ABSTRACT

Experimental Analyses of Structural Regulation in a Marine Sand Community Exposed to Oceanic Swell

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The development of general theories concerning the origin and maintenance of community organization in marine sedimentary environments will benefit from studies of similar processes in the widest possible range of habitat types. The roles of predation and disturbance by large epibenthos are thought to be significant in many such habitats, but the bulk of recent experimental confirmation comes from shallow areas protected from oceanic swell. This field experimental study examines relationships among demersal predators, predator—caused local disturbance, infauna, and infaunal food resources in an exposed marine sand habitat at 17—m depth in southern California, USA. Manipulation of predator densities with exclusion cages, simulation of biological disturbance, and study of dispersal and habitat selection of infauna showed the importance of recurrent local disturbances by the rays Urolophus halleri and Myliobatis californica, which dig pits to expose prey but clear other infauna in the process. Benthic invertebrate populations show complex but reproducible patterns of reoccupation of disturbed sites. The most striking aspect of these patterns is active selection of recently formed pits by certain species. Ray pits are sites of accumulation for organic material on which most of the infauna feed. Experiments showed that populations which rapidly colonize new ray pits are responding to the concentration of food resources which are otherwise sparsely distributed. Responses of infauna to ray disturbance are correlated with postlarval swimming capability and method of feeding. Early colonists are active nocturnal swimmers that feed on detritus at the sand—water interface. Such features allow efficient exploitation of patchy, ephemeral concentrations of organic matter. Later arrivals are primarily subsurface feeders with limited swimming activity. The relative abundances of infauna are sensitive to seasonal changes in ray disturbance rates. Early pit colonists predominate when disturbance rates are high. The ray disturbance phenomenon produces a persistent mosaic of patches in various stages of infaunal recolonization. Other experiments showed the importance of predation by sea stars (Astropecten verrilli) and speckled sand dabs (Citharichthys stigmaeus). Sea stars consume crab larvae soon after they settle to the bottom and begin metamorphosis. During the study, recruitments of two crabs, Cancer gracilis and Portunus xantusii, were much reduced by sea star predation. A caging experiment indicated that high—density populations of P. xantusii have important negative effects on some infaunal populations. Thus, sea star predation on young crabs is important to the maintenance of infaunal community organization. Sand dabs consume infauna which are flushed into the water column or onto the sand surface by digging rays. This commensal behavior constitutes an important additional source of mortality for populationsthat are otherwise unavailable as food for sand dabs, which are visual predators.