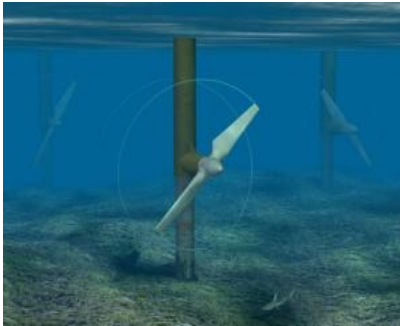
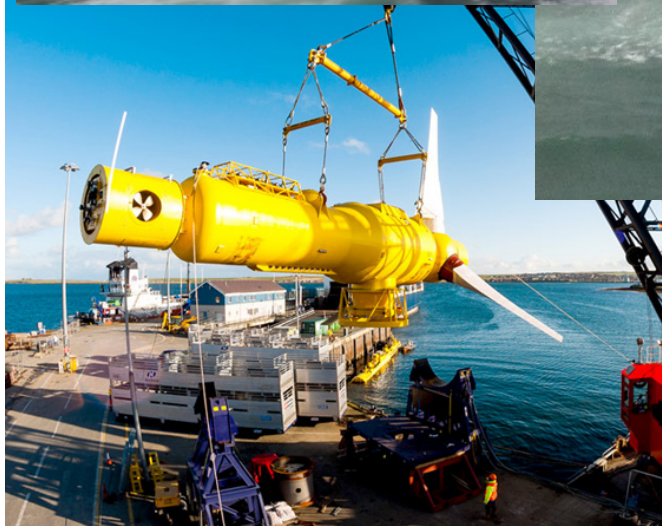
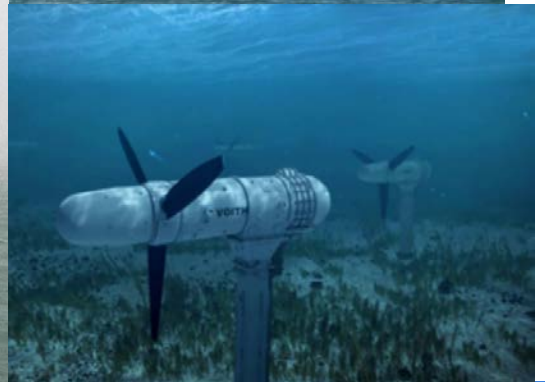


Marine Mammals and Tidal Turbines: Understanding true collision risk

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

*Thursday 1st May
EIMR Stornoway*

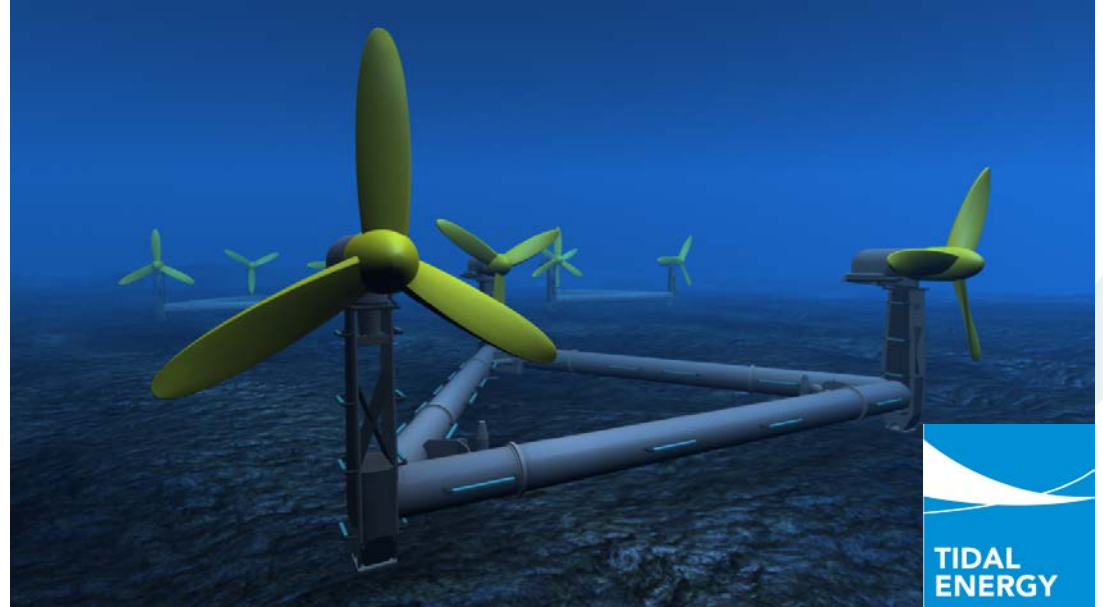






SeaGen, Strangford Lough, Northern Ireland

DeltaStream, Tidal Energy Ltd, Ramsey Sound

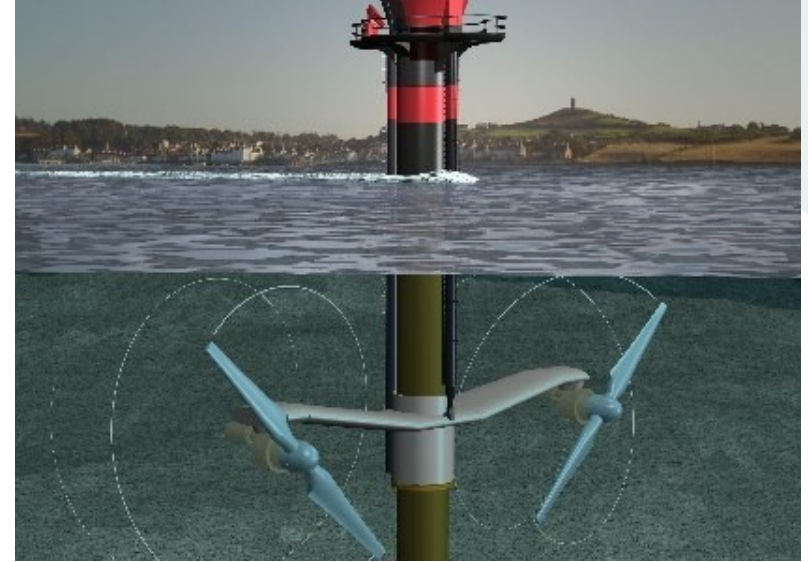
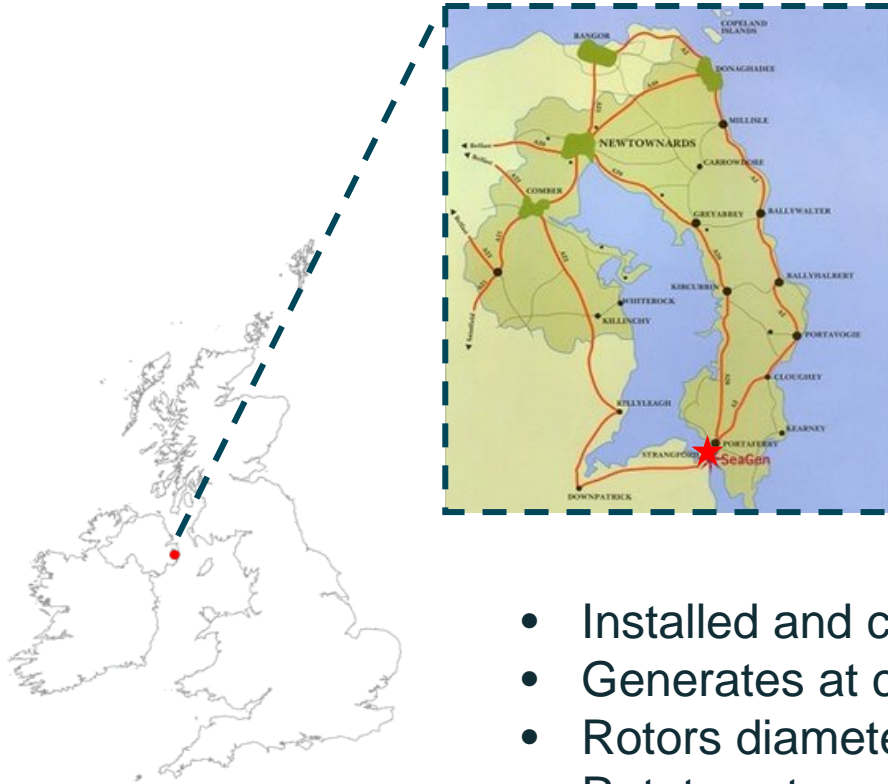


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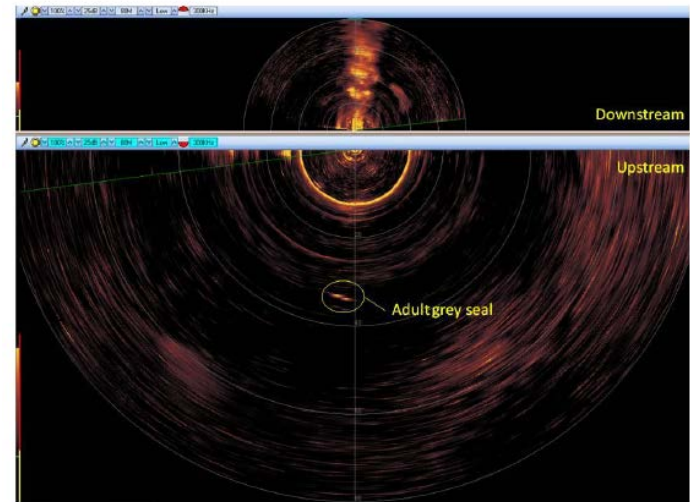
TIDAL
ENERGY

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



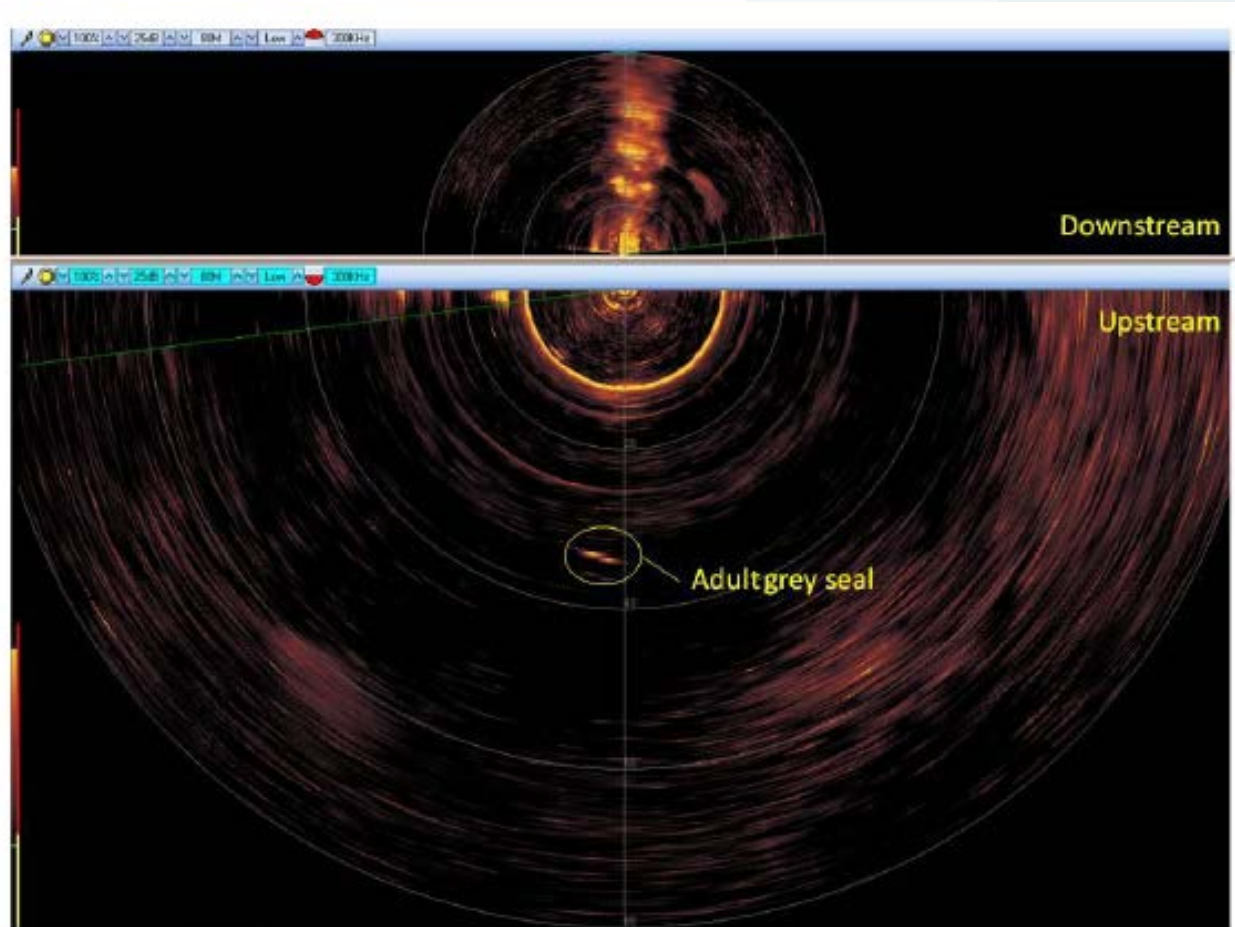
Step 2: reassess risk of collision after 5 years of operation

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

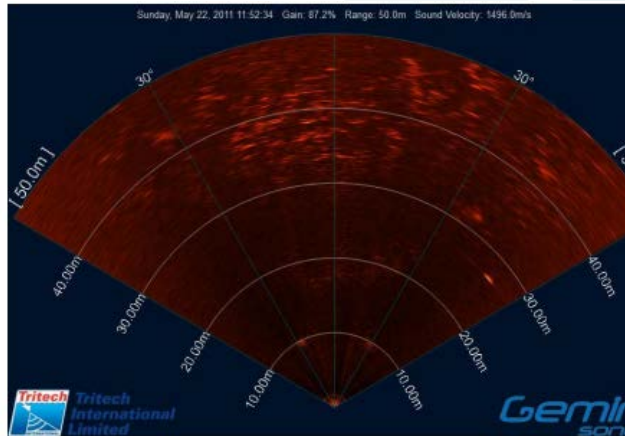
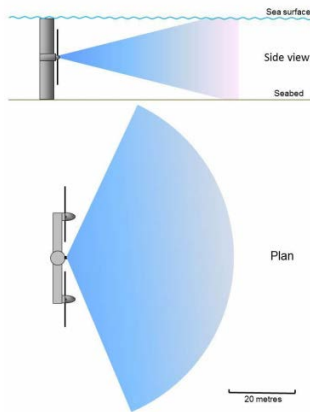
marine
Current
Turbines

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

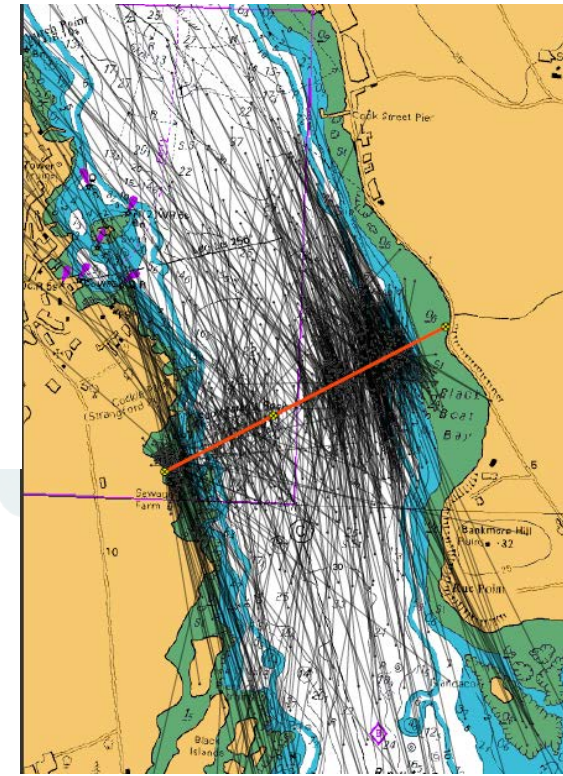


GORDON HASTIE

URN: 120/328: 31 JULY 2013

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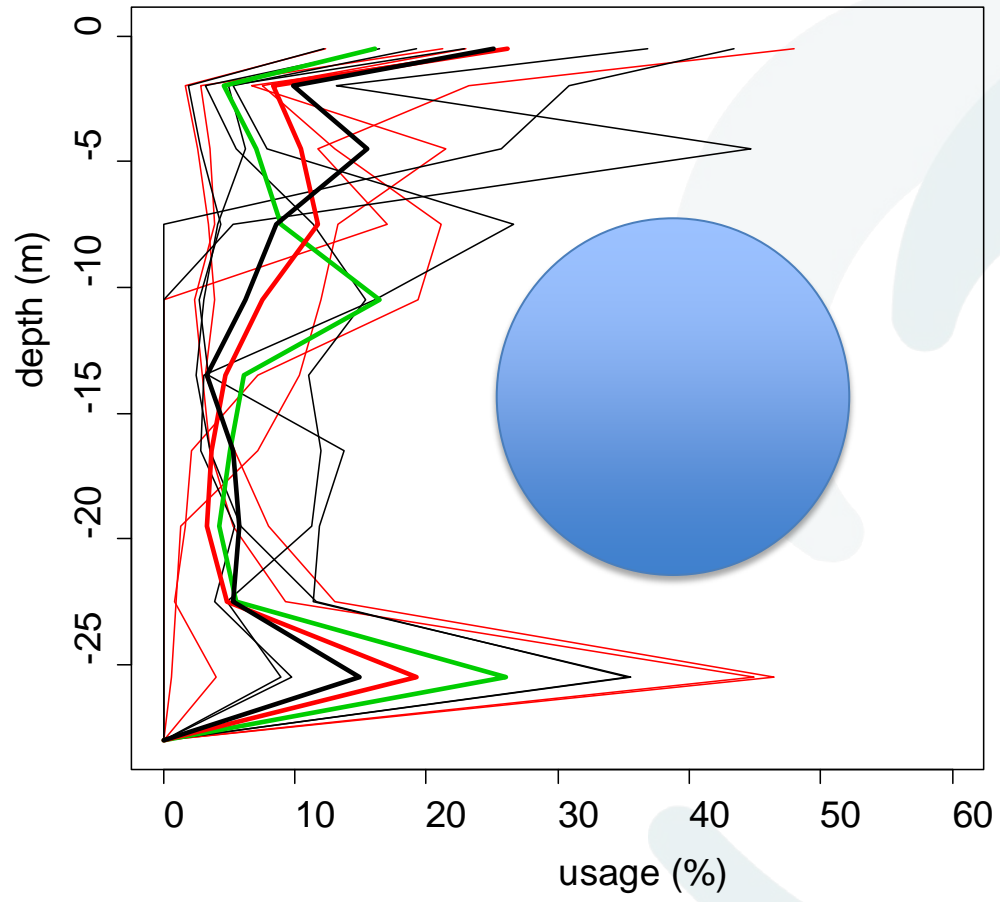
1



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

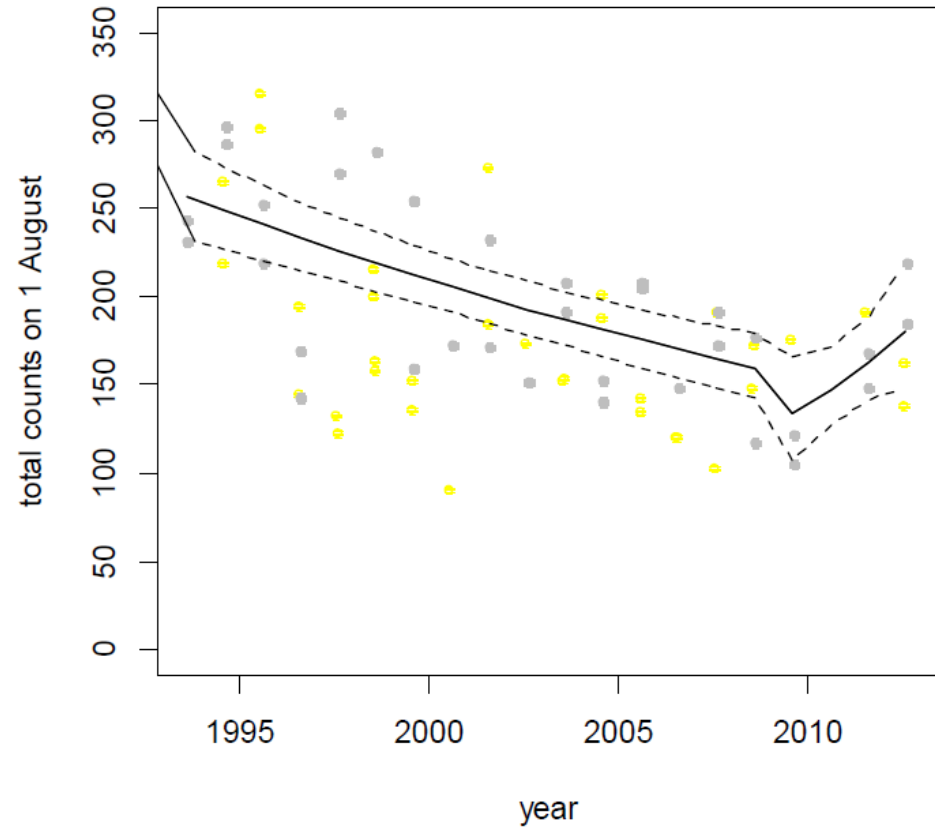
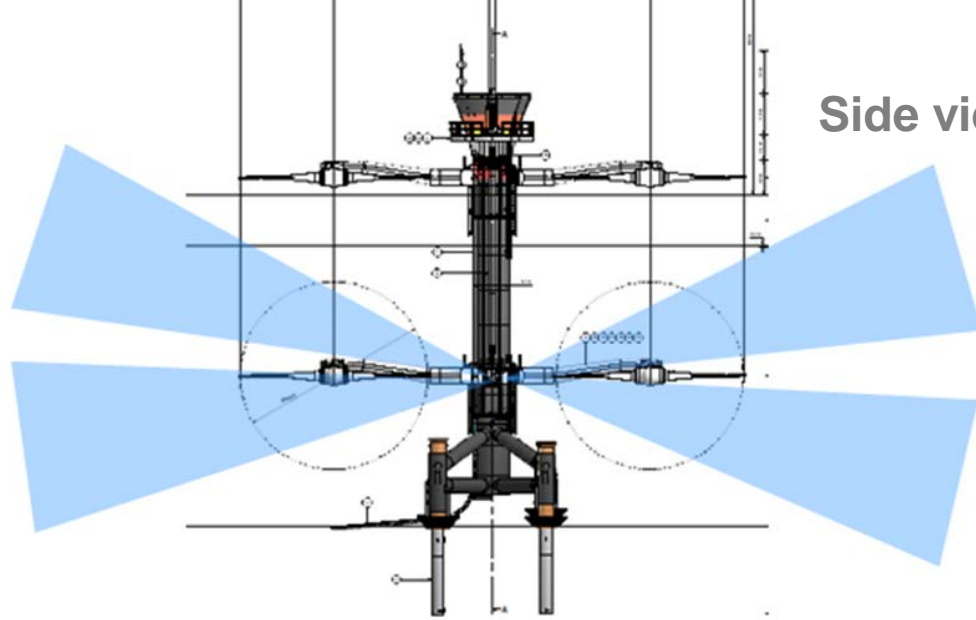


Figure 7: Modelled interannual changes in total numbers of harbour seals (adults plus pups) that would be counted in Strangford Lough and the Narrows on 1st August each year. The model combines a seasonal pattern with an interannual trend that changes in 2008 and a step change in that year. The broken 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.

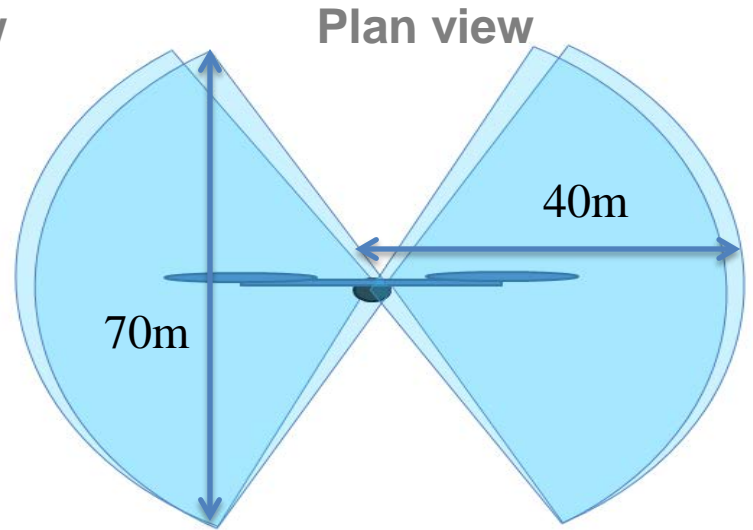


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Side view



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???

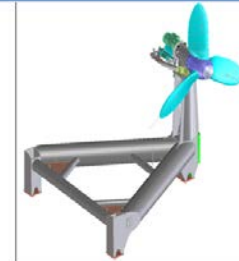
Tidal Energy Ltd's DeltaStream unit being deployed in Ramsey Sound



2014

Operational Monitoring and Collision
Monitoring and Adaptive Management Plan

DeltaStream Demonstration, Ramsey Sound



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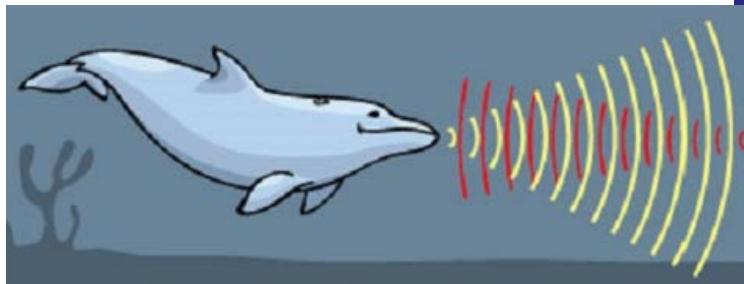


Cyfoeth
Naturiol
Cymru
Natural
Resources
Wales

Passive acoustic monitoring:

3D Hydrophone array:

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



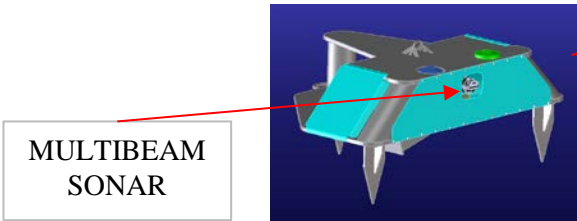
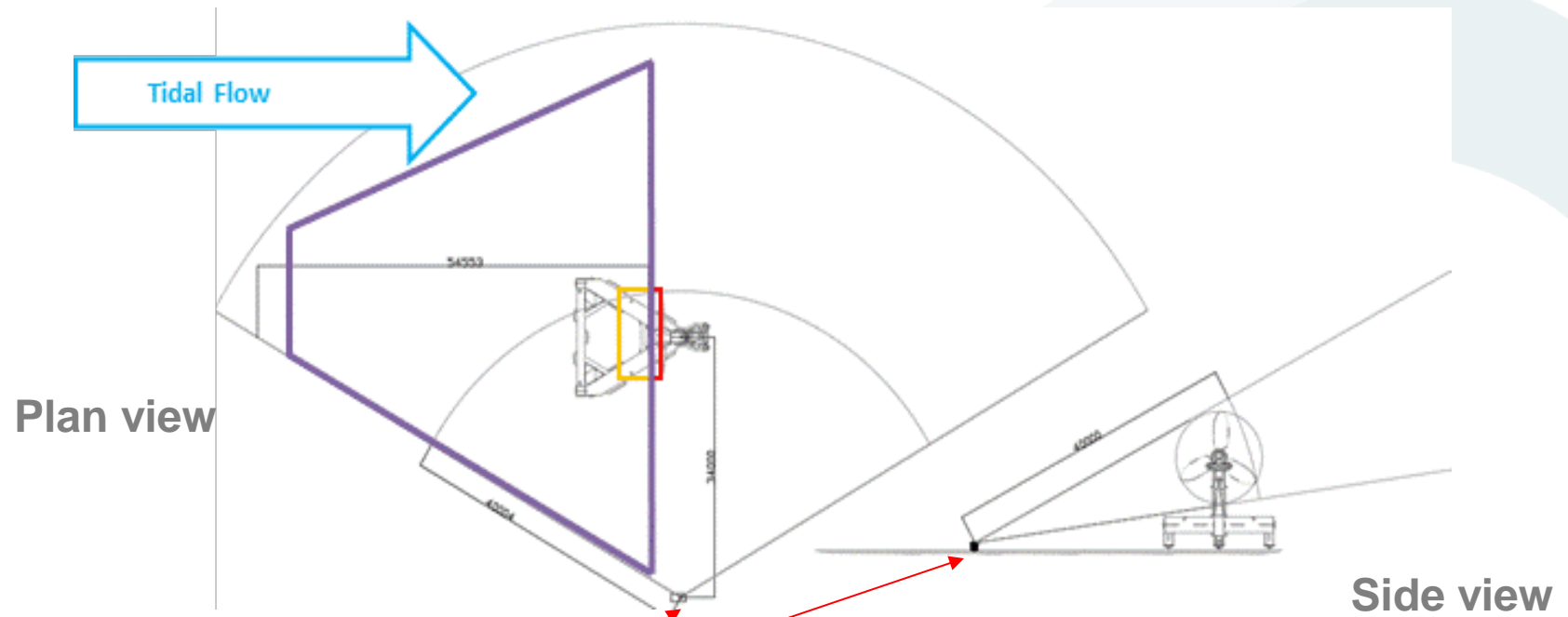
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Cyfoeth
Naturiol
Cymru
Natural
Resources
Wales

Active acoustic monitoring:





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