

Overview of SOCAL-BRS project off California



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BRS Socal

Why SOCAL?

- *Species density and diversity*
- *Area of high Navy activity*
- *Collaboration with ongoing projects*



SOCAL-BRS targets many species, but Beaked Whales are top priority



Deep-divers (*Beaked whales, Sperm whales*)

- particular sensitivity: beaked whales
- endangered status: sperm whales



Mysticetes (*Blue, Fin, Humpback, Minke whales*)

- endangered status



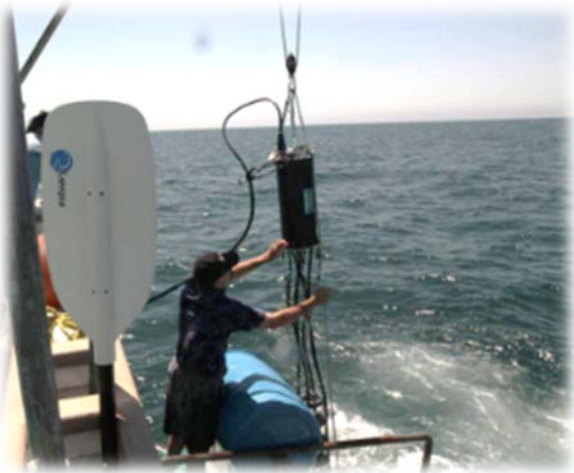
Other Delphinids (*Rissos, Common, Bottlenose dolphin*)

- common occurrence, exposure
- large percentage of Navy “takes”

SOCAL-BRS Field Configuration

Decentralized Vessel Strategy:

- * Fast, independent tag boats
- * Small, flexible central platform
- * Small portable sound source
(cannot be towed)



SOCAL-BRS Animals Tagged (2010-2014)



SOCAL-BRS: ALL Tags and CEEs (2010-15)

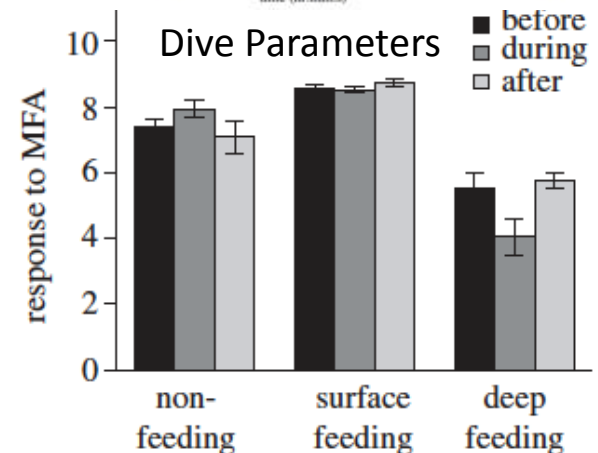
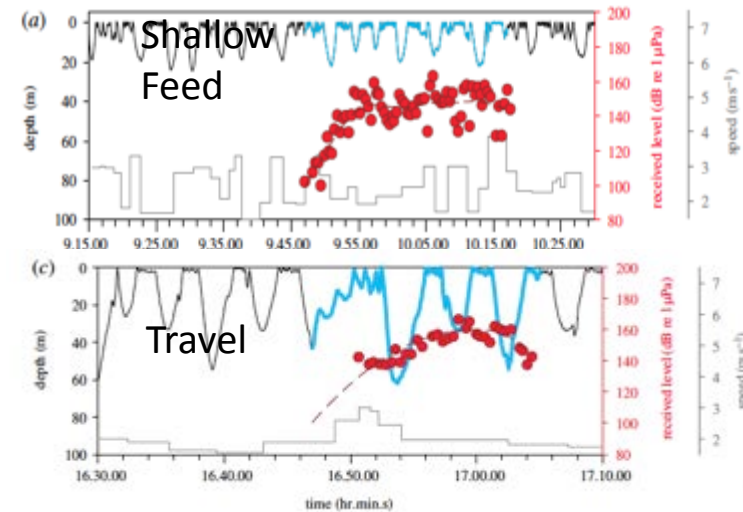
Species	Animals Tagged	Total CEEs	Real Navy MFA	Scaled Source MFA	Scaled Source PRN	Silent Control
Cuvier’s Beaked Whale	6	3	1	2		
Baird’s Beaked Whale	1	1		1		
Sperm Whale	1 (twice)	3		1	1	1
Blue Whale	82	46	3	22	15	9
Fin Whale	25	18	2	10	4	5 (1 real)
Humpback Whale	2	2		2		
Minke Whale	2	1		1		
Risso’s Dolphin	34	18	2	8	2	6
Bottlenose Dolphin	9	0				
Common Dolphin	2	0				

RESPONSES OF BLUE WHALES TO SONAR EXPOSURE



Scaled source Controlled Exposure Experiments

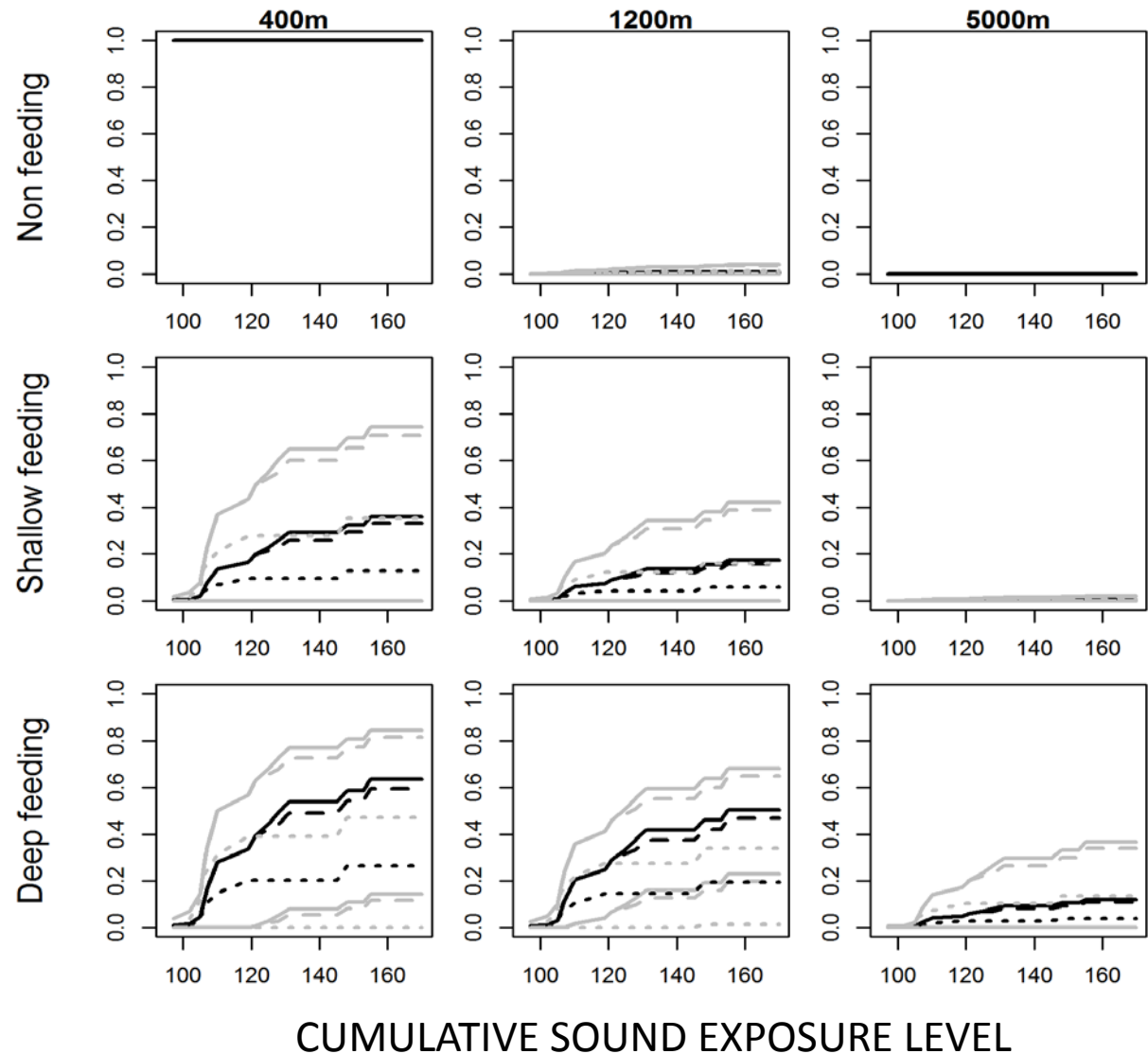
- Large data set shows that context-dependent responses vary by behavioral state
- No clear responses for many whales in non-“deep feeding” behavioral states
- Responses at low RLs in some whales with rapid recovery by stop of exposure
- Avoidance responses strongest in dive parameters during deep feeding
- During exposure, probability of transitioning into deep feeding state falls to essentially zero.



Goldbogen *et al.* (2013)

MODELLING BLUE WHALE RESPONSE TO SONAR AS $F(\text{RECEIVED LEVEL, CONTEXT, RANGE})$

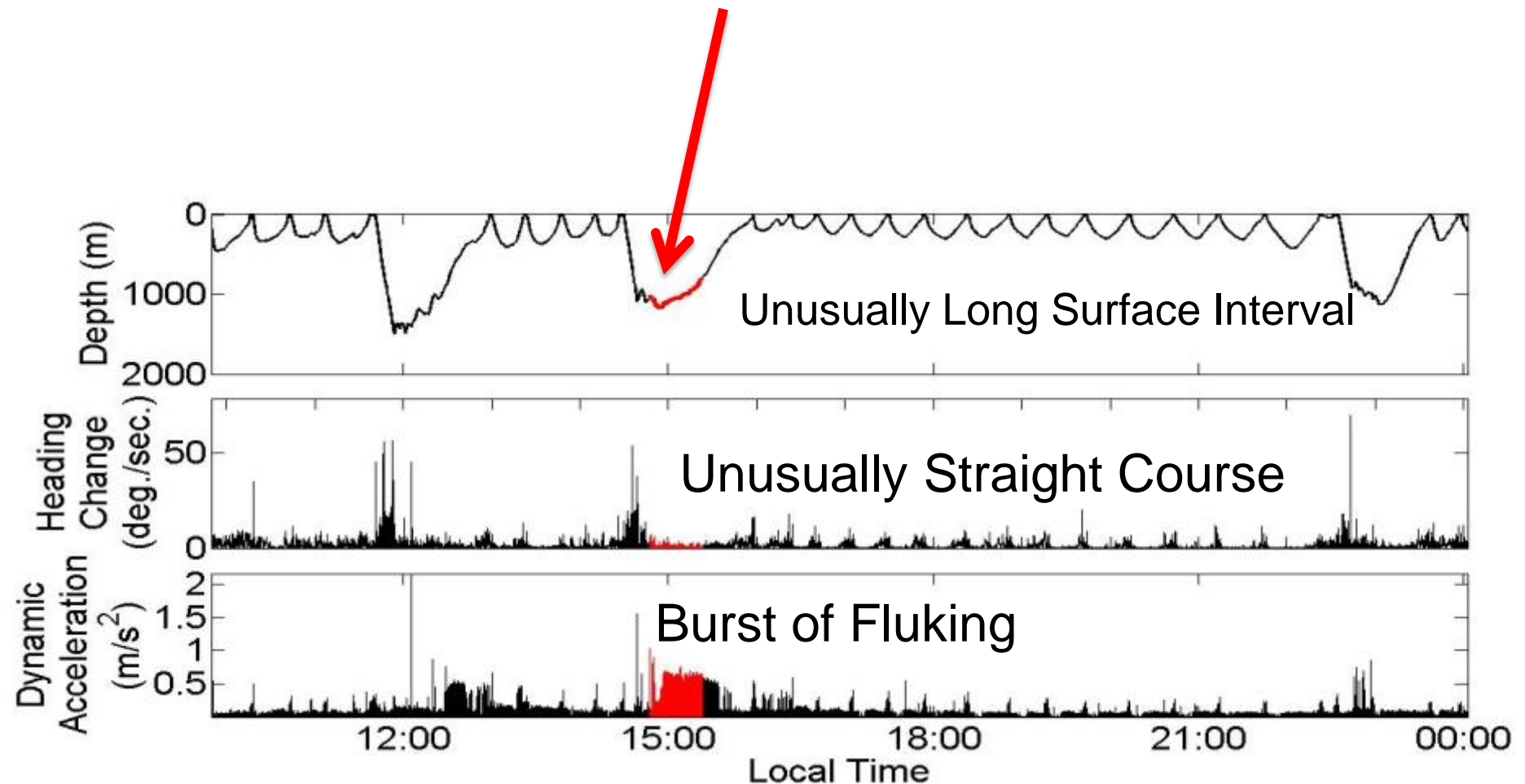
- Dose response severity functions generated using recurrent event survival analysis (MOCHA product – Harris et al., 2015)
- Individual exposures combined to estimate $p(\text{resp})$ as a function of exposure level and contextual covariates



Ziphius is Top Priority because it dominates beaked whale strandings that coincide with naval sonar exercises

- Of 12 cases of beaked whale strandings most closely coincident with naval sonar exercises, 8/12 involved just *Ziphius*. All 4 of the mixed species strandings also included *Ziphius*, 3/4 included *Mesoplodon*.
- Aguilar Soto (2006) report response of *Ziphius* to ship noise
- Experiments testing the response of *Ziphius* to naval sonar are therefore high priority

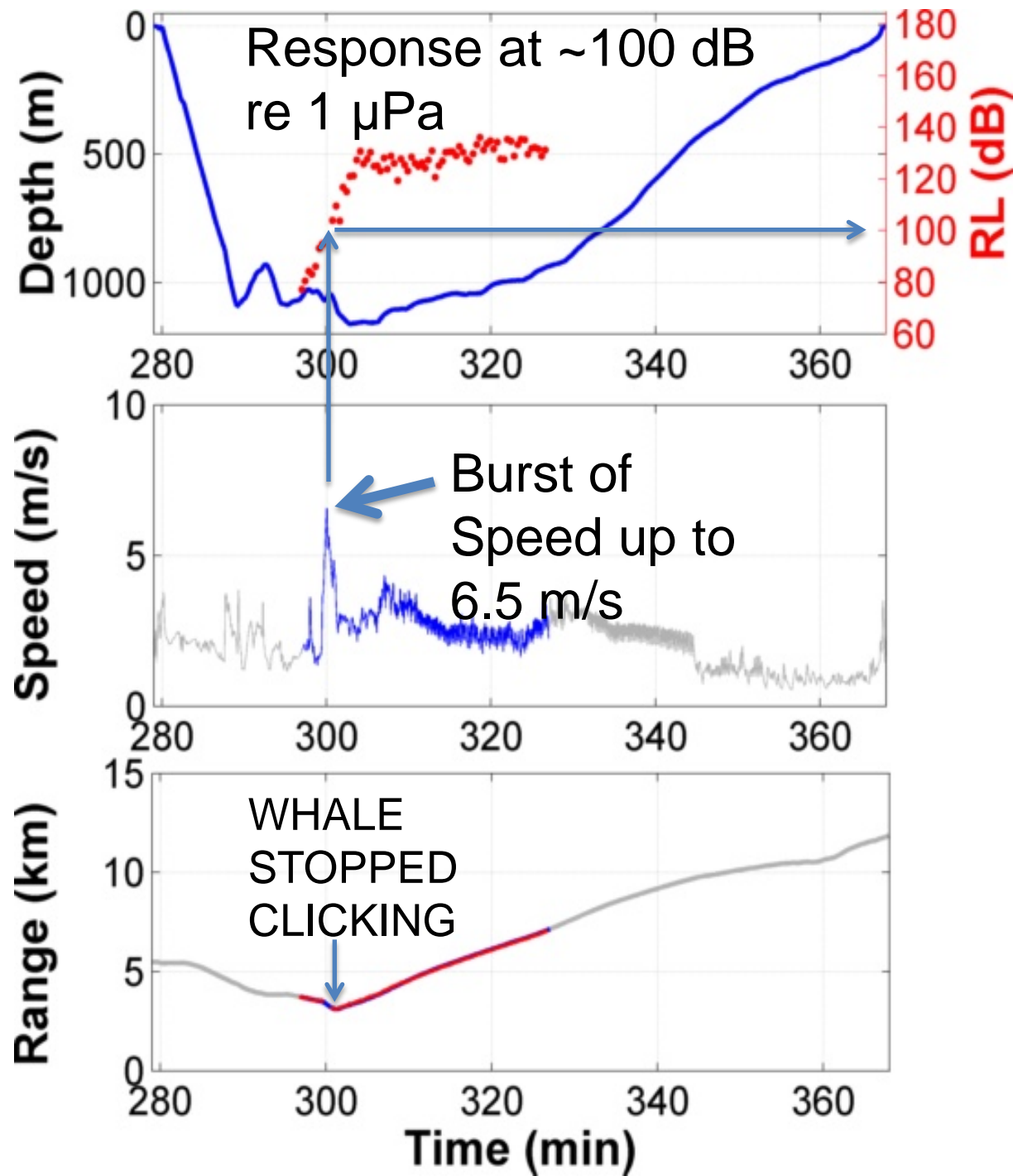
Dive Pattern, Change in Heading, and Dynamic Acceleration of 2010 playback to tagged *Ziphius* – red marks sonar playback



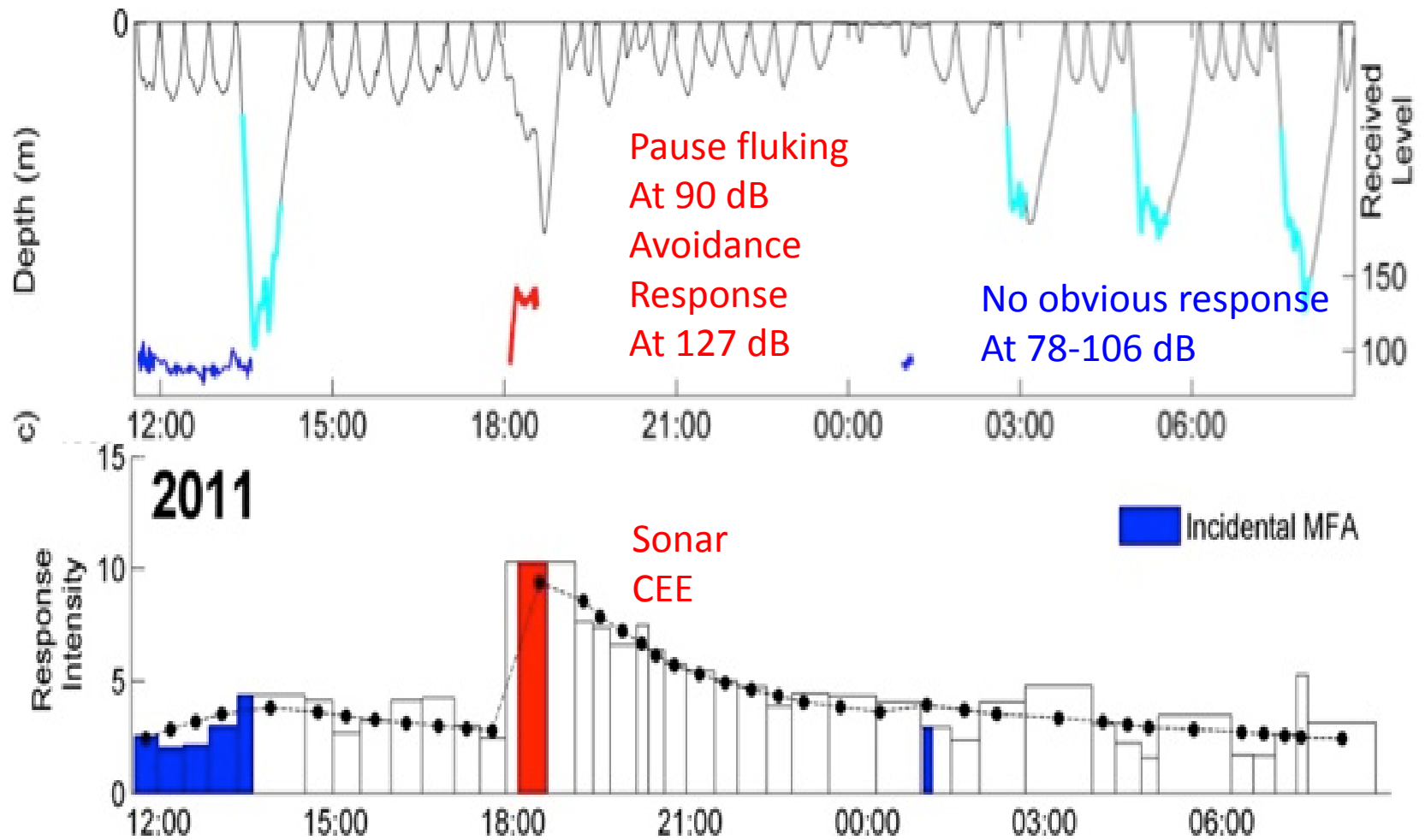
BRS SoCal Exposure and Response of Tagged Ziphius in 2010

Whale moved
from <4 km to 12
km away from
the source
before surfacing

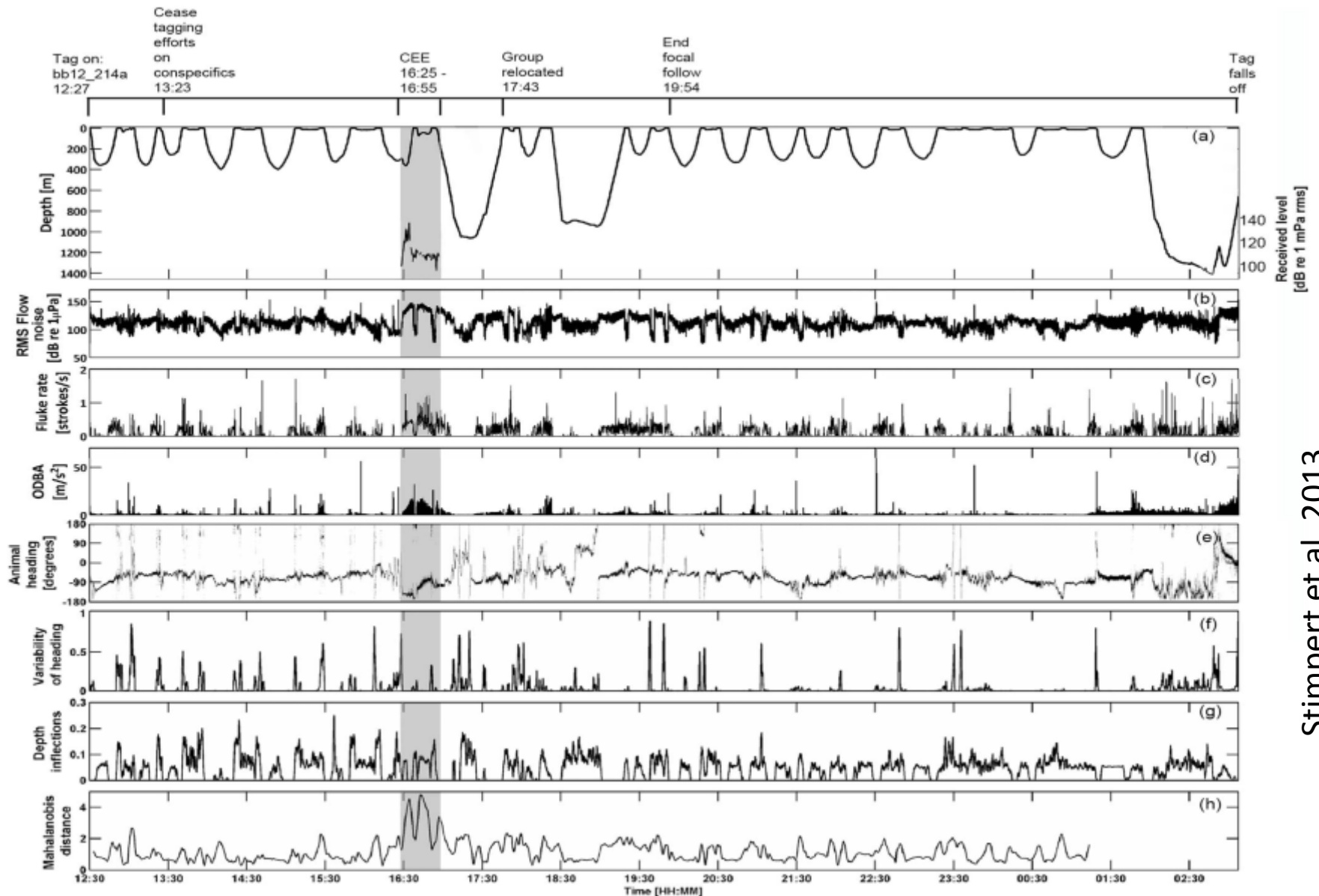
DeRuiter et al 2013



Second SoCal sonar playback to tagged Ziphius included incidental sonar at RL 78-106 dB re 1 μ Pa



BRS SoCal Response of Baird's beaked whale to sonar



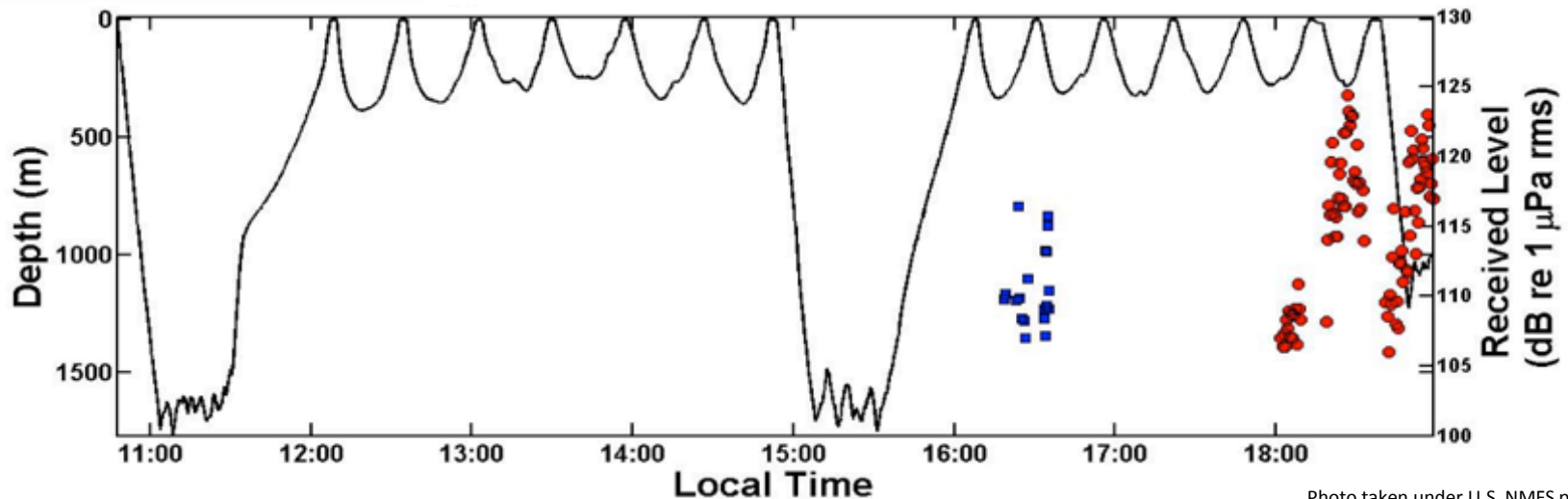
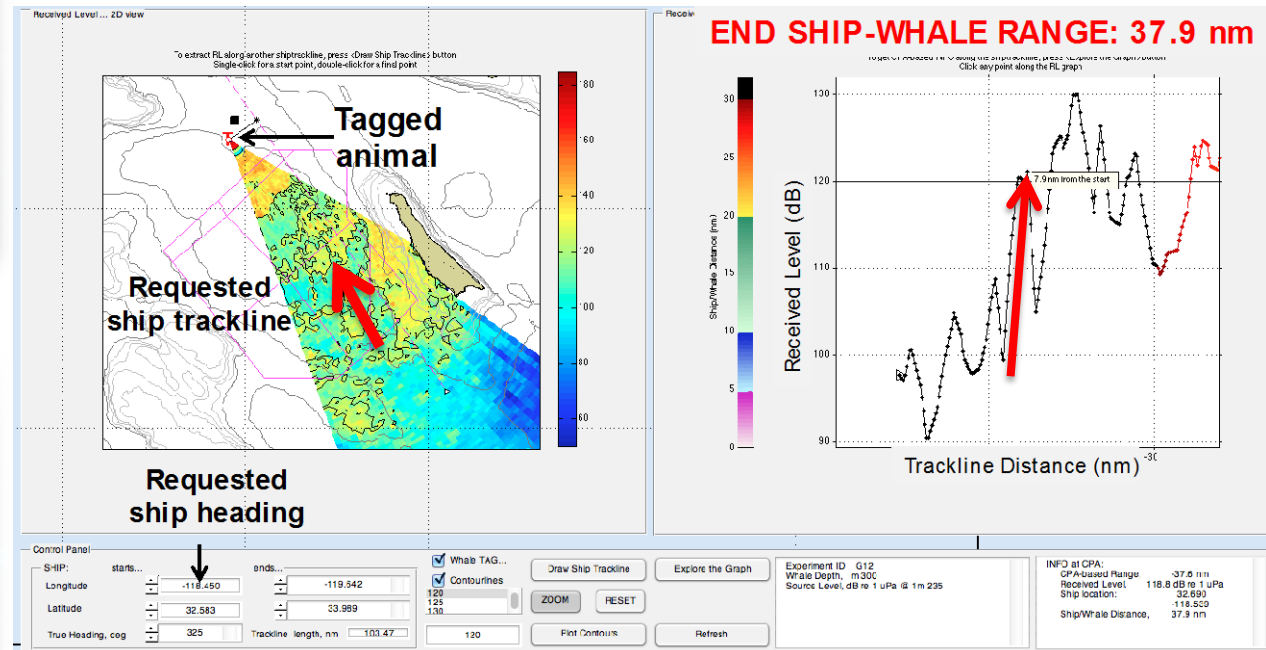
Min Received Levels for Beaked Whale Response

Species	Stimulus	Received Level dB re 1 μ Pa rms broadband	Source
Mesoplodon densirostris 1	Orca	97	BRS AUTC
Ziphius cavirostris 2	MFA	98	BRS SoCal
Hyperoodon ampullatus	MFA	107	3S
Ziphius cavirostris 3	MFA	127	BRS SoCal
Berardius bairdii	MFA	127	BRS SoCal
Ziphius cavirostris 1	Ship propulsion	136	Aguilar et al. (2006) Mar Mam Sci, 22(3): 690–699
Mesoplodon densirostris 1	MFA	138	BRS AUTC
Mesoplodon densirostris 2	PRN	142	BRS AUTC

Controlled Exposure Experiment to Ziphius using sonar on moving navy warship



SOCAL-BRS Collaboration
with *USS Dewey* (DDG 105)
29 July 2013





SOCAL-BRS CONCLUSIONS

Novel findings using simulated sonar CEEs

- Species differences (beaked whales most sensitive)
- Strong context dependence in probability of response and type of response
- *Key factors: behavioral state, perhaps source-receiver range*
- Major progress in analytical methods and multi-pronged approach for **Realistic scales and scenarios**



- Major step forward using real Navy ships in CEEs
- Sustained, concerted, adaptive efforts for ship cooperation in 2015 but various challenges in the field
- Top priority for final field effort in 2016 (target: 4 ships)
- Multiple tag deployments, extended duration, integrate more Passive Acoustic Monitoring

SOCAL-BRS Acknowledgements



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NOAA: NMFS Offices of Science & Technology,
Protected Resources, and SWFSC; Channel Islands
National Marine Sanctuary; SW Stranding Network



Crews of the *R/V Truth* (Truth Aquatics) and *R/V Sproul* (SIO)

Permits, Authorizations: Tammy Adams, Sarah Wilkin, Ned Cyr, Jason Gedamke, Teri Rowles, CA Coastal Commission

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