

Marine littoral ecology: Living between extremes

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Due to environmental protection legislation the understanding the ecological effects from anthropogenic reduction of wave energy has become an important topic.

Developers are required to provide an environmental impact assessment (EIA) prior to any installations, yet their consultants are faced with the problem of having no prior data from the operation of any large scale wave energy converter (WEC) arrays. Further, there is also no quantitative method of determining to what extent the shoreline ecology could be affected through any changes to the wave energy regime. This is the first in-depth research that could provide an answer.

The 'Terobuoy' measurement unit, invented during this research, consists of a robust design that utilises a sacrificial material to deduce measurements of wave energy over a sustained period. A number of units have been installed over spring tide periods to provide an averaged quantitative measurement of wave action and direction during ongoing testing at Billia Croo in Orkney (Fig. 1) the nearest point to the European Marine Energy Centre (EMEC) test site for WEC's. Units can be installed in a variety of locations to provide an averaged quantitative measurement relative to each location.



Figure 1. Site layout at Lang Tainga (Billia Croo), Orkney. Source: Author.

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Figure 4. Changing Terobuoy test blocks at Billia Croo (Dwarf algae-Limpet-Barnacle assemblage) - Aquamarine Oyster WEC in background. Source: [1]

RESULTS SO FAR...

The following data (Figs. 2 & 3) from three units at Billia Croo from May to November 2009 indicates a close correlation between each device. Yet due to the highly dynamic nature of wave action shows significant difference within the two meter spacing of each unit. It also shows a consistently higher wear rate to the right-hand side of the sacrificial block indicating a greater level of wave energy propagating from a Westerly direction consistent with wave buoy data from the EMEC site. Figure 3 indicates a trend of lower average wave action during the summer months and the highest average so far, during test period 5, in October.

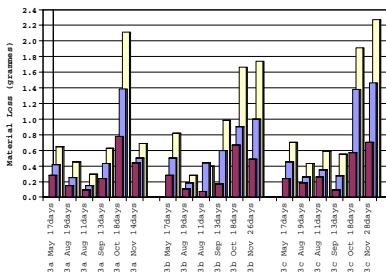


Figure 2. Block end loss comparison and total block mass loss at unit retrieval.

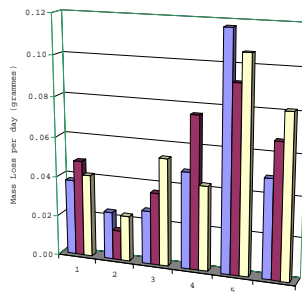


Figure 3. Block Mass Loss per unit, averaged per day, during each test period

The results show a significant difference of wear rates within small spatial scales along the shoreline and may simply be due to the fine scale near shore bathymetry. It should be noted that these results do not indicate extreme water velocities but cumulative averages over each test period. Measurements will continue for one year over a range of sites for comparative studies between wave action and particular species in evidence. Further devices are due to be installed in a variety of different locations around Orkney.

Part of the research linked to this work will allow a direct quantitative measurement of littoral wave action that can be understood in terms of habitat and biotope classification systems. Enabling widespread studies to be directly compared for the first time.

Particular species are being used to investigate the influence from reduced energy levels and its effect on the ecology of the shoreline adjacent to WEC arrays (see Fig. 5) as part of concurrent SuperGen II research at ICIT.

The data acquired from the deployment of Terobuoy devices will be correlated with a series of field studies of biological communities and the current inadequate qualitative method [2] of wave 'exposure', part of the EUNIS (habitat and biotope classification system), used by the Joint Nature Conservancy Council (JNCC) and which underpins the NATURA 2000 special areas of conservation [3].

References

1. Bullen, C., (2009) Image database, International Centre for Island Technology. Orkney. United Kingdom.
2. Lindgarth, M. and Gamfeldt, L., (2005). Contrasting analyses of qualitative and quantitative ecological models: the effects of 'exposure' on rocky shore assemblages. *Ecology*. 86(5): 1346-1357
3. EEA, (2008). About the EUNIS Database. European Environment Agency, Copenhagen, Denmark. <http://eunis.eea.europa.eu/about.jsp> [Accessed 20th March 2009]