

Survey like a BOSS:

Development of Benthic Observation Survey System to Estimate Rockfish Densities Along the U.S. West Coast

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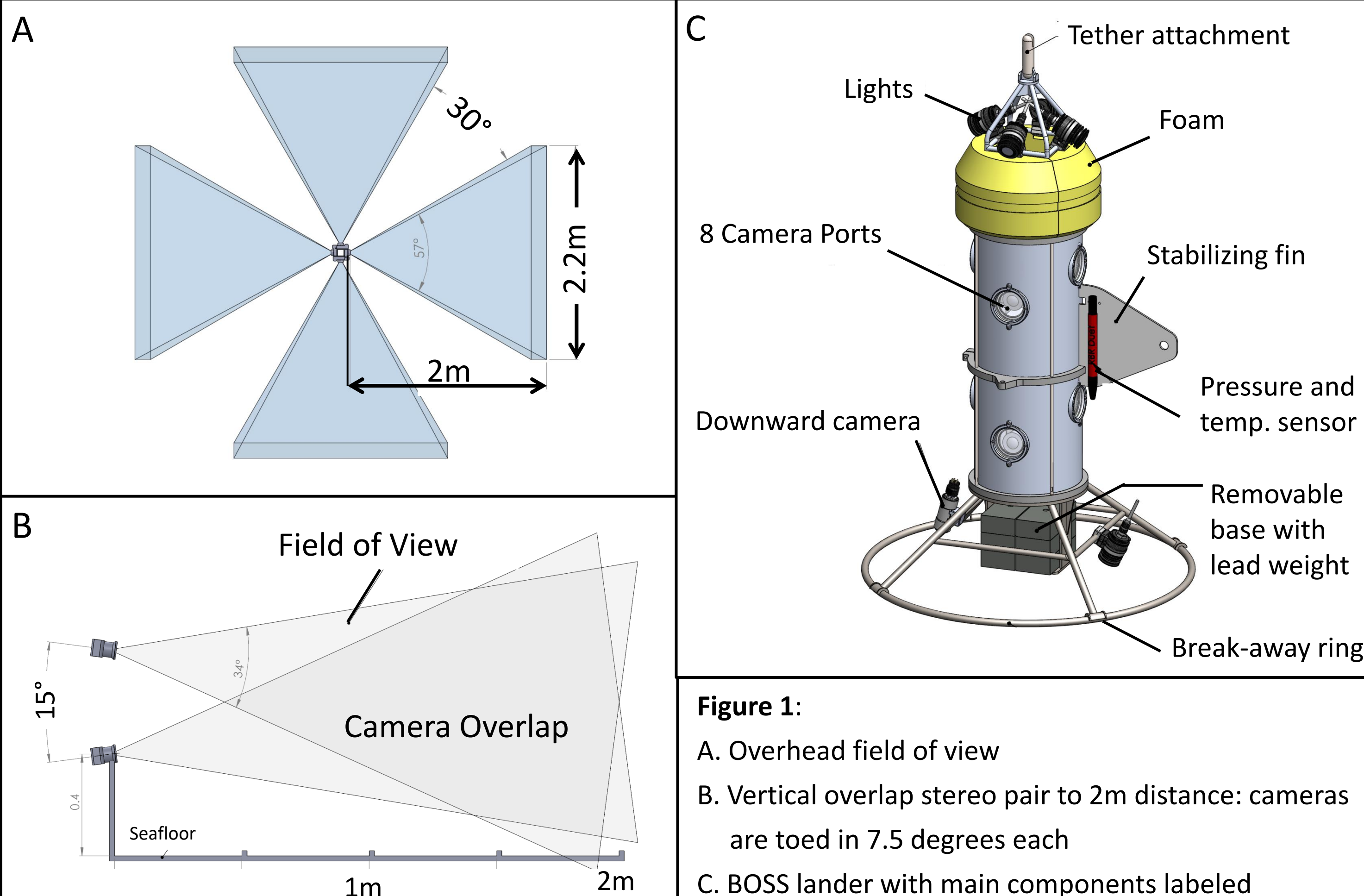
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Introduction

- There is a need for non-destructive techniques to survey fishes in deep water rocky-reef environments, especially overfished rockfishes, that are not well-sampled by current bottom-trawling surveys.
- In a collaborative project, we are developing a Benthic Observation Survey System (BOSS) to rapidly survey demersal fishes in rocky reefs across large spatial scales and to depths of 300 m.
- Building off of pilot efforts, in 2017, we developed a two-camera prototype system and participated in a NMFS experiment to evaluate fishes behavioral responses to underwater vehicles.
- In 2018, we are building a new system with 4 stereo pairs of calibrated cameras to conduct a broad survey that will complement the NMFS trawl surveys. Stereo-photogrammetry allows precise estimation of area-surveyed, fish densities, and fish sizes.
- Our goal is to further the development and utilization of stereo video tools to collect statistically robust data for groundfish stock assessments and monitoring of deep-water protected areas.

BOSS Design

- 8 prosumer HD video cameras with wide-angle lens + 1 down camera for lander placement
- Vertical overlapped stereo pairs
- 4 LED lights [10000 lumen] + 1 down light
- Fiber optic, load-bearing umbilical
- 400 m depth rating
- Interchangeable bases (rocky vs soft)
- Other sensors: compass, pitch and roll, depth, temperature
- Stabilizing fin to allow tow
- W = 12 in, H = 5 ft, Wt = 350 lb



Preliminary Results

- Field and pool tests have allowed fish ID and measurements out to 4 m with sizing error < 2% (Fig. 2).
- Field tests at the Channel Islands indicate that the BOSS is stable on rocky habitat and can be set down within a 5 m radius of a specific coordinate.
- SeaGIS software is used to stitch together 4 video pairs for analysis of close to 360° (Fig. 3).
- Based on preliminary results, 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).

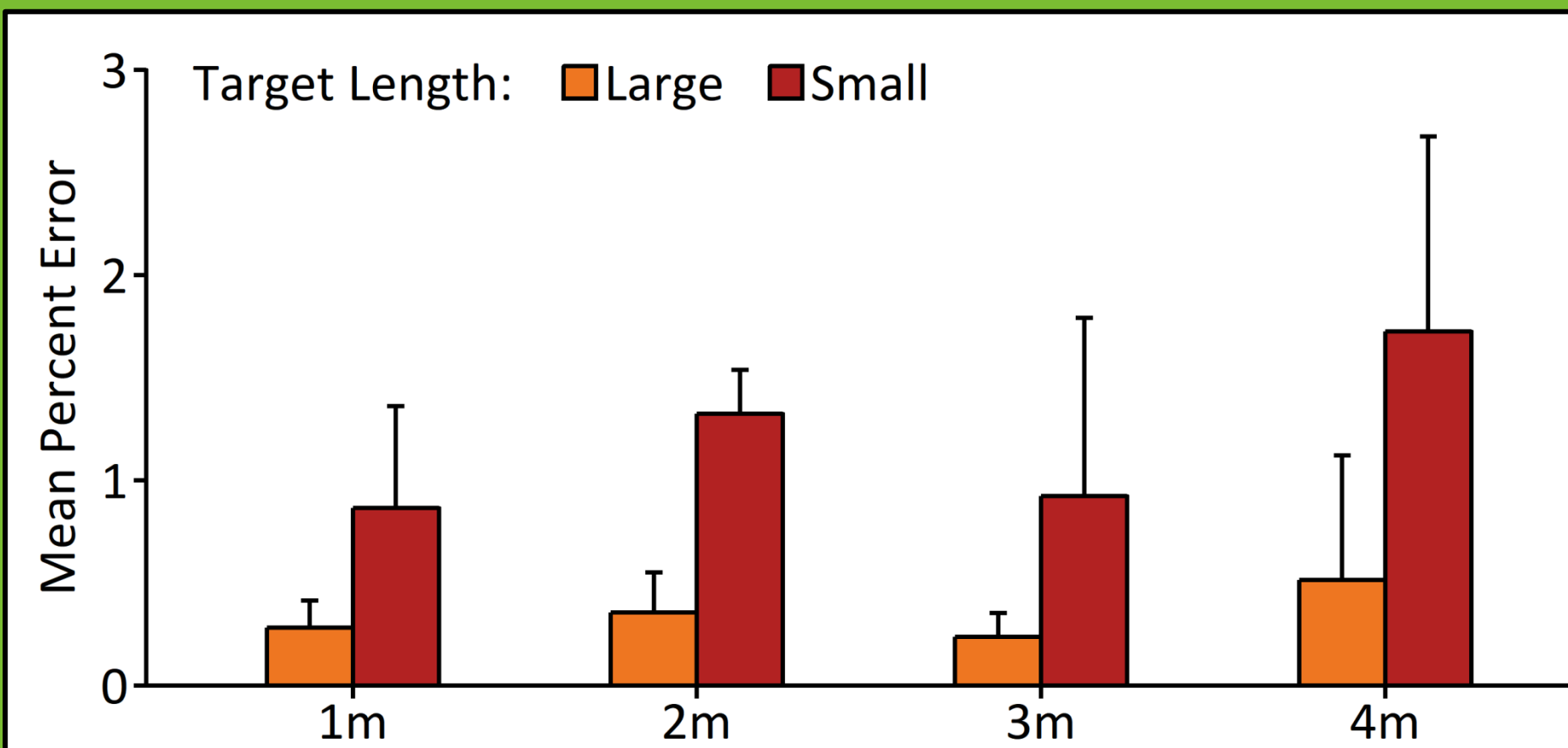


Figure 2: Percent measurement error (+ SD) with distance (m) from the target for 665 mm (orange) and 208 mm (red) targets.

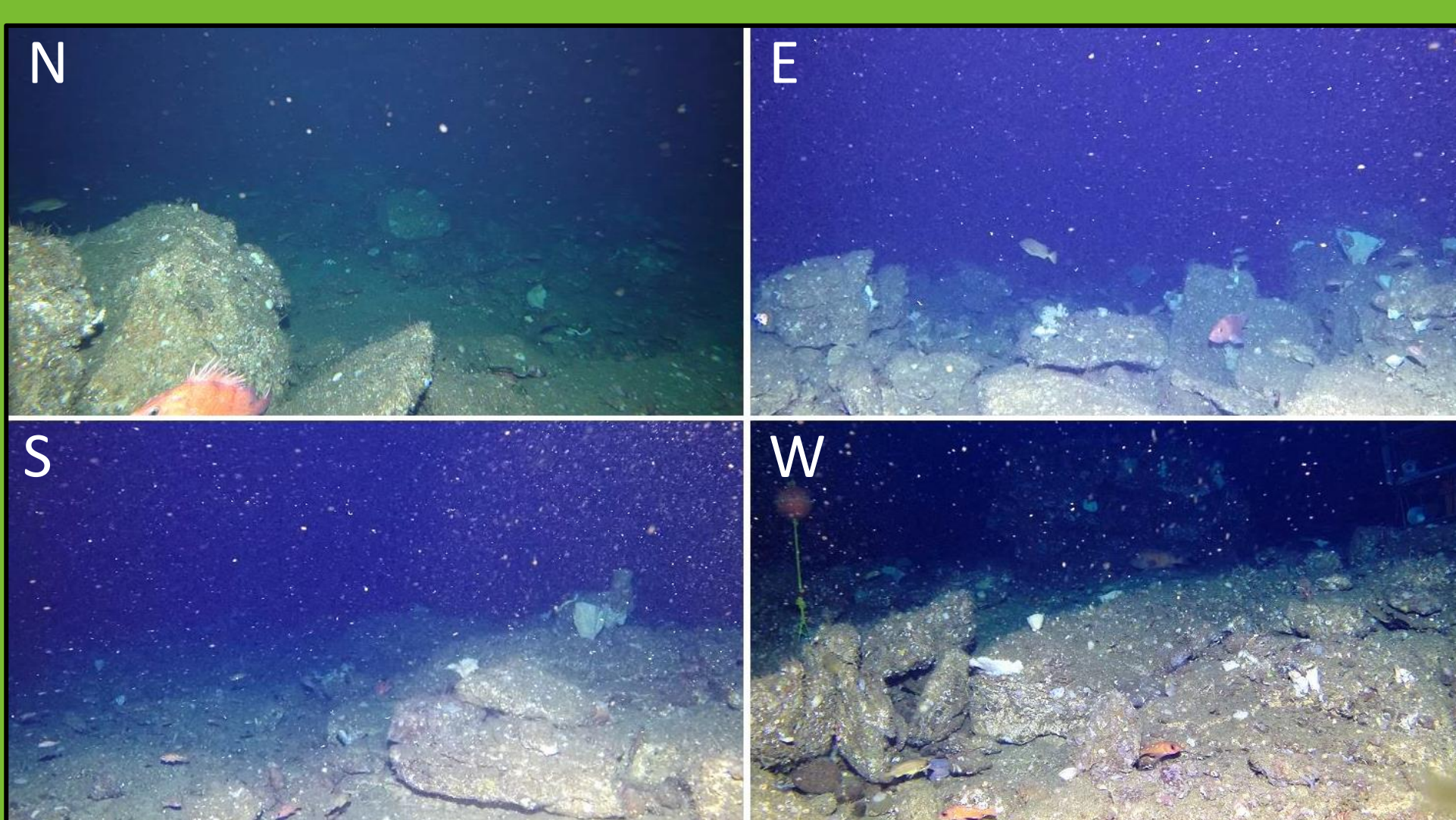


Figure 3: Video from four cameras stitched together. Orientations clockwise from top left (North, East, West, South).

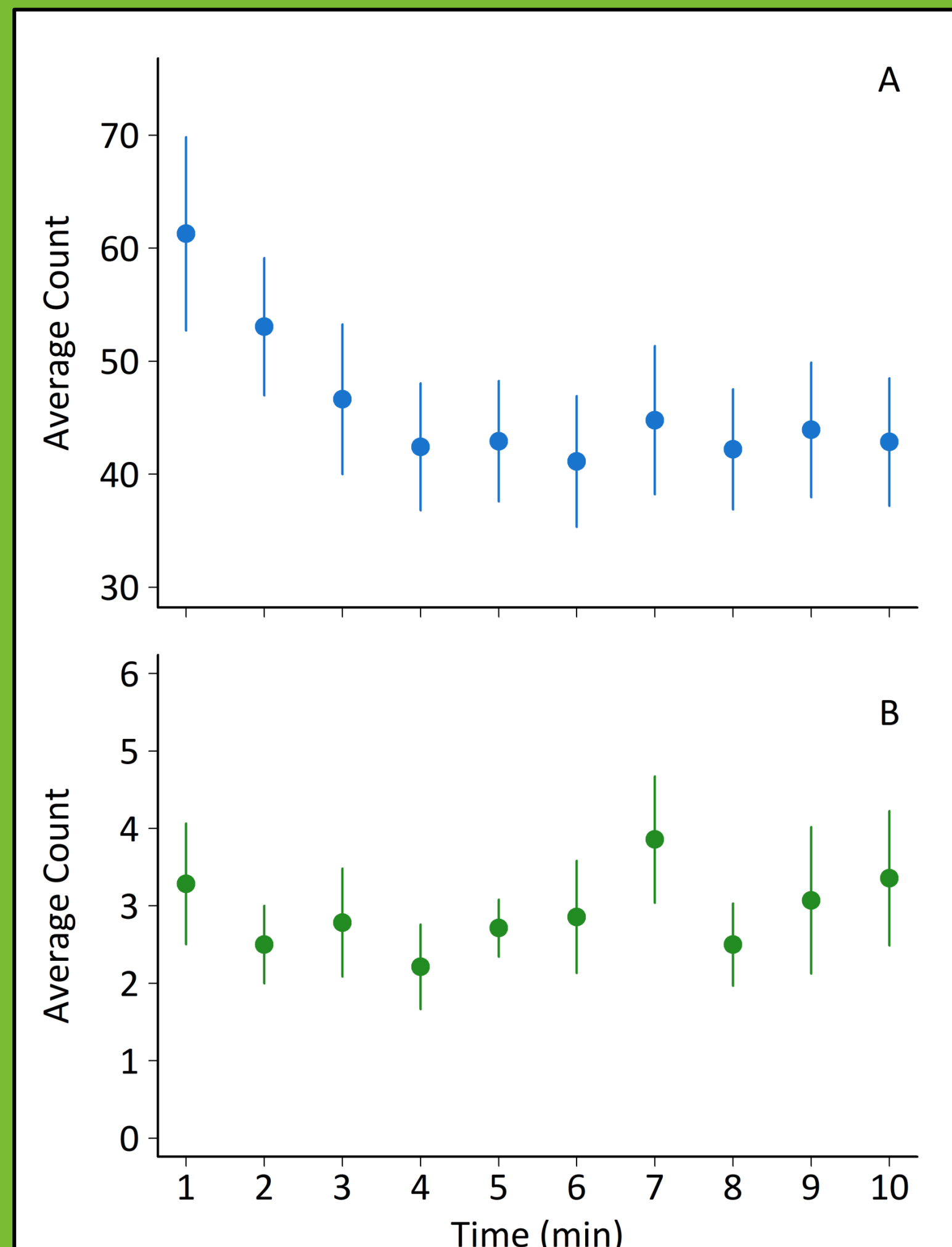


Figure 4: Mean number of fishes observed (+/- SE) during 10 min BOSS deployments for (A) all species combined and (B) large species only.

Future Directions

- Final design, build, and testing of the new BOSS 8-camera system
- 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.)
- Final development of 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 **Starr et al. 2016** (<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0168645>)

