Estuarine and Coastal Restoration

By Dr. Joy B. Zedler

Summary

Coastal habitats are degrading due to human impacts, such as dredging, filling, pollution, fragmentation, and invasive species (Carlton 1989, Kennish 1999), and they are further threatened with major losses due to rising sea levels (e.g., in Florida; geology.com/sea-level-rise/florida.shtml). Thus, widespread efforts are underway to restore coastal and estuarine ecosystems. Under the US National Oceanic and Atmospheric Administration, the National Estuarine Research Reserve (NERR) system has set aside 27 reference sites which were selected to represent coastal gradients of fresh to saline water (including Great Lakes estuaries). The NERR program supports monitoring, research, restoration and education (http://nerrs.noaa.gov/welcome.html).

Scientists and practitioners who are concerned with "restoration" study and/or practice the recovery of degraded ecosystems and some of the earliest restoration science was accomplished in coastal ecosystems. For example, William Niering conducted restoration research in the 1950s, using the terms transplantation and vegetation management studies, and then focused considerable energy on conservation and restoration of salt marshes (cf. Niering 1961). Later, Broome et al. (1974) developed methods for stabilizing shorelines using North Carolina's native cordgrass (*Spartina alterniflora)*. When the journal *Restoration Ecology* was launched in 1993 by the Society for Ecological Restoration, Bill Niering was appropriately named its first editor.

While restoration is often viewed as the return of an ecosystem to a former state or trajectory, this view is adapting to new challenges of land-use alteration and also to climate change, as projections become more explicit geographically. Many restorationists embrace a broader view that accommodates the dynamic nature of ecosystems (Pickett and Parker 1994) and of global environmental conditions (Hobbs et al. 2006). Novel environments might well require novel assemblages of species, if not species that are novel to the location or region (Seastedt et al. 2008). Invasive alien species, however, are still considered more a cause for restoration, than its cure. For example, the same cordgrass that helps restore NC coasts is considered a scourge where it has invaded Pacific Coast estuaries (http://www.ecy.wa.gov/programs/sea/coast/plants/spartina.html).

Restoration is an increasingly important topic for managing estuaries and coasts and for scientific research. From 1990 to early 2009, CERF's journal published 370 papers with "restoration" somewhere in the text. Of these, only 3 appeared between 1990 and 94, then the numbers increased near-linearly, with 65 in the next 5 years and 162 in the next 5 years. The current 5-year period has 133 papers, with 4 issues still to appear in 2009. Over half of the 370 papers concern North American sites. Collectively, the papers include a wide variety of ecosystem types: estuaries (87 papers), bays (65), salt or brackish marsh (33),

coasts (23), tidal/subtidal (16), Mangroves (16), river/streams (11), deltas (9), marsh (7), lagoon (6), reef (4), sound (4) and others (11). Most papers focus on the biota. For example, 80 papers concerned vegetation in general, 19 concerned submersed aquatic vegetation, 34 specified seagrass, 49 concerned the fauna in general, and 57 focused on fish. Abiotic factors mentioned in the titles include carbon, oxygen and metals (33 papers), sediments and substrates (22 papers), storms and disturbances (18), land form/use, site, or local environment (18), light (10), tides/waves (9) and food webs (4).

Future students will find diverse opportunities to advance both the science and practice of restoration, especially given the broad range of restoration targets across regions. Salmon habitat and controlling *Spartina alterniflora* are of interest in the Pacific Northwest, reclaiming diked marshes and salt ponds in San Francisco Bay, and restoring habitat for endangered animals and plants in southern California (Zedler 2001). Restoring wetlands that can keep up with subsidence and the impacts of hurricanes are of great concern along the Gulf Coast (NRC 2006). Restoration of Atlantic and Gulf Coast estuaries is critical for fisheries and shellfisheries, often associated with seagrass beds that are threatened by water quality degradation. In all cases, the need for restoration extends inland to the watersheds that discharge nutrients, sediments, and contaminants.

In the face of uncertain restoration targets and methods, some have adopted adaptive restoration approaches (Thom 1997, 2000; Zedler 2001; Thom et al. 2005). Several large field experiments are taking advantage of restoration efforts to test how best to restore estuarine habitats (Simenstad 1996, Cornu 2002, Zedler 2001). Restoration challenges are thus matched by the unique opportunities that large restoration sites provide for problem solving through ambitious experimentation. But strong science is not sufficient; it must be used effectively (van Cleve and Simenstad 2006).

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Web Resources

www.estuaries.org
http://www.ecy.wa.gov/programs/sea/coast/plants/spartina.html
http://www.springerlink.com/content/120846/ Note: Readers may download the complete record by going to the ERF journal web page, searching on “restoration” and clicking on the download icon.

Image Gallery

Figure 1. Infrared aerial photo of Kunz Marsh showing subdivided basins that tested effects of varying intertidal elevation. Landscape photo showing Kunz Marsh adjacent to Coos Bay (from a slide presentation by Cornu)

Figure 2. The 8-ha Friendship Marsh at Tijuana Estuary was built in 2000 to test the importance of incising tidal creek networks for enhancing biodiversity and ecosystem functioning. In 2002, the multispectral aerial photo shows the three replicate tidal creek networks and three cells without tidal creeks. The gradient of elevations were designed to support succulent-dominated salt marsh, *Spartina foliosa* plantings, and mudflat adjacent to the tidal channel. One constructed tidal creek network is highlighted, along with tidal pools that formed “voluntarily” (from Larkin et al. 2008).

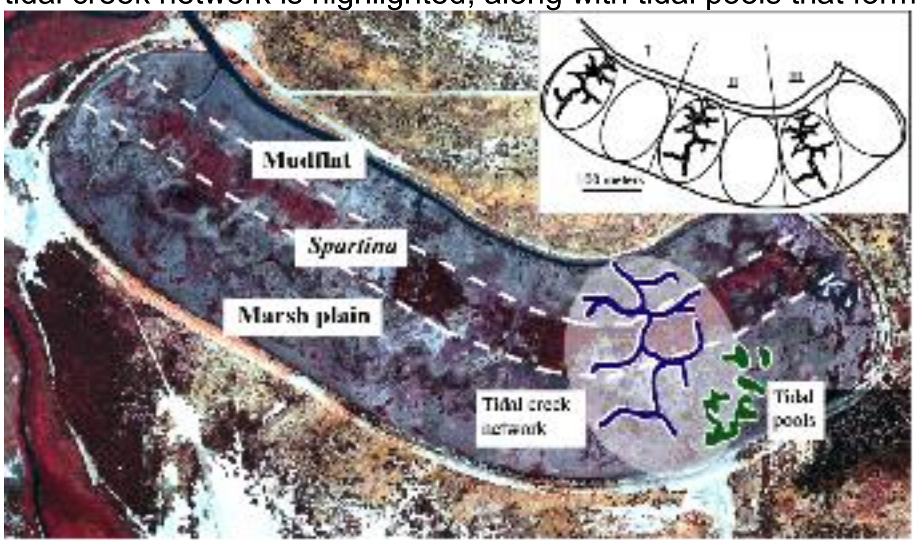
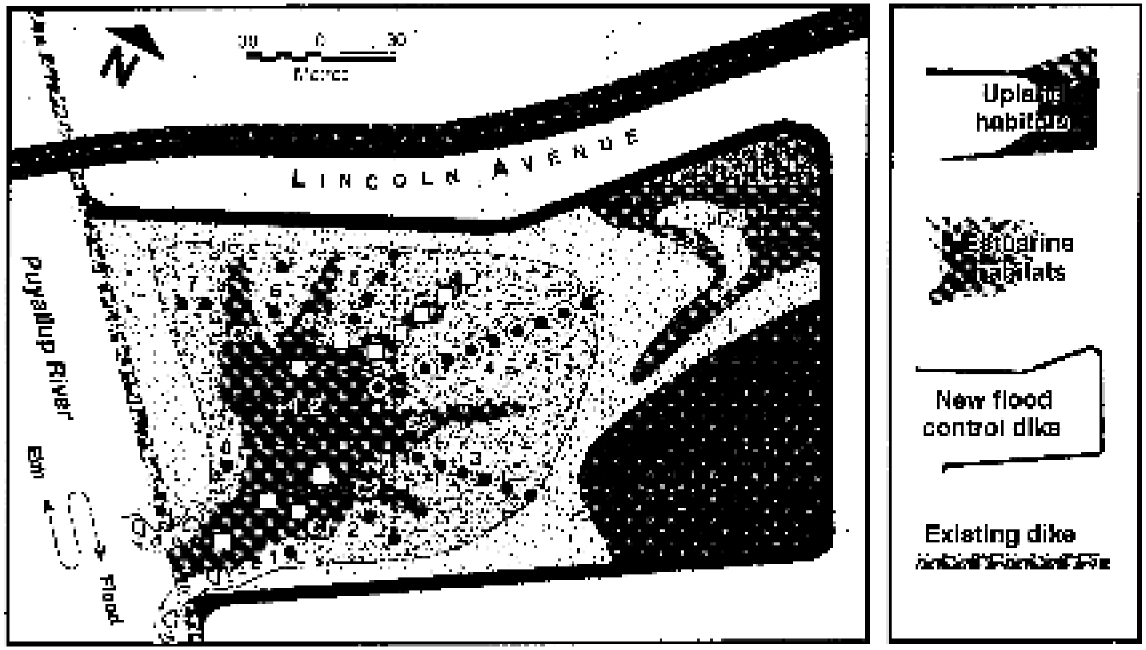


Figure 3. Gog-Le-Hi-Te was excavated within the Puyallup River estuary in Puget Sound, Washington to provide habitat for juvenile salmon. Sampling stations are numbered (from Simenstad and Thom 1996).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LINCOLN AVENUE
Puyallup River
Ebb
Flood
New flood control dike
Existing dike