Survey like a BOSS:
Development of Benthic Observation Survey System to Estimate Rockfish Densities Along the Westcoast

Ryan Fields[1], Richard Starr[1], Mary Gleason[2], Chad Kecy[3], Francois Cazenave[3], Eric Martin[3], Kent Headley[3], Craig Okuda[3], Rick Botman[4], Dirk Rosen[4]

1) Moss Landing Marine Laboratories 2) The Nature Conservancy 3) Monterey Bay Aquarium Research Institute 4) Marine Applied Research and Exploration

Introduction

- There is a growing need for non-destructive survey techniques in deep water rocky-reef environments. Continuing on work our lab conducted between 2012 and 2015, we are developing a Benthic Observation Survey System (BOSS) to rapidly survey rocky reefs along the California coastline to depths of 300m.
- In 2017, we developed the new camera system and participated in a NMFS experiment to evaluate attraction and repulsion of fishes to underwater vehicles.
- In 2018, we plan to use our new system containing 4 stereo pairs of calibrated cameras to conduct a broad survey that will complement the NMFS trawl surveys. Stereophotogrammetry allows precise estimation of area-surveyed and fish densities.
- Our goal is to further the development and utilization of stereo lander tools to collect statistically robust data for groundfish stock assessments.

BOSS Design

- 8 prosumer cameras + 1 down camera
- Wide-angle lens
- Vertical overlapped stereo pairs
- 4 LED lights [3000 lum] + 1 down light
- Fiber optic, load-bearing umbilical
- 400m depth rating
- Interchangeable bases (rocky vs soft)
- Other sensors: compass, pitch and roll, depth, temperature
- Fin to allow towing
- W = 12 in, H = 5 ft, Weight = 350 lbs

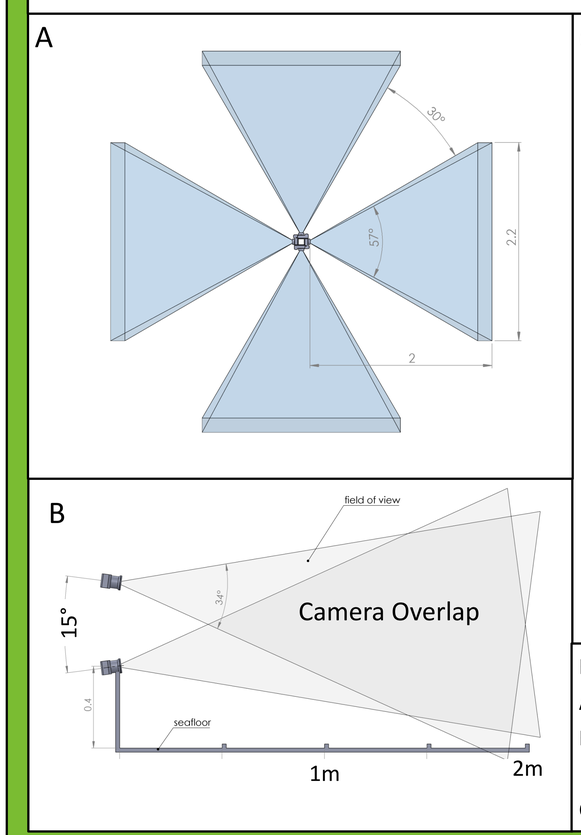

Figure 1:
A. Overhead field of view.
B. Vertical overlap stereo pair to 2m distance . Cameras are toed in 7.5 degrees each.
C. BOSS lander with main components labeled

Preliminary Results

- Field and pool tests have allowed fish ID and measurements out to 4 m with error < 2% (Fig. 2).
- Field tests at the Channel Islands indicate that BOSS is stable on rocky habitat.
- We've worked with SeaGIS to stitch together 4 video pairs for analysis of close to 360° (Fig. 3).
- We reliably set the BOSS down within a 5 m radius of a specific coordinate
- Small fish may have been attracted to the BOSS as it approached the bottom (Fig. 4A), whereas, no significant differences in mean counts of large fishes were detected during 10 min surveys (Fig. 4B). Results of the NMFS experiment will help us evaluate any effect of the BOSS on fish assemblages.

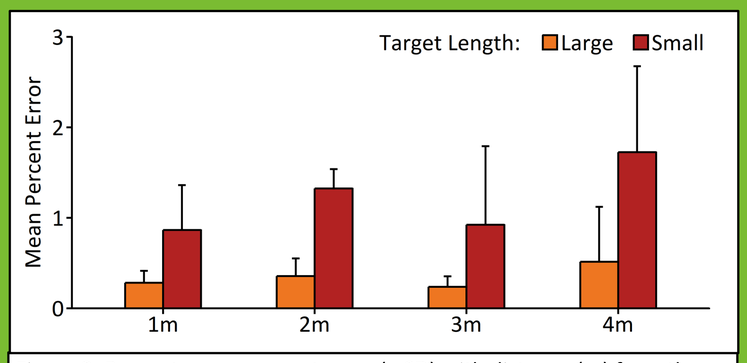

Figure 2: Percent measurement error (+ SD) with distance (m) from the target for 665 mm (orange) and 208 mm (red) targets.

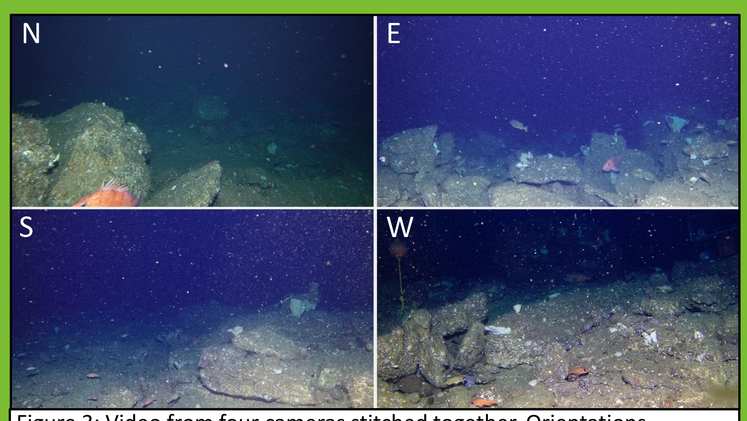

Figure 3: Video from four cameras stitched together. Orientations clockwise from top left (North, East, West, South)

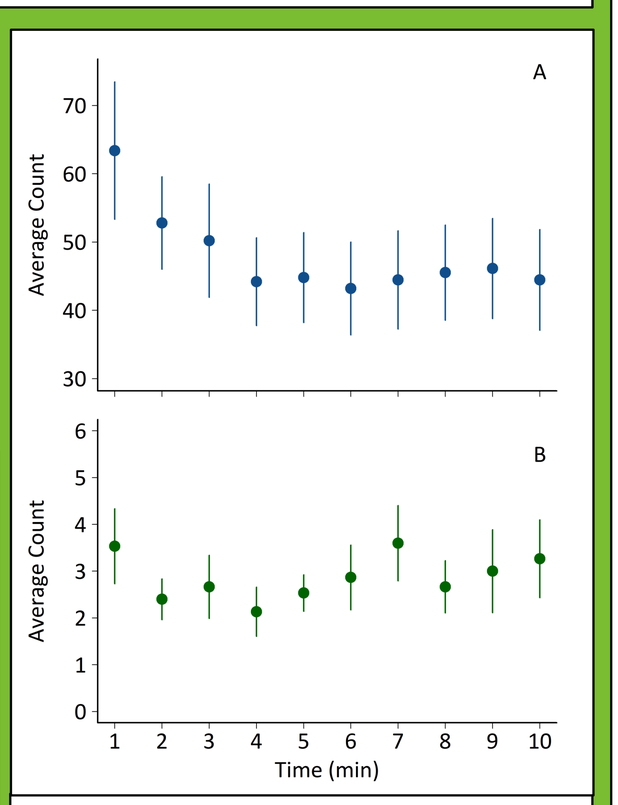

Figure 4: Mean number of fishes observed during 10 min BOSS deployments for (A) all species combined and (B) large species only

Future Directions

- Thorough testing of the new BOSS
- Analyses of species accumulation curves with more replicates over longer soak times
- Central California survey with NMFS assessing groundfish densities in untrawlable habitats using the FRAM trawl survey concepts (e.g. stratified-random, sampling of blocks etc.)
- Video analysis with 4 stereo pairs using new EventMeasure Software
- Continue to work with NMFS on the effects of underwater tools on fish behavior
- Provide estimates of density and size distribution of fished species in comparison with trawl surveys as we did in **http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0168645**

Acknowledgements

Funding was provided by The Nature Conservancy and its donors, the Packard Foundation, and the Monterey Bay Aquarium Research Institute. We would also like to thank the following people and organizations for their contributions towards this project: the National Marine Fisheries Service, the captains and crew aboard the R/V John Martin and R/V Shearwater, and Jimmy Williamson.