# **Volumetric Towed Hydrophone Arrays:** Two alternative designs to improve localization

### Yvonne Barkley<sup>1</sup>, Jay Barlow<sup>2</sup>, Shannon Rankin<sup>2</sup>, Gerald D'Spain<sup>3</sup>, Erin Oleson<sup>1</sup>

1.Protected Species Division, Pacific Islands Fisheries Science Center, National Marine Fisheries Service, National Oceanic & Atmospheric Administration, 1845 Wasp Blvd., Bldg 176, Honolulu, HI 96818 2.Protected Resources Division, Southwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic & Atmospheric Administration, 8901 La Jolla Shores Drive, La Jolla, CA 92037 3.Marine Physical Laboratory, Scripps Institute of Oceanography, 291 Rosecrans Street, San Diego, CA 92106













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### INTRODUCTION

#### BACKGROUND

- Traditional hydrophone arrays with linear configurations1 cannot spatially discriminate the location of cetacean vocalizations.
- Previous sea trials on small research vessels showed that volumetric array prototypes with spatially-arranged hydrophones could successfully localize cetacean groups in three-dimensions2. Excessive noise occurred at speeds higher than 6 knots.



### APPROACH

- Re-design a volumetric array that can:
  - 1. Operate from large vessels at 10 kts
  - 2. Discriminate sounds from all directions
  - 3. Produce low flow noise and maintain stability
  - 4. Be easily handled by a single person
  - 5. Be compatible with existing NMFS PAM systems1

### **METHODS**

#### **RESEARCH and DEVELOPMENT**



 FloWorks simulations of fluid flow at 10 kts from different angles predicted values of torque, pressure, and shear stress.

### METHODS cont.

#### SEA TRIALS - Evaluating Prototype Performance

Conducted 7 field tests on vessels ranging from 65-209 ft

### Data collected

- Wav file recordings assess flow noise levels Accelerometer data – measure array rotational
- orientation StarOddi sensor data – measure array tilt/orientation
- Modifications to prototypes implemented based on data analysis results

### RESULTS



### TORPEDO PROTOTYPE

#### Initial Results

- Outer shell flooded easily upon immersion
- Low levels of flow noise
- Significant rotational movement (accelerometer data)

#### Modifications

- 4-fin structure added to aft end for stabilization
- 1 fin made of bismuth lead

#### Post-Modification Results

Continued low flow noise levels up to 9 kts Improved rotational movement, but varied at different speeds (StarOddi sensors)



with 4 fin

Teledyne Impulse underwater connectors (MHDM-26-CCR) were incorporated for the compatibility of prototypes with current NMFS systems



with higher speeds

(StarOddi sensors)

Internal PVC Structure for Hydrophones 2" ID

Flooding Outer Shell

PVC Array Body 40" L. 4" ID

fow cable with

High levels of flow / vibrational noise, noise increased

Significant rotational movement (accelerometer data)

Improved rotational movement for speeds up to 6 kts

Potted hydrophone pods with polyurethane

Secured hydrophone cables inside struts

The X-array and torpedo array prototypes proved to be handled easily during deployment and retrieval on small and large vessels.

### **ANALYSIS**



\*Bankin, S., et al. (2011). Again to constructing hydroghame arrays for passive scoustic data collection during NMPS Subpool Constance Surveys. NOAA-HWSMIS SWISC\_211. Southall, B., et al. (2012) Biological and Behavioral Responses Studies of Marine Souther California, 2011; SOCAL-17). Fand Project Report. "Zimmer, W. M. (2012) Requestion of cetaceans with compact volumetric arrays. Journal of the Acoustical Society of America 1342, 360-368.

A special thanks to Sulaman Ahmed for dedicating his senior thesis to drawing and modeling our designs, to the engineer team, Dave Price and Scott Jenkins, for building the prototypes, and to Jennifer Keating and Emily Griffiths for their crucial roles in each sea trial. Funding for developing and testing the volumetric arrays was provided by Advanced Science Technology Working Group (ASTWG) of the National Oceanic and Atmospheric Administration



Thank you!