Continuous Multidisciplinary Observations in the Southern California Current Elucidate Events in Climate, the Ecosystem, and Fisheries

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Advanced Survey Technologies
Southwest Fisheries Science Center

NOAA Central Library Brown Bag Seminar

Silver Spring, MD

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Monitoring the California Current Ecosystem

- Acoustic-trawl surveys
  - Survey multiple species

- Pacific sardine
  - Migration
  - Fisheries
  - Oceanographic habitat
  - Status and trend

- CCE moorings
  - Monitor migrations
  - Survey adaptively

  - Differentiate landings
  - Characterize 3-D habitats
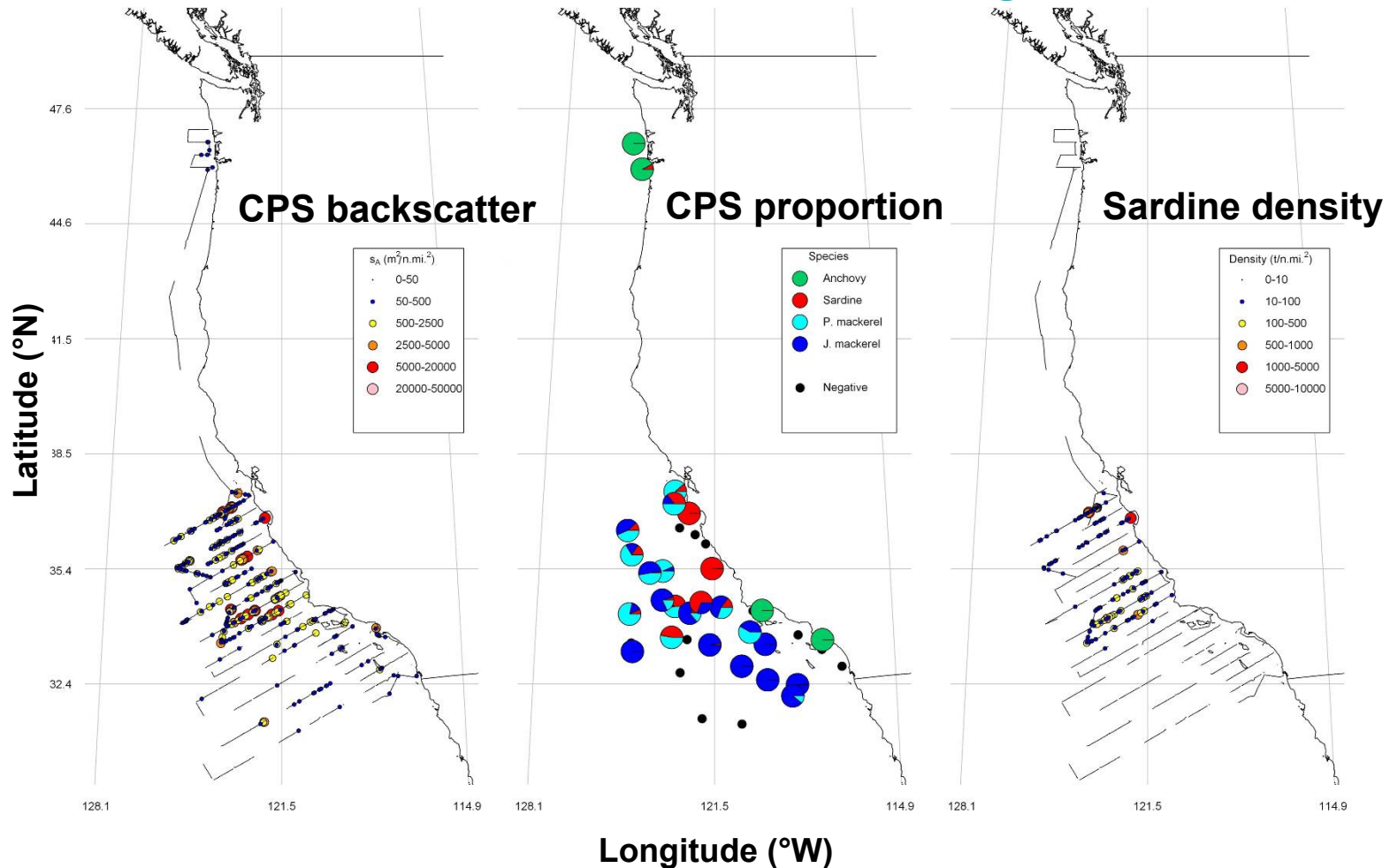 - Estimate biomasses
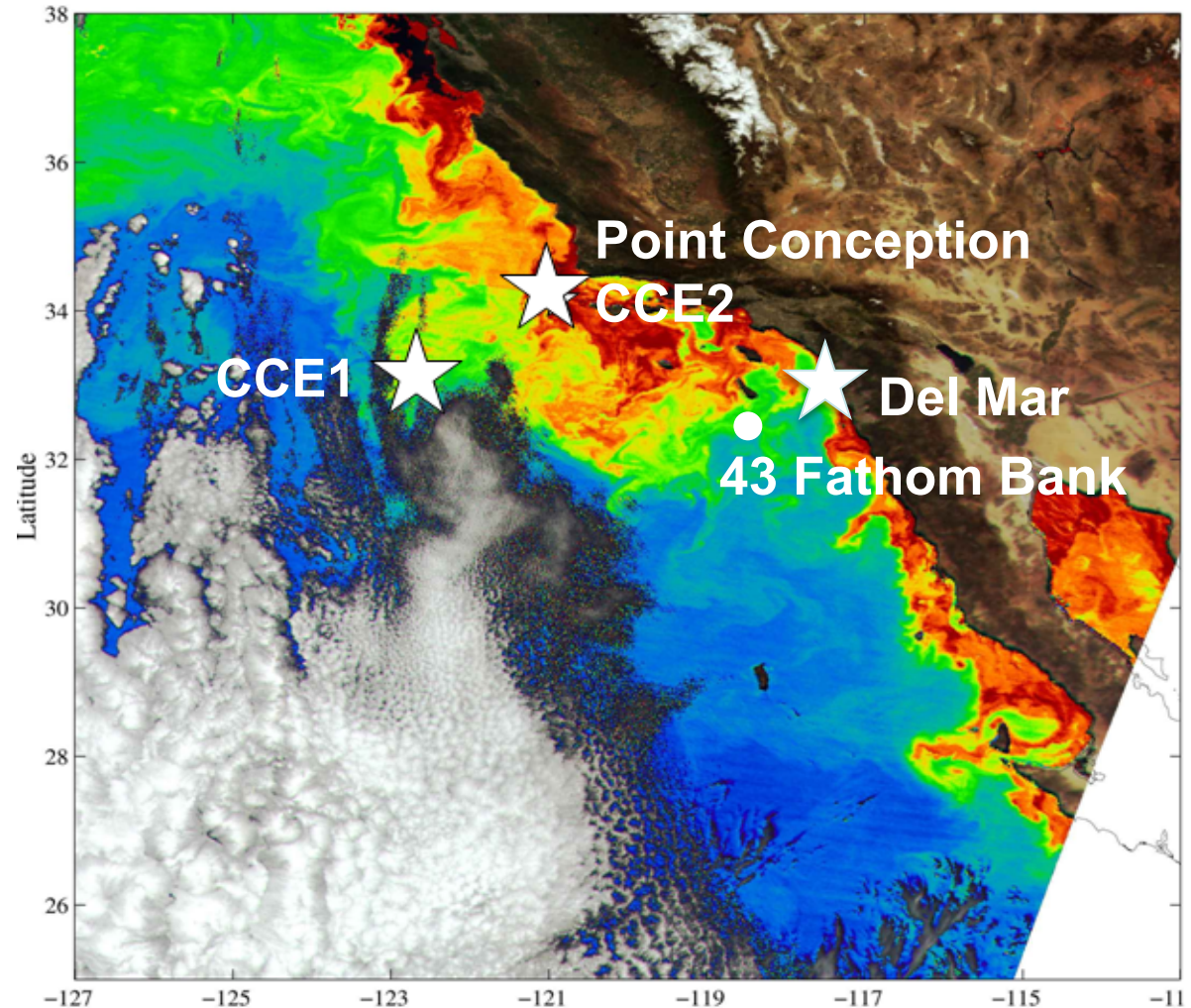
Acoustic-Trawl Sampling

- **Acoustic sampling**
  - Five-frequency echosounders (EK60)
  - Broadbandwidth multibeam (ME70)
  - Map acoustic backscatter

- **Trawl sampling**
  - Surface during nighttime
  - Midwater during daytime
  - Apportion to species and sizes
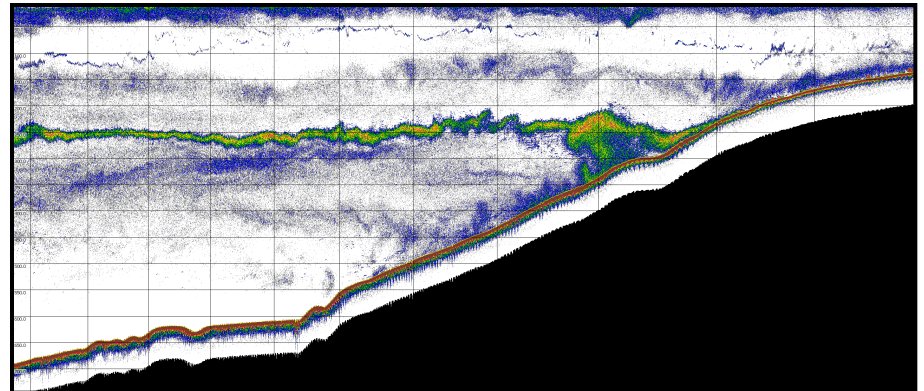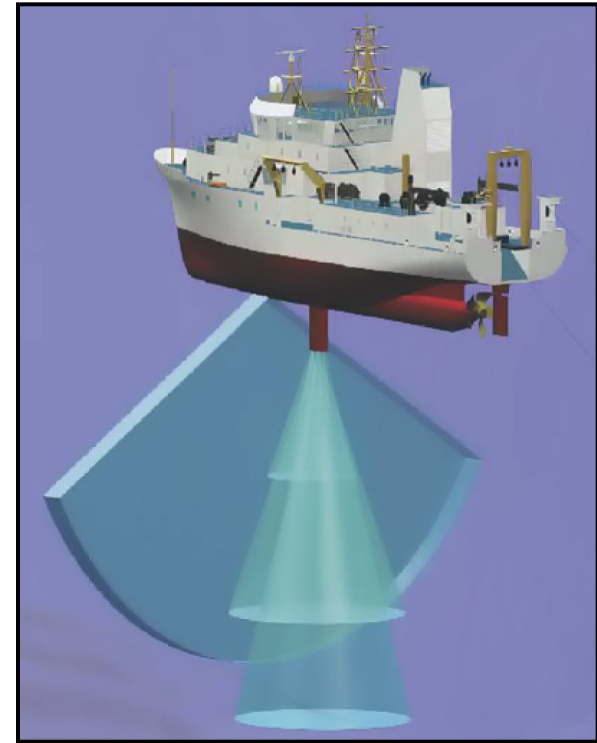
Acoustic-Trawl Data Processing

J.P. Zwolinski, D.A. Demer, K.A. Byers, G.R. Cutter, J.S. Renfree, T.S. Sessions, and B.J. Macewicz, 2012, "Distributions and abundances of Pacific sardine (*Sardinops sagax*) and other pelagic fishes in the California Current Ecosystem during spring 2006, 2008, and 2010, estimated from acoustic—trawl surveys," *Fishery Bulletin* 110: 110-122.

Multi-Species Acoustic-Trawl Surveys

- **Estimate abundances and distributions of:**
  - Northern anchovy
  - Jack mackerel
  - Pacific mackerel
  - Herring
  - Hake
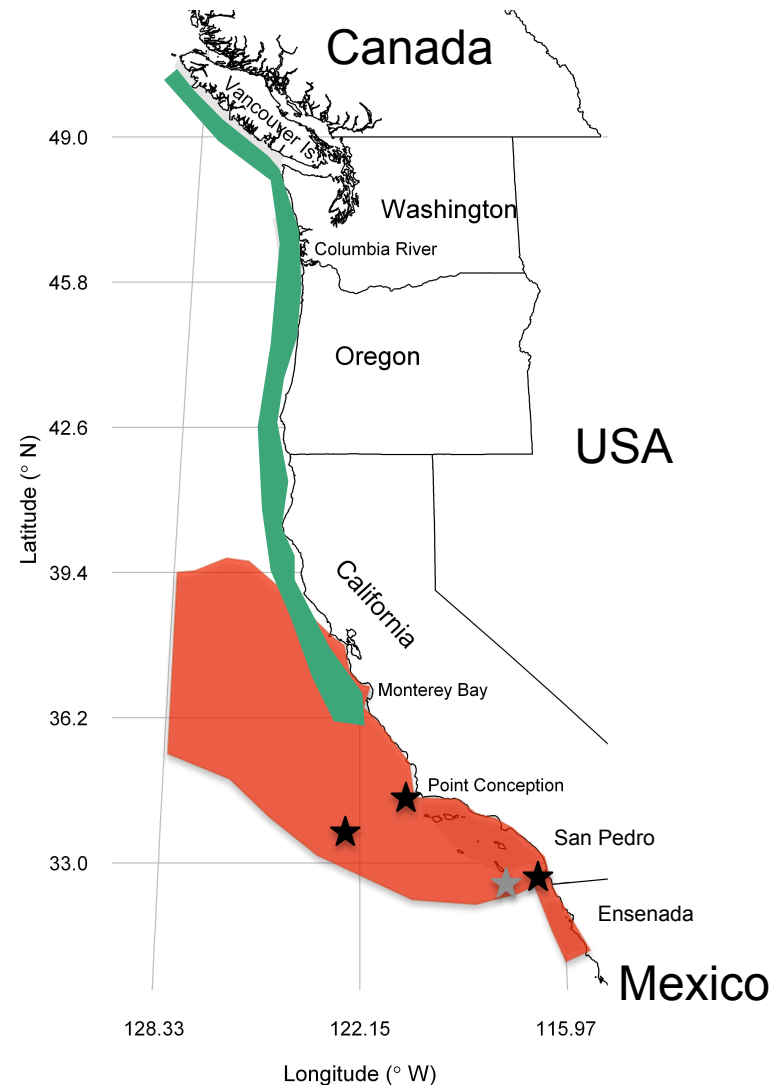 - Krill
- **Monitor stock status and trends**

D.A. Demer, J.P. Zwolinski, K.A. Byers, G.R. Cutter, J.S. Renfree, T.S. Sessions, B.J. Macewicz, "Prediction and confirmation of seasonal migration of Pacific sardine (*Sardinops sagax*) in the California Current Ecosystem," *Fisheries Bulletin*, 110:52-70 (2012).

J. P. Zwolinski, D. A. Demer, G. R. Cutter Jr., K. Stierhoff, and B. J. Macewicz, "Building on Fisheries Acoustics for Marine Ecosystem Surveys," *Oceanography* (in press).
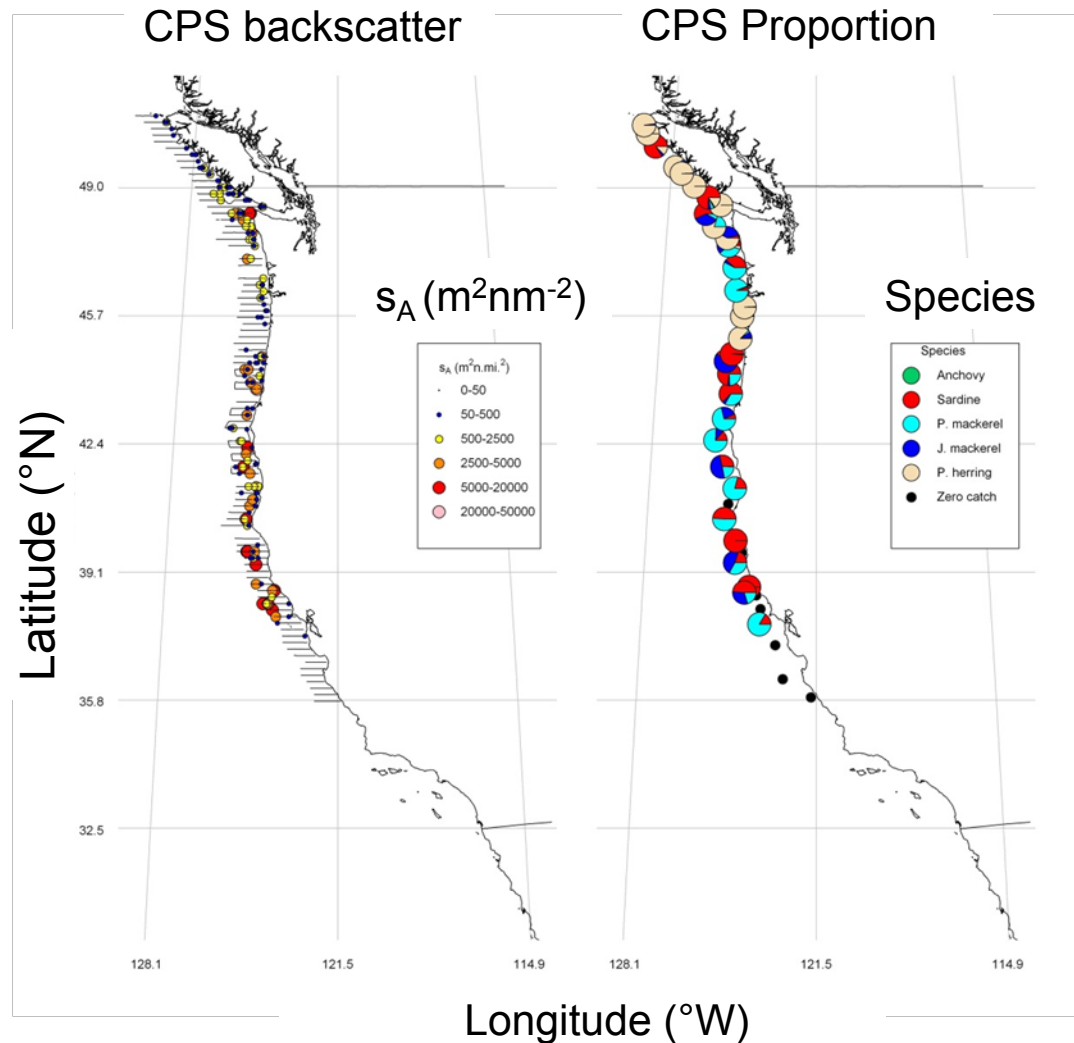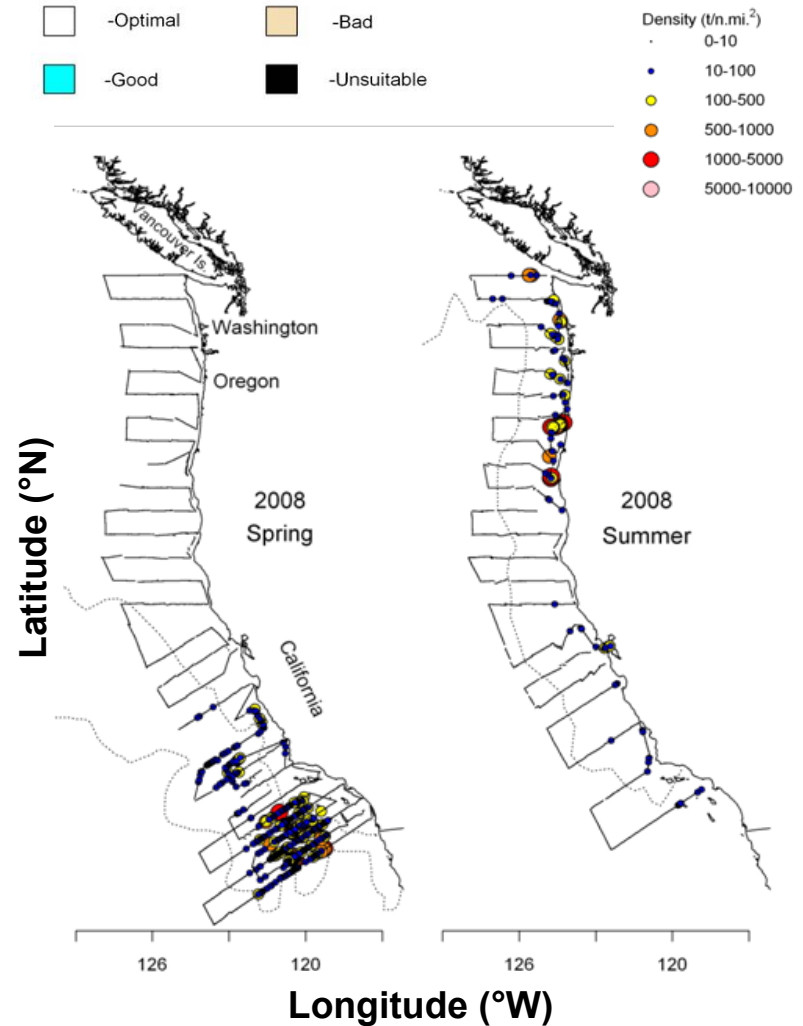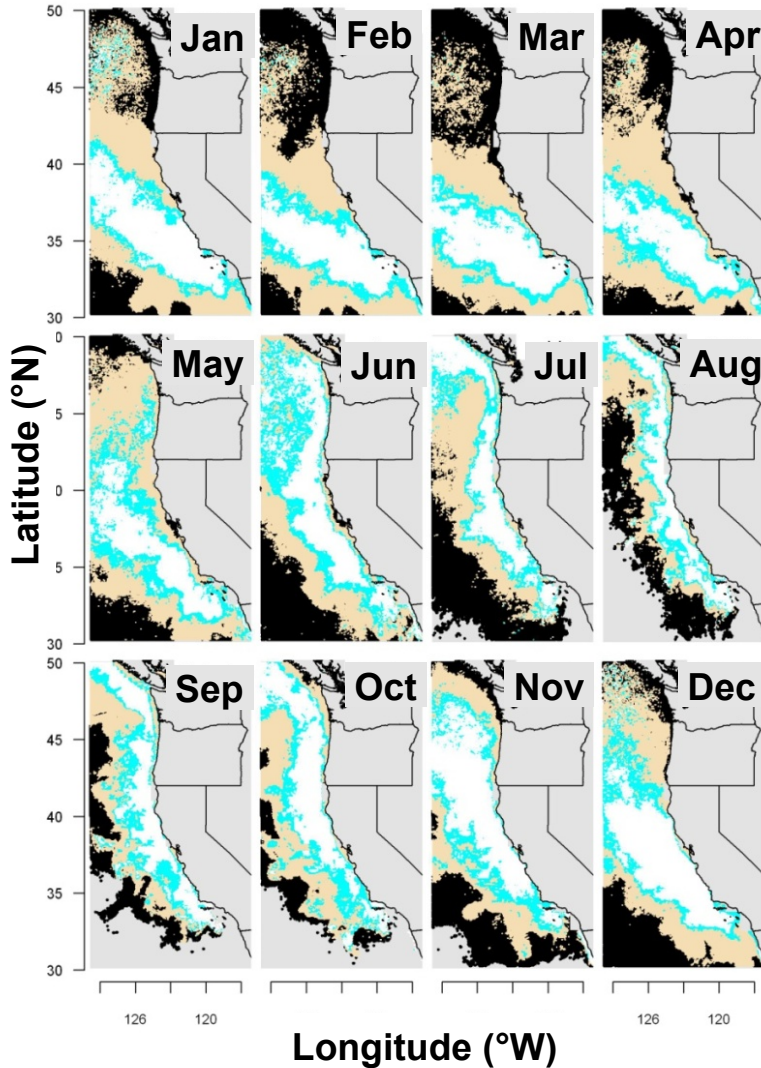

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Northern Stock Sardine

- **Stock spans three countries**

- **Stock migrates seasonally**

  - **Spring** – Mexico to Central California
  - **Summer** – Central CA to Canada

- **Six Regional Fisheries**
- Seasonal
  - Vancouver Island, Canada
  - Washington, USA
  - Oregon, USA
- Continuous
  - Monterey, California, USA
  - San Pedro, California, USA
  - Ensenada, Mexico

- **CCE Moorings**
  - Monitor habitat
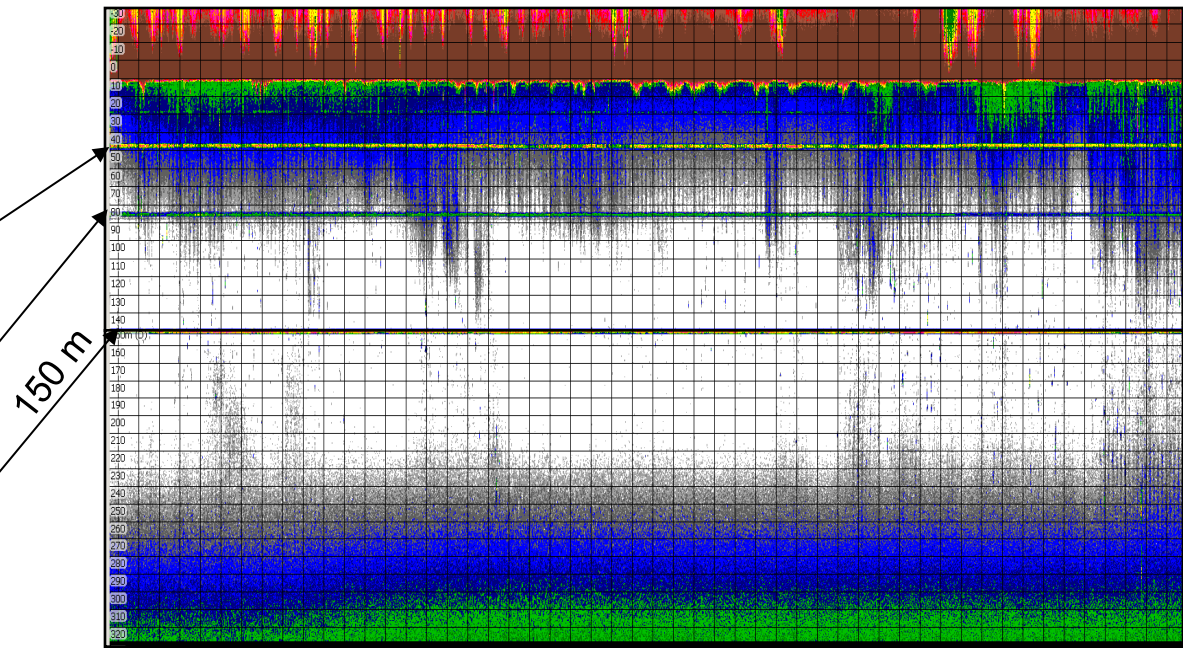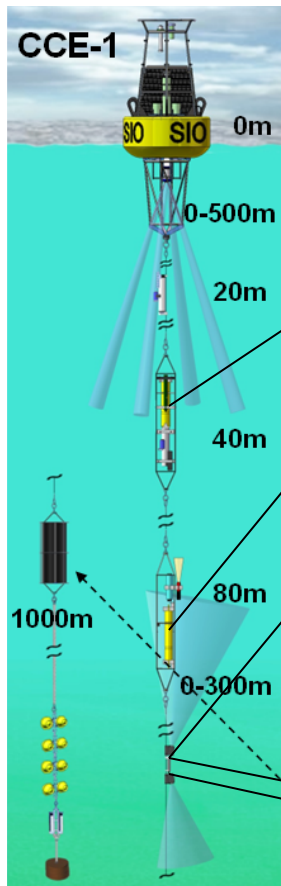 - Monitor migration

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Habitat & Migration

D.A. Demer, J.P. Zwolinski, K.A. Byers, G.R. Cutter, J.S. Renfree, T.S. Sessions, B.J. Macewicz, 2012, "Prediction and confirmation of seasonal migration of Pacific sardine (*Sardinops sagax*) in the California Current Ecosystem," *Fisheries Bulletin*, 110:52-70.
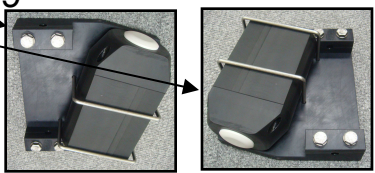
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Monitoring Fish and Zooplankton with Autonomous Micro-echosounders

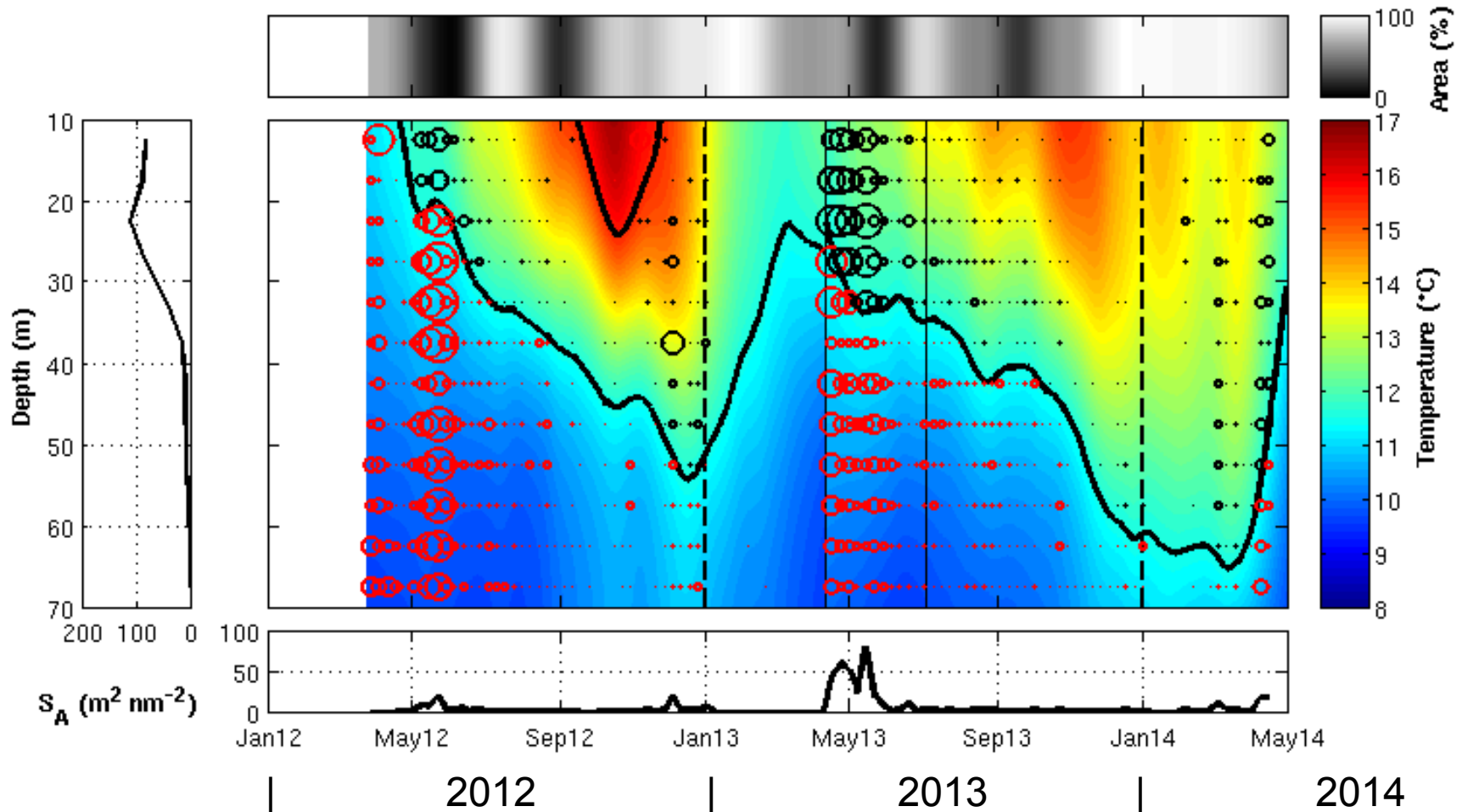Dec 2009   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug 2010

190 kHz EchoTags

- Monitor fish migrations
- Differentiate landings
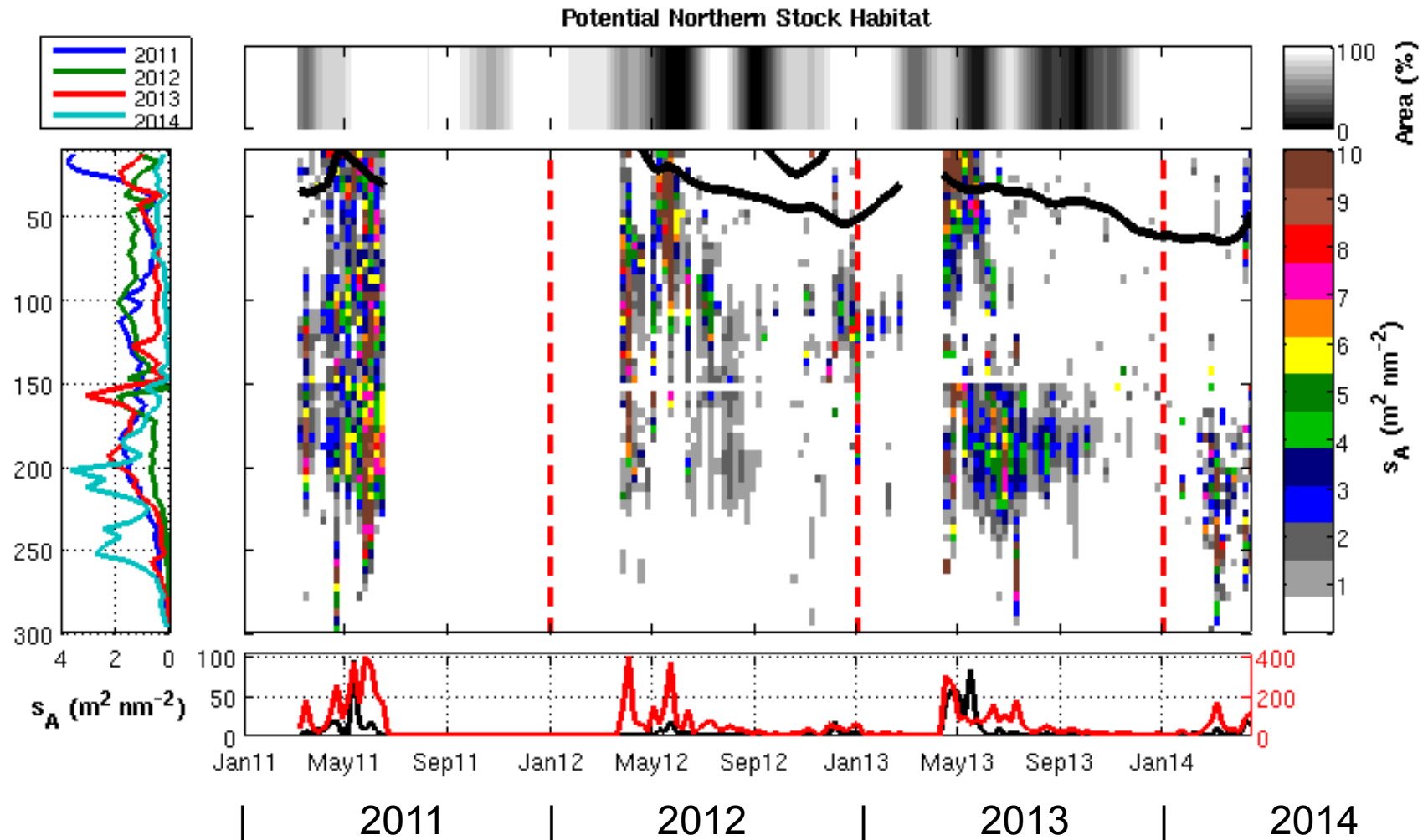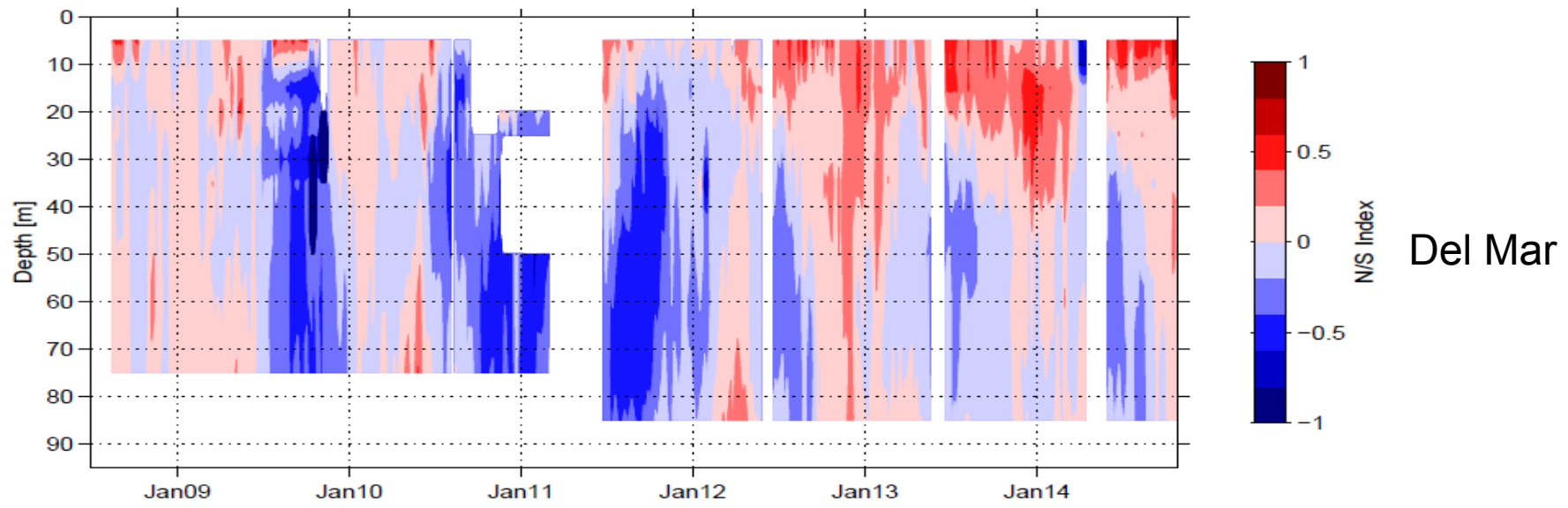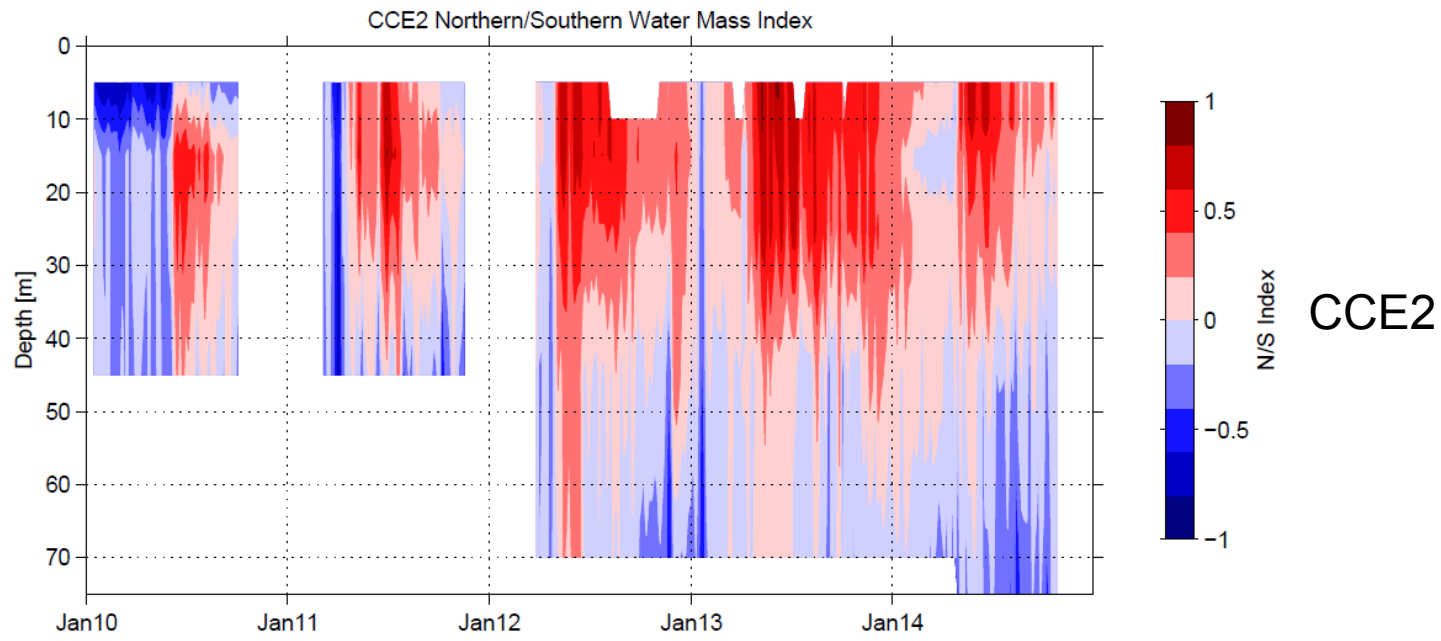- Estimate fish abundances

# CCE-2: Monitoring Sardine Migration & Habitat


Potential Northern Stock Habitat

CCE-2: Monitoring Fish Migration & Habitat

Potential Northern Stock Habitat

CCE2 Northern/Southern Water Mass Index

CCE2

Del Mar

Toll-Gate Biomass Estimation

- Moorings and gliders
- Enhanced acoustic and habitat sensors, and fish tag receivers
- Monitor habitats, diel and seasonal migrations
- Estimate biomasses of multiple species

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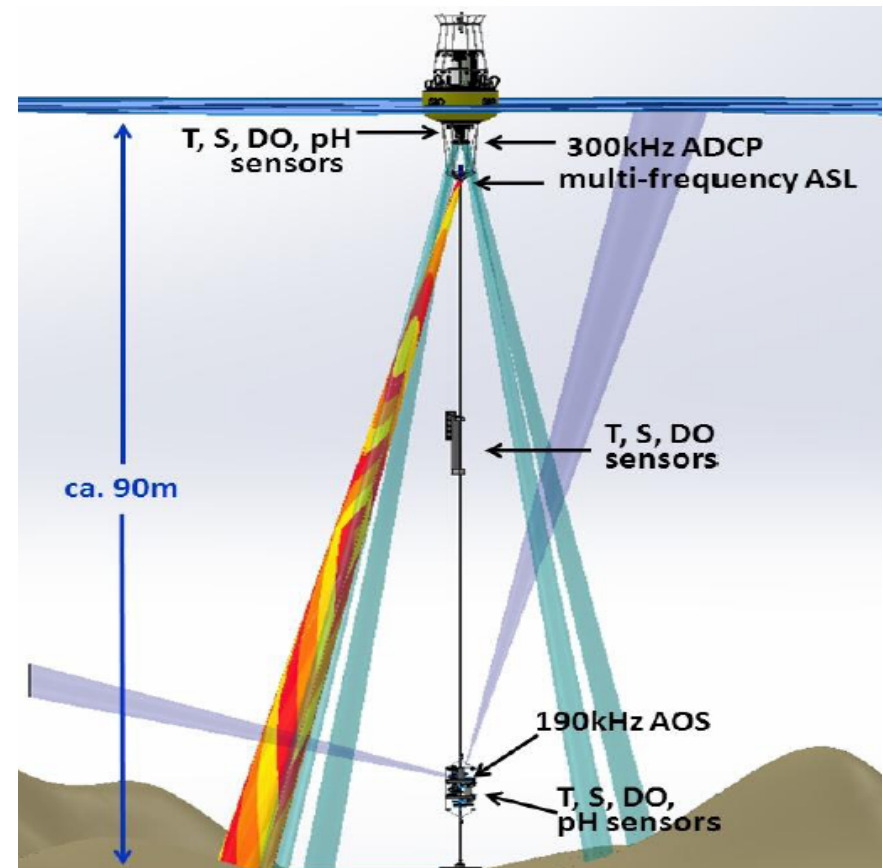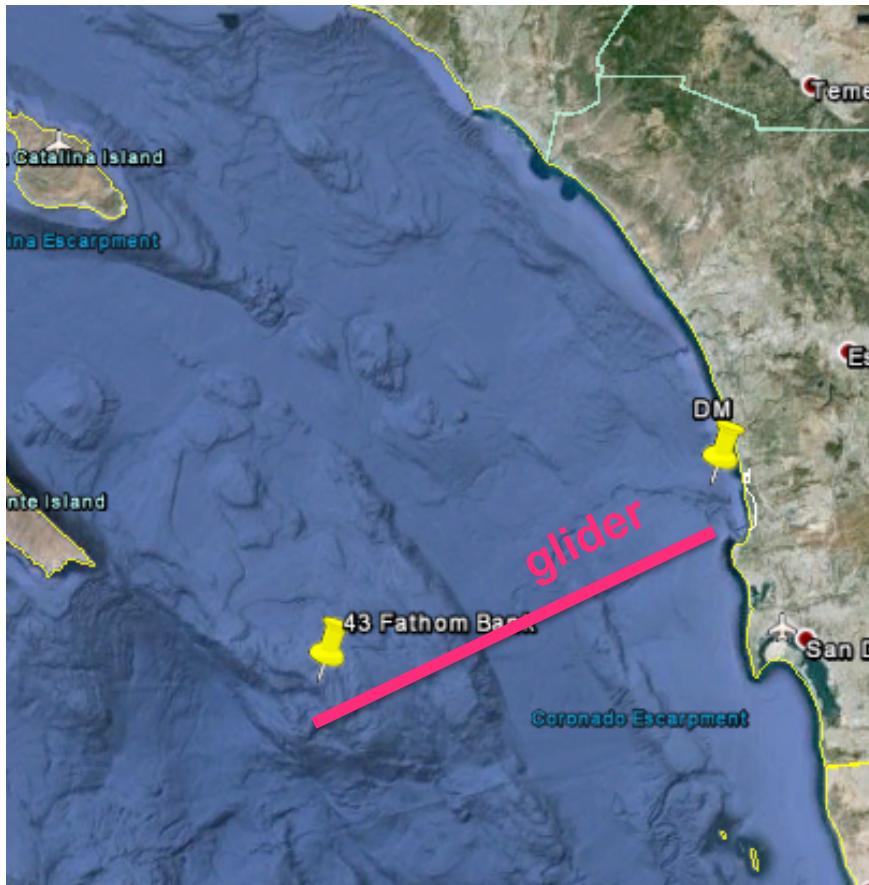
Advantages of the collaborative mooring

- Improve temporal sampling of fishes and their habitats on scales that are critical to ecosystem dynamics, survey efficiency, and effective management.

- Monitor the behaviors and abundances of multiple stocks migrating past lines of instrumented buoys.

- Validate buoy and glider measures using periodic shipboard measurements
  - Seasonal CalCOFI (4X y^{-1})
  - Spring and Summer CCE (2X y^{-1})

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