California MLPA Master Plan Science Advisory Team
Background Information on Wetland and Eelgrass Restoration Activities in the MLPA South Coast Study Region

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Introduction

Wetlands provide important functions for wildlife and humans. Wetlands include estuaries, salt marshes, lagoons and mudflats. Wetlands are key feeding, foraging, and rearing areas for many migratory birds and provide nursery habitat for a variety of fish and invertebrate species. Additionally, wetlands provide "ecosystem services" to humans, including filtering of some pollutants and buffering storm surges and flooding impacts. However, in the Marine Life Protection Act (MLPA) South Coast Study Region (SCSR), much of the original wetland habitat has been lost or altered due to human encroachment[1].

To compensate for this extreme loss, many agencies have undertaken wetland restoration or construction projects in areas such as estuaries, salt marshes, lagoons and mudflats (see Table 1). Wetland restoration for purposes of the MLPA includes the following efforts: 1) enhance, restore or replace wetlands already degraded or destroyed, and 2) create new wetlands in areas not previously supporting wetland habitats.

The general goal of wetland restoration is to bring the environment back to a natural, or pre-disturbance, condition. Whether that goal is achieved is an important concern for the MLPA. If restored wetlands are included in proposed marine protected areas (MPAs), scientists and policy makers need to understand how well they will meet the goals of the act. If restored or created wetlands are functionally and biologically similar to natural wetlands, these areas might also meet the goals of the MLPA when included in MPAs.

Summary of Wetland Studies in MLPA South Coast Study Region

Several studies in the SCSR have investigated the ability of restored and created wetlands to mimic natural wetlands. Each of these studies used a single species or taxonomic group as a proxy to compare restored wetland habitat to natural wetland habitat.

Three studies investigated fish species in wetland habitats. Williams and Zedler[2] monitored fish assemblages in natural and reconstructed wetland channels in Sweetwater Marsh National Wildlife Refuge in San Diego Bay and found no significant differences between the two types of channels, except that California killifish were more abundant in the reconstructed channels. Likewise, Ambrose and Meffert[3] found that fish assemblages in the restored salt marsh at Malibu Lagoon were similar to natural marshes. Finally, Talley[4] found no significant differences in species richness or dominance of fish communities at constructed and natural wetland sites

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[1] Zedler, J.B. 2001. Handbook for Restoring Tidal Wetlands. CRC press, Boca Raton, Florida.

[2] Williams, G.D. and J.B. Zedler. 1999. Fish assemblage composition in constructed and natural tidal marshes of San Diego Bay: relative influence of channel morphology and restoration history. *Estuaries* 22(3A): 702-716.

[3] Ambrose, R.F. and D. Meffert. 1999. Fish assemblage dynamics in Malibu Lagoon, a small hydrologically altered estuary in southern California. *Wetlands* 19(2): 327-340.

[4] Talley, D.M. 2000. Ichthyofaunal utilization of newly-created versus natural salt marsh creeks in Mission Bay, California. *Wet. Ecol. Manag.* 8: 117-132.

in Mission Bay. However, fish were more abundant at the natural sites, while the constructed site had more large fish and fewer small fish. Talley[5] attributed the difference in size structure to the geomorphology of the sites (the constructed site had fewer small channels), and he recorded extreme site fidelity at all sites using stable isotope analyses.

Other studies focused on shorebird utilization of restored wetland sites, and in general, they yielded similar results. Armitage et al.[5] found shorebird diversity at created wetlands in Mugu Lagoon to be higher than or equal to diversity at natural wetlands on four out of five sampling dates, and observed no differences in behavior between the sites. Similarly, Wilcox[6] found higher numbers of dabbling ducks and nesting waterbirds (including the endangered California least tern) in restored wetland sites in Newport Bay compared to natural wetland sites. However, migratory shorebirds were more abundant at natural sites than at restored sites, though numbers at restored sites increased throughout the study. The author notes that the infaunal community at the restored site might not have been fully developed, since the study took place immediately after restoration. He also attributes the increase in breeding birds to the creation of islands in the restored wetland, which provided safe habitat not present in the natural wetland. However, Zedler[7] concluded that restored wetlands in San Diego Bay did not provide adequate breeding habitat for clapper rails, since the vegetation was too short for nest building.

An additional study indirectly investigated shorebird utilization of restored habitats. Huspeni and Lafferty[8] investigated trematode parasite abundance and diversity at a site in Carpinteria marsh before and after restoration, and compared them to a natural site. The authors found trematode abundances and diversity increased dramatically over the six years following restoration, to the point that they were statistically similar to natural sites. Since the trematodes they investigated require an avian definitive host, the authors concluded birds were moving between the natural and restored sites and utilizing both of them.

Finally, Armitage and Fong[9] found that adult snails had insufficient dispersal distances to colonize a restored wetland from an adjacent natural wetland in Mugu Lagoon, though juveniles and subadults appeared to move to the restored area. They concluded that managers should not assume that relatively sedentary species will be able to colonize nearby restored habitat. Likewise, Scatolini and Zedler[10] found more invertebrates in natural than in

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[5] Armitage, A.R., S.M. Jensen, J.E. Yoon, and R.F. Ambrose. 2007. Wintering shorebird assemblages and behavior in restored tidal wetlands in Southern California. *Rest. Ecol.* 15(1): 139-148.
[6] Wilcox, C.G. 1986. Comparison of shorebird and waterfowl densities on restored and natural intertidal mudflats at upper Newport Bay, California, USA. *Col. Waterbirds* 9(2): 218-226.
[7] Zedler, J.B. 1993. Canopy architecture of natural and planted cordgrass marshes: selecting habitat evaluation criteria. *Ecol. App.* 3(1): 123-138.
[8] Huspeni, T.C. and K.D. Lafferty. 2004. Using larval trematodes that parasitize snails to evaluate a saltmarsh restoration project. *Ecol. App.* 14(3): 795-804.
[9] Armitage, A.R. and P. Fong. 2004. Gastropod colonization of a created coastal wetland: potential influcences of habitat suitability and dispersal ability. *Rest. Ecol.* 12(3): 391-400.
[10] Scatolini, S.R. and J.B. Zedler. 1996. Epibenthic invertebrates of natural and constructed marshes of San Diego Bay. *Wetlands* 16(1): 24-37.

constructed marshes in San Diego Bay. Janousek et al.[11], however, found that microphytobenthic assemblages at constructed wetland sites in the Tijuana estuary quickly mirrored those at nearby natural sites, suggesting benthic diatoms might not be as dispersal-limited as the snails in Mugu Lagoon.

Eelgrass Restoration Activities

Eelgrass (*Zostera marina* and *Z. pacifica*) is found growing in protected, shallow, soft-bottomed habitats all along the California coast, including the SCSR. Because eelgrass is particularly sensitive to anthropogenic disturbances such as dredging, trampling, and boat traffic, U.S. law requires mitigation efforts when eelgrass habitat is intentionally destroyed.[12] Since urban development in the SCSR has frequently required eelgrass mitigation, most embayments in the region contain some restored eelgrass habitat. Though there is some concern that restored eelgrass habitat might not be as genetically diverse as natural eelgrass habitat,[13] mitigation sites with persistent eelgrass beds are structurally similar to natural sites. Few studies have compared natural and restored eelgrass habitats in the SCSR, though Pondella et al.[14] found that the diversity and abundance of fishes were similar between natural and mitigation eelgrass habitats in San Diego Bay.

Conclusion

Overall, these studies show that restored wetland and eelgrass habitats can provide important functions and services. Restored and constructed wetlands support diverse assemblages of fishes and birds. Limited research on eelgrass restoration projects suggests they provide habitat value comparable to natural eelgrass beds. It is important to note that species assemblages are not the only measure of a restoration project's success. Researchers caution, therefore, that wetland restoration in the SCSR needs greater oversight and regional collaboration to ensure that restored and natural wetlands provide high quality habitat and function as a network[15].

Though additional work needs to be done to determine if restored wetlands and eelgrass can provide all the same functions as natural sites, they clearly do provide habitat value for a number of species in the SCSR. The habitat provided by restored sites is particularly important considering how few natural wetlands remain and how many eelgrass mitigation sites occur in the SCSR. Therefore, the SAT recommends that existing restored wetlands and eelgrass beds

[11] Janousek, C.N., C.A. Currin, and L.A. Levin. 2007. Succession of micro-phytobenthos in a restored coastal wetland. *Estuar. Coasts* 30(2): 265-276.
[12] Williams, S.L. and C.A. Davis. 1996. Population genetic analyses of transplanted eelgrass (Zostera marina) beds reveal reduced genetic diversity in Southern California. *Rest. Ecol*. 4(2): 163-180.
[13] Williams, S.L. 2001. Reduced genetic diversity in eelgrass transplantations affects both population growth and individual fitness. *Ecol. App.* 11(5): 1472-1488.
[14] Pondella, II, D.J., L.G. Allen, M.T. Craig, and B. Gintert. 2006. Evaluation of eelgrass mitigation and fishery enhancement structures in San Diego Bay, California. *Bull. Mar. Sci.* 78(1): 115-131.
[15] Zedler, J.B. 1996. Coastal mitigation in Southern California: The need for a regional restoration strategy. *Ecol. App.* 6(1): 84-93.

continue to be included with natural habitats when conducting the habitat representation evaluations for proposed MPA arrays.

Table 1. Wetland Restoration Projects in the MLPA South Coast Study Region

Location	County	Size (acres)	Project Status
Santa Barbara	Santa Barbara	39	Completed
Carpinteria Salt Marsh Nature Park	Santa Barbara	20	Completed
Carpinteria Salt Marsh, UC Natural Reserve Sysytem	Santa Barbara	30	Starts Fall 2009
Storke Ranch Habitat Enhancement Demonstration Project	Santa Barbara	1	Completed
Goleta Slough	Santa Barbara		Possible plan
Santa Clara River Mouth	Ventura		In process
Mugu Lagoon	Ventura	Many projects	Various stages
Ormond Beach	Ventura		In planning
Ballona Wetlands Complex	Los Angeles	470	In process
Malibu Lagoon	Los Angeles	23	Pending
Zuma Creek Estuary	Los Angeles		Completed
Topanga Creek Estuary	Los Angeles		In process
Malibu Creek	Los Angeles	1319 (including riparian areas)	
Los Cerritos Wetland	Los Angeles		Potential site
Los Angeles Harbor	Los Angeles		Completed
Dana Point Harbor	Orange		Pending
Santa Ana River	Orange		Completed
Talbert Marsh	Orange		Completed
Huntington Beach Wetland	Orange		In process
Upper Newport Bay	Orange		Partially completed
Bolsa Chica Estuary	Orange	600	Completed
Batiquitos Lagoon	San Diego		Completed
Mission Bay	San Diego		Plan in place
San Diego Bay	San Diego		Partially completed
Tijuana River Estuary	San Diego		Partially completed
San Luis Rey River Wetlands	San Diego		Possible plan
San Elijo Lagoon	San Diego		In process
San Mateo Creek/San Onofre Creek	San Diego		Possible plan
Cabrillo Salt Marsh	San Diego	3.25	In planning
San Dieguito River Mouth	San Diego	120	In process
Los Penasquitos Lagoon	San Diego		In planning
Buena Vista Lagoon	San Diego		In process