

Ecological research in the Pentland Firth to support development of marine renewable energy.



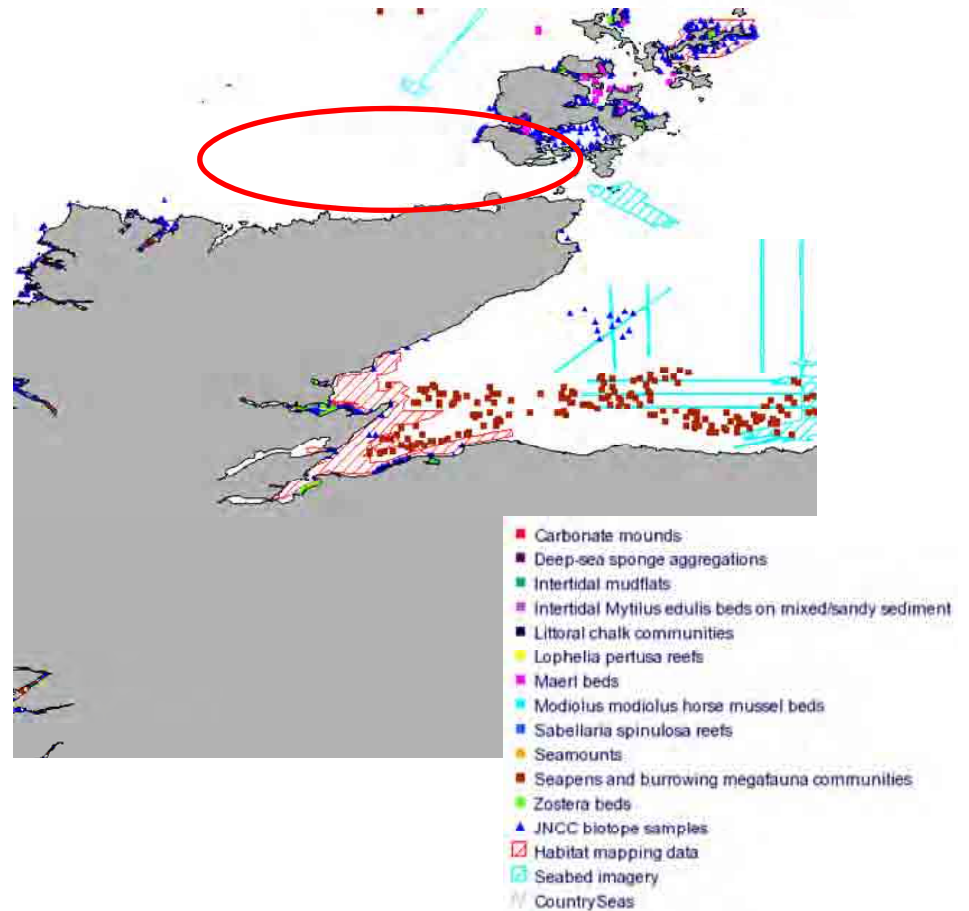
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Environmental Research Institute

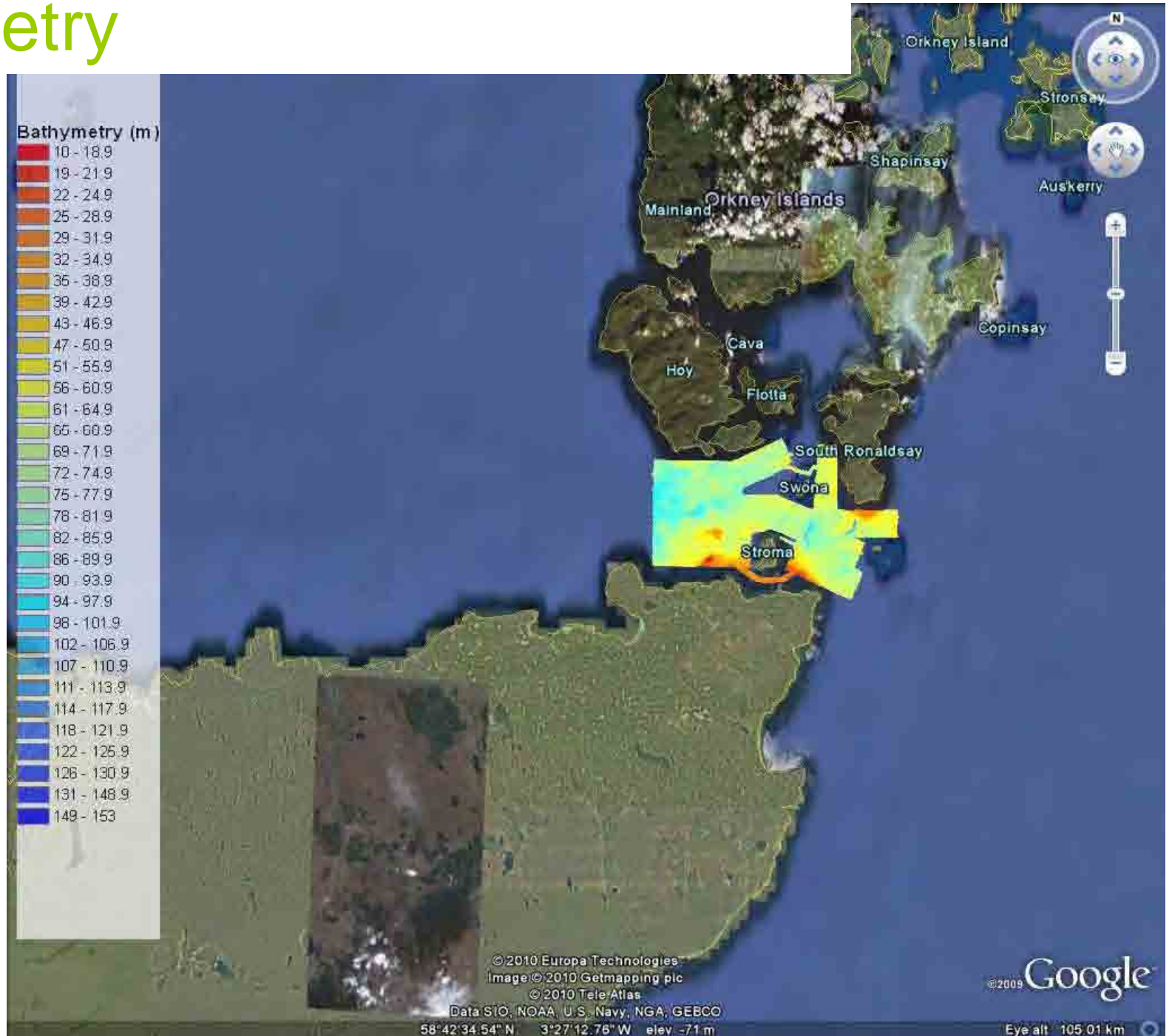


Background

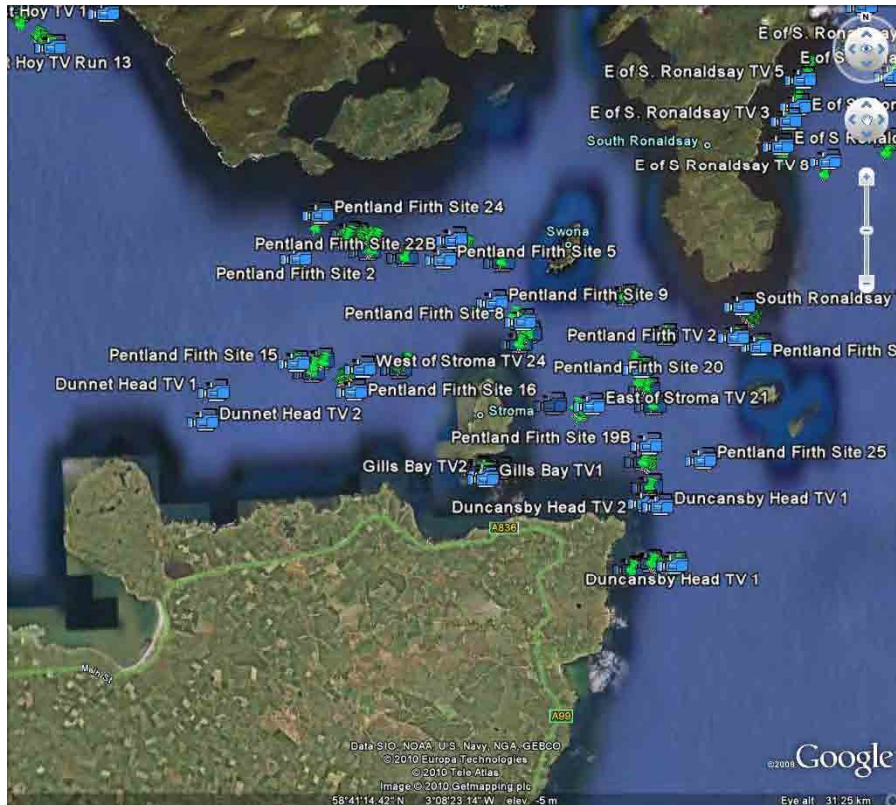
- The Pentland Firth and Orkney waters have enormous potential.
- Development is likely to be rapid.
- Urgent need to understand and predict possible ecological impacts.
- BUT, a major problem is the lack of baseline knowledge.



Bathymetry

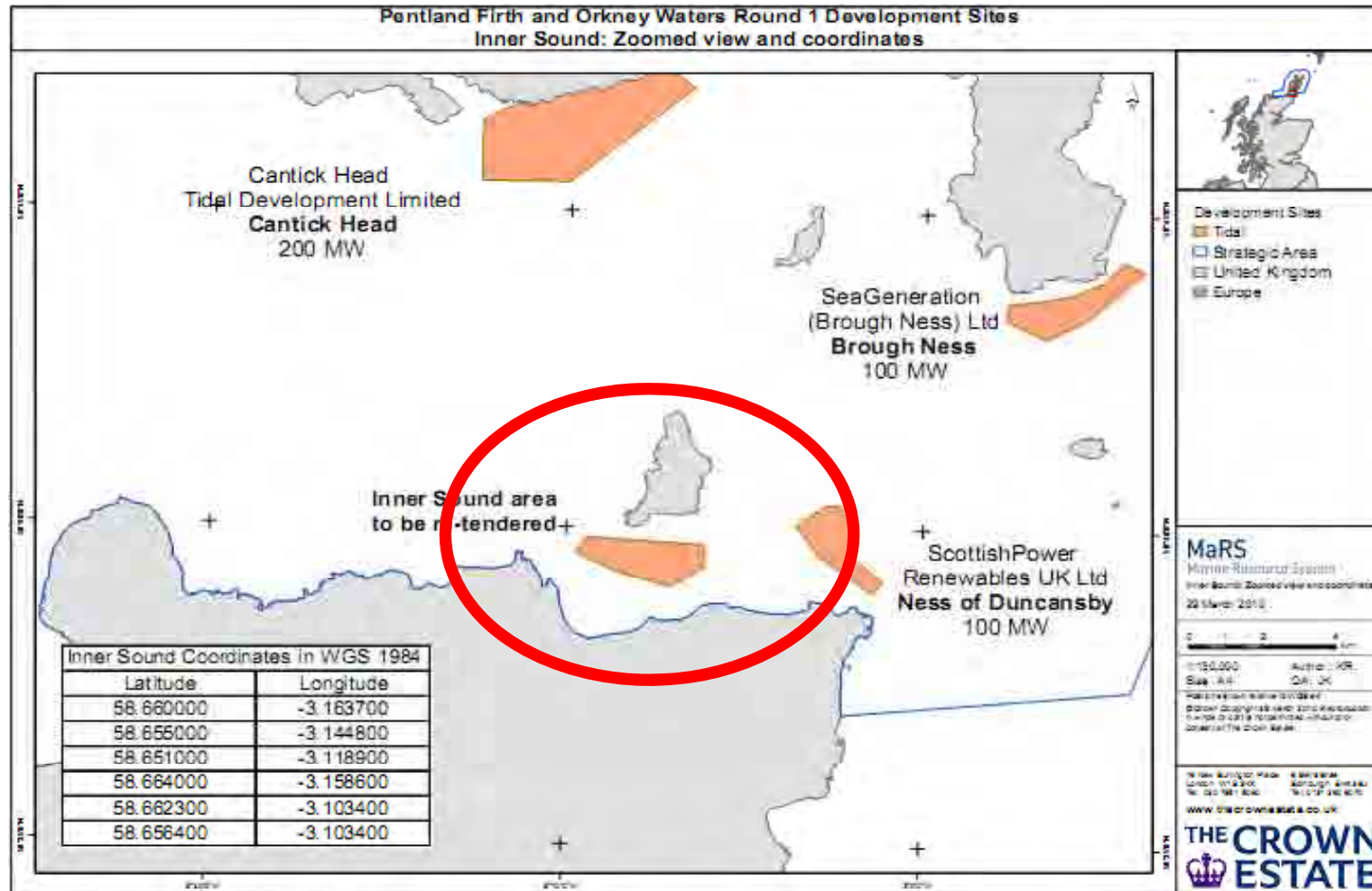


Benthic surveys

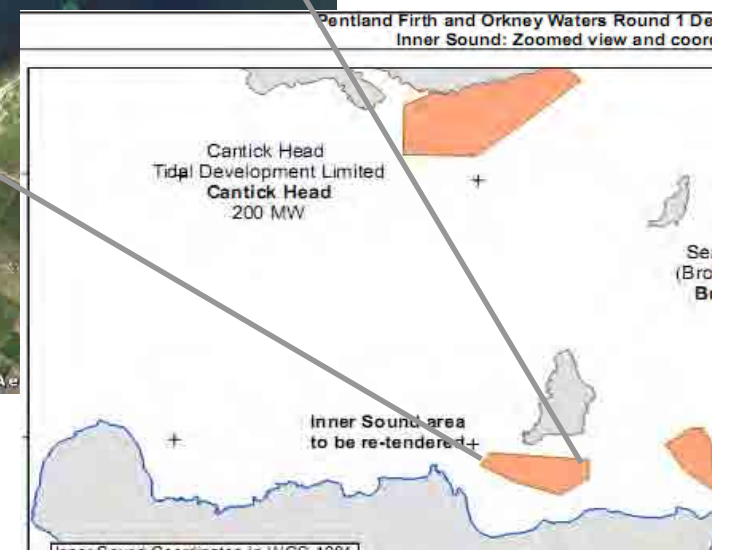


- Mostly rock, some sand and gravel
- Little diversity
- Renewable energy unlikely to have major impacts

Inner Sound of the Pentland Firth

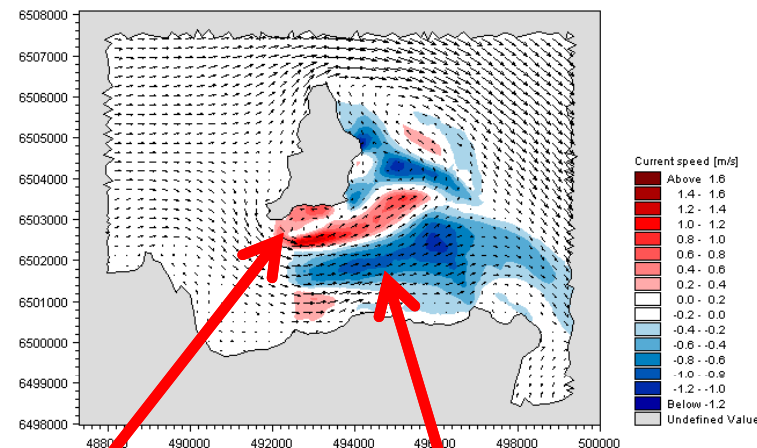
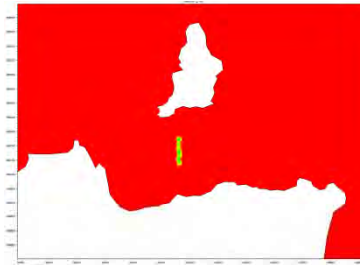


- One of the most energetic tidal areas in the Pentland Firth
- Has potential to generate 200MW or more



Tidal models and simulation of energy extraction

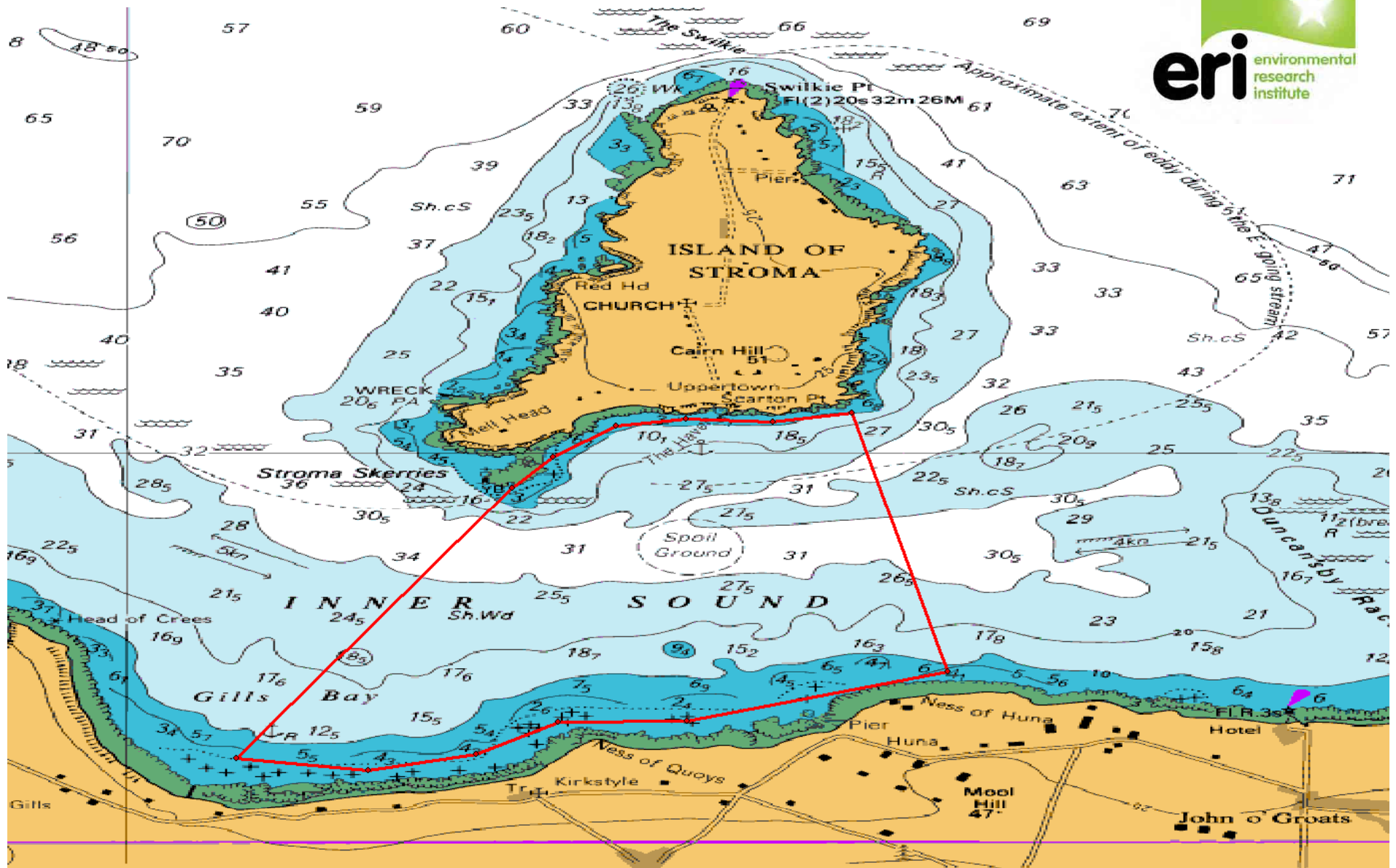
- Simulated tidal energy 'fence'
- Physical effects outside immediate area of 'array'
- Need to understand physical environment and distribution of habitats / species outside the leasing areas.



Flow acceleration
around tidal devices

Decrease in current
speed behind tidal
devices

Study area



Research priorities



- Establish baseline data for Inner Sound
 - Physical environment
 - Benthic communities
 - Seabirds
- Relate biological variables to physical conditions
- Understand natural variability
- Predict potential impacts
- Observe actual impacts

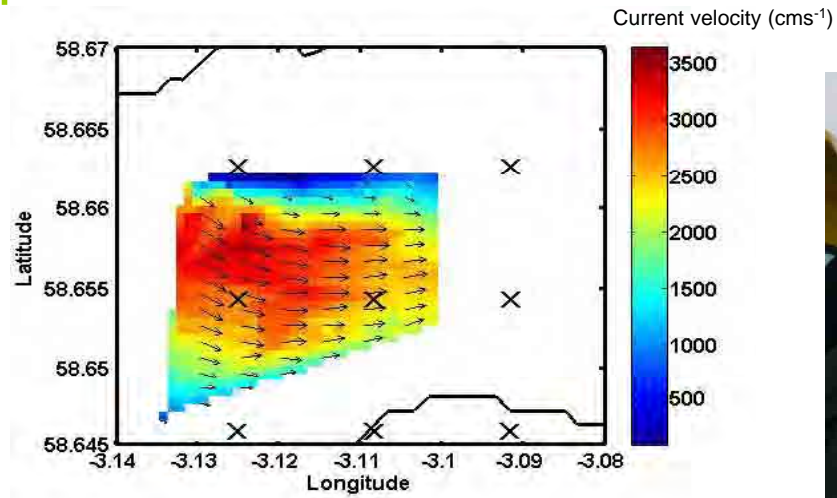


ERI's survey boat "ERI Aurora"

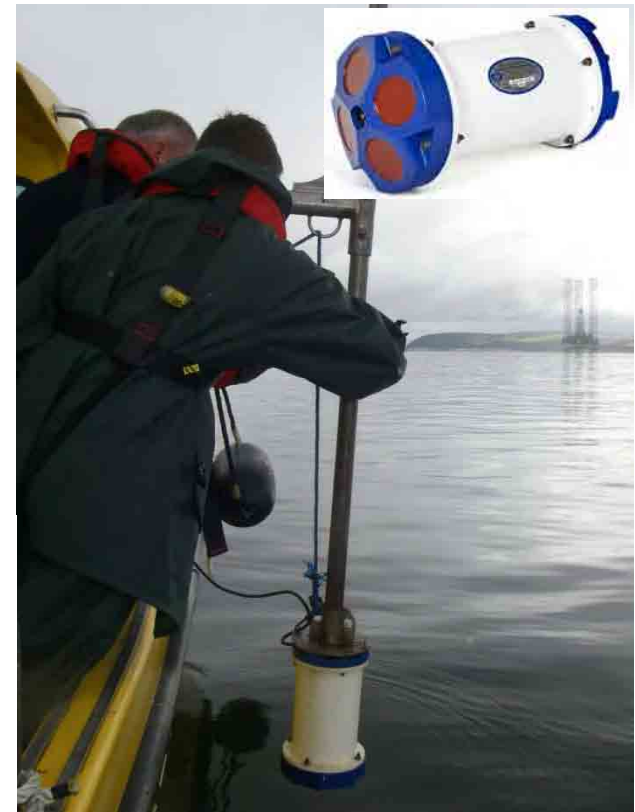
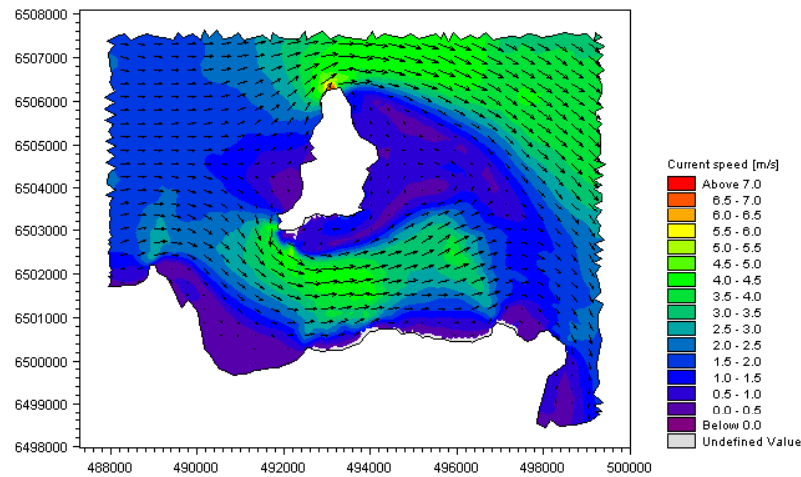
Physical environment

Areas of research:

- Tidal currents
 - ADCP



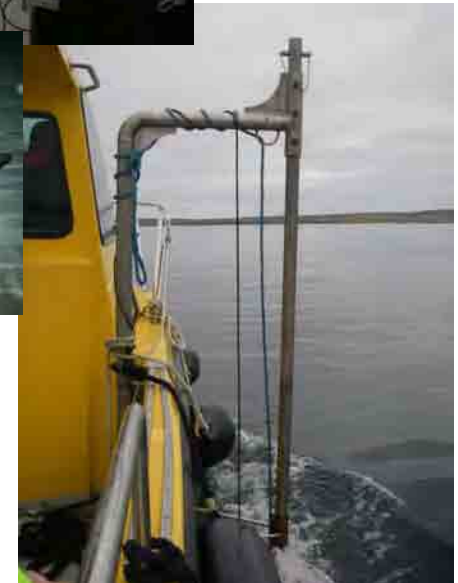
- Tidal models



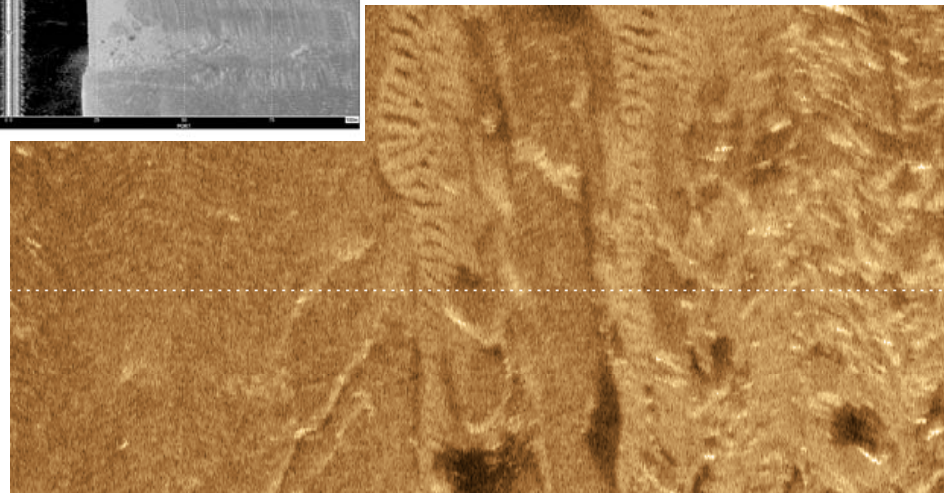
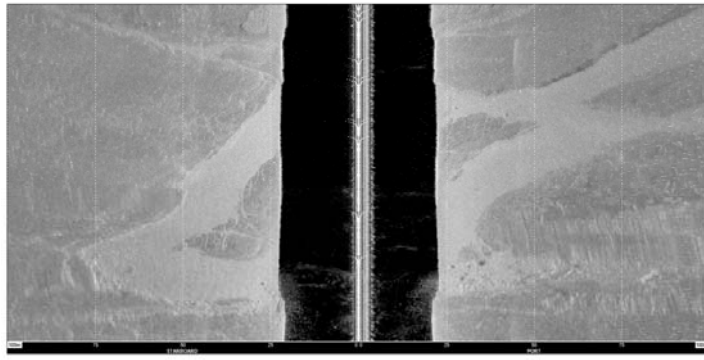
Benthic habitats

Areas of research:

- Tidal currents
- Seabed observation
 - High resolution sidescan sonar for detailed information on seabed features and processes



Sidescan Plotter



Benthic habitats



Areas of research:

- Tidal currents
- Seabed observation
 - High resolution sidescan sonar for detailed information on seabed features and processes
 - Videos and still images from ROV for ground-truthing benthic habitats and identifying species



Fouling and benthic impacts



Potential research areas include:

- Colonization by fouling species and assemblage development
- Seabed modification via 'shell fall'
- Colonization of devices by non-native organisms



Potential approaches include:

- Collection and analysis of ROV video footage
- Analysis of seabed and fouling samples
- Deployment of settlement plates to assess larval supply and recruitment

Fish

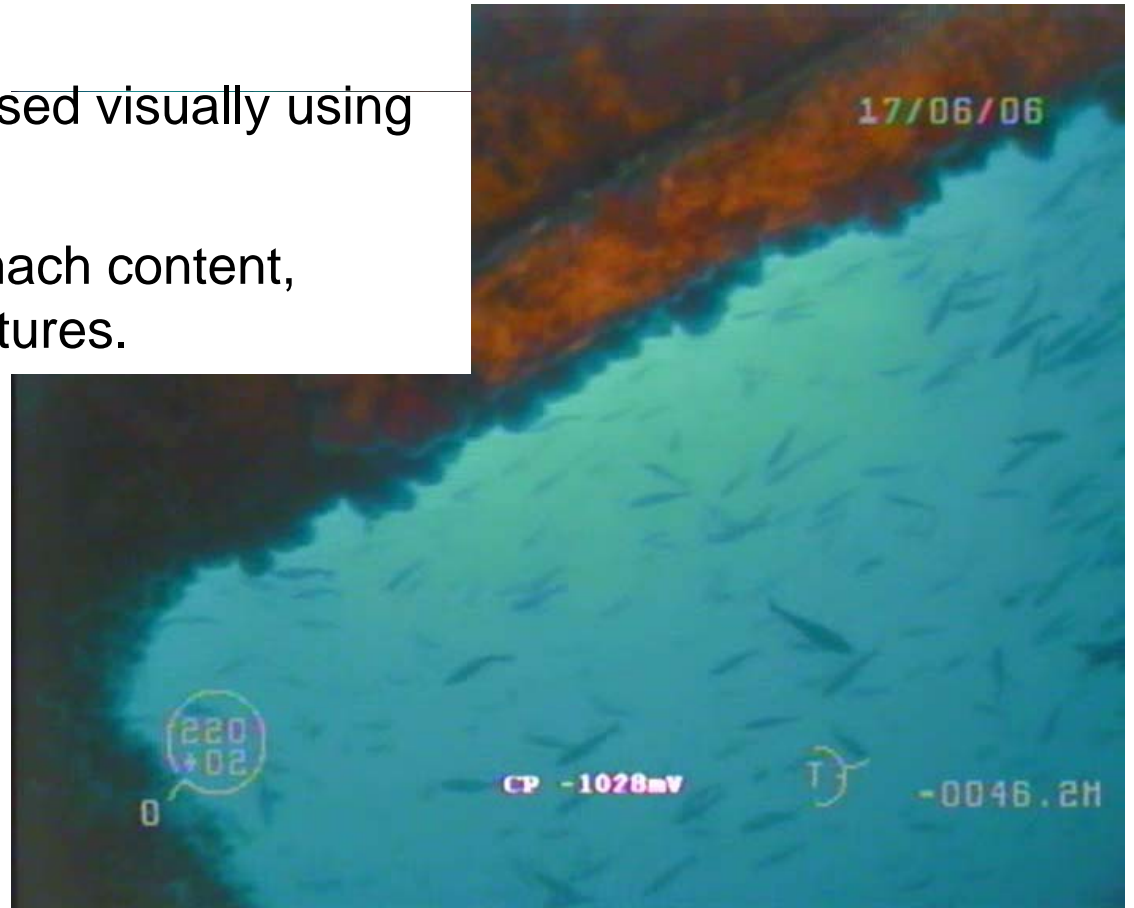


Structures act as Fish Aggregating Devices (FADs)

- Surface penetrating devices attract fish throughout the water column, including pelagics (eg. mackerel)
- Demersal species (eg. cod) may be attracted to seabed infrastructure.

Potential research areas:

- Fish around structures assessed visually using ROV or by imaging sonar.
- Assessment of fish diet (stomach content, stable isotopes) around structures.



Seabirds

Artificial structures at sea may cause:

- Mortality through collision
- Loss, gain or displacement of habitat
- Barriers to movement or additional sites for roosting

Areas of research:

- Interactions with energy devices.
- Assessments at multiple locations of species most likely to be affected



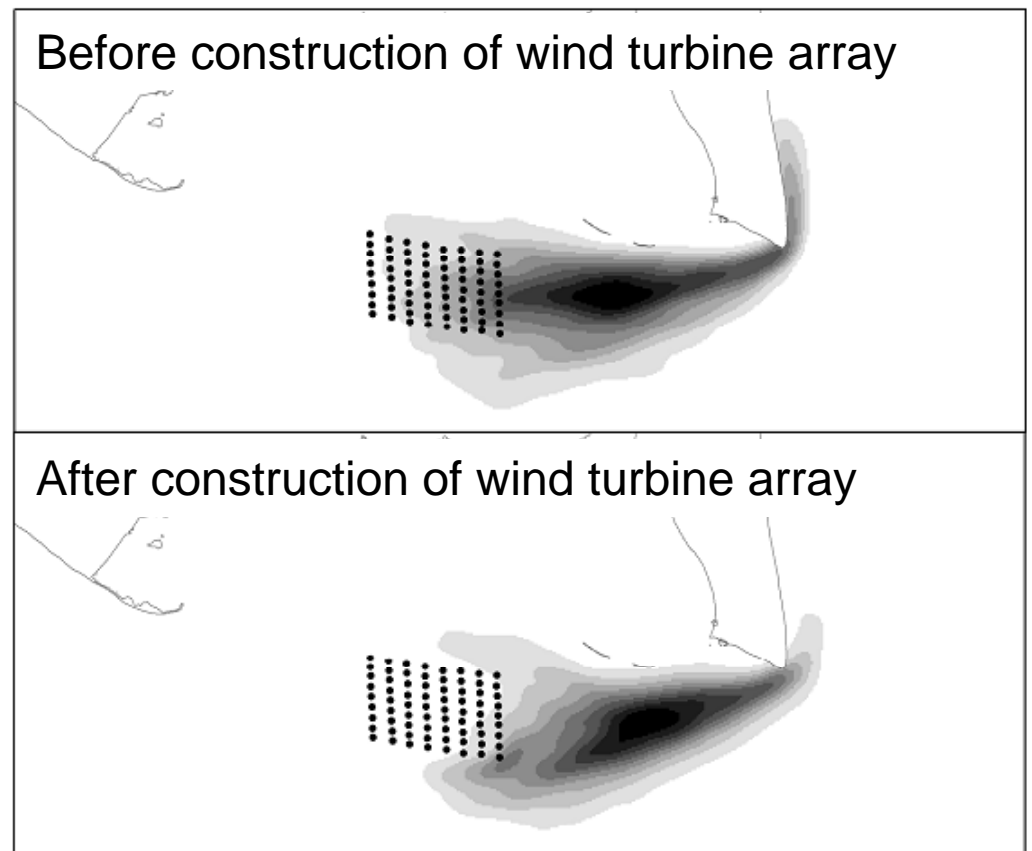
Seabirds

Areas of research:

- Interactions with energy devices.
- Assessments at multiple locations of species most likely to be affected.
- Assessments about use of space in relation to arrays or developments.



Space usage of common eider



Seabirds

Areas of research:

- Interactions with energy devices.
- Assessments at multiple locations of species most likely to be affected
- Assessments about use of space in relation to arrays or developments
- Observations, from shore or vessels

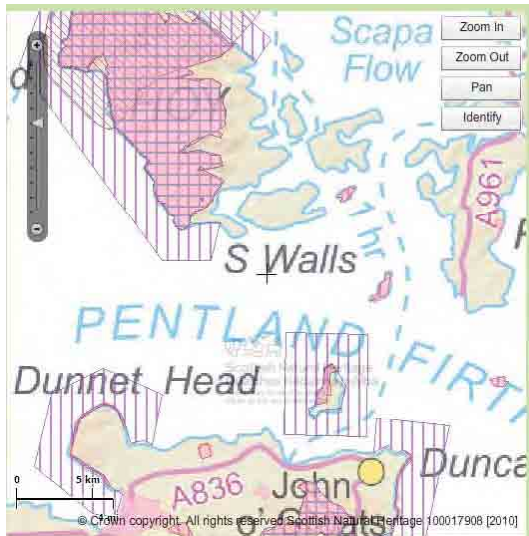


Observing the Inner Sound from St John's head

Seabirds

Areas of research:

- Interactions with energy devices.
- Assessments at multiple locations of species most likely to be affected
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- Observations, from shore or vessels
- Tagging studies



Observing the Inner Sound from St John's head

Seabirds



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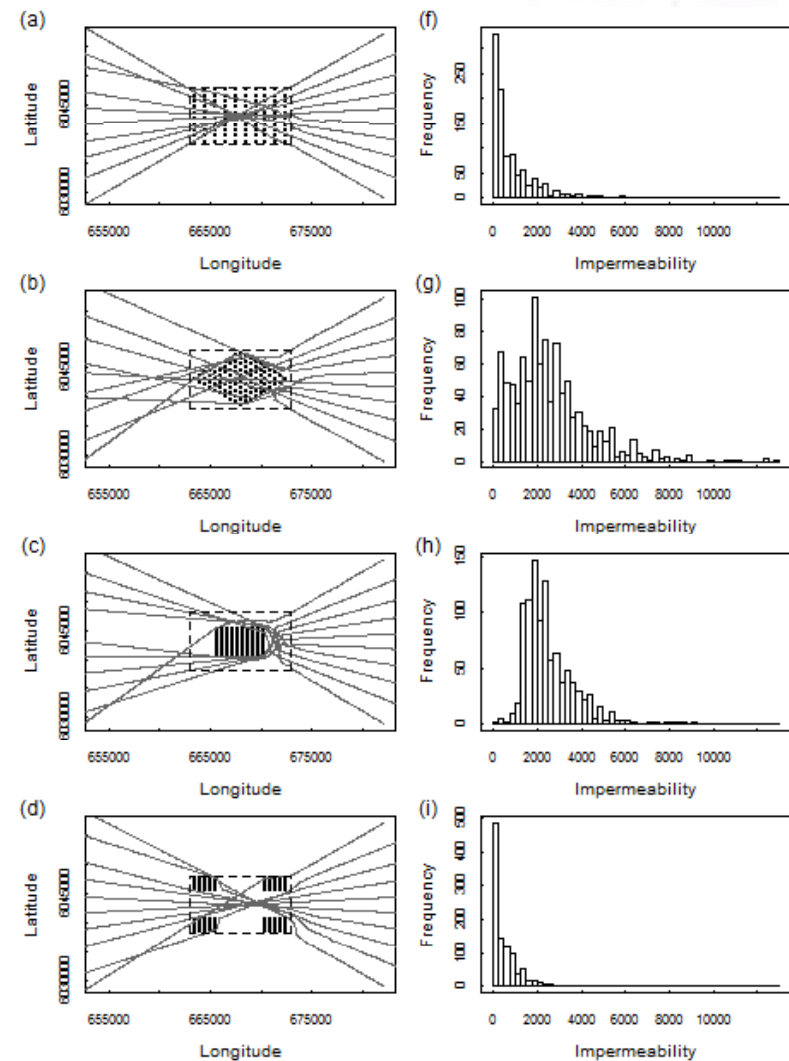
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- Observations, from shore or vessels
- Tagging studies
- Ecological modelling
 - Cumulative impact assessment

$$CI = \sum_{i \in A} \sum_{j \in R} \int_{\Omega} \left(\int_{t_0}^0 I(A_i, R_j, \mathbf{x}, t) dt + \int_0^{t_1} I(A_i, R_j, \mathbf{x}, t) dt \right) d\mathbf{x}$$

Seabirds

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- Observations, from shore or vessels
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- Ecological modelling
 - Cumulative impact assessment
 - Processing and analysis of spatial/movement data

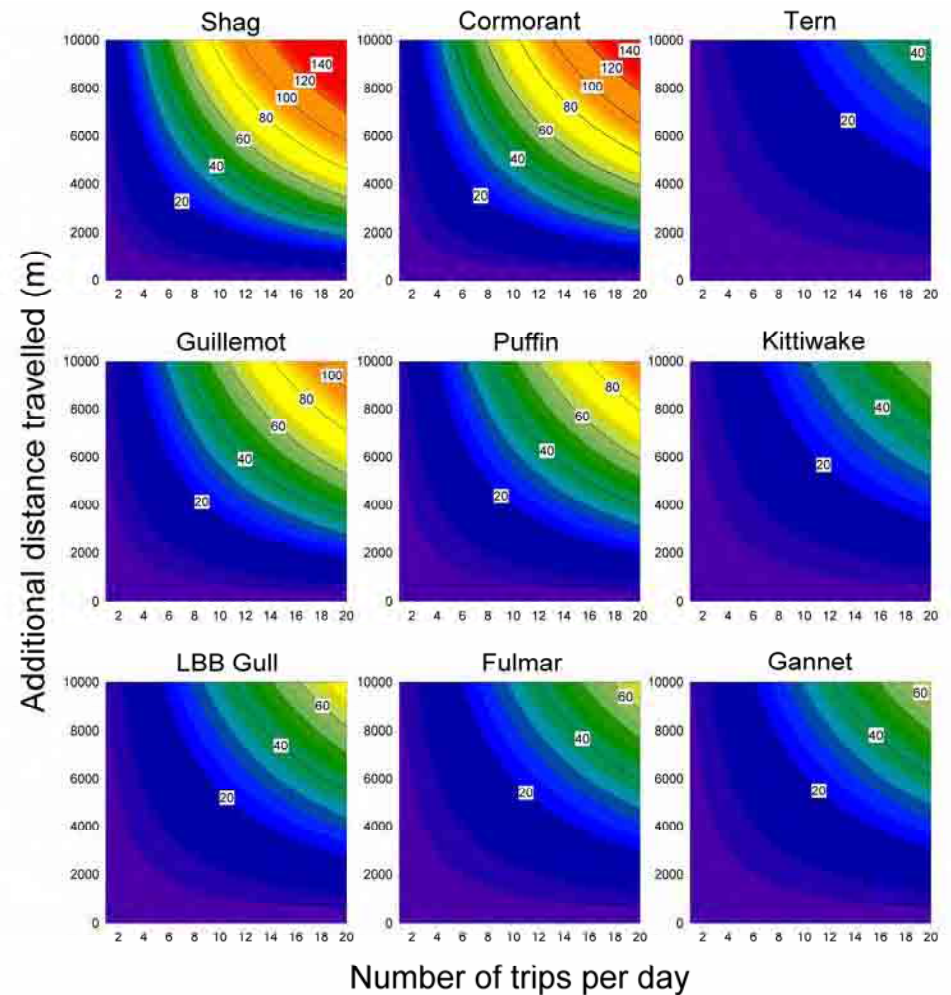


Simulated flight routes through arrays of wind turbines

Seabirds

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- Observations, from shore or vessels
- Tagging studies
- Ecological modelling
 - Cumulative impact assessment
 - Processing and analysis of spatial/movement data
- Energetic costs



Summary



At ERI, we are:

- Addressing some of these knowledge gaps about the biology of these areas
- Mapping habitats and surveying environmental conditions
- Modelling environmental impacts on benthic habitats and seabirds
- Expanding our research in “renewable energy and the environment”
- Making strenuous efforts to understand some of the environmental issues surrounding marine renewable energy

Data and information from this research will support developments in marine renewable energy in the Pentland Firth and beyond.

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