Title
Shelter Use, Movement, and Home Range of Spiny Lobsters in San Diego County

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Shelter use, movement, and home range of spiny lobsters in San Diego County

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Background and objectives

The California spiny lobster is an ecologically and economically important species in southern California coastal waters. In San Diego County, commercial lobster landings average approximately 500,000 pounds per year with a subsequent value of ca. $5 million, and recreational fishing for lobsters is a valued part of life in San Diego for many people. Lobsters are a major predator of benthic invertebrates along the southern California coastline, and they act as a keystone species by preying upon competitively dominant mussels on rocky shorelines and sea urchins that consume kelp, thereby promoting the existence of diverse shoreline communities. Despite the fact that *P. interruptus* has supported a fishery in California for over 100 years and may presently be overfished, we have relatively little fishery-independent information on lobster population dynamics and behavior that could be used to implement conservation efforts. Our goal in this research was to fill some of these gaps in our knowledge by determining linkages between spiny lobster habitat and lobster population structure and movement. Specifically, we tested (1) how characteristics of lobster shelter and of benthic landscapes influence lobster shelter selection and their nocturnal foraging behavior; and (2) how risk of predation influences lobster shelter use behavior. By addressing these objectives we evaluated the utility of various habitats as essential fish habitat for lobsters, and we addressed two priorities set out in the California Marine Life Protection Act (MLPA): (1) to assess the home range of exploited mobile invertebrate species, and (2) to provide baseline information on the abundance, size frequency, population structure and location of nearshore invertebrates.

Lobster shelter selection and nocturnal movement

Methodology. We used a combination of benthic SCUBA-based surveys, and sonic tagging and tracking to assess the relationship between lobsters, shelter, and benthic landscapes. First, we repeatedly surveyed 12 benthic landscapes in the Pt. Loma kelp forest near San Diego for lobster abundance, size frequency, and shelter use. Shelters were measured for size and were characterized as in Mai and Hovel (2007) as ledge shelters, rock shelters, or holdfast shelters. This information provided an index of lobster shelter preferences, an assessment of their tendency to aggregate in shelter (see below for more information), and baseline measures of abundance and size distribution for lobsters. Second, we used sonic tagging to monitor lobster nocturnal movements as they left shelter at dusk and foraged in the kelp forest and in nearby surfgrass beds. We tagged 20 lobsters in 2005 and 22 lobsters in 2006 with VEMCO V-13 continuous pingers. To test how shelter configuration and aggregation size influence (1) propensity to return to shelter, and distance moved, and (3) lobster home range, we placed lobsters in large or small shelters, with or without conspecifics. We then tracked lobsters by relocating them with a boat-mounted hydrophone every 20 minutes from dusk to dawn on at least three nights (ca. 13 lobsters in each year). The remaining tagged lobsters (ca. 7-10 in each year) were relocated only during the day, at which point we assessed their habitat and shelter use.

Results. Overall, lobsters moved great distances from shelters at night, averaging ca. 600 m traveled from shelter in 2005 and ca. 250 m in 2006 (Figure 1). Lobsters moved farther on the first night of tracking, suggesting that the stress of capture may influence movement distance. Data therefore were analyzed with and without the first tracking night included. When tracks were superimposed over existing benthic habitat maps, it was clear that lobster avoided open areas (sand and mud bottoms clear of large rocks and algae) and that they primarily moved within areas that had high kelp cover or surfgrass cover (Figure 2). Most lobsters moved in a linear (rather than circuitous) fashion from the kelp forest to shallower surfgrass habitat. Lobsters occasionally returned to the original shelter, and more often were found returning to specific landscapes, i.e., groups of shelters or particular areas of the kelp forest or nearby surfgrass habitat (Figure 3). The size of shelter did not appear to influence lobster behaviors. However, the presence of conspecifics influenced (1) how far lobsters moved per night, (2) lobster home range, and (3) whether on subsequent nights lobsters were found with conspecifics. Specifically, lobsters placed with conspecifics moved farther, had larger home ranges, and were less likely to use shelter with conspecifics than lobsters placed without conspecifics. These trends are very different than what we expected. Lobster aggregations may be used to deter attacks by predators, and we therefore expected lobsters in aggregations to return to those shelters and to venture shorter distances so that they could return to shelters more easily. It is also surprising that lobsters avoided conspecifics after being placed with them. Our surveys revealed that lobsters occupy shelters with conspecifics approximately 50% of the time, and subsequent predation experiments with lobsters (see below) revealed low risk of mortality for lobsters.

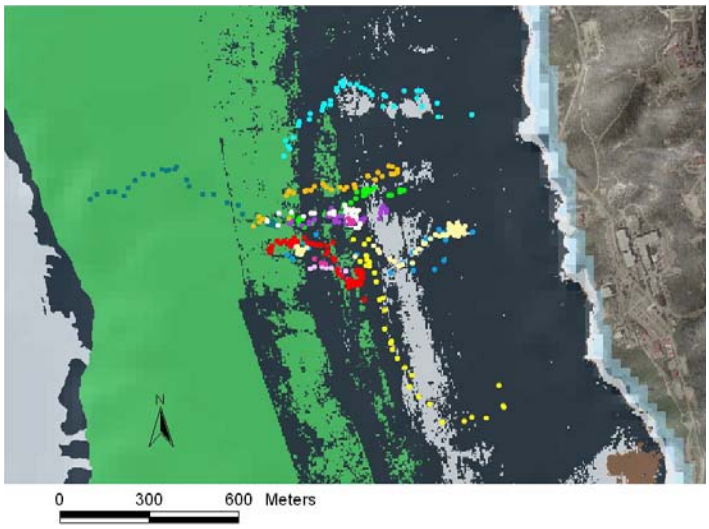

Figure 1. Tracks of tagged lobsters in 2005. Each color represents a different lobster. Light gray areas represent bare sediment that was avoided by lobsters. Darker areas represent surfgrass habitat and green areas represent kelp habitat.

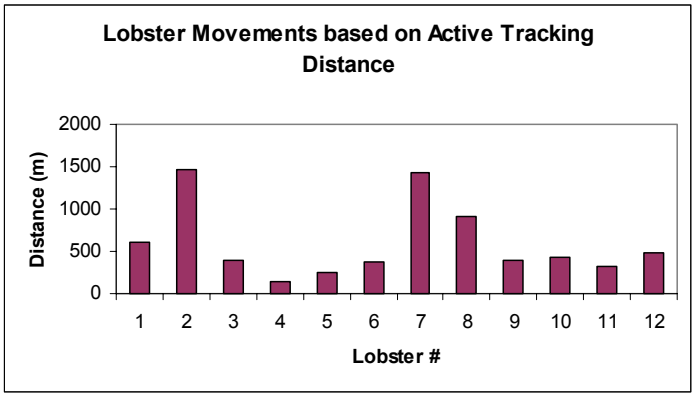

Figure 2. Distances moved by individually tagged lobsters in 2005.

The results from this portion of the project suggest that spiny lobsters in the Pt. Loma kelp forest do not follow behavioral patterns typical of spiny lobsters in other regions of the world. Shelter fidelity was low, shelters with conspecifics were not valued by lobsters, and nocturnal movements were wide ranging. Lobsters appeared to avoid open areas of the benthos, either to avoid predators or because open areas contained little food. We speculate that many of the behaviors we observed may be related to relatively low predation risk in the Pt. Loma kelp forest. We address this in the 2nd portion of our research, described below.

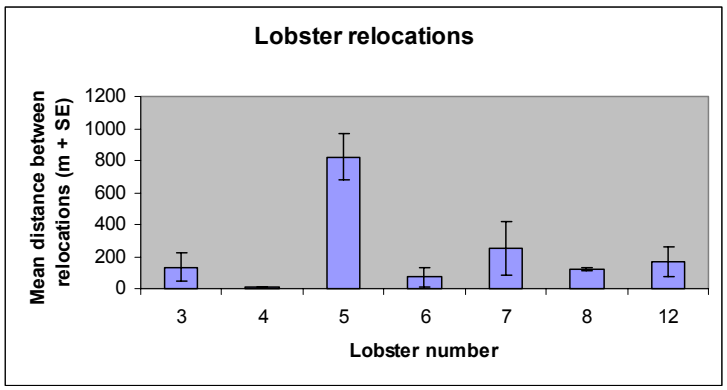

Figure 3. Average distance between daytimes shelters used by individually tagged spiny lobsters over a 2 week period in the summer of 2005. Most lobsters repeatedly used shelters in fairly close proximity after the first tracking night.

Risk of predation and lobster shelter use

Methodology. This component of our project examined how lobster use of shelter varied among populations exposed to high predation risk vs. low predation risk. This component also formed the basis of a master's thesis project by the Sea Grant Trainee, Chad Loflen. We used SCUBA to compare survey data from Pt. Loma (lobster density, lobster size distribution, shelter density and size, predator density) with that of the La Jolla Ecological Reserve (LJER), a small marine protected area north of the Pt. Loma kelp forest. We used transects to survey for predators as well as video of the benthos. After surveys revealed strong differences in predator density between the reserve (high predator density), and Pt. Loma (low predator density), we (1) tethered lobsters in each location to assess relative predation risk, and (2) compared shelter use behavior between the two locations. Shelter use behavior surveys assessed aggregation sizes for lobsters and how well lobsters were scaled to shelters (i.e., whether lobsters use larger or smaller shelters relative to their size; lobsters more closely scaled to shelter size have reduced risk of predation).

Results. Predator densities (large fishes such as sheephead, black sea bass and kelp bass) were several fold higher in the LJER than in Pt. Loma (Figure 4), where we often observed no large fishes in transects. Lobster relative mortality (= predation risk) on tethers was significantly higher in the LJER than in Pt. Loma, as was lobster mean density (Figure 5) and mean body size. Lobsters tended to form larger aggregations in the LJER (Figure 6), which may be a behavioral response to higher predation risk. They also tended to scale their shelters to body size; the larger lobsters of the LJER used similarly sized shelters as did the smaller lobsters of Pt. Loma. These results suggest that lobster behavior (in terms of shelter use) is different among the two sites, and is a response to high predation risk where large fishes (predators) are being protected. Overall, the results demonstrate that the LJER holds a higher density and higher mean size of spiny lobster than does Pt. Loma, but also a higher predation risk, which alters lobster shelter use behavior between the two sites.

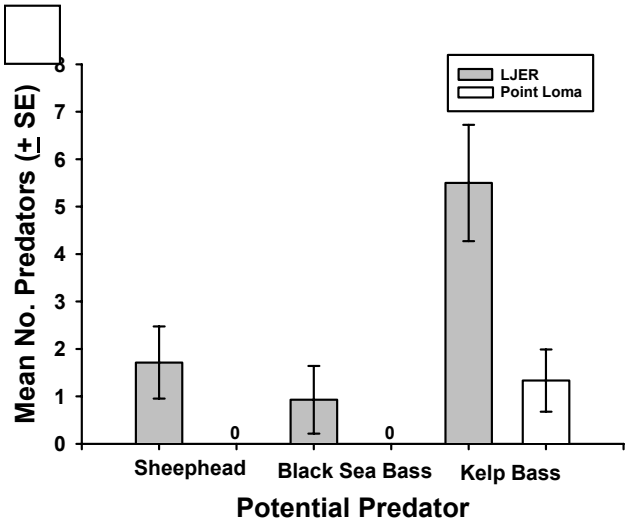

Figure 4. Number of predatory fishes in Pt. Loma and in the La Jolla Ecological Reserve.

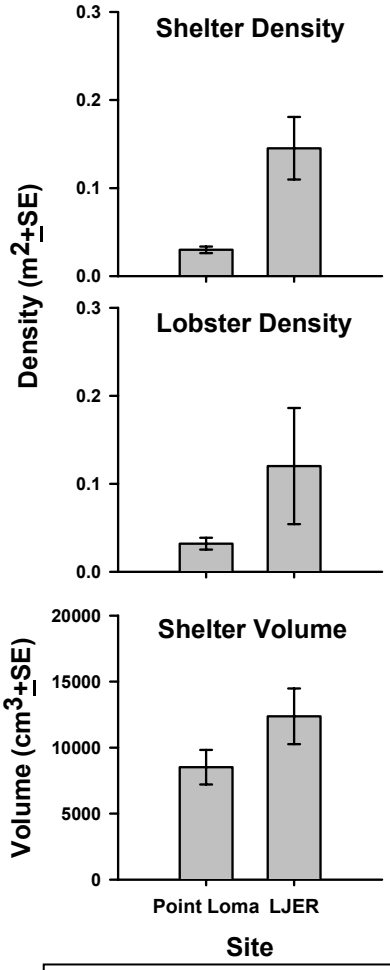

Figure 5. Shelter density, lobster density, and shelter volume in Pt. Loma and in the La Jolla Ecological Reserve.

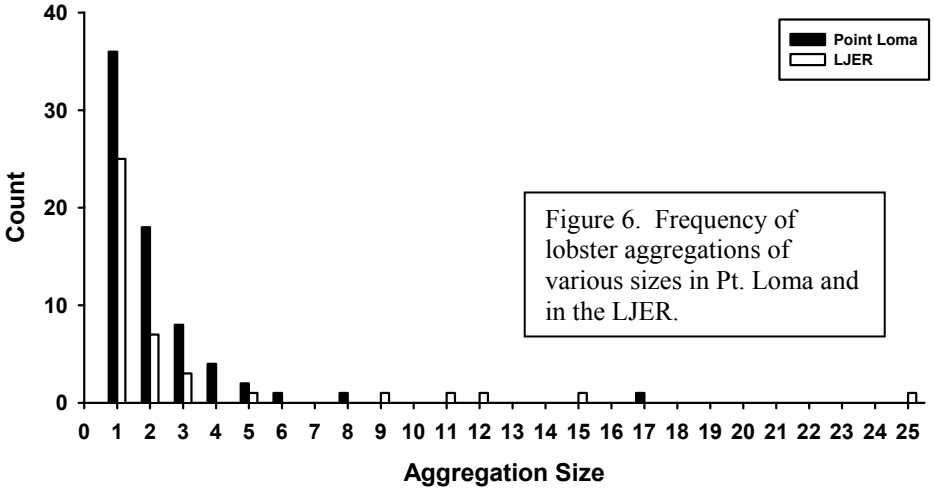

Figure 6. Frequency of lobster aggregations of various sizes in Pt. Loma and in the LJER.