1.1. Commercial Fisheries and Ports of Interest

To focus efforts upon information that would be most useful and cost effective in informing a 5-year management review of the South Coast MPAs, this project identified key consumptive user groups and associated fisheries in which to target our data collection and analysis efforts. These user groups and key fisheries have been identified as occurring mostly in state waters and are most likely to experience both short-term spatial and economic changes associated with MPA implementation and are of high economic importance to the South Coast region.

The following is the list of key commercial fisheries targeted for this project. This list below was developed in collaboration with the California Department of Fish and Wildlife, the MPA Monitoring Enterprise, and the South Coast fishing community to define when applicable the species groupings that compose a fishery. The fisheries of interest for this project are:

1. California halibut–hook & line \((Paralichthys californicus)\)
2. California halibut–trawl \((Paralichthys californicus)\)
3. Coastal pelagics—net
4. Lobster–trap \((Panulirus interruptus)\)
5. Market squid–brail \((Loligo opalescens)\)
6. Market squid–net \((Loligo opalescens)\)
7. Nearshore finfish–live–fixed gear
   a. Nearshore finfish–dead–hook & line
   b. Nearshore finfish–dead–longline
   c. Nearshore finfish–live–hook & line
   d. Nearshore finfish–live–longline
   e. Nearshore finfish–live–trap
8. Rock crab–trap
9. Sea cucumber–dive
10. Sea cucumber–trawl
11. Urchin–dive \((Strongylocentrotus franciscanus)\)

The coastal pelagic species-seine/net fishery consists of Pacific sardine \((Sardinops sagax)\), Pacific mackerel \((Scomber japonicus)\), jack mackerel \((Trachurus symmetricus)\), and northern anchovy \((Engraulis mordax)\). The rock crab fishery is comprised of three species: the Yellow rock crab, \((Cancer anthonyi)\), Brown rock crab \((Cancer antennarius)\) and Red rock crab \((Cancer productus)\). The sea cucumber fishery consists of warty sea cucumber \((Parastichopus parciments)\) and giant red sea \((Parastichopus californicus)\).

The nearshore finfish fishery is a state fishery grouping managed through the California Nearshore Fishery Management Plan which consists of the following 19 species: Rockfish, gopher \((Sebastes carnatus)\); Rockfish, black \((S. melanops)\); Rockfish, black-and-yellow \((S. chrysomelas)\); Rockfish, blue \((S. mystinus)\); Rockfish, kelp \((S. atrovirens)\); Rockfish, copper \((S. caurinus)\); Rockfish, grass \((S. rastrelliger)\); Rockfish, brown \((S. auriculatus)\); Rockfish, quillback \((S. maliger)\); Rockfish, china \((S. nebulosus)\); Rockfish, calico \((S. dallii)\); Treefish \((S. serriceps)\); Rockfish, olive \((S. serranoides)\); Cabezon \((Scorpaenichthys marmoratus)\); California sheephead \((Semicossyphus pulcher)\); California scorpionfish \((Scorpaena guttata)\); Kelp greenling \((Hexagrammos decagrammus)\); Rock greenling \((Hexagrammos lagocephalus)\); and Monkeyface prickleback \((Cebidichthys violaceus)\).

We’d like to note that we provided commercial landings and ex-vessel revenue data on the Nearshore finfish-dead fisheries to provide context but did not target this fishery for interviews with fishermen. We did not target this fishery for interviews as this fishery has now largely transitioned into a live fish fishery and dead fish are landed as a byproduct of the live fish fishery.
Based on California Department of Fish and Wildlife landings data the commercial fishing ports of interest for this project are defined as (Map1):

1. Santa Barbara
2. Ventura
3. Port Hueneme/Oxnard
4. San Pedro/Los Angeles
5. Dana Point
6. Oceanside
7. San Diego

Below we provide a full listing of how CDFW commercial landings data were grouped into these target fisheries and port groupings.

**Port Grouping**

<table>
<thead>
<tr>
<th>Port name</th>
<th>Port Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANA POINT</td>
<td>DANA POINT</td>
</tr>
<tr>
<td>NORTH SHORE</td>
<td>OCEANSIDE</td>
</tr>
<tr>
<td>OCEANSIDE</td>
<td>OCEANSIDE</td>
</tr>
<tr>
<td>PORT HUENEME</td>
<td>PORT HUENEME/OXNARD</td>
</tr>
<tr>
<td>OXNARD</td>
<td>PORT HUENEME/OXNARD</td>
</tr>
<tr>
<td>SURF BEACH</td>
<td>PORT HUENEME/OXNARD</td>
</tr>
<tr>
<td>IMPERIAL BEACH</td>
<td>SAN DIEGO</td>
</tr>
<tr>
<td>MISSION BAY</td>
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</tr>
<tr>
<td>SAN DIEGO</td>
<td>SAN DIEGO</td>
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<tr>
<td>POINT LOMA</td>
<td>SAN DIEGO</td>
</tr>
<tr>
<td>NATIONAL CITY</td>
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</tr>
<tr>
<td>CORONADO</td>
<td>SAN DIEGO</td>
</tr>
<tr>
<td>LA JOLLA</td>
<td>SAN DIEGO</td>
</tr>
<tr>
<td>CHULA VISTA</td>
<td>SAN DIEGO</td>
</tr>
<tr>
<td>HAWAIIAN GARDENS</td>
<td>SAN PEDRO/LOS ANGELES</td>
</tr>
<tr>
<td>MALIBU</td>
<td>SAN PEDRO/LOS ANGELES</td>
</tr>
<tr>
<td>CATALINA ISLAND</td>
<td>SAN PEDRO/LOS ANGELES</td>
</tr>
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<td>AVALON</td>
<td>SAN PEDRO/LOS ANGELES</td>
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<tr>
<td>REDONDO BEACH</td>
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<td>LONG BEACH</td>
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<td>SANTA MONICA</td>
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<tr>
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<td>SAN PEDRO/LOS ANGELES</td>
</tr>
<tr>
<td>Species name</td>
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<tr>
<td>------------------------------------</td>
<td>---------------</td>
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<tr>
<td>CALIFORNIA HALIBUT</td>
<td>CALIFORNIA HALIBUT</td>
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<td>PACIFIC MACKEREL</td>
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<td>JACK MACKEREL</td>
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<td>JUVENILE SARDINE</td>
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<tr>
<td>NORTHERN ANCHOVY</td>
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<td>CALIFORNIA SPINY LOBSTER</td>
<td>LOBSTER</td>
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<tr>
<td>MARKET SQUID</td>
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</tr>
<tr>
<td>CALIFORNIA SHEEPHEAD</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>COPPER (WHITEBELLY) ROCKFISH</td>
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</tr>
<tr>
<td>BLACK-YELLOW ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>BLACK ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>CHINA ROCKFISH</td>
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<tr>
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<tr>
<td>CABEZON</td>
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</tr>
<tr>
<td>GOPHER ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>BROWN ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>KELP GREENLING</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>MONKEYFACE PRickleback EEL</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>OLIVE ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>GRASS ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>COPPER ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>TREEFISH ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>KELP ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
</tr>
<tr>
<td>BLUE ROCKFISH</td>
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</tr>
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<td>BOLINA GROUP ROCKFISH</td>
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<td>NEARSHORE GROUP ROCKFISH</td>
<td>NEARSHORE FINFISH</td>
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<tr>
<td>DEEP NEARSHORE GROUP ROCKFISH</td>
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<td>BROWN ROCK CRAB</td>
<td>ROCK CRAB</td>
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<td>GIANT RED SEA CUCUMBER</td>
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<tr>
<td>SPOT PRAWN</td>
<td>SPOT PRAWN</td>
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<td>--------------------------------</td>
<td>--------------------------------</td>
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<tr>
<td>RED SEA URCHIN</td>
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<td>PURPLE SEA URCHIN</td>
<td>URCHIN</td>
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<tr>
<td>WHITE SEA URCHIN</td>
<td>URCHIN</td>
</tr>
</tbody>
</table>
1.2. CDFW Landings Data Analysis Methods

Under a non-disclosure agreement with the California Department of Fish and Wildlife (CDFW), the commercial fisheries landings data presented throughout this report was developed in collaboration with CDFW staff using ex-vessel landings receipt data contained in the CDFW’s Commercial Fisheries Information System (CFIS) database. As the CFIS database is continually updated it is important to document the date the CFIS database was queried so that the status of the data sets used are known. For 1992–2009 landings data the CFIS database was queried on March 9th, 2011, for 2010 landings data the CFIS database was queried on April 18, 2012, for the 2011 landings data the CFIS database was queried on September 22, 2012, and for the 2012 landings data the CFIS database was queried on September 12, 2013. All data were sent to Point 97/Ecotrust by CDFW staff.

All dollar values presented in this report are corrected for inflation, and are reported in 2010 dollars using the Implicit Price Deflators for Gross Domestic Product from the U.S. Bureau of Economic Analysis. It is important to note that ex-vessel revenues are merely suggestive of differences in economic value, as they do not account for differences in operating costs, and thus profitability, across fisheries. Likewise, they are only first order approximations of the value of fisheries to local economies; a comprehensive assessment of fishery operating costs, multiplier effects, and the full value of fishing activities to local economies are important to assess but are beyond the scope of this study.

Finally, we present only a subset of the landings data available—following CDFW protocol we suppressed all landings data with fewer than 3 commercial fishermen. We strive to summarize the landings data in the most compelling and visual formats. We have consistently color-coded fisheries throughout the report and presented data in consistently formatted and scaled graphs in order to facilitate quick reference of specific fisheries and comparison across fisheries or ports. We avoid repetition whenever possible and recognize there are many more ways to query and analyze the data, however, throughout this report we aimed to present the most relevant and informative analyses possible.

1.3. Survey Data Collection and Analysis Methods

While the use of GIS technology and analysis in marine and fisheries management has expanded steadily over the past decade (Kruse et al. 2001; Breman 2002; Valavanis 2002; Fisher and Rahel 2004; Meaden 2009), its use for socioeconomic research is still somewhat limited. Nevertheless, a growing body of literature has examined GIS-enabled approaches to community-based MPA design and assessment (Aswani and Lauer 2006; Hall and Close 2006; St. Martin et al. 2007; Ban et al. 2009; Gleason et al. 2010) and there are several good examples to build on for improving the spatial specificity of the West Coast knowledge base and data landscape.

Some of the most pertinent applications of GIS technology to socioeconomic questions in marine fisheries concern the spatial extent and intensity of fishing effort (Caddy and Carocci 1999; Green and King 2003; Parnell et. al 2010; Lee et. al 2010) and the use of participatory methods similar to the ones employed here (Wedell et al. 2005; St. Martin 2004; 2005; 2006; Scholz et al. 2011a). We built on these approaches and adapted them for the California South Coast context, following best practices for the use of participatory GIS in natural resource management (Quan et al. 2001), as described in the remainder of this section.

Our project approach builds on methods developed in previous projects on the West Coast of the United States (Chen et al. 2012 and 2013; Steinback et al. 2010; Scholz et al. 2004; 2005; 2006a; 2006b; 2008; 2010; 2011a; 2011b), which demonstrated novel approaches for collecting, compiling, and analyzing spatial fishing patterns and associated economic information at various geographic resolutions to aid the design and assessment of various marine spatial planning efforts (e.g., marine protected areas and wave energy siting). Moreover, the spatial mapping methods used in this study have been assessed against CDFW commercial fishing logbook data.
The assessment was designed to validate the methodology of interviewing fishermen to map their commercial fishing grounds and assign value/importance by allocating 100 pennies across their fishing grounds. The results of this study concluded that the spatial fishing patterns of fishermen interviewed reflected actual behavior (when examining logbook data). Furthermore, in using our sample method, the group of fishermen who were not interviewed but participated in the fishery exhibited similar spatial fishing patterns (when examining logbook data) as those interviewed. The proven methods, successes, and lessons learned in these past projects were directly applied to the methods and tools deployed in this project.

As Point 97 continues to conduct MPA monitoring work in other regions in California we aim to help close existing coastal and marine use information gaps and provide a tested, consistent, and cost-effective method for long-term monitoring across California.

Specifically, Point 97’s approach involved several steps that are designed to engage the fishing community throughout the project from project/survey design to the development of final products. These steps are generally categorized below:

1. Fishing community outreach/engagement;
2. Survey questions and survey tool design;
3. Data collection;
4. Data analysis;
5. Review and validation of data analysis results; and
6. Final reporting.

Point 97 conducted a series of outreach meetings with key fishing community members and fishing organizations/associations prior to beginning interviews in the region and in each port. The objectives of these meetings were to provide a project overview, answer questions, develop relationships, gain insights into the current fishery issues/challenges, raise general awareness, and solicit potential interview participants. During these initial meetings Point 97 also gathered feedback on its proposed project and survey design, such as on what types of information the fishing community felt were important to capture, and when possible the feedback received was incorporated into the data collection tool and data analysis plan.

1.3.1. Sampling Method

Point 97 carried out field work in the summer and fall months of 2013 to collected data on the 2012 post MPA implementation fishing year. To determine a sampling method for the commercial fishing sector, Point 97 compiled CDFW commercial fishing ex-vessel revenue and landings data and as well as contact data (phone numbers taken from the CDFW permits database). We then organized these data into port-fishery combinations to identify commercial fishermen\(^1\) to interview in each target fishery in each port in the region. Since the 2013 commercial landings data were not available during the field work season we utilized 2012 commercial landings data to target commercial fishermen.

As fishermen may land fish in more than one port, the port specific listing of commercial fishermen was not a mutually exclusive list. Thus we could not conduct a random sample of fishermen at the port level as this would bias the sample towards fishermen who land in multiple ports. Furthermore, implementing any systematic or random sample strategy is difficult as at times fishermen are unwilling to participate in interviews. Our experience is that at times fishermen who make a relatively small amounts of revenue in a fishery are less invested in participating in interviews which in itself creates a sample bias and together essentially results in a convenience sample.

\(^1\) The term ‘fishermen’ is used to denote people who fish. In the California fishing community this is the preferred term regardless of gender.
Given the considerations above, project staff set out to contact every commercial fisherman in the landings database in each of our port-fishery lists with the sampling goal of interviewing as many fishermen as possible. For the purpose of this project, Point 97 defines a commercial fisherman as an individual who has commercial fishery landings data (pounds and ex-vessel revenue) associated with his/her commercial license number (L number).

Given our sample strategy, we sought to investigate how our sample was spread across the various ex-vessel revenue ranges for each fishery. This was important as ideally gathering baseline economic information from the commercial fishing fleet would be representative of the fishing community as a whole and represent information from fishermen across varying revenue ranges. To investigate how our sampling was distributed across these revenue ranges we stratified each fishery into four revenue strata. Please see Table 1 for the number of commercial fishermen interviewed in each target fishery compared to the number of fishermen in the landing database separated by the four revenue stratification levels. We indicated the approximate revenue range when possible for each stratification to demonstrate the multitude of relatively small dollar values that are landed by individuals in each fishery. This may be due to several reasons which could include amongst others: fish caught as bycatch in a different fishery but were still landed/sold; fishermen who were trying out a new fishery or new gear type for a fishery and thus landed a relatively small amount; families of fishermen who fish together and land their catch on various L numbers of family members—sometimes just once or twice for an individual; fishermen from outside the region who landed only once or a few times in the region; or fishermen who must land some amount of catch to maintain a permit but do not actively fish the permit as a major income source.

### Table 1. Number of fishermen interviewed as a percent of each quartile revenue strata for each fishery, 2012, South Coast Region

<table>
<thead>
<tr>
<th>Fishery</th>
<th>Revenue strata (quartiles)</th>
<th>Number of individuals in 2012 landings</th>
<th>Number of individuals interviewed with 2012 landings</th>
<th>Percent of individuals in landings strata interviewed</th>
<th>Approximate 2012 Revenue Strata Range (2010$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>California halibut–hook &amp; line</strong></td>
<td>Total</td>
<td>110</td>
<td>3</td>
<td>3%</td>
<td>$199,351</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5</td>
<td>—</td>
<td>—</td>
<td>$7,500 - $18,000</td>
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<td></td>
<td>3</td>
<td>12</td>
<td>—</td>
<td>—</td>
<td>$3,000 - $6,000</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>91</td>
<td>3</td>
<td>3%</td>
<td>$0 - $2,500</td>
</tr>
<tr>
<td><strong>California halibut–trawl</strong></td>
<td>Total</td>
<td>26</td>
<td>5</td>
<td>19%</td>
<td>$246,412</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>$54,000</td>
</tr>
<tr>
<td></td>
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<td>4</td>
<td>22</td>
<td>4</td>
<td>18%</td>
<td>$75 - $12,000</td>
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<tr>
<td><strong>Coastal pelagics–net</strong></td>
<td>Total</td>
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<td>5</td>
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<td>$4,069,765</td>
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<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>50%</td>
<td>*</td>
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<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>—</td>
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<td>3</td>
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<td>2</td>
<td>40%</td>
<td>*</td>
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<tr>
<td></td>
<td>4</td>
<td>34</td>
<td>2</td>
<td>6%</td>
<td>*</td>
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<tr>
<td><strong>Lobster–trap</strong></td>
<td>Total</td>
<td>165</td>
<td>43</td>
<td>26%</td>
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<td></td>
<td>1</td>
<td>15</td>
<td>10</td>
<td>67%</td>
<td>$188,000 - $324,000</td>
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<td>2</td>
<td>20</td>
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<td>3</td>
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<td>4</td>
<td>98</td>
<td>12</td>
<td>12%</td>
<td>$75 - $78,500</td>
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<tr>
<td><strong>Market squid–brail</strong></td>
<td>Total</td>
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<tr>
<td></td>
<td>1</td>
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<td>1</td>
<td>33%</td>
<td>*</td>
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<tr>
<td></td>
<td>2</td>
<td>5</td>
<td>—</td>
<td>—</td>
<td>$122,500 - $182,000</td>
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<tr>
<td></td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>8%</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>50</td>
<td>1</td>
<td>2%</td>
<td>*</td>
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<tr>
<td>Market squid–net</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>10</td>
<td>11%</td>
<td>$46,677,219</td>
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<tr>
<td>1</td>
<td>6</td>
<td>2</td>
<td>33%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>4</td>
<td>40%</td>
<td>$1,006,500 - $502,000</td>
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</tr>
<tr>
<td>3</td>
<td>16</td>
<td>—</td>
<td>—</td>
<td>$50 - $499.00</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>58</td>
<td>4</td>
<td>7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nearshore finfish live–fixed gear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>11</td>
<td>24%</td>
<td>$401,587</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>1</td>
<td>33%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>25%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>2</td>
<td>33%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>7</td>
<td>22%</td>
<td>$0-$2,500</td>
<td></td>
</tr>
<tr>
<td>Rock crab–trap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>20</td>
<td>20%</td>
<td>$2,280,955</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>67%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>2</td>
<td>50%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>5</td>
<td>63%</td>
<td>$47,000 - $91,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>84</td>
<td>11</td>
<td>13%</td>
<td>$0 - $46,500</td>
<td></td>
</tr>
<tr>
<td>Sea cucumber–dive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>12</td>
<td>20%</td>
<td>$1,074,175</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>50%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>3</td>
<td>60%</td>
<td>$43,000 - $69,000</td>
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<tr>
<td>3</td>
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<tr>
<td>4</td>
<td>43</td>
<td>4</td>
<td>9%</td>
<td>$75 - $24,500</td>
<td></td>
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<tr>
<td>Sea cucumber–trawl</td>
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<td></td>
<td></td>
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<td></td>
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<td>4</td>
<td>17%</td>
<td>$700,625</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>50%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>$55,000 - $62,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>3</td>
<td>17%</td>
<td>$0 - $45,500</td>
<td></td>
</tr>
<tr>
<td>Spot prawn–trap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>3</td>
<td>18%</td>
<td>$2,996,653</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>100%</td>
<td>$1,061,000 - $1,494,500</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>$192,000 - $248,500</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>1</td>
<td>9%</td>
<td>$0 - $35000</td>
<td></td>
</tr>
<tr>
<td>Urchin–dive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>175</td>
<td>32</td>
<td>26%</td>
<td>$5,559,458</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>3</td>
<td>67%</td>
<td>$92,000 - $151,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>10</td>
<td>40%</td>
<td>$50,500 - $90,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>32</td>
<td>10</td>
<td>41%</td>
<td>$36,000 - $58,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>113</td>
<td>9</td>
<td>12%</td>
<td>$0 - $35000</td>
<td></td>
</tr>
</tbody>
</table>

Source: CDFW, Current study
— indicates that the port/fishery was not sampled or a zero value data point
* indicates data were collected but cannot be shown due to confidentiality constraints

1.3.2. Interview Protocol

Field Staff Training
Building upon our experience conducting large scale human use data collection projects with fishing communities, Point 97 has established rigorous field staff training procedures and interview protocols to ensure that:

1. Field staff are able to effectively engage in conversations with fisherman about the goals/objectives of this project and the larger MPA monitoring/assessment effort this project will inform;
2. Sensitive fishermen contact information is kept secure and confidential;
3. Fishermen are properly informed of the research project goals and possible risk and agreements on data use before the fishermen engages in an interview;
4. Fisherman data remains confidential and is securely stored, transmitted, and analyzed;
5. Interviews are conducted professionally and consistently; and
6. High quality data is consistently collected across interviews.
To accomplish this, Point 97 staff who are trained in human subjects research protocols conducted extensive training with field staff on proper research protocols and interview approach and procedures. This training includes providing background on Point 97/Ecotrust project history with fishing communities, the Marine Life Protection Act planning process, the MPA monitoring program, and possible reservations fisherman may have to participate in interviews in order for field staff to effectively engage in meaningful conversations with fishermen to solicit interviews. Furthermore, field staff were trained in being aware and respectful of the sensitivities of collecting fishing data and were provided with human subjects research protocols to ensure field staff are aware of proper ways of presenting the research goals and risks to fishermen and that proper informed consent is obtained before interviews begin.

Furthermore, strict procedures and mechanisms are put in place so that individual fisherman data is kept secure and confidential throughout the project from data collection, to transmission of the data, to data analysis, and subsequent storage of the data. Interviews were conducted under individual non-disclosure consent forms and all data were collected on password protected laptop computers. Furthermore, data collection and analysis protocols were utilized which masks all names and identifying characteristics of an individual's fishing grounds.

Field staff are also fully trained in how to ask survey questions and capture responses in a consistent manner. The field staff coordinator initially conducted fisherman interviews with each field staff member to ensure the quality of interviews and periodically conducted fisherman interviews with field staff throughout the field season to ensure that interview quality was maintained. Furthermore, survey data is checked as it is transmitted to the Point 97 main office and reviewed by Point 97 staff to ensure quality data are being captured consistently across field staff.

1.3.3. Interview Procedure

The data collection methods in this project were designed to complement existing data previously acquired from commercial fishermen in the South Coast Region (see Scholz et al. 2008) before the MPA network was established. Interviews in this project were conducted in person using a one-on-one interview format. All interview data were entered directly into a spatially enabled survey tool developed by Point 97 powered by its ViewPoint survey platform technology. Field staff used the survey tool (Screenshot 1) to collect non-spatial survey data (e.g., demographics, basic operating information, descriptive fishing characteristics, impacts from MPAs and other factors, and associated qualitative questions) and to map areas representing a participant's fishing grounds. The survey tool's mapping component utilizes NOAA nautical charts which can be zoomed in and out to reveal more detailed nautical charts and moved directionally (similar to Google Maps) to allow fishermen to draw fishing areas in their natural sizes (polygons) rather than confining responses to a statistical grid or to political boundaries.
All interviews followed a shared protocol:

1. Interviews begin with an explanation of the project goals/objectives, the types of data collected, how data will be analyzed, possible risks of participating in the interview, and any other project information the fisherman would like to discuss.

2. The fisherman is presented an informed consent form agreement which allows Point 97 to utilize interview data, however, the agreement legally binds Point 97 to present data only in the aggregate form and to never release individual data or the identities of those interviewed.

3. Non-spatial survey data is collected on questions pertaining to individual fisherman characteristics and overall commercial fishing operations.

4. Non-spatial survey data is collected for each fishery/activity within a commercial fisherman’s portfolio.

5. Fishing grounds are mapped following these steps (see Screenshot 2). These steps are repeated to map each fishery separately:
   a. **Establish a maximum extent:** Using the electronic nautical charts embedded in survey tool, fishermen were asked to identify the maximum extent north, south, east, and west they would target a fishery. This is done to orient the map to the full extent of their fishing area before fishermen are asked to identify/delineate specific fishing grounds.
   b. **Map fishing grounds:** Within this maximum extent, fishermen were then asked to delineate the area(s) they fish for a particular species/fishery in a given time period. Under the guidance of the fisherman, field staff drew these fishing areas in the survey tool and record associated boundary information for each area such as depth limits and geographic landmarks.
   c. **Assign value:** Fishermen are then asked to rank these fishing areas using a weighted percentage — in which they split and distribute 100 points or ‘100 pennies’ over the various fishing areas based on their relative importance.
1.3.4. Data Review and Verification

There are several data review and verifications steps throughout this project. The following standard quality assurance and quality control (QAQC) steps were conducted:

1. Editing of spatial data by Point 97 staff based on notes from interviews and when required to standardize the data (e.g., clipping a shape to the shoreline or specific depth);
2. Review by each participant of his/her individual maps and information; and
3. Review by fishing community, through group and individual meetings, to verify aggregated results (see Appendix A for a summary of key themes from the community data review).

The collection of spatial data has an inherent higher margin of error and thus several QAQC steps were implemented in our project to ensure the spatial data collected were of the highest quality possible. First, notes were taken on the boundaries of each fishing area drawn during an interview with a fisherman. Once spatial data are collected and transmitted to Point 97 staff for analysis, each spatial dataset is checked against spatial data notes to ensure fishing areas are drawn to the indicated depth limits and spatial extent. Furthermore, if any spatial outliers are identified within a given fishery, individual fishermen are contacted to verify their spatial dataset is accurate. Second, each individual fisherman is mailed maps of his/her fishing grounds for each
They provided spatial information on to review/verify its accuracy. These individual maps are printed on security paper that cannot be photocopied and are mailed with a return addressed and stamped envelope and contact information so fisherman may easily communicate any changes to their spatial data. Third, once all spatial fishing data are aggregated, these maps are reviewed by the fishing community with Point 97 staff.

These review meetings with the fishing community are complimentary to the individual interviews and take a synergistic approach that is important in several ways. Review meetings are an opportunity to review and verify map products as well as share other data analysis results such as having the fishing community assist in interpreting logbook data analysis results, review drafts of the project report, discuss project next steps, build trust within the fishing community, and continue established relationships.

For review meetings, each individual who participated in interviews was contacted to participate in the project results review. During these individual or group review meetings, map products were reviewed for errors. It should be emphasized that spatial data sets are not augmented based on the where an individual who reviews the map(s) thinks areas of importance should be. Instead, the purpose of reviewing the map products are to ensure there are no large errors in the data sets made during the collecting, editing, and compiling of the data. Examples of errors include fishing areas that extend beyond regulatory depth limits or geographic areas in which the fishery occurs (e.g., nearshore finfish grounds extending into rockfish conservation area boundaries) or areas in which no fishing is allowed. Based on our experience, having the community review these map products helps ground-truth the data sets, produce data sets that are of higher quality, and help establish transparency and trust between researchers and the fishing community. For a full summary of the key themes that emerged from the community data review process, please see Appendix A.

Data validation with independent data sets is an important step in providing rigorous research methods, as data collected in any survey are liable to the inconsistencies of memory, subjective judgment, and possible deliberate falsification. Furthermore, validating data sets may also reveal possible sample biases, which can inform interpretation of survey results. Much of the data Point 97 collected in this project from commercial fishermen are novel, or similar data sets to our knowledge do not exist or are not readily accessible to compare survey results. To verify the spatial fishing data sets, commercial logbook data could have been used, however this data is confidential at the individual level and would take considerable resources to compile and analyze at the aggregate level. Furthermore, the spatial scale in which data are collected with logbooks (10 by 10 mile square blocks) are at a much larger scale than Point 97’s data, making it difficult to compare data sets.

For the commercial fishing sector, the landings database provided by CDFW did not contain data on individual fishermen that were comparable to our survey results and we were unable to identify any other data sources to utilize for validation. In light of the difficulties in obtaining and analyzing existing data sets to compare our results, Point 97 thoroughly reviewed all data sets with the fishing community to ensure all data products submitted were verified and accepted by the fishing community and are of the best quality possible.

1.3.5. Spatial Data Analysis Methods

In this section we further detail how spatial data were analyzed in this project. Point 97/Ecotrust’s methodology to analyze spatial fishing data collected was developed and refined through collaboration with fishing communities across California during the MLPA process (Scholz et al. 2011a). The analysis of the fishing grounds information is broadly comprised of two components: determination of the fishing grounds and determination of relative (economic) importance. Below we present a detailed methodology for how spatial data were weighted, analyzed, and aggregated for the commercial fishing sector’s spatial fishing data.
As stated above, all fishermen were asked to map fishing grounds for each fishery separately. For each commercial fisherman, individual spatial fishing data were weighted based on the ex-vessel revenue for the year 2012 from each specific fishery/activity.

The following is a detailed methodology of how we analyzed and aggregated individual spatial fishing data to create port and region level spatial data sets on the relative importance of fishing areas. We would like to emphasize that fishermen are asked to map each fishery separately and the spatial data analysis methodology detailed below is conducted for each fishery separately as well.

Step 1: Individual weighted fishing grounds

During the interview process, each fisherman was presented with a navigable nautical chart (e.g., interviewer could zoom in/out and move the map around) contained within the mapping portion of the survey tool (Figure 1). Fishermen were then asked to direct field staff to draw polygons or areas that could be of any shape or size. Each fisherman was asked to identify his or her fishing grounds for a particular fishery if fishing from any port in the South Coast region. This may include mapping areas outside the study region such as north or south of the study region. Furthermore, these fishing grounds could be one or more set of polygon/areas and together they comprise his or her total fishing grounds for a particular fishery.

Once the fishing area(s) were mapped, we then ask fishermen to allocate some portion of 100 pennies to each fishing area (or if there is only one fishing area all 100 pennies would be allocated to that area by default) such that the sum of the pennies allocated across his/her fishing areas for a particular fishery equals to 100. This is done to determine the relative importance of fishing areas in comparison to each other.

Step 2: Standardize and apply economic value to individual fishing grounds

The second step is to apply economic value to the individual fishing areas and distribute that value spatially based on the proportion of pennies allocated to each fishing area. For commercial fishermen we utilized the reported ex-vessel revenue for each fisherman earned from a fishery (found in the CDFW landings data) and distributed that economic value across the fishing area(s) proportionally with the amount of pennies allocated to a specific fishing area. For example, if a commercial fisherman’s ex-vessel revenue from rockfish was $50,000 and one fishing area was assigned 50 pennies we would allocate $25,000 in economic value to that specific fishing area. This allocation of economic value is applied to each individual spatial fishing data set.

Individual spatial fishing data were weighted based on the specific fisherman’s ex-vessel revenue for the full calendar year 2012. To standardize each data set for aggregation we then converted each fisherman’s fishing ground data layer (polygon layer) for a particular fishery into a 100 x 100 meter cell size grid or raster layer.

Step 3: Aggregate individual fishing ground values to port level data set

To aggregate the individual fishing ground data layers (raster layers) we simply summarize the values in each cell across the individual raster data layers for all respondents in a given landing port. The resulting data set is a ‘heat map’ depicting the relative value of fishing areas for a given fishery in a given port.

Step 4: Aggregate port level data sets to regional data sets

To create regional level data sets for a specific fishery each port data layer is further weighted by the port’s total ex-vessel revenue for the specific fishery (for the given year of interest), which is provided by the CDFW landings data and then combined into a regional data layer. We apply the total ex-vessel revenue to each port level data layer when combining data layers to control for any sample bias at the port level. For example, if we interviewed more fishermen in a given port it
may not necessarily mean that the economic value of that port is greater than that of another port in which we interviewed less commercial fishermen.

Applying this aggregation weight is done by distributing the total ex-vessel revenue value across the respective port level data layer proportionally by the value in each raster cell. Each of these port level raster data layers are then aggregated by summing the values in each raster cell across the port data layers in the region.

1.3.6. Non-spatial Data Analysis Methods

The design of survey questions within this project were largely modeled from survey questions developed through the survey work Point 97/Ecotrust conducted during the MLPA planning process (2005-2011) as well as through a peer review consultation with regional fishery social scientists. The survey was further refined through review with key informants within the South Coast fishing community to tailor the questions to the South Coast Region. The survey questions were designed so that fishermen could easily provide answers/estimates from readily available knowledge commonly known by fishermen. For the instances in which fishermen were unable to provide answers using on-hand information, Point 97 field staff later followed up with the individual to collect the information or the information was omitted when calculating averages.

All non-spatial survey data were exported from the survey tool to an MS Access database and then imported into MS Excel files, which were then summarized into tabular format primarily using pivot table queries. As emphasized above, all data for ports or fisheries with fewer than three respondents have been withheld from publication to protect the confidentiality of the survey respondents. An asterisk, ",", can be found in the data tables in which data has been suppressed. A dash, "-", in the data tables indicates a zero value or that data was not collected for a given port-fishery combination. Often if data were not collected in a given port-fishery combination the fishery does not occur or is not a significant fishery in a port (e.g., is not a target fishery).

Ex-vessel revenue and landings data points with less than three fishermen were suppressed and to ensure the confidentiality of fishermen data, secondary suppression were also made when appropriate in order to prevent the back calculation of suppressed data points from regional totals. In ports with suppressed landings data, the data were not deleted from the aggregate port totals, but instead coded and included as ‘other’.

In the report, there are several survey summary tables that report out on characteristics of fishing activities/income from the year 2008. These averages were taken from a study conducted by Point 97/Ecotrust in 2008 (Scholz et al. 2010). We provide this information to investigate possible initial economic change since 2008.