COASTAL OCEAN RESEARCH

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Alteration of Wetland Habitat by Two Exotic Invertebrates

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Background

California has lost more than 90 percent of its wetlands. The remaining 10 percent now support about 41 percent of the state's rare and endangered plant and animal species. Historically, wetlands have been destroyed by urbanization, dams, and other projects for flood control and irrigation. More recently, they have been plagued by exotic species. In the bustling San Francisco Bay area, for example, hybrids of the nonnative invasive grass *Spartina alterniflora* have converted tidal mud flats into grassy areas, destroying rest stops for migratory birds on the Pacific flyway. Further, loss of wetlands and marshes could impact not only protected species such as the Belding's Savannah sparrow and tidewater gobi, but also commercial fisheries. Even beach erosion could be exacerbated, since healthy lagoons are a source of beach sand.

The Project

Although California's wetlands are known to be vulnerable to exotic invasions, few studies have sought to evaluate, in detail, the ecological consequences of nonnative species. The purpose of this study was to examine closely the effects of the mat-forming Asian mussel (*Musculista senhousia*) and the burrowing Australian isopod (*Sphaeroma quoyanum*) on natural and re-created marshlands and tidal flats in Mission Bay in San Diego, San Diego Bay, and San Francisco Bay.

Asian mussels form dense mats, displacing native clams. Photo: Scott Rumsey.

For the project, scientists led by Dr. Lisa Levin, a professor of biology at Scripps Institution of Oceanography, measured the percent area covered by each of the two invasive species. They then measured the density of isopod burrows and the strength and slope of marsh banks. Isopod burrows were visualized with x-radiography. Wax casts of the burrows were also made. Much of the mussel work focused on looking at how the filter feeders change sediment quality and how their shells alter bottom environments and marine life.

Findings

Among their findings, they observed that isopod burrows undercut marsh banks, increasing erosion and sediment loss by as much as 250 percent. Marsh bank erosion rates were observed to exceed one meter per year at one site. They also found that the slope of a marsh bank influences the ability of the isopod to invade. Isopods only thrive on steep vertical faces.

The mussels were shown to alter their environment, but through a very different mechanism. With them, changes are caused by their tiny shells, which trap fine-grained sediments that otherwise would remain suspended in the water column. As a result, the mussels effectively convert sand flats into mud flats. Another finding: the mussels were more common in restored marshes than in natural ones, suggesting that re-created marshes may function as "disturbed" habitat.

A collapsed marsh bank in San Francisco Bay, caused in part by the presence of burrowing isopods. Photo: Jeff Crooks.

In conclusion, Dr. Levin reported that while the mussels and isopods cause significant physical changes to wetlands, "scores of other invaders present in California bays and estuaries are having demonstrable ecological effects as well."

Applications

From a management perspective, Dr. Levin thinks her work has applications for building and restoring wetlands with a better ability to resist invasion by the Australian isopod. Her work suggests that the

way to do this is to build sloping marsh-bank channels, inhospitable to the isopod.

Findings from this project have been incorporated into the Port of San Diego and the Navy's long-term planning document for San Diego Bay. Reserve managers with the U.S. Fish and Wildlife Service, and the California Department of Fish and Game have also been provided with results from this project, as have the U.S. Geological Survey, Elkhorn Slough National Estuarine Research Reserve, and the San Francisco Estuary Institute.

Cooperating Organizations

California Department of Fish and Game
City of San Diego Park and Recreation
University of California Natural Reserve System
U.S. Fish and Wildlife Service

Awards

University of California, San Diego, Chancellor's Associates Award for Excellence in Research, 2000

Publications

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Graduate Trainee and Thesis

Crooks, Jeffrey, Ph.D. in Biological Oceanography, University of California, San Diego, Scripps Institution of Oceanography, 1998, "The Effects of the Introduced Mussel, *Musculista senhousia*, and other Anthropogenic Agents on Benthic Ecosystems of Mission Bay, San Diego."

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