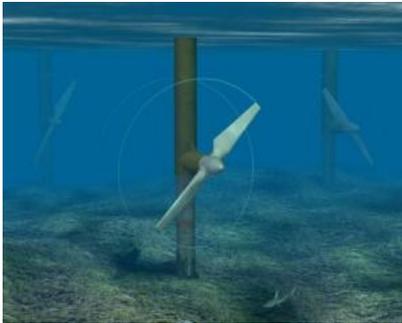


Marine Mammals and Tidal Turbines: Understanding true collision risk

*Carol Sparling, Mike Lonergan, Beth Mackey, Cormac Booth, Gordon Hastie,
Doug Gillespie, Jamie MacAulay*

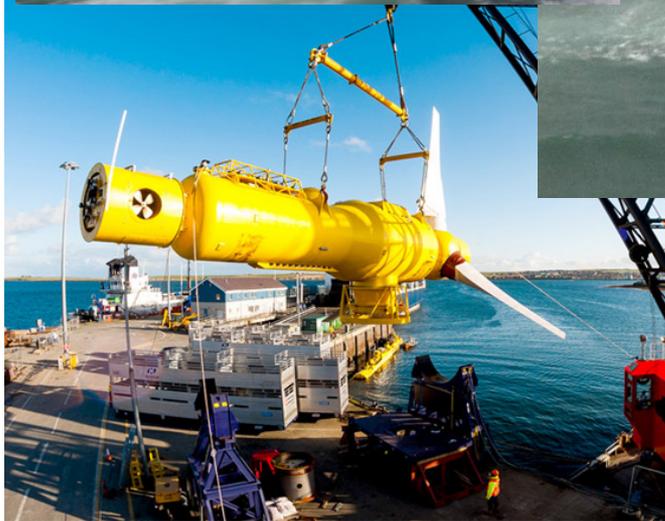
*Thursday 1st May
EIMR Stornoway*

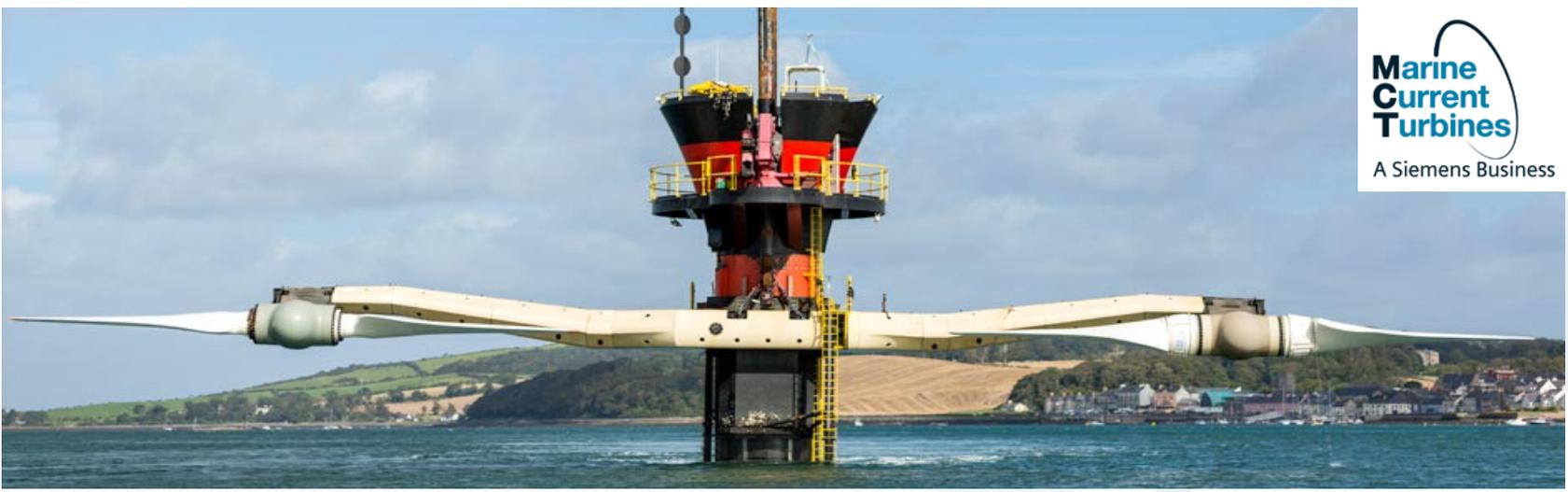


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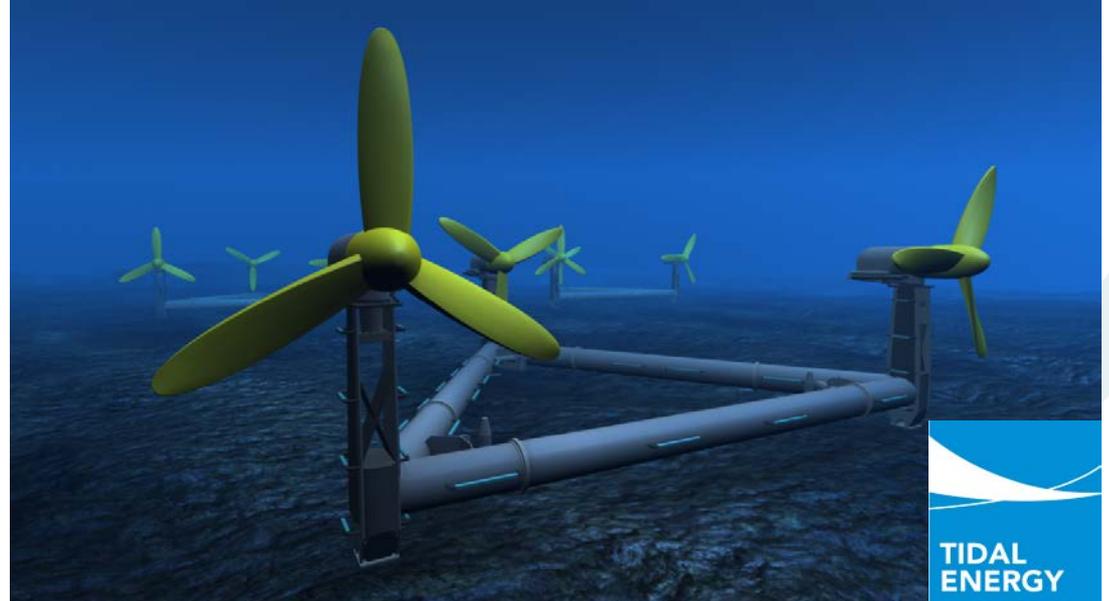






SeaGen, Strangford Lough, Northern Ireland

DeltaStream, Tidal Energy Ltd, Ramsey Sound

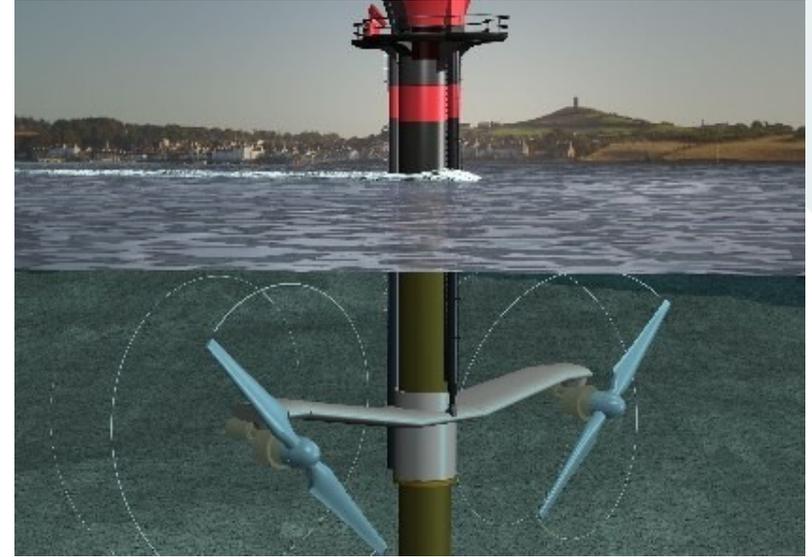
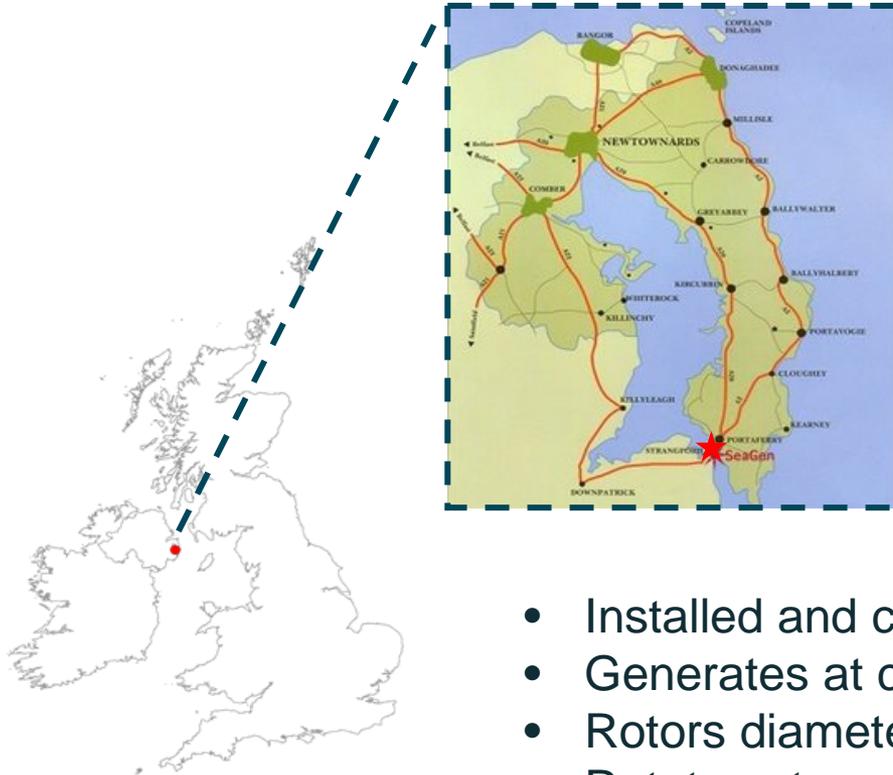


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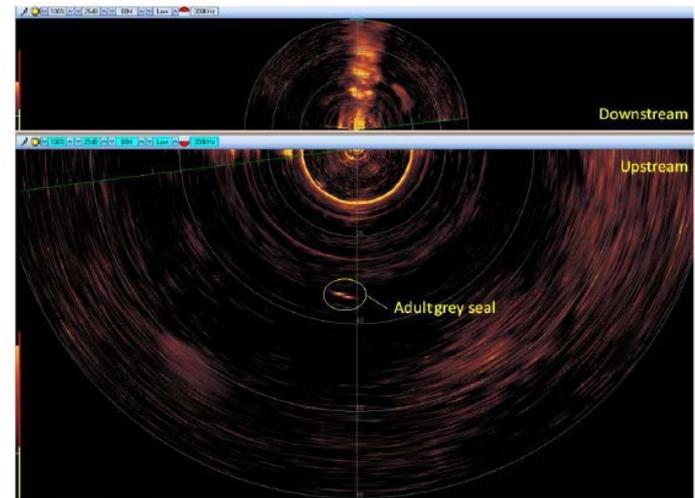
TIDAL
ENERGY

SeaGen, Strangford Lough, Northern Ireland



- Installed and commissioned in 2008
- Generates at currents $>1\text{m/s}$;
- Rotors diameter 16m ;
- Rotates at a maximum speed of 14RPM;
- Maximum tip speed is 12m/s ;

SeaGen, Strangford Lough, Northern Ireland

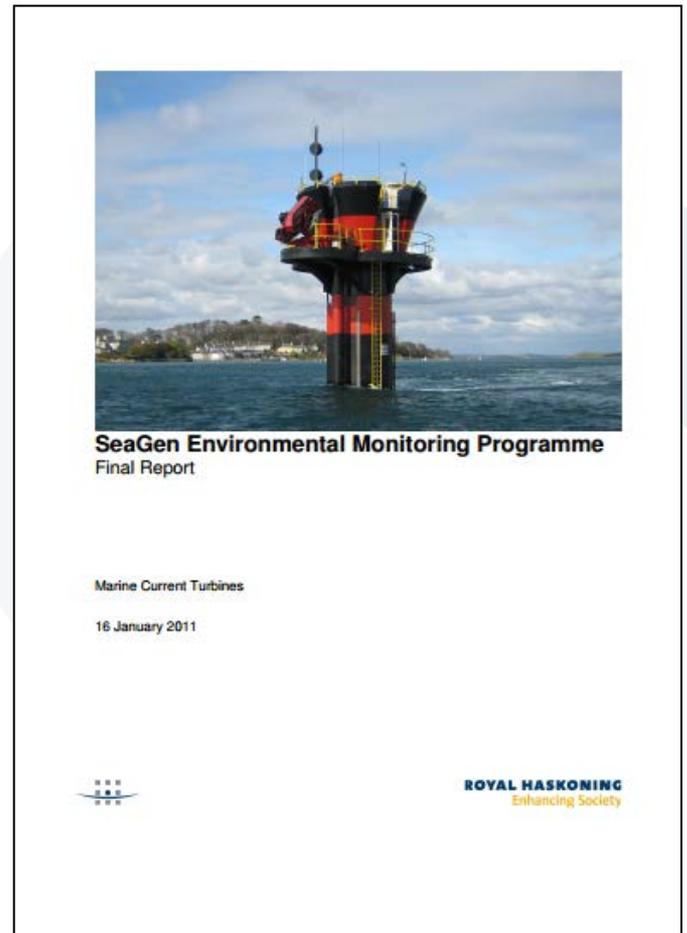


Step 1: Conclusions of EMP: no significant impacts on marine mammals as a result of installation or operation of the turbine

AS LONG AS MITIGATION IN PLACE

Step 2: reassess risk of collision after 5 years of operation

Step 3: carry out a Habitats Regulation Assessment



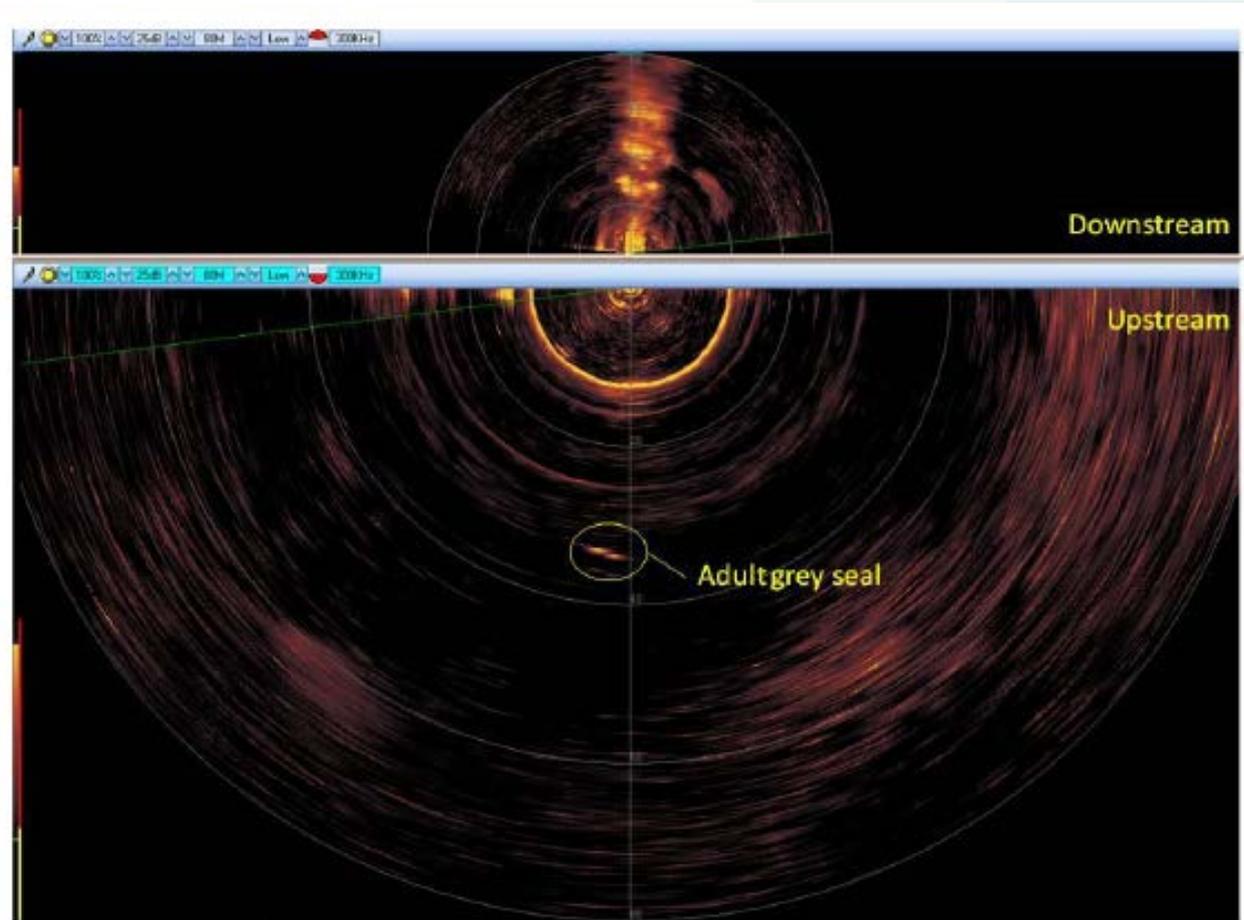
Step 2: reassess risk of collision after 5 years of operation

What is the close range encounter rate between seals and the turbine?

Data sources:

- Super SeaKing Sonar
- Gemini Multibeam Sonar
- Seal telemetry study

Super SeaKing 'mitigation' scanning sonars Since August 2009



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Royal
HaskoningDHV
Enhancing Society Together

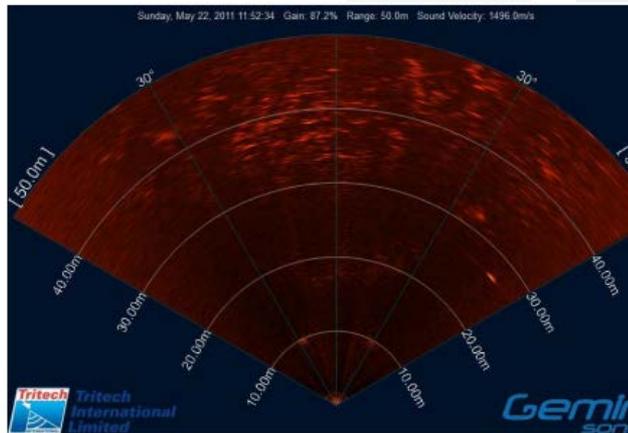
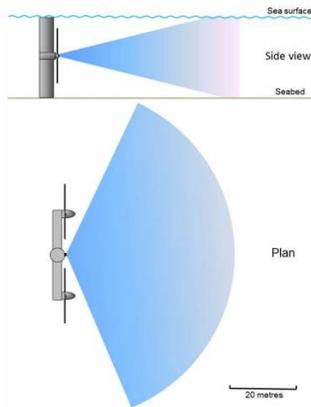
Marine
Current
Turbines

A Siemens Business



Gemini Multibeam deployment May-July 2011

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/232963/OESEA2_SMRU_tracking_marine_mammals_around_renewable_devices.pdf



TRACKING MARINE MAMMALS AROUND
MARINE RENEWABLE ENERGY DEVICES
USING ACTIVE SONAR

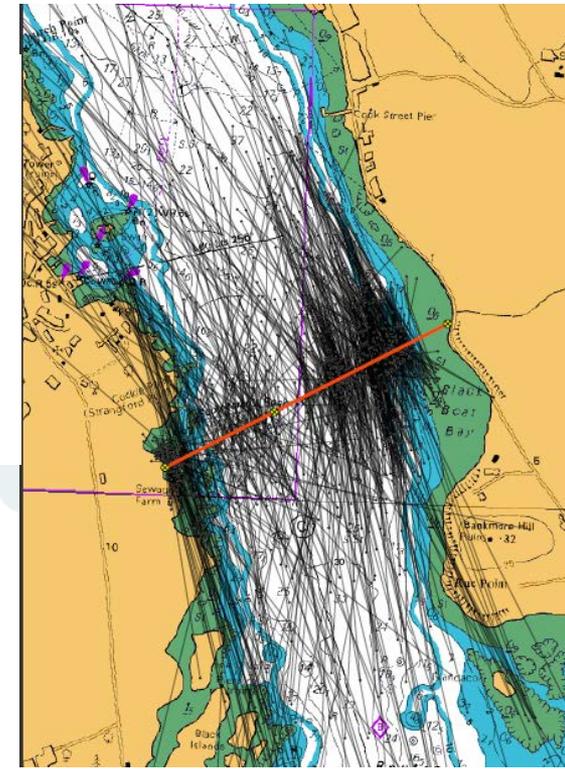
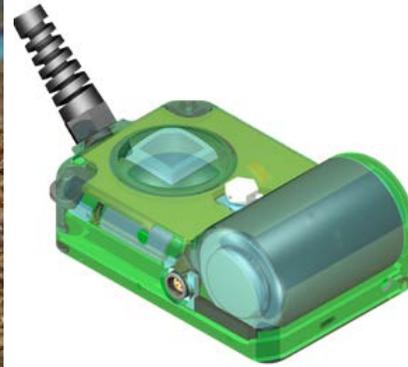


GORDON HASTIE

URN: 120/328: 31 JULY 2013

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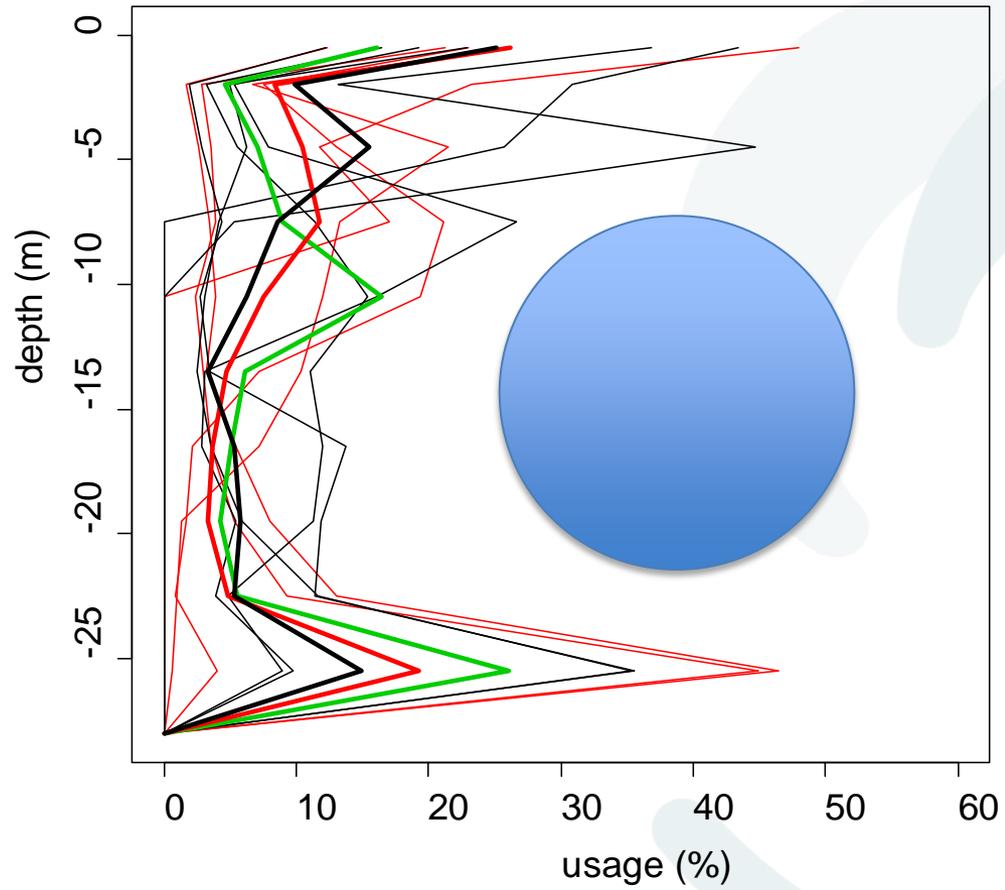
1



Seal telemetry study March-July 2010

12 tagged harbour seals: rate of close transit





Encounter rates -

Table 1. Input parameters for collision risk models from the various data sources – the rate of at-risk passages by harbour seals per month under a range of assumptions regarding depth distribution and avoidance capabilities.

| | Sonar: Super SeaKing (all) | Sonar: Super SeaKing (Summer) | Sonar: Super SeaKing (Winter) | Sonar: Gemini Multibeam (Summer) | Seal Telemetry (March-July) |
|---|-------------------------------------|-------------------------------------|----------------------------------|---|-----------------------------------|
| Uniform depth distribution | 31.9 | 44.2 | 17.0 | 42.5 | 48.0 |
| Non-uniform depth distribution. | 5.3 | 7.4 | 2.8 | 7.1 | 8.0 |
| Uniform depth distribution. 50% Avoidance | 15.9 | 22.1 | 8.5 | 21.3 | 24.0 |
| Uniform depth distribution. 95% Avoidance | 1.6 | 2.2 | 0.9 | 2.1 | 2.4 |
| Non-uniform depth distribution. 50% Avoidance | 2.7 | 3.7 | 1.4 | 3.5 | 4.0 |
| Non-uniform depth distribution. 95% Avoidance | 0.27 | 0.37 | 0.14 | 0.35 | 0.40 |

Table 2. Mean collision probabilities over tidal cycle under different models and animal movement assumptions

| Model | Simple | Simple | Band | Band | Band |
|---|---------|--------|---------|---------------|---------|
| Animal Movement assumption | Passive | 2.3ms | Passive | 2.3msUpstream | 2.3both |
| Mean collision probability over tidal cycle | 0.21 | 0.24 | 0.15 | 0.17 | 0.19 |

**Taking most precautionary encounter rates
and collision probability,
Non uniform depth distribution,
50% avoidance**

Estimated collision risk =

1 seal per month in summer

0.3 seals per month in winter

How much can the population sustain?

Population now appears to be increasing

Calculated PBR is 3.6 seals

HRA 'allows' a 3 month trial over the summer

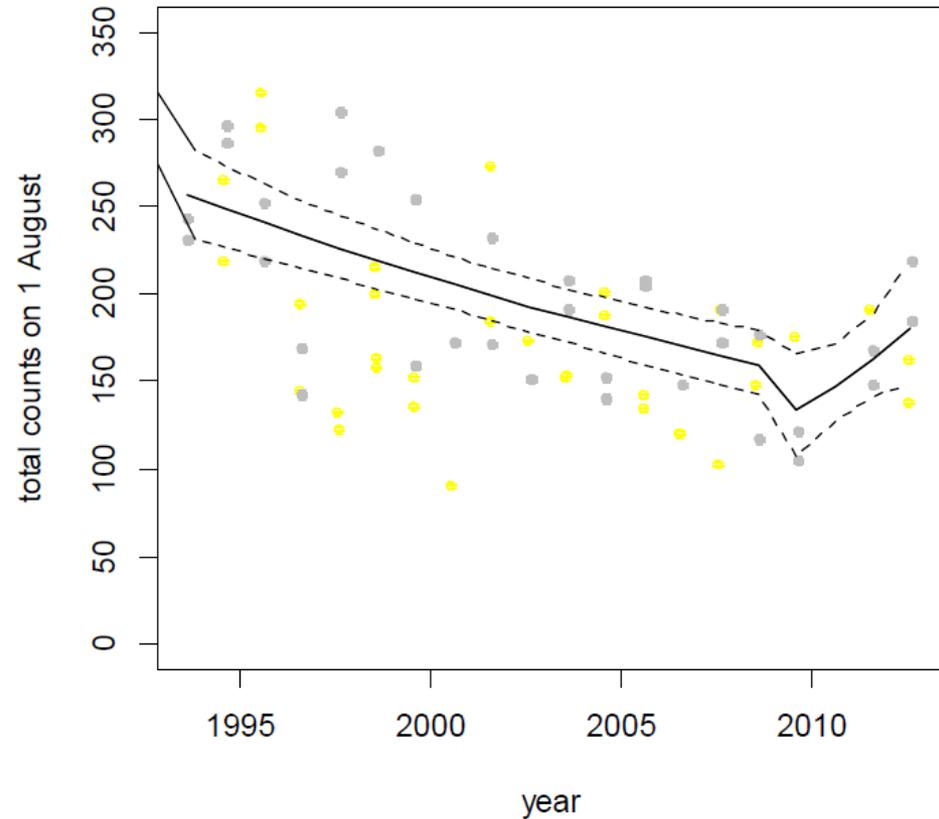
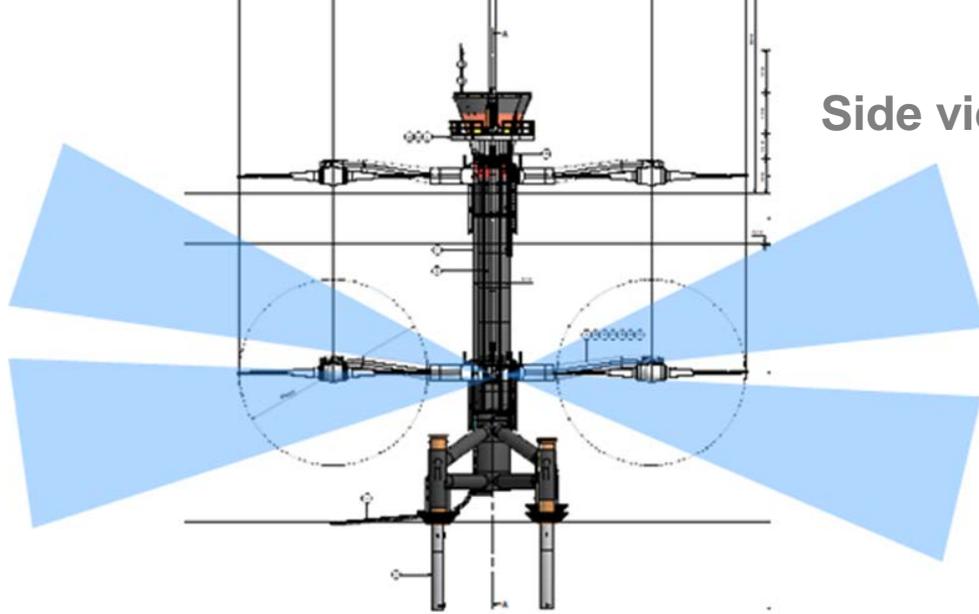


Figure 7: Modelled interannual changes in total numbers of harbour seals (adults plus pups) that would be counted in Strangford Lough and the Narrows on 1st August each year. The model combines a seasonal pattern with an interannual trend that changes in 2008 and a step change in that year. The broken lines are 95% confidence intervals around the trajectory. Yellow points are counts made in July and grey ones those made during August. Figure 8, below, shows the combined pattern.

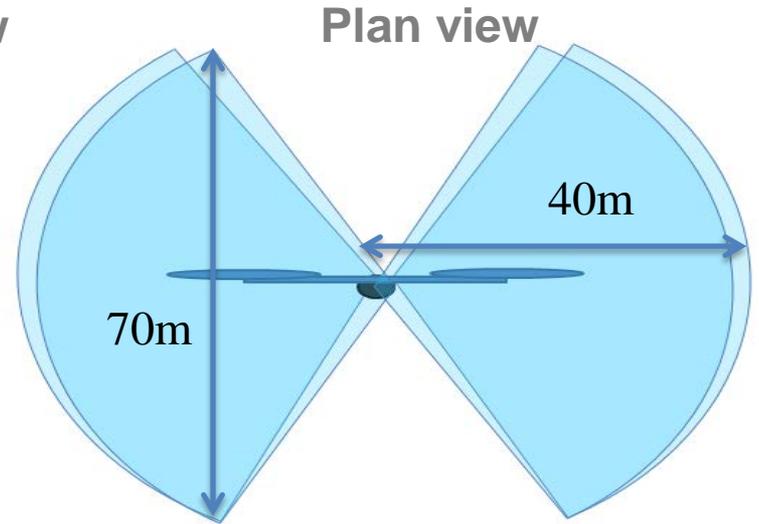


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Side view



Plan view

- Four Gemini multibeam sonars mounted on the cross beam (to maximise vertical coverage of rotors).
- Data on passage rates in the presence of an operating turbine (compare these with previously estimated –refine collision risk)
- Evidence for evasion/avoidance???

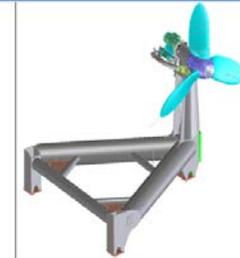
Tidal Energy Ltd's DeltaStream unit being deployed in Ramsey Sound



2014

Operational Monitoring and Collision
Monitoring and Adaptive Management Plan

DeltaStream Demonstration, Ramsey Sound



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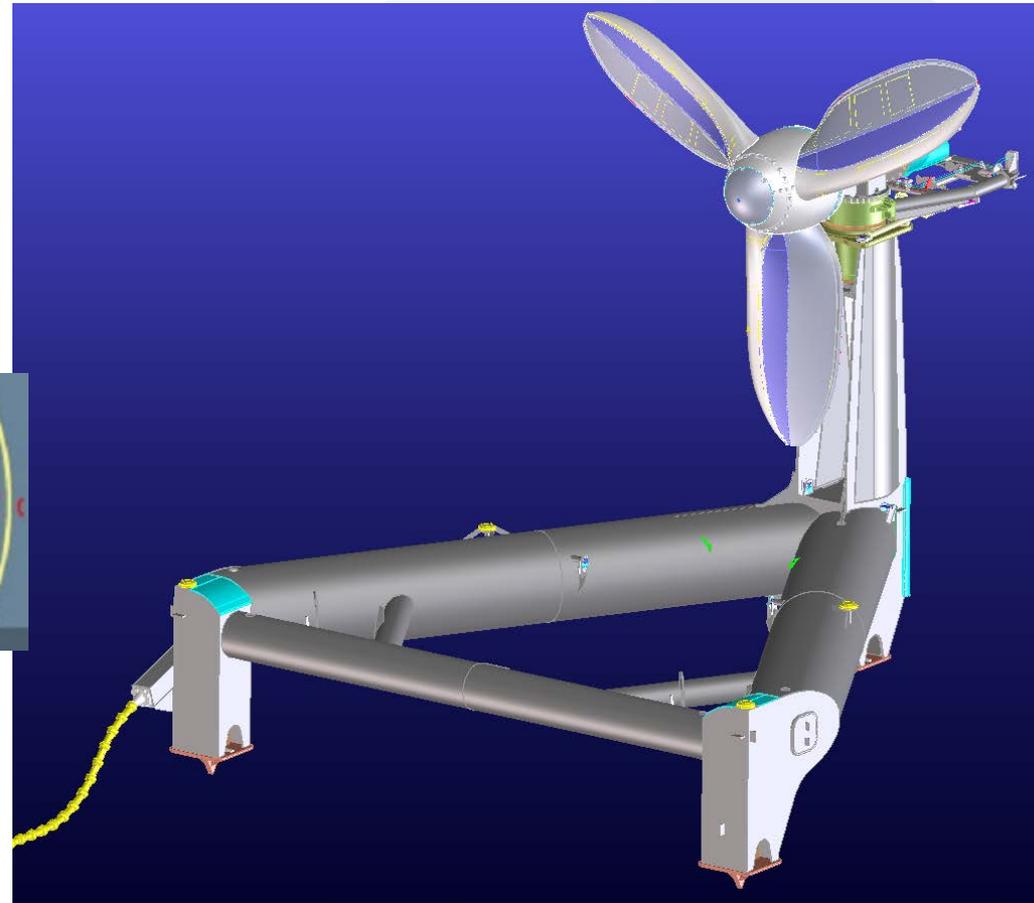
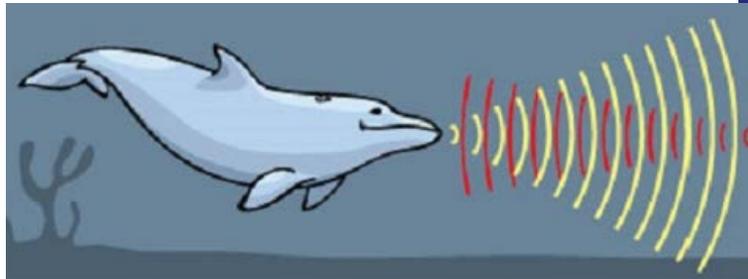


Cyfoeth
Naturiol
Cymru
Natural
Resources
Wales

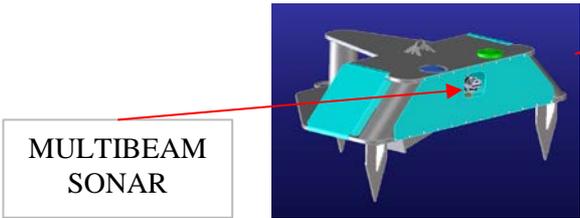
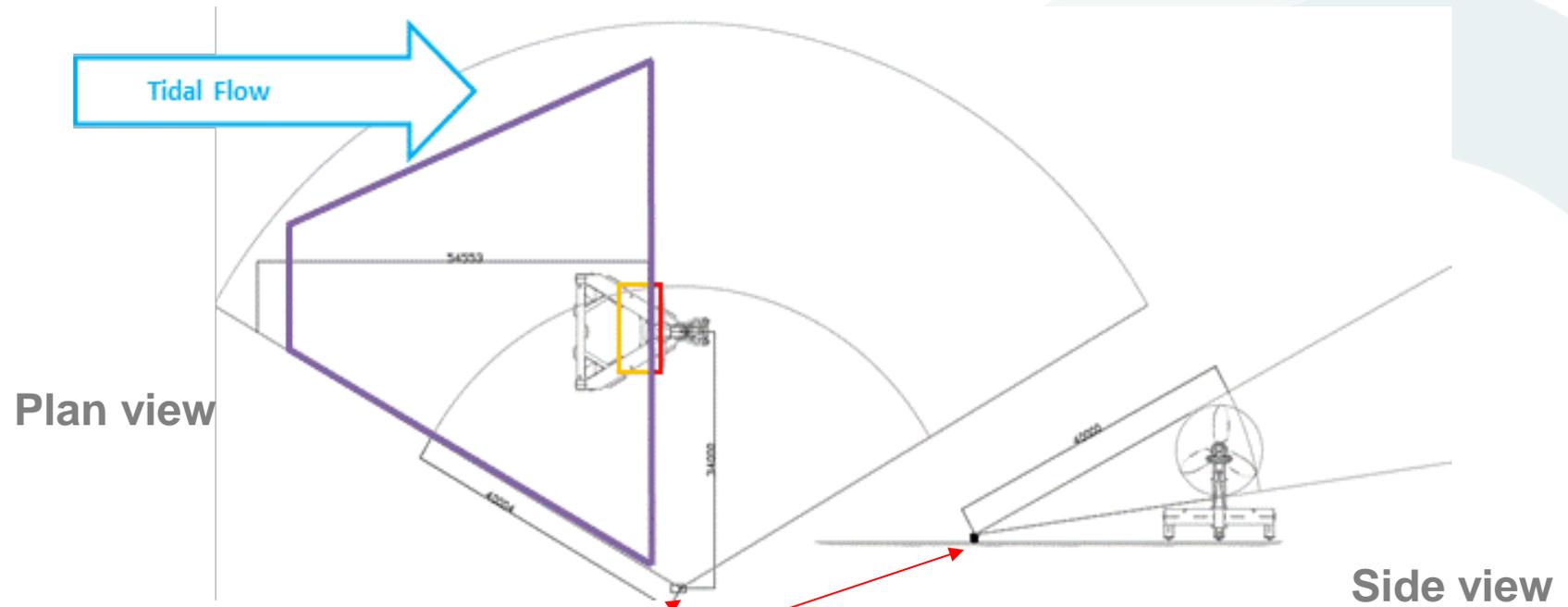
Passive acoustic monitoring:

3D Hydrophone array:

detection and localisation
(tracking) of echolocating
cetaceans around the device



Active acoustic monitoring:





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