

# Mark and recapture studies of nearshore groundfishes at Carmel Pinnacles State Marine Reserve

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## Introduction

In 1999, the California legislature passed the Marine Life Protection Act (MLPA) to help conserve biodiversity, protect habitat, and rebuild depleted fisheries. As part of the MLPA, in fall of 2007 a network of 29 marine protected areas (MPAs) was implemented along the central California coast between Pigeon Pt. and Pt. Conception. The MLPA calls for monitoring of selected areas to assist with adaptive management of the MPA network (MLPA Master Plan, 2007). Baseline data on species and habitats within MPAs and comparable areas outside MPAs are needed to inform this monitoring.

Many of the central coast MPAs are currently being monitored or have been studied in the past; however, few data exist for the Carmel Pinnacles State Marine Reserve (Pinnacles SMR) (Figure 1). The purpose of this study is to collect baseline information on fish populations within Pinnacles SMR and monitor changes over time to help evaluate the MPA's effectiveness. From July through October 2008, data on nearshore groundfish abundances, sizes, catch rates, and movements inside this MPA and in a nearby reference area at Carmel Point were collected by California Department of Fish and Game (DFG) staff using mark/recapture methods.

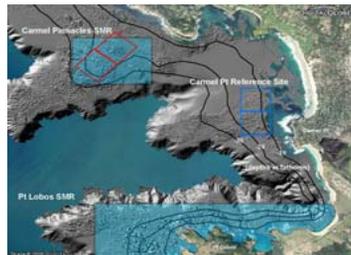
Methodology for this study was adapted from similar projects initiated by researchers from Moss Landing Marine Labs and Cal Poly, San Luis Obispo (Starr, et al., 2007).



**Figure 1.** Underwater image showing the rocky, high-relief bottom type at Carmel Pinnacles SMR. Photo: Kawika Chetron

## Materials and methods

A commercial passenger fishing vessel (CPFV or Party Boat) was used as a platform to hook-and-line catch and tag fishes at the Pinnacles and a nearby reference site, Carmel Point (Figure 2). Fishing occurred within two 500m x 500m grid cells at each site. Three 15-minute drifts were fished in each of the four grid cells each sampling day for nine days from July-September 2008. To utilize local fishing knowledge of the Carmel Bay area, flyers were posted at boat ramps, tackle shops and online to recruit experienced volunteer anglers to catch fish for the study. Locations of each drift within a grid cell were determined by the skipper and fished by 6-12 volunteer anglers. Three gear types were used equally to catch fish: shrimp flies, shrimp flies with bait, and bar jigs with a shrimp fly teaser (Figure 3a). To reduce mortality, fishing was limited to depths less than 120 feet; similar depths were fished both inside the MPA and at the reference site. Following capture, fish were measured, tagged and released. Fish exhibiting excessive trauma or fish that were less than 20 cm total length were released without tagging.



**Figure 2.** Location of sampling sites at Carmel Pinnacles State Marine Reserve and the Carmel Point reference area.

## Materials and methods (con't)

Fish trapping complemented the hook-and-line component of this study to aid in catching fish species more effectively sampled using trap gear. Trapping occurred within the same grid cells as above, but during different weeks than the hook-and-line fishing. Two 10-trap sets were fished in each of the four grid cells during 8 days from August-October 2008. Traps were standard 24" x 24" x 10" commercial wire traps with two 5-inch openings and two-inch mesh (Figure 3b). One pint of squid was used as bait and set in a smaller cage in the center of the trap. Traps were pulled after soaking for about one hour. To reduce mortality and facilitate trap retrieval, trapping was limited to depths less than 75 feet; similar depths were fished both inside the MPA and at the reference site. Following capture, fish were measured, tagged and released.

**Figures 3a and 3b.** Shrimp Fly and bar jig gear used for hook-and-line sampling (left). Tyler Marichic pulling in trap gear (right).

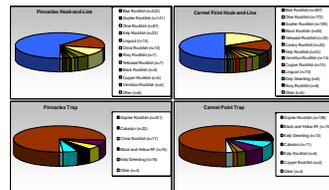


## Results

### Catch and species composition

A total of 72 anglers using hook-and-line gear caught 1834 fish, 1422 of which were tagged (Figure 4). Catch was comprised of 17 different species. More fish were caught outside the MPA than were caught inside. Canary, black, vermilion, olive, and yellowtail rockfish were caught much more frequently at Carmel Point. Blue, gopher and olive rockfish were the most common fishes caught both inside and outside of the MPA.

A total of 472 fish were caught using trap gear, 446 of which were tagged. 12 species were represented in the catch. More fish were trapped inside the MPA than outside; gopher rockfish, china rockfish, and cabezon were more frequently caught at Pinnacles. Gopher rockfish was the most common fish caught at both sites.



**Figure 4.** Species composition of fish caught by site and gear type.

### Abundance

Relative abundances of individual fish species at each site were calculated as catch per unit effort (CPUE). CPUE is listed in Table 1 as average catch per angler hour, for hook-and-line fishing, and average catch per trap for trapping. These baseline relative abundances will be important in looking at trends in catch rates over time.

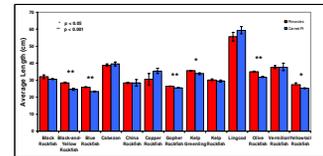
**Table 1.** CPUE for hook-and-line and trap gear. "-" indicates a value of less than 0.1 when rounded and a blank indicates no fish caught for that species. Yellow highlights indicate significant difference in CPUE (ANOVA p<0.05) between sites.

Common Name	Hook-and-line		Trap	
	Pinnacles SMR	Carmel Point	Pinnacles SMR	Carmel Point
Blue Rockfish	4.9	0.5		
Gopher Rockfish	1.3	1.5	2.0	0.9
Olive Rockfish	0.8	1.7		
Red Rockfish	0.3	0.5		
Black Rockfish				
Yellowtail Rockfish	0.1	0.3	0.1	0.1
Red Gaxtreamer		0.1		
Cabezon			0.2	0.1
Black-and-Yellow Rockfish			0.1	0.1
China Rockfish	0.1	0.1		
Lingcod	0.1			
Canary Rockfish		0.2		
Vermilion Rockfish		0.1		
Copper Rockfish	0.1	0.1		
Strip Rockfish	0.1			
Treatfish				
Rock Sole				
Barry Rockfish				
Wool-Eel				
All species combined	0.5	0.6	0.2	0.1

## Results (con't)

### Length Data

Mean total lengths for several of the 13 most frequently caught species (gear types combined by site) were significantly different between sites. A randomization test determined that kelp greenling and black-and-yellow, blue, gopher, olive, and yellowtail rockfishes were all significantly larger inside Pinnacles SMR than at Carmel Point (Figure 5). Cabezon, lingcod and copper rockfish were all moderately larger at Carmel Point than at Pinnacles, however these results were not significant at the p<0.05 level.



**Figure 5.** Average total lengths of the most common species caught at Pinnacles SMR and Carmel Point. Error bar denotes  $\pm$  one standard error.

### Tag recaptures

To date, 13 tagged fish have been recaptured and released by us on our sampling days; 6 tagged fish have been recaptured by the public (recreational skiff fishermen, recreational divers); and 5 tagged fish have been visually "recaptured" by DFG using SCUBA gear on dive surveys for fish (Figures 6 and 7). All fish were recaptured at the same site at which they were originally tagged.



**Figure 6.** Tagged cabezon at Pinnacles SMR January, 2009. Photo: Clinton Bauder.



**Figure 7.** Tagged gopher rockfish at Pinnacles SMR January, 2009. Photo: Jim Van Gogh

## Discussion

This study has been a collaboration between DFG, researchers at Moss Landing Marine Labs (MLML) and Cal Poly San Luis Obispo, members of the commercial fishing industry, and recreational anglers in central California. Locally, MLML scientists have tagged fish at Point Lobos and nearby reference sites. Point Lobos is in the same vicinity as Carmel Pinnacles and has been an MPA for over 30 years. By using similar methods to tag and recapture fish, data from the two studies can be compared.

The purpose of this study has been to collect baseline information on fish populations inside the recently designated Pinnacles SMR and nearby Carmel Point. These data will allow future comparisons to help determine whether the community has changed over time and whether the protected status of Pinnacles SMR has benefited the fish populations. Baseline data collected here are the benchmark for future comparison.

Future work is planned to continue tagging and recapturing fish during the same months (summer/early fall) for three consecutive years and then periodically thereafter to examine the rate of change in populations and any trends that develop over time.

Dive surveys are planned starting in April, 2009, to gather more information on ratios between tagged and untagged fish at the two study sites and to photograph tagged fish.

## Literature cited

California Marine Life Protection Act: Master Plan for Marine Protected Areas. Revised Draft April 13, 2007.  
 Starr, R. M., Wendt, D., Yochum, N., Green, K., Longbach, L. Surveys of Nearshore Fishes in and Near Central California Marine Protected Areas: Final Report Submitted to the Ocean Protection Council and California Sea Grant College Program. June 2008.

## Acknowledgments

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## For further information

More information can be found on the Sanctuary Integrated Monitoring Network website at:

[www.sanctuarysimon.org/monterey/sections/fisheries/projects.php?sec=f](http://www.sanctuarysimon.org/monterey/sections/fisheries/projects.php?sec=f)