University of St Andrews

THE CHALLENGE OF REAL-TIME MITIGATION FOR BEAKED WHALES

Aguilar Soto, N., Donovan, C., Hooker, S., Gillespie, D., Gkikopoulou, K., Harris, C., Harris, D., Isojunno, S., Johnson, M., Marshall, L., Miller, P., Oedekoven, C., Palmer, K., Prieto, R., Smout, S., Thomas, L., Tyack, P., Wensveen, P., Wu, M.

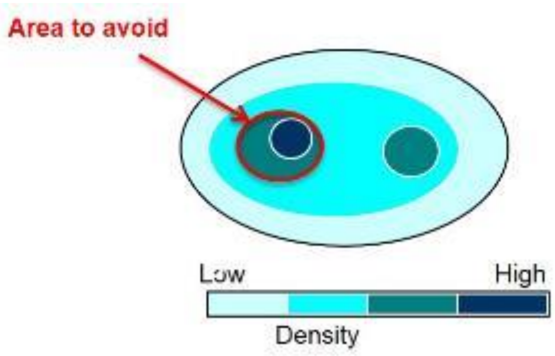
Beaked whales are difficult to see, but some of the 22 species of the Ziphiidae family can be found in all oceans. Millions of years of evolution have driven them to a specialized way of life, stretching their physiological capabilities to perform dives comparable to sperm whales, with a much smaller body size. This, and their poor social defences from predators, may explain why beaked whales are so sensitive to sound, and why behavioural responses breaking their delicate physiological balance may cause mortalities. Population data are scarce offshore, but US-Navy funded long-term monitoring in the Pacific and the Atlantic shows that local populations are small (<100), have high site-fidelity and apparently low connectivity. These characteristics reduce animal resilience to potential population-level impacts.

Photo: ULL

WHY DOES REAL-TIME MITIGATION MATTER?

- Not all behavioural responses are equal: from disturbance (Tyack *et al*. 2007; DeRuiter *et al*. 2013, Miller *et al*. 2015) to acute stress leading to mass-stranding (Cox *et al*. 2006).

- An effective mitigation method is spatio-temporal avoidance of high density areas informed by surveys and habitat modelling & aided by simulation engines.



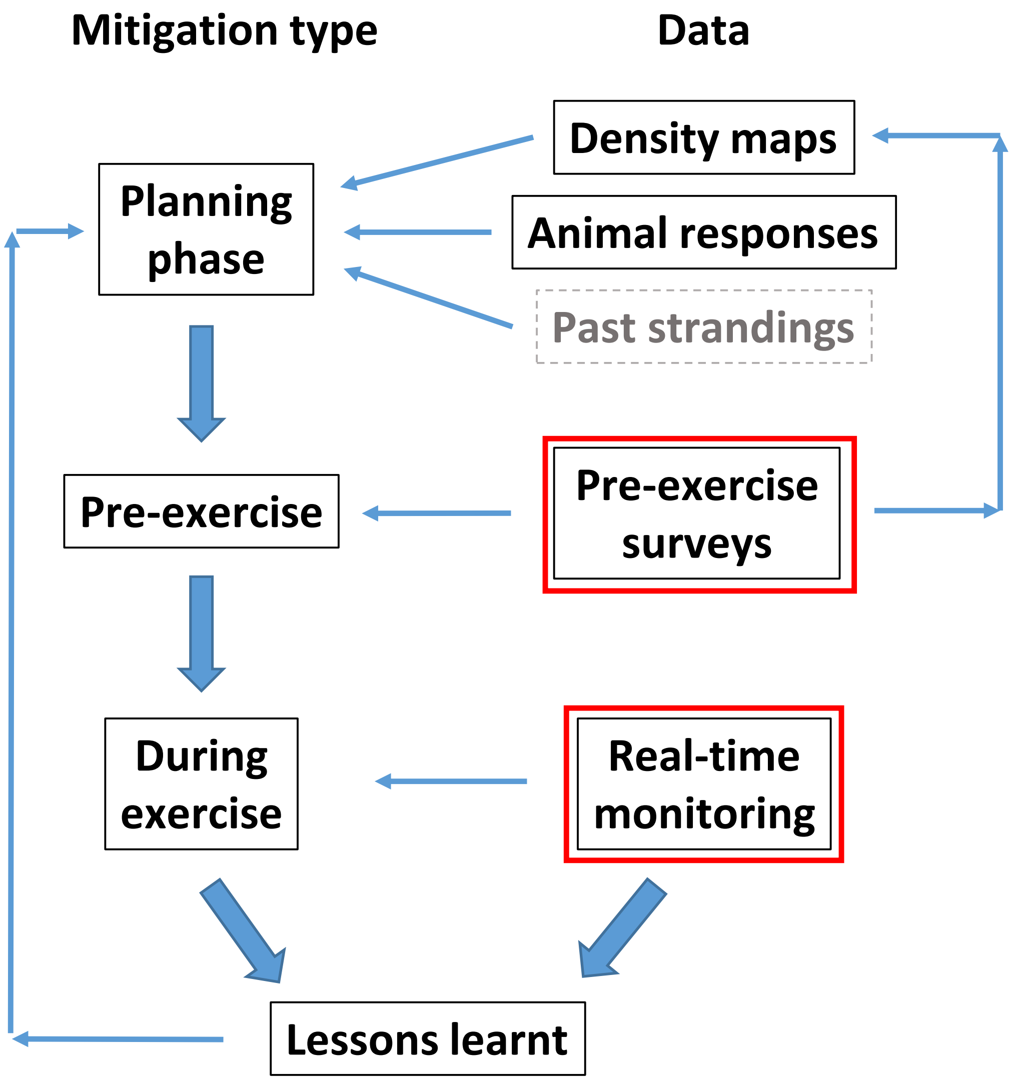
- But the scarcity of data supporting density maps increases uncertainty about the number of takes to be expected in a given area.

- Thus, planning-phase mitigation is essential and can be effective (e.g. Fernández *et al*. 2014) but does not eliminate the possibility of encountering and affecting/harming beaked whales.

Stranding risk exists in off-shore exercises also (Fernández *et al*. 2012).

MAJESTIC EAGLE, 2004: >100 km offshore **Several whales stranded in the coast of Africa and 4 in Canaries. After this, the Spanish Ministry of Defense declared a moratorium to the use of naval sonar within 50 nm of the Canary Islands. No more atypical mass-strandings have been recorded in the archipelago**

A CONCEPTUAL MODEL FOR EFFECTIVE MITIGATION



CAN REAL-TIME MONITORING BE EFFECTIVE?

CHALLENGE 1: time

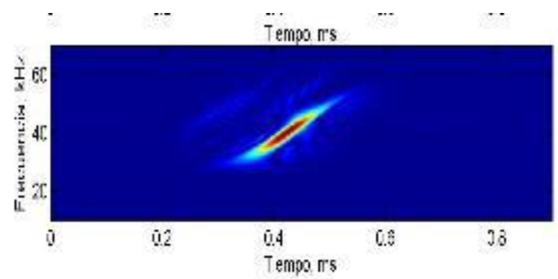
Beaked whales: low temporal availability
8% for visual detection (Aguilar 2006)
20% PAM (Aguilar *et al*. 2012)

CHALLENGE 2: distance

mitigation effectiveness increases
with detection distance
(Marshall, 2012; Leaper *et al*. & Wensveen *et al*. in press)

Good news, in good conditions:
Hydrophone arrays can work from 2 to 6 km
(Ward *et al*. 2006, Benda-Beckman *et al*. 2010, Moretti *et al*. 2010)

On-going efforts for automated detection
to reduce false alarms
(navy funded biennial DCLDE workshops)



Johnson *et al*. (2006)
Zimmer *et al*. (2005)

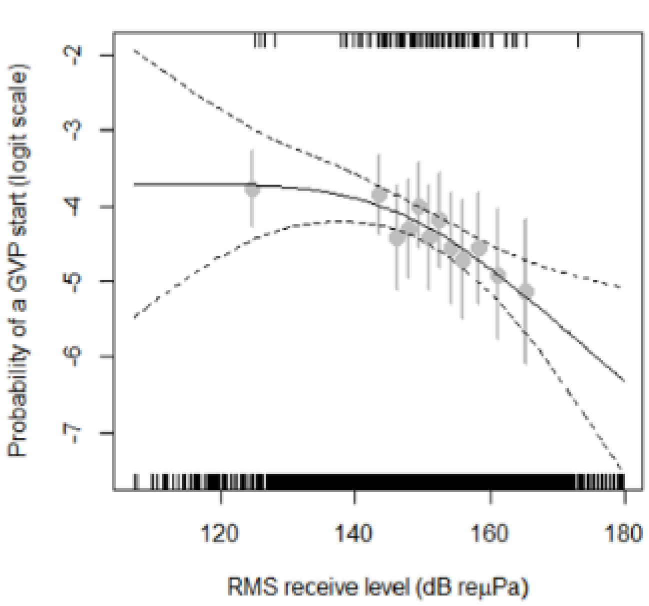
Challenge 3:

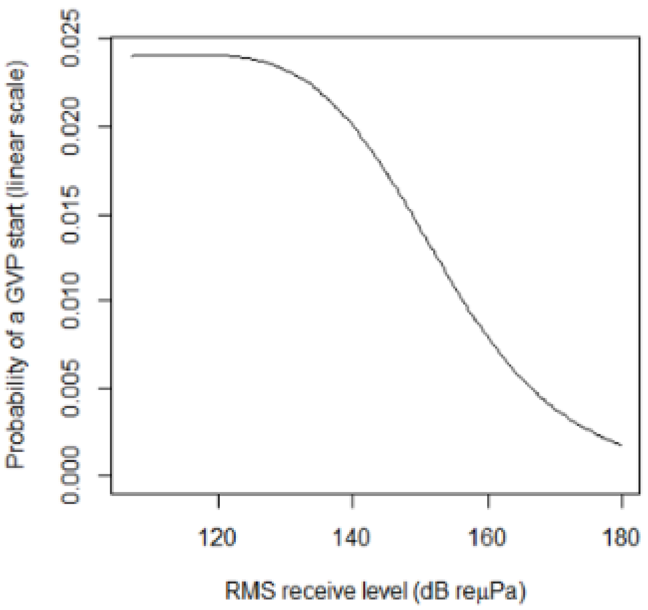
Can we detect whales before they detect us?

Do whales leave the area, reduce vocal output, or both?

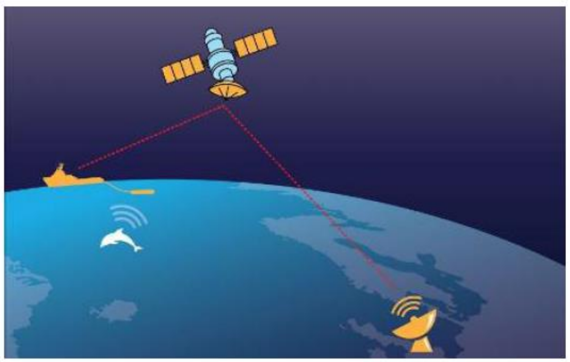
Blainville´s beaked whale (Moretti *et al*. 2007)

Probability (vocal period) declines 50% at RL≈150 dB re 1 µPa





Solution: Increasing detection range increases the probabilities of detecting the whales before they react

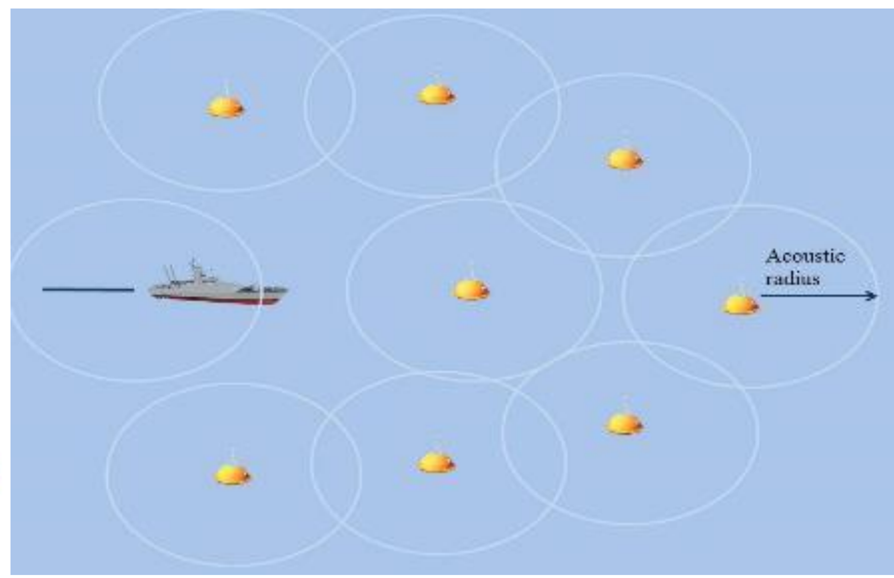


We are not likely to improve much on:

- ☐ Detection range from a single hydrophone
- ☐ Automated classification

But we can deploy multiple detectors

This needs effective survey designs at large spatial scales



NEW MITIGATION METHODS AND EVOLVING ACOUSTIC EXPOSURE GUIDELINES

ECS 2015

MOVING FORWARD

Developing a realistic mitigation protocol requires modelling to predict effectiveness and validation.

Evaluating the effectiveness of mitigation scenarios will enable navies to perform cost-benefit analyses of the different mitigation options.

This will aid optimizing the benefits for marine fauna and commitment to conservation law, within the constraints of practicality in naval exercises.

Photo: I. Tejera. ULL

Modelling different components of a mitigation system:

i) *The objective of the mitigation*: can vary from reducing the number of “takes” to minimizing the risk of animals receiving a dose of sonar exposure higher than a given threshold to reduce the risk of stranding.

ii) *The detection method* determines the likelihood of detecting animals at given spatio-temporal scales. This can range from evaluating density models, to real-time monitoring at different spatial ranges.

iii) *Possible mitigation protocols elicited by detections*: from decisions at the planning phase based on updated density data; to temporary shut-down of sonar sources and/or redirection of the general course of the exercise, etc

MODELS NEED TO CONSIDER VESSEL AND ANIMAL MOVEMENT

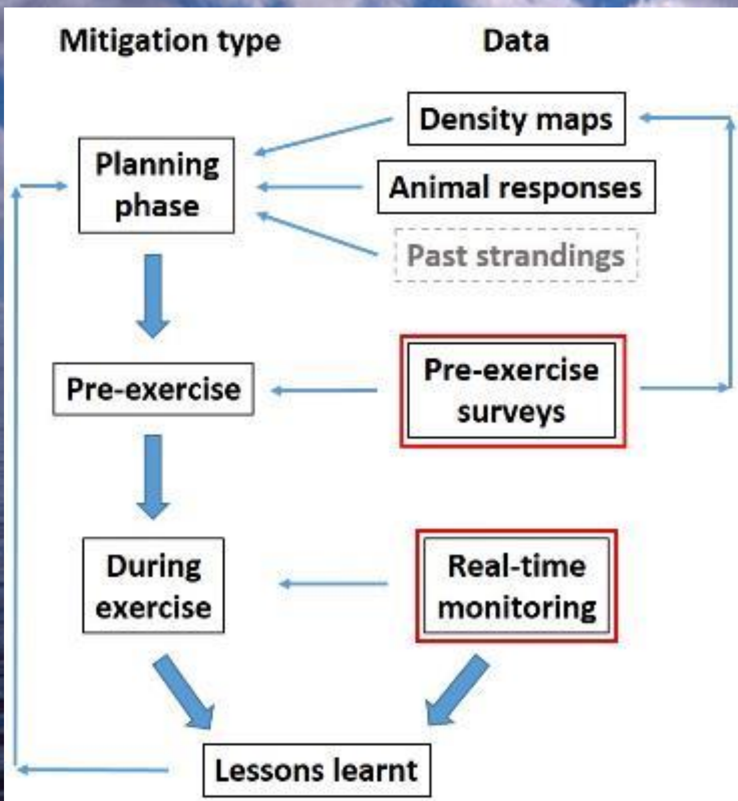
MODELS CAN GUIDE TECHNOLOGICAL DEVELOPMENT

MODEL PREDICTIONS CAN BE TESTED IN NAVAL RANGES

We have advanced…just need to keep improving

NATO Military Oceanography Group, 2005:

"Unless it can be clearly demonstrated that reasonable measures are being taken to avoid harm to marine mammals, pressure groups will use political and/or legal pressure to stop the use of active sonar."



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