

Final Report for Study 3  
Ocean Protection Council – Department of Fish and Game  
Joint Work Plan  
Project A7 – Fisheries-dependent Data Collection, Field Data Collection

**SPORT LOBSTER INTERCEPT SURVEY  
FALL 2007**

Submitted to Pacific States Marine Fisheries Commission and Ocean Protection Council  
In Fulfillment of OPC Agreement Number 07-069, Recreational Fishing Surveys

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June 30, 2008

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## INTRODUCTION

The California spiny lobster, *Panulirus interruptus*, is endemic to the southern coastal regions of California, in particular south of Point Conception, and is fished both commercially and recreationally.

Spiny lobster has been the target of a commercial fishery since at least the first shipment of lobsters from Santa Barbara to San Francisco in 1872. By 1890, local ordinances establishing fishing seasons had been enacted in all counties south of Point Conception except Orange County. The state implemented a closed season in 1901 (continuing more or less to this day) and began systematically collecting landing information in 1916. In 1965, the state began requiring permits to fish commercially for lobster. During the 1973/1974 season, logbooks were required for the first time and began providing information on the location of catch and numbers of legal lobsters retained and shorts (sublegal lobsters) released.

The recreational fishery has been regulated for decades through seasonal closure and bag limit, but in recent years there have been some changes in the fishery. First, an apparent shift from what was primarily hand collection by divers to a mixture of hoop nets and hand collection has increased the number of people available to fish for lobster. Second, the introduction of a rigid frame to the design of hoop nets, a design selling very well in local bait shops, has led to an increase in catch efficiency on the part of fishermen. The new design increases fishing success by requiring less skill on the user's part.

There is a lack of essential information about the recreational fishery. Questions to be answered include: the primary fishing areas, amount of effort and catch at these sites, and the trend in catch per unit of effort (CPUE) over time at these sites. In addition, the CPUE of the entire recreational fishery is unknown. Although the California Department of Fish and Game (Department) has recently completed studies showing that the rigid-frame hoop net is more efficient, the extent of its use in the fishery and its full impact on the recreational take is not documented.

With this creel survey, the Department has taken the first step (since a 1992 survey targeting only the first two weekends of that season) in quantifying the recreational CPUE with two objectives. First, providing a baseline towards understanding the impact of catch and effort on the population based on the first 10 weeks of the season (determine primary access points for the fishery; the amount of effort and catch at these points; effort and catch by each county and combined counties south of Santa Barbara, and by fishing locations; as well as gather lobster biological data: sex, carapace length, weight); and second, estimating the relative contribution of each gear type to spiny lobster effort and catch.

## METHODS AND MATERIALS

### SURVEY METHOD

Between opening day of the 2007/2008 recreational lobster season, September 29, 2007, and December 2, 2007, seven teams, of two people each, performed intercept surveys at specific fishery access points (Tables A and B; Fig. 1) across the

five coastal counties south of Point Conception, California. Santa Barbara, Ventura and Orange counties each had one team conducting surveys while Los Angeles and San Diego counties had two. The teams were generally scheduled for three random nights during the week and two of the three weekend nights (Friday, Saturday, and Sunday) with the exception of the Santa Barbara and Ventura county teams which were scheduled the same five nights each week. The teams were active between 6 PM and midnight. The survey locations, and resulting survey schedules, were chosen, with input from the Department and California Recreational Fisheries Survey (CRFS) personnel, to include high activity sites (Tables A and B, Column 3) while ensuring that data were also collected from less utilized sites. Each scheduled night was usually split unequally between two sites and interviewers stayed at the sites for the entire scheduled time (either two or four hours in duration) regardless of whether fishermen were present to be interviewed.

Upon arrival at a site, interviewers did a pre-count to determine the initial number of fishermen potentially involved in lobster fishing. This was done by counting the number of cars with boat trailers if at a launch ramp, or the number of fishermen present with visible nets or hoop gear if at a pier or jetty. Beach access sites did not have pre-counts performed. A count of fishermen with rods was also performed at piers, jetties, and beaches. After the pre-count, interviewers positioned themselves at points that would allow them to intercept fishermen as they were leaving the site. Only fishermen who had completed their fishing for the night were interviewed. At launch ramps, interviews were conducted at locations where boats on trailers, recently pulled from the water, were undergoing final tie down/cleanup before leaving the launch facility. Pier and jetty interviews took place at the foot of the structure, and beach access interviews occurred at the primary path or stairway leading off the beach. When it came time to leave a site, a post-count of lobster fishermen was performed in the same manner as the pre-count.

Interviewers used a standard form (Fig. 2) with which to conduct their interviews that included interview site, date and time on site, pre- and post-counts as well as interview-specific information. Each interview conducted recorded the time of the interview, number of fishermen in the interviewed group, hours fished, fishing mode (beach, pier, etc.), gear type, fishing location and depth. In addition, the number of non-intercepted fishermen leaving while another group was being interviewed was recorded. Fishermen were asked for the number of lobsters kept and released (not retained, for whatever reason). The interviewers were equipped with calipers for measuring carapace length of kept lobsters to 1 mm, and hanging scales for weighing to the nearest 0.01 kg. The sex of each kept lobster was also recorded. The collection of information was prioritized because of time constraints based on the number and size of fishing groups leaving at a given time. Trip information (number of fishermen, fishing location, gear type, etc.) was recorded first, followed by biological measurements (sex, length and weight). Weight measurements, taking the longest to perform, were considered of lowest priority. Intercepted groups that were not lobster fishing were recorded as fin fishers or 'other activity'. Each group was provided with standardized instructions outlining the methodology (Fig 3).

All survey sheets were entered into a Department-internal formatted text file which was subsequently converted to a MATLAB readable binary file (.mat). All

statistical analyses were performed in MATLAB and, where possible, the routines were written by Department personnel to ensure understanding of the assumptions used during the analyses (e.g., knowing whether variances are calculated for the population or sample).

Catch locations associated with the Channel Islands are identified as from the offshore islands (OSI) and not by county. County locations are San Diego (SD), Orange (OC), Los Angeles (LA), Ventura (VEN), and Santa Barbara (SB). Additionally, catches without an identifiable location were placed in the Unknown category (UNK). The number of records for SB, OSI, and UNK was much smaller than for SD, OC, LA, or VEN. For this reason, statistical comparisons were restricted to the latter four locations.

Gear types are traditional hoop nets (that lie flat on the bottom when deployed), rigid hoop nets (that maintain their shape during deployment), scuba divers, and skin divers. Additionally, traditional and rigid hoop nets were also combined under a general hoop net gear type, and scuba and skin divers under a general diver gear category.

Fishing modes are pier/dock, breakwaters/jetties, beach, personal watercraft (PWC), commercial passenger fishing vessels (CPFVs), and private boats.

## CATCH AND EFFORT DATA

For the purposes of this report we compared results, catch and effort, by county of catch (not interview location), gear type, and fishing mode. A full comparison of catch and effort data required a fisherman's county of catch, gear type, fishing mode, number of kept lobster, and number of released lobsters to all be defined. Early on in the study, however, it became clear that not all information about a given catch would be consistently collected. In particular, fishing mode or gear type was sometimes missing.

Since gear type, fishing mode, number kept, and number released were not available for each interview, we created a number of different effort datasets from the survey data:

1. All records with specified fishermen and gear type. Fishing mode, number of lobster kept and released may or may not be known. This dataset was used to characterize the effort by gear usage across all counties.
2. All records with specified fishermen and fishing modes. Gear type, number of lobster kept and released may or may not be known. This dataset was used to characterize the mode usage across all counties.
3. All records with specified number of hours fished, gear type, fishing modes, kept and released numbers of lobster. This subset was used for CPUE calculations comparing gear type, fishing modes, or both, across all counties. Two different catch types were calculated: total catch (kept and released) and a 'successful' catch (kept only). CPUE was calculated as lobster / hour for each catch type.

Since effort in hours was sensitive to the number of fishermen interviewed and that varied from county to county, we normalized hourly effort for non-CPUE comparisons, by dividing the effort in hours by the number of fishermen. Similarly, hoop net-based catch data were sensitive to the numbers of fishermen interviewed as well.

Generally, the more fishermen interviewed the higher the catch totals were for the given county or fishing mode. We also normalized the net-based catch data by dividing by the total number of nets to produce a catch per net. CPUE was calculated with the original un-normalized catch and effort data, however.

Other effort metrics, such as number of net pulls, were rejected because of lack of consistency in quality across counties during the data collection process (Note: the number of nets, used to normalize catch data above, is not the same as the total number of net pulls). We also rejected effort metrics that were isolated to a particular type of gear or fishing mode without correlates across all gear types or modes; for example, the number of nets used has no commonality with diving effort without knowledge of the number of pulls for each net used, which was not recorded.

## BIOLOGICAL DATA

Recorded biological data consisted of carapace length (to nearest 0.1 mm), weight (to nearest 0.01 kg), sex, and the presence of eggs or spermatophores collected from kept lobsters. No measurements were made for released lobsters and not all kept lobsters were measured, sexed, or weighed. Because of this, fewer data points were available for comparing the biological parameters by county, gear type, or fishing mode. As such, rather than create a subset, as we did with catch and effort data, that contains only interview data with all variates defined, we only rejected missing data for the specific variables being compared. For instance, when comparing county and weight, we selected all pairs where both county and weight were specified, ignoring whether or not associated fishing modes or gear types were specified. We extracted the average, minimum, and maximum lengths and weights by county, gear type, and fishing mode and sex. We also compared the number of male versus female lobsters by county, gear type, and fishing mode.

## STATISTICAL ANALYSES

All results are based on interview responses. No effort has been made to interpret the relevance of missed interviews (i.e., a fisherman leaving without being interviewed while the interview of another fisherman is underway) to the results given. Also, the results are based on the nighttime Department-tracked sampling and do not include daytime California Recreational Fisheries Survey (CRFS)-tracked sampling. CRFS data, separately and in combination with nighttime data, will be presented in a subsequent publication.

Effort (number of hours fished) and catch (number of lobsters) data were compared within counties only because the quantity and scheduling of the different survey site types (e.g. beach versus launch ramp) were not consistent across counties. Since the distribution of survey site types were not uniform within counties as well, comparisons between hoop net effort and catch and dive-based effort and catch should be interpreted to characterize the relative abundance of surveyed site types only and not a preference between hoop netting and diving. Comparisons between traditional and rigid hoop net effort (number of fishermen) were used to judge the relative popularity between the two types of hoop nets within each county and the catch



comparisons were used as a metric of relative success between the two net types. Similar comparisons were made with the diving-based data between skin and scuba. All effort and catch data within each county were compared using Chi-squared Goodness of Fit tests against no preference (1:1 ratio), hoop nets versus divers, traditional nets versus rigid nets, and scuba divers versus skin divers. All tests were conducted with  $\alpha=0.05$ .

Effort data, based on hours fished, were tested for normal distribution using a chi-squared goodness of fit test. Effort datasets not found to be normally distributed were log transformed and retested. If found to be normally distributed two datasets were tested for equal means using a student's t-test, otherwise we used a nonparametric Mann-Whitney U-test. All tests were run with  $\alpha=0.05$ . If more than three datasets were being compared we used ANOVAs. If the variances between the datasets were unequal, as indicated by an F-test, we used the Kruskal-Wallis nonparametric test. All tests were run with  $\alpha=0.05$ .

As mentioned above, CPUE was calculated utilizing the number of lobster kept and released or just the number kept, as the catch size. Effort was calculated as hours fished. The variance resulting from this method can be very large since it does not take into account the number of nets used by single hoop netters or the number of fishermen that contributed to the fishing time of an interview group (which may be just one person or ten). This method was chosen because of the complexity of the statistical analysis of a CPUE normalized for nets and group size and also because some insight can still be gained despite its flaws.

CPUE was compared by calculating individual CPUEs for each pair of known catch and effort. The results were never normally distributed and transforming the results ( $\log_{10}(\text{CPUE}+1)$ ) failed to bring them into conformance with a normal distribution. For this reason, we used nonparametric tests to compare CPUE. In the case of counties and mode, with comparisons across four sets of CPUEs, we used a Kruskal-Wallis test evaluated at  $\alpha=0.05$ . If differences were found, the specific differences were determined with a Tukey-Kramer pairwise comparison test. For comparisons between rigid and traditional hoop nets, scuba and skin diving (both two sample comparisons) we used a Mann-Whitney U-Test.

## **RESULTS**

### **SURVEY SCHEDULING**

Scheduling conflicts, safety issues, and the geographical distance between sites, resulted in changes to the site prioritization planned before the start of the study (Table A, Column 4). With only one team, nominally, per county coupled with the size of the counties, survey schedules were modified to minimize travel times between sites. Some sites, such as Cabrillo Launch Ramp (Los Angeles County), were de-emphasized because of safety and access issues. Santa Barbara County was changed early in the survey from site specific schedules to roaming area-based schedules and then dropped midway into the study because of the lack of interviews (Table B). This might be due to the difficulty of encountering divers across the large expanse of coastline north and south of the city of Santa Barbara, but even within the city, with both piers and a launch

ramp, and about 90 hours on site, only three groups of fishermen were encountered. Comparisons with any of the other counties suggests that Santa Barbara County contributes the least to overall recreational lobster fishing effort in the modes targeted by this study.

Despite these changes, the survey involved 1,355 hours spent on 416 site visits resulting in 1,309 interviews (Table B; last row). Of the original 14 primary sites (Santa Barbara always had 1 primary site despite the changes that occurred there), 11 remained as primary sites and three lower priority sites were changed to primary sites: Shelter Island Pier (San Diego County) because of its proximity to Shelter Island Launch Ramp, San Clemente Pier because of its proximity to southern Orange County primary survey sites, and Redondo Beach Pier which was added as an additional site north of the Palos Verdes (PV) Peninsula. PV Peninsula formed a demarcation in Los Angeles County; teams operated either north or south of it in a single night.

Although the survey sheets included breakwaters and party boats, these modes were not encountered during the survey. A few jetties (Tables A and B) were surveyed but they resulted in few or no interviews and the results were grouped with beaches for analysis. A potential, major source of catch and effort missed entirely by the survey were private boats docked locally in marinas. For example, anecdotal information from both lobster fishermen and California State University (CSU) researchers active during the season, suggests a large amount of effort was directed at the Los Angeles breakwater by boats that returned to private marinas.

#### NUMBER OF FISHERMEN INTERVIEWED VERSUS NUMBER OF SITE VISITS

As expected, our primary effort metric, the number of fishermen (Fig. 4), was highly correlated to the number of interviews (Table C) ( $r=0.996$ ,  $p<<0.01$ ) and these varied from county to county making simple comparisons between counties difficult. In addition, hoop nets were specified with all fishing modes except beach access. In contrast, diving was specified primarily from beaches, private boats, rarely personal watercraft, and never from pier/dock. In the non-beach modes specifying diving, the total number of fishermen was at least an order of magnitude smaller for diving than for hoop netting. For this reason, comparisons of effort and catch between nets and diving are informational only and require more complex analyses to suggest that any differences seen in the number of fishermen diving versus the number of fishermen hoop netting can be interpreted as a preference of one over the other.

#### CPUE SPECIFIC DATASET

Requiring the number of kept lobster, released lobster, gear type, fishing mode, and hours fished all to be defined for a record to be included in the CPUE dataset resulted in a loss of approximately 100 interviews relative to the gear type (possibly without fishing mode) and fishing mode (possibly without gear type) comparison datasets. The loss from the total number of interviews conducted was approximately 180 interviews.

## EFFORT

OSI, San Luis Obispo, SB, and UNK had few or no interviews relative to the other counties. Because of this, statistics are applied and discussed with SD, OC, LA, and VEN only.

### *Effort for specified gear types (without considering fishing mode)*

Of the 2,883 lobster fishermen interviewed, only seven fishermen did not identify at least a specific gear type (Table D, all locations). However, not all of these fishermen identified a fishing mode. Of the fishermen that identified a gear type, 86% used hoop nets and 14% were divers. This trend continued in the individual counties (SD, OC, LA, VEN) where more hoop netters were encountered than divers (Table E) ( $93 \leq X^2 \leq 1270$ ,  $df = 1$ ,  $p < 0.01$  in all cases). Traditional hoop nets were used by more interviewed fishermen than rigid hoop nets in all counties ( $35.74 \leq X^2 \leq 624$ ,  $df = 1$ ,  $p < 0.01$ ) except VEN ( $X^2 = 2.84$ ,  $df = 1$ ,  $p = 0.07$ ) where the same proportion used each type; the percentage of hoop netters using the newer, rigid-style hoop nets ranged from 21% (SD) to 54% (VEN) increasing in use in the northern counties.

Interviewers encountered more scuba divers than skin divers in all counties surveyed (Table D) ( $6.57 \leq X^2 \leq 32.01$ ,  $df = 1$ ,  $p < 0.01$ ).

### *Effort for specified fishing mode (without considering gear type)*

Fishing mode was identified by 2,877, or 99%, of the total number of fishermen interviewed (Table F). Identified modes included pier/dock, beach, personal watercraft, and private boats. Fishermen specifying breakwaters, jetties, or "other structures" were not encountered. The survey did not target CPFV and rental boats. Personal watercraft were encountered at both beaches and launch ramps.

### *Effort Data for CPUE Calculations*

The total number of reported hours spent fishing for all fishermen was 7,619 hours (Table G). Excluding all records with missing fishing mode or gear data resulted in data representing 7,532 hours of fishing effort or 99% of the total number of hours associated with full kept/released information (Table H).

Across southern California, fishermen spent more time per trip fishing with rigid hoop nets than traditional hoop nets (Table H) (Mann-Whitney U-Test,  $p = 0.03$ ), Cumulative fishing effort, however, was 5,293 hours using traditional nets versus only 1,702 hours for fishermen using rigid nets (Table H, J). By counties, only SD had unequal fishing times between hoop net types where longer times were spent fishing with rigid hoop nets (SD: Mann-Whitney U-Test,  $p < 0.01$ , all other counties  $p > 0.05$ ).

Although small in number, divers encountered across all counties were overwhelmingly scuba divers (Table H) ( $X^2 = 217.58$ ,  $df = 1$ ,  $p < 0.01$ ) with a ratio of almost 3:1 scuba to skin diver (Table D). This pattern did not change within the individual counties ( $6.57 \leq X^2 \leq 28.45$ ,  $df = 1$ ,  $p < 0.01$  in all cases). Combining all of

southern California, scuba divers did not spend more total time fishing for lobster than skin divers (Mann-Whitney U-Test,  $p > 0.05$ ) a pattern repeated within each county (Mann-Whitney U-Test,  $p > 0.05$  in all cases) except LA (Mann-Whitney U-Test,  $P = 0.04$ ) and OC (Mann-Whitney U-Test,  $p = 0.02$ ) where more time was spent skin diving.

Four fishermen in SD were using hook and line, an illegal gear type for lobster fishing. They spent a total of eight hours fishing. It is assumed there was a single hook and line rig between all four fishermen.

Of the four types of fishing mode encountered during the survey, the most prevalent, in terms of number of fishermen, were private fishing boats, sampled at launch ramps, followed by piers. Together these two modes (2,605 fishermen) yielded 92% of all the fishermen interviewed (2,842 fishermen) (Table I) and represented 96% (7,209 hours) of the cumulative total hours (7,532 hours) fished for all fishermen interviewed (Table J). Considering SD, OC, LA, and VEN, only OC had equal numbers of fishermen at both piers and launch ramps (OC:  $X^2 = 0$ ,  $df = 1$ ,  $p < 0.96$ ) with the remaining dominated by fishermen on private boats (All:  $51 \leq X^2 \leq 256$ ,  $df = 1$ ,  $p < 0.01$ ). Personal watercraft accounted for 3% of the total fishermen interviewed and were most prevalent in VEN, although VEN accounted for only 37 personal watercraft fishermen. The number of hours per fisherman spent fishing was about 2.6 hours for all modes except beaches, and approximates the overall number of hours per fisherman spent across all modes (ANOVA,  $p < 0.01$ , and Tukey-Kramer). Beaches were fished for approximately 0.82 hours (49 minutes) per fisherman.

There were no differences in the number of hours beaches were fished per fisherman in the four counties analyzed (ANOVA,  $F = 2.01$ ,  $p = 0.12$ ). Piers were fished, on average, for a shorter time in LA than in SD and OC (ANOVA,  $p < 0.01$ , Tukey-Kramer). Fishermen using personal watercraft, on average, fished for the same amount of time across all counties (ANOVA,  $p = 0.06$ ), and fishermen using private boats fished for the same time across all counties except OC which had lower fishing times than all the other counties (ANOVA,  $p < 0.01$ , Tukey-Kramer).

With the exception of traditional hoop nets fished from piers which had the lowest fish time per fisherman, all hoop net related fishing times across modes were similar, and the traditional hoop net times differed statistically only from the longest times recorded for private boats (ANOVA,  $p < 0.01$ , Tukey-Kramer).

## CATCH

The number of lobsters kept, with or without associated gear type, fishing mode, number of fishermen, or time spent fishing, was 2,239. The number of released lobsters, given the same conditions was 9,518. Combining these, the total catch (kept and released) recorded during the study was 11,757 lobsters.

### *Catch for specified gear types (without considering fishing mode)*

Relying on interviews in which both the kept and released number of lobsters were recorded, the survey recorded 2,219 lobsters kept across all counties during the survey for all gear types (Table K). The number of released lobsters was 9,506 lobsters

and the total number (kept and released) of lobsters caught by the survey respondents was a minimum of 11,725 lobsters (Table L).

In the four counties: SD, OC, LA, and VEN, hoop nets caught from 64% (VEN) to 92% of the total reported catch, averaging  $82 \pm 13\%$  across all four. The percentage of the total number of net-caught lobsters that were actually kept ranged from 8% (OC) to 41% (VEN)

For all fishermen reporting lobsters caught by hoop nets, 74% of those lobsters were caught in traditional hoop nets. Traditional hoop nets caught the majority of hoop netted lobsters in all counties except VEN which caught the same number of lobsters in both net types. (VEN:  $X^2=0.10$ ,  $df=1$ ,  $p=0.75$ ; all other counties:  $28.15 \leq X^2 \leq 2,963$ ,  $df=1$ ,  $p < 0.01$ ).

#### *Catch for specified fishing mode (without considering gear type)*

In all counties, private boats yielded the highest catch of lobster reflecting on the high rate of traffic into and out of launch ramps (Table M, N). In terms of the total catch, launch ramps accounted for no less than 83% of the total county catch. The lowest proportion, 83%, was found in OC, a county with a large coastline almost all of which is popular with divers; but divers only accounted for 8% of the catch. Private boats kept 8% to 15% of the total catch in SD/OC and 30% to 40% of the total catch in LA/VEN.

#### *Catch Data for CPUE Calculations*

Based on records in which lobsters kept, lobsters released, number of fishermen, fishing mode, and gear type were all specified, the total catch (kept and released) recorded during the study was 11,727 lobsters. Of those, 2,220 lobsters (18.9%) were kept by fishermen and 9,507 were released (Table O).

Traditional hoop nets accounted for 2 to 3 times more of the catch than rigid nets, and lobsters taken by divers were primarily taken with scuba (3:1 versus skin divers). These approximate ratios were found in both total catch and the kept lobster count (Table P and Q).

#### TOTAL CPUE (KEPT AND RELEASED LOBSTERS)

##### *Total CPUE (Kept and Released) by County*

In pairwise comparisons, all counties had statistically the same CPUE (Tukey-Kramer), except between SD and OC where OC had a significantly higher CPUE (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Fig. 5)

##### *Total CPUE (Kept and Released) by Gear*

There were no significant differences in total CPUE, based on fishing hours, between traditional and rigid hoop nets (Mann-Whitney U Test,  $p=0.29$ ) and between scuba and skin divers (Mann-Whitney U Test,  $p=0.59$ ) (Fig. 6). The total CPUE for all hoop nets was 1.45 lobsters / hour, and significantly higher, 3.01 lobsters / hour, for all

divers (Mann-Whitney U Test,  $p < 0.01$ ). One instance of illegal hook-and-line resulted in a total CPUE of 0.25 lobsters / hour.

#### *Total CPUE (Kept and Released) by Mode*

Piers and docks were the worst place to be if a fisherman wanted to catch lobster, with a significantly lower CPUE (0.32 lobsters / hour) than the other three fishing modes encountered (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Fig. 7). Beaches, personal watercraft, and private boats all yielded the same CPUE (Tukey-Kramer).

#### *Total CPUE (Kept and Released) by Mode and Gear*

The survey did not encounter any fishermen using hoop nets on beaches. Hoop nets (traditional and rigid combined) had a significantly lower CPUE from docks and piers than from either personal watercraft or private boats (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table R). Fishermen in personal watercraft and on private boats, however, experienced similar CPUE when using hoop nets (Tukey-Kramer).

No divers were encountered from piers or docks. In general, however, divers had the same CPUE regardless of the fishing mode used (Kruskal-Wallis,  $p = 0.08$ ), and this pattern also occurred when considering scuba diving CPUE (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) and skin diving CPUEs (Kruskal-Wallis,  $p > 0.05$ ).

No difference in CPUE occurred between rigid hoop nets and traditional hoop nets when considering the piers and docks, personal watercraft, or private boats (all: Kruskal-Wallis,  $p > 0.05$ ). Similarly, scuba and skin divers realized the same CPUE from all fishing modes encountered (all: Kruskal-Wallis,  $P > 0.05$ ). Comparisons were not made between hoop nets and divers for each encountered fishing mode (Table S).

#### *'SUCCESS' CPUE (KEPT LOBSTERS ONLY)*

##### *'Success' (Kept) by County*

The 'success' CPUE in VEN was significantly larger than the rest of the counties (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Fig. 5). Apart from that, the rest of the counties have statistically similar kept lobster CPUE (Tukey-Kramer).

##### *'Success' CPUE (Kept) by Gear*

The 'success' CPUE of rigid hoop nets (0.28 lobster / hour) was significantly higher than with traditional hoop nets (Mann-Whitney U Test,  $p = 0.29$ ) (Fig 6). Divers, on the other hand, experienced no significant difference in 'success' CPUE whether they were scuba or skin diving (Mann-Whitney U Test,  $p = 0.74$ ). The total CPUE for all hoop nets was 0.23 lobsters / hour and, significantly higher, 1.1 lobsters / hour, for all divers (Mann-Whitney U Test,  $p < 0.01$ ).

### *'Success' CPUE (Kept) by Mode*

Pier and dock, prime hoop netting territory, had the lowest 'success' CPUE of the modes encountered during the creel survey (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Fig. 7). The other three modes, beaches, personal watercraft, and private boats had similar CPUE (Tukey-Kramer).

### *'Success' CPUE (Kept) by Mode and Gear*

Statistical results utilizing 'success' CPUE for hoop nets were identical to the results using total catch CPUE and are reiterated here for completeness. Hoop nets (traditional and rigid combined) had a significantly lower CPUE from docks and piers than from either personal watercraft or private boats (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table S). Fishermen in personal watercraft and on private boats, however, experienced similar CPUE when using hoop nets (Tukey-Kramer). These were the same results when considering traditional hoop nets and rigid hoop nets separately (both, Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer).

Unlike total catch CPUE, 'success' CPUE was higher when diving from a private boat than from a beach (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer), while personal watercraft-based CPUE was statistically the same as private boat-based CPUE. (Tukey-Kramer). This pattern also occurred when considering scuba diving CPUE from the perspective of the three fishing modes (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer). No skin diver identified personal watercraft as their fishing mode (or piers and docks) and experienced the same CPUE whether fishing from a beach or a private boat (Kruskal-Wallis,  $p > 0.05$ ).

Results matched total catch CPUE when comparing traditional and rigid hoop net CPUE across fishing modes. No difference in CPUE occurred between rigid hoop nets and traditional hoop nets when considering the piers and docks, personal watercraft, or private boats (all: Kruskal-Wallis,  $p > 0.05$ ). Similarly, scuba and skin divers realized the same CPUE from all fishing modes encountered (all: Kruskal-Wallis,  $P > 0.05$ ). Comparisons were not made between hoop nets and divers for each encountered fishing mode.

## BAG FREQUENCIES AND LIMITS

The overwhelming majority of fishermen, regardless of gear type used, ended up empty handed (Fig. 8). Out of 2,842 fishermen that kept lobster, 24 (0.8%) had 7 or more lobster. Of the 24, 22 had the legal daily bag limit of 7 lobsters, one had 9 lobsters, and one had 10 lobsters. Twenty-one fishermen were on board private boats, two in personal watercraft, and one was scuba diving from the beach. In addition to the beach diver, two fishermen were scuba diving from private boats. Of the remaining 21 fishermen, 15 were using traditional hoop nets, and 6 were using rigid hoop nets. One of the two on personal watercraft had traditional hoop nets while the other used rigid hoop nets.

One bag limit occurred at OSI using a traditional hoop net from a private boat. Twelve bag limits (including the 9 and 10 lobster over-limits) occurred in SD. Eleven

fishermen (including the 10 lobster over-limit) were using traditional hoop nets from private boats and the other fisherman (the 9 lobster over-limit) was scuba diving from a beach.

Only one fisherman from OC got a bag limit and the fisherman was using rigid hoop nets from a private boat. One fisherman from LA got a bag limit using a traditional hoop net from a private boat. The remaining 9 bag limits occurred in VEN and included the two personal watercraft-based fishermen. The other seven fishermen were all on private boats: two scuba divers, three rigid hoop netters, and one traditional hoop netter.

## BIOLOGICAL PARAMETERS

### *Overall Length Frequency*

Overwhelmingly, kept lobsters were within the 83 mm to 92 mm carapace length range (Fig. 9). Lobsters larger than 92 mm were relatively rare and their occurrence decreased with size. Sub-legal size lobsters also occurred and all but one were within 10 mm of legal size.

### *Overall Length/Weight Relationships*

There is a slight curvilinear relationship between carapace length and total weight and a least-squares fit of the log transform of the relationship,  $W=aL^b$ , explains 77% of the total variance of the data ( $R^2 = 0.82$ ) (Fig. 10). The equation for the fitted line,  $\log(W) = \log(1.03992E-5) + 2.4829 \cdot \log(L)$ , is valid for all L where 58 mm CL  $\leq$  L  $\leq$  183 mm CL.

### *Length/Weight by County*

Recorded catches of lobster in each county contained a very few number of large animals (> 125 mm) but their sizes were sufficiently large to skew any calculation of mean size or weight. Because of this, we relied on the median value to indicate an 'average' value (mean values are included in the summary tables, however). OC catches contained the smallest lobsters with a median carapace length of 85 mm (Table T). This median length (as well as the mean length) was probably influenced by the large number of sub-legal sized lobsters in the OC catch (see below for comparisons of sub-legal size lobsters). OC had the smallest measured lengths, followed by SD (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer). LA and VEN had the longest lengths, relative to SD and OC, but were statistically equivalent to each other (Tukey-Kramer).

The lightest lobsters measured were located in OC (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table U) and were probably influenced, again, by the number of sub-legal sized lobsters found in that county. Besides differing from OC, SD and LA also differed from each other with the heavier lobsters occurring in LA (Tukey-Kramer). VEN was statistically equal in weights to both LA and SD (Tukey-Kramer).



### *Length/Weight by Gear*

Lobsters caught with rigid hoop nets were significantly larger than those caught with traditional hoop nets (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table V). Rigid hoop nets also caught larger lobsters than skin divers. No other length comparisons (traditional hoop nets versus rigid hoop nets, skin diving versus scuba diving, or hoop nets versus diving) showed significant differences.

In terms of weight, rigid and traditional hoop nets were just as likely to catch a lobster of a given weight (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table W). Divers, as well, were as likely to catch a given weight skin diving as they were with scuba. Relative to hoop nets, however, scuba divers kept significantly lighter weight lobsters overall.

### *Length/Weight by Mode*

Fishermen fishing from piers and docks landed similar size (based on CL) lobsters as those on beaches. However, beach-caught lobster were significantly shorter than those caught from either personal watercraft or private boats (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table X). Overall, fishing from personal watercraft resulted in catches of significantly larger lobster than from private boats. Private boats fishermen landed larger lobsters than fishermen working from piers or beaches. Fishermen on personal watercraft caught lobsters with the largest mean and median lengths (99 mm and 96 mm respectively) and this particular mode of fishing also caught lobsters with the largest mean and median weights (0.89 kg and 0.82 kg, respectively) Beach mode fishermen took the smallest mean and median length of lobsters (84 mm and 84 mm, respectively), and also took the smallest mean and median weight of lobsters (0.61 kg and 0.59 kg respectively) The mode that took the lobster with the largest length and weight was private boat (183 mm and 4.91 kg respectively, and the mode that took the lobster with the smallest length and weight was beach (58 mm and 0.14 kg respectively).

Heavier lobsters were caught from personal watercraft and private boats than from beaches or piers (Kruskal-Wallis,  $p < 0.01$ , Tukey-Kramer) (Table Y). No other significant difference in weight occurred relative to the fishing mode.

### *Length/Weight by Sex*

The sexes of 366 kept lobsters were not determined by the interviewers. Most of these lobsters were also missing a length (363), weight (364), or both (363). Thus, we treated the lobsters of undetermined sex as missing data and excluded them from this analysis.

Male lobster were found to have significantly higher CL than female lobster, as well as heavier weights (both cases, Mann-Whitney U Test,  $p < 0.01$ ) (Tables Z, AA). These results are based on lobsters measured in every county of the survey.

### *Males vs. Females*

Since 366 lobsters were of unknown sex and the numbers of known male and female lobsters was relatively close (950 versus 899), it is not possible to present conclusively the sex ratio of catch by the variables: county, gear type, or fishing mode; or test for one sex over another being caught based on those variables. Therefore this section presents a simple quantitative description of total lobsters kept by sex by county (Table BB), gear type (Table CC), and fishing mode (Table DD).

### Sublegal-size Lobsters

There were 171 sublegal-size lobsters counted during the survey comprising 8% of the 2,220 lobsters measured during the study. The smallest sublegal lobster had a carapace length of 58 mm. The largest sublegal-size lobster was 82 mm; the legal-size carapace length is 82.5 mm.

All counties with recorded take had at least one short lobster. Overall, an average 8% of all kept lobsters were measured short although most of this was attributed to OC. The median percentage for the four counties was 4%. OC was an anomaly where almost one third of the lobsters kept were short. Given that OC also had the smallest average length of shorts, the large number of shorts implies a lack of concern for and/or understanding of the size limit requirement. The information will allow the Department to focus outreach and enforcement efforts in Orange County.

## **DISCUSSION**

For sixty-five days at the beginning of the 2007/2008 lobster season, seven teams of two people each had the daunting task of surveying the lobster fishing effort between the U.S.-Mexico Border and Point Conception in Santa Barbara County. Operating nominally from sunset to midnight, five days a week, they spent over 1,350 hours compiling a snapshot of the recreational fishery. Visiting piers, launch ramps, dive beaches, and jetties, they recorded the use of private boats, personal watercraft, hoop nets, and skin and scuba diving, in the fishing public's effort to catch lobster. It would be impossible for seven teams to characterize a typical night's recreational effort across the hundreds of miles of Southern California coastline. However, by repeated sampling over the course of the first two months of the season, we have been able to quantify much of the where, when, and how of the fishery and characterize some of the biological aspects of the targeted population of importance to managing the fishery.

Overwhelmingly, the highest activity in all the counties except SB occurred at the launch ramps. Private boats and personal watercraft were intercepted here and both divers and hoop netters interviewed. Private boats probably represent the dominant means that the Southern California public uses to reach the lobster populations. Anecdotal evidence collected during interviews and in conversations with other researchers suggests that boats moving through the launch ramps are only part of the private boat component. Boats moving between private marinas and lobster fishing grounds are the other component and one that was entirely missed by our survey. Interviewees in Los Angeles, for instance, talked of a massive effort off the Los Angeles

breakwater on opening night that was not evident from interviews the same night at the dominant launch ramp in the area. Many of the interviewees described boats departing and returning to the private marinas inside the breakwater.

Personal watercraft (primarily kayaks) were also encountered minimally at the launch ramps. Their prevalence increased moving north from San Diego with the most documented in Ventura. The 'buzz' on fishing websites suggests that a few years ago we might not have encountered any during the survey, and they bear watching in future years as their popularity increases. We encountered people diving from personal watercraft but mostly they were a platform for hoop netting and had a legal-size CPUE on par with private boats.

Piers and docks were the second highest utilized mode after private boats but not every pier was equal in its use. A similar pattern emerged with launch ramps where some were consistently busy with lobster fishermen while others were virtual ghost towns. Some piers when sampled were almost exclusively fished by hoop netters, like Ocean Beach Pier in San Diego. Interestingly, none of the piers in Santa Barbara were frequented by hoop netters while sampling teams were present despite the prominence of piers along that portion of the coast. In particular, we expected Goleta Pier to be utilized by hoop netters because of its proximity to a submerged reef just to the north, but no effort was recorded there. Goleta Pier also has a boat launch which was not heavily used for lobster fishing either. Despite the popularity of some piers, they do not appear to be the place to go for a successful night of lobster fishing, since they possessed the lowest CPUE of any fishing mode observed. They were also the only mode from which illegal fishing gear, a hook-and-line rig, were seen.

Data from the beach mode were difficult to interpret. Even with knowledge that areas were extremely popular with divers, Laguna Beach, for instance, our teams did not encounter the kind of steady traffic seen at launch ramps. Divers had relatively high CPUEs however; probably because they actively hunt for lobsters and, can select only the largest encountered. Hoop netters must attract lobsters to their nets and spend the 40 or so minutes waiting to pull their nets without knowing if anything is in it. Divers spend the same 40 minutes actively hunting. Still, despite high CPUE from diving, the larger number of fishermen encountered hoop netting in other fishing modes, particularly private boats, dwarfs the impact from divers. Lobster fishermen were encountered least of all at beaches. Beaches were, along with launch ramps, an access point for personal watercraft.

Lobster hoop nets come in two varieties: the traditional type that lays flat on the bottom during deployment and only assumes its basket shape during recovery, and a newer, rigid model that maintains basket shape during deployment. Rigid hoop nets have been shown by Department biologists to be substantially more efficient, delivering in excess of 50% more lobster over time than traditional-style nets. Rigid hoop nets were not the most common net seen in our surveys, with three times as many fishermen using traditional than rigid. Although rigid hoop net trips lasted longer than traditional hoop net trips in southern California as a whole, and an equal amount of time (as traditional nets) within each county except SD (SD had longer trip times fishing with rigid hoop nets), the greater use of traditional hoop nets resulted in 74% of the total hoop net catch being caught in traditional nets. That said, however, that proportion is skewed by higher traditional net catches in the southern portion of the five counties surveyed. As

we move north from SD, where rigid nets caught 17% of the total catch, the proportion increases until VEN where the catch is in a statistical dead heat between the two net types. Differences between the two types of hoop net aside, hoop nets caught an average 82% of the total lobster catch recorded by this survey. Additionally, they occurred in three of the four fishing modes observed by our teams, and appear, in the media, to be gaining in popularity.

Despite the number of fishermen recorded by our teams lobster fishing, an extremely small number were actually recorded with the daily bag limit of seven lobsters. Of the 2,883 interviewed fishermen fishing for lobster, 2,842 reported a number of kept lobster, but only 24 (0.8%) had a bag limit; most caught no lobster. Interestingly, of the 24 bag limits, 2 had over-limits of 9 and 10 lobsters, respectively. What modes accounted for the bag limits and how many, follow the generally popularity of the modes themselves. Private boats had 21 recorded bag limits, 2 in personal watercraft, and 1 from a beach diver. Twenty-one occurred with hoop nets, only 6 of which were the new, rigid style. The bag limits occurred in all counties (except SB) with the most in SD (11). SD and VEN together accounted for 20 of the 24 bags.

Of the 2,842 lobsters kept, the largest measured carapace length was 183 mm from a 4.91 kg male lobster caught by a private boat-based rigid hoop net in LA. The smallest lobster, a female, was a 58 mm (under the legal size limit of 82.5 mm), 0.23 kg specimen taken by a scuba diver in SD.

'Shorts', sublegal size lobsters, were encountered in all counties, and in OC accounted for a surprising 28% of the county's total take in lobster. The OC shorts averaged 78 mm  $\pm$  4.6 mm and besides having the most shorts, this constitutes the smallest average length of sublegal size lobsters across all counties. The median number of shorts as a percentage of total county take was 2.9%.

Weight versus length displayed a curvilinear trend although a linear regression successfully recovered 82% of the total variance of the data. Trends by sex cannot be accurately determined by this survey since a large percentage of the kept lobsters, in all counties, were not sexed. That said, measured males tended to be bigger and weigh more than measured females and no females were seen with eggs or spermatophore attached.

Future work involving this study will include additional analyses after adding in survey data from daytime CRFS lobster sampling (which was not included in this report), data from an ongoing Department hoop net study at Zuniga Jetty in SD, and comparisons to recent phone surveys as well as the 1992 creel survey. We also plan to use the 2007/2008 commercial log book and commercial landings data with the recreational data above, to assess the entire lobster fishery, commercial and recreational.

## **RECOMMENDATIONS**

While carrying out the 2007 lobster creel survey, it became apparent that there were many aspects of the survey that could be improved although no critical faults were found that compromised the survey's goals. One desired change would be to make future surveys more like CRFS, which differentiates between weekend and weekday effort, includes CPFVs, and has a uniform method for creating fishery estimates from

the sampling data which is of immediate use to managers. Additional input from CRFS on design considerations should help achieve this goal.

Similar to including CPFVs, the survey could not sample private boats returning to private marinas. CRFS is currently studying methods that would allow these boats to be included in the CRFS daytime surveys, and should be a standard fishing mode investigated by future lobster surveys.

Overall this survey was successful. Most of the problems encountered in this survey can be corrected during subsequent surveys simply because of the experience gained during this first survey effort.

## FIGURES

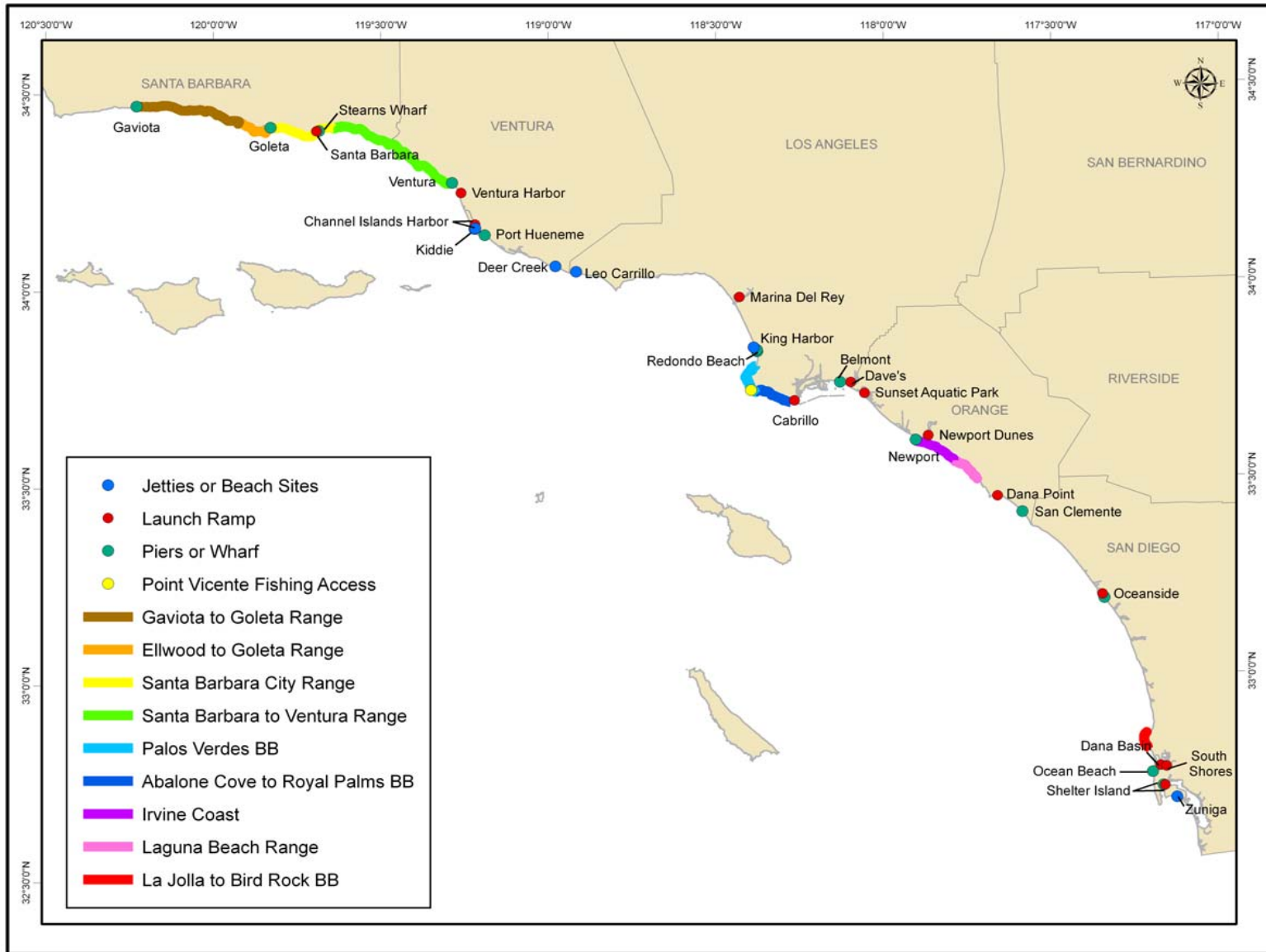


Figure 1. Map of southern California south of Point Conception indicating the types and locations survey sites used in this study. Map courtesy of Gina Schmidt, CDFG.

2007-2008 California Recreational Lobster Survey Form

Page \_\_\_\_\_ of \_\_\_\_\_

Sampler Names: \_\_\_\_\_ Date (mm/dd/yy): \_\_\_\_\_ Site Name: \_\_\_\_\_ Time On(24HR) \_\_\_\_\_ Time Off \_\_\_\_\_  
 Start Boat Trailer count: \_\_\_\_\_ End Boat Trailer Count: \_\_\_\_\_ Start All Fishers Count \_\_\_\_\_ Start Angler Count \_\_\_\_\_ End All Fishers Count \_\_\_\_\_ End Angler Count \_\_\_\_\_

EFFORT						CATCH											Effort			
GROUP #	TIME 2400	# Lobster Fishers	Total Hours Fished (nearest 15 min)	MODE Code (see below)	GEAR Code (See Below)	CATCH LOCATION (Locations from report card by #)	Bottom Depth (ft)	# Lobster Released	# Kept	Lobster Carapace Length (mm) / sex (m or f)							# Missed Lobster Boats or Anglers	# Fin Fishers		
										Weight (decimal kg)										
										1	2	3	4	5	6	7			# Other Activity	
																	Page Total			
Lobster Groups	# Fishers																	Missed	Non-Lob	

**Mode:** 1=Pier/ Dock, 2=Jetty/ Breakwater, 3=Beach, 4=Personal Watercraft (Jet Ski, Kayak, Float Tube), 5=Party/ Charter Boat, 6=Private/ Rental Boat, 7=Other Structure  
**Gear:** 1=Hoop Net (Lays Flat) 2=Hoop Net Rigid (Will Not Collapse) 3=Scuba Diving (Using Tanks) 4=Skin Diving (W/O Tanks)

Figure 2. Creel Survey Interview Sheet. Each sheet was used at a single site each night. Extra sites in a single night, or additional interviews beyond the capacity of a single sheet, required a new sheet.

Lobster Creel Intercept Survey Form Instructions V.9 20 07

Upon arrival at your scheduled site, take a count of vehicles with boat trailers if you are at a launch ramp, or a count of all fishers and a subset count of anglers with rods if at a pier, jetty or beach, and record in spaces at top of form along with other header information. Only lobster fishermen who have completed their fishing trips are to be interviewed. If there is not enough time to examine, measure and weigh the lobster because other groups are leaving, collect all of the other effort and catch information. You can use your judgment and you may be able to collect all information except weight under these conditions as well. Upon approaching a group, first ask them if they were all fishing for lobster tonight. If anyone answers no, then ask those people if they were fishing for finfish tonight. If anyone of them answers yes, tally them under fin fishers at the end of the datasheet row. If they answer no, then tally them under other activity at the end of the row. Continue with the lobster interview for anyone in the group answering yes to lobster fishing or move to another group if no one was lobster fishing. Upon departure from the site, repeat the counts you did on arrival.

- (1) Sample Group – Numeric code starting with '1' for that site and day, for a single group interviewed. While interviewing, segregate each set of fishermen into groups with common mode, gear and location fished.
- (2) Time – Record time interview starts in 24HR dock
- (3) Total Lobster Fishers – Group by mode, gear and location fished
- (4) Total Hours Fished – Ask each fisherman how much time was spent actually fishing for lobster, not travel or walking time to site. Enter group total time in fractions of hours (ie. 3 fishers fished 30, 45 and 60 minutes each – enter 2.25)
- (5) Mode Code – Enter code from bottom of form.
- (6) Gear Code – Enter code from bottom of form – distinguish SCUBA from skin diving by asking if tanks were used or not.
- (7) Catch Location – Ask fishers where they fished and find the matching or nearest location on your site list and enter the site number.
- (8) Bottom Depth (ft) – Ask fishers to estimate the depth(s) where lobster were caught. Enter the depth or an 'average' depth to the nearest foot.
- (9) Lobster released – Ask each group member how many lobster they captured (controlled) and released because they were not legal sized. Add and record total.
- (10) Lobster kept – Ask how many lobster were taken and kept by the group.
- (11) Lobster carapace length – measure each lobster's carapace length to the nearest mm and record
- (12) Lobster sex – record sex as 'M' or 'F' as part of length, ie. 96F for a 96 mm Female.
- (13) Lobster weight – weigh as many lobster as you can and record weight in box under corresponding length. If you need more than 7 boxes for the measurements, go to the next line and start the next fishing group on the next unused row.
- (14) Missed boats or lobster fishers – record those boats at launch ramps you missed, lobster fishing or not and record lobster fishers who you missed and you know were lobster fishing, at piers and jetties.

**Figure 3. Instruction sheet carried by each survey team in the field outlining the intercept survey protocol.**



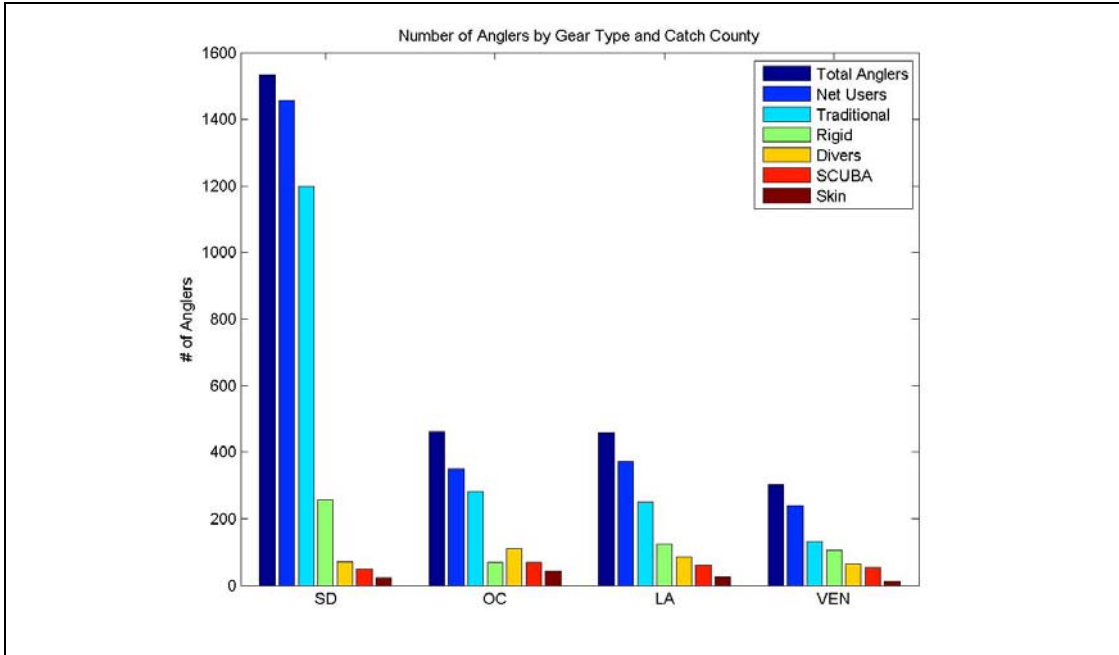


Figure 4. The number of fishermen with both fishing mode and gear type specified, by county and gear type.

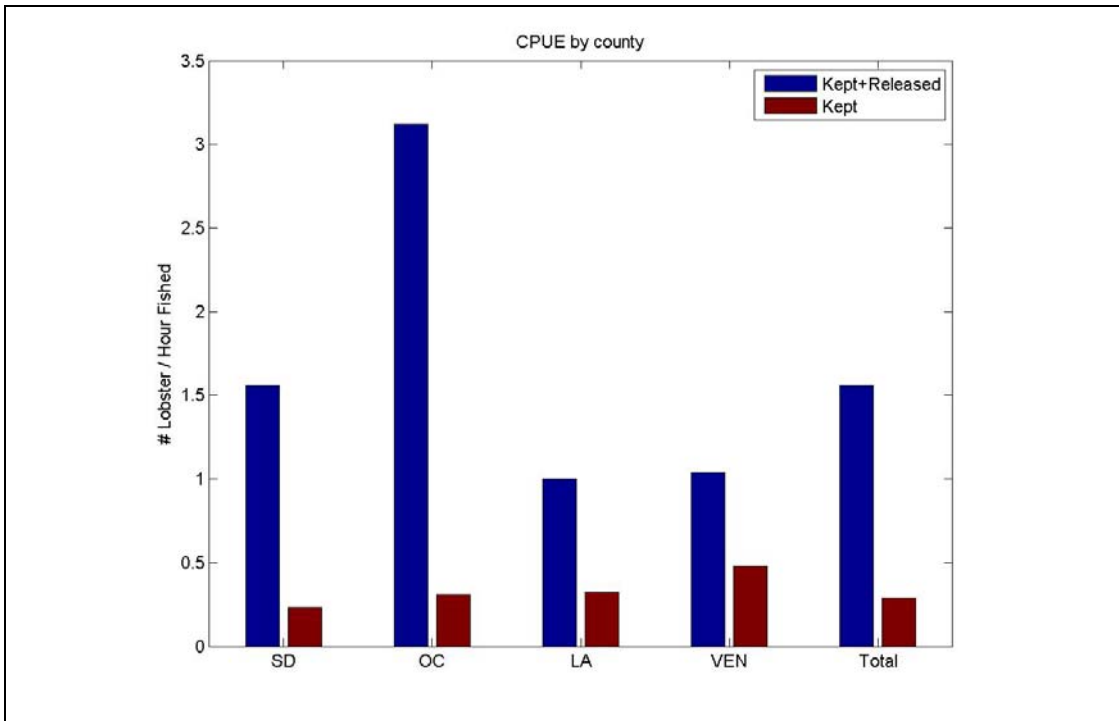


Figure 5. Lobster CPUE by county for both kept and total (kept and released) catch.

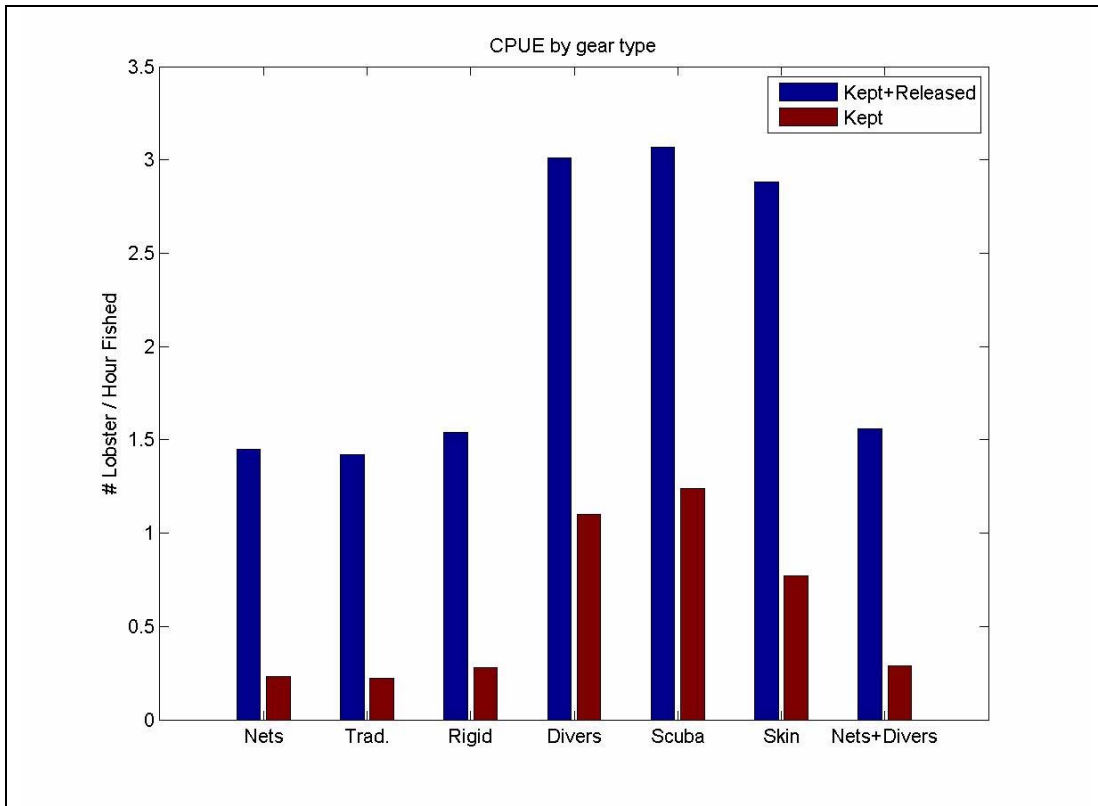


Figure 6. Lobster CPUE by gear for both kept and total (kept and released) catch.

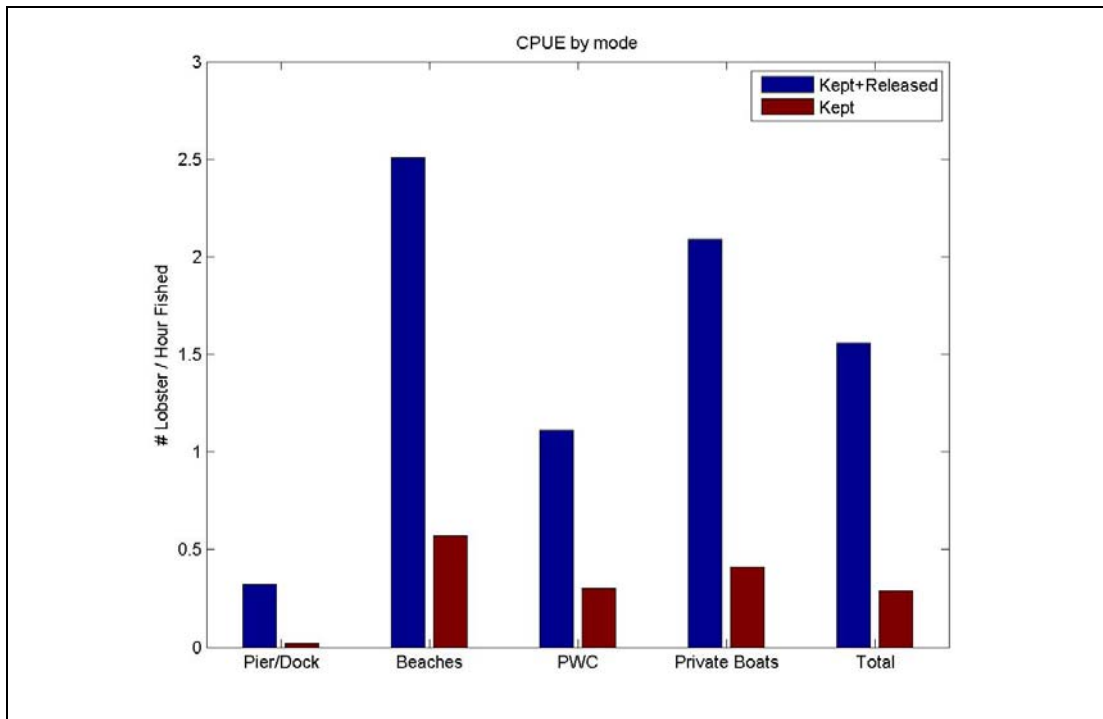


Figure 7. Lobster CPUE by mode for both kept and total (kept and released) catch.

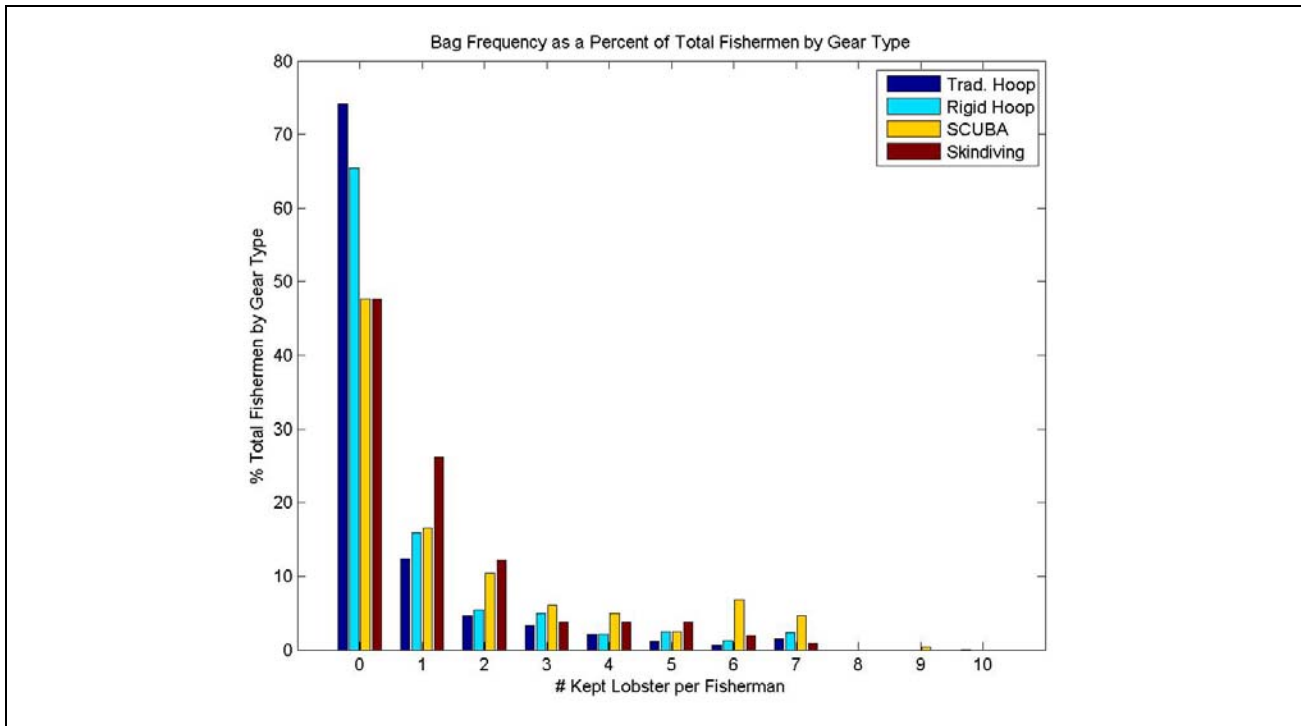


Figure 8. Number of fishermen keeping a specific number of lobsters, by gear type. Bars represent the percentage of total fishermen using each type of gear. Legal bag limit is 7 lobsters per fisherman. The largest number of lobsters kept by an interviewed fisherman was 10.

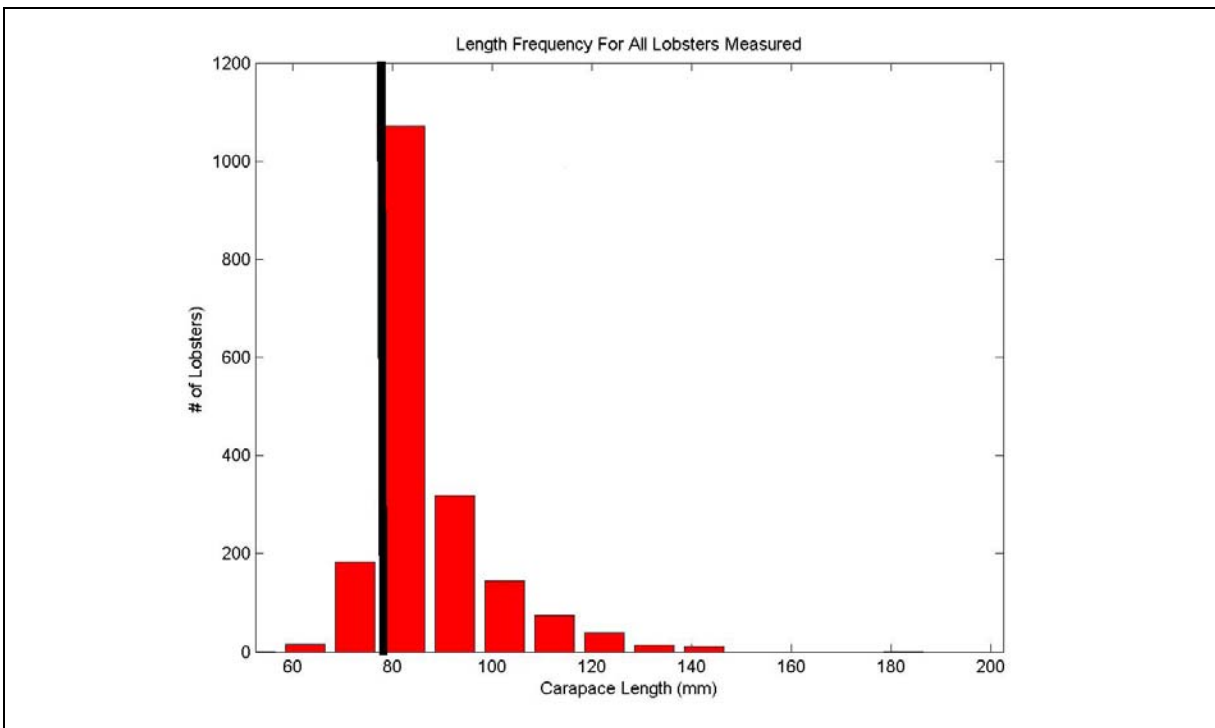


Figure 9. Length Frequencies for measured lobsters arranged in 10 mm wide groups beginning at 52.5 mm. The black line represents the legal carapace length of 82.5 mm.

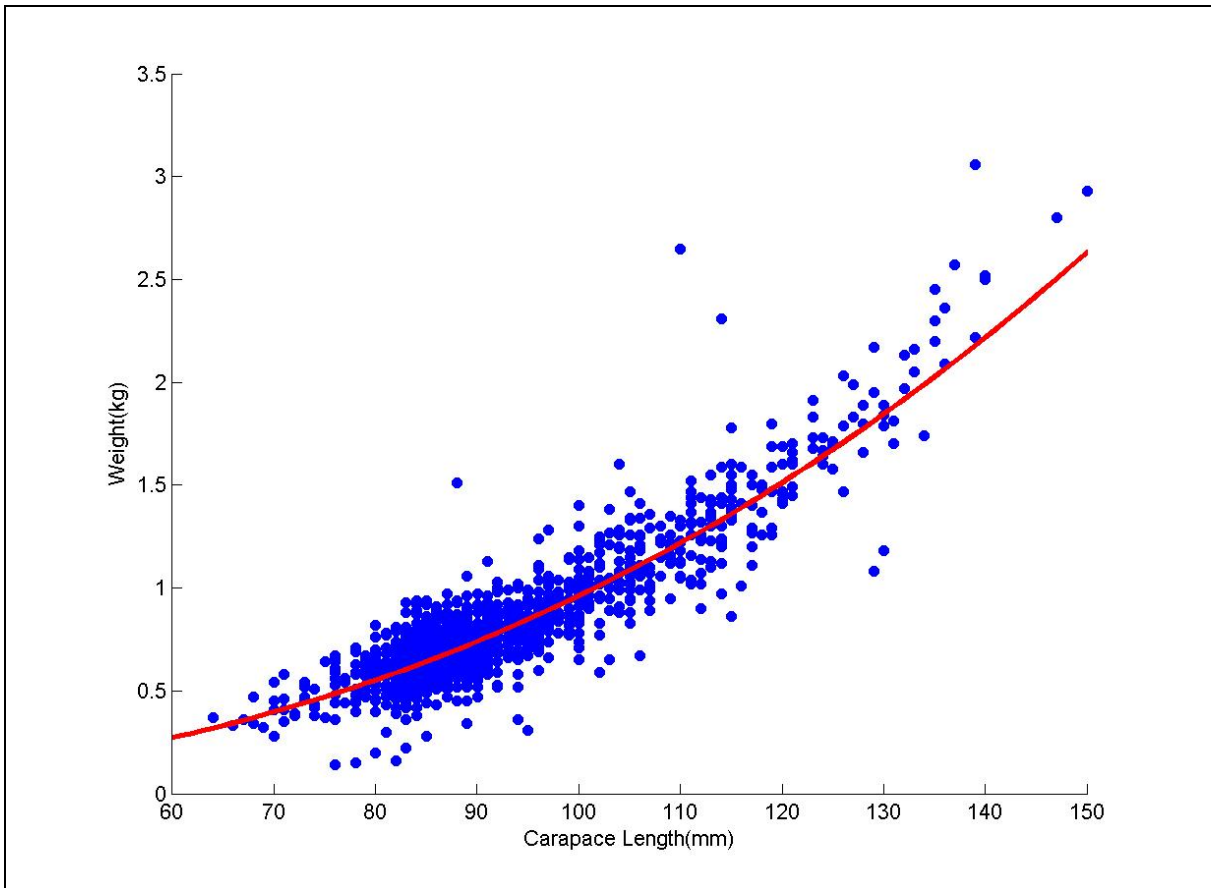


Figure 10. Relationship between carapace length and weight of kept lobsters. The length-weight relationship was estimated by the least-squares method applied to the  $\log_{10}$  transform of  $W=aL^b$ . The resulting equation is  $\log(W) = \log(a) + b \log_{10}(L)$ , where  $W$  is the weight (kg),  $L$  is the carapace length (mm),  $b$  is the slope, and  $a$  is the intercept. Substituting optimal values for  $a$  and  $b$ , the equation becomes  $\log(W) = \log(1.03992E-5) + 2.4829 \log(L)$  and is valid for carapace lengths between 58 mm and 183 mm. The fitted line explains 77% of the variability in the data ( $R^2 = 0.77$ )

## TABLES

Table A. Schedule summary for San Diego, Orange, Los Angeles, and Ventura counties.

County	Location	Targeted Site Priority	Realized Site Priority	# Visits	Hours on Site	# Interviews	# Interviews / Visit	# Interviews / Hour
San Diego	Dana Basin Launch Ramp	1	1	23	82.67	107	4.65	1.29
	Shelter Island Launch Ramp	1	1	25	99.10	214	8.56	2.16
	Ocean Beach Pier	1	1	20	68.10	245	12.25	3.6
	Oceanside Launch Ramp	2	2	11	37.33	18	1.64	0.48
	Shelter Island Pier	2	1	19	40.12	28	1.47	0.7
	La Jolla to Bird Rock BB	3	3	9	21.13	7	0.78	0.33
	Oceanside Pier	4	2	13	31.53	42	3.23	1.33
	South Shores Launch Ramp	4	4	2	3.67	1	0.5	0.27
	Zuniga Jetty	4	4	1	1.23	0	0	0
	Dana Point Launch Ramp	1	1	21	74.88	72	3.43	0.96
Orange	Laguna Beach (Abalone Pt.-Aliso Beach)	1	1	17	63.88	38	2.24	0.59
	Irvine Coast	2	2	9	26.95	9	1	0.33
	San Clemente Pier	3	1	17	31.68	98	5.76	3.09
	Newport Pier	3	2	11	28.27	0	0	0
	Newport Dunes Launch Ramp	4	2	9	21.25	4	0.44	0.19
	Sunset Aquatic Park Launch Ramp	4	3	6	15.07	1	0.17	0.07
	Dave's Launch Ramp	1	1	17	75.75	70	4.12	0.92
	Cabrillo Beach Launch Ramp	1	3	6	17.25	6	1	0.35
	Palos Verdes BB - Malaga Cove to Long Pt.	1	1	21	76.67	22	1.05	0.29
	Marina del Rey Launch Ramp	1	1	13	45.75	51	3.9	1.11
Los Angeles	Redondo Beach Pier	2	1	19	55.75	27	1.42	0.48
	Royal Palms BB	2	4	3	5.75	0	0	0
	Pt. Vicente Fishing Access	3	4	3	4.50	0	0	0
	King Harbor Small Pier	3	3	9	22.87	6	0.67	0.26
	King Harbor Jetty	3	4	3	4.48	1	0.33	0.22
	Belmont Pier	4	3	10	20.58	2	0.2	0.1
	Ventura Harbor Launch Ramp	1	1	18	109.50	102	5.67	0.93
	Deer Creek BB	1	2	10	18.95	3	0.3	0.16
	Leo Carrillo State Beach	1	2	10	20.97	6	0.6	0.29
	Channel Islands Harbor Launch Ramp	1	1	21	95.75	56	2.67	0.58
Ventura	Port Hueneme Pier	2	3	7	14.00	0	0	0
	Channel Islands South Jetty	2	4	2	1.15	2	1	1.74
	Kiddie Beach	2	4	3	9.32	4	1.33	0.43
	Ventura Pier	2	4	2	3.00	1	0.5	0.33
	<b>Total (Table A)</b>			<b>390</b>	<b>1248.85</b>	<b>1243</b>	<b>70.88</b>	<b>23.58</b>

**Table B. Schedule summary for Santa Barbara County.**

<b>County</b>	<b>Location</b>	<b>Targeted Site Priority</b>	<b>Realized Site Priority</b>	<b># Visits</b>	<b>Hours on Site</b>	<b># Interviews</b>	<b># Interviews / Visit</b>	<b># Interviews / Hour</b>
<b>Santa Barbara</b>	<b>Goleta Pier</b>	<b>1</b>	<b>1</b>	<b>9</b>	<b>51.23</b>	<b>4</b>	<b>0.44</b>	<b>0.08</b>
	<b>Stearns Wharf</b>	<b>2</b>	<b>2</b>	<b>7</b>	<b>24.42</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
	<b>Santa Barbara Launch Ramp</b>	<b>3</b>	<b>3</b>	<b>5</b>	<b>15.25</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
	<b>Gaviota Pier</b>	<b>4</b>	<b>4</b>	<b>1</b>	<b>3.50</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
	<b>Santa Barbara City</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>2.0</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
	<b>Ellwood to Goleta</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>4.0</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
	<b>Gaviota to Goleta</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>5.5</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
	<b>Santa Barbara to Ventura</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>
<b>Total (Table B)</b>				<b>26</b>	<b>105.9</b>	<b>4</b>	<b>0.44</b>	<b>0.08</b>
<b>Total (Table A+ B)</b>				<b>416</b>	<b>1354.75</b>	<b>1247</b>	<b>71.32</b>	<b>23.66</b>

**Table C. Total visits and interviews (in parentheses) by site type. Jetties have been grouped into beach sites. Personal watercraft were encountered at both beaches and launch ramps. Beaches and launch ramps both had divers. Only hoop netters were encountered at piers and docks.**

Location	Total Visits(Interviews)	Pier/Dock	Beach	Launch Ramp
SD	123(662)	52(315)	10(7)	61(340)
OC	90(222)	28(98)	26(47)	36(77)
LA	104(185)	38(35)	30(23)	36(127)
VEN	73(174)	9(1)	25(15)	39(158)
SB	26(4)	17(4)	4(0)	5(0)
<b>TOTAL</b>	<b>416(1247)</b>	<b>145(453)</b>	<b>95(93)</b>	<b>177(702)</b>

**Table D. Number of fishermen using a specific gear type by county. The included fishermen may or may not have specified fishing mode or the number of kept and released lobsters. For this reason, these numbers are not suitable for CPUE calculations. Summary total includes OSI, SB, SLO, and UNK which are not shown.**

Location	Total Fishermen	Net Users	Traditional Hoop Nets	Rigid Hoop Nets	Divers	Scuba Divers	Skin Divers
SD	1545	1473	1216	257	72	49	23
OC	464	353	285	68	111	69	42
LA	472	383	250	133	89	64	25
VEN	307	238	132	106	69	58	11
<b>TOTAL</b>	<b>2876</b>	<b>2483</b>	<b>1913</b>	<b>570</b>	<b>393</b>	<b>286</b>	<b>107</b>

**Table E. Chi-squared test results comparing preference for a gear type against no preference by county. Quantities compared were the numbers of fishermen using the specified gear type. The symbol ‘≠’, signifies a significant difference between variables; df=1 in all cases.**

Location	Net vs dive	Trad vs rigid	Scuba vs skin
SD	≠, p<<0.01, x2=1270	≠, p<<0.01, x2=624	≠, p<<0.01, x2=9.39
O	≠, p<<0.01, x2=126	≠, p<<0.01, x2=133	≠, p=0.01 x2=6.57
LA	≠. P<<0.01, x2=183	≠, p<<0.01, x2=35.74	≠, p<<0.01, x2=17.09
VEN	≠. P<<0.01, x2=93	=, p=0.09, x2=2.84	≠, p<<0.01, x2=32.01

**Table F. Number of fishermen using a specific fishing mode by county, regardless of whether a gear type was specified. Total includes OSI, SB, and UNK which are not shown.**

Location	Total Fishermen	Pier/Dock	Beach	PWC	Private Boat
SD	1549	622	10	12	899
OC	464	179	99	6	180
LA	472	61	49	18	344
VEN	307	2	5	37	263
<b>TOTAL</b>	<b>2877</b>	<b>864</b>	<b>167</b>	<b>73</b>	<b>1773</b>

**Table G. Summary of records specifying hours fished, both with and without accompanying catch data, organized by the county where the lobsters were caught. Catch data includes number of kept lobsters, and number of released lobsters. Summary total includes OSI, SB, SLO, and UNK which are not shown.**

Location	Total Number of Hours	Total Hours with Catch Data	Percent Hours Missing from County Total
SD	4742	4697	0.96
OC	620	617	0.48
LA	1210	1179	2.52
VEN	859	853	0.64
<b>TOTAL</b>	<b>7619</b>	<b>7532</b>	<b>1.15</b>

**Table H. CPUE effort in number of hours spent fishing by gear type and county. Total includes OSI, SB, and UNK which are not shown.**

Location	Total Hours	Net Users	Traditional Hoop Nets	Rigid Hoop Nets	Divers	Scuba Divers	Skin Divers	Hook & Line
SD	4,697	4,600	3,715	885	89	52	37	8
OC	617	567	459	109	50	27	23	0
LA	1,179	1,013	649	364	167	115	52	0
VEN	853	747	415	331	107	87	20	0
<b>TOTAL</b>	<b>7,532</b>	<b>6,995</b>	<b>5,293</b>	<b>1,702</b>	<b>529</b>	<b>371</b>	<b>158</b>	<b>8</b>

**Table I. Number of fishermen associated with CPUE effort by fishing mode and gear type.**

Gear	Pier/Dock	Beach	PWC	Private Boat	Total
<b>Hoop Nets</b>	851	0	65	1,536	2,452
<b>Traditional Hoop Nets</b>	748	0	45	1,100	1893
<b>Rigid Hoop Nets</b>	103	0	20	436	559
<b>Divers</b>	0	164	8	214	386
<b>Scuba Divers</b>	0	103	8	168	279
<b>Skin Divers</b>	0	61	0	46	107
<b>Hook and Line</b>	4	0	0	0	0
<b>TOTAL</b>	<b>855</b>	<b>164</b>	<b>73</b>	<b>1,750</b>	<b>2,842</b>



**Table J. CPUE effort in number of fishing hours by gear type and fishing mode.**

<b>Gear</b>	<b>Pier/Dock</b>	<b>Beach</b>	<b>PWC</b>	<b>Private Boat</b>	<b>Total</b>
<b>Hoop Nets</b>	2,197	0	180	4,618	6,995
<b>Traditional Hoop Nets</b>	1,911	0	122	3,260	5,293
<b>Rigid Hoop Nets</b>	286	0	58	1,358	1,702
<b>Divers</b>	0	135	8	386	529
<b>Scuba Divers</b>	0	90	8	273	371
<b>Skin Divers</b>	0	45	0	113	158
<b>Hook and Line</b>	8	0	0	0	8
<b>TOTAL</b>	2,205	135	188	5,004	7,532

**Table K. Total number of lobsters kept by gear type and county. These interviews may not have specified a fishing mode. Totals include OSI, SB, and UNK which are not shown.**

<b>Location</b>	<b># Kept</b>	<b>Net Users</b>	<b>Traditional Hoop Nets</b>	<b>Rigid Hoop Nets</b>	<b>All Divers</b>	<b>Scuba Divers</b>	<b>Skin Divers</b>
<b>SD</b>	1,057	909	778	131	148	93	55
<b>OC</b>	189	147	73	74	42	20	22
<b>LA</b>	380	314	182	132	66	51	15
<b>VEN</b>	406	229	92	137	177	166	11
<b>TOTAL</b>	2,219	1,638	1,154	484	581	460	121

**Table L. Total number of lobsters (kept and released) by gear type and county. These interviews may not have specified a fishing mode. Totals include OSI, SB, and UNK which are not shown.**

<b>Location</b>	<b>Percent Caught</b>	<b>Net Users</b>	<b>Traditional Hoop Nets</b>	<b>Rigid Hoop Nets</b>	<b>All Divers</b>	<b>Scuba Divers</b>	<b>Skin Divers</b>
<b>SD</b>	7,317	6,733	5,600	1,133	584	316	268
<b>OC</b>	1,932	1,725	1,094	631	207	127	80
<b>LA</b>	1,186	990	490	500	196	160	36
<b>VEN</b>	886	564	219	345	322	275	47
<b>TOTAL</b>	11,725	10,130	7,504	2,626	1,595	1,136	459

**Table M. Number of lobsters kept by mode and county for all interviews that specified a fishing mode. These interviews may not have specified a gear type. Totals include OSI, SB, and UNK which are not shown.**

<b>Location</b>	<b>Total Lobsters Kept</b>	<b>Pier/Dock</b>	<b>Beach</b>	<b>PWC</b>	<b>Private Boat</b>
<b>SD</b>	1,058	28	10	3	1,017
<b>OC</b>	189	14	30	3	142
<b>LA</b>	380	0	29	1	350
<b>VEN</b>	406	0	6	50	350
<b>TOTAL</b>	2,220	42	76	57	2,045

Table N. Number of lobsters caught (kept and released) by mode and county for all interviews that specified a fishing mode. These interviews may not have specified a gear type. Totals include OSI, SB, and UNK which are not shown.

Location	Total Lobsters Caught	Pier/Dock	Beach	PWC	Private Boat
SD	7,319	585	50	18	6,666
OC	1,932	118	158	49	1,607
LA	1,186	6	113	14	1,053
VEN	886	0	13	128	745
<b>TOTAL</b>	<b>11,727</b>	<b>709</b>	<b>340</b>	<b>209</b>	<b>10,469</b>

Table O. CPUE catch data, in number of lobsters by county, from all interviews that specified both a gear type and mode. Totals include OSI, SB, and UNK which are not shown.

Location	Total Lobsters Kept	Total Lobsters Released	Total Lobsters Caught	Percent of catch kept
SD	1,058	6,261	7,319	14.46
OC	189	1,743	1,932	9.78
LA	380	806	1,186	32.04
VEN	406	480	886	45.82
<b>TOTAL</b>	<b>2,220</b>	<b>9,507</b>	<b>11,727</b>	<b>18.93</b>

Table P. CPUE catch (kept and released), in number of lobsters from all interviews that specified both a gear type and mode.

Gear	Pier/Dock	Beach	PWC	Private Boat	Total
<b>Hoop Nets</b>	707	0	187	9236	10,130
Traditional Hoop Nets	647	0	131	6,726	7,504
Rigid Hoop Nets	60	0	56	2,510	2,626
<b>Divers</b>	0	340	22	1,233	1,595
Scuba Divers	0	236	22	878	1,136
Skin Divers	0	104	0	355	459
<b>Hook and Line</b>	2	0	0	0	2
<b>TOTAL</b>	<b>709</b>	<b>340</b>	<b>209</b>	<b>10,469</b>	<b>11,727</b>

Table Q. CPUE catch (kept) in number of lobsters from all interviews that specified both a gear type and mode.

Gear	Pier/Dock	Beach	PWC	Private Boat	Total
<b>Hoop Nets</b>	41	0	53	1,544	1,638
Traditional Hoop Nets	35	0	25	1,094	1,154
Rigid Hoop Nets	6	0	28	450	484
<b>Divers</b>	0	76	4	501	581
Scuba Divers	0	51	4	405	460
Skin Divers	0	25	0	96	121
<b>Hook and Line</b>	1	0	0	0	1
<b>TOTAL</b>	<b>42</b>	<b>76</b>	<b>57</b>	<b>2,045</b>	<b>2,220</b>

Table R. Total (kept and released) CPUE by fishing mode and gear type. Effort defined as hours fished.

Gear	Pier/Dock	Beach	PWC	Private Boat
<b>Hoop Nets</b>	0.32	0	1.04	2.00
<b>Traditional Hoop Nets</b>	0.34	0	1.07	2.06
<b>Rigid Hoop Nets</b>	0.21	0	0.97	1.84
<b>Divers</b>	0	2.51	2.75	3.19
<b>Scuba Divers</b>	0	2.63	2.75	3.22
<b>Skin Divers</b>	0	2.25	0	3.13
<b>Hook and Line</b>	0.25	0	0	0

Table S. 'Success' (kept) CPUE by fishing mode and gear type. Effort defined as hours fished.

Gear	Pier/Dock	Beach	PWC	Private Boat
<b>Hoop Nets</b>	0.02	0.00	0.30	0.33
<b>Traditional Hoop Nets</b>	0.02	0.00	0.20	0.34
<b>Rigid Hoop Nets</b>	0.02	0.00	0.48	0.33
<b>Divers</b>	0.00	0.57	0.50	1.30
<b>Scuba Divers</b>	0.00	0.58	0.50	1.48
<b>Skin Divers</b>	0.00	0.56	0.00	0.85
<b>Hook and Line</b>	0.12	0.00	0.00	0.00

Table T. Carapace length (mm) statistics by county.

Location	Median Length	Mean Length	Standard Deviation	Minimum	Maximum
<b>SD</b>	86	89.3	9.5	58	157
<b>OC</b>	85	86.3	9.5	64	147
<b>LA</b>	92	97.4	16.1	74	183
<b>VEN</b>	94	96.7	13.5	69	158

Table U. Weight (kg) statistics by county.

Location	Median Weight	Mean Weight	Standard Deviation	Minimum	Maximum
<b>SD</b>	0.72	0.78	0.29	0.23	4.29
<b>OC</b>	0.65	0.69	0.25	0.33	2.8
<b>LA</b>	0.76	0.95	0.53	0.22	4.91
<b>VEN</b>	0.72	0.86	0.43	0.14	3.07

Table V. Carapace length (mm) statistics by gear type.

Mode	Median Length	Mean Length	Standard Deviation	Minimum	Maximum
<b>Traditional Hoop Net</b>	87	90.9	11.1	68	160
<b>Rigid Hoop Net</b>	90	95.5	15.7	69	183
<b>Scuba Diving</b>	89	91.4	11.5	58	152
<b>Skin Diving</b>	87	88.6	10.3	64	133
<b>Hook and Line</b>	84	84.0	0.0	84	84

Table W. Weight (kg) statistics by gear type.

Mode	Median Weight	Mean Weight	Standard Deviation	Minimum	Maximum
Traditional Hoop Net	0.72	0.81	0.33	0.34	4.29
Rigid Hoop Net	0.73	0.91	0.51	0.28	4.91
Scuba Diving	0.67	0.75	0.41	0.14	3.18
Skin Diving	0.69	0.75	0.26	0.33	2.05
Hook and Line	0.89	0.89	0.00	0.89	0.89
Mixed Gear	0.72	0.80	0.32	0.31	3.17

Table X. Carapace length (mm) statistics by fishing mode.

Mode	Median Length	Mean Length	Standard Deviation	Minimum	Maximum
Piers/Dock	85	85.8	5.4	76	103
Beach	84	84.3	9.7	58	111
PWC	96	98.8	12.3	78	125
Private Boat	88	92.1	12.3	68	183

Table Y. Weight (kg) statistics by fishing mode.

Mode	Median Weight	Mean Weight	Standard Deviation	Minimum	Maximum
Piers/Dock	0.67	0.67	0.17	0.36	1.38
Beach	0.59	0.61	0.24	0.14	1.28
PWC	0.82	0.89	0.3	0.47	1.58
Private Boat	0.72	0.83	0.38	0.22	4.91

Table Z. Carapace length (mm) statistics by sex.

Sex	Median Length	Mean Length	Standard Deviation	Minimum	Maximum
Female	86	88.8	9.1	58	135
Male	90	95.1	14.4	64	183

Table AA. Weight (kg) statistics by sex.

Sex	Median Weight	Mean Weight	Standard Deviation	Minimum	Maximum
Female	0.71	0.77	0.24	0.14	2.20
Male	0.73	0.88	0.48	0.16	4.91

Table BB. Number of male and female lobsters (and unknown sex) by county.

Location	Female	Male	Unknown
SD	556	391	87
OC	87	104	1
LA	178	127	84
VEN	80	215	116

Table CC. Number of male and female lobsters (and unknown) by gear type.

Gear	Female	Male	Unknown
Traditional Hoop Net	392	305	58
Rigid Hoop Net	141	217	64
Scuba Diving	145	163	145
Skin Diving	37	41	36
Hook and Line	1	0	0
Mixed Gear	234	173	63

Table DD. Number of male and female lobsters (and unknown) by fishing mode.

Mode	Female	Male	Unknown
Piers/Dock	28	13	1
Beach	44	34	2
PWC	17	37	3
Private Boat	861	815	360

Table EE. Summary of short lobsters retained.

Location	Number of Fishermen	Number of Lobsters Kept	Number of Shorts	Shorts as Percent of Total Kept	Average Length of Shorts (mm)
OSI	51	127	1	0.8	82
SD	1,533	1,058	104	9.8	80 ± 3.9
OC	462	189	54	28.6	78 ± 4.6
LA	459	380	14	3.7	80 ± 2.5
VEN	303	406	23	5.7	79 ± 3.5
SB	12	47	1	2.1	82
UNK	22	13	0	0	N/A
<b>TOTAL</b>	<b>2,842</b>	<b>2,220</b>	<b>171</b>	<b>7.7</b>	<b>79 ± 4.1 mm</b>

Table FF. Summary of short lobsters retained by sex.

Location	Total Measured	Number Short	Shorts as Percent of Total	Female Shorts	Male Shorts	Males as Percent of Shorts	Females as Percent of Shorts
OSI	50	1	2	0	1	0	100
SD	969	104	10.7	73	31	70.2	29.8
OC	191	54	28.3	41	13	75.9	24.1
LA	307	14	4.6	13	1	92.9	7.1
VEN	295	23	7.8	10	13	43.5	56.5
SB	47	1	2.1	1	0	100	0