California MLPA Master Plan Science Advisory Team
Draft Work Group Responses to Science Questions Posed by the NCCRSG at its August 22-23, 2007 Meeting
Revised November 9, 2007

The following are draft responses of the MLPA Master Plan Science Advisory Team (SAT) to questions posed by the MLPA North Central Coast Regional Stakeholder Group (NCCRSG) at its August 22-23, 2007 meeting. These draft responses have been prepared by work groups of the SAT.

1. **Are the deep water benthic habitats and water column habitat around the Farallon Islands unique as well as worthy of inclusion?**

   This response was adopted by the SAT at its October 1, 2007 meeting.

   Response: The SAT has identified the intertidal, subtidal, and water column habitats around the Farallon Islands as unique. (Please refer to the response to Question 2 from the list of questions from the NCCRSG July 10-11, 2007 meeting.) Habitats that are unique are, according to the regional goals and objectives, worthy of inclusion.

2. **Specifically – where does the subtidal start? For MLPA purposes does it only span to the extent of state waters or does it extend to XX depth (and if so what depth)?**

   This response was adopted by the SAT at its October 1, 2007 meeting.

   Response: The subtidal includes all habitats deeper than the mean lower low water level, including state, federal, and international waters (Please refer to the response to Question 2 from the list of questions from the NCCRSG July 10-11, 2007 meeting).

3. **What level of protection would you assign to marine protected areas (MPAs) that allow take of salmon, abalone, urchin, clams, *halibut, white seabass, and crab*?** (Mark Carr, Ray Hilborn)

   Draft response: The level of protection afforded in an MPA that allows a specific activity was determined by examining the impacts that activity is likely to have on the ecosystems encompassed by the MPA. Those impacts fall into two main categories: (1) direct impacts of the activity and (2) indirect impacts of the activity on community structure and ecosystem dynamics. In the case of fishing, direct impacts include habitat disturbance and bycatch of non-target species caused by the fishing gear/method. Indirect impacts include any change in the ecosystem caused by removal of target and non-target species. In general, removal of species that play an integral role in the food web or perform a key ecosystem function (e.g. biogenic structure) will have impacts on species interactions throughout the ecosystem.

   Several factors were taken into consideration when determining the indirect ecosystem impacts of harvest: 1) target-species interactions with resident species that are likely to be protected by MPAs, and 2) target-species mobility. Ultimately, the question asked was, “would there be a difference between ecosystems within an MPA that prohibits take of this species versus an area outside of the MPA where take is allowed?” For highly mobile species such as salmon, sardines, and anchovies, prohibiting take within an MPA would likely have little impact on local populations, therefore the ecosystem impacts of removing these species are considered to be low.

The levels of protection are presented on a 10-point scale. The numbers are intended as a ranking only and not as a quantitative assessment of the protection afforded. An MPA that allowed multiple activities received the lowest level of protection assigned to those activities.

Very High (10) – no take of any kind allowed, this designation applies only to state marine reserves (SMRs)

High (8) – MPAs were assigned this level of protection if the SAT concluded that the allowed fishing activity had a very low bycatch of resident species, caused minimal habitat damage, and was likely to have little impact on ecosystems in the MPA. The mobility of the target species was an important factor in determining ecosystem impacts. Individuals of highly mobile species are expected to move frequently between MPAs and unprotected waters, so local populations of these species are unlikely to be enhanced by MPAs. Because the fishing activity is likely to have little impact on populations of target or any other species (low bycatch), the activity is expected to have little impact on the ecosystem. For example, fishing activities that received a high level of protection include salmon trolling near the surface in deep-water (>50 meter depth), and pelagic seine fishing for anchovies, sardines, and herring.

Mod-High (6) – Fishing activities assigned to this level of protection caused minimal habitat damage, but had either more bycatch or a greater likelihood of ecosystem impacts than those in the high (8) protection category. For example, MPAs that allowed non-troll salmon fishing or salmon trolling in waters shallower than 50m depth were assigned to this level of protection because of the likelihood of increased bycatch of resident benthic species such as rockfish. Similarly, MPAs that allowed crab fishing with traps/pots were assigned this level of protection because crabs are only moderately mobile and interact directly with the resident ecosystem. It is difficult to predict whether local populations of crabs will be affected by MPAs, but if they are, a reduction in the crab population in fished areas could have ecosystem-wide impacts.

Moderate (4) – Fishing activities assigned to this level of protection had higher bycatch of resident species or a greater likelihood of ecosystem impacts than those assigned to the mod-high (6) category. Examples of fishing activities that received a moderate (4) level of protection included hook and line fishing for halibut and other flatfish, diving for abalone, shore-based fishing with hook and line gear in larger MPAs.

Low (2) – Fishing activities assigned to this level of protection either directly targeted resident species, had significant bycatch of resident species, or targeted species whose removal is expected to have an impact on the resident ecosystem. Examples of fishing activities that received a low (2) level of protection included harvest of urchin, lingcod, cabezon, greenling, rockfish, and surfperches.

Low (0) – Only fishing activities that caused habitat destruction were assigned to this category. Harvest of kelp, mussels, and other habitat-forming organisms received a low (0) level of protection, as did trawl fishing.

Level of Protection Name	Rank Level of Protection	MPA Designations	Activities Associated with this Protection Level
Very high	10	SMR	No take
High	8	SMCA	Salmon trolling in >50m depth sardine, anchovy, and herring (pelagic seine)
Mod-high	6	SMCA	Salmon trolling in <50m depth salmon fishing with non-troll H&L crab (traps) squid (seine)
Moderate	4	SMCA, SMP	Halibut (H&L) other flatfishes (H&L) abalone (diving) – white seabass shore-based finfishing in MPAs that extend offshore (due to limited access) hand harvest of clams
Low	2	SMCA, SMP	Urchin (diving) lingcod, cabezon, greenling, rockfish, and other reef fish surfperches
Low	0	SMCA, SMP	Kelp harvest mussel harvest trawl activities because of habitat destruction

Coastal MPAs are most effective at protecting species with limited range of movement and close associations to seafloor habitats. Less protection is afforded to more wide-ranging, transient species like salmon and other coastal pelagics (e.g., albacore, swordfish, pelagic sharks). This has led to proposals of state marine conservation areas (SMCAs) that prohibit take of bottom-dwelling species, while allowing the take of transient pelagic species. However, fishing for some pelagic species, like salmon near the bottom or in relatively shallow water, increases the likelihood of taking bottom species that are targeted for protection (e.g., California halibut, lingcod, rockfishes). Rates of bycatch are particularly high in shallow water where bottom fish move close to the surface and become susceptible to the fishing gear. In addition, for recreational salmon fishing, the practice of “mooching” has a potentially higher bycatch rate than that of trolling.

Participants at a national conference[1] on benthic-pelagic coupling considered the nature and magnitude of interactions among benthic (bottom-dwelling) and pelagic species, and the implications of these interactions for the design of marine protected areas. At this meeting, scientists, managers and recreational fishing representatives concluded that bycatch is higher in water depths <50m (164 ft) and lower in deeper water. This information, along with incidental catch statistics provided by DFG, contributed to our categorization of MPAs into five possible levels of protection.

Salmon trolling

Direct impacts – salmon trolling causes little or no direct habitat damage as gear never touches the seafloor. CDFG bycatch data are available for both recreational and commercial fisheries (Table 1). However, these data are not depth-specific and the recreational data do not distinguish trolling from mooching. In addition to these bycatch data, NOAA's National MPA Center's convened an expert workshop of fisheries biologists, marine ecologists, MPA managers and recreational fishermen at the MPA Science Institute in November 2005 in Monterey, California. This workgroup concluded that troll gear in deep water (>50m) is sufficiently far from the seafloor that there is little or no bycatch of resident benthic species. In shallower water (<50m), however, the work group concluded that bycatch of resident species (e.g., rockfish species and lingcod) increases.

Indirect impacts – Salmon generally feed on mobile forage species such as herring, sardines, anchovies, krill, squid, and smelt. As both salmon and their prey are highly mobile, MPAs are likely to have little impact on local populations of these species. Thus, the indirect ecosystem impacts of salmon take are predicted to be low.

Level of protection:
High (8) – if water depth in MPA is greater than 50m
Mod-high (6) – if water depth in MPA is less than 50m due to increased bycatch

Table 1. Bycatch estimates for salmon fisheries

Caught on recreational trips targeting salmon w/ H&L (2000-2007)	# of fish	% of Fish caught
salmon	**53,228**	**94.96%**
rockfish	1,584	2.83%
other (<1% of catch)	1,240	2.21%
Total	56,052	

[1] Benthic-pelagic linkages in MPA design: a workshop to explore the application of science to vertical zoning approaches. November 2005. Sponsored by NOAA National Marine Protected Area Center, Science Institute, Monterey, CA.

Caught on commercial* trips targeting salmon w/ troll H&L gear (2000-2006)	lbs of fish	% of Fish wt caught
salmon	**15,557,819**	**99.82%**
other (<1% of catch)	27,297	0.14%
Total	15,585,117	

Caught on commercial* trips targeting salmon w/ non-troll H&L gear (2000-2006)	lbs of fish	% of Fish wt caught
salmon	**141,579**	**82.69%**
halibut	16,253	9.47%
pelagic spp.	6,234	3.64%
rockfish	3,514	2.05%
reef spp.	2,941	1.72%
other (<1% of catch)	696	0.43%
Total	171,218	

* commercial bycatch data is includes landed fish only and does not include any discarded catch

Salmon mooching

Direct impacts – Salmon mooching gear has contact with the bottom, but likely causes little habitat damage. Because this fishing gear targets the bottom, there is greater bycatch of benthic species including rockfish and lingcod which are likely to otherwise be protected by MPAs.

Indirect impacts – Salmon generally feed on mobile forage species such as herring, sardines, anchovies, krill, squid, and smelt. As both salmon and their prey are highly mobile, MPAs are likely to have little impact on local populations of these species. Thus, the indirect ecosystem impacts of salmon take are predicted to be low.

Level of protection:
Mod-high (6) – due to bycatch

Abalone hand collection

Direct impacts –Because divers harvest selectively, there is little or no bycatch of non-target species. However, divers often accidentally remove sub-legal size individuals, which may kill the animal even though it is often immediately replaced. High numbers of divers at local access sites can lead to localized habitat impacts and behavioral responses of mobile species.

Indirect impacts – Abalone are important herbivores and prey in the nearshore rocky environment, therefore removal of this species is likely to have impacts on community structure within an MPA. Although abalone have deep water refugia beyond free-diving depths, depletion of local shallow adult spawning stocks within an MPA, combined with short larval dispersal distances, can reduce the local availability of young abalone as prey to small predators.

Level of protection:
Moderate (4) – due to indirect ecosystem effects

Urchin hand collection

Direct impacts – Hand collection of urchins causes some habitat disturbance (anchoring, which can disturb both rock and kelp as habitat). Because divers harvest selectively, there is little or no bycatch of non-target species.

Indirect impacts – Urchins are important herbivores and prey in the nearshore rocky environment, therefore removal of this species is likely to have impacts on community structure within an MPA. It has also been shown that urchin populations can impact the level of kelp abundance (negatively), thereby altering the relative abundance of this species in a kelp forest. Rogers-Bennet and Pearse (2001) also showed that abalone recruit to sea urchins and that density of abalone recruits was greater in northern CA MPAs where urchins were protected from take.

Level of protection:
Low (2) – due to indirect ecosystem effects

Clam hand digging

Direct impacts – Clam digging causes significant disturbance to soft-bottom intertidal habitats and may also alter the behavior of local shorebirds and marine mammals. There is bycatch associated with this activity as excavation may kill non-target infaunal species, and improperly placed sublegal clams. The depth distribution extends beyond depths at which hand digging is feasible, thereby restricting the proportion of the population harvested.

Indirect impacts – clams are important filter-feeders in the nearshore soft-bottom ecosystem and prey for sharks, skates and rays, therefore removal of this species is likely to have impacts on community structure within an MPA.

Level of protection:
Moderate (4) – due to habitat disturbance and bycatch

Halibut hook and line

Direct impacts – Halibut fishing with hook and line gear (including long-lines) involves bottom contact but causes little habitat disturbance. Bycatch includes demersal sharks, skates and rays, other flatfish, and a variety of reef fish including rockfish, lingcod, and cabezon that would otherwise be protected by MPAs (Table 2). In the recreational fishery, 29% of reported catch on halibut trips was composed of non-target species. In the commercial fishery, roughly 7% of species landed on halibut trips were non-target species. There is no information available on commercial catch discarded.

Indirect impacts – Halibut are an important predator in the coastal ecosystem. Any change in local abundance of halibut is anticipated to have impacts on communities within MPAs, however, the movement patterns of halibut are not fully understood. Several studies indicate that young (mostly sub-legal sized) halibut are only moderately mobile and most stay within 2-5 km of their tagging release site for months or years although some move hundreds of km within that same time period. There is also information to suggest that larger halibut may be more mobile than small. Given available information on halibut movement it is unclear whether local populations will change due to protection by the size of MPAs proposed in this process.

Level of protection:
Moderate (4) – due to bycatch and the importance of halibut as a top predator

Table 2. Bycatch estimates for halibut fisheries.

Caught on recreational trips targeting halibut w/ H&L (2000-2007)	# of fish	% of Fish caught
halibut	**7,888**	**70.63%**
demersal sharks, skates & rays	1,209	10.83%
pelagics wetfish	514	4.60%
freshwater or estuarine spp.	513	4.59%
rockfish	388	3.47%
surfperch	318	2.85%
reef spp.	185	1.66%
other (<1% of catch)	152	1.36%
Total	11,168	

Caught on commercial* trips targeting halibut w/ H&L gear (2000-2006)	lbs of fish	% of Fish wt caught
halibut	**527,982**	**92.59%**
reef spp.	15,037	2.64%
rockfish	11,147	1.95%
salmon	7,193	1.26%

other (<1% of catch)	8,875	1.56%
Total	570,233	

* commercial bycatch data is includes landed fish only and does not include any discarded catch

Halibut trawl

Direct impacts – Bottom trawling for halibut causes significant habitat disturbance and bycatch of a variety of species including other flatfishes and rockfish (Table 3). It should be noted that there is currently no trawling allowed in state waters.

Indirect impacts – Halibut are an important predator in the coastal ecosystem. Any change in local abundance of halibut is anticipated to have impacts on communities within MPAs, however, the movement patterns of halibut are not fully understood. Several studies indicate that young (mostly sub-legal sized) halibut are only moderately mobile and most stay within 2-5 km of their tagging release site for months or years, although some individuals move hundreds of km within that same time period[2 3]. There is also information to suggest that larger halibut may be more mobile than small. Given available information on halibut movement it is unclear whether local populations will change as a result of the protection afforded by MPAs of the size proposed in this process.

Level of protection:
Low (0)

Table 3. Bycatch estimates for halibut trawl

Caught on commercial* trips targeting halibut w/ trawl gear (2000-2006)	lbs of fish	% of Fish wt caught
halibut	**2,286,577**	**43.66%**
flatfish	2,278,898	43.51%
rockfish	362,080	6.91%
roundfish	151,294	2.89%
demersal sharks, skates and rays	94,209	1.80%
reef spp.	51,662	0.99%
other (<1% of catch)	12,588	0.24%
Total	5,237,309	

* commercial bycatch data is includes landed fish only and does not include any discarded catch

[2] Domeier, M. L., C.S. Chun (1995). "A tagging study of the California halibut (Paralichthys californicus)." CalCOFI Rep. **36**: 204-207.

[3] Posner, M., R.J. Lavenberg (1999). "Movement of California halibut along the coast of California." California Fish and Game **85**(2): 45-55.

Crab traps

Direct impacts – Crab traps contact the bottom but cause only minor habitat disturbance. Bycatch includes rock crabs, octopus, sea stars, and female Dungeness crabs in low numbers (Table 4). Sea otters have been known to become entangled in traps.

Indirect impacts – Dungeness crabs are key predators in the benthic environment and their abundant larvae provide food for a variety of pelagic species. A significant reduction in Dungeness crab populations could have ecosystem-wide impacts, however, crabs show moderate mobility (10-15 km)[4] and it is unclear whether protection through MPAs of the sizes proposed would have an effect on local populations.

Level of protection:
Mod-high (6) - due to ecosystem impacts

Table 4. Bycatch estimates for the crab fishery.

Caught on commercial* trips targeting crab with traps/pots (2000-2006)	lbs of fish	% of Fish wt caught
Dungeness	28,324,432	99.87%
other crab	26,488	0.09%
octopus	6,819	0.02%
other (<0.1% of catch)	3,686	0.01%
Total	28,361,426	

* commercial bycatch data is includes landed fish only and does not include any discarded catch

White seabass

Direct impacts – fishing for white seabass with hook and line gear causes little or no direct habitat damage as gear rarely touches the seafloor. White seabass have not been regularly targeted in the study region over the past 7 years, so it was impossible to assess region-specific bycatch for this species. An analysis of recreational bycatch information (Table 5) for white seabass state-wide indicates that a wide variety of reef species including rockfish, kelp bass, and lingcod are regularly caught on trips targeting white seabass. In fact, 77% of the catch on trips targeting white seabass was of non-target species, mostly kelpbass, which are not abundant in the study region. Moreover, it is not clear that these other species are true bycatch, but instead are targeted when seabass catch is poor.

[4] Smith, B. D., G.S. Jamieson (1991). "Movement, spatial distribution, and mortality of male and female dungeness crab Cancer magister near Tofino, British Columbia." Fishery Bulletin **89**(1): 137-148.

Indirect impacts – White seabass mainly feed on highly mobile coastal pelagics such as herring, anchovies, and squid, thus they are likely to have a low impact on the resident benthic ecosystem.

Level of protection:
Moderate (4) - due to bycatch

Table 5. Bycatch estimates for the white seabass fishery

Caught on recreational trips targeting white seabass w/ H&L (2000-2007, all California)	# of fish	% of Fish caught
reef spp.	1,716	41.48%
white seabass	**1,377**	**33.28%**
rockfish	238	5.75%
pelagic spp.	232	5.61%
shallow sand and kelp spp.	176	4.25%
demersal sharks, skates & rays	117	2.83%
halibut	110	2.66%
pelagics wetfish	108	2.61%
other (<1% of catch)	63	1.52%
Total	4,137	

4. **What is range and pattern of movement for the various life-stages of yellow-eye rockfish, surfperch, greenling, cabezon, [monkeyfaced prickleback (a.k.a. monkeyfaced eel, *Cebidichthys violaceus*)] and [rock prickleback, (*Xiphister mucosus*)], halibut, and white seabass?** (Mark Carr, Jan Freiwald)

This response still requires review by the full SAT before being adopted.

Draft response: A literature review conducted by Jan Freiwald shows that 75% of tagged individuals of the following species moved less than 0.5 km during the study period:

- yellow-eye rockfish (*Sebastes ruberrimus*)
- surfperch (*Embiotoca jacksoni* and *E. lateralis*)
- greenling (*Hexagrammos decagrammus*)
- cabezon (*Scorpaenichthys marmoratus*)
- monkeyface prickleback (*Cebidichthys violaceus*)*

* the study on monkeyface prickleback movement was excluded from the literature review analysis because fewer than 10 individuals were tagged. However, all tagged individuals moved less than 3 km.

The SAT was unable to find information on the movement of rock prickleback or white seabass.

References

Coombs, C. I. 1979. Reef fishes near Depoe Bay, Oregon: movement and the recreational fishery. Oregon State University.

DeMott, G. E. 1983. Movement of tagged lingcod and rockfishes off Depoe Bay, Oregon. M.S. Thesis Oregon State University.

DeWees, C. M., and D. W. Gotshall. 1974. An experimental artificial reef in Humbold Bay, California. California Fish and Game 60.

Freiwald, unpublished

Helm, R. C. 1990. Population dynamics of an intertidal eel blenny, Cebidichthys violaceus: Diet, growth, homing, and avian predation. Ph.D. Thesis. University of California Davis.

Hixon, M. A. 1981. An experimental analysis of territoriality in the California reef fish Embiotoca jacksoni (Embiotocidae). Copeia 1981:653-665.

Lea, R. N., R. D. McAllister, and D. VenTresca. 1999. Biological aspects of nearshore rockfishes of the genus sebastes from Central California with notes on ecological related sport fishes Fish Bulletin 177.

Matthews, K. R. 1985. Species similarity and movement of fishes on natural and artificial reefs in Monterey Bay, California. Bulletin of Marine Science 37:252-270.

Miller, D. J., and J. J. Geible. 1973. Summery of blue rockfish and lingcod life histories; a reef ecology study, and giant kelp, Macrocystis pyrifera, experiments in Monterey Bay, California. Fish Bulletin 158:137.

Ralston, S. L., and M. H. Horn. 1986. High tide movements of the temperate-zone herbivorous fish Cebidichthys violaceus (Girard) as determined by ultrasonic telemetry. Journal of Experimental Marine Biology and Ecology 98:35-50.

California Halibut (Paralichthys Californicus)

Tagging studies of California halibut indicate that the majority of individuals remain in a localized area for extended periods of time, while others move long distances along the coast (Domeier and Chun 1995, Posner and Lavenberg 1999). In the Posner and Lavenberg study, 65% of recaptured halibut were recaptured within 5.5km of their release site (this is the highest resolution of movement provided by the data). In the Domeier and Chun study, 60% of recaptured halibut moved less than 2 km during the study period. The authors note that most recaptured fish were at liberty for fewer than 100 days likely due to a high rate of tag loss, however even within that 100 days, some individuals moved more than 300 km.

Any distinctions between adult and juvenile patterns of movement are still unclear, as few of the halibut in these tagging studies were larger than the sport fishery size limit of 56 cm total length (17% in the Domeier and Chun, only 3% in Posner and Lavenberg) In the Domeier and Chun study, halibut larger than 50 cm (approx 30% of sample size) tended to travel markedly greater distances than halibut smaller than 50 cm.

A study focusing on juvenile California halibut settlement revealed preference either for bays or the open coast. However, almost all coastal settlers entered and used the bays as nursery areas during their first year of life, or else they died (Kramer 1991).

References

Domeier, ML and CSY Chun 1995. A Tagging Study of the California Halibut (Paralichthys Californicus). California Department of Fish and Game, CalCOFl Rep., Vol. 36

Kramer, SH 1991. Growth, mortality, and movements of juvenile California halibut Paralichthys californicus in shallow coastal and bay habitats of San Diego County, California. Fishery Bulletin 89(2) 195-207

Posner, M and RJ Lavenberg 1999. Movement of California halibut along the coast of California. California Fish and Game, Vol. 85(2) 45-55

5. **In the central coast study region the recommendation to extend MPAs to the three mile state water limit to cover the range of depths and species that utilize the range of depths made sense but the north central coast study region is largely homogenous out to the three mile limit, so does it still require MPA extension to the three mile state water boundary?**

This response was discussed by the SAT at its October 1, 2007 meeting but may need further clarification before it is adopted.

Draft response: The SAT recommends that MPAs be designed to extend from the intertidal to the boundary of state waters to encompass the depth-related movements of various species across the range of depths in state waters. The SAT recommends that MPAs in the 30-100 m depth range encompass as much of this depth range as possible out to the boundary of state waters, thereby protecting the collective number of species that occur there and accommodate their depth-related migrations. In the case that the habitat is homogeneous (uniform substrate and uniform depth ±5m) across a broad area, MPAs should be designed to encompass adult neighborhood sizes and movement patterns in both alongshore and cross-shore directions. In the design guidelines, the SAT recommends that MPAs span a minimum of 3 miles alongshore to encompass adult movement patterns. In cases where habitat is homogeneous across a broad area, adults are likely to extend their movement in both alongshore and cross-shore directions, therefore MPAs should also extend a minimum of three miles seaward (towards the state waters boundary) to encompass these movements. The SAT notes that extending MPA boundaries to the edge of state waters has the added benefit of allowing for connections with possible future MPA designations in federal waters.

(For additional information please refer to the response to Question 4 from the list of questions from the NCCRSG July 10-11, 2007 meeting.)

6. How do you evaluate proposals relative to Goal 2, Objective 2 for the protection of foraging, nursery and rearing areas?

a. Specifically, also considering seabirds, mammals, and sharks.

This response still requires review and further clarification by the full SAT before being adopted.

Draft response: (Question 6) Fish and invertebrates use habitats already named in the master plan for MPAs goals and objectives (such as estuaries and kelp forest/rocky reefs) for their foraging, nursery, and rearing activities. Therefore, evaluating proposals for protection of these habitats will suffice to evaluate protection of foraging, nursery and rearing areas for most fish and invertebrate species.

Draft response: (Question 6a – reference to sharks) An analysis of available information about shark breeding, forage, and nursery areas indicates that sharks largely use habitats already named in the master plan for MPAs goals and objectives (such as estuaries and soft bottom) for these activities (see table below). Therefore, evaluating proposals for protection of these habitats will suffice to evaluate protection of foraging, nursery and rearing areas for most shark species in the study region. The special importance of estuarine habitats for certain species of shark should be noted. Proposals that protect a high proportion of the available estuarine habitats will be especially protective of these species.

Common Name	**Sci. Name**	**Forage areas**	**Breeding areas**	**Nursery areas**
Sevengill shark	*Notorynchus cepedianus*	SFB	SFB birthing	SFB
Spiny dogfish	*Squalus acanthias*	SFB	(season: Sept-Jan)	young occupy pelagic
Angel shark	*Squatina californica*	soft flat bottoms near vertical relief	unknown	unknown

Common Name	**Sci. Name**	**Forage areas**	**Breeding areas**	**Nursery areas**
Basking shark	*Cetorhinus maximus*	near-surface filter feeders: areas of abundant plankton	unknown	thought to be in plankton-rich oceanic waters at higher latitutdes and far away from coastal areas
White shark	*Carcharodon carcharias*	Farallons, Bodega Headlands, Ano Nuevo	unknown	warm-temperate areas
Leopard shark	*Triakis semifasciata*	SFB, Tomales, Drakes Estero	(in spring) SFB birthing within eel grass beds	SFB, Tomales, Drakes Estero
Brown smoothhound shark	*Mustelus henlei*	SFB, Tomales	unknown	SFB, Tomales
Soupfin shark	*Galeorhinus galeus*	demersal and pelagic	(in spring)	SFB, Tomales (# has declined to since fishery of 30's-40's, still under historic levels)
Torpedo ray	*Torpedo californica*	sandy bottoms, near kelp beds, around rocky reefs	unknown	unknown
Big skate	*Raja binoculata*	coastal benthic	unknown	unknown
California skate	*Raja inornata*	nearshore soft bottom benthic	unknown	unknown
Longnose skate	*Raja rhina*	on or near reefs with vertical relief	unknown	unknown
Starry skate	*Raja stellulata*	nearshore benthic	unknown	unknown
Bat ray	*Myliobatis californicus*	SFB, Tomales, Drakes Estero	unknown	SFB, Tomales, Drakes Estero
White-spotted chimaera	*Hydrolagus colliei*	benthic mud or cobblestone near vertical relief	(maximum spawning during spring and summer) egg cases deposited on mud or gravel substrate	Cordell Banks

Draft response: (Question 6a – reference to birds and mammals) This response is incorporated in the *SAT DRAFT MLPA Evaluation Methods for MPA Array Proposals* document and requires further discussion before being adopted.

7. Provide an estimate of number of pinnipeds in the area and an estimate of weight of fish taken.
   a. Also want to know what impacts range expansion of Humboldt squid has and how that should be considered.

This response still requires review by the full SAT before being adopted.

Draft response: (Question 7) Five pinniped species commonly occur in the north central coast study region: harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), Steller sea lions (*Eumetopias jubatus*), northern fur seals (*Callorhinus ursinus*), and northern elephant seals (*Mirounga angustirostris*). Of these species, only harbor seals are year-round residents; other species visit the region seasonally or are migratory through it. Peak abundance estimates for these species in the NCCSR are:

Harbor seals: ~8000—during the breeding season
California sea lions: ~2000—most are male winter visitors to the study region
Steller sea lions: ~250—southern limit of the species, with small breeding colonies in the study region
Northern fur seals: ~250—this species migrates through the region primarily offshore of state waters, but there is a small breeding population at the Farallons
Northern elephant seals: ~3000—migratory and present in the study region during breeding and molting seasons, likely do not feed in the area

These numbers are the best available average peak population estimates, and actual numbers can vary greatly. Furthermore, abundances and behaviors vary among seasons and among species. Population fluctuations and seasonal variation in feeding intensity make it difficult to provide accurate estimates of the total weight of fish taken in the study region. Current estimates are that actively feeding pinnipeds consume from 4% to 10% of their body weight each day, with an average of 6%. Juveniles and pregnant females consume a higher percentage of their body weight than non-pregnant adults. It is important to note that not all pinnipeds are actively feeding during the breeding season. Also, many pinnipeds target juvenile or mid-sized fish, not large mature individuals. Average pinniped body size and a rough estimate of the weight of fish consumed daily are presented in Table 1.

Table 1

Species	Avg. Female (lbs)	Avg. Male (lbs)	Weight of prey consumed (lbs/day)	Prey species
Harbor Seal	180	180	10	Fish, squid, octopus
Cal. Sea Lion	180	600	10-35	Fish, squid, octopus
Steller Sea Lion	580	1250	30-75	Fish, squid, octopus
Northern Fur Seal	100	525	10-30	Small fish, invertebrates

Northern elephant seals likely do not feed in the area, instead migrating to Alaska and the north Pacific gyre to feed.

References

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Personal communication: Sarah Allen (Point Reyes National Seashore), Beth Phillips (Marine Wildlife Veterinary Care and Research Center), Jacquie Hilterman (The Marine Mammal Center, and Dede Sabbag (The Marine Mammal Center).

Draft response: (Question 7a) Though observational field data shows a recent increase in the number of Humboldt squid (*Dosidicus gigas*) in the California Current ecosystem, it is currently unknown whether these observations represent a permanent range expansion or a temporary intrusion into the north central coast study region at the limit of its range. There is insufficient information on Humboldt squid abundances and feeding habits to accurately predict how increases in their numbers (whether temporary or permanent) can impact local ecosystems. However, as Humboldt squid are predators of commercially-important fish species, as well as being prey of species at higher trophic levels, impacts are conceivable. For the purpose of the MLPA initiative, however, Humboldt squid will probably have negligible direct impacts, as they occur outside of state waters in areas deeper than 200m.

References

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Zeidberg, L.D. and B.H. Robison. 2007. Invasive range expansion by the Humboldt squid, *Dosidicus gigas*, in the eastern North Pacific. PNAS 104: 12948-12950.

8. **Request a finer gradation of the chart Steve Gaines presented on species home range of 10-100 kilometers. *[Is it possible to disaggregate the 10-100 km category for home ranges into a finer set? (they want to know how many species are protected using a finer resolution on home range size and preferred MPA sizes)]*.** (Mark Carr, Jan Freiwald, Rick Starr)

Draft response: Robust studies of the movements of west coast fish and invertebrates are limited, but a thorough review of available literature conducted by Jan Freiwald, enabled a refinement of the adult movement chart

Adult Movement of West Coast Fish and Invertebrates

Move 0-1 km	Move 1-10 km	Move 10-100 km
0-0.5 km	**1-5 km**	**10-20 km**
striped surfperch	gopher rockfish	Dungeness crab
pile surfperch	blue rockfish	lingcod
Pacific staghorn sculpin	bocaccio	yellowtail rockfish
painted greenling	California halibut**	black rockfish
kelp greenling	walleye surfperch*	
kelp bass	greenspotted rockfish*	**20-125 km**
kelp rockfish		canary rockfish
black-and-yellow rockfish		

widow rockfish vermillion rockfish yelloweye rockfish olive rockfish monkeyface prickleback* cabezon black surfperch red irish lord brown rockfish copper rockfish quillback rockfish starry rockfish* grass rockfish* rosy rockfish* treefish*		

* studies of this species had fewer than 10 individuals
** see the response to question 4 in this document for more information

9. **The master plan for MPAs science guidelines suggest that marine assemblages may differ depending on the substrate type, even within the broad 'hard bottom' category. Specifically they suggest there may be differences in assemblages in and over granitic and sedimentary substrate on the central coast. In this regard:**
    a. **Does the same hold true for granitic, sedimentary, and Franciscan substrate on the north central coast?**
    b. **If so, does the SAT know of some way to predict where these substrates occur given the Rikk Kvitek data or otherwise?**
    c. **Can the SAT provide more information on what the composition of the assemblages is likely to be in and over these different substrate types? *(so regional stakeholders know what they're trying to protect, if necessary)***

This response was adopted by the SAT at its October 1, 2007 meeting.

Response: (Question 9a) In general granitic rock forms high relief, broad, dome-shaped reefs relative to sedimentary rock, which tends to form narrow linear ridges, while the relief and morphology of Franciscan formations is highly variable and tends toward isolated sea stacks. In the central coast region, studies have shown that substrate relief influences fish assemblages. There is no data in the NCCSR to determine if such species-habitat relationships occur in the north central region, however, it is likely that reef relief influences fish assemblages in the region, as it does elsewhere.

Response: (Question 9b) Interpretation of multibeam imagery of the ocean floor by Dr. Guy Cochrane (U.S. Geological Survey) and Irina Kogan (Gulf of the Farallones National Marine Sanctuary) in combination with other geological resources indicates that hard substrates in the MLPA North Central Coast Study Region include granitic and sedimentary rocks of the Salinian terrace, sedimentary rocks of the Great Valley Complex, and metasedimentary and metavolcanic rocks of the Franciscan Complex.

- From Pigeon Point (southern boundary of the study region) north to Elephant Rock (just south of Tomales Point) coastal substrate is largely sedimentary rock. Exceptions include:
    - Granite in Montara
    - Franciscan metasedimentary and metavolcanic rocks between Point San Pedro (Pacifica) and in Daly City where the San Andreas fault cuts across the coastline
    - Franciscan rocks (mix of rock types like in the Big Sur coast) between the Golden Gate and eastern Bolinas Lagoon (Wentworth 1997, USGS Open File Report 97-744 Part 5)
- Rock formations from Elephant Rock to Mussel Point and extending offshore to the northwest are granitic.
- From north of Mussel Point to Northwest Cape along the mainland (east of the San Andreas fault) the substrate is metamorphic Franciscan.
- Rock formations from Northwest Cape to Point Arena are sedimentary (Great Valley Complex turbidite sandstone and conglomerate) (Blake et al. 2002, USGS Miscellaneous field studies map MF-2402).

Response: (Question 9c) There are no data in the MLPA North Central Coast Study Region to allow the science advisory team to predict how fish assemblages may vary across the three available substrate types. Based on studies conducted in the MLPA Central Coast Study Region, it is likely that sedimentary formations will support relatively more foliose red algae than benthic invert cover due to the friable/erodable nature of the rock which does not provide a firm substrate for invertebrates. It is also likely that the softer sedimentary substrate will support a greater proportion of burrowing species (eg. Pholad clams).