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Research Final Reports

Title

Reefs that Rock and Roll: Critical Assessment of Rhodolith Bed Habitat

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California Sea Grant College
Program Final Report

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Project Information

Year _____ Grant No.: NA10OAR4170060
Number R/ENV-212 Start Date: 7/1/2010 Completion Date: 12/31/2011
Title Reef that Rock and Roll: Critical assessment of rhodolith bed habitat

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Project Hypothesis

The main hypotheses of this proposal are that 1) a novel benthic marine habitat exists, rhodoliths, exists that has been unrecognized in prior surveys and 2) that human induced disturbance is degrading this common coastal California benthic habitat - rhodolith beds. These beds are diverse and threatened marine habitats that are common in Southern California should be included in coastal protection, monitoring and management decisions. By determining the distribution, measuring habitat metrics and determining the common sources of disturbance in beds around Catalina Island, the information can be used to inform the Southern California MPA process.

Project Goals and Objectives

- 1) Establish the distribution of rhodolith beds around Catalina Island.
- 2) Assess baseline habitat characteristics of all rhodolith beds around Catalina Island.
- 3) Test a new methodology for rapidly mapping and conducting habitat surveys of rhodolith beds in the CA Channel Islands with special focus on the proposed set of reserves.

Over the course of the study, the following additional objectives were added.

- 4) Determine the species and annual growth rates of Catalina rhodoliths.
- 5) Determine the common sources of disturbance and test the effects of the most common disturbance, mooring chain crushing, on Catalina rhodoliths.
- 6) Make preliminary list of invertebrate, algal and fish species associated with Catalina rhodolith beds. This includes making observations on the habitat use of the common organisms and providing pilot data for future studies.

Briefly describe project methodology

1) Distribution. To initially determine the distribution of rhodolith beds around Catalina Island we established baseline surveys using a combination of techniques including manta tows, drop camera, and in situ searches. A systematic search of offshore waters from 0-30 m, combined with underwater mapping, was used to assess the distribution of live and dead rhodolith material around Catalina Island. Survey efforts were initially stratified to focus effort in areas thought likely to support rhodoliths. Anecdotal reports of rhodoliths were gathered from a variety of sources, including Dr. Kathy-Ann Miller, Deidre Sullivan, Dr. Steve Lonhart, and Lorraine Sadler. Search efforts were initially focused in areas where rhodoliths had been reported: Emerald Bay, Cherry Cove, Fourth of July Cove, and Big Fisherman's Cove. After these beds had been located, stratified searches were conducted in other areas likely to support beds; these were identified based on the general physical setting of beds worldwide, i.e. shallow, protected, gently sloping embayments. A combination of methods was employed to survey these locations. SCUBA, snorkel, and Manta tow surveys were used to visually scan the seafloor to depths of ~20 m.

2) Characterizing rhodolith populations. Rhodoliths were collected from each of the seven beds using cores. These cores were processed and the size frequency, branching, sphericity and density of the populations were established for each bed. From each of the seven rhodolith beds located, divers on SCUBA surveyed and mapped areas of both live and dead rhodolith material. Surveys were done to estimate the cover of live and dead rhodoliths and the aerial limits of the beds.

To compare rhodolith characteristics between beds, divers collected three 10-cm deep by 10-cm diameter cores from each bed. Cores were taken within areas of >75% live cover, and distant from each other by at least 5 meters. After transport to shore, non-rhodolith material was removed from all cores, live and dead material separated. Characteristics measured from live material included size frequency, long axis, sphericity, and branch density data and maximum projection sphericity.

3) Acoustic mapping technology. This objective was to test a new methodology for rapidly mapping and conducting habitat surveys of rhodolith beds in the CA Channel Islands with special focus on the proposed set of reserves.

Describe progress and accomplishments toward meeting goals and objectives.

1) Distribution. Using a systematic search of shallow subtidal (0-40 meters) areas, seven beds were detected around Catalina Island, and the area covered by rhodoliths mapped by divers using SCUBA. Living and dead rhodoliths and rhodalgal sediments cover approximately 22,900 and 42,696 square meters of seafloor, respectively. We have met our goal and completed the active surveys.

2) Measuring Bed Characteristics. We have met this goal in that we have measured the percent cover of live and dead material, the size frequency, density, branch density and sphericity of rhodolith populations in all seven beds. Results are presented in the outcomes portion of this report.

3) Testing new remote mapping techniques. Due to a delay in the CA state funding for the CSUMB Habitat Mapping Laboratory's southern California surveys our acoustic surveys were delayed until October 2011. The survey was conducted, the acoustic data post-processed to make maps of the bottom for initial assessment. The first post-processing of the acoustic data has been completed. Drop-camera surveys were conducted, however, the full detailed analysis of the video has not been completed.

4) Growth Estimates and Species ID. Preliminary species identifications were made by taxonomic expert Rafael Riosmena-Rodriguez. The seasonal and annual growth rates were determined.

5) Disturbance estimates. The estimates of sources of disturbances were made and the disturbance experiments were conducted.

6) Preliminary species surveys and species lists were conducted and compiled for macro and infaunal organisms. These studies were initiated by two MLML graduate students, Scott Gabara and Kristin Meagher, both of whom volunteered on the project. The data are currently being worked up and will be presented at the MBNMS Sanctuary Currents meeting in 2012.

PROJECT MODIFICATIONS: Explain briefly any substantial modifications in research plans, including new directions pursued and ancillary research topics developed. Describe major problems encountered and how they were resolved.

As previously mentioned, two additional objectives were added to the study and both of these are completed. These were objectives 4 and 5 and 6 listed below and the methods are included in the methods section under the 4, 5 and 6 heading.

4) Determining the major causes of disturbance to the beds.

5) Determining the growth rates of rhodoliths and species ID.

6) Associated species surveys and lists were compiled.

PROJECT OUTCOMES: Briefly describe data, databases, physical collections, intellectual property, models, instruments, equipment, techniques, etc., developed as a result of this project and how they are being shared.

1) Distribution. We have established that a novel benthic habitat exists in California waters. We have established that using SCUBA based systematic searches in shallow (0-40 meters) areas, can be used to locate rhodolith beds. Using a variety of survey techniques and searching the 70% of the island, seven distinct beds were found around Catalina Island (Avalon, Big Fisherman's Cove East, Big Fisherman's Cove West, Isthmus, 4th of July Cove, Cherry Cove, Emerald Bay. The area of live cover of the seven beds ranged from 671 to 9,765 m², and dead rhodoliths from 2,268 to 13,718 m². Depth of live cover varied among beds, and ranged from 4.2 to 20.7 m. While two beds lie within Blue Cavern State Marine Reserve, and one within a State Marine Conservation area, rhodolith beds are not listed as a recognized habitat. Four beds currently have no protection status. This information will be used to inform the MPA process on the diversity of coastal resources and contribute to an increased understanding of the value of coastal habitats.

2) Measuring Bed Characteristics. Rhodolith Cover. The average live rhodolith cover within a bed ranged from 21 to 51 percent, and varied significantly across beds ($F(6,223) = 3.76, P = 0.001$). The beds in Avalon Harbor and Isthmus Harbor had significantly higher live cover than beds in Big Fisherman's Cove (East and West) and Fourth of July Cove Rhodolith Size, Size Frequency and Branching and Sphericity. In general Catalina rhodoliths had ranged in size from 3 to 25 mm in diameter. In all beds, the majority (76 to 86%) of measured rhodoliths were in the intermediate size class of 5 to 15 mm, with very few (0-12%) in the largest 15-25 mm size class. The remainder (7-17%) were 0-5mm in length.

IMPACTS OF PROJECT: Briefly describe how this project has contributed to a discipline; to developing human resources; to developing physical, institutional or information resources; technology transfer; and society beyond science and technology. Please notify CASG of impacts that occur after your project ends; CASG may contact you after your project ends to learn about additional impacts that occur over time.

This project met all of the objectives that we set out to assess and provided additional data on the basic questions motivated by finding a new and poorly understood habitat. The overarching major impact of this project is that it should increase the awareness in the scientific and resource management community about a common coastal habitat that was previously not considered in any coastal management plan. Rhodolith habitats exist and we should find out more about their biodiversity, dynamics and functional role in benthic ecosystems.

1) Distribution–In this study it was determined that a unique subtidal habitat, rhodolith beds, does exist in California and should lead to further study and protection. Of the seven beds identified, some were distributed in protected areas. The impact of this result indicates that baseline studies that should and could be conducted to compare if protection status has any impact on the "health" of this benthic habitat.

2) Bed Characterizations–The impact of collecting data on the bed characteristics is that this study provided baseline data on the characteristics that can be compared over time. This will allow further studies to make temporal comparisons on all bed characters collected in this study. Even since this study has begun we have witnessed large storm, swell and sedimentary events that likely have changed the bed characters. How persistent the bed distribution and the characters through time are areas for further study.

3) Mapping Techniques–The acoustic detection of California rhodolith beds was variable likely due to wide variation in the beds characters themselves. More clearly delineated beds were more likely to be detected. This was likely a result of the degraded nature of Catalina rhodoliths. The impact of this preliminary survey is that further studies need to be conducted to identify the range of sediment parameters that the acoustic surveys can detect. It is likely that a combination of acoustic, remote camera and diver-based surveys would provide the best description of living beds.

BENEFITS, COMMERCIALIZATION, AND APPLICATION OF PROJECT RESULTS: Please list any companies, agencies, organizations or individuals who have used your project results, scientific/technical advice, etc., and provide names, emails and phone numbers. Briefly describe how results were used and quantify results and socioeconomic benefits, if possible.

The benefits and application of the results of this project to the California resource managers is large. All results strongly suggest that these habitats deserve further study and incorporation into the MPA process and resource management process. Half of the beds found currently fall in MPAs, however due to a lack of information are not currently included. The application of these results would change the approach to studying and protecting coastal resources by the inclusion of rhodolith habitats in protected habitats.

Issue-based forecast capabilities to predict the impacts of a single ecosystem stressor, developed and used for management (i.e., climate change, extreme natural events, pollution, invasive species, and land resource use).

Unknown

PUBLICATIONS

Conference Papers, Proceedings, Symposia

Conference	Western Society of Naturalists	Location	San Diego, CA	Date	November 2010
Title	Rhodoliths at Catalina Island: distribution, growth and consequences of disturbance	Authors	Paul Tompkins, Diana L. Steller		
Conference	Thesis Presentation: Moss Landing Marine Laboratories	Location	Moss Landing Marine	Date	August 2011
Title	Rhodoliths at Catalina Island: distribution, growth and consequences of disturbance	Authors	Paul A. Tompkins		

Non-peer Reviewed Reprints

Sea Grant News - Sea Grant Funding for 17 new projects announced.	Kristina Johnson and Sea Grant News Staff	Fall 2010
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Electronic publications: (non-print formats).

http://escholarship	Distribution, Growth and Disturbance of Catalina Island Rhodoliths	Paul A. Tompkins	August 2011
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Maps, Charts, Atlases

Distribution, Growth and Disturbance of Catalina Island Rhodoliths - contains map and coordinate of the 7 beds found at Catalina Island	Paul A. Tompkins	August 2011
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Theses, dissertations

Distribution, Growth and Disturbance of Catalina Island Rhodoliths	Paul A. Tompkins	San Jose State University	August 2011
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DISSEMINATION OF RESULTS: List any other ways in which results of your project have been disseminated. Indicate targeted audiences, location, date and method.

WORKSHOPS AND PRESENTATIONS: A brief description of location, date, time, topic, number of attendees and name of presenter.

- 1) Presentation Location: San Francisco State University - Biology Departmental Seminar. Seminar titled "Rolling reefs to shifting sands: the role of coralline algae in coastal ecosystems" Fall 2010, time 3pm. Attendees: ~40 people, presenter: Diana Steller.

2) Moss Landing Marine Laboratories - Open House presentation. April 30, 2011. Title "Subtidal research at Moss Landing Marine Laboratories". This presentation highlighted the CA SG funded research conducted at Catalina Island. Time: 2:00pm, attendees: 50, Presenter: Diana Steller

COOPERATING ORGANIZATIONS: List those (e.g., county or state agencies, etc.) who provided financial, technical or other assistance to your project since its inception. Describe the nature of their cooperation.

Academic Organizations

SCMI—Southern California Marine Institute—supported this work out of Wrigley Science Center

INTERNATIONAL IMPLICATIONS: Does your project involve any colleagues overseas or have international implications?

The results from this study have international implications as they add to the worldwide data base on the distribution, growth rates, disturbance and diversity associated with rhodolith beds. These Catalina beds are of particular interest since they are near to urban areas and areas of high coastal use. In the last 20 years there is an increasing international attention in the biological and geological sciences on carbonate rhodolith beds. The publication of these results will be of great interest to this community. The 4th international rhodolith meeting will be held in Spain in September 2012 and the results from this study will be presented.

FOR ALL STUDENTS SUPPORTED BY THIS GRANT,

PLEASE LIST: Volunteer Count 8

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Degree Program	M.S.				
Thesis Title	Distribution, Growth and Disturbance of Catalina Rhodoliths				
Supported by Sea Grant	Yes	Start Date	7/1/2010	End Date	6/30/2011
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Institution	Moss Landing Marine Laboratories				
Department	phycology				
Degree Program	M.S.				
Thesis Title	Nursery role of rhodolith beds at Catalina Island				
Supported by Sea Grant	No	Start Date	3/29/2012	End Date	3/29/2012
