Commercial and recreational fishing grounds and their relative importance off the North Central Coast of California

Report to the California Marine Life Protection Act Initiative

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1. Introduction

Ecotrust was retained by the Marine Life Protection Act Initiative (MLPAI) in June of 2007 to collect, compile and analyze fishery data in support of the North Central Coast Project (see Appendices A and B for Scopes of Work). During the summer and fall of 2007, our research team developed and deployed a local knowledge interview instrument, using an interactive, custom computer interface, to collect geo-referenced information about the extent and relative importance of North Central Coast Study Region (NCCSR) commercial and recreational fisheries. We compiled these data in a geographic information system (GIS) that we delivered to the MLPAI for integration into a central geodatabase. We also analyzed the fishery data in combination with additional data provided to us by the California Department of Fish and Game (CDFG) to estimate first order maximum potential impacts of proposed marine protected area networks developed in the Marine Life Protection Act (MLPA) process.

This report completes our deliverables, complementing the data and analytical deliverables already forwarded to the MLPAI under the terms of the contract. It details the approach and methods used for collecting, compiling and analyzing commercial and recreational fisheries data in the north central coast. We further discuss the results and deliverables from this project. It is important to note, however, that the analysis conducted under the scope of this contract is not the sum total of everything that could be done with the database and the information contained therein. Indeed, the analysis conducted to date suggests additional questions and research that we were not able to address in the timeframe of this study. That said we hope that this project not only makes a useful contribution to the MLPA process, but also opens the door to further inquiry that draws on the expert knowledge of fishermen.

Conducting qualitative research in coastal communities is as challenging as it is rewarding. We have learned a tremendous amount from the commercial and recreational fishermen participating in this study, and the countless other community members, stakeholders, and observers of the MLPA process.

We are deeply thankful to the 174 commercial and 101 recreational fishermen who participated in the interviews—making time in their busy schedules, overcoming sometimes considerable reservations, and sharing their knowledge and experience with us. We thank all the members of the North Central Coast Regional Stakeholder Group and the MLPAI staff, and are especially grateful to our port liaisons, Mat Keller and Dan Wolford. In addition, we would like to thank Caroline Hermans for assisting us in the development phases of the recreational fishery component.

We believe that this project makes a significant contribution to the knowledge base on the coast—not just for marine protected area planning, but for enhancing the public's and decision-makers' understanding of the importance of the coastal ocean to individual commercial and recreational fishermen, as well as coastal communities and economies.

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In addition to serving as the Principal Investigator on this study, Astrid Scholz is also a member of the Master Plan Science Advisory Team of the Marine Life Protection Act Initiative (http://www.dfg.ca.gov/mrd/mlpa/mpsat.html)/.

2. Background

In California, as elsewhere on the Pacific Coast, commercial and recreational fisheries support coastal communities and economies. Fisheries are prosecuted by vessels of all shapes and sizes, using a variety of gear types and fishing strategies, and covering a large part of the coastal ocean. In general, this spatial component of fishing activities is relatively poorly understood.

While a variety of data are collected by state and federal agencies to monitor and enforce fisheries and set harvest allocations, the thematic, temporal and spatial resolution of these data sets varies considerably. Data range from agency observer data in some fisheries to voluntary reports in others, from mandatory daily logbooks with detailed location information in some fisheries, to landing receipts using large statistical reporting blocks. With marine and fisheries management becoming more focused on ecosystem-based approaches, using tools such as time and area closures, accurate spatial information about coastal fisheries is central to informing policy decisions.

These spatial information gaps in coastal fisheries can be filled using existing data or collecting new information, and this report describes one such effort undertaken to redress the spatial information gaps in commercial fisheries in the context of the Marine Life Protection Act (MLPA), and its implementation in the North Central Coast Study Region (NCCSR). In previous iterations of the MLPA process, the use of existing data was controversial since these data are riddled with artifacts. This is especially prevalent in landing receipts, the only source of data consistently available for all commercial fisheries. Landing receipts are typically filled out by fish buyers at the point of landing, and the data collection forms contain a field for statistical reporting blocks. Fishermen report, and agency staff working with landing receipts confirm, that the block information is typically filled in by the buyer irrespective of the actual provenance of the catch, making the spatial information contained in landing receipts unreliable.

Clearly, basing management decisions on the spatial information contained in existing data sources is undesirable. The alternative is to collect new information on the spatial extent of fishing activities and the fishermen who are actively engaged in these fisheries. In the absence of comprehensive observer coverage, vessel monitoring systems or other fishery-independent data collection devices, by far the best source of information about the fishing grounds is the fleet itself.

In this project, therefore, we built on existing approaches to collect fishermen's expert knowledge about the fishing grounds. The goal was to develop maps of the fishing grounds and characterize their relative importance for various fisheries. The following sections contain detailed descriptions of the methods used and the analysis conducted.

3. Methods

3.1. Data Collection

In this project, we built on methods developed in previous projects on the coast (Scholz et al. 2004; 2005; 2006a). More specifically, we used a computer interface to administer a survey, collected information from fishermen[1] and analyzed the responses in a geographic information system (GIS). As in the central coast (Scholz et al. 2006), a key innovation in this project was working with CDFG staff and regional experts to define the region's fisheries in terms of how they are managed. To that end, fisheries were differentiated in terms of practices and/or species (group)-gear configurations and port-groups were used as a means of classifying participants and supporting representative sampling.

While the use of GIS technology and analysis in marine and fishery management has expanded steadily over the past decade (Meaden 1996; Kruse et al. 2001; Breman 2002; Valavanis 2002; Fisher and Rahel 2004), its use for socioeconomic research is still somewhat limited. Many of the applications reviewed in the recent literature focus on urban populations or natural resource use in developing countries (Gimblett 2002; Goodchild and Janelle 2004; Anselin et al. 2004). Nevertheless, 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 fisheries concern the spatial extent of fishing effort and intensity (Caddy and Carocci 1999; Green and King 2003), and use participatory methods similar to the ones employed here (Wedell et al. 2005; St. Martin 2004, 2005, 2006). We built on these approaches and adapted them for the California 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.

3.1.1. Study Region

The study region of this project is congruent with the North Central Coast Project of the MLPAI, extending from Alder Creek, five miles north of Point Arena in Mendocino County, to Pigeon Point in San Mateo County (for details of the North Central Coast Project, see http://www.dfg.ca.gov/mlpa/nccprofile.asp).

Unlike the North Central Coast Project, however, the western extent of our study region is not bounded by the state water boundary. Rather, we considered the entire Exclusive Economic Zone (EEZ) in this project, although in reality most fisheries are confined to within fifty miles offshore. Similarly, we did not impose the southern and northern extent boundaries of the North Central Coast Project. Methodologically this means that we did not "cut off" the area for fishermen to consider, but asked them to draw their fishing grounds irrespective of political boundaries.

In keeping with the convention adopted by the MLPAI, we stratified our study region for commercial and recreational fisheries, respectively. For commercial fisheries, the study region was divided into five port groups: Point Arena, Bodega Bay, Bolinas, San Francisco and Half Moon Bay. For recreational fisheries, the study region was divided into three sub-regions: Region 1 - Ocean Beach in San Francisco County, Region 2 - San Francisco Bay access points to Point Reyes and Region 3 - Point Reyes north to Alder Creek.

3.1.2. Fisheries Studied

In consultation with MLPAI, CDFG staff and fishermen in the region, we selected eight key commercial fisheries on which to focus our efforts, listed in Table 1. They are all fisheries that are at least partially conducted in state waters, are of economic importance in the study region, mostly involve fishing gear

[1] In keeping with the usage in the fishing community, we use "fisherman" to talk about both male and female members of the fishing industry.

that is expected to have some benthic habitat interactions, and are not well captured spatially by existing fisheries-independent data sets. That is to say, the best fishery-independent spatial information available for them is contained in the statistical blocks reported in landing receipts.

Table 1: Summary of NCCSR commercial fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)[2]	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in NCCSR, 7-year average (2000–2006)
California Halibut	1.8%	0.3%	20.3%
Coastal Pelagics	0.2%	0.0%	0.4%
Market Squid	1.9%	0.4%	1.2%
Deeper Nearshore Rockfish	0.7%	0.1%	24.0%
Nearshore Rockfish	1.0%	0.2%	7.1%
Urchin	5.5%	1.0%	8.6%
Dungeness Crab	52.8%	9.9%	31.2%
Salmon	36.3%	6.8%	52.7%

In consultation with MLPAI and CDFG staff, as well as members of the recreational fishing community, we selected five key recreational fisheries on which to focus our efforts: California halibut, Dungeness Dungeness crab, salmon, rockfish/lingcod complex, and striped bass – pier/shore only. Due to both the unknown landings volume and associated value derived from recreational fishing activities, we believe these five fisheries allow us to make broad generalizations about preferences of the recreational fishing population within the study area, adding increased thematic resolution to the MLPA decision-making process.

3.1.3. Sampling the Fishing Fleet

For the commercial fisheries, we used CDFG landing statistics to identify fishermen to interview about the fishing grounds for each of the eight target fisheries. Given the expert nature of the information we were interested in for this project, the use of a random sample was not the most desirable sampling method. Instead, we constructed a purposive, proportional quota sample that was designed to be representative of the fisheries overall. CDFG staff generated a list of fishermen by landings and we inspected this list to identify participants such that, based on the population within the fishery groupings and port-groups, the sample would represent:

- At least 50% of the total landings and/or ex-vessel revenue from 2000-2006; and
- At least five fishermen, except in cases where the sample population is fewer then five.

We encountered varying success in trying to achieve a sample that met the criteria outlined above. Table 2 captures the percentage of ex-vessel revenue (2000-06) that our sample represents for each fishery in each port. Respondents represented at least 20% of ex-vessel revenue for all fisheries, except Bodega Bay, California halibut and nearshore rockfish and Half Moon Bay, California halibut. The overall representation for the study region was 40% of ex-vessel revenue, and by port the highest was Bolinas (86%), followed by Bodega Bay (49%), Point Arena (46%), Half Moon Bay (39%), and San Francisco (33%). It was easier to achieve a greater percentage of the ex-vessel landings in the smaller ports of Point Arena and Bolinas because there are so few fishermen. Table 3 summarizes the number of

[2] Percentage of the eight key NCCSR fisheries considered in this report.

fishermen interviewed who landed catch per fishery in each port. For example, we interviewed six fishermen who landed Dungeness crab in Point Arena, which comprised 97% of the ex-vessel revenue (2000-06) for that fishery in Point Arena, compared to forty-one fishermen who landed Dungeness crab in Bodega Bay, which only comprises 54% of the ex-vessel revenue for that same period. In both cases, we met our sampling criteria, but because there are considerably more landings and fishermen in Bodega Bay it took a greater number of interviews to reach our target of 50%. In total, we interviewed 174 fishermen,[3] of which 136 provided data on their salmon fishing grounds, 102 on Dungeness crab grounds, twenty-two on urchin ground, fifteen on deeper nearshore rockfish ground, fourteen on California halibut ground, nine on nearshore rockfish ground, and one for coastal pelagics and market squid grounds. These numbers are not mutually exclusive, in that a fisherman often participates in more than one fishery. In general, this breakdown of fishermen interviewed per fishery matches the overall distribution of fishermen and value of the fisheries in the NCCSR, shown in Table 1.

Table 2: Percentage the sample represents based on ex-vessel revenue (2000-2006)

Fisheries	Point Arena	Bodega Bay	Bolinas	San Francisco	Half Moon Bay	NCC Total
California Halibut	—	1%	100%	29%	19%	32%
Coastal Pelagics	—	—	—	—	97%	54%
Market Squid	—	—	—	—	73%	49%
Deeper Nearshore Rockfish	58%	36%	100%	22%	45%	31%
Nearshore Rockfish	92%	5%	—	19%	72%	47%
Urchin	36%	40%	—	24%	—	37%
Dungeness Crab	97%	54%	81%	41%	45%	46%
Salmon	53%	46%	94%	23%	25%	32%
Total	46%	49%	86%	33%	39%	40%

Table 3: Summary of the number of fishermen interviewed by landing port

Fisheries	Point Arena	Bodega Bay	Bolinas	San Francisco	Half Moon Bay	NCC Total	Total
California Halibut	—	2	4	9	4	14	14
Coastal Pelagics	—	—	—	—	1	1	1
Market Squid	—	—	—	—	1	1	1
Deeper Nearshore Rockfish	2	4	3	6	5	14	15
Nearshore Rockfish	5	2	—	2	1	9	9
Urchin	16	7	—	2	—	18	22
Dungeness Crab	6	41	3	43	22	89	102
Salmon	7	91	7	62	62	121	136

[3] During the summer of 2007, 174 interviews were conducted, but only 172 were used in subsequent analyses. Two interviews were not used in the analysis because they were provided by fishermen who were under the legal age required to have a commercial fishing license, thus making their landings are difficult to track or detect in the CDFG landing receipts. The ex-vessel value from the CDFG landing receipts form the basis for weighing an individual fisherman's fishing grounds in the aggregated fishing grounds analysis. Without landings information, if their grounds were considered in the analysis, they would decrease the value of the aggregated grounds because only area would be considered, whereas for fishermen with landings, we consider area and ex-vessel value (see Section 5.1. Weighting of Participants Shapes).

For analytical purposes we chose to group fishermen by where they land (Table 3) versus their homeport (Table 4). We did this because the landings information is limited to where fishermen land their catch, thus making it difficult to estimate the total number of fishermen per home port. We can estimate, however, the total number of fishermen and ex-vessel revenue for each fishery based on landing port, which is what we use to derive our sample. Additionally, when fishermen provides their fishing grounds during the interview, it is not restricted to where they land or what they consider as a homeport, but rather, it is based on the entire extent of their fishing grounds and cumulative fishing experience. During the interview process we ask each fisherman to identify his/her homeport, which summarized in Table 4. For example, when comparing the number fishermen per homeport versus landing port, out of the 172[4] fishermen whose information we used, sixty-three fished for salmon and considered Bodega Bay to be their homeport, but according to the landings receipts, ninety-one fishermen landed salmon in Bodega Bay between 2000-06. In addition, not all fishermen interviewed consider their homeport to be inside the NCCSR, as shown in the Outside NCC column of Table 4. These fishermen were targeted because they did fish and/or land in and around the NCCSR waters, specifically north of the study region.

Table 4: Summary of the number of fishermen interviewed by homeport

Fisheries	Point Arena	Bodega Bay	Bolinas	San Francisco	Half Moon Bay	Outside NCC	NCC	Total
California Halibut	—	—	4	7	3	—	14	14
Coastal Pelagics	—	—	—	—	1	—	1	1
Market Squid	—	—	—	—	1	—	1	1
Deeper Nearshore Rockfish	2	1	3	3	4	2	13	15
Nearshore Rockfish	4	1	—	1	1	2	7	9
Urchin	9	6	—	1	—	6	16	22
Dungeness Crab	6	37	3	22	18	16	86	102
Salmon	10	63	4	30	14	15	121	136

Capturing the homeport of each fisherman interviewed allows us to compare what percentage of his/her landings is landed in the homeport he/she has identified compared to elsewhere in the NCCSR (see Table 5). This possibly provides additional insight on the movement of the fleet in each port and/or dependence on the infrastructure (processors or buyers) available to each fishery. For example, of the fishermen that consider Point Arena to be their homeport and landed Dungeness crab there (6); 51% of their catch is landed in Point Arena and 49% is landed elsewhere in the study region. Compare these statistics to those of the nine fishermen we interviewed who participate in the Point Arena Urchin fishery; 100% of their landings are landed in Point Arena. In both cases, the fishermen's landings outside of the study region are considered in this comparison. In most of the fisheries considered in this project, the majority of the fishermen's landings are landed in their homeport, with the exception of Bolinas deeper nearshore rockfish, where only 22% of the landings are landed in Bolinas and 78% are landed elsewhere in the NCCSR. Also, for all ports besides Bolinas, between 72% - 81% of the salmon catch is landed in their homeport versus in other ports in the NCCSR, which could be attributed to the migratory nature of the fishery and/or certain areas during the salmon season that open or regulated by existing fisheries management.

[4] Two interviews (of the 174) were not used in the analysis because they were provided by fishermen who were under the legal age required to have a commercial fishing license, thus making their landings are difficult to track or detect in the CDFG landing receipts.

Table 5: Percentage of ex-vessel landings (2000-06) per fishery that are landed by fishermen in their homeport and other ports in the North Central Coast Study Region

	Point Arena		Bodega Bay		Bolinas		San Francisco		Half Moon Bay	
Fisheries	% landed here	% landed elsewhere in NCCSR	% landed here	% landed elsewhere in NCCSR	% landed here	% landed elsewhere in NCCSR	% landed here	% landed elsewhere in NCCSR	% landed here	% landed elsewhere in NCCSR
California Halibut	—	—	—	—	95%	5%	100%	0%	100%	0%
Coastal Pelagics	—	—	—	—	—	—	—	—	100%	0%
Market Squid	—	—	—	—	—	—	—	—	100%	0%
Deeper Nearshore Rockfish	100%	0%	100%	0%	22%	78%	97%	3%	98%	2%
Nearshore Rockfish	100%	0%	100%	2%	—	—	100%	0%	100%	0%
Urchin	100%	0%	87%	13%	—	—	0%	100%	—	—
Dungeness Crab	51%	49%	98%	2%	100%	0%	98%	2%	91%	9%
Salmon	81%	19%	78%	22%	100%	0%	72%	28%	81%	19%

For the recreational fisheries, we used a stratified solicited sample. A number of factors, including the unknown size of the recreational fishing community within the study area and the study's time and budgetary constraints, made the use of this sampling methodology the most practical. Additionally, this approach served as a first step toward identifying future, improved sampling protocols.

The recreational fishing community was stratified into four key user groups:

- Commercial Passenger Fishing Vessels (CPFVs);
- Private boat recreational anglers;
- Kayak-based anglers; and
- Shore anglers.

Given that relatively little is known about the total population of recreational anglers, we consulted with leaders in the recreational industry and project collaborators on the sample size. The goal of the sample was to represent at least twenty individuals from each of the four key user groups. Summarized below in Table 6 is the total number of recreational fishermen interviewed per sub-region and for the entire NCCSR. Again, for recreational fisheries, the study region was divided into three sub-regions: Region 1 - Ocean Beach in San Francisco County, Region 2 - San Francisco Bay access points to Point Reyes and Region 3 - Point Reyes north to Alder Creek. Recreational fishermen were asked to identify the primary sub-region in which they recreate and were categorized exclusively in only that one sub-region.

Table 6: Total number of recreation fishermen interviewed per user group

User Group	Region 3	Region 2	Region 1	Total (NCCSR)
CPFV	8	8	5	21
Private Vessels	10	17	22	49
Kayak Anglers	5	1	7	13
Pier/Shore	3	5	10	18

Table 7 further characterizes the number of recreational fishermen who provided information for each fishery. For example, we interviewed twenty-two private vessel recreational fishermen in sub-region 1; seventeen of them target California halibut, twenty target Dungeness crab, twenty-one target Rockfish/Lingcod, and all twenty-two target salmon.

Table 7: Total number of recreation fishermen interviewed per user group

	CPFV			Private			Kayak			Pier		
	Regions			Regions			Regions			Regions		
Fisheries	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**
California Halibut	7	5	3	10	12	17	5	1	7	—	3	6
Dungeness Crab	7	4	2	8	11	20	3	—	6	—	3	6
Rockfish/Lingcod Complex	6	6	5	10	17	21	5	1	7	3	5	9
Salmon	8	7	5	10	17	22	4	1	7	—	1	3
Striped Bass	—	—	—	—	—	—	—	—	—	1	3	3

3.1.4. Collection of Fishing Grounds Data

During the summer and fall months of 2007 (June through November) Ecotrust personnel interviewed 174 commercial and 101 recreational fishermen along the north central coast. Commercial fishermen were selected based on CDFG data and recommendations by the Regional Stakeholder Group, as described above. Recreational fishermen were selected through a solicitation for volunteers. More specifically, a request was made through recreational fishing organizations within the study region (e.g. Coastside Fishing Club, NorCal Kayak Anglers) and at other recreational angling events and venues.

Ecotrust personnel contacted fishermen by phone, explained the project and obtained written consent of participants (see Appendices F and G for sample consent forms). The project was also described on a web page, at http://www.ecotrust.org/mlpa, which included an on-line form for submitting any questions. Staff at Ecotrust's office in Portland arranged for interviews with contracted field staff based in Berkeley. The format included one-on-one or small group interviews, with follow-up meetings by fishery and/or gear/user group during which the information collected was validated by fishermen.

Data were entered into a GIS using a custom-built ArcView interface known as OceanMap, which was originally developed by Environmental Defense, was used in the Central Coast Study Region and was modified for the North Central Coast Study Region. The interface allows field staff to enter fishing grounds identified by respondents directly into a spatial database, and standardize this information across a number of respondents or fisheries. It is programmed to allow fishermen to draw shapes in their natural sizes (polygons) rather than confining responses to a grid. Although data are summarized to a variety of different raster outputs for the subsequent analysis, the raw data are entered in natural shapes and at whatever spatial scale makes sense to respondents.

All interviews follow a shared protocol:

1. Maximum extent: Using electronic and paper nautical charts of the area, fishermen are asked to identify, by fishery, the maximum extent north, south, east and west they would forage or target a specie(s).
2. Scaling: They are then asked to identify, within this maximum forage area, which areas are of critical economic importance, over their cumulative fishing experience, and to rank these using a weighted percentage—an imaginary "bag of 100 pennies" that they distribute over the fishing grounds.
3. Non-spatial information pertaining to demographics and basic operations was also collected.

The first step establishes the maximum extent of the fleet in each fishery. This differs for all fisheries, some of which range far along the entire West Coast, while others are confined to inshore waters. In the subsequent analysis this allows us to distinguish between fisheries that take place wholly in the MLPAI NCCSR from others that take place both inside and outside.

The second step serves to scale respondents' reporting of the relative importance of the fishing grounds to a common scale. This is important for making inter and intra fishery comparisons. We chose 100 pennies as an intuitive common sum scale for scoring the relative importance of subareas identified within the larger fishing grounds. It also provides us with a convenient accounting unit for aggregating the stated importance per unit area in the intermediary steps of the various analyses performed.

The non-spatial information related to demographics and basic operations is helpful in creating summary statistics and estimating basic operating costs (a necessary component of the socioeconomic impact assessment). These statistics are summarized in Section 4 of this report.

Throughout the project we strove to protect the confidentiality of the information provided by fishermen. In addition to obtaining the explicit consent of individual participants, we undertook several additional steps for protecting sensitive information. These included training field staff on confidentiality protocols, masking all names and identifying characteristics of shapefiles; incorporating new security features into OceanMap; showing draft aggregated maps for each fishery to no one outside the fishing community for review; developing a mechanism for incorporating the information into the MLPAI Geodatabase at sufficiently aggregated levels; and devising a display format that maintains the information content without making it visible, for use in stakeholder group meetings.

3.2. Analysis of the Fishing Grounds

The analysis of the fishing ground information follows a series of discrete steps:

3.2.1. Determining the Fishing Grounds

Through a set interviews (following the above protocols), fishermen are asked to identify their fishing grounds for a specific fishery. For the commercial fisheries, this is defined as a fishery per port (e.g. Dungeness crab – Bodega Bay). In order to determine the fishing grounds G for any given fishery, the fishing grounds identified by the fishermen (i.e. the area of each shape, j) is summarized. A fisherman's grounds are only considered in a fishery in which they land their catch in. For example, if a fisherman lands Dungeness crab in Bodega Bay and in San Francisco, his/her grounds are considered in both fishing grounds, but weighted proportionally to the amount of ex-vessel revenue attributed his/her catch in each port. This transformation only occurs for the commercial fishing grounds because we can attribute a value (ex-vessel revenue) from the DFG landing receipts.

Each fisherman f interviewed, identifies his/her fishing grounds G_f, per fishery as one or more shapes $G_f = \sum_{j=1\ldots i} j$. The number of shapes differs for each respondent and by fishery. If there is only one shape, then $G_f = j$.

Each shape j in fisherman's f's fishing grounds is then converted to a grid with a 250 meter (m) cell size. For example, in the Dungeness crab fishery, each shape identified by a fisherman now equals some number of 250m cells, so the total number of cells in one shape, $C_j = \sum_{c=1\ldots n} c_j$. The crab fishing grounds for each fisherman G_f, are now represented by the total number of cells for all of his/her shapes:

$$G_f = \sum_{j=1\ldots i} j = \sum_{j=1\ldots i} C_j$$

But, in order to normalize each shape by the total area, the entire crab fishing grounds G_{crab}, need to be determined. This will be used in a later step that effectively weights the response according to the relative size of the respondent's fishing footprint to the composite fishing grounds. The composite fishing grounds G_{crab}, are based on all the shapes provided by all fishermen, and it is necessary to account for the possible overlap of shapes identified by multiple fishermen. This is done by expressing whether a cell exists for j in any given location (cell) through the following equation:

$$G = \sum b$$

Where $b =$ result of the Boolean expression: does j exist for any i for location x, y. 1 = true, 0 = false.

If we were to just sum the number of cells of every j, identified by every f, the resulting sum would not be for a unique x, y location and count multiple occurrences in the same location. In other words, the fishing grounds of any one fisherman G_f, are smaller or equal to the total grounds for that fishery.

3.2.2. Determining Relative Importance

Each respondent allocates a budget, Ω, of 100 "pennies," representing his or her total effort for that fishery, by allocating some portion of pennies, P, to each shape, j, on their fishing grounds, G_f, such that $\sum p = 100$. Each shape j is now associated with a distinct number of cells, C_j, and a weight, P_j. Again, since a fisherman's grounds are considered in each port they land in, we weight his/her shapes by the amount of ex-vessel revenue landed in each port, Lp.

The value of each cell in the shape is then the number of pennies allocated to the shape multiplied by the ex-vessel revenue associated with a given port-fishery derived from the 2000-06 landing receipts and divided by the number of cells in the shape. The result is a weighted surface that accounts for the percentage of landings each fisherman makes to a given port and thus weights each fisherman's shapes according to catch rather then treating them equally.

So as not to overstate the relative importance of cells associated with shapes identified by fishermen who reported smaller fishing grounds (thus concentrating value in a sub-section of the composite grounds, G), we multiply the ex-vessel value for a given port-fishery combination Lp by the number of pennies allocated, divided by the number of cells to a shape, $((P_j * L_p)/C_j))$, and then multiply that value by the total number of cells for that fisherman's grounds, G_f, divided by the total number of cells in the composite fishing grounds for the entire shape (G_f / G). This weights the response according to the ex-vessel value specific to a port-fishery combination relative size of the respondent's fishing footprint, C_j, to the composite fishing grounds, G, or normalizes by the total area. This is for the commercial fishery analysis only. For the recreational fishery analysis, where there is no equivalent to the commercial ex-vessel revenues, we treat everyone's shapes equally.

Each cell for every given shape is now represented by the relative economic importance value normalized by the total area, or V,

$$V_j = ((P_j * L_p)/C_j)) * (G_f / G)$$

Where:

$L_p =$ the ex-vessel revenue associated with a given port-fishery

$P_j =$ the economic importance value of shape j

$C_j =$ the number of cells in shape j

$G =$ the total number of cells in the entire fishery

$G_f =$ the total number of cells in the fishing grounds of one fisherman

The result of this analysis is a weighted surface of the extent and stated importance of the fishing grounds for each port-fishery, which can be used in subsequent analyses as a crude estimate of gross economic ex-vessel revenue across the ocean landscape.

In the late summer of 2007, Ecotrust sent both letters and Emails with a link to our secure online review site. Individuals were able to view the data they contributed and provide feedback (i.e. suggest edits). Additionally, hard-copy maps were included in the letter for those respondents who did not have internet access. Participants also were given an opportunity to contact us directly with any necessary edits. We conducted further review of the aggregated data by sharing it with small groups of survey participants (i.e. by port group) in person- throughout the study region or via conference calls. Revisions from both the online review site and the group meetings were incorporated into subsequent analyses.

3.2.3. Socioeconomic Impact Assessment (Commercial)

The primary purpose of this analysis is to estimate the socioeconomic impacts to the commercial fishery sector associated with each of the MPA proposals. To accomplish this, we estimated the maximum potential economic impact for each of the MPA proposals using methods developed in the Central Coast process (see Wilen and Abbott, 2006). This analysis assumes that each of the MPA proposals completely eliminates fishing opportunities in areas closed to specific fisheries and that fishermen are unable to adjust or mitigate in any way (Wilen and Abbott, 2006). The results can then be used by each group (i.e. stakeholders, SAT, BRTF, Initiative staff, FGC) to site and evaluate MPA proposals. The remainder of this paper describes the steps needed to complete the maximum potential economic impact analysis.

1) Generate Baseline Estimates of Gross Economic Revenue

The first step involves calculating a baseline estimate from which to derive estimates of the socioeconomic impact associated with changes in commercial fisheries that might be induced by each MPA alternative and against which to compare those estimates. We generate the baseline estimate using gross fishing revenues from regional landing receipts. We use a 7 year average, 2000–2006, derived from the California Department of Fish and Game (CDFG) landing receipts reported for ports in the North Central Coast region and then convert these values into real dollars (i.e. 2006 dollars).

More specifically, to generate baseline estimates of gross economic revenue (GER), for any fishery, *f*, $BGER_f$ is the average ex-vessel value of the fishery in 2006 dollars, where

$BGER_f = \sum_{p \in P} BGER(f, p)$, the sum of the baseline estimates of GER for this fishery over all ports.

We also define the fisheries specific to each port, or in other words, create a baseline estimate of gross economic revenue for each port. For a specific port, *p*, being considered in the North Central Coast region the baseline estimate ($BGER_p$) can be calculated as the sum of the baseline estimates of GER for this port over all fisheries:

$$BGER_p = \sum_{f \in F} BGER(f, p)$$.

The baseline gross economic revenue ($BGER_{TOT}$) for all commercial fisheries ($f \in F$) being considered in the North Central Coast region is therefore

$$BGER_{TOT} = \sum_{f \in F} BGER_f = \sum_{f \in F} \sum_{p \in P} BGER(f, p)$$ or equivalently,

$$BGER_{TOT} = \sum_{p \in P} BGER_p = \sum_{p \in P} \sum_{f \in F} BGER(f, p)$$.

2) Generate Gross Economic Revenue for the Various MPA Alternatives

The next step involves using results from the Ecotrust mapping exercise, specifically the stated importance indices from the fishing grounds, to estimate the socioeconomic impact associated with changes in the commercial fisheries that might be induced by each MPA alternative. For a description of the methods used to create stated importance indices, please see Scholz et al. (2006b).

For any fishery, *f*, port, *p*, and any MPA alternative, *a*:

$$GER(f, p, a) = BGER(f, p) - GEI(f, p, a)$$

where $GEI(f, p, a)$ is the estimated gross economic impact on fishery, *f*, at any port, *p*, under any alternative, *a*.

Therefore, we define

$$GER_f(a) = \sum_{p \in P} GER(f, p, a) \quad \text{and} \quad GER_p(a) = \sum_{f \in F} GER(f, p, a)$$

as well as

$$GEI_f(a) = \sum_{p \in P} GEI(f, p, a) \quad \text{and} \quad GEI_p(a) = \sum_{f \in F} GEI(f, p, a)$$.

Gross economic revenue under any alternative, *a*, ($GER_{TOT}(a)$), for all commercial fisheries ($f \in F$) being considered in the North Central Coast region can be calculated as:

$$GER_{TOT}(a) = \sum_{f \in F} GER_f(a) = \sum_{p \in P} GER_p(a) = \sum_{f \in F} \sum_{p \in P} GER(f, p, a) = \sum_{p \in P} \sum_{f \in F} GER(f, p, a)$$

From this we can say for any MPA alternative, *a*,

$$GEI_{TOT}(a) = BGER_{TOT} - GER_{TOT}(a)$$

where GEI_{TOT_a} is defined as the total gross economic impact on all commercial fisheries under any alternative, *a*. Therefore,

$$GEI_{TOT}(a) = \sum_{f \in F} GEI_f(a) = \sum_{p \in P} GEI_p(a) = \sum_{f \in F} \sum_{p \in P} GEI(f, p, a) = \sum_{p \in P} \sum_{f \in F} GEI(f, p, a)$$.

3) Generate Baseline Estimates of Net Economic Revenue

In order to compute net economic benefits, we need to 1) estimate the share of gross fishing revenues represented by costs, and 2) scale the baseline estimate (i.e. gross fishing revenues) calculated in Step 1 using the estimated cost shares. In the Central Coast process, an estimate of 65% was used across all fisheries (Wilen and Abbott, 2006). In the North Central Coast process, we asked several cost related questions during interviews with fishermen in an effort to improve on this estimate as well as allow for the ability to account for cost variability between different fisheries. After all interviews were completed, we broke the cost data out by fishery or fisheries. For example, cost data for a fisherman who fished both salmon and crab would be aggregated with only other interviewees participating in both those fisheries. We then calculated a mean or median cost estimate for each category.

Costs were broken into two categories: fixed costs and variable costs. Fixed costs include costs that are independent of the number of trips a vessel makes or the duration of these trips. For example, vessel repairs and maintenance, insurance, mooring and dockage fees typically considered fixed costs. On the other hand, variable costs include costs that are dependent on the number of trips a vessel makes of the duration of these trips. Variable costs typically include fuel, maintenance, crew share, gear repair/replacement. For the purpose of this study, however, to account for sunk costs, we assume the only variable cost to be crew wages and fuel costs. All other costs were considered fixed costs.

For any fishery, *f*, net economic revenue is calculated as:

$$BNER_f = BGER_f - C_{X_f} - C_{V_f}$$

where C_{X_f} is the fixed cost associated with any fishery, *f*, and is set as a fixed dollar value, and C_{V_f} is the variable cost associated with any fishery , *f*, and is a fixed percentage of $BGER_f$. For further explanation, please see the example below.

Example of Estimate Costs

For fishery *f*, assume the following proportion of gross economic revenue goes to the following costs:

- 20% = fixed costs
- 20% = crew wages
- 10% = fuel costs → 30% = variable costs

Assume that baseline gross economic revenue equals $10,000.00. Under the baseline, fixed costs equal $2,000 and variable costs equal $3,000, resulting in total costs of $5,000. Assume that under MPA alternative *a,* gross economic revenue now equals $5,000. Under this alternative, fixed costs will still equal $2,000; however, variable costs will be recalculated as:
$5,000 * 0.3 = $1,500. This results in total costs of $3,500 under MPA alternative *a.*

Baseline net economic revenue ($BNER$) for <u>all</u> commercial fisheries ($f \in F$) being considered in the North Central Coast region can be calculated as:

$$BNER_{TOT} = \sum_{f \in F} BNER_f$$

4) Generate Estimates of Net Economic Revenue for the Various MPA Alternatives

In order to compute net economic revenue for each of the various MPA alternatives, we also need to a) estimate the share of gross fishing revenues represented by costs under each MPA alternative, and b) scale the estimated gross fishing revenues for that alternative accordingly. Costs will be calculated using the methods described in Step 3.

For any fishery, *f*, and any MPA proposal, *a*,

$$NER_f(a) = GER_f(a) - C_{X_f} - C_{V_f}$$.

For any MPA alternative, *a*, net economic revenue for all commercial fisheries ($NER_{TOT}(a)$) can be calculated as:

$$NER_{TOT}(a) = \sum_{f \in F} NER_f(a)$$

5) Generate Estimate of the Potential Primary Economic Impact for the Various MPA Alternatives
Using the results from the previous steps, the potential primary net economic impact (NEI) of a particular MPA alternative, *a,* on a particular fishery, *f,* can then be calculated as:

$$NEI_f(a) = BNER_f - NER_f(a).$$

The potential primary NEI of any MPA alternative, *a,* on all commercial fisheries ($f \in F$) can then be calculated as:

$$NEI_{TOT}(a) = BNER_{TOT} - NER_{TOT}(a).$$

3.2.4. Individual Impact Assessment (Commercial)

(Please refer to the Summary Report (Appendix C) for a detailed description of the Individual Impact Assessment for Commercial Fisheries)

3.2.5. Analysis of Existing Conservation Areas (Commercial)

(Please refer to Summary Report (Appendix C) for a detailed description of the Analysis of Existing Conservation Areas for Commercial Fisheries)

4. Results and Deliverables

To date, there are two data products (i.e. sets of maps) and two analytical products resulting from this study, all of which have been forwarded to the MLPAI. More specifically, the two sets of maps are port-fishery specific and study region aggregations for both the commercial (34 maps) and recreational (46 maps) fishing grounds (to view maps, see http://www.ecotrust.org/mlpa/NCC_Com_Maps_Final_080630.pdf and http://www.ecotrust.org/mlpa/NCC_Rec_Maps_Final_080630.pdf). The information depicted on the maps was also provided as raster data sets for all fisheries examined at the 250m cell size, and which served as the basis for the impact analysis. All datasets were accompanied by metadata conforming to the Federal Geographic Data Committee (FGDC) standards (http://www.fgdc.gov/standards).

The two analytical products are the, “Summary of potential impacts of the Integrated Preferred Alternative (IPA) and the North Central Coast Regional Stakeholder Group (NCCRSG) MPA proposals on commercial and recreational fisheries in the North Central Coast Study Region, Revised Draft (9 June 2008)” (see Appendix C) and the “Condensed Summary of the Draft (Revised 9 June 2008) (see Appendix D).

In addition to those products, supplemental results based on the information acquired through the interviews with commercial and recreational fishermen are summarized here.

4.1. Additional Summary Statistics

In addition to the information we collected from the participants about their fishing grounds, we also collected demographic information pertaining to their age, years experience fishing, percentage of income derived from fishing, vessel length, and haul capacity. Table 8 shows the minimum, maximum, median, mean result for each statistic at both the port and study region level. Based on the participants we interviewed, there is some variation across ports, but for the entire NCCSR the median respondent is fifty-eight years old, has twenty-nine years of experience fishing, 100% of his/her income is derived from fishing, and he/she uses a vessel thirty-seven feet long with a haul capacity of 6,000 kilograms.

Table 8: Summary statistics for commercial fishermen interviewed

		Age	Years Experience	% Income From Fishing	Vessel Length (in feet)	Haul Capacity (in kilograms)
Point Arena	Min	25	5	10%	16	500
	Max	66	35	100%	40	26,000
	Median	46	21	95%	26	3,500
	Mean	45	22	76%	28	7,321
Bodega Bay	Min	15	3	0%	12	400
	Max	83	65	100%	56	140,000
	Median	58	30	83%	38	6,000
	Mean	57	30	68%	36	11,564
Bolinas	Min	34	14	90%	16	800
	Max	55	37	100%	25	3,500
	Median	44	21	95%	20	1,200
	Mean	44	23	95%	20	1,675
San Fran.	Min	31	5	2%	21	500
	Max	78	61	100%	64	50,000
	Median	50	26	100%	38	9,000
	Mean	51	26	78%	37	11,538
Half-Moon	Min	36	10	18%	24	700
	Max	92	65	100%	100	150,000
	Median	58	33	100%	43	8,000
	Mean	55	34	85%	45	17,210
NCC	Min	15	3	0%	12	400
	Max	92	65	100%	100	150,000
	Median	53	29	100%	37	6,000
	Average	54	28	74%	36	11,694

Again, the stratification described in previous sections resulted in a total of 174 commercial fishermen interviewed. Of the 172 fishermen whose information was used, 145 consider their homeport to be inside the NCCSR. Table 9 summarizes the number of fishermen interviewed in each port and the number of

fisheries they participate in or provided information for out of the 8 commercial fisheries we targeted. For example, we interviewed seventy commercial fishermen who considered Bodega Bay to be their homeport. Out of those seventy fishermen interviewed, thirty-four participate in one fishery (either salmon or Dungeness crab), thirty-four participate in two fisheries (usually salmon and Dungeness crab) and the remaining two participate in three fisheries.

Table 9: Number of commercial fishermen interviewed by homeport and the number of fisheries in which they participate

		Number of Fisheries (out of 8)				
Ports	**Total Interviewed**	**1**	**2**	**3**	**4**	**5**
Point Arena	14	5	4	3	1	1
Bodega Bay	70	34	34	2	0	0
Bolinas	4	0	0	2	2	0
San Francisco	36	12	20	4	0	0
Half Moon Bay	21	7	9	4	0	1
NCC Total	145	58	67	15	3	2
Outside NCC	27	16	8	3	0	0
Total	172	74	75	18	3	2

In addition, we asked similar questions to the recreational fishermen we interviewed. More specifically, we captured information about their age, years of fishing, years operating a vessel, years owning a vessel, vessel length, number of individuals per trip and average number of days fished per year. Table 10 shows the minimum, maximum, median, mean result for each statistic for each user group and for the entire NCCSR.As described previously in Table 6, we interviewed a total of twenty-one CPFV fishermen, forty-nine private vessel fishermen, thirteen kayak fishermen, and eighteen pier/shore fishermen. It should be noted that years experience fishing is in general, not years experience fishing in a particular user group; all other statistics apply to the user group category specifically.

As described in detail in Table 10, the median statistics for each user group are:

CPFV - 55 years old, 40 years experience fishing, 28 years operating a vessel, 23 years owning a vessel, 43 feet in length, 12 individuals fishing per trip, and on average 155 day per year,

Private vessel - 52 years old, 42 years experience fishing, 27 years operating a vessel, 20 years owning a vessel, 25 feet in length, 3 individuals fishing per trip, and on average 30 day per year,

Kayak anglers - 38 years old, 32 years experience fishing, 7 years operating a vessel, 7 years owning a vessel, 15 feet in length, 1 individuals fishing per trip, and on average 50 day per year,

Pier/Shore anglers - 39 years old, 27 years experience fishing, 1 individuals fishing per trip, and on average 46 day per year.

Table 10: Summary statistics for recreational fishermen interviewed

		Age	Years Experience Fishing	Years Operating Vessel	Years Owning Vessel	Vessel Length (in feet)	Individuals per Trip	Average Number Days Fished
CPFV	Min	31	15	5	1	26	2	50
	Max	73	60	60	60	65	40	200
	Median	55	40	28	23	43	12	155
	Mean	54	38	28	22	43	14	141
Private Vessels	Min	30	9	4	4	18	2	10
	Max	69	60	50	43	48	6	150
	Median	52	42	27	20	25	3	30
	Mean	52	40	27	22	26	3	39
Kayak	Min	27	7	3	3	12	1	11
	Max	55	40	35	35	16	4	100
	Median	38	32	7	7	15	1	50
	Mean	39	29	9	9	15	1	45
Pier/shore	Min	21	3	—	—	—	1	12
	Max	66	60	—	—	—	3	150
	Median	39	27	—	—	—	1	46
	Mean	41	29	—	—	—	1	61

4.2. Analytical Products

During the winter and spring of 2007–08, Ecotrust staff conducted a series of analyses on the various MPA proposals under consideration. The goal was to assess the relative maximum potential impacts of the proposals, both in terms of the area of fishing grounds affected and the stated importance of those areas. As expected, our analysis showed that all areas are not valued equally, and some areas are more important to a fishery or fisheries than other areas. Such a finding suggests that even a small closure can have a large impact, expressed in units of stated importance. The summary of these analyses was forwarded to Blue Ribbon Task Force in May 2008 and to the Fish and Game Commission in June 2008, and is included in Appendix C.

Ecotrust is committed to keeping in the public domain as much information as possible about the methods and tools we use, and will make available the specific Arc Macro Language (AML) code used for interpreting and analyzing the data to researchers interested in replicating this research.

As we will discuss further in the next section, the products discussed in this section are not an exhaustive list of products that could be created using the fishing grounds data collected as a part of this study.

5. Discussion and Conclusion

There are several methodological and process lessons that are worth reflecting on, in the hope of informing future iterations or applications of this approach. We also describe some opportunities for further analysis.

5.1. Weighting of Participants Shapes

In the Central Coast process, each participant or fisherman's grounds were given equal treatment in the analysis, starting with the summarized weighted surface for each fishery. Given the novelty of this project's approach and the timeframe in which it was conducted, we had not fully explored the potential ways in which this information could be analyzed. One of the many suggestions from the fishing community received during and after the Central Coast process was that we should consider weighting each fishermen's individual fishing grounds based on some measure of experience or success—potential measures include years experience, percentage of income derived from fishing, percentage of income from a particular fishery investigated, and ex-vessel revenue, which is captured in the CDGF landing receipts. We explored all of these potential weights suggested and decided that, since the goal of the project was to analyze the gross and net economic impacts for each of the MPA network proposals as they were being designed, we needed to create a weighted surface across the ocean landscape that characterized a crude estimate of gross revenue. Consequently we weighted each fisherman's shapes by multiplying the number of "pennies" for a given shape and for a given port-fishery by the landings attributed to each fisherman for each port-fishery combination or average ex-vessel revenue, 2000-06. More specifically, we multiplied the number of "pennies" by the proportion of in-study region landings or average ex-vessel revenue, 2000-06 per fishermen, specific to each port-fishery. This results in a crude revenue-based weighted surface that represents the stated importance of different areas for each port-fishery. Again, this was done so that we could attribute a fisherman's grounds to each port he/she landed at over the last seven years (2000-06). For example, if a fisherman landed salmon in both Bodega Bay and San Francisco, then his/her shapes are used in both maps and weighted based on the percentage of ex-vessel revenue reported to each port in the CDFG landing receipts, 2000-06. The final aggregated maps for each port then represented who lands there, not who homeports there because pounds and ex-vessel revenue are recorded in the CDFG landing receipts by where fish are landed, not by a fisherman's homeport. The home port information is only captured during the interview, but we do not know what that represents in terms of the total commercial fishing population for a given port. The resulting maps are then presented and used by the MLPAI process in sets for each fishery, one map of the fishery for the entire NCCSR and a map for each fishery specific to each landing port in which that fishery occurs. Both study region maps and port specific maps were made available and considered by the NCCRSG as they designed their MPA network proposals.

The time period of 2000-06 was chosen for consistency across all fisheries due to limitations in categorizing DFG landing receipts prior to 2000 for the nearshore and deeper nearshore fisheries. The CDFG Nearshore Fisheries Management Plan was designed, drafted, and implemented in 2001-02. In order to identify individuals to interview for these fisheries, we examined and targeted those individuals who target rockfish and hold a nearshore or deeper nearshore fishing permit. Information for 2007 was not available when the analysis was conducted.

5.2. Timing

Conducting detailed, fieldwork based, participatory research concurrently with a sometimes contentious policy process is ambitious—especially when the work period coincides with the summer fishing season. Ideally, detailed information about the fishing grounds and their relative importance would be available to decision-makers prior to the beginning of a policy process. Timing is always going to be a constraint in the MLPAI process, especially when trying to gain a statistical representation of the region's fishing fleet. In should be noted that timing can be improved considerably by making explicit arrangements to either conduct research prior to the policy process and at times more convenient for the participants.

In the case of this project, we were able to collect data in the field, analyze the results in a manner that they could be used by the NCCRSG and verified by the fishing community. The results were presented to the NCCRSG in a timely manner, which assisted them in their process of siting the placement of MPAs. This is a significant improvement over the Central Coast process where the timeline from collecting data to reviewing results and displaying them in a manner that was acceptable to the fishing community never fully aligned with the meetings of the Regional Stakehodler Group there. In the North Central Coast process, by contrast, stakeholders had all of the information, both biological and socioeconomic at their disposal before they started to design their MPA network proposals. This also may have contributed to the Integrated Preferred Alternative MPA network proposal having about half of the economic impact as the proposal that was accepted in the Central Coast, with both placing approximately the same amount of area proportional to the total area in each study region in MPAs.

The exact timing of when data was collected in the field and delivered to the process is outlined below.

Data collected from commercial fishermen: June 28 – August 18
Data collected from recreational fishermen: September 8 – Nov. 8

Commercial fishing grounds presented and used by the NCCRSG: October 16-17
Recreational fishing grounds presented and used by the NCCRSG: December 11-12

Final proposals developed and presented to the Blue Ribbon Task Force: April 22-23

5.3. Scale and Stratification of Fisheries

One of the many improvements made to this study when compared to the work done in the Central Coast process was to stratify the fisheries by geographical port groups and examine each fishery for each port individually, rather then just considering a fishery for the entire study region. More specifically, for each of the major commercial ports in the region (Point Arena, Bodega Bay, Bolinas, San Francisco, and Half Moon Bay) we used the CDFG landing receipts to stratify our sample so that we would target participations for a given fishery in each port (see Tables 3 and 4). This allowed us to create maps of the fishing grounds that characterized the value and spatial extent for each fishery in each port if the fishery occurred there. In turn, this allowed us to further analyze and report the potential economic impacts for each fishery in each port and in the study region as a whole, whereas in the Central Coast we only evaluated the potential economic impacts for each fishery at the study region level.

Another improvement to the stratification of our commercial fisheries sample was that we grouped species, where applicable, based on how they are targeted or managed. One example of this is in the Central Coast study we collected information for specific species that make up the nearshore fishery or deeper nearshore fishery, whereas in the North Central Coast we targeted fishermen and captured their information based on having a nearshore and\or deeper nearshore fishery permit and asked them to provide their fishing grounds for nearshore species and deeper nearshore species collectively, rather then each species individually. This approach was applied to the coastal pelagics fishery as well.

5.4. Quality Assurance/Quality Control

This project used valuable lessons learned in the Central Coast project to improve quality assurance and quality control mechanisms. The two primary changes made related to questions of confidentiality and verification of information collected.

With respect to the issue of confidentiality, the protocol we developed for this project conforms to human subject standards used at the University of California and elsewhere in academic research. Given the sensitive nature of fishing ground maps and the economic information they contain, at least implicitly, we took additional measures to mask individual informants, and gave the fleet control over what, if any, information they wanted to display publicly, in the NCCRSG meetings.

In the Central Coast process, an incident involving a well-intentioned field staff is illustrative of the special nature of this information and the extra care required in working with it; wanting to illustrate the mapping protocol, she showed the shapes of a previous respondent (A) to a second respondent (B). Even though no identifying information was shared, respondent B thought he recognized the fishing grounds, and called respondent A, who promptly called Ecotrust staff demanding an explanation. We were able to reassure respondent A, and he opted to continue his participation in the project. Since it is not generally the case that fishermen can recognize each other's grounds, we had not foreseen this possibility, and used this incident to sharpen our protocols for field staff working on the North Central Coast project. Specifically, they were instructed to never use actual shapes for demonstration purposes. Because of this change, no similar incidents were encountered in the North Central Coast project.

With respect to data verification, the main mechanism for verifying the data collected in the Central Coast project was individual and group meetings with respondents and others in each fleet. This provided sometimes very detailed verification and sign-off on the extent and relative importance of the fishing grounds for each fishery. Internally, at Ecotrust, we employed several QA/QC protocols that were designed to catch inconsistencies and other problems with the data. For example, we ran an automated check to make sure each respondent's shapes and weights add up to the 100 pennies. In addition to these protocols, there were several additional process improvements we were able to make during the North Central Coast process.

Ecotrust also designed and implemented a secure web-based mapping interface that fishermen were able to log-in to and verify that their individual information was correct, or if not, they were given the opportunity to describe any changes that needed to be made. Out of the 174 fishermen interviewed, eighty-three provided e-mail addresses, which we used to follow up with them using the method described above. Of those eighty-three, twenty-four verified their information using the secure on-line verification system. Recognizing that not every fisherman has access to the internet or may not want to verify their results electronically, each fisherman was also sent a letter and a copy of there fishing grounds. They were asked to respond if any changes needed to be made; if they didn't respond after a three week time period, it was assumed that the information they provided was correct. This method of verifying the information collected resulted in only a handful of fishermen who responded.

After each fisherman had the opportunity to verify their individual results, we created aggregated maps for each port-fishery. Those resulting maps were then reviewed at meetings held in ports and circulated electronically through key members of the fishing community to verify for accuracy and intended display for use by the RSG. The timing of the review process was somewhat constrained, making it difficult to conduct meetings were everyone was notified and could be available to participate. Alternatively, circulating the maps electronically assured that the review process did occur and that key individuals, particularly, members of the fishing community that were on the NCCRSG had a chance to review and approval all maps before they were submitted to the MLPAI process.

5.5. Further Analysis

There are several avenues for further analysis that we are actively exploring. As we already explored in using our data from the Central Coast region, the fishermen-derived information can be used in other computer-based decision support system to explore the range of best options for balancing ecological and socioeconomic objectives of MPA design (Klein et al. 2008a; Klein et al. 2008b). We anticipate continuing to build on our work in the MLPA process for advancing the methodological and computational approach for assisting MPA design. Specifically, we are working with a sub-team of the MLPA's Science Advisory Team on approaches for using a simulation technique (Marxan) for effectively identifying fishing grounds that are of most or least importance to both commercial and recreational fisheries. Anticipating considerable potential conflicts between recreational and commercial interests in Southern California, we anticipate that the resulting aggregated maps that show areas that are more or less relevant for a number of distinct fisheries could be a valuable information product as the southern California stakeholder group commences its work.

In a related effort, we are also working with a group of modelers on the SAT on using our data to parameterize the dynamic population models developed in the North Central Coast (referred to as the UC Davis and EDOM model, respectively, in the SAT materials). As the group begins adapting these dynamic models to the Southern California Study Region, we will use our data to a) compare their outputs to our analysis, since both dynamic and static approaches should yield congruent results for the baseline case with no MPAs, and b) parameterize the models using the new fishing ground data for the South Coast.

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Appendices:

Appendix A: Scope of Work (Commercial Fisheries)
Appendix B: Scope of Work (Recreational Fisheries)
Appendix C: Summary Report
Appendix D: Condensed Summary Report
Appendix E: Port Profiles
Appendix F: Consent Form (English Version)
Appendix G: Consent Form (Vietnamese Version)

Appendix A: Scope of Work (Commercial)

COASTAL CONSERVANCY

Staff Recommendation
May 24, 2007

NORTH CENTRAL COAST SOCIOECONOMIC DATA COLLECTION

File No. 06-109-03
Project Manager: Christine Blackburn

RECOMMENDED ACTION: Consideration and possible Conservancy authorization to disburse to Ecotrust up to $200,000 of funds previously authorized to implement the Ocean Protection Council Department/Fish and Game joint work plan. These funds will be used consistent with the Marine Life Protection Act to collect socioeconomic data in the north central coast study region.

LOCATION: North central coast study region, five miles north of Point Arena to Pigeon Point

PROGRAM CATEGORY: Integrated Coastal and Marine Resources Protection

EXHIBITS

Exhibit 1: January 18, 2007 staff recommendation and
OPC-DFG work plan

RESOLUTION AND FINDINGS:

Staff recommends that the State Coastal Conservancy adopt the following resolution pursuant to Section 31220 of the Public Resources Code:

"The State Coastal Conservancy hereby authorizes the disbursement to Ecotrust of an amount not to exceed two hundred thousand dollars ($200,000) of funds previously authorized to implement the Ocean Protection Council–Department of Fish and Game joint work plan. These funds will be used to collect socioeconomic data in the north central coast study region of the Marine Life Protection Act."

Staff further recommends that the Conservancy adopt the following findings:

"Based on the accompanying staff report and attached exhibits, the State Coastal Conservancy hereby finds that Ecotrust is a nonprofit organization existing under the provisions of U.S. Internal Revenue Code section 501(c)(3), whose purposes are consistent with Division 21 of the Public Resources Code."

PROJECT SUMMARY:

Staff is recommending that the Conservancy authorize the disbursement of up to $200,000 to Ecotrust of funds previously authorized to implement the Ocean Protection Council (OPC)–Department of Fish and Game (DFG) joint work plan. These funds will be used to collect socioeconomic data in the north central coast study region of the Marine Life Protection Act (MLPA).

In January 2007, the Coastal Conservancy authorized the disbursement of up to $4,215,000 for data collection, analysis, monitoring, and other actions to implement the Marine Life Protection Act and Marine Life Management Act as specified in the OPC–DFG joint work plan. It was anticipated at that time that portions of the work plan would be implemented by means of grants to nonprofit organization or other entities having an interest in, and the ability to execute, relevant work plan tasks. The original Conservancy staff recommendation and joint work plan are attached as Exhibit 1.

Component A8 of this work plan calls for preliminary socioeconomic data collection for the MLPA process in the next study region so that these data may be taken into account while planning the next regional network. On December 21, 2006, the north central coast (five miles north of Point Arena to Pigeon Point) was named as the next region. In February, the MLPA Blue Ribbon Task was appointed and the regional stakeholder process was initiated, led by the MLPA Initiative staff. Socioeconomic data are needed for the fall portion of the stakeholder process when groups will begin to analyze different options for marine protected areas (MPAs) in the region.

Project Details:

Ecotrust collected socioeconomic data in the first MLPA study region—the central coast—by compiling and mapping expert knowledge from fishermen to create a comprehensive picture of commercial fishing use patterns in the region. Numerous reviews of the previous Ecotrust project were conducted. These reviews concluded that the work performed by Ecotrust constituted an innovative and vital contribution to the understanding of fisheries and to the engagement of fishermen in participatory research. However, there were also several critiques of the methods used and suggestions for improving the study if the MLPA process proceeded. The proposed project incorporates both suggestions made by these reviewers and additional lessons learned from the Ecotrust Central Coast project.

The project will use a sampling design similar to the one implemented in the Central Coast process; data will again be collected through interviews with fishermen using Oceanmap, a GIS-based data system. Once the data has been collected and reviewed by an Ecotrust analyst, interviewees will be able to verify the accuracy of the information they provided using a secure internet-based application. Ecotrust will design and create this application in order to allow participants to validate their information without the need for group meetings, which proved costly and time intensive in the Central Coast project. After each fisherman reviews and verifies his or her data, composite datasets of the fishing grounds will be created for each fishery to preserve the confidentiality of individual fishing areas. The information and maps will then be analyzed and presented such that they can be incorporated into existing decision-support tools and databases developed for the MLPA process, affording managers and stakeholders the ability to design and assess the potential socioeconomic effects of MPA network alternatives.

Major components of proposed project include:

1. Conducting outreach and education
2. Fine-tuning survey design
3. Field data collection
4. Quality Assurance/Quality Control
5. Analysis and evaluation of the commercial fishing grounds
6. Socioeconomic impact analysis
7. Providing data for use by stakeholders
8. Customizing outputs to the needs identified by:
    a. MLPA Regional Stakeholder Group
    b. MLPA Science Advisory Team
    c. Blue Ribbon Task Force
    d. MLPA Initiative staff
    e. Fish and Game Commission
9. Documentation/Dissemination of project methods and results

Project Timeline:

Due to the fast pace of MLPA process, Ecotrust has already started work on this project to provide completed products by the desired date. Outreach and education, identification of target interviewees and hiring and training of field staff will run concurrently. Furthermore, development of the analysis and on-line components will also run concurrently with the interview process. Ecotrust estimates three teams of two interviewers in the field can complete the required number of interviews within the designated time frame. If approved, the Conservancy grant will reimburse Ecotrust for work completed to date, as well as going forward.

Grantee:

Ecotrust is a conservation and economic development organization that works to strengthen communities and the environment from Alaska to California. They work with native peoples and in the fisheries, forestry, and farming sectors to build a regional economy that is based on social and ecological opportunities. These efforts are predicated on the notion that economic and ecological systems are mutually interdependent. The Ecotrust team conducted a similar study in the previous MLPA region, provided that data to stakeholders and decision makers, and incorporated reviewed and lessons learned from that process into this proposed project. The Ecotrust staff have also continued to improve the computer based tools they will use to present the data to numerous groups, making the data easier to understand and more useful in analyzing alternative MPA package options.

PROJECT FINANCING:

Coastal Conservancy	$200,000
Total Project Cost	**$200,000**

Funding for this grant will be derived from the $4,215,000 authorization by the Conservancy in January 2007 for the implementation of the MLPA and the Marine Life Management Act. The source of Conservancy funds is a direct appropriation from the General Fund to the Conservancy in the FY 2006/07 Budget, which reads as follows:

> "Of the funds appropriated in this item, $8,000,000 shall be available for implementation of the Marine Life Protection Act and Marine Life Management Act. These funds shall be expended pursuant to a plan developed jointly by the Ocean Protection Council and the Department of Fish and Game. The plan shall be submitted to the chairpersons of the fiscal committees in each house of the Legislature and the Chairperson of the Joint Legislative Budget Committee."

OTHER COMPLIANCE:

As an element of the approve OPC–DFG joint work plan, the project is consistent with the authorities, criteria, and requirements described in the Conservancy staff recommendation of January 18, 2007, attached as Exhibit 1.

Appendix B: Scope of Work (Recreational)

Exhibit A

Scope of Work

According to the separate memorandum of understanding ("MOU") between the Resources Agency ("Agency"), the Department of Fish and Game ("Department") and Resources Legacy Fund Foundation ("RLFF"), RLFF has agreed to fund professional services for the Marine Life Protection Act (MLPA) Initiative, a public-private partnership between the Agency, the Department, and RLFF.

Professional Services

Ecotrust shall partner with the U.S. Geological Survey to characterize recreational fishing areas of relative importance in the MLPA Initiative North-Central Coast study region that will be made available to the North-Central Coast Regional Stakeholder Group to facilitate MPA planning. Specific activities include:

- Focus research across the entire range (opposed to 3-mile limit) of the following five primary fisheries: Chinook salmon; rockfish/lingcod complex; California halibut; Dungeness crab; and abalone.

- Assess differing values of fishing groups between the following primary user types: kayak and human-powered vessels; motor-powered private vessels (including possible stratification by vessel length); commercial passenger fishing vessels (including "6-packs"); and shore-based anglers and divers by:
    - Using Ocean Map to conduct field interviews with selected individuals of the primary user groups to ascertain basic information such as vessel size, years operating vessel, fisheries participated in, and access point.
    - Collecting site-specific information on fishing grounds and delineating the locations in real-time within GIS.
    - Implementing a spatial weighing approach used by Ecotrust in evaluation of relative areas of importance in commercial fisheries.
    - Aggregating weighted spatial data for each interviewee using common geospatial and statistical techniques to produce a single map for each fishery depicting relative areas of importance.

- Provide an analysis of MPA citing alternatives for various recreational user types for use by the MLPA Science Advisory Team and North-Central Coast Regional Stakeholder Group.

Deliverables and Due Dates

- Sampling protocol identified and documented. Due Date: August 1, 2007.
- Field teams hired and trained. Due Date: August 10, 2007.
- Begin interviews. Due Date: August 15, 2007.
- Complete interviews. Due Date: October 14, 2007.
- Presentation to North-Central Coast Regional Stakeholder Group on preliminary products. Due Date: October 16, 2007.
- Presentation to MLPA Blue Ribbon Task Force of final products. Due Date: November 29, 2007.
- Presentation of final products to North-Central Coast Regional Stakeholder Group. Due Date: December 11-12, 2007.
- Analysis of MPA alternatives presented to MLPA Blue Ribbon Task Force with report. Due Date: January 23-24, 2008.

Key Staff

- Astrid Scholz, Ecotrust
- Benjamin M. Sleeter (USGS)

Point of Contact

Contractor will work at the direction of the MLPA Initiative Executive Director for matters pertaining to services and work products. For matters pertaining to compensation and reimbursement associated with this contract, Contractor will report to California Coastal and Marine Initiative (CCMI) Program Analyst Robin Jenkins at (916) 442-4880 or rjenkins@resourceslawgroup.com.

Appendix C: Summary Report

Summary of potential impacts of the Integrated Preferred Alternative (IPA) and the North Central Coast Regional Stakeholder Group (NCCRSG) MPA proposals on commercial and recreational fisheries in the North Central Coast Study Region

Draft, Revised 9 June 2008

Astrid Scholz, ajscholz@ecotrust.org, Sarah Kruse, Matt Weber, Charles Steinback and Mike Mertens

1. Introduction

In order to conduct an analysis of the relative effects of MPA proposals on commercial fisheries that are conducted in the waters in the North Central Coast Study Region (NCCSR), we use data layers characterizing the spatial extent and relative stated importance of fishing grounds for eight commercial fisheries (California halibut, coastal pelagics, market squid, deeper nearshore rockfish, nearshore rockfish, urchin, Dungeness crab and salmon). This information was collected during interviews in the summer of 2007, using a stratified, representative sample of 174 commercial fishermen whose individual responses regarding the relative importance of ocean areas for each fishery were standardized using a 100-point scale and normalized to the reported fishing grounds for each fishery.

Additionally, we conduct an assessment of the relative effects of the MPA proposals on key recreational fisheries conducted in the waters in the North Central Coast Study Region. In order to complete that analysis we use data layers characterizing the spatial extent and relative stated importance of recreational fishing grounds for four recreational fisheries (California halibut, Dungeness crab, salmon, rockfish/lingcod complex, and striped bass – pier/shore only). Recreational fishermen are also broken out by user group (i.e. commercial passenger fishing vessels, private vessels, kayak based, and pier/shore based) and by sub-region (i.e. Region 1 - Ocean Beach in San Francisco County, Region 2 - San Francisco Bay access points to Point Reyes and Region 3 - Point Reyes north to Alder Creek). This information was collected during interviews in the summer of 2007, using a stratified solicited sample of 101 recreational fishermen whose individual responses regarding the relative importance of ocean areas for each fishery were standardized using a 100-point scale and normalized to the reported fishing grounds for each fishery.

Using the normalized data described above, we 1) evaluate the potential impacts on the commercial and recreational fishing grounds and 2) conduct a socioeconomic impact analysis on commercial fisheries in order to assess the effects of the Integrated Preferred Alternative (Proposal IPA) relative to the NCCRSG MPA proposals (Proposal 1–3, Proposal 2–XA and Proposal 4). Results are reported at both the study region and port group levels for the commercial fisheries. Port groups have been defined as: Bodega Bay, Point Arena, Bolinas, San Francisco and Half Moon Bay. Recreational fishery results are reported by user group and sub-region.

It should be noted that, with respect to the recreational fishery analysis, the use of a stratified solicited sample limits the use of traditional statistical measures—for example, confidence intervals—meaning they may not deliver their advertised precision. Nevertheless, this approach does allow us to make broad generalizations about preferences of the overall recreational fishing population and the four user groups within the study area, adding increased thematic resolution to the MLPA decision-making process.

2. Overview of Commercial Fisheries

The commercial fisheries considered in this analysis are of varying importance in terms of ex-vessel revenues. Table 1 provides estimates of each fishery's share of NCCSR and California commercial fishing revenues, using a 7-year average of ex-vessel revenues (in 2006 dollars) between 2000 and 2006.[5] For example, Dungeness crab accounts for 52.8% of the NCCSR landings (ex-vessel revenue), but only 9.9% of the state totals. Furthermore, 31.2% of all Dungeness crab landed in California was landed in NCCSR ports. Tables 2–6 provide the same information as Table 1 at the port group level.

[5] A review of NCCSR fishery trends in terms of 1) pounds landed, 2) ex-vessel value and 3) ex-vessel value per fisherman over the 7-year period showed that while fluctuations have occurred, neither upward nor downward trends appear to dominate the fisheries as a whole. Given this, and the need to choose a metric representative of all fisheries being considered in this analysis, a simple average approach was chosen.

Table 2: Summary of NCCSR fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in NCCSR, 7-year average (2000–2006)
California Halibut	1.8%	0.3%	20.3%
Coastal Pelagics	0.2%	0.0%	0.4%
Market Squid	1.9%	0.4%	1.2%
Deeper Nearshore Rockfish	0.7%	0.1%	24.0%
Nearshore Rockfish	1.0%	0.2%	7.1%
Urchin	5.5%	1.0%	8.6%
Dungeness Crab	52.8%	9.9%	31.2%
Salmon	36.3%	6.8%	52.7%

Table 3: Summary of Point Arena fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in Point Arena, 7-year average (2000–2006)
California Halibut	—	—	—
Coastal Pelagics	—	—	—
Market Squid	—	—	—
Deeper Nearshore Rockfish	0.0%	0.0%	0.3%
Nearshore Rockfish	0.4%	0.1%	3.0%
Urchin	3.8%	0.7%	6.0%
Dungeness Crab	0.3%	0.1%	0.2%
Salmon	0.5%	0.1%	0.7%

Table 4: Summary of Bodega Bay port group fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in Bodega Bay, 7-year average (2000–2006)
California Halibut	0.1%	0.0%	1.4%
Coastal Pelagics	—	—	—
Market Squid	—	—	—
Deeper Nearshore Rockfish	0.2%	0.0%	5.5%
Nearshore Rockfish	0.3%	0.0%	1.9%
Urchin	1.6%	0.3%	2.5%
Dungeness Crab	14.6%	2.7%	8.6%
Salmon	12.6%	2.3%	18.3%

Table 5: Summary of Bolinas fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in Bolinas, 7-year average (2000–2006)
California Halibut	0.1%	0.0%	1.7%
Coastal Pelagics	—	—	—
Market Squid	—	—	—
Deeper Nearshore Rockfish	0.0%	0.0%	0.5%
Nearshore Rockfish	—	—	—
Urchin	—	—	—
Dungeness Crab	0.7%	0.1%	0.4%
Salmon	0.1%	0.0%	0.2%

Table 6: Summary of San Francisco port group fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in San Francisco, 7-year average (2000–2006)
California Halibut	1.3%	0.2%	14.7%
Coastal Pelagics	—	—	—
Market Squid	—	—	—
Deep Nearshore Rockfish	0.4%	0.1%	13.2%
Nearshore Rockfish	0.3%	0.1%	2.1%
Urchin	0.1%	0.0%	0.1%
Dungeness Crab	22.7%	4.2%	13.4%
Salmon	13.4%	2.5%	19.5%

Table 7: Summary of Half Moon Bay fisheries considered in analysis

Fishery	% of total NCCSR fisheries revenues, 7-year average (2000–2006)	% of total CA statewide fisheries revenues, 7-year average (2000–2006)	% of CA statewide fisheries revenues landed in Half Moon Bay, 7-year average (2000–2006)
California Halibut	0.2%	0.0%	2.5%
Coastal Pelagics	0.1%	0.0%	0.2%
Market Squid	1.3%	0.2%	0.8%
Deeper Nearshore Rockfish	0.1%	0.0%	4.5%
Nearshore Rockfish	0.0%	0.0%	0.2%
Urchin	—	—	—
Dungeness Crab	14.5%	2.7%	8.6%
Salmon	9.6%	1.8%	14.0%

3. Impact on Commercial Fishing Grounds: Approach

The four MPA proposals under review vary according to their spatial extent and the commercial fisheries they affect. More specifically, they vary by the number and types of fisheries permitted within the boundaries of particular MPAs within a network. Furthermore, study area fisheries themselves vary in spatial extent and frequently overlap. Most of them are conducted in fishing grounds that extend beyond the state waters of the NCCSR, and we report the effects both in terms of total fishing grounds (G) and those that fall within the study area (SA) (i.e. zero to 3 nautical miles from shore). Since any one MPA may have different effects on different fisheries, and different fisheries may be affected differently by all MPAs, it is necessary to consider single MPAs and single fishery uses independently. Note that because current fishery closures affect all proposals equally, they have no differential effect.

A key assumption of this analysis is that each of the MPA proposals completely eliminates fishing opportunities in areas closed to specific fisheries and that fishermen are unable to adjust or mitigate in any way. In other words, the analysis assumes that all commercial fishing in an area affected by a MPA would be lost completely, when in reality it is more likely that effort would shift to areas outside the MPA. The effect of such an assumption is most likely an overestimation of the impacts, or a "worst case scenario."

We conduct an overlay of each MPA with each fishery considered in this study. MPAs are grouped according to level of protection, using the same levels of protection as elsewhere in the Science Advisory Team (SAT) evaluations. In other words, for each MPA and protection level within each proposal, we assess the commercial fisheries that would be affected.

We compile results in a series of spreadsheets, summarizing the effects of the various MPA proposals on commercial fisheries, both in terms of the area affected and the relative value lost. We use the same analytical methods as those developed in the Central Coast process (see Scholz et al., 2006), creating a weighted surface that represents the stated importance of different areas for each fishery. More specifically, we multiply these stated importance values by the proportion of in-study region landings (by landing port and by fishery). The percentage of area and value affected is calculated based on the grounds identified within the NCCSR, not for the whole state of California. These estimates then feed into the socioeconomic impact analysis.

4. Impact on Commercial Fishing Grounds: Assessing MPA Proposals

The percentage change in area and value for each of the commercial fisheries (both for the study region and by port group) were determined by the intersection of each MPA proposal and the fishing grounds specific to that fishery. Each MPA within a proposal was classified by whether it would affect the fishery or not. If a fishery was affected by a MPA, the area and value were summarized and then divided by the total area and value for the entire fishing grounds (G) as derived from interviews with fishermen, and the total study area (SA).

The total percentage of area and value affected for the total fishing grounds and the grounds inside the study area are then summarized for all MPAs affecting each fishery per proposal. MPA proposals vary considerably in their effects, both between and across fisheries, as illustrated in the Tables 7–10.

For example, Proposal 4 has lesser effects (both in terms of study area grounds and value) on the salmon fishery in San Francisco than on either the nearshore rockfish or deeper nearshore rockfish fisheries for this port (see Tables 8 and 10). Illustrating another set of effects, Proposal 1–3 affects 2.8% of the total Dungeness crab fishing grounds (area) for Bodega Bay (see Table 7), but affects 16.3% when considering only those fishing grounds that fall into the (nearer to shore) study area waters (see Table 8). In addition, from Table 3, the Dungeness crab fishery in Bodega Bay constitutes approximately 15% of study area commercial fisheries. In some cases, alternatives can have markedly different effects on area and relative "value". For example, for the Point Arena salmon fishery, Proposal 2–XA affects 9.3% of the study area fishing grounds, but 26.5% of stated importance.

For the commercial deeper nearshore and nearshore rockfish fisheries, we evaluate the additional impacts that potentially occur when considering the existing fishery management area closures and/or fishery exclusion zones, specifically the 2007 and 2008 Rockfish Conservation Area Non-Trawl persistent closure (30 fm – 150 fm) and the closure between the shoreline and 10 fm around the Farallon Islands (Southeast Farallon Island, Middle Farallon Island, North Farallon Island, and Noon Day Rock). We also consider the proposed 2009 Rockfish Conservation Area Non-Trawl persistent closure (20 fm – 150 fm).

The fishing grounds, as defined by the fishermen through the interview process, represent the total area and value regardless of these existing or potential fishery management closures and/or fishery exclusion zones. In order to evaluate the effect of such closures, the fishing grounds that fall inside those areas were removed, and the value associated with the removed area redistributed to the remaining fishing grounds outside the closed areas. In other words, values were redistributed across only what could be considered the available fishing grounds in proportion to their relative value as derived from the interviews. Table 11 represents the percentage of the total fishing grounds value impacted when considering just these fishery management closures, not including any additional impacts of proposed MPAs. For example, after the value associated with the fishing grounds that fall inside the 2007 closure is removed, the impact to the Bolinas deeper nearshore rockfish fishing grounds is 60.8%, in terms of value. Similarly, 72.3% impact to the fishery from the 2008 fishery closures and 81.2% impact in 2009.

Using the same method described above, we determine the percentage change in value by the intersection of each MPA proposal with the total fishing grounds now constrained to areas not inside the closed areas, i.e., the "available fishing grounds". Table 12 compares the percentage of value affected for the available fishing grounds summarized for all MPAs affecting each rockfish fishery per proposal with the same effects for those fisheries without consideration of fishery management closures reported in Table 9. Similar to the results presented in Tables 7–10, MPA proposals vary considerably in their effects, specifically across ports. For example, marginal decrease or no increase in impact is shown to occur for the deeper nearshore fisheries in Point Arena and Half Moon Bay. This is due to the fact that identified fishing grounds are almost entirely in waters less then 30 fathoms. This is also true for the nearshore fishery in all NCCSR ports. Conversely, we see a substantial increase in impacts to the deeper nearshore rockfish fishery for Bolinas across all proposals. This increase in impacts is largely due to the value that Bolinas deeper nearshore rockfish fishermen associate with the Farallon Islands, specifically North Farallon Island. When comparing the impacts of a proposal between the total fishing grounds and the available fishing grounds (Table 12), where there is marginal or no difference also indicates that there is a high degree of overlap between the proposed MPAs and the existing closed areas. Where there is a large difference between the impact of the total fishing grounds and the available fishing grounds indicates that the MPA proposal is impacting additional fishing grounds that are not already impacted by the exisiting fishery management closures.

We also evaluate if there are individual fishermen who would be disproportionally affected by each MPA proposal (i.e. 100% or a large portion of their grounds are inside a proposed MPA that would restrict fishing), see Tables 13–16 and Figure 1. To assess this impact we conducted an analysis which removed the area of each proposed MPA from an individual fisherman's fishing grounds as derived from interviews. The individual's North Central Coast (NCC) ex-vessel revenue values and the area of the fishing grounds were summarized after the removal and percentages were calculated to show any potential losses. The "worst-cast scenario" still applies in that individual fishermen are assumed not to adjust to different fishing grounds. For this analysis the potential impact was calculated for each fishery as well as for all fisheries.

For example, under the Proposal IPA, the largest individual impacts, in dollars, for a single fishery is to one Dungeness crab fisherman, who is estimated to lose more than $20,000 annually. Another example is that under Proposal 4, one urchin fisherman is estimated to lose more than 80% of his annual revenue from that fishery. That said, when looking across all fisheries, no fisherman is estimated to lose more than 20–40% of his/her annual income.

It should be noted that the results of the individual impact analysis suggest that one fisherman will be disproportionately impacted by all four proposals being considered. His estimated annual individual is:

- Proposal 1-3: between 20–40% loss of ex-vessel revenue and $15K–$20K loss
- Proposal 2-XA: between 20–40% loss of ex-vessel revenue and $15K–$20K loss
- Proposal 4: between 40–60% loss of ex-vessel revenue and > $20K loss
- Proposal IPA: between 20–40% loss of ex-vessel revenue and > $20K loss

Additionally, two other individuals are estimated to be disproportionately impacted by two proposals each.

Individual 1:

- Proposal 4: between 20–40% loss of ex-vessel revenue and > $20K loss
- Proposal IPA: between 20–40% loss of ex-vessel revenue and > $20K loss

Individual 2:

- Proposal 4: between 20–40% loss of ex-vessel revenue and $15–20K loss
- Proposal IPA: between 20–40% loss of ex-vessel revenue and $15–20K loss

Table 8: Percentage area of total commercial fishing grounds affected by proposed MPAs by landing port

	Fisheries	1–3	2–XA	4	IPA
Point Arena	California Halibut	—	—	—	—
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	32.0%	16.8%	33.9%	30.0%
	Nearshore Rockfish	16.9%	10.5%	18.1%	16.1%
	Urchin	6.8%	5.7%	9.4%	8.4%
	Dungeness Crab	7.7%	6.4%	11.0%	8.0%
	Salmon	1.7%	1.3%	1.9%	1.8%
Bodega Bay	California Halibut	17.7%	19.2%	27.7%	19.3%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	11.5%	9.8%	13.0%	11.9%
	Nearshore Rockfish	7.3%	4.0%	8.7%	7.8%
	Urchin	10.9%	9.8%	15.3%	13.4%
	Dungeness Crab	2.8%	2.4%	3.8%	2.9%
	Salmon	0.7%	0.5%	0.8%	0.7%
Bolinas	California Halibut	18.2%	19.7%	28.1%	19.8%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	27.5%	23.4%	29.5%	23.4%
	Nearshore Rockfish	—	—	—	—
	Urchin	—	—	—	—
	Dungeness Crab	0.1%	0.6%	4.0%	0.6%
	Salmon	1.4%	1.3%	1.3%	1.3%
San Francisco	California Halibut	5.6%	6.0%	9.3%	6.0%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	10.8%	8.0%	14.0%	8.6%
	Nearshore Rockfish	10.8%	7.5%	15.4%	8.7%
	Urchin	21.3%	16.1%	30.1%	29.9%
	Dungeness Crab	2.5%	2.1%	3.5%	2.6%
	Salmon	0.7%	0.5%	0.8%	0.7%
Half Moon Bay	California Halibut	5.3%	6.1%	16.7%	5.8%
	Coastal Pelagics	0.8%	0.5%	0.8%	0.8%
	Market Squid	3.3%	2.5%	20.5%	2.5%
	Deeper Nearshore Rockfish	12.8%	9.1%	22.7%	8.6%
	Nearshore Rockfish	9.5%	9.5%	9.5%	9.3%
	Urchin	—	—	—	—
	Dungeness Crab	3.6%	3.0%	4.9%	3.6%
	Salmon	0.8%	0.6%	1.0%	0.8%

Table 9: Percentage area of commercial fishing grounds within the study area affected by proposed MPAs by landing port

	Fisheries	1–3	2–XA	4	IPA
Point Arena	California Halibut	—	—	—	—
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	32.0%	16.8%	33.9%	30.1%
	Nearshore Rockfish	28.4%	17.6%	30.4%	26.9%
	Urchin	19.1%	16.1%	26.6%	23.6%
	Dungeness Crab	13.5%	11.1%	19.2%	14.0%
	Salmon	11.9%	9.3%	12.8%	12.5%
Bodega Bay	California Halibut	17.7%	19.2%	27.7%	19.3%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	22.8%	19.5%	26.0%	23.7%
	Nearshore Rockfish	25.9%	14.2%	30.9%	27.7%
	Urchin	18.8%	16.9%	26.4%	23.1%
	Dungeness Crab	16.3%	13.7%	21.7%	16.4%
	Salmon	11.8%	9.3%	14.4%	12.0%
Bolinas	California Halibut	18.2%	19.7%	28.1%	19.8%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	31.2%	26.5%	33.5%	26.5%
	Nearshore Rockfish	—	—	—	—
	Urchin	—	—	—	—
	Dungeness Crab	0.1%	1.1%	7.3%	1.1%
	Salmon	11.6%	11.2%	10.7%	11.2%
San Francisco	California Halibut	8.8%	9.3%	14.5%	9.4%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	18.3%	13.5%	23.8%	14.7%
	Nearshore Rockfish	17.8%	12.2%	25.3%	14.3%
	Urchin	21.5%	16.2%	30.4%	30.1%
	Dungeness Crab	15.6%	13.2%	21.3%	15.7%
	Salmon	11.8%	9.3%	14.4%	12.0%
Half Moon Bay	California Halibut	6.2%	7.2%	19.7%	6.8%
	Coastal Pelagics	9.9%	6.2%	9.8%	9.1%
	Market Squid	3.3%	2.5%	20.5%	2.5%
	Deeper Nearshore Rockfish	15.1%	10.8%	26.8%	10.2%
	Nearshore Rockfish	9.5%	9.5%	9.5%	9.3%
	Urchin	—	—	—	—
	Dungeness Crab	15.8%	13.3%	21.6%	15.9%
	Salmon	11.8%	9.3%	14.4%	12.0%

Table 10: Percentage value of total commercial fishing grounds affected by proposed MPAs by landing port

	Fisheries	1–3	2–XA	4	IPA
Point Arena	California Halibut	—	—	—	—
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	30.6%	7.0%	31.4%	26.4%
	Nearshore Rockfish	27.0%	10.6%	28.1%	24.3%
	Urchin	6.7%	9.9%	11.0%	10.4%
	Dungeness Crab	13.9%	11.3%	16.8%	13.6%
	Salmon	12.4%	13.9%	13.9%	12.4%
Bodega Bay	California Halibut	7.7%	10.2%	11.1%	10.2%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	20.6%	14.9%	23.4%	17.6%
	Nearshore Rockfish	12.4%	12.6%	23.8%	23.3%
	Urchin	17.0%	6.1%	39.0%	31.6%
	Dungeness Crab	6.0%	5.3%	9.1%	7.1%
	Salmon	3.9%	3.1%	4.0%	3.7%
Bolinas	California Halibut	12.3%	15.2%	13.2%	15.2%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	26.8%	23.8%	28.5%	23.8%
	Nearshore Rockfish	—	—	—	—
	Urchin	—	—	—	—
	Dungeness Crab	0.1%	0.5%	3.1%	0.5%
	Salmon	4.1%	4.5%	4.1%	4.5%
San Francisco	California Halibut	0.7%	0.8%	1.0%	0.8%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	20.0%	15.1%	22.8%	15.7%
	Nearshore Rockfish	12.0%	5.8%	15.1%	8.9%
	Urchin	18.1%	7.1%	34.0%	33.9%
	Dungeness Crab	2.3%	2.1%	4.1%	2.3%
	Salmon	2.0%	1.6%	2.3%	2.1%
Half Moon Bay	California Halibut	0.2%	0.3%	27.0%	0.2%
	Coastal Pelagics	0.9%	0.5%	0.8%	0.8%
	Market Squid	0.9%	0.8%	24.9%	0.7%
	Deeper Nearshore Rockfish	11.0%	6.7%	19.4%	6.1%
	Nearshore Rockfish	1.9%	1.9%	1.9%	1.9%
	Urchin	—	—	—	—
	Dungeness Crab	2.8%	2.3%	3.1%	2.5%
	Salmon	2.8%	2.2%	3.1%	2.8%

Table 11: Percentage value of commercial fishing grounds within the study area affected by proposed MPAs by landing port

	Fisheries	1–3	2–XA	4	IPA
Point Arena	California Halibut	—	—	—	—
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	30.7%	7.0%	31.5%	26.5%
	Nearshore Rockfish	29.3%	11.5%	30.5%	26.3%
	Urchin	7.9%	11.7%	13.0%	12.4%
	Dungeness Crab	30.1%	24.3%	36.1%	29.2%
	Salmon	23.6%	26.5%	26.6%	23.6%
Bodega Bay	California Halibut	7.7%	10.2%	11.1%	10.2%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	31.0%	22.5%	35.2%	26.6%
	Nearshore Rockfish	12.9%	13.1%	24.7%	24.2%
	Urchin	17.9%	6.4%	41.0%	33.2%
	Dungeness Crab	10.0%	8.8%	15.3%	11.9%
	Salmon	9.5%	7.7%	9.9%	9.1%
Bolinas	California Halibut	12.3%	15.2%	13.2%	15.2%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	30.1%	26.7%	32.0%	26.7%
	Nearshore Rockfish	—	—	—	—
	Urchin	—	—	—	—
	Dungeness Crab	0.1%	1.2%	7.9%	1.2%
	Salmon	6.8%	7.5%	6.8%	7.5%
San Francisco	California Halibut	0.8%	0.8%	1.1%	0.8%
	Coastal Pelagics	—	—	—	—
	Market Squid	—	—	—	—
	Deeper Nearshore Rockfish	24.9%	18.8%	28.4%	19.5%
	Nearshore Rockfish	20.9%	10.1%	26.4%	15.6%
	Urchin	18.3%	7.2%	34.3%	34.2%
	Dungeness Crab	5.3%	4.9%	9.6%	5.3%
	Salmon	8.8%	7.2%	9.9%	9.0%
Half Moon Bay	California Halibut	0.2%	0.3%	27.1%	0.2%
	Coastal Pelagics	22.5%	14.0%	22.2%	20.7%
	Market Squid	0.9%	0.8%	24.9%	0.7%
	Deeper Nearshore Rockfish	14.4%	8.7%	25.4%	8.0%
	Nearshore Rockfish	1.9%	1.9%	1.9%	1.9%
	Urchin	—	—	—	—
	Dungeness Crab	14.7%	12.4%	16.5%	13.1%
	Salmon	9.2%	7.3%	10.1%	9.2%

Table 12: Percentage of the total fishing grounds value impacted by the existing fishery management area closures and\or fishery exclusion zones (i.e., RCAs)

	Fisheries	2007	2008	2009
Point Arena	Rockfish - Deeper Nearshore	16.3%	16.9%	30.2%
	Rockfish - Nearshore	17.0%	17.7%	32.4%
Bodega Bay	Rockfish - Deeper Nearshore	47.3%	54.4%	69.3%
	Rockfish - Nearshore	1.2%	1.3%	9.3%
Bolinas	Rockfish - Deeper Nearshore	60.8%	72.3%	81.8%
	Rockfish - Nearshore	—	—	—
San Francisco	Rockfish - Deeper Nearshore	15.6%	18.1%	50.3%
	Rockfish - Nearshore	13.7%	14.4%	49.9%
Half Moon Bay	Rockfish - Deeper Nearshore	0.6%	0.7%	6.5%
	Rockfish - Nearshore	0.1%	0.1%	0.1%

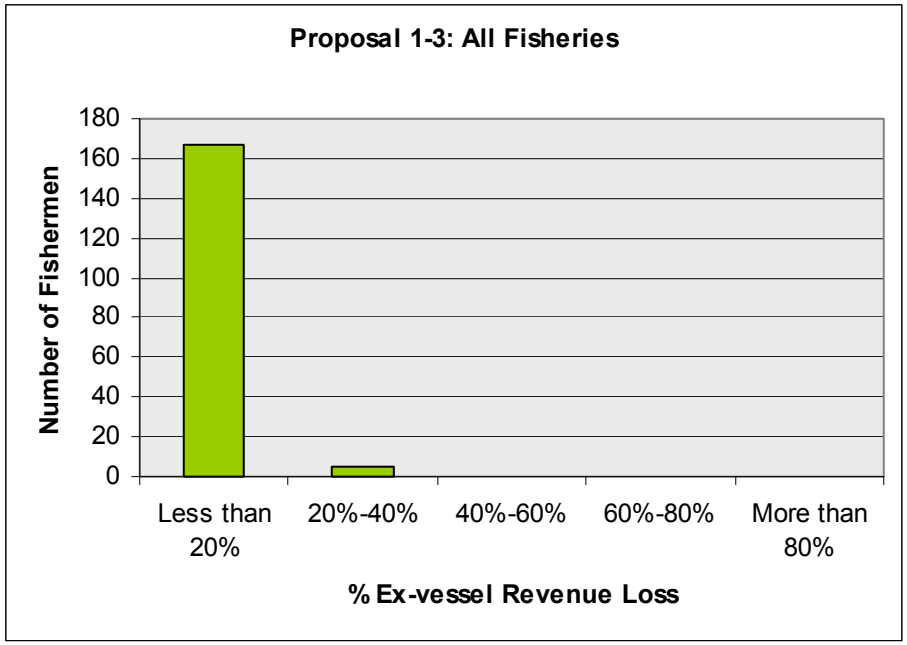
Table 13: Percentage value of commercial deeper nearshore and nearshore rockfish fishing grounds by landing port affected by MPA proposals without and with consideration of existing fishery management area closures in 2008 (i.e., total fishing grounds, versus available fishing grounds after RCA in place)

	Fisheries	Area considered	1-3	2-XA	4	IPA
Point Arena	Deeper Nearshore Rockfish	total fishing grounds	30.6%	7.0%	31.4%	26.4%
	Deeper Nearshore Rockfish	available grounds outside RCA [6]	31.6%	5.0%	32.2%	26.4%
	Nearshore Rockfish	total fishing grounds	27.0%	10.6%	28.1%	24.3%
	Nearshore Rockfish	available grounds outside RCA	27.0%	9.4%	28.0%	23.7%
Bodega Bay	Deeper Nearshore Rockfish	total fishing grounds	20.6%	14.9%	23.4%	17.6%
	Deeper Nearshore Rockfish	available grounds outside RCA	23.4%	13.2%	27.7%	15.9%
	Nearshore Rockfish	total fishing grounds	12.4%	12.6%	23.8%	23.3%
	Nearshore Rockfish	available grounds outside RCA	12.3%	12.4%	23.5%	23.0%
Bolinas	Deeper Nearshore Rockfish	total fishing grounds	26.8%	23.8%	28.5%	23.8%
	Deeper Nearshore Rockfish	available grounds outside RCA	35.2%	24.5%	40.4%	24.4%
	Nearshore Rockfish	total fishing grounds	—	—	—	—
	Nearshore Rockfish	available grounds outside RCA	—	—	—	—
San Francisco	Deeper Nearshore Rockfish	total fishing grounds	20.0%	15.1%	22.8%	15.7%
	Deeper Nearshore Rockfish	available grounds outside RCA	20.3%	15.1%	23.8%	15.2%
	Nearshore Rockfish	total fishing grounds	12.0%	5.8%	15.1%	8.9%
	Nearshore Rockfish	available grounds outside RCA	11.7%	6.1%	15.4%	8.4%
Half Moon Bay	Deeper Nearshore Rockfish	total fishing grounds	11.0%	6.7%	19.4%	6.1%
	Deeper Nearshore Rockfish	available grounds outside RCA	11.0%	6.8%	19.6%	6.2%
	Nearshore Rockfish	total fishing grounds	1.9%	1.9%	1.9%	1.9%
	Nearshore Rockfish	available grounds outside RCA	1.9%	1.9%	1.9%	1.9%

[6] Available fishing grounds are defined as the fishing grounds that exist after removing the fishing grounds that are inside an existing fishery management closure (i.e., 2008 RCA).

Table 14: Individual Impacts for Proposal 1–3

		Annual Ex-vessel Revenue Loss (%)					Annual Ex-vessel Revenue Loss ($ 2006)				
Fishery	n=	Less than 20%	20%-40%	40%-60%	60%-80%	More than 80%	Less than $5k	$5-$10k	$10-$15k	$15-$20k	More than $20k
C. Halibut	14	13	1	0	0	0	14	0	0	0	0
Coast. Pelagics	1	1	0	0	0	0	1	0	0	0	0
Market Squid	1	1	0	0	0	0	1	0	0	0	0
D.N. Rockfish	15	8	6	1	0	0	15	0	0	0	0
N. Rockfish	9	4	5	0	0	0	8	1	0	0	0
Urchin	22	21	1	0	0	0	21	1	0	0	0
D. Crab	102	98	4	0	0	0	93	8	0	1	0
Salmon	136	134	2	0	0	0	134	2	0	0	0
All Fisheries	172	167	5	0	0	0	158	10	2	2	0



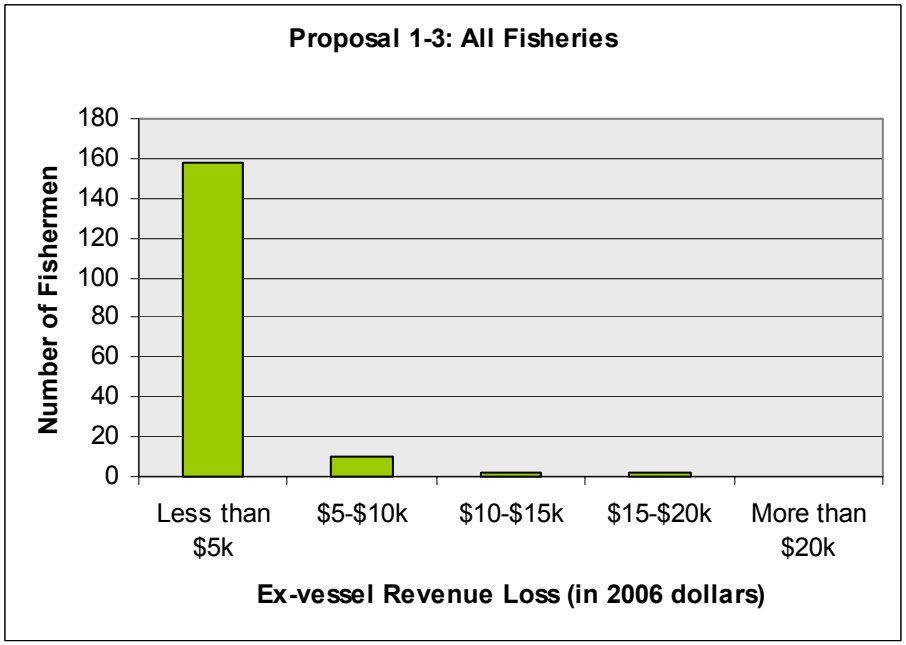
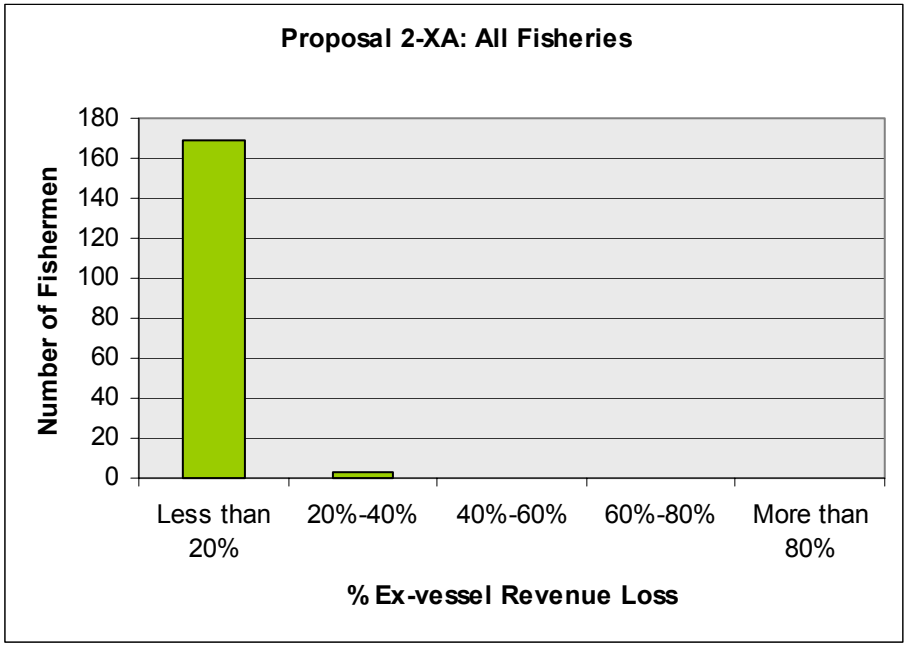


Table 15: Individual Impacts for Proposal 2–XA

		Annual Ex-vessel Revenue Loss (%)					Annual Ex-vessel Revenue Loss ($ 2006)				
Fishery	n=	Less than 20%	20%-40%	40%-60%	60%-80%	More than 80%	Less than $5k	$5-$10k	$10-$15k	$15-$20k	More than $20k
C. Halibut	14	13	1	0	0	0	14	0	0	0	0
Coast. Pelagics	1	1	0	0	0	0	1	0	0	0	0
Market Squid	1	1	0	0	0	0	1	0	0	0	0
D.N. Rockfish	15	11	4	0	0	0	15	0	0	0	0
N. Rockfish	9	9	0	0	0	0	9	0	0	0	0
Urchin	22	21	1	0	0	0	20	1	1	0	0
D. Crab	102	99	3	0	0	0	95	6	0	1	0
Salmon	136	134	2	0	0	0	134	2	0	0	0
All Fisheries	172	169	3	0	0	0	162	5	3	2	0



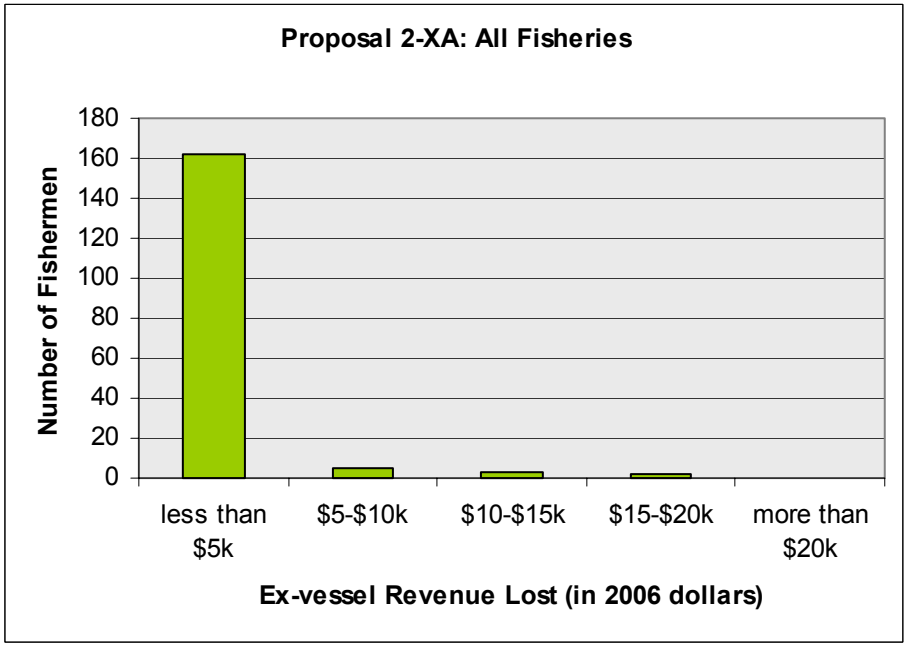
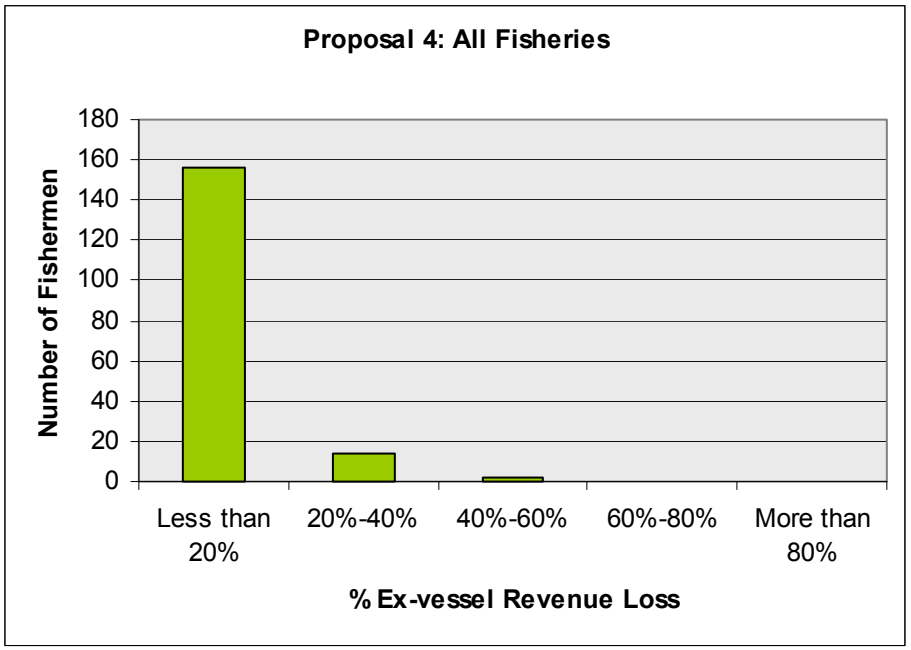


Table 16: Individual Impacts for Proposal 4

		Annual Ex-vessel Revenue Loss (%)					Annual Ex-vessel Revenue Loss ($ 2006)				
Fishery	n=	Less than 20%	20%-40%	40%-60%	60%-80%	More than 80%	Less than $5k	$5-$10k	$10-$15k	$15-$20k	More than $20k
C. Halibut	14	10	4	0	0	0	14	0	0	0	0
Coast. Pelagics	1	1	0	0	0	0	1	0	0	0	0
Market Squid	1	1	0	0	0	0	0	0	0	0	1
D.N. Rockfish	15	7	7	1	0	0	15	0	0	0	0
N. Rockfish	9	4	5	0	0	0	8	1	0	0	0
Urchin	22	11	9	1	0	1	17	2	1	1	1
D. Crab	102	94	8	0	0	0	87	9	5	0	1
Salmon	136	133	2	1	0	0	134	2	0	0	0
All Fisheries	172	156	14	2	0	0	147	12	8	2	3



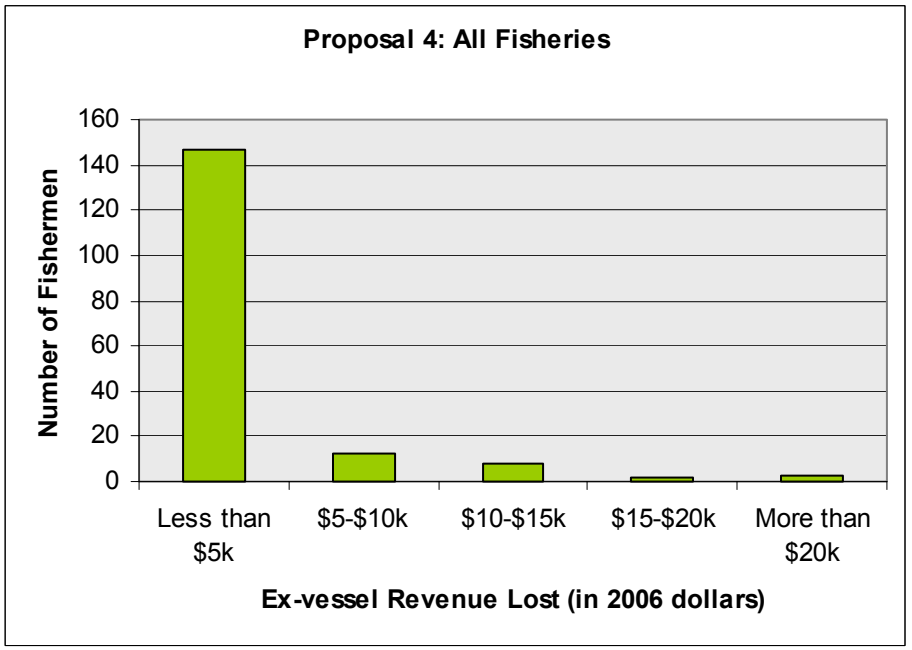
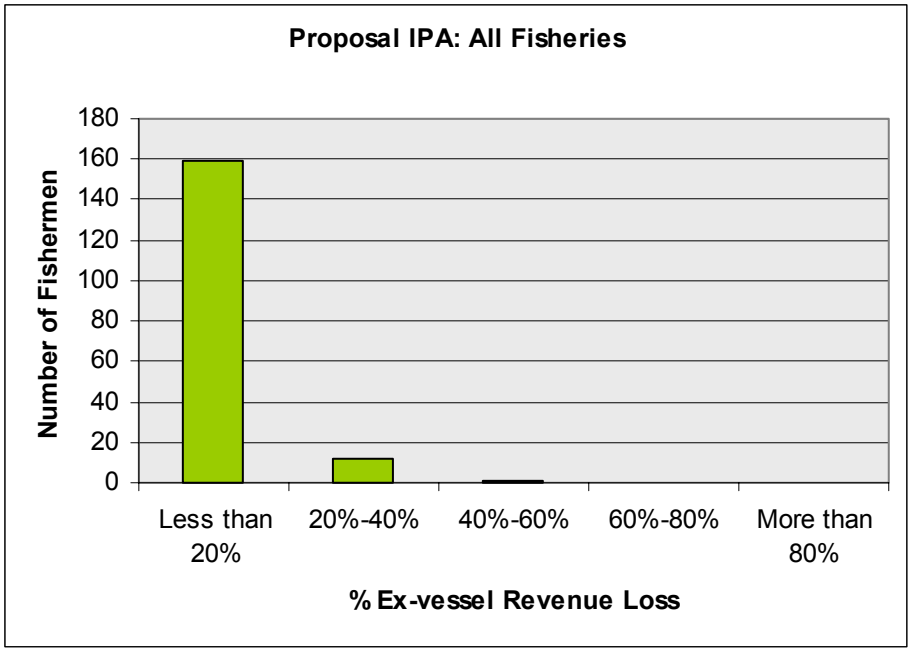


Table 17: Individual Impacts for Integrated Preferred Alternative (IPA)

		Annual Ex-vessel Revenue Loss (%)					Annual Ex-vessel Revenue Loss ($ 2006)				
Fishery	n=	Less than 20%	20%-40%	40%-60%	60%-80%	More than 80%	Less than $5k	$5-$10k	$10-$15k	$15-$20k	More than $20k
C. Halibut	14	13	1	0	0	0	14	0	0	0	0
Coast. Pelagics	1	1	0	0	0	0	1	0	0	0	0
Market Squid	1	1	0	0	0	0	1	0	0	0	0
D.N. Rockfish	15	10	5	0	0	0	15	0	0	0	0
N. Rockfish	9	7	2	0	0	0	8	1	0	0	0
Urchin	22	13	8	1	0	0	19	2	0	1	0
D. Crab	102	97	5	0	0	0	92	7	2	0	1
Salmon	136	133	2	1	0	0	134	2	0	0	0
All Fisheries	172	159	12	1	0	0	156	8	5	1	2



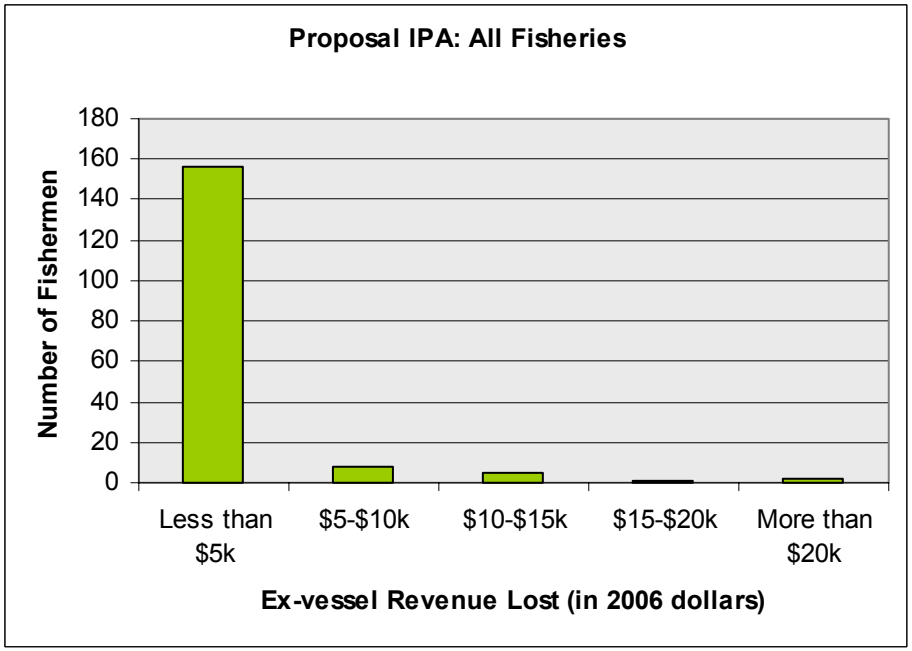
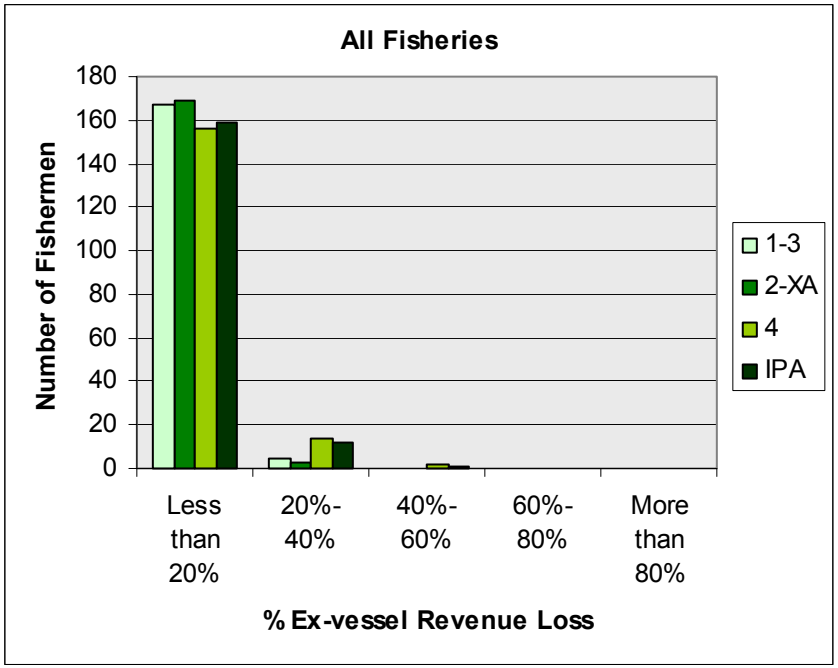
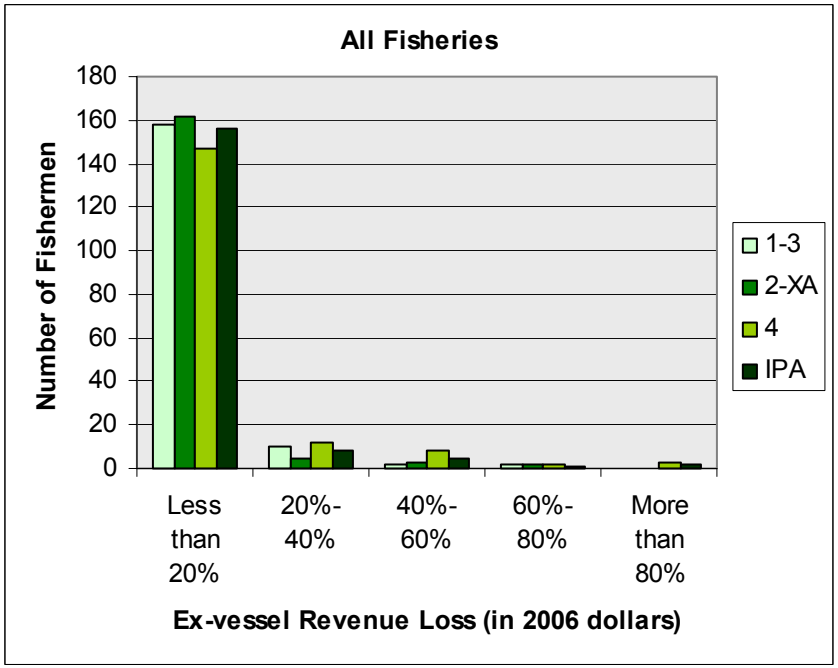


Figure 1: Estimated Individual Impacts for All Proposals





5. Socioeconomic Impact Analysis: Approach

We also estimate "worst-case scenario" or maximum potential economic impact of each MPA proposal (for description of methods, please refer to Appendix A). To accomplish this, we use methods similar to those utilized in the Central Coast process by Wilen and Abbott (2006). This analysis for the North Central Coast, however, differs in a very important respect, that is, by having original survey data on fishermen operating costs collected through the interview process. Wilen and Abbott estimated costs as 65% of gross revenue for all fisheries based on New Zealand and British Columbia data (Wilen and Abbott 2006, pg 7), although costs are known to vary by fishery. The 65% figure was applied as a uniform conservative (high) estimate, since specific data for the study region were not available.

Ecotrust employs a new methodology for estimating fishery costs. The approach is a refinement of the uniform 65% method. As mentioned previously, this refinement is possible due to new data gathered during the interview process on fishery specific operating costs in the study area. As part of the fishermen interview process, field staff asked several questions related to operating costs, including:

- What percentage of your gross revenue goes towards overall operating costs?
- Of your overall operating costs, what percentage goes towards crew share or labor?
- Of your overall operating costs, what percentage goes towards fuel?

With the opportunity to interview NCCSR fishermen directly, information specific to the study region is gained. There is also the opportunity for data resolution regarding types of costs fishermen face. Using data from the fishermen knowledge interviews, two cost categories were created: fixed and variable. Fixed costs include costs that are independent of the number of trips a fishing vessel makes or the duration of these trips. For example, vessel repairs and maintenance, insurance, mooring and dockage fees are typically considered fixed costs. On the other hand, variable costs include costs that are dependent on the number of trips a vessel makes and the duration of these trips. Variable costs typically include fuel, maintenance, crew share, and gear repair/replacement. For the purpose of this study, however, in order to account for sunk costs, we assume the only variable costs to be crew/labor and fuel costs. All other costs will be considered fixed costs.

As mentioned previously, a total of 174 fishermen were interviewed. The same eight fisheries analyzed in the commercial fishing grounds analysis are also considered here. Within these fisheries, the participation patterns of interviewed fishermen yielded 28 possible combinations. For example, 138 of those interviewed participated in the salmon fishery, but of those, only 48 (or 35%) exclusively fish salmon; the remainder fish salmon as well as various combinations of the other fisheries (e.g. salmon and Dungeness crab; salmon, Dungeness crab and deeper nearshore rockfish).

Initially, we calculated fishery costs using data from fishermen that only participate in the fishery in question; however, there were some fisheries having no exclusive participants. Furthermore, this would have ignored interview data from fishermen participating in multiple fisheries, the general case. Given this, we calculated costs for a particular fishery based on all fishermen that participate in that fishery; a single fisherman's data may therefore have been used numerous times. This explains why summing observations "n" across the fisheries does not sum to 174 in Table 17, which also shows summary cost data based on fishermen responses.

The mean estimated total operating costs for all fishermen as a percentage of overall gross revenue was 47.5%. Fixed costs comprise just over half of these costs, while variable costs (i.e. crew and fuel) make up the remainder. Grouped by fishery, the highest overall operating cost as a percentage of gross revenue was 60.0% (Market Squid and Coastal Pelagics) and the lowest was 39.7% (Urchin). While not included here, tables similar to Table 15 were also compiled at the port group level for the NCCSR (i.e. for Point Arena, Bodega Bay, Bolinas, San Francisco, and Half Moon Bay).

Table 18: Estimated Operating Costs

		Mean % of Gross Economic Revenue			
Name	**n=**	**Crew**	**Fuel**	**Fixed**	**Total**
California Halibut	19	5.4%	13.9%	26.6%	45.9%
Coastal Pelagics	1	40.0%	15.0%	5.0%	60.0%
Squid	1	40.0%	15.0%	5.0%	60.0%
Deeper Nearshore and Nearshore Rockfish	18	5.3%	17.3%	28.3%	50.9%
Dungeness Crab	101	14.8%	10.3%	23.3%	48.5%
Urchin	21	7.6%	10.7%	21.4%	39.7%
Salmon	138	9.8%	11.8%	25.0%	46.6%
All Fisheries Combined	174	10.9%	12.1%	24.4%	47.5%

6. Socioeconomic Impact Analysis: Assessing MPA Proposals

The net economic impact (NEI) of each MPA proposal is calculated for each port group, and for the NCCSR as a whole. The NEI results are presented as revenue reductions in both dollar terms ($ 2006) and percentage terms. The starting point for calculating NEI is baseline gross economic revenue (Baseline GER), which is based on a 7-year average (as previously described as described in Section 2). Baseline GER is gross revenue for the fishery in question absent any MPA proposal.

The baseline net economic revenue (Baseline NER) is found by subtracting the fishery-specific fixed and variable costs described in Section 5 from Baseline GER. A similar net economic revenue calculation is performed for each MPA proposal and is then compared with Baseline NER to yield NEI. Please refer to Appendix A for a more detailed methodology. Figure 2 shows the estimated percentage reduction in profit across the study region under a given proposal. As can be seen in Tables 18–23, proposals vary considerably in their effects on ports and fisheries:

- For the NCCSR, the economic impact on the squid fishery is estimated to be 0.5% under Proposal IPA, but 18.8% under Proposal 4 (see Table 23).
- For the NCCSR, the lowest estimated economic impact on deaper nearshore rockfish from any proposal (Proposal 2-XA) is 21.3%. The highest estimated maximum economic impact from any proposal on coastal pelagics is 0.6% (Proposals 1–3, 4 and IPA) (see Table 23).

Additionally, use of both dollar and percentage impacts convey perspective:

- For the port of Point Arena, the economic impact on deeper nearshore rockfish from Proposal 1–3 is estimated to be 48.3%, yet this only translates to an estimated $377 in dollar terms (annually) (see Table 18).

Figure 2: Annual Net Economic Impact of MPA Proposals for the NCCSR

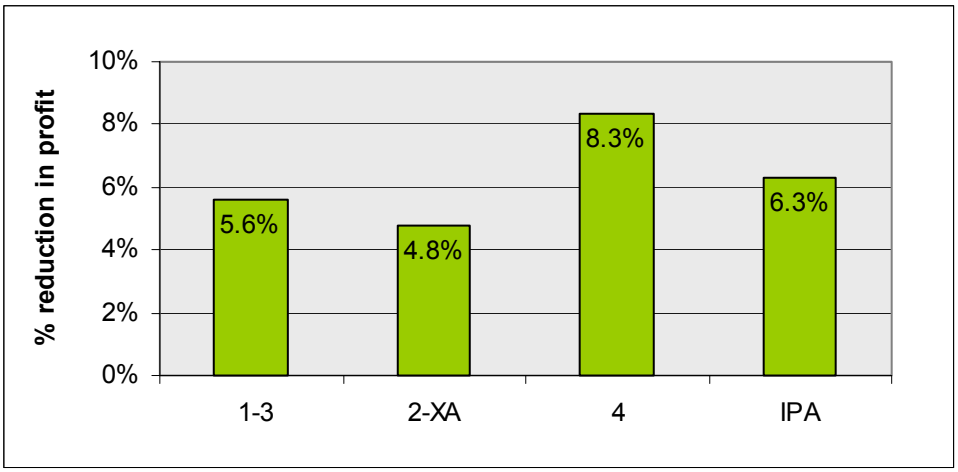


Table 19: Estimated Annual Net Economic Impact (NEI) for Point Arena

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	—	—	—	—	—	—
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$1,424	$699	$337	$77	$346	$291
N. Rockfish	$64,259	$31,544	$13,440	$5,271	$13,977	$12,073
Urchin	$608,226	$366,963	$33,273	$49,288	$54,609	$51,923
Dungeness Crab	$46,951	$24,201	$4,901	$3,969	$5,888	$4,771
Salmon	$77,890	$41,610	$7,558	$8,474	$8,511	$7,564
All Fisheries	**$798,750**	**$465,016**	**$59,510**	**$67,078**	**$83,332**	**$76,623**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	—	—	—	—
Coastal Pelagics	—	—	—	—
Squid	—	—	—	—
D. N. Rockfish	48.3%	11.0%	49.5%	41.7%
N. Rockfish	42.6%	16.7%	44.3%	38.3%
Urchin	9.1%	13.4%	14.9%	14.1%
Dungeness Crab	20.2%	16.4%	24.3%	19.7%
Salmon	18.2%	20.4%	20.5%	18.2%
All Fisheries	**12.8%**	**14.4%**	**17.9%**	**16.5%**

Table 20: Estimated Annual Net Economic Impact (NEI) for Bodega Bay

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$19,928	$10,772	$1,244	$1,641	$1,787	$1,646
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$24,772	$12,160	$3,943	$2,856	$4,480	$3,378
N. Rockfish	$40,634	$19,946	$3,908	$3,965	$7,474	$7,323
Urchin	$247,530	$149,343	$34,369	$12,306	$78,979	$63,941
Dungeness Crab	$2,322,504	$1,197,122	$103,992	$91,645	$158,770	$123,816
Salmon	$1,998,838	$1,067,809	$60,320	$48,726	$62,984	$57,970
All Fisheries	**$4,654,206**	**$2,457,152**	**$207,776**	**$161,140**	**$314,474**	**$258,074**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	11.6%	15.2%	16.6%	15.3%
Coastal Pelagics				
Squid				
D. N. Rockfish	32.4%	23.5%	36.8%	27.8%
N. Rockfish	19.6%	19.9%	37.5%	36.7%
Urchin	23.0%	8.2%	52.9%	42.8%
Dungeness Crab	8.7%	7.7%	13.3%	10.3%
Salmon	5.6%	4.6%	5.9%	5.4%
All Fisheries	**8.5%**	**6.6%**	**12.8%**	**10.5%**

Table 21: Estimated Annual Net Economic Impact (NEI) for Bolinas

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$22,897	$12,376	$2,266	$2,809	$2,438	$2,809
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$2,147	$1,054	$445	$396	$474	$396
N. Rockfish	—	—	—	—	—	—
Urchin	—	—	—	—	—	—
Dungeness Crab	$109,192	$56,282	$41	$384	$2,535	$384
Salmon	$16,978	$9,070	$544	$603	$542	$603
All Fisheries	**$151,214**	**$78,783**	**$3,297**	**$4,192**	**$5,988**	**$4,192**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	18.3%	22.7%	19.7%	22.7%
Coastal Pelagics				
Squid				
D. N. Rockfish	42.3%	37.5%	44.9%	37.5%
N. Rockfish				
Urchin				
Dungeness Crab	0.1%	0.7%	4.5%	0.7%
Salmon	6.0%	6.6%	6.0%	6.6%
All Fisheries	**4.2%**	**5.3%**	**7.6%**	**5.3%**

Table 22: Estimated Annual Net Economic Impact (NEI) for San Francisco

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$203,044	$109,750	$1,179	$1,228	$1,621	$1,228
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$59,192	$29,056	$9,179	$6,912	$10,439	$7,177
N. Rockfish	$44,442	$21,816	$4,113	$2,001	$5,203	$3,071
Urchin	$8,827	$5,326	$1,309	$515	$2,451	$2,443
Dungeness Crab	$3,608,592	$1,860,029	$61,335	$57,282	$111,321	$61,335
Salmon	$2,135,290	$1,140,703	$33,307	$27,449	$37,826	$34,479
All Fisheries	**$6,059,387**	**$3,166,680**	**$110,421**	**$95,387**	**$168,861**	**$109,733**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	1.1%	1.1%	1.5%	1.1%
Coastal Pelagics	—	—	—	—
Squid	—	—	—	—
D. N. Rockfish	31.6%	23.8%	35.9%	24.7%
N. Rockfish	18.9%	9.2%	23.9%	14.1%
Urchin	24.6%	9.7%	46.0%	45.9%
Dungeness Crab	3.3%	3.1%	6.0%	3.3%
Salmon	2.9%	2.4%	3.3%	3.0%
All Fisheries	**3.5%**	**3.0%**	**5.3%**	**3.5%**

Table 23: Estimated Annual Net Economic Impact (NEI) for Half Moon Bay

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$33,896	$18,322	$55	$71	$7,377	$66
Coastal Pelagics	$16,757	$6,703	$64	$40	$63	$59
Squid	$204,407	$81,763	$865	$736	$22,876	$653
D. N. Rockfish	$20,367	$9,998	$1,734	$1,051	$3,057	$958
N. Rockfish	$3,262	$1,601	$48	$48	$48	$47
Urchin	—	—				
Dungeness Crab	$2,299,793	$1,185,416	$47,871	$40,295	$53,382	$42,189
Salmon	$1,532,405	$818,633	$33,512	$26,545	$36,635	$33,272
All Fisheries	**$4,110,888**	**$2,122,436**	**$84,149**	**$68,786**	**$123,439**	**$77,244**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	0.3%	0.4%	40.3%	0.4%
Coastal Pelagics	1.0%	0.6%	0.9%	0.9%
Squid	1.1%	0.9%	28.0%	0.8%
D. N. Rockfish	17.3%	10.5%	30.6%	9.6%
N. Rockfish	3.0%	3.0%	3.0%	3.0%
Urchin				
Dungeness Crab	4.0%	3.4%	4.5%	3.6%
Salmon	4.1%	3.2%	4.5%	4.1%
All Fisheries	**4.0%**	**3.2%**	**5.8%**	**3.6%**

Table 24: Estimated Annual Net Economic Impact (NEI) for the NCCSR[7]

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$279,764	$151,220	$4,744	$5,750	$13,224	$5,749
Coastal Pelagics	$29,804	$11,926	$64	$40	$63	$59
Squid	$303,466	$121,386	$865	$736	$22,876	$653
D. N. Rockfish	$107,902	$52,967	$15,638	$11,292	$18,796	$12,200
N. Rockfish	$152,597	$74,907	$21,510	$11,285	$26,703	$22,514
Urchin	$867,381	$523,320	$68,950	$62,109	$136,040	$118,307
Dungeness Crab	$8,387,032	$4,323,049	$218,139	$193,574	$331,896	$232,494
Salmon	$5,761,401	$3,077,826	$135,242	$111,798	$146,497	$133,888
All Fisheries	**$15,889,359**	**$8,336,602**	**$465,153**	**$396,583**	**$696,094**	**$525,865**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	3.1%	3.8%	8.7%	3.8%
Coastal Pelagics	0.5%	0.3%	0.5%	0.5%
Squid	0.7%	0.6%	18.8%	0.5%
D. N. Rockfish	29.5%	21.3%	35.5%	23.0%
N. Rockfish	28.7%	15.1%	35.6%	30.1%
Urchin	13.2%	11.9%	26.0%	22.6%
Dungeness Crab	5.0%	4.5%	7.7%	5.4%
Salmon	4.4%	3.6%	4.8%	4.4%
All Fisheries	**5.6%**	**4.8%**	**8.3%**	**6.3%**

[7] It should be noted that the “all fisheries” estimates for annual net economic impact for the NCCSR may not equal the sum of all port’s “all fisheries” estimates due to rounding differences.

7. Impact on Recreational Fishing Grounds: Methods

The methods used to assess the impact of the various MPA proposals on recreational fisheries are identical to those used to assess the impact on commercial fisheries (please refer to Section 3 of this document for a description of those methods) with one exception. The commercial fishery impact analysis assessed fishing grounds that were weighted by multiplying stated importance values from the interviews by the proportion of in-study region landings (both by landing port and by fishery), and more specifically, by ex-vessel values for those landings. In contrast, no weighting occurs in the calculation of recreational fishing grounds, but rather, the analysis is done using only stated importance values from the interviews. No weighting occurs for the obvious reason that ex-vessel values do not exist for recreational fishery landings.

8. Impact on Recreational Fishing Grounds: Approach

The approach used for the recreational fishing grounds analysis, like the methods, is identical to those used in the commercial fisheries analysis (please refer to Section 4 of this document for a description) with one exception—the analysis is done using only stated importance values from the interviews.

The recreational data presented here should be used with the following caveats:

1. The data are not representative of the entire population of recreational fishermen due to the less than desirable (less than statistically significant) sample size.
2. The data should only be considered at the sub-region level, not at the entire study region level.
3. There was little or no data collected from recreational fishermen north of Bodega Bay.
4. The data represents interviewees' areas of value, not areas of effort.
5. The data represents interviewees' areas that are important to them over their entire recreational fishing experience, not necessarily the areas that are important to them currently.

That said, Ecotrust and the recreational fishing community believe that the information and the manner in which it was acquired allows us to produce results that are able to speak broadly to both the preferences of the overall recreational fishing population and also each user group and sub-region of anglers.

The total percentage of area and value affected for the total fishing grounds and the grounds inside the study area are then summarized for all MPAs affecting each fishery per proposal. MPA proposals vary considerably in their effects, both between and across fisheries, as illustrated in the Tables 24–27.

For example, Proposal 2-XA has lesser effects (both in terms of study area grounds and value) on the CPFV Dungeness crab fishery in Region 2 (San Francisco Bay access points to Point Reyes) than on any other CPFV fishery (i.e. salmon and rockfish) for this region (see Tables 25 and 27). Illustrating another set of effects across sectors for the recreational rockfish fishery in Region 1 (Ocean Beach in San Francisco County), Proposal IPA affects 13.1% of the total value (see Table 26) for the CPFV sector, 13.8% for private vessels, 5.8% for kayak-based and 4.9% for shore/pier-based anglers. For the recreational fisheries considered in this analysis, results indicate that most, if not all of the fisheries fishing grounds are located in state-waters, especially for kayak-based and shore\pier anglers. For example, Proposal 4 affects 6.7% of the total CPFV California halibut fishing grounds in Region 3 (Point Reyes north to Alder Creek) and the same 6.7% when considering only those fishing grounds that fall into the (nearer to shore) study area waters.

Table 25: Percentage area of total recreational fishing grounds affected by sub-region

		Fisheries	1-3	2-XA	4	IPA
CPFV	Region 3	California Halibut	6.3%	4.6%	6.7%	4.6%
		Dungeness Crab	9.9%	6.9%	15.3%	6.9%
		Rockfish	12.7%	10.5%	14.7%	13.7%
		Salmon	2.4%	2.0%	2.1%	2.0%
	Region 2	California Halibut	11.4%	12.0%	21.7%	11.8%
		Dungeness Crab	1.0%	0.7%	1.4%	0.8%
		Rockfish	15.8%	7.2%	18.7%	7.2%
		Salmon	3.3%	2.9%	4.0%	3.1%
	Region 1	California Halibut	0.8%	2.3%	16.4%	1.9%
		Dungeness Crab	3.6%	2.3%	3.7%	3.2%
		Rockfish	14.7%	12.1%	19.3%	11.7%
		Salmon	3.0%	2.8%	3.7%	2.9%
Private Vessel	Region 3	California Halibut	5.1%	4.9%	8.9%	5.1%
		Dungeness Crab	4.0%	3.4%	7.7%	3.5%
		Rockfish	14.1%	11.3%	16.4%	12.4%
		Salmon	4.8%	3.8%	5.1%	4.8%
	Region 2	California Halibut	3.3%	3.6%	5.9%	3.6%
		Dungeness Crab	3.5%	3.2%	5.9%	3.4%
		Rockfish	9.9%	8.6%	12.2%	8.6%
		Salmon	3.1%	2.6%	3.5%	2.8%
	Region 1	California Halibut	4.3%	6.1%	13.1%	5.7%
		Dungeness Crab	2.3%	1.5%	2.1%	1.9%
		Rockfish	14.1%	11.0%	18.5%	10.7%
		Salmon	1.9%	1.6%	2.5%	1.8%
Kayak Anglers	Region 3	California Halibut	0.0%	0.0%	0.3%	0.0%
		Dungeness Crab	0.0%	0.0%	0.2%	0.0%
		Rockfish	6.4%	7.3%	10.1%	10.6%
		Salmon	3.9%	4.2%	8.7%	4.7%
	Region 2	California Halibut	0.1%	0.0%	0.0%	0.0%
		Dungeness Crab	—	—	—	—
		Rockfish	21.8%	12.1%	23.8%	12.1%
		Salmon	15.4%	10.1%	17.9%	12.9%
	Region 1	California Halibut	0.1%	1.6%	6.1%	1.5%
		Dungeness Crab	5.7%	3.5%	5.6%	5.2%
		Rockfish	6.4%	6.4%	7.6%	6.5%
		Salmon	1.9%	1.6%	1.8%	1.7%
Pier/Shore	Region 3	California Halibut	—	—	—	—
		Dungeness Crab	—	—	—	—
		Rockfish	4.8%	0.3%	15.2%	11.4%
		Salmon	—	—	—	—
		Striped Bass	17.7%	16.9%	34.3%	16.8%
	Region 2	California Halibut	0.0%	0.0%	0.0%	0.0%
		Dungeness Crab	0.0%	0.0%	0.0%	0.0%
		Rockfish	18.0%	11.7%	21.5%	13.2%
		Salmon	—	—	—	—
		Striped Bass	13.9%	13.9%	24.6%	13.9%
	Region 1	California Halibut	3.9%	3.9%	12.4%	3.3%
		Dungeness Crab	21.0%	12.9%	18.5%	17.2%
		Rockfish	10.3%	5.3%	21.3%	5.3%
		Salmon	0.0%	0.0%	0.0%	0.0%
		Striped Bass	10.9%	6.2%	19.2%	5.3%

Table 26: Percentage area of recreational fishing grounds within the study area affected by sub-region

		Fisheries	1-3	2-XA	4	IPA
CPFV	Region 3	California Halibut	6.3%	4.6%	6.7%	4.6%
		Dungeness Crab	12.6%	8.7%	19.4%	8.7%
		Rockfish	14.2%	11.7%	16.4%	15.3%
		Salmon	7.8%	6.5%	6.7%	6.5%
	Region 2	California Halibut	11.9%	12.5%	22.6%	12.3%
		Dungeness Crab	6.6%	4.7%	9.7%	5.5%
		Rockfish	22.7%	10.3%	26.9%	10.3%
		Salmon	11.1%	10.1%	13.8%	10.7%
	Region 1	California Halibut	0.9%	2.6%	18.3%	2.1%
		Dungeness Crab	21.5%	13.6%	21.9%	19.1%
		Rockfish	24.9%	20.4%	32.5%	19.8%
		Salmon	11.7%	10.6%	14.4%	11.2%
Private Vessel	Region 3	California Halibut	8.2%	7.8%	14.2%	8.1%
		Dungeness Crab	8.7%	7.3%	16.5%	7.5%
		Rockfish	23.4%	18.8%	27.2%	20.6%
		Salmon	11.8%	9.2%	12.4%	11.8%
	Region 2	California Halibut	4.9%	5.4%	8.8%	5.4%
		Dungeness Crab	10.0%	9.1%	16.6%	9.5%
		Rockfish	20.1%	17.4%	24.7%	17.4%
		Salmon	11.0%	9.6%	12.6%	10.1%
	Region 1	California Halibut	7.3%	10.4%	22.5%	9.7%
		Dungeness Crab	10.4%	6.8%	9.5%	8.5%
		Rockfish	24.6%	19.1%	32.3%	18.7%
		Salmon	9.9%	8.8%	13.5%	9.4%
Kayak Anglers	Region 3	California Halibut	0.0%	0.0%	0.3%	0.0%
		Dungeness Crab	0.0%	0.0%	0.2%	0.0%
		Rockfish	6.5%	7.4%	10.3%	10.8%
		Salmon	3.9%	4.2%	8.7%	4.7%
	Region 2	California Halibut	0.1%	0.0%	0.0%	0.0%
		Dungeness Crab	—	—	—	—
		Rockfish	21.8%	12.1%	23.9%	12.1%
		Salmon	15.4%	10.1%	17.9%	12.9%
	Region 1	California Halibut	0.3%	3.0%	11.4%	2.9%
		Dungeness Crab	10.9%	6.7%	10.8%	10.0%
		Rockfish	12.1%	12.1%	14.3%	12.3%
		Salmon	3.6%	3.1%	3.6%	3.3%
Pier/Shore	Region 3	California Halibut	—	—	—	—
		Dungeness Crab	—	—	—	—
		Rockfish	4.9%	0.3%	15.5%	11.5%
		Salmon	—	—	—	—
		Striped Bass	17.7%	16.9%	34.3%	16.9%
	Region 2	California Halibut	0.0%	0.0%	0.0%	0.0%
		Dungeness Crab	0.0%	0.0%	0.0%	0.0%
		Rockfish	18.1%	11.7%	21.6%	13.3%
		Salmon	—	—	—	—
		Striped Bass	13.9%	13.9%	24.7%	13.9%
	Region 1	California Halibut	4.0%	4.0%	12.7%	3.3%
		Dungeness Crab	21.0%	12.9%	18.6%	17.2%
		Rockfish	10.3%	5.3%	21.3%	5.3%
		Salmon	0.0%	0.0%	0.0%	0.0%
		Striped Bass	10.9%	6.2%	19.3%	5.3%

Table 27: Percentage value of total recreational fishing grounds affected by sub-region

		Fisheries	1-3	2-XA	4	IPA
CPFV	Region 3	California Halibut	3.7%	2.4%	3.9%	2.4%
		Dungeness Crab	12.6%	7.0%	16.7%	7.0%
		Rockfish	6.4%	5.1%	7.5%	6.1%
		Salmon	2.9%	2.3%	2.1%	2.3%
	Region 2	California Halibut	5.4%	5.8%	10.6%	5.6%
		Dungeness Crab	0.0%	0.0%	0.0%	0.0%
		Rockfish	17.6%	12.8%	18.9%	12.8%
		Salmon	3.2%	3.1%	3.3%	3.2%
	Region 1	California Halibut	0.5%	2.2%	10.3%	2.1%
		Dungeness Crab	6.7%	4.2%	6.8%	5.9%
		Rockfish	12.4%	13.1%	18.2%	13.1%
		Salmon	3.1%	2.4%	3.5%	2.8%
Private Vessel	Region 3	California Halibut	5.7%	5.6%	9.3%	5.7%
		Dungeness Crab	5.2%	3.5%	8.0%	3.6%
		Rockfish	13.6%	11.1%	16.6%	14.4%
		Salmon	4.2%	3.2%	3.5%	3.4%
	Region 2	California Halibut	2.9%	3.3%	5.4%	3.3%
		Dungeness Crab	0.5%	0.4%	1.0%	0.4%
		Rockfish	23.7%	19.7%	25.8%	19.7%
		Salmon	2.6%	2.4%	2.9%	2.7%
	Region 1	California Halibut	4.2%	5.8%	13.9%	5.0%
		Dungeness Crab	3.7%	2.0%	3.6%	3.0%
		Rockfish	14.3%	13.9%	21.3%	13.8%
		Salmon	1.2%	0.9%	2.0%	1.1%
Kayak Anglers	Region 3	California Halibut	0.0%	0.0%	0.2%	0.0%
		Dungeness Crab	0.0%	0.0%	0.1%	0.0%
		Rockfish	2.4%	0.9%	9.4%	4.5%
		Salmon	0.5%	0.6%	6.5%	1.8%
	Region 2	California Halibut	0.1%	0.0%	0.0%	0.0%
		Dungeness Crab	—	—	—	—
		Rockfish	17.0%	7.6%	19.1%	7.6%
		Salmon	12.7%	8.4%	14.4%	11.3%
	Region 1	California Halibut	0.1%	0.3%	4.2%	0.3%
		Dungeness Crab	20.3%	12.0%	20.3%	18.3%
		Rockfish	5.2%	5.7%	6.5%	5.8%
		Salmon	0.7%	0.6%	0.6%	0.7%
Pier/Shore	Region 3	California Halibut	—	—	—	—
		Dungeness Crab	—	—	—	—
		Rockfish	4.1%	1.2%	24.2%	14.8%
		Salmon	—	—	—	—
		Striped Bass	15.1%	14.1%	28.9%	14.1%
	Region 2	California Halibut	0.0%	0.0%	0.0%	0.0%
		Dungeness Crab	0.0%	0.0%	0.0%	0.0%
		Rockfish	14.7%	11.5%	19.6%	12.3%
		Salmon	—	—	—	—
		Striped Bass	6.2%	6.2%	10.7%	6.2%
	Region 1	California Halibut	4.0%	4.0%	12.2%	3.3%
		Dungeness Crab	4.8%	0.8%	4.7%	4.6%
		Rockfish	8.7%	4.9%	16.6%	4.7%
		Salmon	0.0%	0.0%	0.0%	0.0%
		Striped Bass	11.3%	7.4%	20.6%	6.2%

Table 28: Percentage value of recreational fishing grounds within the study area affected by sub-region

		Fisheries	1-3	2-XA	4	IPA
P F	gi on (	California Halibut	3.7%	2.4%	3.9%	2.4%

		Dungeness Crab	14.6%	8.2%	19.5%	8.2%
		Rockfish	6.8%	5.5%	8.0%	6.5%
		Salmon	9.6%	7.4%	6.7%	7.4%
	Region 2	California Halibut	5.7%	6.0%	11.1%	5.9%
		Dungeness Crab	0.1%	0.0%	0.1%	0.1%
		Rockfish	20.5%	14.9%	22.0%	14.9%
		Salmon	7.7%	7.5%	8.1%	7.7%
	Region 1	California Halibut	0.6%	2.4%	11.3%	2.3%
		Dungeness Crab	28.2%	17.9%	28.7%	25.0%
		Rockfish	17.5%	18.5%	25.7%	18.5%
		Salmon	13.1%	10.2%	14.7%	11.6%
Private Vessel	Region 3	California Halibut	6.9%	6.8%	11.4%	6.9%
		Dungeness Crab	9.2%	6.2%	14.0%	6.3%
		Rockfish	15.0%	12.3%	18.4%	15.9%
		Salmon	9.6%	7.3%	8.1%	7.8%
	Region 2	California Halibut	3.7%	4.4%	7.1%	4.4%
		Dungeness Crab	2.1%	1.7%	4.4%	1.9%
		Rockfish	31.4%	26.2%	34.2%	26.1%
		Salmon	4.5%	4.2%	4.9%	4.7%
	Region 1	California Halibut	6.8%	9.2%	22.1%	8.0%
		Dungeness Crab	16.0%	8.6%	15.4%	12.9%
		Rockfish	19.7%	19.2%	29.3%	19.0%
		Salmon	5.7%	4.2%	9.6%	5.1%
Kayak Anglers	Region 3	California Halibut	0.0%	0.0%	0.2%	0.0%
		Dungeness Crab	0.0%	0.0%	0.1%	0.0%
		Rockfish	2.4%	0.9%	9.5%	4.6%
		Salmon	0.5%	0.6%	6.5%	1.8%
	Region 2	California Halibut	0.1%	0.0%	0.0%	0.0%
		Dungeness Crab	—	—	—	—
		Rockfish	17.1%	7.6%	19.2%	7.6%
		Salmon	12.8%	8.4%	14.4%	11.3%
	Region 1	California Halibut	0.2%	0.5%	6.7%	0.4%
		Dungeness Crab	34.8%	20.6%	34.8%	31.3%
		Rockfish	8.1%	9.0%	10.2%	9.1%
		Salmon	1.0%	0.9%	0.9%	1.0%
Pier/Shore	Region 3	California Halibut	—	—	—	—
		Dungeness Crab	—	—	—	—
		Rockfish	4.2%	1.2%	24.7%	15.1%
		Salmon	—	—	—	—
		Striped Bass	15.1%	14.2%	28.9%	14.1%
	Region 2	California Halibut	0.0%	0.0%	0.0%	0.0%
		Dungeness Crab	0.0%	0.0%	0.0%	0.0%
		Rockfish	14.7%	11.6%	19.7%	12.3%
		Salmon	—	—	—	—
		Striped Bass	6.2%	6.2%	10.8%	6.2%
	Region 1	California Halibut	4.0%	4.0%	12.4%	3.4%
		Dungeness Crab	4.8%	0.8%	4.7%	4.6%
		Rockfish	8.7%	5.0%	16.6%	4.7%
		Salmon	0.0%	0.0%	0.0%	0.0%
		Striped Bass	11.3%	7.4%	20.6%	6.2%

APPENDIX A: Socioeconomic Impact Assessment: Methods

The primary goal of this analysis is to estimate the socioeconomic impact to the commercial fishery sector associated with each of the MPA proposals. To accomplish this, we will estimate the maximum potential economic impact for each of the MPA proposals using methods developed in the Central Coast process (see Wilen and Abbott, 2006). This analysis assumes that each of the MPA proposals completely eliminates fishing opportunities in areas closed to specific fisheries and that fishermen are unable to adjust or mitigate in any way (Wilen and Abbott, 2006). The results can then be used by each group (i.e. stakeholders, SAT, BRTF, Initiative staff, FGC) to site and evaluate MPA proposals. The remainder of this paper describes the steps needed to complete the maximum potential economic impact analysis.

1. Generate Baseline Estimates of Gross Economic Revenue

The first step involves calculating a baseline estimate from which to derive estimates of the socioeconomic impact associated with changes in commercial fisheries that might be induced by each MPA alternative and against which to compare those estimates. We generate the baseline estimate using gross fishing revenues from regional landing receipts. We use a 7 year average, 2000–2006, derived from the California Department of Fish and Game (CDFG) landing receipts reported for ports in the North Central Coast region and then convert these values into real dollars (i.e. 2006 dollars).

More specifically, to generate baseline estimates of gross economic revenue (GER), for any fishery, *f*, $BGER_f$ is the average ex-vessel value of the fishery in 2006 dollars, where $BGER_f = \sum_{p \in P} BGER(f, p)$, the sum of the baseline estimates of GER for this fishery over all ports.

We also define the fisheries specific to each port, or in other words, create a baseline estimate of gross economic revenue for each port. For a specific port, *p*, being considered in the North Central Coast region the baseline estimate ($BGER_p$) can be calculated as the sum of the baseline estimates of GER for this port over all fisheries:

$$BGER_p = \sum_{f \in F} BGER(f, p).$$

The baseline gross economic revenue ($BGER_{TOT}$) for <u>all</u> commercial fisheries ($f \in F$) being considered in the North Central Coast region is therefore

$$BGER_{TOT} = \sum_{f \in F} BGER_f = \sum_{f \in F} \sum_{p \in P} BGER(f, p)$$ or equivalently, $$BGER_{TOT} = \sum_{p \in P} BGER_p = \sum_{p \in P} \sum_{f \in F} BGER(f, p).$$

2. Generate Gross Economic Revenue for the Various MPA Alternatives

The next step involves using results from the Ecotrust mapping exercise, specifically stated importance indices from the fishing grounds, to estimate the socioeconomic impact associated with changes in the commercial fisheries that might be induced by each MPA alternative. For a description of the methods used to create stated importance indices, please see Scholz et al. (2006).

For any fishery, *f*, port, *p*, and any MPA alternative, *a*:

$$GER(f, p, a) = BGER(f, p) - GEI(f, p, a)$$

where $GEI(f, p, a)$ is the estimated gross economic impact on fishery, *f*, at any port, *p*, under any alternative, *a*.

Therefore, we define

$$GER_f(a) = \sum_{p \in P} GER(f, p, a)$$ and $$GER_p(a) = \sum_{f \in F} GER(f, p, a)$$

as well as

$GEI_f(a) = \sum_{p \in P} GEI(f, p, a)$ and $GEI_p(a) = \sum_{f \in F} GEI(f, p, a)$.

Gross economic revenue under any alternative, ***a***, ($GER_{TOT}(a)$), for <u>all</u> commercial fisheries ($f \in F$) being considered in the North Central Coast region can be calculated as:

$$GER_{TOT}(a) = \sum_{f \in F} GER_f(a) = \sum_{p \in P} GER_p(a) = \sum_{f \in F} \sum_{p \in P} GER(f, p, a) = \sum_{p \in P} \sum_{f \in F} GER(f, p, a)$$

From this we can say for any MPA alternative, ***a***,

$$GEI_{TOT}(a) = BGER_{TOT} - GER_{TOT}(a)$$

where GEI_{TOT_a} is defined as the total gross economic impact on all commercial fisheries under any alternative, ***a***. Therefore,

$$GEI_{TOT}(a) = \sum_{f \in F} GEI_f(a) = \sum_{p \in P} GEI_p(a) = \sum_{f \in F} \sum_{p \in P} GEI(f, p, a) = \sum_{p \in P} \sum_{f \in F} GEI(f, p, a).$$

3. Generate Baseline Estimates of Net Economic Revenue

In order to compute net economic benefits, we need to 1) estimate the share of gross fishing revenues represented by costs, and 2) scale the baseline estimate (i.e. gross fishing revenues) calculated in Step 1 using the estimated cost shares. In the Central Coast process, an estimate of 65% was used across all fisheries (Wilen and Abbott, 2006). For the North Central Coast process, we plan to ask several cost related questions during interviews with fishermen in an effort to improve on this estimate as well as allow for the ability to account for cost variability between different fisheries in this analysis. After all interviews have been completed, we anticipate breaking the cost data out by fishery or fisheries. For example, cost data for a fisherman who fished both salmon and crab would be aggregated with only other interviewees participating in both those fisheries. We then calculate a mean or median cost estimate for each category.

Costs will be broken into two categories: fixed costs and variable costs. Fixed costs include costs that are independent of the number of trips a vessel makes or the duration of these trips. For example, vessel repairs and maintenance, insurance, mooring and dockage fees typically considered fixed costs. On the other hand, variable costs include costs that are dependent on the number of trips a vessel makes of the duration of these trips. Variable costs typically include fuel, maintenance, crew share, gear repair/replacement. For the purpose of this study, however, to account for sunk costs, we assume the only variable cost to be crew wages and fuel costs. All other costs will be considered fixed costs.

For any fishery, ***f***, net economic revenue is calculated as:

$$BNER_f = BGER_f - C_{X_f} - C_{V_f}$$

where C_{X_f} is the fixed cost associated with any fishery, ***f***, and is set as a fixed dollar value, and C_{V_f} is the variable cost associated with any fishery , ***f***, and is a fixed percentage of $BGER_f$. For further explanation, please see the Appendix.

Baseline net economic revenue ($BNER$) for <u>all</u> commercial fisheries ($f \in F$) being considered in the North Central Coast region can be calculated as:

$$BNER_{TOT} = \sum_{f \in F} BNER_f$$

4. Generate Estimates of Net Economic Revenue for the Various MPA Alternatives

In order to compute net economic revenue for each of the various MPA alternatives, we also need to 1) estimate the share of gross fishing revenues represented by costs under each MPA alternative, and 2) scale the estimated gross fishing revenues for that alternative accordingly. Costs will be calculated using the methods described in Step 3.

For any fishery, *f*, and any MPA proposal, *a*,

$$NER_f(a) = GER_f(a) - C_{X_f} - C_{V_f} \ .$$

For any MPA alternative, *a*, net economic revenue for <u>all</u> commercial fisheries ($NER_{TOT}(a)$) can be calculated as:

$$NER_{TOT}(a) = \sum_{f \in F} NER_f(a)$$

5. Generate Estimate of the Potential Primary Economic Impact for the Various MPA Alternatives
Using the results from the previous steps, the potential primary net economic impact (NEI) of a particular MPA alternative, *a,* on a particular fishery, *f,* can then be calculated as:

$$NEI_f(a) = BNER_f - NER_f(a).$$

The potential primary NEI of any MPA alternative, *a,* on <u>all</u> commercial fisheries ($f \in F$) can then be calculated as:

$$NEI_{TOT}(a) = BNER_{TOT} - NER_{TOT}(a).$$

References

- Scholz, Astrid, Charles Steinback and M. Mertens. 2006. Commercial fishing grounds and their relative importance off the Central Coast of California. Report submitted to the California Marine Life Protection Act Initiative. May 4, 2006.
- Wilen, James and Joshua Abbott, "Estimates of the Maximum Potential Economic Impacts of Marine Protected Area Networks in the Central California Coast," final report submitted to the California MLPA Initiative in partial fulfillment of Contract #2006-0014M (July 17, 2006)

Example of Estimate Costs
For fishery *f*, assume the following proportion of gross economic revenue goes to the following costs:

- 20% = fixed costs
- 20% = crew wages
- 10% = fuel costs → 30% = variable costs

Assume that baseline gross economic revenue equals $10,000.00. Under the baseline, fixed costs equal $2,000 and variable costs equal $3,000, resulting in total costs of $5,000. Assume that under MPA alternative *a,* gross economic revenue now equals $5,000. Under this alternative, fixed costs will still equal $2,000; however, variable costs will be recalculated as:

$5,000 * 0.3 = $1,500

This results in total costs of $3,500 under MPA alternative *a.*

Appendix D: Condensed Summary Report

Summary of potential impacts of the Integrated Preferred Alternative and the North Central Coast Regional Stakeholder Group (NCCRSG) MPA proposals on commercial and recreational fisheries in the North Central Coast Study Region

Condensed Summary of the Draft [Revised 9 June 2008]

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In order to conduct an analysis of the relative effects of Marine Protected Area (MPA) proposals on fisheries that are conducted in the waters in the North Central Coast Study Region (NCCSR), we use data layers characterizing the spatial extent and relative stated importance of fishing grounds for eight commercial fisheries and five recreational fisheries. This information was collected during interviews in the summer of 2007, using a stratified, representative sample of 174 commercial fishermen and a stratified solicited sample of 101 recreational fishermen whose individual responses regarding the relative importance of ocean areas for each fishery were standardized using a 100-point scale and normalized to the reported fishing grounds for each fishery.

Using the normalized data, we 1) evaluate the potential impacts on the commercial and recreational fishing grounds and 2) conduct a socioeconomic impact analysis on commercial fisheries in order to assess the effects of the Integrated Preferred Alternative (Proposal IPA) relative to the three NCCRSG MPA proposals (Proposal 1–3, Proposal 2–XA and Proposal 4). Results are reported at both the study region and port group levels for the commercial fisheries.

It should be noted that this document is a condensed summary of a more comprehensive document, entitled "Summary of potential impacts of the Integrated Preferred Alternative (IPA) and the North Central Coast Regional Stakeholder Group (NCCRSG) MPA proposals on commercial and recreational fisheries in the North Central Coast Study Region [Draft, Revised 9 June 2008]." Please refer to this document for additional details on both methods and results.

Results for Commercial Fisheries

We summarize here the results derived from a series of analyses conducted to evaluate the potential impacts on eight commercial fisheries (i.e. California halibut, coastal pelagics, market squid, deeper nearshore rockfish, nearshore rockfish, urchin, Dungeness crab and salmon).

- *Potential Impacts on Fishing Grounds (Area and Value)*

MPA proposals vary considerably in their effects, both between and across fisheries. All proposals affect the eight commercial fisheries differently, with the smallest effects in terms of both value and area affected generally evidenced in Proposal 2–XA. On average, under all four proposals, the fisheries most likely to see the largest potential impacts across all ports in terms of percentage area and value of total commercial fishing grounds affected are the deeper nearshore rockfish, nearshore rockfish and urchin fisheries.

In terms of **total area** of the fishing grounds potentially impacted for the twenty-eight port-fishery combinations investigated, several patterns emerge from the analysis of the three proposals[8]:

- Proposal 1–3 has the least potential impact on five fisheries and the highest potential impact on one fishery.
- Proposal 2–XA has the least potential impact on eighteen fisheries and the highest potential impact on zero fisheries.
- Proposal 4 has the least potential impact on zero fisheries and the highest potential impact on twenty-five fisheries.
- Proposal IPA has the least potential impact on two fisheries and the highest potential impact on zero fisheries.
- There are seven port-fishery combinations where there is ≤ 1% variation between the potential impacts of each Proposal relative to the other three. Specifically, Point Arena – salmon, Bodega Bay – salmon, Bolinas – salmon, San Francisco – salmon, and Half Moon Bay – coastal pelagics, nearshore rockfish, and salmon.

[8] It should be noted that the number of least potential impacts and highest potential impacts attributed to each proposal may not sum to twenty-eight (in the case of commercial fisheries) or forty-six (in the case of recreational fisheries) due to the fact that only cases where a single proposal had the least or highest impact (as opposed to multiple proposals having the same impact) was it counted.

- There are five port-fishery combinations where there is ≥ 10% variation between the potential impacts of each Proposal relative to the other three. Specifically, Point Arena – deeper nearshore rockfisk, San Francisco – urchin and Half Moon Bay – California halibut, market squid, and deeper nearshore rockfish.

In terms of **total value** of the fishing grounds potentially impacted for the twenty-eight port-fishery combinations investigated, several patterns emerge from the analysis of the three proposals:

- Proposal 1–3 has the least potential impact on six fisheries and the highest potential impact on one fishery.
- Proposal 2–XA has the least potential impact on fifteen fisheries and the highest potential impact on zero fisheries.
- Proposal 4 has the least potential impact on zero fisheries and the highest potential impact on twenty-three fisheries.
- Proposal IPA has the least potential impact on two fisheries and the highest potential impact on zero fisheries.
- There are eight port-fishery combinations where there is ≤ 1% variation between the potential impacts of each Proposal relative to the other three. Specifically, Bodega Bay – salmon, Bolinas – salmon, San Francisco – California halibut and salmon, and Half Moon Bay – coastal pelagics, nearshore rockfish, and Dungeness crab and salmon.
- There are eight port-fishery combinations where there is ≥ 10% variation between the potential impacts of each Proposal relative to the other three. Specifically, Point Arena – deeper nearshore rockfish, nearshore rockfish, Bodega Bay – nearshore rockfish, and urchin, San Francisco – urchin, and Half Moon Bay – California halibut, market squid, and deeper nearshore rockfish
- Proposal 1–3 has a ≤ 10% potential impact on fifteen of the twenty-eight port-fishery combinations, compared nineteen for Proposal 2–XA, eleven for Proposal 4 and fifteen for proposal IPA.
- All four proposals are estimated to have ≤ 5% impact on the ten following fishery/port group combinations: Bodega – salmon, Bolinas – Dungeness crab and salmon, San Francisco – California halibut, Dungeness crab, and salmon, and Half Moon Bay – coastal pelagics, nearshore rockfish, Dungeness crab, and salmon.

▫ *Consideration of Existing Closures*

For the commercial deeper nearshore and nearshore rockfish fisheries, we evaluate the additional impacts that potentially occur when considering the existing fishery management area closures and/or fishery exclusion zones (i.e., Rockfish Conservation Area, 2007–2009). The fishing grounds, as defined by the fishermen through the interview process, represent the total area and value regardless of these existing or potential fishery management closures and/or fishery exclusion zones. In order to evaluate the effect of such closures, the fishing grounds that fall inside those areas were removed, and the value associated with the removed area were redistributed to the remaining fishing grounds outside the closed areas. For example, after the value associated with the fishing grounds that falls inside the 2007 closure is removed, the impact to the Bolinas deeper nearshore rockfish fishing grounds is 60.8%, in terms of value. Similarly, 72.3% impact to the fishery from the 2008 fishery closures and 81.2% impact in 2009. Using the same method described above, we determine the percentage change in value by the intersection of each MPA proposal with the total fishing grounds now constrained to areas not inside the closed areas (i.e., the “available fishing grounds”). Across all proposals, the difference in percentage value of commercial deeper nearshore and nearshore rockfish fishing grounds by landing port affected by MPA proposals when comparing the available fishing grounds summarized for all MPAs with the same effects for those fisheries without consideration of fishery management closures were minimal for Point Arena, San Francisco and Half Moon Bay. We see, however, a substantial increase in impacts to the deeper nearshore rockfish fishery for Bolinas across for Proposals 1–3 and 4. This increase in impacts is largely due to the value that Bolinas deeper nearshore rockfish fishermen associate with the Farallon Islands. More specifically, the percentage differences in potential impact (i.e. considering total fishing grounds and considering only grounds available outside of Rockfish Conservation Areas) are 0.6%, 0.7%, 8.4% and 11.9% under Proposals IPA, 2-XA, 1–3 and 4, respectively. When comparing the impacts of a proposal between the total fishing grounds and the available fishing grounds, where there is marginal or no percentage difference also indicates that there is a high degree of overlap between the proposed MPAs and the existing closed areas. Where there is a large percentage difference between the impact on the total fishing grounds versus on available fishing grounds, this indicates that the MPA proposal is impacting additional fishing grounds that are not already impacted by the existing fishery management closures.

▫ *Potential Impacts on Individual Fishermen*

We also conducted an analysis to assess whether or not there are individual fishermen who would be disproportionally affected by a specific MPA proposal. It should be noted that the results of the individual impact analysis suggest that one fisherman will be disproportionately impacted by all four proposals being considered. His estimated annual individual is:

- Proposal 1-3: between 20–40% loss of ex-vessel revenue and $15K–$20K loss

- Proposal 2-XA: between 20–40% loss of ex-vessel revenue and $15K–$20K loss
- Proposal 4: between 40–60% loss of ex-vessel revenue and > $20K loss
- Proposal IPA: between 20–40% loss of ex-vessel revenue and > $20K loss

Additionally, two other individuals are estimated to be disproportionately impacted by two proposals each.

Individual 1:
- Proposal 4: between 20–40% loss of ex-vessel revenue and > $20K loss
- Proposal IPA: between 20–40% loss of ex-vessel revenue and > $20K loss

Individual 2:
- Proposal 4: between 20–40% loss of ex-vessel revenue and $15–20K loss
- Proposal IPA: between 20–40% loss of ex-vessel revenue and $15–20K loss

▫ *Potential Socioeconomic Impacts*

We also estimate "worst-case scenario" or maximum potential economic impact of each MPA proposal. As seen previously in the other analyses, proposals vary considerably in their effects on ports and fisheries. Table 1 summarizes the results across all fisheries for each port group. As can be seen, Proposal 4 has the highest potential socioeconomic impact across all ports. Proposal 1–3 has the lowest estimated impact on the ports of Point Arena and Bolinas, while Proposal 2–XA is estimated to have the lowest impact on the ports of Bodega Bay, San Francisco and Half Moon Bay. Proposal 2–XA is also estimated to have the lowest socioeconomic impact across the study region as a whole, with an estimated net economic impact of 4.8%, compared to 5.6%, 6.3% and 8.3% under Proposals 1–3, IPA and 4, respectively (see Table 1). The estimated annual net economic impacts of all four proposals, broken out first by port group and then by fishery, are shown in Tables A.1–A.6 (see Appendix: Socioeconomic Impact Assessment Results).

Table 1: Estimated Annual Net Economic Impact (NEI) on Commercial Fisheries by Port Group

			Net Economic Impact under each Proposal ($ reduction in Profit)			
Port	**Baseline GER**	**Baseline NER[9] (Profit)**	**Proposal 1-3**	**Proposal 2-XA**	**Proposal 4**	**Proposal IPA**
Point Arena	$798,750	$465,016	$59,510	$67,078	$83,332	$76,623
Bodega Bay	$4,654,206	$2,457,152	$207,776	$161,140	$314,474	$258,074
Bolinas	$151,214	$78,783	$3,297	$4,192	$5,988	$4,192
San Francisco	$6,059,387	$3,166,680	$110,421	$95,387	$168,861	$109,733
Half Moon Bay	$4,110,888	$2,122,436	$84,149	$68,786	$123,439	$77,244
NCC	**$15,889,359**	**$8,336,602**	**$465,153**	**$396,583**	**$696,094**	**$525,865**

	Net Economic Impact (% reduction in Profit)			
Port	**Proposal 1-3**	**Proposal 2-XA**	**Proposal 4**	**Proposal IPA**
Point Arena	12.8%	14.4%	17.9%	16.5%
Bodega Bay	8.5%	6.6%	12.8%	10.5%
Bolinas	4.2%	5.3%	7.6%	5.3%
San Francisco	3.5%	3.0%	5.3%	3.5%
Half Moon Bay	4.0%	3.2%	5.8%	3.6%
NCC	**5.6%**	**4.8%**	**8.3%**	**6.3%**

Results for Recreational Fisheries

We summarize here the results derived from analyses conducted to evaluate the potential impacts on recreational fisheries (California halibut, Dungeness crab, salmon, rockfish/lingcod complex, and striped bass –pier/shore only). The recreational fisheries are broken out by user group (i.e. commercial passenger fishing vessels, private vessels, kayak based, and pier/shore based) and by sub-region (i.e. Region 1 - Ocean Beach in San Francisco County, Region 2 - San Francisco Bay access points to Point Reyes and Region 3 - Point Reyes north to Alder Creek).

[9] Baseline GER stands for Baseline Gross Economic Revenue. Similarly, Baseline NER states for Baseline Net Economic Revenue

- *Potential Impacts on Fishing Grounds (Area and Value)*

MPA proposals vary considerably in their effects, both between and across fisheries. All the proposals affect the recreational fisheries differently, with the smallest effects in terms of both total value and total area affected generally evidenced in Proposal 2–XA. On average, under all four proposals, the fishery most likely to see the largest potential impacts across all user groups and sub-regions in terms of percentage area and value of total recreational fishing grounds affected is the rockfish/lingcod fishery. Additionally, there are fisheries with specific user group/region combinations that have relatively large impacts, and those fisheries are further detailed in the description below.

In terms of **total area** of the fishing grounds potentially impacted for the 46 user group-region-fishery combinations investigated, several patterns emerge from the analysis of the four proposals:

- Proposal 1–3 has the least potential impact on seven fisheries and the highest potential impact on six fisheries.
- Proposal 2–XA has the least potential impact on nineteen fisheries and the highest potential impact on zero fisheries.
- Proposal 4 has the least potential impact on zero fisheries and the highest potential impact on thirty-six fisheries.
- Proposal IPA has the least potential impact on five fisheries and the highest potential impact on one fishery.
- There are thirteen user group-region-fishery combinations where there is ≤ 1% variation between the potential impacts of each Proposal relative to the other three. Specifically, CPFV - Region 3 - salmon , CPFV - Region 2 – Dungeness crab, CPFV - Region 1 – salmon, Private vessels - Region 2 – salmon, Private vessels - Region 1- Dungeness crab and salmon, Kayak – Region 3 – California halibut and Dungeness crab, Kayak – Region 2 – California halibut, Kayak – Region 1 – salmon, and Pier/Shore – Region 2 – California halibut and Dungeness crab, and Pier/Shore – Region 1 – salmon.
- There are nine user group-region-fishery combinations where there is ≥ 10% variation between the potential impacts of each Proposal relative to the other three. Specifically, CPFV – Region 2 – California halibut, rockfish/lingcod, CPFV – Region 1 – California halibut, Kayak – Region 2 – rockfish/lingcod, and Pier/Shore – Region 3 – rockfish/lingcod and striped bass, Pier/Shore – Region 2 – striped bass, and Pier/Shore – Region 1 – rockfish/lingcod and striped bass.

In terms of **total value** of the fishing grounds potentially impacted for the 46 user group-region-fishery combinations investigated, several patterns emerge from the analysis of the four proposals:

- Proposal 1–3 has the least potential impact on eight fisheries and the highest potential impact on five fisheries.
- Proposal 2–XA has the least potential impact on seventeen fisheries and the highest potential impact on zero fisheries.
- Proposal 4 has the least potential impact on one fishery and the highest potential impact on thirty-five fisheries.
- Proposal IPA has the least potential impact on four fisheries and the highest potential impact on zero fisheries.
- There are thirteen user group-region-fishery combinations where there is ≤ 1% variation between the potential impacts of each Proposal relative to the other three. Specifically, CPFV – Region 3 – salmon, CPFV – Region 2 – Dungeness crab and salmon, Private vessels – Region 3 – salmon, Private vessels – Region 2 – Dungeness crab and salmon, Kayak – Region 3 – California halibut and Dungeness crab, Kayak – Region 2 – California halibut, Kayak – Region 1 – salmon, Pier\Shore – Region 2 – California halibut and Dungeness crab, and Pier\Shore – Region 1 – salmon.
- There are five user group-region-fishery combinations where there is ≥ 10% variation between the potential impacts of each Proposal relative to the other three. Specifically, Kayak – Region 2 – rockfish\lingcod, and Pier\Shore – Region 3 – rockfish\lingcod and striped bass, and Pier/Shore – Region 1 – rockfish\lingcod and striped bass.
- Proposal IPA has ≤ 5% potential impact on twenty-seven of the forty-six user group-region-fishery combinations, compared to twenty-six for Proposal 1–3, twenty-eight for Proposal 2–XA, and nineteen for Proposal 4 (all four Proposals have a ≤ 5% potential impact for those nineteen fisheries).

APPENDIX: COMMERCIAL FISHERY SOCIOECONOMIC IMPACT ASSESSMENT RESULTS

Table A.1: Estimated Annual Net Economic Impact (NEI) for Point Arena

			Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit)			
Fishery	**Baseline GER**	**Baseline NER (Profit)**	**1–3**	**2–XA**	**4**	**IPA**
Ca. Halibut	—	—	—	—	—	—
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$1,424	$699	$337	$77	$346	$291
N. Rockfish	$64,259	$31,544	$13,440	$5,271	$13,977	$12,073
Urchin	$608,226	$366,963	$33,273	$49,288	$54,609	$51,923
Dungeness Crab	$46,951	$24,201	$4,901	$3,969	$5,888	$4,771
Salmon	$77,890	$41,610	$7,558	$8,474	$8,511	$7,564
All Fisheries	**$798,750**	**$465,016**	**$59,510**	**$67,078**	**$83,332**	**$76,623**

	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit)			
Fishery	**1–3**	**2–XA**	**4**	**IPA**
Ca. Halibut	—	—	—	—
Coastal Pelagics	—	—	—	—
Squid	—	—	—	—
D. N. Rockfish	48.3%	11.0%	49.5%	41.7%
N. Rockfish	42.6%	16.7%	44.3%	38.3%
Urchin	9.1%	13.4%	14.9%	14.1%
Dungeness Crab	20.2%	16.4%	24.3%	19.7%
Salmon	18.2%	20.4%	20.5%	18.2%
All Fisheries	**12.8%**	**14.4%**	**17.9%**	**16.5%**

Table A.2: Estimated Annual Net Economic Impact (NEI) for Bodega Bay

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$19,928	$10,772	$1,244	$1,641	$1,787	$1,646
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$24,772	$12,160	$3,943	$2,856	$4,480	$3,378
N. Rockfish	$40,634	$19,946	$3,908	$3,965	$7,474	$7,323
Urchin	$247,530	$149,343	$34,369	$12,306	$78,979	$63,941
Dungeness Crab	$2,322,504	$1,197,122	$103,992	$91,645	$158,770	$123,816
Salmon	$1,998,838	$1,067,809	$60,320	$48,726	$62,984	$57,970
All Fisheries	**$4,654,206**	**$2,457,152**	**$207,776**	**$161,140**	**$314,474**	**$258,074**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	11.6%	15.2%	16.6%	15.3%
Coastal Pelagics	—	—	—	—
Squid	—	—	—	—
D. N. Rockfish	32.4%	23.5%	36.8%	27.8%
N. Rockfish	19.6%	19.9%	37.5%	36.7%
Urchin	23.0%	8.2%	52.9%	42.8%
Dungeness Crab	8.7%	7.7%	13.3%	10.3%
Salmon	5.6%	4.6%	5.9%	5.4%
All Fisheries	**8.5%**	**6.6%**	**12.8%**	**10.5%**

Table A.3: Estimated Annual Net Economic Impact (NEI) for Bolinas

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$22,897	$12,376	$2,266	$2,809	$2,438	$2,809
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$2,147	$1,054	$445	$396	$474	$396
N. Rockfish	—	—	—	—	—	—
Urchin	—	—	—	—	—	—
Dungeness Crab	$109,192	$56,282	$41	$384	$2,535	$384
Salmon	$16,978	$9,070	$544	$603	$542	$603
All Fisheries	**$151,214**	**$78,783**	**$3,297**	**$4,192**	**$5,988**	**$4,192**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	18.3%	22.7%	19.7%	22.7%
Coastal Pelagics	—	—	—	—
Squid	—	—	—	—
D. N. Rockfish	42.3%	37.5%	44.9%	37.5%
N. Rockfish	—	—	—	—
Urchin	—	—	—	—
Dungeness Crab	0.1%	0.7%	4.5%	0.7%
Salmon	6.0%	6.6%	6.0%	6.6%
All Fisheries	**4.2%**	**5.3%**	**7.6%**	**5.3%**

Table A.4: Estimated Annual Net Economic Impact (NEI) for San Francisco

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$203,044	$109,750	$1,179	$1,228	$1,621	$1,228
Coastal Pelagics	—	—	—	—	—	—
Squid	—	—	—	—	—	—
D. N. Rockfish	$59,192	$29,056	$9,179	$6,912	$10,439	$7,177
N. Rockfish	$44,442	$21,816	$4,113	$2,001	$5,203	$3,071
Urchin	$8,827	$5,326	$1,309	$515	$2,451	$2,443
Dungeness Crab	$3,608,592	$1,860,029	$61,335	$57,282	$111,321	$61,335
Salmon	$2,135,290	$1,140,703	$33,307	$27,449	$37,826	$34,479
All Fisheries	**$6,059,387**	**$3,166,680**	**$110,421**	**$95,387**	**$168,861**	**$109,733**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	1.1%	1.1%	1.5%	1.1%
Coastal Pelagics	—	—	—	—
Squid	—	—	—	—
D. N. Rockfish	31.6%	23.8%	35.9%	24.7%
N. Rockfish	18.9%	9.2%	23.9%	14.1%
Urchin	24.6%	9.7%	46.0%	45.9%
Dungeness Crab	3.3%	3.1%	6.0%	3.3%
Salmon	2.9%	2.4%	3.3%	3.0%
All Fisheries	**3.5%**	**3.0%**	**5.3%**	**3.5%**

Table A.5: Estimated Annual Net Economic Impact (NEI) for Half Moon Bay

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$33,896	$18,322	$55	$71	$7,377	$66
Coastal Pelagics	$16,757	$6,703	$64	$40	$63	$59
Squid	$204,407	$81,763	$865	$736	$22,876	$653
D. N. Rockfish	$20,367	$9,998	$1,734	$1,051	$3,057	$958
N. Rockfish	$3,262	$1,601	$48	$48	$48	$47
Urchin	—	—	—	—	—	—
Dungeness Crab	$2,299,793	$1,185,416	$47,871	$40,295	$53,382	$42,189
Salmon	$1,532,405	$818,633	$33,512	$26,545	$36,635	$33,272
All Fisheries	**$4,110,888**	**$2,122,436**	**$84,149**	**$68,786**	**$123,439**	**$77,244**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	0.3%	0.4%	40.3%	0.4%
Coastal Pelagics	1.0%	0.6%	0.9%	0.9%
Squid	1.1%	0.9%	28.0%	0.8%
D. N. Rockfish	17.3%	10.5%	30.6%	9.6%
N. Rockfish	3.0%	3.0%	3.0%	3.0%
Urchin	—	—	—	—
Dungeness Crab	4.0%	3.4%	4.5%	3.6%
Salmon	4.1%	3.2%	4.5%	4.1%
All Fisheries	**4.0%**	**3.2%**	**5.8%**	**3.6%**

Table A.6: Estimated Annual Net Economic Impact (NEI) for the NCCSR[10]

Fishery	Baseline GER	Baseline NER (Profit)	Estimated Annual Net Economic Impact of MPA Proposals ($ reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	$279,764	$151,220	$4,744	$5,750	$13,224	$5,749
Coastal Pelagics	$29,804	$11,926	$64	$40	$63	$59
Squid	$303,466	$121,386	$865	$736	$22,876	$653
D. N. Rockfish	$107,902	$52,967	$15,638	$11,292	$18,796	$12,200
N. Rockfish	$152,597	$74,907	$21,510	$11,285	$26,703	$22,514
Urchin	$867,381	$523,320	$68,950	$62,109	$136,040	$118,307
Dungeness Crab	$8,387,032	$4,323,049	$218,139	$193,574	$331,896	$232,494
Salmon	$5,761,401	$3,077,826	$135,242	$111,798	$146,497	$133,888
All Fisheries	**$15,889,359**	**$8,336,602**	**$465,153**	**$396,583**	**$696,094**	**$525,865**

Fishery	Estimated Annual Net Economic Impact of MPA Proposals (% reduction in Profit) 1–3	2–XA	4	IPA
Ca. Halibut	3.1%	3.8%	8.7%	3.8%
Coastal Pelagics	0.5%	0.3%	0.5%	0.5%
Squid	0.7%	0.6%	18.8%	0.5%
D. N. Rockfish	29.5%	21.3%	35.5%	23.0%
N. Rockfish	28.7%	15.1%	35.6%	30.1%
Urchin	13.2%	11.9%	26.0%	22.6%
Dungeness Crab	5.0%	4.5%	7.7%	5.4%
Salmon	4.4%	3.6%	4.8%	4.4%
All Fisheries	**5.6%**	**4.8%**	**8.3%**	**6.3%**

[10] It should be noted that the "all fisheries" estimates for annual net economic impact for the NCCSR may not equal the sum of all port's "all fisheries" estimates due to rounding differences.

Appendix E: Port Profiles

OVERVIEW

Ecotrust has been retained to collect, compile and analyze information pertaining to commercial fisheries on the North Central Coast of California. The goal of the project is to compile a comprehensive picture of the commercial fishing use patterns along the north central California coast, using both existing data and the expert knowledge of fishermen themselves. The extent to which our recent survey of commercial fishermen is representative is assessed both in terms of ex-vessel value and number of fishermen, shown in Table O.1 and O.2 (see, section 3.1.3 Sampling the Fishing Fleet). Using CDFG landing statistics for ex-vessel values from 2000–06, we calculated the landings of respondents as a percentage of total landings for the North Central Coast Study Region (NCCSR) over that period in terms of landed ex-vessel value (see Table O.1). Survey respondents account for 40% of the ex-vessel value overall for the fisheries listed in Table 0.2, with representation varying by fishery.

Table O.1: Percentage the sample represents based on ex-vessel revenue (2000-2006)

Fisheries	Point Arena	Bodega Bay	Bolinas	San Francisco	Half Moon Bay	NCC Total
California Halibut	—	1%	100%	29%	19%	32%
Coastal Pelagics	—	—	—	—	97%	54%
Market Squid	—	—	—	—	73%	49%
Deeper Nearshore Rockfish	58%	36%	100%	22%	45%	31%
Nearshore Rockfish	92%	5%	—	19%	72%	47%
Urchin	36%	40%	—	24%	—	37%
Dungeness Crab	97%	54%	81%	41%	45%	46%
Salmon	53%	46%	94%	23%	25%	32%
Total	46%	49%	86%	33%	39%	40%

Table O.2: Summary of the number of fishermen interviewed by landing port

Fisheries	Point Arena	Bodega Bay	Bolinas	San Francisco	Half Moon Bay	NCC Total	Total
California Halibut	—	2	4	9	4	14	14
Coastal Pelagics	—	—	—	—	1	1	1
Market Squid	—	—	—	—	1	1	1
Deeper Nearshore Rockfish	2	4	3	6	5	14	15
Nearshore Rockfish	5	2	—	2	1	9	9
Urchin	16	7	—	2	—	18	22
Dungeness Crab	6	41	3	43	22	89	102
Salmon	7	91	7	62	62	121	136

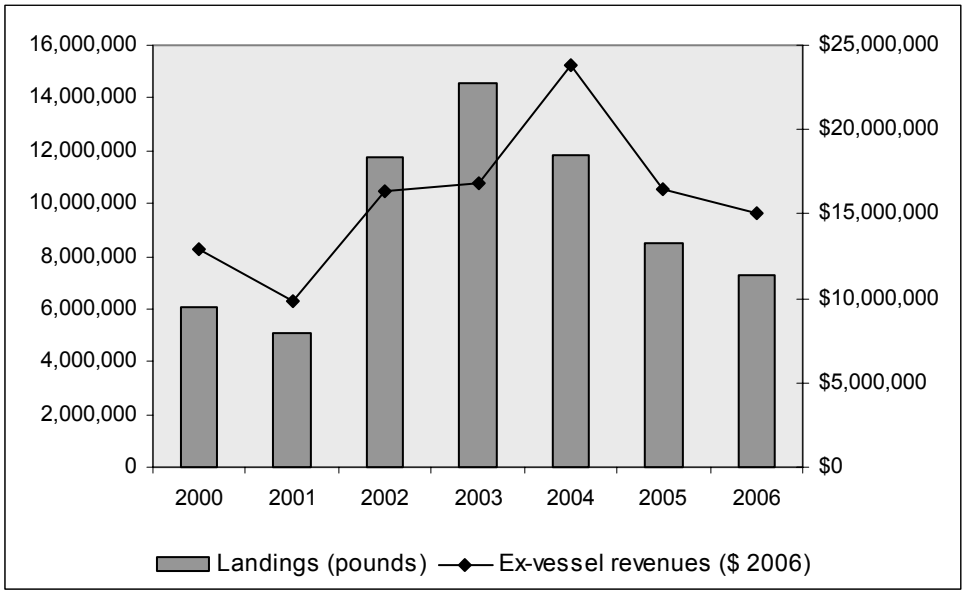
In this section, we present trends in landings, revenues, fishery participation and other characteristics of local fisheries and fisheries related industry for the following port groups within the north central coast study area:

1. Point Arena
2. Bodega Bay (Point Reyes, Petaluma, Dillon Beach: separate subsection for Bolinas);
3. San Francisco; and
4. Half Moon Bay (Pillar Point).

We summarize information derived from a variety of sources, including the California Department of Fish and Game (CDFG) commercial fishing databases, archival sources, observations and information collected during visits to these ports and data collected from interviews with fishermen from these ports. It should be noted that statistics created from the CDFG commercial fishing databases and referenced in this document are for non-trawl landings only and for the eight commercial fisheries examined throughout this project (California halibut, coastal pelagics, market squid, deeper nearshore rockfish, nearshore rockfish, urchin, Dungeness crab and salmon). For each primary port (i.e. Point Arena, Bodega Bay, San Francisco, and Half Moon Bay), we provide a general overview and describe fisheries related industry located in the port. We then more generally discuss each port group's involvement in west coast fisheries.

Figure O.1 shows both annual landings and ex-vessel revenues for the last seven years. The years 2002 and 2003 saw a high volume of landings in the region due to especially large squid, urchin, and Dungeness crab harvests. Since then landings have fallen year to year primarily due to a sharp drip in squid harvests. The landings and ex-vessel revenues are variable over the seven years graphed and individual fishery or overall trends are difficult to predict.

Figure O.1: Commercial Landings and Ex-Vessel Revenues



Ecotrust interviewed 174 fishermen (see Table O.3), of which 145 consider their homeport to be inside the NCCSR. For those 145 fishermen, the average age of the respondents was fifty-four and their average maximum fishing experience was twenty-eight years. Respondents reported that, on average, fishing accounted for 74% of their total income. However a significant number of fishermen derive 100% of their income from fishing, captured in the median statistic.

Table O.3: North Central Coast Survey Summary Statistics

Statistic	
Number of Fishermen Sampled	174
Age, Average	54
Experience, Average of Max per Fisherman	28
Percent of Income from Fishing, Average	74%
Percent of Income from Fishing, Median	100%

1. POINT ARENA

Point Arena, California is located in Mendocino County along Hwy 1, approximately 120 miles north of San Francisco. The population is small (less than 500), though growing at a rate slightly above the California and U.S. averages as measured between 1990 and 2000. The median and per capita incomes are below that of both California and the U.S., and a full 26% of individuals fall below the poverty line, over twice the national average. Demographic characteristics are presented in Table 1.1.

Table 1.1: Selected Demographic Statistics

Statistic	Point Arena	California
Population	474	33,871,648
Population growth (1990-2000)	16.5%	13.8%
Median household income	$27,083	$53,629
Per capita income	$12,591	$26,800
Individuals below poverty level	26.0%	13.3%
Percentage high school graduate or greater	77.2%	80.1%
Percentage aged 65 or greater	9.1%	10.5%

Source: U.S. Census Bureau

Fisheries Related Industry

Point Arena is unique among the harbors in the study area in that it does not provide any moorage for vessels. It does have a hoist that can haul out vessels up to 29' X 10'. There is also a fishing pier and showers are available. Approximately 20% of the haulouts are for commercial vessels. There are two main buyers in Point Arena, Seafood Supplies and NorCal Seafood. Table 1.2 presents selected characteristics of the port.

Table 1.2: Selected Statistics for Point Arena

Employees (#)	Full-Time (#)	Moorage Price
3	3	N/A

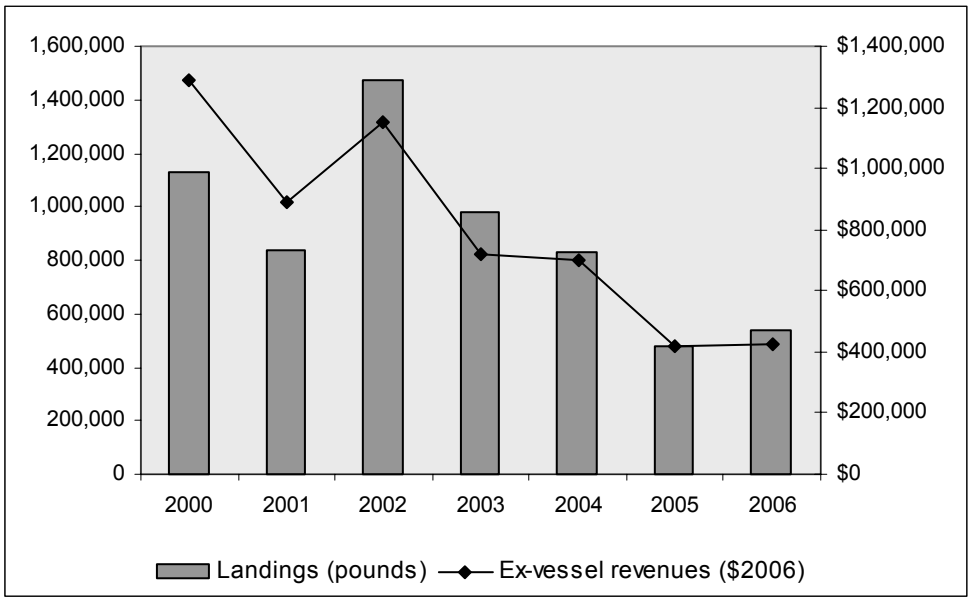
Involvement in West Coast Commercial Fisheries

The main fishery in Point Arena, by a substantial margin, is the urchin fishery. Dungeness crab and salmon are the next largest fisheries, and several smaller fisheries exist in the area. Between 2000 and 2006, both pounds landed and ex-vessel revenues have decreased by more than half. In particular, the urchin fishery saw substantially lower landings in 2005 and 2006 relative to previous years. The salmon fishery saw increased landings from 2000 to 2004, peaked in 2004 and has been declining since then. Table 1.3 presents landings data and revenue for all Point Arena fisheries; 2006 figures are below average, reflecting the declining trend. Figure 1.1 shows changes in landings and revenues over the last seven years.

Table 1.3: Point Arena Commercial Landings

	2006	Avg. Annual 2000-06 ($2006)
Landings (pounds)	540,324	894,923
Ex-vessel revenues	$425,935	$798,761

Figure 1.1: Commercial Landings and Ex-Vessel Revenues for Point Arena



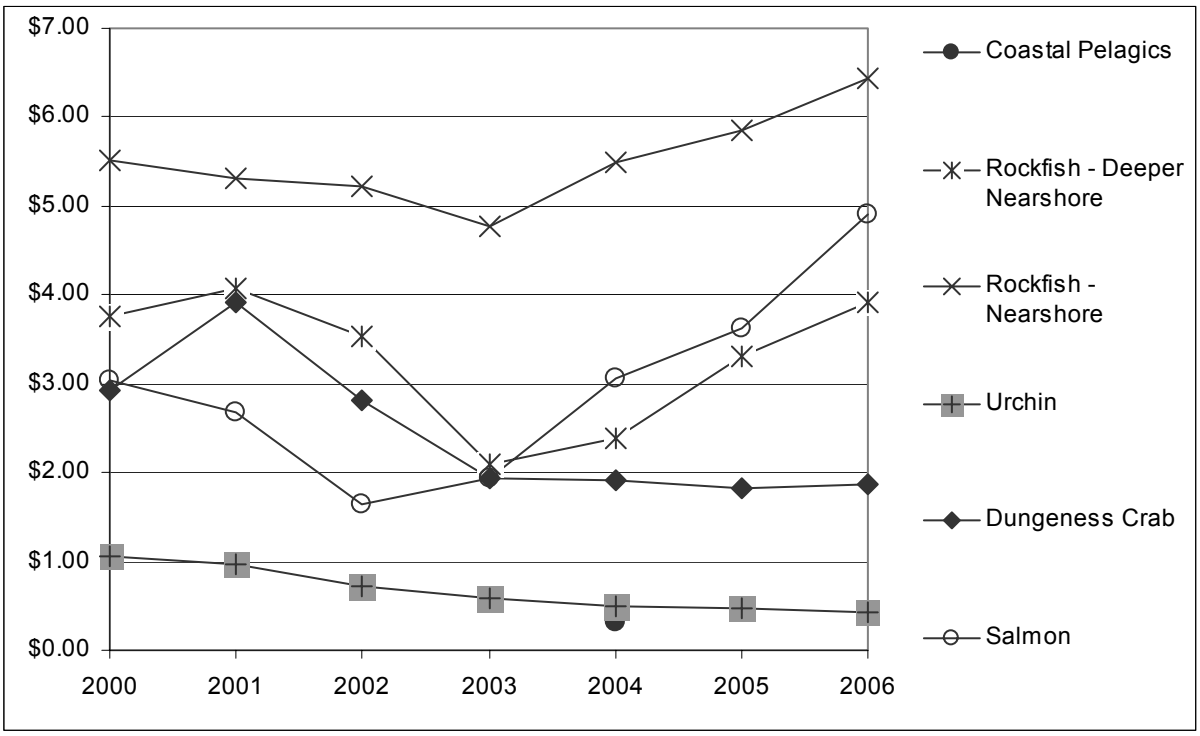
Both the number of vessels and the number of fishermen landing commercial species in Port Arena have declined over the last seven years. In 2000, 93 vessel landings and 106 fishermen landings were reported. In contrast, only 53 vessel landings and 56 fishermen landings were reported in 2006. Not all Point Arena fisheries are experiencing declining landings, however, as the Dungeness crab and salmon fisheries have both seen increases in the number of landings over the last seven years (see Table 1.4).

Table 1.4: Percentage Change in Number of Fishermen from 2000 to 2006

Fisheries	% Change
Rockfish - Deeper Nearshore	-67%
Rockfish - Nearshore	-43%
Urchin	-72%
Dungeness Crab	40%
Salmon	100%

Ex-vessel revenues have not mirrored the declining landings by fishermen, and in fact the nearshore rockfish and salmon fisheries have seen increasing ex-vessel values. However, the main fishery in Port Arena is the urchin fishery, which has seen declining prices over the last seven years.

Figure 1.2: Point Arena Ex-Vessel Values per Pound ($2006)*



* The Coastal Pelagics fishery is intermittent

Survey Representation

Ecotrust interviewed fourteen fishermen from Point Arena (see Table 1.5). The respondents were on average forty-five years old and had an average maximum fishing experience of twenty-two years. Respondents reported that, on average, fishing accounted for 76% of total income.

Table 4.5: Survey Summary Statistics

Statistic	Home Port: Point Arena
Number of Fishermen Sampled	14
Age, Average	45
Experience, Average of Max per Fisherman	22
Percent of Income from Fishing, Average	76%
Percent of Income from Fishing, Median	95%

2. BODEGA BAY

The town of Bodega Bay is located in Northern California's Sonoma County, 67 miles north of San Francisco on California State Route 1. It is situated on the eastern side of Bodega Harbor, an inlet of Bodega Bay and has a total land area of 8.4 mi². According to the 2000 U.S. Census, the population of Bodega Bay was 1,423, and population growth from 1990–2000 was 26.3%, well above both California and U.S. averages of 13.8% and 13.2%, respectively. Selected demographic statistics are presented in Table 2.1.

Table 2.1: Selected Demographic Statistics

Statistic	Bodega Bay	California
Population	1,423	33,871,648
Population growth (1990-2000)	26.3%	13.8%
Median household income	$56,818	$53,629
Per capita income	$37,226	$26,800
Individuals below poverty level	4.3%	13.3%
Percentage high school graduate or greater	86.6%	80.1%
Percentage aged 65 or greater	22.8%	10.5%

Source: U.S. Census Bureau

Fisheries Related Industry

There are three marinas in the town of Bodega Bay: Spud Point Marina, Mason's Marina, and Porto Bodega. Spud Point is the largest, with 244 berths, eighty percent of which are allocated to commercial vessels. The largest slip is 80 feet (ft.), though vessels up to 150 ft. can be accommodated overnight. Other services provided by Spud Point Marina include a Laundromat, water, electricity, restrooms, storage at each berth, two fuel docks, an oil pump-out station, an ice flake plant, a travel lift, two cranes, and an additional 15–20 berths for transient moorage. Mason's Marina has 115 berths and can accommodate vessels up to 50 ft. and also contains a dock, fuel, and a quick market. Porto Bodega is located on the other side of the harbor and has 75 berths, about 40% of which house commercial boats. It has a boat dock and a launch, and trailer hook-ups are provided. Selected statistics for each marina are presented in Table 2.2.

Table 2.2: Selected Statistics for Bodega Bay Marinas

	Employees (#)	Full-Time (#)	Moorage Price
Spud Point	8	3.75	$6.18/ft.
Mason's Marina	3	3	$160/mth for up to 30 ft. $225/mth. for up to 50 ft.
Porto Bodega	5	5	$4.00/ft.

There are also a number of fish processors/buyers located in Bodega Bay. The main processors/buyers are Pisano Brothers/North Coast Fisheries, Tides Wharf, Lucas Wharf, and the Seafood Producers Co-op, which all buy both salmon and Dungeness crab. Table 2.3 lists all processors/buyers in the area, as noted by commercial fishermen interviewed during this process.

Table 2.3: Processors and Other Buyers at Bodega Bay

▫ Albers Seafoods	▫ Ray @ Footloose
▫ Caito Bros Fisheries	▫ Ray Lannes
▫ Dave Legrow-Wholesaler for Farmers Markets	▫ Robert
▫ Jim Lucas	▫ Seafood Producers Co-op
▫ Lucas Wharf - Seafood Guys	▫ Sonoma Coast Seafood
▫ Masons	▫ Sonoma Fisheries
▫ Meredith Fisheries	▫ Spud Point Crab Company
▫ Packwest Seafood	▫ Tides Restaurant
▫ Pisanos Bros-North Coast Fisheries	▫ Tides Wharf

Involvement in West Coast Commercial Fisheries

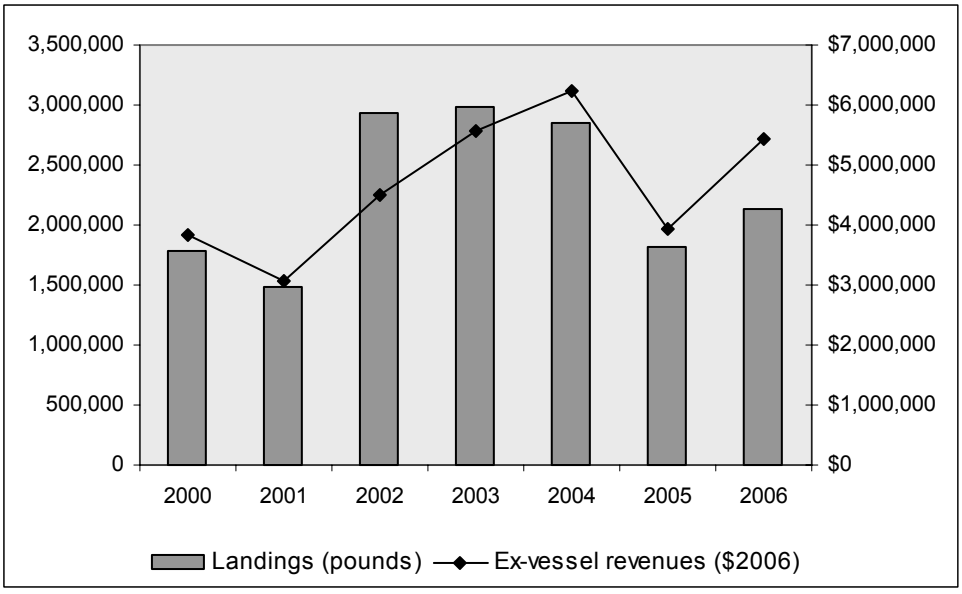
The two primary commercial fisheries for the Bodega Bay port group (Bodega Bay, Point Reyes, Petaluma, and Dillon Beach), both in terms of pounds landed and ex-vessel value, are salmon and Dungeness crab, while urchin is a popular secondary fishery. In addition to these fisheries, several other commercial fish species are regularly landed. It should also be mentioned that albacore tuna is commercially fished out of Bodega Bay but was not examined in this study because that fishery takes place entirely outside of state waters.

Annual landings in Bodega Bay have been variable over the last seven years, with average annual landings of just over 2 million pounds (see Table 2.4). Figure 2.1 shows both annual landings and ex-vessel revenues for the last seven years.

Table 2.4: Bodega Bay Commercial Landings

	2006	Annual Avg. 2000–06 ($2006)
Landings (pounds)	2,137,288	2,282,975
Ex-vessel revenues	$5,432,219	$4,654,296

Figure 2.1: Commercial Landings and Ex-Vessel Revenues for Bodega Bay



The number of fishermen landing commercial species in Bodega Bay has declined as well in recent years (see Table 2.5). The fishery most impacted has been the urchin fishery; in 2006 there were zero fishermen landing

urchin in Bodega Bay. Other fisheries experiencing a substantial decline in the number of fishermen landing harvest in Bodega Bay include nearshore and deeper nearshore rockfish.

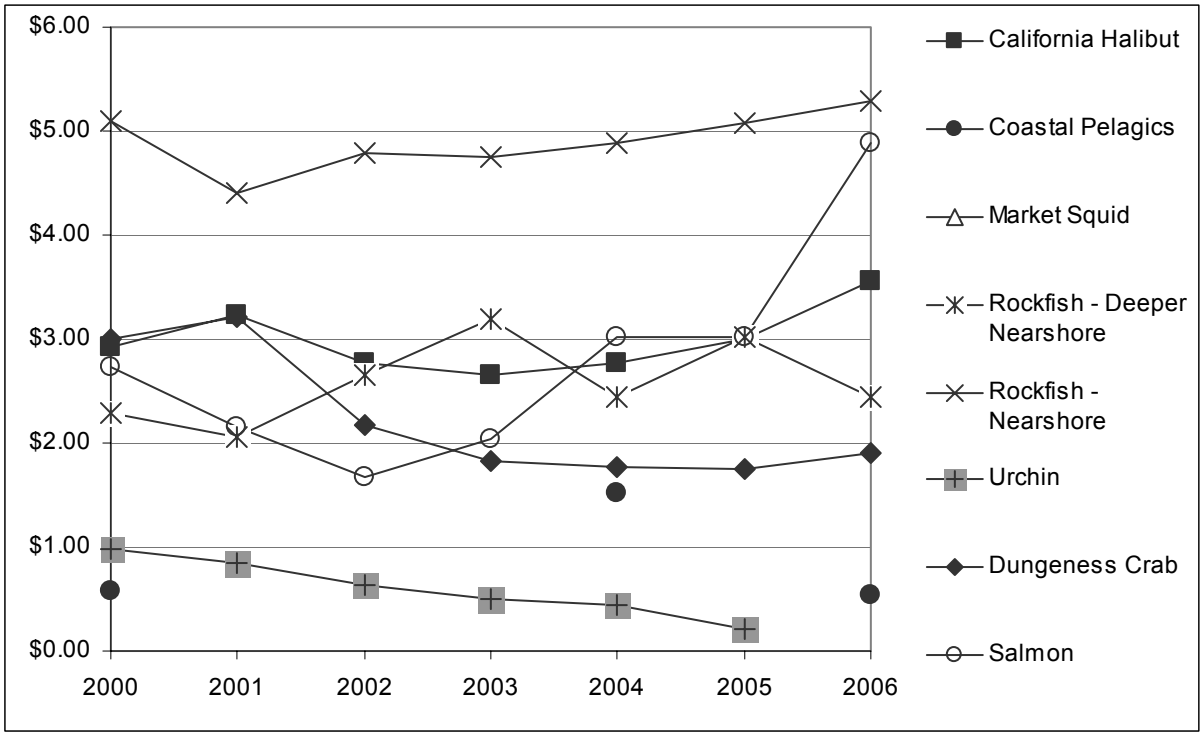
Table 2.5: Bodega Bay Percentage Change in Number of Fishermen from 2000 to 2006

Fisheries	% Change
California Halibut	-32%
Coastal Pelagics	200%
Market Squid	1 in 2006*
Rockfish - Deeper Nearshore	-50%
Rockfish - Nearshore	-63%
Urchin	-100%
Dungeness Crab	-21%
Salmon	-10%

* When zero fishermen represent this fishery in 2000, the number of fishermen in 2006 is shown.

Ex-vessel revenues have more or less mirrored the declining trend seen in both landings and in fishermen landing harvest. That said, for some fisheries such as nearshore rockfish and salmon, ex-vessel values per pound have been increasing in recent years. Figure 2.2 presents the ex-vessel values per pound for the various fisheries landed in Bodega Bay.

Figure 2.1: Bodega Bay Ex-Vessel Values per Pound ($2006)*



* The Market Squid and Urchin fisheries are intermittent

Survey Representation

Ecotrust interviewed seventy fishermen from the Bodega Bay port group (see Table 2.6), which includes Bodega Bay, Point Reyes, Petaluma, Jenner, Dillon Beach, and other locals in and near the proximity of Bodeg Bay. The average age of the respondents was fifty-seven years and their average maximum fishing experience was thirty years. Respondents reported that, on average, fishing accounted for 68% of their total income.

Table 2.6: Survey Summary Statistics

Statistic	Home Port: Bodega Bay
Number of Fishermen Sampled	70
Age, Average	57
Experience, Average of Max per Fisherman	30
Percent of Income from Fishing, Average	68%
Percent of Income from Fishing, Median	83%

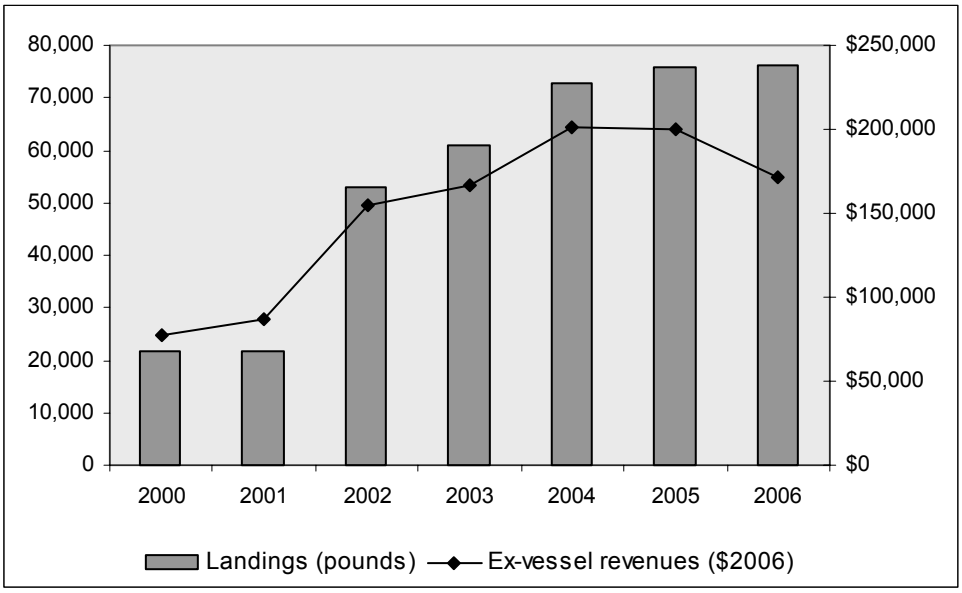
BOLINAS (broken out of Bodega Bay)

Due to its unique character Bolinas was broken out of the Bodega Bay port group for the following selected tabulations and graphs. Table 2.7 shows that landings in Bolinas by poundage and revenue were higher in 2006 relative to the average for 2000-2006. Figure 2.3 displays the upward trend in poundage and revenue, although revenue is affected in latter years by falling ex-vessel prices per pound.

Table 2.7: Bolinas Commercial Landings

	2006	Annual Avg. 2000–06 ($2006)
Landings (pounds)	76,124	54,574
Ex-vessel revenues	$171,012	$151,215

Figure 2.3: Commercial Landings and Ex-Vessel Revenues for Bolinas



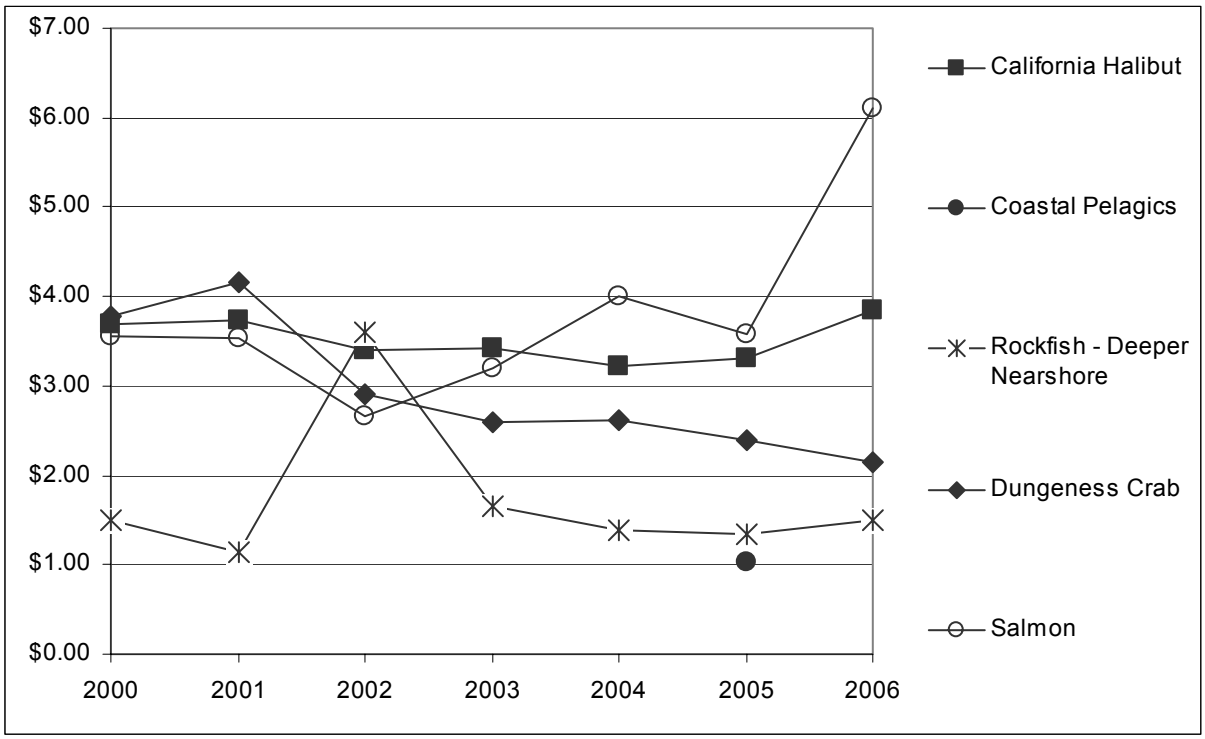
There has been an overall increase in the number of fishermen landing Dungeness crab. There has not been any change in the number of fishermen in other Bolinas fisheries, see Table 2.8.

Table 2.8: Bolinas Percentage Change in Number of Fishermen from 2000 to 2006

Fisheries	% Change
California Halibut	0%
Rockfish - Deeper Nearshore	0%
Dungeness Crab	150%
Salmon	0%

Ex-vessel values per pound have increased markedly for salmon, with other values falling slightly or holding steady, see Figure 2.4.

Figure 2.4: Bodega Bay Ex-Vessel Values per Pound ($2006)*



* The Coastal Pelagics fishery is intermittent

Survey Representation

Ecotrust interviewed four fishermen from Bolinas (see Table 2.9). The average age of the respondents was forty-four years old and their average maximum fishing experience was twenty-three years. Respondents reported that, on average, fishing accounted for 95% of total income.

Table 2.9: Survey Summary Statistics

Statistic	Home Port: Bolinas
Number of Fishermen Sampled	4
Age, Average	44
Experience, Average of Max per Fisherman	23
Percent of Income from Fishing, Average	95%
Percent of Income from Fishing, Median	95%

3. SAN FRANCISCO

San Francisco is a major U.S. port on the west coast of California. In addition to the commercial fishing fleet the port is home to cruise ships, bay excursions (such as to Alcatraz Island and the Golden Gate Bridge), ferry terminals, shipyards, and dry docks. Although other facilities exist in other ports in the San Francisco Bay Area, this assessment will focus on the city of San Francisco proper. The population of San Francisco is over three-quarters of a million people and growing, though at a slower rate than the rest of California. The median and per capita incomes are slightly higher than that of the rest of California and the percentage of people falling below the poverty line is lower. Selected demographic characteristics are presented in Table 3.1.

Table 3.1: Selected Demographic Statistics

Statistic	San Francisco	California
Population (2000)	776,733	33,871,648
Population growth (1990-2000)	7.3%	13.8%
Median household income	$55,221	$53,629
Per capita income	$34,556	$26,800
Individuals below poverty level	11.3%	13.3%
Percentage high school graduate or greater	81.2%	80.1%
Percentage aged 65 or greater	13.7%	10.5%

Source: U.S. Census Bureau

Fisheries Related Industry

While San Francisco is home to many different vessels, from cruise ships to cargo vessels, most of the commercial fishing in San Francisco occurs at Pier 45. It has 177 berths and can accommodate vessels up to 90ft. There is also 1,400 linear feet of transient moorage. Facilities include a hoist for commercial fishermen's use, a crane, a travel lift, a fuel dock, cold storage, and an ice-making facility. Selected statistics on Pier 45 are shown in Table 3.2.

Table 3.2: Selected Statistics for Pier 45

Employees (#)	Full-Time (#)	Moorage Price
3	2.5	$1.66/ft.

San Francisco is a large urban center and has about two dozen buyers, including North Coast Fisheries and the Seafood Producers Co-op. Buyers include wholesalers, restaurants, fish markets, and processors. Table 3.3 is a list of selected buyers.

Table 3.3: Processors and Other Buyers in San Francisco

▫ Alber Seafoods	▫ Monterey Fish Co	▫ Royal Hawaiian Seafood
▫ Brian's Meats	▫ Monterey Fish Market	▫ Sang Sang
▫ C+L Company	▫ Next Seafood	▫ Scoma's Restaurant
▫ Caito Fisheries	▫ North Coast Fisheries	▫ Seafood Center
▫ Flannery Seafood	▫ Osprey Seafood	▫ Seafood Producers Co-op
▫ Fresh Fish Co	▫ Pacific Seafood	▫ Whole Foods
▫ G+J Express	▫ Pezzola Seafood	
▫ Harbor Fisheries	▫ Port Seafood	

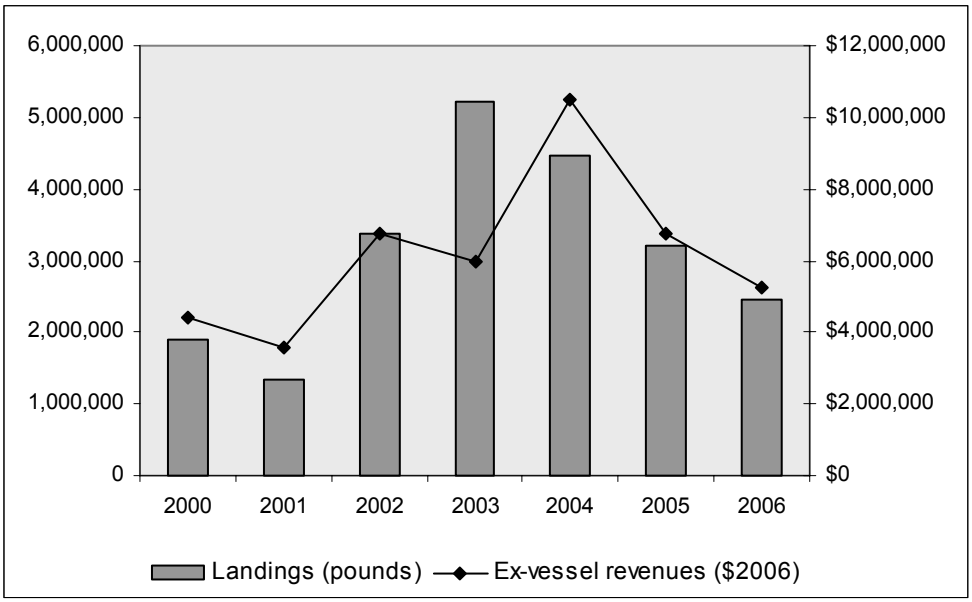
Involvement in West Coast Commercial Fisheries

The largest fisheries for the San Francisco port group by landing volume and revenue are Dungeness crab and salmon. Table 3.4 shows commercial landings for both 2006 and the average landings seen for the years 2000–06. Figure 3.1 shows both annual landings and ex-vessel revenues for the last seven years.

Table 3.4: San Francisco Commercial Landings

	2006	Avg. Annual 2000–06 ($2006)
Landings (pounds)	2,458,379	3,137,138
Ex-vessel revenues	$5,261,097	$6,171,401

Figure 3.1: Commercial Landings and Ex-Vessel Revenues for San Francisco



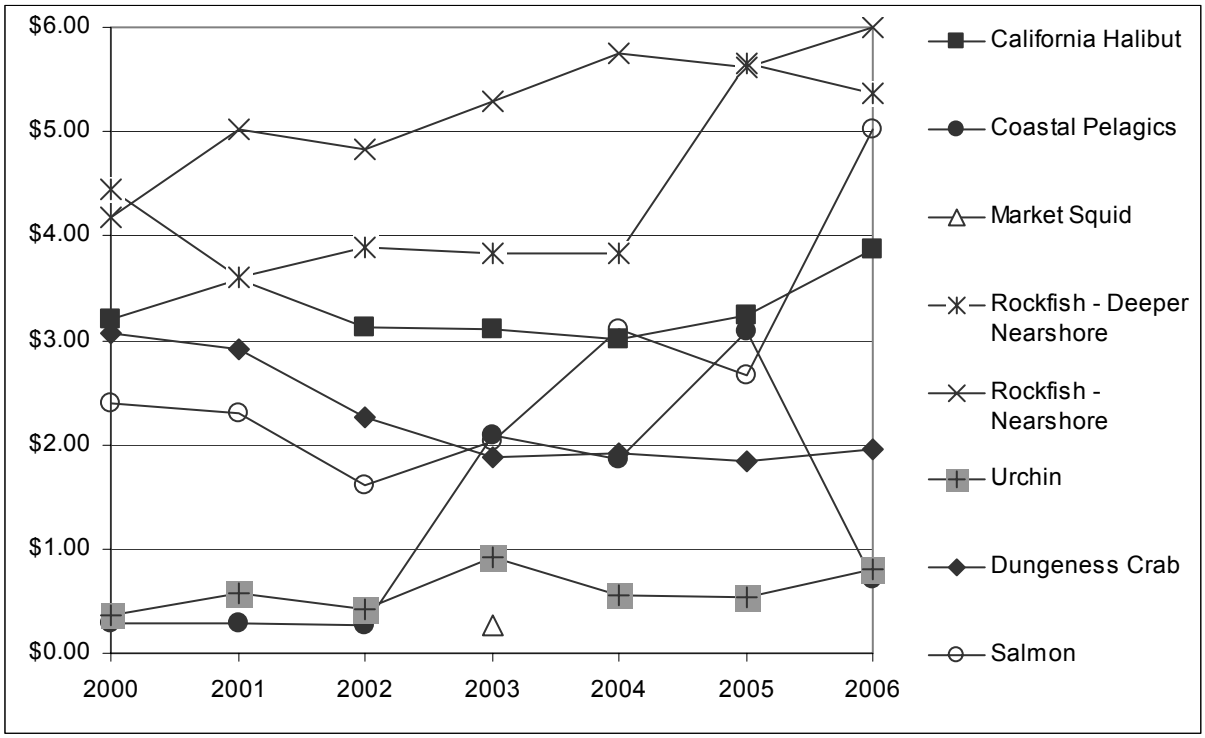
Both the number of vessels and the number of fishermen landing commercial species have declined. In 2000, 771 vessel landings and 938 fishermen landings were reported in San Francisco. By contrast, only 434 vessel landings and 468 fishermen landings were reported in 2006. In fact, the only San Francisco fishery not seeing declines in the number of fishermen landings over that time period was the Dungeness crab fishery (see Table 3.5).

Table 3.5: Percentage Change in Number of Fishermen from 2000 to 2006

Fisheries	% Change
California Halibut	-2%
Coastal Pelagics	-33%
Rockfish - Deeper Nearshore	-40%
Rockfish - Nearshore	-18%
Urchin	-75%
Dungeness Crab	29%
Salmon	-54%

Ex-vessel values per pound have not seen the same level of decline. Both nearshore and deeper nearshore rockfish have seen increasing ex-vessel prices in recent years, as has the salmon fishery (see Figure 3.3)

Figure 3.2: San Francisco Ex-Vessel Values per Pound ($2006)*



* The Market Squid fishery is intermittent

Survey Representation

Ecotrust interviewed thirty-six fishermen from the San Francisco port group (see Table 3.6), which in addition to San Francisco, also includes the ports of Berkeley and Richmond. The average age of the respondents was fifty-one years old and their average maximum fishing experience was twenty-six years. Respondents reported that, on average, fishing accounted for 78% of total income and the median response was 100%.

Table 3.6: Survey Summary Statistics

Statistic	Home Port: San Francisco
Number of Fishermen Sampled	36
Age, Average	51
Experience, Average of Max per Fisherman	26
Percent of Income from Fishing, Average	78%
Percent of Income from Fishing, Median	100%

4. HALF MOON BAY

Half Moon Bay is located in San Mateo County, California, just south of San Francisco. It had a population of just under 12,000 at the time of the 2000 U.S. Census and was growing at a rate more than double that of the U.S. or California. The median and per capita incomes are above that of the U.S. or California, and only 6.1% of the population falls below the poverty line. Demographic characteristics are presented in Table 4.1.

Table 4.1: Selected Demographic Statistics

Statistic	Half Moon Bay	California
Population	11,842	33,871,648
Population growth (1990-2000)	33.2%	13.8%
Median household income	$78,473	$53,629
Per capita income	$37,963	$26,800
Individuals below poverty level	6.1%	13.3%
Percentage high school graduate or greater	77.2%	80.1%
Percentage aged 65 or greater	9.6%	10.5%

Source: U.S. Census Bureau

Fisheries Related Industry

The main harbor in Half Moon Bay is Pillar Point, containing 369 berths. The largest slip is 65 feet, though boats up to 120 feet long can be accommodated with harbormaster permission. Pillar Point also features a boat launch, fuel, a pump-out station, ice, a search and rescue center, wireless internet, restrooms, and showers. The harbor is well protected, having both an inner and outer breakwater. Selected harbor statistics are shown in Table 4.2.

Table 4.2: Selected Statistics for Pillar Point Harbor

Employees (#)	Full-Time (#)	Moorage Price
11	11	$7.30+$15/ft.

There are three main buyers at Pillar Point Harbor: 3 Captains, Morning Star Fisheries, and Pillar Point Seafood. There are other small-scale buyers and farmer's markets in the area, and North Coast Fisheries and Seafood Producers Co-op also both buy some fish in Half Moon Bay (see Table 4.3).

Table 4.3: Processors and Other Buyers in Half Moon Bay

▫ 3 Captains	▫ H&N	▫ Princeton Seafood
▫ Dave Malorie	▫ Larry Furtado	▫ Seafood Producers Co-op
▫ Delmar Seafood	▫ Morning Star Fisheries	▫ Seaworld
▫ Farmer's Markets	▫ North Coast Fisheries	▫ Ship to Shore
▫ Grande	▫ Pillar Point Seafood	

Involvement in West Coast Commercial Fisheries

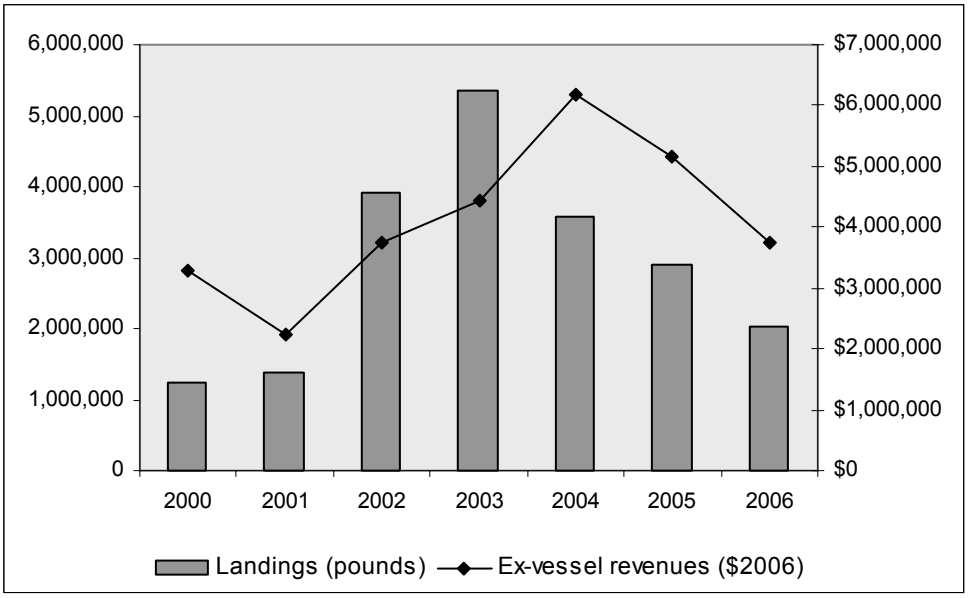
The main fisheries by landing volume in Half Moon Bay are Dungeness crab and market squid. Salmon and coastal pelagics have the next largest volumes, and several other fisheries round out the commercial fishing industry. Landings in Half Moon Bay were down in 2006 relative to the previous several years, though revenue essentially held constant (see Table 4.4).

Table 4.4: Half Moon Bay Commercial Landings

	2006	Avg. Annual 2000–06 ($2006)
Landings (pounds)	2,040,991	2,911,629
Ex-vessel revenues	$3,732,393	$4,113,686

Figure 4.1 shows both annual landings and ex-vessel revenues for the last seven years. As can be seen, landings show a peak in 2003 due to increased landings in market squid whereas a revenue peak occurred in 2004 due to an increase salmon landed in Half Moon Bay.

Figure 4.1: Commercial Landings and Ex-Vessel Revenues for Half Moon Bay



Both the number of vessels and the number of fishermen landing commercial species in Half Moon Bay have declined over the last seven years. In 2000, 624 vessel landings and 657 fishermen landings were reported. In contrast, only 301 vessel landings and 311 fishermen landings were reported in 2006. Not all Half Moon Bay fisheries are experiencing declining fishermen landings, however, as both the Dungeness crab, and squid fisheries have seen increases in the number of fishermen making landings over the last seven years (see Table 4.5).

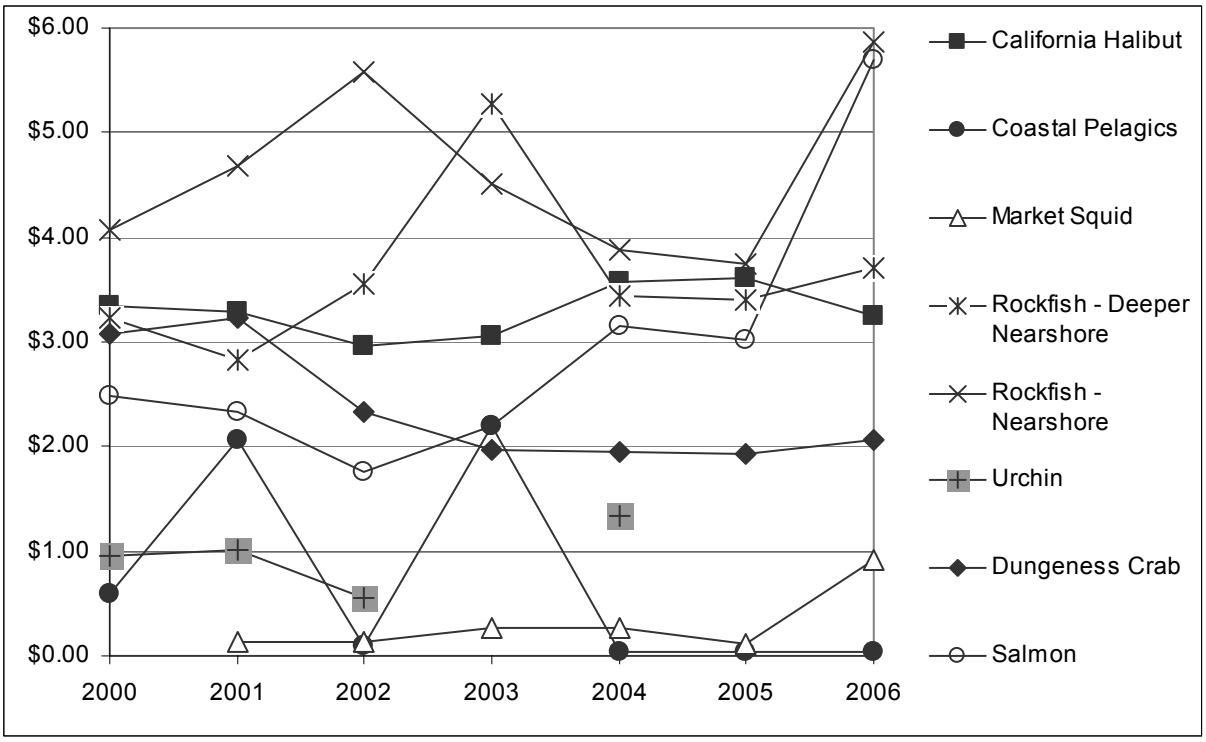
Table 4.5: % Change in Number of Fishermen from 2000 to 2006

Fisheries	% Change
California Halibut	-68%
Coastal Pelagics	-67%
Market Squid	2 in 2006*
Rockfish - Deeper Nearshore	-38%
Rockfish - Nearshore	0%
Urchin	-100%
Dungeness Crab	20%
Salmon	-61%

* When zero fishermen represent this fishery in 2000, the number of fishermen in 2006 is shown.

Ex-vessel values per pound in some Half Moon Bay fisheries over the last seven years have increased (see Figure 4.2).

Figure 4.2: Half Moon Bay Ex-Vessel Values per Pound ($2006)*



* The Market Squid and Coastal Pelagics fisheries are intermittent

Survey Representation

Ecotrust interviewed twenty-one fishermen from the Half Moon Bay port group, which included Half Moon Bay and Pillar Point (see Table 4.6). The average age of the respondents was fifty-five years old and their average maximum fishing experience was thirty-four years. Respondents reported that, on average, fishing accounted for 85% of total income and the median response was that fishing accounted for 100% of their personal income.

Table 4.6: Survey Summary Statistics

Statistic	Home Port: Half Moon Bay
Number of Fishermen Sampled	21
Age, Average	55
Experience, Average of Max per Fisherman	34
Percent of Income from Fishing, Average	85%
Percent of Income from Fishing, Median	100%

Appendix F: Consent Form (English Version)

MLPA Initiative – North Central Coast Study Region
Fisheries Uses and Values Project – Project Description

The Marine Life Protection Act (MLPA) is a state law directing the California Department of Fish and Game (CDFG) to design and manage an improved network of marine protected areas off California's coast. To implement this law, a public-private partnership has been formed between the California Resources Agency, CDFG, and Resources Legacy Fund Foundation—the MLPA Initiative. As part of this effort, Ecotrust has been retained to collect, compile and analyze information pertaining to commercial fisheries on the north central coast. The project is designed to provide spatially explicit socioeconomic information to the MLPA Initiative.

The goal of the Fisheries Uses and Values Project is to compile a comprehensive picture of the commercial fishing use patterns along the north central California coast, using the expert knowledge of fishermen themselves. The purpose of this project is fourfold:

1. Incorporate commercial fishermen's knowledge into the deliberations of the Regional Stakeholder Group in the MLPA North Central Coast Study Region;
2. Use this information to improve on the spatial resolution and accuracy of CDFG landings and logbook data;
3. Develop accurate maps of the local fishing grounds and their economic importance to the local fleets; and
4. Estimate the maximum potential socioeconomic impact of proposed MPA networks to the commercial fishery sector.

This kind of spatially explicit information on commercial fisheries and their value will ensure representation of socioeconomic values in the design, implementation and management of marine protected areas.

During the summer months of 2007 (June through August) Ecotrust personnel will interview approximately 150–200 fishermen along the north central coast. Fishermen will be selected based on CDFG data and recommendations by peers and the Regional Stakeholder Group. The interview approach is based on peer-reviewed, social science techniques for collecting local expert knowledge. The sample is designed to capture the majority of landings for the most significant regional fisheries, as well as the depth of expertise of longtime and successful fishermen.

Ecotrust personnel will contact fishermen directly, and arrange for interviews with contracted staff based in San Francisco, Half Moon Bay\Pillar Point, Bodega Bay and Fort Bragg. The format includes one-on-one or small group interviews, with follow-up meetings by fishery and/or gear group in which the information collected will be validated by fishermen. Due to the sensitive nature of commercial fishing information, only Ecotrust staff (operating under a strict confidentiality protocol) will handle the raw data generated during the interviews. All information collected in the interviews is anonymous and confidential on the individual level. All analyses and results will be presented in aggregate form, and will be reviewed in aggregate form by participating fishermen from each fishery. The information will be used to create a comprehensive profile of the commercial fishing use patterns and values along California's north central coast, and may also be written up in a peer-reviewed journal.

Your willingness to participate and/or to refer other fishermen we should contact is not only appreciated, but indeed vital to the success of this project. If you have any questions or concerns, contact Charles Steinback at charles@ecotrust.org or 971.404.5632. The project website is www.ecotrust.org/mlpa.

If you agree to participate under the conditions described above, please print and sign your name.

Participant's name _____ Signature _____

Field Staff signature _____ Date _____

Ecotrust, 721 NW 9th Avenue, Suite 200, Portland, OR 97209, Tel 503 227 6225 www.ecotrust.org

Appendix G: Consent Form (Vietnamese Version)

MLPA Initiative – North Central Coast Study Region
Fisheries Uses and Values Project – Project Description

Luật bảo vệ Tài nguyên biển (MLPA) là luật của bang liên quan trực tiếp đến cơ quan nghề cá và vui chơi giải trí của bang California (CDFG) được soạn thảo ra để quản lý và hoàn thiện hệ thống quản lý các khu bảo tồn ở khu vực biển của California. Để thực thi được luật này, một sự hợp tác giữa cá nhân và cộng đồng đã được hình thành giữa California Recourse Agency; CDFG và Resource Legacy Fund Foundation với MLPA Initiative. Một phần của nỗ lực này, Ecotrust đã được thuê để thu thập, tập trung và phân tích những thông tin kinh tế xã hội đi đôi với thông tin ngành đánh bắt cá ở vùng bờ trọng điểm. Dự án được thiết lập để cung cấp thông tin kinh tế xã hội rõ ràng.

Mục tiêu của Dự án Sử dụng và Giá trị Thuỷ sản là để hoàn thiện một bức tranh toàn diện cho ngành đánh bắt cá điển hình trong vùng đánh bắt trọng điểm của biển California, thông qua việc sử dụng kiến thức của các chuyên gia và những ngư dân. Mục đích của dự án tập trung vào 4 điểm sau:

1. Kết hợp chặt chẽ sự hiểu biết của ngư dân chuyên nghiệp vào những cân nhắc, suy tính của các bên liên quan trong khu vực của MLPA và khu vực vùng bờ nghiên cứu chủ yếu (central coast study region)
2. Sử dụng những thông tin này để hoàn thiện về nghị quyết không gian (on the spatial resolution) và sự chính xác của khu vực CDFG (CDFG landings) và thông tin số liệu của nhật ký hàng hải; và
3. Xây dựng bản đồ chính xác cho khu vực đánh bắt cá trong vùng và những khu vực có tiềm năng kinh tế quan trọng về ngành thủy hải sản.
4. Dự đoán sự ảnh hưởng tối đa đến tiềm năng kinh tế xã hội của mạng lưới dự án MPA đối với các tổ chức của ngành đánh bắt cá.

Loại thông tin này cung cấp không gian rõ ràng về chuyên ngành đánh bắt thủy hải sản và những giá trị của nó có thể đảm bảo sự có mặt của những giá trị kinh tế xã hội, việc thực hiện và quản lý khu vực bảo tồn biển.

Trong mùa hè 2007 (tháng 6 đến tháng 8) nhân viên của Ecotrust sẽ phỏng vấn khoảng 150-200 ngư dân ở khu vực dựa vào dữ liệu CDFG và sự đề nghị của các Hiệp hội liên quan trong khu vực. Phỏng vấn dựa vào việc đánh giá đồng bộ (peer reviewed), dựa vào phương pháp khoa học kỹ thuật để thu thập các hiểu biết của ngư dân địa phương. Mẫu được thiết kế để thu thập thông tin của 10-12 cảng cá chính ở những vùng có nghề cá quan trọng, cũng như những ngư dân thành công có kinh nghiệm chuyên môn lâu năm trong ngành đánh bắt thủy hải sản.

Kết quả của dự án này sẽ được CDFG và MBNMS sử dụng để thảo luận, thực thi, và quản lí các khu vực bảo tồn sinh thái biển trong tiểu bang và lưu vực biển California. Đặc biệt là Hiệp hội có liên quan trong khu vực trọng điểm của vùng vịnh và Hiệp hội Sanctuary' s MPA.

Nhân viên của Ecotrust sẽ liên lạc trực tiếp với các ngư dân, và sắp xếp các cuộc phỏng vấn với các nhân viên tại Half Moon Bay, San Francisco, Bodega Bay, và Fort Bragg. Hình thức phỏng vấn bao gồm phỏng vấn từng người một hoặc phỏng vấn theo nhóm, tiếp theo đó là các cuộc họp giữa những ngư dân và/hoặc các tổ chức chuyên ngành Do sự nhạy cảm của các thông tin nghề cá thương mại, chỉ có nhân viên Ecotrust (hoạt động dưới một điều lệ nghiêm ngặt) được sử dụng những số liệu phỏng vấn này. Tất cả các thông tin thu thập được trong quá trình phỏng vấn sẽ được bảo mật ở mức độ cá nhân. Tất cả các phân tích và kết quả sẽ được xem xét đánh giá bởi những ngư dân tham gia. Thông tin sẽ được sử dụng để tạo ra một bức tranh toàn diện về hình thức và giá trị nghề cá thương mại của khu vực trọng điểm cuả vịnh California (California Central coast) , và cũng có thể được đăng ở những Tạp chí đánh giá đồng cấp (peer reviewed). Là một người tham gia, bạn đồng ý để thông tin của bạn được sử dụng cho mục đích này.

Sự sẵn lòng trả lời các câu hỏi của bạn thật quý giá, Nếu bạn muốn biết thêm thông tin hoặc có câu hỏi gì vui lòng liên lạc với Charles Steinback tại địa chỉ charles@ecotrust.org hoặc gọi số 971 404 5632 hoặc vào trang web của dự án www.ecotrust.org/mlpa. Nếu bạn đồng ý tham gia với điều kiện nêu trên, vui lòng ghi danh và ký tên dưới đây.

Tên người tham gia_____ Ký tên

Chữ ký của nhân viên thực địa _____ Ngày