Riding the waves: use of the Pelamis device by seabirds

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Introduction

- Rapid developments in the marine renewable energy industry are generating the need for ecological studies about uncertain impacts caused by such developments.
- There are no deployed arrays of devices, so there are few opportunities for case-studies in the field. Studies have been limited to baseline surveys[1], literature review and expert opinion[2], modelling scenarios[3], development of methods[4] and small-scale experiments at test-sites[this study].
- Seabirds are important marine predators, stimulating particular interest[5,6]. Seabirds often take advantage of structures at sea as platforms for foraging or resting[7,8]. Behaviour of birds is often influenced by local conditions of tide, wind and waves[9].
- To investigate how seabirds might use the new floating, coastal structures, an automated camera recorded attendance by birds at the Pelamis P2 wave-energy device owned by Scottish Power Renewables at the EMEC site at Billia Croo, Orkney.

I predicted that: 1) shags, gulls and terns would use the machine to rest or roost.

2) more birds would use the machines during summer months than during winter months.

3) use of the machine would be influenced by the time of day and state of the tide.

4) there would be some conditions of wind or waves, during which the machine would not be used.

Methods

- An *in-situ* digital stills camera, mounted facing aft on section 1 of the P2 took photographs of seabirds using sections 2-5 of the device (Fig. 1).
- Images were collected at five minute intervals, 24 hours a day, during three deployments (Feb.-Mar.; May; June) in 2013.
- From these photos, numbers and identities of all visible birds sitting on the machine were recorded.
- Data on tidal state (ebb/flood), waves (significant wave height and maximal wave height) and wind speed were acquired from the European Marine Energy Centre (EMEC).
- Patterns of use in relation to these variables were explored using polar plots and correlations

Figure 1. Autonomous camera mounted on Pelamis.

Results

- Seabirds made extensive use of the new floating platform provided by Pelamis (Figs 2 & 3). 8 species were recorded (Table 1). No birds were seen in February. Numerous Arctic terns (≤ 65) began to use the device during early May, which coincided closely with their arrival from Antarctica.
- Small numbers of black guillemot regularly used the machine and its vicinity, particularly during June.

Table 1. Species of bird recorded on the Pelamis at Billia Croo during 2013.

Common name	Presence
Arctic tern	Frequently from early May
Black guillemot	Regular, but in small numbers
Greater black-backed gull	Occasional single bird
Herring gull	Occasional single bird
Black-legged kittiwake	Regularly during June
Black-headed gull	One seen regularly with kittiwakes during June
Fulmar	Occasional
Wheatear?	1 possible record

Figure 2. Arctic terns resting on the Pelamis

Figure 3. Black guillemot and Arctic terns on the Pelamis.

Time and tide

- Different species of bird used the device at different times. Terns were present between lunchtime and the evening (Fig. 4), whereas black guillemot were seen during the very early morning.
- Terns were not influenced by state of tide, but kittiwakes were seen only during ebb tide (Fig. 5).

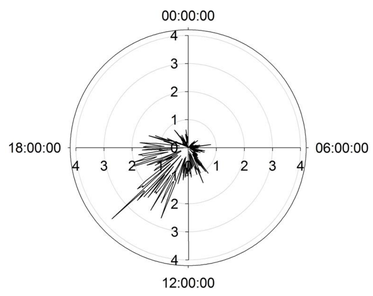

Figure 4. During three weeks in June 2013, Arctic terns used Pelamis mainly between midday and 18:00. Radial axes show mean number of birds

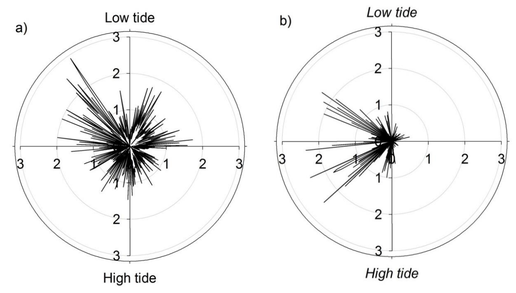

Figure 5. Numbers of a) Arctic terns and b) kittiwake present at different states of tide. Radial axes show mean number of birds.

Waves and wind

- There were weak, but significant negative correlations between numbers of birds and significant wave-height (Fig. 6) (e.g. June; $r = 0.12$, $n = 446$, $p < 0.01$).
- In May there was a moderate and significant negative correlation between wind-speed and number of birds ($r = 0.29$, $n = 268$, $p < 0.001$). This pattern was weaker in June.

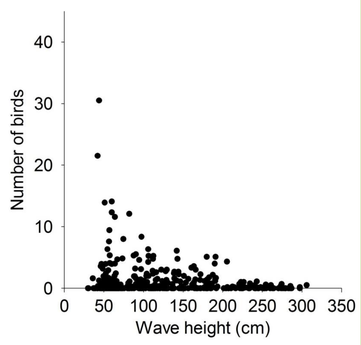

Figure 6. Numbers of birds present on Pelamis with significant wave height

Conclusions

- Low-cost equipment can collect continuous, medium-term (weeks-months) data about use of offshore wave-energy devices by seabirds.
- Floating wave-energy devices can provide some species of seabird with new locations to rest and forage.
- Use of these platforms is influenced by season and local conditions and may not be a resource that is available at all times.
- This approach has scope for testing hypotheses about use of renewables devices by seabirds. It could also facilitate post-deployment monitoring and investigation of cumulative effects of multiple devices or arrays, e.g. through contemporaneous data from multiple devices or locations.

Acknowledgements

This study was part of work-package 4 of the Hebridean Marine Energy Futures Project. The author is grateful to staff at Pelamis Wave Power Ltd., to Scottish Power Renewables Ltd. for access to their machine and to EMEC for providing metocean data. He also gratefully acknowledges the support of the project advisory board and funding from Highlands and Islands Enterprise, the Scottish Funding Council, the European Regional Development Fund, Eon and Scottish Power Renewables.

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