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Kentish Flats Offshore Wind Farm Turbine Foundation Faunal Colonisation Diving Survey

Report No 08/J/1/03/1034/0839

Final

Prepared on behalf of Kentish Flats Ltd

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EXECUTIVE SUMMARY

Emu Limited was commissioned by Kentish Flats Limited to undertake a marine ecological survey of two turbine foundations, within the Kentish Flats Offshore Wind Farm.

The aims of the study were to investigate the faunal colonisation of the subsea monopile foundations, using diver collected stills photography and video footage, MNCR Phase II recording data, and collection of scrape samples. The survey was undertaken approximately three years after installation of the turbine foundations.

The survey of turbines numbered D2 and C4 (see Figure 1) was undertaken on the 30th July 2008.

The following data was collected at each of the 2 turbine monopiles;

- Stills photography of the monopiles from sea surface to seabed,
- Video footage from sea surface to the seabed,
- Video footage of the seabed within the immediate vicinity of the monopile,
- Four surface scrapes ($0.01m^2$) on each monopile,
- MNCR Phase II biological recording.

The recorded species during the survey were comparable for the two turbines surveyed. The fauna recorded on the foundations of these two turbines are considered likely to be generally representative of the fauna colonising all of the foundations at the Kentish Flats offshore wind farm site, notwithstanding the potential for localised features / communities.

The predominant species found on the turbines were barnacles in the intertidal area, through to an infralittoral zone, which was dominated by the mussel *Mytilus edulis*, with the anemones *Sagartia elegans* and *Metridium senile*. Below the mussel zone, the area became dominated by anemones along with barnacles, hydroids and the tube forming worm, *Pomatoceros* sp. All of the recorded species are typical colonisers of hard substrates and are regularly found on man made surfaces in UK waters.

At the seabed, the shelly sand and gravel substrate was, in places, almost completely covered with the starfish *Asterias rubens*. This species is very common and could be expected to be present given the considerable density of its prey species, *Mytilus edulis* on the turbine foundations.

As a broad overview of the monopiles, three zones were present, which can be matched to biotopes described in Connor et al, (2004). The species assemblages recorded on the monopiles and their corresponding biotopes are:

- the upper barnacle dominated zone (**LR.HLR.MusB**),
- the infralittoral *Mytilus edulis* zone (**IR.LIR.IFaVS**),
- the *Metridium senile* fouling communities (**CR.FCR.FouFa**).

These biotopes are typical for this type of hard substrate, although the biotopes were relatively impoverished in some areas.

The biomass values for the scrapes taken at each biological zone on the monopile confirmed that *Mytilus edulis* is the major biomass contributor and accounts for the intra-zonal variability in biomass observed.

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1.0 Introduction

1.1 Background to the Study

The Kentish Flats offshore wind farm was constructed during 2004 and 2005 and became fully operational in December 2005. It is located within the outer Thames Estuary and offshore of north Kent. The site occupies an area of 10km^2 and lies approximately 8.5km from Herne Bay.

Emu Limited was commissioned by Kentish Flats Limited to undertake a turbine foundation faunal colonisation diving survey of two monopiles and the surrounding seabed, within the Kentish Flats wind farm. The work was undertaken as part of the monitoring conditions outlined within the Food and Environmental Protection Act (FEPA) licence reference: 31780/03/0, which requires that any colonisation of the turbine foundations and scour protection be investigated.

1.2 Objectives of the Study

The aims of the study were to investigate the colonisation of the monopiles using video and stills footage and the collection of scrape samples. Colonisation by faunal and floral species was recorded using MNCR Phase 2 recording methods with dominant species given an abundance value using the SACFOR scale.

Samples were collected on each monopile at depths relating to observed changes in habitat and observed faunal community. The samples consisted of surface scrapes and these were used for specific species identification and to estimate wet weight (biomass) for the total sample collected.

The combination of stills photography, video analysis and scrape samples, coupled with the in-situ recording during the diver survey, enabled a description of the biological zonation present on the subsea monopile foundations. Biotopes were ascribed to each faunal assemblage and any commercially important species were highlighted, where appropriate.

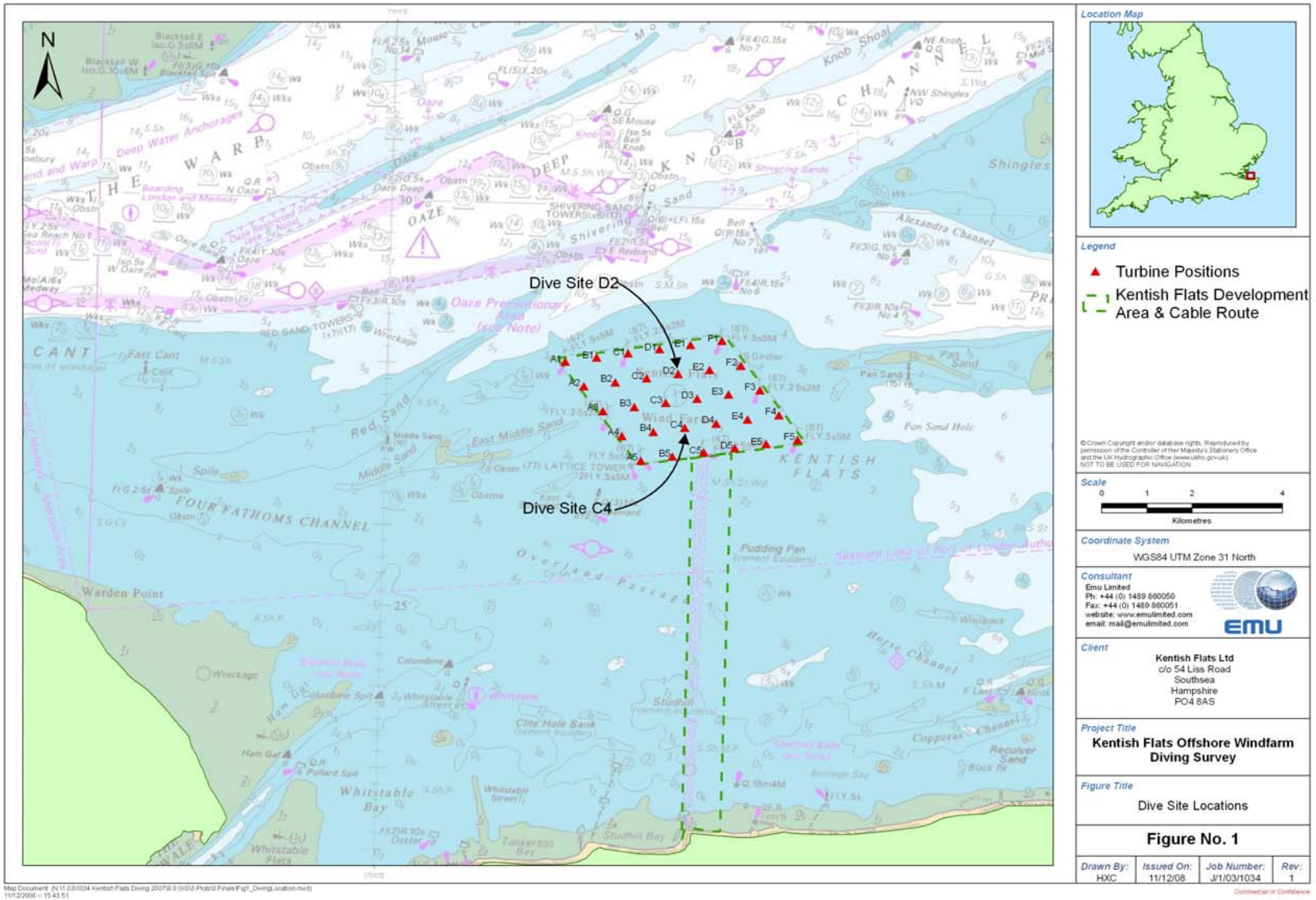
1.3 Physical Site Conditions

The Kentish Flats offshore wind farm site is located in water depths ranging between 3 and 6m Chart Datum (CD) (Figure 1).

The tidal currents at the wind farm site are moderately strong, (as defined in Hiscock, 1996), reaching up to 2.4 knots on a spring tide, and 1.6 knots on a neap tide, as indicated by tidal diamond data (Admiralty Chart 1183, tidal diamond B). The predominant tidal axis across the site is approximately east – west.

The site is classified as an exposed, fully marine environment (classifications according to Hiscock, 1996). The seabed sediments sampled during the recent grab sampling surveys within the wind farm were classified as heterogeneous sands and gravels. The seabed around turbine D2 was found to be gravelly sand, the seabed around C4 being similarly described but with a slightly higher sand fraction overall. Muds and fines were a very minor component of the substrate, around 5% on average. (Emu Ltd, 2007).

The physical conditions at the wind farm site described above are those considered to be the principal factors influencing the species composition on and around the monopiles.


N
Dive Site D2
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Location Map
Legend
Turbine Positions
Kentish Flats Development Area & Cable Route
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2.0 Methods

2.1 Survey Design

The turbines surveyed were numbers D2 and C4 (Figure 1). These sites were selected by the client and agreed with CEFAS as part of the approval for the Kentish Flats FEPA monitoring program.

The following data was collected at each of the 2 turbine monopiles;

- Stills photography of the monopiles from sea surface to seabed,
- Video footage from sea surface to the seabed,
- Video footage of the seabed within the immediate vicinity of the monopile,
- Four surface scrapes ($0.01m^2$) on each monopile,
- MNCR Phase II biological recording.

2.2 Field Methodology

The diving survey was undertaken on 30th July 2008, onboard the vessel MV *Arie Dirk.*

All divers were part of the Emu Ltd dive team, and performed in accordance with the Approved Code of Practice for Scientific and Archaeological Diving Projects plus Emu Ltd.'s in-house Method Statement, (EmuMet18) – Operating Procedures and Rules for Scientific Diving within Emu Ltd.

At each turbine, divers surveyed the faunal communities growing on the foundations and surrounding seabed using MNCR Phase 2 methods, recording the habitats and species within each distinct biological zone from surface to seabed. Dominant species were given an abundance value using the SACFOR scale. The boundary of a biological zone is defined as where a notable change in the abundance of species, or a change in the species assemblage occurs. Water depths were recorded at each change in biological zone on the monopile and at scrape sample locations. Below sea level depths (BSL) were recorded from the diver's depth gauges or diving computers. These depths were subsequently converted to Chart Datum (CD) depths using UK Hydrographic data derived from secondary port data for Herne bay (UKHO, 2008).

Four samples were taken at each monopile, consisting of a scraping within a $0.01m^2$ quadrat, one in each area of observed biological change. The scrapings were used for more specific species identification and to record wet weight (biomass) for each total sample.

Video and stills photography were undertaken throughout the survey area, recording each observed biological zone. The images were used for post survey review and to support *in-situ* species identification

Faunal sample collection was consistent with Emu Ltd's in house method statement EMU MET05 (Emu, 1998). All other methods employed by Emu Ltd conformed to In-House operating procedures and/or **I**nternational **S**tandard **O**rganisation (ISO) 9001 control procedures where appropriate.

2.3. Surface Scrapes

At four locations on each monopile, a 10cm by 10cm surface area ($0.01m^2$) was scraped clear of all fauna and flora and placed into a pre labelled sealable bag. The location of each of the surface scrape samples was decided upon during each dive, to ensure that each biological zone was appropriately sampled.

These samples were collected in order to undertake total sample biomass analysis and to collect specimens which were components of the different biological zone for confirmation of identification and estimation of abundance. These data are recorded in Appendix II.

2.4 Stills Photography and Video

Stills photography was undertaken using a Nikon Coolpix 7900 7.1 megapixel camera in a Nikon underwater housing with Sea and Sea 25 Auto Strobe.

Subsea video footage was collected on each monopile using a Canon MV1 Video Camcorder (records on mini DV), in an Amphibico housing with light source. Video footage was collected from the water surface to the base of the monopile. The underwater visibility during the diving survey varied between 3 and 4 m (diver observations).

2.5 Laboratory Methodologies

Samples were logged into the Emu Ltd wet-lab system. Each sample container, labelled with the job number, site and date, was assigned a unique wet-lab (WL) number to identify it within the laboratory.

2.5.1 Species Identification

Analysis (taxonomic) of the macrofaunal samples was undertaken by Emu who are participants in the National Marine Biological Analytical Quality Control Scheme (NMBAQC) scheme. This scheme is an independent, national QC scheme designed to assess the quality of marine benthic taxonomy within laboratories in the UK.

The scrape samples were sieved over a 1mm mesh to remove preservative, and sorted on white trays. Conspicuous / representative species were sorted into pots for further identification. The species present within the scrape samples were assigned a figure from 1 to 5 based on a linear abundance scale, 1 being rare and 5 indicating very high abundance, (Emu Method Statement 07 Issue 5). This approach allowed adequate analysis of and comment upon the observed biological zonation.

2.5.2 Biomass

The biomass analysis was completed at Emu's laboratory on the scrape samples. The total wet weight of each scrape sample was recorded (Appendix II).

2.6 Stills Photography and Video Review

On return from the field, stills photographs were reviewed in order to confirm species identification where required. Appropriate photographs have been incorporated within this report to depict the biological zonation observed.

Video review was undertaken to identify any additional species not noted during the in-situ survey and were scored using the SACFOR scale where possible (Table 1). In this instance, the video footage had a limited contribution and did not provide any additional information to supplement the biological recording and stills photography undertaken.

Growth Form			Size of individuals/colonies				Density
%cover	Crust /Meadow	Massive /Turf	<1cm	1-3cm	3-15cm	>15cm	
>80%	**S**		**S**				>1/0.001m^2
40-79%	**A**	**S**	**A**	**S**			1-9/0.001m^2
20-39%	**C**	**A**	**C**	**A**	**S**		1-9/0.01 m^2
10-19%	**F**	**C**	**F**	**C**	**A**	**S**	1-9/0.1 m^2
5-9%	**O**	**F**	**O**	**F**	**C**	**A**	1-9/ m^2
1-5% or density	**R**	**O**	**R**	**O**	**F**	**C**	1-9/10 m^2
<1% density		**R**		**R**	**O**	**F**	1-9/100 m^2
					R	**O**	1-9/1000 m^2
						R	<1/1000 m^2

Key:
S = Superabundant, **A** = Abundant, **C** = Common, **F** = Frequent, **O** = Occasional, **R** = Rare, **P** = present (used when the abundance of an organism could not be estimated accurately).

Table 1. Abundance Scales used for both Littoral and Sublittoral Taxa
(After: Hiscock, 1998)

3.0 Results

3.1 General Results

The following sections outline the results from the monopile foundation subsea colonisation study.

The results derived from this study provide an overall description of the communities present both on the monopile foundations and on the seabed in their immediate vicinity.

3.2 Monopile Foundation Colonisation

It was found that each of the monopiles surveyed, had been colonised with a pattern of biological zonation which was generally comparable between the two turbines surveyed (Table 2). Raw data in Appendix I indicate an additional zonation change on turbine C4 within biotope zone 2. However, closer inspection of the habitat and associated species tends to support the observation that this is a slightly impoverished area of the surrounding biotope and does not justify full zone separation. To reflect this, the depth bands noted below have been modified slightly to reflect the observed synchronisation between the two sites.

	Depth Band (m BCD)	Biotope Code	Biotope	Comments
Biotope 1	+6.5 to +2.5	LR.HLR.MusB	Mussel and/or barnacle communities	Impoverished form dominated by *Balanus crenatus* and *Elminius modestus*.
Biotope 2	+2.5 to -1.5	IR.LIR.IFaVS	Faunal communities on variable or reduced salinity infralittoral rock	A slightly impoverished form of the biotope, dominated by dense *Mytilus edulis*, with anemones and barnacles.
Biotope 3	-1.5 to -4.6	CR.FCR.FouFa	Circalittoral fouling faunal communities	An impoverished form of the biotope, dominated by *Metridium senile*, *Sagartia elegans*, with barnacles and the encrusting tube worm, *Pomatoceros* sp.
Biotope 4	-4.6 at seabed	SS.SMx.IMx	Infralittoral mixed sediment	Basic sediment biotope to describe the shelly sand and gravel substrate. *Asterias rubens* dominated the area. A variety of crabs also present.

Table 2 Biotopes for the three monopile foundation biological zones and seabed area.

It should be noted that the depths at which the communities were observed to change, are not at precise depths, with the change occurring gradually. The depths, therefore, are only an indication of the change in communities on the monopile, and should not be considered as definitive.

The different communities and habitat zones on the monopiles are described in the following sections.

3.2.1 Intertidal Barnacle Dominated Zone

A barnacle dominated area was found in the intertidal zone, from approximately +6.5m BCD to +2.5m BCD. It was present on both turbines, and in both cases, appeared to be the only fauna visible. The species were identified as *Balanus crenatus* and *Elminius modestus*. *B. crenatus* is a common native species around the coast of Britain that colonises a wide variety of hard substrates. It is predominantly a sublittoral species but is widespread within infralittoral areas on suitable substrates. *Elminius modestus* is a non-native species that has been present here since 1946 at least and is known to compete with endemic species and be a very successful coloniser of all suitable substrates. Plate 1. illustrates the change from the barnacle dominated intertidal zone to the *Mytilus edulis* dominated infralittoral zone.

Plate 1. Mussels, barnacles and green algae in the boundary between the intertidal zone and the upper infralittoral area. Turbine D2, +3 mBCD.

3.2.2 Infralittoral *Mytilus edulis*, with green algae and anemones

The infralittoral and sublittoral fringe area, from approximately +2.5m BCD to -1.5m BCD, was dominated by the common mussel, *Mytilus edulis*. On both turbines, the shallower areas were covered by new growth, with more mature individuals as the depth increased. On the upper areas of the zone, the green alga *Ulva* spp.* was evident to varying densities along with the barnacles *Balanus crenatus* and *Elminius modestus*, with *Mytilus edulis* individuals amongst them. Once they were present consistently the *Mytils edulis* were recorded as super-abundant on both monopiles (Plate 2) although becoming less dense at lower levels of the biological zone on turbine number C4. Larger individuals (at lower density) of *Mytilus edulis* were generally noted at greater depths and in these instances the anemones *Sagartia elegans* (more evident on turbine C4) and *Metridium senile* were characteristic.

* Note – A recent reclassification of the green algae has resulted in species previously identified as the genus *Enteromorpha* , to be re-classified under the genus *Ulva*, (Budd, G.C. & Pizzola, P., 2008). As both *Enteromorpha* sp and *Ulva* sp were logged in the field, this has been re-recorded as *Ulva* spp, to account for the two or more species observed during the survey.

The mussels also created a dense coverage over associated structures, such as the access ladder. From analysis of the scrape samples in this zone, other species of note were the barnacles *Elminius modestus* and *Balanus crenatus*, the caprellid shrimp, *Caprella linearis*, amphipods *Corophium asherusicum*, and *Jassa falcata*. *Jassa falcata* is well documented as an important fouling organism, constructing dense tube mats from fine particulate debris, (Hill, J.M., 2000). On turbine C4, the large solitary ascidian *Styela clava* was also recorded - another species historically associated with fouling communities. Also at turbine C4, dense growths of the hydroid *Obelia longissima* were noted, a species often recorded on artificial substrates (Tyler-Walters 2003).

Two large crab species, velvet swimming crab, *Necora puber* and the edible crab, *Cancer pagurus* were also noted amongst the mussels.

Plate 2. Area of high density, generally small individual size mussels. Turbine D2, 0 mBCD.

Mytilus edulis is common around all British coasts, from the intertidal to the shallow subtidal and is found on a very wide range of suitable substrates, from hard substrates right through to muddy sands. It can withstand conditions in high energy environments and is tolerant of a wide range of temperatures. The lower limit of its distribution is said to be strongly influenced by predation. The starfish *Asterias rubens* and the dog whelk *Nucella lapillus* are two well documented predators (Tyler-Walters, 2008).

3.2.3 Lower Infralittoral with anemones

With a further increase in depth, the density of *Mytilus edulis* reduced and from approximately -1.5m to -4.6m BCD (seabed), the monopile became devoid of mussels, being replaced by the anemones *Metridium senile* and *Sagartia elegans* (Plate 3). Neither species was present in huge quantities, being recorded as frequent and occasional on turbine D2 and common and rare on turbine C4. Both anemones are common around most of Britain and are often found colonising artificial substrates. On turbine D2, the keel worm *Pomatoceros triqueter* and the barnacle *Balanus crenatus* became notable at this point. The hydroid *Sertularia argentea* also became more evident in this area on both monopiles.

Plate 3. Lower infralittoral with *Metridium senile* and *Sagartia elegans* . Turbine D2, -4.0 mBCD.

3.2.4 Sediment boundary and seabed community

At the boundary of monopile number D2 and the seabed, a very small area of exposed concrete was evident, approximately 10cm in depth, running round the turbine base. The keel worm, *Pomatoceros triqueter* was the only noted species. This area of exposed concrete was not found on monopile C4. The concrete exposure could not necessarily be attributed to scour and no greater evidence of scour, such as scour pits, was seen.

The seabed sediments at the base of each of the turbines were generally comparable. They were comprised of shelly sand and gravel, with the shell fragments composed mainly of *Mytilus*.

Asterias rubens was the dominant fauna in this area (Plate 4), the only other notable species being the crabs, *Necora puber*, *Paguridae* sp, and *Liocarcinus* sp. *Asterias rubens* was recorded as super-abundant around turbine C4 and common around turbine D2. The presence of *Asterias rubens* in such large quantities is not unexpected due to the density of its prey species, *Mytilus edulis*.

During the dive, fish were not observed in the area at any time, and review of the available video footage and stills images confirmed the overall observation.

Plate 4. *Asterias rubens* on shelly sand and gravel at the base of the monopile. Turbine D2, -4.6m BCD

3.3 Monopile Biomass

The full results of the biomass studies are presented within Appendix II. The *Mytilus edulis* communities comprised the largest proportion of the biomass on each of the monopiles.

On turbine D2, the greatest biomass was recorded at 0m BCD, in the *Mytilus edulis* biotope area. The shallower area sampled had a much reduced biomass but recorded a relatively high score for the mussels on the linear abundance scale, which reflected a high density of very small mussels. The third biomass sample from -1.5m BCD, is very small (4.5 g compared to 713g for the *Mytilus* dominated area), and reflects the impoverished nature of this anemone and barnacle dominated fouling community. A slight increase in biomass was recorded at -4m BCD due to a cluster of very small *Mytilus edulis* but this is not indicative of another dominant *Mytilus edulis* area, but is a reflection of patchiness of this species at some areas on the monopile.

On turbine C4 a similar trend in biomass was observed, with the greatest biomass recorded from +1.8m BCD, within the *Mytilus edulis* dominated biotope area (922g). The biomass reduces from this to its lowest value at -3.7m BCD, within the fouling faunal community, with anemones, barnacles and the encrusting tube worm, *Pomatoceros* sp.

The wet weight biomass calculations for each of the four samples are by their very nature, only a rough estimate, but they can be used to give a general indication of the total biomass on each turbine. Given the nature of the sampling, an average value of each 0.01m^2 sample area was taken for the two turbines in each observed zone, and the surface area of each biotope band width subsequently calculated (turbine diameter 4.7m), to arrive at a rough estimation of biomass per biological area. The

total biomass was then multiplied to represent the whole of the 30 turbine array. The values are presented in Table 3.

	Biotope 1 ***Upper barnacle area*** **Band width 4.0m**	**Biotope 2** ***Infralittoral mussel zone*** **Band width 4m**	**Biotope 3** ***Lower level fouling community*** **Band width 3.1m**
Turbine D2 (g)	36.18	713.73	207.817
Turbine C4 (g)	Used figure for D2	922.57	183.949
Average per 0.01m^2(g)	36.18	818.15	195.883
Mean Biomass per zone (kg)	213.5	4827.1	895.2
Total Mean Biomass per turbine(kg)	5935.8		
Projected Total Biomass for the 30 turbine array (kg)	178074		

Table 3 Mean biomasss for the three monopile foundation biotopes and 30 turbine array.

4.0 Discussion

4.1 General

The recorded species during the survey were comparable between the turbines surveyed. The two turbines are considered likely to be generally representative of all the turbines on the Kentish Flats offshore wind farm site, notwithstanding the potential for localised features / communities. The predominant species found on the turbines, barnacles, *Mytilus edulis* and *Metridium senile* are typical of colonised hard substrata or man made surfaces.

Within Connor et al, (2004), biotopes are described for a variety of communities. The species assemblages recorded on the monopiles may be summarised as follows:

- the upper barnacle zone which matches the LR.HLR.MusB biotope
- the infralittoral zone with *Mytilus edulis* and *Metridium senile* communities, corresponding to the IR.LIR.IFaVS
- and the lower infralittoral fouling community with anemones, barnacles and encrusting tube worms, equivalent to CR.FCR.FouFa

As is often the case when assigning biotope codes, the species assemblages can show a significant degree of variation from those described by the biotope classification - as was the case during this study. In that sense, the communities recorded could be said to be somewhat impoverished forms of the biotopes described.

Within the mussel dominated areas and the deeper fouling communities, the plumose anemone, *Metridium senile*, was regularly noted. It is commonly found on hard substrata and is widely distributed around the British and Irish Coasts. The anemone is capable of out-competing other species dominating large areas of artificial substrata and it is speculated that it may also provide a food source for many fish species (Hiscock, K. & Wilson, E., 2007).

The mussel, *Mytilus edulis* comprised the majority of the biomass on the monopiles, and was found as relatively small individuals within the intertidal zone, increasing in size with a corresponding increase in depth. This species of mussel is very common along the British and Irish coasts, and inhabits a variety of substrata. The distribution of mussels, is strongly influenced by predation, and abrasion by sediment (Tyler-Walters, 2008). During the monopile surveys, the common starfish, *Asterias rubens* was seen feeding on *Mytilus edulis*. It is likely that the edible crab *Cancer pagurus* and the velvet swimming crab *Necora puber* also predate on the mussels although this was not observed during the current study.

The high biomass measurements recorded are directly related to *Mytilus edulis* density and illustrate that large amounts of mussels are able to colonise these substrates in a very short space of time. The effectiveness of its growth rate can also result in the obstruction of vital structures such as access ladders.

The observed biological zonation is not uncommon and has been recorded recently at the North Hoyle Wind Farm site (Bunker, 2004) which was surveyed one year after the installation of the monopiles. A barnacle zone was present in the intertidal, and the mussel dominated area was also observed to commence at approximately +2m to -2m BCD. As with the present survey, the majority of the subtidal area, from around -2m BCD to the seabed at -10m BCD at North Hoyle and -4.6m BCD at Kentish Flats, was dominated by a barnacle, keel worm and anemone covered biotope. Bunker also speculated that North Hoyle was too exposed for successful cultivation of mussels for commercial purposes but that harvesting of small mussels for seed for other locations might be a possibility. The

Kentish Flats location may also be unsuitable for commercial cultivation of mussels, but may be able to provide seed mussels for other locations. In contrast to North Hoyle, where large shoals of whiting were observed, with sporadic sightings of plaice and cod, no fish were recorded during this survey.

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6.0 AUDIT TRAIL

Title :. Kentish Flats Offshore Wind Farm Turbine Foundation Faunal Colonisation Diving Study			
Report No: 08/J/1/03/1034/0839 - **Final** **Job No:** J/1/03/1034 **Client Name:** Kentish Flats Ltd **Client Contact:** Steve Bellew			
		Initials	**Date**
Project Manager:	Nigel Thomas		
Data Analysis undertaken by:	Alison Bessell		
Field work undertaken by:	Nigel Thomas Adrian Cherry		
Report written by:	Alison Bessell		
Report checked by:	Dr Nigel Thomas		
Report Authorised by:	Dr Nigel Thomas		

APPENDIX I MNCR Phase II Recording species data from the Turbine Monopiles

Kentish Flats Offshore Windfarm Diving Study (J/1/03/1034)
Date of survey 30.07.08
Turbine Number D2
Turbine Number C4

Site number		**D2**	**D2**	**D2**	**D2**	**C4**	**C4**	**C4**	**C4**	**C4**
Habitat record number		**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**
Depth (m BCD)		**+6.5 to +2.5**	**+2.5 to -1.2**	**-1.2 to -4.6**	**Seabed at -4.6**	**+6.8 to +2.8**	**+2.8 to +0.3**	**+0.3 to -1.2**	**-1.2 to -4.3**	**Seabed at -4.3**
Species	MCS Code									
Urticina felina	D0684								R	
Metridium senile	D0710		O	O				O	C	R
Sagartia elegans	D0713			F			C	C	R	
Pomatoceros triqueter	P1341			C						
Balanus sp	R0074	SA	C	C		A		F		
Paguridae sp	S1445				F					
Cancer pagurus	S1566		R						O	
Liocarcinus sp.	S1577				R					C
Necora puber	S1589		O	R	O			F		R
Mytilus edulis	V0024		SA				SA	F		
Ostrea edulis	W1758			O						
Bryozoan crust	Y0001		F							
Alcyonidium diaphanum	Y0076									O
Asterias rubens	ZB0100				C					SA
Styela clava	ZD0104							R	R	
Ulva spp.	ZS0174		O				C			

APPENDIX II Scrape Sample Species Results and Biomass

Kentish Flats Offshore Windfarm Diving Study (J/1/03/1034)
Faunal and Epifaunal Dataset
Linear abundance scale 1 to 5.
1 = rare
5 = super abundant

	Turbine Number	D2	D2	D2	D2	C4	C4	C4	C4
	Sample Site	1	2	3	4	1	2	3	4
	Depth (m BCD)	-4.0	-1.5	0	+3.0	-3.7	-1.2	+0.3	+1.8
	WL02	1847	1848	1849	1850	1851	1852	1853	1854
Species	**MCS**								
Sertularia spp.	D0433		1						
Obelia longissima	D0521								2
ANTHOZOA	D0583	2	1	3		2	1	1	
Lepidonotus squamatus	P0082					1			
Pomatoceros spp.	P1339	2	2	1		1	2		
Phoxichilidium femoratum	Q0048	3							
Elminius modestus	R0068	2		2	4				3
Balanus crenatus	R0077	4		4			4	2	1
Jassa falcata	S0569	5	5	5	4	4	5	5	3
Corophium asherusicum	S0606					4			
Caprella linearis	S0646	3	3	3				3	
Pisidia longicornis	S1482	5	2	3	2		2	2	
Cancer pagurus	S1566			1					
Liocarcinus pusillus	S1584								1
Crepidula fornicata	W0439	1							
Mytilus edulis	W1695	4	2	5	4		3	3	3
Alcyonidium mytili	Y0080	3		2			2	1	1
Conopeum reticulum	Y0172	3		2			2	2	2
Electra pilosa	Y0178	2	1	2					2
Polycarpa (juv.)	ZD0110	1							
Polycarpa pomaria	ZD0115					1			
Total Sample Biomass (g)		**203.2773**	**4.5393**	**713.7314**	**36.1842**	**47.8988**	**136.0502**	**86.4380**	**922.5691**