

# Preliminary Assessment of the Responses of Rockfish Populations to Rockfish Conservation Areas in Central California

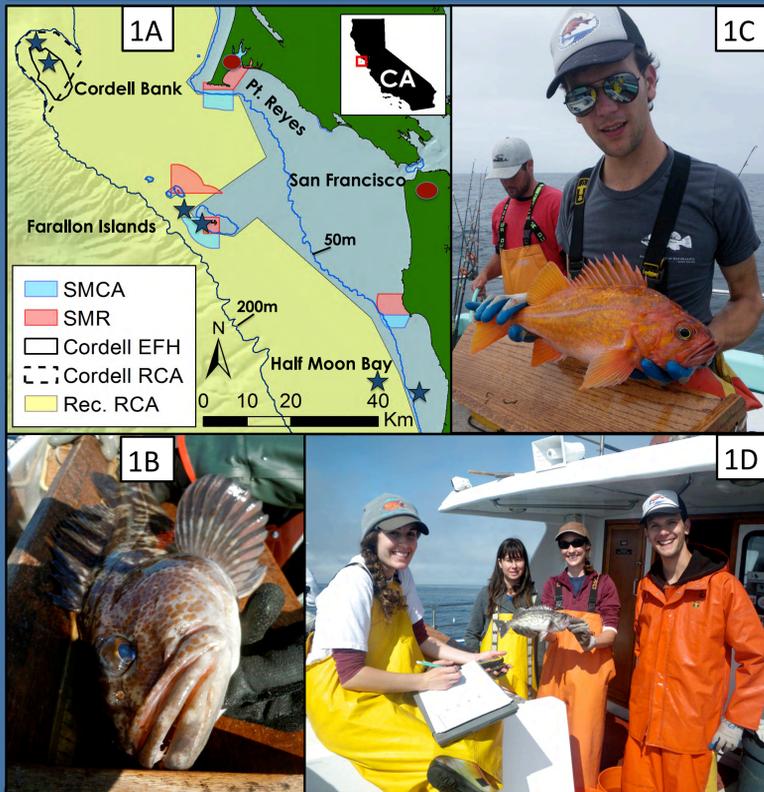
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## Introduction

- Between 1987 and 1998, California Department of Fish and Game (CDFG) (Now Department of Fish and Wildlife) conducted sampling onboard 2,267 sport fishing trips: recording catch-rates, size, and species compositions for nearly 300,000 fishes
- Rockfish Conservation Areas (RCAs) were established in 2002 after seven rockfish species (Bocaccio, Canary Rockfish, Cowcod, Darkblotched Rockfish, Pacific Ocean Perch, Widow Rockfish, and Yelloweye Rockfish) were declared overfished
- This collaborative project was formed between P.I.'s Dr. Sue Sogard and Dr. John Field of the the National Marine Fisheries Service (NMFS) and Dr. Rick Starr of Moss Landing Marine Laboratories (MLML) with the goal of assessing how 12 years of RCAs have affected rockfish populations, especially in relatively shallower regions of the RCA, which were previously frequented by fisheries.

## Results and Discussion

- Mean catch per unit effort (CPUE) increased at all sites relative to 1996-98 catch-rate data (Fig 2A)
- Yellowtail Rockfish, collected from 2012-13, were significantly larger at Cordell Bank, a result of ontogenetic shift to deep water (Fig 2B)
- Significant differences were found among mean total lengths of Yellowtail Rockfish, Canary Rockfish, 'Northern Blue' Rockfish and Widow Rockfish caught in the RCA and those caught in the respective REF sites. These also likely represent ontogenetic shifts to deeper water (Fig 2C).
- Yellowtail Rockfish (*Sebastes flavidus*) comprised the largest portion of fishes caught (Figs 2A and 2D)



**Figure 1**  
**A:** Map of study area with three study locations labeled: Cordell Bank (Cordell), Farallon Islands (Farallons), and Half Moon Bay (HMB). Sample sites are marked with blue stars. State Marine Conservation Areas (SMCA) are shown in light blue. State Marine Reserves (SMR) are shown in light red. 50 m and 200 m isobaths are displayed in light and dark blue respectively.

**B:** Science crew measuring a Lingcod (*Ophiodon elongatus*)

**C:** MLML lead science crew, Ryan Fields, with a Canary Rockfish (*Sebastes pinniger*)

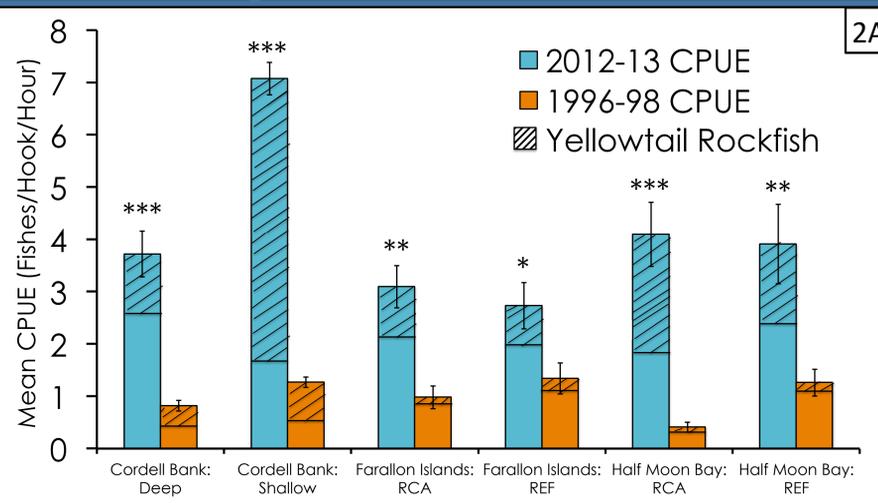
**D:** MLML and NMFS science crew with Blue Rockfish (*Sebastes mystinus*)

## Methods

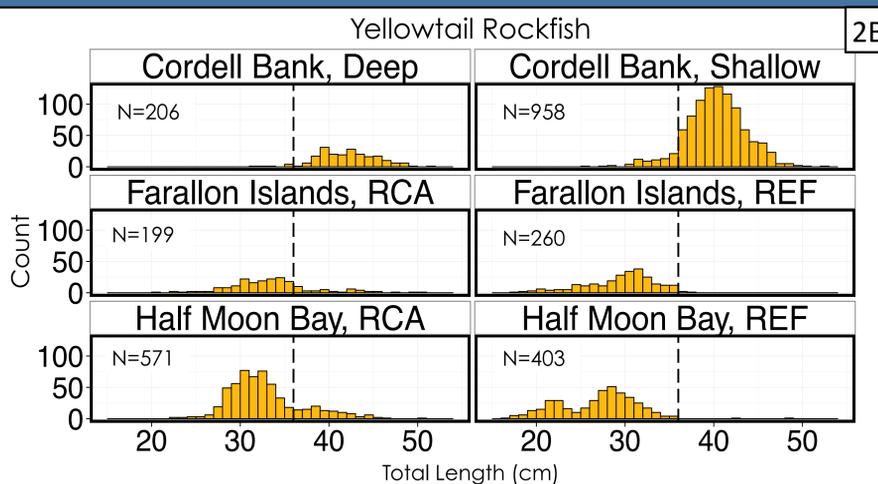
- 23 fisheries-independent, standardized hook and line fishing trips were conducted using the expertise of local captains and volunteer anglers
- 342 angler-hours were fished with 91 volunteers since October 2012
- Each trip, 1.5 hours were fished inside the RCA and outside at a reference site (REF) at the sample Locations (Half Moon Bay, Farallon Islands or Cordell Bank)
- Species composition, catch-rate, length and condition data were collected from 5,508 fishes from 29 species
- Ovaries were collected for ongoing rockfish reproductive ecology study

## Acknowledgments

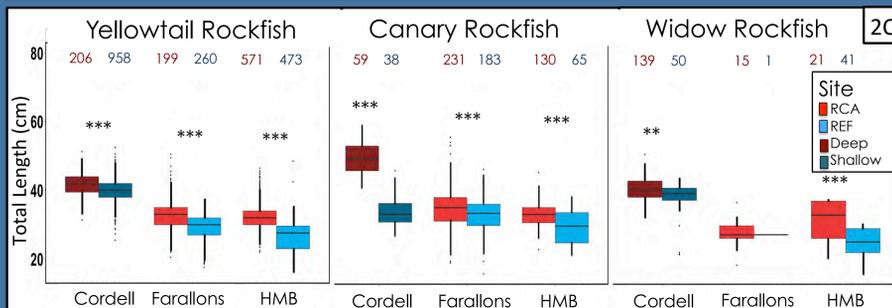
We would like to thank the following people and organizations for their contributions towards this project: funding from California Sea Grant, San Jose State University, Collaborative Fisheries Research West, and the National Oceanic and Atmospheric Administration. The MLML Fisheries and Conservation Biology Lab. The charter boat captains and deckhands aboard the vessels *F/V New Sea Angler*, *F/V Huli Cat*, and *F/V Salty Lady*. And to the many anglers who volunteered and helped make this project possible.



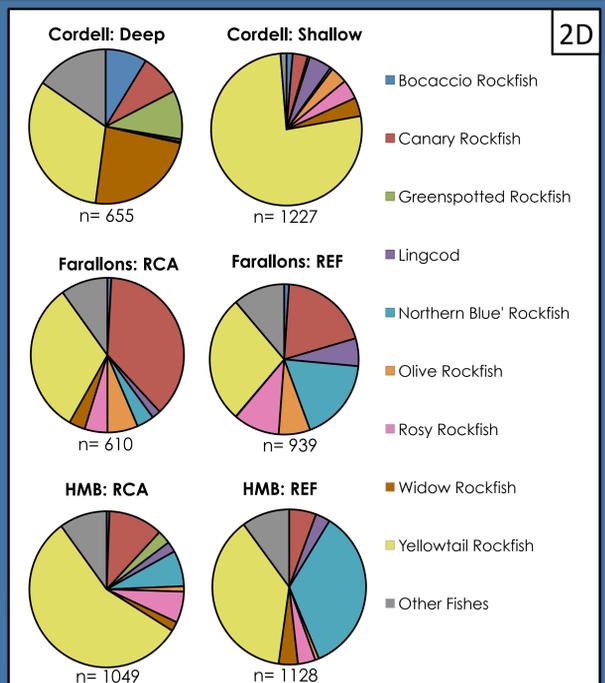
**2A:** Mean CPUE  $\pm$  SE (fishes/hook/hour) shown for 2012-13 data (blue) and 1996-98 data (orange). Yellowtail Rockfish (*Sebastes flavidus*) are represented in hashed lines. [t-test statistical significance between mean CPUE values: (\*)  $p \leq .05$ ; (\*\*)  $p \leq .01$ ; (\*\*\*)  $p \leq .001$ ]



**2B:** Length-frequency histograms for Yellowtail Rockfish (*Sebastes flavidus*) collected from 2012-13. Female length at 50% maturity is shown in hashed vertical line (Wyllie Escheverria, 1987)



**2C:** Median length for Yellowtail, Canary and Widow Rockfish by location and site. Blue represents shallow or REF sites while red denotes deep or RCA sites. Sample size is displayed above each boxplot. [t-test statistical significance between mean lengths: (\*)  $p \leq .05$ ; (\*\*)  $p \leq .01$ ; (\*\*\*)  $p \leq .001$ ]



**2D:** Species compositions calculated as percent of total CPUE (fishes/hook/hour)



We collected 145 ovaries with eggs or pre-parturition larvae from 15 *Sebastes* species for an ongoing reproductive study.

- In some *Sebastes* species, older and larger females :
- invest comparatively more energetic resources into greater larval quality (larger sized oil globule)
  - release larvae earlier in the parturition season
  - produce disproportionately more young in terms of absolute fecundity (# of larvae), and relative fecundity (#larvae per g somatic weight)
  - Show an increase in the occurrence of multiple broods over a single reproductive season

Maternal effects on larval traits or the number of larvae produced may result in increased larval survival post-parturition and a reduction in recruitment variability.



## Future Steps

Catch-rate, species composition and mean length data from the spring 2014 sample season will be integrated into the database. The 2012-14 mean species length data will be compared to 1996-98 mean length data by site to look at relative changes in length over time. The fecundity data collected is part of an ongoing project and will continue to be processed and presented at a later date.

