The acoustic response of coastal dolphins to mine exercise (MINEX) training activities

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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.

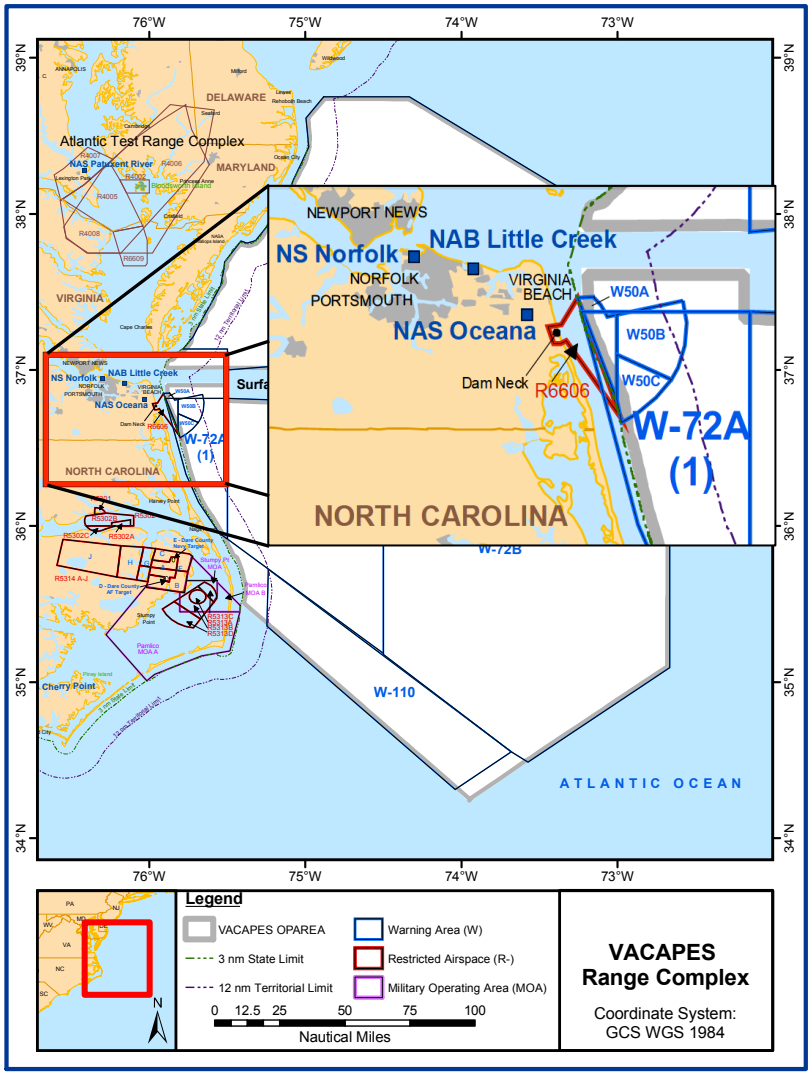
Los Angeles Times – 25 March, 2011

- 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

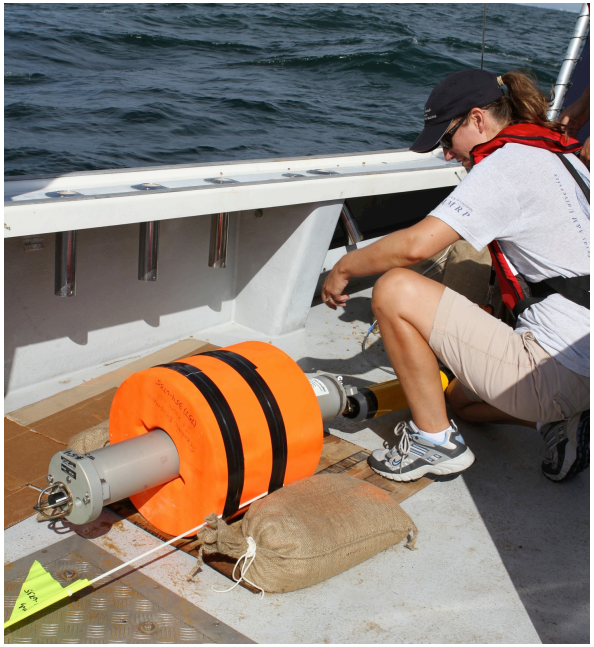
- Establish the daily and seasonal pattern of occurrence of dolphins in the W-50 MINEX training area
- Detect explosions related to MINEX activities
- Determine whether dolphins in the area show evidence of a behavioral response to explosions

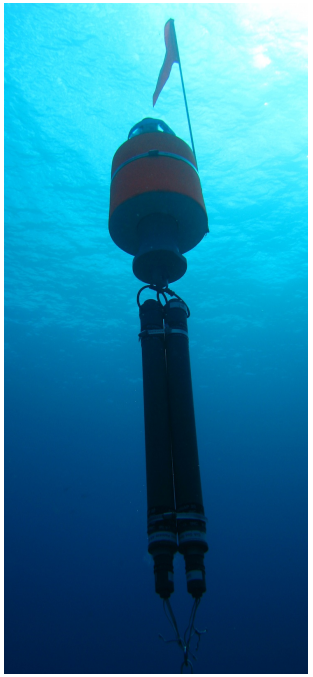


Methods

Ecological Acoustic Recorder (EAR)

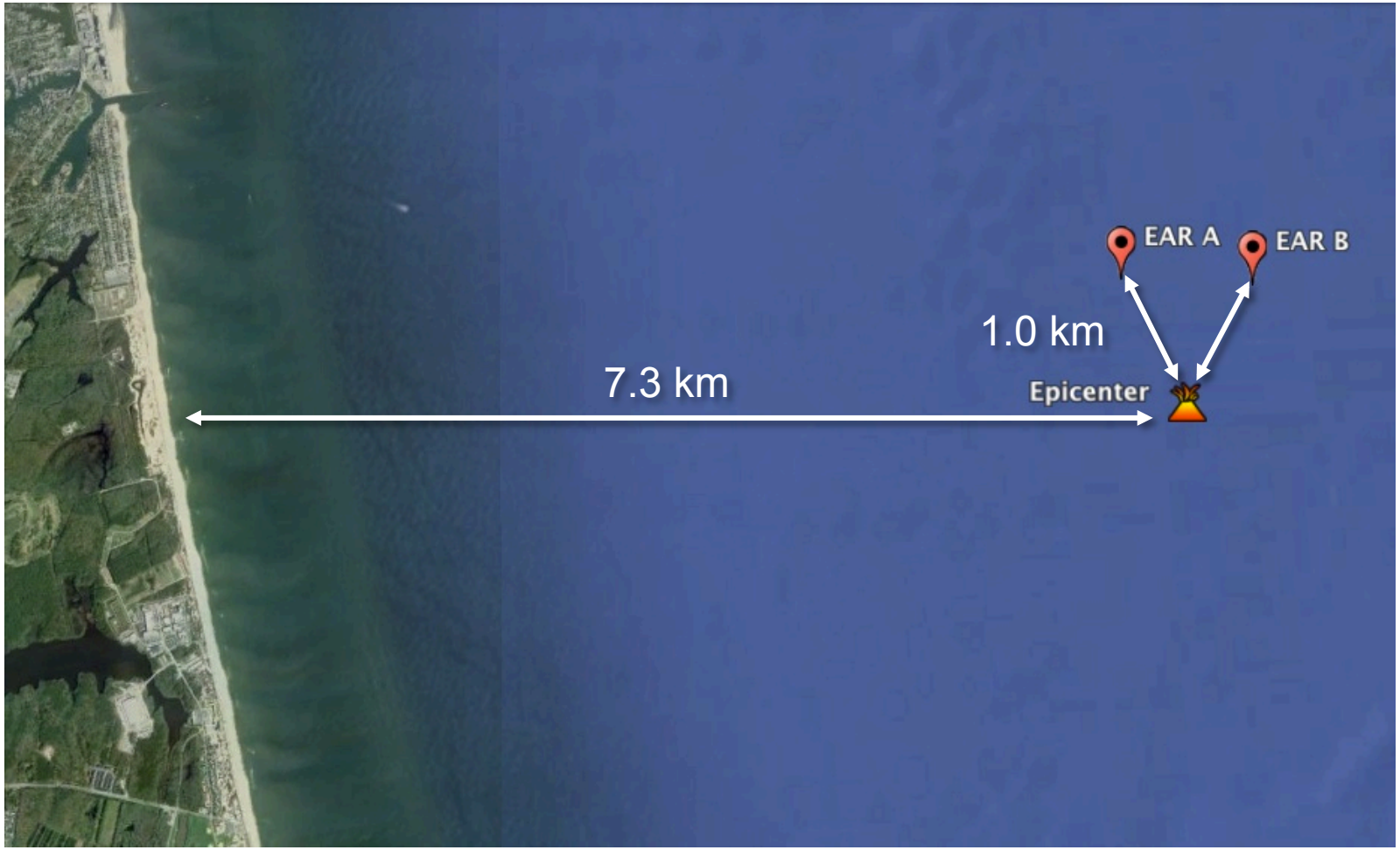
- Recording bandwidth= 25 kHz
- Offset duty cycles = 3 min ‘on’ every 6 min (50%)
- Refurbished approx. every 2 months





Methods

EAR locations



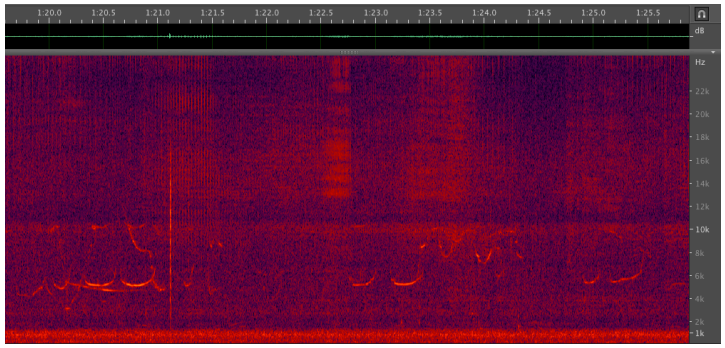
Methods

Data analysis

- Visual/aural inspection of all recordings for presence/absence of dolphin signals, explosions, vessel noise or other anthropogenic noise.

- Detailed assessment of dolphin acoustic activity during the day before, during and after detected explosions.

- Acoustic activity index assigned for each 3-minute recording.

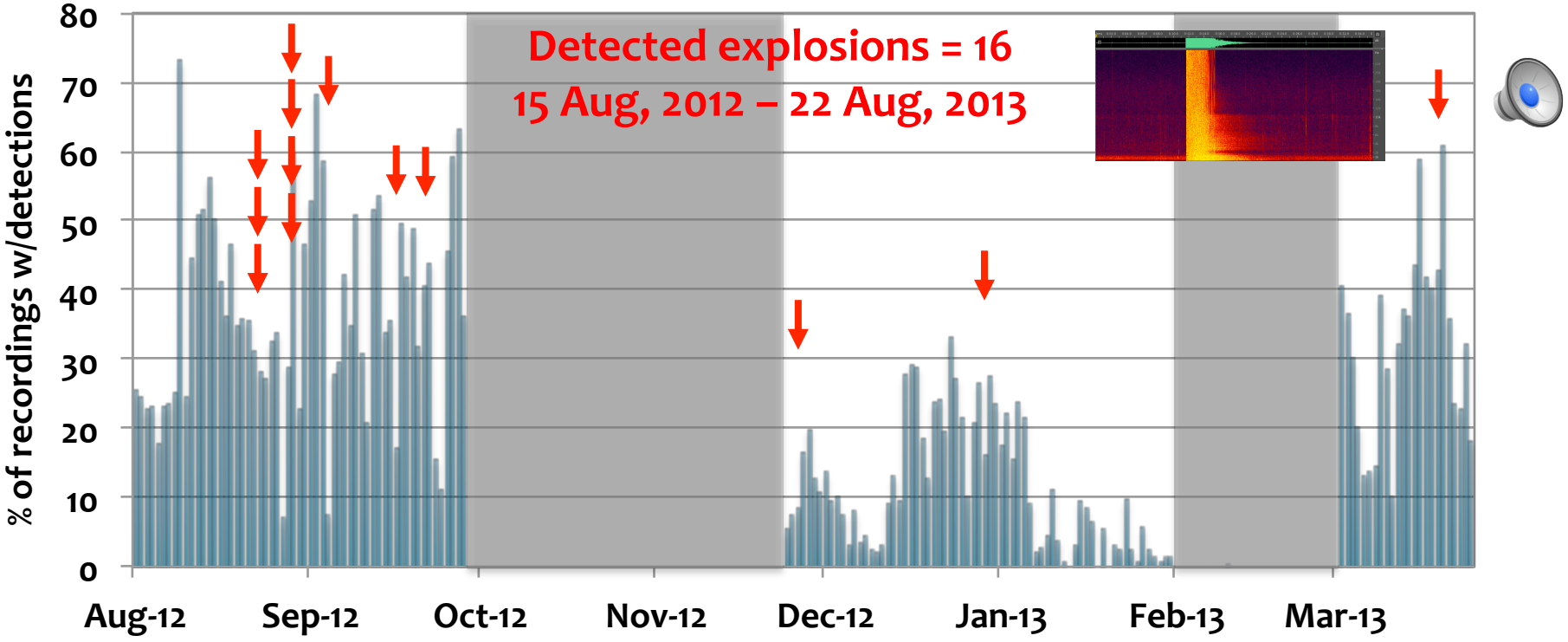


Acoustic category	Index value
1-20 whistles	1
BP only <10	1
Sonar only <2 clicks/sec	1
21-40 whistles	1.5
Sonar only >2 clicks/sec	1.5
BP only >10	1.5
Sonar & BP <10	1.5
1-20 whistles & sonar or BP	2
>41 whistles	2.5
Sonar & BP >10	2.5
1-20 whistles, sonar & BP	3
21-40 whistles & sonar or BP	3
21-40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

Results

Temporal presence of dolphins

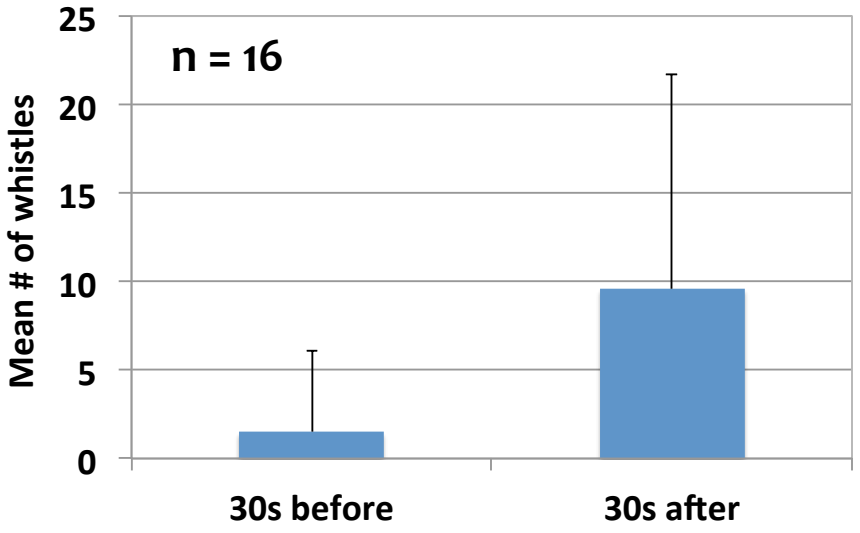
- Dolphins were detected on 98% of recording days
- Significantly fewer detections Dec-Feb (One-way ANOVA, $p < 0.001$)



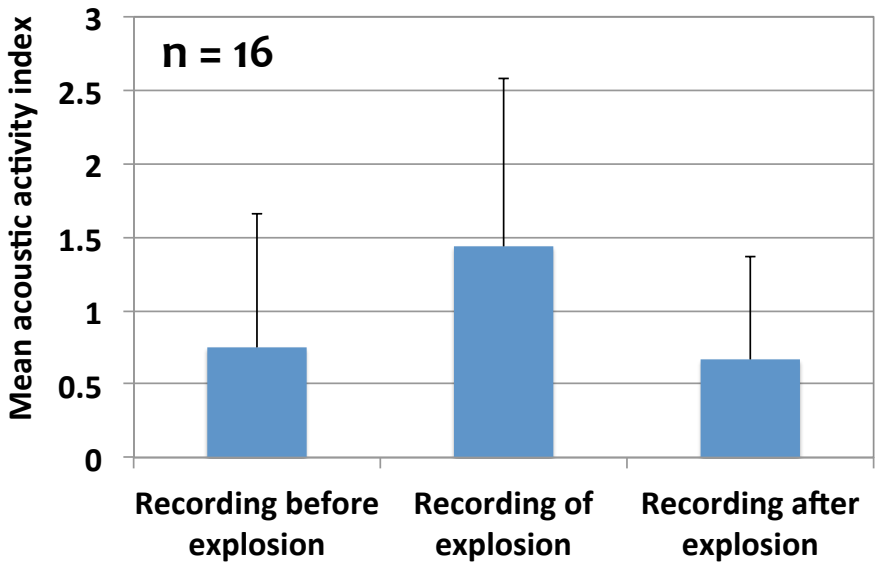
Results

Response to explosion

- Dolphin acoustic activity observed immediately before and after an explosion
- Short-term increase in production of whistles



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

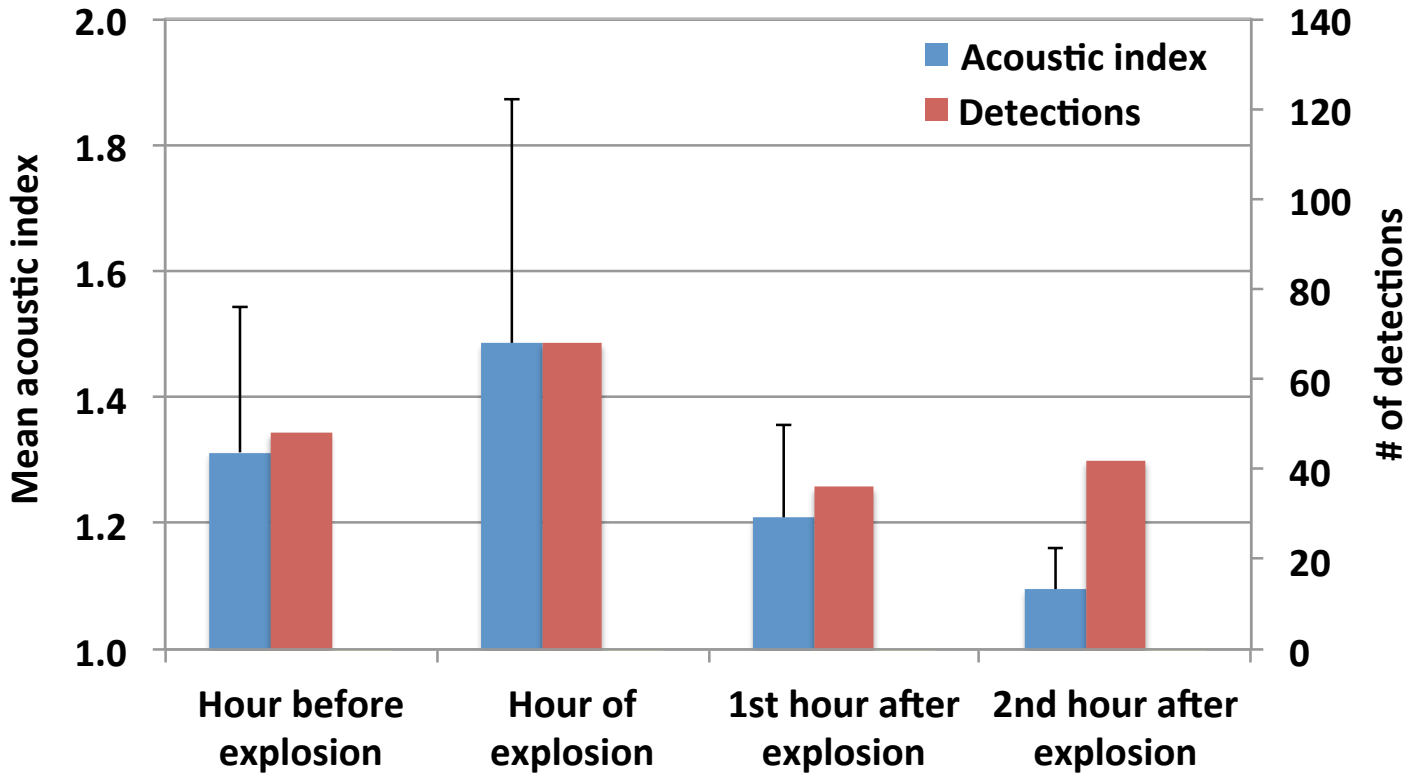


One-way ANOVA, n = 16, p = 0.05

Results

Response to explosion

- Dolphin acoustic activity observed in the hour before, during and 1st and 2nd hour after an explosion

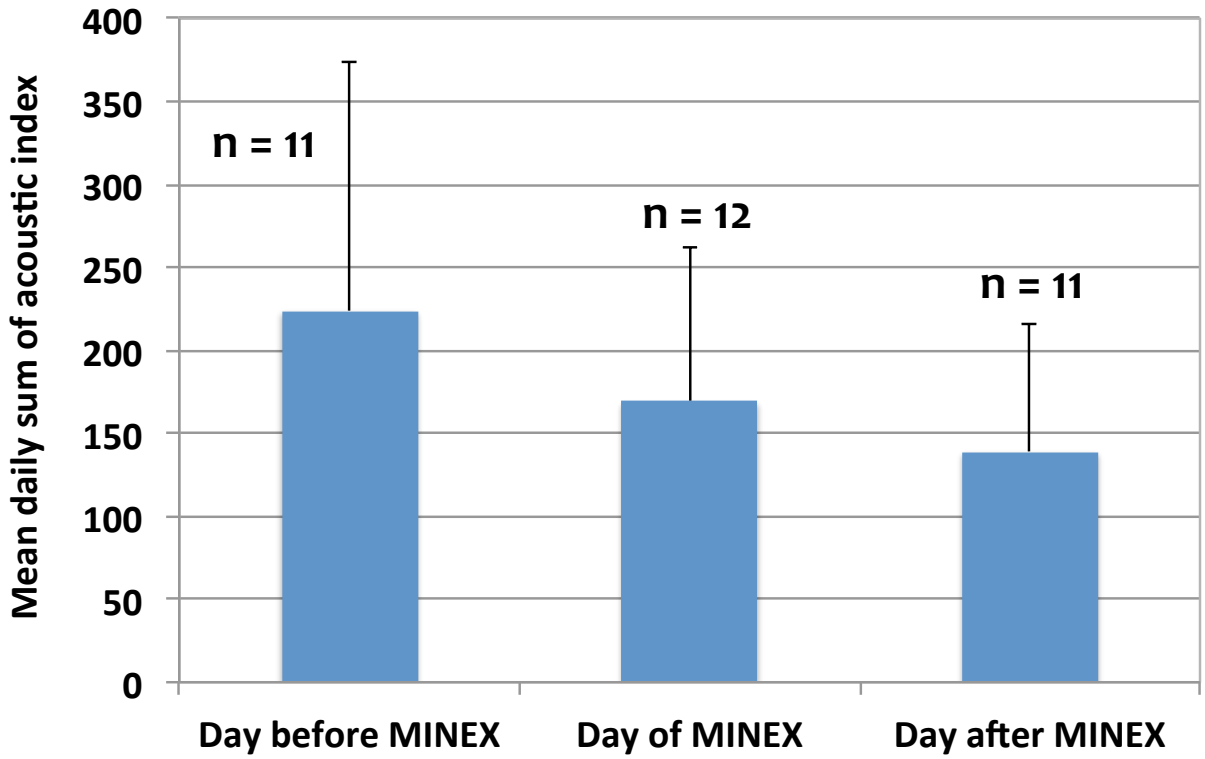


One-way ANOVA, DF = 3, F = 6.24, $p < 0.001$

Results

Response to explosion

- Dolphin acoustic activity the day before, during and after a MINEX training event

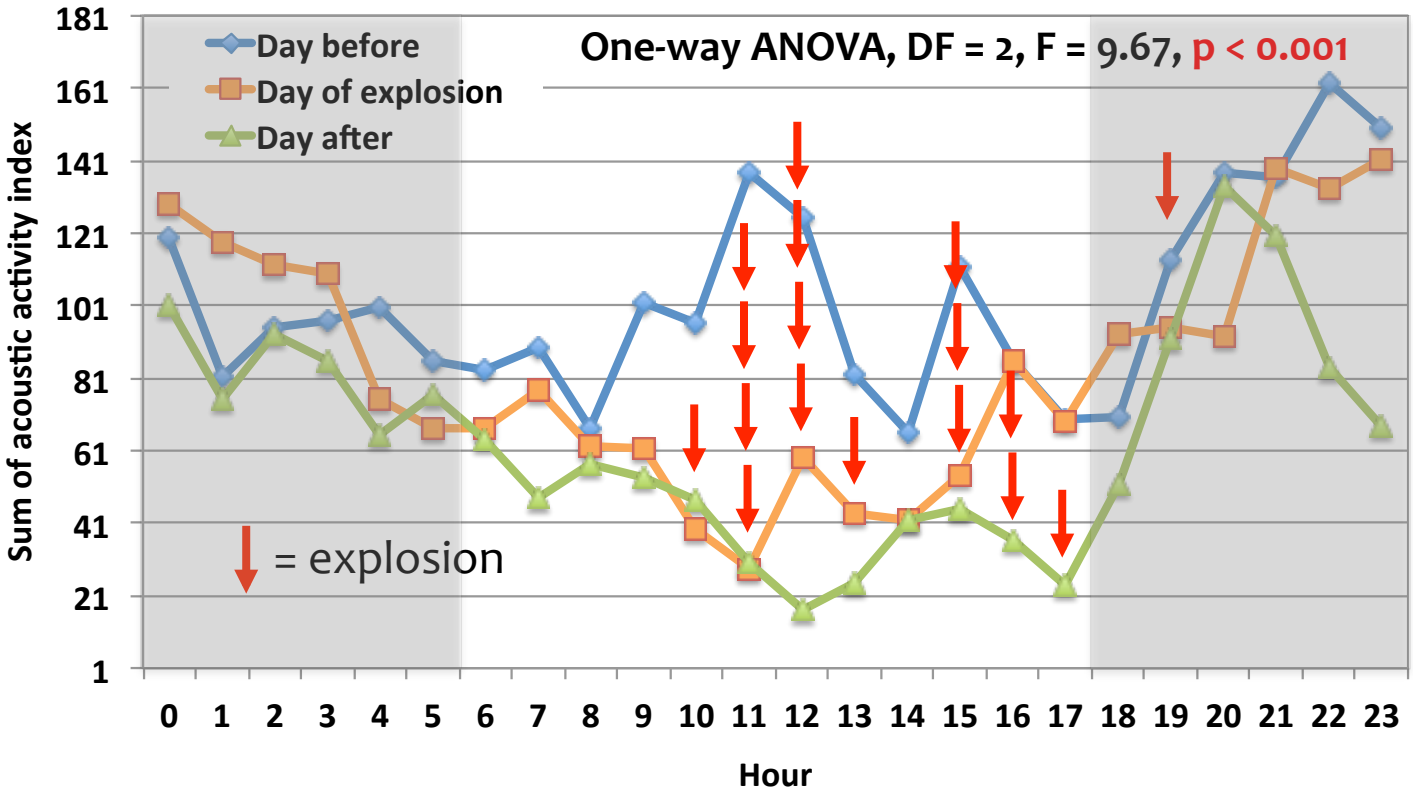


One-way ANOVA, DF = 2, F = 1.67, p = 0.204

Results

Diel acoustic response

- Summed hourly dolphin acoustic activity for the day before, during and after MINEX training events (n = 11)



Conclusion

Summary

- Dolphins were present nearly daily in or near the MINEX range during the period examined to date (Aug 2012 - Apr 2013).
- 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.

Conclusion

Moving forward

- Data collection at MINEX site B will continue until August 2014.
- In 2013-2014, 4 EARs will be deployed in a coastal array configuration to examine spatial redistribution of animals
- A 4-EAR localization array will be created to establish the approximate range of dolphins during explosions

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