

Assessing population disturbance: beaked whales



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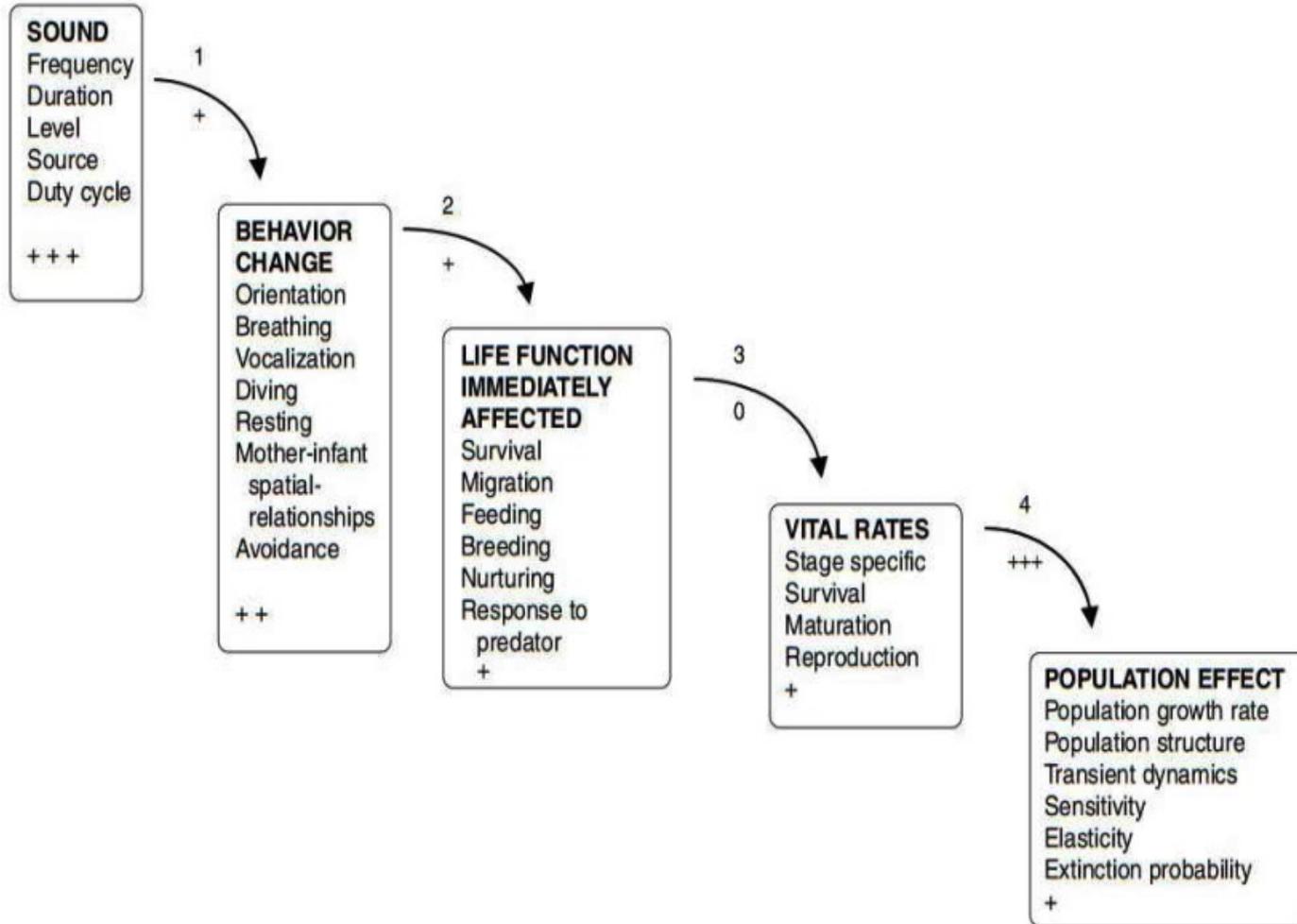
UC San Diego, Scripps Institute of Oceanography

Supporting documents

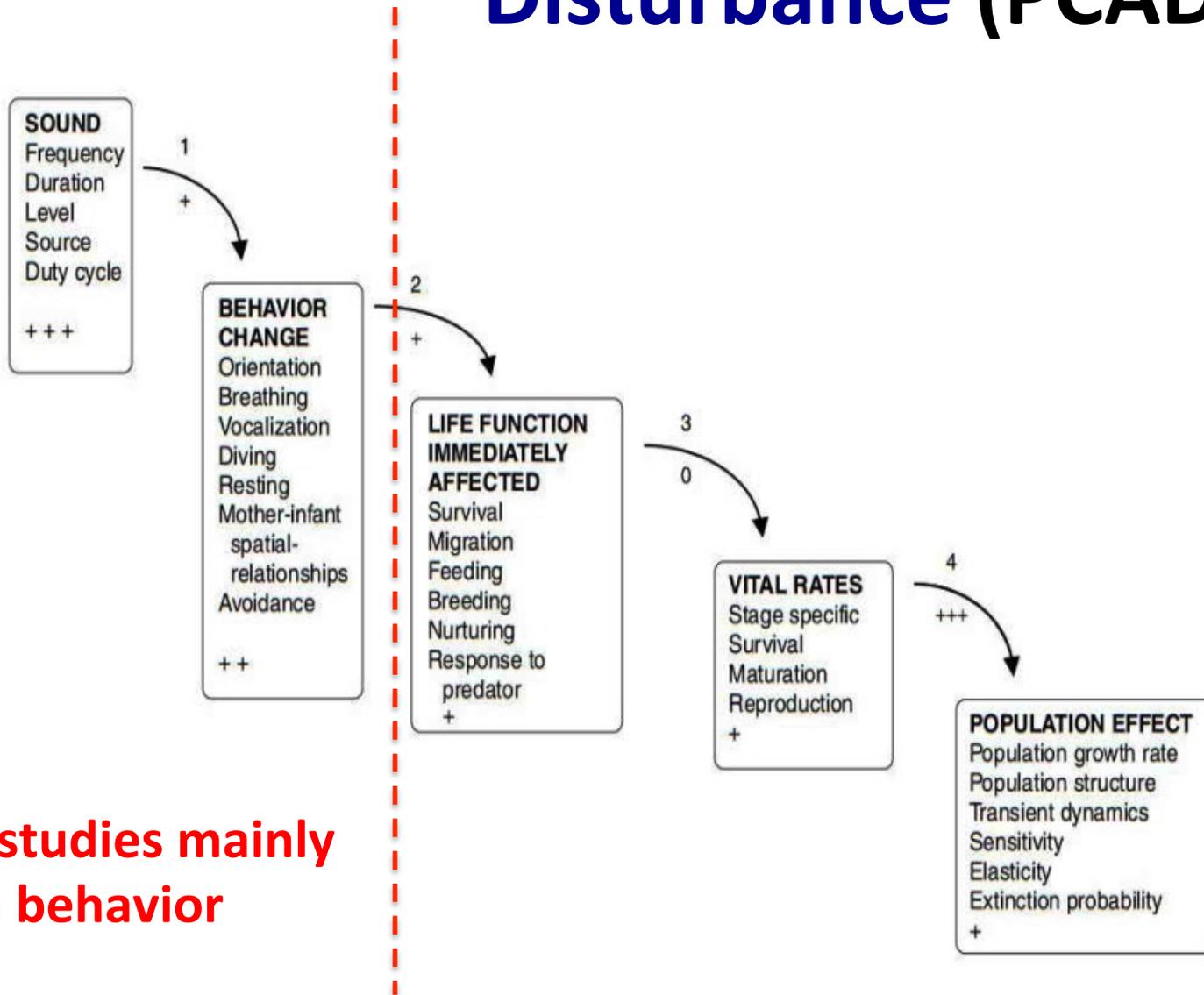
Tyack, Zimmer, Moretti, Southall, Claridge, Durban, Clark, D'Amico, DiMarzio, Jarvis, McCarthy, Morrissey, Ward, Boyd. 2011. **Beaked whales respond to simulated and actual navy sonar.** PLoS ONE 6(3):e17009

Claridge, Dunn, Ylitalo, Herman, Durban, Parsons. 2015. **Behavioral Ecology of deep-diving odontocetes in The Bahamas.** Draft final report to the Department of Defense's Strategic Environmental Research and Development Program (SERDP). Project RC-2113.

Population Consequences of Acoustic Disturbance (PCAD)



Population Consequences of Acoustic Disturbance (PCAD)



Current studies mainly focus on behavior

Background

Beaked whale strandings have correlated with sonar use.

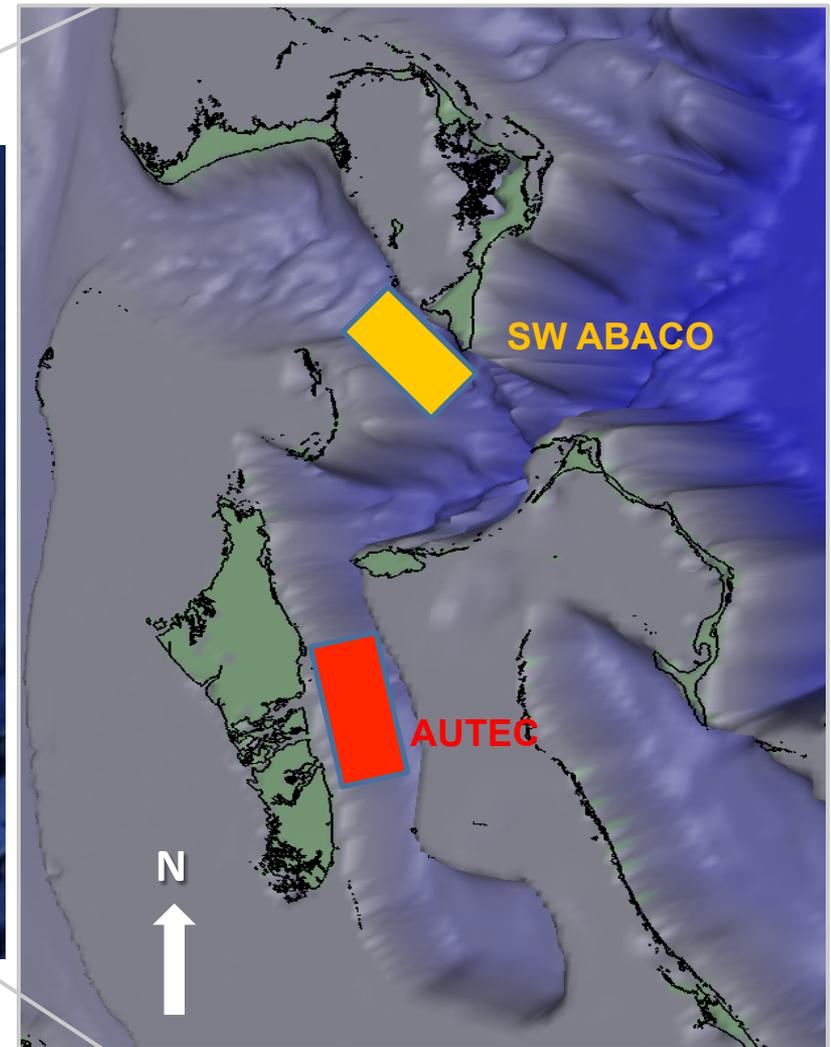
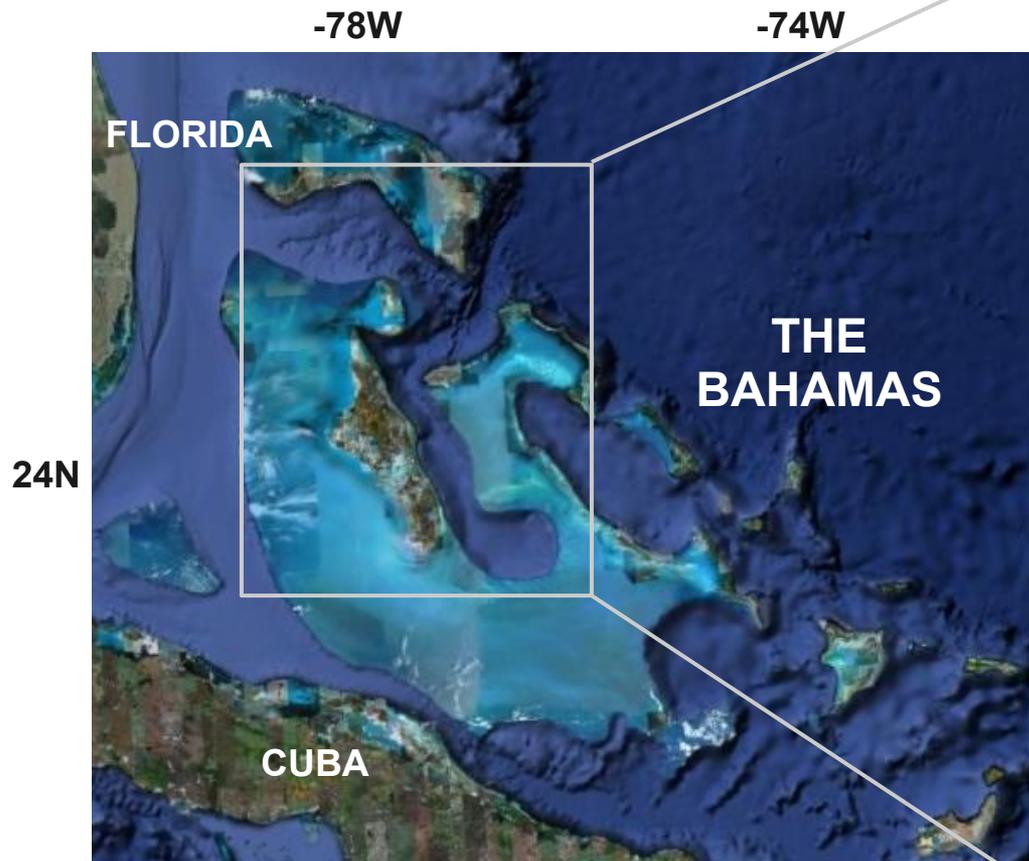
Behavioral responses of Blainville's beaked whales at U.S. Navy's AUTECH operating area in the Bahamas.

We aim to characterize responses AND assess **population-level affects.**

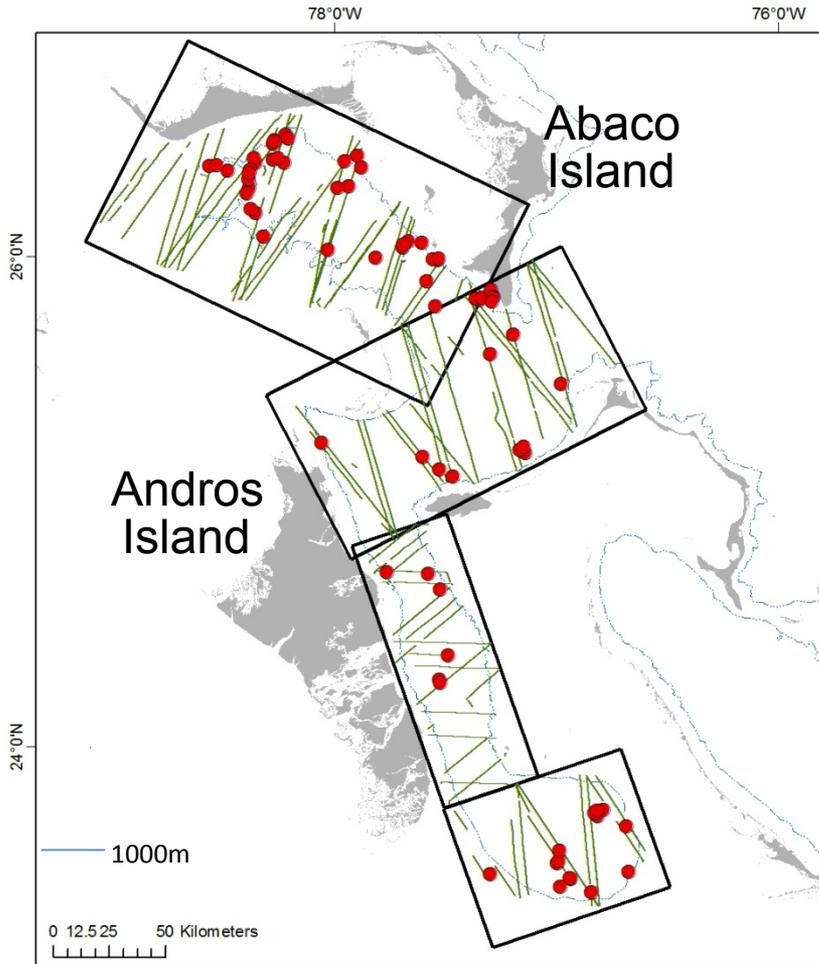


One of 14 beaked whales that stranded March 15th 2000, Bahamas

Study area



A high density of beaked whales



Claridge and Durban

ONR Award Number:
N00014-07-1-0120



Particularly Blainville's beaked whale

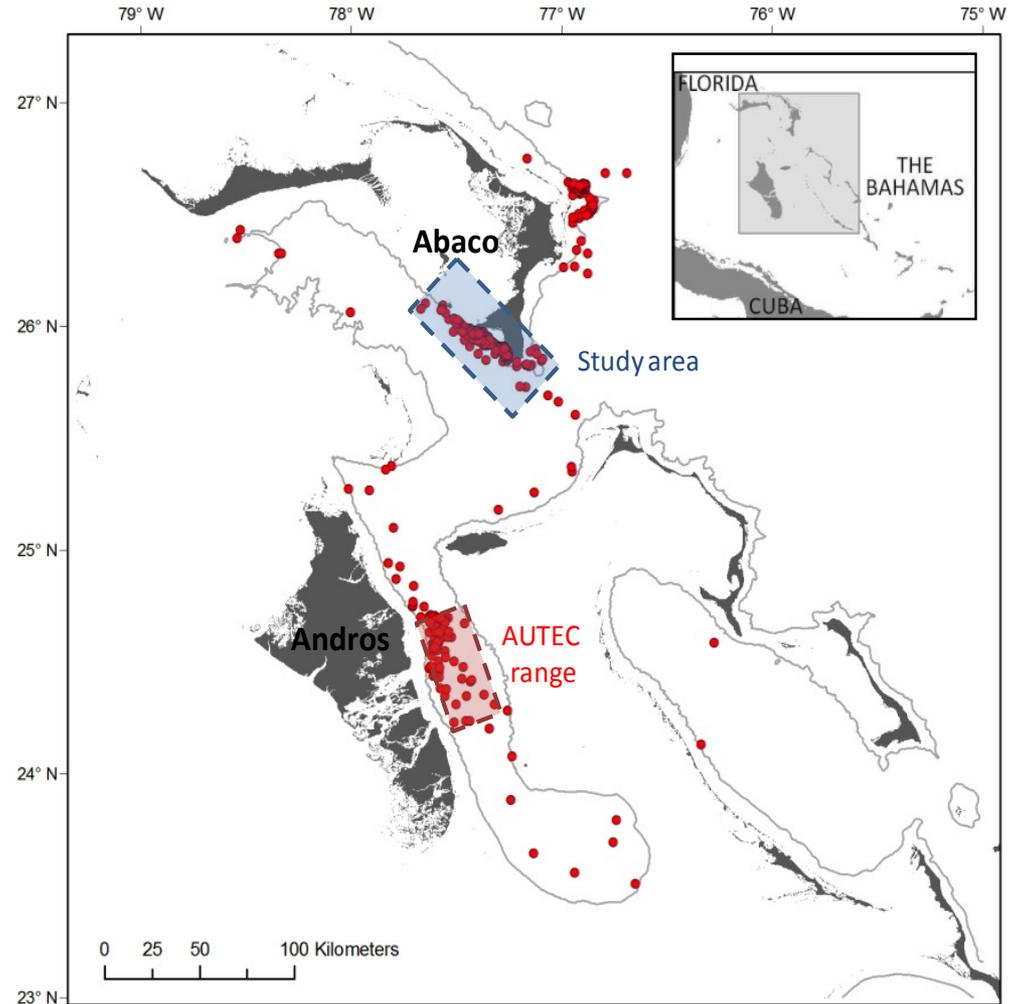
1991-2014:

457 groups photo-id

96 biopsy samples

12 satellite tags

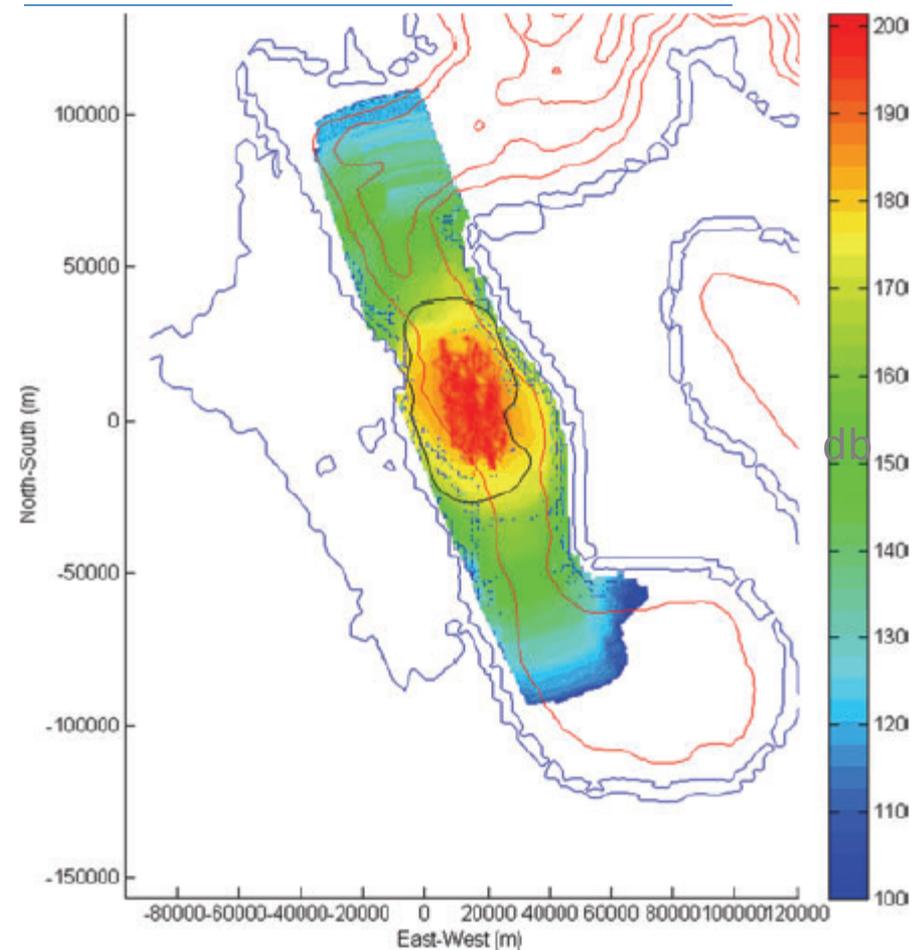
**Unprecedented sample
for beaked whales**



Scope for population-level effects

Cumulative sound exposure during a multi-day exercise with sonar use at AUTECH

McCarthy et al. 2011. Marine Mammal Science 27, E206-E226



Characterizing responses

Small satellite LIMPET tags transmit location and dive-depth data (2009-2014).

Deployed on a range of species, with focus on Blainville's beaked whales.



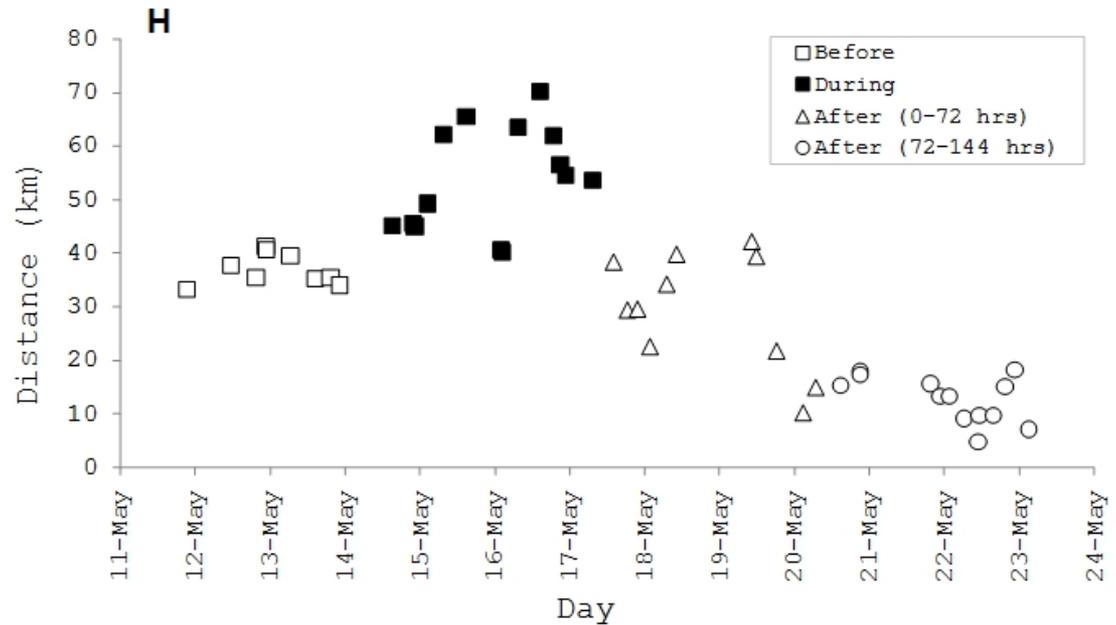
Satellite tagging



Characterizing responses

A tagged adult male Blainville's beaked whale moved away from a Navy sonar test at AUTECH, and returned after.

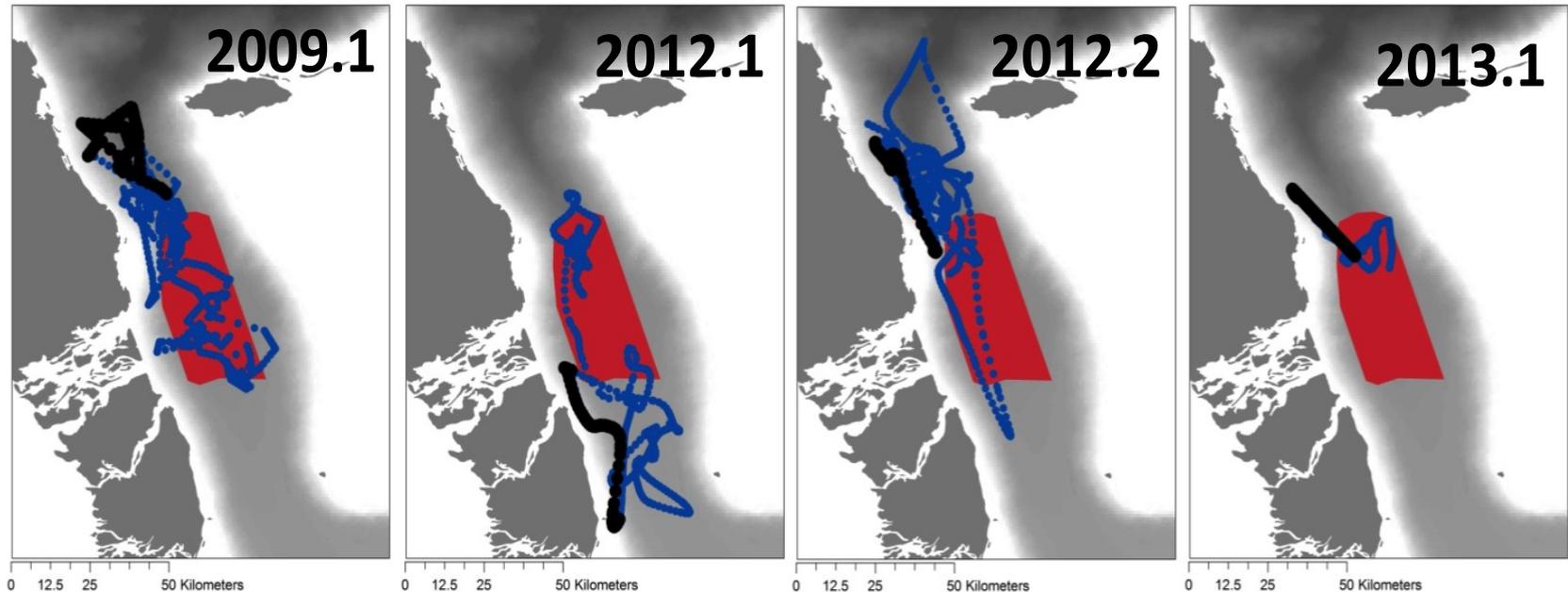
Tyack et al. 2011. Beaked Whales Respond to Simulated and Actual Navy Sonar. PLoS ONE. 6, e1700



Distance from the centre of the AUTECH range to the estimated locations of the tagged whale before, during and after a multi-day sonar test.

Supported by further tags

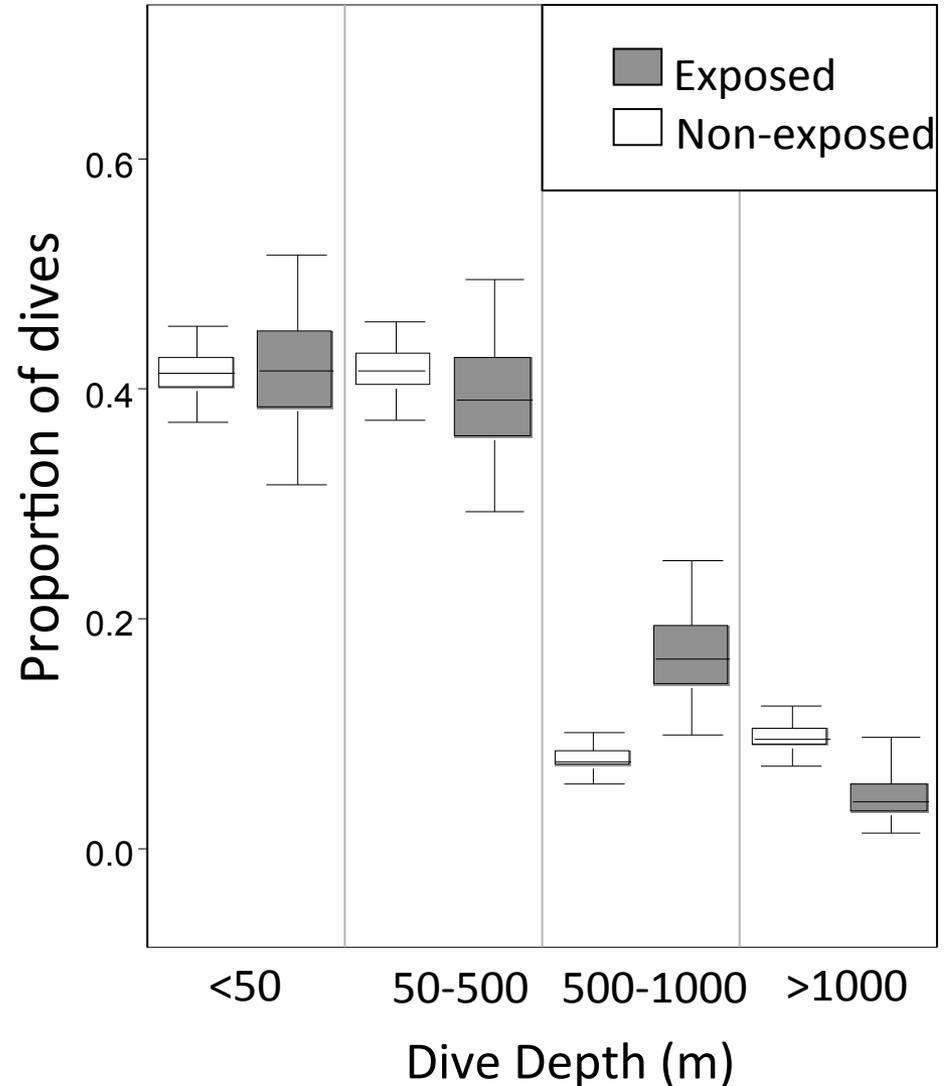
Tags on four whales (one male, three females) tracked movement away from the AUTEK range (red) to the western edge of the deep canyon during sonar tests (black part of track).



A diving response

Tag closest to the AUTEK range showed a change in diving behavior during displacement, with fewer deep dives (>1000m) and more dives to intermediate depths (500-1000m).

Consequences for feeding success and condition?



Population comparisons

Tagging showed limited ranges of Blainville's beaked whales (<100km) for periods up to 6 weeks.

No exchange between Abaco and AUTEK ; supports 20-year photo-id data, suggesting Abaco a "control" site.

Distinct sub-population at AUTEK
(Genetics, Phil Morin)

Site fidelity could increase exposure

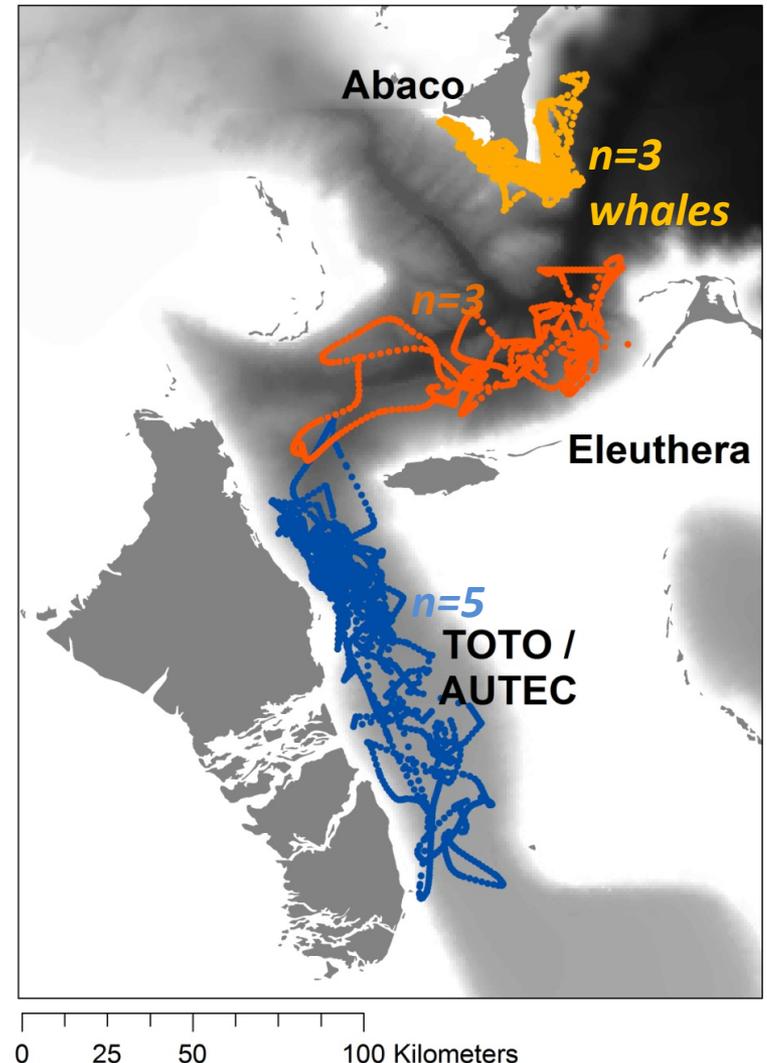


Photo-identification



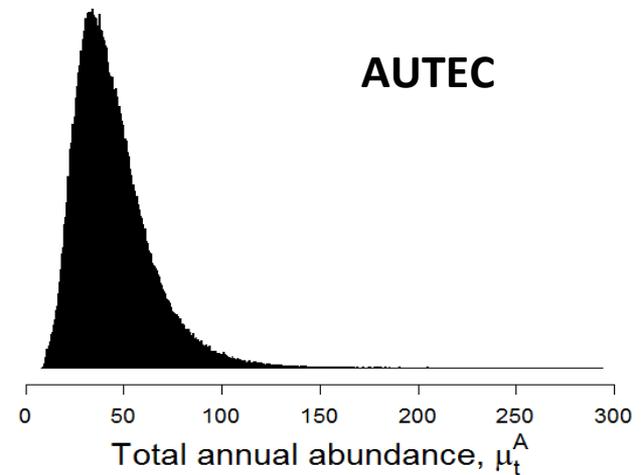
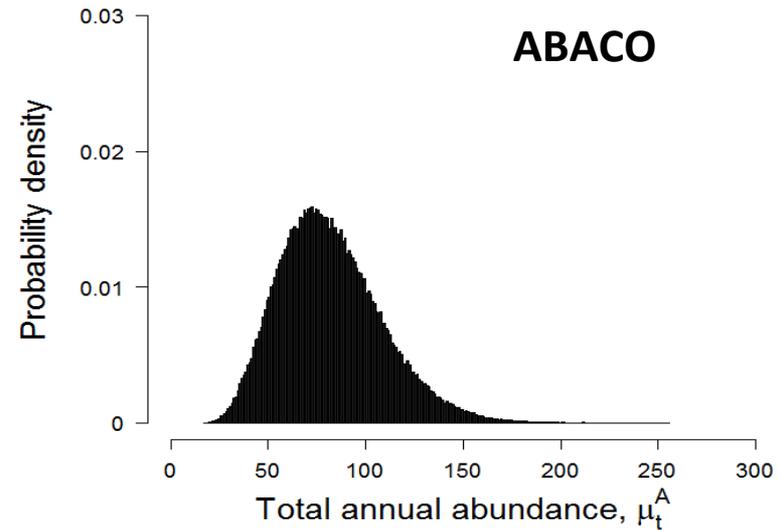
1998



2008

Population comparisons

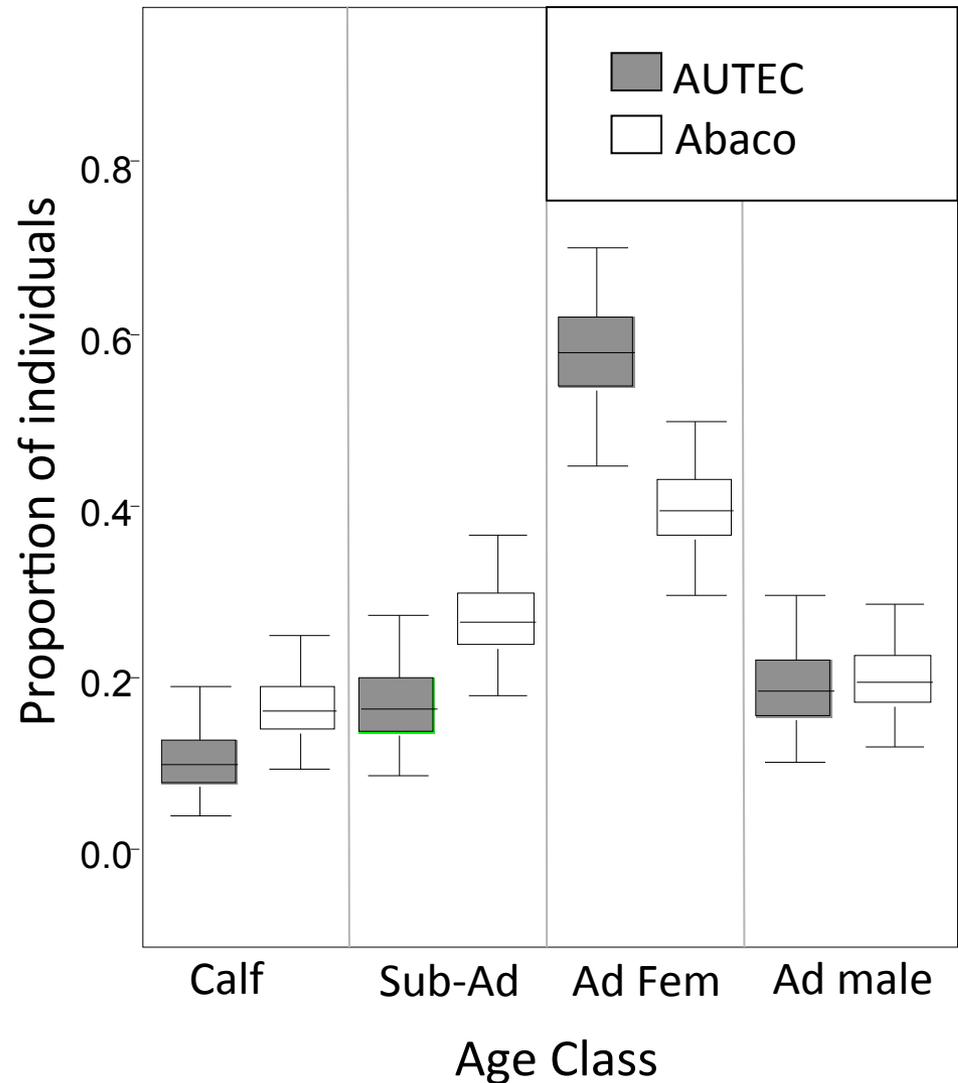
Photographic mark-recapture shows lower abundance of Blainville's beaked whales at AUTEK, compared to Abaco.



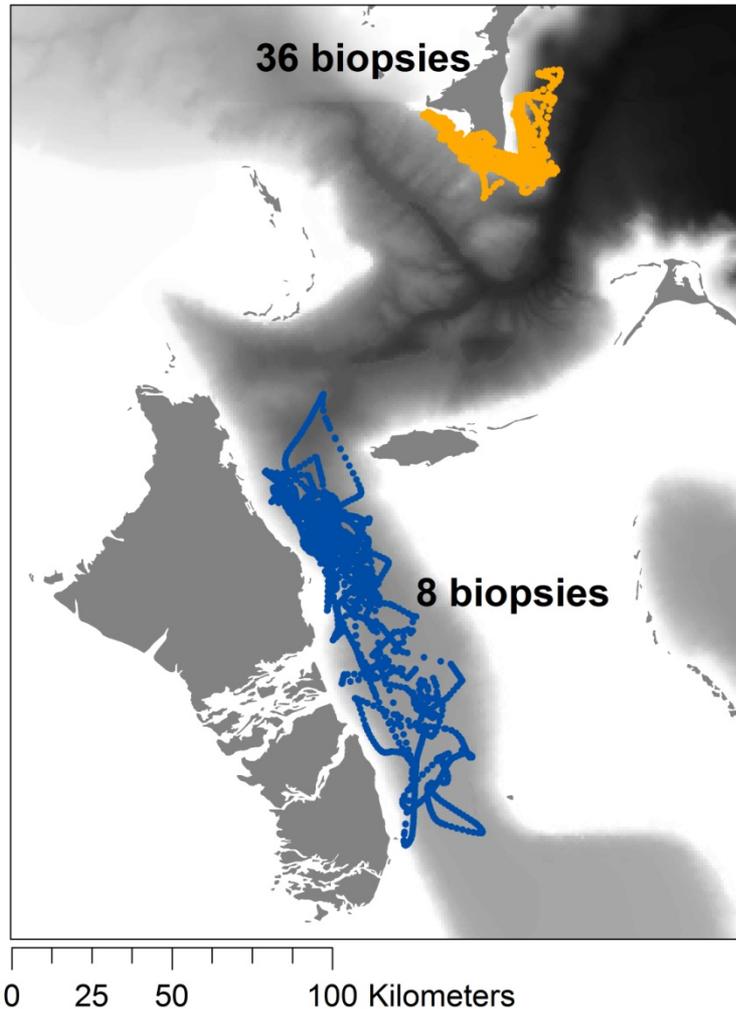
Low recruitment at AUTEC

Comparatively few calves and sub-adults at AUTEC.

Suggests relatively low reproductive success and recruitment over at least the last decade.



Assessing pregnancy and stress



Assessing steroid hormones
in blubber biopsies

Kellar et al. *ongoing*

ONR Award Number:
N000141110433



Other species

A total of 75 tags deployed on six odontocete species:

Blainville's beaked whales

Cuvier's beaked whales

Sperm whales

Short-finned pilot whales

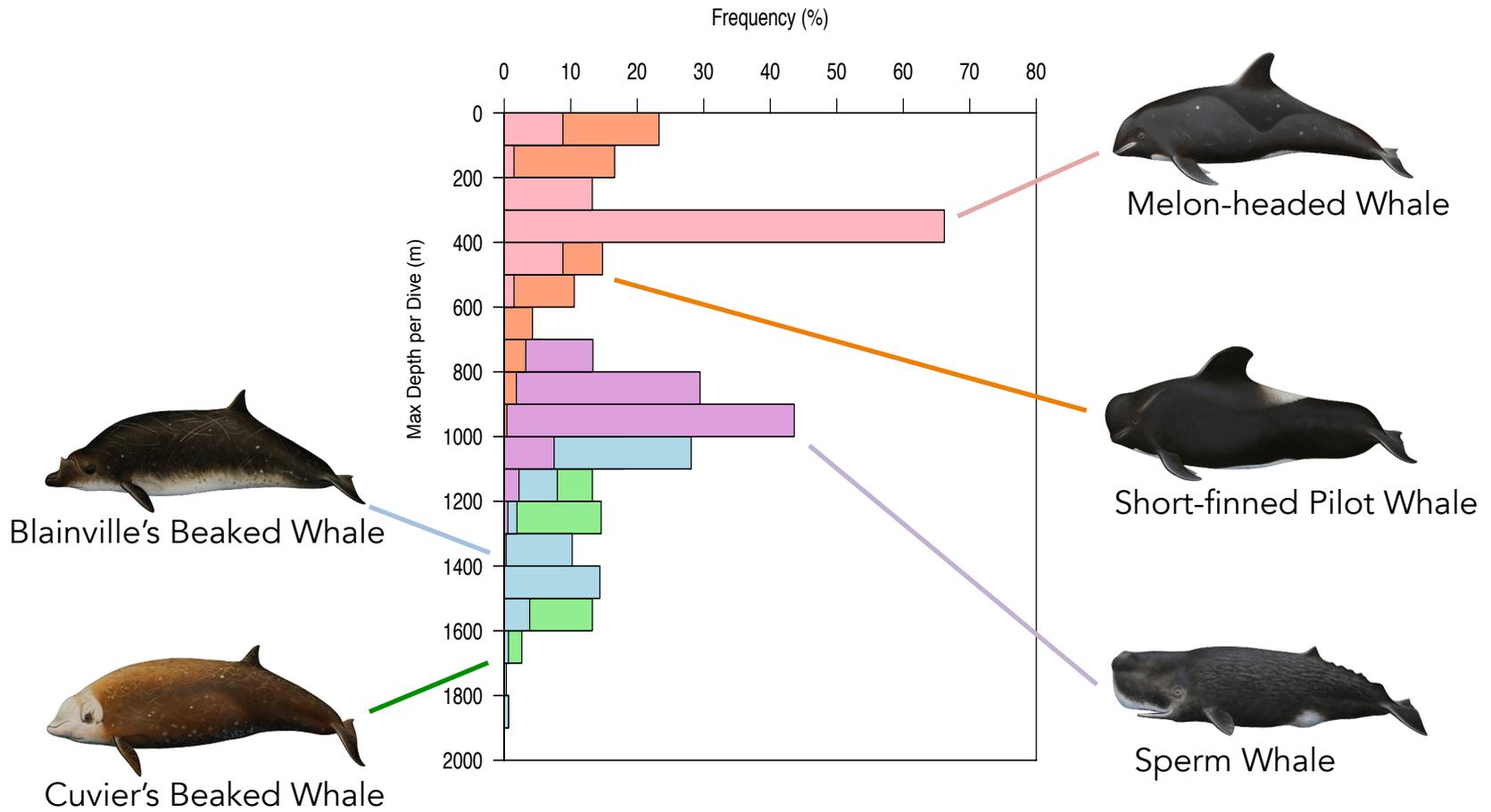
Melon-headed whales

Rough-toothed dolphins

Comparative vulnerabilities



Comparative diving



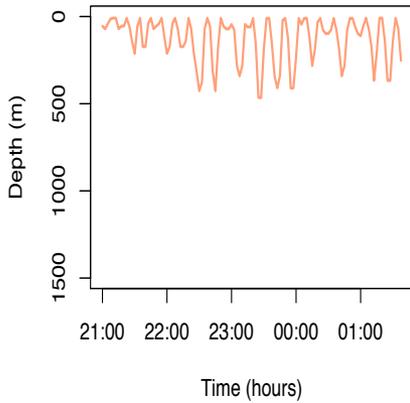
Comparative diving



Short-finned Pilot Whale



Sperm Whale



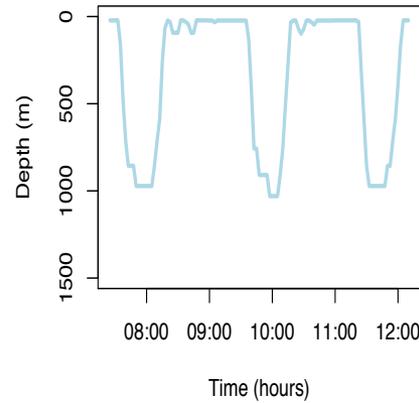
\leq Aerobic Dive Limit



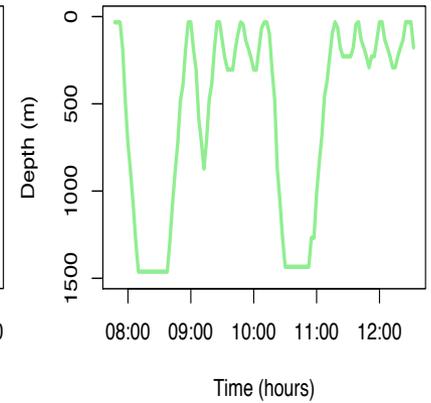
Blainville's Beaked Whale



Cuvier's Beaked Whale



$>$ Aerobic Dive Limit



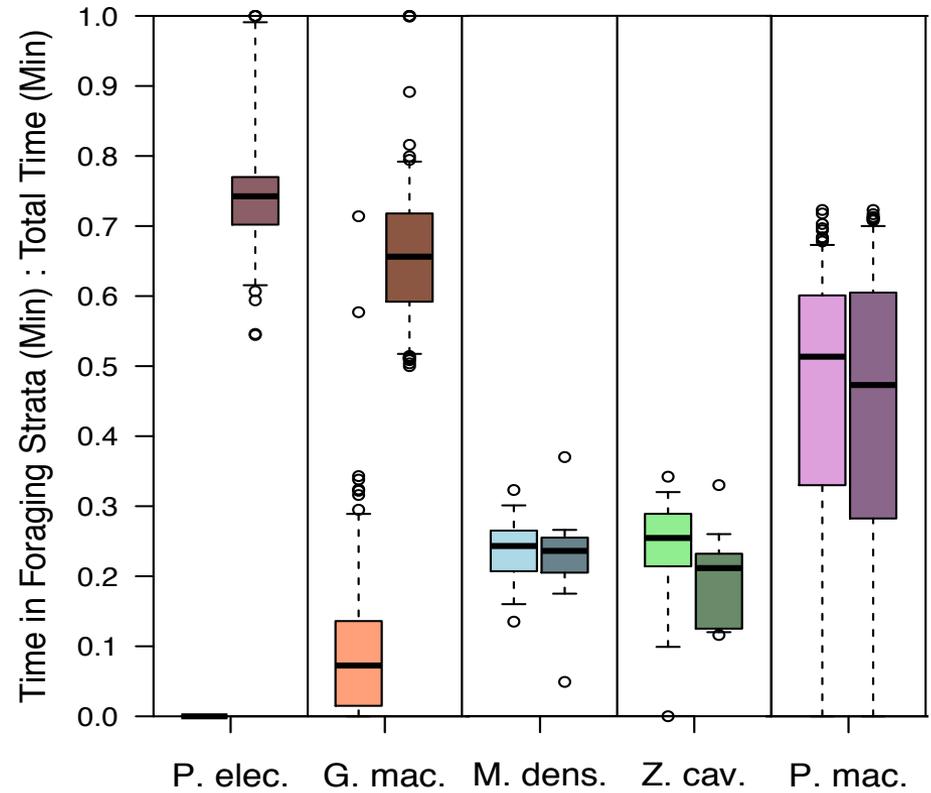
Comparative diving <- vulnerability

Beaked whales spend less time at foraging depth

Physiologically constrained

Vulnerable to disturbance

Compromised body condition?



Assessing body condition



Assessing body condition
Durban et al. *Awarded*



Individual monitoring



Individual monitoring

Photo-id history of adult females. Dark shading = with calf.

Monitoring INDIVIDUAL condition relative to reproductive status and disturbance.

WHALE	YEAR															
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Md064	X	X														
Md070	X	X	X		X	X		X	X	X	X	X				
Md071	X	X	X	X	X											
Md076	X	X	X	X	X	X	X	X	X	X						
Md078	X		X	X	X	X	X									
Md079	X		X	X	X	X	X									
Md091		X	X							X		X		X	X	X
Md094		X	X	X	X	X	X	X	X	X	X	X		X	X	X
Md106		X	X	X	X	X	X	X	X	X						
Md107										X				X		X
Md111		X			X											
Md112		X	X									X				
Md121						X	X							X	X	X
Md134											X		X		X	X
Md135										X	X				X	X
Md139			X			X	X			X	X				X	X
Md141				X	X	X		X		X	X				X	
Md144				X							X					
Md156				X							X					
Md160				X							X					
Md163				X											X	
Md181						X	X	X								
Md184						X				X						
Md185					X		X	X								
Md190							X									X
Md193							X					X				
Md196														X	X	
Md201								X	X							
Md233												X				X
Md238													X		X	

An integrated package

- Population-level effects, not just behavioral responses
- Multi-disciplinary approach

Tagging (movements and diving)

Photo-identification

Genetics

Steroid hormones

Photogrammetry

- MMTD in-house expertise

