

Marine Energy Converters: Will They Affect Inshore Ecosystems?

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INTRODUCTION

Installation of wave energy devices in high energy inshore zones will lead to changes in the incident wave and current climate

These changes may have significant effects on the biodiversity and community stability of these ecosystems

For marine energy project approval purposes, there is thus an urgent need to predict the possible impacts on coastal inshore zones.

WHY STUDY KELP?



- Cold water inshore ecosystems are among the most productive in the world
- Main component are large brown seaweeds (kelps), which occur in the immediate subtidal area down to 15 – 25 m.

The kelp zone:

- Has a very high biodiversity
- Supports complex food webs
- Is a nursery area for fish
- Is economically important for the medicinal, food and cosmetic industry
- Acts as a buffer by absorbing wave energy thereby reducing shore erosion

WHAT CONTROLS KELP GROWTH?



The main factors influencing growth rates of individual kelp plants are:

- Light
- Nutrient availability
- Temperature
- Hydrodynamics – Increased water flow usually associated with increased growth rates

Hydrodynamics are especially important as they will:

- Influence nutrient and carbon acquisition through boundary layer effects thereby influencing photosynthesis and growth
- Reduces self-shading of the fronds
- Affect plants and populations directly through physical damage – storm effects

PROJECT AIM AND APPROACH

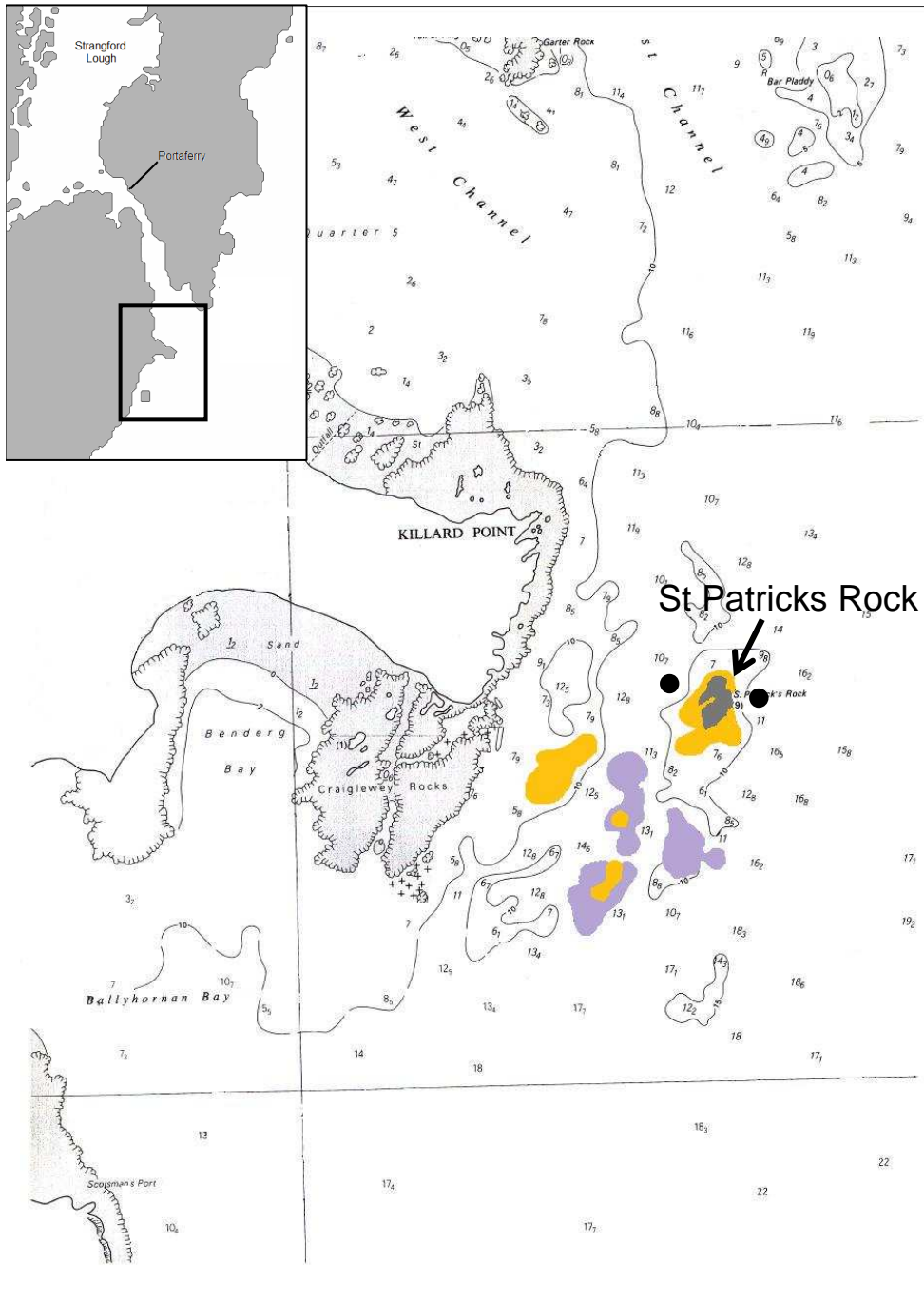


AIM:

To assess the influence of contrasting hydrodynamic regimes on the growth and stability of comparable kelp populations

APPROACH:

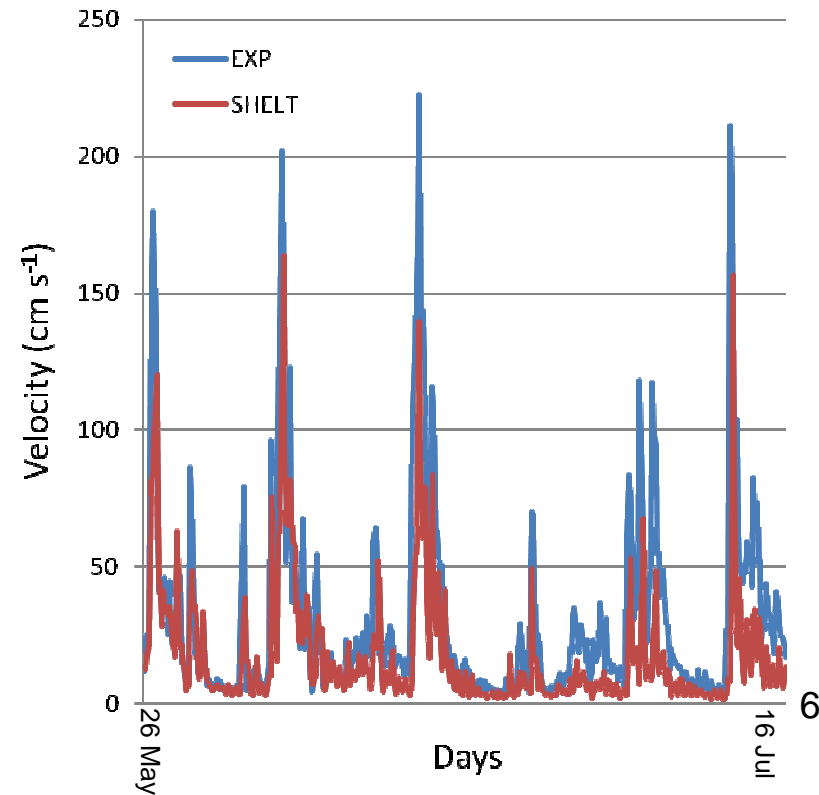
To investigate the relationship between the growth rate and water motion of natural populations of the kelp *Laminaria hyperborea* at two sites exhibiting high and low wave energy



SITES

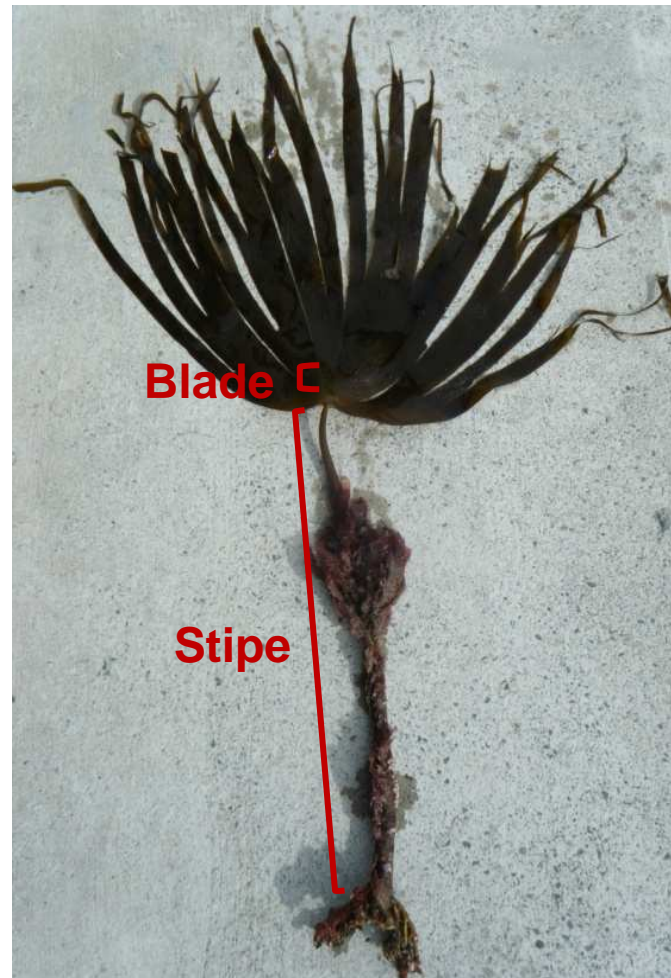


- High and low wave energy sites located by St Patricks Rock close to entrance to the Strangford Narrows
- Deployed one Acoustic Doppler Current Profiler (ADCP) at each site (14 m MLT)

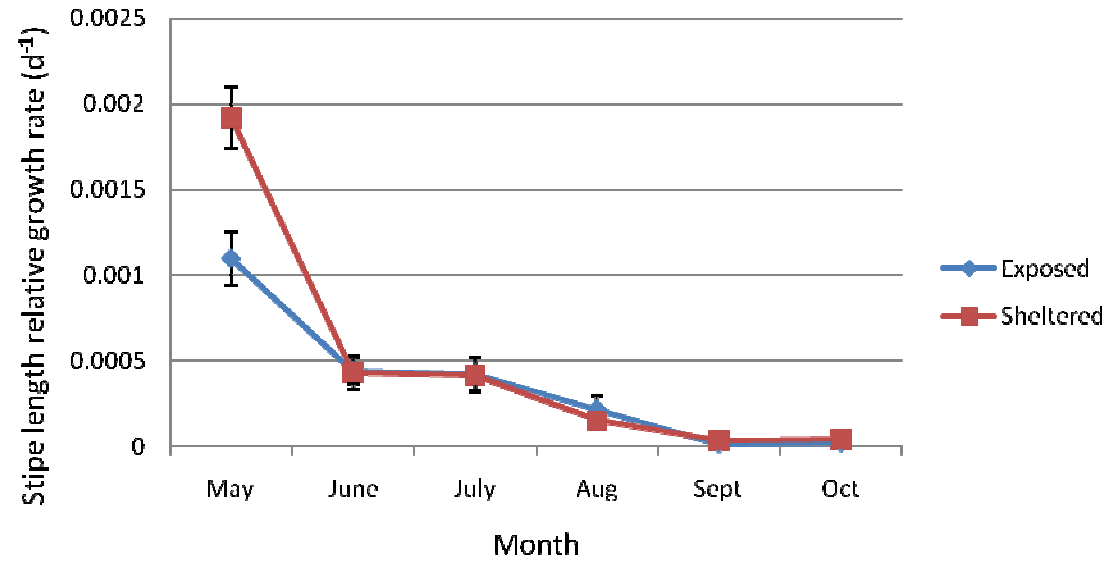


Growth measurements

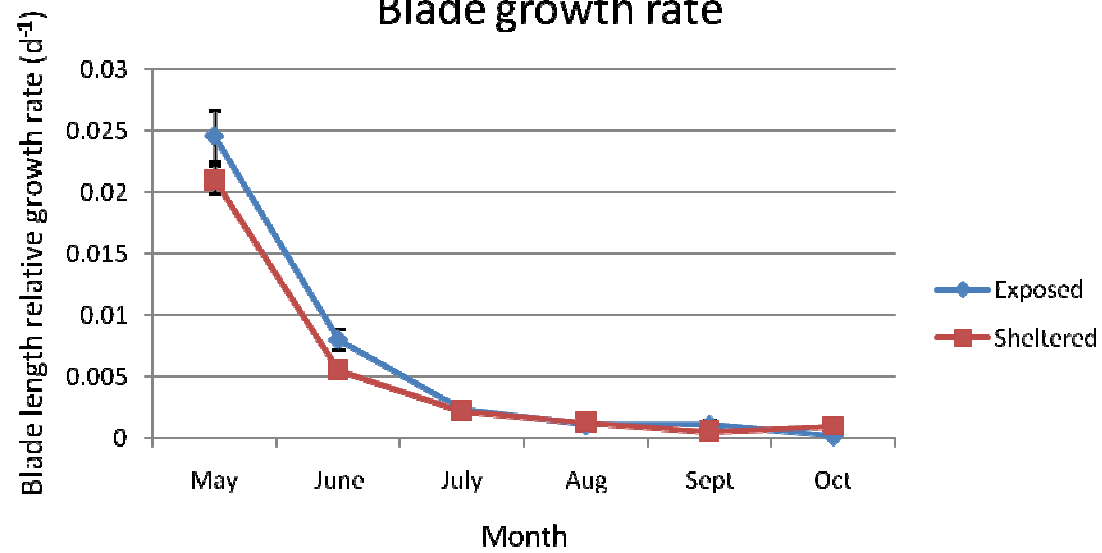
- 20 plants at each site
- Measured once a month
- Measure stipe length
- Measure blade length using the hole punch method
- Seawater nutrient samples
- Light measurements
- Temperature measurements
- Internal nutrient status of the plants



Stipe growth rate



Blade growth rate



ARE THE CONCLUSIONS TO DATE OF SIGNIFICANCE TO THE INSHORE WAVE ENERGY INDUSTRY?



Wave energy arrays are unlikely to have an impact on the growth rate of *Laminaria hyperborea* during the summer

HOWEVER

The critical main growth phase of the kelp and the storm season are during the winter/spring.

The ongoing survey work over the coming winter will establish whether there is net growth of the kelp (plant growth vs. plant losses from damage) and how this is related to differences in the hydrodynamic environment



ASSOCIATED ONGOING RESEARCH

- Measurement of energy absorption by canopies of *Laminaria hyperborea* – concurrent deployments of ADCP's on the seaward fringe of a kelp zone and at a range of distances within the kelp bed
- Growth rates of kelps under controlled flow rates in laboratory conditions – the emphasis is on low flow rates $< 20 \text{ cm s}^{-1}$ and limiting boundary layer conditions
- Growth rates of kelps under various tidal current flows in the field – complementary measurements on the inshore kelp species *L. digitata*

WIDER SIGNIFICANCE AND THE FUTURE



- To reiterate: kelps are the basis of the highly important inshore ecosystem
- This investigation will provide an important first step in predicting whether inshore wave energy devices will have any long term environmental impact
- The major significance of the project is that we shall be quantifying hydrodynamic parameters using measurements of relevance to engineers

HOWEVER

- We don't know as yet how secondary biological effects such as increases in kelp grazers (e.g. sea urchins) or epiphytic fauna on the kelp plants, will interact with the purely hydrodynamic effects on kelp growth population dynamics