OpenHydro – Fish Response to the Open-Centre Turbine

DOE MHK | 29th August 2011

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Agenda

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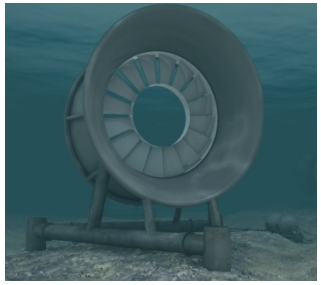
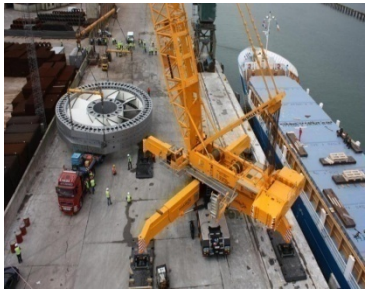
2. Project aim
3. Methodology
4. Results
5. Future works
6. Summary





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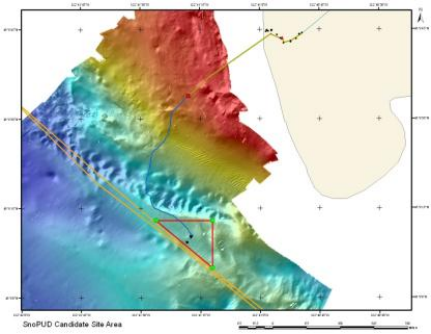
Background

- Gaps in knowledge of baseline ecological conditions at tidal energy sites
- Existing information describes sites as extremely hydrodynamic and climatic environments
- Species and habitats influenced by a range of environmental variables such as velocity flow and biological factors such as recruitment



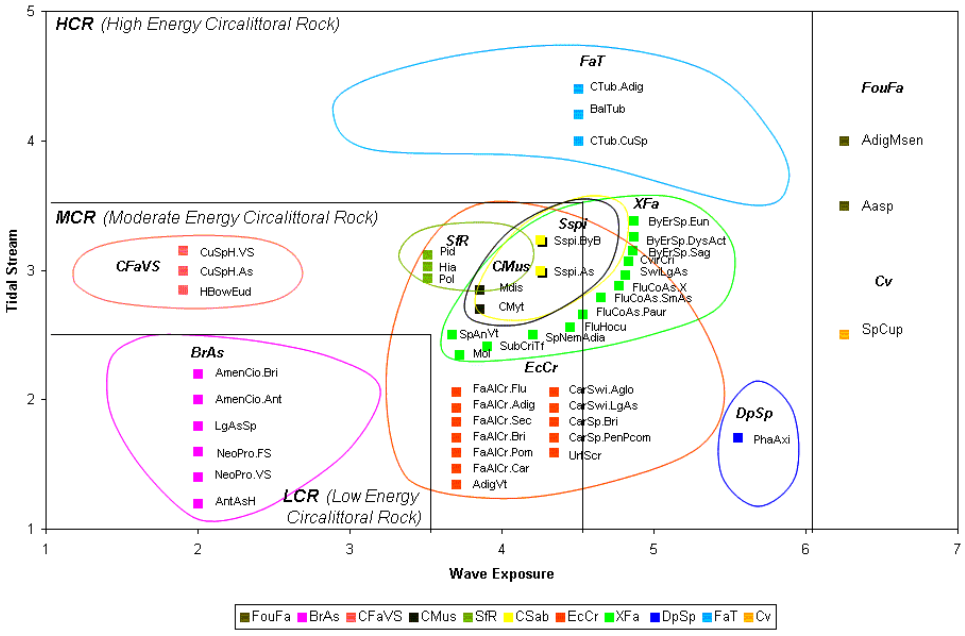


Fig.1. Circalittoral habitat matrix (JNCC)

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How do we determine ecological effects ?

- Past studies reference interaction with other renewable energy devices
- Large gaps in knowledge on specific ecological interactions in tidal streams
- Tidal turbine deployment sites are difficult to sample due to environmental conditions
- Commonly used survey methods may be inappropriate or miss potential ecological interactions

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Methodology

- Located on the West coast of Isle of Eday within the Orkney Isles, Scotland
- Part of the EMEC tidal power test site within the Fall of Warness tidal stream
- (> 8.5 knots, 4 m/s)
- Research conducted on the deployed OpenHydro tidal test turbine platform
- Surveys undertaken between June – July during 2009 and 2010

Fig. 3. Location of EMEC Tidal Test Site.

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Methodology

- ❑ Continuous video recordings using a fixed camera system
- ❑ Data split into hour segments for each day
- ❑ 5 randomised photographs created
- ❑ Fish identified and counted within each photograph frame
- ❑ Count data averaged across the 5 photographs

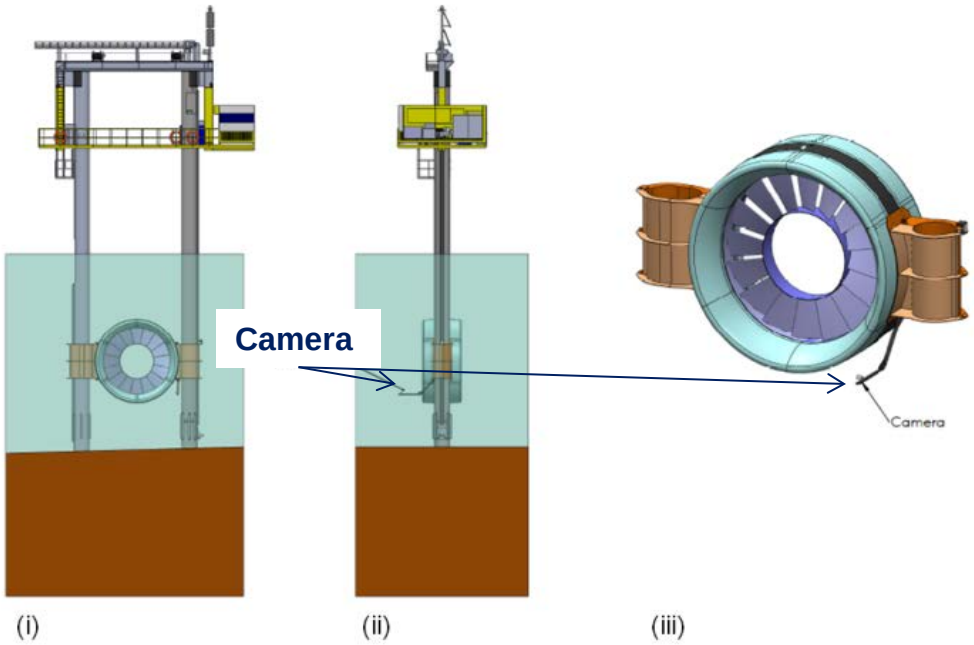

Fig. 4. Schematic view of the deployed OpenHydro Ltd turbine platform

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Project Objectives

- To examine fish interactions with a deployed tidal turbine device
- To assess abundance responses of *P. pollachius* to a deployed tidal turbine
- To assess abundance responses in relation to temporal scales: hour, day and year
- To assess abundance response in relation to important abiotic variables such as velocity flow
- To integrate video camera techniques with ADCP methods to assess responses

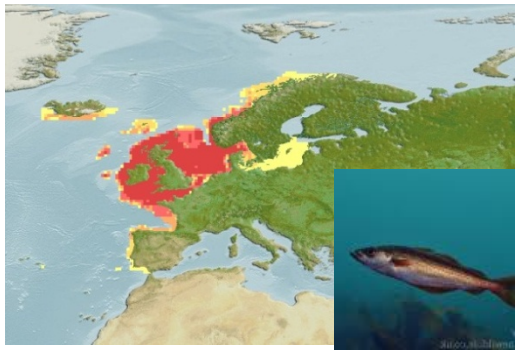

Fig. 2. *P. pollachius* distribution range

Velocity flow measurements

- Nortek Aquadopp two beam ADCP data collected

- Continuous horizontal velocity rates measured every 10 seconds

Data analysis

- Fish abundance counts were compared at different times of the day

- The relationship between fish abundance counts and velocity flow was assessed using a statistical analysis

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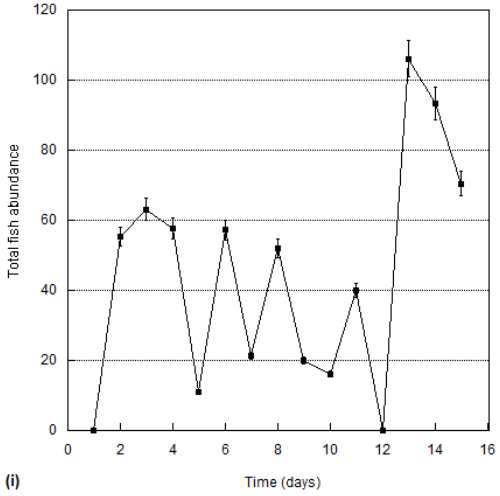
Results

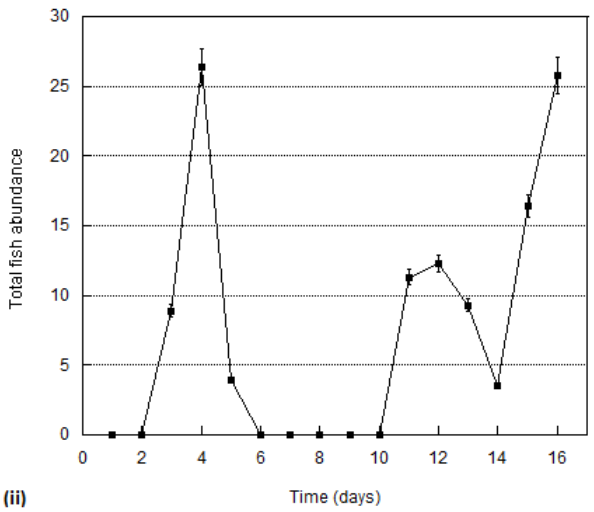
- A total number of 261 hours of video footage was recorded during both survey years
- *P. pollachius* was recorded in aggregations for both survey years round the device platform
- Aggregations may be attracted to the platform for refuge or feeding opportunities
- Fish presence accounted for 13% of the total video footage in 2009 and 8% in 2010

Fig. 5. Examples of photographic stills captured from the video surveys

Results - Abundance Responses

- The number fish observed within each hour ranged from 0 – 46 in 2009 and 0 – 11 in 2010
- Abundance counts fluctuated considerably across each hour and survey day for both years, with no clear relationships observed





Explanatory Variable	Year	F	p-value
Hour	2009	0.297	0.586
	2010	0.031	0.8605
Day	2009	1.34	0.248
	2010	1.94	0.1639
Year		25.60	<0.001

Fig. 6. Total abundance counts of *P. pollachius* per day within the 2009 (i) and 2010 (ii) video surveys (± S.E.)

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Results - Abundance response to Velocity

- Statistical results suggest fish abundance is heavily related to velocity rate for both years
- Observations of fish decline as velocity rates increase:
  - 2009 few observations after **1.3 m/s**
  - 2010 few observations after **1.8 m/s**
- High velocity rates may therefore drive fish aggregations to other areas for refuge or better feeding conditions
- A proportion of unexplained variance was identified which may be due to other abiotic / biotic factors or sampling methods used

Explanatory Variable	Year	F	p-value
Tidal Velocity	2009	38.31	< 0.001
	2010	4.45	0.001

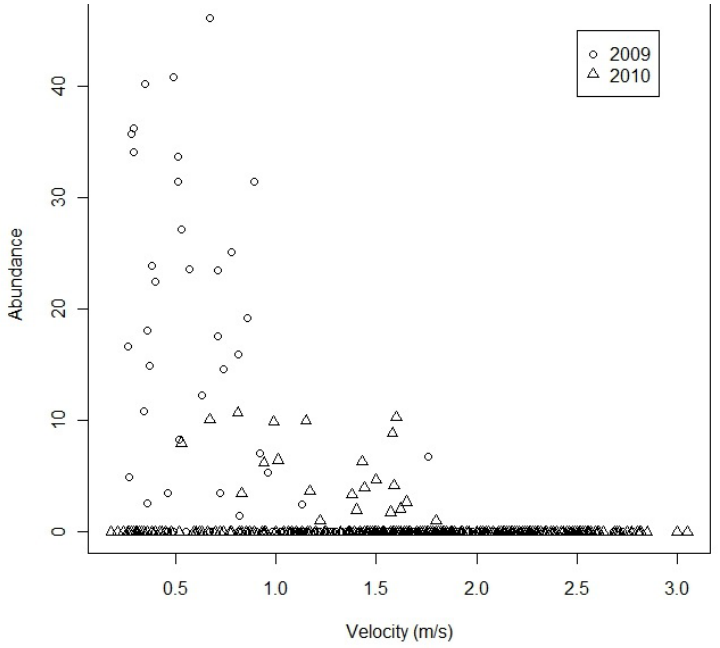

Fig. 7. Abundance counts of *P. pollachius* with corresponding velocity rates for the 2009 and 2010 surveys

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Results

- Overall, fish abundance was significantly larger in 2009 than 2010:
  - 664 total individuals recorded in 2009
  - 121 total individuals recorded in 2010
- Past literature outlines that fish show natural daily, seasonal and annual movement patterns
- No fish collisions or entrainment observed
- Fish only present at very low states of tide and specific times of year
- Only one species observed, no marine mammals in the vicinity of the device

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Future Work

- Extension of project to include further annual, seasonal and daily comparisons

- assess abundance response at seasonal temporal scales
- further investigate responses to tidal cycles

❑ Assess and enhance survey methodology and equipment

- model testing
- potential for addition camera surveys
- potential for fish size measurements

❑ Integrate additional abiotic factors:

- water temperature
- climate/ weather conditions

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Thank you for listening
and
many thanks to:

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