

ID: W1513926490

TITLE: Methane seep ecosystem functions and services from a recently discovered southern California seep

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ABSTRACT:

Abstract The recent discovery of a methane seep with diverse microhabitats and abundant groundfish in the San Diego Trough (1020 m) off the coast of Del Mar, California raised questions about the role of seep ecosystem functions and services in relation to continental margins. We used multicorer and ROV grab samples and an ROV survey to characterize macrofaunal structure, diversity, and trophic patterns in soft sediments and authigenic carbonates; seep microhabitats and taxa observed; and the abundance and spatial patterns of fishery-relevant species. Biogenic microhabitats near the Del Mar Seep included microbially precipitated carbonate boulders, bacterial mats, vesicomyid clam beds, frenulate and ampharetid beds, vestimentiferan tubeworm clumps, and fields of *Bathysiphon filiformis* tubes. Macrofaunal abundance increased and mean faunal  $\delta^{13}\text{C}$  signatures decreased in multicorer samples nearer the seep, suggesting that chemosynthetic production enhanced animal densities outside the seep center. Polychaetes dominated sediments, and ampharetids became especially abundant near microbial mats, while gastropods, hydroids, and sponges dominated carbonate rocks. A wide range of stable isotopic signatures reflected the diversity of microhabitats, and methane-derived carbon was the most prevalent source of nutrition for several taxa, especially those associated with carbonates. Megafaunal species living near the seep included longspine thornyhead ( *Sebastolobus altivelis* ), Pacific dover sole ( *Microstomus pacificus* ), and lithodid crabs ( *Paralomis verrilli* ), which represent targets for demersal fisheries. *Sebastolobus altivelis* was especially abundant (6.5–8.2 fish·100 m<sup>-2</sup>) and appeared to aggregate near the most active seep microhabitats. The Del Mar Methane Seep, like many others along the world's continental margins, exhibits diverse ecosystem functions and enhances regional diversity. Seeps such as this one may also contribute ecosystem services if they provide habitat for fishery species, export production to support margin food webs, and serve as sinks for methane-derived carbon.

SOURCE: Marine ecology

PDF URL: None

CITED BY COUNT: 53

PUBLICATION YEAR: 2015

TYPE: article

CONCEPTS: ['Petroleum seep', 'Chemosynthesis', 'Groundfish', 'Cold seep', 'Oceanography', 'Continental shelf', 'Megafauna', 'Ecology', 'Geology', 'Fishery', 'Biology', 'Paleontology', 'Fishing', 'Hydrothermal vent', 'Methane', 'Fisheries management', 'Hydrothermal circulation', 'Pleistocene']