

Key issue 19 - The potential wider or secondary effects on protected or sensitive littoral coastal communities due to installation and/or operation of wave and tidal energy converters and associated moorings or support structures

What are the relevant technologies and support structures?

The following technologies and support structures were identified during the assessment process to have the potential to significantly affect benthic habitats / species through changes in sediment dynamics, smothering, deposition, scour, changes in coastal processes or dissipation of wave energy and should therefore, be subject to further investigation on a project specific basis.

Relevant technologies and support structures	Relevant features, components or activities	Phase
Gravity / deadweight anchor and mooring lines Gravity base structure Monopile Oscillating water column (shoreline) Overtopping device (shoreline) Oscillating wave surge converter Submerged pressure differential	Change in sediment dynamics <i>Sediment accumulated in device may be entrained into outflow of shoreline overtopping device</i> <i>Structures may create a shadow, reduce flows or change turbulence resulting in the deposition of mobile sediments</i> <i>Change in shoreline profile may lead to localised changes to flows or changes in turbulence affecting sediment movement</i>	Operation
Oscillating water column (shoreline) Overtopping device (shoreline)	Smothering <i>Placement of structures / materials on the shoreline or changes in sediment dynamics due to these structures / materials may result in smothering</i>	Installation and operation
Gravity / deadweight anchor and mooring lines Gravity base structure Monopile Oscillating wave surge converter Point absorber Submerged pressure differential	Deposition <i>Device / moorings may create a shadow, reduce flows or change turbulence resulting in the deposition of mobile sediments</i>	Operation
Gravity / deadweight anchor and mooring lines Gravity base structure Monopile Rock anchors and mooring lines Overtopping device (shoreline) Oscillating wave surge converter	Scour <i>Localised changes due to accelerated flows and turbulence induced by structures on or near the seabed</i>	Operation
Oscillating water column (shoreline) Overtopping device (shoreline) Oscillating wave surge converter	Change in coastal processes <i>Sediment dynamics and other coastal processes may be affected by a change in coastal profile and energy removal</i>	Operation
Oscillating water column (offshore) Overtopping device (offshore) Attenuator Oscillating wave surge converter Point absorber	Dissipation of wave energy <i>Presence of structures and extraction of wave energy may cause wave shadow effects</i>	Operation

What species / groups may be vulnerable?

The following species were identified during the assessment process as being particularly sensitive to changes in sediment dynamics, smothering, deposition, scour, changes in coastal processes or dissipation of wave energy and should therefore, be considered further on a project specific basis.

Relevant species / groups ¹	Possible consequences
<p>A1.1 : High energy littoral rock A1.2 : Moderate energy littoral rock A2.7 : Littoral biogenic reefs A2.8 : Features of littoral sediment "</p>	<p>Change in sediment dynamics <i>Change in sediment dynamics may affect species in this habitat.</i></p> <p><i>Some of these habitats defined by rocky substrata, including boulder fields, so if sediments moved into these areas, the entire habitat and associated species would change.</i></p> <p><i>Some habitats are defined by containing biogenic reefs, so if sediments moved into these areas, the entire habitat and associated species could change.</i></p>
<p>A1.1 : High energy littoral rock A1.2 : Moderate energy littoral rock A2.7 : Littoral biogenic reefs A2.8 : Features of littoral sediment</p>	<p>Smothering <i>Smothering by sediment or other material can inhibit respiration, feeding and growth and in particular may hinder feeding by filter feeding species.</i></p> <p><i>Smothering will affect small species, juvenile stages and settlement of propagules in particular.</i></p> <p><i>Sessile species are unlikely to be able to move up through smothering material.</i></p> <p><i>Smothering material may change the nature of this rocky habitat.</i></p>
<p>A1.1 : High energy littoral rock A1.2 : Moderate energy littoral rock A2.7 : Littoral biogenic reefs A2.8 : Features of littoral sediment</p>	<p>Deposition <i>Deposition of sediment or other material can inhibit respiration, feeding and growth and in particular may hinder feeding by filter feeding species (but some could benefit from increased deposition of organic material).</i></p> <p><i>Deposition of sediment, during high tide, onto hard substrata may change the entire character of the habitat and alter the under-boulder environment.</i></p> <p><i>Sediment deposited on frond surfaces of algae may reduce light available for photosynthesis.</i></p> <p><i>Deposition is unlikely in high energy habitats, but would be scored as 1 if under-boulder communities (Biodiversity Action Plan) are present.</i></p> <p><i>Deposition of sediment, during high tide, may change the entire character of the habitat e.g. by filling-in interstices between mussels forming beds or animals forming biogenic.</i></p>
<p>A1.1 : High energy littoral rock A1.2 : Moderate energy littoral rock A1.2 : Moderate energy littoral rock A2.7 : Littoral biogenic reefs</p>	<p>Scour <i>During high tide, increased scour may interfere with feeding by filter feeders.</i></p>

¹ Species or habitats of conservation interest (e.g. Habitats directive, BAP habitat, OSPAR, CITES) or limited distribution found within the following Eunis habitats (see assessment for details):

Relevant species / groups ¹	Possible consequences
A2.8 : Features of littoral sediment	<i>Increased scour may affect settlement of reproductive propagules</i>
A1.1 : High energy littoral rock A1.2 : Moderate energy littoral rock A2.7 : Littoral biogenic reefs A2.8 : Features of littoral sediment	<p>Change in coastal processes <i>Changes to coastal processes may influence directly these species because this habitat is intertidal and, where present, forms the actual coastline.</i></p> <p><i>Other conditions that change as a consequence (e.g. coastal currents, tidal flow, reflectance of waves, etc.) may also cause indirect effects on these species.</i></p> <p><i>Changes in coastal processes may affect dispersal and recruitment of reproductive propagules.</i></p>
A1.1 : High energy littoral rock A2.7 : Littoral biogenic reefs A2.8 : Features of littoral sediment	<p>Dissipation of wave energy <i>During high tide, in the absence of moderate or strong tidal streams, decreases in wave action may have an adverse effect on filter feeders because food supplies will be reduced and siltation may occur.</i></p> <p><i>In the absence of moderate or strong tidal streams, decreases in wave action may influence rates of deposition during high tide and may alter feeding by and growth of some species.</i></p> <p><i>Decreases in amount of scour may affect availability of sediment to <i>S. alveolata</i>, which builds tubes from sand grains.</i></p>

What species / groups are affected by which technologies and support structures

The following table provides a summary of the assessment results for each species or habitats in combination with each technology & Moorings/Support structures listed above.

Potentially significant at a 10MW scale	Unknown whether this will be significant at a 10 MW scale	Not Applicable	Assessed as not significant at a 10MW scale
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Deposition	Technology & Moorings and Support structures														
Habitat	Horizontal axis turbine & Gravity/deadweight anchor and mooring lines	Horizontal axis turbine & Gravity base structure	Horizontal axis turbine & Monopile	Vertical axis turbine & Gravity/deadweight anchor and mooring lines	Vertical axis turbine & Gravity base structure	Reciprocating hydrofoils & Gravity base structure	Reciprocating hydrofoils & Monopile	Oscillating water column (offshore) & Gravity/deadweight anchor and mooring lines	Overtopping device (offshore) & Gravity/deadweight anchor and mooring lines	Attenuator & Gravity/deadweight anchor and mooring lines	Oscillating wave surge converter & Gravity base structure	Point absorber & Gravity/deadweight anchor and mooring lines	Point absorber & Rock anchors and mooring lines	Point absorber & Drag embedment anchor and mooring lines	Submerged pressure differential & Gravity base structure
A1.1 : High energy littoral rock Including BAP Habitat "Tidal swept channels"															
A1.2 : Moderate energy littoral rock Including BAP habitat "Under boulder communities"															
A2.7 : Littoral biogenic reefs Including BAP habitat "Blue mussel beds"															
A2.8 : Features of littoral sediment Including BAP habitat "Blue mussel beds"															

Smothering	Technology & Moorings and Support structures	
Habitat	Oscillating water column (shoreline)	Overtopping device (shoreline)
A1.1 : High energy littoral rock Including BAP Habitat "Tidal swept channels"		
A1.2 : Moderate energy littoral rock Including BAP habitat "Under boulder communities"		
A2.7 : Littoral biogenic reefs Including BAP habitat "Blue mussel beds"		
A2.8 : Features of littoral sediment Including BAP habitat "Blue mussel beds"		

Change in sediment dynamics	Technology & Moorings and Support structures														
Habitat	Horizontal axis turbine & Gravity/deadweight anchor and mooring lines	Horizontal axis turbine & Gravity base structure	Horizontal axis turbine & Monopile	Vertical axis turbine & Gravity/deadweight anchor and mooring lines	Vertical axis turbine & Gravity base structure	Reciprocating hydrofoils & Gravity base structure	Reciprocating hydrofoils & Monopile	Oscillating water column (offshore) & Gravity/deadweight anchor and mooring lines	Oscillating water column (shoreline)	Overtopping device (offshore) & Gravity/deadweight anchor and mooring lines	Overtopping device (shoreline)	Attenuator & Gravity/deadweight anchor and mooring lines	Oscillating wave surge converter & Gravity base structure	Point absorber & Gravity/deadweight anchor and mooring lines	Submerged pressure differential & Gravity base structure
A1.1 : High energy littoral rock Including BAP Habitat "Tidal swept channels"															
A1.2 : Moderate energy littoral rock Including BAP habitat "Under boulder communities"															
A2.7 : Littoral biogenic reefs Including BAP habitat "Blue mussel beds"															
A2.8 : Features of littoral sediment Including BAP habitat "Blue mussel beds"															

Scour

Habitat	Technology & Moorings and Support structures										
	Horizontal axis turbine & Gravity/deadweight anchor and mooring lines	Horizontal axis turbine & Gravity base structure	Horizontal axis turbine & Monopile	Horizontal axis turbine & Rock anchors and mooring lines	Vertical axis turbine & Gravity/deadweight anchor and mooring lines	Vertical axis turbine & Gravity base structure	Vertical axis turbine & Rock anchors and mooring lines	Reciprocating hydrofoils & Gravity base structure	Reciprocating hydrofoils & Monopile	Overtopping device (shoreline)	Oscillating wave surge converter & Gravity base structure
A1.1 : High energy littoral rock Including BAP Habitat "Tidal swept channels"											
A1.2 : Moderate energy littoral rock Including BAP habitat "Under boulder communities"											
A2.7 : Littoral biogenic reefs Including BAP habitat "Blue mussel beds"											
A2.8 : Features of littoral sediment Including BAP habitat "Blue mussel beds"											

Change in coastal processes	Technology & Moorings and Support structures		
Habitat	Oscillating water column (shoreline)	Overtopping device (shoreline)	Oscillating wave surge converter & Gravity base structure
A1.1 : High energy littoral rock Including BAP Habitat "Tidal swept channels"			
A1.2 : Moderate energy littoral rock Including BAP habitat "Under boulder communities"			
A2.7 : Littoral biogenic reefs Including BAP habitat "Blue mussel beds"			
A2.8 : Features of littoral sediment Including BAP habitat "Blue mussel beds"			

Dissipation of wave energy	Technology & Moorings and Support structures												
Habitat	Oscillating water column (offshore) & Gravity/deadweight anchor and mooring lines	Oscillating water column (offshore) & Rock anchors and mooring lines	Oscillating water column (offshore) & Drag embedment anchor and mooring lines	Overtopping device (offshore) & Gravity/deadweight anchor and mooring lines	Overtopping device (offshore) & Rock anchors and mooring lines	Overtopping device (offshore) & Drag embedment anchor and mooring lines	Attenuator & Gravity/deadweight anchor and mooring lines	Attenuator & Rock anchors and mooring lines	Attenuator & Drag embedment anchor and mooring lines	Oscillating wave surge converter & Gravity base structure	Point absorber & Gravity/deadweight anchor and mooring lines	Point absorber & Rock anchors and mooring lines	Point absorber & Drag embedment anchor and mooring lines
A1.1 : High energy littoral rock Including BAP Habitat "Tidal swept channels"													
A2.7 : Littoral biogenic reefs Including BAP habitat "Blue mussel beds"													
A2.8 : Features of littoral sediment Including BAP habitat "Blue mussel beds"													

How could the issue be addressed on a project and site specific basis?

The following tables provide a series of suggested activities and recommendations that may be taken forward to address the effects changes in sediment dynamics, smothering, deposition, scour, changes in coastal processes or dissipation of wave energy on benthic species and communities for those technologies and/or support structures, and species / habitats, assessed as significant in the assessment. This information is not prescriptive and should be used as a platform for discussion on a project and site specific basis in order to develop an appropriate impact assessment strategy and monitoring programme for the project.

Single test deployments

Preliminary desk based studies

Activity	Objective	Recommendation / comment
No activity recommended	N/A	N/A

Baseline characterisation surveys

Activity	Objective	Recommendation / comment
No activity recommended	N/A	N/A

Further desk based studies

Activity	Objective	Recommendation / comment
No activity recommended	N/A	N/A

Monitoring during and post installation

Activity	Objective	Recommendation / comment
No activity recommended	N/A	N/A

Demonstration arrays

Preliminary desk based studies

Activity	Objective	Recommendation / comment
Review of existing information regarding coastal communities in the proposed development area	To inform baseline survey plans and predict the presence / absence of habitats or species identified	This work should be undertaken for all projects.
Undertake impact assessment	To identify any particular areas of concern regarding the proposed development and to determine what/if further baseline characterisation is required (see below)	This should follow the normal project specific EIA procedures.

Baseline characterisation surveys

Activity	Objective	Recommendation / comment
Baseline survey using Phase 1 Habitat Mapping along coastline	To identify any particularly sensitive habitats / species within and adjacent to the proposed development area	This work should be undertaken for all projects (in unsurveyed areas). If sensitive a species / habitat is found to be present, wider survey to establish distribution of that species in the wider area.

Further desk based studies

Activity	Objective	Recommendation / comment
Undertake impact assessment	To determine the suitability of the proposed deployment site in terms of the habitats and species present within and adjacent to the proposed development area To determine, based on baseline characterisation surveys, whether or not there are likely to be any potentially significant effects on the species identified	This work should be undertaken for all projects

Monitoring during and post installation

Activity	Objective	Recommendation / comment
Carry out repeated post-installation surveys	To monitor any changes in coastal communities, validate predictions, inform environmental monitoring and future site selection and project development work	This should only be undertaken where a development proceeds within a particularly sensitive area (as determined by the baseline characterisation work and the EIA). Long-term studies may be required to detect any change.
Measure the level and extent of changes in wave action and tidal flows and fluxes using appropriate equipment such as waverider buoys or Acoustic Doppler Current Profilers	To monitor any change in hydrographic conditions following installation	