

## **Walls of Sound: The acoustic field of multiple vessels hammering on metal pipes**

3/17/2013 - draft

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The following document is a short report on acoustic data taken during the 3/30/2013 “Killer Whale Hazing Drill”

I wish to thank my able assistants: Jason Wood (acoustics), Eric Adelberger (Laser ranging) and Scott Hearning (photography)

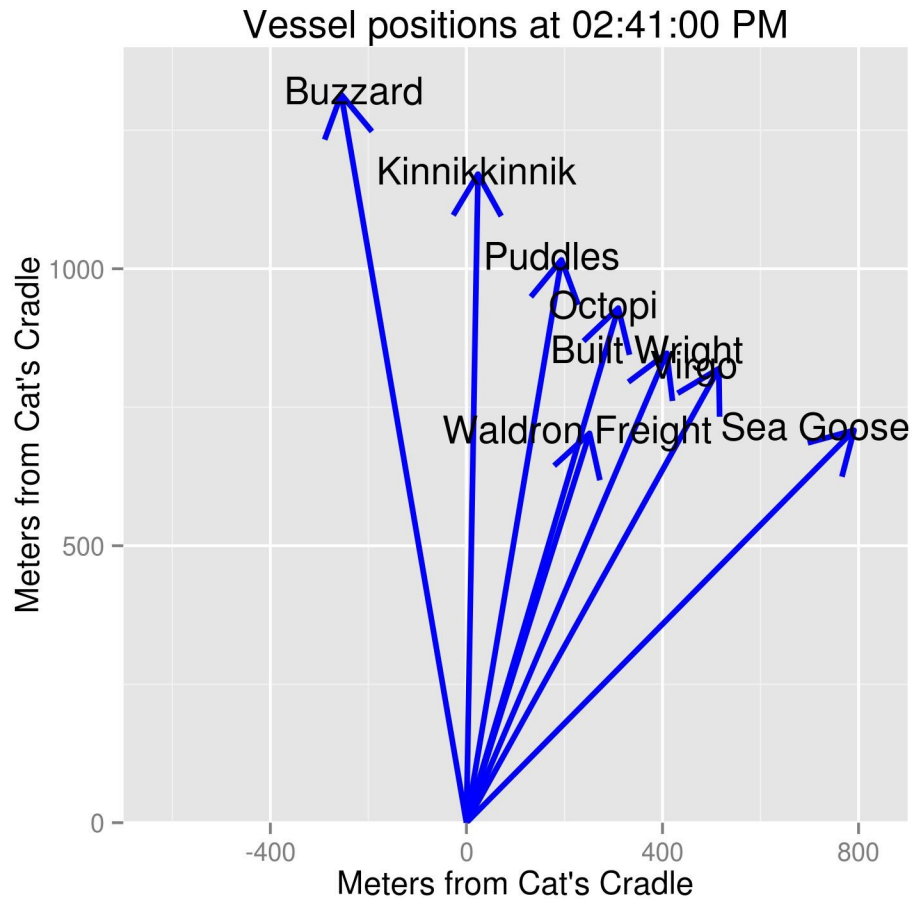
On the following pages I have summarized the physical and acoustic situation for each of the separate sound files that were recorded on the Gato Verde. The recordings were made with a calibrated InterOcean hydrophone and were recorded at a sampling rate of 48,000 samples per second on a Marantz solid state recorder. Analysis was performed with Audacity and acoustic analysis software that I have written. GPS data were analyzed and spatial plots were made with the program R.

Pipe banging vessels in position across Upright Channel while Orcas ferry passes behind.



Passing pinniped apparently unperturbed.

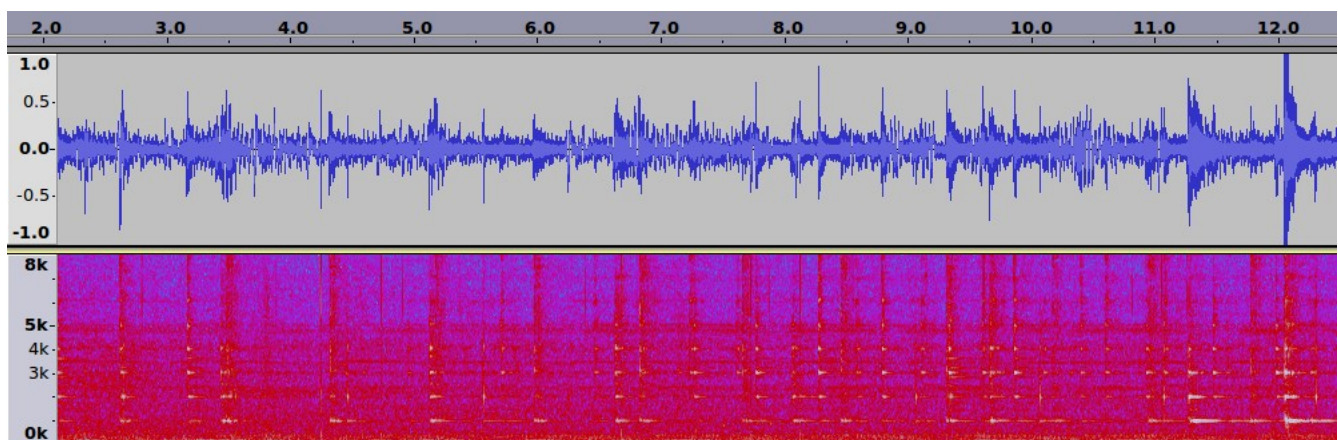




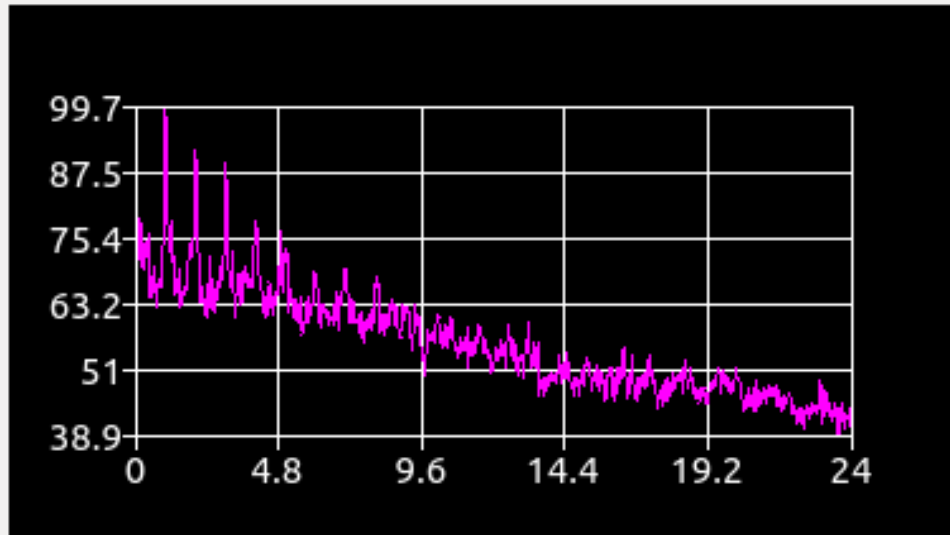
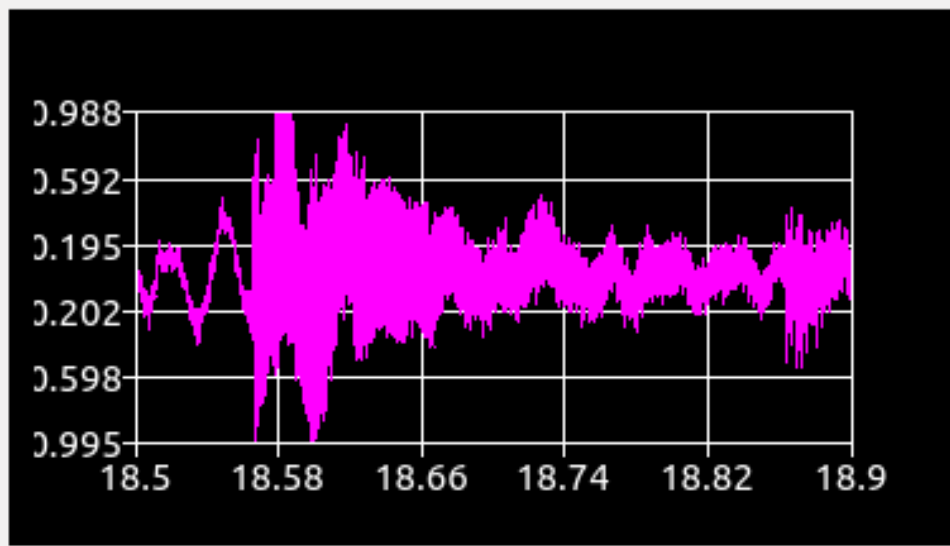
Question? Can anyone confirm that Waldron Freight was in front of the line of vessels at the beginning of our exercise?

Distance to the line: 1000 meters  
Sound file : 3  
Calibration scale: 130

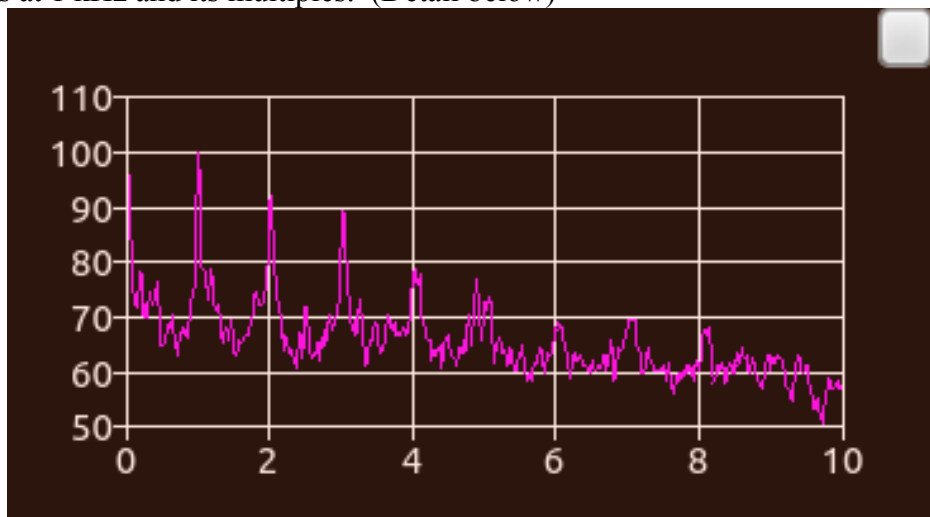
Average sound level (rms) 114 dB re 1 microPa  
Peak sound level (rms) 123 dB re 1 microPa over 60 ms window

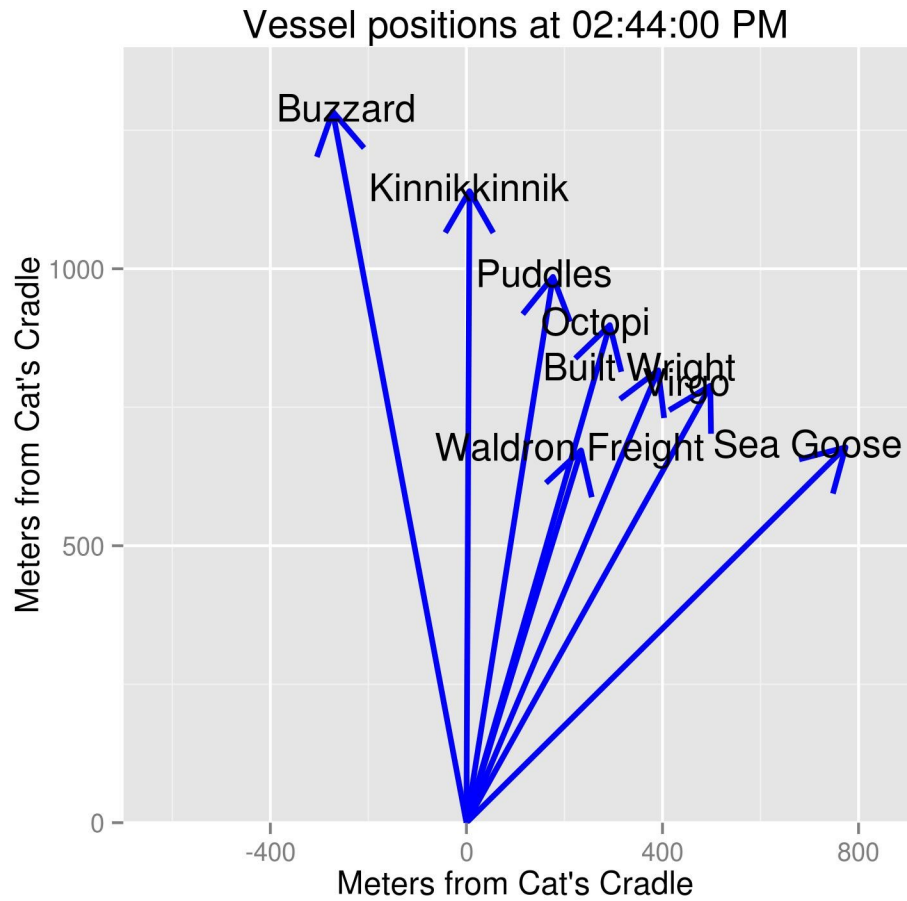


Time series  
of a single  
bang above  
with



corresponding spectrum levels in dB re 1  $\mu\text{Pa}^2/\text{hertz}$  vs frequency in kHz below. Note the harmonic peaks at 1 kHz and its multiples. (Detail below)





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Distance to the line: 800 meters

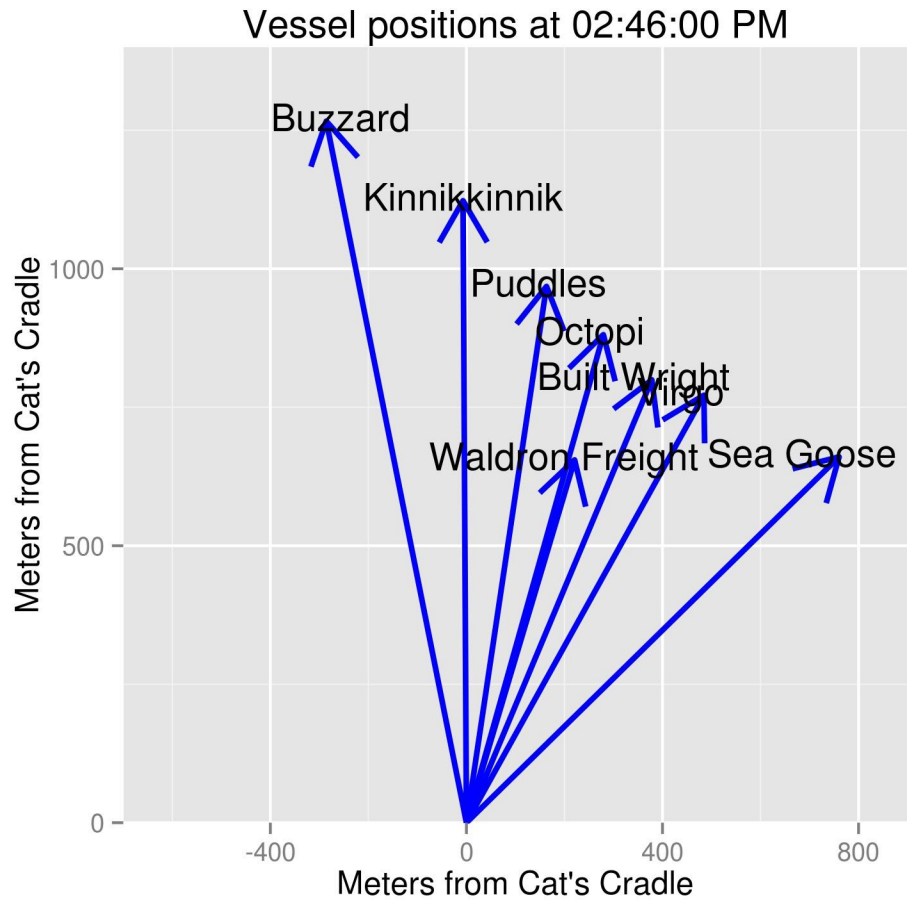
Sound file : 4

Calibration scale: 120

Note: Some of the pings are clipped

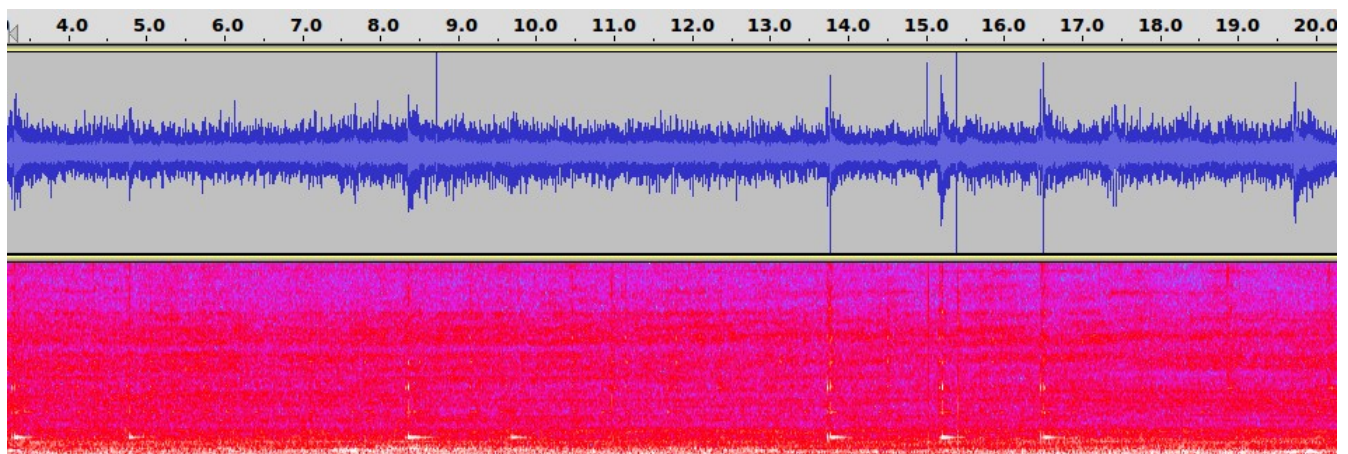
Average sound level (rms) 108 dB re 1 microPa

Peak sound level (rms) 116 dB re 1 microPa over 60 ms window

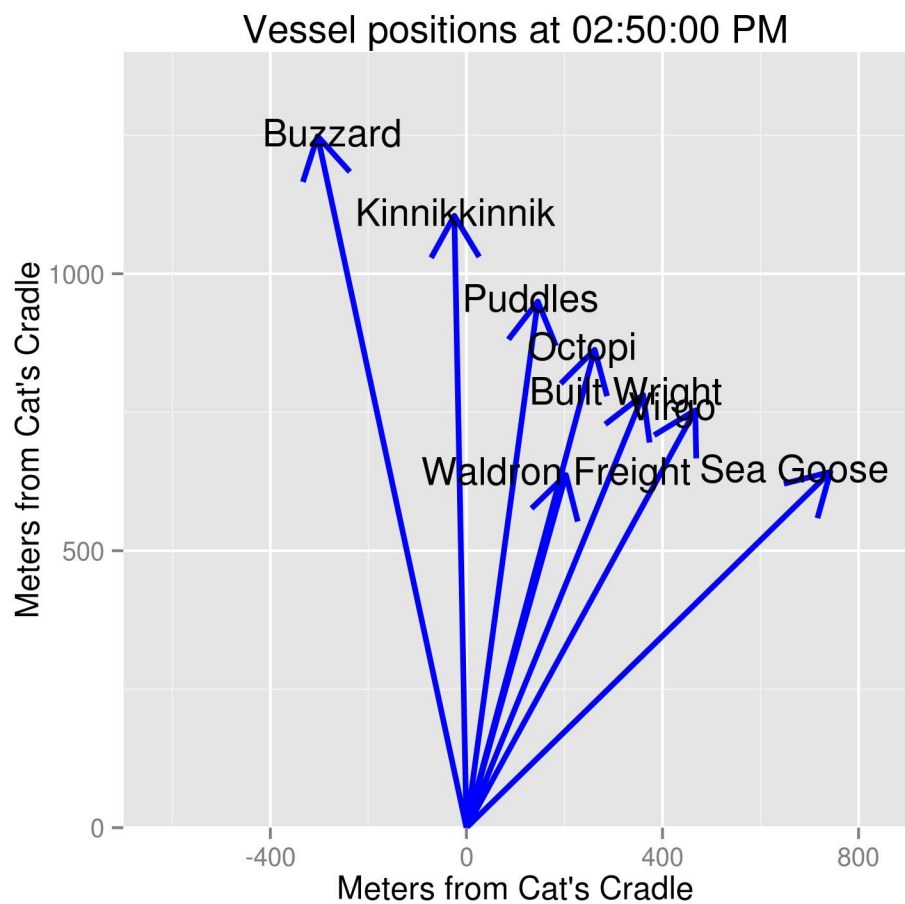


Distance to the line: 800 meters  
Sound file : 5  
Calibration scale: 140

Average sound level (rms) 125 dB re 1 microPa  
Peak sound level (rms) 134 dB re 1 microPa over 60 ms window  
Background between pings (rms) 123 dB re 1 microPa







Distance to the line: 1000 meters

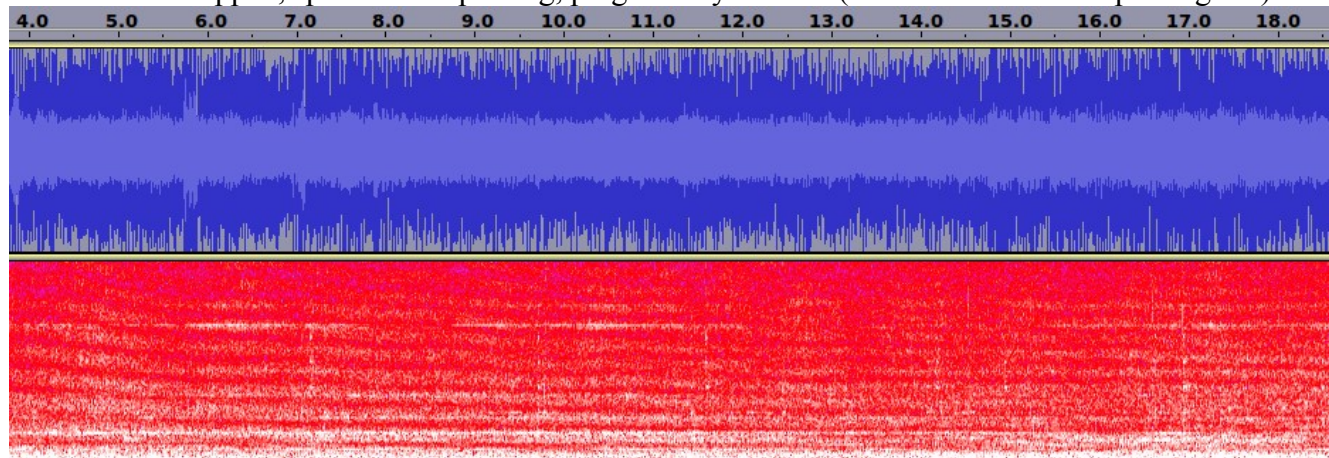
Average sound level (rms) 125 dB re 1 microPa

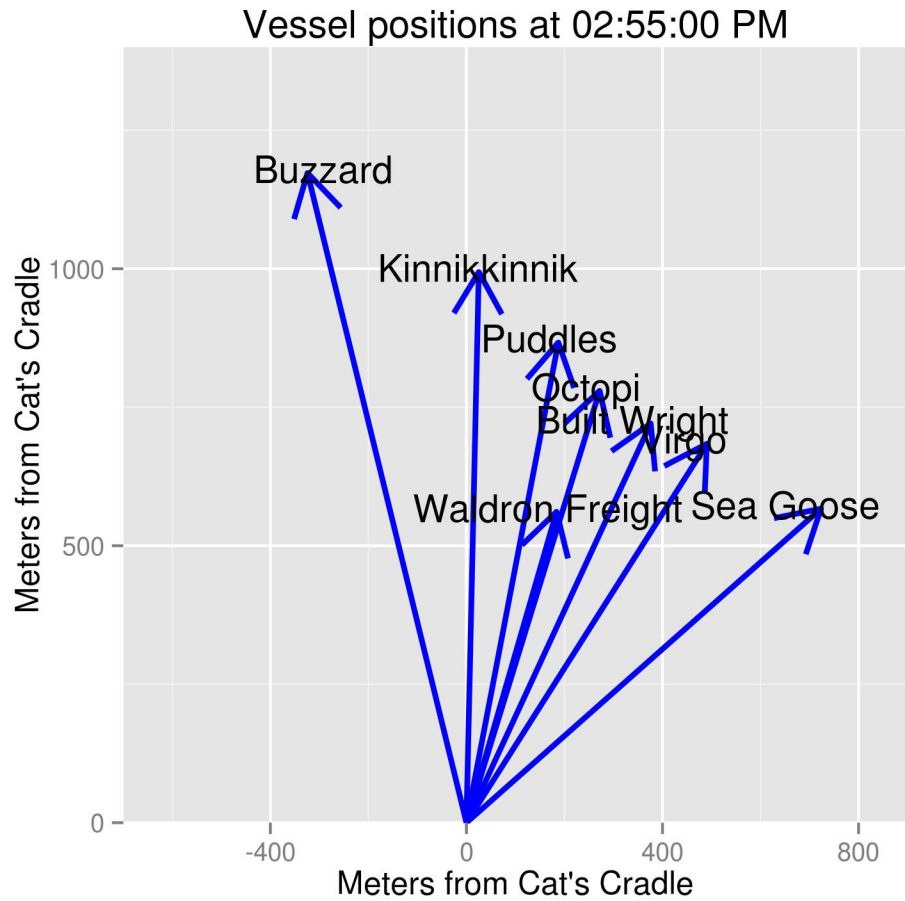
Sound file : 7

Peak sound level (rms)

Calibration scale: 130

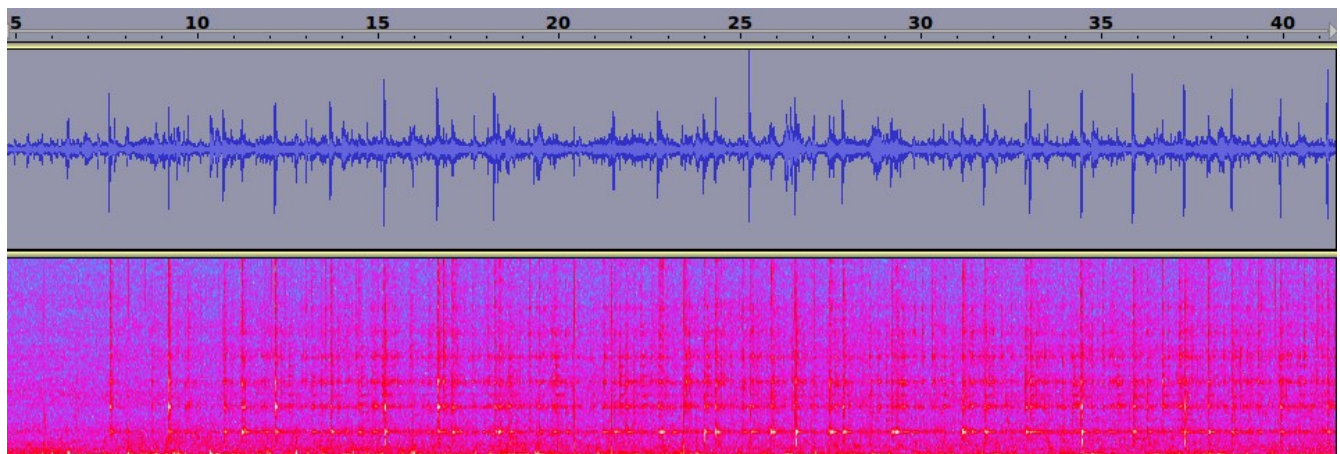
Note: File is clipped, speedboat is passing, pings barely audible (see vertical lines in spectrogram)

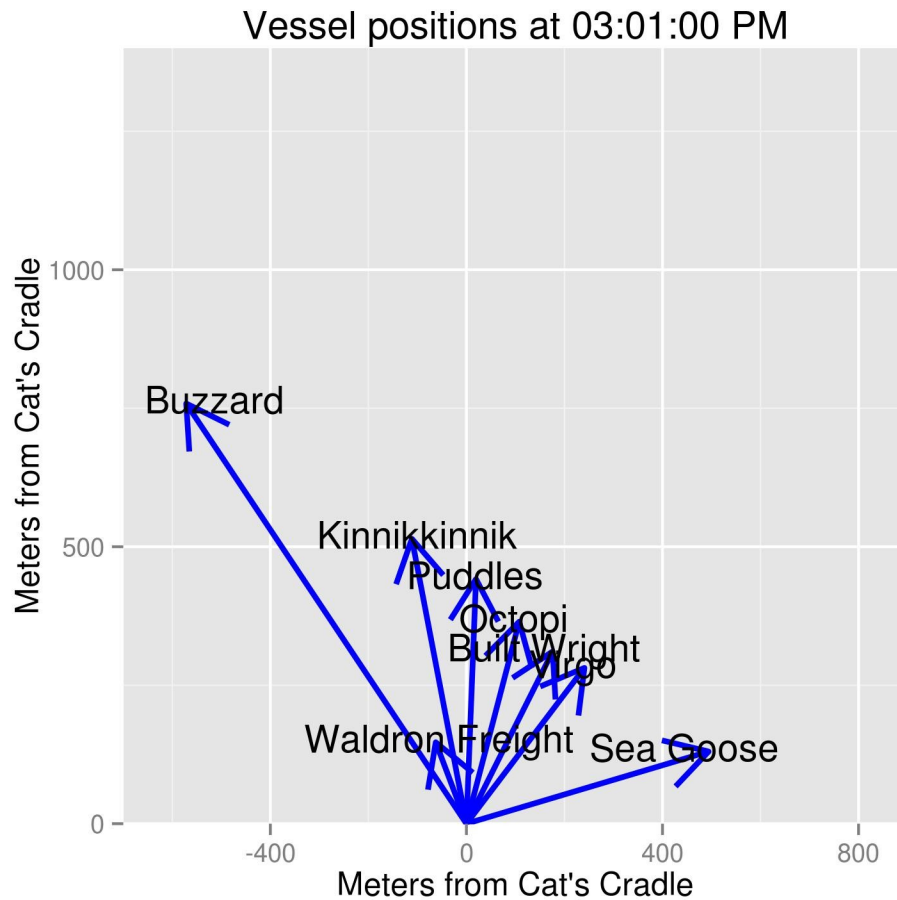




Distance to the line: 800 meters  
Sound file : 8  
Calibration scale: 140

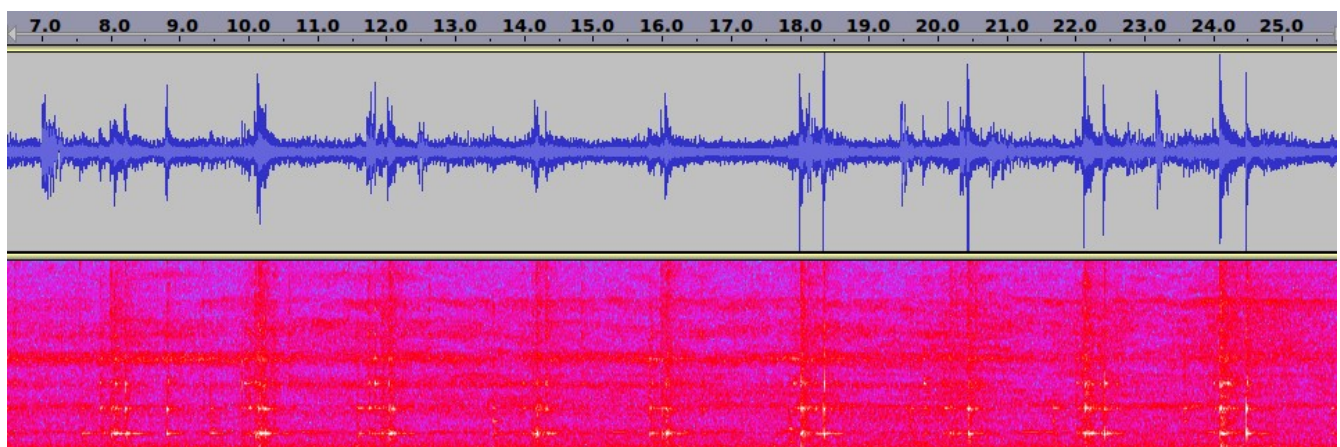
Average sound level (rms) 118 dB re 1 microPa  
Peak sound level (rms) 123 dB re 1 microPa over 60 ms window  
Background (rms) 114



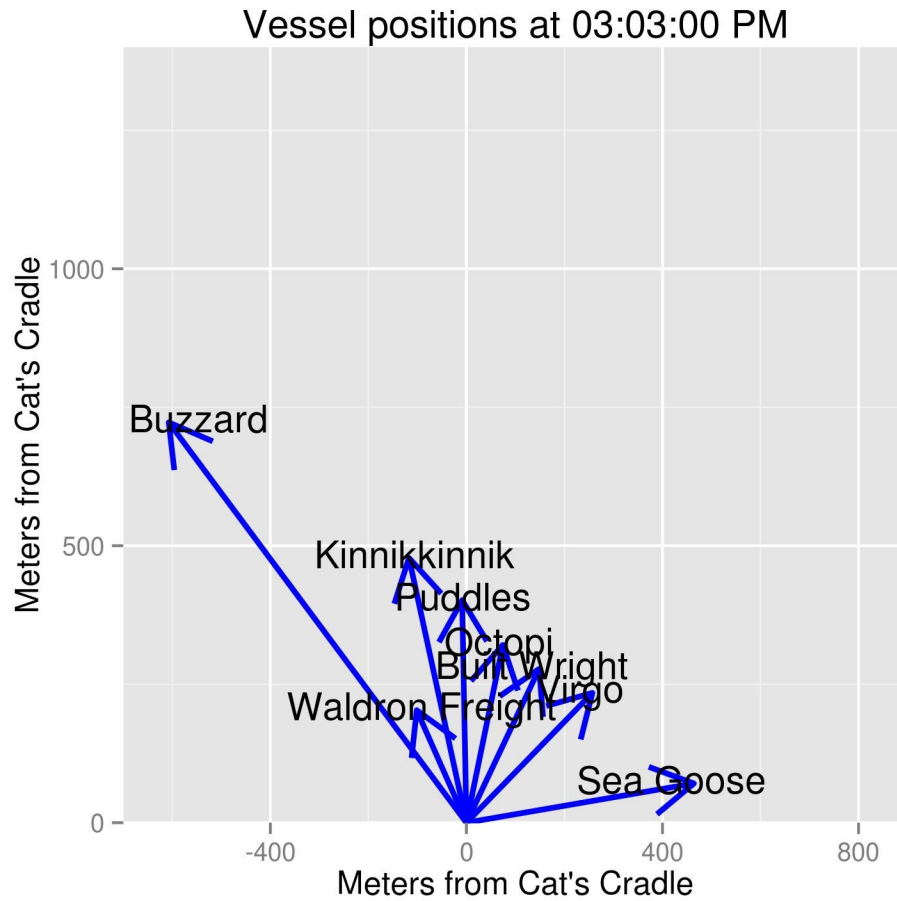


Distance to the line: 400 meters  
Sound file : 9  
Calibration scale: 140

Average sound level (rms) 124 dB re 1 microPa  
Peak sound level (rms) 131 dB re 1 microPa over 60 ms window  
Background (rms) 114







Distance to the line: 380 meters

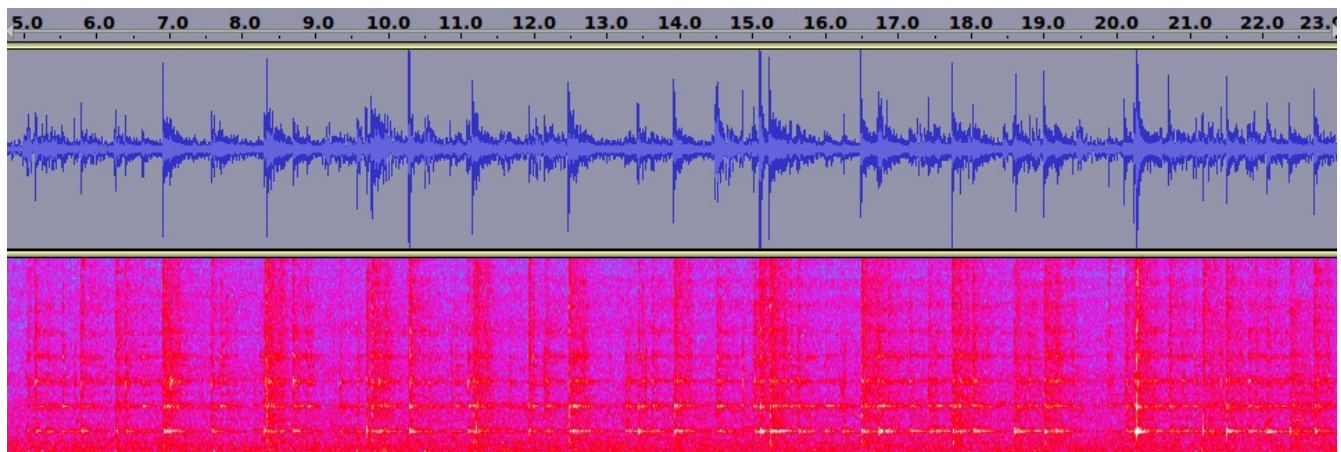
Sound file : 11

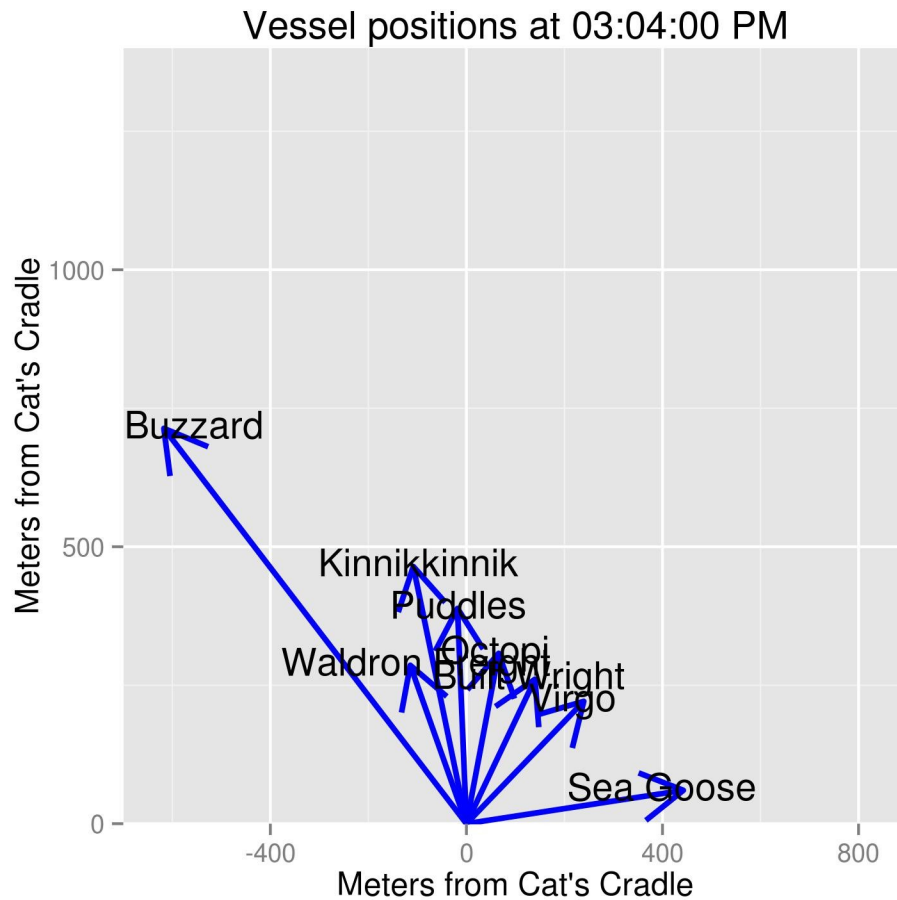
Calibration scale: 140

Average sound level (rms) 121 dB re 1 microPa

Peak sound level (rms) 130 dB re 1 microPa over 60 ms window

Background (rms) 117





Distance to the line: 370 meters

Average sound level (rms) 121 dB re 1 microPa

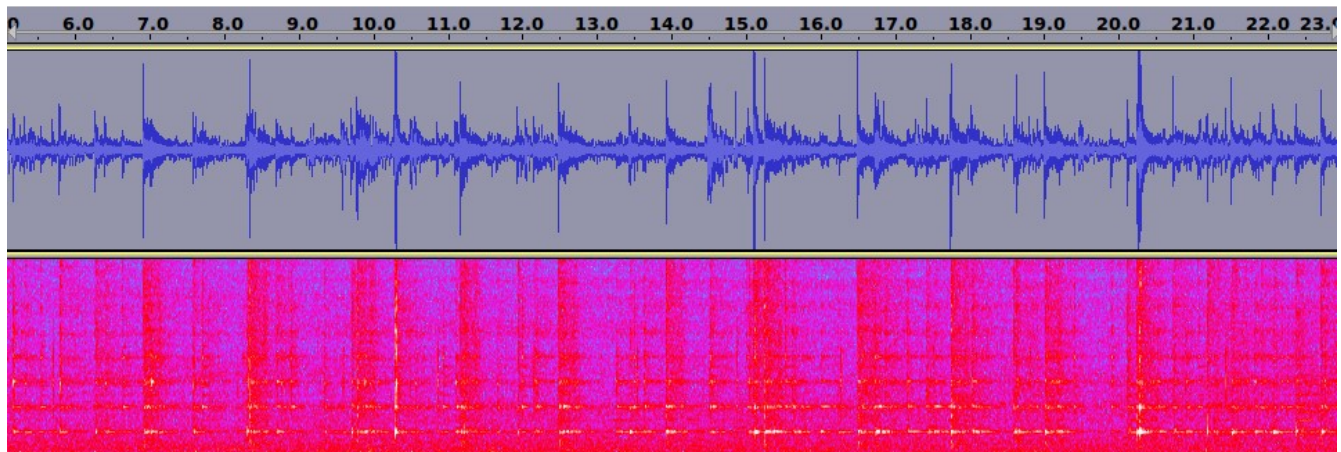
Sound file : 12

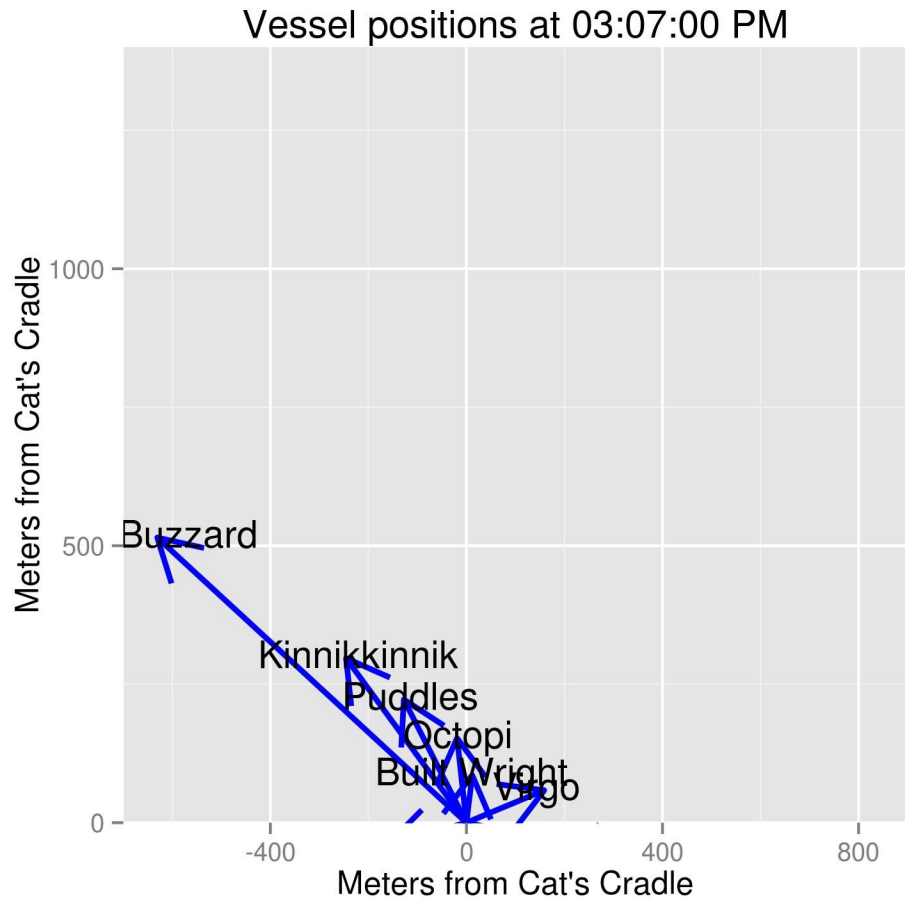
Peak sound level (rms) 134 dB re 1 microPa over 60 ms window

Calibration scale: 150

Background (rms) 116

Note: Pipe harmonics are present all the time, loudest pings clipped





Distance to the line: 220 meters

Sound file : 13

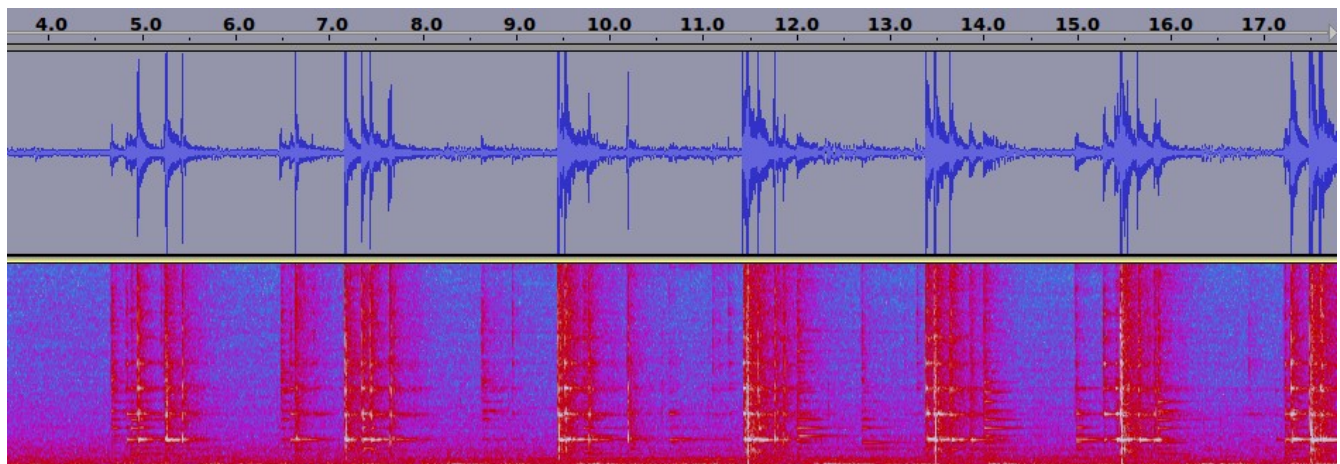
Calibration scale: 150

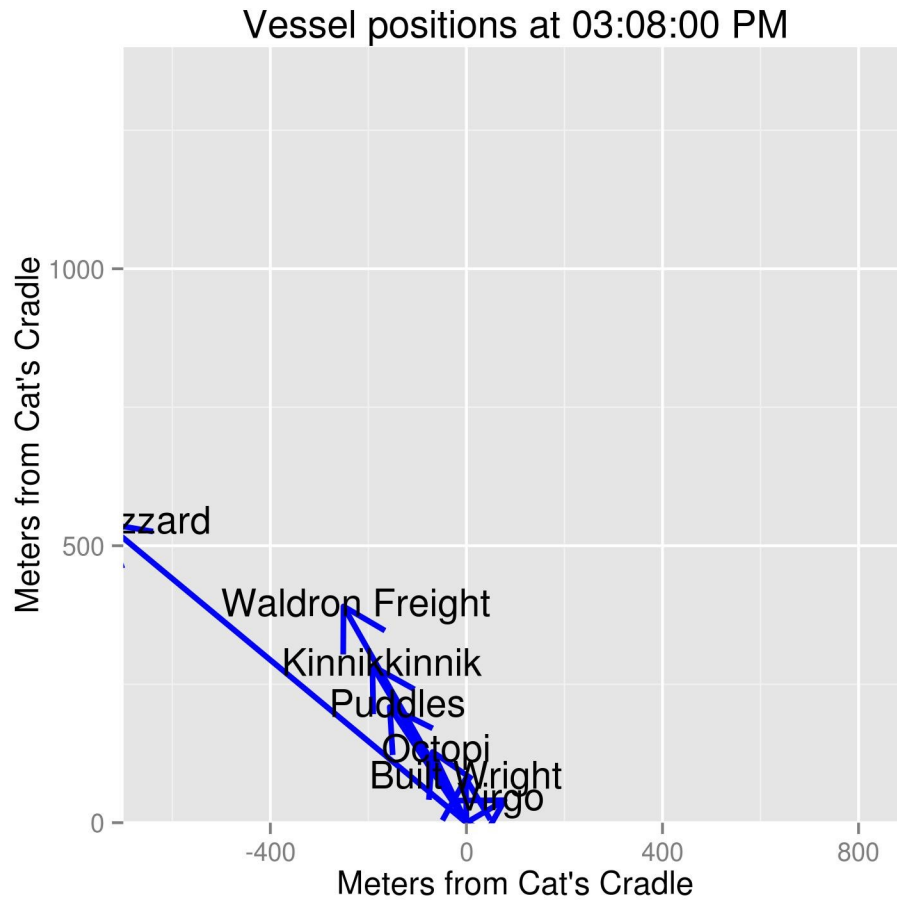
Note: loudest pings clipped

Average sound level (rms) 131 dB re 1 microPa

Peak sound level (rms) 146 dB re 1 microPa over 60 ms window

Background (rms) 116





Distance to the line: 100 meters

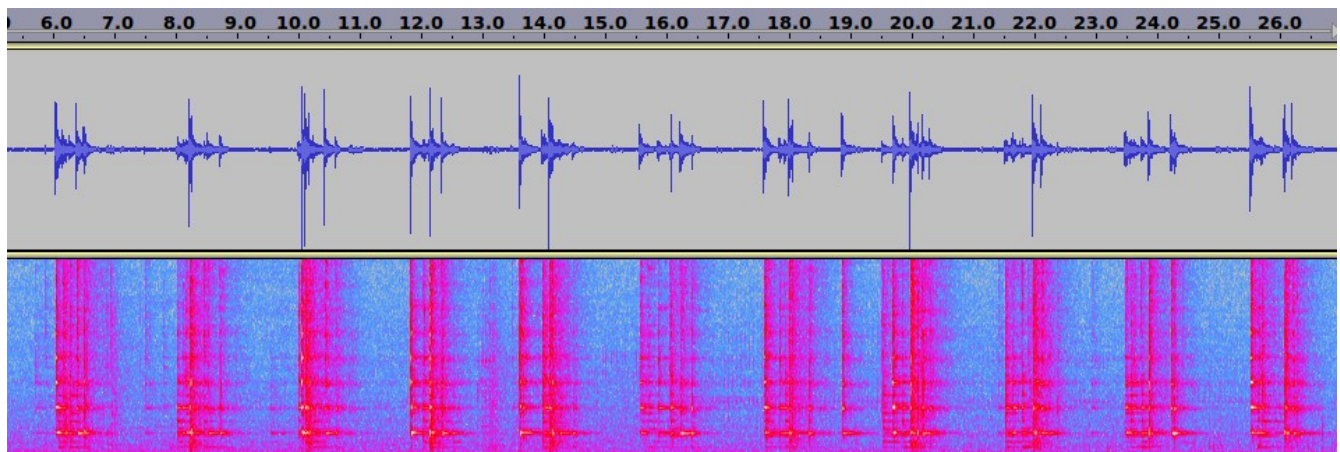
Sound file : 14

Calibration scale: 160

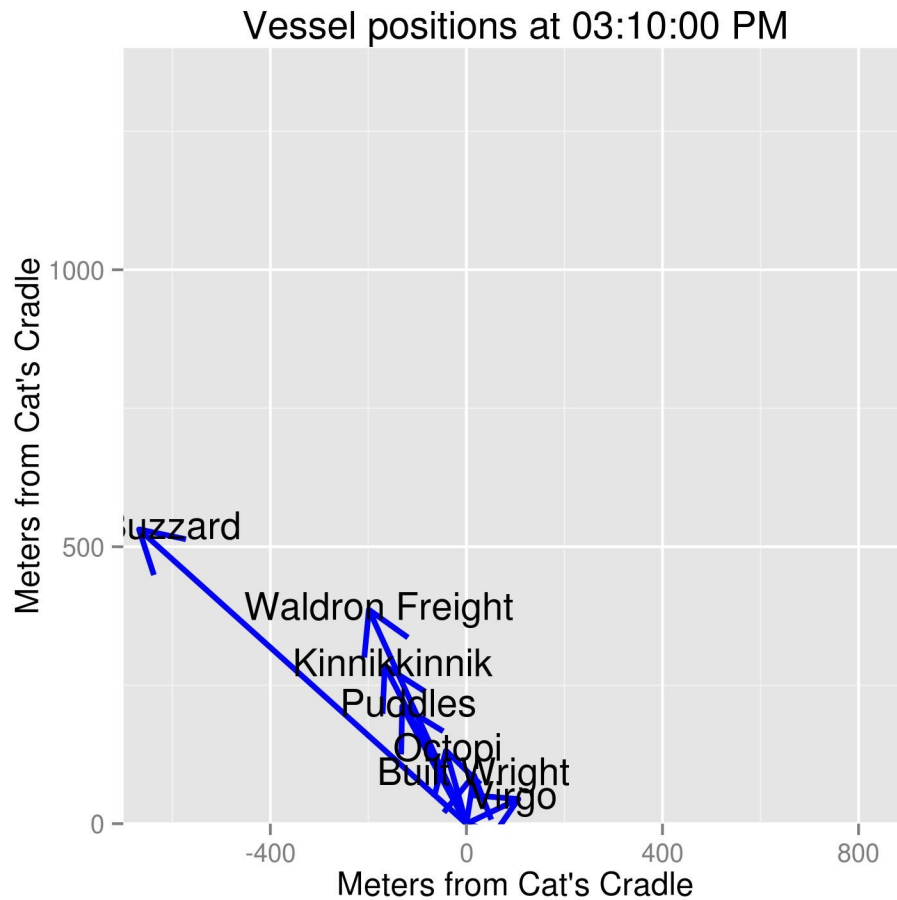
Average sound level (rms) 132 dB re 1 microPa

Peak sound level (rms) 147 dB re 1 microPa over 60 ms window

Background (rms) 119

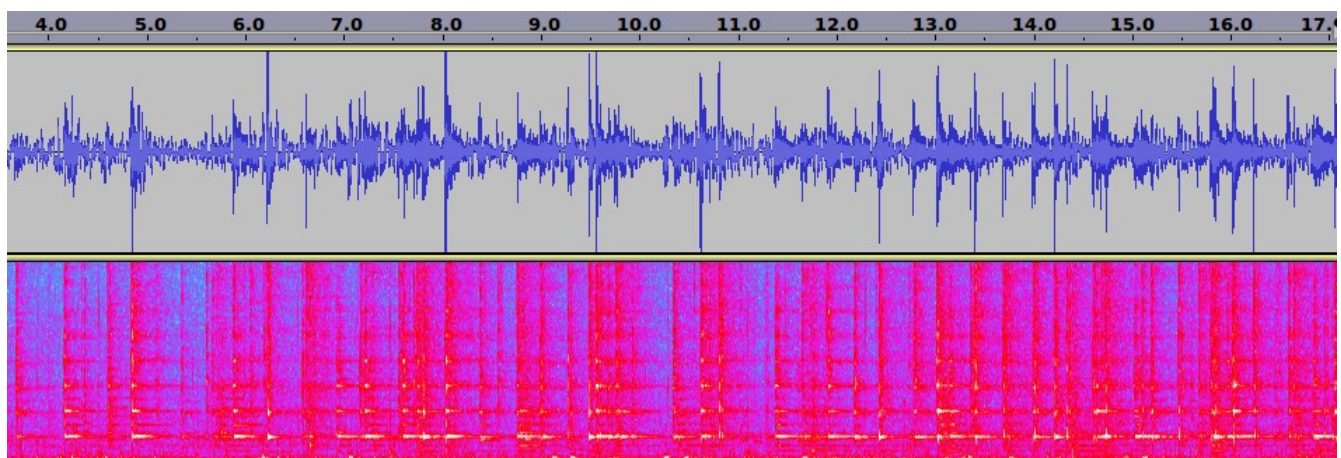


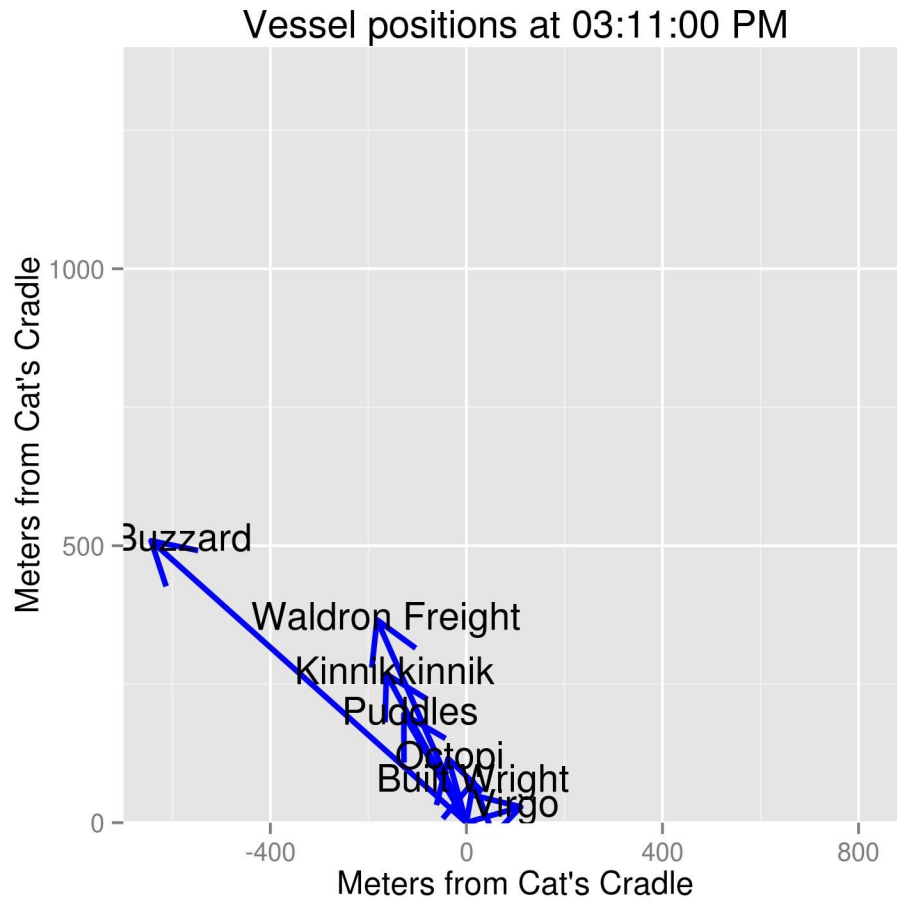




Distance to the line: 125 meters  
Sound file : 15  
Calibration scale: 150

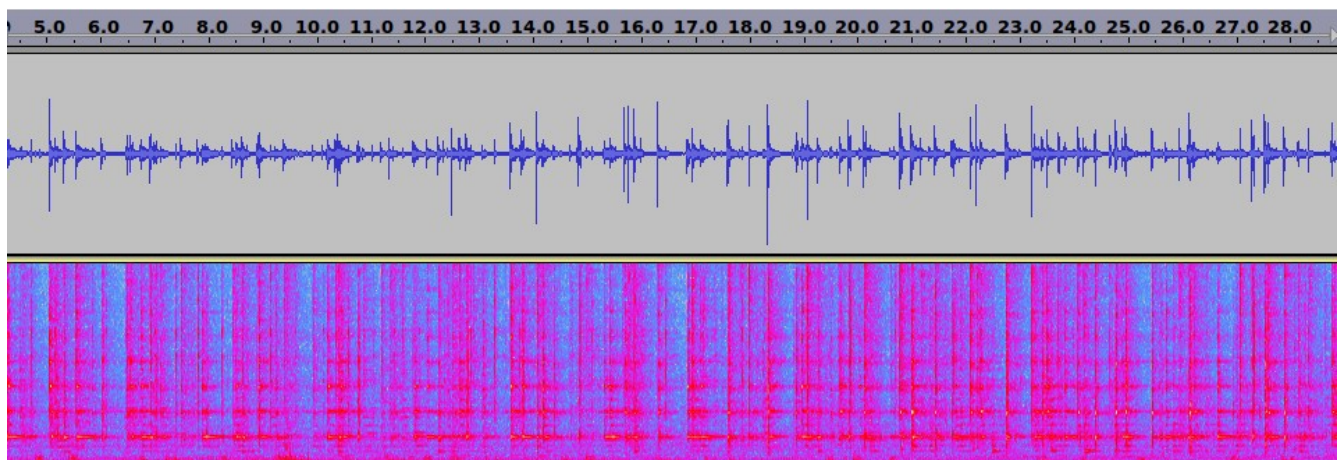
Average sound level (rms) 131 dB re 1 microPa  
Peak sound level (rms) 140 dB re 1 microPa over 60 ms window  
Background (rms) 123

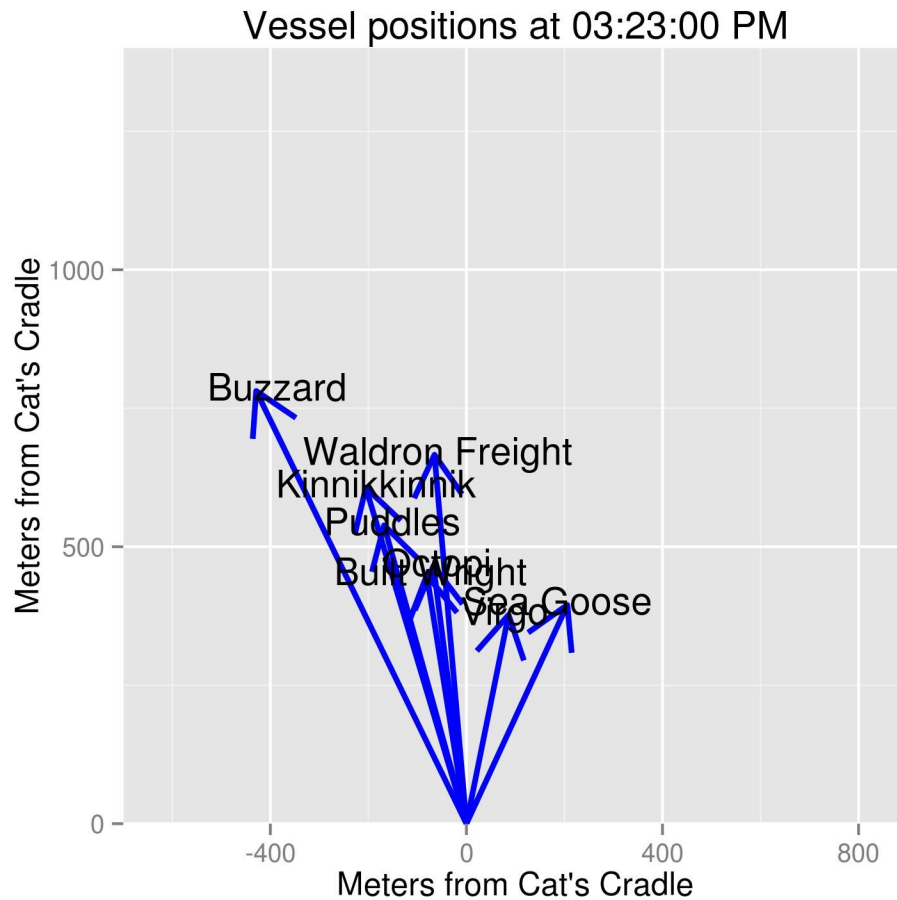




Distance to the line: 130 meters  
Sound file : 16  
Calibration scale: 160

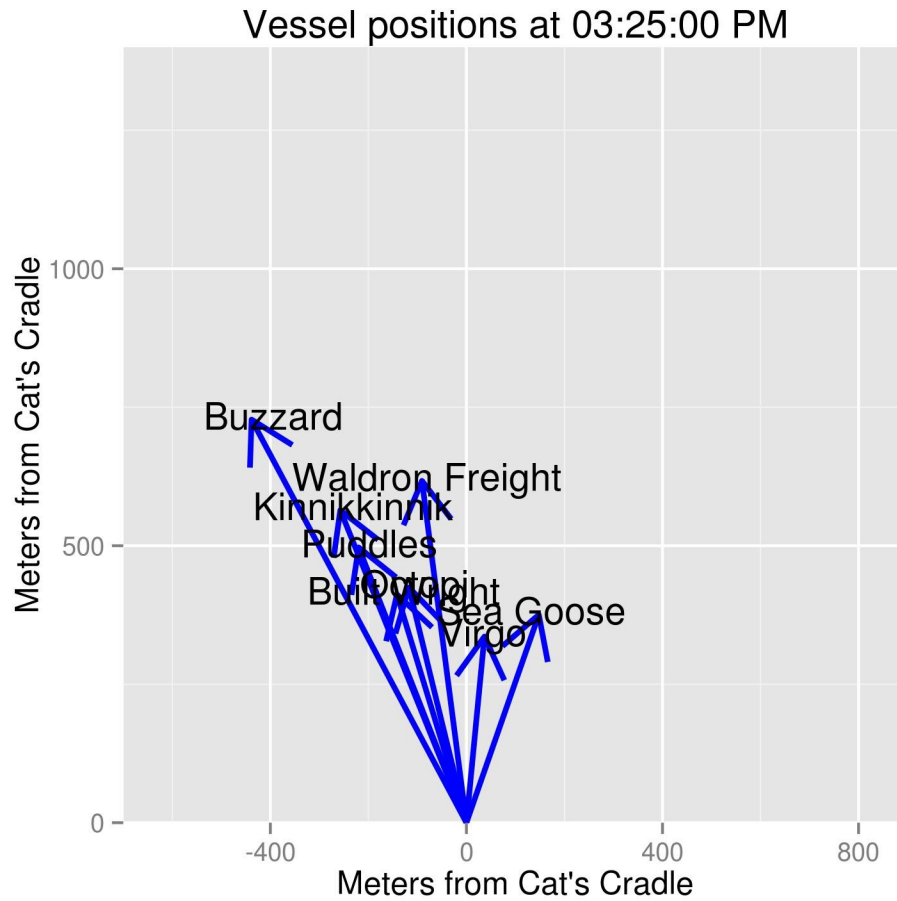
Average sound level (rms) 129 dB re 1 microPa  
Peak sound level (rms) 140 dB re 1 microPa over 60 ms window  
Background (rms) 119





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Distance to the line: 500 meters      Average sound level (rms) 127 dB  
Sound file : 17      Peak sound level (rms)  
Calibration scale: 140      Background (rms)  
Note: Hear ferry clearly – No pings detected



Distance to the line: 400 meters

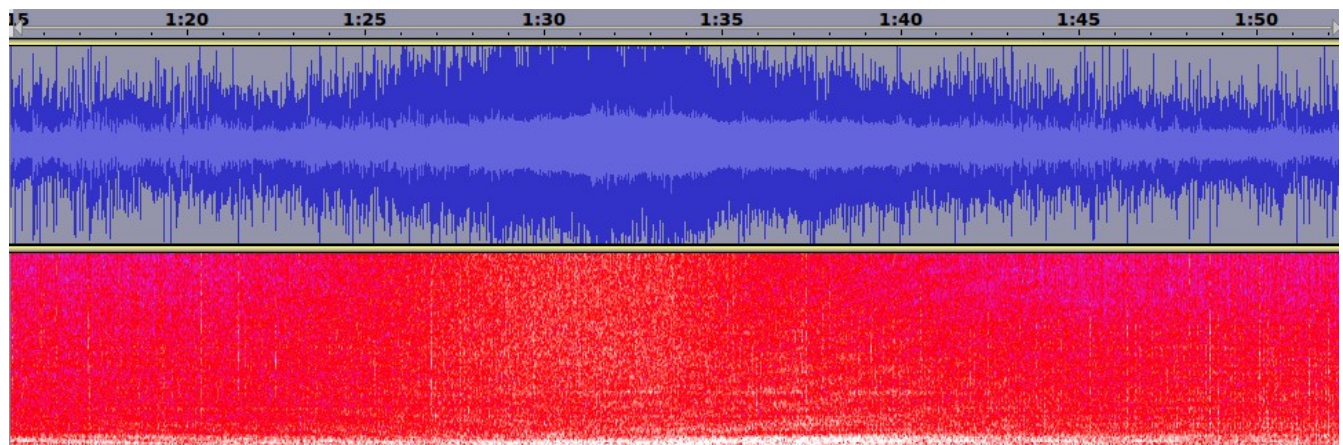
Average sound level (rms) 126 dB re 1 microPa

Sound file : 18

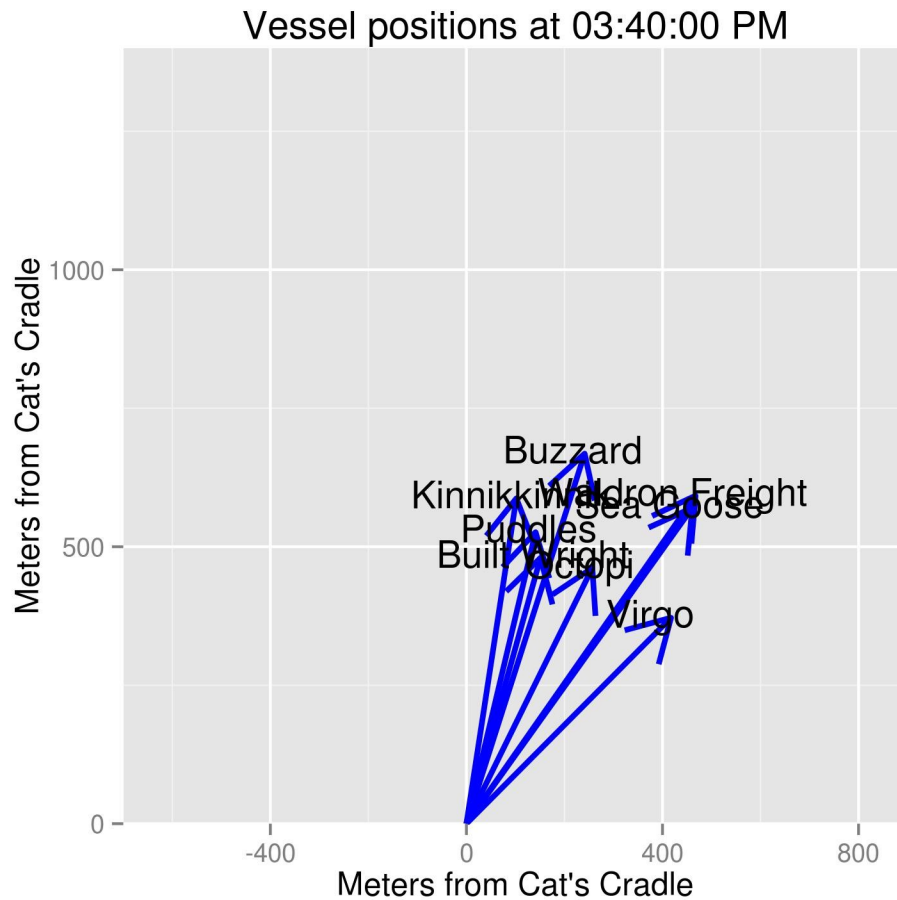
Peak sound level (rms) 133 dB re 1 microPa over 60 ms window

Calibration scale: 140

Note: Hear ferry clearly and airplane passes overhead at 3:38:30 (1:33 in file), no pings

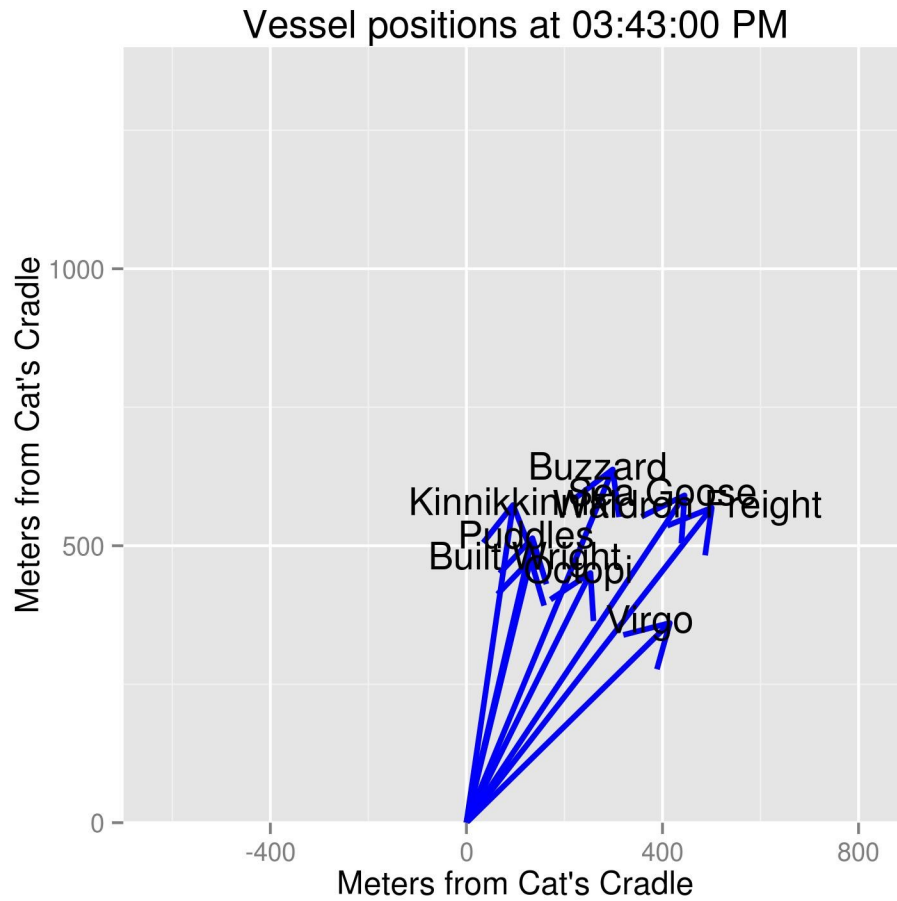






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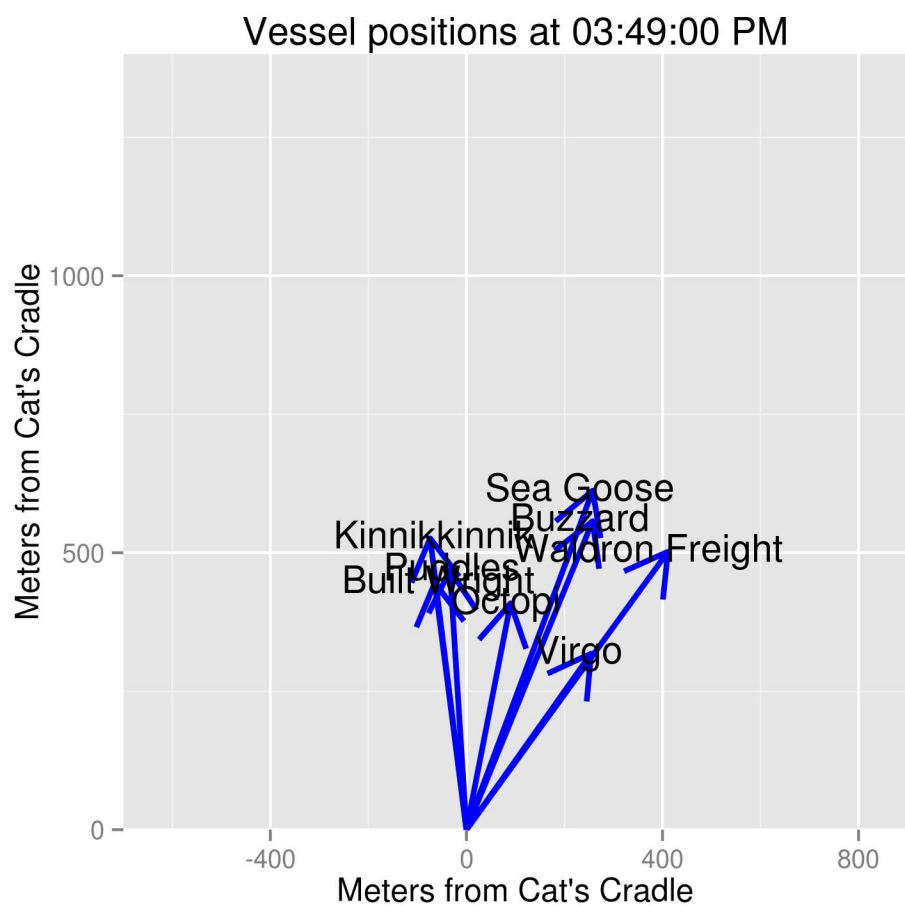
Distance to the line: 500 meters	Average sound level (rms) 123 dB
Sound file : 19	Peak sound level (rms)
Calibration scale: 130	Background (rms)
Note: Ferry is very badly clipped in this file and we hear no pings	



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Distance to the line: 400 meters	Average sound level (rms)
Sound file : 20	Peak sound level (rms)
Calibration scale: 130	Background (rms)

Note: Vessels have doubled the line, terrible flow noise and no pings



Distance to the line: 400 meters

Average sound level (rms) 123 dB re 1 microPa

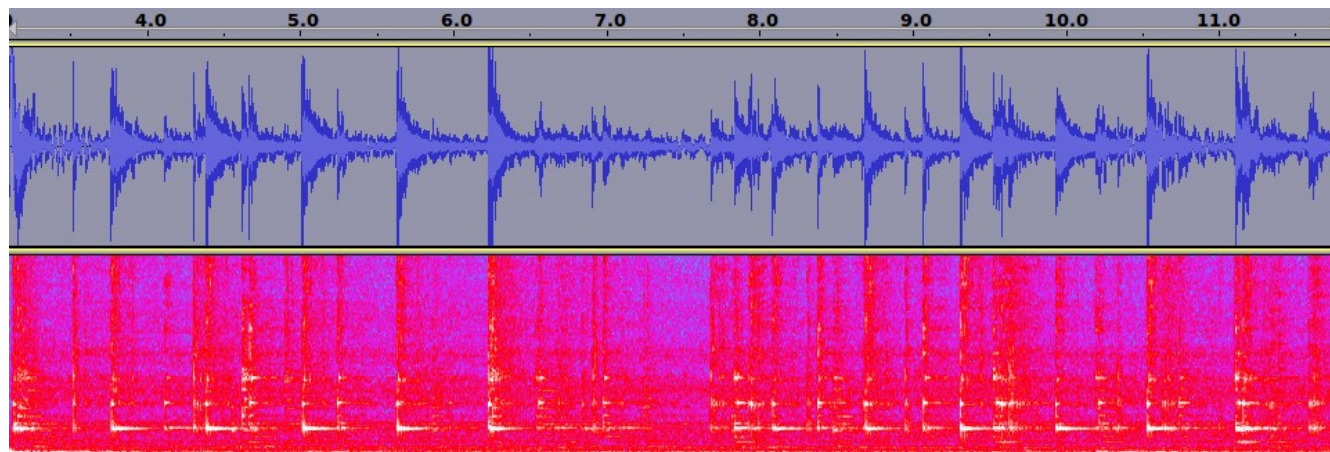
Sound file : 22

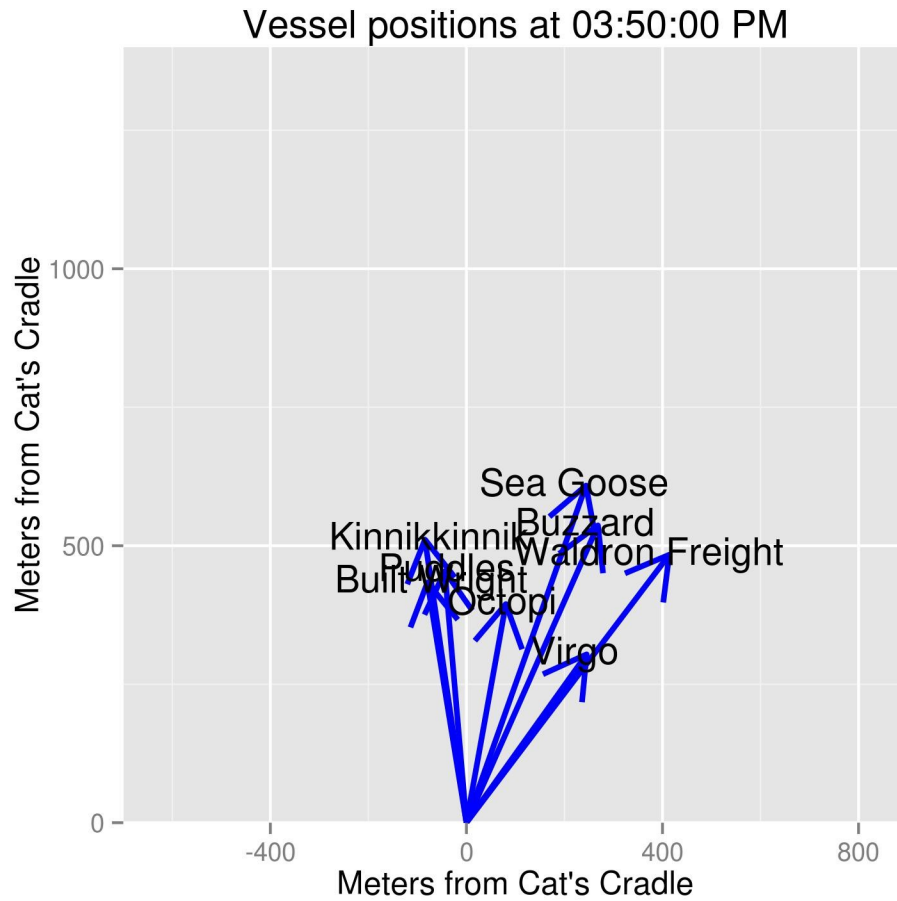
Peak sound level (rms) 133 dB re 1 microPa over 60 ms window

Calibration scale: 140

Background (rms) 114

Notes: Line has been doubled, loudest pings clipped





Distance to the line: 400 meters

Sound file : 23

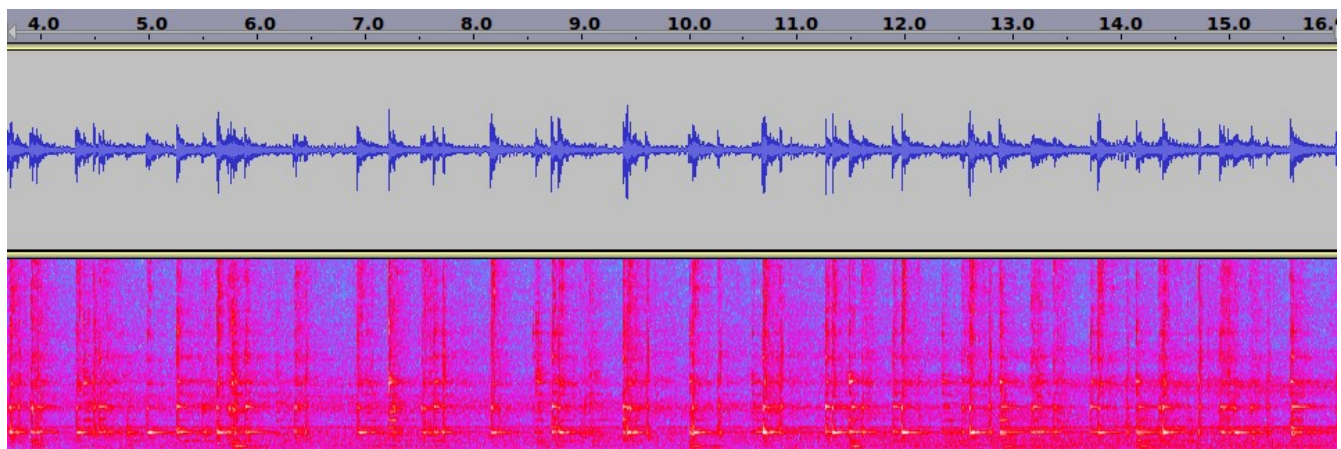
Calibration scale: 150

Note: Line is doubled

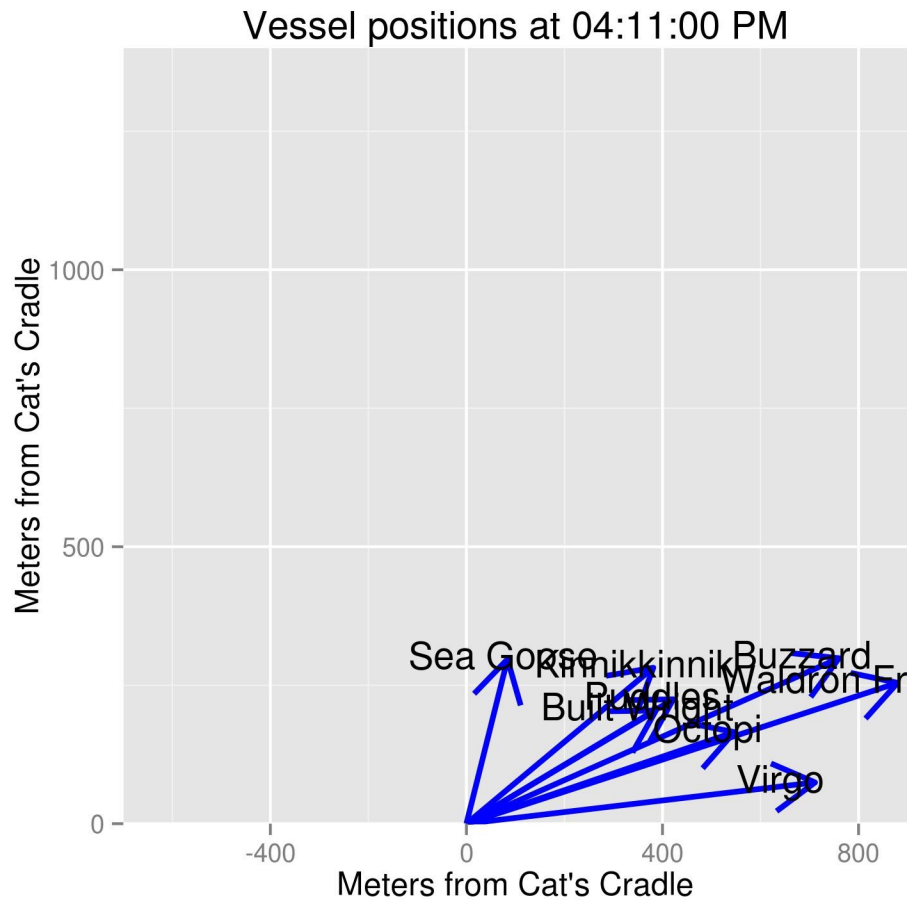
Average sound level (rms) 124 dB re 1 microPa

Peak sound level (rms) 132 dB re 1 microPa over 60 ms window

Background (rms) 116 dB



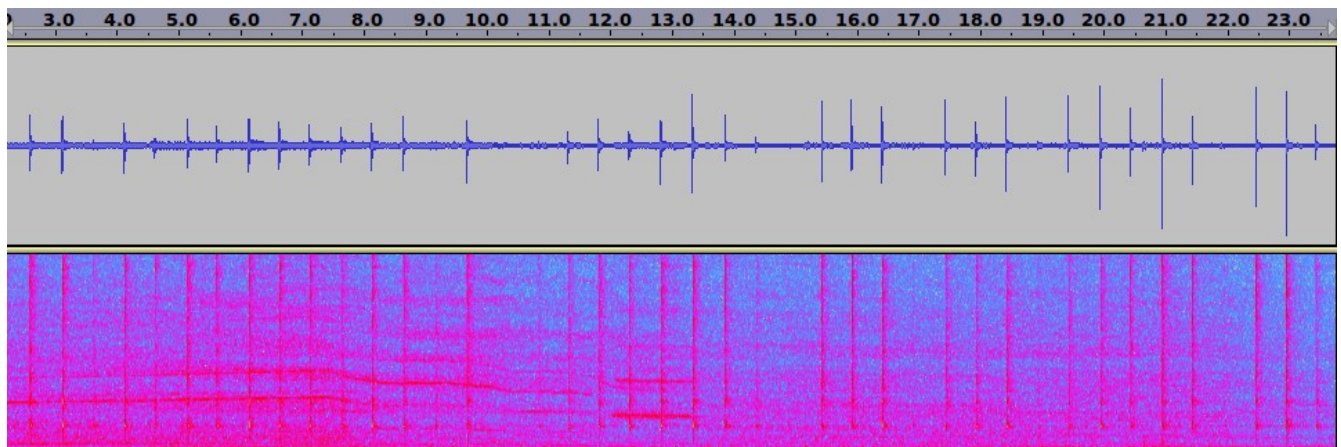




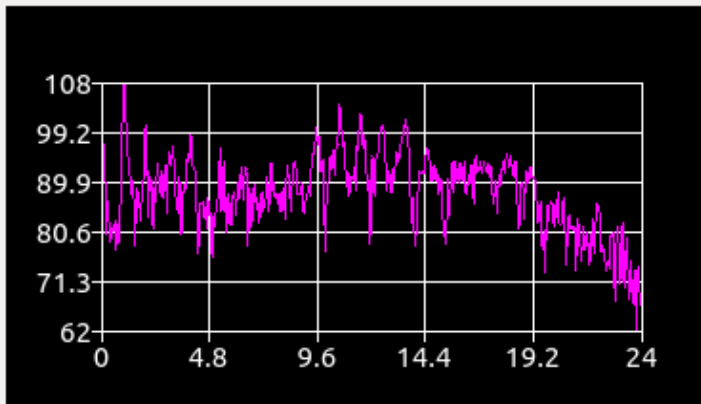
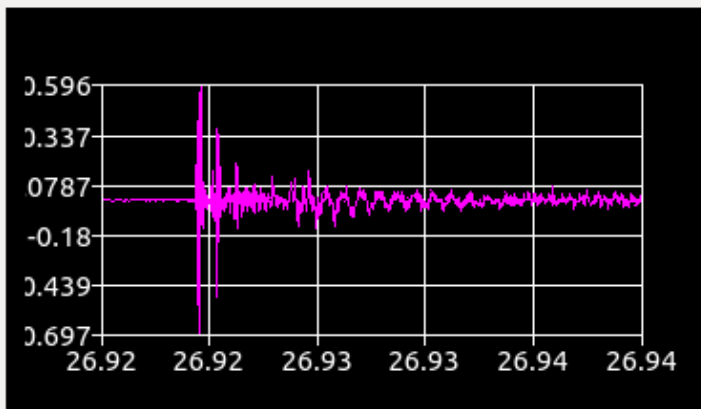
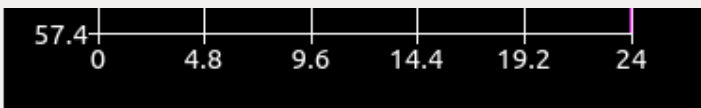
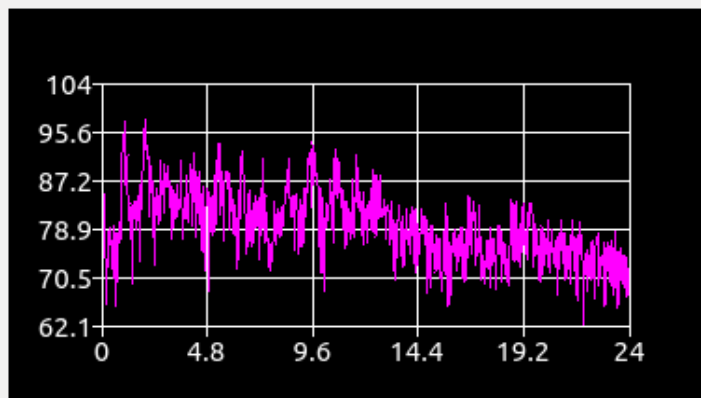
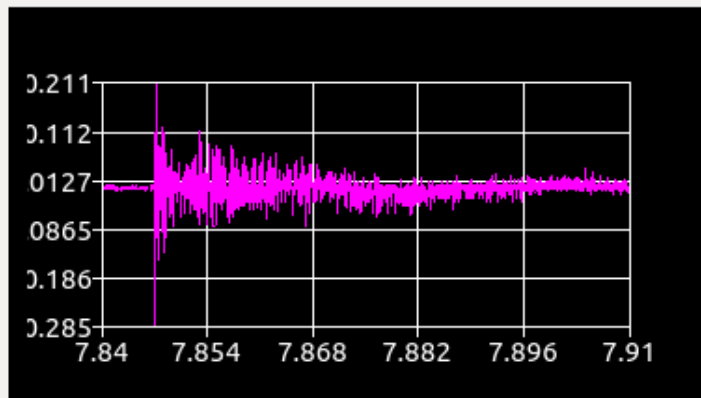
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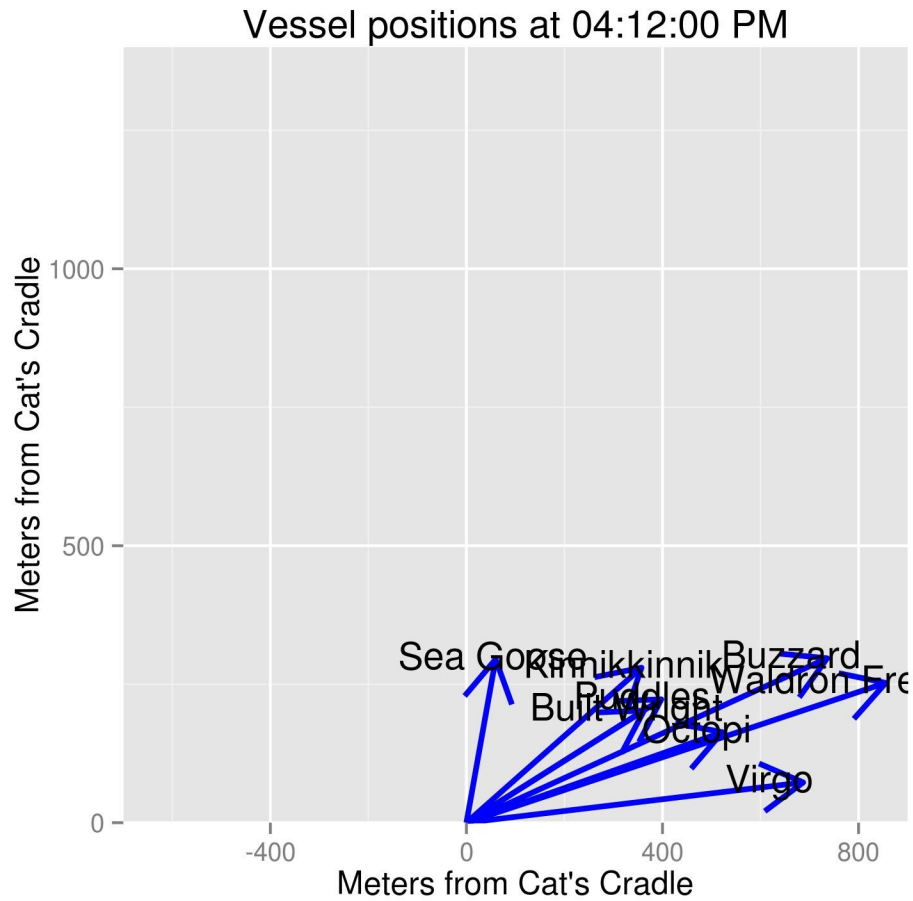
Distance to the line: 300 meters	Average sound level (rms) 125 dB re 1 microPa
Sound file : 27	Peak sound level (rms) 141 dB re 1 microPa over 60 ms window
Calibration scale: 160	Background (rms) 118 (after speed boat at beginning) 123 earlier

Note: Single pipe, empty, distance is to Sea Goose



A couple of pings:  
(Waveform above and  
Spectrogram below)





Distance to the line: 300 meters

Average sound level (rms) 126 dB re 1 microPa

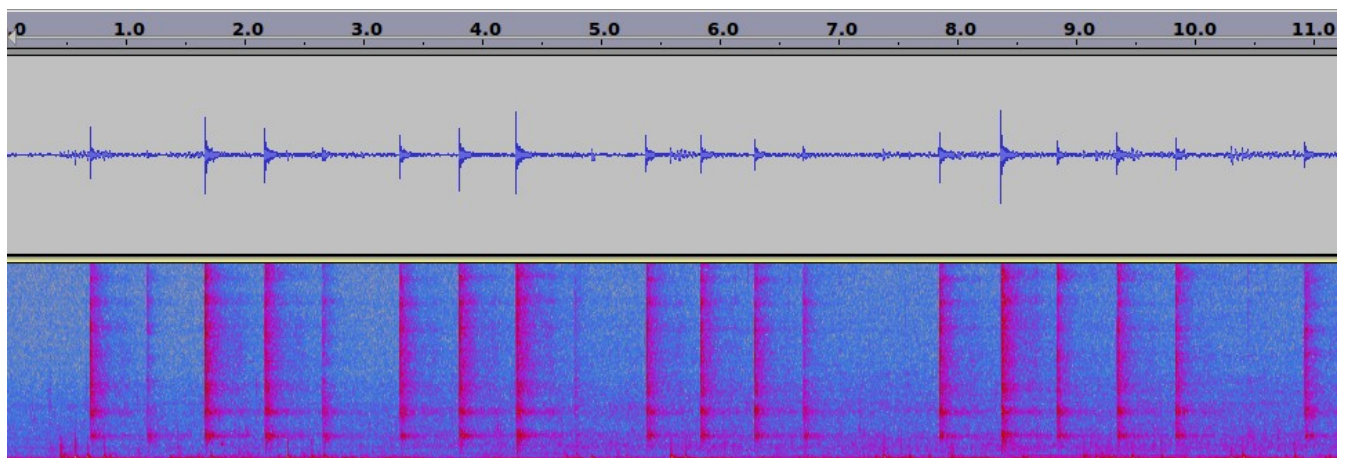
Sound file : 28

Peak sound level (rms) 138 dB re 1 microPa over 60 ms window

Calibration scale: 160

Background (rms) 118 dB

Note: Single pipe filled, distance is to Sea Goose



A couple of pings:  
(Waveform above and  
Spectrogram below)

