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STUDY TITLE: Biomass and mass-balance isotope content of seep populations on the upper slope Gulf of Mexico, determined from archived samples

REPORT TITLE: Biomass and mass-balance isotope content of seep populations on the upper slope Gulf of Mexico, determined from archived samples

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KEY WORDS: Seep Community, Chemosynthesis, Mixotrophic, Trophic Ecology

BACKGROUND: Benthic communities based on foundation chemosynthetic organisms are an important part of the larger deep Gulf of Mexico ecosystem. Associated with hydrocarbon seepage, these systems may be put at risk by oil and gas development. As such it is important to know natural conditions and be able to distinguish them from conditions that might reflect impacts. This project seeks to determine from a large number of samples what the trophic conditions of two natural populations are. In addition it is being determined if mussel shells alone may provide similar information. Archived specimens were used.

OBJECTIVES: There were four objectives:

1. to determine if the mass percent of carbon, nitrogen, and sulfur in tissue of the seep mussel *Bathymodiolus childressi* provide a useful tool for assessing the overall condition of populations;

2. to determine if the stable isotope composition of carbon, nitrogen and sulfur in mussel tissue provides a useful indication of trophic condition of a population capable of both chemosynthesis and heterotrophic feeding;

3. to determine if when trophic condition of a foundation species is determined is that condition also reflected in a consumer organism such as the snail *Bathynerita naticoidea* in the same system;

4. to determine if analysis of mussel shells have the potential of providing information on the trophic condition that might be used to assess past seepage condition.

DESCRIPTION: Archived formalin-preserved specimens of the mussel *Bathymodiolus childressi* and the snail *Bathynerites naticoidea* from Bush Hill and Brine Pool NR-1 were selected for analysis. Mass and stable isotope composition of carbon, nitrogen, and sulfur were determined for tissue samples. On a subset of organisms, shell carbon stable isotopes were also determined. Isotope values were used to estimate proportional consumption of four trophic sources. Analyses of variance were used to test significances between seeps, at different positions within seeps and over time.

SIGNIFICANT CONCLUSIONS: The dominant upper-slope chemosynthetic mussel *Bathymodiolus childressi* is mixotrophic rather than strictly dependent on methane-based symbiosis as previously assumed. Four food sources were identified; two make use of methane and two make use of detritus consumed by filter feeding on algae and sulfur-using microbes living in the seep environment. The degree of use varies between places and through time. Shell retains a record of methane consumption and could be used to determine cause of mortality in death assemblages.

STUDY RESULTS: Stable isotope and elemental mass was determined for mussels and snails from archives of the Bush Hill (GC-185) and Brine Pool NR-1 (GC-233) sites. Statistical analysis of carbon data confirmed that the former receives thermogeneic methane and the latter biogenic. Analyses of nitrogen and sulfur indicated that filter feeding on detritus was also an important trophic pathway. Such feeding was a greater part of the diet at Bush Hill. These results showed that seep communities live within a more complex set of resources than previously thought. Seeping resources are important and to a lesser degree phytoplankton detritus. It was unexpected that filter feeding also results in the consumption of a seep-generated detritus as well based on sulfide-dependent chemosynthesis. Use of detritus adds resiliency to seep systems during periods of declining seepage. The mixed diets of the mussels are also found in the heterotrophic snail associates. Stable carbon from shells was found to reflect methane availability and can be used in the analysis of death assemblages.

STUDY PRODUCT(S): Carney, S.R. 2015. Biomass and mass-balance isotope content of seep populations on the upper slope Gulf of Mexico, Determined from Archived Samples. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study BOEM 2015-051. 65 p.

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