



Conor Ryan

cryan@mcr-team.org

Cetacean distribution in the Aegean and Levantine Seas in relation to ambient noise and shipping density

Ryan, C.* , Boisseau, O., Cucknell, A-C., Romagosa, M. Moscrop, A. and McLanaghan, R.

Song of the Whale team, Marine Conservation Research International, 17A High Street, Kelvedon, Essex, CO5 9AG, UK

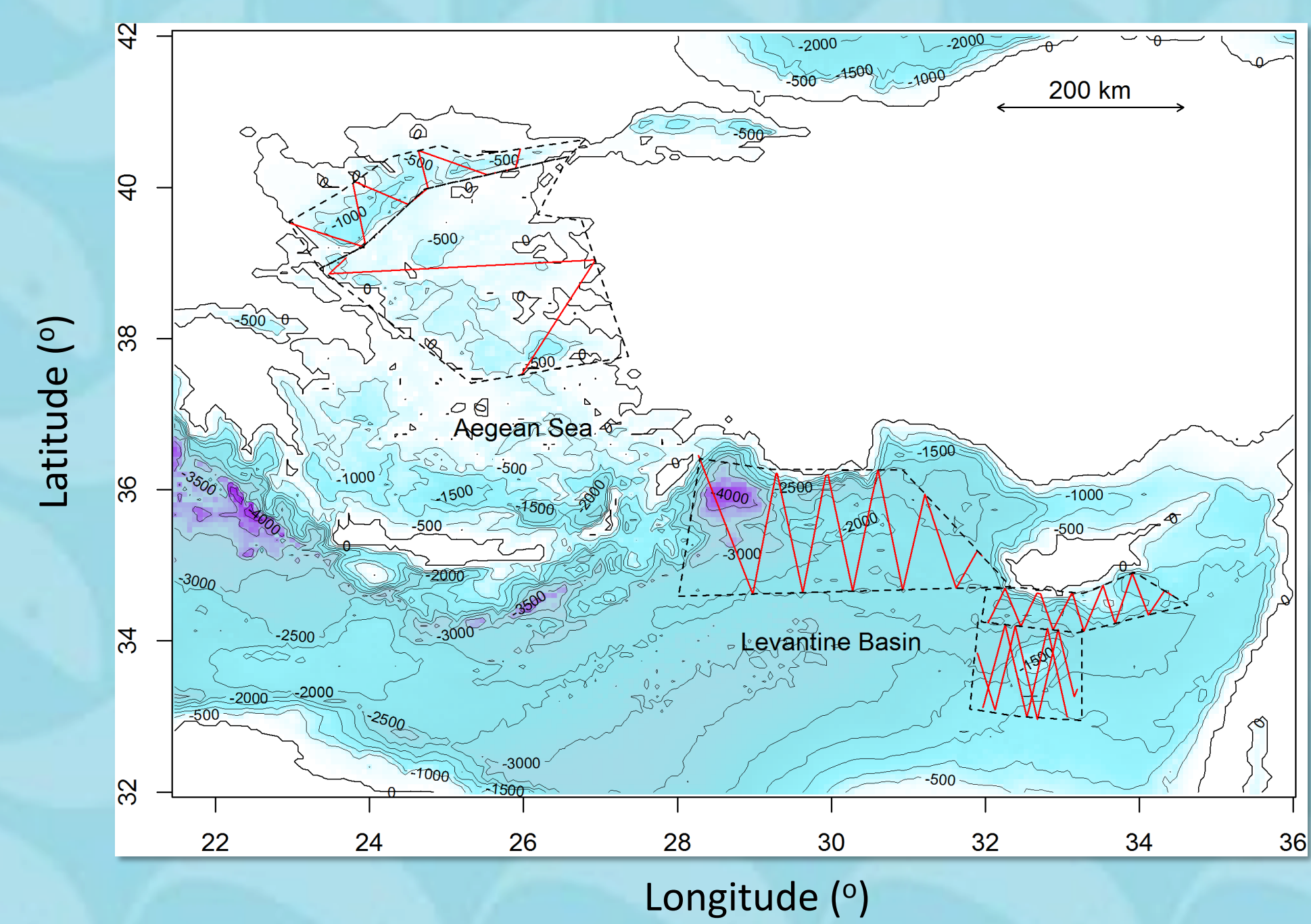


Fig. 1. Survey area showing track-lines designed in DISTANCE

INTRODUCTION

A recent ACCOBAMS report identified mortality from ship-strikes and habitat degradation due to anthropogenic noise as key conservation issues in the eastern Mediterranean Sea (Notarbartolo di Sciara & Birkun, 2010). The EU Marine Strategy Frameworks Directive 2008/56/EC obliges member states to monitor and reduce levels of underwater noise (Descriptor 11), towards a goal of 'Good Environmental Status' in EU waters by 2020. A visual/acoustic survey of the Aegean and Levantine Seas was conducted by the Song of the Whale team during summer 2013, where data were collected on the abovementioned threats.

METHODS

The survey was carried out from R/V *Song of the Whale* between 7 Jul - 2 Sep 2013. Simultaneous visual and acoustic surveys were conducted along pre-determined track-lines (Fig. 1). Two twin-channel hydrophone arrays sampled at 48, 192 and 500 kHz for delphinids/sperm whales, beaked whales and harbour porpoises respectively via Pamguard (Gillespie *et al.*, 2009). Ambient noise was recorded with a calibrated RESON TC4032 hydrophone (± 2.5 dB between 10 Hz and 80 kHz) at 41 stations (Fig.3). Voltages were converted to broadband sound pressure levels (SPL) from 10 to 24,000 Hz for each 30 s recording with SpectraPLUS (Pioneer Hill Software). Power spectrum density levels (PSDL) were measured for 1/3 octave bands (centred at 63, 125 and 1000 Hz) to examine frequency-specific variation in ambient noise (Van der Graaf *et al.* 2012). AIS data were recorded continuously from the navigation system (Dkart) and compared to those recorded from the region during 2007. For detailed methods see Ryan *et al.*, 2014.

RESULTS

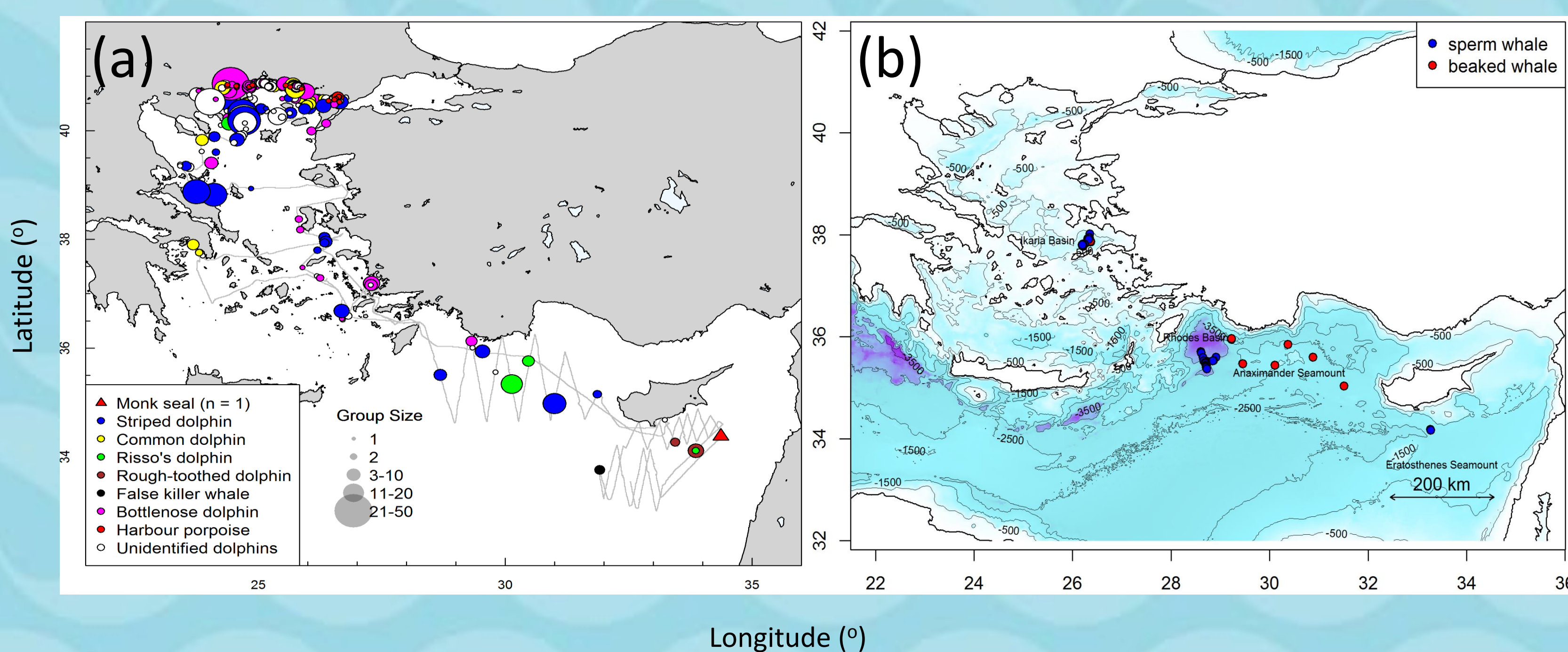


Fig. 2. Distribution of (a) sightings and (b) acoustic detections of marine mammals during the survey

- 3654 km of visual effort: 148 sightings of 7 cetacean species including harbour porpoise (See Cucknell *et al.* talk at 17:45 on Monday)(Fig. 2)
- Relative encounter rates (cetacean sightings 100 km⁻¹): northern Aegean, 0.06; central Aegean, 0.04; Levantine Sea, >0.01.
- 7530 km of acoustic effort: beaked and sperm whales recorded (max group sizes 2 and 3 respectively) but not sighted (Fig. 2b).
- Highest noise (power spectrum density levels) in shipping thoroughfares which were also coincident with detections of sperm and beaked whale (Figs. 2 & 3).
- Mean speed of Individual vessels ($n = 192$) recorded in both 2013 (12.2 kn) and 2007 (15.2 kn) along the Suez-Black Sea thoroughfare were significantly different ($t = 33.51$; $df = 786$; $p < 0.001$).

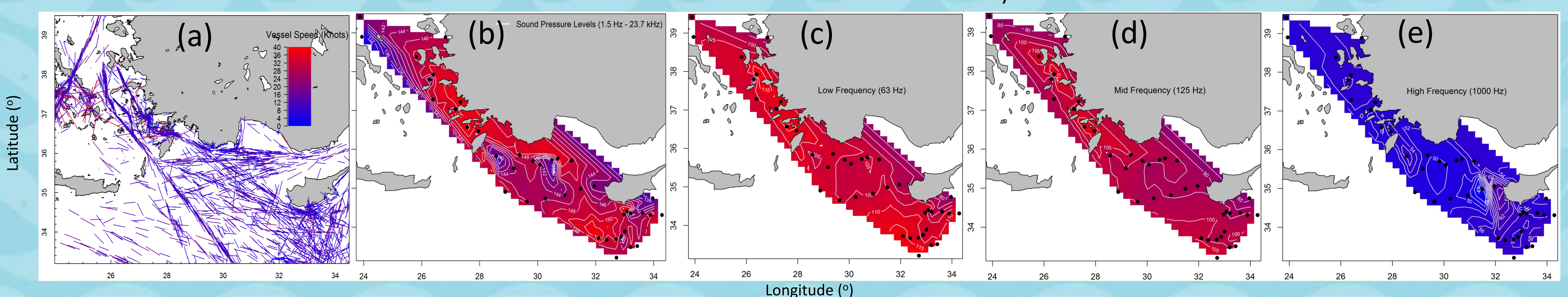


Fig. 3. (a) Vectors showing vessel heading and speed; (b) SPL measured in dB re 1 µPa; (c,d,e) PSDL measured in dB re 1 µPa²/Hz for low, mid and high frequency 1/3 octave bands. Standard bivariate kernel density smoothing was used to interpolate PSDLs within the sampling area using linear splines. Sampling points shown as black dots.

DISCUSSION

- Northern Aegean Sea is home to diverse assemblage of cetacean species and with relatively high cetacean encounter rates compared the Levantine Sea.
- The cetacean community of the Levantine Sea is quite distinct with rough-toothed dolphin and false killer whales found there but not in the Aegean Sea.
- Beaked and sperm whales were recorded in deep-water basins in areas of high traffic density and with high SPLs at low and broadband frequencies.
- Slower ships speeds at present are believed to be influenced by fuel prices, not policy.
- Broadband acoustic footprint of ships in the region has reduced by an estimated 50% in 2013 compared to 2007 (Leaper *et al.*, 2014).
- An opportunity exists to regulate ship speeds in key areas while vessel speeds are slow.

ACKNOWLEDGMENTS

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