5. Session Topic Tables

Session 1. What are the expected effects of the network of marine protected areas (MPAs) along the California coast on California's marine fisheries? What are the best ways to monitor for these effects?

Topic 1.1. What are the potential negative impacts to the fishery (e.g., resource availability, behavioral, economic)? Identify and discuss where and when one might expect this for each fishery. Is it captured by MPA or fisheries monitoring? What are the consequences to the fisheries?

Topic 1.2. What are the potential contributions MPAs may have to the fishery?

Topic 1.3. What are the biological/ecological responses (e.g., scale: regional, local, population dynamics)?

Topic 1.4. What other system drivers should be considered (how and when)?

Topic 1.5. What other essential fishery information (EFI) can marine protected areas provide that is beneficial to management, and what types of monitoring/research could be conducted to acquire this information?

Note: Session 1 discussion focused on topics that are often shared across fisheries, as reflected in the general discussion column. Comments specific to each of the four featured workshop fisheries are captured in its corresponding column. Empty cells in the featured workshop fisheries columns do not necessarily indicate a lack of potential effects or interactions for a given fishery, but rather indicate they are likely shared across fisheries.

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Identified Effects	General Discussion	Cabezon	Red Abalone	Brown Rockfish	California Spiny Lobster
Effort shift	❖ Shifts are likely to vary across fisheries and for different sectors of a given fishery, and may depend on MPA size and configuration, as well as the quality and amount of habitat within an MPA versus habitat available to the fishery. ❖ Based on the scale at which stocks are managed,	❖ May not be a population concern due to the scale of	❖ See discussion below pertaining to serial depletion. ❖ May be mitigated by minimum size		❖ Possibility of concentration of effort (e.g., Laguna area) likely depends on habitat and habitat

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	major shifts are important to identify, but moderate shifts are not likely to affect the population/fishery in a detectable manner. ❖ The localized importance will vary by species, based on when potential realized effects would be detectable. ❖ Predicting whether effort shifts may occur requires identifying fishable versus non-fishable habitats/areas (e.g., areas with physical obstructions/regulatory restrictions). For example, the spatial locations for fish catch were used in the Marine Life Protection Act planning process to provide such estimates. ❖ Only fisheries where effort shifts and spillover would be significant enough to impact fishery management should be monitored. ❖ Recreational anglers may target MPA edges for larger "trophy" fish. ❖ Displaced effort to larval source areas could be a concern.	the fishery	limits and depth refuge (e.g., skin divers are generally limited to a depth of less than 30 feet or 9 meters)		diversity ❖ May be mitigated by a minimum size limit ❖ Challenging to manage "turfs" (i.e., fishing grounds sometimes established informally by individuals in fishing communities) vs. regulations
Localized/serial depletion	❖ Currently there is no fisheries management approach to measure localized depletion, and doing so infers a shift in the scale at which fisheries are managed to a smaller regional/local scale. ❖ Moderate localized depletion generally does not have a significant impact on total sustainable yield. o Example: Lobsters have a minimum size limit, which prevents localized depletion from causing significant impacts to lobster. In other words, effort shift can be mitigated by		❖ Department of Fish and Game is already aware of the risk of serial depletion for abalone ❖ Likely varies depending on fishing access and proximity to major human populations		❖ Likely depends on size of MPAs and diversity of habitats inside and outside MPAs (i.e., adult spillover)

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	minimum size limits. ❖ MPAs may act as insurance against depletion of an area through fishing, but not natural disasters. For example, MPAs are more important for preserving larval sources/sinks and protecting from depletion outside of MPAs; whereas natural disasters would impact all areas indiscriminately. However, if larval sources and sinks are incorrectly identified in MPAs (and are indeed placed outside of these resource-rich areas), then they would not act as an insurance, in which case effects of localized depletion may be significant.				
Reduced participation	❖ The effect may not be permanent (latent effort may emerge later). ❖ The effects would likely matter most to individual anglers.				
Reduced catch (short/long term)	❖ Overall reduction in yield outside of MPAs does not appear to be of particular concern based on modeling studies.				

Topic 1.2. What are the potential contributions MPAs may have to the fishery? Considering topics that are useful to management strategies, identify these and note differences among fisheries. Is it captured by MPA or fisheries monitoring? What are the consequences to the fisheries?					
Identified Contributions	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
Spillover (larval output)	❖ True spillover is difficult to measure. The focus should be on simple metrics (e.g., density and size inside/outside of MPAs) for adult fish and invertebrate species.				❖ Due to the size and location of MPAs, spillover is unlikely to

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	❖ Large fish may skew the results and not be representative of the fished populations. ❖ Effectively monitoring or measuring larval output would likely require understanding a number of factors, such as larval dispersal potential, oceanographic conditions, scale of MPAs, and identifying larval sinks/sources to name a few. It is therefore probably not practical and/or financially feasible.				be meaningful to fishery management. ❖ Very much depends on scale.
Increased biomass/size and catch	❖ This factor is likely to vary by species and the management effectiveness, including the scale to which fisheries are managed and the scale to which abundance is expected to increase. For example, if management measures were effective outside of MPAs, the contribution from MPAs to increased catch may not be detectable because of the temporal and spatial recruitment variability (unfished biomass is transitory in nature). o However, size may increase. It may not be noticeable in kelp beds, for example, because of ontogenetic shift patterns in which fish leave when they are big enough. o Alternatively, if management measures were not effective outside of MPAs, there may be noticeable effects. ❖ Rock scallops may benefit from MPAs since they are currently only managed by bag limits. This has potential for reducing risk of management mistakes because it relieves the DFG from developing specific management plans for this species.				
Reduced risk	❖ MPAs may act as a buffer to provide insurance for mistakes. Alternatively, they may increase the potential for mistakes. Either way, it should be possible to detect size differences. ❖ Large fish leaving the reserve may cause the fishery to appear more productive than it is, particularly if the amount of large fish leaving an MPA is unknown. ❖ MPAs may be used as an insurance factor for less than				

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	precautionary approaches to management (e.g., Restrepo et al. 1998[1], Restrepo and Powers 1999[2]). ❖ MPAs may allow an accurate assessment of what an unfished population may look like.				

Topic 1.3. What are the biological/ecological responses (e.g., scale: regional, local, population dynamics)?					
Identified Responses	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
Density dependent ❖ Movement ❖ Competition ❖ Reproduction ❖ Larval recruitment and settlement	❖ Understanding movement patterns (e.g. immigration and emigration) of species is important for understanding density changes with in MPAs. Most of the movement studies have been on adults; therefore, monitoring movements over longer periods and broader cycles needs to be analyzed. ❖ The driving force is unfished density, not biomass. ❖ Natural mortality estimates should be improved by focusing on primarily sedentary species. (Accuracy is related to how much a species moves.) ❖ Information on population sources and sinks may be important. o Track a species through its entire life history (model beginning at larval stages). o However, expensive instruments to accomplish this (e.g., current meters)		❖ If abalone can be planted in an MPA as experimental control, must use only as control because of differential growth and recruitment between northern and southern California ❖ Density dependent reproduction is a factor as substantial recruitment is not expected in areas with low numbers of abalone.		❖ Shelters, how they respond to habitats in MPAs from a behavioral response ❖ Competition for habitat holes resulting in spillover

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	are not available. Building a Regional Ocean Modeling System (ROMS) is very expensive. Perhaps partnerships that already use the ROMS model could be effective. ❖ MPAs could possibly be used as an experiment to investigate species interactions, compensatory responses, and/or to stock selected species within MPAs for focused monitoring assessments.				
Lifetime egg production	Measuring Lifetime Egg Production (LEP) is not urgent. ❖ The current model for LEP is an equilibrium model so one might as well wait until equilibrium (measure with equilibrium response). ❖ Measuring LEP is not a high priority relative to other metrics. Measuring changes in size, age, and movement may be the most important effects to measure, each of which should be monitored as soon as MPAs are adopted.				
Trophic interactions/structure	❖ Finding driving forces behind changes/impacts are important considerations but require more study before adjusting management. Studies should include behavioral response and predation impacts, including ratios of top tier predators.				

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Age and size structure	❖ Change in size and age is important but must be measured from the very beginning (preferably before MPA is established). ❖ Early monitoring of changes in age/size structure/and mortality is important (concurrently captured via MPA monitoring plan). ❖ For some species, changes may not be seen for many years.				
Larval connectivity	❖ Characterize it as "population" sinks and sources. Identifying larval sources and sinks is a big question mark in estimating a network effect. It is an extremely difficult question to answer. ROMS models may help but may not really get at this question for some time. ❖ For larval connectivity, ascertain whether the right assumptions were made about MPA sites vs. sources and sinks (important for lobster).				

[1]Restrepo, V., G. Thompson, P. Mace, W. Gabriel, L. Low, A. MacCall, R. Methot, J. Powers, B. Taylor, P. Wade, and J. Witzig. 1998. Technical guidance on the use of precautionary approaches to implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. NOAA Technical Memorandum NMFS-F/SP0-31. 54 pp. Available from: http://www.nmfs.noaa.gov/sfa/NSGtkgd.pdf

[2]Restrepo, V., and J. Powers. 1999. Precautionary control rules in US fisheries management: specification and performance. ICES Journal of Marine Science 56:846-852. Available from: http://icesjms.oxfordjournals.org/content/56/6/846.full.pdf

Topic 1.4. What other system drivers should be considered (how and when)? How do these affect fisheries in terms of management strategies, and when should these be considered?					
Identified System Drivers	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
Ocean conditions ❖ Pacific Decadal Oscillation (PDO) ❖ El Nino/Southern Oscillation (ENSO) ❖ Upwelling index ❖ Sea Surface Temperature (SST)	❖ Larval output depends on oceanographic conditions. ❖ Record temperature using data from other researchers. ❖ Productivity can be highly dependent on temperature.				
Climate change and sea level rise	❖ MPAs may be used to account for climate change. ❖ These are longer-term impacts that would cause noticeable or measurable effects further down the road compared to measuring changes in size, age, and movement.				
Compliance	❖ More quantitative estimates of compliance and use are needed as a control when interpreting MPA monitoring data/results (e.g., size, density, and abundance). MPA monitoring results could be erroneous if compliance is not accounted for.				

Topic 1.5. What other EFI can MPAs provide that is beneficial to management, and what types of monitoring/research could be conducted to acquire this information?					
Identified EFI	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
Unfished density	❖ MPAs could be useful for measuring/estimating unfished density. ❖ Accounting for movement patterns of adults is important for understanding density changes.				
Mortality	❖ MPAs can be useful for estimating natural mortality but should be measured from the onset of MPA implementation.				