Understanding the Capabilities of Imaging Technologies to Survey West Coast Groundfish

A Collaborative Project between the SWFSC and the NWFSC

Background: Long-term surveys of groundfish are needed in areas and habitats of the West Coast not surveyed adequately by bottom trawls. There are species such as cowcod and yelloweye rockfish that have high associations with rocky habitat and for which there is a particular need to collect additional information to provide adequate monitoring of stock status. Non-lethal means of conducting these surveys are desirable to minimize impact on these vulnerable species and their habitat.

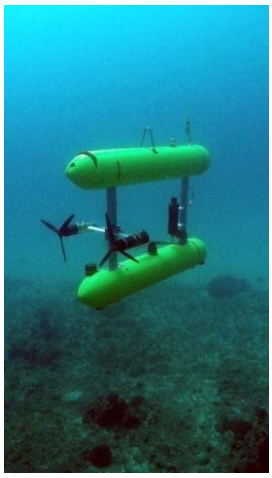
Goal: In order to develop a long-term plan, the capability and efficiency of existing technologies to perform such a survey must be assessed. A field study is planned to assess efficacy and capabilities of tools, accuracy and precision of results, and amount of associated ecosystem information that can be collected.

Technologies to be assessed: Three survey approaches have been used on the West Coast.

1. Collaborative Optically Assisted Acoustical Survey Technique (COAST)
2. Seabed AUV
3. Delta submersible (SUB)

Collaborative Optically Assisted Acoustical Survey Technique, (COAST): This method uses five EK60 (18-200Khz) echosounders mounted on NOAA or chartered vessels, and cameras deployed on a remotely operated vehicle (ROV). The combined use of acoustics and ROV is an extension of existing methods of validating acoustic biomass estimates with midwater trawls to confirm species and size composition. With COAST, echosounders are used to measure aggregations of groundfish and the ROV is used to measure species and size composition in the aggregations. The five frequencies provide additional information on size composition of the acoustic targets. Pilot studies using COAST have been conducted on numerous banks off southern California.

Seabed AUV: The Seabed AUV developed by Hanumant Singh at Woods Hole Oceanographic is a multi-hull hover-capable vehicle that, unlike traditional torpedo shaped AUVs, is capable of working extremely close to the seafloor while maintaining very precise altitude and navigation control. Its small footprint coupled with its 2000m depth rating makes it a possible platform for conducting surveys on ships ranging from standard NOAA oceanographic vessels to smaller fishing vessels of opportunity. The Seabed AUV has been used routinely for conducting archeological and habitat



surveys. Only recently has this AUV been used to quantify fish and well as habitat so biases and uncertainties of data collected using this method have not been assessed. Digital images collected by the AUV are color corrected and the fish and invertebrates quantified from those images. The AUV derives density estimates from a photo mosaic analysis. Pilot studies using this method have been conducted on banks off Oregon and California.

The Delta Submersible: The Delta manned submersible is operated by Delta Oceanographic in Ventura CA. One scientific observer onboard the submersible quantifies fish and associated biota. Video as well as digital stills are used to supplement that information. The Delta submersible is the only one of these tools from which groundfish survey information has been collected and subsequently reviewed and used in a groundfish stock assessment. Several potential biases and sources of uncertainty have been evaluated for this survey vehicle. Submersible surveys use line transect techniques to estimate densities of fish near the sea floor.

Study Design: These three survey approaches are at various stages of development, but all have potential to be used as the basis for extensive surveys. The methods are expected to overlap in their capabilities, but are optimized for different conditions. COAST's use of acoustics allows it to observe off-bottom fish, but it is most challenged in detecting and measuring more solitary fish that are close to the bottom. Conversely, the AUV and SUB are expected to perform best for less aggregated and sedentary species, and to be most challenged to provide abundance data for off-bottom species. Understanding this range of overlap is an important consideration in the plan described here. In principle, the acoustic method could be paired with any of the optical methods and the ROV could be used without pairing with the acoustics. The study will be designed with these considerations in mind. Acoustics remain a valuable tool to investigate fish behavior in response to observing vehicles even for those species that are best surveyed by optical methods alone.

There are two basic questions to be answered in order to design future surveys:

1. Are the 3 optical deployment methods (AUV, SUB, ROV) sufficiently similar so that they could be used somewhat interchangeably in the future, after taking into account minor calibration factors?
2. For which species is the combined use of acoustic biomass estimates and optical validation the optimal design, versus the direct use of optical methods alone?

Each technology will be deployed and analyzed as it is envisioned to be used in a survey mode. The goal of the surveys conducted by each method is to produce

estimates of abundance and biomass for rockfish species at the selected study site, along with associated estimates of variance. Transects for each optical method will be laid out according to the statistical and logistical requirements of that method. There could be added statistical power if the three optical methods occupied essentially the same transects, but this may not be operationally feasible and should not be done if it compromised the transect design of any method alone. Some of the ROV transects could be laid out according to the spatial distribution of biomass observed acoustically, as is the intent of the COAST method, and some could be distributed across the entire study site to enable more direct comparison to the SUB and AUV methods. However the acoustically allocated transects would need to be analyzed separately from those transects assigned before the acoustic data is collected.

Ideally, this design will allow us to:

1. Compare species-specific abundance and size composition among the 3 direct optical methods and to the acoustically weighted method (COAST);
2. Compare total rockfish abundance from acoustics to total rockfish abundance from each of the optical methods;
3. Compare rockfish species composition in regions of high acoustically measured abundance and/or high off-bottom abundance to rockfish species composition in regions with low acoustic abundance using at least the ROV optical observations and possibly the optical observations from SUB and AUV also.

We have chosen to conduct this study at a site in the southern California region where cowcod and a diversity of other rockfish species are found. Cowcod provides a good example of a groundfish species that is easily identified with optical methods but that is tightly associated with rocky habitat.

The study site will be chosen by mutual agreement. Factors in site selection can include: proximity to shore facilities, prior experience by one or more teams, expected species composition, exposure to harsh weather, and other relevant factors. The site will need to be sufficiently small so that the limited survey time available will be able to produce results that are precise enough to enable quantitative comparisons.

The target time for the study is constrained by contract schedules, weather, and prior commitments for the equipment to be used. At this time, the most feasible dates appear to be in early spring 2011.

It is expected that each method will have specific support vessel requirements and these will be contracted by each group to meet these requirements. These vessel contracts will be initiated with the available FY10 funds which will be equally divided among the three involved research divisions. It is estimated that approximately 10 days in the field (including weather days and mobilization/ demobilization) will be needed and a team of experts will deploy each vehicle using protocols similar to those used during an operational long-term survey. We expect this to require up to four vessels in order to conduct the acoustic, ROV, AUV and SUB observations as synoptically as feasible. Each team will itemize

costs of the survey including vessel charters, equipment rentals, supplies and overtime. A cost benefit analysis will be an integral part of the results.

Division chiefs will provide intermediate reports of project progress to their Center's Deputy Directors with copy to Rick Methot. Alternatively, a consolidated report could be provided to all. The first report should be in a couple of months when date and location are determined, and the second should be a few months in advance of the cruise to provide an update on progress and a draft cruise plan.

Data Discussion and Review: After data have been collected and analyzed, the principal investigators will convene a workshop to discuss and review the results. Results of these evaluations will be used to identify a method or mix of methods to be deployed in a more extensive survey mode, and to identify specific factors that are amenable to improved calibration through targeted studies of fish behavior and other factors.