Benthic habitats in extreme flow environments of the Pentland Firth – the Inner Sound of Stroma

Astrid Harendza[1], Dr Angus Jackson[1], Dr Mark Shields[2], Prof. Jonathan Side[3]

Work stream 10: Ecological Consequences of Tidal and Wave Energy Conversion

Introduction

The Pentland Firth, located between the North coast of mainland Scotland (UK) and the Orkney Islands, is an area with excellent potential for generation of tidal energy. Development sites with an overall capacity of 800 MW were awarded for this area by the Crown Estate during 2010 (Fig. 1). With the first deployments of tidal energy devices (TED) planned for 2013, the need for a better ecological and physical understanding of this unique environment, characterised by strong and turbulent tidal currents, is urgent. Baseline data are required to assess possible ecological impacts due to tidal energy development [1].

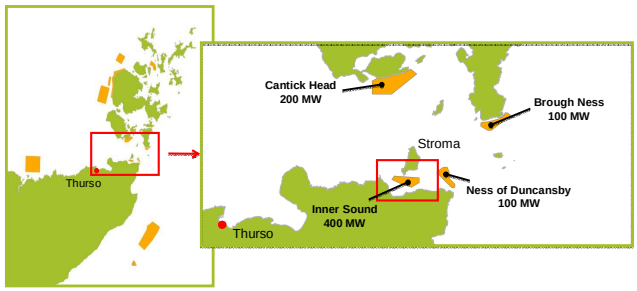

Fig. 1: The Pentland Firth and it's designated tidal energy development sites

Benthic organisms, living in highly energetic environments, are expected to develop particular adaptations to their environment. Installation of TEDs induce alteration current flow due to their physical presence and extraction of energy. Ecological implications of the alteration of flow and hydrokinetic energy in the marine environment are yet poorly understood [2].

Aims

This study will improve understanding of interactions of benthic habitats with extreme flow environments and thus, allow formulation of hypotheses about possible ecological implications to benthic habitats arising from the installation of TEDs. The focus is, thereby, on the Inner Sound, located between the island of Stroma and Caithness (Fig. 2). This site is one of the most energetic tidal areas in the Pentland Firth with a designated tidal energy development of 400 MW.

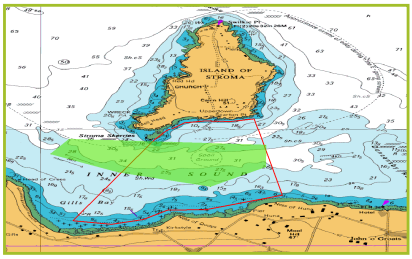

Fig. 2: The Inner Sound of Stroma. Red framed area defines the survey area, while the development site is highlighted in green.

Methods

Key requirements:

- ***Physical environment***
  - → bathymetry & topography
  - → tidal currents & boundary layer
  - → substratum
- ***Benthic organisms***
  - → density
  - → distribution
  - → diversity

- Admiralty Charts
- Multibeam data (Marine Scotland surveys)
- Slope profiles (Sidescan Sonar surveys)

- Acoustic Doppler Current Profiler (Workhorse Sentinel)
  - vessel-mounted, cover of the whole area
- Acoustic Doppler Current Profiler (Aquadopp Z Cell)
  - bottom-mounted, multiple locations
- → Linear interpolations of current measurements along the track and time correction
- → Comparison with Polpred® and MIKE21 outputs

- Sidescan sonar surveys (Starfish 450F)
  - → texture analysis using gray-level co-occurrence matrices

- Remote operated vehicle (Outland 1000)
  - → Point transect surveys after distance sampling method

- Multivariate statistical analysis
  - → correlation of biotic and environmental data

Outcomes

- detailed depth and slope profile
- current profiles during different states of tide
- classification of different flow environments
- determination of "flow habitats" in relation to identified flow classes
- determination of substratum type
- identification of habitat boundaries
- list of species
- abundance of species
- habitat classification

Interactions of benthic habitats with extreme flow environments

References

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[1]Environmental Research Institute, Thurso, KW14 7JD
[2] University of Aberdeen, Oceanlab, Newburgh, AB41 6AA
[3] Heriot-Watt University, ICIT, Stromness, Orkney, KW16 3AW

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