“Relative influence of habitat complexity and edges on seagrass epifaunal communities”

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Executive Summary
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Habitat structure strongly influences faunal density, distribution, and diversity within ecosystems. At local scales (i.e. within habitat patches), habitat structural complexity may be defined as the amount, density, and configuration of structural elements, such as tree branches, grass blades, or kelp fronds. At the landscape scale, differences in the size, shape, and dispersion of habitat patches create variability in attributes of landscape structure such as total habitat area, amount of edge, and patch connectivity. Although structural complexity and landscape structure both influence ecological processes in many habitats, their relative effects have rarely been assessed simultaneously.

In shallow-water seagrass systems worldwide, epifaunal (small crustaceans and molluscs living on and among the blades) density at local scales generally increases with increased habitat structural complexity (e.g. shoot density or shoot biomass per unit area), likely due to increased food availability, living space, and enhanced refuge from predators. In turn, structural complexity often varies with other aspects of habitat structure at patch scales, such as proximity to patch edges, which itself modifies ecological processes that structure epifaunal communities. The seagrass patch interior, patch edge, and matrix habitat (i.e. adjacent non-seagrass habitat) provide different resources for organisms, which often preferentially inhabit only one of these areas. Epifaunal abundance may be elevated at edges due to high settlement rates there or due to accumulation of organisms moving among patches. Alternatively, epifaunal abundance may be low at the edge if predation risk is elevated due to predators using edges or adjacent unvegetated habitat as movement corridors or if epifauna are more visible at an edge. Because local scale attributes, like shoot density, may covary based on location in the bed (edge vs. interior), the relative effects of each scale of structural variation can be difficult to identify.

The goal of our study was to assess the relative influence of two aspects of habitat structure that covary in seagrass habitat – structural complexity and proximity to the patch edge – on the abundance and diversity of epifaunal organisms and their predators. We worked in San Diego Bay, southern California, USA to determine (i) whether seagrass (*Zostera marina*) structural complexity varied between the edge and interior of large seagrass patches; (ii) whether the density and diversity of epifauna (prey) and fishes (predators) varied with structural complexity or between the edge and interior of patches; and (iii) the relative influence of structural complexity, distance from patch edges, and the presence of predators on epifaunal density and community structure in artificial seagrass habitat. Because many of the fishes inhabiting these seagrass beds are commercially and ecologically important, understanding the aspects of habitat structure that influence the abundance of their prey may be useful in seagrass habitat management and restoration.

We surveyed the seagrass within patches at three sites in the bay: Shelter Island, near the bay mouth, and two central bay sites. We sampled seagrass from two locations near the edge of each bed, as well as from the interior to compare attributes of shoot density, shoot length, and biomass of seagrass blades throughout the bed. We found that seagrass structural complexity generally increased from the edge of patches to the interior of patches, and that there was variability in these attributes between sites and also sampling periods. We also sampled the epifaunal community in the same 3 bed locations, at the same sites and found that epifaunal density increased from the edge to the interior of patches at mid-bay sites, but decreased from the edge to the interior at our front-bay site (Shelter Island). There were also specific taxa that varied in their distribution, suggesting the unique ecological needs of each species are important in determining their response to variable habitat structure.

We also surveyed the fish community along the patch edge and patch interior, and found little evidence of fish preferentially inhabiting only one location. We did see differences in fish abundance and community composition between different sites in the bay, and through stomach content analysis were able to determine they were feeding primarily on the mobile epifauna we'd sampled as above. These mobile fishes are likely feeding throughout the bed, but may not move large distances throughout the bay on a regular basis.

To identify the relative influence of shoot density vs. location in the patch on the epifaunal community, we conducted a manipulative experiment, allowing epifauna to colonize experimental patches of artificial seagrass of either sparse or dense shoot assemblages, which we placed either at the patch edge or interior. We also enclosed a subset of these plots in predator exclusion cages to observe epifaunal colonization in the absence of predator pressure, and utilized partial cage-controls to identify potential caging artifacts in our results. We found that structural complexity (shoot density) and proximity to patch edges both strongly influenced epifaunal density and diversity in the manipulative experiment, and both had larger effects on epifaunal density and diversity than did predator access. Again, we saw individual taxa colonizing in different patterns, depending on their ecology and behavior. Overall, prey biomass was higher in dense vs. sparse artificial eelgrass, higher in caged plots than in those exposed to predators and in cage-control plots, and higher at the patch edge than in the interior.

Overall, our results indicate that local-scale and patch-scale attributes of eelgrass habitat structure covary in San Diego Bay and jointly influence epifaunal and fish density, diversity, and community composition, but that the interactive effects of these factors differ among sites and sampling periods. The diversity of the epifaunal and fish community, as well as their choice of habitat, suggests that healthy seagrass beds should have a variety of microhabitats, including patchy areas and contiguous beds, and areas variable in local scale attributes of complexity as well. Our results emphasize the importance of addressing and evaluating habitat structure at multiple scales to better understand the distribution and interactions of organisms in a particular environment.