

Assessing Spatial and Socioeconomic Change in the California Central Coast Commercial and CPFV Fisheries

EXECUTIVE SUMMARY REPORT

Report to the MPA Monitoring Enterprise, California Ocean Science Trust

Authors:

Cheryl Chen
Leanne Weiss
Rebecca Barger
Taylor Hesselgrave
Charles Steinback
Jon Bonkoski
Kristen Sheeran
Nick Lyman
Jennifer Bloeser
Debbie Aseltine-Neilson

July 30, 2012

For questions or comments, please contact Charles Steinback, Director of Marine Planning, at Ecotrust,
721 NW 9th Avenue, Suite 200
Portland, OR 97209; charles@ecotrust.org; 503.467.0777



Table of Contents

1. INTRODUCTION.....	1
2. COMMERCIAL FISHING SECTOR	4
2.1. Historical Trends and Initial Changes in the Commercial Fishing Sector	4
2.1.1. Historical Trends in the Commercial Fishing Sector	4
2.1.2. Initial Changes in the Commercial Fishing Sector	9
2.2. Baseline Characterization of the Commercial Fishing Sector.....	11
2.3. Spatial Baseline Characterization of the Commercial Fishing Sector.....	14
2.4. Initial Spatial Change in the Commercial Fishing Sector	22
2.5. Marine Protected Areas and Commercial Fishing	28
3. COMMERCIAL PASSENGER FISHING VESSEL (CPFV) SECTOR	31
3.1. Historical Trends and Initial Changes in the CPFV Sector	31
3.1.1. Historical Trends in the CPFV Sector	32
3.1.2. Initial Changes in the CPFV Sector.....	37
3.2. Baseline Characterization of the CPFV Sector	38
3.3. Spatial Baseline Characterization of the CPFV Sector	41
3.4. Marine Protected Areas and the CPFV Sector	45
4. LESSONS LEARNED	49
5. RECOMMENDATIONS ON KEY MONITORING METRICS	49
5.1. Monitoring Metrics for the Commercial Fishing Sector	50
5.2. Monitoring Metrics for the CPFV Sector	51
6. CONCLUSION	52

Ecotrust

For more than 20 years, Ecotrust has converted \$80 million in grants into more than \$500 million in capital for local people, businesses, and organizations from Alaska to California. Ecotrust's many innovations include co-founding the world's first environmental bank, starting the world's first ecosystem investment fund, creating a range of programs in fisheries, forestry, food, farms and indigenous affairs, and developing new scientific and information tools to improve social, economic and environmental decision making. Ecotrust works locally in ways that promise hope abroad, and it honors and supports the wisdom of Native and First Nation leadership. Learn more at <http://www.ecotrust.org>

Acknowledgements

Conducting research in coastal communities is as challenging as it is rewarding. We have learned a tremendous amount from the commercial and CPFV fishermen who provided guidance and feedback during this study as well as the countless other community members, state agency staff, and observers of this project. We are deeply thankful to the commercial fishermen and CPFV operators/owners who participated in this project and for making time in their busy schedules, overcoming sometimes considerable reservations, and sharing their knowledge and experience with us.



1. INTRODUCTION

The waters off the Central Coast of California (Map 1 and Map 2) which stretches from Pigeon Point in the north to Point Conception in the south have long supported fishing activities that are integral to the cultural and economic history of the area. Fisheries exemplify the interdependencies between the natural environment and coastal communities that have characterized California since well before statehood. To protect California's marine resources, in September 22, 2007, as part of the Marine Life Protection Act (MLPA) Initiative, the California Fish and Game Commission (CFGC) designated 29 marine protected areas (MPAs) within the Central Coast state waters of California.

As part of the baseline marine protected areas (MPAs) monitoring effort to characterize the ecological and socioeconomic conditions and changes within the Central Coast Region since MPA implementation, this report provides three sets of primary findings:

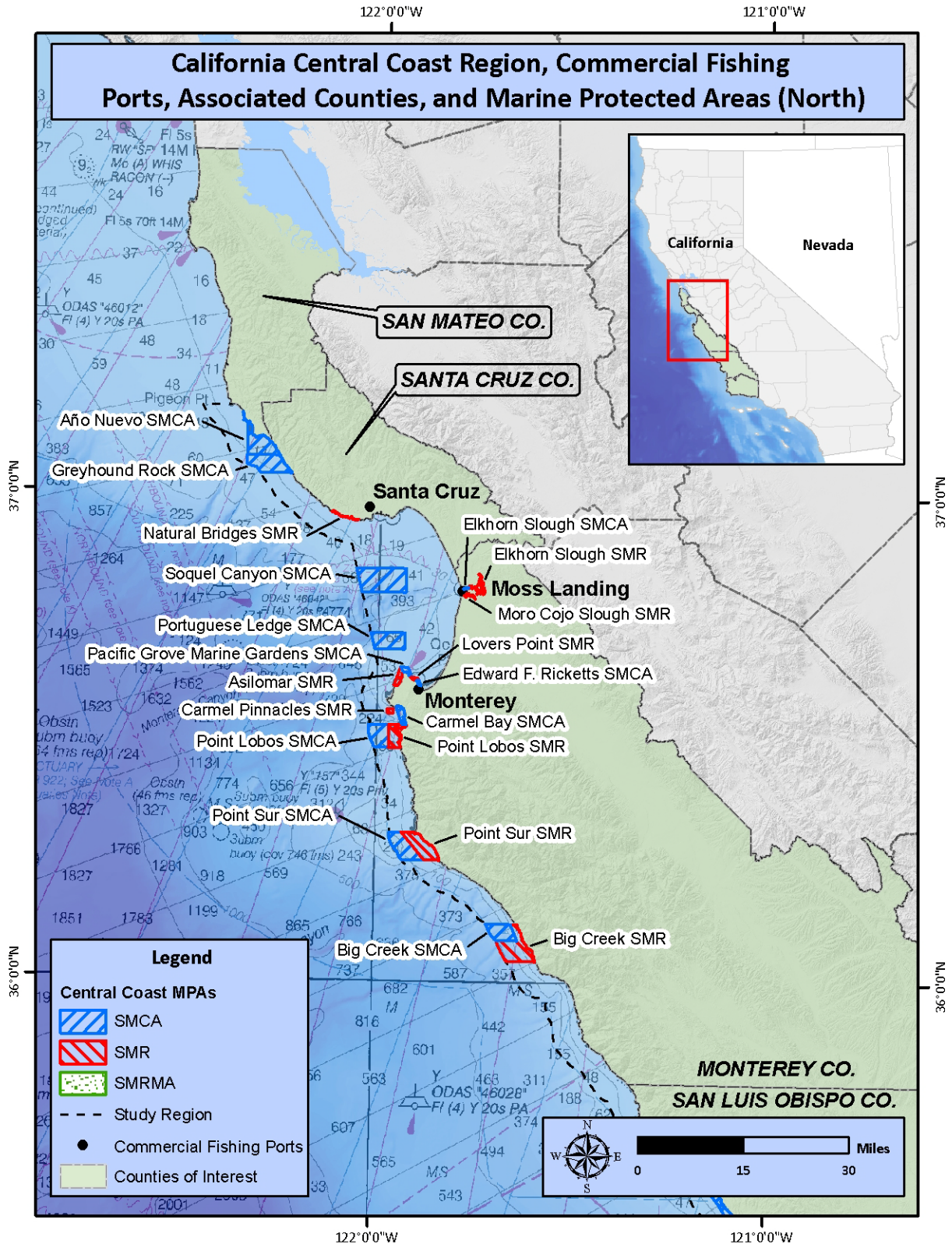
1. A spatial and socioeconomic baseline characterization of select commercial fisheries and the commercial passenger fishing vessel (CPFV) fleet in the California Central Coast Region;
2. An assessment of initial spatial and socioeconomic changes following MPA implementation; and
3. An investigation of the role of MPAs and other major driving factors in observed spatial and economic changes

Establishing a baseline characterization of the commercial fishing and CPFV fleets of the California Central Coast provides a better understanding of the current socioeconomic health of the Central Coast fishing communities and provides a benchmark of socioeconomic conditions and spatial fishing patterns against which future MPA impacts and benefits can be measured. Furthermore, assessing historical trends along with initial changes in socioeconomic conditions and spatial fishing patterns that followed MPA implementation will help inform how MPAs and other driving factors may interplay to influence observed changes.

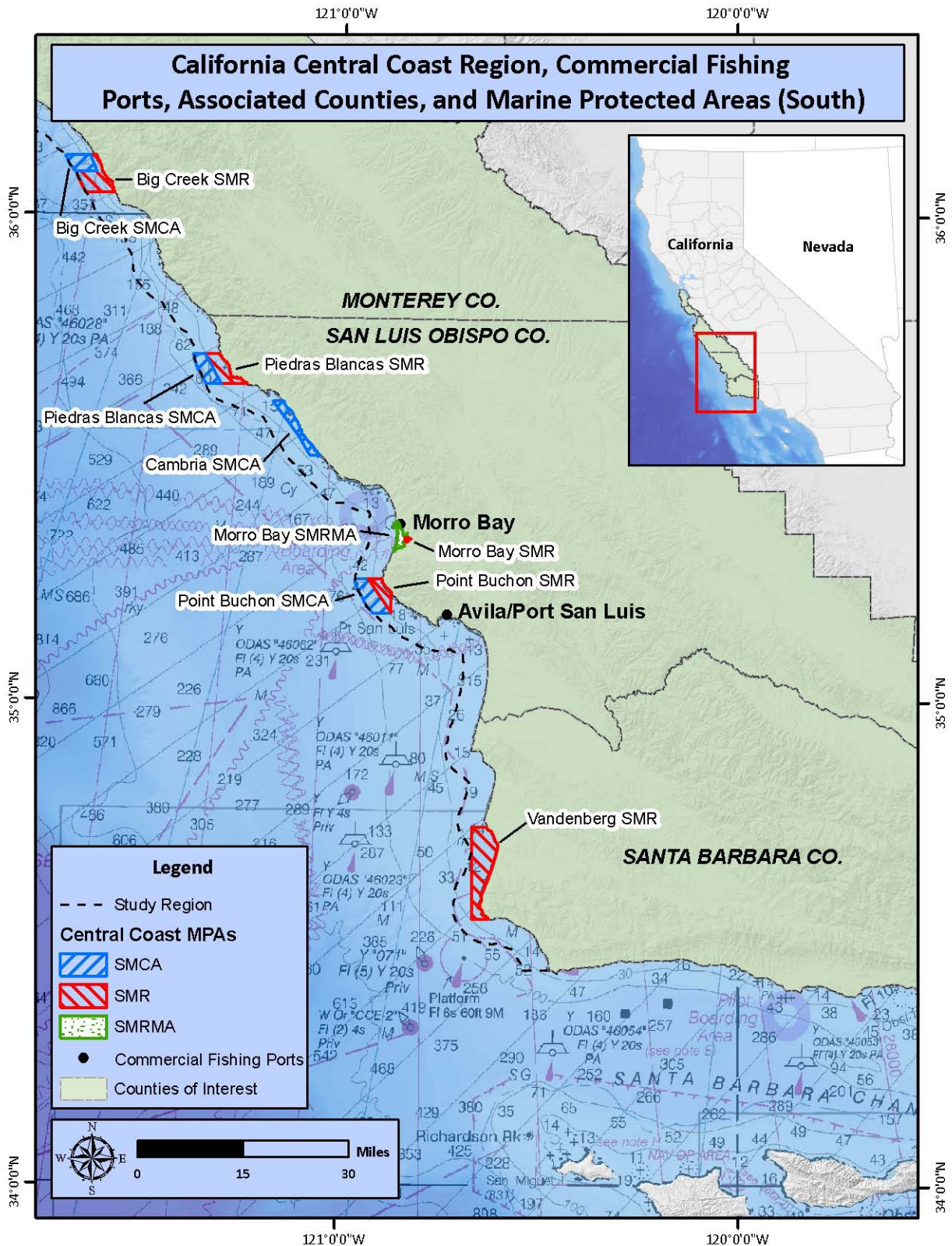
In this executive summary report we summarized survey results and present fishery specific maps of fishing grounds to establish a baseline characterization of the commercial fishing and CPFV fleet of the Central Coast Region. Furthermore, we also examined California Department of Fish and Game (CDFG) commercial fisheries landings data and CPFV logbook data to provide information as to the historical trends and initial changes in select fisheries and ports after the Central Coast MPA network was implemented. Lastly, utilizing pre and post MPA spatial data collect by Ecotrust in 2005 and 2011 we present fishery specific spatial change maps to illustrate the change in the relative value of fishing areas.

The information in this executive summary report is provided at the Central Coast Region level. Additional detailed information may be found in the fishery and port profiles in our technical report. These profiles contain additional analyses of historical landings data, survey data summaries, port level map products, and spatial change analyses.

Map 1. Central Coast Region (north)



Map 2. Central Coast Region (south)



2. COMMERCIAL FISHING SECTOR

2.1. Historical Trends and Initial Changes in the Commercial Fishing Sector

Commercial landings and ex-vessel revenue data supplied by the CDFG were examined over a twenty year period of 1992–2011 for the Central Coast Region and our five ports of interest: Santa Cruz, Moss Landing, Monterey, Morro Bay, and Avila/Port San Luis. On average across this time period and over all fisheries, 810 fishermen landed 62.7 million pounds for \$17.9 million in ex-vessel revenues annually. Overall, Central Coast commercial landings increased in total over the study period while total ex-vessel revenues varied (Figure 1). The number of fishermen consistently declined in the Central Coast Region by nearly 70 percent from 1992 to 2011. Additionally, on average, each Central Coast Region fisherman landed 110,047 pounds for \$27,042 in ex-vessel revenue annually over the study period (Figure 2).

To focus efforts, this project identified key fisheries of interests to investigate in the historical trends and initial changes section of this report. In examining historical landings data, we chose to focus on these fisheries of interest as they occur mostly in state waters, are most likely to experience both short term spatial and economic changes associated with MPA implementation, and are of high economic importance to the Central Coast Region. The eleven fisheries of interest are:

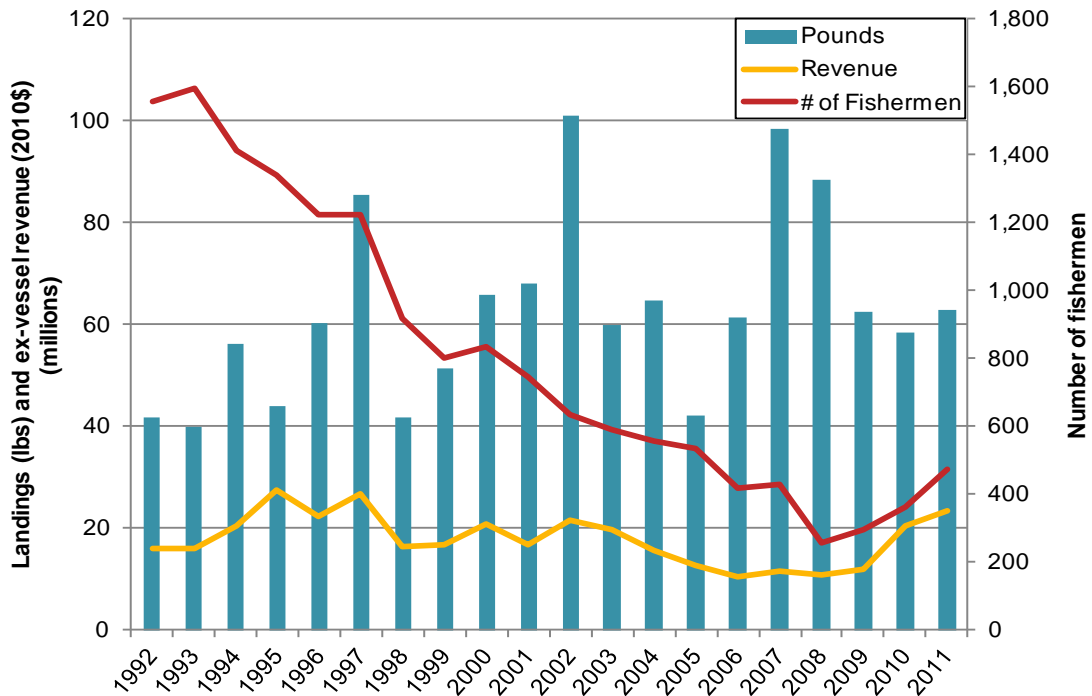
1. California halibut–hook & line;
2. Coastal pelagic species–seine/net;
3. Dungeness crab–trap;
4. Market squid–seine;
5. Nearshore finfish–dead–hook & line;
6. Nearshore finfish–dead–longline;
7. Nearshore finfish–live–hook & line;
8. Nearshore finfish–live–longline;
9. Nearshore finfish–live–trap;
10. Salmon–troll; and
11. Spot prawn–trap

2.1.1. Historical Trends in the Commercial Fishing Sector

In 1992, fisheries of interest landings and ex-vessel revenues comprised only 51.2 percent and 26.5 percent of total landings and ex-vessel revenues in the Central Coast Region respectively (Figure 3). By 2011, these percentages increased to 92.4 percent and 63.3 percent respectively as the eleven fisheries of interest became more significant in the Central Coast Region overall.

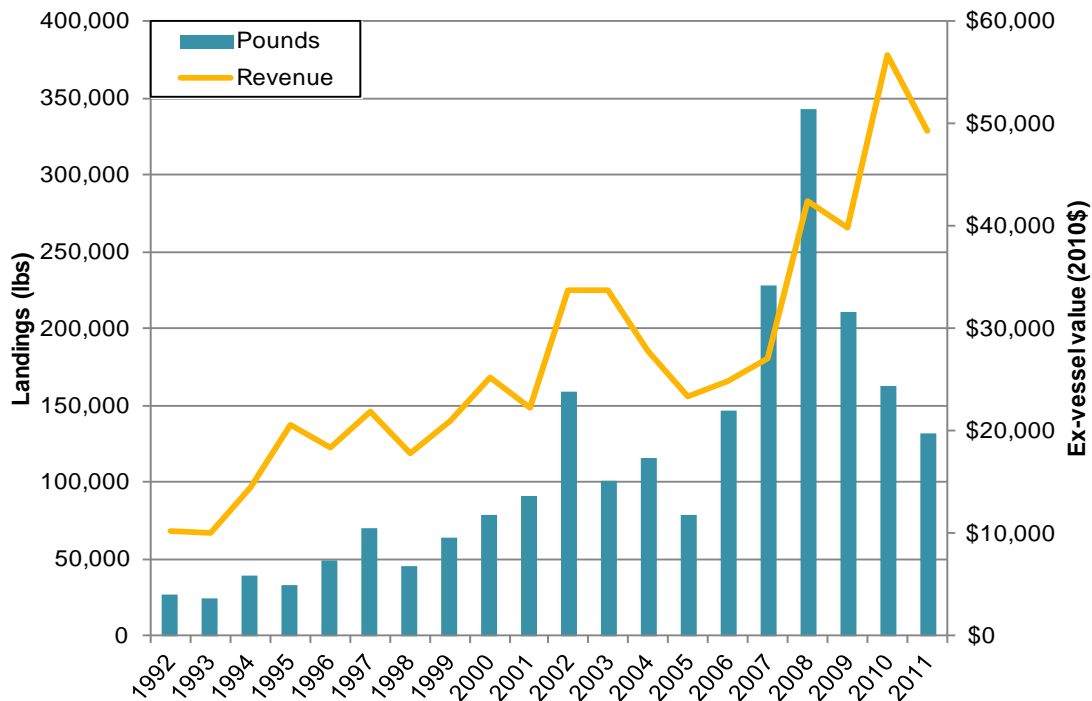
By volume landed (Figure 4), the coastal pelagic species–seine/net fishery was the most significant in the region over the study period, landing 57.2 percent of total landings on average annually. In terms of ex-vessel revenues (Figure 5), the market squid–seine fishery constituted 16.3 percent of total ex-vessel revenues in the region. The salmon–troll fishery was very significant to the region and each Central Coast Region port over the study period, constituting 14 percent of total ex-vessel revenues on average annually which was spread relatively evenly across ports, before its closure in 2008 and 2009. In years that the salmon–troll fishery was closed, many fishermen relied more heavily upon other fisheries, most notably the California halibut–hook & line, Dungeness crab–trap, and nearshore finfish–live fisheries.

Figure 1. Central Coast Region total commercial landings, ex-vessel revenues, and number of fishermen, all fisheries, 1992–2011



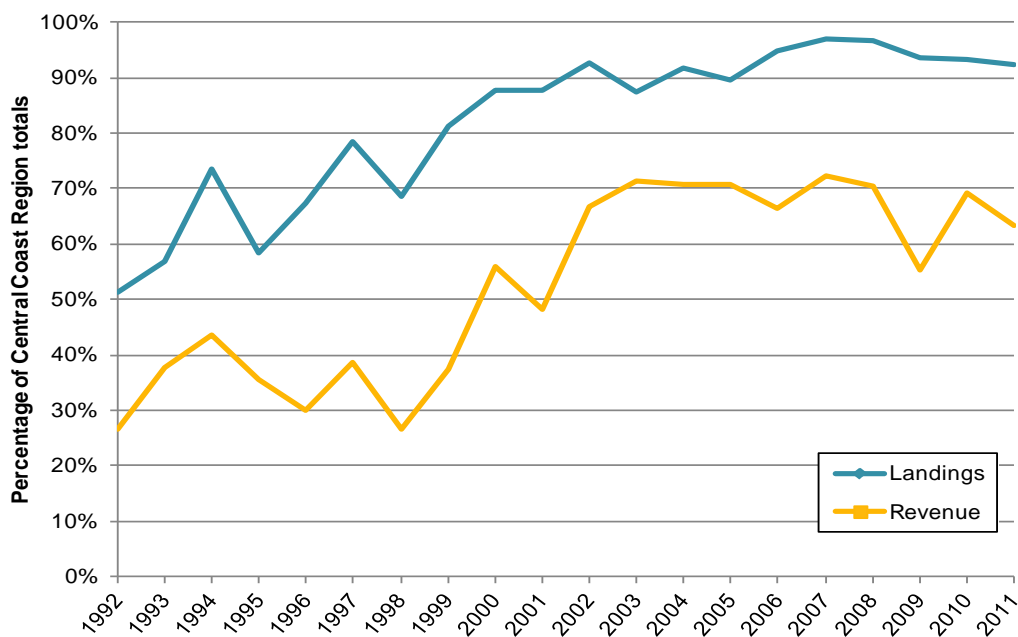
Source: Landings data from CDFG

Figure 2. Average commercial landings and ex-vessel revenue per fisherman in the Central Coast Region, 1992–2011



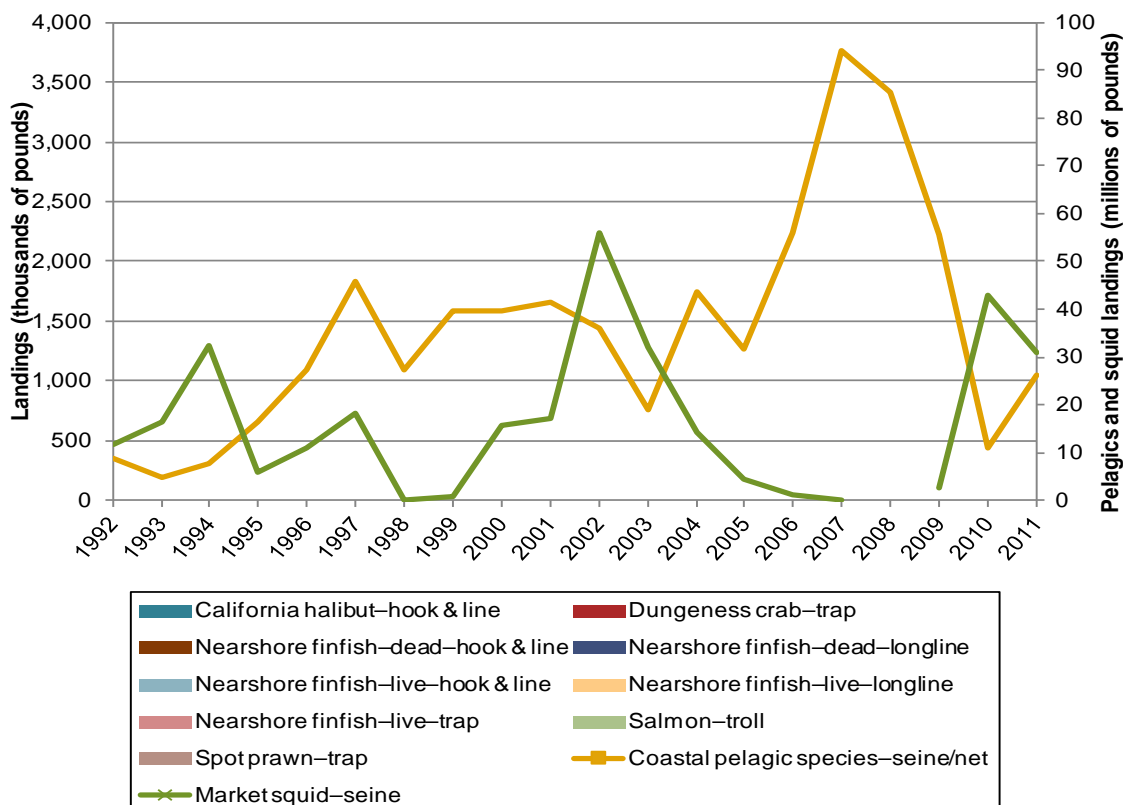
Source: Landings data from CDFG

Figure 3. Fisheries of interest as a percentage of all commercial fisheries landings and ex-vessel revenues in the Central Coast Region, 1992–2011



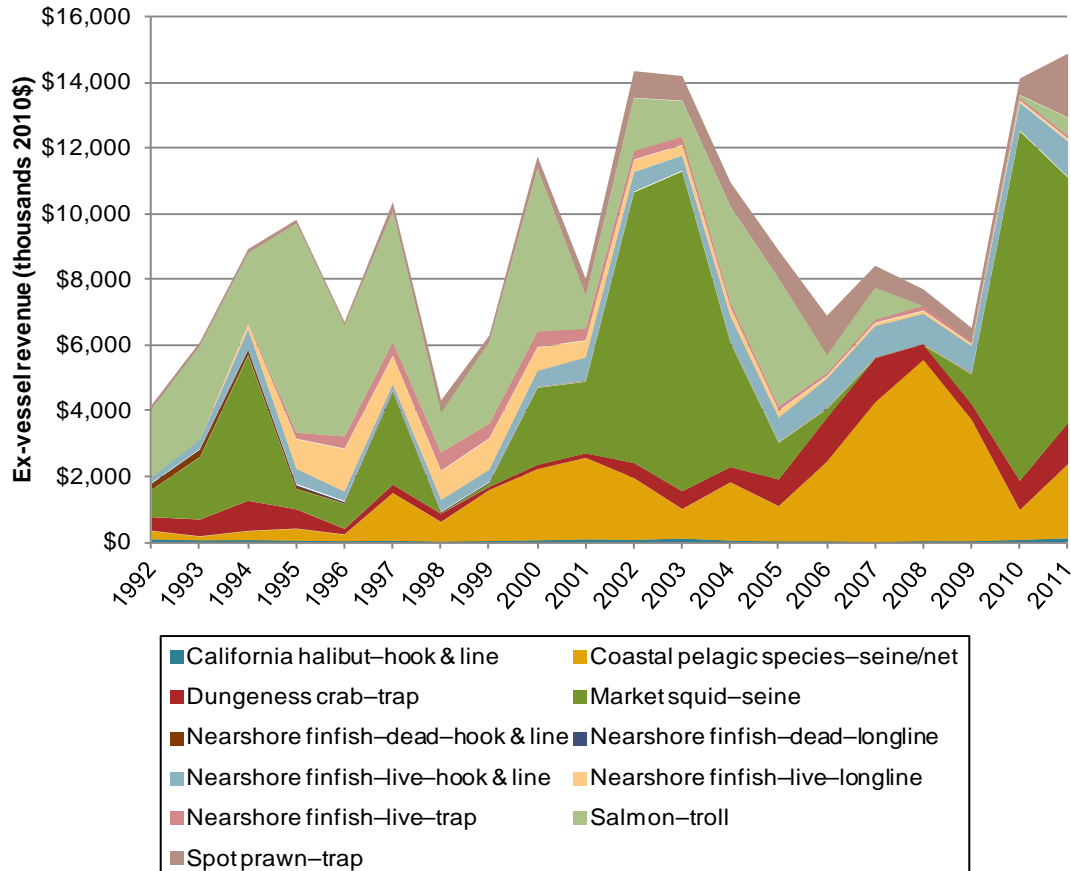
Source: Landings data from CDFG

Figure 4. Central Coast Region commercial landings for fisheries of interest, 1992–2011



Source: Landings data from CDFG

Figure 5. Central Coast Region commercial ex-vessel revenues for fisheries of interest, 1992–2011

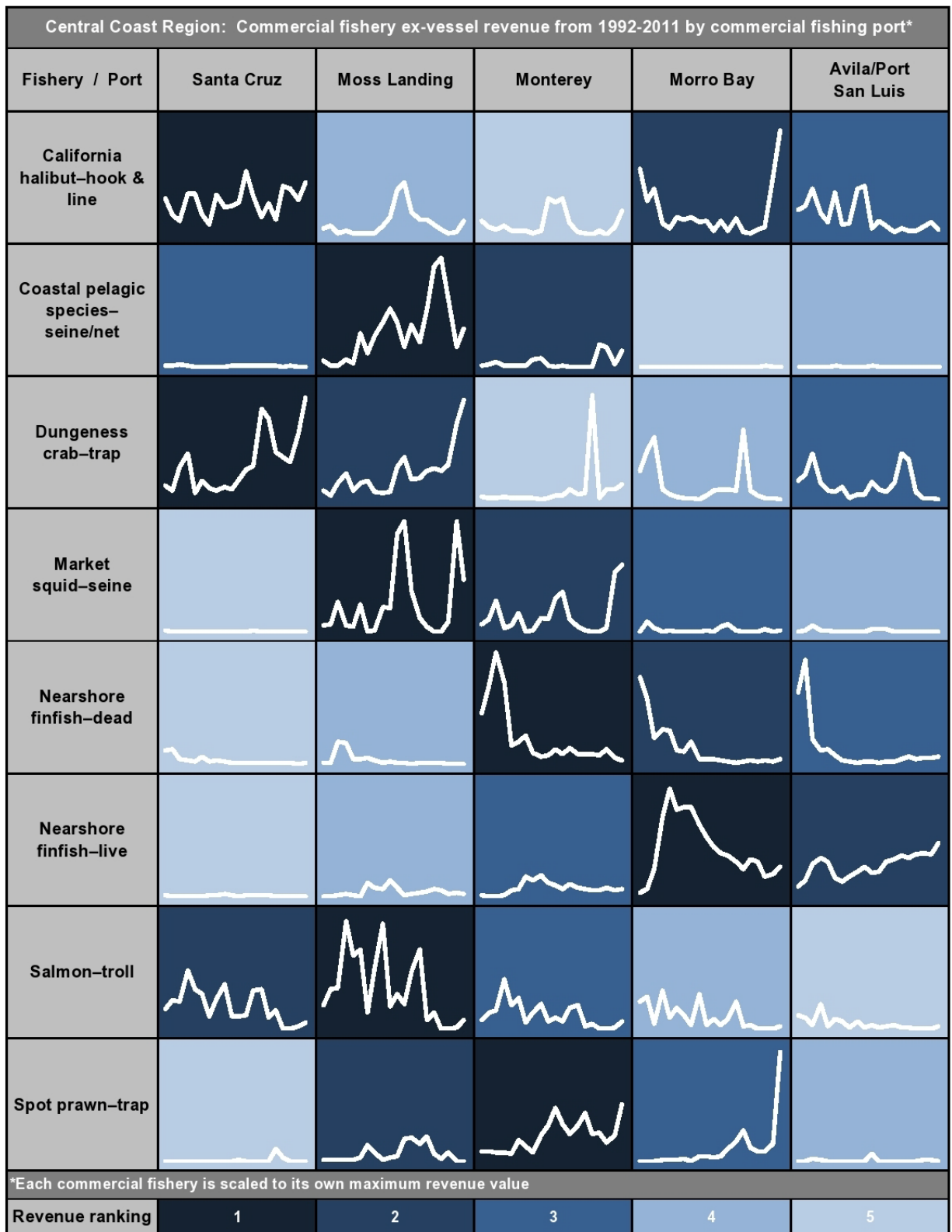


Source: Landings data from CDFG

As illustrated in the information graphic below (Figure 6), ex-vessel revenues from the California halibut–hook & line fishery generally increased among all Central Coast Region ports except in the case of Avila/Port San Luis. Instead, that port saw significant increases in the nearshore finfish–live fisheries to a greater extent relative to other ports. Similarly, the Dungeness crab–trap fishery saw relatively consistent increases in ex-vessel revenues across Central Coast Region ports over the study period, although along with the nearshore finfish–dead–longline fishery, was one of only two fisheries in the Central Coast Region to experience lower average ex-vessel prices per pound observed in 2011 than those observed in 1992. The nearshore finfish–dead fisheries experienced a steady decline of landings, ex-vessel revenues, and number of participating fishermen over the study period with many fishermen transitioning into the nearshore finfish–live fishery. The nearshore finfish–live fishery has increased in ex-vessel revenue over the study period most noticeably in the port of Avila/Port San Luis and Morro Bay. Both the coastal pelagic species–seine/net and market squid–seine fisheries are highly variable over the study period with ex-vessel revenue levels increasing and decreasing with environmental conditions which strongly influence the presence of these species in the Central Coast Region waters. Lastly, the emergence of the spot prawn–trap fishery was particularly notable across the study region, especially in the ports of Monterey and Morro Bay.

Numerical values were intentionally left out as the information graphic below was developed to help provide a visual and broad overview of the historical trends and variations in the eleven fisheries of interest. The gradation in color illustrates a ranking of ports in their average contribution to the total Central Coast Region ex-vessel revenues of a fishery over the 1992–2011 study period. Darker colors indicate a higher average contribution to total fishery ex-vessel revenue than lighter colors.

Figure 6. Commercial fishery ex-vessel revenue by commercial fishing port in the Central Coast Region, 1992-2011



2.1.2. Initial Changes in the Commercial Fishing Sector

Ex-vessel revenues were examined for pre MPA (2000-2003 and 2004-2007) and post MPA (2008-2011) time periods for the eleven fisheries of interest (Table 1). Across these two time periods the top five fisheries of interest varied in their percent contribution to total ex-vessel revenues in the Central Coast Region. Percent change was calculated as the difference between the starting year and ending year of the specified time period. From pre MPA (2004-2008) to post MPA (2008-2011) time periods the coastal pelagic species-seine/net fishery's percent contribution to total ex-vessel revenue changed from 19.8 percent to 23.8 percent; market squid-seine from 9.0 percent to 23.0 percent; nearshore finfish-live-hook & line from 7.1 percent to 6.1 percent; spot prawn-trap from 7.2 percent to 4.7 percent; and Dungeness crab-trap from 8.5 percent to 4.5 percent.

Table 1. Average percentage of fishery of interest ex-vessel revenues to Central Coast Region total ex-vessel revenues, commercial fishing

Fishery	Annual average 1992–2011		Average percent of revenue to total revenues			
	Landings	Ex-vessel revenues	Pre MPA (2000–2003)	Pre MPA (2004–2007)	Post MPA (2008–2011)	2000–2011
California halibut–hook & line	17,127	\$62,492	0.5%	0.3%	0.4%	0.4%
Coastal pelagic species–seine/net	35,844,355	\$1,694,536	9.6%	19.8%	23.8%	11.8%
Dungeness crab–trap	209,626	\$576,282	1.6%	8.5%	4.5%	3.7%
Market squid–seine	15,657,520	\$2,913,192	28.0%	9.0%	23.0%	14.8%
Nearshore finfish–dead–hook & line	32,106	\$47,361	0.1%	0.1%	0.1%	0.3%
Nearshore finfish–dead–longline	7,868	\$10,147	0.0%	0.0%	0.0%	0.0%
Nearshore finfish–live–hook & line	102,666	\$616,205	3.0%	7.1%	6.1%	4.0%
Nearshore finfish–live–longline	74,723	\$388,677	2.4%	1.2%	0.4%	2.0%
Nearshore finfish–live–trap	38,698	\$216,153	1.8%	0.9%	0.8%	1.2%
Salmon–troll	901,034	\$2,114,986	10.7%	16.0%	0.7%	11.3%
Spot prawn–trap	45,778	\$533,599	3.1%	7.2%	4.7%	3.4%

Source: Landings data from CDFG

Table 2 displays the percent change in ex-vessel revenues and average ex-vessel revenue per fisherman for fisheries of interests over recent time periods organized into both pre and post MPA implementation periods. Changes are presented for the Central Coast Region and compared with those observed in the fishery at the state level. Drivers of percent changes in ex-vessel revenue values vary across each fishery. Such factors as the implementation of regulations/fishery closures, decline in the number of fishermen, changes in price and market conditions, changes in environmental conditions (e.g., El Niño events), fish abundance cycles, and many other factors in addition to the implementation of the Central Coast MPA network all interplay to effect ex-vessel landings revenue levels. For a more detailed account of changes in ex-vessel revenue levels and potential drivers of changes in each fishery, please see the fishery profiles in our technical report.

Table 2. Percent change in ex-vessel revenue in pre MPA and pre MPA periods, Central Coast Region compared to California State trends

Fishery	Commercial ex-vessel revenue	Percent change			
		Pre MPA (2000-2003)	Pre MPA (2004-2007)	Post MPA (2008-2011)	2000-2011
California halibut-hook & line	Central Coast Region total	85.6%	-66.6%	205.2%	103.9%
	Central Coast Region average per fisherman	33.2%	-9.8%	17.8%	23.1%
	State total	75.9%	-32.5%	-21.3%	61.7%
	State average per fisherman	68.5%	-4.5%	-27.0%	66.6%
Coastal pelagic species-seine/net	Central Coast Region total	-58.8%	139.7%	-59.2%	4.0%
	Central Coast Region average per fisherman	-45.0%	314.0%	-75.0%	-6.0%
	State total	-63.8%	70.0%	-37.9%	-49.4%
	State average per fisherman	-54.4%	48.3%	-41.8%	-37.8%
Dungeness crab-trap	Central Coast Region total	313.7%	189.7%	165.3%	864.0%
	Central Coast Region average per fisherman	175.8%	189.7%	107.3%	623.0%
	State total	145.4%	-39.2%	119.4%	194.5%
	State average per fisherman	154.2%	-34.0%	98.8%	200.6%
Market squid-seine	Central Coast Region total	314.6%	-99.8%	n/a	217.7%
	Central Coast Region average per fisherman	115.3%	-98.4%	n/a	114.4%
	State total	-11.7%	32.6%	148.5%	98.4%
	State average per fisherman	12.7%	59.9%	65.1%	107.4%
Nearshore finfish-dead-hook & line	Central Coast Region total	-12.9%	-6.3%	-11.6%	12.4%
	Central Coast Region average per fisherman	42.0%	4.5%	-5.6%	77.2%
	State total	-42.6%	-2.8%	-44.3%	-64.4%
	State average per fisherman	10.3%	16.3%	-28.5%	7.8%
Nearshore finfish-dead-longline	Central Coast Region total	-31.2%	-92.3%	251.4%	-97.7%
	Central Coast Region average per fisherman	7.5%	-69.3%	195.8%	-80.6%
	State total	-83.9%	35.7%	-60.9%	-94.5%
	State average per fisherman	-67.9%	121.1%	-44.8%	-64.3%
Nearshore finfish-live-hook & line	Central Coast Region total	-11.3%	24.8%	15.0%	111.4%
	Central Coast Region average per fisherman	14.0%	40.8%	29.8%	298.8%
	State total	-40.1%	15.7%	-14.6%	-16.4%
	State average per fisherman	10.9%	30.5%	8.4%	169.9%
Nearshore finfish-live-longline	Central Coast Region total	-56.8%	-63.5%	-27.4%	-91.5%
	Central Coast Region average per fisherman	-37.5%	-0.3%	3.8%	-1.9%
	State total	-65.4%	-0.7%	-23.1%	-78.2%
	State average per fisherman	-39.3%	74.9%	15.3%	36.9%
Nearshore finfish-live-trap	Central Coast Region total	-45.9%	-39.6%	-36.7%	-78.9%
	Central Coast Region average per fisherman	-19.8%	-36.8%	21.3%	-29.5%
	State total	-51.2%	-32.5%	-28.6%	-71.5%
	State average per fisherman	-0.8%	-21.6%	3.7%	24.0%
Salmon-troll	Central Coast Region total	-77.9%	-66.4%	n/a	-88.7%
	Central Coast Region average per fisherman	-51.7%	-57.8%	n/a	-71.0%
	State total	12.1%	-60.5%	n/a	-62.2%
	State average per fisherman	50.9%	-50.3%	n/a	-34.4%
Spot prawn-trap	Central Coast Region total	101.8%	-8.8%	280.8%	423.9%
	Central Coast Region average per fisherman	101.8%	-29.1%	280.8%	423.9%
	State total	-12.5%	18.8%	46.1%	133.2%
	State average per fisherman	74.9%	8.9%	46.1%	345.2%

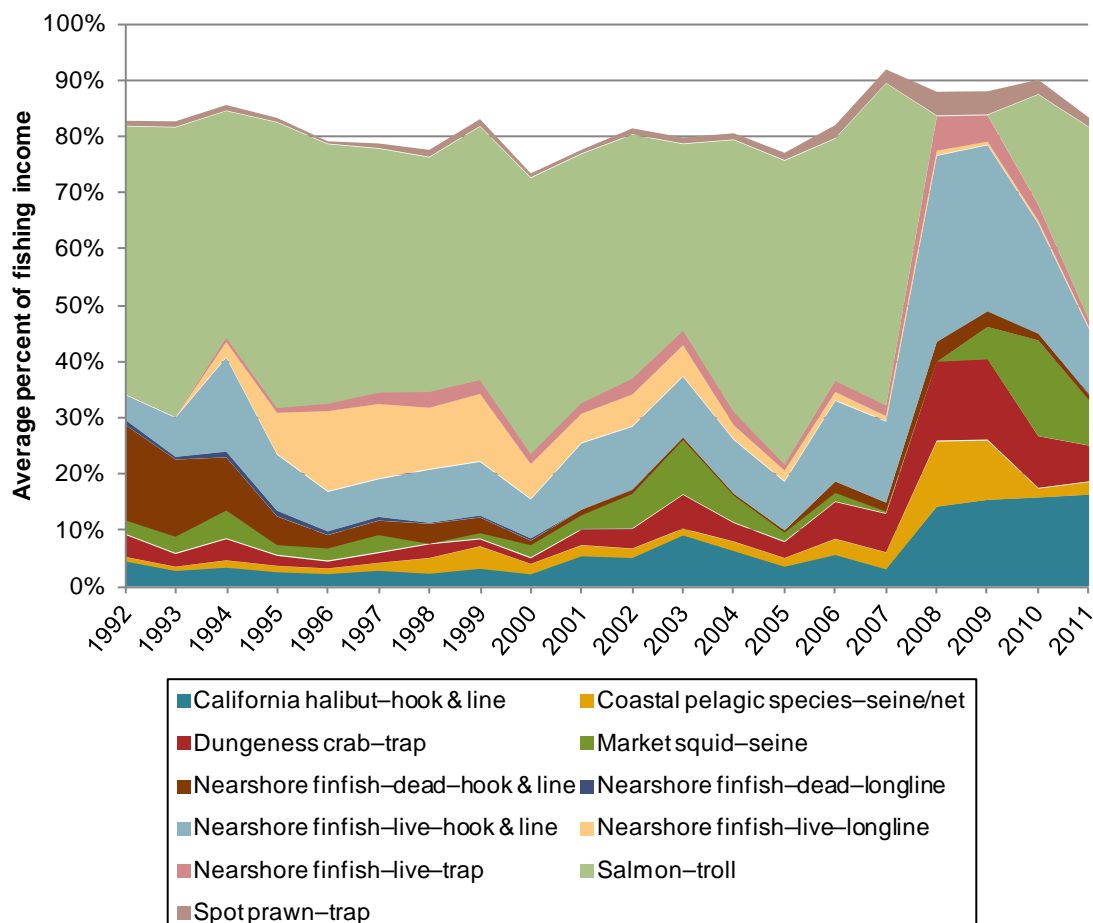
Source: Landings data from CDFG

Percents were calculate from the starting year to end year of each period

n/a indicates the data point could not be calculated due to a zero value in one year

Average percent of individual ex-vessel revenue derived from each fishery relative to other fisheries of interests were also calculated for the 1992-2011 study period (Figure 7). This type of analysis helps to reveal the degree in which individual fishermen on average relied upon a fishery as a portion of their fishing income. For pre MPA (2004-2007) and post MPA (2008-2011) time periods, the salmon—troll fishery's percent contribution to individual fisherman ex-vessel revenue changed from 50.6 percent to 13.4 percent; nearshore finfish—live—hook & line from 11.7 percent to 23.4 percent; California halibut—hook & line from 4.8 percent to 15.6 percent; Dungeness crab—trap from 4.8 percent to 10.9 percent; coastal pelagic species—seine/net from 2.3 percent to 6.5 percent; and market squid—seine from 2.1 percent to 7.7 percent.

Figure 7. Average percent of individual fishing income from commercial fisheries of interest, Central Coast Region, 1992–2011



Source: Landings data from CDFG

2.2. Baseline Characterization of the Commercial Fishing Sector

In this study we targeted nine fisheries for data collection to establish a baseline characterization of commercial fishing in the Central Coast region. These fisheries are:

1. California halibut—hook & line
2. Coastal pelagic species—seine/net;
3. Dungeness crab—trap;
4. Market squid—seine;

5. Nearshore finfish—live—hook & line;
6. Nearshore finfish—live—longline;
7. Nearshore finfish—live—trap;
8. Salmon—troll; and
9. Spot prawn—trap

In the Central Coast Region the target fisheries (listed below in Table 3) for data collection generated over \$14.8 million in 2011. Almost half of the total revenue from the region came from the market squid—seine fishery (\$7.5 million). The next largest producer was coastal pelagic species—seine/net (\$2.2 million), followed by spot prawn—trap (\$1.9 million). We interviewed 29 commercial fishermen with most fishermen participating in more than one fishery, producing 57 data sets. Nearshore finfish—live includes the following three gear types; hook & line, trap, and longline. These fisheries are grouped together due to their similarities and in order to present data that would have been suppressed if presented separately. We interviewed 12 unique nearshore finfish—live fishermen producing 16 data sets, 10 of which are fishermen using hook & line gear, 5 are from fishermen using trap gear, and 1 is from a fisherman using longline gear.

Table 3. Number of commercial fishermen interviews conducted, non spatial survey, Central Coast Region

Fishery	2011 Landings revenue (2010\$)	Total number of individuals in 2011 landings revenue	Number interviewed
California halibut—hook & line	\$130,577	101	10
Coastal pelagic species—seine/net	\$2,241,160	31	4
Dungeness crab—trap	\$1,260,304	32	7
Market squid—seine	\$7,478,293	40	4
Nearshore finfish—live—hook & line	\$1,077,290	62	10
Nearshore finfish—live – longline	\$60,374	7	1
Nearshore finfish—live—trap	\$101,018	12	5
Nearshore finfish—live	\$1,238,682	66	12
Salmon – troll	\$558,358	173	13
Spot prawn—trap	\$1,940,848	7	3
All target fisheries	\$14,848,223	338	29

Source: CDFG landings data, Current study

* indicates data were collected but cannot be shown due to confidentiality constraints

— indicates that the port/fishery was not sampled or a zero value data point

We interviewed 29 commercial fishermen in the Central Coast Region and the average age of respondents was 51.2 years old and had 26.0 years experience commercial fishing. On average, fishermen interviewed indicated 76.3 percent of their total income was from commercial fishing (Table 4) with most fishermen who had other occupations employed in the skilled labor force such as construction or contracting work. On average commercial fishermen spent 50.3 percent of his/her total commercial fishing gross economic revenue on overall commercial fishing operating costs (Table 5). For each target fishery, Table 6 displays the average percentages of gross economic revenue spent on crew and fuel.

It should be noted that in the report, there are several survey summary tables which report out on characteristics of fishing activities/income from the year 2006. As limited non-spatial survey data was collected during the 2005 study by Ecotrust, we included these questions in our survey to provide some estimates as to possible socioeconomic change. Furthermore, asking questions about activities in 2006 as well as 2011 together allowed us to gather important qualitative information on the major factors driving any reported/perceived changes between the two years. Summaries on the qualitative information collected may be found in our technical report. We chose the year 2006 to serve as the pre-MPA year in

which to gauge subsequent change as it was the last full year before the Central Coast MPA network was implemented.

Table 4. Percent change in income from overall commercial fishing from 2006–2011, Central Coast Region

Fisheries	2006		2011		Percent change	
	Average	Standard	Average	Standard	Average	Standard
California halibut–hook & line	60.6%	31.9%	52.2%	34.2%	-9.5%	43.8%
Coastal pelagic species–seine/net	97.5%	5.0%	97.5%	5.0%	—	—
Dungeness crab–trap	92.9%	12.2%	96.4%	9.4%	4.8%	12.6%
Market squid–seine	97.5%	5.0%	97.5%	5.0%	—	—
Nearshore finfish–live	75.4%	33.9%	80.4%	29.9%	132.6%	509.2%
Salmon – troll	78.5%	24.4%	70.4%	37.4%	-15.2%	34.3%
Spot prawn–trap	100.0%	—	100.0%	—	—	—
All target fisheries (unique individuals)	77.0%	31.1%	76.3%	33.2%	63.2%	368.2%

Source: Current study

— indicates that the port/fishery was not sampled or a zero value data point

Table 5. Percent change in overall commercial fishing operating costs from 2006–2011, Central Coast Region

Fisheries	2006		2011		Percent change (average)	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
California halibut – hook & line	34.1%	27.0%	47.0%	31.7%	23.8%	30.7%
Coastal pelagic species – seine/net	70.0%	13.2%	73.5%	5.1%	7.1%	10.1%
Dungeness crab – trap	47.9%	25.1%	51.4%	19.7%	13.3%	22.3%
Market squid – seine	70.0%	13.2%	73.5%	5.1%	7.1%	10.1%
Nearshore finfish – live	35.6%	20.5%	40.8%	18.6%	19.4%	23.5%
Salmon – troll	45.8%	26.5%	54.6%	28.2%	16.8%	26.7%
Spot prawn – trap	50.0%	—	50.0%	—	—	—
All target fisheries (unique individuals)	41.7%	26.3%	50.3%	25.0%	22.3%	27.2%

Source: Current study

— indicates that the port/fishery was not sampled or a zero value data point

Table 6. Additional commercial fishery specific data, Central Coast Region

Fisheries	Years experience in fishery		Number of crew per trip		Percent GER to crew		Percent GER to fuel	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
California halibut–hook & line	19.2	15.3	0.5	0.5	11.0%	12.6%	12.4%	5.8%
Coastal pelagic species–seine/net	27.8	5.9	5.3	1.0	46.3%	8.5%	10.0%	—
Dungeness crab–trap	16.0	16.6	1.4	0.8	20.7%	15.9%	23.6%	15.2%
Market squid–seine	31.8	1.7	5.3	1.0	46.3%	8.5%	10.0%	—
Nearshore finfish–live	14.9	8.1	0.9	0.3	14.1%	9.4%	14.6%	4.9%
Salmon–troll	26.7	13.2	0.6	0.7	5.5%	8.7%	18.6%	14.4%
Spot prawn–trap	20.3	13.4	1.7	0.6	23.0%	2.6%	12.0%	7.1%

Source: Current study

— indicates that the port/fishery was not sampled or a zero value data point

2.3. Spatial Baseline Characterization of the Commercial Fishing Sector

The number of fishermen who participated in the mapping portion of the interview and the percent of 2011 ex-vessel revenue represented by those individuals are presented below in Table 7. Table 8 indicates the spatial data sets or maps that are available for both the pre (2005) and post (2011) MPA survey efforts. The post MPA maps may be found below and the pre MPA maps may be found in Appendix A of our technical report.

Table 7. Number of commercial fishermen interviews conducted and ex-vessel landings value represented, spatial survey, Central Coast Region

Fishery	2011 Landings revenue (2010\$)	Percent of ex-vessel revenue represented by interviews	Total number of individuals in 2011 landings revenue	Number of fishermen who mapped with 2011 landings
California halibut–hook & line	\$130,577	13.4%	101	4
Coastal pelagic species–seine/net	\$2,241,160	32.4%	31	4
Dungeness crab–trap	\$1,260,304	27.6%	32	3
Market squid–seine	\$7,478,294	22.0%	40	4
Nearshore finfish–live–hook & line	\$1,077,290	13.4%	62	8
Nearshore finfish–live – longline	\$60,374	92.7%	7	1
Nearshore finfish–live–trap	\$101,018	35.3%	12	4
Spot prawn–trap	\$1,940,848	98.3%	7	3
All target fisheries	\$14,289,865		229	23

Source: California Department of Fish and Game, Current study

* indicates data were collected but cannot be shown due to confidentiality constraints

— indicates that the port/fishery was not sampled or a zero value data point

Table 8. Spatial data sets available for the commercial fishing sector, pre and post MPA

Fishery/Port	Survey	Santa Cruz	Moss Landing	Moss Landing/ Monterey	Monterey	Morro Bay	Avila/Port San Luis	Central Coast Region
California halibut- hook & line	Pre MPA	Yes	Yes	-	Yes	Conf	Yes	Yes
	Post MPA	Conf	-	-	-	Yes	Conf	Yes
Coastal pelagic species - seine/net	Pre MPA	-	-	-	-	-	-	-
	Post MPA	-	Conf	Yes	Conf	-	-	Yes
Dungeness crab - trap	Pre MPA	Yes	Conf	-	Yes	Conf	Conf	Yes
	Post MPA	Conf	Conf	-	-	-	-	Yes
Market squid - seine	Pre MPA	-	Yes	-	Yes	Conf	Conf	Yes
	Post MPA	-	Conf	-	Yes	Conf	-	Yes
Nearshore finfish live - hook & line	Pre MPA	-	Yes	-	Yes	Yes	Yes	Yes
	Post MPA	-	-	-	-	Yes	Yes	Yes
Nearshore finfish live - trap	Pre MPA	-	-	-	-	Yes	Conf	Yes
	Post MPA	-	Conf	-	-	Yes	-	Yes
Salmon - troll	Pre MPA	-	-	-	-	-	-	-
	Post MPA	-	-	-	-	-	Conf	Conf
Spot prawn - trap	Pre MPA	Conf	-	-	Conf	Conf	Conf	Conf
	Post MPA	-	-	-	Conf	Conf	-	Conf

Source: Current study

The ports of Moss Landing and Monterey were combined for the coastal pelagic species fishery only

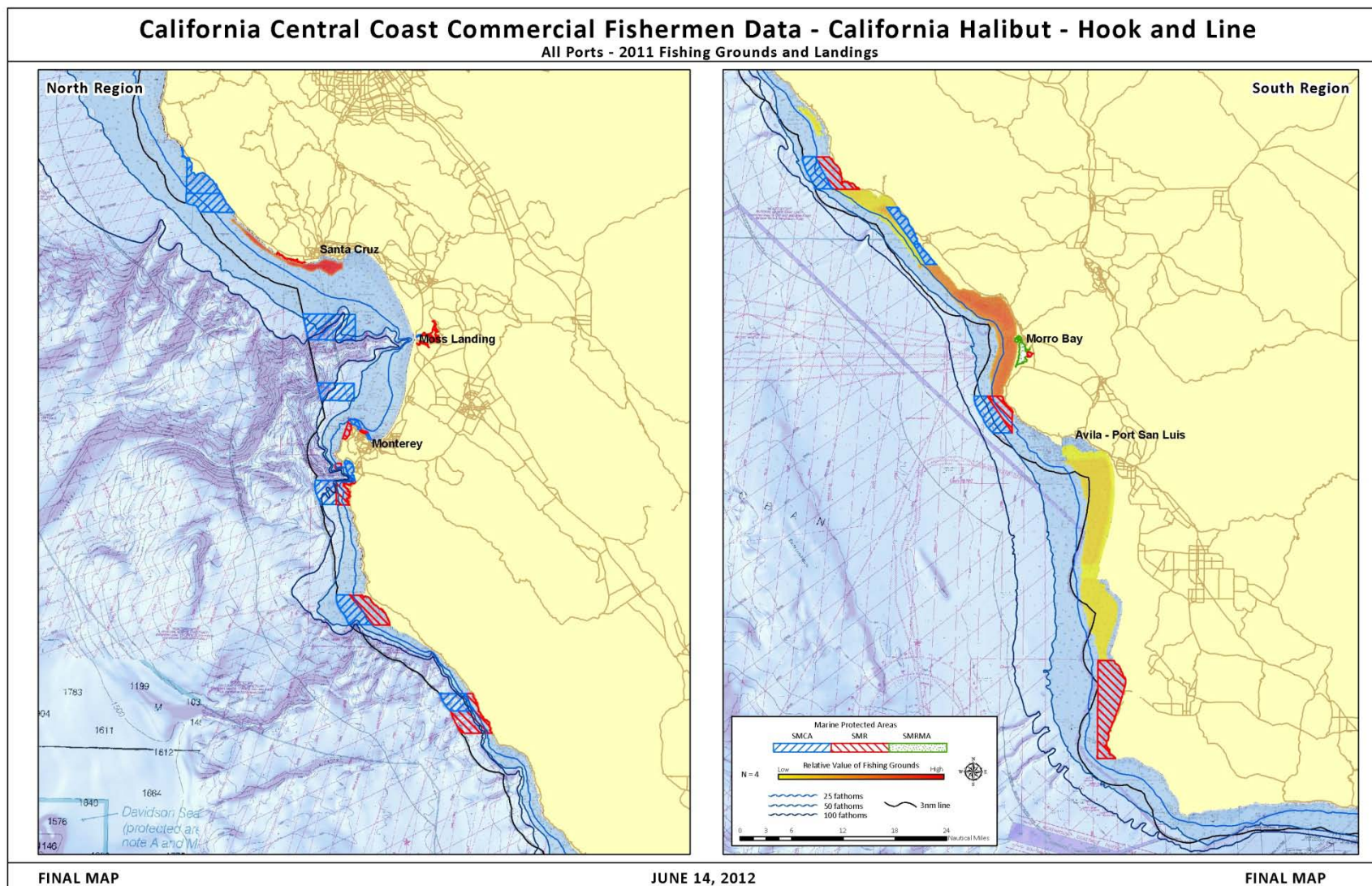
Data was collected only post-MPA for the coastal pelagic species-seine/net fishery

Data was collected only post-MPA for the salmon-troll fishery

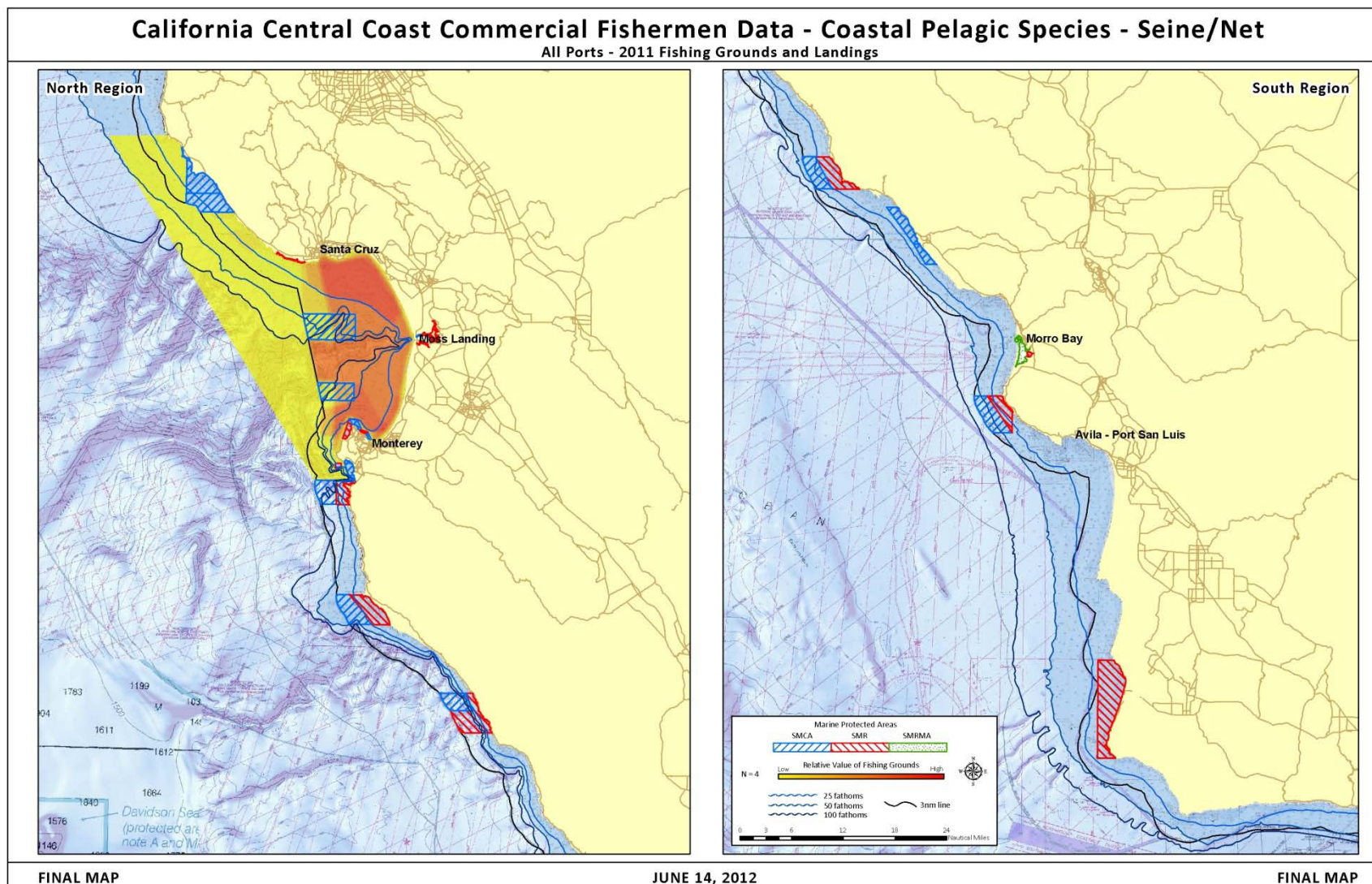
'Conf' indicates data were collected but are not available due to confidentiality constraints

Spot prawn spatial data sets were suppressed to protect the location of individual fishing grounds even though 3 or more fishermen contributed to the data set

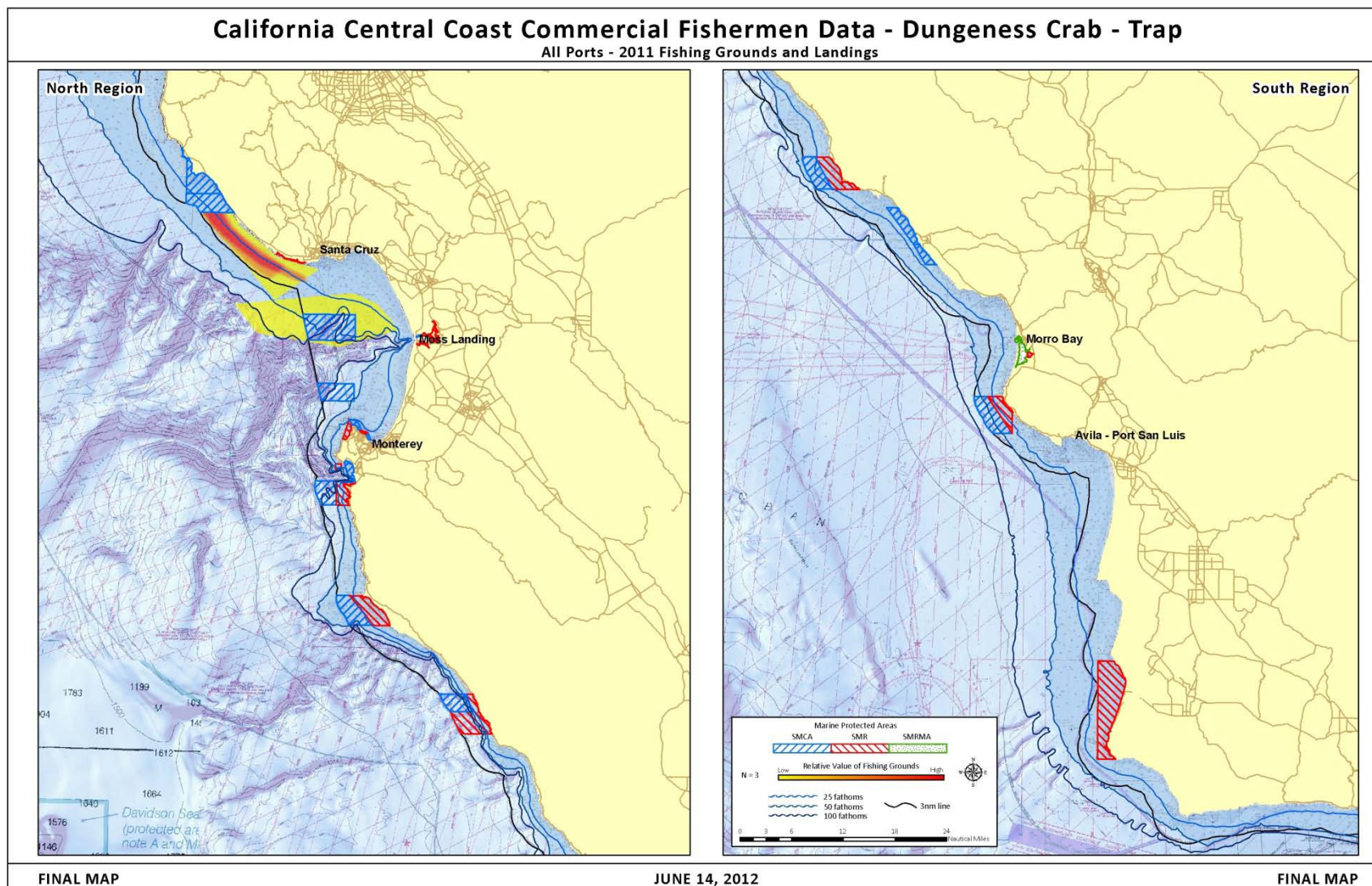
Map 3. California halibut–hook & line 2011 commercial fishing value map, Central Coast Region



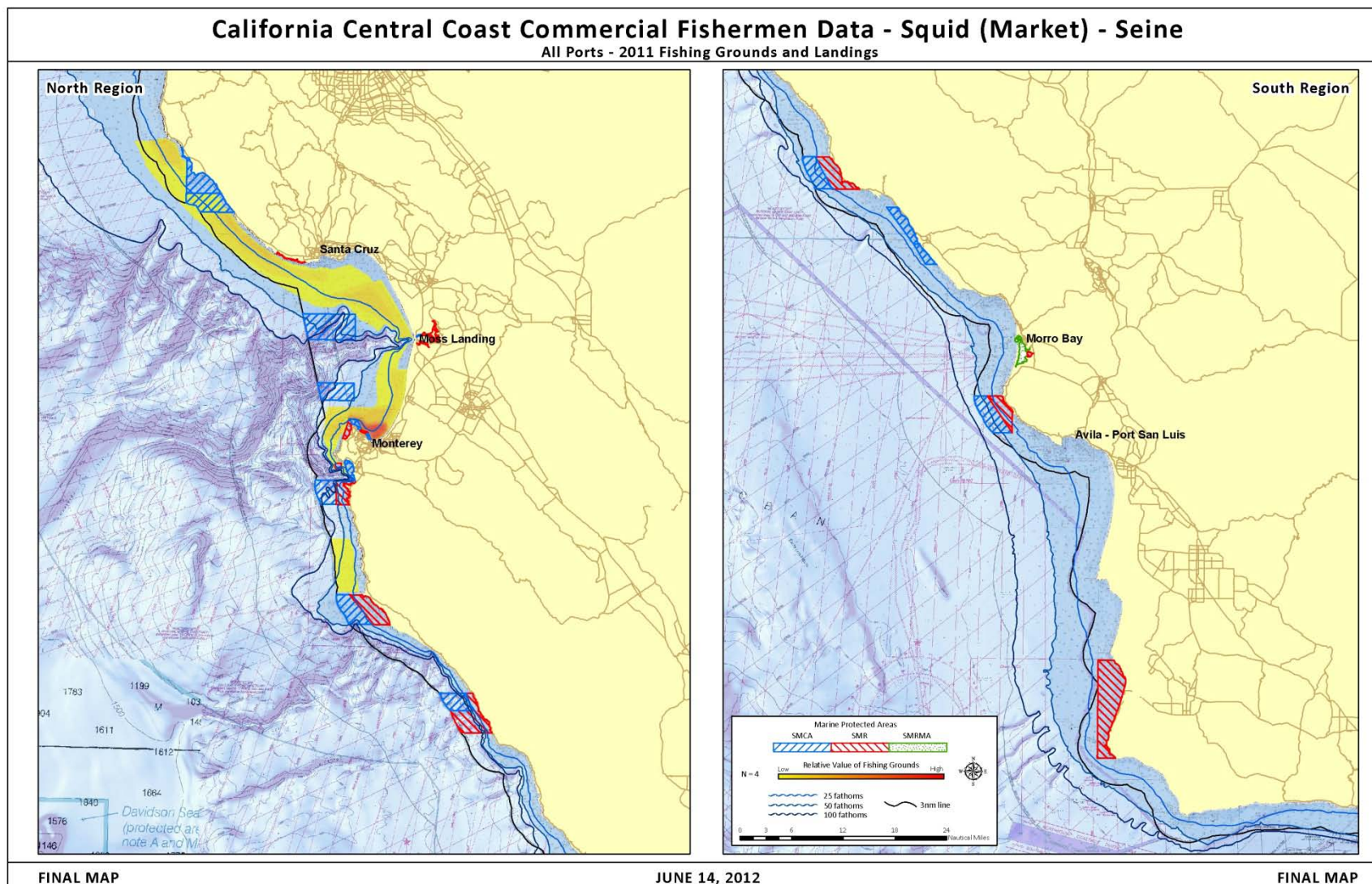
Map 4. Coastal pelagic species-seine/net 2011 commercial fishing value map, Central Coast Region



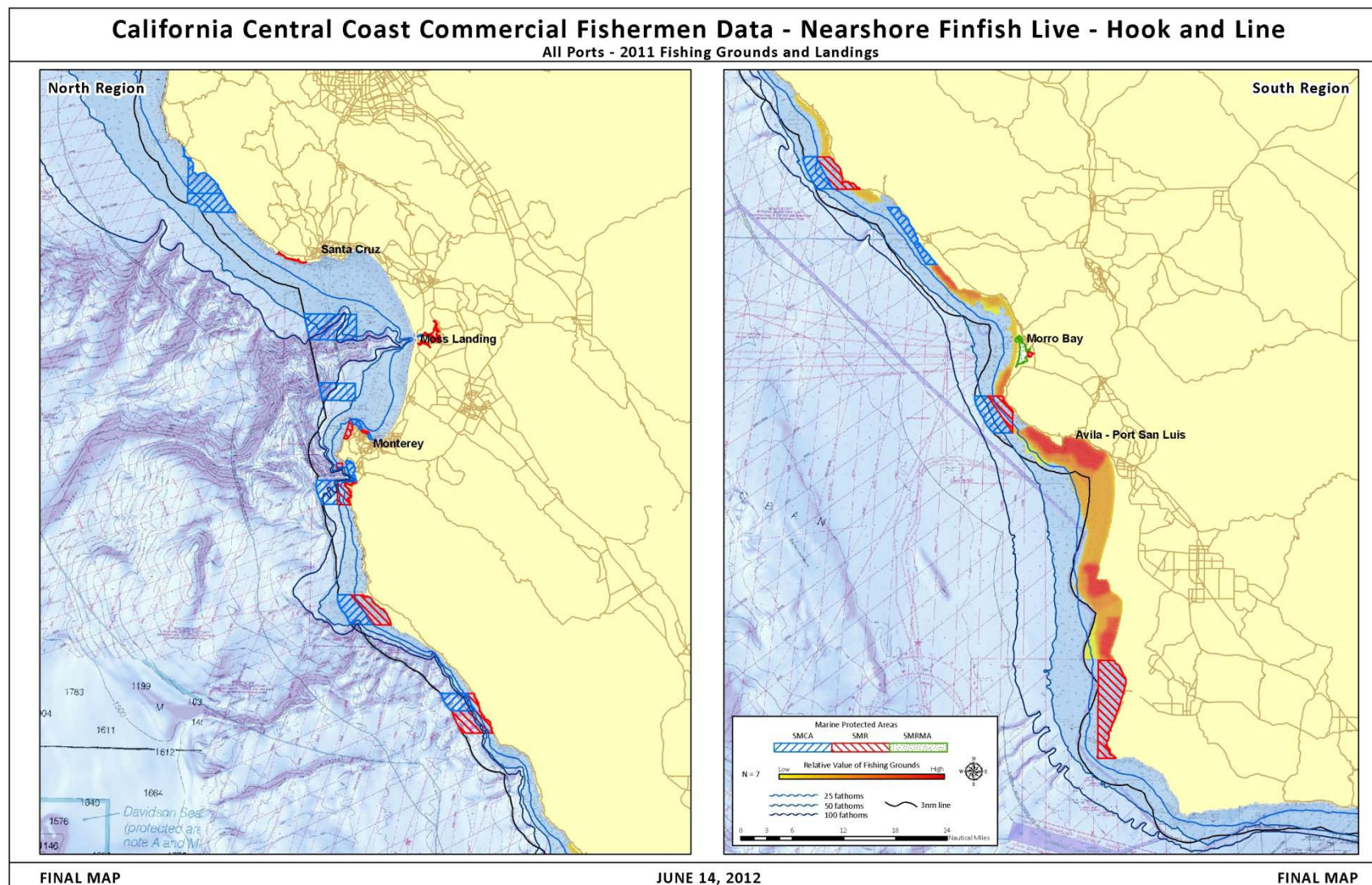
Map 5. Dungeness crab-trap 2011 commercial fishing value map, Central Coast Region



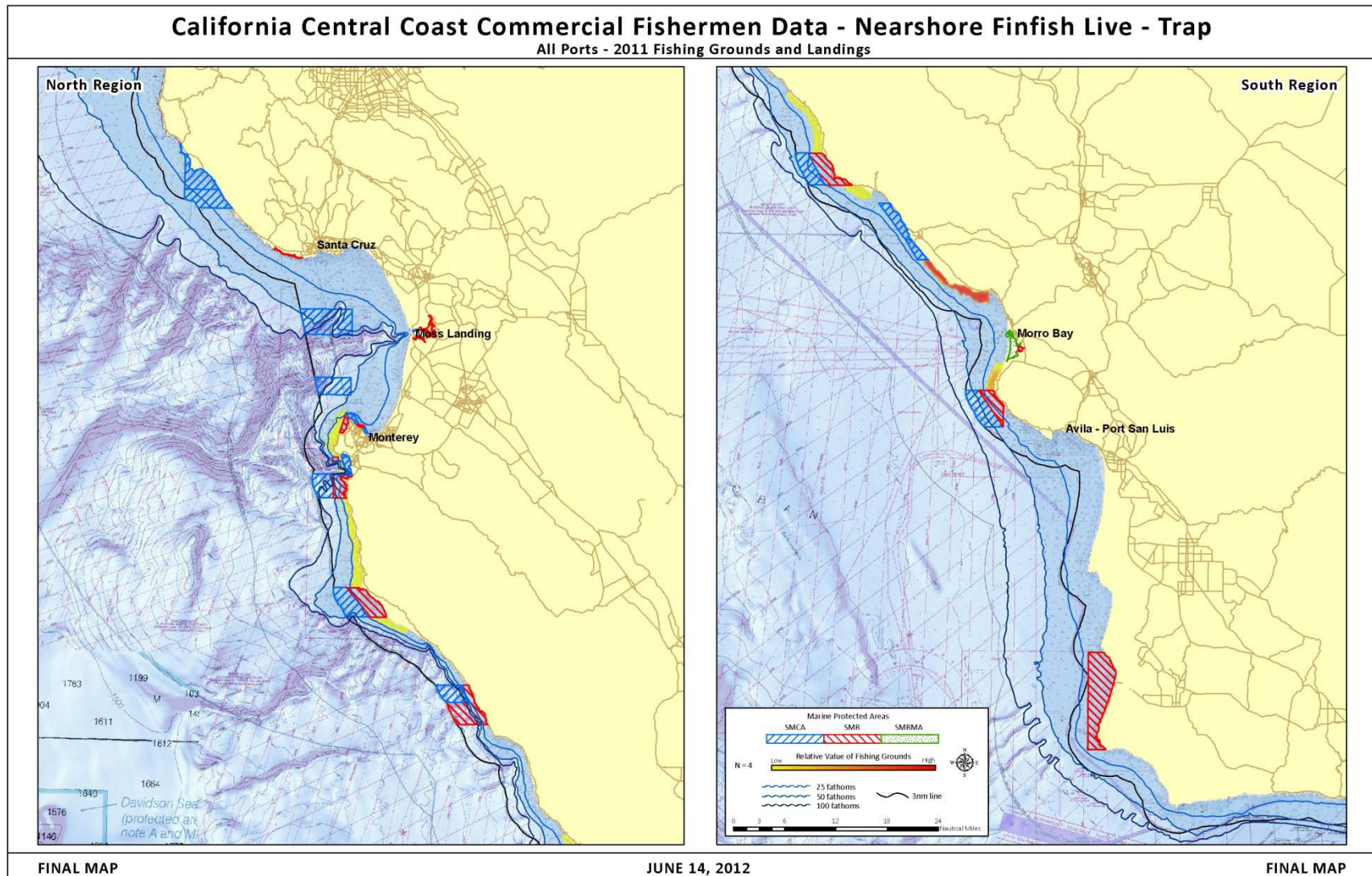
Map 6. Market squid-seine 2011 commercial fishing value map, Central Coast Region



Map 7. Nearshore finfish-live-hook & line 2011 commercial fishing value map, Central Coast Region



Map 8. Nearshore finfish-live-trap 2011 commercial fishing value map, Central Coast Region



2.4. Initial Spatial Change in the Commercial Fishing Sector

In this section we present an effort to examine change in the relative value of fishing areas for the Central Coast Region commercial fishing sector. Ecotrust conducted commercial fishermen interviews in 2005 as part of the MLPA planning process and the data collected established a pre-MPA data set on fisheries uses and values across the region. Since then our methods for data collection and analysis were updated and improved upon based on feedback received from the fishing community and peer-review. Based on this improved methodology the pre-MPA dataset collected in 2005 was re-analyzed at the port-fishery level and weighted individual spatial fishing data sets using an average annual (2000-2004) ex-vessel revenue for each fishery. Previously, spatial data were only analyzed at the region level and each fisherman was given equal weight. Furthermore, during the 2005 study fishermen were asked to map fishing grounds based on their cumulative experience whereas in the post-MPA dataset, fishermen were asked to map fishing ground based on the 2011 fishing season. The Central Coast Region datasets that we examined for the spatial change analyses can be found in Table 9. For maps of the pre-MPA datasets please see Appendix A in our technical report.

Table 9. Count number of fishermen and percent of 2011 ex-vessel commercial fishing landings represented in interviews, spatial change analysis target fisheries, pre and post MPA

Ports	Fishery	Count of fishermen interviewed		Percent of 2011 ex-vessel revenue represented	
		Pre MPA	Post MPA	Pre MPA	Post MPA
Central Coast Region	California halibut - hook & line	26	4	26.8%	13.4%
	Dungeness crab - trap	9	3	25.0%	32.4%
	Market squid - seine	9	4	30.7%	27.6%
	Nearshore finfish - live - hook & line	29	8	27.5%	13.4%
	Nearshore finfish - live - trap	7	4	36.8%	35.3%

Source: Current study and landings data from CDFG

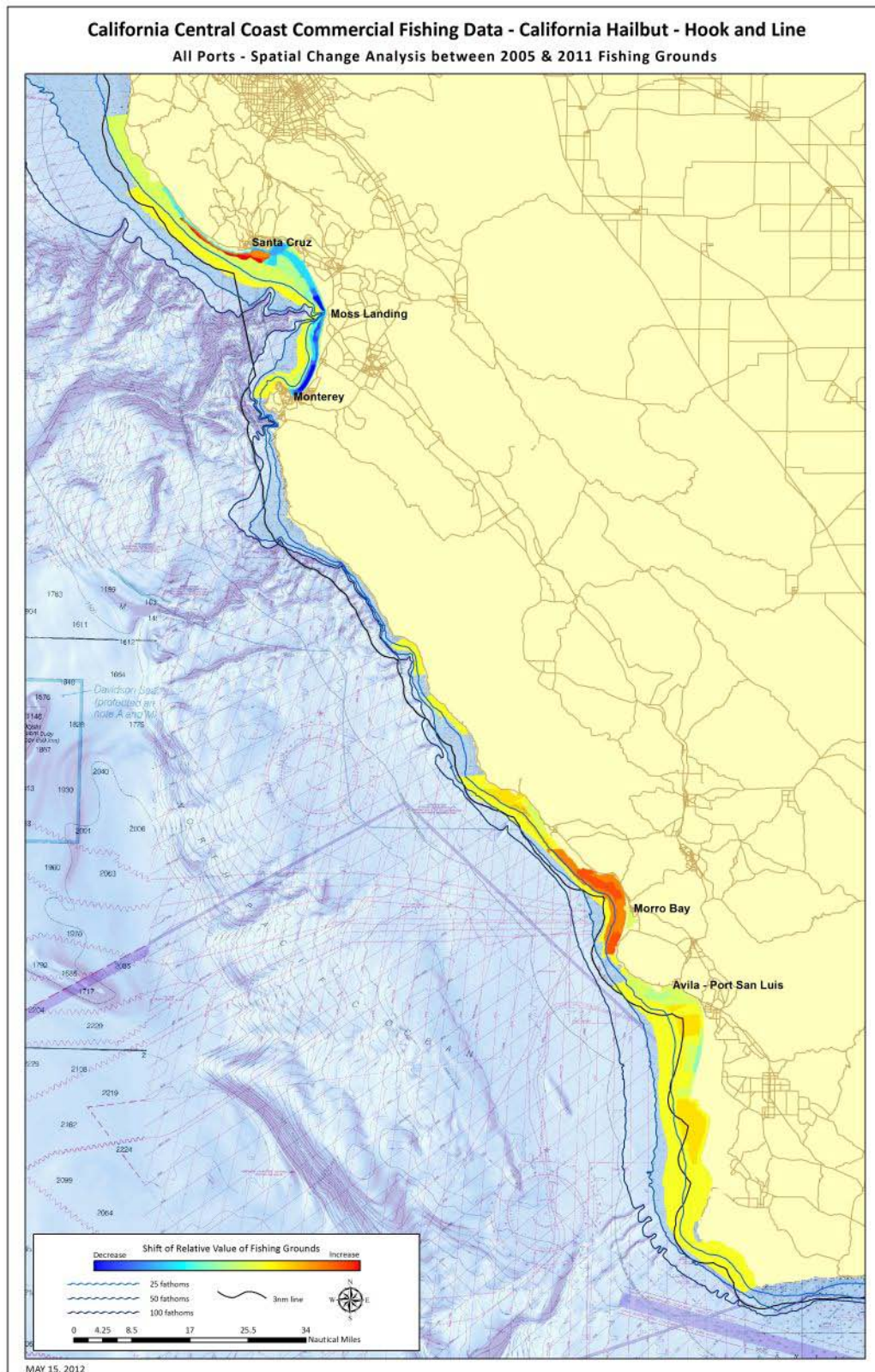
Note: The spot prawn fishery maps are not publically available as these data were withheld to protect confidential data

The spatial change analysis utilized the raster math functions in ArcGIS to calculate the difference between the pre MPA and post MPA spatial data. To conduct this analysis we used a snap grid, which is a raster layer that provides the over arching spatial extent and a common structure to build our raster layer products. It is important to emphasize that only the relative value surface (also known as a 'heat map') that was developed for the pre and post MPA datasets were used in these analyses. In other words, revenue was not associated with the 'heat map' value surface. This was done to reduce the number of variables which would influence analysis results. Thus, results are simply an examination of changes in the values/importance of fishing areas to a fishery—not spatial changes in revenue across the two datasets.

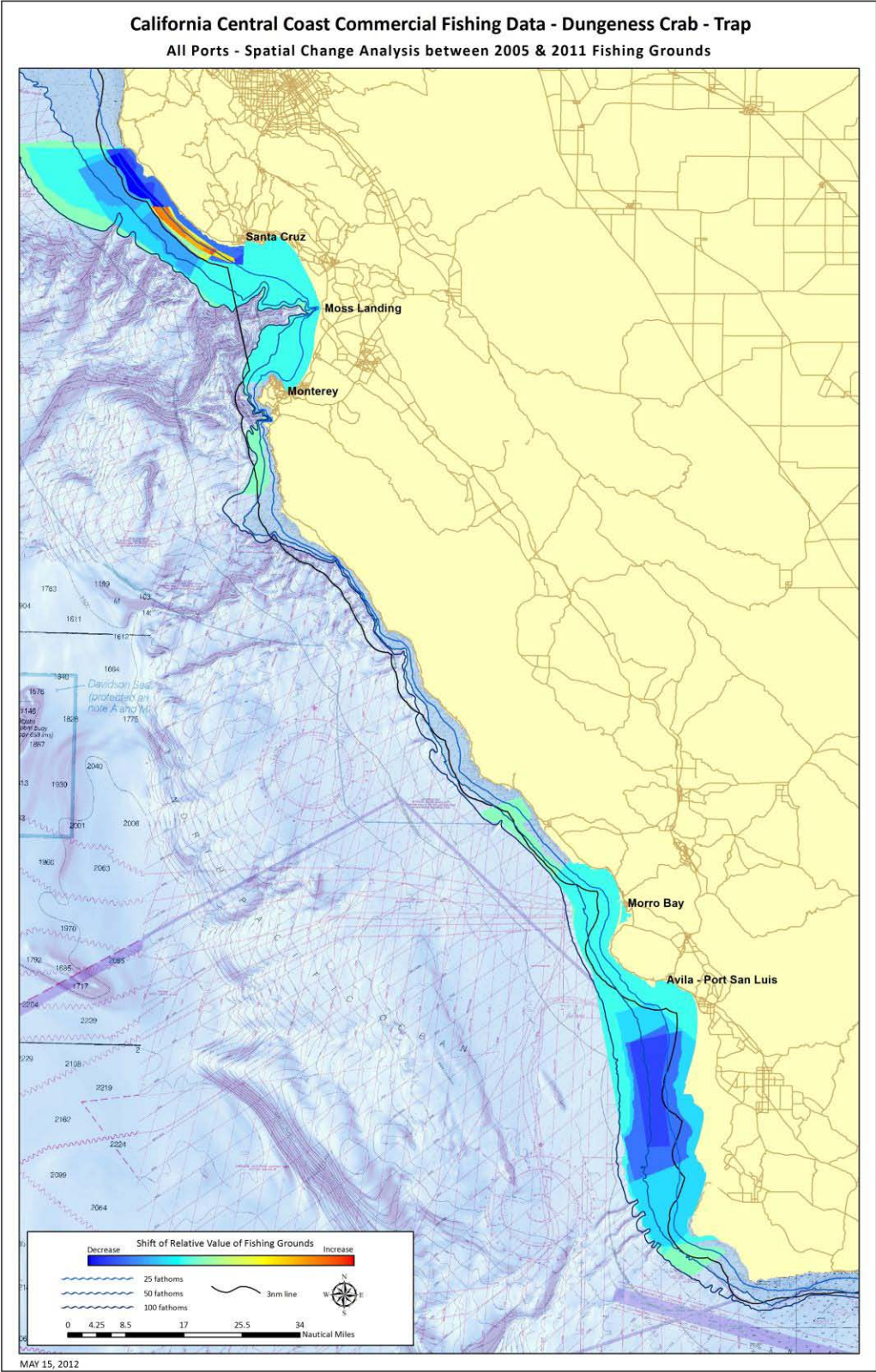
Furthermore, the limited number of fishermen interviewed for the post MPA data set should be emphasized when interpreting the reliability of these analysis results. However, even though we interviewed significantly less fishermen in the post MPA data set we generally represented relatively similar percentages in ex-vessel revenue (Table 9). This may be due to the decline in the number of commercial fishermen in the region from 2005 to 2011.

Below these series of maps illustrate the location in which fishing grounds have increased or decreased in relative value between the two survey efforts.

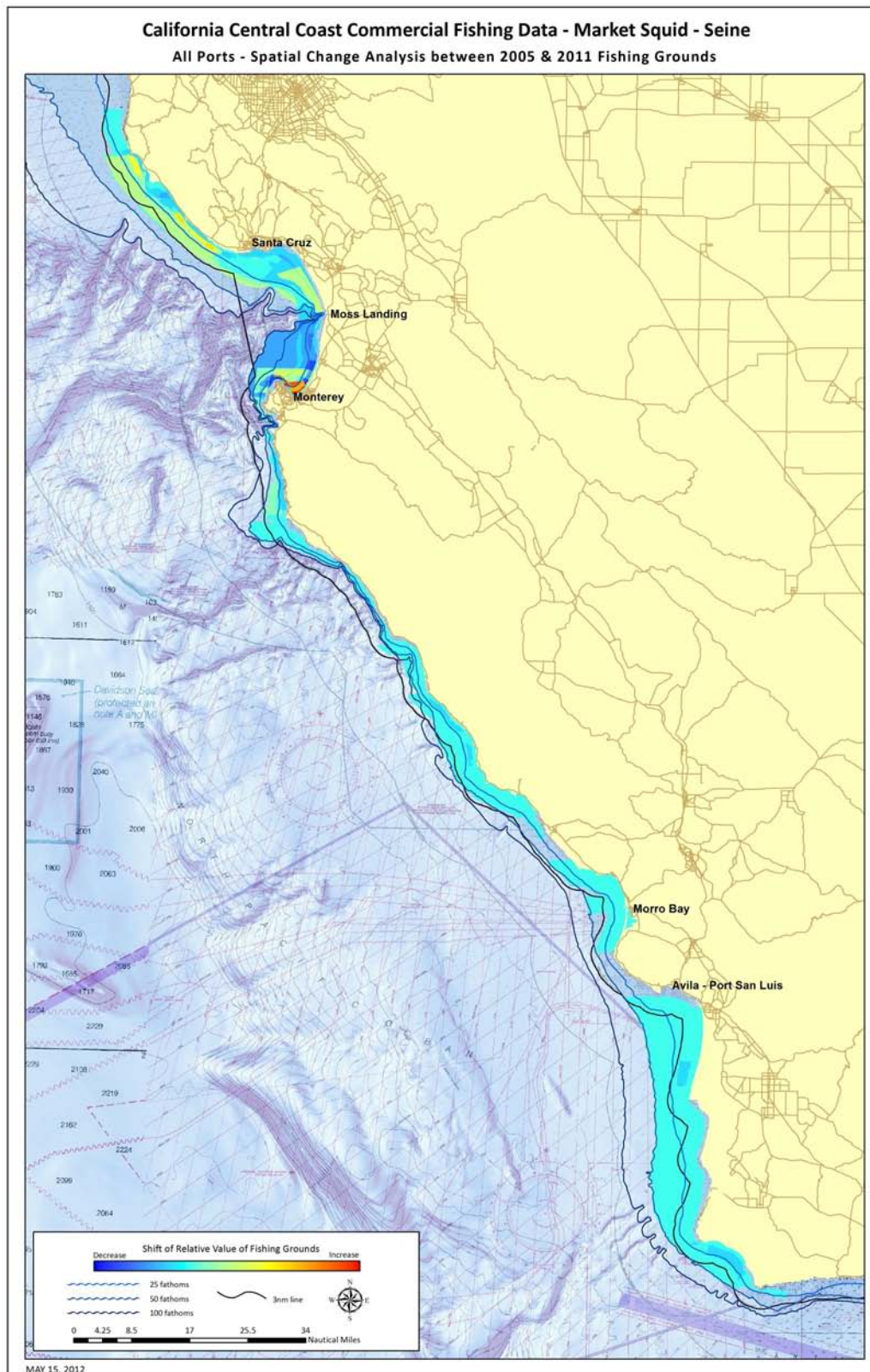
Map 9. California halibut—hook & line spatial change map, Central Coast Region



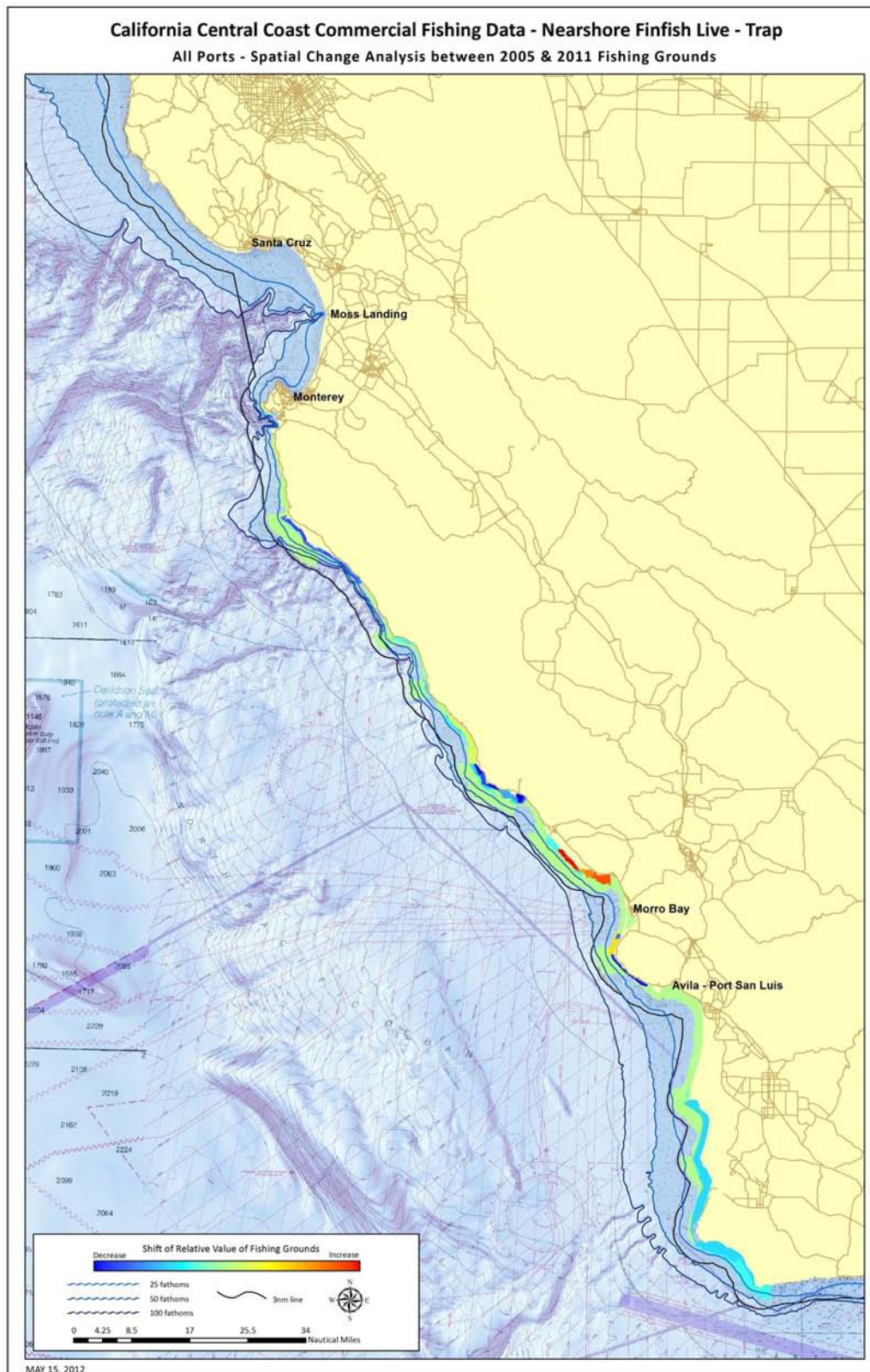
Map 10. Dungeness crab—trap spatial change map, Central Coast Region



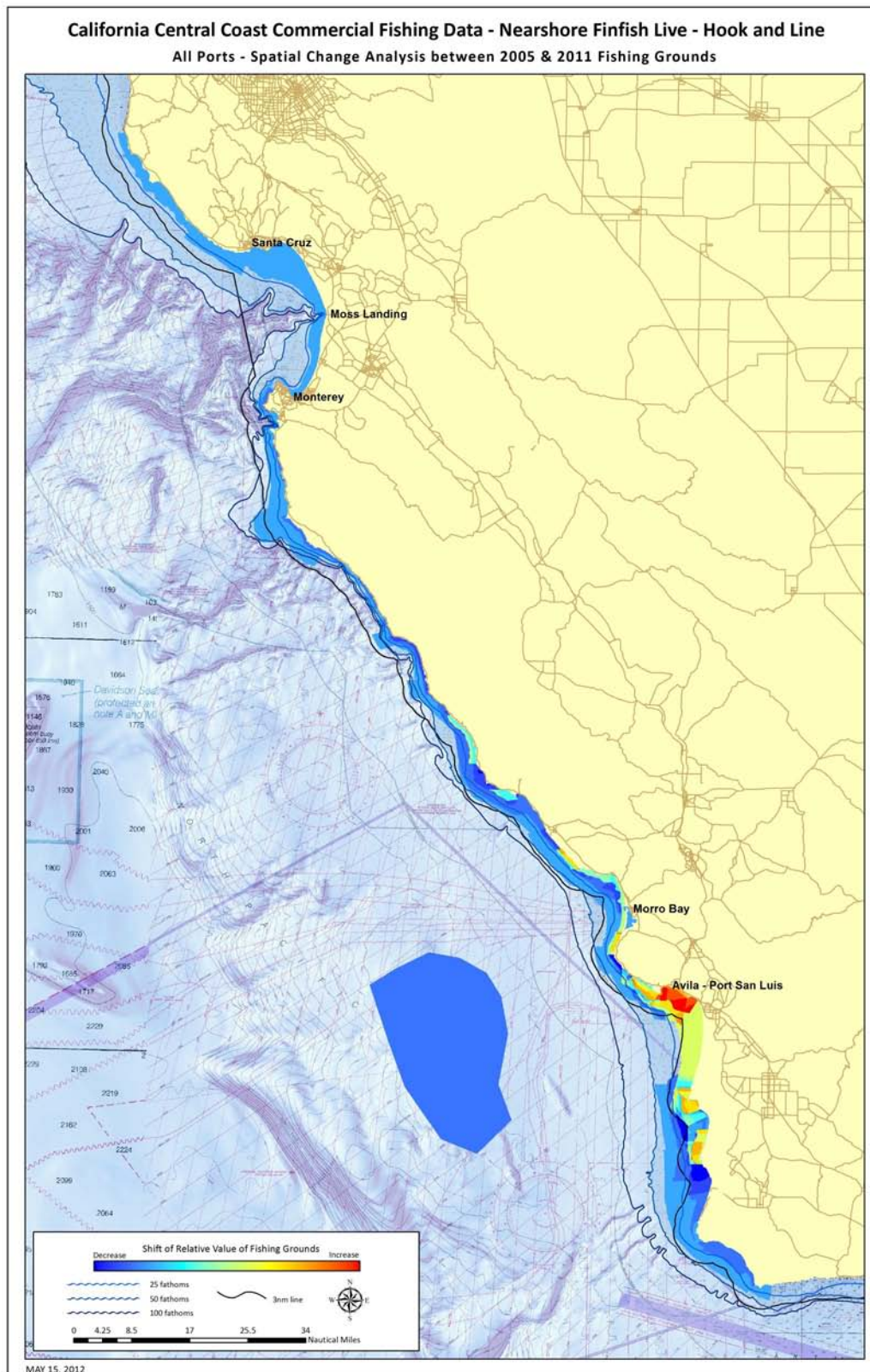
Map 11. Market squid—seine spatial change map, Central Coast Region



Map 12. Nearshore finfish—live—trap spatial change map, Central Coast Region



Map 13. Nearshore finfish—live—hook & line spatial change map, Central Coast Region



2.5. Marine Protected Areas and Commercial Fishing

Determining and measuring the impact of MPAs upon commercial fishermen is challenging to quantify and unravel from the multitude of environmental, regulatory, and economic factors and the inherent variation operating in systems of fishing. Despite this, we sought to capture information from fishermen as to how they perceive they have been impacted by MPAs and the specific MPAs which are impacting their fishing. This section provides information at the region level (port level analyses may be found in the technical report) and summarizes the response from the following three questions which were asked during interviews for each fishery the individual participates in:

- 1) Has your fishery been directly impacted by the recently established MPAs?;
- 2) If so, how have you been impacted?; and
- 3) What MPAs have impacted your specific fishery?

Question one was posed as a simple yes or no response and questions two and three were open-ended questions in which responses were later coded and categorized into the tables below.

Across the entire Central Coast Region, 61.4 percent of responses indicated that his/her fishing had been impacted in some way by MPAs. The fishery with the fewest number of fishermen reporting impacts from MPAs was salmon-troll (15.4 percent) and the most was nearshore finfish-live (81.3 percent). All of the nearshore finfish-live fishermen who reported they were impacted also indicated they had lost traditional fishing areas to MPAs. Additionally, 43.8 percent of the nearshore finfish-live fishermen interviewed reported having to travel longer distances at times (often past MPAs) in order to fish. Most nearshore finfish – live fishermen expressed that the MPAs on top of pre-existing regulations, such as the Rockfish Conservation Area (RCA) has resulted in a large portion of traditional fishing grounds being lost.

Table 10. Percent of individuals indicating specific direct impact from MPAs for each fishery, commercial fishermen, Central Coast Region

Fisheries	Number responding	Percent of respondents indicating direct impacts by MPAs	Type of impact			
			Fishing at borders	Traveling longer distances	Shifted efforts to areas with less predictable/worse weather	Loss of traditional fishing grounds
California halibut – hook & line	10	60.0%	40.0%	20.0%	20.0%	60.0%
Coastal pelagic species – seine/net	4	75.0%	25.0%	25.0%	—	50.0%
Dungeness crab – trap	7	85.7%	71.4%	57.1%	42.9%	71.4%
Market squid – seine	4	75.0%	50.0%	25.0%	25.0%	50.0%
Nearshore finfish – live	16	81.3%	31.3%	43.8%	37.5%	81.3%
Salmon – troll	13	15.4%	—	7.7%	7.7%	7.7%
Spot prawn – trap	3	66.7%	33.3%	66.7%	33.3%	66.7%
All target fisheries	57	61.4%	31.6%	31.6%	24.6%	54.4%

Source: Current study

Participants were allowed to select multiple types of impacts

— indicates that the port/fishery was not sampled or a zero value data point

In addition to the commonly mentioned impacts from MPAs displayed in the table above, Table 11 provides additional perceived impacts from MPAs that fishermen discussed during interviews. Many fishermen cited that the loss of fishing area further concentrates fishing effort into smaller areas—causing over-fishing and the catch of smaller sized fish in some remaining open fishing areas.

Furthermore, some fishermen with smaller vessels also indicated that MPAs have decreased the overall area of available fishing grounds as their vessels may only travel safely a certain distance from port and with both MPAs and the RCA—they are forced to fish harder in remaining open areas or expend more effort/increase operating costs/increase the number of trips than in the past to fish less productive grounds. Several fishermen also expressed distress over unintended infractions such as traps or nets swept into MPAs and confusion around regulations or MPA boundaries. Lastly, fishermen also noted that MPAs have disrupted traditional fishing patterns such as in the salmon fishery in which they cannot follow schools of salmon through MPAs. Furthermore, fishermen indicated they often have a portfolio of fishing grounds they fish in rotation to let areas rest and that there are particular sequences in the fishing grounds they might fish or efficient routes they used to take on a given trip. This type of knowledge of fishing grounds is built over years of experience and several fishermen indicated that MPAs have disrupted these long-standing patterns of use.

Table 11. Other ways MPAs have impacted specific commercial fisheries, Central Coast Region

Responses	Number responding					
	California halibut – hook & line	Dungeness crab – trap	Market squid – seine	Nearshore finfish – live	Salmon – troll	Spot prawn – trap
Concentration of fishing effort into smaller areas/over-crowding	1	1	—	3	—	2
Decrease in available fishing grounds	1	1	—	4	2	2
Fishery less profitable	1	—	—	—	—	—
Less time at home	1	—	—	—	—	—
Fishing less productive areas	1	—	—	2	—	—
Loss of fishing opportunities	1	—	—	1	1	—
Distress around unintended infractions	1	1	1	—	—	—
Disrupts traditional fishing pattern	1	—	—	4	2	2
Increase in the number of trips	—	—	—	2	—	—
Increased operating costs	—	—	—	3	—	—
Total number responding	5	2	1	11	2	2

Source: Current study

— indicates that the port/fishery was not sampled or a zero value data point

Participants were allowed to include multiples responses

The 25 MPAs listed in Table 12 were reported to have impacted at least one person in a specific port-fishery combination. There are an additional four MPAs that were not noted as having an impact on any of the interview participants; these MPAs were Edward F Ricketts SMCA, Elkhorn Slough SMCA, Elkhorn Slough SMR, and Moro Cojo Slough SMR. The largest number of fisheries that a single MPA impacted was five fisheries - these MPAs which impacted five fisheries are Año Nuevo SMCA, Greyhound Rock SMCA, and Soquel Canyon SMCA. Across the region, California halibut – hook & line and nearshore finfish – live fishermen reported being impacted by the largest number of MPAs (20 MPAs). The last column in the table sums the number of responses across each fishery and divides by the number of responses across all fisheries (57 responses) to show which MPAs were most commonly reported as having the most impact on fishermen. Across the region and across all fisheries, Año Nuevo SMCA impacted the largest number of fishermen interviewed. It should be noted that coastal pelagic species-seine/net fishermen indicated that they are impacted by the Portuguese Ledge SMCA and Soquel Canyon SMCA, however, upon review of the MPA regulations these MPAs

allow the take of ‘pelagic finfish’. Fishermen may have responded that these MPAs have impacted them as they are unclear as to the current regulations of those MPAs.

Table 12. Percent of respondents indicating specific MPA impacting commercial fishery, Central Coast Region

MPAs	California halibut – hook & line	Coastal pelagic species – seine/net	Dungeness crab – trap	Market squid – seine	Nearshore finfish – live	Salmon – troll	Spot prawn – trap	All target fisheries
Number responding	10	4	7	4	16	13	3	57
Año Nuevo SMCA	20.0%	50.0%	71.4%	50.0%	12.5%	—	—	22.8%
Asilomar SMR	—	—	—	—	12.5%	—	—	3.5%
Big Creek SMCA	10.0%	—	—	—	6.3%	7.7%	—	5.3%
Big Creek SMR	10.0%	—	—	—	18.8%	7.7%	33.3%	10.5%
Cambria SMCA	30.0%	—	—	25.0%	25.0%	7.7%	—	15.8%
Carmel Bay SMCA	10.0%	—	—	25.0%	6.3%	—	—	5.3%
Carmel Pinnacles SMR	—	—	—	—	6.3%	—	—	1.8%
Greyhound Rock SMCA	10.0%	50.0%	71.4%	50.0%	12.5%	—	—	21.1%
Lovers Point SMR	10.0%	—	—	—	—	—	—	1.8%
Morro Bay SMR	10.0%	—	—	—	—	—	—	1.8%
Morro Bay SMRMA	20.0%	—	—	—	—	—	—	3.5%
Natural Bridges SMR	20.0%	—	—	—	—	—	—	3.5%
Pacific Grove Marine Gardens SMCA	—	—	—	—	6.3%	—	—	1.8%
Piedras Blancas SMCA	20.0%	—	—	—	18.8%	7.7%	—	10.5%
Piedras Blancas SMR	20.0%	—	—	—	31.3%	7.7%	—	14.0%
Point Buchon SMCA	30.0%	—	—	—	31.3%	7.7%	—	15.8%
Point Buchon SMR	20.0%	—	—	—	50.0%	7.7%	—	19.3%
Point Lobos SMCA	10.0%	—	—	—	12.5%	—	—	5.3%
Point Lobos SMR	10.0%	—	—	—	12.5%	—	—	5.3%
Point Sur SMCA	20.0%	—	—	—	37.5%	—	—	14.0%
Point Sur SMR	20.0%	—	—	—	50.0%	—	—	17.5%
Portuguese Ledge SMCA	—	25.0%	57.1%	25.0%	—	—	33.3%	12.3%
Soquel Canyon SMCA	—	25.0%	85.7%	25.0%	6.3%	—	33.3%	17.5%
Vandenberg SMR	20.0%	—	—	—	37.5%	7.7%	—	15.8%
White Rock-Cambria SMCA	30.0%	—	—	25.0%	25.0%	7.7%	—	15.8%
Total number of MPAs impacting fishery/region	20	4	4	7	20	9	3	25

Source: Current study

— indicates that the port/fishery was not sampled or a zero value data point

Participants were allowed to select multiple MPAs

3. COMMERCIAL PASSENGER FISHING VESSEL (CPFV) SECTOR

Commercial Passenger Fishing Vessels (CPFV) are often called party-boats or charter fishing boats and make a business in taking members of the public to recreationally fish and more recently to enjoy non-consumptive types trips such as whale watching or leisure cruises. In a study conducted by Responsive Management in 2007, the majority of Californian's (84.0 percent) agree that CPFV opportunities are important to maintain as they provide opportunities for people to experience coastal resources who otherwise would not be able to as they cannot afford a boat of their own.

3.1. Historical Trends and Initial Changes in the CPFV Sector

This section provides a summary and analysis of California Department of Fish and Game (CDFG) CPFV logbook data from 2000 to 2011 to provide historical trends and initial changes in CPFV fishing characteristics since MPA implementation. Trips into the Central Coast Region by CPFV operators from ports outside the Central Coast region were not included in the analyses provided. The following types of information listed below are the analyses presented in this section of the report at the region level. Analyses at the port level are provided in the technical report:

1. Total number of vessels, anglers, and trips
2. Average number of anglers per trip and per vessel
3. Average number of trips per vessel
4. Total number of fish caught for select species/fisheries
5. Total number of trips for each species/fishery
6. Total number of trips for multiple species/fishery combo trips
7. Percent change in total number of vessels, trips, and anglers in pre and post MPA periods

CPFV operators are required to complete and submit a log to the CDFG for each fishing trip. This log includes information on the catch (number caught by species) and effort (number of anglers) for each trip as well as the port of departure and the Fish and Game Block in which most of the fishing occurs.

The examined fisheries and their associated species were:

- Albacore tuna (albacore tuna)
- Salmon (Chinook salmon; pink salmon were included, but were rarely taken)
- Rockfish (all rockfish species; lingcod)
- California halibut (California halibut)
- Sanddabs (unidentified sanddab; longfin sanddab; Pacific sanddab; speckled sanddab)
- Dungeness crab (Dungeness crab; red rock crab; yellow rock crab; brown rock crab; rock crab unidentified)
- White seabass (white seabass)
- Humboldt squid (Humboldt squid, also known as the jumbo squid)

Trips that did not catch anything, did not keep any catch, or did not keep any of the target species or species groups were not assigned to a fishery. These trips made up less than 5 percent of the Central Coast Region's total trips and were not examined any further. Furthermore, the CPFV logbook data presented in this initial changes section only includes data on fishing trips as logbook data does include information on non-consumptive trips such as whale watching.

During the study period, 2000-2011, the ocean environment, the regulatory environment, and the socioeconomic environment experienced several changes. The California Current System at this time was transitioning from a warm to a cold regime which affected the availability of certain kinds of fish targeted by anglers. Furthermore, a deep recession, which began in December 2007, and higher gas prices impacted people's livelihoods and discretionary monies. Major changes in regulations occurred for rockfish (season closures initiated in 2000 with the addition of depth closures starting in 2001¹) and salmon (in particular,

¹ Rockfish regulations in 2004-2006 were more restrictive in the Central Coast area between Lopez Point and Pigeon Point than in the area between Point Conception and Lopez Point.

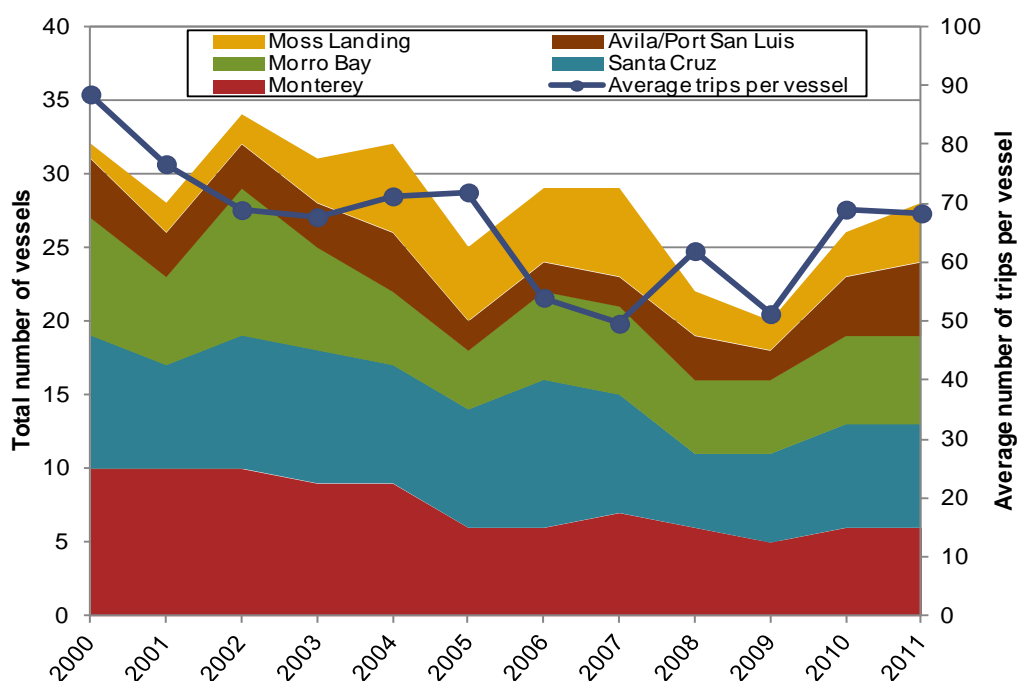
closures in 2008 and 2009). In addition, the Central Coast Marine Protected Areas (MPAs) were implemented in September, 2007. All of these factors likely affected fishing in the study area to various degrees; three of these factors (recession, salmon season closures, and the implementation of the MPAs) occurred at essentially the same time.

3.1.1. Historical Trends in the CPFV Sector

The total number of vessels working out of Central Coast Region ports in 2011 was lower than that observed in 2000 by 13 percent (Figure 8 and Table 13). Decreases in vessels occurred between 2000 and 2009; increases then were observed at most ports between 2010 and 2011. The three ports with the largest CPFV fleets, Monterey, Santa Cruz, and Morro Bay, all decreased over the study period by a combined total of 8 vessels, but the two smaller ports together gained 4 vessels.

The average number of trips per vessel showed a generally decreasing trend between 2000 and 2007, followed by a generally increasing trend from 2008 through 2011 (Figure 8). However, this pattern of change was more indicative of what was observed in the northern ports while in the south, Morro Bay showed a general increasing trend with fluctuations throughout and Avila/Port San Luis showed a generally decreasing trend.

Figure 8. Total number of CPFV vessels and average number of trips per vessel, Central Coast Region, 2000-2011



Source: CDFG CPFV logbook data

The total number of trips decreased over most of the time period followed by an increase over the last several years of the study period, with this total number decreasing by 36 percent from 2000 to 2011 (Figure 9, Table 13). The lowest number of trips was observed in 2009 (second year of the salmon closure), although due to the unavailable values from confidentiality constraints for Moss Landing and Avila/Port San Luis, this low may have occurred one year prior in 2008. The decrease in trips within the initial 8-9 years reflects the decrease that occurred in the two larger northern ports (Santa Cruz and Monterey). The total number of trips in the southern ports (Morro Bay and Avila/Port San Luis) fluctuated over the entire time period, with the lowest total number of trips for Morro Bay (and probably also for Avila/Port San Luis)

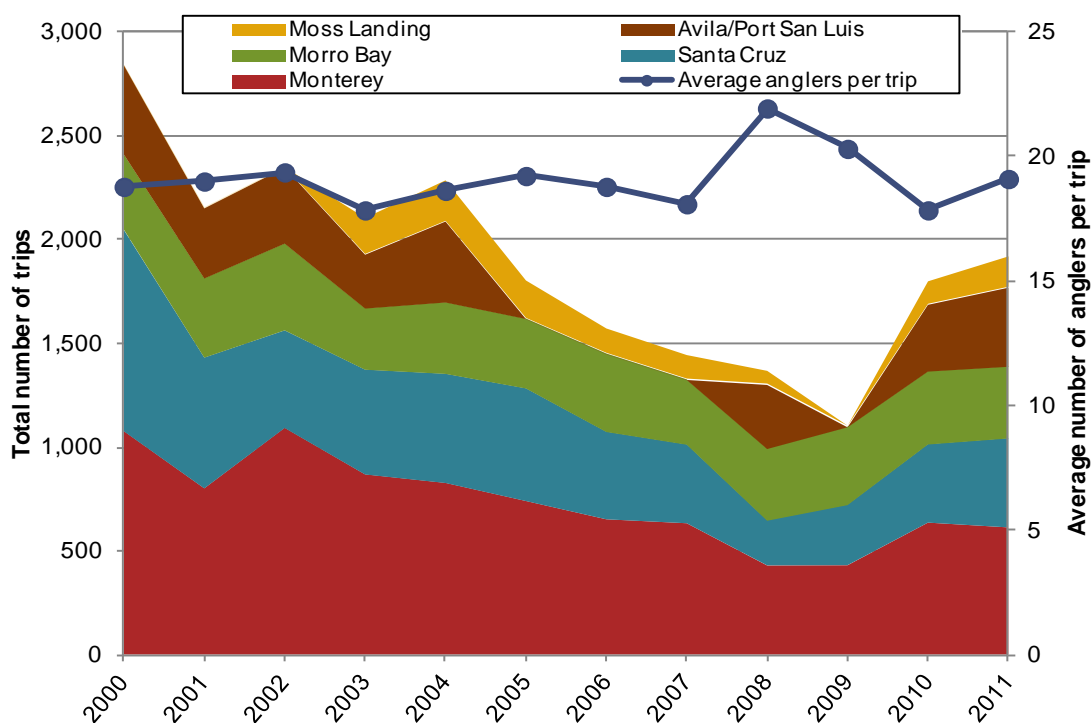
occurring in 2003. This low in 2003 coincided at the same time when rockfish regulations started to be modified. While the combined total number of trips increased slightly between 2010 and 2011, this is more reflective of the increases observed in Moss Landing and Avila/Port San Luis. (Due to unavailable data values, it is possible that these increases started earlier in 2009.) Increases in Santa Cruz and Monterey occurred earlier between 2009 and 2010.

The greatest total number of trips by Central California CPFVs in 2000 were recorded from Monterey, followed by Santa Cruz, Avila/Port San Luis, and Morro Bay with this same order also observed in 2011. Moss Landing recorded the lowest number of trips for all years when values were available.

The average number of anglers per trip remained fairly stable throughout the entire study period except for 2008 and 2009 which showed a slightly higher average number of anglers per trip. This increase, particularly in 2008, occurred more in the northern ports than in the southern ports.

The changes noted for anglers were similar to those for the total number of trips; the total number of anglers for all ports combined was lower in 2011 than in 2000 by 35 percent (Figure 10, Table 13). This metric decreased over most of the time period followed by an increase at the end of the study period. Due to the unavailable values for anglers from Moss Landing and Avila/Port San Luis, the lowest total number of anglers seemed to have occurred in 2009. Certainly, the number of vessels dropped during this year in both of these ports, so it is likely that the number of anglers also dropped to some extent. Consequently, what can be noted is that the total number of anglers generally decreased between 2000 and 2007 and may have dropped further in 2009. This decrease reflects the decreases observed in the northern ports; the total number of anglers in Morro Bay actually increased over this time period and remained somewhat the same in Avila/Port San Luis. The increase in total number of anglers between 2010 and 2011 was more reflective of the increases observed in Moss Landing and Avila/Port San Luis. Increases in Santa Cruz and Monterey occurred earlier between 2009 and 2010.

Figure 9. Total number of CPFV trips and average number of anglers per trip, Central Coast Region, 2000-2011

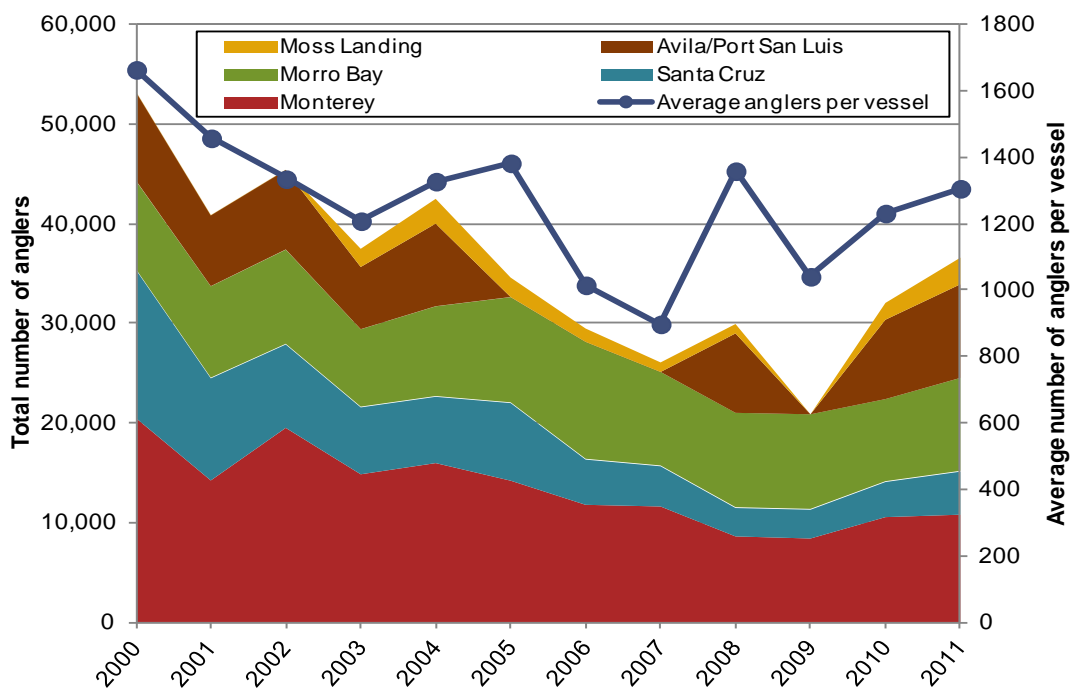


Source: CDFG CPFV logbook data

The greatest total number of anglers in 2000 was recorded in Monterey, followed by Santa Cruz, Avila/Port San Luis, and Morro Bay; in 2011, the order was similar, but Avila/Port San Luis and Morro Bay switched their ranking. Moss Landing recorded the lowest number of anglers for all years when values were available.

The average number of anglers per vessel showed a general decreasing trend between 2000 and 2007, with a spike in 2008, and then generally increased from 2009 through 2011. The trends observed in this statistic for the five ports varied greatly, so this average for all ports is more a blending of patterns than a reflection of any one dominant pattern. For port specific trends please see our technical report.

Figure 10. Total number of CPFV anglers and average number of anglers per vessel, Central Coast Region, 2000-2011



Source: CDFG CPFV logbook data

For the Central Coast ports combined, rockfish was the predominant species being caught by CPFV operators. Salmon, albacore tuna, and flounder also were taken at the beginning of the study period, but were replaced in later years by sanddabs, Pacific mackerel, Dungeness crab, and Humboldt squid (Figure 11). Some lingcod was also taken throughout the study period. Decreases in the total number of anglers corresponded to decreases in catch in 2001 and 2003, but this number decreased during the period of time when catches were highest, and started increasing prior to when catches increased in 2010 and 2011. Both the total number of fish caught and the total number of anglers reflect more of what was observed in the northern ports than in the southern ports, and the overall trends generally mirror those seen in Monterey (Figure 11).

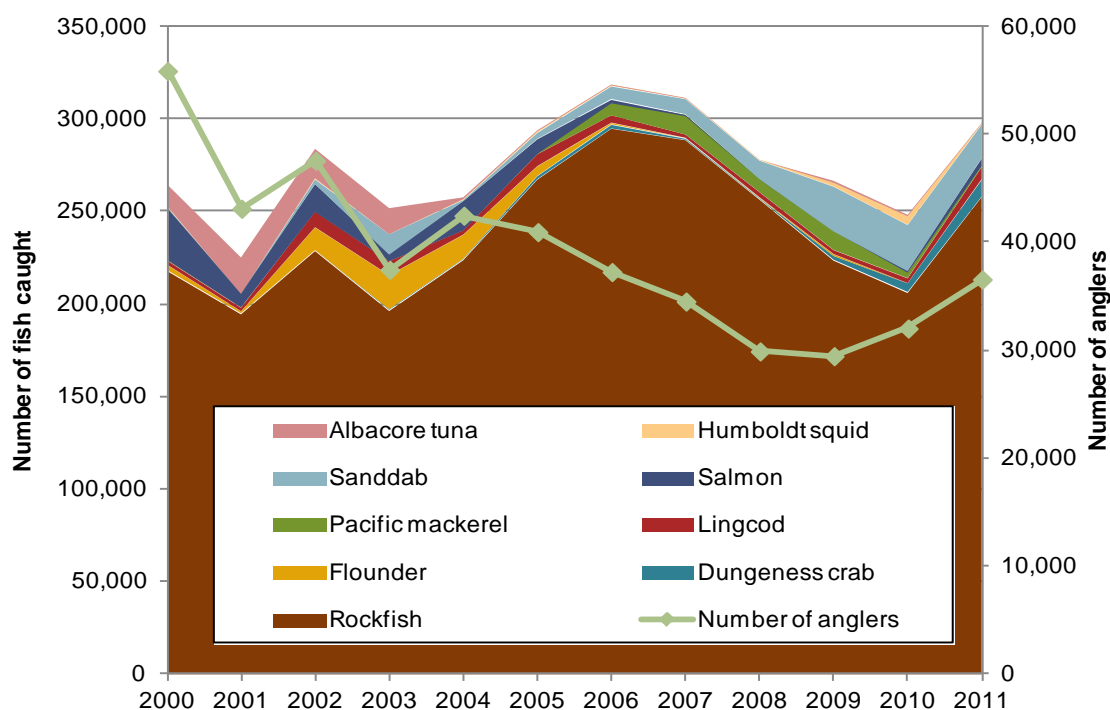
CPFVs from Monterey took the most fish in 2000, followed by Avila/Port San Luis, Morro Bay, and Santa Cruz. In 2011, the catch from Monterey still was the highest followed by Morro Bay, Avila/Port San Luis, Santa Cruz, and Moss Landing. (Moss Landing recorded the lowest catch for all years when values were available.) Differences between ports in the total number of fish caught can be partly attributed to the fisheries being targeted. Anglers over this study period were limited to two salmon per day (with restrictions sometimes imposed on the total number of fish taken in 7 days) while angler bag limits for rockfish were 10 fish for all rockfish combined (nearshore rockfish limited to 2 fish from 2003-2008). For all sanddabs except

Pacific sanddabs (the sanddab most commonly encountered on charter vessels), anglers could take up to 20 fish in combination, with not more than 10 fish of any one species. Anglers could take as many Pacific sanddabs as they could catch.

The number of trips for all Central Coast ports combined decreased to a low in 2009, although the value in 2009 was most likely higher than illustrated, as the values for Moss Landing and Avila/Port San Luis were not included due to data confidentiality constraints. Rockfish trips remained fairly stable throughout the entire study period. Salmon, albacore tuna, and California halibut trips became less prevalent while sanddab, Dungeness crab, and Humboldt squid trips increased. Rockfish, salmon, and California halibut trips all increased to varying degrees between 2009 and 2011 (Figure 12). These patterns reflect more of what was observed in Santa Cruz and Monterey than in the southern ports.

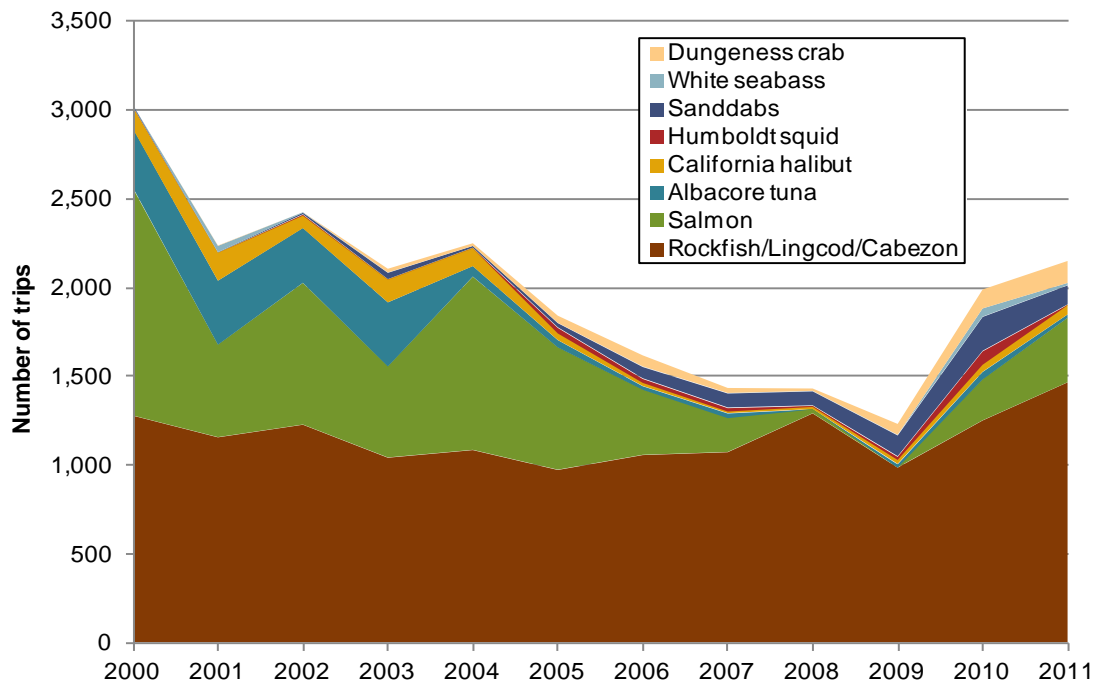
Salmon-rockfish trips for all ports combined generally decreased over the entire study period. Rockfish-halibut trips also decreased during the mid-2000s, but then increased again in the later part of the study period. Sanddab-rockfish, crab-rockfish, and crab-sanddab trips rarely occurred in the early 2000s, however became very important from the mid-2000s through the end of the study period. The institution of these new combination trips occurred to some degree throughout the Central Coast Region, although most of these combination trips occurred in the northern ports (crab-sanddab trips primarily occurred in Monterey) while sanddab-rockfish trips were the primary combination trip in Morro Bay and crab-rockfish trips were important in Avila/Port San Luis (Figure 13).

Figure 11. CPFV total number of fish caught for each fishery, Central Coast Region, 2000-2011



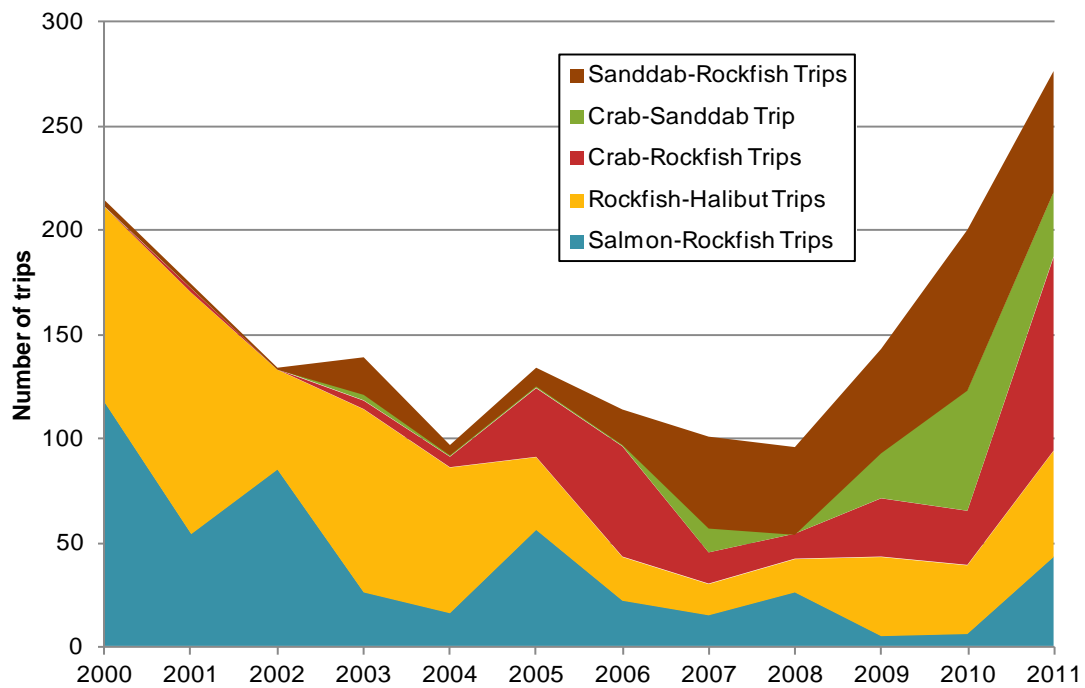
Source: CDFG CPFV logbook data

Figure 12. Total number of CPFV trips for each fishery, Central Coast Region, 2000-2011



Source: CDFG CPFV logbook data

Figure 13. Count of select multiple species CPFV trips, Central Coast Region, 2000-2011



Source: CDFG CPFV logbook data

From the analyses above, it is clear that the northern and southern ports within the Central Coast are different. Rockfish is an important component of the catch in all ports, but in the southern ports rockfish is the primary target, while salmon is of more importance in the northern ports. The changes observed in the Central Coast Region during the study period of 2000-2011 reflect these preferences. New season and depth restrictions were placed on rockfish during the early 2000s while salmon catches decreased during the mid-2000s, likely due to reduced availability of fish.

3.1.2. Initial Changes in the CPFV Sector

In Santa Cruz and Monterey, the number of trips and anglers decreased from 2000-2003, and again from 2004-2007 (Table 13). In contrast, the number of trips and anglers decreased in Morro Bay from 2000-2003, but showed only slight changes (decrease in trips, increase in anglers) from 2004-2007. After the implementation of the MPAs (2008-2011), all ports except for Morro Bay reported increases in the total number of trips and anglers. In Morro Bay, the total number of trips and anglers showed relatively no change. Notably, these increases primarily took place from 2009 through 2011. The post MPA time period included a two-year salmon closure as well as the continuation of season and depth closures for rockfish. After 2009, however, trips for salmon began to rebound with the renewed access to salmon and bag limit regulations changes in 2009 increased the number of nearshore rockfish that could be caught daily. Also, vessels that remained in the northern ports diversified their trips to include sanddabs, crabs, and Humboldt squid. Trips that included sanddabs and crabs also occurred in the southern ports, but not to the extent observed in the northern ports.

Table 13. Percent change in CPFV vessels, trips, and anglers per port and region wide, 2000-2011

Ports/Region		Percent change			2000-2011
		Pre MPA (2000-2004)	Pre MPA (2004-2007)	Post MPA (2008-2011)	
Central Coast Region	Number of Vessels	-3%	-9%	27%	-13%
	Number of Trips	-30%	-23%	40%	-36%
	Number of Anglers	-33%	-19%	22%	-35%
Santa Cruz	Number of Vessels	0%	0%	40%	-22%
	Number of Trips	-48%	-28%	97%	-56%
	Number of Anglers	-55%	-39%	52%	-71%
Moss Landing	Number of Vessels	200%	0%	33%	33%
	Number of Trips	N/A	-42%	139%	-16%
	Number of Anglers	N/A	-61%	183%	46%
Monterey	Number of Vessels	-10%	-22%	0%	-40%
	Number of Trips	-19%	-24%	43%	-43%
	Number of Anglers	-28%	-27%	25%	-47%
Morro Bay	Number of Vessels	-13%	20%	20%	-25%
	Number of Trips	-18%	-9%	0%	-4%
	Number of Anglers	-12%	4%	-2%	5%
Avila/Port San Luis	Number of Vessels	-25%	-50%	67%	25%
	Number of Trips	-40%	N/A	23%	-11%
	Number of Anglers	-30%	N/A	18%	6%

Source: Current study

N/A indicates that data were suppressed to protect confidential data

Percents were calculate from the starting year to end year of each period

Red percentages were calculated from 2003-2011 as previous years data was suppressed to protect confidential data

3.2. Baseline Characterization of the CPFV Sector

In the CPFV baseline characterization we summarized the primary data collected from CPFV operator interviews carried out in this project. Establishing a baseline characterization of the Central Coast Region CPFV fleet provides a benchmark of socioeconomic conditions and spatial fishing patterns in which future MPA impacts and benefits can be measured

Table 14 shows the number of CPFV operators/owners we interviewed. Across the study region eight of the 14 individuals we interviewed were both owners and operators, four were hired captains (operators only) and two were owners only. As indicated below no CPFV operator from Avila/Port San Luis participated in an interview.

Table 14. Number of CPFV interviews completed, Central Coast Region

Port	Individuals interviewed
Santa Cruz	4
Monterey	6
Moss Landing	1
Morro Bay	3
Avila/Port San Luis	—
Central Coast Region	14

Source: Current study

Individuals interviewed includes operator, owners, and owner/operators

— indicates that the port/fishery was not sampled or a zero value data point

The average CPFV operator is 54.9 years old, has 20.2 years experience owning a CPFV boats (if applicable) and 21.2 years operating CPFV boat (if applicable). The average individual we interviewed makes 67.4 percent of his income from CPFV related operations. Ten of the individuals we interviewed were in the CPFV business in 2006 and at that time 90 percent of their income came from CPFV operations (Table 15).

Table 15. CPFV survey response statistics, Central Coast Region

	Response	Standard deviation
Individuals interviewed	14	-
Hired captain	4	-
Owner and captain	8	-
Owner only	2	-
Average age	54.9	12.3
Average number of years owning CPFV boat/s	20.2	20.0
Average number of years operating CPFV boat/s	21.2	17.1
Average percent income from CPFV operations in 2011	67.4%	39.7%
Number of those interviewed who were operating in 2006	10	-
Average percent income from CPFV operations in 2006	90.0%	18.9%

Source: Current study

The remaining data presented in this section will include 12 respondents who are CPFV captains as we also interviewed two CPFV owners but their information was merged with the data collected from their CPFV

captains. Furthermore, in the report, there are several survey summary tables which report out on characteristics of fishing activities/income from the year 2006. As limited non-spatial survey data was collected during the 2005 study by Ecotrust, we included these questions in our survey to provide some estimates as to possible socioeconomic change. Furthermore, asking questions about activities in 2006 as well as 2011 together allowed us to gather important qualitative information on the major factors driving any reported/perceived changes between the two years. Summaries on the qualitative information collected may be found in our technical report. We chose the year 2006 to serve as a pre-MPA year in which to gauge subsequent change as it was the last full year before the Central Coast MPA network was implemented.

Respondents were asked to indicate the percent of their total income that was from CPFV operation for 2006 and 2011. If different percentages were reported for the two years, fishermen were asked an open-ended question to describe factors to which they attributed the change in the percent of total income from CPFV operation. Fisherman responses were later coded and organized into several categories which are shown below in Table 16. Of those responding three operators were not in operation in 2006 and the majority of respondents cited general economic decline, decrease in the number of clients, and an increase in regulation as having an impact on their income.

Table 16. Cause in change in percent income from CPFV operations from 2006 to 2011, Central Coast Region

Response	Number responding
Began business after 2006/wasn't participating	3
Economic decline	4
Increase in regulation	4
Increase in operation cost	2
Decrease in clients	4
Negative public impression of fishing	1
Inability to provide consistent employment	1
Total number responding	12

Source: Current study

Participants were allowed to give multiples responses

Over the study region the respondents reported an average gross economic revenue (GER) of \$106,000 in 2011, a \$62,000 decrease from 2006. Respondents reported that 16.9 percent of their 2011 GER went to crew, 23.0 percent to fuel, and 43.5 went to other operating costs. Some individuals indicated that all of their gross revenue went back into operating costs in 2011.

Table 17. Average CPFV gross economic revenue (GER) to operating costs, Central Coast Region

	Average response	Standard deviation
Total GER 2011	\$106,000	\$112,120
% GER to crew	16.9%	12.4%
% GER to fuel	23.0%	10.1%
% GER to other operating costs	43.5%	31.4%
Total GER 2006	\$168,667	\$133,322

Source: Current study

In Table 18 eleven respondents conducted consumptive (fishing) trips in 2011 and six conducted non consumptive trips. Non consumptive trips are non-fishing trips such as whale watching, leisure cruises, nature cruises, etc. Consumptive trips were operated more frequently and passengers were charged a higher price than for non consumptive trips. Non consumptive trips averaged more passengers per trip. All

individuals reported either zero or one crew members on consumptive trips and up to three crew members on non consumptive trips.

Table 18. CPFV trip statistics, Central Coast Region

	Consumptive trips		Non consumptive trips	
	Response	Standard deviation	Response	Standard deviation
Number of people reporting trips	11	—	6	—
Average number of trips per vessel	97.3	80.8	89.5	59.8
Average number of passengers(per trip)	10.5	7.6	21.1	10.0
Average price per passengers (per trip)	\$125	\$82	\$49	\$45
Average number of crew (per trip)	0.8	0.8	1.3	1.0

Source: Current study

Across the study region respondents reported spending more days fishing (an average of 76.4 days) and making a larger portion of their income (an average of 44.1 percent) from the rockfish/lingcod fishery than any other fishery. Overall, respondents reported spending the most days whale watching (an average of 91.7) but made less of their income from this activity (an average of 32.5 percent) than they did from fishing for rockfish/lingcod. The number of days spent fishing or conducting an activity and the percent of GER generated from each fishery/activity are found below in Table 19.

Table 19. CPFV fishery/activity specific data, Central Coast Region

	Fishery/activity	Individuals interviewed	Number of days targeting species (2011)		Percent of GER from fishery/activity (2011)	
			Average	Standard deviation	Average	Standard deviation
Fishery	Albacore tuna	6	3.83	3.37	5.4%	4.6%
	California halibut	6	21.17	38.98	13.8%	10.0%
	Dungeness crab	2	*	*	*	*
	Humboldt squid	1	*	*	*	*
	Rockfish/lingcod	11	76.50	65.61	44.1%	21.4%
	Salmon	11	40.09	37.89	21.8%	13.2%
	Sanddab	5	22.40	33.14	4.0%	5.2%
	White sea bass	5	5.50	4.36	18.7%	27.2%
Activity	Whale watching	6	91.17	59.93	32.5%	22.9%
	^Other	7	15.00	15.92	23.8%	35.8%

Source: Current study

* indicates data were collected but cannot be shown due to confidentiality constraints

^ Other includes: Funeral services, government charters, recreational diving, and research charters.

3.3. Spatial Baseline Characterization of the CPFV Sector

Table 20 indicates the spatial data sets or maps that are available for CPFV fisheries at the region and port level. Due to the limited number of fishing maps available at the port level all CPFV fishing maps can be found in this section of the report following this table. It should be noted that the ports of Moss Landing and Monterey were merged together to develop a rockfish/lingcod CPFV fishing map as the fishing grounds for both ports are very similar and combining the ports allows us to present the information without confidentiality constraints.

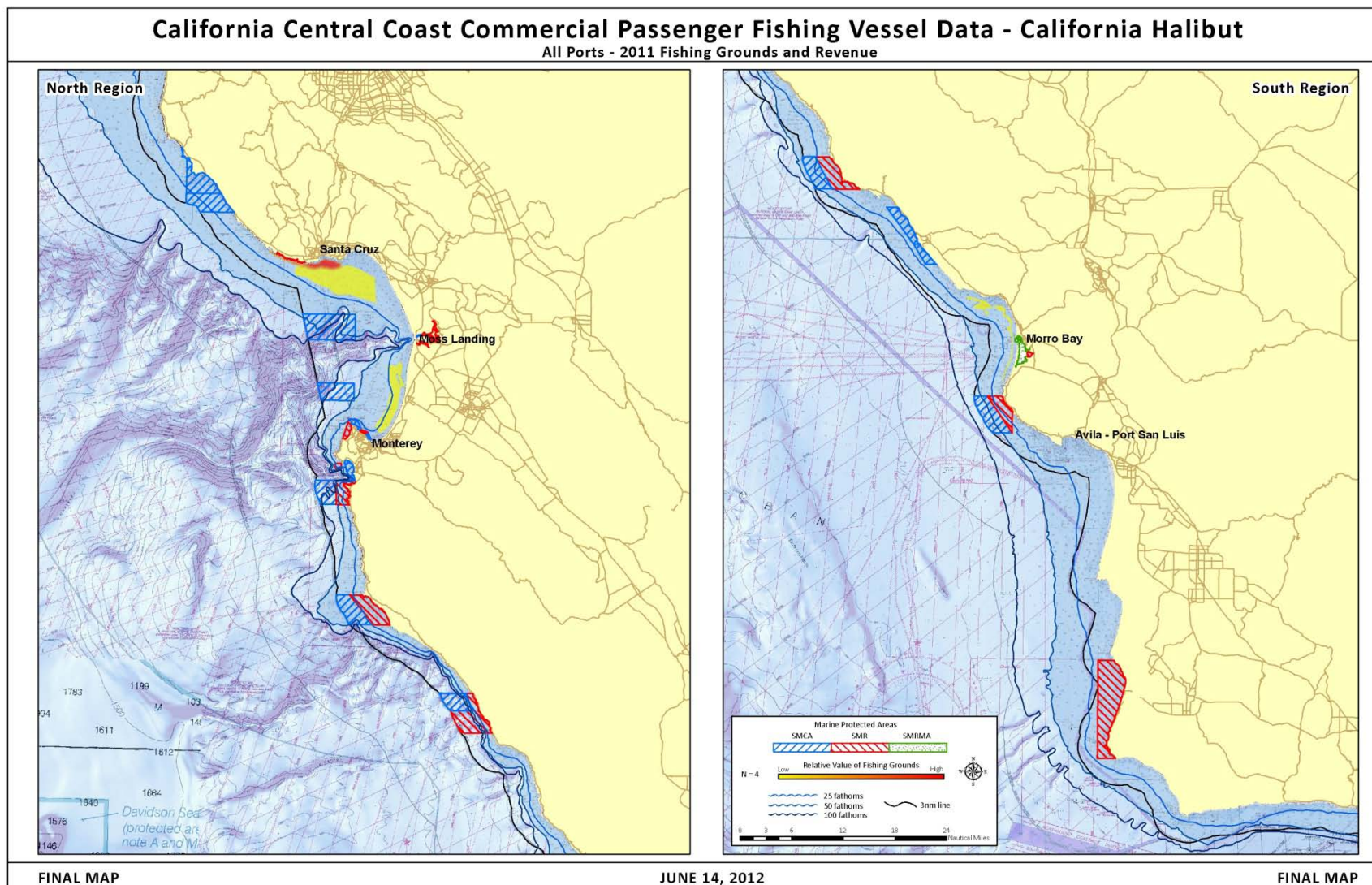
Table 20. Spatial data sets available for the CPFV sector, post MPA

Fishery	Santa Cruz	Moss Landing	Monterey/ Moss Landing	Monterey	Morro Bay	Central Coast Region
California halibut	Conf	Conf	-	Conf	Conf	Yes
Dungeness crab	-	-	-	Conf	-	Conf
Humboldt squid	-	-	-	Conf	-	Conf
Rockfish/Lingcod	Yes	Conf	Yes	Conf	Conf	Yes
Salmon	Conf	-	-	Conf	-	Yes
Sanddab	Conf	-	-	Conf	-	Conf
White sea bass	-	-	-	Conf	-	Conf

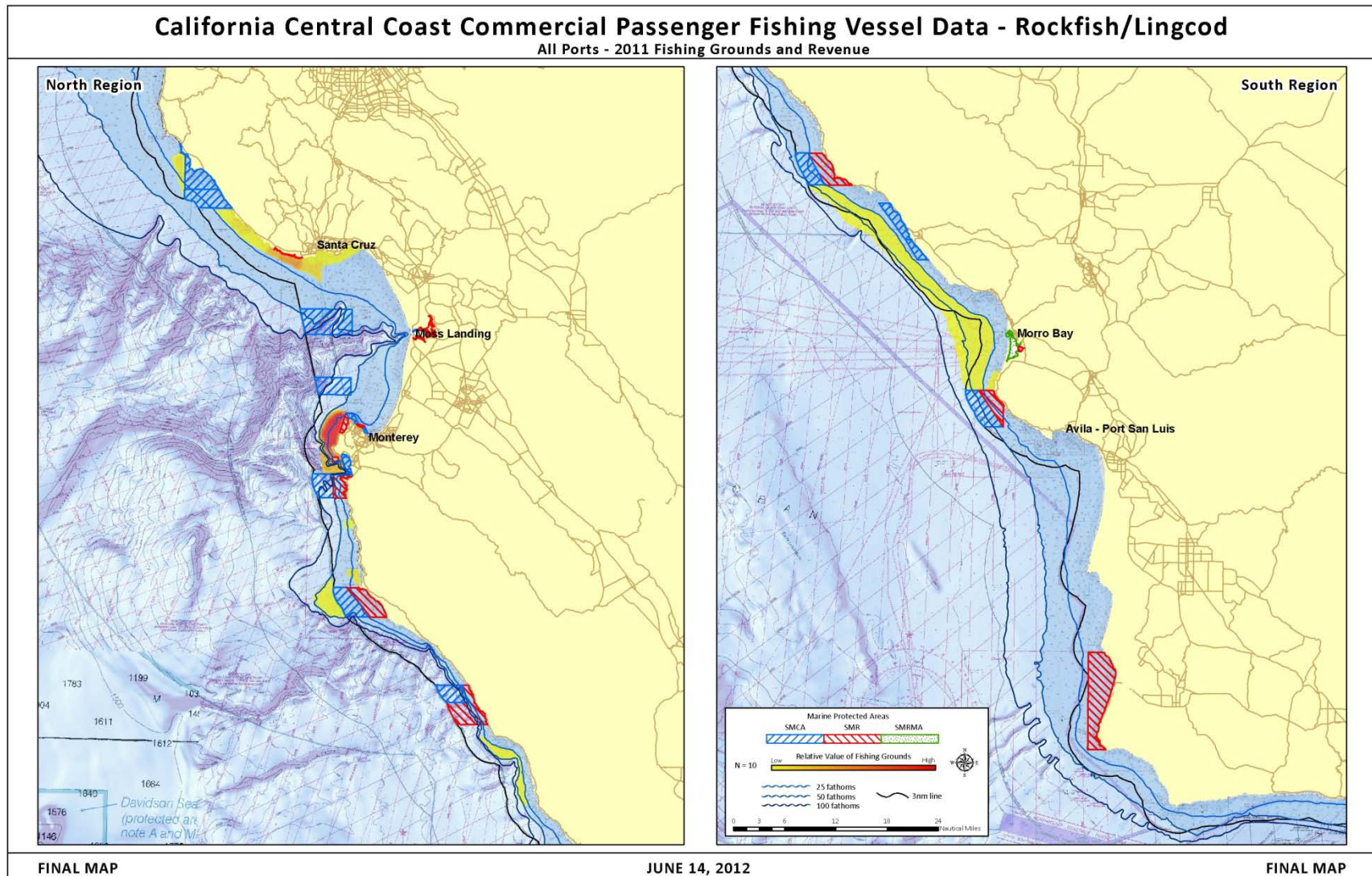
Source: Current study

Conf' indicates data were collected but are not available due to confidentiality constraints

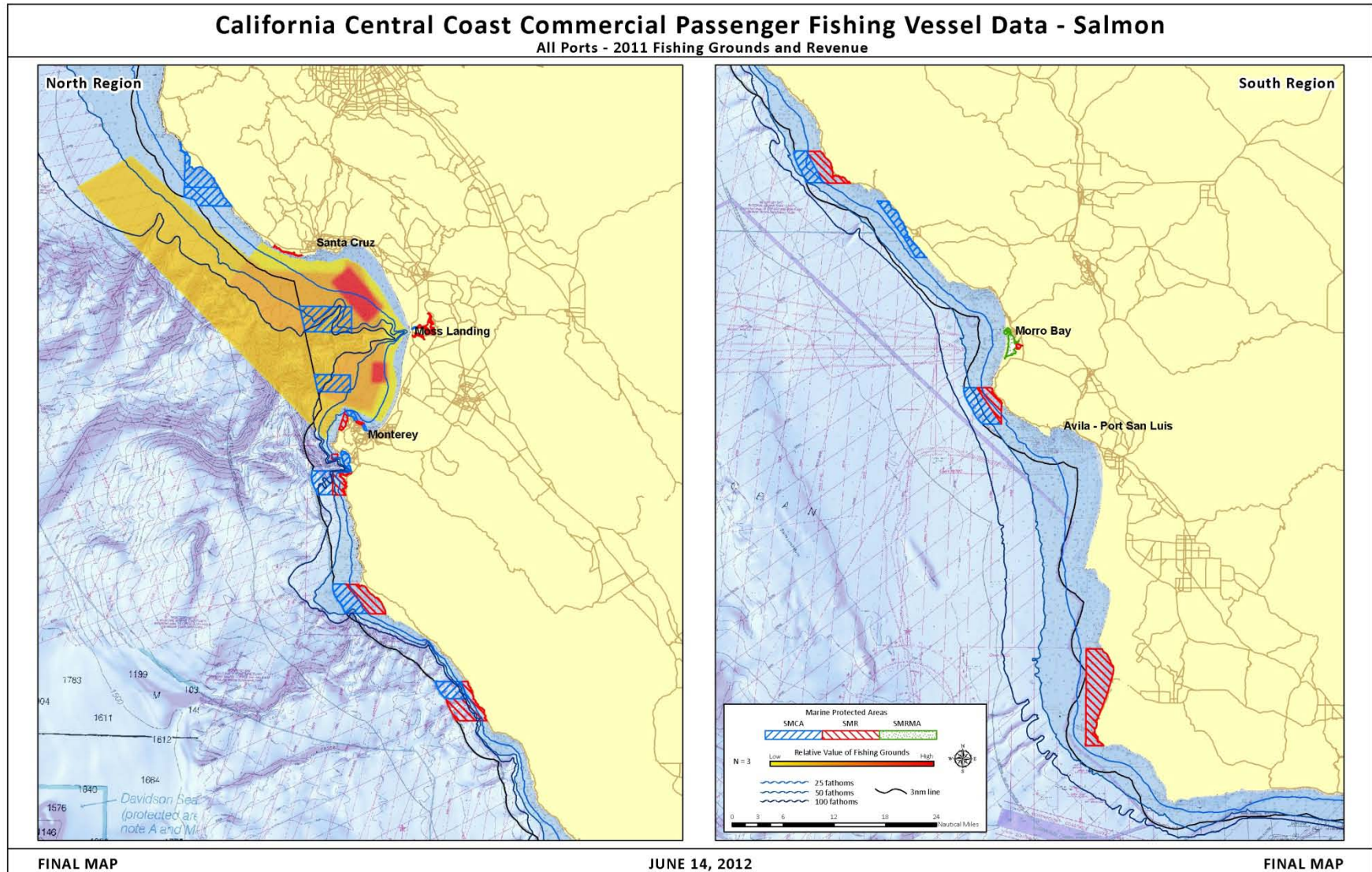
Map 14. California halibut CPFV post-MPA 2011 spatial value map, Central Coast Region



Map 15. Rockfish/Lingcod CPFV post-MPA 2011 spatial value map, Central Coast Region



Map 16. Salmon CPFV post-MPA 2011 spatial value map, Central Coast Region



3.4. Marine Protected Areas and the CPFV Sector

Determining and measuring the impact of MPAs upon CPFV activities is challenging to quantify and unravel from the multitude of environmental, regulatory, and economic factors and the inherent variation operating in systems of fishing and tourism. Despite this, we sought to capture information from CPFV operators as to how they perceive they have been impacted by MPAs and the specific MPAs which are impacting their fisheries/activities.

This section provides information at the region and port levels and summarizes the response from the following three questions which were asked during interviews for each fishery/activity the individual participates in:

- 1) Has your fishery/activity been directly impacted by the recently established MPAs?;
- 2) If so, how have you been impacted?; and
- 3) What MPAs have impacted your specific fishery/activity?

Question one was posed as a simple yes or no response and questions two and three were open-ended questions in which responses were later coded and categorized into the tables below.

Across the entire Central Coast Region, 40.0 percent of responses indicated that their CPFV fishing/activities had been impacted in some way by MPAs. The fishery with the fewest number of CPFV operators reporting impacts from MPAs was salmon (18.2 percent) and the most was rockfish/lingcod (100.0 percent). Responses in the Albacore tuna, Humboldt squid, and white sea bass fisheries all reported no impacts from MPAs. One CPFV operator had indicated being positively impacted by or benefitted from MPAs in their whale watching activities. This operator had mentioned that whales have been transiting through the MPAs and felt this was perhaps due to the increased bait fish or biomass in the MPAs. All of the rockfish/lingcod CPFV operators who reported they were impacted also indicated they had lost traditional fishing areas to MPAs. Additionally, 45.5 percent of the Rockfish/lingcod CPFV operators interviewed reported having to travel longer distances at times to fish and 36.4 percent are fishing in areas with worse or less predictable weather. 42.9 percent of respondents who conduct other CPFV activities such as government charters, research charters, and recreational diving trips indicated they were impacted by MPAs, however, these were generally positive impacts in that MPAs have generated research and diving interests.

Table 21. Percent of individuals indicating direct impact from MPAs for each fishery, CPFV fishermen, Central Coast Region

Fisheries		Number responding	Percent of respondents indicating direct impacts by MPAs	Type of impact				
				Moved homeport	Fishing at borders	Traveling longer distances	Shifted efforts to areas with less predictable/worse weather	Loss of traditional fishing grounds
Fishery	Albacore tuna	6	—	—	—	—	—	—
	California halibut	6	66.7%	16.7%	16.7%	50.0%	33.3%	50.0%
	Dungeness crab	2	50.0%	—	50.0%	50.0%	50.0%	50.0%
	Humboldt squid	1	—	—	—	—	—	—
	Rockfish/lingcod	11	100.0%	—	18.2%	45.5%	36.4%	100.0%
	Salmon	11	18.2%	—	—	—	—	9.1%
	Sanddab	5	40.0%	—	—	—	—	20.0%
	White sea bass	5	—	—	—	—	—	—
Activity	Whale watching	6	16.7%	—	—	—	—	—
	^Other	7	42.9%	—	—	14.3%	—	—
All target fisheries/ activities		60	40.0%	1.7%	6.7%	16.7%	11.7%	28.3%

Source: Current study

* indicates data were collected but cannot be shown due to confidentiality constraints

— indicates that the port/fishery was not sampled or a zero value data point

^ Other includes: Funeral services, government charters, recreational diving, and research charters.

In addition to the impacts from MPAs displayed in the table above, Table 22 provides additional perceived impacts from MPAs that CPFV operators discussed during interviews. Several operators indicated that MPA boundaries were hard to identify and follow which was also causing distress over unintended MPA infractions such as drifting into MPAs. CPFV operators also reported that MPAs have caused operators to fish in areas that are further from port which is dangerous as the rescue response times have doubled. This is further exacerbated by increased operating costs which have lead to some reduction in the number of crew.

Table 22. Other ways MPAs have impacted specific CPFV fisheries, Central Coast Region

Response	Number responding		
	California halibut	Rockfish/ lingcod	Sanddabs
Decrease in available fishing grounds	1	—	—
Fishing less productive areas	1	—	—
Loss of fishing opportunities	—	—	—
Distress around unintended infractions	—	1	—
Increased operating costs	1	—	—
MPA boundaries hard to identify and follow	1	1	1
Greater risk due to distance and lack of crew	1	1	—
Total number responding	3	3	1

Source: Current study

Participants were allowed to give multiples responses

— indicates that the port/fishery was not sampled or a zero value data point

The 20 MPAs listed in Table 23 were reported to have impacted at least one person in a specific port-fishery combination. The largest number of fisheries/activities that a single MPA impacted was three fisheries/activities (not including 'other' activities) - these MPAs are Asilomar SMR, Carmel Pinnacles SMR, Point Buchon SMR, Portuguese Ledge SMCA, and Soquel Canyon SMCA. Across the region, operators conducting rockfish/lingcod and California halibut trips reported being impacted by the largest number of MPAs (20 and 12 MPAs respectively). The last column in the table sums the number of responses across each fishery/activity and divides by the number of responses across all fisheries/activities (60 responses) to show which MPAs were most commonly reported as having the most impact on CPFV operators. Across the region and across all fisheries/activities, these MPAs are Asilomar SMR, Carmel Pinnacles SMR, Point Lobos SMR, Point Sur SMR and SMCA, and Soquel Canyon SMCA. It should be noted that for the Carmel Pinnacles SMR, Carmel Bay SMCA, and Point Buchon SMR one respondent indicated he/she conducted non-consumptive activities such as research charters or recreational diving in this MPA and thus the MPA had a positive impact on their operation of these types of activities.

Table 23. MPAs impacting specific CPFV fisheries/activities, Central Coast Region

MPA	Fishery								Activity		
	Albacore tuna	California halibut	Dungeness crab	Humboldt squid	Rockfish/ lingcod	Salmon	Sanddab	White sea bass	Whale watching	^Other	All target fisheries/ activities
Number responding	6	6	2	1	11	11	5	5	6	7	60
Año Nuevo SMCA	—	16.7%	—	—	27.3%	—	—	—	—	—	6.7%
Asilomar SMR	—	16.7%	—	—	36.4%	9.1%	—	—	—	—	10.0%
Carmel Bay SMCA	—	—	—	—	27.3%	—	—	—	—	14.3%	6.7%
Carmel Pinnacles SMR	—	16.7%	—	—	36.4%	—	—	—	—	14.3%	10.0%
Edward F Ricketts SMCA	—	—	—	—	27.3%	—	—	—	—	—	5.0%
Greyhound Rock SMCA	—	16.7%	—	—	27.3%	—	—	—	—	—	6.7%
Lovers Point SMR	—	16.7%	—	—	27.3%	—	—	—	—	—	6.7%
Natural Bridges SMR	—	16.7%	—	—	9.1%	—	—	—	—	—	3.3%
Pacific Grove Marine Gardens SMCA	—	16.7%	—	—	27.3%	—	—	—	—	—	6.7%
Piedras Blancas SMCA	—	16.7%	—	—	9.1%	—	—	—	—	—	3.3%
Piedras Blancas SMR	—	16.7%	—	—	18.2%	—	—	—	—	—	5.0%
Point Buchon SMCA	—	16.7%	—	—	18.2%	—	—	—	—	—	5.0%
Point Buchon SMR	—	16.7%	—	—	27.3%	—	—	—	—	14.3%	8.3%
Point Lobos SMCA	—	—	—	—	45.5%	—	—	—	—	—	8.3%
Point Lobos SMR	—	—	—	—	45.5%	9.1%	—	—	—	—	10.0%
Point Sur SMCA	—	—	—	—	54.5%	—	—	—	—	—	10.0%
Point Sur SMR	—	—	—	—	54.5%	—	—	—	—	—	10.0%
Portuguese Ledge SMCA	—	—	50.0%	—	18.2%	—	20.0%	—	—	—	6.7%
Soquel Canyon SMCA	—	—	—	—	27.3%	9.1%	40.0%	—	—	—	10.0%
White Rock-Cambria SMCA	—	16.7%	—	—	9.1%	—	—	—	—	—	3.3%
Number of MPAs impacting fishery	—	12	1	—	20	3	2	—	—	3	20

Source: Current Study

* indicates data were collected but cannot be shown due to confidentiality constraints

— indicates that the port/fishery was not sampled or a zero value data point

^ Other includes: Funeral services, government charters, recreational diving, and research charters.

4. LESSONS LEARNED

Outreach efforts to port communities were initiated at the project's inception and continued throughout the project. Building trust and collaborating with fishing communities were important measures of success for our project; however, due to several factors such as: distrust in how information will be used; concerns around the project's funding source; dissatisfaction with the MPA network planning process and its outcome; concerns around Ecotrust's methodology used to map fishing ground during the 2005 study; and unclear benefits of participating in the project, many fishermen were reticent to participate in the project.

This presented a difficult challenge to the project, and the nature of these concerns listed above was difficult to address in a limited timeline. Despite this, Ecotrust networked within the fishing community and attended fishermen meetings to disseminate information and answer questions as to how Ecotrust's methodology has improved since the 2005 study, the intentions of the project, and to the extent possible explain how data will be used to inform the 5-year review of the Central Coast MPA network. Furthermore, Ecotrust spent extensive efforts to keep the fishing community informed of project progress to develop transparency in our work and re-build relationships in the Central Coast Region. We hope to continue and maintain these relationships into the future. We hope through engaging the Central Coast fishing community in this way MPA monitoring is now strengthened through this effort. This strengthened engagement, at a minimum, provides the foundation for future or long-term support for MPA monitoring.

In future projects, these issues of trust, project intentions, incentives to participate, and how data will be used may be better be addressed up front with strategic joint outreach efforts with state agencies responsible for MPA monitoring and review efforts to engage fishermen early on, acknowledge and address to the extent possible their concerns, and incorporate fishermen in the overall MPA monitoring process. Meaningfully incorporating fishermen into MPA monitoring efforts such as project design, data review/analysis, and data dissemination are important to build trust and transparency as well as empower fishermen and foster a sense of ownership and legitimacy over the data, information, and process which may potentially impact their livelihood.

5. RECOMMENDATIONS ON KEY MONITORING METRICS

Below are Ecotrust's recommendations for key metrics to monitor within the commercial fishing and CPFV sectors. To inform the existing monitoring plan structure we included the key monitoring metrics recommended for consumptive uses detailed in the North Central Coast and South Coast MPA monitoring plans and added additional metrics with an associated rationale.

5.1. Monitoring Metrics for the Commercial Fishing Sector

Table 24. Recommendations for key monitoring metrics in the commercial fishing sector

Metric	Purpose	Source
Landings (pounds and ex-vessel revenue)	This metric is to monitor how many pounds of fish are being caught and how much revenue is being generated in key fisheries. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG commercial landings data
Operating costs (average yearly percentages)	This metric is to monitor how operating costs may be changing over time. This may be increases/decreases in fuel costs, equipment costs, maintenance costs, crew costs, etc. From this information changes in net revenue for individual fishermen may be calculated. These operating cost percentages may also be used to help estimate secondary economic impacts upon commercial fishing support industries. It is recommended that operating costs be collected at the fishery level as some fisheries are more equipment intensive or require less/more fuel and crew.	Survey data
Total number of fishermen landing in key fisheries	This metric is to monitor how many fishermen are participating in key fisheries each year. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG commercial landings data
Total number of trips in key fisheries	This metric is to monitor how many total trips fishermen are taking in key fisheries each year. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG commercial landings data
Landings (pounds and ex-vessel revenue) and trips per fisherman	This metric is to monitor how landings (pounds and revenue) and fishing effort may be changing at the individual fisherman level for key fisheries	CDFG commercial landings data
Spatial value of fishing areas	This metric is to monitor changes in how coastal/ocean areas are being utilized and valued by fishermen. Data may be analyzed with previous spatial data sets to determine spatial shifts in the value of fishing areas for key fisheries	CDFG commercial landings data
Catch per unit effort (CPUE)	This metric is to monitor the average amount effort expended by fishermen in key fisheries. This data may be calculated by examining pounds/ex-vessel revenue per trip for key fisheries and	CDFG commercial landings data
Price per pound	This metric is to monitor changes in the average ex-vessel price received by fishermen in key fisheries. This metric may be calculated on average by dividing ex-vessel revenue by pounds landed.	CDFG commercial landings data
Average percent of fishing revenue from key fisheries	This metric is to monitor changes in the average proportion individual fishermen rely upon a fishery for their fishing income. This metric may be calculated by examining and averaging across the ex-vessel revenue portfolio of individual fishermen who make landings in a given port or region.	CDFG commercial landings data
Attitudes and perceptions	This information is to monitor and collect contextual information that may help identify key fishery issues and factors driving the change observed in the metrics listed above.	Survey data/focus groups

5.2. Monitoring Metrics for the CPFV Sector

Table 25. Recommendations for key monitoring metrics in the CPFV sector

Metric	Purpose	Source
Landings (number of fish caught)	This metric is to monitor how many fish are being caught in key CPFV fisheries. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG CPFV logbook data
Average annual gross revenue from CPFV operations	This metric is to monitor how gross economic revenue levels may be changing over time	Survey data
Average percent of revenue from key fisheries/activities	This metric is to monitor changes in the average proportion of CPFV operator gross economic revenue relies upon a specific fishery/activity.	Survey data
Operating costs (average yearly percentages)	This metric is to monitor how operating costs may be changing over time. This may be increases/decreases in fuel costs, equipment costs, maintenance costs, crew costs, etc. From this information changes in net revenue for individual CPFV operators may be calculated. These operating cost percentages may also be used to help estimate secondary economic impacts upon CPFV support industries.	Survey data
Total number of CPFV vessels operating	This metric is to monitor how many vessels are operating, each year. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG CPFV logbook data
Total number of CPFV fishing trips	This metric is to monitor changes in the number of CPFV fishing trips that are being conducted each year as this is an indicator of economic conditions. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG CPFV logbook data
Total number of anglers	This metric is to monitor how many anglers are taking CPFV trips each year as this is an indicator of economic conditions. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG CPFV logbook data
Catch per unit effort (CPUE)	This metric is to monitor the average amount of fish caught per unit of effort. This metric is useful in helping determine changes in fish abundance or the success of fishing trips which is related to customer satisfaction. This metric may be calculated by dividing the number of fish caught (landings) by the number of trips or the number of anglers.	CDFG CPFV logbook data
Number of anglers per trip	This metric is to monitor the average number of anglers participating in each CPFV fishing trip as this is an indicator of economic conditions. This metric may be calculated by dividing the total number of anglers by the total number of trips. This data may be analyzed at the port, region, and state scales so that nested comparisons may be made of trends over time.	CDFG CPFV logbook data
Spatial value of fishing area	This metric is to monitor changes in how coastal/ocean areas are being utilized and valued by CPFV operators. Data may be analyzed with previous spatial data sets to determine spatial shifts in the value of fishing areas for key fisheries	Survey data
Attitudes and perceptions	This information is to monitor and collect contextual information that may help identify key CPFV issues and factors driving the change observed in the metrics listed above.	Survey data/focus groups

6. CONCLUSION

The intention of this report was to provide a baseline characterization and description of initial changes since MPA implementation of key target fisheries and ports of the commercial fishing and CPFV sectors in the California Central Coast Region. It should be noted that in this report we do not account for the secondary economic effects of changes in fishing revenue and how that may affect support industries such as fish processors/buyers, port workers, crew, and the tourism economy which benefits and may rely on the business of CPFV passengers. Indeed, these industries are vital to the success and health of fishing communities and are important to account for in future monitoring efforts.

It is difficult to discern the effects of MPAs on fishing communities as they are confounded by a multitude of factors such as other regulatory constraints (e.g., area based closures, quota limits, and limited entry fisheries) and general economic downturn, environmental variability/change, market variability, and increasing competition for marine space. However, advancing our understanding of how humans utilize, value, and rely upon marine space will be critical to unraveling these interconnections as well as monitor how MPAs are benefitting or impacting fishing communities into the future. This information may then be used in adaptive management measures to improve the performance of MPAs towards meeting ecological and socioeconomic goals. Similarly, it is our hope that the data collected/compiled and lessons learned through this project will be applied to future MPA monitoring efforts to build a time series data set on how human uses and the socioeconomic health of fishing communities are changing over time. Such a robust and longitudinal dataset that provides both socioeconomic characterization and spatial fishing patterns on consumptive human uses could be used for a wide array of marine spatial planning application including the monitoring of MPAs.