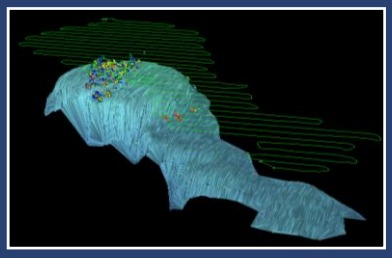
Science, Service, Stewardship

NOAA FISHERIES SERVICE

Southwest Fisheries Science Center



Fisheries Resources Division

The Fisheries Resources Division develops the scientific foundation for the conservation and management of marine resources in the California Current and Pan-Pacific Pelagic Ecosystems. We serve the public and contribute information to management organizations and the scientific community.

Advanced Survey Technologies Program

To meet NOAA's mandate of ecosystem-based fisheries management, huge quantities of multi-disciplinary data must be efficiently collected over the areas and time periods that are important to the interactions of animals with each other and their environment. In particular, the areas near the sea-surface, seafloor, and seashore (oceanic boundaries) must be sampled on large time- and fine spatial-scales. To accomplish this, surveys from large research vessels must be augmented with measurements from other sensor platforms such as satellites, buoys, small-craft, and autonomous underwater vehicles or AUVs. The AST enables ecosystem-based fisheries management through development and novel use of sensors and deployment platforms.

Program Members

L-R: David Demer, Steve Sessions, Josiah Renfree, and Randy Cutter (staff); Derek Needham, Mike Paterson, Andre Hoek (contractors); Kyle Byers (LTjg/NOAA Corps); and Juan Zwolinski (post-doctoral researcher).

Primary Activities

Sardine Surveys:

AST conducts surveys of Pacific sardine and other coastal pelagic fish species (CPS) and their prey using: improved allocation of sampling effort (e.g., through complementary use of Lidar or satellite-sensed oceanography); state-of-the-art multifrequency, sidescan, and multibeam acoustic methods (i.e., Simrad EK60 and ME70 echosounders); a broad-bandwidth multiscattering hyperbaric tank and methods for measuring 'acoustic signatures' of various species; and a novel towed stereo-camera system (AST's FasTowCam) for validating the acoustic classifications. In February 2011, the acoustic-trawl method and survey results will be reviewed by the Pacific Fisheries Management Council (PFMC) and the Center for Independent Experts (CIE) for possible inclusion in assessments of sardine and other CPS.

Rockfish Surveys:

AST has led the development of the Collaborative Optically-assisted Acoustic-Survey Technique (COAST) to survey the distributions and abundances of rockfishes in the Southern California Bight, by species. The technique uses historical fishing maps to initially define the survey sites, echosounders to map rockfishes and their seabed habitats, and video and still images obtained with a remotely operated vehicle (ROV) to estimate the proportions and size-distributions of species in mixed assemblages. Towards use of the 2004/5, 2007/9, and future survey results in stock assessments, the COAST may also be reviewed by the PFMC and CIE in 2011.

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Primary Activities, Cont.

Analytical Methods and Models Development:

AST invents methods and models for improving the science and management of marine, freshwater, anadromous, and aquacultured fishes. For example, AST has developed: a technique for using ADCPs to measure the three-dimensional (3D) velocities of marine organisms; a model for krill target strength (TS) which was adopted as the international standard; a procedure for quantifying total error (random and systematic components of measurement and sampling error) in acoustic surveys; and a versatile multiscattering technique. This technique can be used for: quantifying fish and zooplankton and their behaviors and growth rates in tanks; measuring their broad bandwidth sound scattering and absorption spectra ('acoustic signatures'); and, incidentally, acoustically measuring the numbers and sizes of humans in a room, and their amount of clothing. AST has also invented multiple powerful techniques based on Multifrequency Biplanar Interferometry (MBI) for greatly improved 3D imaging and classifications of fish and seabed.

Sensor Development:

AST develops sensors (generally miniature, low-cost, low-power, and autonomous) to sample oceanic boundary zones on critical temporal-spatial scales. For example, AST has designed, constructed, and deployed: Remote Echosounder Modules (REMs) on ships and buoys of opportunity; micro-echosounders (EchoTags) for deployments on animals, bouys, and gliders; a deepwater cast echosounder (DropTS) for measuring TS accurately; and a towed stereo camera (FasTowCam) for validating acoustic targets.

Sensor Platform Development:

To survey fisheries resources in the context of their ecosystems, AST develops and increasingly utilizes instrumented small craft, buoys, and AUVs. These instrumented platforms should improve the accuracies, precisions, and efficiencies of many routine studies, expand some to more critical time- and spatial-scales, and make other investigations feasible for the first time.

Significant Program Citations

R.P. Hewitt and D.A. Demer, "Krill abundance," *Nature*. 353-310. (1991).

D.A. Demer, M.A. Soule and R.P. Hewitt, "A Multi-frequency method for improved accuracy and precision of *in situ* target strength measurements," *Journal of the Acoustical Society of America*, 105 (4): 2359-2376. (1999).

D.A. Demer, S. Conti, J. De Rosny, and P. Roux, "Absolute measurements of total target strength from reverberation in a cavity," *Journal of the Acoustical Society of America*, 113(3):1387-1394 (2003).

D.A. Demer and S.G. Conti, "New target-strength model indicates more krill in the Southern Ocean," *ICES Journal of Marine Science*, 62(1):25-32 (2005).

D.A. Demer, G.R. Cutter, J.S. Renfree, and J.L. Butler. "A statistical-spectral method for echo classification". *ICES Journal of Marine Science*, 66: 1081–1090 (2009).

G.R. Cutter and D.A. Demer, "Multifrequency biplanar interferometric imaging," *IEEE Geoscience and Remote Sensing Letters*. 77(1) (2010).