Cetacean abundance estimation through passive acoustics

JAY BARLOW, SHANNON RANKIN & JENNIFER KEATING

Contributions of the SWFSC

- Species Recognition
- Hardware
- Software
- Methodology
- Goals

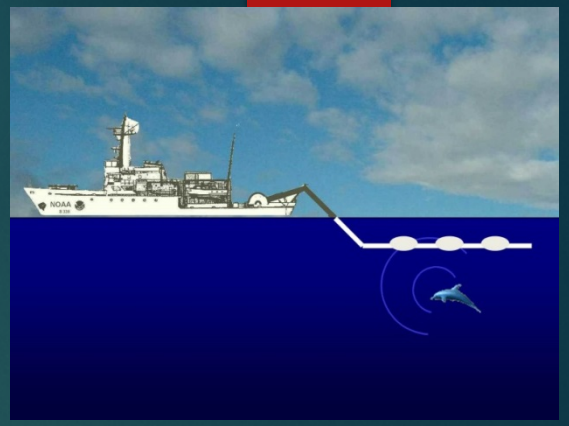
Funders:

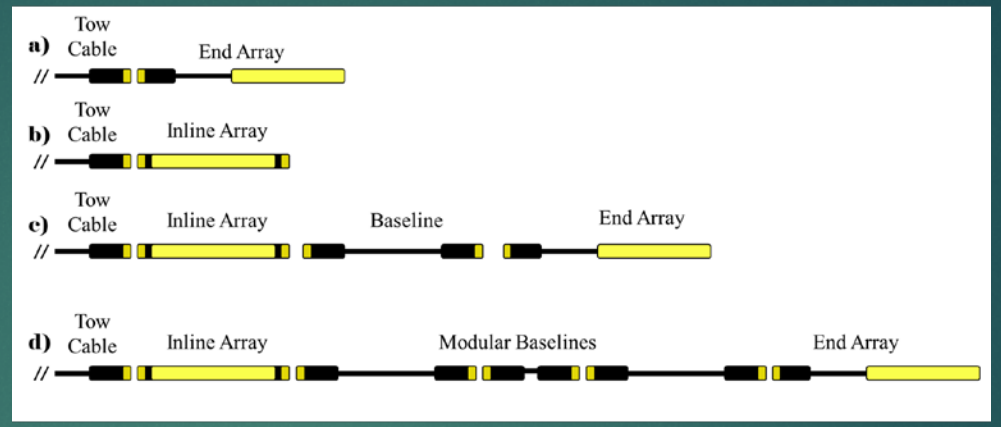
- U.S. Navy Living Marine Resources (LMR) Program (Frank Stone)
- U.S. Navy Office of Naval Research
- NOAA Fisheries: Ocean Acoustics Program
- NOAA Fisheries: Advanced Sampling Technology Working Group

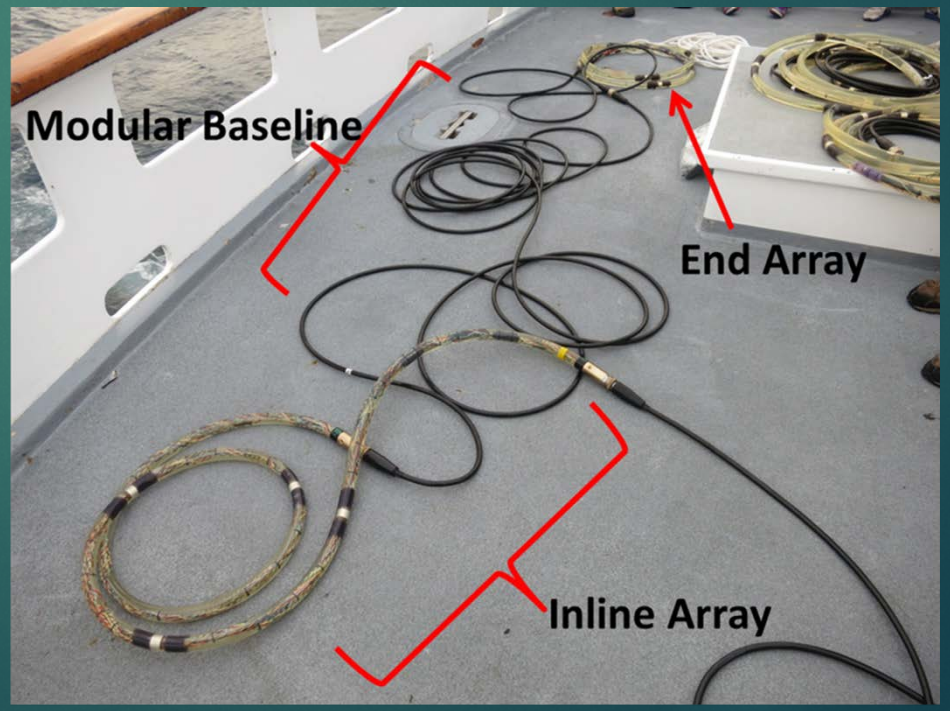
Species recognition

- "First" recordings from: Pacific minke whales, Baird's beaked whales, Pacific sei whales, Longman's beaked whale, Pacific Bryde's whales, & Fraser's dolphins.
- Known-species recordings for all Pacific odontocetes
- Species classification algorithms:
  - ROCCA - Real-time Odontocete Call Classsification Algorithm (Julie Oswald)
  - Random Forest Classification/Misclassification approach (Shannon Rankin & Eric Archer)

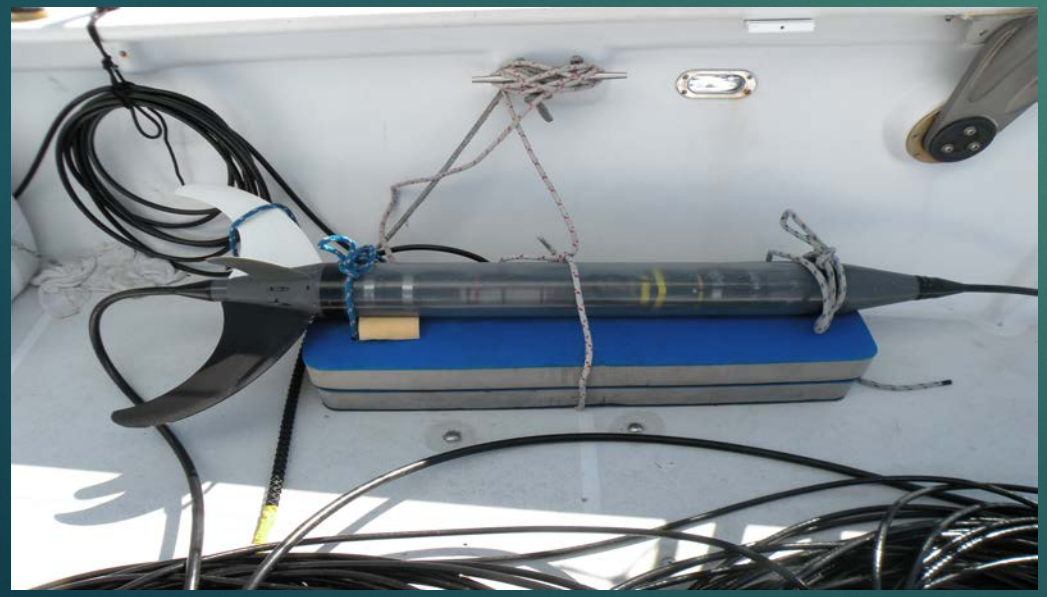
Hardware – Towed Hydrophone Arrays







Hardware – Towed Volumetric Hydrophone Arrays

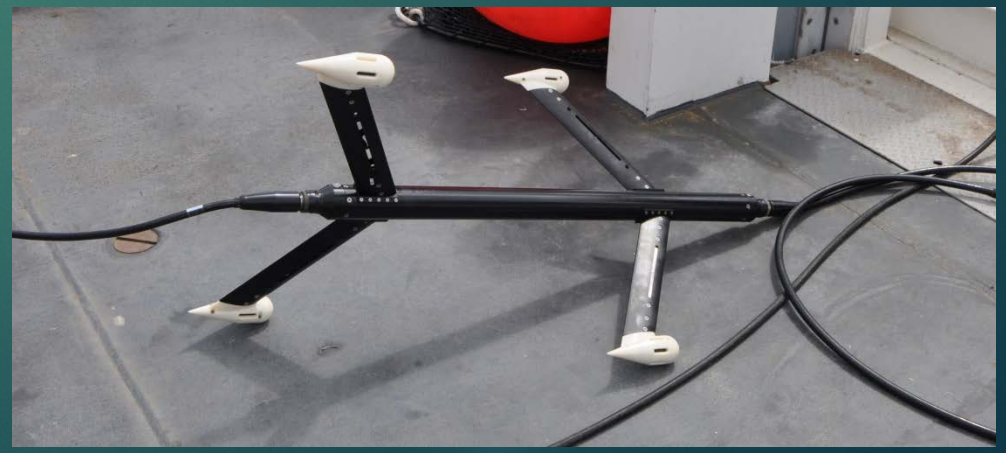


Provide:

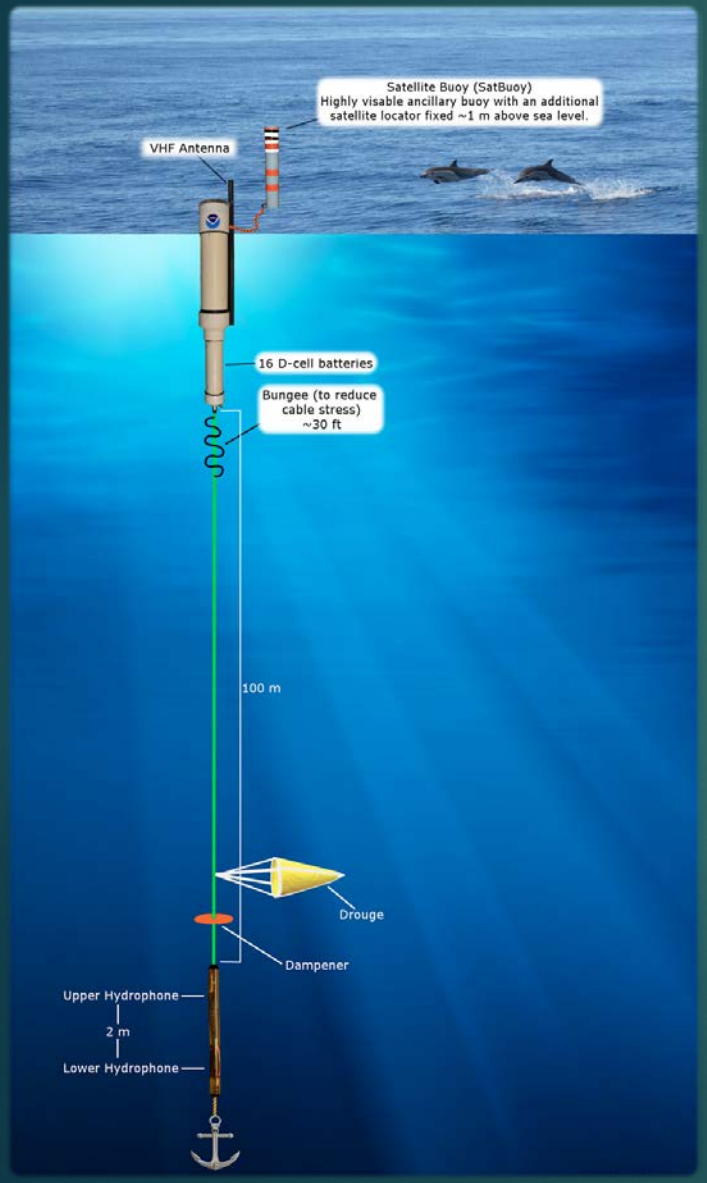
Instantaneous localization of sound source in 3-D based on a single sound

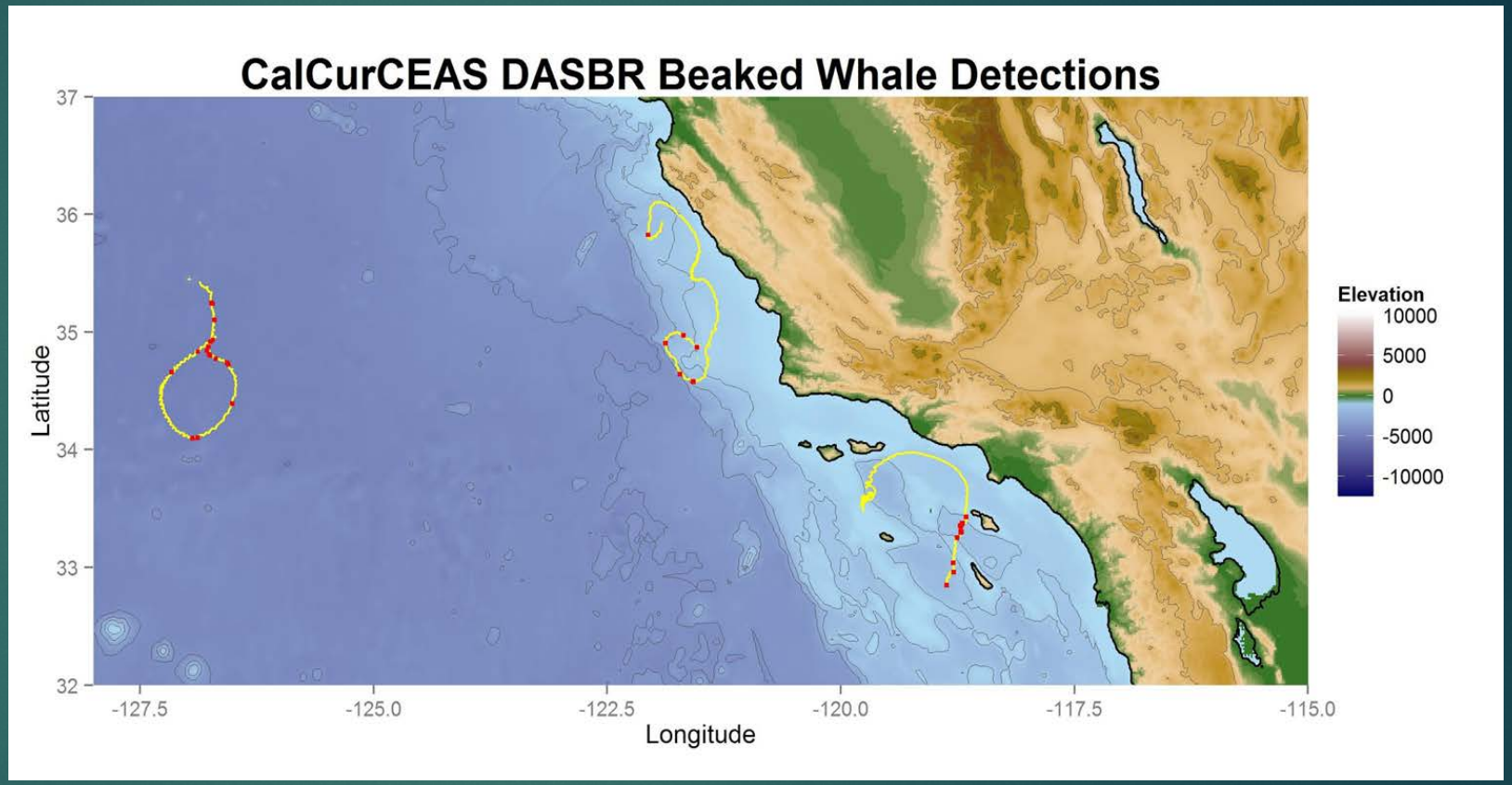
Resolve left/right ambiguity

More accurately estimate range to beaked whales



Hardware – Buoy Recorder Systems





Point-transect density estimates for hard-to-survey species like beaked whales.

Software

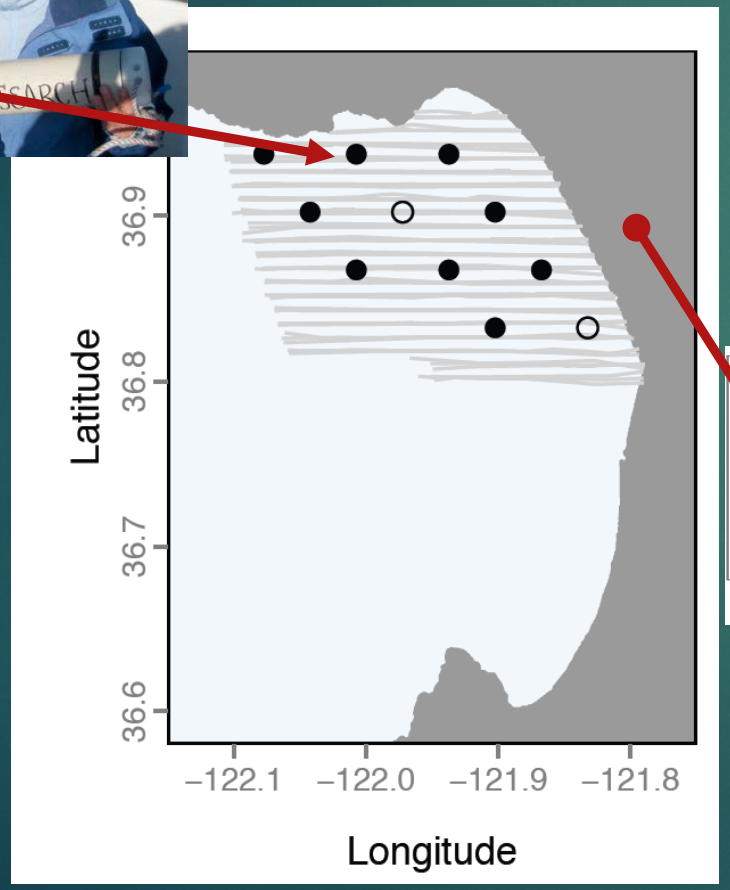
- ISHMAEL – Initiated by SWFSC (thru Oregon State U.) to provide real-time analysis tools for towed hydrophone surveys.
- WHALTRAK – Written by SWFSC (Barlow) to integrate with ISHMAEL and provide interactive bearing/tracking capability.
- ROCCA – Realtime Odontocete Call Classification Algorithm written by Julie Oswald (SWFSC Grad Student) & integrated into PAMGuard.
- PAMGuard modules – Click Interval Indicator & Array Orientation Indicator written under contract to SWFSC.
- All made publicly and freely available to entire user community.

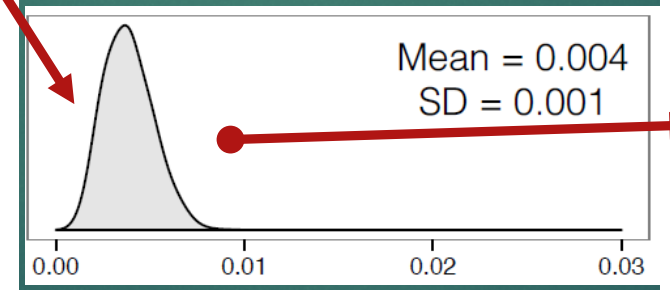
New methodology

- Methods for estimating beaked whale abundance using a buoy-based recording system.
- Methods to remove bias in estimating detection distance for beaked whales using towed tetrahedral hydrophone arrays.
- Methods to combine visual & acoustic data in the same analysis to estimate the fraction missed by each method.
- Methods to use density estimated from visual surveys to estimate the unknown parameters needed for acoustic surveys.

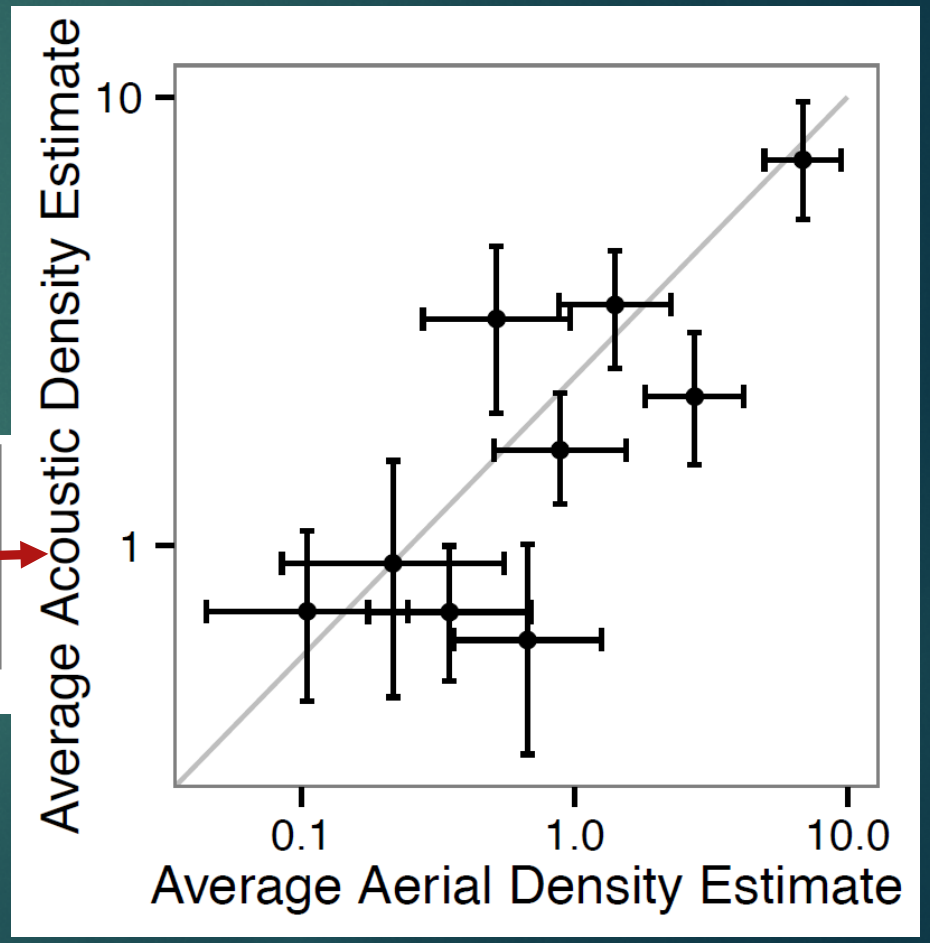
Using density estimated from aerial surveys to estimate acoustic detection area

C-POD: Porpoise acoustic detector

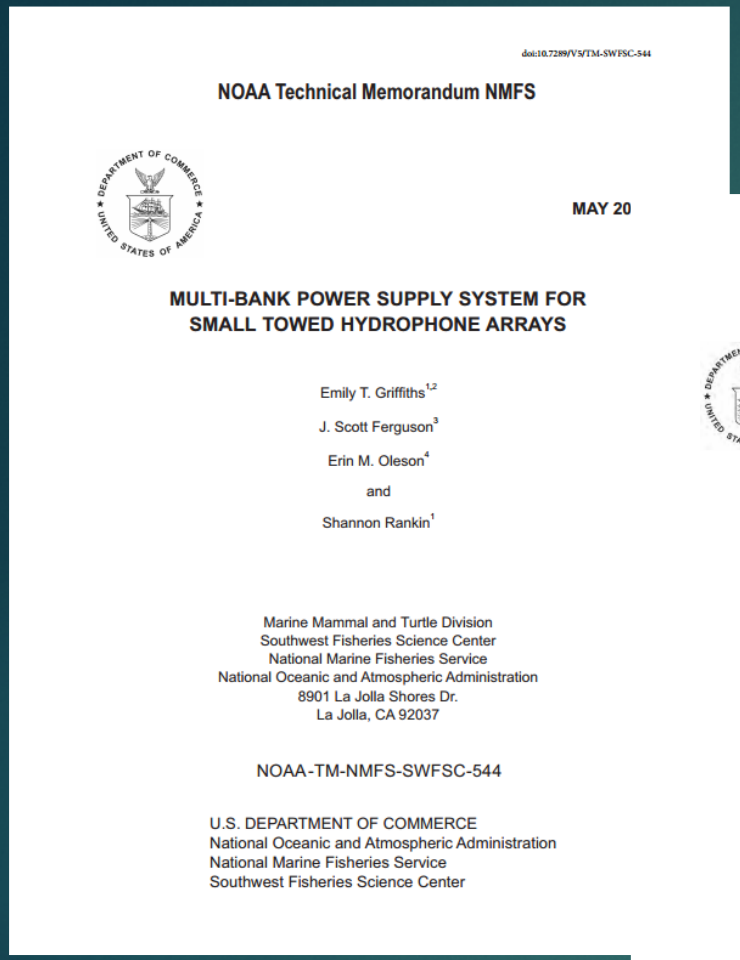




Acoustic Detection Area (km²)



New Methodology



doi:10.7289/V5/TM-SWFSC-544

NOAA Technical Memorandum NMFS

MAY 20

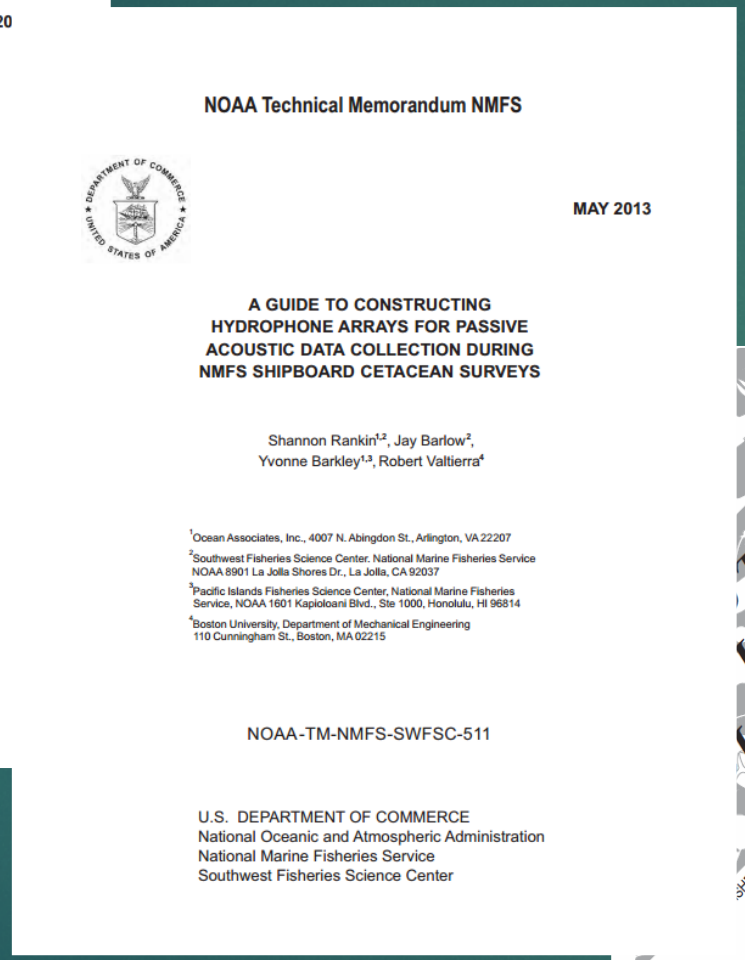
MULTI-BANK POWER SUPPLY SYSTEM FOR SMALL TOWED HYDROPHONE ARRAYS

Emily T. Griffiths[1,2]
J. Scott Ferguson[3]
Erin M. Oleson[4]
and
Shannon Rankin[1]

Marine Mammal and Turtle Division
Southwest Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
8901 La Jolla Shores Dr.
La Jolla, CA 92037

NOAA-TM-NMFS-SWFSC-544

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center



NOAA Technical Memorandum NMFS

MAY 2013

A GUIDE TO CONSTRUCTING HYDROPHONE ARRAYS FOR PASSIVE ACOUSTIC DATA COLLECTION DURING NMFS SHIPBOARD CETACEAN SURVEYS

Shannon Rankin[1,2], Jay Barlow[2],
Yvonne Barkley[1,3], Robert Valtierra[4]

[1]Ocean Associates, Inc., 4007 N. Abingdon St., Arlington, VA 22207
[2]Southwest Fisheries Science Center. National Marine Fisheries Service NOAA 8901 La Jolla Shores Dr., La Jolla, CA 92037
[3]Pacific Islands Fisheries Science Center, National Marine Fisheries Service, NOAA 1601 Kapioloani Blvd., Ste 1000, Honolulu, HI 96814
[4]Boston University, Department of Mechanical Engineering 110 Cunningham St., Boston, MA 02215

NOAA-TM-NMFS-SWFSC-511

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

NATIONAL MARINE FISHERIES SERVICE - SOUTHWEST FISHERIES SCIENCE CENTER

APRIL 2011

ACOUSTIC RECORDING SYSTEM: A PORTABLE HARDWARE SYSTEM FOR SHIPBOARD PASSIVE ACOUSTIC MONITORING OF CETACEANS USING A TOWED HYDROPHONE ARRAY

by

Shannon Rankin and Jay Barlow

ADMINISTRATIVE REPORT LJ-11-01

Disseminating methods and expertise to the worldwide community of researchers interested in using passive acoustic survey tools.

Noise Impacts

- Partners in the Southern California Behavioral Response Study (SoCal BRS) to determine the response of beaked and other whales to Navy sonar.

- Ocean noise monitoring:
  - Partner in the NOAA Ocean Noise Reference Station program, deploying a long-term recorder in the Channel Islands National Marine Sanctuary.

  - Developed buoy recording system that can measure ocean noise inexpensively in the pelagic realm.

Goals:

- Calibrated ocean noise measurement capability by January 2016
- Acoustic-based beaked whale density estimation – proof of concept paper by summer 2016.
- Combined visual & acoustic estimate of sperm whales off US West Coast by January 2017.
- Method paper for estimating fin whale calling rate parameters for point-transect surveys using sonobuoys by summer 2017.