Ecosystem services associated with methane seeps on the California continental margin

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Growing human disturbance on continental margins creates a need to better understand the services provided by the diverse habitats present. Ecosystem services (ES) associated with methane seeps are largely unknown, despite growing human impacts from oil and gas drilling and exploration. These ES are the results of ecosystem structures (e.g. species diversity and abundance, physical and chemical properties), ecological functions, and the interaction among these components. For example, commercially-fished Sebastolobus altivelis (longspine thornyhead) and Microstomus pacificus (Dover sole) are found in abundance at the Del Mar methane seep. The exact reason is still unknown but potential explanations include feeding on the elevated production or avoiding predators via the sulfidic environment. Carbonates precipitated by microbial consortia at seeps sequester methane, a potent greenhouse gas. Symbiont-bearing and heterotrophic animal tissues also reflect methane-derived carbon. We used a combination of remotely-operated vehicle (ROV) video and stable isotope analysis to elucidate the relationship among structure, function, and service. We characterize the biological community as a first step towards understanding how structures might translate into functions and services. Key questions include: (1) what are species diversity and relative abundances of the megafauna community, (2) how do they reflect or promote ES, and (3) are stable isotope signatures of the community indicative of trophic structures or functions that provide ES? The understanding and use of ES can be helpful in several steps of environmental management, such as monitoring programs and marine protection area designation, especially as human impacts on deep-sea habitats continue to increase.