

MLPA Master Plan Science Advisory Team
Summary of potential impacts of the October 2007 MPA proposals on commercial fisheries in the MLPA North Central Coast Study Region

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1. Introduction

In order to conduct the analysis of relative effects of the 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 of 8 commercial fisheries (California halibut, coastal pelagics, market squid, deep 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 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 this data, we 1) conduct an analysis and evaluation of the potential impacts on commercial fishing grounds and 2) complete a socioeconomic impact analysis on commercial fisheries in order to assess the relative effects of the 10 MPA proposals (Proposals Emerald A, Emerald B, Jade A, Jade B, Turquoise A, Turquoise B, Alternative A, Alternative B, Alternative C, Alternative D). For both, results are reported at the study region and port group levels. For this analysis, the ports/port groups are defined as: Point Arena, Bodega Bay, Bolinas, San Francisco and Half Moon Bay.

2. Overview of Fisheries

The commercial fisheries considered in this analysis are of varying importance in terms of ex-vessel revenues. Table 1 provides estimates of each fisheries share of NCCSR and California commercial fishing revenues, using a 7-year average of nominal ex-vessel revenues between 2000 and 2006. For example, Dungeness crab accounts for 53.2% of the NCCSR landings (ex-vessel revenue), but only 10% of the state totals. Furthermore, 31.1% 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.

Table 1: 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%	20.5%
Coastal Pelagics	0.2%	0.0%	0.4%
Market Squid	1.9%	0.4%	1.2%
Deeper Nearshore Rockfish	0.7%	0.1%	23.9%
Nearshore Rockfish	1.0%	0.2%	7.2%
Urchin	5.2%	1.0%	8.5%
Dungeness Crab	53.2%	10.0%	31.1%
Salmon	36.1%	6.8%	52.7%

Table 2: 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	3.7%	0.7%	6.0%
Dungeness Crab	0.3%	0.1%	0.2%
Salmon	0.5%	0.1%	0.7%

Table 3: 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%	1.5%
Coastal Pelagics	—	—	—
Market Squid	—	—	—
Deeper Nearshore Rockfish	0.2%	0.0%	5.5%
Nearshore Rockfish	0.3%	0.0%	1.9%
Urchin	1.5%	0.3%	2.4%
Dungeness Crab	14.7%	2.8%	8.6%
Salmon	12.6%	2.4%	18.4%

Table 4: 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 5: 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%	15.0%
Coastal Pelagics	—	—	—
Market Squid	—	—	—
Deep Nearshore Rockfish	0.4%	0.1%	13.0%
Nearshore Rockfish	0.3%	0.1%	2.1%
Urchin	0.1%	0.1%	0.1%
Dungeness Crab	22.9%	4.3%	13.4%
Salmon	13.3%	2.5%	19.4%

Table 6: 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%	2.4%
Coastal Pelagics	0.1%	0.0%	0.2%
Market Squid	1.3%	0.2%	0.8%
Deeper Nearshore Rockfish	0.1%	0.0%	4.6%
Nearshore Rockfish	0.0%	0.0%	0.2%
Urchin	—	—	—
Dungeness Crab	14.6%	2.7%	8.5%
Salmon	9.6%	1.8%	14.0%

3. Impact on Commercial Fishing Grounds: Approach

The ten MPA proposals under review vary according to their spatial extent and the commercial fisheries they affect. Specifically, they vary by the number and types of fisheries permitted within the boundaries of particular MPAs within a network. Furthermore, study area (SA) 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. 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.

It should also be noted that this analysis assumes that each of the MPA proposals completely eliminate 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 an 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 method of analysis as 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 North Central Coast region, not for the whole state of California. These estimates then feed into the socioeconomic impact calculations described below.

In forthcoming evaluations, we will consider the percentage of area and value affected within fishing grounds which are constrained by existing fishery management areas closures and/or fishery exclusion zones. Additionally, we will also evaluate and determine if there are individual fisherman that would be disproportionately affected by each MPA proposal (i.e. 100% or a large portion of their grounds are inside a proposed MPA that would restrict fishing).

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 an 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 the area and value affected for the total fishing grounds and the grounds inside the study area is then summarized for all MPAs affecting each fishery per proposal. MPA proposals vary considerably in their effects, both between and across fisheries, as the Table 7 illustrates. Internal NCC Regional Stakeholder MPA proposals (Emerald A, Emerald B, Turquoise A, Turquoise B, Jade A, and Jade B) are based on their October 18th, 2007 submission. External proposals (A, B, C, and D) are based on their proponents' October 4th, 2007 submission.

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

Table 7: Percentage area of total fishing grounds affected by landing port

Fisheries		EA	EB	JA	JB	TA	TB	A	B	C	D
Point Arena	California Halibut	--	--	--	--	--	--	--	--	--	--
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	31.5%	62.8%	51.7%	27.9%	29.4%	30.5%	23.2%	34.0%	55.5%	32.5%
	Nearshore Rockfish	16.0%	33.4%	27.4%	14.8%	14.3%	14.8%	11.6%	17.6%	29.5%	16.5%
	Urchin	12.4%	12.2%	10.9%	8.3%	12.4%	14.1%	4.2%	9.7%	11.5%	10.5%
	Dungeness Crab	3.0%	4.8%	9.0%	1.8%	4.1%	3.8%	0.6%	2.3%	9.5%	3.2%
	Salmon	1.5%	1.0%	1.8%	0.5%	0.9%	0.9%	0.2%	0.5%	5.4%	0.5%
Bodega Bay	California Halibut	14.5%	8.4%	23.2%	8.4%	9.6%	10.8%	12.9%	7.2%	27.6%	9.7%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	17.4%	14.4%	15.9%	9.3%	11.5%	14.2%	10.0%	10.1%	23.7%	11.4%
	Nearshore Rockfish	8.5%	14.2%	10.0%	4.2%	7.2%	8.3%	3.6%	6.7%	10.1%	7.2%
	Urchin	13.3%	14.5%	10.9%	8.2%	11.9%	12.8%	4.6%	9.6%	10.9%	9.7%
	Dungeness Crab	2.0%	2.5%	3.7%	1.1%	1.5%	1.6%	0.4%	0.9%	5.7%	1.1%
	Salmon	0.7%	0.6%	0.7%	0.3%	0.5%	0.5%	0.1%	0.3%	1.7%	0.3%
Bolinas	California Halibut	14.6%	9.1%	23.9%	8.6%	10.0%	11.2%	12.8%	7.4%	28.1%	9.8%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	59.3%	14.6%	31.8%	11.8%	41.0%	33.8%	28.5%	9.2%	79.4%	4.1%
	Nearshore Rockfish	--	--	--	--	--	--	--	--	--	--
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	0.0%	0.0%	20.1%	0.0%	0.0%	0.0%	3.2%	0.0%	10.9%	0.0%
	Salmon	2.0%	0.6%	0.6%	0.4%	0.8%	1.0%	0.3%	0.3%	5.6%	0.3%
San Francisco	California Halibut	4.5%	2.2%	6.6%	1.8%	2.2%	2.9%	3.0%	1.5%	8.3%	2.4%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	13.9%	13.0%	16.4%	11.3%	14.6%	15.8%	9.3%	10.4%	18.6%	6.2%
	Nearshore Rockfish	12.2%	13.6%	16.5%	10.0%	14.5%	16.7%	11.0%	9.2%	17.8%	7.4%
	Urchin	28.8%	35.9%	27.4%	21.7%	30.8%	32.6%	12.7%	28.6%	26.0%	24.4%
	Dungeness Crab	1.9%	2.5%	3.5%	1.1%	1.4%	1.5%	0.4%	0.9%	5.3%	1.0%
	Salmon	0.7%	0.6%	0.7%	0.3%	0.5%	0.5%	0.1%	0.3%	1.7%	0.3%
Half Moon Bay	California Halibut	11.1%	10.8%	9.5%	5.7%	5.9%	9.5%	5.2%	5.3%	16.1%	6.5%
	Coastal Pelagics	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.0%	0.0%	0.8%	0.8%
	Market Squid	19.7%	19.1%	20.3%	2.6%	12.4%	25.0%	0.1%	2.6%	32.2%	11.8%
	Deeper Nearshore Rockfish	19.1%	17.6%	20.7%	13.6%	20.7%	20.5%	10.0%	10.8%	27.5%	7.0%
	Nearshore Rockfish	9.5%	53.5%	9.5%	9.5%	9.5%	9.5%	6.9%	9.5%	40.4%	9.1%
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	2.6%	3.4%	5.0%	1.5%	2.0%	2.1%	0.5%	1.2%	7.6%	1.4%
	Salmon	0.8%	0.7%	0.8%	0.3%	0.5%	0.6%	0.1%	0.4%	2.0%	0.4%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

Table 8: Percentage area of fishing grounds within the study area affected by landing port

Fisheries		EA	EB	JA	JB	TA	TB	A	B	C	D
Point Arena	California Halibut	--	--	--	--	--	--	--	--	--	--
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	31.5%	62.8%	51.7%	27.9%	29.4%	30.5%	23.2%	34.0%	55.5%	32.5%
	Nearshore Rockfish	26.9%	56.0%	45.9%	24.8%	24.0%	24.9%	19.4%	29.5%	49.5%	27.7%
	Urchin	32.8%	32.4%	28.9%	22.1%	32.7%	37.3%	11.2%	25.7%	30.4%	27.7%
	Dungeness Crab	7.1%	11.3%	21.2%	4.3%	9.6%	8.9%	1.3%	5.4%	22.3%	7.4%
	Salmon	10.2%	6.7%	12.4%	3.3%	6.4%	6.0%	1.3%	3.5%	37.9%	3.2%
Bodega Bay	California Halibut	14.5%	8.5%	23.2%	8.4%	9.6%	10.8%	12.9%	7.2%	27.6%	9.7%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	34.8%	28.7%	31.7%	18.5%	23.0%	28.2%	19.8%	20.1%	47.4%	22.7%
	Nearshore Rockfish	30.1%	50.0%	35.2%	14.9%	25.4%	29.4%	12.8%	23.7%	35.6%	25.3%
	Urchin	35.4%	38.7%	29.2%	21.8%	31.8%	34.2%	12.2%	25.7%	29.1%	26.0%
	Dungeness Crab	11.8%	14.7%	22.2%	6.8%	8.8%	9.4%	2.4%	5.4%	33.7%	6.3%
	Salmon	12.0%	10.9%	12.2%	5.1%	8.2%	8.6%	2.4%	5.4%	30.6%	6.2%
Bolinas	California Halibut	14.7%	9.1%	23.9%	8.6%	10.0%	11.2%	12.8%	7.4%	28.1%	9.8%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	67.3%	16.6%	36.1%	13.5%	46.5%	38.4%	32.3%	10.5%	90.2%	4.6%
	Nearshore Rockfish	--	--	--	--	--	--	--	--	--	--
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	0.0%	0.0%	36.8%	0.0%	0.0%	0.0%	5.8%	0.0%	20.0%	0.0%
	Salmon	14.0%	3.9%	4.2%	2.8%	5.6%	7.1%	2.3%	2.0%	39.4%	1.8%
San Francisco	California Halibut	6.6%	3.3%	9.8%	2.7%	3.3%	4.4%	4.5%	2.3%	12.3%	3.6%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	23.6%	22.0%	27.7%	19.1%	24.8%	26.7%	15.7%	17.6%	31.5%	10.6%
	Nearshore Rockfish	19.9%	22.1%	26.8%	16.3%	23.6%	27.1%	17.9%	15.0%	28.9%	12.0%
	Urchin	29.1%	36.2%	27.7%	21.9%	31.0%	33.0%	12.8%	28.9%	26.3%	24.6%
	Dungeness Crab	11.9%	15.3%	21.4%	6.7%	8.6%	9.3%	2.4%	5.3%	32.8%	6.2%
	Salmon	12.0%	11.0%	12.2%	5.1%	8.2%	8.6%	2.4%	5.4%	30.6%	6.2%
Half Moon Bay	California Halibut	13.0%	12.8%	11.2%	6.8%	7.0%	11.2%	6.1%	6.3%	19.0%	7.6%
	Coastal Pelagics	9.9%	9.9%	10.3%	10.3%	10.3%	10.3%	0.0%	0.0%	10.3%	9.9%
	Market Squid	19.7%	19.1%	20.3%	2.6%	12.4%	25.0%	0.1%	2.6%	32.2%	11.8%
	Deeper Nearshore Rockfish	21.9%	20.2%	23.8%	15.6%	23.8%	23.6%	11.5%	12.4%	31.6%	8.1%
	Nearshore Rockfish	9.5%	53.5%	9.5%	9.5%	9.5%	9.5%	6.9%	9.5%	40.4%	9.1%
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	11.7%	15.2%	21.9%	6.6%	8.6%	9.3%	2.4%	5.2%	33.6%	6.0%
	Salmon	12.0%	10.9%	12.2%	5.1%	8.2%	8.6%	2.4%	5.4%	30.6%	6.2%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

Table 9: Percentage value of total fishing grounds affected by landing port

Fisheries		EA	EB	JA	JB	TA	TB	A	B	C	D
Point Arena	California Halibut	--	--	--	--	--	--	--	--	--	--
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	31.5%	62.8%	51.7%	27.9%	29.4%	30.5%	23.2%	34.0%	55.5%	32.5%
	Nearshore Rockfish	22.9%	50.7%	41.9%	21.9%	17.0%	21.7%	17.9%	25.2%	45.7%	23.8%
	Urchin	13.8%	26.1%	14.1%	15.9%	10.2%	15.5%	9.5%	17.9%	13.7%	17.4%
	Dungeness Crab	1.8%	6.1%	11.5%	3.8%	9.6%	4.7%	1.4%	6.7%	13.2%	2.9%
	Salmon	10.2%	10.8%	20.3%	21.6%	27.9%	21.8%	10.0%	27.0%	19.1%	18.4%
Bodega Bay	California Halibut	6.5%	5.0%	9.4%	5.2%	5.7%	6.5%	14.7%	4.4%	6.5%	5.8%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	26.0%	18.4%	34.6%	10.0%	25.1%	33.0%	23.2%	10.7%	26.0%	10.4%
	Nearshore Rockfish	25.1%	23.2%	23.2%	10.7%	40.4%	40.7%	11.1%	22.2%	25.1%	24.2%
	Urchin	37.3%	40.0%	35.9%	8.6%	29.6%	37.3%	8.9%	29.5%	37.3%	36.8%
	Dungeness Crab	4.7%	6.8%	10.2%	1.8%	2.9%	3.3%	0.5%	1.9%	4.7%	2.9%
	Salmon	2.8%	5.5%	5.2%	2.1%	4.0%	4.3%	0.3%	1.8%	2.8%	3.3%
Bolinas	California Halibut	9.4%	9.5%	12.9%	9.4%	9.8%	11.3%	16.8%	8.3%	9.4%	11.0%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	68.6%	16.3%	31.4%	8.4%	43.1%	36.1%	20.3%	6.0%	68.6%	2.2%
	Nearshore Rockfish	--	--	--	--	--	--	--	--	--	--
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	0.0%	0.0%	17.2%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
	Salmon	2.9%	1.6%	1.7%	1.0%	1.5%	1.6%	3.0%	0.7%	2.9%	0.6%
San Francisco	California Halibut	0.5%	0.1%	1.3%	0.1%	0.1%	0.2%	0.4%	0.1%	0.5%	0.1%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	31.7%	19.7%	30.9%	18.9%	28.6%	27.5%	11.6%	16.8%	31.7%	10.5%
	Nearshore Rockfish	11.4%	13.5%	18.1%	9.2%	13.7%	16.0%	10.2%	8.2%	11.4%	6.2%
	Urchin	34.9%	43.3%	33.6%	13.6%	27.3%	32.1%	14.3%	31.5%	34.9%	33.0%
	Dungeness Crab	1.9%	2.1%	4.7%	1.0%	1.3%	1.5%	0.3%	0.7%	1.9%	0.9%
	Salmon	1.9%	1.5%	1.9%	0.7%	1.2%	1.3%	0.4%	0.6%	1.9%	0.7%
Half Moon Bay	California Halibut	0.6%	0.8%	0.6%	0.2%	0.5%	0.6%	0.4%	0.2%	0.6%	0.2%
	Coastal Pelagics	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.0%	0.0%	0.9%	0.9%
	Market Squid	23.0%	11.7%	23.1%	0.9%	4.7%	22.6%	0.2%	0.9%	23.0%	3.1%
	Deeper Nearshore Rockfish	13.1%	18.9%	15.0%	11.5%	15.4%	15.8%	7.5%	9.6%	13.1%	6.9%
	Nearshore Rockfish	1.9%	68.5%	1.9%	1.9%	1.9%	1.9%	1.4%	1.9%	1.9%	1.8%
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	1.3%	3.4%	1.7%	0.7%	0.5%	0.7%	0.1%	0.3%	1.3%	0.5%
	Salmon	1.9%	2.0%	2.5%	0.8%	1.5%	1.6%	0.2%	0.7%	1.9%	1.1%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

Table 10: Percent value of fishing grounds within the study area affected by landing port

Fisheries		EA	EB	JA	JB	TA	TB	A	B	C	D
Point Arena	California Halibut	--	--	--	--	--	--	--	--	--	--
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	29.4%	30.5%	51.7%	27.9%	31.5%	62.8%	23.2%	34.0%	55.5%	32.5%
	Nearshore Rockfish	18.7%	23.9%	46.1%	24.1%	25.2%	55.8%	19.7%	27.8%	50.3%	26.3%
	Urchin	11.6%	17.6%	16.0%	18.1%	15.7%	29.6%	10.7%	20.3%	15.6%	19.8%
	Dungeness Crab	18.7%	9.1%	22.6%	7.5%	3.5%	12.0%	2.7%	13.1%	25.8%	5.6%
	Salmon	53.4%	41.8%	39.0%	41.4%	19.5%	20.7%	19.1%	51.7%	36.5%	35.3%
Bodega Bay	California Halibut	5.7%	6.5%	9.4%	5.2%	6.5%	5.0%	14.7%	4.4%	12.6%	5.8%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	37.5%	49.3%	51.7%	15.0%	38.8%	27.5%	34.6%	15.9%	65.3%	15.6%
	Nearshore Rockfish	42.0%	42.2%	24.1%	11.1%	26.0%	24.1%	11.5%	23.0%	24.1%	25.1%
	Urchin	31.9%	40.3%	38.7%	9.3%	40.2%	43.1%	9.6%	31.8%	37.7%	39.7%
	Dungeness Crab	4.8%	5.6%	17.2%	3.0%	7.9%	11.5%	0.9%	3.2%	23.6%	5.0%
	Salmon	9.7%	10.5%	12.9%	5.1%	6.9%	13.4%	0.7%	4.4%	31.2%	8.2%
Bolinas	California Halibut	9.8%	11.3%	13.0%	9.4%	9.5%	9.6%	16.8%	8.3%	14.5%	11.0%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	48.5%	40.5%	35.3%	9.4%	77.1%	18.3%	22.8%	6.8%	96.3%	2.4%
	Nearshore Rockfish	--	--	--	--	--	--	--	--	--	--
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	0.0%	0.0%	40.6%	0.0%	0.0%	0.0%	6.3%	0.0%	22.1%	0.0%
	Salmon	2.5%	2.7%	2.7%	1.7%	4.8%	2.7%	5.0%	1.1%	31.1%	1.0%
San Francisco	California Halibut	0.1%	0.2%	1.5%	0.1%	0.6%	0.1%	0.5%	0.1%	0.6%	0.1%
	Coastal Pelagics	--	--	--	--	--	--	--	--	--	--
	Market Squid	--	--	--	--	--	--	--	--	--	--
	Deeper Nearshore Rockfish	35.6%	34.1%	38.4%	23.5%	39.3%	24.4%	14.4%	20.8%	50.1%	13.1%
	Nearshore Rockfish	23.5%	27.3%	30.9%	15.7%	19.5%	23.0%	17.5%	13.9%	31.0%	10.5%
	Urchin	27.6%	32.5%	34.0%	13.8%	35.3%	43.7%	14.5%	31.8%	30.3%	33.4%
	Dungeness Crab	3.0%	3.4%	11.0%	2.3%	4.5%	4.8%	0.8%	1.6%	13.9%	2.0%
	Salmon	5.4%	5.6%	8.4%	2.9%	8.3%	6.4%	1.6%	2.6%	31.0%	3.1%
Half Moon Bay	California Halibut	0.5%	0.6%	0.6%	0.2%	0.6%	0.8%	0.4%	0.2%	0.8%	0.2%
	Coastal Pelagics	23.4%	23.4%	23.4%	23.4%	22.5%	22.5%	0.0%	0.0%	23.4%	22.5%
	Market Squid	4.7%	22.6%	23.1%	0.9%	23.0%	11.7%	0.2%	0.9%	26.5%	3.1%
	Deeper Nearshore Rockfish	20.2%	20.7%	19.6%	15.0%	17.2%	24.8%	9.9%	12.6%	26.2%	9.0%
	Nearshore Rockfish	1.9%	1.9%	1.9%	1.9%	1.9%	68.5%	1.4%	1.9%	48.7%	1.8%
	Urchin	--	--	--	--	--	--	--	--	--	--
	Dungeness Crab	2.8%	3.8%	8.4%	3.4%	6.9%	17.5%	0.5%	1.5%	24.9%	2.5%
	Salmon	4.9%	5.1%	8.1%	2.5%	6.3%	6.5%	0.6%	2.2%	30.7%	3.6%

For example, the Turquoise A proposal has lesser effects (both in terms of area and value) on the Dungeness crab fishery in Point Arena than on, say, the urchin or deeper nearshore rockfish fisheries. Illustrating another set of effects, the Emerald A proposal affects 2% of the total Dungeness crab fishing grounds for Bodega Bay, but close to 12% when considering those fishing grounds that fall into the (nearer to shore) study area waters. In this case, the effects on fishing importance or the relative “value” of the area affected are almost identical, with 4.68% and 4.83% of stated importance affected, respectively. In addition, from Table 3, the Dungeness crab fishery in Bodega Bay constitutes approximately 23% of study area commercial fisheries. In some cases, alternatives can have markedly different effects on area and relative “value”. For example, for the San Francisco deeper nearshore rockfish, the External C proposal affects 31.46% of the study area fishing grounds for, but 50.07% of stated importance.

5. Socioeconomic Impact Analysis: Approach

We also estimate maximum potential economic impact of each MPA proposals (for description of methods, please refer to Appendix B. To accomplish this, we use using 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?

For each question, field staff provided additional details to ensure that respondents correctly understood each question.

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 or the duration of these trips. Variable costs typically include fuel, maintenance, crew share, 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. Ecotrust thus calculated costs for a particular fishery based on all fishermen that participate in that fishery; a single fisherman's data may thus

have been used numerous times. This explains why summing observations "n" across the fisheries does not sum to 174 in Table 11, 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 is 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). Tables similar to Table 11 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 11: Estimated Operating Costs

Name	n=	Mean % of Gross Economic Revenue			
		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%

In forthcoming evaluations, we will estimate the maximum economic impact of the MPA proposals using the mean cost estimates for all fisheries combined and will also provide a discussion of gross economic impacts.

6. Socioeconomic Impact Analysis: Assessing MPA Proposals

Based on the methods described in Appendix B, the net economic impact (NEI) of each MPA proposals is calculated for each fishery at both the study region and port group levels (see Appendix A for results). The NEI is also calculated as both a dollar value difference and as a percentage change from the Baseline Net Economic Revenue (BNER). The BNER for a particular fishery is the baseline gross economic revenue (BGER) for that fishery minus the estimated overall operating costs (both fixed and variable) for that fishery.

As can be seen in Appendix A, proposals vary considerably in their effects, between and across both ports and fisheries. For example,

- For the NCCSR, the maximum economic impact on urchin is estimated to be 12.62% under External A, but 40.79% under Emerald B.
- For the NCCSR, the lowest estimated maximum economic impact on nearshore rockfish from any proposal (External A) is still 21.27%. The highest estimated maximum economic impact from any proposal on coastal pelagics is 0.58% (Turquoise A, Turquoise B, Jade A, Jade B).
- For the port of Point Arena, the maximum economic impact on deeper nearshore rockfish from Emerald B is estimated to be 98.99%, yet this translates to an estimated \$4,415 in dollar terms.

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

APPENDIX A: Estimated Net Economic Impact (NEI)**I. POINT ARENA**

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	\$ NEI	—	—	—	—	—	—	—	—	—	—
Coastal Pelagics	\$ NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	\$ NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	\$ NEI	\$2,212	\$4,415	\$3,633	\$1,964	\$2,068	\$2,146	\$1,631	\$2,392	\$3,901	\$2,281
N. Rockfish	\$ NEI	\$73,792	\$163,531	\$135,254	\$70,694	\$54,973	\$70,080	\$57,781	\$81,411	\$147,391	\$76,956
Urchin	\$ NEI	\$429,485	\$811,665	\$438,822	\$495,464	\$318,690	\$482,082	\$294,415	\$557,397	\$426,062	\$541,214
Dungeness Crab	\$ NEI	\$4,120	\$13,907	\$26,243	\$8,740	\$21,805	\$10,652	\$3,187	\$15,272	\$29,976	\$6,578
Salmon	\$ NEI	\$40,755	\$43,202	\$81,509	\$86,764	\$111,754	\$87,446	\$39,993	\$108,184	\$76,455	\$73,808
All Fisheries	\$ NEI	\$550,364	\$1,036,720	\$685,461	\$663,626	\$509,290	\$652,406	\$397,007	\$764,657	\$683,784	\$700,836

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	% NEI	—	—	—	—	—	—	—	—	—	—
Coastal Pelagics	% NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	% NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	% NEI	49.6%	99.0%	81.5%	44.0%	46.4%	48.1%	36.6%	53.6%	87.5%	51.2%
N. Rockfish	% NEI	36.0%	79.9%	66.0%	34.5%	26.8%	34.2%	28.2%	39.8%	72.0%	37.6%
Urchin	% NEI	18.7%	35.3%	19.1%	21.6%	13.9%	21.0%	12.8%	24.3%	18.6%	23.6%
Dungeness Crab	% NEI	2.6%	8.9%	16.7%	5.6%	13.9%	6.8%	2.0%	9.7%	19.1%	4.2%
Salmon	% NEI	14.9%	15.8%	29.8%	31.7%	40.9%	32.0%	14.6%	39.6%	28.0%	27.0%
All Fisheries	% NEI	18.7%	35.3%	23.3%	22.6%	17.3%	22.2%	13.5%	26.0%	23.3%	23.9%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

II. BODEGA BAY

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	\$ NEI	\$6,658	\$5,094	\$9,632	\$5,320	\$5,907	\$6,668	\$15,086	\$4,559	\$6,658	\$5,927
Coastal Pelagics	\$ NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	\$ NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	\$ NEI	\$31,610	\$22,389	\$42,045	\$12,197	\$30,517	\$40,114	\$28,136	\$12,962	\$31,610	\$12,646
N. Rockfish	\$ NEI	\$50,792	\$47,020	\$47,000	\$21,716	\$81,916	\$82,463	\$22,466	\$44,973	\$50,792	\$49,007
Urchin	\$ NEI	\$463,068	\$496,836	\$446,059	\$106,890	\$367,102	\$463,440	\$109,994	\$365,737	\$463,068	\$457,109
Dungeness Crab	\$ NEI	\$530,011	\$765,572	\$1,150,622	\$200,453	\$322,763	\$371,461	\$61,155	\$216,308	\$530,011	\$332,956
Salmon	\$ NEI	\$285,129	\$554,022	\$530,684	\$211,056	\$400,804	\$432,259	\$28,411	\$181,630	\$285,129	\$336,878
All Fisheries	\$ NEI	\$1,367,267	\$1,890,933	\$2,226,044	\$557,632	\$1,209,008	\$1,396,405	\$265,248	\$826,168	\$1,367,267	\$1,194,524

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	% NEI	9.7%	7.4%	14.0%	7.7%	8.6%	9.7%	21.9%	6.6%	9.7%	8.6%
Coastal Pelagics	% NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	% NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	% NEI	41.0%	29.1%	54.6%	15.8%	39.6%	52.1%	36.5%	16.8%	41.0%	16.4%
N. Rockfish	% NEI	39.5%	36.6%	36.5%	16.9%	63.7%	64.1%	17.5%	35.0%	39.5%	38.1%
Urchin	% NEI	50.6%	54.2%	48.7%	11.7%	40.1%	50.6%	12.0%	39.9%	50.6%	49.9%
Dungeness Crab	% NEI	6.8%	9.8%	14.8%	2.6%	4.1%	4.8%	0.8%	2.8%	6.8%	4.3%
Salmon	% NEI	4.1%	8.0%	7.7%	3.1%	5.8%	6.3%	0.4%	2.6%	4.1%	4.9%
All Fisheries	% NEI	8.6%	11.9%	14.0%	3.5%	7.6%	8.8%	1.7%	5.2%	8.6%	7.5%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

III. BOLINAS

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	\$ NEI	\$11,267	\$11,374	\$15,433	\$11,231	\$11,637	\$13,475	\$20,004	\$9,906	\$11,267	\$13,069
Coastal Pelagics	\$ NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	\$ NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	\$ NEI	\$7,735	\$1,833	\$3,536	\$944	\$4,864	\$4,068	\$2,283	\$680	\$7,735	\$242
N. Rockfish	\$ NEI	—	—	—	—	—	—	—	—	—	—
Urchin	\$ NEI	—	—	—	—	—	—	—	—	—	—
Dungeness Crab	\$ NEI	\$0	\$0	\$92,024	\$0	\$0	\$0	\$14,215	\$0	\$0	\$0
Salmon	\$ NEI	\$2,525	\$1,408	\$1,417	\$859	\$1,271	\$1,374	\$2,593	\$584	\$2,525	\$507
All Fisheries	\$ NEI	\$21,526	\$14,616	\$112,409	\$13,034	\$17,772	\$18,917	\$39,095	\$11,170	\$21,526	\$13,818

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	% NEI	14.1%	14.2%	19.3%	14.0%	14.6%	16.8%	25.0%	12.4%	14.1%	16.3%
Coastal Pelagics	% NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	% NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	% NEI	108.1%	25.6%	49.4%	13.2%	68.0%	56.9%	31.9%	9.5%	108.1%	3.4%
N. Rockfish	% NEI	—	—	—	—	—	—	—	—	—	—
Urchin	% NEI	—	—	—	—	—	—	—	—	—	—
Dungeness Crab	% NEI	0.0%	0.0%	25.0%	0.0%	0.0%	0.0%	3.9%	0.0%	0.0%	0.0%
Salmon	% NEI	4.3%	2.4%	2.4%	1.5%	2.2%	2.3%	4.4%	1.0%	4.3%	0.9%
All Fisheries	% NEI	4.2%	2.8%	21.9%	2.5%	3.5%	3.7%	7.6%	2.2%	4.2%	2.7%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

IV. SAN FRANCISCO

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	\$ NEI	\$5,401	\$847	\$13,660	\$953	\$1,271	\$1,906	\$4,659	\$847	\$5,401	\$1,377
Coastal Pelagics	\$ NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	\$ NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	\$ NEI	\$90,966	\$56,505	\$88,897	\$54,436	\$82,286	\$78,952	\$33,340	\$48,170	\$90,966	\$30,265
N. Rockfish	\$ NEI	\$25,177	\$29,757	\$40,067	\$20,288	\$30,377	\$35,377	\$22,567	\$18,053	\$25,177	\$13,629
Urchin	\$ NEI	\$16,065	\$19,907	\$15,462	\$6,277	\$12,558	\$14,772	\$6,590	\$14,486	\$16,065	\$15,181
Dungeness Crab	\$ NEI	\$342,186	\$365,116	\$829,006	\$169,329	\$227,536	\$255,757	\$58,207	\$121,705	\$342,186	\$149,927
Salmon	\$ NEI	\$202,680	\$155,495	\$203,752	\$71,849	\$130,830	\$136,192	\$39,678	\$63,270	\$202,680	\$75,067
All Fisheries	\$ NEI	\$682,474	\$627,628	\$1,190,845	\$323,132	\$484,858	\$522,956	\$165,041	\$266,533	\$682,474	\$285,444

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	% NEI	0.8%	0.1%	1.9%	0.1%	0.2%	0.3%	0.7%	0.1%	0.8%	0.2%
Coastal Pelagics	% NEI	—	—	—	—	—	—	—	—	—	—
Market Squid	% NEI	—	—	—	—	—	—	—	—	—	—
D. N. Rockfish	% NEI	49.9%	31.0%	48.8%	29.9%	45.1%	43.3%	18.3%	26.4%	49.9%	16.6%
N. Rockfish	% NEI	17.9%	21.2%	28.5%	14.5%	21.6%	25.2%	16.1%	12.9%	17.9%	9.7%
Urchin	% NEI	47.3%	58.6%	45.5%	18.5%	37.0%	43.5%	19.4%	42.7%	47.3%	44.7%
Dungeness Crab	% NEI	2.8%	3.0%	6.8%	1.4%	1.9%	2.1%	0.5%	1.0%	2.8%	1.2%
Salmon	% NEI	2.8%	2.1%	2.8%	1.0%	1.8%	1.9%	0.5%	0.9%	2.8%	1.0%
All Fisheries	% NEI	3.3%	3.1%	5.8%	1.6%	2.4%	2.5%	0.8%	1.3%	3.3%	1.4%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

V. HALF MOON BAY

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	\$ NEI	\$1,103	\$1,413	\$1,051	\$379	\$775	\$1,051	\$655	\$345	\$1,103	\$414
Coastal Pelagics	\$ NEI	\$420	\$420	\$440	\$440	\$440	\$440	\$0	\$0	\$420	\$420
Market Squid	\$ NEI	\$134,090	\$67,979	\$134,790	\$5,018	\$27,133	\$132,106	\$934	\$5,018	\$134,090	\$17,972
D. N. Rockfish	\$ NEI	\$13,259	\$19,152	\$15,176	\$11,636	\$15,643	\$15,987	\$7,629	\$9,698	\$13,259	\$6,969
N. Rockfish	\$ NEI	\$327	\$11,710	\$327	\$327	\$328	\$328	\$238	\$327	\$327	\$313
Urchin	\$ NEI	—	—	—	—	—	—	—	—	—	—
Dungeness Crab	\$ NEI	\$150,547	\$383,109	\$186,499	\$74,150	\$60,668	\$83,138	\$11,235	\$34,828	\$150,547	\$53,927
Salmon	\$ NEI	\$147,252	\$152,677	\$189,877	\$58,126	\$115,476	\$120,127	\$13,950	\$52,701	\$147,252	\$83,701
All Fisheries	\$ NEI	\$446,997	\$636,460	\$528,160	\$150,075	\$220,464	\$353,177	\$34,640	\$102,916	\$446,997	\$163,716

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	% NEI	1.0%	1.2%	0.9%	0.3%	0.7%	0.9%	0.6%	0.3%	1.0%	0.4%
Coastal Pelagics	% NEI	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.0%	0.0%	1.0%	1.0%
Market Squid	% NEI	25.9%	13.1%	26.0%	1.0%	5.2%	25.5%	0.2%	1.0%	25.9%	3.5%
D. N. Rockfish	% NEI	20.6%	29.8%	23.6%	18.1%	24.3%	24.8%	11.9%	15.1%	20.6%	10.8%
N. Rockfish	% NEI	3.0%	108.0%	3.0%	3.0%	3.0%	3.0%	2.2%	3.0%	3.0%	2.9%
Urchin	% NEI	—	—	—	—	—	—	—	—	—	—
Dungeness Crab	% NEI	1.9%	5.0%	2.4%	1.0%	0.8%	1.1%	0.1%	0.5%	1.9%	0.7%
Salmon	% NEI	2.8%	2.9%	3.6%	1.1%	2.2%	2.3%	0.3%	1.0%	2.8%	1.6%
All Fisheries	% NEI	3.2%	4.6%	3.8%	1.1%	1.6%	2.6%	0.3%	0.7%	3.2%	1.2%

Summary of potential impacts on commercial and recreational fisheries in North Central Coast Study Region

VI. NORTH CENTRAL COAST STUDY REGION

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	\$ NEI	\$24,428	\$18,728	\$39,776	\$17,884	\$19,590	\$23,101	\$40,404	\$15,657	\$24,428	\$20,787
Coastal Pelagics	\$ NEI	\$420	\$420	\$440	\$440	\$440	\$440	\$0	\$0	\$420	\$420
Market Squid	\$ NEI	\$134,090	\$67,979	\$134,790	\$5,018	\$27,133	\$132,106	\$934	\$5,018	\$134,090	\$17,972
D. N. Rockfish	\$ NEI	\$145,781	\$104,296	\$153,287	\$81,177	\$135,377	\$141,267	\$73,018	\$73,903	\$147,470	\$52,404
N. Rockfish	\$ NEI	\$150,088	\$252,019	\$222,648	\$113,024	\$167,594	\$188,248	\$103,052	\$144,763	\$223,687	\$139,905
Urchin	\$ NEI	\$908,618	\$1,328,408	\$900,343	\$608,631	\$698,351	\$960,293	\$410,999	\$937,620	\$905,194	\$1,013,503
Dungeness Crab	\$ NEI	\$1,026,864	\$1,527,703	\$2,284,395	\$452,672	\$632,772	\$721,008	\$147,998	\$388,114	\$1,052,720	\$543,388
Salmon	\$ NEI	\$678,339	\$906,804	\$1,007,240	\$428,654	\$760,136	\$777,398	\$124,625	\$406,369	\$714,040	\$569,960
All Fisheries	\$ NEI	\$3,068,629	\$4,206,357	\$4,742,919	\$1,707,500	\$2,441,393	\$2,943,862	\$901,031	\$1,971,444	\$3,202,050	\$2,358,339

Fishery	Impact	EA	EB	JA	JB	TA	TB	A	B	C	D
Ca. Halibut	% NEI	2.5%	1.9%	4.1%	1.8%	2.0%	2.4%	4.1%	1.6%	2.5%	2.1%
Coastal Pelagics	% NEI	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.0%	0.0%	0.6%	0.6%
Market Squid	% NEI	17.4%	8.8%	17.5%	0.7%	3.5%	17.1%	0.1%	0.7%	17.4%	2.3%
D. N. Rockfish	% NEI	43.5%	31.1%	45.7%	24.2%	40.4%	42.1%	21.8%	22.0%	44.0%	15.6%
N. Rockfish	% NEI	31.0%	52.0%	45.9%	23.3%	34.6%	38.8%	21.3%	29.9%	46.2%	28.9%
Urchin	% NEI	27.9%	40.8%	27.6%	18.7%	21.4%	29.5%	12.6%	28.8%	27.8%	31.1%
Dungeness Crab	% NEI	3.6%	5.4%	8.1%	1.6%	2.2%	2.6%	0.5%	1.4%	3.7%	1.9%
Salmon	% NEI	3.4%	4.6%	5.1%	2.2%	3.8%	3.9%	0.6%	2.0%	3.6%	2.9%
All Fisheries	% NEI	5.7%	7.8%	8.8%	3.2%	4.5%	5.5%	1.7%	3.7%	5.9%	4.4%

APPENDIX B: 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 eliminate 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

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

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

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

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

as well as

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

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} 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 (Wilens 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 or 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 all 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 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:

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

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*.