# California MLPA Master Plan Science Advisory Team
# Evaluation of North Coast Round 1 External Proposed MPA Arrays: Habitat Representation, Habitat Replication, MPA Size, and MPA Spacing Analyses
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The Marine Life Protection Act (MLPA) Master Plan Science Advisory Team (SAT) evaluates marine protected area (MPA) proposals in relation to the goals of the MLPA. SAT evaluations of habitat representation and habitat replication primarily address goals 1 and 4 of the MLPA, which focus on ecosystems and habitats. SAT evaluations of MPA size and spacing between MPAs primarily address goals 2 and 6 of the MLPA, which focus on marine life populations and connectivity. The discussion and associated figures and tables in this document compare the eight external proposed MPA arrays (External A – External H or ExA – ExH) developed during round 1 of the north coast MPA planning process and the 'no change' alternative (Proposal 0, labeled as "P0" in graphs and tables) for each of the four evaluations listed above.

Methods for these analyses, including explanations of levels of protection (LOPs), are described in an associated document: *Draft Methods Used to Evaluate Marine Protected Area Proposals in the MLPA North Coast Study Region* (SAT Evaluation Methods Document).

Most external proposed MPA arrays indicated that tribal uses would be allowed in many MPAs, including otherwise "no-take" areas, but did not specify the types of uses. The SAT did not have sufficient information in round 1 to integrate tribal uses in evaluations (i.e., proposed tribal uses were not considered in assigning levels of protection), but this will likely change in round 2. For the sake of consistency, state marine conservation areas (SMCAs) in ExC that proposed tribal uses only were evaluated as state marine reserves (SMRs). In addition, for the purpose of evaluation, mobile MPAs in ExA were treated as static, and stewardship zones were not evaluated.

## Habitat Representation

Habitat abundance in the north coast study region varies by habitat type and bioregion (Figure 1.1a). The most abundant open coast habitat in the study region is soft bottom (30-100 meters [m]), which is also the most abundant habitat in each of the two bioregions where it represents over 200 square miles (sq mi) in each. Several rock and rock-associated habitats, including kelp, rocky shores, and offshore rocks are more abundant in the southern bioregion, whereas soft bottom habitats including beaches and 0-30m soft bottom are more abundant in the northern bioregion. Deep rock (100-3000m) is rare in the study region, found only between Cape Mendocino and Shelter Cove, with just 0.51 square miles (sq mi) available in the northern bioregion and 0.57 sq mi in the southern bioregion.

Estuarine habitats, including total estuary area, tidal flats, and coastal marsh are much more abundant in the northern bioregion (Figure 1.1b). Total estuary available habitat in the northern bioregion is 42.44 sq mi compared to a total of 1.05 sq mi in the southern bioregion. In particular, approximately two-thirds of the available estuarine habitat in the northern bioregion is found within Humboldt Bay (as indicated in Figure 1.1b). Humboldt Bay encompasses an area of 27.44 square miles (sq mi) which is over six times greater than the next largest estuary in the study region, the Eel River estuary (4.24 sq mi). The other large estuaries (> 1.0 sq mi) in the study region are also all located in the northern bioregion (Lake Earl, Big Lagoon, Klamath River and Smith River), whereas the largest estuary in the southern bioregion is the

Big River estuary (0.35 sq mi). In addition, most of the estuaries found in the southern bioregion are characterized by narrow channels and surrounded by steep sides, limiting the availability of coastal marsh, tidal flats, and eelgrass habitat.

The availability of eelgrass is much higher in the northern bioregion due to the large, dense eelgrass beds found in Humboldt Bay. Eelgrass is not comprehensively mapped across the study region, and high resolution mapping appropriate for assessing area is only available for Humboldt Bay (labeled as “mapped eelgrass” in below figures and tables). MLPA Initiative staff has also confirmed eelgrass presence/absence for all major estuaries in the study region which allows the SAT to assess the proportion of known eelgrass locations protected (labeled as “all eelgrass locations” in figures and tables).

An overall summary of round 1 external MPA arrays by designation type and by level of protection can be found in Figure 1.2. In recognition of evolving policy guidance regarding tribal uses in the MPA planning process and limited information about the nature of tribal uses, the SAT did not consider proposed tribal uses in round 1 evaluations. For the purpose of this analysis, MPAs were assigned levels of protection based on proposed non-tribal consumptive uses *only*. Additional guidance from the MLPA Blue Ribbon Task Force may alter the SAT’s treatment of tribal uses in future rounds of proposal evaluations.

Key points from Figure 1.2 include:

- ExD and ExE encompass the largest proportion of the study region at or above moderate-high protection
- ExC, ExD and ExE all encompass just under 10% of the study region at or above high protection
- ExB, ExF, ExG and ExH encompass a similar amount of the study region at moderate-high and very high protection, and a lower proportion than ExC, ExD and ExE
- ExA includes a large proportion of the study region in MPAs that fall below moderate-high protection

Key points from habitat-specific analyses (figures 2.1 – 2.3) include:

- ExC, ExD and ExE include a larger proportion of rocky habitats at or above moderate-high protection as compared to other arrays.
- ExC, ExD and ExE include a larger proportion of most soft bottom habitats at or above moderate-high protection as compared to other arrays.
- ExB, ExF, ExG and ExH include a similar proportion of nearly all rocky and soft bottom habitats (except for rock 30-100m and rock 100-300m) at or above moderate-high protection. These four arrays protect about half of that habitat protected by ExC, ExD and ExE
- ExA includes the highest proportion of each rocky habitat (except for deep rock 100-3000m) and a similar proportion of soft bottom habitats as ExD and ExC, but most of the area is in low protection MPAs.

- Deep rock (100-3000m) is represented in SMRs for most arrays including about 25% or greater of the available habitat, with the exception of ExA
- All proposed external MPA arrays include approximately the same amount of estuarine habitats at or above moderate-high protection, with a few exceptions:
  - ExA and ExE include more mapped eelgrass compared to the other arrays
  - ExC, ExD and ExE include more eelgrass locations throughout the study region, and ExC includes more eelgrass locations throughout the study region at very high protection
  - ExD includes more shoreline length of tidal flats in MPAs as compared to other arrays
- Ranking of proposals by average representation at or above moderate-high protection across all habitats:
  - ExD > ExE > ExC > [ExF & ExG] > [ExB & ExH] > ExA

Key points from habitat representation overview analyses (figures 2.4 – 2.6) include:

- ExC, ExD, and ExE represent the largest proportion of all rocky habitats at very high, high, and moderate-high protection.
- Representation of most soft bottom habitats at very high protection is similar across arrays with the exception of soft 30-100m and soft 100-3000m, for which ExC, ExD and ExE represent a larger proportion than other arrays
- ExD includes the largest proportion of all soft bottom habitats at moderate-high protection, followed by ExE and ExC.
- Representation of estuarine habitats at or above moderate-high protection is similar across all arrays with a few exceptions:
  - ExA and ExE include the largest proportion of mapped eelgrass at or above moderate-high protection.
  - ExC, ExD and ExE include more eelgrass locations at or above moderate-high protection.
  - ExD includes the largest proportion of tidal flats at very high, high, and moderate-high protection.

## Habitat Replication

Replication of habitats within three to five SMRs in each biogeographical region (Point Conception to the Oregon border) is a guideline within the master plan for MPAs. Additionally, for within-habitat ecosystem representation, monitoring and evaluation opportunities, the SAT has recommended that habitats are replicated in at least one MPA in each of the two bioregions of the north coast study region. In order to be counted in the replication analysis the MPA must meet the minimum size guideline (9 sq mi), and a given habitat within the MPA must be present in a sufficient amount to encompass 90% of associated biodiversity (see

Chapter 5: Habitat Replication Analyses in the SAT Evaluation Methods Document for further details.).

The results of the habitat replication analysis are displayed in figures 3.1 to 3.4. In figures 3.1 and 3.2, the number of MPAs that contain a sufficient amount of each habitat to count as a replicate is shown for each MPA proposal at very high (Figure 3.1a), high (Figure 3.1b), and moderate-high protection levels (Figure 3.1c). Error bars in figures 3.1 and 3.2 indicate the potential change in replication if MPAs are split at the bioregion boundary. In ExD, splitting MPAs at the bioregion boundary would increase replication for some habitats and decrease replication for others, while in ExE, splitting MPAs at the bioregion boundary would only increase replication for some habitats. For all other arrays, MPAs were not split at the bioregion boundary because the MPA area was not sufficient to meet the size guidelines (9 square mines) on *both* sides of the bioregion boundary. Figure 3.3 contains similar information to 3.1 and 3.2, but is conducted only for estuarine habitats. Grey bars in figures 3.1 – 3.3 indicate the number of replicates elsewhere in the biogeographic region. Figure 3.4 shows, for each proposal, the number of bioregions where a habitat replicate is proposed in an MPA. This analysis is conducted at the three highest levels of protection. Parentheses indicate the number of bioregions with replicates if MPAs are split at the bioregion boundary. Grey boxes denote habitats for which a proposal does not have a replicate in all of the possible bioregions.

Key points from the habitat replication analyses (figures 3.1 – 3.3) include:

- For most habitats, 3-5 replicates already exist elsewhere in the biogeographic region (north central and central coast study regions)
- All arrays include 1-3 replicates of most habitats
- On average, ExC, ExD and ExE provide the largest number of replicates of open coast habitats at very high, high, and moderate-high protection
- All arrays include 2-3 replicates of estuary, coastal marsh, and eelgrass locations.All arrays include 1 replicate of mapped eelgrass in Humboldt Bay
- All arrays include at least 1 location with eelgrass outside of Humboldt Bay (for a total of 2 eelgrass locations), with the exception of ExC which includes a total of 3 eelgrass locations at or above moderate-high protection
- Most MPAs proposed in the northern bioregion do not replicate a large number of habitats. For example, proposed MPAs in the Pyramid Point vicinity replicate mostly beaches, rocky shores, and shallow sand habitats (soft 0-30m proxy). Similarly, proposed MPAs in the Reading Rock vicinity replicate mostly beaches, shallow sand (soft 0-30m proxy, soft 30-100m), and in ExC, ExD and ExE, rock 30-100m.
- MPAs that capture the greatest number of habitat replicates in the southern bioregion include proposed MPAs in the Punta Gorda and Ten Mile River vicinities. Proposed MPAs in the Point Viscaino/Usal vicinity also replicate a number of habitats.
- Ranking of arrays for replication across all habitats at moderate-high protection:
  - ExD > ExE > ExC > [ExB, ExF & ExG] > ExH > ExA

Key points from the analyses of habitat replication by bioregion (figure 3.4) include:

- Existing MPAs located in the northern half of the north central coast study region contribute to replication of all habitats except rock 100-3000m, soft 0-30m, soft 100-3000m, and mapped eelgrass. Replicates in existing NCCSR MPAs are counted toward replication in the southern bioregion of the north coast study region, meaning that arrays can achieve replication in both bioregions for many habitats by replicating those habitats in the northern bioregion only.
- All arrays except ExA replicate rocky shores, offshore rocks, and rock 30-100m in both bioregions at very high protection.
- None of the arrays replicate rock 0-30m north of the Punta Gorda area, however this replicate falls into the northern bioregion in ExB, ExF, ExG, and ExH, complimenting the existing replicates of this habitat in the NCCSR.
- Splitting MPAs at the bioregion boundary yields replicates of rock 100-3000m in both bioregions for ExD and ExE, however this deep rocky habitat is only available in one location, thus this increase in bioregional replication does not indicate protection across broader environmental gradients than the other arrays.
- All arrays except ExA replicate beaches and soft 30-100m in both bioregions at very high protection. For beaches ExD and ExE achieve replication in both bioregions at very high protection only when MPAs are split at the bioregion boundary.
- Only ExC, ExD and ExE replicate soft 0-30m in both bioregions at very high protection
- All arrays replicate beaches, soft 0-30m and soft 30-100m in both bioregions at moderate-high protection
- Kelp and soft 100-3000m are replicated in only one bioregion for most arrays at or above moderate-high protection
  - None of the proposed external MPA arrays replicated kelp in the northern bioregion. The amount of kelp habitat in the northern bioregion is not sufficient to count as a replicate except in the vicinity from approximately Castle Rock to Crescent City harbor.
  - None of the proposed external MPA arrays replicated soft 100-3000m in the northern bioregion. Arrays did not contain MPAs in the one location (near Point Saint George) where this habitat exists in sufficient quantities to count as a replicate. .
- All estuarine habitats are replicated at very high protection in all possible bioregions for all arrays.

## MPA Size

MPA size guidelines were developed to provide for the persistence of important bottom-dwelling fish and invertebrate groups within MPAs (see Chapter 6: MPA Size in the SAT Evaluation Methods Document for further details). To accommodate adult movements and life history needs for a range of species, science guidelines in the *California Marine Life Protection Act Master Plan for Marine Protected Areas* state that MPAs should have a minimum

alongshore span of 3-6 statute miles (preferably 6-12.5 statute miles) and should extend offshore to deep waters (note that state waters generally extend offshore to 3 nautical miles). The SAT combined and simplified these two guidelines to recommend that an individual MPA or MPA cluster should have a minimum area of 9-18 square statute miles (preferably 18-36 square statute miles).

The size analysis considers the number of MPA “clusters” (adjacent MPAs at or above a given LOP) that meet the minimum and preferred size guidelines at very high, high, and moderate-high LOP. An MPA cluster may consist of a single MPA, or several contiguous MPAs. Estuarine MPAs are not included in the size analysis because the sizes of estuaries vary and their boundaries are fixed.

Figure 4.1 displays results of the MPA size analysis. Each proposal is displayed on a separate line of the figures and each circle indicates the size of an MPA "cluster", with larger MPA clusters further to the right and smaller MPA clusters further to the left. The pink shaded area to the far left of a figure indicates MPA clusters that fall below the minimum MPA size recommended by the SAT (9 square statute miles). The yellow shaded area in the middle of the figure indicates MPA clusters that are bigger than the minimum size guideline, but smaller than the preferred size recommended by the SAT (18 square statute miles). The blue shaded area to the right of the figure indicates MPA clusters that fall within the preferred size range recommended by the SAT (18 – 36 square statute miles). MPA clusters larger than 36 square statute miles are considered as preferred size MPAs. These results also are tabulated on the right hand side of the figure.

Key points from the size analyses (Figure 4.1) include:

- ExD includes the largest number of MPA clusters that meet the size guidelines and the largest number of MPA clusters in the preferred size range at very high protection (4), followed by ExC and ExE, which each have 3 preferred size clusters.
- ExD includes the largest number of MPA clusters in the preferred size range at moderate-high protection (6), followed by ExE with 5 preferred size clusters.
- ExA includes fewest MPA clusters that meet the size guidelines (i.e. within the minimum or preferred size ranges) at high (1) and moderate-high protection (3). At very high protection ExA includes 1 MPA cluster within the minimum size range.
- At very high protection, all arrays except ExA include 2-4 MPA clusters in the preferred size range, all arrays except ExD include 1 MPA cluster in the minimum size range, and all arrays include 1-2 MPA clusters below the minimum size range
- At high protection, all arrays except ExA include 2-4 MPA clusters in the preferred size range, all arrays include 1 MPA cluster in the minimum size range, and all arrays except ExD include 1-2 MPA clusters below the minimum size range
- At moderate-high protection, all arrays except ExA include 3-6 MPA clusters in the preferred size range, all arrays include 2-3 MPA clusters in the minimum size range, and all arrays include 1 or fewer MPA clusters below the minimum size
- Ranking of arrays for median cluster size at moderate-high protection:

- ExD > ExE > ExC > [ExB, ExF, ExG & ExH] > ExA

## MPA Spacing

MPA spacing guidelines were developed to provide for the dispersal of larvae for a range of important bottom-dwelling fish and invertebrate groups between MPAs and to promote connectivity in the network. Further details on these methods are available in Chapter 7: MPA Spacing of the SAT Evaluation Methods Document. To facilitate dispersal and connectivity, spacing guidelines along the mainland recommend that habitats be replicated in MPAs placed at a maximum of 31-62 statute miles from each other. Since marine populations are generally habitat specific, the spacing evaluation is conducted for each habitat. To be included in the spacing analysis, habitat must be protected in sufficient quantity to count as a replicate, which encompasses the amount of habitat needed to include 90% of the associated species (see habitat replication, above). MPAs or MPA clusters also must meet the minimum size guidelines (9 square statute miles) to count as a replicate in the spacing analysis.

Spacing analyses include 1) the maximum distance (gap) between MPA clusters that include a replicate of each habitat (figures 5.1-5.2) and 2) the number of spacing gaps that exceed SAT spacing guidelines (> 62 square statute miles) for a given habitat (Figure 5.3 a-h). Both analyses are conducted for MPAs at very high, high, and moderate-high LOP.

### *Maximum Distance (gap)*

Figures 5.1 and 5.2 display the results of the MPA spacing analysis for all open coast habitats. The height of each bar indicates the maximum distance between adjacent habitat replicates in a given proposal. These maximum distances, or gaps, for each habitat may be compared to the spacing guidelines, a maximum of 31 to 62 miles between MPAs, which is indicated by the horizontal dashed red lines on the figure. Habitats marked with an asterisk in the legend are unevenly distributed, making it impossible for the spacing guidelines to be met. For all habitats, spacing in excess of the guideline or minimum possible is reflected with hatch marks across the bars.

### *All Gaps that Exceed the SAT Spacing Guidelines*

Table 5.3a-h provides the number of spacing gaps that exceed SAT spacing guidelines between adjacent MPA clusters for a given habitat. The location and distance of each gap also is identified for each habitat. The intent of this analysis is to provide the MLPA North Coast Regional Stakeholder Group, the MLPA Blue Ribbon Task Force, and the California Fish and Game Commission with detailed information about spacing gaps by habitat for each proposal, in order to identify specific MPA proposal designs that result in large spacing gaps that could compromise the network function of the proposed MPAs.

Key points from the spacing analyses (figures 5.1 and 5.2, Table 5.3a-h) include:

- Spacing guidelines cannot be met for three habitats: kelp (115 mi minimum gap), rock 100-3000m (110 mi minimum gap), and soft bottom 100-3000m (95 mi minimum gap). None of the proposed external MPA arrays fall within the spacing guidelines for any habitats at very high protection, however:

  - ExC and ExE approach the maximum spacing guideline for rock 30-100m and soft 30-100m
  - All arrays except ExA approach the minimum possible spacing for rock 100-3000m.
- None of the proposed external MPA arrays meet the spacing guidelines for any habitats at high protection, however:
  - ExC, ExD, and ExE approach the maximum spacing guideline for rock 30-100m and soft 30-100m.
  - All arrays except ExA approach the minimum possible spacing for rock 100-3000m.
- At moderate-high protection, maximum gaps are reduced across all arrays as compared to high or very high protection. However, all arrays include gaps that exceed the guideline or minimum possible spacing for some habitats.
  - ExD is the only proposal that meets the spacing guidelines for any habitat, meeting the guidelines for rocky shores, offshore rocks, and soft 0-30m.
  - On average, gaps in ExD exceed the guidelines or minimum possible spacing by the smallest margin, an average of 13 miles across all habitats, followed by ExE
  - ExE includes the fewest large gaps (3) that exceed the guideline or minimum possible spacing by more than 10 miles. ExC and ExD have 5 large gaps, ExB, ExF, ExG, and ExH have 6 and ExA exceeds the spacing guidelines by more than 10 miles for all 10 habitats.
- For most external proposed MPA arrays, the major gap for hard 0-30m proxy is between the Oregon border and Punta Gorda (see replication section for locations where this habitat exists)
- Overall, the largest spacing gaps occur in the northern part of the north coast study region, where proposed MPAs do not replicate a large number of habitats. The Reading Rock cluster found in many proposed external MPA arrays helps to meet spacing guidelines for beaches, soft 0-30m proxy, and soft 30-100m habitats. An additional portion of this cluster found in ExC, ExD and ExE also captures rock 30-100m habitat and helps towards meeting minimum SAT spacing guidelines for this habitat.
- Spacing guidelines are better met in the southern bioregion, with MPAs in the Punta Gorda and Ten Mile River vicinities responsible for filling most spacing gaps. Proposed MPAs in the Viscaino/Usal and Point Cabrillo vicinities also help meet SAT spacing guidelines for some habitats.
- Ranking of arrays based on average gap in excess of the guideline or minimum possible spacing:
  - ExD < ExE < ExC < [ExB, ExF, ExG & ExG] < ExA