Investigating the response of coastal dolphins to mine exercise (MINEX) training activities

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HDR

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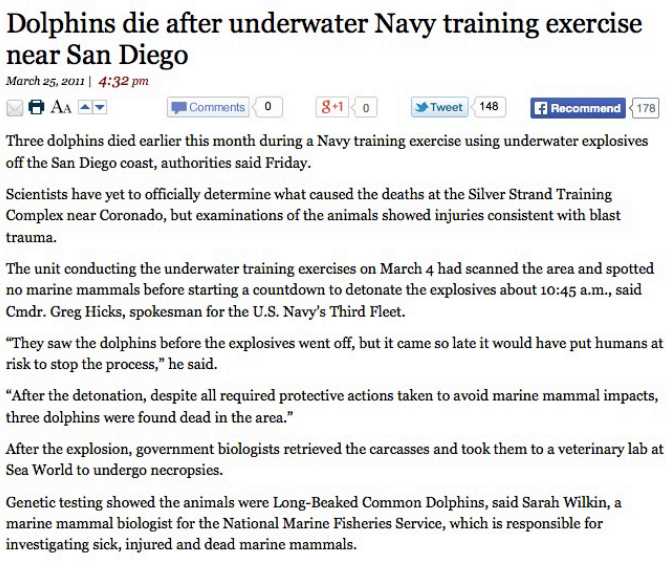
Introduction

Background

- Naval mine exercise (MINEX) training activities have the potential to injure or kill marine mammals
- In March 2011, 3 common dolphins were accidentally killed during a MINEX event at the Silver Strand Training Complex (San Diego, CA).



Dolphins die after underwater Navy training exercise near San Diego

March 25, 2011 | 4:32 pm

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Three dolphins died earlier this month during a Navy training exercise using underwater explosives off the San Diego coast, authorities said Friday.

Scientists have yet to officially determine what caused the deaths at the Silver Strand Training Complex near Coronado, but examinations of the animals showed injuries consistent with blast trauma.

The unit conducting the underwater training exercises on March 4 had scanned the area and spotted no marine mammals before starting a countdown to detonate the explosives about 10:45 a.m., said Cmdr. Greg Hicks, spokesman for the U.S. Navy's Third Fleet.

"They saw the dolphins before the explosives went off, but it came so late it would have put humans at risk to stop the process," he said.

"After the detonation, despite all required protective actions taken to avoid marine mammal impacts, three dolphins were found dead in the area."

After the explosion, government biologists retrieved the carcasses and took them to a veterinary lab at Sea World to undergo necropsies.

Genetic testing showed the animals were Long-Beaked Common Dolphins, said Sarah Wilkin, a marine mammal biologist for the National Marine Fisheries Service, which is responsible for investigating sick, injured and dead marine mammals.

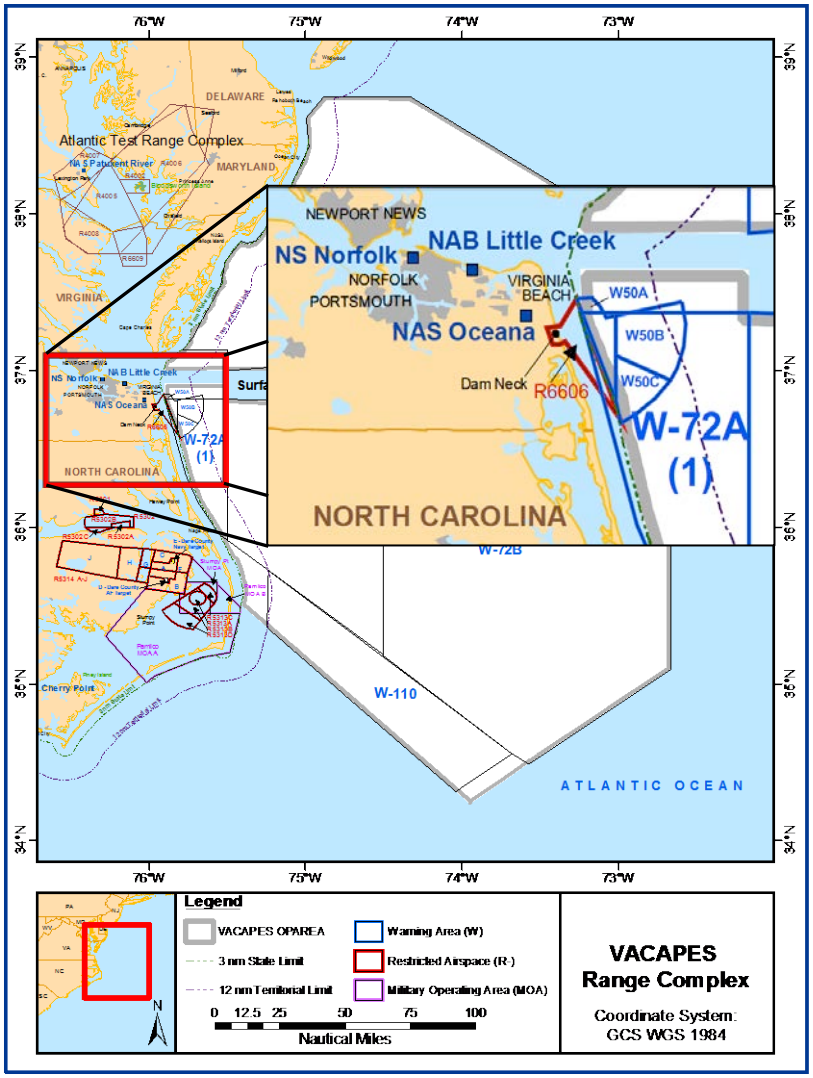
Los Angeles Times – 25 March, 2011

- An effort was begun in August 2012 to monitor odontocete activity at the Virginia Capes (VACAPES) MINEX range using PAM and visual surveys as part of the U.S. Navy's Integrated Comprehensive Monitoring Plan

Introduction

Objectives

- Establish the daily and seasonal pattern of occurrence of dolphins in the W-50 MINEX training area
- Detect explosions related to MINEX activities
- Determine whether dolphins in the area show evidence of a behavioral response to explosions



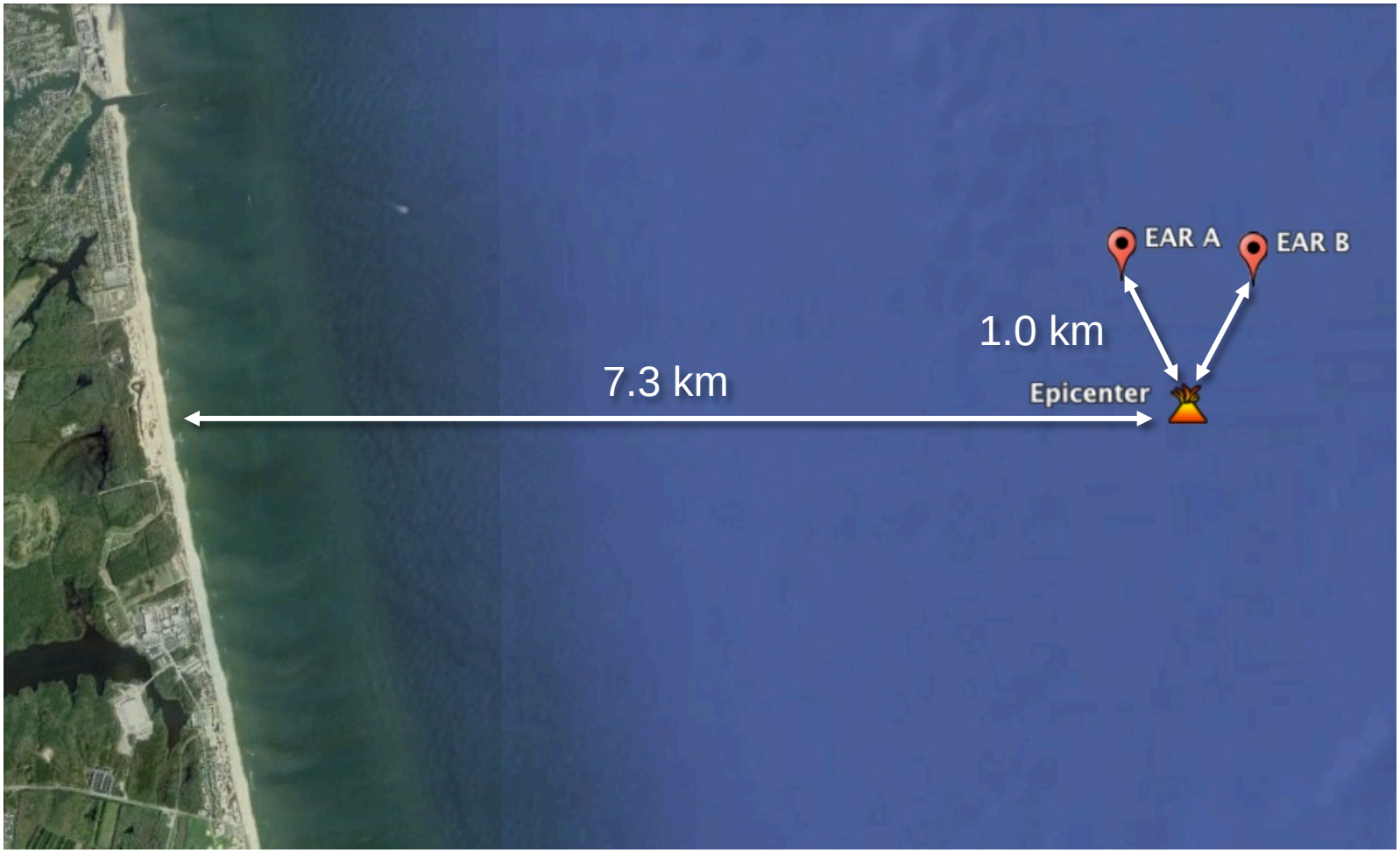
Methods

Ecological Acoustic Recorder (EAR)

- Recording bandwidth= 25 kHz
- Offset duty cycles = 3 min ‘on’ every 6 min (50%)
- Refurbished approx. every 2 months

Methods

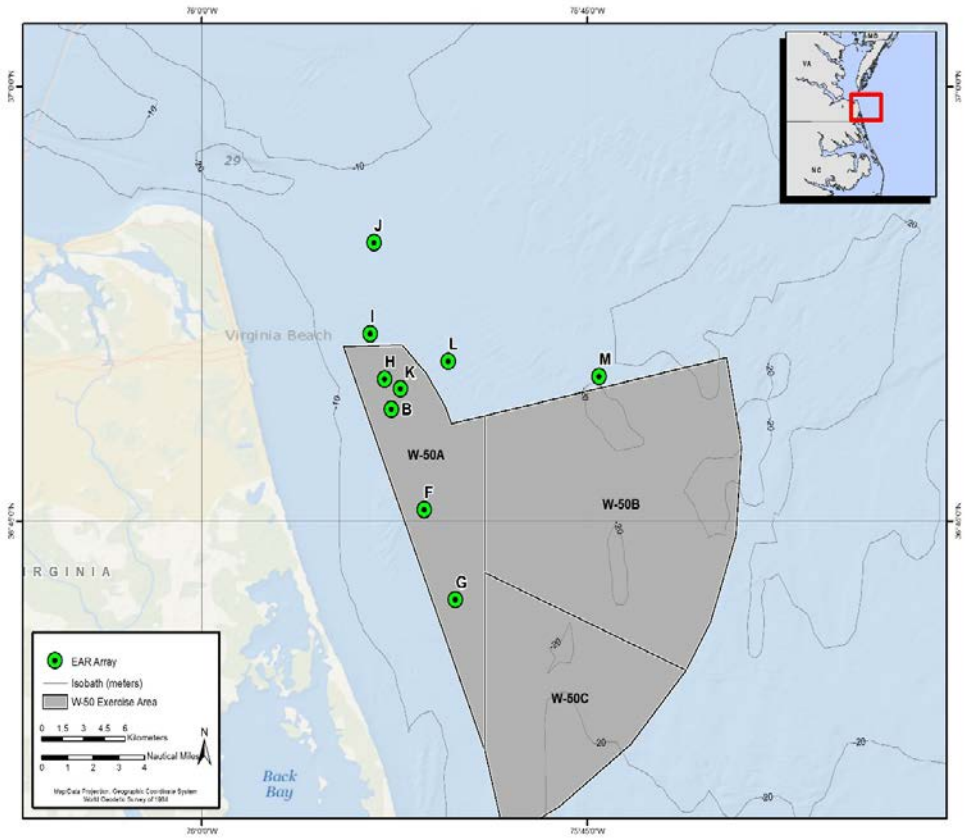
EAR locations – Year 1



Methods

EAR locations – Year 2

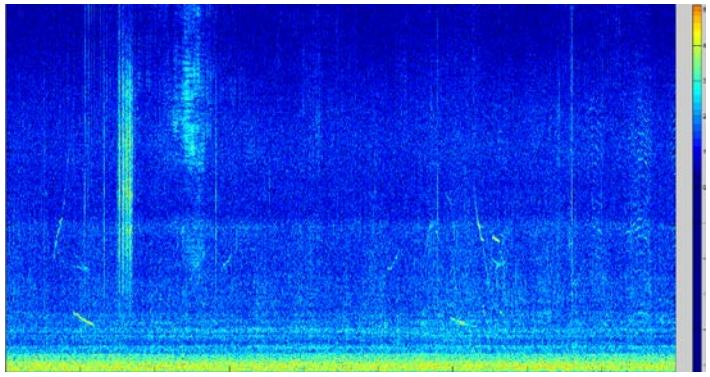
- 4 EARs deployed in a coastal array configurations spaced 1, 3, 6 & 12 km apart to the N, S & E of epicenter to examine:
  - At what distance from the training area is a response observed?
  - Do animals re-locate further away in response to MINEX training events?



Methods

Data analysis

- Visual/aural inspection of all recordings for presence/absence of dolphin signals & explosions.
- Detailed assessment of dolphin acoustic activity during the day before, during and after detected explosions.
- Acoustic activity index assigned for each 3-minute recording.



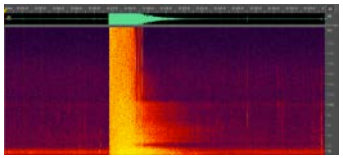
Acoustic category	Index value
1-20 whistles	1
BP only <10	1
Sonar only <2 clicks/sec	1
21-40 whistles	1.5
Sonar only >2 clicks/sec	1.5
BP only >10	1.5
Sonar & BP <10	1.5
1-20 whistles & sonar or BP	2
>41 whistles	2.5
Sonar & BP >10	2.5
1-20 whistles, sonar & BP	3
21-40 whistles & sonar or BP	3
21-40 whistles, sonar & BP	3.5
>41 whistles & sonar or BP	3.5
>41 whistles, sonar & BP	4

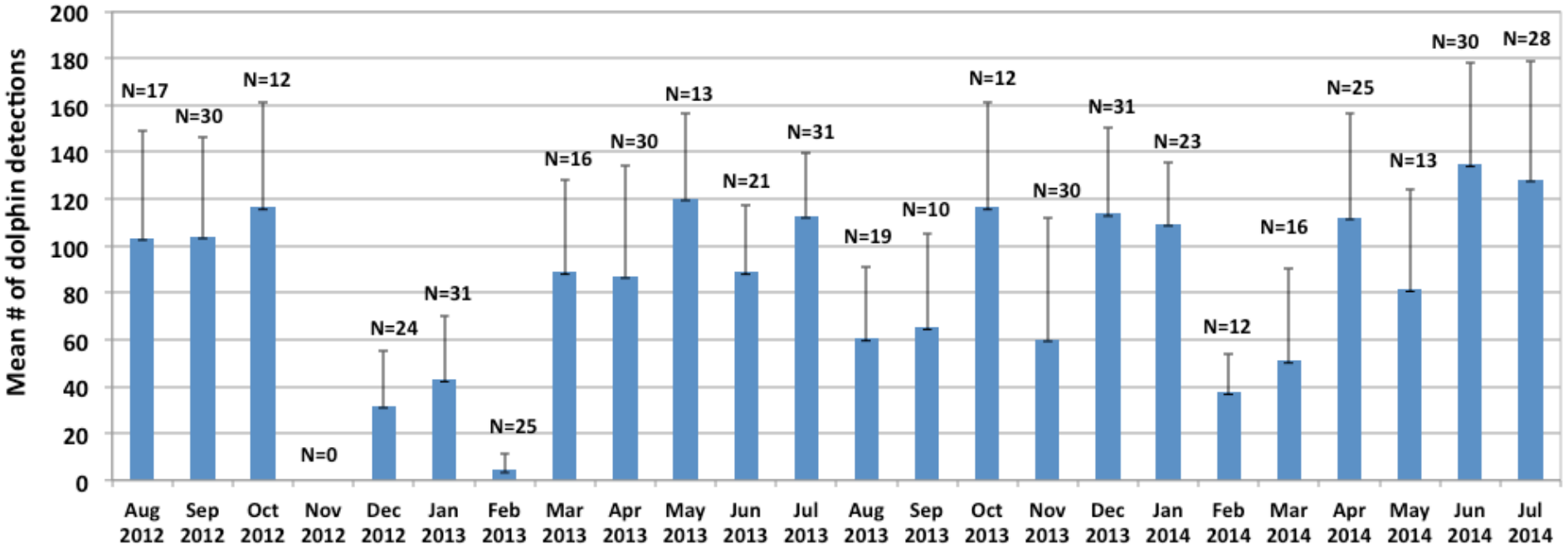
Results

Occurrence of dolphins (1 km from 'epicenter')

- Dolphins were detected year-round & on 97% of recording days
- Fewer detections in winter between December & March

Detected explosions = 45
15 Aug, 2012 – 28 Jul, 2014

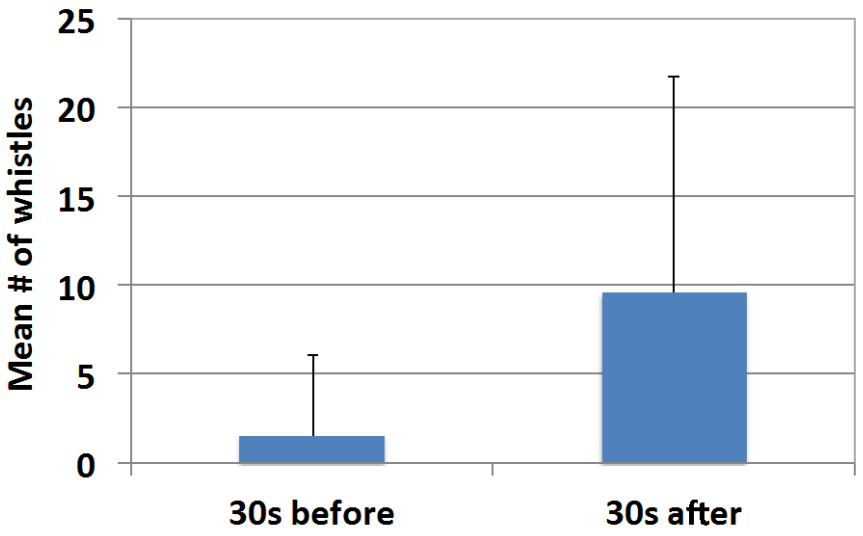




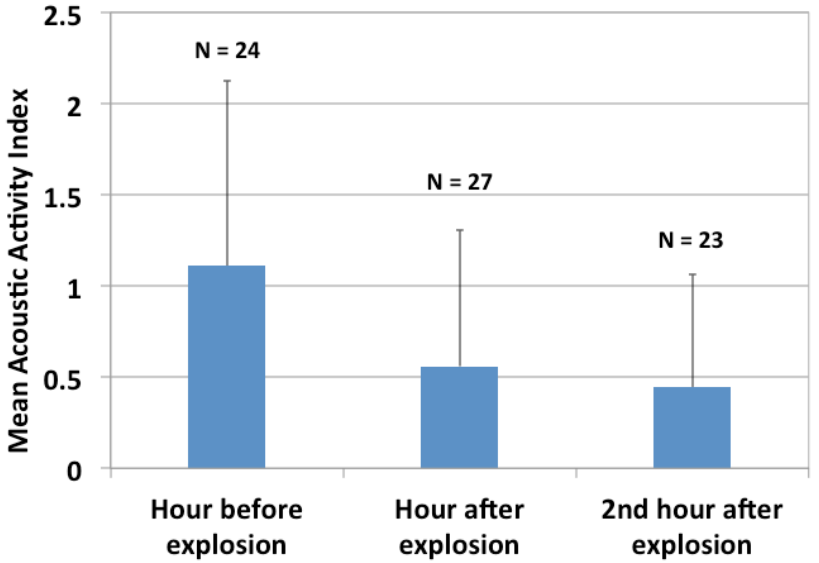
Results

Response to explosion (1 km from 'epicenter')

- A short-term increase in production of whistles occurs immediately after an explosion
- Dolphin acoustic activity decreased during the 1st and 2nd hours after an explosion



Mann-Whitney U-test, n = 16, p = 0.02

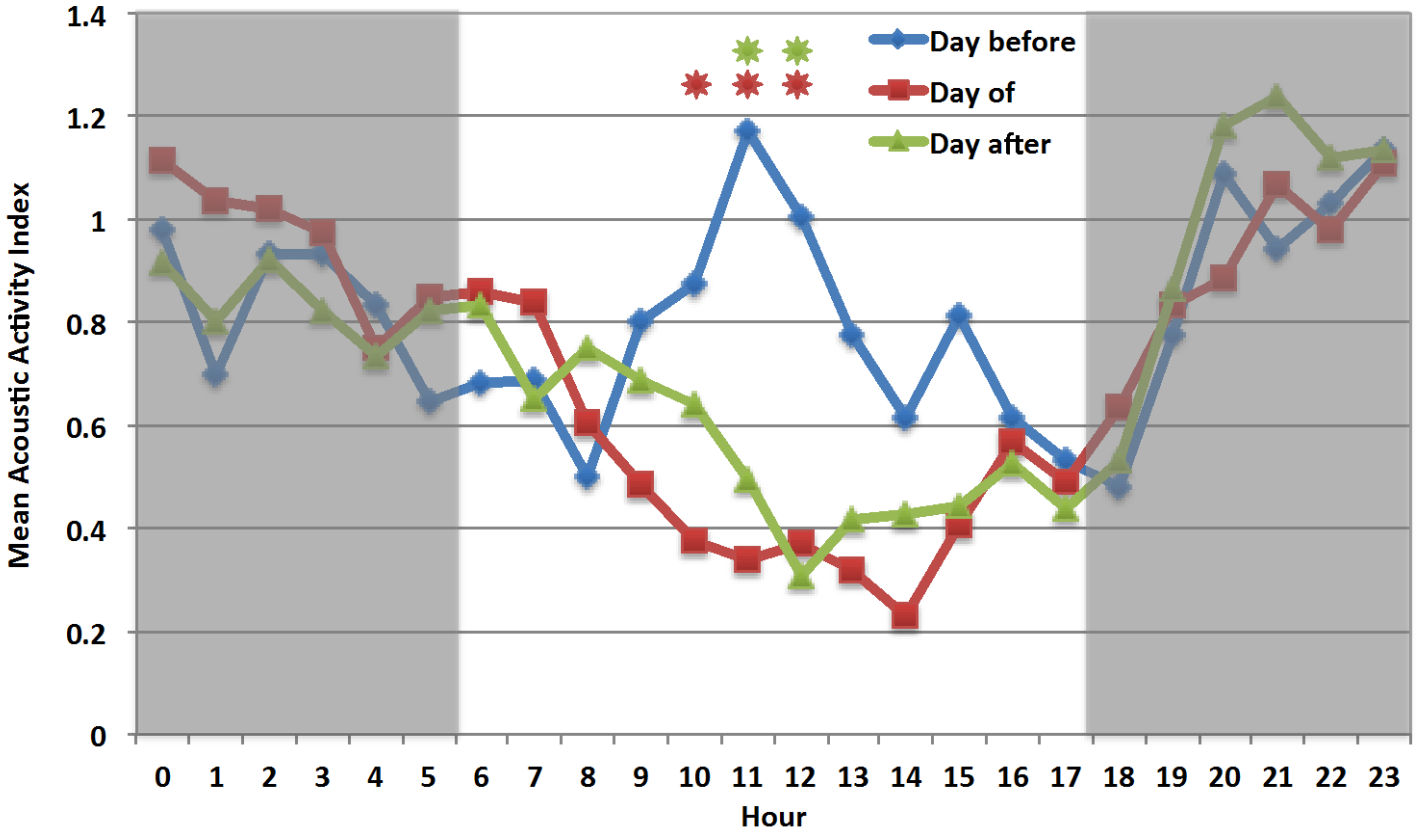


One-way ANOVA, DF = 2, F = 9.2, p < 0.001

Results

Diel acoustic activity (1 km from 'epicenter')

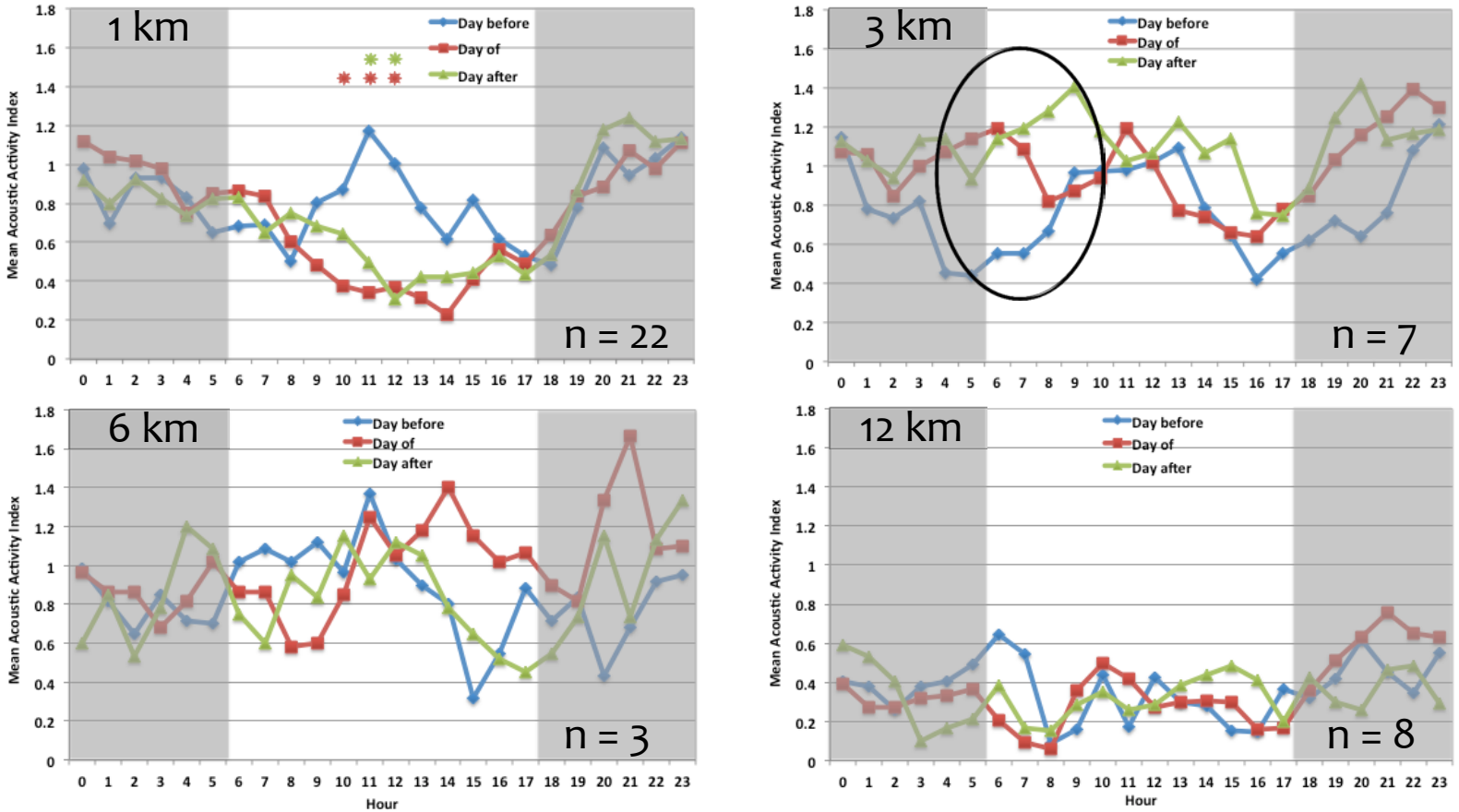
- Hourly dolphin acoustic activity for the day before, during and after, averaged over 22 MINEX training events



Results

Diel acoustic activity (1, 3, 6 & 12 km from 'epicenter')

- No evidence of an acoustic response at distances > 1 km
- Evidence of redistribution at 3 km?



Summary

1st & 2nd year of monitoring

- Dolphins were present daily in the W-50 MINEX range during the two-year period examined (Aug 2012 – Jul 2014).
- Dolphins exhibit a short-term acoustic response immediately following an explosion event. Acoustic activity increases briefly and then declines substantially for several hours.
- Decreased acoustic activity is repeated during the daytime hours of the following day, suggesting some continued avoidance of the area.

Ongoing work

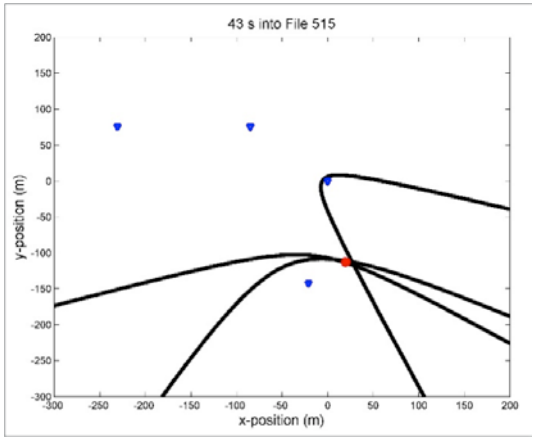
Year 3 (Sep. 2014 – Aug. 2015)

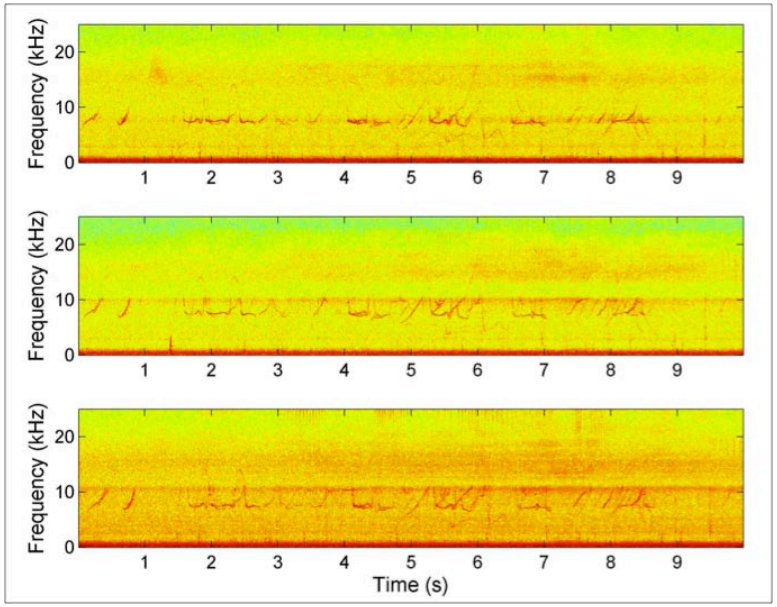
- Coastal array deployments are ongoing to further examine whether animals redistribute following MINEX events.
- An EAR localization array deployed 1 km from epicenter is being used to:
  - Establish the approximate range of dolphins during explosions.
  - Further characterize the acoustic response following an explosion.

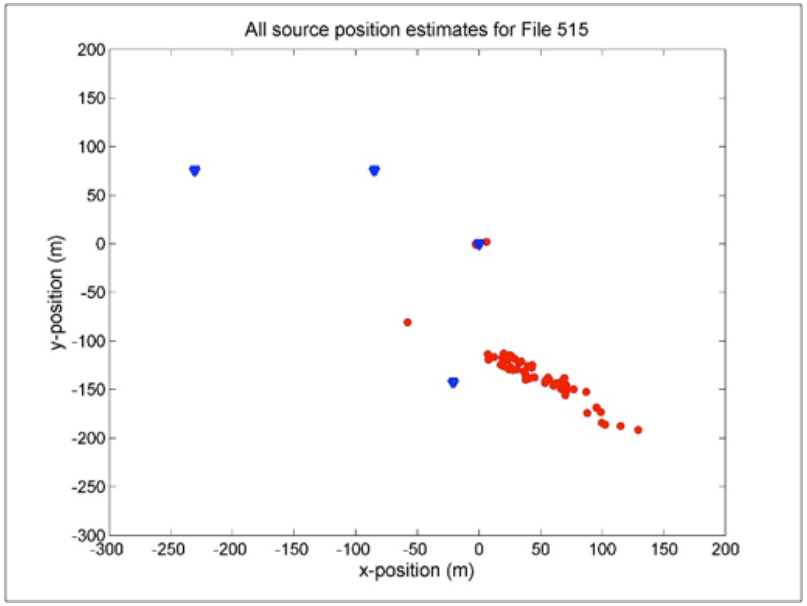
Ongoing work

Localization array

- 4 EARs & 1 co-located pinger
- 1st array deployed 16 Aug – 7 Nov 2014
- Focus to date on clock synchronization and algorithm development (Eva Nosal)







Remembering W. Watkins

LISTENING TO HAWAIIAN SPINNER PORPOISES, *STENELLA* CF. *LONGIROSTRIS*, WITH A THREE-DIMENSIONAL HYDROPHONE ARRAY

WILLIAM A. WATKINS AND WILLIAM E. SCHEVILL

ABSTRACT.—A three-dimensional array of hydrophones was anchored for 6 days (8 to 13 May 1971) in Kealakekua Bay on the island of Hawaii in order to listen to the underwater sounds of a resident population of spinner porpoises, *Stenella* cf. *longirostris* (Gray, 1828). Arrival-times for individual porpoise sounds were measured, and source locations were calculated to provide a three-dimensional indication of position for calling animals. Most sounds originated at depths less than 10 meters, and many of them were exchanges of sounds by porpoises within 10 to 15 meters of each other. Source level calculations indicated a wide range of levels that suggest intentional control of sound level. The three-dimensional array provided information that would not have been available by single hydrophone listening.

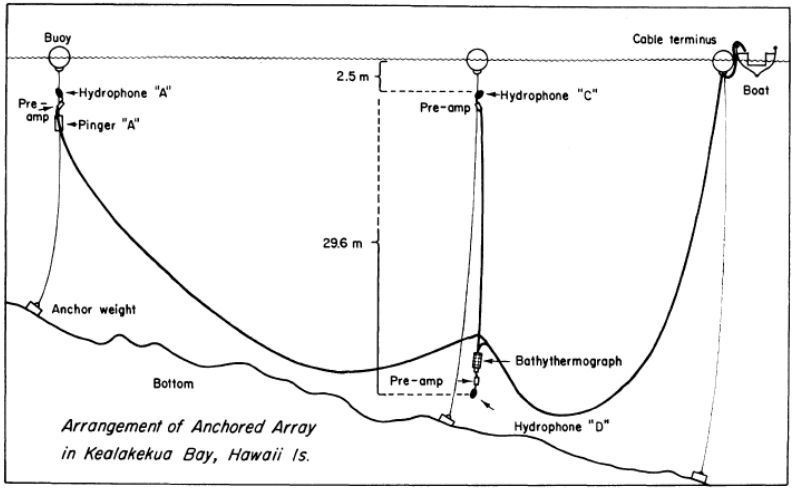


FIG. 1.—Arrangement of the hydrophone array was an attempt to keep the components off the bottom and well below the surface. Hydrophone B is omitted from this diagram.

Thanks for leading the way, Bill…

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