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YEARS

Detecting and tracking marine mammals around tidal turbines: development of a dual multibeam sonar system

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Sea Mammal
Research
Unit

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Thanks...

Scot. Govt. steering group: Elaine Tait (MSPaP), Paul Thompson (UoA), Kelly Macleod (JNCC), Janelle Braithwaite (MSPaP), Roger May (MSLOT), Ian Davies (MSS), Ross Culloch (MSS), John Armstrong (MSS), Jared Wilson (MSS), Ewan Edwards (MSS), Denise Risch (SAMS), George Lees (SNH), Erica Knott (SNH), Chris Eastham (SNH), Karen Hall (SNH), Cara Donovan (Atlantis), Daniel Coles (Atlantis), and Lily Burke (MSPaP);

Simon Moss, Steve Balfour, and Matt Bivins (SMRU);

Benjamin Williamson (ERI/UoA);

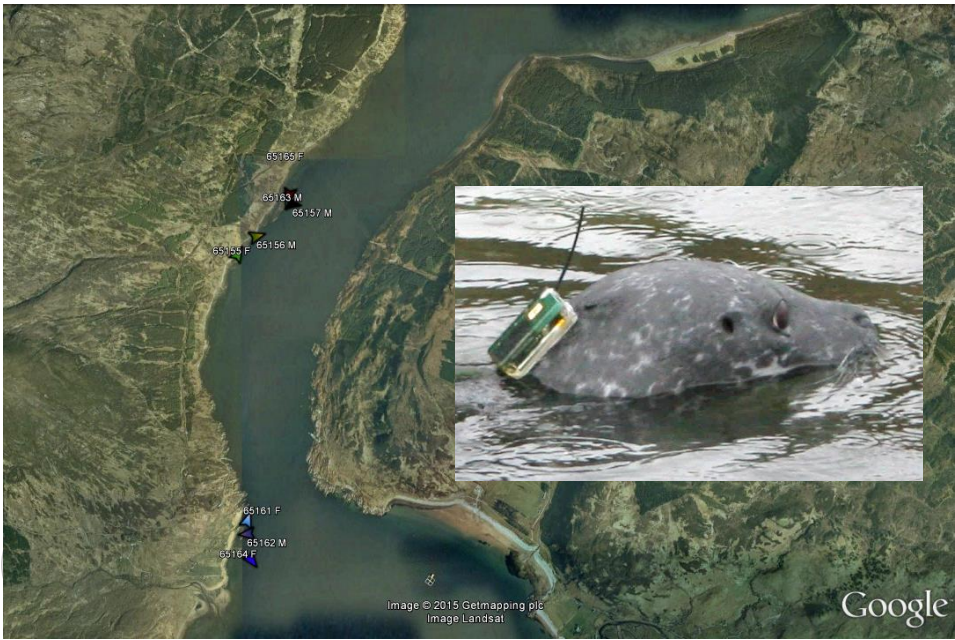
Fraser Johnson, Rowan Boswood, and Lorna Slater (Atlantis);



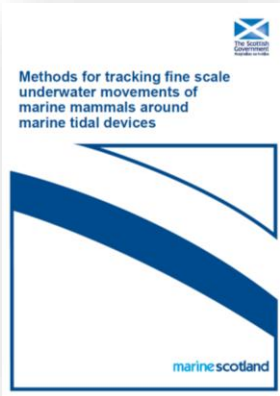
Sea Mammal
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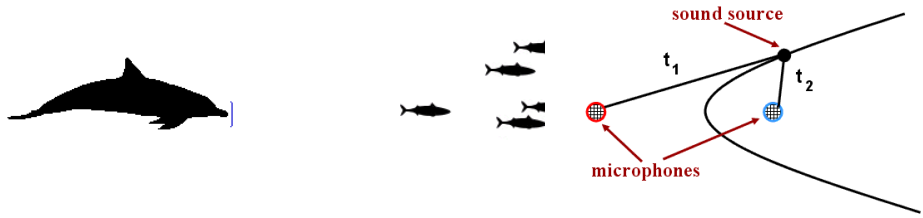
Energetic habitats: important for tidal turbines and seals



Tools to measure underwater behaviour



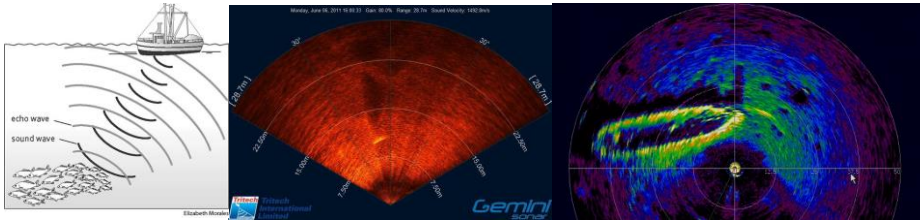
Passive acoustic tracking



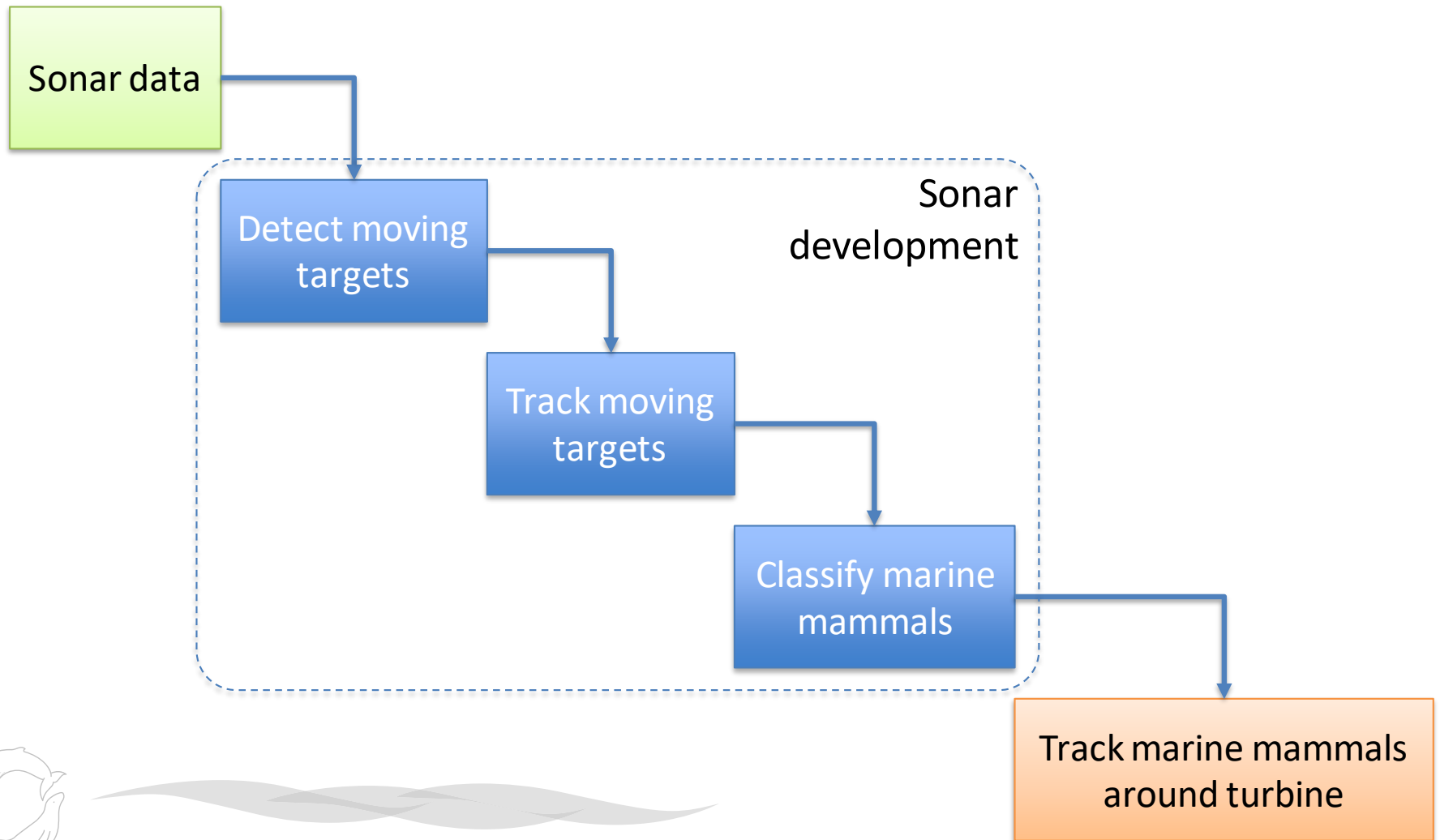
Animal borne tags/telemetry



Active acoustic tracking



Tracking marine mammals with sonar: the process



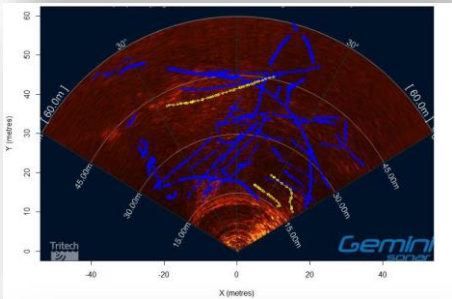
Sonar data



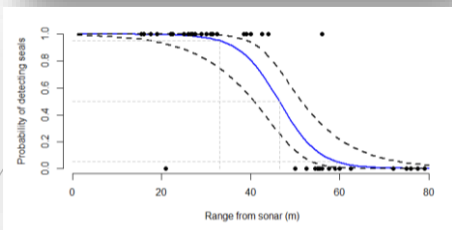
Tritech Gemini: 720 kHz multibeam



No measured responses to signals by seals

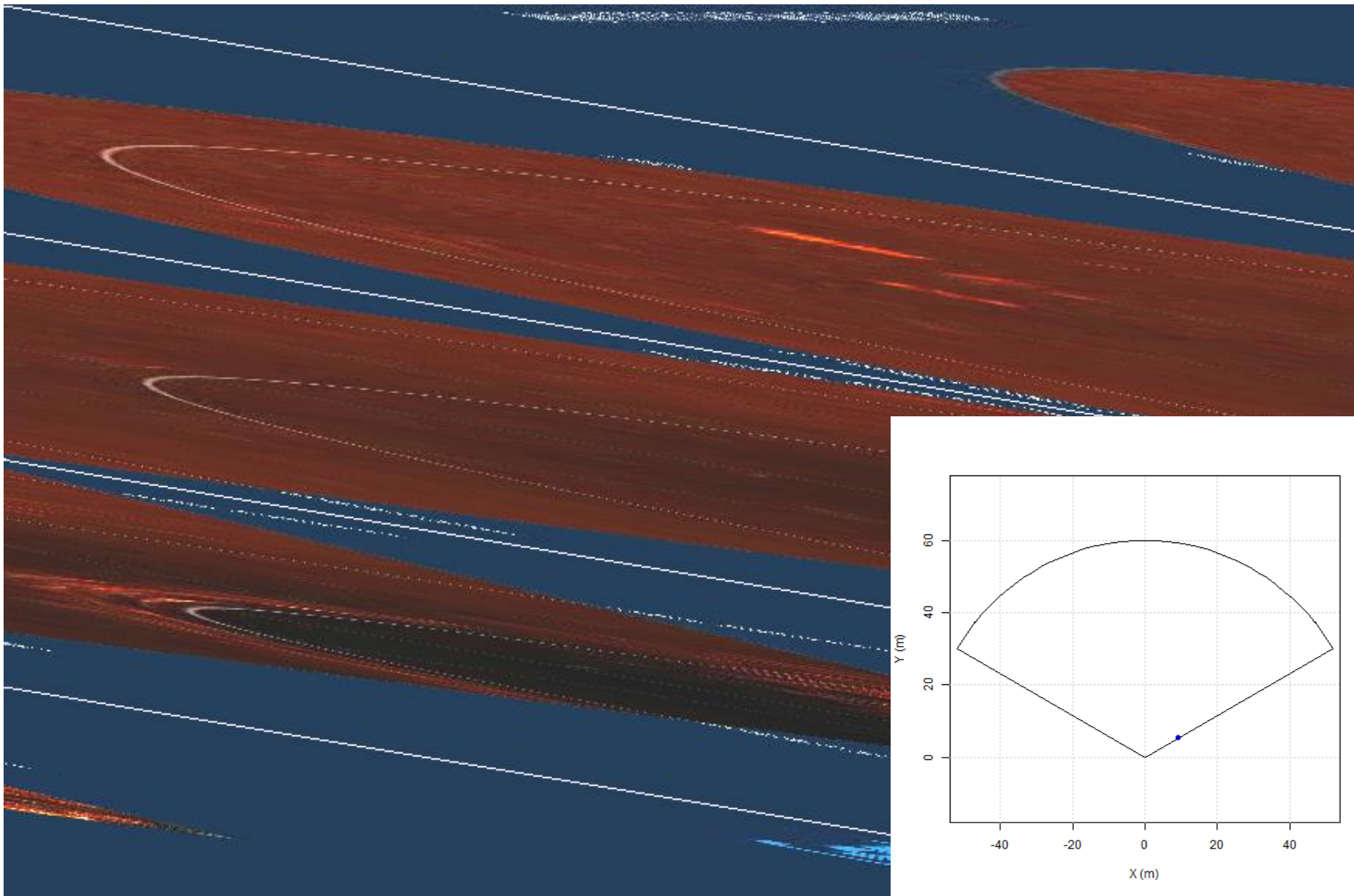


Existing target tracking module



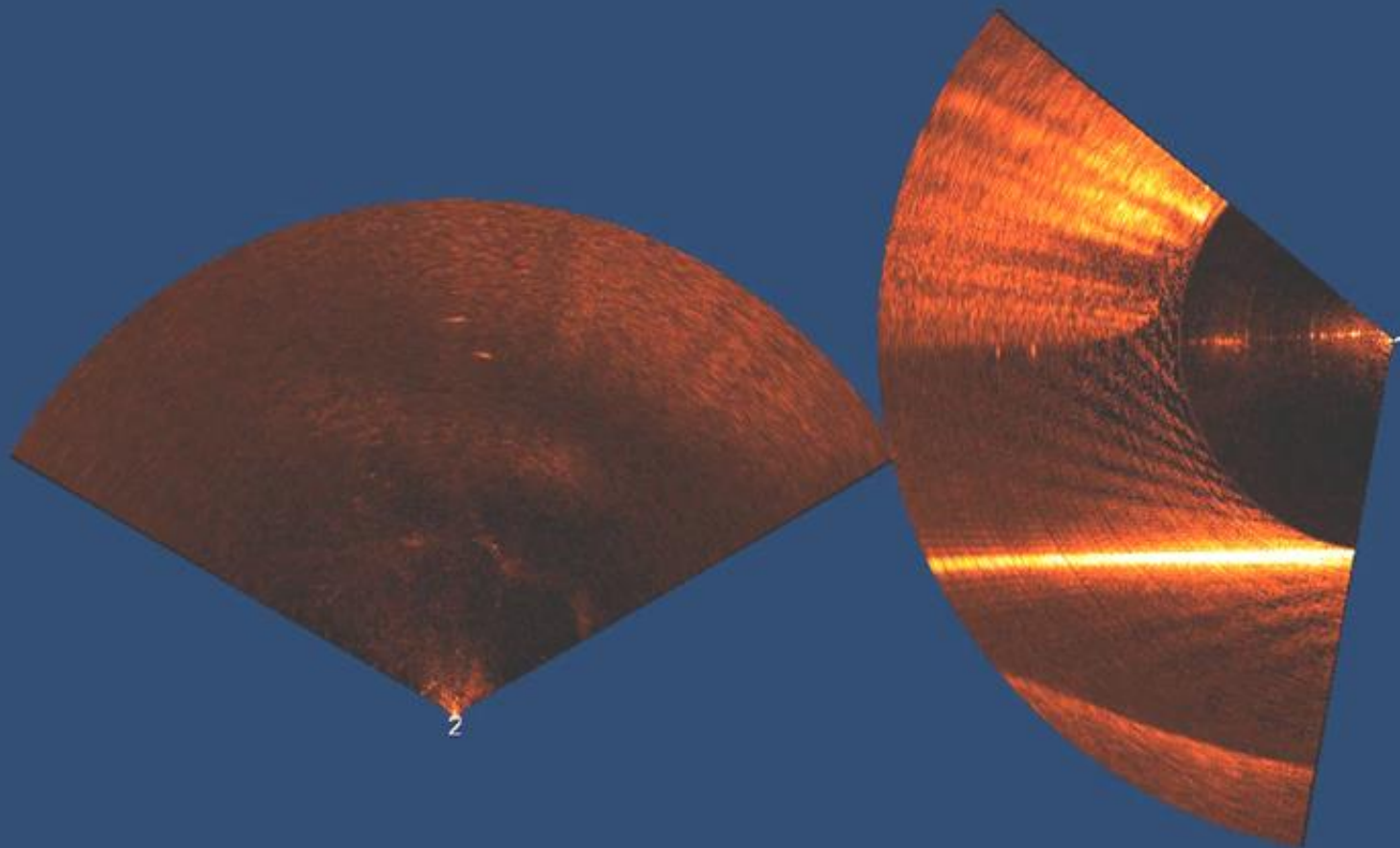
Detection probability (seals) >0.95 up to 30m

Detect and track targets



Detect and track targets – 3D

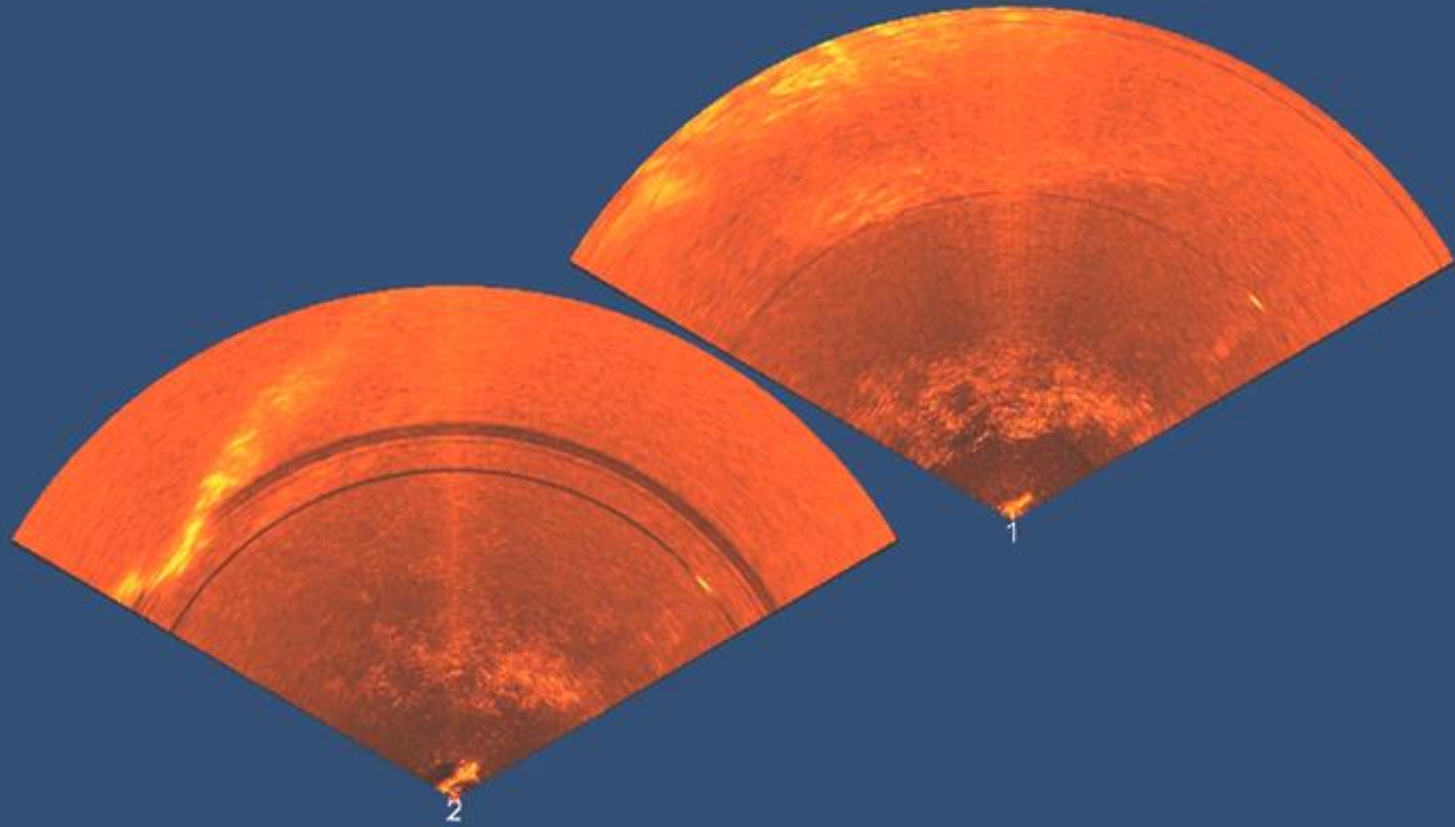
Tx Time (UTC): Thursday, June 11, 2015 12:23:47 Gain: 80.0% Range: 55.0m Sound Velocity: 1489.6m/s



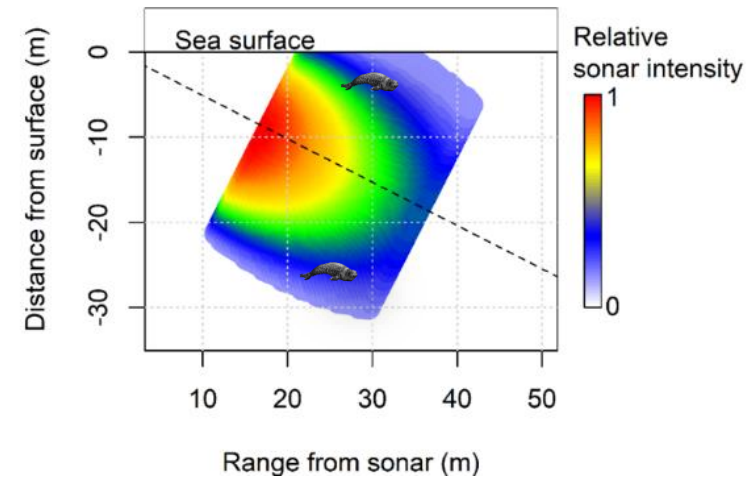
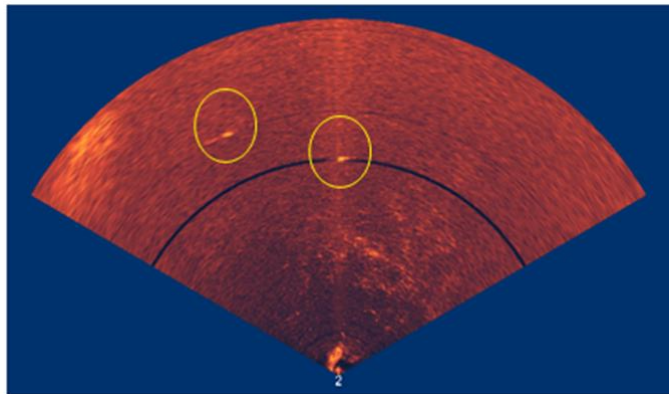
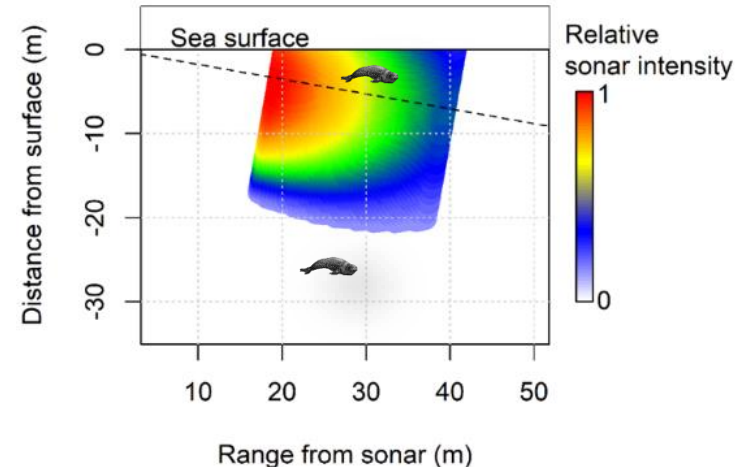
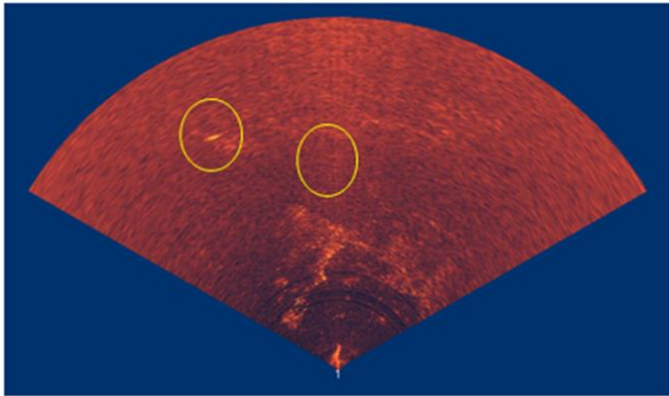
Gemini
sonar

Detect and track targets – 3D

Tx Time (UTC): Wednesday, June 10, 2015 19:57:11 Gain: 100.0% Range: 46.0m Sound Velocity: 1489.6m/s



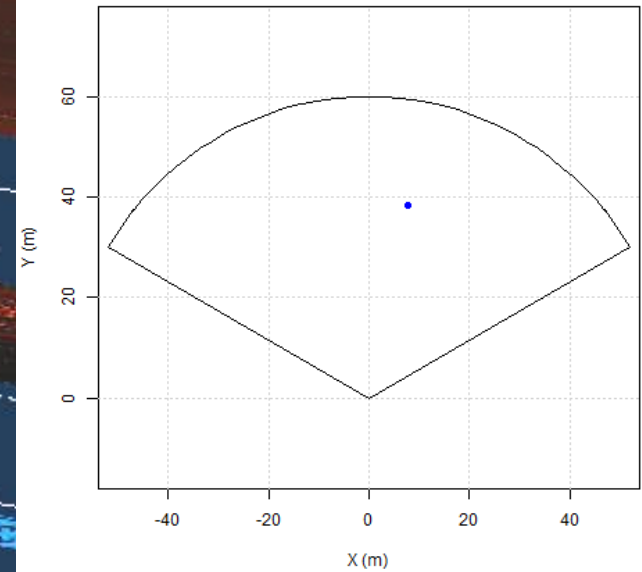
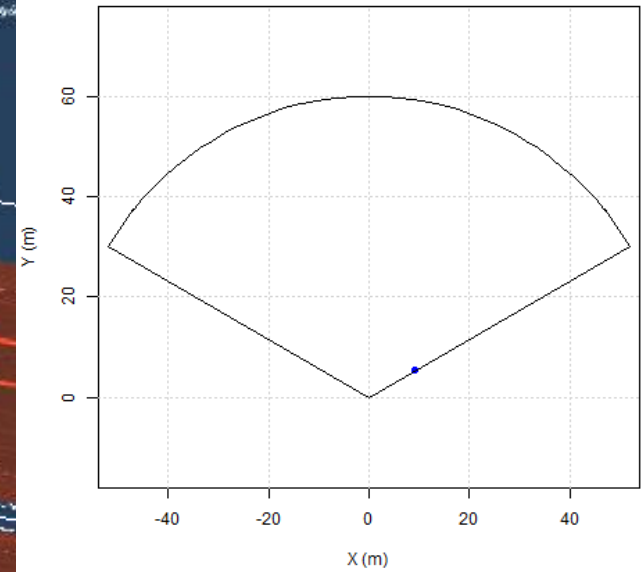
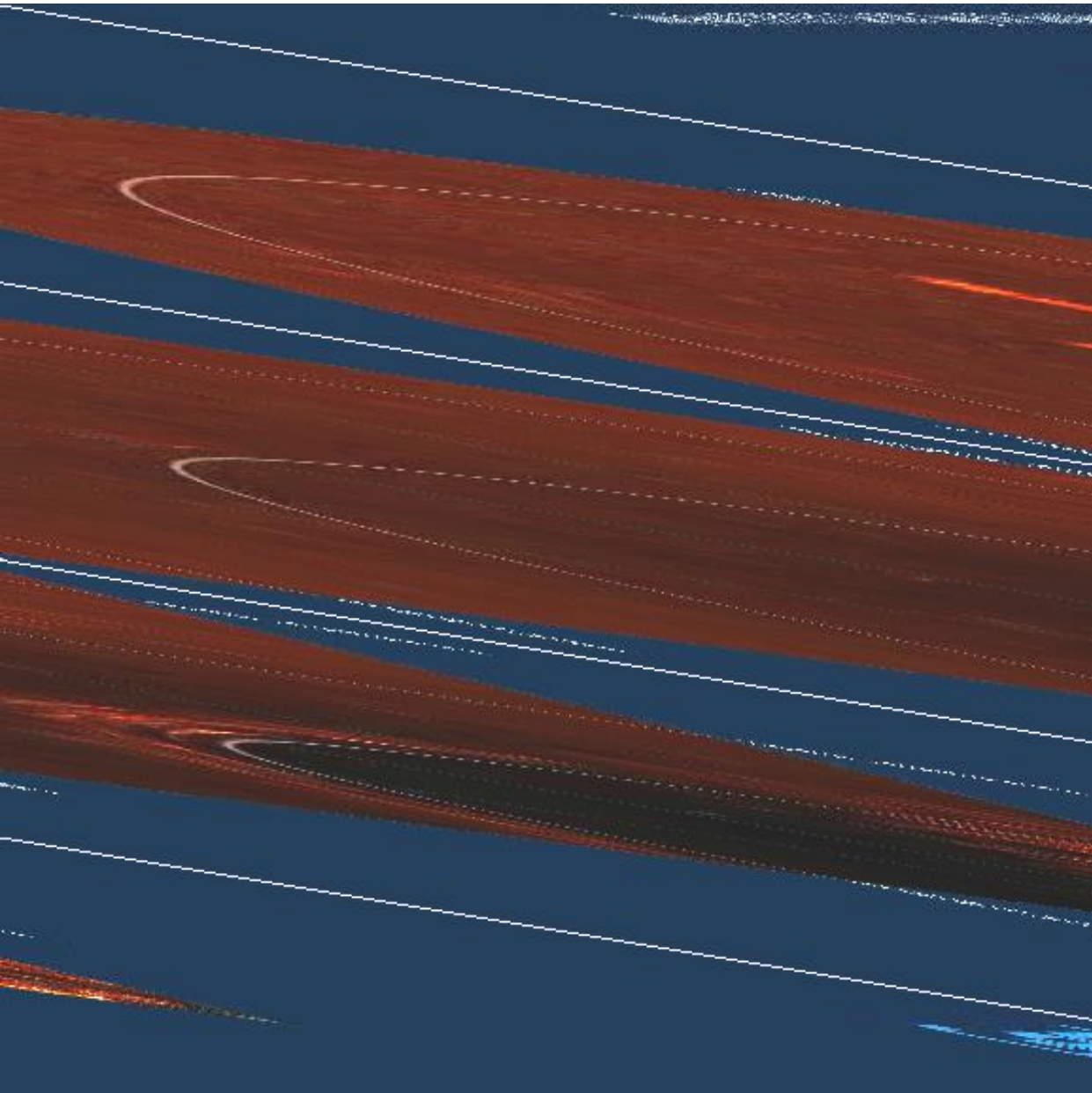
Detect and track targets – 3D



Mean absolute error:
2.16 m (95% CIs = 2.01 – 2.32)

Hastie et al (2019). Aquatic Conservation:
Marine and Freshwater Ecosystems.

Classify marine mammals



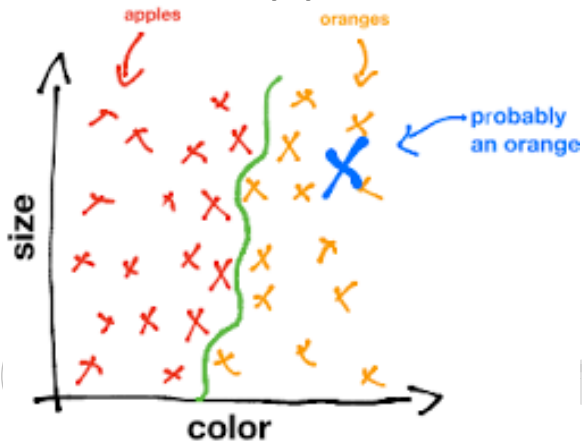
Classify marine mammals

Mobile targets in tidally energetic environments



- 95 targets.hr⁻¹
 - ❖ 6.6 seals.hr⁻¹
 - ❖ 88.8 non-seals.hr⁻¹
- Each day = ~2,100 non-seal targets;
- Need an effective means of data reduction.

kernel Support Vector Machines



The objective is to train a classification model based on labelled data. The trained model is then used for classifying novel data.

Kernel support vector machines

Used for a wide range of pattern recognition applications in biology



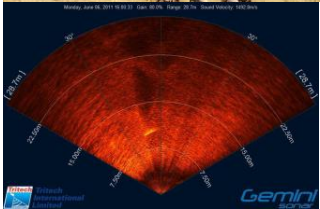
Quantifying movement behaviour of cheetahs from GPS tags;



Constructing social networks based on co-occurrences of jackdaws;



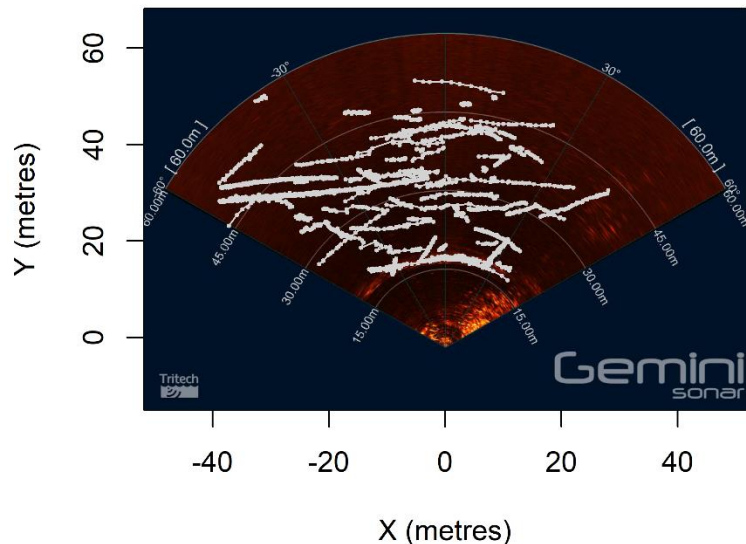
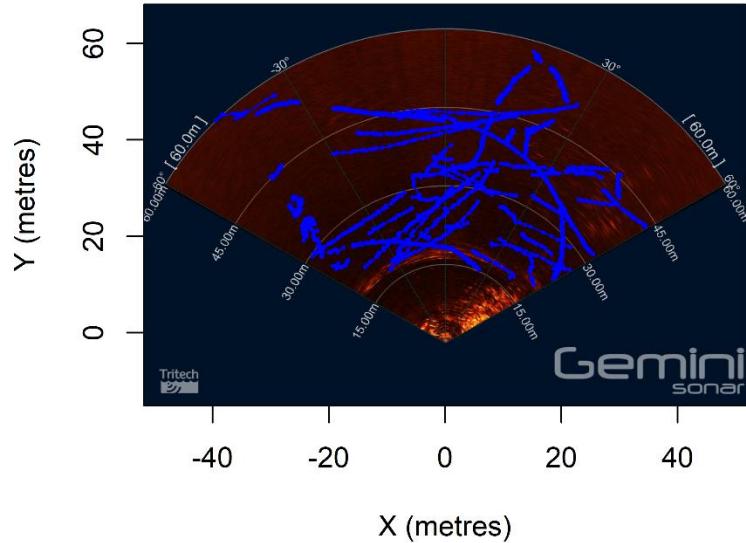
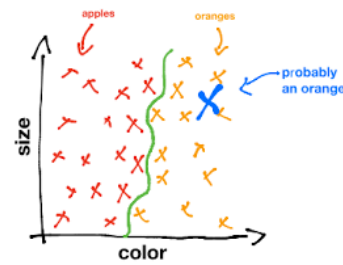
Counting individual wildebeest within aerial survey photo;



Classify seals in sonar data?



Kernel support vector machines



	Classified Seal	Classified Non-seal
Confirmed seals	100%	0%
Non-seal targets	8%	82%

- All seals correctly classified;
- Majority of non-seals correctly classified;
- ~8% of non-seals classified as seals.

From: ~**89** false positive detections/hour
 To: ~**8** false positive detections/hour

Hastie et al (In press). Aquatic Conservation:
 Marine and Freshwater Ecosystems.

Seal tracking with sonar:

Summary

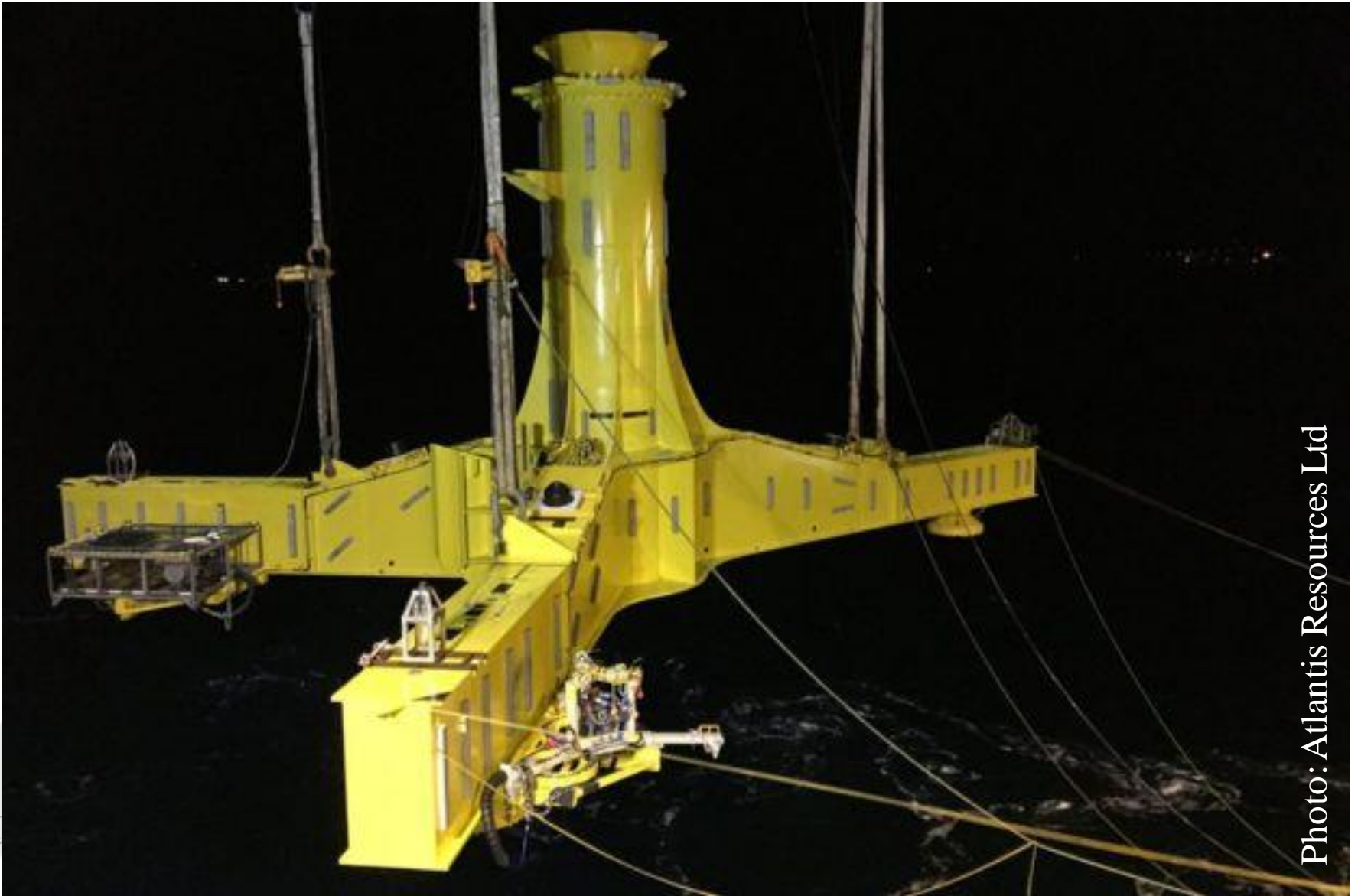
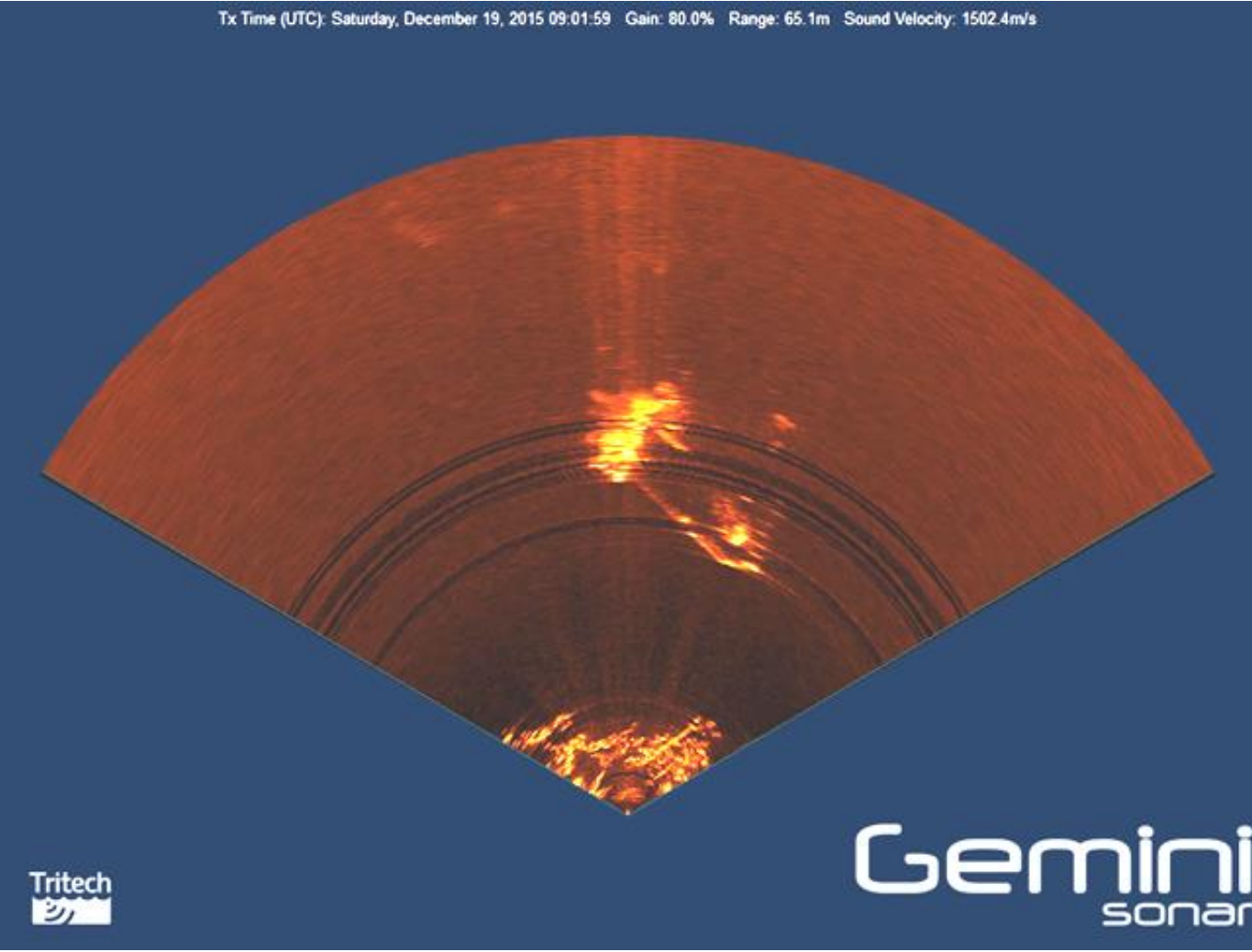


Photo: Atlantis Resources Ltd

Next steps: redeployment around operating turbine...

Photo credit: Rebecca Hewitt, University of Aberdeen



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