Consideration of Sanctuary Research Needs with Respect to Existing MPAs Situated in the Monterey Bay National Marine Sanctuary

Prepared for

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Introduction

The National Oceanic and Atmospheric Administration (NOAA) Office of National Marine Sanctuaries (ONMS) is moving forward with a process to propose Marine Protected Areas (MPAs) in the federal waters of the Monterey Bay National Marine Sanctuary (MBNMS or Sanctuary). One of the three principal management objectives for moving forward with MPAs as additional marine zones in the federal waters of the sanctuary is: "Designation of research areas to differentiate between natural variation versus human impacts to ecological processes and components" (MBNMS 2008).

The Sanctuary has noted that research studies designed to differentiate between natural variation vs. human impacts to ecological processes and components could employ MPAs as control areas, with minimal extractive activity. The purpose of such studies would be to determine the responses to human influence by comparing changes in key resources in the MPAs to other areas of the Sanctuary (MBNMS 2008).

In a letter to the Sanctuary Advisory Council Members (MBNMS 2008), the Sanctuary provided a list of the types of questions that can be addressed by establishing MPAs for research purposes, which include (but are not limited to): 1) what variability is inherent in the natural ecosystem components and what changes may be the result of human influence, 2) what are the effects of extractive activities on ecosystem components, 3) how would benthic communities change in response to a further reduction in human activity, 4) what are the recovery trajectories in disturbed habitats, 5) where along the continuum of community structure does the protected area fall compared to unprotected or heavily used areas, and 6) what is the functional role of deep-sea biogenic habitats, such as deepwater corals, sponges, and chemosynthetic biological communities in regulating community structure.

The Alliance of Communities for Sustainable Fisheries has asked the question: To what extent do the presently existing MPAs situated in the MBNMS, including State of California MPAs and Pacific Fishery Management Council (PFMC or Council) "fishery-based" MPAs -- such as Essential Fish Habitat (EFH) and Rockfish Conservation Areas (RCAs) already meet some if not all of the stated MBNMS-MPA research needs?

The purpose of this paper is to 1) review the goals and objectives of MPAs presently existing in the MBNMS, 2) compare these goals and objectives with the MPA research needs identified by the MBNMS, and 3) evaluate whether the existing MPAs could, in principle, address the types of research questions identified by the MBNMS.

Approach

For the purposes of this paper, the MPAs presently existing within the MBNMS are considered under two general categories: 1) State of California MPAs -- established under the California Marine Life Protection Act (MLPA) (CDFG 2006, 2007, 2010), and 2) PFMC fishery-based MPAs -- which include areas designated as groundfish EFH Conservation Areas and Rockfish Conservation Areas (RCAs) (PFMC 2008). Information describing the goals and objectives for

both of these types of MPAs was compiled from published sources and summarized in tabular form for cross comparison with the six MBNMS research needs (MBNMS 2008).

Results

Evaluation of Existing MPAs and MBNMS Research Needs

State of California MPAs. A substantial body of information regarding the development of MPAs along the Central California coast is available as a consequence of the MLPA process (http://www.dfg.ca.gov/mlpa). Under this process, the planning for and implementation of MPAs has been conducted regionally, and in stages over time. Of the twenty-five state MPAs located within the MBNMS, two were developed through the MLPA North Central Coast regional project (Montara SMR and Pillar Point SMCA), and the remaining twenty-three were developed through the MLPA Central Coast regional project (Figure 1; Tables 1a-1d). These twenty-five MPAs collectively comprise 165.61 sq. mi. and span a diverse range of mostly nearshore habitats, although some are inclusive of deepwater environs as well (Jagielo 2010). Commercial fishing for groundfish is prohibited in all of the state MPAs. All groundfish take is prohibited in 19 of the state MPAs (144.2 sq mi) and limited recreational fishing is permitted in six of the state MPAs (21.46 sq. mi.) (CDFG 2007; CDFG 2010) (Table 5).

While the objectives for the North Central and Central coast regions vary (albeit only slightly), the state MPAs in the MBNMS share a common set of six goals established by the MLPA, namely: 1) to protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems, 2) to help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted, 3) to improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity, 4) to protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value, 5) to ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines and 6) to ensure that the state's MPAs are designed and managed, to the extent possible, as a network.

Considering all six of the state MPA goals, it is evident that goals one through four could apply to MPAs in general, while goals five and six pertain more specifically to particular MPLA objectives. Therefore, for the purposes of this paper, the focus will be on goals one through four. The individual goals and objectives for each one of the twenty-five state MPAs situated in the MBNMS was identified from MLPA documents (MPLA 2005; MPLA 2008) and is summarized in Tables 2 and 3. Examination of Tables 2 and 3 reveals that all twenty-five of the state MPAs situated in the MBNMS are consistent with substantial portions of goals one through four; all of the MPAs have identified at least one of the four goals, and over twenty of the MPAs fall under any given one of the four goals.

Since the state MPAs situated in the MBNMS clearly embody MLPA goals one through four, one way to evaluate whether they could address the six Sanctuary research needs is to consider to what extent each of these four state MPA goals is consistent with respect to each of the six

research needs. A matrix comparing the state MPA goals with the MBNMS research needs is given in Table 4. As noted above, goals five and six are specific to state MPA objectives, and thus are not considered useful to address the MBNMS research needs. A case can be made, however, that each of the state MPA goals one through four is consistent with each of the six MBNMS research needs. The reasoning for this is that each of the first four state MPA goals speaks directly to the ecosystem components identified by the MBNMS targeted for research, namely: 1) the structure, function and integrity of marine ecosystems (goal 1), 2) rebuilding depleted populations (goal 2), 3) biodiversity (goal 3), and 4) representative and unique habitats (goal 4). An MPA-specific comparison with each of the MBNMS research needs is given in Table 5. In Table 5, all twenty-five of the state MPAs (Montara SMR through Cambria SMP) was assigned a "Y" indicating consistency with each of the MBNMS research needs one through five; because of the goals these twenty-five MPAs embody, they could in principal serve as control areas for research studies to address these MBNMS research needs. Only four of the twenty-five state MPAs (Soquel Canyon SMCA, Portuguese Ledge SMCA, Pt. Lobos SMCA, and Big Creek SMR), were deemed consistent with research need six, which pertains specifically to deepwater habitats (Table 5).

Fishery-Based MPAs. Essential Fish Habitat Conservation Areas (EFH) and Rockfish Conservation Areas (RCAs), are two types of large-scale, coastwide MPAs established by the PFMC that afford resource and habitat protection for much of the MBNMS (PFMC 2008). Collectively, these MPAs cover a substantial portion of the MBNMS and span a wide variety of both nearshore and deepwater habitats (Figure 2). Parrish (2007) analyzed the spatial coverage of these fishing area closures in the MBNMS. When combined with other closed areas (including state waters closed to groundfish fishing, and federal waters greater than 700 fm) he reported that "no-trawling" areas in the MBNMS (including the Davidson Seamount) totaled 3,479.9 sq mi. and "no bottomfish take" areas totaled 1,023.0 sq mi. (69.7% and 20.5% of the MBNMS, respectively). The specific locations of closed EFH and RCA areas in the MBNMS are posted on http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-Closed-Areas.

On June 12, 2006, the area shoreward of 100 fm off the West Coast States of Washington, Oregon, and California was designated as EFH for Pacific Coast groundfish (NMFS 2006). The objectives of the PFMC and the National Marine Fisheries Service (NMFS) in designating EFH are to 1) describe and identify EFH for the fishery, 2) designate Habitat Areas of Particular Concern (HAPC), 3) minimize to the extent practicable the adverse effects of fishing on EFH, and 4) identify other actions to encourage the conservation and enhancement of EFH (PFMC 2008). Three types of EFH Conservation Area closures are utilized, including areas where 1) no trawling is allowed, 2) no bottom contact of fishing gear is allowed, and 3) no-bottom-contact gear is allowed - within an additional off-bottom buffer. While essentially permanent, EFH designations are scheduled to be reviewed at least every five years (PFMC 2008). When implementing EFH Conservation Areas, the Council noted that establishing research sites, unaffected by fishing, could be used in comparative studies to better understand the effects of fishing on habitat; over time these sites could be compared with sites where fishing is ongoing and such research sites should include a representative sample of habitat types in order to allow comparison of the effects of fishing across these different types (PFMC 2005; PFMC 2008).

Three EFH no trawl areas within the MBNMS span a total of 1,435.0 sq. mi. and include 1) the Monterey Bay/Canyon (831.3 sq. mi.), 2) the Point Sur Deep (84.4 sq. mi), and 3) a portion of the Big Sur Coast/Port San Luis area (519.3 sq mi. within the MBNMS) (Parrish 2007). In view of the EFH mandate for habitat protection, and the stated intent for these areas to serve as research sites for ecosystem components (PFMC 2005; PFMC 2008), it is reasonable to assign these MPAs a "Y" for being consistent with the MBNMS research goals one through six (Table 5). Also part of the MBNMS, the Davidson Seamount (775.5 sq mi.) is a no-bottom-contact area with an off-bottom buffer. For this analysis, it was assigned a "Y" for being consistent with the MBNMS research needs one, two, five, and six; however, in view of its pristine nature, it would not appear to fit research needs three and four -- which pertain to the recovery of impacted benthic areas (Table 5).

Rockfish Conservation Areas (RCAs) were established along the entire US West Coast by NMFS and the PFMC in 2003 (PFMC 2008). The specific objective of these spatial closures is to rebuild overfished rockfish populations; RCA boundaries are intended to approximate particular depth contours and vary by region depending upon fishing gear types and the particular species targeted for rebuilding locally. Fishing is prohibited for groundfish in RCAs but the closures do not apply to pelagic fisheries for salmon, coastal pelagic species, highly migratory species, or invertebrates taken in traps or pots. These spatial closures can have a seasonal component, have not been declared permanent, and are expected to be lifted when the resources sufficiently recover (Parrish 2007).

Fishing closures designated as RCAs in the MBNMS include 1) a recreational fishing RCA that extends from 30 fathoms (55 m) to 200 miles offshore from June to November and from the shoreline to 200 miles from December to May, 2) a year-round commercial non-trawl gear RCA that extends from 30 to 150 fathoms (55-274 m), and 3) a year-round commercial trawl gear RCA that extends from 100 to 150 fathoms (183-274 m) (Parrish 2007). Considering the mandate for resource protection under which they were established, RCAs could be considered consistent with the research needs of the MBNMS. Although RCAs are intended specifically to rebuild overfished rockfish species, they also offer collateral protection for other benthic marine life and can afford opportunities to study recovering ecosystem components. However, because these spatial closures can have a seasonal component and they are not deemed to be permanent, they were assigned only a conditional "(Y)" for this analysis (Table 5).

Parrish (2007) also pointed out that federal regulations enacted along with the EFH closures, in June 2006, prohibit all trawling between 700 (1280 m) and 3500 fathoms (6400 m) and trawling is also prohibited in state waters. When combined, the no-trawl areas occupy 64% of the area of the MBNMS (69.7% when the Davidson Seamount is included) which leaves trawling allowed in only three areas on the upper and lower slope and one large and two small areas on the inner shelf break and outer shelf (i.e. between State waters and the RCA).

Discussion

The value of MPAs as control areas for anthropogenic-impact research studies is well documented (Allison et al 1998; Guenette et al 1998; Botsford et al 2003; Gerber et al 2003). Most commonly, such studies have focused on the effects of extractive activities (i.e. fishing)

(Guenette et al 1998). Studies of this type typically employ habitat-specific comparative experimental designs and are structured to incorporate bottom depth and benthic habitat diversity as parameters to insure representativeness of the target study area (Smith et al 1993; Guidetti 2002). Thus, in order for MPAs to serve as useful control areas for evaluation of extractive impacts in the MBNMS, it follows that they should 1) contain depth specific habitats representative of the MBNMS, and 2) be paired in experiments with comparable depth specific habitats where the extractive impact under evaluation is not regulated (i.e. areas open to fishing).

Habitat diversity is clearly evident in the state MPAs of the MBNMS, as can be seen by the wide range of nearshore benthic habitats protected (Tables 1a -1d); however, deepwater habitats are relatively less well represented (with noteworthy exceptions: Soquel Canyon SMCA, Portuguese Ledge SMCA, Pt. Lobos SMCA, and Big Creek SMR). Both types of fishery-based MPAs of the MBNMS (EFH and RCAs) span diverse habitats in both nearshore and offshore zones. In protecting groundfish habitats, EFH Conservation Areas afford year-round, ancillary protection to a wide range of marine life, and are essentially permanent closures. Extensive marine life protection is also provided by RCAs, but they are intended to be species specific, and are potentially more variable temporally and spatially – although it is conceivable that creative experimental designs could be put in place now to address research needs regarding the recovery of ecosystem components within these areas in the MBNMS. Work of this type in RCAs could potentially demonstrate the utility of "adaptive management" within the bounds of the MBNMS.

Aside from the "research needs" management objective for MPAs in the MBNMS, another stated objective is "Preservation of unique and rare areas in their natural state for the benefit of future generations" (MBNMS 2008). Recently added to the MBNMS (designated on March 9, 2009), the Davidson Seamount Management Zone (DSMZ) also affords a large area of unique deepwater habitat for research operations in the MBNMS. Lacking a set of defining criteria for the "unique and rare" objective, it is not clear if the Davidson Seamount would qualify, or what kinds of other areas in the MBNMS might be considered for this purpose.

Considering the broad extent to which MBNMS habitats are represented in the currently existing MPAs, it is apparent that ample control areas presently exist for studies to differentiate between natural variation and human impacts to ecological processes and components. With regard to evaluating extractive impacts, because of extensive fishing restrictions (cf. Parrish 2007), it may actually be more challenging to identify representative habitat-specific *experimental sites* for comparative studies where fishing (especially groundfish trawling) is permissible in the MBNMS. Researchers could find it difficult to get authorization for such work in this setting. For example, the very productive and diverse shelf break habitat (i.e.100-150 fathoms) is closed to all fishing for bottomfishes over the entire MBNMS, and any evaluation of the effects of fishing in this habitat will be impossible until the RCA is opened to fishing.

As control areas for differentiating between natural variation and anthropogenic forcing, MPAs could also conceivably be used to evaluate some types of non-fishing impacts. While some non-fishing impacts can reasonably be controlled for, others cannot, including certain cumulative impacts. Examples of non-fishing cumulative impacts include various kinds of physical disturbance, sedimentation, chemical alteration of the seawater, and many other things; the cumulative and synergistic effects of multiple threats can include the effects of natural stresses

such as storm damage or climate-based environmental shifts (Hanson et al 2003). In recent years, investigators have become increasingly aware of large-scale oceanic processes that can potentially impact the ecosystem components of the California Current Ecosystem; examples include ocean acidification (Hauri et al 1999) and global climate change (NOAA 2009). Such potentially confounding factors can have the effect of "re-defining" what we would call "natural variation" in the context of comparative studies intended to assess human impacts to ecological processes and components.

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Figure 1. Map of California State MPAs in Monterey Bay National Marine Sanctuary.
Source: http://www.sanctuarysimon.org/monterey/sections/reserves/index.php

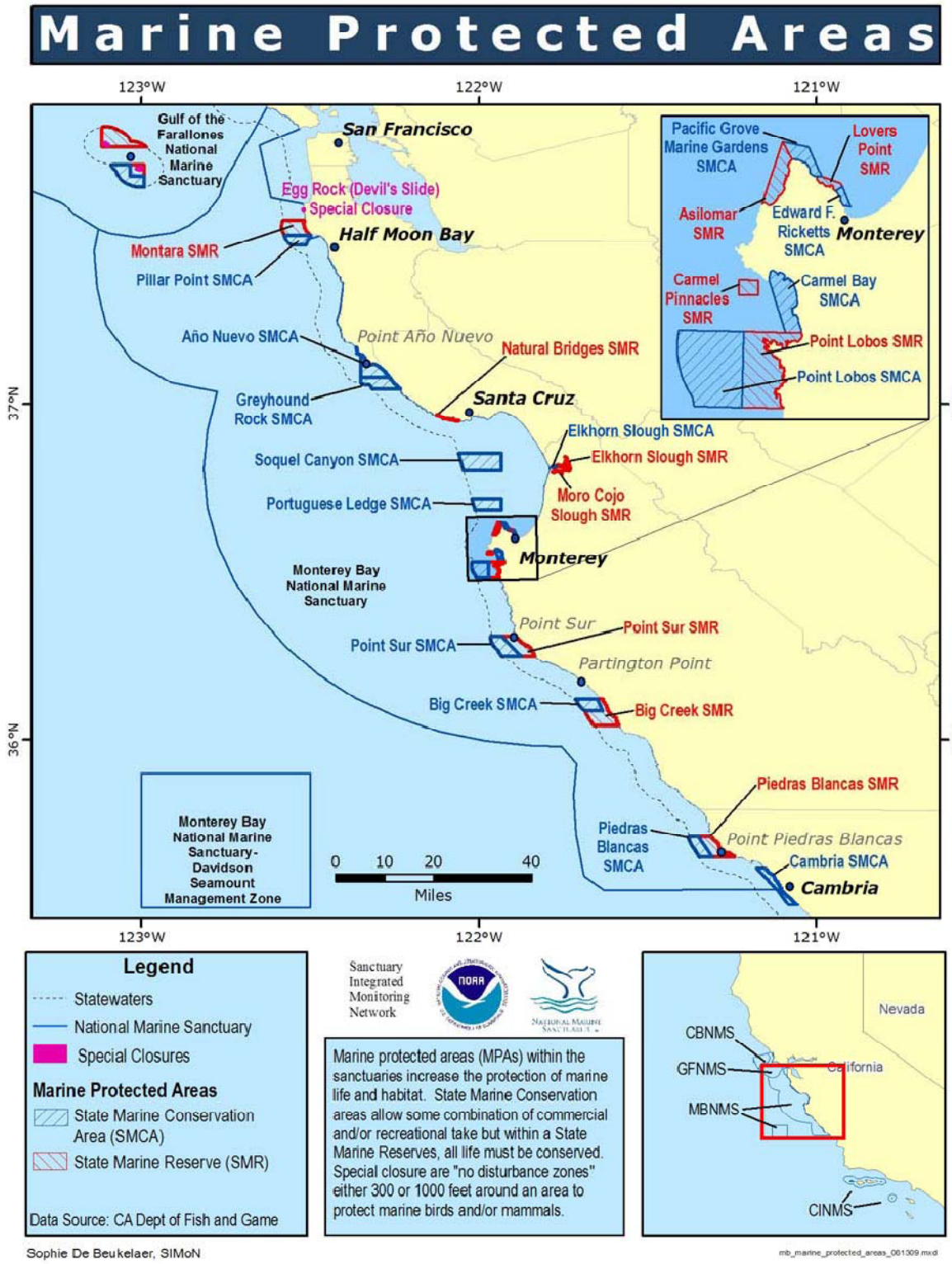

Figure 2. Map showing location of EFH and RCAs in MBNMS. Map prepared by MBNMS; Source: Parrish (2007)

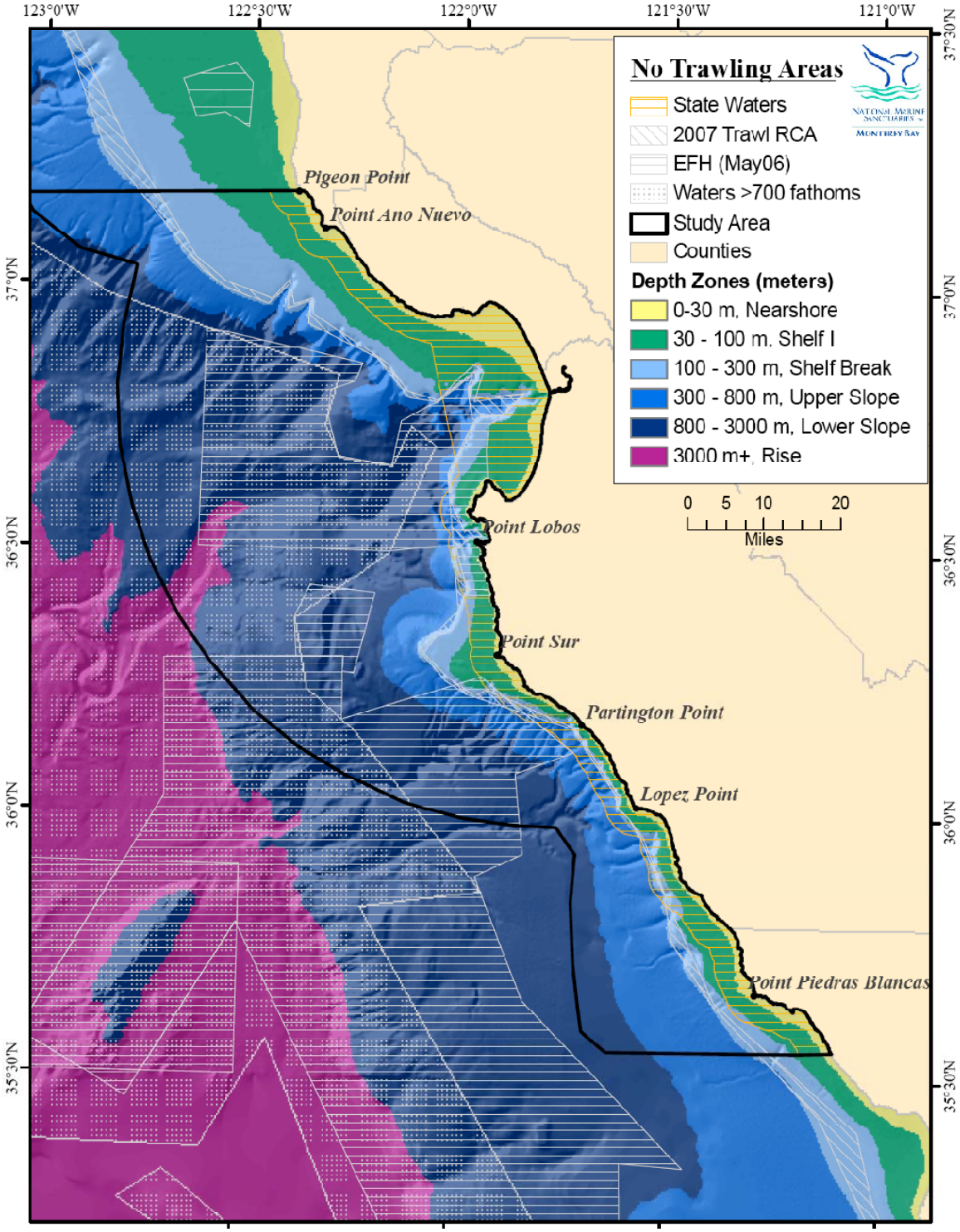

Table 1a. Habitat summary of Central California Marine Protected Areas within the Monterey Bay National Marine Sanctuary (Montara SMR to Elkhorn Slough SMP). Data Source: Paulo Serpa, CDFG (4/28/2010 and 5/10/2010).

	Units	**Montara SMR**	**Pillar Point SMCA**	***Año Nuevo SMR***	***Greyhound Rock SMCA***	***Natural Bridges SMR***	***Elkhorn Slough SMR***	***Elkhorn Slough SMP***
MPA Classification		SMR	SMCA	SMR	SMCA	SMR	SMR	SMP
Area	**Area (mi2)**	11.76	6.66	11.07	11.81	0.58	1.48	0.09
Minimum Depth	**Feet**	0.00	0.00	0	0	3	0	0
Maximum Depth	**Feet**	168.00	174.00	175	216	21	10	10
Alongshore span	**Linear (mi)**	3.1	1.9	8.4	3.1	4.1	4.4	1.4
ESI Shoreline Length	**Linear (mi)**	4.09	0.38					
Sandy or gravel beaches	**Linear (mi)**	0.64	0.07	10.47	2.72	3.1	0	0.17
Rocky intertidal and cliff	**Linear (mi)**	3.45	0.31	4.89	3.31	3.58	0	0
Coastal marsh	**Linear (mi)**	0.00	0.00	0	0	0.68	9.16	0.95
Tidal flats	**Linear (mi)**	0.00	0.00	0	0	0	9.16	0.99
Surfgrass	**Linear (mi)**	3.42	0.35	6.32	3.94	4.3	0	0
Eelgrass	**Area (mi2)**	0.00	0.00	0	0	0	0.03	0.01
Estuary	**Area (mi2)**	0.00	0.00	0	0	0	1.48	0.09
Soft 0 - 30m	**Area (mi2)**	0.45	0.08	4.8	0.81	0	1.48	0.09
Soft 30 - 100m	**Area (mi2)**	7.74	5.42	2.7	9.03	0	0	0
Soft 100 - 200m	**Area (mi2)**	0.00	0.00	0	0	0	0	0
Soft 200 - 3000m	**Area (mi2)**	0.00	0.00	0	0	0	0	0
Hard 0 - 30m	**Area (mi2)**	0.92	0.42	3.56	1.96	0.58	0	0
Hard 30 - 100m	**Area (mi2)**	0.72	0.61	0	0	0	0	0
Hard 100 - 200m	**Area (mi2)**	0.00	0.00	0	0	0	0	0
Hard >200	**Area (mi2)**	0.00	0.00	0	0	0	0	0
Kelp 1989	**Area (mi2)**	0.00	0.00	0.02	0	0.03	0	0
Kelp 1999	**Area (mi2)**	0.00	0.00	0	0	0.01	0	0
Kelp 2002	**Area (mi2)**	0.00	0.00	0	0.02	0.03	0	0
Kelp 2003	**Area (mi2)**	0.00	0.00	0	0	0.01	0	0
Kelp 2004	**Area (mi2)**	0.01	0.00					
Kelp 2005	**Area (mi2)**	0.00	0.00					
Persistent Kelp (present 3 of 4 years)	**Area (mi2)**			0	0	0	0	0
Canyon 0-30m	**Area (mi2)**			0	0	0	0	0
Canyon 30-100m	**Area (mi2)**			0	0	0	0	0
Canyon 100-200m	**Area (mi2)**			0	0	0	0	0
Canyon >200m	**Area (mi2)**			0	0	0	0	0

Table 1b. Habitat summary of Central California Marine Protected Areas within the Monterey Bay National Marine Sanctuary (Moro Cojo SMR to Asilomar SMR). Data Source: Paulo Serpa, CDFG (4/28/2010 and 5/10/2010).

	Units	*Moro Cojo SMR*	Soquel Canyon SMCA	*Portuguese Ledge SMCA*	*Edward F. Ricketts SMCA*	*Lovers Pt. (Hopkins) SMR*	*Pacific Grove Marine Gardens SMCA*	*Asilomar SMR*
MPA Classification		SMR	SMCA	SMCA	SMCA	SMR	SMCA	SMR
Area	**Area (mi2)**	0.46	23.41	10.91	0.22	0.3	0.93	1.51
Minimum Depth	**Feet**	0	247	302	0	0	3	0
Maximum Depth	**Feet**	10	2113	4838	74	88	151	172
Alongshore span	**Linear (mi)**	5	7.8	5.4	1	1	1.5	2.3
ESI Shoreline Length	**Linear (mi)**							
Sandy or gravel beaches	**Linear (mi)**	0	0	0	0.34	0.62	1.72	2.05
Rocky intertidal and cliff	**Linear (mi)**	0	0	0	0.8	1.42	1.92	2.85
Coastal marsh	**Linear (mi)**	0	0	0	0	0	0	0
Tidal flats	**Linear (mi)**	0	0	0	0	0	0	0
Surfgrass	**Linear (mi)**	0	0	0	0.99	1.61	1.81	1.92
Eelgrass	**Area (mi2)**	0	0	0	0	0	0	0
Estuary	**Area (mi2)**	0.46	0	0	0	0	0	0
Soft 0 - 30m	**Area (mi2)**	0.46	0	0	0.12	0.12	0.17	0.25
Soft 30 - 100m	**Area (mi2)**	0	13.2	1.46	0	0	0.02	0.01
Soft 100 - 200m	**Area (mi2)**	0	1.77	4.45	0	0	0	0
Soft 200 - 3000m	**Area (mi2)**	0	3.14	1.48	0	0	0	0
Hard 0 - 30m	**Area (mi2)**	0	0	0	0.06	0.09	0.48	0.59
Hard 30 - 100m	**Area (mi2)**	0	2.38	0.38	0	0	0.14	0.08
Hard 100 - 200m	**Area (mi2)**	0	2.05	1.62	0	0	0	0
Hard >200	**Area (mi2)**	0	0.87	1.51	0	0	0	0
Kelp 1989	**Area (mi2)**	0	0	0	0.06	0.07	0.18	0.31
Kelp 1999	**Area (mi2)**	0	0	0	0.01	0.01	0.04	0.05
Kelp 2002	**Area (mi2)**	0	0	0	0.09	0.14	0.19	0.05
Kelp 2003	**Area (mi2)**	0	0	0	0.05	0.1	0.16	0.03
Kelp 2004	**Area (mi2)**							
Kelp 2005	**Area (mi2)**							
Persistent Kelp (present 3 of 4 years)	**Area (mi2)**	0	0	0	0.03	0.04	0.05	0
Canyon 0-30m	**Area (mi2)**	0	0	0	0	0	0	0
Canyon 30-100m	**Area (mi2)**	0	0.02	0	0	0	0	0
Canyon 100-200m	**Area (mi2)**	0	0.6	0	0	0	0	0
Canyon >200m	**Area (mi2)**	0	2.25	1.72	0	0	0	0

Table 1c. Habitat summary of Central California Marine Protected Areas within the Monterey Bay National Marine Sanctuary (Carmel Pinnacles SMR to Point Sur SMCA). Data Source: Paulo Serpa, CDFG (4/28/2010 and 5/10/2010).

	Units	*Carmel Pinnacles SMR*	*Carmel Bay SMCA*	*Pt. Lobos SMR*	*Pt. Lobos SMCA*	*Point Sur SMR*	*Point Sur SMCA*
MPA Classification		SMR	SMCA	SMR	SMCA	SMR	SMCA
Area	**Area (mi2)**	0.53	2.12	5.36	8.85	9.72	9.96
Minimum Depth	**Feet**	69	0	0	268	0	139
Maximum Depth	**Feet**	223	471	408	1858	183	624
Alongshore span	**Linear (mi)**	1	3.1	4.7	3.2	5.4	5.4
ESI Shoreline Length	**Linear (mi)**						
Sandy or gravel beaches	**Linear (mi)**	0	3.03	2.09	0	5.8	0
Rocky intertidal and cliff	**Linear (mi)**	0	2.62	13.67	0	3.71	0
Coastal marsh	**Linear (mi)**	0	0	0	0	0	0
Tidal flats	**Linear (mi)**	0	0	0	0	0	0
Surfgrass	**Linear (mi)**	0	2.98	11.01	0	5.71	0
Eelgrass	**Area (mi2)**	0	0	0	0	0	0
Estuary	**Area (mi2)**	0	0	0	0	0	0
Soft 0 - 30m	**Area (mi2)**	0.02	0.84	0.5	0	2.16	0
Soft 30 - 100m	**Area (mi2)**	0.07	0.05	2.32	0.18	2.34	8.1
Soft 100 - 200m	**Area (mi2)**	0	0	0.06	2.94	0	0
Soft 200 - 3000m	**Area (mi2)**	0	0	0	2.88	0	0
Hard 0 - 30m	**Area (mi2)**	0.07	0.71	1.03	0	3.41	0
Hard 30 - 100m	**Area (mi2)**	0.37	0.04	1.13	0.26	1.8	1.84
Hard 100 - 200m	**Area (mi2)**	0	0	0	1.64	0	0.01
Hard >200	**Area (mi2)**	0	0	0	0.95	0	0
Kelp 1989	**Area (mi2)**	0.04	0.43	0.37	0	1.7	0
Kelp 1999	**Area (mi2)**	0	0.01	0.04	0	0.12	0
Kelp 2002	**Area (mi2)**	0	0.54	0.38	0	1.17	0
Kelp 2003	**Area (mi2)**	0	0.23	0.28	0	0.37	0
Kelp 2004	**Area (mi2)**						
Kelp 2005	**Area (mi2)**						
Persistent Kelp (present 3 of 4 years)	**Area (mi2)**	0	0.13	0.14	0	0.09	0
Canyon 0-30m	**Area (mi2)**	0	0.14	0.07	0	0	0
Canyon 30-100m	**Area (mi2)**	0	0.02	0.01	0.02	0	0
Canyon 100-200m	**Area (mi2)**	0	0	0	0.15	0	0
Canyon >200m	**Area (mi2)**	0	0	0	0.15	0	0

Table 1d. Habitat summary of Central California Marine Protected Areas within the Monterey Bay National Marine Sanctuary (Big Creek SMCA to Cambria SMR, and Totals for MPAs in MBNMS). Data Source: Paulo Serpa, CDFG (4/28/2010 and 5/10/2010).

	Units	*Big Creek SMCA*	*Big Creek SMR*	*Piedras Blancas SMR*	*Piedras Blancas SMCA*	*Cambria SMP*	*Total of MPAs in MBNMS*
MPA Classification		SMCA	SMR	SMR	SMCA	SMP	
Area	**Area (mi2)**	10.11	12.35	10.4	8.76	6.26	165.61
Minimum Depth	**Feet**	0	0	0	94	0	0
Maximum Depth	**Feet**	1964	2393	157	337	105	4,838
Alongshore span	**Linear (mi)**	2.5	3.3	6.4	4.9	5.8	96.1
ESI Shoreline Length	**Linear (mi)**						4.47
Sandy or gravel beaches	**Linear (mi)**	1.08	1.54	5.49	0	5.4	46.33
Rocky intertidal and cliff	**Linear (mi)**	1.77	2.95	5.83	0	3.77	56.84
Coastal marsh	**Linear (mi)**	0	0	0	0	0.47	11.26
Tidal flats	**Linear (mi)**	0	0	0	0	0.15	10.30
Surfgrass	**Linear (mi)**	2.8	4.44	8	0	4.82	64.43
Eelgrass	**Area (mi2)**	0	0	0	0	0	0.04
Estuary	**Area (mi2)**	0	0	0.01	0	0.01	2.05
Soft 0 - 30m	**Area (mi2)**	0.91	0.73	6.09	0	4.48	24.56
Soft 30 - 100m	**Area (mi2)**	2.19	2.61	2.56	8.2	0.44	68.65
Soft 100 - 200m	**Area (mi2)**	0.36	0.84	0	0	0	10.42
Soft 200 - 3000m	**Area (mi2)**	6.12	7.05	0	0	0	20.67
Hard 0 - 30m	**Area (mi2)**	0.4	0.57	1.6	0	1.34	17.79
Hard 30 - 100m	**Area (mi2)**	0.06	0.11	0.15	0.56	0	10.64
Hard 100 - 200m	**Area (mi2)**	0.05	0.01	0	0	0	5.38
Hard >200	**Area (mi2)**	0.02	0.03	0	0	0	3.38
Kelp 1989	**Area (mi2)**	0.24	0.31	0.48	0	0.95	5.19
Kelp 1999	**Area (mi2)**	0.1	0.06	0.11	0	0.06	0.62
Kelp 2002	**Area (mi2)**	0.19	0.3	0.86	0	0.71	4.67
Kelp 2003	**Area (mi2)**	0.13	0.17	0.56	0	0.56	2.65
Kelp 2004	**Area (mi2)**						0.01
Kelp 2005	**Area (mi2)**						0.00
Persistent Kelp (present 3 of 4 years)	**Area (mi2)**	0.08	0.08	0.1	0	0.33	1.07
Canyon 0-30m	**Area (mi2)**	0	0	0	0	0	0.21
Canyon 30-100m	**Area (mi2)**	0.12	0.25	0	0	0	0.44
Canyon 100-200m	**Area (mi2)**	0.1	0.29	0	0	0	1.14
Canyon >200m	**Area (mi2)**	2.29	3.17	0	0	0	9.58

Table 2. North Central Coast MPA Regional Goals and Objectives.
Adopted by the MLPA Blue Ribbon Task Force on February 14, 2008.
Source: http://www.dfg.ca.gov/mlpa/northcentralhome.asp

Goals	Objectives	Montara SMR	Pillar Point SMCA
Goal 1. To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems	Objective 1. Protect species diversity and abundance consistent with natural fluctuations by including and maintaining areas of high native species diversity and representative habitats.	Y	Y
	Objective 2. Include areas with diverse habitat types in close proximity to each other.	Y	Y
	Objective 3. Protect natural size and age structure and genetic diversity of populations in representative habitats.	Y	Y
	Objective 4. Protect natural trophic structure and food webs in representative habitats.	Y	Y
	Objective 5. Protect ecosystem structure, function, integrity and ecological processes to facilitate recovery of natural communities from disturbances both natural and human induced.	Y	Y
Goal 2. To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.	Objective 1. Help protect or rebuild populations of rare, threatened, endangered, depressed, depleted, or overfished species, where identified, and the habitats and ecosystem functions upon which they rely.	Y	Y
	Objective 2. Sustain or increase reproduction by species most likely to benefit from MPAs through retention of large, mature individuals	Y	Y
	Objective 3. Sustain or increase reproduction by species most likely to benefit from MPAs through protection of breeding, foraging, rearing or nursery areas.	Y	Y
	Objective 4. Protect selected species and the habitats on which they depend while allowing the commercial and/or recreational harvest of migratory, highly mobile, or other species		Y

Table 2. (Cont'd) North Central Coast MPA Regional Goals and Objectives.
Adopted by the MLPA Blue Ribbon Task Force on February 14, 2008.
Source: http://www.dfg.ca.gov/mlpa/northcentralhome.asp

Goals	Objectives	Montara SMR	Pillar Point SMCA
Goal 3. To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbances, and to manage these uses in a manner consistent with protecting biodiversity.	Objective 1. Ensure some MPAs are close to population centers, coastal access points, and/or research and education institutions and include areas of educational, recreational, and cultural use.	Y	Y
	Objective 2. Sustain or enhance cultural, recreational, and educational experiences by improving catch rates, high scenic value, lower congestion, or increased size or abundance of species.	Y	Y
	Objective 3. To enhance the likelihood of scientifically valid studies, replicate appropriate MPA designations, habitats or control areas (including areas open to fishing) to the extent possible.	Y	Y
	Objective 4. Develop collaborative scientific monitoring and research projects evaluating MPAs that link with fisheries management information needs, classroom science curricula, volunteer dive programs, and fishermen, and identify participants.	Y	Y
Goal 4. To protect marine natural heritage, including protection of representative and unique marine life habitats in north central California waters, for their intrinsic value.	Objective 1. Include within MPAs the following habitat types: estuaries, the intertidal zone at the Farallon Islands, and subtidal waters (including the water column and benthic habitats) around the Farallon Islands		
	Objective 2. Include and replicate to the extent possible [practicable], representatives of all marine habitats identified in the MLPA or the California MLPA Master Plan for Marine Protected Areas across a range of depths.	Y	Y
Goal 5. To ensure that north central California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.	Objective 1. Minimize negative socio-economic impacts and optimize positive socio-economic impacts for all users, to the extent possible, and if consistent with the Marine Life Protection Act and its goals and guidelines.		Y
	Objective 2. For all MPAs in the region involve interested parties to help; develop objectives, a long-term monitoring plan that includes standardized biological and socioeconomic monitoring protocols, and a strategy for MPA evaluation, and ensure that each MPA objective is linked to one or more regional objectives.	Y	Y
	Objective 3. To the extent possible, effectively use scientific guidelines in the California MLPA Master Plan for Marine Protected Areas.	Y	Y

Table 2. (Cont'd) North Central Coast MPA Regional Goals and Objectives.
Adopted by the MLPA Blue Ribbon Task Force on February 14, 2008.
Source: http://www.dfg.ca.gov/mlpa/northcentralhome.asp

Goals	Objectives	Montara SMR	Pillar Point SMCA
Goal 6. To ensure that the north central coast's MPAs are designed and managed, to the extent possible, as a component of a statewide network.	Objective 1. Develop a process to inform adaptive management that includes stakeholder involvement for regional review and evaluation of management effectiveness to determine if regional MPAs are an effective component of a statewide	Y	Y
	Objective 2. Develop a mechanism to coordinate with future MLPA regional stakeholder groups in other regions to ensure that the statewide MPA network meets the goals of the MLPA.	Y	Y

Table 3. Central Coast MPA Regional Goals and Objectives. Amended by the MLPA Blue Ribbon Task Force 11/30/2005. Source: http://www.dfg.ca.gov/mlpa/phase1.asp

Goals	Objectives	Año Nuevo SMR	Greyhound Rock SMCA	Natural Bridges SMR	Elkhorn Slough SMR	Elkhorn Slough SMP	Moro Cojo SMR	Soquel Canyon SMCA	Portuguese Ledge SMCA	Edward F. Ricketts SMCA	Lovers Pt. (Hopkins) SMR	Pacific Grove Marine Gardens SMCA	Asilomar SMR	Carmel Pinnacles SMR	Carmel Bay SMCA	Pt. Lobos SMR	Pt. Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMCA	Big Creek SMR	Piedras Blancas SMR	Piedras Blancas SMCA	Cambria SMP
Goal 1. To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems	Objective 1. Protect areas of high species diversity and maintain species diversity and abundance, consistent with natural fluctuations, of populations in representative habitats.	Y	Y	Y	Y	Y		Y	Y		Y		Y			Y		Y	Y	Y	Y	Y	Y	
	Objective 2. Protect areas with diverse habitat types in close proximity to each other.	Y		Y	Y	Y		Y	Y					Y		Y	Y	Y	Y	Y	Y	Y	Y	
	Objective 3. Protect natural size and age structure and genetic diversity of populations in representative habitats.	Y	Y	Y	Y	Y		Y	Y							Y		Y	Y	Y	Y	Y	Y	
	Objective 4. Protect natural trophic structure and food webs in representative habitats.	Y		Y	Y											Y		Y	Y		Y	Y		
	Objective 5. Protect ecosystem structure, function, integrity and ecological processes to facilitate recovery of natural communities from disturbances both natural and human induced.	Y														Y		Y	Y		Y	Y	Y	

Table 3 (Cont'd.) Central Coast MPA Regional Goals and Objectives. Amended by the MLPA Blue Ribbon Task Force 11/30/2005. Source: http://www.dfg.ca.gov/mlpa/phase1.asp

Goals	Objectives	Año Nuevo SMR	Greyhound Rock SMCA	Natural Bridges SMR	Elkhorn Slough SMR	Elkhorn Slough SMP	Moro Cojo SMR	Soquel Canyon SMCA	Portuguese Ledge SMCA	Edward F. Ricketts SMCA	Lovers Pt. (Hopkins) SMR	Pacific Grove Marine Gardens SMCA	Asilomar SMR	Carmel Pinnacles SMR	Carmel Bay SMCA	Pt. Lobos SMR	Pt. Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMCA	Big Creek SMR	Piedras Blancas SMR	Piedras Blancas SMCA	Cambria SMP
Goal 2. To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.	Objective 1. Help protect or rebuild populations of rare, threatened, endangered, depleted, or overfished species, where identified, and the habitats and ecosystem functions upon which they rely.	Y	Y		Y		Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	
	Objective 2. Protect larval sources and restore reproductive capacity of species most likely to benefit from MPAs through retention of large, mature individuals.	Y	Y	Y	Y			Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	
	Objective 3. Protect selected species and the habitats on which they depend while allowing the harvest of migratory, highly mobile, or other species where appropriate through the use of state marine conservation areas and state marine parks.					Y		Y	Y	Y					Y									Y

Table 3 (Cont'd.) Central Coast MPA Regional Goals and Objectives. Amended by the MLPA Blue Ribbon Task Force 11/30/2005. Source: http://www.dfg.ca.gov/mlpa/phase1.asp

Goals	Objectives	Año Nuevo SMR	Greyhound Rock SMCA	Natural Bridges SMR	Elkhorn Slough SMR	Elkhorn Slough SMP	Moro Cojo SMR	Soquel Canyon SMCA	Portuguese Ledge SMCA	Edward F. Ricketts SMCA	Lovers Pt. (Hopkins) SMR	Pacific Grove Marine Gardens SMCA	Asilomar SMR	Carmel Pinnacles SMR	Carmel Bay SMCA	Pt. Lobos SMR	Pt. Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMCA	Big Creek SMR	Piedras Blancas SMR	Piedras Blancas SMCA	Cambria SMP
Goal 3. To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbances, and to manage these uses in a manner consistent with protecting biodiversity.	Objective 1. Ensure some MPAs are close to population centers and research and education institutions and include areas of traditional non-consumptive recreational use and are accessible for recreational, educational, and study opportunities.	Y		Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y			Y
	Objective 2. To enhance the likelihood of scientifically valid studies, replicate appropriate MPA designations, habitats or control areas (including areas open to fishing) to the extent possible.			Y	Y		Y	Y	Y			Y		Y		Y		Y				Y		Y
	Objective 3. Develop collaborative scientific monitoring and research projects evaluating MPAs that link with fisheries management information needs, classroom science curricula, volunteer dive programs, and fishermen of all ages, and identify participants.			Y						Y	Y	Y	Y		Y	Y				Y	Y	Y		
	Objective 4. Protect or enhance recreational experience by ensuring natural size and age structure of marine populations.											Y				Y								Y

Table 3 (Cont'd.) Central Coast MPA Regional Goals and Objectives. Amended by the MLPA Blue Ribbon Task Force 11/30/2005. Source: http://www.dfg.ca.gov/mlpa/phase1.asp

Goals	Objectives	Año Nuevo SMR	Greyhound Rock SMCA	Natural Bridges SMR	Elkhorn Slough SMR	Elkhorn Slough SMP	Moro Cojo SMR	Soquel Canyon SMCA	Portuguese Ledge SMCA	Edward F. Ricketts SMCA	Lovers Pt. (Hopkins) SMR	Pacific Grove Marine Gardens SMCA	Asilomar SMR	Carmel Pinnacles SMR	Carmel Bay SMCA	Pt. Lobos SMR	Pt. Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMCA	Big Creek SMR	Piedras Blancas SMR	Piedras Blancas SMCA	Cambria SMP
Goal 4. To protect marine natural heritage, including protection of representative and unique marine life habitats in central California waters, for their intrinsic value.	Objective 1. Include within MPAs the following habitat types: estuaries, heads of submarine canyons, and pinnacles.				Y		Y	Y						Y		Y		Y				Y		
	Objective 2. Protect, and replicate to the extent possible, representatives of all marine habitats identified in the MLPA or the Master Plan Framework across a range of depths.	Y		Y				Y	Y							Y		Y			Y	Y		
Goal 5. To ensure that central California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.	Objective 1. Minimize negative socio-economic impacts and optimize positive socio-economic impacts for all users, to the extent possible, and if consistent with the Marine Life Protection Act and its goals and guidelines.							Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		Y
	Objective 2. For all MPAs in the region, develop objectives, a long-term monitoring plan that includes standardized biological and socioeconomic monitoring protocols, and a strategy for MPA evaluation, and ensure that each MPA objective is linked to one or more regional objectives.																					Y		
	Objective 3. To the extent possible, effectively use scientific guidelines in the Master Plan Framework.							Y	Y							Y	Y	Y	Y		Y		Y	

Table 3 (Cont'd.) Central Coast MPA Regional Goals and Objectives. Amended by the MLPA Blue Ribbon Task Force 11/30/2005. Source: http://www.dfg.ca.gov/mlpa/phase1.asp

Goals	Objectives	Año Nuevo SMR	Greyhound Rock SMCA	Natural Bridges SMR	Elkhorn Slough SMR	Elkhorn Slough SMP	Moro Cojo SMR	Soquel Canyon SMCA	Portuguese Ledge SMCA	Edward F. Ricketts SMCA	Lovers Pt. (Hopkins) SMR	Pacific Grove Marine Gardens SMCA	Asilomar SMR	Carmel Pinnacles SMR	Carmel Bay SMCA	Pt. Lobos SMR	Pt. Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMCA	Big Creek SMR	Piedras Blancas SMR	Piedras Blancas SMCA	Cambria SMP
Goal 6. To ensure that the central coast's MPAs are designed and managed, to the extent possible, as a component of a statewide network.	Objective 1. Develop a process for regional review and evaluation of implementation effectiveness that includes stakeholder involvement to determine if regional MPAs are an effective component of a statewide network.																							
	Objective 2. Develop a mechanism to coordinate with future MLPA regional stakeholder groups in other regions to ensure that the statewide MPA network meets the goals of the MLPA.																							

Table 4. Matrix comparing MBNMS Research Needs with Central Coast MPA Goals.

		Central Coast MPA Goals					
		Goal 1. To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems	Goal 2. To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.	Goal 3. To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbances, and to manage these uses in a manner consistent with protecting biodiversity.	Goal 4. To protect marine natural heritage, including protection of representative and unique marine life habitats in central California waters, for their intrinsic value.	Goal 5. To ensure that central California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.	Goal 6. To ensure that the central coast's MPAs are designed and managed, to the extent possible, as a component of a statewide network.
MBNMS Research Needs	RN-1: What variability is inherent in the natural ecosystem components and what changes may be the result of human influence?	Y	Y	Y	Y	N	N
	RN-2: What are the effects of extractive activities on ecosystem components?	Y	Y	Y	Y	N	N
	RN-3: How would benthic communities change in response to a further reduction in human activity?	Y	Y	Y	Y	N	N
	RN-4: What are the recovery trajectories in disturbed habitats?	Y	Y	Y	Y	N	N
	RN-5: Where along the continuum of community structure does the protected area fall compared to unprotected or heavily used areas?	Y	Y	Y	Y	N	N
	RN-6: What is the functional role of deep-sea biogenic habitats, such as deepwater corals, sponges, and chemosynthetic biological communities in regulating community structure?	Y	Y	Y	Y	N	N

Table 5. Matrix evaluation of MPAs with respect to research needs in the MBNMS.

			MBNMS Research Needs					
MPA	**Fishing Restrictions**	**Recr. GF?**	RN-1: What variability is inherent in the natural ecosystem components and what changes may be the result of human influence?	RN-2: What are the effects of extractive activities on ecosystem components?	RN-3: How would benthic communities change in response to a further reduction in human activity?	RN-4: What are the recovery trajectories in disturbed habitats?	RN-5: Where along the continuum of community structure does the protected area fall compared to unprotected or heavily used areas?	RN-6: What is the functional role of deep-sea biogenic habitats, such as deepwater corals, sponges, and chemosynthetic biological communities in regulating community structure?"
PFMC RCAs	LTMR	Y/N	(Y)	(Y)	(Y)	(Y)	(Y)	(Y)
EFH	LTMR	Y/N	Y	Y	Y	Y	Y	Y
Davidson Seamount	LTMR	N	Y	Y	N	N	Y	Y
Montara SMR	LTMR	N	Y	Y	Y	Y	Y	N
Pillar Point SMCA	LTMR	N	Y	Y	Y	Y	Y	N
Año Nuevo SMR	NTMR	N	Y	Y	Y	Y	Y	N
Greyhound Rock SMCA	LTMR	Y	Y	Y	Y	Y	Y	N
Natural Bridges SMR	NTMR	N	Y	Y	Y	Y	Y	N
Elkhorn Slough SMR	NTMR	N	Y	Y	Y	Y	Y	N
Elkhorn Slough SMP	LTMR	Y	Y	Y	Y	Y	Y	N
Moro Cojo SMR	NTMR	N	Y	Y	Y	Y	Y	N
Soquel Canyon SMCA	LTMR	N	Y	Y	Y	Y	Y	Y
Portuguese Ledge SMCA	LTMR	N	Y	Y	Y	Y	Y	Y
Edward F. Ricketts SMCA	LTMR	Y	Y	Y	Y	Y	Y	N
Lovers Pt. (Hopkins) SMR	NTMR	N	Y	Y	Y	Y	Y	N
Pacific Grove Marine Gardens SMCA	LTMR	Y	Y	Y	Y	Y	Y	N
Asilomar SMR	NTMR	N	Y	Y	Y	Y	Y	N
Carmel Pinnacles SMR	NTMR	N	Y	Y	Y	Y	Y	N
Carmel Bay SMCA	LTMR	Y	Y	Y	Y	Y	Y	N
Pt. Lobos SMR	NTMR	N	Y	Y	Y	Y	Y	N
Pt. Lobos SMCA	LTMR	N	Y	Y	Y	Y	Y	Y
Point Sur SMR	NTMR	N	Y	Y	Y	Y	Y	N
Point Sur SMCA	LTMR	N	Y	Y	Y	Y	Y	N
Big Creek SMCA	LTMR	N	Y	Y	Y	Y	Y	N
Big Creek SMR	NTMR	N	Y	Y	Y	Y	Y	Y
Piedras Blancas SMR	NTMR	N	Y	Y	Y	Y	Y	N
Piedras Blancas SMCA	LTMR	N	Y	Y	Y	Y	Y	N
Cambria SMP	LTMR	Y	Y	Y	Y	Y	Y	N