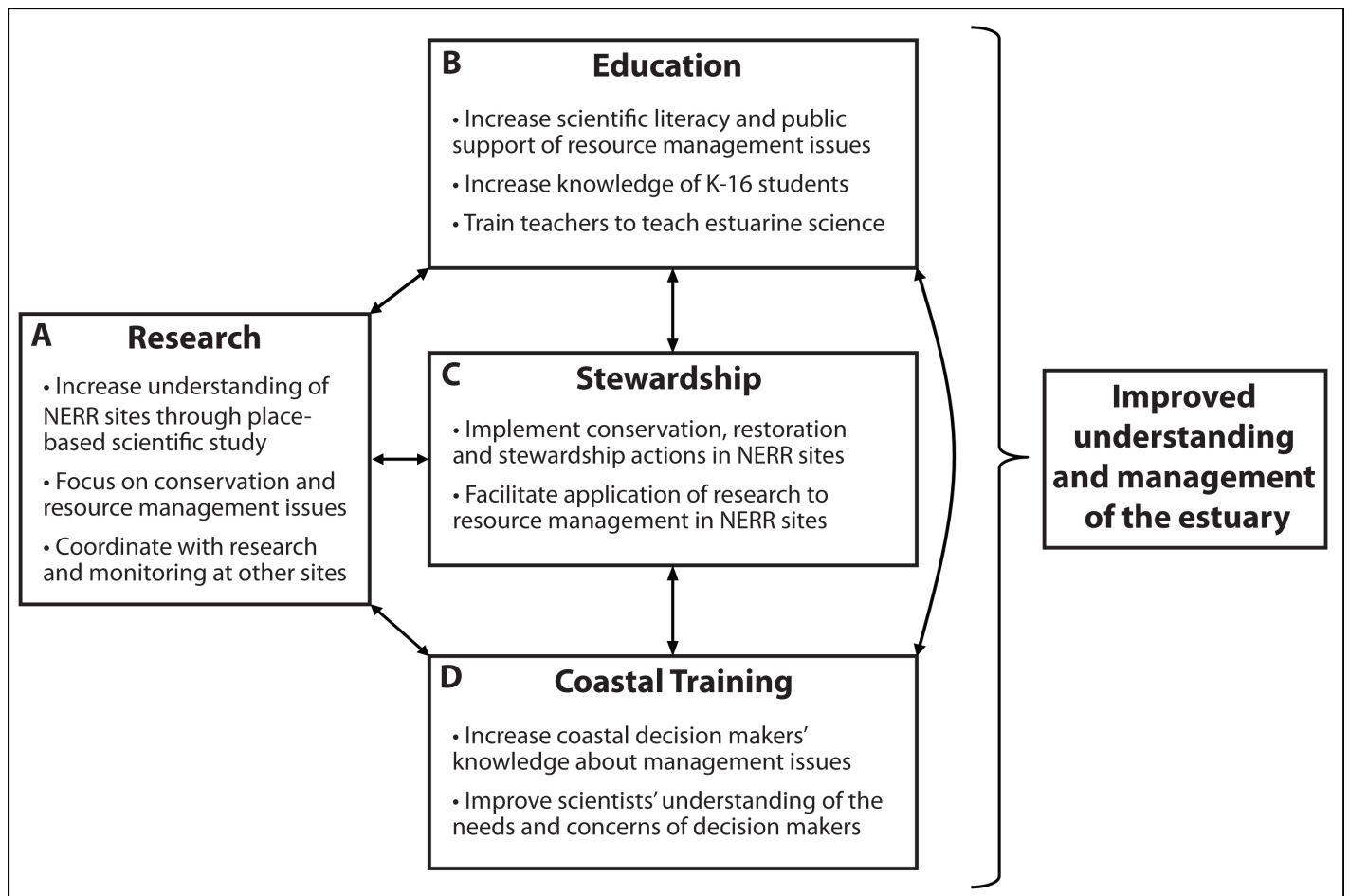


Figure 3 Illustration of how NERR programs support each other for the benefit of coastal communities. Integration of research, education, stewardship, and coastal training within the NERR has the potential to lead to improved understanding and management of the estuary, primarily at China Camp and Rush Ranch but also within similar habitats throughout the region. For example, one important and unresolved management issue relates to the future impacts of sea level rise and flooding in the estuary. In Suisun Marsh, many tidal wetlands have been diked and managed for waterfowl, leading to marsh subsidence and risk of flooding in the event of dike or levee failure. Currently projected rates of sea level rise suggest that catastrophic flooding of these areas could occur unless management changes are enacted. SF Bay NERR could inform and improve this impending situation through integrated efforts of its programs: (A) Research and monitoring of sediment elevation, water levels and vegetation changes in both diked and natural marshes at Rush Ranch can provide baseline data for understanding and predicting marsh responses to changing water levels; (B) Education of local communities about challenges facing Suisun Marsh and the realities of sea level rise can increase support for environmentally sensible policy changes; (C) Stewardship and resource management in existing marshes at Rush Ranch can provide examples to private land owners and generate data and case studies for future planning and adaptation; and (D) Training workshops and facilitated discussions can provide opportunities for information exchange among scientists, resource managers, private land owners and politicians, ultimately leading to more informed policy and action. Through integration of these programs, the NERR, its partners, and local land owners and managers can cooperate to reach mutually beneficial agreements and enact necessary changes in the management of Suisun Marsh. For more information about programs within SF Bay NERR and the NERRS in general, visit <http://www.nerrs.noaa.gov>.

management (Shellhammer, Spautz and others, Takekawa and others, Wood and others). Many of the authors emphasize that climate change and sea level rise threaten special-status species and the sustainability of both historic and restored tidal wetlands around the SFE (Callaway and others, Parker and others, Shellhammer, Takekawa and others, Vasey and others, Whitcraft and others). Sea level rise is expected to increase marsh inundation and lead to higher salinities in brackish and freshwater tidal wetlands, ultimately decreasing plant diversity and altering marsh structure and function (Parker and others). Because tidal wetland plant diversity increases from the Golden Gate towards the western Delta where future salinity stress is expected to be particularly severe, increased resilience of marshes might be best achieved by maximizing conservation and restoration efforts near the freshwater end of the estuarine salinity gradient (Vasey and others).

It is also clear from these articles that physical structure and resultant ecological function of tidal wetlands are more important than mere acreage (e.g., Baye, Callaway and others, Takekawa and others, Wood and others). Remnant geomorphologies found in the historic marshes of the NERR support relatively stable native plant and animal communities often not present in restored or more impacted marshes (e.g., Baye, Wood and others). Invertebrates and wildlife are strongly associated with particular microhabitats within the marsh (Robinson and others, Shellhammer, Takekawa and others), including regionally rare marsh-terrestrial ecotones that form the front lines of marsh transgression in response to sea level rise and provide shelter to wildlife during high tide (e.g., Shellhammer). Marsh-terrestrial ecotones are plentiful at both NERR sites and offer research opportunities to increase understanding of these transitional habitats and to inform regional restoration efforts. As sea level rise accelerates, these critical ecotones may stand with fringing marshes as the last vestiges of tidal wetlands in the SFE.

CONCLUSION

The NERR sites of China Camp and Rush Ranch represent rare examples of habitats that were once common, including native grasslands, tidal wetlands, marsh-terrestrial ecotones, tidal flats, and rocky intertidal areas. In particular, they contain some of the last remaining historic tidal marshes in the estuary and serve as reference sites for the design and evaluation of restored and created tidal wetlands. The articles in this Special Issue review the basic ecology of China Camp and Rush Ranch, and also provide regional context and guidance for future applied science. It is critical that the long-term monitoring and research supported in these sites by the NERR be continued and complemented by ongoing scientific efforts throughout the region. Through its emphasis on understanding the least disturbed wetlands in the SFE, the NERR is not “reinventing the wheel” on widely confronted challenges like pollution, invasive species and climate change, but rather it is enhancing understanding and management of estuarine natural resources through a sustained focus on site-based research, education and stewardship.

ACKNOWLEDGEMENTS

The many authors and reviewers who contributed to this Special Issue should be commended for their commitment to the SFE and their flexibility in navigating the requirements of several intertwined publication efforts. Wim Kimmerer offered the original suggestion to publish these articles in *San Francisco Estuary and Watershed Science*, an idea that was ultimately realized because of the steadfast editorial support and direction of Sam Luoma and Lauren Muscatine. Sarah Ferner provided countless rounds of review and critical feedback in her determined effort to make the NERR an effective resource for scientists, managers and the general public. Jaime Kooser also provided support and encouragement throughout the project. This work was funded by a grant under the Federal Coastal Zone Management Act, administered by the National Oceanic and Atmospheric Administration’s Office of Ocean and Coastal Resource Management and awarded to San Francisco State University.