

# Characterisation of the biofouling community on a floating wave energy device

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## Supplementary material

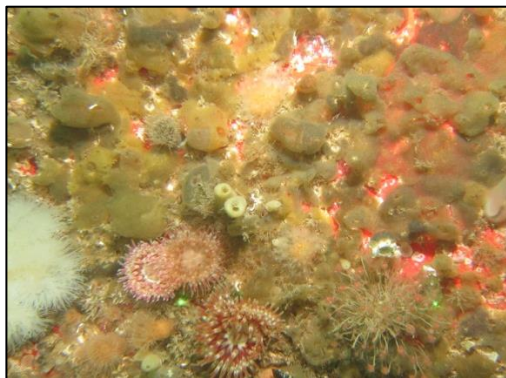
a.



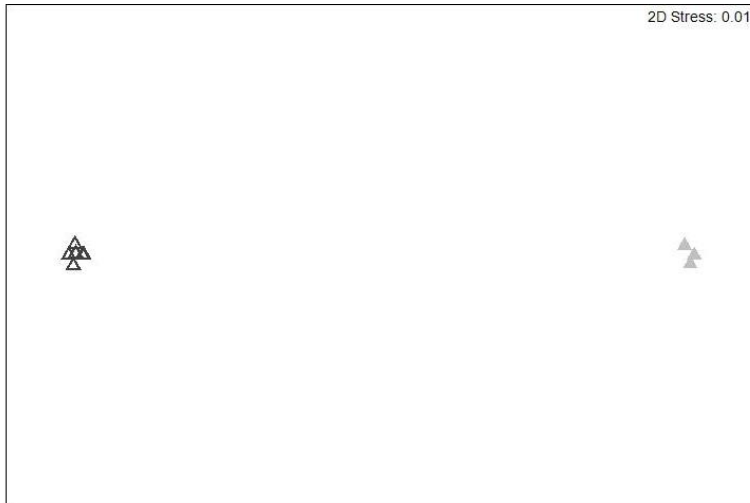
b.



c.



**Figure S1** Images of the biofouling from sampling areas of the Pelamis wave energy convertor. **a.** front section of P2-001 device which had been removed from water for maintenance; this algal community is similar in appearance to biofouling sampled from the waterline of the P2-002 device. Image courtesy of Angus Jackson. **b.** intersection of P2-002 device at ~0.5-2m water depth; image courtesy of Rob Ionides **c.** underside of P2-002 device; image taken using the ROV stills camera.

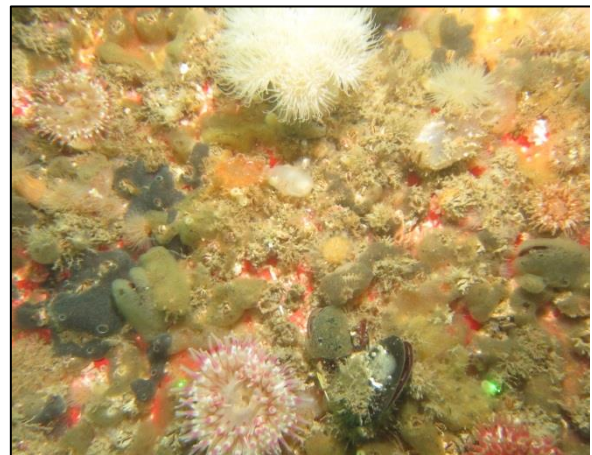


**Figure S2** MDS ordination of biofouling assemblages from just below the waterline (~0-0.25m) and at ~0.5-2m depth in the intersections of Pelamis. Solid grey triangles = ~0.5-2m; Black hollowed triangles = ~0-0.25m. A stress value of <math><0.2</math> indicates the MDS plot accurately represents the similarity rankings (Clarke and Warwick 2001)

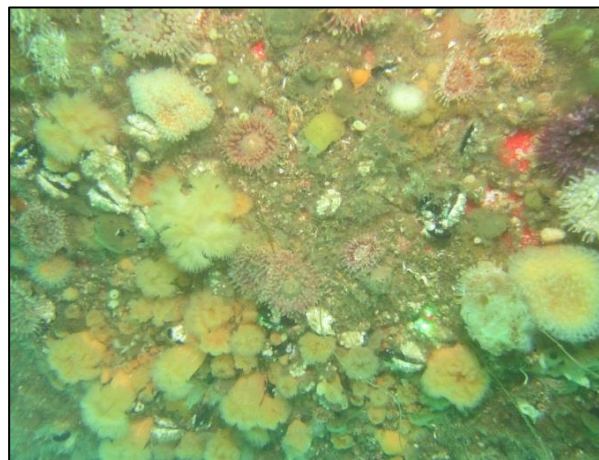
**P2-001 April 2014**



**P2-002 April 2014**


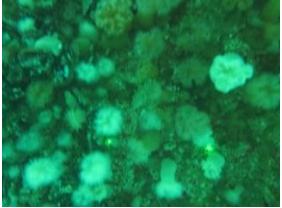

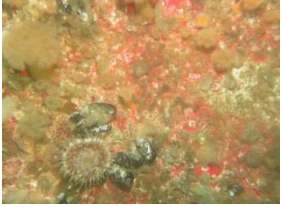
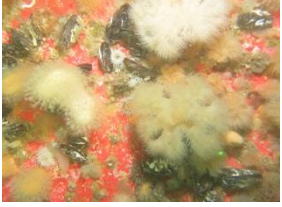


**P2-002 June 2014**



**Figure S3** Photoquadrats representing biofouling communities on the underside of P2-001 and P2-002 devices in April 2014 and P2-002 in June 2014.

**Table S1** Image quality scoring scheme

Image Quality Score	Criteria	Example images
0 – ‘Junk’	<ul style="list-style-type: none"> <li>• Image shows no species or features of interest</li> <li>• Image too blurry / out of focus for reliable species identification</li> </ul>	
1 – ‘Poor’	<ul style="list-style-type: none"> <li>• Image badly lit</li> <li>• Image out of focus</li> <li>• Image taken from too far away for species ID</li> <li>• Image poorly aligned with features</li> <li>• Some general species ID may be possible</li> </ul>	
2 – ‘OK’	<ul style="list-style-type: none"> <li>• Better focus and/or illumination</li> <li>• Some species ID possible, but not quantitative</li> <li>• Image may not be well aligned with device features</li> </ul>	
3 – ‘Good’	<ul style="list-style-type: none"> <li>• Generally good focus and mostly even illumination</li> <li>• Biofouling ID consistently possible</li> <li>• Image well aligned – facing flat surface (device underside) directly</li> <li>• Both laser scaling points visible</li> <li>• Field of view not too large (no more than approximately 2-3 times the distance between the laser scaling points)</li> </ul>	
4 – ‘Excellent’	<ul style="list-style-type: none"> <li>• Good focus and even illumination</li> <li>• Biofouling ID consistently possible</li> <li>• Image well aligned</li> <li>• Both laser scaling points visible</li> <li>• Field of view of similar magnitude to the distance between the two laser scaling points</li> </ul>	

**Table S2** Species inventory for biofouling community on the Pelamis wave energy devices. Mean wet biomass ( $\text{g m}^{-2} \pm \text{s.e.}$ ) is given for destructive scrape sampling where available. \*species only recorded on P2-001 in ‘Opportunistic’ images (not used in photoquadrat analyses), †species only recorded on P2-002 in ROV images captured in June 2014. Non-native species and cryptogenic species are underlined.

Phyla	Species (or highest taxonomic resolution)	Destructive scrape sampling of P2-002 (mean biomass, $\text{g m}^{-2} \pm \text{standard error}$ )			ROV images of underside	
		Shallow (0 – 0.25 m depth)		Deep Intersection (0.5 – 2m depth)	P2-001	P2-002
		Outer surface	Intersection			
<b>Annelida</b>	Aphroditoidea					Present
	<i>Amblyosyllis formosa</i>			$0.3 \pm 0.15$		
	<i>Arenicolides ecaudata</i>			$0.89 \pm 0.89$		
	<i>Eumida sanguinea</i>			$0.01 \pm 0.01$		
	<i>Eupolymnia nebulosa</i>			$1.2 \pm 1.18$		
	<i>Hydroides norvegicus</i>			$7.41 \pm 4.51$	Present	Present
	<i>Nereimyra punctata</i>			$1.13 \pm 0.39$		
	<i>Nereis pelagica</i>	$1.7 \pm 1.29$	$0.07 \pm 0.07$	$22.96 \pm 7.03$		
	<i>Phyllodoce</i> sp.	$2.37 \pm 2.11$		$3.7 \pm 3.7$		
	<i>Polynoinae</i> spp.	$0.52 \pm 0.52$		$9.63 \pm 5.42$		
	<i>Sabella pavonina</i>			$23.85 \pm 23.85$	Present *	Present †
	<i>Serpula vermicularis</i>				Present	Present
	<i>Spirobranchus triqueter</i>	$0.67 \pm 0.67$	$0.23 \pm 0.22$	$43.27 \pm 23.88$	Present	Present
	<i>Syllis</i> sp.	$0.38 \pm 0.21$	$0.22 \pm 0.1$	$1.93 \pm 1.04$		
<b>Arthropoda - Chelicerata</b>	<i>Phoxichilidium femoratum</i>	$0.15 \pm 0.15$	$0.59 \pm 0.42$			
	Pycnogonida (unidentified)					Present
<b>Arthropoda - Crustacea</b>	<i>Ampithoe gammaroides</i>	$0.22 \pm 0.22$				
	<i>Balanus balanus</i>			$37.78 \pm 34.71$	Present	Present †
	<i>Balanus crenatus</i>	$323.71 \pm 187.46$	$528.37 \pm 286.62$	$195.11 \pm 148.07$	Present	Present
	<i>Cancer pagurus</i>			$1.63 \pm 1.63$		

Phyla	Species (or highest taxonomic resolution)	Destructive scrape sampling of P2-002 (mean biomass, g m <sup>-2</sup> ± standard error)			ROV images of underside	
		Shallow (0 – 0.25 m depth)		Deep Intersection (0.5 – 2m depth)	P2-001	P2-002
		Outer surface	Intersection			
Arthropoda - Crustacea	<i>Caprella mutica</i>			2.96 ± 1.67	Present *	
	<i>Chirona hameri</i>				Present	Present
	<i>Dexamine thea</i>	0.08 ± 0.07	0.07 ± 0.07			
	<i>Gammarellus angulosus</i>	31.04 ± 22.36	2.52 ± 1.24	0.44 ± 0.44		
	<i>Galathea</i> sp.				Present *	
	<i>Hyale pontica</i>		0.15 ± 0.15			
	<i>Hyas</i> sp.			6.84 ± 4.45	Present *	
	<i>Idotea granulosa</i>		3.98 ± 2.11			
	<i>Idotea pelagica</i>	3.33 ± 1.1	4.59 ± 3.1			
	<i>Jassa herdmani</i>	0.45 ± 0.3	0.82 ± 0.81	0.3 ± 0.15		
	Juvenile crab			1.48 ± 0.74		
	<i>Monocorophium</i> sp.	0.01 ± 0.01	0.09 ± 0.07			
	<i>Necora puber</i>			23.41 ± 23.41		
	<i>Munna</i> sp.		0.07 ± 0.07			
	<i>Verruca stroemia</i>	0.07 ± 0.07				
Arthropoda - Hexapoda	Chironomidae Larva	0.01 ± 0.01	0.08 ± 0.07			
Bryozoa	<i>Bugulina fulva</i>			Present		
	<i>Callopora dumerilii</i>			10.96 ± 10.96		
	<i>Celleporella hyalina</i>	0.23 ± 0.15	0.23 ± 0.15	15.41 ± 11.26		
	<i>Celleporina caliciformis</i>			6.83 ± 6.83		
	Cyclostomatida			0.3 ± 0.3		
	<i>Electra pilosa</i>	13.93 ± 13.66		0.3 ± 0.3	Present *	
	<i>Membranipora membranacea</i>	6.89 ± 6.89				

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		Shallow (0 – 0.25 m depth)		Deep Intersection (0.5 – 2m depth)	P2-001	P2-002
		Outer surface	Intersection			
<b>Bryozoa</b>	<i>Microporella ciliata</i>			0.03 ± 0.01		
	<i>Schizoporella japonica</i>	0.15 ± 0.15		Present	Present *	
	<i>Scrupocellaria scruposa</i>			32.31 ± 32.29		
	<i>Tubulipora</i> sp.			0.59 ± 0.59		
<b>Chordata - Osteichthyes</b>	<i>Taurulus</i> sp.				Present	
<b>Chordata - Tunicata</b>	<i>Ascidella aspersa</i>	9.26 ± 9.26	1.56 ± 1.56	220.44 ± 87.99	Present	Present
	<i>Ascidella scabra</i>					Present
	<i>Botrylloides</i> spp.					Present
	<i>Botryllus schlosseri</i>				Present	Present
	<i>Ciona intestinalis</i>				Present	Present
	<i>Corella eumyota</i>			0.59 ± 0.59	Present *	Present
	<i>Diplosoma listerianum</i>	166.15 ± 64.7	265.7 ± 168.05	300.96 ± 52.86	Present	Present
	<i>Molgula</i> sp.	0.15 ± 0.15				
<b>Cnidaria - Anthozoa</b>	<i>Alcyonium digitatum</i>			17.3 ± 17.3	Present	Present
	<i>Metridium dianthus</i>	0.89 ± 0.89		86.96 ± 78.34	Present	Present
	<i>Sagartia elegans</i> var. <i>miniata</i>				Present	Present
	<i>Sagartia elegans</i> var. <i>nivea</i>				Present	Present
	<i>Sagartia elegans</i> var. <i>venusta</i>				Present	Present
	<i>Urticina eques</i>				Present	Present
	<i>Urticina felina</i>				Present	Present
<b>Cnidaria - Hydrozoa</b>	<i>Bougainvillia muscus</i>	0.44 ± 0.36				
	<i>Clytia hemisphaerica</i>	0.37 ± 0.37	21.41 ± 13.59	9.24 ± 9.24		

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		Shallow (0 – 0.25 m depth)		Deep Intersection (0.5 – 2m depth)	P2-001	P2-002
		Outer surface	Intersection			
<b>Cnidaria - Hydrozoa</b>	<i>Coryne eximia</i>	0.96 ± 0.8				
	<i>Eudendrium</i> sp.			57.19 ± 41.81		
	<i>Halecium</i> sp.			0.01 ± 0.01		
	<i>Obelia</i> sp.	0.01 ± 0.01	0.3 ± 0.29	1.81 ± 1.81		
	<i>Tubularia</i> sp.	0.15 ± 0.15	63.63 ± 57.3	33.85 ± 23.24	Present	Present
<b>Echinodermata</b>	<i>Asterias rubens</i>			240.74 ± 240.74	Present *	
	<i>Echinus esculentus</i>			Present	Present	Present
	<i>Ophiothrix fragilis</i>				Present *	Present †
<b>Mollusca - Bivalvia</b>	<i>Anomia ephippium</i>	1.19 ± 0.82	1.41 ± 0.64	53.04 ± 29.03	Present	Present
	<i>Hiatella arctica</i>	0.74 ± 0.74	0.37 ± 0.24	60.15 ± 36.55		
	<i>Mytilus edulis</i>	2.37 ± 2.28	0.37 ± 0.37	3072.74 ± 3070.3	Present	Present
<b>Mollusca - Gastropoda</b>	<i>Aeolidia papillosa</i>				Present	Present
	<i>Doto</i> sp.		0.15 ± 0.15	0.01 ± 0.01		
	<i>Flabellina</i> sp.	0.01 ± 0.01	0.81 ± 0.54			
	<i>Patella vulgata</i>				Present *	
	<i>Rissoa</i> sp.		0.75 ± 0.58	0.3 ± 0.3		
<b>Nematoda</b>	Nematode sp.			0.01 ± 0.01		
<b>Nemertea</b>	<i>Nemertea</i> cf. <i>Emplectonema neesii</i>			16.74 ± 16.74		
	<i>Nemertea</i> sp.			8.74 ± 8.74		
<b>Porifera</b>	<i>Leucosolenia</i> sp.		8.15 ± 8.15			
	<i>Sycon ciliatum</i>				Present	Present
<b>Platyhelminthes</b>	<i>Stylostomum ellipse</i>			1.63 ± 0.97		

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		Shallow (0 – 0.25 m depth)		Deep Intersection (0.5 – 2m depth)	P2-001	P2-002
		Outer surface	Intersection			
Misc.	Empty barnacle/ serpulid shells	6.74 ± 5.59		853.78 ± 71.5		
	Egg mass		0.22 ± 0.22			
<b>ALGAE</b>						
<b>Chlorophyta</b>	<i>Acrosiphonia arcta</i>	321.19 ± 110.26	2.15 ± 0.99			
	<i>Cladophora</i> sp.	2.67 ± 2.67				
	Filamentous green spp.	11.93 ± 7.48				
	<i>Ulva</i> sp.	295.11 ± 119.01	217.93 ± 99.04		Present	
<b>Ochrophyta - Phaeophyceae</b>	<i>Alaria esculenta</i>	415.04 ± 150.3	296.46 ± 117.83		Present *	
	<i>Ascophyllum nodosum</i>				Present *	
	<i>Chorda filum</i>	199.56 ± 62.54	3.93 ± 2.68			Present †
	<i>Desmarestia aculeata</i>	9.11 ± 6.8				
	<i>Desmarestia viridis</i>	36.39 ± 35.66	1.49 ± 1.23			
	Filamentous brown spp. (mixture of <i>Ectocarpus</i> and <i>Hincksia</i> species)	112.52 ± 38.23	23.93 ± 15.73			
	Kelp holdfast	27.56 ± 27.56				
	<i>Laminaria</i> spp.	56.59 ± 28.14	6.52 ± 2.9		Present *	
	<i>Petalonia fascia</i>	6.96 ± 4.61	1.19 ± 1.19			
	<i>Saccharina latissima</i>	203.85 ± 203.85				
	<i>Scytosiphon lomentaria</i>	26 ± 26	3.7 ± 3.7			
	Thin branched brown sp.	2.44 ± 2.44				
	<b>Rhodophyta</b>	<i>Aglaothamnion</i> sp.	0 ± 0	19.41 ± 17.2		
<i>Ceramium</i> sp.		4.53 ± 2.69	33.93 ± 21.18			
<i>Dasysiphonia japonica</i>		37.19 ± 29.49	17.93 ± 12.41			
<i>Lomentaria clavellosa</i>		0.3 ± 0.3	5.63 ± 3.65			



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		Shallow (0 – 0.25 m depth)		Deep Intersection (0.5 – 2m depth)	P2-001	P2-002
		Outer surface	Intersection			
<b>Rhodophyta</b>	<i>Lomentaria orcadensis</i>	1.7 ± 1.7	0.22 ± 0.22			
	Filamentous red spp.	11.04 ± 9.22	4.21 ± 4.21			
	<i>Palmaria palmata</i>	0.37 ± 0.37				
	<i>Polysiphonia</i> sp.	57.41 ± 37.52	257.93 ± 155.59			
	<i>Porphyra</i> sp.	0.67 ± 0.67			Present *	
	<i>Pterothamnion plumula</i>	0.01 ± 0.01				
	Red encrusting				Present *	Present †
<b>Bacillariophyta</b>	<i>Licmophora</i> sp.		0.37 ± 0.37			

**Table S3** GLM analysis, comparing biomass between sub-habitat and deployment factors on the P2-002 device. Deployment factor refers to the treatment levels: pre- and post-deployment at the energy extraction site

<b>Source</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b><i>p</i></b>
Sampling area	1	19.595	5.220	<b>0.028</b>
Deployment	1	11.800	3.144	0.085
Sampling area*Deployment	1	0.273	0.073	0.789
Residual	36	3.754		