Go with the flow:

Understanding the ecological implications of altering the hydrodynamics of the marine environment

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Potential impacts associated with each phase of a development

Installation

Habitat removal; increased turbidity; smothering of species and habitats; contamination; increased noise and vibration.

Operation

Electromagnetic fields; collision risk; increased habitat heterogeneity; colonization opportunity; increased noise and vibration; sediment transport; alteration of water movement.

Decommission

Habitat removal; increased turbidity; smothering of species and habitats; decreased habitat heterogeneity; colonization opportunity, increased noise and vibrations

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Benthic Ecology

Understanding the physical environment will be essential for understanding the ecology of high energy environments.

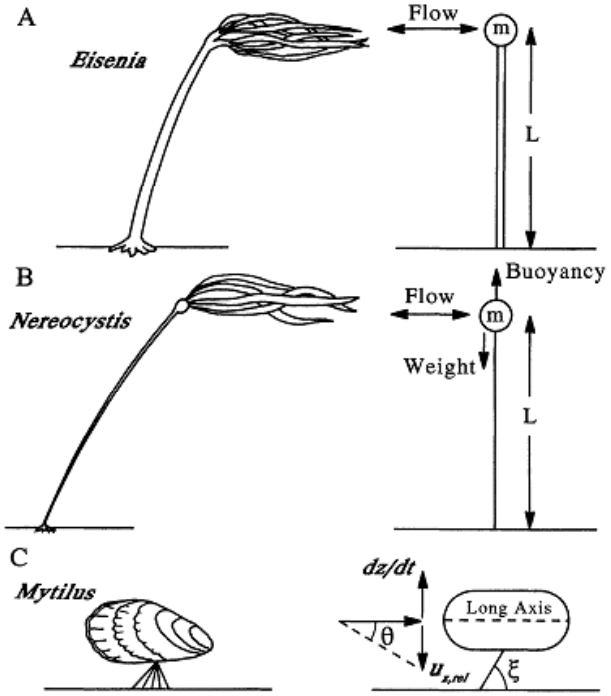
We have an understanding of how benthic organisms can survive in high energy environments.

Benthic organisms have various adaptations that allow them to survive:

A) Kelp - Thick holdfast

B) Kelp - Thin flexible holdfast

C) Mussels - Many byssus threads



Denny et al 1998

Benthic species and habitats

There is insufficient information on the benthic ecology of high energy marine environments.

Removing energy may influence:

- Sediment resuspension/settlement.
- Species distribution.
- Growth and survival of suspension feeders.
- Foraging by predators.
- Body morphology.

Understanding the resource is essential for predicting the ecological implications of altering that resource.

Habitat Classification Approach

EUNIS Habitat Classification Scheme:

'It is a continuous work programme to develop a comprehensive framework for the classification of European habitats and to provide descriptions of European habitat types within the framework.'

A habitat is defined:

- Primarily by physical features e.g. geomorphology, salinity, human impacts, wave exposure etc
- Secondly by the species of plants and animals

There are limitations, it is a comprehensive but not complete classification of all marine habitats. This is most notable in high energy environments due to our limited understanding of the ecology.

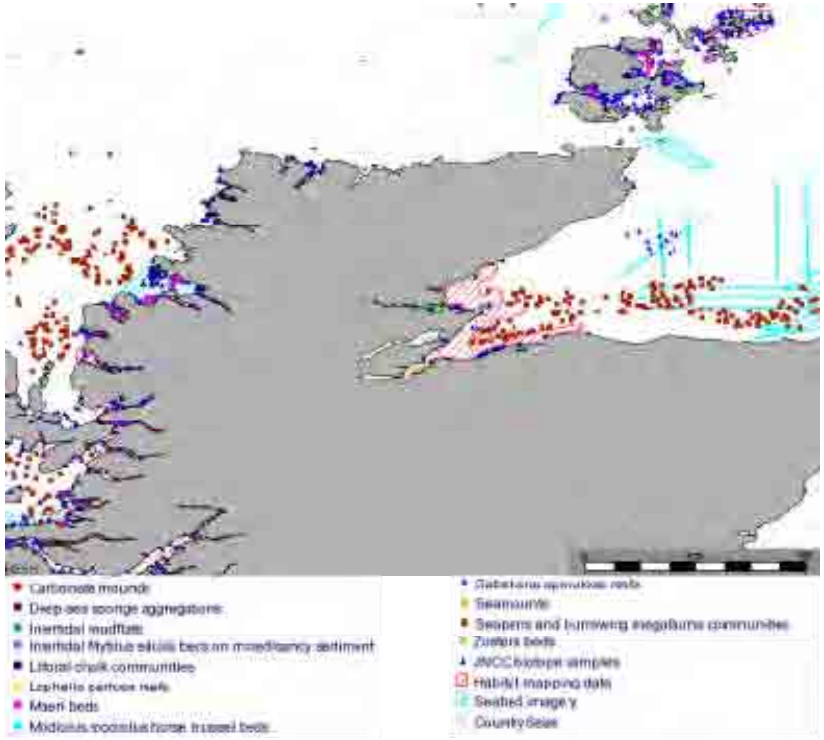
Habitat Classification Approach

					Energy balances and flows			
Characteristic EUNIS Level 3 habitats	Description	Relevant Species at EUNIS Level 3	Species legal status	Category	Increase in water flow rate	Decrease in water flow rate	Increase in wave exposure	Decrease in wave exposure
A3.2 : Atlantic and Mediterranean moderate energy infralittoral rock	Infralittoral zone, bedrocks and/or boulders, moderately wave exposed and/or moderately strong to weak tidal streams	*Laminaria digitata*	None	Intolerance	Low	Intermediate	Low	Intermediate
				Recoverability	High	High	High	High
				Sensitivity	Low	Low	Low	Low
				Evidence / Confidence	Low	Low	High	Moderate
A4.1 : Atlantic and Mediterranean high energy circalittoral rock	Circalittoral zone, bedrocks and/or boulders, exposed to extremely exposed wave action and/or strong tidal streams	*Balanus crenatus*	UKBAP: Tidal rapids	Intolerance	Low	Insufficient information	Low	Insufficient information
				Recoverability	Very high	Insufficient information	Very high	Insufficient information
				Sensitivity	Very low	Insufficient information	Very low	Insufficient information
				Evidence / Confidence	Low	Not relevant	Low	Not relevant
A5.1 : Sublittoral coarse sediment	Coarse sediments including coarse sand, gravel, pebbles, shibgle and cobbles. Coarse sediments often unstable due to tidal currents and/or wave action	*Modiolus modiolus*	EU Habitats Directive Annex I: Reefs; UKBAP: Modiolus modiouls beds; The OSPAR Conventino Annex IV	Intolerance	Intermediate	Intermediate	Intermediate	Tolerant*
				Recoverability	Low	Low	Low	Not relevant
				Sensitivity	High	High	High	Not sensitive*
				Evidence / Confidence	Low	Moderate	Very low	Very low

(White 2004; Tyler-Walters 2007; Hill 2008)

Marine habitats in the Pentland Firth (2008)

There is often limited ecological data available for areas of interest for marine renewable energy developments.



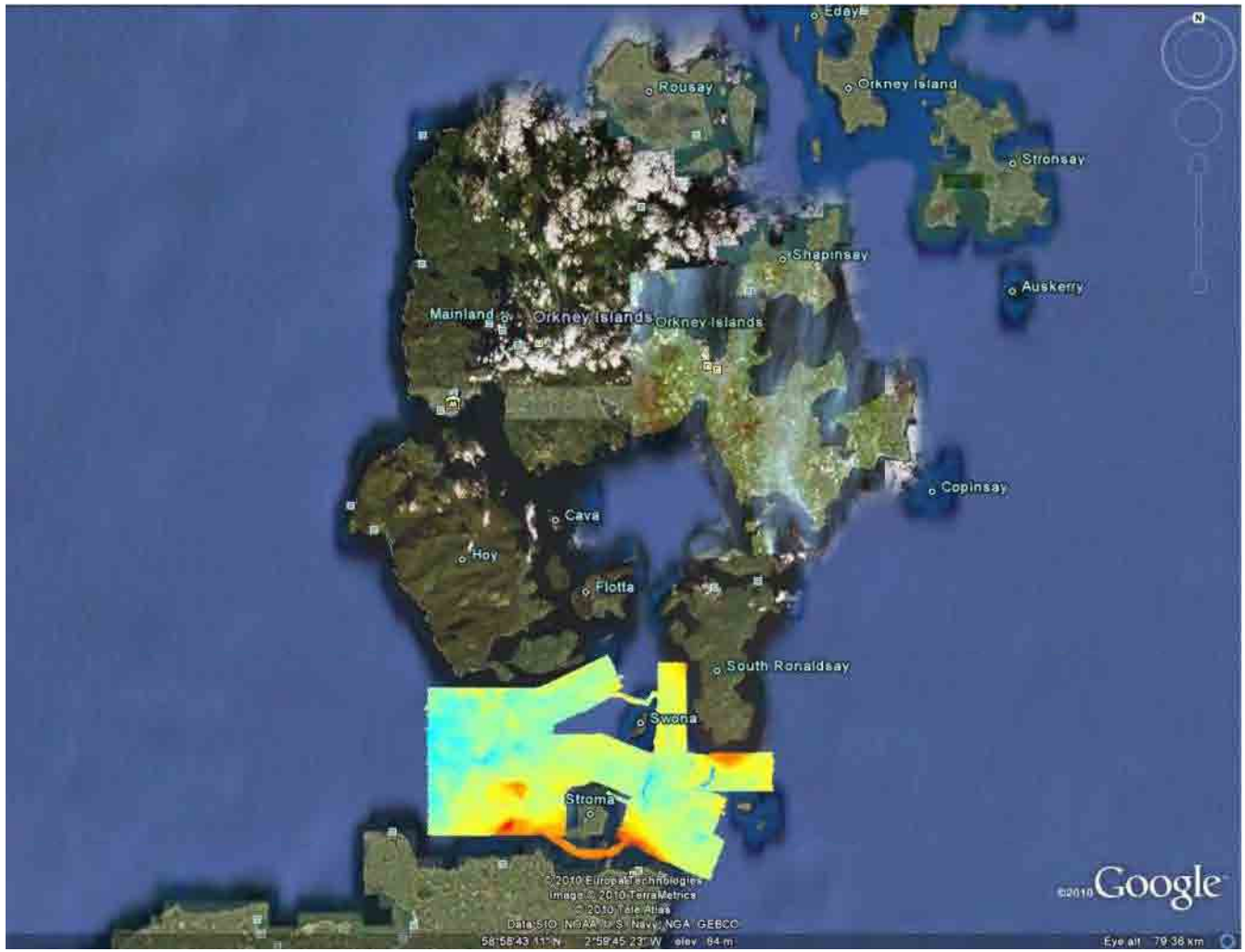
Habitat data available for northern Scotland. (www.searchmesh.net) Highlighting the limited habitat data for the Pentland Firth.

Shields et al (2008)

Marine habitats in the Pentland Firth (2010)

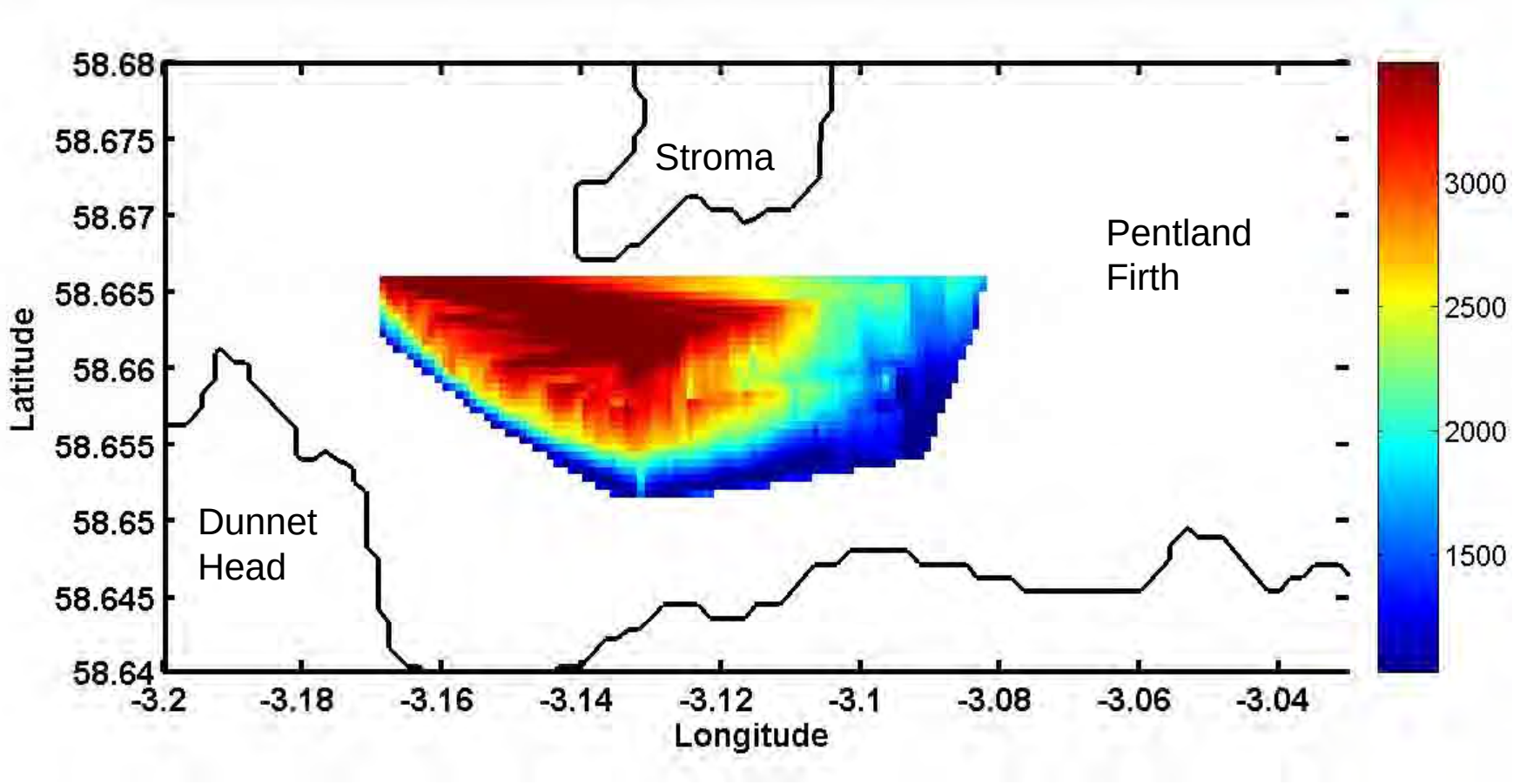
http://www.scotland.gov.uk/Topics/marine/science/MSInteractive

Multibeam data for the Pentland Firth



http://www.scotland.gov.uk/Topics/marine/science/MSInteractive

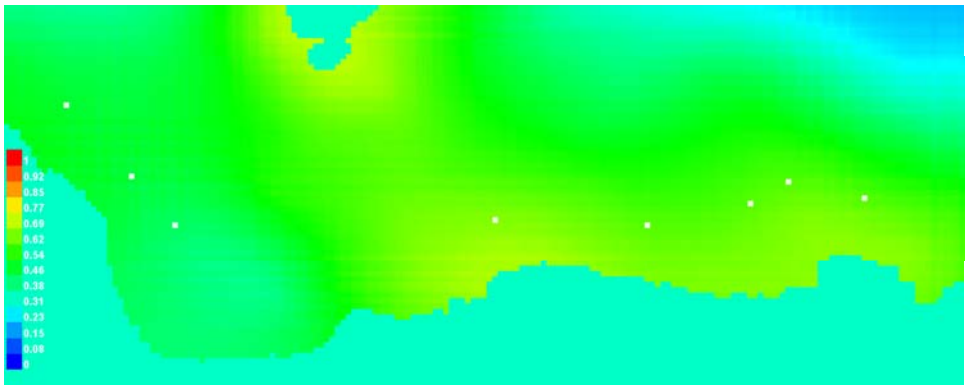
Generating useful data

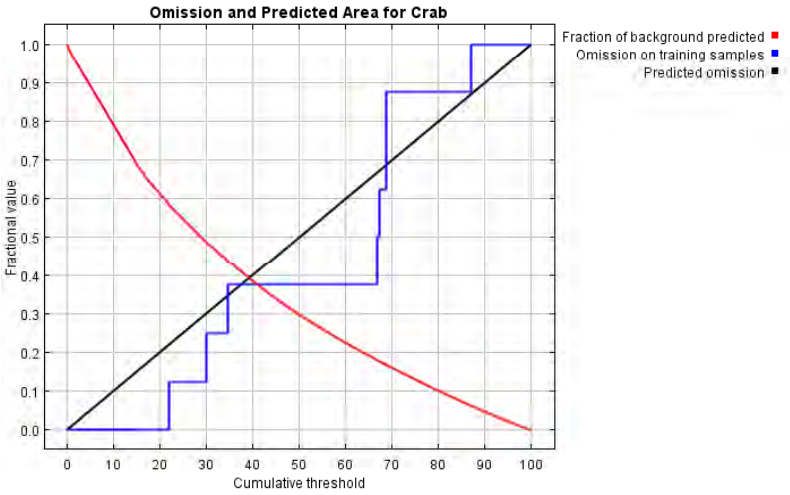


Work undertaken when at the ERI.
Courtesy of Goddijin-Murphy.

Modelling distributions of organisms

Spatiotemporal modelling incorporating habitats and distributions of benthic can assist with licensing of regions of seabed designated as suitable for marine energy device installation.





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Subsea biology & instrumentation

Oceanlab
UNIVERSITY OF ABERDEEN

- Monitoring & measuring the sea floor with Landers & ROV operated tools to 10,000m