Session 3. Can we incorporate the presence of a network of marine protected areas (MPAs) into stock evaluation, designation of harvest control rules, and other processes related to defining fishery yields? When should we do so?

Topic 3.1. How do MPAs affect the way stock assessments are developed for both assessed and unassessed stocks? Consider risk. Do MPAs alter stock productivity?

Topic 3.2. Under what conditions should harvest control rules/strategies change and what kind of data are needed to implement control rules? Do MPAs alter the risk of overfishing, or a stock becoming overfished?

Topic 3.3. How does the network of MPAs affect local populations, and what does that mean for management?

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Stock Assessments	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
Data Rich Scenario:					
Biomass ❖ Area models ❖ Data ❖ Parameters	Two-Area Model ❖ If an MPA is significantly affecting a species, then the MPA should be taken into consideration. The two-area model might help to inform the assessment on the effects of MPAs on biomass, but size or age data provides more useful information. If assessments are marginal then it probably will be less precise for the portion of the stock within an MPA. ❖ For current nearshore assessments, is it critical to consider the differences between biomass inside versus outside of MPAs? o Catch Per Unit Effort (CPUE): Currently used in assessments will	❖ Recommend two-area model o Need information from closed areas to prevent biased results o Need sex stratified ages for accurate mortality estimates (currently not enough data for most stocks)			

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	not reflect abundance in the whole area – it will only reflect abundance in fished areas. Option: To reduce bias, use fishery-dependent CPUE and survey data in only the fished areas if a two-area model is used. o A two-area model is potentially biased because of: 1) species movement and ontogenic movement effects; 2) some surveys conducted primarily in MPAs; and 3) lethal sampling not allowed in some MPAs. Single-Area Model ❖ Exclude MPA data until there are better tools to measure MPA effects. This could take a very long time (10 to 20 years). o Historical catch in the MPAs is needed (information not presently available). ❖ Perhaps MPA fish should not be considered part of the assessment, as they are sometimes considered a "different stock." ❖ Federal surveys do not take into consideration Rockfish Conservation Areas; similarly model MPAs (i.e., no change in assessments). ❖ Current tools to measure two-area models are not always highly accurate. It is most likely that traditional methods for assessment				

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	will perpetuate until an alternative is introduced that proves that MPAs have a significant effect. However, in order to prove this, historical catch data is required. ❖ Be wary of assuming depletion due to initial effort displacement (so no management changes should be made initially). o Depletion outside of MPAs may be an effect of migration. This could be a scaled effect, and may result in a reduction of CPUE.				
Do MPAs represent additional sources of uncertainty that could be included in decision tables?	❖ Trying to break the data down into pieces would be extremely complex. ❖ Could management just be adjusted? Decision tables are not being used right now, but are not beyond the realm of possibility.				
Data Moderate and Data Poor Scenario:					
Density ratios: Do density ratios work for one type of stock and not another?	❖ Recruitment level in the MPA will not reflect that of an unfished population. However, population structure in the MPA could represent an unfished population. ❖ The density method predicts a drop in CPUE due to effort shifts. This has not been seen on the central California coast. This would indicate that shifts in fishing effort have not		❖ We currently have eight index sites for which we calculate density annually, and they are all outside of MPAs. This raises two questions: 1) Do we continue with these sites in the fished areas and presume that MPA benefits will show up in future recruitments, or 2) begin to collect density		

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What type, quality, and quantity of data are needed?	affected populations. Trap fisheries tend to be clean, which is an advantage. Bycatch compounds problems and complexity. It is more expensive to manage on a finer scale; that is why a season was used. Critical questions: What kind of geographic scale? Can you aggregate across all the MPAs? Answers will depend on the species. Radar monitoring of recreational vessels could provide some information on effort, but it only assesses the boats and their movement, not what they are doing. ❖ Ratio is affected by level of effort, so the ratios in and out of MPAs are not equivalent. ❖ MPA Monitoring – what data are needed? o MPAs represent the baseline. We need data that will signal shifts in the baseline. This requires monitoring to begin "at time zero" to order to standardize inside versus outside of MPAs to a common metric. o Standardize for differences in potential productivity, but consider that changes in productivity may change inside versus outside of MPAs. o Ignoring standardization reflects		estimates in MPAs (where it is possible to get density ratios)? ❖ Recruitment is not consistent. Good recruitment is once every 5-7 years or longer. ❖ Creation of new index sites within MPAs is advised. Just get size comps inside and outside. A fixed size limit makes it easier to work with the size comps. o Jeremy Prince was arguing this for San Miguel; wanted to explore alternatives in how to use the size comps. o Index sites within and outside of MPAs will help show the exploitation rate. ❖ Aggregation considerations – need an average aggregation size of four animals (or more) to increase the probability that each aggregation has at least one male and one female. The probability of at least one of each sex in each aggregation declines dramatically below 2000 animals/hectare = minimum viable population density (equates to average aggregation size of four animals). If the average aggregation size is less than		

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	poorly on the management/science of MPAs. o If the present control rule is based on achieving a sustainable level of take, then climate change will be the most useful as a measure of what we are facing. That is, MPAs will be best used to measure what climate is doing to the stock, so that the management targets could be adjusted accordingly.		four animals, then there is the concern that each sex will not be present. Then the decline in reproductive output is compounded. This is also consistent with our experience in the south coast; when densities dropped below 2000/hectare those populations did not recover. ❖ Surveying inside the MPAs: one could pick up an environmental effect and then adjust the fished areas. ❖ Density estimates and size frequencies can be used as a means for adjusting the proscribed reduction on total catch when density thresholds are reached, or, raising the floor for minimum densities in the management areas.		
Others: Do MPAs create potential bias or require adjustment in other kinds of data-poor (or moderate) assessment approaches? Examples?	❖ The underlying reason for changes in abundance is important to know. By comparing changes in abundance inside MPAs versus outside, it shows what can be attributed to fishing (outside) versus environmental conditions (inside). ❖It's unlikely that MPAs are going to give an estimate for all species. All data should be collected now for				

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	species of interest, then later determining what data and species needs to be continued.				

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Harvest Control Rules	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
When setting harvest catch targets and limits, should the biomass inside of an MPA be treated differently for the Optimum Yield (OY) or Annual Catch Limit (ACL)?	❖ The present nearshore control rule (i.e., 60/20) is based on sound concepts. ❖ Continue to use data-poor management systems when abundance is unknown. Numbers are unlikely to be recalculated unless you discover your catch history has changed. ❖ Apply the Restrepo method (Restrepo et al. 1998[1], Restrepo and Powers 1999[2]) the way it was originally intended — make an expert judgment on the status of resources, which translates into varying degrees of downward adjustment from historical catches, depending upon perceived stock status. Very rarely has		❖ Abalone may have effort shifts because we need to curtail some of the fishing at Ft. Ross where density levels are falling. MPAs will make serial depletion more likely to occur because effort becomes forced into other areas. Fishermen are headed for the closest (and safest) point of entry, putting too much pressure on that area. Think of abalone effort as effort/hectare. Then effort will be managed in very small areas. How would rotating beaches work? They would need to be closed 5-7 years.		

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	it been used in that manner. This exercise is separate from MPAs. With MPAs, that may affect views on where the status of the resource is relative to the target. ❖ Changes in total mortality could be evaluated. o There are no catch curve analyses conducted on a regular basis, but a change in mortality would be a useful response variable. However, total mortality for stocks would be lower because of reduced probability of being caught due to the restrictive nature of MPAs. ❖ Increasing the catches could be expected in the outside areas due to effort shift; no obvious correction is needed.				
Assessed stocks: Should the control rules change because of MPA interactions. If so, how?	❖ There is reason to consider adjusting the 60/20 harvest control rule (HCR) to 60/10 now that we have MPAs. It is a management model based on something that can not be measured. The public is interested in less				❖ In upcoming FMP, set contingency plan to end season if catch falls below certain level (or shorten season to one month). ❖ Stock assessment results expected in a

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Do the Nearshore Fishery Management Plan or Groundfish Fishery Management Plan control rules need to be modified?	stringent HCRs. There should be more concern about a misestimated biomass. ❖ As stocks become assessed, they tend to be healthy or not overfished. ❖ Fishing at a rate greater than MSY is generally not a significant issue. o When we created the 60/20 HCR, part of the rationale was that we did not expect that the network of MPAs would sequester more than 20% of the biomass of the nearshore finfishes. When a stock is within the precautionary zone (< B40%; >B25%) (B% of spawning biomass prior to fishing); we would still not exceed the MSY rate in the open area due to the precautionary nature of the 60/20 HCR. o When this was created, was it viewed as transitional? If we sequestered more than 20% of the biomass, then we should revisit the HCR. ❖ The production curve assumes that a population is at B40%.				month or two (May); then will launch into FMP process covering all this ground again

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	o If the assumption is correct, then the federal 40/10 HCR for west coast groundfish equilibrates at B40 below that level catch is being reduced faster than the population is falling. o If the assumption is incorrect, then the graph becomes an upside down "U". That system goes to a good place almost anywhere the curve goes. However, populations do not behave based on those deterministic rules.				
Unassessed stocks / precautionary management: For a data poor stock managed using the Restrepo-type approach (fraction of previous landings to set OY) or the Depletion Corrected Average Catch (DCAC) approach, is it advisable to modify the way catch limits are set? (Risk management decision to take 50% of historic catch; do MPAs alter perception of that risk?)	❖ A logic argument, but not quantitative argument, can be made with Restrepo-type management versus MPAs. ❖ Essentially an effort adjustment is made by not adjusting the OY or ACL downward for MPAs. ❖ Density ratio is a good way to ensure consistency in abundance over time and avoid collapse, but it does not help in finding the optimal yield. Because density is so important to stakeholders, standardizing the measurements inside				

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	and outside of MPAs is necessary.				
Regulation restrictions: Is there reason to modify an unassessed fishery that does not set harvest limits but for example manages on season, size, restricted access, sex?					❖ Currently there are no limits on effort and total catch. Is there a reason to modify any current regulations due to MPAs? o To the extent that Mexico is subsidizing recruitment (i.e., larval immigration), decreasing the minimum size limit might be considered. This change may have potential for recreational effort to increase, but we do not know the level of recruitment being supplied. o Control effort in terms of season and traps (i.e., gear type). Possible scenarios include a recruitment decline due to a cold-water regime and becoming critical if combined with increased

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					recreational fishing. ❖ Assuming current regulations are correct (e.g., minimum size limit), there is some logic to reducing the minimum size because of an MPA if it is in place for growth fishing purposes. If lobster are not recruitment-limited, then one could argue for limiting minimum size. ❖ Consider Puerulus collectors such as those used in Australia.

[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 3.3. How does the network of MPAs affect local populations, and what does that mean for management?					
Regional Approach	**General Discussion**	**Cabezon**	**Red Abalone**	**Brown Rockfish**	**California Spiny Lobster**
Incorporating a regional approach into stock evaluations: Does the network of MPAs affect local populations or fishing behavior? What does that mean for management? Does fishing effort need to be controlled to account for edge effects?	❖ Carey's method (McGilliard et al. 2011[3]) provides more opportunity for fine-tuning regional management. ❖ There are some nearshore fishery permits by region. That is a management improvement, but management cost must also be considered to be realistic. ❖ MPAs provide the opportunity to study regional effects, but resources should be dispersed appropriately between regional versus statewide issues. Currently, financial resources are not available to conduct regional assessments neither recreationally nor commercially. ❖ Model suggestion: Use "no exchange" as one model. It can be profiled over the exchange rate/spillover rate as a way to characterize MPA effectiveness. Effort Shifts ❖ Serial depletion could happen with or without MPAs. (Serial depletion and MPAs are independent factors.) ❖ MPAs exacerbate the risk of serial depletion because they reduce the available area where effort shifts occur. From		❖ In the case of abalone, it would be problematic to reduce the bag limit because fishery participants from outside areas would be disproportionately affected; it would be allocative. ❖ In Washington, management measures result in the frequent opening and closing of beaches. How would this work for abalone? Given the life cycle of abalone, we may have to do closure cycles of extended periods. (The commercial urchin fishery had rotations of 5-7 years.)		

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	a management standpoint, MPAs create additional complexity to potential causes of serial depletion. ❖ Estimates and geographic distribution of effort change over time. Increased effort in different locations can occur, while for the overall fishery, effort remains relatively constant (i.e., focal points change). ❖ Shorter closures help to show/track effort shifts. Outstanding Questions ❖ Do we have to incorporate MPAs in the assessment, or can we allow for management uncertainty? ❖ Could it be taken into consideration in the probability of overfishing discussion?				

[3]McGilliard, C., R. Hilborn, A. MacCall, A. Punt, and J. Field. 2011. Can information from Marine Protected Areas be used to inform control rule-based management of small-scale, data-poor stocks? ICES Journal of Marine Sciencies 68:201-211.