Offshore renewable energy structures as artificial islands: implications for population connectivity, and biogeography of coastal species

Raeanne Miller, Michael Burrows, Clive Fox, Mark Inall

Work stream 7: Ecological consequences of wave and tidal energy conversion

Introduction
Harnessing Scotland’s available marine energy resources necessitates the construction of energy extraction devices and infrastructure in offshore waters. These structures will alter the availability of shallow water and intertidal hard surfaces around the UK. Arrays of devices may span existing marine vicariance boundaries, and colonization may have significant implications for the biogeography of coastal species.

Clarifying linkages between coastal benthic populations as well as how they may be altered by offshore constructions requires further understanding of processes affecting both benthic and planktonic life stages of marine organisms. This remains a significant challenge for ecologists, though marine renewable energy device (MRED) installation represents a rare opportunity to explore the mechanisms limiting dispersal, population connectivity, and species distributions.

Approach
This project takes a logical, conditional approach to the inherently biophysical problem of MRED connectivity effects (Figure 2). Focusing on acorn barnacles in the Firth of Lorn on Scotland’s west coast a combined physical modelling and fieldwork approach addresses the role of:

- Oceanographic flow regimes
- Benthic adult population dynamics
- Seasonal variability
- Larval processes

Results
A preliminary survey provided background information which will form the basis for future targeted studies addressing the conditions for MRED effects on population biogeography.

- Total barnacle larval abundance increases in the offshore direction (Figure 3)
- Subtidal species and those with longer lived larvae are found farther offshore
- Evidence of stage-specific horizontal distributions; later stage larvae are found farther offshore
- Cyprid larvae, competent for settlement, are found mainly offshore (Figure 3). It is likely that species will settle on hard substrate at appropriate depths, including MRED devices.
- Areas of interest for further depth-stratified plankton studies have been identified.

Future work
Future project work will include:

- Depth-stratified plankton study to clarify the role of vertical migration in larval transport, dispersal and population connectivity
- Development of a 3-dimensional biophysical model of the Firth of Lorn
- Application of biophysical modelling techniques to include MRED installations
- Investigation of the importance of MRED array configuration and location for the magnitude and pattern of connectivity and biogeographic effects (Figure 4).

References