

Rockfish MPA Workshop

1998 ed. Mary Yoklavich

Habitat

Purpose

< 5%

Heritage Sites and Fishery Research

5-20%

Supplement Fishery Management

20-50%

Alternative Management Strategy

SAT Guidelines for Size and Spacing

	Minimum	Midpoint	Maximum
Alongshore Span	5 km	12.5 km	20 km
Spacing	50 km	75 km	100 km
Spacing to Span ratio	10	6	5
All MPAs to 3 nm	8.3 %	14.2%	16.7%
Ave. MPA to 2 nm	5.6%	9.5%	11.2%

Review of the Science Guidelines for California
Marine Protected Areas

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This was written in an attempt to summarize the Science Advisory Team's (SAT) guidance on MPA network design given in the Final Master Plan Framework and to describe the type of networks that would result if the mid-points of the range of options for the various design criteria were followed.

Note that the Framework contains two similar but differently worded versions of the Science Advisory Teams guidance. One is in the Executive Summary and the other is in section 3 of the Framework. For the purposes of this work I will use the version in Section 3 of the Framework. This section is reproduced in green below.

Section 3. Considerations in the Design of MPAs

*California Department of Fish and Game Master Plan Framework
August 22, 2005 Page 37*

Science Advisory Team Guidance on MPA Network Design

The MLPA calls for the use of the best readily available science, and establishes a science team as one vehicle for fostering consistency with this standard. The MLPA also requires that the MPA network and individual MPAs be of adequate size, number, type of protection, and location as to ensure that each MPA and the network as a whole meet the objectives of the MLPA. In addition, the MLPA requires that representative habitats in each bioregion be replicated to the extent possible in more than one marine reserve.

The availability of scientific information is expected to change and increase over time. As with the rest of this framework, the following guidelines should be modified if new science becomes available that indicates changes. Additionally, changes should be made based on adaptive management and lessons learned as MPAs are monitored throughout various regions of the state.

The science team provided the following guidance in meeting these standards. This guidance, which is expressed in ranges for some aspects such as size and spacing of MPAs, should be the starting point for regional discussions of alternative MPAs. Although this guidance is not prescriptive, any significant deviation from it should be consistent with both regional goals and objectives and the requirements of the MLPA. The guidelines are linked to specific objectives and not all guidelines will necessarily be achieved by each MPA. For each recommendation below, detailed references are provided in the bibliography with notation linking them to the appropriate section.

Overall MPA and network guidelines:

- The diversity of species and habitats to be protected, and the diversity of human uses of marine environments, prevents a single optimum network design in all environments.

This tells the stakeholders that no matter what they do, it will not be right.

- For an objective of protecting the diversity of species that live in different habitats and those that move among different habitats over their lifetime, every 'key' marine habitat should be represented in the MPA network.

No marine habitat, for which there is a stakeholder, can be omitted. This is the primary reason for the first bullet.

- For an objective of protecting the diversity of species that live at different depths and to accommodate the movement of individuals to and from shallow nursery or spawning grounds to adult habitats offshore, MPAs should extend from the intertidal zone to deep waters offshore.

Where deep water occurs within state waters, MPAs should extend from the shore to the edge of state waters. Nothing is said about what to do if the continental shelf extends beyond state waters.

- For an objective of protecting adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an alongshore span of 5-10 km (3-6 m or 2.5-5.4 nm) of coastline, and preferably 10-20 km (6-12.5 m or 5.4-11 nm). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish.

There are a number of confusing ideas and wordings in the above bullet:

1. The way the size bullet is worded it offers almost no guidance as to what the average size MPAs should be. Is the average alongshore extent of MPA intended to be 7.5 km (the mid-point between 5 and 10 km) 10km (which is mentioned twice), or 12.5 km (the mid-point between 5 and 20 km)? Assuming MPAs extend from the coast to the outer edge of state waters the areas of MPAs with 7.5 km (4.0 nm), 10 km (5.4 nm) and 12.5 km (6.75 nm) are 12 sq nm, 16.2 sq nm and 20.25 sq nm. I will assume that the average alongshore extent of MPAs is intended to be 6.75 nm and the average offshore distance is 3 nm giving an average MPA size of 20.25 sq nm.. Note that these assumptions are the largest that could reasonably be made from the guidance given. In particular, note that the offshore boundaries of many of the MPAs in the July 2001 Draft Proposal were squared off on their offshore edges and many others extended 1 nm or less from the shore
2. Marine birds and mammals are already fully protected.
3. To fully protect any of the important migratory fishes in California an MPA would have to be larger than the entire area of California state waters.

- For an objective of facilitating dispersal of important bottom-dwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal, MPAs should be placed within 50-100 km (31-62 m or 27-54 nm) of each other.

The MPAs that provide the core of the network should not be closer together than 27 nm or further apart than 54 nm. The mid-point between 27 and 54 nm is 40 nm. I assume that MPAs intended for purposes other than sustaining viable populations can be closer together than 27 nm or further apart than 54 nm.

- For an objective of providing analytical power for management comparisons and to buffer against catastrophic loss of an MPA, at least three to five replicate MPAs should be designed for each habitat type within a biogeographical region.

The Blue Ribbon Task Force stated that there is only one biogeographical region north of Point Conception; therefore there should be at least 2-3 replicates in the Central Region and at least 2-3 replicates north of the Central Region. Note that the Central Region is considerably less than half of the area between Point Conception and the Oregon Border

- For an objective of lessening negative impact while maintaining value, placement of MPAs should take into account local resource use and stakeholder activities.

Economic, social and recreational values need to be factored into the design; but there are no guidelines about how this is to be done.

- Placement of MPAs should take into account the adjacent terrestrial environment and associated human activities.

The use of the land adjacent to the MPA should be taken into account. Unfortunately the SAT does not say how. Is it better to put an MPA next to a city, a national forest or a nuclear power plant?

- For an objective of facilitating adaptive management of the MPA network into the future, and the use of MPAs as natural scientific laboratories, the network design should account for the need to evaluate and monitor biological changes within MPAs.

A system for evaluation of the ecological, economic and social effect of the network should be developed along with the network. It is not clear how this could be accomplished by the Stakeholders.

PERCENTAGE AREA IN THE MPA NETWORK:

I am unable to find any written recommendations in the Framework, Regional Profile or from the Science Panel for the percentage of state waters that should be placed in reserves or other MPAs. In my opinion the reason for this is that there is no consensus in the science community on what the percentage should be. Any written recommendation would undoubtedly come under intense scientific criticism.

A 30% area figure is commonly cited and was used by the CINMS science team in the MRWG process. Given their assumptions the models that gave this value are perfectly valid, the critical assumption that makes the model results bogus in the Central California Region was the specification of extremely excessive harvest rates in the area open to fishing. If there are no limitations on fishing in the open areas you probably do need AT LEAST 30% of the area in MPAs to maintain viable populations. Ten years ago the no limitation concept could have validly been suggested as an option for some California fisheries. Five years ago it would have been pretty far out and at the present time, in my opinion, it is untenable because both the Pacific Fishery Management Council and the State of California have greatly reduced harvest rates to levels that will rebuild

overfished stocks. In addition, the Pacific Council is in the process of permanently protecting extensive areas of essential fish habitat from trawling and in some cases from any bottom contact fishing gear. About 15% of the present trawl footprint will be affected.

Since the Science Advisory Team did not provide any direct guidance regarding the percentage of state waters the Stakeholders need to sort through what the Team did suggest to arrive at a percentage. To do this we need the average size of MPAs, the average spacing between MPAs, the number of replicates required and the relative protection level of the several types of MPAs.

BUILDING A MPA NETWORK FOR THE CENTRAL REGION

One way to build a network is to decide upon a network core of good-sized MPAs that is intended to provide the bulk of the network's population, diversity and ecological protection. This network should then be evaluated for what is missing. If what is missing is not large; then the network can be completed with a few additional medium, small or tiny MPAs to fill in some of the holes in the network.

Remember the SAT's first bullet! Do not expect to accomplish everything. The Central Region is only about 25% of the total area in state waters and 3 of the MPAs in the Channel Islands National Marine Sanctuary are in the same Oregonian faunal zone. In essence when the two existing medium sized reserves in the Central Region (Vandenberg and Big Creek) are added we already have 5 replicates of many Oregonian habitats and this does not include present or future MPAs from Pigeon Point to the Oregon Border.

In the July 2001 Draft MPA Network the three regions north of Point Conception utilized nested MPAs that had small or medium sized reserves entirely surrounded by larger conservation areas. All four regions utilized reserves adjacent to conservation areas as a method to enhance protection of species of concern. Both of these types of configurations result in protection over a larger, contiguous area than would the case if they were separated. In effect these types of MPAs should be considered to be a single MPA for size and spacing purposes.

The four regions in the July 2001 Draft MPA Network had considerable variation in the percentage area included in reserves, parks and conservation areas (Figure 1). The level of protection to various species groups also varied considerably between the four regions (Figure 2). For example, the South/Central region had the lowest percentage of area in reserves but it had the highest protection of groundfish. The North region had the second highest percentage of reserves but the lowest percentage of protection from recreational fishing for groundfish. The

North/Central region had very simple regulations no take in reserves and only salmon could be taken in conservation areas.

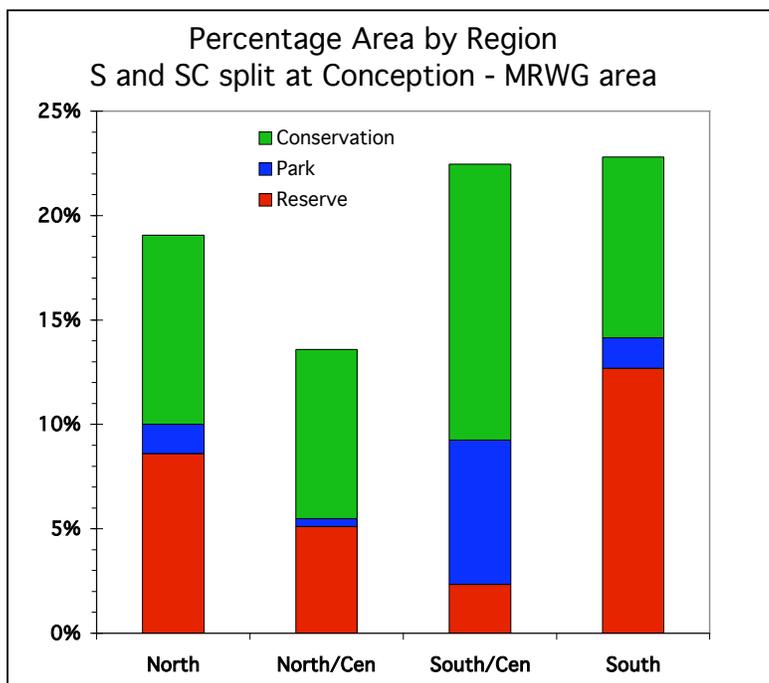


Figure 1. July 2001 Proposed MPA Network by Percentage of Area

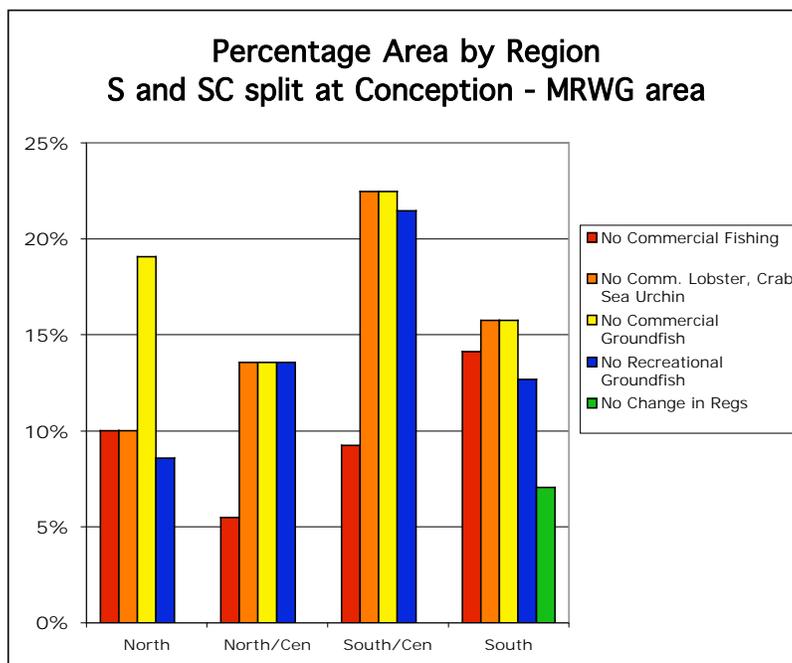


Figure 2. July 2001 Proposed MPA Network by Percentage of Area.

To summarize the protection levels that were proposed for the area of the current Central region in the July 2001 Draft MPA Network for the South/Central region, the area was trimmed to Point Conception in the South and expanded to Pigeon Point in the north to calculate the percentages (Table 1).

Table 1. Proposed protection by fishery type in the Pigeon Point to Point Conception Region in the July 2001 Draft MPA Network.

Fishery	Percent of area closed to fishing
Recreational fishing	8.3%
Recreational salmon	8.3%
Commercial fishing	8.5%
Commercial salmon	8.5%
Invertebrates	15.6%
Recreational groundfish	16.3%
Commercial groundfish	20.2%

A. Average size of individual MPAs

As mentioned above the SAT does present some indirect recommendations for the size of individual MPAs; they offer a very generalized view of the alongshore length of MPAs, and they suggest that MPAs should extend from the coast to deep offshore waters. Although the SAT bullet used the coastline as its alongshore measure, I assume that they actually meant that the alongshore dimension of an MPA is a straight line along the general angle of the local coastline, not the actual coastline length as measure in the GIS. Note that the coastline length of an MPA has little to do with the size of the MPA. For example, the data from the July 2001 Draft Proposal for the South/Central Region gives Point Lobos SMR 6.71 nm of coastline and an area of 0.83 sq nm. The proposed Point Sur SMCA had 3.98 nm of coastline and an area of 7.81 sq nm.

The SAT guidelines give an average alongshore dimension of 6.75 nm and an offshore dimension of 3 nm. These dimensions result in an average MPA size of 20.25 sq nm for core MPAs; as noted above this is a maximum estimate of the average size of MPAs recommended by the SAT.

For the purposes of this report small non-core MPAs will not be used to determine the average size of core MPAs. In my opinion, the present small or tiny reserves, such as Point Lobos (0.9 sq nm) and Hopkins (0.1 sq nm), are not large enough to be considered core MPAs. Unless these reserves are greatly enlarged or incorporated into a nested conservation area such as that proposed for Point Lobos in the July 2001 Draft MPA Network, they should just be

grandfathered into the MPA network, perhaps with minor adjustments. If grandfathered into the network it is most likely that the Science Advisory Team will consider them to be minor additions to the ecological functioning of the network rather than significant components. In other words, unless these areas are significantly altered, just add them on top of the areas and percentages discussed below. To a much lesser degree this also applies to the present Big Creek and Vandenberg Reserves. At 1.7 and 1.9 sq nm these areas are well below the minimum size presented in the Science Advisory Teams recommendations.

MPAs the size of Point Lobos and Hopkins can effectively be used for the purposes that these areas were established in the first place; i.e. to protect unique habitats and to provide accessible protected sites for scientific research.

MPAs the size of Big Creek, Vandenberg and Carmel Bay SMCA can effectively be used to provide replicates of habitat types, enhance recreation, preserve non-extractive social and economic values and also add depth to the network in areas where larger MPAs would be undesirable for social or economic reasons. MPAs of this size, when combined with replicate habitat in larger MPAs, can also be use to compare the effectiveness of different sized MPAs. A case can also be made that these three MPAs should not be altered as they have been in existence for a considerable amount of time and therefore they are the only areas in the Central Region that can presently be used to determine the effects of MPAs.

Note:

The July 2001 Proposal for MPAs had 22 MPAs in the present Central Region. Five of these were larger than 10 sq nm and only the Point Conception SMP (with about 45 of 55 sq nm actually within the Central Region) was larger than 20.25 sq nm. However, four of the reserves were nested inside of or adjacent to conservation areas. The average size of these four combination areas plus the portion of the Point Conception SMP that is in the present Central Region is 23.1 sq nm. This is very similar to the 20.25 sq nm figure used in this report.

B. Number of MPAs: Distance between MPAs and replicates

The Science Advisory Teams recommendation for the distance between MPAs for larval dispersal is straightforward. They suggest a range of 50-100 km (27-54 nm). The straight-line distances from Pigeon Point to Point Sur to Point Arguello to Point Conception total 196 nm. The coastline length given in Table 2 of the Regional Profile is 371 nm.

Assuming that the Science Advisory Team was referring to the straight-line distance between MPAs, the mid-point in spacing between MPAs would be 40 nm. It is possible to design a network that achieves 40 nm spacing with only 4

MPAs; however, with 4 MPAs the placement of the reserves is more dependent upon the spacing than the habitat. Therefore spacing requirements realistically result in a minimum network core of 5 MPAs.

Using 5 MPAs the spacing determines the general area where the MPAs will be located. Starting in the north the first would be around Ano Nuevo, the second would be in the Monterey or Carmel Submarine Canyons, the third somewhere above Cape San Martin, the fourth near Diablo Canyon and the fifth above or below Point Arguello. Increasing the number to 6-8 MPAs greatly increases the range of potential locations.

The core of the network will be based on the larger MPAs and spacing should primarily be evaluated as the distance between the larger core MPAs. Tiny and small MPAs such as Hopkins and Point Lobos will essentially be ignored for spacing purposes as they are not large enough to be ecologically effective.

The Blue Ribbon Task Force stated that there is only one biogeographical region north of Point Conception; therefore there should be 2-3 replicates of each habitat type in the Central Region. Note that it may not be desirable, or possible, to achieve 2-3 replicates of habitat types (i.e. river mouths or estuarine habitats) or oceanographic settings (i.e. retention areas) that are poorly represented in the Central Region. Replicates may, or may not, be a determinate in the minimum number of MPAs as a minimum of 5 MPAs are required by the above spacing requirement. The problem will be to include replicates of the common habitat types without increasing the number or increasing the size of individual core MPAs.

D. Relative protection level of different types of MPAs

The SAT provides no guidance regarding the relative ecological value of the protection provided by the several types of MPAs. Therefore I have listed some general guidelines based on my experience, modeling and readings. It should be noted that protection of exploited species with MPAs will, unless fishing effort is proportionately reduced, result in increased mortality rates outside of the MPAs. Unless other management measures are taken the increase in population levels inside the MPA network will be at the expense of a decrease in population levels outside of the network.

1. Reserves

a. Resident species with limited mobility (i.e. nearshore groundfish and many invertebrates)

Reserves provide nearly complete protection to individuals within the reserve.

Reserves provide little protection to populations that are regulated with quotas because the same volume of fish will be removed with or without the reserve. Reserves may provide protection to species regulated by quotas if the reserve network is large enough to prevent the annual quota from being harvested outside. However, this would be very poor economics.

b. Migratory species with high mobility (i.e. sardine, hake, tunas and squids)

Reserves provide little protection to migratory species at either the individual or population level. The exception to this is that migratory, benthic spawning species that are harvested on limited nearshore spawning grounds could be protected by placing part of their known spawning grounds in reserves (i.e. squid and herring).

Reserves may provide protection to species regulated by quotas if the reserve network is large enough to prevent the annual quota from being harvested outside (i.e. hake, sardine and Pacific mackerel).

2. Marine Parks and Conservation Areas

There is a wide range of protective measures that can be applied in marine parks and conservation areas and a fairly large range was used the July 2001 Draft MPA Network.

- a. The most restrictive was the very large (55 sq nm) Point Conception Marine Park that allowed only recreational hook and line fishing from shore for finfish.
- b. Conservation areas used in the North/Central Region prohibited all fishing except for recreational and commercial fishing for salmon. This is a targeted and highly restrictive type of conservation area.
- c. Several of the conservation areas used in the South/Central Region prohibited all commercial and recreational fishing except for pelagic fishes (salmon, coastal pelagic species and highly migratory species). This is also a targeted and quite restrictive type of conservation area.
- d. The Naples Conservation Area in the South Region had no commercial or recreational fishing permitted, except for commercial lobster fishing and recreational fishing for lobster and finfish.
- e. Conservation areas in the North Region were designed for a different purpose. These conservation areas were intended to maintain higher densities of groundfish in the vicinity of major ports while not affecting other fisheries. Only commercial fishing for groundfish was prohibited in these conservation areas.
- f. The existing Carmel Bay SMP was retained with the same restrictions prohibiting commercial fishing and allowing recreational fishing.

- g. The large Santa Monica Bay SMCA was created with no additional protective measures. It was considered to already have enough fishery limitations to qualify as a SMCA.

The first three types of MPAs listed above would provide 95-99% of the protection to invertebrates and benthic fishes as would the same area in a marine reserve. The second three, which prohibit commercial fishing for groundfish but allow recreational fishing for these species, would provide about 40-60% of the protection to groundfish as would the same area in a marine reserve. The last type of SMCA provided no new protection from fishing; however, its designation as a SMCA would tend to provide protection from other forms of human activities that could degrade the environment.

Table 2. Hypothetical Single Size MPA Network Cores (Average Area is for core MPAs only: 196-TL refers to subtraction of total length of MPAs from the total along shore length of 196 nm).

Network	#	Length nm	Width nm	Ave. sq nm	Total sq nm	Total length	196-TL nm	Mean spacing	% area
A4	4	6.75	3	20.3	81	27	169	42	9.4%
B4	4	5.4	3	16.2	64.8	21.6	174	44	7.5%
A5	5	6.75	3	20.3	101	33.8	162	32	11.7%
A6	6	6.75	3	20.3	121.5	40.5	156	26	14.0%
A8	8	6.75	3	20.3	162	54	142	18	18.7%
A8(2)	8	6.75	2	13.5	108	54	142	18	12.5%
B5	5	3	5.4	16.2	81	27	169	34	9.4%

Table 3. Hypothetical Mixed Size MPA Network Cores (Average Area is for core MPAs only: 196-TL refers to subtraction of total length of MPAs from the total along shore length of 196 nm). Network C6 is shown in Figure 3.

Network	#	Length nm	Width nm	Ave. sq nm	Total sq nm	Total length	196-TL nm	Mean spacing	% area
C4	2	16.1	3	25.7	102.6	38.2	158	39	11.8%
	2	3	1						
C5	2	12.4	3	20.3	101.4	33.8	162	32	11.7%
	3	3	3						
C5+	2	12.4	3	20.3	106.7	33.8	162	32	12.7%
	3	3	3						

+ Elkhorn+Hopkins+Pacific Grove+Carmel Bay+Point Lobos+Big Creek
+ Vandenberg (8.9 sq nm)

C6	2	10.2	3	16.2	97.2	32.4	164	27	11.2%
	4	3	3						
C6+	2	10.2	3	16.2	106.1	32.4	164	27	12.2%
	4	3	3						
	+ Elkhorn+Hopkins+Pacific Grove+Carmel Bay+Point Lobos (5.3 sq nm)								

MPAs with 7.5 km (4.0 nm), 10 km (5.4 nm) and 12.5 km (6.75 nm) are 12 sq nm, 16.2 sq nm and 20.25 sq nm if run 3 nm offshore. Total area in the Central Region is 866.3 sq nm.

A more complicated type of Central Region MPA network, at the same general size as the above networks, is described in Table 1 and Figures 4abc. This network has 10 areas in MPAs with several nested or adjacent MPAs of different types. It has 10 reserves, 3 type 1 conservation areas, 3 type 2 conservation areas and 1 type 3 conservation area. The total size of the network is about 102 sq nm (11.8%) and the effective protection of the network is equal to about 85 sq nm of reserve (9.8%). See Appendix for explanation of conservation area types and effective protection percentages.

Table 4. Hypothetical MPA Network with Reserves and three types of Conservation Areas (see Appendix for description of SMCA Types 1-3)

Name of MPA	Reserve sq nm	SMCA Type 1 sq nm	SMCA Type 2 sq nm	SMCA Type 3 sq nm	TOTAL sq nm	
Ano Nuevo 2001	7.28				7.28	
Santa Cruz Canyon	2	16	10		12.00	
Pacific Grove	1		11		12.00	
Carmel Bay-Point Lobos	2			2	4.00	
Julia Pfeiffer	2	14			16.00	
Big Creek 2001	1.71				1.71	
Cambria 2001	5.18				5.18	
Diablo Canyon- Vandenberg 2001 Rev.	5	11	7		12.00	
TOTAL	31.17	41	28	2	102.17	11.8%
Percentage	3.6%	4.7%	3.2%	0.2%		
Percentage Protection	100%	95%	50%	50%		
ADJUSTED TOTAL	31.17	38.95	14	1	85.12	9.8%

(2001 refers MPA areas proposed in the July 2001 Draft or it's revision).

DISCUSSION

It is not intended that any of the networks presented here should form the basis of any proposal submitted to the present MLPA process. The example networks include a moderate percentage of state waters (7.5% to 18.7%), and the majority of the networks are in the range of 11-12%. This range conforms to the mid-points of the size and spacing guidelines presented by the SAT. The presentation of a number of networks with a common 11-12% percent area of state waters is intended to demonstrate the wide range of alternatives that occurs even when the size of the network remains constant.

Many of the described networks provide a network core that achieves the protection to populations, ecological pathways and diversity that is recommended by the SAT. What is not presented with these networks is their relative success in achieving replicate MPAs for the many habitat types and oceanographic settings. In addition there is no evaluation of their relative success in achieving the social, spiritual, economic and non-extractive recreation values that are mentioned in the recently adopted "Provisional Regional Goals and Objectives Package, Draft Master Plan Framework and Regional Profile.

The use of nested or adjacent MPAs of different types is a particularly useful configuration to achieve both the size and spacing suggested by the SAT and the goals and objectives agreed upon by the Stakeholders. The use of marine parks or conservation areas that prohibit most or all commercial fishing while allowing recreational fishing is one of the few management alternatives that can effectively be used to prevent further serial depletion, to effectively assist in rebuilding of the near port areas that were depleted decades ago and at the same time achieve the stated goals and objectives.

APPENDIX

The material below is a description of the role of the different MPA types as gleaned from the discussions of the Master Science Team meetings in 2000-01.

STATE MARINE RESERVES (SMR): The intention is to have no take or disturbance of plants, animals, substrate or water quality.

Specifically:

1. No scientific collections by scientists. Research should be limited to no take ecological studies and very limited take, under a special waiver, for evaluation of reserves.
2. No direct input of pollutants.
3. Scientific collections allowed in reserves designed for scientific study (i.e. Hopkins Marine Life Refuge).
4. Limited or regulated public access where necessary to protect the habitat. This primarily applied to intertidal areas in small reserves.

STATE MARINE PARKS (SMP): The intention is to provide high quality non-commercial usage of near pristine habitat. The principal feature of parks is that recreational take of some species is allowed.

Note that the present policy seems to completely ignore SMPs. For example the July 2001 Draft MPA Network considered the existing Carmel Bay Park to be a State Marine Park. Its original protection level clearly described it as a Park; however, it is now called a conservation area.

The "Ricketts area" along Cannery Row is a better candidate for a park than a reserve. This is due to the very large public use of the area; classification as a park, with no direct recreational take of animals or plants, avoids the limited or regulated access concepts in the designation of the same area as a reserve.

STATE MARINE CONSERVATION AREAS (SCMA): The intention is to provide additional protection to species that are susceptible to overfishing; while allowing the continued harvest of mobile and migratory species that are not amenable to management by MPAs.

Note that the federal use of conservation areas has been to provide protection to groundfish and groundfish habitat. Federal MPAs under the Pacific Fishery Management Council have been primarily temporary groundfish conservation areas designed to assist in rebuilding depressed groundfish stocks. These conservation areas are very large (i.e. the Cow Cod closure in Southern California is about 3,600 sq. nm). The recently adopted, but not yet enacted,

Essential Fish Habitat area closures, which comprise about 15% of the recent trawl footprint, are intended to be permanent no trawling (most areas) or no bottom contact areas (in biogenic areas). The network of these areas was designed to protect sensitive habitat from trawling and/or other destructive fishing gear.

Below are possible types of conservation areas which could be used to achieve a MPA network which balances ecological protection and minimizes recreational, social and economic negative impacts. Type names also refer to names used in the attached figures (4abc). The degree of protection refers to the likely level of protection to resident species in comparison to the same area in a reserve. The expected level of protection to non-exploited species would be expected to be no less than that provided to exploited species.

I am not aware of any data that could be used to accurately determine the level of protection given by the types of SMCAs listed below. Nevertheless, the values given are reasonable and this type of evaluation must be made to determine the relative value of different degrees of protection provided by different types of MPAs.

SMCA Type 1

No commercial or recreational take of groundfish or invertebrates except squid and prohibition of fishing gear with bottom contact. Commercial and recreational Fishing allowed for species managed by the federal Salmon, Coastal Pelagic Species and Highly Migratory Species Management Plans.

Degree of protection to groundfish	- 95-99%
Degree of protection to invertebrates	- 95-99%

Possible modifications: Allow bottom contact trap fishing for prawns, crabs and/or lobster and/or diving for sea urchins.

Degree of protection to groundfish	- 85-99%
Degree of protection to prohibited invertebrates.	- 85-99%

SMCA Type 2

No commercial fishing except for species managed by the federal Salmon, Coastal Pelagic Species and Highly Migratory Species Management Plans. Recreational fishing for finfish allowed.

Degree of protection to groundfish	- 40-60%
Degree of protection to invertebrates	- 85-95%

Possible modifications: Allow commercial trap and recreational fishing for crabs, prawns and lobster and/or diving for sea urchins. Allow recreational fishing for the above invertebrates plus some intertidal or sub-tidal invertebrates. Allow commercial harvest of giant kelp. The degree of protection would have a considerable variation for different exploited invertebrates (i.e. prawns vs estuarine clams).

Degree of protection to groundfish	- 40-60%
Degree of protection to crabs ect	- 40-60%
Degree of protection to prohibited invertebrates	- 80-95%
Degree of protection to other harvested invertebrates	- 0-60%
Degree of protection to other species If kelp harvest is allowed	- reduce by an additional 5-10%

SMCA Type 3

No commercial fishing; recreational fishing allowed. Same regulations as the present Carmel Bay SMCA.

Degree of protection to species taken by recreational fishing	- 40-60%
Degree of protection to species not taken by recreational fishing	- 85-95%

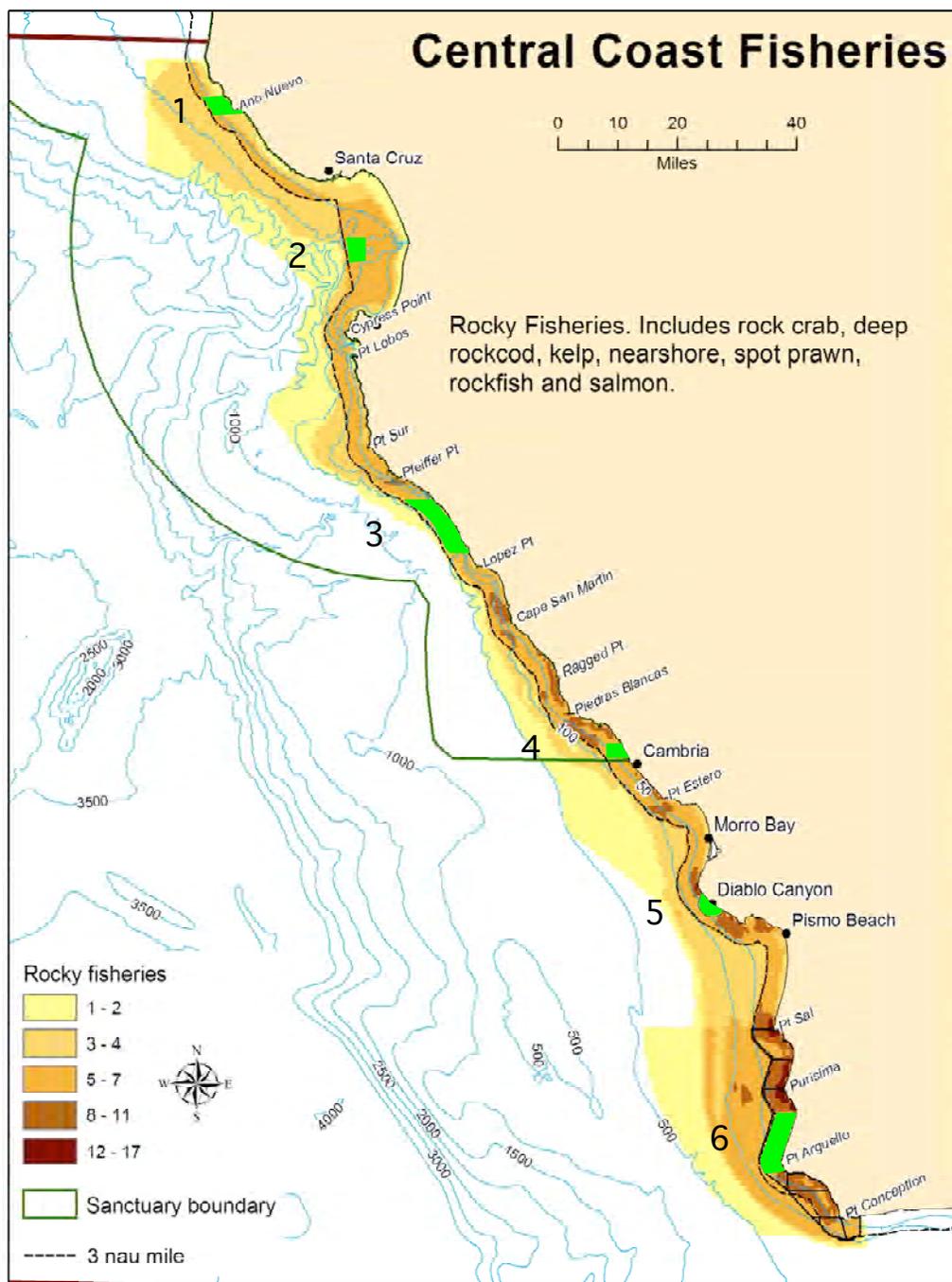
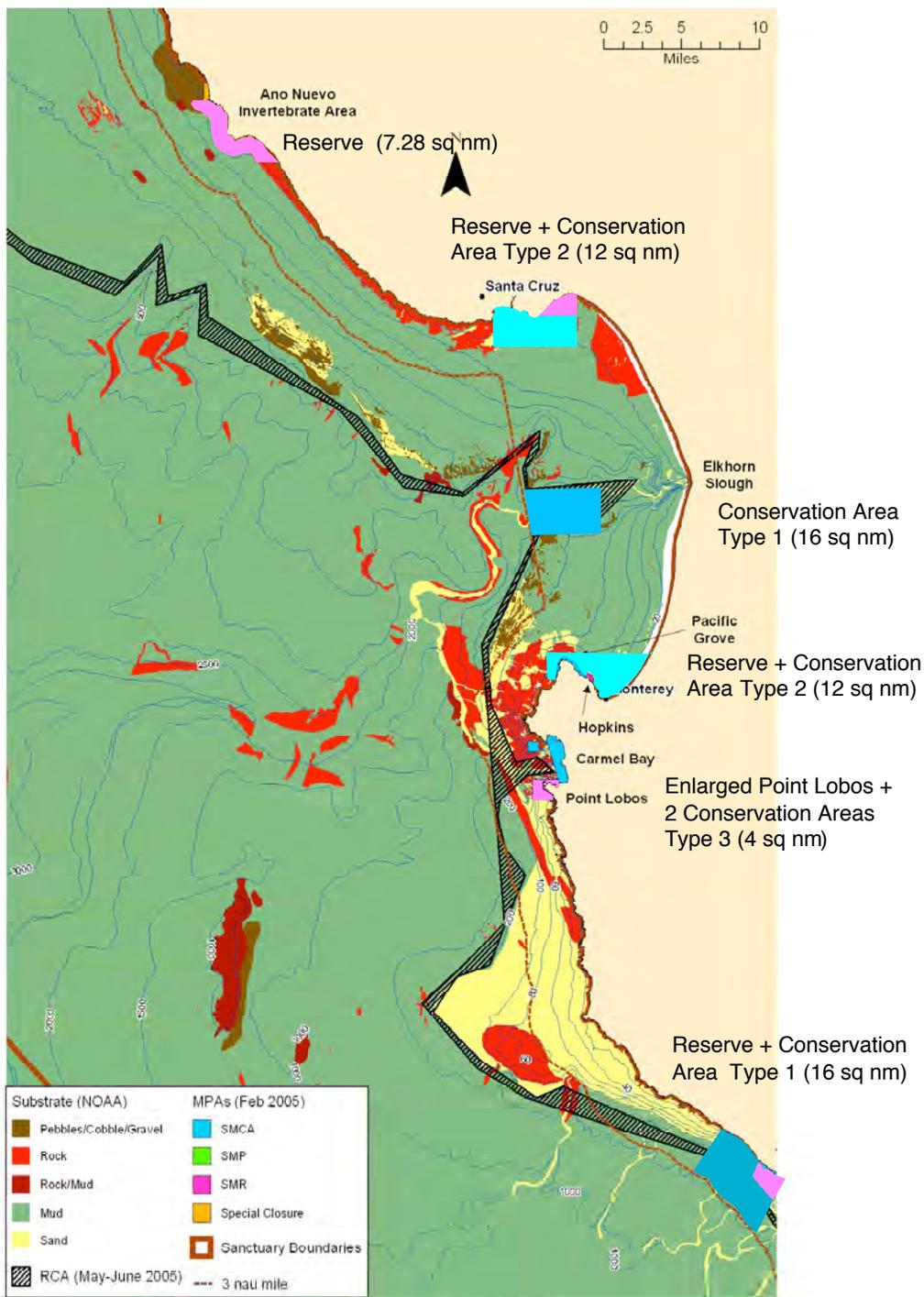


Figure 3. MPA network C6 (Table 3: 11.2%)

Central CA Coast - North

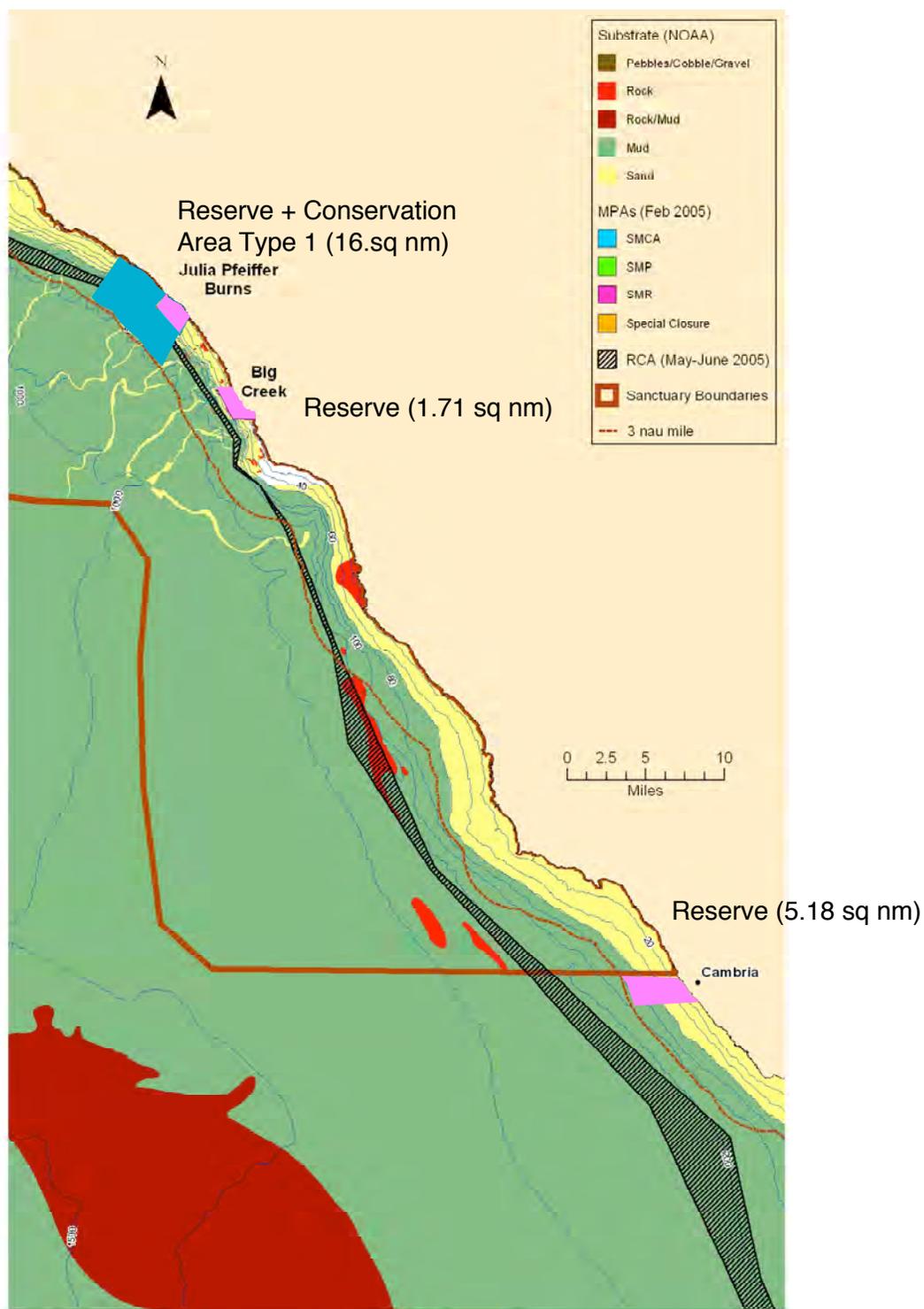


Data: Pacific Coast Groundfish Essential Fish Habitat Project, NOAA Biogeography Program, CA DFG. Projection: CA Albers Equal Area Conic, North American Datum of 1983. Bathymetry in meters. Scale: 1:350,000. Design: M. Robinson, 2005.

Figure 4a. MPA Network with reserves and three types of conservation areas (Table 4: Total area 102 sq nm; effective area 85 sq nm).

Figure 4b. (continued)

Central CA Coast - Middle



Data: Pacific Coast Groundfish Essential Fish Habitat Project, NOAA Biogeography Program, CA DFG.
 Projection: CA Albers Equal Area Conic, North American Datum of 1983, Bathymetry in meters. Scale: 1:350,000. Design: M.Robinson, 2005.

Central CA Coast - South

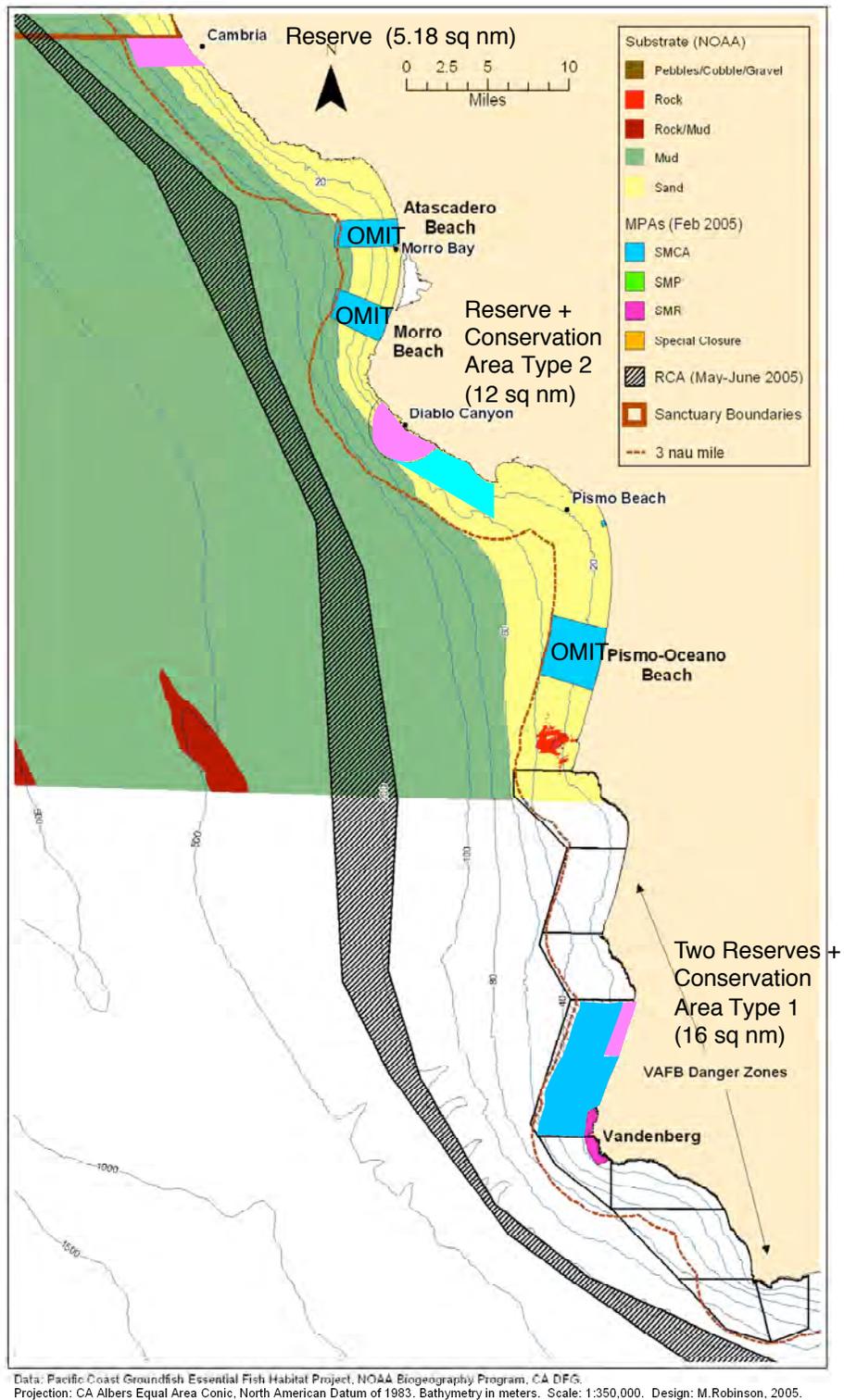


Figure 4c. (continued)