

WASHINGTON SEA GRANT PROGRESS REPORT
for the period 2/1/2008 – 1/31/2009

WSG Project Number: R/NP-6
Project Title: Glass Sponge Reef Habitat in the Pacific Northwest

Principal Investigator(s) and Affiliation:
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1. ABSTRACT ELEMENTS

OBJECTIVES

Canadian geophysicists recently discovered massive glass sponge reefs (Porifera, Hexactinellida) on the British Columbia continental margin, and have shown that these reefs occupy over 1000 km² of the continental shelf. Sponge reefs provide a rich and complex habitat for non-sponge fauna, including commercial species of rockfish and prawns. There is, however, concern that up to a third of the reefs in Canadian waters have been destroyed by trawling. Recent evidence indicates the presence of glass sponge reefs on the Washington continental margin near Grays Harbor, which would play a similar critical role in the marine ecology of the shelf. We propose a 3-year program that would characterize the spatial extent, environmental damage and viability of the sponge reefs near Grays Canyon, as the first step in defining the components of a sustainable seafloor habitat on the Washington margin.

METHODOLOGY:

Living glass sponges colonize the skeletons of previous generations, and individual reefs can exceed 20 meters in height above the seafloor. The initial stages of sponge reef characterization would use geophysical methods that include (a) mapping of the reef structures with side-scan sonar and (b) determining the vertical extent of the reefs using 3.5 kHz sub-bottom profiles. Once spatially located, reefs on the WA margin would then be (c) extensively mapped by deep-tow camera, which can identify both the specific sponge and non-sponge species of the reef. Environmental parameters would be measured using (d) CTD casts, current meters, nutrient analyses of Niskin bottle samples, and (rarely and carefully) bottom grab and sediment coring.

RATIONALE

Preliminary data indicate both pristine and damaged reefs are present on the Grays Harbor shelf. Individual glass sponges are slow-growing (100 to 200 years to reach maturity) and reefs can occupy the same area of the seafloor for thousands of years. The regeneration rate of trawl-damaged reefs is not known, nor is it understood how well a damaged reef can function as a nursery for other species. Understanding of the role of sponge reef-formation on the Washington margin is a long-term project requiring the expertise of a wide diversity of scientists, including fisheries experts, macro- and microbiologists, physical oceanographers, and chemists. This proposed program would be the essential first-step, laying the foundation for subsequent studies.

2. ACCOMPLISHMENTS AND OUTCOMES - In 2007 and 2008, two short UW cruises were conducted on the Washington outer continental shelf ~60 km west of Grays Harbor. These cruises made several important discoveries that represent a complex, and distinctly unique type of ecosystem that could be widespread, where there are strong indications that sub-surface methane seepage from the sub-seafloor plays an important role. Here, large reefs of glass sponges were mapped using side-scan sonar and then confirmed by photography and sample grabs. These reef structures were vastly more extensive than our survey area (100 miles² in extent) consisting of both ancient (10's of thousands of years old, as indicated by the presence of iceberg gouges) and modern (live) sponge reefs. Near the glass sponge reefs, seeps were discovered emitting fluids with highly elevated concentrations of dissolved methane, silica, phosphate, and nitrate. In some areas, methane bubble plumes reach the sea surface from 170-m depths. In the immediate proximity of the methane bubble streams, we observed large swarms of euphausiids (identified as *Thysanoessa spinifera*) at extraordinary biomass densities.

3. IMPACTS - Examination of the UW archive of 3.5 khz seismic reflection data from the glass sponge reef site completed in the past funding year indicate that the co-location of methane bubble plumes and acoustic targets, which likely were euphausiid swarms, 100's of meters in horizontal extent by 60 – 70 m thick, is a fairly common occurrence at the head of Grays Canyon, with the individual plumes/swarms separated by several miles. Abundant visible bacterial floc also was observed in association with the methane bubble plumes, suggesting a possible link between the high euphausiid abundances and the methane seeps. Although krill have never been reported to use methane-derived carbon as a food source; krill have been reported to feed on bacteria in the photic zone. Similarly, near-bottom water samples taken during ROV traverses of the glass sponge reefs in 2008 showed reef segments with live glass sponges in areas with methane concentrations >70 nM, while in areas with <30 nM methane only dead sponge skeletons were observed. Although our sample set is too small (7 sites) to draw firm conclusions, these preliminary data suggests that the filter-feeding glass sponges also may use methanotrophic bacteria as part of their carbon/energy source. The newly identified partially-chemosynthetic ecosystem on the Washington margin may have even larger implications for biological productivity on similar (Oregon, Alaska) continental shelves.

4. PERFORMANCE MEASURES

Measure 1: Economic and societal benefits derived from the discovery and application of new sustainable coastal, ocean, and Great Lakes products from the sea.

Actual (reporting period covered by this report): The discovery of the new species associated with the unique ecosystem represented by the glass sponge reefs, methane plumes, massive krill swarms and large numbers of commercial fish predators appears to be a new relationship between widely diverse species that exploit or require the subsurface carbon from the methane seeps. This discovery represents a possible new food/energy source for marine biological 'hot spots', which would provide resource managers with data on a potentially new (and commercially important) ecosystem.

Anticipated (12-month period following this reporting period): The Washington margin location of the glass sponge reefs is not fundamentally different in terms of seafloor geology, sea water environment and methane seep potential from other areas of the NE Pacific and the new discoveries may be applicable to the Oregon, British Columbian and Alaskan continental margins as well. To further examine these new discoveries, we are planning an additional 6-day small boat cruise to the Washington margin glass sponge reef site in the summer of 2009, to obtain additional samples and data regarding the extent of the sponge reefs and their association with

active methane plumes from the sub-surface. This cruise will focus on samples of the sponges and associated populations, to determine if the methane carbon isotope signature is transferred to the glass sponges.

Measure 2: Cumulative number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management.

These have not yet been developed.

Measure 3: Percentage/number of tools, technologies, and information services that are used by managers (NOAA and/or its partners and customers) to improve ecosystem-based management.

Actual: The tools and techniques used so far in this program are standard oceanographic tools.

Anticipated: We plan to use a new hydrophone method in the up-coming 2009 cruise, to detect methane bubble formation sound within the glass sponge reefs. This method, if successful, should allow the detection of methane bubble plumes rapidly and unequivocally. Given the recently discovered association between methane plumes, glass sponge reefs and large commercial fish populations, this could be useful new tool for fisheries management.

5. PUBLICATIONS

Please refer to instructions for hardcopy reprint requirements and citation formats.

A. Journal articles: none yet. Major manuscript on glass sponge reef discovery is in progress.

B. Theses and dissertations: none

C. Book chapters: none

D. Book or Monograph: none

E. Paper in Proceedings: none

F. Proceedings or Symposia: none

G. Technical reports: Two cruise reports published on WA Sea Grant web site.

H. Advisory publications (e.g. handbooks, manuals, guides): none

I. Magazine articles: several published in previous (2007, 2008) years.

J. Media Placements: extensive media coverage of 2007 and 2008 cruises.

K. Other publications (e.g., videos, DVDs, software, websites): contributions to Sea Grant web site; contribution to the main entrance page to University of Washington web site.

6. PRESENTATIONS - inc. Conference (Poster or Oral), Seminar & Public:

- a. Oral Presentation to Anacortes Beach Walkers group (regional conservation group).
- b. Oral Presentation to Northwest Indian Fisheries Council (Forks, WA)
- c. Oral UW presentation to Biological Oceanography Section

7. PATENTS AND COPYRIGHTS

none

8. NEW BUSINESSES OR JOBS CREATED

none

9. LIST ALL STUDENTS SUPPORTED BY OR AFFILIATED WITH THIS PROJECT

Student Name: Marie Salmi
Department: Oceanography
Major/Degree field: Marine Geology and Geophysics
Major Professor: H. P. Johnson
Student Type: undergraduate, B.S.
Dissertation/Thesis title: N/A
Date of graduation (actual or anticipated): March, 2010
Total support or affiliation period: Summer, 2007 to present
Type of support: Research Assistant.
Current employment if applicable: currently employed on this program.

10. INTERACTIONS

Pending NSF proposal to study methane plumes at the sponge reef site; proposal would incorporate students from the Quinault high school as shipboard participants of the 2010 and 2011 cruises (if proposal funded). This would include tutorial periods for the Quinault students in data acquisition techniques at UW, prior to the cruises.

11. OUTREACH AND INFORMATION/TECHNOLOGY TRANSFER

Continuing to present talks on Washington margin glass sponge reefs to various conservation and social groups within Washington State.

12. FUTURE ACTIVITIES

Cruise to site in August, 2009. Publication of glass sponge reef discovery in scientific literature.