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Ichthyofaunal Utilization of a Man-Made Salt Marsh Creak in Mission Bay, California, 25 Years After Creation

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ABSTRACT: Southern California's wetlands are drastically declining due to human activities. Increasingly, marsh restoration and creation are being used to mitigate such losses. This study used minnow traps to resample the ichthyofauna of a created marsh (Crown Point Mitigation Site; CPMS) and an adjacent natural marsh (Kendall Frost) in Mission Bay, California, 26 years following the marsh creation. These data were compared to data collected from 1995-1998, immediately after marsh creation. Fishes trapped included *Fundulus parvipinnis*, *Gillichthys mirabilis*, *Ctenogobius sagittula*, *Atherinops affinis*, and *Mugil cephalus*. Species richness, and dominance measures were higher in the natural relative to the created marsh. The size-structure of *F. parvipinnis* in the natural marsh was skewed towards larger sizes relative to those in the created marsh. These size differences are the opposite of those noted in the years immediately following marsh creation and appear to arise from differences in creek morphology between the created and natural systems, with the created marsh having become shallower through time. The differences in size-structure and species richness between the created and natural systems suggest that marsh and creek geomorphology may affect the suitability of habitat for resident fishes, and so should be considered when designing marsh restoration projects.

KEYWORDS: Fundulus parvipinnis, Crown Point Mitigation Site (CPMS), Kendall Frost Northern Wildlife Preserve (NWP),

Introduction

California's wetlands are one of the most threatened habitats on earth, having lost 90% of their historical acreage to human activities throughout the years (Talley, 2000). Mission Bay, in San Diego, CA, was largely intertidal marsh and mudflat habitat as recently as 1940, but now consists of only three small, isolated remnant marshes (Talley, 2000). Through the years, marsh restoration and creation have become increasingly common and with it, its effects of resident marsh fish communities within these areas. Resident fishes play a vital role in marsh ecosystems, both directly and indirectly affecting organisms on which they prey and feed, and in the process transfer energy and nutrients from the marsh surface (Talley, 2000).

Despite their ecological importance, there is limited information on the ecology of marsh-resident ichthyofauna of southern California, in particular for *Fundulus parvipinnis* (California killifish), with even fewer studies of the effectiveness of marsh creation in restoring ichthyofaunal populations (Talley, 2000).

In 1996, the City of San Diego completed construction of the Crown Point Mitigation Site (CPMS), also known as the Stribley Marsh, adjacent to a natural marsh, the Kendall Frost Northern Wildlife Preserve (NWP), in Mission Bay. A study of resident fish species in the first few years following construction found that the created marsh initially did not provide the same function for the wetland fish communities as the adjacent natural marsh, with the deep channel

and minimal shallow water habitat in the CPMS leading to populations that were skewed towards larger size (Talley, 2000).

In this study, I focused on resampling the ichthyofaunal community in the same location 26 years following the marsh creation, to make comparisons with the 2000 study. The following questions were addressed in this investigation: (1) Do the 2000 study results for *F. parvipinnis* size, diversity, and depth of the marshes remain? (2) How has the resident fish community composition changed over the last 26 years and does it resemble that in the natural creek? And (3) How has the size-structure of the dominant marsh-resident fish, *F. parvipinnis*, in the changed relative to that of the natural creek? The results collected will be used to compare the progression of the ecological systems and suggest improvements in the process of effective conservation and restoration efforts.

Methods

Fishes were sampled in the same creeks of a natural (Northern Wildlife Preserve) (NWP) and adjacent created (Crown Point Mitigation Site) (CPMS) marsh in the northern part of Mission Bay, San Diego, California (32◦ 47" N, 117◦ 14'W)(Figure 1A). The NWP is a natural marsh of approximately 12 hectares which is managed by the City of San Diego and the University of California, San Diego. The NWP has three discrete creek systems; the system closest to the mitigation marsh will be used for this study (Figure 1B). The CPMS is a created salt marsh system (approximately 2.8 hectares of intertidal and subtidal habitat and approximately 0.8 hectares of upland habitat), established by the City of San Diego to mitigate for losses of intertidal habitat.

The created marsh was built by grading dredge spoils on what was formerly an unsuccessful least tern nesting site, although this area historically was tidal wetland (Marcus, 1989). The site was planted with *Spartina foliosa* (cordgrass) and upland vegetation. The CPMS was first opened to tidal flushing on December 14, 1995, and planting took place from March 22–26, 1996.

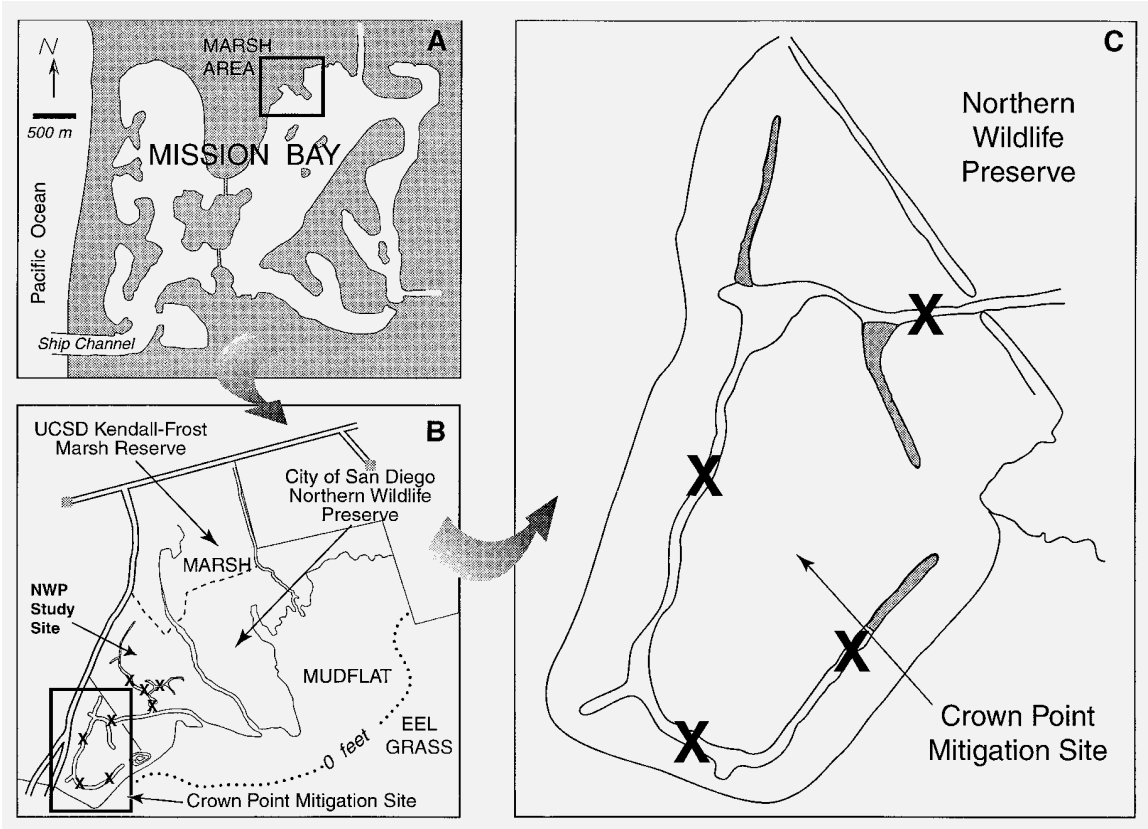

Figure 1. Map of study site, showing (A) Mission Bay, San Diego, CA (B) the Crown Point Mitigation Site (CPMS) and Northern Wildlife Preserve (NWP), and (C) the CPMS study site. Xs mark the locations of minnow traps. Shaded area in (C) indicates shallow subtidal habitat.

Sampling followed the protocols of Talley 2000, using the same locations, soak time, and assessment methods. The ichthyofauna were sampled with Gee minnow traps, 22-cm diameter at the center, tapering to 19 cm at each end, made of 0.6 cm wire mesh with 2 cm openings. Traps were be baited with canned cat food, attached to stakes with 2–3 m of rope, and placed at four locations in the creek at CPMS and four locations in the NWP (Figure 1B, C). Between June 21, 2021, and July 15, 2021, traps were placed in creeks during daytime low tide and were recovered the following day at low tide (i.e., soak time ≈ 24 hours). During recovery, all fish were counted, identified to species, and measured (total length) to the nearest mm.

Results

There were differences in *F. parvipinnis* population size-structure between the created and natural creeks. For all sampling dates, *F. parvipinnis* populations in the NWP were skewed towards larger individuals relative to the CPMS (paired t-test, $p < 0.05$) (Figure 2). A total of five species were recorded over the course of the sampling, including *Fundulus parvipinnis, Gillichthys mirabilis, Ctenogobius sagittala* (long-tailed goby), *Atherinops affinis (topsmel*t), and *Mugil cephalus (mullet*) which were captured in the NWP marsh and only *F. parvipinnis* was present for CPMS during the entire sampling. Evaluated across all sampling dates,

ichthyofaunal species richness was greater in the NWP natural marsh than the CPMS created (figure 3).

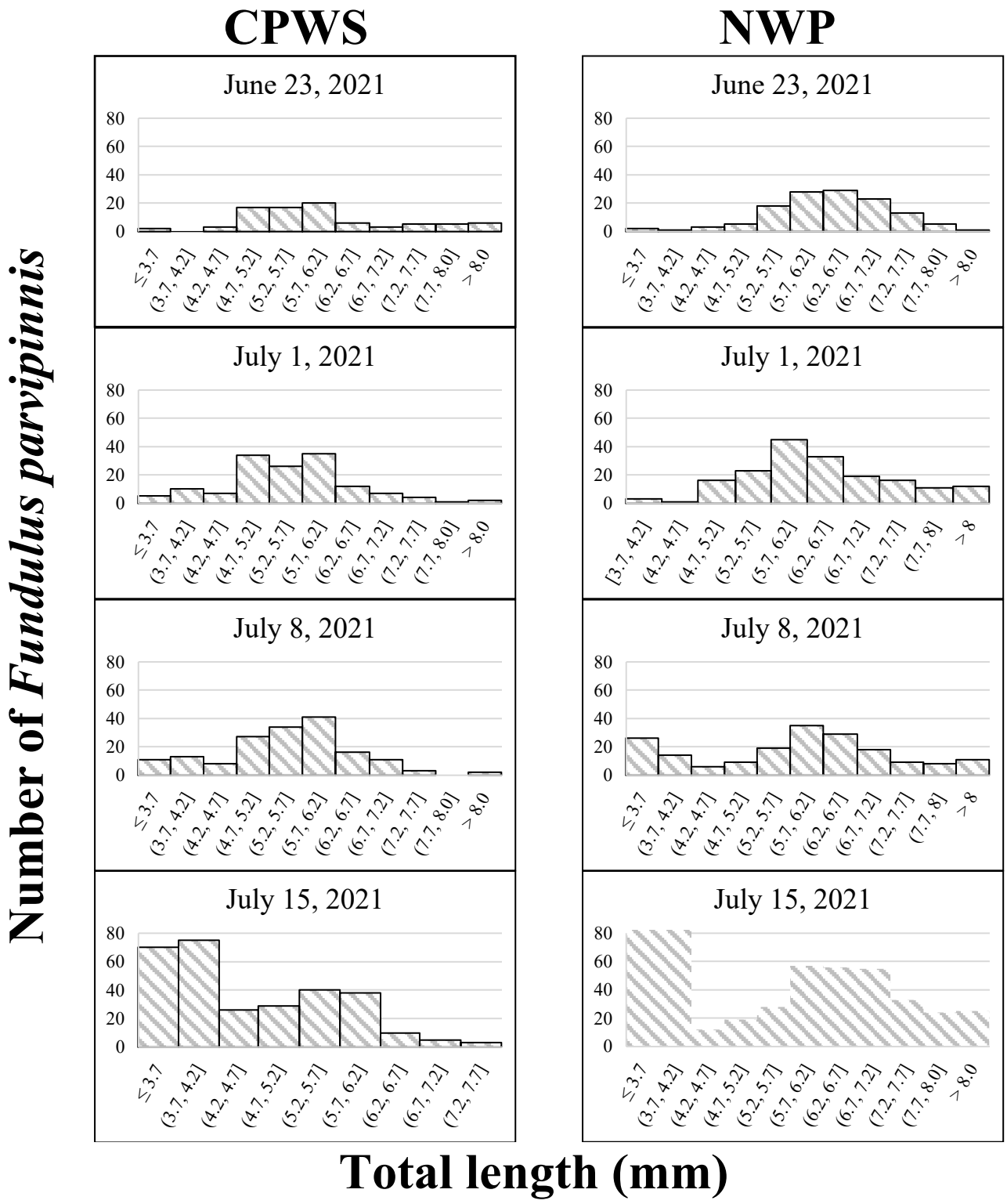

Figure 2. Length-frequency histograms for *Fundulus parvipinnis* from the Crown Point Mitigation Site (CPMS) and the Northern Wildlife Preserve (NWP) creeks.

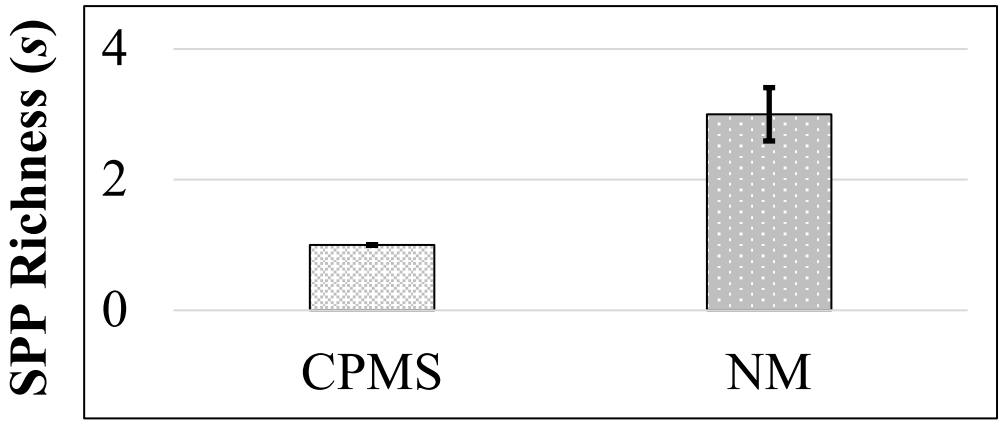

Figure 3. Calculated mean of species richness from the Crown Point Mitigation Site (CPMS) and the Northern Wildlife Preserve (NWP) creeks.

Discussion

Results from this study support the emerging view that functional equivalence of a created marsh requires more than simply abundance or diversity similarities. In this study, the size-structure of the numerical dominant, *F. parvipinnis,* was skewed towards larger size classes in the natural marsh, contrary to previous results (Talley 2000). This difference most likely resulted from an increase in shallow-water habitat now present in the created marsh. In 1998, the natural and created marshes themselves were not significantly different in depth, although the created marsh had less overall shallow water habitat than did the natural marsh (Talley, 2000); however, the CPMS is now shallower than it was during the previous study and even shallower than the NWP in 2021 ((t-test, $p<0.05$; figure 4). It appears the CPMS channel has filled with sediment, creating far more shallow-water habitat than it had in 1998 (Figure 4). This difference in depth between the marshes likely accounts for the differences in distribution and mean size being shifted towards smaller fishes in CPMS relative to NWP, since juveniles prefer shallow water that provides protection from potential predators (Kneib,1987).

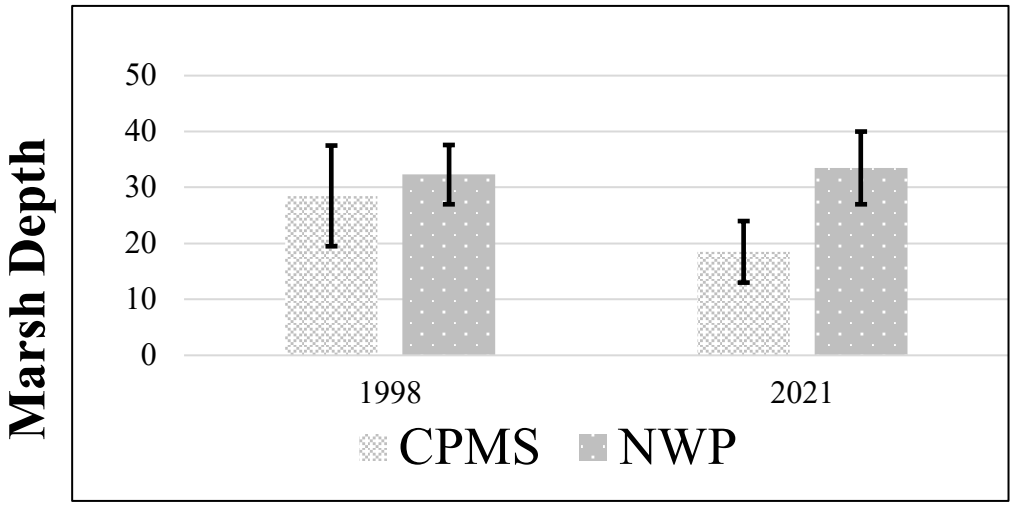

Figure 4. Depth of Crown Point Mitigation Site (CPMS) and the Northern Wildlife Preserve (NWP) marsh in 1998 and 2021.

The CMPS is still not functioning identically to the adjacent natural marsh, as determined in the previous study, but now is inhabited by a lower diversity and smaller size classes of fishes.

After 25 years, the created marsh still does not have the equivalent ecosystem function of the natural marsh, from the perceptive of the ichhyofaunal species examined here. This implies the need for long-term monitoring of these dynamic systems and a reassessment of design in marsh restoration projects to understand more of the geomorphology and salt marsh functions under a wide range of natural variation in environmental settings. The size-structure of the numerical dominants F. parvipinnis was skewed towards lar ger size classes in the natural marsh, contrary to previous results (Talley 2000). The differences in size-structure and species richness between the created and natural systems suggest that marsh and creek geomorphology may affect the suitability of habitat for resident fishes, and so should be considered when designing marsh restoration projects.

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