

BLUE WHALE FORAGING STRATEGIES: responses to a dynamic prey field off southern Australia

MARGIE MORRICE^{1, 2}
PETER GILL^{1, 2}
JOHN CALAMBOKIDIS³
GREG SCHORR³
TOBY JARVIS⁴

(1) *PhD student, School of Life and Environmental Sciences, Deakin University, PO Box 423, Warrnambool, Victoria 3280, Australia;*
(2) *Blue Whale Study, C/- Post Office, Narrawong, Victoria 3285, Australia;*
(3) *Cascadia Research Collective, Olympia, WA 98501, USA;*
(4) *Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia;*
Contact email: mmorr@deakin.edu.au

Introduction

Blue whales aggregate to feed (Nov-May) in a regional upwelling system along the continental shelf off southern Australia, where their distribution is highly variable (Gill, 2004; see Gill *et al.* MMS poster). Individual whales rely on finding and exploiting food resources (i.e. krill swarms) whose distribution is influenced by broad and local physical and biological processes. Here we present the findings of a fine-scale study where we examined the distribution and densities of whales and krill, in the context of whale foraging behaviour and upwelling features.

Methods & results

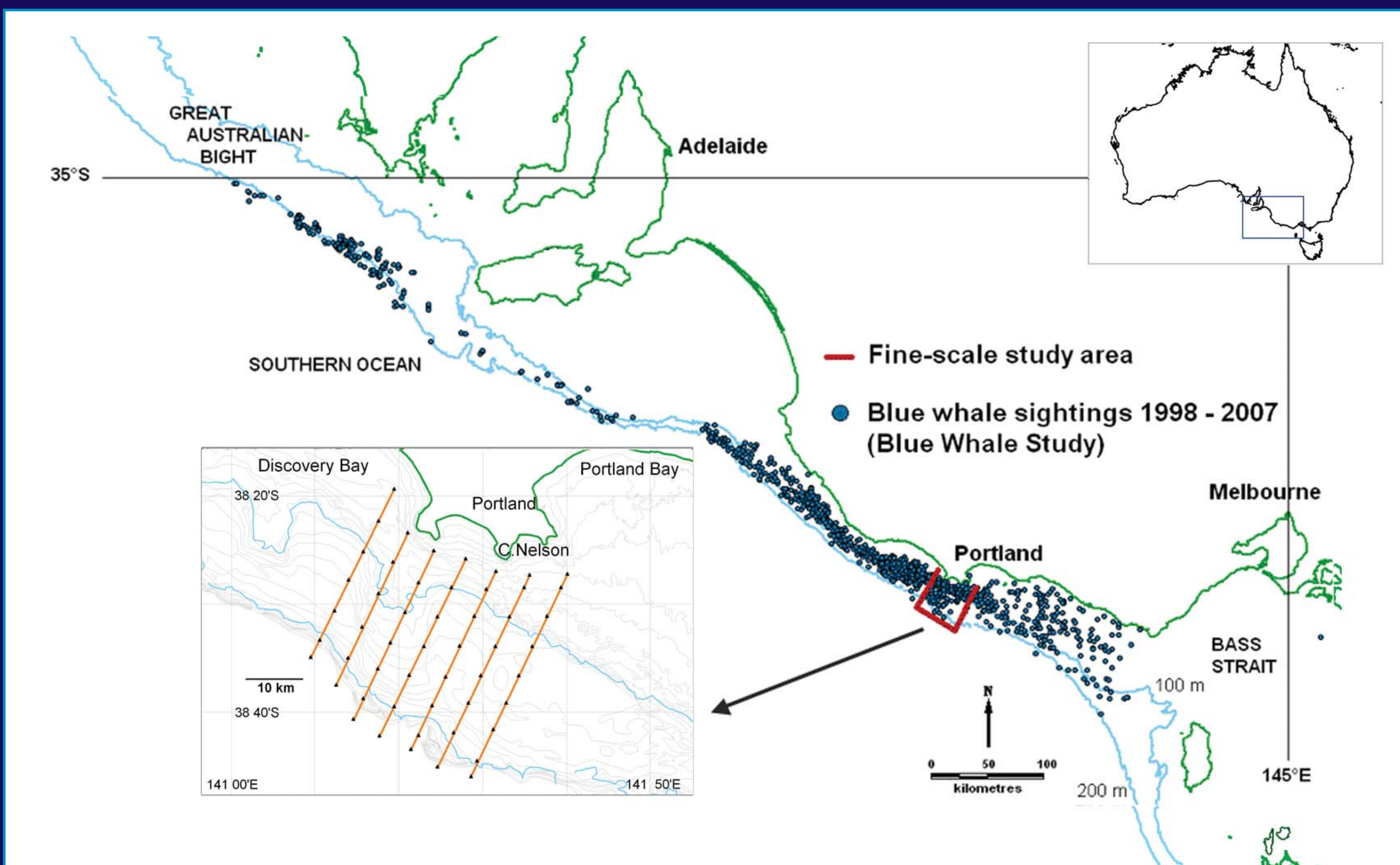


FIGURE 1. Fine-scale study area, sampled using systematic aerial and small vessel surveys during March-May 2003, 2004 and 2007. Vessel surveys (inset) covered up to 163 km in on effort transects each year including repeat transects, and recorded distribution and densities of whales, prey scattering features from continuous hydroacoustics, and thermal layers from regular CTD deployments (black▲, inset) and remote sensing (SST, Chl-*a*).

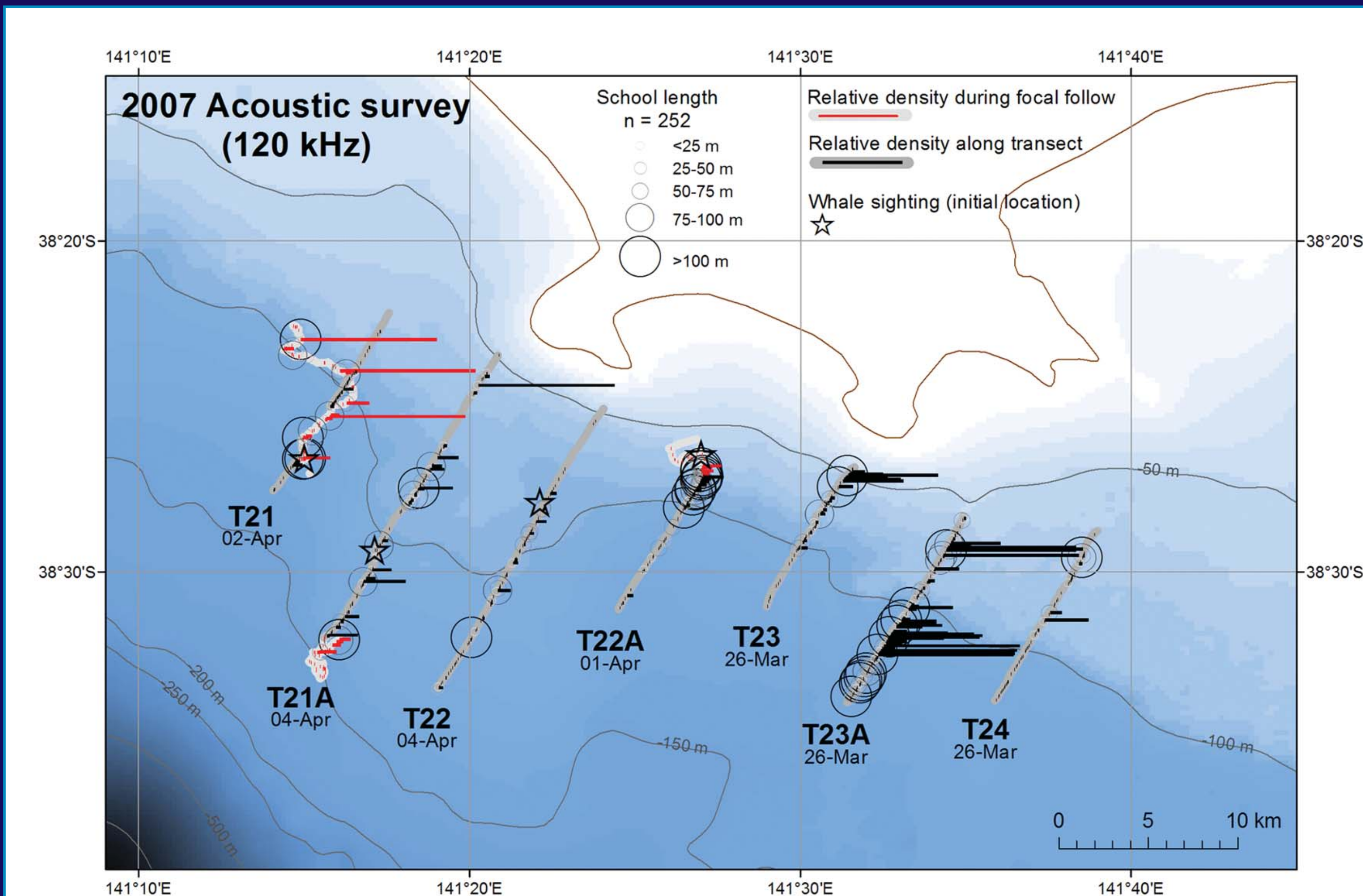


FIGURE 2. Integrated acoustic densities (100m bins, unclassified), schools (likely *Nyctiphanes australis*), and 'on effort' blue whale sightings (4 sightings, 7 ind.) along select transects in 2007. The blue whales were all sighted close to the 100m depth contour in areas characterised by relatively large and/or dense acoustic schools (mean density=70m²nm⁻², range 2-700; mean length 65m, range 5-460; n=81 schools). However, no whales were sighted where the largest, most dense schools were found on **T23A** (mean density=520m² nm⁻², range 2-11,000; mean length 70m, range 10-840; n=65 schools).

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Examples of dense swarms, 2007 surveys

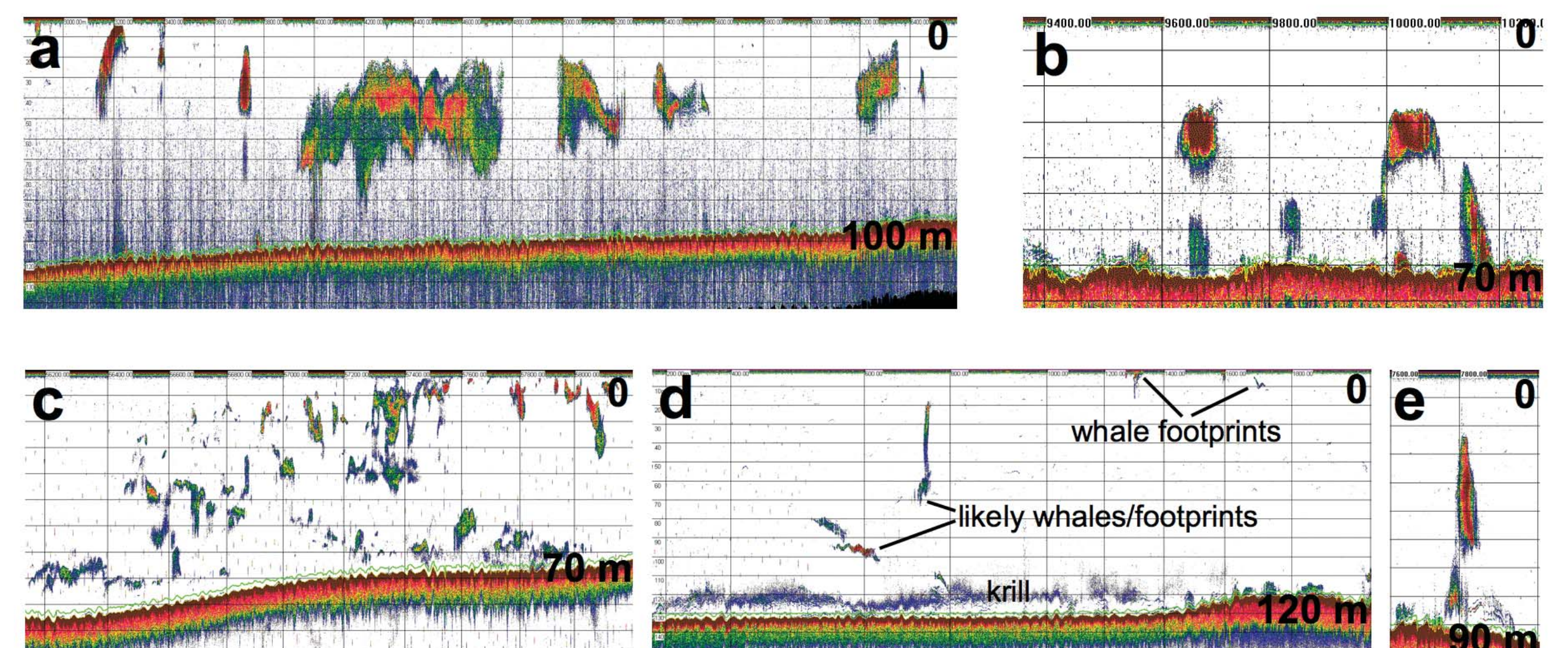
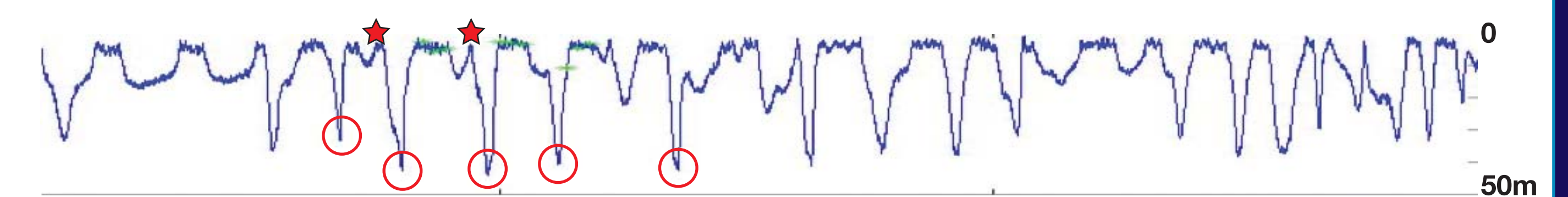
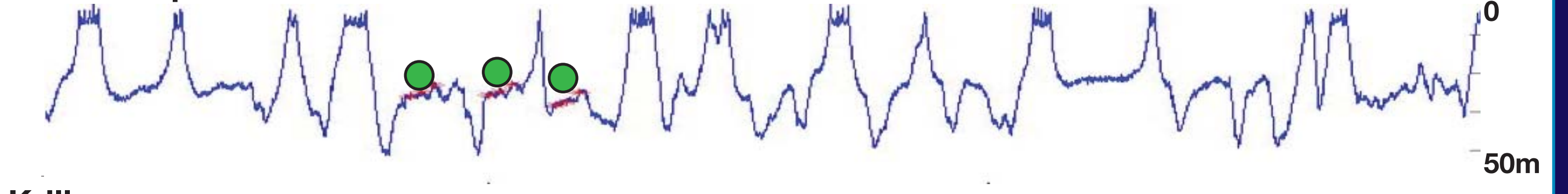


FIGURE 3. Examples of: (a) and (b) dense swarms from **T23A** (Figure 2); and dense swarms adjacent to feeding whales (c) **T22A**, (d) and (e) **T21**. Surface swarms not well detected due to weather and transducer 'ringdown'.

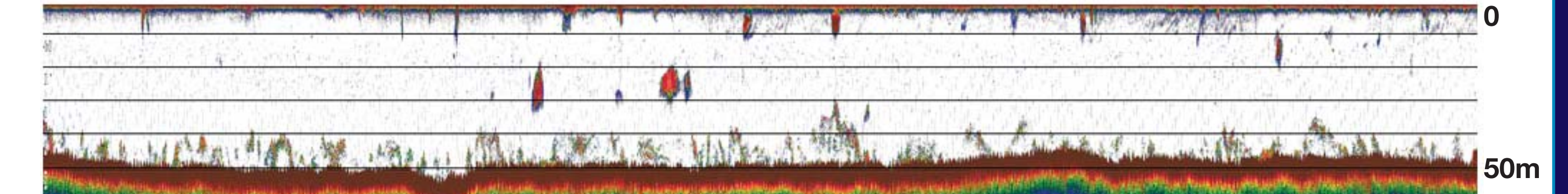
Female dive profile



Male dive profile



Krill swarms



18:00 18:30 19:00 19:30

FIGURE 4. Dive profiles for a pair of Burgess-tagged (Goldbogen *et al.*, 2006) whales (first worldwide). In 2007, underwater behaviour was collected in conjunction with surface behaviour, prey and environmental data to extract features of target prey patches, and relationships to thermal gradients (e.g. mixed layer depths). The female (lead) is shown here lunging close to the bottom (red circles) and at the surface (red stars) with krill swarms for the same depth and time period. The male called (song sequences =green circles) as the female was feeding.

Summary & Significance

- Early analysis of krill surveys showed most whales in locally productive areas, however are other more productive 'hotspots' available to whales. Highlights importance of fine-scale focal follow data to capture 'true' target swarm characteristics.
- Diversity in distribution of prey patches was reflected in range of dive behaviour, compared to more discrete prey patches driven by diurnal behaviour, and regular dive patterns in California (Croll *et al.*, 2005) and Western Australia (McCauley, Salgado, Jenner & Jenner, unpub. data)
- Relatively few feeding lunges were detected in 27hrs of tag data. Several whales were observed in low condition late in the season, suggesting low feeding success in the Bonney or other feeding grounds.
- Next step to model patterns in whale distribution and behaviour with ground-truthed krill and upwelling features, particularly to define gradients and thresholds of optimal blue whale habitat at a range of scales.