Session 2. Do our management strategies need to change in response to a network of marine protected areas (MPAs)? How should these strategies change?

Topic 2.1.A. What set of potential effects and/or characteristics (e.g., specific MPA effects, species life history characteristics, fishery characteristics) might be the most important for **fisheries in general**, what conditions might arise from these effects, and what scale of effects might be expected?

Topic 2.1.B. Given the conditions discussed on the previous topic, what management responses (in general terms) might be advisable, and what are the risks associated with taking or not taking management action?

Topic 2.2.A. What set of potential effects and/or characteristics (e.g., specific MPA effects, species life history characteristics, fishery characteristics) might be the most important for **cabezon**, what conditions might arise from these effects, and what scale of effects might be expected?

Topic 2.2.B. Given the conditions discussed on the previous topic, what management responses (in general terms) might be advisable, and what are the risks associated with taking or not taking management action?

Topic 2.3.A. What set of potential effects and/or characteristics (e.g., specific MPA effects, species life history characteristics, fishery characteristics) might be the most important for **California spiny lobster**, what conditions might arise from these effects, and what scale of effects might be expected?

Topic 2.3.B. Given the conditions discussed on the previous topic, what management responses (in general terms) might be advisable, and what are the risks associated with taking or not taking management action?

Topic 2.4.A. What set of potential effects and/or characteristics (e.g., specific MPA effects, species life history characteristics, fishery characteristics) might be the most important for **brown rockfish**, what conditions might arise from these effects, and what scale of effects might be expected?

Topic 2.4.B. Given the conditions discussed on the previous topic, what management responses (in general terms) might be advisable, and what are the risks associated with taking or not taking management action?

Note: Workshop participants during Session 2 were asked to focus on one specific species/fishery at a time and consider: 1) what conditions might arise given a set of MPA effects or characteristics (development of a potential scenario); and 2) what management actions might be advisable given that scenario. The following tables reflect this approach with the development of the scenario provided in Topic A and the potential management actions, given this scenario, provided in Topic B. Only three of the four focal species/fisheries were discussed. Some of the input provided during these different species/fishery discussions applied more to fisheries in general than to the focal species/fishery. This input was moved into a separate “general fisheries” table (Topic 2.1 A, B).

Topic 2.1.A. What set of potential effects and/or characteristics (e.g., specific MPAs, species life history characteristics, fishery characteristics) might be the most important for fisheries in general, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: General Fisheries**
What effects and/or characteristics are important?	❖ The response of a specific species or fishery to the implementation of the statewide MPA network, and the resulting conditions under which it will need to be managed, will depend on potential effects and/or characteristics. A number of potential effects were identified during Session 1, the most relevant of which are included here: o Effort shift/depletion o MPA design/configuration o Spillover/movement o Sequestering biomass o Stock stability o Compliance o Environmental conditions o Life history characteristics o Fishery characteristics
What conditions might arise from these effects and/or characteristics?	❖ Responses are unique and vary spatially and temporally; consequently, management needs to be adaptive. Understanding the response requires information beyond what is needed to determine whether MPAs are protecting/conserving ecosystems and habitat. ❖ MPAs may only demonstrate changes for certain fish/fisheries. They are unlikely to provide sufficient evidence for conclusions that apply to all fisheries outside of MPAs. o Focused evaluations should be considered for those fish species or fisheries that may be affected by MPAs. ❖ Mixed species stocks – MPAs have the potential to bring attention to issues surrounding the mixing weak stocks with healthy assemblages, a topic of currently neglect. o On the west coast of the United States, weak stocks are being lumped into healthy assemblages; on the east coast, weak stocks species are being taken out of fishery management plans and are not included in assemblages. o Composition inside and outside of MPAs (through surveys) may be illuminating on this front; they may provide a snapshot of assemblages, and reveal whether fisheries are changing the nature of these assemblages. ❖ Setting aside small parts of the ocean does not mean that we will see “natural” assemblages. o Even if MPAs do not represent a “natural” state, they represent a “more natural” state of less exploitation. o MPA size may constrain how much “natural” structure we will see. o Outside fishing activities can potentially impact assemblages inside of MPAs. o If MPA implementation is combined with increasing Total Allowable Catch (TAC), then confidence of seeing “natural” assemblages will not be high. ❖ Whether MPA network placement will increase larval production is unknown and depends on locations of larval sources

Topic 2.1.A. What set of potential effects and/or characteristics (e.g., specific MPAs, species life history characteristics, fishery characteristics) might be the most important for fisheries in general, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: General Fisheries**
	(areas with high larval dispersal) versus larval sinks (areas with high larval retention). This is worth studying for evaluating MPA siting effectiveness.
What scale of effects might occur?	❖ Are effects likely to occur on a regular basis throughout the MPA network or just occasionally in a particular locale? ❖ Are effects likely to impact the entire stock or substocks and/or populations? ❖ Are effects likely to impact community structure? ❖ Are effects likely to impact all of a fishery, a specific subset of the fishery, or just a few fishery participants? ❖ What is the temporal scale (e.g., short-term, long-term)? ❖ The scale of management response (regional vs. statewide) will most likely be constrained by resources (financial and otherwise).

Topic 2.1.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: General Fisheries**
What possible management actions might be considered?	❖ How do we interpret the effects of fishing - by looking at what we see inside a state marine reserve? Will it inform how effective management is outside of the MPAs? ❖ To what extent do bigger fish coming out of MPAs matter to fisheries? Is the amount of spillover enough to matter to fisheries? ❖ Are MPAs a sufficient alternative to precautionary management measures to merit reconsidering the need for those measures? o Many factors need to be considered before MPAs can be considered a replacement for the precautionary model (e.g., larval and adult movement and inherent differences between areas inside and outside of MPAs). o Will sufficient biomass be sequestered in MPAs to sufficiently lead to stock stability/resilience? ❖ What data would merit an increased TAC? Use caution in changing management based on the supposition that MPAs will have a positive effect on populations. Wait for evidence. o Perhaps, we can ONLY talk about changing the aspects that are built-in precautions. We need to distinguish what part of management is precautionary and what is fundamental. ❖ Multiple changes at once will not inform us on what is working (e.g., evaluating the effects of MPAs concurrently with a new increased TAC would complicate the comparison between, inside, and outside of MPAs)

Topic 2.1.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: General Fisheries**
	❖ Drop the bottom threshold (e.g., to less than 10% of spawning biomass prior to fishing [B_0]). Under the federal Harvest Control Rule (HCR) of 40/10 for Pacific coast groundfish, rebuilding goes into effect at 25% of initial biomass. For targeted fishing to occur, groundfish need to be kept above 10% of B_0. We need to follow the precept of federal law, which requires biomass targets and thresholds. This will require some phase planning. ❖ Examine the potential for integrating MPAs into new stock assessment methods. ❖ We may need to redefine level of what is "sustainable fishing" outside of MPAs given that MPAs sequester unfished populations.
What are the potential risks with taking or not taking management actions? ❖ Stock ❖ Fishery ❖ Ecosystem conservation	❖ Clarify what information is needed for management actions. o The effects of MPAs will likely not be identified until some time has passed; we cannot afford (biologically) to wait until monitoring data are sufficient. We should consider whether to use modeling approaches initially in lieu of long-term data sets and whether resulting information will be sufficient to justify changing current management. ❖ The degree to which MPAs can replace other sources of precaution depends on movement and connectivity. o The protected substock in MPAs may not be the same as in fished areas; if it is not, then differences in fishing mortality in these areas could lead to reduced genetic diversity. ❖ Consider making the assumption that MPAs buffer against fishery management failures/uncertainties and, consequently, that the MPAs provide a means of built-in precaution due to sequestering part of the stock. This precaution can increase the risk tolerance (less risk to stock). o A lower harvest buffer could be considered. (e.g., set ABC/OY=MSY or, under more recent reference point terminology, allow ABC to be buffered down to 85% of OFL instead of 80%, or allow fishing at FMSY; where ABC=Acceptable Biological Catch, OY=Optimum Yield, MSY=Maximum Sustainable Yield, and OFL= Overfishing Limit) o Risk associated with dropping the bottom of the federal 40/10 HCR to less than 10% or even to zero is low; the trade-off is high social gain. ❖ The managers' risk tolerance will be affected by the suite of management measures that are in place (less risk if traditional management measures also in place). ❖ The jury is out on risk of increasing harvest outside (to FMSY); it depends on the manager's confidence in the FMSY estimate. o Fishing at levels higher than FMSY: Sustainable fishing is possible, but concurrent lower level production of FMSY catch will result. A precedent for fishing at higher than FMSY exists. (FMSY=Fishing mortality rate, which if applied constantly, would result in MSY.) o A higher risk is associated with our current policy of using a proxy for FMSY based on spawning potential ratio (SPR). Possibly we can use data from inside of MPAs to calculate a more reliable SPR. (This applies to less productive species). In time, the SPR will increase. ❖ Counting on MPAs as a precautionary measure is not risky; fishing at FMSY is not a big deal. There is risk in getting an

Topic 2.1.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: General Fisheries**
	assessment wrong and consequently implementing wrong management actions. ❖ The Pacific coast groundfish disaster occurred because fishing was at $f_{35\%}$ (approximately FMSY), so the stocks became depleted. o Fishing above or below FMSY in terms of catch is not much for species that are not very productive, like rockfish. It is easier to make small errors in calculation, which trickle down into large errors because of the small catch of rockfish to begin with. o Low turnover: A frequent misconception is that rockfish would have a high yield, but this does not manifest due to low turnover. ❖ Having a network structure distributes risk and opportunity, which can prevent localized depletion. Initial evidence due to shifting effort may be apparent, but be cautious not to act on that because trends will settle out over time.

Topic 2.2.A. What set of potential effects and/or characteristics (e.g., specific marine protected area effects, species life history characteristics, fishery characteristics) might be the most important for cabezon, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: Cabezon**
What effects and/or characteristics are important?	❖ Effort shift/depletion ❖ Spillover/movement ❖ Life history characteristics
What conditions might arise from these effects and/or characteristics?	❖ Stock has been assessed. ❖ Commercial fishery— year-round fishery; functional slot-limit (in addition to minimum size limits, live finfish markets prefer "platter-sized" fish so larger fish are typically not taken). Because females grow larger, this may result in mostly males being taken, possibly impacting stock assessments. ❖ Recreational fishery—all sizes above minimum size limit are taken. ❖ Discarded fish have high survivability. The fishery has little impact on sub-adults, but the number of sub-adults is important in terms of replenishment to the fishery. o Do MPAs increase the number of sub-adults? ❖ The fishery operates under a variable TAC; TAC was recently increased substantially because of updated stock assessment indicating a healthy stock; therefore, displacement (i.e., effort shift) is not a significant biological concern but possibly a social issue.

Topic 2.2.A. What set of potential effects and/or characteristics (e.g., specific marine protected area effects, species life history characteristics, fishery characteristics) might be the most important for cabezon, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: Cabezon**
	❖ Tagging studies suggest high site fidelity with potential sojourns. ❖ Anecdotal information indicates that larger individuals are in deeper water. o MPAs may not make a difference in available sizes of cabezon. ❖ Nesting occurs during the winter. ❖ There is uncertainty regarding nest-guarding sites relative to MPA placement. Nest-guarding patchiness may be a factor if key nesting sites are mainly outside of MPAs; ❖ Recreational fishing is closed for two winter months of the nesting period (January-February), but commercial is not. ❖ Is there enough hard substrate within MPAs (e.g., North-Central Coast) to say that this species is protected? ❖ Effort shift is not a driver for changing current fishery management. ❖ More information is need on movement (juveniles, sub-adults, adults) and distribution of large female breeders and nest guarding males respective to MPA locations. ❖ Sequestering biomass may be beneficial if nesting is also protected.
What scale of effects might occur?	❖ Substocks or evolution of sub-stocks must be considered as a result of MPAs (inside vs. outside of MPAs). ❖ Consideration of MPA placement relative to key ecological conditions: o Are nesting areas captured? If nesting areas are outside of MPAs, this may affect a local stock heavily. If nesting areas are patchy, there are likely to be at least some protected by MPAs, especially for males of desirable size. o Are pathways provided to connect ontogenetic movements? How do movement of juveniles from tidepools and dispersal of sub-adults relate to MPA placement and boundaries? o What is the larval dispersal in regard to larval sources and sinks?

Topic 2.2.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: Cabezon**
What possible management actions might be considered?	❖ No management response is advised; hold the status quo until we can observe what the MPAs are actually doing to the system. There are inherent risks in taking two actions at once (i.e., implementing MPAs and changing management measures or TAC simultaneously would confound our ability to understand the role of each action). o However, how much information/observation would be considered “sufficient” to act? We cannot afford to wait until all answers are crystal-clear. o Modeling may be an approach to address this until long-term data are available.

Topic 2.2.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: Cabezon**
	❖ Consider a commercial closure in winter to protect nest guarding. ❖ Select measures that are in place for precaution of conservation (but not fundamental management measures) can be reduced. Alternatively, conservation measures that can be considered replaced by MPAs can also be changed. (e.g., consider MPA area closures as replacement to seasonal closures) ❖ We can lower the bottom threshold of the nearshore fishery management plan HCR 60/20 down to 60/10. ❖ Dropping the lower end may gain a lot of credibility without a big change in harvest. (If the bottom threshold were moved from 20 to 10, then the present TAC likely would not change by maybe more than 5 tons. Though the harvest change might be insignificant, this could create a major positive shift in perception.)
What are the potential risks with taking or not taking management actions? ❖ Stock ❖ Fishery ❖ Ecosystem conservation	❖ "Risks associated with no management response" are mostly social in nature. Examine trade-offs by modeling changes (for more immediate responses to change fishery management) versus holding the status quo for 20-30 yrs to see actual MPA effects.

Topic 2.3.A. What set of potential effects and/or characteristics (e.g., specific marine protected area effects, species life history characteristics, fishery characteristics) might be the most important for California spiny lobster, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: Lobster**
What effects and/or characteristics are important?	❖ Effort shift/depletion ❖ MPA design/configuration ❖ Spillover/movement ❖ Environmental conditions
What conditions might arise from these effects and/or characteristics?	❖ Development of a fishery management plan is under consideration and a stock assessment is in progress. Current model results indicate that the stock is close to MSY. ❖ The fishery is almost fully capitalized. ❖ Concerning MPA design, the quality/diversity of habitat influences whether or not lobster forage outside of MPAs or move

Topic 2.3.A. What set of potential effects and/or characteristics (e.g., specific marine protected area effects, species life history characteristics, fishery characteristics) might be the most important for California spiny lobster, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: Lobster**
	from MPAs. "Hard bottom habitat" is a broad characterization that does not work for lobster. This habitat classification needs to be refined. ❖ Size-frequency will change but will not have a big effect on the fishery due to commercial size preferences. ❖ This species shows high sensitivity to environmental conditions (ocean temperature changes). o How does recruitment change with environmental conditions? ❖ Recruitment increases from MPAs are not expected with this species due to larval duration and steady supply of recruits. o The proportion of larvae coming from California vs. Mexico is unknown; stocks are much larger in Mexico, and they are generally well managed. ❖ Could there be a negative effect to MPAs? Lobsters aggregate and have behavioral changes to disturbance, so fishing the line will drive lobsters into the MPA. ❖ Do southern California MPAs include enough habitat to make a difference for this stock? o Close to 30% of catch is taken from just the Point Loma-La Jolla area (block 860). ❖ Compliance here is a factor for the commercial fishery because of trap gear and potential movement into the MPA and resulting violations. o Risk to maintaining a permit leads to commercial fishery participants NOT fishing the line (e.g., Channel Islands). o Assume poaching is a constant. ❖ Effort shift is expected. ❖ Information is needed regarding habitat distribution/diversity inside and outside of MPAs and lobster use/movement within this habitat. ❖ Any effect of movement/spillover is likely minimal to the overall fishery. ❖ Any evaluation of lobster in MPAs will need to take into account changes in environment (e.g., temperature).
What scale of effects might occur?	❖ Localized trophic shifts may be observed due to effects on community structure. Behavioral aspects would change on a local scale. o MPAs are producing larger lobster, but other ecological changes in community structure (e.g. changes in kelp, urchins) are not evident. o These ecological effects (e.g., those above; predatory effects) may not change for long time and require more investigation. o Changes in behavioral aspects may be more important in short-term effects. o See Kevin Hovel's work on bight-wide assessment (student research). ❖ This stock is highly productive. The current management system (i.e., no TAC) works because of the consistent supply of recruits. Therefore, stock-level changes in recruitment are not expected from MPAs. ❖ Open areas may see reduced catch-per-unit-effort (CPUE) that is not related to stock size reduction but because of

Topic 2.3.A. What set of potential effects and/or characteristics (e.g., specific marine protected area effects, species life history characteristics, fishery characteristics) might be the most important for California spiny lobster, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: Lobster**
	movement into MPAs (i.e., will lobsters moving from MPA edges into MPAs reduce fishing opportunities, as observed in closed waterfowl zones?). Will this be compounded by compaction issues? ❖ Discrete areas could see an effect in CPUE due to behavioral changes in the short-term, but likely would not be a population-scale effect. In the long-term, this would be countered by density-dependent movement out due to MPA saturation. ❖ Could movements be related to temperature?

Topic 2.3.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: Lobster**
What possible management actions might be considered?	❖ No management response is suggested. o Do not change management in response to social experiences in the short-term due to lobster behavior changes (initially). Track the changes for initial years. ❖ Given that a lot of recruitment comes from Mexico (where much area is under reserve), we need to manage for catch rates – not for fishery sustainability. Edge effect is a minor factor for this stock. ❖ Fishery participants want compensation for the effect of sequestering biomass. ❖ Marine Stewardship Council (MSE) Certification: The lobster fishery would get credit for MPAs (in consideration for fishery sustainability). Will science support this MPA credit? ❖ Create structure outside the MPA to provide safe harbor for density-dependent movement out (in the future) and to 'earn" fishery participant compliance. ❖ Consider similarities to the Dungeness crab fishery (trap limits, etc). ❖ Turfs (i.e., user right incentives): o Experiment by University of California Santa Barbara academics in Channel Islands assigning user turfs next to MPAs. The concept is to provide incentive to comply with no fishing in MPAs. o Turfs are not practical from management perspective.

Topic 2.4.A. What set of potential effects and/or characteristics (e.g., specific marine protected area effects, species life history characteristics, fishery characteristics) might be the most important for brown rockfish, what conditions might arise from these effects, and what scale of effects might be expected?	
Potential Conditions	**Discussion Points: Brown Rockfish**
What effects and/or characteristics are important?	❖ MPA design/configuration ❖ Sequestering biomass
What conditions might arise from these effects and/or characteristics?	❖ Brown rockfish is a member of the federal nearshore rockfish complex south of 40° 10. ❖ Complex managed using Restrepo-type control rules (e.g., Restrepo et al. 1998[1], Restrepo and Powers 1999[2]) and an acceptable catch limit (ACL) ❖ Harvest levels for this complex were increased for 2011-2012. ❖ Commercial fishing for nearshore rockfish is covered under a restricted access program. Commercial fishing for brown rockfish requires a Deeper Nearshore Fishing Permit. The number of these permits is capped, and they are non-transferable. ❖ Are MPAs sufficiently large to capture the whole range of the population? o Distribution of low relief rock inside/outside MPAs will affect movement. o Large ontogenetic movement (high settlement in bays/estuaries) occurs, so contiguous bay/inshore/offshore configuration will be a factor. o MPAs will protect sedentary species at a higher level than other species with high movement (consider species movement). ❖ Sequestering biomass is a possibility, but presently there is not enough existing evidence to support that it will happen. ❖ Currently there is no size limit. Many are caught in San Francisco Bay. ❖ More information is needed on movement of juveniles, sub-adults, and adults to help evaluate MPA design/configuration and potential biomass sequestering.
What scale of effects might occur?	❖ Conservation benefit at stock scale: o This is a species with less information than other stocks, so there may be a conservation benefit in demonstrating MPA effects on this fishery. o There is less risk of overfishing within the nearshore rockfish complex despite lack of data. ❖ Are pathways provided to connect ontogenetic movements? How do movement of juveniles from tidepools or estuaries and dispersal of sub-adults relate to MPA placement and boundaries?

[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 2.4.B. Given the conditions discussed in the previous table, what management responses (in general terms) might be advisable and what are the risks associated with taking or not taking management action?	
Potential Actions	**Discussion Points: Brown Rockfish**
What possible management actions might be considered?	❖ No specific management response is suggested. Modification of Rockfish Conservation Areas or expanded seasons as a result of sequestered rockfish would not be appropriate. ❖ Consider whether any select conservation measures can be considered replaced by MPAs. ❖ Consider relaxing existing depth restrictions, which are primarily in place for species of concern. ❖ TACs are increasing, so more fish will be available for fishery participants. ❖ Since the species is managed under federal groundfish FMP, the HCR threshold is 40/10; a drop below 10 is constrained by federal precept.
What are the potential risks with taking or not taking management actions? ❖ Stock ❖ Fishery ❖ Ecosystem conservation	❖ Over-harvest of sensitive species within the assemblage may be a concern. MPAs will protect uniformly, so there will be less potential for over-harvest of sensitive species.