



**NOAA**  
**FISHERIES**

# Fisheries Acoustics aboard FSV *Lasker*

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Technology Program



Who we are and what we do

New fishery research ships

*Reuben Lasker* – San Diego, CA

*Bell M. Shimada* – Newport, OR

Survey tools, methods and analyses

Questions?

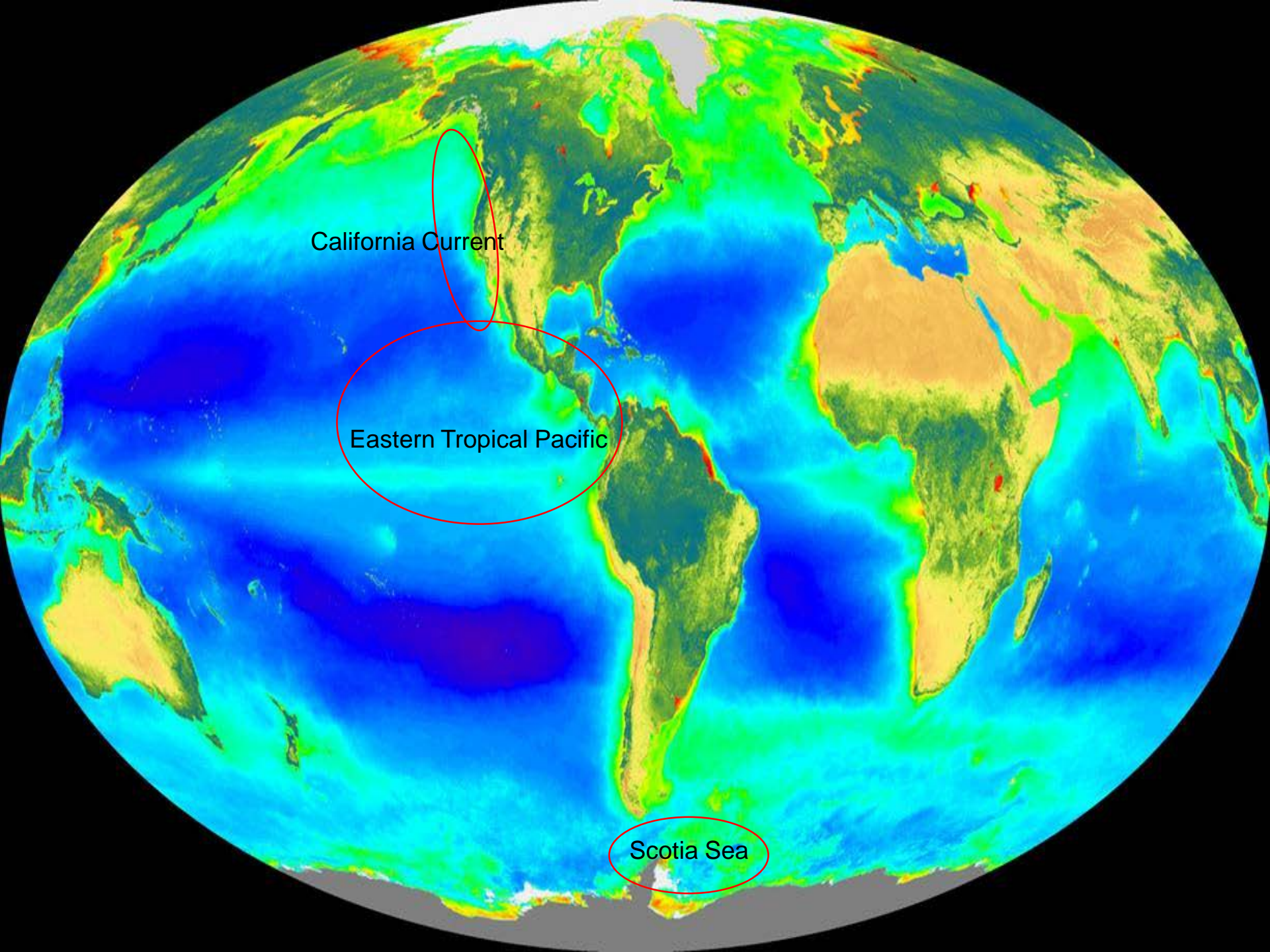


# Mission

Provide science-based advice for the conservation and management of living marine resources

Octavio Aburto





California Current

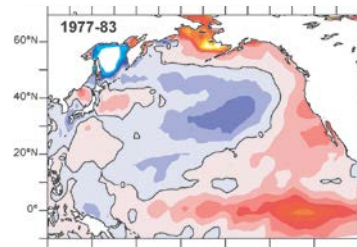
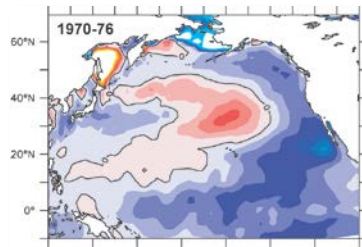
Eastern Tropical Pacific

Scotia Sea

# What We Do



- Conduct scientific monitoring of marine ecosystems (distribution, abundance)
- Conduct research on biological and ecological processes (stock structure and behavior)
- Forecast the impacts of climate
- Develop sampling technologies (acoustics and optics)
- Serve ocean data to the public
- Provide science-based advice for management of living marine resources





# Research Programs

## Coastal Pelagic Species

Pacific sardine, anchovy, Pacific mackerel, market squid

## Highly Migratory Species

albacore tuna, bluefin tuna, striped marlin, sharks

## Demersal Species

rockfishes (Sebastes species)

## Anadromous Species

chinook salmon, coho salmon, steelhead, green sturgeon

## Abalone

white, black

## Marine Mammals

dolphins, whales, pinnipeds

## Marine Turtles

leatherback turtles, green turtles

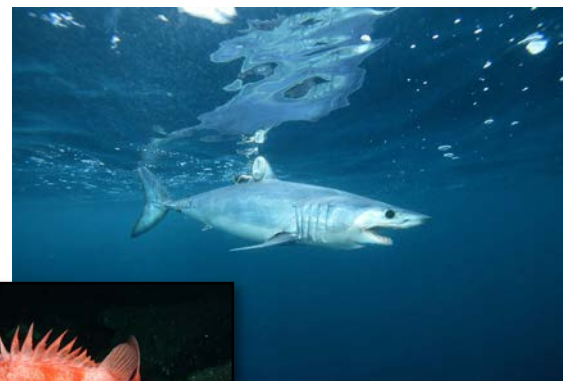
## Antarctic Ecosystem

krill, fish, pinnipeds, penguins

## Technology Development

acoustics, optics, ROVs, AUVs, genetics, photogrammetry

## Integrated Ecosystem Assessments



# New class of NOAA Fisheries Survey Vessels

Acoustic-Computer Laboratory  
Controlled Environment Room  
Scientist Ready Room

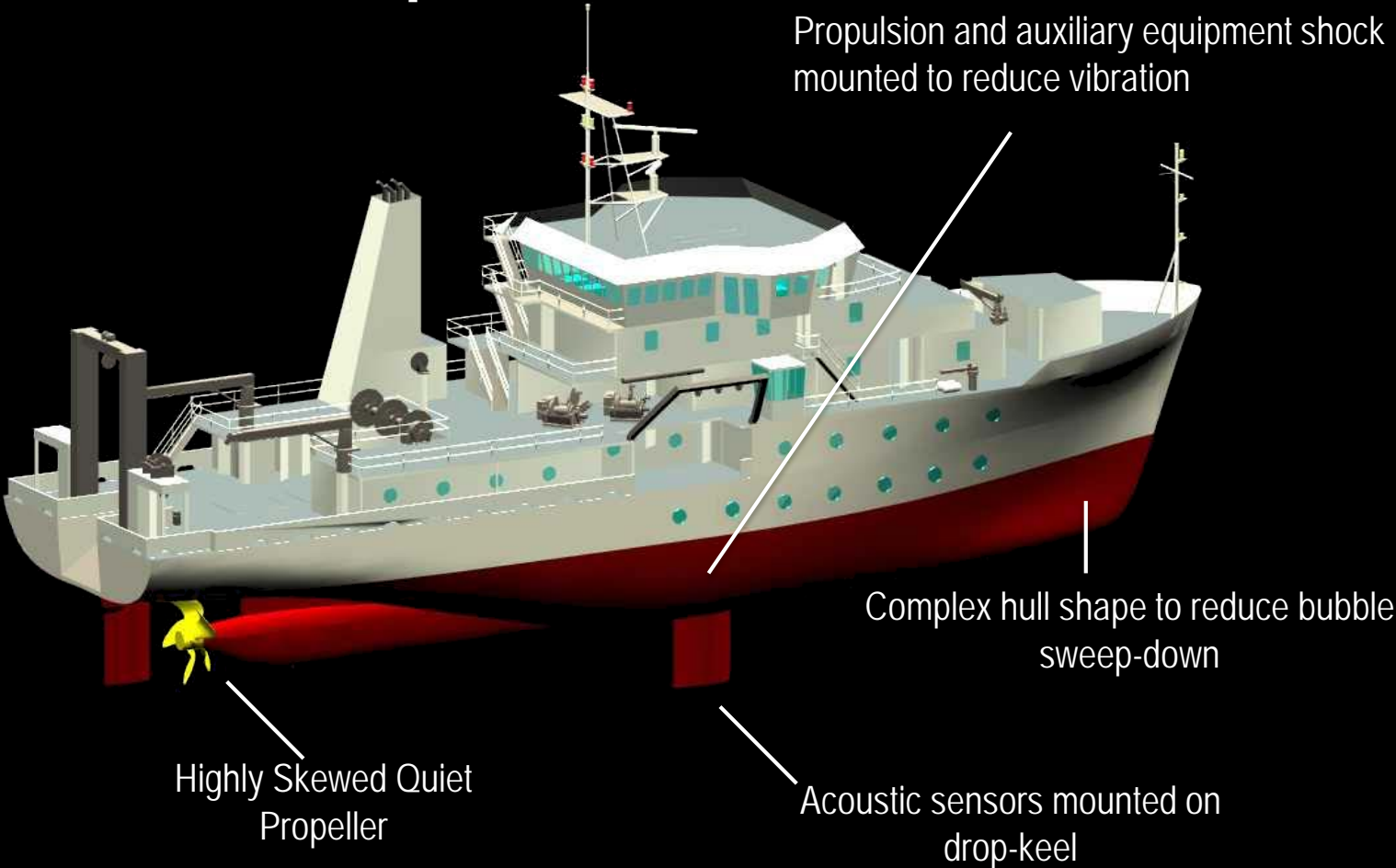
Fish Laboratory  
Chemistry Laboratory  
Dry Laboratory  
Side Sampling Station

All labs interconnected via Scientific Computer System and provided with stable power and UPS

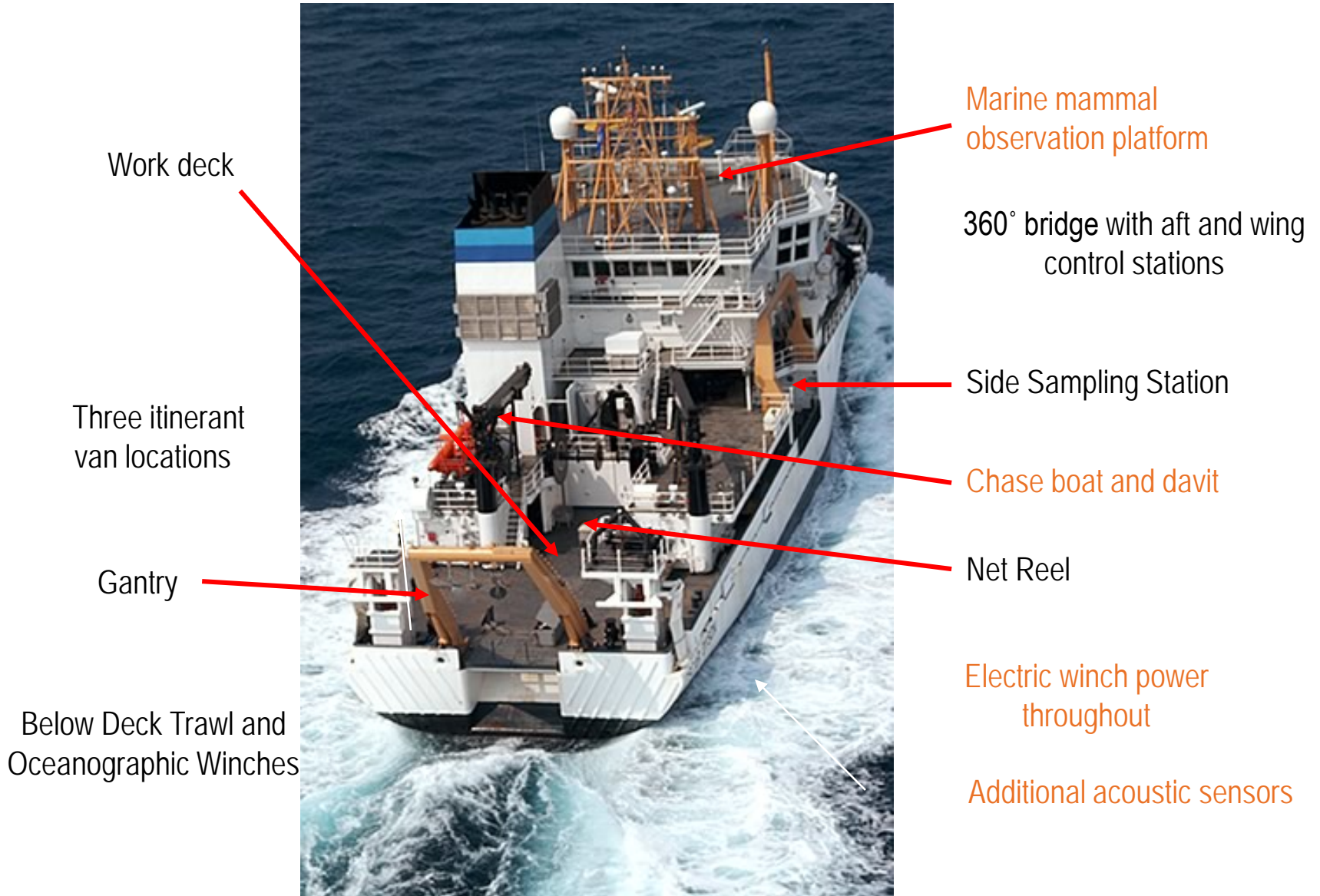


**NOAA FISHERIES**

# Stealth ship







Work deck

Three itinerant  
van locations

Gantry

Below Deck Trawl and  
Oceanographic Winches

Marine mammal  
observation platform

360° bridge with aft and wing  
control stations

Side Sampling Station

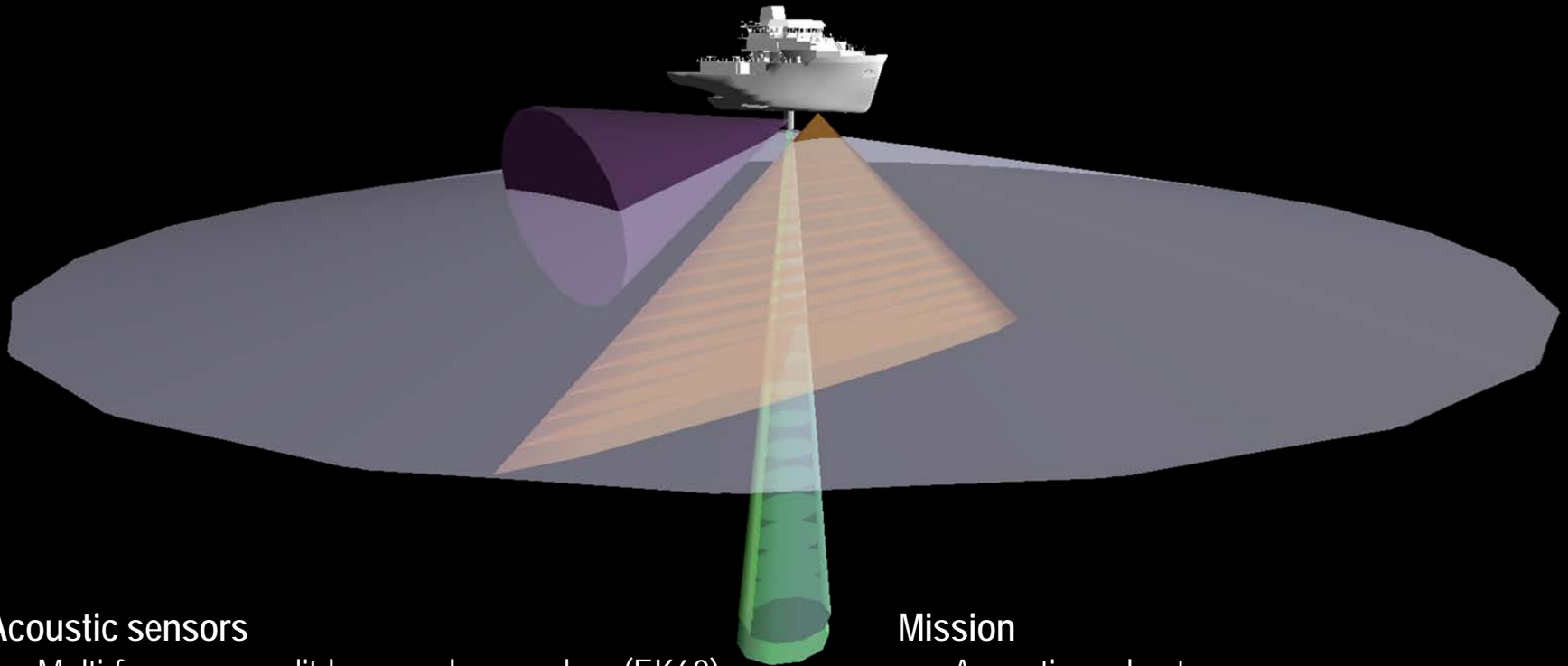
Chase boat and davit

Net Reel

Electric winch power  
throughout

Additional acoustic sensors

# NOAA Ship *Reuben Lasker*



## Acoustic sensors

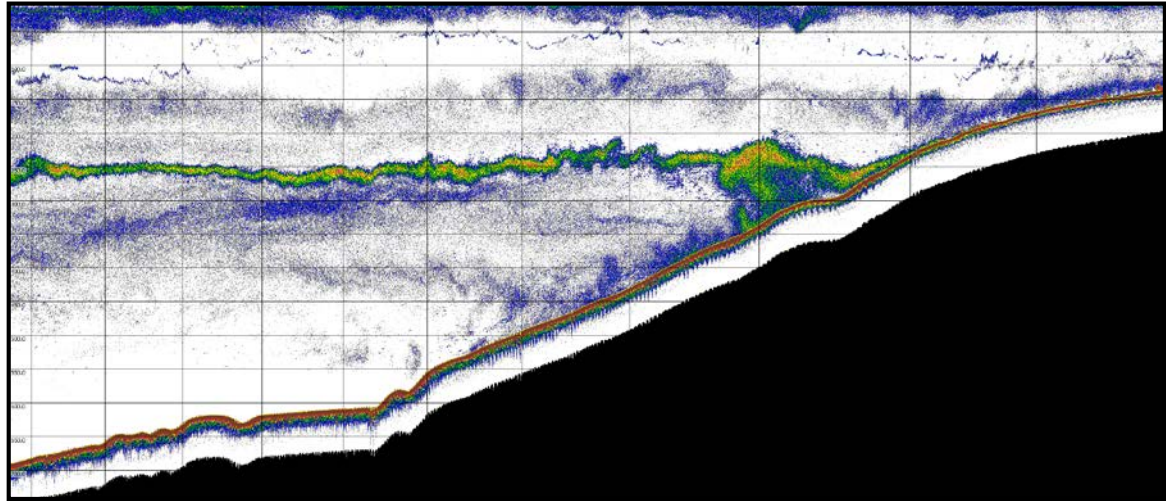
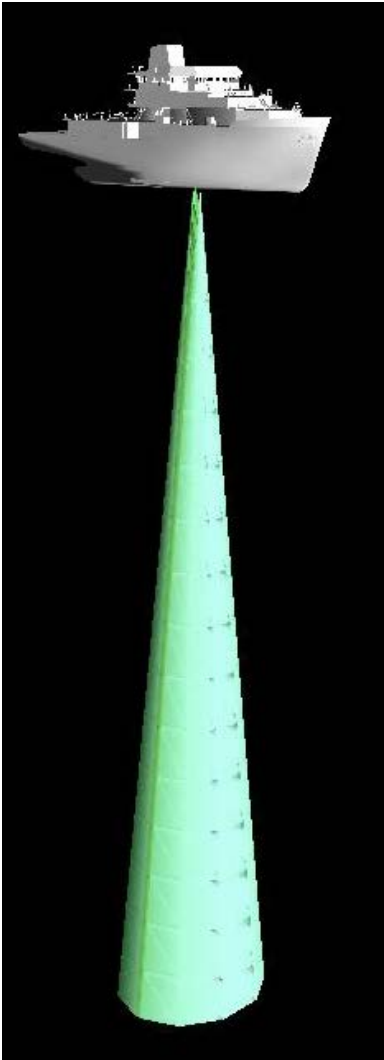
- Multi-frequency split-beam echosounders (EK60)
- Broad-bandwidth split-beam multi-beam (ME70)
- Long range scanning sonar (SX90)
- Broad-bandwidth imaging multi-beam (MS70)
- Acoustic Doppler current profiler (Longranger)
- Additional hydrophones and transceivers for acoustic signal and noise monitoring, acoustic releases, asset tracking, and net mensuration

## Mission

- Acoustic and net surveys
- Marine mammal and seabird surveys
- Oceanographic and meteorological sampling
- Habitat mapping
- Sampling technology development

# Acoustic-Trawl Sampling

Six frequency Simrad EK60s, transitioning to wide bandwidth EK80s

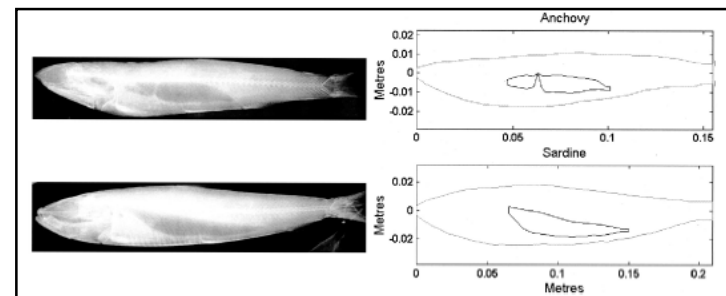
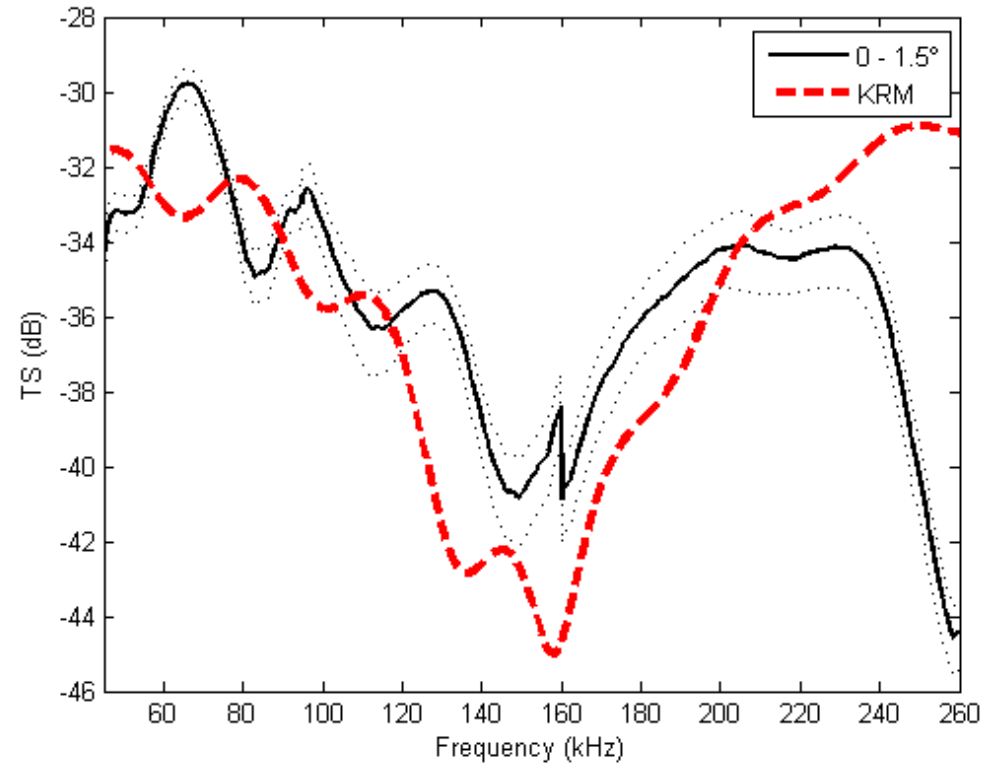
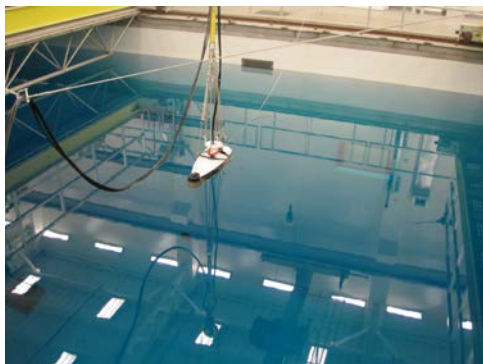
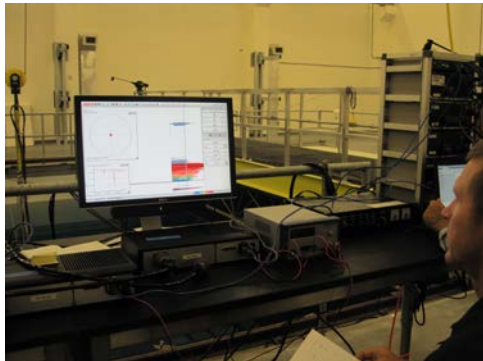


Daytime mid-water trawls; nighttime surface trawls

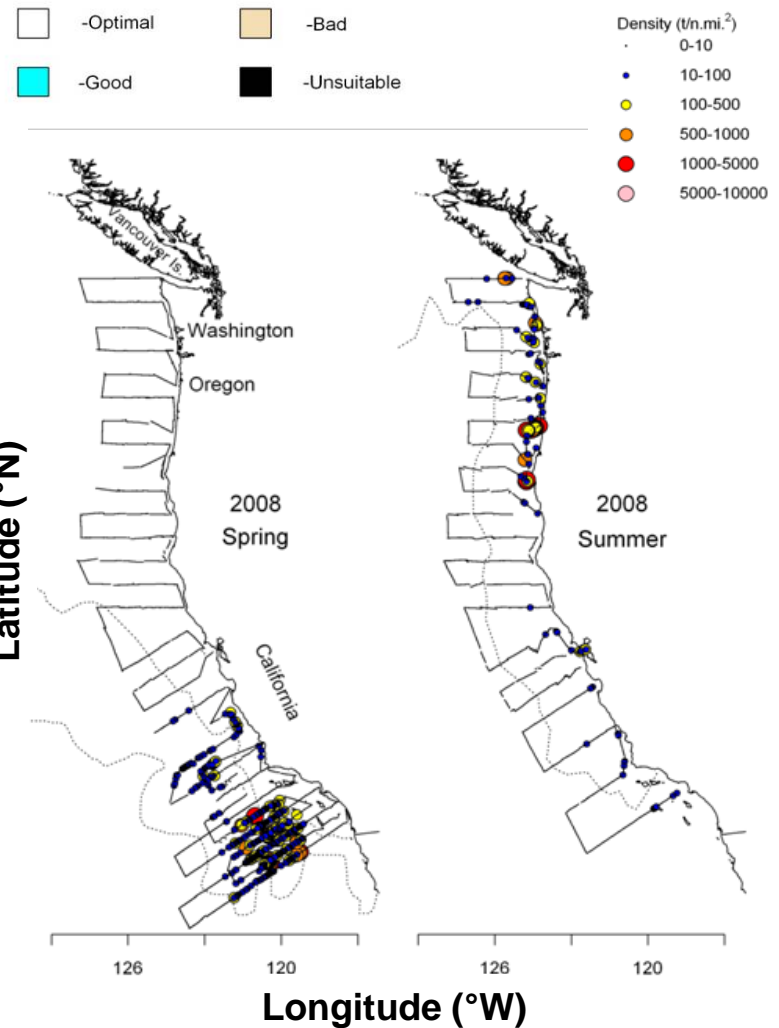
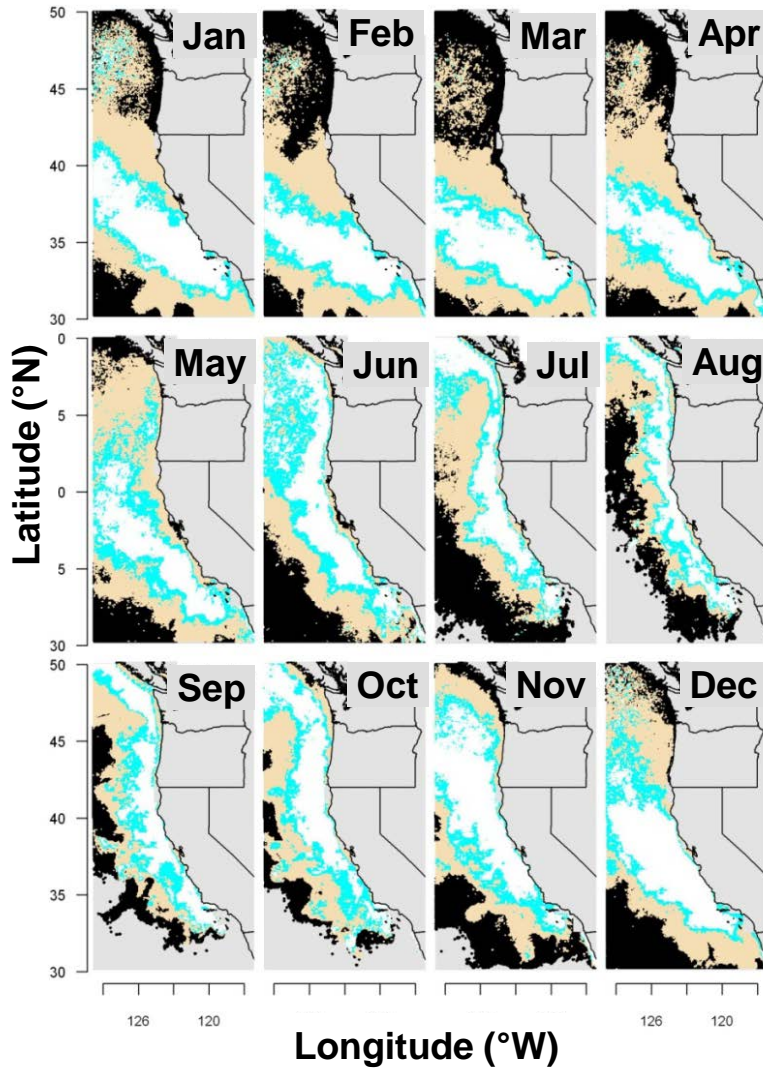


# Wide Bandwidth Measures of Sardine $TS$

- New Simrad EK80
- Pacific sardine
  - $TL = 23.4$  cm;  $W = 130$  g
  - Monofilament tether
  - Swimming

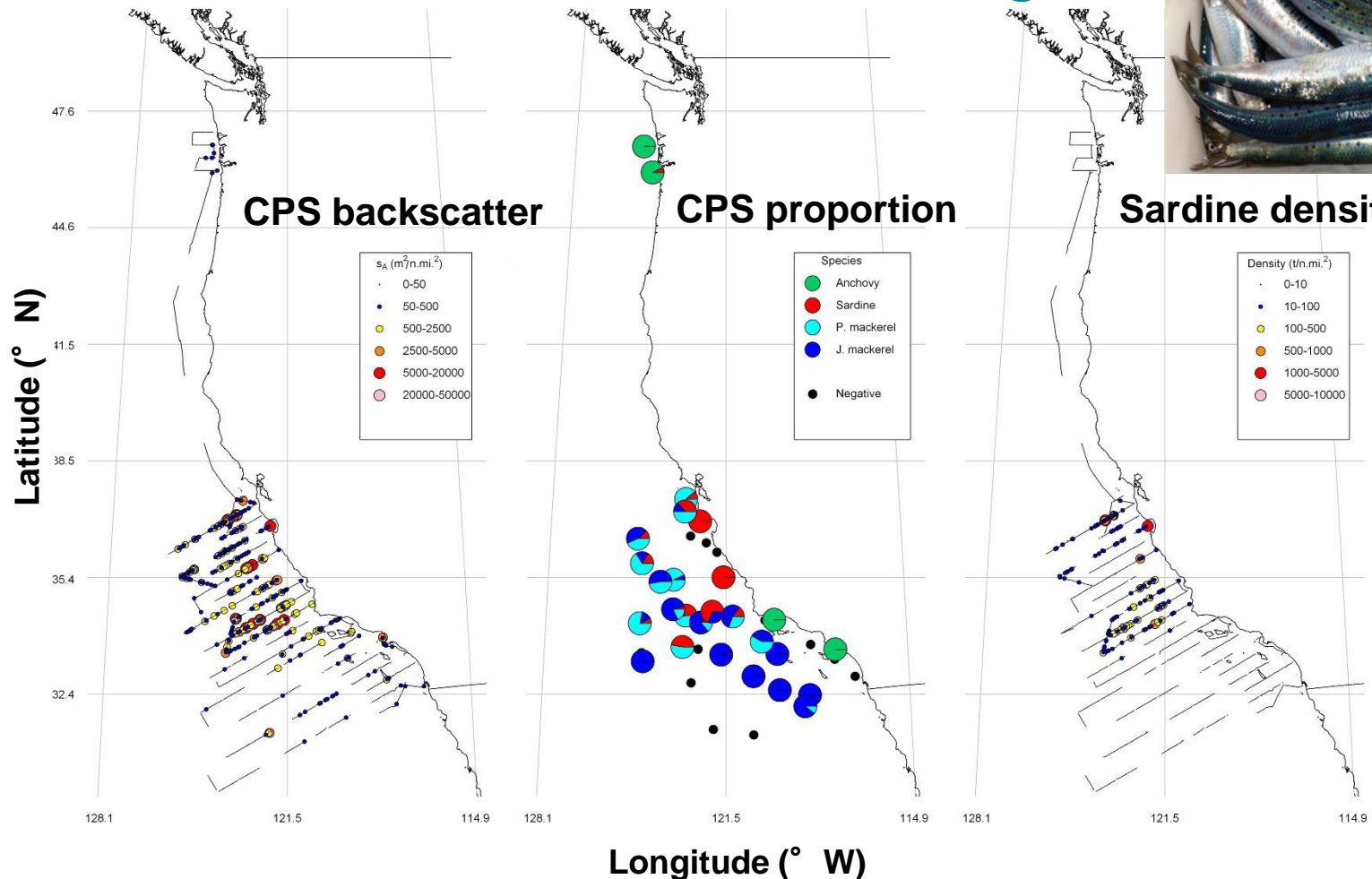


# Seasonal Migrations



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.

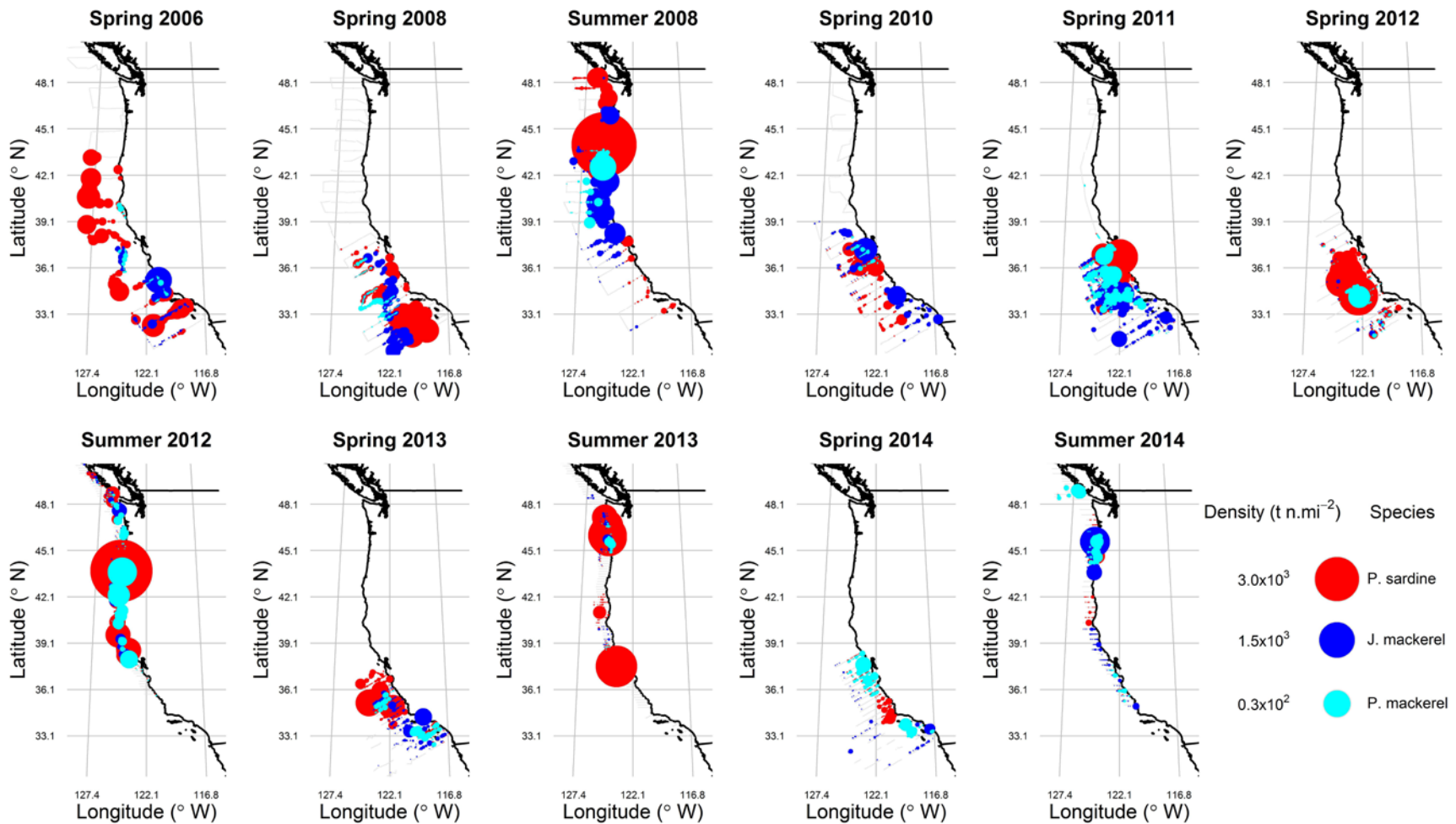
# Acoustic-Trawl Data Processing



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.

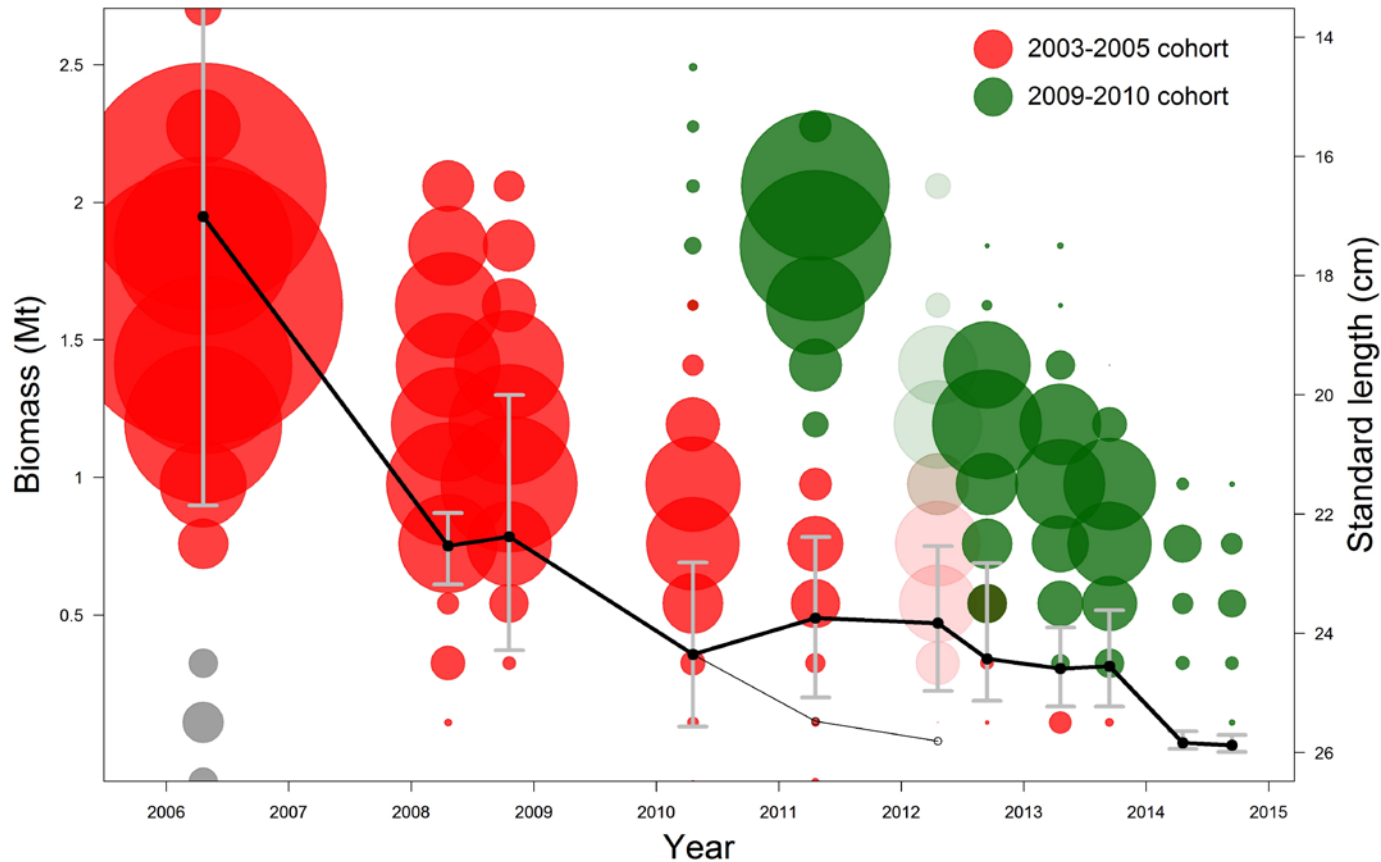


# Multi-Species Acoustic-Trawl Surveys



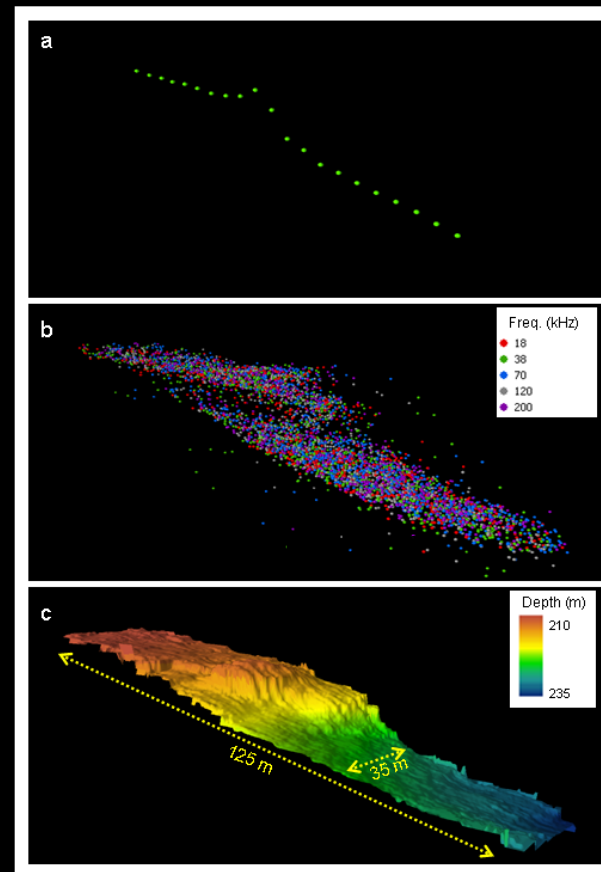
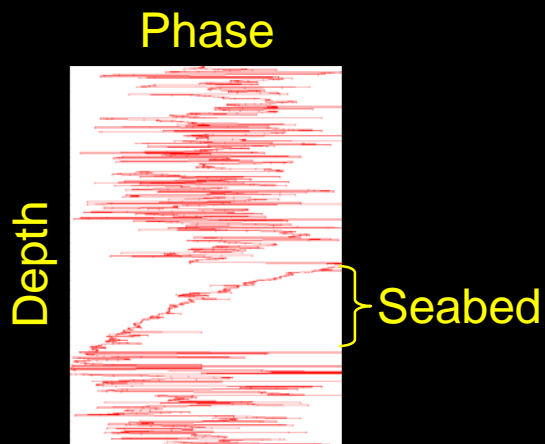
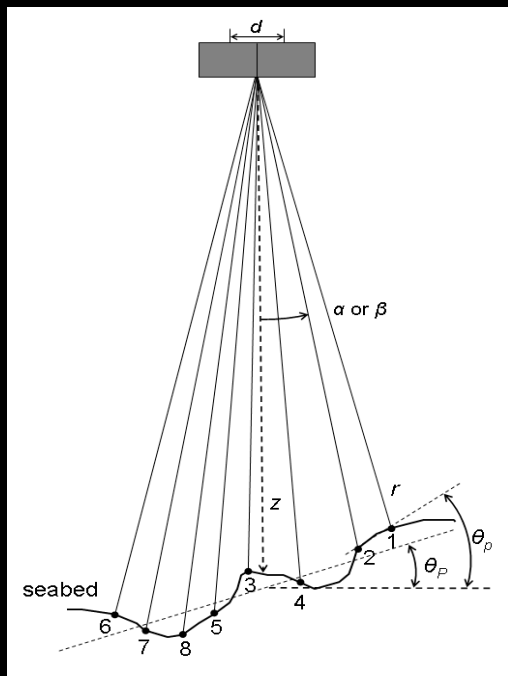
Zwolinski, J.P., D.A. Demer, G.R. Cutter Jr., K. Stierhoff, and B.J. Macewicz. 2014. Building on fisheries acoustics for marine ecosystem surveys. *Oceanography* 27(4):68–79, <http://dx.doi.org/10.5670/oceanog.2014.87>.

# Sardine Lengths and Biomass



Zwolinski, J.P., D.A. Demer, B.J. Macewicz, G.R. Cutter Jr., B.E. Elliot, S.A. Mau, D.W. Murfin, J.S. Renfree, T.S. Sessions, and K.L. Stierhoff. 2015. Acoustic-trawl estimates of sardine biomass off the west coasts of the United States of America and Canada during summer 2014, Appendix B in Hill, K.T. et al., Assessment of the Pacific sardine resource in 2015 for U.S.A. management in 2015-16.

# Biplanar Interferometry



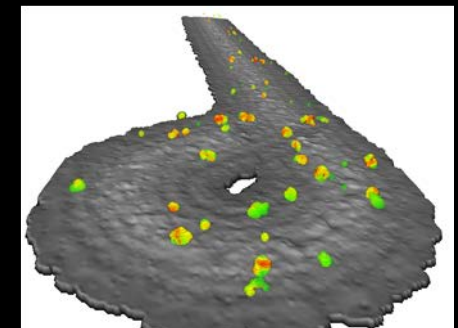
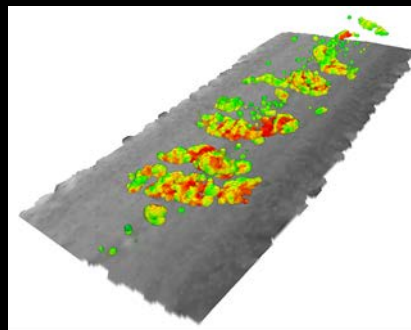
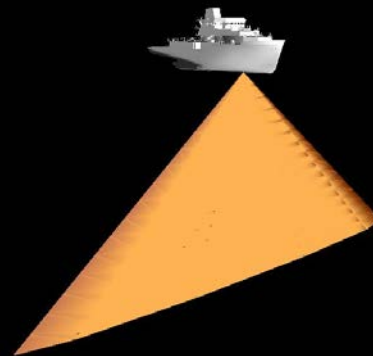
Cutter, G.R. Jr, Demer, D.A. 2010. Multifrequency Biplanar Interferometric Imaging. IEEE Geoscience and Remote Sensing Letters, 7(1): 171-175.



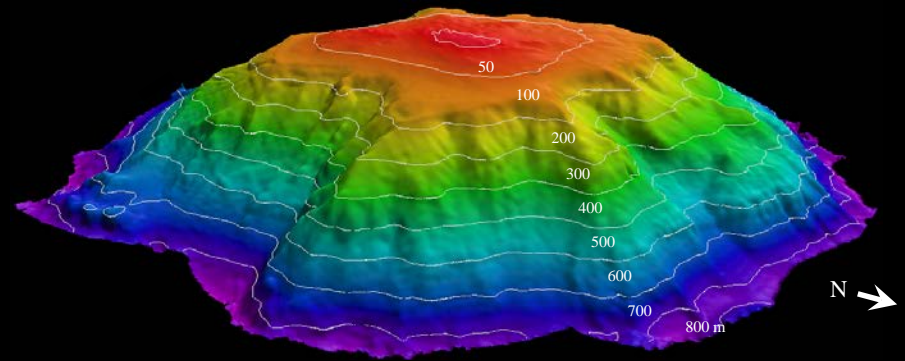
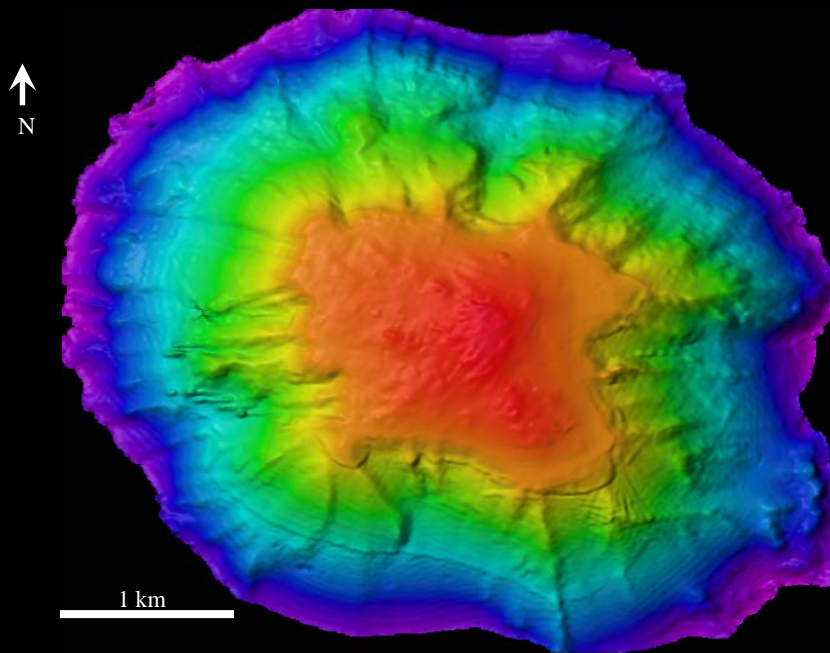
# Biplanar Interferometry



- ID coherent samples
- Convert phase angles to Cartesian distances
- Estimate sub-beam
  - Range
  - Position
  - Slope
  - Roughness
  - Spectra
  - Directivity

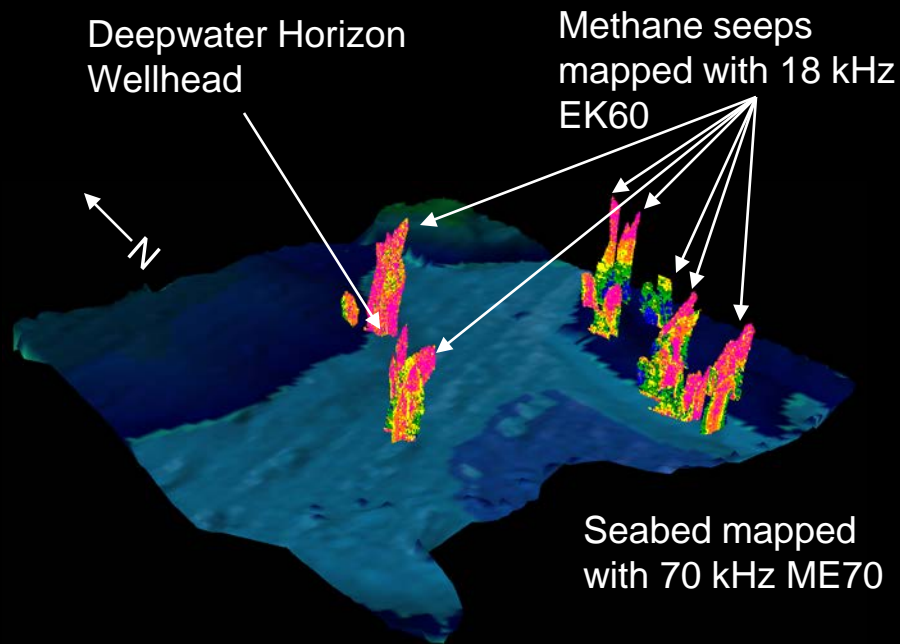


# Biplanar Interferometric Bathymetry Mapping



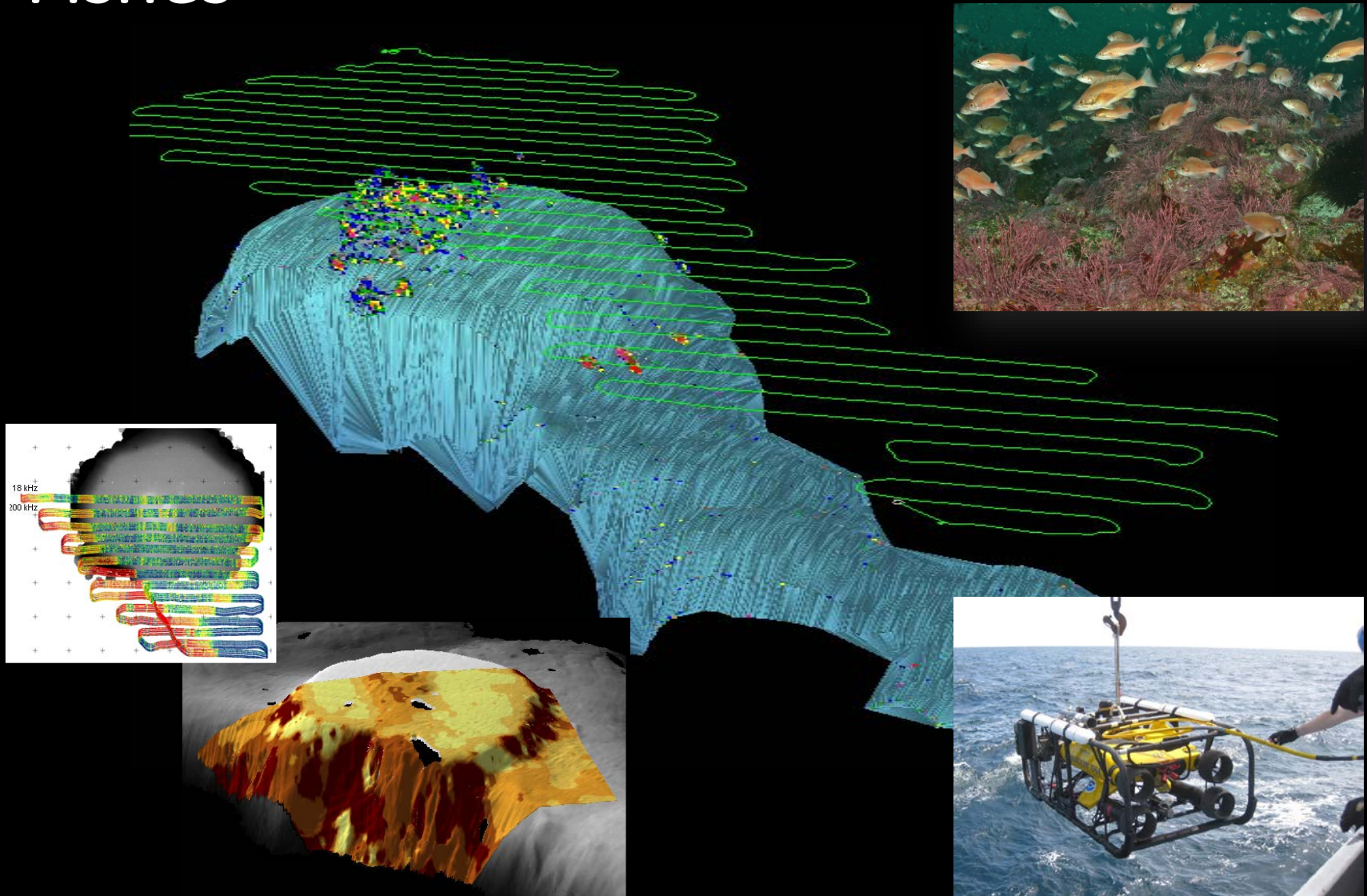
**Shimada Seamount**  
**16° 52' N / 117° 30' W**

# BI Imaging of Seeps & Seabed

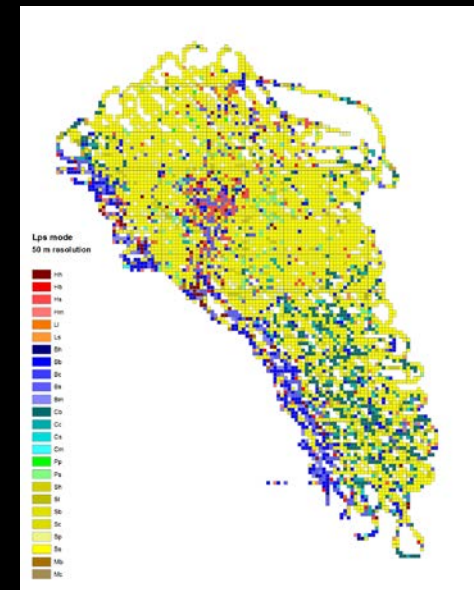
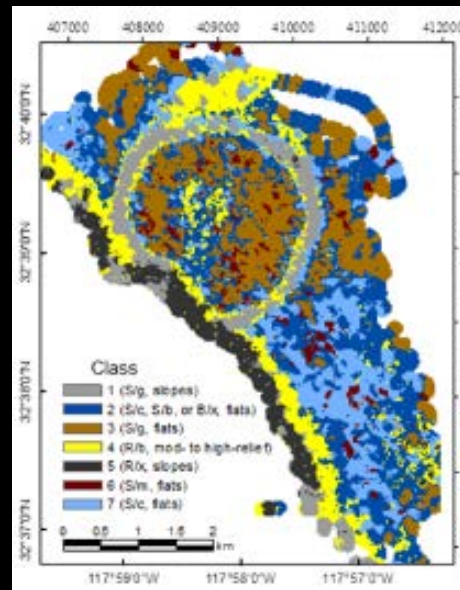
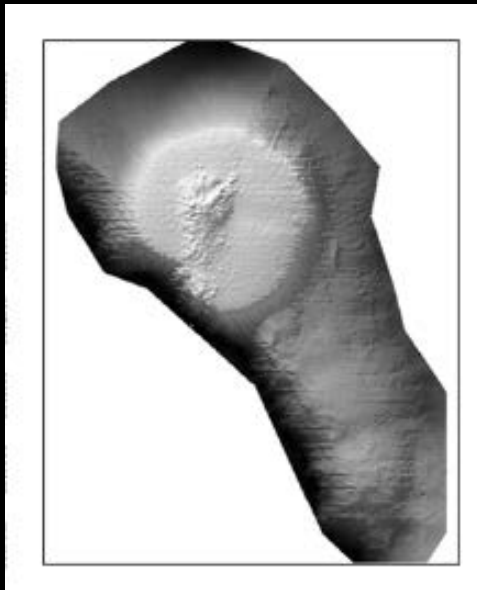




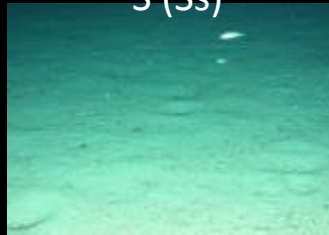
# Acoustic-Optical Surveys of Demersal Fishes



# Acoustic-Optical Seabed Classification



S (Ss)



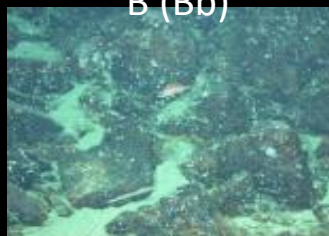
P (Ps)



C (Cs)



B (Bb)



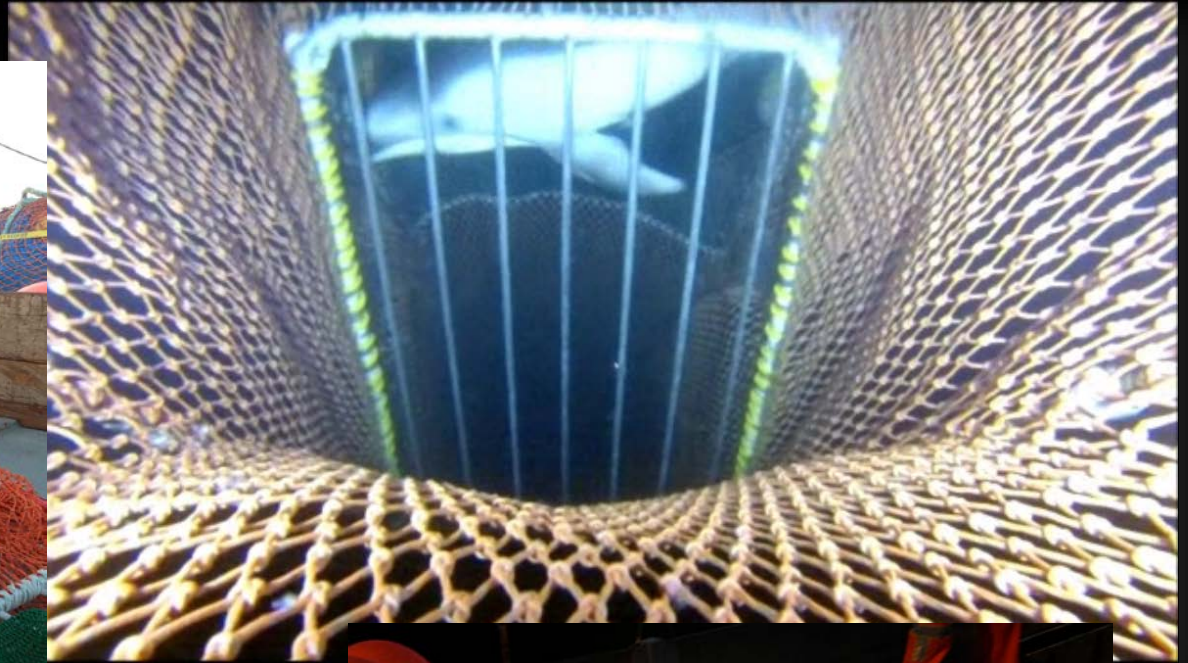
L (Ls)



H (Hh)







# Trawl NetCams

*For observing trawl performance and species' behaviors*



Questions?

