

# UC San Diego

## Research Final Reports

### **Title**

California spiny lobsters and benthic community structure in Southern California: top-down and bottom-up interactions

### **Permalink**

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### **Supplemental Material**

<https://escholarship.org/uc/item/4f85c5d5#supplemental>

California Sea Grant Sea Grant  
Final Project Progress Report  
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California spiny lobsters and benthic community structure in Southern  
California: top-down and bottom-up interactions

**Project Hypotheses**

We hypothesize that: spiny lobster movement behavior is governed by a combination of forces acting from the bottom-up (i.e. food availability) and from the top-down (i.e. risk of predation); and that spiny lobsters significantly influence the structure of benthic communities in kelp forest and seagrass habitat.

**Project Goals and Objectives**

1. Compare patterns of lobster size, movement, and home range among kelp forest, surfgrass, and eelgrass habitats;
2. Determine how geological and biological features of the benthos influence lobster movement and survival within kelp forest, surfgrass, and eelgrass habitats;
3. Compare the effects that lobsters have on benthic community structure within kelp forest, surfgrass, and eelgrass habitat.

**Briefly describe project methodology**

Lobsters are tagged with sonic tags and tracked through the kelp forest; tagged lobsters also are monitored for long-term movement using listening stations. Surveys are used to examine lobster abundance in different habitat types during the day and during the night. Urchins (lobster prey) are exposed to predators during the day and the night to determine whether lobsters have strong effects on urchin density-dependent mortality.

**Describe progress and accomplishments toward meeting goals and objectives**

The major components of this study have been to:

1. Evaluate lobster movement patterns in the La Jolla Ecological Reserve (LJER), and nearby areas. Lobsters were tagged and tracked with acoustic transmitters, boat-mounted hydrophones, and moored submersible listening stations. We measured the home range and patterns of movement for 22 lobsters, and determined that lobsters in this area generally have small home ranges that are smaller in area than the LJER.

2. Evaluate lobster and prey (urchin) habitat use inside and outside of the LJER and in Point Loma, and measure urchin density-dependent mortality. We conducted transects to record density of lobsters, their predators, and their purported prey, as well as sheltering behavior of urchin prey. These patterns of abundance and behavior were compared to companion experiments in which we measured whether lobster and fish predation on urchins is density-dependent. We found fish and lobster predation to be inversely-density dependent, suggesting that the role of predators in controlling urchin populations is not straightforward. We used these data and data from published studies to construct an individual-based model (IBM) that will allow us to simulate the kelp forest community and to predict the conditions under which lobsters and fish predators may control urchin populations.

### **Project modifications**

One modification is a focus on lobster movement in the La Jolla Ecological Reserve. After our previous lobster research indicated that lobster risk of mortality is high in the reserve, and with the MLPA process about to establish reserves in Southern California, we shifted our focus from Point Loma to the La Jolla Reserve. We have focused on movement of lobsters in the reserve and retention of lobsters in the reserve. This has resulted in little time spent on determining lobster movement in eelgrass habitat, though we have made some progress on that in our companion project taking place in San Diego Bay. One problem is the complex habitat and high predator abundance in the La Jolla reserve makes lobster tracking more difficult. We have learned to carefully check for live tagged lobsters after tracking (i.e., we determine if lobsters have dropped tags or been eaten by predators often). We spent time attempting to develop methods for observing lobsters and fishes as they eat urchins during the day and night. Daytime video methodology was straightforward, but nighttime video was problematic. We were attempting to use these techniques to learn more about the rate at which lobsters and fishes consume urchins in the field.

### **Project outcomes**

1. We have developed data sets on lobster movement using active tracking and listening stations, which continuously characterize lobster positions in the LJER over short-term (repeated nights) and long-term (months); we have developed data sets on lobster and urchin abundance and sheltering behavior in the Pt. Loma and La Jolla kelp forests; we developed techniques to expose urchins to predators during the day and the night, and to record predator behavior when foraging on urchins, and produced data on urchin mortality rate from these experiments; and we have produced an individual-based model (IBM) that simulates urchin-lobster-fish interactions in the kelp forest.
2. We are in the process of publishing these results in peer-reviewed journals, and in the process of following-up on these results with a subsequent, larger-scale study also funded by Sea Grant. Thus data and results are being shared via normal professional channels and also with colleagues in California who also are interested in these kelp forest interactions. The project PI works closely with a colleague from the Department of Fish and Game who is developing a stock assessment for spiny lobsters, and the project PI plans to share data and use results to inform MPA monitoring as the MLPA established marine reserves in southern California.

**Impacts of project**

The project has contributed to the discipline of marine ecology by providing the only data sets on California spiny lobster movement under a variety of conditions. We also have addressed the well-debated issue of how and whether predators help to control kelp forest community structure. The project also has supported two master's students conducting theses on the project objectives, and an undergraduate honors thesis.

**Benefits, commercialization and application of project results**

N/A

**Economic benefits generated by discovery**

N/A

**Issue-based forecast capabilities**

N/A

**Tools, technologies and information services developed**

N/A

**Publications**

Conference papers, proceedings, symposia

Title: California spiny lobsters and marine reserves: what can we learn and what do we know?

Authors: Kevin Hovel and Chris Lowe

Date: November 10, 2007

Conference Title: Western Society of Naturalists 88th annual conference

Location: Ventura, CA

Title: Ecology and conservation of the California spiny lobster

Authors: Hovel, Kevin A.

Conference Title: NA

Location: Scripps Institution of Oceanography

**Theses, dissertations**

Title: Movement and habitat use of California spiny lobsters in southern California kelp forests

Authors: Withy-Allen, Kira R.

Schools: San Diego State University, Department of Biology

Date: May 2010

Title: The effects of predators and habitat on sea urchin densities in southern California kelp forests

Authors: Nichols, Katheryn D.

School: San Diego State University, Department of Biology

Date: May 2009

**Please list any workshops/presentations given**

Western Society of Naturalists 88th annual meeting, Ventura, CA: Hovel and Lowe: California spiny lobsters and marine reserves: what can we learn and what do we know? 300 attendees; marine ecologists, graduate students

San Diego Oceans Foundation, invited seminar at Scripps Institution of Oceanography. Ecology and conservation of the California spiny lobster. Approx. 60 attendees, fishermen, SD Oceans Volunteers, K-12 students.

**Dissemination of results**

Seminars presented at conferences by graduate students (three presentations) and undergraduate students performing honors theses (one presentation).

Presentations at: Western Society of Naturalists annual conferences, Ventura, CA (Nov. 2008) and Monterey, CA (Nov. 2009), Annual Benthic Ecology Meeting in Wilmington, NC, March 2010 (1 graduate student oral presentation and one undergraduate student oral presentation; undergraduate won Best Undergraduate Student Presentation Award).

**Students**

Kathryn Nichols  
San Diego State University  
Department of Biology  
Degree program enrolled in: M.S.  
Thesis/dissertation title: The effects of predators and habitat structure on sea urchin density in Southern California kelp forests  
Supported by Sea Grant funds?  yes  no  
Start date: 09/01/2006  
End date: 08/31/2009

Kira Withy-Allen  
San Diego State University  
Department of Biology  
Degree program enrolled in: M.S.  
Movement and habitat use of California spiny lobsters  
Supported by Sea Grant funds?  yes  no  
Start date: 09/01/2007  
End date: 08/31/2010

Leah Segui  
San Diego State University  
Department of Biology  
Degree program enrolled in: B.S.  
Theses/dissertation title: Predators and urchin mortality in southern California kelp forests  
Supported by Sea Grant funds?  yes  no  
Start date: 05/01/2009  
End date: 12/15/2010

**How many students volunteers were involved in the project?** 3

**International implications**

N/A

**Awards**

Edna Bailey Sussman Foundation award to Kathryn Nichols, 5/31/07; internship at CDFG for lobster research. Best Undergraduate Presentation Award, Annual Benthic Ecology Meeting, Wilmington, NC, March 2010

**Keywords**

spiny lobster; marine reserves; top-down; predation; movement; urchin; habitat