California MLPA Master Plan Science Advisory Team Responses to Science Questions Posed during MLPA Public Meetings from March 1 to March 25, 2010

Revised May 12, 2010

This document contains science questions posed to the Marine Life Protection Act (MLPA) Master Plan Science Advisory Team (SAT) during its March 16-17, 2010 meeting , the MLPA Blue Ribbon Task Force (BRTF) during its March 1-2, 2010 meeting , and the MLPA North Coast Regional Stakeholder Group during its March 24-25, 2010 meeting. In addition, several questions were posed in writing to MLPAcomments@resources.ca.gov. The SAT reviewed and approved these questions during its May 12, 2010 meeting.

MPA Size and Spacing

1. ***What is the difference (in terms of species protected) between minimum and preferred guidelines?***

Response: The number and variety of marine species protected by an MPA is related to the MPA size and the types of habitat protected in the MPA. Highly mobile species, such as salmon and coastal pelagic species, are unlikely to be protected by MPAs of the sizes recommended to address the goals of the MLPA (minimum of 9-18 square miles and preferred size of 18-36 square miles), because individuals of these species move long distances and will regularly cross MPA boundaries and move into waters where they may be targeted by fishing. MPAs are more likely to protect species that exhibit limited movements within a defined home range (i.e., not continuous diffusive movement along the coast). The range of those movements relative to MPA size determines the likelihood that an individual will cross an MPA boundary and thus move into waters where they may be targeted by fishing. Only species with home ranges small enough to ensure that some individuals will spend their entire lives in an MPA are likely to realize the full benefits of protection from the MPA. Individuals that live their whole lives in an MPA are more likely to realize their full reproductive potential, enhancing the supply of larvae both within and outside of the MPA, depending on larval dispersal patterns.

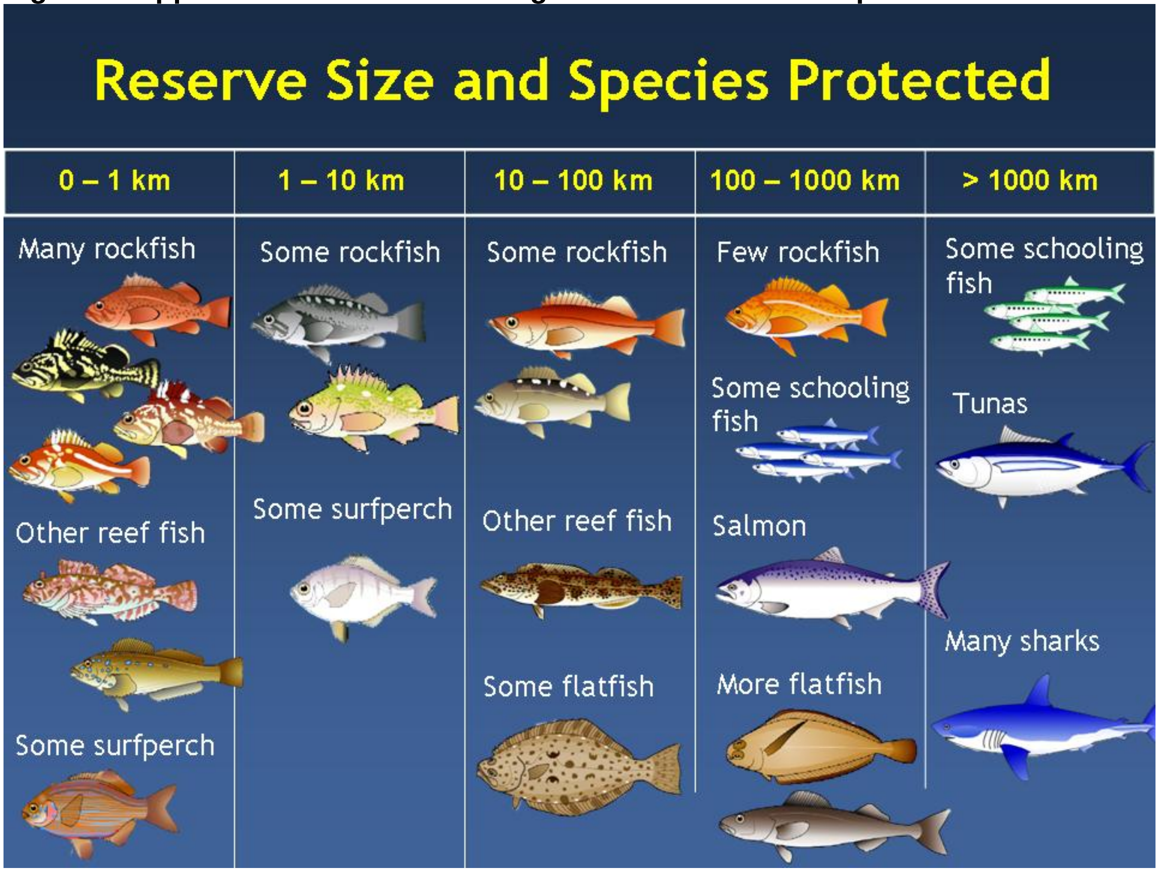
Clearly, an MPA that is large enough to include the home range of a single individual, may not be large enough to support an entire population of that species, but how much larger than the home range must an MPA be to protect a viable population? The relationship between home range and MPA size is complex and depends on a number of factors, including the distribution of habitats within and outside the MPA, the species' larval dispersal potential, the proximity to other MPAs, the intensity and distribution of fishing pressure outside the MPA, and the patterns of home range usage. For example, a species such as kelp greenling exhibits territorial behavior so there is little or no overlap in the home ranges of individual fish. Thus an MPA designed to protect a kelp greenling population of 100 adult individuals would need to contain enough appropriate habitat to accommodate 100 greenling home ranges. A smaller MPA size relative to home range size may be needed to protect a comparable population of non-territorial species, since their home ranges can overlap.

To elucidate the complex relationship between home range size, larval dispersal, and protection afforded by different MPA configurations, Moffitt et al. (2009) conducted a number of modeling experiments. The results of this study indicate that under certain conditions (a single MPA with continuous habitat and a specific combination of home range size and larval dispersal distance), an MPA as little as two times the home range size may protect a local population. Under other conditions, such as heavy fishing pressure outside the home range, long larval dispersal distances, and distant spacing between MPAs, even MPAs more than 10 times larger than the home range size may not fully protect a persistent population. Also included in this study was an evaluation of the MPA network implemented in California's central coast study region. The results of this evaluation indicate that only species with a home range greater than 4 kilometers (2.5 miles) are likely to lack protection in the MPA network if larval dispersal distances are long and there is poor management outside the MPAs. Reducing fishing mortality would allow species with larger home ranges to realize population benefits from the same network of MPAs. The study further indicates that, due to network effects, the percentage of the coastal habitats protected in MPAs may have a stronger effect on the species protected than the size of individual MPAs, particularly for species with average larval dispersal distances greater than several kilometers.

It is difficult to predict which species are likely to respond to MPAs of different sizes because of the complex relationship between MPAs, the habitats protected and species that forage, breed, and shelter in those habitats. The movement patterns of some of California's marine species have been extensively studied (Figure 1), but the movements of many more remain unknown. From the available information about fish and invertebrate movements, however, it is possible to draw broad conclusions about the types of species protected in MPAs of different sizes. For example, many invertebrates and marine algae are sessile as adults (e.g., barnacles, mussels, sea palms) or move no more than a few meters (e.g., abalone, clams). Populations of these sedentary species are likely to respond to small MPAs (even those below the minimum MPA size guidelines). The movements of fish and more mobile invertebrates, however, vary widely and may be related to habitat characteristics. For example, species that inhabit rocky reefs, where prey resources can be concentrated, tend to have smaller home ranges than species that inhabit soft-bottom habitats, where resources are often more dispersed. A review of movement data for 25 reef fishes that inhabit California waters indicates that 76% of these species likely have scales of movement less than 0.5 kilometers (0.3 miles) (Freiwald 2009). Although no similar review of movement information for soft-bottom species has been conducted, available information indicates that most soft-bottom associated species likely have home ranges of 5 kilometers (3 miles) or more. Finally, species that inhabit the water column or feed on highly mobile prey (e.g., salmon, anchovies, tunas) are likely to move hundreds or even thousands of miles in their lives.

In general, small MPAs (below minimum size) are likely to protect algae, sedentary invertebrates and some resident rocky reef species. MPAs within the minimum size range (9-18 square miles) are likely to protect a wider variety of reef-associated fishes and invertebrates and a few soft-bottom species with limited movement, while MPAs in the preferred size range (18-36 square miles) are likely to protect the widest array of rocky reef species (including most rockfishes) and soft bottom species (including many flatfishes).

Figure 1. Approximate Movement Ranges of California Fish Species.



References

Freiwald, J. 2009. Causes and consequences of the movement of temperate reef fishes. PhD Dissertation, University of California, Santa Cruz.

Moffitt, E. A., L. W. Botsford, D. M. Kaplan, and M. R. O'Farrell. 2009. Marine reserve networks for species that move within a home range. Ecological Applications 19:1835-1847.

Mapping and Habitat Replication

2. What is the latitude line for the split between bioregions in the north coast study region? And how will the SAT assess replication of habitats for MPAs that straddle the bioregion split?

Response: The split between the north and south bioregions runs due east-west from the mouth of the Mattole River at Latitude 40°17’48” N.

Because the divide between northern and southern bioregions in the MLPA North Coast Study Region is not a strong ecological break, but rather a gradual transition zone between areas with different habitat distributions and ecological assemblages, MPAs that fall on this divide could reasonably be assigned to either of the two bioregions. In evaluating Round 1 external draft MPA arrays, the SAT assigned MPAs that straddled the divide to one of the two bioregions based on the location of the MPA center point. This somewhat arbitrary bioregion assignment, lead to artifacts in the evaluation results that were potentially misleading. In order to alleviate confusion in Round 2 draft MPA proposal evaluations, the SAT will evaluate bioregional replication in more detail, including an assessment of the number of replicates in each of the bioregions. For MPAs that straddle the bioregional divide, the SAT will divide habitat replicates across the two bioregions (1/2 replicate in each) to indicate that these habitat replicates occur in the transitional zone between bioregions and could reasonably be assigned to either bioregion. More details about evaluation methods for habitat replication can be found in Chapter 5 of the document *Draft Methods Used to Evaluate Marine Protected Area Proposals in the MLPA North Coast Study Region*.

Adaptive Management and LOPs

3. ***How will adaptive management (e.g. sea urchin management areas) be considered with respect to levels of protection (LOP)? What is the LOP for adaptive management of urchin? If only experimental take is allowed in an MPA, can the MPA receive a higher LOP than commercial take of urchin?***

Response: The response to this question is summarized in Document G.1. Proposed Concepts for Designing Experimental MPAs to Inform Adaptive Management to be presented at the May 12, 2010 SAT meeting.

Mobile MPAs

4. ***What does the SAT think of the mobile MPAs and how will mobile MPAs be evaluated in future rounds?***

Response: While mobile MPAs may be an effective tool for managing fisheries for particular species, they are not likely to provide substantial ecosystem benefits because populations within the area of MPA movement will be subject to periodic fishing mortality. Thus, fished species within mobile MPAs are unlikely to achieve a natural (i.e. unfished) abundance, size and age structure, or full reproductive potential.

A simple modeling exercise reveals that mobile MPAs of the type proposed in Round 1 of the MLPA north coast MPA design process (from External Proposed MPA Array A) are likely to result in a minor reduction in fishing effort and mortality across the zone of MPA movement (referred to as the “stewardship zone” in External A). In population simulations for a typical rockfish-like species (small adult home range and long distance larval dispersal) the reduction in fishing effort within the zone of MPA movement resulted in a modest increase in biomass compared to simulations with no MPA, but this increase in biomass was substantially less than that realized in nearby static MPAs (see Figure 1). In order to interpret these results, it is important to understand that the simple model assumes uniform fishing effort across the entire zone of MPA movement. For the sake of illustration, model results for the scenario of unsustainable fisheries management outside of the MPAs are shown in Figure 1. Model outputs for lower levels of fishing mortality showed similar results, but the effect of the mobile MPAs was more difficult to discern in the figures.

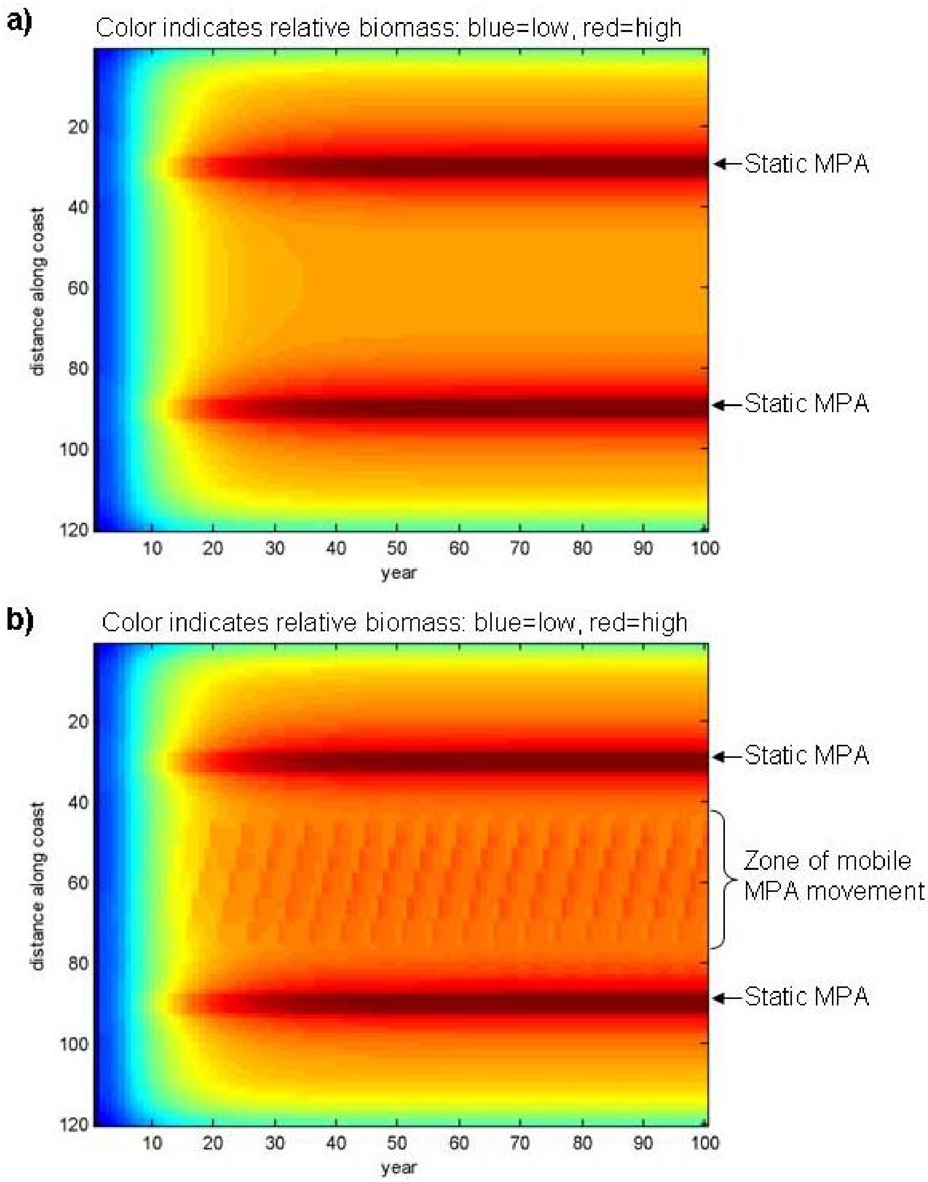
Because populations in mobile MPAs are only sporadically protected from fishing and thus are unlikely to achieve a natural abundance, size, and age structure, many of the ecosystem and population benefits of static MPAs will likely not be realized by their mobile counterparts. Because fished adults of long-lived species are unlikely to achieve large size or high reproductive output within the mobile MPA, the benefits of enhanced larval supply within MPAs and adjacent fished areas will likely not be realized. Thus, mobile MPAs are unlikely to contribute substantially to achievement of goals 2 and 6 of the MLPA. Likewise, adults of fished species are unlikely to achieve natural (i.e. unfished) abundances across the zone of MPA movement. Thus, the functional role of these species in the ecosystem is likely to be altered by fishing and mobile MPAs are unlikely to contribute substantially to achievement of goals 1 and 4 of the MLPA.

If mobile MPAs are proposed in future rounds of the nNorth coast MPA design process, the SAT will not evaluate these MPAs as static (as was done in Round 1), but will evaluate the entire zone of MPA movement as an area of slightly reduced fishing pressure. If necessary, the SAT will assign a level of protection to the zone of MPA movement that considers the take of all legally fished species within that zone.

Additional Information

Game, E.T., M. Bode, E. McDonald-Madden, H.S. Grantham, and H.P. Possingham. 2009. Dynamic marine protected areas can improve the resilience of coral reef systems. Ecology Letters 12: 1336–1346.

Figure 1: Modeled Population Response of a Rockfish-like Species with and without Mobile MPAs. Model results displayed here show the relative biomass response of a rockfish-like species to two different MPA network configurations under a scenario of unsustainable fisheries management outside the MPAs. Plot A shows an MPA configuration with two static MPAs placed a distance from one another along a uniform coastline. Plot B shows the same MPA configuration with the addition of a mobile MPA that shifts location annually within a larger zone.



Modeling

5. ***The protection of marine life's natural diversity and abundance is a central goal of the Marine Life Protection Act. Additionally, species diversity and abundance are typical indicators for adaptive management programs. However, I find myself lacking information about how marine protected areas (MPA) on the North Coast are likely to affect diversity or abundance. It has been suggested that in some MPAs, the abundance of larger fish (e.g., adult lingcod) may increase, while the abundance of smaller fish (e.g., juvenile rockfish) may decline. It has also been suggested that some MPAs may become "sea urchin barrens". In the SAT assessment of MPA arrays, it would be useful to know how individual MPAs and MPA arrays are expected to affect species diversity and abundance. The details of this assessment are important. If an MPA, or MPA array, is expected to have a significant impact on diversity or abundance, it would be important to know what the expected change is (e.g., more lingcod, higher biodiversity, etc.). Furthermore, some estimate of the certainty in these assessments would be valuable to decision makers who will evaluate MPA alternatives. I do realize that these estimates of certainty are likely to be qualitative. Nevertheless, as arbitrary examples, it would be important to know that – MPA X is likely to have significantly higher biodiversity than MPA Y within X years - or – the difference in red abalone abundance that would result from MPA Array Alternative X versus MPA Array Alternative Y is highly uncertain. Can species diversity and abundance be explicitly considered, as described above, in the SAT assessment of external MPA arrays? Submitted to MLPAcomments on February 11.***

Response: The bioeconomic models yield predictions for individual species' responses to the implementation of MPAs based on the best available information about each species' biology and population dynamics. The population dynamics implicitly include density-dependent mechanisms by which a population affects its own dynamics. Interactions between species (e.g., competition or predator-prey interactions) are not explicitly modeled, but are included implicitly in the estimates of natural growth and mortality rates for each species. The species selected for model analysis are targeted by fishing and have been studied well enough so that their biology and population dynamics are known. In addition, the species selected for model analysis tend to achieve relatively large size as adults and are, in many cases, near the top of the marine food web. Additionally, these species generally have diverse diets (they feed on many species) and are vulnerable to predation by multiple species. Because of these characteristics, the direct effect of MPAs on the mortality rates of these model species is likely to be greater than secondary (or indirect) effects caused by changes in populations of other species (such as predators, competitors and prey). For these and similar species, therefore, predictions of MPA effects based on single-species models are likely to be robust, even though they do not include multi-species interactions.

Model results have been developed for a suite of species that span a broad range of adult and larval movement patterns with the intent of providing insight into expected single-species responses to the implementation of MPAs. In contrast to the modeled species, for which fishing can be a major driver of population dynamics, the majority of species in marine ecosystems are not subject to direct take by humans. For many species, effects of MPAs on their abundance or population structure will likely depend less on the direct effects of fishing and more on ecological links to other species also protected within the MPAs. Species that compete directly with harvested species or are prey for harvested species are likely to exhibit local declines in abundance within MPAs. For example, if an MPA effectively protects lingcod, cabezon, and larger rockfish species from fishing, the increased abundance and size of these predators is likely to result in a reduction in abundance of smaller fish and invertebrate species that are prey for these large predators.

Responses are more difficult to predict for species that do not interact directly with harvested species. The overall effect of an MPA on species affected indirectly by fishing may be determined as much or more by ecological interactions than by a reduction of fishing. Interconnected ecological changes across the marine food web (known as trophic cascades) might be observed in MPAs established in ecosystems where predator-prey interactions strongly influence community structure (Micheli et al. 2004, Baskett et al. 2007). Overall, results from existing MPAs such as those in California's Channel Islands, suggest that targeted species tend to be higher in abundance within MPAs than outside, while non-targeted species show no consistent pattern (e.g. Hamilton et al. 2010).

Ecological theory does not provide a firm prediction for the effect of MPAs on "biodiversity" per se; that is, the total number and evenness of species in a community. A review of other MPAs worldwide recently found that diversity (measured as number of species) was on average 21% higher inside MPAs than outside (Lester et al. 2009). However, it is important to note that diversity did not increase in all studies and this global average does not necessarily predict the likely outcome in California MPAs.

Conceptually, it is possible to predict the effects of MPAs on a suite of species in order to infer the effects on the biodiversity of the entire community. However, developing rigorous quantitative predictions for this purpose will require implementation of multi-species models that include all ecologically significant species-species interactions, such as direct predator-prey relationships, competitive interactions, or apparent competition mediated through a common predator (or fishery). It is possible to construct theoretical models that include species interactions (e.g. Baskett et al. 2007), but the inputs into such models of the full ecosystem require extensive information, which may not be available for many species. Existing ecosystem models, such as EcoPath with EcoSim and Atlantis (Field et al. 2006, Horne et al. 2010, and Kaplan and Levin 2009), could be useful for making general predictions about the outcomes of ecological interactions, but the ecological data necessary to formulate such models is lacking and such models tend to operate at a coarser spatial scale than would be desired for the MLPA process.

In short, the current state-of-the-art modeling falls short of being able to make quantitative predictions about multiple interacting species at fine spatial scales. However, information collected through MPA monitoring has strong potential enhance our understanding of ecological interactions in coastal marine ecosystems, and high resolution models including species interactions are in development. While these efforts cannot inform the current phase of the MLPA process, they can be expected to inform adaptive management and design of MPAs in the future. Although scientists are unable to predict specific or quantitative changes to biodiversity in MPAs using the current bioeconomic models, models will developed in the coming years that likely will produce quantitative predictions that could be useful in interpreting monitoring data.

References

Baskett ML, Michelie F, and Levin SA. 2007. Designing marine reserves for interacting species: insights from theory. Biological Conservation 137: 163-179

Field, J.C., R.C. Francis and K. Aydin. 2006. Top-down modeling and bottom-up dynamics: Linking a fisheries-based ecosystem model with climate hypotheses in the Northern California Current. Progress in Oceanography 68: 238-270.

Hamilton SL, Caselle JE, Malone DP, and Carr MH. In press. Incorporating biogeography into evaluations of the Channel Islands marine reserve network. Proceedings of the National Academy of Science.

Horne, P., I.C. Kaplan, K. Marshall, P.S. Levin, C.J. Harvey, A.J. Hermann, and E.A. Fulton. 2010. Design and parameterization of a spatially explicit ecosystem model of the central California Current. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-104.

Kaplan, I.C., and P.S. Levin. 2009. Ecosystem-based management of what? An emerging approach for balancing conflicting objectives in marine resource management. Springer, 736 p.

Lester, SE, Halpern BS, Grorud-Colvert K, Lubchenco J, Ruttenberg BI, Gaines SD, Airame S, and Warner RR. 2009. Biological effects within no-take marine reserves: a global synthesis. Marine Ecology Progress Series 384: 33-46.

Micheli F, Halpern B, Botsford LW, and Warner RR. 2004. Trajectories and correlates of community changes in no-take marine reserves. Ecological Applications 14: 1709-1723.

6. Is there a way to use the models to predict the economic consequences in 2-5 years? Please look into the benefits of 10-year closures.

Response: At present, it is not possible to use the bioeconomic models to produce meaningful predictions of biological or economic responses to implementation of MPAs over short periods of time. Instead, modelers focus on steady-state conditions expected after a long period of time. The time required to reach this steady-state depends on the population dynamics and biology of the modeled species: a long-lived species will require more time than a short-lived species for abundance, biomass, and age-structure to reach steady state. The ecosystem focus of the Marine Life Protection Act suggests that it is necessary to consider the longest-lived species in setting appropriate time frames for evaluating the steady state. Assemblages of marine animals in Northern California include species with maximum life spans greater than 50 years, and the models describe species with maximum life spans ranging from 10-50 years.

There are two main reasons that modelers rely on long-term steady-state conditions rather than on the short-term or transient responses to implementation of MPAs. Both reasons are related to the practical limitations of the available data rather than an underlying conceptual limitation of the models themselves.

First, scientists lack information on abundance and size structure of populations at sufficiently high spatial resolution to serve as initial conditions from which to run the model. The predicted state of a model population after a short period of time is sensitive to the population state at the start of the model run. The long-term steady-state condition, however, is not sensitive to assumptions about initial conditions. Additionally, some species, particularly those that are long-lived as noted above, can be expected to show relatively little biological response within the short term (2-5 years), although the change over 20 or 50 years may be substantial. Additionally, the short-term responses depend strongly on the specific larval survival and transport conditions that affect the populations, whereas average larval survival and transport conditions are better captured in predictions of the long-term steady state.

Second, scientists lack information about how fish and fishers will respond in the short-term to implementation of MPAs. Quantifying economic effects also requires information on the current distribution of fished populations, as this will influence where fishers focus their efforts after MPAs are established. Some economic data on commercial and recreational fisheries, gathered by Ecotrust, are available in the north coast study region and these data were used to model “fleet-scale” responses to proposed MPAs, taking into account other opportunities to fish.

Birds and Mammals

7. ***Is there a way to model the responses of bird and mammal communities to SMR placement? What are the differences between SMRs and SMCAs in providing benefits to birds and mammals?***

Response: The existing bioeconomic models are suitable for modeling marine fish and invertebrates for species with sufficient information known about the life histories, habitats, oceanographic circulation, and the distribution of fishing effort. Different models would need to be developed to take into account the habitats used by seabirds and marine mammals and the interactions between the proposed MPAs, prey species, competitors, and birds and mammals. The SAT Modeling Work Group is not planning at this time to develop a new model to consider responses of birds and mammals.

Models of population responses of birds and mammals to proposed MPAs would need to account for changes in populations of prey species of fish and invertebrates protected in proposed MPAs. Little is known about the diet of cormorant species on the north coast of California. Other seabirds foraging in the nearshore predominantly prey on mobile, schooling species (e.g., smelt, herring, anchovy, euphausiids) and Pacific Sandlance. These prey species are not primary targets for most fisheries in the north coast and therefore MPAs, which may prohibit or limit commercial and recreational fisheries, are not likely to cause substantial changes in populations of these prey species. Benefits of offshore MPAs to seabirds and marine mammals are mainly due to potential reduction of displacement on foraging grounds by vessel traffic. These benefits are modeled in the nearshore foraging analysis (to assess the impact of MPAs to the three mile buffers around breeding sites) and the neritic ‘hotspot’ foraging analysis.

Reduction of close-approach vessel traffic and human access at breeding sites is, by far, the greatest benefit to birds and mammals from establishing MPAs. In this respect, special closures, which prohibit vessel traffic, provide the greatest benefits to birds and mammals; SMRs, which prohibit all consumptive uses and associated vessels, provide the next greatest benefit, and some SMCAs that limit close approach of vessels to breeding sites also may provide benefits comparable to SMRs.

8. How does the SAT rank the potential impacts of various activities on birds and mammals? Could the SAT make an "LOP" chart for activities that may negatively affect birds and mammals?

Response: For Round 1 draft MPA array analyses, the evaluation of birds and mammals was restricted to state marine reserves (SMRs) (and some state marine conservation areas (SMCAs) from External Proposed MPA Array C). However, the SAT recognizes that some activities have greater impacts to birds and mammals than others and SMCAs permitting certain activities should be considered independently in the analysis of potential benefits and impacts of proposed MPAs to birds and mammals. The SAT Marine Birds and Marine Mammals Work Group identified activities in SMCAs that would be consistent with providing benefits to marine birds. In Round 2, SMCAs providing benefits to marine birds will be included in the appropriate aspects of the evaluation (see Table 9.2). Given the lack of information on the impacts of specific activities, only special closures and SMRs will be included in the marine mammal analyses.

Table 9-2 from Evaluation Methods. Proposed activities that will qualify (Yes) or disqualify (No) an SMCA for consideration as part of the evaluation of potential benefits of proposed MPAs to seabirds.

Activity	Breeding Colony/Hot Spots Analysis	Roost Analysis	Near-colony Foraging Analysis	Neritic Foraging Analysis	Estuary / Beach Analysis
Coonstripe shrimp and spot prawn (trap)	No	No	No	No	Yes
Pacific halibut (H&L)	No	No	No	No	Yes
Surf and night smelts (dip net, a-frame net, cast net)	Yes	Yes	Yes	Yes	No
Salmon – Recreational (H&L or troll in waters >50m depth)	Yes	Yes	No	No	Yes
Salmon – Commercial (H&L or troll in waters >50m depth)	Yes	Yes	Yes	No	Yes
Salmon – Recreational (troll in water <50m depth)	Yes	Yes	No	No	Yes
Salmon – Commercial (troll in water <50m depth)	Yes	Yes	Yes	No	Yes
Salmon – Recreational (H&L in waters <50m depth)	No	No	No	No	Yes
Salmon – Commercial (H&L in waters <50m depth)					
Coastal pelagic finfish (H&L, round-haul net, dip net)	Yes	Yes	No	No	No
Dungeness crab – Recreational (trap, hoop-net, diving)	No	No	No	No	Yes
Dungeness crab – Commercial (trap, hoop-net, diving)	Yes	Yes	Yes	No	Yes
Smelt (H&L, dip net)	Yes	Yes	No	No	No

Activity	Breeding Colony/Hot Spots Analysis	Roost Analysis	Near-colony Foraging Analysis	Neritic Foraging Analysis	Estuary / Beach Analysis
Redtail surfperch and other surfperch (H&L from shore)	Yes	Yes	Yes	Yes	No
Surfperch (H&L)	No	No	No	No	No
California halibut (H&L)	No	No	No	No	No
Clams (intertidal hand harvest)	Yes	Yes	Yes	Yes	No
Turf algae (intertidal hand harvest)	Yes	Yes	Yes	Yes	No
Lingcod, cabezon and rockfishes and greenlings (H&L, spearfishing, trap)	No	No	No	No	No
Red abalone (free-diving)	No	No	Yes	Yes	No
Urchin (diving)	No	No	No	No	Yes
Rock scallop (diving)	No	No	No	No	No
Mussels (hand harvest)	Yes	Yes	Yes	Yes	No
Bull kelp (hand harvest)	No	No	No	No	No
Ghost shrimp (hand harvest)	Yes	Yes	Yes	Yes	No
Sea palm (intertidal hand harvest)	No	No	No	Yes	No
Canopy-forming algae (intertidal hand harvest)	No	No	No	Yes	No

9. Are there areas where pigeon guillemots are more densely concentrated for foraging?

Response: During the nesting season (April – August), Pigeon Guillemots and Pelagic Cormorants both rely heavily on rocky bottom habitat for foraging, and they stay close to nesting colonies. For this reason, these bird species are expected to receive more benefit from MPAs that protect rocky bottom habitats in locations close to nesting colonies. Other seabirds are expected to receive more benefit from MPAs that protect the neritic 'hotspot' foraging areas, which are based on bird distribution throughout the coast, not just near colony areas. The neritic foraging analysis will be available soon in MarineMap.

Fisheries and Economics

10. Why were surfperch not included as recreational species in the Ecotrust evaluation?

Response: Ecotrust collected information about the commercial fishery for surfperch. During the design phase for the recreational survey, Ecotrust—in consultation with MLPA Initiative and DFG staff—decided to omit the pier/shore sector, which includes surfperch. This and other recreational sectors are covered by DFG's California Recreational Fisheries Survey (CRFS) dataset. DFG determined that the sample size of surfperch fishermen was so small that it was not possible to make predictions about the effort occurring from the beach in the north coast study region.

11. How are the economic impacts to aquaculture considered in the Ecotrust evaluation?

Response: Ecotrust is not considering potential economic impacts to aquaculture because the California Fish and Game Commission cannot designate MPAs that close existing aquaculture leases. There are, therefore, no potential economic impacts to aquaculture associated with any MPA proposal. In response to requests from the mariculture industry in the north coast study region and the MLPA Initiative and DFG staff, Ecotrust created a geographic information system (GIS) dataset and economic report for use by the MLPA North Coast Regional Stakeholder Group (NCRSG) because a comprehensive GIS dataset did not exist. This dataset is in MarineMap and allows the NCRSG to identify potential MPA sites that overlap with a mariculture lease, which effectively requires mariculture as an allowed use and SCMA designation of that MPA. The Ecotrust evaluation methods and reporting will indicate whether an MPA overlaps a mariculture site (presence/absence). A description of how the mariculture dataset was created and a summary of responses to the economic survey are reported in Appendix H: Shellfish summary statistics, *Survey Methods and Summary Statistics for Ecotrust's North Coast Study Region Fishery Uses and Values Project.*

12. Where are impacts to shore-based fishing included in the Ecotrust evaluation?

Response: Ecotrust is seeking guidance from DFG regarding how to incorporate shore/pier fishing impacts based on DFG's California Recreational Fisheries Survey (CRFS) datasets. The CRFS dataset provides information about shore-based fishing, so instead of duplicating effort, time, and resources to collect data, Ecotrust and DFG decided that DFG would prepare the CRFS datasets for visualizing shore/pier fishing effort and provide guidance to Ecotrust for how to incorporate this information into its analysis. DFG is preparing the CRFS datasets for evaluation.

13. Why are only two ports included for recreational kayaking in the Ecotrust evaluation?

Response: Only two ports were included for recreational kayaking in the north coast study region because of the small sample size/responses. The sample statistics are described in the data/methods report that published by Ecotrust. Of all the datasets for commercial and recreational activities, the data for recreational kayaking gains the least confidence of the scientists who conducted the surveys and evaluations because of the relatively low number of people sampled and the limited geographical distribution of responses throughout the north coast study region.

Water Quality

14. Are the sewer treatments from Fort Bragg and Eureka secondary or tertiary treatment plants?

Response: All sewer treatments from Fort Bragg and Eureka are secondary treatment plants.

15. How should dredge disposal sites be considered in the design of MPAs?

Response: The SAT Water Quality Work Group will aim to produce a draft response for review during the June 29-30 SAT meeting.

16. Did the SAT consider water quality in the Klamath River and the associated impacts to False Klamath Cove?

Response: The SAT Water Quality Work Group will aim to produce a draft response for review during the June 29-30 SAT meeting. The work group may consider Klamath and other river systems as part of this question.