

The Bahamas BRS AUTEC 2007-2008

SMM BRS Workshop – Session 2:

Lessons from experimentally-designed
studies, with a focus on sonar effects

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Photo: A Friedlaender

AUTEC BRS – The First BRS

Motivated by past strandings, especially of beaked whales, and trying to understand the behavioural and physiological responses that might start the chain of events that lead to stranding

Main study species: beaked whales,
but also other toothed whales: pilot whales, melon headed whales, false killer whales

Three Stimuli

- MFA: Mid Frequency Active Sonar - First BRS with actual 53c waveform
- PSN: Pseudo-random noise with same timing and overall bandwidth as MFA
- ORCA: calls from mammal eating killer whales



Photo: A Friedlaender

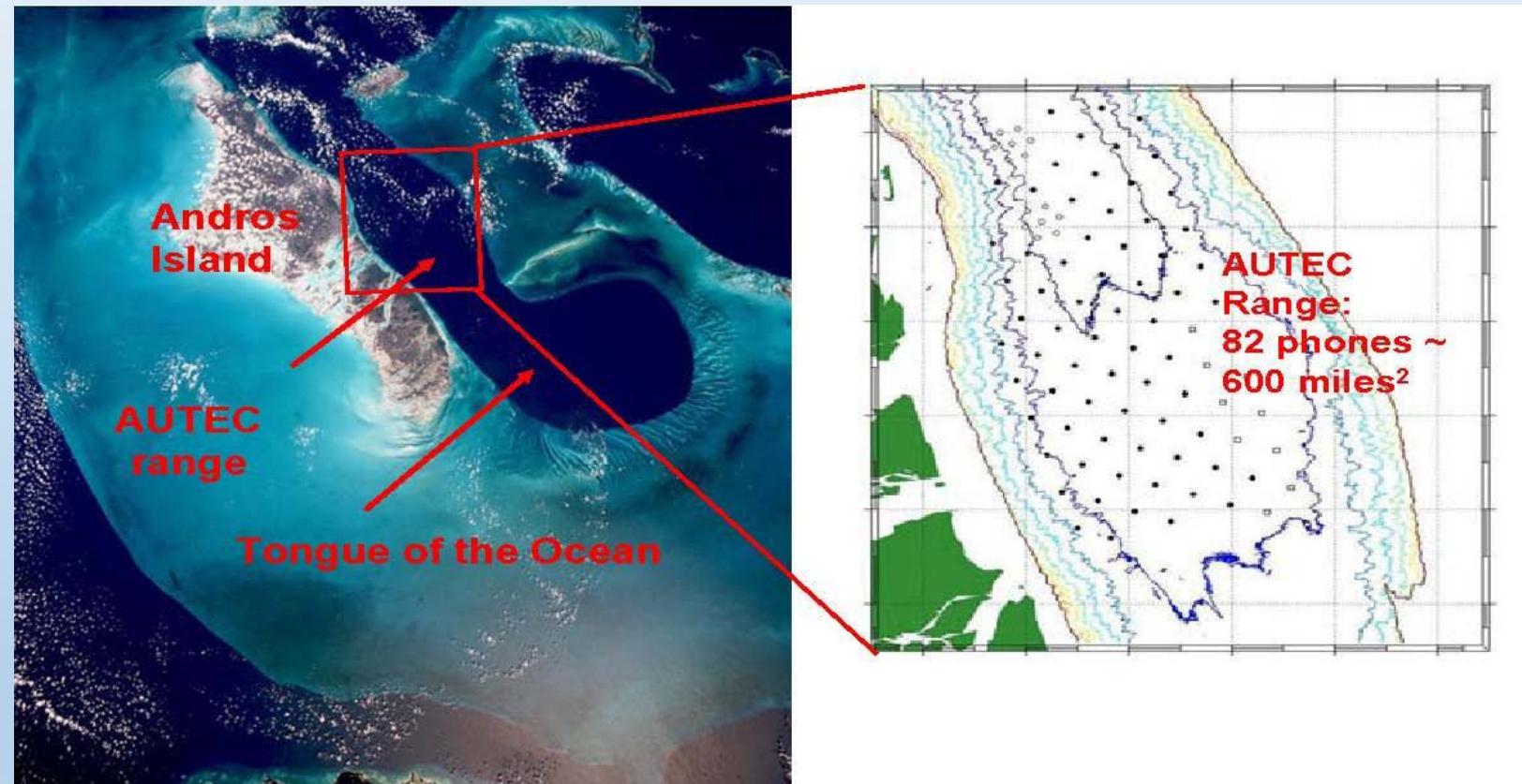
AUTEC BRS – The First BRS

Andros Island – Bahamas
Tongue of the Ocean (TOTO)

Atlantic Undersea Test and
Evaluation Center (AUTEC)

AUTEC has a 600-square-mile
permanent grid of seafloor
hydrophones

August and September 2007
& 2008



AUTEC BRS – The First BRS

The goal of the first BRS: To identify a response to sonar that was safe for the subject, but that could be used as an indicator of the probability of risk from real military operations and to quantify the exposure conditions required to elicit the response

Before this Behavioural Response Study took place, the type and magnitude of potential responses of individual whales to exposure of simulated sonar, especially MFA, and other natural sounds were largely unknown.

Thus, a highly precautionary approach was required to evaluate and mitigate harmful impacts from the experiment by using an adaptive design to enable rapid response to negative indicators.

We were careful

Main expectations

Establish, test and refine new protocols for studying beaked whales in playbacks, i.e. demonstrate feasibility

Establish whether beaked whales, or other species of odontocete whales, show a behavioural response to MFA sonar

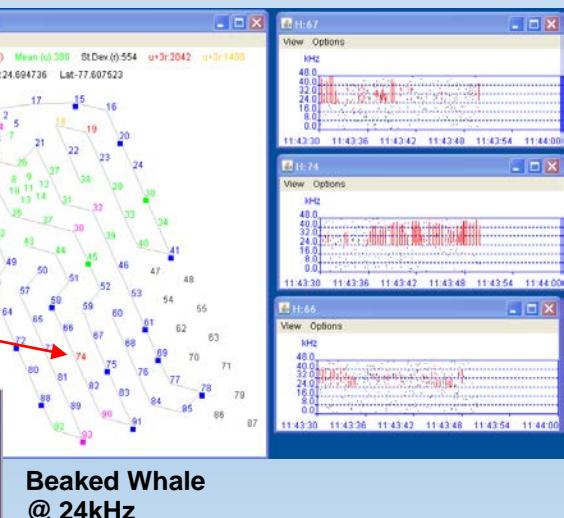
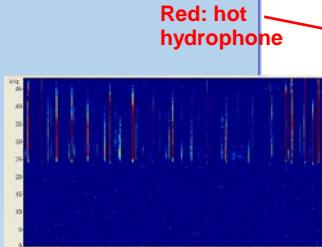
Collect base-line (control) data to provide a basis for comparison with playback results



DTAGs for fine scale behavioural analysis



Real time passive acoustic monitoring from the AUTEC array



Real time monitoring pre, during and post CEE

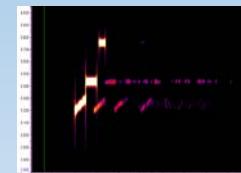
Behavioural focal follows and photo-identification



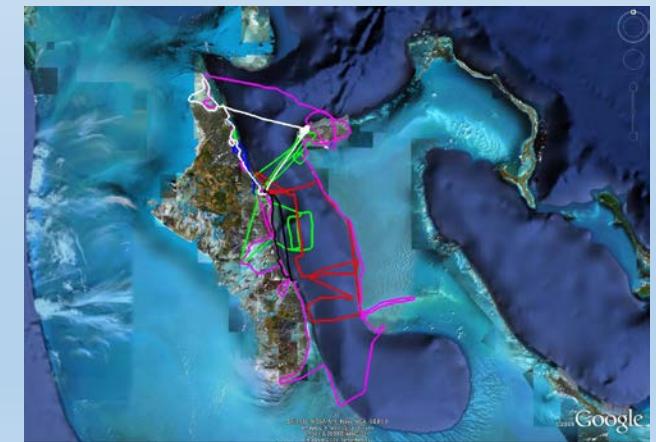
Visual observer teams using big eye binoculars



Sound source
Deployed from boat
Ramp up of 3 dB
every 25 seconds to
a maximum or until
whales stopped
clicking



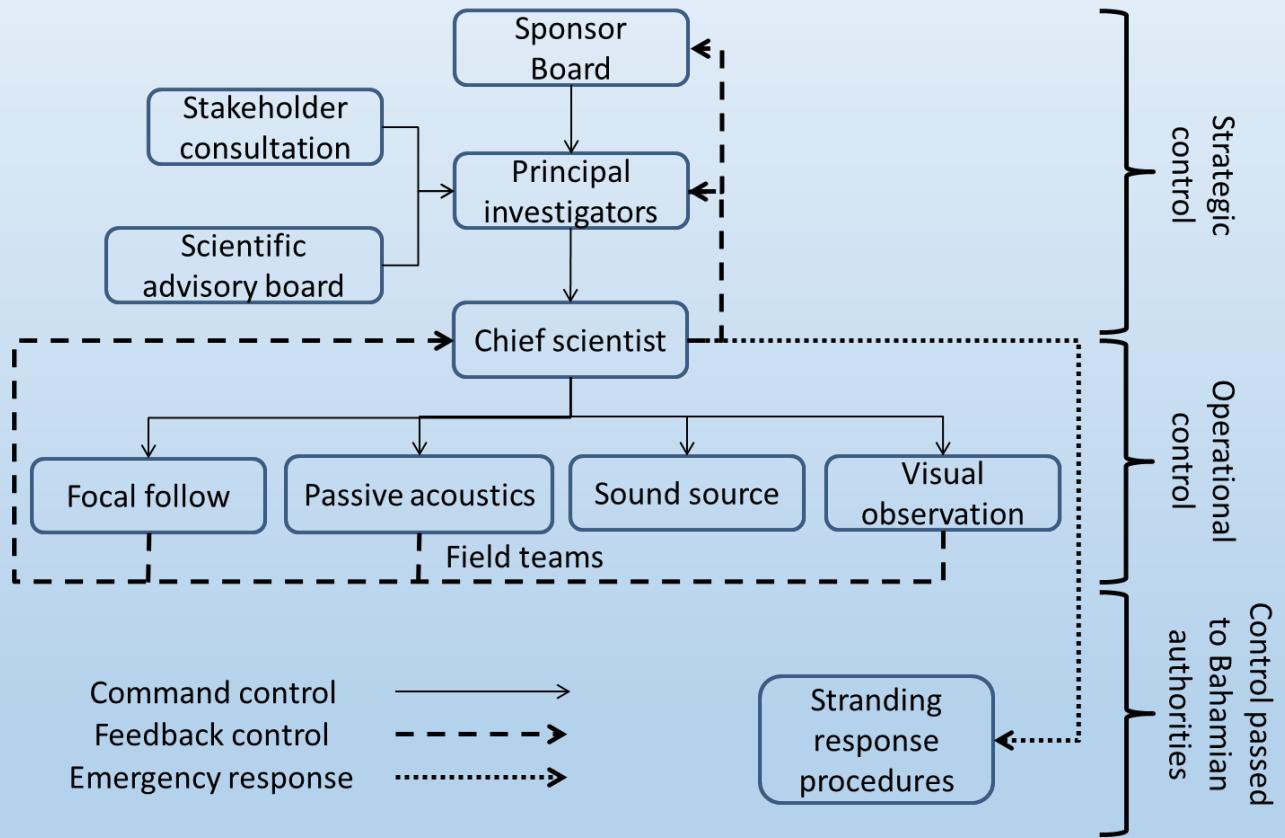
Aerial surveys post CEE



Monitoring and Mitigation

Adaptive Mitigation – feedback control procedure for real-time mitigation of potential harm

Three categories of mitigation methods were developed and integrated within the experimental protocol incorporating designed, engineered, and operational mitigation measures.



Mitigation of Harm

Designed mitigation:

1. Site selection
 - Continuous real time acoustic monitoring
 - Animals that were accessible and possibly habituated to a degree to sonar exposure
2. Environmental conditions
3. Observational time and space scales

Scale	Space	Time	Mode	Platform
Large	10 - >100km	Days – weeks	1. Aerial surveys 2. Acoustic Array	1. Twin engine aircraft 2. AUTEC array
Medium	0 – 10km	Hrs - <1 day	1. Ship-based elevated platform using big eyes 2. Acoustic array	1. >30m vessel 2. AUTEC array
Small	10m - 1km	Secs – hrs	Focal follows of exposed animals	<6m vessel

Mitigation of Harm

Engineered mitigation:

1. Sound source output maximum received levels
2. Ramp up procedure as part of dose-escalation protocol
3. Sound propagation modelling

Operational mitigation:

1. Strict protocol of operational modes - Activities within each mode had to be completed before next mode began
 1. Search and assessment
 2. Tagging
 3. Playback
 4. Post playback
 5. Stand-down



© BMMRO

Mitigation of Harm

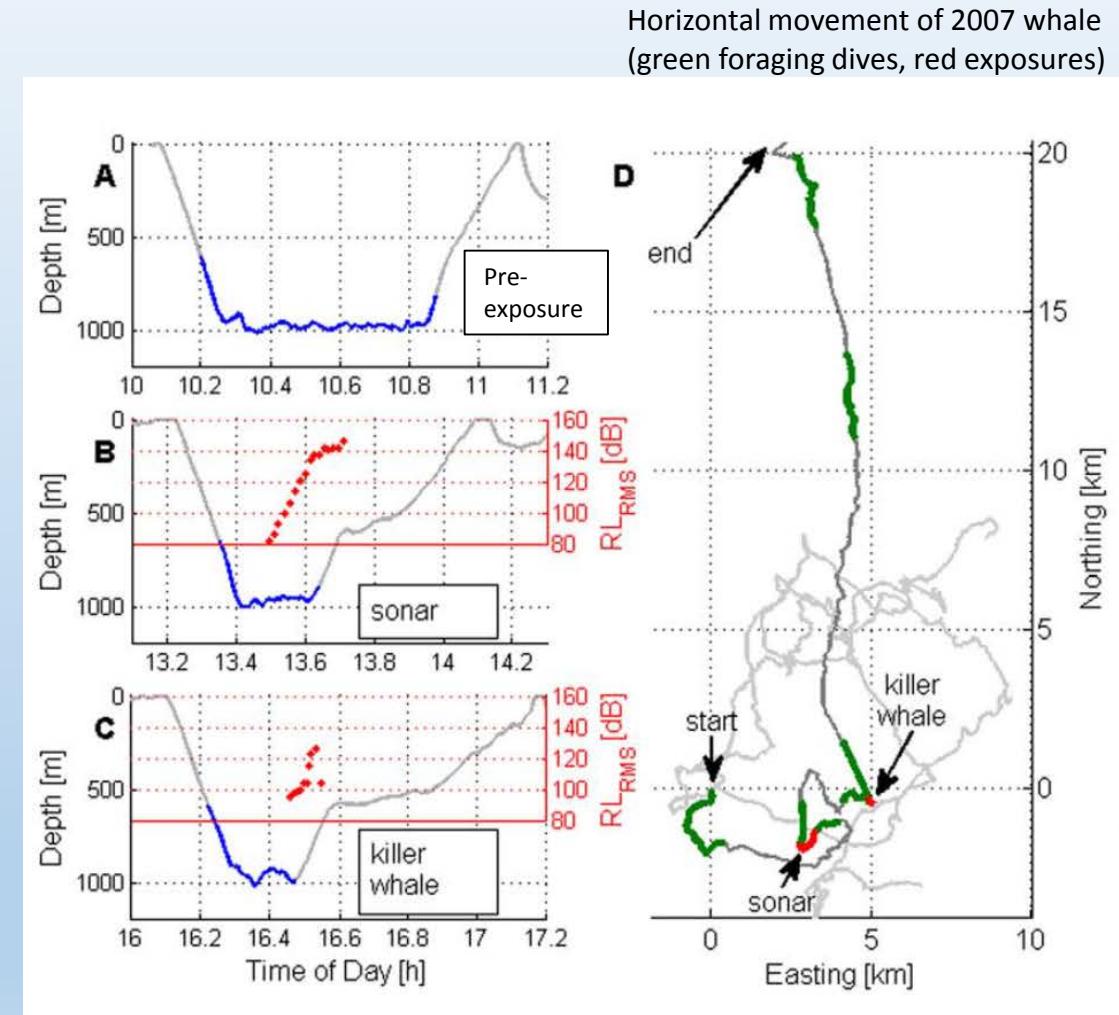
LESSONS LEARNED AND FUTURE RESEARCH

1. The scale of monitoring and mitigation was high and would be difficult to replicate in all studies
 2. Relying exclusively on visual observers to monitor cryptic species is difficult
 3. Adaptive mitigation with the ability react quickly if negative effects are detected was key
 4. The large scale approach had logistical challenges
-
1. This initial BRS focussed on potentially habituated animals, and demonstrating feasibility. Future studies could focus on naïve animals and should adapt monitoring and mitigation scales to suit.

Beaked whale responses to playback

The 2007 response to the MFA sonar stimulus was similar but less intense than that to killer whale calls.

It involved premature cessation of a foraging dive and directed avoidance away from the location of playback.



Beaked whale responses to playback

LESSONS LEARNED AND FUTURE RESEARCH

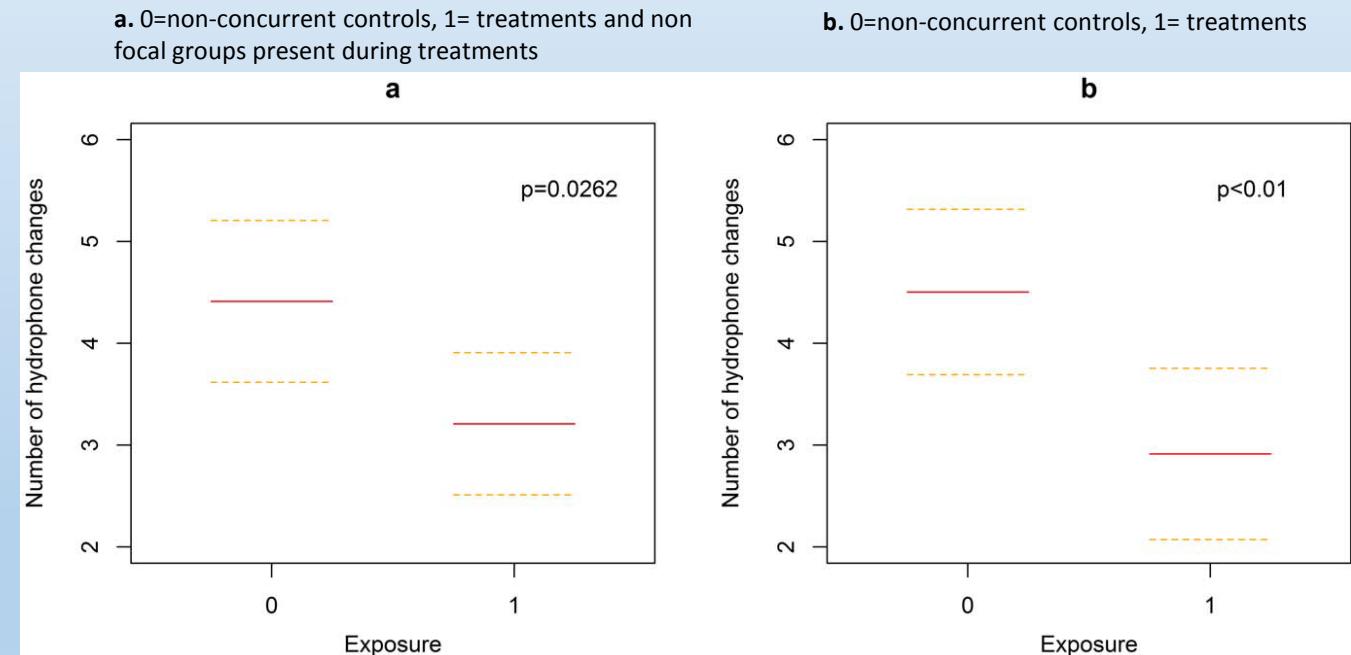
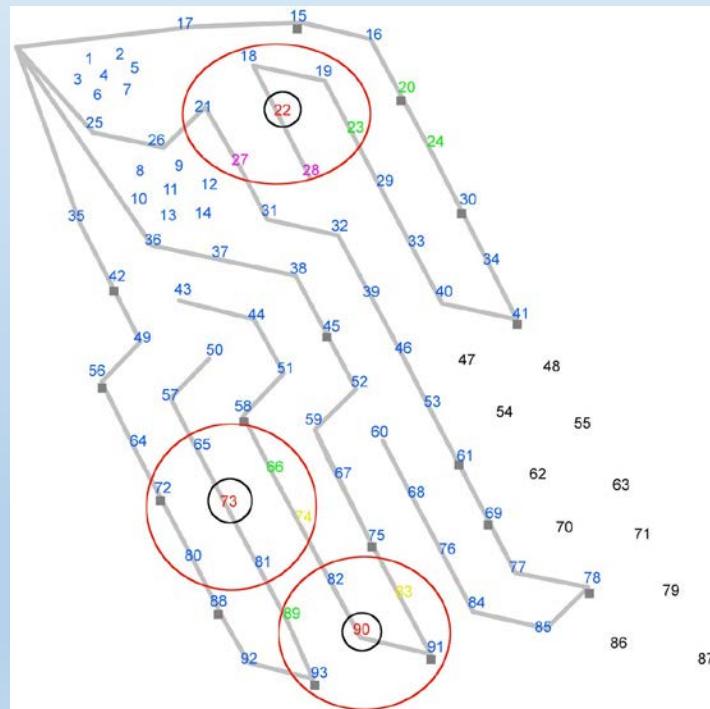
1. Metrics of beaked whale response to playbacks
 2. Dose-escalation protocol to identify the lowest sound exposure that elicits a particular behavioural response
 3. Long term photo-identification by BMMRO showed re-sights of exposed animal in 2008, 2009, 2011, 2012, 2103
 4. Beaked whale response to killer whale calls – ceased foraging and showed directed avoidance
-
1. How do types of response change with context and exposure level
 2. Responses to predator calls
 3. Sufficient information on the variation in baseline is needed to determine response

Ship Noise Evaluation Trials

Compared groups exposed and not exposed to broadband ship noise .

Saw a significant change in beaked whale behaviour up to at least 5.2 kilometers away from the vessel.

The results of this study suggest that vessel noise has a significant effect on the movement behavior of Blainville's beaked whales while they are foraging



Ship Noise Evaluation Trials

LESSONS LEARNED AND FUTURE RESEARCH

1. The use of noisy vessels during BRS may significantly alter natural beaked whale behaviour
2. The number of boats and the amount of noise they produce should be included as a covariate in experimental studies in order to be able to discern between the effects of the playbacks and the confounding effects of boat noise.

1. How does ambient noise influence responses in different populations

Other delphinids

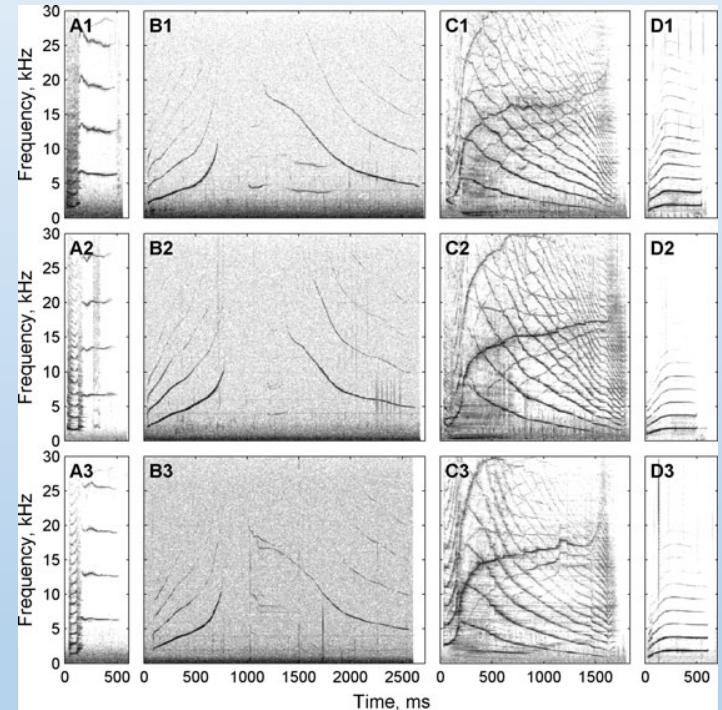
False killer whale group,
overall whistle rate and
production rate of the most
MFA-like whistles decreased
with time since last MFA
reception.

Melon-headed whales,
indicated minor transient
silencing after each signal
reception.

No apparent relationships
between pilot whale
whistle rates and MFA sounds
within the exposure period.



Pilot whales have complex vocal
repertoires



Other delphinids

LESSONS LEARNED AND FUTURE RESEARCH

1. Small delphinids showed variable vocal responses that may depend not only on species and sound source, but also on the social, behavioral, or environmental contexts of exposure.

1. Functional significance of call types and rates to look at responses to noise
2. Characterisation of the variation in baseline vocal behaviour with context

Final Thoughts

Achievements against expectations and future work

Expectations

Establish, test and refine new protocols for studying beaked whales in playbacks, i.e. demonstrate feasibility

Achievements and future work

**AUTEC BRS demonstrated that the BRS concept works.
But with suggestions for improvements in future BRS studies**

Establish whether beaked whales, or other species of odontocete whales, show a behavioural response to MF sonar

**Observed a measurable behavioural response from beaked whales, and possibly also from pilot whales, that are within the normal adaptive behaviour of these species.
But larger sample sizes are needed**

Collect base-line (control) data to provide a basis for comparison with playback results

**Increased knowledge of basic behaviour in beaked whales.
Need sufficient base-line to be confident that we can measure responses of animals.**

Thanks.....
to the many people involved with the AUTEC
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Diane Claridge

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Dave Moretti

Brandon Southall

Peter Tyack

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